CITY OF ROSEVILLE CALIFORNIA

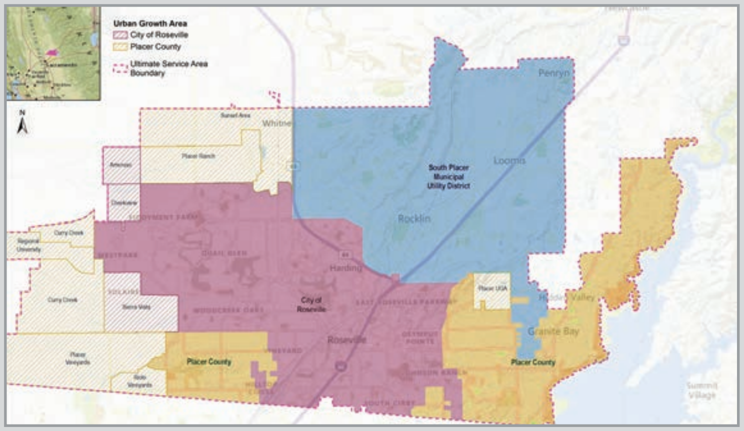
COUNTY OF Placer

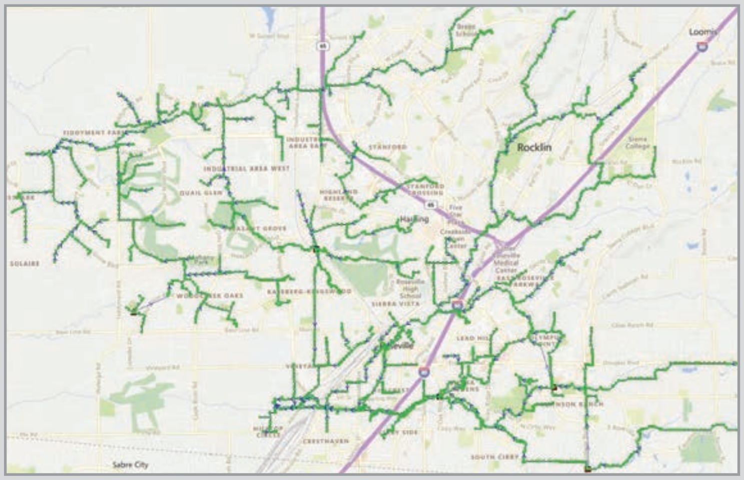
SOUTH PLACER MUNICIPAL UTILITY DISTRICT

SOUTH PLACER WASTEWATER AUTHORITY

Partners: City of Roseville, Placer County, South Placer Municipal Utility District

South Placer Regional Wastewater 2020 Systems Evaluation Report





December 2020

Prepared by

WOODARD & CURRAN

SOUTH PLACER REGIONAL WASTEWATER 2020 SYSTEMS EVALUATION REPORT

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0011183.00
South Placer
Wastewater Authority
December 2020

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Acknowledgements

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List of Abbreviations

AA	average annual
ac	acres
ADWF	average dry weather flow
AFY	acre feet per year
APN	assessor parcel number
BOD	biochemical oxygen demand
BSF	base sanitary flow
CIP	Capital Improvement Program
DC	Dry Creek
DCWWTP	Dry Creek Wastewater Treatment Plant
du, DU	dwelling unit
DWF	dry weather flow
ea	each
EDU	Equivalent Dwelling Unit
ENR-CCI	Engineering News Record Construction Cost Index
ft	feet
FY	fiscal year
GIS	Geographical Information System
gpd	gallons per day
gpm	gallons per minute
GWI	groundwater infiltration
I/I	inflow and infiltration
in	inches
lb/day	pounds per day
MCRT	mean cell residence time
MG	million gallons
mgd	million gallons per day
MM	maximum month
NPDES	National Pollutant Discharge Elimination System
PDWWF	peak day wet weather flow
PG	Pleasant Grove
PGWWTP	Pleasant Grove Wastewater Treatment Plant
PHWWF	peak hour wet weather flow
PMF	peak month flow
PS	pump station
PWWF	peak wet weather flow
RAS	return activated sludge
RDI/I	rainfall dependent infiltration/inflow

RWQCB	Regional Water Quality Control Board
SMD-2	Placer County Sewer Maintenance District 2
SMD-3	Placer County Sewer Maintenance District 3
SPMUD	South Placer Municipal Utility District
SPWA	South Placer Wastewater Authority
SWRCB	State Water Resources Control Board
Systems Evaluation	Regional Wastewater and Recycled Water Systems Evaluation
TM	technical memorandum
TSS	total suspended solids
UGA	Urban Growth Area
UV	ultraviolet
WAS	waste activated sludge
WWF	wet weather flow
WWTP	wastewater treatment plant

EXECUTIVE SUMMARY

This report summarizes the results and recommendations of the Systems Evaluation prepared for the South Placer Wastewater Authority (SPWA), which is a Joint Powers Authority comprised of the City of Roseville (City), South Placer Municipal Utility District (SPMUD), and the County of Placer (Placer County). The Systems Evaluation was prepared by Woodard & Curran in close coordination with City, County and District staff. The Systems Evaluation will be used to guide improvements to the regional wastewater collection system and wastewater treatment plants to accommodate current and future development and ensure that SPWA's customers continue to receive a high level of service.

Background and Purpose of the Systems Evaluation

The South Placer Wastewater Authority (SPWA) was created under a Joint Powers Agreement in October 2000 and comprises the City of Roseville (City), South Placer Municipal Utility District (SPMUD), and the County of Placer (Placer County). Flow from SPMUD and portions of Placer County discharge into the City's sewer collection system. The City of Roseville, on behalf of the regional partners, owns and operates two regional wastewater treatment facilities: the Pleasant Grove Wastewater Treatment Plant (PGWWTP), and the older Dry Creek Wastewater Treatment Plant (DCWWTP). Additionally, the City of Roseville owns and operates the network of gravity sewers, pump stations, and force mains that serve customers within the City's limits, including the joint (regional) facilities that convey flow from the SPWA partners. SPMUD owns and operates gravity sewers, pump stations, and force mains in Rocklin, Loomis, and portions of southern Placer County. Placer County owns and operates gravity sewers, pump stations, and force mains in unincorporated areas of Placer County that are not served by other agencies.

The South Placer Regional Wastewater and Recycled Water Systems Evaluation prepared in 2009 (2009 Systems Evaluation), defined the SPWA service area boundary; evaluated the wastewater collection, wastewater treatment, and recycled water distribution systems; and identified existing and potential future improvement needs. Since that study was completed, the recycled water distribution system has been "removed" from the SPWA system (reallocated as an asset) and is now wholly managed by the City of Roseville. SPWA is now updating the Systems Evaluation to better evaluate future wastewater collection and treatment capacity needs that may have changed since 2009. This report documents the evaluation of the wastewater collection system capacity and the capacity of the wastewater treatment plants versus projected flows and loads.

This South Placer Regional Wastewater Systems Evaluation (Systems Evaluation) has been conducted to accomplish the following:

- Document the existing (2020) capacity and the flows and loadings on regional trunk sewer and wastewater treatment infrastructure and facilities present in 2020;
- Project buildout conditions based upon regional planning documents and planned regional developments in southwestern Placer County; and,
- Present a Regional Systems evaluation, with system deficiencies identified, and capital projects forecasted, which will inform the SPWA partners in identifying their ability to provide service for planned and proposed development both presently and for buildout conditions.

The service area is shown in Figure 1-1, and the regional collection system is shown in Figure ES-2. Figure 1-1 also indicates the location of the Urban Growth Areas (UGAs) within the service area, which are included in this study. Note that Creekview has been incorporated into the City of Roseville service area as of January 2019, while Amoruso and Sierra Vista are anticipated to be incorporated into the City's service area in early 2021.

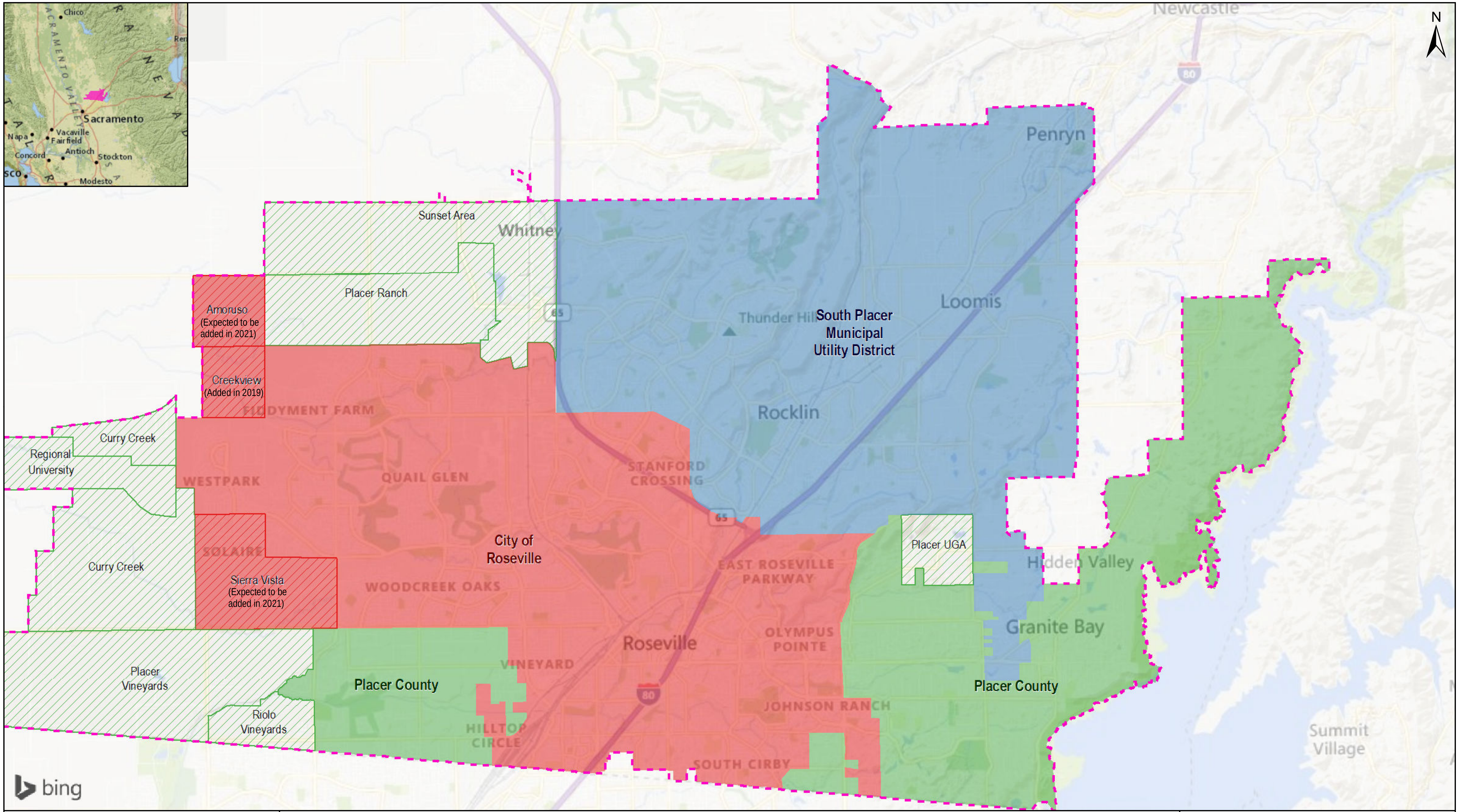

Figure ES-1

2021 Service Area Boundary

South Placer Wastewater Authority
2020 Systems Evaluation

0 ½ 1 2 Miles

2021 Partner Agency Service Area

- 🟥 City of Roseville
- 🟩 Placer County
- 🟦 SPMUD

Urban Growth Area

- ▨ City of Roseville UGA
- ▨ Placer County UGA
- ▭ Ultimate Service Area Boundary

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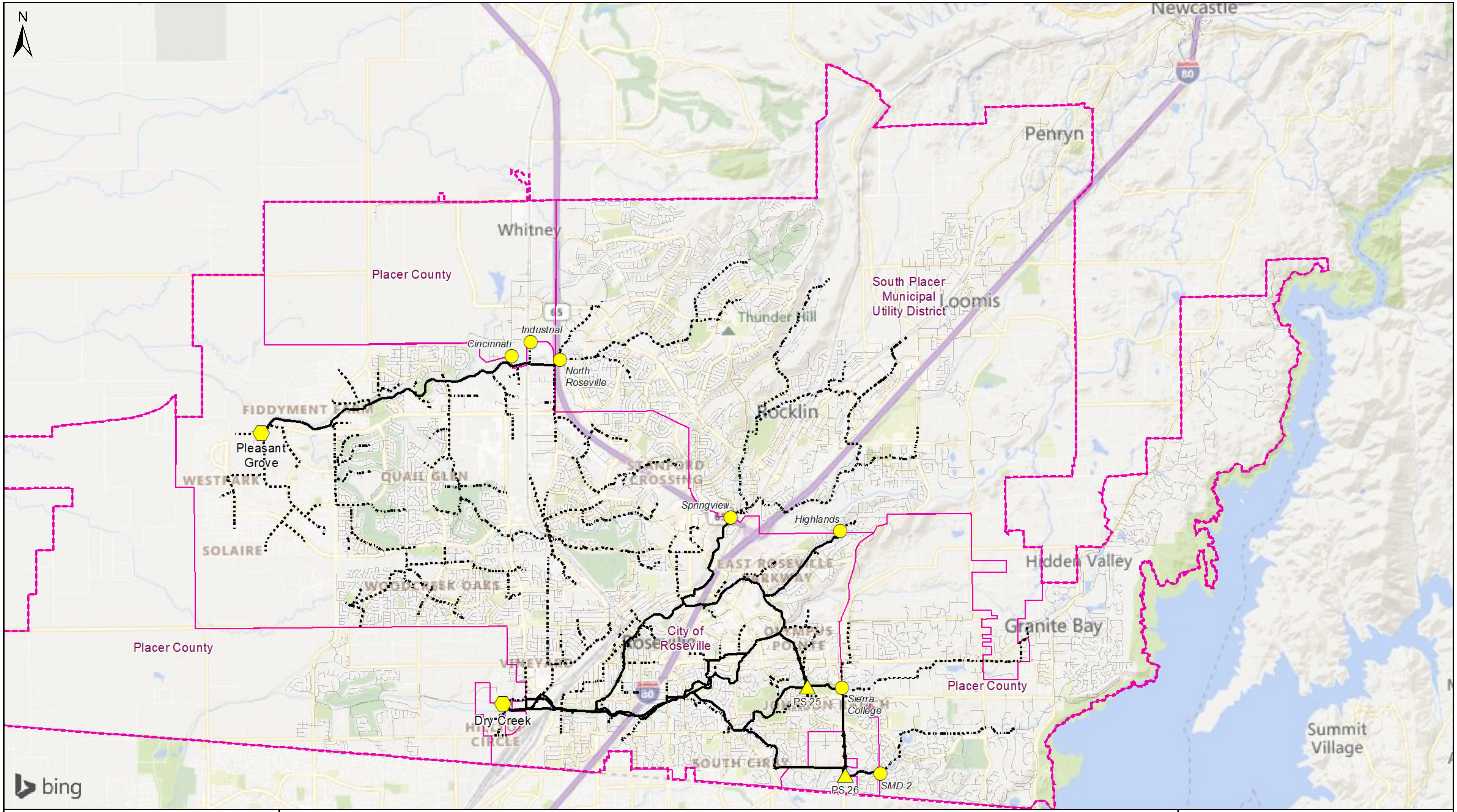

Figure ES-2
Modeled Trunk System

South Placer Wastewater Authority
2020 Systems Evaluation

0 ½ 1 2
Miles

▬	Regional Gravity Sewer
●▬●	Regional Force Main
⋯	Non-Regional Modeled Sewer
─	Non-Modeled Sewer
⬢	Wastewater Treatment Plant
▲	Pump Station
●	Permanent Flow Meters
☐	Partner Agency Boundary
⬚	Ultimate Service Area Boundary

Project #: 0011183.00
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Modeled Flow Projections

The flow projections developed for this Systems Evaluation were based on the information collected for the system's hydraulic model updates, including the updates performed for the current study. In 2007, a hydraulic model of the City's sewer collection system was developed using the H2OMap Sewer modeling platform (2007 Model Development Project), in parallel with a trunk sewer model for the combined Roseville, SPMUD, and Placer County systems. The models were later updated as part of the 2009 Systems Evaluation. Subsequently, the City's sewer model was updated in 2017 to reflect existing and future demands within the City, and to upgrade the modeling platform to the fully dynamic InfoWorks ICM software. For the current Systems Evaluation Update, the City's model was updated to reflect existing and future projected flows from Placer County and SPMUD.

Existing base wastewater flows were developed based on the assumptions summarized below; currently connected parcels are indicated in Figure ES-3. Note that flow projections (referred herein as loads) are intended to represent the level of development present during the flow monitoring periods used to calibrate the hydraulic model. Buildout loads were based on projected development within the service area. Two buildout scenarios were developed: (1) Buildout scenario representing the currently anticipated development density, and (2) Buildout-Sensitivity scenario, representing higher density development and some potential redevelopment areas.

For the City of Roseville, existing loads were developed based on water consumption data, and calibrated during the 2017 model update. A 15% rebound to reflect drought conditions was assumed for existing sewer loads. A buildout scenario was developed based on infill of currently vacant parcels using land use information from the City's General Plan or provided by the City's planning department, and development of UGAs within the City. The Buildout-Sensitivity scenario considers potential intensification and redevelopment in the downtown Roseville area.

Placer County provided spreadsheets summarizing existing equivalent dwelling units (EDUs) for each APN[1], which formed the basis of the existing model loads. (Note: an EDU is defined as the flow equivalent of one single-family residence.) For the Buildout scenario, flows were based on a spreadsheet provided by Placer County that summarized the anticipated EDUs for all entitled projects in Placer County[2], development of other currently vacant parcels (based on general plan data[2]), and development of the Placer County UGAs. For the Buildout scenario, an average development density for vacant parcels was assumed within the General Plan limits. For the Buildout-Sensitivity scenario, the development density was assumed to be at the maximum range allowed by the General Plan. A Base Wastewater Flowrate (BWF) of 180 gpd per EDU was assumed for Placer County and SPMUD.

SPMUD provided a shapefile[3] which provided EDUs for the year 2020 (which was identified as "existing" land use by SPMUD staff), and 2060 (which was identified as "Buildout" by SPMUD staff). This shapefile formed the basis of the Existing and Buildout scenarios.

For the UGAs, land use and flow projections were based on the most recent wastewater master plans for each UGA.

The locations of future developments, including urban growth areas, are indicated in Figure ES-4.

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[1] Spreadsheets included: Existing dry creek EDU-7-24-19.xls, Existing SMD 2- EDU-2018-12-12.xlsx, Existing SMD 3- EDU-2018-12-12.xlsx, Existing Sunset EDU-7-24-19.xls

[2] 2018-12-18-Entitled-Planned Project.xlsx (provided December, 2018) and GeneralPlans_CommPlans.shp (downloaded from Placer County website, dated October 20, 2019)

[3] SPMUD_SewerLoading_AddressPoints, provided August 7, 2019.

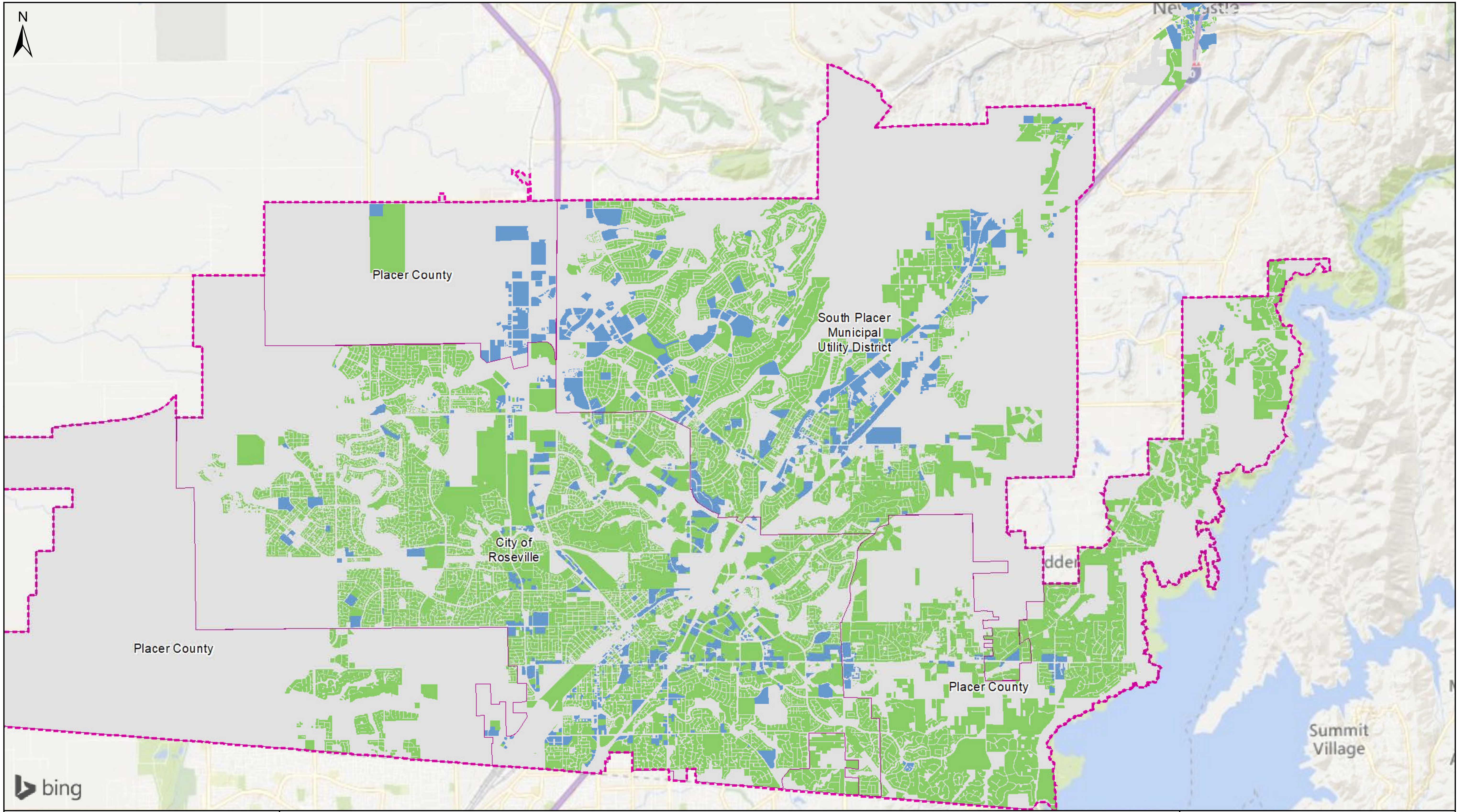

Figure ES-3

Existing Connected Parcels

South Placer Wastewater Authority
2020 Systems Evaluation

0 ½ 1 2 Miles

Parcel Land Use

- 🟦 Commercial/Industrial
- 🟩 Residential
- ⬜ Unconnected
- ▭ Service Area Boundary
- ▭ Partner Agency Boundary

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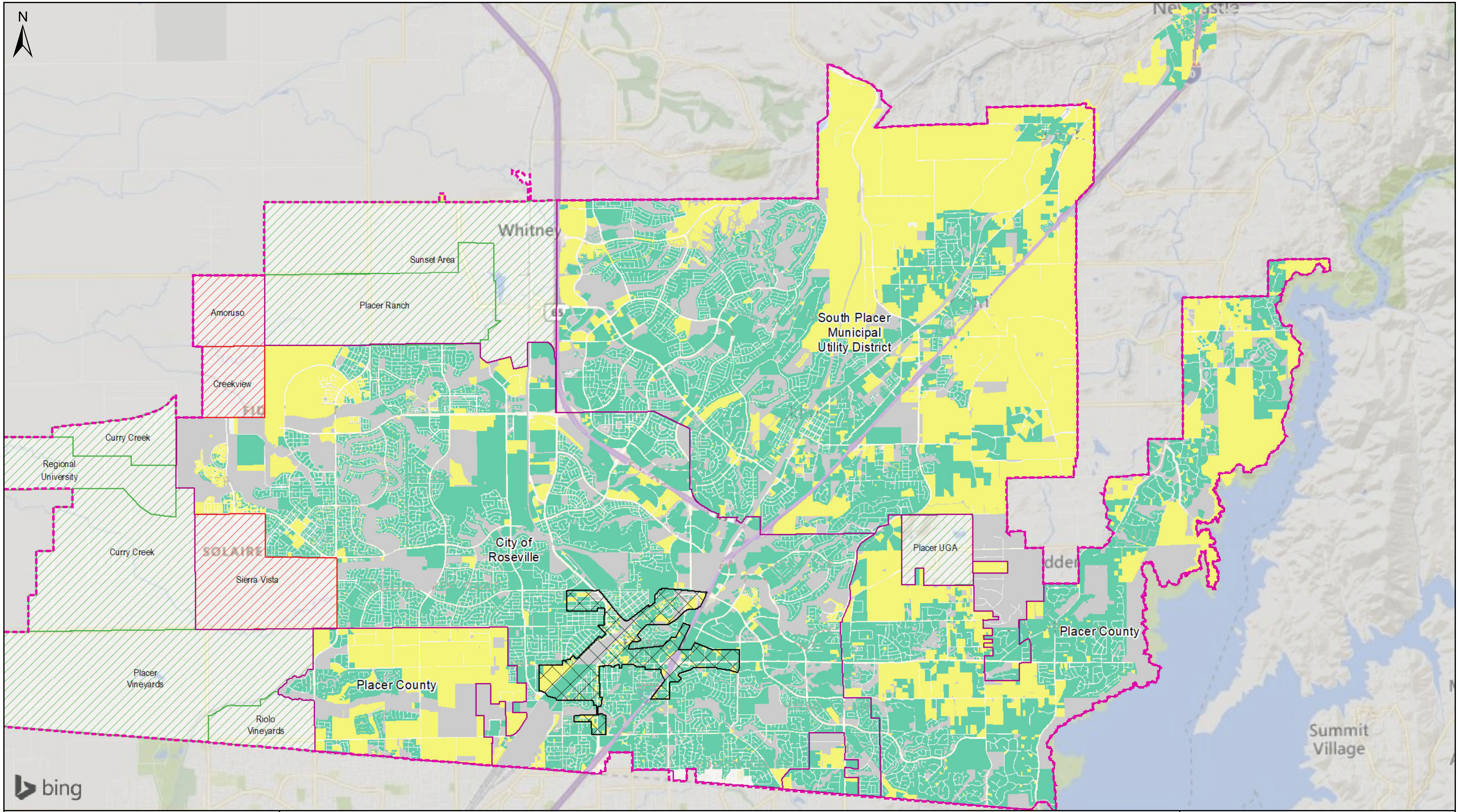

Figure ES-4

Future Development and Urban Growth Areas

South Placer Wastewater Authority
2020 Systems Evaluation

0 ½ 1 2 Miles

Buildout Status

- 🟩 Existing
- 🟨 Future Connection
- ⬜ Unconnected
- ☒ Redevelopment Area

Urban Growth Area

- ▨ City of Roseville UGA
- ▨ Placer County UGA
- ▭ Partner Agency Boundary

▭ Service Area Boundary

Project #: 0011183.00
Map Created: December 2020

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Model loads were calibrated based on temporary monitoring programs for the 2015/2016 wet weather season (30 meters for the City's 2017 Model Update) and 12 meters during the 2018/2019 wet weather season (for SPMUD and Placer County). V&A Consulting Engineers, under subcontract to Woodard & Curran, conducted the monitoring. As part of the calibration process, rates of wet season groundwater infiltration (GWI, observed as a constant additional flow throughout the monitoring period), and rainfall-dependent inflow and infiltration (RDI/I) were calculated. Existing and projected flows predicted by the model are summarized in Table ES-1 and Table ES-2.

Table ES-1: Estimated Dry Weather Flows[a] by Agency

WWTP	**Agency**	**Existing Calibration ADWF (mgd)**	**Existing ADWF with Drought Rebound**	**Buildout ADWF (mgd)**	**Buildout-Sensitivity[b] ADWF (mgd)**
Pleasant Grove	Roseville	5.87	6.70	13.01	13.04
	Placer County	0.18	0.20	9.85	9.85
	SPMUD	2.25	2.97	3.63	3.63
	Total	8.30	9.87	26.49	26.52
Dry Creek	Roseville	5.60	6.27	6.89	8.23
	Placer County	2.57	2.81	7.19	7.42
	SPMUD	2.90	3.64	5.16	5.16
	Total	11.06	12.72	19.24	20.81

Notes:

a. Includes wet season GWI.
b. For the Buildout-Sensitivity scenario, the development density was assumed to be at the maximum range allowed by the General Plan. A Base Wastewater Flowrate (BWF) of 180 gpd per EDU was assumed for Placer County and SPMUD

Table ES-2: Modeled ADWF And Peak WW Flow Summary

	Existing (Rebound)			Buildout			Buildout-Sensitivity		
WWTP	BWF[a] (mgd)	ADWF (mgd)	PWWF[b] (mgd)	BWF[a] (mgd)	ADWF (mgd)	PWWF[b] (mgd)	BWF[a]	ADWF (mgd)	PWWF[b] (mgd)
Pleasant Grove	9.5	9.9	27.4	26.1	26.5	55.8	26.2	26.5	56.0
Dry Creek	10.1	12.7	41.9	16.7	19.2	59.2	18.2	20.8	60.6

Notes:

a. Does not include wet season groundwater infiltration (GWI).
b. Modeled PWWF assumes improvements have been implemented to eliminate overflows and significant surcharging.

Trunk Sewer Evaluation

The calibrated model was run for Existing, Buildout, and Buildout-Sensitive land use scenarios under the design event described above. Several deficiencies were identified in non-regional facilities which resulted in model-predicted overflows for one or more of the scenarios; to ensure flows were conveyed to regional sewers, pipes were upsized in this analysis to eliminate any overflows. As the current model is a calibrated fully-dynamic model, the design condition represents a relatively infrequent storm event, and many of SPWA's sewers are relatively deep, surcharging up to within 5 feet of the manhole rims (ground surface) was considered acceptable under 10-year design storm PWWF, as long as the surcharge (flow height in the manhole) does not exceed 4 feet from the top of pipe up the manhole.

Model results under Existing and Buildout conditions are summarized in Table ES-3 and results for the Buildout scenario are shown in Figure ES-5. Within the regional system, seven deficiency areas have been identified as indicated in Figure ES-5. There was no significant difference in modeled surcharge between the Buildout and Buildout-Sensitivity scenarios.

Table ES-3: Sewer Capacity Results under Existing and Buildout Land Use Scenarios[a]

Area	Existing (with Rebound)			Buildout and Buildout-Sensitivity		
	Length of Throttle Surcharge (ft)	Maximum Surcharge Depth (ft)	Minimum Freeboard (ft)	Length of Throttle Surcharge (ft)	Maximum Surcharge Depth (ft)	Minimum Freeboard (ft)
A	5,530	7.3	0.0	5,530	7.8	0.0
B	3,369	1.9	2.0	3,948	7.7	0.0
C	522	1.0	7.4	6,009	6.4	2.8
D	700	1.1	8.6	4,220	3.3	6.4
E	--	--	--	2,223	3.1	5.6
F	--	0.9	12.2	1,716	7.3	2.2
G	--	--	--	0	2.3	6.3

Notes:

a. Areas that exceed the hydraulic capacity criteria but do not have modeled overflows are highlighted yellow, while areas with modeled overflows are highlighted orange.

Based on these model results, improvement projects have been identified to relieve the capacity deficiencies. Improvement Project 1 would relieve existing deficiencies, while Improvement Project 2 and 3 would relieve deficiencies identified in the Buildout system. Improvement Project 2 and 3 would largely be triggered by additional growth in Placer County's SMD2 and SMD3 service areas. Subsequent model runs were performed to estimate the number of EDUs that would trigger the need for these additional projects; based on this analysis, the projects would be needed after approximately 1,800 additional EDUs (compared to 2018 development). Based on the EDU projections provided by Placer County, this additional growth is not anticipated until after Fiscal Year (FY) 2059/2060. Note that this estimate is based on dry weather flows and rainfall response estimated as part of the model update; changes in these projected flows may occur (in the future with additional flow monitoring and model updates) which would trigger the need for the projects earlier, or delay or eliminate the need for the projects.

The proposed capacity improvement projects are summarized in Table ES-4 and the locations are shown in Figure ES-6.

Table ES-4: Proposed Capacity Improvement Projects

Project	Description	Estimated Capital Improvement Cost	Approximate Additional EDUs in SMD2/SMD3 to Trigger Project[a]
1	Increased Capacity of PS 26 and sewers on Sierra College Blvd directly downstream of PS 26 to relieve Old Auburn Trunk sewer (Area A)	$1,606,000	Existing
2	Redirect flows from PS 26 and Sierra College Blvd down Eureka Road to relieve Area E.	$1,831,000	~1,800[b]
3	Increased Firm capacity of PS 25 to meet Buildout PWWF. New weir structure or adjustments to existing structure at PS 25 to convey the maximum potential flow through PS 25 without any dry weather flows.	$758,000	~1,800[c]

Notes:

a. Based on a percentage of buildout factor applied to future model loads. Represents approximately 60% of buildout.

b. There are approximately 8,400 Existing EDUs upstream of the deficiency triggering Improvement Project 2, and approximately 10,200 EDUs would trigger the need for improvement. Represents approximately 60% of buildout.

c. There are approximately 11,900 Existing EDUs upstream of the deficiency triggering Improvement Project 3, including 7,600 in Placer County, 4,200 in Roseville, and less than 100 in SPMUD. Approximately 13,700 EDUs would trigger the need for the improvement.

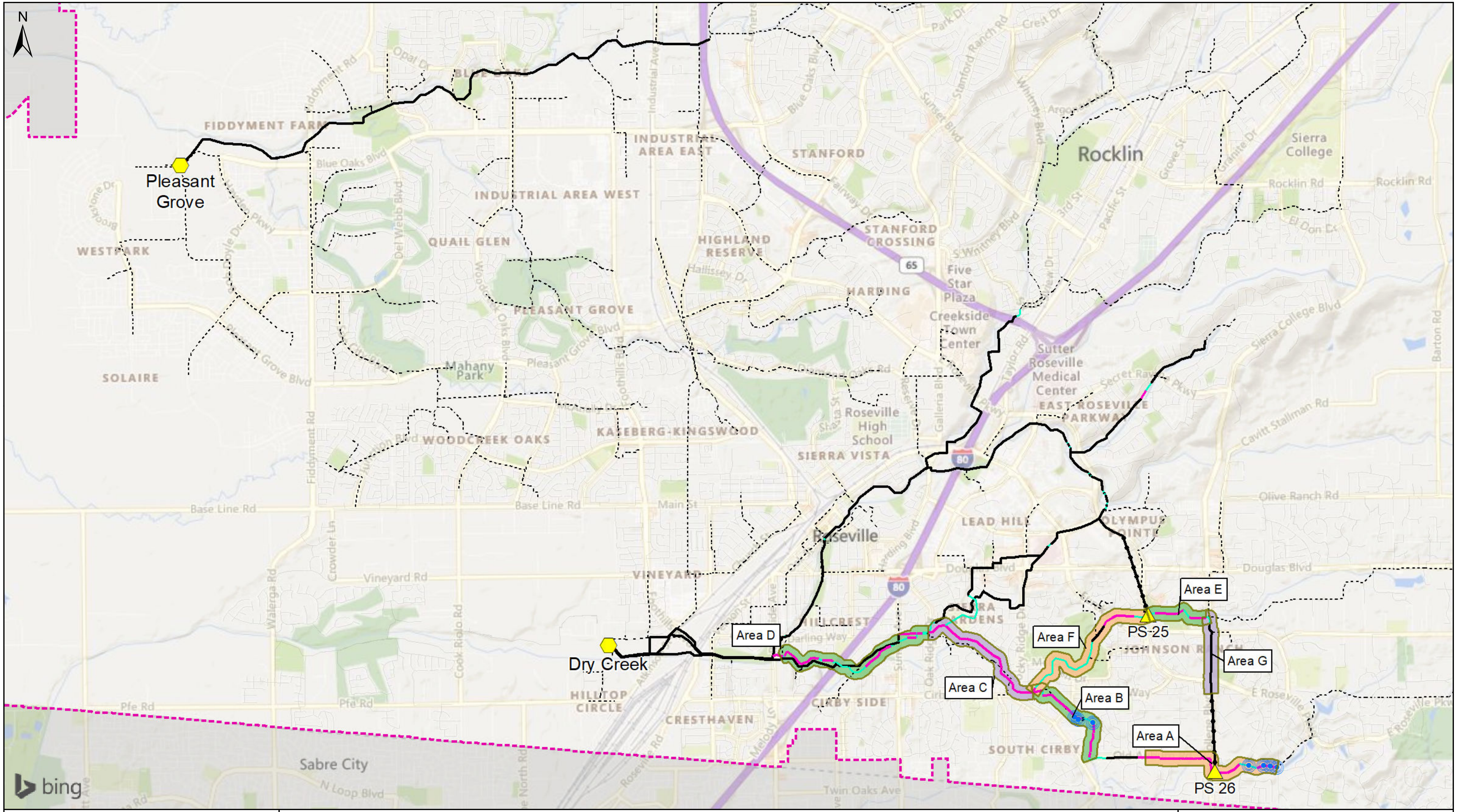

Figure ES-5

Model Results (Buildout and Buildout Sensitivity PWWF)

South Placer Wastewater Authority
2020 Systems Evaluation

0 ¼ ½ 1 Miles

- Regional Gravity Sewer
- Force Main
- Non-Regional Modeled Sewer
- Backwater Surcharge
- Throttle Surcharge
- ◉ Modeled Sewer Overflow
- ▨ Deficiency Area
- Ultimate Service Area Boundary

Project #: 0011183.00
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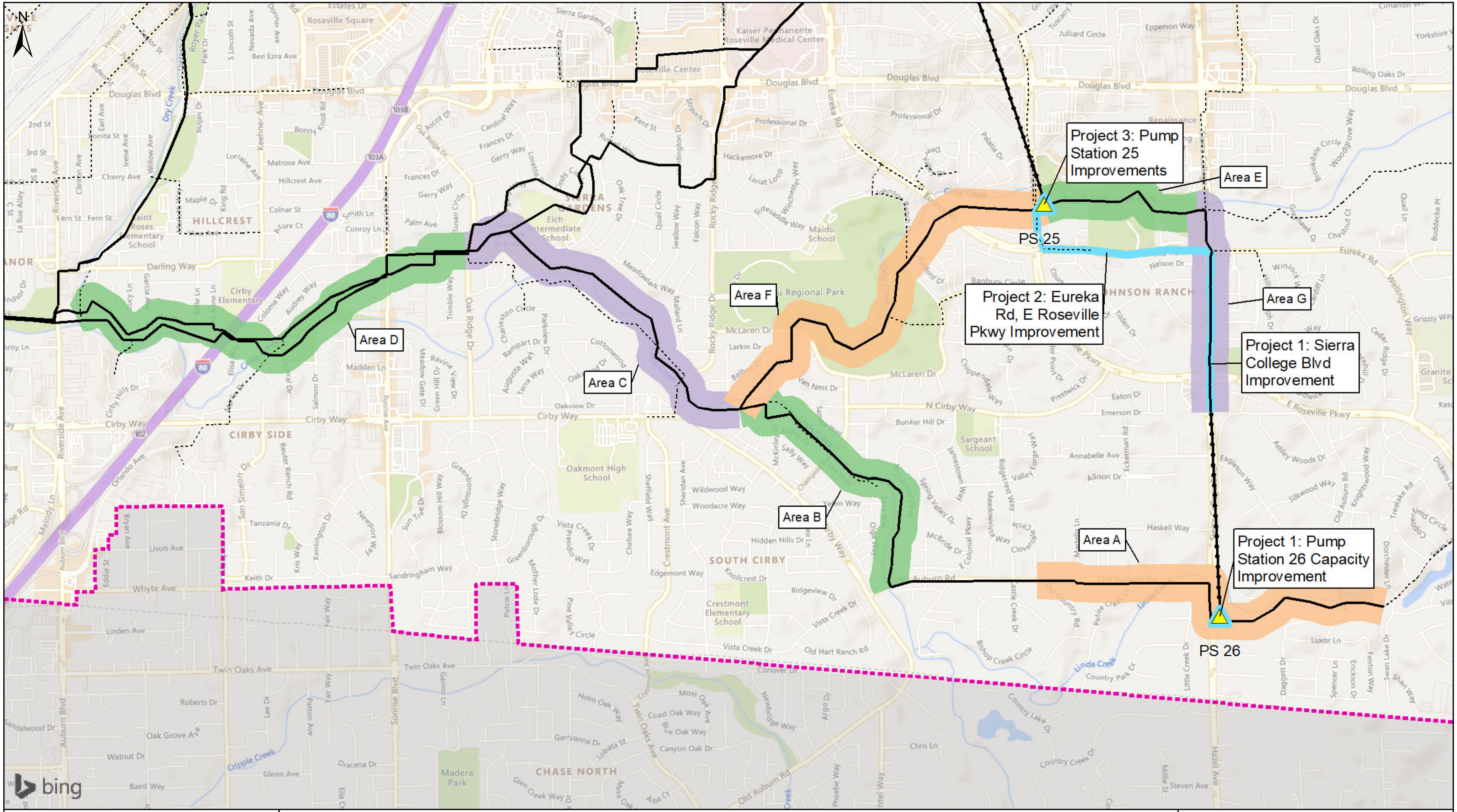

Figure ES-6
Proposed Improvement Locations

South Placer Wastewater Authority
2020 Systems Evaluation

Project #: 0011183.00
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Wastewater Treatment Plant Expansion Evaluation

Based on the updated growth projections provided by the SPWA partners, wastewater flow and loading (organic loading as measured by Biochemical Oxygen Demand, or BOD, and solids loading as measured by Total Suspended Solids, or TSS) projections were developed for the Dry Creek Wastewater Treatment Plant (DCWWTP) and Pleasant Grove Wastewater Treatment Plant (PGWWTP). The flow and loading projections were compared to the most recent evaluations of treatment plant capacity from 2009 for DCWWTP and from 2016 for PGWWTP. Projected shortfalls in hydraulic capacity or biological treatment capacity were identified and preliminary recommendations for expansion and upgrade projects were proposed. The recommendations address phasing, timing, and preliminary conceptual costs of the expansions required through buildout to address both flows and loads, as well as identifying next steps for confirming current plant capacity and refining expansion and upgrade projects.

Wastewater Flow and Loading Evaluation

Current influent flows and loadings for both plants were established by analyzing daily plant influent data provided by the City of Roseville for the period from January 1, 2016 through September 19, 2019 for influent flow and from January 1, 2013 through September 19, 2019 for wastewater loadings. Notably, the waste loadings for biochemical oxygen demand (BOD) over the past 6 years have been significantly higher than documented for prior studies and design projects. In previous studies, average BOD concentrations of 248 mg/L at DCWWTP and 285 mg/L at PGWWTP were documented. The 2013-2019 data set shows an average influent BOD concentration of 425 mg/L at DCWWTP and 358 mg/L at PGWWTP. These higher concentrations may be a result of water conservation efforts over the past decade combined with the drought conditions that were experienced throughout California from 2011-2016, but should be confirmed through additional testing. While TSS and nutrient loadings were also calculated, now that the Roseville WWTPs are addressing nutrient removal in their water quality strategies, the focus herein is on organic loading, as measured by BOD, because that is where the capacity constraints present themselves.

Projected flows were calculated based on population and non-residential growth, normalized to account for diversity in land uses by establishing equivalent dwelling units (EDUs). EDU projection data were provided by each of the SPWA partners. Flow projections were developed by multiplying the projected EDUs by an ADWF contribution of 190 gallons per day (gpd) per EDU, in accordance with the estimate developed in the 2009 Systems Evaluation (a conservative value used for regional treatment capacity planning).

The plant data show that current BOD loadings are higher than the BOD treatment capacities estimated in the prior reference documents for both plants. However, according to City staff, the plants have consistently been in compliance with their NPDES discharge permits. This suggests that the actual plant capacities are beyond their nominal design capacity with respect to BOD. Additionally, it is unclear to what extent interim improvements such as the Nitrate Reduction Improvements project at DCWWTP have affected the plant capacity. For the purposes of this Systems Evaluation, it is assumed that the annual average BOD removal capacity at each plant is, at minimum, the same as the current BOD loadings. It is recommended that process-specific sampling, process modeling, and, if needed, stress testing be performed to determine the actual plant capacity, the limiting processes, and corresponding process improvements needed at each plant. While this evaluation will be immediately helpful at Pleasant Grove, it is immediately essential at Dry Creek because of the large discrepancy between current loading and nominal capacity.

The current and projected flows and loadings to the treatment plants are summarized in Table ES-5 along with the treatment capacities based on current operating conditions. This comparison of current plant capacity and projected future flows and loads accounts for only hydraulic and carbonaceous BOD treatment capacity because these parameters have driven capacity expansion timing in the past (vs. TSS and nutrient treatment capacity). Potential nutrient removal requirements have not been considered in expansion timing and phasing. Evaluation of plant capacity with respect to TSS and nutrient removal should be incorporated into the subsequent analysis of plant capacity.

Table ES-5: Current and Projected Flows and Organic (BOD) Loadings

Parameter	Condition	Unit	Capacity			
				Current	FY59/60	Buildout
Dry Creek Wastewater Treatment Plant						
EDU		#		57,747	87,772	96,000
Flow	Average Dry Weather Flow	mgd	18	8.6	16.7	18.2
BOD	Annual Average Loading	lbs/day	33,900[1]	33,900	52,000	56,000
Pleasant Grove Wastewater Treatment Plant						
EDU		#		54,907	92,864	145,000
Flow	Average Dry Weather Flow	mgd	12[2]	7.6	17.6	27.6
BOD	Annual Average Loading	lbs/day	22,400[1]	22,400	38,000	60,000

Notes:

1. Current BOD loadings based on plant data from January 2013 through September 2019.
2. Plant improvements that expand treatment capacity at PGWWTP are currently under construction and are expected to be in service by FY 22-23.

Recommended Expansion Phasing

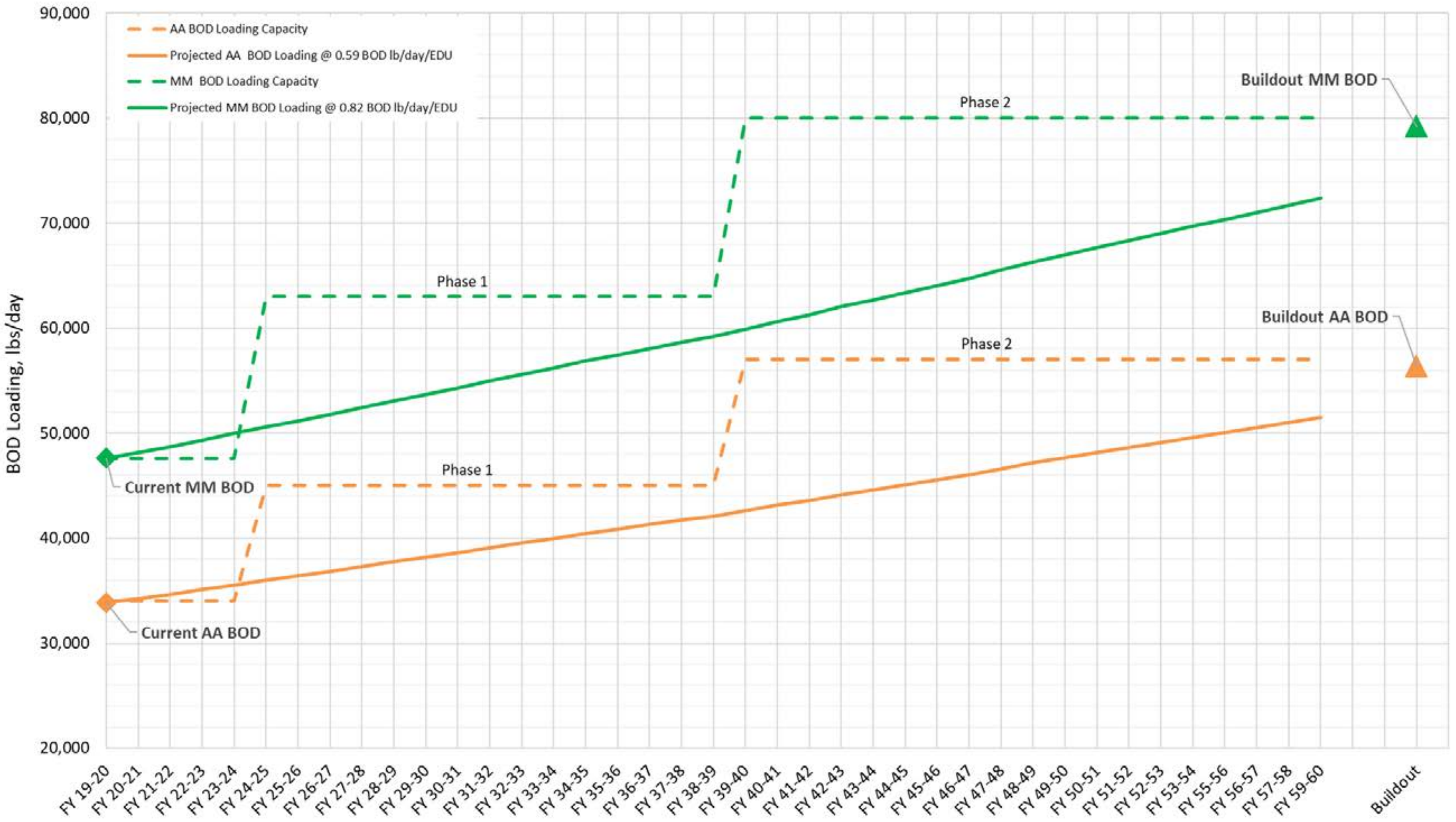
Prior to implementing any further improvements, it is recommended that process-specific sampling, process modeling, and if needed, stress testing be performed to determine the actual plant capacity, the limiting process, and corresponding process improvements needed at each plant.

Dry Creek Wastewater Treatment Plant. Based on the projected ADWF of 16.7 for FY 59/60 and 18.2 mgd for buildout, the current ADWF hydraulic capacity of 18 mgd is effectively sufficient through buildout. As shown in Table ES-5, DCWWTP appears to be currently running at or beyond its nominal design capacity with respect to BOD loading. Figure ES-7 shows annual average (AA) and maximum monthly (MM) biological treatment capacities plotted against the loadings projected over the planning period and the anticipated expansion phasing. Depending on the results of the capacity testing, a Phase 1 expansion project may be necessary in approximately FY 24/25, which is the earliest practical time frame considering planning, design, and construction duration. The plant will reach 94% of the expanded Phase 1 AA and MM BOD loading capacity in FY 39/40. Therefore, it is recommended to implement Phase 2 biological improvements at this time. Phase 2 improvements in FY 39/40 are recommended to bring the plant BOD loading capacity to its buildout AA and MM projections of 56,000 and 79,000 lbs/day, respectively. The timing and magnitude of the recommended projects should be refined after additional capacity analysis and facility planning is completed, as described in the 3rd paragraph in the Wastewater Flow and Loading Evaluation section above.

Pleasant Grove Wastewater Treatment Plant. The improvements currently under construction will expand PGWWTP's treatment capacity to 12 mgd by FY 22-23. Based on the ADWF projections, this capacity expansion should be sufficient to handle flows through FY 28-29, though timing would depend on whether any rebound in sewer flows occurs.. Based on current estimates of capacity, Phase 1 hydraulic expansion at PGWWTP may be needed by approximately FY 28-29 to expand the plant ADWF to 15 mgd. Phase 1 expansion would carry the PGWWTP through FY 40-41. At that point, Phase 2 improvements may be needed to increase the plant ADWF capacity to the FY 59/60 flow projections of 17.6 mgd. Figure ES-8 shows ADWF plotted against the flow projected over the planning period and the anticipated phasing for improvements.

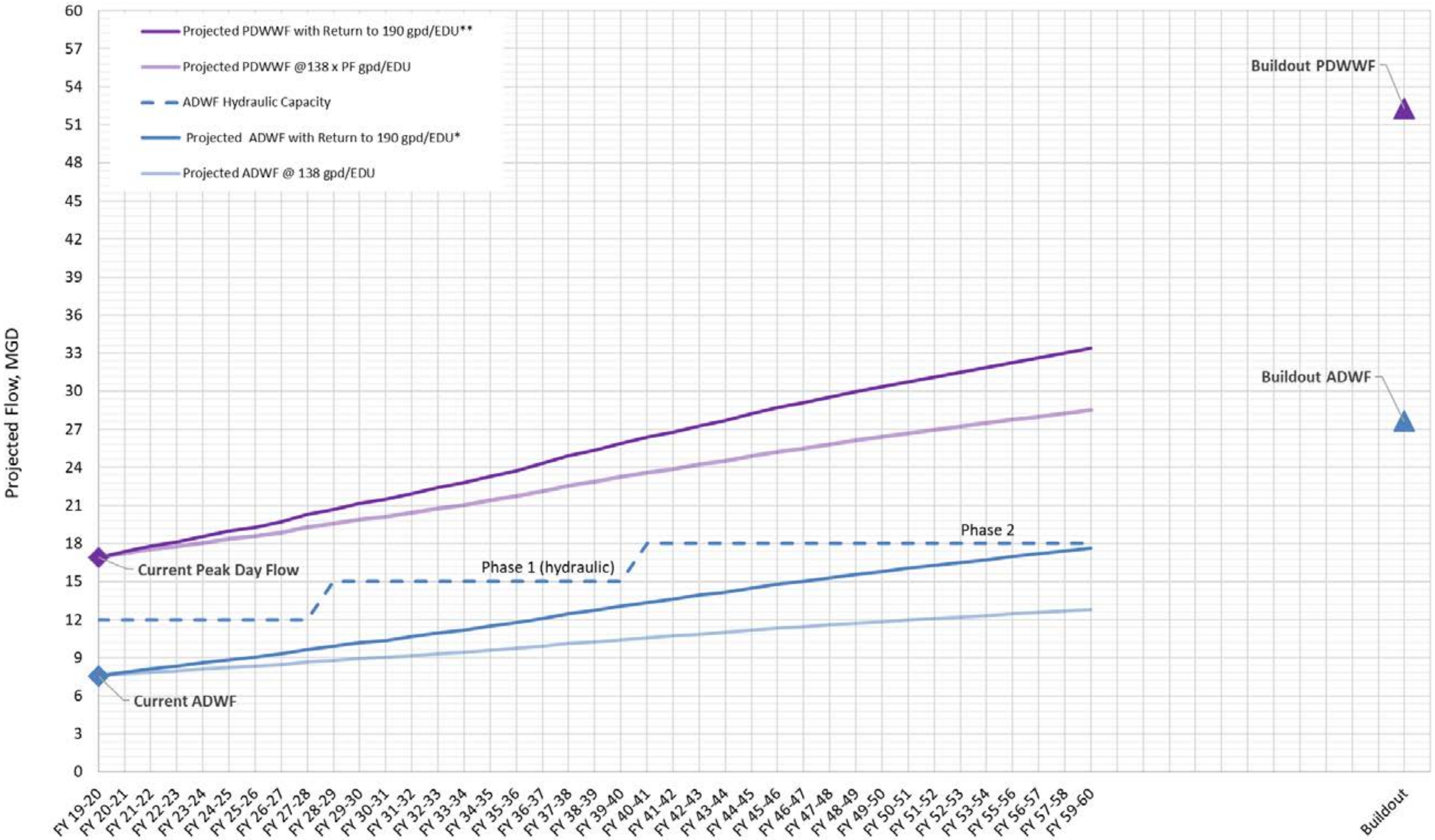
As shown in Table ES-5, PGWWTP is currently running at or beyond its nominal design capacity with respect to BOD loading. Figure ES-9 shows AA and MM biological treatment capacities plotted against the loadings projected over the planning period and the anticipated expansion phasing. The improvements currently under construction will expand the plant's AA and MM BOD loading capacities to 34,500 lbs/day and 40,100 lbs/day, respectively. These improvements should be sufficient to meet projected BOD loadings through FY 40/41 when Phase 2 hydraulic capacity improvements are recommended at PGWWTP. During Phase 2 expansion, it is recommended that plant capacity be increased to accommodate projected FY59/60 AA and MM BOD loadings of 38,000 lbs/day and 48,000 lbs/day, respectively. The timing and magnitude of the recommended projects should be refined after additional capacity analysis and facility planning is completed, as described in the Wastewater Flow and Loading Evaluation section above.

Figure ES-7: DCWWTP Biological Capacity Comparison



* Buildout date is currently unknown and is shown for graphical purposes only.

Figure ES-8: PGWWTP Hydraulic Capacity Comparison

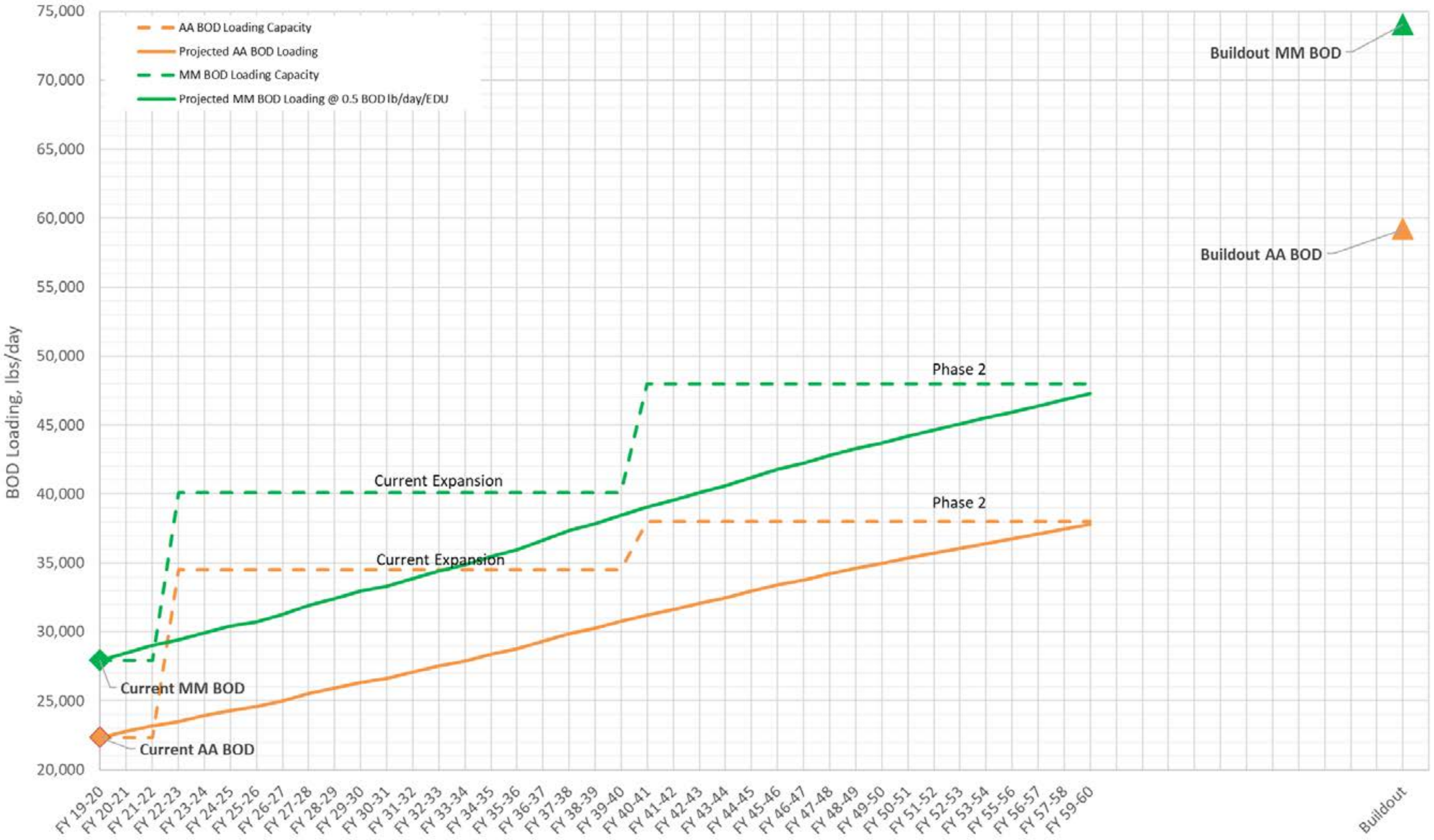


* ADWF GPD/EDU factor is assumed to reach 190 gpd/EDU by FY 59/60, with a linear increase from 138 gpd/EDU at FY 19/20

**PDWWF is assumed to be ADWF flow plus 170 gpd/EDU of wet weather flow, based on current wet weather flowrates

*** Buildout date is currently unknown and is shown for graphical purposes only.

Figure ES-9: PGWWTP Biological Capacity Comparison



* Buildout date is currently unknown and is shown for graphical purposes only.

Conceptual Level Capital Cost Estimates

Preliminary opinions of probable cost at the conceptual level were developed for the recommended expansion phases. Estimates were developed by extrapolating from process unit cost estimates found in prior plant studies and applying appropriate escalation factors, allowances, and contingencies. Improvements that may be required after the FY 59/60 planning horizon have not been estimated.

Dry Creek Wastewater Treatment Plant. The preliminary phased improvements on a process basis are provided in Table ES-6. The listed improvements in Phase 1 (FY 24/25) will increase the AA BOD treatment capacity from 34,000 to 45,000 lbs/day (an equivalent increase in plant ADWF capacity from 11.5 mgd to 14.5 mgd). In Phase 2 (FY 39/40), the improvements will increase the AA BOD treatment capacity from 45,000 to 57,000 lbs/day (an equivalent increase in plant ADWF capacity from 14.5 mgd to 18 mgd). It should be emphasized that the cost estimates provided below are conceptual level costs for capacity expansion projects and do not include rehabilitation and replacement projects or discretionary projects. More detailed cost estimating should be developed when the plant capacity is determined and phased improvement projects are updated accordingly.

Pleasant Grove Wastewater Treatment Plant. The preliminary phased improvements on a process basis are provided in Table ES-7. The recommended phased improvements in Phase 1 (FY 28-29) increase the plant ADWF capacity from 12 mgd to 15 mgd. Phase 2 improvements will increase the ADWF capacity from 15 mgd to 18 mgd and the AA BOD treatment capacity from 35,000 to 38,000 lbs per day. It should be emphasized that the cost estimates provided below are conceptual level costs for capacity expansion projects and do not include rehabilitation and replacement projects or discretionary projects. More detailed cost estimating should be developed when the plant capacity is determined, and phased improvement projects are updated accordingly.

Table ES-6: DCWWTP Phase 1 and Phase 2 Capital Cost Estimates (ENR CCI: 12115)[a]

Process	Process Unit Cost	Phase 1 FY 24/25	Phase 2 FY 39/40
		# of units	# of units
Coarse Screens	$280,000	-	1
Influent Pump Station	$2,000,000	-	1
Fine Screens	$170,000	2	1
Odor Control	$210,000	1	1
Grit Basins	$290,000	-	1
Primary Sedimentation	$3,400,000	-	2
Aeration Basins	$2,600,000	4	6
Blowers	$290,000	1	-
Mixed Liquor Return Pumps	$150,000	4	6
Rehab Existing Anoxic Zones	$290,000	1	
Secondary Clarifiers	$4,100,000	4	2
RAS/WAS Pump Station	$860,000	1	1
Tertiary Filtration	$730,000		2
Waste Backwash Pumps	$100,000		1
UV Disinfection	$2,100,000		1
Anaerobic Digesters	$3,300,000	1	1
Centrifuges	$650,000	2	
Cooling Units	$290,000		2
Total Unit Process Costs		$34,000,000	$43,000,000
Site Yard Piping & Mechanical (5%)		$1,700,000	$2,200,000
Site Electrical / I&C/SCADA (15%)		$5,100,000	$6,500,000
Site Civil (5%)		$1,700,000	$2,200,000
Subtotal of Direct Construction Costs		$43,000,000	$54,000,000
Mobilization/Demobilization (5%)		$2,200,000	$2,700,000
Contractor Overhead & Profit (20%)		$8,600,000	$10,800,000
Subtotal of Direct and Indirect Costs		$54,000,000	$68,000,000
Contingency (30%)		$16,000,000	$20,000,000
Total Estimated Construction Cost		$70,000,000	$88,000,000
Engineering, Permitting, CM, ESDC (25%)		$18,000,000	$22,000,000
Total Estimated Capital Cost		$88,000,000	$110,000,000

Notes:

a. Costs based on Average of SF and “20 Cities” ENR for April 2020: 12115

Table ES-7: PGWWTP Phase 1 and Phase 2 Capital Cost Estimates (ENR CCI: 12115)[a]

Process	Process Unit Cost	Phase 1 FY 24/25	Phase 2 FY 39/40
		# of units	# of units
Influent Pumps	$120,000	1	-
Grit Basins	$290,000	1	-
Fine Screens	$170,000	2	-
Primary Sedimentation	$3,400,000	-	1
Oxidation Ditches	$7,100,000	-	1
Secondary Clarifiers	$4,100,000	1	1
RAS/WAS Pump Station	$860,000	1	-
Tertiary Filtration	$730,000	2	1
UV Disinfection	$2,100,000	3	-
Thickeners Building Modification	$490,000	-	1
Digesters Building Modification	$490,000	-	1
Total		$13,000,000	$16,000,000
Site Yard Piping & Mechanical (5%)		$650,000	$800,000
Site Electrical / I&C/SCADA (15%)		$2,000,000	$2,400,000
Site Civil (5%)		$650,000	$800,000
Subtotal of Direct Costs		$16,000,000	$20,000,000
Mobilization/Demobilization (5%)		$800,000	$1,000,000
Contractor Overhead & Profit (20%)		$3,200,000	$4,000,000
Subtotal of Direct and Indirect Costs		$20,000,000	$25,000,000
Contingency (30%)		$6,000,000	$7,500,000
Total Estimated Construction Cost		$26,000,000	$33,000,000
Engineering, Permitting, CM, ESDC (25%)		$6,500,000	$8,300,000
Total Estimated Capital Cost		$33,000,000	$41,000,000

Notes:

a. Costs based on Average of SF and "20 Cities" ENR for April 2020: 12115

Capacity Improvement Project Summary

Table ES-8 summarizes the capacity improvements identified in this systems evaluation. Note that the improvement needs projected for Dry Creek and Pleasant Grove WWTPs are significantly larger and more expensive than the improvement projects projected for the collection system, but are based on limited available data. The estimated costs for Dry Creek WWTP are especially high because of the size and age of that plant; when it was designed, the organic loading in Roseville was far lower than when Pleasant Grove was designed; since the mid 2000's organic loading to both plants has continued to increase. Further studies, as described in the Wastewater Flow and Loadings Section should be undertaken for both treatment plants, and the capacity improvement projects should be refined based on those findings.

Table ES-8: Proposed Capacity Improvement Projects

		Existing	FY 24/25 or FY 28/29	FY 39/40	After FY 59/60
Collection System	Description	Improvement Project 1 (Increased Capacity of PS 26 and sewers on Sierra College Blvd)	None	None	Improvement Project 2 (Redirect flows from PS 26 and Sierra College Blvd down Eureka Road) Improvement Project 3 (Increased Firm capacity of PS 25 with diversion structure improvements)
	Estimated Capital Cost	$1,610,000	-	-	$2,590,000
Dry Creek WWTP	Description	Plant Capacity, Condition Assessment, and Facilities Plan	Phase 1 (Increase AA BOD Capacity to ~45,000 lbs/day)	Phase 2 (Increase AA BOD Capacity to ~57,000 lbs/day)	Phase 3: Increase BOD Capacity and Hydraulic Capacity (not estimated)
	Estimated Capital Cost	$550,000	$88,000,000	$110,000,000	Not Estimated
Pleasant Grove WWTP	Description	Plant Capacity, Condition Assessment, and Facilities Plan	Increase ADWF hydraulic capacity to 15 mgd	Increase ADWF hydraulic capacity to 18 mgd. Increase AA BOD Loading Capacity to 38,000 lbs/day	Phase 3: Increase BOD Capacity and Hydraulic Capacity (not estimated)
	Estimated Capital Cost	$450,000	$33,000,000	$41,000,000	Not Estimated

Next Steps

Based on the findings of this preliminary evaluation, and discussions with the project team the following next steps are recommended for consideration by SPWA:

- Conduct an analysis of process performance and current biological treatment and hydraulic capacity at both DCWWTP and PGWWTP. This will likely require process-specific sampling and development of calibrated process models. Biological treatment capacity should consider both BOD and nitrate plus nitrite permit limitations set forth within each plant's respective NPDES permit. Results of this study should determine a capacity rating for each unit process at the plant and the limiting processes. This analysis will provide a sound basis for the planning of new facilities and is integral to determining required future capital improvement projects during phased expansions. It is recommended that DCWWTP capacity analysis take precedence over PGWWTP considering DCWWTP appears to be currently operating beyond its nominal BOD removal capacity.

- Review previous condition assessment work conducted on the plant assets and perform additional assessment needed to identify and prioritize repair and replacement (R&R) projects. This effort would include a risk assessment to identify likelihood of failure and criticality of each asset. Results of this study would identify R&R projects which may need to be implemented prior to or concurrent with phased expansions.

- Based on the capacity analysis and R&R project planning, develop Facilities Plans for DCWWTP and PGWWTP. Considering both plants could be running at or above their nominal design capacities, it is recommended that facilities planning begin immediately after the capacity analysis. This effort would evaluate various process optimization steps and upgrade alternatives and provide recommended improvements for phased expansions. The Facilities Plans would include review of the 190 gpd/EDU flow factor that is critical to the timing and magnitude of any hydraulic capacity improvements.

- Develop Class 4 cost estimates for recommended improvements at the WWTPs under each expansion phase and for R&R projects to assist SPWA partners in assessing capital needs in the future.

- For the collection system, periodically update the model network based on any configuration changes, perform re-calibration to confirm the actual and anticipated flows, and to update future loads into the model network. An update frequency of every 5-10 years is recommended, depending on changes in development planning and/or system configuration.

We also recommend that SPWA evaluate funding and financing options to support implementation of the recommended capital improvements, especially Phase 1 at Dry Creek given its size and relative immediacy. With the implementation of the steps above, and the ongoing high level performance of the SPWA Regional System, SPWA will be able to continue its excellent level of service to the Regional Partners.

1. INTRODUCTION

The South Placer Wastewater Authority (SPWA) was created under a Joint Powers Agreement in October 2000 and comprises the City of Roseville (City), South Placer Municipal Utility District (SPMUD), and the County of Placer (Placer County). Flow from SPMUD and portions of Placer County discharge into the City's sewer collection system. The City of Roseville, on behalf of the regional partners, owns and operates two regional wastewater treatment facilities: the Pleasant Grove Wastewater Treatment Plant (PGWWTP), and the older Dry Creek Wastewater Treatment Plant (DCWWTP). Additionally, the City of Roseville owns and operates the network of gravity sewers, pump stations, and force mains that serve customers within the City's limits, including the joint (regional) facilities that convey flow from the SPWA partners. SPMUD owns and operates gravity sewers, pump stations, and force mains in Rocklin, Loomis, and portions of southern Placer County. Placer County owns and operates gravity sewers, pump stations, and force mains in unincorporated areas of Placer County that are not served by other agencies.

Figure 1-1 shows the service area boundaries of the SPWA partner agencies and the overall SPWA service area. Figure 1-1 also indicates the location of several Urban Growth Areas (UGAs), both inside and outside the City, which have significant development plans under varying stages of progress.

The South Placer Regional Wastewater and Recycled Water Systems Evaluation prepared in 2009 (2009 Systems Evaluation), defined the SPWA service area boundary; evaluated the wastewater collection, wastewater treatment, and recycled water distribution systems; and identified existing and potential future improvement needs. Since that study was completed, the recycled water distribution system has been removed from the SPWA system (reallocated as an asset) and is now wholly managed by the City of Roseville. SPWA is now updating the Systems Evaluation to better evaluate future wastewater collection and treatment capacity needs that may have changed since 2009. This report documents the evaluation of the regional wastewater collection system capacity and the capacity of the wastewater treatment plants versus projected flows and loads.

1.1 Objectives of the Systems Evaluation

The specific need for this Systems Evaluation was precipitated by several factors, including:

- Recent annexations of land by SPWA partner agencies;
- Changes in water consumption rates and associated dry weather flow rates;
- Planned development and redevelopment within the 2005 SPWA service area;
- Revisions in the planning for proposed Urban Growth Areas (UGAs) in the vicinity of the 2005 SPWA service area;
- Wastewater characteristics (i.e., flow and strength) that have changed since the 2009 Systems Evaluation.

This South Placer Regional Wastewater Systems Evaluation (Systems Evaluation) has been conducted to accomplish the following:

- Document the existing (2020) capacity and the flows and loadings on regional trunk sewer and wastewater treatment infrastructure and facilities present in 2020;
- Project buildout conditions based upon regional planning documents and planned regional developments in southwestern Placer County; and,
- Present a Regional Systems evaluation, with system deficiencies identified, and capital projects forecasted, which will inform the SPWA partners in identifying their ability to provide service for planned and proposed development, both presently and for buildout conditions.

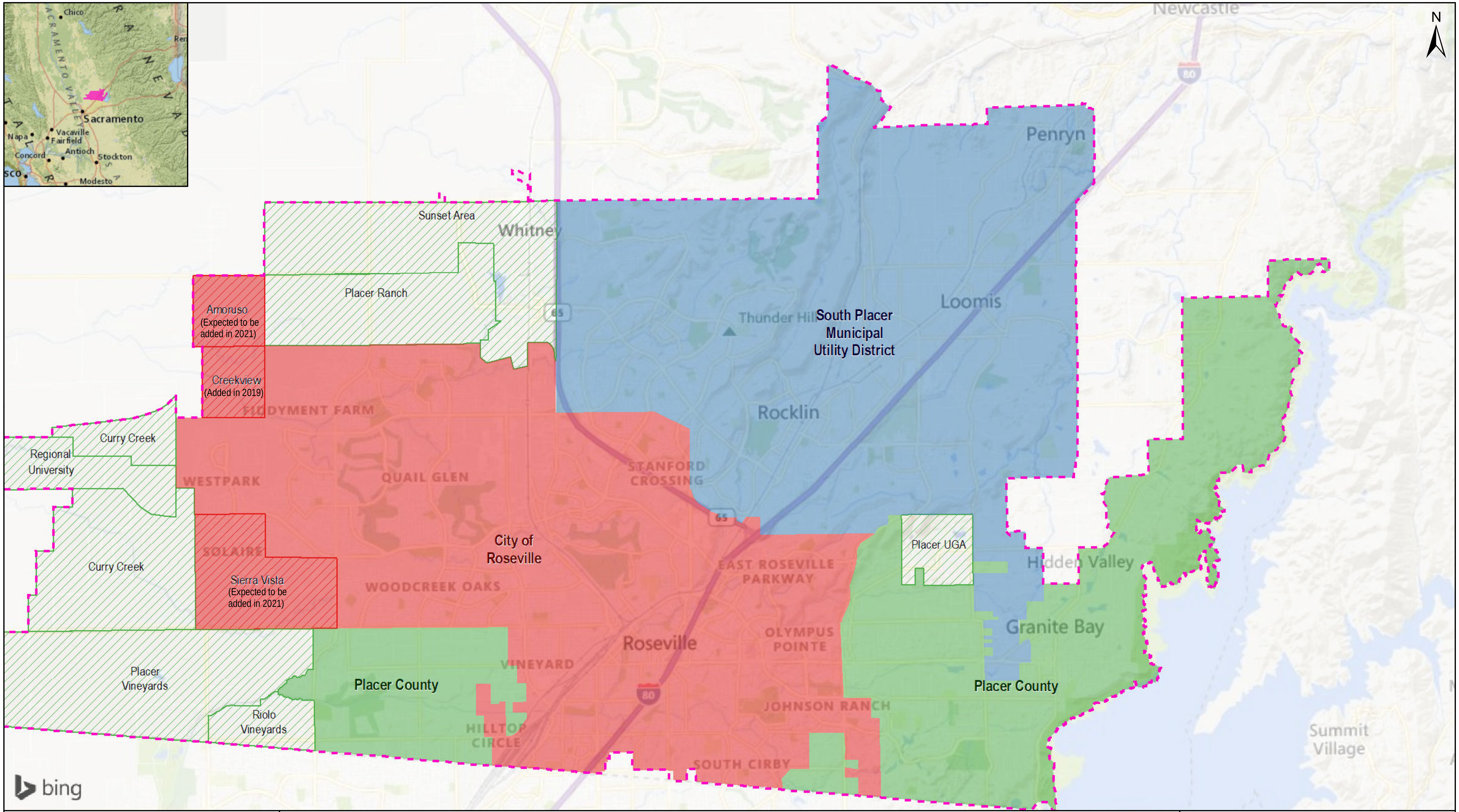


Figure 1-1

2021 Service Area Boundary

South Placer Wastewater Authority
2020 Systems Evaluation

0 ½ 1 2 Miles

2021 Partner Agency Service Area

- 🟥 City of Roseville
- 🟩 Placer County
- 🟦 SPMUD

Urban Growth Area

- ▨ City of Roseville UGA
- ▨ Placer County UGA
- ⬚ Ultimate Service Area Boundary

Project #: 0011183.00
Map Created: December 2020

Third Party GIS Disclaimer: This map is for reference and graphical purposes only and should not be relied upon by third parties for any legal decisions. Any reliance upon the map or data contained herein shall be at the users' sole risk. **Data Sources:** SPWA Agencies, ESRI, W&C

Placer CITY OF ROSEVILLE CALIFORNIA SPMUD WOODARD & CURRAN

Figure Exported: 12/21/2020 By: cvanlienden Using: \\woodardcurran.net\shared\Projects\RMC\WCR\0091 Roseville, City of\0011183.00 SPWA Systems Evaluation\G. GIS\3 MXDs\Report Figures\1-1_SPWA_Service_Area.mxd

1.2 Project Scope

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

- Task 1 – Project Management.

  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.

- Task 2 – Data Collection and Review.

  This task involved assembling, organizing, and reviewing information and data related to the sewer system, including previous reports; maps and drawings of sewer system facilities and recent sewer improvement projects; water use and customer account data; the City's General Plan and other relevant planning information; and sewer design standards and specifications. This task also included meetings with City Planning staff, Placer County and SPMUD to confirm growth and future land use assumptions within the City of Roseville as well as from the SPWA partners outside the City.

- Task 3 – Flow Monitoring.

  A plan for flow and rainfall monitoring in the collection system during the 2015/16 wet weather season was developed. The program included 30 temporary flow meters (including 5 meters authorized by Task 5) and two rain gauges installed for a period of approximately two months (mid-January through mid-March). Gauge adjusted radar rainfall (GARR) data was also obtained for the rainfall periods. The monitoring was conducted by Woodard & Curran's subconsultant, V&A Consulting Engineers, and the GARR data was provided by OneRain, Inc.

- Task 4 – Model Update and Calibration.

  A hydraulic model of the City's trunk sewer system was developed using InfoWorks™ ICM software. The model network was developed using as-builts, the City's GIS data, and information from the 2005 Model Development Project. 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 model was calibrated for dry and wet weather conditions using the flow monitoring data collected under Task 2.

- Task 5 – Update Flow Projections.

  Based on data collected under Task 2 and discussions with SPWA and partner agencies' staff, existing and projected flows were developed. As part of this task, the best available planning information was collected and documented, including plans for Urban Growth Areas and parcel based data within the agencies' current service areas. A database of parcel-based projections within the SPMUD and Placer County Service areas was also prepared in this task. This information was used to estimate future flows and potential capacity needs.

- Task 6 – Trunk Sewer Evaluation

  In this task, the existing trunk sewers were evaluated against hydraulic performance criteria under the design storm conditions identified for the 2009 System Evaluation. Using the calibrated model and the selected design storm, existing and future model runs were performed to identify capacity deficiencies in the trunk sewer system. For those deficiencies, capacity improvement projects were developed.

- Task 7 – Wastewater Treatment Plant Expansion Evaluations

Based on the flow projections developed in Task 5 and buildout timeline information provided by City of Roseville, Placer County, and SPMUD, design flows and biological loading for both the Dry Creek and Pleasant Grove Wastewater Treatment Plants were developed. Based on these design flows and work completed by the City of Roseville, phased WWTP capacity expansions were identified considering current and future changes in regulatory requirements, and preliminary cost estimates were developed.

- Task 8 – Prepare Systems Evaluation

  This report was prepared to summarize and present the results and recommendations of the study.

1.3 Report Organization

This report includes five chapters, which are described below

- Chapter 1, Introduction, presents the background, objectives, and scope of the System Evaluation.
- Chapter 2, Modeled Flow Projections, discusses the service 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, Trunk Sewer Evaluation, describes the modeled trunk sewer system, development of the model network and model loads, flow monitoring program, and model calibration. This chapter also identifies the results of the capacity analysis, including preliminary solutions for the identified capacity deficiencies.
- Chapter 4, Wastewater Treatment System Evaluation, summarizes the wastewater treatment upgrade and expansion analyses performed for the Systems Evaluation, including the development of flow and loading peaking factors, facility expansion recommendations to handle projected flows and loadings at buildout, and a timeline for phasing the construction of the improvements.
- Chapter 5, Capacity Improvement Summary, summarizes the recommended capacity improvements, including project costs, phasing, and implementation recommendations.

2. BASIS OF FLOW PROJECTIONS

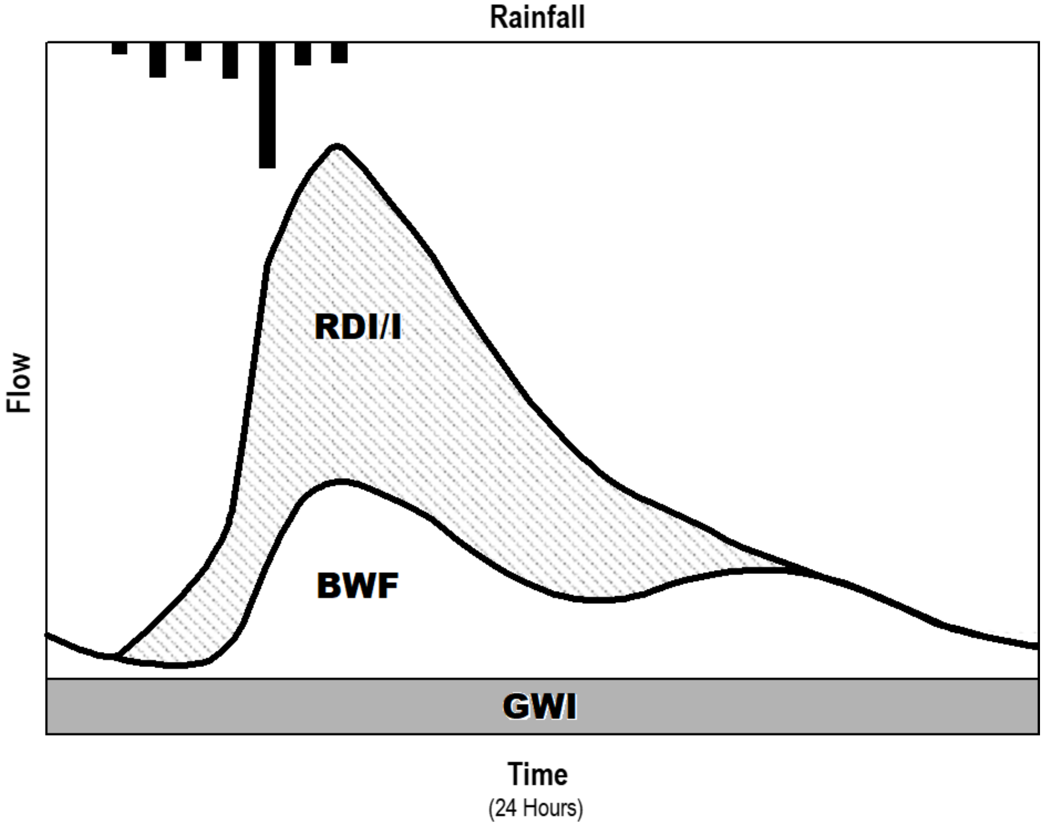
2.1 Introduction

The flow projections developed for this Systems Evaluation were based on the information collected for the system's hydraulic model updates, including the updates performed for the current study. In 2007, a hydraulic model of the City's sewer collection system was developed using the H2OMap Sewer modeling platform (2007 Model Development Project), in parallel with a trunk sewer model for the combined Roseville, SPMUD, and Placer County systems. The models were later updated as part of the 2009 Systems Evaluation. Subsequently, the City's sewer model was updated in 2017 to reflect existing and future demands within the City, and to upgrade the modeling platform to the fully dynamic InfoWorks ICM software. For the current Systems Evaluation Update, the City's model was updated to reflect existing and future projected flows from Placer County and SPMUD.

This section describes the flow components used in the hydraulic model and the existing and projected future land uses for the service area, which form the basis for generating base wastewater flows, in the current hydraulic model. Note that flow projections (referred herein as loads) are intended to represent the level of development present during the flow monitoring periods used to calibrate the hydraulic model. Design flow estimates were developed based on criteria developed for each component of wastewater flows: base wastewater flow (BWF), groundwater infiltration (GWI), and rainfall-dependent infiltration and inflow (RDI/I), and confirmed through model calibration, as described in Chapter 3. Average dry weather flow (ADWF) projections for each treatment plant area discussed in the Wastewater Treatment Plant Expansion Evaluations TM.

The three components of wastewater flows are 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. ADWF represents the average flows at each WWTP from July to September. The source of these flows is a combination of BWF and GWI. RDI/I is storm water inflow and infiltration that enter the system in direct response to rainfall events, 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. RDI/I typically results in short term peak flows that recede quickly after the rainfall ends.

Figure 2-1: Wastewater Flow Components
(Not to scale)



2.2 Average Dry Weather Flow

ADWF has been estimated for four development scenarios: (1) Existing loads for model calibration; (2) Existing loads for capacity analysis; (3) Buildout; and (4) Buildout Sensitivity, which includes some additional densification and redevelopment assumptions based on feedback from the SPWA partners. As part of this Systems Evaluation, a database of existing and future loads for each parcel in Placer County and SPMUD service areas has been developed and provided to the City. As noted above, ADWF includes two components: GWI and BWF.

In 2007, a hydraulic model of the City's sewer collection system was developed using the H2OMap Sewer modeling platform (2007 Model Development Project), in parallel with a trunk sewer model for the combined Roseville, SPMUD, and Placer County systems. The models were later updated as part of the 2009 Systems Evaluation. Subsequently, the City's sewer model was updated in 2017 to reflect existing and future demands within the City, and to upgrade the modeling platform to the fully dynamic InfoWorks ICM software. For the current Systems Evaluation Update, the City's model was updated to reflect existing and future projected flows from Placer County and SPMUD.

This section describes the flow projections and model development process used to evaluate the SPWA collection system (sewers conveying flows from more than one partner agency), as well as findings from that effort.

2.2.1 Diurnal Base Wastewater Flow Curves

BWF varies throughout the day in a typical way, generally peaking early in the morning in upstream sewers and later and less sharply in larger downstream sewers. Typical hourly peak flows from small residential areas tend to be about twice the average flow (or even higher for very small areas), whereas peak flows further downstream may be less than 1.5 times average flows due to flow attenuation in the collection system. Higher peaks can occur on atypical days of the year (e.g., on major holidays such as Thanksgiving or at halftime on Super Bowl Sunday).

For the current Systems Evaluation Update, typical diurnal profiles were developed for residential and commercial/industrial (non-residential) wastewater flow, for both weekend and weekday conditions. These hydraulic profiles are shown in Figure 2-2 and Figure 2-3. The residential profiles were developed based on monitored flows for smaller, primarily residential meter areas and refined during calibration. Two non-residential profiles were developed to represent flow patterns from two different types of uses: commercial/retail pattern, and an industrial/professional pattern. For parcels inside the City, each non-residential parcel was assigned a non-residential diurnal profile according to the land use code in the parcel database; a summary of the diurnal profile assigned to each land use code is provided in Appendix A. For non-residential parcels in Placer County and SPMUD, the commercial/retail pattern was used.

For UGAs, the residential profile was used for all residential uses, and the retail/commercial diurnal profile was used for all non-residential and mixed use land uses.

Figure 2-2: Residential Diurnal Curves

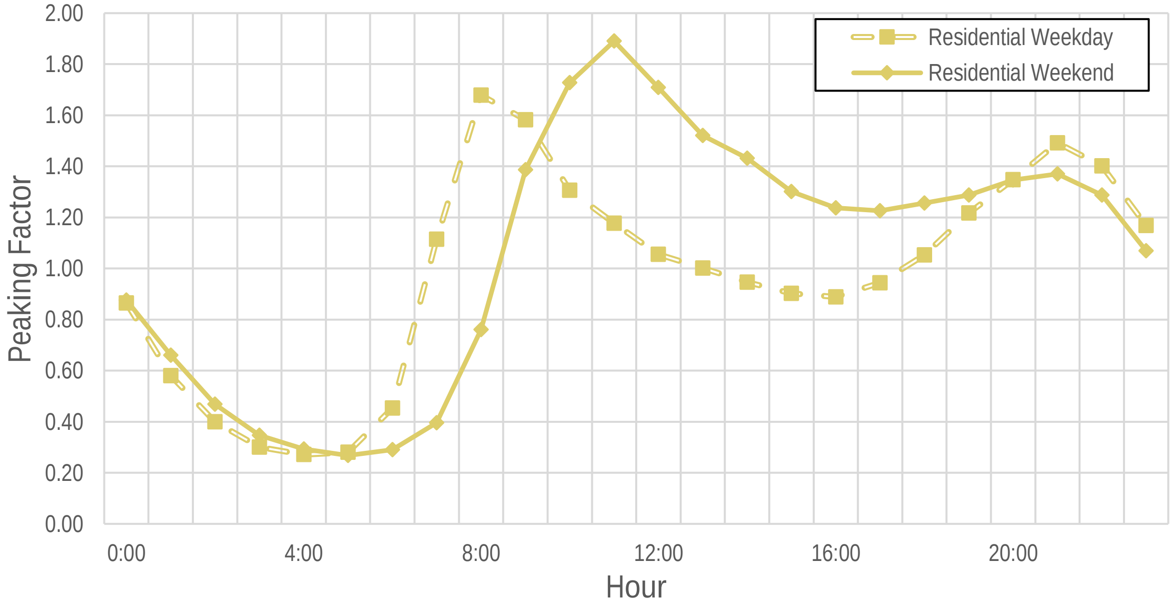
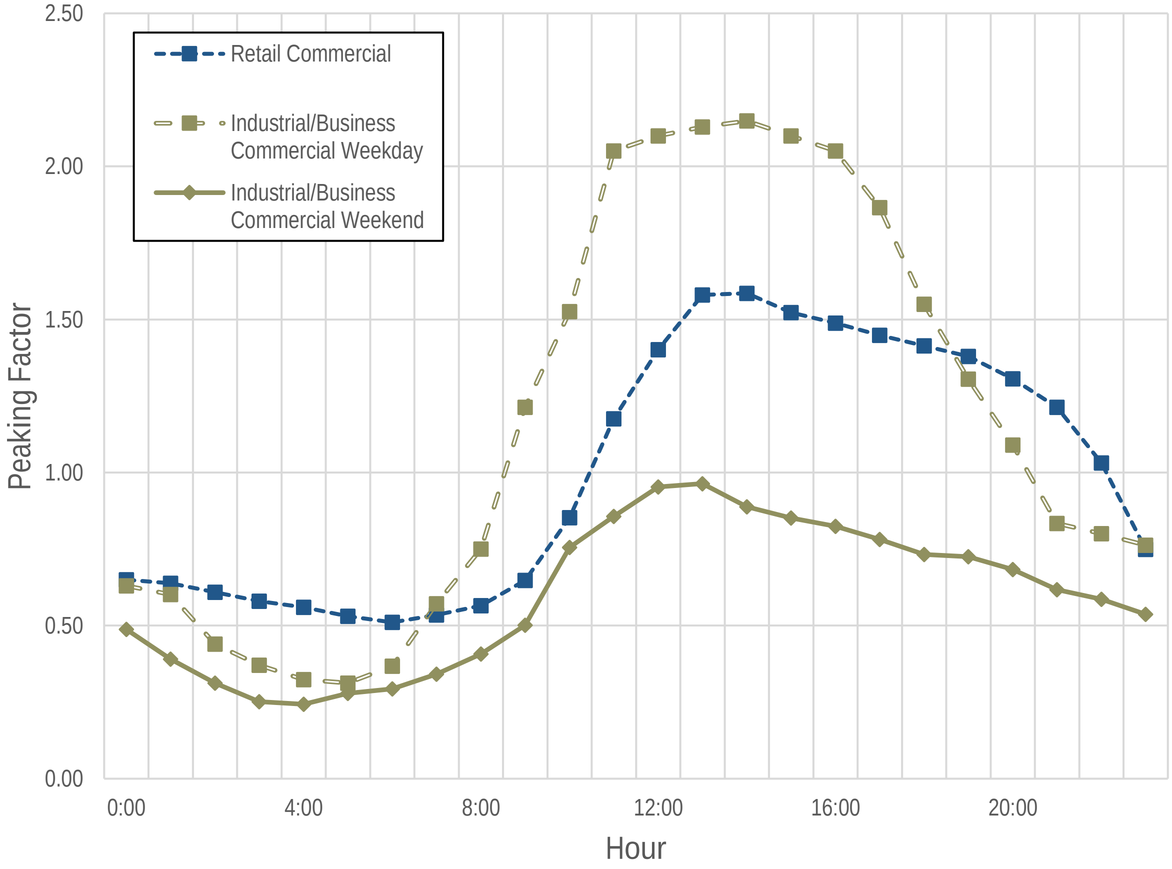


Figure 2-3: Non-Residential Diurnal Curves



2.2.2 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 within 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 100 to over 1,000 gpad.

GWI flows for existing connected parcels were estimated through the model calibration process (see Chapter 3) by comparing model-simulated BWF to actual flow measurements from the temporary flow monitoring program. Cases where model-predicted BWF was noticeably lower than monitored flow indicated the possible occurrence of GWI.

2.2.3 Existing Base Wastewater Flows

Existing base wastewater flows were developed based on the assumptions summarized below; currently connected parcels are indicated in Figure 2-4. Note that loads are intended to represent the level of development present during the flow monitoring periods used to calibrate the hydraulic model.

2.2.3.1 City of Roseville

As noted previously, flows within City limits were estimated as part of the 2017 Sewer Model Update. As part of that study, existing residential and non-residential BWF within the City was determined based on water billing data provided by the City. The City has relatively complete water use records for all parcels within the City; billing data from December 2013 through April 2016 was provided for use in developing BWF estimates for the model. Metered water use during the winter months is assumed to most closely approximate wastewater generation, since outdoor water use is at a minimum. As data for the City of Roseville came from work done in 2016, existing BWF estimates for the City of Roseville represents 2016 land use.

December 2015 through March 2016 data was selected to represent winter water use, as it was generally wetter than prior years and therefore less irrigation was employed. This data also coincides with the flow monitoring period for the 2017 Sewer Model Update and should therefore correlate better with the recorded data during model calibration. It was assumed that all water use during these months was returned to the sewer; this assumption was validated during calibration. Note that the 2015/2016 wet season occurred after several years of drought. Therefore, water use levels may be lower than non-drought years due to conservation.

Where water use data was not available (limited portions of the City), sewer generation rates were estimated based on existing dwelling units indicated in the parcel database. For purposes of calibration, a single family rate of 160 gpd per DU and a multi-family rate of 120 gpd per DU were assumed, based on average rates from the December 2015 through March 2016 billing data. Using GIS processes, BWF loads from each parcel were then allocated to the nearest City sewer.

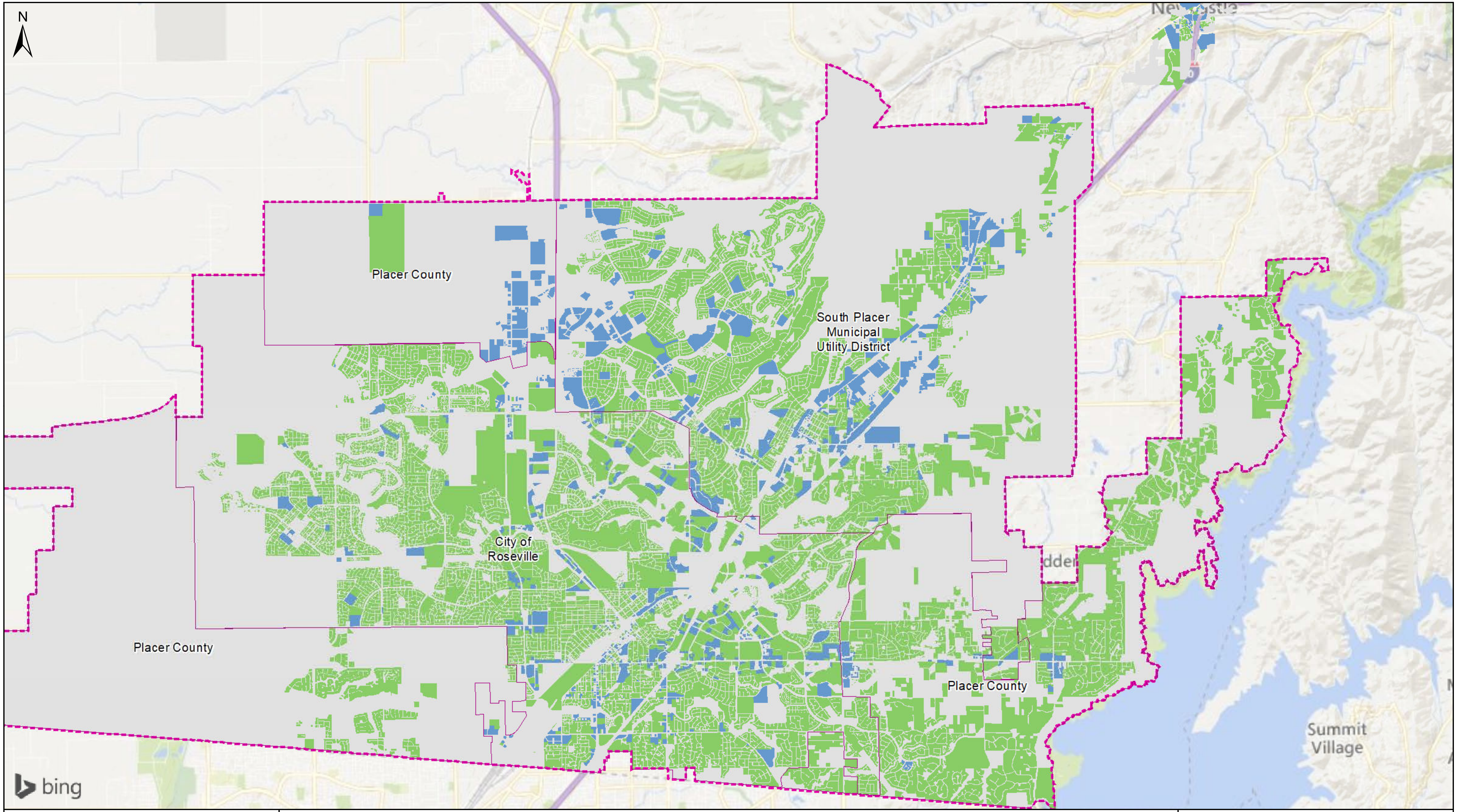


Figure 2-4

Existing[1] Connected Parcels

South Placer Wastewater Authority
2020 Systems Evaluation

0 ½ 1 2 Miles

Parcel Land Use

- 🟦 Commercial/Industrial
- 🟩 Residential
- ⬜ Unconnected
- ▭ Service Area Boundary
- ▭ Partner Agency Boundary

[1] "Existing" represents 2015/2016 connections within the City of Roseville and 2019 connections for Placer County and SPMUD.

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2.2.3.2 Placer County and SPMUD

Placer County provided spreadsheets summarizing equivalent dwelling units (EDUs) for each APN[1]. (Note: an EDU is defined as the flow equivalent of one single-family residence.) This dataset was then joined to a parcel dataset downloaded from the County website (downloaded March 20th, 2019), and then allocated to the nearest Placer County sewer. Since not all Placer County sewers are included in the model, GIS processes were used to identify the modeled manhole downstream of the parcel. All of the EDUs included in the spreadsheets were assigned to parcels and allocated to modeled manholes in this way. Each parcel was assigned either a residential or commercial loading pattern based on its general plan category as summarized in Appendix A.

SPMUD provided a shapefile[2] which provided EDUs for the year 2020 (which was identified as "existing" land use by SPMUD staff), an associated SPMUD manhole, and a type of use (residential or commercial) for each parcel. As for Placer County, GIS processes were used to identify the modeled manhole downstream of the parcel.

During calibration, a base wastewater flowrate of 160 gpd per EDU was typically applied, but this factor was adjusted down in some cases by 15 or 20 percent based on data from wastewater flow meters in the collection system.

2.2.3.3 Drought Rebound

The calibration period occurred during the third year of an ongoing drought. Billing data and flow records indicate a general decline in water use, likely due to the drought-induced conservation primarily limiting irrigation water use but also reducing indoor water use. Analysis of billing data indicates that on a per dwelling unit basis, water use was reduced by approximately 15 percent between 2014 and 2016. Therefore, for capacity analysis purposes of the existing system and for all future scenarios, it has been assumed that base wastewater flows within the City would increase by 15 percent.

For Placer County and SPMUD, BWF was increased to 180 gpd per EDU, which is consistent with the BWF assumptions used in the 2009 Systems Evaluation and is approximately a 15 percent increase compared to calibrated flow factors overall, though specific flow meter basins assume a higher rebound percentage (wherever the flowrate per EDU was decreased during calibration).

2.2.4 Future Average Dry Weather Flow

Future BWF from the City, SPMUD, and Placer County have been estimated for a Buildout scenario (representing likely future land use based on current data) as well as a Buildout-Sensitivity scenario (representing higher potential growth) using the factors summarized in Table 2-1. For consistency with WWTP flow projections, ADWF flow factors are used, which includes some dry season GWI.

The locations of future developments, including urban growth areas, are indicated in Figure 2-5, and discussed further in the next sections.

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[1] Spreadsheets included: Existing dry creek EDU-7-24-19.xls, Existing SMD 2- EDU-2018-12-12.xlsx, Existing SMD 3- EDU-2018-12-12.xlsx, Existing Sunset EDU-7-24-19.xls

[2] SPMUD_SewerLoading_AddressPoints, provided August 7, 2019.

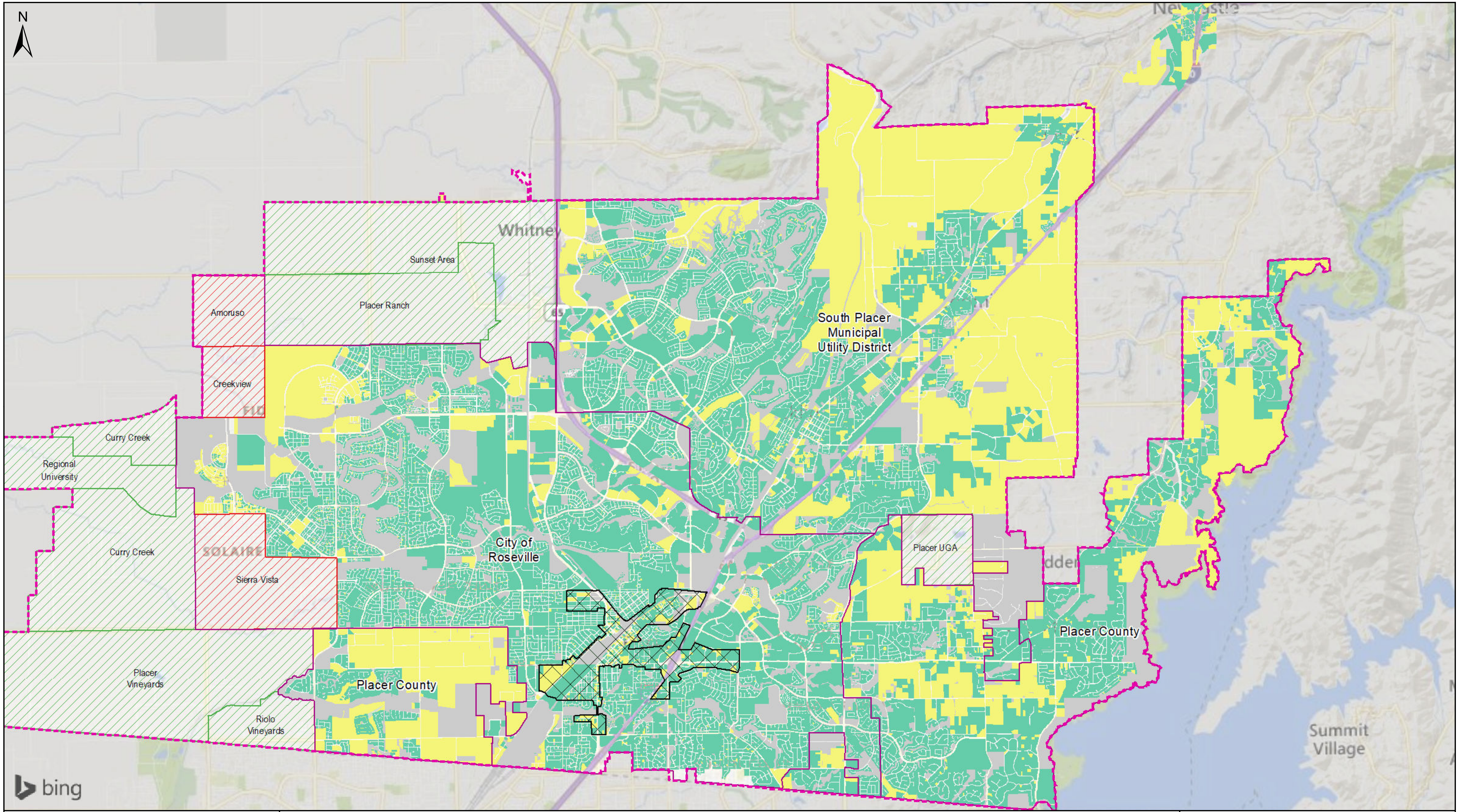

Figure 2-5

Future Development and Urban Growth Areas

South Placer Wastewater Authority
2020 Systems Evaluation

0 ½ 1 2
Miles

Buildout Status

- 🟩 Existing
- 🟨 Future Connection
- ⬜ Unconnected
- ☒ Redevelopment Area

Urban Growth Area

- ▨ City of Roseville UGA
- ▨ Placer County UGA
- ☐ Partner Agency Boundary

- ⬚ Service Area Boundary

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Table 2-1: Average Dry Weather Flow Factors

Land Use Designation	Units	Unit Flow Factors [a]
Commercial	gpd per acre	850
Heavy Industrial	gpd per acre	850
Light Industrial	gpd per acre	850
Mixed Use	gpd per acre	2,300
Public/Quasi-Public	gpd per acre	660
Schools	gpd per acre	170
Residential Single DU (or EDU)	gpd per du	190
Residential Mult. DU [b]	gpd per acre	2,040
Parks > 10 Acres	gpd per acre	10
Vacant/Open Space	gpd per acre	0

Notes:

a. Includes allowance for GWI.

b. The Residential Multiple DU unit flow factor can also be represented as 130 gpd per du

2.2.4.1 City of Roseville

For the City of Roseville, the Buildout scenario is based on infill of currently vacant parcels, using land use information from the City's General Plan or provided by the City's planning department, and development of the Sierra Vista, Creekview, and Amoruso UGAs. Sources of data included the following:

- Parcel data downloaded from the City's website (download dated 8/25/2016). The parcel data has the following fields that were used for to estimate future demands:
    - PotUnits: The total number of units allocated to the parcel, prior to any development. Once development beings, potential units is reduced to zero.
    - Undevunits: Once development commences, undeveloped units are the number of vacant lots in the subdivision that do not have a single family unit
    - PotArea: the total developable square footage of the parcel upon its creation. Once development begins, the area is reduced to zero.
    - UndevArea: Once development commences, if the parcel is not fully developed, the number refers to the remaining available square footage of land available to be developed
- The West Roseville Specific Plan (*West Roseville Specific Plan*, EIP Associates, dated February 4, 2004) was used to confirm future units within the West Roseville Specific Plan area.
- Land use data for several specific developments was provided by City Planning, where that data was likely to be more current and more detailed than available in the current GIS.

Infill locations are indicated in Figure 2-5.

2.2.4.1.1 Redevelopment (Buildout-Sensitivity Scenario)

The Buildout-Sensitivity scenario includes redevelopment of a portion of the City, as indicated in Figure 2-5. Redevelopment occurs where existing land uses are removed and replaced with new, typically more intensive land uses (and associated sewer flows). Redevelopment land uses are based on parcel-based classifications developed for the 2009 Systems Evaluation. It was assumed that existing land uses for the parcels in the redevelopment area would be replaced by the land uses in the redevelopment plan. Overall, redevelopment results in an increase in ADWF of about 1.5 mgd from the Buildout Scenario. More detailed information on the redevelopment land uses inside the City is included in TM 9C of the 2009 Systems Evaluation.

2.2.4.2 Placer County and SPMUD

Placer County provided a spreadsheet that summarized the anticipated EDUs for all entitled projects in Placer County[1]. EDUs for other currently vacant parcels were estimated using general plan data[1]. Specifically, the general plan shapefile indicated a minimum and maximum density for each category; the categories used for this study, and the associated density and diurnal curve used are summarized in Appendix A. For the Buildout-Sensitivity scenario, Placer County staff suggested an assumption that 60 percent of parcels zoned for residential development would densify to 30 percent higher than the maximum density allowed in the general plan. GIS processes were used to allocate each parcel to the nearest Placer County sewer, and then associated with the modeled manhole downstream of the parcel.

The shapefile provided by SPMUD specified the EDUs in 2060 for each parcel, as well as an associated SPMUD manhole. As for assignment of existing loads, GIS processes were used to identify the modeled manhole downstream of the parcel.

Locations of future development in Placer County and SPMUD are indicated on Figure 2-5.

2.2.4.3 Urban Growth Areas

Several UGAs were identified in the 2009 Systems Evaluation and have been included in this evaluation. Locations of the UGAs are shown in Figure 2-5. Placer County UGAs include Placer Ranch, Sunset Area, Placer Vineyards, Regional University, Riolo Vineyards, and Curry Creek; the SMD-3 UGA has been incorporated into the current Service Area Boundary. UGAs within the City identified for included Sierra Vista, Creekview, and Amoruso; these UGAs either have already been added to the current Service Area Boundary or are expected to be added in early 2021 (as shown in Figure 1-1) but are included here for consistency with the City's 2017 Model Update. Land use and flow projections were based on the most recent wastewater master plans for each UGA, as indicated below. Flows associated with each UGA are summarized in Table 2-2. A more detailed summary of land uses for each UGA broken out by sewershed is included in Appendix B.

- Sierra Vista (*Sierra Vista Specific Plan Sanitary Sewer Master Plan*, Mackay & Somps Civil Engineers, July 2009)
- Creekview (*Creekview Specific Plan Sanitary Sewer Master Plan*, Mackay & Somps Civil Engineers, November 2010)
- Amoruso (*Amoruso Ranch Specific Plan Area Wastewater Master Plan*, Kimley Horn, September 2015)
- Placer Ranch (*Placer Ranch Sewer Master Plan,* Mackay & Somps, July 2017*)*

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[1] 2018-12-18-Entitled-Planned Project.xlsx (provided December, 2018) and GeneralPlans_CommPlans.shp (downloaded from Placer County website, dated October 20, 2019)

- Sunset Area (*Sunset Area Water, Wastewater, and Recycled Water Technical Report,* Psomas, October 2017)
- Placer Vineyards (*Placer Vineyards Specific Plan; Sanitary Sewer Master Plan Addendum 1,* Mackay & Somps, May 2019)
- Regional University (*Regional University Specific Plan, Sanitary Sewer Demand*, Mackay & Somps, September 1, 2017)
- Riolo Vineyards (*Riolo Vineyards Sanitary Sewer Master Plan Update*, Unico Engineering, April 2016)
- Curry Creek (*2009 SPWA Systems Evaluation*, RMC Water & Environment, 2009). No current planning information is available for Curry Creek. Preliminary land use estimates were developed for the 2009 Systems Evaluation and used again for this evaluation.
- Placer UGA (*Hawk Homestead Sewer Analysis – Supplementary Information Requested by Placer County Environmental Engineering,* Derrick Whitehead, Municipal Consulting Group, January 29, 2016)

Table 2-2: ADWF from UGAs

UGA	Agency	WWTP	Total Area (ac)	Buildout ADWF (mgd)
Sierra Vista	Roseville	Pleasant Grove	2,064	1.83
Creekview	Roseville	Pleasant Grove	501	0.43
Amoruso[a]	Roseville	Pleasant Grove	694	0.61
Placer Ranch	Placer County	Pleasant Grove	2,213	2.15
Sunset Area[b]	Placer County	Pleasant Grove	2,888	3.80
Placer Vineyards	Placer County	Dry Creek	5,230	2.89
Regional University	Placer County	Pleasant Grove	1,159	1.17
Riolo Vineyards	Placer County	Pleasant Grove	879	0.23
Curry Creek	Placer County	Pleasant Grove	3,212	2.74
Placer UGA	Placer County	Pleasant Grove	617	0.04

Notes:

a. Includes 274 units north of Amoruso that would contribute flow through sewers in Amoruso (Toad Hill)
b. Does not include the Placer Ranch subset of the Sunset Area Plan

2.2.5 Dry Weather Flow Summary

Existing and Projected Future Dry Weather Flows are summarized in Table 2-3. Note that these estimates include wet season GWI, which may be higher than dry season GWI.

Table 2-3: Estimated Dry Weather Flows[a] by Agency

WWTP	Agency	Existing Calibration ADWF (mgd)	Existing ADWF with Drought Rebound	Buildout ADWF (mgd)	Buildout-Sensitivity[b] ADWF (mgd)
Pleasant Grove	Roseville	5.87	6.70	13.01	13.04
	Placer County	0.18	0.20	9.85	9.85
	SPMUD	2.25	2.97	3.63	3.63
	Total	8.30	9.87	26.49	26.52
Dry Creek	Roseville	5.60	6.27	6.89	8.23
	Placer County	2.57	2.81	7.19	7.42
	SPMUD	2.90	3.64	5.16	5.16
	Total	11.06	12.72	19.24	20.81

Notes:

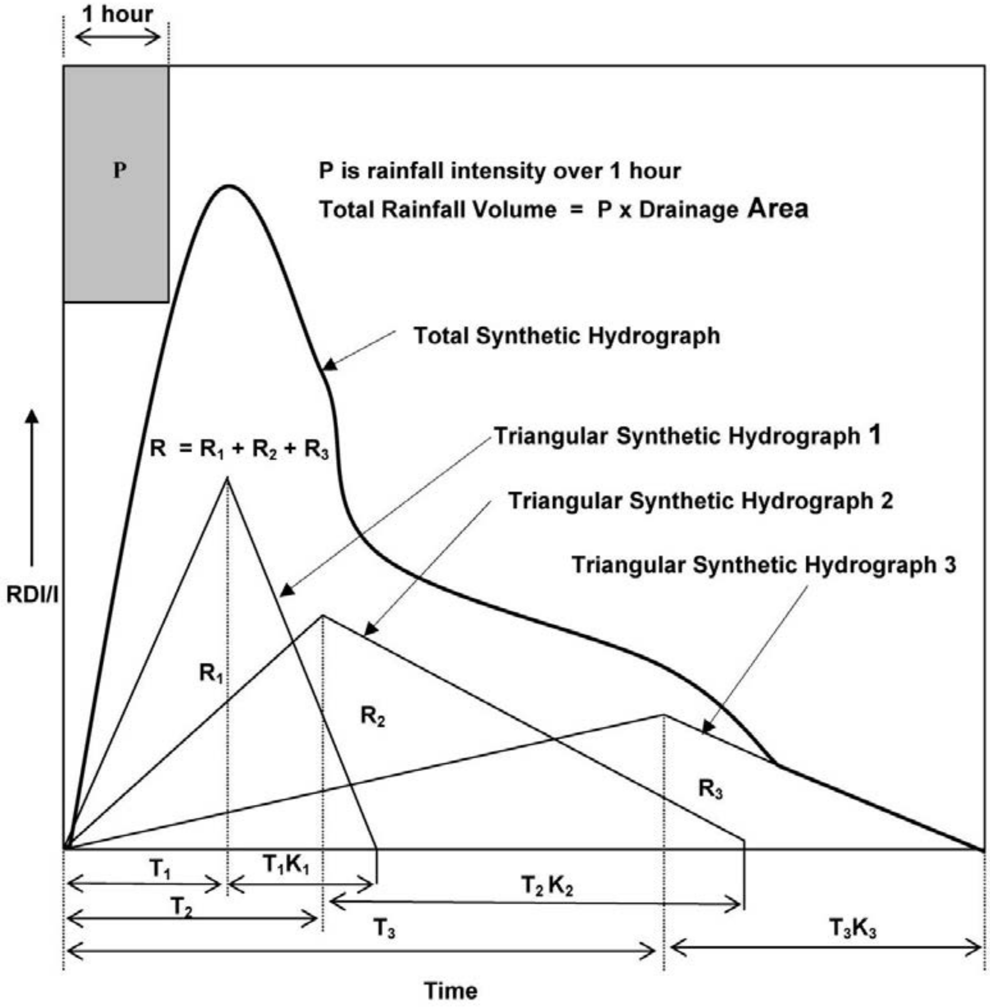
a. Includes wet season GWI.

b. For the Buildout-Sensitivity scenario, the development density was assumed to be at the maximum range allowed by the General Plan. A Base Wastewater Flowrate (BWF) of 180 gpd per EDU was assumed for Placer County and SPMUD.

2.3 Rainfall-Dependent Infiltration and Inflow

RDI/I flows result from rainfall events that produce infiltration and inflow of storm water runoff into the sewer system. RDI/I flows are defined by the magnitude, shape, and timing of the RDI/I response. RDI/I varies depending on many factors, including the magnitude and intensity of the storm event, area topography, type of soil, and the condition of the sewers, manholes, and sewer service laterals. In a dynamic model, RDI/I is typically computed as a percentage of the rainfall (sometimes referred to as the "R value") falling on the contributing area of a subcatchment for each of three or more hydrograph components, representing different response times to rainfall, e.g., fast, medium, and slow, as illustrated in Figure 2-6. The contributing area is assumed to be the sum of the area of all developed parcels, except for large open areas such as parks and parking lots. Summing all of the component hydrographs for the entire duration of the rainfall event results in the total RDI/I hydrograph for the event for that subcatchment. Note that although the "slow" RDI/I component can contribute significantly to the total RDI/I volume, the "fast" component has the biggest impact on the magnitude of the peak wet weather flow.

Figure 2-6: RDI/I Hydrograph Components



3. TRUNK SEWER EVALUATION

3.1 Introduction

This section describes the hydraulic analysis and design criteria used to evaluate system performance and size capacity relief projects in the trunk sewer system and identifies the capacity deficiencies based on the results of model runs.

3.2 Model Network Development

This section describes the development of the hydraulic model used for the capacity assessment of the SPWA trunk sewers. The modeling software used for this study was InfoWorks ICM by Innovyze, a fully dynamic hydraulic modeling program that has been used for many other collection systems in California, including Sacramento Area Sewer District, Regional San, and the City of Folsom. This section provides an overview of the model development process, including description of the modeled sewer network, the flow monitoring program, and the calibration of the model.

3.2.1 Modeling Terminology

Key modeling terms are defined below.

- Network refers to the representation of the physical facilities being modeled. Modeled network components include pipes, manholes, and pump stations.
- Nodes are primarily manholes, but also include pump station wet wells and outfalls (discharge points from the modeled system). Key data associated with nodes include manhole ground elevations and pump station wet well elevations and cross-sectional areas.
- Pipes or conduits are connections (links) between nodes, and include both gravity sewers, force mains and conduits. Key data associated with pipes are upstream and downstream node IDs, pipe length, diameter, roughness factor, and upstream and downstream invert elevations.
- Pumps, gates, and overflow weirs are represented in the model as links between nodes. Data associated with these facilities depend on the structure type. For example, data for weirs include width, elevation, and weir discharge coefficient.
- Subcatchments are areas that contribute flow to the modeled sewer network. They may represent parcels, or an area comprised of multiple parcels that are collected by unmodeled sewers in the collection system (sewershed). Data associated with subcatchments include BWF (computed based on population, water use, or other available data), type of diurnal BWF profile (which is a function of land use), I/I parameters, and the node at which the flow from the subcatchment enters the modeled system.
- Model loads are the flows entering the modeled sewer system from each subcatchment. Model loads include residential and commercial sanitary or BWF, GWI, and 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 (e.g., rainfall, diurnal profiles, inflows from other areas, etc.) that comprise a specific model scenario.

3.2.2 Modeled System

The model network for this Systems Evaluation included trunk sewers from the City's model, as well as selected pipe reaches in SPMUD and Placer County. The extent of the modeled sewers in SPMUD and Placer County is consistent with the extent used in the 2009 Systems Evaluation, and generally includes 15-inch and larger trunk sewers. The existing modeled network is shown in Figure 3-1. Figure 3-1 also highlights the trunk sewers within Roseville that convey flow from multiple SPWA partners and are the focus of the capacity analysis.

As noted previously, the model network was based on the model developed for the City's 2017 Sewer Model Update. For the trunk sewers in that model update, the City's GIS data was updated with rim and invert elevation data extracted from record drawings or, in some cases, ground elevation data from other datasets. In a few cases (e.g. at all flow splits) additional data was collected through survey or field inspection by City staff.

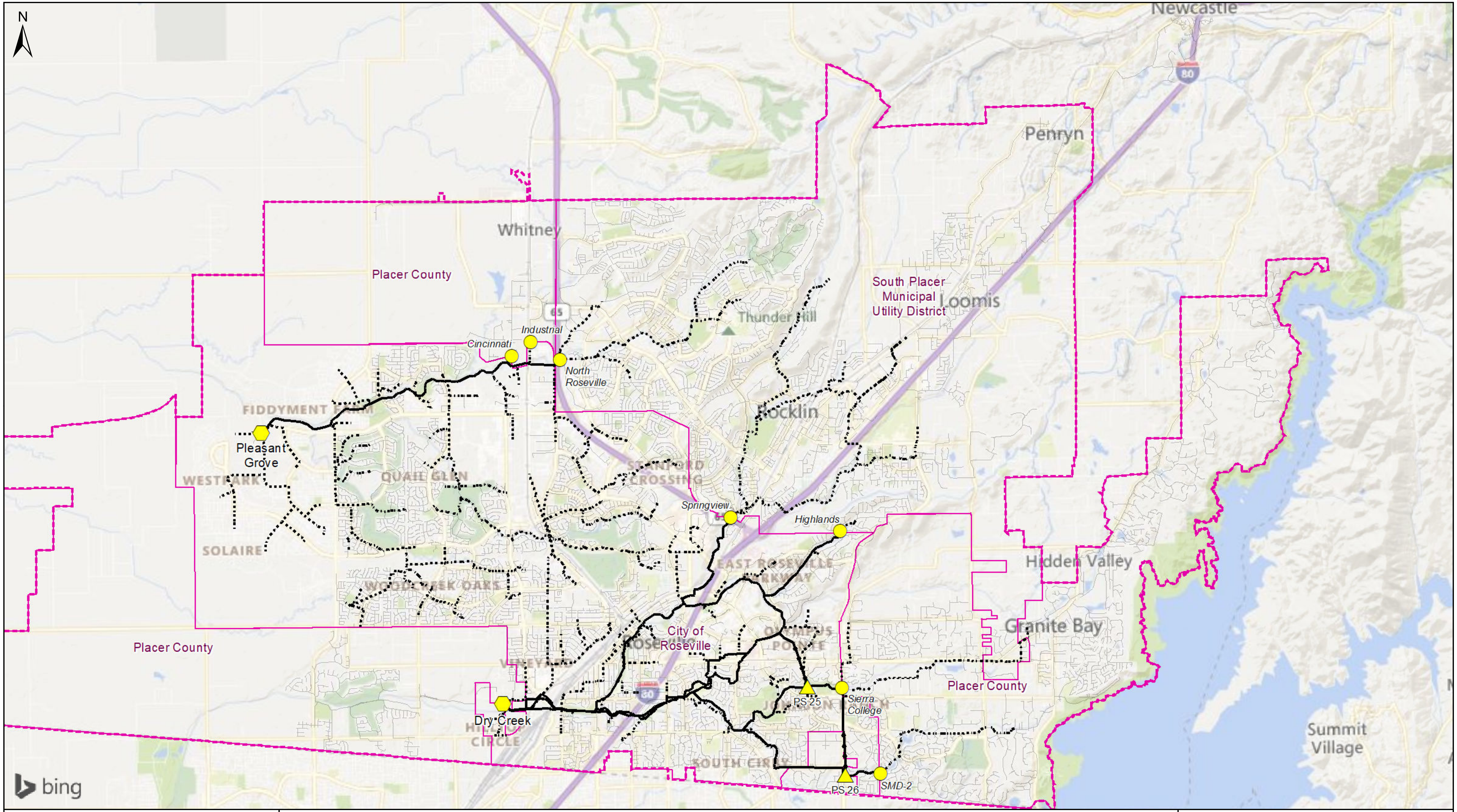
For the current Systems Evaluation Update, that model was extended into Placer County and SPMUD service areas to provide a more complete analysis of the regional trunk sewer system. GIS data provided by Placer County and SPMUD was used as the basis for extending the network into their respective systems. The model extent was limited to the extent used for the 2009 Systems Evaluation, but generally includes most 15-inch and larger sewers, as well as selected smaller diameter sewers. A model validation process was undertaken, similar to the process used in the City's 2017 Sewer Model Update.

Model validation generally includes the following:

- Connectivity checks. The modeled networks were checked for connectivity, which includes verifying that correct upstream/downstream manholes were identified for each pipe, with no missing links or nodes in the network. A connected network means that all pipes and manholes will be selected when the network is traced upstream from the model outfalls.
- Missing data checks. Key data required for modeling were reviewed to identify missing values. Missing data were inferred where reasonable (e.g., where one or two invert elevations were missing between populated values, the data could be interpolated), or populated based on data from the 2009 Systems Evaluation.
- Profile review. Profiles were plotted for each series of pipe segments in the modeled network to visually check for suspect data. Examples of suspect data include negative pipe slopes, abrupt steps up or down in pipe inverts, and pipe diameters that conflict with surrounding pipes. Where appropriate, corrections to suspect data were inferred. Otherwise, verification in the form of as-built drawings or field investigations were requested.
- Special structures. Flow splits (manholes with more than one outlet pipe) were identified for further verification of outlet pipe elevations and/or the existence of weir overflows or other control structures. Field verification and/or as-built drawings were requested as needed.

In all, the model includes approximately 83 miles of gravity trunk sewers, of which about 32 miles are considered SPWA facilities. All gravity pipelines are modeled assuming a Manning's n of 0.013.

The modeled system includes two pump stations that can convey regional flows as summarized in Table 3-1. PS 25 and PS 26 were designed to operate during high wet weather conditions by transferring flow between trunk sewers, thereby alleviating downstream capacity issues. Flow enters the pump station wet well when surcharge conditions in the adjacent gravity sewer overtops an associated weir. PS 25 is designed to limit surcharging in the trunk sewer on Old Auburn Road and conveys flows (mostly originating in Placer County) north towards the 21-inch trunk sewer downstream of Placer County's Sierra College Meter. PS 26 is designed to limit surcharging in that 21-inch easement sewer by conveying flows further north on East Roseville Parkway. City operations staff note that PS 26 is used regularly during wet weather conditions, but PS 25 has not been used in a number of years.



Regional Gravity Sewer

Regional Force Main

Non-Regional Modeled Sewer

Non-Modeled Sewer

⬢ Wastewater Treatment Plant

▲ Pump Station

● Permanent Flow Meters

▭ Partner Agency Boundary

⬚ Ultimate Service Area Boundary

Figure 3-1
Modeled Trunk System

South Placer Wastewater Authority
2020 Systems Evaluation

0 ½ 1 2
Miles

Project #: 0011183.00
Map Created: December 2020

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Table 3-1: Regional Pump Station Facilities

Pump Station	No. of Pumps	Firm Capacity[a] (mgd)	Total Capacity (mgd)	Force Main Dia. (in.)
PS 25[b] (Johnson Ranch)	2	2.02	3.20	12
PS 26 (Old Auburn)	2	0.43	0.68	8

Notes:

a. Capacity with one pump out of service.

b. Capacity of PS 25 is based on information collected as part of the 2009 Systems Evaluation. Capacity has not been evaluated for this study. Based on reports from City operations, PS 26 has not been used in several years.

3.2.3 Flow Monitoring Program

To support the development of the hydraulic model and flow projections for the Systems Evaluation Update, a temporary flow monitoring program was conducted as part of this study, including 30 meters during the 2015/2016 wet weather season (for the City's 2017 Model Update) and 12 meters during the 2018/2019 wet weather season (for SPMUD and Placer County). V&A Consulting Engineers, under subcontract to Woodard & Curran, conducted the monitoring. The meters and rain gauges were installed for a 2-month period from early January through early March for each wet weather season to capture the flow from the tributary areas. In addition, two recording rain gauges were also installed during both seasons and used for calibration of gauge-adjusted radar rainfall data. The locations of the flow monitoring sites are shown in Figure 3-2. The figure also shows the associated tributary area (basin) for each flow meter.

The locations of the flow meters relative to each other and to flow splits within the collection system are shown schematically in Figure 3-3. Note that many of the meters were located downstream of other meters; therefore, the tributary areas shown for each of these meters in Figure 3-2 are the "incremental" areas between the flow meter and tributary basins of the upstream flow meters. Flow meter locations, pipe diameters, and upstream meters are listed in Table 3-2 and Table 3-3 for the permanent meters and temporary meters, respectively. Data for all meters during both flow monitoring periods are included in Appendix C.

The purpose of the flow monitoring program was to quantify the flows in the system to provide data with which to calibrate the hydraulic model (discussed later in this section), and to quantify the I/I response to storm events in various areas of the system.

Table 3-2: Permanent Flow Meters

Flow Meter ID (FM ID)	Agency	Downstream Meters	Upstream Meters
Cincinnati	Placer County	22	
Industrial	Placer County	22	
SMD-2	Placer County	11	161
Sierra College	Placer County	18	159, 160
Highlands	SPMUD	19	
North Roseville	SPMUD	22	151, 152, 153, 154, 155
Springview	SPMUD	14	156, 157, 158

Table 3-3: Temporary Flow Meter Locations

Flow Meter ID (FM ID)	Manhole ID	Diameter (in)[a]	Downstream Meters	Upstream Meters
1	E04-042	18	25	
2	E01-180	15	23	
3	D02-280	15	21	
4	B06-195	15	16, 17	
5	B04-003	12	15	
5A	B04-225	21	15	
6	C06-161	18	14	
7	D02-354	23.5	21	7A
7A	D03-115	12	7	
8	D04-201	24	24	
9	D02-068	18	21	
10	B06-341	18	16	
11[b]	A08-034	14.5	PS 26, 16, 17	SMD-2
12	B03-029	21	DC WWTP	
13[c]	B03-042	42	DC WWTP	16
14	B03-024	66	DC WWTP	6, 19, Springview
15	B03-053	36	DC WWTP	5, 5A, 15A, 17
15A	B04-082	12	15	
16	B04-151	30	13	4, 10, 11, 16A, 18
16A	B06-161	15	16, 17	
17	B05-258	21	15	4,1 6A, 11
18	B07-242	22.5	16	11, Sierra College
19	C06-024	35.5	14	20, Highlands
20	C07-003	24	19	
21	E01-149	33	23	3, 7, 9
22	F01-136	72	PG WWTP	24, 25, Cincinnati, Industrial, North Roseville
23	F01-147	36	PG WWTP	2, 21
24	F02-074	41.5	22	8
25	G04-041	21	22	1
26	F99-035	42	PG WWTP	
151	L02-001	24	North Roseville	
152	K02-005	18	North Roseville	
153	L03-014	18	North Roseville	
154	M06-004	18	North Roseville	
155	M06-003	21	North Roseville	
156	J07-058	15	Springview	
157	J07-060	18	Springview	
158	I10-037	18	Springview	
159	C9-02	17.4	Sierra College	161
160	C9-04	14.4	Sierra College	
161	B12-03	14.4	SMD-2	
162	D14-03	14.4	159	

Notes:

a. Actual measured diameter used for meter flow calculations (may be slightly different than pipe nominal diameter).

b. Meter located directly downstream of SMD-2 meter to confirm SMD-2 flows and for consistency with 2005 Flow Monitoring Program. Meter confirmed accuracy of flows at SMD-2 meter.

c. Meter placed for consistency with 2005 Flow Monitoring Program and to confirm measured flows to DC WWTP.

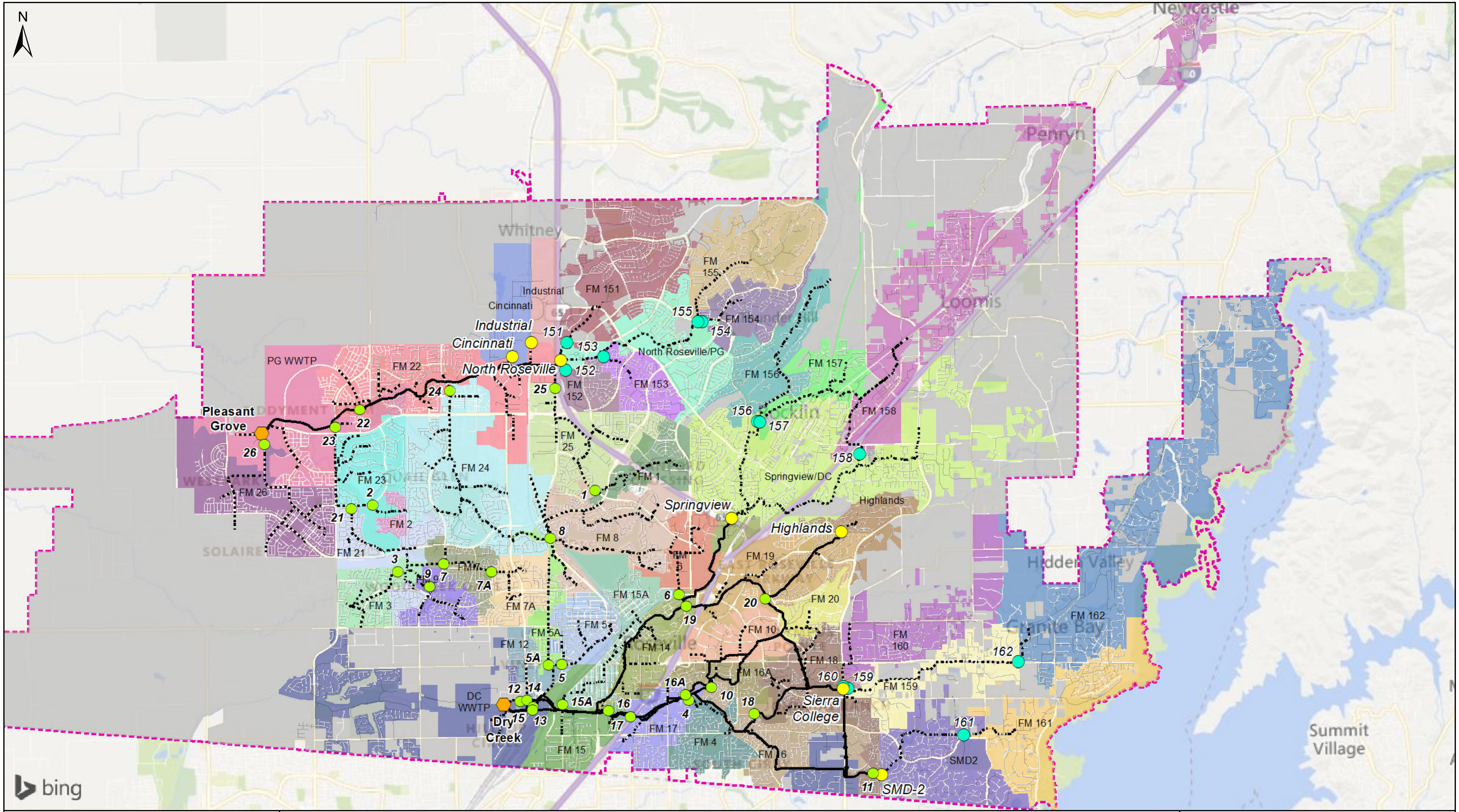

Figure 3-2

Flow Monitoring Locations

South Placer Wastewater Authority
2020 Systems Evaluation

0 ½ 1 2
Miles

▬	Regional Gravity Sewer
●▬●	Regional Force Main
······	Non-Regional Modeled Sewer
─	Non-Modeled Sewer
●	Permanent Flow Meters
● 152	2018/2019 Temporary Flow Meter
● 5	2015/2016 Temporary Flow Meter
⬢	Wastewater Treatment Plant
FM 152	Flow Meter Basin
▭	Ultimate Service Area Boundary

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Placer CITY OF ROSEVILLE CALIFORNIA SMUD WOODARD & CURRAN

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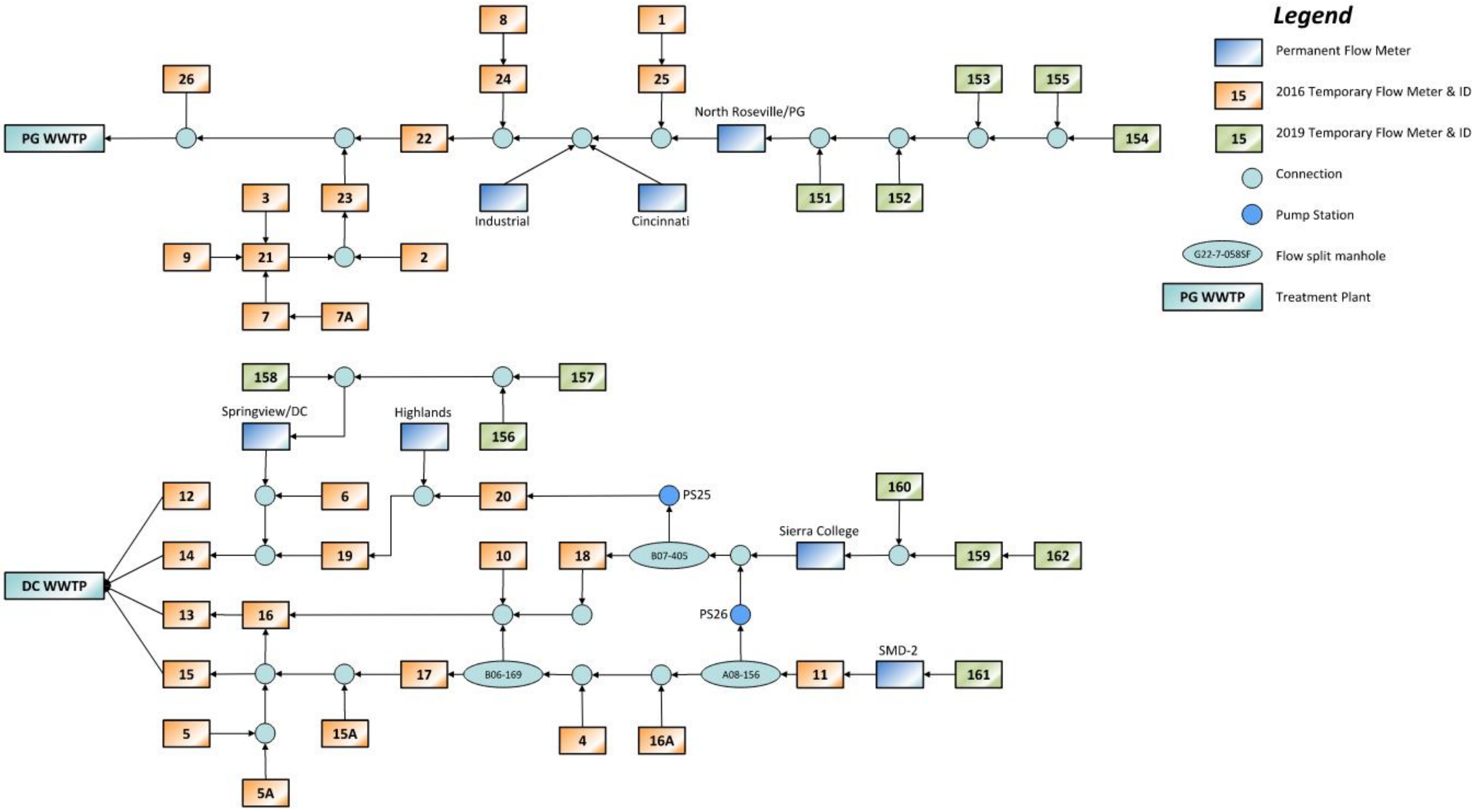
Figure 3-3: Flow Meter Schematic



3.2.3.1 Radar Rainfall Data

To obtain the most accurate spatial rainfall data for use in model calibration, gauge-adjusted radar rainfall (GARR) data was obtained for the rainfall events that occurred during both monitoring periods. GARR data combines the use of spatial rainfall estimates from radar data with point rainfall measurements from rain gauges located on the ground. The radar measures the reflected signals from falling raindrops in the atmosphere, which can then be translated into estimates of rainfall rates using mathematical and empirical relationships. However, the conversion of the reflected signals to rainfall rates is not sufficiently accurate to consistently estimate actual rainfall amounts at a given location, but does provide good information about the relative rainfall amounts at different locations (i.e., the spatial variation of rainfall). Therefore, the radar rainfall estimates are calibrated to (i.e., adjusted to match) more accurate rainfall measurements from rain gauges located on the ground in the area of study.

The process of converting radar images to GARR estimates is complex and must be conducted by trained and experienced radar rainfall specialists. There are several providers of GARR data throughout U.S. Each uses its own data processing techniques and proprietary algorithms to generate the gauge-adjusted radar rainfall estimates. For this study, Woodard & Curran contracted with OneRain, Inc. to provide the GARR data. The rainfall collected by the two V&A temporary rain gauges was provided to OneRain for use in their GARR calibration to supplement data available from permanent rain gauges owned by the City for its Flood Alert System.

OneRain developed the GARR data for the flow monitoring period in 5-minute time increments for 1 kilometer by 1 kilometer pixels (each approximately 250 acres in size) covering the entire SPWA service area (including SPMUD and Placer County). Approximately 200 pixels cover the sewered portions of the service area. The data was aggregated to 15-minute intervals for use in the model. The pixel containing the centroid of each model subcatchment defines the rainfall for that subcatchment for each rainfall event.

3.2.4 Model Loading

Section 4.4 described how BWF model loads were developed from water use and land use and growth projections. GWI and RDI/I flows were also loaded to the model by parcel by associating each parcel with a flow meter area. For each parcel, a sewershed (“contributing”) area (i.e., area that potentially contributes I/I) was determined based on land use. Contributing areas for non-open space land uses, including residential, commercial, industrial, and institutional uses, were based on the full parcel area. Contributing areas for parks and other land uses that may contribute sewer flows but are likely to have significant open space were limited to 1 acre. Parcels comprised of open space, drainage channels, and large roadways such as freeways not likely to contribute sewer flows were assigned zero contributing area. I/I flows for each parcel were computed in the model by applying the appropriate meter area GWI and RDI/I parameters (determined during the model calibration process described below) to the contributing area of the parcel.

Parcels loading to the same modeled manhole are grouped into subcatchments. All BWF loads associated with each parcel in the subcatchment are then summed to calculate the overall BWF loading from the subcatchment. The contributing areas are also summed, and the appropriate meter area GWI and RDI/I parameters are assigned to calculate I/I flows for each subcatchment.

3.2.5 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. The model is calibrated for both dry and wet weather conditions.

As described above, temporary flow monitoring programs were conducted during the late January through mid-March 2016 and 2018 wet weather periods. The data collected during these flow monitoring programs, as well as data from the permanent meters, were used for model calibration.

3.2.6 Dry Weather Calibration

The dry period in early to mid-February 2016 (for flow meters in the City) and late January 2019 (for flow meters in SPMUD and Placer County) were used as the dry weather calibration periods for the model. 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). The dry period immediately prior to the wet weather calibration period in early March was also used to confirm the calibration.

Figure 3-4 shows an example plot of model vs. metered flow for one meter location (Site 155). In this graph, the green line represents the monitored (observed) flow, and the red line is the model-simulated flow. Calibration graphs for all meters throughout the monitoring program are included in Appendix D. Note that the Sierra College permanent meter was not operational during much of the 2019 season; however, nearly all tributary flows to this meter were measured as part of the temporary metering program. While most meters calibrated well for both 2016 and 2019 data, there were a few meters with discrepancies. The discrepancies are mostly due to differences in GWI observed in the temporary meters upstream of the Springview and Sierra College meters during the 2019 flow monitoring program versus the 2016 program. As 2016 had significantly less rainfall preceding the flow monitoring program, this GWI was likely not present during the 2016 flow monitoring program.

Table 3-4 summarizes the dry weather loading parameters determined for each flowmeter area during calibration. Calibrated unit flow factors are indicated on Figure 3-5, while estimated GWI rates for each flowmeter area are indicated on Figure 3-6.

The model calibration resulted in a reasonably good match of modeled to metered flow at most locations, but some differences at others. These differences may be due to inaccuracies in the meter data, inaccuracies in the water consumption data, or in the configuration of the system (e.g., upstream flow splits). The calibration process also resulted in further investigation and adjustments at the major flow split locations in the model (manholes SMH B06-169, SMH A08-156, SMH B07-405 and SMH D04-442). To ensure accuracy during calibration, sewers in the City's trunk model were updated based on survey, field investigation and City drawings to capture the physical structures of the flow splits and then adjusted as needed to better calibrate to the flow meter data.

For a few of the meters (FM 6, 10, and 16A), the water consumption data was not sufficient to account for all of the apparent flow observed by the flowmeter. This could be due to water use not in the water consumption database (e.g. water from another source, or error in the water consumption database), or an error in the flow meter data. To be conservative, some residential flow (less than 0.1 mgd) was distributed in each of the meter areas across all parcels to improve calibration.

Table 3-4: Dry Weather Flow Loading Parameters

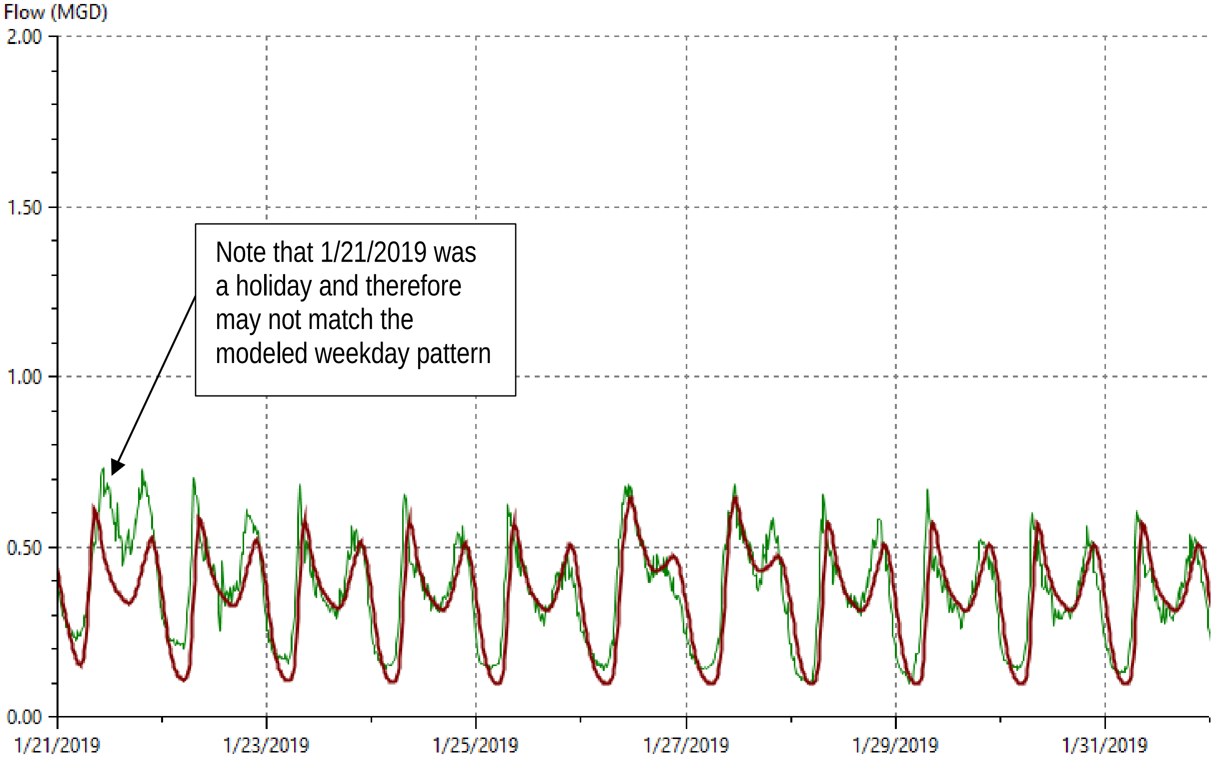
Flow Meter ID (FM ID)	Contributing Area[a] (acres)	Incremental Calibrated ABWF[a] (mgd)	Calibration ABWF Reduction Factor[b]	GWI (gpd/ac.)	GWI[a] (mgd)	Incremental Calibrated ADWF[a] (mgd)
1	297	0.28	0%	--	--	0.28
2	174	0.14	0%	--	--	0.14
3	270	0.29	0%	--	--	0.29
4	397	0.30	0%	--	--	0.30
5	241	0.30	0%	373	0.09	0.39
5A	181	0.14	0%	441	0.08	0.22
6	209	0.23	0%	192	0.04	0.27
7	181	0.19	0%	--	--	0.19
7A	349	0.42	0%	--	--	0.42
8	588	0.51	0%	425	0.25	0.76
9	209	0.22	0%	--	--	0.22
10	363	0.32	0%	--	--	0.32
11	0[b]	0.00	0%	--	--	0.00
12	157	0.15	0%	--	--	0.15
13	0[c]	0.00	0%	--	--	0.00
14	428	0.43	0%	--	--	0.43
15	328	0.31	0%	--	--	0.31
15A	326	0.30	0%	--	--	0.30
16	470	0.41	0%	1064	0.50	0.91
16A	219	0.27	0%	593	0.13	0.40
17	352	0.31	0%	--	--	0.31
18	364	0.34	0%	302	0.11	0.45
19	374	0.51	0%	561	0.21	0.72
20	172	0.18	0%	--	--	0.18
21	327	0.26	0%	--	--	0.26
22	857	0.58	0%	--	--	0.58
23	283	0.20	0%	--	--	0.20
24	932	1.38	0%	--	--	1.38
25	589	0.53	0%	170	0.10	0.53
26	423	0.34	0%	--	--	0.34
151	757	0.64	15%	--	--	0.64
152	218	0.25	0%	--	--	0.25
153	280	0.23	20%	--	--	0.23
154	384	0.23	20%	--	--	0.23
155	521	0.35	15%	--	--	0.35
156	562	0.21	15%	302	0.17	0.38
157	314	0.16	0%	96	0.03	0.19
158	1766	0.74	15%	130	0.23	0.97
159	497	0.11	0%	80	0.04	0.15
160	570	0.17	20%	175	0.1	0.27
161	818	0.21	0%	342	0.28	0.49
162	2124	0.44	0%	311	0.66	1.10
Cincinnati[d]	204	0.09	0%	--	--	0.09
Industrial[d]	121	0.06	0%	--	--	0.06
SMD-2	783	0.28	0%	--	--	0.28
Sierra College	14	0.01	0%	--	--	0.01
Highlands	344	0.11	0%	--	--	0.11

Flow Meter ID (FM ID)	Contributing Area[a] (acres)	Incremental Calibrated ABWF[a] (mgd)	Calibration ABWF Reduction Factor[b]	GWI (gpd/ac.)	GWI[a] (mgd)	Incremental Calibrated ADWF[a] (mgd)
North Roseville (Pleasant Grove)	1997	1.25	15%	--	--	1.25
Springview (Dry Creek)	605	0.55	15%	--	--	0.55

Notes:

a. For meters with upstream basins, represents the incremental meter basin area or flow, as shown on Figure 3-2.
b. Meter located directly downstream of SMD-2 meter to confirm SMD-2 flows and for consistency with 2005 Flow Monitoring Program
c. Meter placed for consistency with 2005 Flow Monitoring Program and to confirm measured flows to DC WWTP.
d. Due to highly variable and relatively small industrial flows, calibration of Cincinnati and Industrial meters was limited.

Figure 3-4: Example DWF Model Calibration Graph (Site 155)



Note that 1/21/2019 was a holiday and therefore may not match the modeled weekday pattern

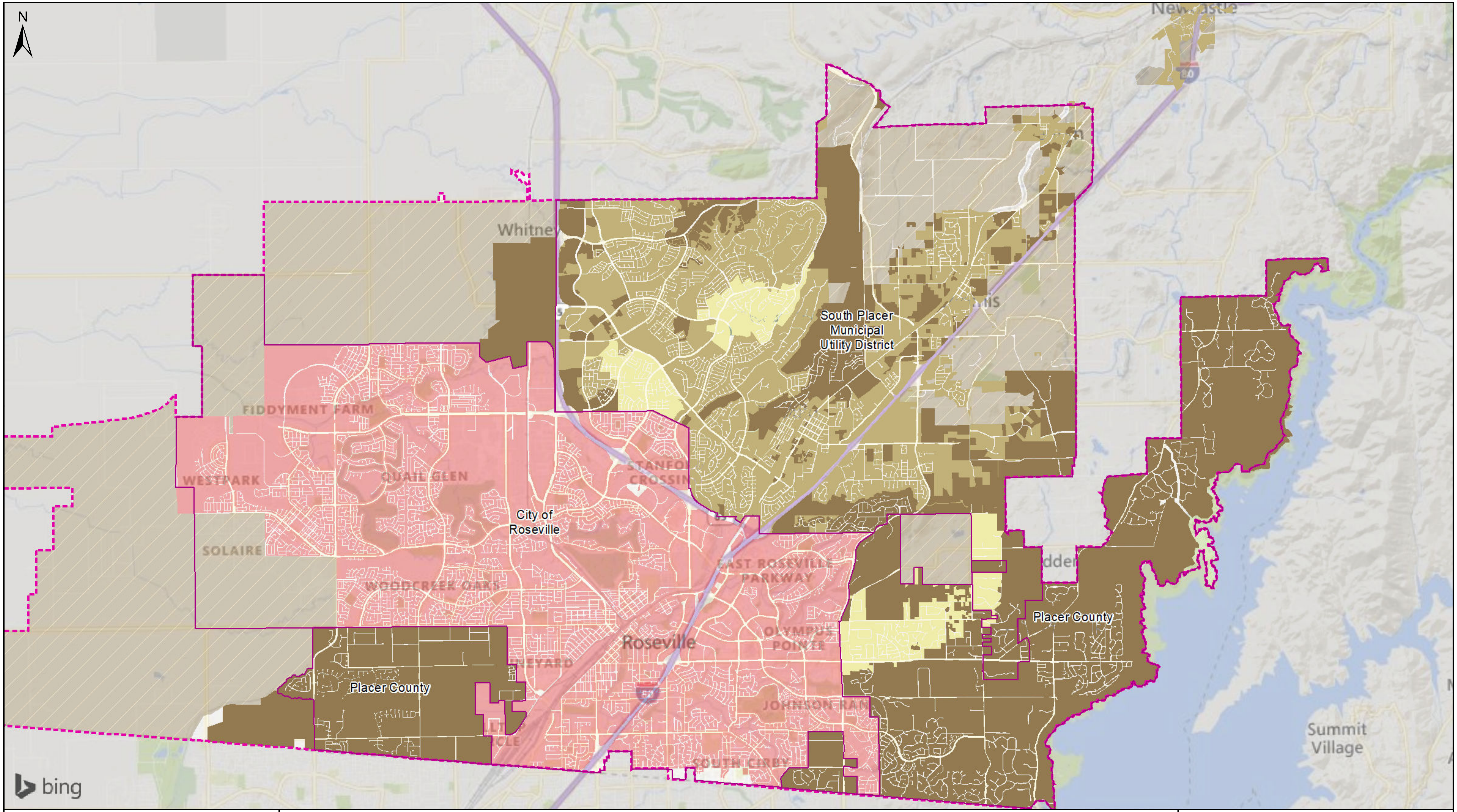


Figure 3-5

Calibrated Unit Flow Factors

South Placer Wastewater Authority
2020 Systems Evaluation

0 ½ 1 2 Miles

Flow Factor (gpd/EDU)

🟨	128
▨	136
🟫	160

- 🟥 City of Roseville (Water Billing Data)
- ▨ Future Connection
- ⬚ Ultimate Service Area Boundary
- ☐ Partner Agency Boundary

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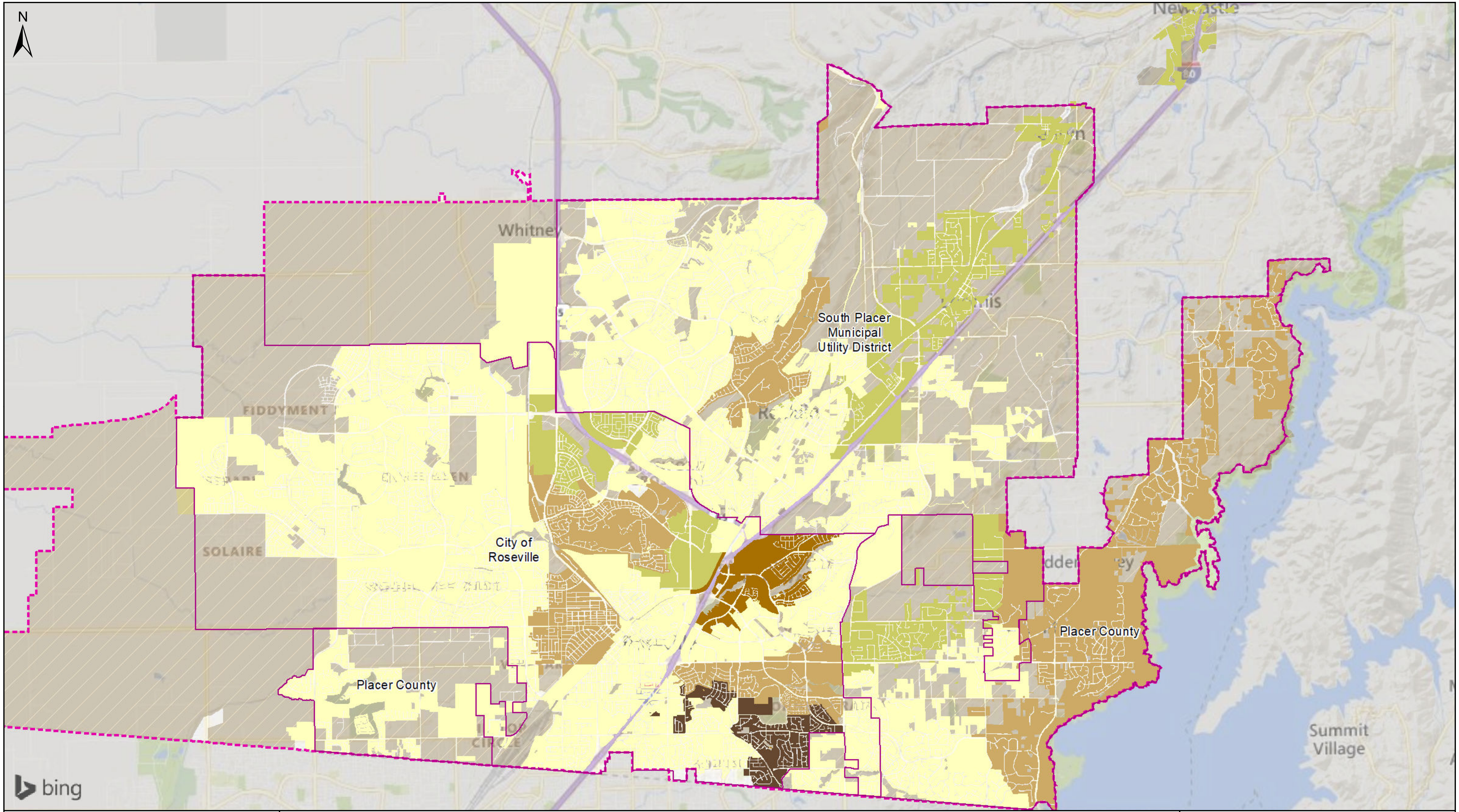

Figure 3-6

Calibrated GWI Rates

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3.3 Wet Weather Flow Projections

3.3.1 Wet Weather Calibration

During wet weather calibration, parameters are adjusted to simulate the volume and timing of RDI/I for monitored storm events. Rainfall was assigned to each parcel or subcatchment using data from the GARR pixel at the centroid of the parcel or subcatchment. Through the wet weather calibration process, RDI/I hydrograph parameters were developed for each metered area. For calibration of the City's meters, the rainfall period from March 4th through March 15th, 2016 was used to determine RDI/I parameters. This period had two storms: the first storm occurring around March 5th-6th generally had the highest rainfall totals; the second storm on March 12th-13th generally had the highest peak flows. The soils for the second storm were more saturated, and generated a larger response. For a conservative calibration, RDI/I parameters were selected to best match the response to the March 12th-13th storm. These conservative calibration conditions should be considered when using this model to evaluate capacity.

For meters in Placer County and SPMUD, two storms were used for wet weather calibration: one event occurring January 15th through January 17th, and another event February 25th through 27th, 2019. The January event was generally higher peak intensity but lower total volume, while the February event was less intense but had more total rain. Both events had similar (generally wet) antecedent conditions. Some meters had higher peak flows during the January event, while others had higher peak flows during the February event; in general, an attempt was made to calibrate for both events. Storm information for the calibration events are summarized in Table 3-5.

Table 3-5: Calibration Rainfall Events

Start Date/Time	Storm Duration (hours)	Total Storm Rainfall (in.)			Peak Hour (in.)		
		DC WWTP	Rocklin (Site 157)	Granite Bay (Site 162)	DC WWTP	Rocklin (Site 157)	Granite Bay (Site 162)
2016 Calibration Events							
3/5/2016 13:00	69	2.68	3.16	2.84	0.15	0.21	0.22
3/12/2016 14:00	86	2.29	2.52	2.70	0.21	0.22	0.25
2019 Calibration Events							
1/16/2019 12:00	12	1.55	1.71	1.83	0.36	0.34	0.44
2/24/2019 17:00	44	3.59	3.78	3.49	0.23	0.19	0.19

Table 3-6 summarizes the results of the wet weather calibration in terms of the R values assigned to each flow meter basin. An example wet weather calibration graph is presented in Figure 3-7. Calibration graphs for all meters are included in Appendix D.

Overall, most meters had relatively low R values, indicative of a tight system with newer pipes (see Figure 3-8). The FM 5 and FM 7 areas exhibited more significant peak flow response. Further investigations, such as smoke tests or CCTV, may be appropriate in these area or others with higher R factors to identify potential sources of I/I (such as unauthorized stormwater discharge or leaking pipes or manholes) and any capacity concerns.

A few areas did not exhibit enough response to rainfall to develop calibration parameters; a minimum R volume response of 0.6 percent was assumed, distributed evenly between the fast, medium, and slow response R factors. For future growth areas, a minimum R volume response of 0.6 percent was also assumed, which results in a peak RDI/I under the design storm of approximately 700 gallons per acre per day (consistent with criteria for new development documented in TM 3A of the 2009 Systems Evaluation).

Table 3-6: Wet Weather Calibration Parameters

Flow Meter ID (FM ID)	R1 RDI/I Vol (%)	R2 RDI/I Vol (%)	R3 RDI/I Vol (%)	Rtot RDI/I Vol (%)
1	0.2	0.4	4.0	4.6
2	1.2	1.0	3.0	5.2
3	0.2	0.2	2.0	2.4
4	0.8	0.5	2.0	3.3
5	3.0	6.0	8.0	17.0
5A	0.2	2.0	3.5	5.7
6	0.5	1.5	1.0	3.0
7	2.5	2.0	12.0	16.5
7A	1.0	0.7	3.0	4.7
8	0.2	2.0	6.0	8.2
9	0.5	3.0	5.0	8.5
10	0.2	0.4	0.5	1.1
11	0.8	2.0	2.2	5.0
12	0.2	0.2	4.0	4.4
13	0.5	1.0	3.0	4.5
14	0.3	1.3	3.8	5.4
15	3.0	2.5	0.3	5.8
15A	0.8	0.3	0.3	1.4
16	0.5	1.0	3.0	4.5
16A	1.5	1.0	6.0	8.5
17[a]	0.2	0.2	0.2	0.8
18	0.3	2.0	5.0	7.3
19	0.3	1.3	3.8	5.4
20	0.2	0.6	3.0	3.8
21	0.2	2.0	2.0	4.2
22	0.2	0.4	4.0	4.6
23[a]	0.2	0.2	0.2	0.6
24	0.2	1.0	0.5	1.7
25	0.2	1.5	6.0	7.7
26[a]	0.2	0.2	0.2	0.6
151	0.6	0.7	0.2	1.5
152	0.7	0.3	0.1	1.1
153	1.0	0.5	0.2	1.7
154	0.4	0.5	0.1	1.0
155	1.3	1.0	1.0	3.3
156	1.0	1.3	2.0	4.3
157	0.7	0.4	0.4	1.5

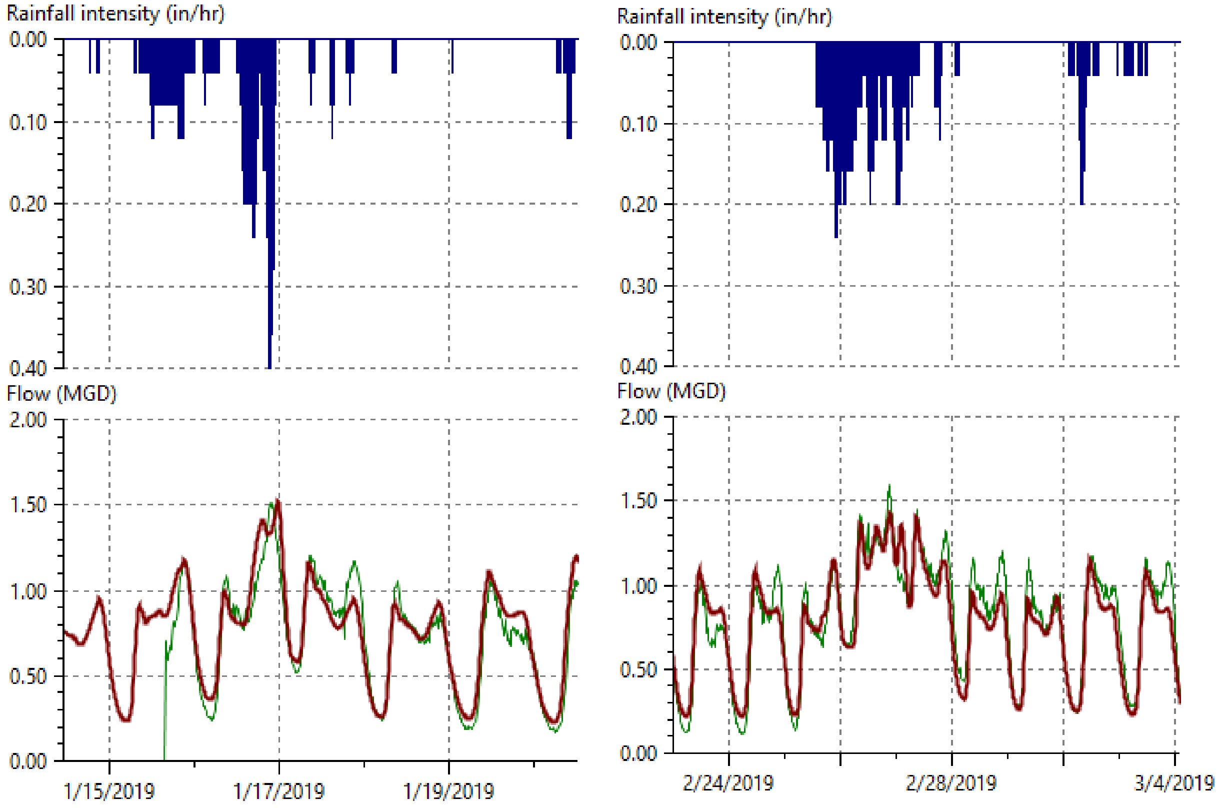
Flow Meter ID (FM ID)	R1 RDI/I Vol (%)	R2 RDI/I Vol (%)	R3 RDI/I Vol (%)	Rtot RDI/I Vol (%)
158	0.3	1.1	3.0	4.4
159	0.2	0.5	1.3	2.0
160	0.9	1.3	2.5	4.7
161	0.6	1.0	2.0	3.6
162	0.2	0.5	1.3	2.0
Cincinnati[b]	0.1	0.1	1.3	1.5
Industrial[b]	0.1	0.1	0.3	0.5
SMD-2	0.6	1.0	2.0	3.6
Sierra College	0.5	0.9	1.9	3.3
Highlands	0.7	1.0	0.4	2.1
North Roseville (Pleasant Grove)	1.3	1.3	0.3	2.9
Springview (Dry Creek)	0.7	2.0	10.0	12.7

Notes:

a. Where flowmeters did not indicate a significant response to rainfall, a minimum response of 0.6% was assumed, disbributed evenly between R1, R2, and R3. A minimum response of 0.6% was also assumed for areas of future growth.

b. Due to highly variable and relatively low industrial flows, calibration of Cincinnati and Industrial meters was limited.

Figure 3-7: Example WWF Model Calibration Graph (Site 155)



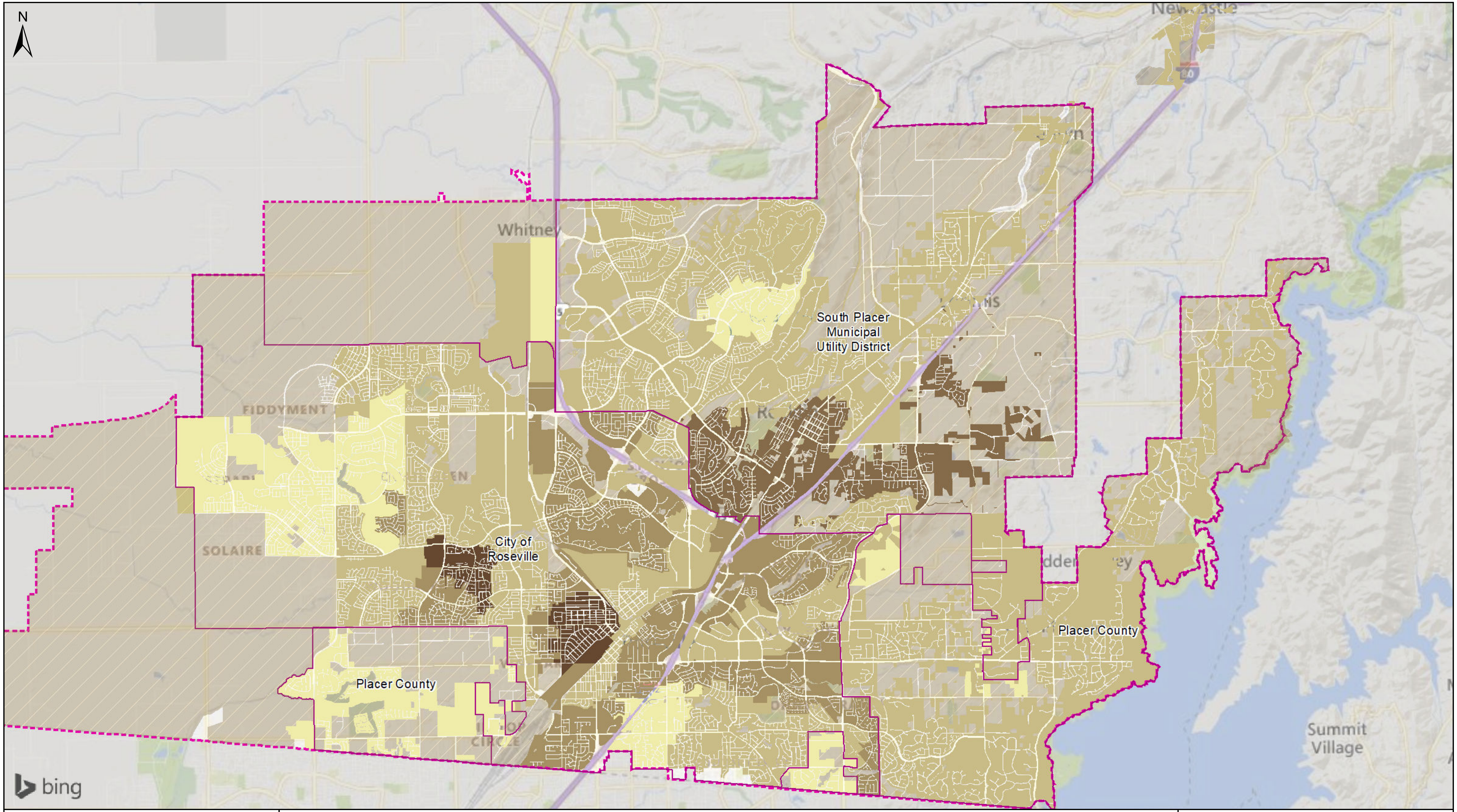


Figure 3-8

Calibrated R Values

South Placer Wastewater Authority
2020 Systems Evaluation

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3.4 Capacity Analysis

This section describes the hydraulic analysis and capacity criteria used to evaluate system performance and size capacity relief projects in the trunk sewer system, and identifies the capacity deficiencies based on the results of model runs.

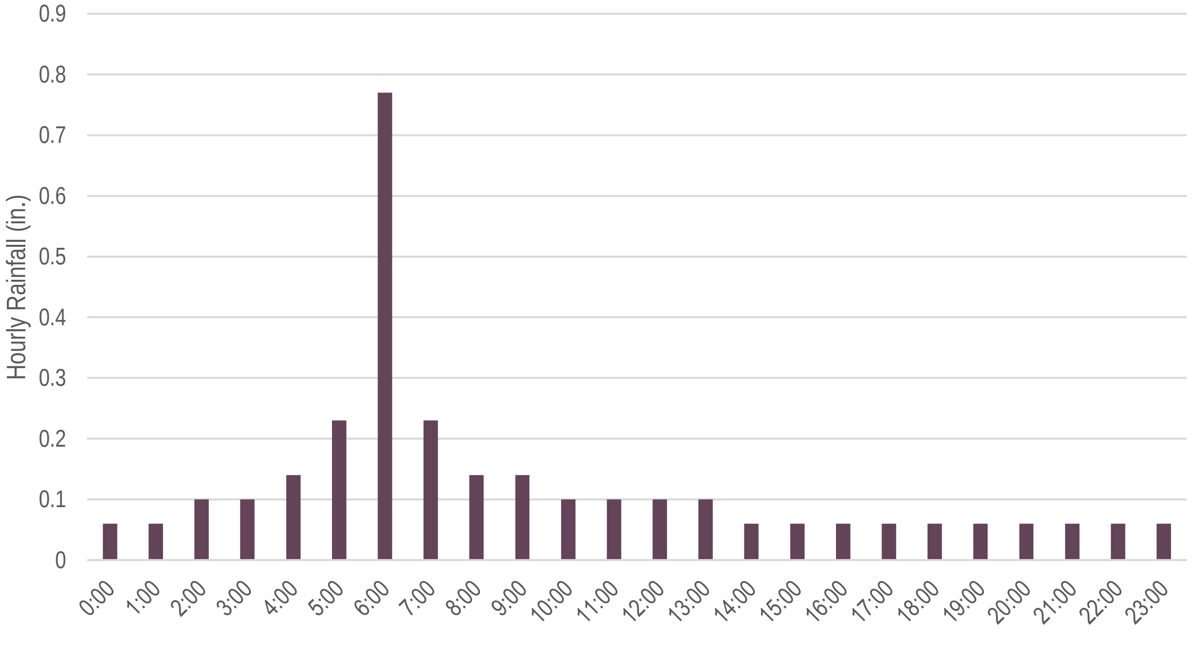
3.4.1 Design Flow Criteria

Design flows for sewer systems consist of BWF, GWI, and RDI/I. Criteria for computing existing BWF, GWI, and RDI/I (developed as part of model calibration), and flow assumptions for future development were discussed in the previous chapters. Note that for capacity analysis purposes, base wastewater flows assume rebound of approximately 15 percent from current flows.

For this Systems Evaluation Update, design RDI/I is based on a 10-year 24-hour synthetic rainfall pattern that occurs uniformly across the entire service area. The event used is the same event as used for the previous 2009 Systems Evaluation. The design storm hyetograph was developed utilizing Table 5-A-1 (elevation (h) = 150 feet) from the 1990 Placer County Flood Control and Water Conservation District Stormwater Management Manual (1990 Placer County Stormwater Management Manual). This event has a 1 hour peak intensity of 0.77 inches and a 24-hour rainfall depth of 2.97 inches. The peak rainfall hour was set at 6 a.m. so that the peak RDI/I response (which would normally occur about 1-2 hours after the rainfall for a typical basin) roughly coincides with the peak hour of the dry weather profiles to give a conservative flow response in the collection system. The intensity and timing of the design storm is presented in Figure 3-9.

It should be noted that current NOAA statistics (NOAA Atlas 14, updated in 2014) have a somewhat lower peak hour rainfall intensity, though slightly higher 24-hour rainfall depth (1 hour peak intensity of 0.65 and 24-hour depth of 3.35 inches). As the design event developed from the 1990 Placer County Stormwater Management Manual was likely to result in higher peak flows, and therefore more conservative estimate of system capacity, that design event was selected for this evaluation. NOAA Atlas 14 data confirms that design rainfall intensity does not vary significantly across the SPWA service area.

Figure 3-9: SPWA 10-year Design Storm Event



3.4.1.1 Summary of Flows Under Design Storm

A summary of modeled flows based on the design flow criteria is included in Table 3-7.

Table 3-7: Modeled ADWF and Peak Wet Weather Flow Summary

	Existing (Rebound)			Buildout			Buildout-Sensitivity		
WWTP	BWF[a] (mgd)	ADWF (mgd)	PWWF[b] (mgd)	BWF[a] (mgd)	ADWF (mgd)	PWWF[b] (mgd)	BWF[a]	ADWF (mgd)	PWWF[b] (mgd)
Pleasant Grove	9.5	9.9	27.4	26.1	26.5	55.8	26.2	26.5	56.0
Dry Creek	10.1	12.7	41.9	16.7	19.2	59.2	18.2	20.8	60.6

Notes:

a. Does not include wet season groundwater infiltration (GWI).
b. Modeled PWWF assumes improvements have been implemented to eliminate overflows and significant surcharging.

3.4.2 Hydraulic Capacity Criteria

Capacity deficiency or performance criteria are used to determine when the capacity of a sewer pipeline is exceeded to the extent that a capacity improvement project (e.g., a relief sewer or larger replacement sewer) is required. Capacity deficiency criteria are sometimes called “trigger” criteria in that they trigger the need for a capacity improvement project. These criteria may differ from “design criteria” that are applied to determine the size of a new facility, which may be more conservative than the performance criteria. The 2009 Systems Evaluation identified several hydraulic capacity criteria:

- No surcharging in SPWA sewers, though exceptions were made where limited surcharging may occur in relatively deep pipes. Note that surcharging due to downstream conditions (i.e. backwater conditions) may not be considered a deficiency.

- Pump stations are considered capacity deficient if the design storm PWWF exceeds the pump station capacity with the largest pumping unit out of service (i.e. firm capacity).

- Force mains with velocities exceeding 7 feet per second under PWWF may require further investigation, though would not trigger a project unless the pump station required additional capacity.

As the current model is a calibrated fully-dynamic model, the design condition represents a relatively infrequent storm event, and many of SPWA’s sewers are relatively deep, a less conservative surcharge criteria was applied, with surcharging up to within 5 feet of the manhole rims (ground surface) considered acceptable under 10-year design storm PWWF, as long as the surcharge (flow height in the manhole) does not exceed 4 feet from the top of pipe up the manhole. The pump station and force main criteria from the 2009 Systems Evaluation were unchanged.

3.4.3 Capacity Analysis Results

The calibrated model was run for Existing, Buildout, and Buildout-Sensitive land use scenarios under the design event described above. Several deficiencies were identified in non-regional facilities which resulted in model-predicted overflows for one or more of the scenarios; to ensure flows were conveyed to regional sewers, pipes were upsized in this analysis to eliminate any overflows.

Within the regional system, seven areas have been identified that either have deficiencies or could be impacted when upstream deficiencies are relieved. Note that not all areas have been identified as having capacity deficiencies.

- Area A includes the sewers on Old Auburn Road immediately downstream and upstream of PS 26. This area is designed to divert flows above the springline of the sewer into PS 26. However, since PS 26 has insufficient firm capacity during peak wet weather flows, the sewers back up into the upstream sewers and results in a modeled overflow. This is an area of known capacity concerns. If flows through PS 26 were increased, the capacity issues in this area would be relieved.

- Area B includes the trunk sewer downstream of Area A from Old Auburn Road to SMH A06-257, which is where flow from PS 26 rejoins this trunk sewer. Note that there are two shallow manholes in this area that have less than 5 feet of cover (SMH A07-234 and SMH A07-091). Sewer depths should be investigated, and, if depths are confirmed, bolting manhole covers should be considered.

- Area C includes the trunk sewer downstream of Area B (from SMH A06-257) to the junction structure at Oak Ridge Drive. The junction structure at Oak Ridge Drive connects a 15-inch trunk (modeled, but not part of the regional system) to the main 33-inch trunk, but allows high flows to overtop a weir into a parallel 15-inch trunk sewer.

- Area D includes the 30-inch and 33-inch trunk sewer downstream of the Area C (from Oak Ridge Drive), to the 42-inch sewer near Riverside Age.

- Area E includes the 15 and 21-inch sewers from the Sierra College permanent meter to the weir structure adjacent to PS 25.

- Area F includes the area downstream of Area E, extending from PS 25 to the upstream manhole of Area C (SMH A06-257).

- Area G includes the gravity sewer downstream of PS 26, extending to the intersection with Area E.

Model results under Existing and Buildout conditions are summarized in Table 3-8 and shown in Figure 3-10 and Figure 3-11, respectively. The figures indicate existing trunk sewers that were predicted by the model to be surcharged (water levels in manholes above the crowns of the pipes) due to “throttle” conditions (peak flow exceeding full pipe capacity) or due to backwater from a downstream throttle condition, and locations of model-predicted overflows. Note that Figure 3-11 shows the results for both the Buildout and Buildout-Sensitivity scenarios (i.e. there is no difference in surcharge locations between the scenarios). In Table 3-8, areas that exceed the hydraulic capacity criteria but do not have modeled overflows are highlighted yellow, while areas with modeled overflows are highlighted orange. Hydraulic profiles for each area under existing and Buildout land use conditions are included in Appendix E.

Table 3-8: Capacity Results under Existing and Buildout Land Use Scenarios[a]

Area	Existing (with Rebound)			Buildout and Buildout-Sensitivity		
	Length of Throttle Surcharge (ft)	Maximum Surcharge Depth (ft)	Minimum Freeboard (ft)	Length of Throttle Surcharge (ft)	Maximum Surcharge Depth (ft)	Minimum Freeboard (ft)
A	5,530	7.3	0.0	5,530	7.8	0.0
B	3,369	1.9	2.0	3,948	7.7	0.0
C	522	1.0	7.4	6,009	6.4	2.8
D	700	1.1	8.6	4,220	3.3	6.4
E	--	--	--	2,223	3.1	5.6
F	--	0.9	12.2	1,716	7.3	2.2
G	--	--	--	0	2.3	3.3

a. Areas that exceed the hydraulic capacity criteria but do not have modeled overflows are highlighted yellow, while areas with modeled overflows are highlighted orange.

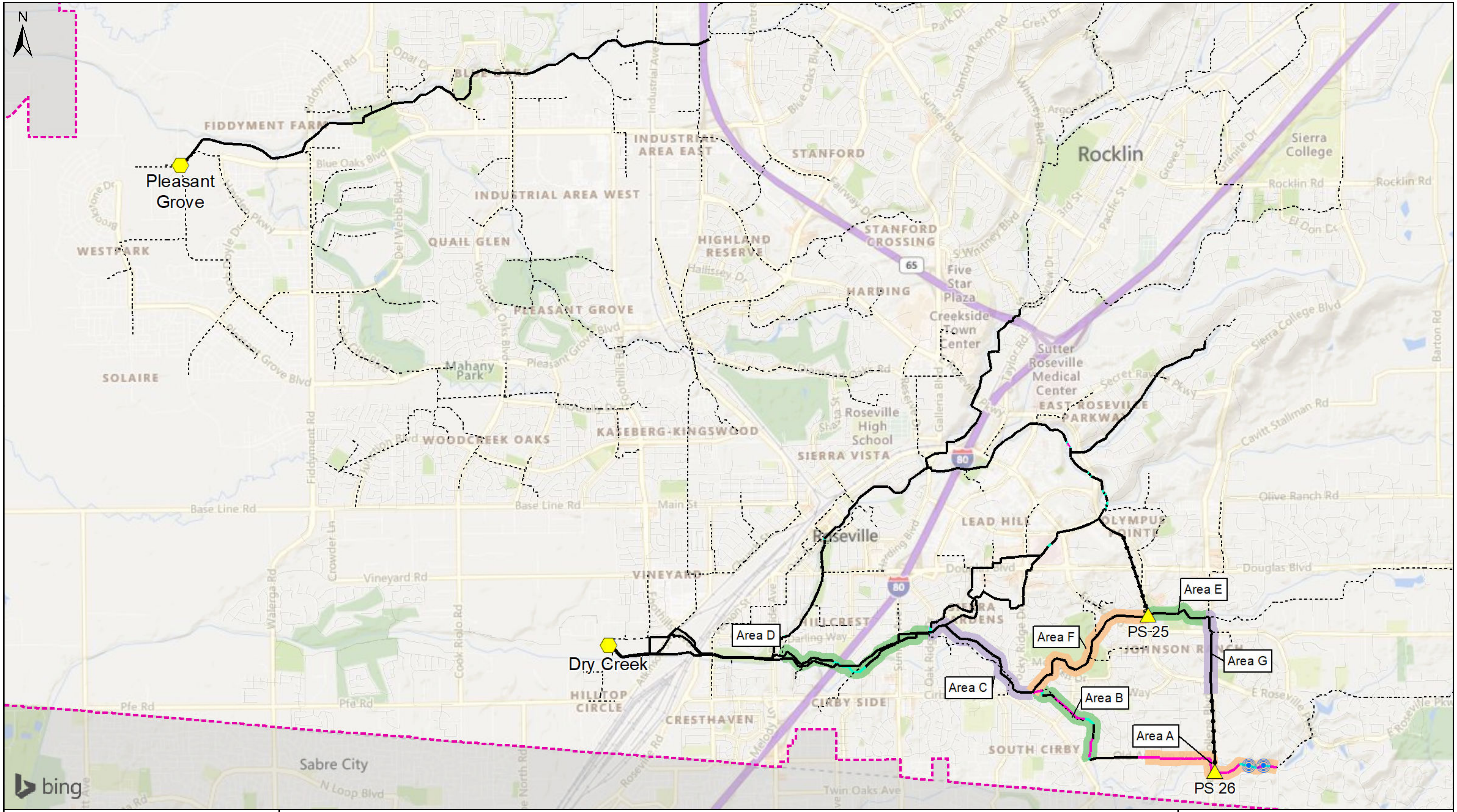


Figure 3-10
Model Results (Existing PWWF)

South Placer Wastewater Authority
2020 Systems Evaluation

0 ¼ ½ 1
Miles

- ━ Regional Gravity Sewer
- ━●━ Force Main
- ----- Non-Regional Modeled Sewer
- ━ Backwater Surcharge
- ━ Throttle Surcharge
- ◉ Modeled Sewer Overflow
- ▨ Deficiency Area
- ⬚ Ultimate Service Area Boundary

Project #: 0011183.00
Map Created: December 2020

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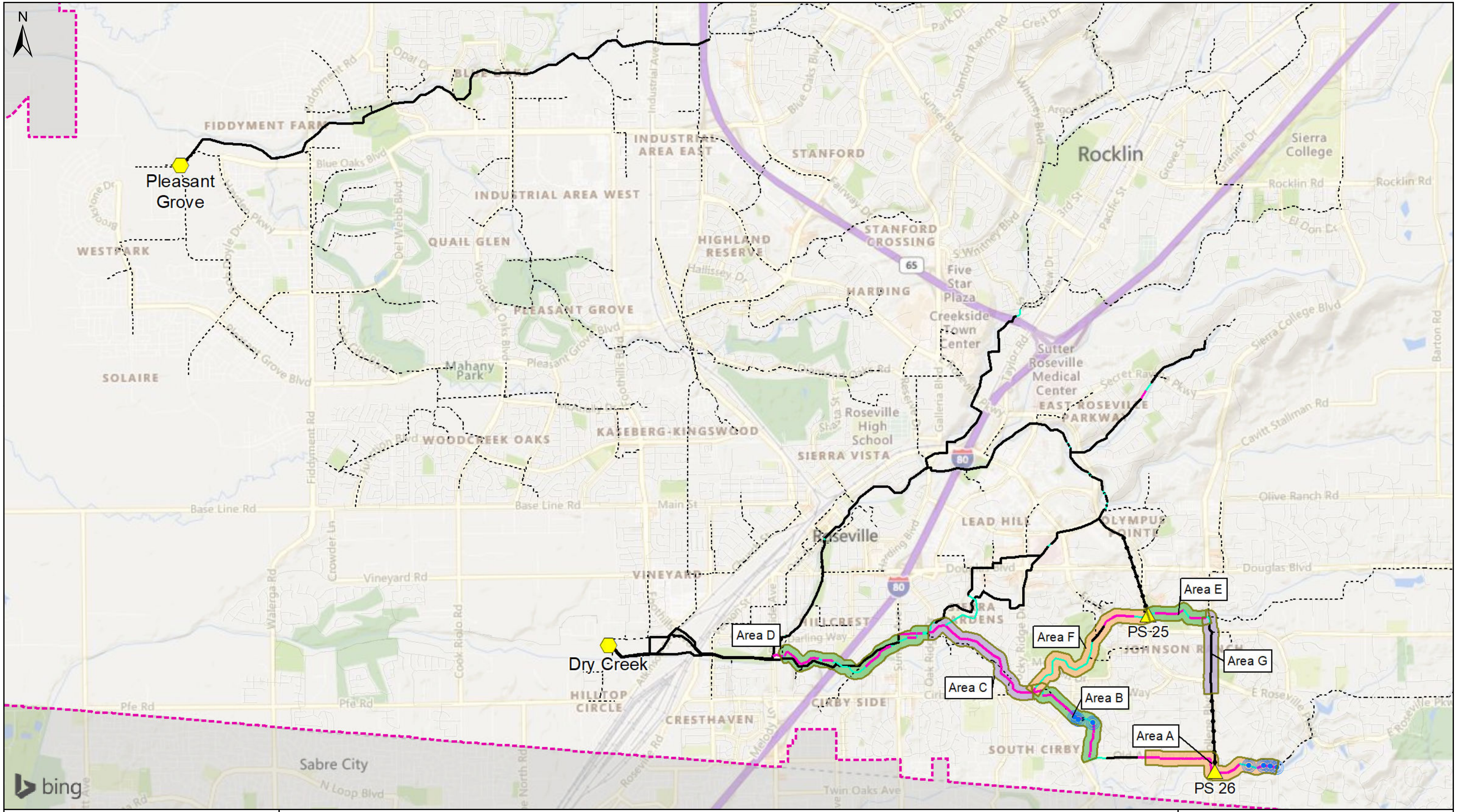

Figure 3-11

Model Results (Buildout and Buildout Sensitivity PWWF)

South Placer Wastewater Authority
2020 Systems Evaluation

Project #: 0011183.00
Map Created: December 2020

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3.5 Proposed Improvements

Proposed improvement projects have been developed, and verified using the hydraulic model, to alleviate surcharge in the areas described in the previous section. Each proposed project was reviewed on aerial mapping to identify potential design and constructability issues. Preliminary estimates of probable construction costs were prepared.

This section discusses these proposed improvements as well as the criteria used to develop them and estimate costs. The projects are considered planning level, and further pre-design of each project is recommended prior to implementation.

3.5.1 Design Criteria for New Sewer Facilities

Section 9 of the City of Roseville Design Standards (January 2019) details criteria for Sanitary Sewer Design. These criteria are used during the development of new standards and applied to any new infrastructure.

3.5.1.1 Gravity Sewers

Below is a list of select City design standards for gravity sewers. See Section 9 of the Design Standards for a full listing of criteria.

- Minimum slopes and flow capacities summarized below

Pipe Diameter (in)	Slope (ft/ft)	Capacity (at 0.7 Depth)	Capacity Flowing Full
6	0.0050	0.22 MGD	
8	0.0035	0.38 MGD	
10	0.0025	0.58 MGD	
12	0.0020	0.85 MGD	1.00 MGD
15	0.0015	1.32 MGD	1.60 MGD
18	0.0012	1.95 MGD	2.35 MGD

- Maximum allowable depth-to-diameter ratio (d/D) of 0.7 at design flow for laterals 10 inches or less. Pipes 12" or greater may be designed to flow full unless connections are planned, in which case the 0.7 depth-to-diameter ratio governs.
- Flow velocities must be between 2 feet per second and 10 feet per second.
- Maximum bury depth of main with lateral connection shall be 15 feet. Minimum slope of lateral connection shall be ¼ inch per foot with a minimum bury depth of 12 inches at any buildable location within the properties to be served.
- Maximum spacing of manholes shall be 500 feet for all straight lines of 10 inches in diameter or less. Manhole spacing for mains 12 inches and larger shall be considered on a case by case basis.
- The invert elevation for pipe of the same diameter entering a manhole shall have a 0.10-foot drop between the entering and exiting pipe and invert elevations for pipe of different diameters shall match crown of exiting pipe. The crown of the entering pipe shall be at the same elevation or higher than the exit pipe.
- Drop connections shall be permitted under special conditions and with the approval of the Environmental Utilities Director

3.5.1.2 Pump Stations and Force Mains

Below is a list of select City design standards for pump stations and force mains. See Section 9 of the Design Standards for a full listing of criteria.

- A sufficient number of centrifugal pumping units shall be installed such that station capacity can be maintained with any one unit out of service.
- Provisions for 4 hour storage capacity shall be provided.
- Planning level criteria as follows:

Pump Stations	
Capacity	PWWF (hydraulic modeling required for pipes 18 inches and larger)
Storage	4 hours
Operation	Lead/lag for duty pump(s), plus 1 standby pump
Maximum Pump Cycles	6 cycles/hour (3 cycles per pump)
Force Mains	
Headloss	Hazen-Williams roughness coefficient (C-factor) of 120
Maximum Velocity	7-10 feet per second
Minimum Velocity	3.0 feet per second

3.5.2 Cost Criteria

Opinions of probable costs for proposed capacity improvement projects were developed based on Woodard & Curran's experience with similar projects and discussions with product vendors. The estimated construction costs are based on a Class 4 estimate as defined by the Association for the Advancement of Cost Engineering (AACE) International cost estimate classification system. Table 3-9 provides a summary of the estimate classes and expected accuracy range. For Class 4 estimates, the expected accuracy range is -15% to -30% on the low end and +20% to +50% on the high end.

Table 3-9: Cost Estimate Classification Matrix (AACE International)

Estimate Class	Level of Project Definition	Purpose of Estimate	Methodology	Expected Accuracy Range
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgement, or analogy	Low: -20% to -50% High: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	Low: -15% to -30% High: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	Low: -10% to -20% High: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	Low: -5% to -15% High: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-cost	Low: -3% to -10% High: +3% to +15%

Source: AACE International Recommended Practice No. 18R-97

These estimates are suitable for use for budget forecasting, CIP development, and project evaluations, with the understanding that refinements to the project details and costs would be necessary as projects proceed into the design and construction phases. All costs have been adjusted to an Engineering News Record Construction Cost Index (ENR CCI) of approximately 12,115, which represents the average of the April 2020 ENR CCI for “20 Cities Average” and “San Francisco” indices.

Cost criteria include baseline unit construction costs for gravity sewers using open-cut methods. Pipe bursting is sometimes a more cost-effective option for projects that involve upsizing existing sewers to 15-inch diameter or smaller; this construction method could be considered during design. Costs for gravity trunk sewers vary with pipe diameter and depth (in the case of open-cut construction). Allowances added to the baseline construction cost include mobilization/demobilization and project-specific for remove and replace construction and traffic control for work in roadways. A 30 percent allowance for contingencies for unknown conditions was also included for all projects, as well as an allowance of 25 percent of construction cost for engineering, administration, and legal costs. For pump stations, costs include site work, mechanical and electrical equipment specific to each station.

3.5.3 Proposed Capacity Improvement Project Descriptions

Improvement projects were developed as a series of improvements that sequentially decrease surcharging in downstream sewers. These improvement projects, including estimated capital improvement costs, are discussed below and summarized in Table 3-10 and shown in Figure 3-12. Individual improvement project cost estimate details as well as detailed project figures are provided in Appendix F.

3.5.3.1 Improvement Project 1

Improvement Project 1 would increase the capacity of PS 26 (Sierra College Boulevard PS) as needed to limit surcharging in the Old Auburn Trunk sewer (Area A and Area B). The weir leading to PS 26 would be unchanged and would divert flows when depth in the sewer exceeds half the sewer diameter. Because this project would substantially increase flows through the sewer on Sierra College Boulevard (Area G), this project also includes upsizing those pipelines to 10, 12, and 15-inch sewers to eliminate surcharging in that line.

PS 26 will need to be modified to meet the increased firm capacity, from 0.43 mgd to 1.6mgd. If the existing wet well is large enough, it could be retrofitted with new, higher flow pumps. The existing wet well at PS 26 is 8 feet in internal diameter. Updated design criteria were provided to a Flygt pump representative and, based on the minimum wet well sizing for their recommended pump selection, the existing wet well is sufficiently large to be reused with a larger pump.

The pump selection provided should be considered preliminary. Given the high total pump station head and large motor of the resulting pump selection, an evaluation of alternatives to reduce the pump size, via upsizing the discharge force main for example, should be considered during pre-design. A life cycle cost analysis may be appropriate to compare the difference between the additional headloss and resulting pumping costs versus the cost to upsize the force main.

3.5.3.2 Improvement Project 2

Improvement Project 2 would re-route the sewer on Sierra College Boulevard east on Eureka and reconnect to the regional trunk at East Roseville Parkway (Area F). This would relieve surcharge in Area E. Excess flows resulting in surcharge in Area F would be diverted through PS 25 to the northern sewershed, which does not have capacity concerns. The preliminary project would upsize existing 8 and 10-inch sewer on Eureka Road and E Roseville Parkway. Since the connection is about 100 feet downstream of the PS 25 diversion structure, this improvement project may increase flows (and associated surcharge) in Area F (unless adjustments are made to the PS 25 diversion structure, as discussed in Improvement Project 3).

3.5.3.3 Improvement Project 3

Improvement Project 3 would alter the piping and diversion structure in the vicinity of PS 25 (Rollingwood PS) to convey additional flow away from Area C, Area D, and Area F, and increase the capacity of PS 25 as needed to accommodate the additional flow. For this improvement project, the diversion structure would be converted to divert any flows exceeding peak dry weather flow (up to approximately 2.6 mgd with buildout land uses under peak wet weather conditions),. It should be noted that the 2009 Systems Evaluation assumed diversion of 3.2 mgd through PS 25 with buildout land uses under peak wet weather conditions.

A new junction structure would need to be installed at E Roseville Parkway (or the existing junction structure would need to be relocated) in order to capture the additional flows.

PS 25 would need to be modified to meet the increased firm capacity. If the existing wet well is large enough, it could be retrofitted with new, higher flow pumps. The existing wet well at PS 25 is 10 feet in internal diameter. Updated design criteria were provided to a Flygt pump representative and, based on the minimum wet well sizing for their recommended pump selection, the existing wet well could be reused.

Table 3-10: Proposed Capacity Improvement Projects

Project	Location	Existing Sizes	Improved Sizes[a]	Description	Estimated Capital Improvement Cost
1	PS 26	0.43 mgd firm capacity	1.6 mgd PWWF at Buildout	Increased Capacity of PS 26 and sewers on Sierra College Blvd directly downstream of PS 26 to relieve Old Auburn Trunk sewer (Area A)	$1,606,000
	Sierra College Blvd (Area G)	500 ft of 8-inch 1,900 ft of 10-inch	500 ft of 10-inch (upsized from 8-inch) 900 ft of 12-inch (upsized from 10-inch) 1,000 ft of 15-inch (upsized from 10-inch)		
2	Eureka Road and E. Roseville Parkway	800 ft of 8-inch 1,400 ft of 10-inch	2,200 of 15-inch (upsized from 8 or 10-inch) 1,200 ft of new 15-inch.	Redirect flows from PS 26 and Sierra College Blvd down Eureka Road to relieve Area E.	$1,831,000
3	PS 25 (pumps)	2.02 mgd firm capacity	2.6 mgd PWWF at Buildout	Increased Firm capacity of PS 25 to meet Buildout PWWF (depends on alternative). New weir structure or adjustments to existing structure at PS 25 to convey the maximum potential flow through PS 25 without any dry weather flows.	$758,000
	PS 25 diversion structure	N/A	New diversion structure and related piping		

Notes:

a. Note that pipeline capacity increases could be accomplished through parallel pipes, rather than upsizes.

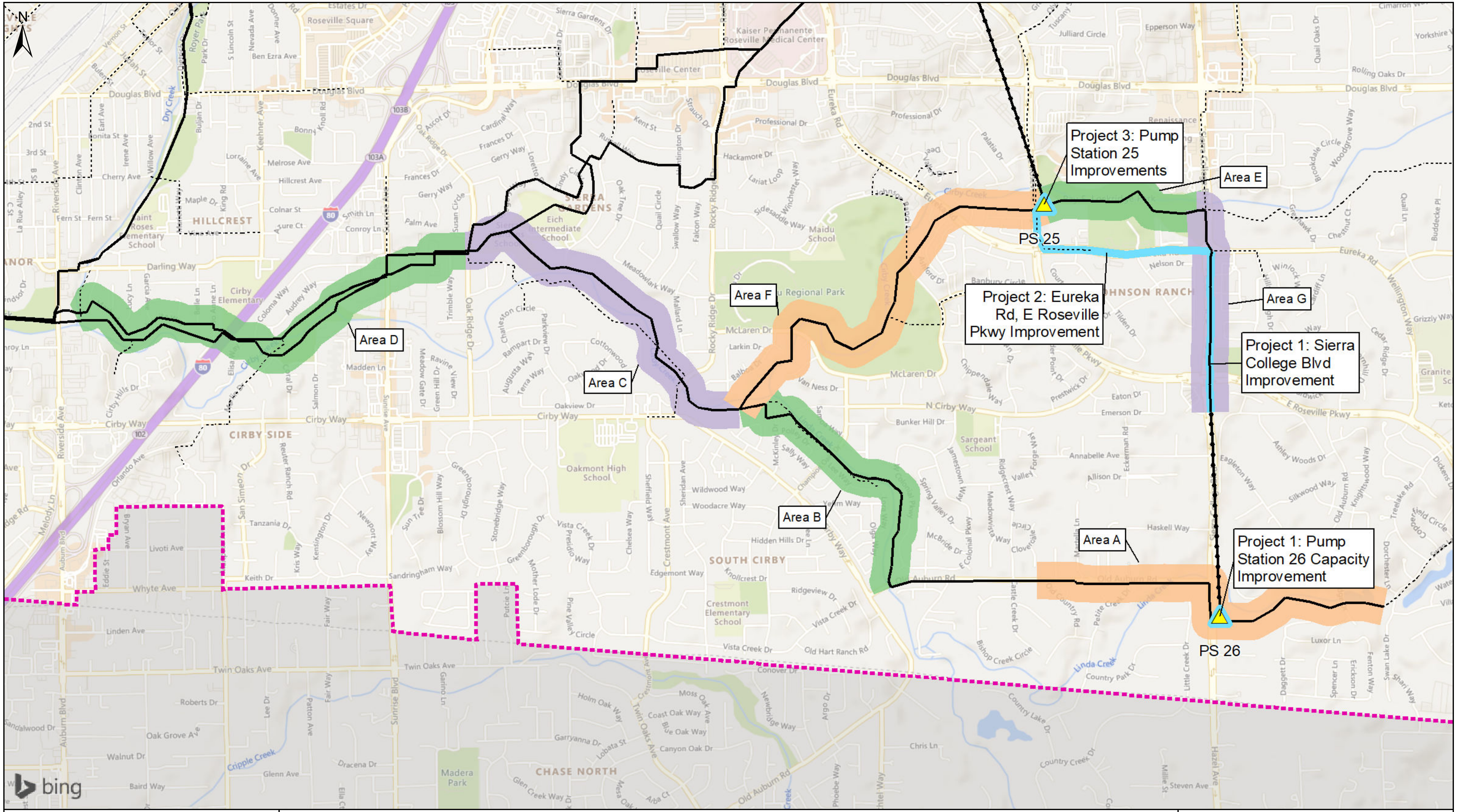

Figure 3-12
Proposed Improvement Locations

South Placer Wastewater Authority
2020 Systems Evaluation

0 0.125 0.25 0.5 Miles

—	Regional Gravity Sewer
—●—	Force Main
┈	Non-Regional Modeled Sewer
△	Pump Station
🟦	Preliminary Capacity Improvement Area
▨	Deficiency Area
⬚	Service Area Boundary

Project #: 0011183.00
Map Created: December 2020

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3.5.4 Timing of Proposed Improvement Projects

While Project 1 is needed for current demands, Project 2 and Project 3 are expected to be triggered by future development. For the purpose of this Systems Evaluation, an approximate number of equivalent dwelling units upstream of the capacity deficiency that would trigger the need for a project has been estimated by applying a reduction factor to future flows to represent percentage of buildout. Nearly all of the future growth that would trigger the projects would occur in SMD-2 and SMD-3 (with less than 100 EDUs of future growth anticipated for SPMUD and Roseville). Based on the SMD2 and SMD3 growth projections provided by Placer County, this would occur beyond the 2060 planning horizon provided.

The timing estimated here is subject to change, and could be impacted by the following assumptions:

- Inflow and Infiltration rates for existing sewers are assumed to remain approximately the same. These rates could change based on pipe condition and maintenance activities (such as rehabilitation and repair) in the collection system.
- Inflow and Infiltration rates for new sewers are assumed based on typical values. Actual I/I rates could be higher or lower than assumed.
- The estimates are based on an assumed rebound of dry weather flows to 190 gpd per EDU. If dry weather flows do not rebound, the timing for Project 2 and Project 3 could be somewhat delayed.

Future studies should monitor the I/I rates and update these estimates as needed. The number of EDUs in SMD2/SMD3 that would trigger the proposed project are summarized in Table 3-11.

Table 3-11: Timing of Proposed Capacity Improvement Projects

Project	Description	Estimated Capital Improvement Cost	Approximate Additional EDUs in SMD2/SMD3 to Trigger Project[a]
1	Increased Capacity of PS 26 and sewers on Sierra College Blvd directly downstream of PS 26 to relieve Old Auburn Trunk sewer (Area A)	$1,606,000	Existing
2	Redirect flows from PS 26 and Sierra College Blvd down Eureka Road to relieve Area E.	$1,831,000	~1,800[b]
3	Increased Firm capacity of PS 25 to meet Buildout PWWF (depends on alternative). New weir structure or adjustments to existing structure at PS 25 to convey the maximum potential flow through PS 25 without any dry weather flows.	$758,000	~1,800[c]

Notes:

a. Based on a percentage of buildout factor applied to future model loads.

b. Represents approximately 60% of buildout. There are approximately 8,400 Existing EDUs upstream of the deficiency triggering Improvement Project 2, and approximately 10,200 EDUs would trigger the need for improvement.

c. Represents approximately 60% of buildout. There are approximately 11,900 Existing EDUs upstream of the deficiency triggering Improvement Project 3, including 7,600 in Placer County, 4,200 in Roseville, and less than 100 in SPMUD. Approximately 13,700 EDUs would trigger the need for the improvement.

4. WASTEWATER TREATMENT PLANT EXPANSION EVALUATION

4.1 Introduction

Based on the updated growth projections provided by the SPWA partners through fiscal year 2059-2060 and at buildout, this section provides facility expansion recommendations for Dry Creek Wastewater Treatment Plant (DCWWTP) and Pleasant Grove Wastewater Treatment Plant (PGWWTP), which treat the entirety of flows from the SPWA service area. The recommendations address timing, phasing, and preliminary conceptual costs of the expansions required through buildout to address both flows and loads, as well as identifying next steps for confirming current plant capacity to accurately reflect recent and ongoing capital improvements.

The analysis provides updates to the following flow and loading parameters for DCWWTP and PGWWTP:

- Flows: existing and projected influent flow through buildout:
    - Average Dry Weather Flow (ADWF)
    - Average Annual flow (AA)
    - Peak Month Flow (PMF)
    - Peak Day Wet Weather Flow (PDWWF)
    - Peak Hour Wet Weather Flow (PHWWF)
- Loads: existing and projected influent loads through buildout:
    - Biochemical Oxygen Demand (BOD), Annual Average (AA) and Maximum Month (MM)
    - Total Suspended Solids (TSS), AA and MM
    - Ammonia (NH_3), AA and MM

4.1.1 Dry Creek Wastewater Treatment Plant

Much of the DCWWTP was constructed in 1974 and was expanded in 1991 to treat an ADWF of 18 mgd. In June of 2004, a portion of the influent flow was diverted to the newly constructed PGWWTP, freeing up some treatment capacity at the time. Recently, nutrient removal upgrades were completed at DCWWTP to ensure reliable compliance with the NPDES permit limits (including the 10 mg/L average monthly limit for nitrate plus nitrite).[1] Currently, the flow meter on the discharge of the Influent Pump Station is being modified to increase the PHWWF hydraulic capacity to 36 mgd.

Population in the SPWA service area has continued to grow steadily, with loadings increasing substantially while ADWF decreased. The ADWF at DWWTP has decreased from 10.5 mgd in 2009to approximately 8.6 mgd as of 2019.

Equally as important as the hydraulic capacity of a plant is its biological treatment capacity. Design of the 1991 expansion of the plant was based on an influent BOD concentration of 160 mg/L, and the corresponding AA and MM loadings of 24,000 lbs/day and 36,000 lbs/day. Since 1991, the influent BOD concentration has increased to 425 mg/L, resulting in much higher BOD loadings than in previous projections. The impact of higher influent BOD concentration and loadings is discussed in Section 4.3.1.

A schematic of the DCWWTP liquid and solids treatment train is shown in Figure 4-1.

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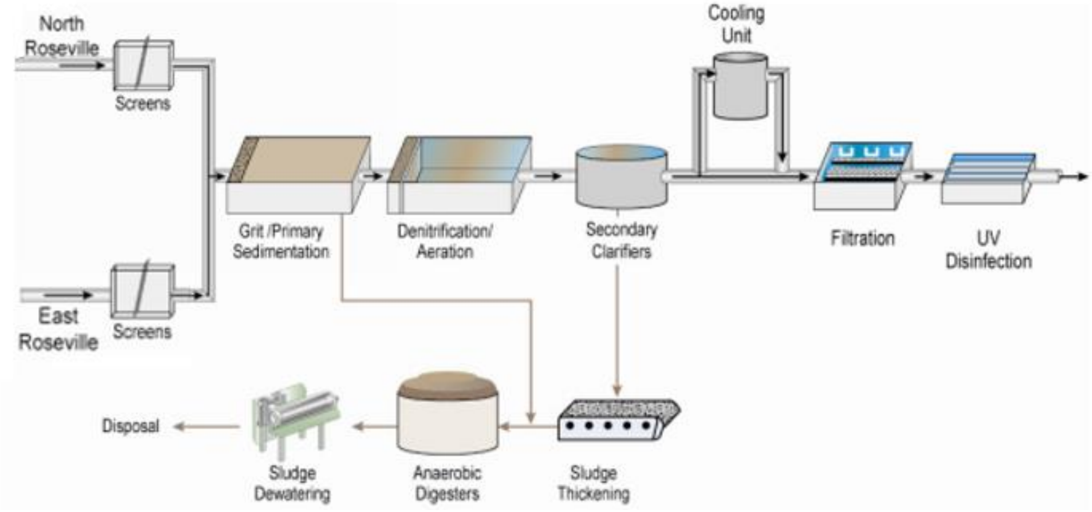
[1] Source: City of Roseville, DCWWTP Nitrate Reduction Improvements Project, Basis of Design Report (May 2017).

Figure 4-1: DCWWTP Treatment Schematic



4.1.2 Pleasant Grove Wastewater Treatment Plant

Construction of the PGWWTP was completed in 2004. It was designed for an ADWF of 12 mgd, assuming historical domestic strength wastewater, similar to the Dry Creek Plant. Subsequent study of the plant's treatment processes and influent loading resulted in PGWWTP's capacity being lowered to an equivalent flow of 9.5 mgd. Like the DCWWTP, this was partially a result of influent BOD concentrations trending much higher over time than anticipated in the initial design. Current ADWF is approximately 7.6 mgd with an average influent BOD concentration of 358 mg/L.

To ensure the plant can reliably treat 12 mgd ADWF at the current higher loadings, an expansion project is currently underway, with anticipated completion/commissioning by fiscal year (FY) 22/23.[1] The expansion will add a primary sedimentation process to the liquid treatment train, which currently includes influent screening and grit removal, secondary treatment/denitrification in oxidation ditches, secondary clarification, filtration, and disinfection. The solids treatment process is being upgraded with sludge thickening using rotary drum thickeners and anaerobic digestion of the combined thickened secondary sludge and primary sludge, upstream of the existing dewatering centrifuges (which currently dewater only the secondary sludge). These upgrades will provide additional solids treatment capacity as well as biological treatment capacity. Figure 4-2 shows a schematic of the PGWWTP treatment train reflecting the upgrades currently under construction.

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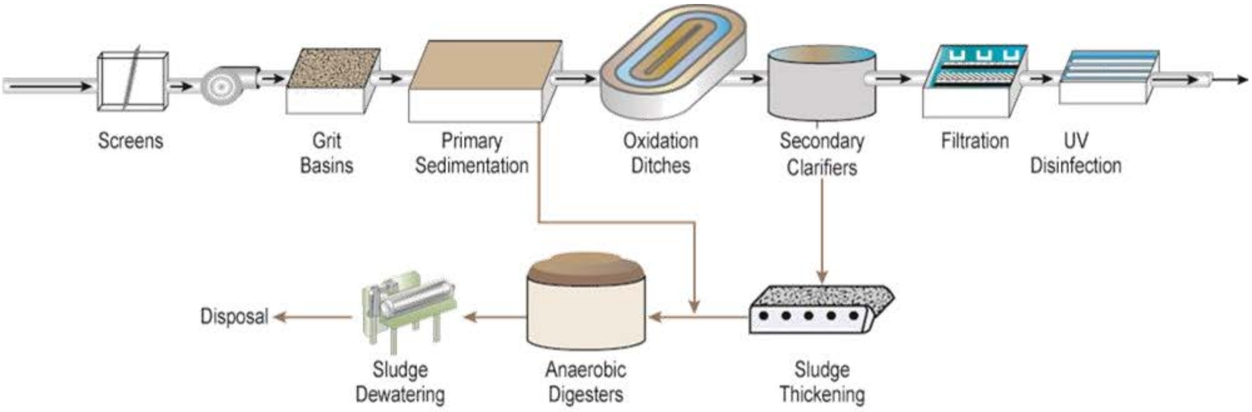
[1] Source: City of Roseville, PGWWTP Expansion Basis of Design Report (March 2016).

Figure 4-2: PGWWTP Treatment Schematic



4.2 Flows and Loadings

Influent flows and loading (organic loading as measured by BOD and solids loading as measured by TSS) for both the DCWWTP and PGWWTP were established by analyzing daily plant influent data provided by the City of Roseville for the period from January 1, 2016 through September 19, 2019 for influent flow and from January 1, 2013 through September 19, 2019 for loadings. In addition, hourly flow data from December 1, 2016 to September 17, 2019 (which incorporated high winter flow periods) was used to establish peak hour flows.

Projected flows for both the DCWWTP and PGWWTP were calculated based on population and non-residential growth, normalized to account for diversity in land uses by establishing equivalent dwelling units (EDUs). EDU projection data were provided by each of the SPWA JPA Partners (City of Roseville, Placer County, and South Placer Municipal Utility District)[1]. Flow projections were developed by multiplying the projected EDUs by an ADWF contribution of 190 gallons per day (gpd) per EDU, in accordance with the estimate developed in the 2009 Systems Evaluation.

4.2.1 Current Flows and Peaking Factors

Current ADWF was established by averaging flows observed at each plant for the period of July through September. While the ADWF is usually thought of as the rated capacity of a treatment plant, the design of treatment systems must also accommodate significant seasonal and diurnal variations in influent flow. A treatment plant must be designed to prevent hydraulic overloads and wash out of solids during peak day and peak hour events. Generally, preliminary and primary treatment systems are sized for peak day or peak hour flow, while secondary treatment systems must meet maximum month organic loading peaks. Sizing treatment processes appropriately aids treatment plants in meeting discharge limits during the higher flows and loading periods that can otherwise stress or overwhelm the plant processes.

Current flow conditions and the associated peaking factors for both plants are summarized in Table 4-1.

---

[1] Data provided on July 2019 for Placer County, August 2019 for SPMUD, and November 2016 for the City of Roseville

Table 4-1: Current Flows and Peaking Factors

Flow Condition	DCWWTP		PGWWTP	
	Current Flow, mgd	Peaking Factor	Current Flow, mgd	Peaking Factor
ADWF	8.6	1.0	7.6	1.0
AA	10.8	1.2	8.1	1.07
PMF	18.4	2.12	10.3	1.36
PDWWF	27.9	3.22	16.9	2.23
PHWWF	36.0	4.19	20.4	2.69

It should be noted that the current plant data reflect a significantly lower flow contribution per EDU than the previously established unit flow factor of 190 gpd/EDU. Approximately 57,747 EDUs are tributary to DCWWTP for FY 19/20. Based on the current ADWF, the equivalent unit flow contribution is approximately 150 gpd/EDU. At PGWWTP, there are approximately 54,907 EDU tributary to the plant for FY19/20, which reflects a flow contribution of 138 gpd/EDU. This is likely the result of several factors, including water conservation efforts over the past decade, drought conditions that were experienced throughout California from 2011-2016, and lower levels of development than previously anticipated prior to the impacts of the recession in 2008-2009.

These flow contributions per EDU may rebound back to historical levels and, to provide a safety factor, the 190 gpd/EDU will continue to be used for this analysis. This unit flow factor should be tracked closely and, if warranted, the per EDU value adjusted accordingly over time.

4.2.2 Projected Plant Influent Flows

Future plant flows were projected over the planning horizon to fiscal year 2059-2060 (FY 59/60)[1] and to ultimate buildout conditions, based on the information provided in Chapter 2. ADWF projections at FY 59/60 and buildout are calculated by multiplying the EDU projection by the flow contribution per EDU. Peaking factors from Table 4-1 were then applied to established ADWF per EDU based on current flows (138 gpd/EDU at PGWWTP and 150 gpd/EDU at DCWWTP) and added to ADWFs difference calculated from 190 gpd/EDU and current ADWF/EDU to project the additional flow conditions. This approach avoids using peaking factors on projected ADWF calculated from 190 gpd/EDU for a more realistic flow estimate. These flows are summarized in Table 4-2 and Table 4-3.

Table 4-2: Projected FY 59/60 and Buildout EDUs and Flows at DCWWTP

Condition	DCWWTP			
	FY 59/60 EDU	FY 59/60 Flow, mgd	Buildout EDU	Buildout Flow, mgd
ADWF	87,772	16.7	96,000	18.2
AA	---	19.9	---	21.8
PMF	---	31.5	---	34.4
PDWWF	---	45.9	---	50.2
PHWWF	---	58.6	---	64.1

---

[1] SPWA's fiscal year runs from July 1 to June 30.

Table 4-3: Projected FY 59/60 and Buildout EDUs and Flows at PGWWTP

Condition	PGWWTP			
	FY 59/60 EDU	FY 59/60 Flow, mgd	Buildout EDU	Buildout Flow, mgd
ADWF	92,864	17.6	145,000	27.6
AA	---	18.6	---	29.0
PMF	---	22.2	---	34.8
PDWWF	---	33.4	---	52.3
PHWWF	---	39.3	---	61.5

4.2.3 Current BOD Loadings

In previous studies, design parameters were established based on much lower influent BOD concentrations, ranging from 248 mg/L at DCWWTP to 285 mg/L at PGWWTP. The plant data set provided for this TM (which is an extended data set from 2013-2019) indicates an average influent BOD concentration of 425 mg/L at DCWWTP, and 358 mg/L at PGWWTP. The range in influent BOD concentrations at both plants are shown in Figure 4-3 and Figure 4-4.

Figure 4-3: Influent BOD Concentrations at DCWWTP

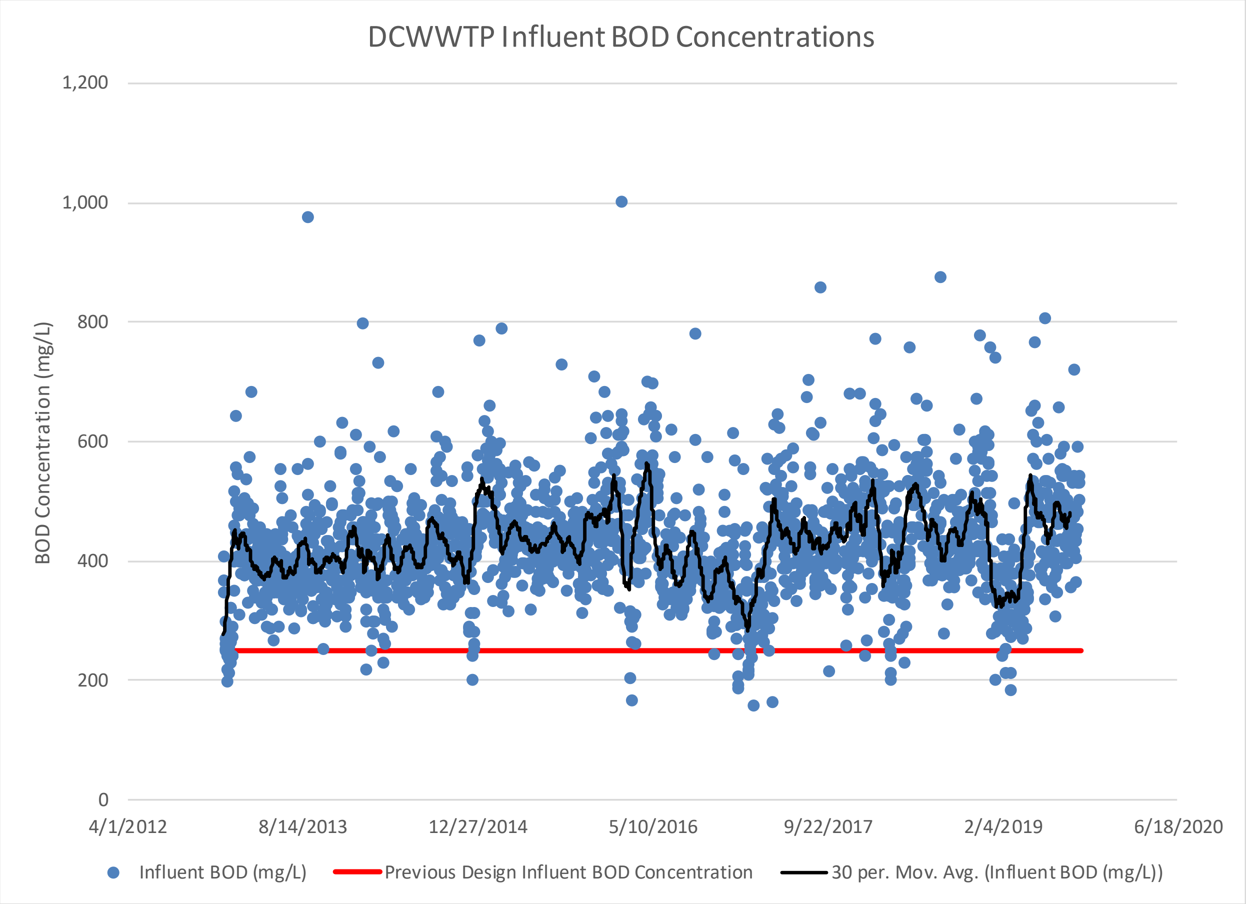
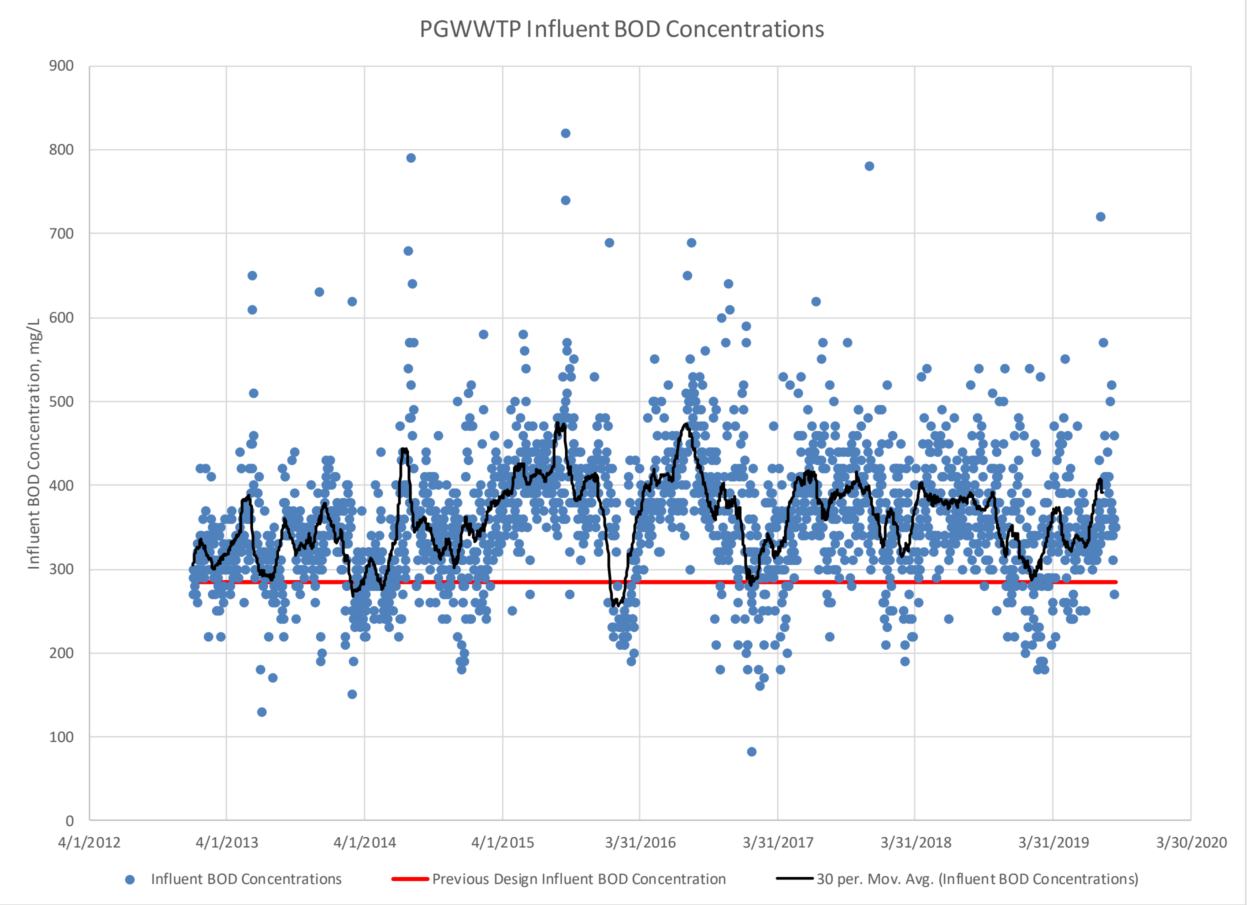


Figure 4-4: Influent BOD Concentrations at PGWWTP



These higher concentrations are likely a result of water conservation efforts over the past decade, combined with the drought conditions that were experienced throughout California from 2011-2016, though the relatively high concentrations at DCWWTP should be confirmed. The effect of conservation is on top of the demographic changes in the SPWA service area since the treatment plants were designed that brought much more commercial flows and loadings along with changing development patterns, such that the strength of the wastewater at both plants evolved from low strength domestic wastewater to moderate strength commercial wastewater, influenced by more food service, restaurant, brewery and other contributions.

A 30-day moving average of influent BOD concentrations is also shown on these figures. This moving average shows that current influent concentrations are now holding relatively constant, though they are higher than previous designs accounted for. This is an indication that influent BOD concentrations have now leveled off, however we recommend the SPWA monitor this parameter in the long term. When the State experiences another drought or there are changes to land use within the service area such as densification, influent loading concentrations may increase further.

4.2.4 Current and Projected Plant Influent Loadings

The January 1, 2013 through September 19, 2019 data set also included daily influent plant loadings for BOD, TSS, and NH_3. These data were analyzed to establish current annual average (AA) and maximum month (MM) pollutant loadings. Current MM loadings were established by taking the maximum value of a 30-day running average of the daily influent data provided. The peaking factors for each parameter were established by dividing the MM loading by the AA loading.

Projected loads, shown in Table 4-4 and Table 4-5, were calculated by using the average loadings from the data set provided and establishing AA loading per EDU. Peaking factors were then applied to establish the FY 59/60 and buildout MM loads.

Table 4-4: Current and Projected Influent Loading at DCWWTP

Parameter	Condition	Unit	DCWWTP			
			Current	FY59/60	Buildout	Peaking Factor
BOD	Average Concentration	mg/L	425	---	---	---
	AA Loading	lbs/day	33,900	52,000	56,000	---
	MM Loading	lbs/day	47,600	73,000	79,000	1.41
TSS	Average Concentration	mg/L	540	---	---	---
	AA Loading	lbs/day	42,800	65,000	71,000	---
	MM Loading	lbs/day	60,800	92,000	101,000	1.42
NH_3	Average Concentration	mg/L	23	---	---	---
	AA Loading	lbs/day	1,800	2,800	3,100	---
	MM Loading	lbs/day	2,500	4,000	4,200	1.35

Table 4-5: Current and Projected Influent Loading at PGWWTP

Parameter	Condition	Unit	PGWWTP			
			Current	FY59/60	Buildout	Peaking Factor
BOD	Average Concentration	mg/L	358	---	---	---
	AA Loading	lbs/day	22,400	38,000	60,000	---
	MM Loading	lbs/day	28,000	48,000	75,000	1.25
TSS	Average Concentration	mg/L	291	---	---	---
	AA Loading	lbs/day	18,100	31,000	48,000	---
	MM Loading	lbs/day	26,400	45,000	70,000	1.46
NH_3	Average Concentration	mg/L	40	---	---	---
	AA Loading	lbs/day	2,400	4,100	6,400	---
	MM Loading	lbs/day	2,700	4,600	7,100	1.11

4.3 Plant Capacity Comparison and Expansion Phasing

This comparison of current plant capacity and projected future flows and loads accounts for only hydraulic and carbonaceous BOD treatment capacity because these parameters have driven capacity expansion timing in the past. Potential nutrient removal requirements have not been considered in expansion timing and phasing. Evaluation of plant capacity with respect to TSS and ammonia removal should be incorporated into a subsequent analysis of plant capacity. Existing plant capacity was provided in the following documents:

- South Placer Regional Wastewater and Recycled Water Systems Evaluation, RMC Water and Environment, December, 2009
- Technical Memorandum 4b: Wastewater Treatment Plants Expansion Requirements (TM 4b), RMC Water and Environment, March 28, 2006
- DCWWTP Initial Assessment Final Report, CH2M Hill, Inc, August 2008
- Final Pleasant Grove Wastewater Treatment Expansion Basis of Design Report, Kennedy/Jenks Consultants, March 2016
    - Executive Summary
    - Technical Memorandum No. 1: Influent Flow and Load Characteristics and Projections, Pleasant Grove Wastewater Treatment Plant

- City of Roseville, Dry Creek Wastewater Treatment Plant, Influent Pump Station Hydraulic Analysis, Waterworks Engineers, March 2018.

Current loading capacities at each plant based on these documents are summarized in Table 4-6.

Table 4-6: Current Hydraulic and Organic (BOD) Capacities at DCWWTP and PGWWTP

Plant	DCWWTP Existing	PGWWTP	
		Existing	FY 22-23[a]
ADWF Hydraulic Treatment Capacity, mgd	18[b]	12[b]	12[a,c]
Biological Treatment Capacity, AA BOD Loading, lbs/day	26,200[d]	22,000[b]	34,500[c]
Biological Treatment Capacity, MM BOD loading, lbs/day	32,500[d]	N/A	40,100[c]

Notes:

a. Plant improvements that expand treatment capacity at PGWWTP are currently under construction and are expected to be in service by FY 22-23. Capacity comparisons in this TM take this into consideration.

b. Permitted plant capacity and capacity documented in the South Placer Regional Wastewater and Recycled Water Systems Evaluation, RMC Water and Environment, December 2009.

c. Source: Table 1.1, Technical Memorandum No. 1: Influent Flow and Load Characteristics and Projections. Final Pleasant Grove Wastewater Treatment Expansion Basis of Design Report, Kennedy/Jenks Consultants, March 2016

d. Source: Table 5-1, DCWWTP Initial Assessment Final Report, CH2M Hill, Inc, August 2008

The plant data show that current BOD loadings are higher than the BOD treatment capacities estimated in the reference documents at both plants (marginally higher at Pleasant Grove). However, according to City staff, the plants have consistently been in compliance with their NPDES discharge permits. This suggests that the actual plant capacities are beyond their nominal design capacity with respect to BOD. Additionally, it is unclear to what extent interim improvements such as the Nitrate Reduction Improvements project at DCWWTP have affected the plant capacity. For the purposes of this TM, it is assumed that the AA and MM BOD removal capacity at each plant are, at minimum, the same as their current BOD loadings. Table 4-7 shows the revised treatment capacities based on current AA and MM BOD loadings. It is recommended that process-specific sampling, process modeling, and, if needed, stress testing be performed to determine the actual plant capacity, the limiting processes, and corresponding process improvements needed at each plant. While this evaluation will be immediately helpful at Pleasant Grove, it is essential at Dry Creek because of the large discrepancy between current loading and nominal capacity.

Table 4-7: Revised Current Hydraulic and Organic (BOD) Capacities at DCWWTP and PGWWTP

Plant	DCWWTP	PGWWTP	
		Existing	FY 22-23[a]
ADWF Hydraulic Treatment Capacity, mgd	18[b]	12[b]	12[a,c]
Biological Treatment Capacity AA BOD Loading, lbs/day	33,900[d]	22,400[d]	34,500[c]
Biological Treatment Capacity, MM BOD Loading, lbs/day	48,000[d]	28,000[d]	40,100[c]

Notes:

a. Plant improvements that expand treatment capacity at PGWWTP are currently under construction and are expected to be in service by FY 22-23. Capacity comparisons in this TM take this into consideration.

b. Permitted plant capacity and capacity documented in the South Placer Regional Wastewater and Recycled Water Systems Evaluation, RMC Water and Environment, December, 2009.

c. Source: Table 1.1, Technical Memorandum No. 1: Influent Flow and Load Characteristics and Projections. Final Pleasant Grove Wastewater Treatment Expansion Basis of Design Report, Kennedy/Jenks Consultants, March 2016

d. Current BOD loadings based on plant data from January 2013 through September 2019.

4.3.1 Dry Creek Wastewater Treatment Plant

This section discusses the hydraulic and biological capacity of the DCWWTP and preliminary phasing of future improvements. Based on the estimated plant capacity and projected flow and loading requirements, two phases of improvements are recommended.

4.3.1.1 Hydraulic Capacity and Phasing

Based on the projected ADWF of 16.7 for FY 59/60 and 18.2 mgd for buildout, the current DCWWTP ADWF hydraulic capacity of 18 mgd is effectively sufficient through buildout. Figure 4-5 shows ADWF capacity plotted against the flow projected over the planning period. Figure 4-5 also presents graphs for ADWF and PDWWF rebound based on a linear interpolation from 150 gpd/EDU calculated based on current flows in FY 19/20 to a potential flow factor of 190 gpd/EDU in FY 59/60. This is not to say that all unit processes are sufficient to handle future peak flows associated with wet weather; assuming peaking factors hold steady over time, or increase, unit processes based upon flow criteria (as opposed to loading) will need to be expanded as presented below.

4.3.1.2 Biological Capacity and Phasing

Preliminary biological capacity improvements for DCWWTP have been identified, which should be confirmed and refined when additional capacity testing has been completed. Based on Table 4-7, DCWWTP is currently running at or beyond its nominal design capacity with respect to BOD loading. It is recommended that SPWA implement Phase 1 expansion in approximately FY 24/25 which is the earliest practical time frame it could be implemented considering planning, design, and construction duration. The plant will reach 94% of the expanded Phase 1 AA and MM BOD loading capacity in FY 39/40. Therefore, it is recommended to implement Phase 2 biological improvements at this time concurrent with necessary wet weather hydraulic improvements. Phase 2 improvements in FY 39/40 are recommended to bring the plant BOD loading capacity to its buildout AA and MM projections of 56,000 and 79,000 lbs/day, respectively. Figure 4-6 shows AA and MM biological treatment capacities plotted against the loadings projected over the planning period and the anticipated phasing. As discussed in Chapter 5, the timing and size of the recommended projects should be reviewed after additional capacity analysis and facility planning is completed.

4.3.2 Pleasant Grove Wastewater Treatment Plant

This section discusses the hydraulic and biological capacity of the PGWWTP and the recommended phasing of future improvements. This phasing includes improvements that are currently under design and are expected to be in service by FY 22-23. Based on the estimated plant capacity and projected flow and loading requirements, two phases of improvements beyond the FY 22-23 project are recommended.

4.3.2.1 Hydraulic Capacity and Phasing

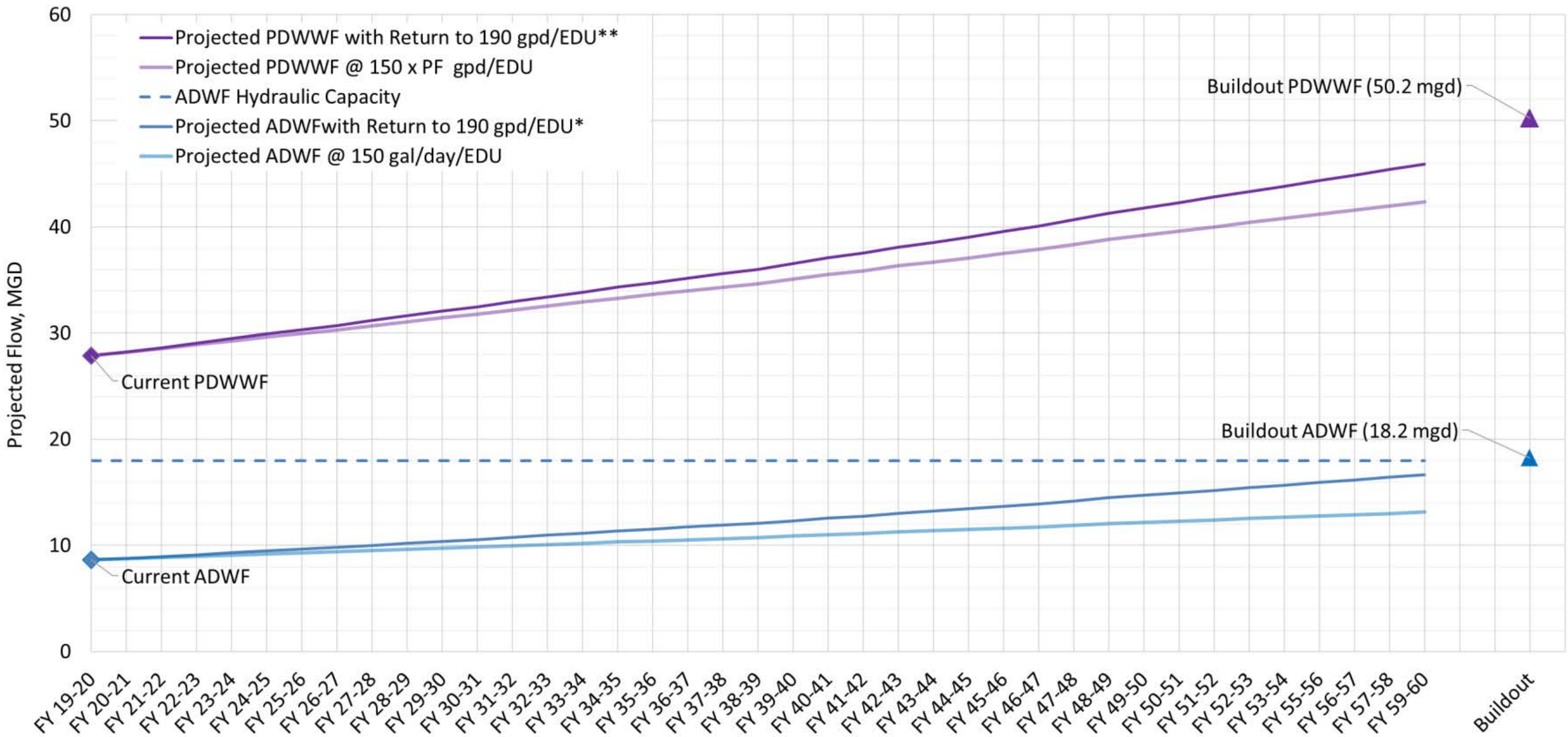
Although the PGWWTP hydraulic capacity is 12 mgd, based on the references above, the current ADWF treatment capacity at the PGWWTP is rated at 9.5 mgd. The improvements currently under construction will expand PGWWTP's treatment capacity to its hydraulic capacity rating of 12 mgd. Based on the ADWF projections calculated from a linear interpolation between current flow of 138 gpd/EDU and historic 190 gpd/EDU flow contribution, this capacity expansion should be sufficient to handle flows through approximately FY 28-29, though timing would depend on the rate of any rebound in sewer flows. It is currently recommended that Phase 1 hydraulic expansion be implemented in FY 28-29 to expand the plant ADWF to 15 mgd. Phase 1 expansion would carry the PGWWTP through FY 40-41. At that point, Phase 2 improvements may be needed to increase the plant ADWF capacity to FY 59/60 flow projections of 18 mgd. Figure 4-7 shows ADWF plotted against the flow projected over the planning period and the anticipated phasing for improvements. Figure 4-7 presents graphs for ADWF and PDWWF rebound based on linear interpolation from 138 gpd/EDU calculated based on current flows in FY 19/20 to a potential flow factor of 190 gpd/EDU in FY 59/60. As discussed in Chapter 5, the timing and size of the recommended projects should be reviewed after additional facility planning is completed and the gpd/EDU assumption is confirmed.

4.3.2.2 Biological Capacity and Phasing

Based on Table 4-7, PGWWTP is currently running at or beyond its nominal design capacity with respect to BOD loading. The improvements currently under design will expand the plant's AA and MM BOD loading capacities to 34,500 lbs/day and 40,100 lbs/day. These improvements should be sufficient to meet projected BOD loadings through FY 40/41 when Phase 2 hydraulic capacity improvements are recommended. During Phase 2 expansion, it is recommended that plant capacity be increased to accommodate projected FY59/60 AA and MM BOD loadings of 38,000 lbs/day and 48,000 lbs/day, respectively. The timing and magnitude of additional expansion to accommodate buildout will be determined in subsequent planning documents.

Figure 4-8 shows AA and MM biological treatment capacities plotted against the loadings projected over the planning period and the anticipated phasing.

Figure 4-5: DCWWTP Hydraulic Capacity Comparison

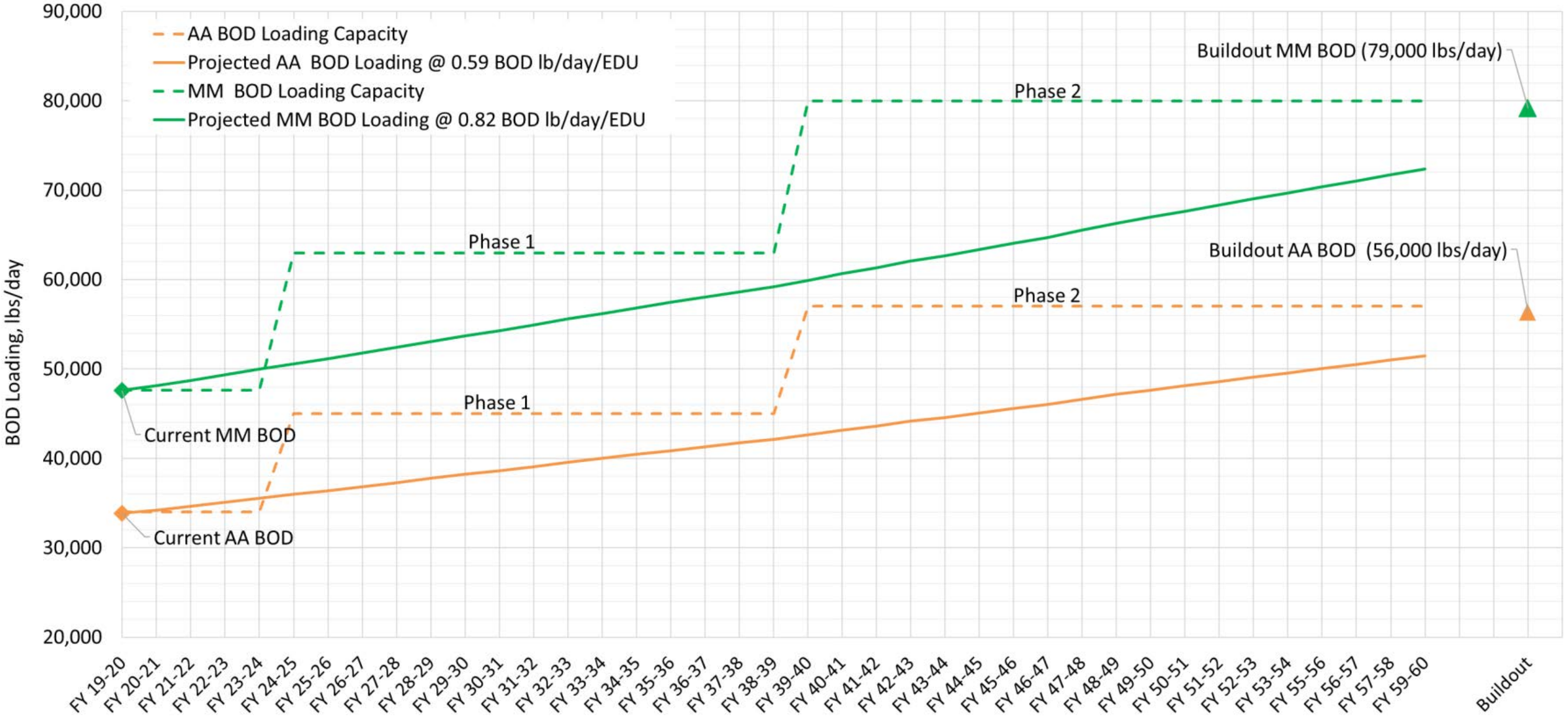


* ADWF gpd/EDU flow factor is assumed to reach 190 gpd/EDU by FY 59/60, with a linear increase from 150 gpd/EDU at FY 19/20

**PDWWF is assumed to be ADWF flow plus 330 gpd/EDU of wet weather flow, based on current wet weather flowrates

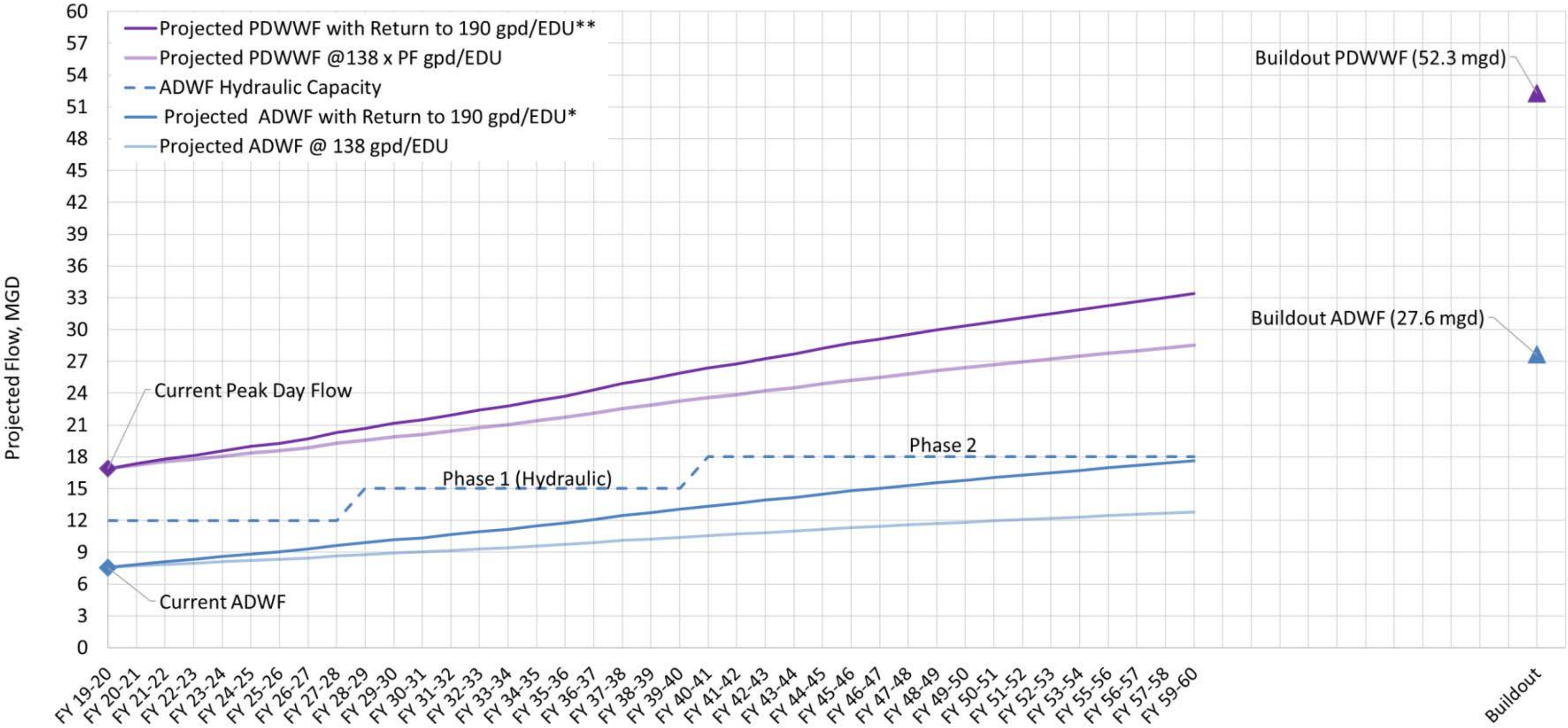
*** Buildout date is currently unknown and is shown for graphical purposes only.

Figure 4-6: DCWWTP Biological Capacity Comparison



* Buildout date is currently unknown and is shown for graphical purposes only.

Figure 4-7: PGWWTP Hydraulic Capacity Comparison

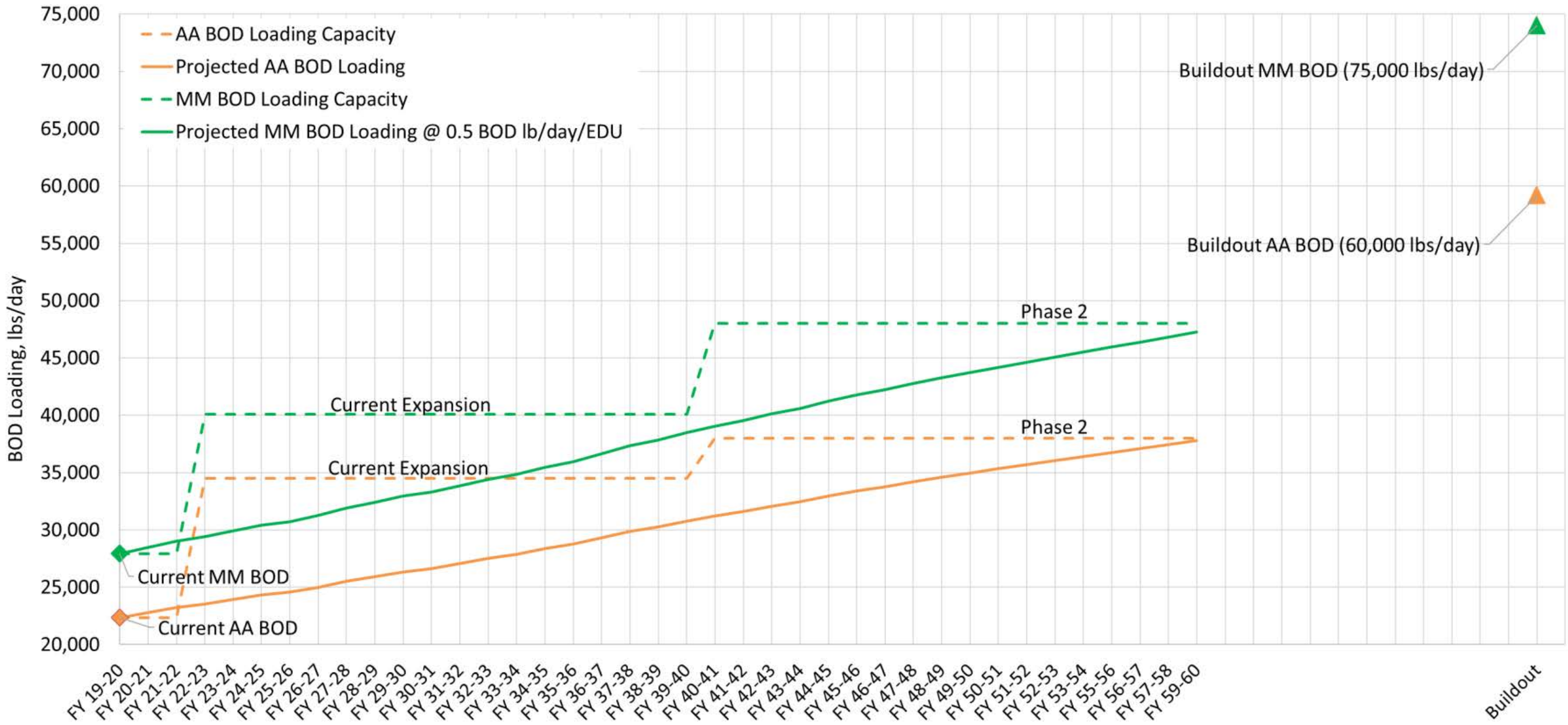


* ADWF GPD/EDU factor is assumed to reach 190 gpd/EDU by FY 59/60, with a linear increase from 138 gpd/EDU at FY 19/20

**PDWWF is assumed to be ADWF flow plus 170 gpd/EDU of wet weather flow, based on current wet weather flowrates

*** Buildout date is currently unknown and is shown for graphical purposes only.

Figure 4-8: PGWWTP Biological Capacity Comparison



* Buildout date is currently unknown and is shown for graphical purposes only.

4.4 Conceptual Capital Cost Estimates

Opinions of probable cost were developed for the recommendations of this TM and are presented in this section. This section also provides the procedures and methodology used for developing planning-level capital cost estimates for PGWWTP and DCWWTP phased improvement projects. Note that improvements that would be required after the FY 59/60 planning horizon have not been estimated.

4.4.1 Cost Estimation Approach

This section describes the assumptions and procedures used to develop cost estimates for phased improvements at PGWWTP and DCWWTP. The cost estimates provided in this TM include improvements that would increase the plant capacity to treat the projected flows and loadings but does not include repair and replacement (R&R) projects or discretionary projects such as resource recovery improvements.

The estimated construction costs are based on a Class 5 estimate as defined by the Association for the Advancement of Cost Engineering (AACE) International cost estimate classification system. Table 4-8 provides a summary of the estimate classes and expected accuracy range. For Class 5 estimates, the expected accuracy range is -20% to -50% on the low end and +30% to +100% on the high end.

Table 4-8: Cost Estimate Classification Matrix (AACE International)

Estimate Class	Level of Project Definition	Purpose of Estimate	Methodology	Expected Accuracy Range
Class 5	0% to 2%	Concept screening	Capacity factored, parametric models, judgement, or analogy	Low: -20% to -50% High: +30% to +100%
Class 4	1% to 15%	Study or feasibility	Equipment factored or parametric models	Low: -15% to -30% High: +20% to +50%
Class 3	10% to 40%	Budget authorization or control	Semi-detailed unit costs with assembly level line items	Low: -10% to -20% High: +10% to +30%
Class 2	30% to 75%	Control or bid/tender	Detailed unit cost with forced detailed take-off	Low: -5% to -15% High: +5% to +20%
Class 1	65% to 100%	Check estimate or bid/tender	Detailed unit cost with detailed take-cost	Low: -3% to -10% High: +3% to +15%

Source: AACE International Recommended Practice No. 18R-97

Construction costs were developed based on the improvements and unit costs provided in the prior planning documents listed below:

- Technical Memorandum 4b: Wastewater Treatment Plants Expansion Requirements, RMC Water and Environment, March 28, 2006 (TM 4b).
- DCWWTP Initial Assessment Final Report, CH2M Hill, Inc, August 2008 (CH2M Hill, 2008)
- Final Pleasant Grove Wastewater Treatment Expansion Basis of Design Report, Kennedy/Jenks Consultants, March 2016

Raw construction costs are estimated for each component based on estimated unit costs multiplied by quantity.

Construction cost factors were used to develop and escalate unit costs to reflect the current bid environment, industry trends, and project location as well as plant capacity increase. These factors are incorporated into the unit costs and are represented in two categories:

- **Engineering News Record's (ENR) Construction Cost Index (CCI)** – All project construction cost estimates are indexed to an ENR CCI of 12115 which represents the average of the April 2020 indices for San Francisco (SF) ENR and the "20-Cities" ENR, to account for the greater Sacramento area construction market.
- Capacity Adjustment Factor – The number of units listed in TM 4b were associated with different capacity increases than required in proposed improvement phasing in this Systems Evaluation. Proportional adjustment factors were used to account for these capacity increase differences. Further discussion is provided below.

Based on the level of detail available for Class 5 estimates, allowances are used for some of the direct construction elements including the site electrical, and instrumentation and control (I&C), site yard piping and mechanical, and site civil work estimates (i.e. direct construction costs). Allowance estimates are made using the percentages listed in Table 4-9.

Table 4-9: Direct Construction Cost Allowances

Construction Cost Allowance Types	Percent
Site Yard Piping & Mechanical	5%
Site Electrical / I&C/SCADA	15%
Site Civil	5%

From the direct construction cost subtotal, indirect construction cost factors are applied to develop an estimated total construction cost. These construction cost markups include the following:

- Overhead and Profit – Contractor overhead and profit (O&P) represents the general contractor's operating costs and estimated profit levels. The O&P factor typically varies between 10% and 25% of the direct construction cost subtotal, depending on the size of the project and market conditions, with larger projects typically having lower O&P factors. For this Systems Evaluation, an O&P factor of 20% was used.
- Estimating Contingency – The estimating contingency is defined as unknown costs due to lack of detailed engineering during the planning phase that are estimated as a percentage of defined project costs (i.e. direct and indirect construction cost subtotal). For this Systems Evaluation, a contingency factor of 30% was used since the projects are at conceptual planning level.

The estimated total construction cost is then multiplied by an allowance of 25% for Engineering, Permitting, Construction Management, and Engineering Services during Construction.

4.4.2 Dry Creek WWTP Cost Estimates

The proposed Phase 1 and 2 improvements and process unit cost estimates in TM 4b were used as the basis of the cost estimate. Several revisions and updates were made to the TM 4b improvements to develop the new phased improvements list and cost estimates in this Systems Evaluation, including the following:

- Influent Pump Station –Several improvements have been completed at East Roseville influent pump station including installation of new pumps and emergency generator, demolition of the old East Roseville Pump Station and Pump Station Annex, and replacement of PLCs. Therefore, TM 4b Phase 1 improvements were updated to remove the influent pump installation.
- Influent Coarse Screen – The existing two coarse screens have a PHWWF capacity of 30 mgd each. The existing screens provide sufficient capacity through buildout with project PHWWF of 54.7 mgd with two screens in service and using the existing bypass channel in the event that one of the screens is out of service. Therefore, it is recommended that a third screen be installed in Phase 2.
- Aeration Tanks – TM 4b proposed installation of ten new aeration tanks including replacement of four of the exiting smaller size aeration tanks constructed in 1974 with larger tanks (same size as tanks constructed in 1991) in Phase 1. The CH2M Hill, 2008 report evaluation indicated existing aeration basin volumes were sufficient for Phase 1 improvements which assumed a projected AA BOD loading capacity about the same as the current plant loading and recommended providing additional aeration and mixed liquor recycle (MLR) pumping capacity. New MLR pumps were installed at the plant per the Nitrate Removal Project Basis of Design Report (B&C, 2017). A rough evaluation of the aeration tank sizes indicated that replacement of two aeration tanks and construction of two new ones (total of four) in Phase 1 and replacement of the remaining 2 aeration tanks and construction of 4 new ones in Phase 2 (total of six) would provide sufficient capacity at each of the 2 phases.
- Capacity Increase Adjustment Factor – Biological treatment capacity increases for AA BOD loading were used to calculate the DCWWTP adjustment factor. The Adjustment Factor was obtained from the ratio between incremental capacity increases proposed in TM 4b and in this TM.

  BOD loading increase in Phase 1 based on TM 4b was 10,500 lb/day and the required capacity increase per this TM is 11,100. An adjustment factor of 1.06 was calculated and applied to the number of units.

  BOD loading increase in Phase 2 based on TM 4b was 13,700 lb/day and the required capacity increase per this TM is 12,000 lb/day. An adjustment factor of 0.88 was calculated and applied to the number of units.

The preliminary phased improvements are provided in Table 4-10. The listed improvements increase the plant ADWF capacity based on AA BOD loading from 11.5 mgd to 14.5 mgd in Phase 1 and to 18 mgd in Phase 2. It should be emphasized that the cost estimates provided below are conceptual level costs for capacity expansion projects and do not include rehabilitation and replacement projects or discretionary projects. More detailed cost estimating should be developed when the plant capacity is determined, and phased improvement projects are updated accordingly.

Table 4-10: DCWWTP Phase 1 and Phase 2 Capital Cost Estimates (ENR CCI: 12115)[a]

Process	Process Unit Cost	Phase 1 FY 24/25	Phase 2 FY 39/40
		# of units	# of units
Coarse Screens	$280,000	-	1
Influent Pump Station	$2,000,000	-	1
Fine Screens	$170,000	2	1
Odor Control	$210,000	1	1
Grit Basins	$290,000	-	1
Primary Sedimentation	$3,400,000	-	2
Aeration Basins	$2,600,000	4	6
Blower	$290,000	1	-
Mixed Liquor Return Pumps	$150,000	4	6
Rehab Existing Anoxic Zones	$290,000	1	
Secondary Clarifiers	$4,100,000	4	2
RAS/WAS Pump Station	$860,000	1	1
Tertiary Filtration	$730,000		2
Waste Backwash Pumps	$100,000		1
UV Disinfection	$2,100,000		1
Anaerobic Digesters	$3,300,000	1	1
Centrifuges	$650,000	2	
Cooling Units	$290,000		2
Total Unit Process Costs		$34,000,000	$43,000,000
Site Yard Piping & Mechanical (5%)		$1,700,000	$2,200,000
Site Electrical / I&C/SCADA (15%)		$5,100,000	$6,500,000
Site Civil (5%)		$1,700,000	$2,200,000
Subtotal of Direct Construction Costs		$43,000,000	$54,000,000
Mobilization/Demobilization (5%)		$2,200,000	$2,700,000
Contractor Overhead & Profit (20%)		$8,600,000	$10,800,000
Subtotal of Direct and Indirect Costs		$54,000,000	$68,000,000
Contingency (30%)		$16,000,000	$20,000,000
Total Estimated Construction Cost		$70,000,000	$88,000,000
Engineering, Permitting, CM, ESDC (25%)		$18,000,000	$22,000,000
Total Estimated Capital Cost		$88,000,000	$110,000,000

Notes:

a. Costs based on Average of SF and “20 Cities” ENR for April 2020: 12115

4.4.3 PGWWTP Cost Estimates

The proposed Phase 1 and 2 improvements and cost estimates in TM 4b were used as the basis of the cost estimate. Several revisions and updates were implemented on these proposed improvements for Phase 1 and Phase 2 to develop the new phased improvements cost estimates, including the following:

- Current Expansion – As described in 1.2, several improvements are currently being constructed at PGWWTP per the Pleasant Grove Wastewater Treatment Plant Expansion BODR (Kennedy/Jenks, 2016). Therefore, TM 4b Phase 1 improvements were updated by removing the current expansion projects from Phase 1 scope, including the following:
    - Installation of four new primary sedimentation basins
    - Installation of 1 odor control system
    - Installation of 2 new solid thickening systems and building
    - Installation of 2 new digesters and building
    - Installation of 1 new co-generation system
- Hydraulic Capacity Increase – Proposed Phase 1 improvements in this TM are to increase PGWWTP peak day hydraulic capacity. Therefore, proposed projects in Phase 1 improvements in TM 4b were revised to include only improvements to unit process that increase the plant hydraulic capacity and the remaining projects associated with BOD removal capacity including installation of one digester and one oxidation ditch, and construction of associated buildings were moved to Phase 2 improvements .
- Capacity Increase Adjustment Factor – For Phase 1, since only hydraulic capacity increase is required, an Adjustment Factor was obtained from the ratio between the hydraulic capacity increase in TM 4b and in this TM. Both TMs propose 3 mgd hydraulic capacity increases in Phase 1, therefore the adjustment factor of 1 was multiplied by the number of units proposed in TM 4b.

  For Phase 2, biological treatment capacity increases for AA BOD loading were used. The Phase 2 BOD loading capacity increase in TM 4b was 21,000 lb/day and the proposed capacity increase in this TM is 3,500 lb/day. An adjustment Factor of 0.17 was calculated from TM 4b and proposed capacity increase ratio and was multiplied by the number of units proposed in TM 4b.

  An adjustment factor was not applied to building modifications.

The updated opinion of probable cost for the phased improvements is provided in Table 4-11. The recommended phased improvements increase the plant ADWF capacity from 12 mgd to 15 mgd in Phase 1 and from 15 mgd to 18 mgd in Phase 2. It should be emphasized that the cost estimates provided below are conceptual level costs for capacity expansion projects and do not include rehabilitation and replacement projects or discretionary projects. More detailed cost estimating should be developed when the plant capacity is determined, and phased improvement projects are updated accordingly.

Table 4-11: PGWWTP Phase 1 and Phase 2 Capital Cost Estimates (ENR CCI: 12115)[a]

Process	Process Unit Cost	Phase 1 FY 28/29	Phase 2 FY 39/40
		# of units	# of units
Influent Pumps	$120,000	1	-
Grit Basins	$290,000	1	-
Fine Screens	$170,000	2	-
Primary Sedimentation	$3,400,000	-	1
Oxidation Ditches	$7,100,000	-	1
Secondary Clarifiers	$4,100,000	1	1
RAS/WAS Pump Station	$860,000	1	-
Tertiary Filtration	$730,000	2	1
UV Disinfection	$2,100,000	3	-
Thickeners Building Modification	$490,000	-	1
Digesters Building Modification	$490,000	-	1
Total		$13,000,000	$16,000,000
Site Yard Piping & Mechanical (5%)		$650,000	$800,000
Site Electrical / I&C/SCADA (15%)		$2,000,000	$2,400,000
Site Civil (5%)		$650,000	$800,000
Subtotal of Direct Costs		$16,000,000	$20,000,000
Mobilization/Demobilization (5%)		$800,000	$1,000,000
Contractor Overhead & Profit (20%)		$3,200,000	$4,000,000
Subtotal of Direct and Indirect Costs		$20,000,000	$25,000,000
Contingency (30%)		$6,000,000	$7,500,000
Total Estimated Construction Cost		$26,000,000	$33,000,000
Engineering, Permitting, CM, ESDC (25%)		$6,500,000	$8,300,000
Total Estimated Capital Cost		$33,000,000	$41,000,000

Notes:

a. Costs based on Average of SF and “20 Cities” ENR for April 2020: 12115

5. CAPACITY IMPROVEMENT PROJECT SUMMARY & NEXT STEPS

Table 5-1 summarizes the capacity improvements identified in this systems evaluation. Note that the improvement needs projected for Dry Creek and Pleasant Grove WWTPs are significantly larger and more expensive than the improvement projects projected for the collection system, but are based on limited available data. The estimated costs for Dry Creek WWTP are especially high because of the size and age of that plant; when it was designed, the organic loading in Roseville was far lower than when Pleasant Grove was designed; since the mid 2000's organic loading to both plants has continued to increase. Further studies, as described in Chapter 4, should be undertaken for both treatment plants, and the capacity improvement projects should be refined based on those findings.

Note that only capacity improvement projects have been identified; condition and reliability related improvement needs have not been evaluated in this study.

Table 5-1: Proposed Capacity Improvement Projects

		Existing	FY 24/25	FY 39/40	After FY 59/60
Collection System	Description	Improvement Project 1 (Increased Capacity of PS 26 and sewers on Sierra College Blvd)	None	None	Improvement Project 2 (Redirect flows from PS 26 and Sierra College Blvd down Eureka Road) Improvement Project 3 (Increased Firm capacity of PS 25 with diversion structure improvements)
	Estimated Capital Cost	$1,610,000	-	-	$2,590,000
Dry Creek WWTP	Description	Plant Capacity Analysis, Condition Assessment, and Facilities Plan	Phase 1 (Increase AA BOD Capacity to ~45,000 lbs/day)	Phase 2 (Increase AA BOD Capacity to ~57,000 lbs/day)	Phase 3: Increase BOD Capacity and Hydraulic Capacity (not estimated)
	Estimated Capital Cost	$550,000	$88,000,000	$110,000,000	Not Estimated
Pleasant Grove WWTP	Description	Plant Capacity Analysis, Condition Assessment, and Facilities Plan	Increase ADWF hydraulic capacity to 15 mgd	Increase ADWF hydraulic capacity to 18 mgd. Increase AA BOD Loading Capacity to 38,000 lbs/day	Phase 3: Increase BOD Capacity and Hydraulic Capacity (not estimated)
	Estimated Capital Cost	$450,000	$33,000,000	$41,000,000	Not Estimated

5.1 Next Steps

Based on the findings of this preliminary evaluation, and discussions with the project team, the following next steps are recommended for consideration by SPWA:

- Conduct an analysis of process performance and current biological treatment and hydraulic capacity at both DCWWTP and PGWWTP. This will likely require process-specific sampling and development of calibrated process models. Biological treatment capacity should consider both BOD and nitrate plus nitrite permit limitations set forth within each plant's respective NPDES permit. Results of this study should determine a capacity rating for each unit process at the plant and the limiting processes. This analysis will provide a sound basis for the planning of new facilities and is integral to determining required future capital improvement projects during phased expansions. It is recommended that DCWWTP capacity analysis take precedence over PGWWTP considering DCWWTP is currently operating well beyond its nominal BOD removal capacity.

- Review previous condition assessment work conducted on the plant assets and perform additional assessment needed to identify and prioritize repair and replacement (R&R) projects. This effort would include a risk assessment to identify likelihood of failure and criticality of each asset. Results of this study would identify R&R projects which may need to be implemented prior to or concurrent with phased expansions.

- Based on the capacity analysis and R&R project planning, develop Facilities Plans for DCWWTP and PGWWTP. Considering both plants are running at or above their nominal design capacities, it is recommended that facilities planning begin immediately after the capacity analysis. This effort would evaluate various process optimization steps and upgrade alternatives and provide recommended improvements for phased expansions. The Facilities Plans would include review of the 190 gpd/EDU flow factor that is critical to the timing and magnitude of any hydraulic capacity improvements.

- Develop Class 4 cost estimates for recommended improvements at the WWTPs under each expansion phase and for R&R projects to assist SPWA partners in assessing capital needs in the future.

- For the collection system, periodically update the model network based on any configuration changes, perform re-calibration to confirm the actual and anticipated flows, and to update future loads into the model network. An update frequency of every 5-10 years is recommended, depending on changes in development planning and/or system configuration.

We also recommend that SPWA evaluate funding and financing options to support implementation of the recommended capital improvements, especially Phase 1 at Dry Creek, given its size and relative immediacy. With the implementation of the steps above, and the ongoing high level performance of the SPWA Regional System, SPWA will be able to continue its excellent level of service to the Regional Partners.

APPENDIX A – PLACER COUNTY GENERAL PLAN DENSITIES

General Plan Designation	Maximum Density (EDU/Acre)	Diurnal Profile
Commercial	21	Commercial
Greenbelt & Open Space	0	Residential
High Density Residential 4 - 10 DU/Ac.	10	Residential
Industrial	4.356	Commercial
Low Density Residential 0.4 - 0.9 Ac. M	2.5	Residential
Low Density Residential 1 - 2 DU./Ac.	2	Residential
Low Density Residential Density Transf	2.5	Residential
Low Density Residential Development	2	Residential
Medium Density Residential 2 - 4 DU/A	4	Residential
Open Space	0	Residential
Professional Office	4.356	Commercial
Public Facility	0	Commercial
Rural Estate 4.6 - 20 Ac. Min.	0.21739	Residential
Rural Low Density Residential 0.9 - 2.3	1.11	Residential
Rural Low Density Residential 0.9 - 2.3	1.11	Residential
Rural Low Density Residential 0.9 - 2.3	1.11	Residential
Rural Low Density Residential 0.9 - 2.3	1.39	Residential
Rural Low Density Residential 1 - 2.3 A	1	Residential
Rural Residential 2.3 - 4.6 Ac. Min.	0.43478	Residential
Public Facility/Agricultural 80 Ac. Min.	0	Residential
Low Density Residential 0.4 - 2.3 Ac. M	1.11	Residential
Riparian Drainage	0	Residential
Agriculture/Timberland - 20 Ac. Min.	0	Residential
Rural Residential 1 - 10 Ac. Min.	1	Residential

APPENDIX B – URBAN GROWTH AREA LAND USE SUMMARIES

PLACER COUNTY URBAN GROWTH AREAS

Placer Ranch UGA[a]

Land Use	Flow Factor	Land Use Quantities		
		Western Shed	Central Shed	Eastern Shed
Single Family Residential (Units)	190 gpd/DU	2,244	1,254	320
Multi Family Residential (Units)	130 gpd/DU	397	782	831
Mixed Use (acres)	2,300 gpd/ac	-	33.8	15.1
Commercial (acres)	850 gpd/ac	73.2	309.9	38.0
Parks > 10 acres (acres)	10 gpd/ac	37.8	17.1	-
Public/Quasi-Public (acres)	660 gpd/ac	0.8	0.8	3.9
Schools (acres)	170 gpd/ac	32.0	-	-
Total ADWF (mgd)		**0.55**	**1.95**	**0.24**

Footnotes:

a. See Exhibit D of the Placer Ranch Sewer Master Plan (Mackay & Somps, 2017). Approximately 1,300 acres in the Sunset Industrial Area outside of Placer Ranch are anticipated to drain through Placer Ranch sewers, when fully developed.

Sunset Industrial Area[a]

Land Use	Flow Factor	Land Use Quantities			
		PR-POC 1	PR-POC 2	Existing POC 1	Existing POC 2
Single Family Residential (Units)	190 gpd/DU	2,361	297	0	0
Multi Family Residential (Units)	130 gpd/DU	0	0	0	0
Mixed Use (acres)	2,300 gpd/ac	257	161	0	0
Commercial/ Industrial (acres)	850 gpd/ac	1,287	85	531	277
Parks > 10 acres (acres)	10 gpd/ac	0	0	0	0
Public/Quasi-Public (acres)	660 gpd/ac	0	0	0	0
Schools (acres)	170 gpd/ac	0	0	0	0
Point Sources[d]	gpd	480,000	0	0	0
Total ADWF (mgd)		**2.61**	**0.50**	**0.45**	**0.24**

Footnotes:

a. Sunset Area Water, Wastewater, and Recycled Water Technical Report (Psomas, October 2017)

b. Includes low density residential and medium density residential units.

c. Approximately 1,300 acres in the Sunset Industrial Area outside of Placer Ranch are anticipated to drain through Placer Ranch sewers, when fully developed.

d. Includes Thunder Valley Casino and Area L270 (County area east of the Sunset Area proposed to drain through the Sunset Area)

Placer Vineyards[a]

Land Use	Flow Factor	Land Use Quantities		
		Shed A1	Shed A2	Shed B
Single Family Residential (Units)	190 gpd/DU	1,723	7,051	1,951
Multi Family Residential (Units)	130 gpd/DU	0	2,822	270
Mixed Use (acres)	2,300 gpd/ac	0	50.5	0
Commercial/ Industrial (acres)	850 gpd/ac	0	234.2	25.0
Parks > 10 acres (acres)	10 gpd/ac	0	30	12.0
Public/Quasi-Public (acres)	660 gpd/ac	0	113	27.2
Schools (acres)	170 gpd/ac	12	155	0
Total ADWF (mgd)		**0.33**	**2.12**	**0.45**

Footnotes:

a. Placer Vineyards Specific Plan; Sanitary Sewer Master Plan Addendum 1 (Mackay & Somps, May 20, 2019)

Table 0-1: Regional University[a]

Land Use	Flow Factor	Land Use Quantities
Single Family Residential (Units)	190 gpd/DU	1,845
Multi Family Residential (Units)	130 gpd/DU	349
Mixed Use (acres)	2,300 gpd/ac	10.98
Commercial/ Industrial (acres)	850 gpd/ac	25
Parks > 10 acres (acres)	10 gpd/ac	27.3
Public/Quasi-Public (acres)	660 gpd/ac	5.0
Schools (acres)	170 gpd/ac	32.6
University	mgd	0.725
Total ADWF (mgd)		**1.18**

Footnotes:

a. Regional University Specific Plan, Sanitary Sewer Demand (Mackay & Somps, September 1, 2017)

Riolo Vineyards[a]

Land Use	Flow Factor	Land Use Quantities		
		Lift Station Shed	Gravity Shed 1	Gravity Shed 2
Single Family Residential (Units)	190 gpd/DU	673[b]	172	153
Multi Family Residential (Units)	130 gpd/DU	0	0	0
Mixed Use (acres)	2,300 gpd/ac	0	0	0
Commercial/ Industrial (acres)	850 gpd/ac	26.5[b]	0	10
Parks > 10 acres (acres)	10 gpd/ac	0	0	0
Public/Quasi-Public (acres)	660 gpd/ac	0	0	11
Schools (acres)	170 gpd/ac	0	16	0
Total ADWF (mgd)		**0.15**	**0.035**	**0.045**

Footnotes:

a. Riolo Vineyards Sanitary Sewer Master Plan Update (Unico Engineering, April 2016)

b. Includes flows from offsite draining through these sheds

Placer UGA[a]

Land Use	Flow Factor	Land Use Quantities	
		North Shed	South Shed
Single Family Residential (Units)	190 gpd/DU	147	41.7
Multi Family Residential (Units)	130 gpd/DU	0	0
Mixed Use (acres)	2,300 gpd/ac	0	0
Commercial/ Industrial (acres)	850 gpd/ac	0	0
Parks > 10 acres (acres)	10 gpd/ac	0	0
Public/Quasi-Public (acres)	660 gpd/ac	0	0
Schools (acres)	170 gpd/ac	0	0
Total ADWF (mgd)		**0.028**	**0.008**

Footnotes:

a. *Hawk Homestead Sewer Analysis – Supplementary Information Requested by Placer County Environmental Engineering*, Derrick Whitehead, Municipal Consulting Group, January 29, 2016

CITY OF ROSEVILLE URBAN GROWTH AREAS

Land Use	Flow Factor	Creekview[a]	Amoruso[b]	Sierra Vista[c]	
				North Shed[d]	**South Shed**
Single Family Residential (Units)	190 gpd/DU	2,019	4,239[e]	1,658	2,118
Multi Family Residential (Units)	130 gpd/DU	758	873	1,058	1,478
Mixed Use (acres)	2,300 gpd/ac	0.0	27.3	13.3	34.9
Commercial (acres)	850 gpd/ac	15.5	23.9	37.7	181.0
Parks > 10 acres (acres)	10 gpd/ac	0.0	0.0	10.0	39.9
Public/Quasi-Public (acres)	660 gpd/ac	2.6	7.6	10.1	6.6
Schools (acres)	170 gpd/ac	7.0	9.6	10.0	45.6
Total ADWF (mgd)		**0.43**	**0.61**	**0.59**	**1.24**

Footnotes:

a. *Creekview Specific Plan Sanitary Sewer Master Plan*, Mackay & Somps Civil Engineers, November 2010

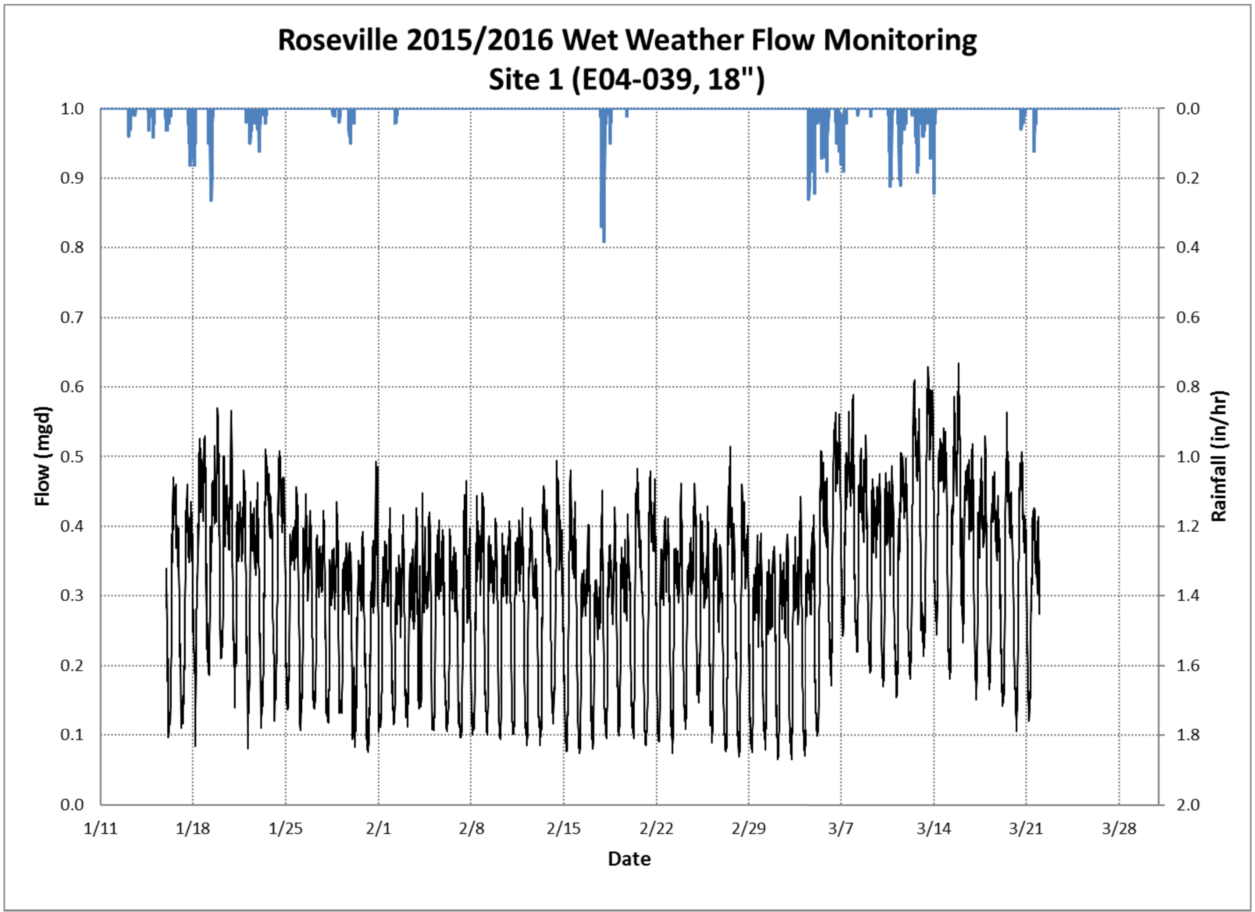
b. *Amoruso Ranch Specific Plan Area Wastewater Master Plan*, Kimley Horn, September 2015

c. *Sierra Vista Specific Plan Sanitary Sewer Master Plan*, Mackay & Somps Civil Engineers, July 2009

d. Includes the Westbrook portion of Sierra Vista

e. Includes 274 units north of Amoruso that would contribute flow through sewers in Amoruso (Toad Hill)

APPENDIX C – FLOW MONITORING DATA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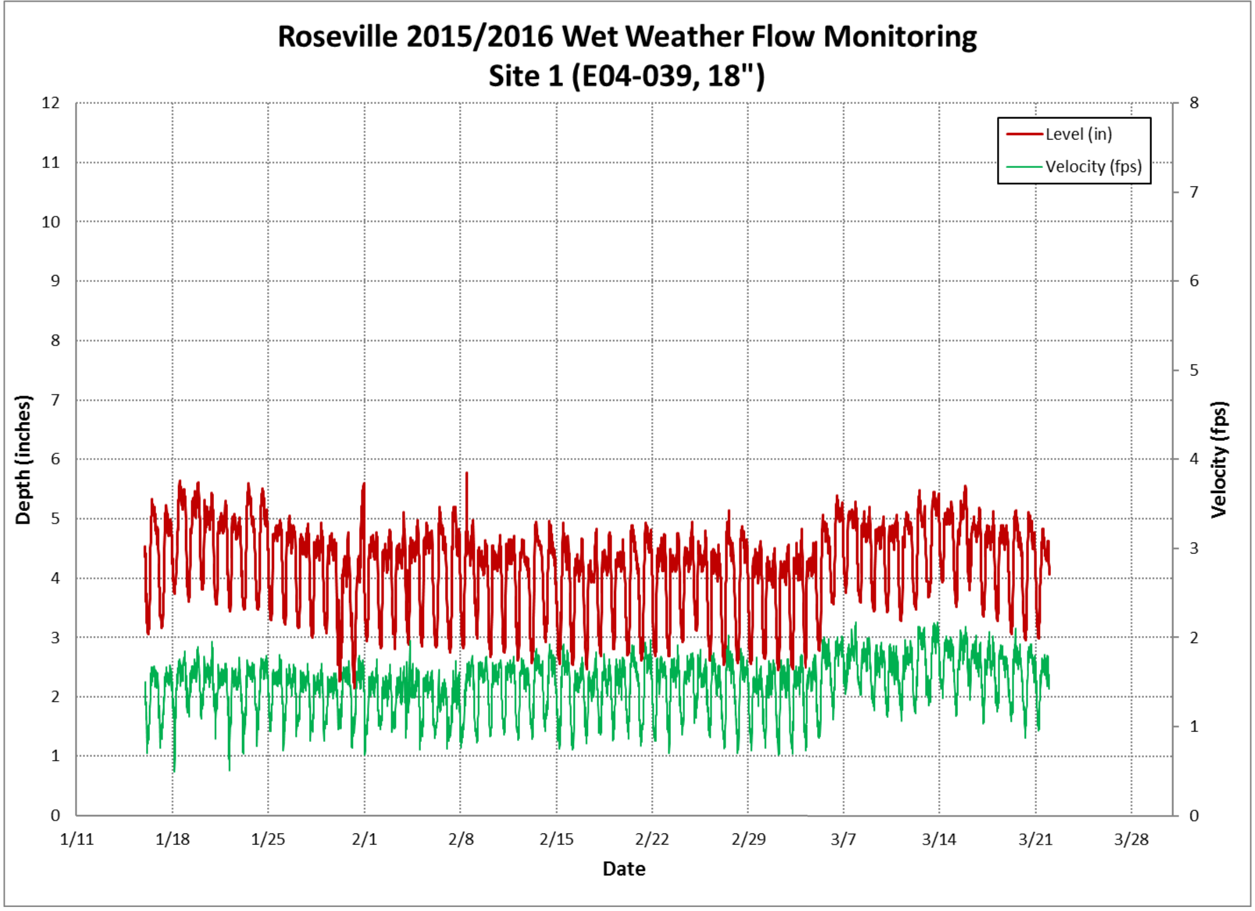
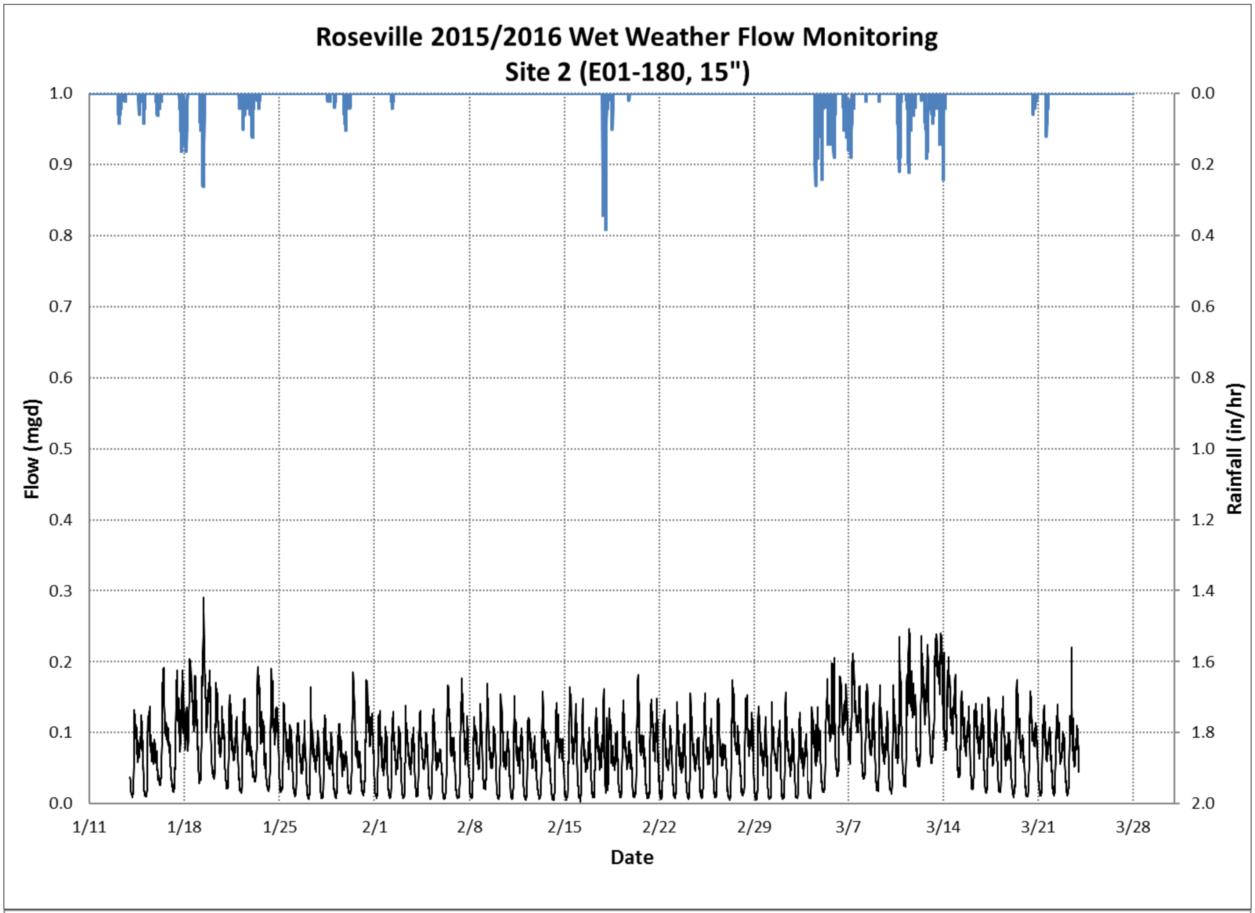
Site 1 (E04-039, 18")
Flow (mgd)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 1 (E04-039, 18")
Level (in)
Velocity (fps)
Depth (inches)
12
11
10
9
8
7
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date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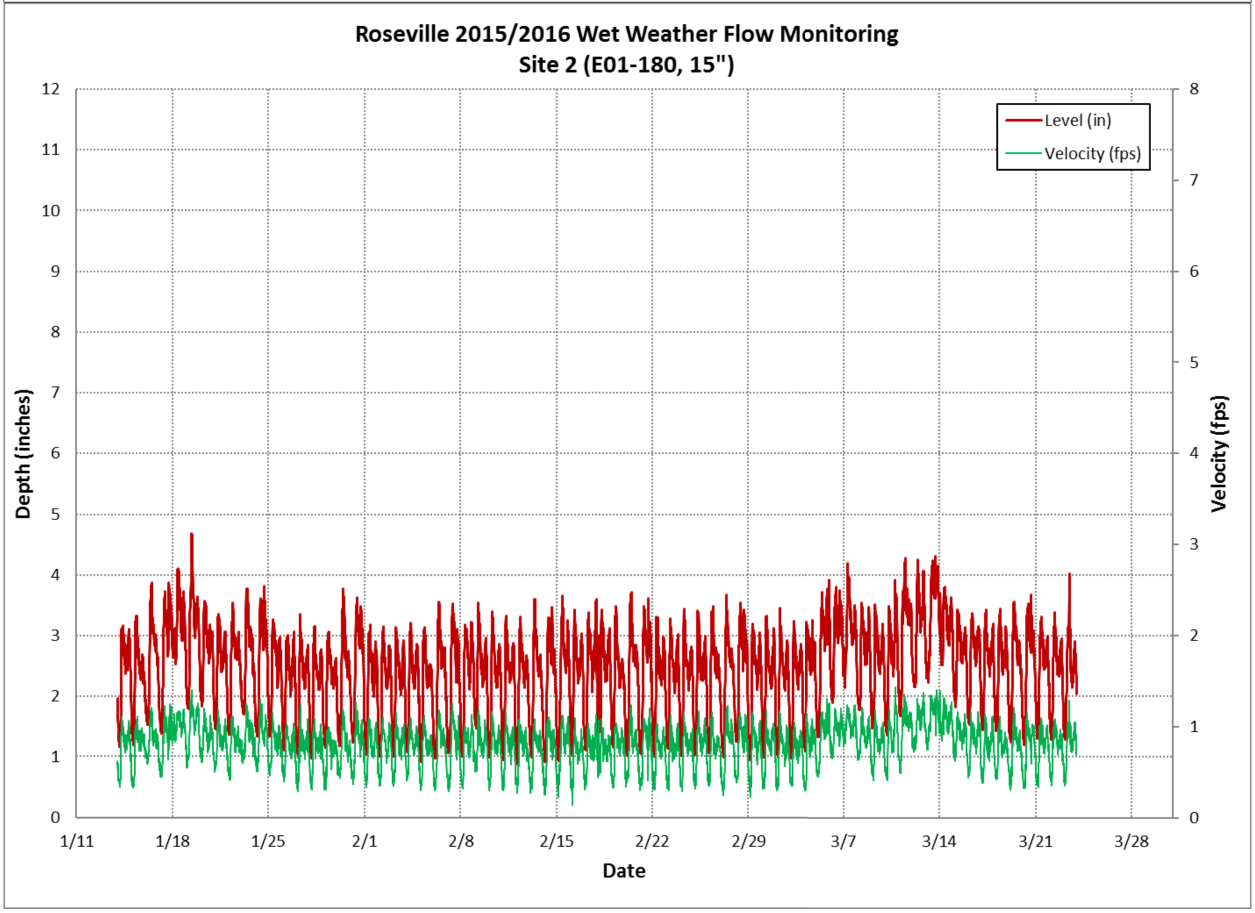
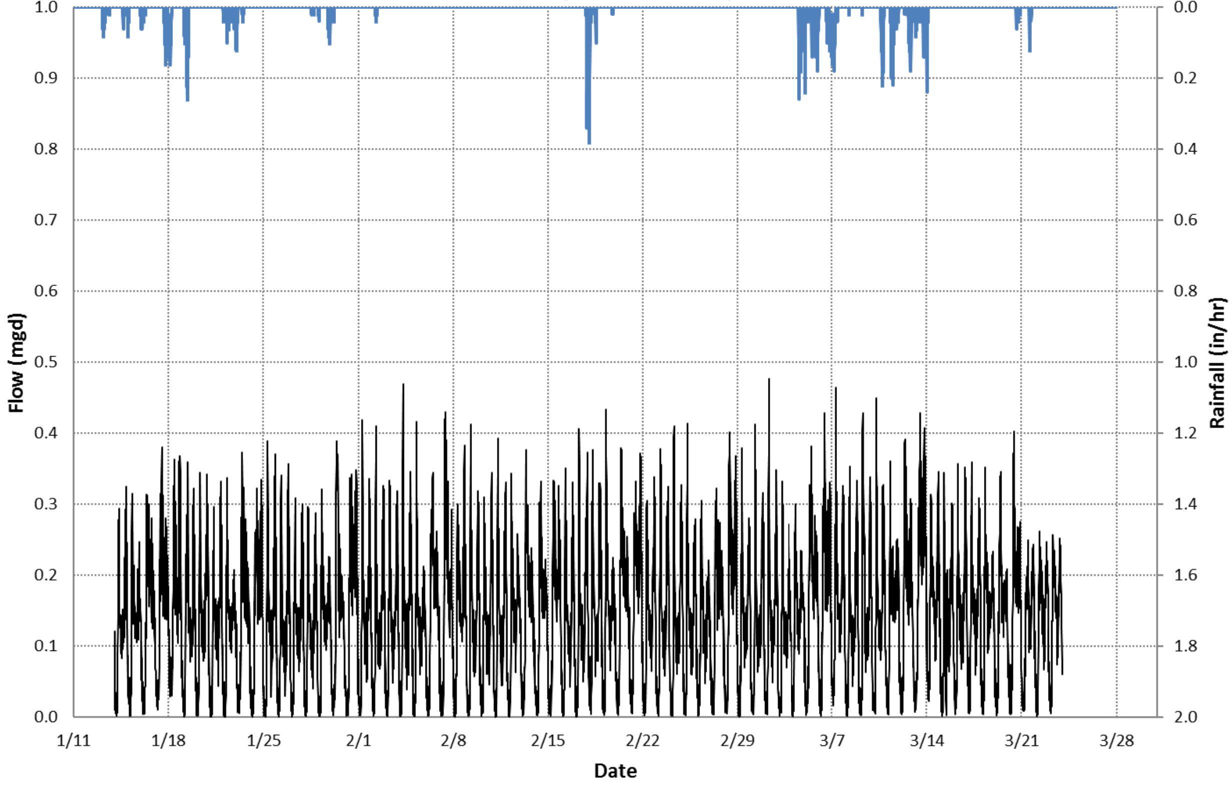
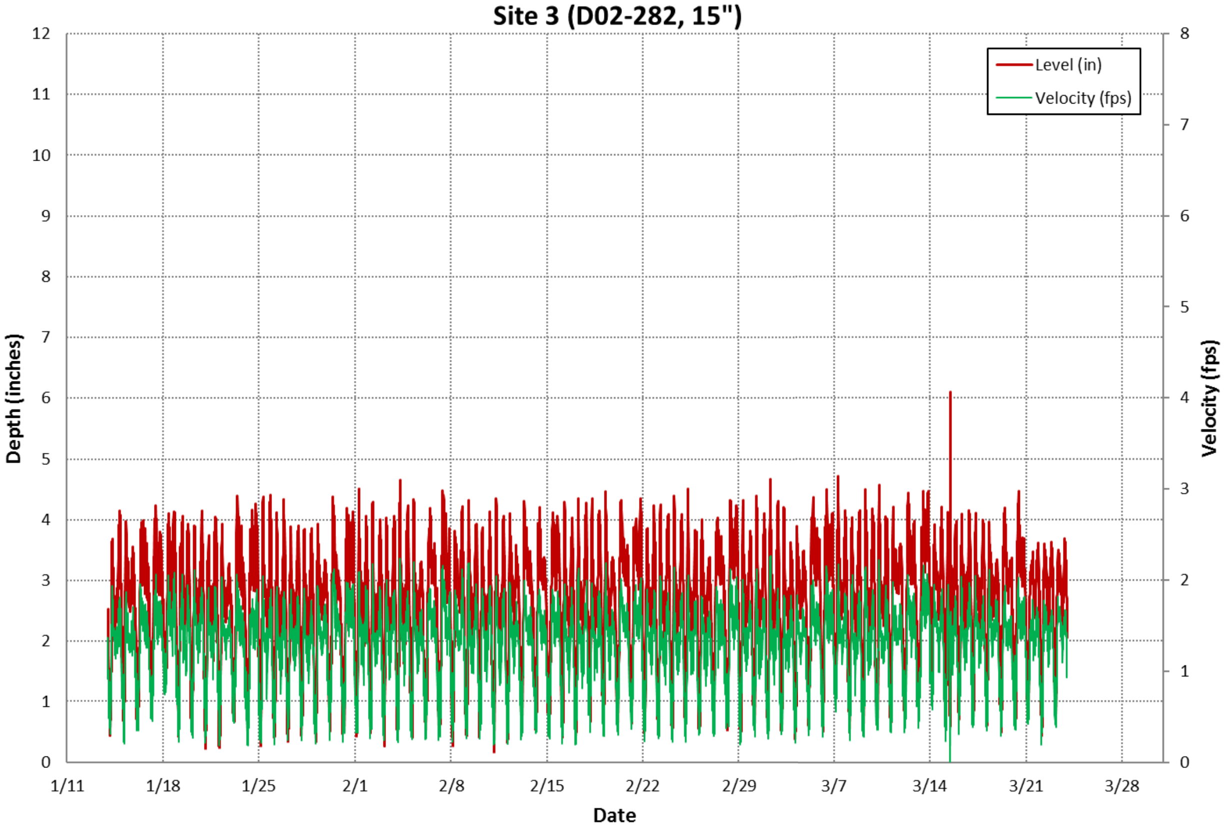
Site 2 (E01-180, 15")
Flow (mgd)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

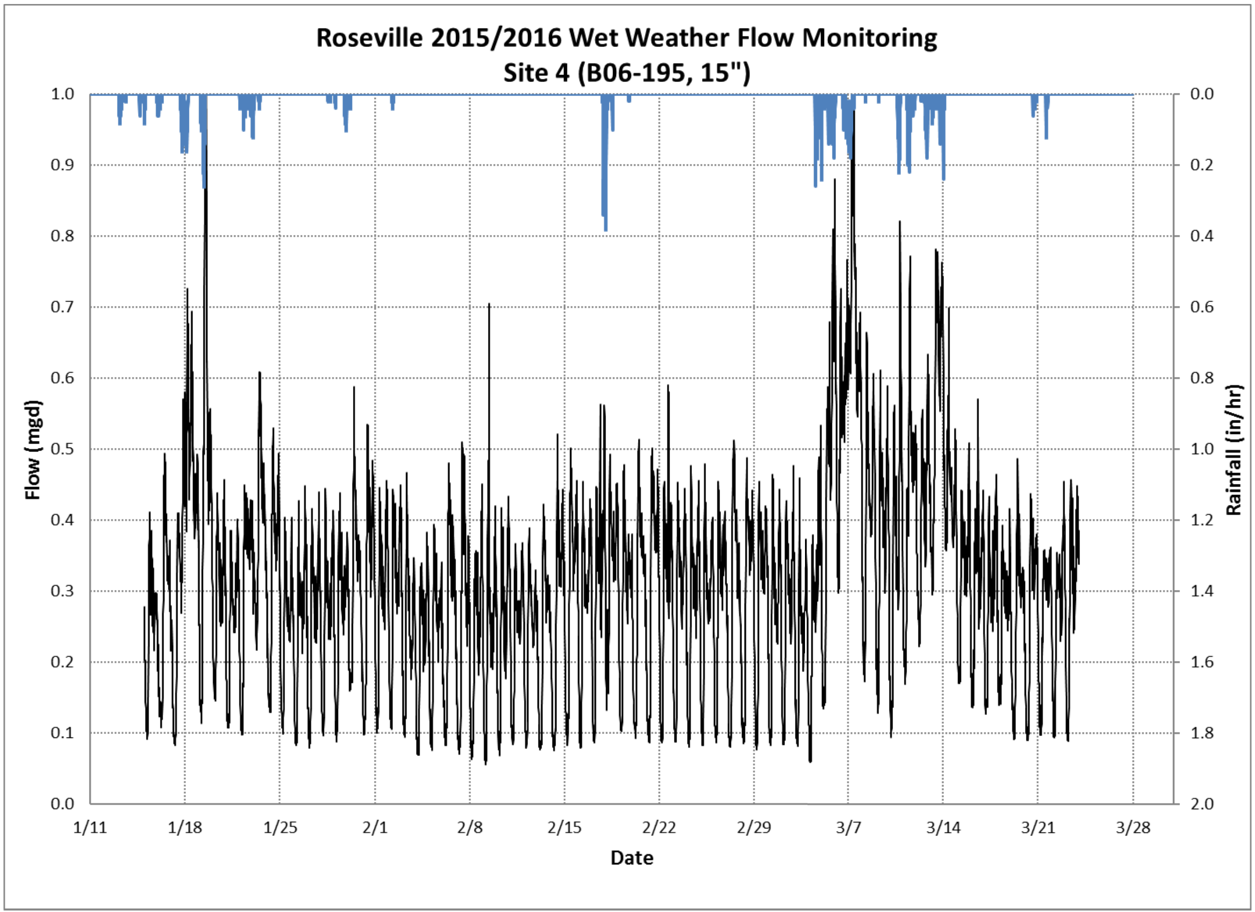

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 2 (E01-180, 15")
Level (in)
Velocity (fps)
Depth (inches)
12
11
10
9
8
7
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 3 (D02-282, 15")



Roseville 2014/2015 Wet Weather Flow Monitoring
Site 3 (D02-282, 15")

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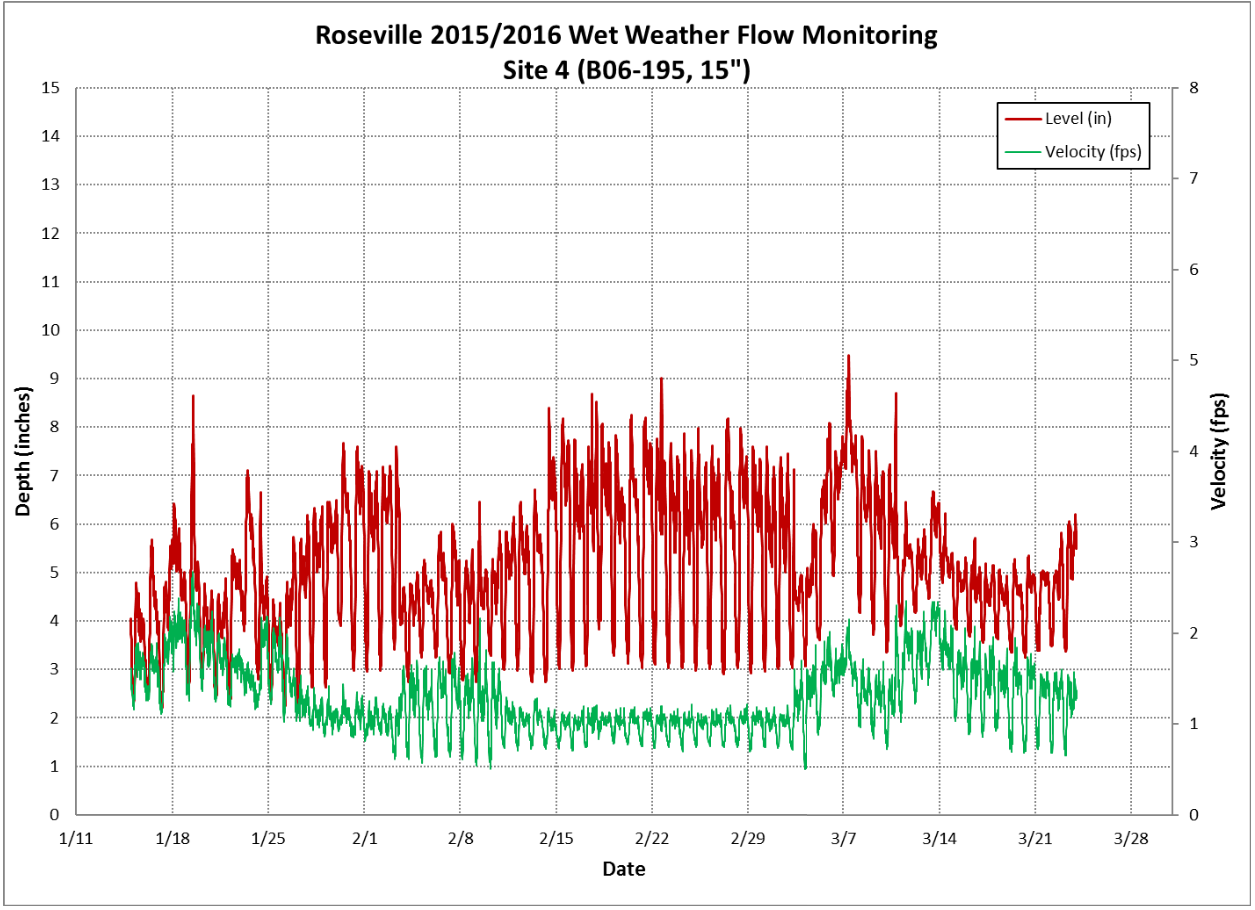
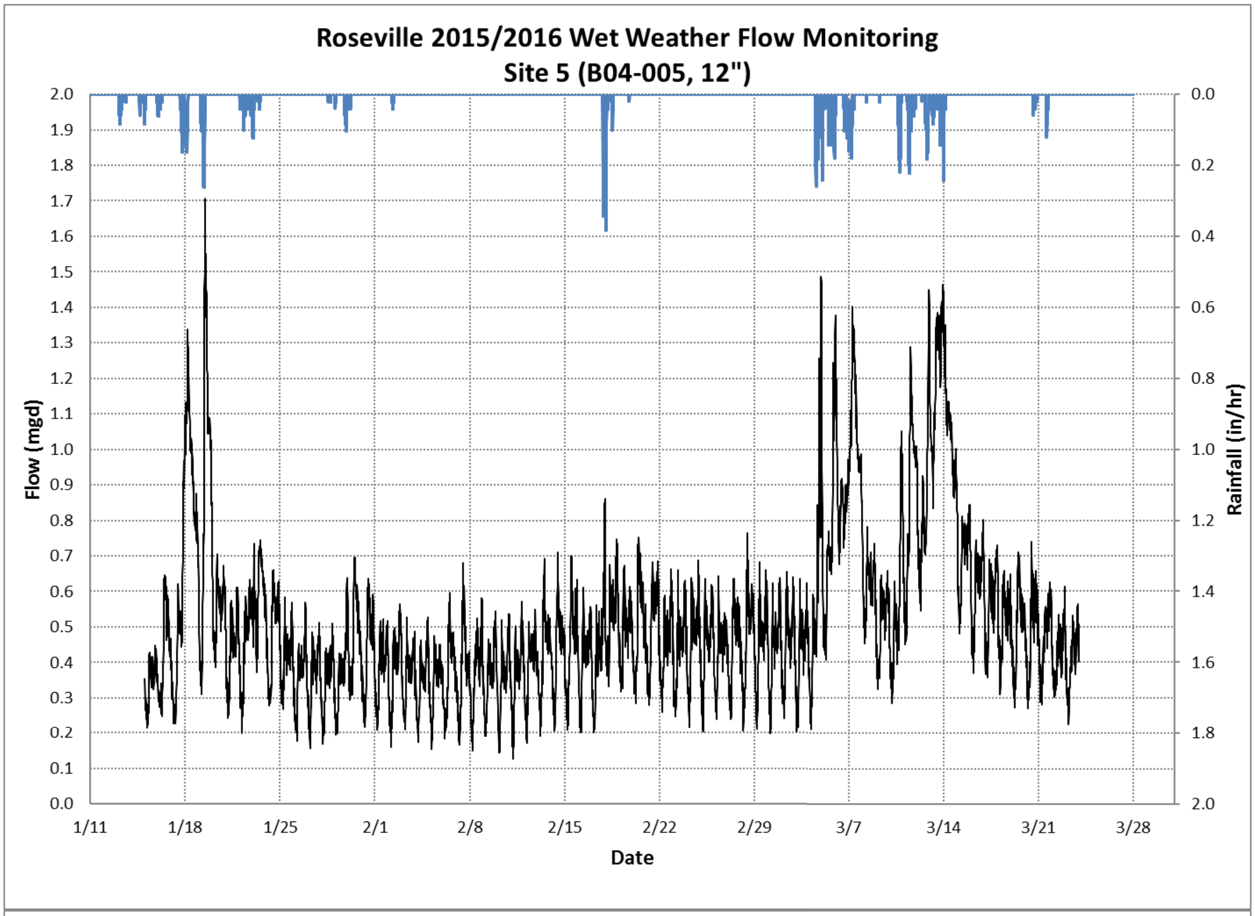
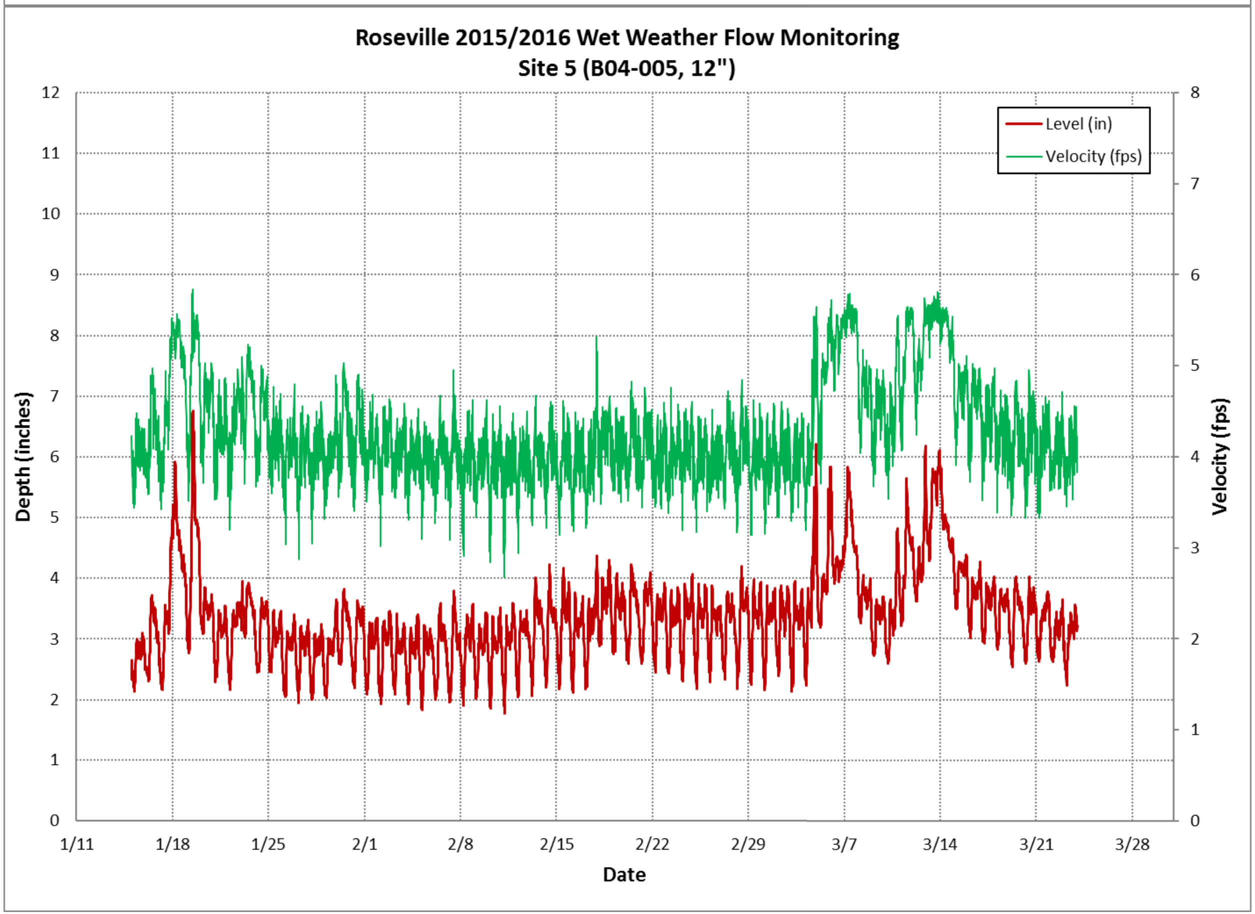
Site 4 (B06-195, 15")
Flow (mgd)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 4 (B06-195, 15")
Level (in)
Velocity (fps)
Depth (inches)
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 5 (B04-005, 12")
Flow (mgd)
Rainfall (in/hr)
Date
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 5 (B04-005, 12")
Level (in)
Velocity (fps)
Depth (inches)
Velocity (fps)
Date
12
11
10
9
8
7
6
5
4
3
2
1
0
8
7
6
5
4
3
2
1
0
1/11
1/18
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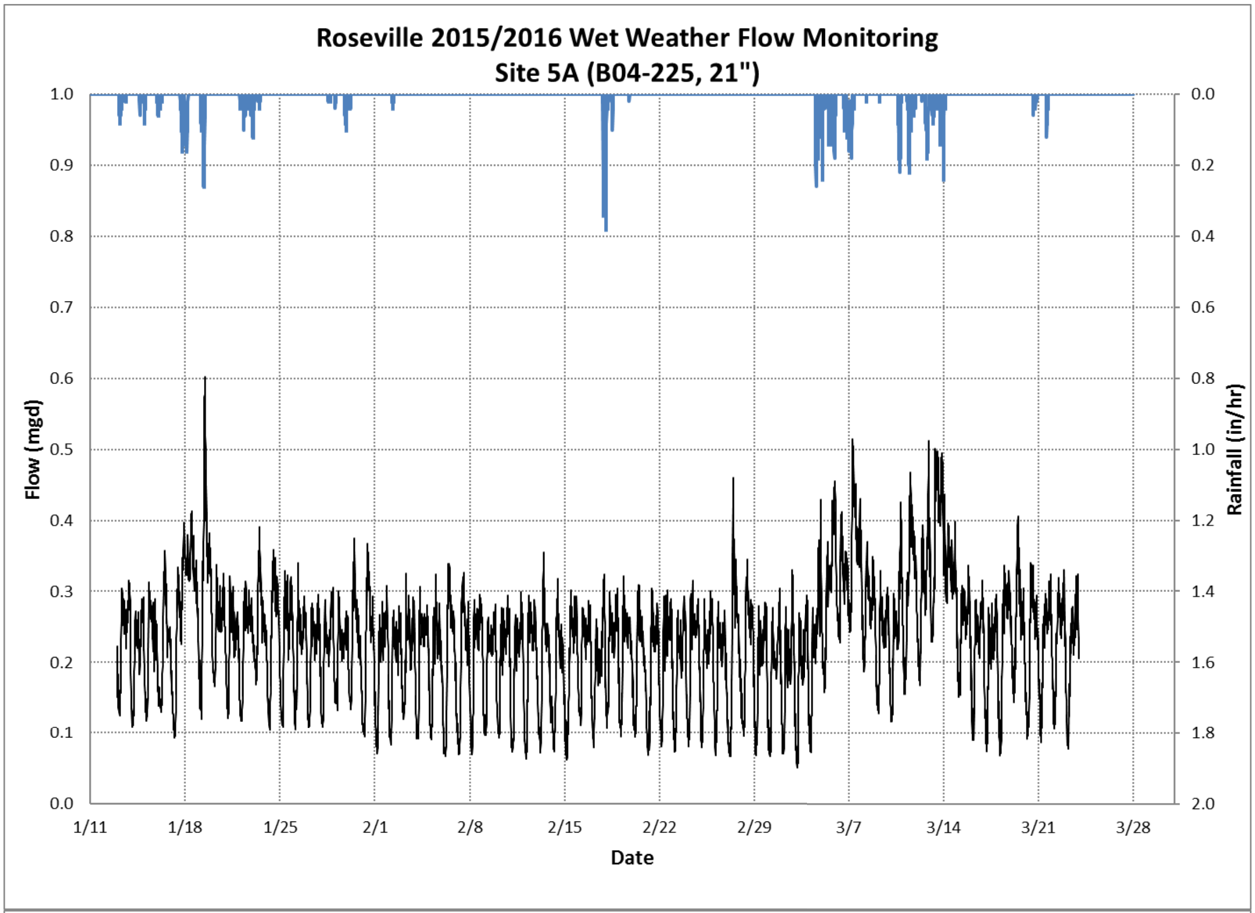
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 5A (B04-225, 21")
Flow (mgd)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
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2/1
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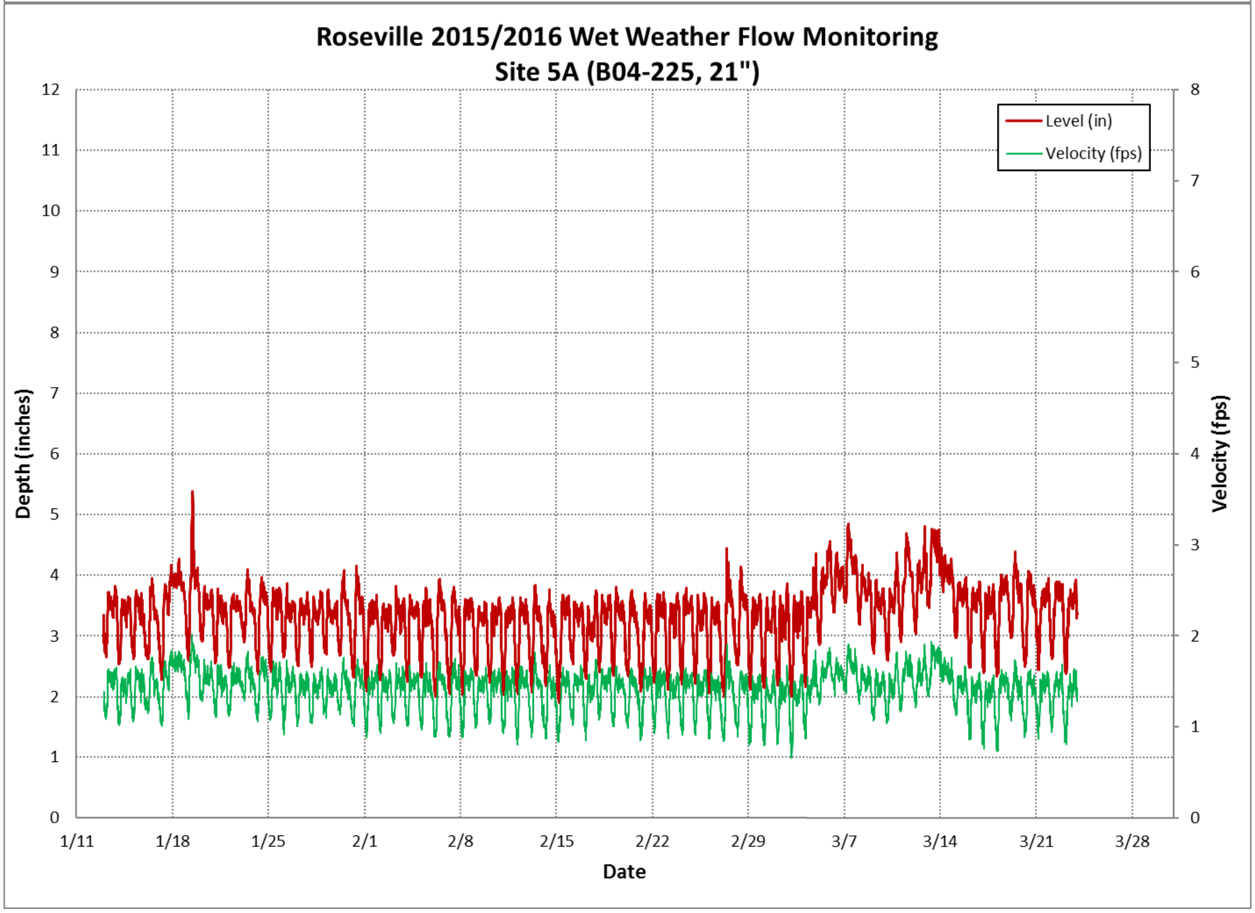
2/29
3/7
3/14
3/21
3/28
Date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Site 5A (B04-225, 21")
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Velocity (fps)
Depth (inches)
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11
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9
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6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
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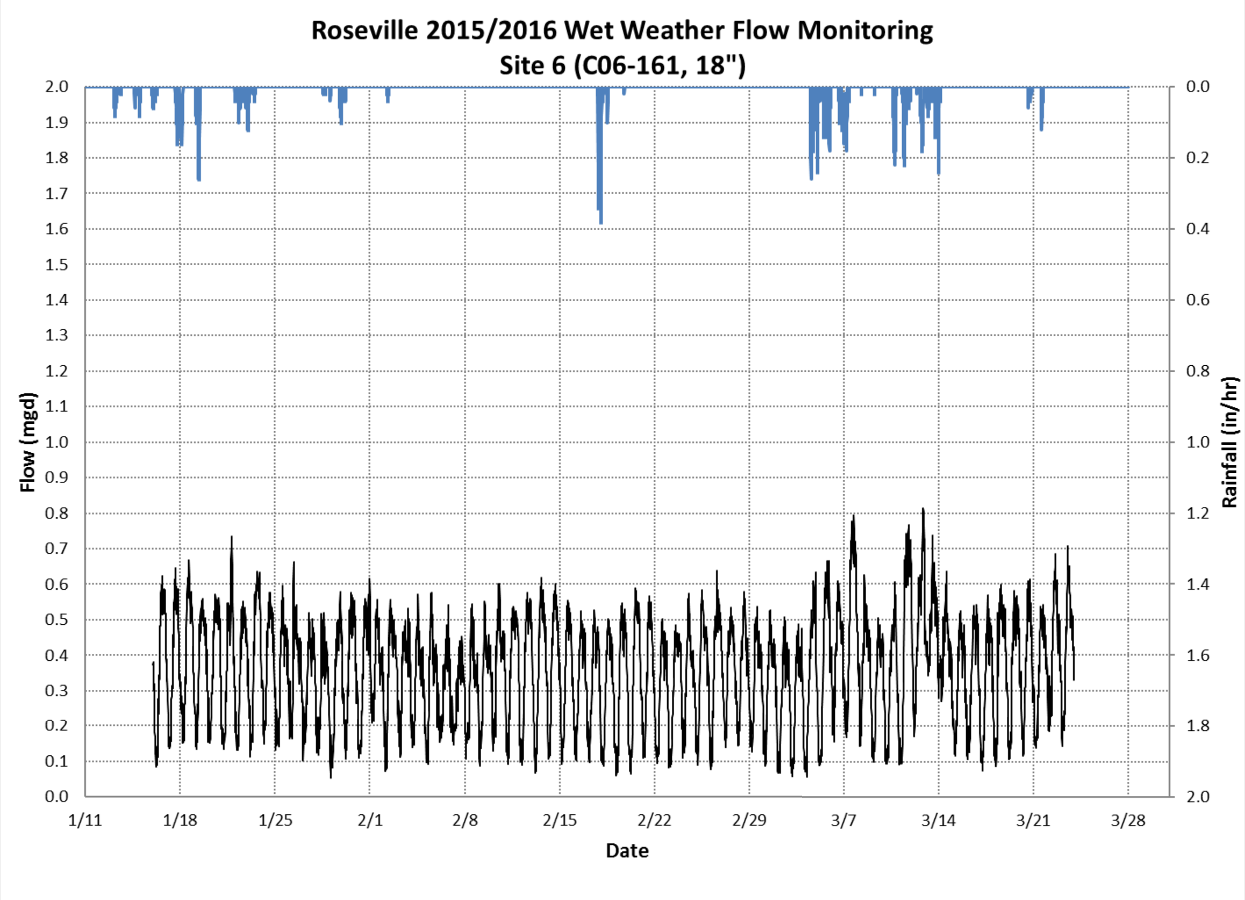
Date


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 6 (C06-161, 18")
Flow (mgd)
2.0
1.9
1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
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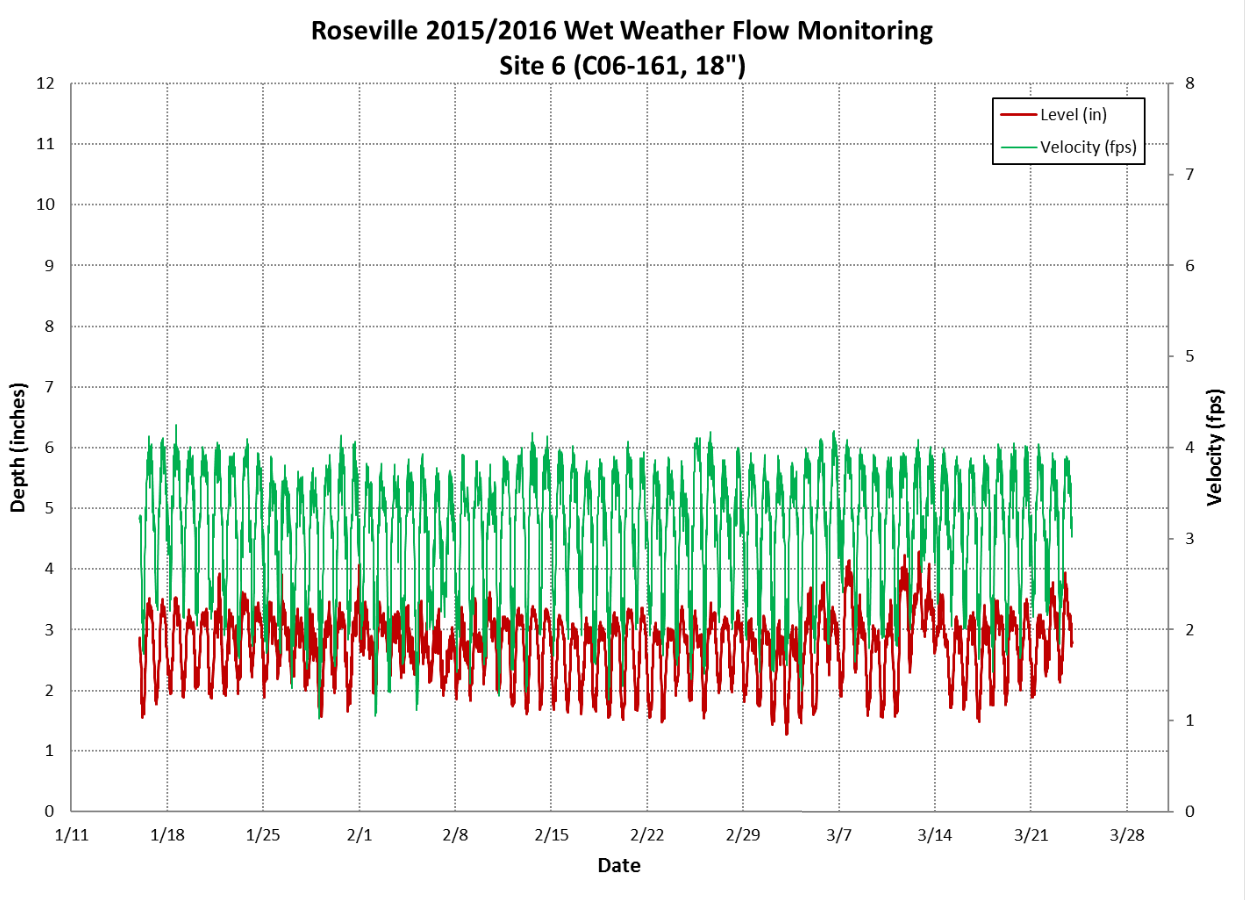
3/21
3/28
Date


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 6 (C06-161, 18")
Depth (inches)
12
11
10
9
8
7
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
Level (in)
Velocity (fps)
1/11
1/18
1/25
2/1
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2/15
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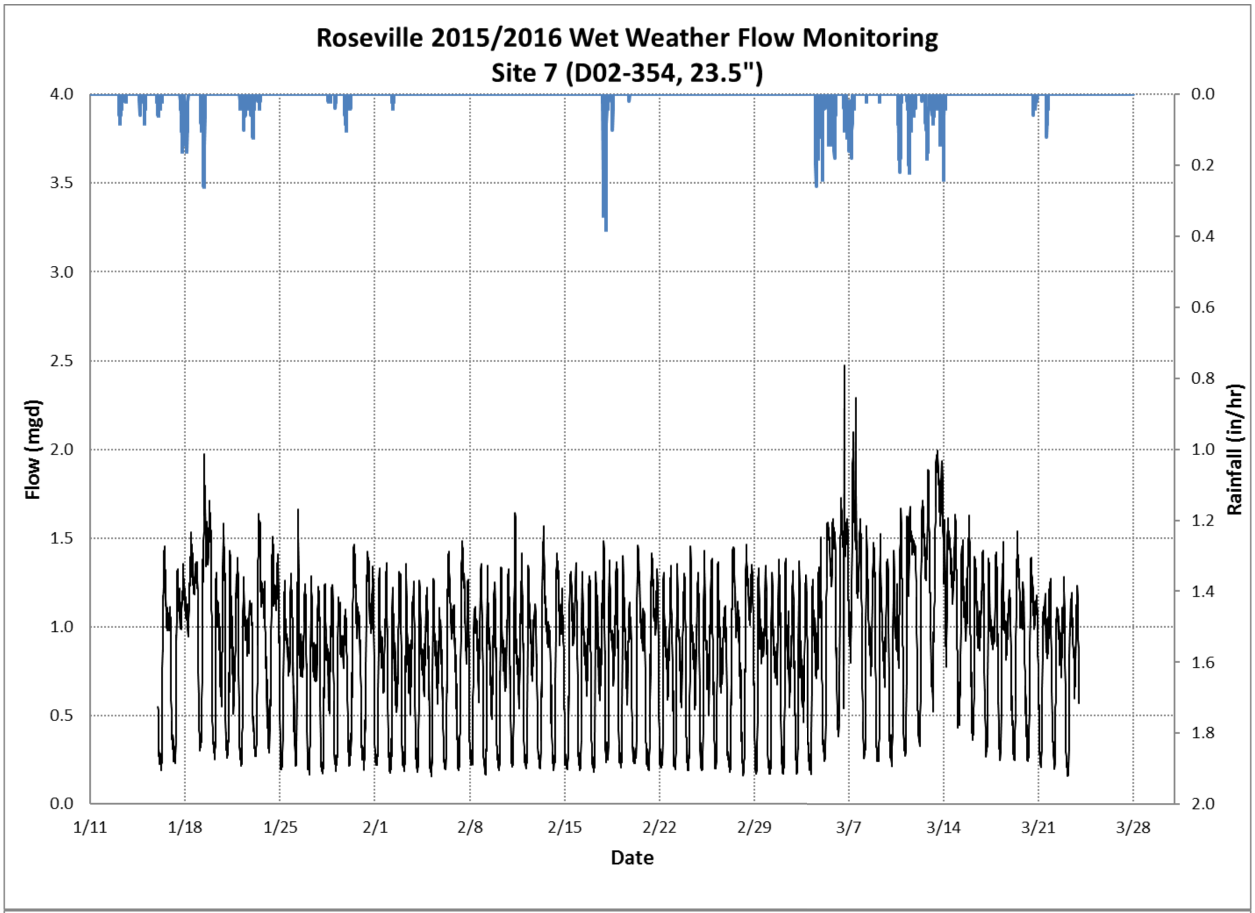
3/21
3/28
Date


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 7 (D02-354, 23.5")
Flow (mgd)
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3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
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3/7
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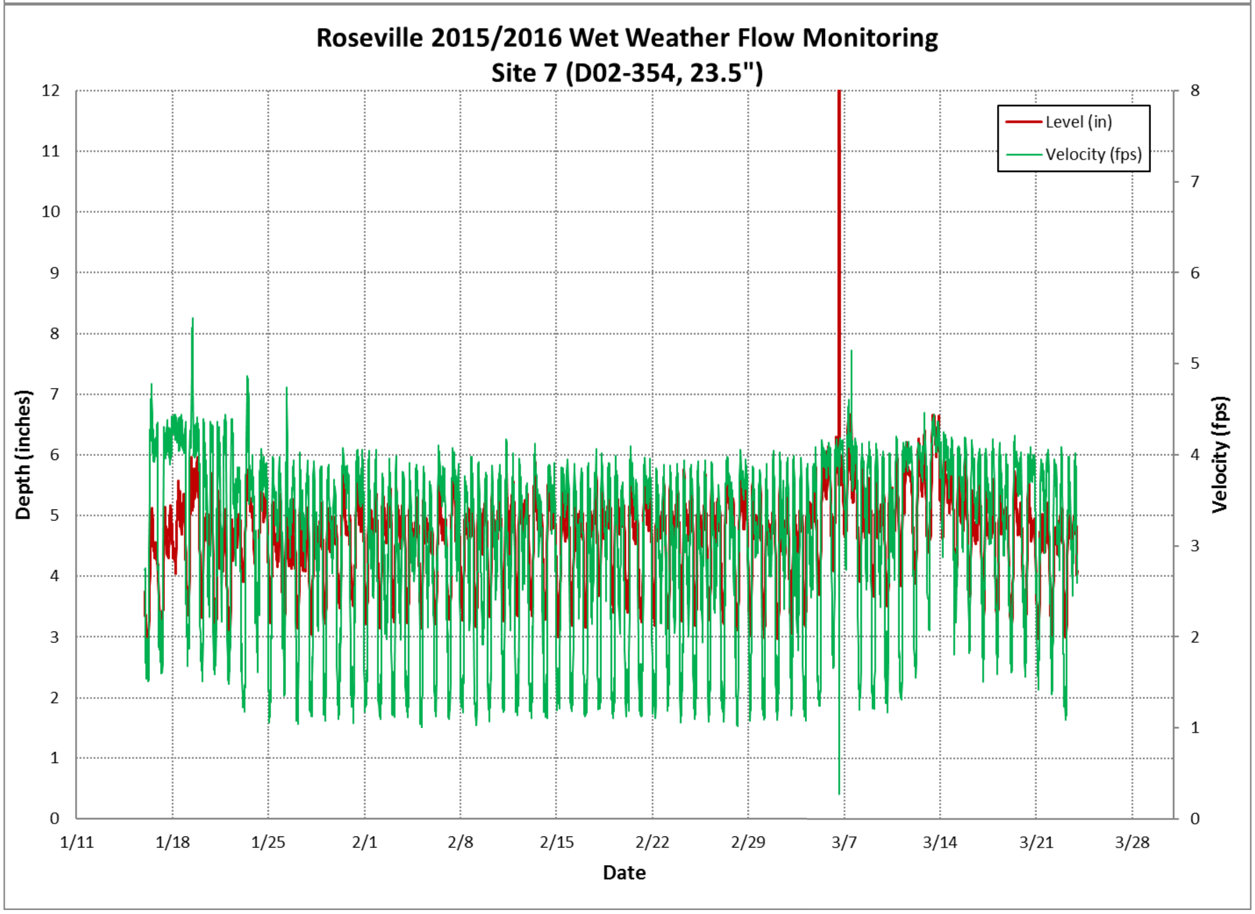
Date


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 7 (D02-354, 23.5")
Level (in)
Velocity (fps)
Depth (inches)
12
11
10
9
8
7
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
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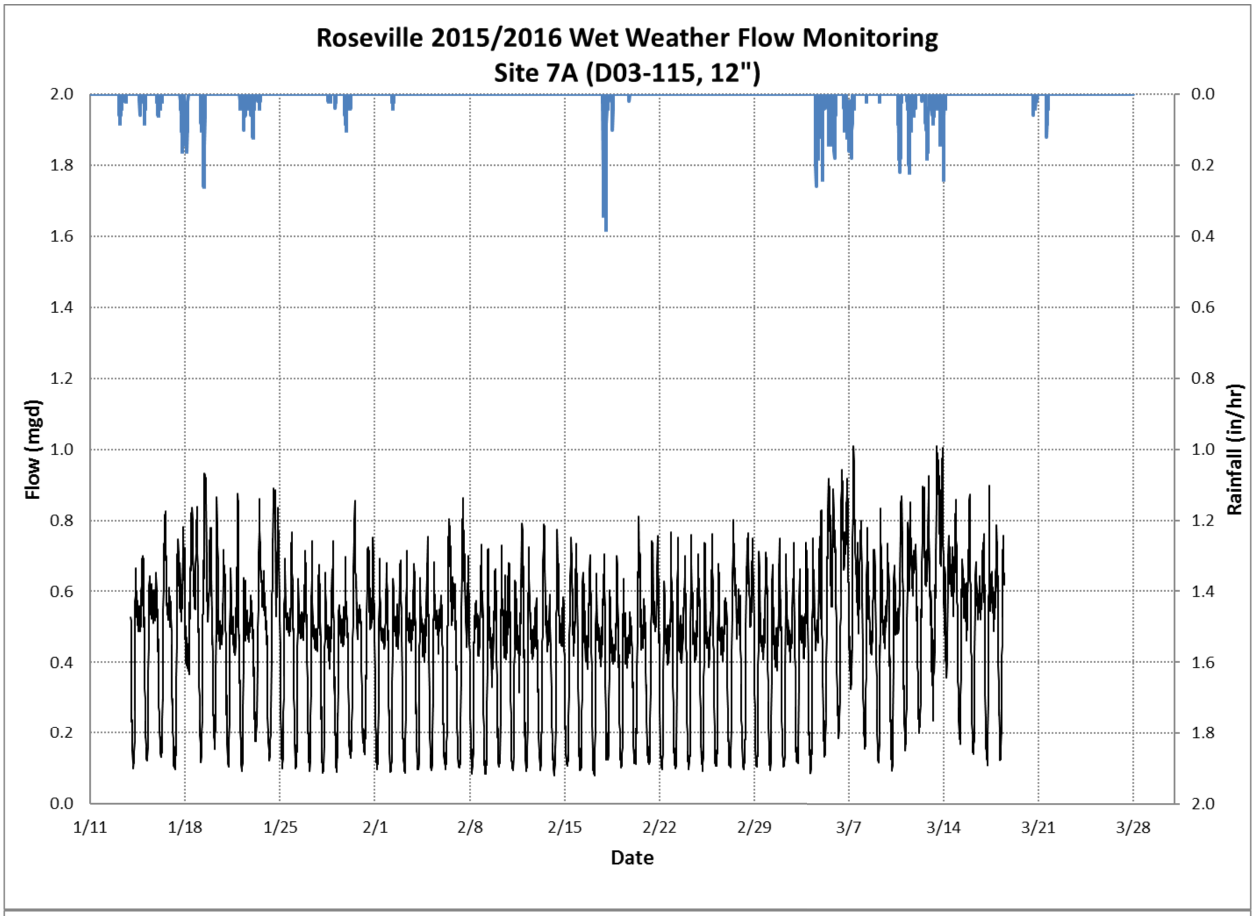
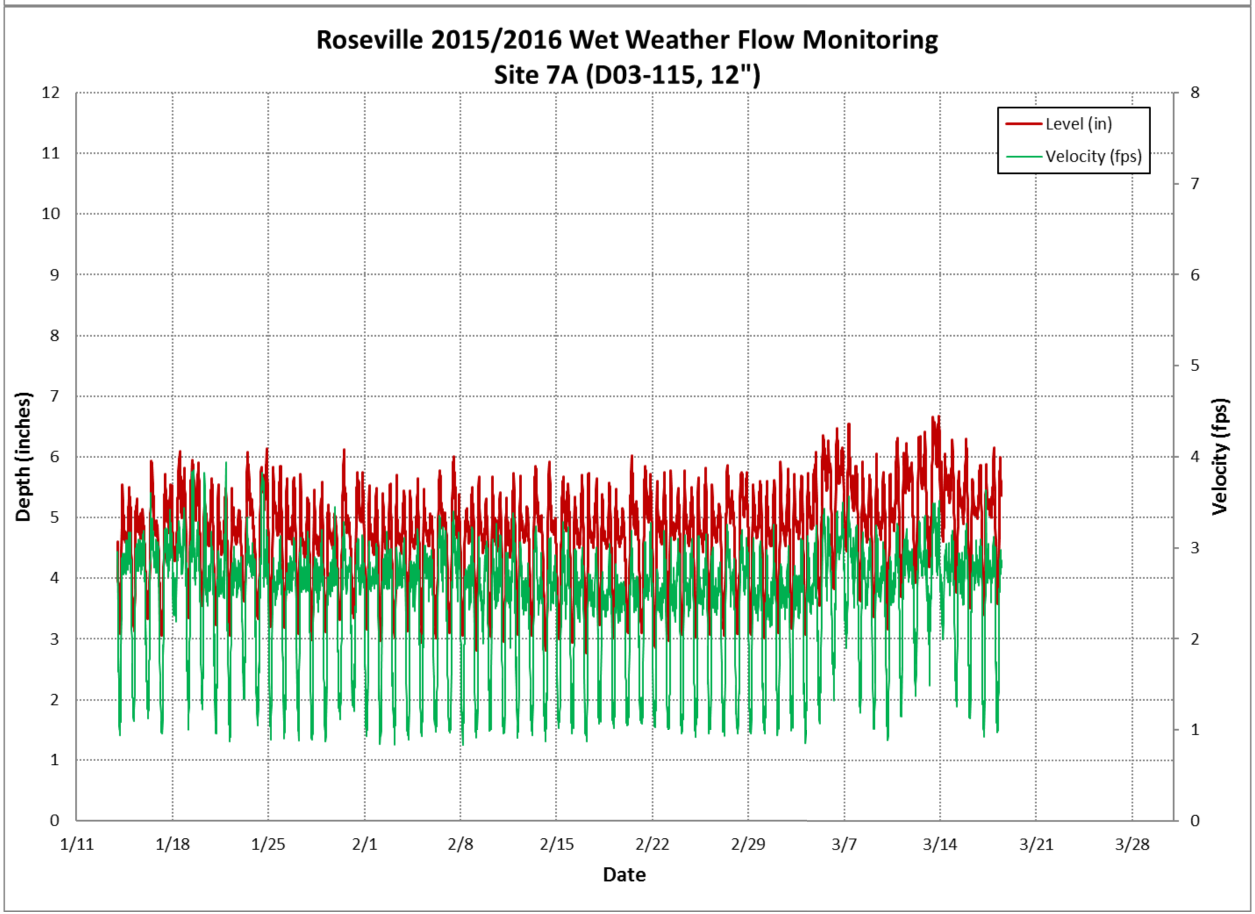
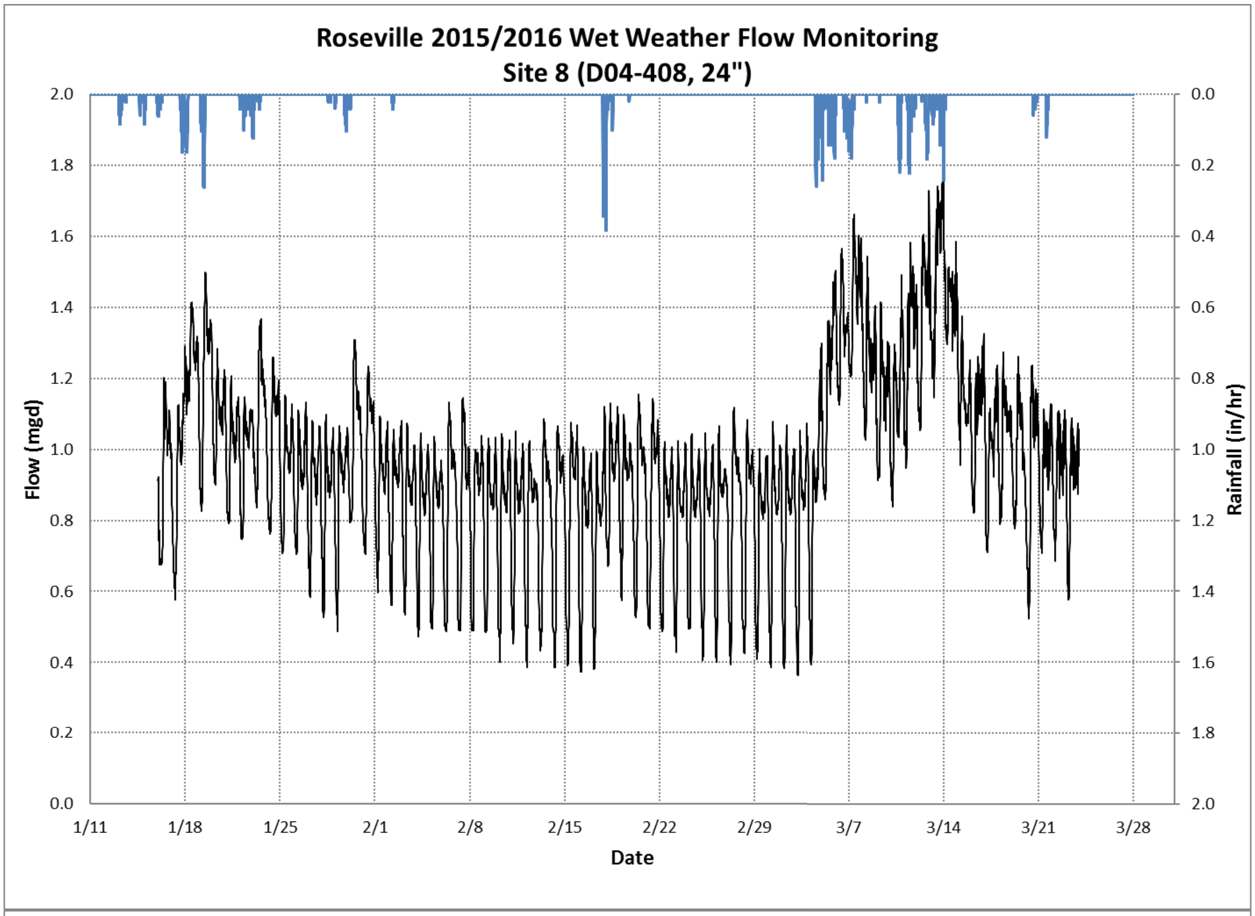
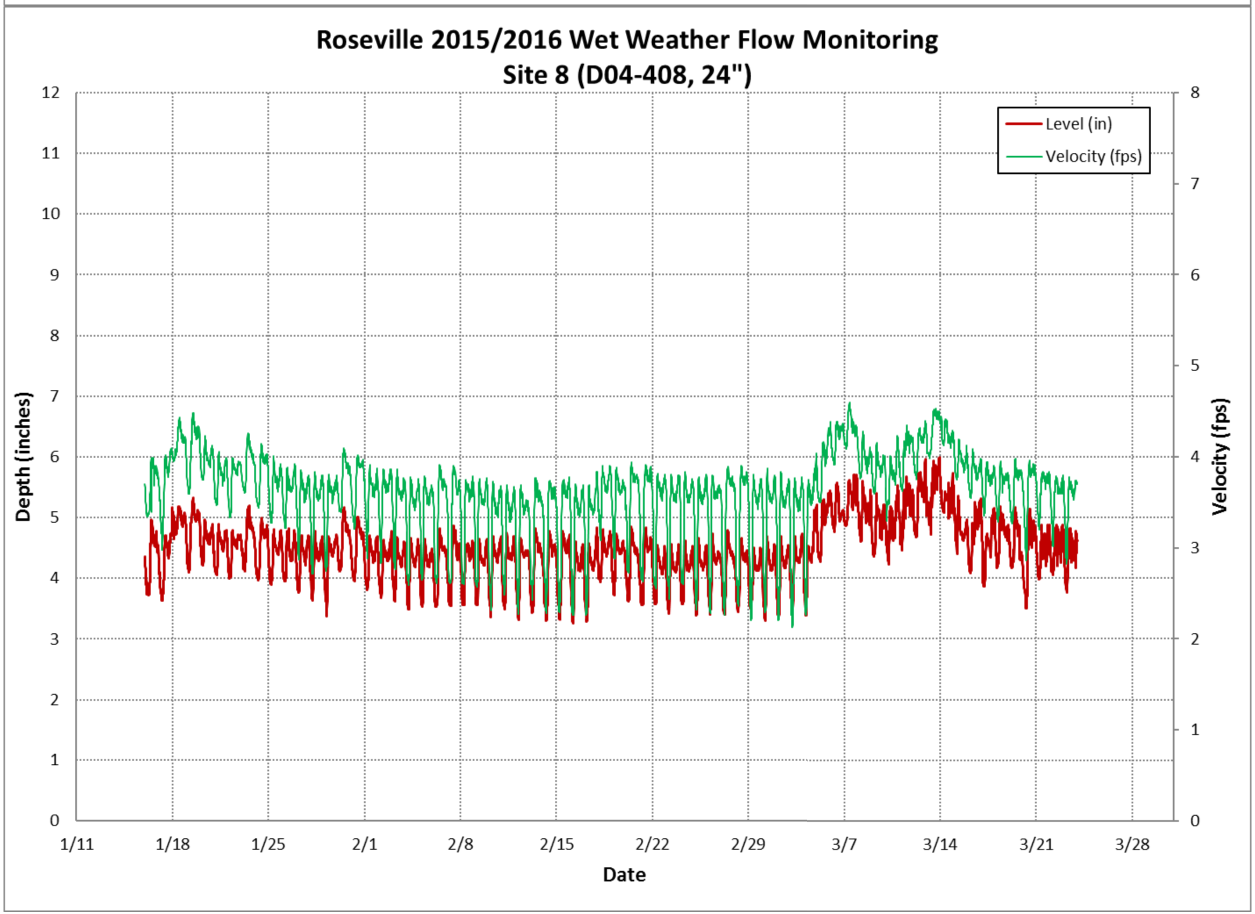
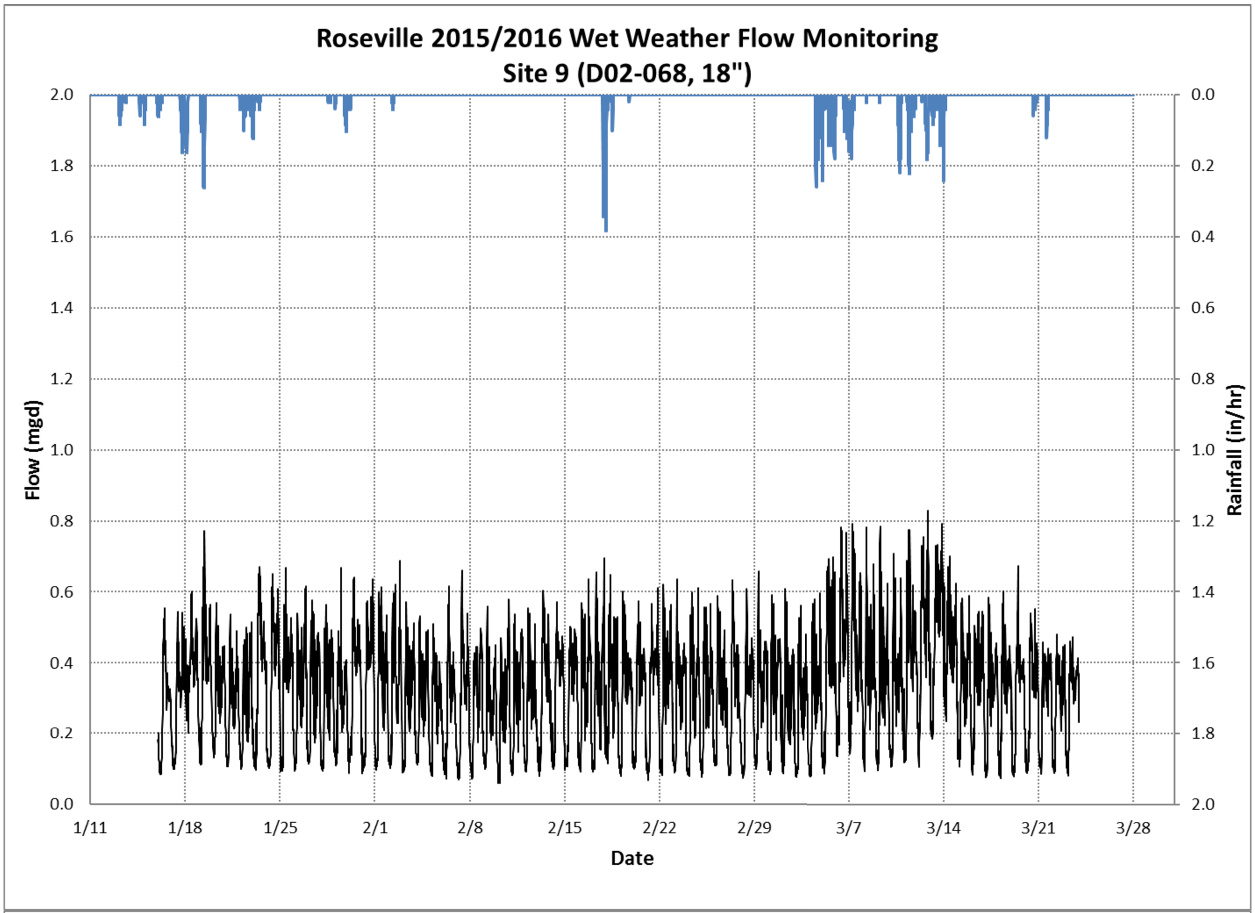
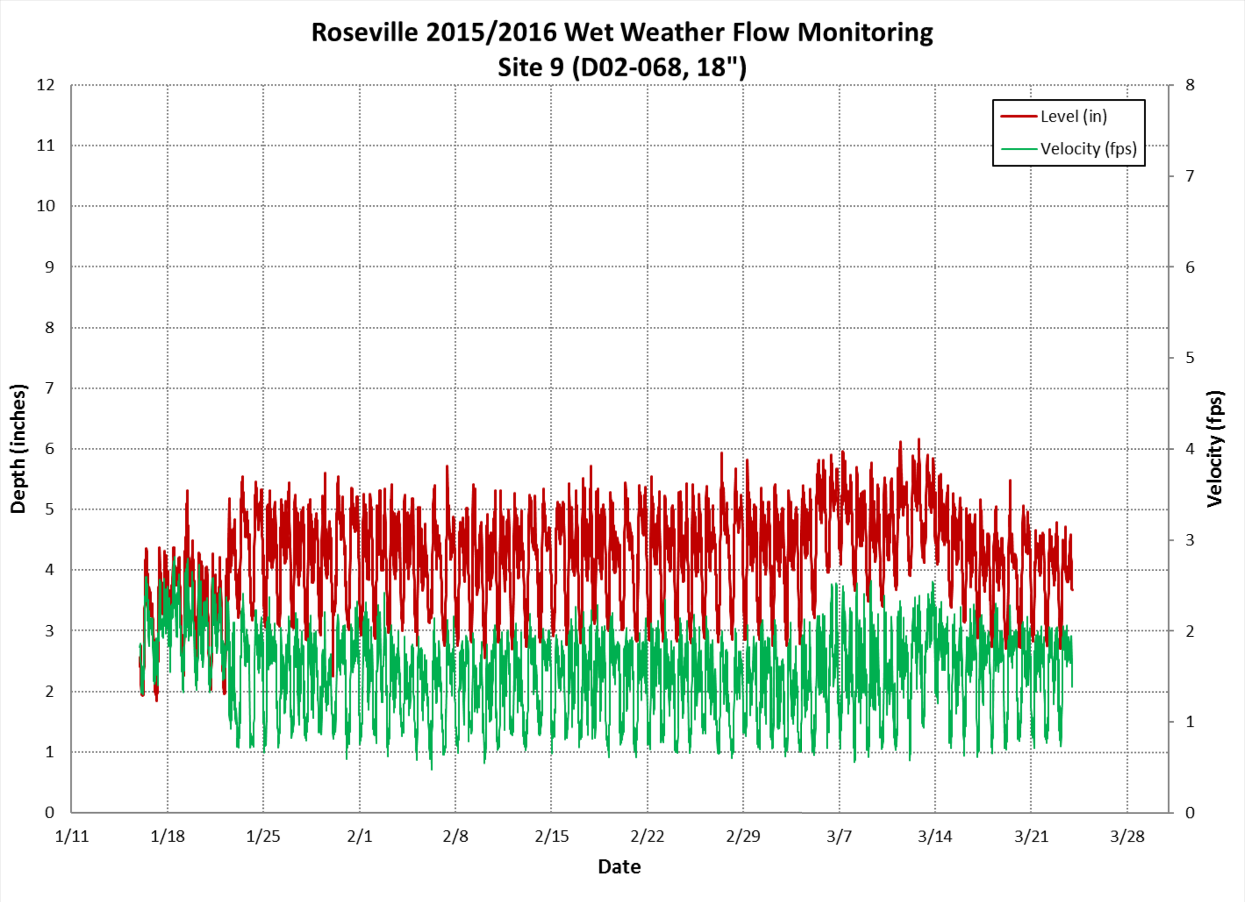

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 7A (D03-115, 12")
Flow (mgd)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

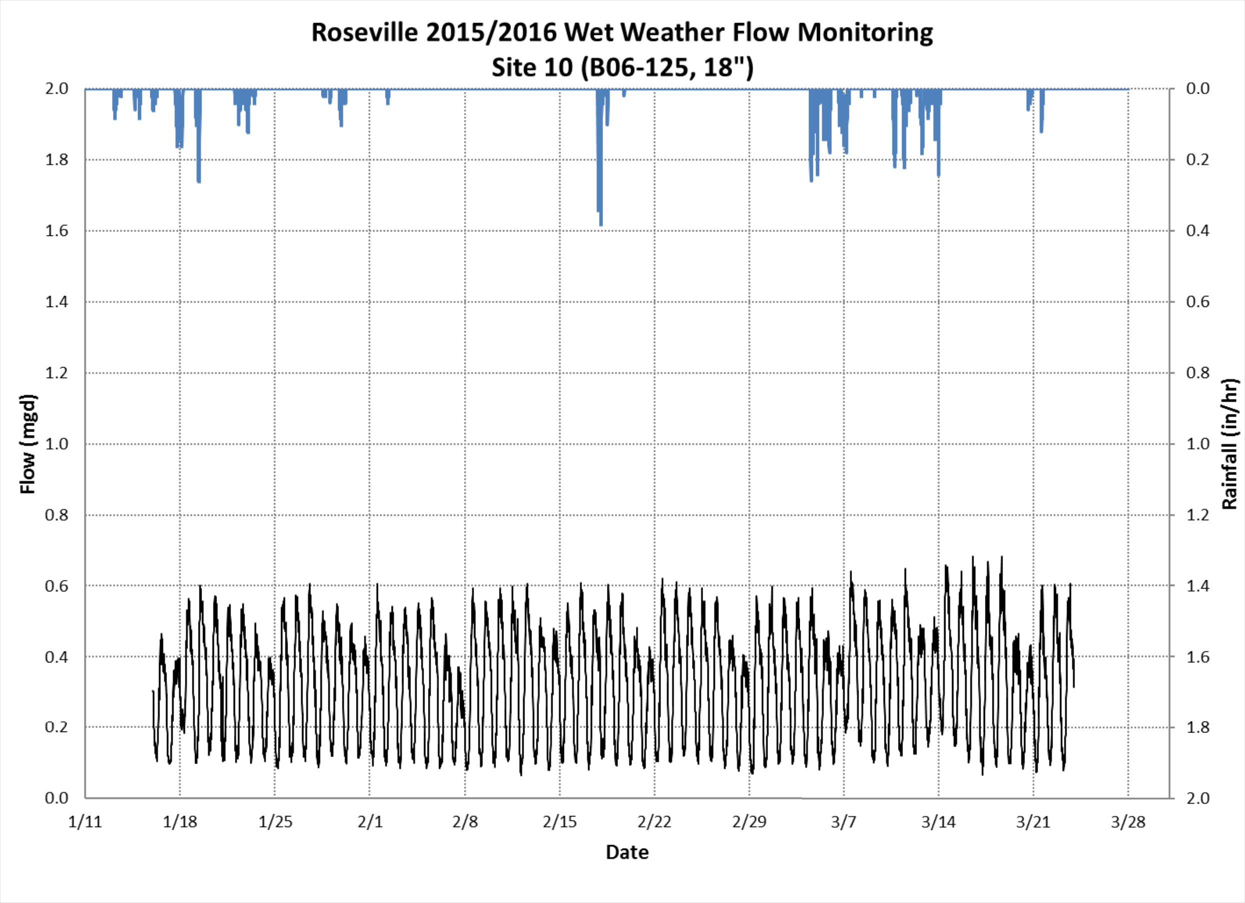

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 7A (D03-115, 12")
Level (in)
Velocity (fps)
Depth (inches)
12
11
10
9
8
7
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 8 (D04-408, 24")
Flow (mgd)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

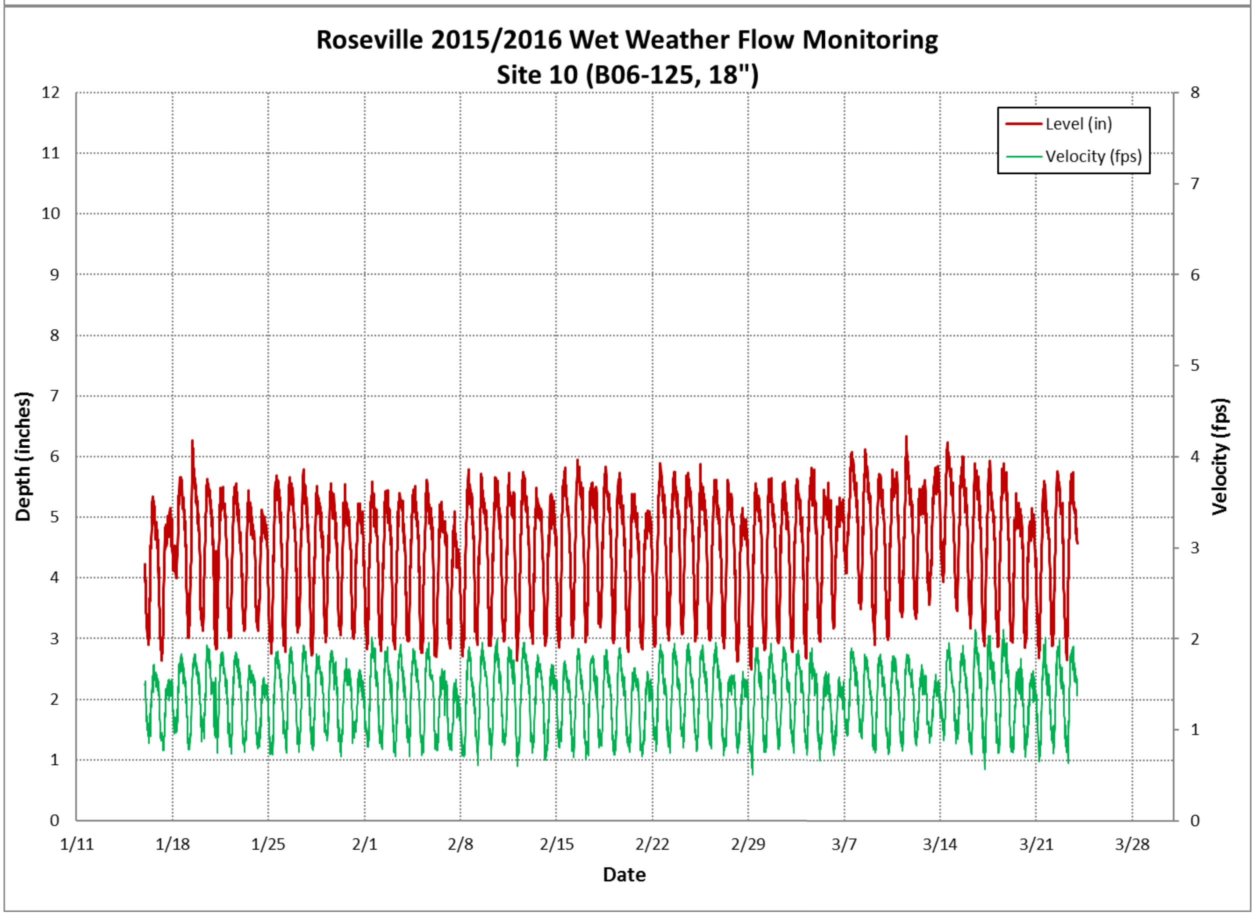

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 8 (D04-408, 24")
Level (in)
Velocity (fps)
Depth (inches)
12
11
10
9
8
7
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 9 (D02-068, 18")

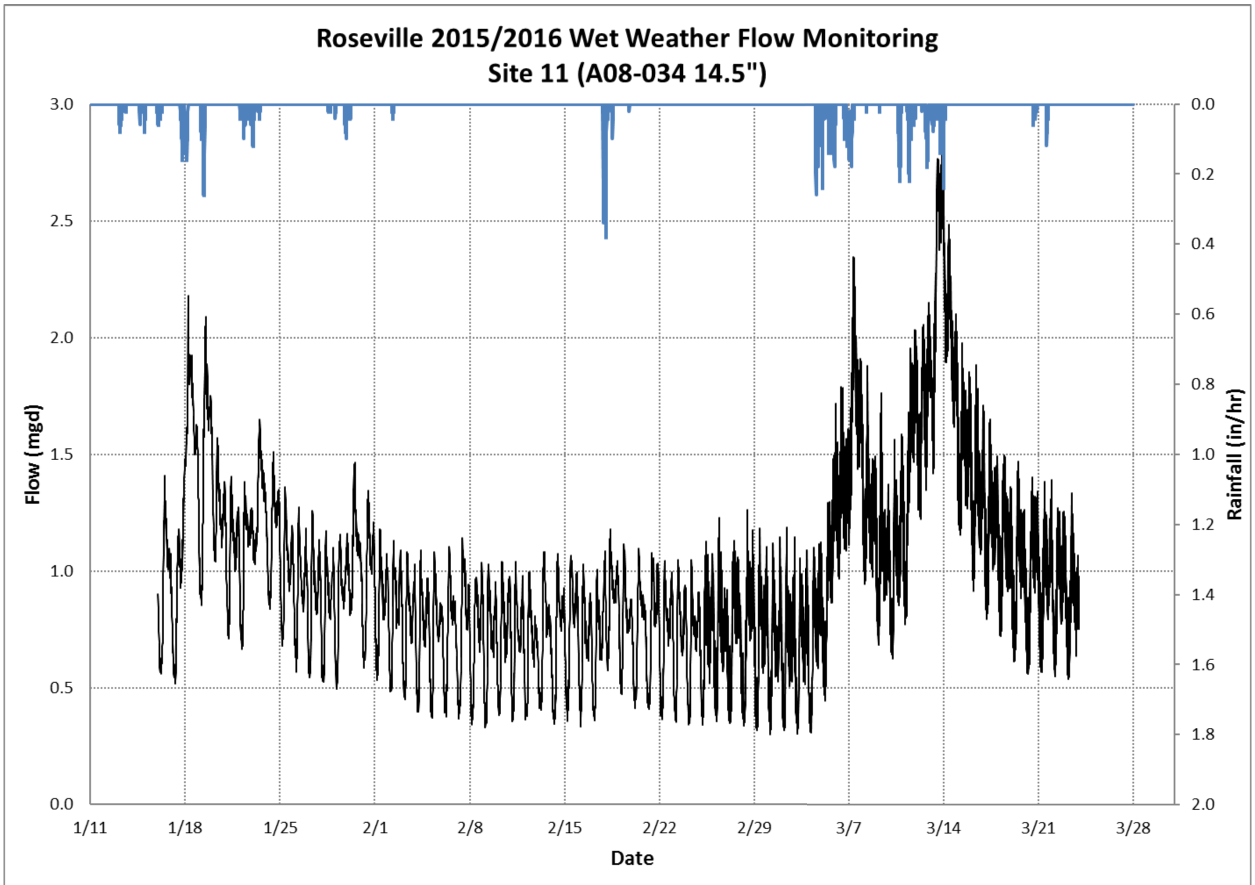

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 9 (D02-068, 18")

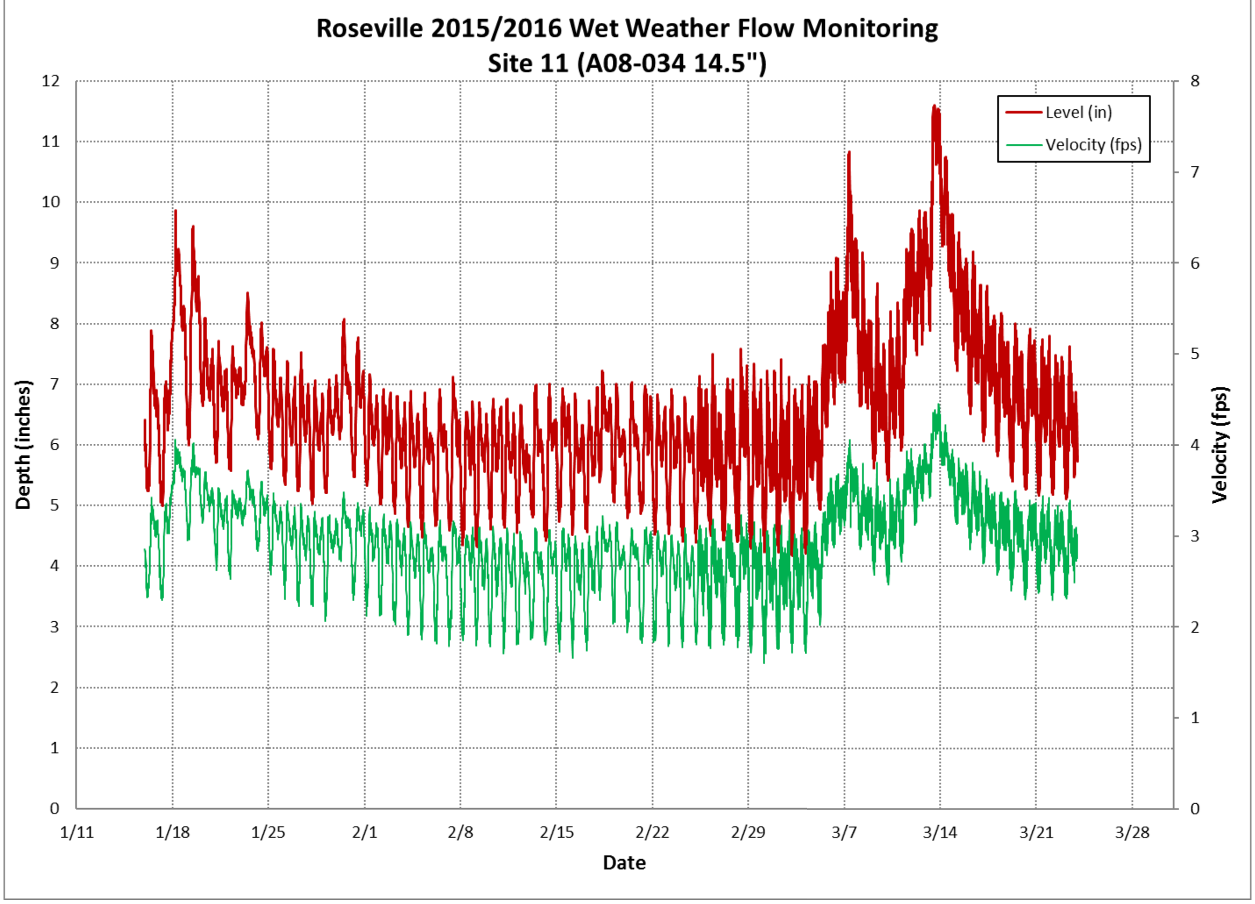


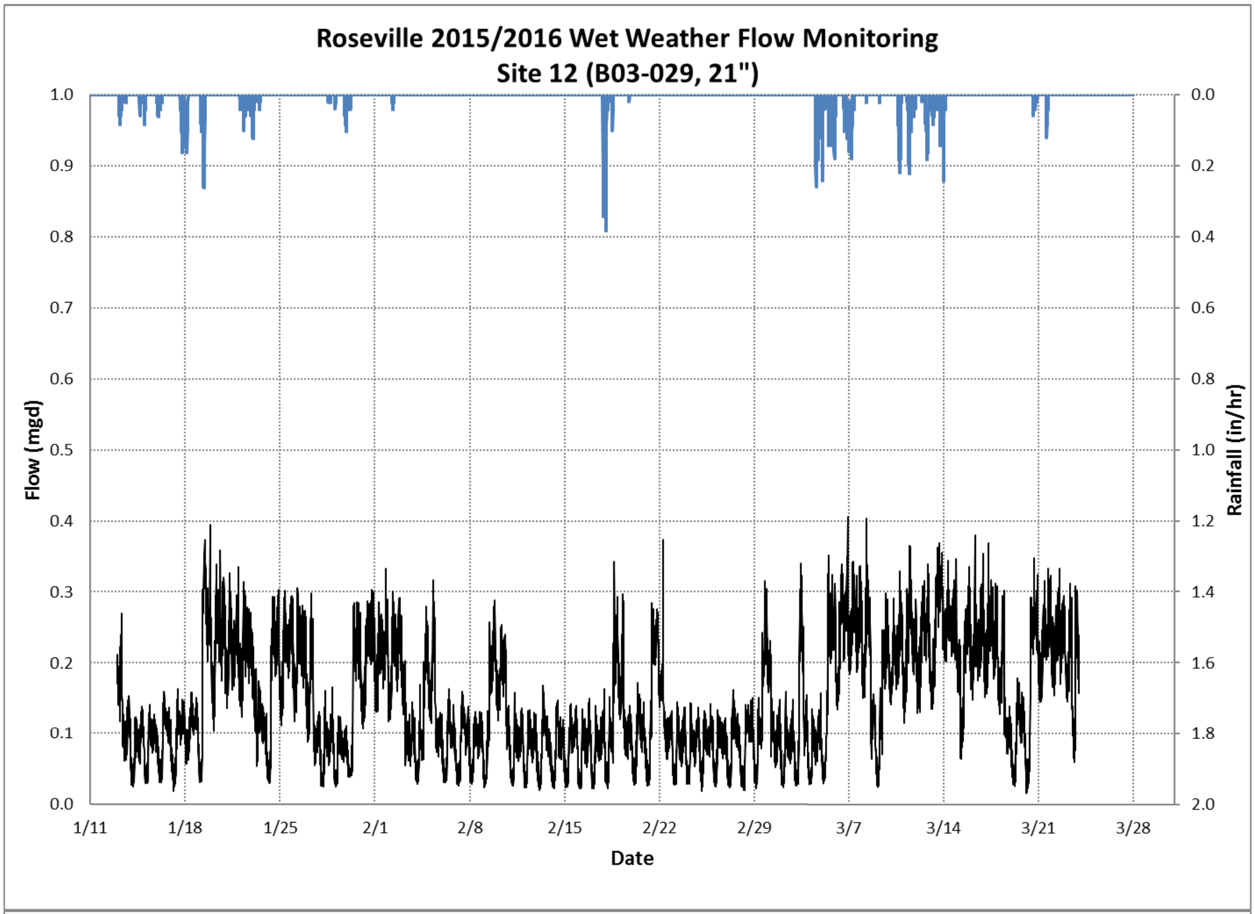
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 10 (B06-125, 18")
Flow (mgd)
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

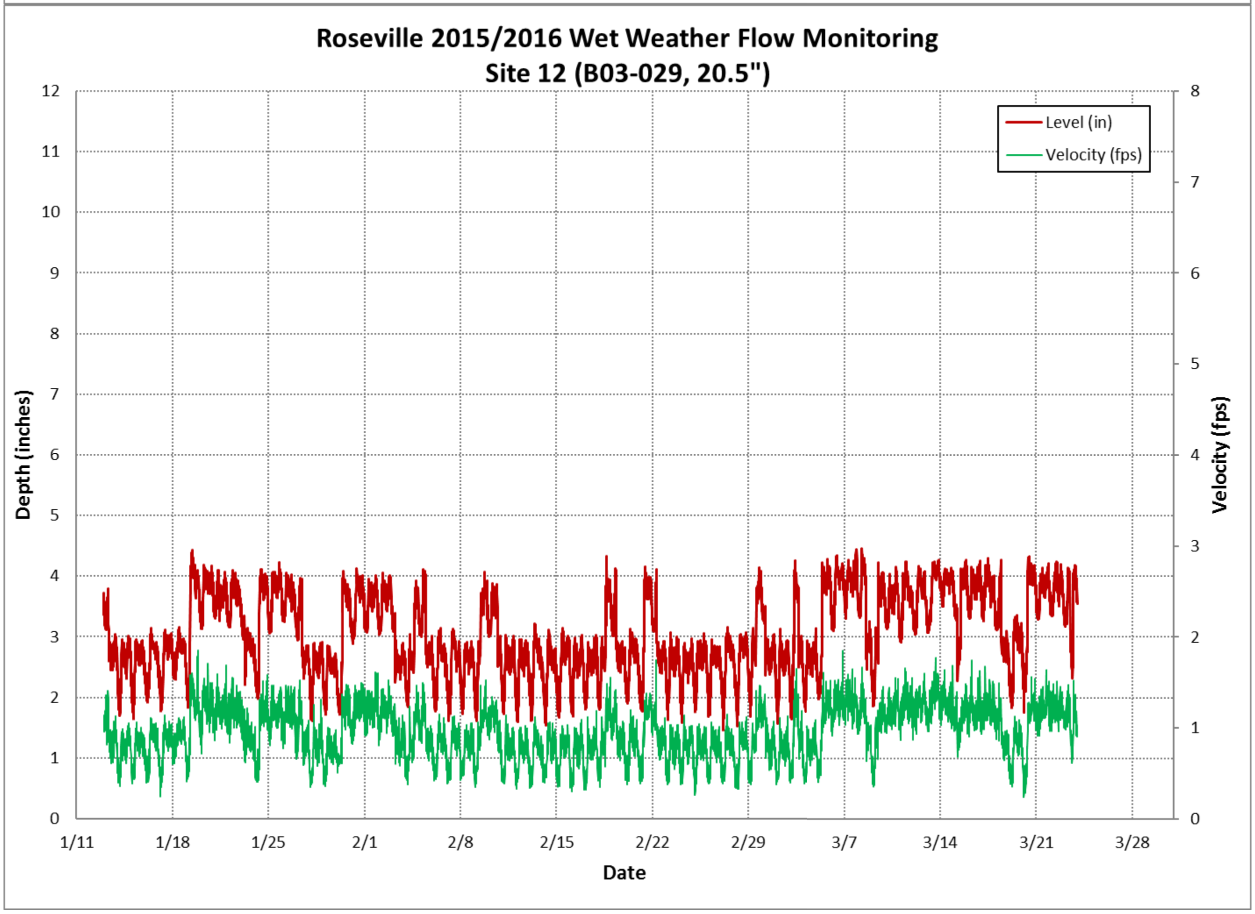


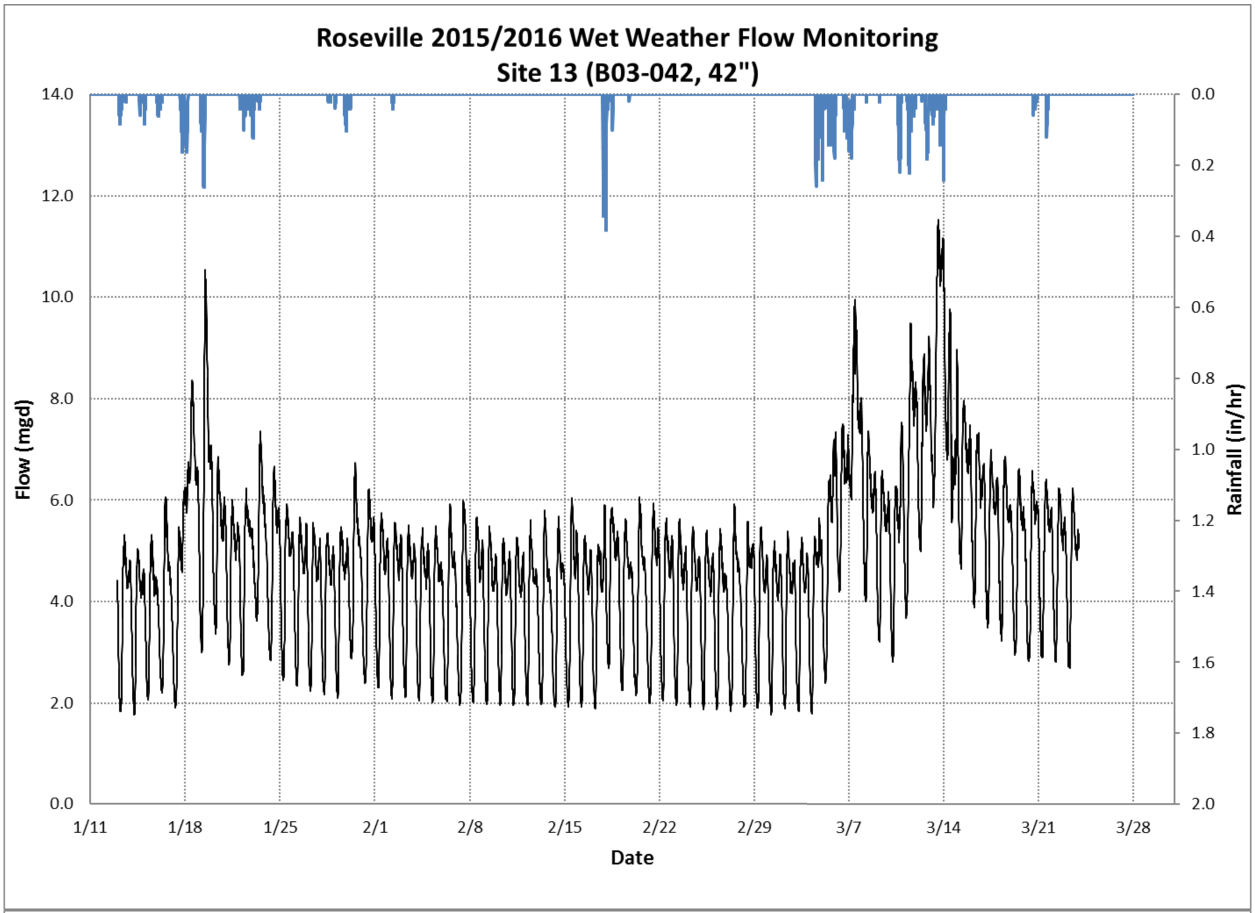
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 10 (B06-125, 18")
Level (in)
Velocity (fps)
Depth (inches)
12
11
10
9
8
7
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

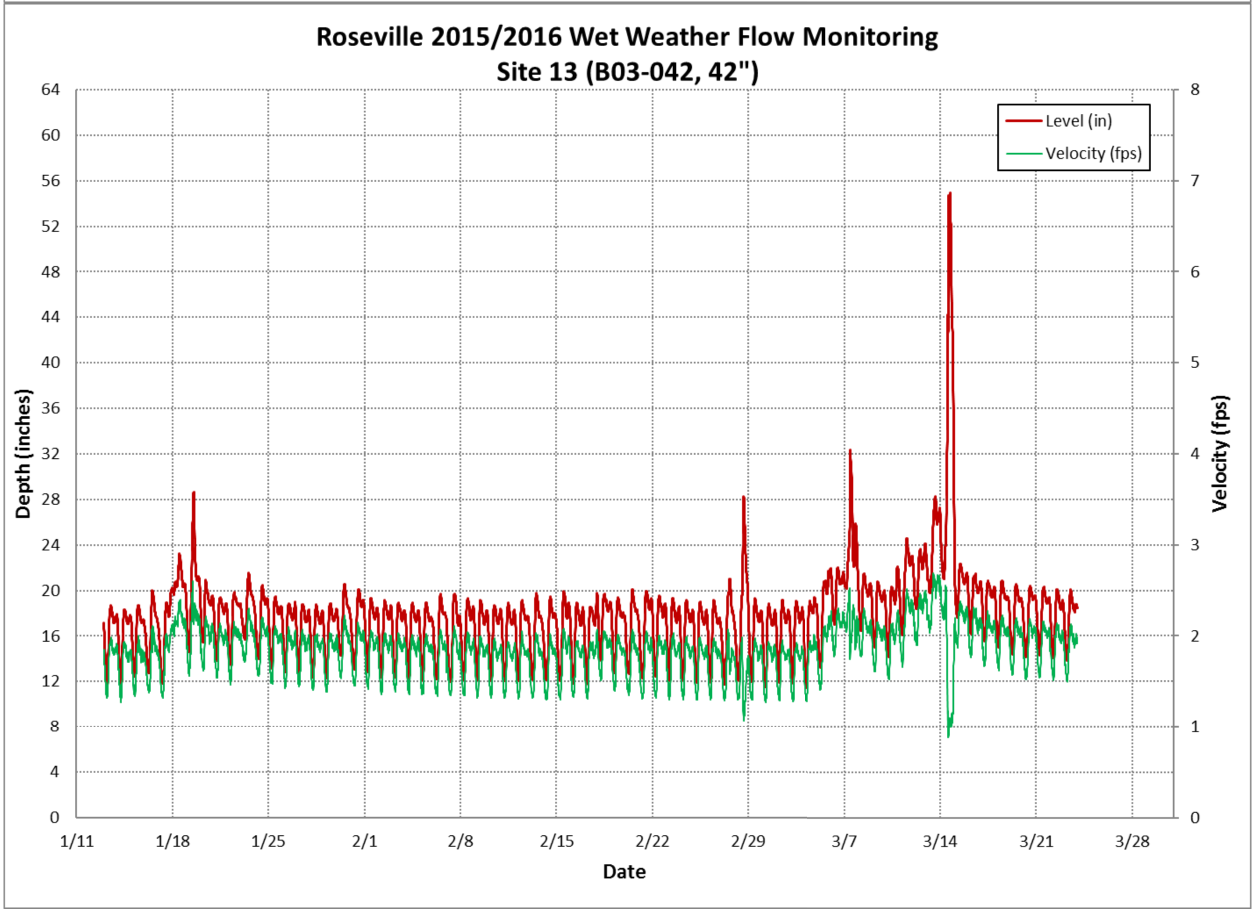

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 11 (A08-034 14.5")
Flow (mgd)
Rainfall (in/hr)
Date
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28

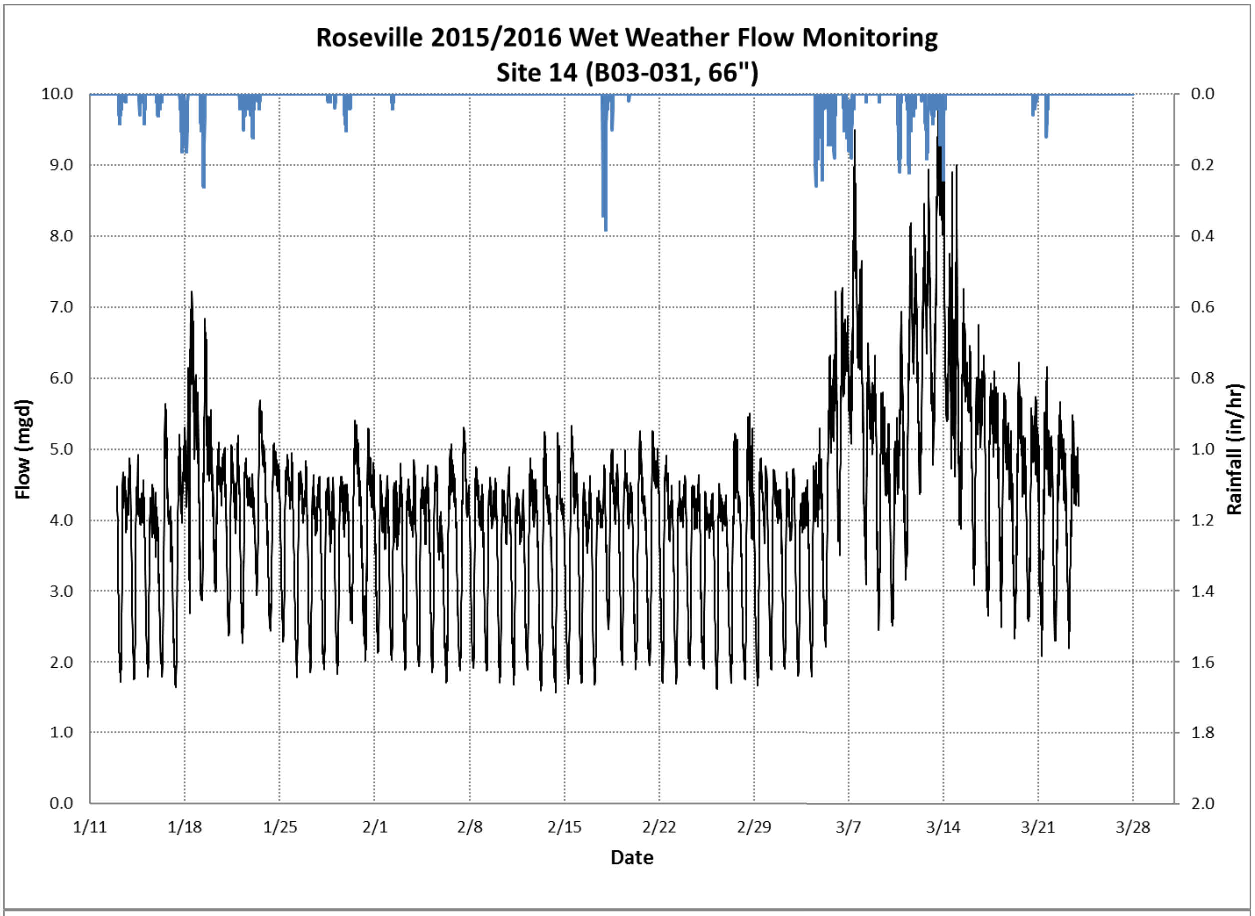

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 11 (A08-034 14.5")
Level (in)
Velocity (fps)
Depth (inches)
Velocity (fps)
Date
12
11
10
9
8
7
6
5
4
3
2
1
0
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28

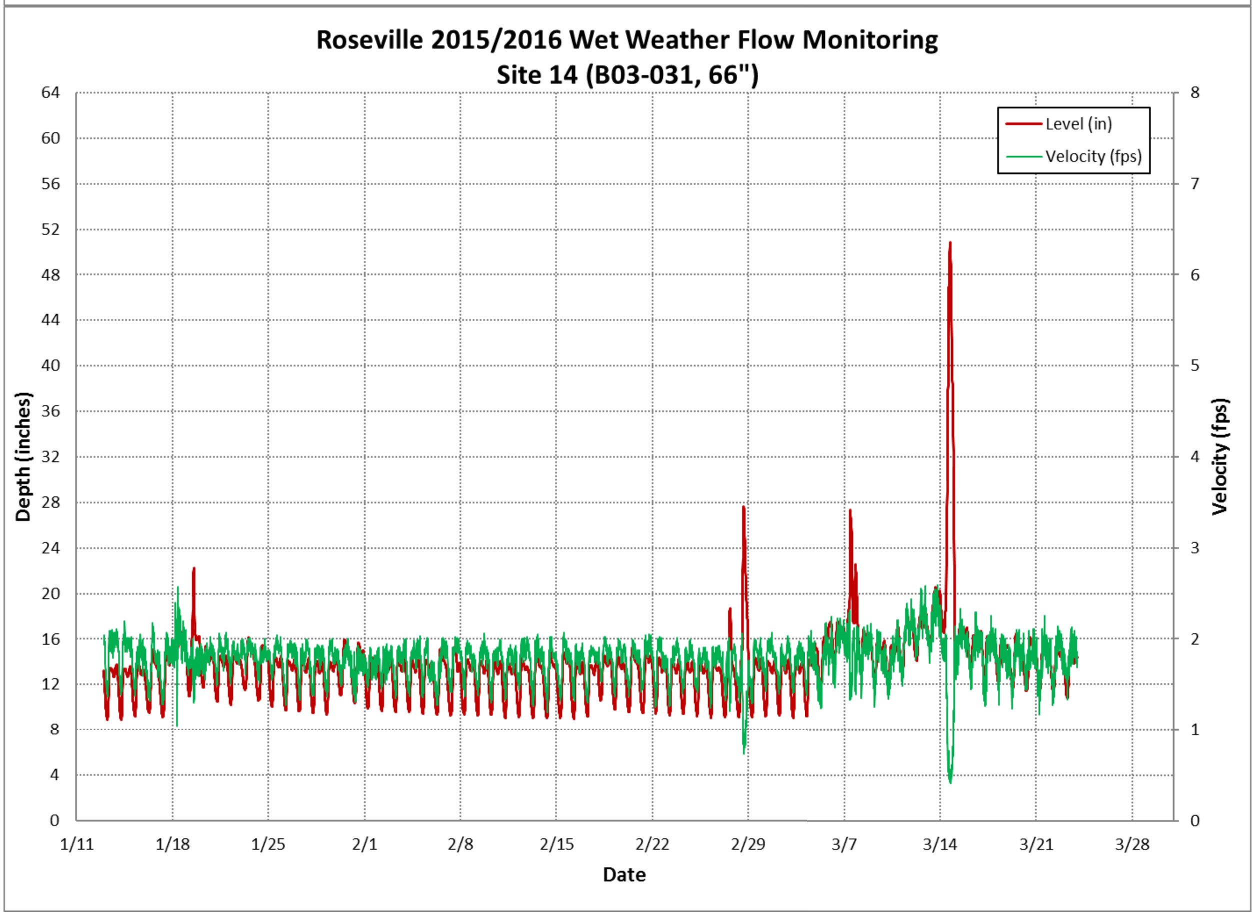

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 12 (B03-029, 21")
Flow (mgd)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

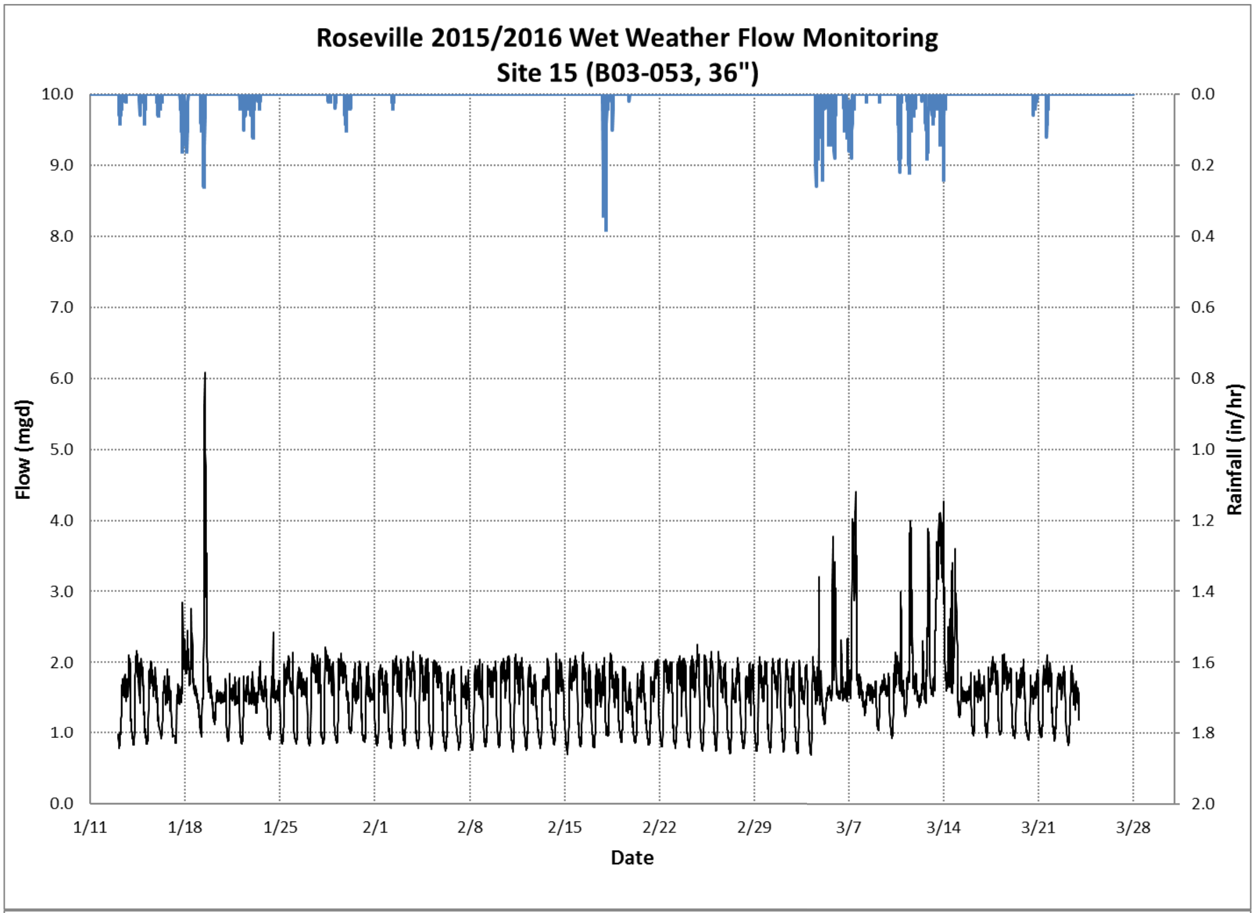

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 12 (B03-029, 20.5")
Level (in)
Velocity (fps)
Depth (inches)
12
11
10
9
8
7
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

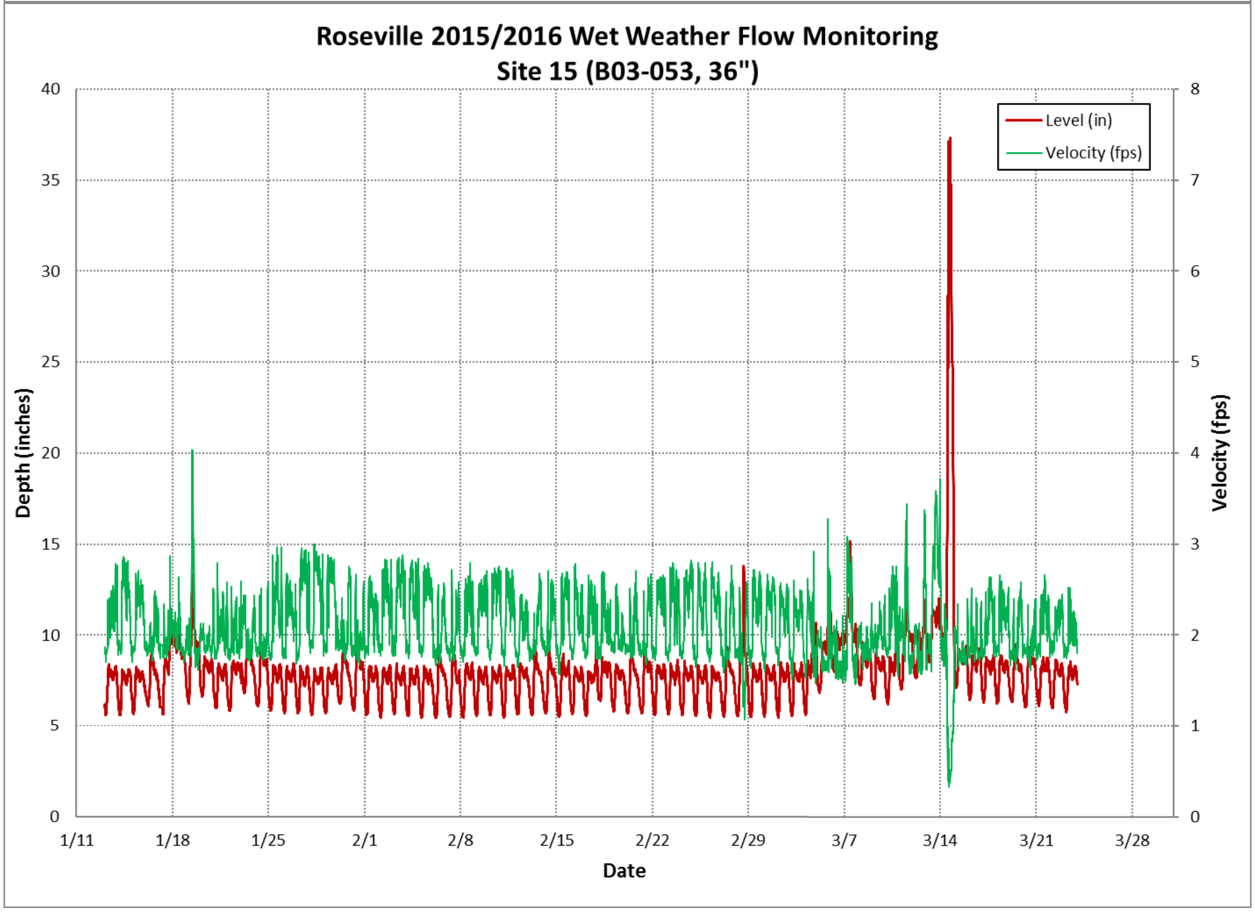

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 13 (B03-042, 42")
Flow (mgd)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

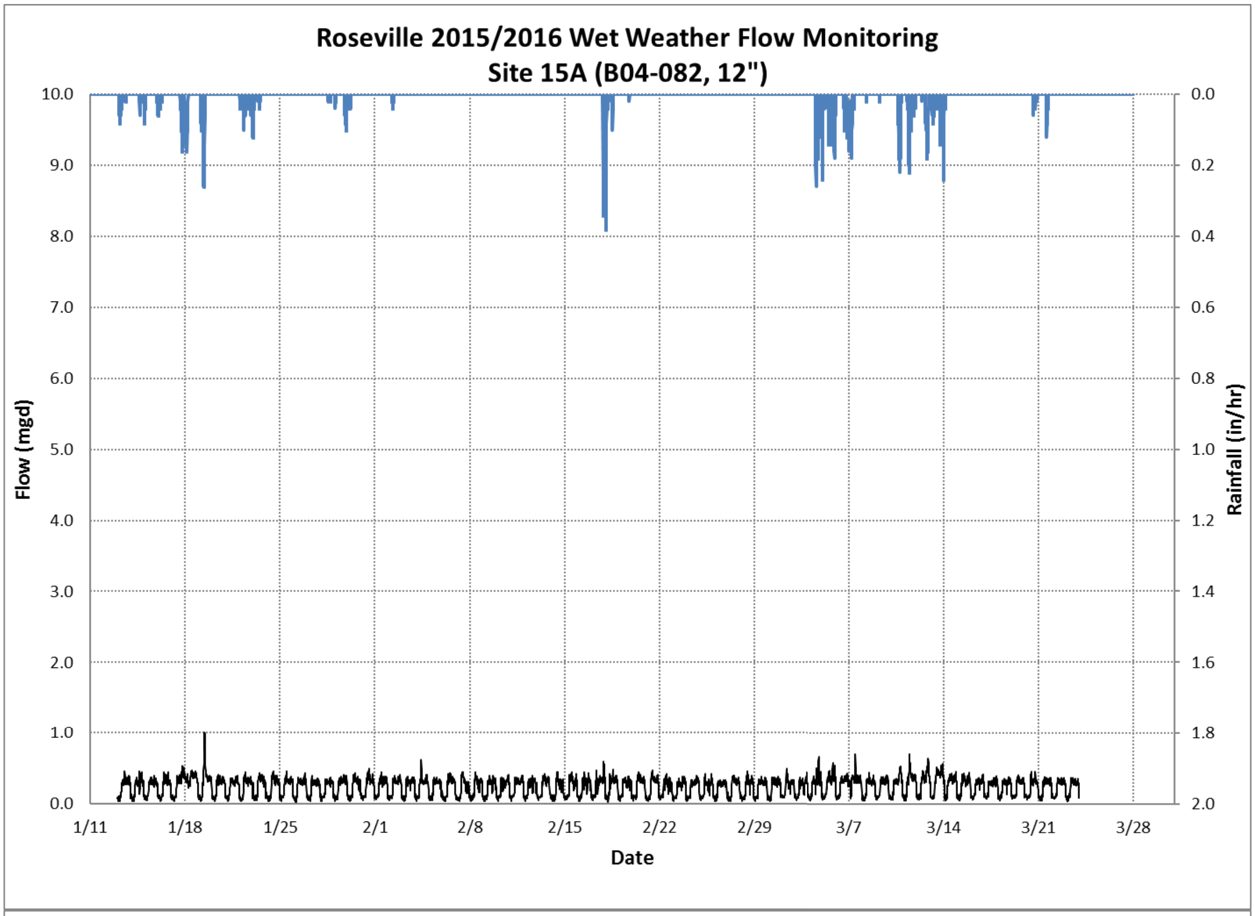

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 13 (B03-042, 42")
Level (in)
Velocity (fps)
Depth (inches)
64
60
56
52
48
44
40
36
32
28
24
20
16
12
8
4
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

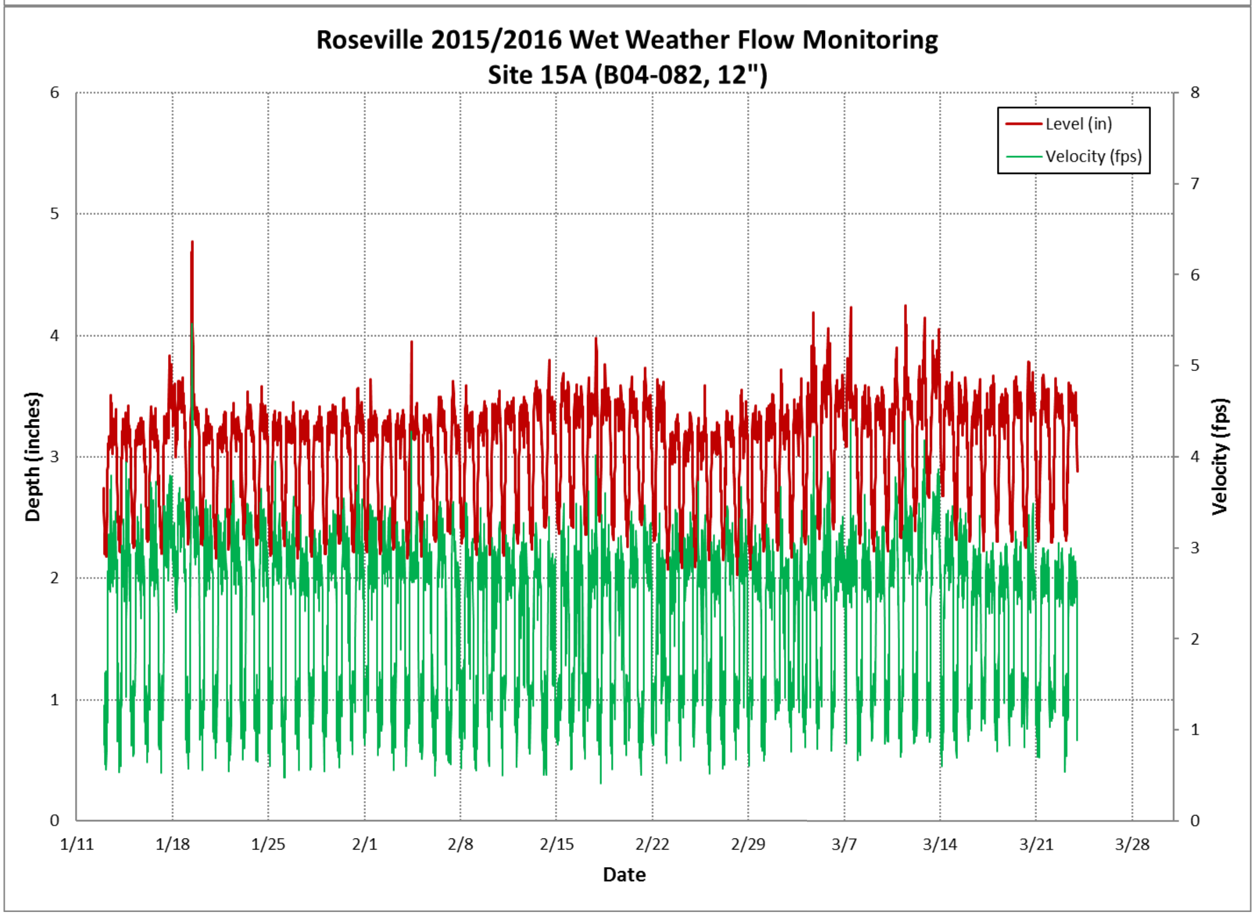

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 14 (B03-031, 66")
Flow (mgd)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

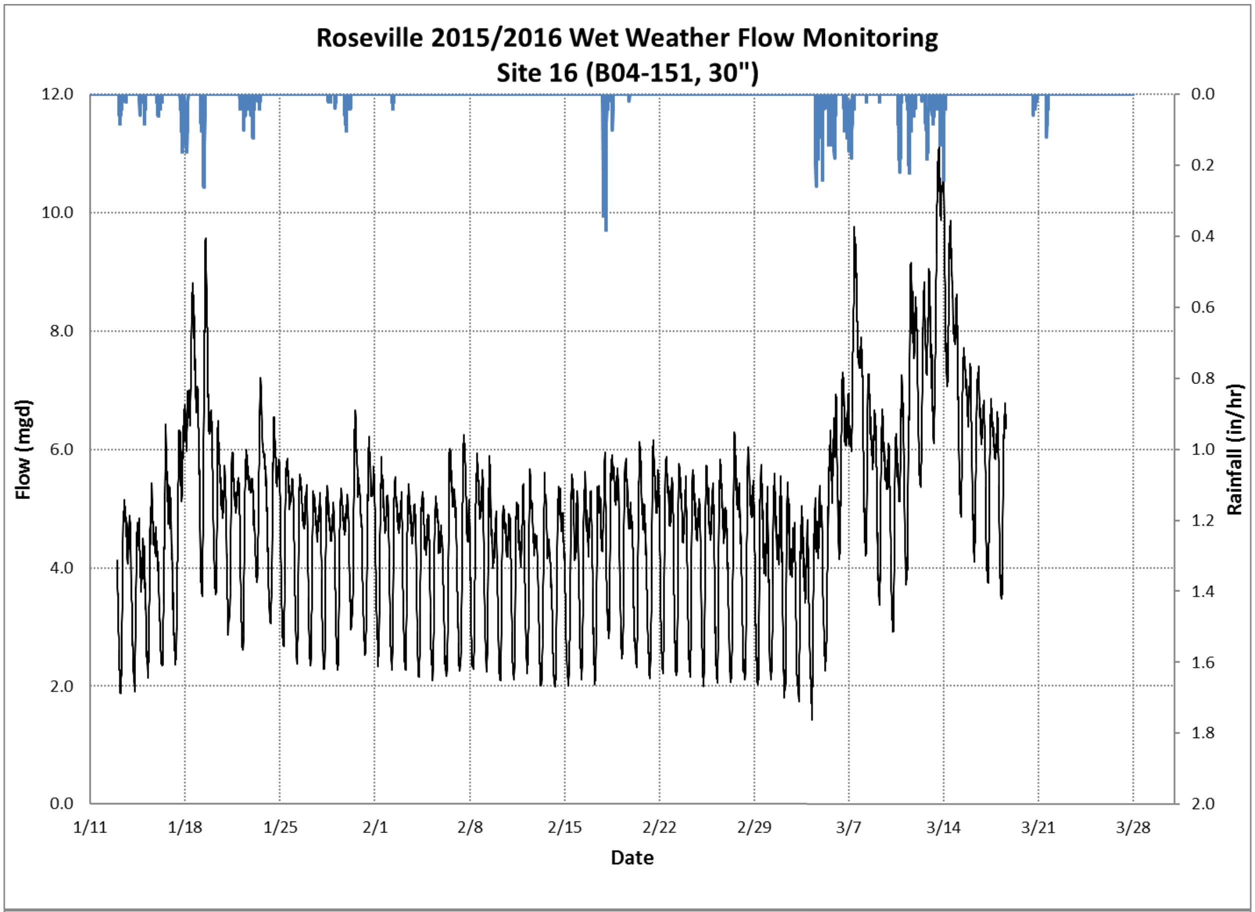

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 14 (B03-031, 66")
Level (in)
Velocity (fps)
Depth (inches)
64
60
56
52
48
44
40
36
32
28
24
20
16
12
8
4
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

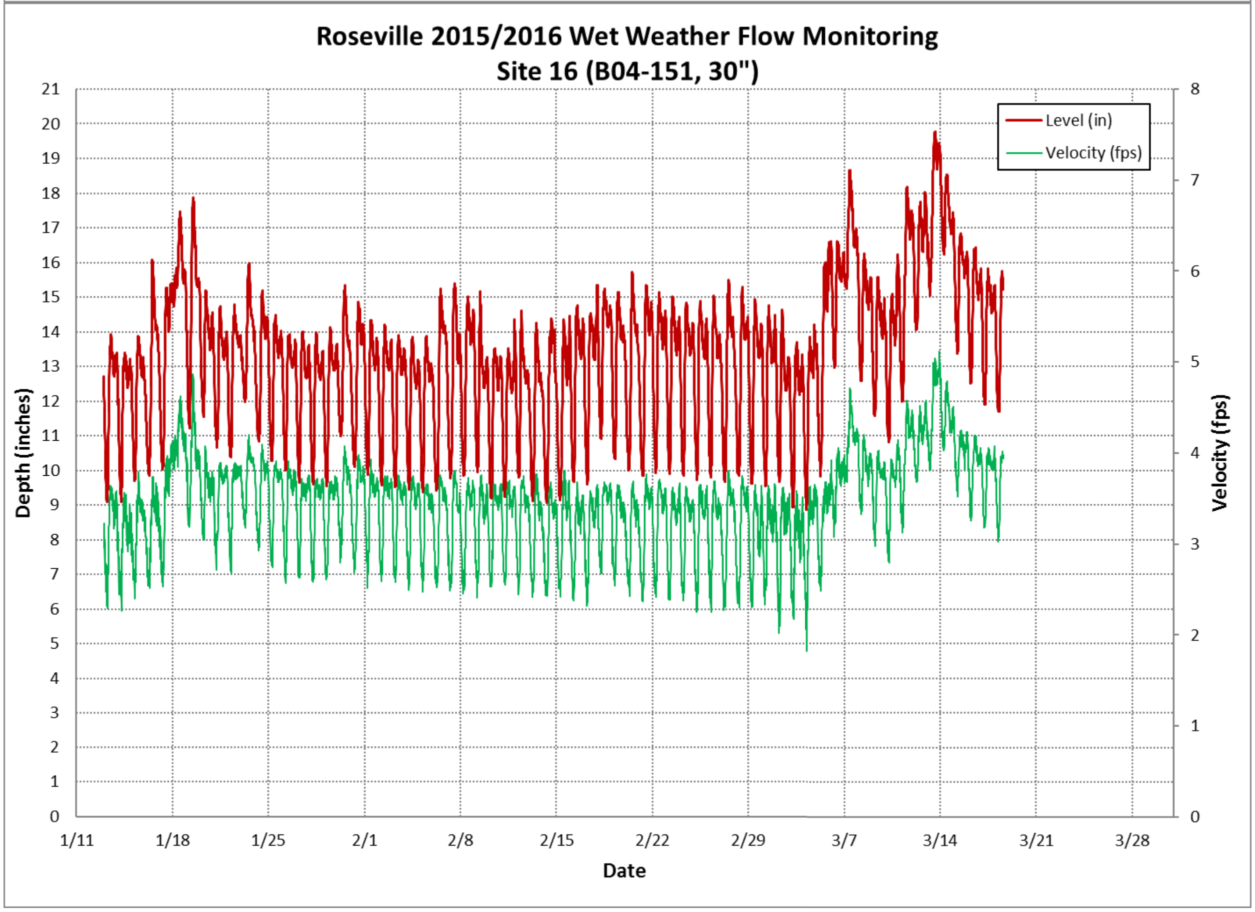

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 15 (B03-053, 36")
Flow (mgd)
Rainfall (in/hr)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

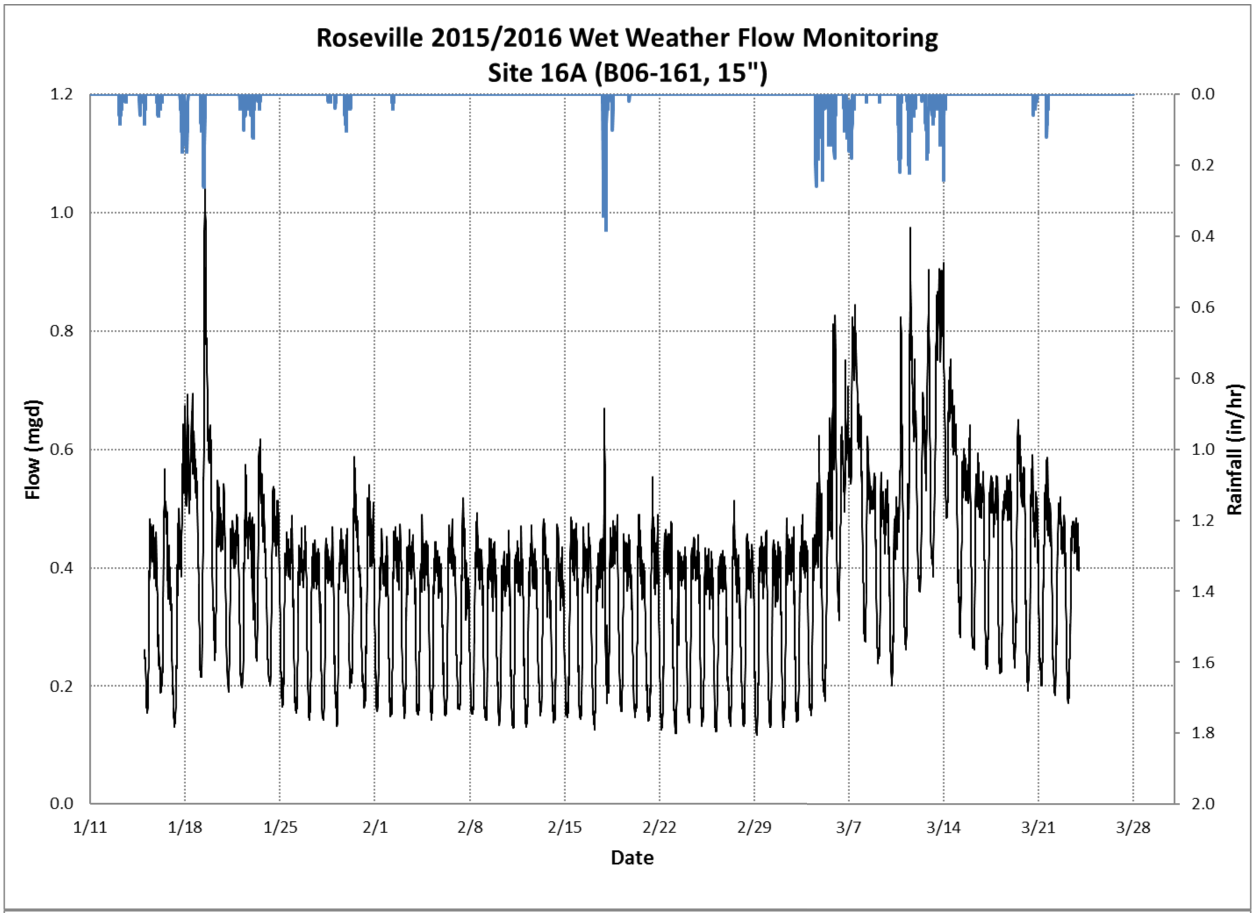

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 15 (B03-053, 36")
Level (in)
Velocity (fps)
Depth (inches)
Velocity (fps)
40
35
30
25
20
15
10
5
0
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

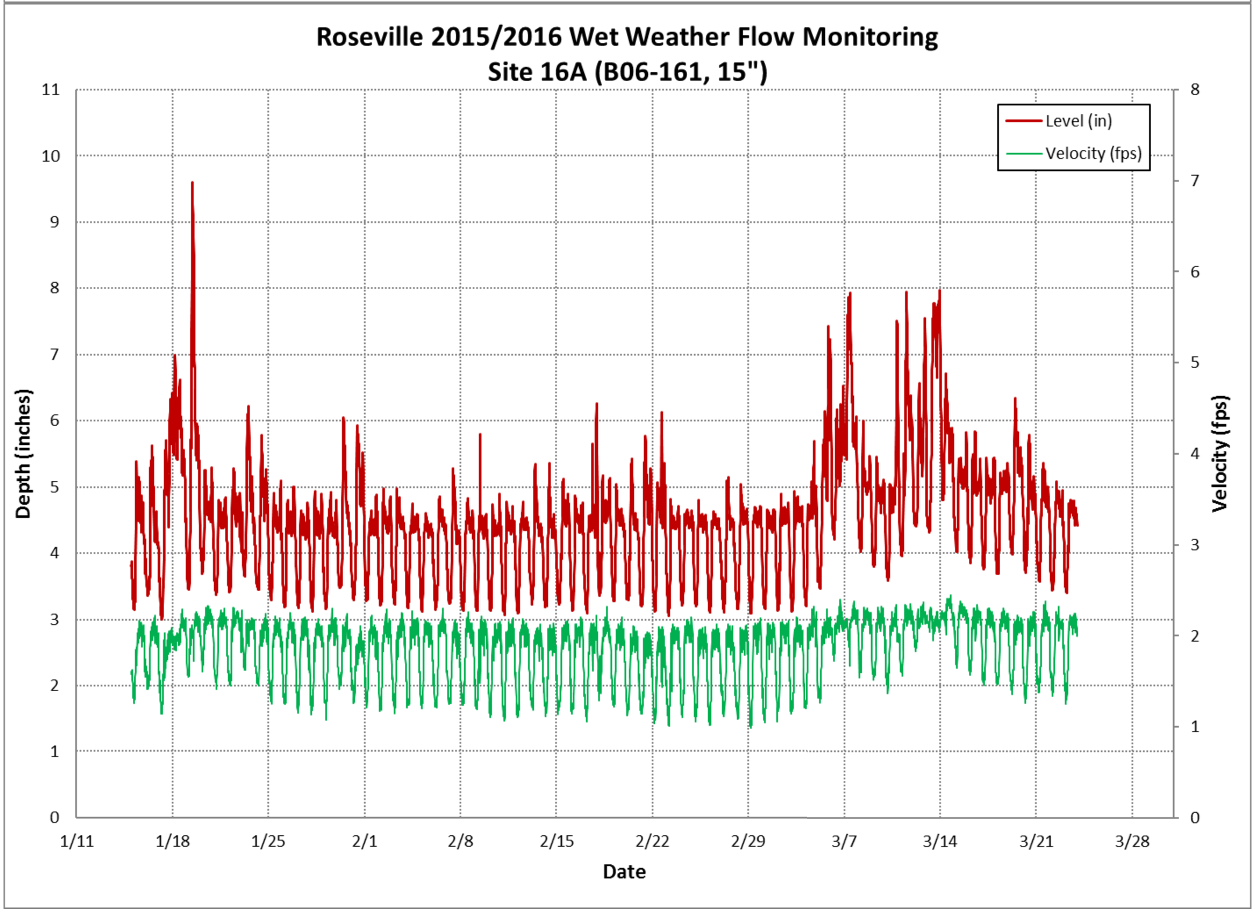

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 15A (B04-082, 12")

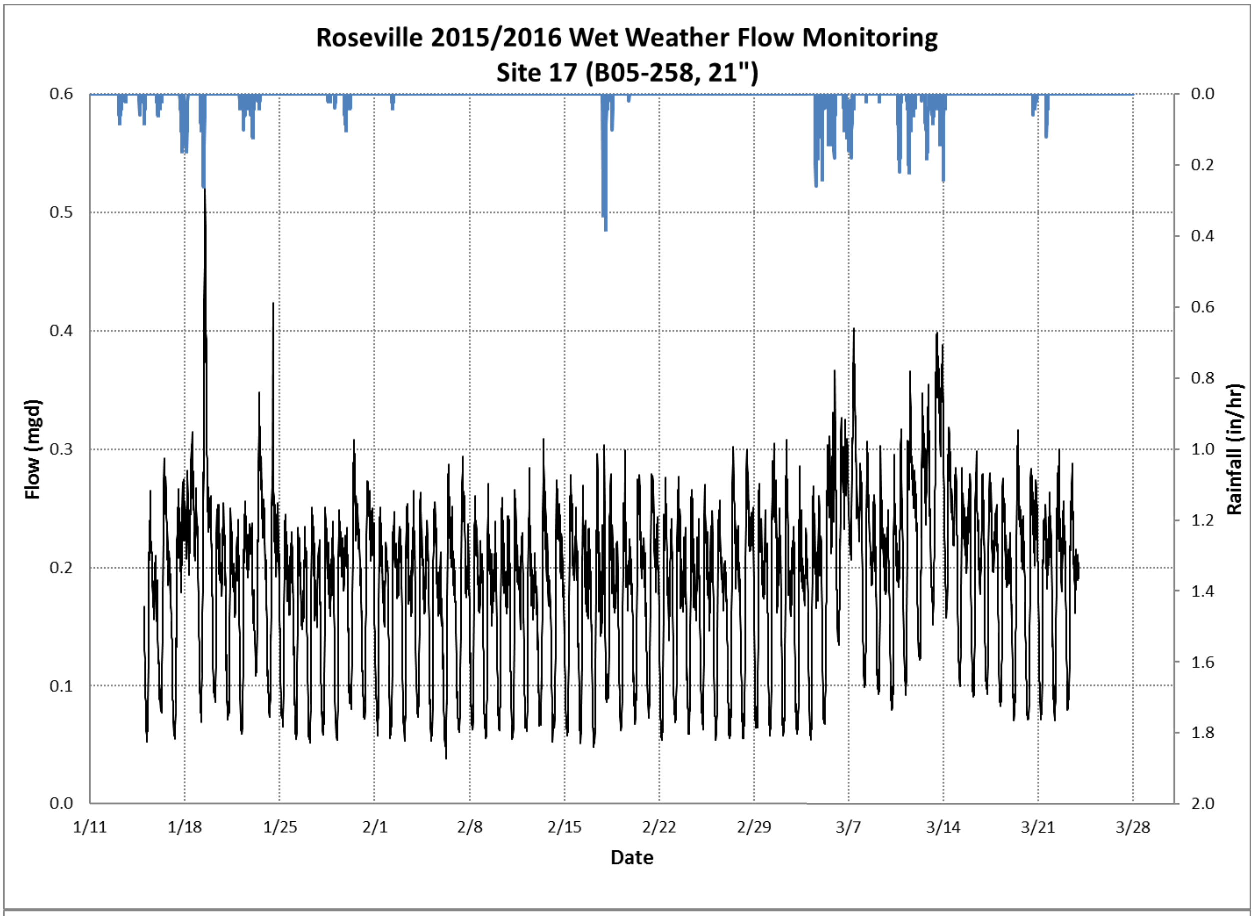

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 15A (B04-082, 12")

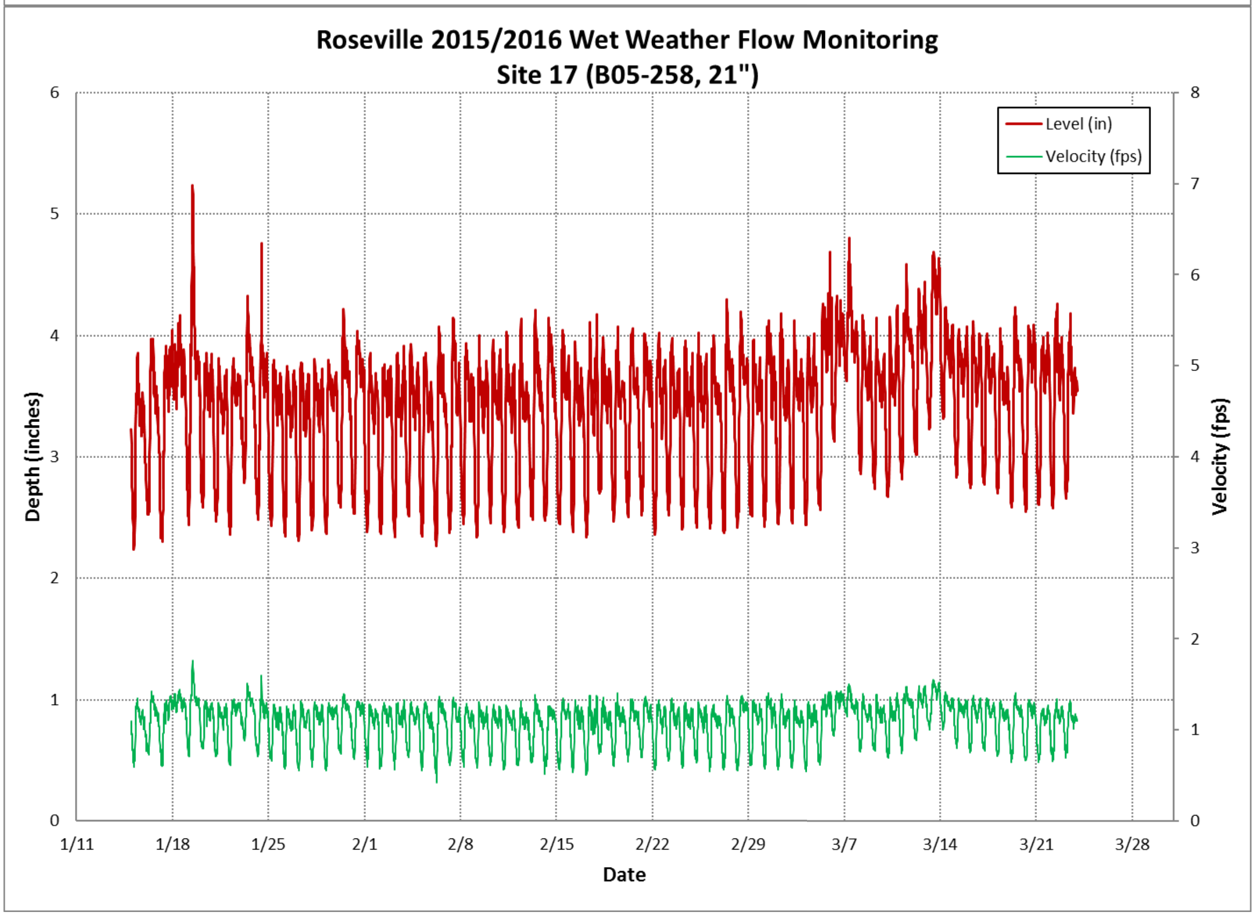

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 16 (B04-151, 30")

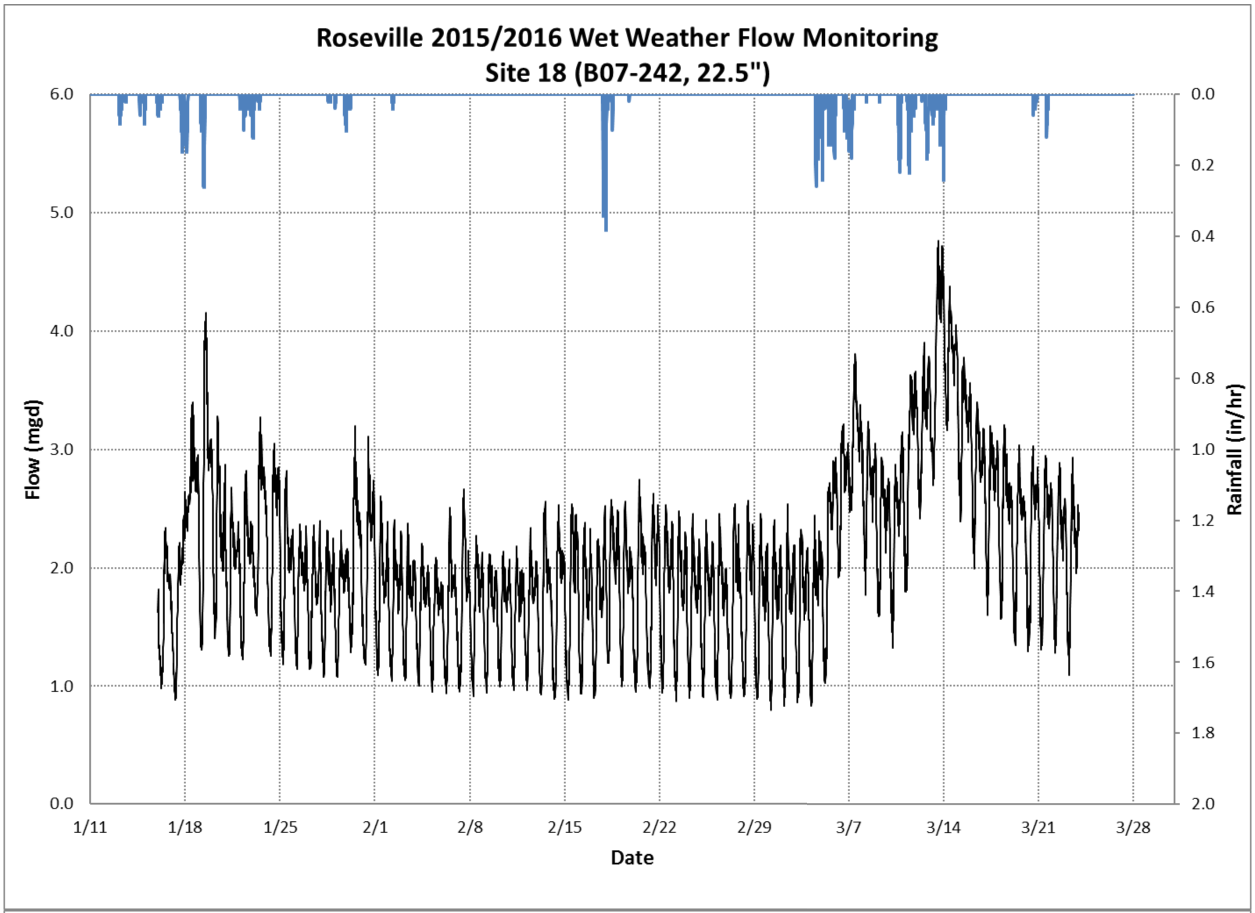

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 16 (B04-151, 30")


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 16A (B06-161, 15")
Flow (mgd)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

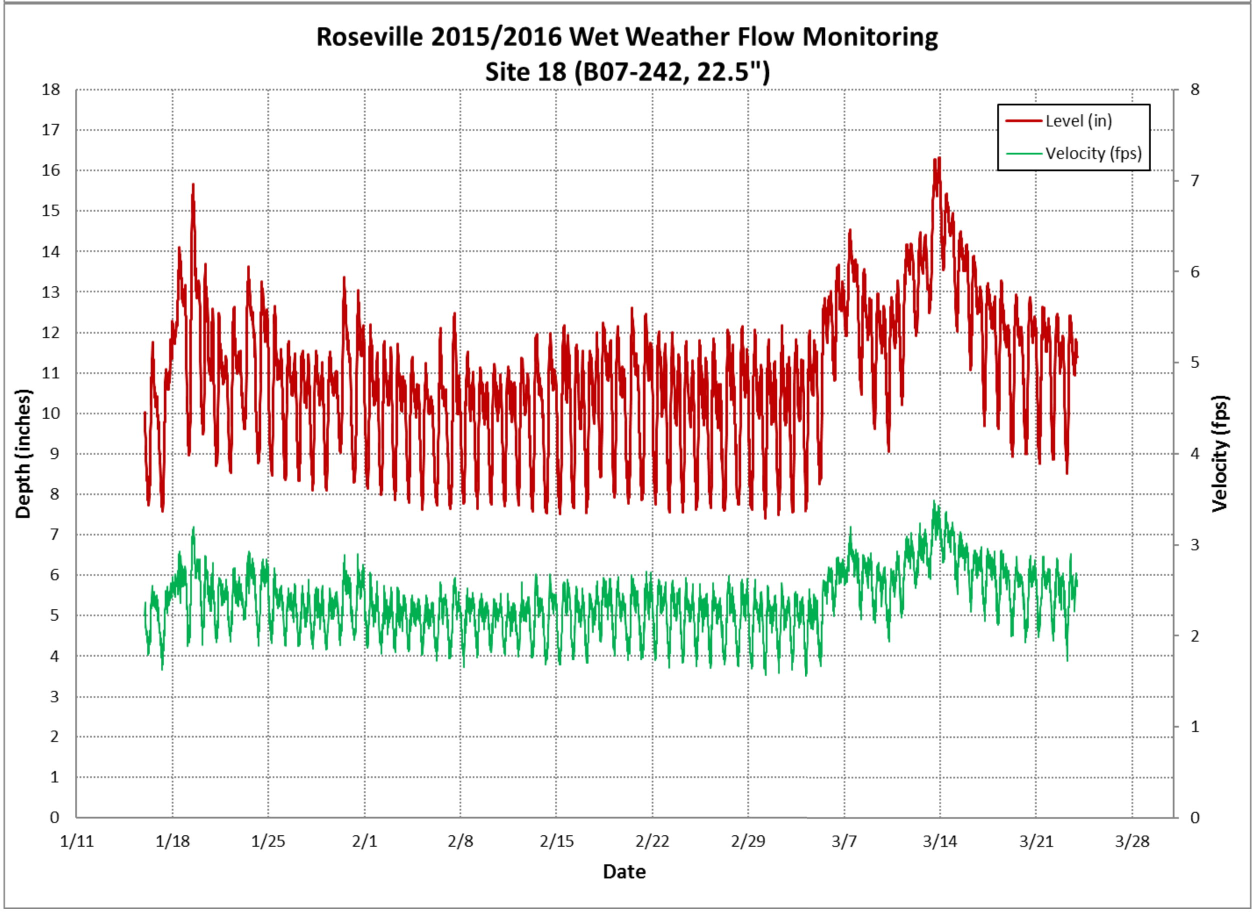

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 16A (B06-161, 15")
Level (in)
Velocity (fps)
Depth (inches)
11
10
9
8
7
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 17 (B05-258, 21")
Flow (mgd)
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

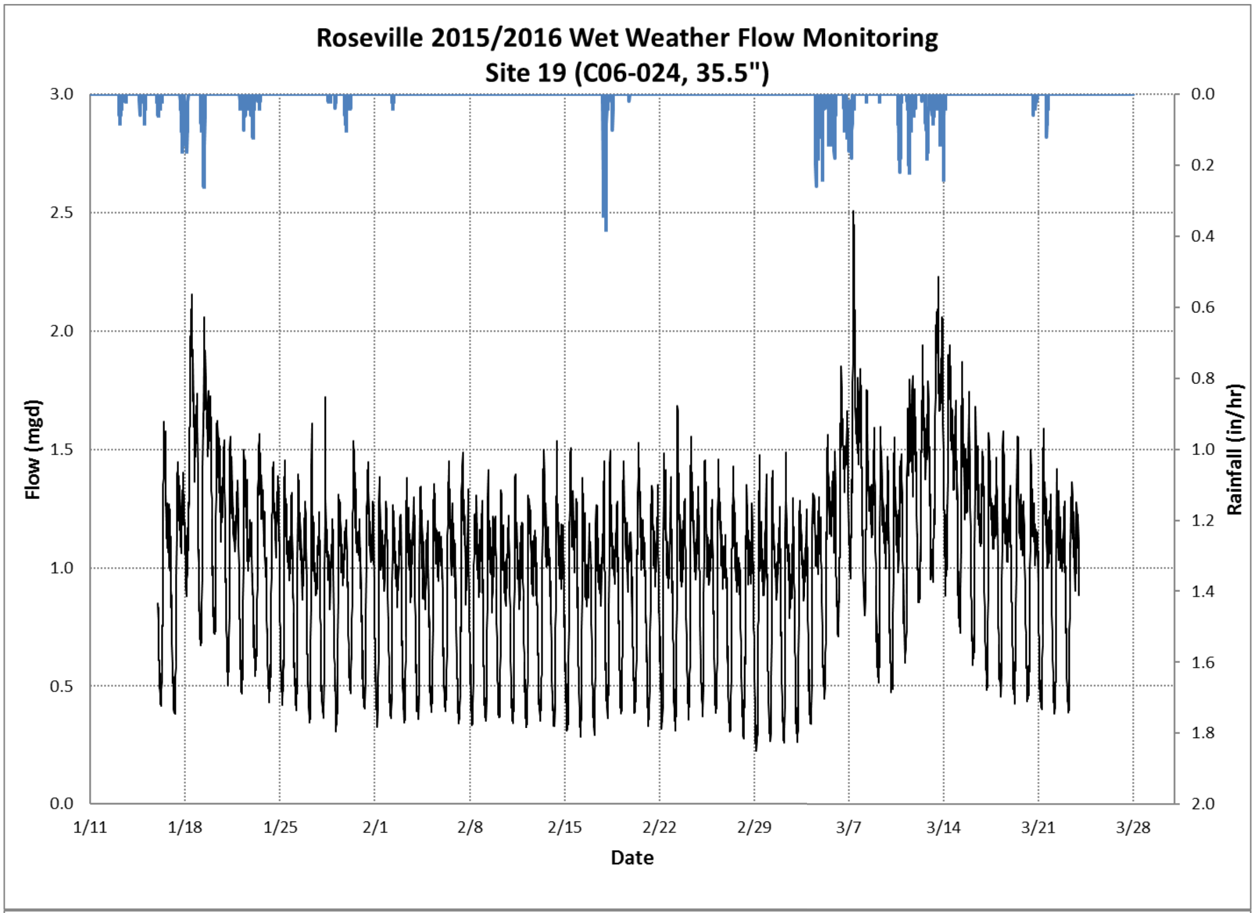

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 17 (B05-258, 21")
Level (in)
Velocity (fps)
Depth (inches)
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

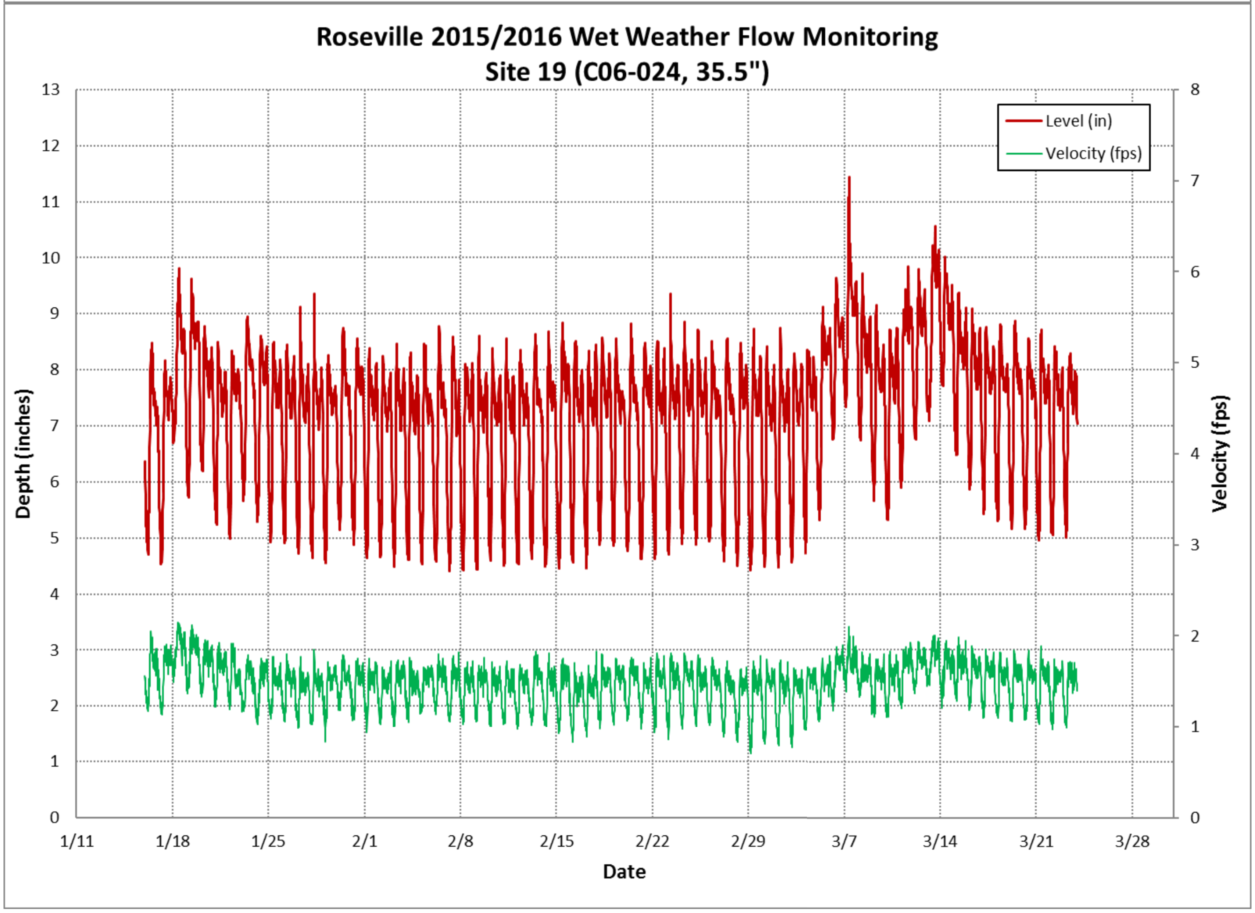


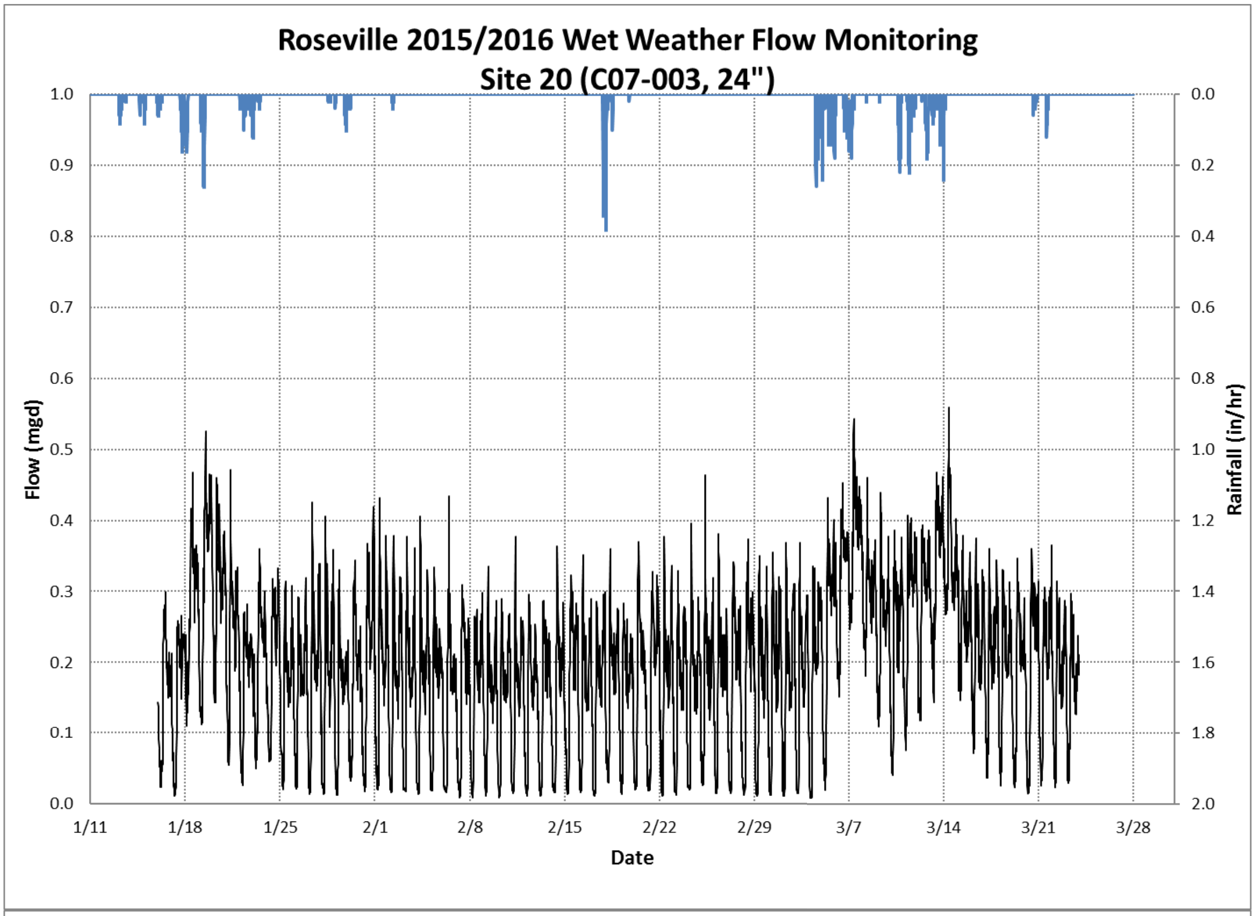
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 18 (B07-242, 22.5")

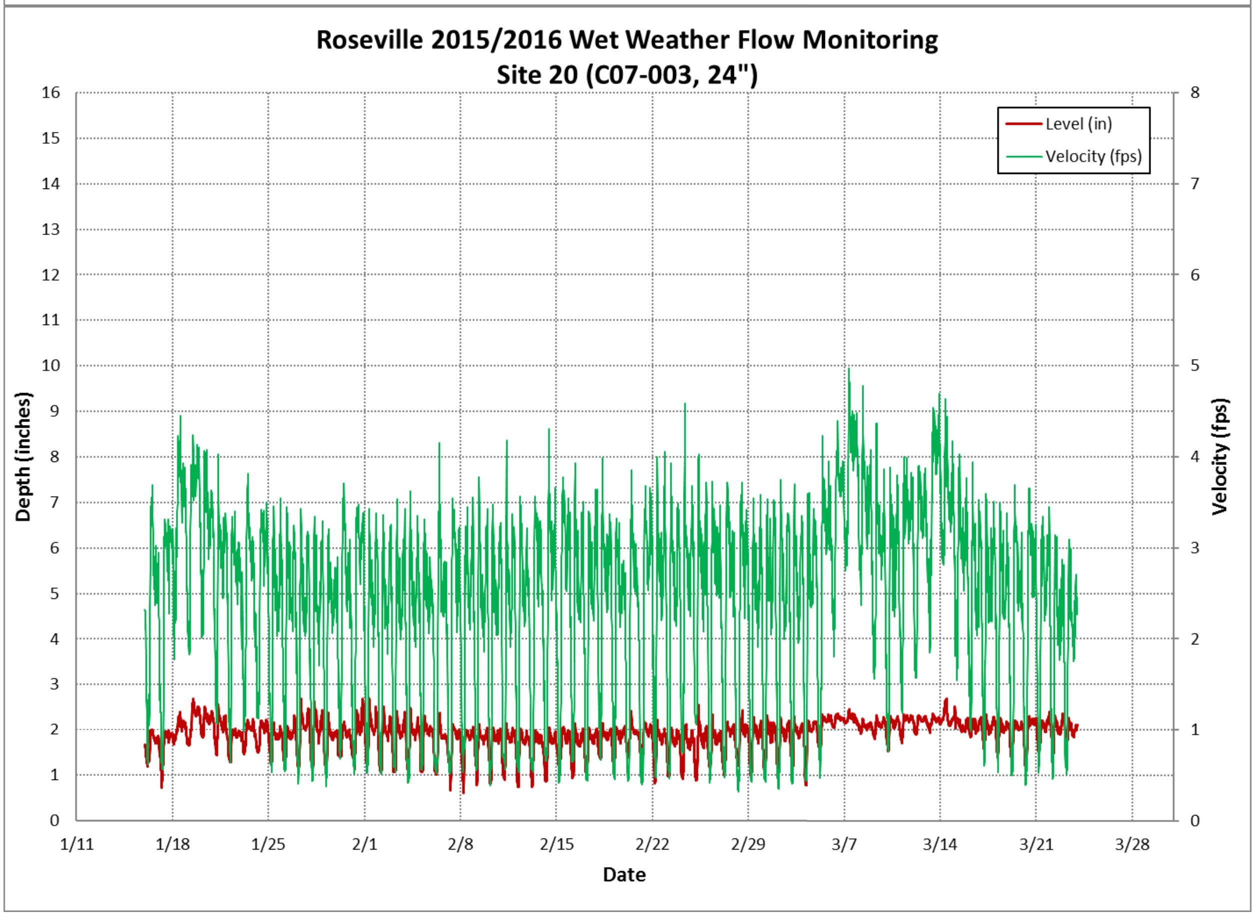


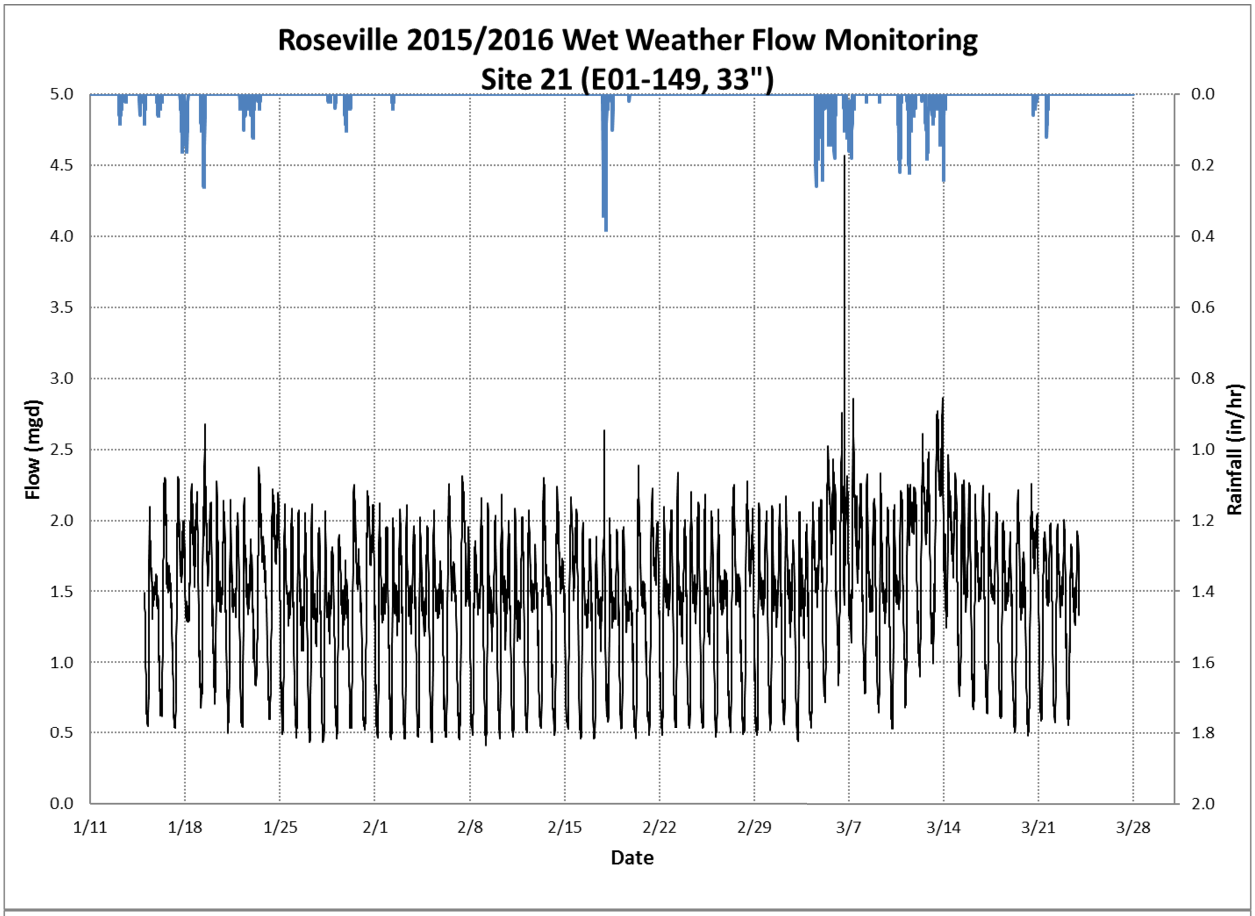
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 18 (B07-242, 22.5")

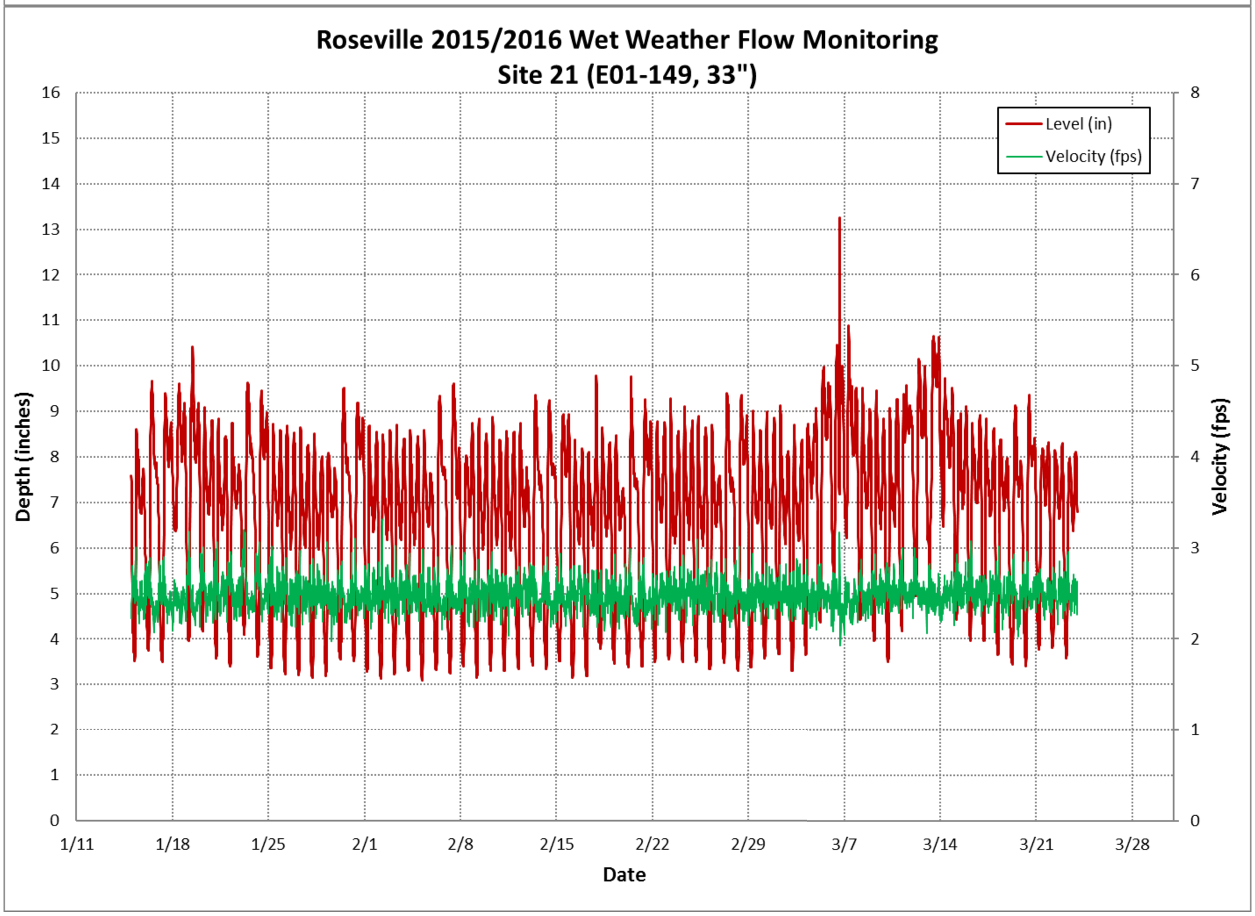

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 19 (C06-024, 35.5")

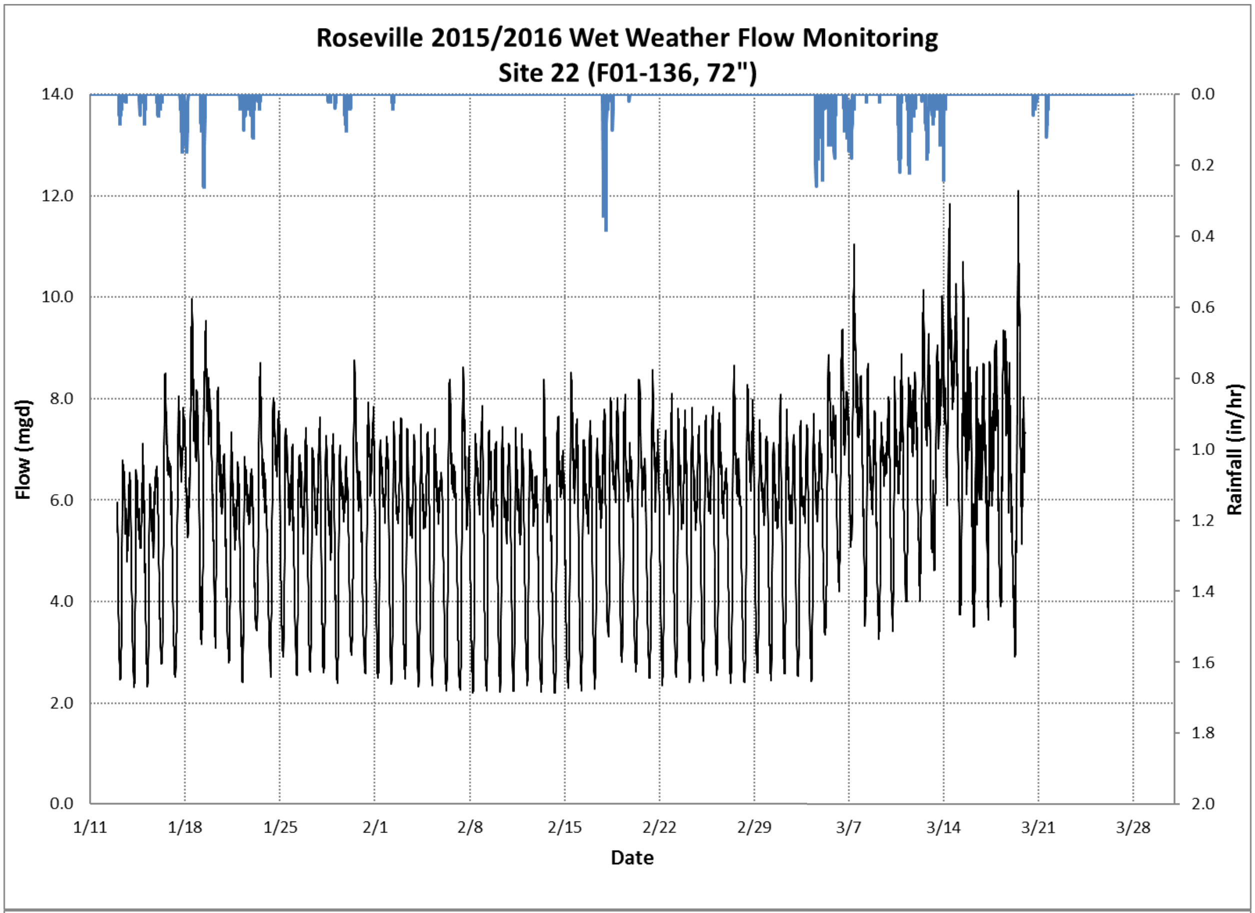

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 19 (C06-024, 35.5")

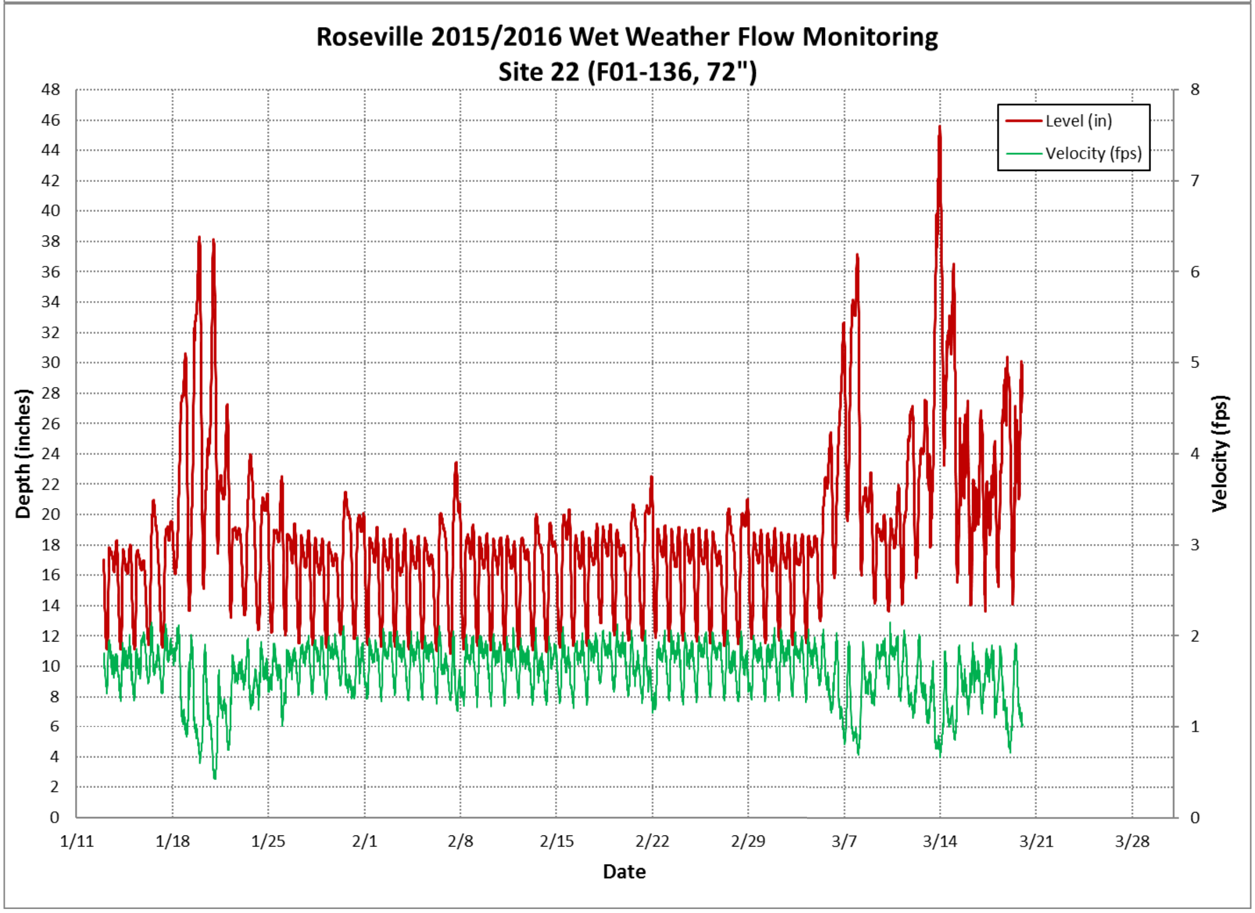

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 20 (C07-003, 24")
Flow (mgd)
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

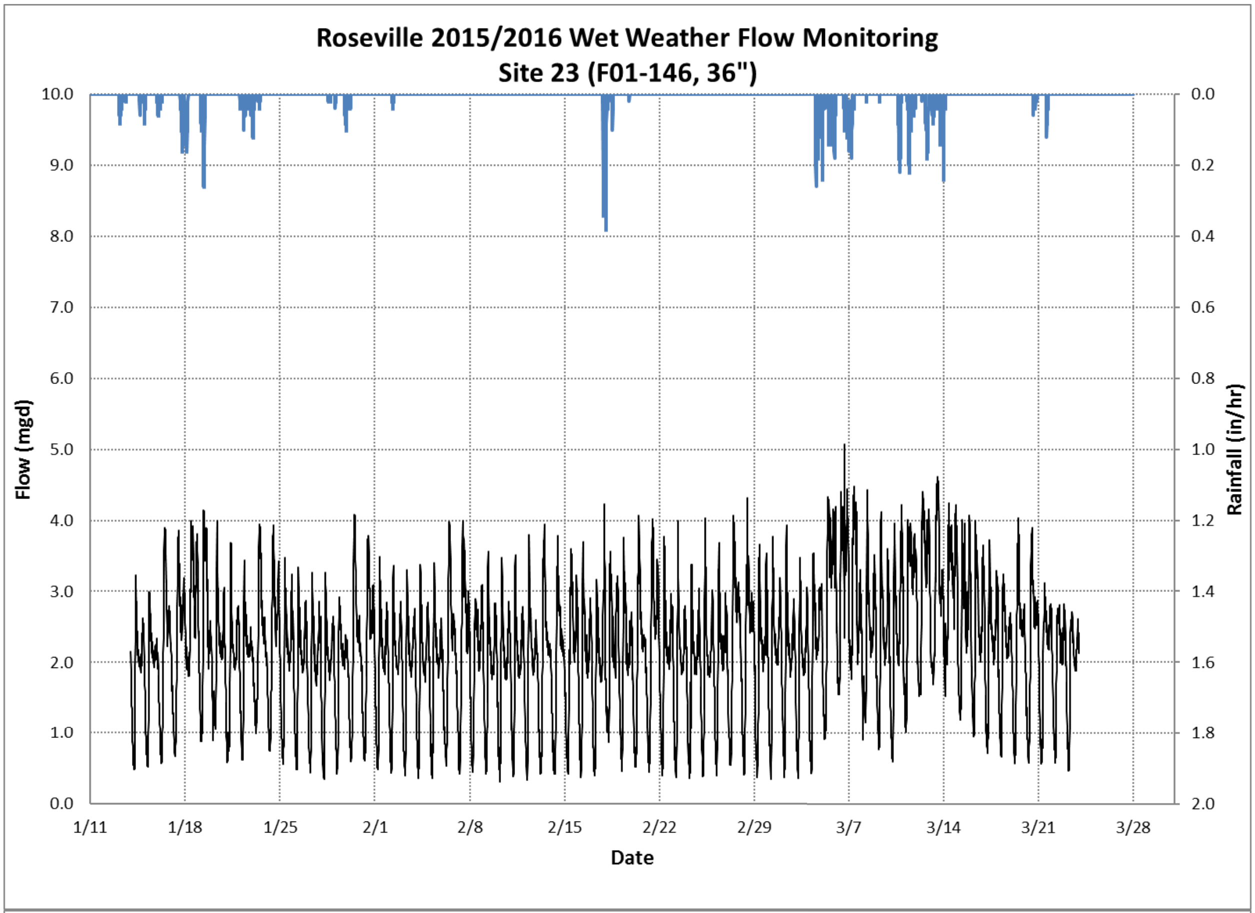

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 20 (C07-003, 24")
Level (in)
Velocity (fps)
Depth (inches)
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

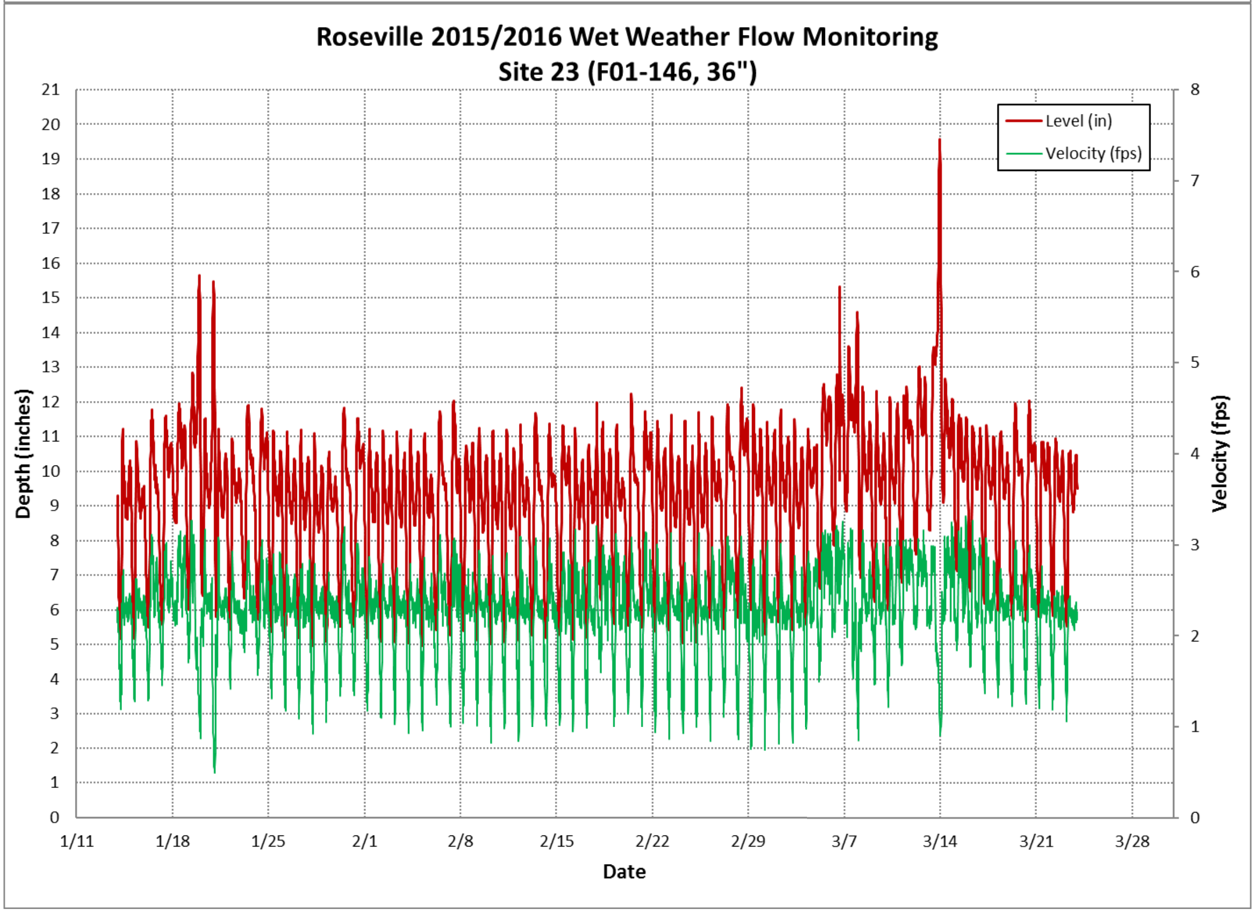

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 21 (E01-149, 33")
Flow (mgd)
Rainfall (in/hr)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

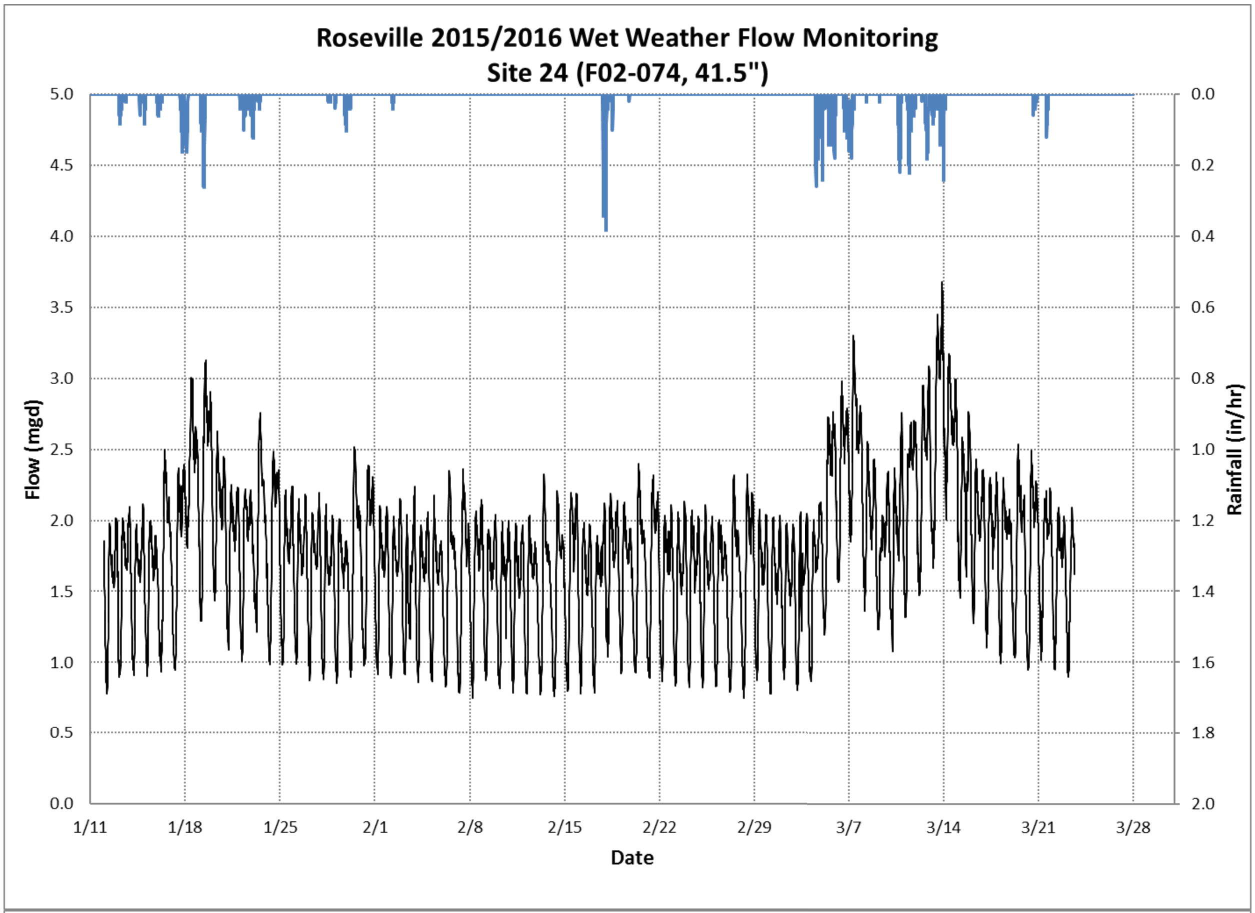

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 21 (E01-149, 33")
Level (in)
Velocity (fps)
Depth (inches)
Velocity (fps)
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

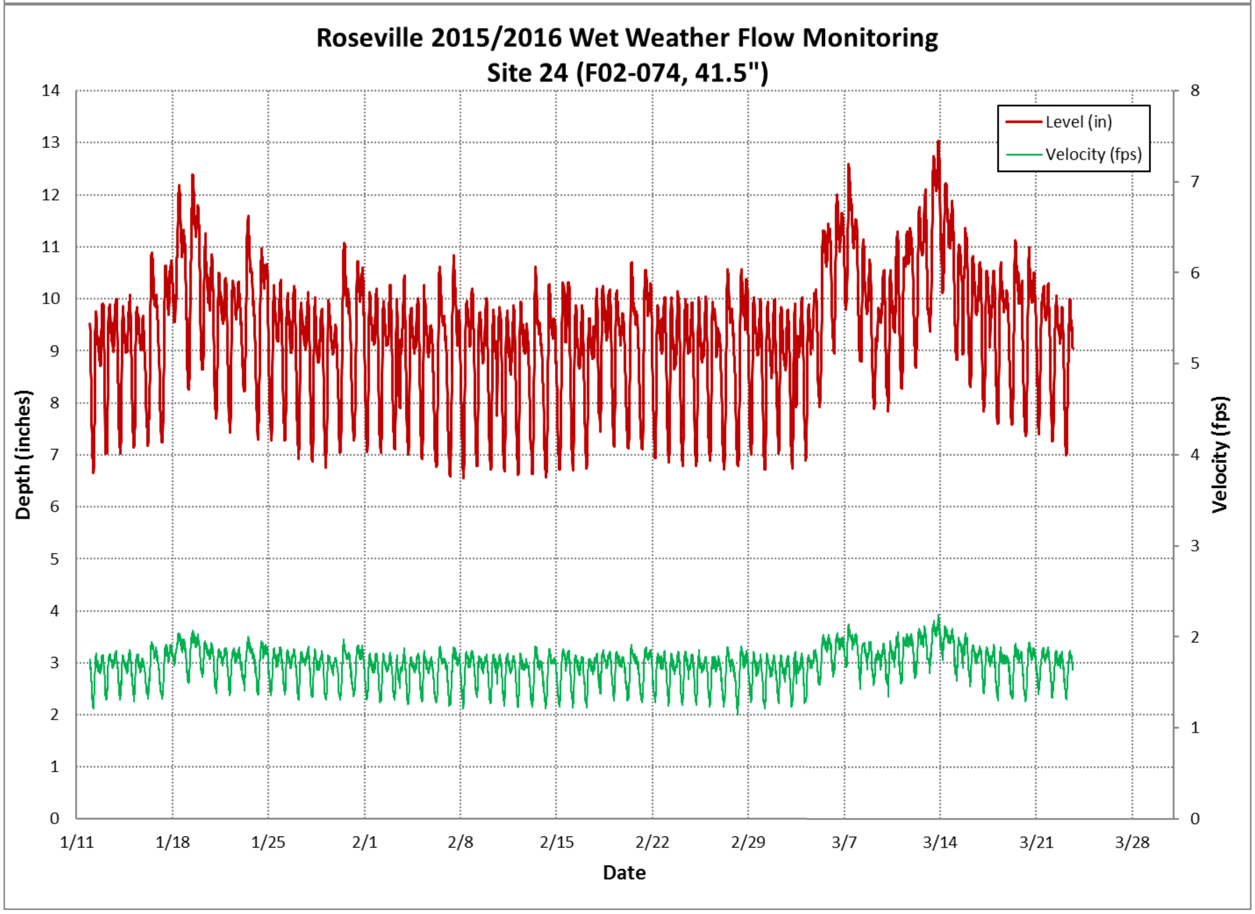

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 22 (F01-136, 72")
Flow (mgd)
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

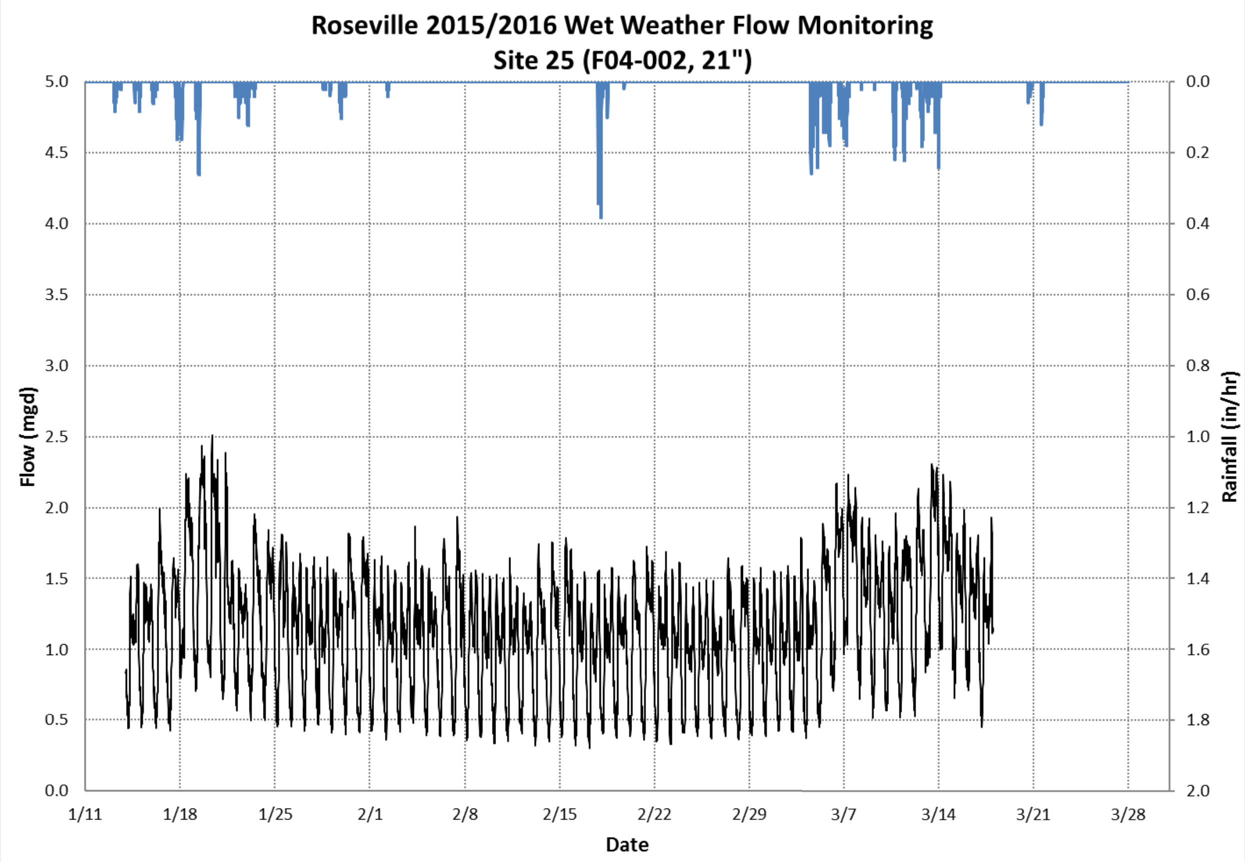

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 22 (F01-136, 72")
Level (in)
Velocity (fps)
Depth (inches)
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
Velocity (fps)
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 23 (F01-146, 36")
Flow (mgd)
Rainfall (in/hr)
Date
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28

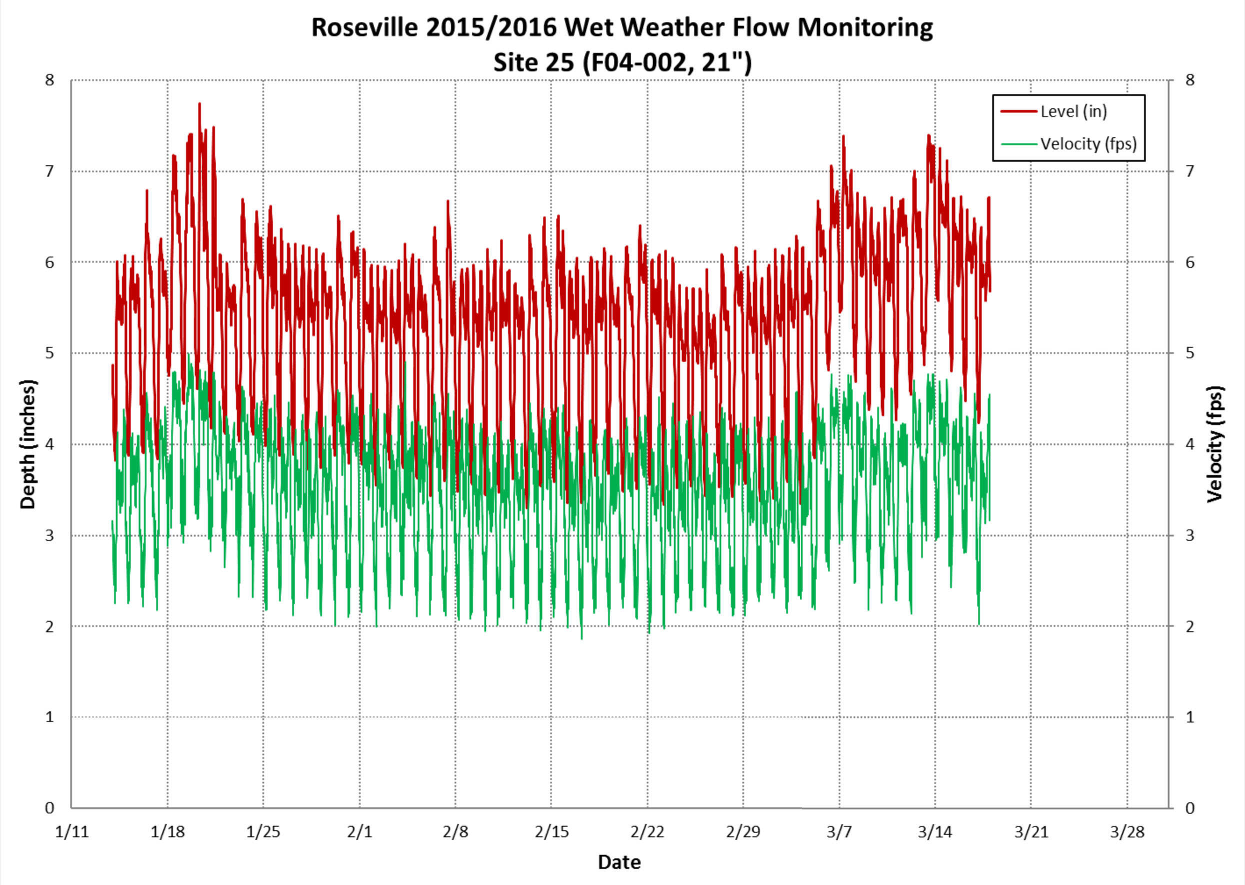

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 23 (F01-146, 36")
Level (in)
Velocity (fps)
Depth (inches)
Velocity (fps)
Date
21
20
19
18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28


Roseville 2015/2016 Wet Weather Flow Monitoring
Site 24 (F02-074, 41.5")

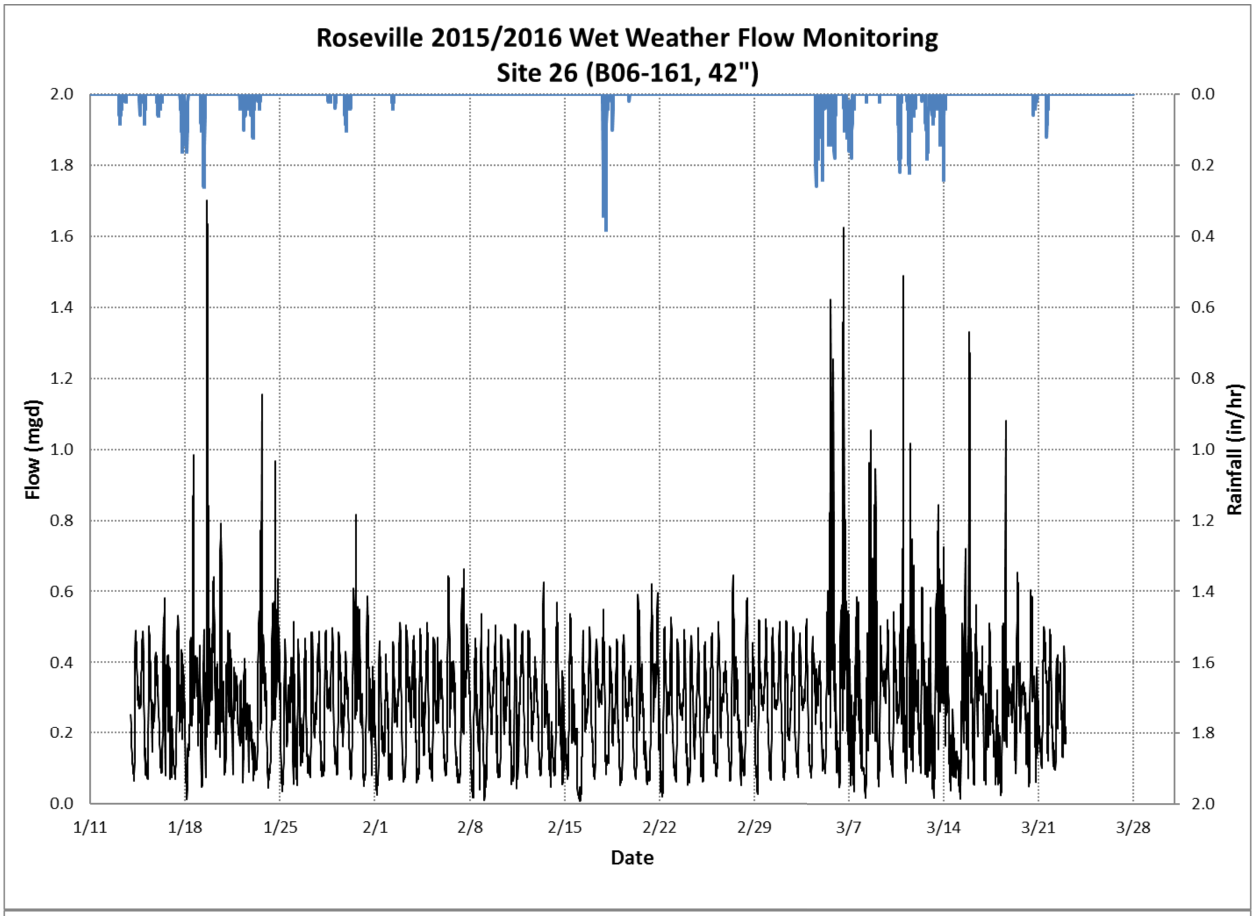

Roseville 2015/2016 Wet Weather Flow Monitoring
Site 24 (F02-074, 41.5")



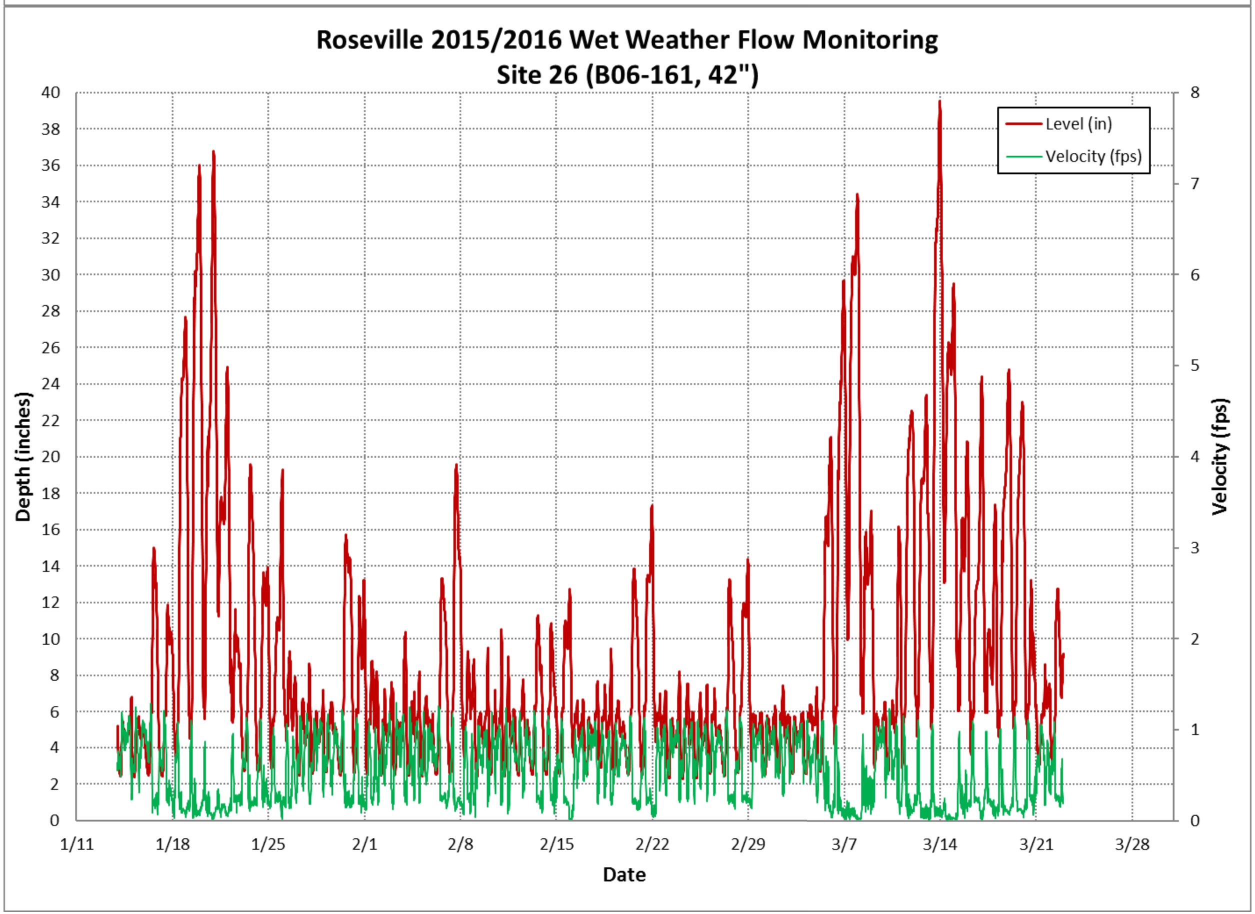
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 25 (F04-002, 21")
Flow (mgd)
Rainfall (in/hr)
Date
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28



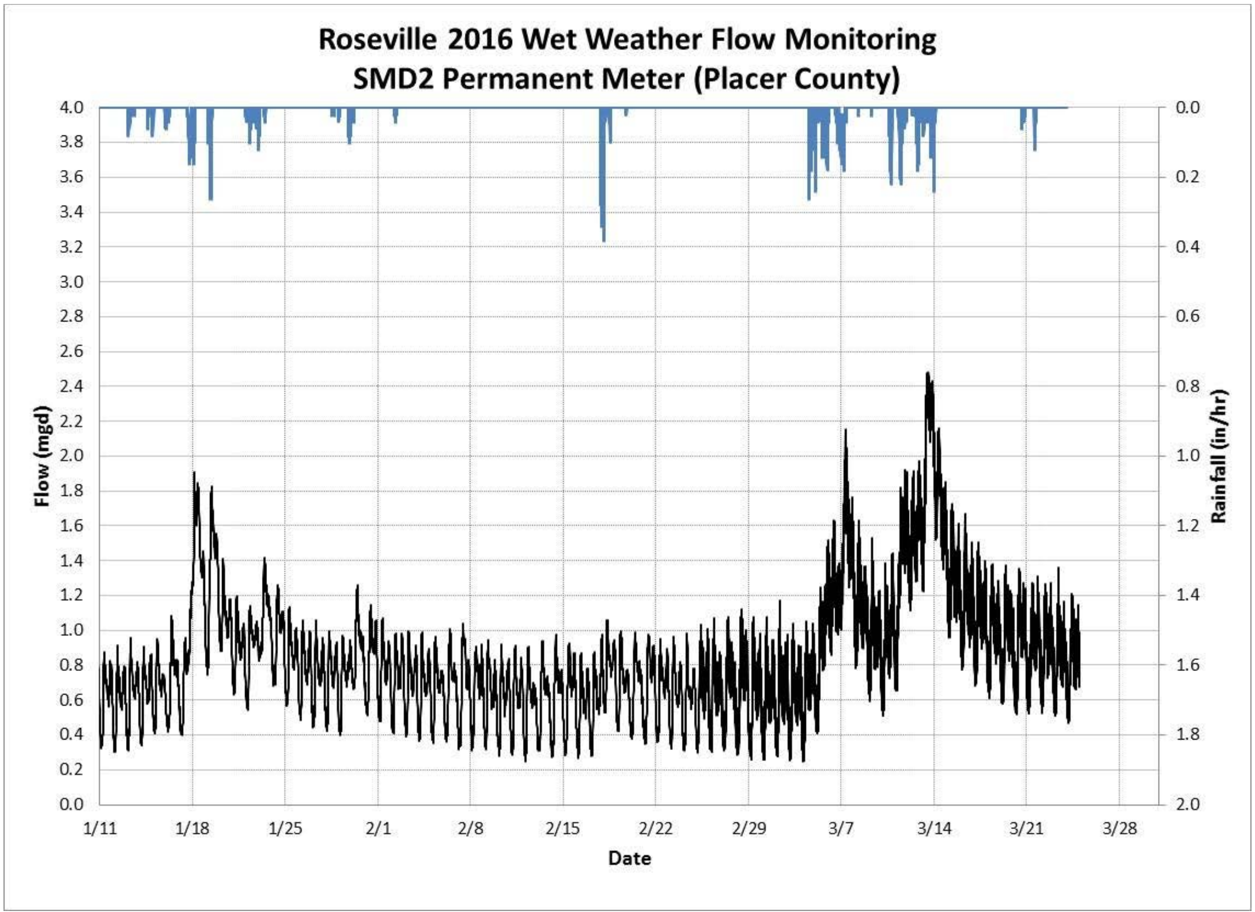
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 25 (F04-002, 21")
Level (in)
Velocity (fps)
Depth (inches)
Velocity (fps)
Date
8
7
6
5
4
3
2
1
0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28

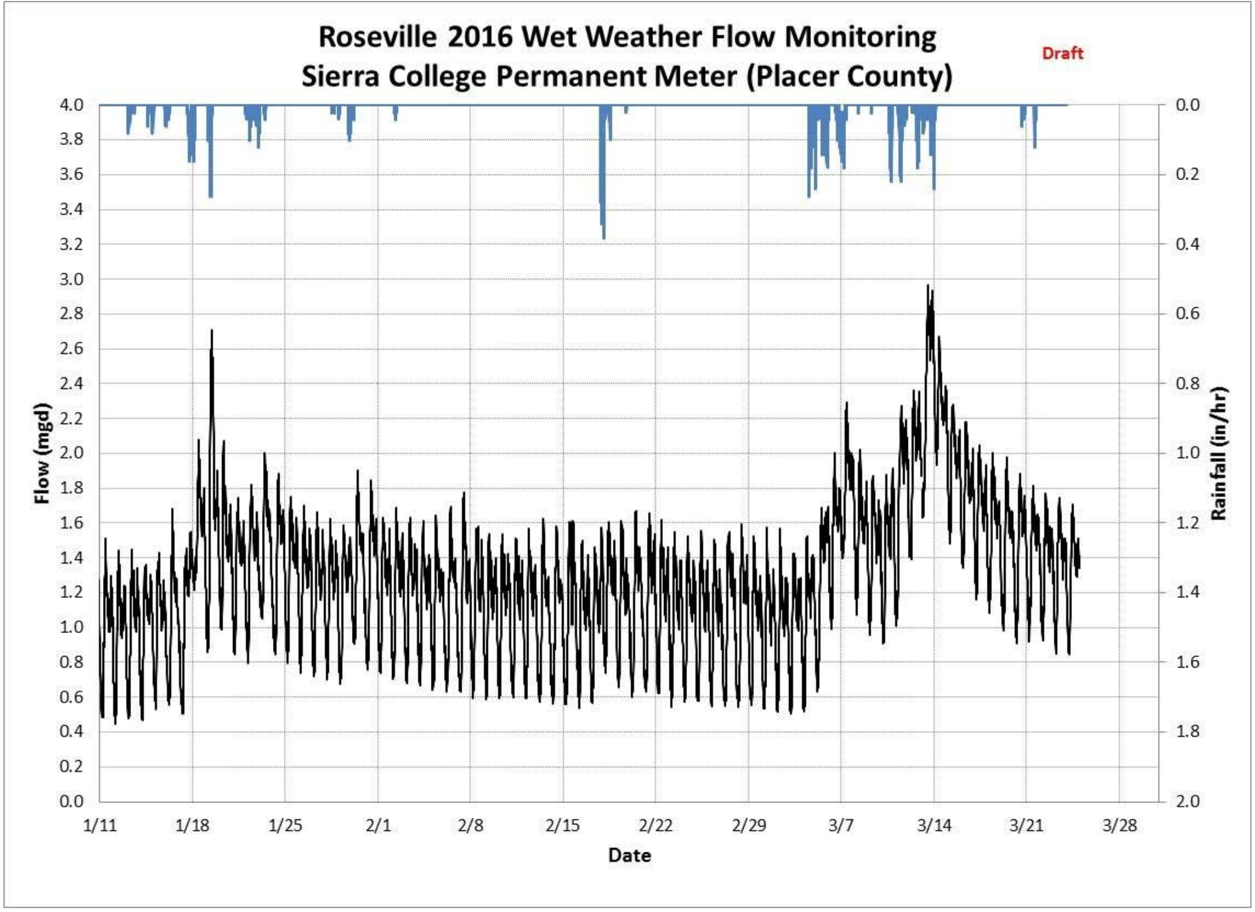


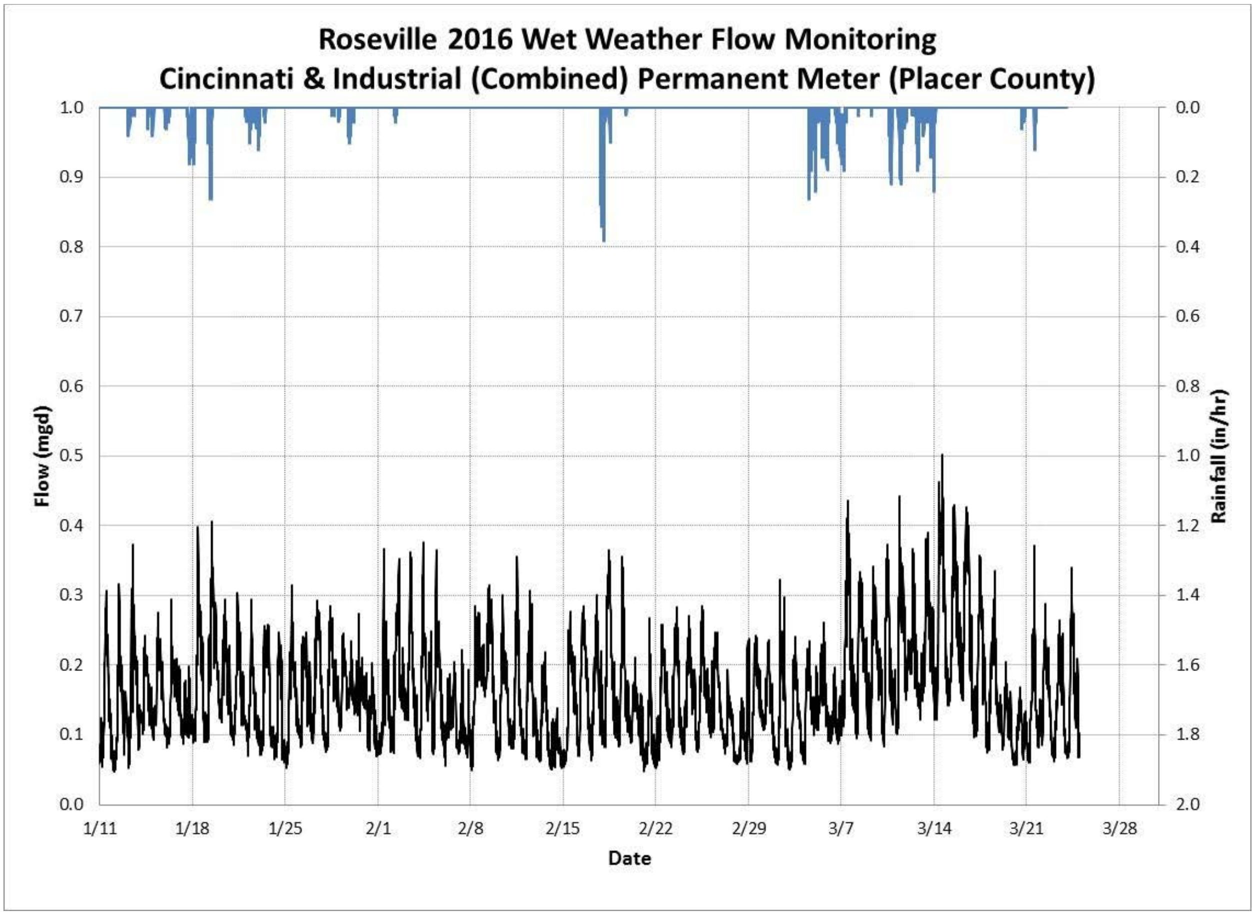
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 26 (B06-161, 42")



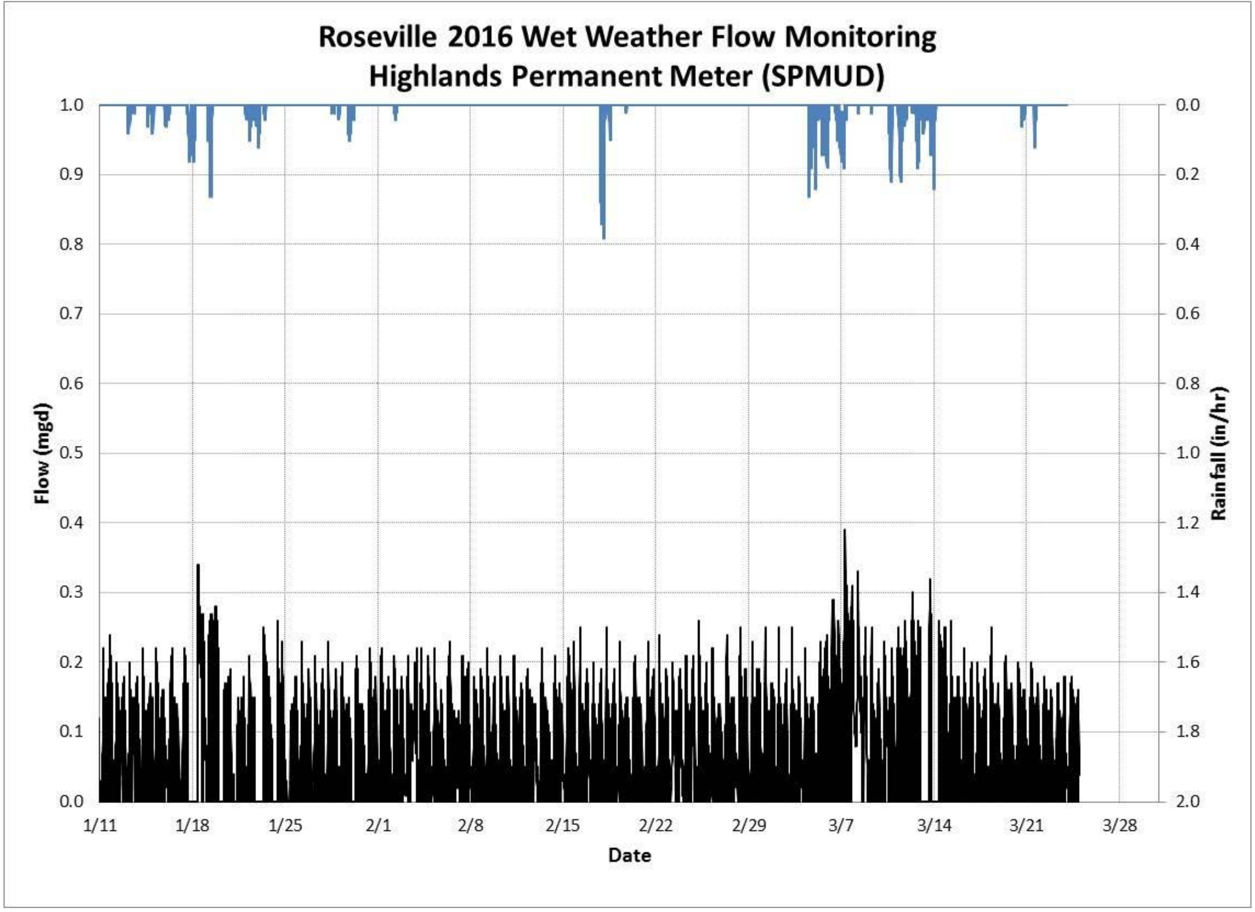
Roseville 2015/2016 Wet Weather Flow Monitoring
Site 26 (B06-161, 42")


Roseville 2016 Wet Weather Flow Monitoring
SMD2 Permanent Meter (Placer County)
Flow (mgd)
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date


Roseville 2016 Wet Weather Flow Monitoring
Sierra College Permanent Meter (Placer County)
Draft
Flow (mgd)
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
Rainfall (in/hr)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
1/11
1/18
1/25
2/1
2/8
2/15
2/22
2/29
3/7
3/14
3/21
3/28
Date

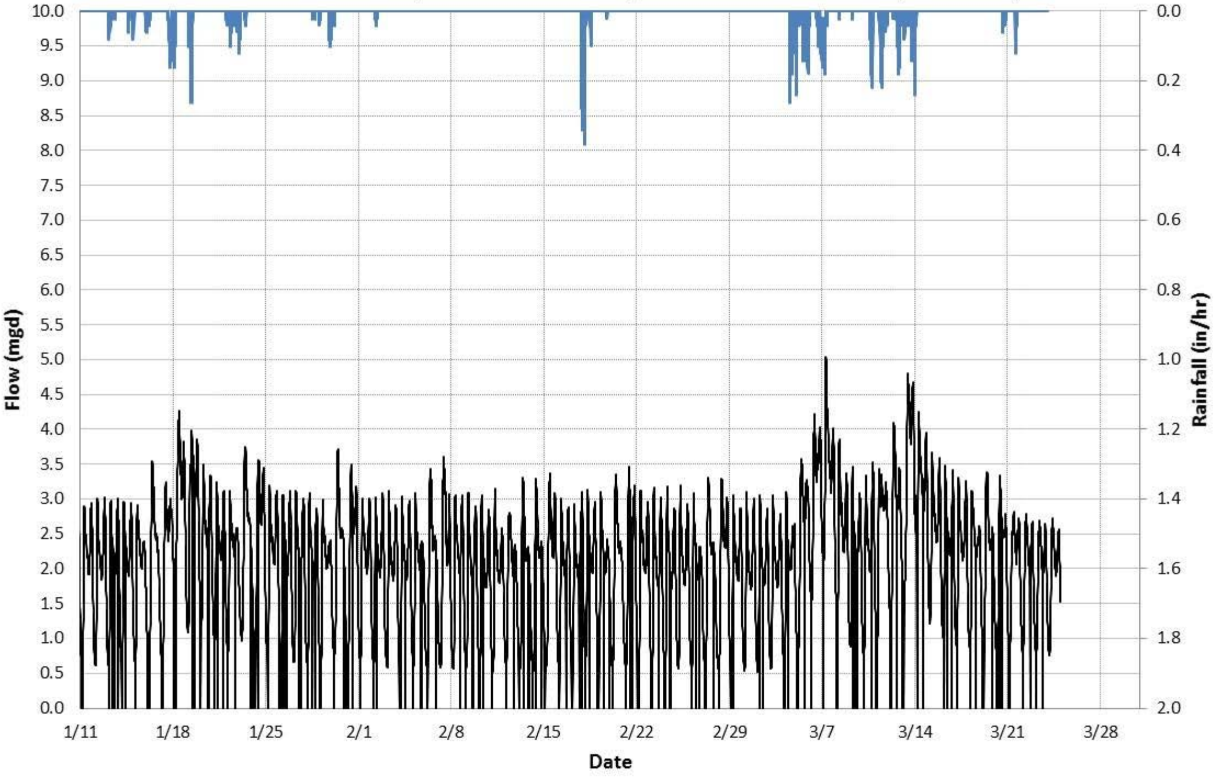


Roseville 2016 Wet Weather Flow Monitoring
Cincinnati & Industrial (Combined) Permanent Meter (Placer County)

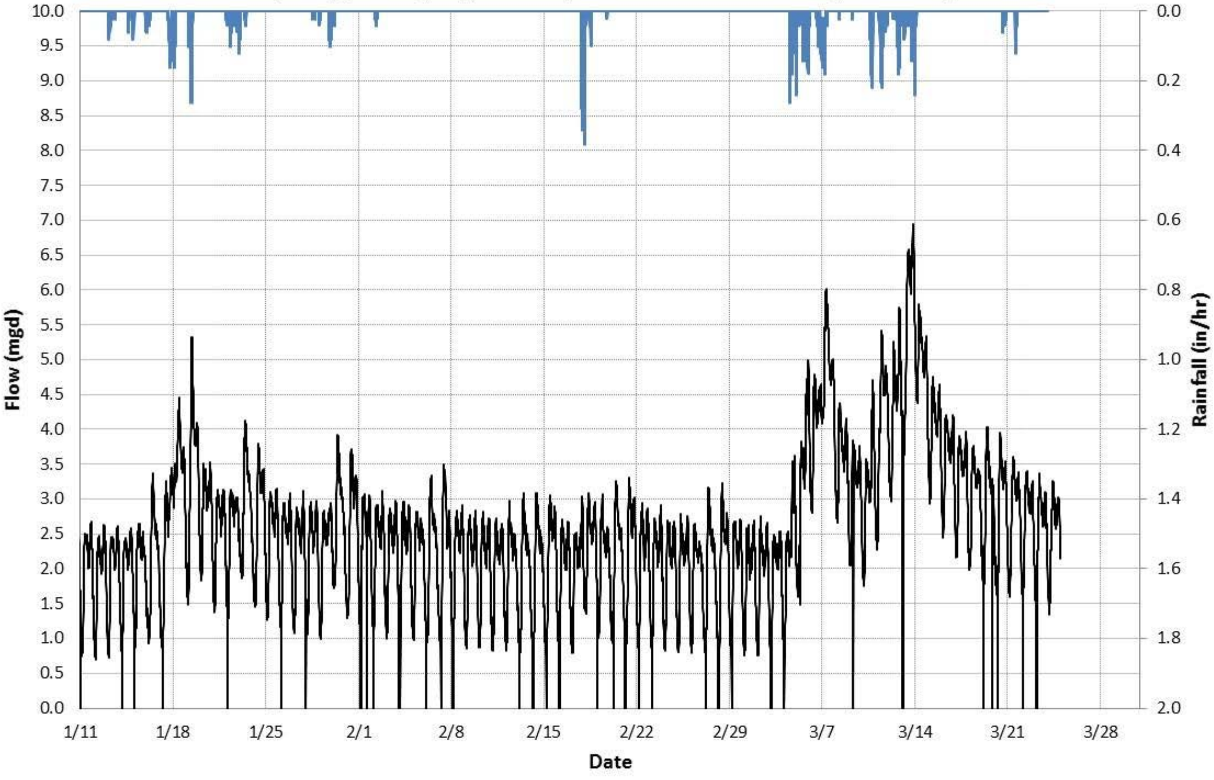


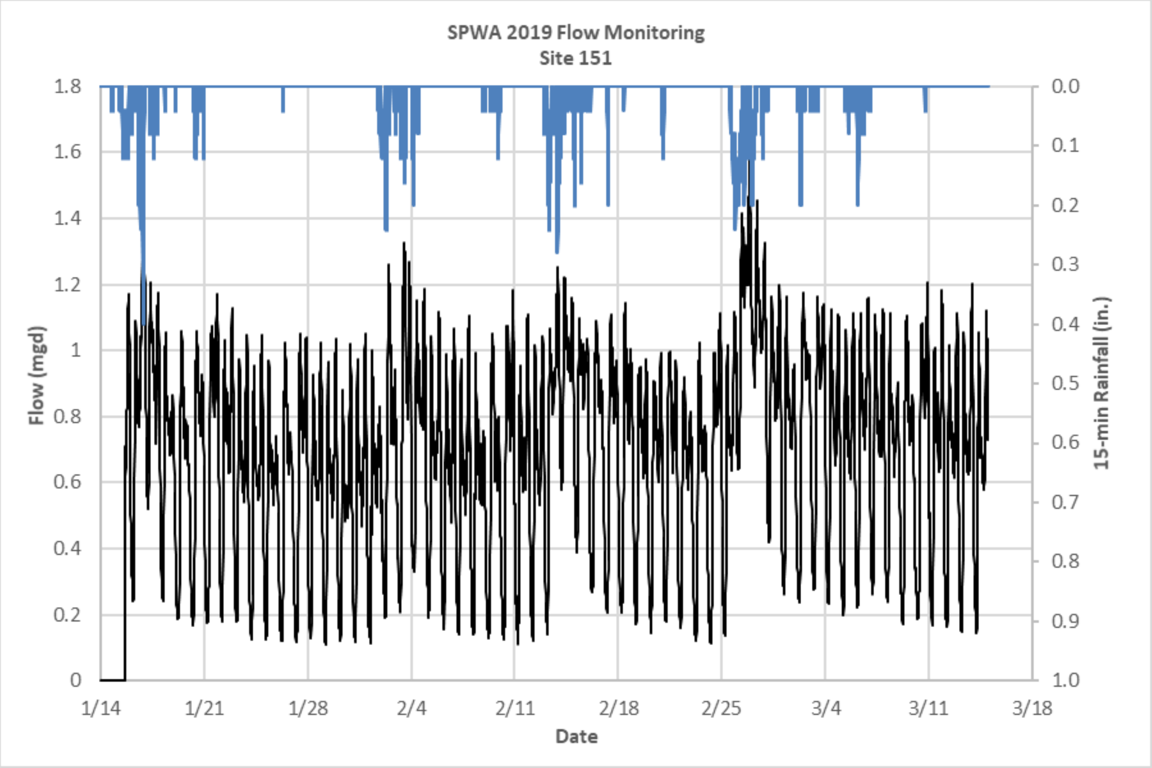
Roseville 2016 Wet Weather Flow Monitoring
Highlands Permanent Meter (SPMUD)

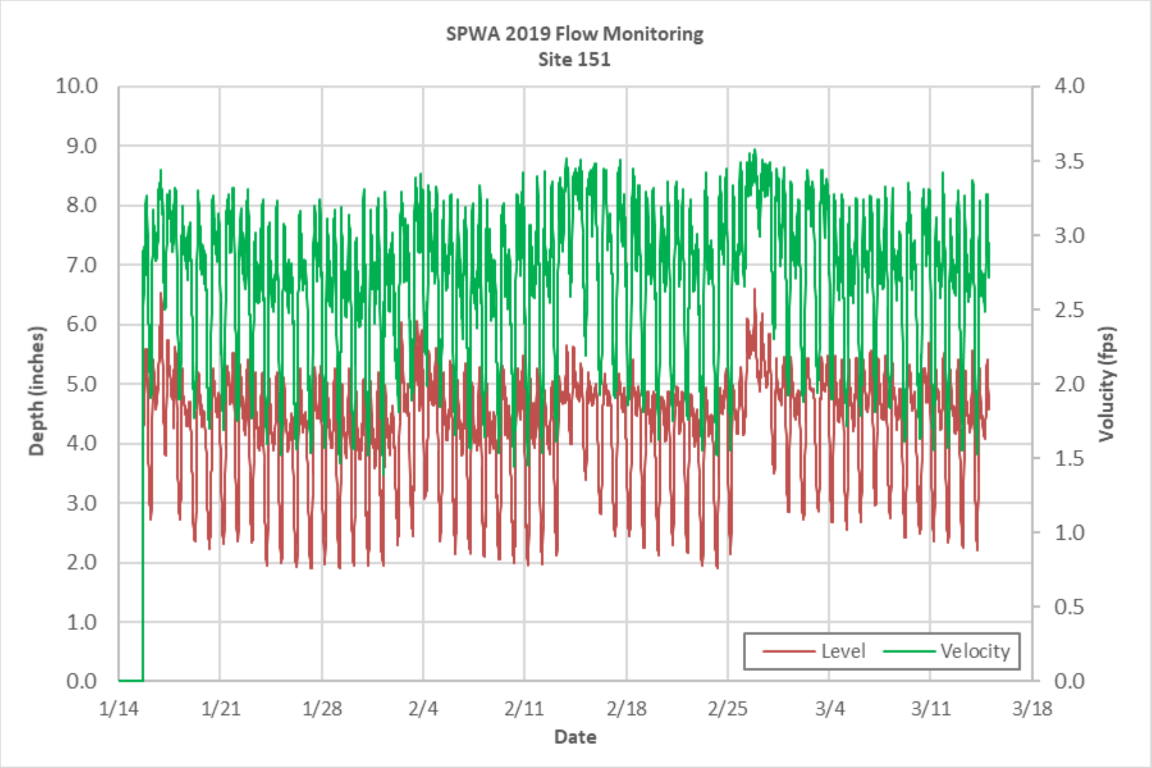
Roseville 2016 Wet Weather Flow Monitoring
North Roseville (Pleasant Grove) Permanent Meter (SPMUD)

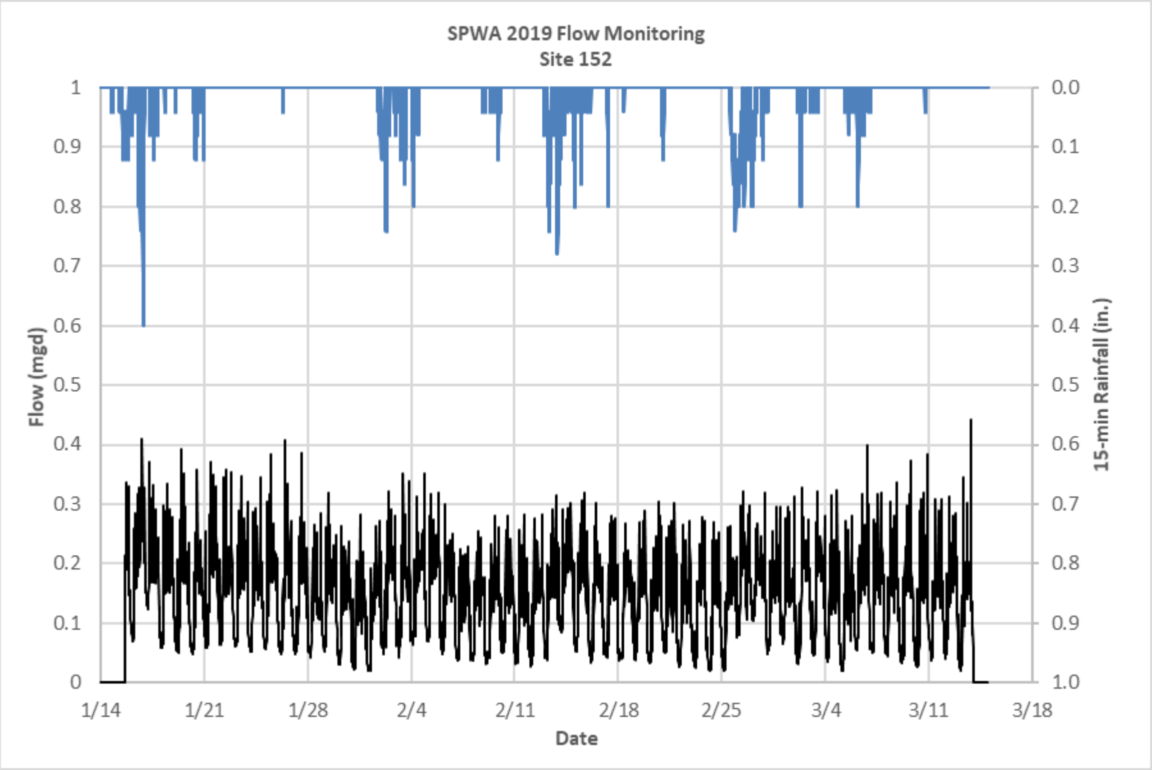


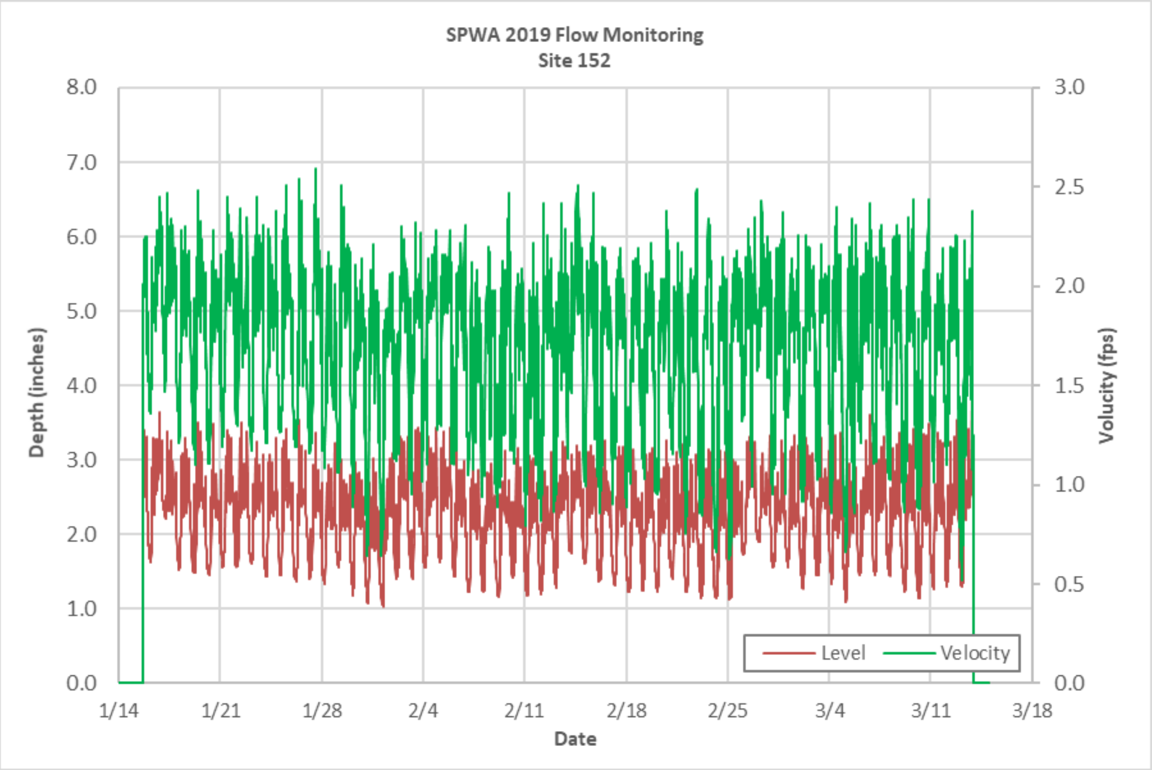
Roseville 2016 Wet Weather Flow Monitoring
Springview (Dry Creek) Permanent Meter (SPMUD)

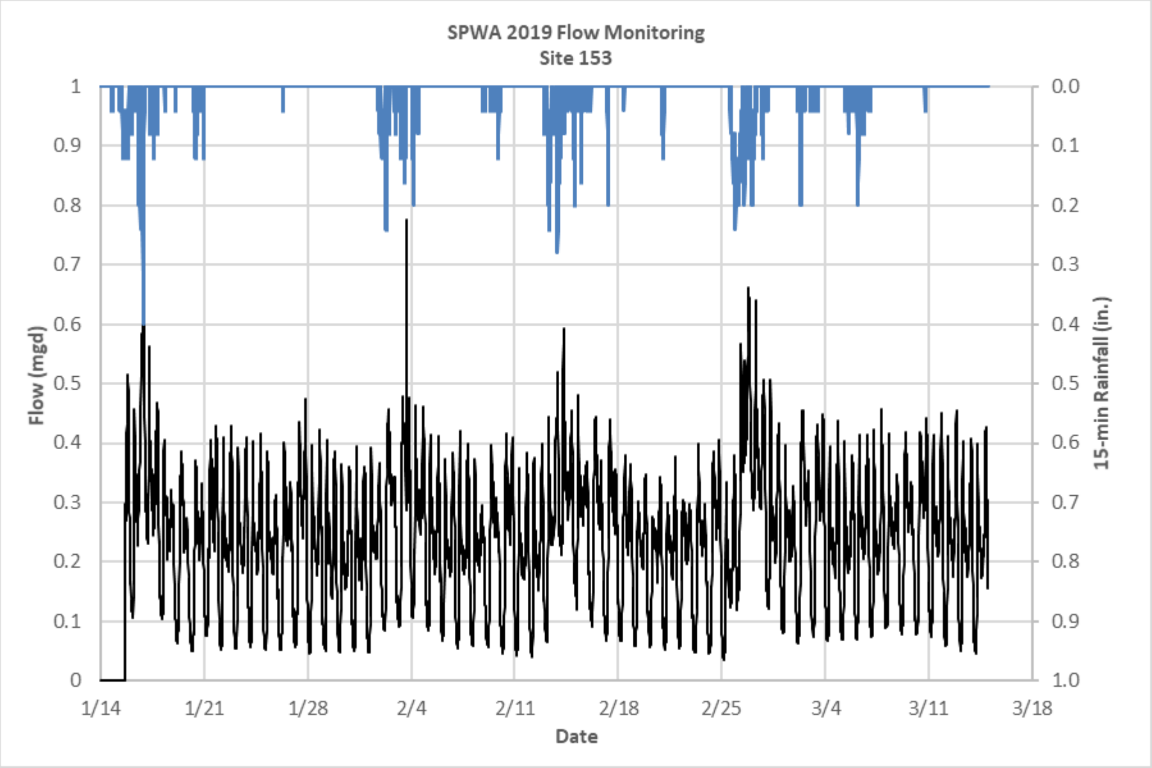


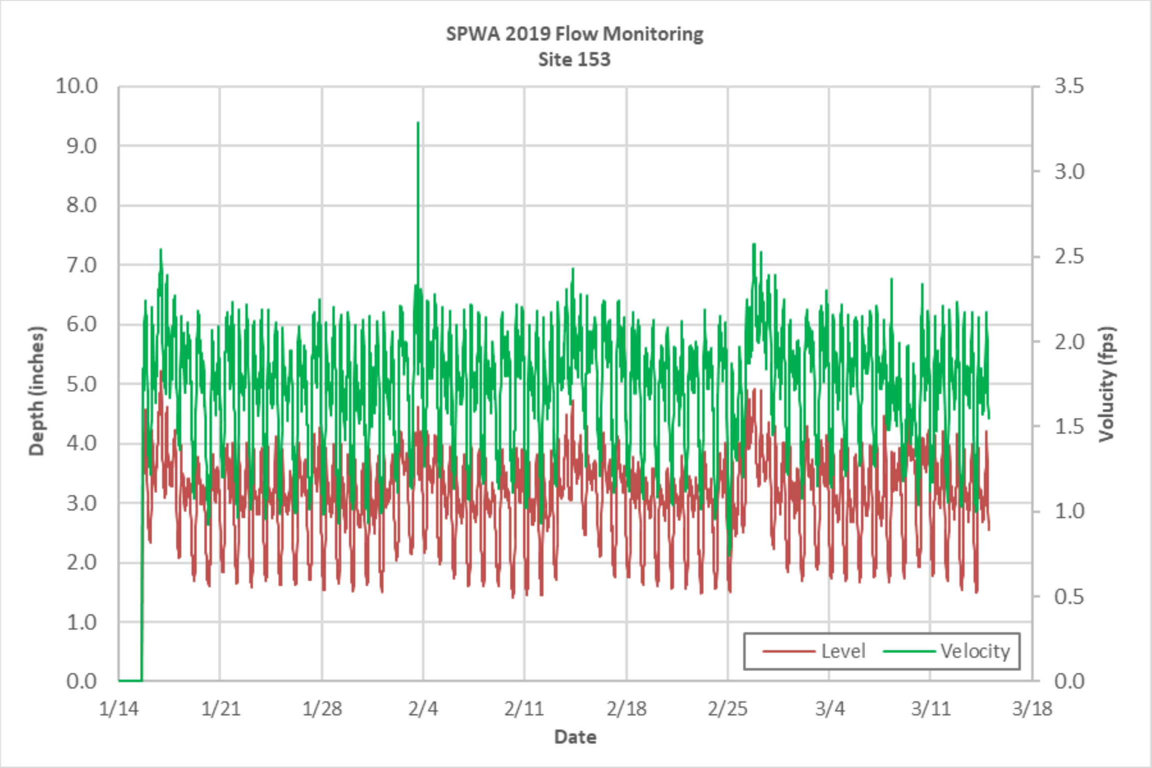

SPWA 2019 Flow Monitoring
Site 151
Flow (mgd)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

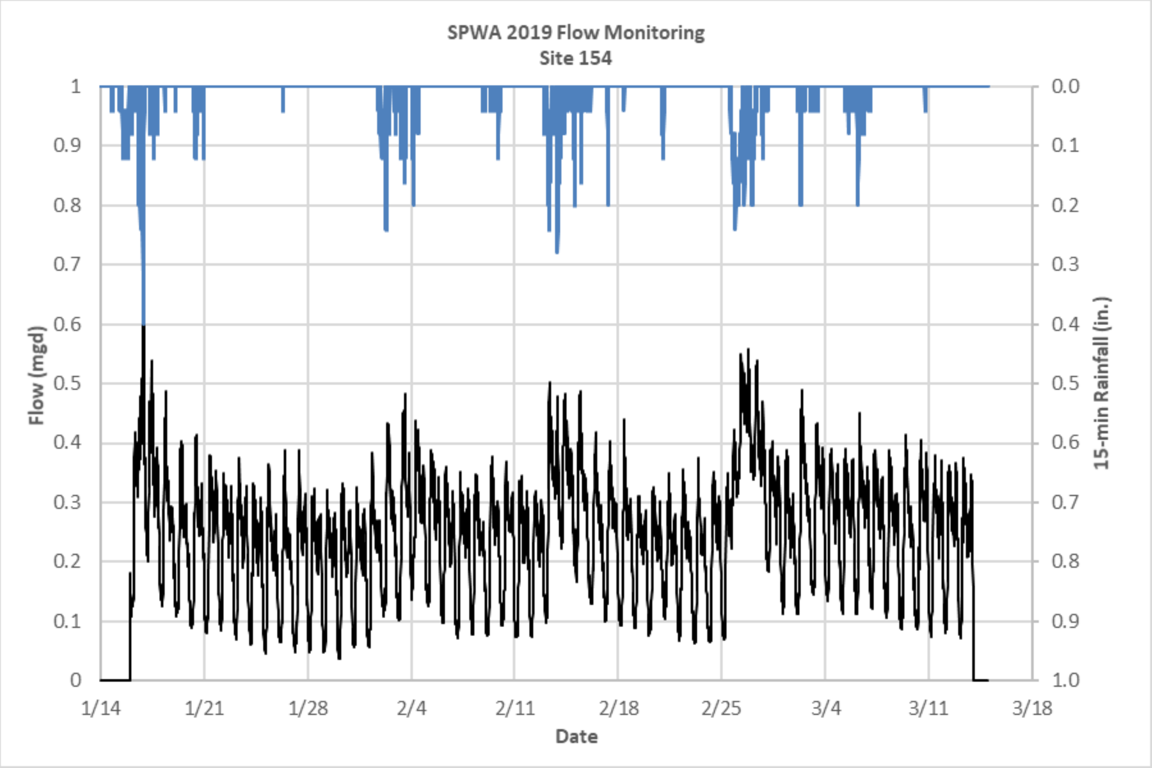

SPWA 2019 Flow Monitoring
Site 151
Depth (inches)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Volucity (fps)
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date
Level
Velocity

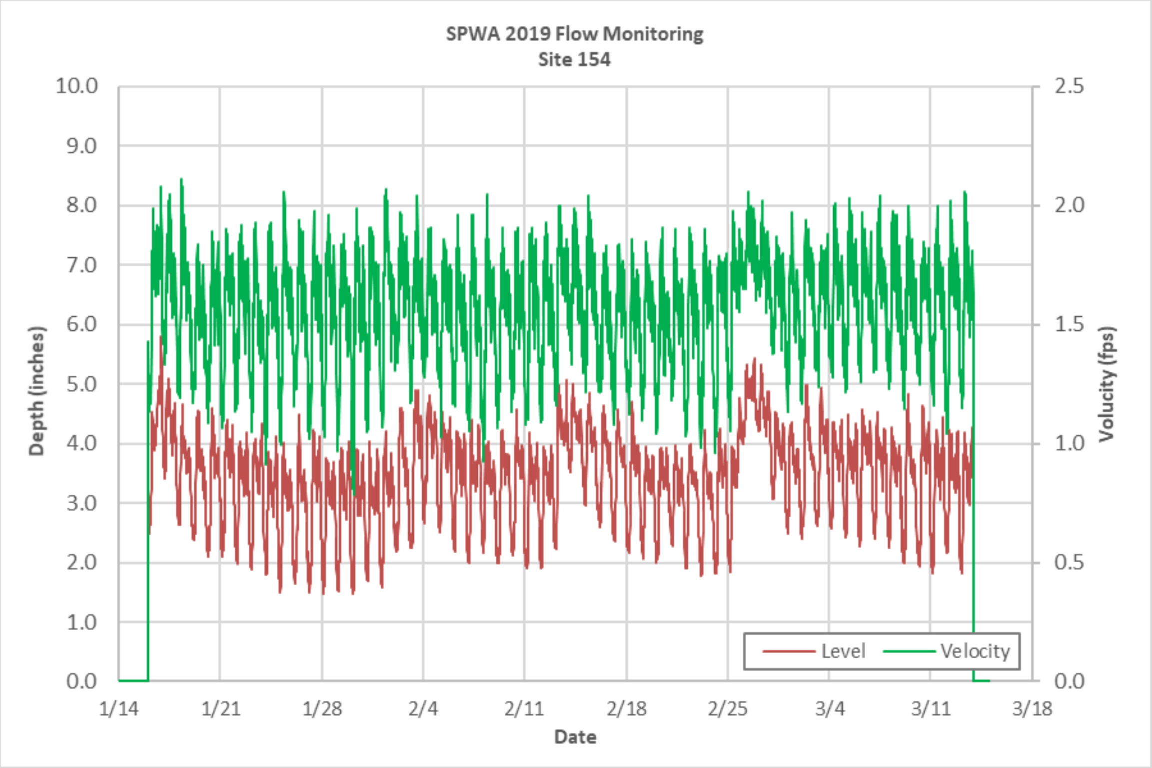

SPWA 2019 Flow Monitoring
Site 152
Flow (mgd)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

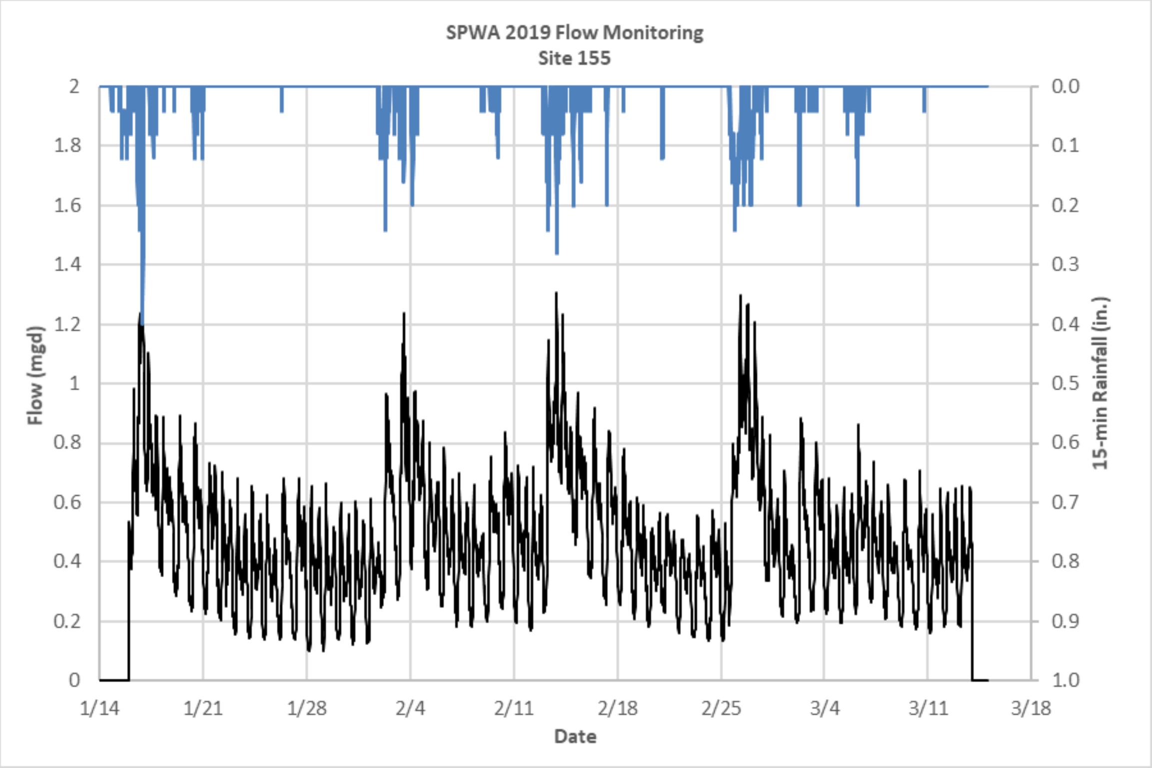

SPWA 2019 Flow Monitoring
Site 152
Depth (inches)
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Volucity (fps)
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Level
Velocity
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

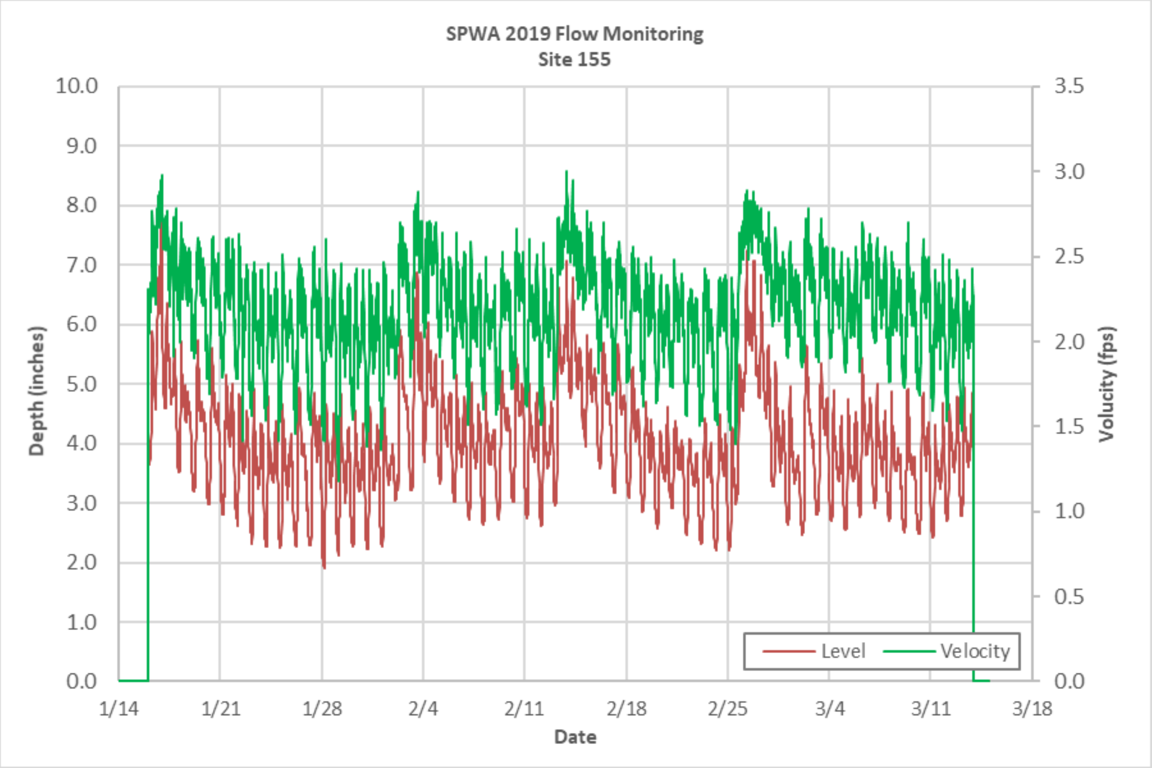

SPWA 2019 Flow Monitoring
Site 153
Flow (mgd)
15-min Rainfall (in.)
Date
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18

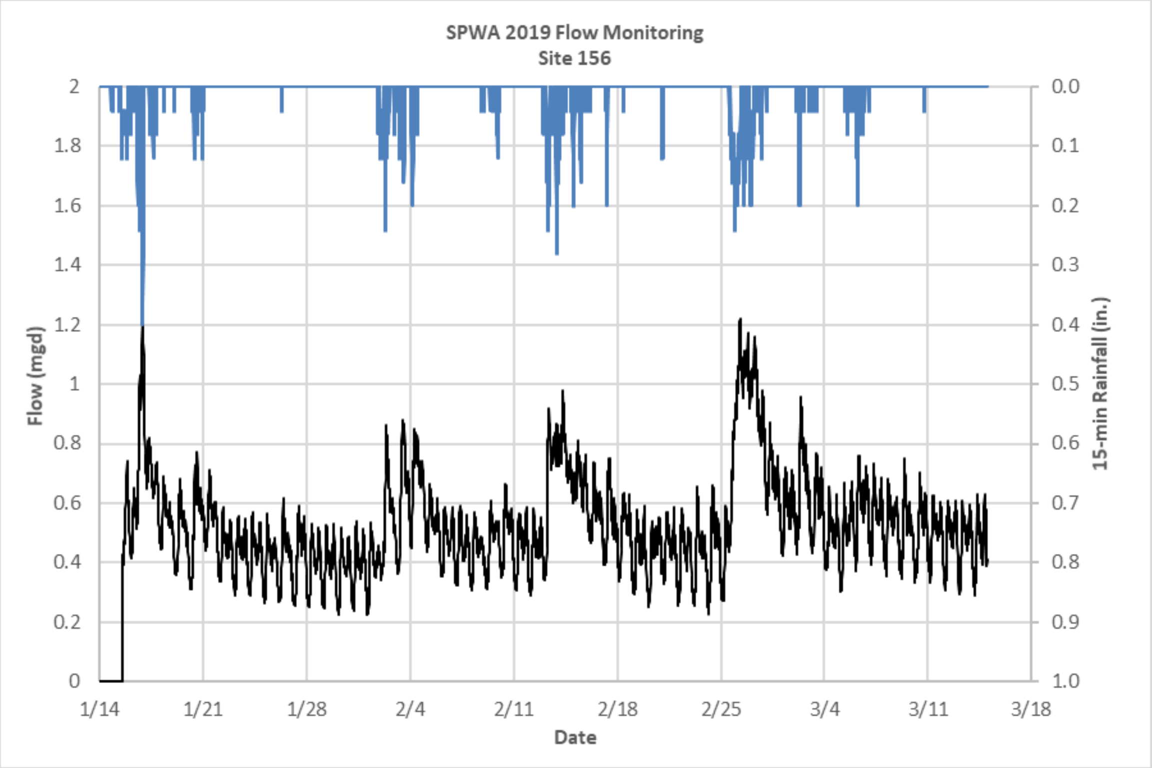

SPWA 2019 Flow Monitoring
Site 153
Depth (inches)
Volucity (fps)
Date
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Level
Velocity

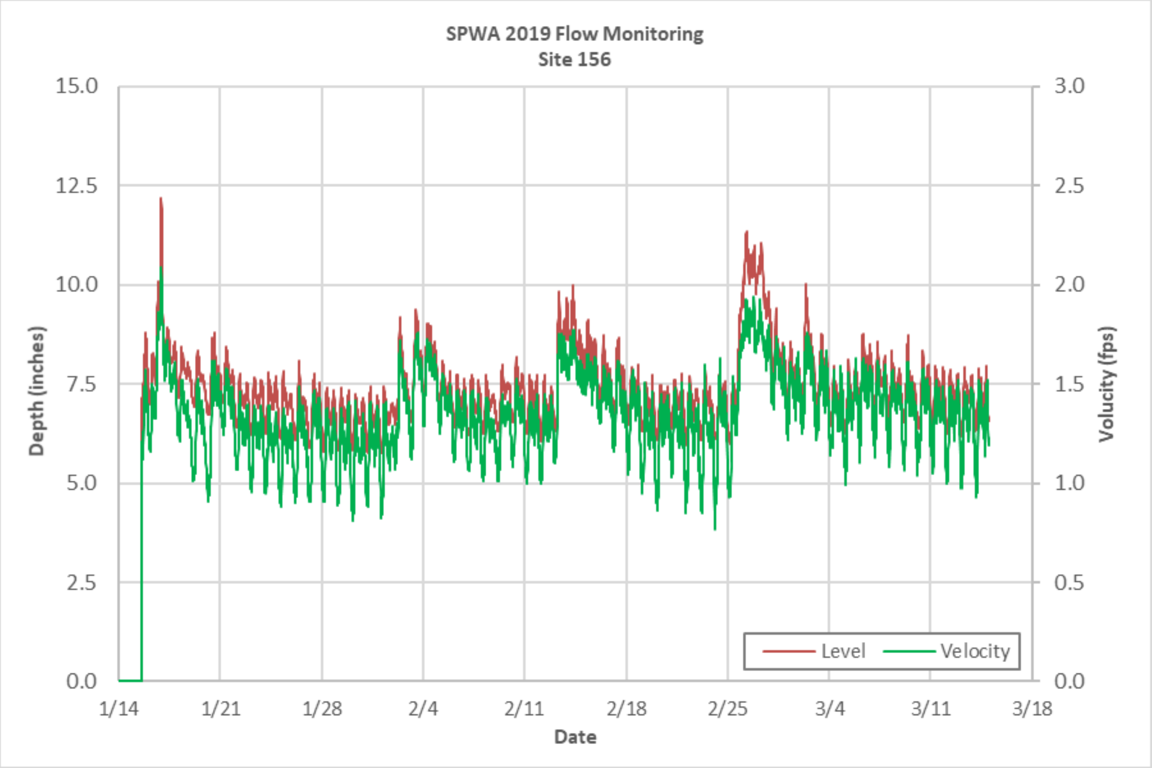

SPWA 2019 Flow Monitoring
Site 154
Flow (mgd)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

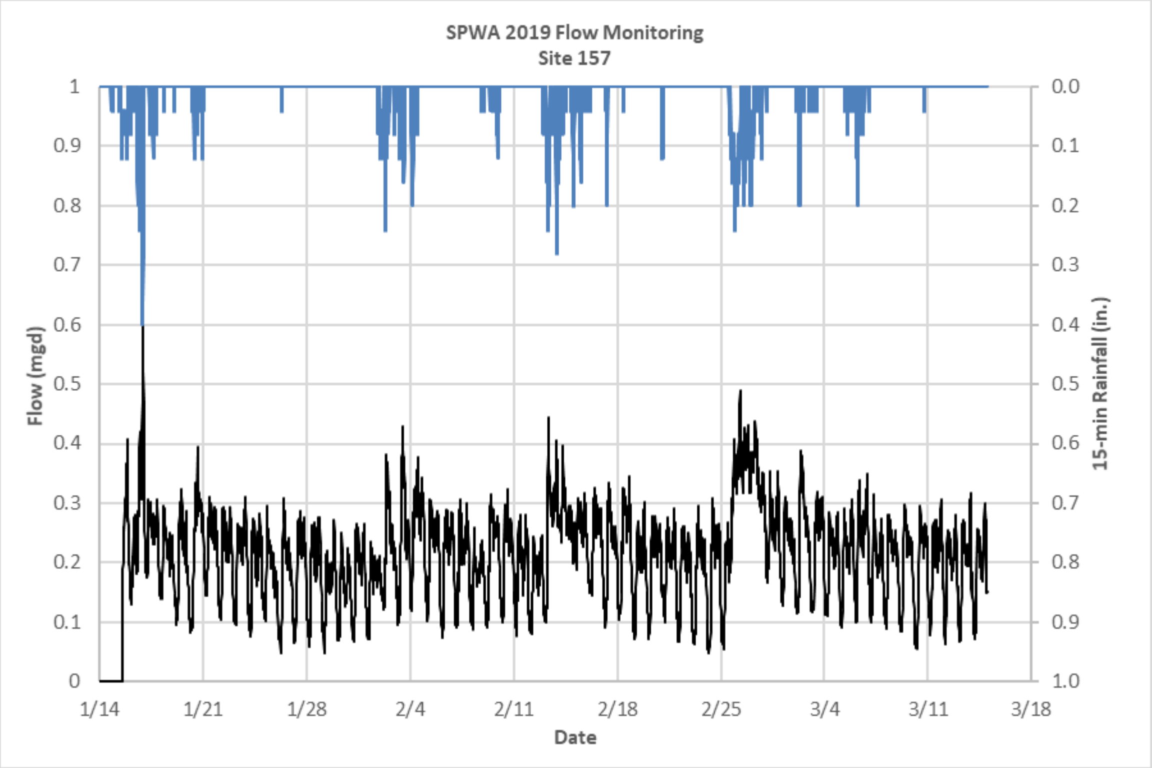

SPWA 2019 Flow Monitoring
Site 154
Depth (inches)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Volucity (fps)
2.5
2.0
1.5
1.0
0.5
0.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date
Level
Velocity

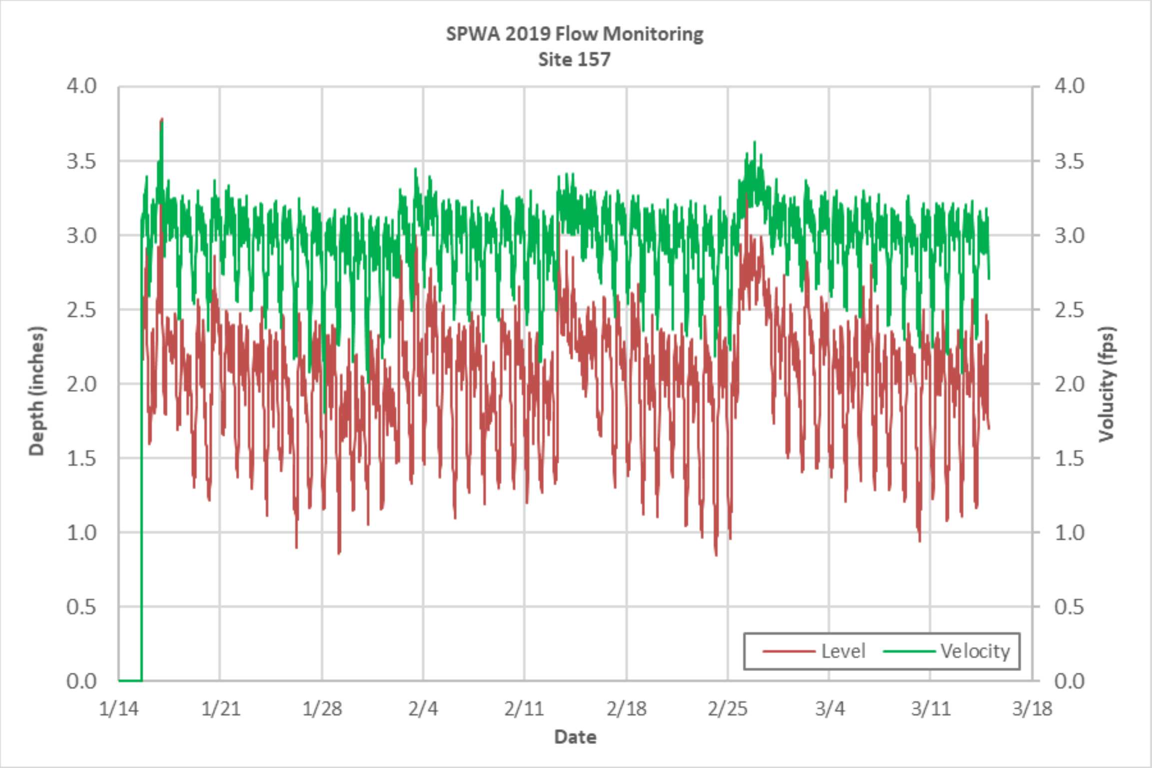

SPWA 2019 Flow Monitoring
Site 155
Flow (mgd)
15-min Rainfall (in.)
Date
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18

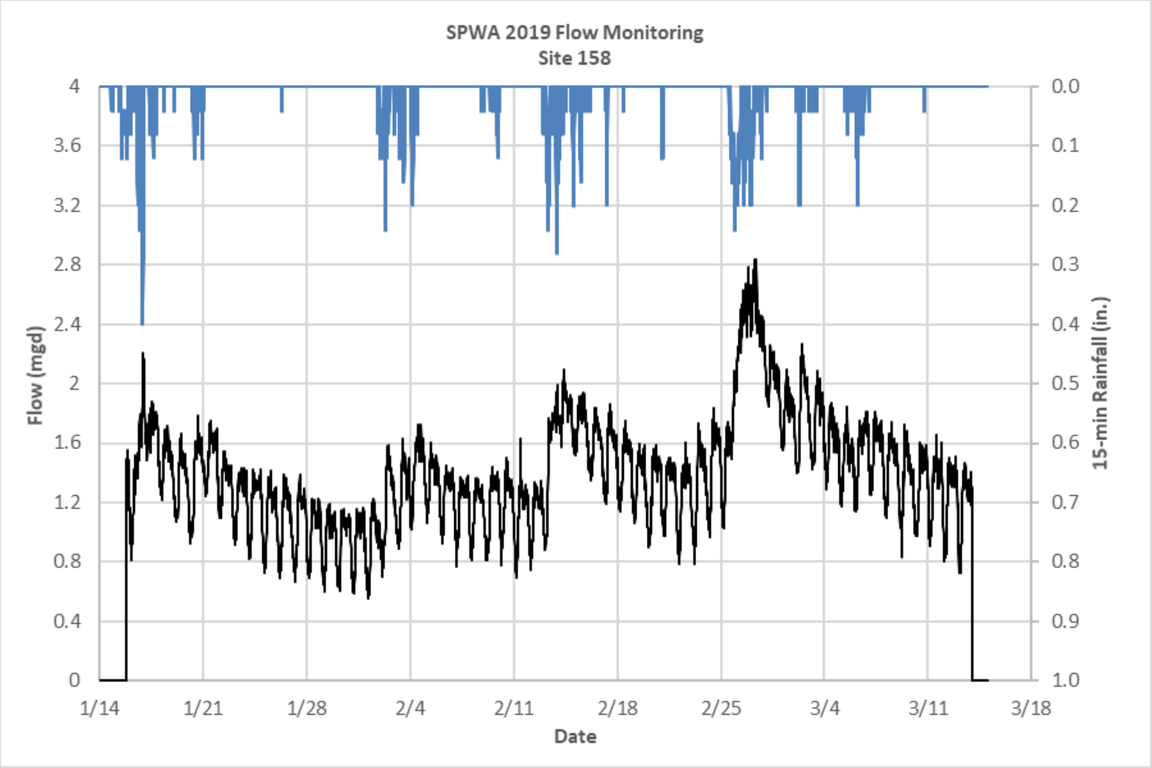

SPWA 2019 Flow Monitoring
Site 155
Depth (inches)
Volucity (fps)
Date
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Level
Velocity

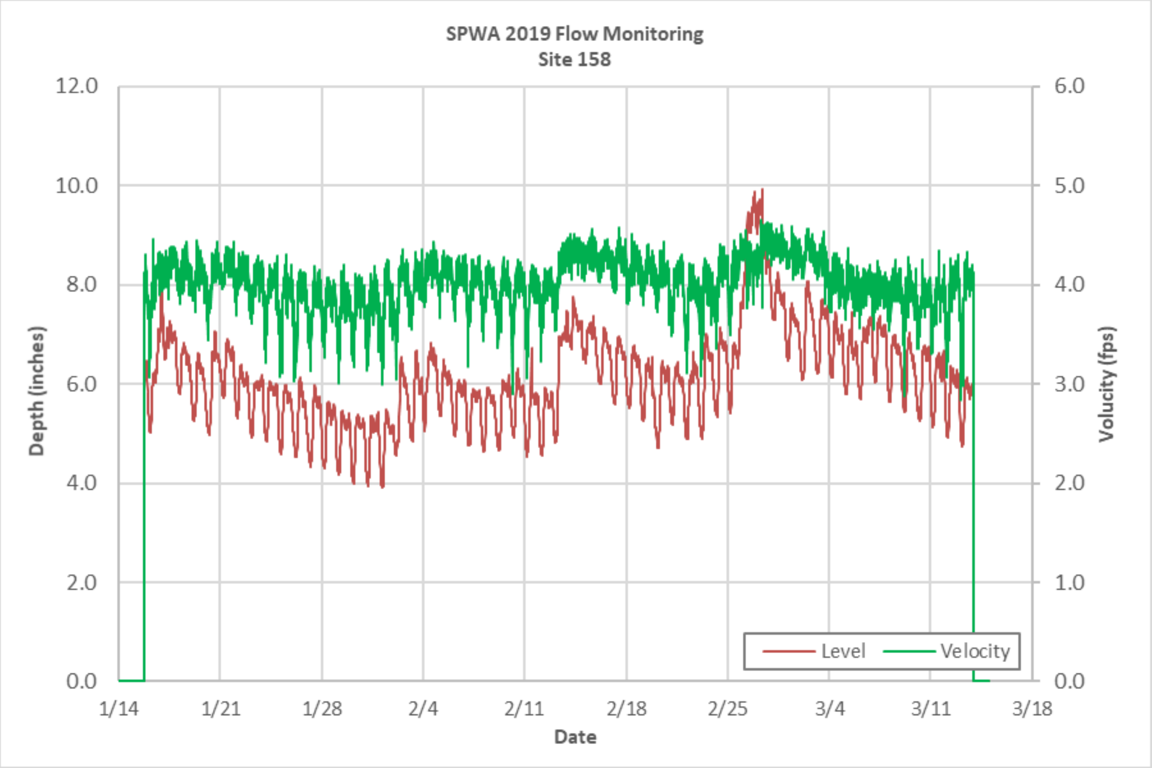

SPWA 2019 Flow Monitoring
Site 156
Flow (mgd)
15-min Rainfall (in.)
Date
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18

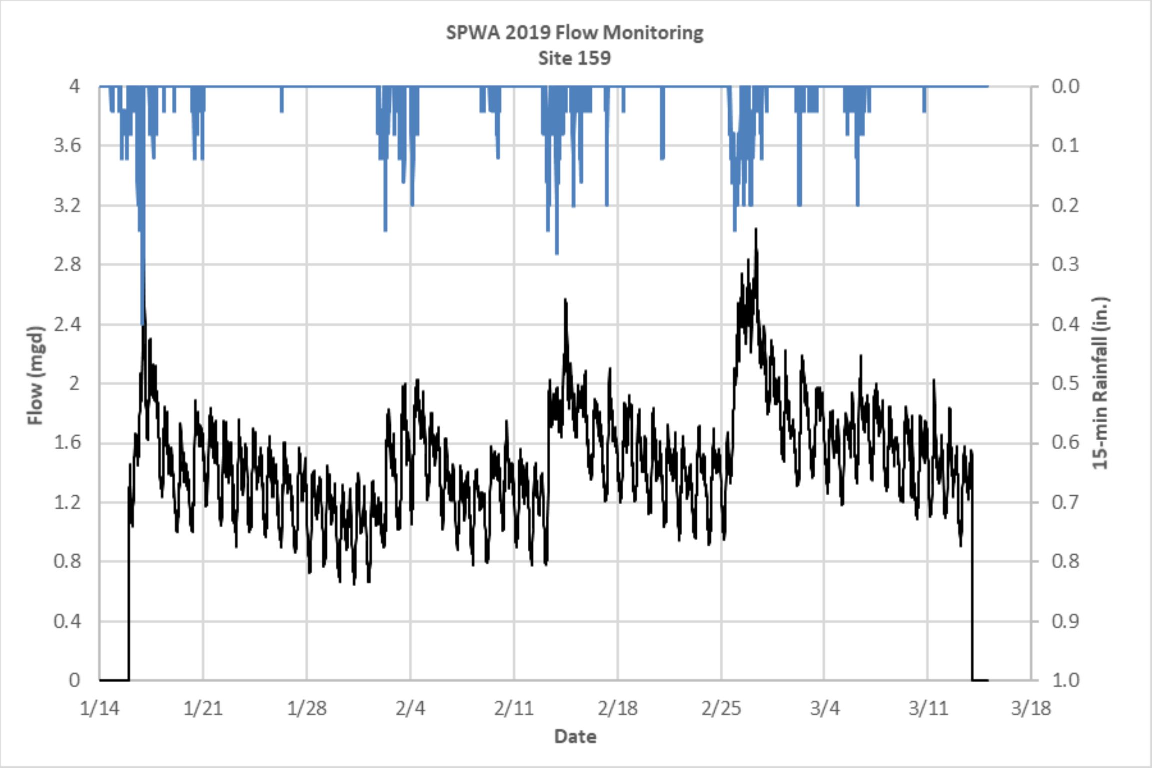

SPWA 2019 Flow Monitoring
Site 156
Depth (inches)
Volucity (fps)
Date
15.0
12.5
10.0
7.5
5.0
2.5
0.0
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Level
Velocity

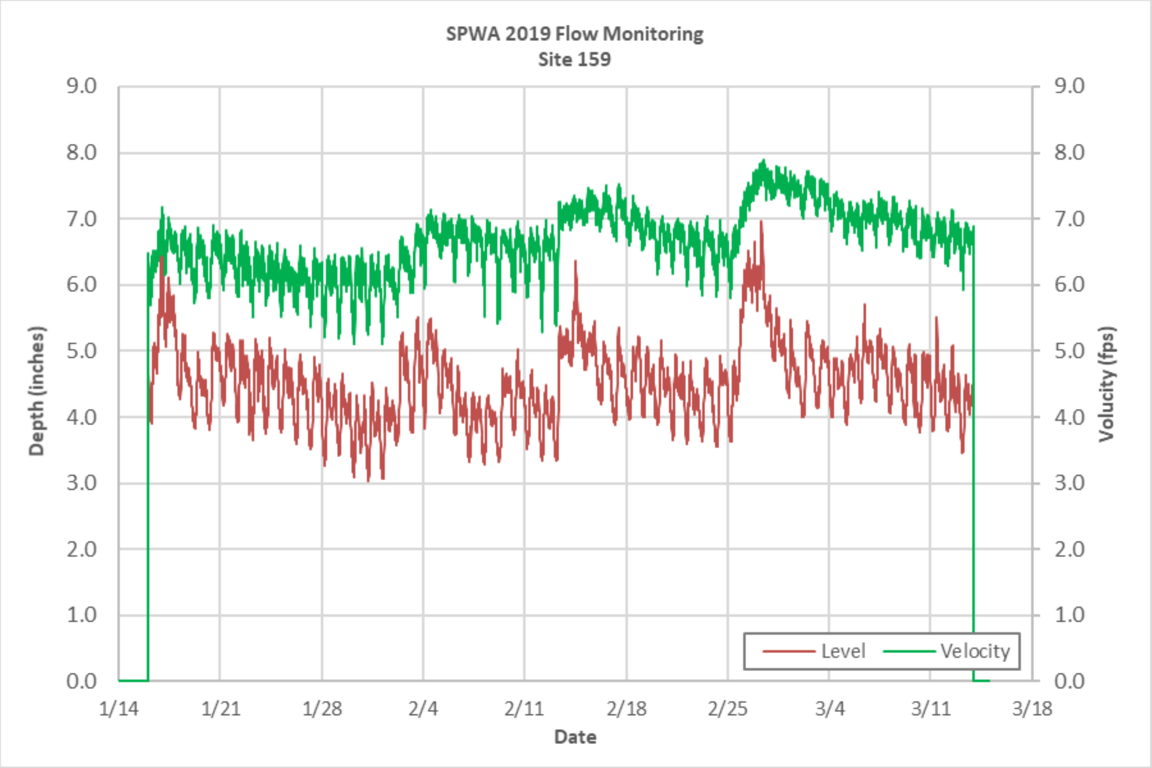

SPWA 2019 Flow Monitoring
Site 157
Flow (mgd)
15-min Rainfall (in.)
Date
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18

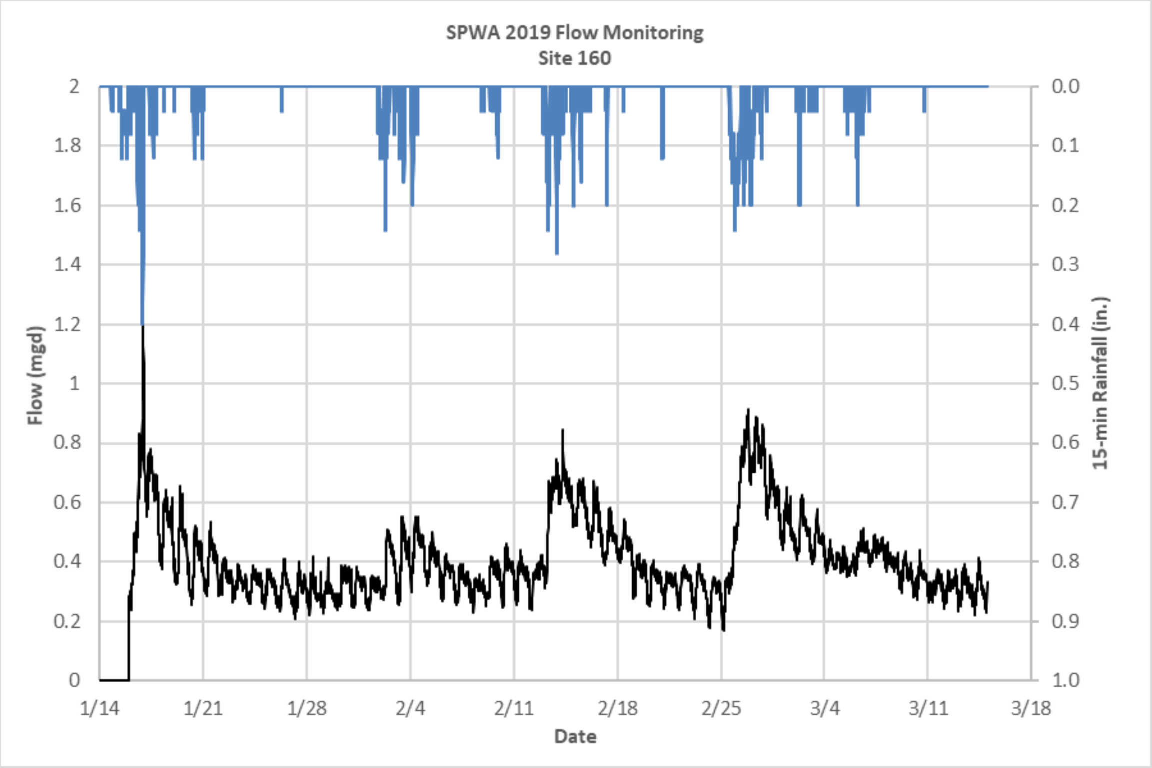

SPWA 2019 Flow Monitoring
Site 157
Depth (inches)
Volucity (fps)
Date
Level
Velocity
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18

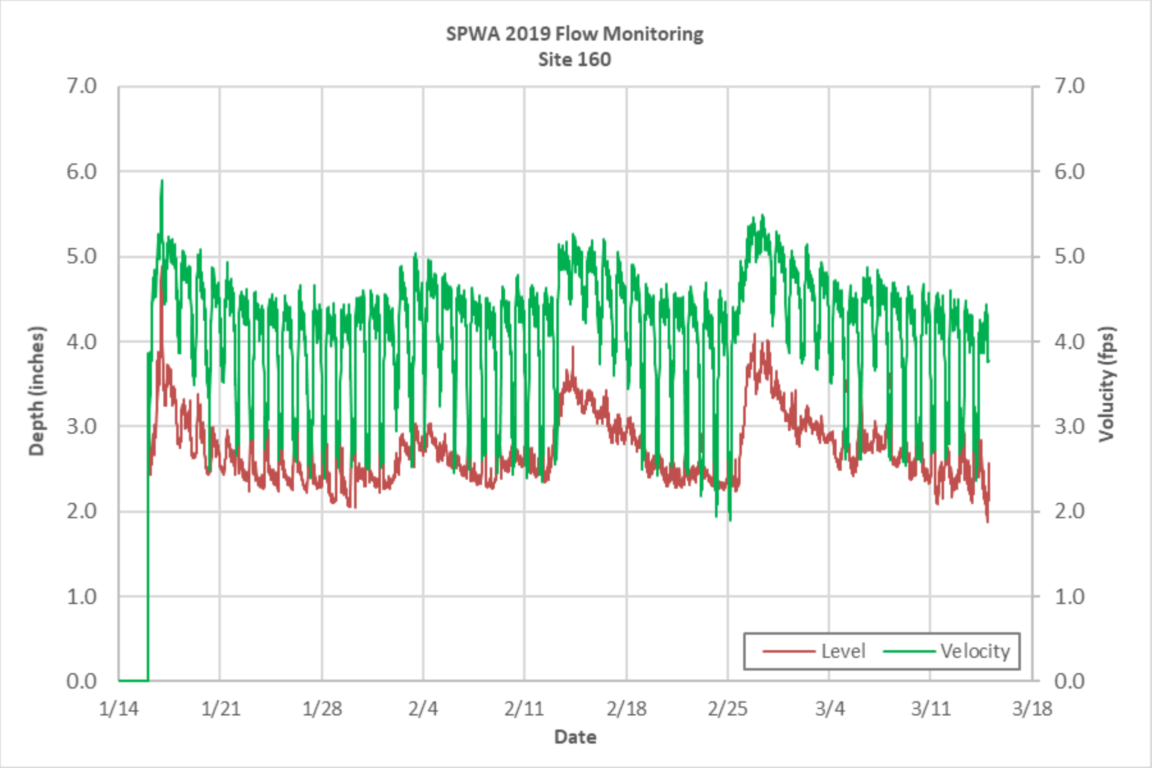

SPWA 2019 Flow Monitoring
Site 158
Flow (mgd)
4
3.6
3.2
2.8
2.4
2
1.6
1.2
0.8
0.4
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

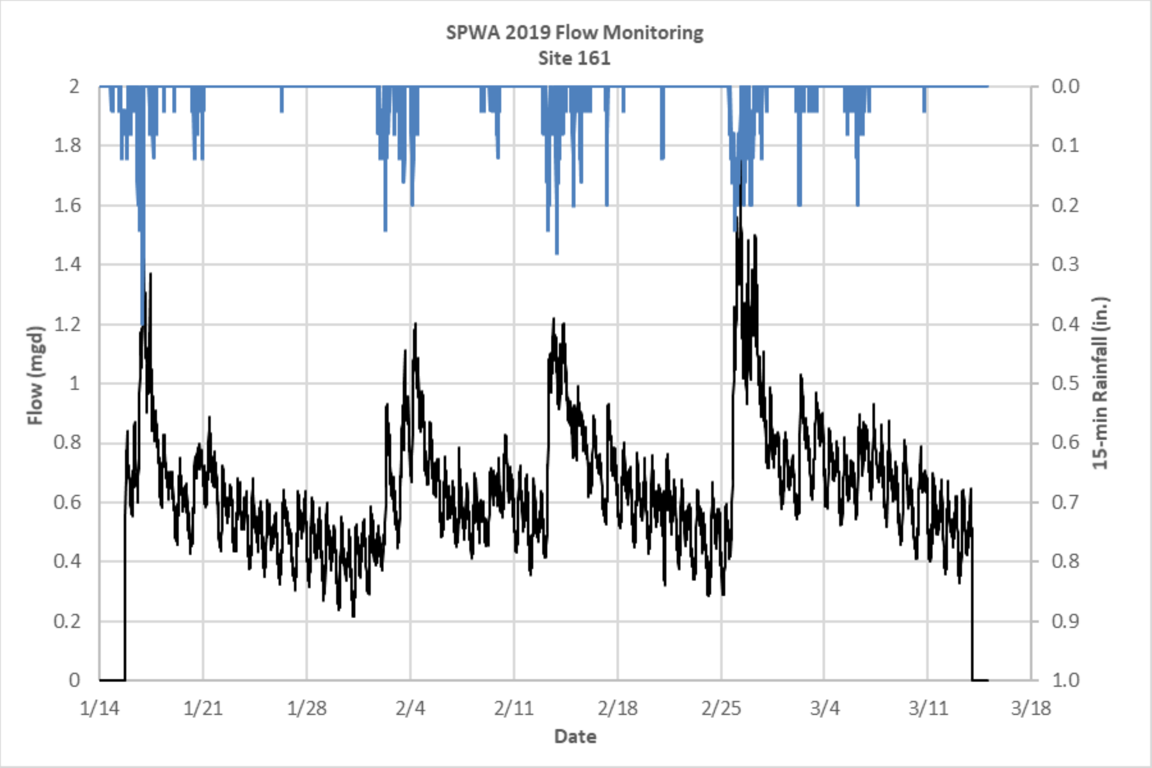

SPWA 2019 Flow Monitoring
Site 158
Depth (inches)
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Volucity (fps)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Level
Velocity
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

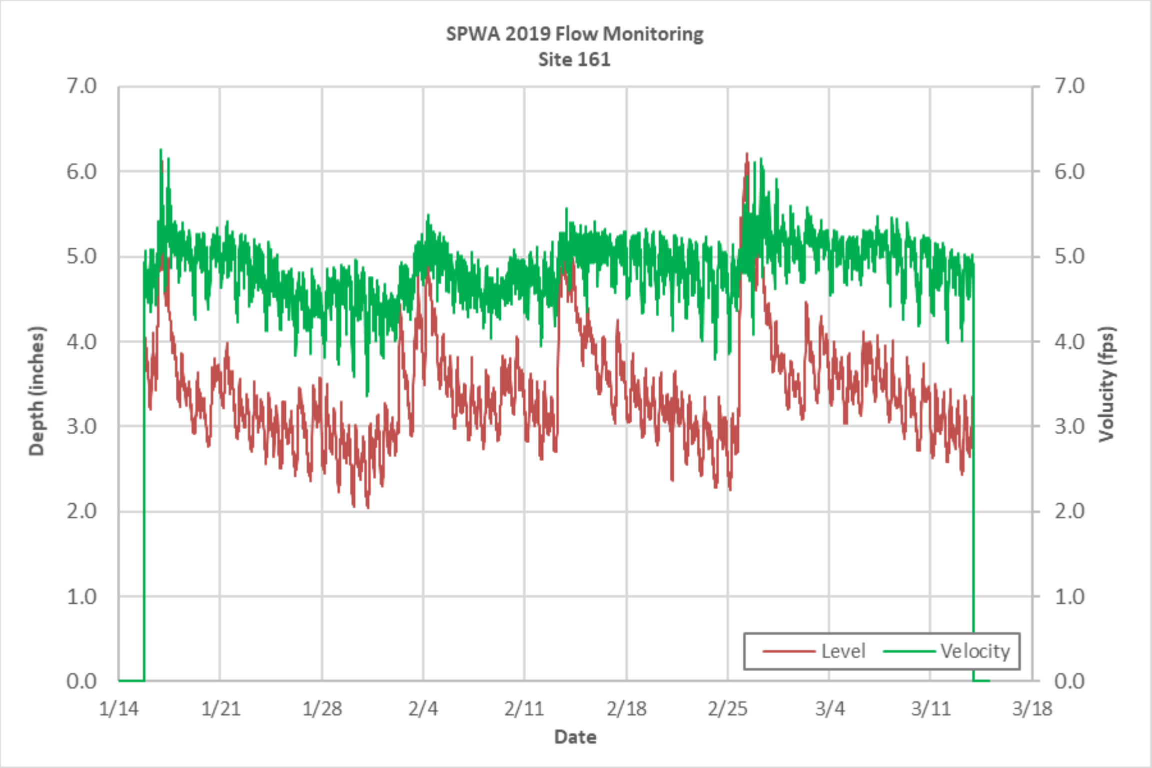

SPWA 2019 Flow Monitoring
Site 159
Flow (mgd)
4
3.6
3.2
2.8
2.4
2
1.6
1.2
0.8
0.4
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

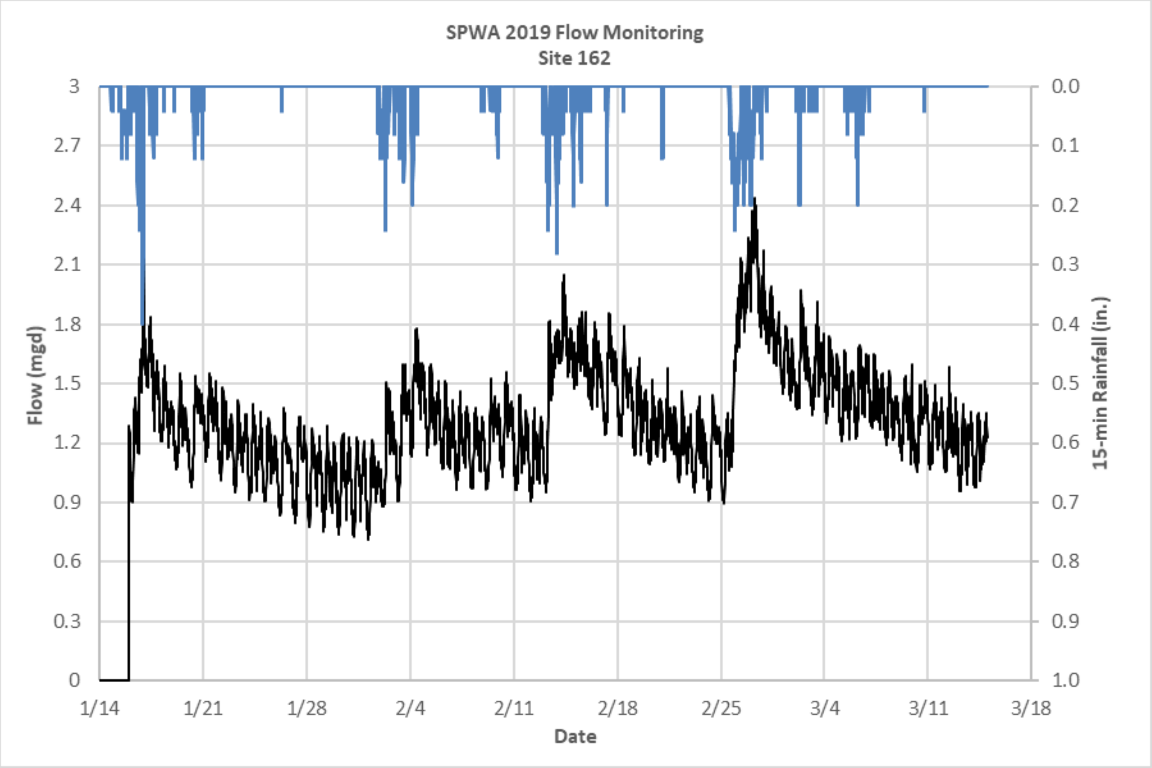

SPWA 2019 Flow Monitoring
Site 159
Depth (inches)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Volucity (fps)
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Level
Velocity
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

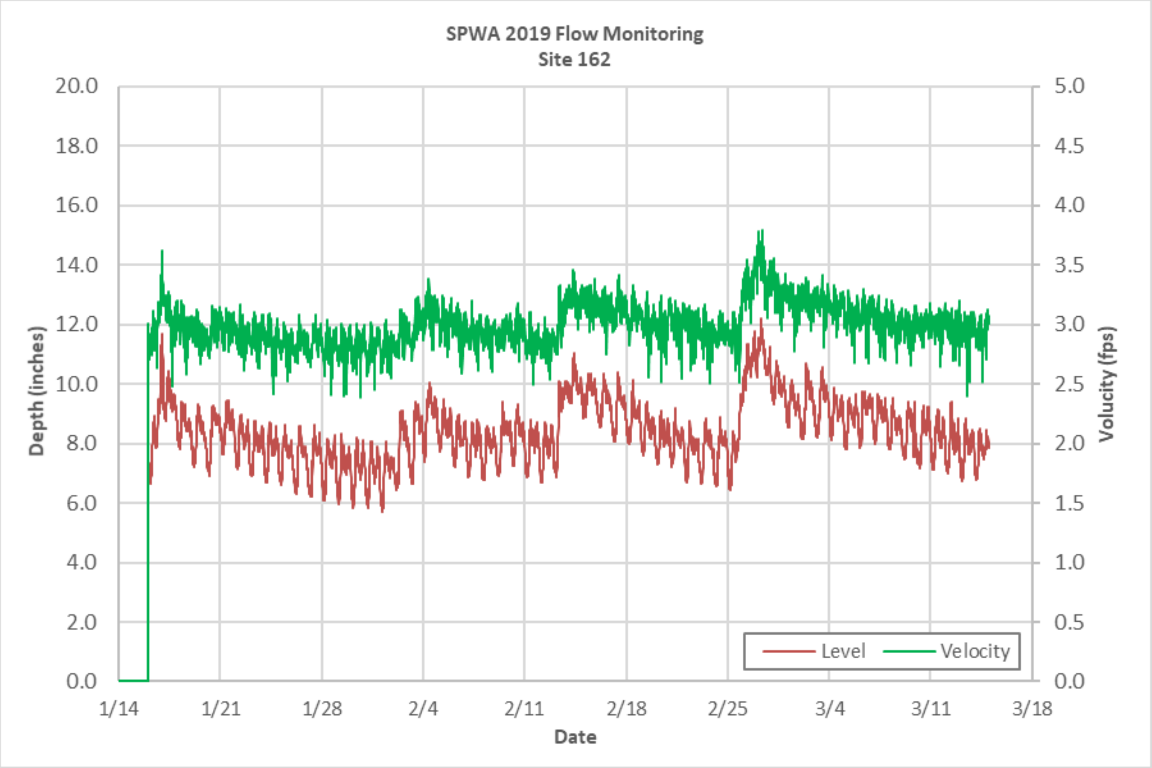

SPWA 2019 Flow Monitoring
Site 160
Flow (mgd)
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

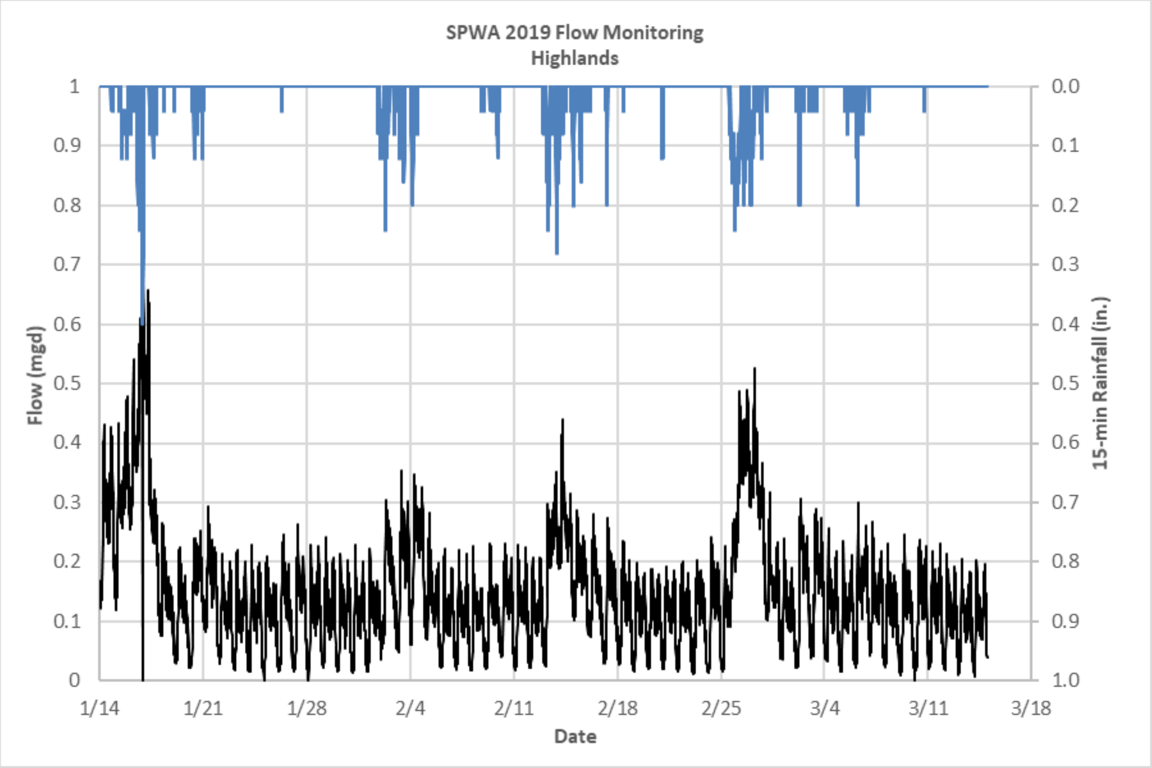

SPWA 2019 Flow Monitoring
Site 160
Depth (inches)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Volucity (fps)
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Level
Velocity
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

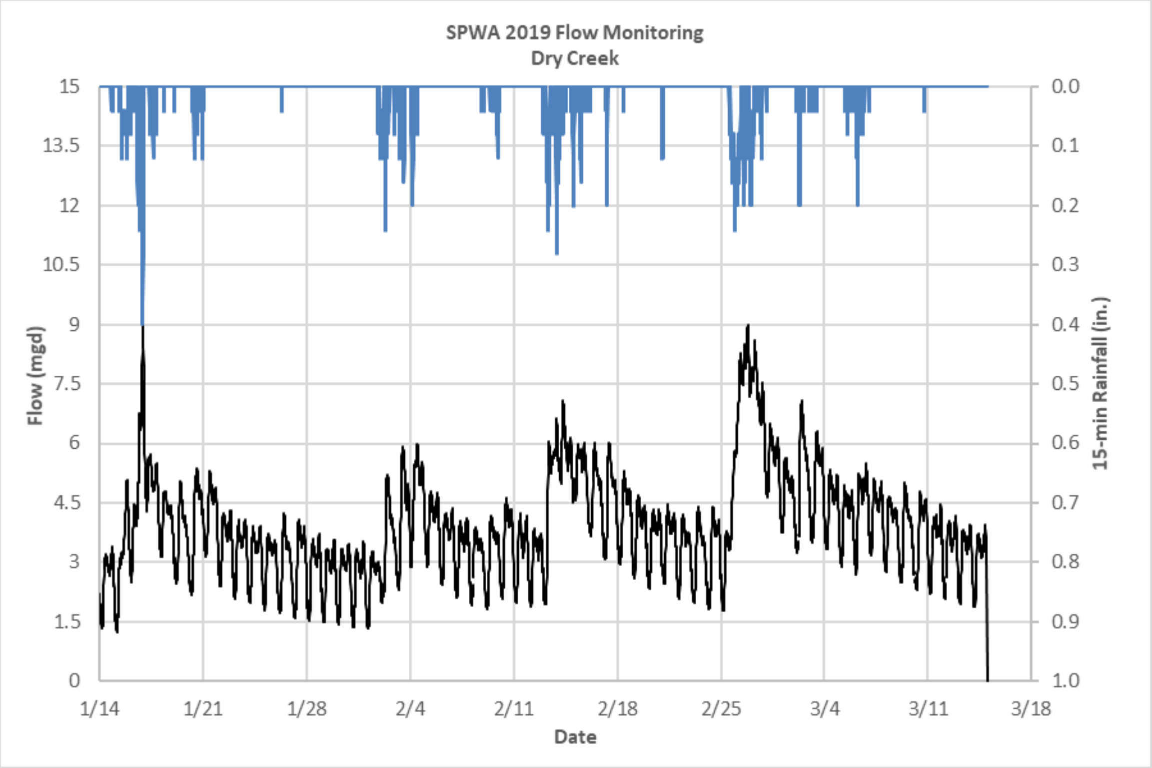

SPWA 2019 Flow Monitoring
Site 161
Flow (mgd)
15-min Rainfall (in.)
Date
2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18

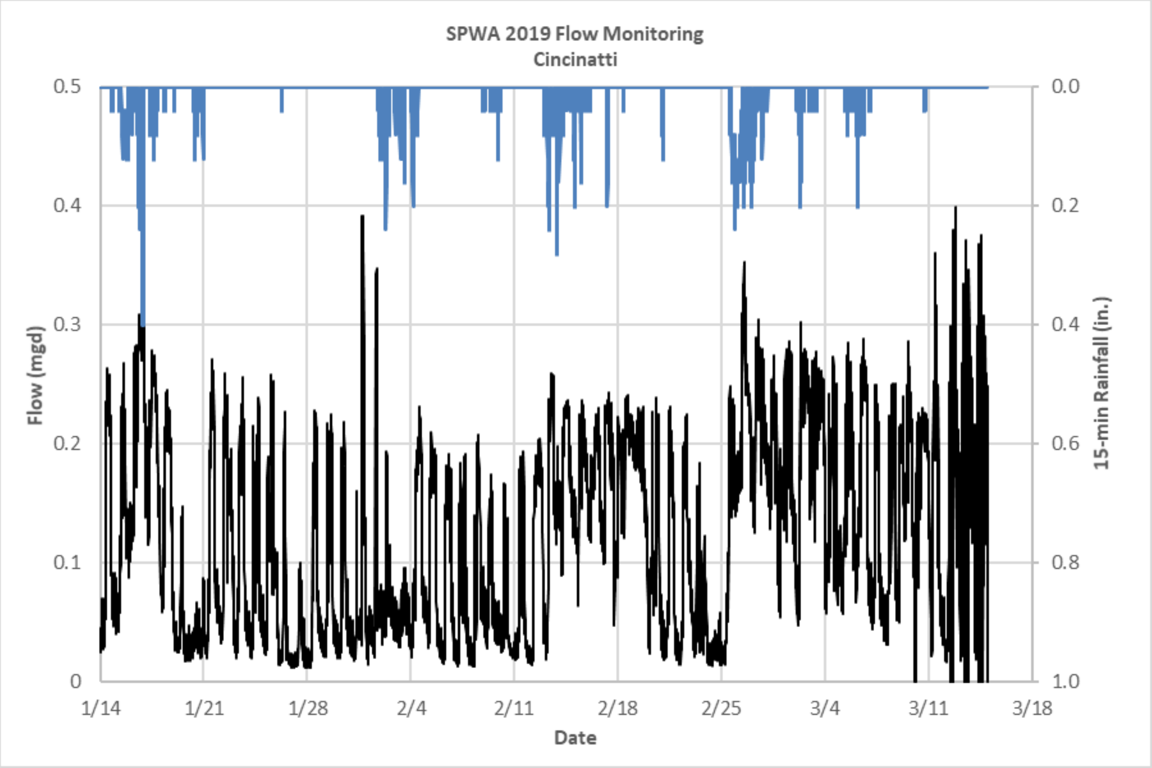

SPWA 2019 Flow Monitoring
Site 161
Depth (inches)
Volucity (fps)
Date
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Level
Velocity

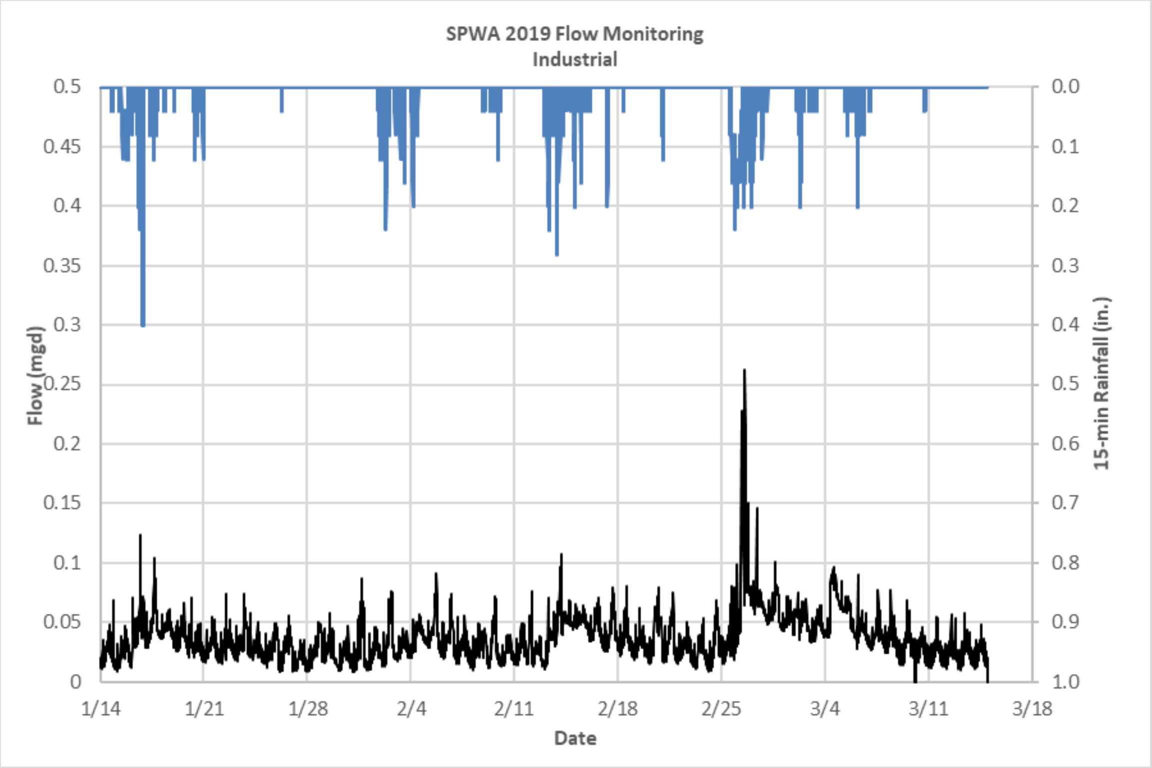

SPWA 2019 Flow Monitoring
Site 162
Flow (mgd)
3
2.7
2.4
2.1
1.8
1.5
1.2
0.9
0.6
0.3
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

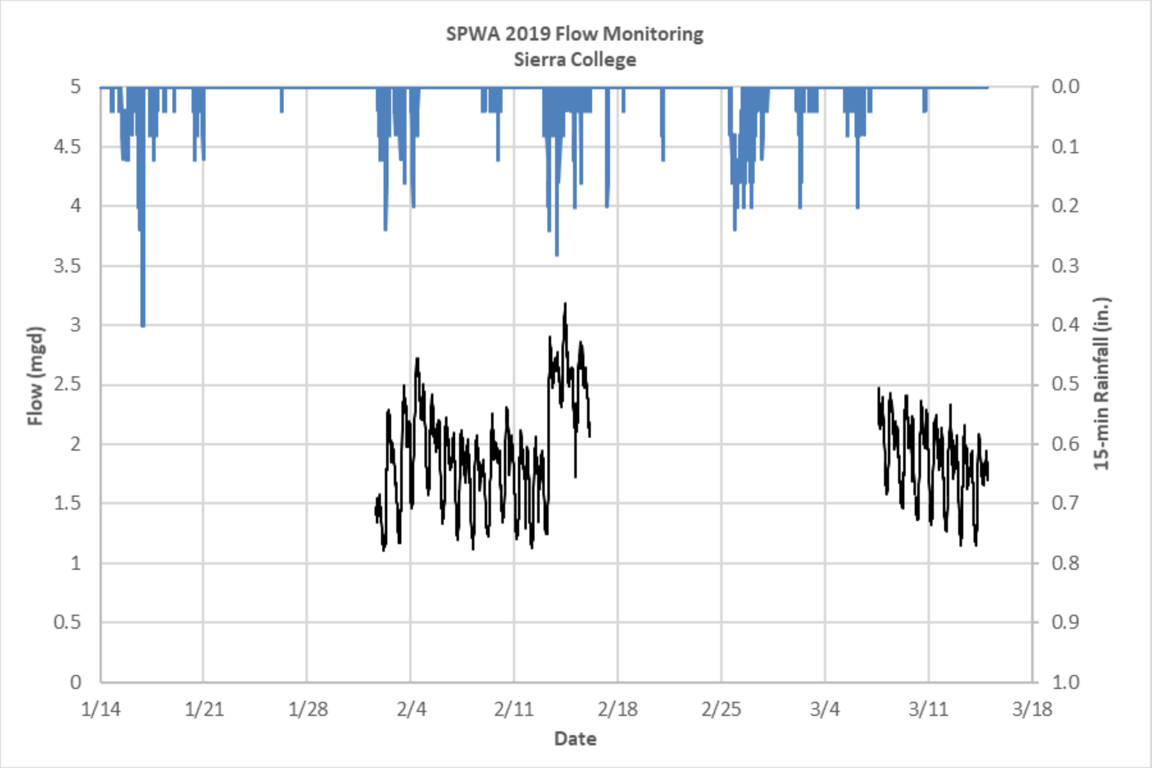

SPWA 2019 Flow Monitoring
Site 162
Depth (inches)
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
Volucity (fps)
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Level
Velocity
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

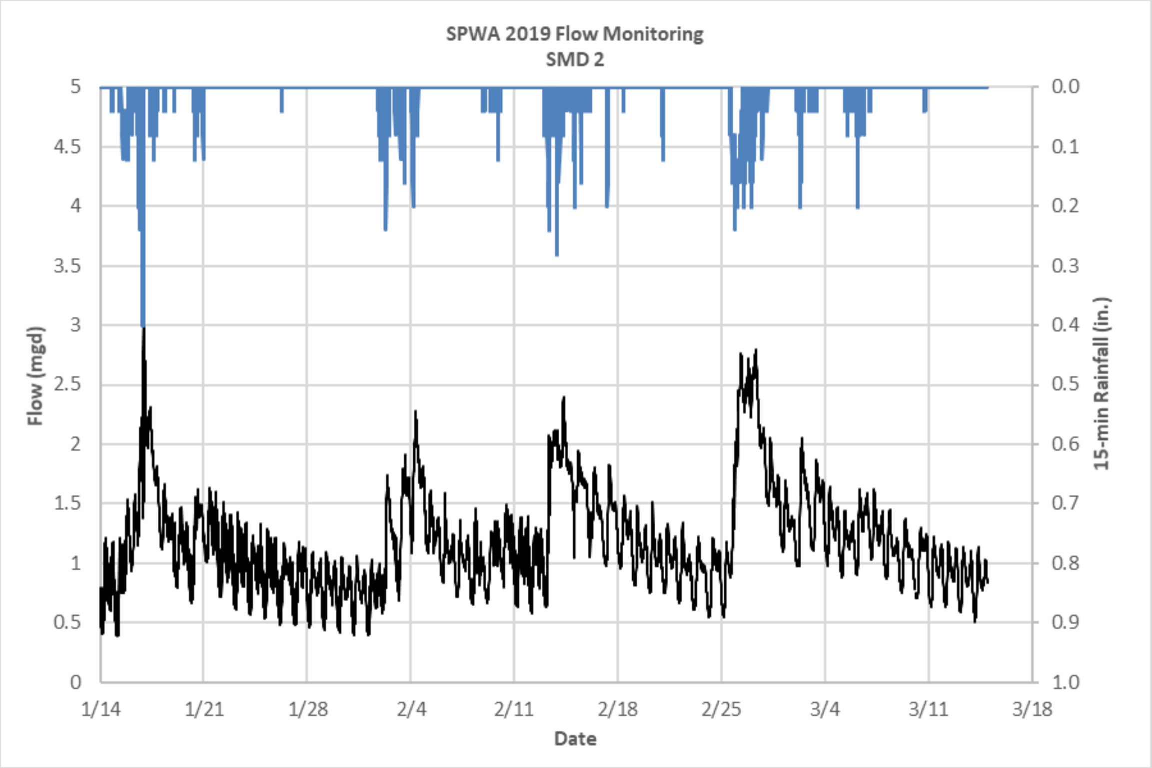

SPWA 2019 Flow Monitoring
Highlands
Flow (mgd)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date


SPWA 2019 Flow Monitoring
Dry Creek
Flow (mgd)
15
13.5
12
10.5
9
7.5
6
4.5
3
1.5
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date


SPWA 2019 Flow Monitoring
Cincinatti
Flow (mgd)
0.5
0.4
0.3
0.2
0.1
0
15-min Rainfall (in.)
0.0
0.2
0.4
0.6
0.8
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date


SPWA 2019 Flow Monitoring
Industrial
Flow (mgd)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

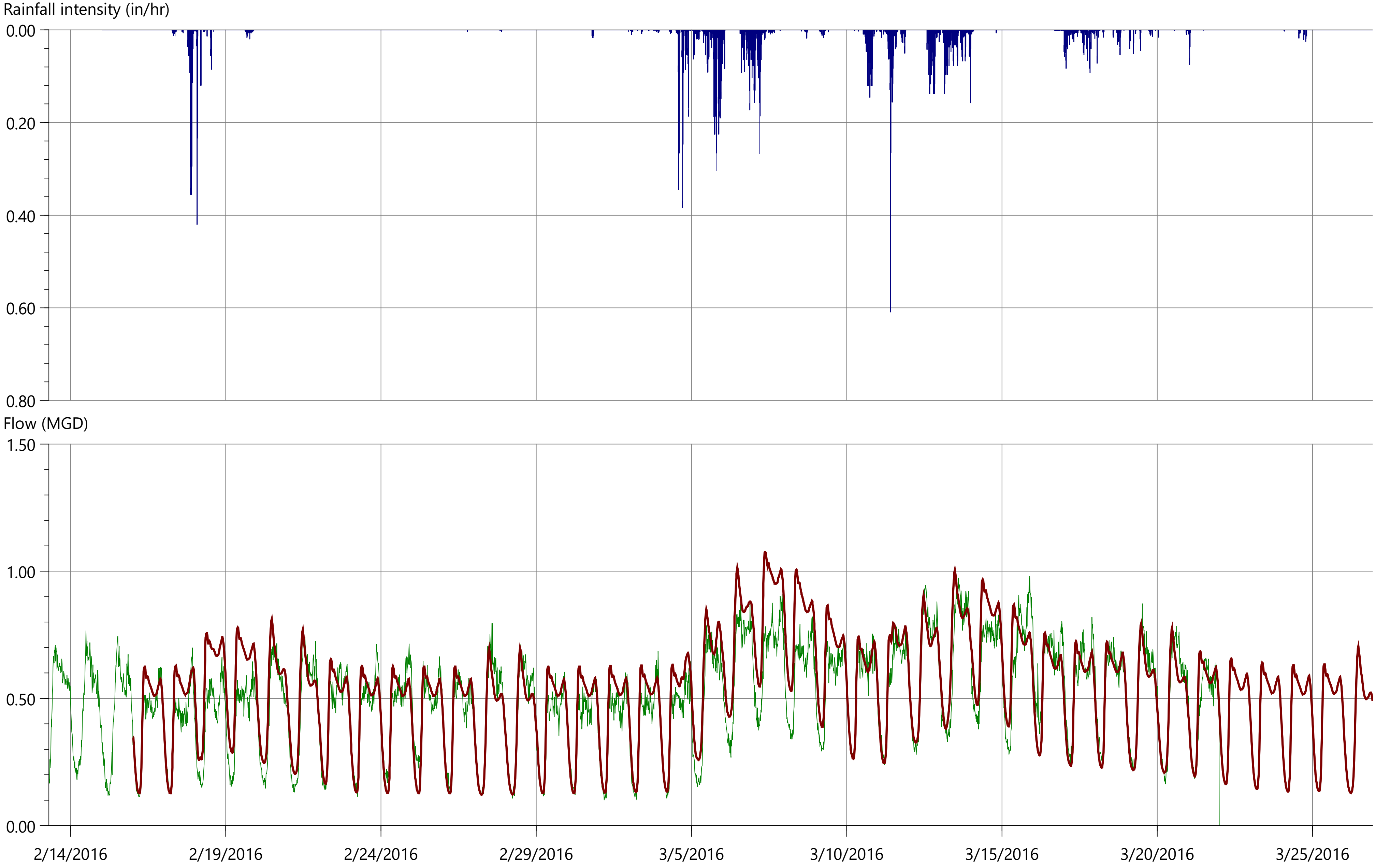

SPWA 2019 Flow Monitoring
Sierra College
Flow (mgd)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date


SPWA 2019 Flow Monitoring
SMD 2
Flow (mgd)
5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
15-min Rainfall (in.)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1/14
1/21
1/28
2/4
2/11
2/18
2/25
3/4
3/11
3/18
Date

APPENDIX D – CALIBRATION GRAPHS

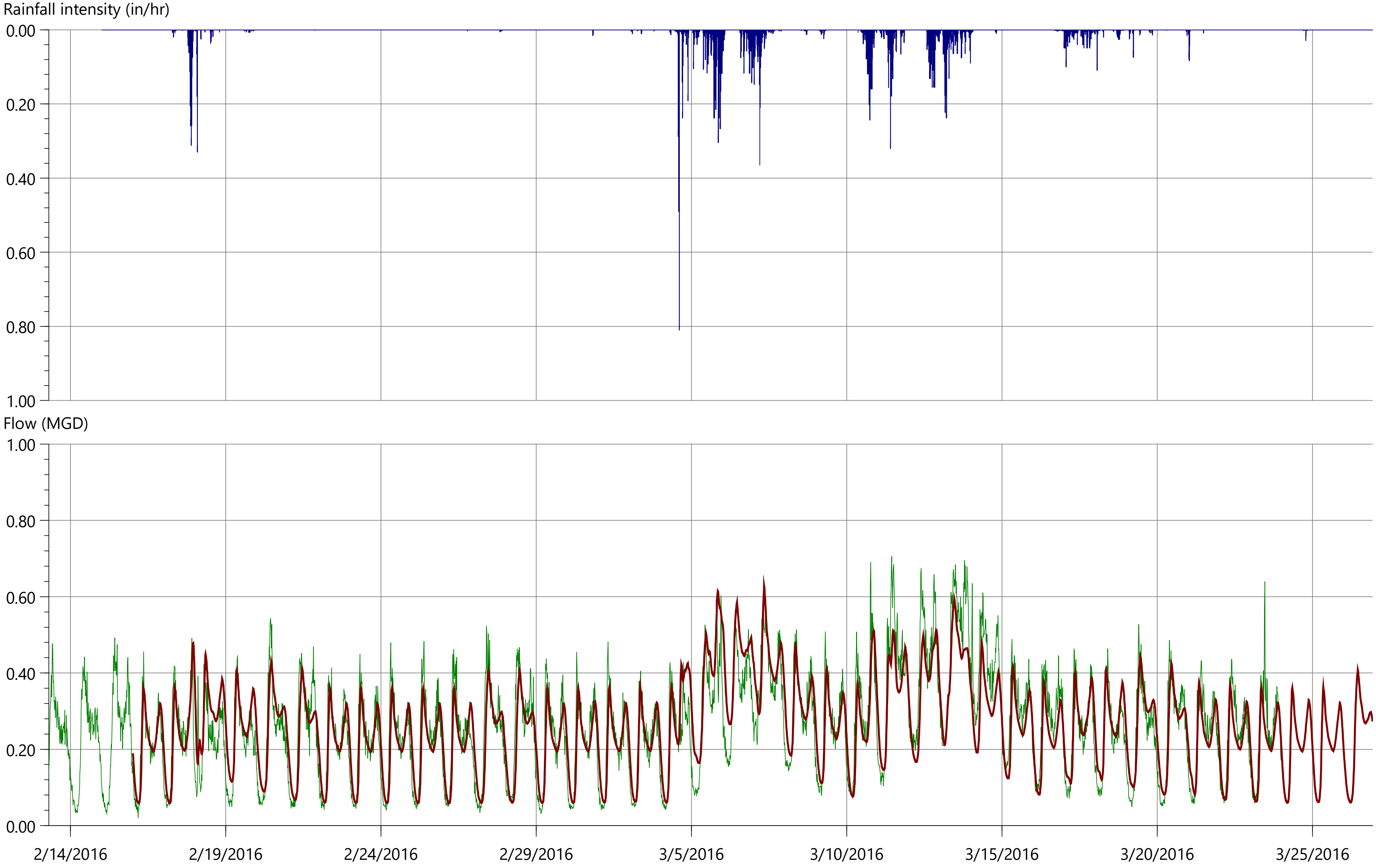
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 1 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 1, Model Location (Pred.) D/S SMH E04-043.1, Rainfall Profile: 311



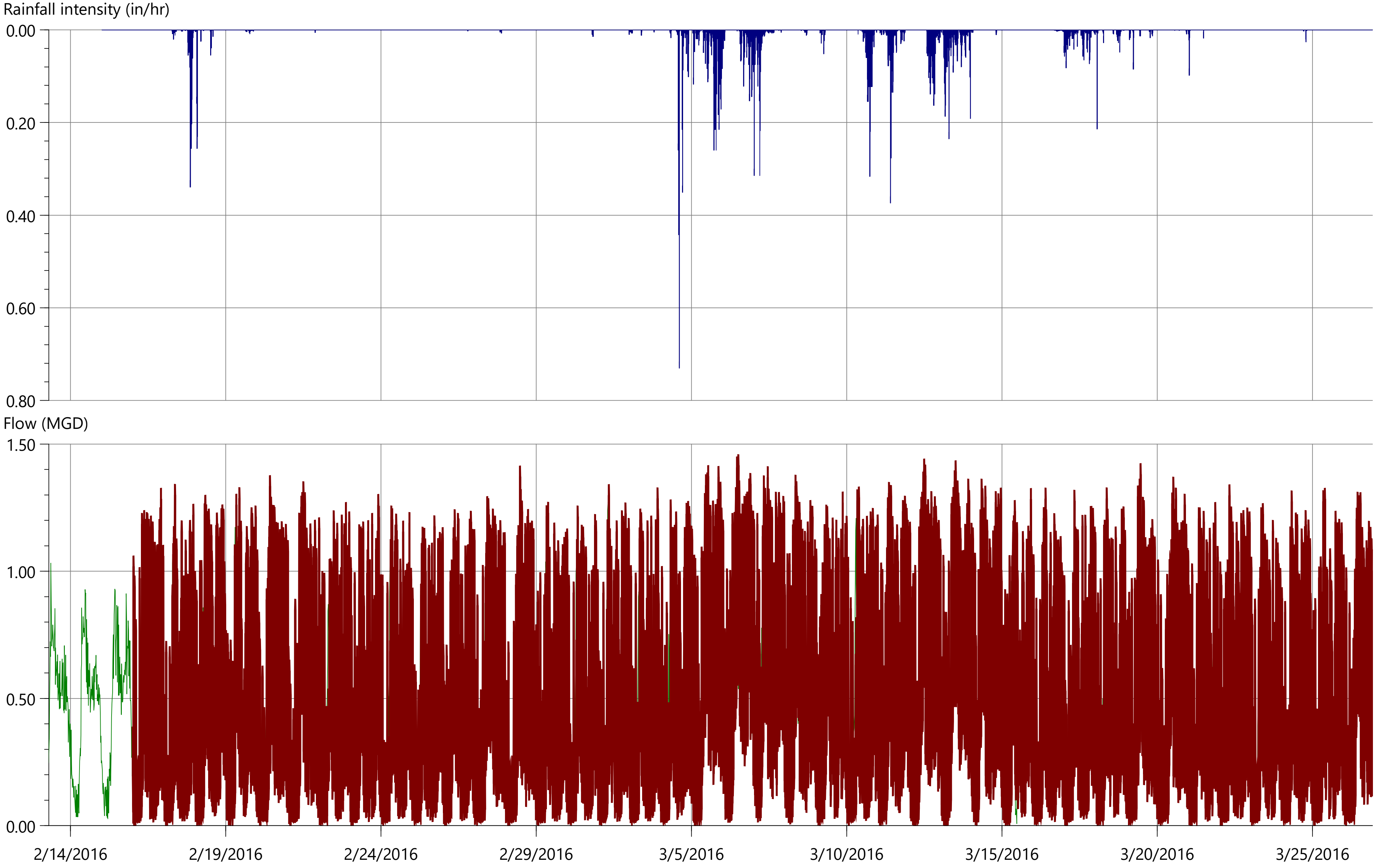
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.950	0.609	0.007			
Observed				0.000	0.981	1628041.595
…ta20160215_20160315				0.121	1.076	1849194.017

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 2 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 2, Model Location (Pred.) D/S SMH E01-166.1, Rainfall Profile: 305



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.168	0.810	0.007			
Observed				0.020	0.706	914240.023
...ta20160215_20160315				0.059	0.629	906202.549

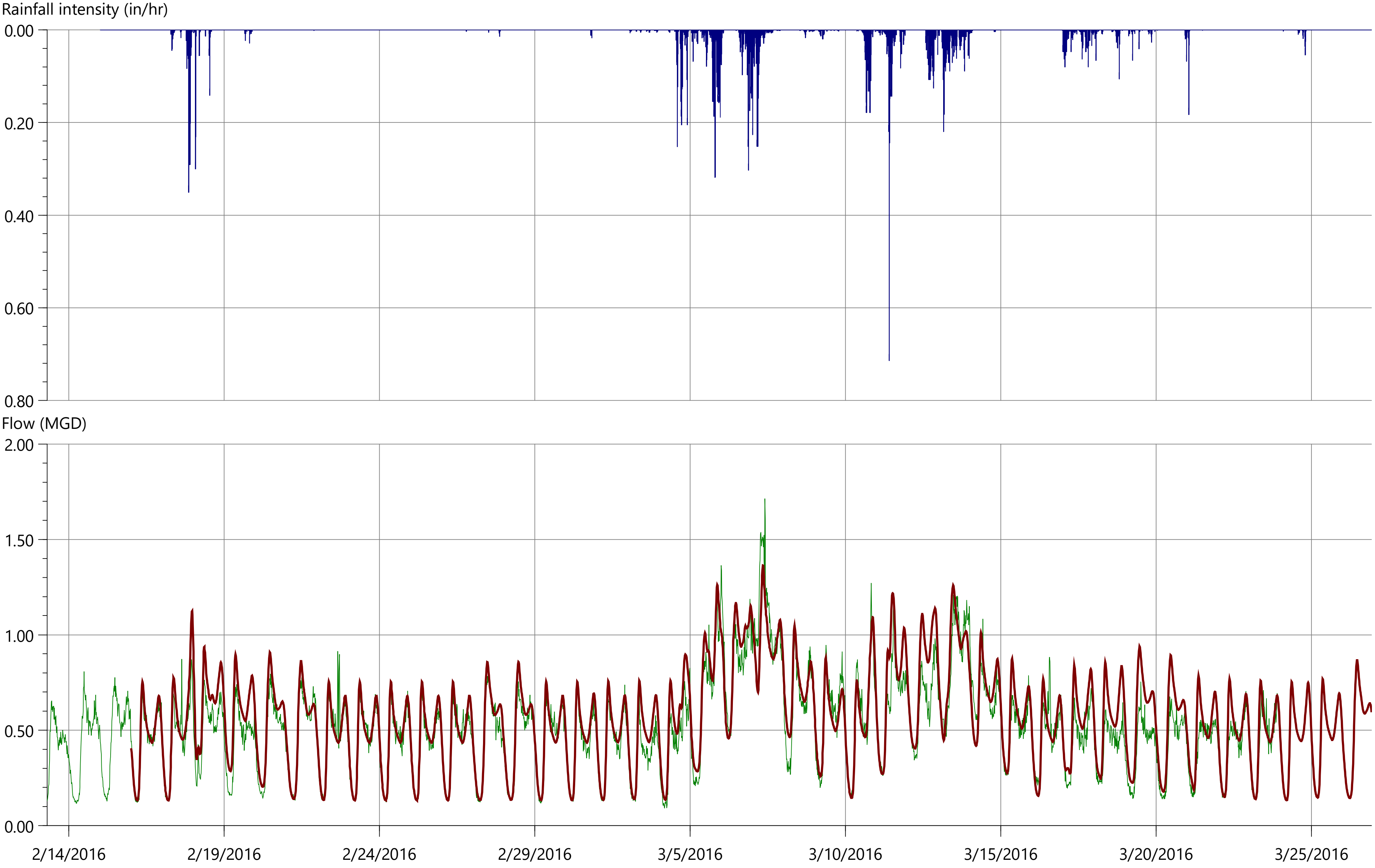
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 3 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 3, Model Location (Pred.) D/S SMH D01-090.1, Rainfall Profile: 273



		Rainfall			Flow		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	—	7.131	0.730	0.007			
Observed	—				0.007	1.272	1577879.095
...ta20160215_20160315	—				0.014	1.417	1694134.628

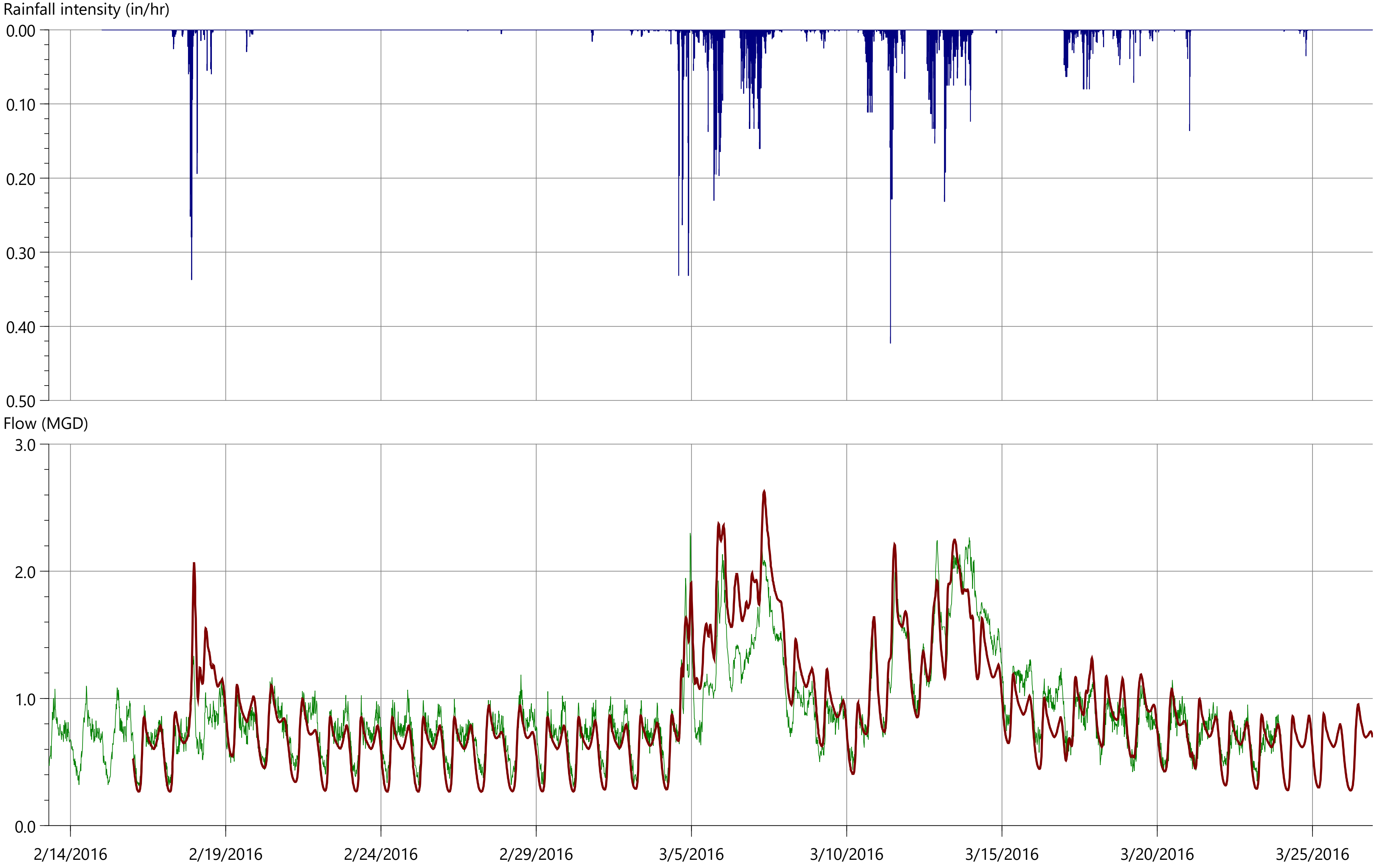
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 4 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 4, Model Location (Pred.) D/S SMH B06-185.1, Rainfall Profile: 182



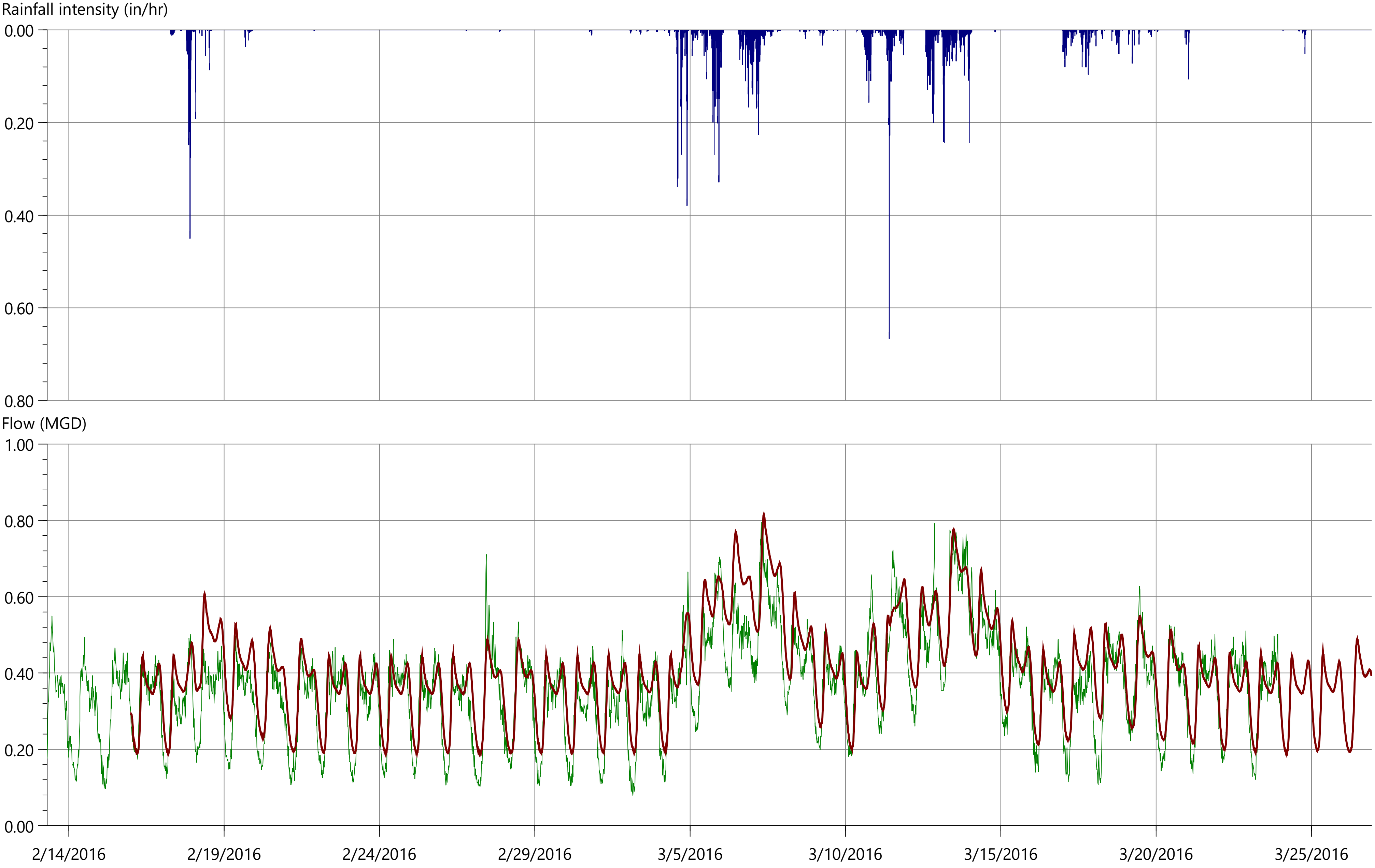
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.006	0.714	0.007			
Observed				0.092	1.713	1767988.571
...ta20160215_20160315				0.132	1.364	1962773.049

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 5 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 5, Model Location (Pred.) D/S SMH B04-006.1, Rainfall Profile: 179



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.524	0.423	0.007			
Observed				0.308	2.299	3030867.347
...ta20160215_20160315				0.267	2.627	3046741.062

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 6 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 5A, Model Location (Pred.) D/S SMH B04-001.1, Rainfall Profile: 178

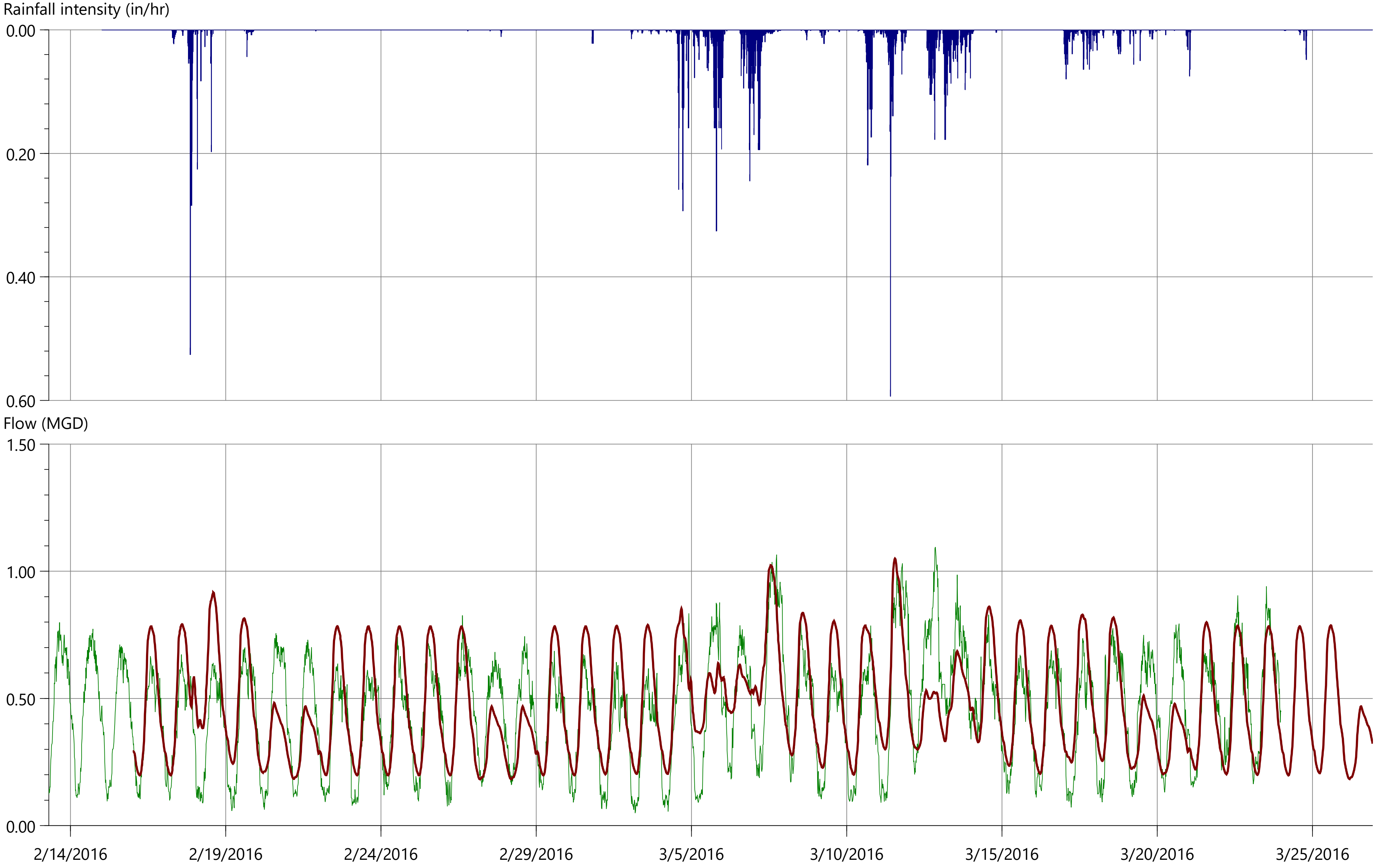


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.650	0.666	0.007			
Observed				0.078	0.796	1250814.058
...ta20160215_20160315				0.189	0.815	1385997.841

Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 6, Model Location (Pred.) D/S SMH C06-160.1, Rainfall Profile: 248

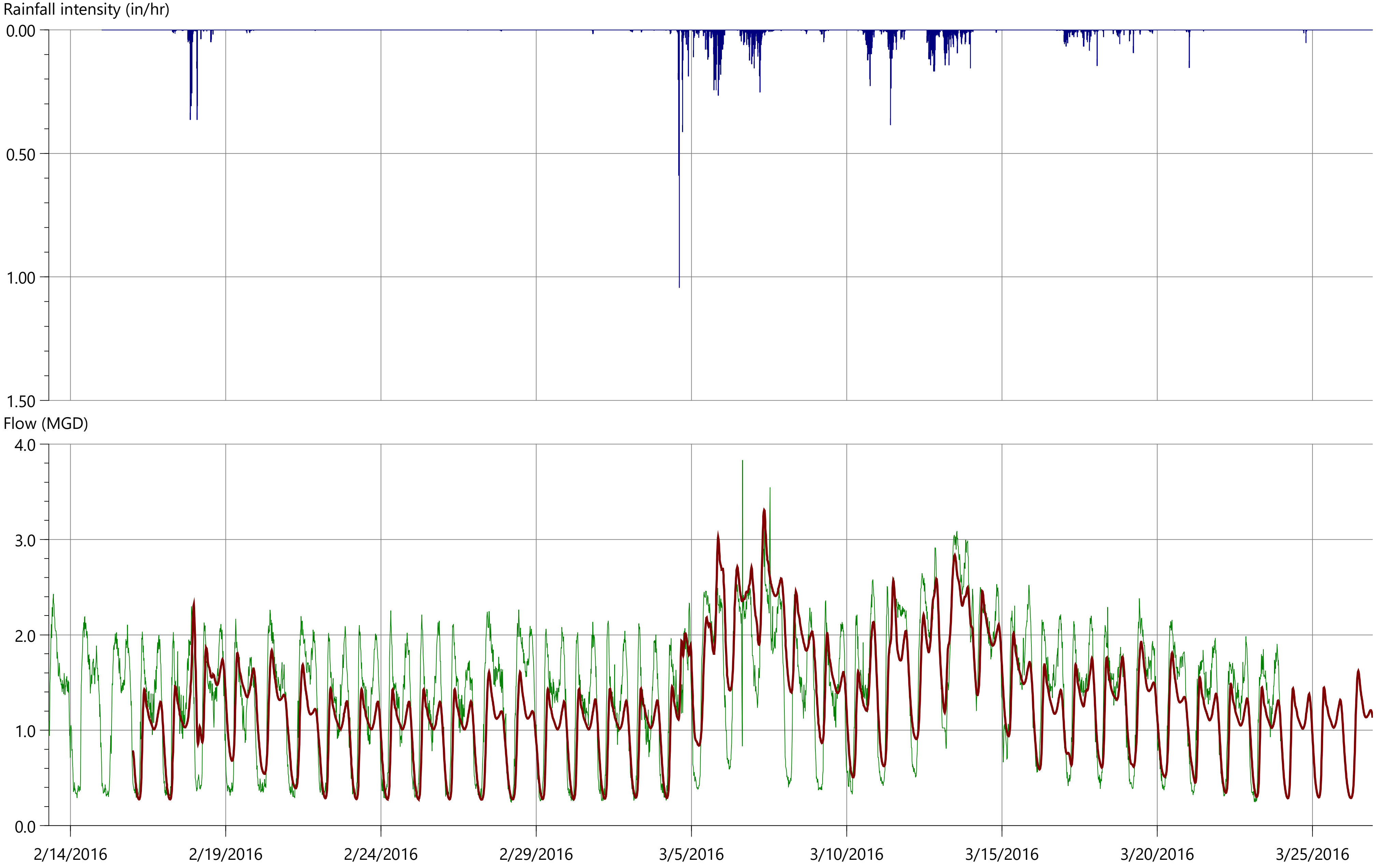


		Rainfall			Flow		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	—	6.748	0.593	0.007			
Observed	—				0.050	1.095	1561247.890
...ta20160215_20160315	—				0.182	1.050	1627844.217

Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

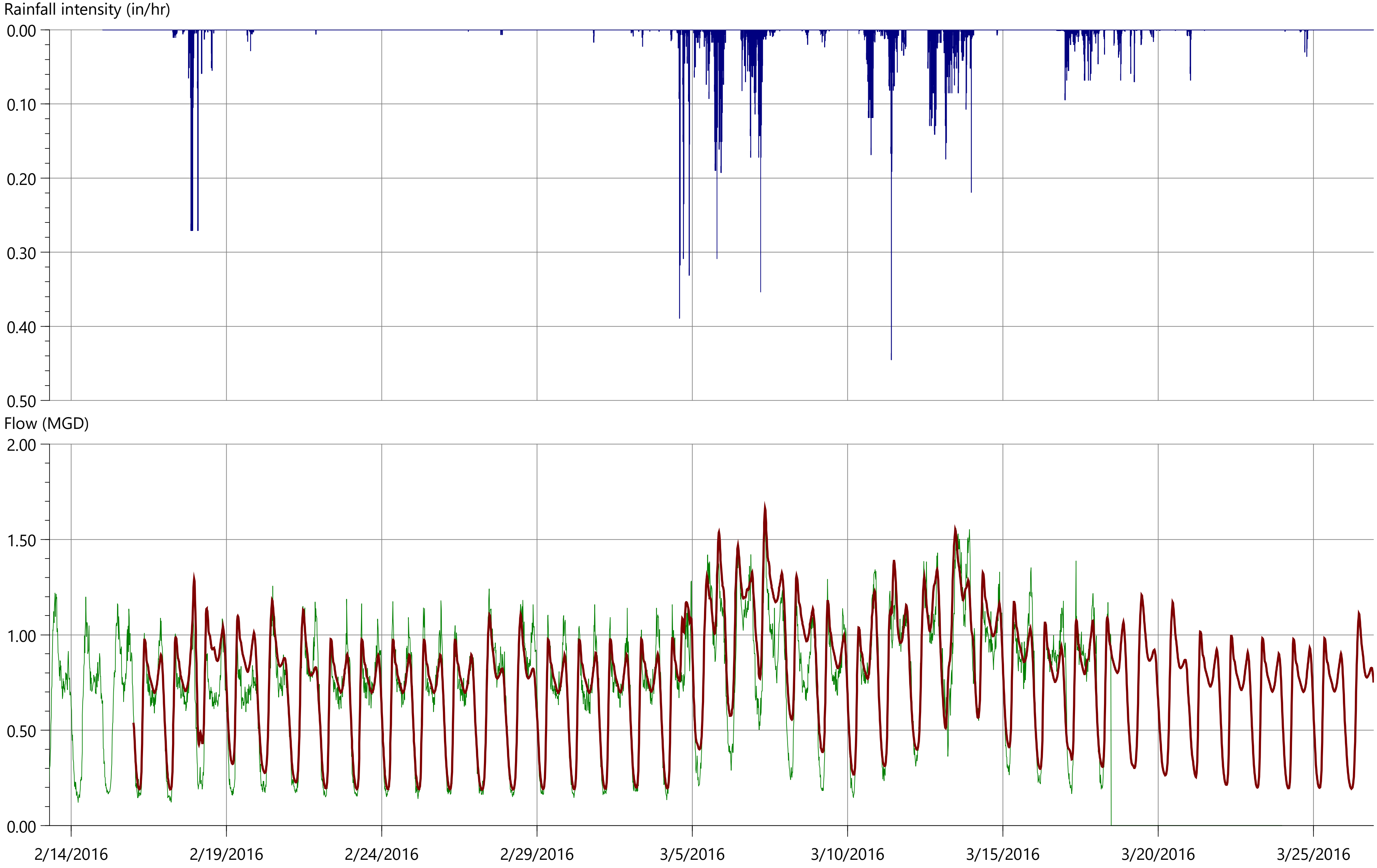
Flow Survey Location (Obs.) FM 7, Model Location (Pred.) D/S SMH D02-353.1, Rainfall Profile: 274



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.005	1.043	0.007			
Observed				0.243	3.830	4848161.759
...ta20160215_20160315				0.272	3.309	4389105.386

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 9 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 7A, Model Location (Pred.) D/S SMH D03-116.1, Rainfall Profile: 276

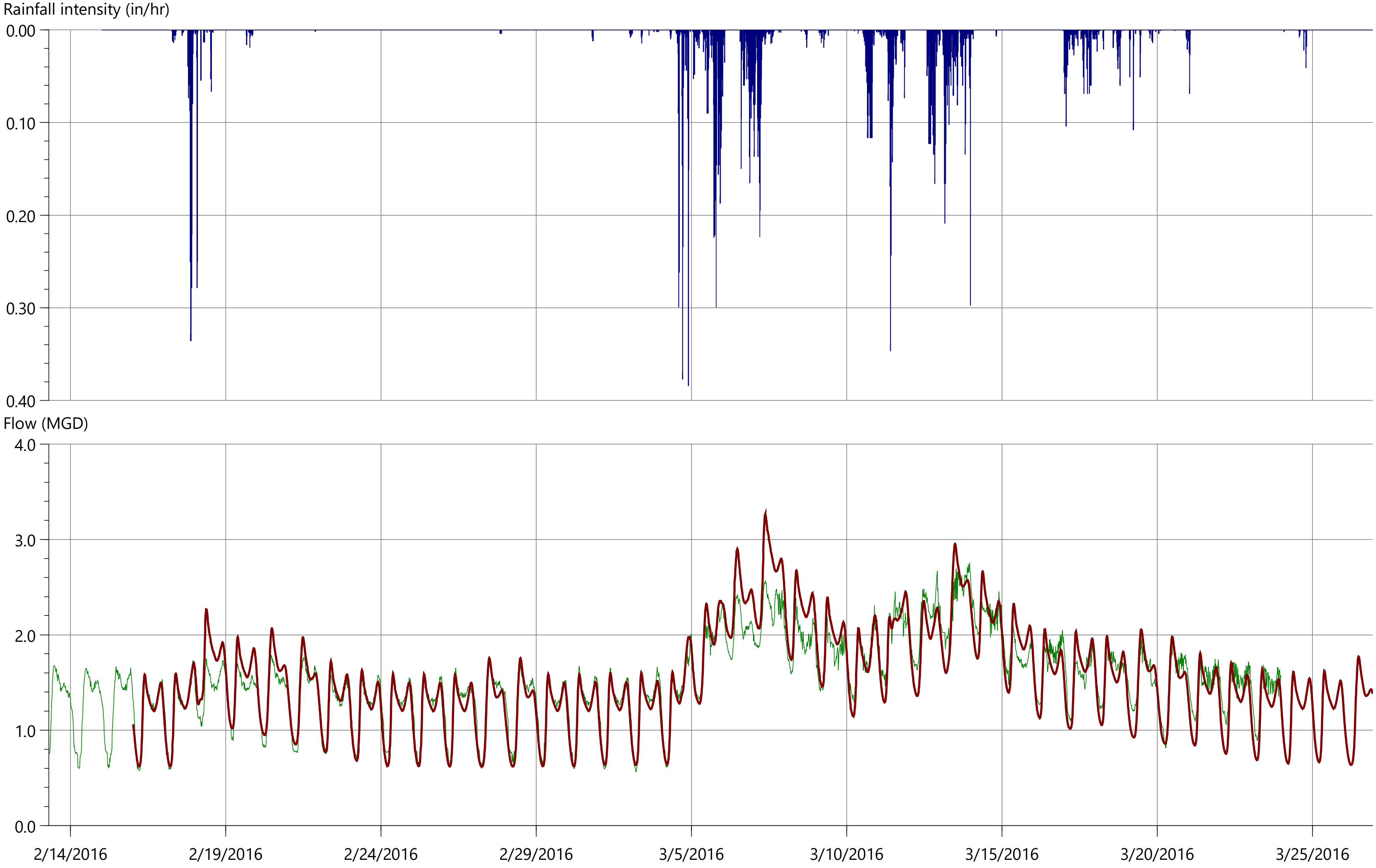


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.644	0.445	0.007			
Observed				0.000	1.560	2175152.424
...ta20160215_20160315				0.188	1.664	2640259.610

Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)

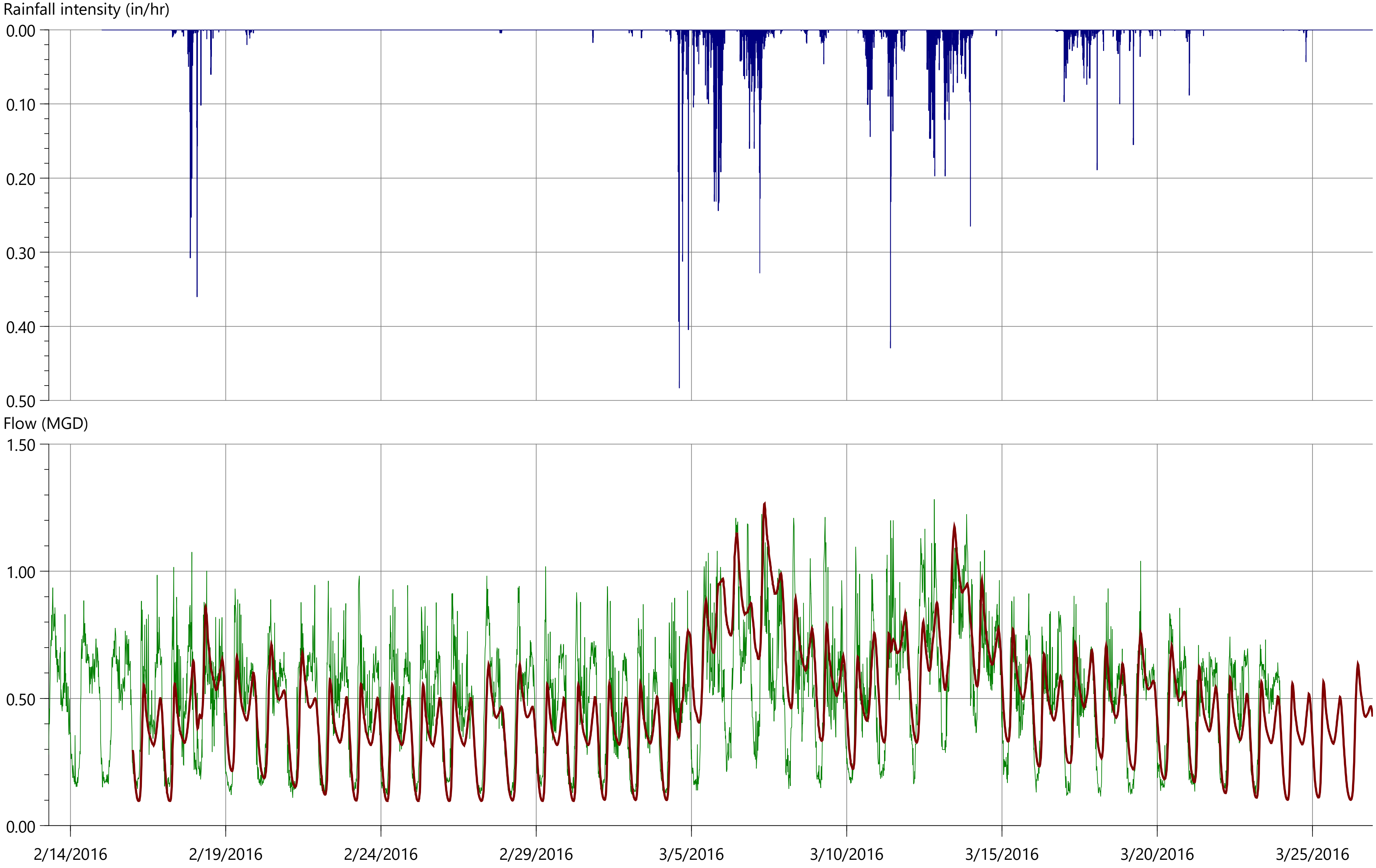
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 8, Model Location (Pred.) D/S SMH D04-201.1, Rainfall Profile: 277



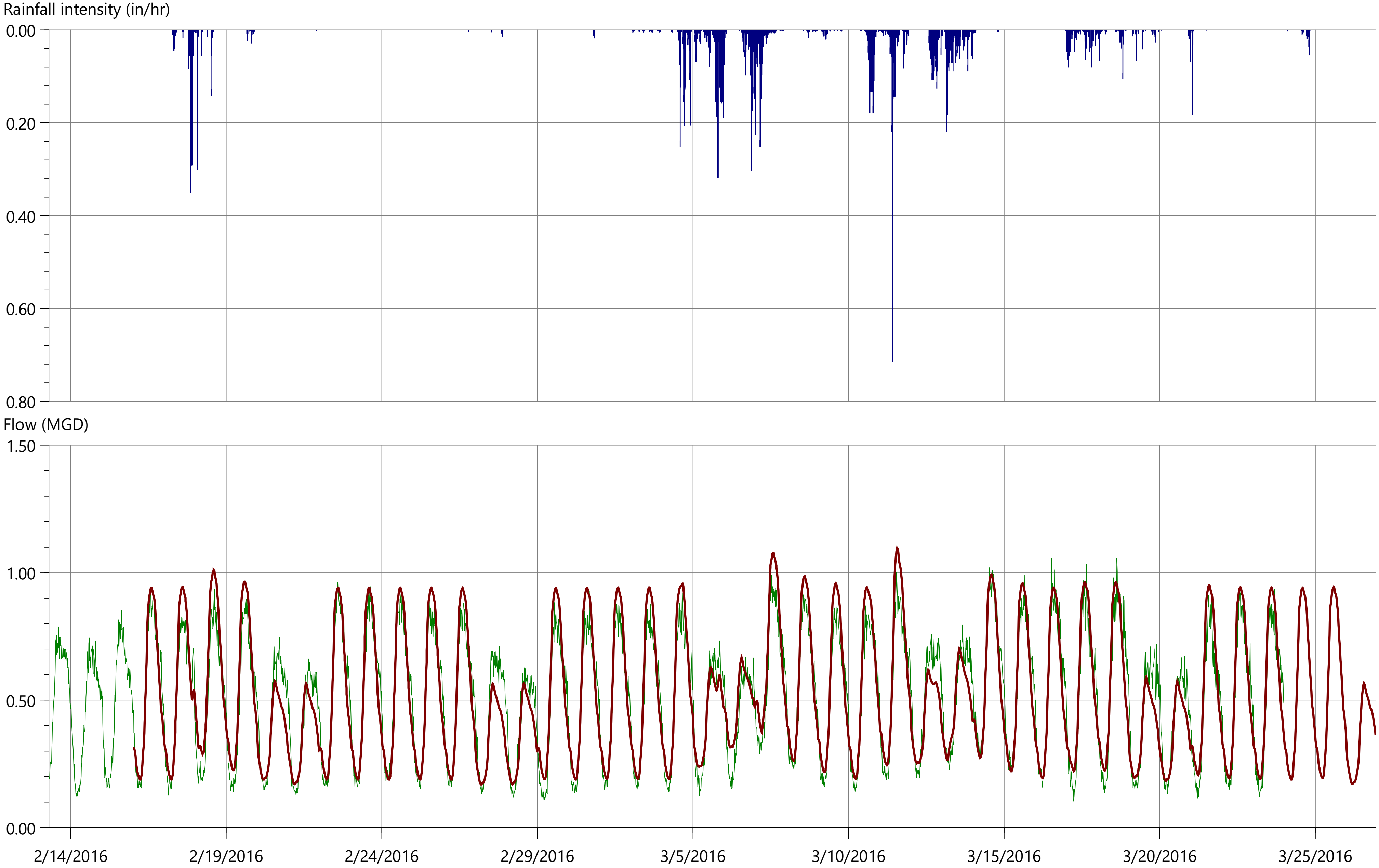
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.750	0.384	0.007			
Observed				0.563	2.756	5257075.125
...ta20160215_20160315				0.617	3.265	5297174.358

Flow Survey Location (Obs.) FM 9, Model Location (Pred.) D/S SMH D02-069.1, Rainfall Profile: 241



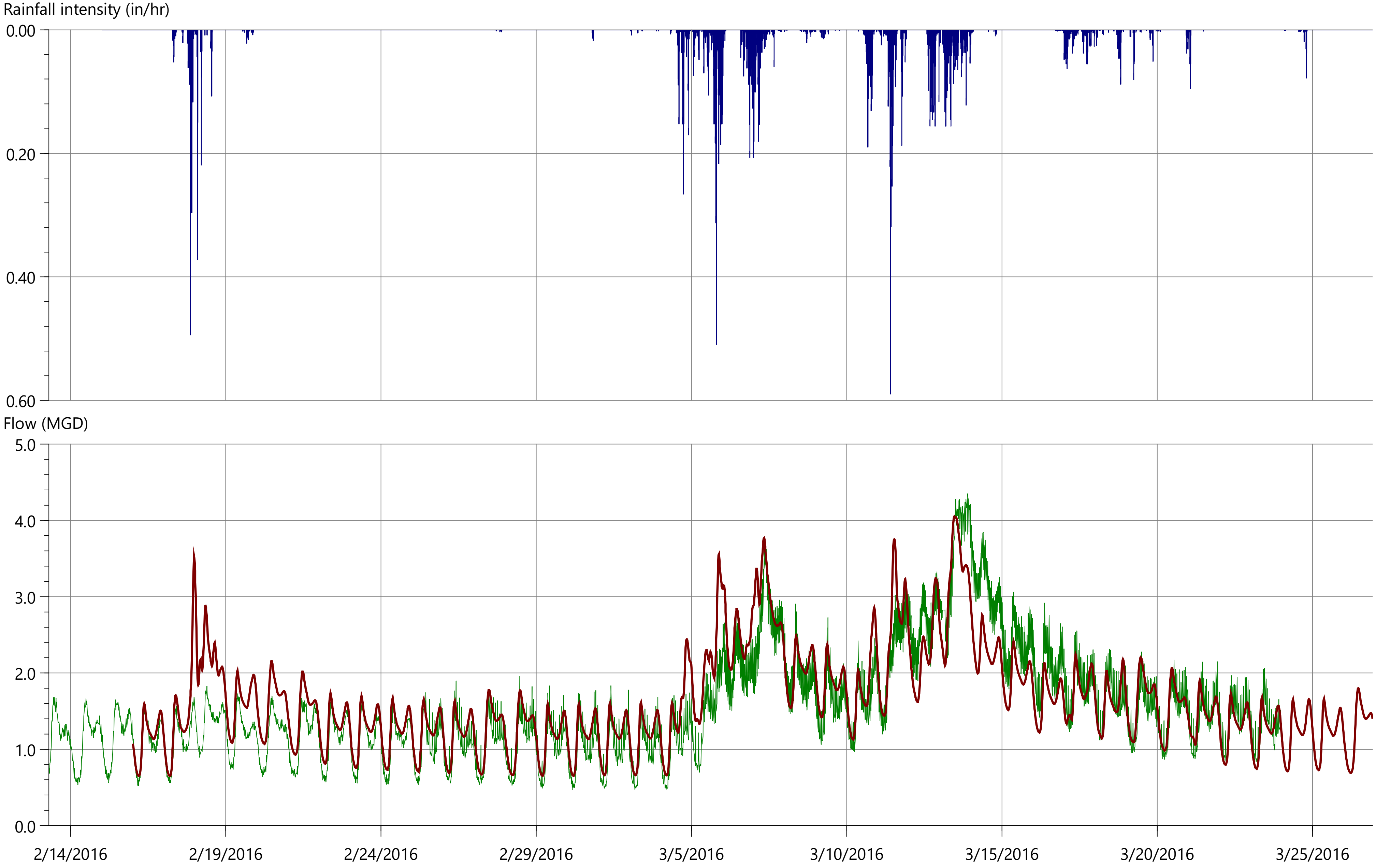
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.982	0.483	0.007			
Observed				0.110	1.283	1753822.349
...ta20160215_20160315				0.097	1.266	1626219.910

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 12 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 10, Model Location (Pred.) D/S SMH B06-340.1, Rainfall Profile: 182



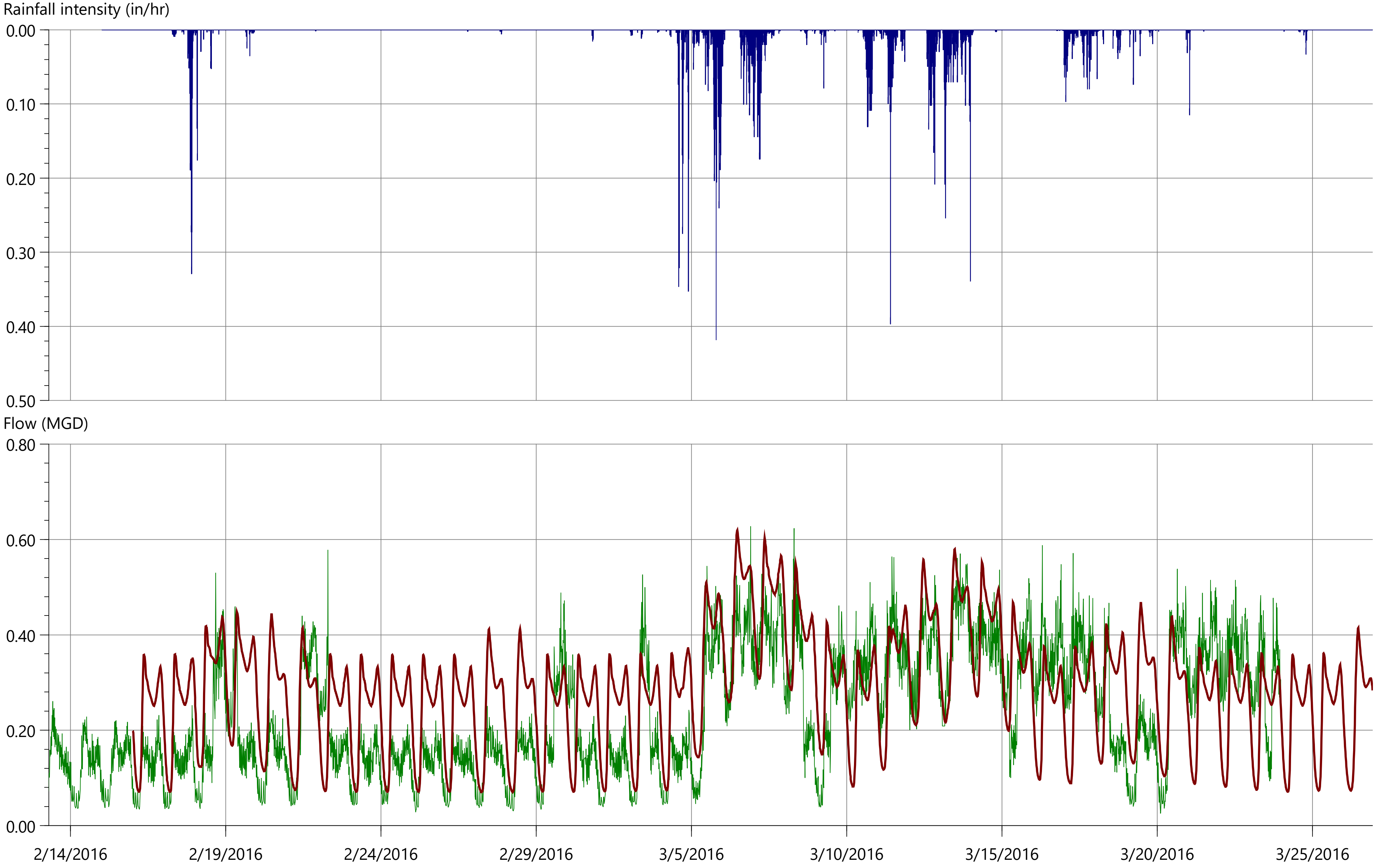
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.006	0.714	0.007			
Observed				0.103	1.057	1756657.949
...ta20160215_20160315				0.169	1.096	1787262.390

Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 11, Model Location (Pred.) D/S SMH A08-019.1, Rainfall Profile: 121



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.634	0.590	0.008			
Observed				0.468	4.351	5269869.468
...ta20160215_20160315				0.651	4.054	5683303.761

Flow Survey Location (Obs.) FM 12, Model Location (Pred.) D/S SMH B03-030.1, Rainfall Profile: 177



		Rainfall			Flow		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	—	6.394	0.418	0.007			
Observed	—				0.025	0.627	798653.119
...ta20160215_20160315	—				0.070	0.620	991725.521

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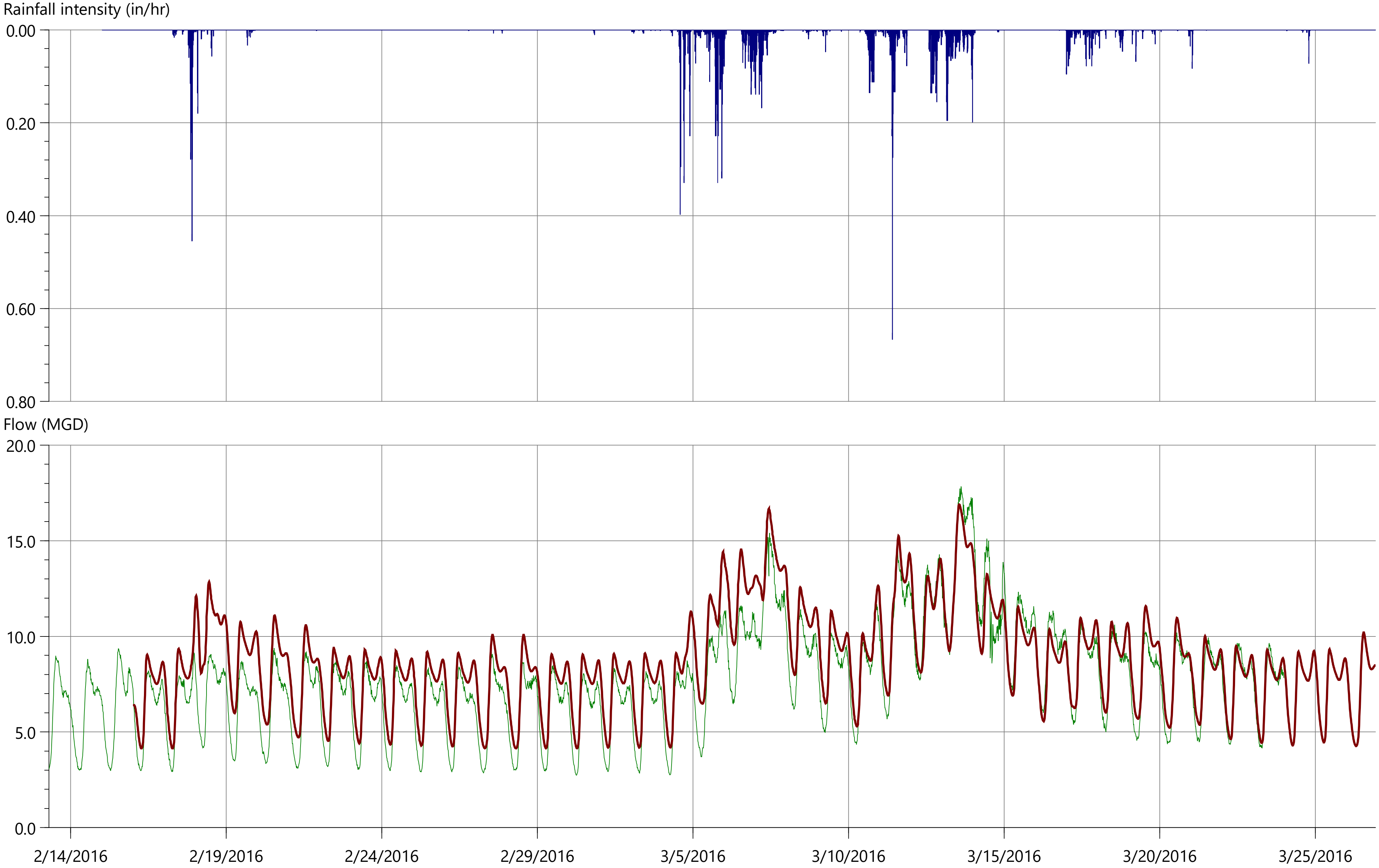
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 13, Model Location (Pred.) D/S SMH B03-043.1, Rainfall Profile: 145

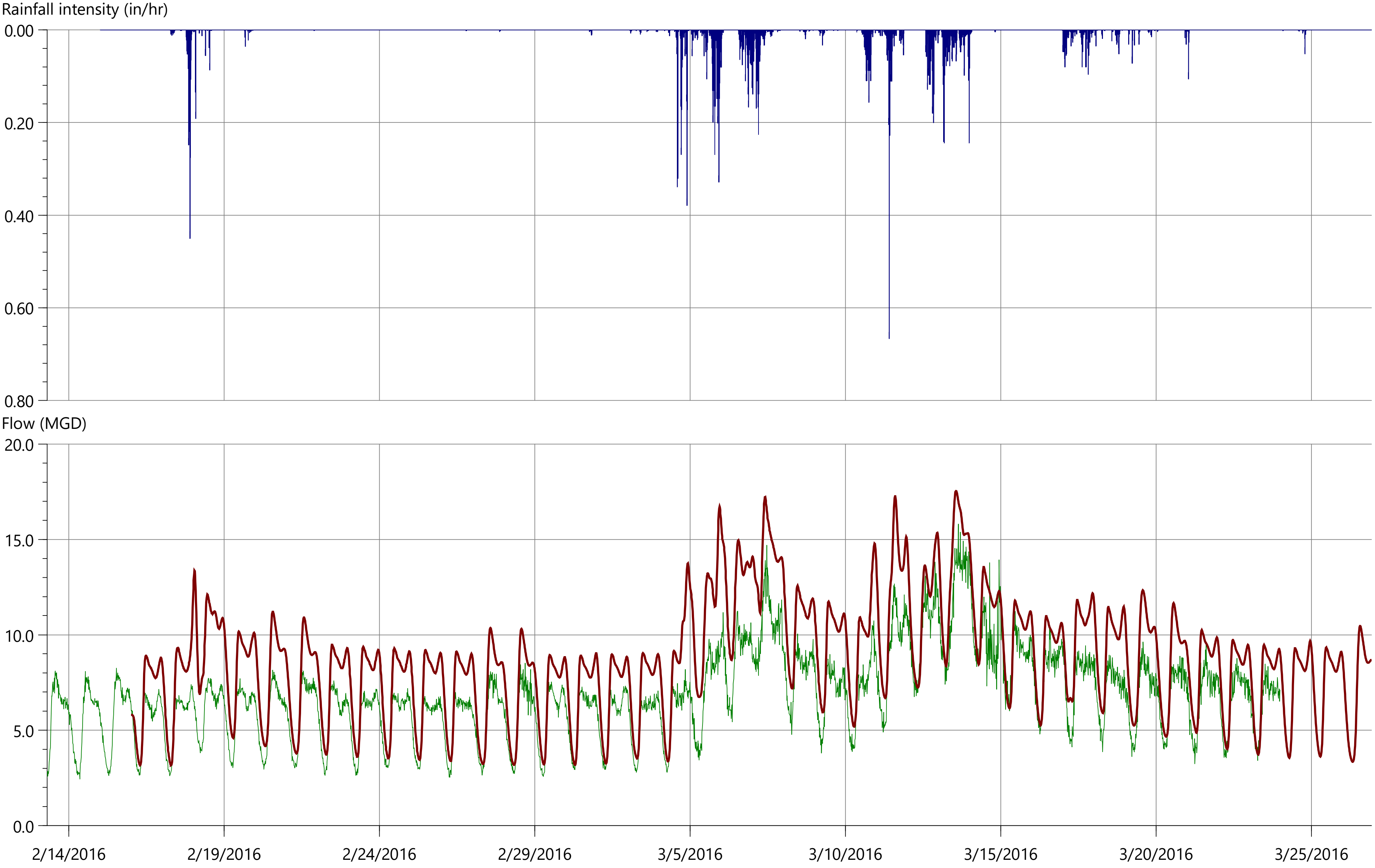


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.618	0.666	0.007			
Observed				2.731	17.837	26538612.826
...ta20160215_20160315				4.129	16.903	30158188.130

Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 14, Model Location (Pred.) D/S SMH B03-024.1, Rainfall Profile: 178

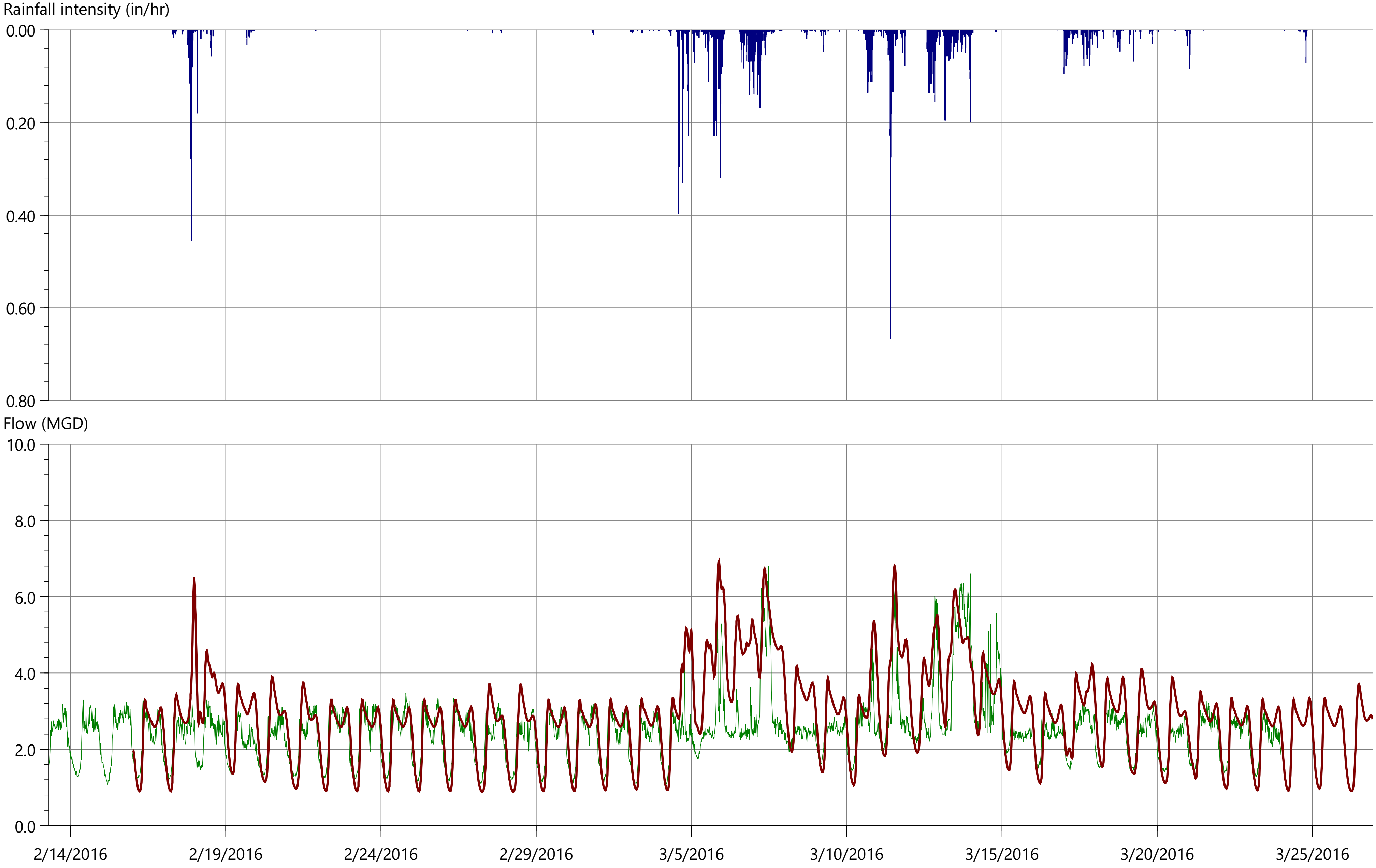


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.650	0.666	0.007			
Observed				2.435	15.807	23553734.551
...ta20160215_20160315				3.164	17.544	30549718.631

Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)

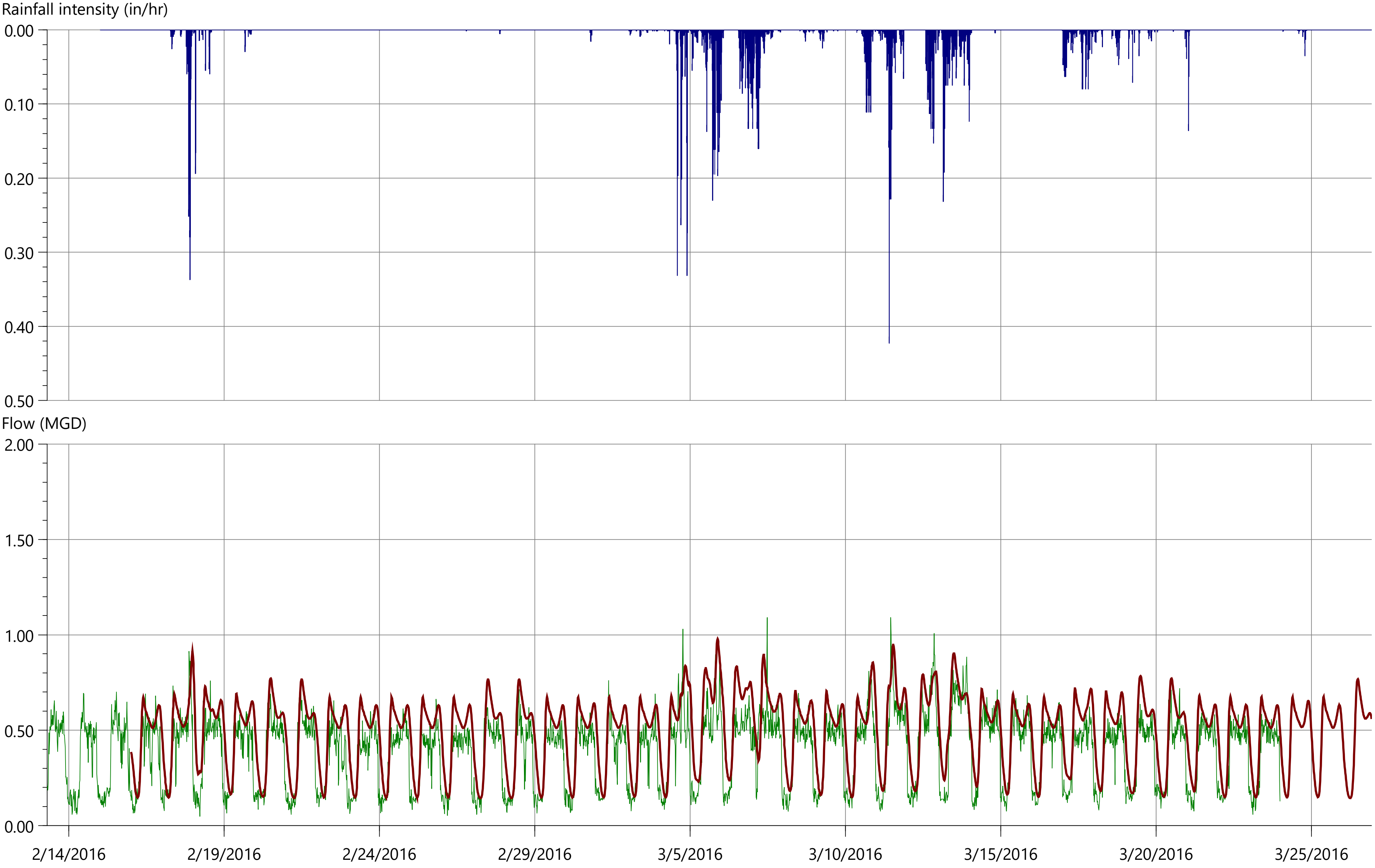
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 15, Model Location (Pred.) D/S SMH B03-053.1, Rainfall Profile: 145



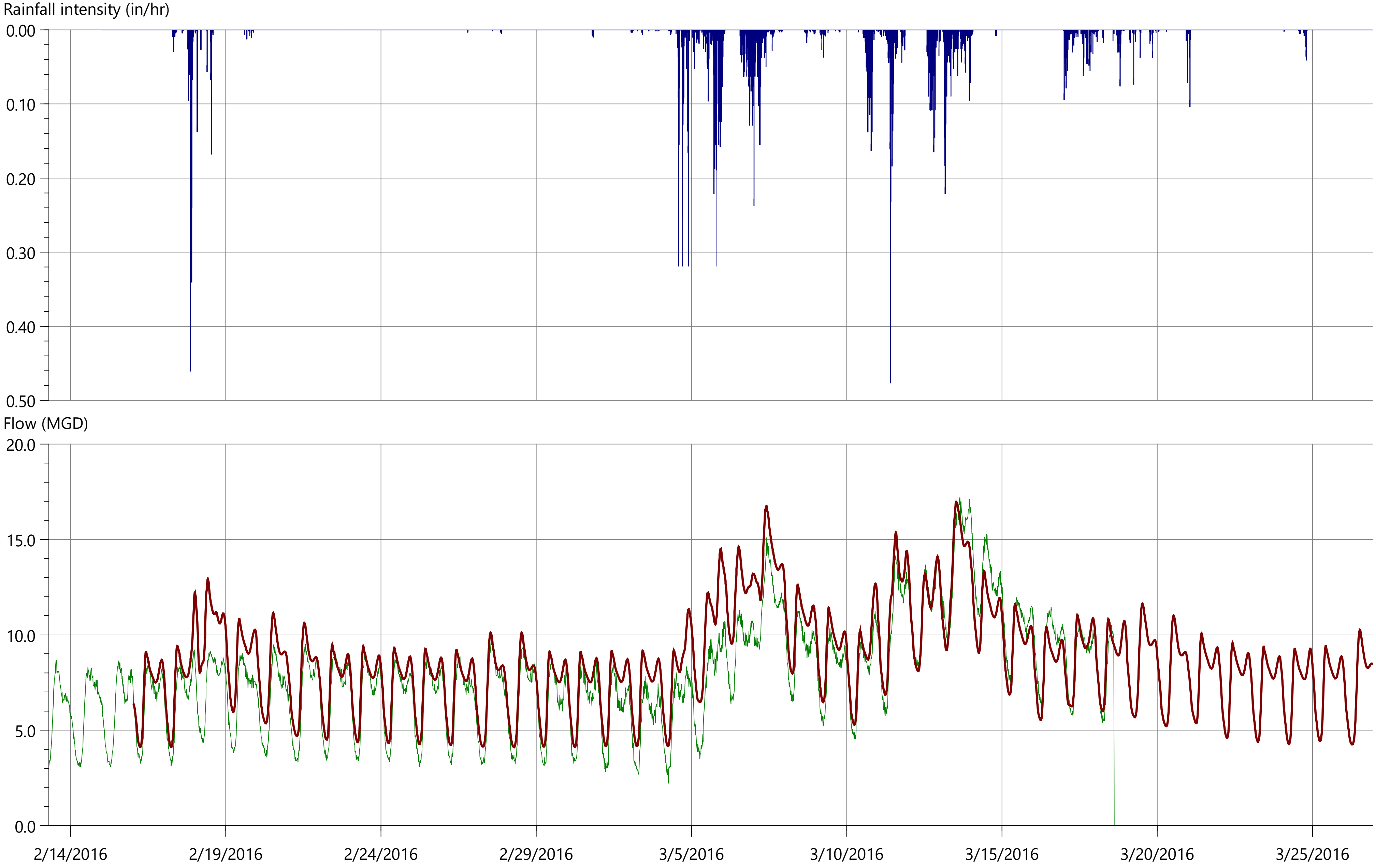
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.618	0.666	0.007			
Observed				1.071	6.810	8508039.397
...ta20160215_20160315				0.886	6.940	9988758.893

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 18 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 15A, Model Location (Pred.) D/S SMH B04-061.1, Rainfall Profile: 179



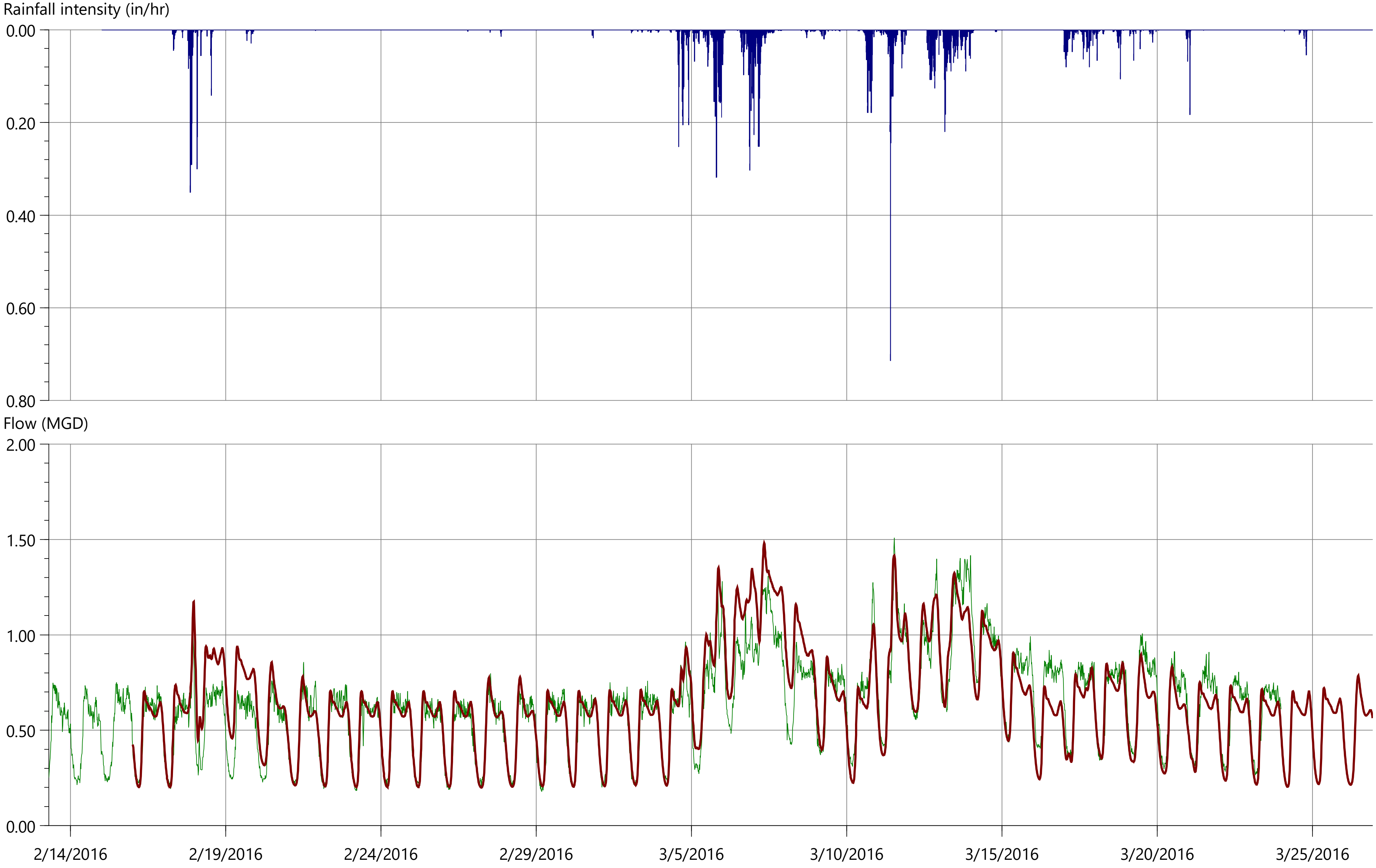
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.524	0.423	0.007			
Observed				0.048	1.091	1332963.500
...ta20160215_20160315				0.143	0.978	1724557.621

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 19 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 16, Model Location (Pred.) D/S SMH B05-230.1, Rainfall Profile: 147



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.581	0.476	0.007			
Observed				0.000	17.190	23376320.562
...ta20160215_20160315				4.111	16.980	30162930.049

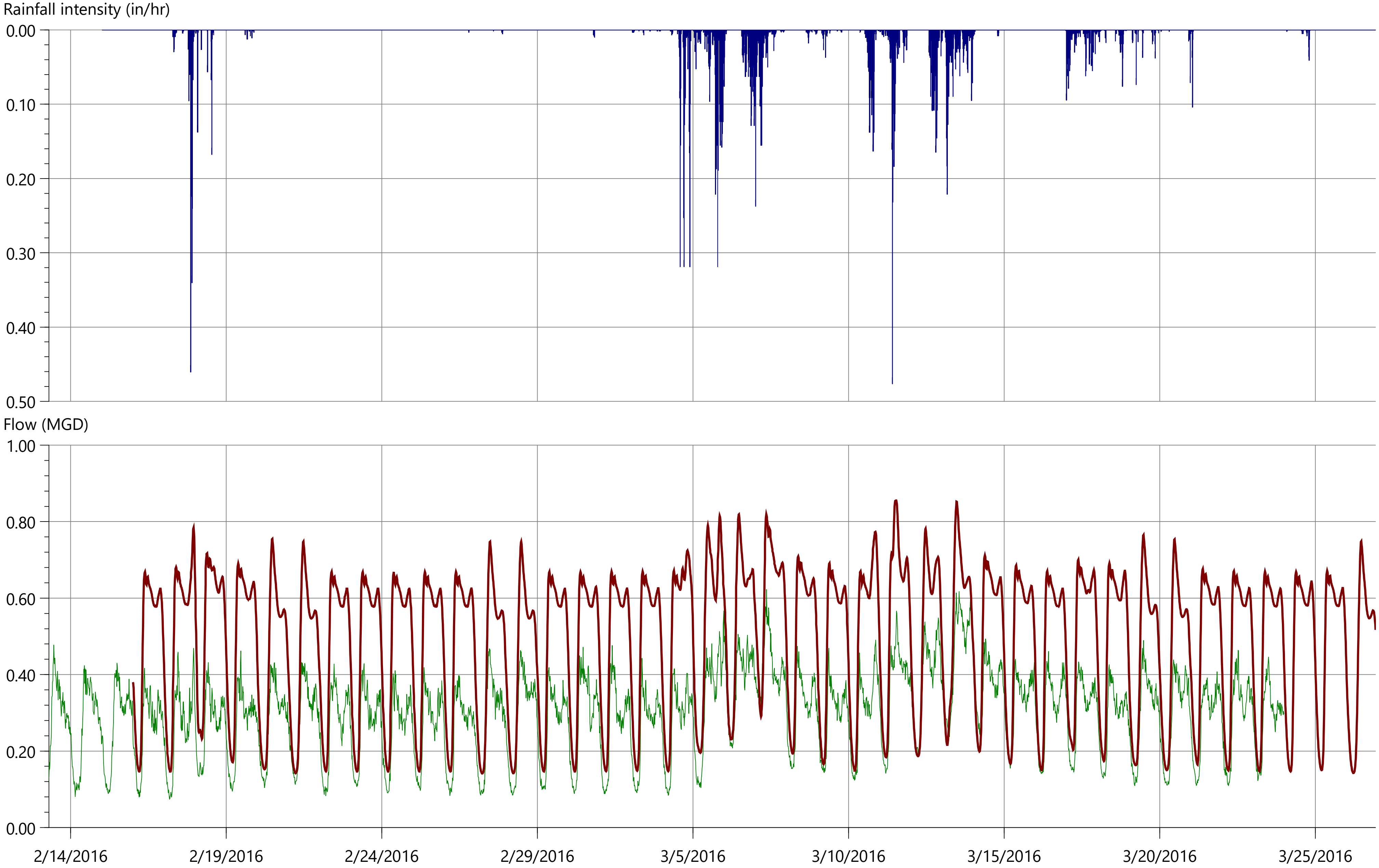
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 20 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 16A, Model Location (Pred.) D/S SMH B06-148.1, Rainfall Profile: 182



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.006	0.714	0.007			
Observed				0.179	1.509	2154876.607
...ta20160215_20160315				0.200	1.482	2224728.980

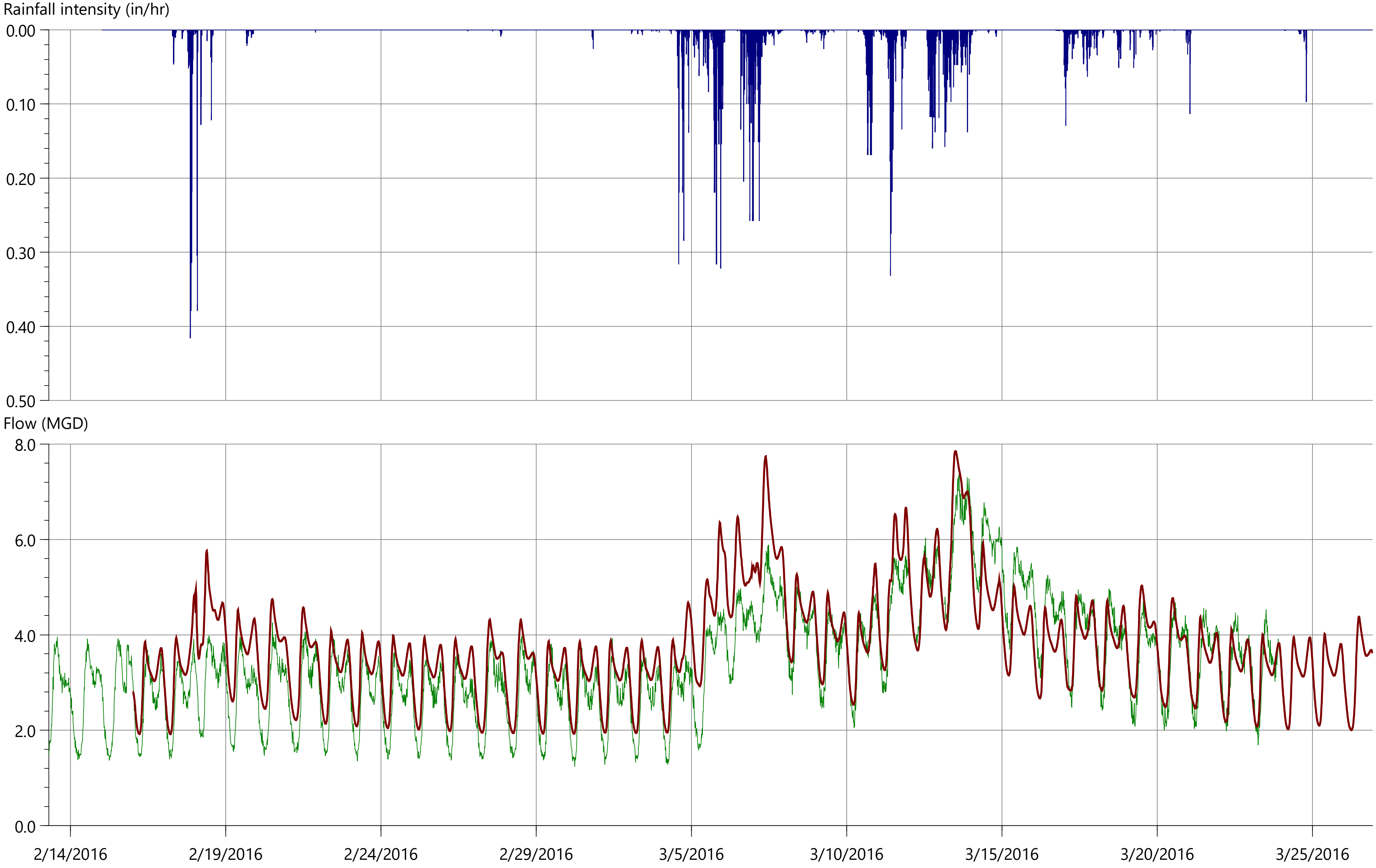
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 21 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 17, Model Location (Pred.) D/S SMH B05-448.1, Rainfall Profile: 147



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.581	0.476	0.007			
Observed				0.074	0.623	1027152.765
...ta20160215_20160315				0.141	0.855	1734444.106

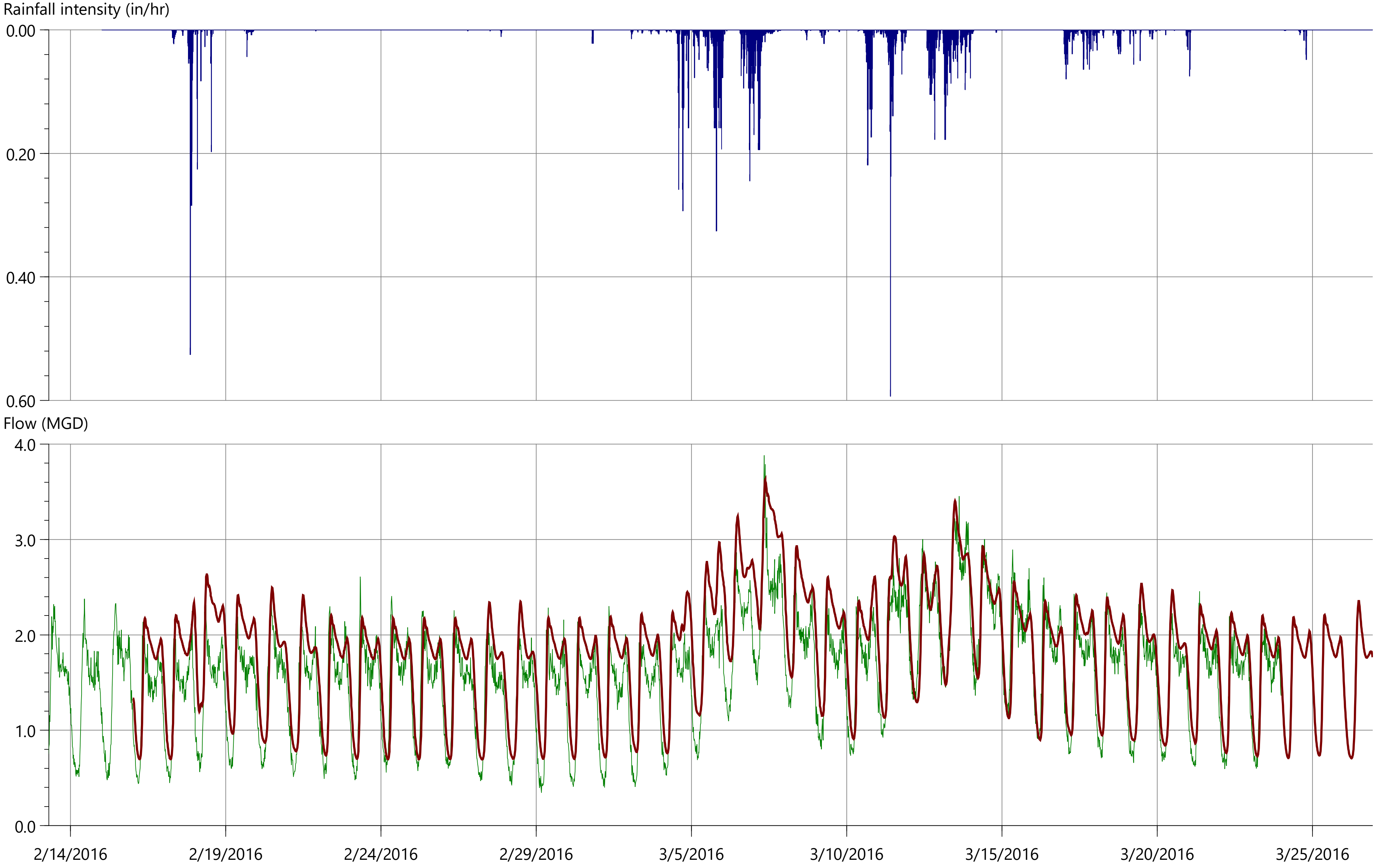
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 22 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 18, Model Location (Pred.) D/S SMH B07-233.1, Rainfall Profile: 151



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.452	0.416	0.008			
Observed				1.241	7.372	11745270.797
...ta20160215_20160315				1.920	7.850	12994404.563

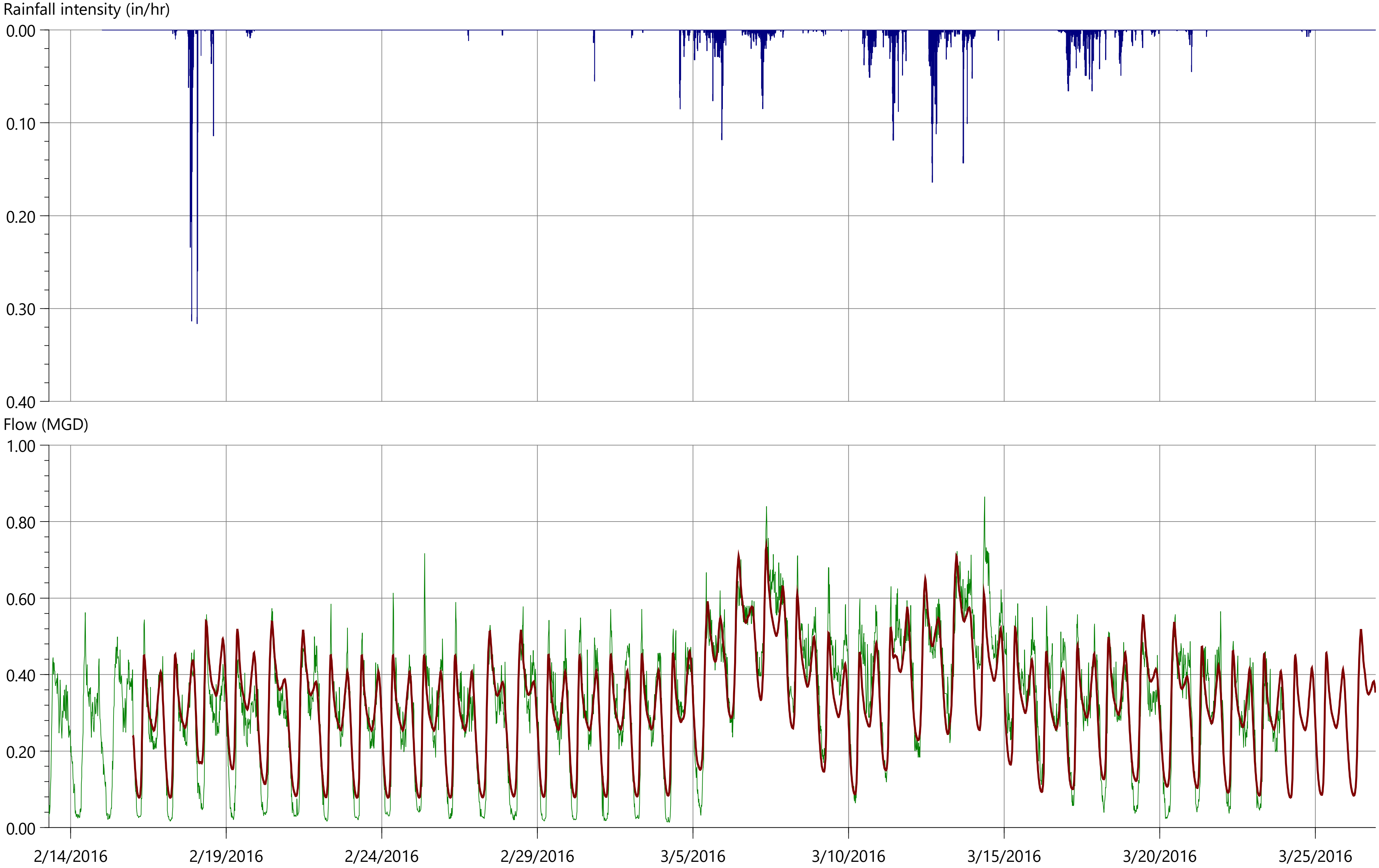
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 23 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 19, Model Location (Pred.) D/S SMH C06-025.1, Rainfall Profile: 248



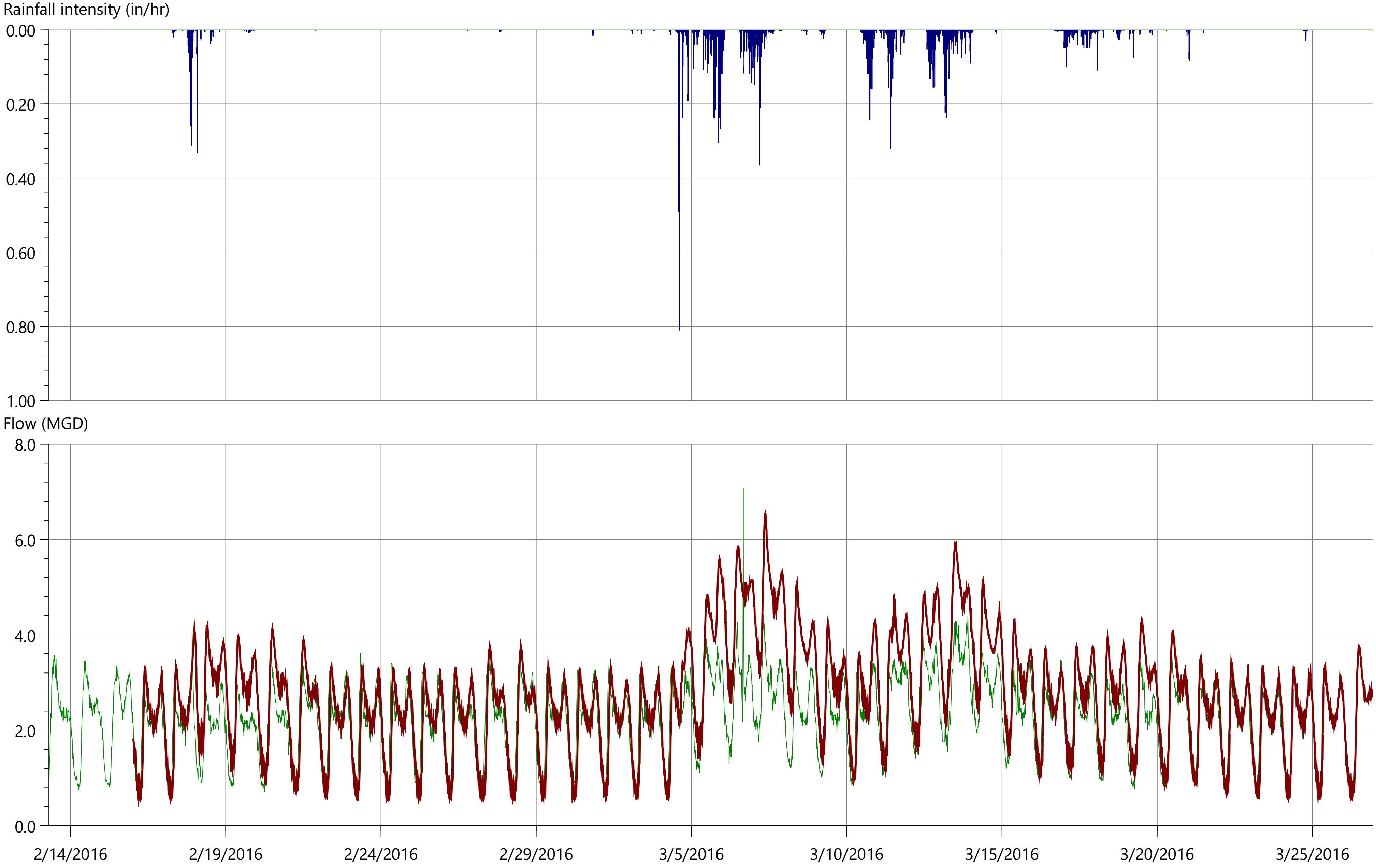
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.748	0.593	0.007			
Observed				0.347	3.882	5522255.777
...ta20160215_20160315				0.691	3.629	6310657.038

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 24 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 20, Model Location (Pred.) D/S SMH C07-004.1, Rainfall Profile: 200



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	3.133	0.316	0.003			
Observed				0.014	0.865	1110452.108
...ta20160215_20160315				0.078	0.732	1119212.084

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 25 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 21, Model Location (Pred.) D/S SMH E01-150.1, Rainfall Profile: 305

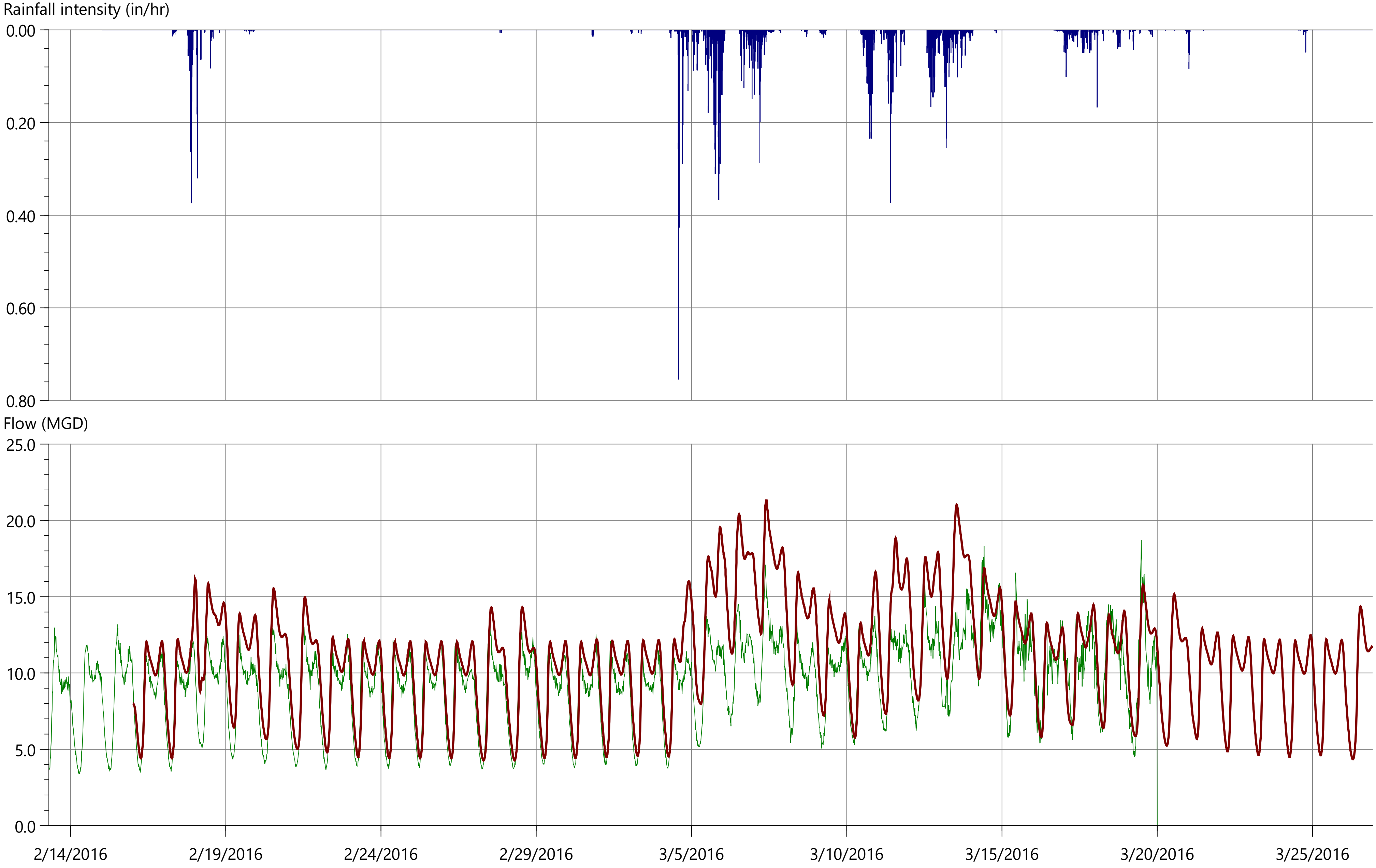


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.168	0.810	0.007			
Observed				0.681	7.071	7871327.215
...ta20160215_20160315				0.529	6.540	9303644.977

Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 22, Model Location (Pred.) D/S SMH F01-135.1, Rainfall Profile: 371

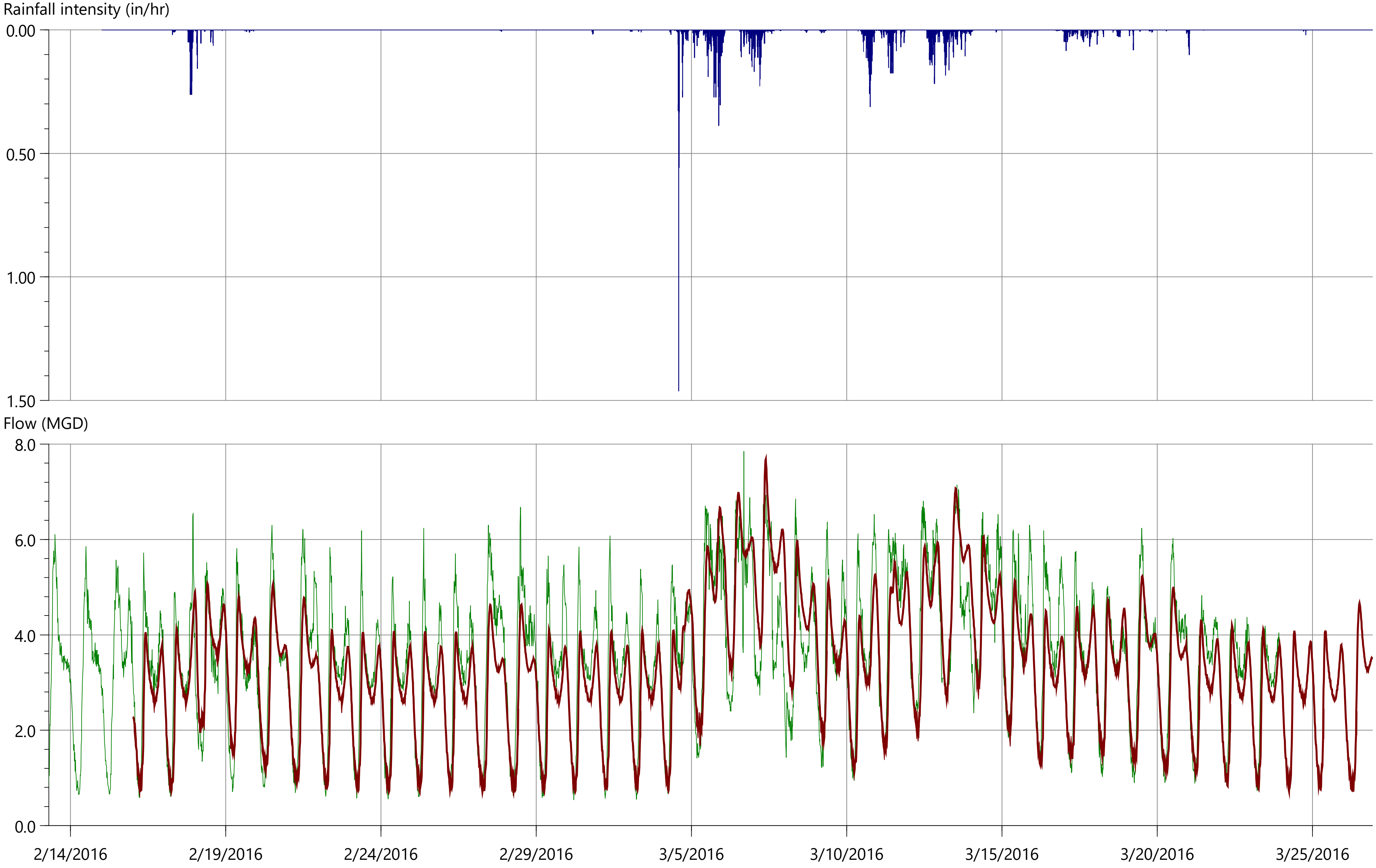


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.422	0.754	0.008			
Observed				0.000	18.708	29305470.700
...ta20160215_20160315				4.271	21.309	38289677.747

Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) FM 23, Model Location (Pred.) D/S SMH F01-147.1, Rainfall Profile: 370



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain —	7.432	1.462	0.008			
Observed —				0.542	7.848	12177525.807
...ta20160215_20160315 —				0.707	7.678	11302643.288

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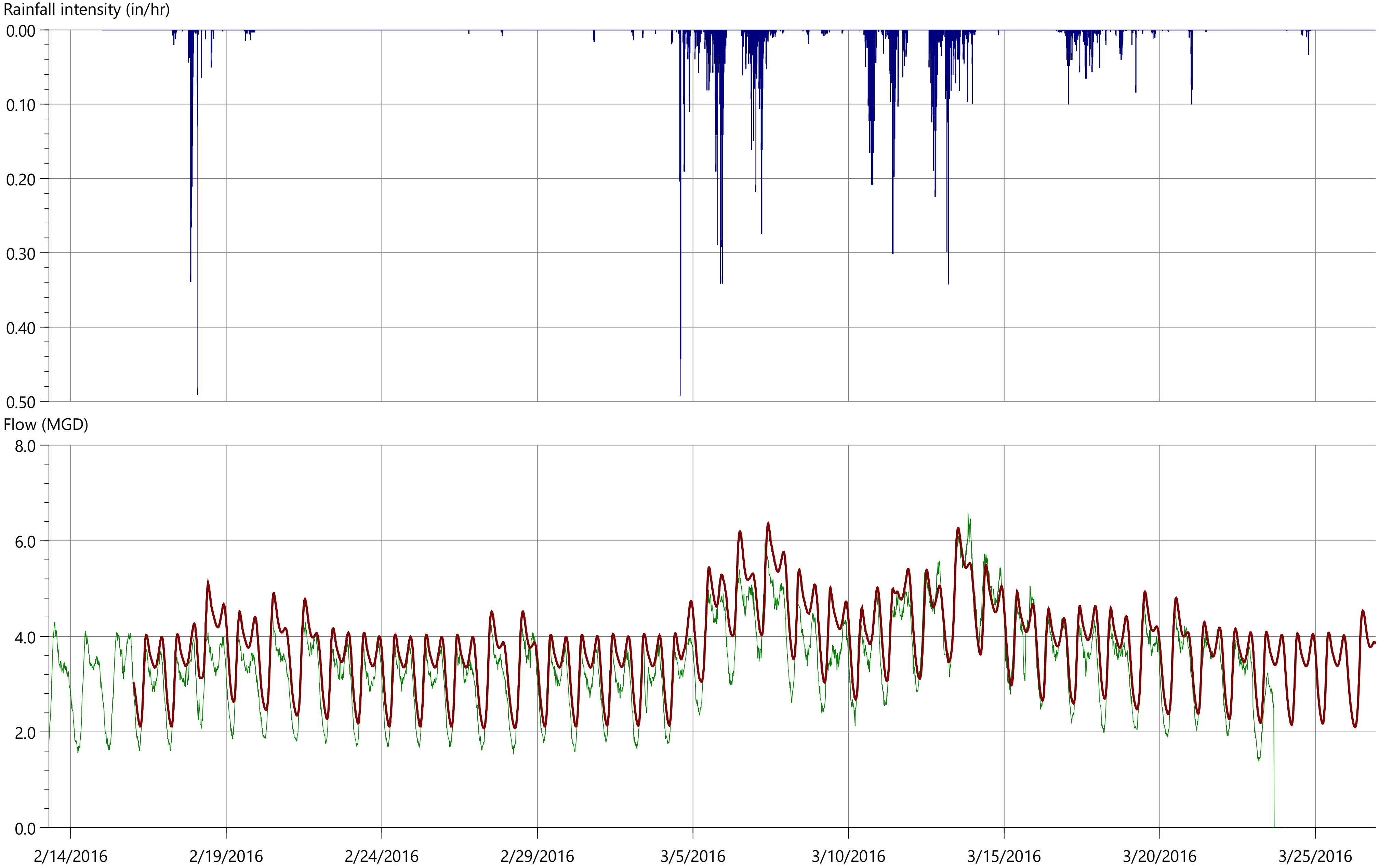
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 24, Model Location (Pred.) D/S SMH F02-073.1, Rainfall Profile: 406



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.235	0.492	0.007			
Observed				0.000	6.569	11673591.208
...ta20160215_20160315				2.078	6.365	13083521.477

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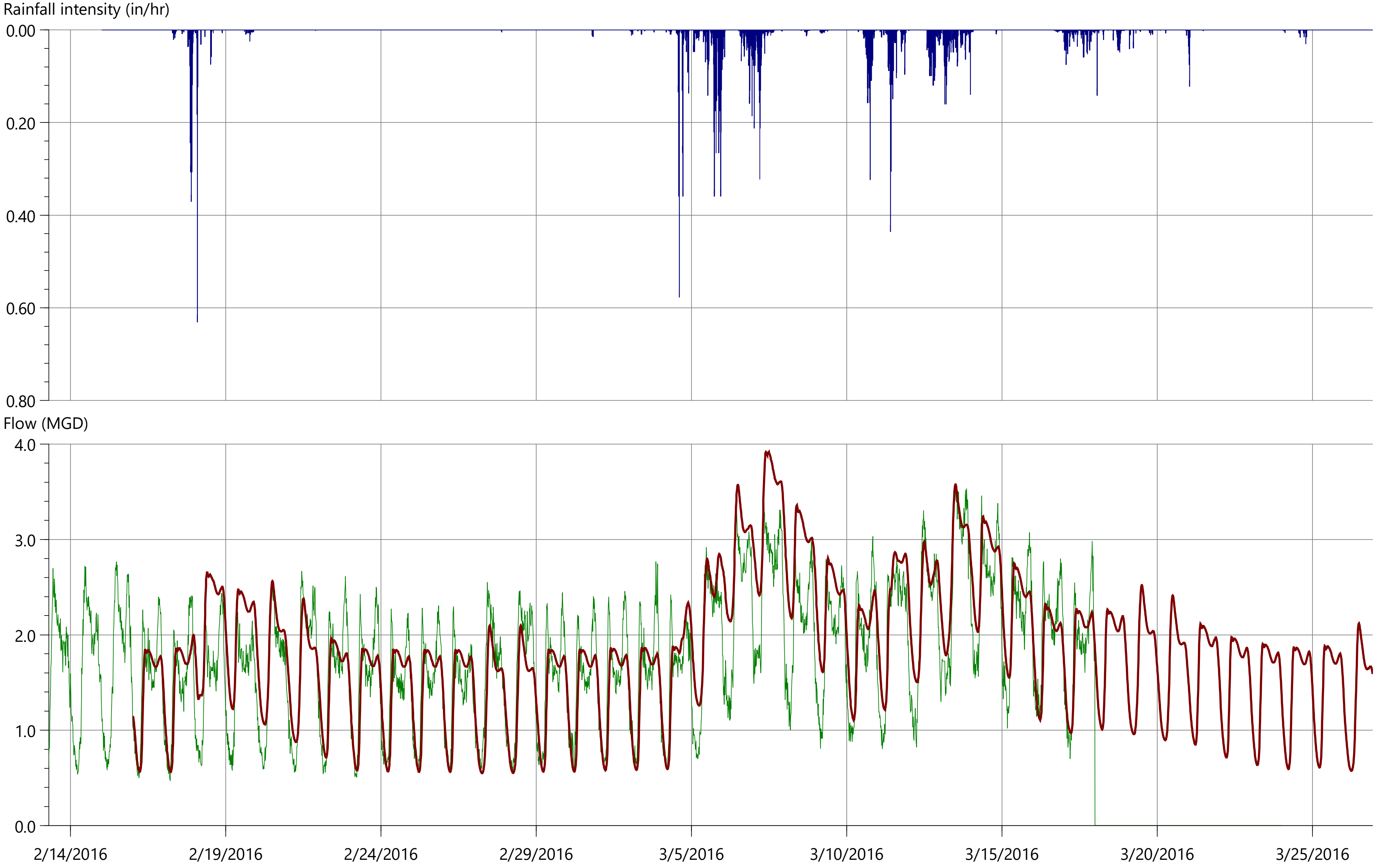
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 25, Model Location (Pred.) D/S SMH F04-003.1, Rainfall Profile: 409



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.213	0.631	0.007			
Observed				0.000	3.566	5191133.127
...ta20160215_20160315				0.550	3.917	6371709.144

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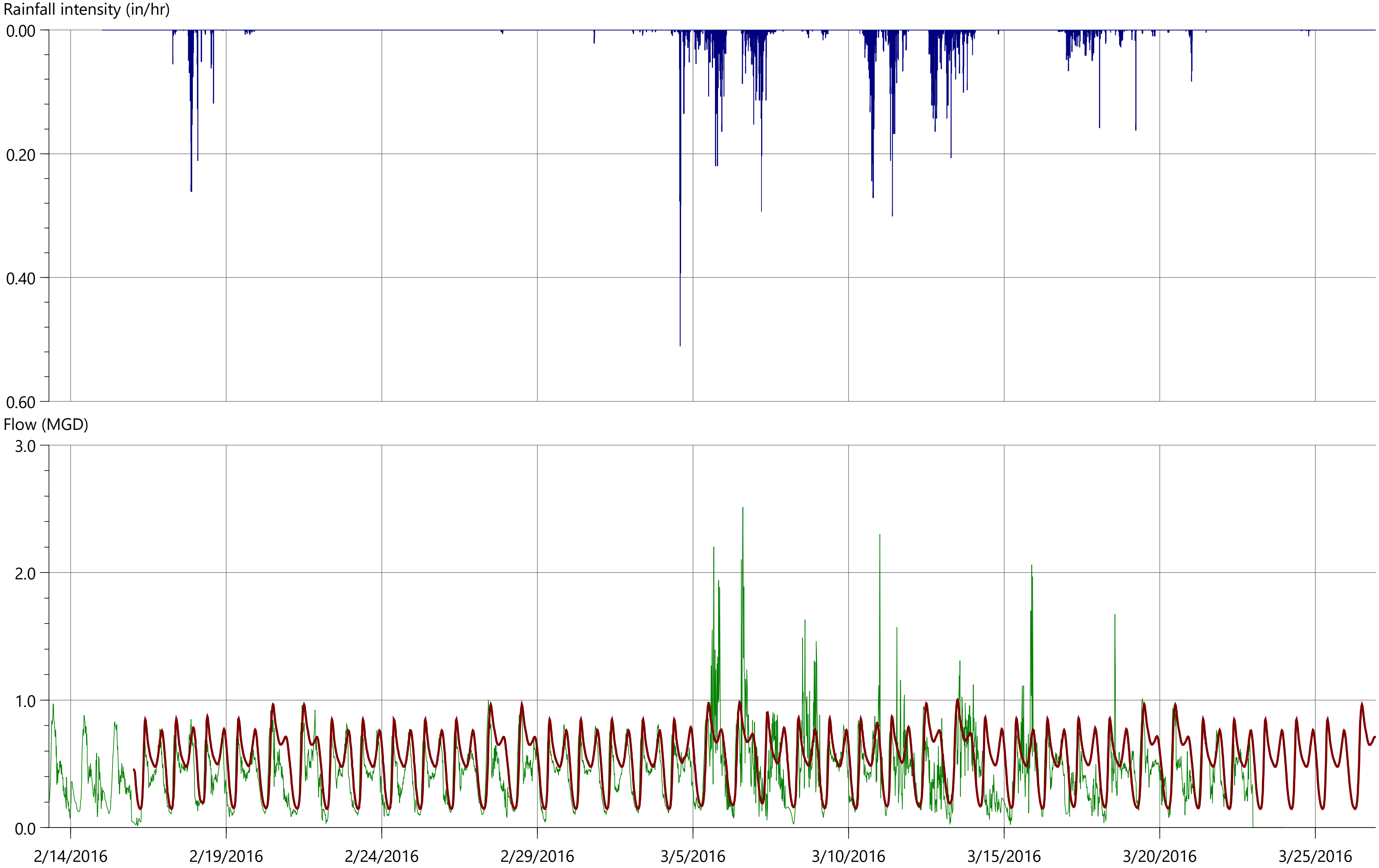
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) FM 26, Model Location (Pred.) D/S SMH F99-034.1, Rainfall Profile: 336



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.185	0.510	0.006			
Observed				0.000	2.513	1488940.567
...ta20160215_20160315				0.146	1.003	1837826.434

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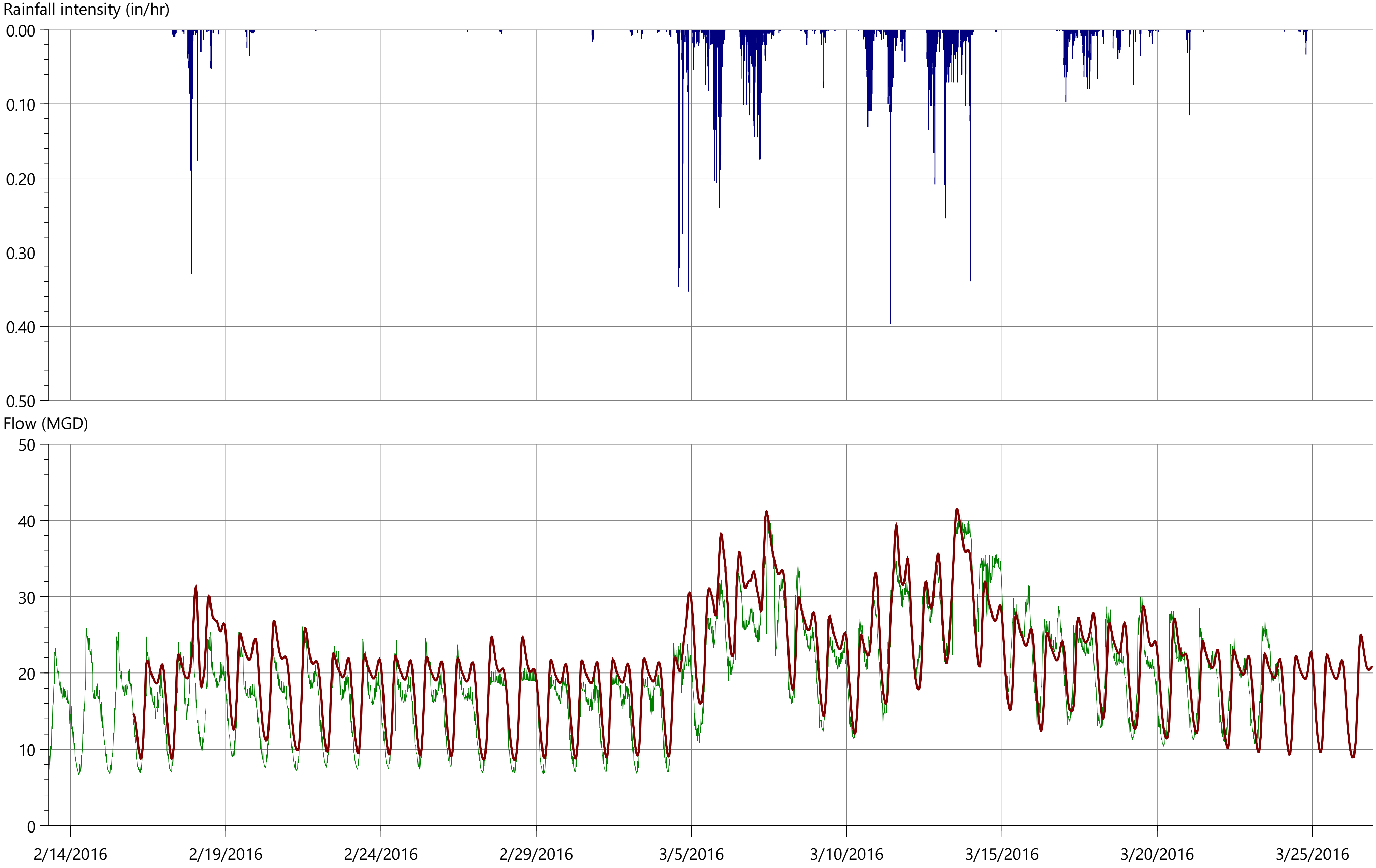
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

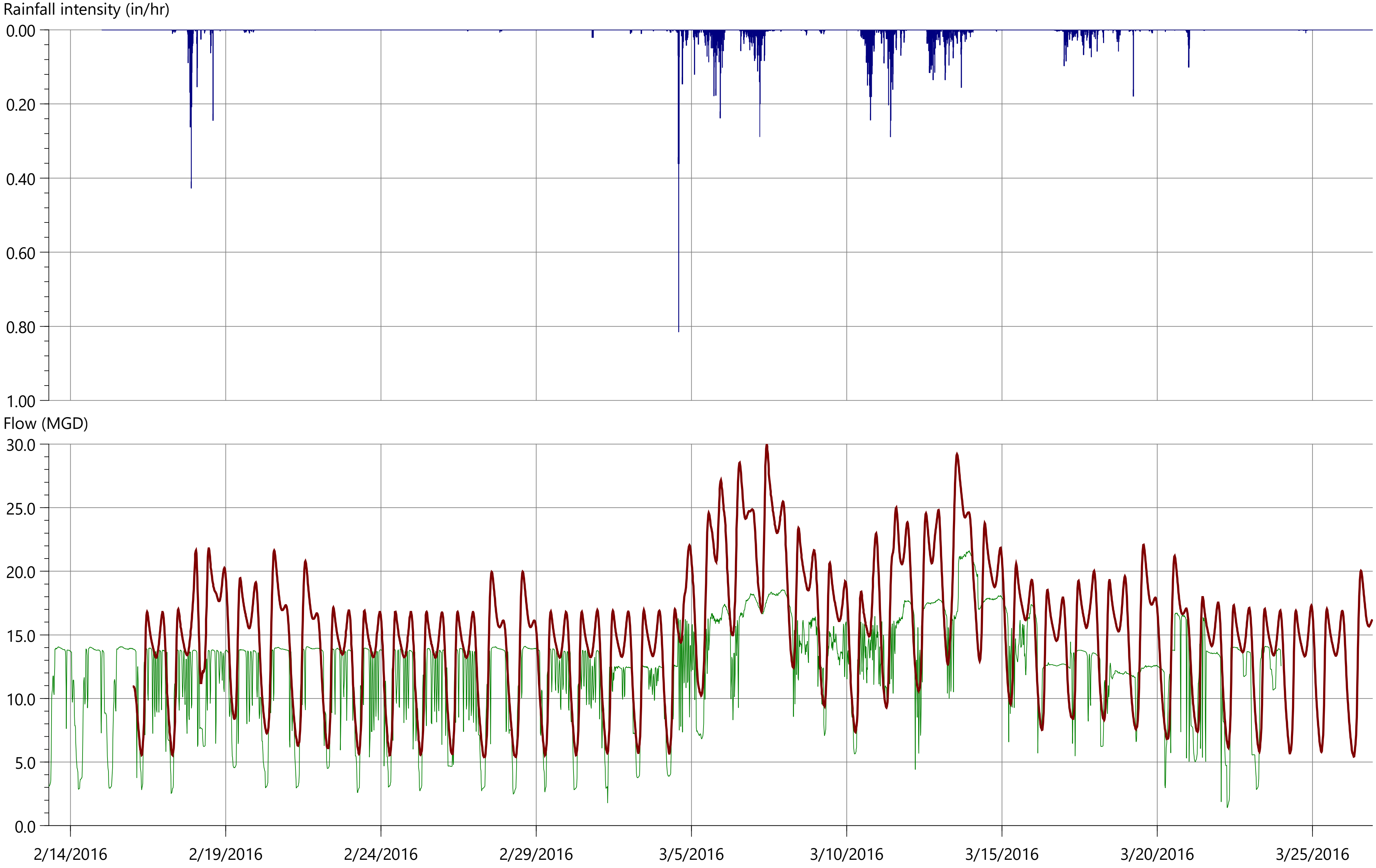
Flow Survey Location (Obs.) DC WWTP, Model Location (Pred.) D/S CAP B03-DCWWTP.1, Rainfall Profile: 177



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.394	0.418	0.007			
Observed				6.736	40.725	66602465.109
...ta20160215_20160315				8.618	41.482	73053377.582

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 32 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) PG WWTP, Model Location (Pred.) D/S SMH F99-016.1, Rainfall Profile: 368



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain ───	5.985	0.815	0.006			
Observed ───				1.411	21.613	42223364.633
...ta20160215_20160315 ━━━				5.391	29.963	52253557.072

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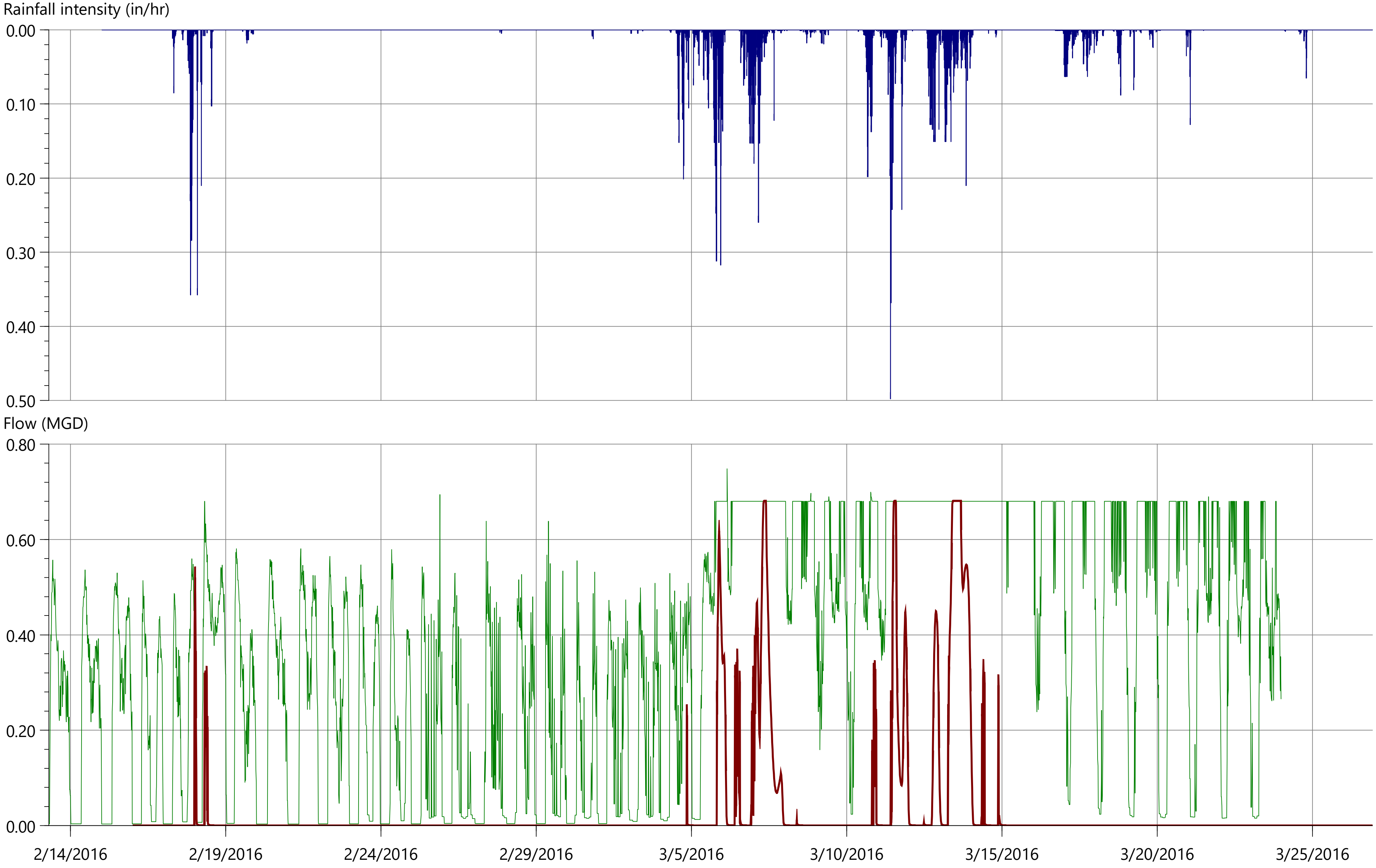
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) PS 26, Model Location (Pred.) D/S A08-169D1.1, Rainfall Profile: 120



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.479	0.498	0.008			
Observed				0.003	0.748	1268714.090
...ta20160215_20160315				0.000	0.681	104826.425

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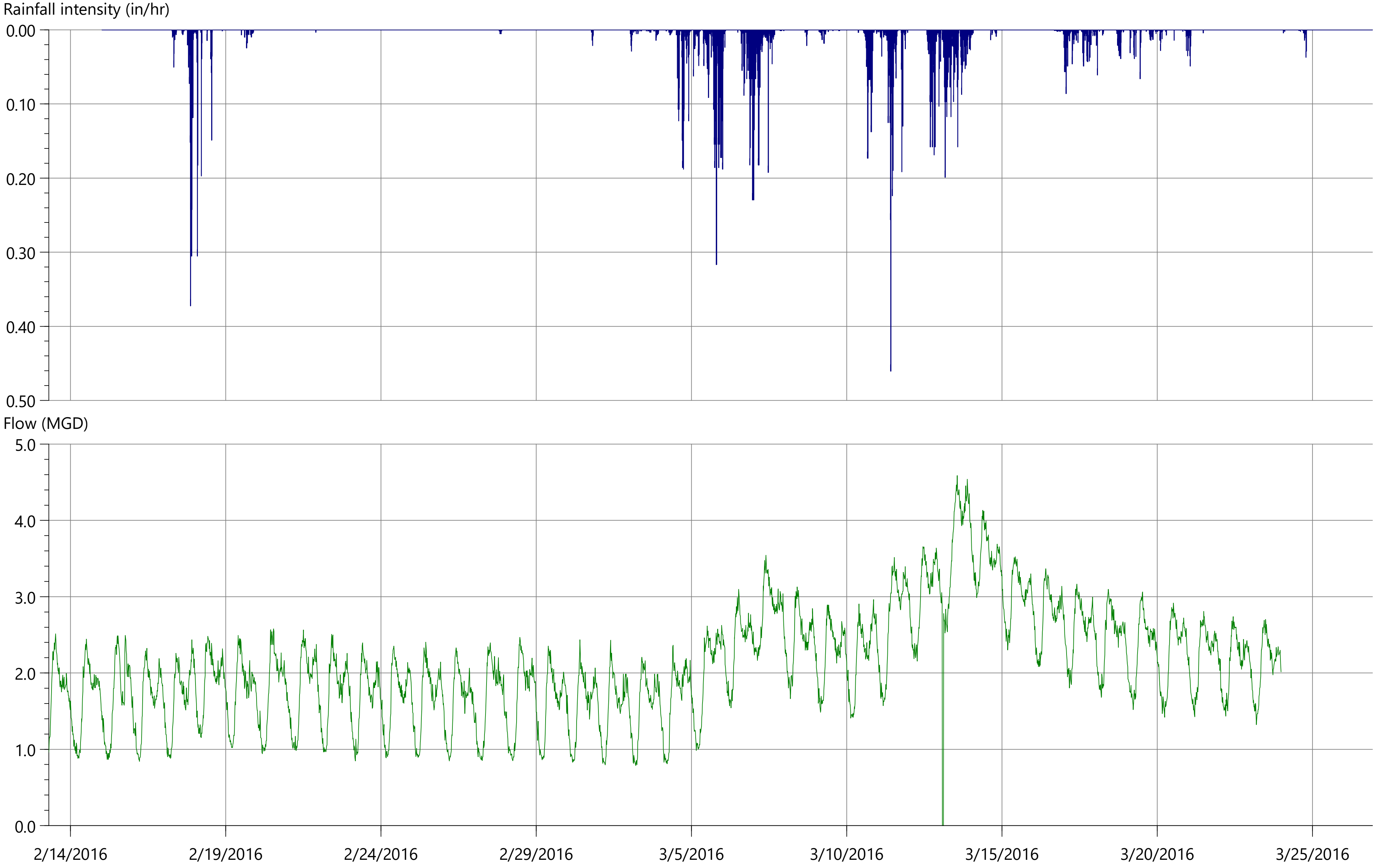
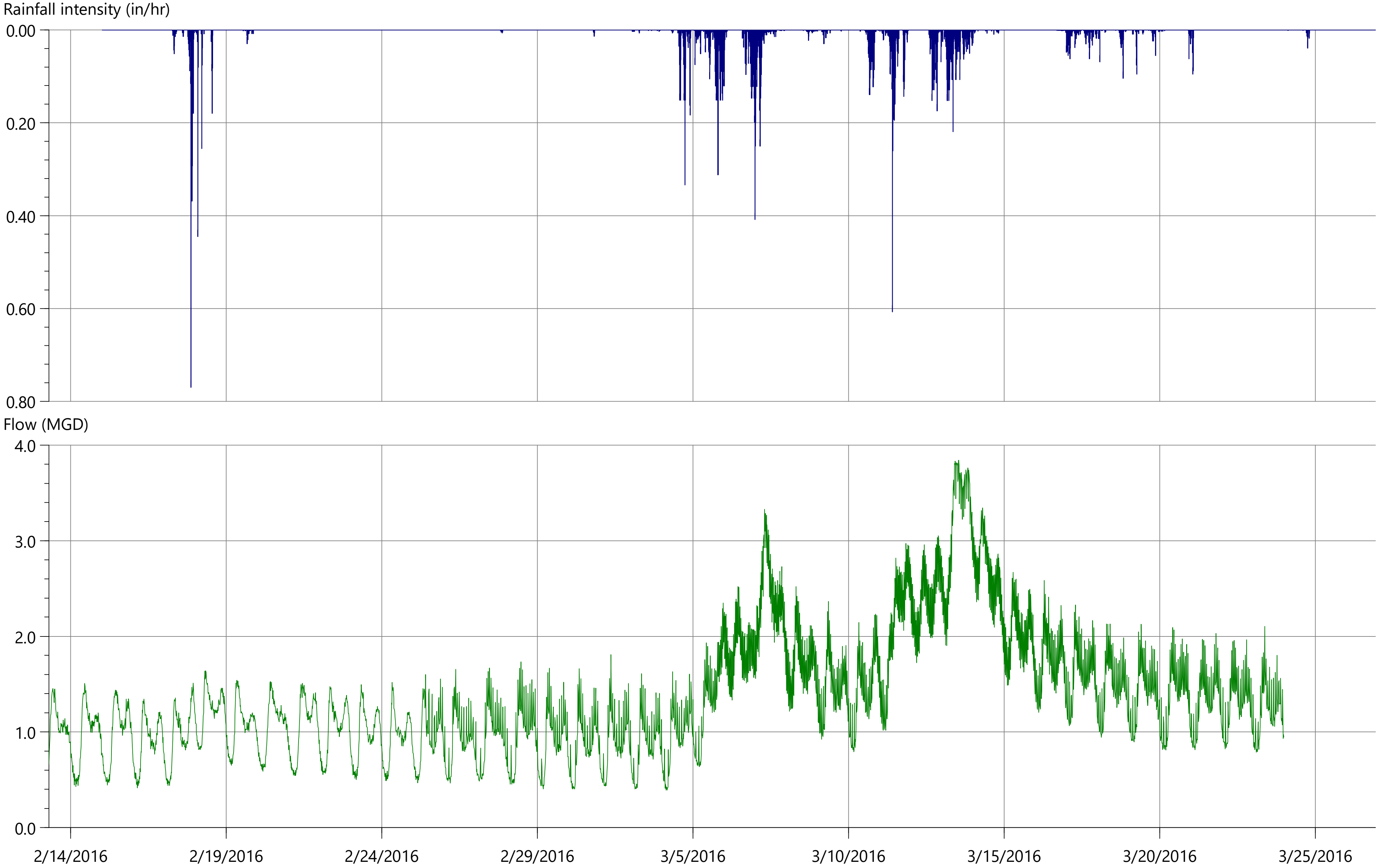
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) Sierra College (Placer County), Model Location (Pred.) D/S Sierra College.1, Rainfall Profile: 289



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.146	0.460	0.007			
Observed				0.000	4.589	7230337.020
...ta20160215_20160315						

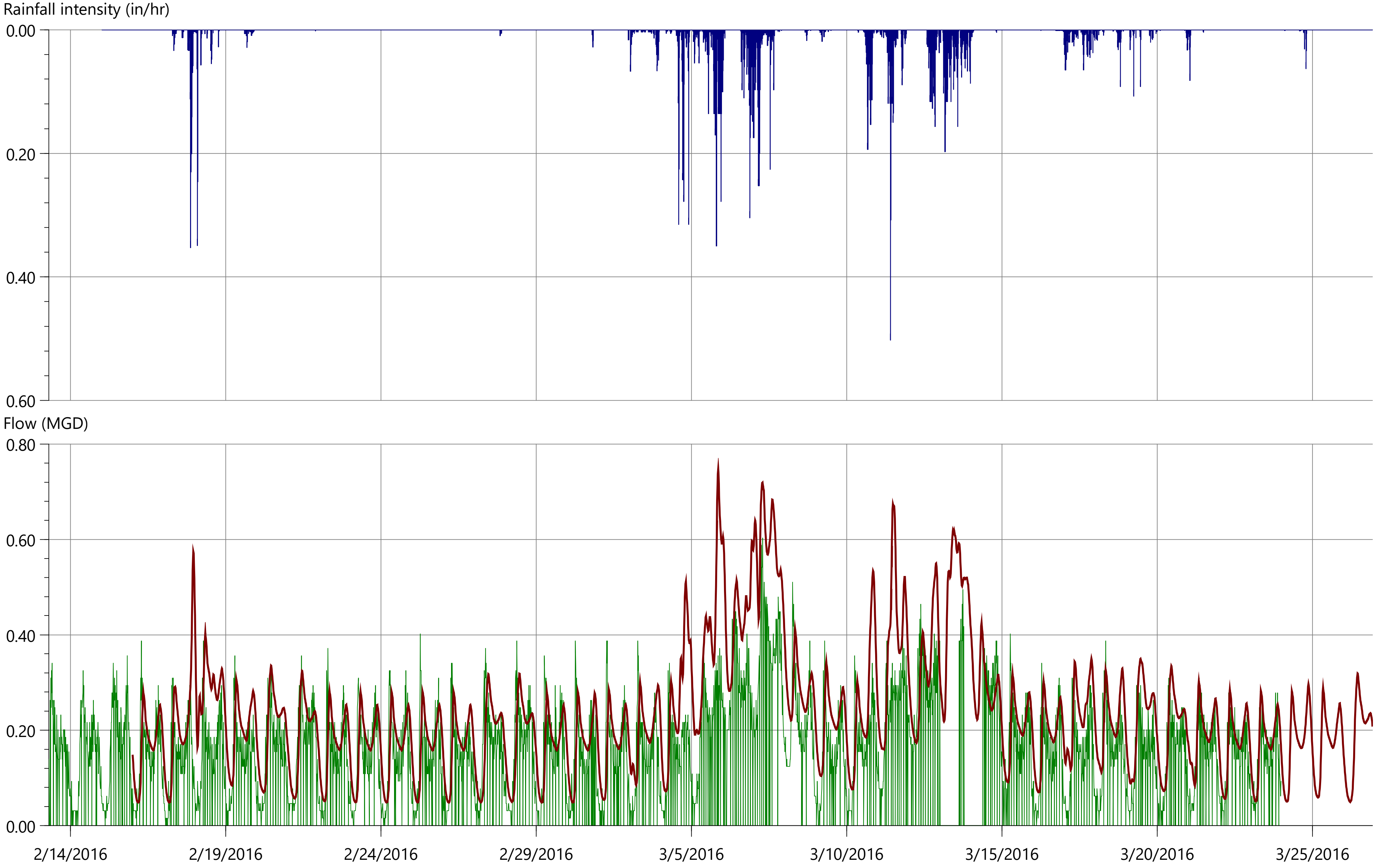
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 35 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) SMD2, Model Location (Pred.) D/S SMH A08-023.1, Rainfall Profile: 157



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.706	0.770	0.008			
Observed				0.391	3.843	4692173.351
...ta20160215_20160315						

Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) Highlands, Model Location (Pred.) D/S SMH D08-006.1, Rainfall Profile: 318



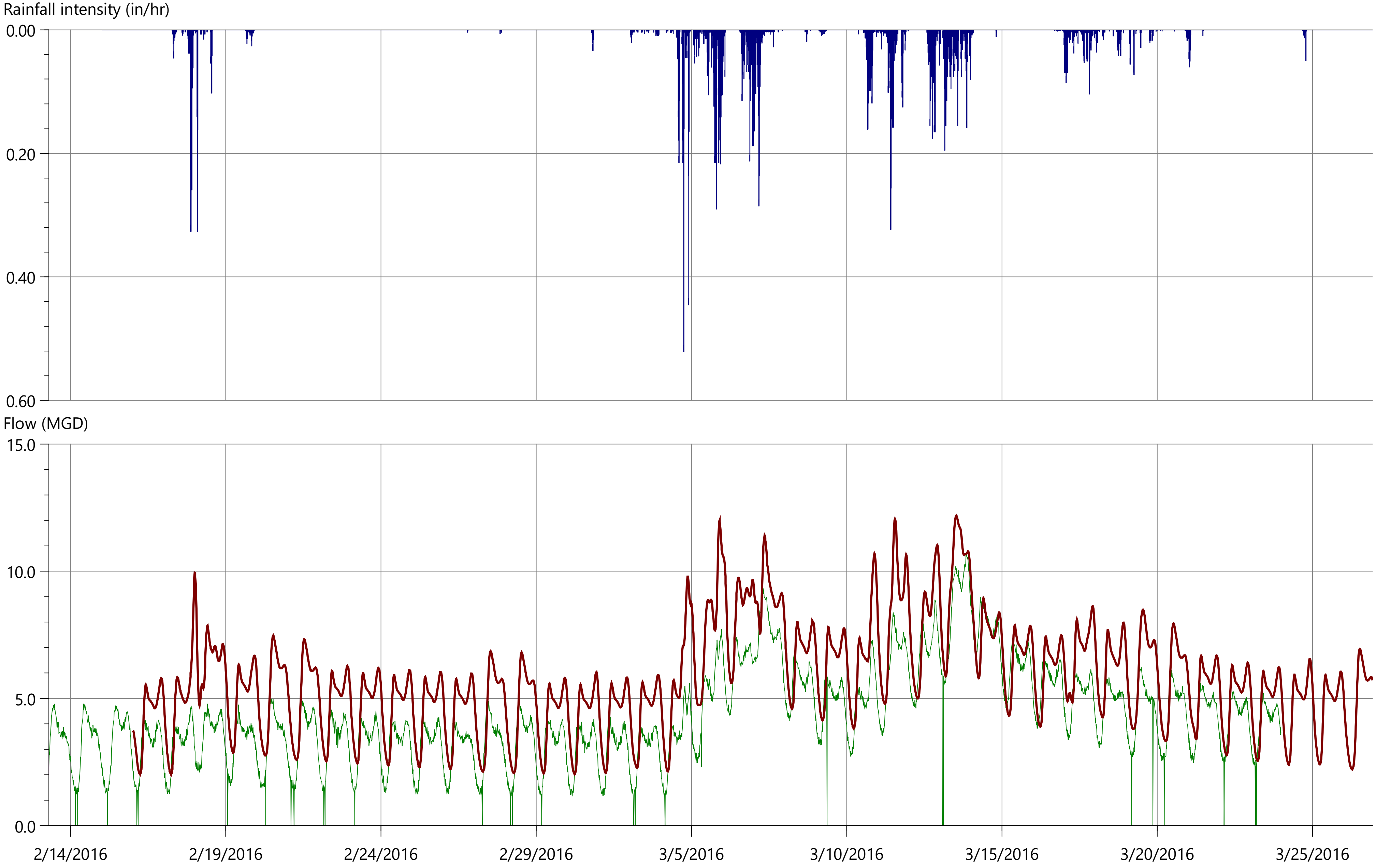
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.486	0.502	0.008			
Observed				0.000	0.603	498513.323
...ta20160215_20160315				0.048	0.748	814212.771

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 37 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) North Roseville, Model Location (Pred.) D/S NorthRoseville.1, Rainfall Profile: 479

	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.580	0.504	0.008			
Observed				0.000	7.798	11333261.397
...ta20160215_20160315						

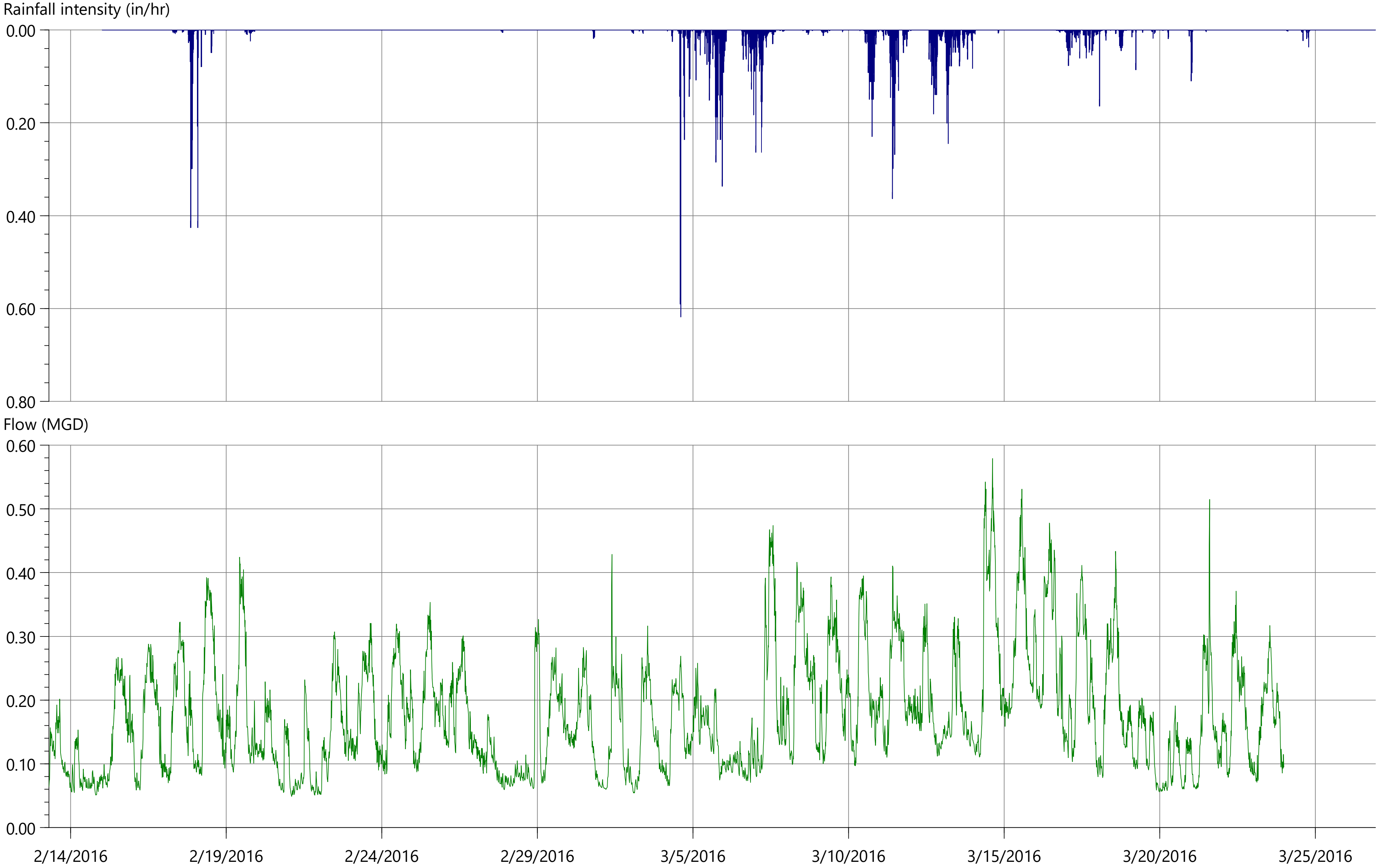
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 38 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) Springview, Model Location (Pred.) D/S SMH C06-213.1, Rainfall Profile: 418



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.461	0.521	0.008			
Observed				0.000	10.738	14884868.215
...ta20160215_20160315				2.010	12.195	20206568.688

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:43:54 AM) Page 39 of 40
Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) Cincinnati, Model Location (Pred.) D/S SMH G03-032.1, Rainfall Profile: 441

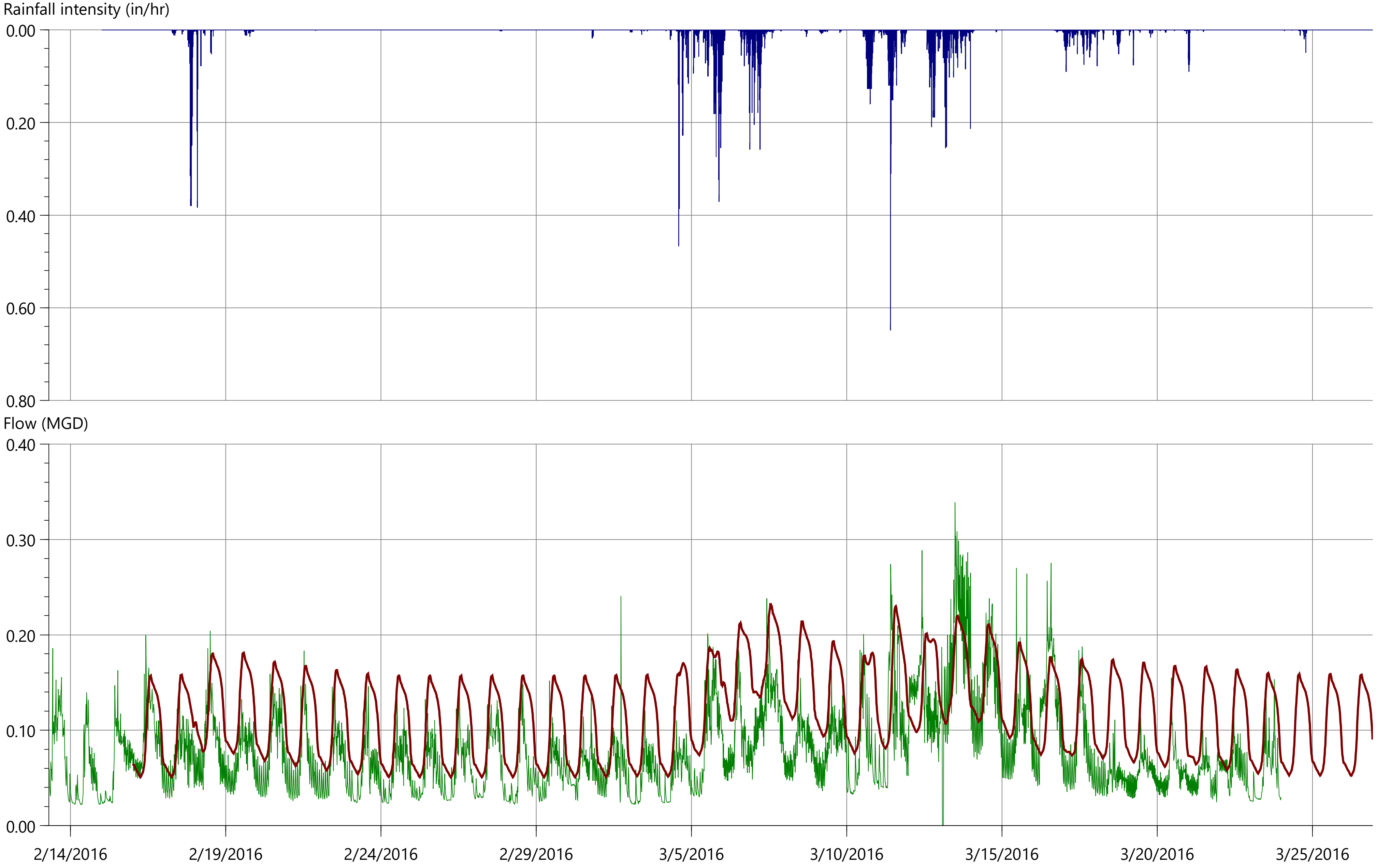


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain —	7.365	0.618	0.007			
Observed —				0.049	0.579	607274.558
...ta20160215_20160315 —						

Flow survey: >Roseville>3. Data>Flow Data>Flow survey - All data (12/1/2016 1:53:11 PM)

Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315 (11/6/2019 11:21:22 AM)

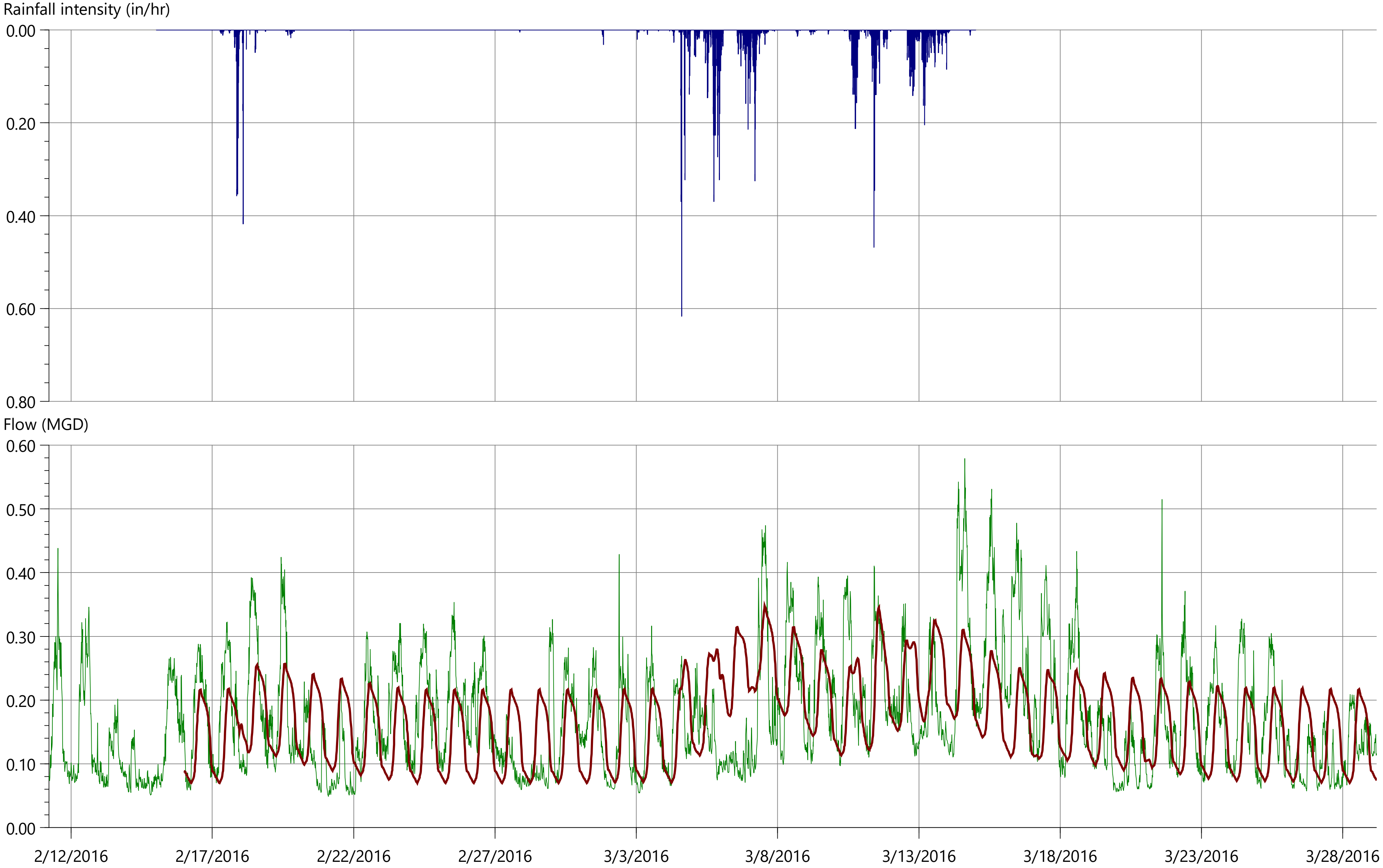
Flow Survey Location (Obs.) Industrial, Model Location (Pred.) D/S SMH G03-062.1, Rainfall Profile: 475



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	7.576	0.648	0.008			
Observed				0.000	0.339	266882.195
...ta20160215_20160315				0.051	0.232	407592.659

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:25 AM) Page 1 of 7
Flow survey: >Roseville>3. Data>Flow Data>Permanent Meter Data (12/1/2016 10:54:47 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315_RGBoundaries (11/6/2019 11:21:22 AM)

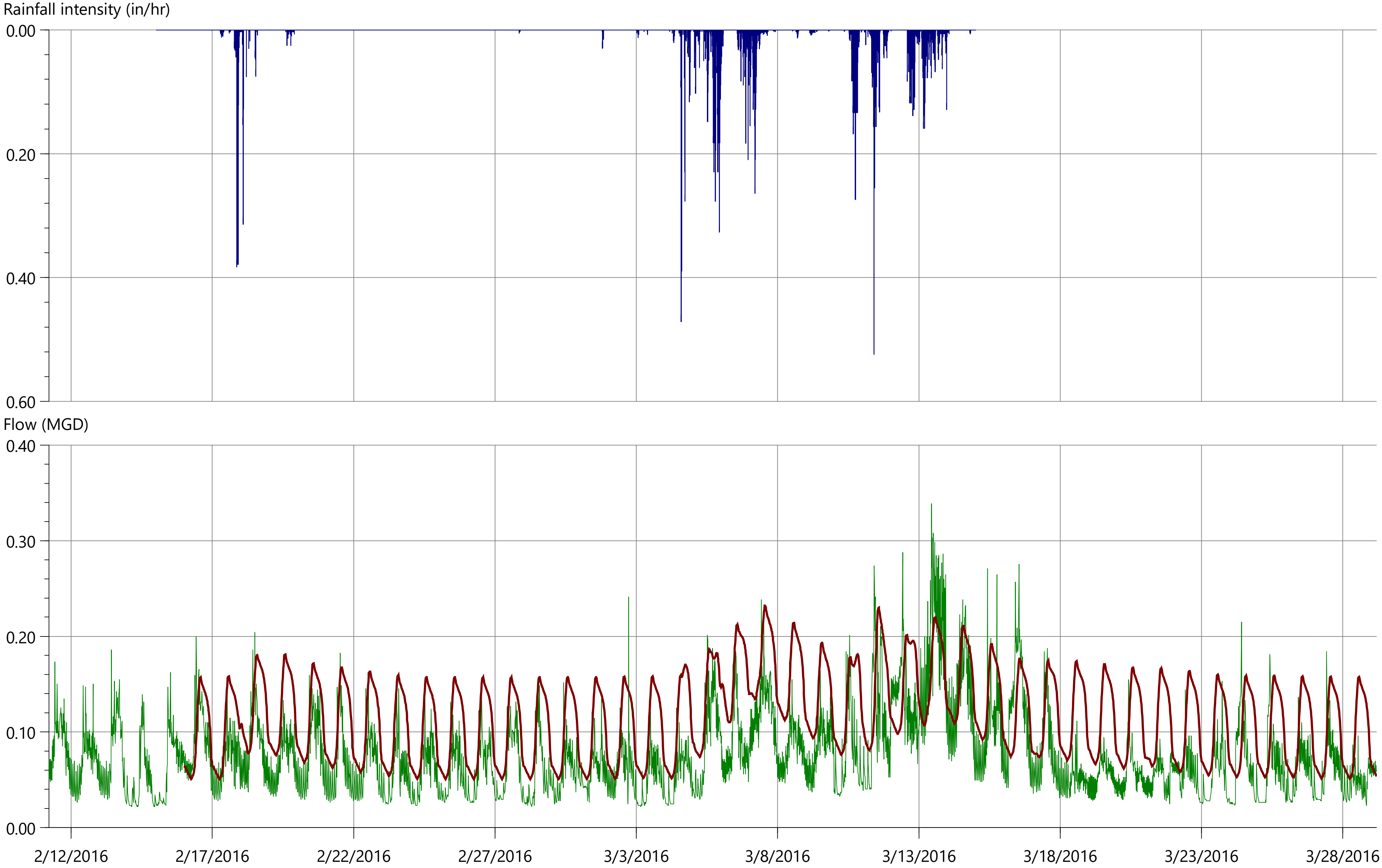
Flow Survey Location (Obs.) Cincinnati, Model Location (Pred.) D/S CA4-RSVL28.1, Rainfall Profile: 408



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.438	0.617	0.009			
Observed				0.049	0.579	695745.611
...160315_RGBoundaries				0.069	0.348	611280.586

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:25 AM) Page 2 of 7
Flow survey: >Roseville>3. Data>Flow Data>Permanent Meter Data (12/1/2016 10:54:47 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315_RGBoundaries (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) Industrial, Model Location (Pred.) D/S SMH G03-062.1, Rainfall Profile: 442

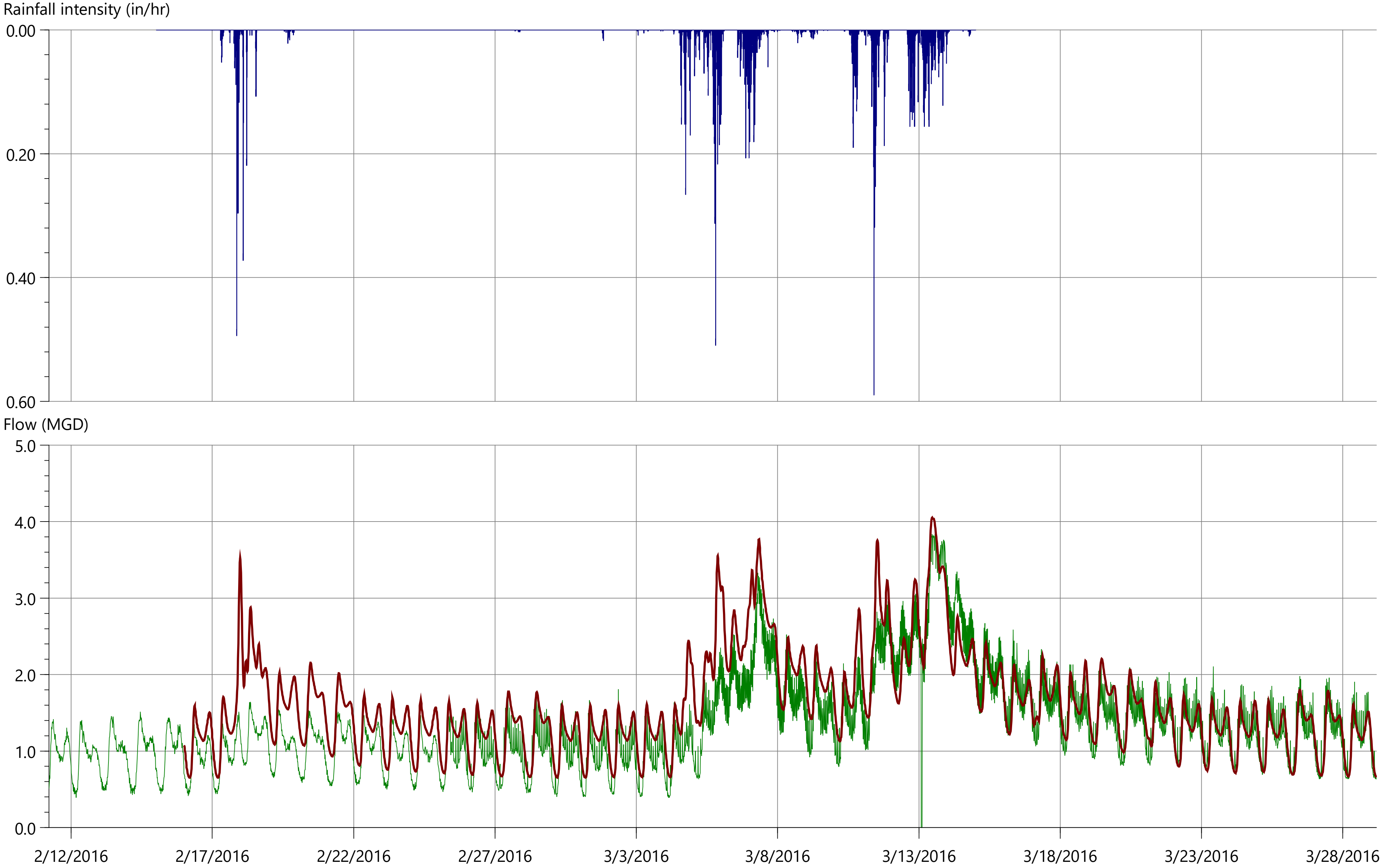


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.635	0.524	0.010			
Observed				0.022	0.339	307302.659
...160315_RGBoundaries				0.051	0.232	426162.383

Flow survey: >Roseville>3. Data>Flow Data>Permanent Meter Data (12/1/2016 10:54:47 AM)

Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315_RGBoundaries (11/6/2019 11:21:22 AM)

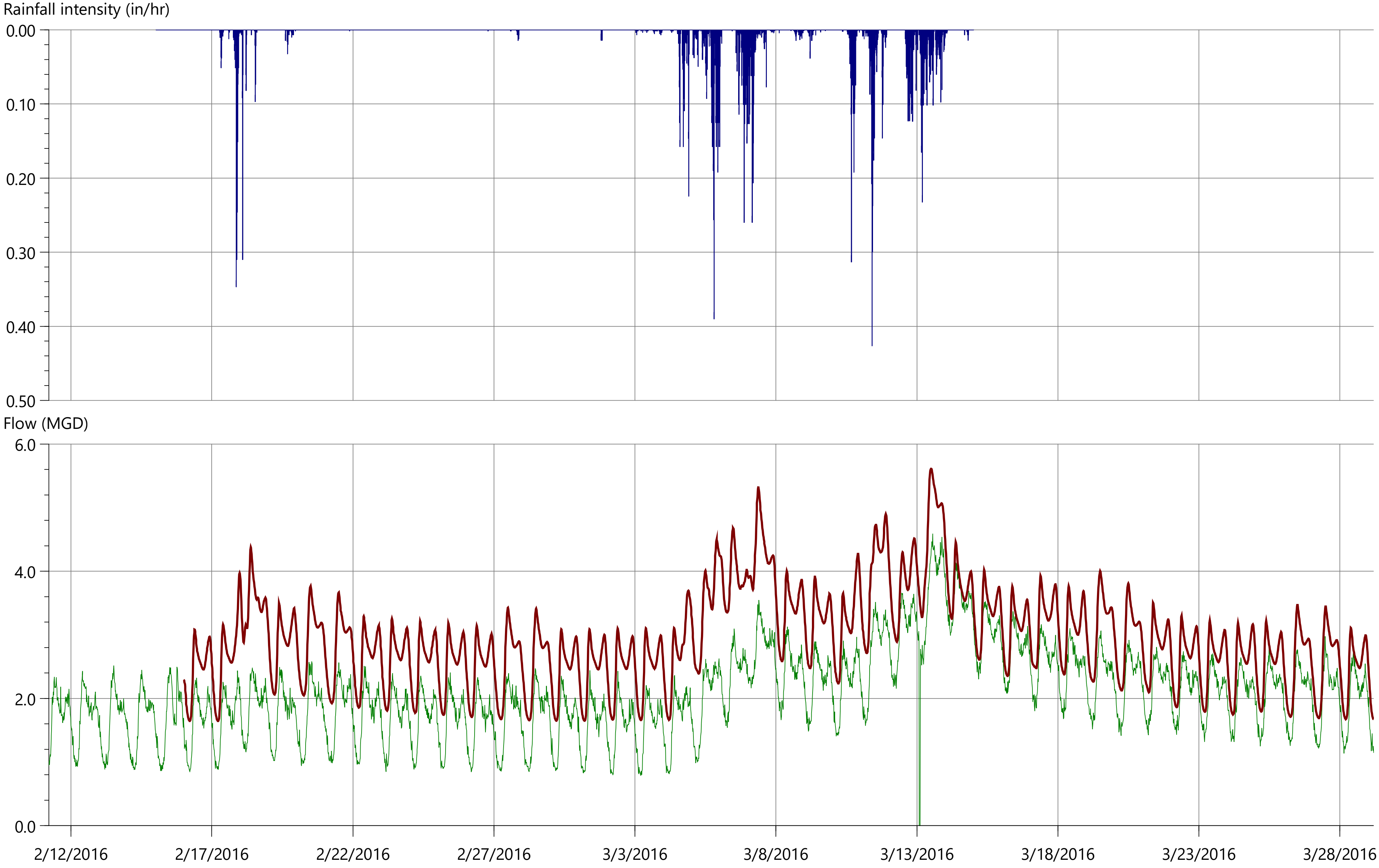
Flow Survey Location (Obs.) SMD2, Model Location (Pred.) D/S A10-03.1, Rainfall Profile: 121



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.898	0.590	0.010			
Observed				0.000	3.843	5383819.870
...160315_RGBoundaries				0.651	4.053	5913576.081

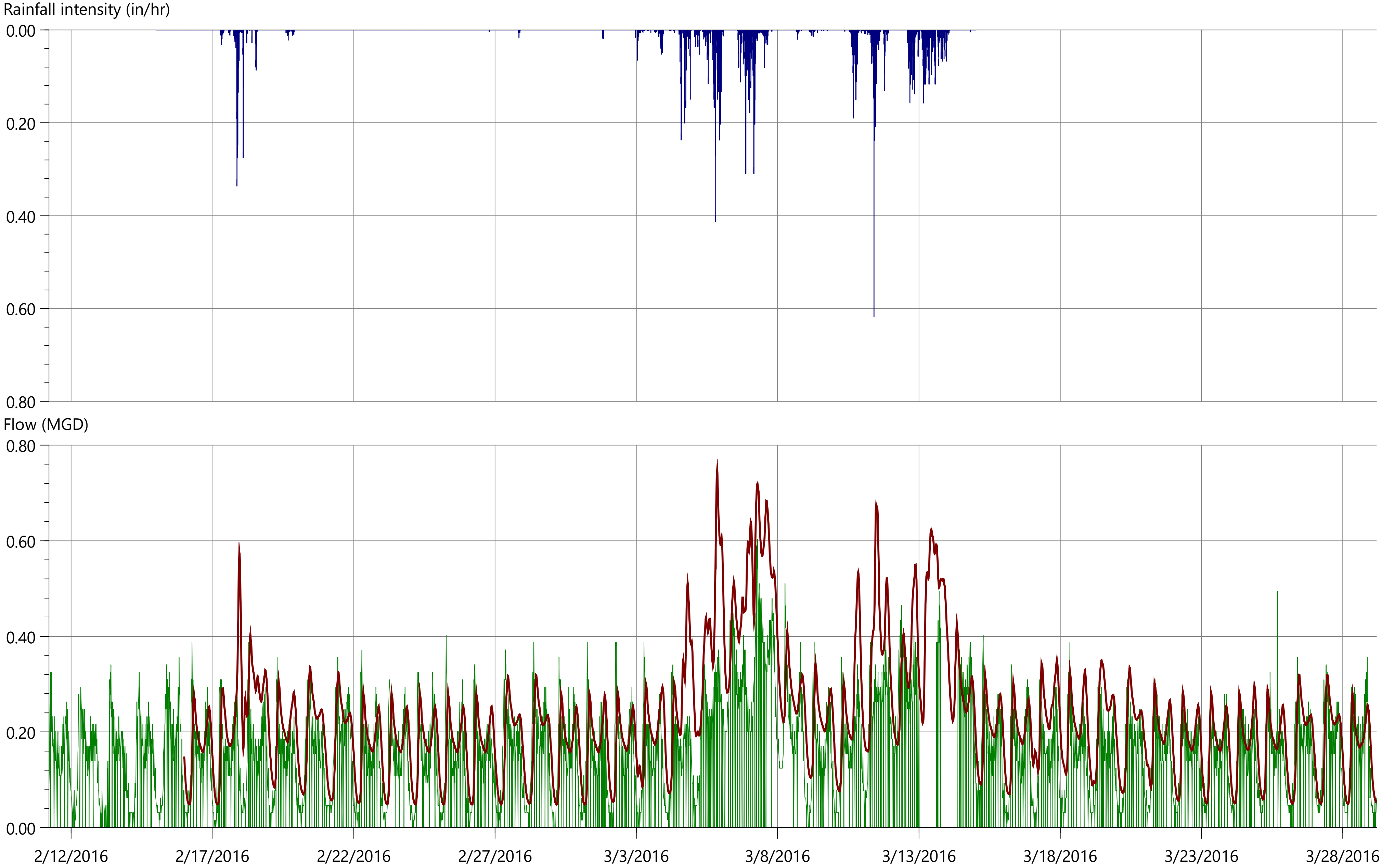
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:25 AM) Page 4 of 7
Flow survey: >Roseville>3. Data>Flow Data>Permanent Meter Data (12/1/2016 10:54:47 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315_RGBoundaries (11/6/2019 11:21:22 AM)

Flow Survey Location (Obs.) Sierra College/StrapRav, Model Location (Pred.) D/S SMH B08-040.1, Rainfall Profile: 186



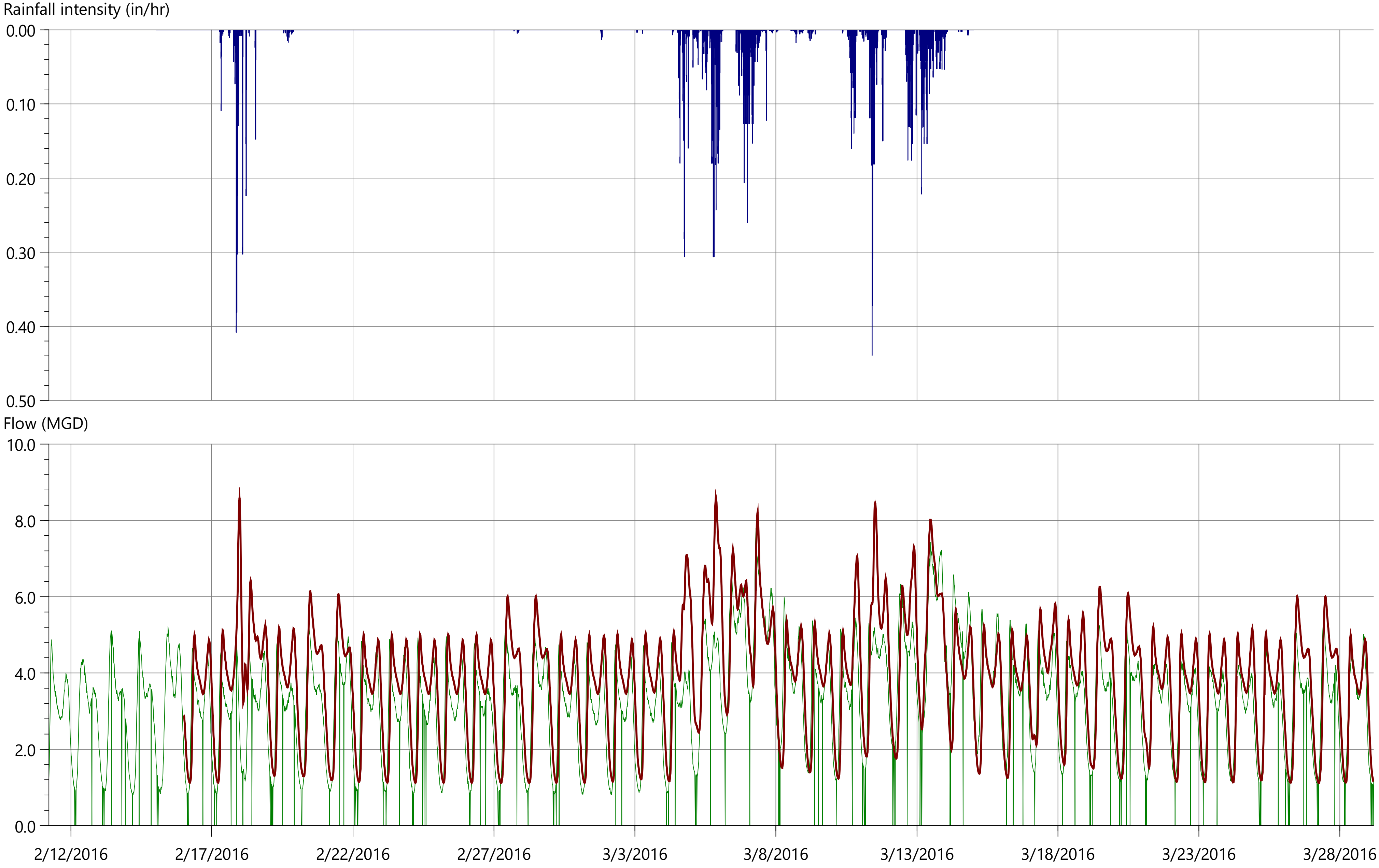
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.450	0.426	0.009			
Observed				0.000	4.589	8440619.727
...160315_RGBoundaries				1.646	5.613	10844812.901

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:25 AM) Page 5 of 7
Flow survey: >Roseville>3. Data>Flow Data>Permanent Meter Data (12/1/2016 10:54:47 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315_RGBoundaries (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) Highlands, Model Location (Pred.) D/S SMH D08-006.1, Rainfall Profile: 285



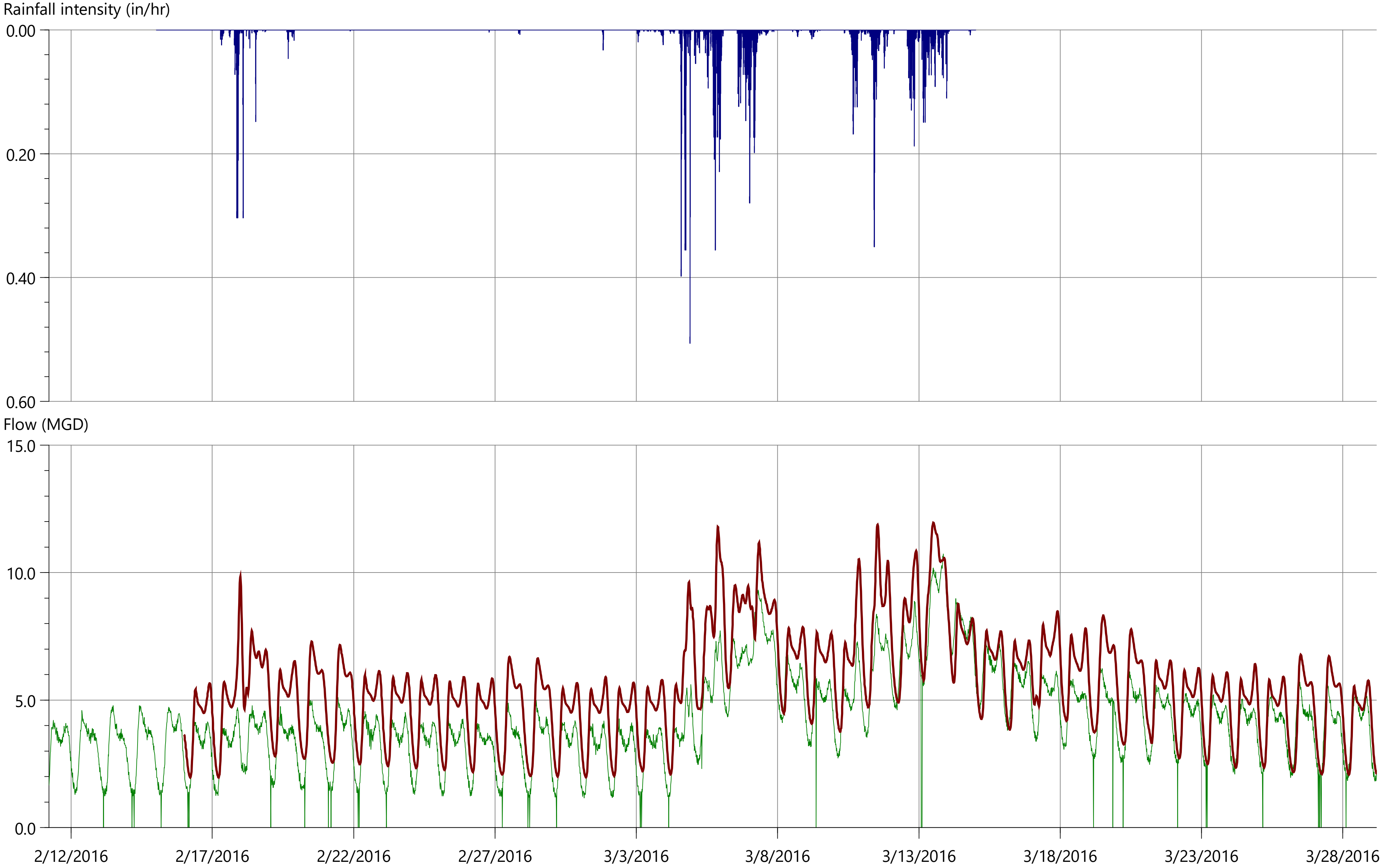
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.502	0.618	0.009			
Observed				0.000	0.603	582182.933
...160315_RGBoundaries				0.048	0.748	847296.033

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:25 AM) Page 6 of 7
Flow survey: >Roseville>3. Data>Flow Data>Permanent Meter Data (12/1/2016 10:54:47 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315_RGBoundaries (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) North Roseville/PG, Model Location (Pred.) D/S RSVL-001.1, Rainfall Profile: 410



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	6.973	0.439	0.010			
Observed				0.000	7.798	13146868.221
...160315_RGBoundaries				1.119	8.612	14109574.857

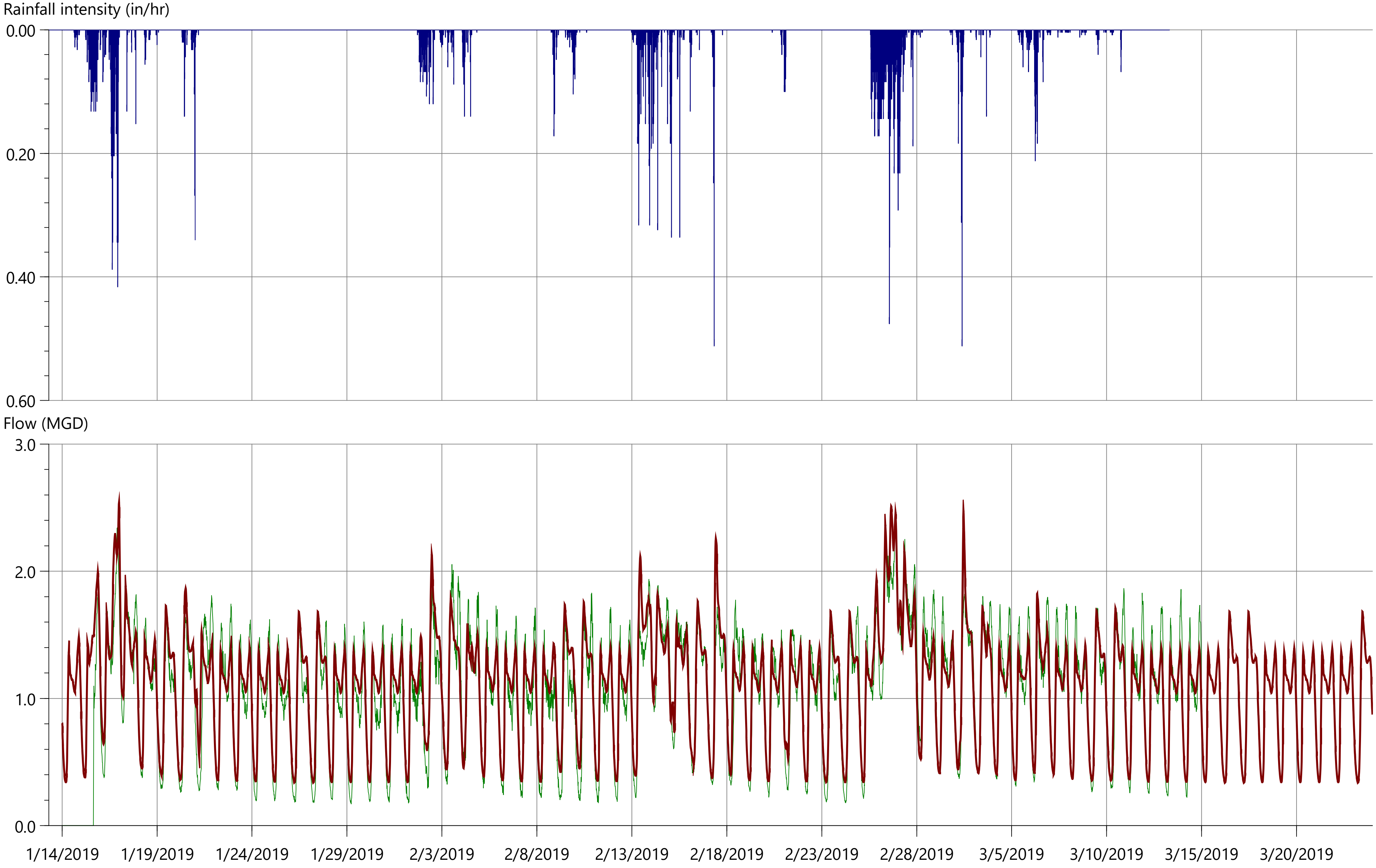
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:25 AM) Page 7 of 7
Flow survey: >Roseville>3. Data>Flow Data>Permanent Meter Data (12/1/2016 10:54:47 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2016 rainfall)!!>OneRainData20160215_20160315_RGBoundaries (11/6/2019 11:21:22 AM)
Flow Survey Location (Obs.) Springview/DC, Model Location (Pred.) D/S H07-168.1, Rainfall Profile: 315



		Rainfall			Flow		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	—	6.280	0.506	0.009			
Observed	—				0.000	10.738	17143559.755
...160315_RGBoundaries	—				1.960	11.958	20629240.945

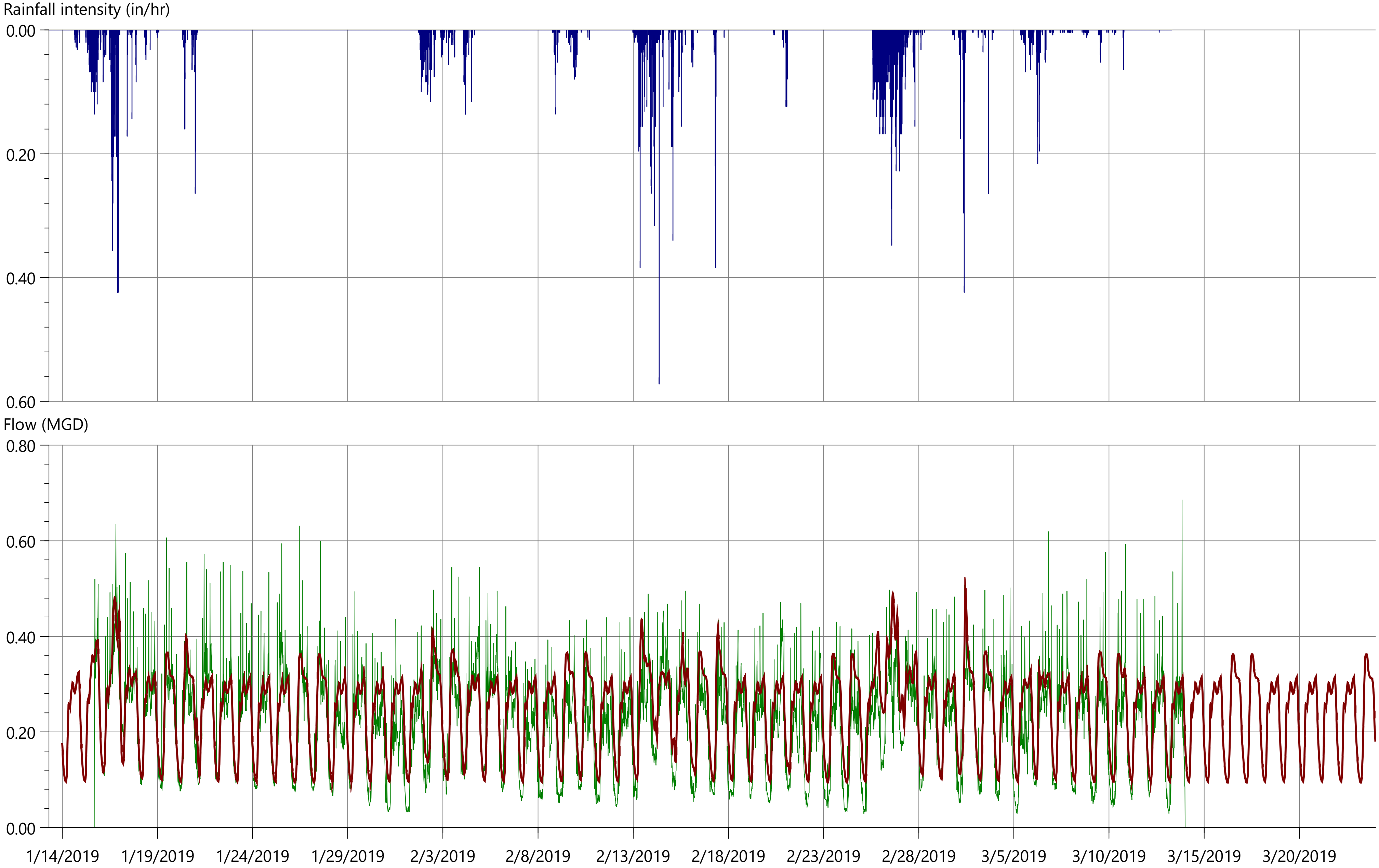
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:39:30 AM) Page 1 of 12
Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)

Flow Survey Location (Obs.) SIte 151, Model Location (Pred.) D/S L02-001.1, Rainfall Profile: 443



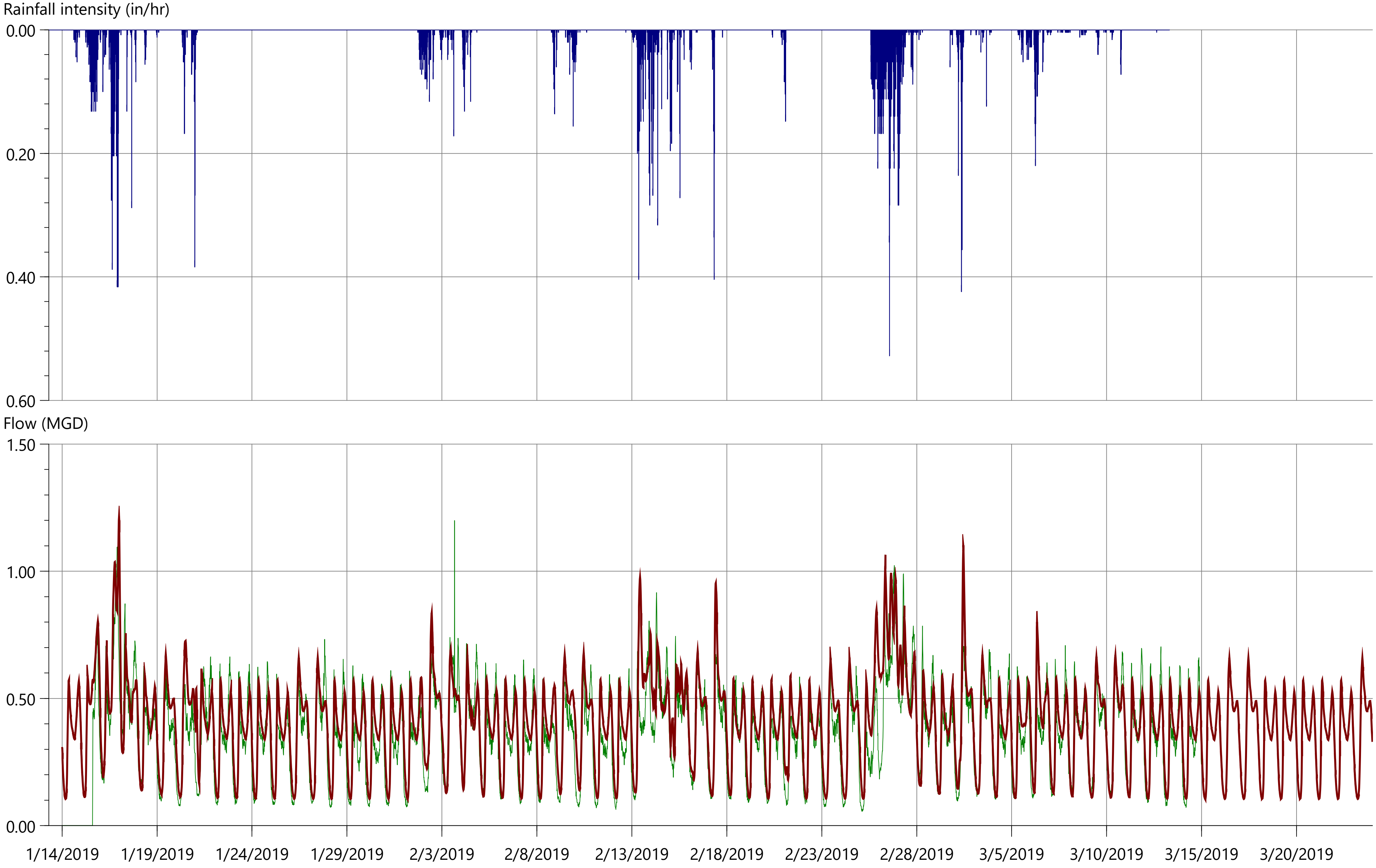
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	13.630	0.512	0.010			
Observed				0.000	2.474	5395503.465
...ta20190113_20190313				0.337	2.542	6508637.228

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:39:30 AM) Page 2 of 12
Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)
Flow Survey Location (Obs.) Site 152, Model Location (Pred.) D/S K02-005.1, Rainfall Profile: 410



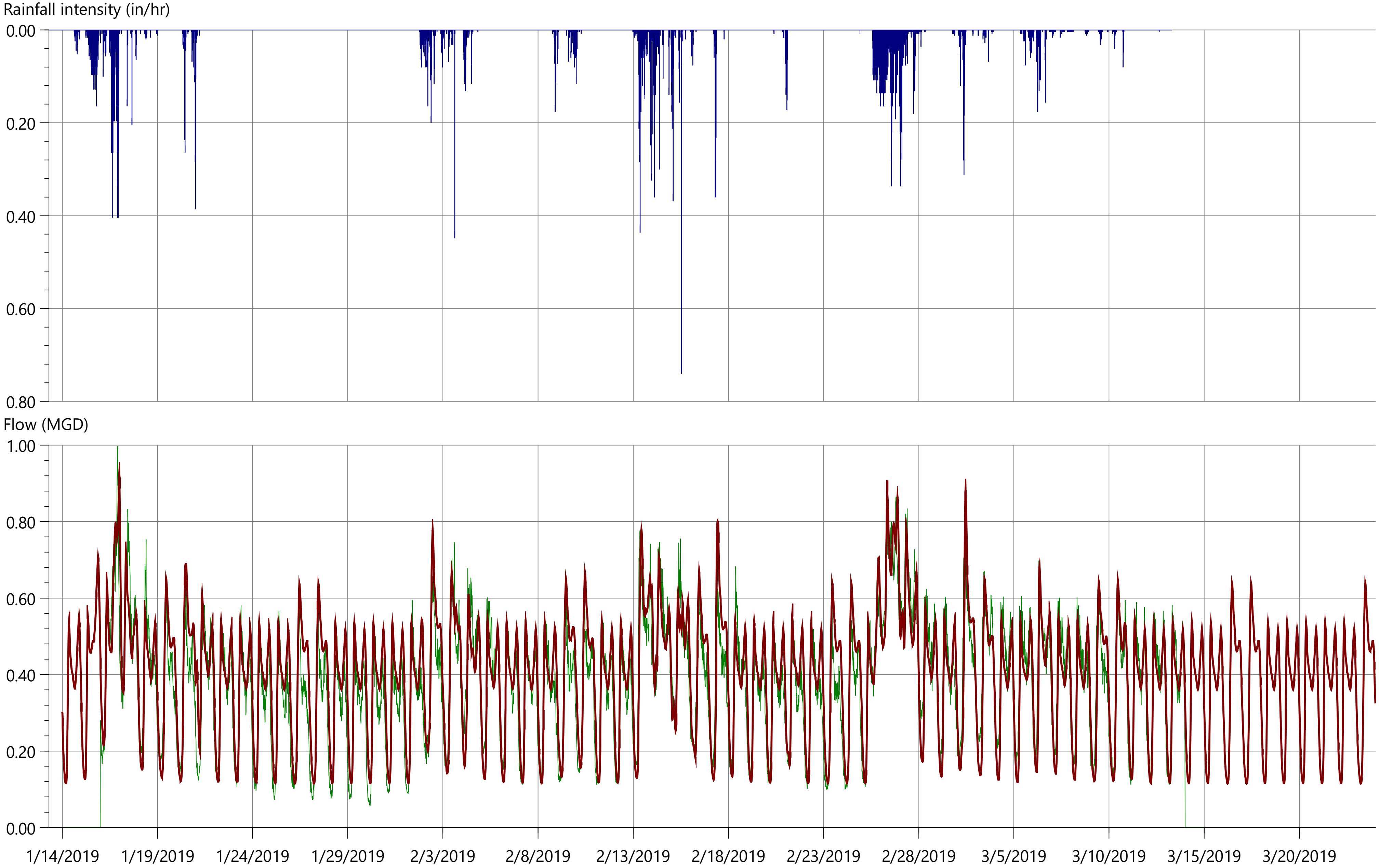
		Rainfall			Flow		
		Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	—	13.411	0.572	0.009			
Observed	—				0.000	0.685	1076804.266
...ta20190113_20190313	—				0.094	0.501	1458697.862

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:39:30 AM) Page 3 of 12
Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)
Flow Survey Location (Obs.) Site 153, Model Location (Pred.) D/S L03-014.1, Rainfall Profile: 411



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	13.898	0.528	0.010			
Observed				0.000	1.199	1862998.190
...ta20190113_20190313				0.105	1.214	2386062.923

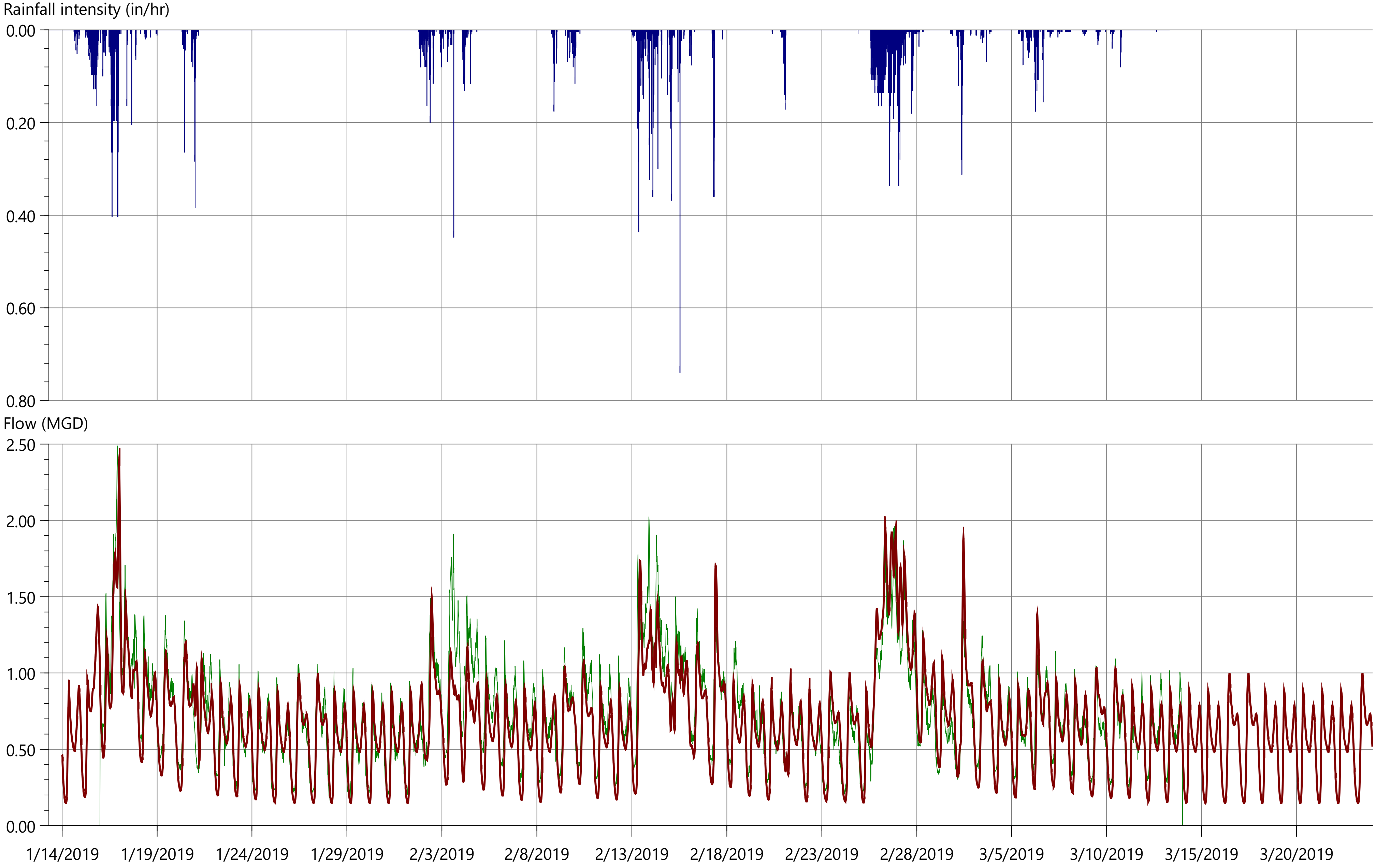
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:39:30 AM) Page 4 of 12
Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)
Flow Survey Location (Obs.) Site 154, Model Location (Pred.) D/S M06-004.1, Rainfall Profile: 446



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	14.389	0.740	0.010			
Observed				0.000	0.996	1886813.424
...ta20190113_20190313				0.115	0.927	2363415.830

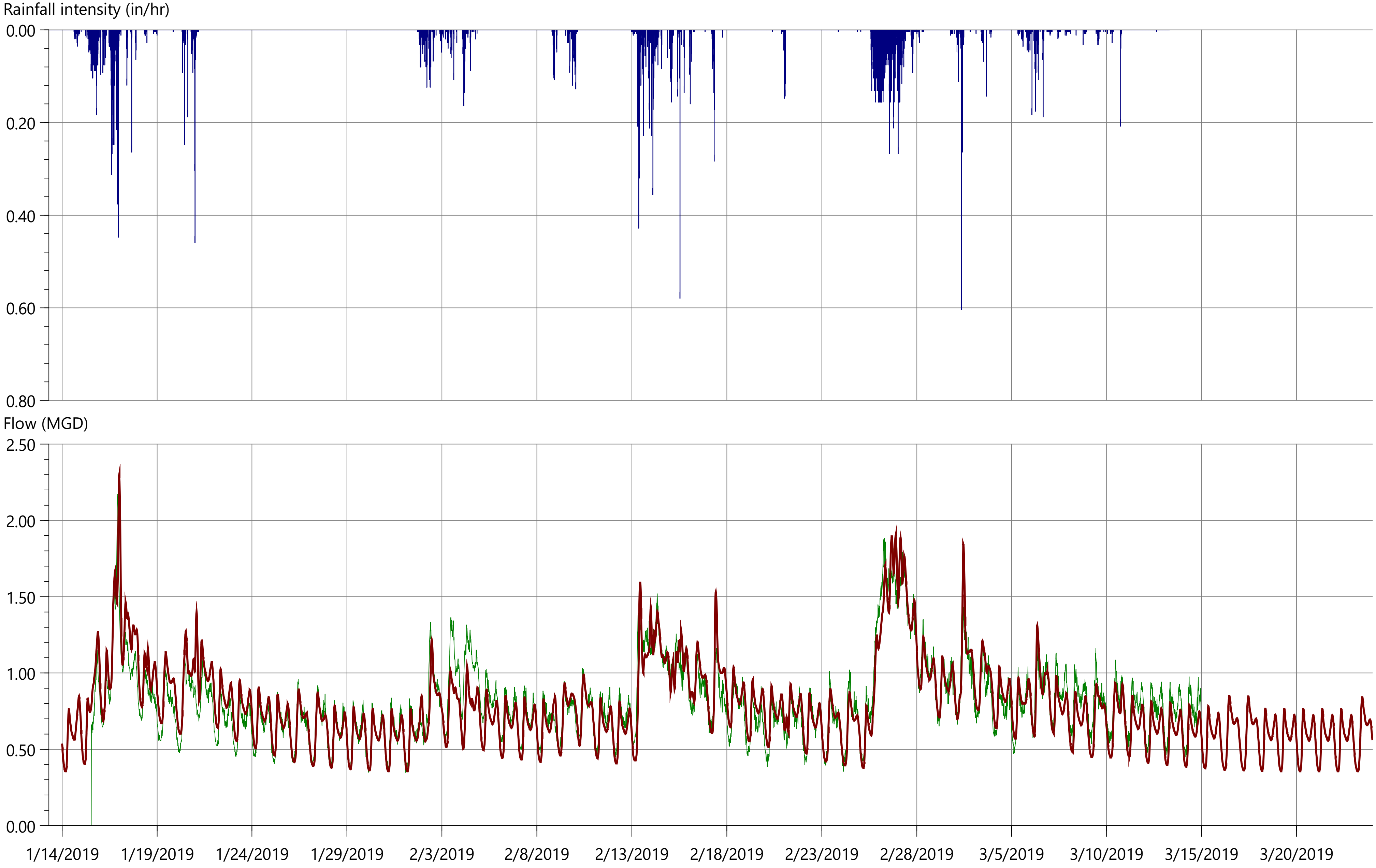
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:39:30 AM) Page 5 of 12
Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)

Flow Survey Location (Obs.) Site 155, Model Location (Pred.) D/S M06-019.1, Rainfall Profile: 446



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	14.389	0.740	0.010			
Observed				0.000	2.488	3621783.843
...ta20190113_20190313				0.148	2.402	3981049.716

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:39:30 AM) Page 6 of 12
Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)
Flow Survey Location (Obs.) Site 156, Model Location (Pred.) D/S J07-058.1, Rainfall Profile: 382

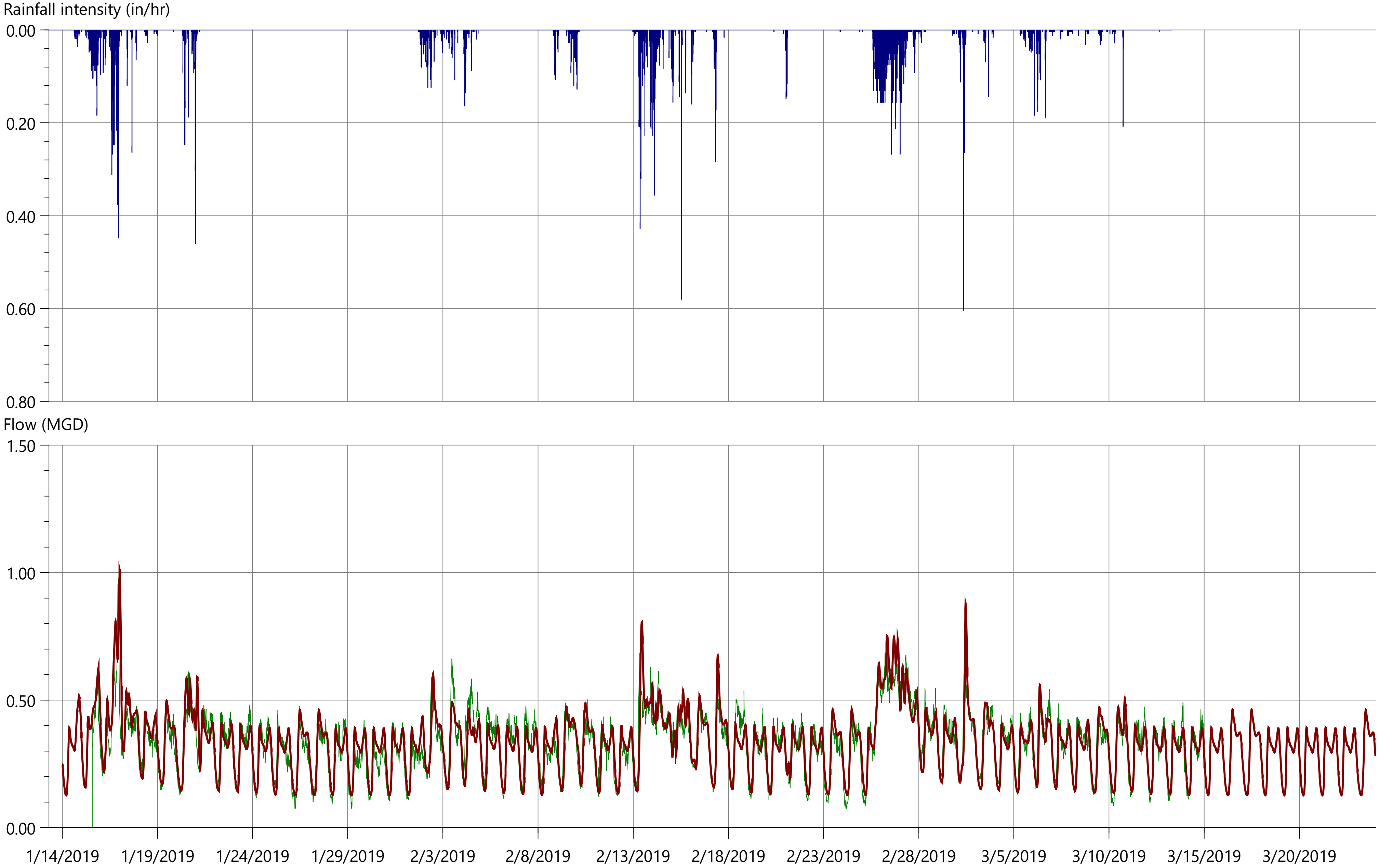


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	13.556	0.604	0.010			
Observed				0.000	2.172	4141187.489
...ta20190113_20190313				0.354	2.300	4657328.067

Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)

Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)

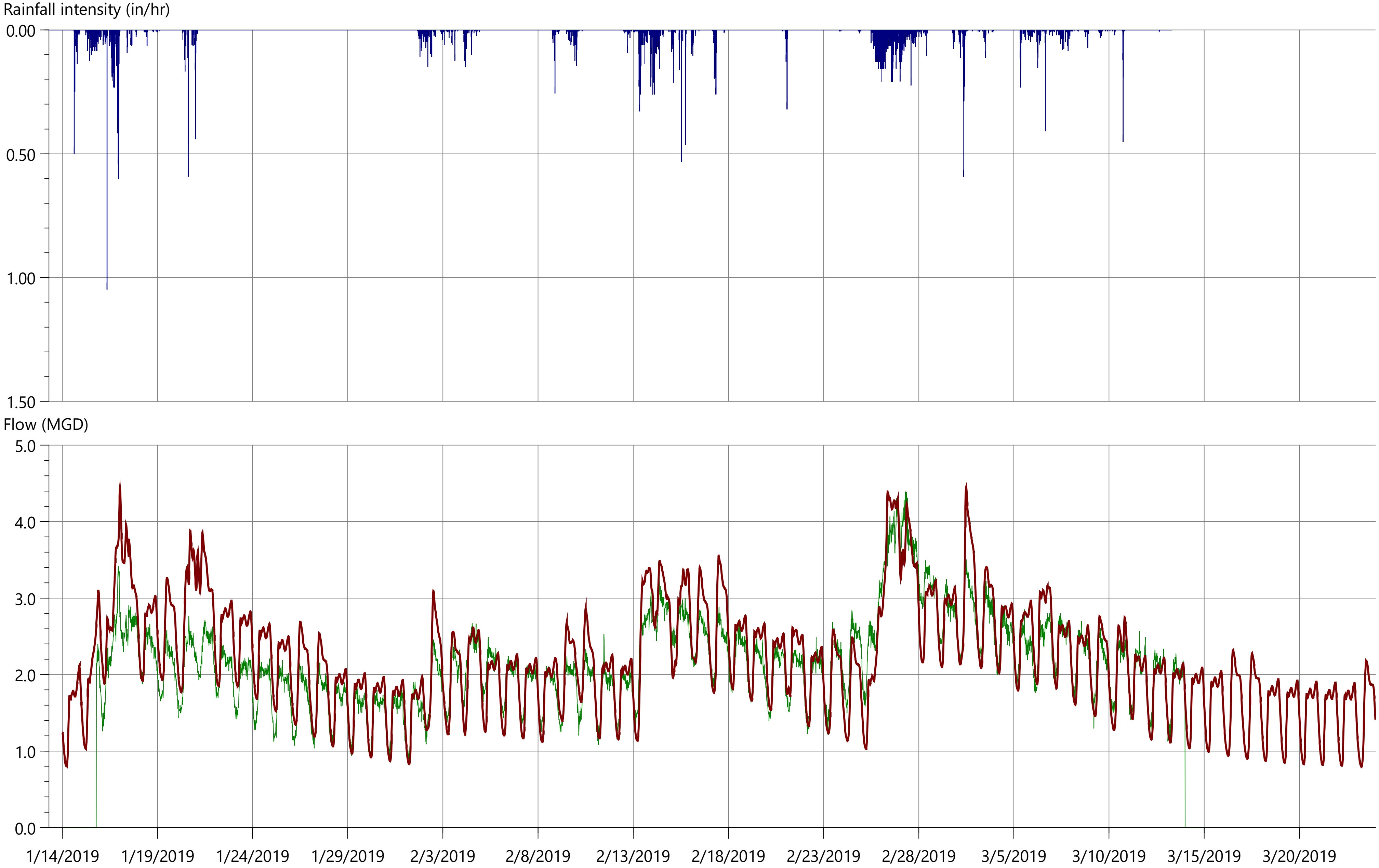
Flow Survey Location (Obs.) Site 157, Model Location (Pred.) D/S J07-060.1, Rainfall Profile: 382



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	13.556	0.604	0.010			
Observed				0.000	0.976	1682585.005
...ta20190113_20190313				0.127	1.012	1976167.131

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:39:30 AM) Page 8 of 12
Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)

Flow Survey Location (Obs.) Site 158, Model Location (Pred.) D/S I10-037.1, Rainfall Profile: 352

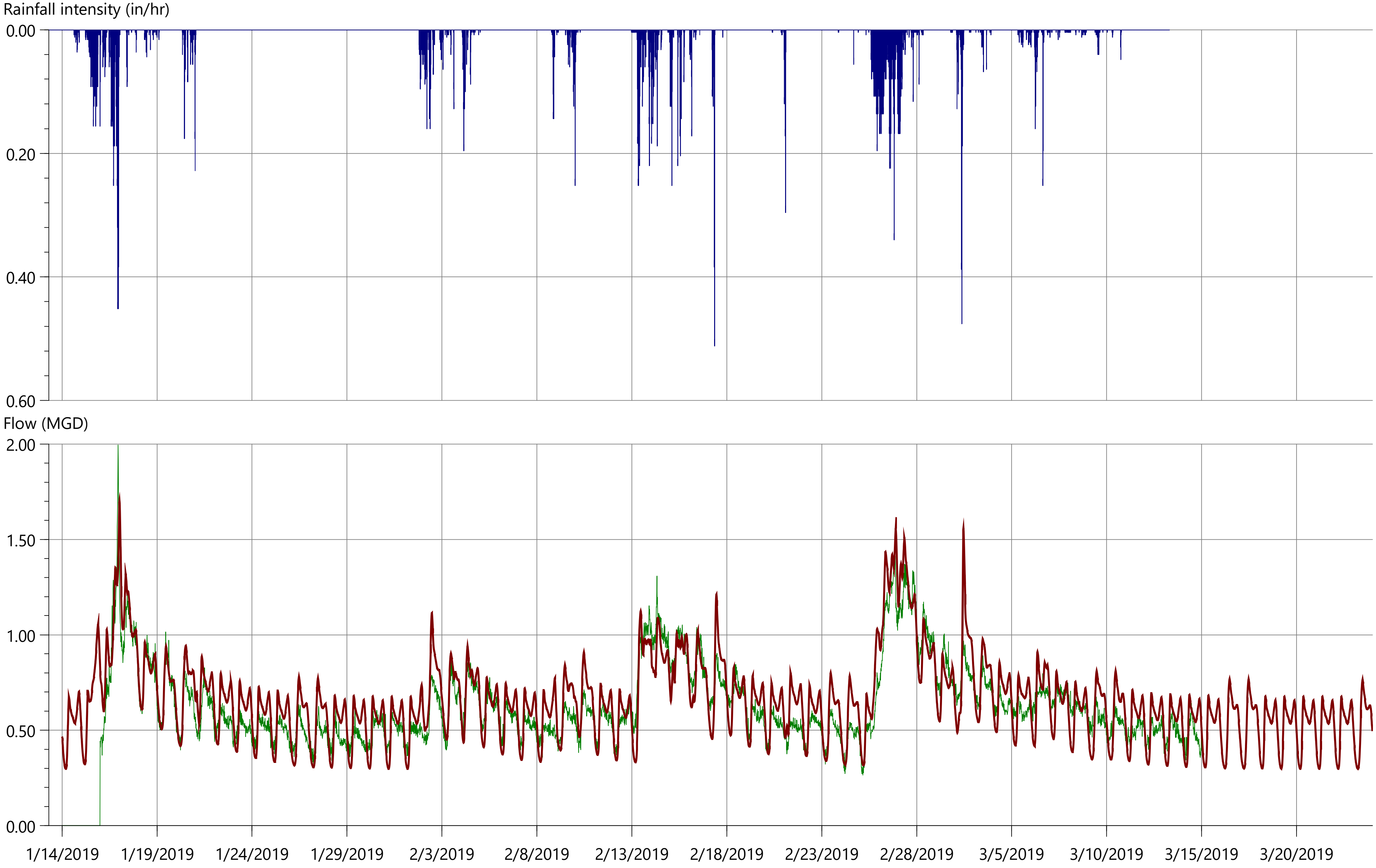


	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	14.813	1.048	0.010			
Observed				0.000	4.389	10714291.384
...ta20190113_20190313				0.794	4.452	13146876.273

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:39:30 AM) Page 9 of 12
Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)
Flow Survey Location (Obs.) Site 159, Model Location (Pred.) D/S C9-02.1, Rainfall Profile: 186

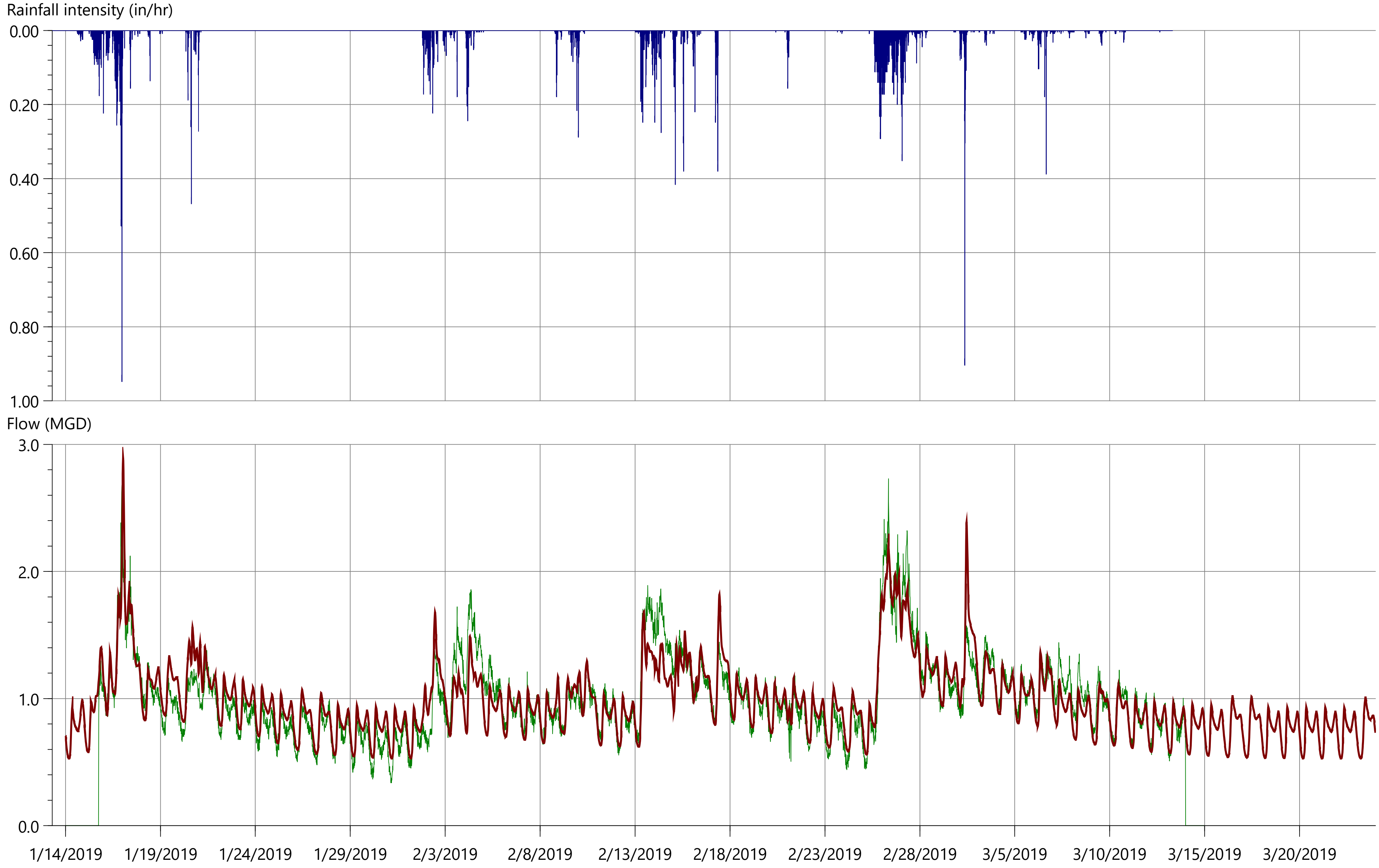
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	13.176	0.512	0.009			
Observed				0.000	4.702	11317470.919
...ta20190113_20190313				1.335	4.375	13934551.632

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:39:30 AM) Page 10 of 12
Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)
Flow Survey Location (Obs.) Site 160, Model Location (Pred.) D/S SMH B08-031.1, Rainfall Profile: 186



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	13.176	0.512	0.009			
Observed				0.000	1.996	3174137.958
...ta20190113_20190313				0.297	1.702	3927509.288

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:39:30 AM) Page 11 of 12
Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)
Flow Survey Location (Obs.) Site 161, Model Location (Pred.) D/S B12-02.1, Rainfall Profile: 156



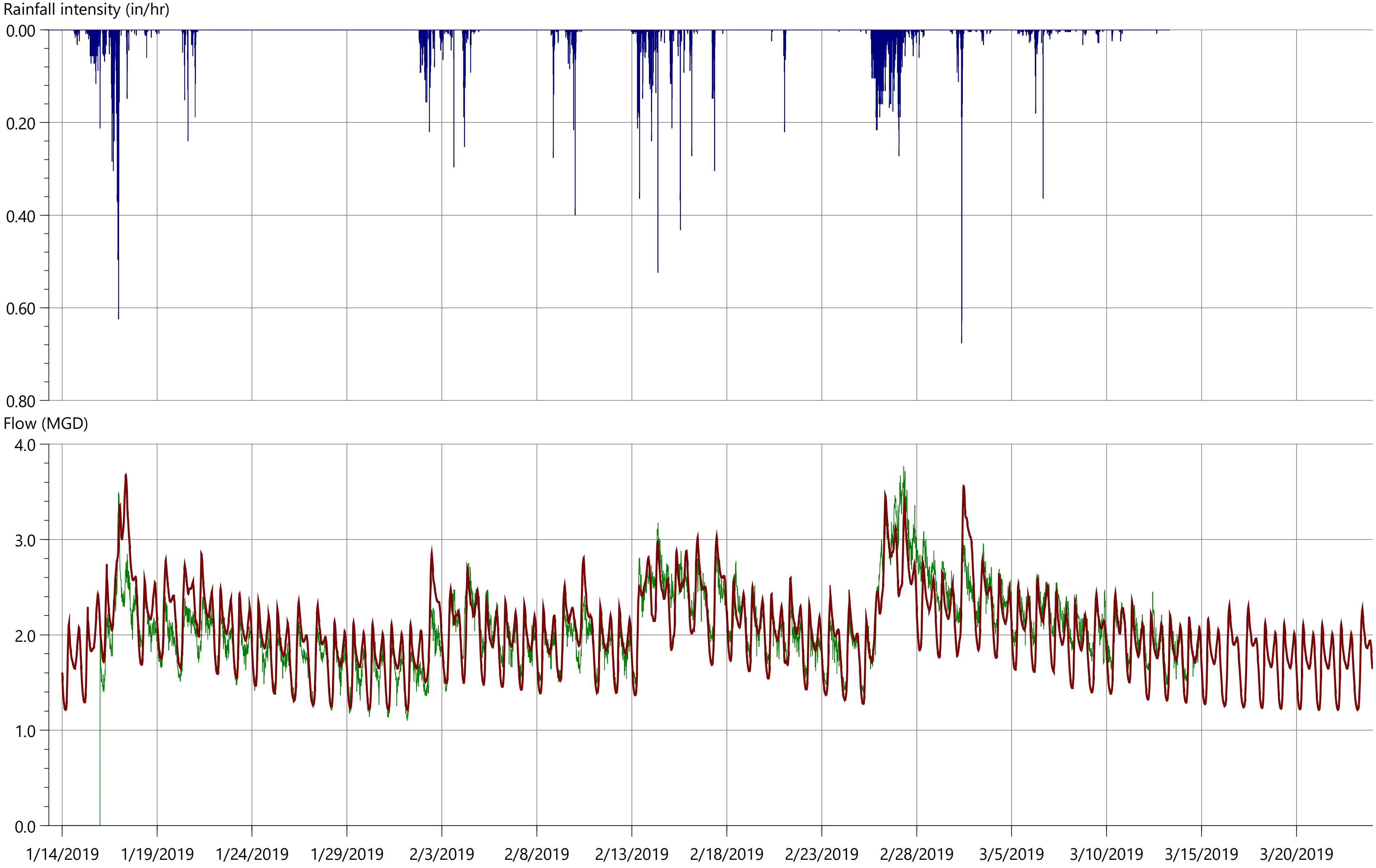
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	13.733	0.948	0.010			
Observed				0.000	2.731	4995129.055
...ta20190113_20190313				0.528	2.894	5828937.326

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:39:30 AM) Page 12 of 12

Flow survey: >SPWA>3. Data>Flow Data>Temp Flow Meter Data Jan01-Mar31 (April 16 2019) (2/11/2019 8:55:41 AM)

Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)>OneRainData20190113_20190313 (11/6/2019 11:14:10 AM)

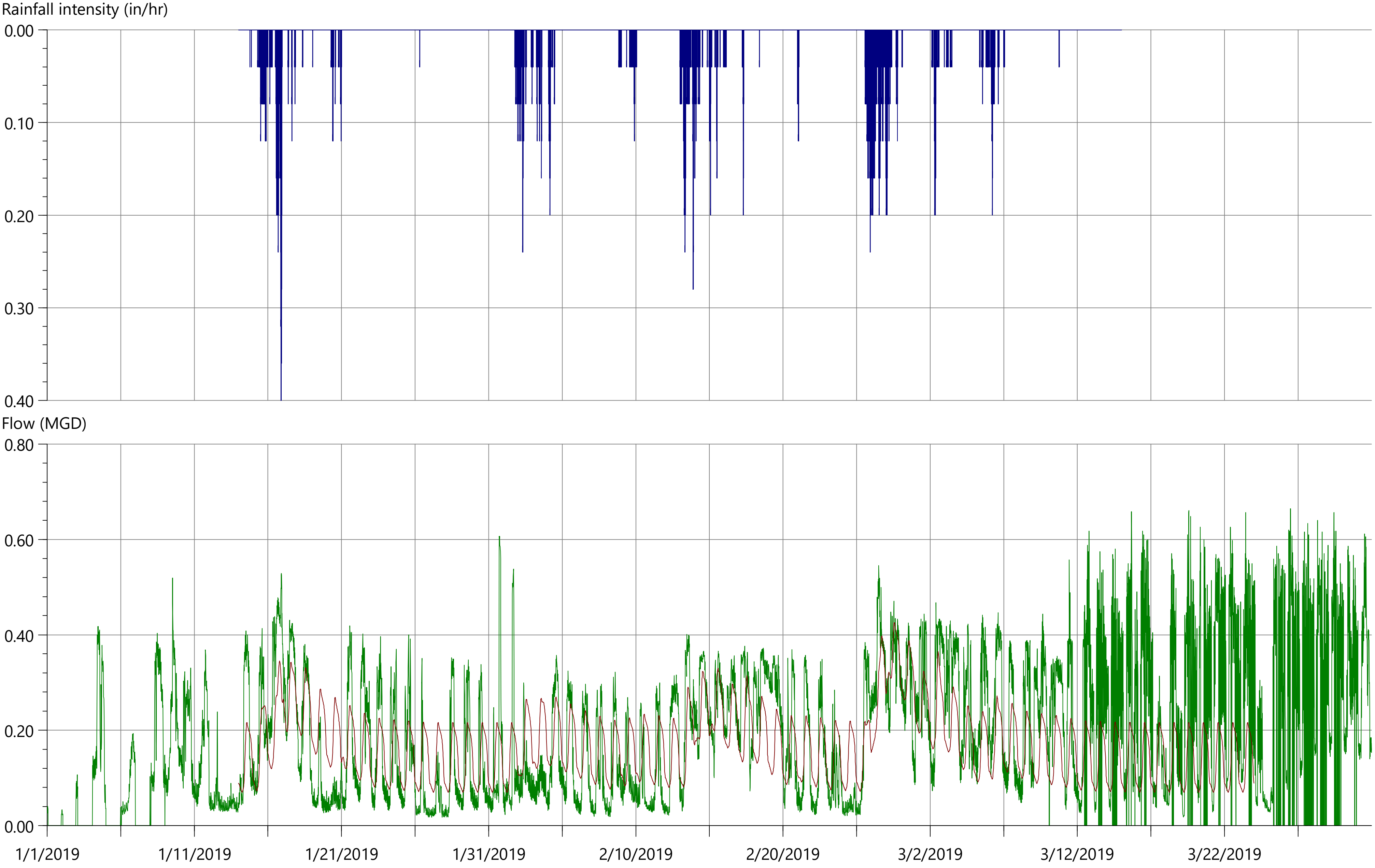
Flow Survey Location (Obs.) Site 162, Model Location (Pred.) D/S D14-03.1, Rainfall Profile: 191



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	12.949	0.676	0.009			
Observed				0.000	3.767	10312984.650
...ta20190113_20190313				1.214	3.671	12012636.316

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:28 AM) Page 1 of 7
Flow survey: >SPWA>3. Data>Flow Data>Permanent Flow Meter Data Jan01-Mar31 (June 05 2019) (6/5/2019 1:51:15 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)_v29>OneRainData20190113_20190313_*4_RGBoundaries (11/6/2019 11:14:10 AM)

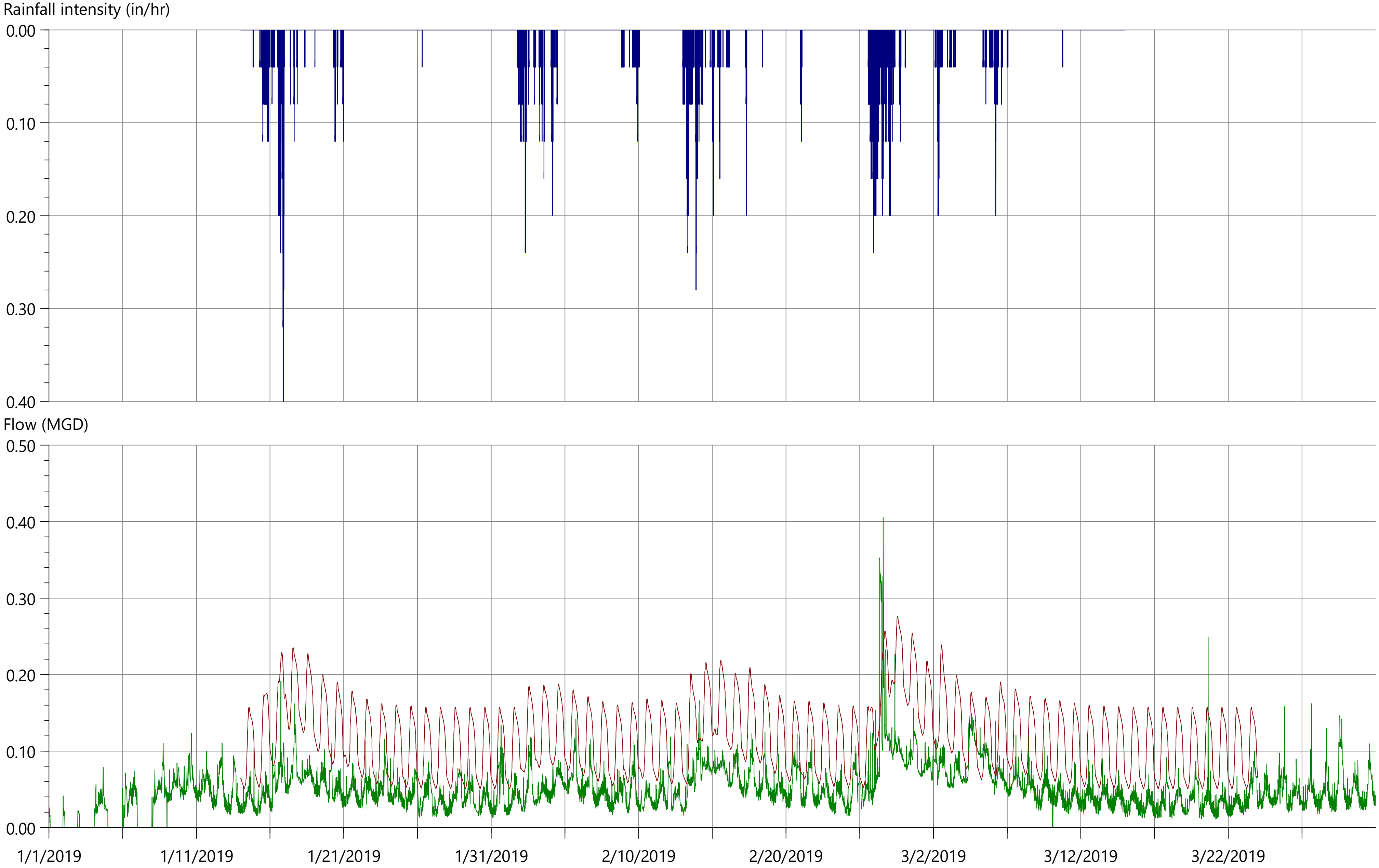
Flow Survey Location (Obs.) Cincinnati, Model Location (Pred.) D/S CA4-RSVL28.1, Rainfall Profile: 408



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	15.530	0.400	0.011			
Observed				0.000	0.665	1464913.927
...0313_*4_RGBoundaries				0.069	0.425	1025101.467

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:28 AM) Page 2 of 7
Flow survey: >SPWA>3. Data>Flow Data>Permanent Flow Meter Data Jan01-Mar31 (June 05 2019) (6/5/2019 1:51:15 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)_v29>OneRainData20190113_20190313_*4_RGBoundaries (11/6/2019 11:14:10 AM)

Flow Survey Location (Obs.) Industrial, Model Location (Pred.) D/S SMH G03-062.1, Rainfall Profile: 442



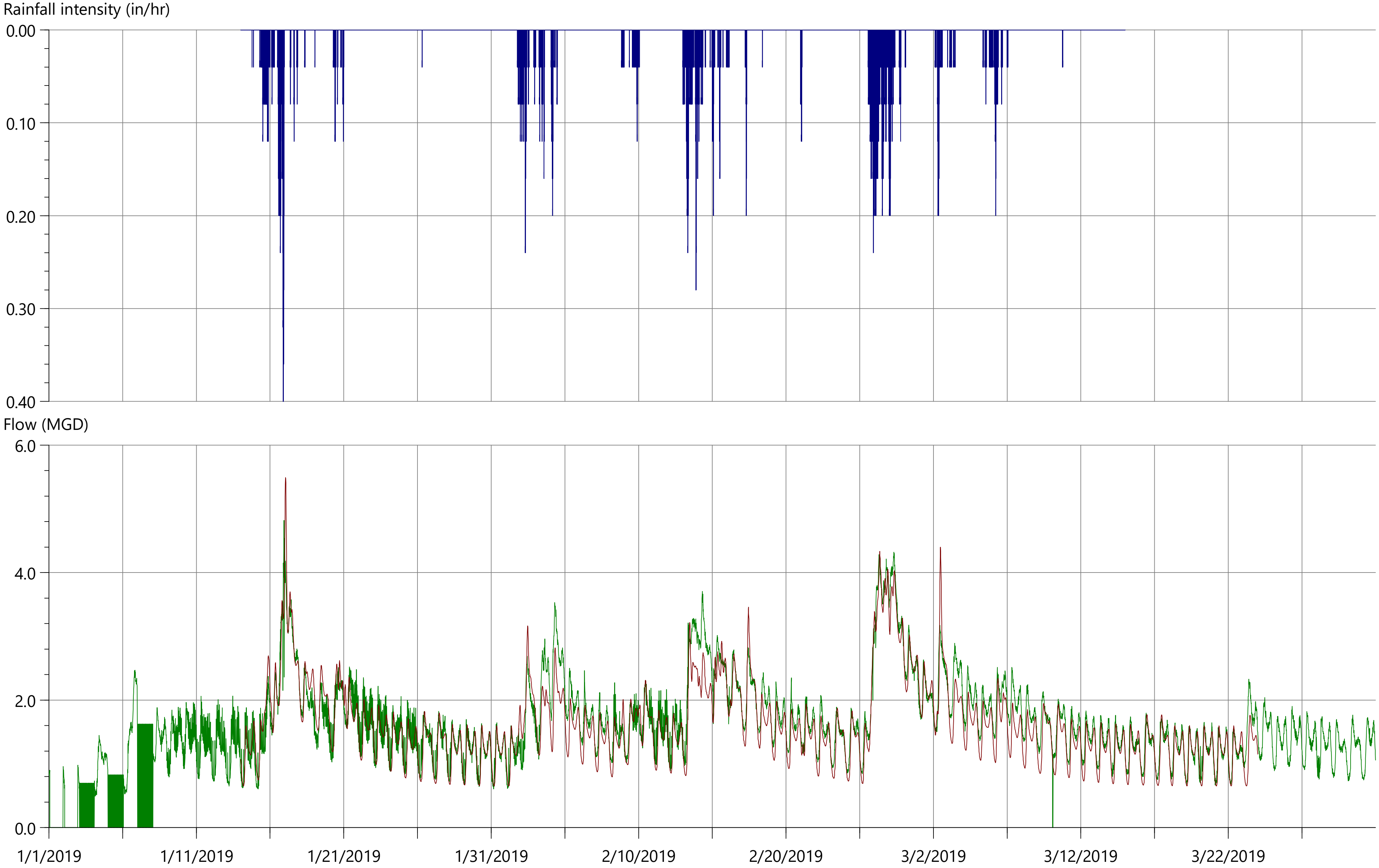
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	15.530	0.400	0.011			
Observed				0.000	0.405	388057.020
...0313_*4_RGBoundaries				0.051	0.276	712709.520

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:28 AM) Page 3 of 7

Flow survey: >SPWA>3. Data>Flow Data>Permanent Flow Meter Data Jan01-Mar31 (June 05 2019) (6/5/2019 1:51:15 PM)

Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)_v29>OneRainData20190113_20190313_*4_RGBoundaries (11/6/2019 11:14:10 AM)

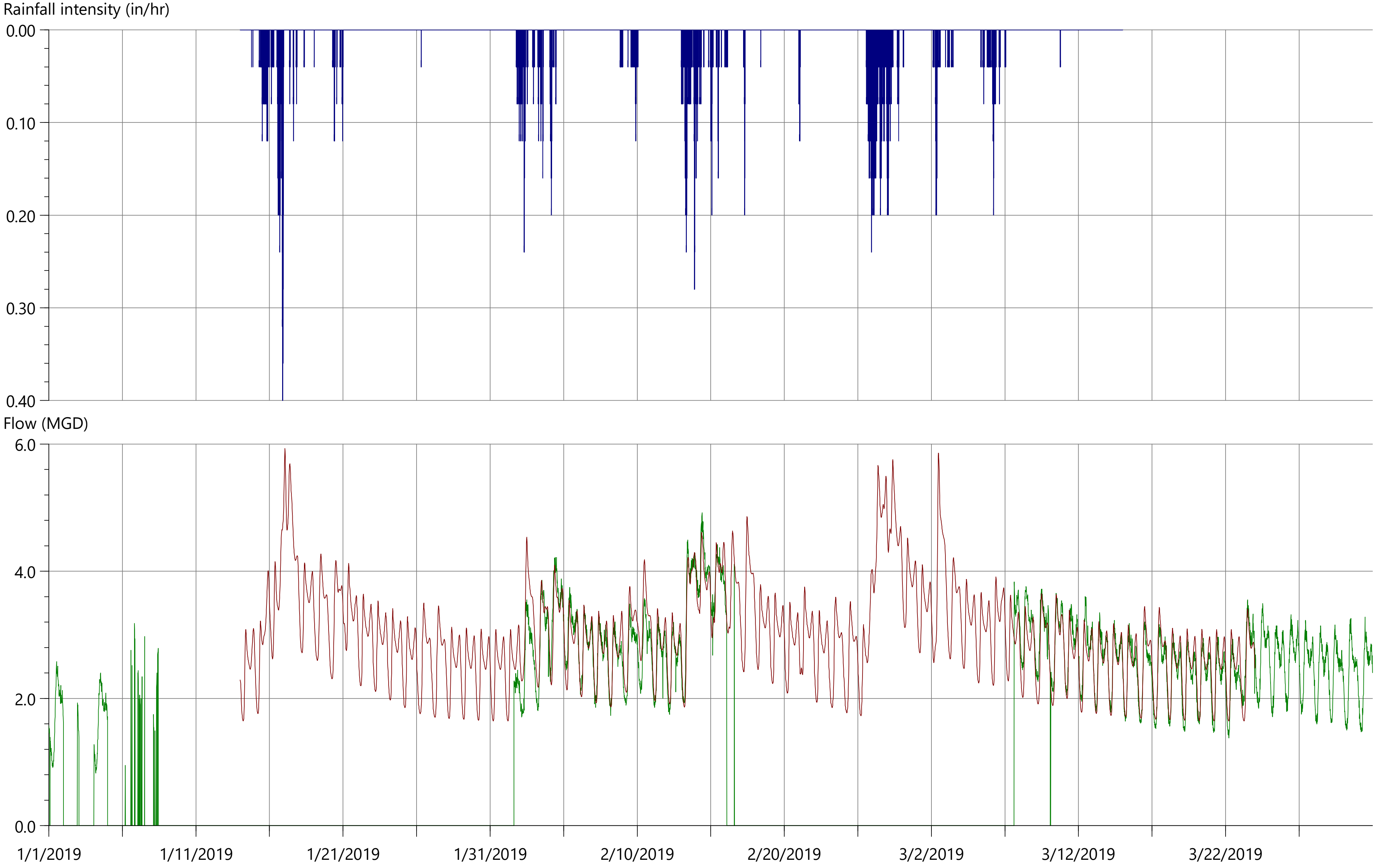
Flow Survey Location (Obs.) SMD2, Model Location (Pred.) D/S A10-03.1, Rainfall Profile: 121



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	15.530	0.400	0.011			
Observed				0.000	4.823	12344642.590
...0313_*4_RGBoundaries				0.651	5.493	9792069.402

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:28 AM) Page 4 of 7
Flow survey: >SPWA>3. Data>Flow Data>Permanent Flow Meter Data Jan01-Mar31 (June 05 2019) (6/5/2019 1:51:15 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)_v29>OneRainData20190113_20190313_*4_RGBoundaries (11/6/2019 11:14:10 AM)

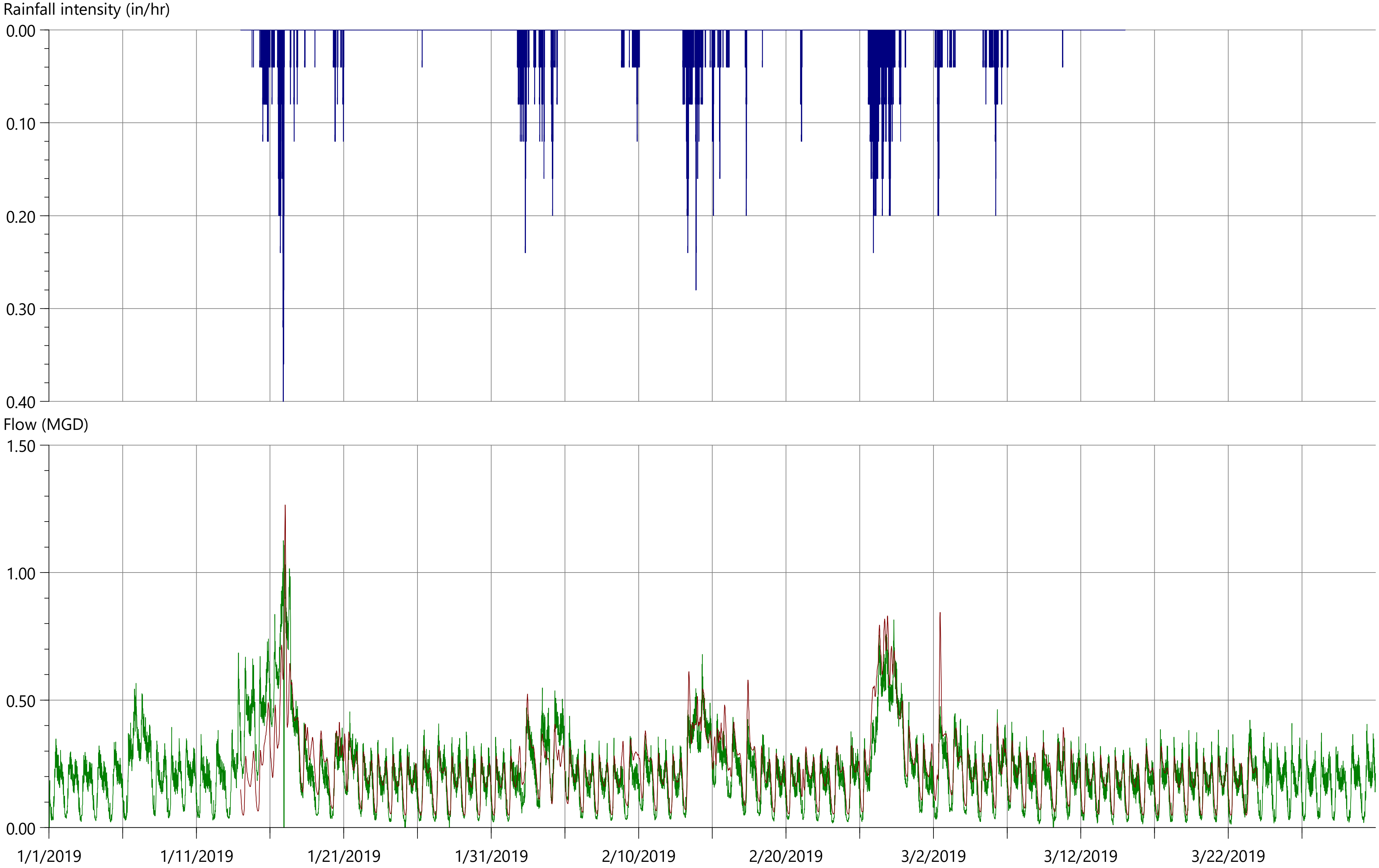
Flow Survey Location (Obs.) Sierra College, Model Location (Pred.) D/S SMH B08-040.1, Rainfall Profile: 186



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	15.530	0.400	0.011			
Observed				0.000	4.921	9530740.132
...0313_*4_RGBoundaries				1.644	5.931	18004207.945

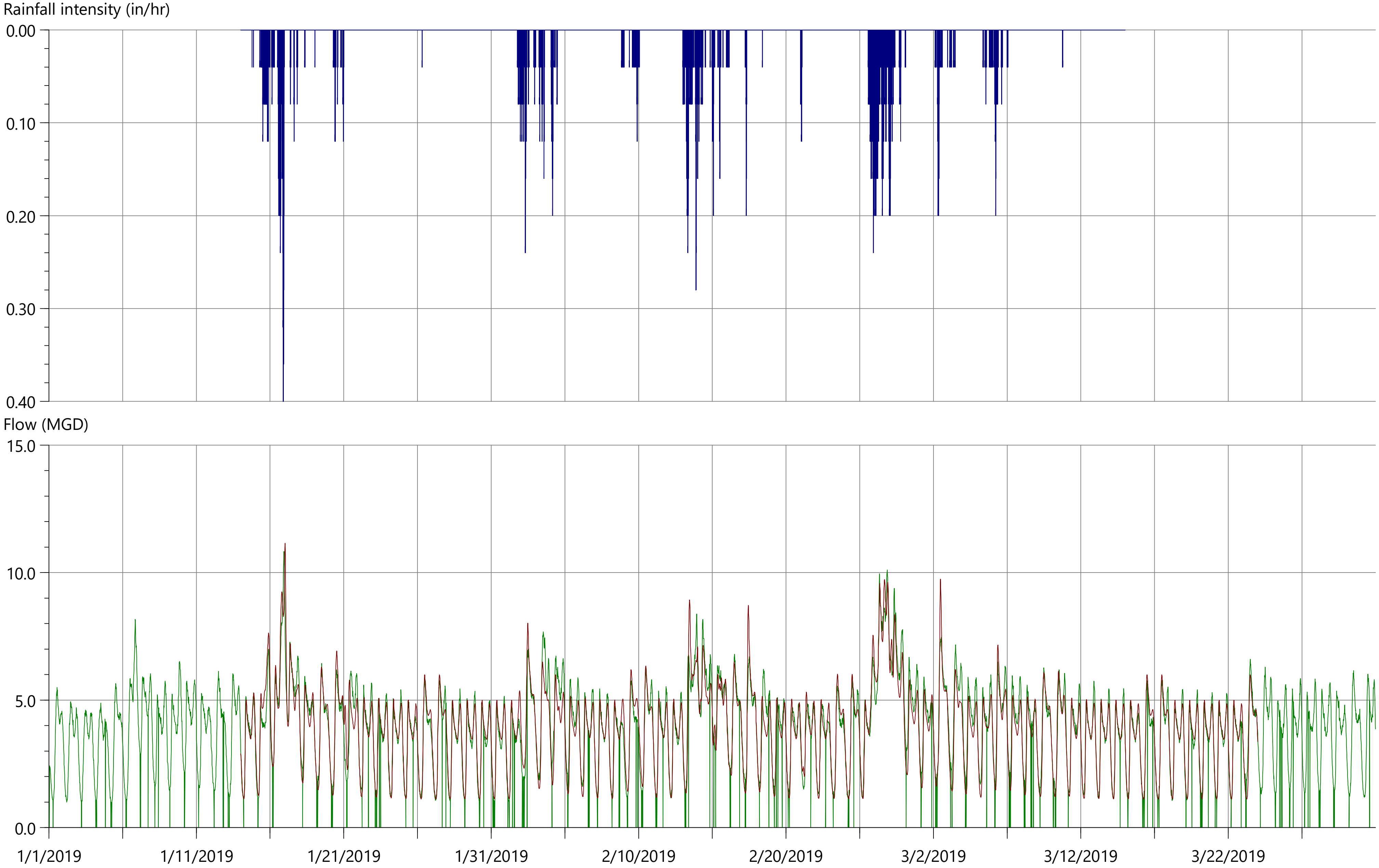
Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:28 AM) Page 5 of 7
Flow survey: >SPWA>3. Data>Flow Data>Permanent Flow Meter Data Jan01-Mar31 (June 05 2019) (6/5/2019 1:51:15 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)_v29>OneRainData20190113_20190313_*4_RGBoundaries (11/6/2019 11:14:10 AM)

Flow Survey Location (Obs.) Highlands, Model Location (Pred.) D/S SMH D08-006.1, Rainfall Profile: 285



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain —	15.530	0.400	0.011			
Observed —				0.000	1.126	1614243.848
...0313_*4_RGBoundaries —				0.048	1.266	1387804.155

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:28 AM) Page 6 of 7
Flow survey: >SPWA>3. Data>Flow Data>Permanent Flow Meter Data Jan01-Mar31 (June 05 2019) (6/5/2019 1:51:15 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)_v29>OneRainData20190113_20190313_*4_RGBoundaries (11/6/2019 11:14:10 AM)
Flow Survey Location (Obs.) Pleasant Grove (SPMUD), Model Location (Pred.) D/S RSVL-001.1, Rainfall Profile: 410



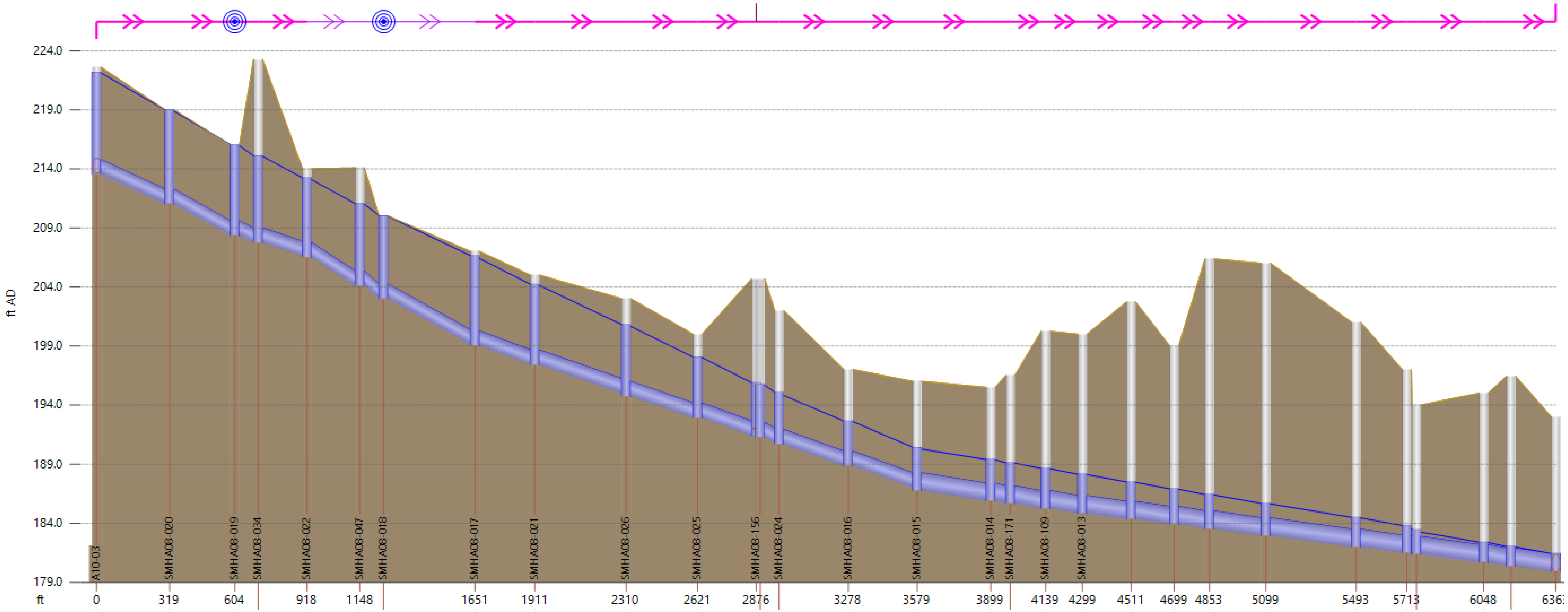
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	15.530	0.400	0.011			
Observed				0.000	10.836	30336214.148
...0313_*4_RGBoundaries				1.119	11.157	23452688.731

Observed / Predicted Report Produced by cvanlienden (11/7/2019 11:35:28 AM) Page 7 of 7
Flow survey: >SPWA>3. Data>Flow Data>Permanent Flow Meter Data Jan01-Mar31 (June 05 2019) (6/5/2019 1:51:15 PM)
Sim: >SPWA>5. Model Runs>Calibration>combined WWF Calibration (2019 10 01)_v29>OneRainData20190113_20190313_*4_RGBoundaries (11/6/2019 11:14:10 AM)
Flow Survey Location (Obs.) Dry Creek, Model Location (Pred.) D/S H07-168.1, Rainfall Profile: 315

	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft3/s)	Max (ft3/s)	Volume (ft3)
Rain	15.530	0.400	0.011			
Observed				0.000	15.348	42982669.853
...0313_*4_RGBoundaries				1.944	16.123	35431318.112

APPENDIX E – MODELED HYDRAULIC PROFILES

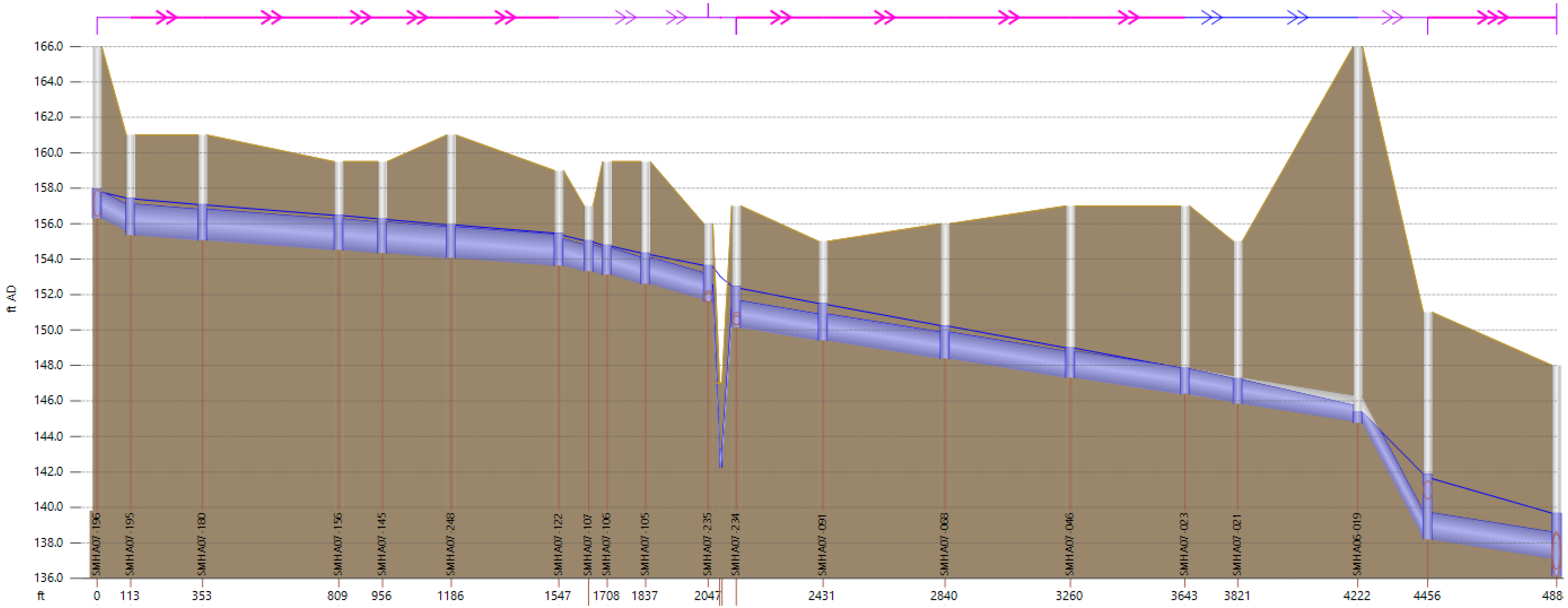
EXISTING LAND USE – AREA A



Link	A10-03.1	-	-	-	-	-	SMH A08-018.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
length (ft)	319.0	284.5	-	212.9	230.3	-	398.9	260.9	398.2	311.2	255.4	-	302.2	300.1	320.7	-	155.0	160.0	212.0	188.0	154.0	246.0	393.4	220.7	292.1	-	195.0
width (in)	15.0	15.0	-	15.0	15.0	-	15.0	15.0	15.0	15.0	15.0	-	15.0	15.0	18.0	-	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
us inv (ft AD)	213.530	211.020	-	207.750	206.510	-	203.000	199.010	197.410	194.750	192.920	-	190.690	188.850	186.770	-	-	-	184.840	-	-	183.550	182.960	182.000	181.380	-	-
ds inv (ft AD)	211.020	208.340	-	206.610	204.089	-	199.110	197.420	194.990	192.920	191.390	-	188.850	187.020	185.900	-	-	-	184.350	-	-	182.960	182.000	181.490	180.690	-	-
grad (%)	0.787	0.942	-	0.535	1.051	-	0.975	0.609	0.608	0.588	0.599	-	0.609	0.610	0.271	-	0.265	0.262	0.231	0.229	0.240	0.240	0.244	0.231	0.236	-	0.251
surc	2.00	2.00	-	2.00	1.00	-	1.00	2.00	2.00	2.00	2.00	-	2.00	2.00	2.00	-	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
r.pfc (MGD)	3.70	4.05	-	3.06	4.28	-	4.12	3.26	3.26	3.20	3.23	-	3.26	3.26	3.54	-	3.49	3.48	3.26	3.25	3.33	3.33	3.35	3.26	3.30	3.40	3.40
DS flow (MGD)	4.1241	4.1241	-	3.8486	3.8339	-	3.8972	3.8833	3.8673	3.8545	3.8438	-	3.5282	3.5230	3.5705	-	-	-	3.6413	3.6412	-	3.6412	3.6412	3.6412	3.6412	-	3.6411

Node	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ground (ft AD)	-	219.000	-	-	-	-	210.000	207.000	205.000	203.000	200.000	-	-	197.000	196.000	-	-	-	-	-	-	-	206.000	201.000	-	-	-	-	-
level (ft AD)	-	218.975	-	-	-	-	210.000	206.621	204.217	200.795	198.059	-	-	192.641	190.421	-	-	-	-	-	-	-	185.682	184.500	-	-	-	-	-
flood dep (ft)	-	-0.025	-	-	-0.770	-	0.000	-0.379	-0.783	-2.205	-1.941	-	-	-4.359	-5.579	-	-	-	-	-	-	-	-20.318	-16.500	-	-	-	-	-

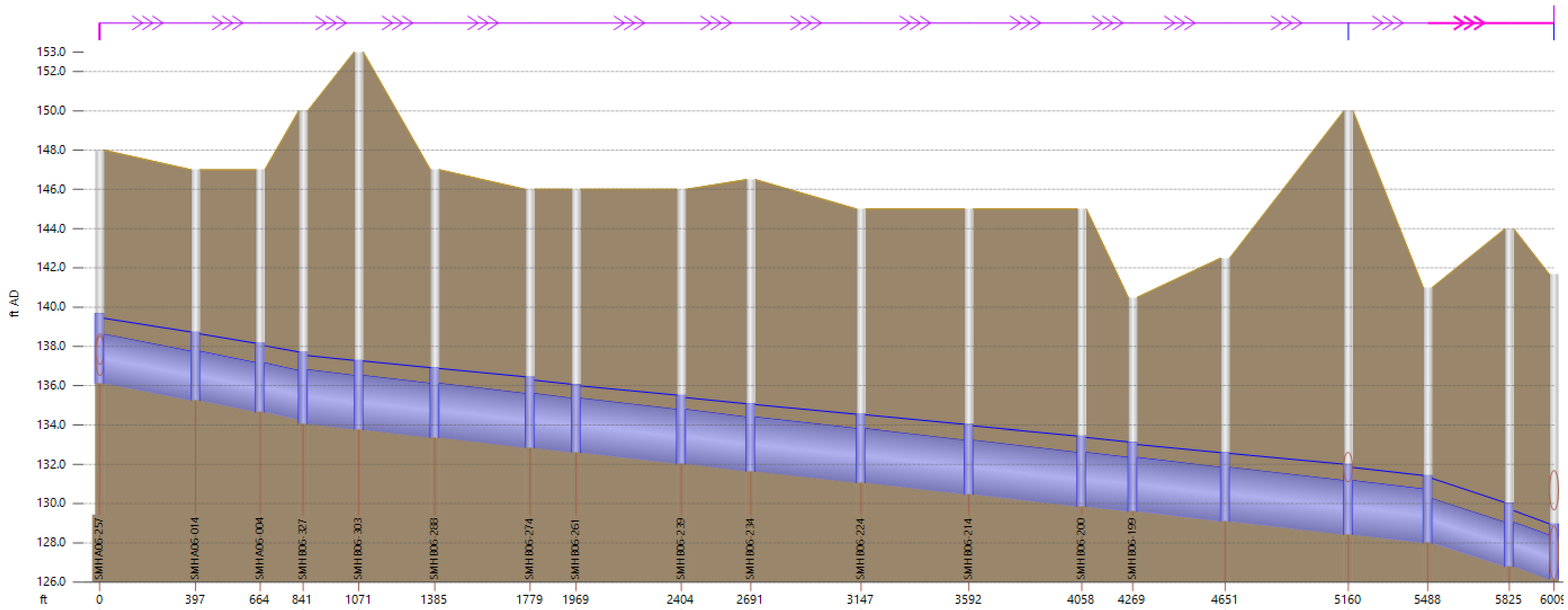
EXISTING LAND USE – AREA B



Link	-	-	SMH A07-180.1	-	-	SMH A07-248.1	-	-	-	-	-	-	SMH A07-091.1	SMH A07-068.1	SMH A07-046.1	-	SMH A07-021.1	-	SMH B06-329.1
length (ft)	112.5	240.7	456.0	146.8	230.3	360.3	99.4	-	128.8	209.5	-	290.6	408.7	419.5	383.8	177.3	401.8	233.8	431.9
width (in)	18.0	21.0	21.0	21.0	21.0	21.0	18.0	-	18.0	18.0	-	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
us inv (ft AD)	-	155.350	155.060	-	154.340	154.060	-	-	-	152.590	-	150.140	149.400	148.380	147.300	146.380	145.830	144.740	138.190
ds inv (ft AD)	-	155.060	154.510	-	154.060	153.630	-	-	-	151.720	-	149.400	148.380	147.300	146.380	145.930	144.840	138.290	137.110
grad (%)	0.622	0.120	0.121	0.116	0.122	0.119	-	-	0.411	0.415	-	0.255	0.250	0.257	0.240	0.254	0.246	2.759	0.250
surc	1.00	2.00	2.00	2.00	2.00	2.00	1.00	-	1.00	1.00	-	2.00	2.00	2.00	2.00	0.95	0.90	1.00	2.00
r.pfc (MGD)	5.36	3.56	3.56	3.49	3.57	3.54	3.79	-	4.36	4.38	-	3.43	3.39	3.45	3.32	3.42	3.37	11.28	3.40
DS flow (MGD)	-	3.6566	3.6456	3.6416	3.6391	3.6354	-	-	-	3.6347	-	3.6346	3.6346	3.6345	3.6345	3.6344	3.6344	3.6338	4.8577

Node	-	SMH A07-180	-	-	-	-	-	-	-	-	-	SMH A07-091	SMH A07-068	SMH A07-046	-	-	SMH A06-019	SMH B06-329	-
ground (ft AD)	-	161.000	159.500	-	161.000	159.000	-	-	-	-	-	155.000	156.000	157.000	157.000	155.000	166.000	151.000	148.000
level (ft AD)	-	157.080	156.471	-	155.938	155.463	-	-	-	-	-	151.496	150.245	148.993	147.847	147.253	145.359	141.881	139.668
flood dep (ft)	-3.561	-3.920	-3.029	-3.231	-5.062	-3.537	-	-	-5.161	-	-4.535	-3.504	-5.755	-8.007	-9.153	-7.747	-20.641	-9.119	-8.332

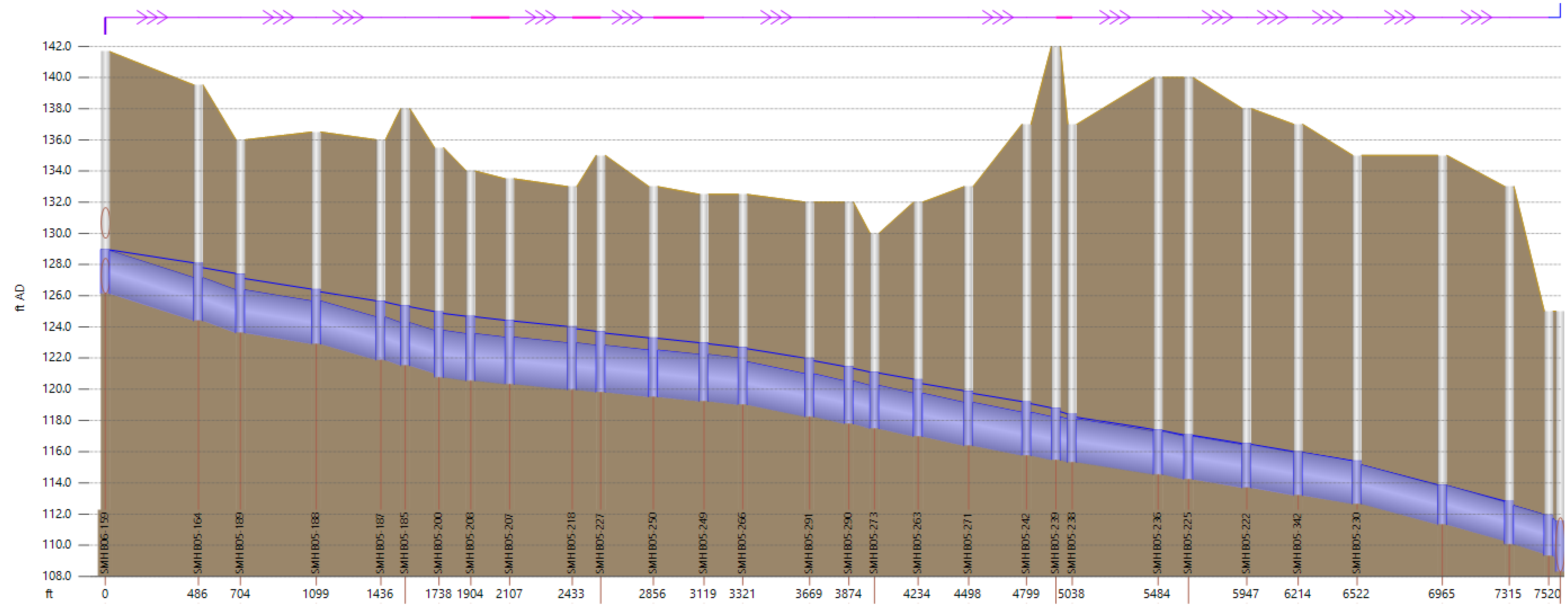
EXISTING LAND USE – AREA C



Link	SMH A06-257.1	-	-	-	-	SMH B06-288.1	-	SMH B06-261.1	-	SMH B06-234.1	SMH B06-224.1	SMH B06-214.1	-	SMH B06-199.1	SMH B06-186.1	-	-	-
length (ft)	396.7	267.4	177.3	229.3	314.6	393.4	190.1	435.0	287.1	455.6	445.4	466.4	210.4	382.2	509.2	327.5	337.3	184.4
width (in)	30.0	30.0	30.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	27.0	27.0
us inv (ft AD)	136.110	135.240	-	134.050	133.760	133.360	-	132.600	132.030	131.640	131.060	130.470	129.850	129.600	129.090	128.420	127.990	-
ds inv (ft AD)	135.240	134.660	-	133.760	133.360	132.840	-	132.030	131.640	131.060	130.470	129.850	129.600	129.090	128.420	127.990	126.792	-
grad (%)	0.219	0.217	0.220	0.126	0.127	0.132	0.126	0.131	0.136	0.127	0.132	0.133	0.119	0.133	0.132	0.131	0.355	0.358
surc	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00	2.00
r.pfc (MGD)	12.42	12.35	12.43	12.16	12.19	12.43	12.15	12.37	12.60	12.20	12.44	12.46	11.78	12.49	12.40	12.39	11.93	11.98
DS flow (MGD)	11.4670	11.4562	-	11.4373	11.5043	11.4871	-	11.4617	11.4509	11.4344	11.4189	11.4033	11.3963	11.3836	11.3678	12.1626	12.1555	-

Node	-	-	-	-	-	-	-	-	-	-	SMH B06-224	SMH B06-214	-	-	SMH B06-186	SMH B06-163	-	-	-
ground (ft AD)	-	147.000	-	-	153.000	147.000	146.000	146.000	146.000	146.500	145.000	145.000	145.000	140.500	142.500	150.000	141.000	143.984	-
level (ft AD)	-	138.722	-	-	137.284	136.911	136.434	136.062	135.504	135.073	134.537	134.024	133.439	133.133	132.597	131.997	131.432	130.022	-
flood dep (ft)	-8.332	-8.278	-8.851	-	-15.716	-10.089	-9.566	-9.938	-10.496	-11.427	-10.463	-10.976	-11.561	-7.367	-9.903	-18.003	-9.568	-13.962	-

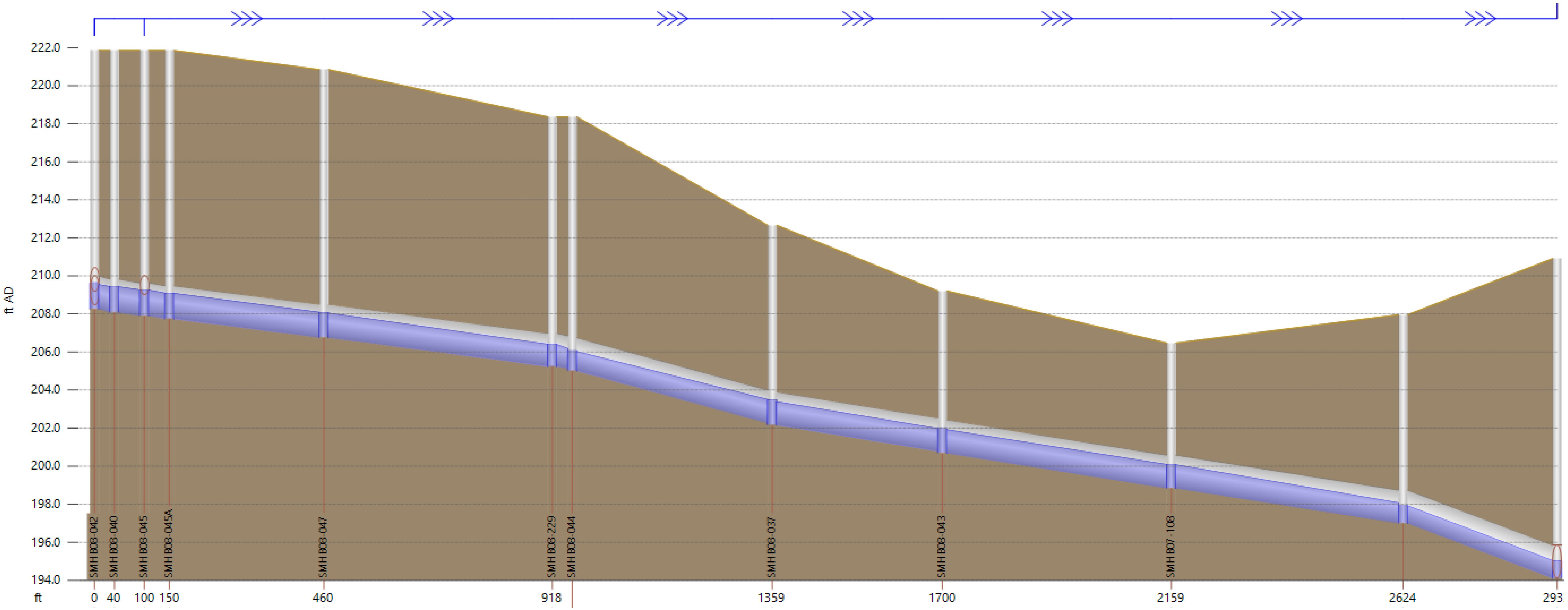
EXISTING LAND USE – AREA D



Link		SMH B06-159.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
length (ft)		485.7	218.4	394.8	337.0	-	176.0	-	202.7	326.1	-	274.6	263.3	201.7	348.2	204.6	-	227.1	263.3	301.6	-	-	446.8	-	303.8	267.3	307.6	443.8	349.1	205.1	
width (in)		33.0	33.0	33.0	33.0	-	33.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	33.0	33.0	-	33.0	33.0	33.0	33.0	-	33.0	33.0	33.0	33.0	33.0	30.0	30.0	30.0	
us inv (ft AD)		126.132	-	123.610	122.900	-	-	-	-	120.330	-	119.810	119.500	-	119.000	-	-	-	116.980	116.390	-	-	115.330	-	114.230	113.690	113.200	112.650	111.330	-	
ds inv (ft AD)		124.392	-	122.900	121.870	-	-	-	-	119.960	-	119.500	119.220	-	118.230	-	-	-	116.390	115.760	-	-	114.550	-	113.690	113.200	112.650	111.330	110.270	-	
grad (%)		0.358	0.358	0.180	0.306	-	0.284	-	0.109	0.113	-	0.113	0.106	0.109	0.221	0.225	-	0.220	0.224	0.209	-	-	0.175	-	0.178	0.183	0.179	0.297	0.304	0.302	
surc		1.00	1.00	1.00	1.00	-	1.00	1.00	2.00	1.00	2.00	1.00	2.00	1.00	1.00	1.00	-	1.00	1.00	1.00	1.00	-	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
r.pfc (MGD)		20.46	20.46	14.50	18.90	-	18.22	-	14.20	14.52	-	14.49	14.06	14.24	16.08	16.21	-	16.04	16.18	15.62	-	-	14.28	-	14.41	14.64	14.46	14.46	14.61	14.58	
DS flow (MGD)		14.6273	-	14.5897	14.5340	-	-	-	-	14.4058	-	14.3370	14.2976	-	14.2118	-	-	-	14.1618	14.1594	-	-	14.1449	-	14.1337	14.1268	14.1198	14.1189	14.1184	-	

Node	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ground (ft AD)	-	139.514	136.000	136.500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140.000	-	-	-	135.000	135.000	-	-
level (ft AD)	-	128.077	127.390	126.402	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	117.423	-	-	-	115.415	113.877	-	-
flood dep (ft)	-	-11.437	-8.610	-10.098	-	-	-	-	-9.080	-	-	-9.706	-	-9.810	-	-	-	-	-	-	-	-	-22.577	-	-21.473	-20.988	-19.585	-21.123	-	-

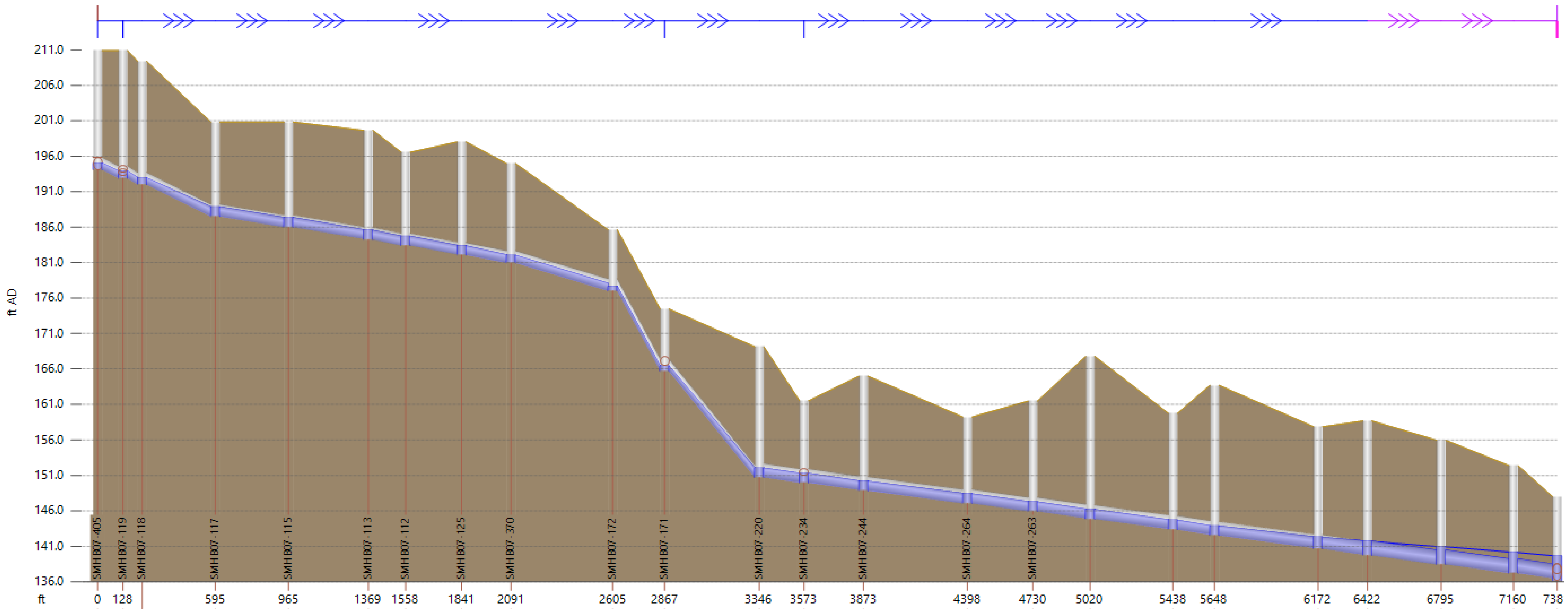
EXISTING LAND USE – AREA E



Link	-	-	-	SMH B08-045A.1	SMH B08-047.1	-	SMH B08-044.1	SMH B08-037.1	SMH B08-043.1	SMH B07-108.1	SMH B07-107.1
length (ft)	-	60.0	-	310.0	458.0	-	401.0	341.0	459.2	464.7	308.9
width (in)	-	21.0	-	21.0	21.0	-	21.0	21.0	21.0	21.0	21.0
us inv (ft AD)	-	-	-	207.732	206.750	-	205.000	202.150	200.680	198.840	197.000
ds inv (ft AD)	-	-	-	206.750	205.233	-	202.250	200.780	198.840	197.000	194.107
grad (%)	-	-	-	0.317	0.331	-	0.686	0.402	0.401	0.396	0.937
surc	-	0.78	-	0.76	0.73	-	0.71	0.70	0.71	0.70	0.53
r.pfc (MGD)	-	5.76	-	5.76	5.89	-	8.48	6.49	6.48	6.45	9.91
DS flow (MGD)	-	-	-	5.2707	5.2707	-	5.3000	5.3032	5.3031	5.3031	5.3031

Node	-	-	-	SMH B08-047	SMH B08-229	SMH B08-044	SMH B08-037	SMH B08-043	SMH B07-108	SMH B07-107	-
ground (ft AD)	-	-	221.854	220.847	218.361	218.361	212.662	209.204	206.463	207.955	210.904
level (ft AD)	-	-	209.080	208.068	206.386	206.059	203.479	201.956	200.078	197.921	195.031
flood dep (ft)	-	-	-12.774	-12.779	-11.975	-12.302	-9.183	-7.248	-6.385	-10.034	-15.873

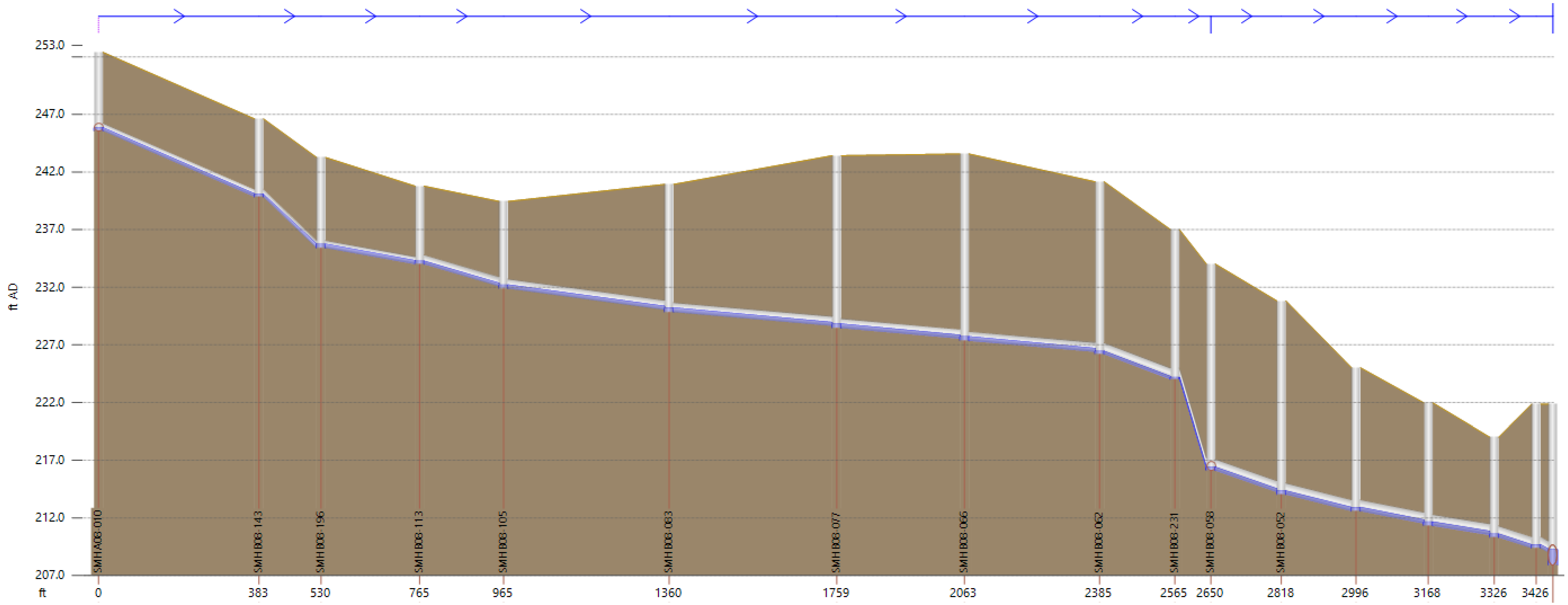
EXISTING LAND USE – AREA F



Link	-	-	-	-	-	-	-	-	SMH B07-370.1	-	SMH B07-171.1	-	-	SMH B07-244.1	-	-	-	-	SMH B07-242.1	-	-	-	-
length (ft)	-	-	370.0	370.5	403.7	189.0	282.5	249.9	514.2	262.6	479.1	226.2	300.0	525.4	331.8	289.9	418.2	210.2	523.9	249.6	373.1	365.7	220.5
width (in)	-	-	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	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)	-	-	192.000	187.500	186.000	-	183.416	182.070	180.950	177.000	165.650	-	149.975	148.860	147.080	145.950	144.870	-	142.540	140.670	139.730	138.470	-
ds inv (ft AD)	-	-	187.500	186.000	184.350	-	182.170	180.950	177.000	165.750	150.740	-	148.960	147.080	145.950	144.970	143.460	-	140.770	139.830	138.470	137.230	-
grad (%)	-	-	1.216	0.405	0.409	0.441	0.441	0.448	0.768	4.284	3.112	0.338	0.338	0.339	0.341	0.338	0.337	0.343	0.338	0.337	0.338	0.339	0.327
surc	-	-	0.78	0.77	0.76	0.74	0.73	0.72	0.61	0.38	0.76	0.66	0.65	0.70	0.68	0.65	0.66	0.65	0.79	0.98	1.00	1.00	1.00
r.pfc (MGD)	-	-	11.30	6.52	6.55	6.80	6.80	6.86	8.98	21.20	18.07	8.50	8.51	8.51	8.53	8.50	8.49	8.56	8.50	8.48	8.50	8.52	8.36
DS flow (MGD)	-	-	5.9914	5.9913	5.9913	-	6.0622	6.0622	6.0814	6.0814	6.3607	6.3607	6.5535	6.5534	6.5534	6.5534	6.5533	6.5533	6.5533	6.5529	6.5487	6.6404	6.6295

Node	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ground (ft AD)	-	-	200.819	200.813	199.641	-	-	194.963	185.616	174.439	169.113	-	164.971	159.204	161.463	167.769	159.712	163.680	157.842	158.647	155.955	152.380	-
level (ft AD)	-	-	188.866	187.346	185.605	-	-	182.039	177.667	166.399	152.061	-	150.223	148.465	147.308	146.245	144.741	143.910	142.341	141.774	140.975	140.198	-
flood dep (ft)	-	-	-11.953	-13.467	-14.036	-	-	-12.924	-7.949	-8.040	-17.052	-	-14.748	-10.739	-14.155	-21.524	-14.971	-19.770	-15.501	-16.873	-14.980	-12.182	-

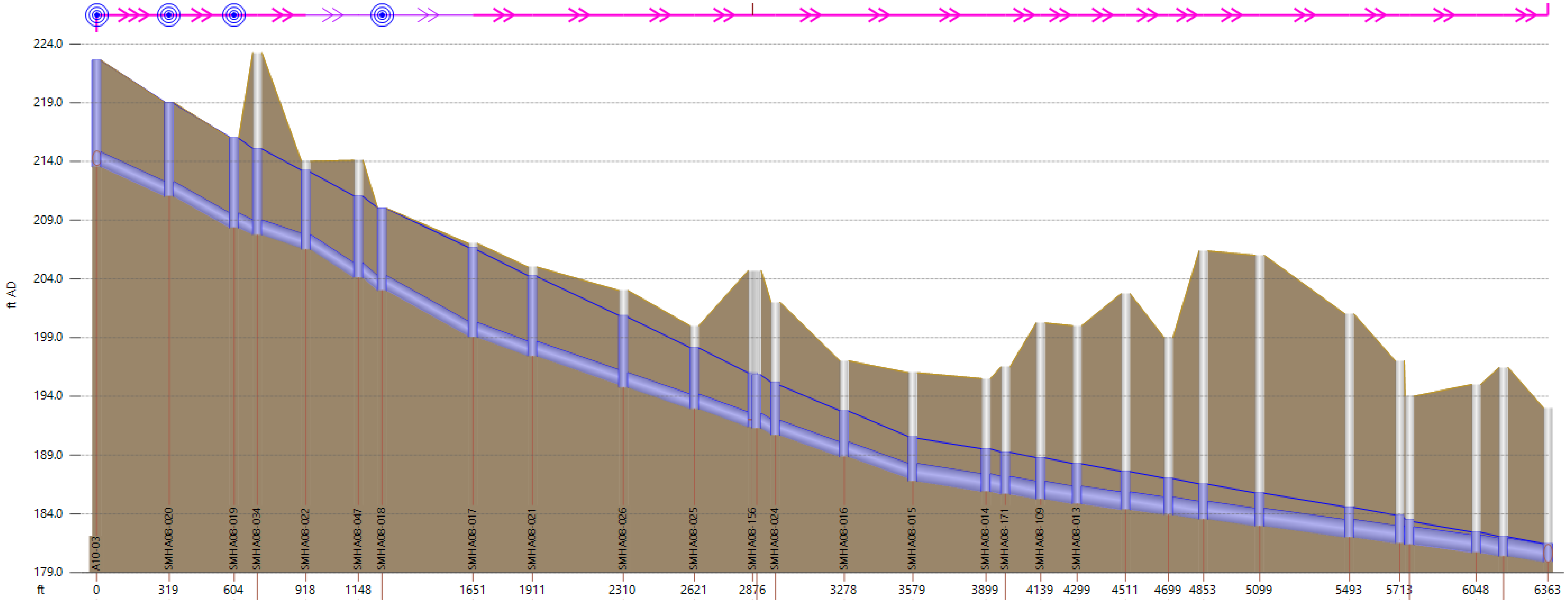
EXISTING LAND USE – AREA G



Link	SMH A08-010.1	-	SMH B08-196.1	-	SMH B08-105.1	SMH B08-083.1	SMH B08-077.1	SMH B08-066.1	-	-	-	-	-	-	-	-
length (ft)	382.5	147.9	234.6	200.3	394.4	399.4	304.0	322.1	179.5	85.6	168.0	178.0	172.0	157.2	100.0	-
width (in)	8.0	8.0	8.0	10.0	10.0	10.0	10.0	10.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	-
us inv (ft AD)	245.580	239.840	235.400	233.990	231.880	229.840	228.440	227.340	226.180	-	216.100	214.030	212.580	211.300	-	-
ds inv (ft AD)	239.840	235.400	233.990	232.080	230.040	228.640	227.530	226.380	223.990	-	214.230	212.580	211.500	210.500	-	-
grad (%)	1.501	3.002	0.601	0.954	0.467	0.300	0.299	0.298	1.220	9.100	1.113	0.815	0.628	0.509	0.929	-
surc	0.38	0.49	0.49	0.31	0.37	0.43	0.43	0.43	0.25	0.19	0.29	0.32	0.32	0.34	0.29	-
r.pfc (MGD)	0.96	1.35	0.61	1.38	0.97	0.78	0.77	0.77	2.54	6.95	2.43	2.08	1.83	1.64	2.22	-
DS flow (MGD)	0.2779	0.2779	0.2779	0.2779	0.2779	0.2900	0.2900	0.2900	0.2900	-	0.3819	0.3819	0.3819	0.3819	0.3819	-

Node	-	SMH B08-143	-	SMH B08-113	SMH B08-105	SMH B08-083	SMH B08-077	SMH B08-066	SMH B08-062	-	-	-	-	-	-	-
ground (ft AD)	252.381	246.609	243.258	240.770	239.440	240.920	243.415	243.560	241.150	-	-	230.810	225.000	221.960	-	-
level (ft AD)	245.835	240.057	235.727	234.252	232.191	230.199	228.799	227.700	226.429	-	-	214.326	212.897	211.637	-	-
flood dep (ft)	-6.546	-6.552	-7.531	-6.518	-7.249	-10.721	-14.616	-15.860	-14.721	-12.840	-	-16.484	-12.103	-10.323	-8.412	-

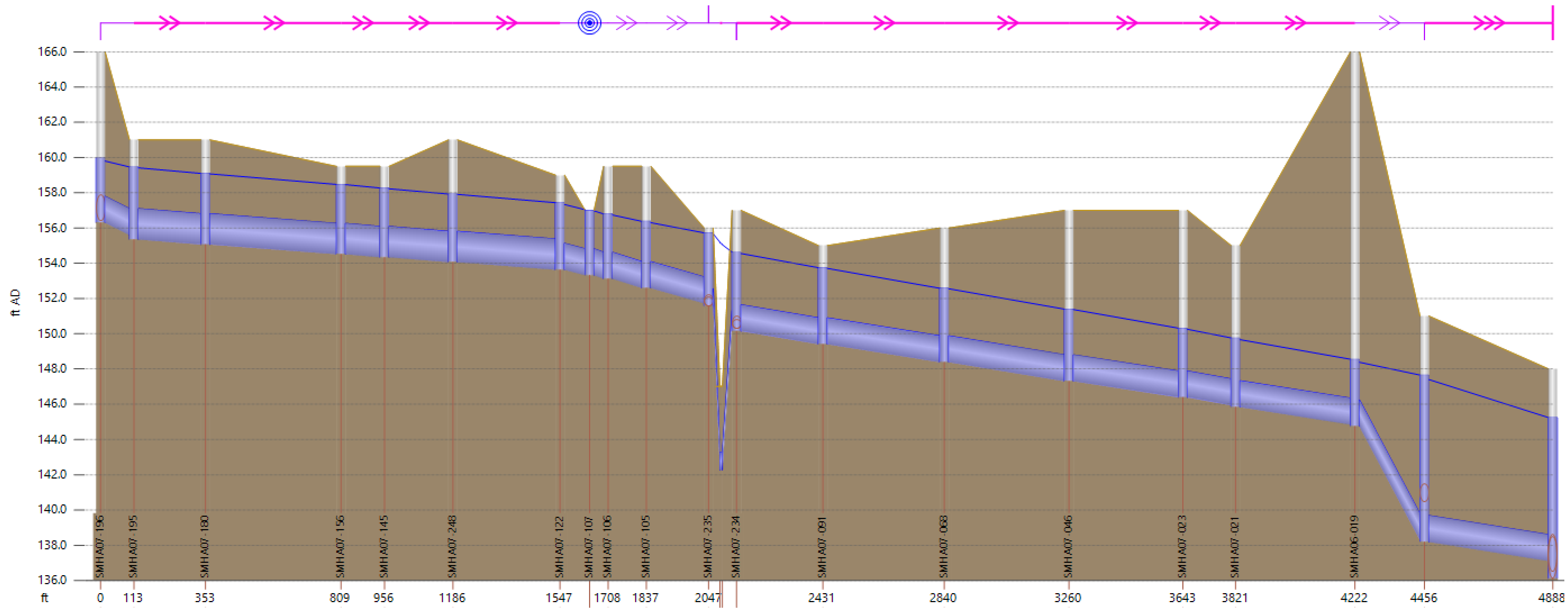
BUILDOUT LAND USE – AREA A



Link	A10-03.1	-	-	-	-	-	SMH A08-018.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
length (ft)	319.0	284.5	-	212.9	230.3	-	398.9	260.9	398.2	311.2	255.4	-	302.2	300.1	320.7	-	155.0	160.0	212.0	188.0	154.0	246.0	393.4	220.7	292.1	-	195.0
width (in)	15.0	15.0	-	15.0	15.0	-	15.0	15.0	15.0	15.0	15.0	-	15.0	15.0	18.0	-	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
us inv (ft AD)	213.530	211.020	-	207.750	206.510	-	203.000	199.010	197.410	194.750	192.920	-	190.690	188.850	186.770	-	-	-	184.840	-	-	183.550	182.960	182.000	181.380	-	-
ds inv (ft AD)	211.020	208.340	-	206.610	204.089	-	199.110	197.420	194.990	192.920	191.390	-	188.850	187.020	185.900	-	-	-	184.350	-	-	182.960	182.000	181.490	180.690	-	-
grad (%)	0.787	0.942	-	0.535	1.051	-	0.975	0.609	0.608	0.588	0.599	-	0.609	0.610	0.271	-	0.265	0.262	0.231	0.229	0.240	0.240	0.244	0.231	0.236	-	0.251
surc	2.00	2.00	-	2.00	1.00	-	1.00	2.00	2.00	2.00	2.00	-	2.00	2.00	2.00	-	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
r.pfc (MGD)	3.70	4.05	-	3.06	4.28	-	4.12	3.26	3.26	3.20	3.23	-	3.26	3.26	3.54	-	3.49	3.48	3.26	3.25	3.33	3.33	3.35	3.26	3.30	3.40	3.40
DS flow (MGD)	4.3727	4.1683	-	3.9082	3.8859	-	3.9267	3.9075	3.8864	3.8696	3.8558	-	3.5250	3.5183	3.5582	-	-	-	3.6701	3.6700	-	3.6700	3.6699	3.6699	3.6699	-	3.6698

Node	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ground (ft AD)	-	219.000	-	-	-	-	210.000	207.000	205.000	203.000	200.000	-	-	197.000	196.000	-	-	-	-	-	-	-	206.000	201.000	-	-	-	-	-
level (ft AD)	-	219.000	-	-	-	-	210.000	206.648	204.261	200.863	198.146	-	-	192.766	190.563	-	-	-	-	-	-	-	185.784	184.585	-	-	-	-	-
flood dep (ft)	-	-0.000	-	-	-0.764	-	0.000	-0.352	-0.739	-2.137	-1.854	-	-	-4.234	-5.437	-	-	-	-	-	-	-	-20.216	-16.415	-	-	-	-	-

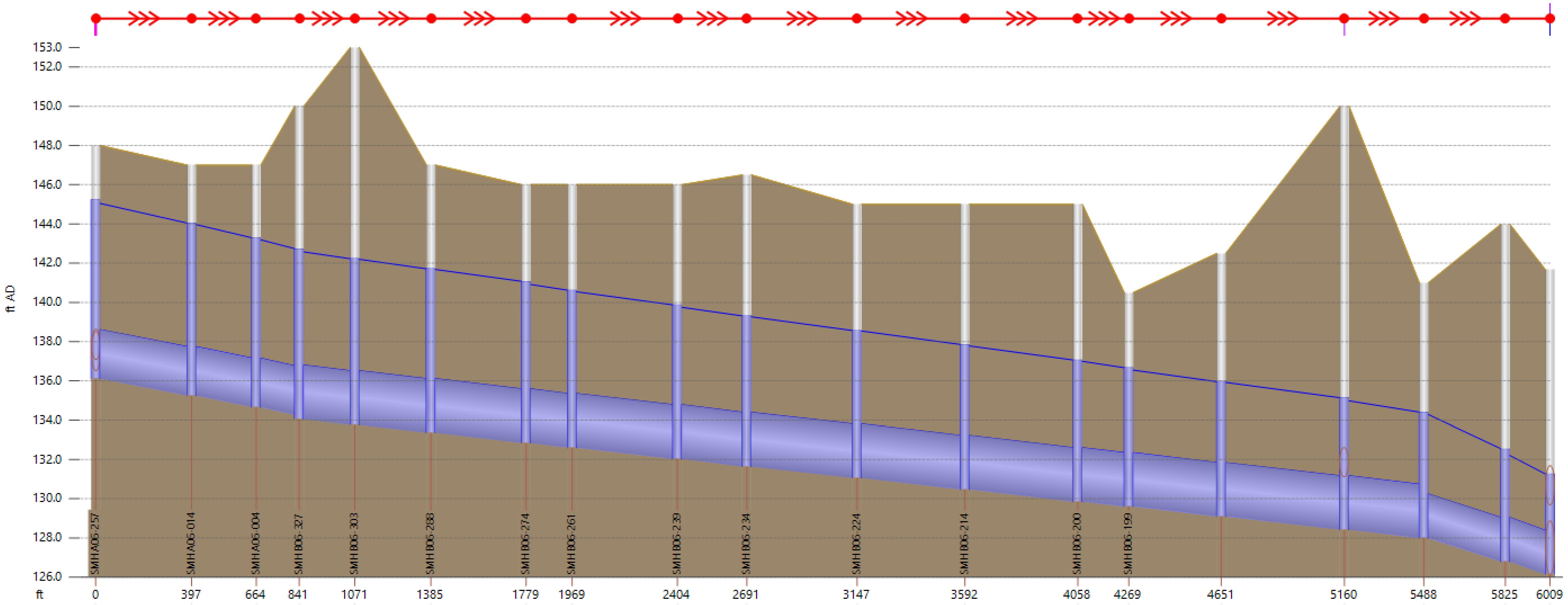
BUILDOUT LAND USE – AREA B



Link	-	-	SMH A07-180.1	-	-	SMH A07-248.1	-	-	-	-	-	-	SMH A07-091.1	SMH A07-068.1	SMH A07-046.1	-	SMH A07-021.1	-	SMH B06-329.1
length (ft)	112.5	240.7	456.0	146.8	230.3	360.3	99.4	-	128.8	209.5	-	290.6	408.7	419.5	383.8	177.3	401.8	233.8	431.9
width (in)	18.0	21.0	21.0	21.0	21.0	21.0	18.0	-	18.0	18.0	-	18.0	18.0	18.0	18.0	18.0	18.0	18.0	18.0
us inv (ft AD)	-	155.350	155.060	-	154.340	154.060	-	-	-	152.590	-	150.140	149.400	148.380	147.300	146.380	145.830	144.740	138.190
ds inv (ft AD)	-	155.060	154.510	-	154.060	153.630	-	-	-	151.720	-	149.400	148.380	147.300	146.380	145.930	144.840	138.290	137.110
grad (%)	0.622	0.120	0.121	0.116	0.122	0.119	-	-	0.411	0.415	-	0.255	0.250	0.257	0.240	0.254	0.246	2.759	0.250
surc	1.00	2.00	2.00	2.00	2.00	2.00	1.00	-	1.00	1.00	-	2.00	2.00	2.00	2.00	2.00	2.00	1.00	2.00
r.pfc (MGD)	5.36	3.56	3.56	3.49	3.57	3.54	3.79	-	4.36	4.38	-	3.43	3.39	3.45	3.32	3.42	3.37	11.28	3.40
DS flow (MGD)	-	3.6922	3.6921	3.6921	3.6921	3.6920	-	-	-	3.6350	-	3.6331	3.6319	3.6309	3.6307	3.6316	3.6328	3.6340	4.8525

Node	-	SMH A07-180	-	-	-	-	-	-	-	-	-	SMH A07-091	SMH A07-068	SMH A07-046	-	-	SMH A06-019	SMH B06-329	-
ground (ft AD)	-	161.000	159.500	-	161.000	159.000	-	-	-	-	-	155.000	156.000	157.000	157.000	155.000	166.000	151.000	148.000
level (ft AD)	-	159.098	158.474	-	157.925	157.432	-	-	-	-	-	153.744	152.576	151.392	150.307	149.750	148.534	147.638	145.233
flood dep (ft)	-1.543	-1.902	-1.026	-1.234	-3.075	-1.568	-	-	-3.128	-	-2.386	-1.256	-3.424	-5.608	-6.693	-5.250	-17.466	-3.362	-2.767

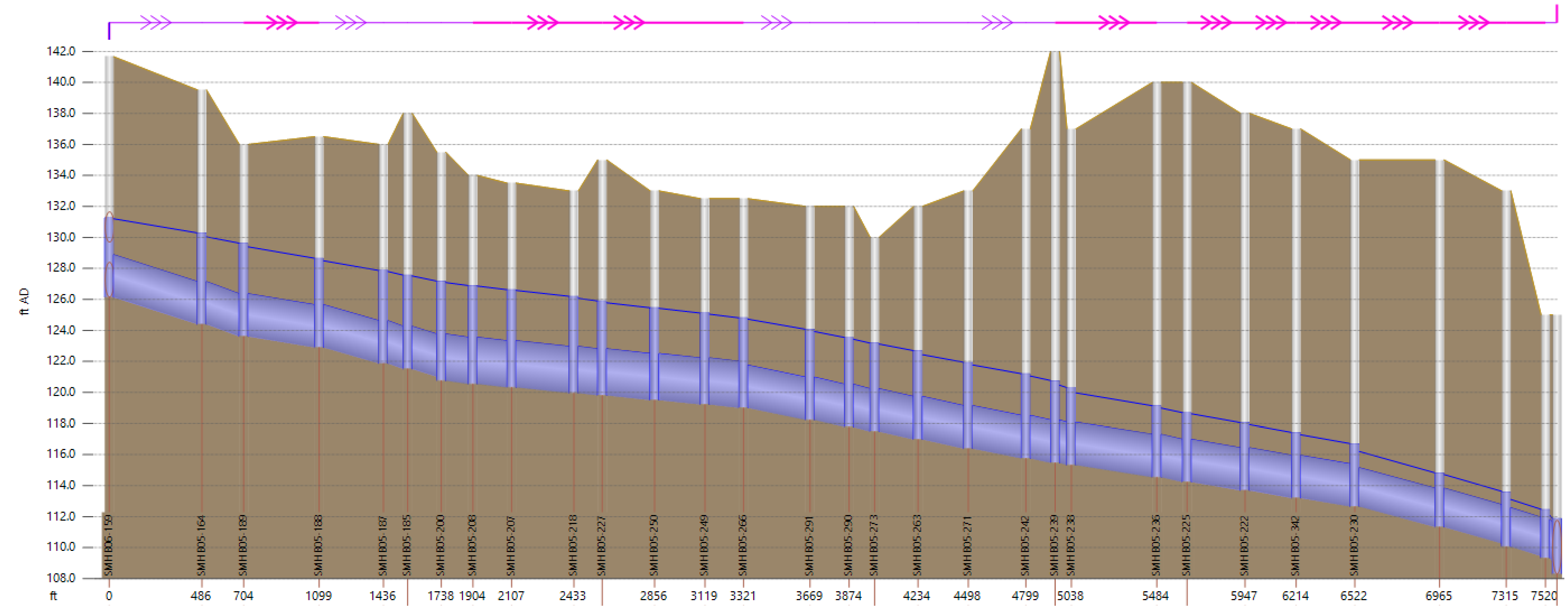
BUILDOUT LAND USE – AREA C



Link	SMH A06-257.1	-	-	-	-	SMH B06-288.1	-	SMH B06-261.1	-	SMH B06-234.1	SMH B06-224.1	SMH B06-214.1	-	SMH B06-199.1	SMH B06-186.1	-	-	-
length (ft)	396.7	267.4	177.3	229.3	314.6	393.4	190.1	435.0	287.1	455.6	445.4	466.4	210.4	382.2	509.2	327.5	337.3	184.4
width (in)	30.0	30.0	30.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	33.0	27.0	27.0
us inv (ft AD)	136.110	135.240	-	134.050	133.760	133.360	-	132.600	132.030	131.640	131.060	130.470	129.850	129.600	129.090	128.420	127.990	-
ds inv (ft AD)	135.240	134.660	-	133.760	133.360	132.840	-	132.030	131.640	131.060	130.470	129.850	129.600	129.090	128.420	127.990	126.792	-
grad (%)	0.219	0.217	0.220	0.126	0.127	0.132	0.126	0.131	0.136	0.127	0.132	0.133	0.119	0.133	0.132	0.131	0.355	0.358
surc	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
r.pfc (MGD)	12.42	12.35	12.43	12.16	12.19	12.43	12.15	12.37	12.60	12.20	12.44	12.46	11.78	12.49	12.40	12.39	11.93	11.98
DS flow (MGD)	13.2598	13.2587	-	13.2570	13.3380	13.3370	-	13.3354	13.3348	13.3340	13.3333	13.3327	13.3323	13.3318	13.3313	14.2827	14.2828	-

Node	-	-	-	-	-	-	-	-	-	-	SMH B06-224	SMH B06-214	-	-	SMH B06-186	SMH B06-163	-	-	-
ground (ft AD)	-	147.000	-	-	153.000	147.000	146.000	146.000	146.000	146.500	145.000	145.000	145.000	140.500	142.500	150.000	141.000	143.984	-
level (ft AD)	-	144.039	-	-	142.225	141.711	141.059	140.614	139.861	139.304	138.562	137.847	137.055	136.658	135.954	135.125	134.398	132.519	-
flood dep (ft)	-2.767	-2.961	-3.716	-7.281	-10.775	-5.289	-4.941	-5.386	-6.139	-7.196	-6.438	-7.153	-7.945	-3.842	-6.546	-14.875	-6.602	-11.465	-

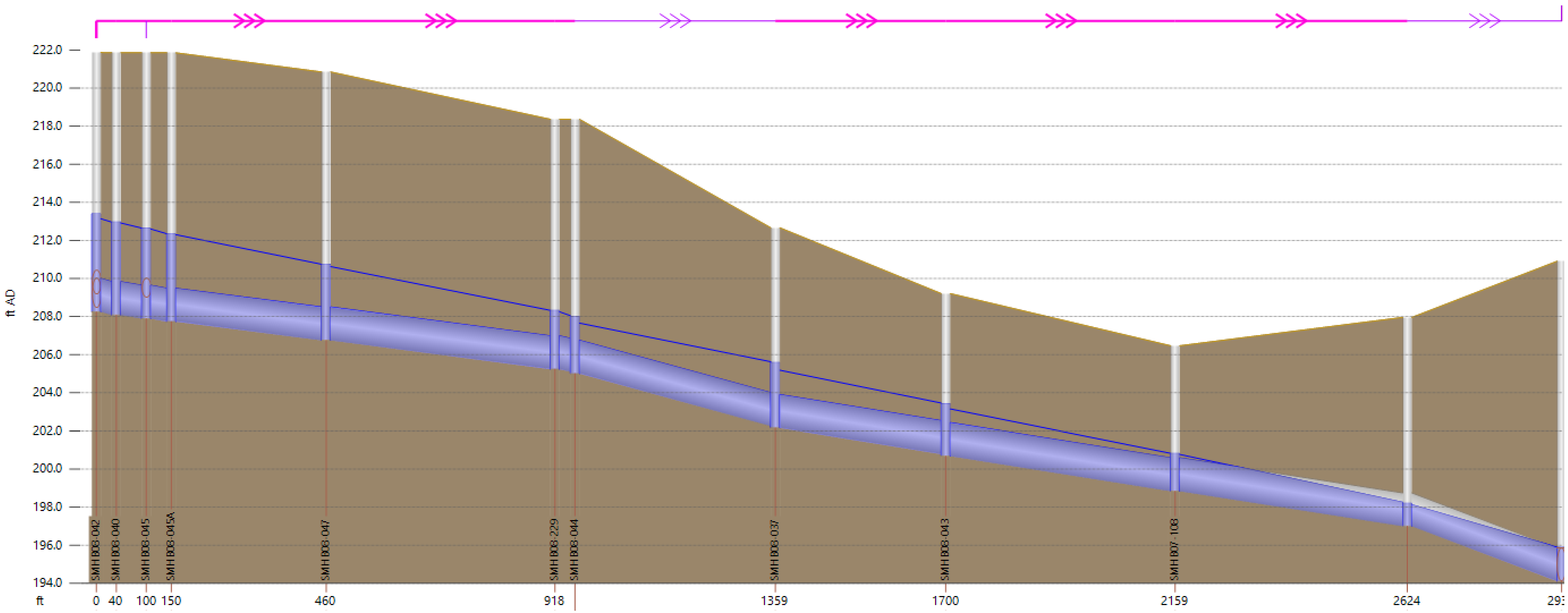
BUILDOUT LAND USE – AREA D



Link	SMH B06-159.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
length (ft)	485.7	218.4	394.8	337.0	-	176.0	-	202.7	326.1	-	274.6	263.3	201.7	348.2	204.6	-	227.1	263.3	301.6	-	-	446.8	-	303.8	267.3	307.6	443.8	349.1	205.1	
width (in)	33.0	33.0	33.0	33.0	-	33.0	36.0	36.0	36.0	36.0	36.0	36.0	36.0	33.0	33.0	-	33.0	33.0	33.0	33.0	-	33.0	33.0	33.0	33.0	33.0	30.0	30.0	30.0	
us inv (ft AD)	126.132	-	123.610	122.900	-	-	-	-	120.330	-	119.810	119.500	-	119.000	-	-	-	116.980	116.390	-	-	115.330	-	114.230	113.690	113.200	112.650	111.330	-	
ds inv (ft AD)	124.392	-	122.900	121.870	-	-	-	-	119.960	-	119.500	119.220	-	118.230	-	-	-	116.390	115.760	-	-	114.550	-	113.690	113.200	112.650	111.330	110.270	-	
grad (%)	0.358	0.358	0.180	0.306	-	0.284	-	0.109	0.113	-	0.113	0.106	0.109	0.221	0.225	-	0.220	0.224	0.209	-	-	0.175	-	0.178	0.183	0.179	0.297	0.304	0.302	
surc	1.00	1.00	2.00	1.00	-	1.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	1.00	1.00	-	1.00	1.00	1.00	1.00	-	2.00	1.00	2.00	2.00	2.00	2.00	2.00	2.00	
r.pfc (MGD)	20.46	20.46	14.50	18.90	-	18.22	-	14.20	14.52	-	14.49	14.06	14.24	16.08	16.21	-	16.04	16.18	15.62	-	-	14.28	-	14.41	14.64	14.46	14.46	14.61	14.58	
DS flow (MGD)	15.0889	-	15.0329	15.0057	-	-	-	-	14.9060	-	14.8692	14.8577	-	14.8171	-	-	-	14.7435	14.7259	-	-	14.7239	-	14.7225	14.7217	14.7210	14.7201	14.7194	-	

Node	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ground (ft AD)	-	139.514	136.000	136.500	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	140.000	-	-	-	135.000	135.000	-	-
level (ft AD)	-	130.268	129.608	128.638	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	119.125	-	-	-	116.675	114.817	-	-
flood dep (ft)	-	-9.246	-6.392	-7.862	-	-	-	-	-6.879	-	-	-7.544	-	-7.698	-7.942	-	-	-	-	-	-	-	-20.875	-	-19.957	-19.586	-18.325	-20.183	-	-

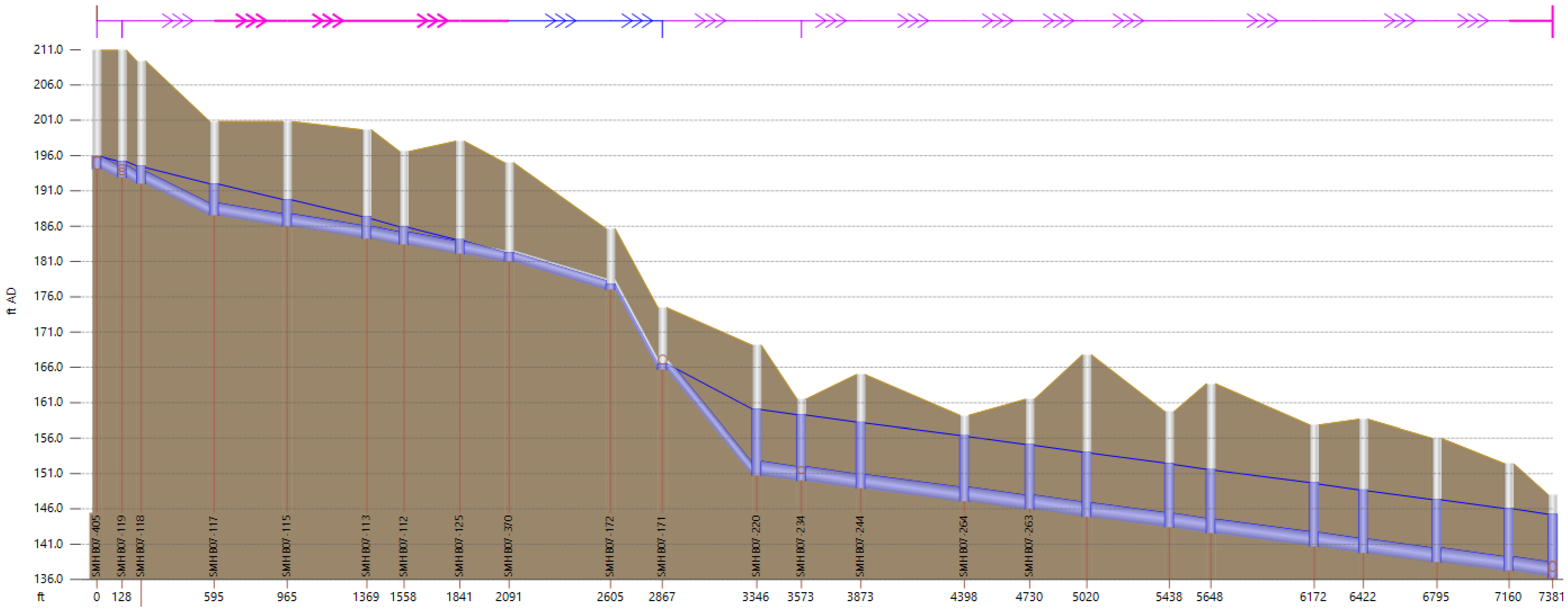
BUILDOUT LAND USE – AREA E



Link	-	-	-	SMH B08-045A.1	SMH B08-047.1	-	SMH B08-044.1	SMH B08-037.1	SMH B08-043.1	SMH B07-108.1	SMH B07-107.1
length (ft)	-	60.0	-	310.0	458.0	-	401.0	341.0	459.2	464.7	308.9
width (in)	-	21.0	-	21.0	21.0	-	21.0	21.0	21.0	21.0	21.0
us inv (ft AD)	-	-	-	207.732	206.750	-	205.000	202.150	200.680	198.840	197.000
ds inv (ft AD)	-	-	-	206.750	205.233	-	202.250	200.780	198.840	197.000	194.107
grad (%)	-	-	-	0.317	0.331	-	0.686	0.402	0.401	0.396	0.937
surc	-	2.00	-	2.00	2.00	-	1.00	2.00	2.00	2.00	1.00
r.pfc (MGD)	-	5.76	-	5.76	5.89	-	8.48	6.49	6.48	6.45	9.91
DS flow (MGD)	-	-	-	7.2196	7.2195	-	7.2509	7.2534	7.2534	7.2534	7.2522

Node	-	-	-	SMH B08-047	SMH B08-229	SMH B08-044	SMH B08-037	SMH B08-043	SMH B07-108	SMH B07-107	-
ground (ft AD)	-	-	221.854	220.847	218.361	218.361	212.662	209.204	206.463	207.955	210.904
level (ft AD)	-	-	212.343	210.734	208.318	208.010	205.584	203.427	200.820	198.192	195.893
flood dep (ft)	-	-	-9.511	-10.113	-10.043	-10.351	-7.078	-5.777	-5.643	-9.763	-15.011

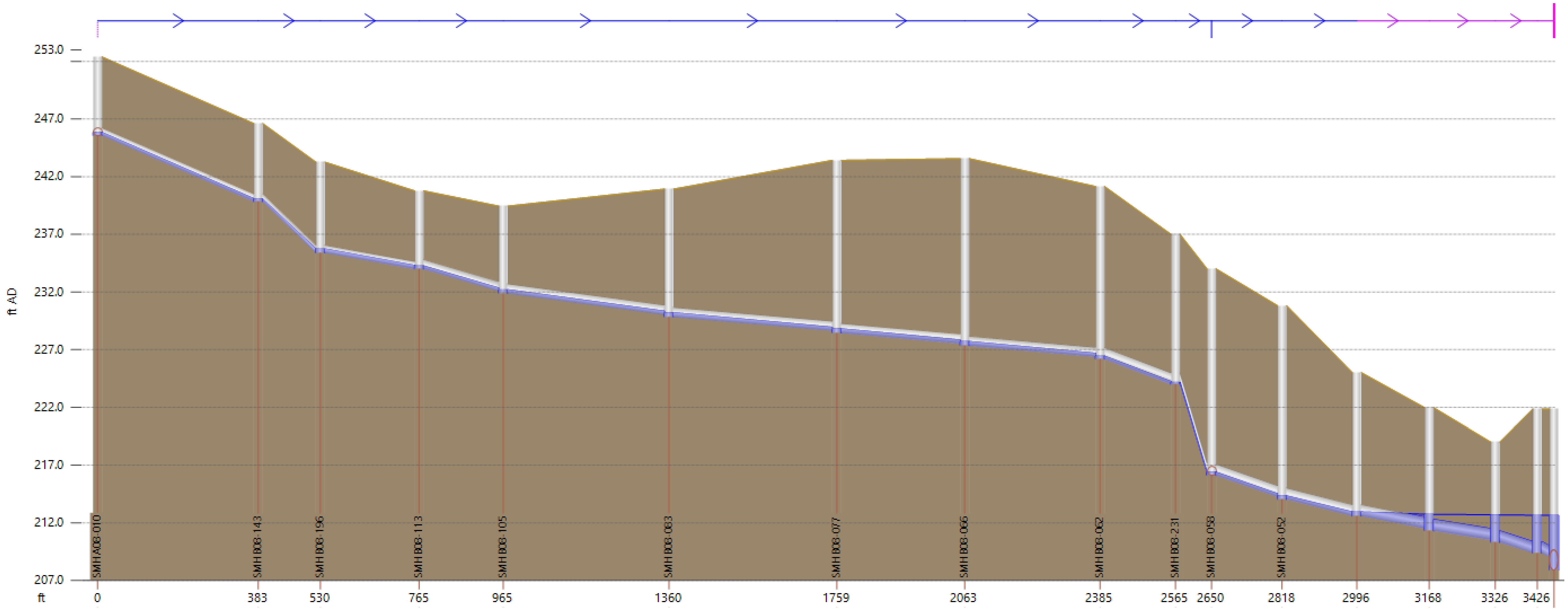
BUILDOUT LAND USE – AREA F



Link	-	-	-	-	-	-	-	-	SMH B07-370.1	-	SMH B07-171.1	-	-	SMH B07-244.1	-	-	-	-	SMH B07-242.1	-	-	-	-
length (ft)	-	-	370.0	370.5	403.7	189.0	282.5	249.9	514.2	262.6	479.1	226.2	300.0	525.4	331.8	289.9	418.2	210.2	523.9	249.6	373.1	365.7	220.5
width (in)	-	-	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	21.0	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)	-	-	192.000	187.500	186.000	-	183.416	182.070	180.950	177.000	165.650	-	149.975	148.860	147.080	145.950	144.870	-	142.540	140.670	139.730	138.470	-
ds inv (ft AD)	-	-	187.500	186.000	184.350	-	182.170	180.950	177.000	165.750	150.740	-	148.960	147.080	145.950	144.970	143.460	-	140.770	139.830	138.470	137.230	-
grad (%)	-	-	1.216	0.405	0.409	0.441	0.441	0.448	0.768	4.284	3.112	0.338	0.338	0.339	0.341	0.338	0.337	0.343	0.338	0.337	0.338	0.339	0.327
surc	-	-	1.00	2.00	2.00	2.00	2.00	2.00	0.72	0.44	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	2.00
r.pfc (MGD)	-	-	11.30	6.52	6.55	6.80	6.80	6.86	8.98	21.20	18.07	8.50	8.51	8.51	8.53	8.50	8.49	8.56	8.50	8.48	8.50	8.52	8.36
DS flow (MGD)	-	-	7.8057	7.8057	7.8057	-	7.8765	7.8765	7.8969	7.8969	8.1616	8.1590	8.3502	8.3481	8.3468	8.3458	8.3447	8.3440	8.3430	8.3424	8.3418	8.4519	8.4514

Node	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ground (ft AD)	-	-	200.819	200.813	199.641	-	-	194.963	185.616	174.439	169.113	-	164.971	159.204	161.463	167.769	159.712	163.680	157.842	158.647	155.955	152.380	-
level (ft AD)	-	-	192.010	189.781	187.328	-	-	182.280	177.763	166.511	160.091	-	158.261	156.391	155.117	154.027	152.482	151.592	149.709	148.676	147.314	146.045	-
flood dep (ft)	-	-	-8.809	-11.032	-12.313	-	-	-12.683	-7.853	-7.928	-9.022	-2.197	-6.710	-2.813	-6.346	-13.742	-7.230	-12.088	-8.133	-9.971	-8.641	-6.335	-

BUILDOUT LAND USE – AREA G



Link	SMH A08-010.1	-	SMH B08-196.1	-	SMH B08-105.1	SMH B08-083.1	SMH B08-077.1	SMH B08-066.1	-	-	-	-	-	-	-	-
length (ft)	382.5	147.9	234.6	200.3	394.4	399.4	304.0	322.1	179.5	85.6	168.0	178.0	172.0	157.2	100.0	-
width (in)	8.0	8.0	8.0	10.0	10.0	10.0	10.0	10.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	-
us inv (ft AD)	245.580	239.840	235.400	233.990	231.880	229.840	228.440	227.340	226.180	-	216.100	214.030	212.580	211.300	-	-
ds inv (ft AD)	239.840	235.400	233.990	232.080	230.040	228.640	227.530	226.380	223.990	-	214.230	212.580	211.500	210.500	-	-
grad (%)	1.501	3.002	0.601	0.954	0.467	0.300	0.299	0.298	1.220	9.100	1.113	0.815	0.628	0.509	0.929	-
surc	0.38	0.49	0.49	0.31	0.37	0.43	0.43	0.43	0.25	0.19	0.29	0.36	1.00	1.00	1.00	-
r.pfc (MGD)	0.96	1.35	0.61	1.38	0.97	0.78	0.77	0.77	2.54	6.95	2.43	2.08	1.83	1.64	2.22	-
DS flow (MGD)	0.2779	0.2779	0.2779	0.2779	0.2779	0.2900	0.2900	0.2900	0.2900	-	0.3825	0.3827	0.3871	0.3878	0.3885	-

Node	-	SMH B08-143	-	SMH B08-113	SMH B08-105	SMH B08-083	SMH B08-077	SMH B08-066	SMH B08-062	-	-	-	-	-	-	-
ground (ft AD)	252.381	246.609	243.258	240.770	239.440	240.920	243.415	243.560	241.150	-	-	230.810	225.000	221.960	-	-
level (ft AD)	245.835	240.057	235.727	234.252	232.191	230.199	228.799	227.700	226.429	-	-	214.326	212.939	212.742	-	-
flood dep (ft)	-6.546	-6.552	-7.531	-6.518	-7.249	-10.721	-14.616	-15.860	-14.721	-12.840	-	-16.484	-12.061	-9.218	-6.307	-

APPENDIX F – PROPOSED CAPACITY IMPROVEMENT PROJECT DETAILS

Project 1: Pump Station 26 Capacity Improvement and Sierra College Blvd. Improvement

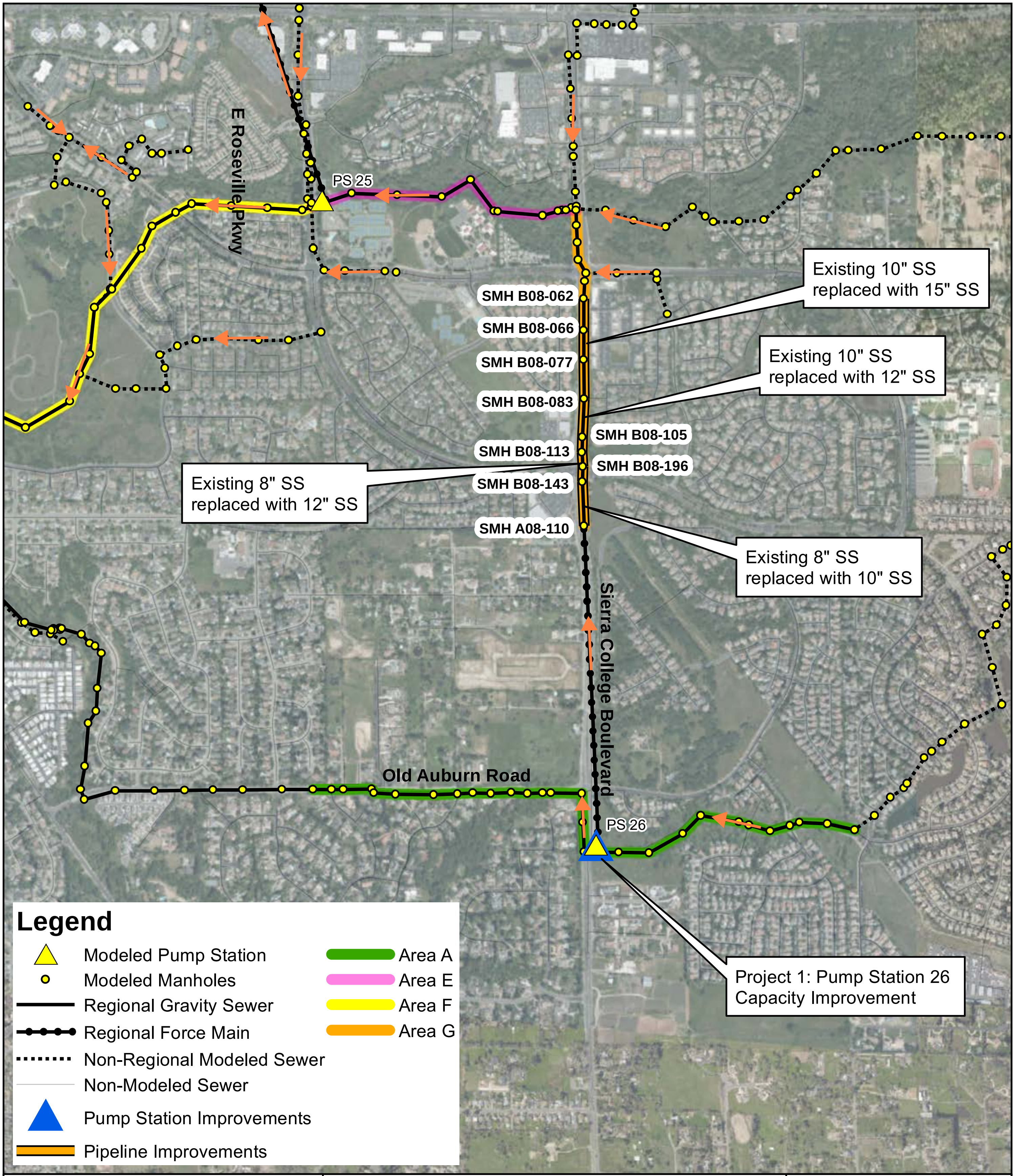
PROJECT DESCRIPTION

Project ID 1
Project Name .... Pump Station 26 Capacity Improvement and Sierra College Blvd. Improvement
Project Location .... PS 26 and Sierra College Boulevard
Description .... Increased Capacity of PS 26 and sewers on Sierra College Blvd (from 0.43 to 1.6 mgd)
Estimated Capital Imp. Cost $1,606,000
Comments .... (i) Pipes are listed in order from upstream to downstream
Assumptions .... (i) Pipe cost estimates are based on the 20 Cities & SF Average April 2020 ENR CCI of 12115
(ii) Cost assumes project will be implemented using open-cut construction method

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 ($/LF)	Total Cost ($)
SMH A08-010	SMH B08-143	8	10	383	1.50	7	Open Cut	$171	$ 65,363
SMH B08-143	SMH B08-196	8	10	148	3.00	7	Open Cut	$171	$ 25,274
SMH B08-196	SMH B08-113	8	12	235	0.60	7	Open Cut	$189	$ 44,236
SMH B08-113	SMH B08-105	10	12	200	0.95	7	Open Cut	$189	$ 37,769
SMH B08-105	SMH B08-083	10	12	394	0.47	9	Open Cut	$189	$ 74,368
SMH B08-083	SMH B08-077	10	15	399	0.30	13	Open Cut	$242	$ 96,492
SMH B08-077	SMH B08-066	10	15	304	0.30	16	Open Cut	$259	$ 78,818
SMH B08-066	SMH B08-062	10	15	322	0.30	15	Open Cut	$259	$ 83,511

Baseline Pipeline Construction Cost:	**$**	**505,831**
Sheeting and Shoring for High Groundwater Area	$	-
Dewatering	$	-
Bypass Pumping (10% of pipe construction cost)	$	50,583
Remove & Replace Factor (5% of pipe construction cost)	$	25,292
Major Traffic Control (10% of pipe construction cost)	$	-
Pipeline Construction Cost Subtotal:	**$**	**581,705**
Pumps (including 8.25% sales tax)	$	164,540
Allowance for new PG&E Service	$	20,000
Electrical improvements (new service, new MCC, new cables, soft starts)	$	35,000
Installation (25% of raw cost)	$	54,885
Piping & Structural Modifications Allowance	$	25,000
Contractor Overhead & Profit (20%)	$	59,885
Pump Station Construction Cost Subtotal:	**$**	**359,310**
Construction Subtotal:	**$**	**941,015**
Mobilization/Demobilization (5% of subtotal)	$	47,051
Construction Total:	**$**	**988,066**
Contingencies (30% of construction subtotal)	$	296,420
Total Estimated Construction Cost:	**$**	**1,284,486**
Engineering, Administration, Legal (25% of construction cost)	$	321,121
Estimated Capital Improvement Cost:	**$**	**1,606,000**



Improvement Project 1

South Placer Wastewater Authority
2020 Systems Evaluation

0 750 1,500 3,000
Feet

N

WOODARD & CURRAN

Project #: 0011183.00
Map Created: June 2020

Figure Exported: 6/15/2020 By: apdavis Using: \\woodardcurran.net\shared\Projects\RMC\WCR\0091 Roseville, City of\0011183.00 SPWA Systems Evaluation\G. GIS\3 MXDs\Improvement Project 1_cvl.mxd

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Project 2: Eureka Road, E Rosevville Parkway Improvement

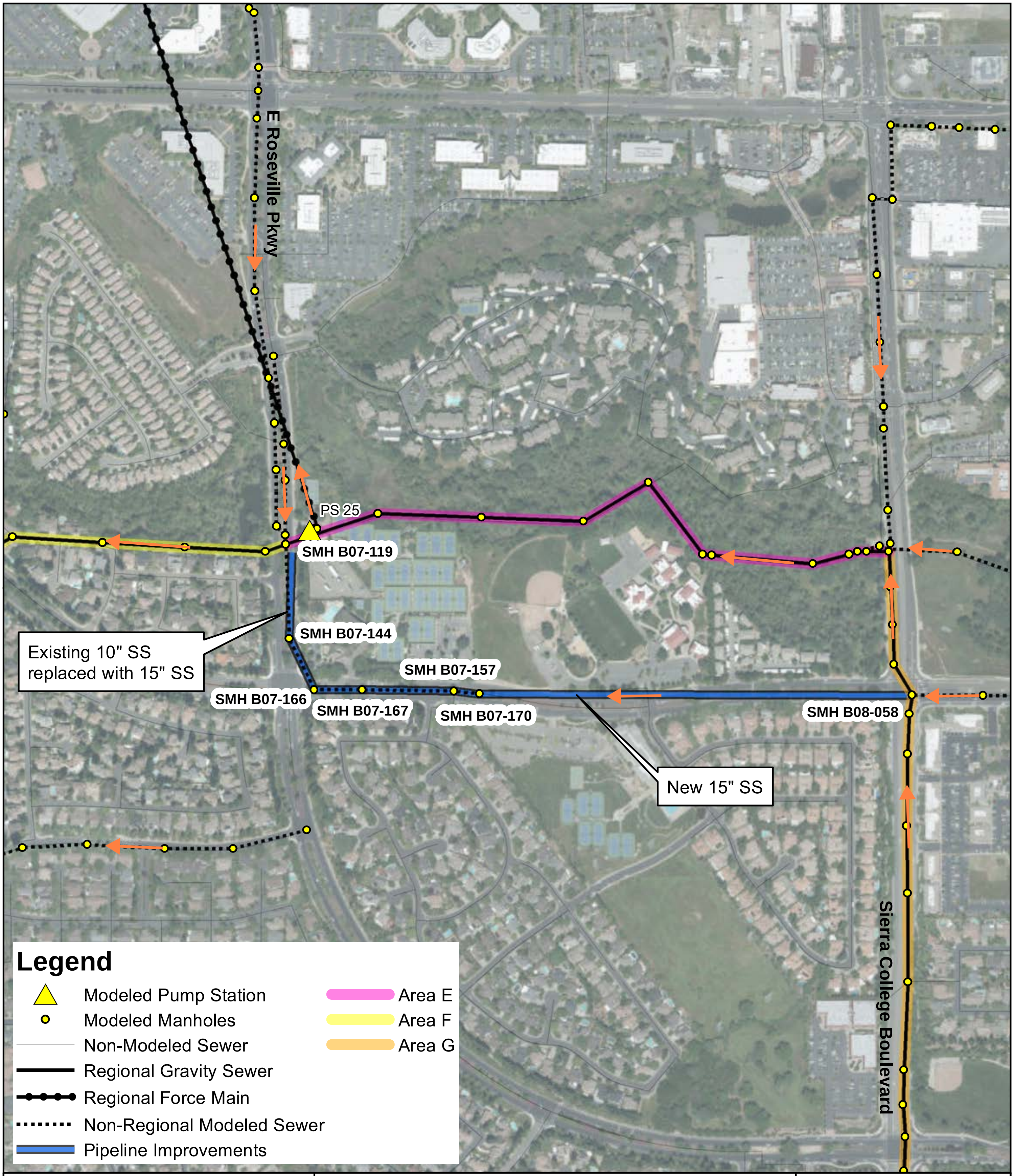
PROJECT DESCRIPTION

Project ID …………………………………………………………	2
Project Name …………………………………………………	Eureka Road, E Rosevville Parkway Improvement
Project Location ……………………………………………	Eureka Road and E. Roseville Parkway
Description ………………………………………………………	Redirect flows from PS 26 and Sierra College Blvd. down Eureka Rd via upsizing of approximately 1,310ft, installing approximately 2,740 ft of new 15in pipe and 4 new manholes.
Estimated Capital Imp. Cost ……………………………	$1,831,000
Comments ……………………………………………………	(i) Pipes are listed in order from upstream to downstream
Assumptions …………………………………………………	(i) Cost estimates are based on the 20 Cities & SF Average April 2020 ENR CCI of 12115 (ii) Cost assumes project will be implemented using open-cut construction method

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 ($/LF)	Total Cost ($)	
SMH B08-058	SMH B07-170	new pipe	15	697	0.22	15	Open Cut	$259	$	180,608
SMH B07-170	SMH B07-157	new pipe	15	1942	0.25	13	Open Cut	$242	$	469,198
SMH B07-157	SMH B07-167	10	15	413	0.97	12	Open Cut	$242	$	99,730
SMH B07-167	SMH B07-166	10	15	216	0.50	12	Open Cut	$242	$	52,112
SMH B07-166	SMH B07-144	10	15	255	0.53	11	Open Cut	$242	$	61,630
SMH B07-144	SMH B07-119	10	15	424	0.48	14	Open Cut	$242	$	102,435

Baseline Pipeline Construction Cost:	$	965,712
Sheeting and Shoring for High Groundwater Area	$	-
Dewatering	$	-
Bypass Pumping (10% of upsized pipe construction cost)	$	31,591
Remove & Replace Factor (5% of upsized pipe construction cost)	$	15,795
Major Traffic Control (10% of pipe construction cost)	$	-
Pipeline Construction Cost Subtotal:	**$**	**1,013,098**
Installation of 4 new manholes	$	60,000
Manhole Construction Cost Subtotal:	**$**	**60,000**
Construction Subtotal:	**$**	**1,073,098**
Mobilization/Demobilization (5% of subtotal)	$	53,655
Construction Total	**$**	**1,126,753**
Contingencies (30% of construction subtotal)	$	338,026
Total Estimated Construction Cost:	**$**	**1,464,779**
Engineering, Administration, Legal (25% of construction cost)	$	366,195
Estimated Capital Improvement Cost:	**$**	**1,831,000**



Improvement Project 2

South Placer Wastewater Authority
2020 Systems Evaluation

WOODARD & CURRAN

Project #: 0011183.00
Map Created: June 2020

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Project 3 Alternative A: Pump Station 25 Improvements

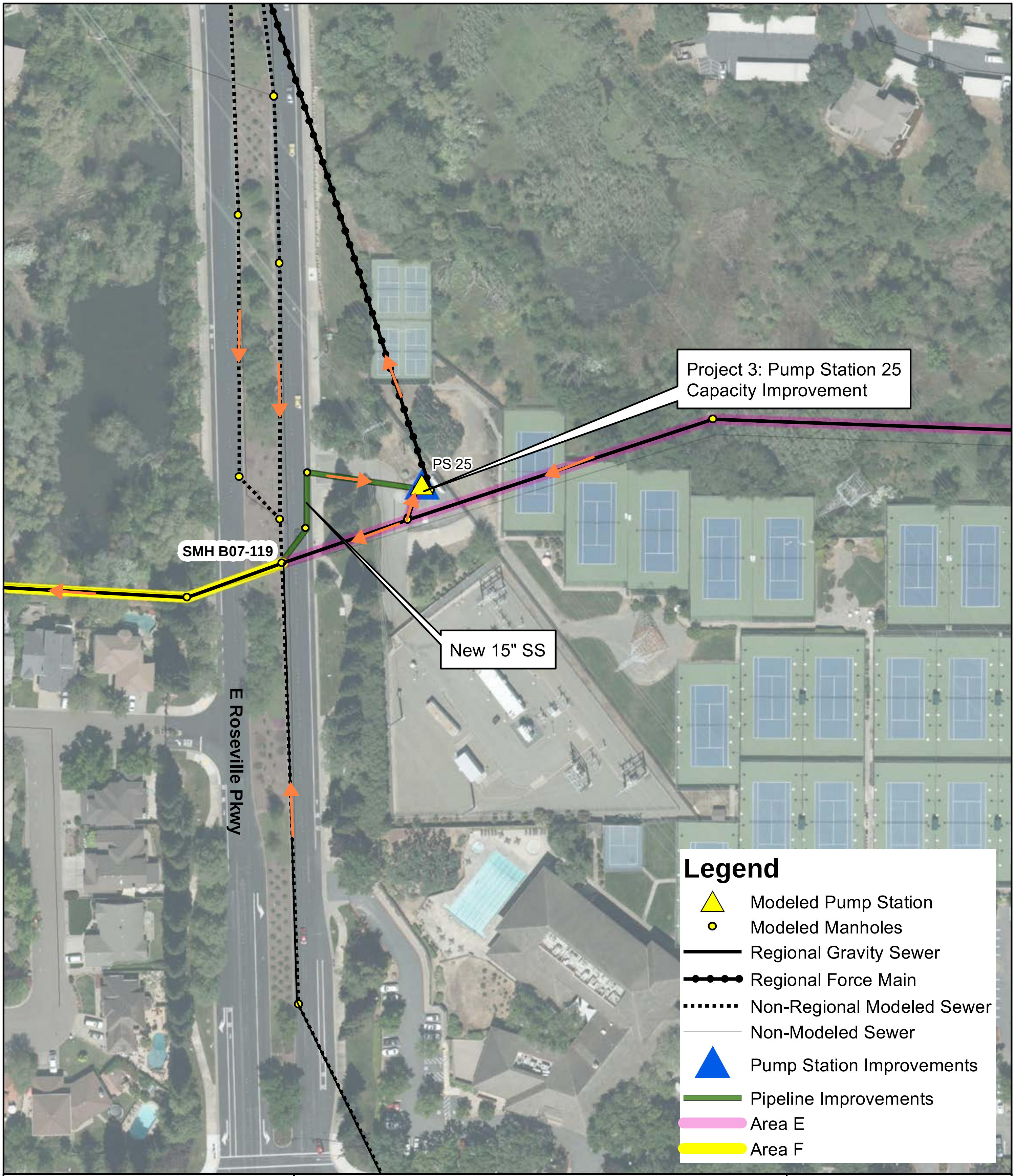
PROJECT DESCRIPTION

Project ID	3 Alternative A
Project Name	Pump Station 25 Improvements
Project Location	PS 25 (pumps)
Description	New weir structure or adjustments to existing structure at PS 25
Estimated Capital Imp. Cost	$758,000
Comments	(i) Pipes are listed in order from upstream to downstream
Assumptions	(i) Cost estimates are based on the 20 Cities & SF Average April 2020 ENR CCI of 12115 (ii) Cost assumes project will be implemented using open-cut construction method

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 ($/LF)		Total Cost ($)
SMH B07-119	SMH B07-119_DU2	new pipe	18	10	2%	17	Open Cut	$298	$	2,982
SMH B07-119_DU2	PS 25 Wetwell	new pipe	15	215	2%	14	Open Cut	$242	$	51,942

Baseline Pipeline Construction Cost:	**$**	**54,924**
Sheeting and Shoring for High Groundwater Area	$	-
Dewatering	$	-
Bypass Pumping (10% of pipe construction cost)	$	-
Remove & Replace Factor (5% of pipe construction cost)	$	-
Major Traffic Control (10% of pipe construction cost)	$	-
Pipeline Construction Cost Subtotal:	**$**	**54,924**
Installation of 2 new manhole	$	30,000
Manhole Construction Cost Subtotal:	**$**	**30,000**
Pumps (including 8.25% sales tax)	$	164,540
Allowance for new PG&E Service	$	20,000
Electrical improvements (new service, new MCC, new cables)	$	35,000
Installation (25% of raw cost)	$	54,885
Piping & Structural Modifications Allowance	$	25,000
Contractor Overhead & Profit (20%)	$	59,885
Pump Station Construction Cost Subtotal:	**$**	**359,310**
Construction Subtotal:	**$**	**444,234**
Mobilization/Demobilization (5% of subtotal)	$	22,212
Estimated Construction Cost Subtotal:	**$**	**466,446**
Contingencies (30% of construction subtotal)	$	139,934
Total Estimated Construction Cost:	**$**	**606,380**
Engineering, Administration, Legal (25% of construction cost)	$	151,595
Estimated Capital Improvement Cost:	**$**	**758,000**



Improvement Project 3

South Placer Wastewater Authority
2020 Systems Evaluation

0 75 150 300 Feet

N

WOODARD &CURRAN

Project #: 0011183.00
Map Created: June 2020

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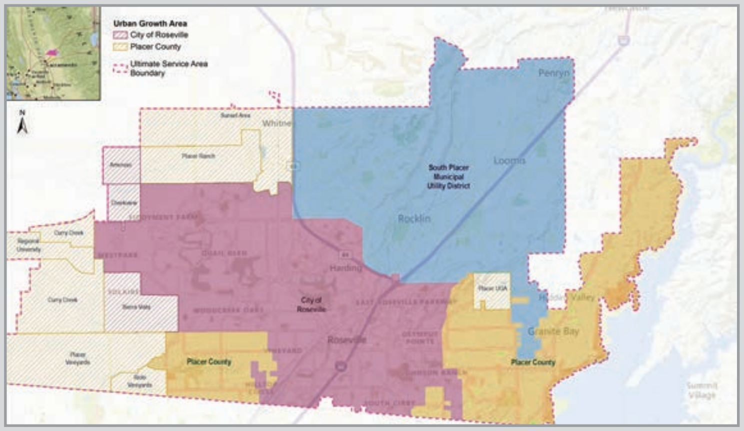

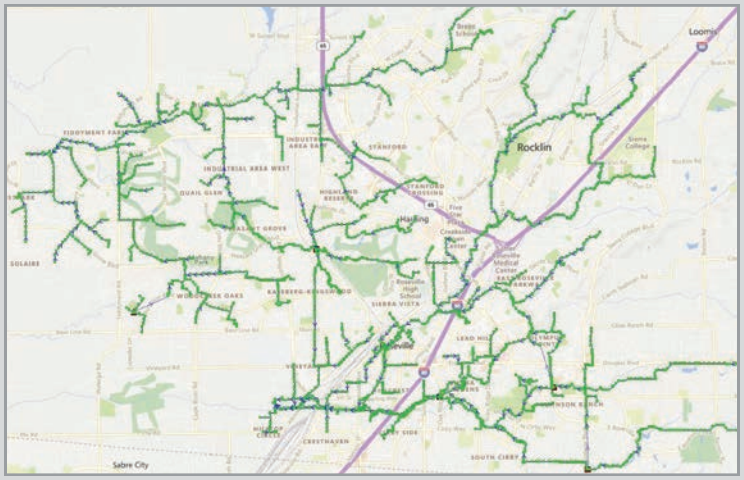

COMMITMENT & INTEGRITY DRIVE RESULTS