

City of Santa Clara

Sanitary Sewer Master Plan Update Final Report

Prepared by:



April 2016

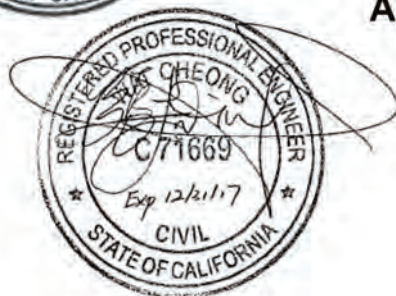


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Abbreviations and Definitions

ABAG	Association of Bay Area Governments
ABWF	Average base wastewater flow
ADWF	Average dry weather flow
APN	Assessor parcel number
Backwater	A condition in which the hydraulic gradeline (see definition of HGL below) increases upstream of a location in the system due to a downstream hydraulic constriction.
BWF	Base wastewater flow: sanitary and process flow contributions from residential, commercial, institutional, and industrial users.
CIP	Capital Improvement Program
City	City of Santa Clara
CSJ	City of San Jose
CuSD	Cupertino Sanitary District
d/D	Ratio of flow depth to pipe diameter
Design Storm	A rainfall event, defined based on statistical probability of occurrence, which determines the peak wet weather flow conditions for which the capacity of sewer system facilities are evaluated and/or designed.
Diurnal Curve	Change in dry weather flow over a typical 24-hour period on an hourly basis.
DU	Dwelling unit
DWF	Dry weather flow: the flow during non-rainfall periods, composed of normal base wastewater flow plus any dry season groundwater infiltration.
ENR-CCI	Engineering News Record Construction Cost Index; an index published monthly by Engineering News Record magazine and used to reference construction costs (such as those for wastewater system facilities) to a specific date and location.
Firm capacity	The capacity of a pump station with the largest pump out of service.
fps	Feet per second
GIS	Geographic Information System: a computerized system in which geographical features (e.g., sewer facilities, parcels, land use) are linked to an attribute database to facilitate analysis and presentation of information
gpad or gpd/ac	Gallons per day per acre
gpcd	Gallons per capita per day
gpd	Gallons per day
GWDR	General Waste Discharge Requirements for Sanitary Sewer Systems: regulations adopted by the State Water Resources Control Board in 2006 that address the operation, maintenance, and management of publicly-owned sanitary sewer systems in California

GWI	Groundwater infiltration: extraneous water that infiltrations into a sewer system from the ground through defective pipes and manholes. Groundwater infiltration is considered to be a relatively constant daily flow that varies seasonally and depends on location of sewers with respect to the groundwater table.
HGL	Hydraulic Grade Line: in a gravity pipeline system, the water surface elevation in the pipes; or in a system flowing under pressure, the elevation representing the sum of pressure head plus elevation head
Hydrograph	A graph of flow versus time.
IDF	Intensity-duration-frequency: rainfall statistics that establish the rainfall intensity over specified durations for various recurrence frequencies
I/I	Infiltration/inflow (see definitions below)
Infiltration	Extraneous groundwater or storm water that enters sewer pipes, manholes, and service laterals via the soil through breaks, cracks, and defective joints.
Inflow	Storm water that enters the sewer system from the ground surface through direct drainage connections (e.g., directly connected catch basins, area drains, or roof drains) or through manhole or cleanout lids.
Inverted Siphon	A sewer configuration (also called a “siphon”), typically consisting of a downward leg, horizontal section, and upward leg, in which the flow is forced through the pipe by the pressure head created by the elevation difference between the upstream and downstream ends of the siphon. An inverted siphon is typically used to cross under a creek, channel, or another pipeline.
Isohyetal	A contour of equal precipitation (typically average annual rainfall)
K	Recession coefficient of RDI/I unit hydrograph (see Figure 2-4)
lf	Linear feet
Loading Manhole	A manhole in the modeled sewer network to which flows from unmodeled sewers discharge into the modeled network (also see definition of subcatchment below).
LS	Lift Station
MAP	Mean annual precipitation
mgd	Million gallons per day
NAICS	North American Industrial Classification System
O&M	Operations and maintenance
PDWF	Peak dry weather flow: the peak flow during non-rainfall periods.
PS	Pump Station
PWWF	Peak wet weather flow: the peak flow during a given storm event from dry weather flow plus infiltration and inflow.
R	Ratio of RDI/I volume to rainfall volume
RDI/I	Rainfall-dependent infiltration/inflow: the infiltration and inflow into a sewer system directly related to a rainfall event. RDI/I may cause rapid, short-term peak flows in the sewer system that recede after the rainfall has ended.
RG	Rain gauge
RMC	RMC Water and Environment

sf or sq. ft.	Square feet
SCVWD	Santa Clara Valley Water District
SECAP	System Evaluation and Capacity Assurance Plan
Siphon	See Inverted Siphon
SJ/SC RWF	San Jose / Santa Clara Regional Wastewater Facility
SSMP	Sewer System Management Plan
SSO	Sanitary sewer overflow
Subcatchment	A small area of the sewer system that contributes flow to the modeled sewer network, in which the unmodeled collection sewers are assumed to discharge to a common point (manhole) in the modeled network
Surcharge	The hydraulic condition in a sewer pipeline in which the elevation of the hydraulic gradeline (water level) is above the crown (top) of the pipe. Under such a condition, the water in the pipe rises into the manholes and could overflow onto the ground if the hydraulic gradeline exceeds the elevation of the manhole rims.
T	Time to peak of RDI/I unit hydrograph (see Figure 2-4)
TM	Technical Memorandum
WWF	Wet weather flow: the flow during rainfall periods, composed on base wastewater flow, wet season groundwater infiltration, and rainfall-dependent I/I.

Executive Summary

This report summarizes the results and recommendations of the Sanitary Sewer Master Plan Update (Master Plan) for the City of Santa Clara (City). The Master Plan was prepared by RMC Water and Environment (RMC) in close coordination with City staff. The Master Plan will be used to guide improvements to the City's sanitary sewer system to accommodate current and future development and ensure that the City continues to provide a high level of service to its customers.

Background and Purpose of Master Plan

The City of Santa Clara is located in central Santa Clara County adjacent to the Cities of San Jose, Cupertino, and Sunnyvale. The City has a population of approximately 120,000 and is served by a wastewater collection system consisting of approximately 270 miles of sewer pipelines and seven sewage pump stations. The system collects wastewater flows generated within the City limits and also flows from the major portion of the Cupertino Sanitary District (CuSD) via a connection at Homestead Road and Swallow Drive. Flow is conveyed eastward to the City of San Jose's interceptor sewer on Zanker Road and also northward to the Northside and Rabello Pump Stations, where the flow is pumped to the San Jose/Santa Clara Regional Wastewater Facility (SJ/SC RWF) for treatment and disposal. The City's sewer system and service area are shown in **Figure ES-1**.

The City's last sanitary sewer master plan was completed in 2007¹. Since that time, the City has completed a number of sewer improvement projects and is experiencing significant growth and redevelopment in a number of areas, necessitating an evaluation of the capacity of the sanitary sewer system to handle future wastewater flows. This Master Plan will help identify future capital needs for capacity improvements and associated requirements for financing those improvements through increased connection fees or other sources of funding.

The City is also required to comply with the Statewide General Waste Discharge Requirements for Sanitary Sewer Systems (GWDR) adopted in 2006 by the State Water Resources Control Board. The GWDR, which applies to all publicly-owned sewer systems in California, includes the requirement to complete a Sewer System Management Plan (SSMP). The SSMP addresses the overall management, operation, and maintenance of the sanitary sewer system and must include a System Evaluation and Capacity Assurance Plan (SECAP). Therefore, this Master Plan is also intended to satisfy the SECAP requirements of the SSMP.

The overall objectives of this Master Plan are to develop wastewater flow projections for the City's collection area using up-to-date water use and land use information and flow monitoring data; develop an updated hydraulic model of the trunk sewer system; use the model to identify existing capacity deficiencies and future projected capacity requirements; and develop a Capital Improvement Program (CIP), including budget estimates, for implementing the required capacity improvements to the collection system.

This Executive Summary is presented in two parts:

- ***How the Capacity Assessment Was Prepared*** describes the scope and methodologies of the planning effort, including the key planning and technical assumptions incorporated into the sewer system capacity analysis.
- ***Recommended Capacity Improvement Program*** presents the recommended CIP, including capacity improvement projects, priorities, and estimated costs. In addition, recommendations are presented for implementing the proposed capacity improvement program.

¹ City of Santa Clara Sanitary Sewer Capacity Assessment, RMC Water and Environment, May 2007.

How the Capacity Assessment Was Prepared

The City's wastewater collection system includes sewer pipelines ranging in size from 4 to 48 inches in diameter. The larger pipes, primarily the 10-inch and larger sewers and a portion of the smaller diameter pipes, comprise the trunk sewer system, which is the primary network for conveying flows generated from the City's service area and CuSD to the SJ/SC RWF. The trunk sewer system, comprising about 34 percent of the total pipe footage in the system, was the focus of the capacity assessment in this study.

The project team used a systematic process that incorporated land use planning information, water use and flow monitoring data, and design criteria for estimating wastewater flows, applied in a computer hydraulic model of the trunk sewer system. The modeled system is shown in **Figure ES-2**. The model was used to assess how the system would perform under various planning and flow scenarios and identify pipes and/or pump stations that may not have sufficient capacity to convey the predicted flows under existing or future conditions. Improvement projects were developed to provide the required capacity, the capital costs of the required projects were estimated, and the projects were prioritized based on the model results.

Capacity Assessment Considers Existing and Future Planning Scenarios

Two planning scenarios were evaluated for this study: existing (2015) and future (2035) scenarios. The existing scenario examined the current capacity of the sewer system based on existing land use, with flows defined based on winter water use data and calibrated to flow monitoring data collected in the 2014/15 winter season. The future scenario incorporated information on planned development provided by the City. **Figure ES-3** shows the location of the areas of anticipated development. Planned development within the City represents over 15,000 new residential dwelling units and over 20 million square feet of commercial and industrial building floor space. In addition, CuSD has also projected an increase in their base wastewater flow due to anticipated additional development. Together, these projections are estimated to increase current base wastewater flows by over two folds. The future scenario was used to examine the impact on the system of future increases in wastewater flows due to anticipated development and determine the required sewer system capacity needed to serve both existing and future users.

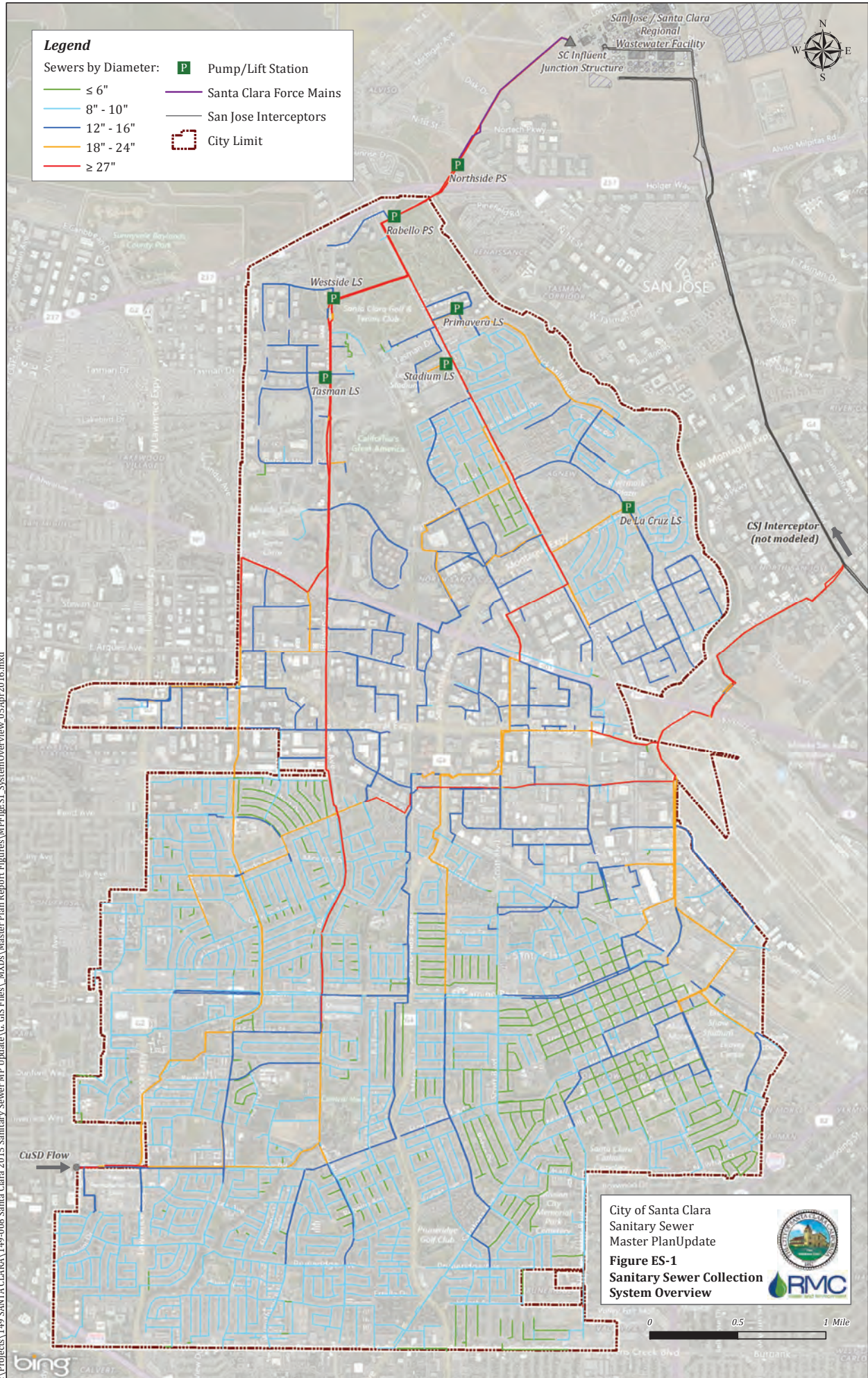
Potential Capacity Deficiencies under Existing and Future Flow Conditions

For each of the planning scenarios, projected dry and wet weather flows were simulated in the hydraulic model. The model was calibrated to flow monitoring data to ensure that it represents a reasonably accurate depiction of system conditions. For this study, a flow monitoring program consisting of 25 temporary flow meters installed in the system during the 2014/15 wet weather season was conducted to provide data to calibrate the hydraulic model and verify existing system flows. The collected data was useful for confirming dry weather flows and characterizing the relative wet weather flow response in different areas of the system.

The model integrates various dry and wet weather flow parameters to determine system capacity under different flow and planning scenarios. Key flow components incorporated into the model included: base (dry weather) wastewater flow (BWF), estimated based on winter water use data; groundwater infiltration (GWI), which occurs when water seeps into pipes under the ground through cracks and pipe joints; and rainfall-dependent infiltration and inflow (RDI/I) during storm events. For this Master Plan, a 10-year return period, 24-hour duration rainfall event was selected as the "design storm" to serve as the basis for computing design peak wet weather flows in the system. A 10-year return period has become a standard design storm criterion for many Bay Area agencies. **Table ES-1** presents the estimated existing and future average dry weather flow (ADWF) and peak wet weather flow (PWWF) for the selected design storm for the City's sewer system, based on the modeling conducted for this study.

Legend

- Sewers by Diameter:
- ≤ 6"
 - 8" - 10"
 - 12" - 16"
 - 18" - 24"
 - ≥ 27"
- Pump/Lift Station
 - Santa Clara Force Mains
 - San Jose Interceptors
 - City Limit



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City of Santa Clara
Sanitary Sewer
Master Plan Update
Figure ES-1
Sanitary Sewer Collection
System Overview

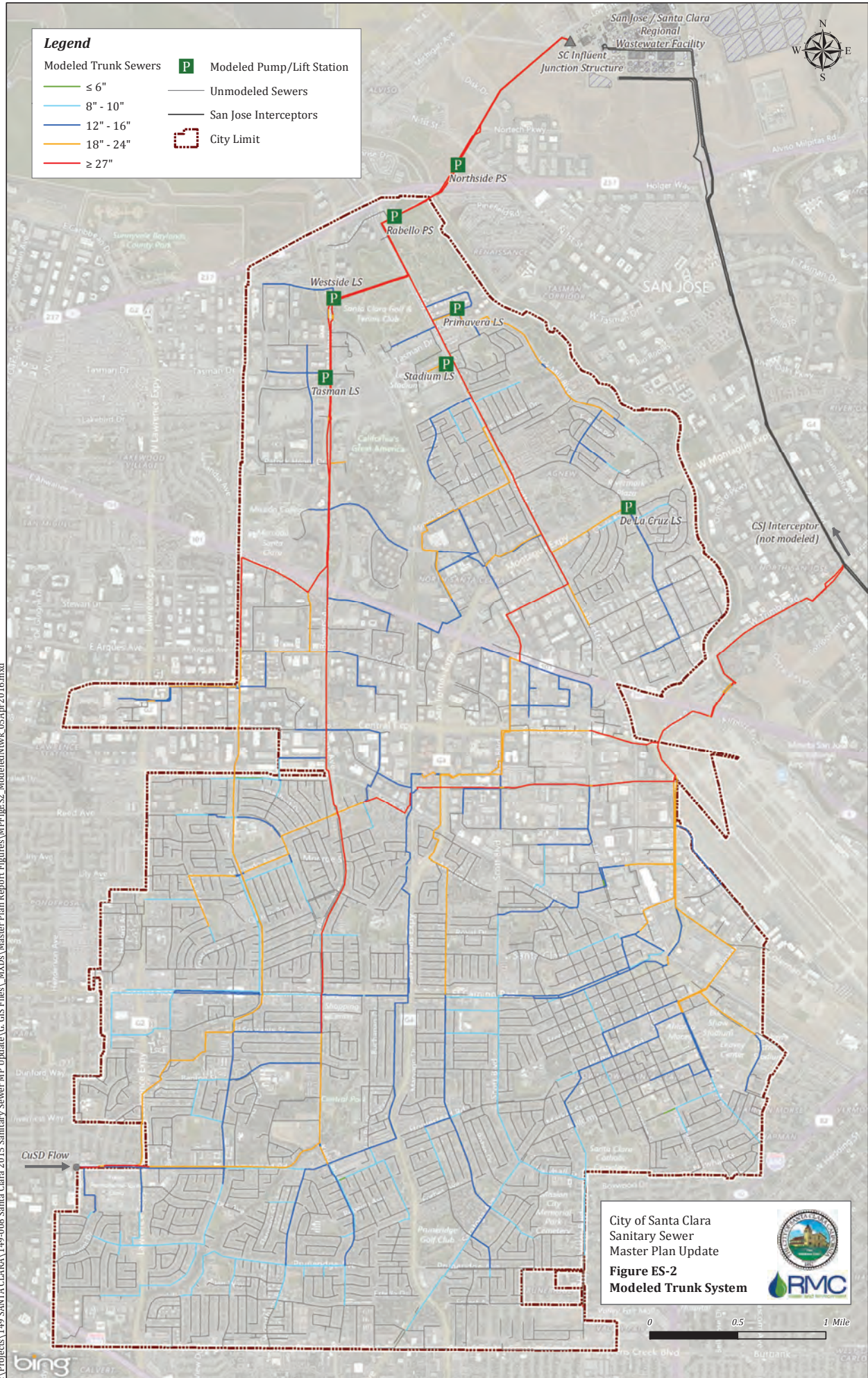


0 0.5 1 Mile



Legend

- Modeled Trunk Sewers
 - ≤ 6"
 - 8" - 10"
 - 12" - 16"
 - 18" - 24"
 - ≥ 27"
- P Modeled Pump/Lift Station
- Unmodeled Sewers
- San Jose Interceptors
- City Limit










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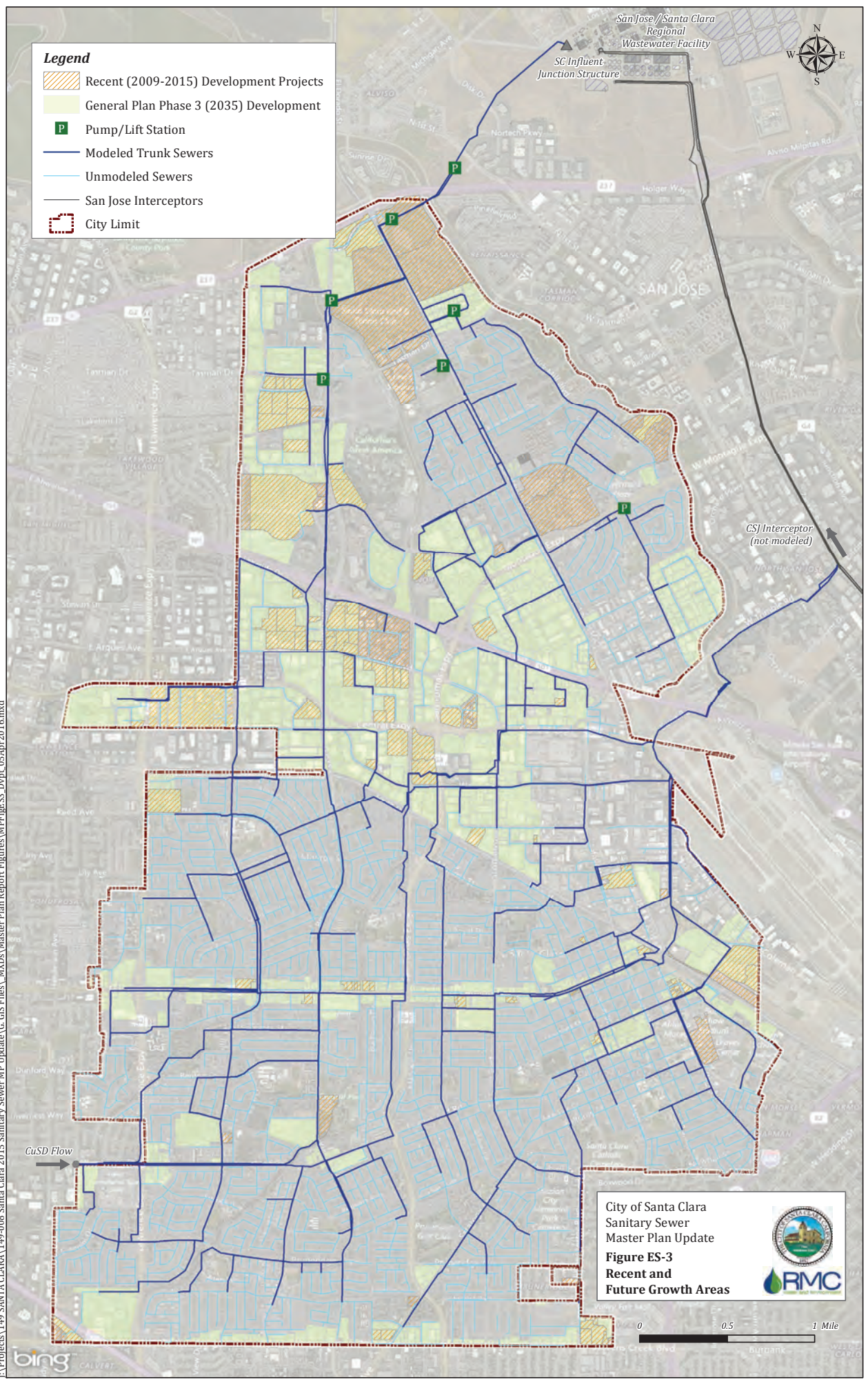
City of Santa Clara
Sanitary Sewer
Master Plan Update
Figure ES-2
Modeled Trunk System



0 0.5 1 Mile

Legend

-  Recent (2009-2015) Development Projects
-  General Plan Phase 3 (2035) Development
-  Pump/Lift Station
-  Modeled Trunk Sewers
-  Unmodeled Sewers
-  San Jose Interceptors
-  City Limit



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City of Santa Clara
 Sanitary Sewer
 Master Plan Update
Figure ES-3
Recent and
Future Growth Areas





Table ES-1: Collection System Flow Estimates

	Existing ADWF ⁽²⁾ (mgd)	Existing PDWF ⁽²⁾ (mgd)	Existing PWWF ⁽³⁾ (mgd)	Future ADWF ⁽²⁾ (mgd)	Future PDWF ⁽²⁾ (mgd)	Future PWWF ^(3,4) (mgd)
Flow Estimates by System Outfall ⁽¹⁾						
North (to Northside and Rabello Pump Stations)	10.2	15.2/16.0	27.9	24.6	33.5/34.4	41.0
East (to San Jose Zanker Road Interceptor)	4.7	6.4	11.7	9.8	13.3	18.3
Total	14.9	21.6/22.4	39.6	34.4	46.8/47.7	59.4
Flow Estimates by Agency ⁽¹⁾						
Santa Clara System	11.3	15.4/16.2	26.8	27.5	34.6/35.5	45.6
Cupertino Sanitary District	3.5	6.2	12.8	6.9	12.2	13.8
Total	14.9	21.6/22.4	39.6	34.4	46.8/47.7	59.4

1. Assuming that trunk sewer capacity deficiencies are relieved with recommended capital improvement projects presented in Table ES-2.
2. Includes groundwater infiltration for a typical wintertime period. ADWF and first value shown for PDWF includes typical non-game day flow from Levi's Stadium; second value shown for PDWF includes a peak game day flow from Levi's Stadium.
3. For 10-year design storm; assumes non-game day flow from Levi's Stadium.
4. Assuming peak wet weather flow from CuSD would not increase above its contractual maximum flow of 13.8 mgd.

Model results were examined to determine trunk system capacity needs, as indicated by areas where the flow in the pipes would exceed their capacity and cause surcharge conditions (water levels higher than the tops of the pipes). **Figure ES-4** shows the capacity assessment results for future PWWF conditions, indicating existing trunk sewers that were predicted by the model to be surcharged due to “throttle” conditions (peak flow exceeding full pipe capacity) or due to backwater from a downstream throttle condition, and locations of where the model predicts a surcharge condition severe enough to violate the City’s capacity criteria, defined as water level that exceeds one (1) foot above the top of pipe. Most of these locations were predicted to be capacity issues only under future PWWF. Note that the locations of criteria violations are not necessarily the locations of the actual capacity-deficient pipes, but are typically located further upstream due to backwater from downstream deficiencies.

Note that no overflows are predicted under design storm conditions. Furthermore, all of the modeled pump stations have adequate firm capacity (capacity with largest pumping unit out of service) to convey the predicted PWWF without violating freeboard criteria or resulting in sewer overflows, although for two of the stations (Westside and Tasman), noticeable backwater surcharge was predicted because the switch-on set points for the lead pumps are higher than the influent lines.

Recommended Capacity Improvement Program

The Capital Improvement Program (CIP) recommended in this study is designed to provide for adequate sewer system capacity for the City’s existing and anticipated future development. **Figure ES-5** and **Table ES-2** present the recommended capacity improvement projects. Projects have been assigned relative priorities based on the extent of criteria violations or surcharge. Priority 1 and 2 projects are required to address capacity deficiencies that result in criteria violations under current conditions, while Priority 3 projects are those that result in criteria violations under future conditions. In addition to these projects, there was also an additional project (Project E1) that was triggered by an entitlement requirement, discussed in more detail in Chapter 5.

As indicated in **Table ES-2**, the total estimated cost of the recommended capacity improvement program (without Project E1) is about \$1.7 million. The total estimated cost, if the City implements Project P6-Alt instead of P6, would be approximately \$2.8 million. Note that implementing Project P6-Alt would also increase the peak flow to the Rabello and Northside Pump Stations by about 1 mgd to each pump station, which could require further evaluation of and potential improvements to increase pump station capacity.

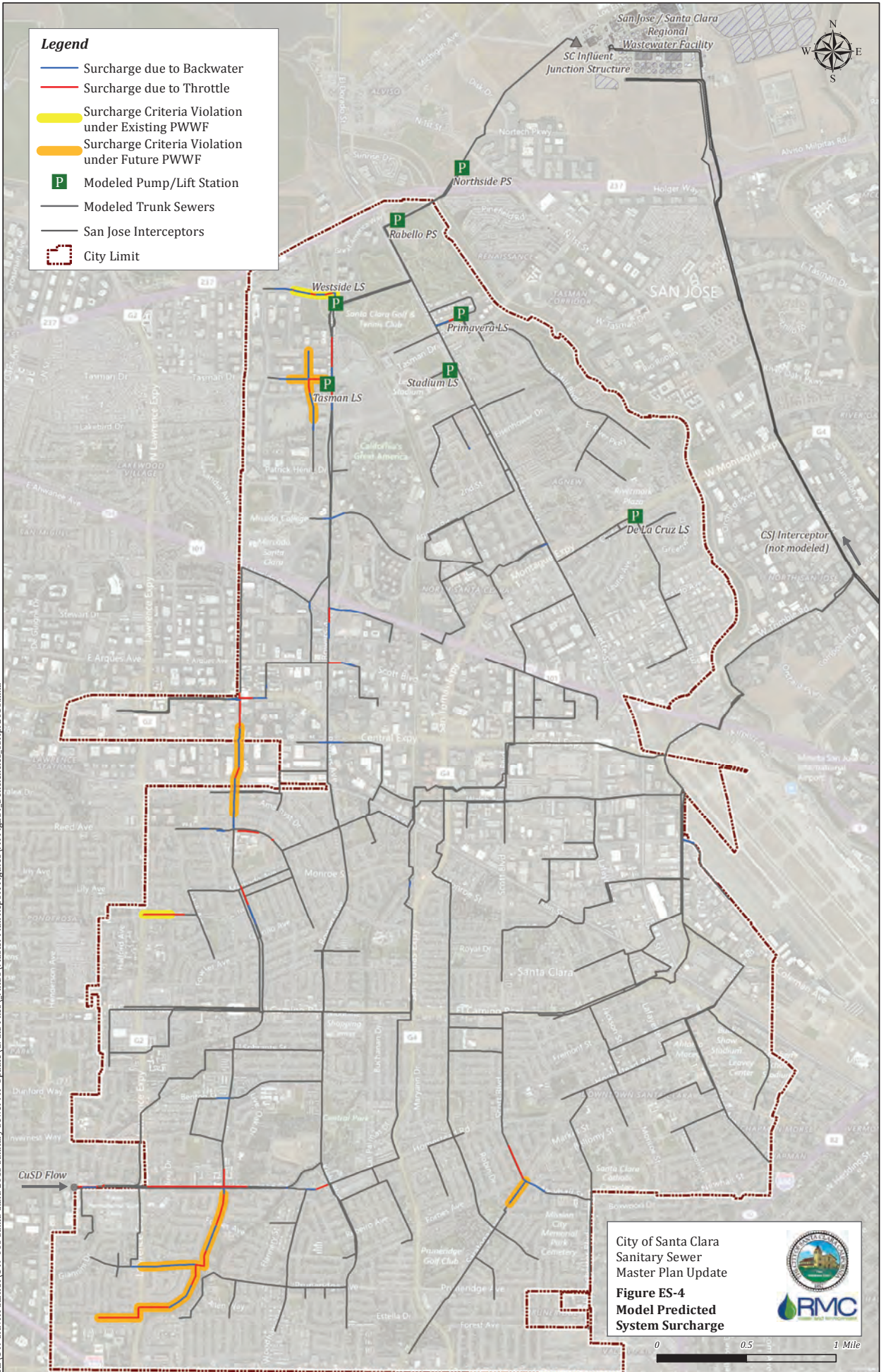
Implementation Recommendations

The City should begin implementation of the Capital Improvement Program recommended in this Master Plan, starting with the highest priority projects. The following items should be considered in project scheduling and design, and in future updates of the Master Plan.

- The alignments and sizes of projects should be verified with detailed predesign analyses, including topographic surveys, geotechnical investigations, utility research, and constructability reviews.
- The estimated costs assumed open cut construction, but alternative methods such as trenchless construction or construction of parallel relief pipes could be considered during design. The decision to parallel or replace existing sewers should consider the physical condition and remaining useful life of the existing pipelines; the availability of pipeline corridors for new sewer construction; and operation and maintenance concerns.
- The hydraulic model has been developed to assist the City in performing capacity analyses and updating the Master Plan in the future. The model should be kept up-to-date with changes to existing sewer connections, development plans, and sewer system facilities.
- The City should conduct additional flow monitoring at key locations in the sewer system, particularly the area tributary to the Chromite/Machado trunk sewers where both the 2006 and 2015 flow monitoring programs indicated high I/I. The City should also conduct smoke testing and television inspection to identify potential sources of I/I. Flow levels during large storm events should be compared to the peak flows simulated by the hydraulic model to verify the modeling predictions for the 10-year design storm and confirm the need for and sizing of Project P3 (Cabrillo Avenue Sewer Improvement).
- The City should coordinate with the CuSD on flow and planning assumptions to ensure that adequate capacity exists in the Santa Clara system to handle future flows from the District. The City should encourage CuSD to monitor the flows at the flow meter that it operates and maintains on Homestead Road at Swallow Drive on an on-going basis and periodically confirm meter calibration to verify the wastewater flows entering the Santa Clara system.
- The City should coordinate with the City of San Jose to ensure that its flow criteria and planning assumptions are consistent with those used by San Jose in its capacity master planning.
- The City should verify the need to implement project E1 (Tracy Drive Sewer Improvement). The project is triggered by the large sewer discharge assumed for parcel APN 316-17-018, which holds an entitlement agreement to discharge a potential flow of 0.95 mgd; however, it is currently discharging less than 10 percent of the entitled rate. While the City is obligated to provide capacity for entitlement holders, it is important to note that implementing this project now may result in oversized sewers where the current daily flow is not sufficient to provide the minimum cleaning velocity and thus creating potential debris and odor issues.

Legend

- Surge due to Backwater
- Surge due to Throttle
- Surge Criteria Violation under Existing PWWF
- Surge Criteria Violation under Future PWWF
- P Modeled Pump/Lift Station
- Modeled Trunk Sewers
- San Jose Interceptors
- City Limit



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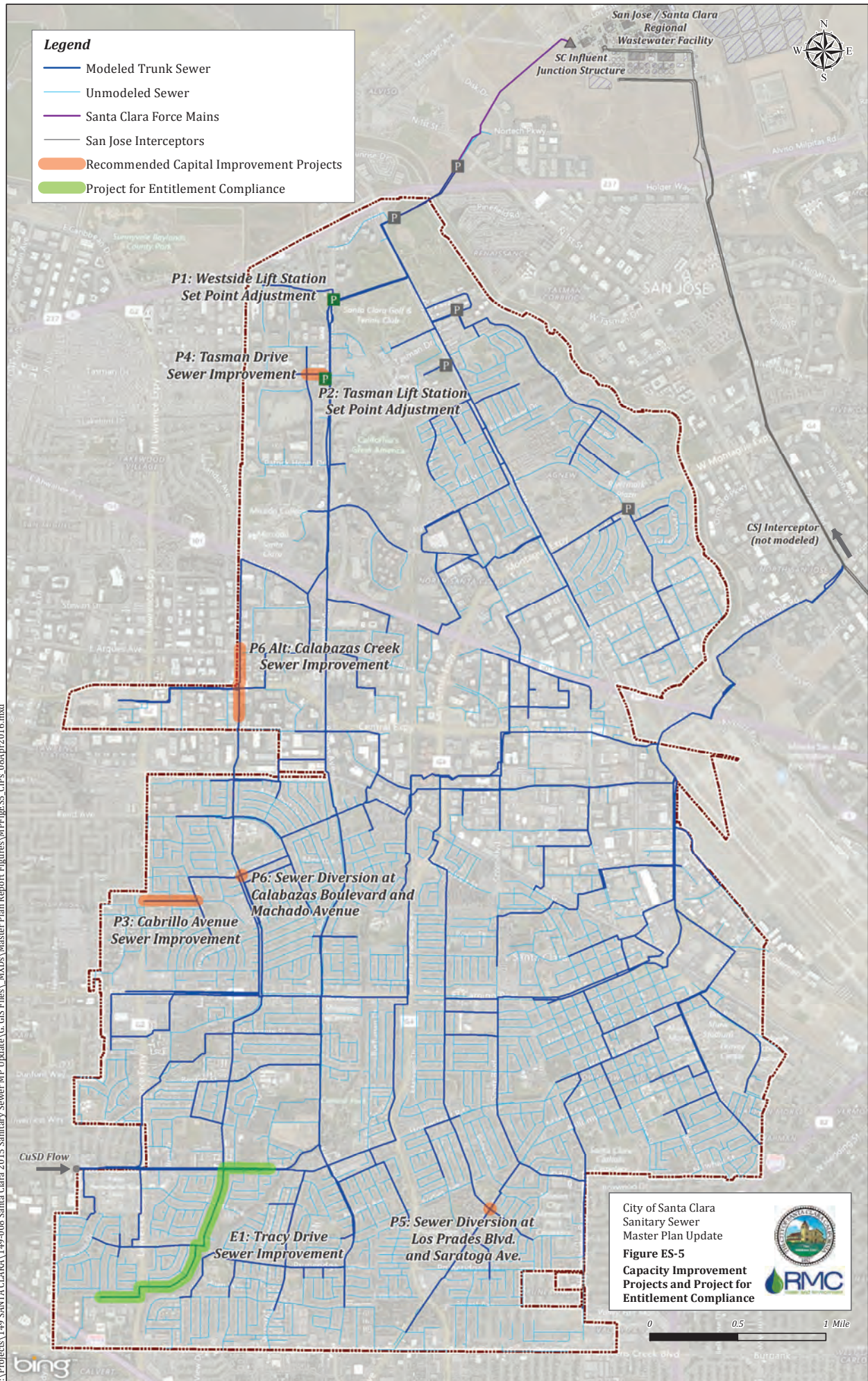
City of Santa Clara
Sanitary Sewer
Master Plan Update
Figure ES-4
Model Predicted
System Surge



0 0.5 1 Mile

Legend

- Modeled Trunk Sewer
- Unmodeled Sewer
- Santa Clara Force Mains
- San Jose Interceptors
- Recommended Capital Improvement Projects
- Project for Entitlement Compliance



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City of Santa Clara
Sanitary Sewer
Master Plan Update
Figure ES-5
Capacity Improvement
Projects and Project for
Entitlement Compliance

Table ES-2: Recommended Capacity Improvement Projects

Project ID	Priority	Project Name	U/S MHID	D/S MHID	Description	Est. Capital Improvement Cost ¹
P1 ²	1	Westside Lift Station Set Point Adjustment	N/A	N/A	Adjust the set points for the pumps to a lower elevation to eliminate unnecessary backups in the influent line.	--
P2 ²	2	Tasman Lift Station Set Point Adjustment	N/A	N/A	Adjust the set points for the pumps to a lower elevation to eliminate unnecessary backups in the influent line.	--
P3	2	Cabrillo Avenue Sewer Improvement	S41-13	S41-20	Upsize 1,600 feet of 8-inch line in Cabrillo Ave. between Lawrence Expressway and Nobili Ave. to a 12-inch line.	\$1,097,000
P4	3	Tasman Drive Sewer Improvement	S93-24	S93-35	Upsize 600 feet of 12-inch line in Tasman Dr. between Old Ironsides Dr. and Great America Pkwy. to a 15-inch line.	\$327,000
P5	4	Sewer Diversion at Los Prades Boulevard and Saratoga Avenue	S25-85	S25-85	Install a weir in manhole S25-85 located in the intersection of Padres Blvd. and Saratoga Ave. to divert flow northwest to the existing 12-in line in Los Padres Blvd.	\$77,000
P6	4	Sewer Diversion at Calabazas Boulevard and Machado Avenue	U/S of S52-93	S52-120	Install a new manhole upstream of S52-93 in the intersection of Calabazas Blvd. and Machado Ave., and install a new 15-inch high-level diversion line (approximately 200 feet) to divert excess flow from the existing 24-inch line in Calabazas Blvd. to the 21-inch line in Machado Ave. The diversion line should be about 6 inches higher than the invert of the 24-inch line.	\$166,000
P6-Alt. ³	4	Calabazas Creek Sewer Improvement	S62-31	S72-20	Upsize 1,800 feet of 24-inch line next to Calabazas Creek between Kifer Rd. and Scott Blvd. to a 27-inch line.	\$1,334,000
Estimated Total Cost for Recommended Projects P1 to P6:						\$1,667,000
Estimated Total Cost for Projects P1 to P5 and P6-Alt:						\$2,835,000
E1 ⁴	N/A	Tracy Drive Sewer Improvement	S10-77	S22-51	Upsize approximately 6,600 feet of 10- to 12-inch line in Tracy Dr. and Pomeroy Ave. to a 15-inch line; install a new 15-inch line between manholes S22-55 and S22-46 in Pomeroy Ave. and Homestead Rd. (approximately 50 feet) to divert flow into Homestead Rd., and upsize approximately 1,400 feet of 18-inch line downstream to a 21-inch.	\$4,654,000
Estimated Total Cost (P1 to P6) including Project E1:						\$6,321,000
Estimated Total Cost (P1 to P5 and P6-Alt) including Project E1:						\$7,489,000

1. All costs are presented in 2015 dollars and include 30 percent allowance for contingencies for unknown conditions and 25 percent for engineering, administration, and legal costs.
2. These proposed projects are operational, not capital improvements. Refer to Table 4-4 for recommended set points.
3. Project P6-Alt is presented for the purpose of identifying the solution and associated cost to maintain the current system flow configuration. Project P6 is the recommended project.
4. Project E1 addresses the potential capacity deficiency when parcel APN 316-17-018 begins to discharge its entitled flow of 0.95 mgd into the City's system.

Chapter 1 Introduction

This report presents the results and recommendations of the Sanitary Sewer Master Plan Update (Master Plan) for the City of Santa Clara (City). The report was prepared by RMC Water and Environment (RMC).

1.1 Background and Study Objectives

The City of Santa Clara is located in central Santa Clara County adjacent to the Cities of San Jose, Cupertino, and Sunnyvale. The City has a population of approximately 120,000 and is served by a wastewater collection system consisting of approximately 270 miles of sewer pipelines and seven sewage pump stations. The system collects wastewater flows generated within the City's service area and also wastewater flows from the major portion of the Cupertino Sanitary District (CuSD) via a connection at Homestead Road and Swallow Drive. Flow is conveyed eastward to the City of San Jose's interceptor sewer on Zanker Road and also northward to the Northside and Rabello Pump Stations, where the flow is pumped to the San Jose/Santa Clara Regional Wastewater Facility (SJ/SC RWF) for treatment and disposal. The City's sewer system and service area are shown in **Figure 1-1**.

The City's last sanitary sewer master plan was completed in 2007². Since that time, the City has completed a number of sewer improvement projects and is experiencing new development in a number of areas, necessitating an evaluation of the capacity of the sanitary sewer system to handle future wastewater flows. This evaluation will help identify future capital needs for capacity improvements and associated requirements for financing those improvements through increased connection fees or other sources of funding. This Master Plan will confirm flows in the collection system and identify capital needs for capacity improvements.

The City is also required to comply with the Statewide General Waste Discharge Requirements for Sanitary Sewer Systems (GWDR) adopted in 2006 by the State Water Resources Control Board. The GWDR, which applies to all publicly-owned sewer systems in California, includes the requirement to complete a Sewer System Management Plan (SSMP). The SSMP addresses the overall management, operation, and maintenance of the sanitary sewer system and must include a System Evaluation and Capacity Assurance Plan (SECAP). Therefore, this Master Plan is also intended to satisfy the SECAP requirements of the SSMP.

The overall objectives of this Master Plan are to develop wastewater flow projections for the City's collection area using up-to-date water use and land use information and flow monitoring data; develop an updated hydraulic model of the trunk sewer system; use the model to identify existing capacity deficiencies and future anticipated capacity requirements; and develop a phased Capital Improvement Program (CIP), including budget estimates, for implementing the required capacity improvements to the collection system.

² City of Santa Clara Sanitary Sewer Capacity Assessment, RMC Water and Environment, May 2007.

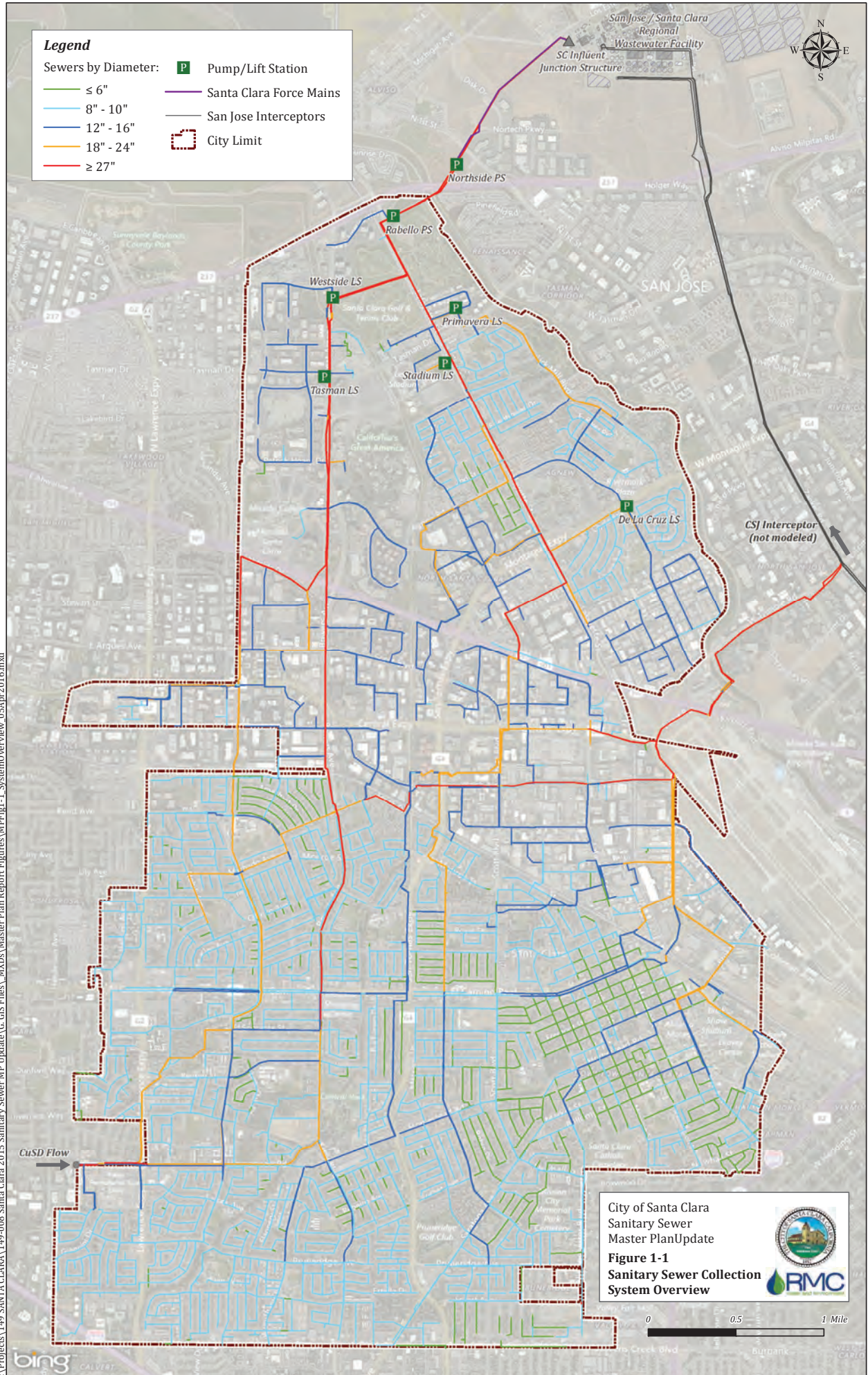
1.2 Scope of Study

The scope of the Master Plan, as well as a brief discussion of work conducted under each task, is described below.

- **Task 1 – Project Management and Coordination.** Periodic progress meetings were held with City staff to review project status and discuss project issues, and monthly status reports were prepared to document the work completed. Quality control was carried out, including checking of data and calculations, as well as senior review of proposed criteria, recommendations, and project deliverables.
- **Task 2 – Data Collection and Review.** Data, maps, geographic information system (GIS) files, and previous reports related to the wastewater collection system were reviewed to identify the information available for completing the Master Plan.
- **Task 3 – Flow Monitoring.** A flow monitoring program, consisting of the 23 meters and 4 rain gauges installed in the collection system for a period of about two months during the 2014/15 wet weather season was conducted to obtain data to characterize flows in the system and calibrate the hydraulic model. Two additional FloDar meters were also installed at the Guadalupe Chart Station on the Trimble Road trunk sewer to confirm flows recorded by the City’s existing permanent meters at that site. Four of the sites were installed early, including a meter at Levi’s Stadium to capture the 2014 Thanksgiving Day football game, and at the three most downstream meters to capture total flows to the Rabello and Northside Pump Stations.
- **Task 4 – Hydraulic Model Update.** An expanded hydraulic model of the City’s trunk sewer system was developed using InfoWorks™ CS modeling software. Subcatchments (small areas of unmodeled sewers that contribute flow to the modeled system) were delineated to define areas loading to the model, and flow loads to the model were compiled using water use and land use data and flow factors representing unit base wastewater flow (BWF) rates, diurnal BWF patterns, and infiltration/inflow (I/I). The expanded model also included the Northside and Rabello Pump Stations, the two associated force mains, and a junction structure between the pump stations and the SJ/SC RWF. Meetings were held with City planning staff to identify and obtain pertinent land use data and to discuss specific planning issues and potential growth or development areas in the City. Additional meetings were also held with the City of Cupertino and the CuSD to obtain updated flow projections. The model was verified for system connectivity, calibrated for dry weather conditions, and then calibrated for wet weather conditions using actual storm events from the flow monitoring program under Task 3.
- **Task 5 – Evaluate System Hydraulic Performance and Develop Capital Improvement Projects.** The model was used to determine sewer system capacity requirements and identify capacity deficiencies under peak dry and wet weather flow conditions, defined based on a design storm and system performance criteria. Potential solutions to capacity deficiencies were identified and tested in the model, and capacity improvement projects and associated costs were developed based on these analyses. The model was also used to confirm the results of the City’s 2010 Pump Station Evaluation to determine if the City’s pump stations are adequate to convey future flows. The recommended capacity improvement projects were prioritized to develop a Capital Improvement Program (CIP).
- **Task 6 – Prepare Sanitary Sewer Master Plan (Update) Report.** This report was prepared to summarize and present the results and recommendation of the study.

Legend

- Sewers by Diameter:
- ≤ 6" (Green line)
 - 8" - 10" (Light Blue line)
 - 12" - 16" (Blue line)
 - 18" - 24" (Orange line)
 - ≥ 27" (Red line)
- Pump/Lift Station
- Santa Clara Force Mains
- San Jose Interceptors
- City Limit



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City of Santa Clara
Sanitary Sewer
Master Plan Update
Figure 1-1
Sanitary Sewer Collection
System Overview



0 0.5 1 Mile

1.3 Report Organization

This report includes five Chapters, which are described below.

- **Chapter 1, Introduction**, presents the background, objectives, and scope of the Sanitary Sewer Master Plan Update.
- **Chapter 2, Basis of Flow Estimates**, discusses the planning area land use projections, the basis for developing estimates for each component of wastewater flows, and the base wastewater flow projections for the service area.
- **Chapter 3, Hydraulic Model Development**, describes the modeled sewer system, development of the model network and model loads, flow monitoring program, and model calibration.
- **Chapter 4, Capacity Analysis**, describes the capacity analysis and design criteria, model results, and potential solutions for identified capacity deficiencies.
- **Chapter 5, Recommended Capacity Improvement Program**, presents the recommended capacity improvement CIP, including project costs, prioritization, and implementation recommendations.

The Appendices to this report include plots of the flow monitoring data, model calibration graphs, model hydraulic profiles, and documentation for the recommended CIP, including project descriptions and cost estimates.

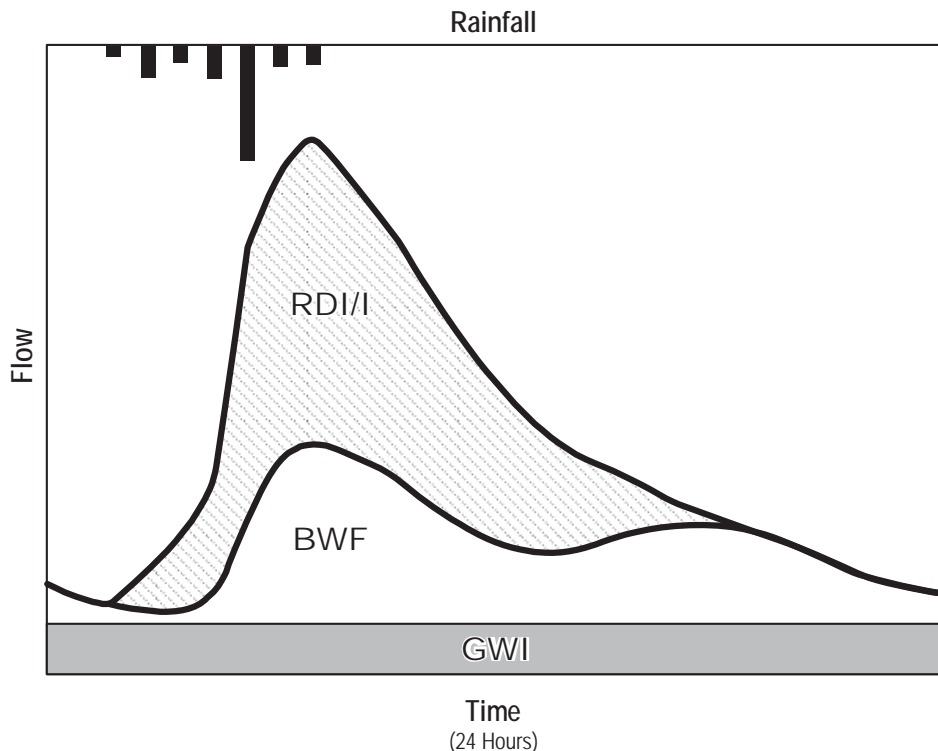
Chapter 2 Basis of Flow Estimates

This chapter presents the basis of wastewater flow estimates for the City’s sanitary sewer system. The section describes the wastewater flow components used in the hydraulic model and the existing and projected future land uses for the City, which form the basis for generating base wastewater flows. Design flow estimates were developed based on criteria developed for each flow component: base wastewater flow, groundwater infiltration, and rainfall-dependent infiltration and inflow, and confirmed through model calibration, as described in Chapter 3 of this report.

2.1 Wastewater Flow Components

Wastewater flows include three components: base wastewater flow (BWF), groundwater infiltration (GWI), and rainfall-dependent infiltration/inflow (RDI/I), as illustrated conceptually in **Figure 2-1**. BWF represents the sanitary and process flow contributions from residential, commercial, institutional, and industrial users of the system. GWI is groundwater that infiltrates into defects in sewer pipes and manholes, particularly in winter and springtime in low-lying areas. GWI is typically seasonal in nature and remains relatively constant during specific periods of the year. RDI/I is storm water inflow and infiltration that enter the system in direct response to rainfall events, typically through direct connections such as holes in manhole covers or illegally connected roof leaders or area drains or, more commonly, through defects in sewer pipes, manholes, and service laterals that may have resulted from poor initial construction, settlement of trench backfill, or deterioration due to age. RDI/I typically results in short-term peak flows that recede quickly after the rainfall ends.

Figure 2-1: Wastewater Flow Components



2.2 Base Wastewater Flow

For the City's Master Plan Update, BWF loads were developed for both existing and future development conditions. Existing loads were developed based on average winter water use data from the City's customer billing records, and future loads were based mainly on the General Plan Phase 3 (2035) development forecast and known development and redevelopment projects that had occurred in recent years. The loading methodology for existing conditions and for projecting future BWF are discussed in the following subsections.

2.2.1 Existing Base Wastewater Flow

Existing BWF was estimated based on actual water billing records in the City's customer billing database. Data were first processed to exclude non-wastewater generating accounts such as fire, construction, or irrigation accounts; data for the remaining accounts were converted to average water use (in gallons per day, gpd) using the billing dates and quantities. Each account's BWF was estimated based on the average water use during the four winter periods between December 2010 and February 2014. Each user was also assigned one of three land use types (residential, commercial, or industrial) according to the account's North American Industry Classification System (NAICS) designation.

The City also has customers who use domestic wells and/or recycled water. The BWF for these customers were individually estimated based on their winter well usage data and recycled water billing data.








The BWF data (both water use and land use type) were further processed in GIS by geocoding the data to their corresponding parcels using the account's service address. The total BWF for each sewer subcatchment was then estimated by overlaying the subcatchment boundary on the parcels and summing the BWF of all parcels within each subcatchment.

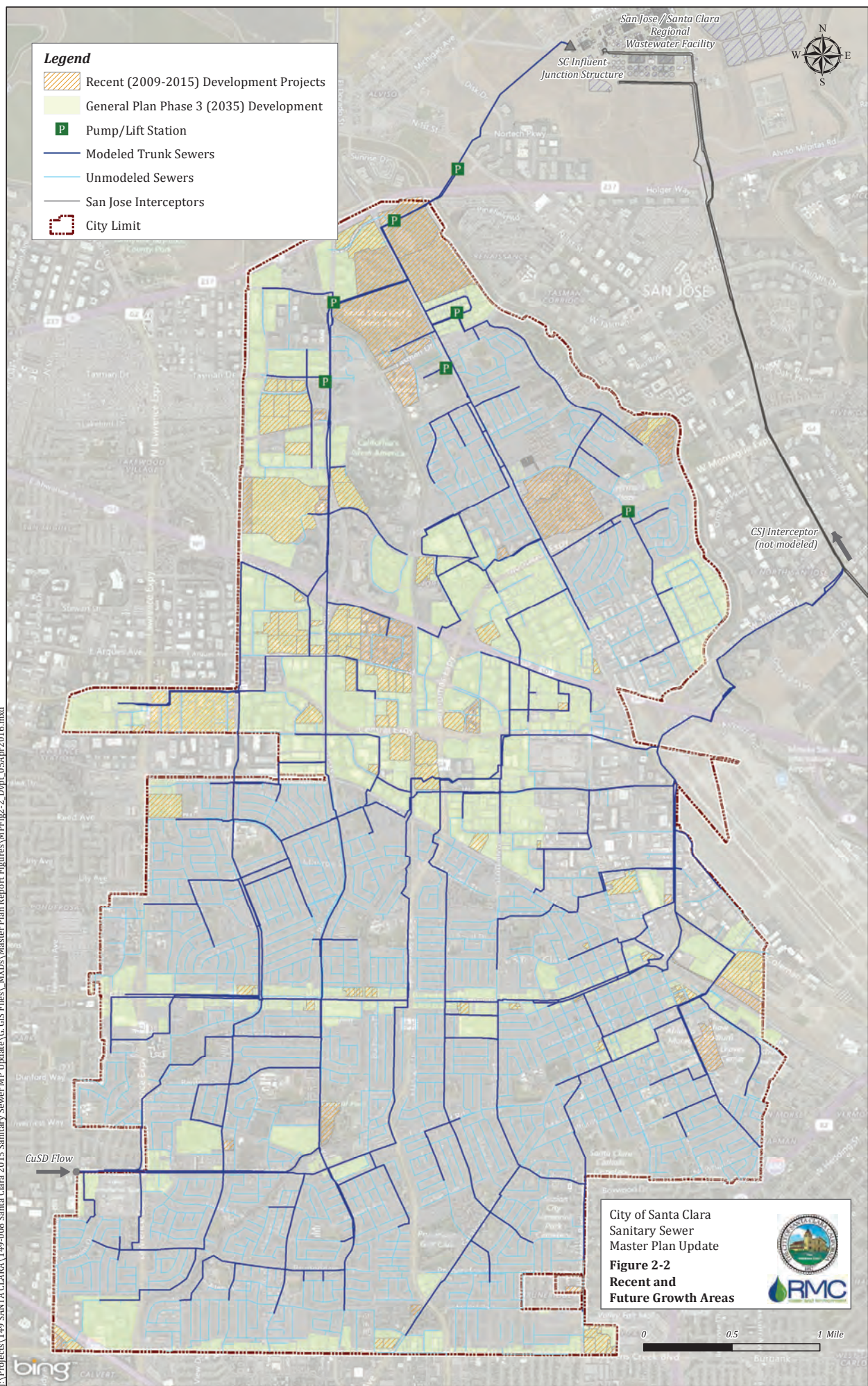
The data were then imported into the hydraulic model to perform a dry weather simulation run, and the results were compared to the flow data collected during the most recent flow monitoring program, in which a total of 25 meters were installed at selected locations throughout the system and collected actual flow data between November 2014 and March 2015 (see further discussion of model calibration in Chapter 3). It was noticed that the modeled flows were consistently about 10 to 20 percent higher than the observed flows. One possible explanation was that there was some level of irrigation activities occurring even in the winter months due to the lack of rainfall in recent years. As such, a wastewater return factor of 10 to 20 percent was applied to the estimated BWF based on the water use data to attain a more reasonable match with actual flows observed in the field. The revised estimated BWF including the wastewater return factor is 6.5 million gallons per day (mgd) for residential accounts and 4.4 mgd for commercial and industrial accounts. These estimates do not include flow from the Levi's Stadium, which varies widely depending on the use of the venue and could potentially generate daily peak flows ranging from less than 0.1 mgd (for local events such as team practice or stadium public tours) to 1.0 mgd or higher (for major events such as the Super Bowl).

2.2.2 Future Base Wastewater Flow

The future scenario for this Master Plan Update refers to the projected flow condition in year 2035, which is the planning horizon for the City's current General Plan. The BWF for this scenario was estimated using multiple data sources, including the original General Plan Phase 3 development forecast that was prepared in 2009 plus various additions and corrections that City staff identified in 2015, development and redevelopment projects that have occurred between 2009 and 2015, and entitlement agreements for specific parcels. These areas are shown in **Figure 2-2**. A more detailed map and tabulation of the recent developments are included in **Appendix G**.



Legend

-  Recent (2009-2015) Development Projects
-  General Plan Phase 3 (2035) Development
-  Pump/Lift Station
-  Modeled Trunk Sewers
-  Unmodeled Sewers
-  San Jose Interceptors
-  City Limit



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City of Santa Clara
Sanitary Sewer
Master Plan Update
Figure 2-2
Recent and
Future Growth Areas


The original future BWF projection was developed in 2009 as part of the City’s overall General Plan Update effort, in which over one thousand parcels with development potential were identified and their developments were quantified in terms of dwelling units (for residential developments) and/or building square footage (for non-residential developments). The development quantities were multiplied by the corresponding unit flow factors depending on land use to convert the information into BWF estimates. These unit flow factors are summarized in **Table 2-1**.

Table 2-1: Base Wastewater Flow Unit Flow Factors

Type of Development	Unit Flow Factor ⁽¹⁾	Basis
Single Family Detached	245 gpd/DU	3.5 people/DU, 70 gpcd
Townhouse or Condominiums	175 gpd/DU	2.5 people/DU, 70 gpcd
Apartments	154 gpd/DU	2.2 people/DU, 70 gpcd
Hotels	100 gpd/room	n/a
Commercial Offices	0.1 gpd/sq. ft.	n/a
R&D Offices	0.15 gpd/sq.ft.	n/a

1. All unit flow factors are consistent with factors used in the 2007 Capacity Assessment.

Parcels that were not identified with development potential were assumed to retain the same land use through 2035 and therefore also maintain approximately the same level of wastewater generation, which was developed based on their 2005-2006 winter water billing data. This version of the future BWF projection has since then been used for various capacity evaluations, and was updated regularly when new development or redevelopment project applications were submitted to the City for capacity evaluation.

In 2015, the City identified a number of additional developments that were not accounted for in the original General Plan Phase 3 development forecast prepared in 2009. The City also identified a list of parcels with entitlement agreements that allow the owners of these parcels to discharge wastewater up to a certain flow rate without applying for permission or notifying the City. Neither set of data was accounted for in the original projection. Furthermore, the revised existing BWF estimates are noticeably lower than those developed based on the 2005-2006 winter water billing data. The decline could be mostly attributed to increased water conservation activities in response to the recent drought. This is also evidenced in the City’s potable water sales records, which shows a sharp decline in the past ten years despite continuous population growth in the City. While it is possible that water use could rebound if and when the drought is over (e.g., behavioral changes such as reverting back to longer showers), some of the reduction is likely to remain permanent as a result of installing water-efficient plumbing fixtures and greater awareness of the need to continue conserving water.

In light of the various changes in water use and development information, a focused effort was undertaken to revise the City’s future BWF projections. Parcels that were identified to have development potential in the revised General Plan Phase 3 forecast were re-processed using the updated development quantities. Parcels that were not identified with development potential were assumed to maintain their current water use, which is the updated existing BWF described in the previous section, instead of the original BWF based on previous 2005-2006 water use data, plus a 10 percent rebound factor to account for possible increase in water use in the future. For parcels that are on the list of development/redevelopment projects that the City has received between 2009 and 2015, their BWF was estimated according to the development quantities specified in their project applications. For parcels that hold entitlement agreements, BWF was set to their entitled flow rates.

Table 2-2 summarizes the existing (circa 2015) and future (2035) BWF for residential and non-residential sectors. Based on these estimates, BWF is projected to increase by over two fold to 27.1 mgd in 2035.

Table 2-2: Base Wastewater Flow Estimates

Land Use	Existing Flow (mgd)	Future Flow (mgd)
Residential	6.5	10.7
Non-Residential (1)	4.4	16.4
Total (2)	11.0	27.1

1. Does not include flow from the Levi's Stadium, which varies greatly depending on the use of the venue; average flow on a peak game day is approximately 0.19 mgd based on flow monitoring conducted as part of this project.
2. Does not include flow from the Cupertino Sanitary District (CUSD), which is discussed in section 2.5.

2.2.3 Diurnal Curves

In most sewer systems, BWF typically exhibits distinctive diurnal patterns depending on the land use, usually categorized as residential, commercial, and industrial. For Santa Clara, flow monitoring data showed typical responses to commercial and industrial patterns, but also two residential patterns: the northeastern part of the City in the vicinity of Lafayette Street and Montague Expressway appeared to have a more pronounced morning peak flow and a lower evening peak, while the rest of the City had a less peaky morning peak and a somewhat higher evening peak. As such, two residential diurnal curves were created to represent these two patterns.

The diurnal curves are shown in **Figure 2-3**. Each subcatchment was assigned one of the residential curves according to its location (Lafayette Area vs. all other areas); and one of the non-residential curves according to the primary type of non-residential establishments (commercial or industrial).

Figure 2-3: Wastewater Diurnal Curves

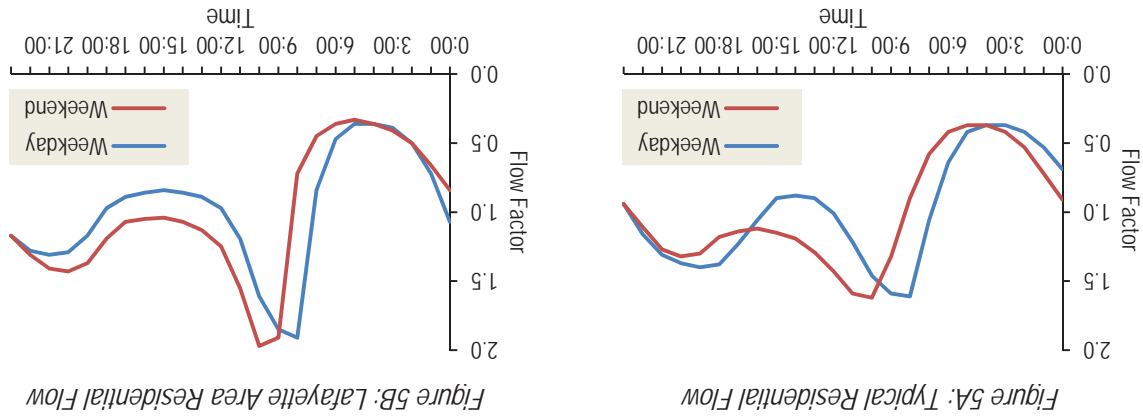


Figure 5C: Commercial Flow

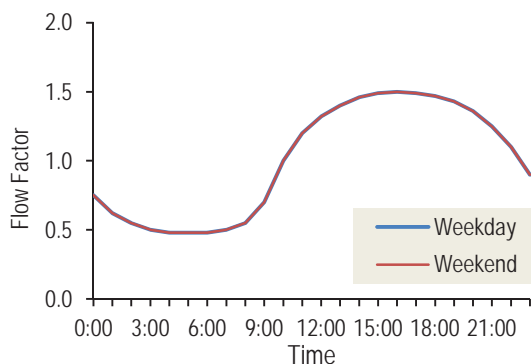
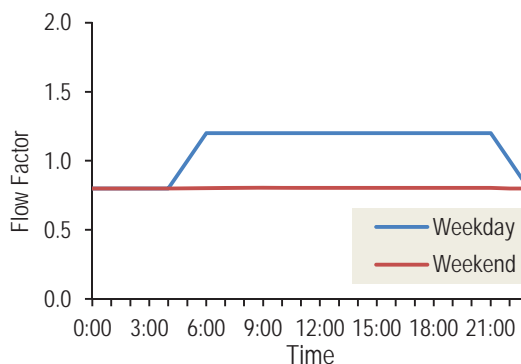


Figure 5D: Industrial Flow



Some of the City’s large water users do not exhibit typical diurnal curves. To ensure their flow patterns are accurately reflected in the model, nonresidential accounts with average water use of over 50,000 gpd were identified and individually researched. A total of 18 such large users were identified, and City staff contacted each user to collect operational information regarding their sewer discharge pattern. Individual diurnal curves were created for each based on the operational hours indicated on their wastewater discharge permits or surveys. These large water users are summarized in **Table 2-3**.

Table 2-3: City’s Large Water Users

Account Holder	APN	Address	Est. Average Flow (mgd)
Graphic Packaging Intl. Inc.	230-03-100	2600 De La Cruz Blvd.	0.587
Siliconix Inc.	104-39-023	2201 Laurelwood Rd.	0.405
Streamline Circuits Corp.	224-06-170	1415 Richard Ave.	0.308
Intel Corporation	104-48-010	3600 Juliette Ln.	0.191
Intel Corporation	216-46-015	3065 Bowers Ave.	0.099
Marvell Semiconductor Inc.	104-52-024	5488 Marvell Ln.	0.081
APCT Inc.	101-15-033	3495 De La Cruz Blvd.	0.074
Perkin Elmer Optoelectronics	104-13-083	2175 Mission College Blvd.	0.071
Owens Corning Sales LLC	224-07-099	960 Central Exp.	0.069
Applied Materials	216-49-024	3070 Bowers Ave.	0.067
Reaction Technology Inc.	104-51-001	3400 Bassett St.	0.067
City of Santa Clara – Electrical Dept.	230-03-067	524 Robert Ave.	0.065
Abbott Diagnostics Div.	104-50-016	5440 Patrick Henry Dr.	0.063
Diana Fruit Co. Inc.	224-40-001	651 Mathew St.	0.061
Oracle America Inc.	097-08-114	4100 Network Cl.	0.058
Digital 3011 Lafayette LLC	224-36-052	3011 Lafayette St.	0.053
Intel Corporation	104-39-020	2200 Mission College Blvd.	0.053
Agilent Technology	316-17-018	5301 Stevens Creek Blvd.	0.051

2.3 Groundwater Infiltration

Groundwater infiltration is generally quantified based on actual flow monitoring data, since it is difficult to predict GWI rates based on physical system data alone. In the context of design flow criteria, GWI represents the incremental groundwater infiltration that occurs during the wet weather season above the “baseline” infiltration level during the driest months of the year.

GWI can be estimated based on minimum flows during non-rainfall periods during a wet weather flow monitoring period. Minimum flows typical occur during the nighttime or early morning hours when base wastewater flows are at a low. Alternatively, GWI can be estimated as the difference between average metered flow during non-rainfall periods and computed average BWF. In either case, the resulting GWI, is expressed on a unit basis (gpd/acre or gpad) by dividing by the sewered acreage of the monitored area. Typical GWI rates may range from about 100 to 1,000 gpad.

GWI were estimated through the model calibration process (described in Chapter 3) by comparing model-simulated BWF to actual flow measurements from the temporary flow monitoring programs. Cases where model-predicted BWF was noticeably lower than monitored flow indicated the possible occurrence of GWI.

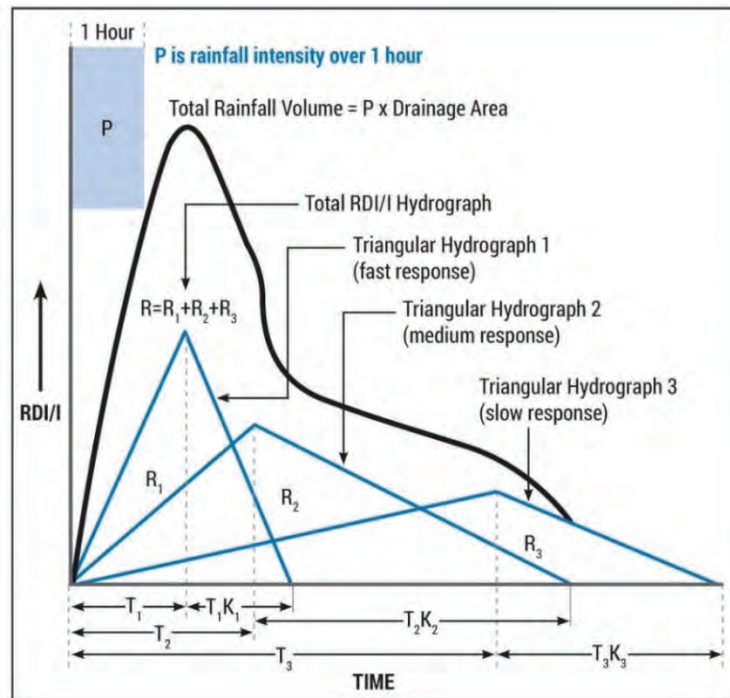
2.4 Rainfall-Dependent I/I

RDI/I flows result from rainfall events that produce infiltration and inflow of storm water into the sewer system. RDI/I can be quantified as the difference between the total flow during and immediately following a storm event and the non-rainfall “base flow” (BWF plus GWI) that is estimated to have occurred during the storm period. The magnitude of the resulting RDI/I response is typically described by the percentage of the rainfall volume (called the “R value”) represented by the volume of the RDI/I hydrograph. The R value can vary from storm to storm, depending on such factors as the degree of soil saturation (due to antecedent rainfall) prior to the storm event.

The shape of the RDI/I hydrograph is also important in determining the peak RDI/I response. The RDI/I hydrograph shape is often defined by separating the total RDI/I hydrograph volume into components, representing different response times to rainfall (fast, medium, and slow). Each component is identified by a percentage of the total RDI/I volume and specific time to peak (T) and recession coefficient (K), illustrated in **Figure 2-4**. The R component percentages and T and K values can be applied to each hour of rainfall to generate a “synthetic hydrograph” that approximates the volume and shape of the hydrograph from the actual observed event. These parameters, when applied to a different rainfall pattern, can be used to estimate the RDI/I response to that particular rainfall event. This methodology is used to synthesize RDI/I hydrographs for a “design storm” for collection system modeling (see Chapter 3 for discussion of design storms).

Design criteria for RDI/I include design R values and hydrograph shape parameters and the hourly rainfall for the selected design storm event. As described in the next chapter, R values and hydrograph parameters are determined through the process of model calibration, in which actual observed rainfall events are simulated in the hydraulic model, and the resulting model hydrographs are compared to the measured flows at flow meters locations. The RDI/I parameters are adjusted as needed to achieve the best match of modeled to monitored flows. Once calibrated, the model RDI/I parameters can be applied to a design storm to simulate wet weather flows for a design event.

Figure 2-4: RDI/I Hydrograph Components



2.5 Flow from Cupertino Sanitary District

CuSD provides sewer collection services for the majority of City of Cupertino, portions of the City of Saratoga, and several unincorporated areas within Santa Clara County east of San Jose. Most of the flow is discharged into the Santa Clara system via a 27-inch sewer line in Homestead Road; the rest is discharged into the City of San Jose (CSJ) system at various other connection points.

CuSD maintains a permanent flow meter at its discharge point in Homestead Road. Meter data between November 2014 and March 2015 were reviewed and analyzed; the average dry weather flow (ADWF) was about 3.5 mgd. Similar to the declining trend observed for the City, CuSD's flow has also declined over 28 percent from the 2007 estimates of 4.9 mgd to the current estimates of 3.5 mgd, most likely also due to increased water conservation activities in response to the recent drought.

Multiple meetings were held with City staff and CuSD staff to discuss development projections within the CuSD service areas in an effort to estimate the future BWF for the CuSD system. Information from sources such as the City of Cupertino's General Plan 2020 and General Plan 2040, CuSD-SJ Joint Interceptor Cost Sharing Agreement (which indicates how much flow CuSD would be discharging into the San Jose system), ABAG projections, and CuSD meter data were discussed. Characteristics of the CuSD system, such as system age and I/I, planned sewer improvements, and known large development projects were also considered. Preliminary model simulations were conducted to understand the potential impact of the CuSD flow on the Santa Clara system under future peak design storm condition. For this Master Plan Update, City staff has directed RMC to use 6.90 mgd as CuSD's future ADWF, and cap its future PWWF at 13.8 mgd, which is the maximum flow rate set forth in the agreement³ between the City and CuSD.

³ Agreement between the City of Santa Clara and the Cupertino Sanitary District for (a) the purchase of capacity in Cupertino's sanitary interceptor sewer within the City of Santa Clara and (b) continued use by Cupertino Sanitary District of 13.8 MGD Peak Capacity in the City of Santa Clara's interceptor sewer system.

Chapter 3 Hydraulic Model Development

This chapter describes the process of developing and calibrating the hydraulic model for use in the capacity assessment, including the flow monitoring program that was conducted for this study.

3.1 Modeling Terminology

Network refers to the representation of the physical facilities being modeled. The primary components of the modeled network are pipes, manholes, and pump stations.

Nodes are primarily manholes, but also include pump station wet wells, outfalls (discharge points of the modeled system) and breaks (changes in slope or diameter without a structure, such as at the vertical bends in inverted siphons). The primary data associated with nodes are rim and invert elevations. In the case of wet wells, the data also includes the diameter (for a circular well) or cross-sectional area.

Pipes are connections between nodes. The primary data associated with pipes are upstream and downstream node IDs, pipe length, diameter, and upstream and downstream invert elevations. Pipes include both gravity sewers and force mains.

Pumps are represented by links connecting the wet well node(s) and the discharge manhole or upstream end of the force main. Pumps are controlled by a number of user-defined parameters, including the switch-on and switch-off levels, types of pumps, and head discharge curves.

Other model components include **Gates and Weirs**, which are represented by links with zero length. Primary data associated with gates are the opening width and invert; data associated with weirs are the crest width and crest elevation.

Subcatchments are areas that contribute flow to the modeled sewer network and represent the unmodeled sewers in the collection system. Data associated with subcatchments include base wastewater (sanitary) flow (computed based on population, water use, or other available data), type of land use (which defines the diurnal profile associated with the base wastewater flow), infiltration/inflow (I/I) parameters, and the node at which the flow from the subcatchment enters the modeled system.

Loads are the flows assigned to each subcatchment. Components of model loads include residential and commercial base wastewater flow (BWF), groundwater infiltration (GWI), and rainfall-dependent I/I (RDI/I). As a sum, they represent the total wastewater flow applied to the model.

Models are the combination of a modeled network, its associated subcatchments and loads, and other data files (e.g., rainfall, diurnal profiles, etc.) that comprise a specific model scenario.

3.2 Delineation of Modeled System

A hydraulic model is typically developed to represent the *trunk* sewer system, which is the network of larger diameter pipes that comprises the “backbone” of the entire system. The City’s original hydraulic model was developed by RMC as part of the 2007 Capacity Assessment project and included approximately 28 percent (about 76 miles) of the total sewer pipelines and four of the pump stations. The model was originally constructed using modeling software MIKE URBAN™ (SWMM version) and was converted to InfoWorks™ CS in 2008. RMC has continuously maintained and updated the model as sewer improvement projects were implemented or when new network data became available.

For this Master Plan Update, the model was expanded to include approximately 34 percent (about 92 miles) of the total pipelines and all seven pump stations. The force mains downstream of the Rabello and Northside pump stations were also added. A summary of the system’s pipeline inventory is provided in **Table 3-1**. The modeled network is shown in **Figure 3-1**.

Table 3-1: Sewer Collection System Model Summary

Pipe Diameter (in)	Total Length ¹ (ft)	Length Modeled ¹ (ft)	Percent Modeled
4-6	197,400	1,800	0.9%
8	619,600	48,300	8%
10	132,300	65,200	49%
12	224,900	120,300	53%
14-16	62,800	59,400	95%
18	43,700	42,000	96%
20-21	15,300	15,300	100%
24	49,600	49,600	100%
27	15,000	15,000	100%
30	25,900	25,900	100%
>30	38,100	38,100	100%
Force Main	13,000	13,000	100%
Total (feet)	1,437,600	493,900	34%
Total (miles)	272.3	93.5	34%
Approx. No. of Manholes	5,260	1,870	36%
No. of Siphons²	53	53	100%

1. Rounded to the nearest hundred feet.
2. This refers to the total number of barrels. Some siphons have multiple barrels.

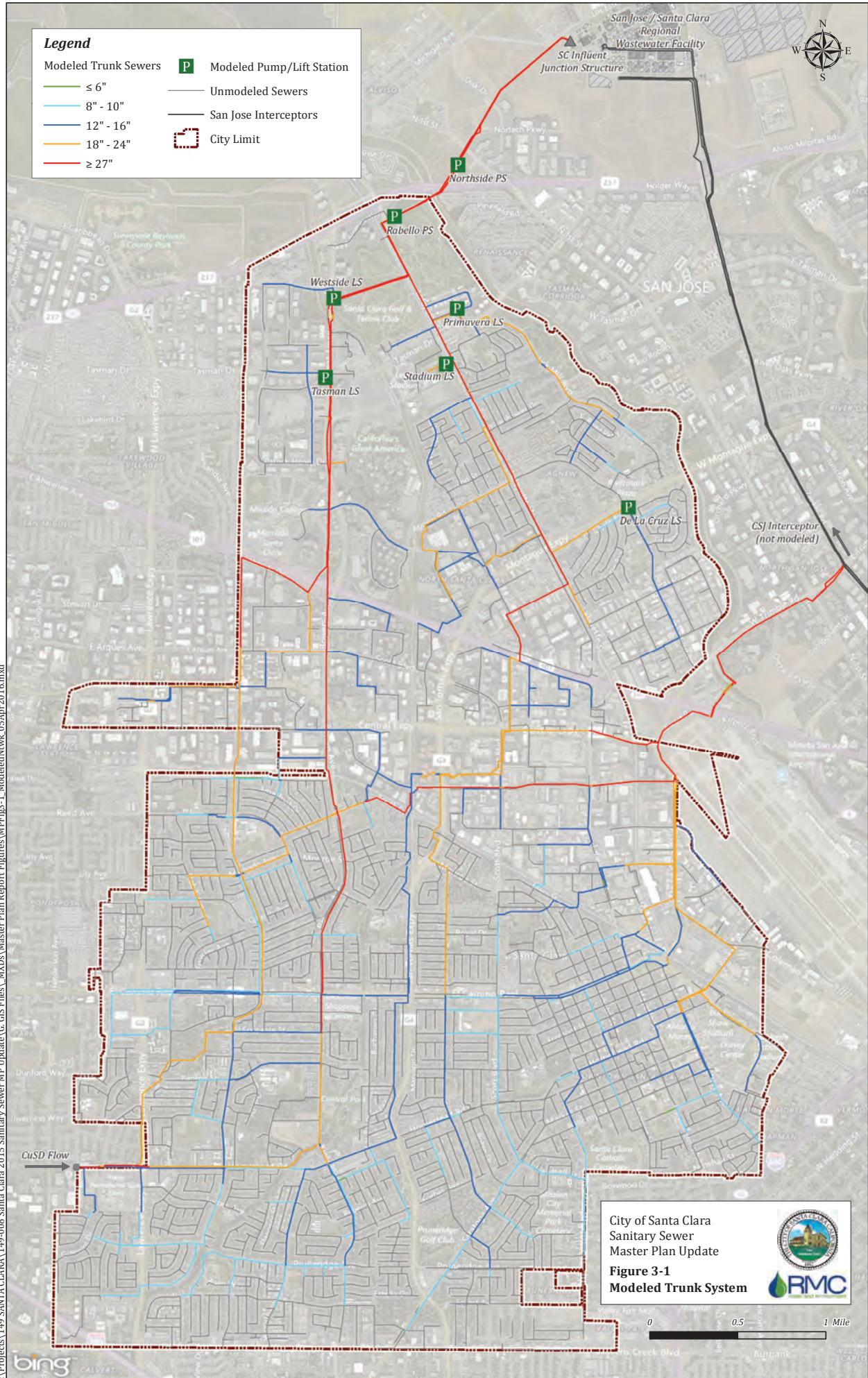
All seven pump stations in the system are included in the model. A survey was conducted to collect information on pump curves and the operational sequences, as summarized in **Table 3-2** below. Pump capacity analysis was conducted for all stations and the results are summarized in Chapter 4 of this report.

Table 3-2: Collection System Pump Station Summary

No.	Station Name	No. of Pumps	Description	Emergency Bypass
1	Westside Lift Station	2	Identical Flygt 3127 pumps.	Yes
2	Tasman Lift Station	2	Identical Flygt 3127 pumps.	Yes
3	De La Cruz Lift Station	2	Identical Flygt 3127 pumps.	Yes
4	Primavera Lift Station	6	Identical Flygt 3127 pumps.	Yes
5	Stadium Lift Station	6	New lift station completed in 2014. Two identical low-flow pumps (Flygt 3127) and four identical high-flow pumps (Flygt 3153).	Yes
6	Rabello Pump Station	8	Identical Flygt 3202 pumps. Four new pumps installed in 2013 and in 2014.	Yes
7	Northside Pump Station	4	Four identical Flygt 3356 pumps.	Yes

Legend

- Modeled Trunk Sewers
 - ≤ 6"
 - 8" - 10"
 - 12" - 16"
 - 18" - 24"
 - ≥ 27"
- P Modeled Pump/Lift Station
- Unmodeled Sewers
- San Jose Interceptors
- City Limit



City of Santa Clara
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Figure 3-1
Modeled Trunk System



0 0.5 1 Mile

Flows are loaded into the model at “loading manholes,” each representing the point where flows from adjacent parcels or parcels connected to unmodeled sewers discharge to the modeled network. The parcels connected to unmodeled sewers were grouped into sewer subcatchments based on the modeled manhole to which the unmodeled sewers drain. Each subcatchment was associated with a unique load manhole in the model network. Approximately 860 sewer subcatchments and associated loading manholes were delineated for defining the model loads. The subcatchments and load manholes are shown in **Figure 3-2**.

3.3 Model Network Construction and Validation

Data of the expanded network were compiled from available as-built drawings, field measurements, and Excel files from previous modeling efforts. The network was also validated using the following steps:

- The entire modeled network (both the original network and the expanded portion) was checked for connectivity, i.e., verifying that correct upstream/downstream manholes were identified for each pipe and there were no missing links in the network.
- Profiles were plotted for each series of pipe segments to visually check for missing or suspect data, such as missing rim or invert elevations, negative pipe slopes, or abrupt steps up or down in pipe inverts. Where appropriate, data were interpolated or verified through field investigation or as-built drawings.
- As-built drawings and field data were used to develop details for the modeled pump stations, such as wet well elevations and dimensions, number of pumps, pump types, on/off levels, and discharge curves.
- Flow splits (manholes with more than one outlet pipe) were identified, and field verification and/or as-built drawings were requested as needed for further verification of outlet pipe elevations and/or the existence of weirs or other flow diversion structures.

3.4 Flow Monitoring Program

Flow monitoring was conducted between November 2014 and March 2015 to measure actual flows in the system for analysis and calibration purposes. The monitoring was conducted by V&A Consulting Engineers (V&A) as subcontractor to RMC. The flow monitoring program originally consisted of 23 flow meters and four rain gauges. Most of the meters were installed and operational from December 10, 2014 to March 4, 2015 (approximately 12 weeks). Four of the meters, Meters 1 through 4, were installed earlier on November 22, 2014 to collect data during scheduled game events at the new Levi’s Stadium.

Factors that were considered in selecting the flow meter sites included:

- Location of sites used in 2006 flow monitoring program for the City’s previous sewer system capacity assessment study
- Similar sized tributary areas
- Ability to isolate areas to characterize flows for model calibration
- Provides more specific information about flow splits
- Preferred hydraulic conditions (i.e., manholes on a straight line preferred over manholes on bends or with multiple incoming pipes)
- Ease of access and safety considerations

In addition to the 23 sites, the City also owns and maintains two permanent flow meters at the Guadalupe Chart Station just upstream of the connection with the City of San Jose’s Interceptors. Upon review of the data collected at these two meters, it was determined that a field calibration was necessary. V&A performed field calibration, and also installed two temporary flow meters at the same site to verify and ensure data quality of the two permanent meters.

The flow monitoring sites are listed in **Table 3-3** and shown on **Figure 3-3**. A flow meter schematic is shown on **Figure 3-4**. Four rain gauges were installed to collect representative rainfall data over the service area during the monitoring period. The rain gauge locations are also shown on **Figure 3-3**.

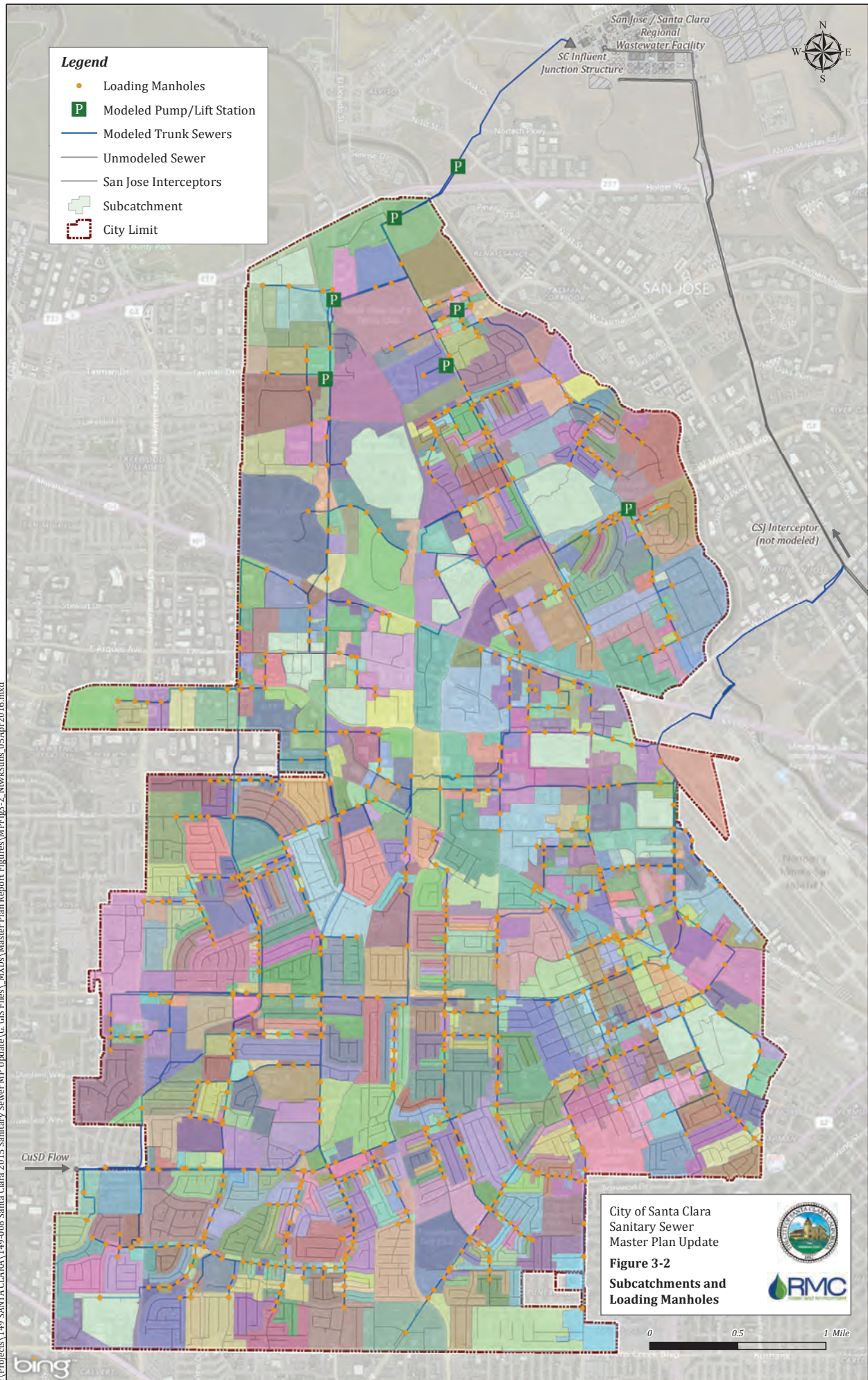
Table 3-3: Summary of Flow Monitoring Sites

Meter ID	Location	Manhole ID	Pipe Size (in)	Avg. Flow ⁽¹⁾ (mgd)	Peak Flow ⁽²⁾ (mgd)
1 ⁽³⁾	Lafayette St. north of Calle de Mundo	S104-28	36	3.91	7.95
2 ⁽³⁾	Golf course private road west of Lafayette St.	S104-26	33	3.97	8.36
3 ⁽³⁾	Lafayette St. north of Calle de Mundo	S104-30	42	3.05	9.24
4 ^(3, 4)	Parking lot of the new Levis Stadium	S94-35	24	0.22	0.94
5	Mission College Blvd. north of Our Lady's Wy.	S83-21	33	3.97	10.3
6	Mission College Blvd. north of Our Lady's Wy.	S83-22	30	2.60	6.37
7	Upstream of Primavera Lift Station.	S105-34	24	0.89	1.81
8	Lafayette St. north of Montague Expwy.	S86-12	30	1.79	4.80
9	Calabazas Creek south of Kifer Rd.	S62-40	24	1.98	6.34
10	San Juan Ave. and Monroe St.	S52-79	24	0.80	2.80
11	Chromite Dr. and Pilot Knob Dr.	S53-40	24	1.06	4.76
12	Chromite Dr. and Alhambra	S53-23	24	1.19	4.74
13	Bowers Ave. just north of Bonnie Dr.	S53-54	30	3.50	7.22
14	South Dr. south of Loma Vista Ln.	S54-16	15	0.53	1.12
15	Nvidia Parking lot, west off of Scott Blvd. south of Central Expwy.	S65-50	18	0.45	1.44
16	Central Expwy west of UPRR	S67-13	27	1.43	2.70
17	De La Cruz Blvd. north of Martin Ave.	S58-9	24	0.40	1.48
18	De La Cruz Blvd. north of Martin Ave.	S58-8	24	1.14	
19	North of intersection of Wren Ave. at Kent Avenue	S21-18	24	1.63	3.13
20	Homestead Rd. west of Cherry Orchard Place	S21-47	18	1.74	4.00
21	Kiely Blvd. south of Kaiser Dr.	S23-6	24	2.25	3.68
22	Los Padres Blvd. at Bray Ave.	S45-80	18	0.76	4.60
23	Brokaw Rd. north-east of UPRR	S48-31	18	0.58	1.81
M1 ⁽⁵⁾	Guadalupe Chart Station East Line	N/A	33 ⁽⁶⁾	3.89	5.80
M2 ⁽⁵⁾	Guadalupe Chart Station West Line	N/A	33	1.07	2.64

1. Average flow during non-rainfall period in mid- to late January.
2. Peak 15-minute flow during flow monitoring period (during December 11-12, 2014 storm event for most meters)
3. Meters 1 through 4 were installed on November 22, 2014. All other meters were installed on or around December 10, 2014. All meters were removed on or around March 4, 2015.
4. Average flow represents a typical non-game day flow; peak flow represents a game day flow.
5. Meters M1 and M2 were installed starting January 9, 2015 in addition to the two permanent meters at the Guadalupe Chart Station.
6. Field measurements and observation show this line to be a 36-inch pre-fabricated T-lock lined pipe, while design drawings show its diameter to be 33 inches. A research was done to verify the pipe diameter but did not reach a conclusive result. As such, this pipe remains a 33-inch in the model.

Legend

- Loading Manholes
- Modeled Pump/Lift Station
- Modeled Trunk Sewers
- Unmodeled Sewer
- San Jose Interceptors
- Subcatchment
- City Limit



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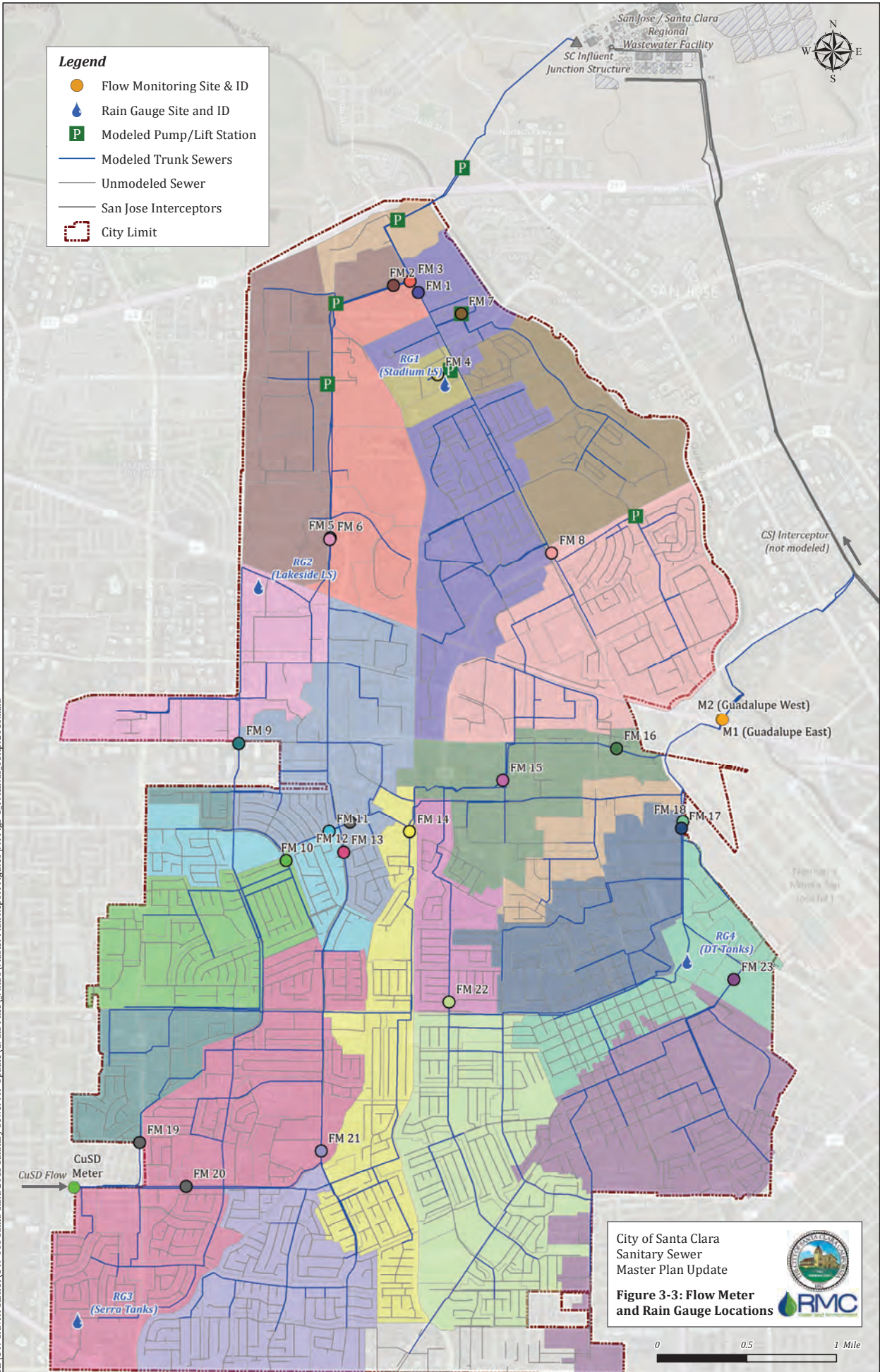
City of Santa Clara
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Master Plan Update
Figure 3-2
Subcatchments and
Loading Manholes



0 0.5 1 Mile


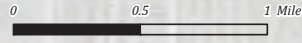
Legend

-  Flow Monitoring Site & ID
-  Rain Gauge Site and ID
-  Modeled Pump/Lift Station
-  Modeled Trunk Sewers
-  Unmodeled Sewer
-  San Jose Interceptors
-  City Limit



City of Santa Clara
Sanitary Sewer
Master Plan Update

Figure 3-3: Flow Meter and Rain Gauge Locations

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During the flow monitoring period, all of the monitoring sites and the two permanent meter sites at the Guadalupe Chart Station were visited approximately biweekly to check meter operation and site conditions, obtain field calibration measurements, and download collected data. Field calibration involves taking manual depth measurements and flow velocity measurements using a portable velocity meter. These calibration measurements were compared to and used to adjust monitor-recorded depth and velocity if needed. Calibration measurements were taken at different times of day in order to obtain calibration points for the full range of typical diurnal flows.

Approximately four storm events occurred during the flow monitoring period. The biggest event occurred on December 11, 2014, in which over 3 inches of rainfall were recorded within a 24-hour period, with a peak hour rainfall of 0.38 inch between 9 a.m. and 10 a.m. This is the event used for wet weather flow calibration, discussed further in Chapter 3.

Plots of the flow monitoring data and a tabular summary of daily average, minimum, and maximum flows for each meter are included in **Appendix A**.

3.5 Model Calibration

Model calibration is the process of comparing model-computed flows to observed (monitored) flows to verify that the model is accurately simulating flows in the sewer system. As described above, temporary flow monitoring programs consisting of 25 flow meters installed in the Santa Clara system during the 2014/15 winter season as part of the study. The data collected during this flow monitoring program were used for model calibration.

3.5.1 Dry Weather Calibration

The 14-day non-rainfall period from January 17 to January 30, 2015 was used for dry weather calibration. The dry weather calibration process was used to verify BWF loads and diurnal curves, and to quantify GWI (as indicated by monitored flows that were higher than estimated BWF). **Table 3-4** compares the model vs. metered average dry weather flow (ADWF) at each of the meter locations. **Figure 3-5** shows an example plot of model vs. metered flow for one of the flow monitoring locations in the system (Meter 5). Dry weather calibration graphs for all meters are included in **Appendix B**.

Overall, the model calibration resulted in a reasonably good match at most locations, but there were differences at some locations. These differences may be due to inaccuracies in the meter data, water use loadings, or configuration of the system (e.g., upstream flow splits, weir settings, etc.). Extensive effort was made to resolve as many of the calibration differences as possible. As shown in **Table 3-4**, the sum of the observed flows at the most downstream meters (Meters 1, 2, 3, M1 and M2) was within 6 percent of the modeled flows, which provides confidence that the overall flows in the model are reasonably accurate.

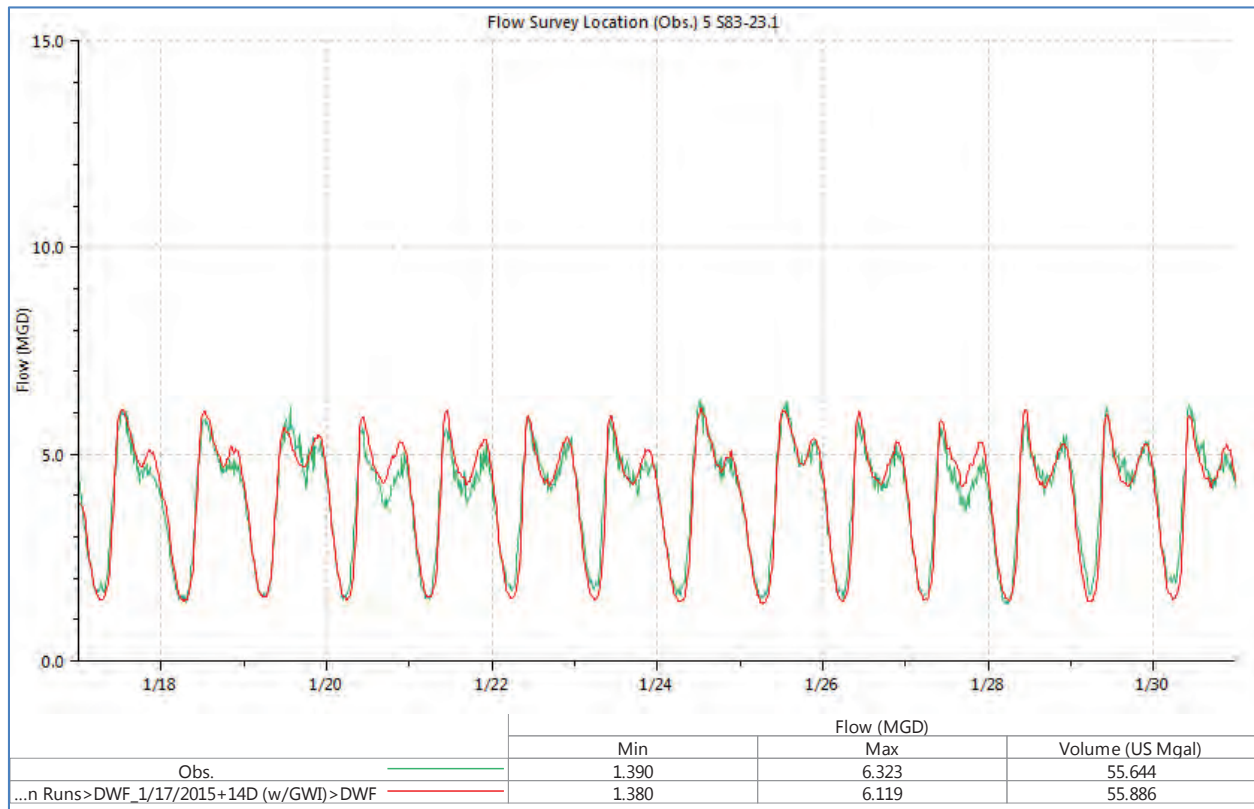
Note that the total model ADWF is higher than the estimated existing BWF shown in Table 2-2 because the model ADWF also accounts for the CuSD flow (observed flow data was used, which was approximately 3.57 mgd for the calibration period) and about 0.35 mgd of GWI that was added to the system during the calibration process, which was applied to the basins tributary to meters 10 and 11, at an estimated rate of 1,000 gpd/acre. As described in Chapter 2, GWI is calculated based on the difference between average flow on non-rainfall days during the flow monitoring period and estimated BWF for meters for which estimated BWF is noticeable lower than monitored flow. Other meter areas may also include some nominal dry weather GWI, which is assumed to be included in the BWF estimates.

Table 3-4: Dry Weather Flow Calibration Results

Meter ID	Meter Avg. Flow (mgd)	Model Avg. Flow (mgd)	Difference (mgd)	Percent Difference
1	3.91	3.42	-0.49	-12%
2	3.97	3.71	-0.26	-7%
3	3.05	3.27	0.21	7%
4 ⁽¹⁾	0.22	0.22	0.00	0%
5	3.97	3.99	0.02	0%
6	2.60	2.54	-0.06	-2%
7	0.89	0.74	-0.16	-17%
8	1.79	1.70	-0.09	-5%
9	1.98	2.25	0.27	13%
10	0.80	0.80	0.00	0%
11	1.06	1.10	0.04	4%
12	1.19	1.14	-0.05	-4%
13	3.50	3.59	0.09	3%
14	0.53	0.51	-0.02	-4%
15 ⁽²⁾	0.45	0.81	0.36	79%
16 ⁽²⁾	1.43	1.06	-0.37	-26%
15 & 16 ⁽²⁾	1.88	1.87	-0.01	-1%
17	0.40	0.54	0.14	34%
18	1.14	0.99	-0.15	-13%
19	1.63	1.56	-0.07	-4%
20	1.74	1.51	-0.23	-13%
21	2.25	2.09	-0.15	-7%
22	0.76	0.91	0.14	19%
23 ⁽³⁾	0.58	0.69	0.11	18%
M1 (Guadalupe East)	3.89	3.41	-0.48	-12%
M2 (Guadalupe West)	1.07	1.16	0.09	8%
Sum of D/S Meters ⁽⁴⁾	15.90	14.97	-0.92	-6%

- Meter 4 was installed immediately downstream of the Levi's stadium with the intention to collect data to study flow patterns during major game events. The meter did capture good flow data for a number of game events, but also encountered a technical issue in late January that caused data collected between January 20 and February 18 (overlapping with the calibration period) to be unrecoverable. As such, data collected between January 11 and January 18 (a 7-day non-rainfall period when the venue was not used for any games) was used to establish the baseline flow for the stadium.
- Meters 15 and 16 had an unexpected shift in flow distribution between late December 2014 and early January 2015, possibly caused by a temporary blockage upstream of the two meters. City staff was informed of this shift but could not provide an explanation. Although the meter flows did return to a higher level in late January 2015, they never returned to the pre-shift level. As such, their data was deemed not suitable to be used for calibration for each meter basin individually; instead, their tributary subcatchments were calibrated together as one basin using the combined data of the two meters.
- Meter 23 was located downstream of the Santa Clara University. The dry weather calibration period coincided with the registration week of the school's winter quarter when student population was not at its maximum. The observed flow for this meter was therefore noticeably lower than the modeled flow (which was developed based normal school period).
- Downstream (D/S) Meters are meters 1, 2, 3, M1, and M2. See system schematic in Figure 3-4.

Figure 3-5: Example Dry Weather Calibration Graphs



3.5.2 Wet Weather Calibration

The storm that occurred on December 11, 2014 was used for wet weather calibration. As described previously, RDI/I response to rainfall events was quantified in terms of three sets of triangular unit hydrograph parameters that represent the volume percentage of rainfall that enters the system as RDI/I and the shape of the RDI/I hydrograph as a function of each hour of rainfall. Through the wet weather calibration process, RDI/I hydrograph parameters were developed for each meter area. In general, the response to rainfall in the Santa Clara system is relatively small, as evidenced by the relatively low peak flow response to the rainfall event, with the exception of areas in the western portion of the City near Monroe Street, which showed both a high peak inflow during the rainfall event and an extended period of infiltration after the event.

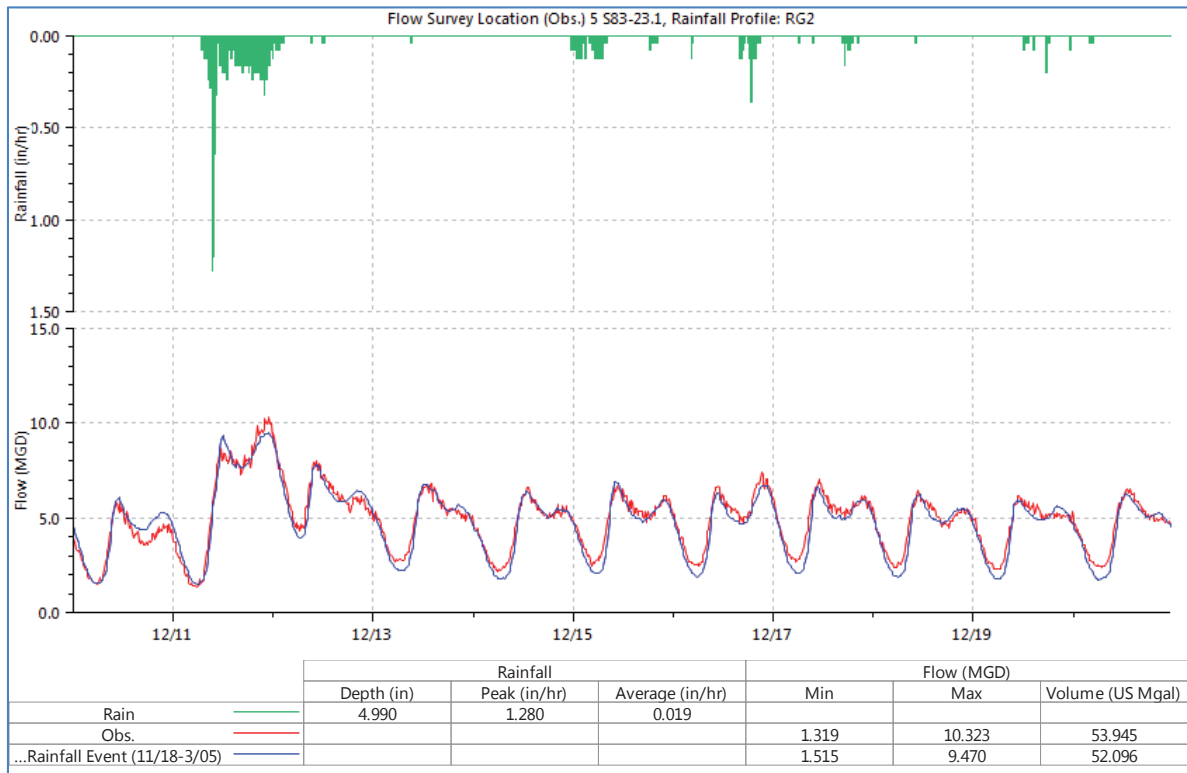
Table 3-5 lists the “R values” (as percentages of rainfall) for each flow meter area. **Figure 3-6** shows an example plot of model vs. metered flow for one of the flow monitoring locations in the system (Meter 5). A complete set of wet weather calibration graphs of modeled vs. metered flow for all meter locations are included in **Appendix C**.

Table 3-5: Wet Weather Flow Calibration Results

Meter ID	R1 RDI/I Vol. (%)	R2 RDI/I Vol. (%)	R3 RDI/I Vol. (%)	Total R (%)
1	0.3%	0.3%	0.8%	1.4%
2	0.1%	0.5%	0.8%	1.4%
3	0.1%	0.1%	0.1%	0.3%
4	1.0%	0.1%	0.1%	1.2%
5	0.1%	1.0%	1.5%	2.6%
6	0.1%	0.5%	1.5%	2.1%
7	0.2%	0.5%	0.8%	1.5%
8	0.3%	0.5%	1.2%	2.0%
9	0.5%	3.5%	8.0%	12.0%
10	1.0%	4.2%	8.0%	13.2%
11	0.1%	2.0%	15.0%	17.1%
12	0.2%	1.0%	20.0%	21.2%
13	0.1%	0.1%	0.8%	1.0%
14	0.4%	0.1%	0.5%	1.0%
15 & 16 ⁽¹⁾	0.1%	0.1%	0.3%	0.5%
17	0.5%	0.5%	0.5%	1.5%
18	0.5%	0.8%	1.0%	2.3%
19	0.3%	0.4%	0.5%	1.2%
20	0.1%	0.1%	0.1%	0.3%
21	0.2%	0.1%	0.1%	0.4%
22	0.1%	0.2%	0.1%	0.4%
23	0.5%	0.2%	0.1%	0.8%
CuSD	0.25%	0.35%	0.5%	1.1%

1. Meters 15 and 16 were calibrated together due to unexpected field conditions. See note 2 under Table 3-4.

Figure 3-6: Example Wet Weather Calibration Graphs for 2014 Storm Period



Chapter 4 Capacity Analysis

This chapter describes the hydraulic analysis and design criteria used to evaluate system performance and size capacity relief projects, the capacity deficiencies based on the results of model runs, and preliminary solutions to identified capacity deficiencies. The chapter also summarizes the pump station capacity evaluation and analysis.

4.1 Design Event Criteria

Peak design flows for sewer systems consist of dry weather base wastewater flow (BWF), groundwater infiltration (GWI), and rainfall-dependent infiltration/inflow (RDI/I). Criteria for computing existing BWF, GWI, and RDI/I (developed as part of model calibration), and unit flow assumptions for future development were discussed in the previous chapters. However, the peak design flow criteria must also specify the set of conditions (e.g., design storm rainfall and timing with respect to seasonal GWI and diurnal BWF) that will generate the highest peak flows that the sewer system must be capable of hydraulically conveying.

The following subsections discuss design storm criteria, present data from recent storm events, and identify options and recommendations for selection of a design event for use in this Master Plan Update.

4.1.1 Design Storm Condition

The use of wet weather design events as the basis for sewer capacity evaluation is a well-accepted practice. The approach is to first calibrate a hydraulic model of the system to match wet weather flows from observed storms, and then apply the calibrated model to a design rainfall event to identify capacity deficiencies and size improvement projects. The design event may be synthesized from rainfall statistics, or may be an actual historical rainfall event of appropriate duration and intensity.

A design storm is used to simulate a peak wet weather flow condition to identify system deficiencies and develop solutions for them. Design storms are typically classified by their return period and duration. The return period defines the probability that the design rainfall will be exceeded in any given year. For example, a storm with a 10-year return period means there is a 1 in 10 chance, or 10 percent probability, of exceeding the design rainfall in a given year. The chosen return period reflects the degree of risk an agency will tolerate of experiencing sanitary sewer overflows (SSOs) due to future storm events. However, choosing a design storm with a very high return period (reflecting a very low risk tolerance) could lead to the identification of so many system capacity deficiencies that the cost of improvements is prohibitive. Additionally, sizing a system for a very rare event could mean that the system does not function well under typical conditions during much lower flows (due to slow velocities in oversized pipes, or oversized pump stations).

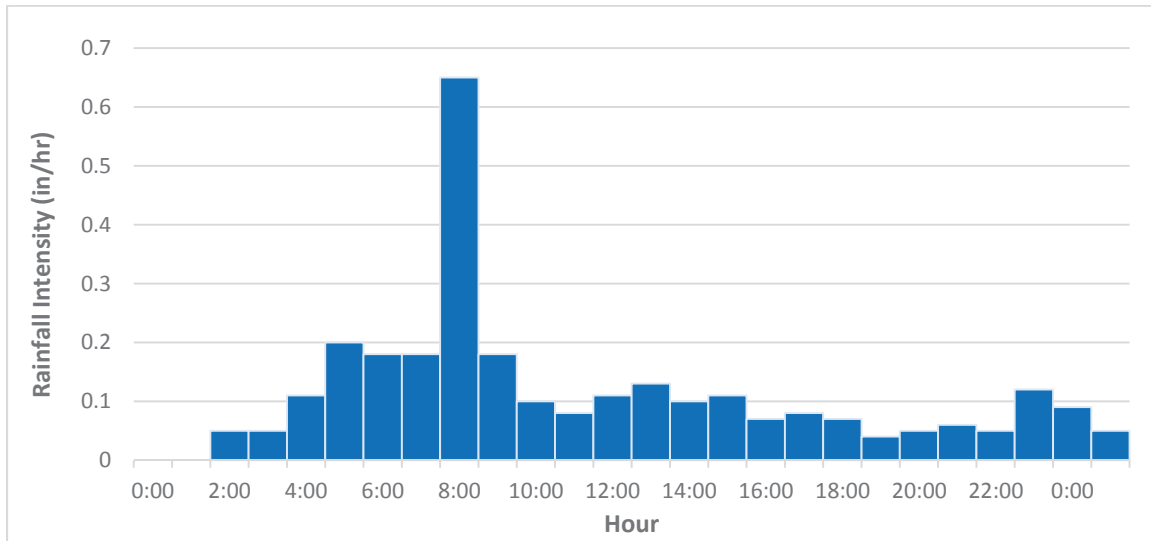
A storm duration must be specified along with the return period. Most Bay Area agencies use a 24-hour storm, though shorter or longer durations may sometimes be appropriate depending on system size and how quickly or slowly the system responds to rainfall. Design storm may be actual historical rainfall events or synthetic events that are designed to represent a certain return period for a specified storm duration or durations.

The City's 2007 Capacity Assessment used a 10-year, 24-hour storm, with one-hour and six-hour 10-year events included within the 24-hour event. This storm was based on the Santa Clara County intensity-duration-frequency (IDF) curve that was current at the time, representing rainfall statistics at the San Jose International Airport. To reflect differences in rainfall characteristics across the service area, the storm was scaled for different areas based on the isohyetal map of average annual rainfall from the Consoer, Townsend & Associates Sanitary Sewer I/I Analysis, dated 1974.

Since the completion of the Capacity Assessment, Santa Clara County released a new County Drainage Manual in October 2007. The Manual includes updated mean annual precipitation isohyetal lines from Santa Clara Valley Water District (SCVWD) and updated, distinct IDF curves for each mean annual

precipitation area. In addition to the IDF curves, Appendix D of the 2007 manual includes a 24-hr design storm pattern. According to the manual, this storm pattern is based on an actual event that occurred in December 1955, but with some adjustments to better reflect IDF statistics for various storm durations. Like the previous design storm, the design storm used for this Master Plan Update is also a 10-year, 24-hour storm that varies across the service area, but the storm pattern and hourly rainfall intensities are based on this updated Santa Clara County Drainage Manual. **Figure 4-1** shows the design storm hourly rainfall as it occurs in the vicinity of the San Jose International Airport. At this location, the total rainfall for the 1, 6-, and 24-hour durations is 0.65, 1.49, and 2.92 inches, respectively.

Figure 4-1: Design Storm Pattern for the San Jose International Airport MAP Area



The design storm represents the “point precipitation” at any single location in the system. The storm is applied in the model at the subcatchment level, with the assumption that the rainfall occurs simultaneously on all subcatchments, which is a conservative assumption.

As noted previously, the timing of the design storm also affects the resulting peak wastewater flows. If the design storm is timed to cause peak RDI/I at the same time as peak base wastewater flow, the total peak wet weather flow will be higher than if the design storm occurs during minimum or average base wastewater flow. Due to variations in the diurnal flow patterns as well as variations in the calibrated I/I response throughout the system, it is not possible to time the rainfall to create a peak-on-peak response everywhere in the system. However, the design storm was timed to achieve a peak-on-peak response in most areas of the system, with the peak hour rainfall occurring at 8:00 a.m. on a weekday.

4.2 Hydraulic Capacity Criteria

The hydraulic capacity criteria determine which sewer pipes should be relieved or replaced due to inadequate capacity to convey existing or future peak flows, and how large the new sewers should be. The criteria adopted by the City should ideally be stringent enough to ensure that sewer overflows caused by capacity limitations (as distinguished from other causes such as obstructions or structural failures) are very rare occurrences, but not so conservative that they cause the City to spend capital improvement funds unnecessarily or result in pipes that are so large that cleaning velocities cannot be achieved under normal flow conditions, causing solids build up and related problems.

The capacity deficiency criteria identify the need to replace an existing facility, while design criteria determine the sizing of new facilities. These criteria are discussed in the paragraphs below.

4.2.1 Capacity Deficiency Criteria

The capacity deficiency criteria are used to determine when the capacity of an existing sewer facility is exceeded to the extent that a relief sewer or larger replacement sewer or potential pump station capacity upgrade is required. Capacity deficiency criteria are sometimes called “trigger” criteria in that they trigger the need for a capacity relief project. These criteria often differ from criteria that are applied to determine the size of a new facility, which are typically more conservative.

It is important that the capacity deficiency criteria be coordinated with the peak design flow criteria. For example, if the peak design flow were to be based on only peak dry weather flow (PDWF), the deficiency criteria would need to be conservative (e.g., require pipes to flow less than full to allow capacity for I/I). On the other hand, if the peak design flow includes I/I from an infrequent storm event, it may be appropriate to allow the sewers to flow surcharged to some extent, since the peak flows will be infrequent and brief in duration.

Gravity Sewers

Since the peak wet weather design flow as recommended in the previous section of this chapter includes RDI/I from a 10-year return period event and is assumed to be concurrent with peak BWF, the City should consider it acceptable to allow gravity sewers to flow surcharged to some extent before a capacity relief project is triggered. For example, significant surcharging may be acceptable in larger, deeper sewers provided the hydraulic gradeline remains a reasonable distance below the ground surface and no surcharging occurs during dry weather flow conditions. For smaller or shallow sewers, a more conservative criteria could be considered to account for the chance that capacity could also be compromised by factors such as offset joints, roots, grease, and debris (which cannot be accounted for in the hydraulic model), or that surcharge could result in flow backing up into connecting laterals.

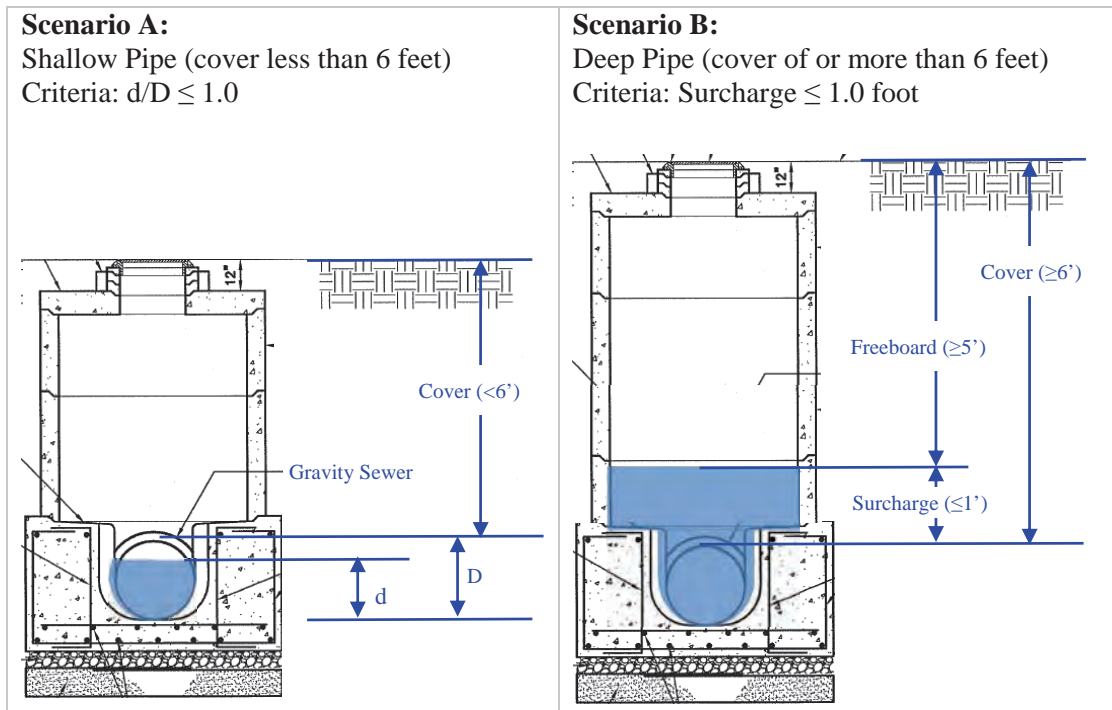
Based on discussion of these considerations, the following criteria are proposed under which gravity sewers would be considered capacity deficient:

- PDWF: No surcharge allowed ($d/D \leq 1.0$)
- PWWF:
 - Gravity sewer with less than 6 feet of cover: no surcharge allowed (i.e., $d/D \leq 1.0$)
 - Gravity sewer with 6 feet or more of cover: surcharge of up to 1 foot under PWWF (see Figure 4-2 for clarification)
- Case-by-case exceptions could be made for isolated short pipe reaches. Conversely, more stringent criteria could be applied for sewers located in areas where the consequences of an overflow would be greater (e.g., adjacent to creeks, schools, or hospitals).
- Note that for evaluating the performance of existing sewers, a Manning’s “n” value of 0.013 is assumed for all pipes, regardless of material or age. Although new pipes, particularly plastic materials, would provide a lower initial roughness factor, it is assumed that over time, a “slime layer” formation on the walls of the pipes and/or other obstructions in the sewer, such as roots, debris, or structural defects, may increase pipe roughness. Therefore, an assumption of 0.013 for all pipes is considered to be appropriately conservative for master planning purposes.

Pump Stations and Force Mains

For master planning capacity assessments, the performance of pump stations and force mains are typically evaluated based on pumping capacity and peak force main velocities. Pump stations are considered to be capacity deficient if the station’s firm capacity (capacity with largest pumping unit out of service) is insufficient to convey the peak design flow. Force mains are considered to be deficient if velocity under peak design flow exceeds 10 feet per second (fps).

Figure 4-2: PWWF Hydraulic Deficiency Criteria for Gravity Sewers



4.2.2 Sizing Criteria for New Sewer Facilities

The following criteria are proposed for sizing new trunk gravity sewers as part of the Master Plan. They are consistent with the City's current sanitary sewer design criteria. Note that the City may use somewhat different criteria for new developments or actual design, e.g., varying Manning's n for different pipe materials, or a more conservative d/D for smaller diameter sewer mains. These criteria would be based on the modeled design storm peak wet weather flows in the system.

- Maximum allowable flow depth-to-diameter ratio (d/D) of 0.75 under peak design flow
- A Manning's ' n ' of 0.013
- Minimum pipe size of 8 inches diameter in residential areas; 10 inches in commercial areas; and 12 inches in industrial areas
- Minimum velocity of 2 feet per second (fps) at half-full pipe
- Maximum velocity of 10 fps at peak design flow
- Downstream pipes at least as large as upstream pipes
- Minimum and maximum pipe slopes determined based on above velocity criteria to the extent feasible (it is recognized that elevation constraints in the existing system may prevent achieving desired minimum slopes for some projects, and terrain may dictate higher maximum slopes in some cases)
- Minimum pipe cover of 6 feet

4.3 Capacity Analysis Results and Proposed Solutions

Based on the criteria described above, the hydraulic model was run for four sets of conditions representing combinations of existing or future development and dry weather flow or design storm wet weather flow. **Figure 4-3** shows the model results for future PWWF conditions. Pipes shown in red are predicted to be surcharged due to “throttle” (peak flow exceeding full pipe capacity), and pipes shown in blue are surcharged due to backwater from a downstream throttle condition. Locations of capacity criteria violations (surcharge of more than 1 foot due to either throttle or backwater conditions) are highlighted in yellow (pipes with criteria violations under both existing and future conditions) or orange (future conditions only).

Note that the locations of criteria violations (i.e., higher than allowable surcharge) are not necessarily the locations of the actual capacity-deficient pipes, but are typically located further upstream due to backwater from downstream throttle conditions. **Appendix D** includes model hydraulic profiles for each of these areas.

Potential solutions for the identified capacity deficiencies were developed in order to assess the potential extent of required capacity improvements and to estimate the resulting peak flow to the SJ/SC RWF once capacity deficiencies are relieved. **Table 4-1** summarizes the predicted flow under each condition. **Table 4-2** describes the solutions. The solutions model results indicate that the combined total estimated design storm future PWWF from the City’s system (including flows from CuSD) would be approximately 59 mgd.

Table 4-1: Summary of Capacity Analysis Results

	Existing ADWF ⁽²⁾ (mgd)	Existing PDWF ⁽²⁾ (mgd)	Existing PWWF ⁽³⁾ (mgd)	Future ADWF ⁽²⁾ (mgd)	Future PDWF ⁽²⁾ (mgd)	Future PWWF ^(3,4) (mgd)
Flow Estimates by System Outfall ⁽¹⁾						
North (to Northside and Rabello Pump Stations)	10.2	15.2/16.0	27.9	24.6	33.5/34.4	41.0
East (to San Jose Zanker Road Interceptor)	4.7	6.4	11.7	9.8	13.3	18.3
Total	14.9	21.6/22.4	39.6	34.4	46.8/47.7	59.4
Flow Estimates by Agency ⁽¹⁾						
Santa Clara System	11.3	15.4/16.2	26.8	27.5	34.6/35.5	45.6
Cupertino Sanitary District	3.5	6.2	12.8	6.9	12.2	13.8
Total	14.9	21.6/22.4	39.6	34.4	46.8/47.7	59.4

1. Assuming that trunk sewer capacity deficiencies are relieved with recommended capital improvement projects presented in Table ES-2.
2. Includes groundwater infiltration for a typical wintertime period. ADWF and first value shown for PDWF includes typical non-game day flow from Levi’s Stadium; second value shown for PDWF includes a peak game day flow from Levi’s Stadium.
3. For 10-year design storm; assumes non-game day flow from Levi’s Stadium.
4. Assuming peak wet weather flow from CuSD would not increase above its contractual maximum flow of 13.8 mgd.

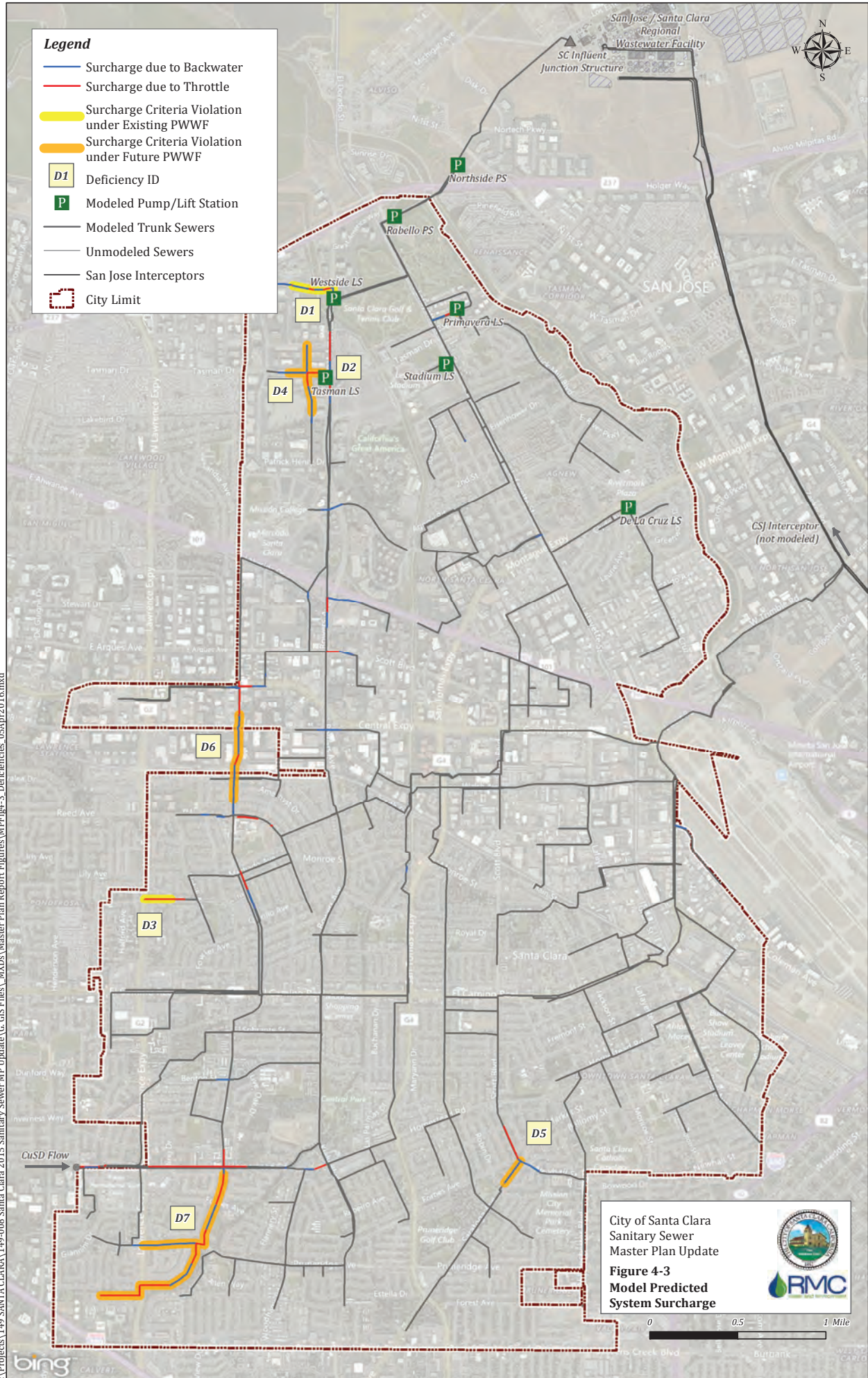
Table 4-2: Capacity Deficiencies and Proposed Solutions

Def. ID	Deficiency Location ⁽¹⁾	Trigger Scenario	Surcharge or Criteria Violation ⁽²⁾	Proposed Solution
1	Westside Lift Station	2015 PDWF	Current set point of the lead pump is about 5 feet above the invert of the influent line, causing backup issues upstream between MH S102-3 and S103-8 (station wet well).	Adjust the set point of the lead pump to be equal or lower than the invert of the influent gravity line.
2	Tasman Lift Station	2015 PDWF	Current set point of the lead pump is about 2 feet above the invert of the influent line, causing backup issues upstream between MH S93-24 and S93-35 (station wet well).	Adjust the set point of the lead pump to be equal or lower than the invert of the influent gravity line.
3	Cabrillo Avenue	2015 PWWF	Surcharge of up to 5 feet from MH S41-13 to S41-20 under existing PWWF scenario and potential overflow in S41-13, S41-14 and S41-15 under future PWWF scenarios.	Conduct smoke testing and television inspection in the flow tributary area to identify and address high inflow/infiltration sources. If field investigations indicate that I/I reduction is not feasible or cost-effective, then upsize the existing 8-inch line to a 12-inch between S41-13 and S41-20.
4	Tasman Drive and Old Ironsides Drive	2035 PWWF	Surcharge of up to 3 feet upstream of Tasman Lift Station.	Upsize 800 feet of existing 12-inch line between S93-24 and S93-35 to a 15-inch line.
5	Scott Blvd.	2035 PWWF	Surcharge of up to 1 foot between S25-78 and S26-44, and S26-57 and S25-37.	Install a weir in S25-85 to divert flow northwest to Los Padres Blvd.
6	Calabazas Creek Trunk Sewer	2035 PWWF	Surcharge of up to 3 feet in the existing 24-inch line along Calabazas Creek between S52-52 and S62-14.	Install a new 200-ft 15-inch line between S42-12 and S52-93 (Calabazas Blvd. and Machado Ave.) to partially divert flow from the 24-inch to the 21-inch on Machado Ave.
7	Tracy Dr., Pomeroy Ave., and Homestead Rd.	2035 PWWF	Surcharge and potential overflow between S10-77 and S22-55.	Upsize the existing 10- to 12-inch line between S10-77 and S22-55 to a 15-inch line, install a new 15-inch diversion line between S22-55 and S22-46, and upsize the existing 18-inch line between S22-46 and S22-51 to a 21-inch line.

1. Refer to Figure 4-3 for deficiency locations
2. Under PWWF conditions.

Legend

- Surge due to Backwater
- Surge due to Throttle
- Surge Criteria Violation under Existing PWWF
- Surge Criteria Violation under Future PWWF
- D1 Deficiency ID
- P Modeled Pump/Lift Station
- Modeled Trunk Sewers
- Unmodeled Sewers
- San Jose Interceptors
- City Limit



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City of Santa Clara
Sanitary Sewer
Master Plan Update
Figure 4-3
Model Predicted
System Surcharge



0 0.5 1 Mile

4.3.1 Pump Station Firm Capacity Analysis

All seven lift and pump stations in the system were evaluated to determine if each station had adequate firm capacity to handle the design peak flow. Firm capacity is defined as the capacity of a station with the largest pump out of service. **Table 4-3** below provides a summary of station firm capacity compared with peak inflow for future PWWF conditions.

Table 4-3: Pump Station Firm Capacity Analysis

No.	Station Name	No. of Pumps	Estimated Peak Inflow (mgd) ⁽¹⁾	Estimated Firm Capacity (mgd)	Firm Capacity Status ⁽⁶⁾
1	Westside Lift Station	2	0.6	0.6 ⁽³⁾	Sufficient firm capacity
2	Tasman Lift Station	2	1.5	1.5 ⁽³⁾	Sufficient firm capacity
3	De La Cruz Lift Station	2	1.2	1.7 ⁽³⁾	Sufficient firm capacity
4	Primavera Lift Station	6	2.0	5.7 ⁽³⁾	Sufficient firm capacity
5	Stadium Lift Station	6	1.0	6.0 ⁽⁴⁾	Sufficient firm capacity
6	Rabello Pump Station	8	20 ⁽²⁾	20 ⁽⁵⁾	Sufficient firm capacity
7	Northside Pump Station	4	21 ⁽²⁾	21 ⁽⁵⁾	Sufficient firm capacity

1. Peak inflow refers to the maximum flows predicted by the model under future peak wet weather scenario using the solution network. The solution network eliminates flow restrictions upstream of the pump stations.
2. Peak inflow reflects the maximum flows predicted by the solution network in which CIP Project P6 (Sewer Diversion at Calabazas Boulevard and Machado Avenue) is implemented, which would divert excess flow from the 24-inch sewer line along Calabazas Boulevard into the 21-inch sewer line in Machado Ave, ultimately flowing to the City of San Jose's interceptor in Zanker Road. This would reduce the flow conveyed north to the Rabello and Northside Pump Stations to the values shown in the table. Conversely, implementation of Project P6-Alt. would increase the peak flow to the Rabello and Northside Pump Stations by about 1 mgd to each pump station, which could require further evaluation of and potential improvements to increase pump station capacity.
3. Source: Table 1 (Pump Station Firm Capacities and Inflows) of the City of Santa Clara Sanitary Sewer Pump Station Evaluation, Schaaf & Wheeler, December 2010. The firm capacities of Primavera, Tasman, Westside, and De La Cruz lift stations were determined by performing a drawdown test.
4. Based on results from field drawdown tests conducted on September 17, 2015.
5. Source: Rabello and Northside Pump Station Capacity and Forcemain Calibration Technical Memorandum, Schaaf & Wheeler, November 13, 2015. See **Appendix E**.
6. The lift and pump stations have sufficient firm capacities within the accuracy of the estimated peak flows and capacities.

Although no capacity issues were identified for the pump stations, review of pump station drawings and current on/off set points for the pumps revealed that four of the stations may experience backwater issues in the influent pipes. The current set point of the lead pump at Tasman, Westside, and De La Cruz is above the crown of the influent gravity line. Under this condition, the lead pump will not turn on until the influent line is completely submerged, causing backwater issues upstream. This can be resolved by adjusting the set points to be equal or lower than the invert of the influent line. Primavera Lift Station has a similar condition with the set point of the lag pump. **Table 4-4** summarizes the review findings and presents the suggested set points for each of the four stations. Set point revisions for Westside and Tasman are needed to address capacity criteria violations (Deficiencies 1 and 2 in Table 4-2). These settings should be evaluated by the City's pump operators to determine feasibility and if there are other operational issues that should be considered.

Table 4-4: Recommended Revised Set Levels for Lift Stations

Pump Station	Maximum Starts Per Hour Per Pump w/ Existing Set Levels ⁽¹⁾	Maximum Starts Per Hour Per Pump w/ Recommended Set Levels ⁽¹⁾	Set points	Recommended Revised Set Points (ft from Wet Well Floor) ⁽²⁾
Westside Lift Station No. of Pumps: 2	7.2	3.7	Level Alarm: High Low	8.0 1.2
			Lead Pump on off	6.0 1.7
			Lag Pump on off	7.0 2.2
Tasman Lift Station No. of Pumps: 2	4.6	6.4	Level Alarm: High Low	7.0 1.2
			Lead Pump on off	6.0 1.7
			Lag Pump on off	6.5 2.2
De La Cruz Lift Station No. of Pumps: 2	4.8	6.2	Level Alarm: High Low	6.0 1.2
			Lead Pump on off	5.5 1.7
			Lag Pump on off	6.0 2.2
Primavera Lift Station No. of Pumps: 6	1.0	2.0	Level Alarm: High Low	6.0 1.2
			Lead Pump on off	5.5 1.7
			Lag Pump 1 on off	6.0 2.2
			Lag Pump 2 on off	6.0 1.2
			Lag Pump 3 on off	5.5 1.7
			Lag Pump 4 on off	6.0 2.2
Lag Pump 5 on off	6.0 1.2			

1. Based on predicted future peak wet weather flow condition.
2. Recommendations provided by Schaaf & Wheeler based on pump information provided by RMC.

Chapter 5 Recommended Capacity Improvement Program

This section summarizes the capacity improvement projects recommended for the City of Santa Clara's sanitary sewer system. Recommended improvements were developed from the results of hydraulic modeling of the trunk sewer system for predicted flow conditions, as described in Chapter 4. This section discusses the projects needed to address potential capacity deficiencies and unnecessary backups in the existing trunk sewer system including estimated capital costs and priorities for construction.

5.1 Development of Capacity Improvement Projects

Based on the proposed solutions described above, each proposed project was reviewed to identify potential design, permitting, environmental, and constructability issues. Feasible construction methods were also identified for each project, and preliminary estimates of probable construction costs were prepared. Estimated costs for capacity improvements were based on cost data compiled by RMC from similar projects. The costs are conceptual level estimates, considered to have an estimated accuracy range of -30 to +50 percent, suitable for use for budget forecasting, capital improvement program development, and project evaluations, with the understanding that refinements to the project details and costs would be necessary as projects proceed to design and construction. All costs are presented in 2015 dollars and include a 30 percent allowance for contingencies for unknown conditions and a 25 percent allowance for engineering, administration, and legal costs.

Figure 5-1 shows the locations of the proposed improvements, and **Table 5-1** presents the recommended capacity improvement projects, including brief project descriptions and estimated capital costs. Relative priorities have been assigned to the projects based on the flow scenario in which deficiency criteria are violated. Priority 1 and Priority 2 projects are required to address deficiencies that result in criteria violations under current flow conditions. Priority 3 projects are required to address deficiencies that result in criteria violations under future (2035) flow conditions.

Note that an alternative for Project P6 is also presented. While substantially more expensive than Project P6, this alternative would maintain the current system flow configuration of conveying all flows in the Calabazas Creek trunk sewer (including flows from CuSD) to the Northside and Rabello Pump Stations and avoid increasing flows in the Machado, Chromite, and Walsh Avenue trunk sewers that may be needed in the future to handle additional new development within the City. Implementation of Project P6-Alt would also increase flow to the Rabello and Northside Pump Stations by about 1 mgd to each pump station, which could require further evaluation of and potential improvements to increase pump station capacity.

The total estimated cost of the recommended capacity improvement program is approximately \$1.7 million. The total estimated cost, if the City were to implement Project P6-Alt instead of P6, would be approximately \$2.8 million. More detailed project descriptions and cost estimates and maps of the recommended capacity improvement projects are included in **Appendix F**.

One of the projects was triggered due to the large sewer discharge assumed for parcel APN 316-17-018, which holds an entitlement agreement to discharge a potential flow of 0.95 mgd; however, it is currently discharging less than 10 percent of the entitled rate. While the City is obligated to provide capacity for entitlement holders, it is important to note that implementing this project may result in oversized sewers where the daily flow is not sufficient to provide the minimum cleaning velocity and thus creating potential debris and odor issues. This project is included in the summary table as project E1 (Tracy Drive Sewer Improvement), and is not part of the recommended Capital Improvement Program. It is recommended that the City implement project E1 as part of its Capital Improvement Program before the parcel begins to discharge its entitled flow of 0.95 mgd.

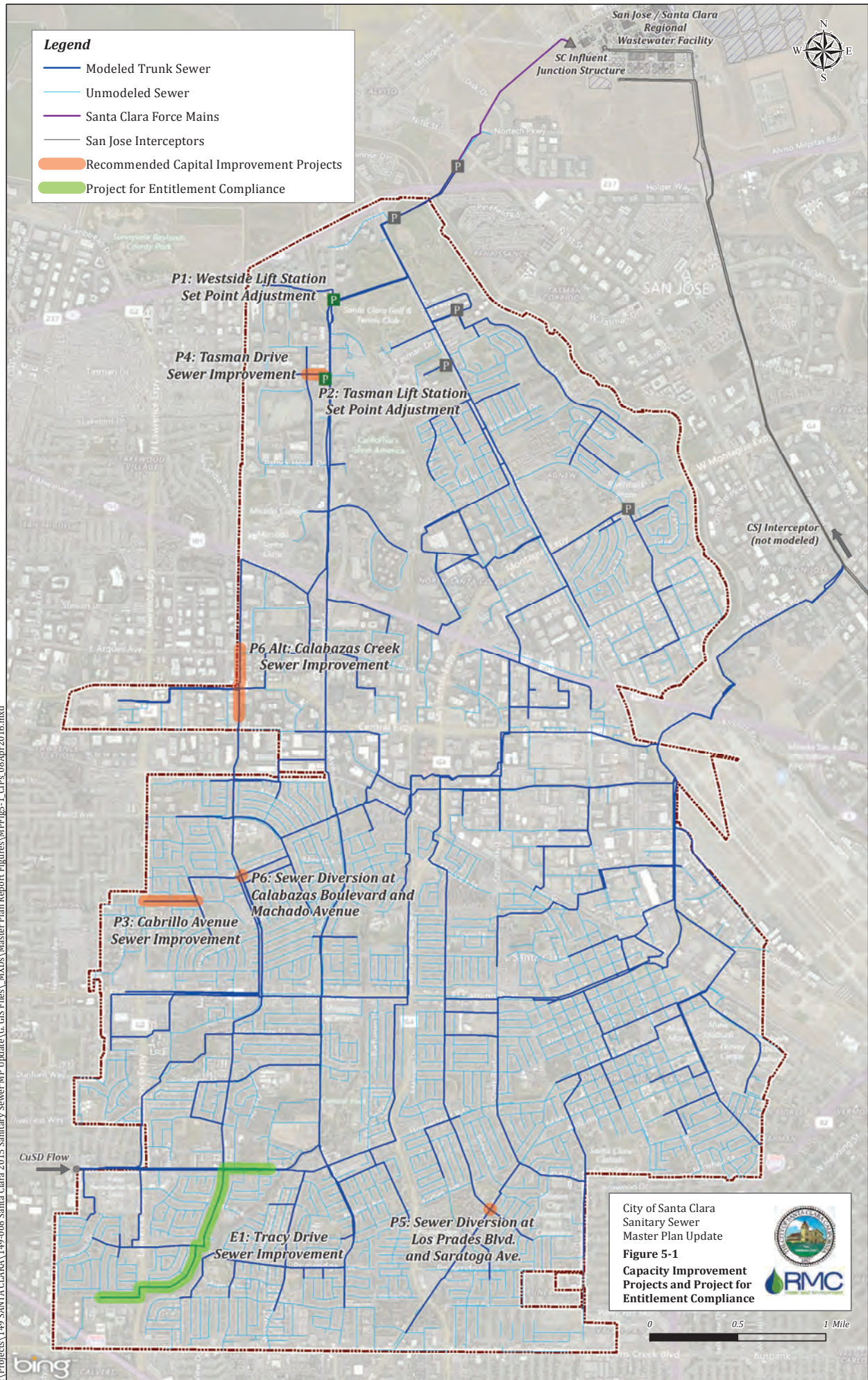
Table 5-1: Recommended Capacity Improvement Projects

Project ID	Priority	Project Name	U/S MHID	D/S MHID	Description	Est. Capital Improvement Cost ¹
P1 ²	1	Westside Lift Station Adjustment	N/A	N/A	Adjust the set points for the pumps to a lower elevation to eliminate unnecessary backups in the influent line.	--
P2 ²	2	Tasman Lift Station Adjustment	N/A	N/A	Adjust the set points for the pumps to a lower elevation to eliminate unnecessary backups in the influent line.	--
P3	2	Cabrillo Avenue Sewer Improvement	S41-13	S41-20	Upsize 1,600 feet of 8-inch line in Cabrillo Ave. between Lawrence Expressway and Nobili Ave. to a 12-inch line.	\$1,097,000
P4	3	Tasman Drive Sewer Improvement	S93-24	S93-35	Upsize 600 feet of 12-inch line in Tasman Dr. between Old Ironsides Dr. and Great America Pkwy. to a 15-inch line.	\$327,000
P5	4	Sewer Diversion at Los Prades Boulevard and Saratoga Avenue	S25-85	S25-85	Install a weir in manhole S25-85 located in the intersection of Padres Blvd. and Saratoga Ave. to divert flow northwest to the existing 12-in line in Los Padres Blvd.	\$77,000
P6	4	Sewer Diversion at Calabazas Boulevard and Machado Avenue	U/S of S52-93	S52-120	Install a new manhole upstream of S52-93 in the intersection of Calabazas Blvd. and Machado Ave., and install a new 15-inch high-level diversion line (approximately 200 feet) to divert excess flow from the existing 24-inch line in Calabazas Blvd. to the 21-inch line in Machado Ave. The diversion line should be about 6 inches higher than the invert of the 24-inch line.	\$166,000
P6-Alt. ³	4	Calabazas Creek Sewer Improvement	S62-31	S72-20	Upsize 1,800 feet of 24-inch line next to Calabazas Creek between Kifer Rd. and Scott Blvd. to a 27-inch line.	\$1,334,000
Estimated Total Cost for Recommended Projects P1 to P6:						\$1,667,000
Estimated Total Cost for Projects P1 to P5 and P6-Alt:						\$2,835,000
E1 ⁴	N/A	Tracy Drive Sewer Improvement	S10-77	S22-51	Upsize approximately 6,600 feet of 10- to 12-inch line in Tracy Dr. and Pomeroy Ave. to a 15-inch line; install a new 15-inch line between manholes S22-55 and S22-46 in Pomeroy Ave. and Homestead Rd. (approximately 50 feet) to divert flow into Homestead Rd., and upsize approximately 1,400 feet of 18-inch line downstream to a 21-inch.	\$4,654,000
Estimated Total Cost (P1 to P6) including Project E1:						\$6,321,000
Estimated Total Cost (P1 to P5 and P6-Alt) including Project E1:						\$7,489,000

1. All costs are presented in 2015 dollars and include 30 percent allowance for contingencies for unknown conditions and 25 percent for engineering, administration, and legal costs.
2. These proposed projects are operational, not capital improvements. Refer to Table 4-4 for recommended set points.
3. Project P6-Alt is presented for the purpose of identifying the solution and associated cost to maintain the current system flow configuration. Project P6 is the recommended project.
4. Project E1 addresses the potential capacity deficiency when parcel APN 316-17-018 begins to discharge its entitled flow of 0.95 mgd into the City's system.

Legend

- Modeled Trunk Sewer
- Unmodeled Sewer
- Santa Clara Force Mains
- San Jose Interceptors
- Recommended Capital Improvement Projects
- Project for Entitlement Compliance



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City of Santa Clara
Sanitary Sewer
Master Plan Update
Figure 5-1
Capacity Improvement
Projects and Project for
Entitlement Compliance



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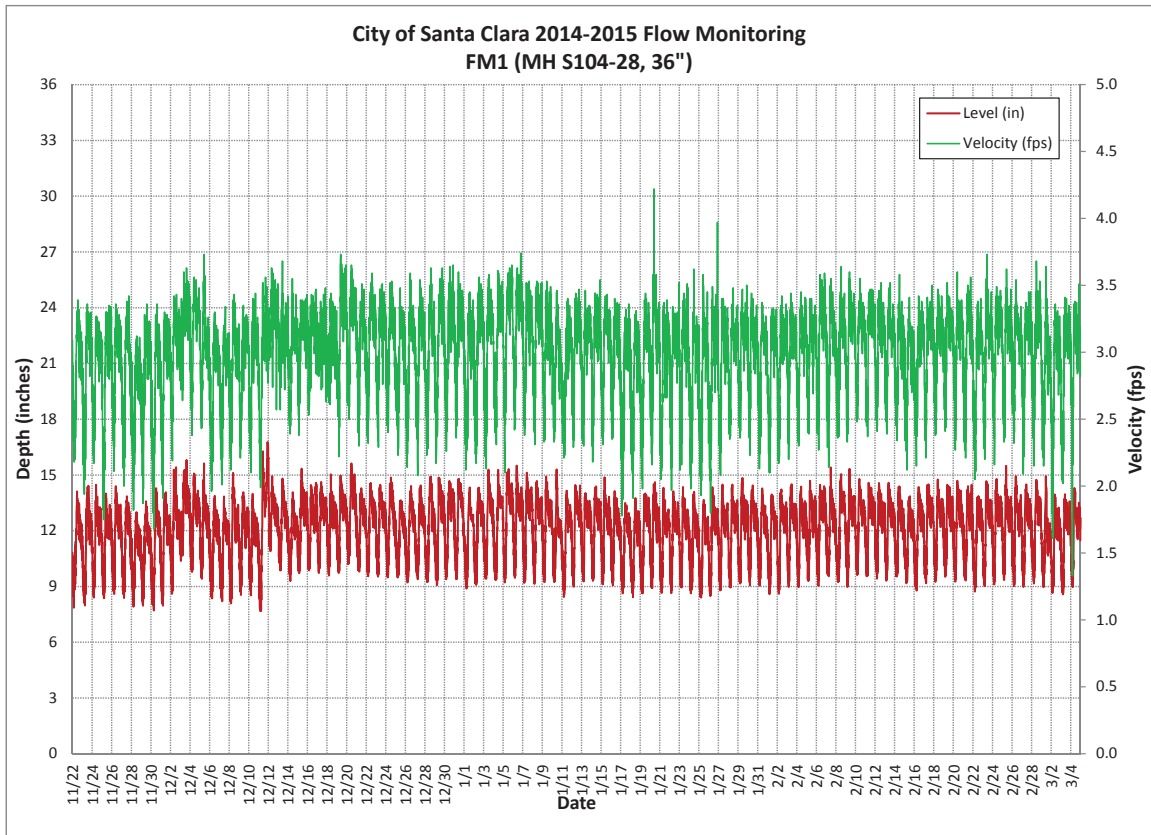
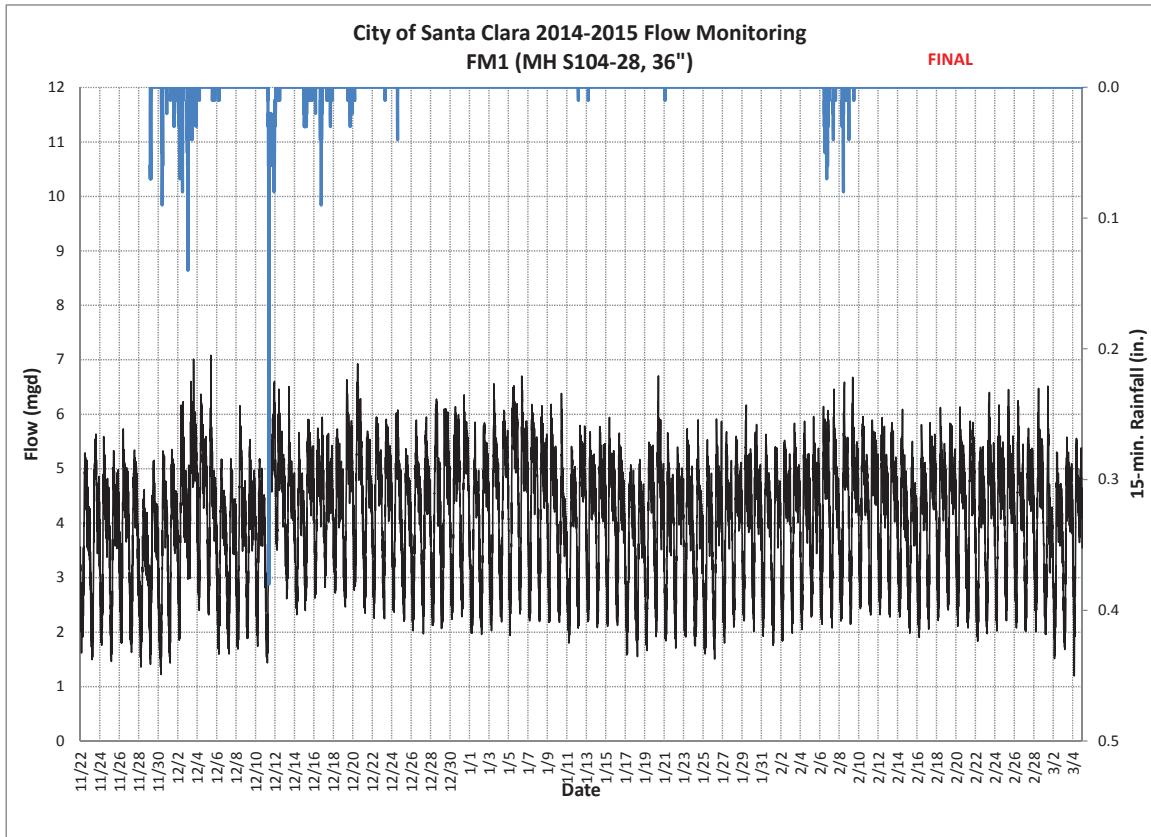
5.2 Implementation Recommendations

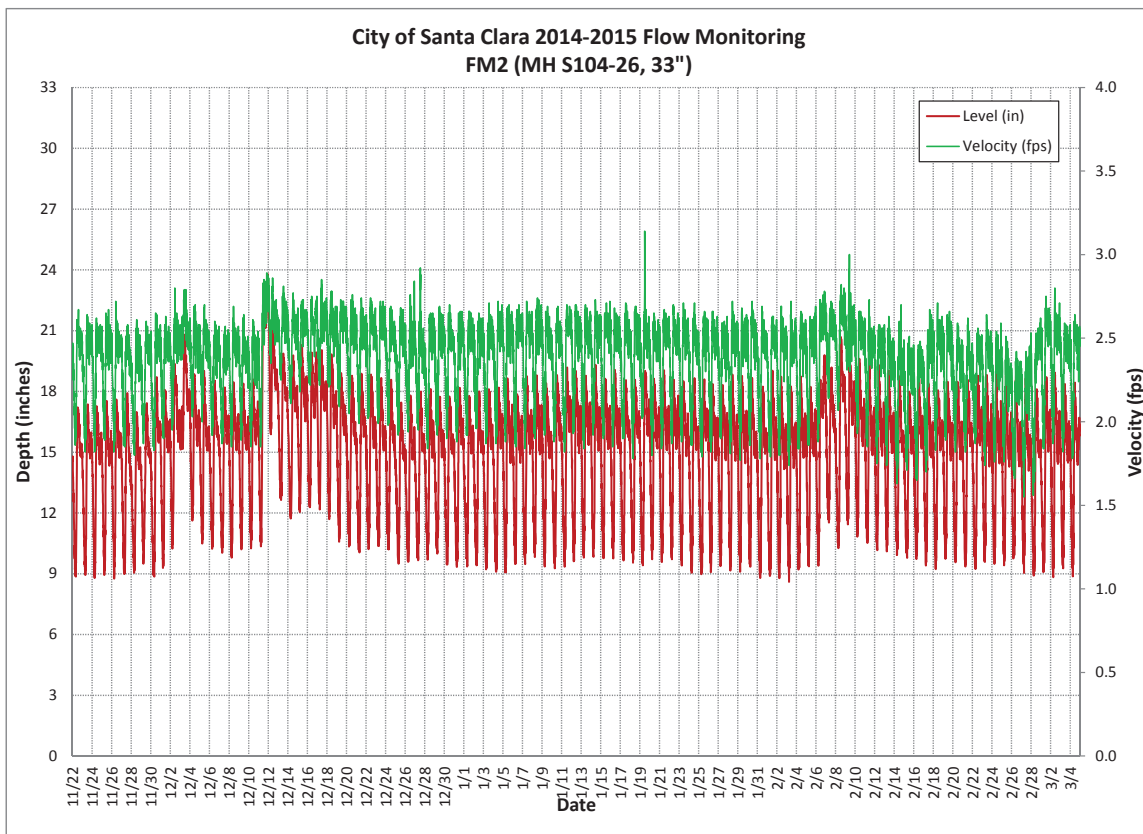
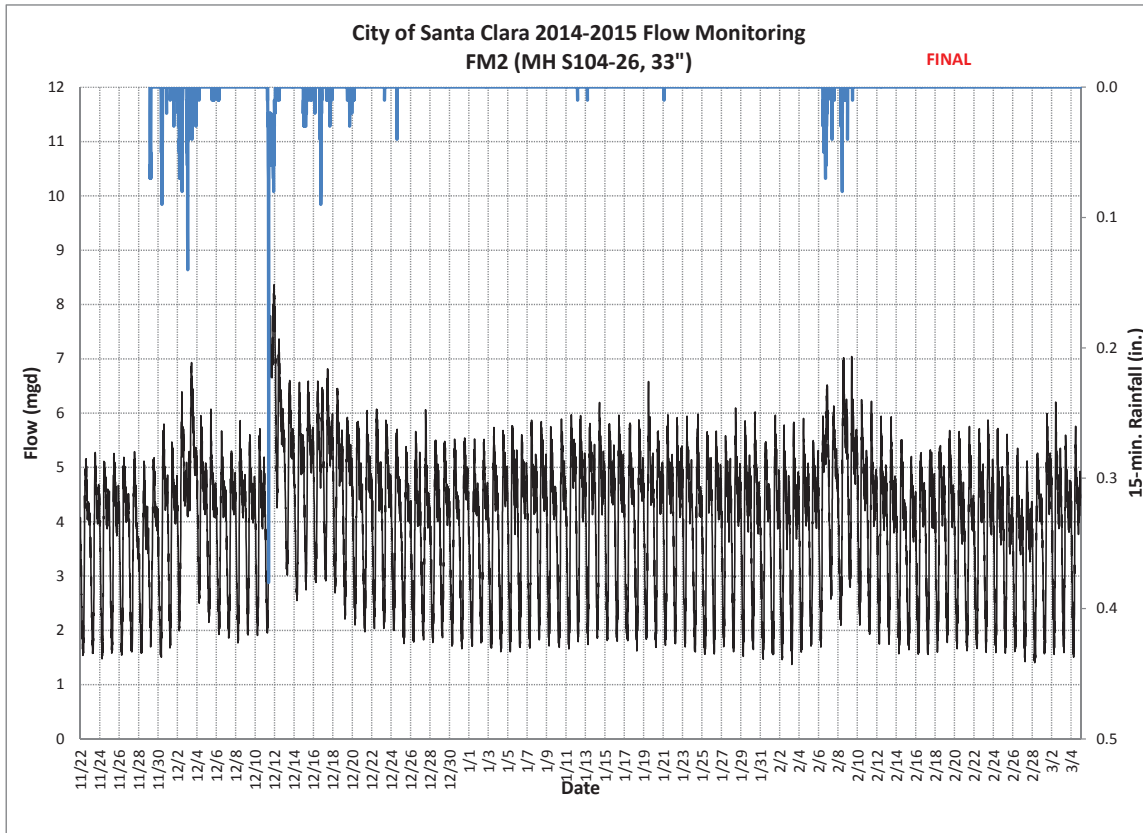
The City should begin implementation of the Capital Improvement Program recommended in this Master Plan, starting with the highest priority projects. The following items should be considered in project scheduling and design, and in future updates of the Master Plan.

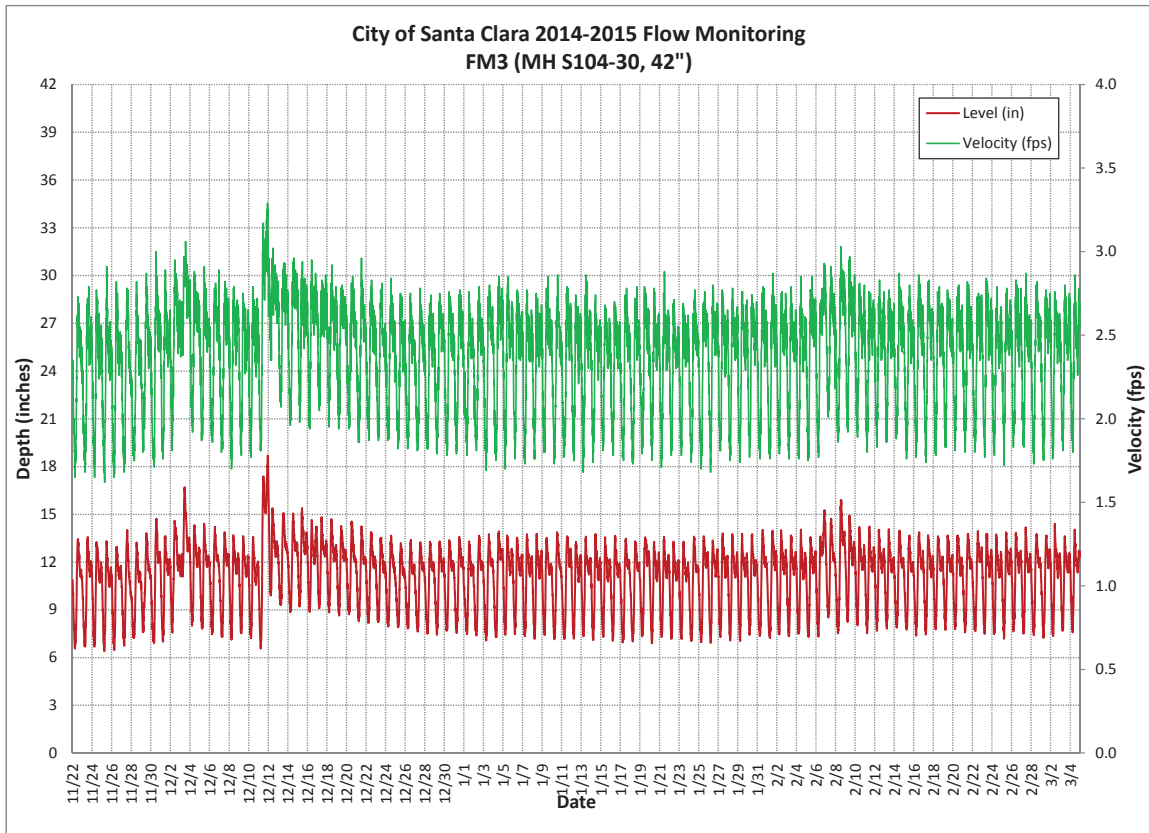
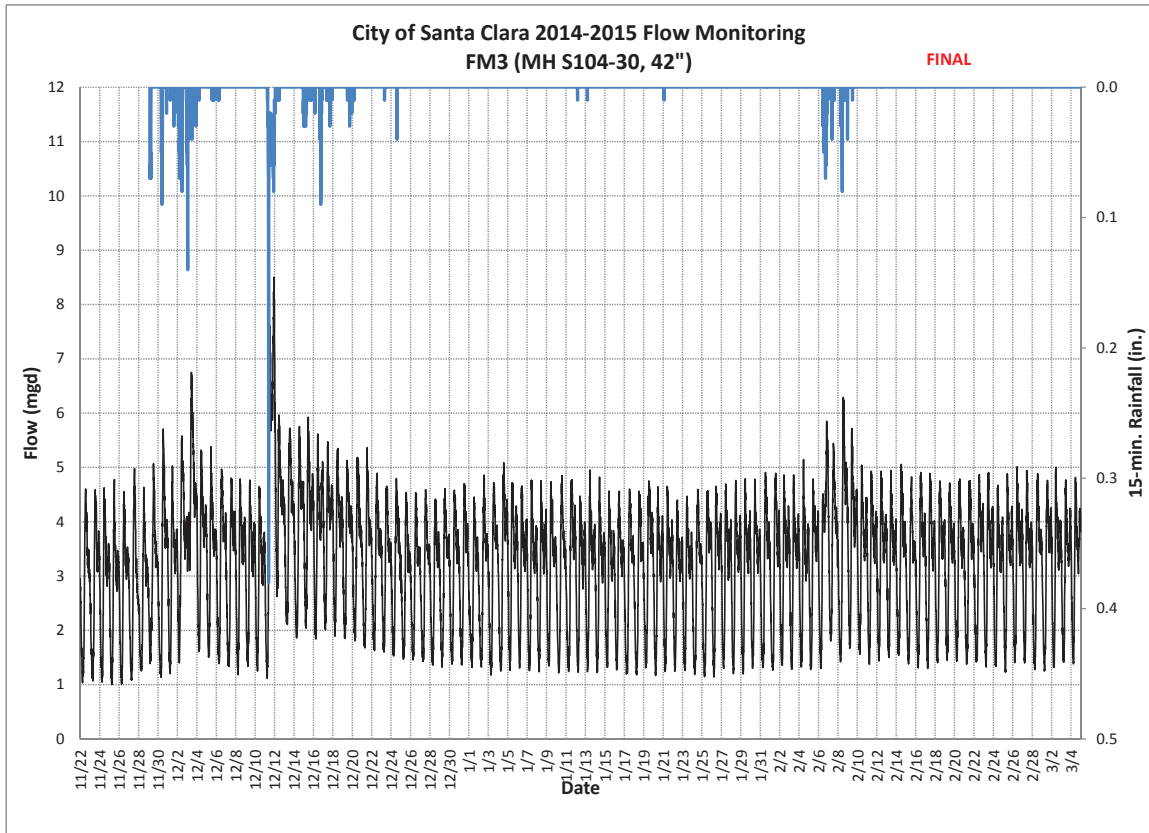
- The alignments and sizes of all recommended projects should be verified with detailed predesign analyses, including topographic surveys, geotechnical investigations, utility research, and constructability reviews.
- The estimated costs assumed open cut construction, but alternative methods such as trenchless construction or construction of parallel relief pipes could be considered during design. The decision to parallel or replace existing sewers should consider the physical condition and remaining useful life of the existing pipelines; the availability of pipeline corridors for new sewer construction; and operation and maintenance concerns.
- The hydraulic model has been developed to assist the City in performing capacity analyses and updating the Master Plan in the future. The model should be kept up-to-date with any changes to existing sewer connections, development plans, and sewer system facilities.
- The City should conduct additional flow monitoring at key locations in the sewer system, particularly the area tributary to the Chromite/Machado trunk sewers where both the 2006 and 2015 flow monitoring programs indicated high I/I. City should also conduct smoke testing and television inspection to identify potential sources of I/I. Flow levels during large storm events should be compared to the peak flows simulated by the hydraulic model to verify the modeling predictions for the 10-year design storm and confirm the need for and sizing of Project P3 (Cabrillo Avenue Sewer Improvement).
- The City should coordinate with the CuSD on flow and planning assumptions to ensure that adequate capacity exists in the Santa Clara system to handle future flows from the District. The City should encourage CuSD to monitor the flows at the flow meter that it operates and maintains on Homestead Road at Swallow Drive on an on-going basis and periodically confirm meter calibration to verify the wastewater flows entering the Santa Clara system.
- The City should consider adjusting its set points for the four lift stations identified in Table 4-4 to address upstream backwater issues and capacity criteria violations. These settings should be evaluated by the City's pump operators to determine feasibility and if there are other operational issues that should be considered. In addition, the City should continue to conduct regular maintenance as needed to maintain adequate firm pumping capacity at all pump stations, including cleaning the force mains as needed.
- The City should coordinate with the City of San Jose to ensure that its flow criteria and planning assumptions are consistent with those used by San Jose in its capacity master planning.
- Parcel APN 316-17-018 holds an entitlement agreement to discharge up to 0.95 mgd into the City's system; however, it is currently discharging less than 10 percent of its entitled rate. While the City is obligated to provide capacity for entitlement holders, it is important to note that implementing this project may result in oversized sewers where the daily flow is not sufficient to provide the minimum cleaning velocity and thus creating potential debris and odor issues. However, the City should implement project E1 (Tracy Drive Sewer Improvement) to address the potential capacity deficiency before the parcel begins to discharge its entitled flow of 0.95 mgd.

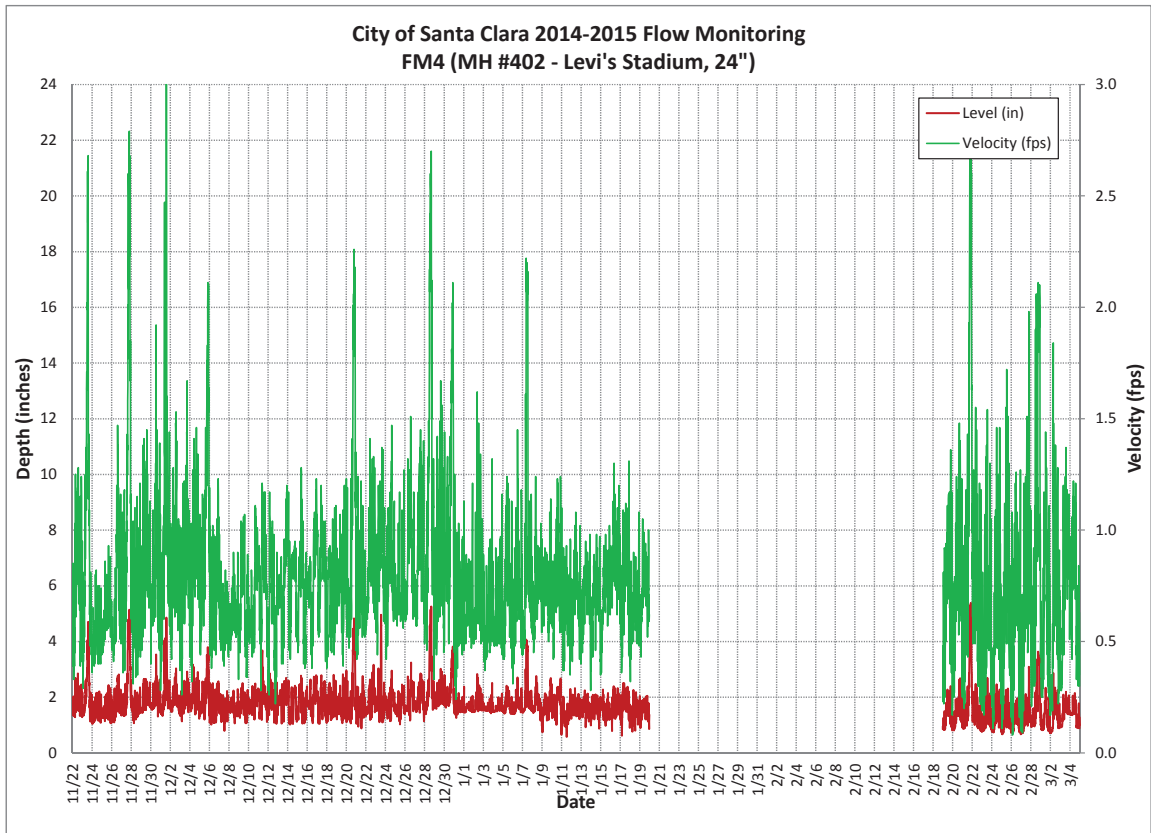
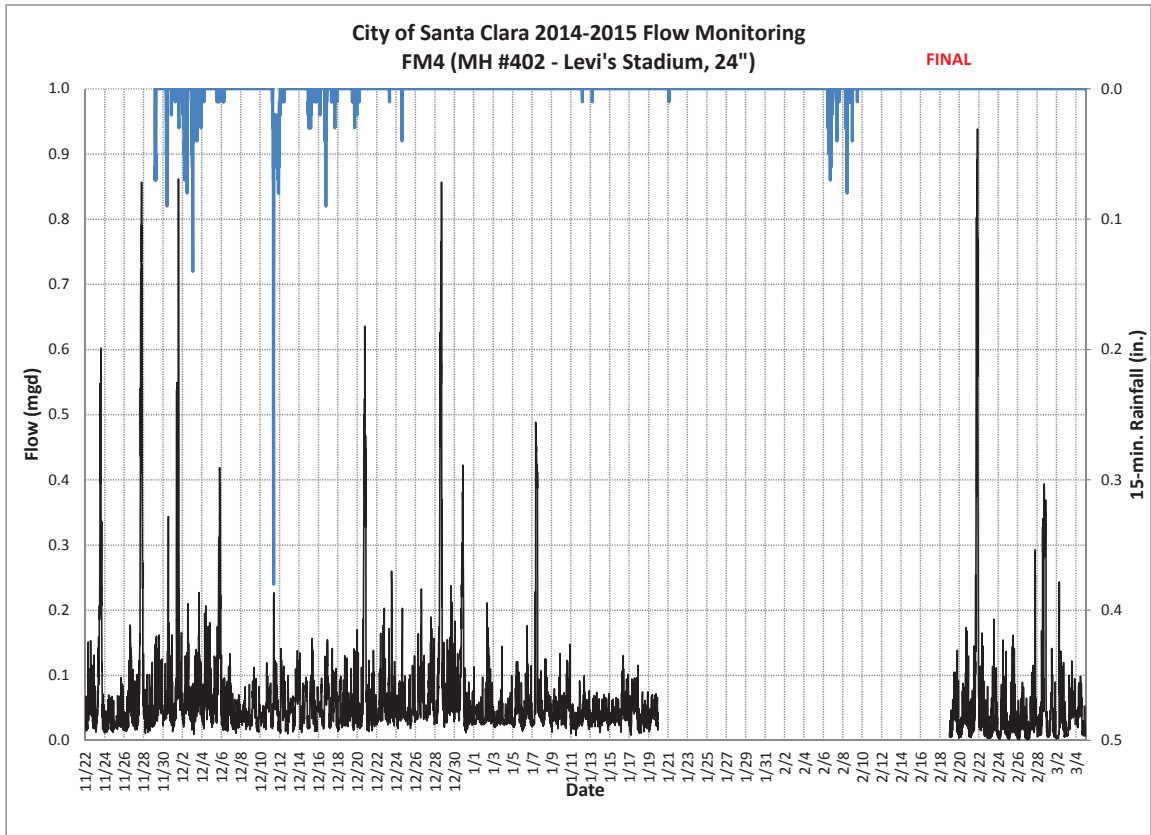
This Master Plan report is intended to be a working document to be refined and updated as additional data and new planning information becomes available. The capacity assessment should be updated whenever there are major changes in planning assumptions or, at a minimum, every ten years.

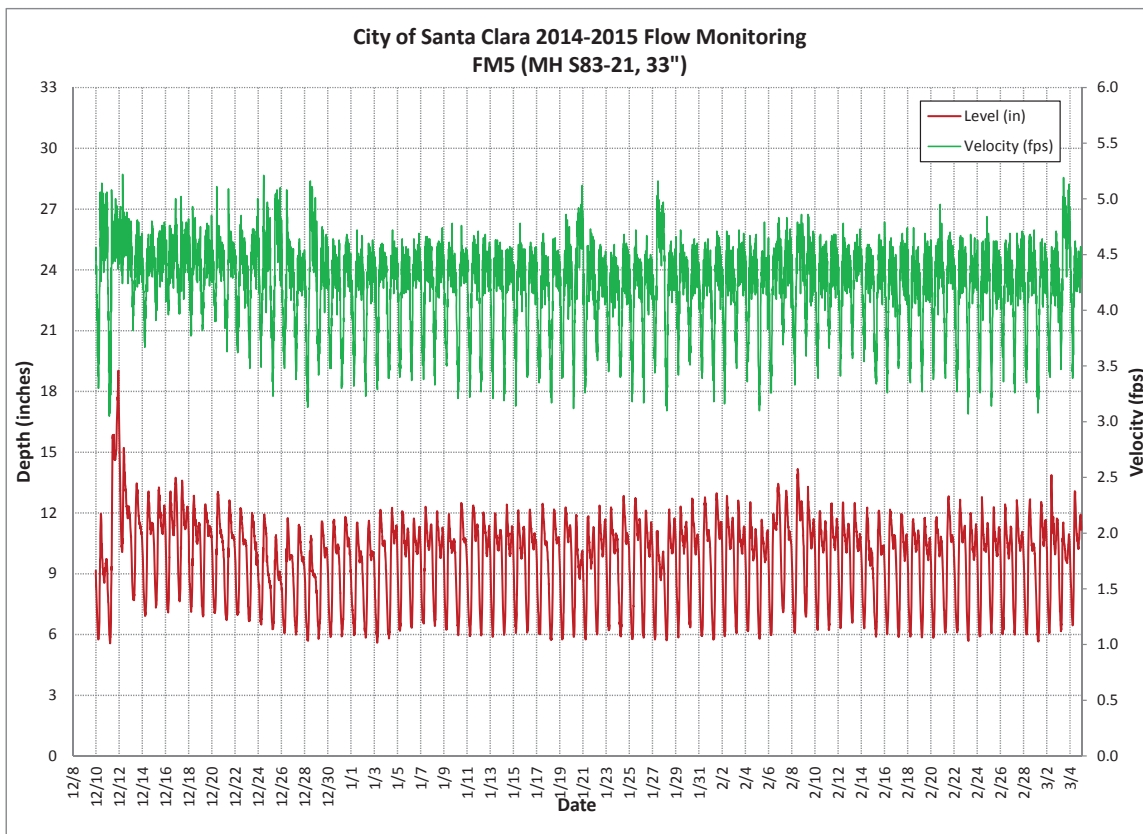
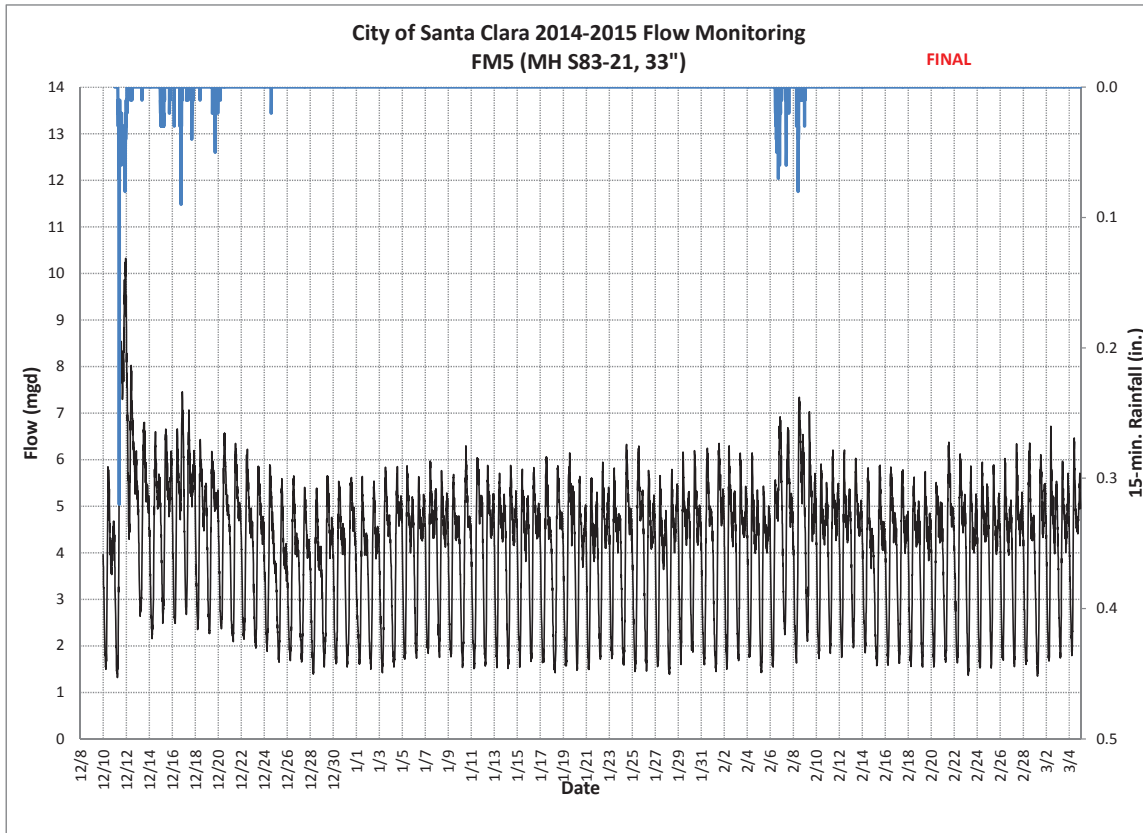
Appendix A - Plots of Flow Monitoring Data and Summary of Daily Flows

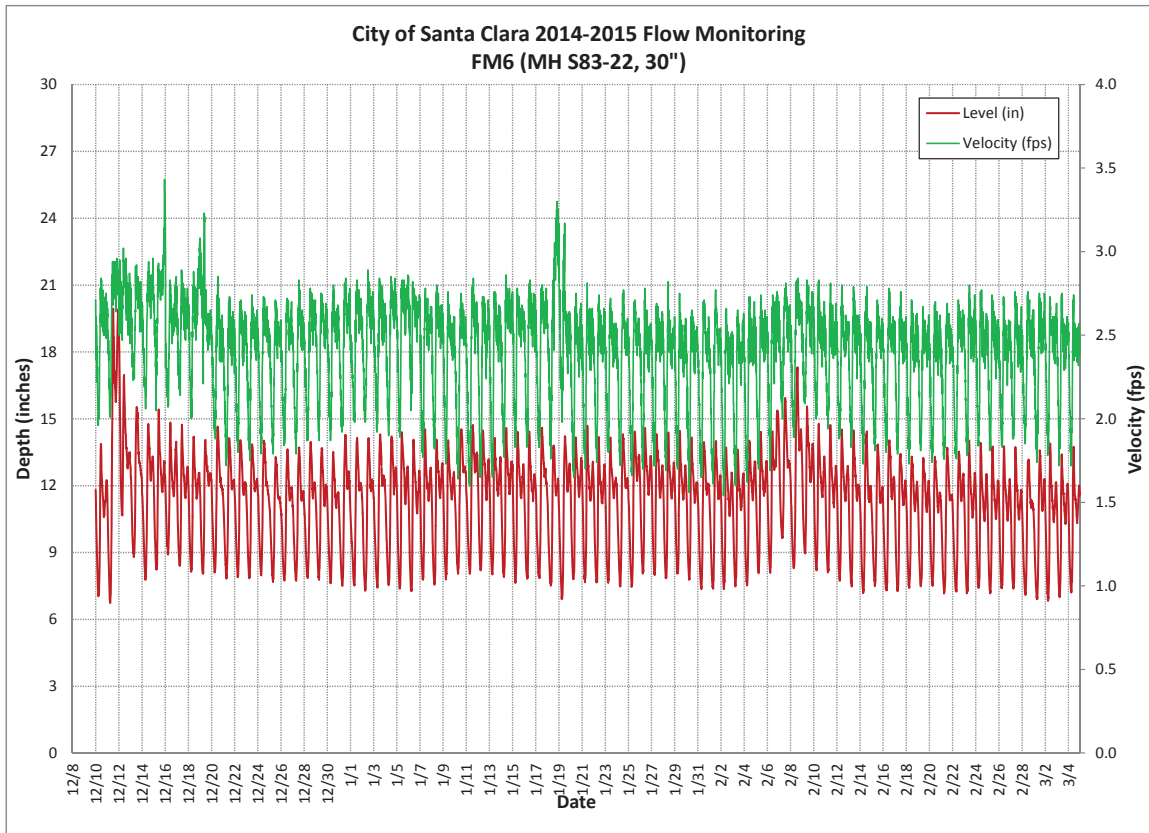
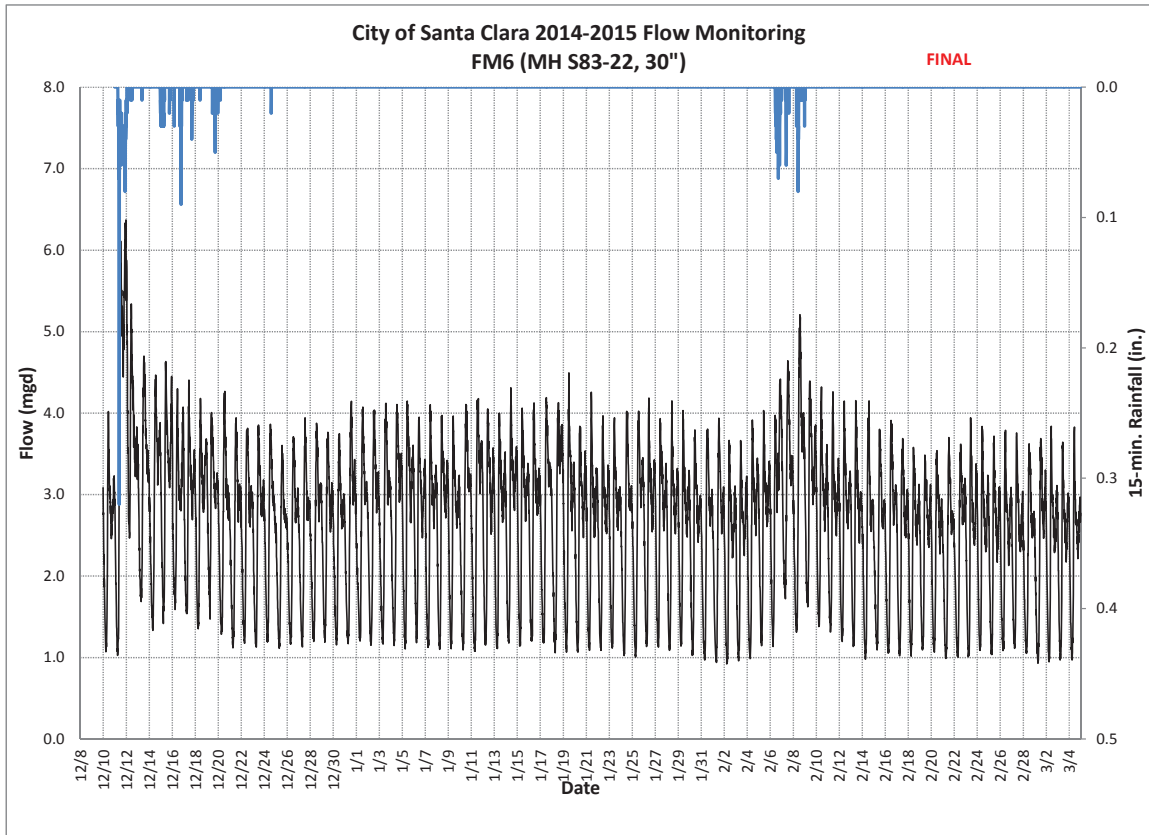


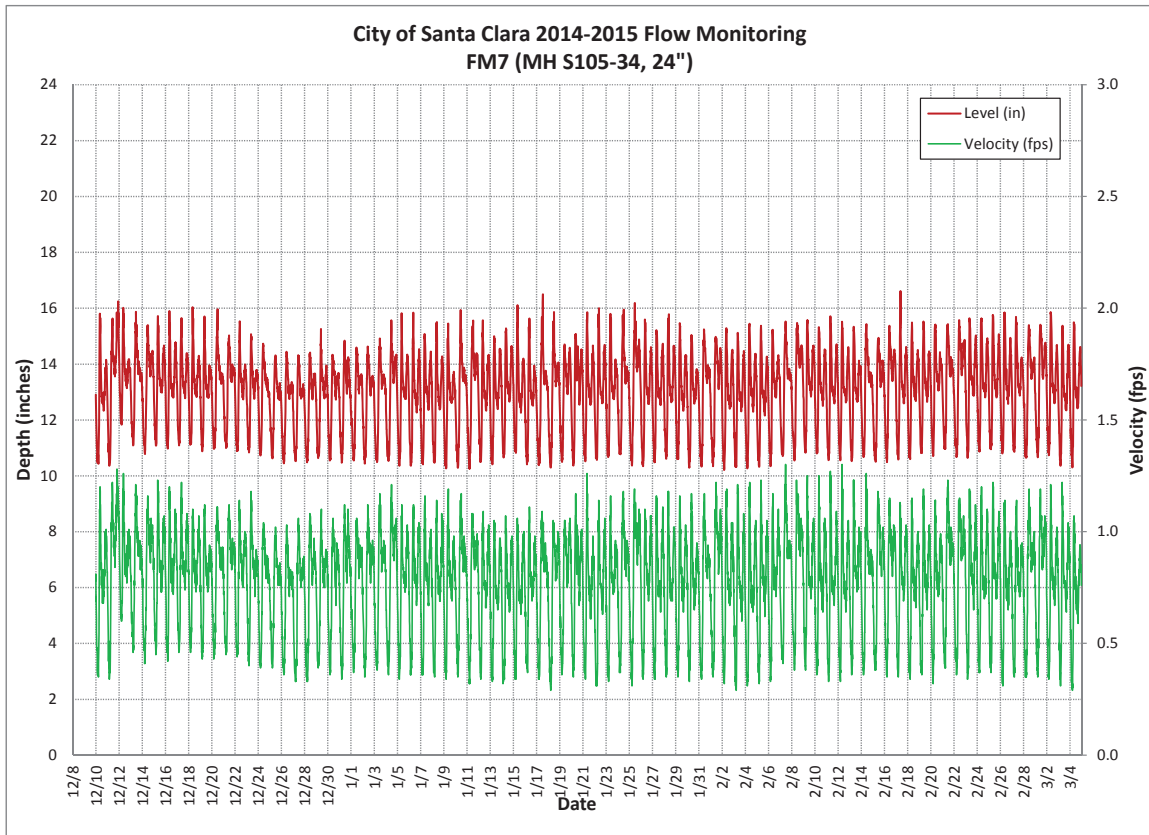
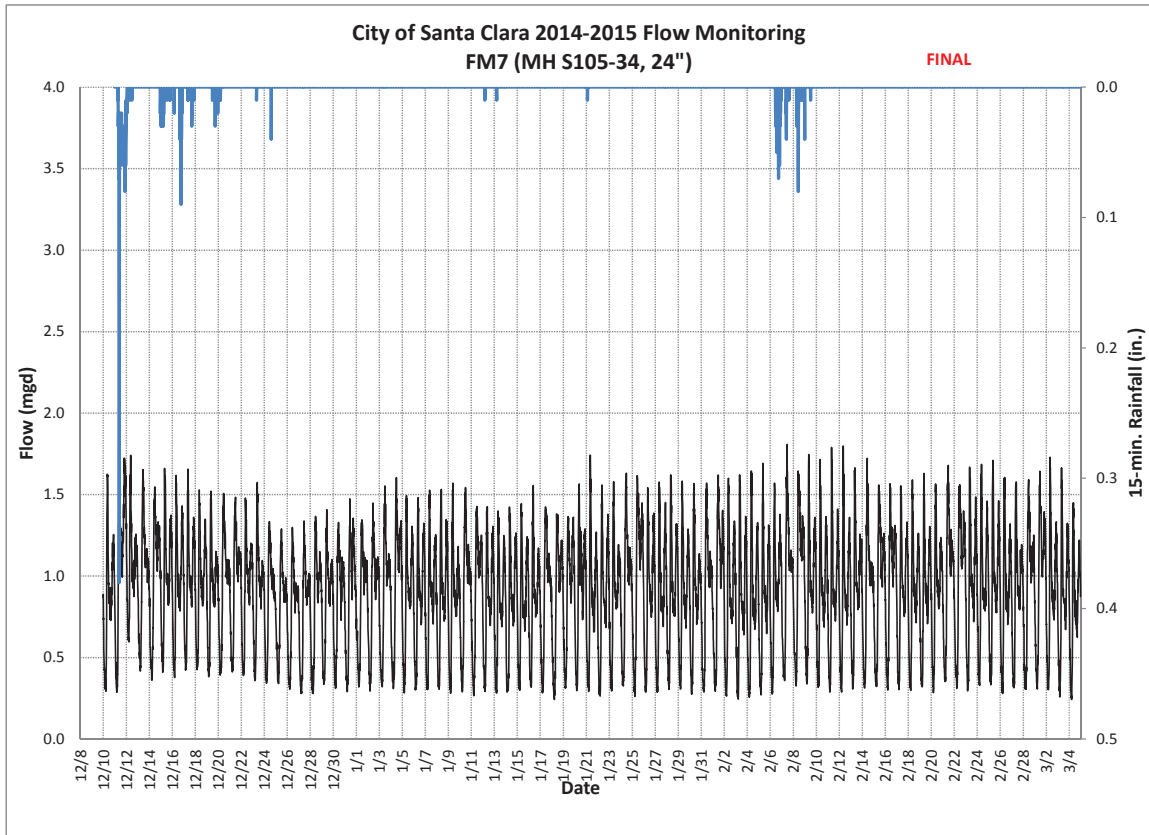


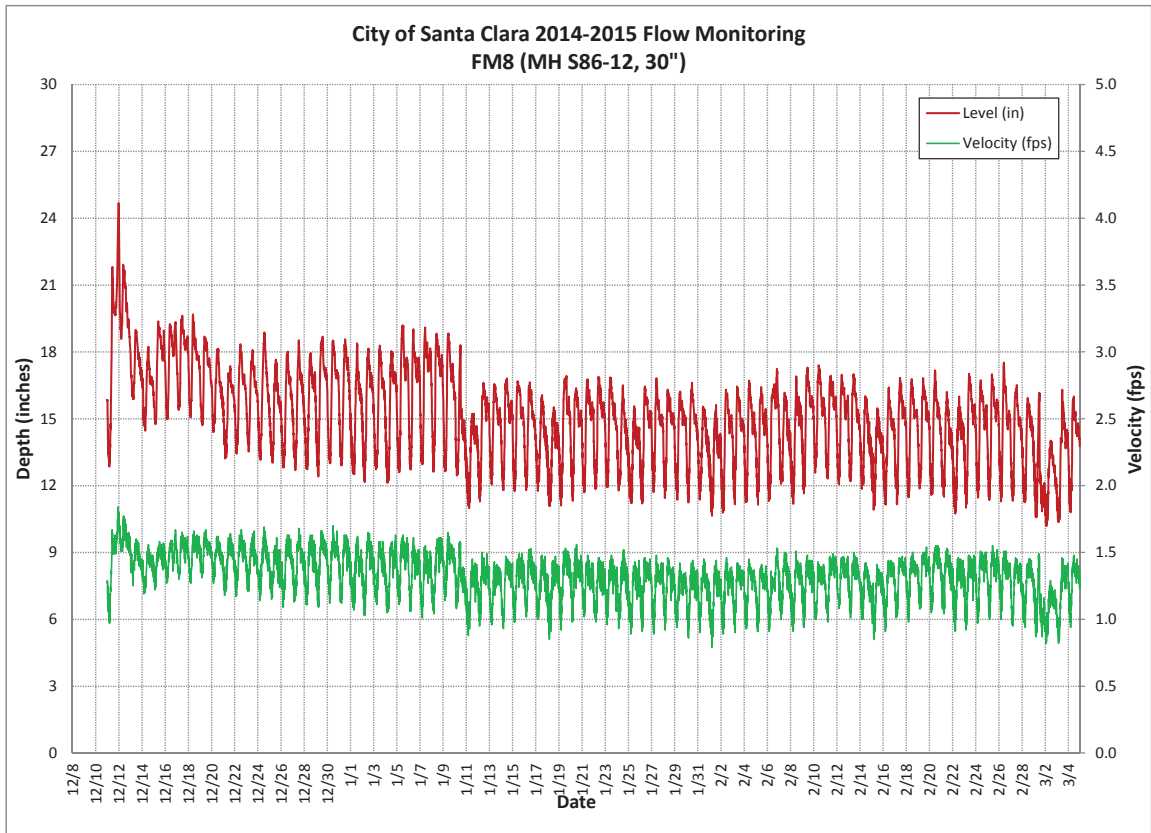
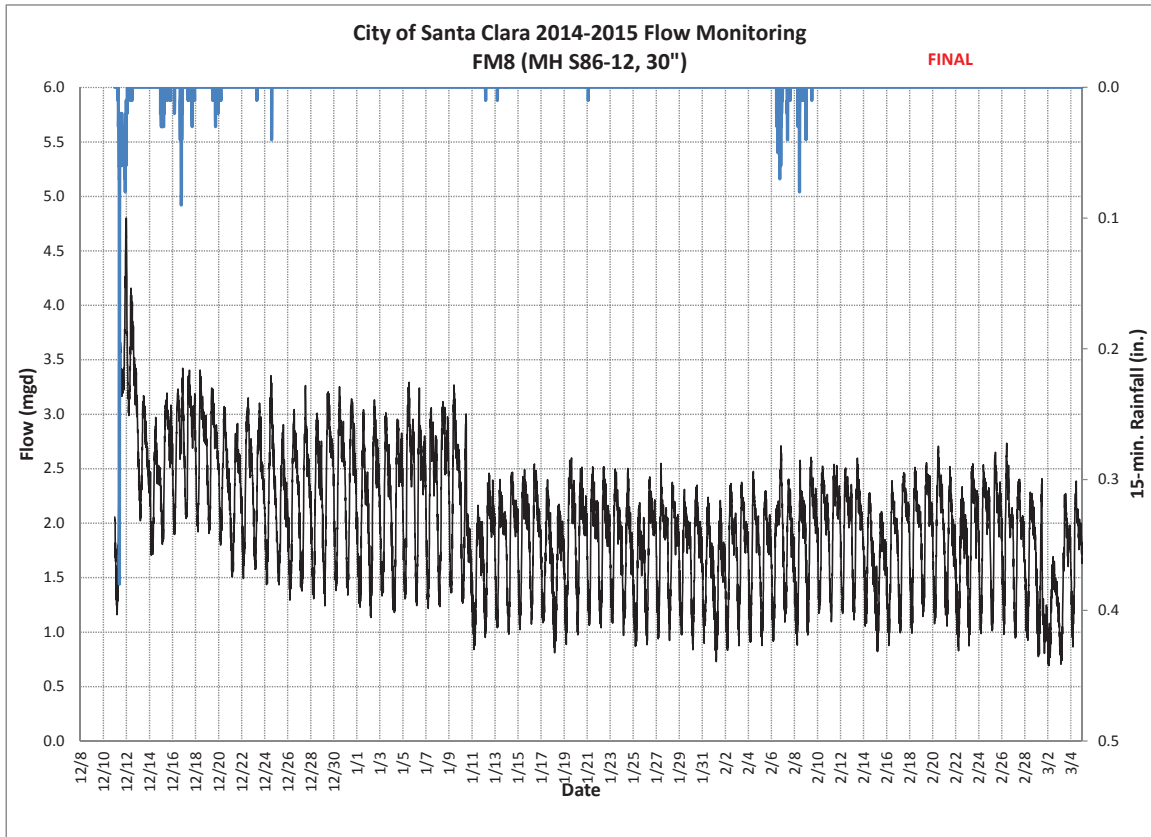


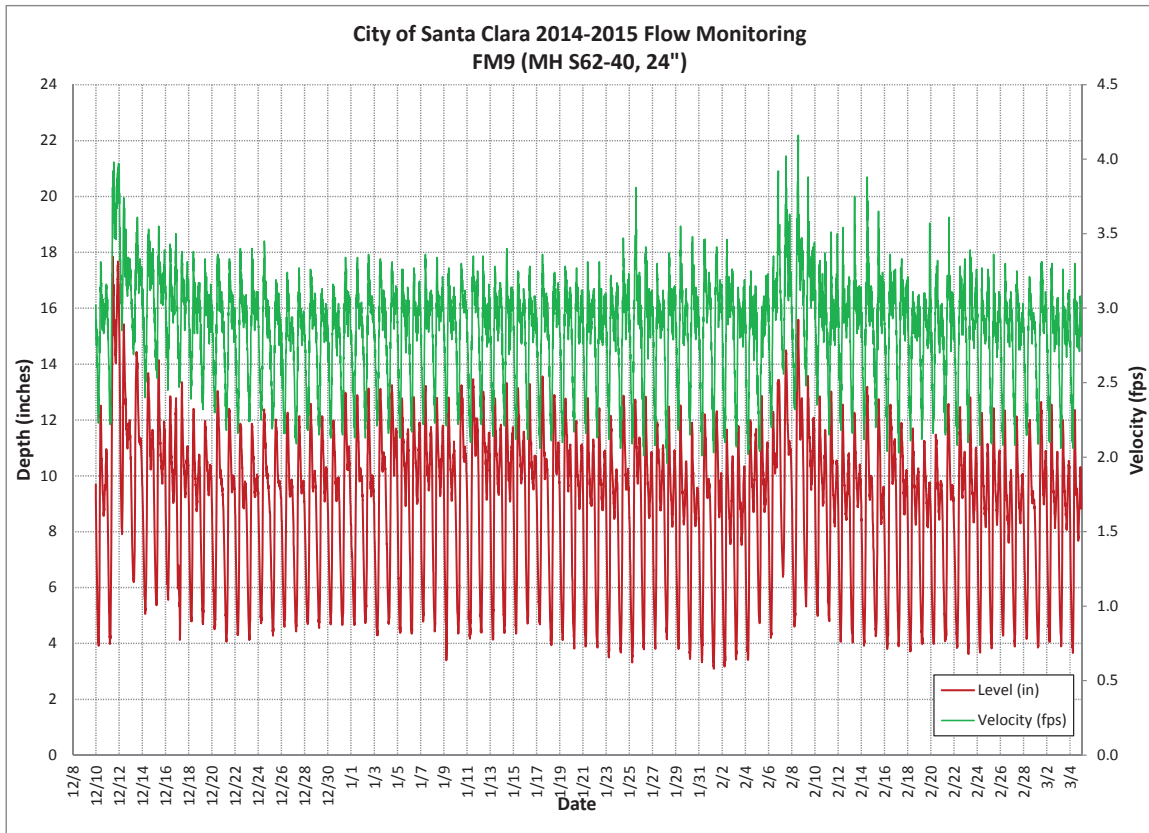
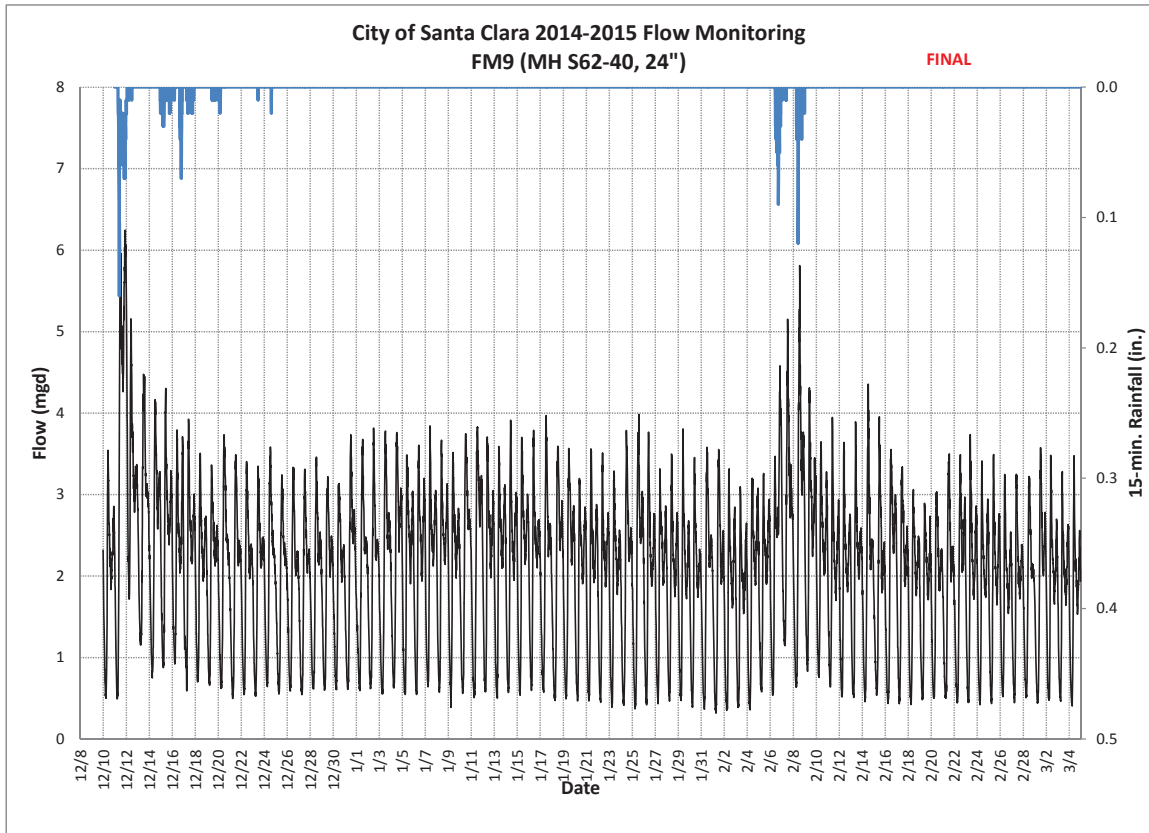


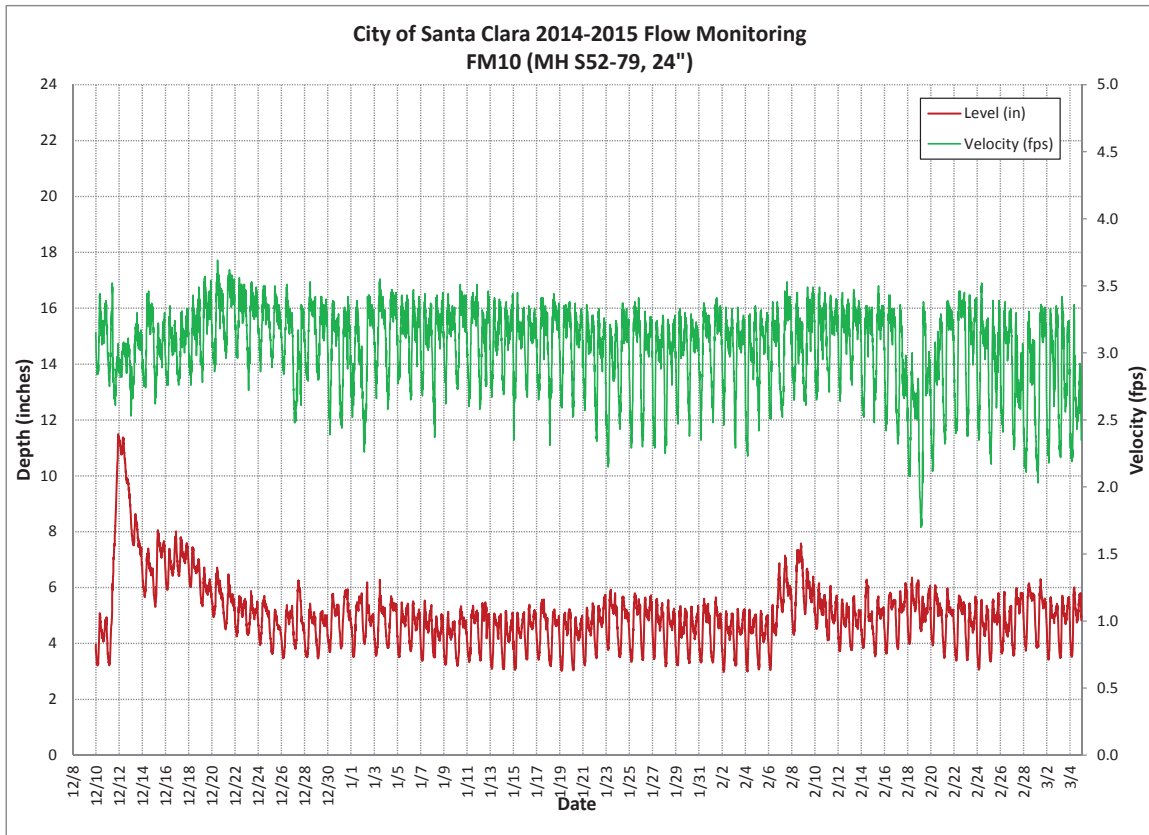
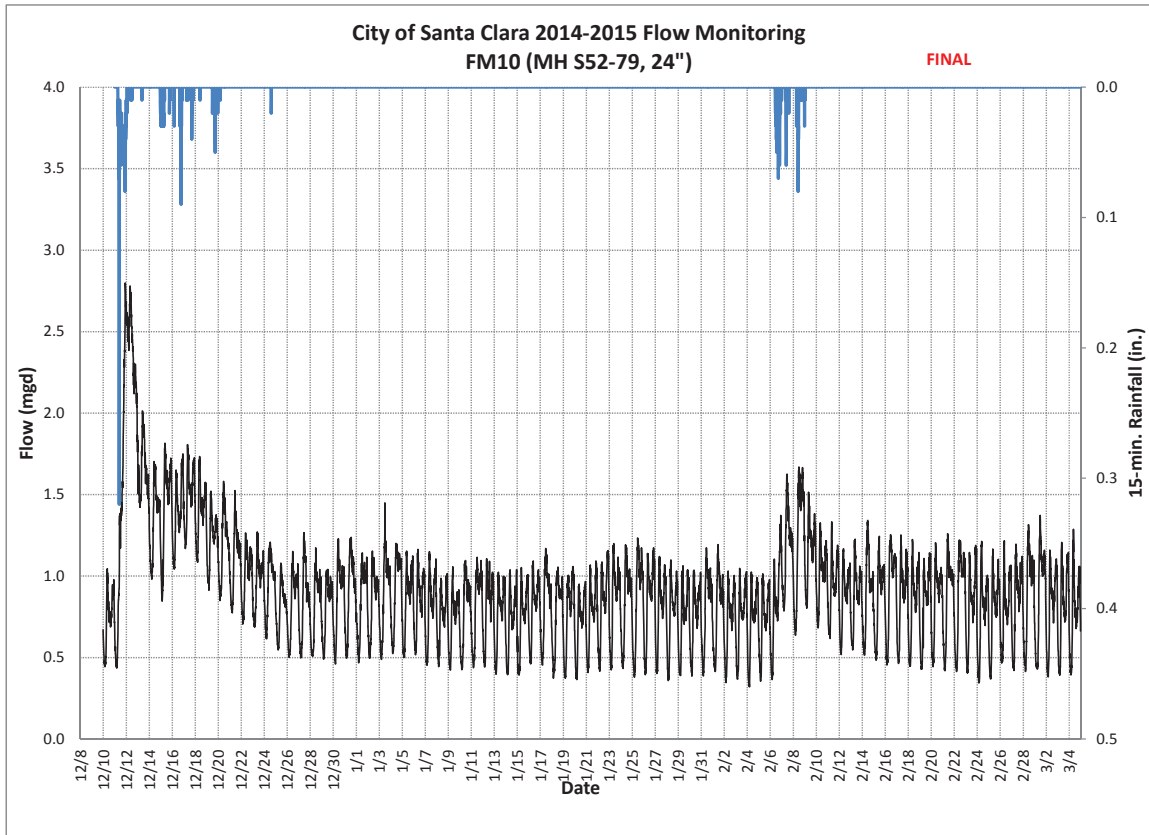


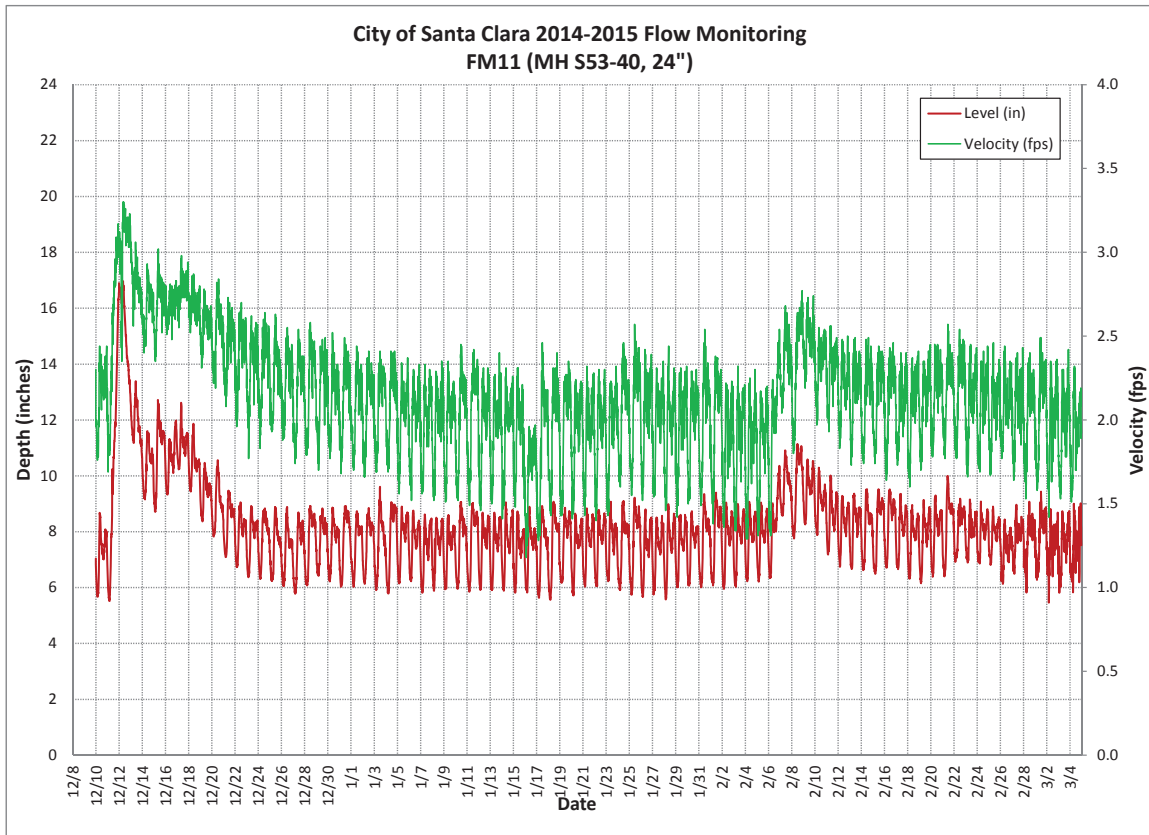
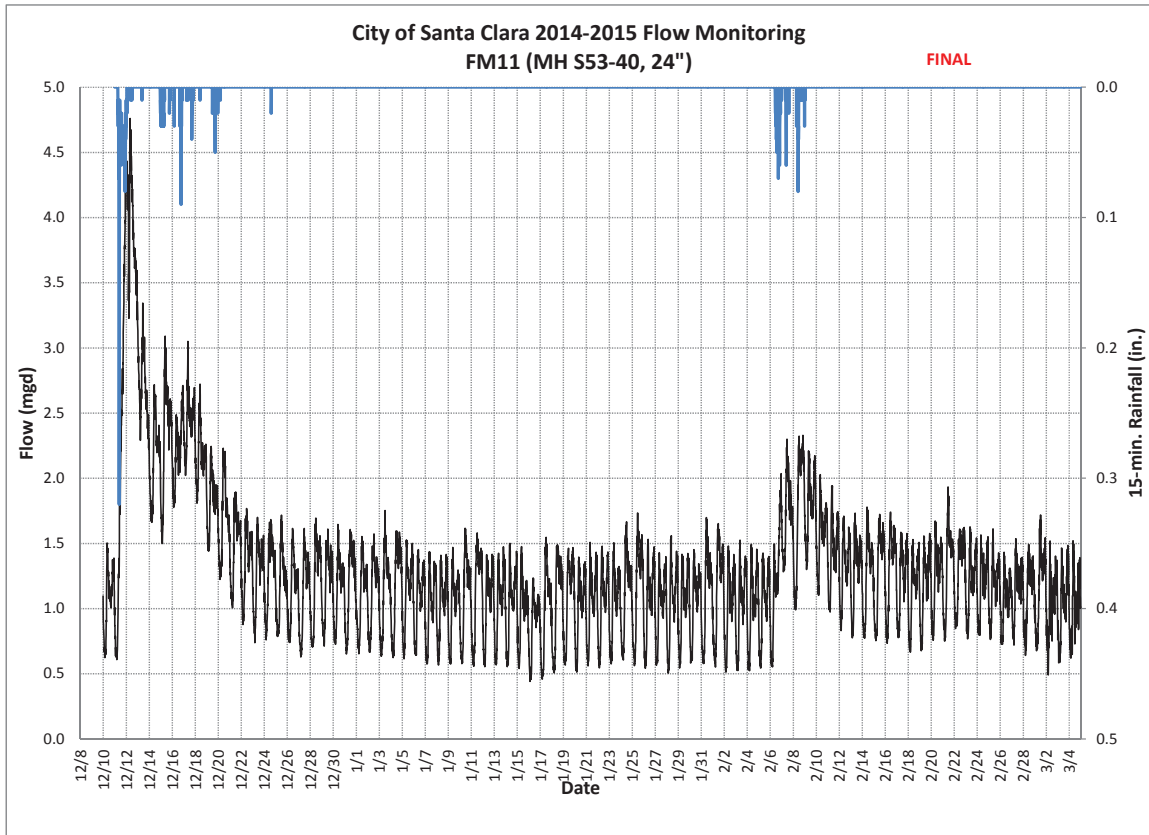


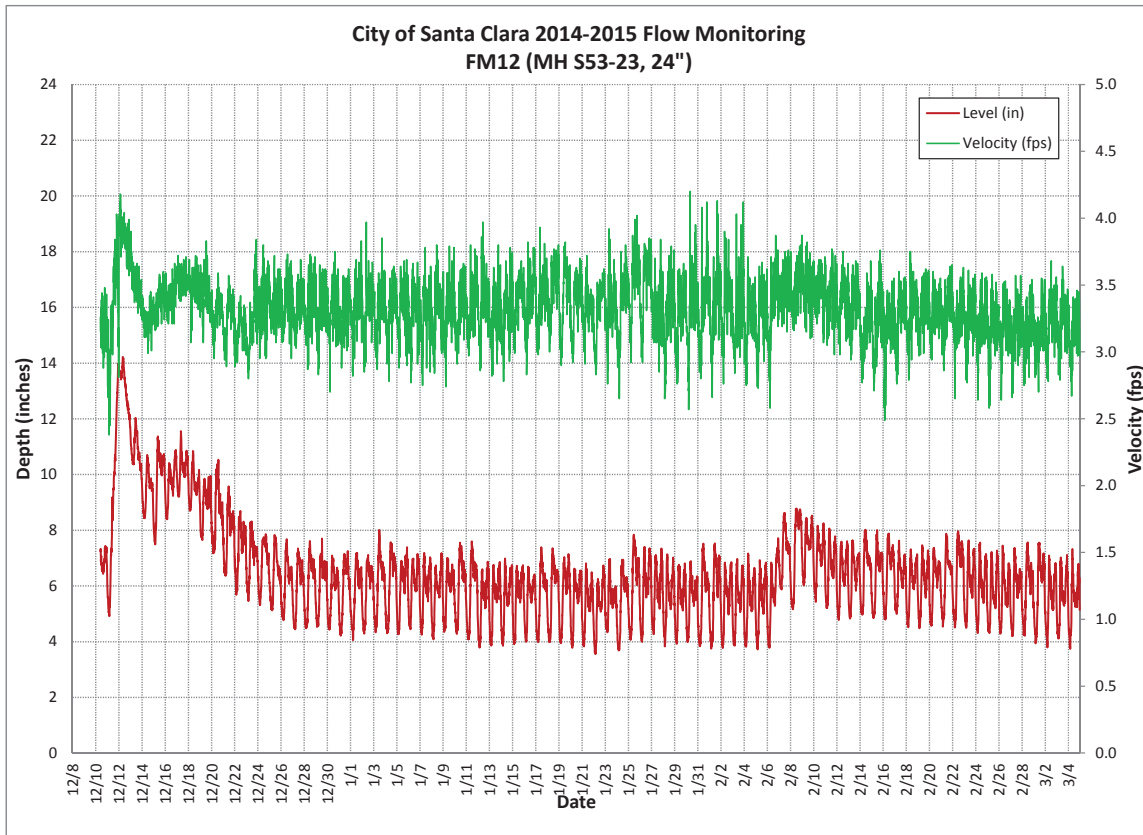
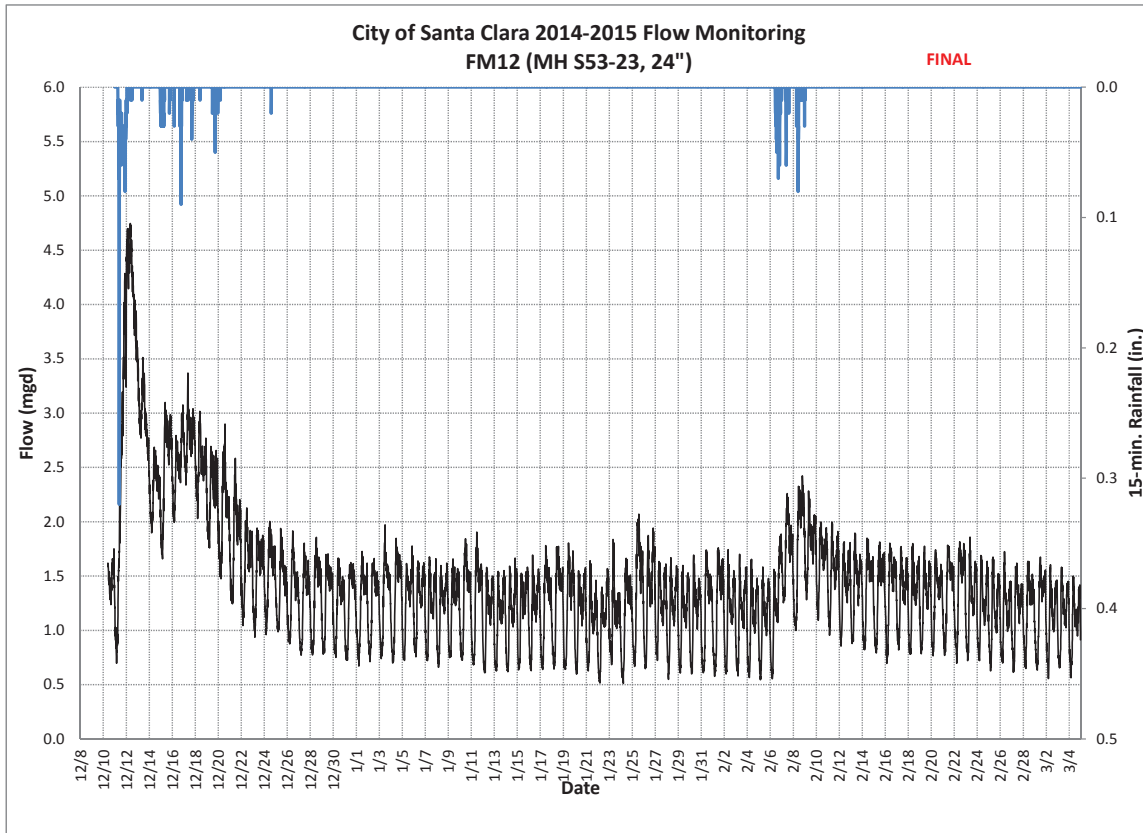


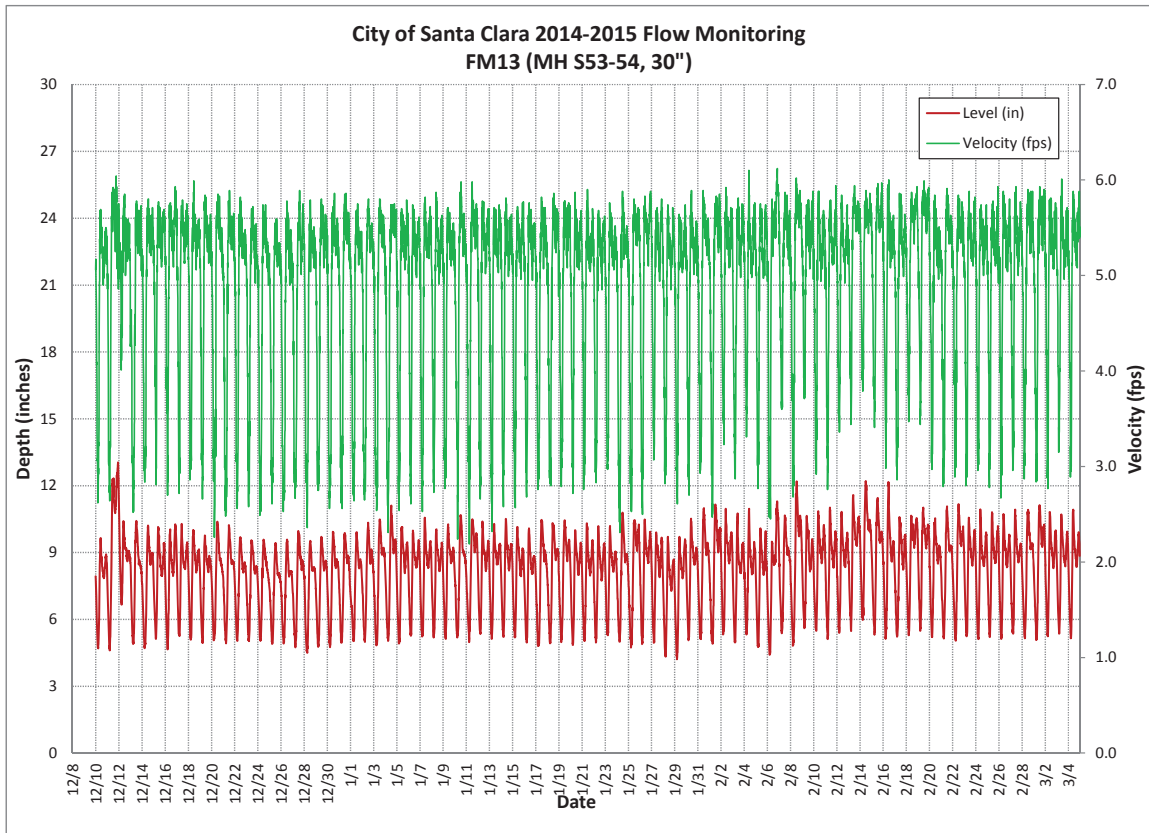
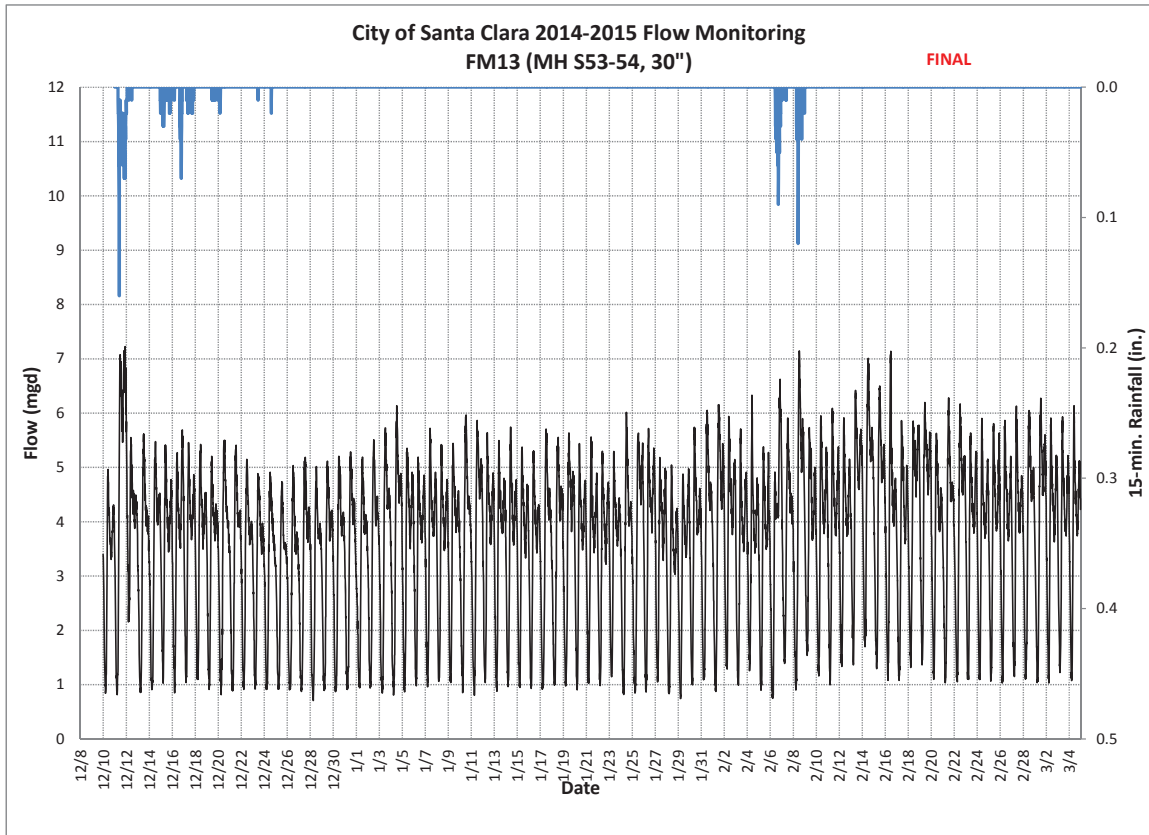


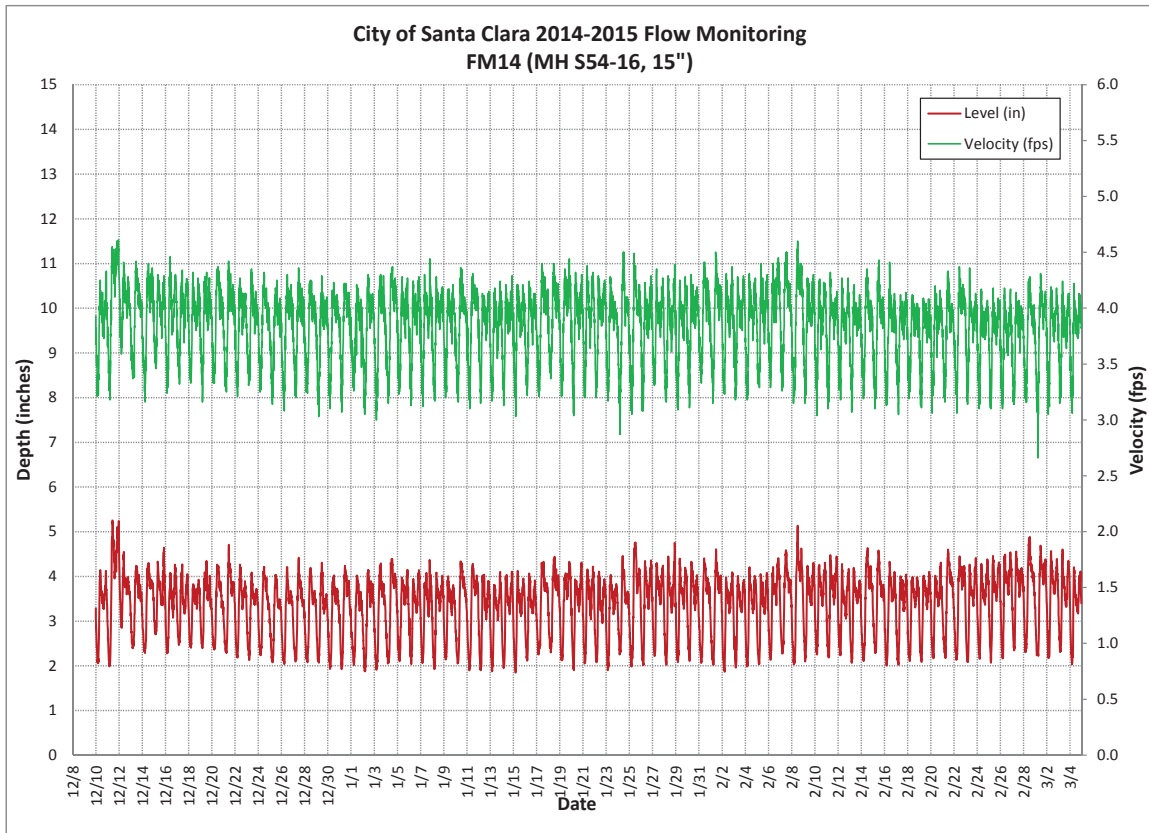
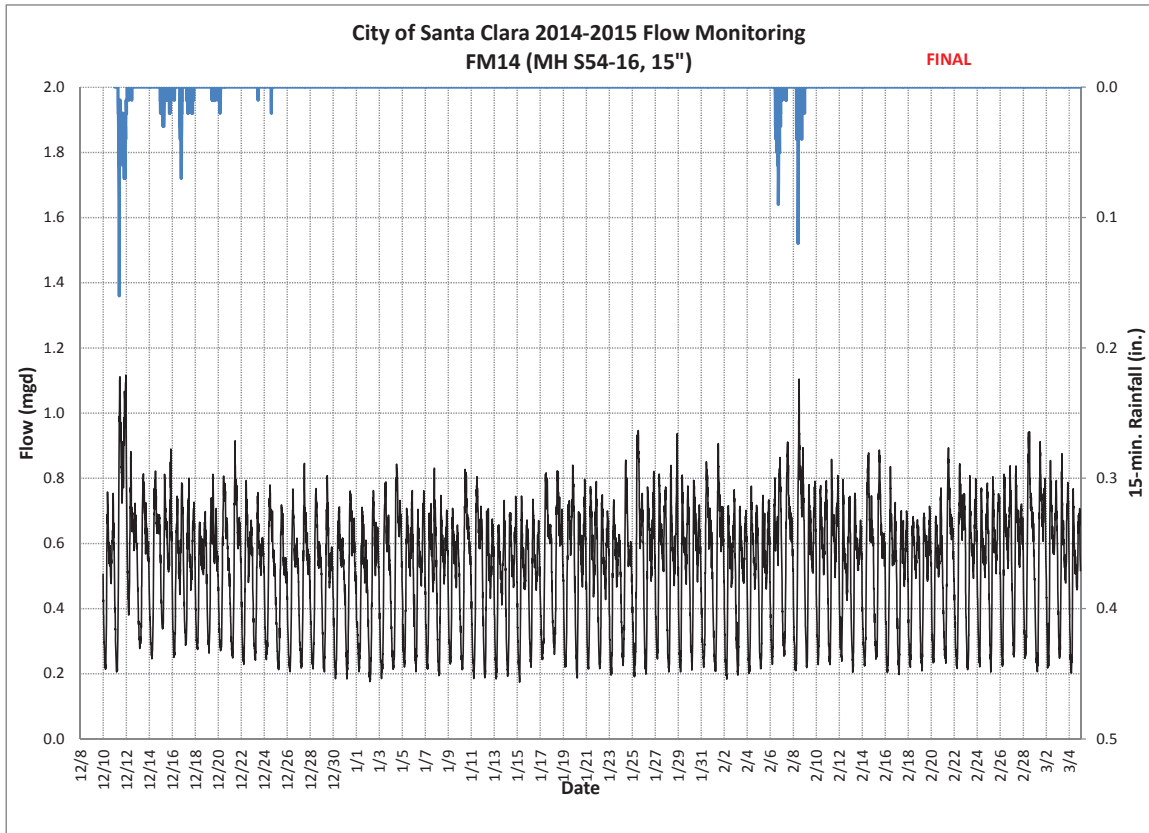


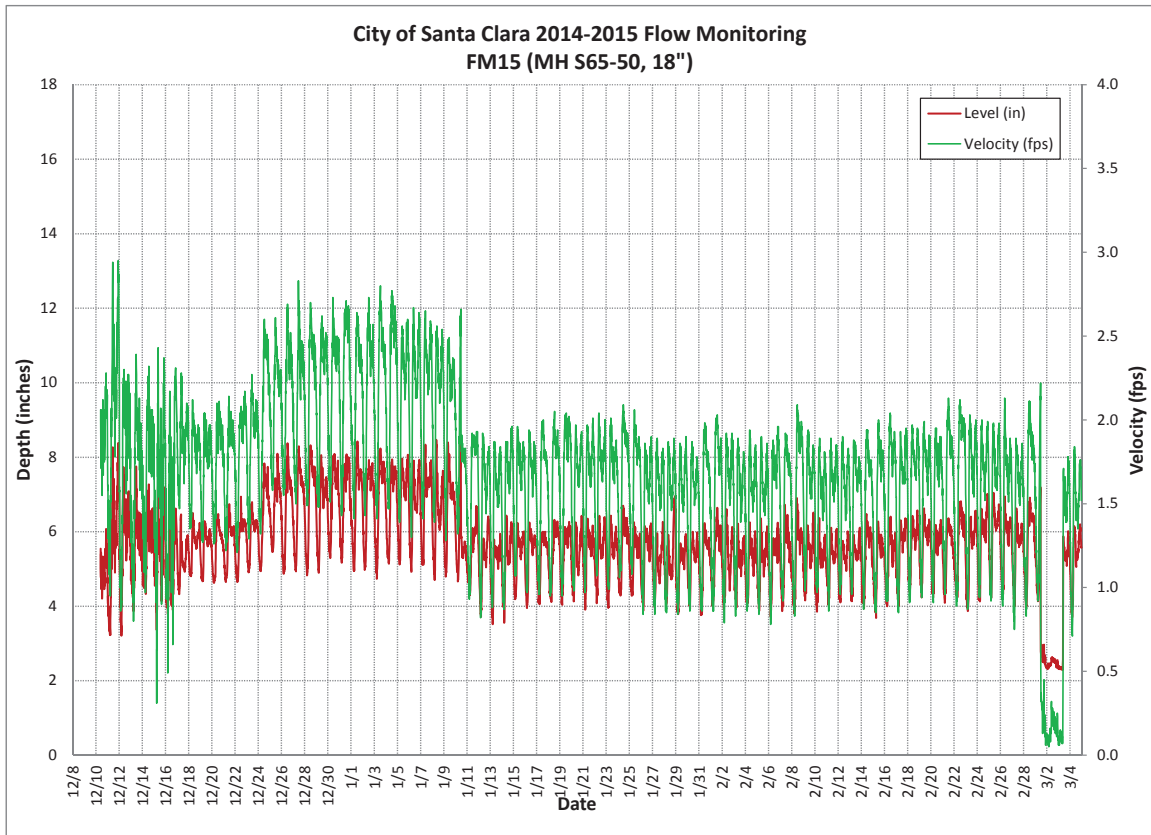
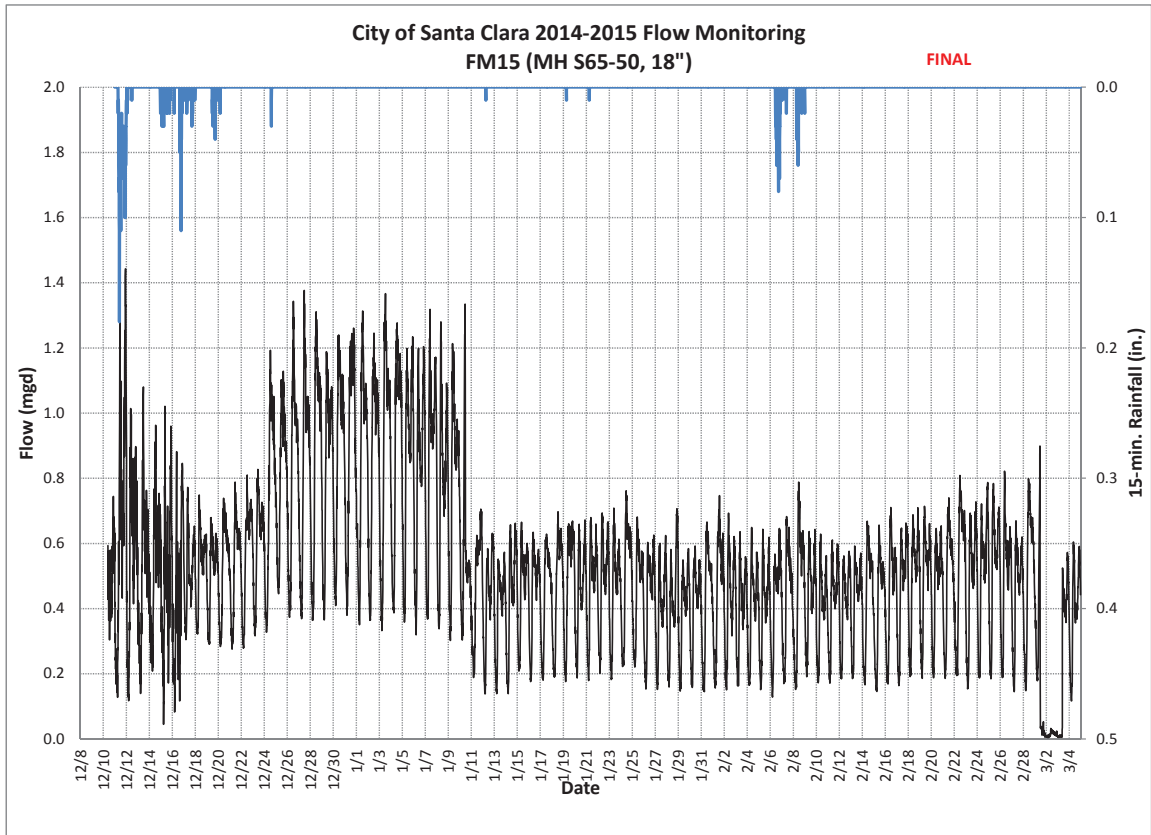


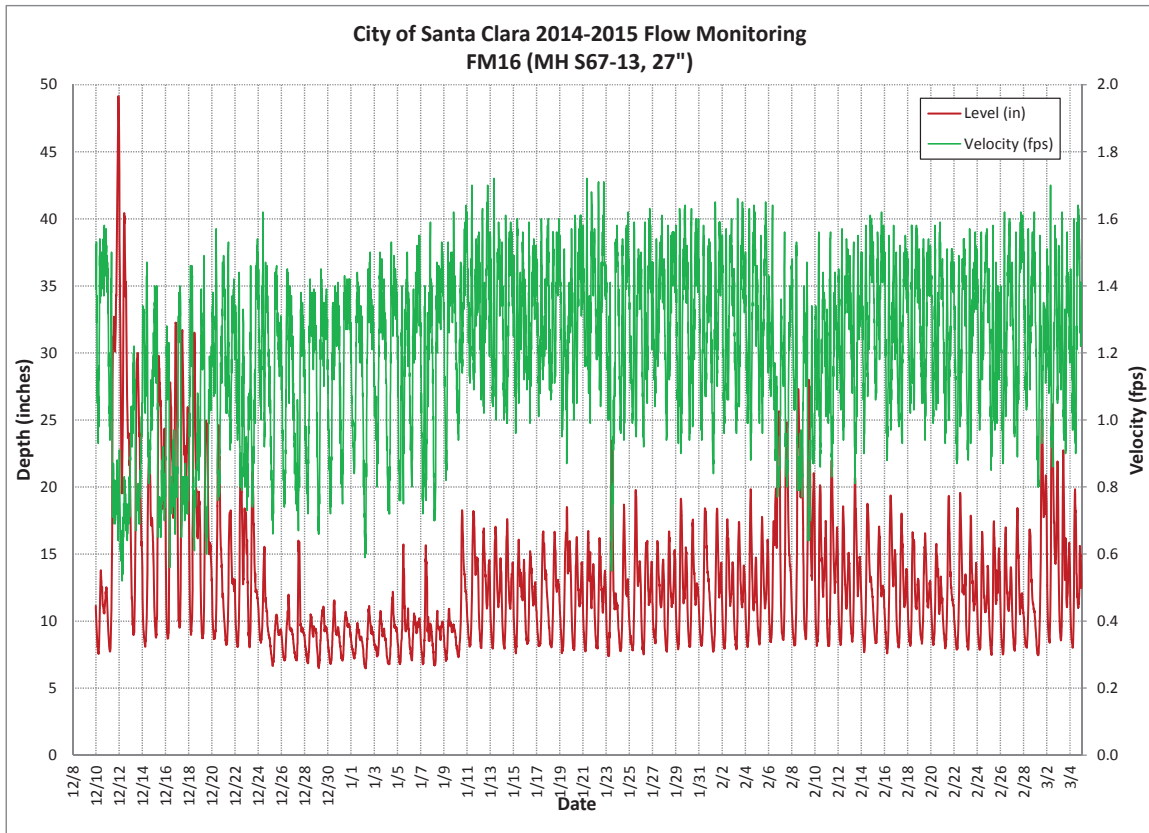
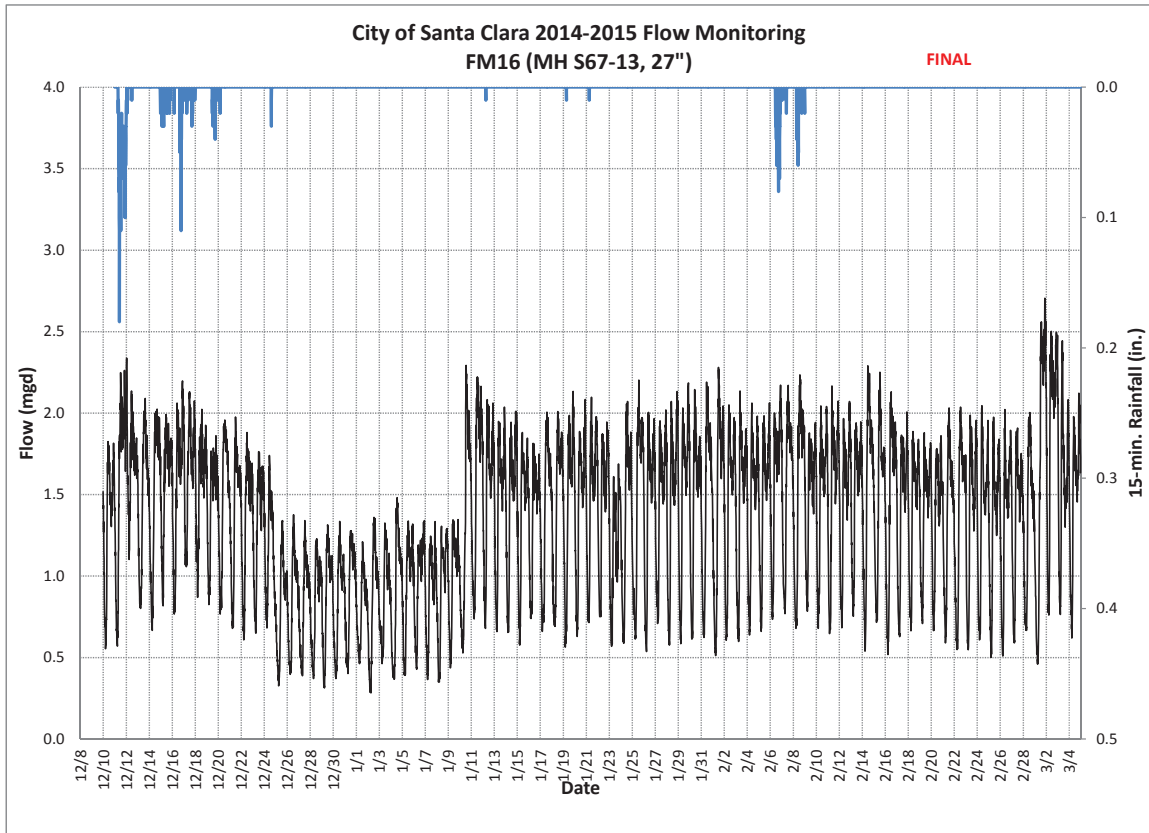






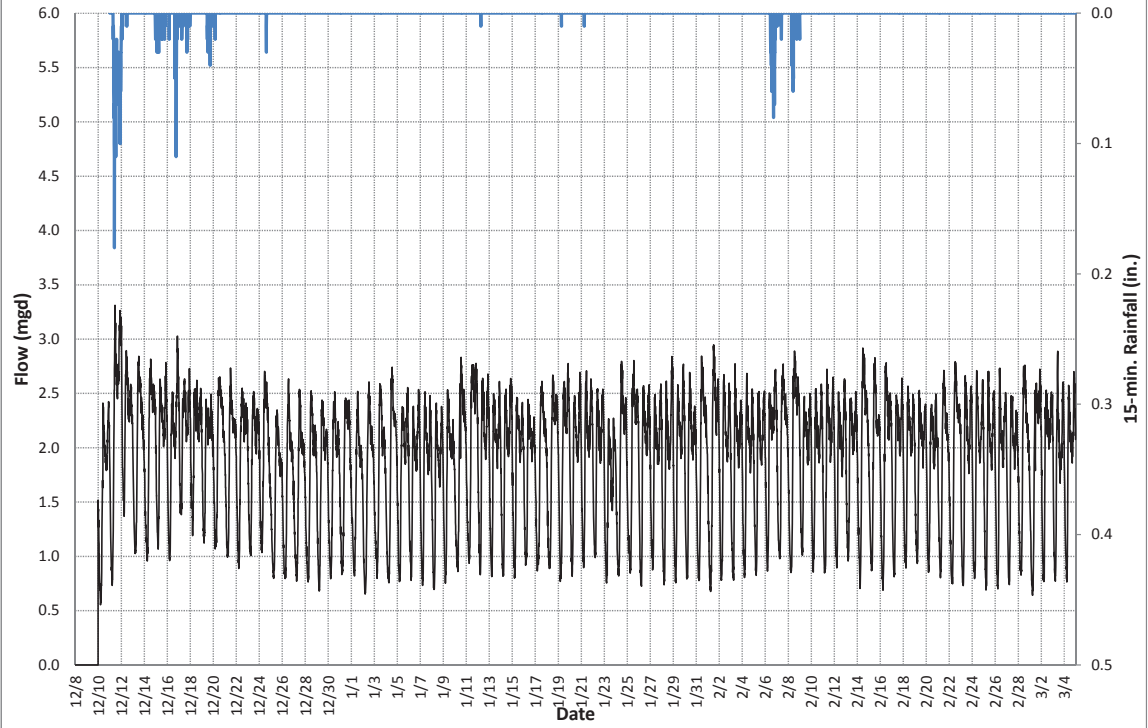


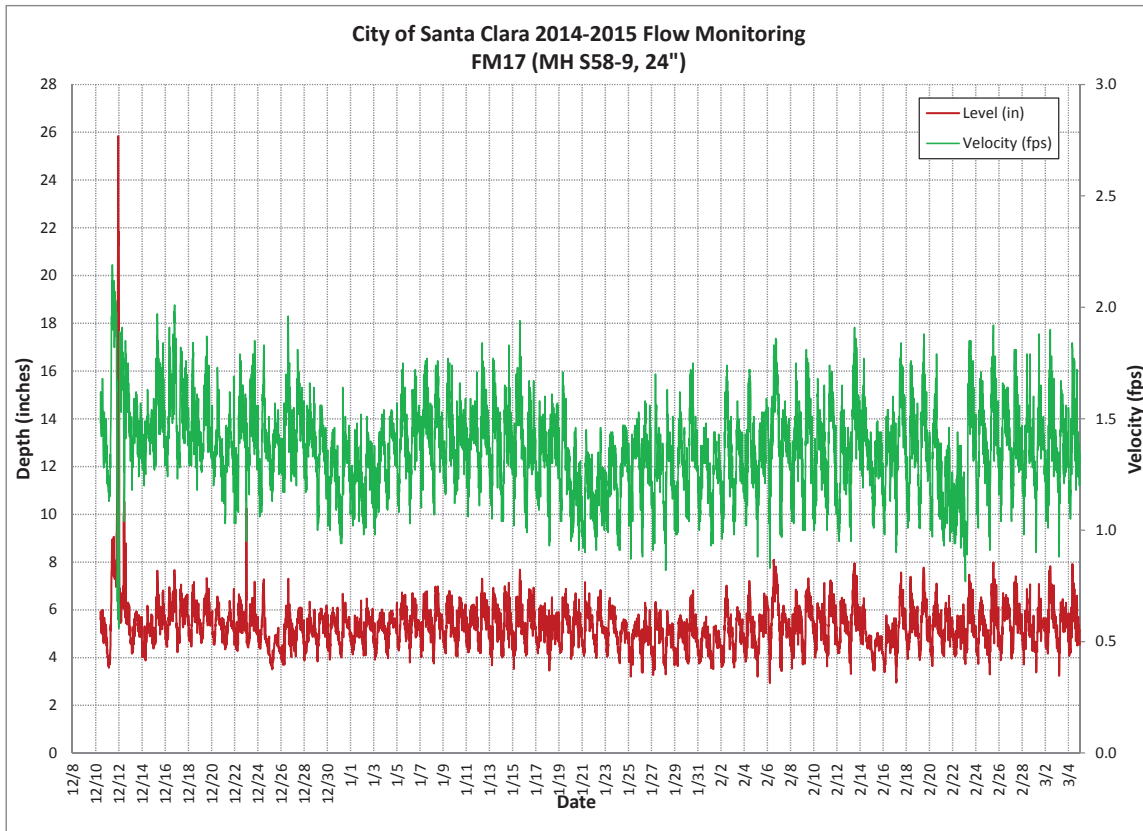
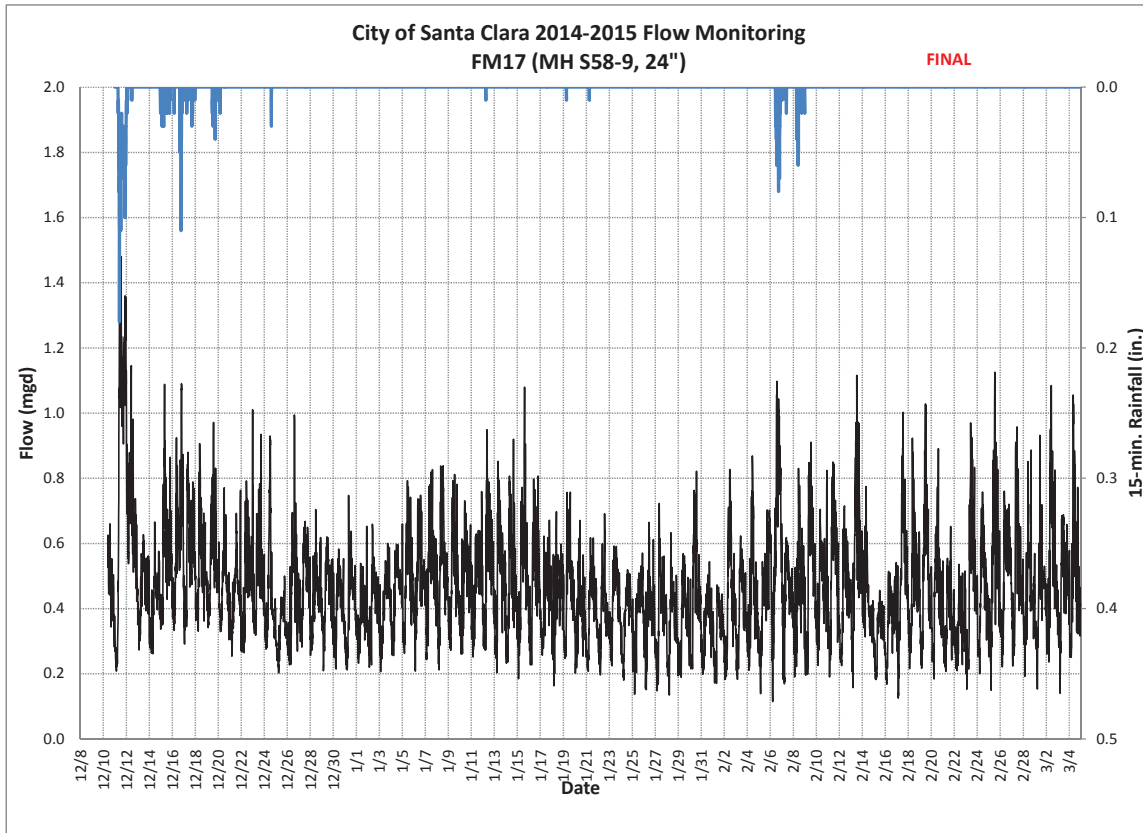


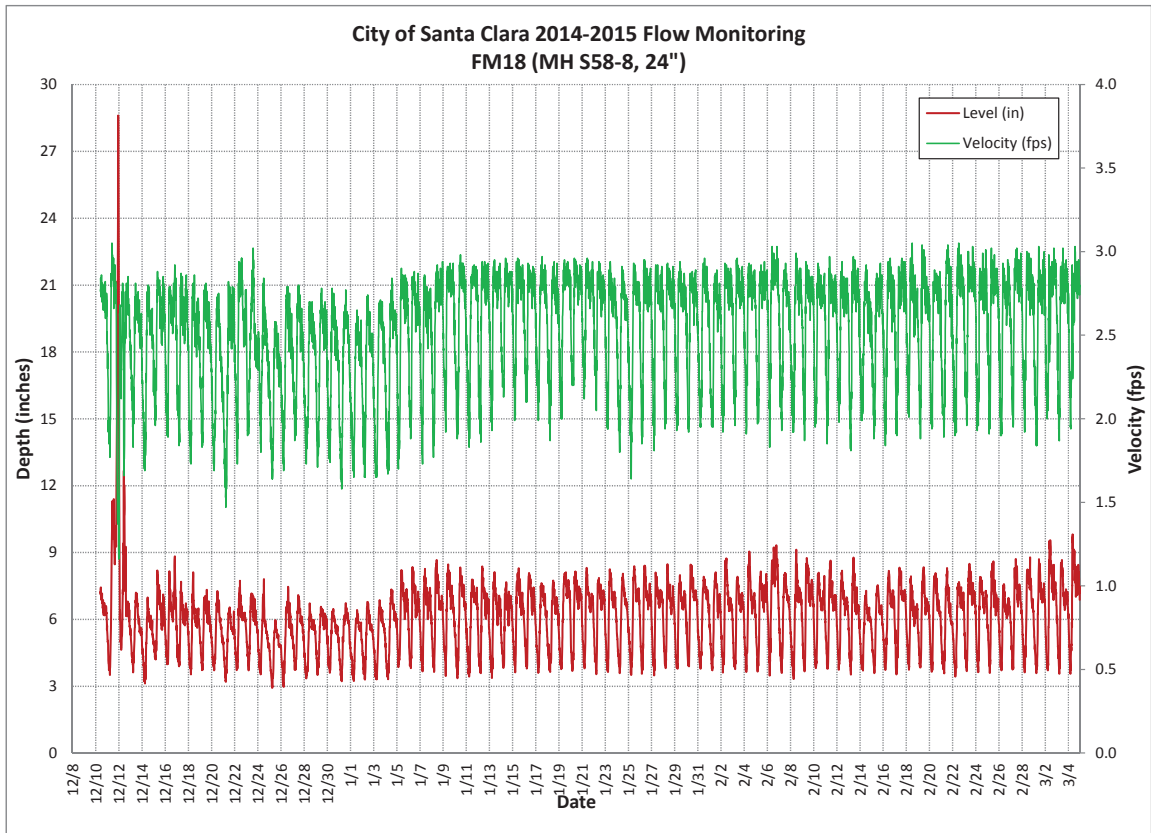
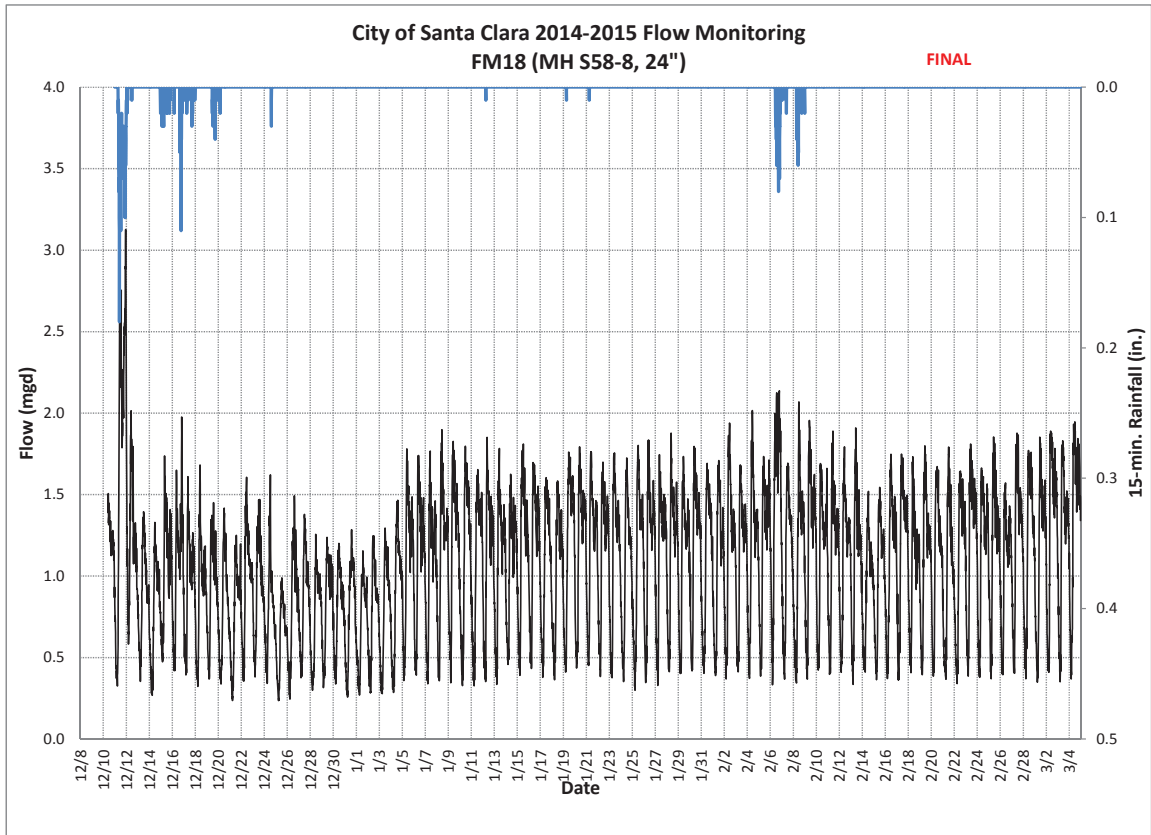


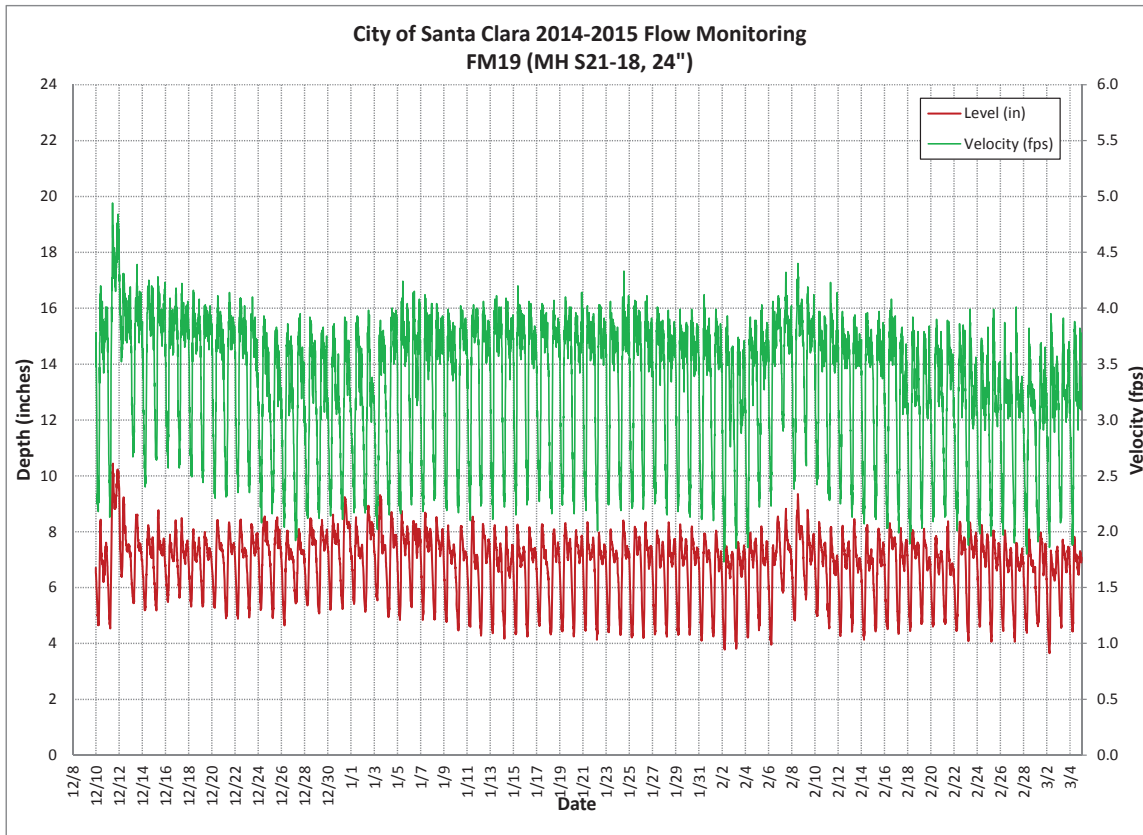
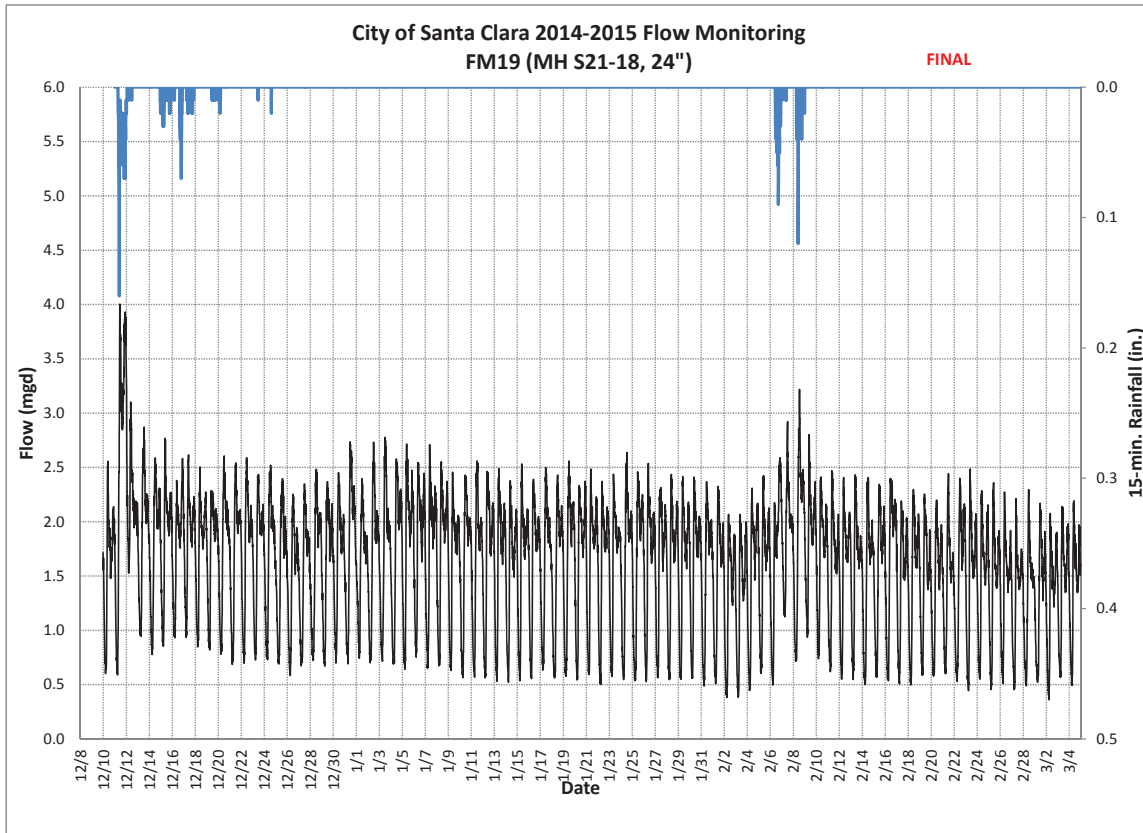
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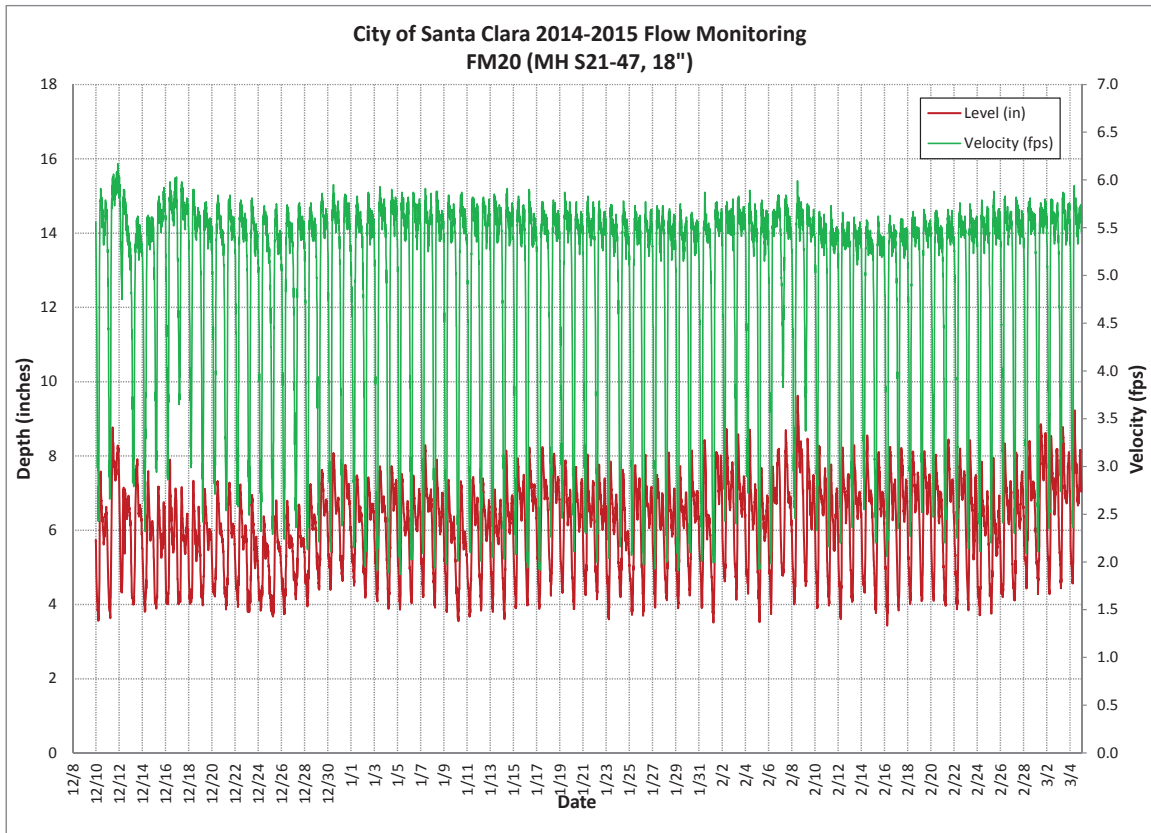
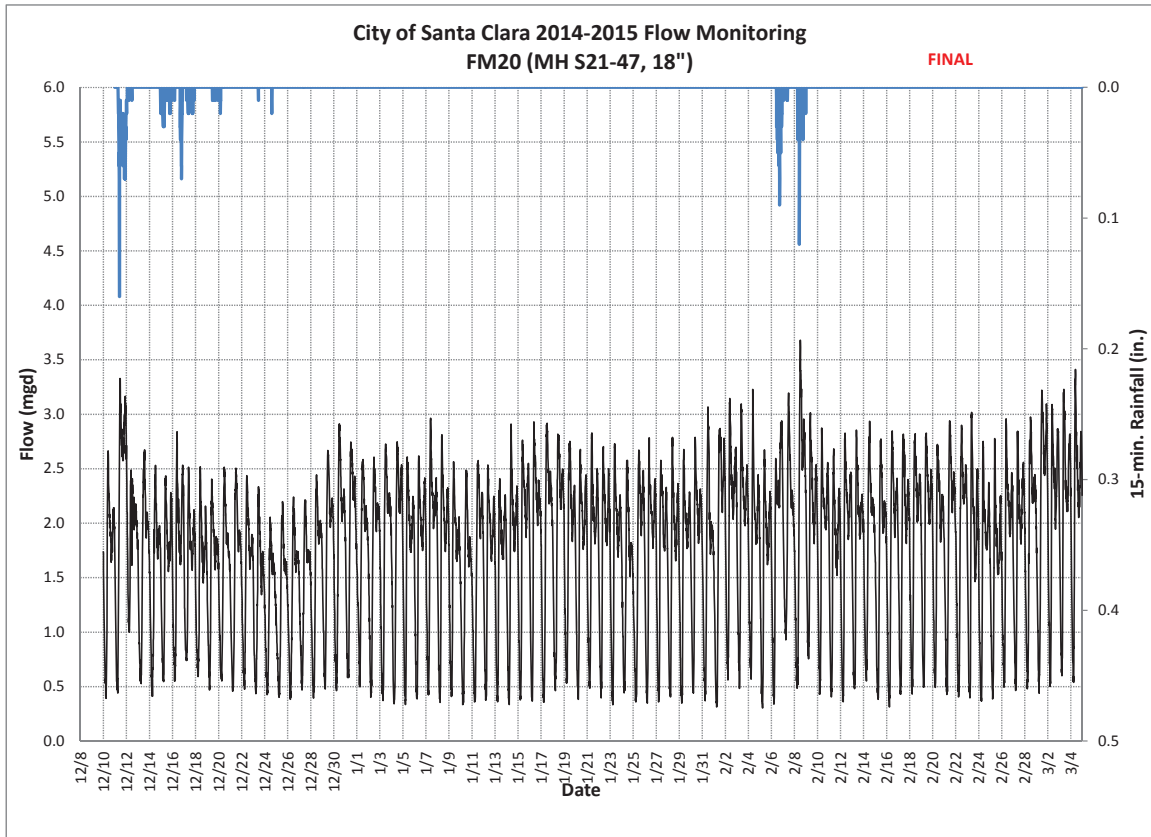
PRELIMINARY

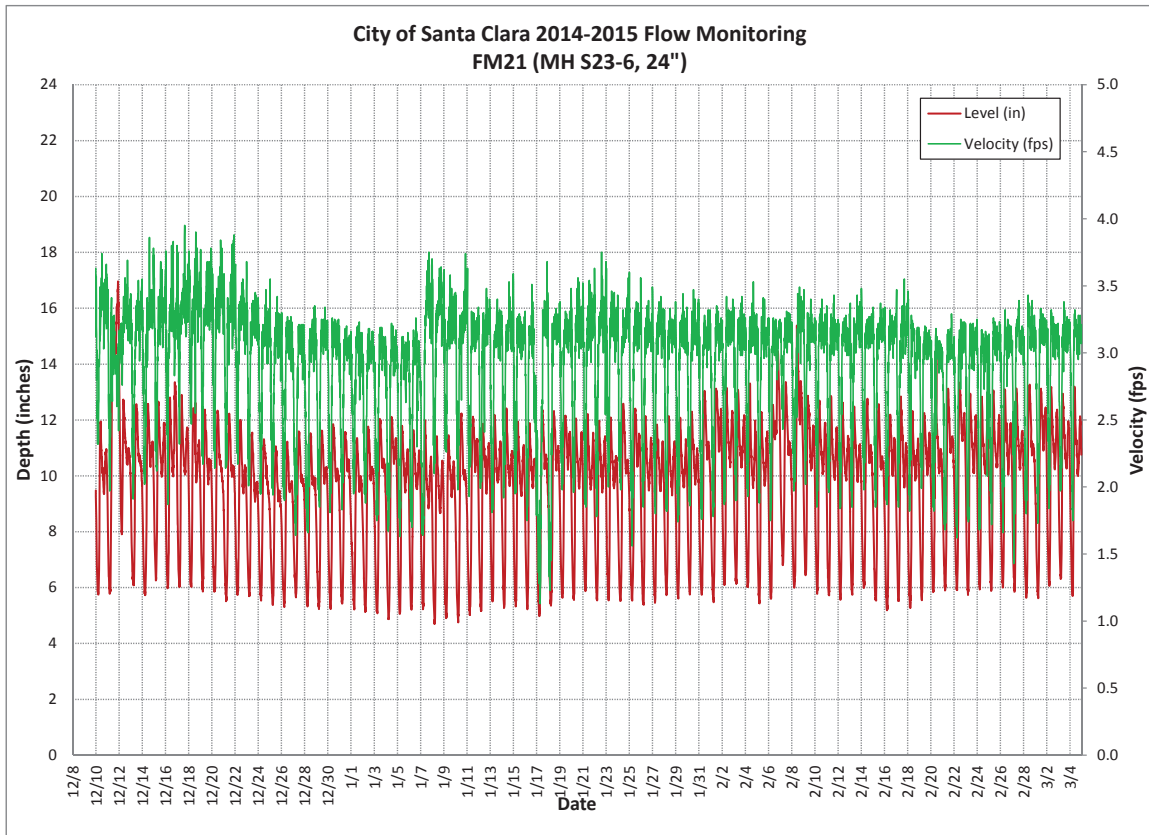
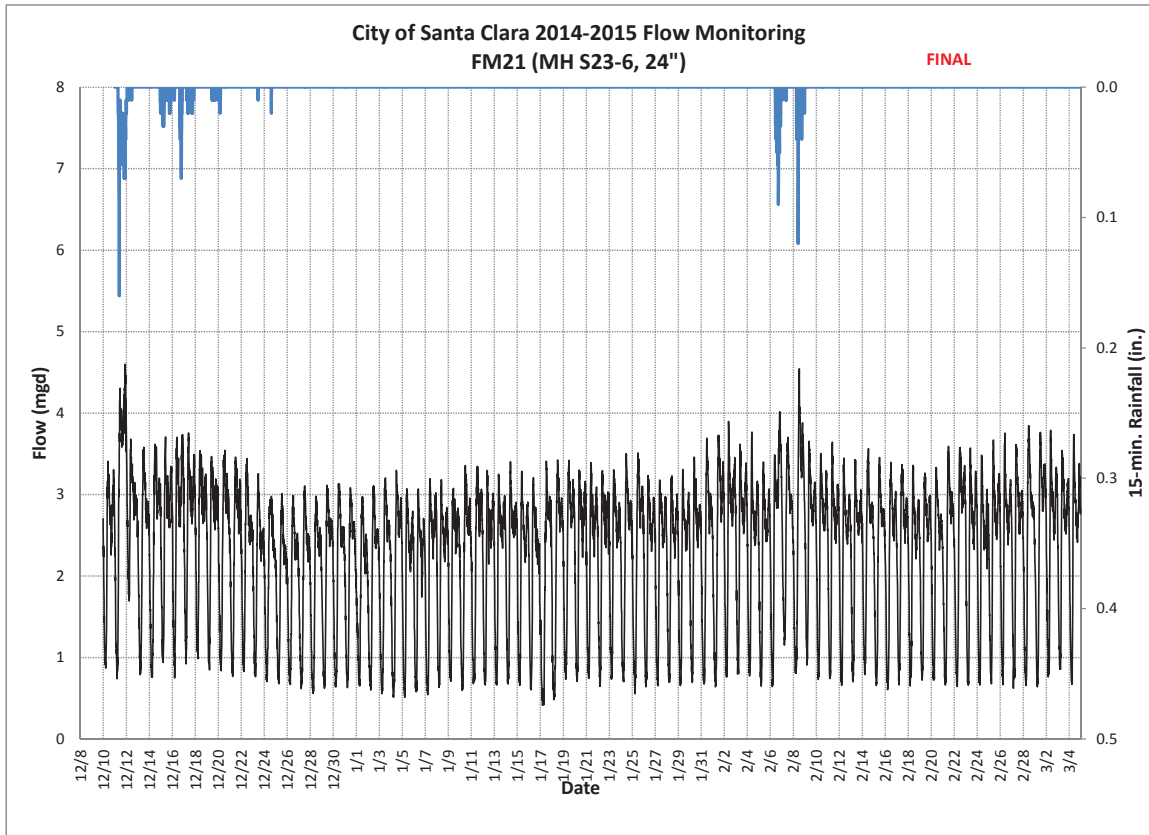


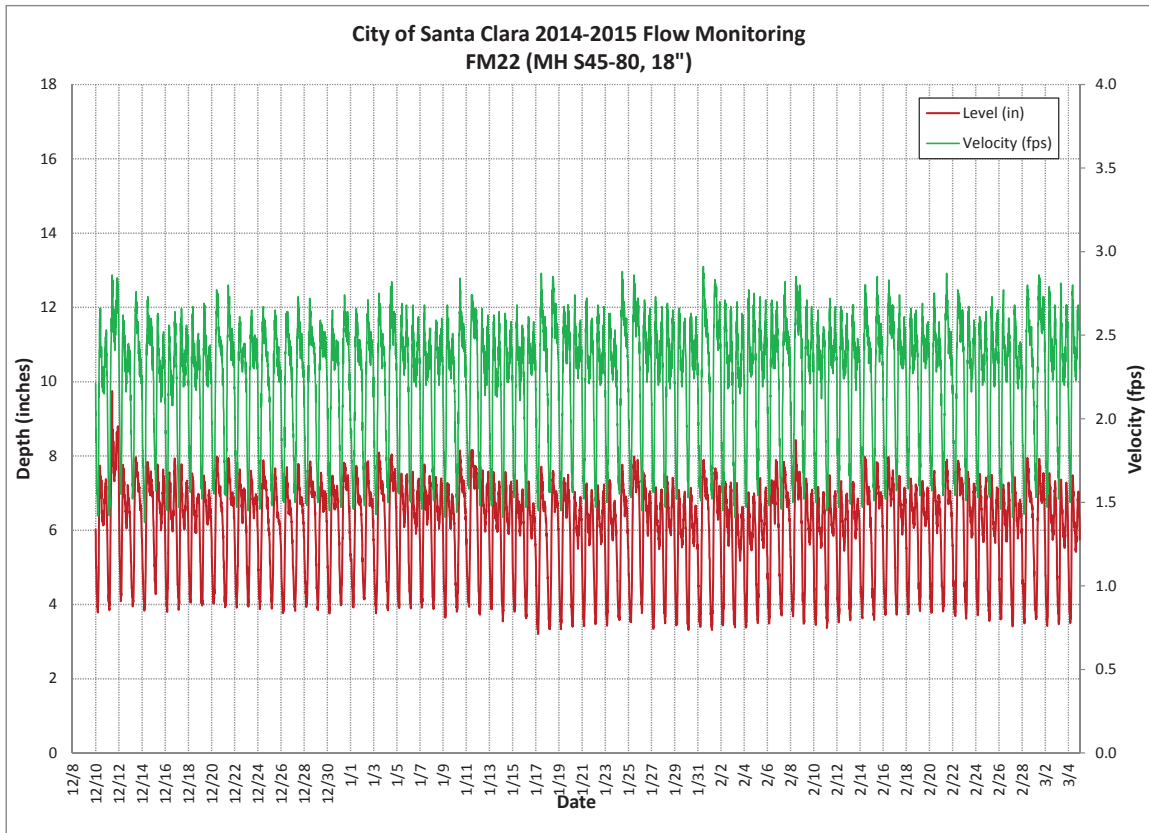
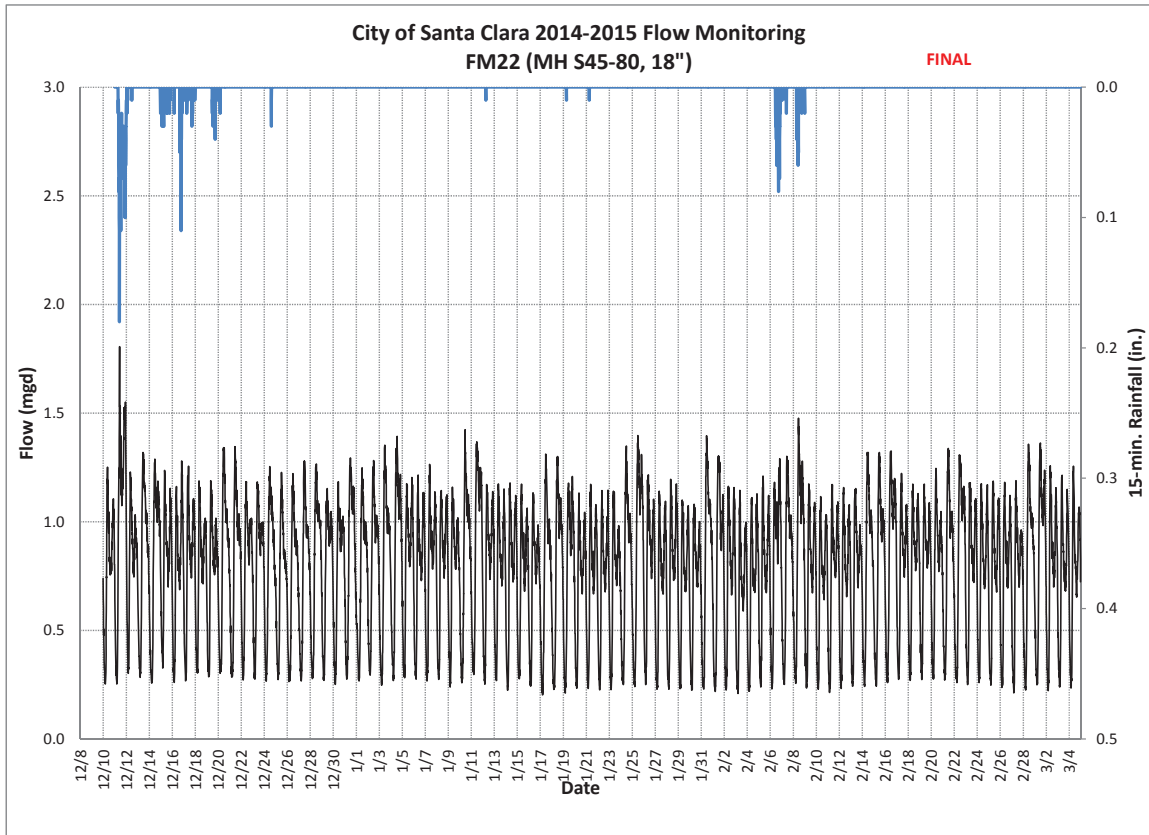


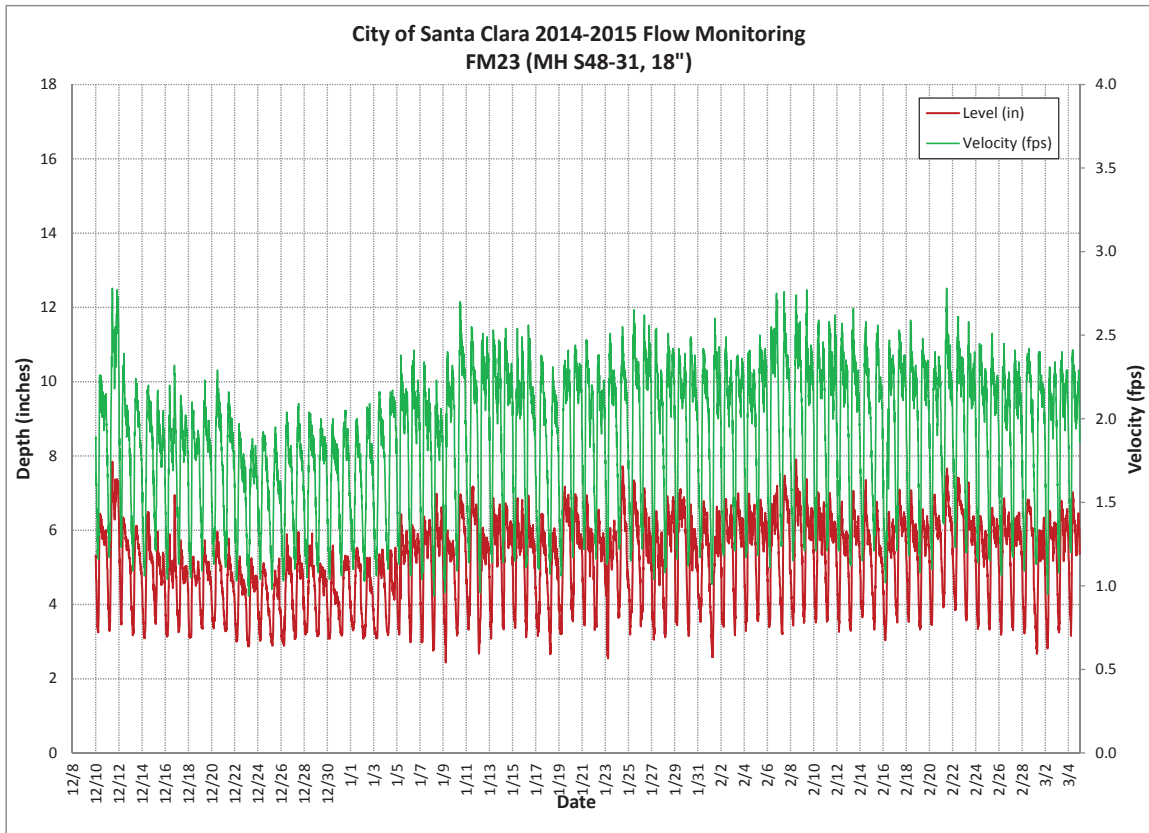
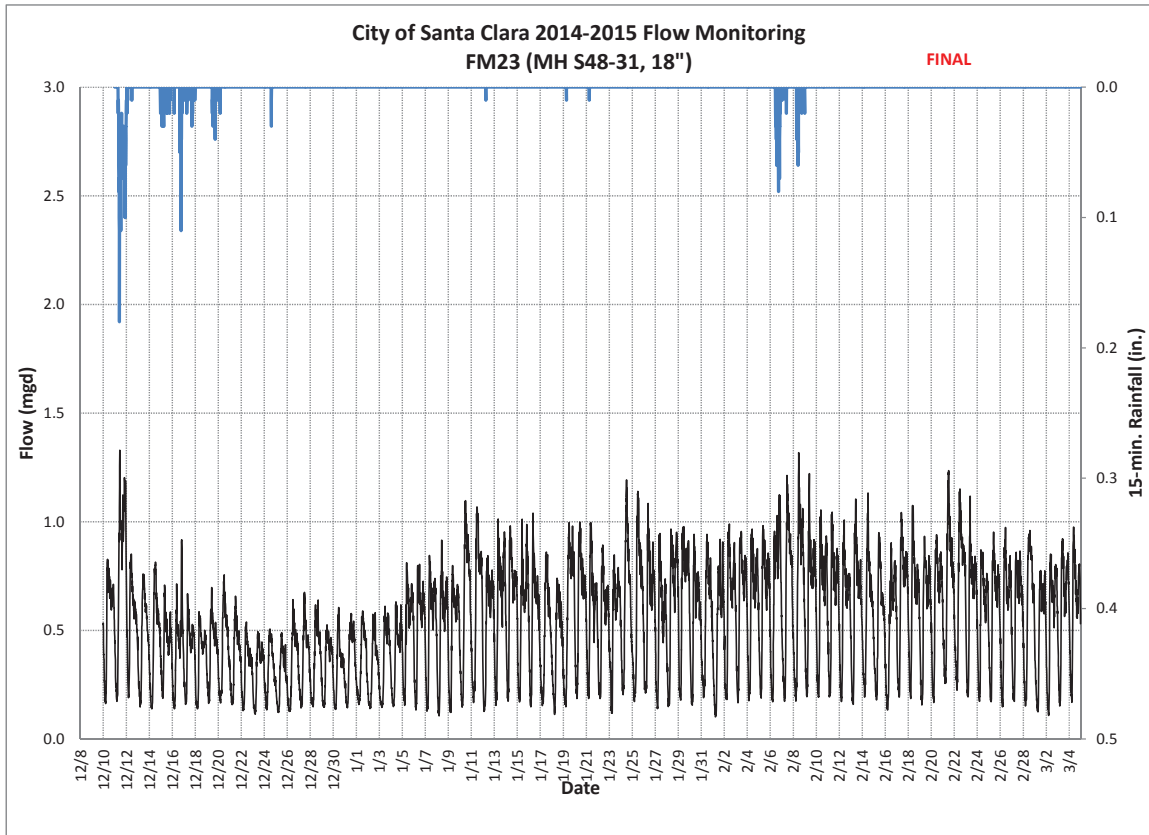


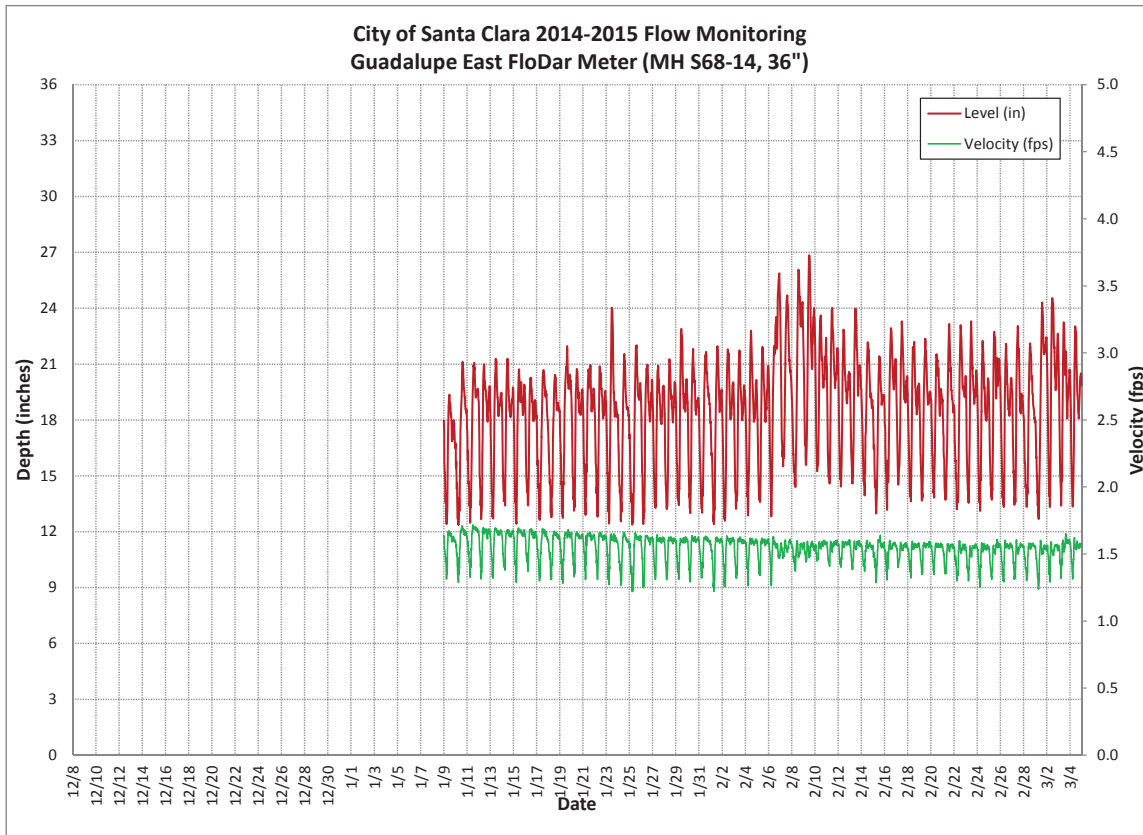
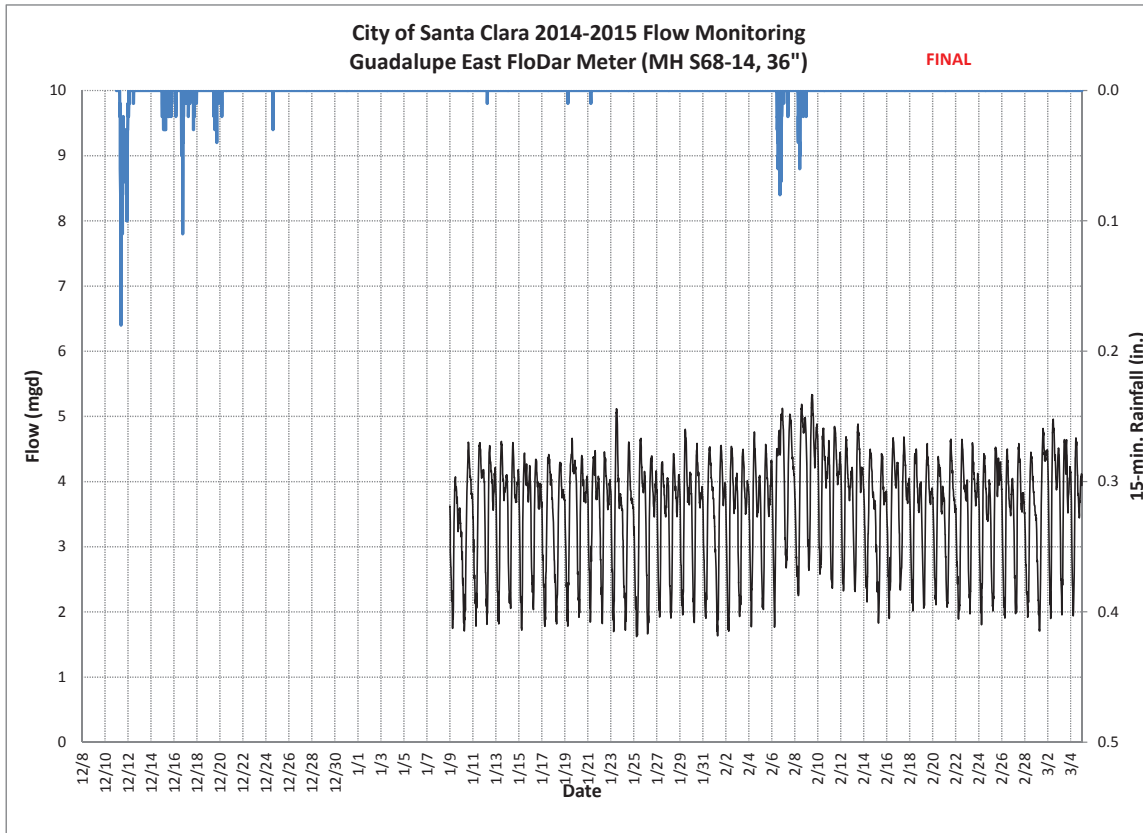


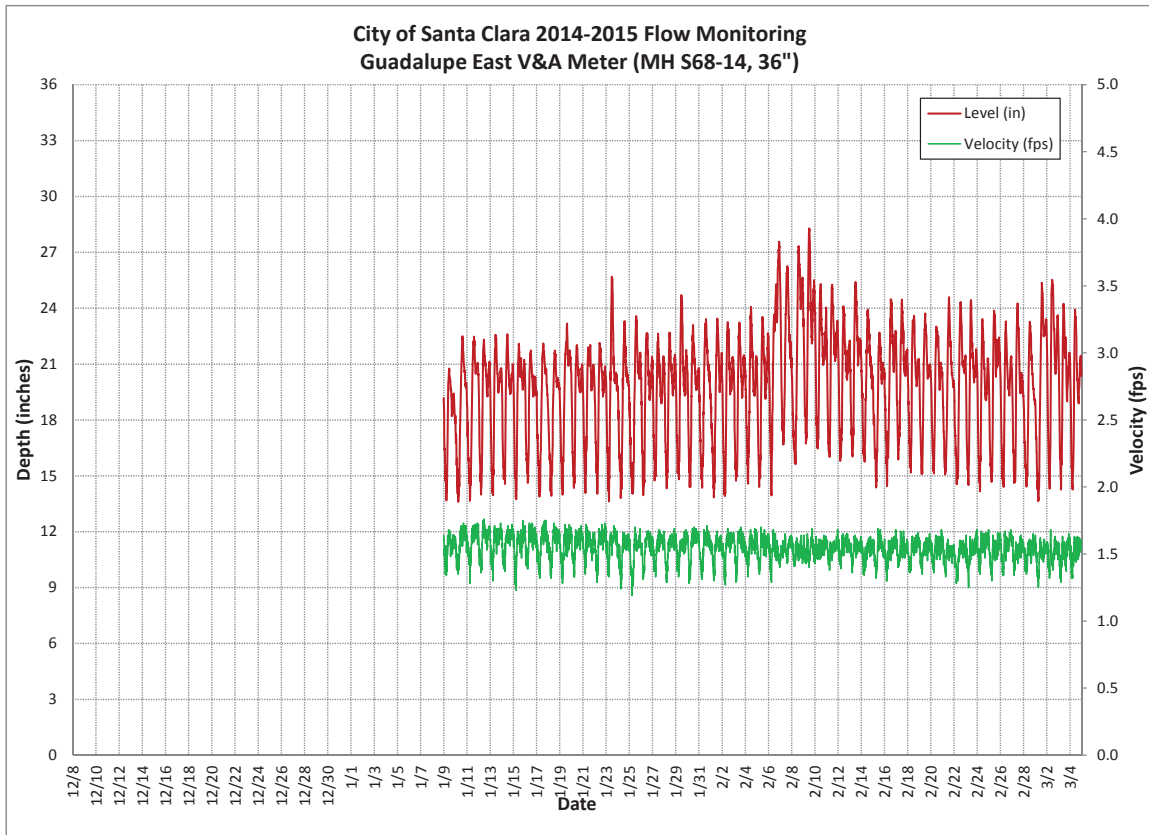
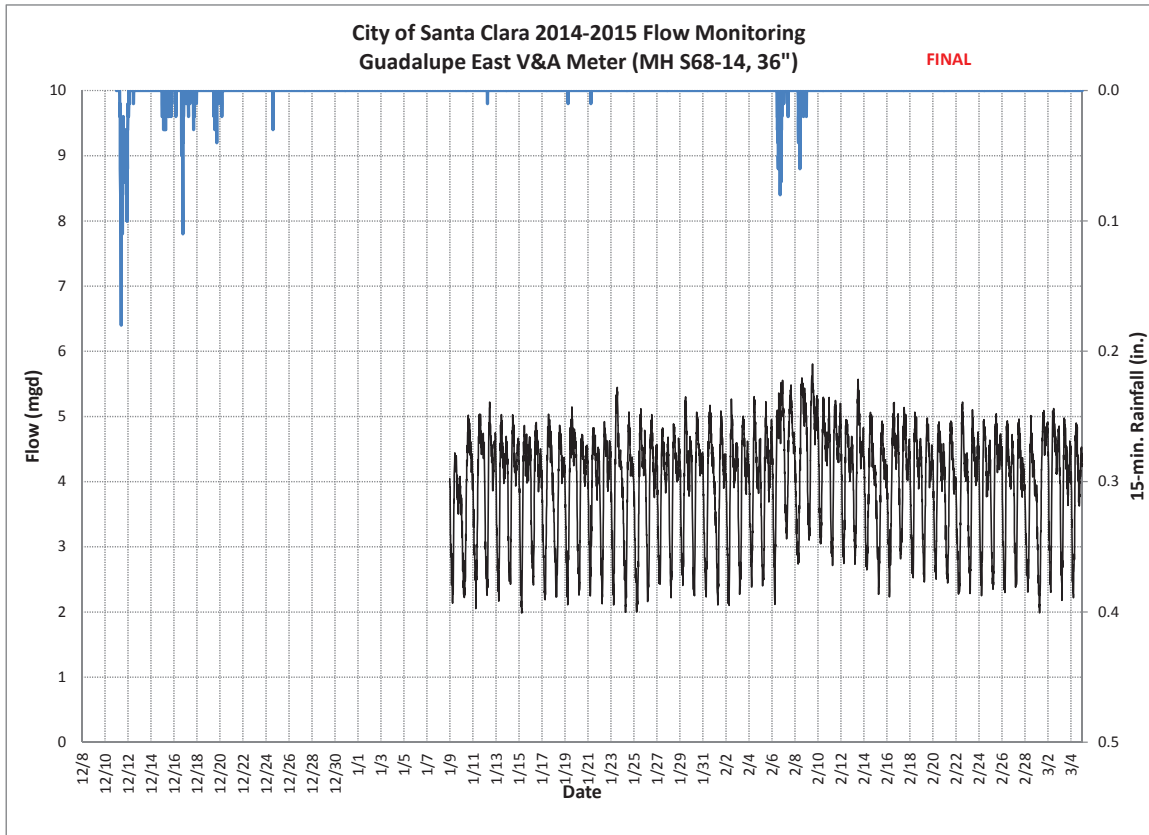


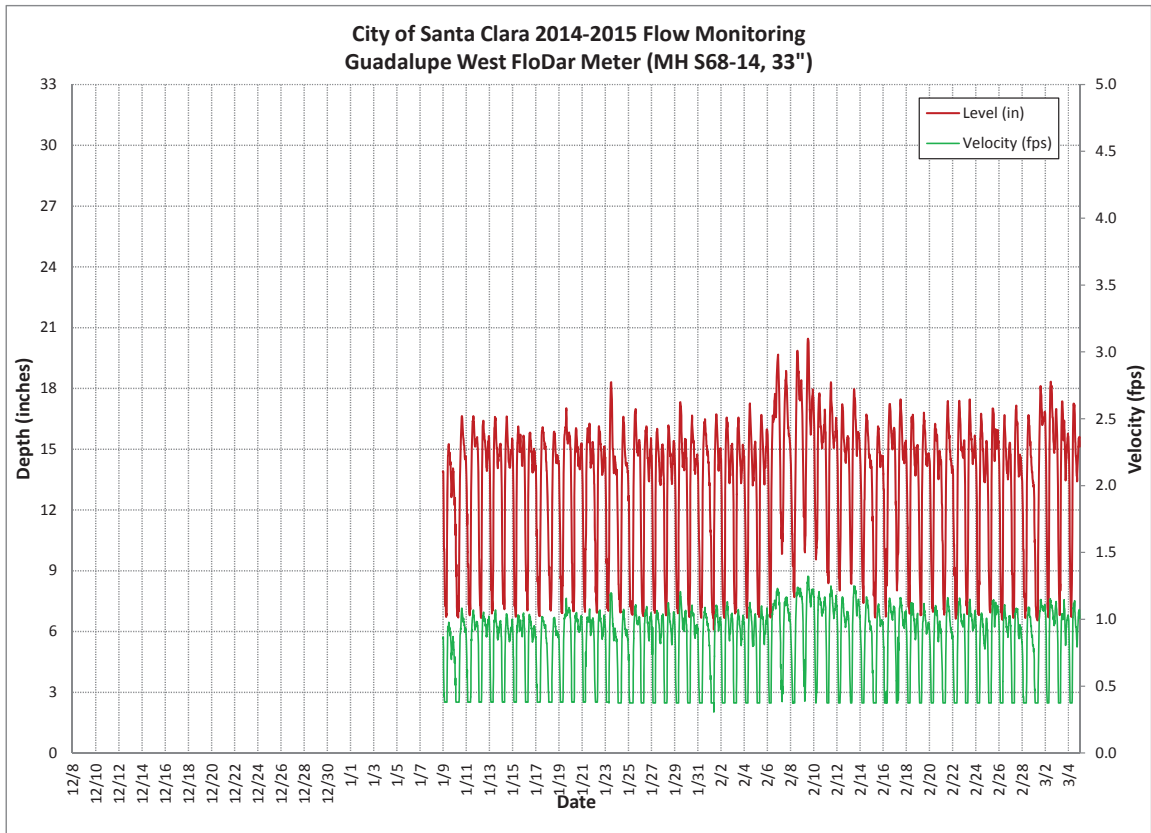
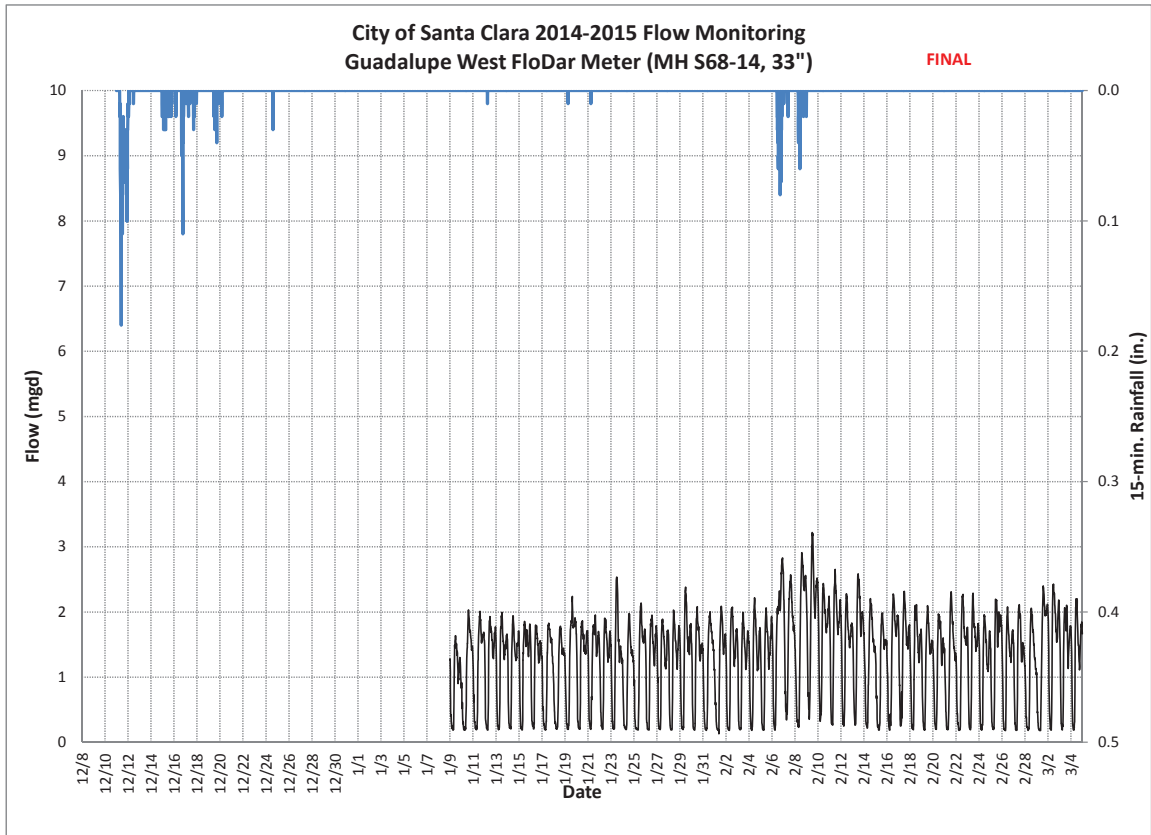


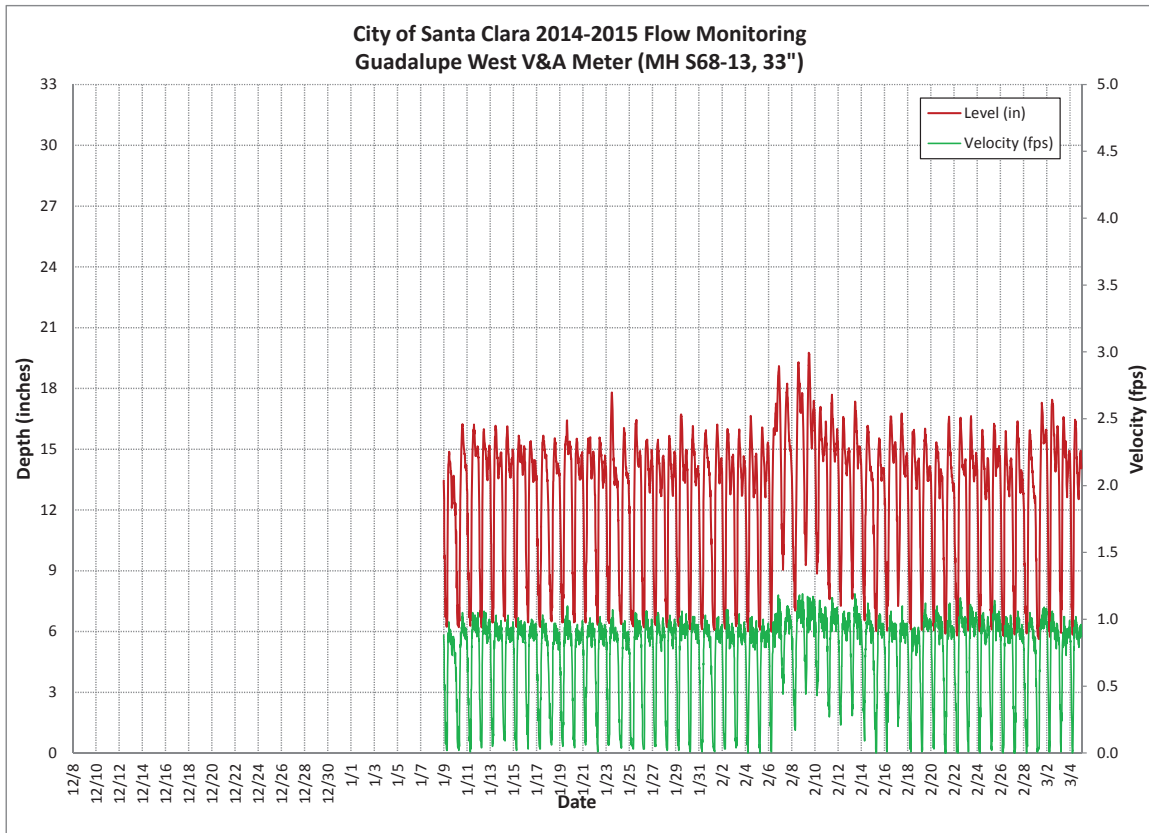
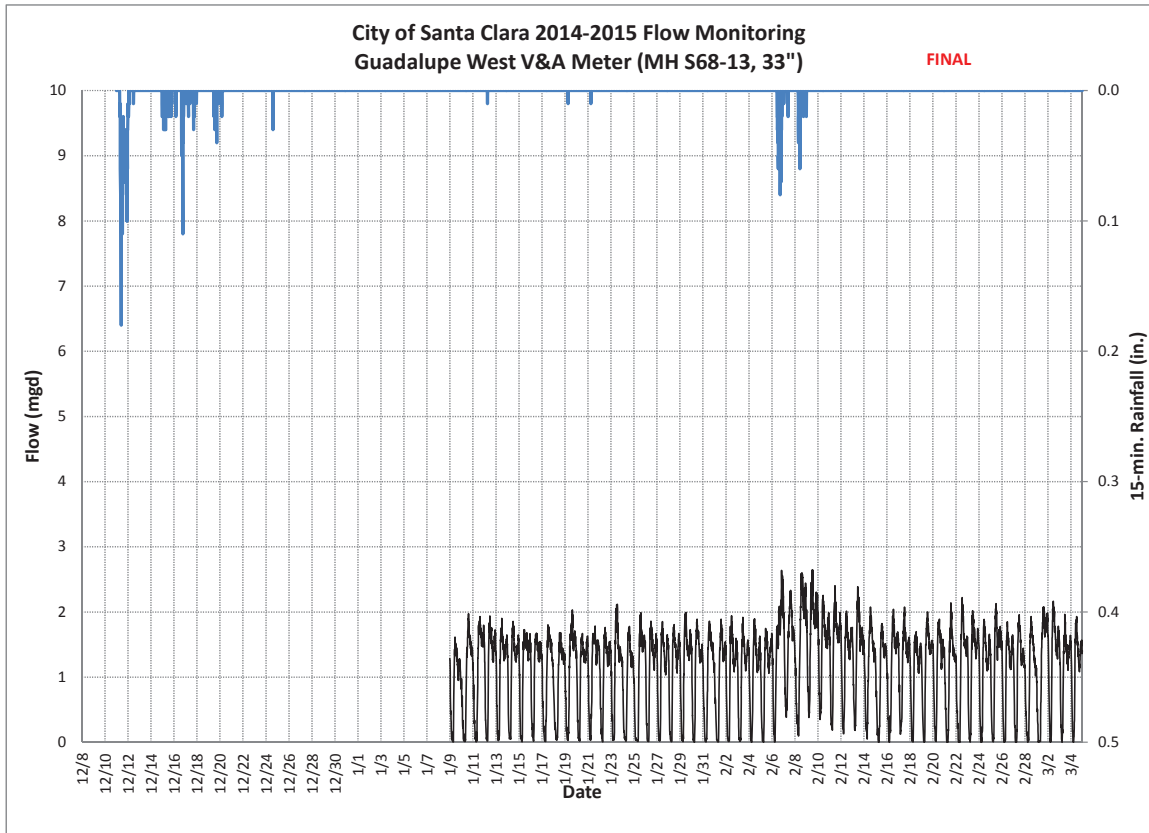






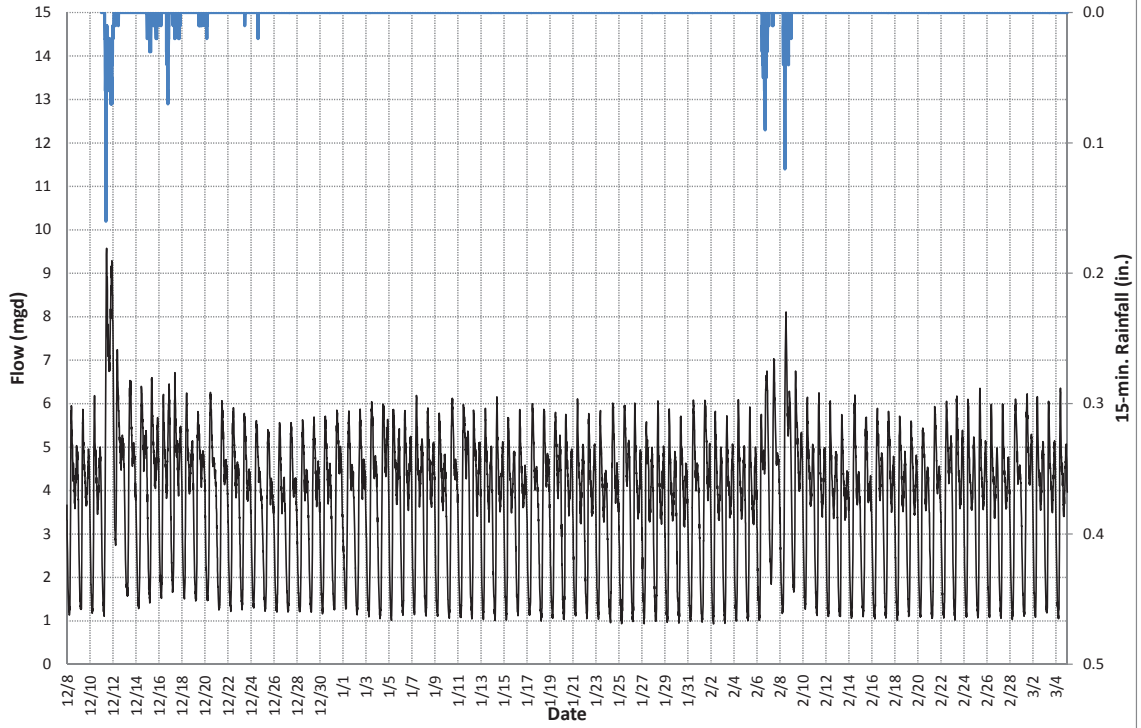






City of Santa Clara 2014-2015 Flow Monitoring
CuSD Homestead Flume Meter (MH S20-9, 27")

FINAL



**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 1			Site 2			Site 3			Site 4		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
11/22/14	3.32	4.77	1.61	3.59	5.16	1.54	2.78	4.60	1.04	0.05	0.15	0.01
11/23/14	3.36	5.16	1.23	3.62	5.27	1.58	2.80	4.59	1.07	0.12	0.60	0.01
11/24/14	3.48	5.21	1.54	3.69	5.11	1.48	2.83	4.62	1.05	0.03	0.07	0.01
11/25/14	3.39	4.92	1.31	3.68	5.25	1.58	2.73	4.78	1.00	0.03	0.10	0.02
11/26/14	3.38	5.06	1.43	3.70	5.18	1.54	2.77	4.55	1.01	0.05	0.18	0.01
11/27/14	3.16	4.71	1.30	3.48	5.29	1.61	2.77	4.98	1.08	0.19	0.86	0.02
11/28/14	2.75	4.07	1.09	3.35	5.11	1.58	2.69	4.63	1.25	0.04	0.13	0.01
11/29/14	3.07	4.66	1.14	3.60	5.18	1.70	3.03	5.07	1.39	0.07	0.16	0.02
11/30/14	3.22	5.02	1.08	3.71	5.80	1.51	3.19	5.71	1.14	0.06	0.34	0.02
12/1/14	3.57	5.16	1.34	3.85	5.47	1.68	3.14	5.06	1.21	0.10	0.86	0.01
12/2/14	4.04	6.07	1.76	4.32	6.39	1.99	3.72	5.75	1.47	0.06	0.21	0.02
12/3/14	4.74	6.80	2.86	5.31	6.93	4.09	4.79	6.94	3.27	0.07	0.23	0.01
12/4/14	4.41	6.08	2.24	4.35	5.95	2.50	3.58	5.32	1.61	0.07	0.21	0.02
12/5/14	4.15	6.81	2.10	4.09	6.07	2.15	3.37	5.38	1.51	0.11	0.42	0.02
12/6/14	3.60	5.15	1.62	3.89	5.67	1.92	3.26	4.96	1.39	0.05	0.13	0.01
12/7/14	3.51	5.07	1.52	3.80	5.30	1.86	3.14	4.80	1.33	0.03	0.08	0.01
12/8/14	3.90	6.13	1.68	3.95	5.86	1.77	3.16	4.79	1.18	0.03	0.09	0.02
12/9/14	3.87	5.44	1.84	3.96	5.60	1.91	3.12	4.76	1.34	0.04	0.11	0.01
12/10/14	3.86	5.22	1.69	3.99	5.71	1.91	3.08	4.71	1.26	0.05	0.12	0.02
12/11/14	5.16	7.95	1.73	5.55	8.36	1.95	5.16	9.24	1.25	0.06	0.23	0.02
12/12/14	6.00	7.87	4.51	6.02	8.17	4.25	4.94	8.06	3.08	0.05	0.14	0.01
12/13/14	4.69	6.89	2.88	4.95	6.60	3.02	3.82	5.55	2.00	0.06	0.14	0.01
12/14/14	4.26	5.94	2.48	4.62	6.56	2.55	3.71	5.62	1.76	0.05	0.13	0.01
12/15/14	4.80	6.20	2.60	4.90	6.59	2.74	3.99	5.90	2.02	0.05	0.16	0.01
12/16/14	4.83	6.35	2.81	4.94	6.59	2.88	3.94	5.72	1.88	0.06	0.15	0.02
12/17/14	4.86	6.10	3.16	5.00	6.81	2.91	3.95	5.60	2.15	0.06	0.14	0.02
12/18/14	4.74	6.15	3.07	4.80	6.45	2.69	3.76	5.35	1.89	0.05	0.13	0.01
12/19/14	4.81	6.80	2.58	4.48	5.92	2.21	3.61	5.13	1.85	0.05	0.14	0.02
12/20/14	4.82	6.80	2.69	4.25	5.85	2.10	3.53	5.18	1.80	0.14	0.64	0.02
12/21/14	4.25	5.58	2.27	4.15	6.05	1.97	3.36	5.36	1.68	0.04	0.14	0.01
12/22/14	4.38	5.88	2.21	4.24	6.07	2.03	3.29	4.89	1.63	0.06	0.20	0.02
12/23/14	4.27	5.80	2.20	4.18	5.86	2.04	3.20	4.65	1.60	0.07	0.26	0.02
12/24/14	4.23	5.89	2.25	4.02	5.70	2.00	3.12	4.79	1.53	0.06	0.20	0.02
12/25/14	3.83	5.19	2.10	3.72	5.38	1.76	2.95	4.54	1.47	0.04	0.13	0.02
12/26/14	3.93	5.71	1.92	3.75	5.66	1.78	2.96	4.53	1.45	0.07	0.23	0.03
12/27/14	4.06	5.86	1.89	3.76	6.06	1.82	2.97	4.59	1.43	0.07	0.19	0.02
12/28/14	4.38	6.46	2.15	3.74	5.50	1.78	2.94	4.41	1.36	0.19	0.86	0.02
12/29/14	4.58	6.37	2.25	3.84	5.48	1.86	3.02	4.61	1.32	0.07	0.24	0.03
12/30/14	4.58	6.24	2.33	3.80	5.52	1.71	3.05	4.58	1.38	0.12	0.42	0.03
12/31/14	4.58	6.41	2.30	3.82	5.54	1.66	3.08	4.70	1.36	0.04	0.11	0.01
1/1/15	4.04	6.01	2.06	3.70	5.52	1.71	2.86	4.45	1.32	0.04	0.11	0.02
1/2/15	4.25	5.92	2.04	3.79	5.51	1.77	2.98	4.86	1.33	0.05	0.21	0.02
1/3/15	4.29	6.46	1.99	3.78	5.73	1.68	3.05	4.72	1.18	0.04	0.14	0.02
1/4/15	4.38	5.99	2.11	3.87	5.68	1.61	3.18	5.08	1.25	0.04	0.10	0.02
1/5/15	4.87	6.55	1.97	3.99	5.76	1.61	3.22	4.71	1.26	0.05	0.12	0.02
1/6/15	4.79	6.72	2.33	4.02	5.60	1.69	3.16	4.66	1.31	0.04	0.18	0.01
1/7/15	4.76	6.33	2.29	4.05	5.87	1.67	3.08	4.76	1.26	0.12	0.49	0.02
1/8/15	4.70	6.37	2.34	4.12	5.84	1.83	3.07	4.75	1.24	0.05	0.12	0.02
1/9/15	4.49	6.30	2.26	3.98	5.75	1.71	3.09	4.73	1.34	0.05	0.13	0.01
1/10/15	4.00	6.42	2.22	3.90	5.89	1.69	3.01	4.85	1.22	0.05	0.15	0.02
1/11/15	3.74	5.32	1.77	4.09	5.97	1.66	3.07	4.77	1.24	0.03	0.09	0.01
1/12/15	4.18	5.65	1.96	4.18	5.95	1.79	3.02	4.47	1.23	0.04	0.10	0.02
1/13/15	4.14	5.56	2.13	4.18	5.81	1.74	3.12	4.95	1.24	0.04	0.07	0.01
1/14/15	4.21	5.64	2.00	4.21	6.19	1.85	3.01	4.82	1.22	0.04	0.07	0.01
1/15/15	4.21	5.87	2.07	4.19	5.80	1.81	3.01	4.56	1.32	0.04	0.07	0.02
1/16/15	4.06	5.64	2.09	4.14	5.96	1.80	3.00	4.56	1.27	0.06	0.13	0.01

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 1			Site 2			Site 3			Site 4		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
1/17/15	3.74	5.18	1.67	3.97	5.81	1.81	2.95	4.60	1.19	0.05	0.12	0.01
1/18/15	3.66	5.24	1.56	3.97	5.87	1.62	2.91	4.56	1.18	0.03	0.07	0.01
1/19/15	4.07	5.62	1.75	4.16	6.58	1.84	3.12	4.75	1.31	0.04	0.07	0.01
1/20/15	4.34	6.76	1.94	4.07	5.67	1.69	2.98	4.64	1.17			
1/21/15	3.96	5.74	1.89	4.07	5.97	1.72	3.03	4.65	1.24			
1/22/15	4.03	5.41	1.72	4.08	5.91	1.76	2.93	4.40	1.25			
1/23/15	3.99	5.74	1.91	4.02	5.94	1.69	2.94	4.47	1.26			
1/24/15	3.71	5.93	1.78	3.81	5.98	1.60	2.94	4.59	1.19			
1/25/15	3.64	5.52	1.59	3.82	5.66	1.56	3.01	4.57	1.15			
1/26/15	3.89	5.88	1.50	3.92	5.67	1.56	3.09	4.65	1.14			
1/27/15	3.92	5.57	1.75	3.93	5.58	1.70	3.10	4.69	1.30			
1/28/15	3.96	5.40	2.00	3.95	6.09	1.61	3.08	4.76	1.20			
1/29/15	3.94	5.78	1.99	3.93	5.86	1.52	3.09	4.79	1.20			
1/30/15	3.86	5.37	1.75	3.93	6.02	1.65	3.11	4.78	1.30			
1/31/15	3.66	5.23	1.71	3.71	5.47	1.47	3.12	4.90	1.31			
2/1/15	3.55	5.00	1.52	3.73	5.96	1.55	3.13	4.89	1.27			
2/2/15	3.77	5.19	1.64	3.78	5.78	1.46	3.18	4.86	1.35			
2/3/15	3.98	5.53	1.81	3.77	5.83	1.37	3.15	4.86	1.28			
2/4/15	3.92	5.55	1.88	3.88	5.90	1.60	3.10	5.14	1.33			
2/5/15	3.97	5.60	2.04	3.94	5.49	1.71	3.20	4.79	1.28			
2/6/15	4.28	5.93	1.99	4.50	6.52	1.69	3.69	6.01	1.31			
2/7/15	4.12	6.31	2.02	4.58	6.13	2.57	3.81	5.65	1.93			
2/8/15	4.21	6.36	2.03	4.68	7.02	2.09	3.88	6.45	1.51			
2/9/15	4.40	6.60	2.09	4.83	7.04	2.79	3.73	5.78	1.73			
2/10/15	4.37	5.87	2.42	4.39	6.24	2.10	3.41	5.03	1.56			
2/11/15	4.26	5.67	2.18	4.12	6.22	1.93	3.31	4.93	1.38			
2/12/15	4.17	5.69	2.17	4.01	5.94	1.75	3.29	4.93	1.43			
2/13/15	4.11	5.56	2.12	3.97	5.93	1.74	3.26	4.94	1.50			
2/14/15	3.77	5.69	2.05	3.75	5.51	1.57	3.24	5.05	1.54			
2/15/15	3.58	5.15	1.77	3.56	5.20	1.64	3.07	4.83	1.38			
2/16/15	3.84	5.55	1.76	3.64	5.27	1.56	3.19	4.91	1.31			
2/17/15	4.03	5.58	1.91	3.77	5.32	1.56	3.20	4.89	1.30			
2/18/15	4.01	5.75	2.00	3.89	5.40	1.60	3.20	4.75	1.40			
2/19/15	4.06	5.43	2.14	3.92	5.68	1.78	3.22	4.71	1.45	0.03	0.14	0.00
2/20/15	4.03	5.79	1.91	3.70	5.66	1.66	3.20	4.79	1.43	0.04	0.17	0.01
2/21/15	3.99	5.59	1.90	3.66	5.75	1.62	3.16	4.75	1.38	0.18	0.94	0.00
2/22/15	3.72	5.13	1.71	3.74	5.71	1.67	3.19	4.87	1.42	0.04	0.16	0.00
2/23/15	3.98	6.04	1.78	3.86	5.87	1.59	3.23	4.90	1.32	0.03	0.19	0.00
2/24/15	4.06	5.86	1.86	3.75	5.72	1.59	3.12	4.67	1.34	0.03	0.15	0.00
2/25/15	4.07	6.08	1.99	3.65	5.61	1.58	3.20	4.88	1.23	0.03	0.16	0.00
2/26/15	3.96	5.88	1.86	3.55	5.35	1.61	3.29	5.01	1.41	0.02	0.09	0.00
2/27/15	3.90	5.38	1.83	3.44	5.12	1.43	3.24	4.93	1.40	0.04	0.29	0.00
2/28/15	3.86	5.92	1.72	3.57	5.26	1.41	3.17	4.88	1.28	0.11	0.39	0.01
3/1/15	3.36	5.99	1.69	3.89	5.99	1.57	3.16	4.76	1.25	0.03	0.14	0.00
3/2/15	3.37	4.89	1.30	4.01	6.20	1.56	3.17	5.00	1.32	0.04	0.24	0.00
3/3/15	3.70	5.26	1.50	3.86	5.59	1.59	3.18	4.77	1.41	0.04	0.12	0.01
3/4/15	3.89	5.35	1.79	3.83	5.75	1.51	3.25	4.81	1.38	0.04	0.10	0.01

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 5			Site 6			Site 7			Site 8		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
11/22/14												
11/23/14												
11/24/14												
11/25/14												
11/26/14												
11/27/14												
11/28/14												
11/29/14												
11/30/14												
12/1/14												
12/2/14												
12/3/14												
12/4/14												
12/5/14												
12/6/14												
12/7/14												
12/8/14												
12/9/14												
12/10/14	3.71	5.84	1.50	2.52	4.02	1.07	0.87	1.62	0.29			
12/11/14	6.08	10.32	1.32	3.91	6.37	1.03	1.09	1.72	0.29	2.87	4.78	1.16
12/12/14	6.28	9.52	4.29	3.93	5.88	2.47	1.06	1.74	0.60	3.50	4.80	2.83
12/13/14	4.84	6.80	2.64	3.18	4.70	1.69	1.00	1.65	0.42	2.62	3.17	2.02
12/14/14	4.48	6.60	2.16	2.96	4.47	1.33	0.99	1.55	0.36	2.33	2.97	1.71
12/15/14	4.91	6.65	2.48	3.18	4.63	1.42	0.98	1.66	0.41	2.64	3.19	1.81
12/16/14	5.02	7.46	2.48	2.96	4.30	1.59	0.96	1.62	0.38	2.73	3.42	1.90
12/17/14	5.06	7.06	2.67	2.91	4.40	1.54	0.97	1.65	0.42	2.81	3.40	2.04
12/18/14	4.61	6.43	2.35	2.85	4.18	1.35	0.95	1.53	0.43	2.74	3.40	1.92
12/19/14	4.55	6.17	2.26	2.95	4.00	1.47	0.92	1.52	0.38	2.65	3.24	1.91
12/20/14	4.50	6.57	2.37	2.67	4.27	1.29	0.94	1.51	0.39	2.44	3.07	1.80
12/21/14	4.29	6.35	2.09	2.54	3.94	1.12	0.96	1.48	0.41	2.27	2.91	1.51
12/22/14	4.22	6.22	2.14	2.59	3.81	1.17	0.93	1.48	0.39	2.42	3.15	1.49
12/23/14	4.10	5.86	1.95	2.57	3.85	1.13	0.90	1.57	0.36	2.35	3.10	1.58
12/24/14	3.86	5.89	1.88	2.59	3.86	1.19	0.86	1.33	0.34	2.36	3.35	1.44
12/25/14	3.53	5.59	1.65	2.39	3.60	1.11	0.81	1.29	0.34	2.15	2.90	1.43
12/26/14	3.66	5.65	1.68	2.46	3.71	1.16	0.79	1.30	0.31	2.24	3.04	1.29
12/27/14	3.62	5.40	1.65	2.49	3.94	1.13	0.79	1.34	0.28	2.26	3.26	1.38
12/28/14	3.42	5.38	1.39	2.55	3.87	1.20	0.82	1.37	0.28	2.26	3.01	1.31
12/29/14	3.71	5.65	1.55	2.56	3.76	1.19	0.85	1.41	0.34	2.41	3.21	1.24
12/30/14	3.74	5.53	1.62	2.49	3.74	1.16	0.85	1.33	0.31	2.40	3.25	1.38
12/31/14	3.81	5.61	1.54	2.63	4.14	1.17	0.89	1.47	0.29	2.35	3.14	1.34
1/1/15	3.56	5.64	1.61	2.60	4.07	1.20	0.86	1.34	0.32	2.11	3.04	1.23
1/2/15	3.65	5.54	1.50	2.63	4.03	1.15	0.87	1.45	0.29	2.23	3.13	1.13
1/3/15	3.82	5.84	1.43	2.66	4.12	1.16	0.89	1.55	0.32	2.20	3.01	1.33
1/4/15	3.89	5.85	1.55	2.72	4.10	1.15	0.94	1.60	0.31	2.16	2.95	1.18
1/5/15	4.05	5.87	1.71	2.77	4.15	1.11	0.87	1.49	0.28	2.42	3.29	1.30
1/6/15	4.03	5.63	1.74	2.71	3.95	1.18	0.88	1.48	0.30	2.31	3.24	1.24
1/7/15	4.16	5.97	1.84	2.64	4.10	1.12	0.87	1.53	0.30	2.30	3.06	1.22
1/8/15	4.10	5.76	1.75	2.67	3.97	1.10	0.87	1.53	0.31	2.40	3.11	1.23
1/9/15	3.96	5.68	1.77	2.59	3.96	1.11	0.85	1.57	0.28	2.38	3.27	1.36
1/10/15	3.97	6.30	1.54	2.69	4.10	1.09	0.91	1.54	0.29	1.89	3.00	1.27
1/11/15	4.08	6.04	1.51	2.76	4.18	1.08	0.91	1.43	0.27	1.61	2.16	0.84
1/12/15	4.06	5.87	1.57	2.71	4.05	1.15	0.85	1.42	0.29	1.86	2.46	0.95
1/13/15	4.05	5.71	1.53	2.67	4.00	1.11	0.83	1.40	0.28	1.83	2.40	1.04
1/14/15	4.01	5.87	1.51	2.77	4.31	1.18	0.84	1.42	0.29	1.87	2.47	0.98
1/15/15	4.02	5.79	1.54	2.75	4.06	1.14	0.84	1.44	0.30	1.91	2.49	1.02
1/16/15	4.04	5.83	1.67	2.70	4.12	1.20	0.85	1.56	0.32	1.91	2.54	1.07

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 5			Site 6			Site 7			Site 8		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
1/17/15	3.91	6.06	1.64	2.73	4.19	1.18	0.88	1.42	0.28	1.72	2.40	1.09
1/18/15	3.85	5.87	1.42	2.79	4.13	1.06	0.86	1.38	0.24	1.62	2.17	0.81
1/19/15	4.04	6.14	1.57	2.67	4.49	1.07	0.91	1.36	0.31	1.92	2.60	0.89
1/20/15	3.82	5.64	1.48	2.61	3.84	1.07	0.93	1.56	0.30	1.90	2.51	0.98
1/21/15	3.83	5.60	1.49	2.61	4.25	1.09	0.85	1.74	0.29	1.89	2.52	1.06
1/22/15	4.06	5.94	1.71	2.55	3.97	1.09	0.86	1.56	0.26	1.86	2.51	1.04
1/23/15	4.06	5.82	1.73	2.56	3.94	1.12	0.88	1.58	0.29	1.87	2.50	1.08
1/24/15	4.03	6.32	1.59	2.57	4.02	1.02	0.94	1.63	0.32	1.75	2.50	0.97
1/25/15	4.05	6.29	1.45	2.62	4.02	1.00	0.98	1.62	0.26	1.59	2.19	0.87
1/26/15	3.96	5.77	1.46	2.67	4.18	1.13	0.89	1.54	0.29	1.82	2.42	0.89
1/27/15	3.78	5.66	1.55	2.65	3.93	1.13	0.88	1.58	0.29	1.82	2.55	0.94
1/28/15	3.93	5.79	1.39	2.58	4.15	1.09	0.90	1.62	0.30	1.81	2.37	0.92
1/29/15	4.19	6.16	1.60	2.58	4.03	1.14	0.88	1.58	0.31	1.73	2.31	0.98
1/30/15	4.15	6.19	1.87	2.49	3.79	1.03	0.86	1.57	0.27	1.73	2.35	0.84
1/31/15	4.07	6.24	1.60	2.44	3.80	0.97	0.89	1.57	0.29	1.62	2.24	0.90
2/1/15	4.12	6.35	1.45	2.43	3.94	0.94	0.96	1.62	0.29	1.51	2.21	0.73
2/2/15	4.17	6.29	1.50	2.34	3.66	0.92	0.88	1.60	0.26	1.73	2.36	0.83
2/3/15	4.13	6.14	1.68	2.38	3.66	0.96	0.86	1.62	0.24	1.78	2.37	0.88
2/4/15	3.99	6.14	1.76	2.53	3.91	0.99	0.85	1.64	0.26	1.77	2.47	0.91
2/5/15	3.78	5.43	1.43	2.64	4.03	1.15	0.86	1.69	0.27	1.74	2.30	0.88
2/6/15	4.46	6.92	1.54	2.93	4.42	1.13	0.90	1.57	0.28	1.87	2.71	0.92
2/7/15	4.53	6.68	2.24	3.17	4.64	1.72	0.98	1.81	0.36	1.79	2.40	1.09
2/8/15	4.67	7.34	1.63	3.16	5.20	1.31	1.02	1.64	0.33	1.77	2.57	0.88
2/9/15	4.50	7.03	2.10	3.08	4.39	1.62	0.94	1.75	0.34	1.95	2.60	0.97
2/10/15	4.14	5.90	1.73	2.80	4.32	1.38	0.91	1.71	0.32	1.95	2.52	1.17
2/11/15	4.26	6.20	1.84	2.66	4.26	1.31	0.90	1.79	0.29	1.98	2.54	1.10
2/12/15	4.20	6.21	1.75	2.65	4.15	1.20	0.89	1.80	0.29	1.98	2.51	1.17
2/13/15	4.26	6.03	1.96	2.60	4.15	1.14	0.91	1.66	0.31	1.93	2.60	1.11
2/14/15	3.92	5.82	1.85	2.47	4.15	0.98	0.92	1.72	0.31	1.71	2.28	1.05
2/15/15	3.79	5.88	1.57	2.44	3.80	1.09	0.94	1.56	0.32	1.58	2.11	0.82
2/16/15	3.97	5.84	1.58	2.49	3.91	1.06	0.97	1.57	0.30	1.75	2.39	0.88
2/17/15	3.94	5.78	1.63	2.44	3.69	1.02	0.90	1.55	0.30	1.90	2.46	0.99
2/18/15	3.90	5.62	1.56	2.39	3.58	1.02	0.88	1.59	0.30	1.90	2.51	0.99
2/19/15	3.82	5.74	1.55	2.38	3.48	1.09	0.90	1.63	0.32	1.96	2.55	1.14
2/20/15	3.93	5.50	1.55	2.35	3.54	1.06	0.91	1.56	0.28	1.99	2.70	1.08
2/21/15	4.13	6.37	1.65	2.34	3.70	0.99	0.99	1.68	0.35	1.81	2.52	1.06
2/22/15	4.05	6.12	1.63	2.38	3.62	1.00	0.99	1.56	0.31	1.67	2.33	0.83
2/23/15	3.93	5.86	1.37	2.45	3.94	1.01	0.94	1.67	0.30	1.90	2.55	0.87
2/24/15	4.05	5.94	1.53	2.45	3.84	1.09	0.93	1.68	0.33	1.94	2.53	0.99
2/25/15	3.98	5.88	1.53	2.39	3.71	1.04	0.94	1.71	0.33	1.96	2.65	1.01
2/26/15	4.03	6.02	1.69	2.40	3.79	1.09	0.89	1.60	0.28	1.94	2.73	0.98
2/27/15	4.10	6.34	1.55	2.39	3.75	1.11	0.90	1.58	0.31	1.80	2.40	0.95
2/28/15	3.97	6.35	1.60	2.34	3.62	1.05	0.94	1.59	0.31	1.72	2.28	0.93
3/1/15	3.97	6.10	1.35	2.35	3.69	0.93	0.98	1.64	0.31	1.27	2.41	0.77
3/2/15	4.19	6.71	1.68	2.36	3.84	0.95	0.89	1.73	0.30	1.25	1.69	0.69
3/3/15	4.18	5.96	1.74	2.35	3.64	0.97	0.88	1.66	0.26	1.57	2.27	0.70
3/4/15	4.32	6.46	1.79	2.32	3.83	0.97	0.82	1.45	0.24	1.74	2.39	0.86

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 9			Site 10			Site 11			Site 12		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
11/22/14												
11/23/14												
11/24/14												
11/25/14												
11/26/14												
11/27/14												
11/28/14												
11/29/14												
11/30/14												
12/1/14												
12/2/14												
12/3/14												
12/4/14												
12/5/14												
12/6/14												
12/7/14												
12/8/14												
12/9/14												
12/10/14	1.98	3.54	0.50	0.74	1.04	0.44	1.07	1.50	0.62	1.48	1.75	1.24
12/11/14	3.66	6.34	0.49	1.33	2.80	0.44	2.10	4.36	0.61	2.26	4.28	0.70
12/12/14	3.38	5.59	1.72	2.40	2.78	1.76	3.96	4.76	3.19	4.19	4.74	3.47
12/13/14	2.72	4.48	1.15	1.65	2.01	1.38	2.72	3.34	2.22	3.00	3.51	2.42
12/14/14	2.46	4.16	0.75	1.35	1.70	0.98	2.16	2.72	1.66	2.31	2.68	1.90
12/15/14	2.47	4.30	0.88	1.43	1.81	0.85	2.34	3.09	1.50	2.53	3.10	1.66
12/16/14	2.33	3.79	0.92	1.39	1.75	1.04	2.23	2.71	1.78	2.52	3.07	1.99
12/17/14	2.20	3.92	0.59	1.50	1.81	1.17	2.43	3.05	2.02	2.78	3.37	2.34
12/18/14	2.09	3.51	0.70	1.40	1.73	1.08	2.17	2.72	1.81	2.54	3.01	2.03
12/19/14	2.08	3.36	0.66	1.22	1.52	0.91	1.82	2.24	1.44	2.26	2.69	1.76
12/20/14	2.08	3.73	0.62	1.19	1.58	0.85	1.69	2.23	1.22	2.09	2.90	1.48
12/21/14	1.95	3.49	0.50	1.10	1.52	0.77	1.49	1.89	1.01	1.82	2.58	1.24
12/22/14	1.93	3.40	0.54	1.01	1.26	0.71	1.35	1.77	0.88	1.62	2.13	1.04
12/23/14	1.94	3.35	0.53	0.97	1.27	0.69	1.29	1.70	0.74	1.53	1.94	0.94
12/24/14	2.05	3.58	0.64	0.95	1.21	0.62	1.28	1.68	0.76	1.53	2.00	0.96
12/25/14	1.88	3.24	0.55	0.81	1.08	0.55	1.18	1.72	0.79	1.41	1.94	0.99
12/26/14	1.89	3.33	0.59	0.84	1.15	0.50	1.15	1.61	0.74	1.35	1.91	0.88
12/27/14	1.87	3.31	0.54	0.85	1.26	0.50	1.11	1.61	0.63	1.27	1.80	0.77
12/28/14	1.94	3.46	0.61	0.81	1.17	0.51	1.20	1.69	0.71	1.31	1.85	0.77
12/29/14	1.93	3.22	0.60	0.81	1.04	0.49	1.19	1.61	0.71	1.30	1.70	0.78
12/30/14	1.91	3.13	0.61	0.87	1.23	0.46	1.15	1.64	0.73	1.24	1.66	0.75
12/31/14	2.08	3.73	0.61	0.90	1.24	0.50	1.18	1.61	0.65	1.24	1.62	0.73
1/1/15	2.01	3.68	0.59	0.85	1.14	0.47	1.11	1.55	0.65	1.24	1.73	0.67
1/2/15	2.02	3.81	0.62	0.84	1.15	0.50	1.13	1.57	0.67	1.26	1.66	0.71
1/3/15	2.08	3.78	0.55	0.89	1.45	0.49	1.14	1.75	0.64	1.32	1.97	0.74
1/4/15	2.22	3.76	0.63	0.92	1.20	0.52	1.18	1.60	0.62	1.31	1.85	0.70
1/5/15	2.10	3.49	0.55	0.86	1.15	0.50	1.12	1.53	0.62	1.27	1.78	0.72
1/6/15	2.12	3.60	0.55	0.84	1.16	0.52	1.07	1.45	0.64	1.27	1.64	0.76
1/7/15	2.20	3.84	0.64	0.81	1.15	0.45	1.03	1.44	0.58	1.22	1.67	0.72
1/8/15	2.17	3.67	0.57	0.76	1.01	0.44	1.05	1.41	0.57	1.20	1.62	0.66
1/9/15	2.09	3.52	0.39	0.74	1.06	0.42	1.03	1.47	0.58	1.24	1.66	0.75
1/10/15	2.20	3.75	0.56	0.78	1.09	0.43	1.10	1.62	0.58	1.29	1.84	0.73
1/11/15	2.26	3.83	0.51	0.82	1.11	0.44	1.13	1.58	0.56	1.28	1.90	0.68
1/12/15	2.15	3.71	0.58	0.81	1.11	0.44	1.05	1.42	0.56	1.14	1.58	0.61
1/13/15	2.14	3.59	0.50	0.76	1.02	0.40	1.04	1.47	0.57	1.13	1.55	0.63
1/14/15	2.15	3.91	0.57	0.73	1.04	0.39	1.04	1.50	0.55	1.13	1.66	0.62
1/15/15	2.19	3.70	0.54	0.74	1.05	0.39	0.98	1.47	0.54	1.19	1.58	0.64
1/16/15	2.12	3.79	0.59	0.81	1.09	0.46	0.88	1.23	0.44	1.18	1.69	0.63

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 9			Site 10			Site 11			Site 12		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
1/17/15	2.12	3.97	0.57	0.83	1.17	0.45	0.99	1.55	0.46	1.21	1.78	0.64
1/18/15	2.04	3.59	0.47	0.77	1.05	0.37	1.05	1.49	0.51	1.27	1.77	0.64
1/19/15	2.08	3.56	0.49	0.77	1.06	0.37	1.08	1.47	0.57	1.25	1.80	0.64
1/20/15	1.96	3.20	0.47	0.72	0.97	0.37	1.02	1.39	0.51	1.17	1.58	0.60
1/21/15	1.99	3.56	0.47	0.78	1.09	0.41	1.04	1.51	0.56	1.07	1.64	0.63
1/22/15	1.92	3.51	0.45	0.83	1.16	0.42	1.06	1.48	0.55	1.07	1.57	0.52
1/23/15	1.87	3.29	0.39	0.85	1.20	0.42	1.05	1.50	0.58	1.14	1.84	0.68
1/24/15	1.99	3.78	0.41	0.84	1.19	0.43	1.12	1.67	0.61	1.14	1.66	0.51
1/25/15	2.10	3.98	0.37	0.86	1.23	0.38	1.16	1.73	0.56	1.40	2.07	0.67
1/26/15	2.00	3.76	0.42	0.85	1.17	0.39	1.05	1.53	0.54	1.33	1.94	0.65
1/27/15	1.97	3.31	0.43	0.80	1.12	0.40	1.04	1.43	0.56	1.23	1.63	0.72
1/28/15	1.94	3.50	0.46	0.77	1.10	0.36	1.04	1.56	0.51	1.16	1.67	0.55
1/29/15	1.92	3.80	0.47	0.75	1.06	0.39	1.04	1.42	0.54	1.14	1.60	0.61
1/30/15	1.81	3.45	0.39	0.76	1.03	0.39	1.06	1.45	0.58	1.15	1.69	0.60
1/31/15	1.90	3.58	0.37	0.81	1.17	0.39	1.12	1.70	0.58	1.20	1.74	0.61
2/1/15	1.87	3.55	0.32	0.80	1.19	0.41	1.15	1.65	0.55	1.23	1.76	0.58
2/2/15	1.78	3.32	0.35	0.73	1.03	0.35	1.03	1.48	0.51	1.15	1.74	0.60
2/3/15	1.73	3.09	0.39	0.75	1.05	0.37	1.04	1.52	0.53	1.14	1.70	0.58
2/4/15	1.91	3.20	0.36	0.73	1.02	0.32	1.03	1.49	0.52	1.10	1.65	0.56
2/5/15	1.99	3.26	0.58	0.73	1.01	0.35	1.04	1.42	0.54	1.09	1.58	0.55
2/6/15	2.43	4.58	0.54	0.83	1.37	0.37	1.21	2.03	0.55	1.22	1.88	0.55
2/7/15	2.73	5.15	1.14	1.18	1.62	0.78	1.73	2.30	1.28	1.74	2.26	1.25
2/8/15	2.74	5.81	0.64	1.23	1.67	0.64	1.76	2.33	0.99	1.78	2.42	1.00
2/9/15	2.51	4.31	0.83	1.16	1.51	0.80	1.79	2.21	1.30	1.79	2.28	1.28
2/10/15	2.20	3.65	0.76	1.02	1.33	0.68	1.58	2.03	1.10	1.64	2.00	1.09
2/11/15	2.03	3.94	0.64	0.94	1.33	0.62	1.44	1.94	0.97	1.52	2.00	0.96
2/12/15	1.97	3.64	0.52	0.87	1.17	0.52	1.31	1.71	0.83	1.40	1.81	0.85
2/13/15	2.00	3.89	0.51	0.87	1.23	0.55	1.29	1.73	0.78	1.40	1.89	0.88
2/14/15	2.05	4.35	0.46	0.90	1.34	0.51	1.26	1.78	0.77	1.38	1.85	0.82
2/15/15	1.91	3.95	0.54	0.87	1.24	0.48	1.29	1.72	0.75	1.35	1.81	0.79
2/16/15	2.05	3.55	0.43	0.92	1.25	0.45	1.30	1.74	0.73	1.37	1.80	0.70
2/17/15	1.95	3.34	0.43	0.87	1.25	0.46	1.21	1.58	0.78	1.33	1.77	0.82
2/18/15	1.80	3.06	0.42	0.84	1.22	0.45	1.15	1.53	0.67	1.30	1.80	0.78
2/19/15	1.75	2.89	0.48	0.82	1.14	0.43	1.18	1.57	0.68	1.29	1.77	0.79
2/20/15	1.80	3.03	0.50	0.85	1.20	0.44	1.24	1.67	0.76	1.31	1.74	0.77
2/21/15	1.91	3.50	0.50	0.86	1.26	0.42	1.32	1.93	0.75	1.35	1.78	0.77
2/22/15	1.91	3.49	0.44	0.88	1.22	0.41	1.28	1.62	0.85	1.38	1.81	0.70
2/23/15	1.93	3.74	0.45	0.82	1.19	0.41	1.21	1.63	0.77	1.26	1.86	0.72
2/24/15	1.87	3.41	0.42	0.78	1.21	0.34	1.20	1.56	0.80	1.22	1.69	0.72
2/25/15	1.88	3.49	0.43	0.78	1.16	0.37	1.16	1.61	0.76	1.17	1.67	0.63
2/26/15	1.78	3.25	0.52	0.80	1.22	0.47	1.06	1.43	0.73	1.16	1.72	0.70
2/27/15	1.82	3.25	0.45	0.85	1.20	0.42	1.15	1.54	0.72	1.17	1.62	0.61
2/28/15	1.83	3.22	0.51	0.89	1.31	0.41	1.12	1.49	0.64	1.21	1.63	0.65
3/1/15	1.90	3.57	0.44	0.89	1.37	0.43	1.17	1.72	0.68	1.20	1.67	0.63
3/2/15	1.86	3.48	0.48	0.81	1.16	0.38	1.04	1.52	0.49	1.12	1.60	0.56
3/3/15	1.81	3.28	0.46	0.81	1.21	0.39	1.04	1.48	0.58	1.14	1.58	0.65
3/4/15	1.75	3.47	0.40	0.77	1.29	0.39	1.00	1.52	0.62	1.07	1.50	0.56

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 13			Site 14			Site 15			Site 16		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
11/22/14												
11/23/14												
11/24/14												
11/25/14												
11/26/14												
11/27/14												
11/28/14												
11/29/14												
11/30/14												
12/1/14												
12/2/14												
12/3/14												
12/4/14												
12/5/14												
12/6/14												
12/7/14												
12/8/14												
12/9/14												
12/10/14	3.22	4.96	0.84	0.50	0.76	0.21	0.50	0.74	0.30	1.35	1.82	1.79
12/11/14	4.74	7.22	0.81	0.71	1.12	0.21	0.67	1.44	0.13	1.55	2.26	0.73
12/12/14	4.15	5.84	2.16	0.62	0.96	0.38	0.58	1.04	0.12	1.73	2.34	1.37
12/13/14	3.36	5.62	0.86	0.54	0.81	0.28	0.52	1.08	0.14	1.48	2.09	1.03
12/14/14	3.38	5.47	0.91	0.55	0.82	0.25	0.54	0.96	0.21	1.48	2.02	0.96
12/15/14	3.56	5.41	1.03	0.58	0.89	0.34	0.50	1.02	0.04	1.57	1.99	1.07
12/16/14	3.64	5.69	0.85	0.53	0.79	0.25	0.45	0.88	0.08	1.57	2.20	0.96
12/17/14	3.64	5.45	1.04	0.54	0.80	0.29	0.51	0.77	0.30	1.66	2.13	1.38
12/18/14	3.55	5.42	1.10	0.51	0.70	0.27	0.54	0.75	0.32	1.58	2.02	1.19
12/19/14	3.41	5.20	0.91	0.54	0.81	0.26	0.51	0.68	0.29	1.45	1.86	1.12
12/20/14	3.41	5.50	0.82	0.53	0.81	0.27	0.53	0.74	0.28	1.47	1.96	1.07
12/21/14	3.33	5.41	0.89	0.55	0.91	0.25	0.53	0.79	0.28	1.39	1.98	0.99
12/22/14	3.30	5.15	0.91	0.52	0.79	0.23	0.57	0.81	0.28	1.36	1.88	0.89
12/23/14	3.22	4.88	0.92	0.50	0.76	0.24	0.60	0.83	0.32	1.32	1.76	1.01
12/24/14	3.14	4.91	0.91	0.51	0.78	0.24	0.75	1.19	0.33	1.17	1.74	1.04
12/25/14	2.98	4.74	0.92	0.47	0.72	0.21	0.81	1.13	0.45	0.83	1.34	0.80
12/26/14	3.01	5.03	0.90	0.48	0.77	0.21	0.82	1.34	0.37	0.86	1.38	0.80
12/27/14	3.23	5.18	0.87	0.49	0.85	0.22	0.84	1.38	0.37	0.85	1.34	0.77
12/28/14	3.06	5.01	0.71	0.49	0.77	0.22	0.87	1.31	0.36	0.84	1.23	0.76
12/29/14	3.23	5.11	0.89	0.48	0.81	0.21	0.84	1.19	0.37	0.89	1.31	0.68
12/30/14	3.26	5.20	0.87	0.47	0.71	0.18	0.88	1.24	0.41	0.85	1.33	0.79
12/31/14	3.30	5.28	0.91	0.50	0.76	0.18	0.90	1.26	0.38	0.91	1.28	0.83
1/1/15	3.22	5.19	0.94	0.46	0.71	0.21	0.86	1.31	0.35	0.81	1.21	0.82
1/2/15	3.40	5.51	0.94	0.48	0.76	0.18	0.86	1.24	0.36	0.84	1.36	0.65
1/3/15	3.49	5.73	0.85	0.49	0.79	0.19	0.88	1.37	0.33	0.88	1.33	0.80
1/4/15	3.65	6.13	0.81	0.53	0.84	0.21	0.88	1.28	0.39	0.91	1.48	0.76
1/5/15	3.53	5.35	0.87	0.51	0.76	0.22	0.87	1.23	0.36	0.93	1.34	0.77
1/6/15	3.53	5.19	0.98	0.50	0.76	0.21	0.83	1.20	0.32	0.96	1.34	0.78
1/7/15	3.59	5.72	0.96	0.51	0.83	0.21	0.87	1.32	0.37	0.90	1.33	0.73
1/8/15	3.53	5.42	1.06	0.50	0.75	0.19	0.78	1.28	0.34	0.92	1.30	0.70
1/9/15	3.57	5.44	1.04	0.49	0.71	0.23	0.80	1.21	0.30	0.99	1.35	0.75
1/10/15	3.61	5.96	0.85	0.52	0.83	0.21	0.57	1.33	0.30	1.34	2.29	0.86
1/11/15	3.73	5.86	0.80	0.52	0.80	0.19	0.47	0.71	0.19	1.57	2.22	0.94
1/12/15	3.61	5.64	1.04	0.48	0.71	0.19	0.43	0.63	0.14	1.52	2.08	0.83
1/13/15	3.59	5.49	0.88	0.47	0.73	0.18	0.40	0.57	0.14	1.48	2.04	0.81
1/14/15	3.59	5.74	0.96	0.49	0.74	0.19	0.44	0.66	0.14	1.45	2.01	0.82
1/15/15	3.48	5.37	0.95	0.49	0.75	0.17	0.46	0.66	0.21	1.40	1.88	0.80
1/16/15	3.41	5.30	0.93	0.50	0.74	0.22	0.45	0.63	0.18	1.38	1.81	0.92

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 13			Site 14			Site 15			Site 16		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
1/17/15	3.47	5.70	0.92	0.54	0.82	0.24	0.45	0.63	0.18	1.41	2.00	0.87
1/18/15	3.52	5.55	0.99	0.55	0.82	0.26	0.47	0.70	0.19	1.42	2.01	0.89
1/19/15	3.64	5.63	0.97	0.55	0.84	0.22	0.49	0.67	0.18	1.46	2.13	0.77
1/20/15	3.49	5.43	0.90	0.52	0.80	0.19	0.46	0.67	0.19	1.45	2.08	0.82
1/21/15	3.48	5.56	1.02	0.53	0.79	0.22	0.47	0.68	0.18	1.49	2.10	0.90
1/22/15	3.44	5.30	0.98	0.50	0.75	0.22	0.48	0.69	0.20	1.45	1.94	0.99
1/23/15	3.47	5.29	1.15	0.49	0.73	0.20	0.46	0.71	0.18	1.19	1.69	0.76
1/24/15	3.50	6.01	0.82	0.52	0.86	0.23	0.50	0.76	0.22	1.39	2.07	0.82
1/25/15	3.68	5.63	0.84	0.57	0.95	0.19	0.46	0.68	0.22	1.44	2.20	0.85
1/26/15	3.75	5.71	0.86	0.54	0.82	0.20	0.44	0.63	0.15	1.45	2.00	0.73
1/27/15	3.55	5.18	1.05	0.55	0.81	0.25	0.40	0.62	0.15	1.47	2.02	0.88
1/28/15	3.09	5.04	0.83	0.54	0.94	0.21	0.42	0.71	0.16	1.47	2.13	0.74
1/29/15	3.28	4.97	0.75	0.54	0.81	0.21	0.40	0.58	0.15	1.52	2.18	0.76
1/30/15	3.61	5.74	1.00	0.53	0.79	0.21	0.41	0.59	0.16	1.46	2.14	0.79
1/31/15	3.72	6.05	1.09	0.54	0.85	0.22	0.43	0.67	0.15	1.47	2.19	0.78
2/1/15	3.84	6.15	0.87	0.54	0.91	0.21	0.46	0.75	0.16	1.46	2.28	0.68
2/2/15	3.89	5.94	1.29	0.50	0.76	0.18	0.42	0.69	0.15	1.47	2.05	0.78
2/3/15	3.53	5.70	0.99	0.50	0.71	0.20	0.41	0.64	0.16	1.46	2.14	0.78
2/4/15	3.65	6.33	1.26	0.51	0.78	0.20	0.41	0.65	0.16	1.47	2.06	0.80
2/5/15	3.45	5.38	0.90	0.50	0.75	0.22	0.40	0.64	0.15	1.47	2.06	0.82
2/6/15	3.74	6.62	0.75	0.57	0.86	0.23	0.43	0.65	0.13	1.58	2.17	0.86
2/7/15	3.84	5.91	1.39	0.58	0.91	0.25	0.43	0.68	0.17	1.56	2.17	0.98
2/8/15	4.16	7.14	0.90	0.60	1.10	0.21	0.47	0.79	0.15	1.54	2.23	0.85
2/9/15	3.88	5.73	1.54	0.55	0.79	0.22	0.44	0.64	0.19	1.50	1.94	1.01
2/10/15	3.86	5.95	1.16	0.55	0.79	0.23	0.40	0.63	0.17	1.50	2.04	0.85
2/11/15	3.83	6.09	1.00	0.55	0.86	0.23	0.42	0.61	0.17	1.52	2.17	0.85
2/12/15	3.81	5.91	1.33	0.52	0.80	0.24	0.42	0.58	0.18	1.49	2.07	0.89
2/13/15	4.41	6.41	1.36	0.51	0.75	0.20	0.42	0.59	0.19	1.51	1.95	0.96
2/14/15	4.66	7.00	1.70	0.55	0.88	0.22	0.44	0.67	0.17	1.53	2.29	0.71
2/15/15	4.25	6.50	1.30	0.55	0.89	0.24	0.42	0.66	0.15	1.49	2.25	0.87
2/16/15	4.00	7.13	1.08	0.51	0.84	0.20	0.45	0.71	0.17	1.46	2.13	0.69
2/17/15	3.69	5.86	1.08	0.50	0.70	0.20	0.47	0.66	0.16	1.43	2.01	0.81
2/18/15	4.19	5.85	1.32	0.50	0.68	0.22	0.49	0.71	0.19	1.41	1.89	0.89
2/19/15	4.35	6.19	1.37	0.51	0.71	0.21	0.49	0.71	0.19	1.40	1.88	0.93
2/20/15	3.73	5.62	1.10	0.51	0.77	0.23	0.47	0.65	0.19	1.38	1.86	0.85
2/21/15	3.81	6.28	1.04	0.56	0.89	0.23	0.49	0.74	0.19	1.38	2.03	0.80
2/22/15	3.91	6.17	1.05	0.56	0.84	0.22	0.52	0.81	0.19	1.37	2.04	0.75
2/23/15	3.79	5.63	1.10	0.53	0.81	0.21	0.48	0.73	0.15	1.39	1.99	0.73
2/24/15	3.73	5.90	1.09	0.54	0.78	0.22	0.51	0.79	0.19	1.39	2.04	0.80
2/25/15	3.81	5.80	1.07	0.56	0.80	0.21	0.53	0.78	0.18	1.34	1.97	0.69
2/26/15	3.78	5.86	1.03	0.57	0.84	0.22	0.50	0.82	0.19	1.35	2.02	0.70
2/27/15	3.78	6.13	1.15	0.57	0.84	0.25	0.45	0.67	0.14	1.37	1.91	0.74
2/28/15	3.87	6.04	1.10	0.59	0.94	0.25	0.52	0.80	0.15	1.37	2.00	0.83
3/1/15	4.00	6.27	1.04	0.57	0.91	0.21	0.20	0.90	0.01	1.64	2.70	0.64
3/2/15	3.86	5.91	1.03	0.57	0.85	0.22	0.01	0.03	0.00	1.91	2.50	0.77
3/3/15	3.82	5.93	1.22	0.55	0.88	0.25	0.27	0.57	0.01	1.61	2.44	0.77
3/4/15	3.83	6.13	1.07	0.50	0.77	0.20	0.40	0.60	0.12	1.50	2.12	0.76

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 17			Site 18			Site 19			Site 20		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
11/22/14												
11/23/14												
11/24/14												
11/25/14												
11/26/14												
11/27/14												
11/28/14												
11/29/14												
11/30/14												
12/1/14												
12/2/14												
12/3/14												
12/4/14												
12/5/14												
12/6/14												
12/7/14												
12/8/14												
12/9/14												
12/10/14	0.46	0.66	0.28	1.23	1.51	0.87	1.62	2.56	0.60	1.64	2.66	0.39
12/11/14	0.86	1.48	0.21	1.71	3.13	0.33	2.53	4.00	0.59	2.15	3.33	0.44
12/12/14	0.69	1.15	0.42	1.26	2.33	0.58	2.24	3.47	1.53	1.91	2.71	1.00
12/13/14	0.46	0.63	0.27	0.89	1.39	0.35	1.90	2.87	0.95	1.66	2.67	0.53
12/14/14	0.42	0.67	0.26	0.80	1.33	0.27	1.79	2.59	0.78	1.55	2.53	0.41
12/15/14	0.59	1.09	0.34	1.06	1.74	0.47	1.84	2.77	0.86	1.61	2.43	0.55
12/16/14	0.62	1.09	0.33	1.07	1.98	0.42	1.81	2.58	0.93	1.73	2.84	0.55
12/17/14	0.58	0.88	0.29	0.96	1.61	0.39	1.85	2.61	0.94	1.62	2.51	0.74
12/18/14	0.54	0.91	0.33	0.91	1.68	0.32	1.76	2.50	0.85	1.55	2.52	0.59
12/19/14	0.54	0.97	0.34	0.92	1.45	0.37	1.75	2.28	0.82	1.55	2.40	0.47
12/20/14	0.48	0.77	0.30	0.82	1.42	0.34	1.75	2.61	0.78	1.56	2.51	0.55
12/21/14	0.45	0.76	0.25	0.76	1.25	0.24	1.71	2.54	0.69	1.55	2.50	0.46
12/22/14	0.49	1.01	0.26	0.97	1.60	0.36	1.74	2.59	0.70	1.54	2.44	0.48
12/23/14	0.51	0.93	0.32	0.93	1.47	0.38	1.72	2.43	0.73	1.39	2.33	0.44
12/24/14	0.45	0.93	0.28	0.81	1.62	0.34	1.70	2.52	0.73	1.29	2.05	0.43
12/25/14	0.34	0.50	0.20	0.63	0.99	0.24	1.61	2.40	0.69	1.31	2.20	0.40
12/26/14	0.44	0.99	0.23	0.82	1.49	0.24	1.49	2.25	0.58	1.38	2.24	0.38
12/27/14	0.48	0.67	0.28	0.86	1.38	0.38	1.55	2.35	0.67	1.44	2.21	0.47
12/28/14	0.43	0.70	0.26	0.76	1.26	0.30	1.64	2.48	0.72	1.54	2.44	0.39
12/29/14	0.45	0.62	0.21	0.84	1.24	0.31	1.62	2.37	0.67	1.75	2.67	0.48
12/30/14	0.41	0.58	0.21	0.80	1.20	0.34	1.67	2.45	0.70	1.82	2.91	0.46
12/31/14	0.41	0.75	0.21	0.78	1.28	0.26	1.78	2.74	0.69	1.84	2.74	0.58
1/1/15	0.39	0.65	0.23	0.72	1.15	0.27	1.63	2.40	0.74	1.73	2.58	0.50
1/2/15	0.41	0.66	0.22	0.78	1.25	0.28	1.69	2.73	0.70	1.70	2.60	0.40
1/3/15	0.41	0.60	0.21	0.78	1.29	0.28	1.72	2.78	0.72	1.75	2.73	0.37
1/4/15	0.44	0.60	0.26	0.89	1.46	0.29	1.72	2.58	0.69	1.77	2.75	0.34
1/5/15	0.51	0.79	0.26	1.11	1.78	0.36	1.79	2.71	0.64	1.69	2.61	0.34
1/6/15	0.49	0.75	0.21	1.10	1.74	0.39	1.81	2.54	0.75	1.72	2.62	0.39
1/7/15	0.52	0.83	0.24	1.09	1.77	0.34	1.77	2.71	0.65	1.85	2.96	0.42
1/8/15	0.52	0.84	0.21	1.16	1.90	0.36	1.76	2.55	0.67	1.74	2.81	0.36
1/9/15	0.49	0.81	0.27	1.19	1.83	0.35	1.65	2.45	0.63	1.61	2.56	0.41
1/10/15	0.47	0.73	0.26	1.11	1.80	0.33	1.64	2.43	0.56	1.47	2.49	0.34
1/11/15	0.47	0.76	0.25	1.09	1.65	0.33	1.64	2.56	0.57	1.63	2.57	0.36
1/12/15	0.53	0.95	0.27	1.13	1.85	0.35	1.68	2.46	0.56	1.65	2.53	0.38
1/13/15	0.49	0.85	0.20	1.11	1.78	0.33	1.66	2.49	0.53	1.62	2.41	0.36
1/14/15	0.47	0.92	0.23	1.09	1.62	0.46	1.58	2.38	0.52	1.71	2.91	0.33
1/15/15	0.52	1.08	0.18	1.17	1.81	0.39	1.65	2.53	0.54	1.83	2.76	0.38
1/16/15	0.47	0.81	0.23	1.17	1.70	0.43	1.64	2.39	0.56	1.86	2.93	0.37

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 17			Site 18			Site 19			Site 20		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
1/17/15	0.43	0.67	0.26	1.07	1.60	0.38	1.62	2.50	0.63	1.82	2.92	0.36
1/18/15	0.44	0.70	0.16	1.02	1.58	0.36	1.58	2.43	0.56	1.89	2.82	0.46
1/19/15	0.47	0.76	0.25	1.19	1.76	0.41	1.67	2.56	0.58	1.81	2.75	0.53
1/20/15	0.38	0.67	0.20	1.19	1.79	0.43	1.67	2.37	0.54	1.74	2.68	0.38
1/21/15	0.40	0.62	0.21	1.19	1.76	0.45	1.67	2.48	0.59	1.78	2.83	0.49
1/22/15	0.39	0.69	0.20	1.15	1.70	0.38	1.62	2.37	0.50	1.76	2.70	0.40
1/23/15	0.42	0.59	0.22	1.13	1.76	0.38	1.62	2.44	0.57	1.70	2.73	0.33
1/24/15	0.37	0.52	0.18	1.05	1.72	0.35	1.64	2.64	0.55	1.55	2.58	0.44
1/25/15	0.38	0.57	0.14	1.12	1.80	0.30	1.64	2.46	0.54	1.68	2.67	0.36
1/26/15	0.38	0.66	0.15	1.18	1.83	0.35	1.65	2.54	0.53	1.73	2.78	0.35
1/27/15	0.39	0.72	0.15	1.15	1.74	0.33	1.63	2.31	0.56	1.70	2.58	0.36
1/28/15	0.35	0.63	0.13	1.15	1.88	0.41	1.62	2.43	0.55	1.69	2.79	0.40
1/29/15	0.37	0.57	0.19	1.12	1.73	0.40	1.62	2.41	0.55	1.67	2.68	0.35
1/30/15	0.43	0.82	0.21	1.19	1.79	0.42	1.61	2.41	0.56	1.77	2.79	0.44
1/31/15	0.34	0.54	0.20	1.11	1.69	0.40	1.55	2.37	0.49	1.70	3.07	0.37
2/1/15	0.33	0.47	0.17	1.08	1.71	0.39	1.49	2.32	0.51	1.85	2.87	0.31
2/2/15	0.44	0.83	0.18	1.18	1.94	0.37	1.36	2.07	0.38	2.04	3.14	0.56
2/3/15	0.39	0.62	0.18	1.14	1.68	0.41	1.36	2.07	0.38	1.97	3.09	0.48
2/4/15	0.43	0.87	0.21	1.17	2.01	0.37	1.54	2.31	0.45	1.86	3.23	0.57
2/5/15	0.42	0.70	0.14	1.18	1.73	0.39	1.59	2.42	0.60	1.65	2.67	0.30
2/6/15	0.64	1.10	0.11	1.45	2.14	0.33	1.68	2.59	0.50	1.93	2.94	0.34
2/7/15	0.45	0.66	0.17	1.12	1.69	0.37	1.91	2.92	1.12	2.01	3.19	0.93
2/8/15	0.46	0.83	0.19	1.12	2.07	0.34	1.91	3.22	0.72	2.11	3.68	0.49
2/9/15	0.51	0.91	0.20	1.24	1.95	0.37	1.87	2.80	0.94	1.98	3.01	0.75
2/10/15	0.47	0.82	0.23	1.15	1.69	0.42	1.70	2.41	0.74	1.86	2.87	0.43
2/11/15	0.52	0.85	0.19	1.17	1.89	0.40	1.57	2.47	0.62	1.67	2.68	0.40
2/12/15	0.44	0.72	0.22	1.13	1.79	0.41	1.60	2.41	0.55	1.81	2.83	0.36
2/13/15	0.57	1.12	0.16	1.12	1.91	0.34	1.57	2.43	0.55	1.79	2.85	0.48
2/14/15	0.44	0.77	0.30	0.95	1.52	0.41	1.51	2.41	0.50	1.82	2.94	0.55
2/15/15	0.32	0.46	0.18	1.01	1.54	0.36	1.56	2.34	0.57	1.72	2.77	0.38
2/16/15	0.36	0.54	0.17	1.12	1.75	0.37	1.67	2.40	0.54	1.76	2.85	0.31
2/17/15	0.51	1.00	0.13	1.18	1.75	0.36	1.49	2.19	0.51	1.83	2.82	0.43
2/18/15	0.48	0.92	0.22	1.05	1.73	0.41	1.52	2.29	0.50	1.87	2.82	0.43
2/19/15	0.50	1.03	0.22	1.12	1.80	0.39	1.45	2.25	0.59	1.90	2.82	0.50
2/20/15	0.45	0.89	0.18	1.12	1.67	0.39	1.45	2.20	0.58	1.81	2.72	0.49
2/21/15	0.38	0.65	0.21	1.03	1.79	0.37	1.44	2.44	0.60	1.87	2.94	0.43
2/22/15	0.34	0.54	0.21	1.08	1.64	0.34	1.53	2.40	0.53	1.87	2.90	0.41
2/23/15	0.49	0.97	0.15	1.22	1.81	0.39	1.52	2.48	0.45	1.76	3.02	0.40
2/24/15	0.45	0.76	0.20	1.16	1.66	0.38	1.50	2.28	0.55	1.65	2.75	0.37
2/25/15	0.53	1.12	0.15	1.18	1.85	0.37	1.44	2.36	0.45	1.58	2.78	0.39
2/26/15	0.50	0.76	0.22	1.06	1.57	0.39	1.41	2.27	0.51	1.83	2.96	0.49
2/27/15	0.51	0.96	0.22	1.22	1.88	0.40	1.33	2.21	0.45	1.82	2.84	0.46
2/28/15	0.45	0.89	0.19	1.19	1.77	0.37	1.33	2.30	0.49	1.94	2.97	0.48
3/1/15	0.45	0.93	0.15	1.16	1.85	0.35	1.34	2.17	0.52	2.12	3.22	0.44
3/2/15	0.52	1.08	0.24	1.31	1.89	0.41	1.29	2.08	0.36	2.05	3.09	0.50
3/3/15	0.46	0.69	0.14	1.22	1.83	0.35	1.44	2.14	0.57	2.12	3.23	0.60
3/4/15	0.50	1.05	0.25	1.35	1.94	0.37	1.41	2.19	0.49	2.12	3.41	0.54

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 21			Site 22			Site 23			CuSD Homestead Flume		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
11/22/14										3.57	5.91	1.08
11/23/14										3.62	5.82	1.04
11/24/14										3.45	5.48	0.99
11/25/14										3.44	5.50	0.92
11/26/14										3.56	5.55	1.10
11/27/14										3.48	6.24	1.15
11/28/14										3.39	5.69	1.11
11/29/14										3.68	5.95	1.21
11/30/14										3.91	6.95	1.04
12/1/14										3.72	5.84	1.12
12/2/14										4.21	6.76	1.33
12/3/14										5.43	8.37	3.41
12/4/14										3.97	6.16	1.51
12/5/14										3.78	6.13	1.29
12/6/14										3.81	6.14	1.22
12/7/14										3.82	6.09	1.22
12/8/14										3.74	5.95	1.14
12/9/14										3.69	5.87	1.27
12/10/14	2.39	3.41	0.87	0.79	1.25	0.25	0.56	0.83	0.16	3.66	6.18	1.18
12/11/14	3.05	4.60	0.74	1.04	1.81	0.25	0.77	1.33	0.17	5.86	9.57	1.11
12/12/14	2.86	3.92	1.69	0.82	1.23	0.30	0.56	0.85	0.19	5.06	7.89	2.74
12/13/14	2.39	3.58	0.79	0.83	1.32	0.28	0.47	0.76	0.15	4.13	6.53	1.57
12/14/14	2.40	3.62	0.76	0.83	1.29	0.26	0.47	0.81	0.14	4.02	6.39	1.28
12/15/14	2.57	3.71	0.94	0.82	1.24	0.33	0.43	0.71	0.19	4.18	6.59	1.41
12/16/14	2.66	3.73	0.75	0.78	1.28	0.26	0.43	0.92	0.14	4.21	6.45	1.52
12/17/14	2.66	3.76	0.92	0.80	1.26	0.27	0.41	0.67	0.16	4.23	6.71	1.66
12/18/14	2.61	3.54	0.99	0.78	1.19	0.30	0.38	0.59	0.14	4.02	6.24	1.50
12/19/14	2.50	3.47	0.85	0.78	1.19	0.29	0.42	0.70	0.16	3.97	5.81	1.46
12/20/14	2.42	3.54	0.84	0.83	1.34	0.30	0.43	0.75	0.17	3.91	6.25	1.47
12/21/14	2.34	3.46	0.77	0.82	1.35	0.28	0.38	0.66	0.16	3.76	6.06	1.25
12/22/14	2.31	3.44	0.83	0.80	1.18	0.27	0.33	0.54	0.13	3.72	5.90	1.22
12/23/14	2.16	3.26	0.76	0.80	1.18	0.28	0.32	0.49	0.11	3.66	5.78	1.26
12/24/14	2.07	2.98	0.71	0.80	1.25	0.27	0.32	0.51	0.13	3.59	5.60	1.30
12/25/14	1.95	3.01	0.68	0.74	1.23	0.27	0.30	0.49	0.12	3.39	5.40	1.22
12/26/14	1.96	2.99	0.67	0.75	1.22	0.26	0.35	0.64	0.13	3.38	5.56	1.20
12/27/14	1.99	3.10	0.62	0.78	1.28	0.27	0.38	0.67	0.14	3.43	5.56	1.20
12/28/14	1.93	2.98	0.56	0.81	1.27	0.28	0.38	0.64	0.15	3.47	5.62	1.21
12/29/14	2.06	3.11	0.62	0.79	1.15	0.27	0.35	0.52	0.15	3.57	5.69	1.20
12/30/14	2.06	3.13	0.64	0.78	1.18	0.25	0.33	0.60	0.14	3.59	5.71	1.16
12/31/14	2.04	3.08	0.63	0.84	1.29	0.28	0.37	0.58	0.14	3.69	5.85	1.25
1/1/15	1.95	2.97	0.65	0.77	1.25	0.27	0.36	0.59	0.16	3.60	5.83	1.27
1/2/15	2.01	3.11	0.60	0.81	1.28	0.29	0.34	0.58	0.14	3.61	5.87	1.14
1/3/15	2.05	3.20	0.56	0.82	1.35	0.25	0.37	0.61	0.15	3.70	6.04	1.09
1/4/15	2.08	3.29	0.51	0.87	1.39	0.27	0.39	0.63	0.15	3.80	5.99	1.05
1/5/15	2.04	3.07	0.51	0.82	1.20	0.28	0.51	0.81	0.15	3.80	5.86	1.01
1/6/15	2.02	3.07	0.58	0.78	1.21	0.28	0.51	0.80	0.13	3.77	5.84	1.13
1/7/15	2.14	3.19	0.54	0.81	1.26	0.27	0.53	0.84	0.13	3.80	6.19	1.14
1/8/15	2.14	3.18	0.63	0.80	1.14	0.27	0.51	0.91	0.11	3.74	5.90	1.11
1/9/15	2.17	3.08	0.71	0.77	1.16	0.24	0.51	0.80	0.12	3.67	5.78	1.11
1/10/15	2.16	3.35	0.60	0.83	1.42	0.26	0.62	1.10	0.15	3.71	6.12	1.06
1/11/15	2.24	3.34	0.68	0.90	1.37	0.30	0.63	1.07	0.17	3.81	5.98	1.08
1/12/15	2.22	3.30	0.66	0.79	1.17	0.25	0.54	0.84	0.13	3.71	5.85	1.05
1/13/15	2.24	3.25	0.66	0.77	1.17	0.27	0.63	1.01	0.15	3.64	5.89	1.03
1/14/15	2.26	3.40	0.68	0.77	1.18	0.22	0.64	0.98	0.17	3.65	6.15	1.01
1/15/15	2.19	3.29	0.66	0.76	1.17	0.28	0.60	1.01	0.17	3.62	5.67	1.02
1/16/15	2.07	3.21	0.60	0.73	1.13	0.24	0.57	1.04	0.15	3.59	5.86	1.12

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Site 21			Site 22			Site 23			CuSD Homestead Flume		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
1/17/15	1.97	3.41	0.41	0.77	1.31	0.20	0.49	0.86	0.15	3.62	5.99	1.13
1/18/15	2.15	3.42	0.48	0.78	1.30	0.23	0.46	0.74	0.11	3.60	5.86	0.99
1/19/15	2.34	3.42	0.73	0.78	1.21	0.21	0.61	1.00	0.15	3.69	5.79	1.06
1/20/15	2.31	3.30	0.71	0.73	1.13	0.23	0.63	1.00	0.19	3.59	5.75	1.04
1/21/15	2.31	3.39	0.75	0.74	1.17	0.23	0.59	0.99	0.19	3.62	6.11	1.12
1/22/15	2.31	3.29	0.65	0.73	1.14	0.23	0.54	0.89	0.19	3.60	5.77	1.05
1/23/15	2.30	3.30	0.74	0.73	1.14	0.23	0.54	0.85	0.12	3.48	5.84	1.04
1/24/15	2.26	3.50	0.70	0.80	1.35	0.25	0.64	1.19	0.20	3.51	6.01	0.96
1/25/15	2.29	3.51	0.55	0.88	1.40	0.24	0.63	1.14	0.17	3.66	5.96	0.93
1/26/15	2.23	3.23	0.64	0.81	1.22	0.25	0.62	1.08	0.21	3.54	6.01	0.98
1/27/15	2.24	3.18	0.65	0.73	1.14	0.23	0.54	0.94	0.14	3.55	5.58	0.93
1/28/15	2.22	3.23	0.70	0.77	1.20	0.23	0.63	0.97	0.15	3.50	6.06	0.99
1/29/15	2.22	3.31	0.66	0.73	1.10	0.23	0.67	0.98	0.18	3.47	5.88	0.97
1/30/15	2.28	3.46	0.69	0.71	1.08	0.22	0.57	0.94	0.16	3.49	5.71	0.95
1/31/15	2.31	3.69	0.67	0.84	1.39	0.23	0.57	0.94	0.19	3.58	6.08	0.99
2/1/15	2.41	3.73	0.64	0.81	1.30	0.22	0.51	0.92	0.10	3.62	6.07	0.97
2/2/15	2.54	3.90	0.76	0.76	1.16	0.23	0.62	0.99	0.18	3.51	5.82	0.93
2/3/15	2.50	3.62	0.80	0.68	1.14	0.21	0.64	0.95	0.17	3.50	5.72	0.94
2/4/15	2.39	3.76	0.77	0.71	1.13	0.22	0.63	0.97	0.18	3.54	6.09	1.00
2/5/15	2.27	3.40	0.65	0.75	1.21	0.24	0.63	0.98	0.19	3.47	5.92	1.00
2/6/15	2.62	4.02	0.64	0.83	1.29	0.23	0.69	1.12	0.17	4.22	6.75	1.02
2/7/15	2.60	3.70	1.15	0.80	1.30	0.25	0.67	1.21	0.17	4.32	7.03	1.84
2/8/15	2.69	4.54	0.81	0.88	1.48	0.26	0.70	1.32	0.17	4.49	8.11	1.17
2/9/15	2.56	3.65	0.91	0.76	1.17	0.23	0.68	1.22	0.20	4.19	6.75	1.66
2/10/15	2.43	3.50	0.73	0.73	1.12	0.23	0.65	1.05	0.19	3.80	6.14	1.27
2/11/15	2.38	3.64	0.74	0.75	1.17	0.21	0.64	1.04	0.19	3.65	6.25	1.13
2/12/15	2.31	3.45	0.66	0.74	1.16	0.23	0.61	1.01	0.17	3.60	6.06	1.10
2/13/15	2.32	3.43	0.70	0.75	1.15	0.24	0.62	1.10	0.16	3.51	5.75	1.10
2/14/15	2.36	3.56	0.79	0.81	1.32	0.24	0.60	1.13	0.19	3.54	6.19	1.06
2/15/15	2.25	3.45	0.66	0.81	1.32	0.24	0.55	0.95	0.18	3.41	5.69	1.10
2/16/15	2.25	3.40	0.60	0.87	1.32	0.26	0.53	0.90	0.13	3.57	5.89	1.05
2/17/15	2.33	3.37	0.66	0.79	1.22	0.27	0.66	1.04	0.19	3.59	5.82	1.07
2/18/15	2.22	3.36	0.65	0.79	1.17	0.27	0.63	1.07	0.19	3.57	5.71	1.02
2/19/15	2.27	3.26	0.72	0.79	1.17	0.27	0.60	0.93	0.16	3.54	5.59	1.10
2/20/15	2.24	3.33	0.72	0.79	1.24	0.28	0.63	0.94	0.17	3.52	5.43	1.09
2/21/15	2.30	3.59	0.66	0.82	1.34	0.27	0.72	1.23	0.26	3.58	5.93	1.06
2/22/15	2.42	3.58	0.65	0.85	1.31	0.26	0.71	1.15	0.22	3.76	6.05	1.06
2/23/15	2.38	3.57	0.67	0.78	1.18	0.25	0.64	1.12	0.19	3.76	6.17	1.02
2/24/15	2.29	3.48	0.66	0.77	1.17	0.26	0.58	0.87	0.17	3.69	6.10	1.09
2/25/15	2.42	3.67	0.68	0.77	1.19	0.25	0.60	0.95	0.17	3.70	6.35	1.07
2/26/15	2.42	3.75	0.67	0.76	1.18	0.24	0.59	0.97	0.15	3.65	5.98	1.08
2/27/15	2.42	3.61	0.62	0.75	1.19	0.21	0.58	0.86	0.17	3.61	5.99	1.06
2/28/15	2.42	3.84	0.65	0.82	1.36	0.22	0.60	0.96	0.15	3.70	6.10	1.03
3/1/15	2.48	3.76	0.64	0.85	1.36	0.25	0.50	0.77	0.13	3.79	6.22	1.11
3/2/15	2.50	3.79	0.76	0.78	1.26	0.22	0.56	0.85	0.11	3.73	6.16	1.08
3/3/15	2.47	3.54	0.86	0.76	1.21	0.24	0.61	0.92	0.15	3.72	6.05	1.19
3/4/15	2.43	3.74	0.67	0.77	1.25	0.23	0.61	0.97	0.17	3.67	6.35	1.05

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

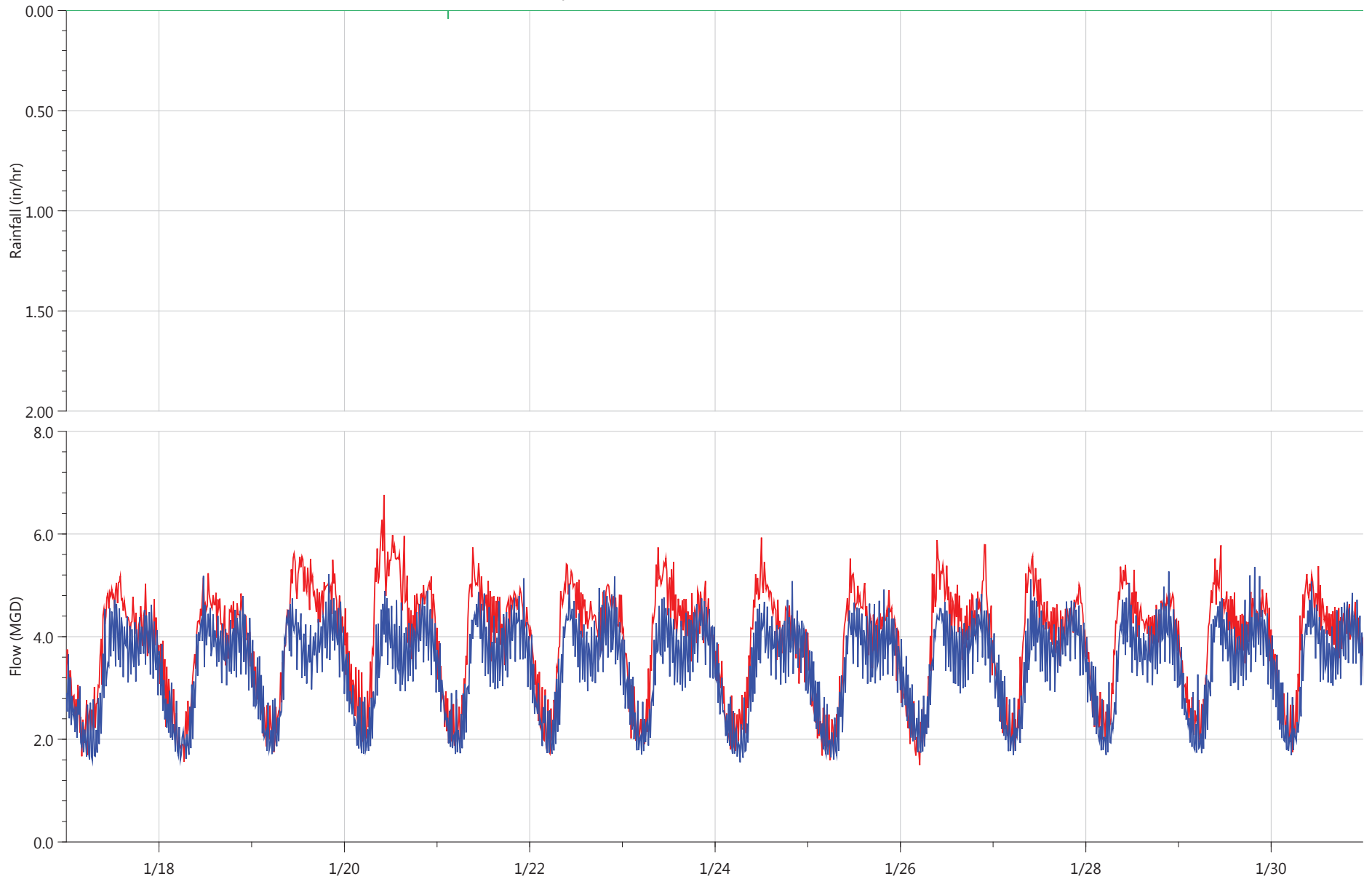
Date	Guad (SE) V&A			Guad (SE) FloDar			Guad (NW) V&A			Guad (NW) FloDar		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
11/22/14												
11/23/14												
11/24/14												
11/25/14												
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11/27/14												
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11/29/14												
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1/3/15												
1/4/15												
1/5/15												
1/6/15												
1/7/15												
1/8/15												
1/9/15	3.59	4.44	2.14	3.21	4.07	1.75	0.90	1.61	0.01	0.95	1.63	0.19
1/10/15	3.77	5.02	2.22	3.34	4.60	1.71	0.99	1.97	0.01	1.07	2.03	0.19
1/11/15	3.91	5.03	2.05	3.50	4.59	1.78	1.10	1.93	0.01	1.15	2.01	0.19
1/12/15	3.98	5.22	2.26	3.55	4.55	1.81	1.15	1.94	0.02	1.22	1.93	0.19
1/13/15	3.94	5.03	2.17	3.57	4.61	1.82	1.13	1.90	0.02	1.21	1.99	0.20
1/14/15	3.97	5.03	2.43	3.57	4.60	2.05	1.12	1.85	0.05	1.18	1.94	0.21
1/15/15	3.89	4.86	1.98	3.55	4.44	1.72	1.13	1.73	0.01	1.23	1.85	0.19
1/16/15	3.93	4.91	2.41	3.50	4.34	2.04	1.10	1.67	0.02	1.16	1.80	0.20

**City of Santa Clara 2014/15 Flow Monitoring
Daily Flow Data (MGD)**

Date	Guad (SE) V&A			Guad (SE) FloDar			Guad (NW) V&A			Guad (NW) FloDar		
	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.	Avg.	Max.	Min.
1/17/15	3.81	5.03	2.19	3.37	4.41	1.78	1.00	1.80	0.01	1.07	1.82	0.19
1/18/15	3.77	4.86	2.23	3.32	4.29	1.82	0.94	1.68	0.03	1.01	1.78	0.20
1/19/15	3.96	5.14	2.11	3.57	4.66	1.78	1.12	2.03	0.03	1.27	2.24	0.20
1/20/15	3.91	4.72	2.26	3.53	4.40	1.92	1.08	1.67	0.02	1.22	1.86	0.20
1/21/15	3.92	4.82	2.25	3.56	4.47	1.84	1.12	1.78	0.03	1.23	1.95	0.20
1/22/15	3.92	4.92	2.13	3.50	4.45	1.82	1.08	1.76	0.01	1.19	1.90	0.20
1/23/15	4.04	5.45	2.11	3.58	5.11	1.70	1.14	2.12	0.03	1.27	2.53	0.20
1/24/15	3.77	5.07	2.00	3.32	4.61	1.72	0.94	1.78	0.02	1.06	1.97	0.20
1/25/15	3.73	5.12	2.00	3.33	4.66	1.62	1.00	1.99	0.01	1.11	2.14	0.19
1/26/15	3.86	5.03	2.16	3.43	4.39	1.66	1.09	1.86	0.01	1.20	1.95	0.19
1/27/15	3.90	4.82	2.43	3.45	4.30	1.92	1.08	1.85	0.03	1.19	1.89	0.20
1/28/15	3.91	4.88	2.22	3.46	4.43	1.90	1.09	1.81	0.01	1.20	2.03	0.19
1/29/15	4.00	5.30	2.41	3.59	4.80	1.95	1.17	1.99	0.01	1.32	2.38	0.20
1/30/15	3.98	5.06	2.25	3.51	4.58	1.84	1.12	1.89	0.00	1.22	2.08	0.19
1/31/15	3.92	5.17	2.23	3.44	4.53	1.90	1.02	1.86	0.01	1.14	2.00	0.19
2/1/15	3.82	5.08	2.11	3.37	4.55	1.63	1.00	1.89	0.01	1.13	2.08	0.13
2/2/15	3.91	5.27	2.10	3.45	4.54	1.70	1.06	1.94	0.01	1.20	2.07	0.18
2/3/15	3.98	5.00	2.27	3.49	4.49	1.93	1.05	1.91	0.02	1.18	1.99	0.19
2/4/15	4.00	5.30	2.38	3.55	4.76	1.77	1.07	1.90	0.00	1.23	2.21	0.19
2/5/15	3.98	5.22	2.40	3.53	4.57	2.04	1.06	1.75	0.00	1.22	2.06	0.19
2/6/15	4.40	5.55	2.12	4.00	5.12	1.76	1.43	2.64	0.00	1.68	2.83	0.19
2/7/15	4.47	5.48	3.12	4.07	5.03	2.68	1.51	2.33	0.38	1.66	2.60	0.35
2/8/15	4.38	5.59	2.74	3.99	5.18	2.25	1.52	2.60	0.10	1.67	2.91	0.23
2/9/15	4.68	5.80	3.10	4.27	5.33	2.64	1.73	2.64	0.38	1.96	3.22	0.35
2/10/15	4.38	5.29	3.05	3.96	4.82	2.58	1.49	2.25	0.35	1.65	2.43	0.32
2/11/15	4.31	5.24	2.71	3.89	4.84	2.36	1.43	2.40	0.19	1.62	2.65	0.26
2/12/15	4.14	4.95	2.74	3.73	4.69	2.32	1.29	2.01	0.13	1.43	2.28	0.25
2/13/15	4.29	5.57	2.73	3.84	4.88	2.31	1.40	2.39	0.18	1.59	2.58	0.26
2/14/15	4.00	5.06	2.64	3.55	4.49	2.15	1.21	2.07	0.05	1.30	2.20	0.22
2/15/15	3.82	4.93	2.27	3.38	4.43	1.83	1.03	1.82	0.00	1.14	1.98	0.19
2/16/15	4.02	5.21	2.23	3.60	4.67	1.90	1.14	2.04	0.00	1.33	2.27	0.19
2/17/15	4.13	5.13	2.81	3.67	4.68	2.33	1.22	2.07	0.12	1.42	2.31	0.25
2/18/15	4.03	5.06	2.53	3.54	4.50	2.02	1.06	1.70	0.01	1.27	2.11	0.19
2/19/15	3.98	4.98	2.46	3.55	4.58	2.06	1.18	2.00	0.01	1.23	2.09	0.19
2/20/15	3.97	4.92	2.50	3.51	4.38	2.11	1.16	1.89	0.01	1.21	1.97	0.20
2/21/15	3.86	4.93	2.44	3.47	4.65	2.07	1.09	2.14	0.00	1.21	2.31	0.19
2/22/15	3.82	5.22	2.27	3.43	4.65	1.89	1.12	2.22	0.00	1.21	2.27	0.18
2/23/15	3.94	5.10	2.28	3.56	4.59	1.97	1.23	2.02	0.00	1.33	2.29	0.19
2/24/15	3.94	4.95	2.25	3.44	4.43	1.80	1.11	1.88	0.00	1.18	1.96	0.19
2/25/15	3.98	5.04	2.35	3.59	4.52	2.01	1.22	2.13	0.01	1.36	2.19	0.20
2/26/15	3.90	4.93	2.30	3.45	4.50	1.90	1.07	1.85	0.00	1.20	2.08	0.18
2/27/15	3.87	4.96	2.38	3.50	4.58	1.97	1.09	1.96	0.00	1.22	2.11	0.18
2/28/15	3.72	5.01	2.31	3.38	4.45	1.92	1.00	1.93	0.00	1.10	2.06	0.18
3/1/15	3.90	5.09	1.99	3.56	4.81	1.71	1.15	2.08	0.00	1.31	2.40	0.18
3/2/15	4.15	5.12	2.30	3.88	4.95	1.90	1.29	2.16	0.00	1.54	2.43	0.19
3/3/15	3.96	4.97	2.18	3.73	4.64	1.95	1.15	1.96	0.00	1.36	2.10	0.19
3/4/15	3.87	4.90	2.22	3.61	4.67	1.94	1.14	1.93	0.00	1.32	2.20	0.19

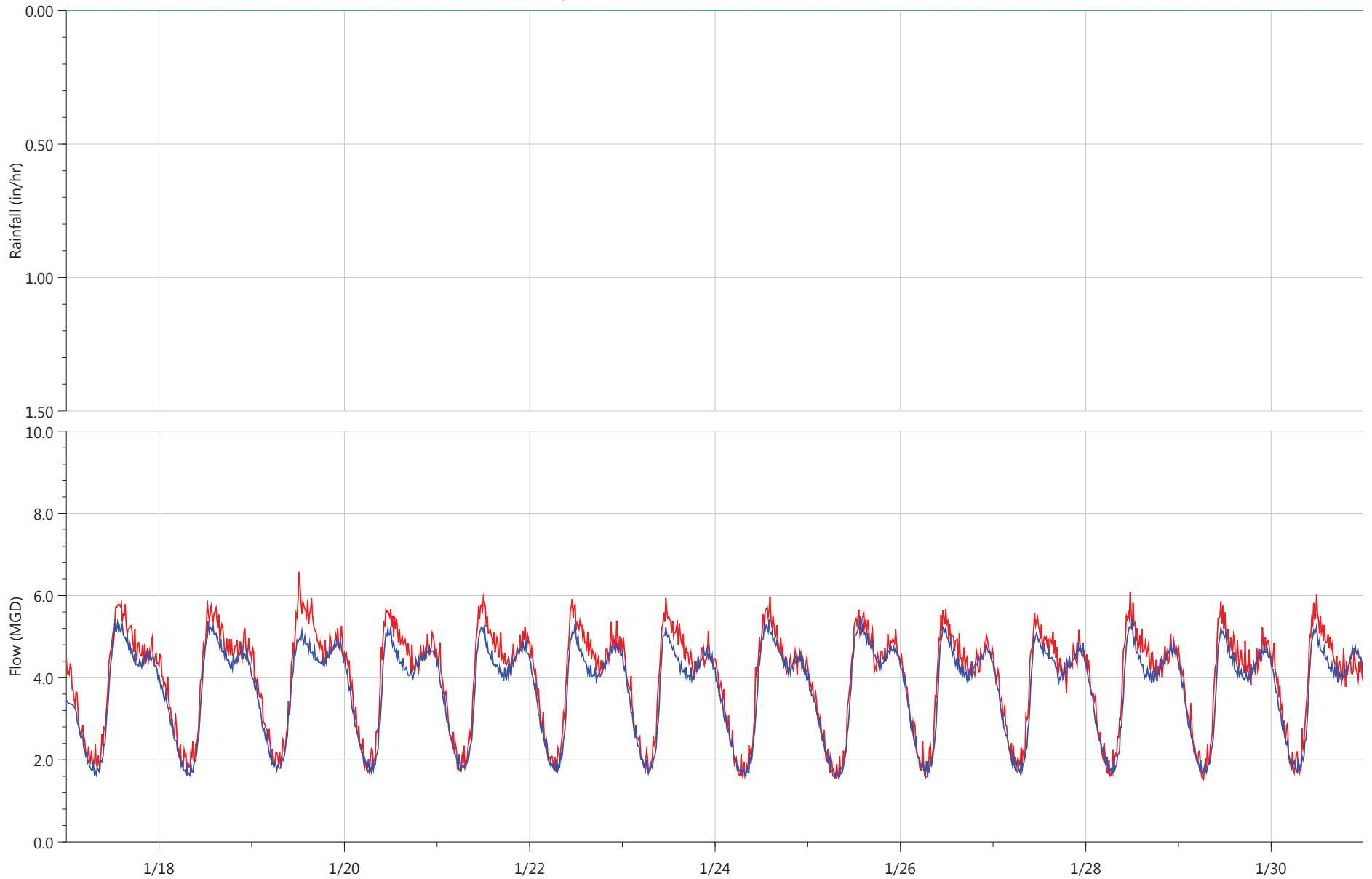
Appendix B - Dry Weather Flow Calibration Graphs

Flow Survey Location (Obs.) 1 S104-29.1, Rainfall Profile: RG1



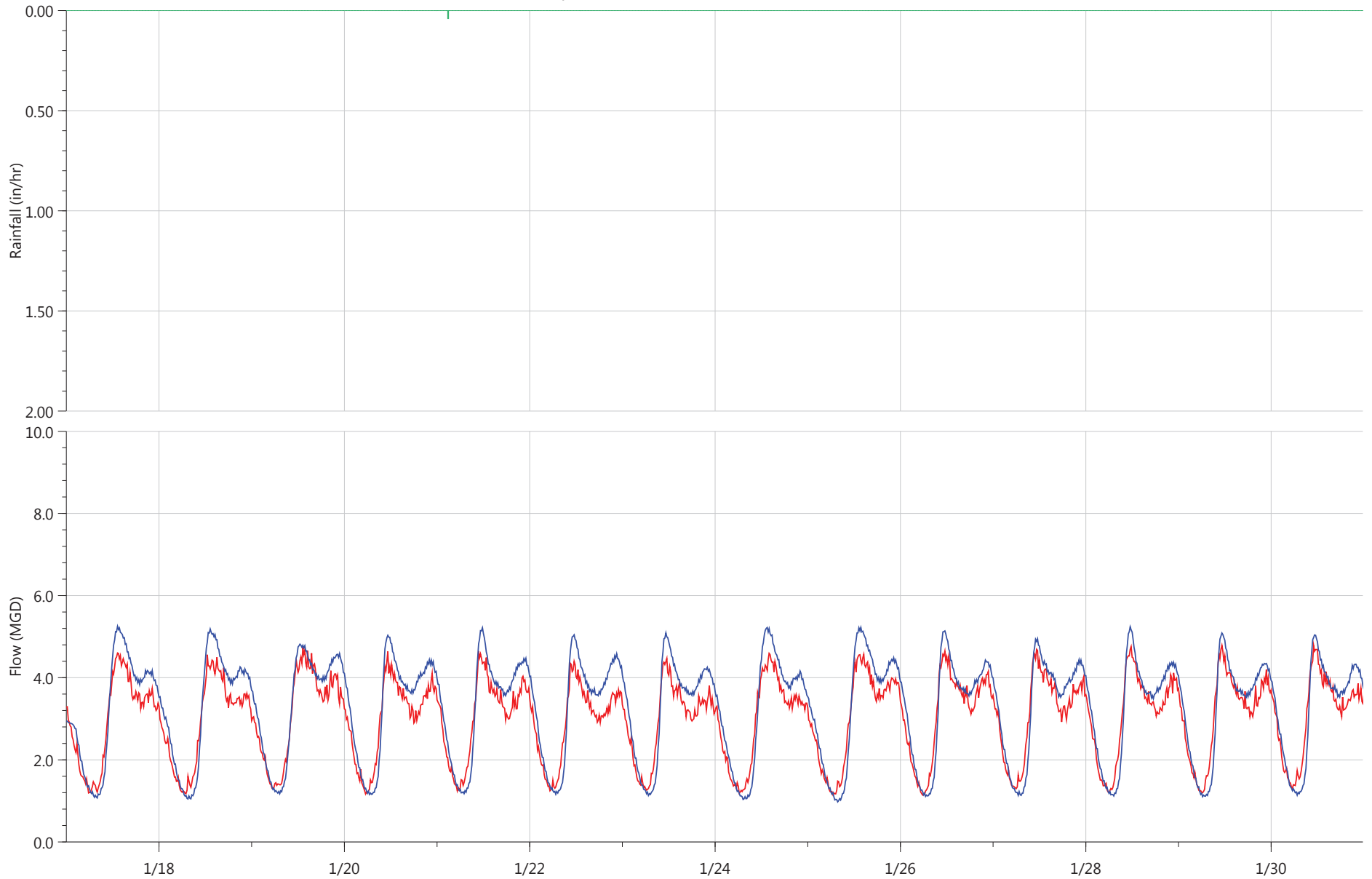
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.010	0.040	0.000			
Obs.				1.500	6.760	54.726
..._1/17/2015+14D (w/GWI)>DWF				1.552	5.356	47.865

Flow Survey Location (Obs.) 2 S104-24.1, Rainfall Profile: RG2



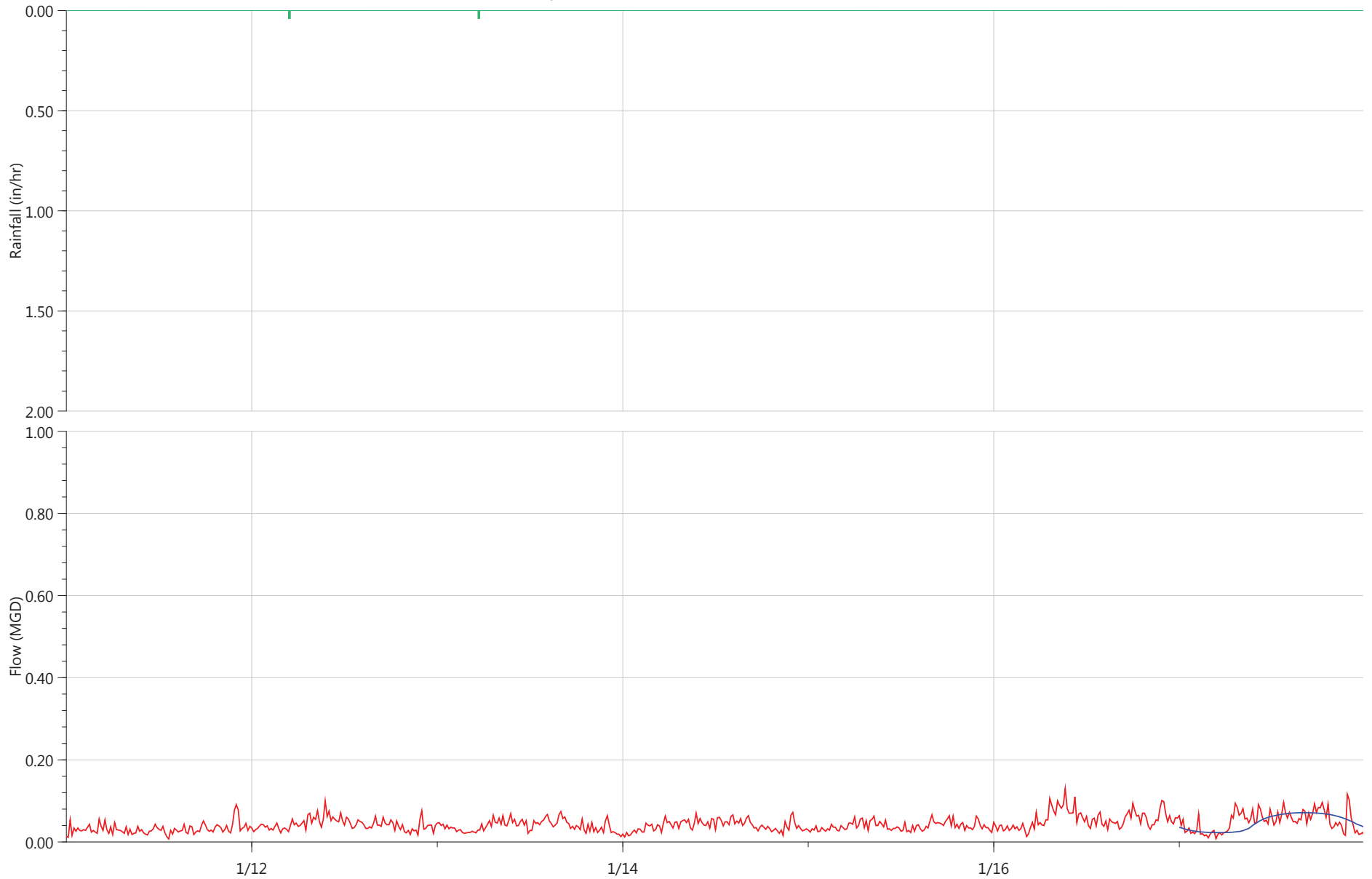
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.000	0.000	0.000			
Obs.				1.520	6.578	55.623
..._1/17/2015+14D (w/GWI)>DWF				1.593	5.492	51.975

Flow Survey Location (Obs.) 3 S104-27.1, Rainfall Profile: RG1



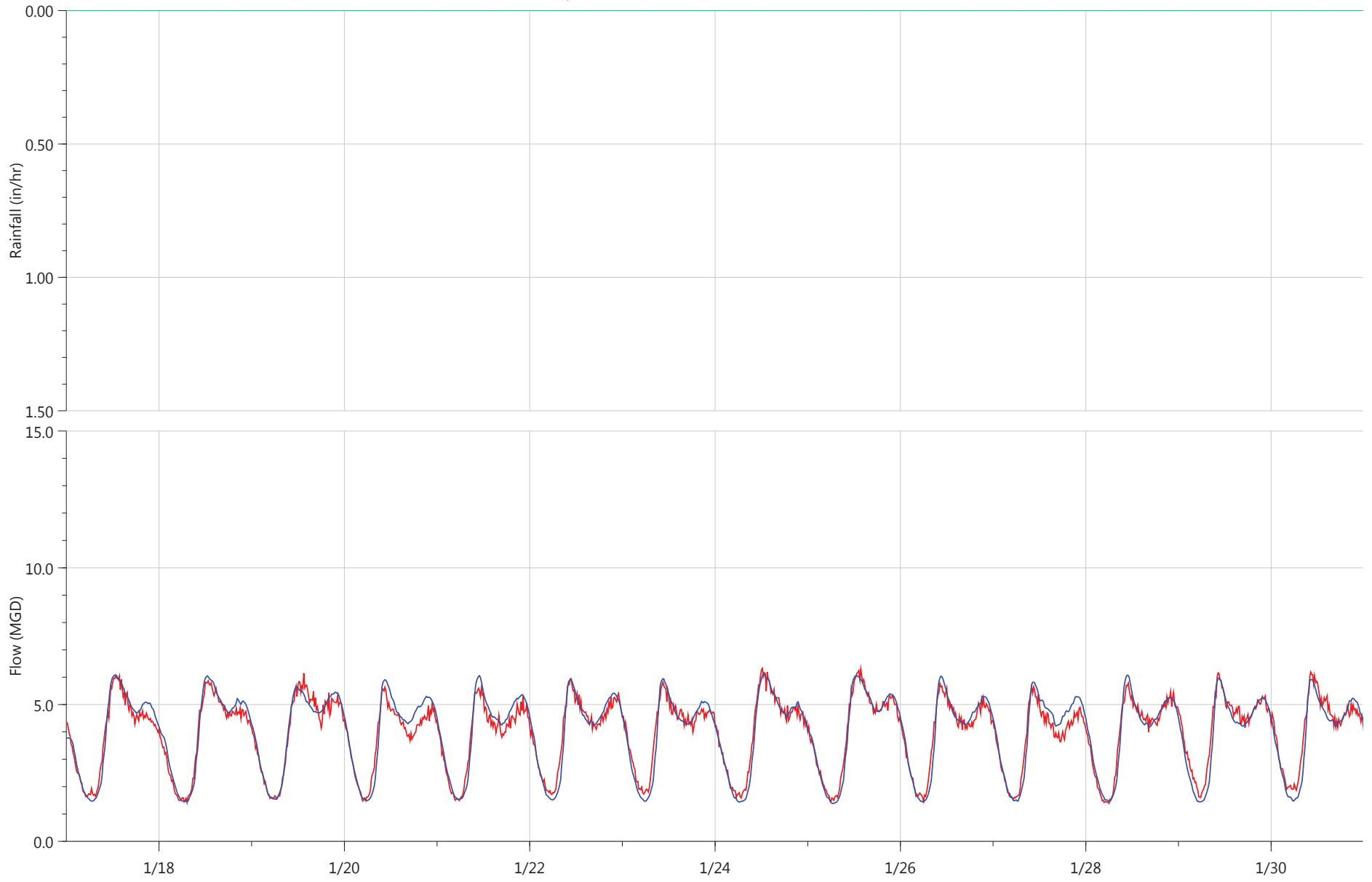
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.010	0.040	0.000			
Obs.				1.142	4.790	42.272
..._1/17/2015+14D (w/GWI)>DWF				0.976	5.251	45.765

Flow Survey Location (Obs.) 4 SSMH #401.1, Rainfall Profile: RG1



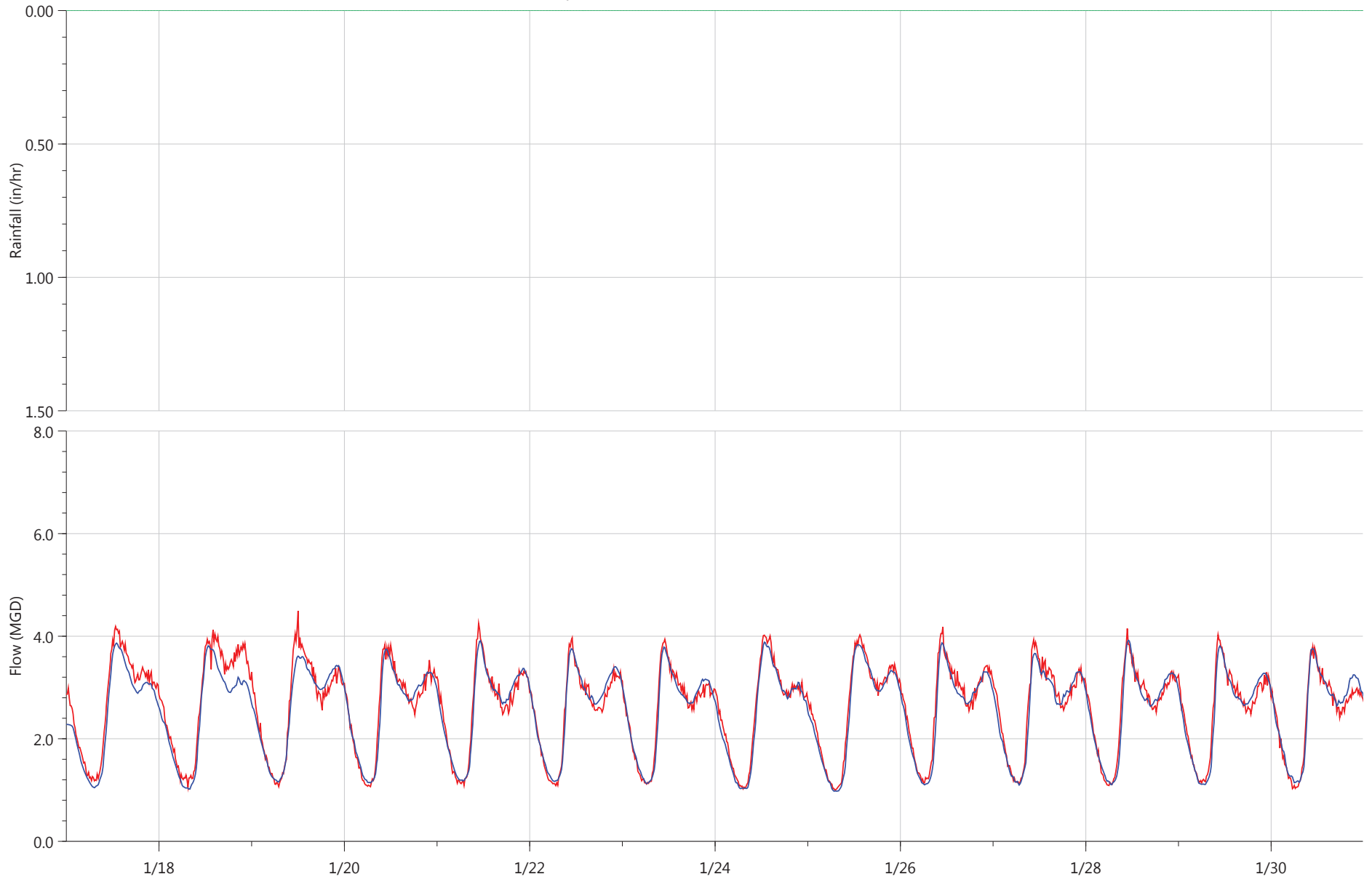
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.020	0.040	0.000			
Obs.				0.007	0.130	0.299
..._1/17/2015+14D (w/GWI)>DWF				0.023	0.071	0.048

Flow Survey Location (Obs.) 5 S83-23.1, Rainfall Profile: RG2



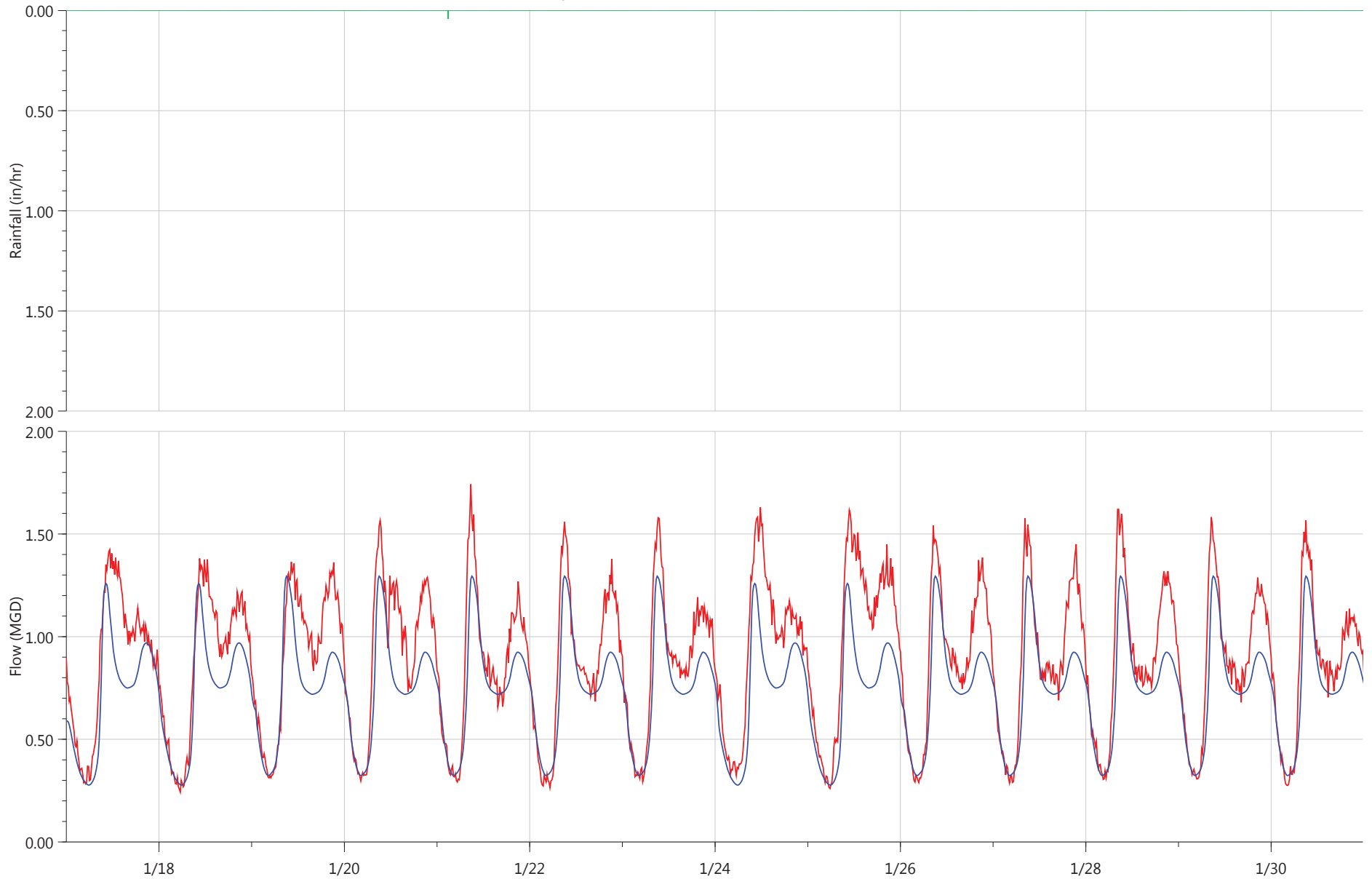
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.000	0.000	0.000			
Obs.				1.390	6.323	55.644
..._1/17/2015+14D (w/GWI)>DWF				1.380	6.119	55.886

Flow Survey Location (Obs.) 6 S83-25.1, Rainfall Profile: RG2



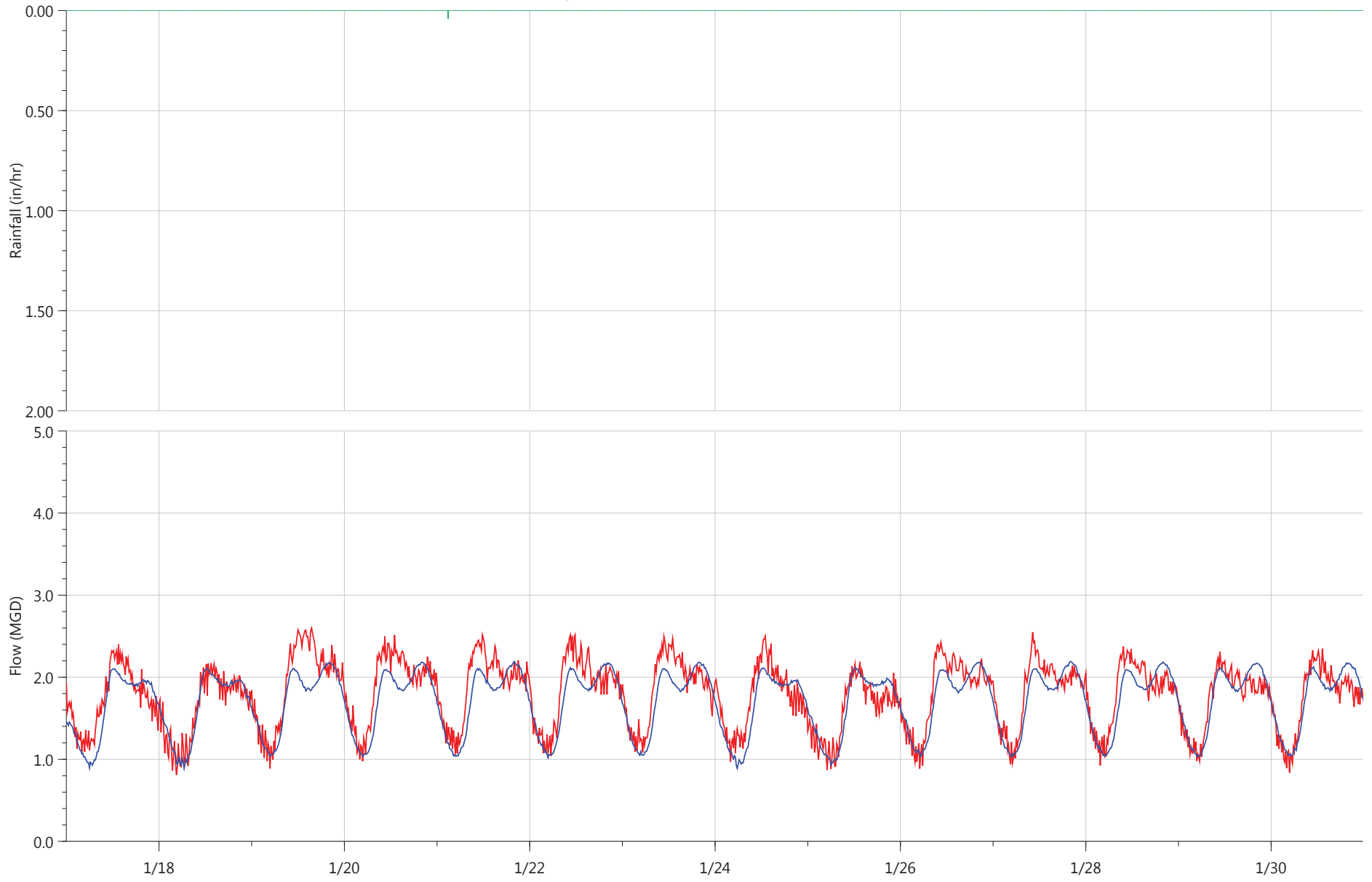
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	—	0.000	0.000	0.000			
Obs.	—				1.004	4.493	36.689
..._1/17/2015+14D (w/GWI)>DWF	—				0.977	3.919	35.608

Flow Survey Location (Obs.) 7 S105-35.1, Rainfall Profile: RG1



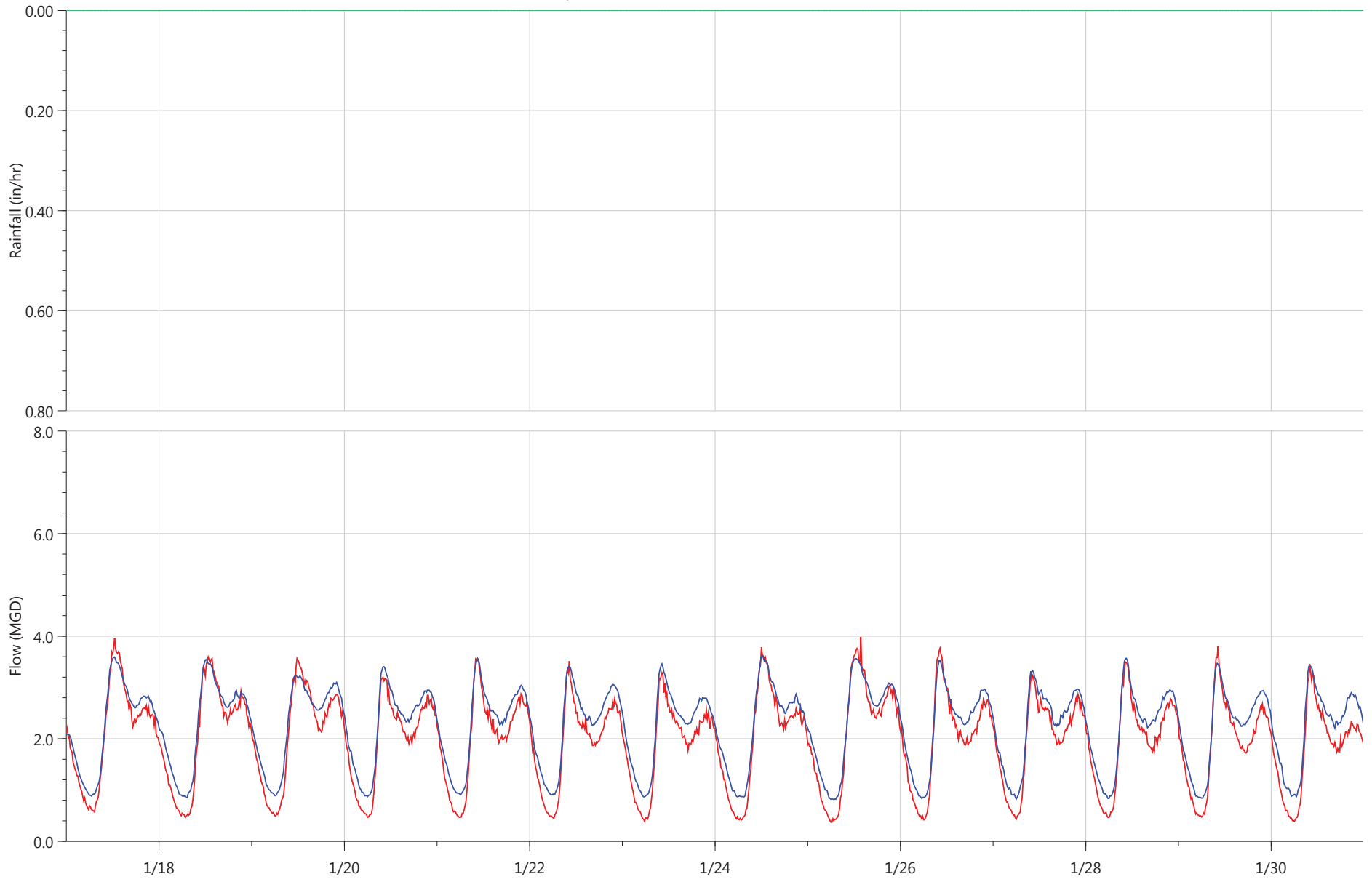
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.010	0.040	0.000			
Obs.				0.243	1.742	12.512
..._1/17/2015+14D (w/GWI)>DWF				0.277	1.295	10.337

Flow Survey Location (Obs.) 8 S86-13.1, Rainfall Profile: RG1



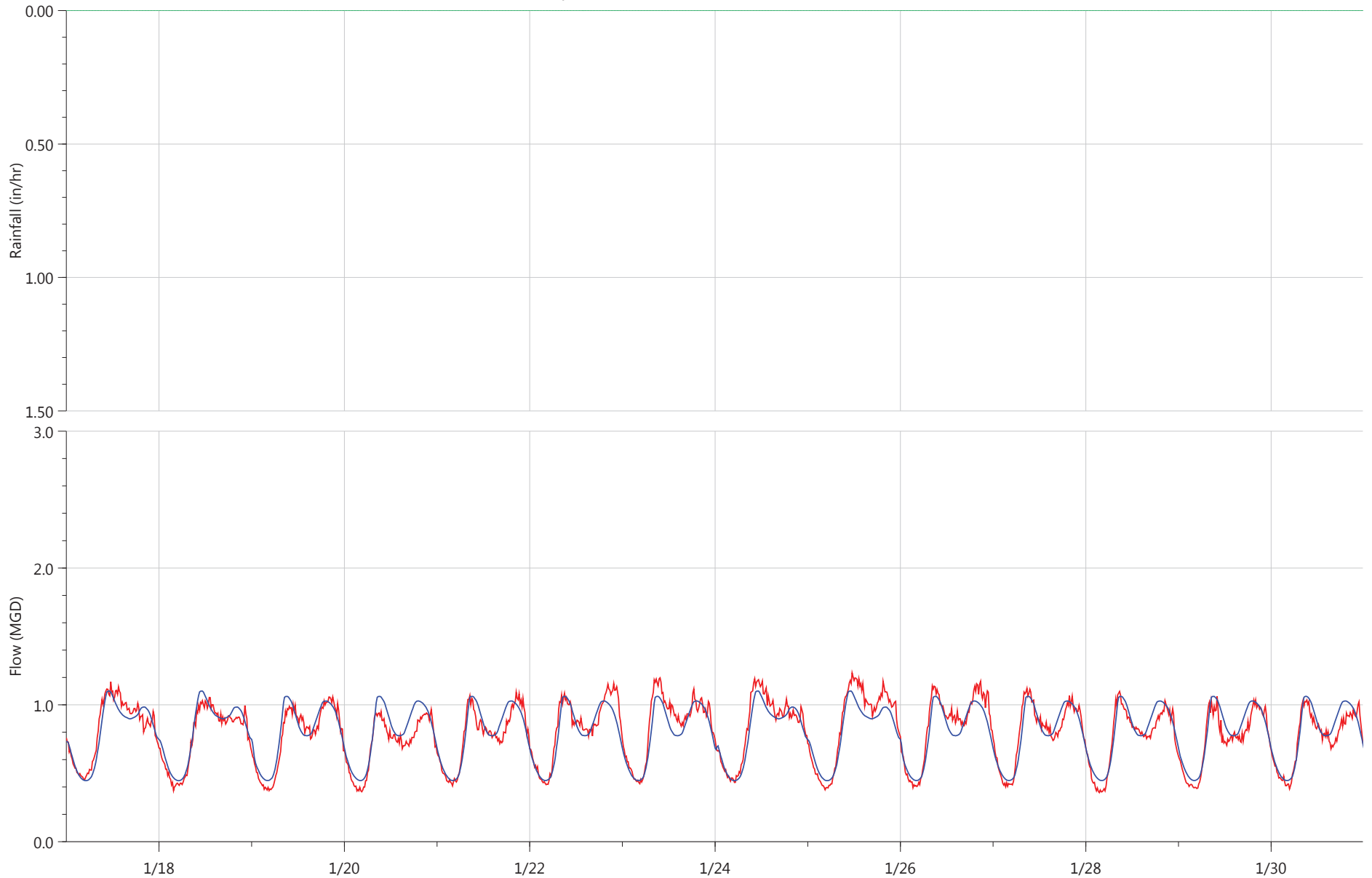
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.010	0.040	0.000			
Obs.				0.811	2.598	25.025
..._1/17/2015+14D (w/GWI)>DWF				0.889	2.192	23.795

Flow Survey Location (Obs.) 9 S62-48.1, Rainfall Profile: RG3



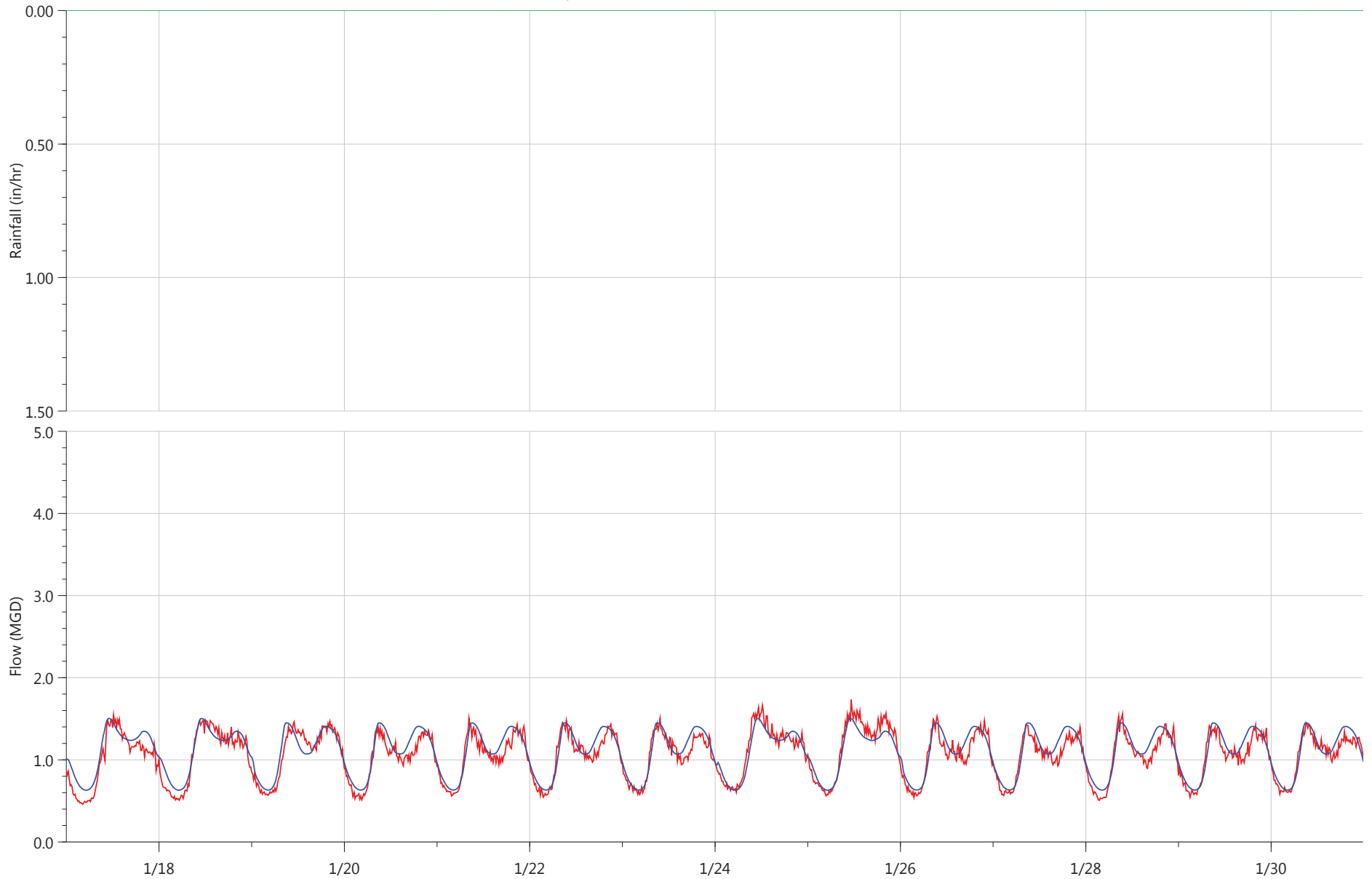
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	—	0.000	0.000	0.000			
Obs.	—				0.371	3.982	27.716
..._1/17/2015+14D (w/GWI)>DWF	—				0.815	3.622	31.439

Flow Survey Location (Obs.) 10 S52-80.1, Rainfall Profile: RG2



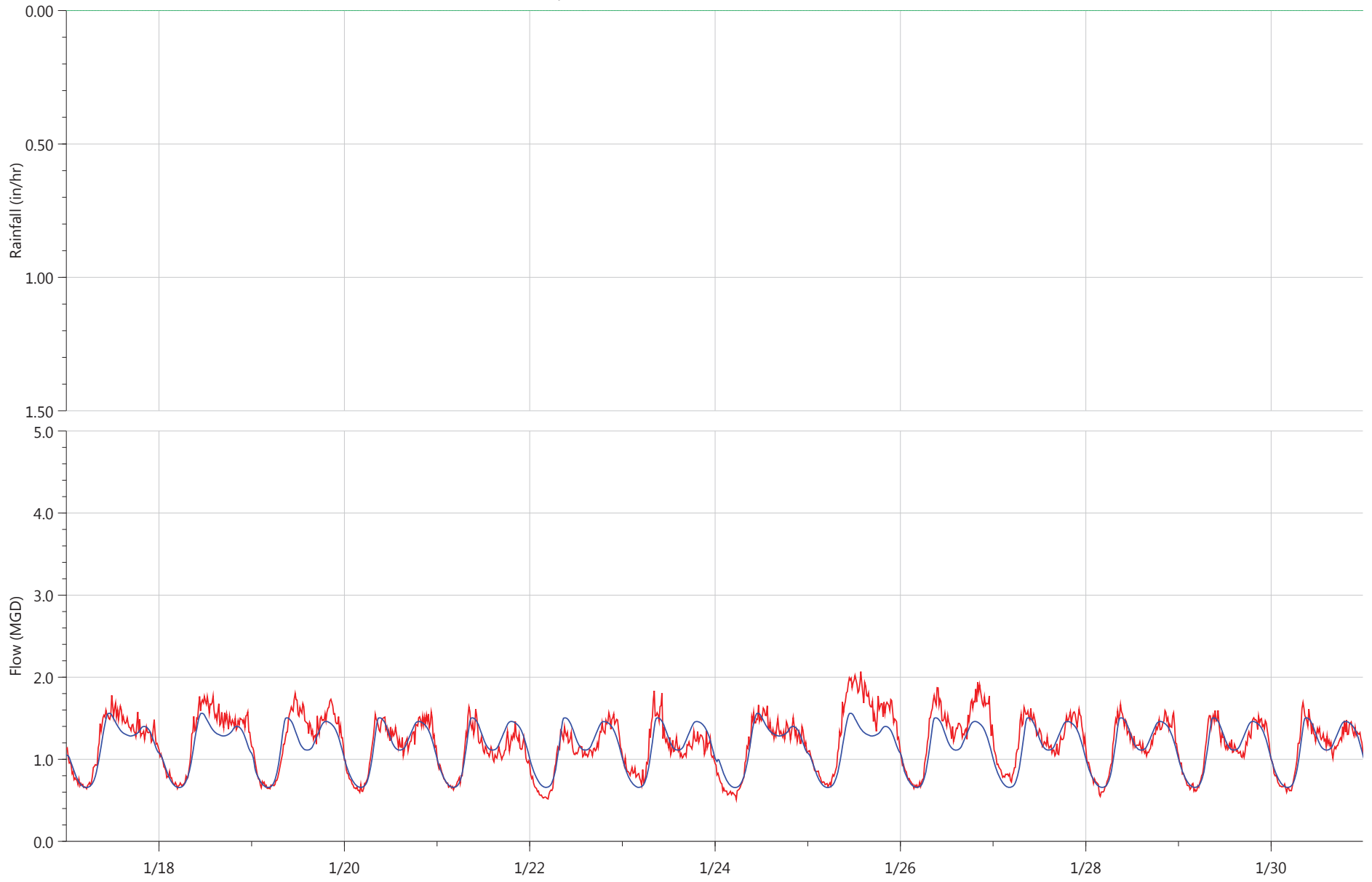
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	—	0.000	0.000	0.000			
Obs.	—				0.359	1.233	11.168
..._1/17/2015+14D (w/GWI)>DWF	—				0.446	1.101	11.167

Flow Survey Location (Obs.) 11 S53-9.1, Rainfall Profile: RG2



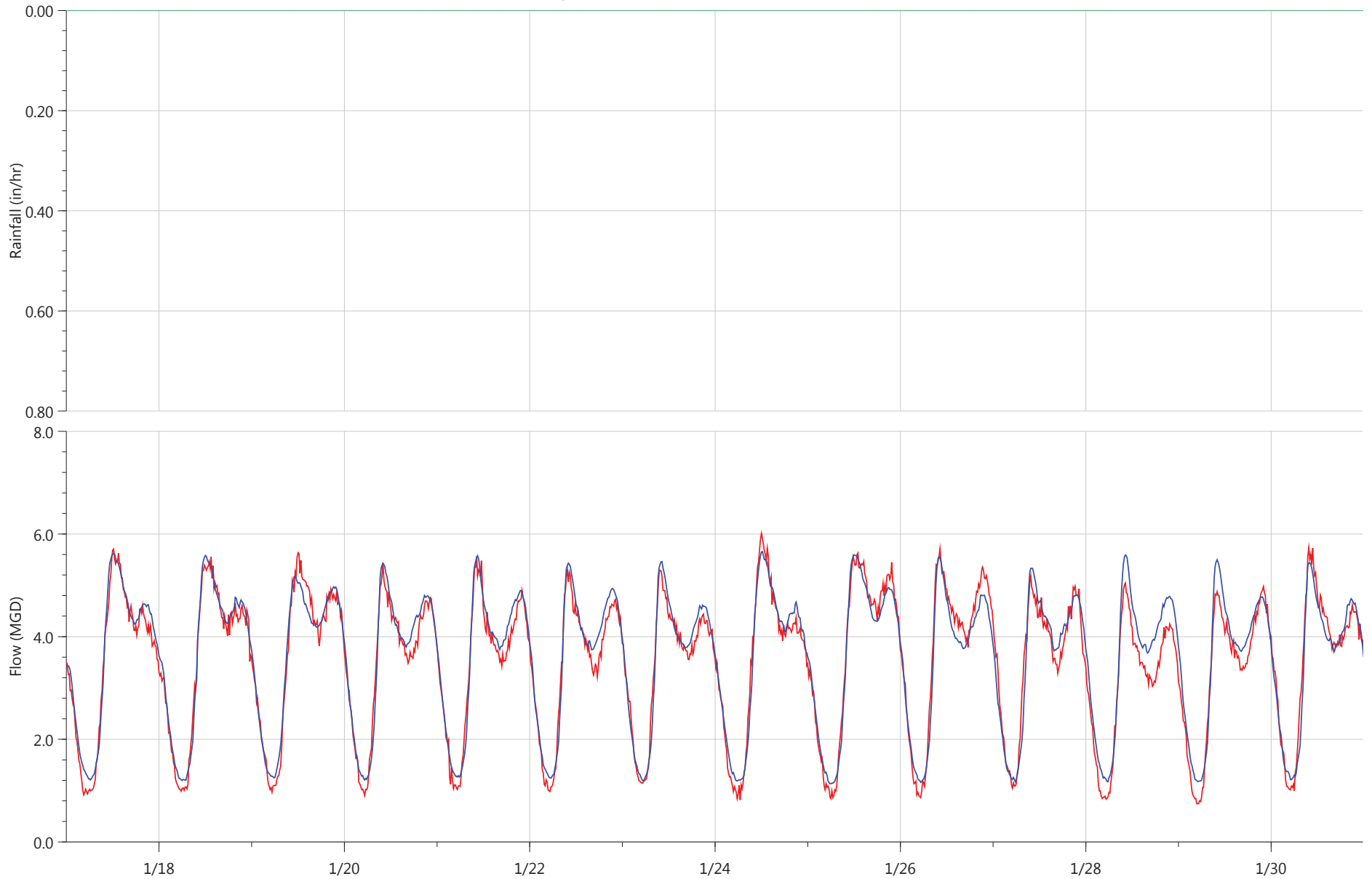
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.000	0.000	0.000			
Obs.				0.459	1.733	14.801
..._1/17/2015+14D (w/GWI)>DWF				0.631	1.502	15.391

Flow Survey Location (Obs.) 12 S53-109.1, Rainfall Profile: RG2



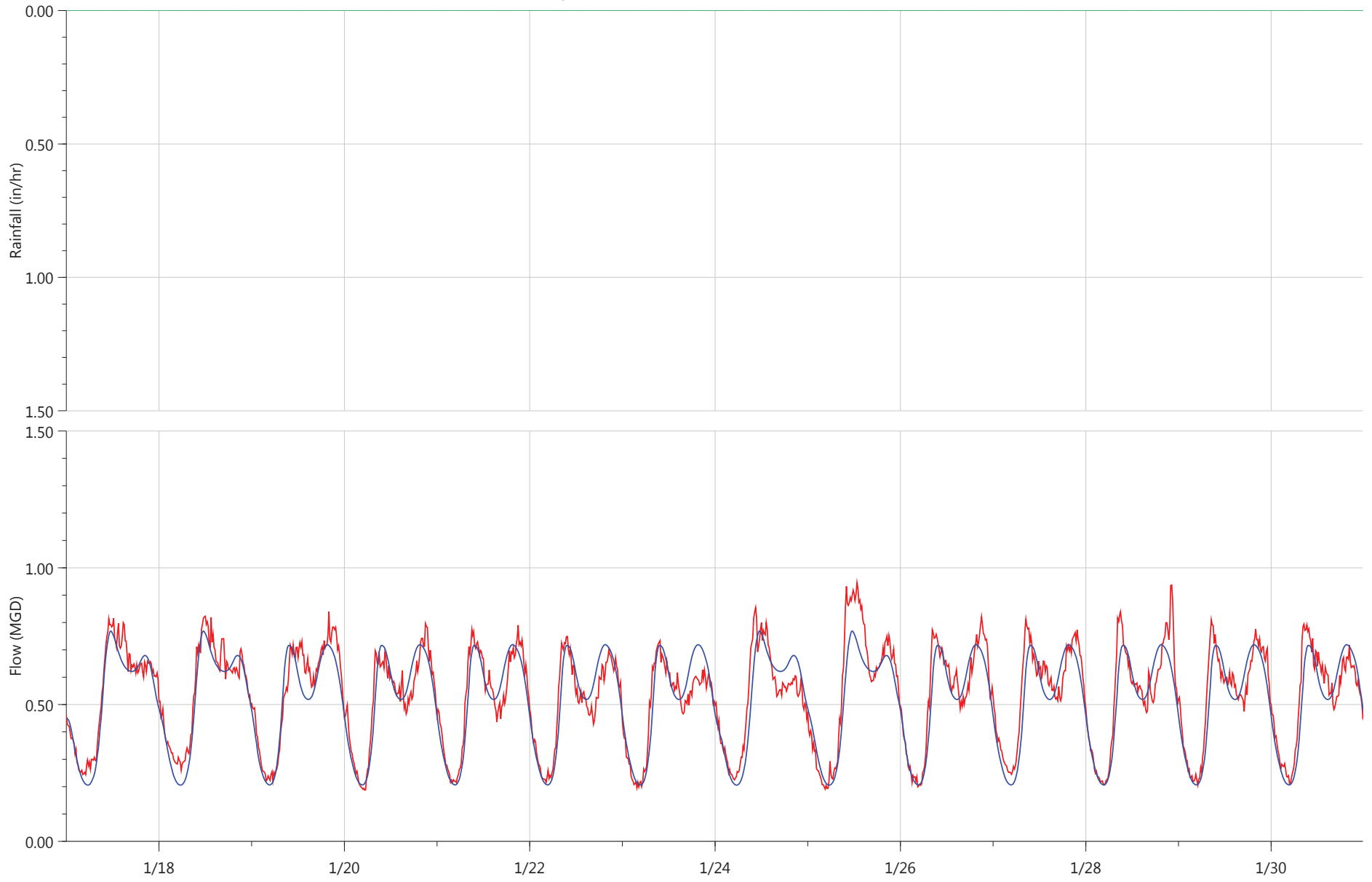
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	—	0.000	0.000	0.000			
Obs.	—				0.511	2.069	16.722
..._1/17/2015+14D (w/GWI)>DWF	—				0.656	1.560	15.990

Flow Survey Location (Obs.) 13 S53-73.1, Rainfall Profile: RG3



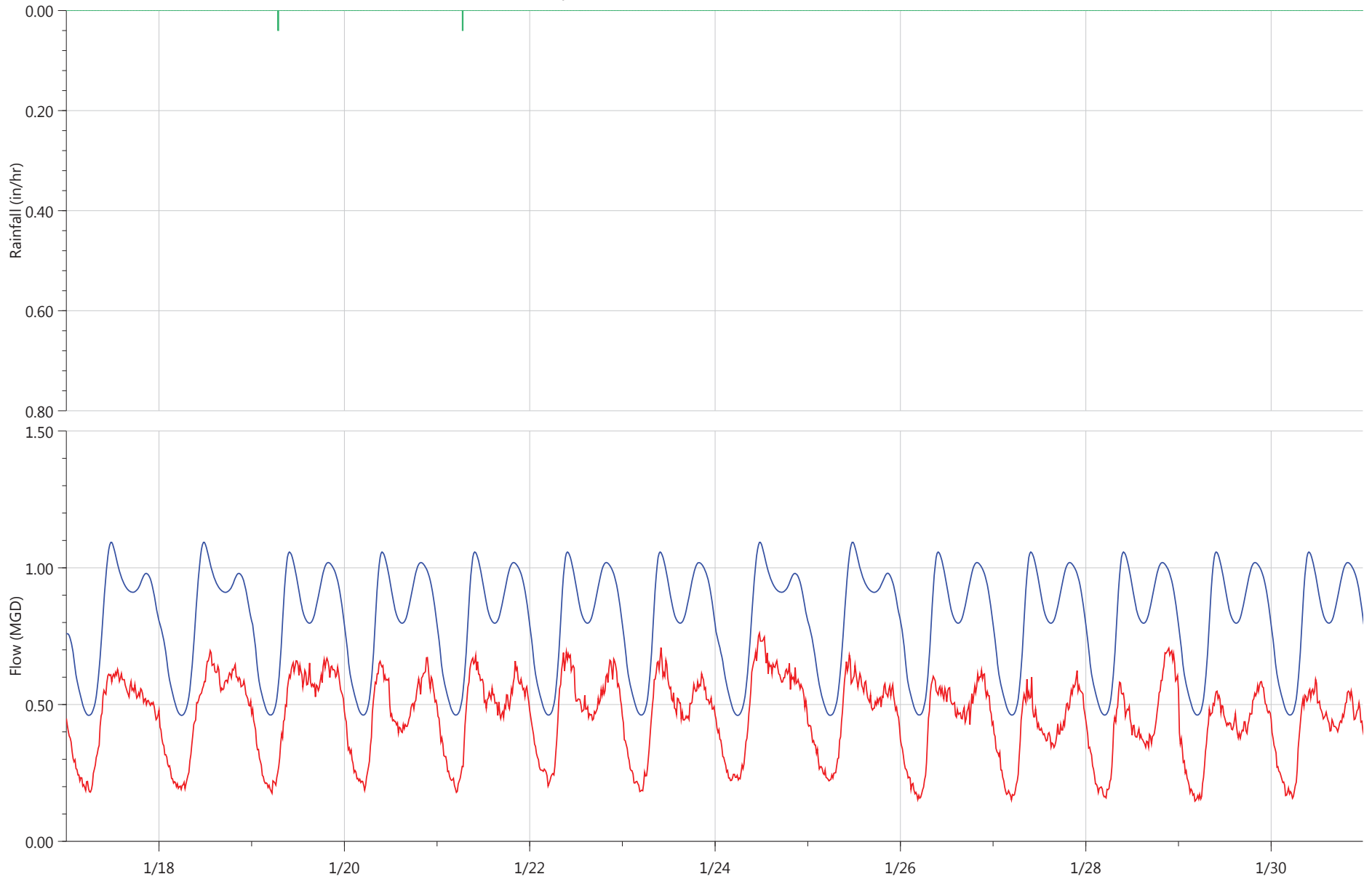
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	—	0.000	0.000	0.000			
Obs.	—				0.745	6.011	48.962
..._1/17/2015+14D (w/GWI)>DWF	—				1.133	5.656	50.242

Flow Survey Location (Obs.) 14 S54-17.1, Rainfall Profile: RG2



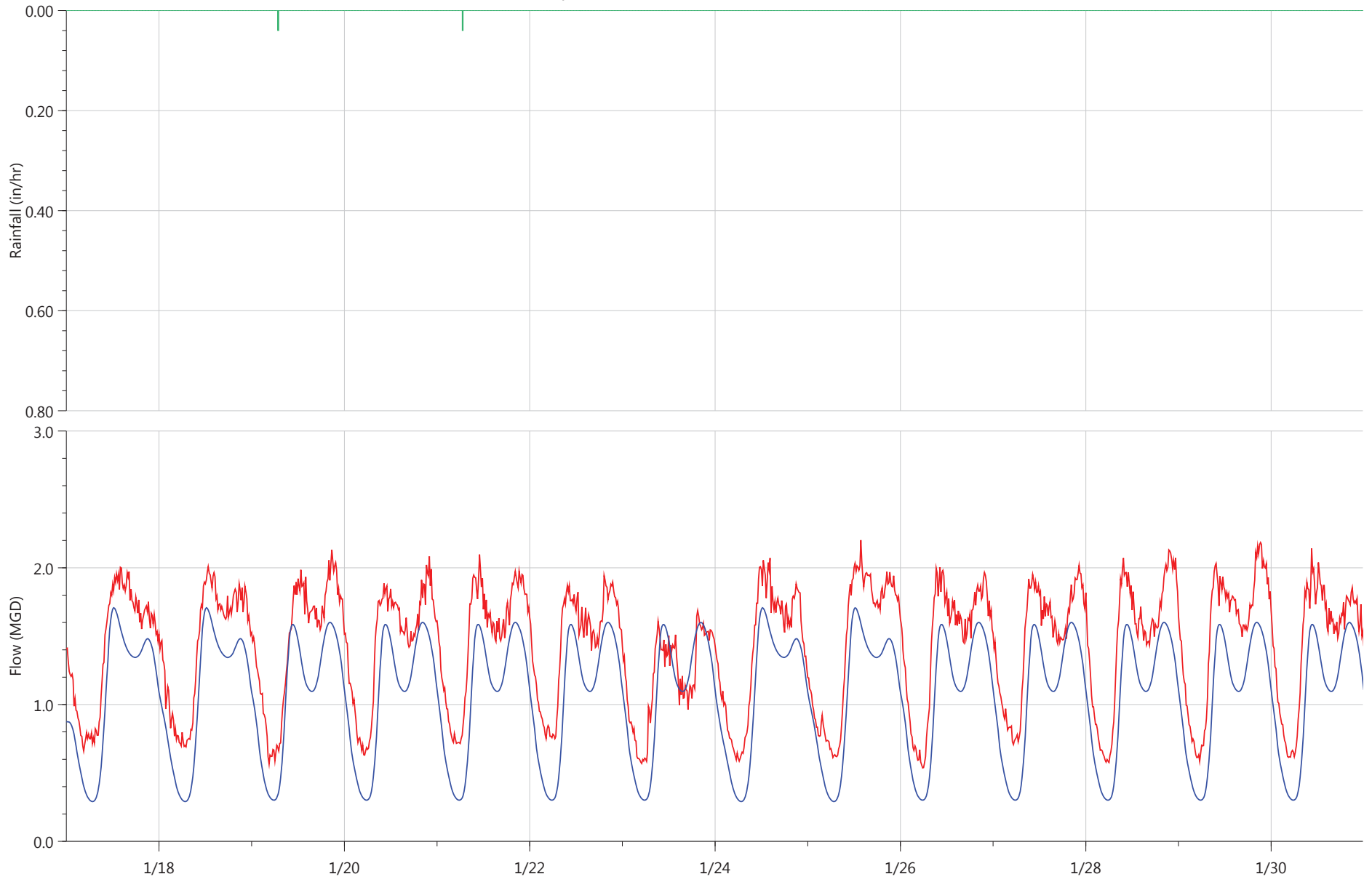
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.000	0.000	0.000			
Obs.				0.187	0.946	7.479
..._1/17/2015+14D (w/GWI)>DWF				0.206	0.769	7.200

Flow Survey Location (Obs.) 15 S65-48.1, Rainfall Profile: RG4



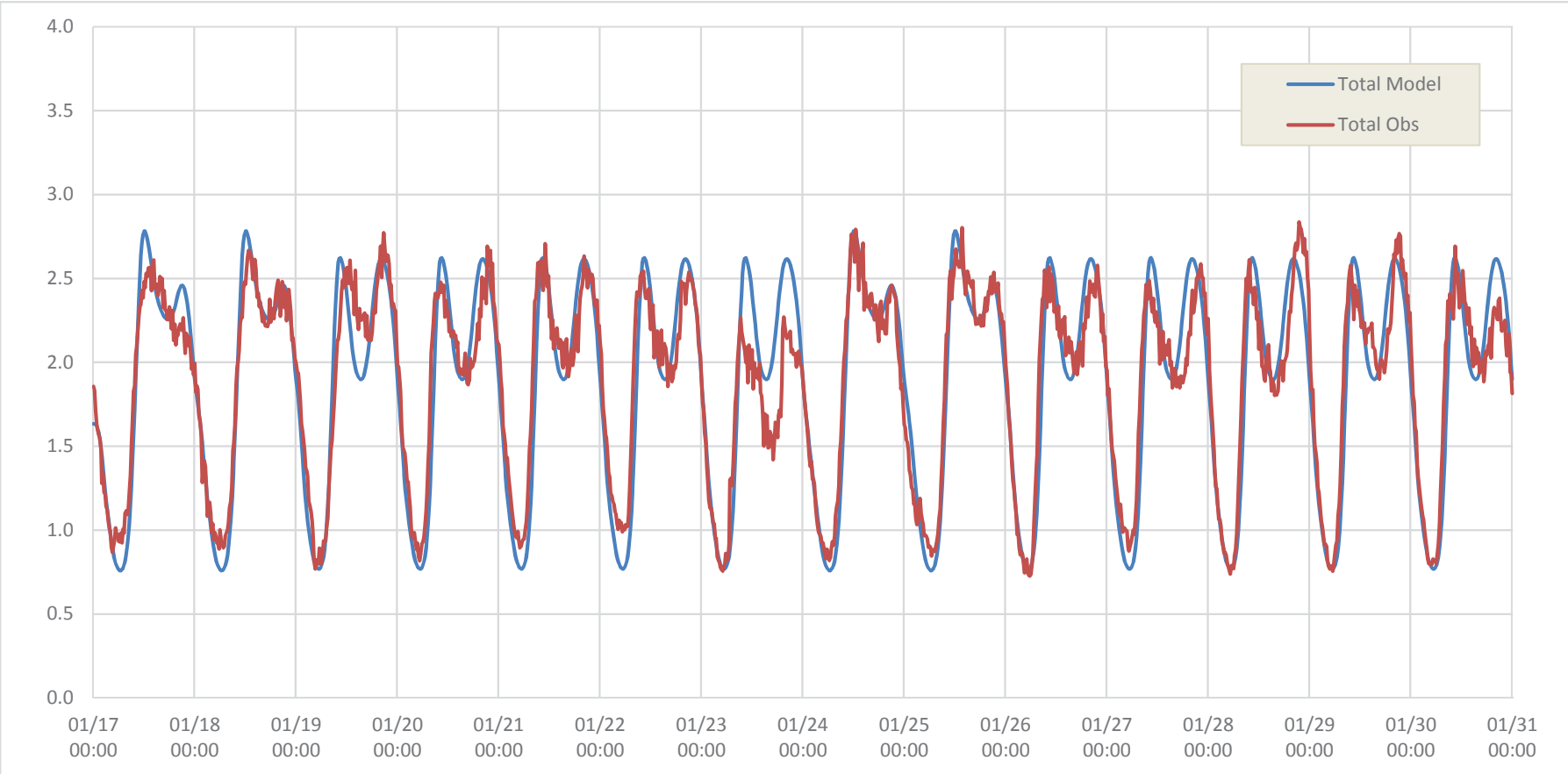
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		0.020	0.040	0.000			
Obs.					0.147	0.761	6.307
..._1/17/2015+14D (w/GWI)>DWF					0.461	1.093	11.320

Flow Survey Location (Obs.) 16 S67-12.1, Rainfall Profile: RG4



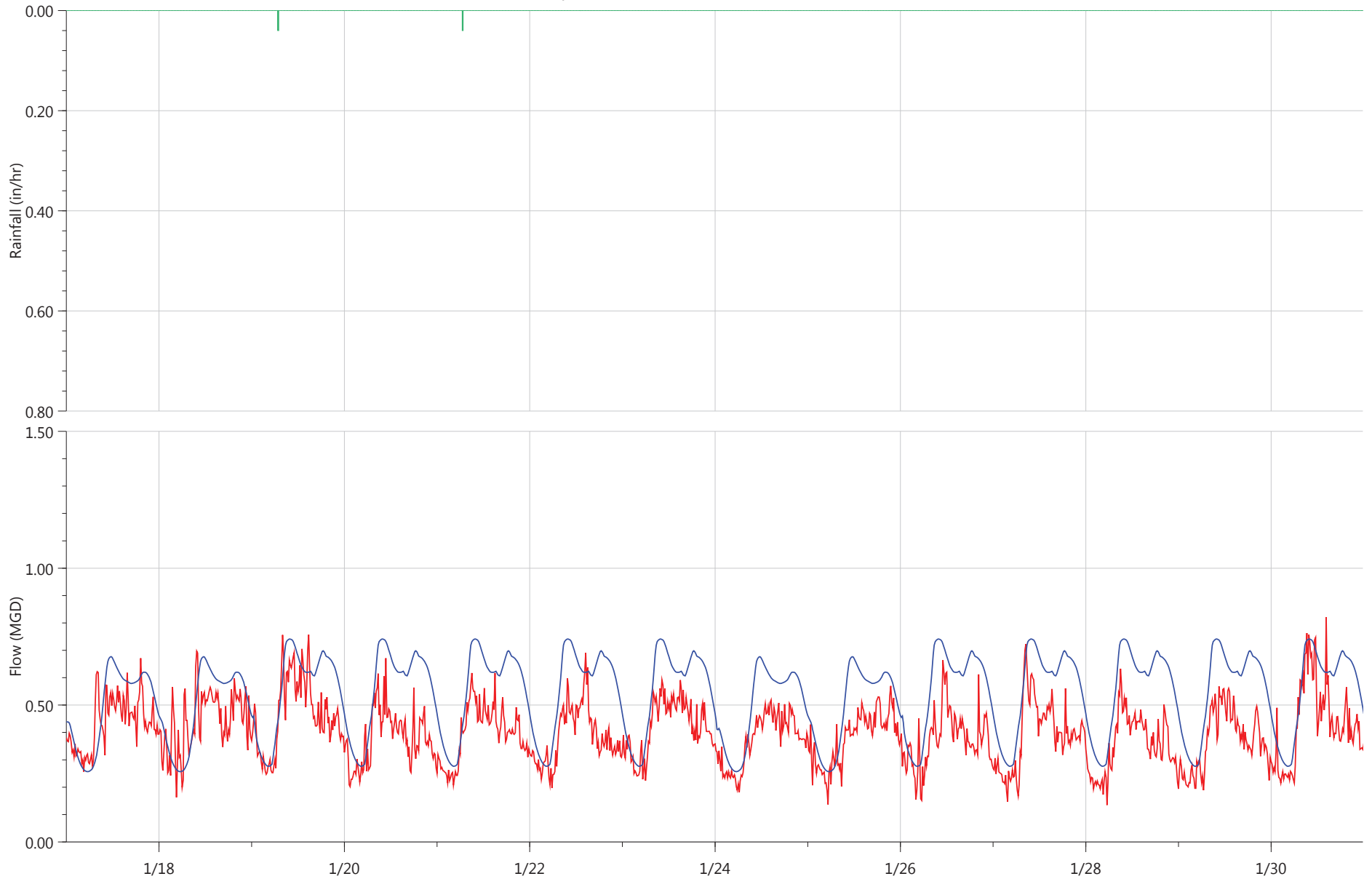
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.020	0.040	0.000			
Obs.				0.537	2.202	20.070
..._1/17/2015+14D (w/GWI)>DWF				0.291	1.708	14.902

Flow Meters 15 + 16



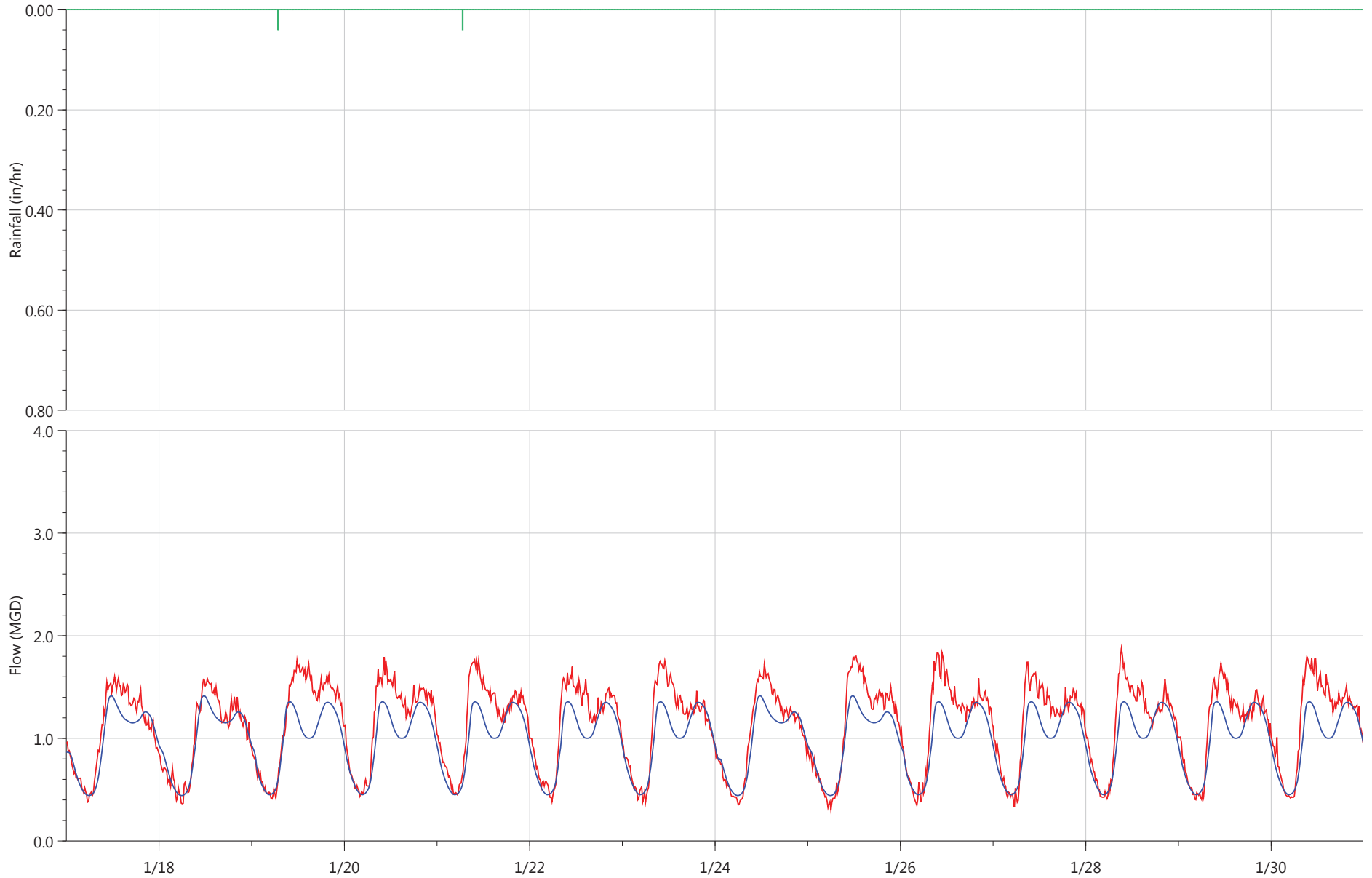
	Min	Max	Volume
Obs	0.726	2.837	26.375
Model	0.759	2.783	26.221

Flow Survey Location (Obs.) 17 S58-12.2, Rainfall Profile: RG4



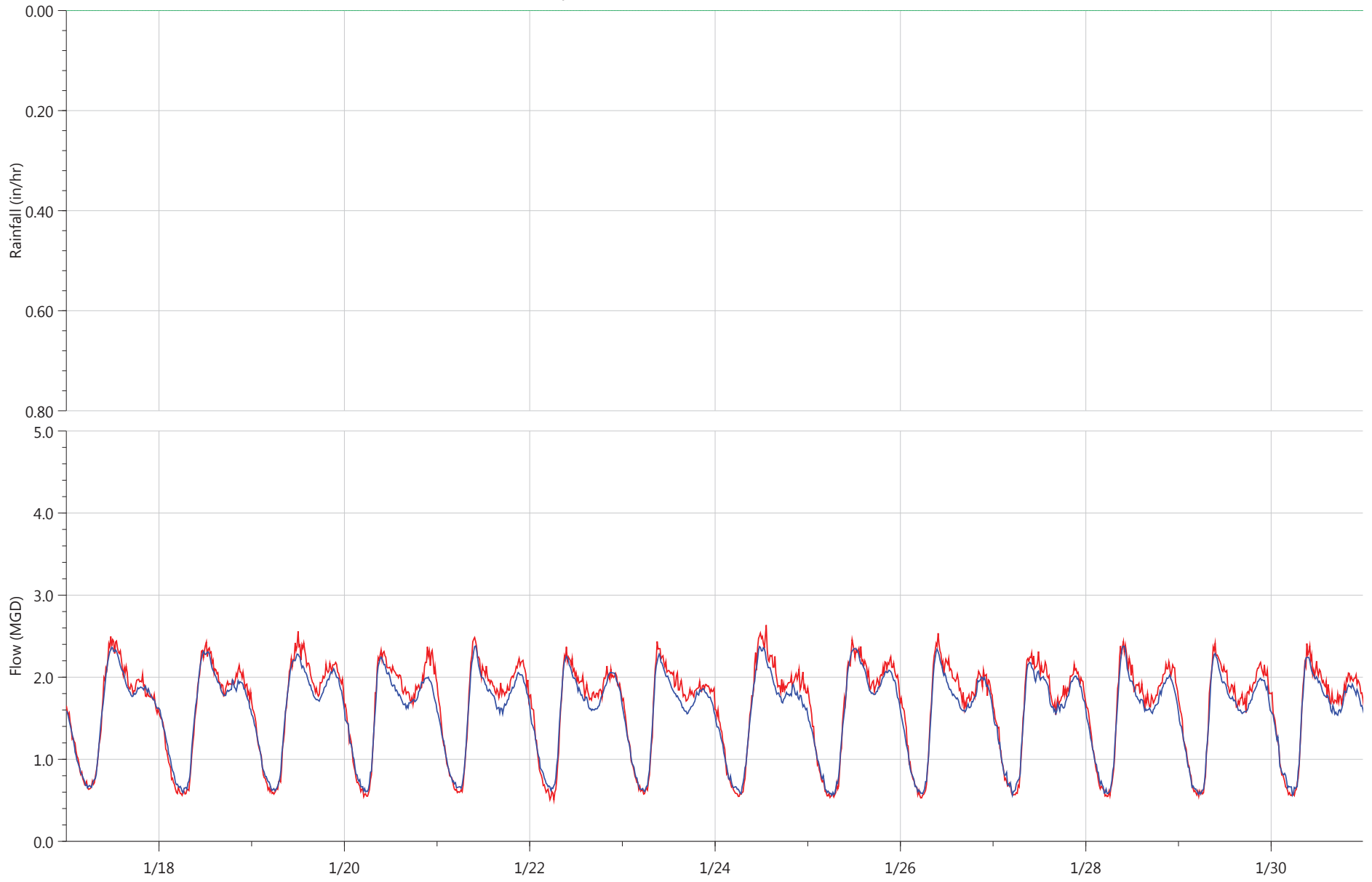
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.020	0.040	0.000			
Obs.				0.135	0.821	5.599
..._1/17/2015+14D (w/GWI)>DWF				0.257	0.741	7.525

Flow Survey Location (Obs.) 18 S58-11.1, Rainfall Profile: RG4



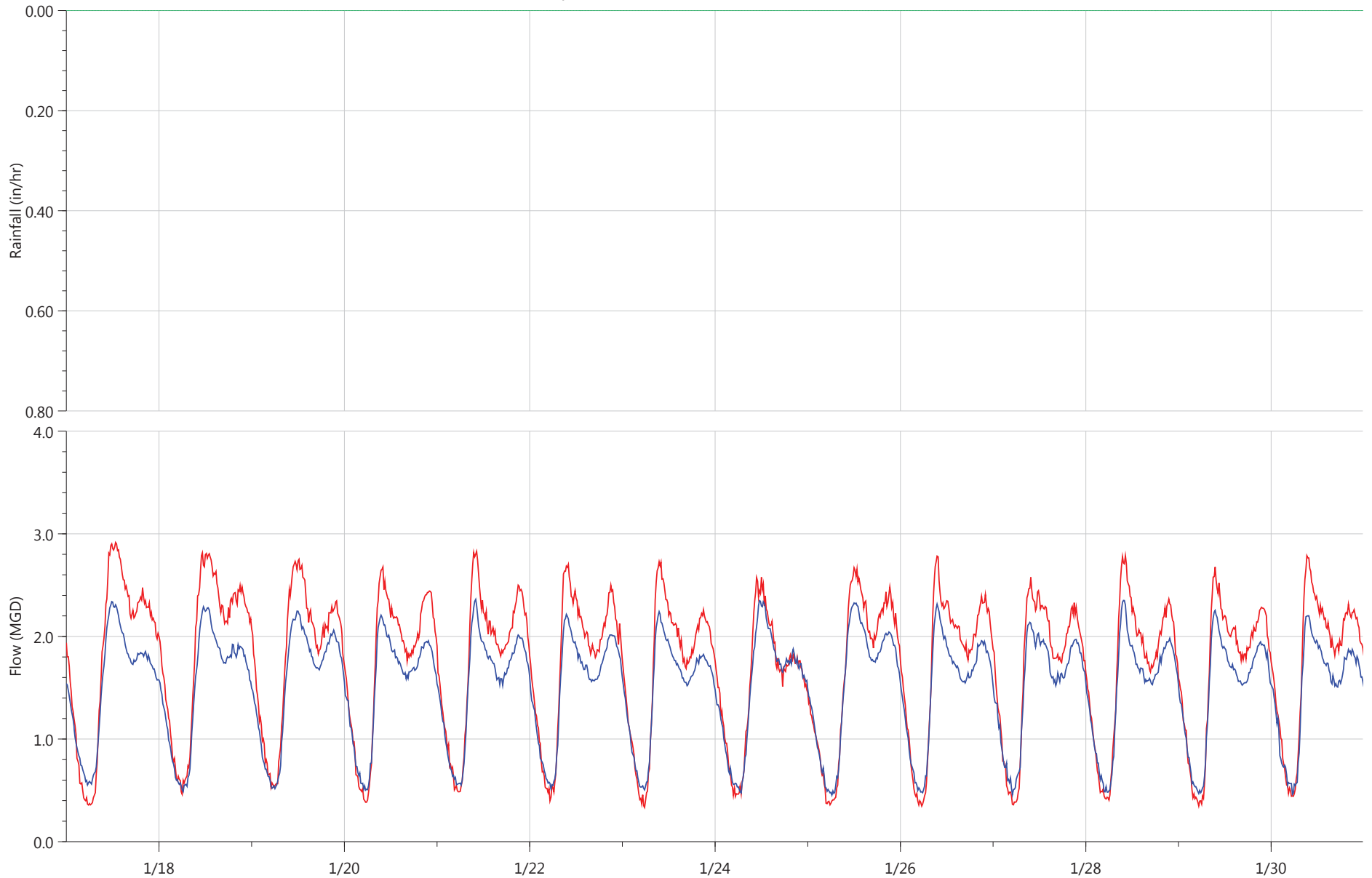
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.020	0.040	0.000			
Obs.				0.300	1.877	15.899
..._1/17/2015+14D (w/GWI)>DWF				0.443	1.415	13.811

Flow Survey Location (Obs.) 19 S21-23.1, Rainfall Profile: RG3



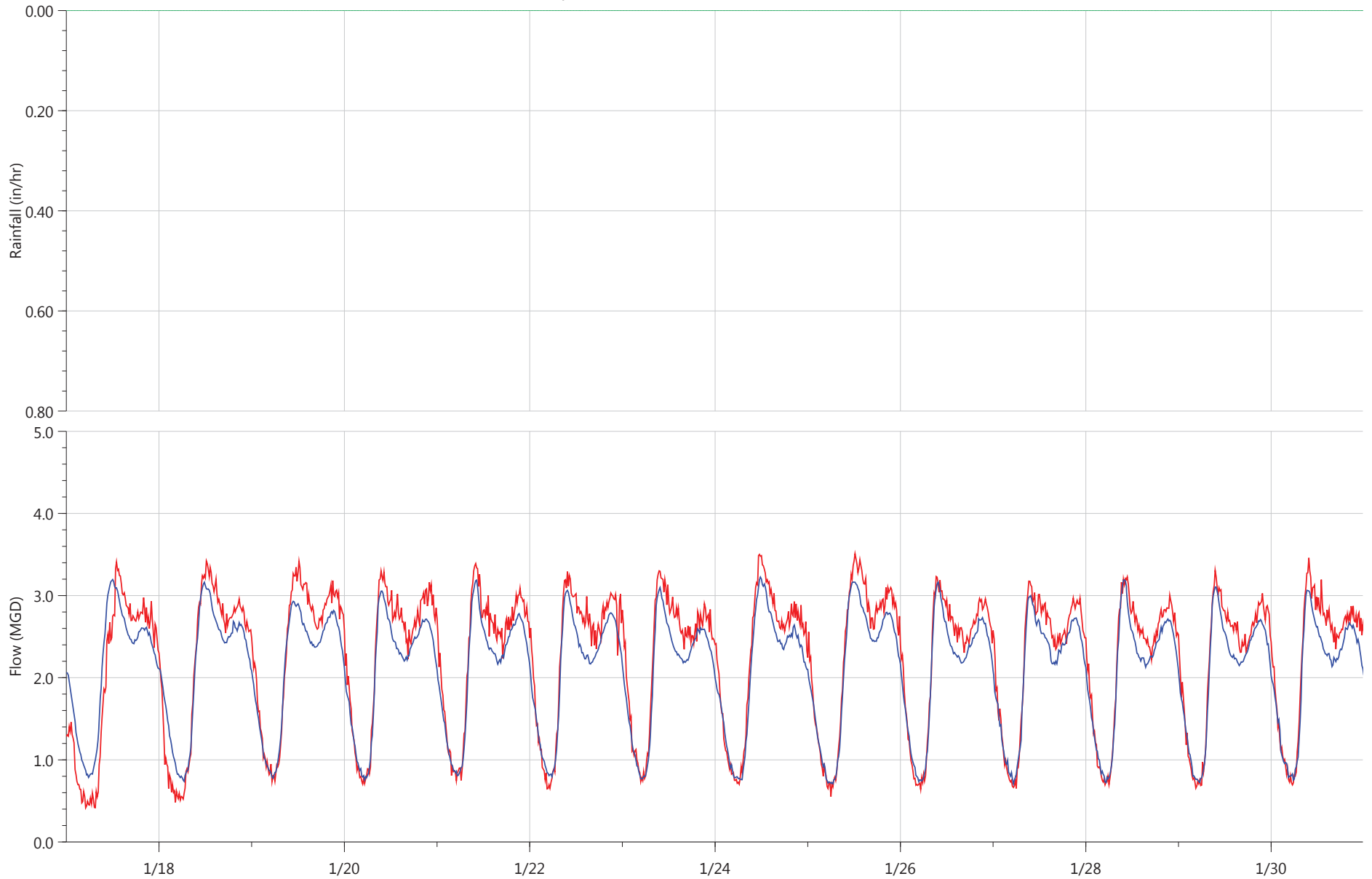
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.000	0.000	0.000			
Obs.				0.503	2.636	22.859
..._1/17/2015+14D (w/GWI)>DWF				0.558	2.382	21.876

Flow Survey Location (Obs.) 20 S21-46.1, Rainfall Profile: RG3



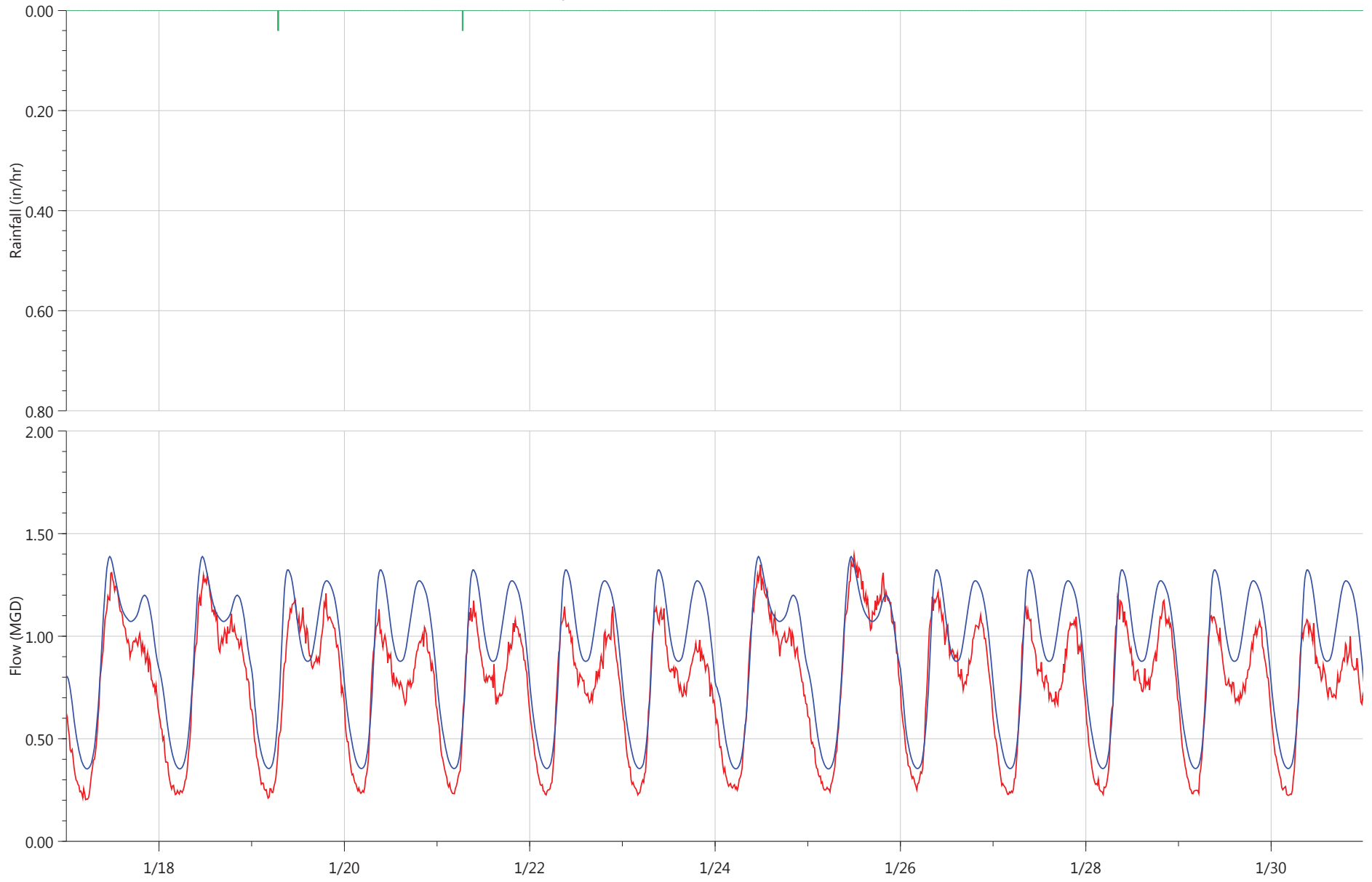
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		0.000	0.000	0.000			
Obs.					0.333	2.916	24.300
..._1/17/2015+14D (w/GWI)>DWF					0.454	2.361	21.124

Flow Survey Location (Obs.) 21 S23-14.1, Rainfall Profile: RG3



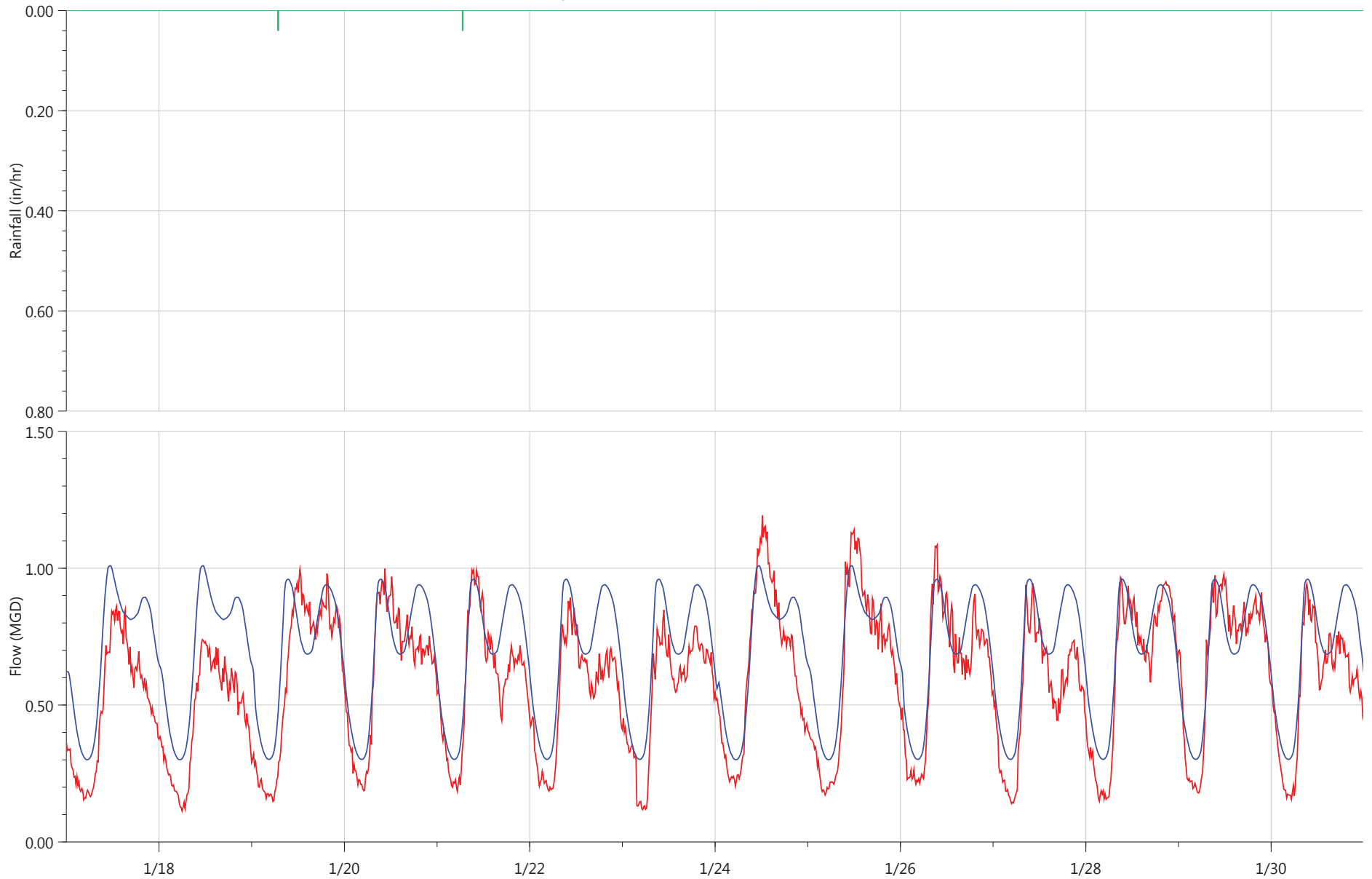
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.000	0.000	0.000			
Obs.				0.415	3.510	31.446
..._1/17/2015+14D (w/GWI)>DWF				0.708	3.224	29.283

Flow Survey Location (Obs.) 22 S45-88.1, Rainfall Profile: RG4



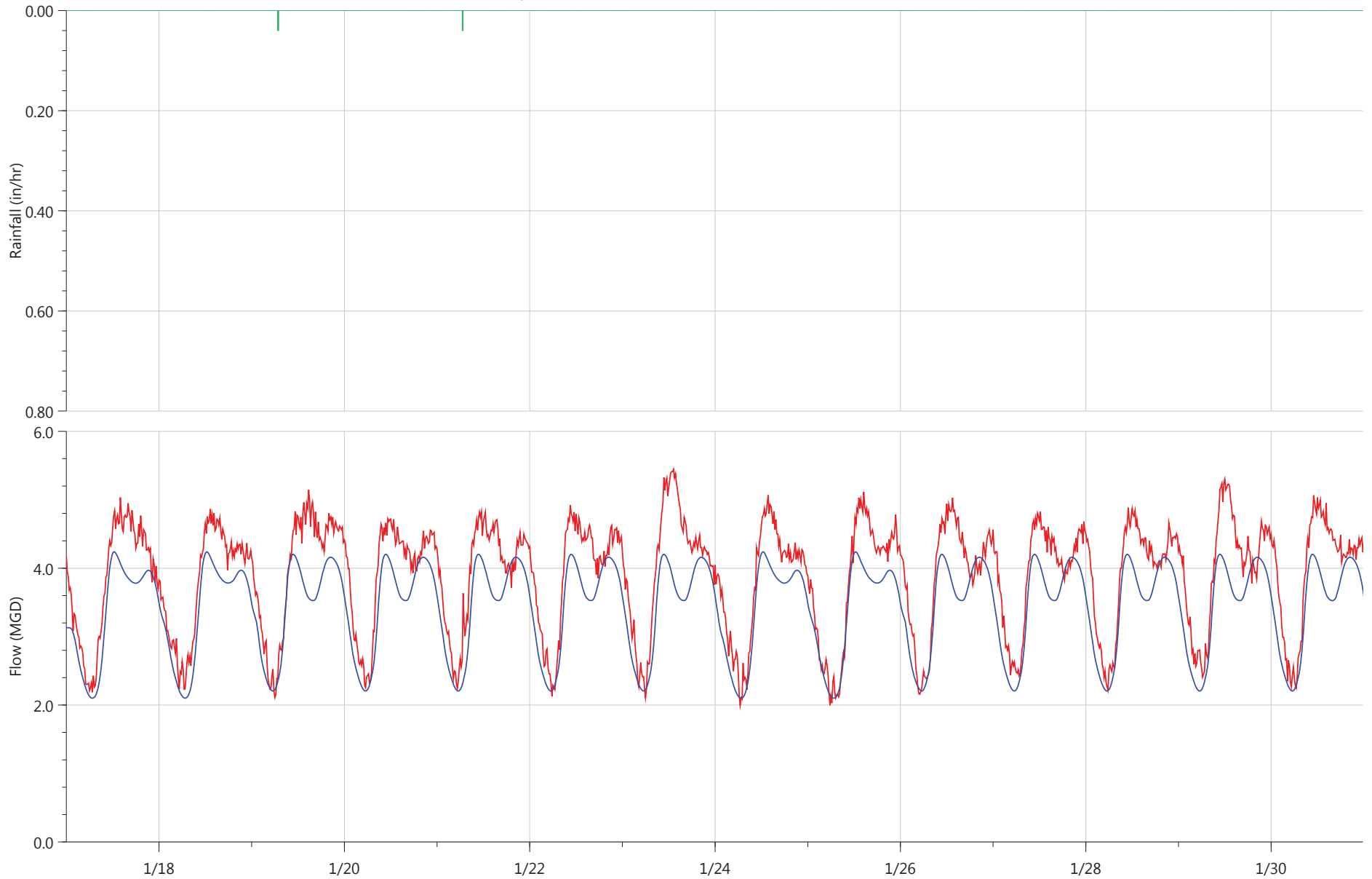
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		0.020	0.040	0.000			
Obs.					0.203	1.396	10.686
..._1/17/2015+14D (w/GWI)>DWF					0.353	1.388	12.715

Flow Survey Location (Obs.) 23 S48-32.1, Rainfall Profile: RG4



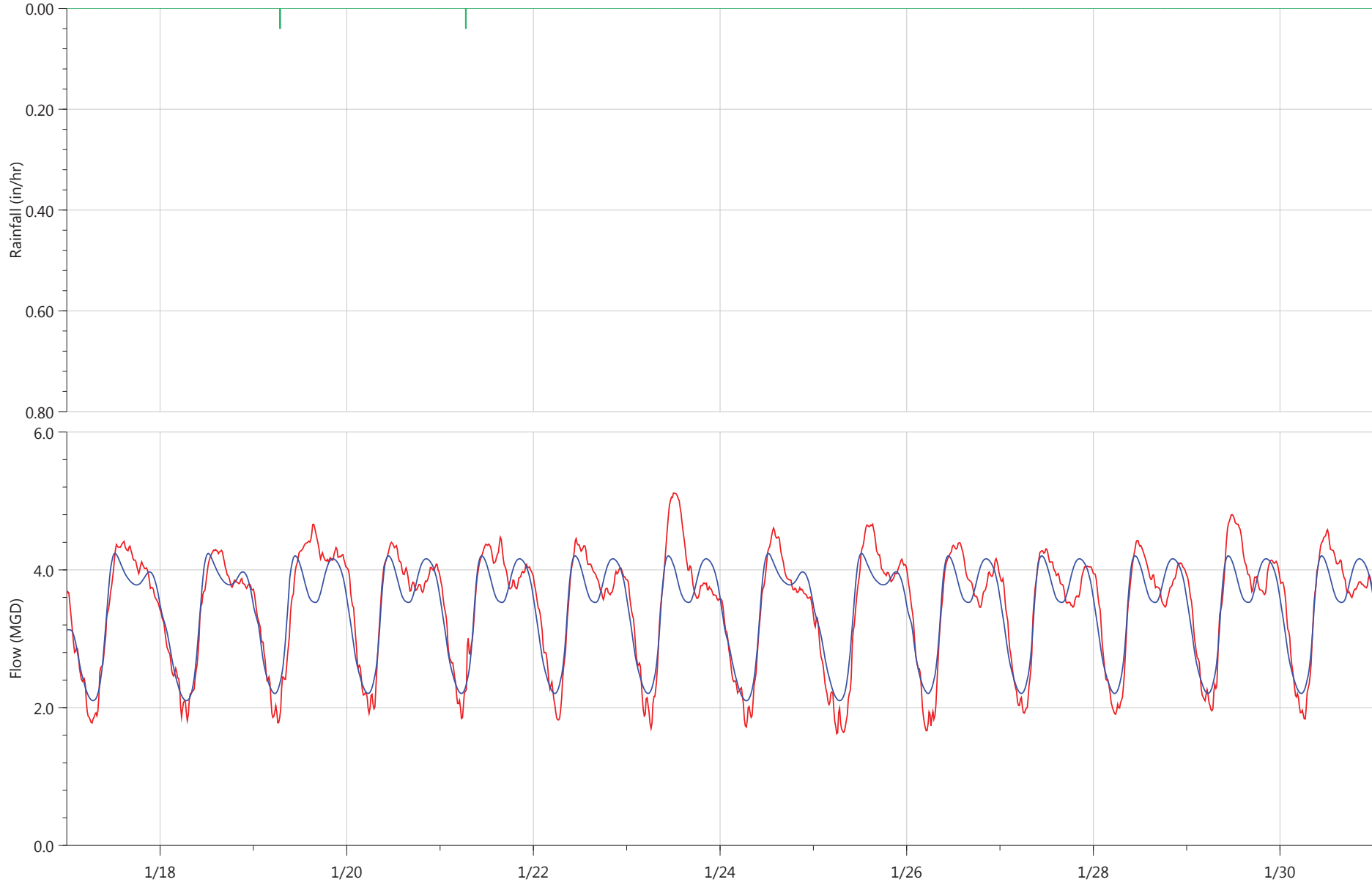
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.020	0.040	0.000			
Obs.				0.113	1.192	8.176
..._1/17/2015+14D (w/GWI)>DWF				0.301	1.009	9.675

Flow Survey Location (Obs.) GuadEast V&A S68-14.1, Rainfall Profile: RG4



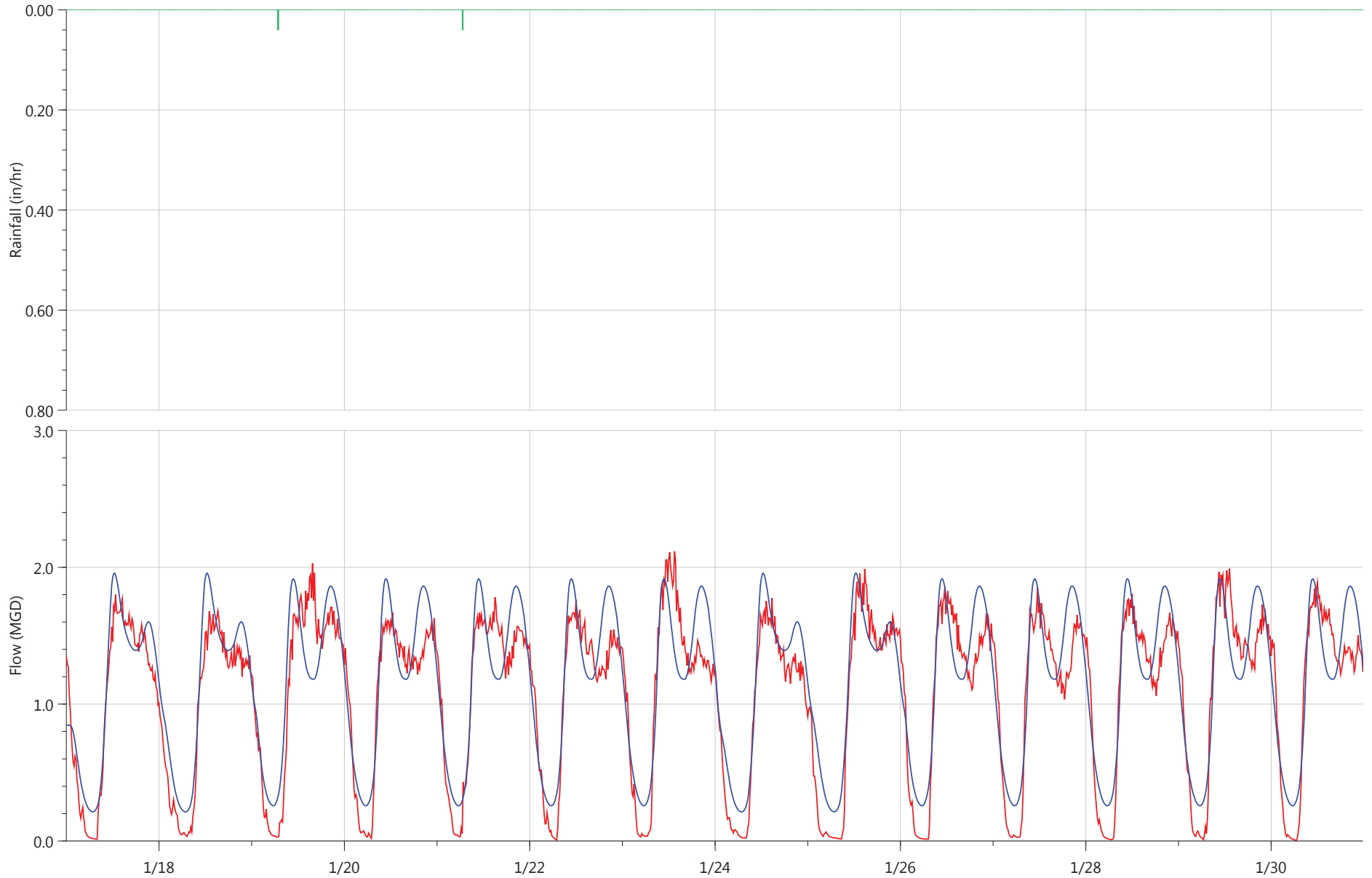
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.020	0.040	0.000			
Obs.				1.997	5.446	54.478
..._1/17/2015+14D (w/GWI)>DWF				2.101	4.238	47.805

Flow Survey Location (Obs.) GuadEast FloDar S68-14.1, Rainfall Profile: RG4



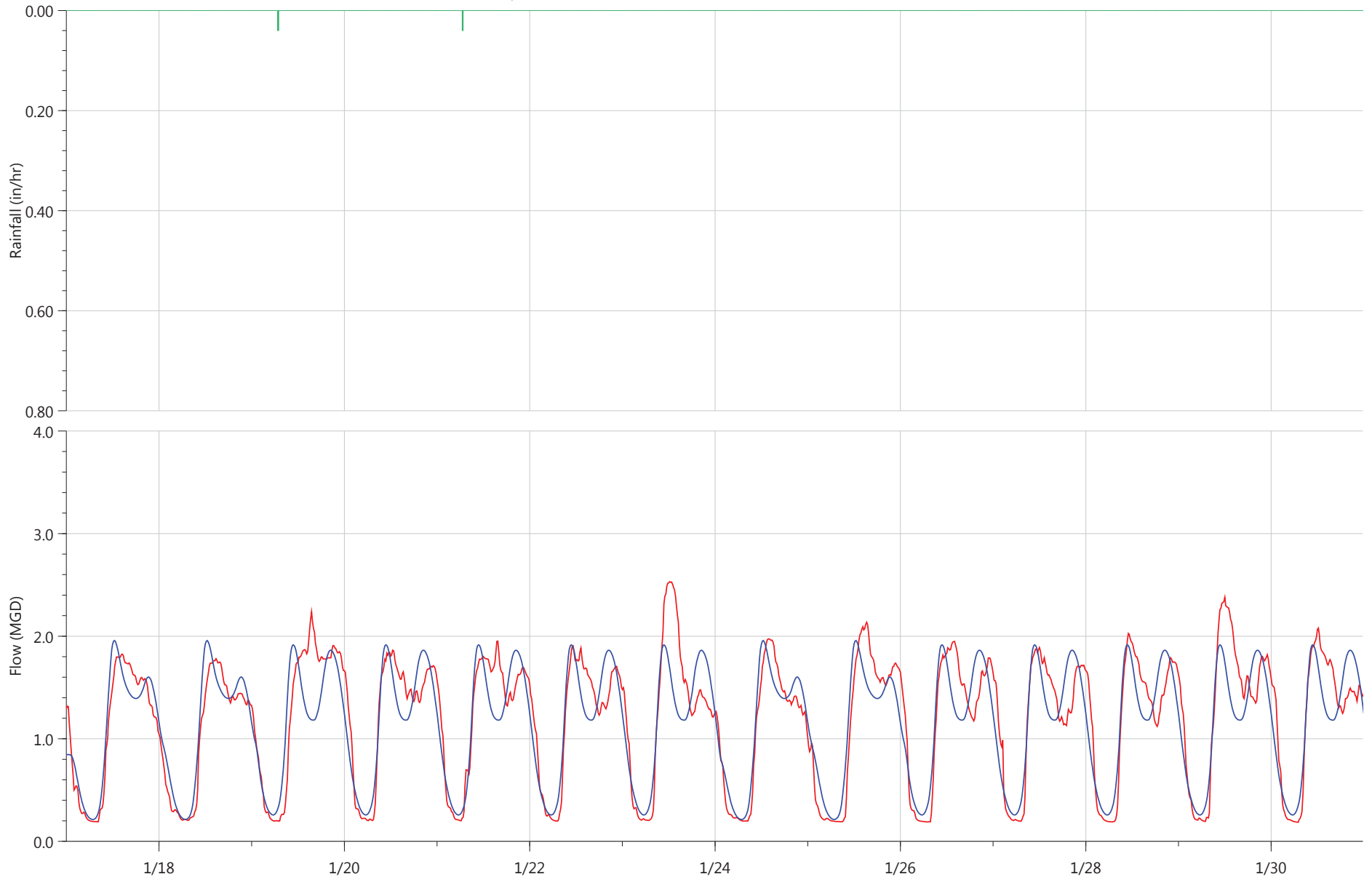
	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.020	0.040	0.000			
Obs.				1.622	5.114	48.531
..._1/17/2015+14D (w/GWI)>DWF				2.101	4.238	47.805

Flow Survey Location (Obs.) GuadWest V&A S68-13.1, Rainfall Profile: RG4



		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		0.020	0.040	0.000			
Obs.					0.003	2.117	14.968
..._1/17/2015+14D (w/GWI)>DWF					0.213	1.957	16.190

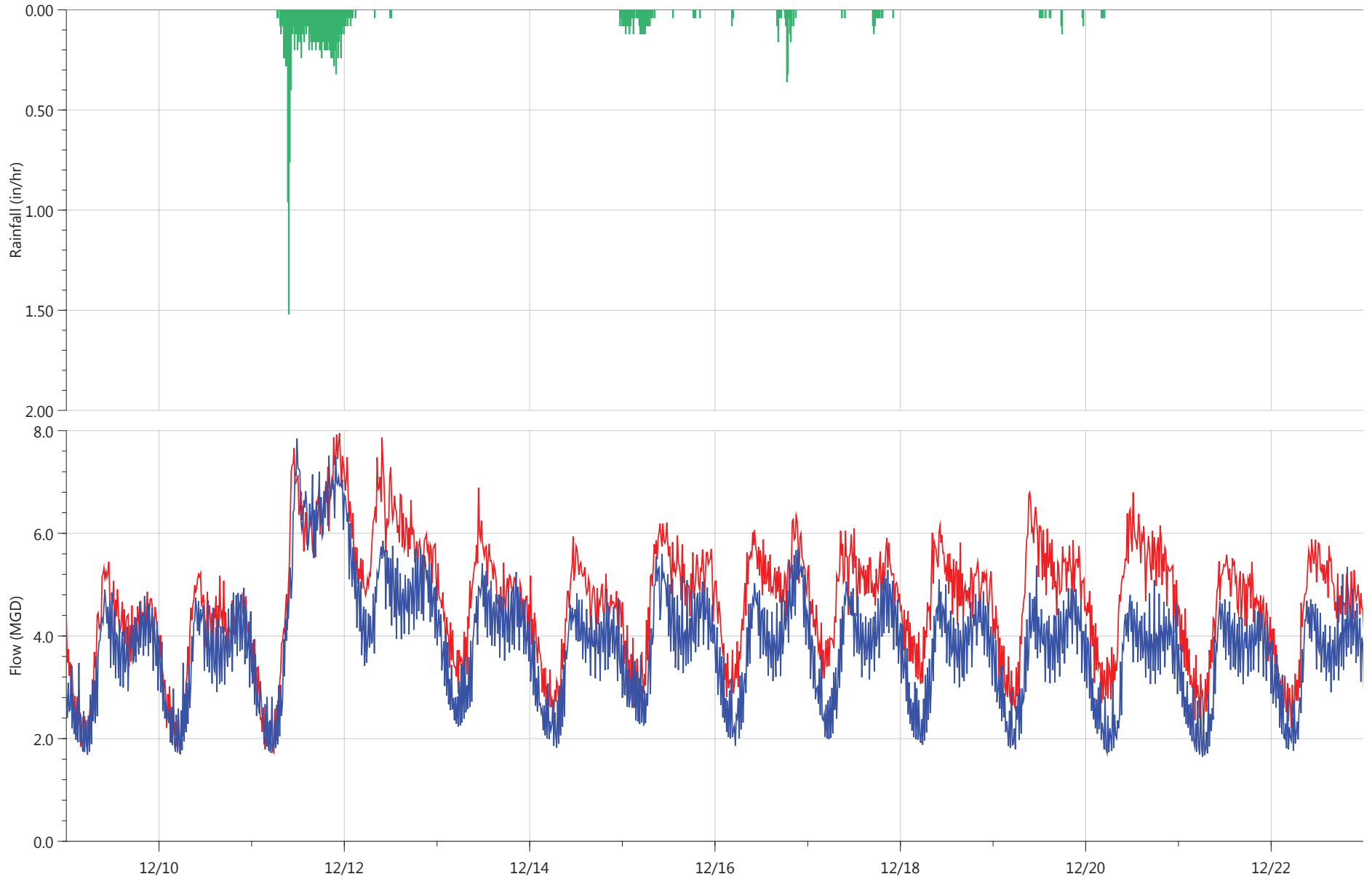
Flow Survey Location (Obs.) GuadWest FloDar S68-13.1, Rainfall Profile: RG4



	Rainfall			Flow (MGD)		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain	0.020	0.040	0.000			
Obs.				0.186	2.531	16.561
..._1/17/2015+14D (w/GWI)>DWF				0.213	1.957	16.190

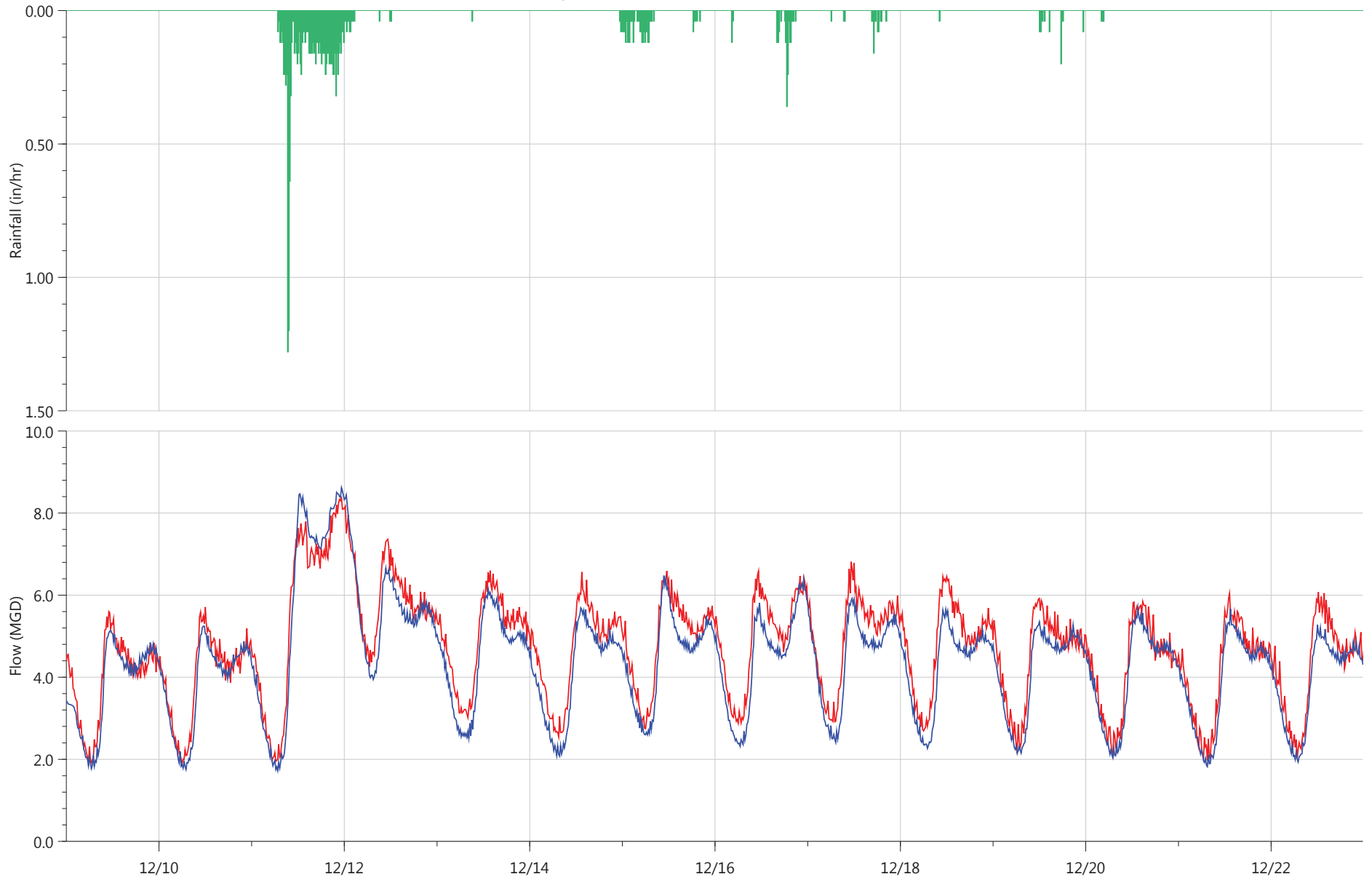
Appendix C - Wet Weather Flow Calibration Graphs

Flow Survey Location (Obs.) 1 S104-29.1, Rainfall Profile: RG1



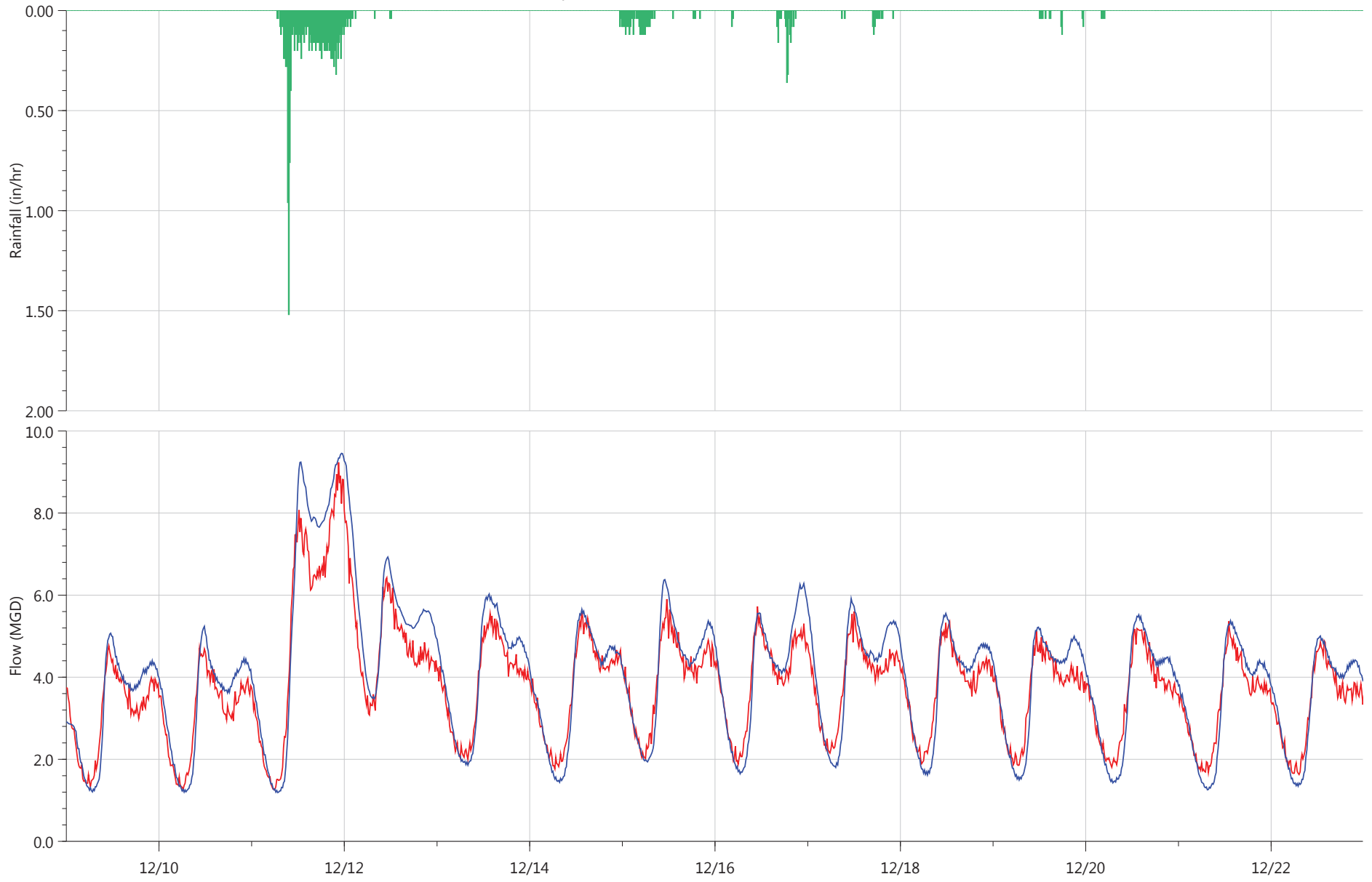
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		5.220	1.520	0.016			
Obs.					1.694	7.950	65.331
...WI>Rainfall Event (11/18-3/05)					1.645	7.846	53.371

Flow Survey Location (Obs.) 2 S104-24.1, Rainfall Profile: RG2



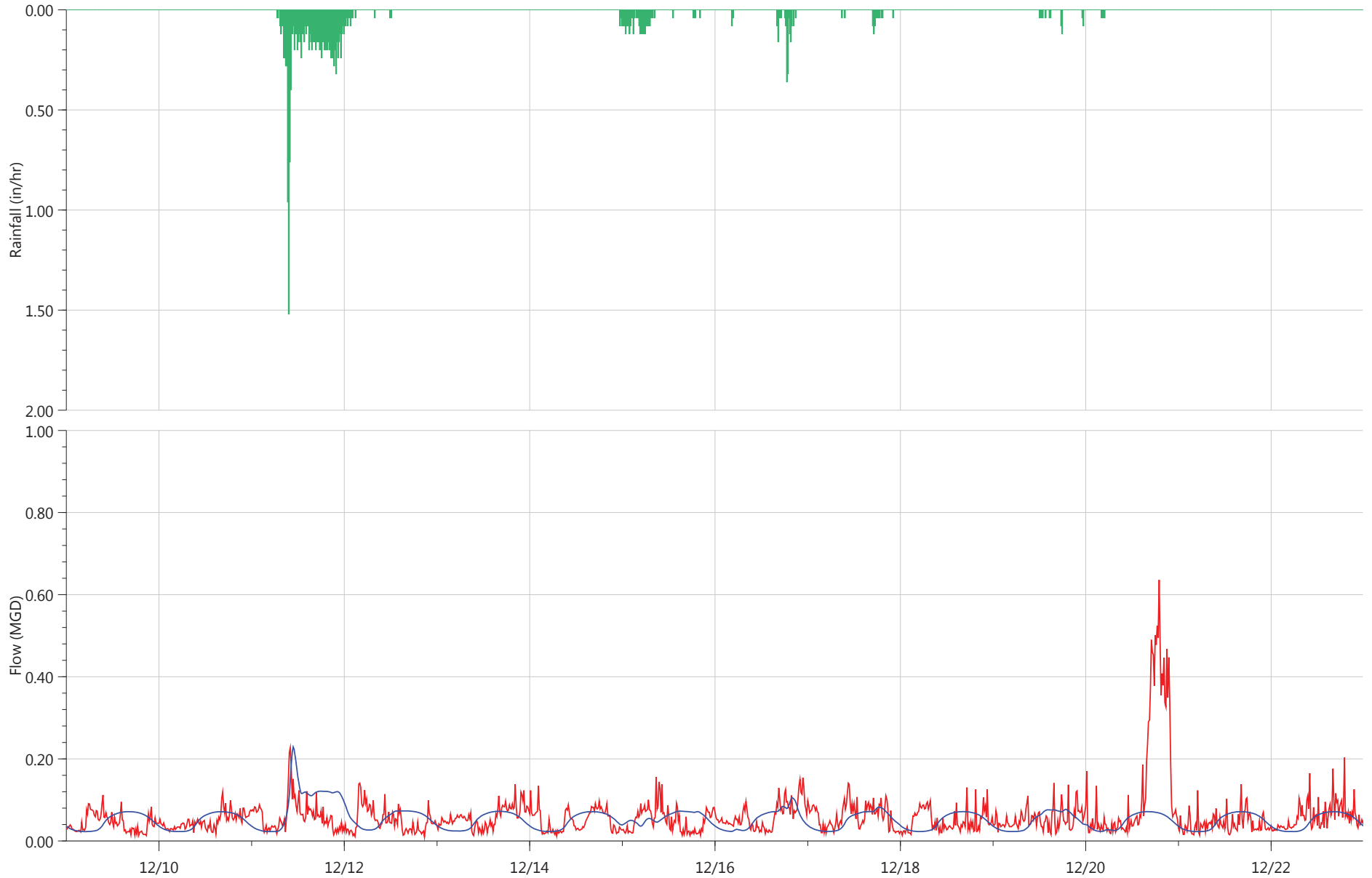
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.990	1.280	0.015			
Obs.					1.906	8.363	65.865
...WI>Rainfall Event (11/18-3/05)					1.723	8.618	60.850

Flow Survey Location (Obs.) 3 S104-27.1, Rainfall Profile: RG1



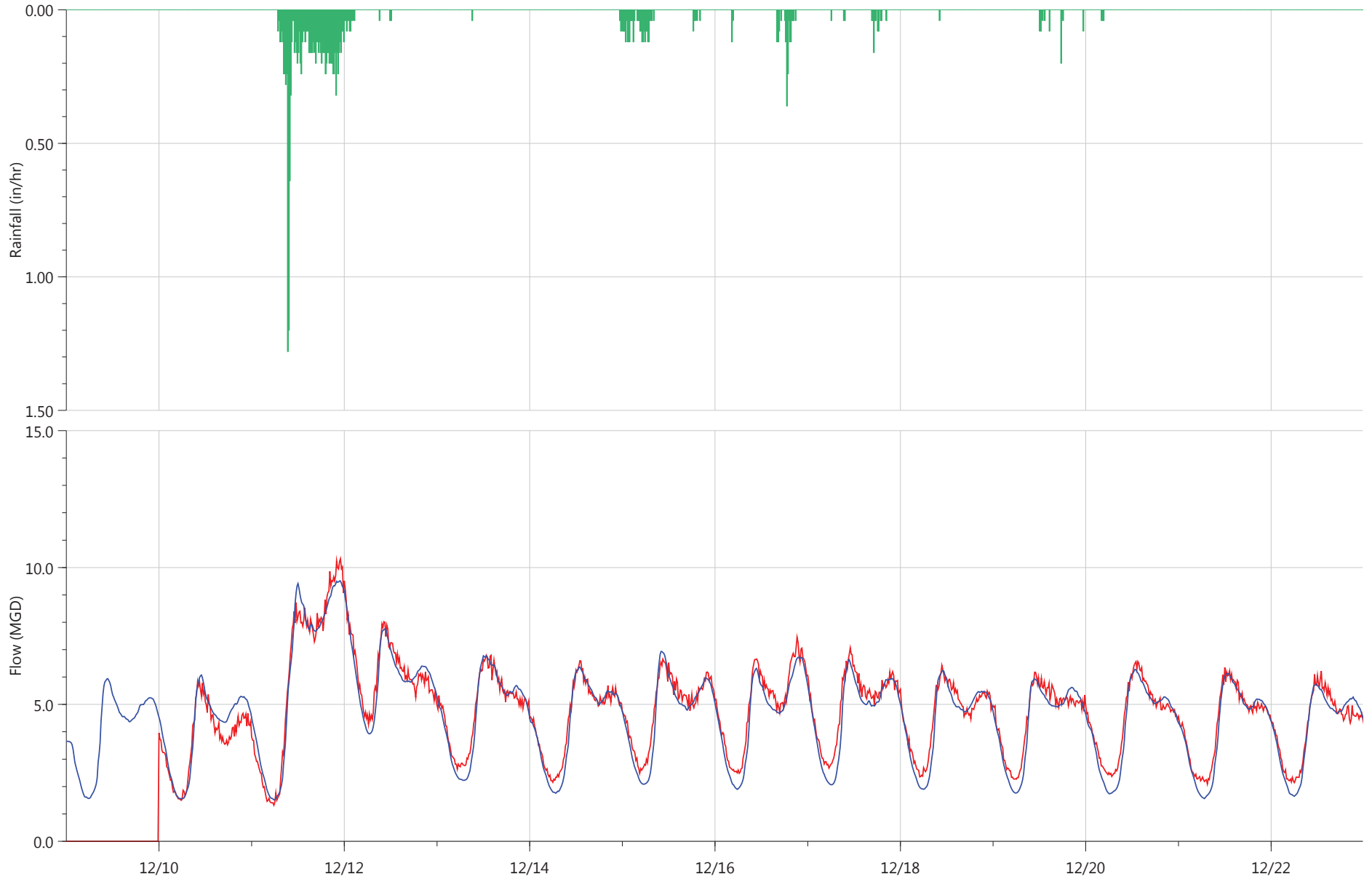
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		5.220	1.520	0.016			
Obs.					1.254	9.236	53.265
...WI>Rainfall Event (11/18-3/05)					1.187	9.456	56.356

Flow Survey Location (Obs.) 4 SSMH #401.1, Rainfall Profile: RG1



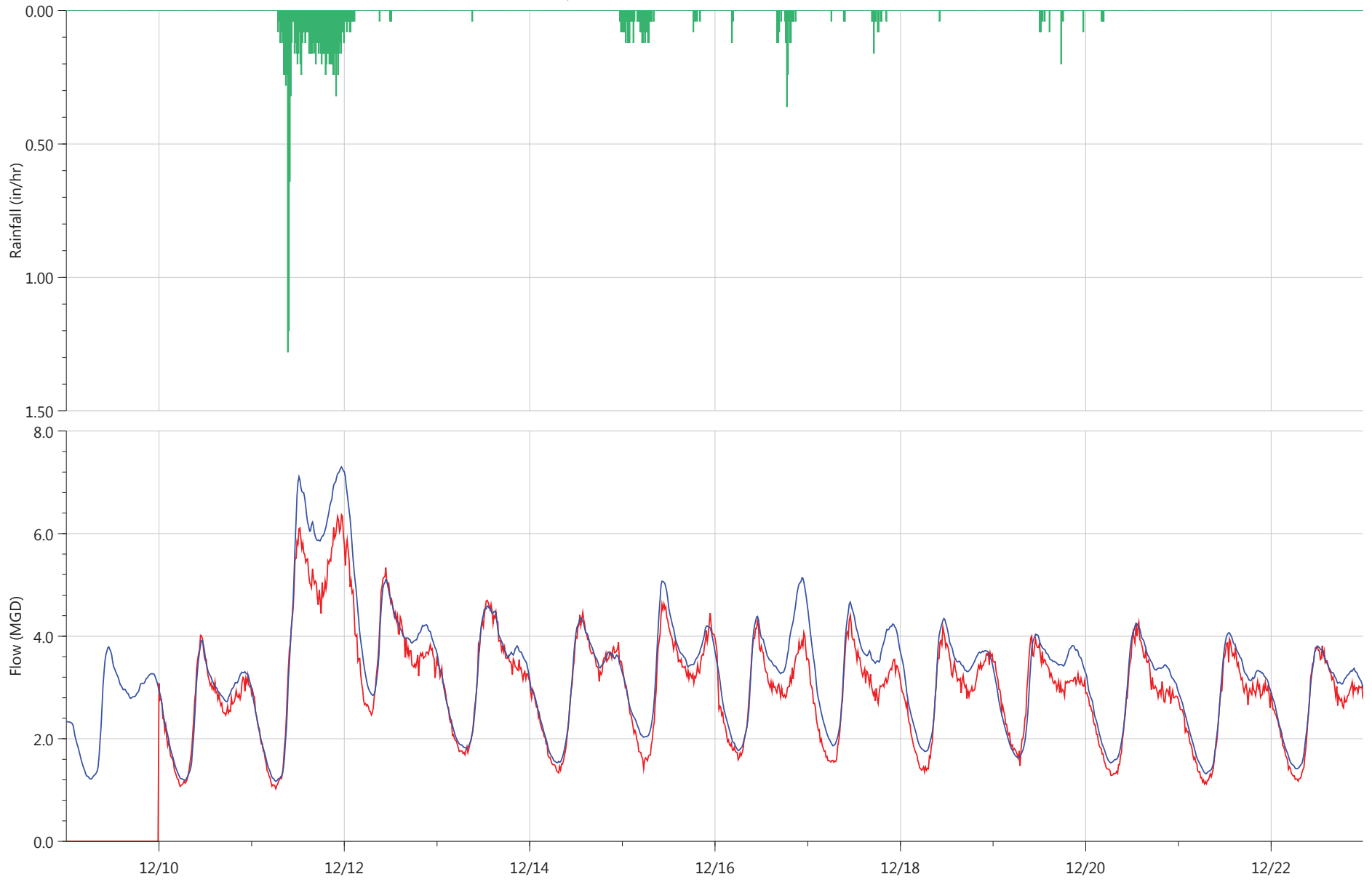
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		5.220	1.520	0.016			
Obs.					0.010	0.636	0.834
...WI>Rainfall Event (11/18-3/05)					0.023	0.229	0.737

Flow Survey Location (Obs.) 5 S83-23.1, Rainfall Profile: RG2



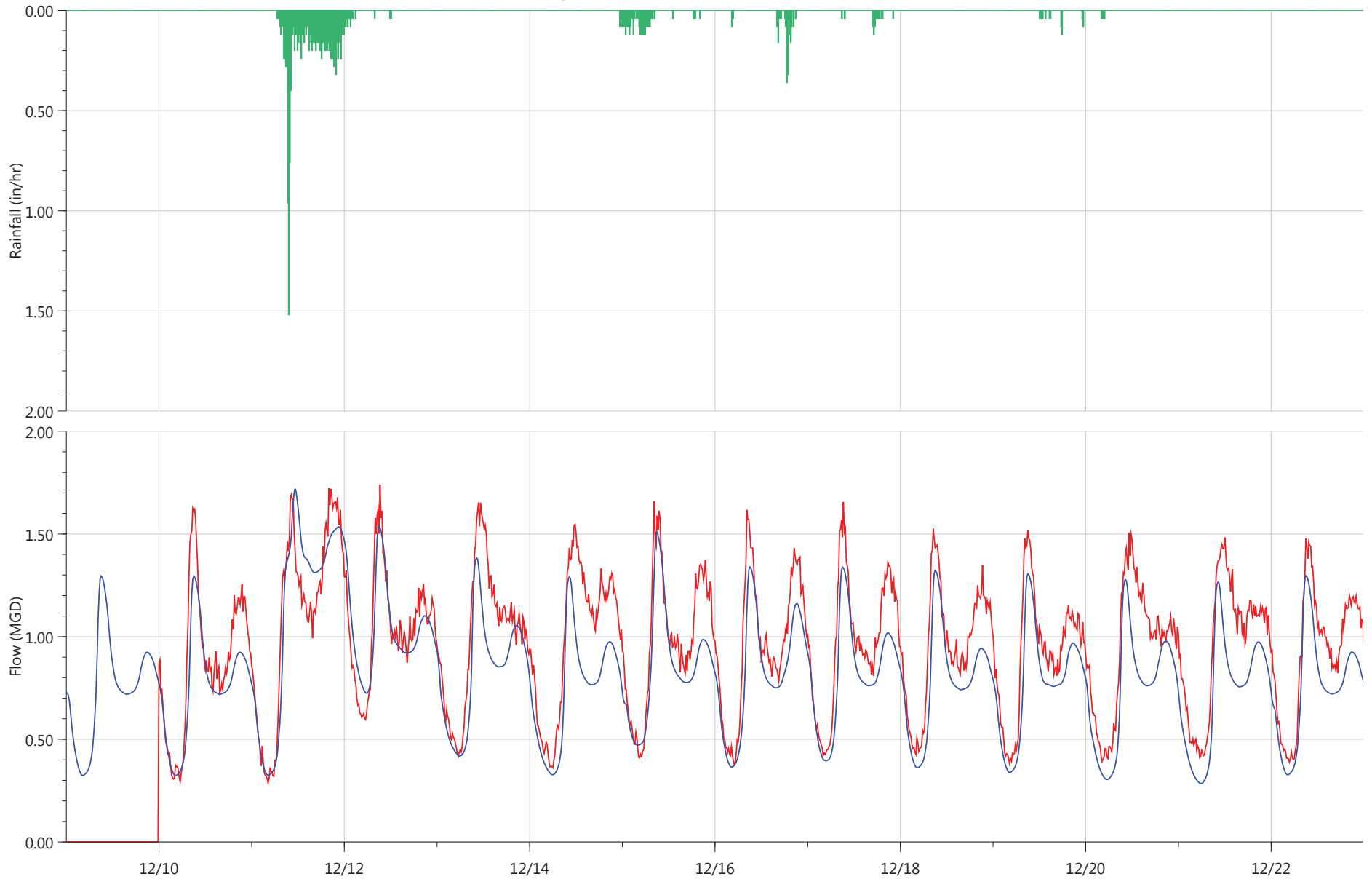
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.990	1.280	0.015			
Obs.					0.000	10.323	62.567
...WI>Rainfall Event (11/18-3/05)					1.516	9.510	64.535

Flow Survey Location (Obs.) 6 S83-25.1, Rainfall Profile: RG2



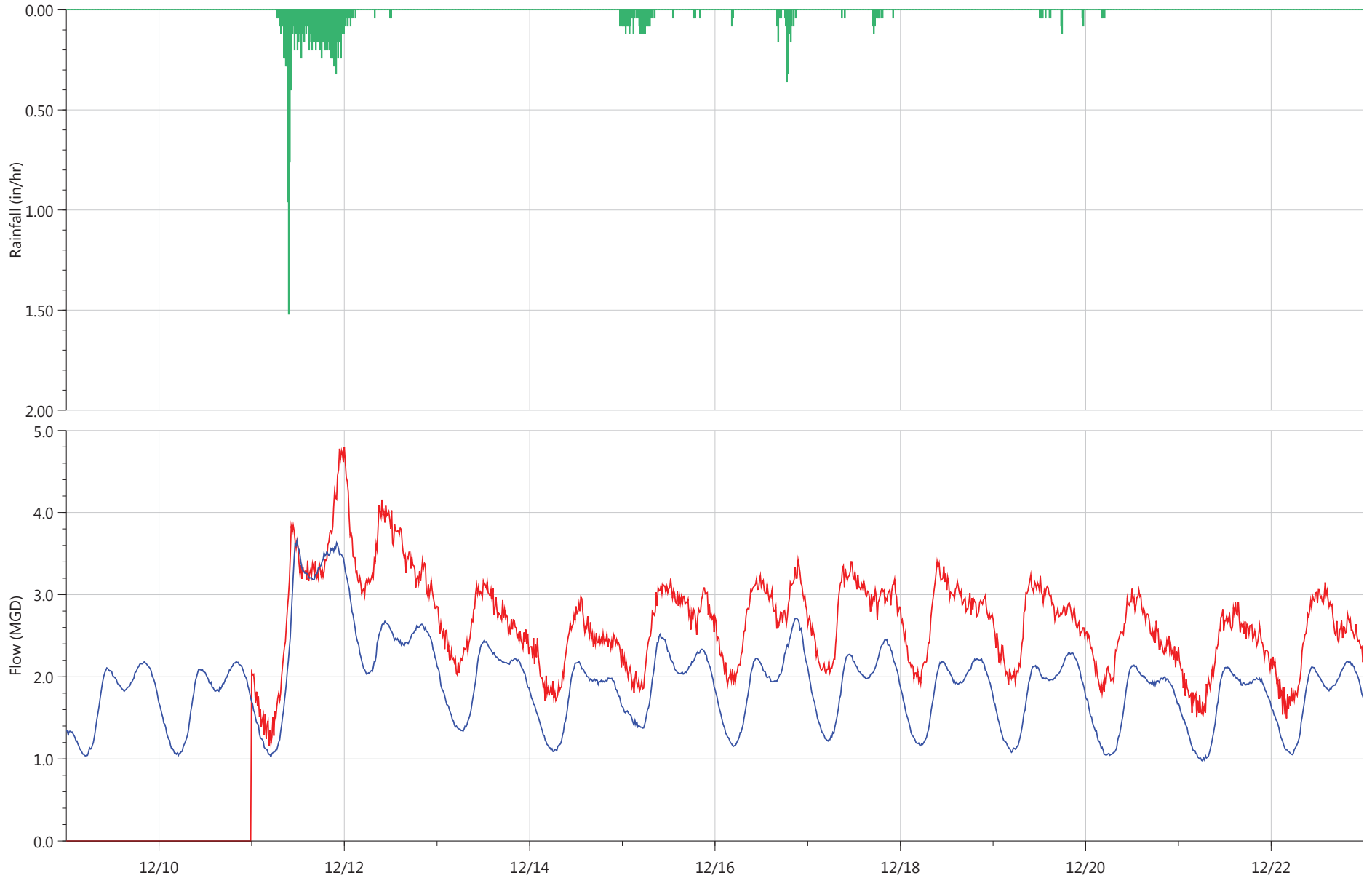
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.990	1.280	0.015			
Obs.					0.000	6.367	39.162
...WI>Rainfall Event (11/18-3/05)					1.170	7.299	45.162

Flow Survey Location (Obs.) 7 S105-35.1, Rainfall Profile: RG1



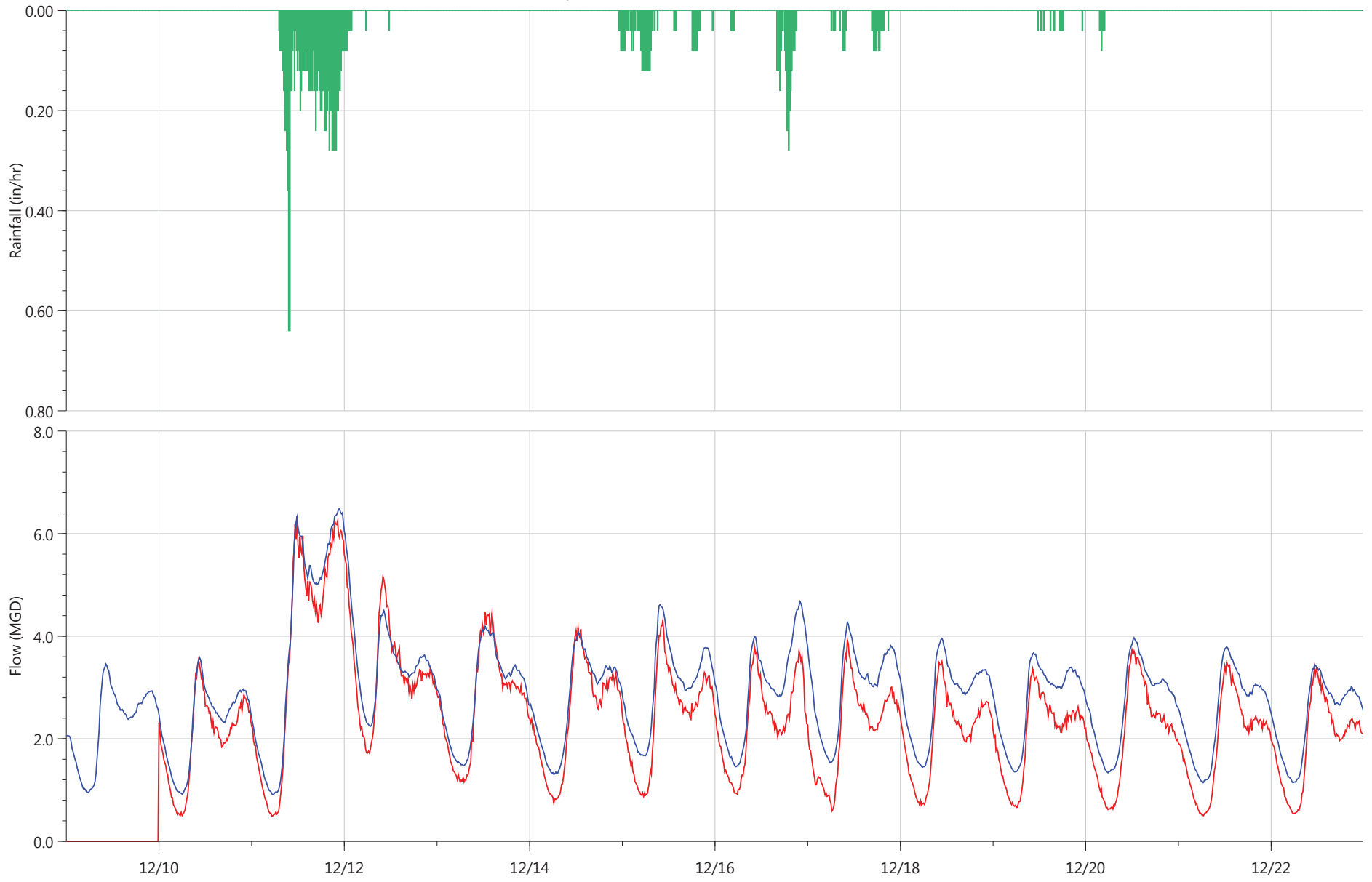
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		5.220	1.520	0.016			
Obs.					0.000	1.740	12.614
...WI>Rainfall Event (11/18-3/05)					0.285	1.719	11.473

Flow Survey Location (Obs.) 8 S86-13.1, Rainfall Profile: RG1



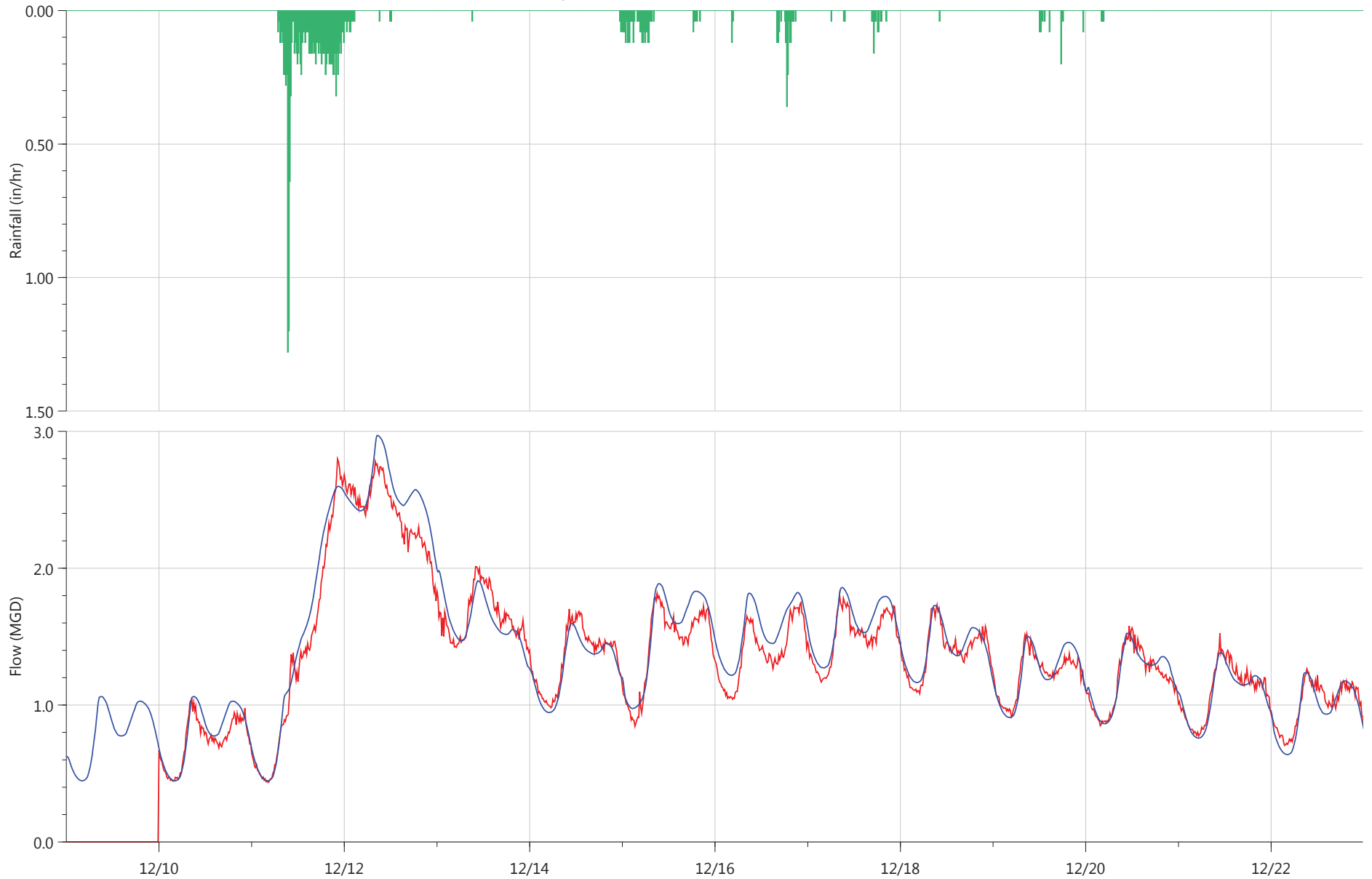
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		5.220	1.520	0.016			
Obs.					0.000	4.800	32.032
...WI>Rainfall Event (11/18-3/05)					0.976	3.654	26.675

Flow Survey Location (Obs.) 9 S62-48.1, Rainfall Profile: RG3



		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.910	0.640	0.015			
Obs.					0.000	6.343	31.348
...WI>Rainfall Event (11/18-3/05)					0.909	6.485	39.902

Flow Survey Location (Obs.) 10 S52-80.1, Rainfall Profile: RG2



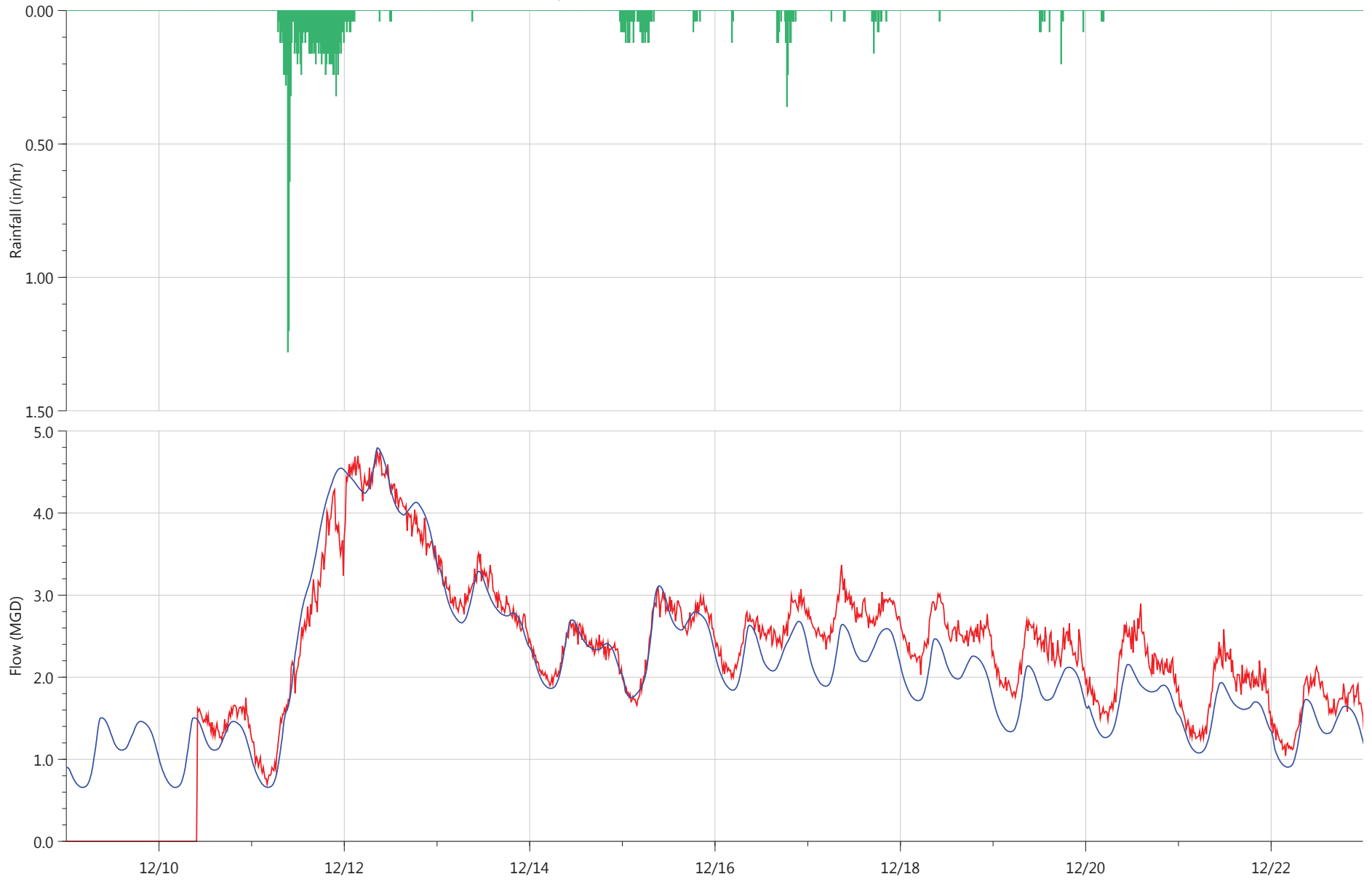
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.990	1.280	0.015			
Obs.					0.000	2.798	17.728
...WI>Rainfall Event (11/18-3/05)					0.447	2.970	19.021

Flow Survey Location (Obs.) 11 S53-9.1, Rainfall Profile: RG2



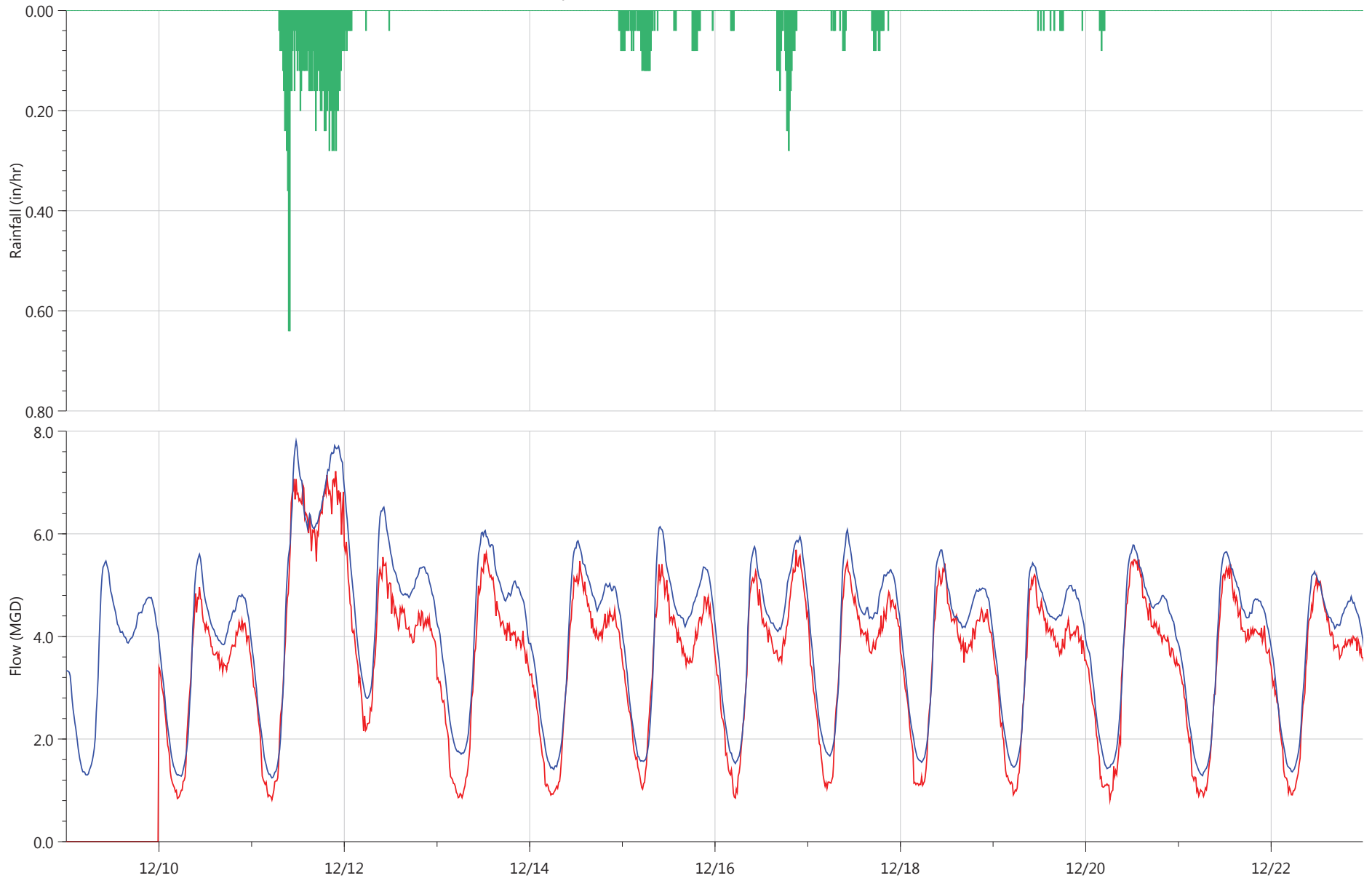
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.990	1.280	0.015			
Obs.					0.000	4.760	27.546
...WI>Rainfall Event (11/18-3/05)					0.632	4.564	28.254

Flow Survey Location (Obs.) 12 S53-109.1, Rainfall Profile: RG2



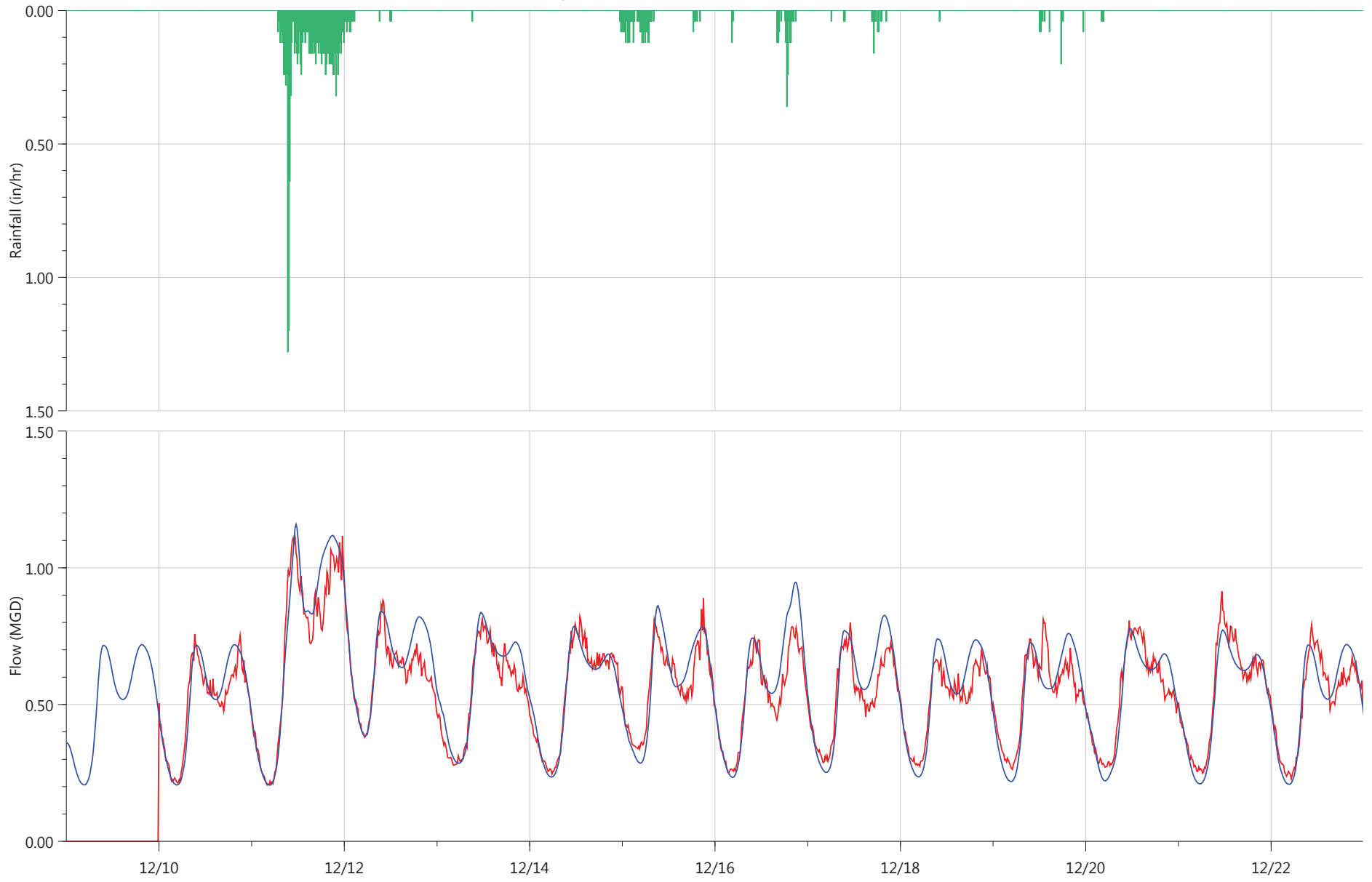
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.990	1.280	0.015			
Obs.					0.000	4.744	30.784
...WI>Rainfall Event (11/18-3/05)					0.658	4.793	29.586

Flow Survey Location (Obs.) 13 S53-73.1, Rainfall Profile: RG3



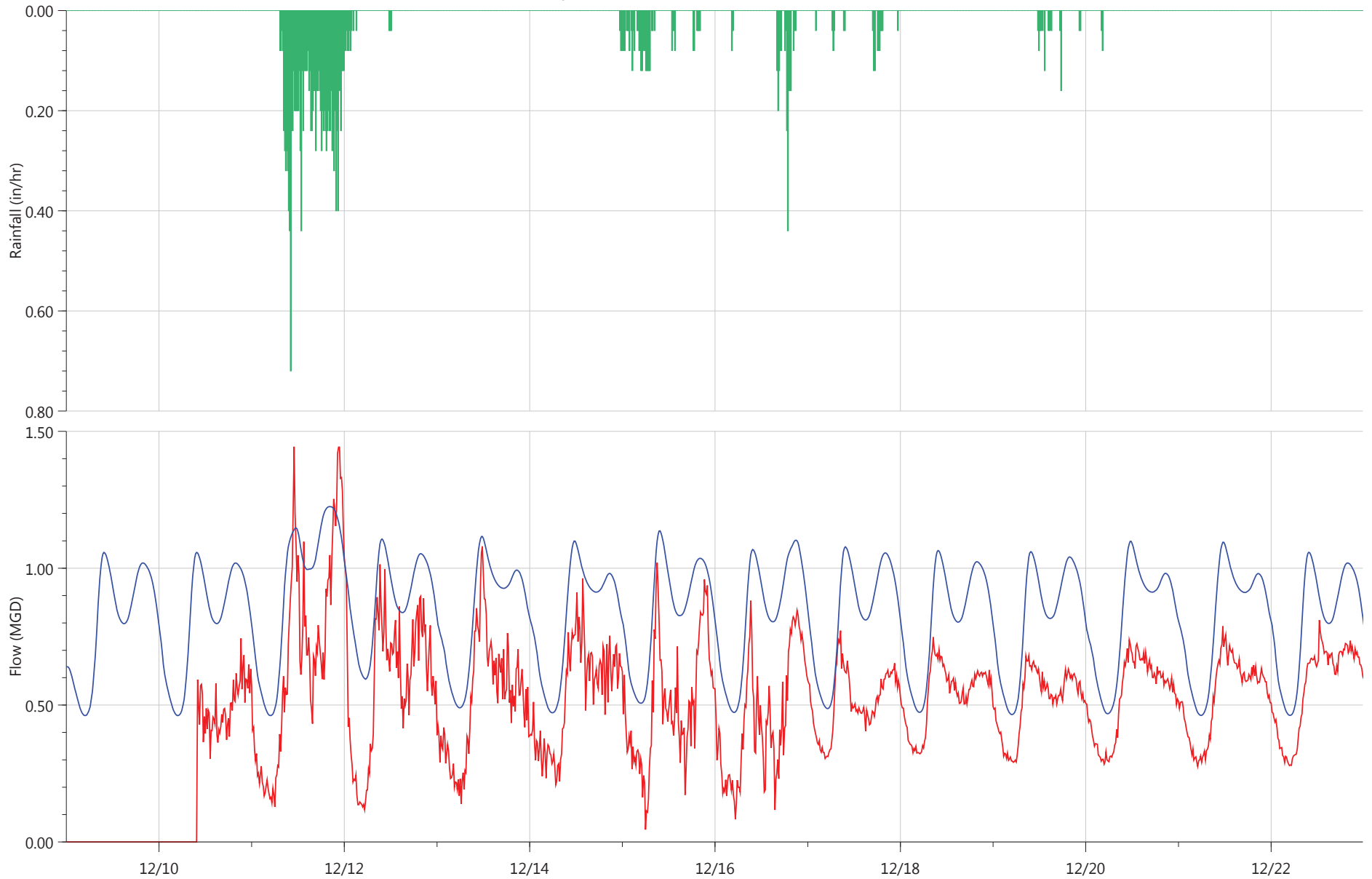
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.910	0.640	0.015			
Obs.					0.000	7.220	46.706
...WI>Rainfall Event (11/18-3/05)					1.243	7.806	56.519

Flow Survey Location (Obs.) 14 S54-17.1, Rainfall Profile: RG2



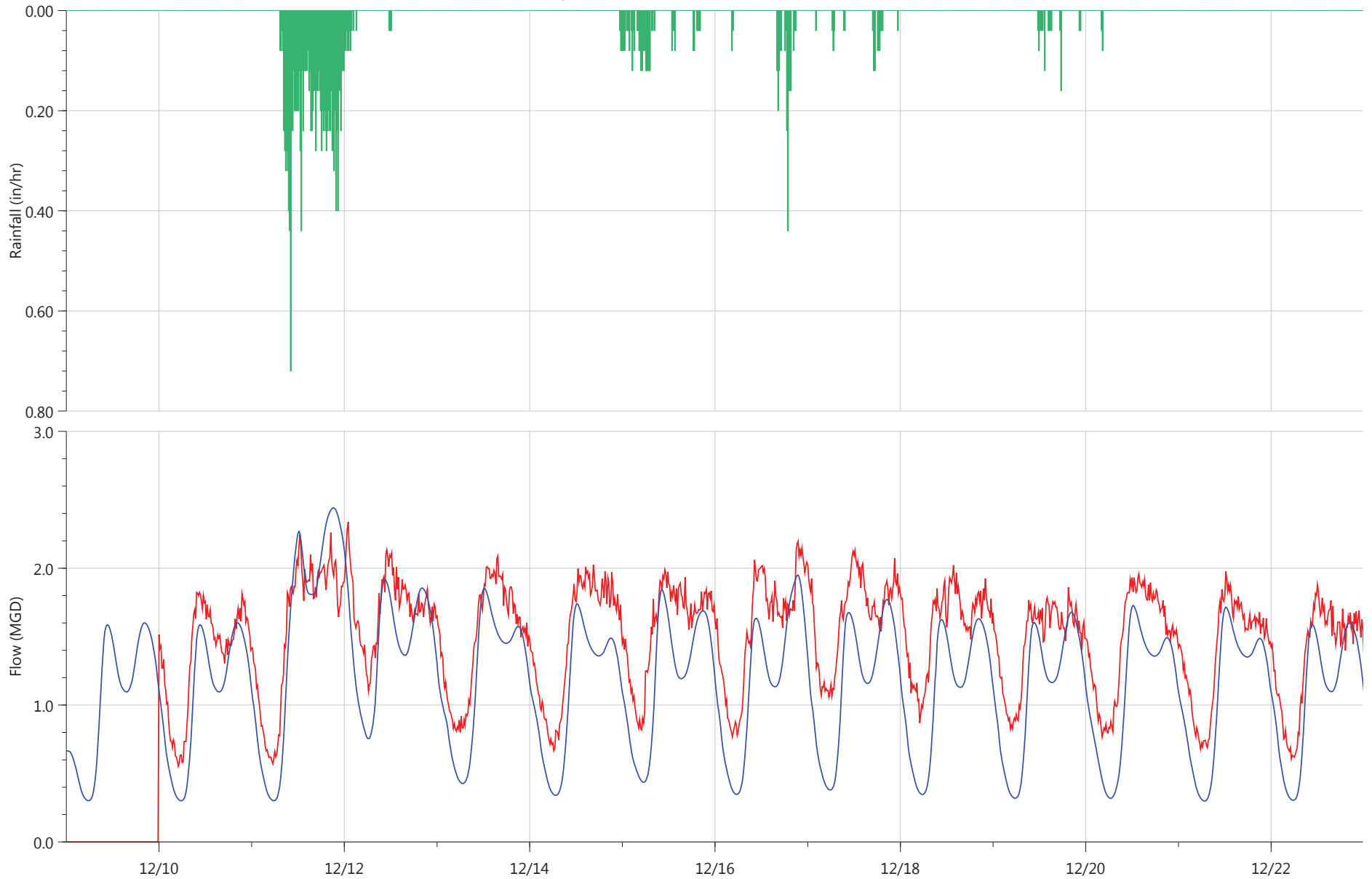
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.990	1.280	0.015			
Obs.					0.000	1.116	7.220
...WI>Rainfall Event (11/18-3/05)					0.206	1.159	7.918

Flow Survey Location (Obs.) 15 S65-48.1, Rainfall Profile: RG4



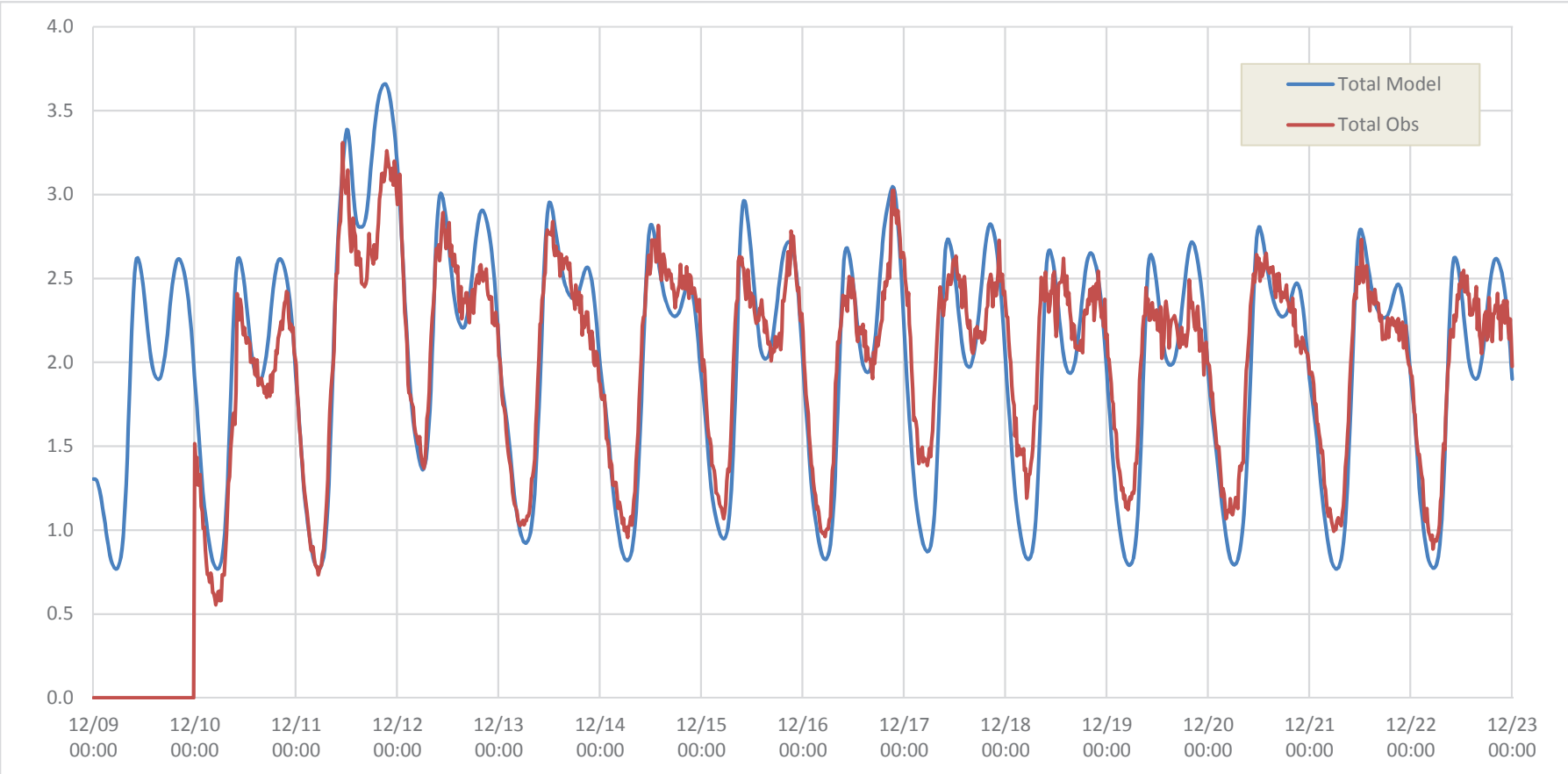
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		5.510	0.720	0.016			
Obs.					0.000	1.444	6.741
...WI>Rainfall Event (11/18-3/05)					0.462	1.225	11.647

Flow Survey Location (Obs.) 16 S67-12.1, Rainfall Profile: RG4



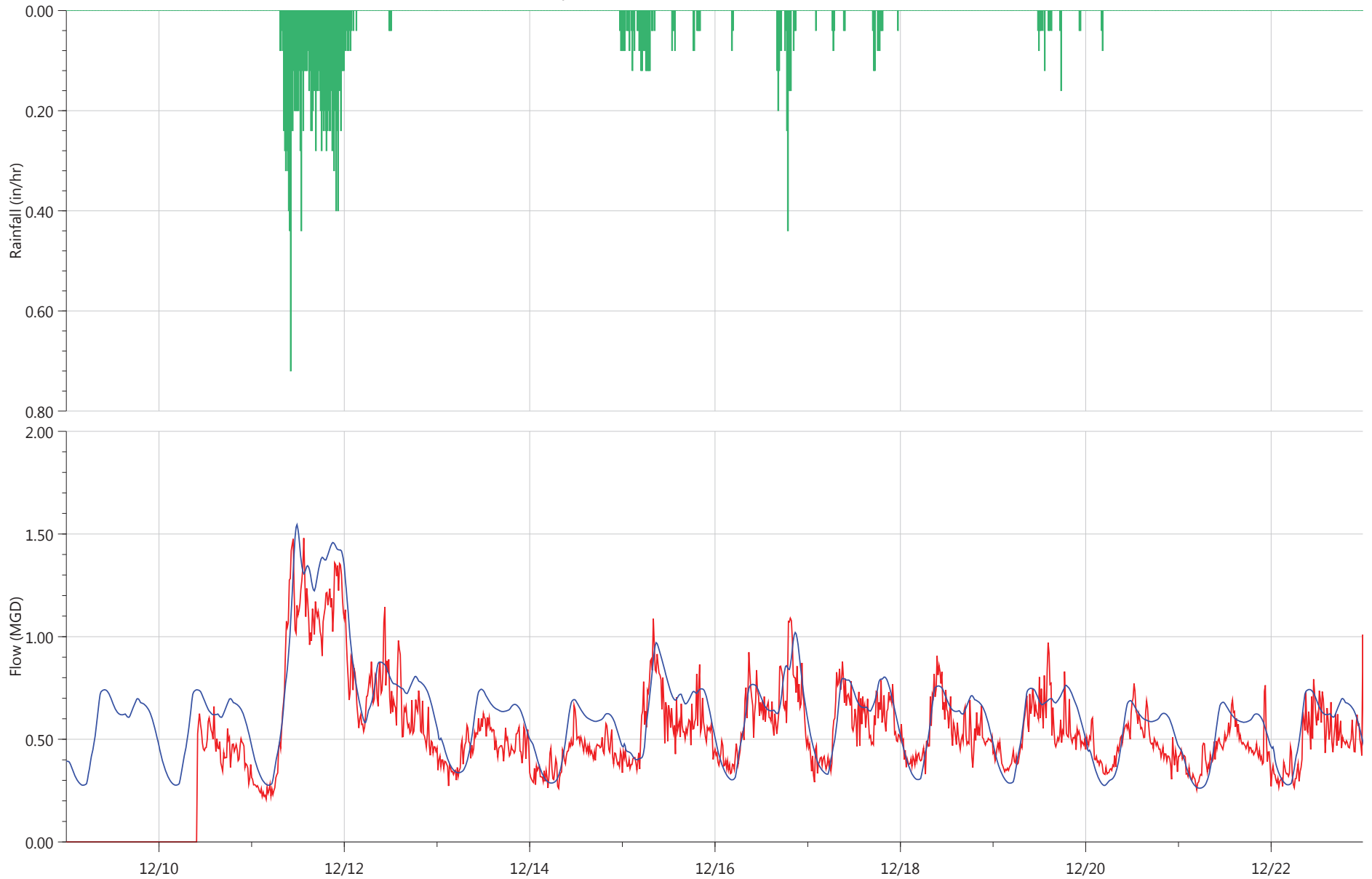
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		5.510	0.720	0.016			
Obs.					0.000	2.337	19.637
...WI>Rainfall Event (11/18-3/05)					0.299	2.440	16.365

Flow Meters 15 + 16



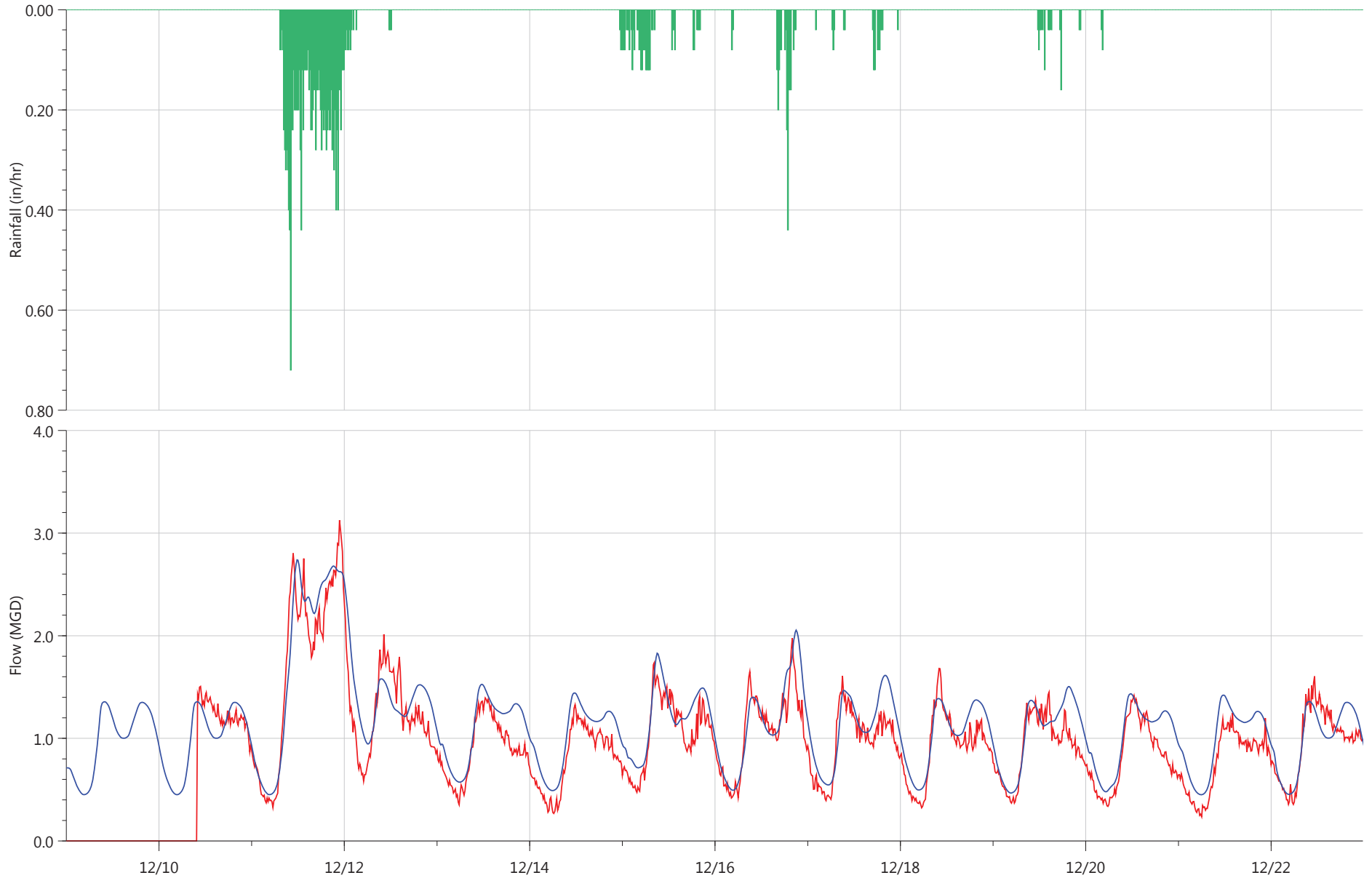
	Min	Max	Volume
Obs	-	3.310	26.368
Model	0.769	3.660	28.007

Flow Survey Location (Obs.) 17 S58-12.2, Rainfall Profile: RG4



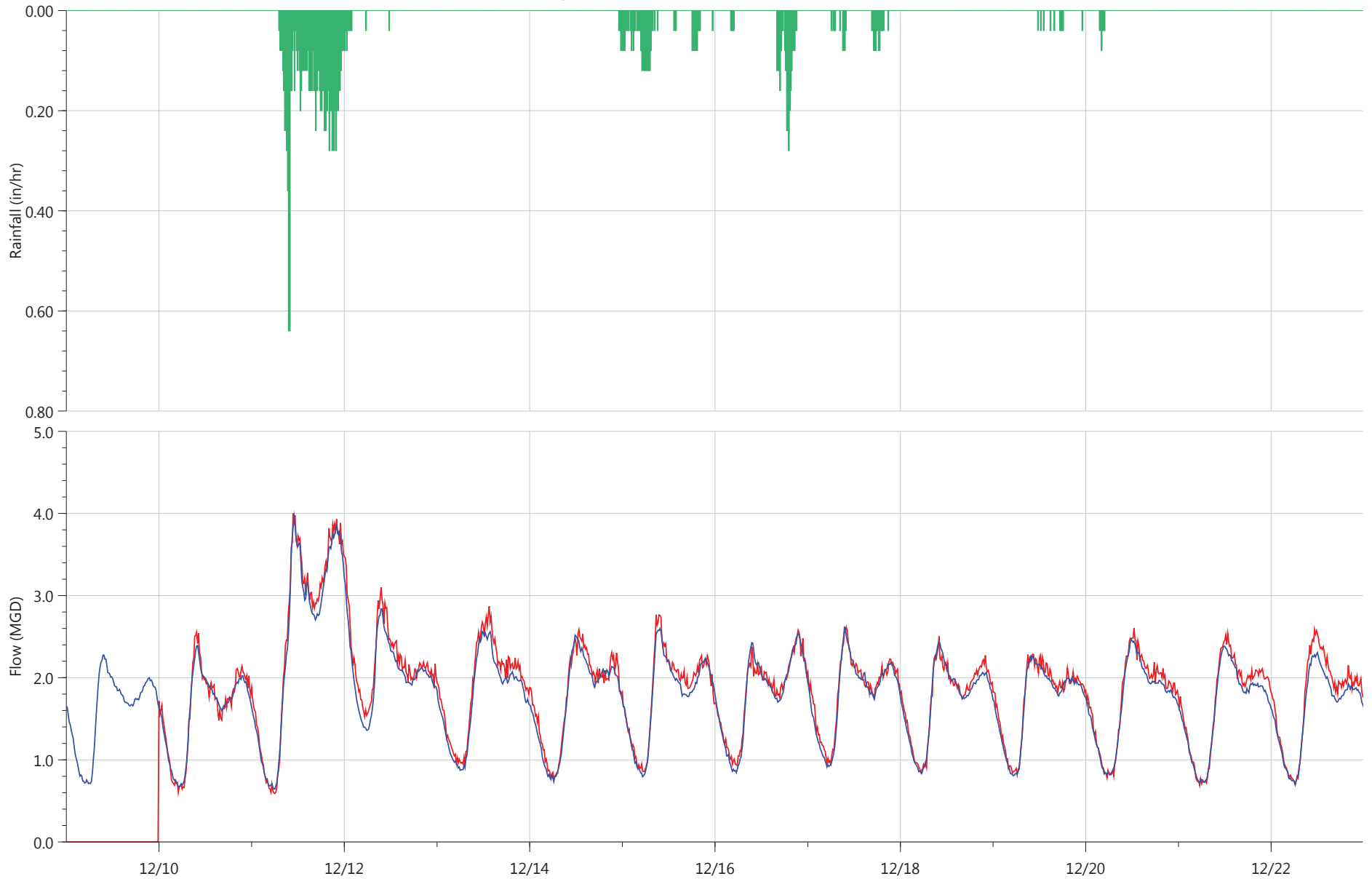
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		5.510	0.720	0.016			
Obs.					0.000	1.480	6.975
...WI>Rainfall Event (11/18-3/05)					0.262	1.545	8.583

Flow Survey Location (Obs.) 18 S58-11.1, Rainfall Profile: RG4



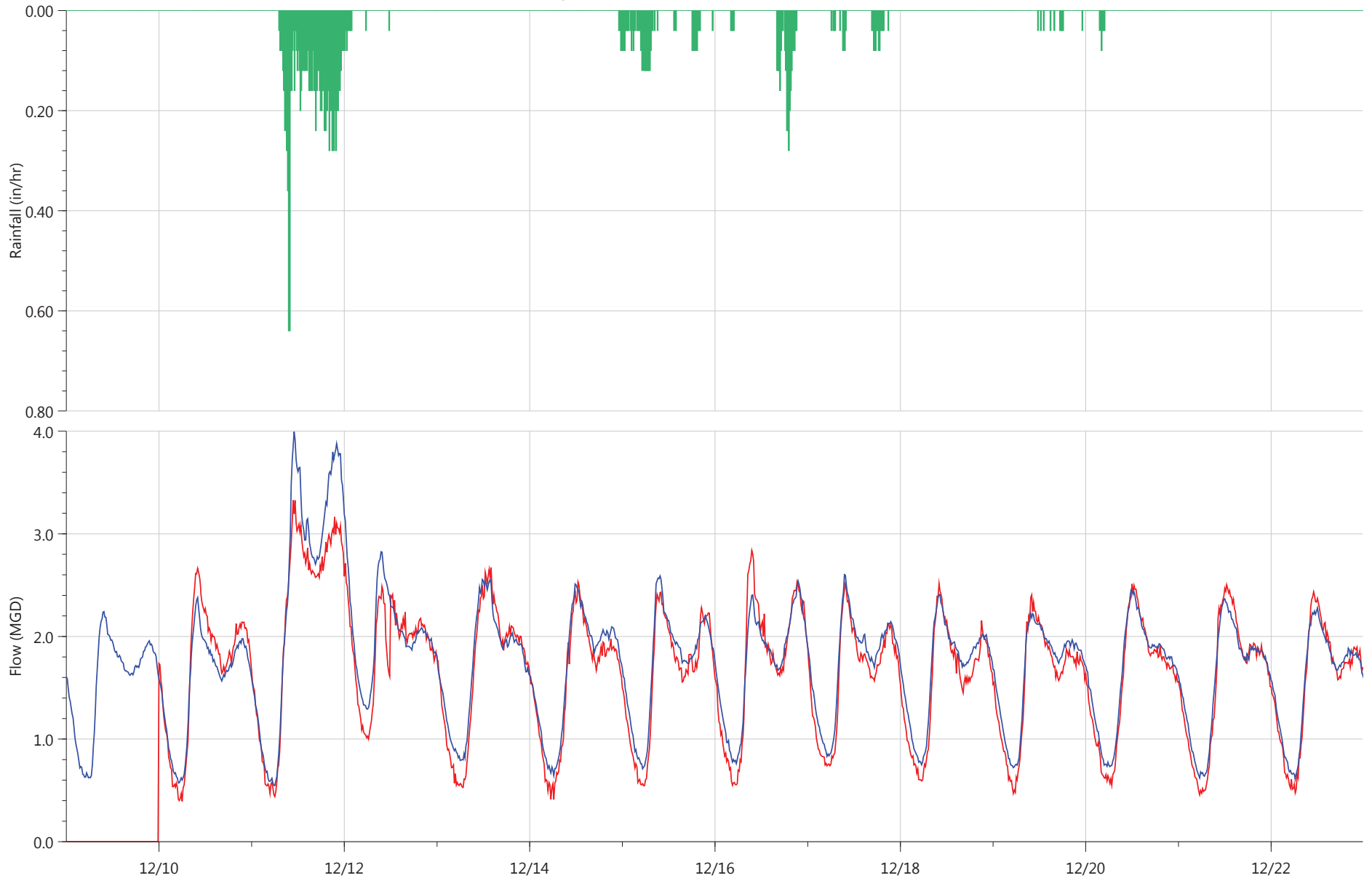
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		5.510	0.720	0.016			
Obs.					0.000	3.126	12.863
...WI>Rainfall Event (11/18-3/05)					0.451	2.739	15.733

Flow Survey Location (Obs.) 19 S21-23.1, Rainfall Profile: RG3



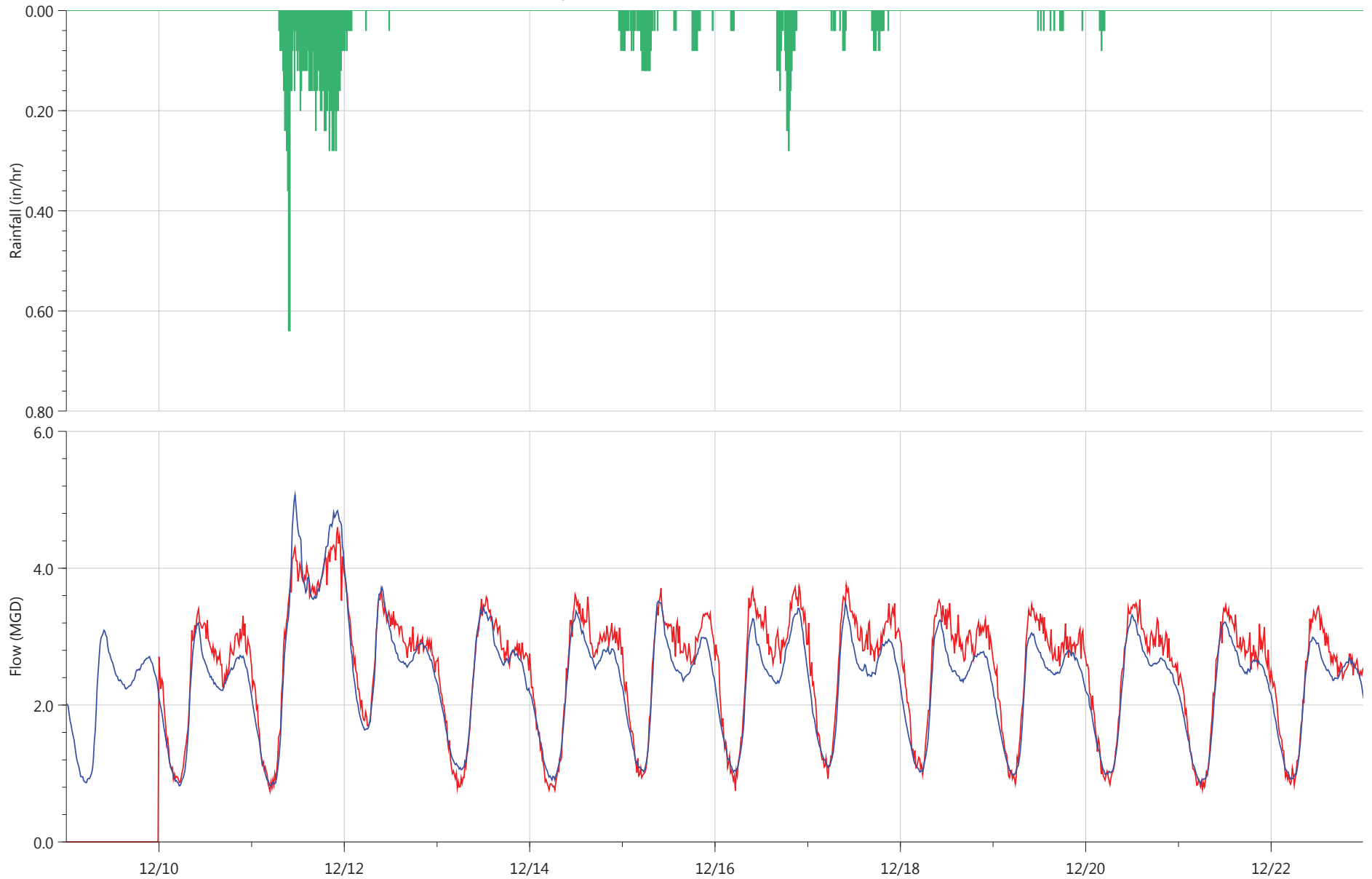
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.910	0.640	0.015			
Obs.					0.000	4.003	24.296
...WI>Rainfall Event (11/18-3/05)					0.643	3.964	24.949

Flow Survey Location (Obs.) 20 S21-46.1, Rainfall Profile: RG3



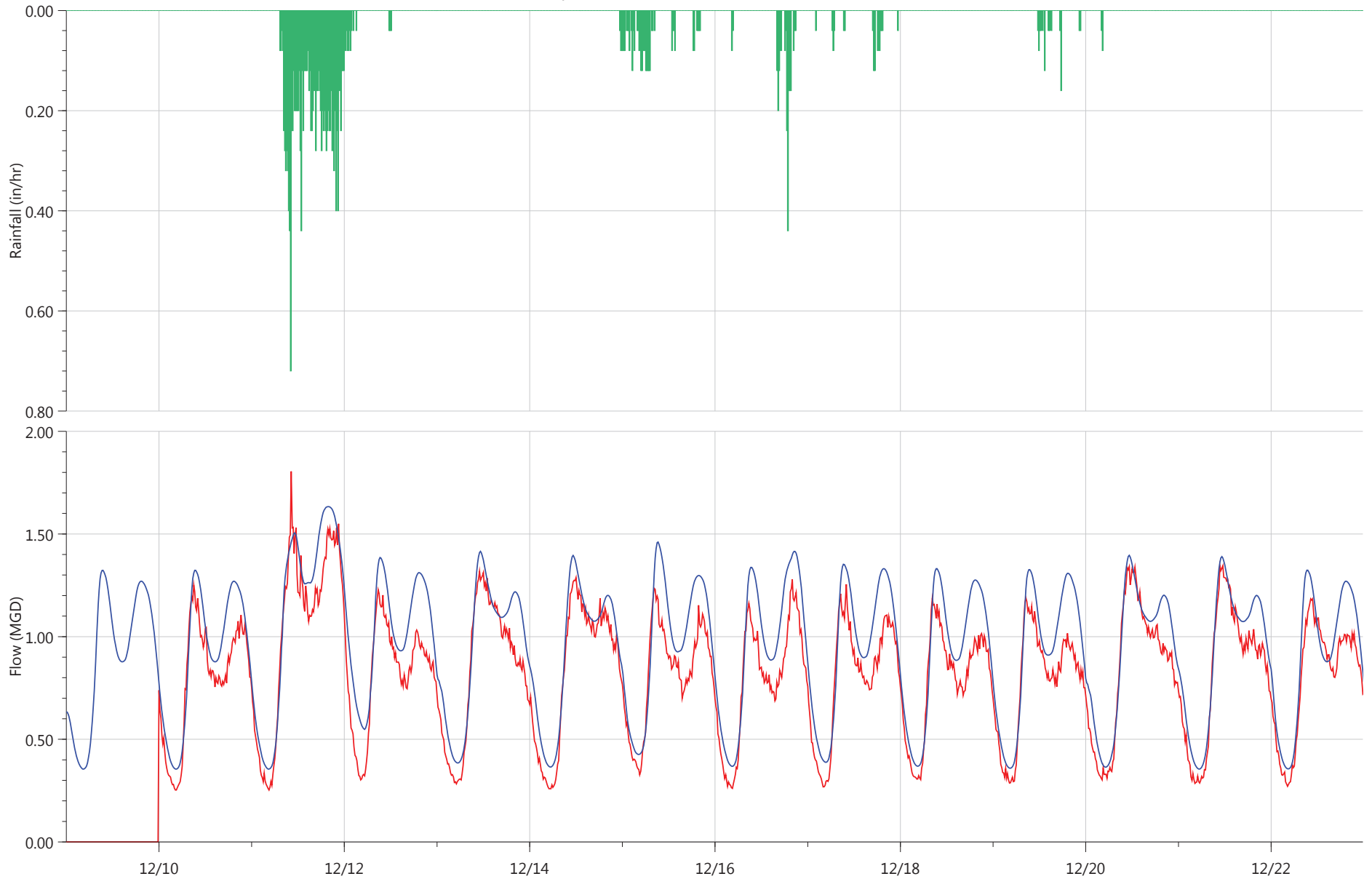
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.910	0.640	0.015			
Obs.					0.000	3.327	21.626
...WI>Rainfall Event (11/18-3/05)					0.546	3.994	24.277

Flow Survey Location (Obs.) 21 S23-14.1, Rainfall Profile: RG3



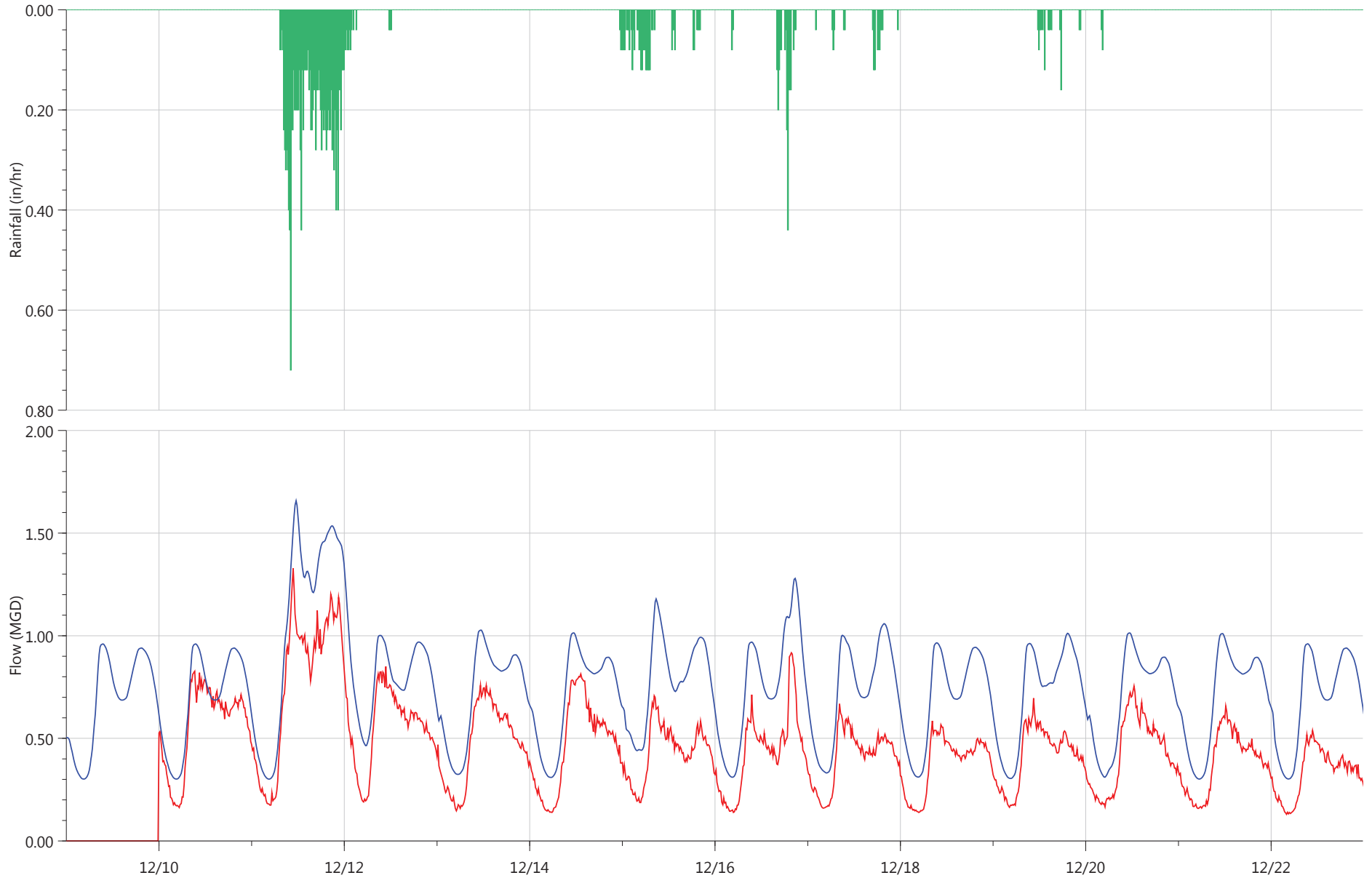
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		4.910	0.640	0.015			
Obs.					0.000	4.598	33.191
...WI>Rainfall Event (11/18-3/05)					0.820	5.070	32.771

Flow Survey Location (Obs.) 22 S45-88.1, Rainfall Profile: RG4



		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		5.510	0.720	0.016			
Obs.					0.000	1.805	10.722
...WI>Rainfall Event (11/18-3/05)					0.355	1.633	13.257

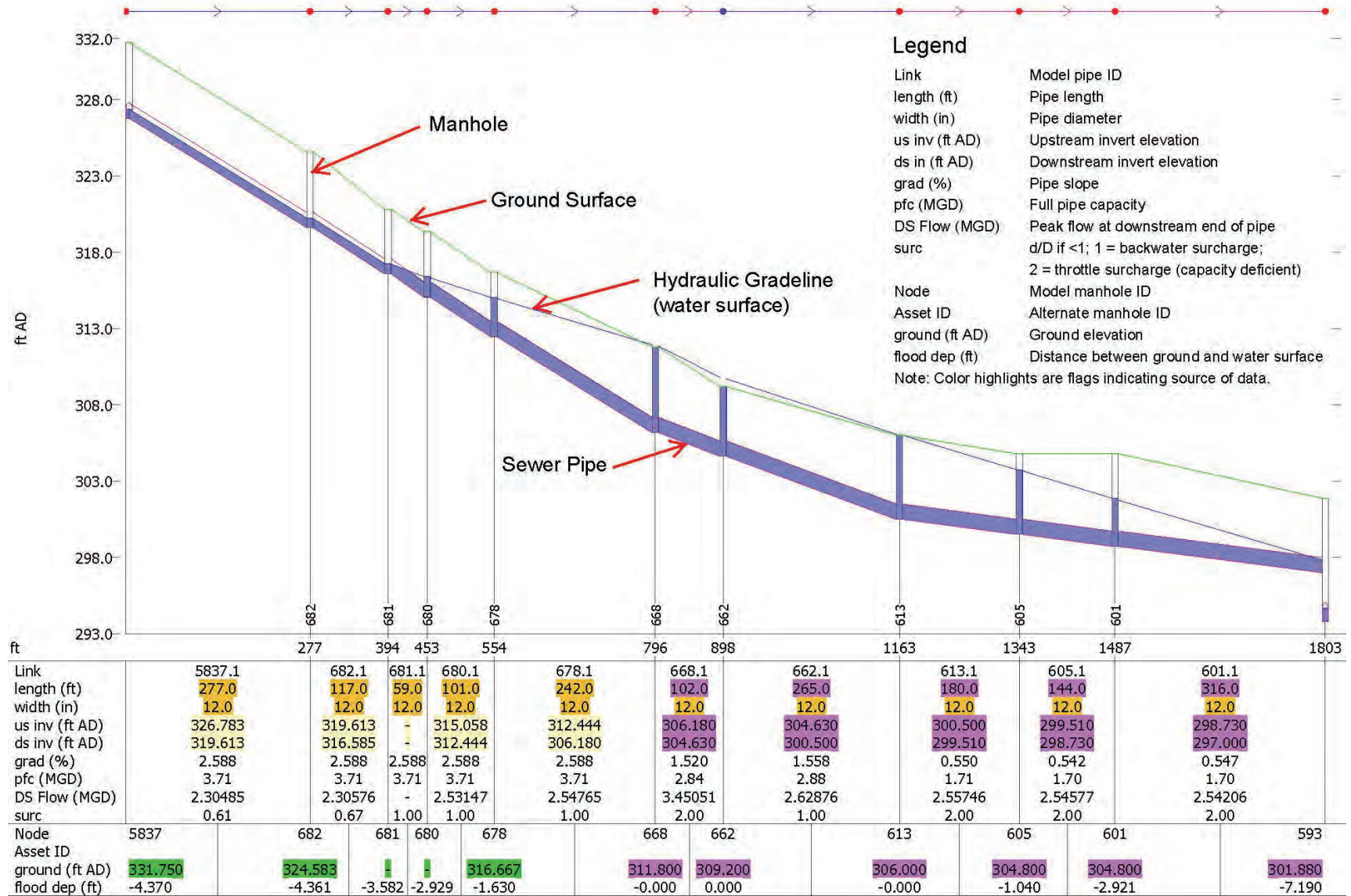
Flow Survey Location (Obs.) 23 S48-32.1, Rainfall Profile: RG4



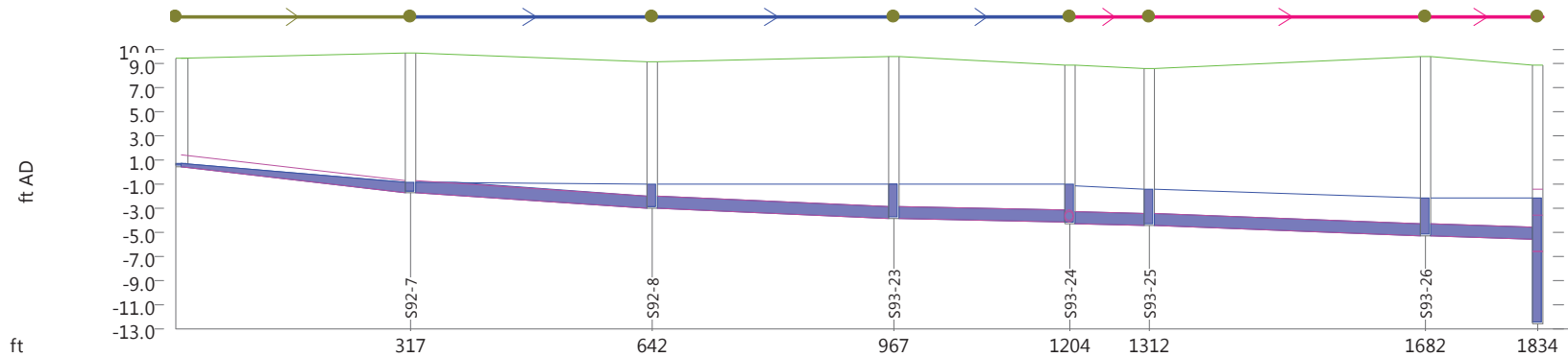
		Rainfall			Flow (MGD)		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min	Max	Volume (US Mgal)
Rain		5.510	0.720	0.016			
Obs.					0.000	1.328	6.045
...WI>Rainfall Event (11/18-3/05)					0.302	1.657	10.419

Appendix D - Model Hydraulic Profiles of Capacity Deficiencies

Example Model Hydraulic Profile and Legend

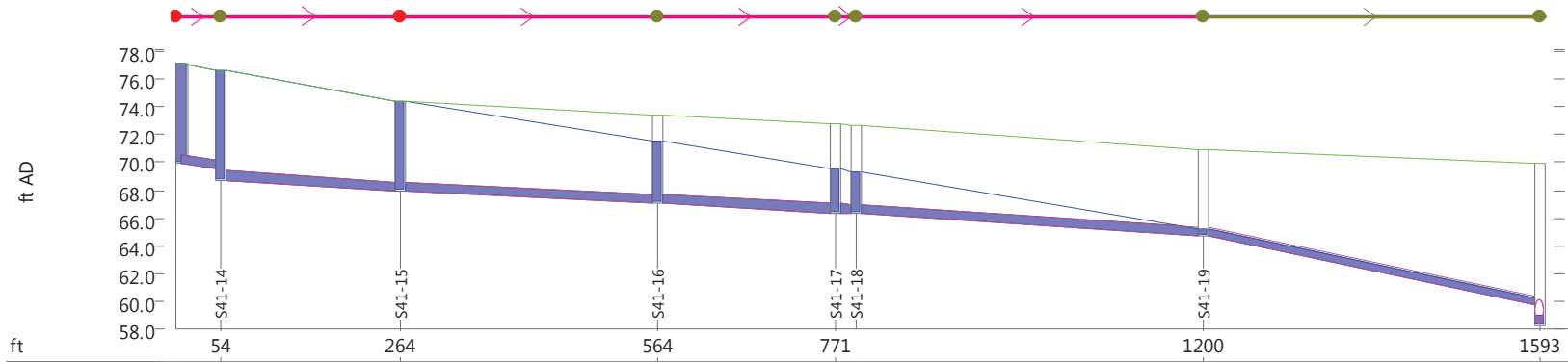


Deficiency ID: 2 (Tasman Lift Station, future peak wet weather flow)



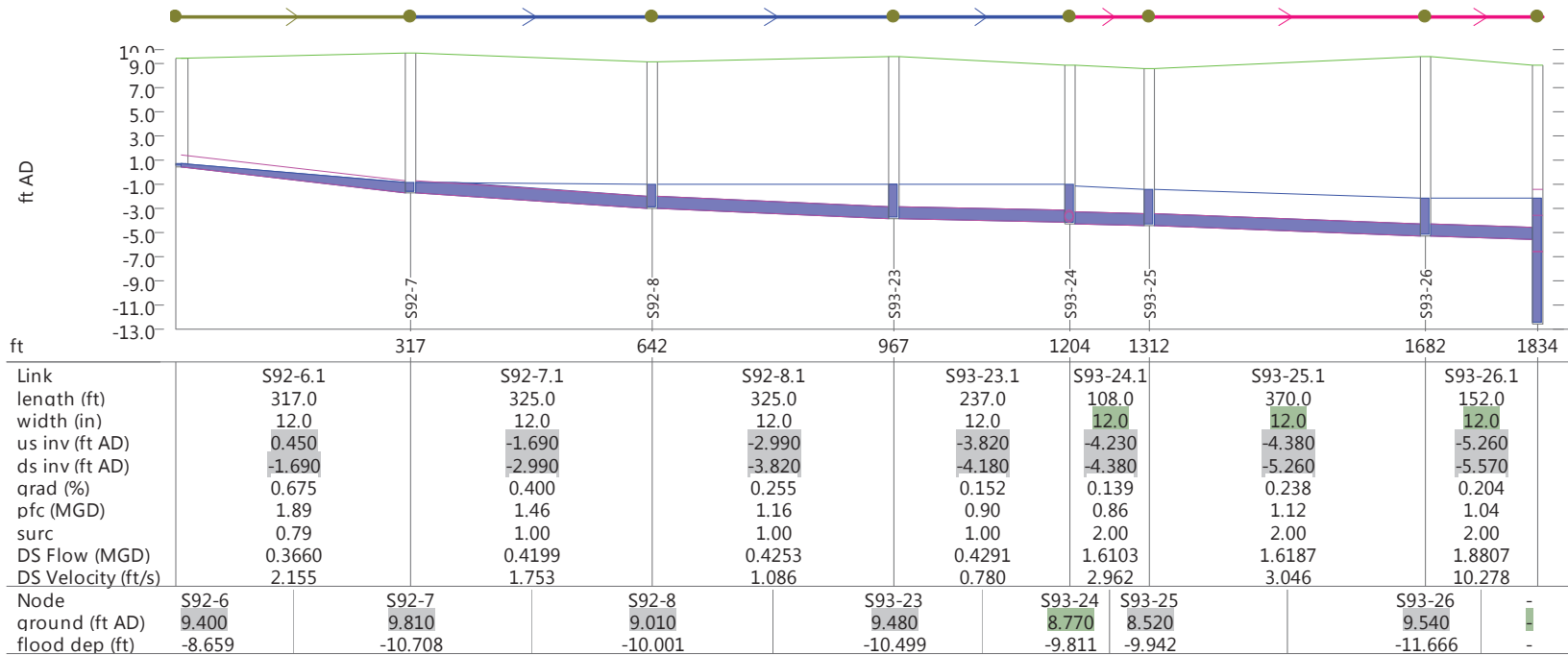
Link	S92-6.1	S92-7.1	S92-8.1	S93-23.1	S93-24.1	S93-25.1	S93-26.1
length (ft)	317.0	325.0	325.0	237.0	108.0	370.0	152.0
width (in)	12.0	12.0	12.0	12.0	12.0	12.0	12.0
us inv (ft AD)	0.450	-1.690	-2.990	-3.820	-4.230	-4.380	-5.260
ds inv (ft AD)	-1.690	-2.990	-3.820	-4.180	-4.380	-5.260	-5.570
grad (%)	0.675	0.400	0.255	0.152	0.139	0.238	0.204
pfc (MGD)	1.89	1.46	1.16	0.90	0.86	1.12	1.04
surc	0.79	1.00	1.00	1.00	2.00	2.00	2.00
DS Flow (MGD)	0.3660	0.4199	0.4253	0.4291	1.6103	1.6187	1.8807
DS Velocity (ft/s)	2.155	1.753	1.086	0.780	2.962	3.046	10.278
Node	S92-6	S92-7	S92-8	S93-23	S93-24	S93-25	S93-26
ground (ft AD)	9.400	9.810	9.010	9.480	8.770	8.520	9.540
flood dep (ft)	-8.659	-10.708	-10.001	-10.499	-9.811	-9.942	-11.666

Deficiency ID: 3 (Cabrillo Avenue, future peak wet weather flow)

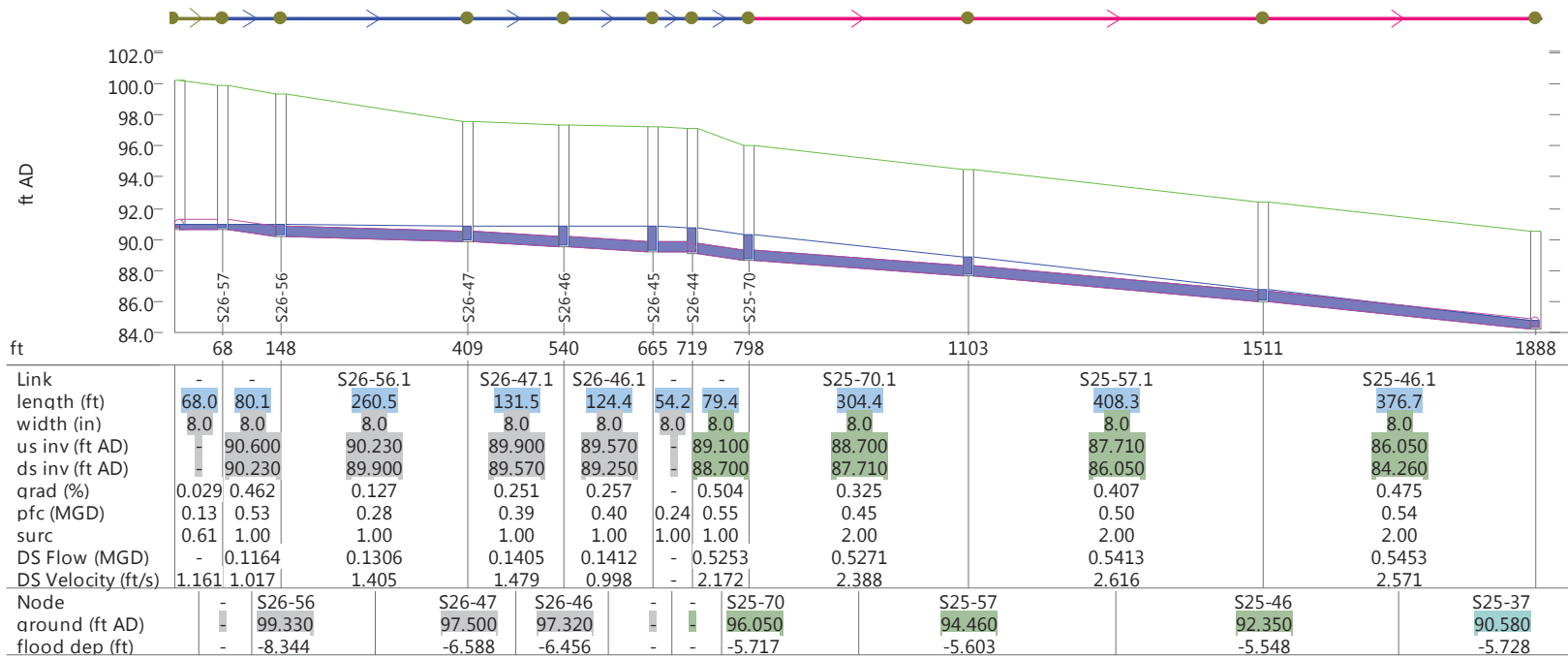
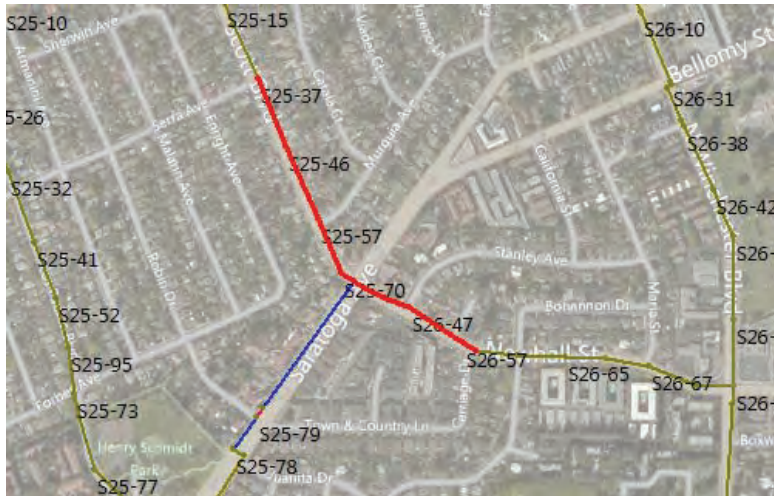


Link length (ft)	-	S41-14.1	S41-15.1	S41-16.1	-	S41-18.1	S41-19.1
width (in)	54.0	209.6	300.3	207.0	-	404.0	392.9
us inv (ft AD)	8.0	8.0	8.0	8.0	8.0	8.0	8.0
ds inv (ft AD)	-	68.740	67.920	67.020	66.350	66.290	64.730
grad (%)	-	67.920	67.020	66.350	66.290	64.730	59.770
pfc (MGD)	-	0.391	0.300	0.324	0.386	0.49	1.262
surc	0.63	0.49	0.43	0.44	0.49	0.88	0.88
DS Flow (MGD)	2.00	2.00	2.00	2.00	2.00	2.00	0.75
DS Velocity (ft/s)	-	0.7757	0.7506	0.7537	0.7657	0.7657	0.7784
	-	2.736	2.819	2.956	4.064	4.342	
Node ground (ft AD)	S41-14	S41-15	S41-16	S41-17	S41-18	S41-19	S41-20
flood dep (ft)	76.540	74.370	73.320	72.700	72.690	70.880	69.860
	-0.004	0.000	-1.754	-3.134	-3.393	-5.636	-10.764

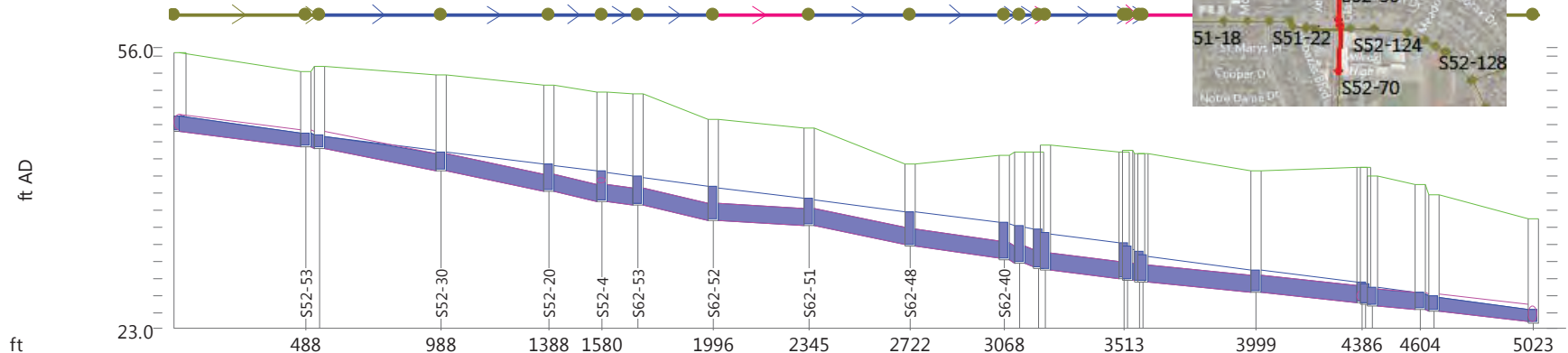
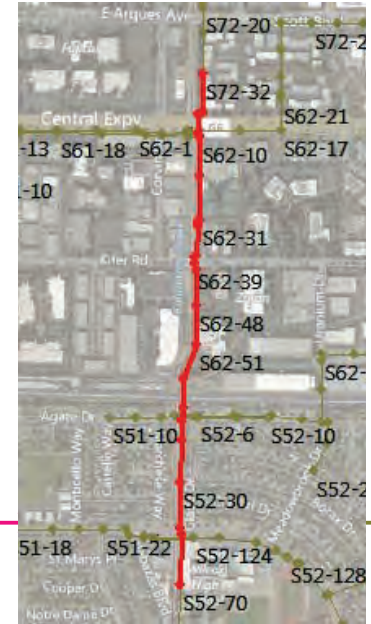
Deficiency ID: 4 (Tasman Drive, future peak wet weather flow)



Deficiency ID: 5 (Scott Blvd., future peak wet weather flow)



Deficiency ID: 6 (Calabazas Creek, future peak wet weather flow)



Link	S52-70.1	S52-52.1	S52-30.1	-	-	S62-53.1	S62-52.1	S62-51.1	S62-48.1	-	S62-38.1	S62-31.1	S62-29.1	-	S62-15.1
length (ft)	488.0	446.0	400.0	192.0	24.0	282.4	349.4	377.2	345.3	292.8	421.8	386.4	177.7	371.6	
width (in)	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	24.0	
us inv (ft AD)	46.200	44.190	41.530	-	-	37.500	35.830	35.170	32.790	30.000	28.500	27.270	-	25.140	
ds inv (ft AD)	44.410	41.530	39.150	-	-	35.830	35.170	32.890	31.290	28.930	27.270	26.130	-	23.880	
grad (%)	0.367	0.596	0.595	0.594	-	0.591	0.189	0.604	0.434	0.365	0.292	0.295	0.270	0.339	
pfc (MGD)	8.86	11.29	11.28	11.27	9.05	11.25	6.36	11.37	9.64	8.84	7.90	7.94	7.60	8.52	
surc	0.92	1.00	1.00	1.00	1.00	1.00	2.00	1.00	1.00	1.00	2.00	2.00	2.00	0.79	
DS Flow (MGD)	8.9664	8.9647	8.9647	-	-	8.8144	8.8145	8.8146	8.8147	8.8151	8.8158	8.8161	-	8.2537	
DS Velocity (ft/s)	5.312	5.995	5.720	4.933	-	4.094	5.796	5.714	5.787	4.847	4.227	4.244	4.195	5.185	
Node	-	S52-53	S52-30	S52-20	-	-	S62-52	S62-51	S62-48	-	-	-	S62-29	-	-
ground (ft AD)	-	53.310	53.810	52.950	51.710	-	47.740	46.720	42.360	-	-	-	41.540	-	-
flood dep (ft)	-7.509	-7.243	-8.042	-9.025	-9.362	-	-7.912	-8.325	-5.527	-	-	-	-11.608	-	-

**Appendix E - Rabello & Northside Pump Station
Capacity and Forcemain Calibration TM**

MEMORANDUM

TO: Winola Cheong, PE, RMC Water and Environment DATE: November 13, 2015

FROM: Glen Anderson, PE JOB#: RM&C.06.15

SUBJECT: Rabello and Northside Pump Station Capacity and Forcemain Calibration

Background

As part of the Sanitary Sewer Master Plan (SSMP) for the City of Santa Clara, RMC retained Schaaf & Wheeler to assist in pump station analysis. As part of this analysis, Schaaf & Wheeler performed flow testing on the Northside and Rabello pump stations to determine the pump station capacity. In order to ensure accurate results, the City calibrated the flow meters and installed pressure gauges on the forcemains leaving each station. It is important to note that the tests were performed under dynamic circumstances, and though accurate, are subject to errors induced by changing conditions, inaccurate equipment, and error in reading equipment output.

Flow Tests

The Rabello pump station is equipped with eight, 60 horsepower Flygt NP 3202 pumps. During the flow test, combinations of pumps were run, and the wetwell level, flow rate, and forcemain pressure were recorded. The results of the Rabello pump station flow test are outlined in Table 1 below.

Table 1: Rabello Pump Test Results

No. of Pumps	Pressure (psi)	Wetwell Level (ft)	Flow Rate (MGD)
0	4	7	0
1	5	6.6	8.04
3	12	6.3	14.95
5	16.5	5.9	18.5
7	19.5	5.4	20.1

The Northside pump station is equipped with four, 70 horsepower Flygt NP 3356 pumps. During the flow test, combinations of pumps were run, and the wetwell level, flow rate, and forcemain pressure were recorded. The results of the Northside pump station flow test are outlined in Table 2 below.

Table 2: Northside Pump Test Results*

No. of Pumps	Pressure (psi)	Wetwell Level (ft)	Flow Rate (kgpm)
0	1	7	0
1	4	6.5	7.0
2	9.5	5.9	10.9
3	13	5.2	14.4

**Schaaf & Wheeler was not present for these tests. Results provided by RMC.*

Using the data points above, as well as known forcemain lengths and diameters, and pump station record drawings, Schaaf & Wheeler created a system curve for each of the pump stations as shown in Figures 1 and 2. A theoretical system curve was generated using the Hazen-Williams equation, and the C factor, which is representative of pipe roughness, was adjusted until the theoretical system curve was similar to the observed system performance curve.

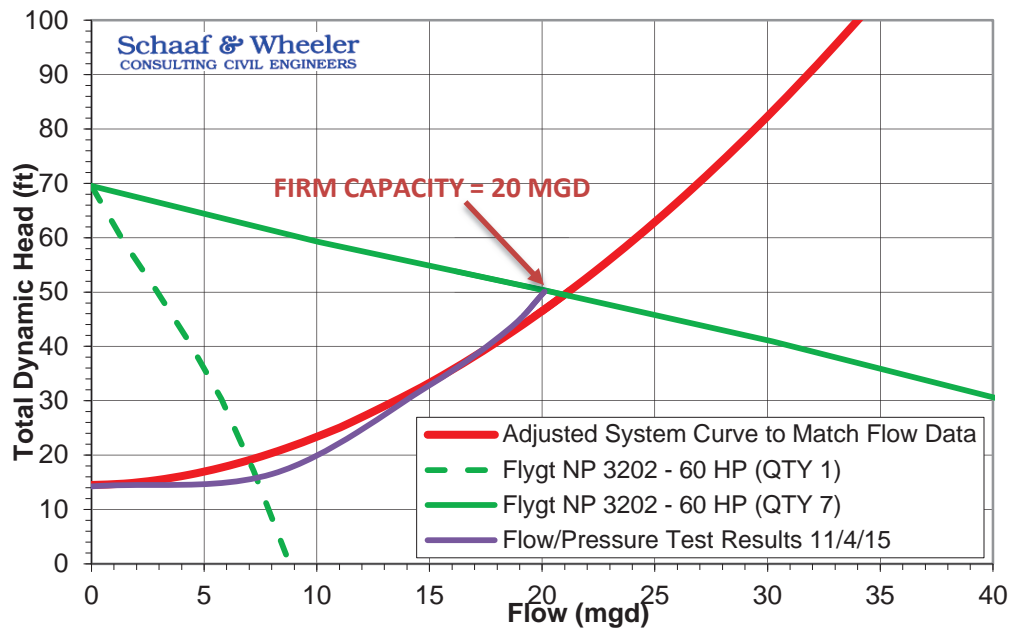


Figure 1: Rabello System Curve

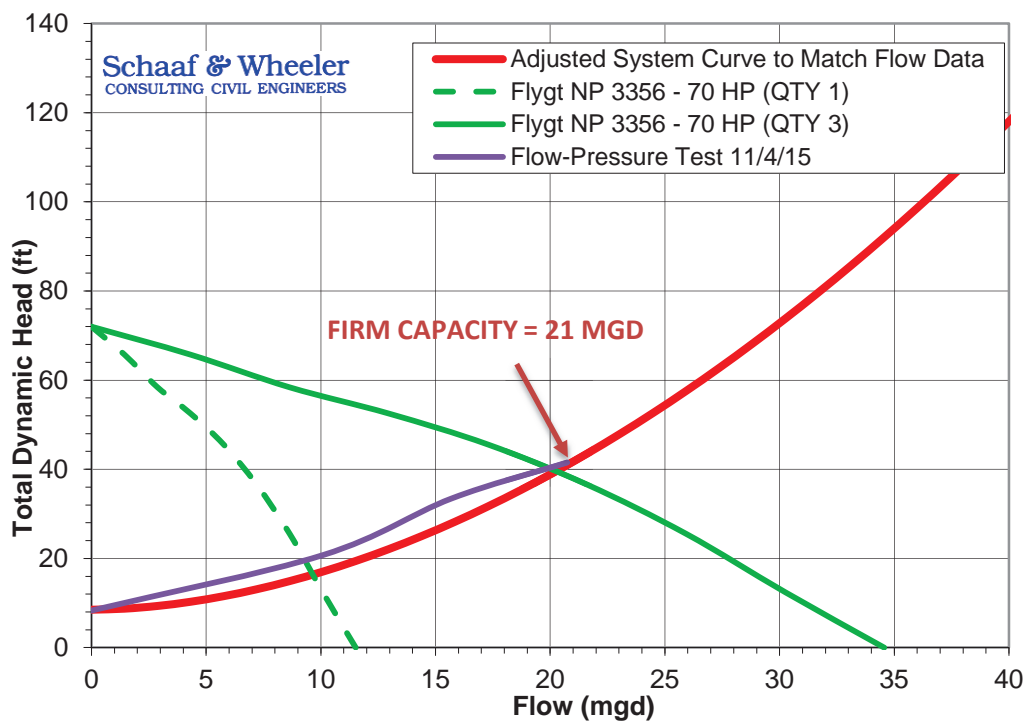


Figure 2: Northside System Curve

Results

By adjusting the C factor for each of the forcemains, Schaaf & Wheeler was able to closely match the theoretical system curve to the observed performance of each station. The C factor for the Rabello forcemain is 78 and the C factor for Northside is 77. Typical C factors for forcemains range from 100 to 150, with the higher C factor representing a smoother pipe. The low C factors of the Rabello and Northside forcemains indicate that the pipelines have rougher profiles than typical, or have severely reduced cross-sectional areas due to sediment buildup, or a combination of the two. It is recommended that the City include inspection and cleaning of each of these lines in its operations plan moving forward.

The Northside pumps appear to be operating at, or near their original performance point based on the provided pump curves. The Rabello pumps appear to be operating at a 12% reduction in performance when compared to the provided pump curves. The apparent performance reduction may be the result of an inaccurate flow meter, damaged pumps or impellers, or some unknown restriction between the pump inlet and the pressure gauge location.

Appendix F - Project Descriptions and Cost Estimates

City of Santa Clara Sanitary Sewer Improvement Projects

Project ID	Project Name	Priority	Estimated Capital Cost	Estimated Capital Cost for Alternatives
P1	Westside Lift Station Adjustment	1	\$ -	\$ -
P2	Tasman Lift Station Adjustment	1	\$ -	\$ -
P3	Cabrillo Avenue Sewer Improvement	2	\$ 1,097,000	\$ -
P4	Tasman Drive Sewer Improvement	3	\$ 327,000	\$ -
P5	Sewer Diversion at Los Prades Boulevard and Saratoga Avenue	3	\$ 77,000	\$ -
P6	Sewer Diversion at Calabazas Boulevard and Machado Avenue	3	\$ 166,000	\$ -
P6-Alt	Calabazas Creek Sewer Improvement	3	\$ -	\$ 1,334,000
E1	Tracy Drive Sewer Improvement	--	\$ 4,654,000	\$ -
Total Estimated Cost for Projects P1 through P6:			\$ 1,667,000	
Total Estimated Cost for Projects P1 through P5 and P6-Alternative:				\$ 2,835,000
Total Estimated Cost for Projects P1 through P6, and Project E1:			\$ 6,321,000	
Total Estimated Cost for Projects P1 through P5, P6-Alternative, and Project E1:				\$ 7,489,000

¹ **Priority**

1 - Triggered under Current PDWF

2 - Triggered under Current PWWF

3 - Triggered under Future PWWF

Project P1: Westside Lift Station Adjustment

PROJECT DESCRIPTION	
Project ID	P1
Project Name	Westside Lift Station Adjustment
Project Location	Westside Lift Station
Description	Adjust set points for both pumps to eliminate backups in the influent line
Priority	1 - Triggered under Current PDWF
Estimated Capital Imp. Cost	\$0
Comments	The current set point of the lead pump is several feet above the invert of the influent gravity line. Under this condition, the lead pump will not turn on until the influent line is completely submerged, causing backwater issues upstream. This can be resolved by adjusting the set points to be equal or lower than the invert of the influent line. The table below summarizes the recommended set points for both the lead pump and the lag pump. These settings should be evaluated by the City's pump operators to determine feasibility and if there are other operational issues that should be considered.

Recommended Revised Set Levels:

	Distance from Wet Well Floor (ft)		Distance from Wet Well Floor (ft)
High Level Alarm	8	Low Level Alarm	1.2
Lead On	6	Lead On	1.7
Lag On	7	Lag Off	2.2

Recommendations are based on the following information provided by the City:

Number of pumps at Westside Lift Station: 2 pumps. Identical.

Pump Make and Model: Flygt 3127

Project P2: Tasman Lift Station Adjustment

PROJECT DESCRIPTION	
Project ID	P2
Project Name	Tasman Lift Station Adjustment
Project Location	Tasman Lift Station
Description	Adjust set points for both pumps to eliminate backups in the influent line
Priority	1 - Triggered under Current PDWF
Estimated Capital Imp. Cost	\$0
Comments	The current set point of the lead pump is several feet above the invert of the influent gravity line. Under this condition, the lead pump will not turn on until the influent line is completely submerged, causing backwater issues upstream. This can be resolved by adjusting the set points to be equal or lower than the invert of the influent line. The table below summarizes the recommended set points for both the lead pump and the lag pump. These settings should be evaluated by the City's pump operators to determine feasibility and if there are other operational issues that should be considered.

Recommended Revised Set Levels:

	Distance from Wet Well Floor (ft)		Distance from Wet Well Floor (ft)
High Level Alarm	7	Low Level Alarm	1.2
Lead On	6	Lead On	1.7
Lag On	6.5	Lag Off	2.2

Recommendations are based on the following information provided by the City:

Number of pumps at Tasman Lift Station: 2 pumps. Identical.

Pump Make and Model: Flygt CP 3127

Project P3: Cabrillo Avenue Sewer Improvement

PROJECT DESCRIPTION	
Project ID	P3
Project Name	Cabrillo Avenue Sewer Improvement
Project Location	Cabrillo Ave. between Lawrence Expy. and Nobili Ave.
Description	Upsize approximately 1,600 feet of 8-in pipe to 12-in pipe
Priority	2 - Triggered under Current PWWF
Estimated Capital Imp. Cost	\$1,097,000
Comments	(i) Pipes are listed in order from upstream to downstream (ii) The City should consider conducting a comprehensive inflow/infiltration (I/I) study with additional flow monitoring and other field investigations (e.g, smoke testing and CCTV inspection) prior to implementing this project. The project is located in an area of very high I/I according to flow data collected during the 2014/15 winter season. A previous flow monitoring program conducted in 2006 also showed similar findings. It is recommended that the City determine if it is cost-effective to identify and address/eliminate the I/I sources, rather than upsizing the sewer lines to accommodate the I/I flow.
Assumptions	(i) Cost estimates are based on the SF Area November 2015 ENR CCI of 11169 (ii) Cost assumes open-cut replacement
Alternatives	(i) Conduct a focused I/I study to identify the possible sources of inflow or/and infiltration, and implement solutions to reduce the I/I for the area. (ii) Install parallel pipe or implement project by pipe bursting.

PROJECT COST DETAIL

U/S MH ID	D/S MH ID	Existing Diameter (inches)	New Diameter (inches)	Length (feet)	Slope (%)	Pipe Depth (feet BGL)	Construction Method	Unit Cost (\$/LF)	Total Cost (\$)
S41-13	S41-14	8	12	54	0.65	7	Open Cut	\$210	\$ 11,328
S41-14	S41-15	8	12	210	0.39	7	Open Cut	\$210	\$ 43,971
S41-15	S41-16	8	12	300	0.30	6	Open Cut	\$210	\$ 62,998
S41-16	S41-17	8	12	207	0.32	6	Open Cut	\$210	\$ 43,425
S41-17	S41-18	8	12	25	0.24	6	Open Cut	\$210	\$ 5,245
S41-18	S41-19	8	12	404	0.39	6	Open Cut	\$210	\$ 84,752
S41-19	S41-20	8	12	393	1.26	8	Open Cut	\$210	\$ 82,424

Total Baseline Pipe Construction Cost	\$	334,143
Lower lateral replacement and cleanout, Approx. 50	\$	225,000
Baseline Construction Cost:	\$	559,143
Bypass Pumping (10% of pipe construction cost)	\$	33,414
Remove & Replace Factor (5% of pipe construction cost)	\$	16,707
Traffic Control (10% of pipe construction cost)	\$	33,414
Subtotal:	\$	642,679
Mobilization/Demobilization (5% of subtotal)	\$	32,134
Estimated Construction Cost Subtotal:	\$	674,813
Contingencies (30% of construction subtotal)	\$	202,444
Total Estimated Construction Cost:	\$	877,256
Engineering, Administration, Legal (25% of construction cost)	\$	219,314
Estimated Capital Improvement Cost:	\$	1,097,000



Project P4: Tasman Drive Sewer Improvement

PROJECT DESCRIPTION	
Project ID	P4
Project Name	Tasman Drive Sewer Improvement
Project Location	Tasman Dr. between Old Ironsides Dr. and Great America Pkwy.
Description	Upsize approximately 600 feet of 12-in pipe to 15-in pipe
Priority	3 - Triggered under Future PWWF
Estimated Capital Imp. Cost	\$327,000
Comments	(i) Pipes are listed in order from upstream to downstream
Assumptions	(i) Cost estimates are based on the SF Area November 2015 ENR CCI of 11169 (ii) Cost assumes pipe will be upsized using open-cut construction method
Alternatives	(i) Install parallel pipe

PROJECT COST DETAIL

U/S MH ID	D/S MH ID	Existing Diameter (inches)	New Diameter (inches)	Length (feet)	Slope (%)	Pipe Depth (feet BGL)	Construction Method	Unit Cost (\$/LF)	Total Cost (\$)
S93-24	S93-25	12	15	108	0.14	13	Open Cut	\$221	\$ 23,849
S93-25	S93-26	12	15	370	0.24	14	Open Cut	\$221	\$ 81,705
S93-26	S93-35	12	15	152	0.20	15	Open Cut	\$221	\$ 33,565

Total Baseline Pipe Construction Cost	\$	139,120
Lower lateral replacement and cleanout, Approx. 4	\$	18,000
Baseline Construction Cost:	\$	157,120
Bypass Pumping (10% of pipe construction cost)	\$	13,912
Remove & Replace Factor (5% of pipe construction cost)	\$	6,956
Traffic Control (10% of pipe construction cost)	\$	13,912
Subtotal:	\$	191,899
Mobilization/Demobilization (5% of subtotal)	\$	9,595
Estimated Construction Cost Subtotal:	\$	201,494
Contingencies (30% of construction subtotal)	\$	60,448
Total Estimated Construction Cost:	\$	261,943
Engineering, Administration, Legal (25% of construction cost)	\$	65,486
Estimated Capital Improvement Cost:	\$	327,000

Legend


- Modeled Manhole
- Unmodeled Manhole
- ➔ Unmodeled Sewer
- Modeled Trunk Sewer
- 15-in
(12-in) Req'd Diameter (Ex. Dia)
- Proposed Capital Improvement Project



0 125 250 500 Feet



City of Santa Clara
 Sanitary Sewer Improvement Projects
**Project P4: Tasman Drive
 Sewer Improvement**



Project P5: Sewer Diversion at Los Prades Boulevard and Saratoga Avenue

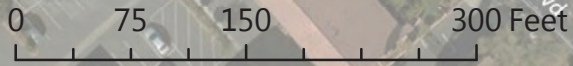
PROJECT DESCRIPTION	
Project ID	P5
Project Name	Sewer Diversion at Los Prades Boulevard and Saratoga Avenue
Project Location	Manhole S25-85 located in the intersection of Los Padres Blvd. and Saratoga Ave.
Description	Install a weir in manhole S25-85 to divert flow northwest to Los Padres Blvd.
Priority	3 - Triggered under Future PWWF
Estimated Capital Imp. Cost	\$77,000
Comments	(i) Pipes are listed in order from upstream to downstream
Assumptions	(i) Cost estimates are based on the SF Area November 2015 ENR CCI of 11169

PROJECT COST DETAIL

Install Weir	\$	35,000
Baseline Construction Cost:	\$	35,000
Traffic Control	\$	10,000
Subtotal:	\$	45,000
Mobilization/Demobilization (5% of subtotal)	\$	2,250
Estimated Construction Cost Subtotal:	\$	47,250
Contingencies (30% of construction subtotal)	\$	14,175
Total Estimated Construction Cost:	\$	61,425
Engineering, Administration, Legal (25% of construction cost)	\$	15,356
Estimated Capital Improvement Cost:	\$	77,000


Legend

- Unmodeled Manhole
- Modeled Manhole
- ➔ Unmodeled Sewer
- Modeled Trunk Sewer
- █ Proposed Capital Improvement Project



Install weir in manhole S25-85 to divert excess flow northwest to Los Padres Blvd.

City of Santa Clara
 Sanitary Sewer Improvement Projects
**Project P5: Sewer Diversion at
 Los Prades Blvd. and Saratoga Ave.**



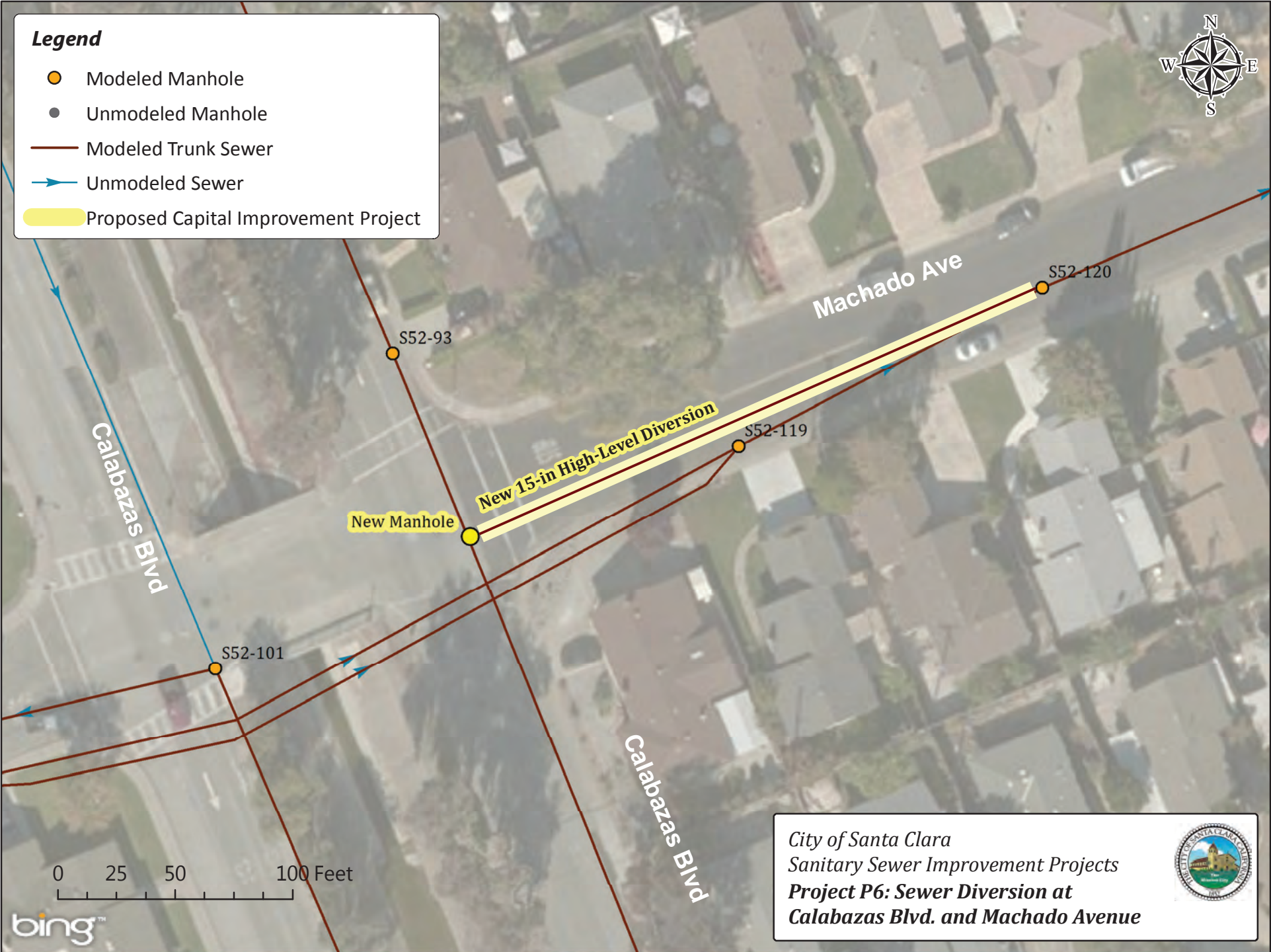

Project P6: Sewer Diversion at Calabazas Boulevard and Machado Avenue

PROJECT DESCRIPTION	
Project ID	P6
Project Name	Sewer Diversion at Calabazas Boulevard and Machado Avenue
Project Location	Calabazas Blvd. and Machado Ave.
Description	Install a new manhole upstream of S52-93 south of the intersection of Calabazas Blvd. and Machado Ave., and install a new 15-inch line (approximately 200 feet) to divert excess flow from the existing 24-inch line along Calabazas Blvd. to the 21-inch line in Machado Ave.
Priority	3 - Triggered under Future PWWF
Estimated Capital Imp. Cost	\$166,000
Comments	(i) Pipes are listed in order from upstream to downstream
Assumptions	(i) Cost estimates are based on the SF Area November 2015 ENR CCI of 11169 (ii) Cost estimates assume no right-of-way costs. City should verify this during design.
Alternatives	Upsize approximate 1,800 feet of 24-inch line between S62-31 and S72-31 to a 27-inch line. See project P6-Alternative.

PROJECT COST DETAIL

U/S MH ID	D/S MH ID	Existing Diameter (inches)	New Diameter (inches)	Length (feet)	Slope (%)	Pipe Depth (feet BGL)	Construction Method	Unit Cost (\$/LF)	Total Cost (\$)
CIP MH 01	S52-120	New Pipe	15	210	0.71	8	Open Cut	\$221	\$ 46,373

Total Baseline Pipe Construction Cost	\$	46,373
Install New Manhole and Reconnect Pipes	\$	36,000
Baseline Construction Cost:	\$	82,373
Traffic Control	\$	15,000
Subtotal:	\$	97,373
Mobilization/Demobilization (5% of subtotal)	\$	4,869
Estimated Construction Cost Subtotal:	\$	102,242
Contingencies (30% of construction subtotal)	\$	30,673
Total Estimated Construction Cost:	\$	132,914
Engineering, Administration, Legal (25% of construction cost)	\$	33,229
Estimated Capital Improvement Cost:	\$	166,000



Legend

- Modeled Manhole
- Unmodeled Manhole
- Modeled Trunk Sewer
- Unmodeled Sewer
- Proposed Capital Improvement Project



0 25 50 100 Feet



Sources: BING Basemap

City of Santa Clara
 Sanitary Sewer Improvement Projects
Project P6: Sewer Diversion at Calabazas Blvd. and Machado Avenue



Project P6-Alternative: Calabazas Creek Sewer Improvement

PROJECT DESCRIPTION	
Project ID	P6-Alternative
Project Name	Calabazas Creek Sewer Improvement
Project Location	Calabazas Creek from Central Expy. To Scott Blvd.
Description	Replace approximately 2100 feet of 24-in pipe with 27-in pipe
Priority	3 - Triggered under Future PWWF
Estimated Capital Imp. Cost	\$1,334,000
Comments	(i) Pipes are listed in order from upstream to downstream
Assumptions	(i) Cost estimates are based on the SF Area November 2015 ENR CCI of 11169
Alternatives	(i) Install parallel pipe.

PROJECT COST DETAIL

U/S MH ID	D/S MH ID	Existing Diameter (inches)	New Diameter (inches)	Length (feet)	Slope (%)	Pipe Depth (feet BGL)	Construction Method	Unit Cost (\$/LF)	Total Cost (\$)
S62-31	S62-29	24	27	422	0.29	15	Open Cut	\$298	\$ 125,744
S62-29	S62-10	24	27	386	0.30	15	Open Cut	\$298	\$ 115,191
S62-10	S62-11	24	27	17	1.33	16	Open Cut	\$298	\$ 5,157
S62-11	S62-13	24	27	23	0.22	16	Open Cut	\$298	\$ 6,886
S62-13	S62-14	24	27	178	0.27	15	Open Cut	\$298	\$ 52,975
S62-14	S62-15	24	27	48	0.17	14	Open Cut	\$298	\$ 14,160
S62-15	S72-32	24	27	372	0.34	13	Open Cut	\$298	\$ 110,779
S72-32	S72-31	24	27	402	0.35	13	Open Cut	\$298	\$ 119,842
S72-31	S72-20	24	27	250	0.55	13	Open Cut	\$298	\$ 74,528

Total Baseline Pipe Construction Cost \$ 625,263

Baseline Construction Cost: \$ 625,263

Bypass Pumping (10% of pipe construction cost) \$ 62,526

Remove & Replace Factor (5% of pipe construction cost) \$ 31,263

Traffic Control (10% of pipe construction cost) \$ 62,526

Subtotal: \$ 781,578

Mobilization/Demobilization (5% of subtotal) \$ 39,079

Estimated Construction Cost Subtotal: \$ 820,657

Contingencies (30% of construction subtotal) \$ 246,197

Total Estimated Construction Cost: \$ 1,066,855

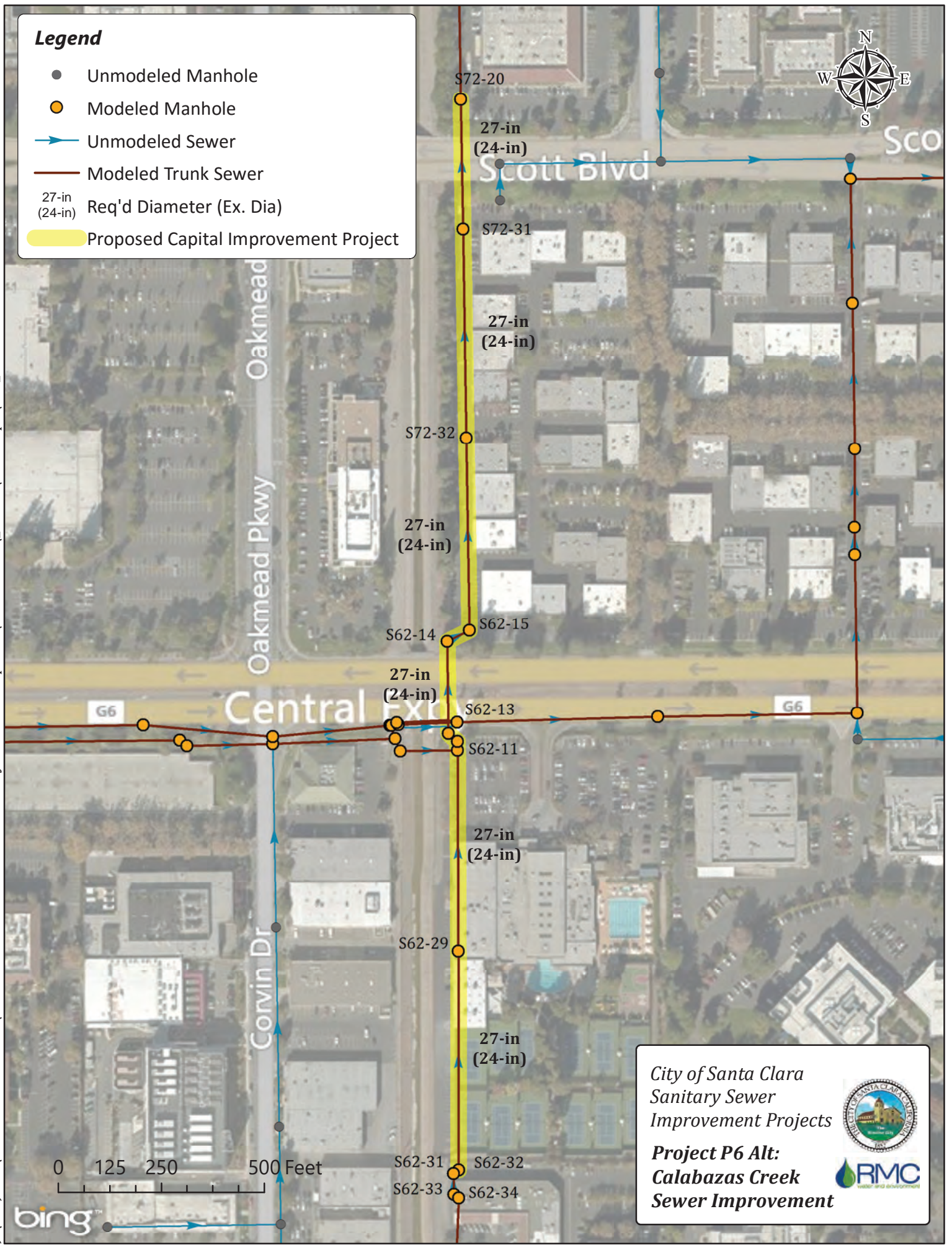
Engineering, Administration, Legal (25% of construction cost) \$ 266,714

Estimated Capital Improvement Cost: \$ 1,334,000

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Legend

- Unmodeled Manhole
- Modeled Manhole
- ➔ Unmodeled Sewer
- Modeled Trunk Sewer
- 27-in (24-in) Req'd Diameter (Ex. Dia)
- Proposed Capital Improvement Project



City of Santa Clara
 Sanitary Sewer
 Improvement Projects

**Project P6 Alt:
 Calabazas Creek
 Sewer Improvement**

Project E1: Tracy Drive Sewer Improvement

PROJECT DESCRIPTION	
Project ID	E1
Project Name	Tracy Drive Sewer Improvement
Project Location	Project begins at manhole S10-77 west of Lawrence Expy. and Tracy Dr., then Pruneridge Ave., Pomeroy Ave., and ends at manhole S22-51 in Homestead Rd. and Pepper Tree Ln.
Description	Upsize approximately 8,000 feet of 10 to 12-in and 18-in pipe to 15-in to 21-in pipe
Priority	N/A
Estimated Capital Imp. Cost	\$4,654,000
Comments	(i) Pipes are listed in order from upstream to downstream (ii) The City should verify the need and the appropriate timing of implementing this project. This project is triggered by the large sewer discharge assumed for parcel APN 316-17-018, which holds an entitlement agreement to discharge a potential flow of 0.95 mgd; however, it is currently discharging less than 10 percent of the entitled rate. While the City is obligated to provide capacity for entitlement holders, it is important to note that implementing this project may result in oversized sewers where the daily flow is not sufficient to provide the minimum cleaning velocity and thus causing potential debris and odor issues.
Assumptions	(i) Cost estimates are based on the SF Area November 2015 ENR CCI of 11169
Alternatives	(i) Install parallel pipe.

PROJECT COST DETAIL

U/S MH ID	D/S MH ID	Existing Diameter (inches)	New Diameter (inches)	Length (feet)	Slope (%)	Pipe Depth (feet BGL)	Construction Method	Unit Cost (\$/LF)	Total Cost (\$)
S10-77	S10-78	10	15	315	0.22	10	Open Cut	\$221	\$ 69,560
S10-78	S10-79	10	15	300	0.27	11	Open Cut	\$221	\$ 66,247
S10-79	S10-80	10	15	300	0.16	10	Open Cut	\$221	\$ 66,247
S10-80	S11-83	10	15	262	0.31	8	Open Cut	\$221	\$ 57,746
S11-83	S11-76	10	15	307	0.51	8	Open Cut	\$221	\$ 67,749
S11-76	S11-77	10	15	109	0.43	9	Open Cut	\$221	\$ 24,114
S11-77	S11-78	10	15	164	0.44	8	Open Cut	\$221	\$ 36,215
S11-78	S11-80	10	15	316	0.48	6	Open Cut	\$221	\$ 69,736
S11-80	S11-81	10	15	321	0.54	6	Open Cut	\$221	\$ 70,951
S11-81	S11-70	10	15	286	0.86	6	Open Cut	\$221	\$ 63,045
S11-70	S11-67	10	15	311	1.21	7	Open Cut	\$221	\$ 68,566
S11-67	S11-60	10	15	335	0.68	7	Open Cut	\$221	\$ 73,910
S11-60	S11-50	10	15	308	0.32	6	Open Cut	\$221	\$ 68,080
S11-50	S11-41	10	15	338	0.43	7	Open Cut	\$221	\$ 74,639
S11-41	S11-42	10	15	252	0.28	8	Open Cut	\$221	\$ 55,626
S11-42	S11-30	10	15	240	0.54	7	Open Cut	\$221	\$ 52,910
S11-30	S11-29	10	15	79	0.40	7	Open Cut	\$221	\$ 17,335
S11-29	S11-19	10	15	138	0.66	8	Open Cut	\$221	\$ 30,474
S11-19	S11-10	10	15	401	1.00	8	Open Cut	\$221	\$ 88,617
S11-10	S22-93	10	15	425	1.06	9	Open Cut	\$221	\$ 93,740
S22-93	S22-80	10	15	339	0.56	9	Open Cut	\$221	\$ 74,793
S22-80	S22-74	10	15	314	0.47	9	Open Cut	\$221	\$ 69,251
S22-74	S22-69	10	15	276	0.21	9	Open Cut	\$221	\$ 61,014
S22-69	S22-55	12	15	180	0.40	9	Open Cut	\$221	\$ 39,638
S22-55	S22-46	New Pipe	15	53	0.49	10	Open Cut	\$221	\$ 11,682
S22-46	S22-47	18	21	313	0.68	14	Open Cut	\$254	\$ 79,587
S22-47	S22-48	18	21	30	0.68	13	Open Cut	\$254	\$ 7,618
S22-48	S22-49	18	21	320	0.68	13	Open Cut	\$254	\$ 81,263
S22-49	S22-50	18	21	367	0.68	13	Open Cut	\$254	\$ 93,199
S22-50	S22-51	18	21	349	0.68	13	Open Cut	\$254	\$ 88,526

Total Baseline Pipe Construction Cost \$ 1,822,079
 Lower lateral replacement and cleanout, Approx. 100 \$ 450,000
Baseline Construction Cost: \$ 2,272,079

Bypass Pumping (10% of pipe construction cost) \$ 182,208
 Remove & Replace Factor (5% of pipe construction cost) \$ 91,104
 Traffic Control (10% of pipe construction cost) \$ 182,208
Subtotal: \$ 2,727,599

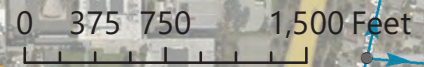
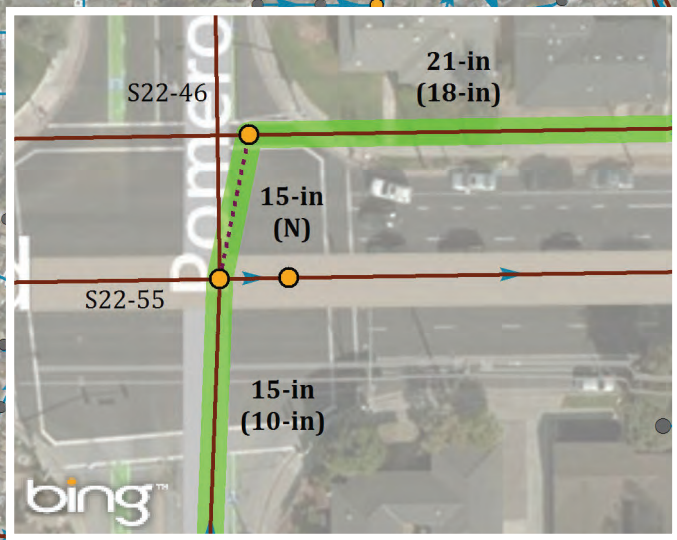
Mobilization/Demobilization (5% of subtotal) \$ 136,380
Estimated Construction Cost Subtotal: \$ 2,863,979

Contingencies (30% of construction subtotal) \$ 859,194
Total Estimated Construction Cost: \$ 3,723,173

Engineering, Administration, Legal (25% of construction cost) \$ 930,793
Estimated Capital Improvement Cost: \$ 4,654,000

Legend

- Unmodeled Manhole
- Modeled Manhole
- ➔ Unmodeled Sewer
- Modeled Trunk Sewer
- 15-in (10-in) Req'd Diameter (Ex. Dia)
- Improvement Project Triggered by Entitlement










City of Santa Clara
 Sanitary Sewer Improvement Projects
**Project E1: Tracy Drive
 Sewer Improvement**

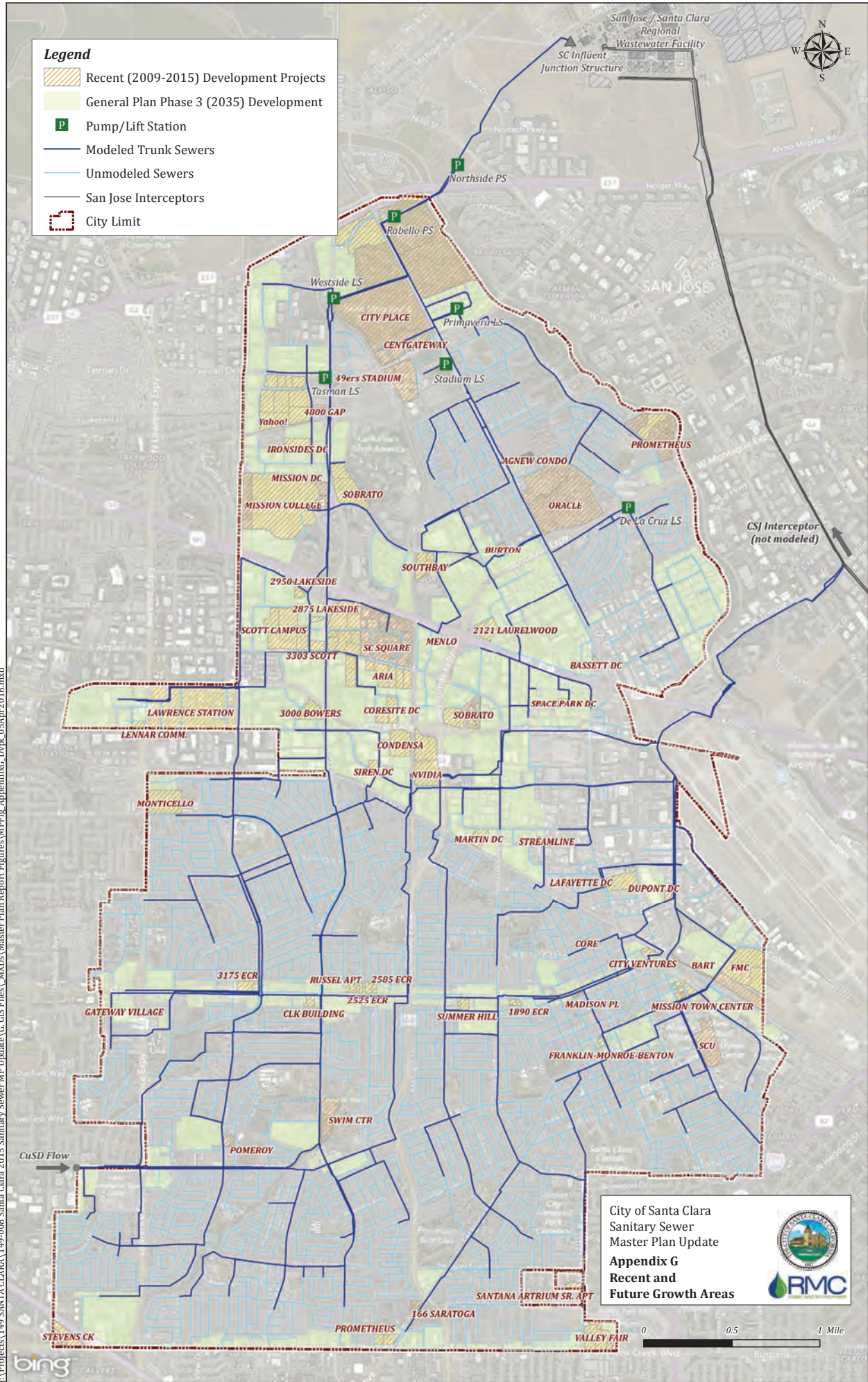


Appendix G - General Plan Land Use and Recent (2009-2015) Developments

General Plan Phase 3 (2035) Development List is included on the enclosed CD



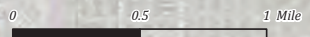
Legend

-  Recent (2009-2015) Development Projects
-  General Plan Phase 3 (2035) Development
-  Pump/Lift Station
-  Modeled Trunk Sewers
-  Unmodeled Sewers
-  San Jose Interceptors
-  City Limit



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City of Santa Clara
 Sanitary Sewer
 Master Plan Update
Appendix G
 Recent and
 Future Growth Areas

Recent Development Projects (2009-2015) Included in Estimating Future Loads

ID	Name	Proposed Land Use	Proposed Development ^{1,2}	
1	BART Extension	Commercial	--	--
2	Lafayette Data Center	Data Center	--	--
3	Bassett Data Center	Data Center	--	--
4	Old Ironsides Data Center	Data Center	--	--
5	Valley Fair Expansion	Commercial	23,000	SF
6	Sobrato - Lawson Lane	Commercial	516,000	SF
7	South Bay Development	Commercial	564,000	SF
8	2875 Lakeside Dr. Hotel	Commercial	170	DU
9	2525 El Camino Real	Residential	48	DU
10	Mansion Grove Apartment	Residential	124	DU
11	CORE	Residential	28	DU
12	Menlo Equities	Commercial	1,403,000	SF
13	Mission College Campus	Commercial	--	--
14	Yahoo! Development	Commercial	3,641,000	SF
15	49ers stadium	Commercial	1,850,000	SF
16	Martin Ave. Data Center	Data Center	--	--
17	Agnew Dr. Development	Residential	50	DU
18	Coresite Data Center	Data Center	--	--
19	Space Park / Pelio Data Center	Data Center	--	--
20	Siren Data Center	Data Center	--	--
21	SCU Graham Residence Hall	Residential	376	DU
22	Oracle Campus Cooling Tower	Industrial	--	--
23	Sreamline Circuits	Industrial	--	--
24	Burton Dr.	Commercial	--	--
25	865 Pomeroy Ave. Development	Residential	21	DU
26	3175 El Camino Real	Residential	133	DU
27	Stevens Creek Development	Commercial	375,000	SF
28	FMC Site	Mixed Use	1,000	DU
			1,500,000	SF
29	3000 Bowers Ave (Sobrato Development)	Commercial	317,000	SF
30	2121 Laurelwood	Commercial	245,000	SF
31	Mission College Data Center	Data Centers	--	--
32	Russel Building	Residential	195	DU
33	Monticello Village	Mixed Use	825	DU
			40,000	SF
34	NVIDIA	Commercial	1,041,000	SF
35	3303 Scott Blvd.	Commercial	230,000	SF

ID	Name	Proposed Land Use	Proposed Development ^{1,2}	
36	Sobrato Development Revision	Commercial	1,043,000	SF
37	4800 Great America Parkway	R&D Offices	170,000	SF
38	Condensa	Commercial	909,000	SF
39	2585 El Camino Real	Residential	60	DU
40	Prometheus	Residential	222	DU
41	166 Saratoga Development	Residential	33	DU
42	Madison Place	Mixed Use	28	DU
			7,000	SF
43	Franklin-Monroe-Benton Development	Mixed Use	--	--
44	Gateway Village	Mixed Use	--	--
45	Aria Project	R&D Offices	6,000	SF
46	Oracle Development	Commercial	--	--
47	Santana Artrium Senior Apartment	Residential	90	DU
48	Scott Campus	R&D Offices	1,372,000	SF
49	Valley Fair Development	Commercial	127,000	SF
50	Santa Clara Square	Commercial	2,200	DU
			1,842,000	SF
51	Mission Town Center	Mixed Use	450	DU
			27,000	SF
52	Summer Hill Apartments	Residential	151	DU
53	City Ventures	Residential	--	--
54	Santa Clara City Place	Mixed Use	1,360	DU
			7,800,000	SF
55	Lennar Commercial	Commercial	199,000	SF
56	Dupont Fabrous Data Center	Data Center	--	--
57	2950 Lakeside Drive Hotel	Commercial	--	--
58	CLK Building	Commercial	131,000	SF
59	1890 El Camino Real	Mixed Use	--	--
60	Swimming Center	Commercial	--	--
61	Lawrence Station	Mixed Use	3,000	DU
			104,000	SF
Minimum Total Residential Dwelling Units:			10,564	DU
Minimum Total Non-Residential Square Footage:			25,482,000	SF

1. Non-Residential developments are rounded to the nearest 1,000 square feet.
2. Building square footage (SF) or dwelling units (DU) are not applicable to developments with unique land use such as data centers and swim center. For these types of developments, use-specific flow rates were used for modeling purpose.