CITY OF BEAUMONT

2021

WASTEWATER MASTER PLAN

Draft

August 2021

AKEL
ENGINEERING GROUP, INC.

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Smart Planning Our Water Resources

August 24, 2021

City of Beaumont
550 E 6th Street
Beaumont, CA 92223

Attention: Jeff Hart, P.E.
Public Works Director

Subject: 2021 Wastewater Master Plan – Draft Report

Dear Jeff:

We are pleased to submit the draft report for the City of Beaumont Wastewater Master Plan. The master plan documents the following:

- Existing wastewater system facilities, acceptable hydraulic performance criteria, and projected wastewater flows consistent within the City's service area.
- Development and calibration of the City's GIS-based wastewater collection system hydraulic model.
- Capacity evaluation of the existing wastewater collection system with improvements to mitigate existing deficiencies and to accommodate future growth.
- Capital Improvement Program (CIP) with an opinion of probable construction costs.

We extend our thanks to you; Jeff Hart, Public Works Director; Kristine Day, Assistant City Manager; Thaxton Van Belle, Chief Plant Operator; Kevin Lee, Wastewater Plant Supervisor; and other City staff whose courtesy and cooperation were valuable components in completing this study.

Sincerely,

AKEL ENGINEERING GROUP, INC.

Tony Akel, P.E.
Senior Principal

Enclosure: Report

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Acknowledgements

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David Fenn

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Todd Parton, City Manager

Kristine Day, Assistant City Manager

Jeff Hart, Public Works Director

Thaxton Van Belle, Chief Plant Operator

Kevin Lee, Wastewater Plant Supervisor

Other City Engineering, Planning, and Operations Staff

City of Beaumont
Wastewater Master Plan

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APPENDICES

EXECUTIVE SUMMARY

This executive summary provides a brief background of the City of Beaumont's (City) wastewater collection system, the planning area characteristics, the planning and design criteria, and the hydraulic model development.

The hydraulic model was used to evaluate the capacity adequacy of the existing wastewater collection system and for recommending improvements to mitigate existing deficiencies and for servicing future growth. The prioritized capital improvement program accounts for growth through the Beaumont Planning Area.

ES.1 STUDY OBJECTIVES

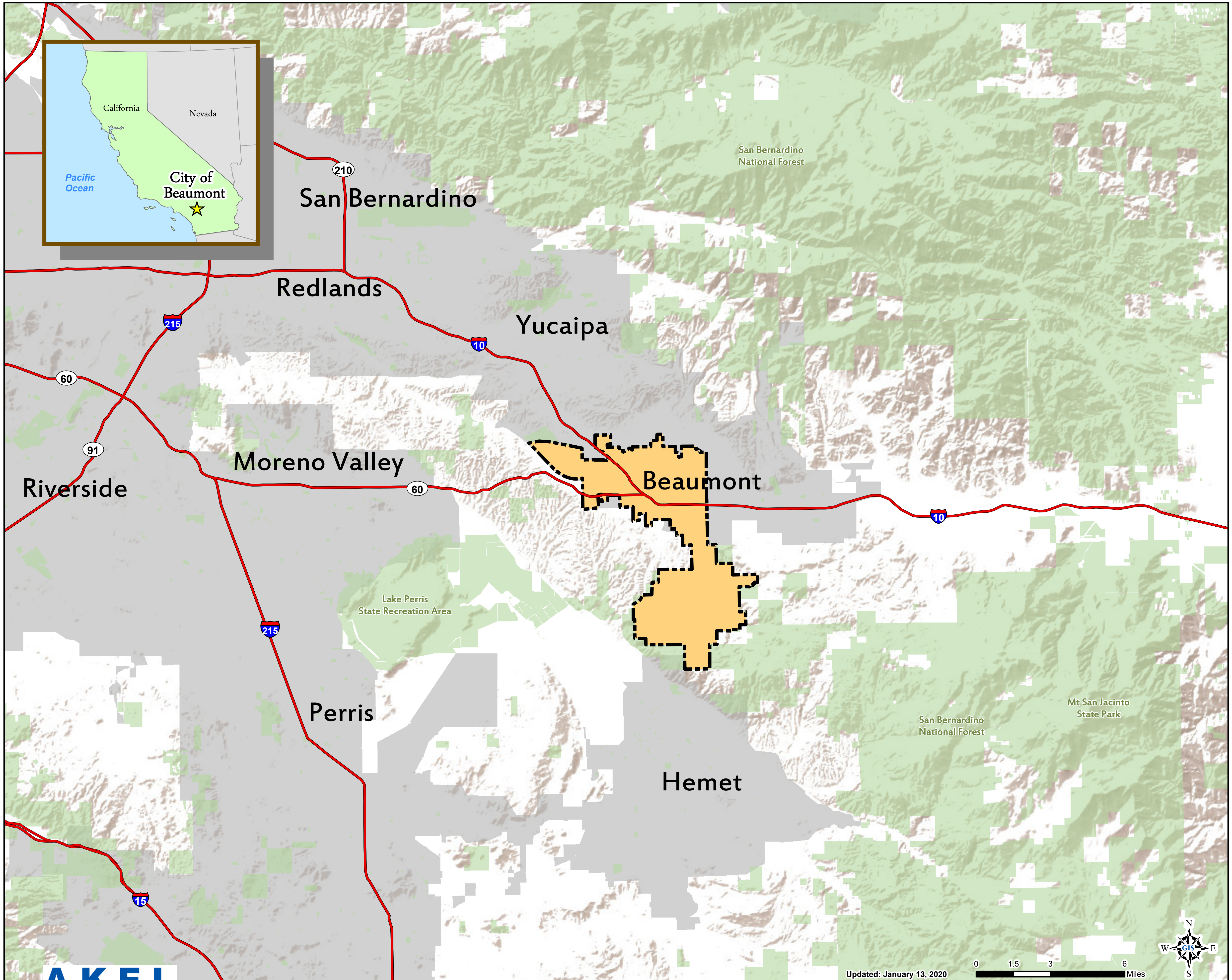
Recognizing the importance of planning, developing, and financing system facilities to provide reliable wastewater service to existing customers and for servicing anticipated growth within the sphere of influence, the City initiated the development of the 2021 Wastewater Master Plan.

This master plan includes the following tasks:

- Summarize the City's existing wastewater collection system facilities.
- Document growth planning assumptions and known future developments.
- Summarize the wastewater system performance criteria and design storm event.
- Project future wastewater flows.
- Develop and calibrate the physical characteristics of the hydraulic model (gravity mains, force mains, and lift stations).
- Evaluate the adequacy of capacity for the wastewater collection system facilities to meet existing and projected peak dry weather flows and peak wet weather flows.
- Recommend a capital improvement program (CIP) with an opinion of probable construction costs.
- Develop a 2021 Wastewater Master Plan Report.

ES.2 STUDY AREA DESCRIPTION

The City of Beaumont is located in Riverside County on the southern portion of California, east of the City of Banning. The City is located approximately 11 miles north of the City of Hemet, 5 miles east of the City of Banning, 12 miles east of City of Monero Valley, and 7 miles southeast of the City of Yucaipa. The City currently encompasses an area greater than 26,000 acres, with an approximate population of 50,000 residents. **Figure ES.1** displays the City's location.



Legend

- Major Highways
- City of Beaumont
- Urbanized Area
- Protected Open Space

PRELIMINARY

ES.1
Regional Location Map
Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA

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The City's service area is generally bound to the north by Brookside Avenue, to the east by Highlands Springs Avenue, and to the southwest of Monero Valley Freeway. The topography is generally steep, with slopes increasing from north to south toward the Interstate 10. **Figure ES.2** displays the City's existing service area and the general plan boundary.

The City operates and maintains a wastewater collection system that covers the majority of the developable area within Planning Boundary. Currently, the wastewater flows are conveyed to the City of Beaumont Wastewater Treatment Plant (WWTP).

ES.3 SYSTEM PERFORMANCE AND DESIGN CRITERIA

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

Partial Flow Criteria (d/D)

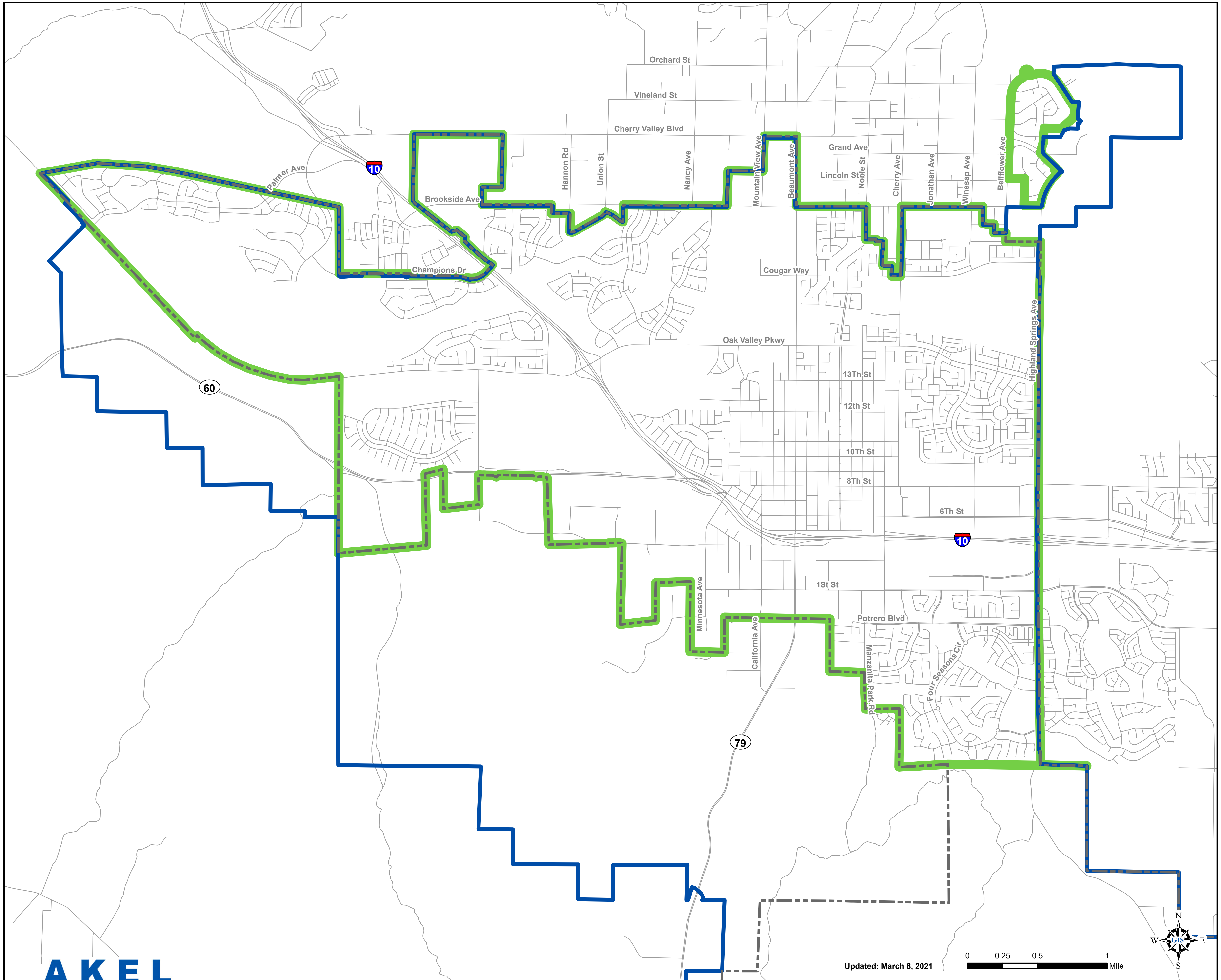
Partial flow in gravity sewers is expressed as a depth of flow to pipe diameter ratio (d/D). For circular gravity conduits, the highest capacity is generally reached at 92 percent of the full height of the pipe (d/D ratio of 0.92). This is due to the additional wetted perimeter and increased friction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

When designing wastewater pipelines, it is common practice to use variable flow depth criteria that allow higher safety factors in larger sizes. Thus, design d/D ratios may range between 0.5 and 0.92, with the lower values used for smaller pipes. The smaller pipes may experience flow peaks greater than planned or may experience blockages from debris. The City's design standards pertaining to the d/D criteria are summarized in **Table ES.1**.

During peak dry weather flows (PDWF), the maximum allowable d/D ratio for gravity pipelines are summarized as follows:

- 12-inch diameter and smaller: 0.50
- 15-inch diameter and larger: 0.70

During peak wet weather flows (PWWF), the maximum allowable d/D ratio for proposed pipes (all diameters) is 0.75. The maximum allowable d/D ratio for all existing pipes (all diameters) is 1.00. The criterion for existing pipes is relaxed in order to maximize the use of the existing pipes before costly pipes improvements are required. This condition is evaluated using the dynamic hydraulic model and the criteria listed on **Table ES.1**.



Legend

- Sewer Service Area
- General Plan Boundary
- City Limits
- Street Centerlines

PRELIMINARY

ES.2
Service Area
Wastewater Master Plan
City of Beaumont

BEAUMONT
CALIFORNIA

Table ES.1 Wastewater System Performance and Design Criteria

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Dry Weather Flow Criteria

Sewer Trunk	d/D
Diameter < 15 inches	0.50
Diameter ≥ 15 inches	0.70

Wet Weather Flow Criteria

Sewer Trunk	d/D
Existing System	1.00
Future System	0.75

Pipe Slope Criteria

Pipe Size	Minimum Slope (ft/ft)
8"	0.004
10"	0.0032
12"	0.0024
15"	0.0016
18"	0.0014
21"	0.0012
24" and Up	0.001

Pipe Velocity Criteria

Pipe Type	Minimum / Maximum Velocity (fps)
Gravity Sewer	Minimum 2 / Maximum 10
Force Main	Desired 2 to 6.5 / Maximum 10

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3/2/2021

Notes:

1. Source: Eastern Municipal Water District Wastewater Collection System Master Plan
2. Wastewater Collection System performance criteria shall be in accordance with EMWD WCSMP.

ES.4 EXISTING WASTEWATER COLLECTION SYSTEM OVERVIEW

The City provides wastewater collection services to approximately 15,671 residential, commercial, public facilities and institutional accounts. rThe City's existing wastewater collection system consists of approximately 196 miles of gravity mains and force mains, and 10 lift stations that convey flows to the City's WWTP.

The City's existing wastewater collection system is shown in **Figure ES.3**, which displays the existing system by pipe size. This figure provides a general color coding for the collection mains, as well as labeling the existing lift stations.

ES.5 WASTEWATER FLOWS

The wastewater flows collected and treated at the City of Beaumont WWTP vary monthly, daily, and hourly. While the dry weather flows are influenced by customer uses, the wet weather flows are influenced by severity of storm events and the condition of the system.

Flow data influent to the City of Beaumont WWTP was obtained from City operation staff. The flow data covered a period from 2012 to 2019. From this data monthly, daily, and peak daily flows, were determined.

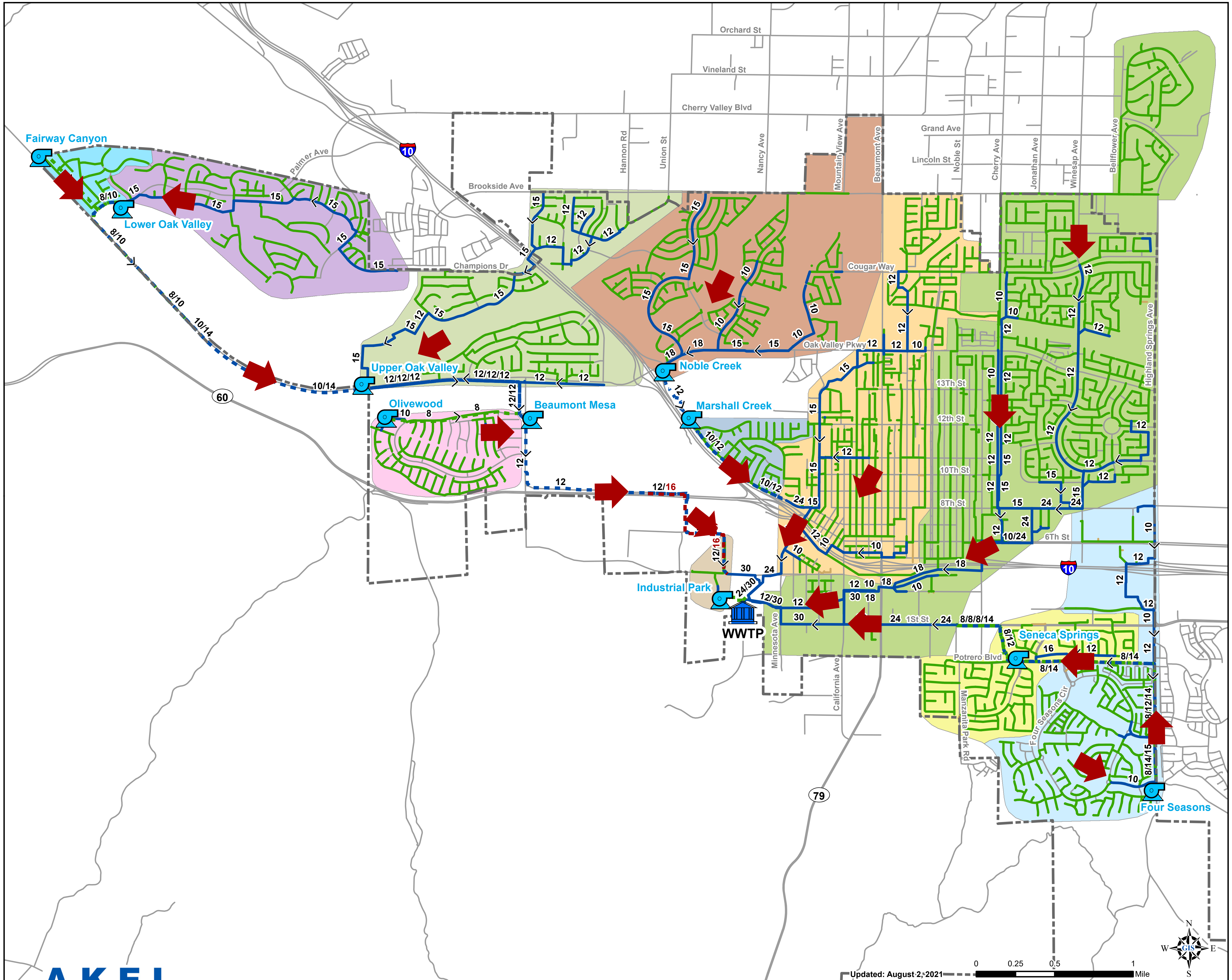
The land use methodology was used to estimate the buildout wastewater flows from City's Planning Area and to be consistent with the General Plan. The undeveloped lands were multiplied by the corresponding unit flow factor to estimate the wastewater flows. The buildout average daily flows were calculated at 17.8 mgd.

ES.6 HYDRAULIC MODEL DEVELOPMENT AND CALIBRATION

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

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

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



ES.3
Sewer Collection Basins
Wastewater Master Plan
City of Beaumont

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Model Development

The hydraulic model for the City of Beaumont was skeletonized to include the pipelines essential to the hydraulic analysis. By comparison, skeletonizing was necessary to reduce the model from 4,300 pipes extracted from GIS to 800 pipes; the total system includes approximately 196 miles of pipe, whereas the hydraulic model includes approximately 56 miles of pipelines. Skeletonizing the model is useful in creating a system that accurately reflects the hydraulics of the pipes within the system while reducing the complexities of large models. This process reduces the time of analysis while maintaining accuracy, but will also comply with the limitations imposed by the computer program. The modeled pipes included pipes 8-inches in a diameter and larger, in addition to some critical smaller gravity wastewater pipes. The inventory pipelines included in the hydraulic model is approximately 28 percent of the overall system.

Model Calibration

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

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

- Peak dry weather flows.
- Peak wet weather flows from storm rainfall Event No. 1(12 March 2020 -13 March 2020)
- Peak wet weather flows from storm rainfall Event No. 2(9 March 2020 - 10 March 2020)

After the model is calibrated to these conditions, it is benchmarked and used for evaluating the capacity adequacy of the wastewater collection system, under dry and wet weather conditions. The model was also used to identify improvements necessary for mitigating existing system deficiencies and for accommodating future growth.

The hydraulic model is a valuable investment that will continue to prove its worth to the City as future planning issues or other operational conditions surface. It is recommended that the model be maintained and updated with new construction projects to preserve its integrity.

ES.7 CAPACITY EVALUATION

The system performance and design criteria were used as a basis to judge the adequacy of capacity for the existing wastewater collection system. The design flows simulated in the hydraulic model for existing conditions and are listed as follows:

- Existing PDWF = 9.3 mgd
- Existing PWWF = 9.8 mgd

During the peak dry weather simulations, the maximum allowable pipe d/D criteria for gravity pipelines (0.50 for wastewater mains less than or equal to 12-inch or, 0.70 for wastewater mains greater than 12-inch) was used. During the peak wet weather simulations, the existing wastewater mains are allow to reach the full capacity of 1.0 while the future wastewater mains are allow to 75 percent full.

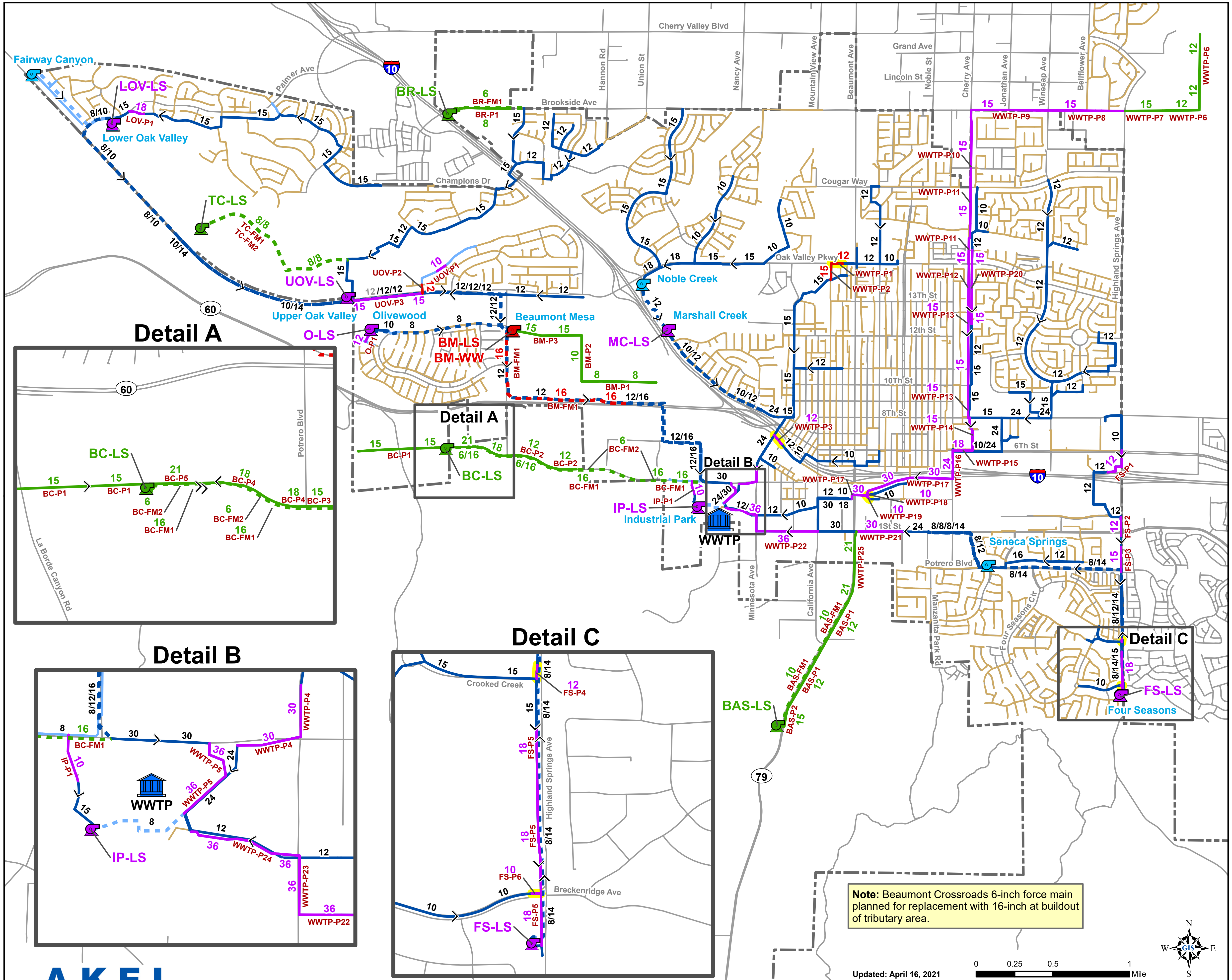
In general, the hydraulic model indicated that the wastewater collection system exhibited acceptable performance to service the existing customers during both peak dry weather flows and peak wet weather flows. Future flows were then added to the hydraulic model and the existing system was expanded in order to serve these future customers. The proposed improvements for the future system are shown with pipe sizes on an overall exhibit on **Figure ES.4**.

ES.8 CAPITAL IMPROVEMENT PROGRAM

The Capital Improvement Program includes pipeline and lift station improvements recommended in this master plan (**Table ES.3**). Each improvement was assigned a uniquely coded identifier associated with its tributary area. The baseline costs for pipelines and lift stations are shown in **Table ES.2**. Improvements are shown in **Figure ES.4**.

The estimated costs include the baseline costs plus **20 percent** contingency allowance to account for unforeseen events and unknown field conditions. Capital improvement costs include the estimated construction costs plus **30 percent** project related costs (engineering design, project administration, construction management and inspection, and legal costs).

The costs in this Wastewater Master Plan were benchmarked using a 20-City national average ENR CCI of 11,849, reflecting a date of April 2021. In total, the CIP includes approximately 23 miles of gravity mains and force mains, on-going CCTV Program, lift station condition assessment, as well as wastewater treatment plant improvements with a cost totaling over $99 million dollars.



Legend

Future Improvements

Lift Stations
- Existing Deficiency
- Capacity Increase for Future Dev.
- Future Development Only

Force Mains
- Existing Deficiency
- Future Development Only

Gravity Mains
- Existing Deficiency
- Capacity Increase for Future Dev.
- Future Development Only
- Pipe Slope Reconstruction

Existing System
- Lift Stations

Modeled Force Mains
- 8" and Smaller
- 10" and Larger

Modeled Gravity Mains
- 8"
- 10" and Larger
- Non-Modeled Pipes
- Street Centerlines
- City Limits

PRELIMINARY

ES.4
Capital Improvement Program
Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA

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Table ES.2 Unit Costs

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Pipeline	
Gravity Main[1]	
Pipe Size (in)	**Cost[1]** ($/lineal foot)
8	$191
10	$200
12	$208
15	$230
18	$247
21	$331
24	$396
27	$468
30	$526
36	$670
Force Main[1]	
6	$216
8	$264
10	$278
16	$376
Operational and Maintenance[2]	
Sewer Pipeline CCTV	$2.10
Sewer Pipeline Cleaning	$1.80

Lift Station[3]

Estimated Lift Station Project Cost = $9,665*Q^2$ + 314,097*Q + 365,718, where Q is in mgd

AKEL ENGINEERING GROUP, INC.

5/21/2021

Notes :

1. Unit costs indexed using the Engineering News Record (ENR) Construction Cost Index of 11,849 for April 2021.
2. Sewer pipeline operational and maintenance costs based on Akel Engineering Group experience on similar projects.
3. Lift Station costs based on Akel Engineering Group experience on similar projects and escalated using the Engineering News Record (ENR) Construction Cost Index of 11,849 for April 2021.

Table ES.3 Capital Improvement Program
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvements Details				Infrastructure Costs		Baseline Constr. Cost	Estimated Const. Cost[1]	Capital Impro. Cost[2,3]	Future Flow Service Location	Construction Trigger[4]
				Existing Diameter (in)	New/ Replace	Diameter (in)	Length (ft)	Unit Cost ($)	Infr. Cost ($)	($)	($)	($)		
Lower Oak Valley Lift Station Tributary Area														
Gravity Main Improvements														
LOV-P1	Future Capacity Increase	Irwin St	From Floyd Cir to Palmer Ave	15	Replace	18	525	247	129,621	129,700	155,700	202,500	Within City Limit	Approximately 200 EDUs
Lift Station Improvements														
LOV-LS	Lift Station Replacement	Lower Oak Valley Lift Station		-	Replace	3 @ 625 gpm		-	1,284,238	1,284,300	1,541,200	2,003,600	Within City Limit	Approximately 260 EDUs
				Subtotal - Lower Oak Valley Lift Station Tributary Area Improvements						**1,414,000**	**1,696,900**	**2,206,100**		
Tukwet Canyon (New) Lift Station Tributary Area														
Force Main Improvements														
TC-FM1	New Force Main	Sorenstam Dr/Price St	From Tukwet Canyon lift station to approx. 1,000' n/o Upper Oak Valley lift station	-	New	8	6,250	264	1,652,656	1,652,700	1,983,300	2,578,300	Within City Limit	As Development Occurs
TC-FM2	New Force Main	Sorenstam Dr/Price St	From Tukwet Canyon lift station to approx. 1,000' n/o Upper Oak Valley lift station	-	New	8	6,250	264	1,652,656	1,652,700	1,983,300	2,578,300	Within City Limit	As Development Occurs
Lift Station Improvements														
TC-LS	New Lift Station	Tukwet Canyon Lift Station		-	New	3 @ 375 gpm		-	899,920	900,000	1,080,000	1,404,000	Within City Limit	As Development Occurs
				Subtotal - Tukwet Canyon (New) Lift Station Tributary Area Improvements						**4,205,400**	**5,046,600**	**6,560,600**		
Upper Oak Valley Lift Station Tributary Area														
Gravity Main Improvements														
UOV-P1	Future Capacity Increase	Straightaway Dr	From Balata St to 350' sw/o Balata St	8	Replace	10	350	200	69,910	70,000	84,000	109,200	Within City Limit	Approximately 70 EDUs
UOV-P2	Existing Capacity Deficiency	Apron Ln	From Stableford Ct to Oak Valley Pkwy	8	Replace	12	300	208	62,342	62,400	74,900	97,400	Within City Limit	FY 2023/24
UOV-P3	Future Capacity Increase	Oak Valley Pkwy	From Apron Ln to 2,450' w/o Apron Ln	12	Replace	15	2,500	230	575,740	575,800	691,000	898,300	Within City Limit	Approximately 1,360 EDUs
Lift Station Improvements														
UOV-LS	Lift Station Replacement	Upper Oak Valley Lift Station		-	Replace	3 @ 1,850 gpm		-	3,493,305	3,493,400	4,192,100	5,449,800	Within City Limit	Approxiamtely 2,360 EDUs
				Subtotal - Upper Oak Valley Lift Station Tributary Area Improvements						**4,201,600**	**5,042,000**	**6,554,700**		
Olivewood Lift Station Tributary Area														
Gravity Main Improvements														
O-P1	Future Capacity Increase	ROW	From Artisan Pl to approx. 500' n/o Artisan Pl	10	Replace	12	525	208	109,099	109,100	131,000	170,300	Within City Limit	Approximately 750 EDUs
Lift Station Improvements														
O-LS	Lift Station Replacement	Olivewood Lift Station		-	Replace	2 @ 650 gpm		-	987,577	987,600	1,185,200	1,540,800	Within City Limit	Approximately 710 EDUs
				Subtotal - Olivewood Lift Station Tributary Area Improvements						**1,096,700**	**1,316,200**	**1,711,100**		

Table ES.3 Capital Improvement Program
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvements Details				Infrastructure Costs		Baseline Constr. Cost	Estimated Const. Cost[1]	Capital Impro. Cost[2,3]	Future Flow Service Location	Construction Trigger[4]
				Existing Diameter (in)	New/ Replace	Diameter (in)	Length (ft)	Unit Cost ($)	Infr. Cost ($)	($)	($)	($)		
Brookside Avenue (New) Lift Station Tributary Area														
Gravity Main Improvements														
BR-P1	New Capacity	Brookside Ave	From 480' w/o Deodar Dr to Brookside Ave lift station	-	New	8	2,200	191	420,656	420,700	504,900	656,400	Within City Limit	As Development Occurs
Force Main Improvements														
BR-FM1	New Force Main	Brookside Ave	From Brookside Ave lift station to Deodar Dr	-	New	6	2,825	216	609,832	609,900	731,900	951,500	Within City Limit	As Development Occurs
Lift Station Improvements														
BR-LS	New Lift Station	Brookside Ave Lift Station		-	New	2 @ 300 gpm		-	644,313	644,400	773,300	1,005,300	Within City Limit	As Development Occurs
						Subtotal - Brookside Avenue (New) Lift Station Tributary Area Improvements				**1,675,000**	**2,010,100**	**2,613,200**		
Beaumont Mesa Lift Station Tributary Area														
Gravity Main Improvements														
BM-P1	New Capacity	ROW	From 800' n/o Monero Valley Fwy to 2,600' e/o Potrero Blvd	-	New	8	2,575	191	492,359	492,400	590,900	768,200	Within City Limit	As Development Occurs
BM-P2	New Capacity	ROW	From 2,600' e/o Potrero Blvd to 1,400' s/o Oak Valley Pkwy	-	New	10	1,600	200	319,588	319,600	383,600	498,700	Within City Limit	As Development Occurs
BM-P3	New Capacity	ROW	From 1,400' s/o Oak Valley Pkwy to Beaumont Mesa lift station	-	New	15	2,350	230	541,196	541,200	649,500	844,400	Within City Limit	As Development Occurs
Force Main Improvements[5]														
BM-FM1	Force Main Design and Pump Design			-	New			-	-	-	-	450,000	Within City Limit	FY 2021/22
BM-FM1	New Force Main	Potrero Blvd/Western Knolls Ave	From Beaumont Mesa lift station to 1,300' w/o Western Knolls Ave	-	New	16	6,500	-	-	-	-	4,000,000	Within City Limit	FY 2022/23
Lift Station Improvements[5]														
BM-LS	Pump Replacement/Addition Construction			-	New	2 @ 3,500 gpm 2 @ 1,500 gpm		-	-	-	-	750,000	Within City Limit	FY 2022/23
BM-WW	Wet Well Design			-	New			-	-	-	-	400,000	Within City Limit	FY 2021/22
BM-WW	New Wet Well			-	New			-	-	-	-	4,000,000	Within City Limit	FY 2024/25
						Subtotal - Beaumont Mesa Lift Station Tributary Area Improvements				**1,353,200**	**1,624,000**	**11,711,300**		
Beaumont Crossroads (New) Lift Station Tributary Area														
Gravity Main Improvements														
BC-P1	New Capacity	W 4th St	From 1,875' s/o Moreno Valley Fwy to Beaumont Crossroads lift station	-	New	15	3,125	230	719,676	719,700	863,700	1,122,900	Within City Limit	As Development Occurs
BC-P2	New Capacity	W 4th St	From 275' w/o of Prosperity Way to 400' e/o Potrero Blvd	-	New	12	2,100	208	436,397	436,400	523,700	680,900	With Annexation	As Development Occurs
BC-P3	New Capacity	W 4th St	From 400' e/o Potrero Blvd to Potrero Blvd	-	New	15	375	230	86,361	86,400	103,700	134,900	With Annexation	As Development Occurs
BC-P4	New Capacity	W 4th St	From Potrero Blvd to 1,350' w/o Potrero Blvd	-	New	18	1,450	247	358,001	358,100	429,800	558,800	With Annexation	As Development Occurs
BC-P5	New Capacity	W 4th St	From 1,350' w/o Potrero Blvd to Beaumont Crossroads lift station	-	New	21	800	331	264,625	264,700	317,700	413,100	With Annexation	As Development Occurs

Table ES.3 Capital Improvement Program
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvements Details				Infrastructure Costs		Baseline Constr. Cost	Estimated Const. Cost[1]	Capital Impro. Cost[2,3]	Future Flow Service Location	Construction Trigger[4]
				Existing Diameter	New/ Replace	Diameter	Length	Unit Cost	Infr. Cost					
				(in)		(in)	(ft)	($)	($)	($)	($)	($)		
Force Main Improvements														
BC-FM1	New Force Main	W 4th St	From Beaumont Crossroads lift station to 100' e/o Nicholas Rd	-	New	16	9,175	376	3,447,614	3,447,700	4,137,300	5,378,500	With Annexation	As Development Occurs
BC-FM2	New Force Main	W 4th St	From Beaumont Crossroads lift station to 100' e/o Nicholas Rd	-	New	6	9,175	216	1,980,605	1,980,700	2,376,900	3,090,000	With Annexation	As Development Occurs
Lift Station Improvements														
BC-LS	New Lift Station	Beaumont Crossroads Lift Station		-	New	3 @ 2,350 gpm		-	4,550,536	4,550,600	5,460,800	7,099,100	With Annexation	As Development Occurs
Subtotal - Beaumont Crossroads (New) Lift Station Tributary Area Improvements										**11,844,300**	**14,213,600**	**18,478,200**		
Marshall Creek Lift Station Tributary Area														
Lift Station Improvements														
MC-LS	Lift Station Replacement	Marshall Creek Lift Station		-	Replace	2 @ 1,700 gpm		-	2,135,215	2,135,300	2,562,400	3,331,200	Within City Limit	Approximately 1,200 EDUs
Subtotal - Marshall Creek Lift Station Tributary Area Improvements										**2,135,300**	**2,562,400**	**3,331,200**		
Industrial Park Lift Station Tributary Area														
Gravity Main Improvements														
IP-P1	Future Capacity Increase	Risco Cir	From W 4th St to 425' s/o W 4th St	8	Replace	10	475	200	94,878	94,900	113,900	148,100	Within City Limit	Approximately 190 EDUs
Lift Station Improvements														
IP-LS	Lift Station Replacement	Industrial Park Lift Station		-	Replace	2 @ 300 gpm		-	644,313	644,400	773,300	1,005,300	Within City Limit	Approximately 20 EDUs
Subtotal - Industrial Park Lift Station Tributary Area Improvements										**739,300**	**887,200**	**1,153,400**		
Beaumont Avenue South (New) Lift Station Tributary Area														
Gravity Main Improvements														
BAS-P1	New Capacity	Beaumont Ave	From 1,200' n/o Laird Rd to 2,775' sw/o Laird Rd	-	New	12	4,125	208	857,209	857,300	1,028,800	1,337,500	With Annexation	As Development Occurs
BAS-P2	New Capacity	Beaumont Ave	From 2,775' sw/o Laird Rd to Beaumont Avenue lift station	-	New	15	875	230	201,509	201,600	242,000	314,600	With Annexation	As Development Occurs
Force Main Improvements														
BAS-FM1	New Force Main	Beaumont Ave	From Beaumont Avenue lift station to 2,450' s/o E 1st St	-	New	10	5,025	278	1,398,669	1,398,700	1,678,500	2,182,100	With Annexation	As Development Occurs
Lift Station Improvements														
BAS-LS	New Lift Station	Beaumont Avenue South Lift Station		-	New	3 @ 900 gpm		-	1,733,029	1,733,100	2,079,800	2,703,800	With Annexation	As Development Occurs
Subtotal - Beaumont Avenue South (New) Lift Station Tributary Area Improvements										**4,190,700**	**5,029,100**	**6,538,000**		
Wastewater Treatment Plant Tributary Area														
Gravity Main Improvements														
WWTP-P1	Future Capacity Increase	Oak Valley Pkwy	From 550' w/o San Miguel Dr to 150' w/o San Miguel Dr	12	Replace	12	425	208	88,319	88,400	106,100	138,000	Within City Limit	Approximately 370 EDUs

Table ES.3 Capital Improvement Program

Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvements Details				Infrastructure Costs		Baseline Constr. Cost	Estimated Const. Cost[1]	Capital Impro. Cost[2,3]	Future Flow Service Location	Construction Trigger[4]
				Existing Diameter (in)	New/ Replace	Diameter (in)	Length (ft)	Unit Cost ($)	Infr. Cost ($)	($)	($)	($)		
WWTP-P2	Existing Capacity Deficiency	Edgar Ave	From Oak Valley Pkwy to 575' s/o Oak Valley Pkwy	12	Replace	15	575	230	132,420	132,500	159,000	206,700	Within City Limit	FY 2022/23
WWTP-P3	Future Capacity Increase	Luis Estrada Rd	From 400' se/o Veile Ave to Veile Ave	12	Replace	12	425	208	88,319	88,400	106,100	138,000	Within City Limit	Approximately 3,830 EDUs
WWTP-P4	Future Capacity Increase	Minnesota Ave/W 4th St	From 525' n/o W 4th St to 600' w/o Minnesota Ave	24	Replace	30	1,125	526	592,178	592,200	710,700	924,000	Within City Limit	Approximately 5,890 EDUs
WWTP-P5	Future Capacity Increase	ROW	From 4th St to 1,100' w/o Minnesota Ave	30	Replace	36	950	670	636,064	636,100	763,400	992,500	Within City Limit	Approximately 8,820 EDUs
WWTP-P6	New Capacity	ROW	From 2,300 ne/o Highland Springs Ave to 1,300 e/o Highland Springs Ave	-	New	12	3,875	208	805,257	805,300	966,400	1,256,400	With Annexation	As Development Occurs
WWTP-P7	New Capacity	ROW	From 1,300' e/o Highland Springs Ave to Highland Springs Ave	-	New	15	1,300	230	299,385	299,400	359,300	467,100	With Annexation	As Development Occurs
WWTP-P8	Future Capacity Increase	Brookside Ave	From Highland Springs Ave to Orchard Heights Ave	8	Replace	15	2,650	230	610,285	610,300	732,400	952,200	With Annexation	As Development Occurs
WWTP-P9	Future Capacity Increase	Brookside Ave	From Orchard Heights Ave to Cherry Ave	8	Replace	15	2,700	230	621,800	621,800	746,200	970,100	Within City Limit With Annexation	Approximately 320 EDUs
WWTP-P10	Future Capacity Increase	Cherry Ave	From Brookside Ave to Cougar Way	8	Replace	15	2,650	230	610,285	610,300	732,400	952,200	Within City Limit With Annexation	Approximately 300 EDUs
WWTP-P11	Future Capacity Increase	Cherry Ave	From Cougar Way to Oak Valley Pkwy	8	Replace	15	2,675	230	616,042	616,100	739,400	961,300	Within City Limit With Annexation	Approximately 210 EDUs
WWTP-P12	Future Capacity Increase	Cherry Ave	From oak Valley Pkwy to Antonell Ct	10	Replace	15	1,700	230	391,504	391,600	470,000	611,000	Within City Limit With Annexation	Approximately 1,170 EDUs
WWTP-P13	Future Capacity Increase	Cherry Ave	From Antonell Ct to E 8th St	12	Replace	15	3,675	230	846,338	846,400	1,015,700	1,320,500	Within City Limit With Annexation	Approximately 2,430 EDUs
WWTP-P14	Future Capacity Increase	Illinois Ave	From E 8th St to E 6th St	12	Replace	15	1,175	230	270,598	270,600	324,800	422,300	Within City Limit With Annexation	Approximately 2,300 EDUs
WWTP-P15	Future Capacity Increase	E 6th St	From Illinois Ave to Pennsylvania Ave	15	Replace	18	700	247	172,828	172,900	207,500	269,800	Within City Limit With Annexation	Approximately 4,070 EDUs
WWTP-P16	Future Capacity Increase	Pennsylvania Ave	From E 6th St to 175' s/o Interstate 10	18	Replace	24	975	396	385,811	385,900	463,100	602,100	Within City Limit With Annexation	Approximately 1,940 EDUs
WWTP-P17	Future Capacity Increase	ROW	From Pennsylvania Ave to 75' w/o Beaumont Ave	18	Replace	30	3,800	526	2,000,246	2,000,300	2,400,400	3,120,600	Within City Limit With Annexation	Approximately 380 EDUs
WWTP-P18	Future Capacity Increase	ROW	From 125' n/o 3rd St to 400' e/o Beaumont Ave	10	Replace	10	125	200	24,968	25,000	30,000	39,000	Within City Limit	Approximately 2,680 EDUs
WWTP-P19	Future Capacity Increase	ROW	From 3rd St to 400' e/o Beaumont Ave	10	Replace	10	175	200	34,955	35,000	42,000	54,600	Within City Limit	Approximately 1,760 EDUs
WWTP-P20	Future Capacity Increase	ROW	From Rover Ln to 350' w/o Houstonia Ln	12	Replace	15	2,550	230	587,255	587,300	704,800	916,300	Within City Limit	Approximately 2,070 EDUs
WWTP-P21	Future Capacity Increase	E 1st St	From Palm Ave to Beaumont Ave	24	Replace	30	1,600	526	842,209	842,300	1,010,800	1,314,100	Within City Limit	Approximately 6,350 EDUs
WWTP-P22	Future Capacity Increase	E 1st st	From California Ave to Minnesota Ave	30	Replace	36	2,125	670	1,422,776	1,422,800	1,707,400	2,219,700	Within City Limit With Annexation	Approximately 15,780 EDUs
WWTP-P23	Future Capacity Increase	Minnesota Ave	From E 1st St to 575' n/o E 1st St	30	Replace	36	575	670	384,986	385,000	462,000	600,600	Within City Limit With Annexation	Approximately 23,390 EDUs
WWTP-P24	Future Capacity Increase	ROW	From 575' n/o E 1st St to 1,025' w/o Minnesota Ave	30	Replace	36	1,100	670	736,496	736,500	883,800	1,149,000	Within City Limit With Annexation	Approximately 2,500 EDUs
WWTP-P25	New Capacity	Beaumont Ave	From E 1st St to 1,275' n/o Laird Rd	-	New	21	2,475	331	818,683	818,700	982,500	1,277,300	With Annexation	As Development Occurs
				Subtotal - Wastewater Treatment Plant Tributary Area Improvements						**14,021,100**	**16,826,200**	**21,875,400**		

Table ES.3 Capital Improvement Program
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvements Details: Existing Diameter (in)	New/ Replace	Diameter (in)	Length (ft)	Infrastructure Costs: Unit Cost ($)	Infr. Cost ($)	Baseline Constr. Cost ($)	Estimated Const. Cost[1] ($)	Capital Impro. Cost[2,3] ($)	Future Flow Service Location	Construction Trigger[4]
Four Seasons Lift Station Tributary Area														
Gravity Main Improvements														
FS-P1	Future Capacity Increase	Highland Springs Ave	From E 6th St to 450' w/o Highland Springs Ave	10	Replace	12	1,225	208	254,565	254,600	305,600	397,300	Within City Limit	Approximately 640 EDUs
FS-P2	Future Capacity Increase	Highland Springs Ave	From 550' n/o E 1st St to 100' s/o E 1st St	10	Replace	12	650	208	135,075	135,100	162,200	210,900	Within City Limit	Approximately 690 EDUs
FS-P3	Future Capacity Increase	Highland Springs Ave	From 800' n/o Potrero Blvd to 50' s/o Potrero Blvd	12	Replace	15	850	230	195,752	195,800	235,000	305,500	Within City Limit	Approximately 1,340 EDUs
FS-P4	Pipe Slope Reconstruction	Highland Springs Ave	From 100' n/o Crooked Creek to Crooked Creek	12	Replace	12	100	208	20,781	20,800	25,000	32,500	Within City Limit	Approximately 1,470 EDUs
FS-P5	Future Capacity Increase	Highland Springs Ave	From 350' s/o Crooked Creek to 375' s/o Breckenridge Ave	15	Replace	18	1,525	247	376,518	376,600	452,000	587,600	Within City Limit	Approximately 1,840 EDUs
FS-P6	Future Capacity Increase	Breckenridge Ave	From 75' w/o Highland Springs Ave to Highland Springs Ave	10	Replace	10	75	200	14,981	15,000	18,000	23,400	Within City Limit	Approximately 1,830 EDUs
Lift Station Improvements														
FS-LS	Lift Station Replacement	Four Seasons Lift Station		-	Replace	3 @ 1,350 gpm		-	2,526,260	2,526,300	3,031,600	3,941,100	Within City Limit	Approximately 3,810 EDUs
									Subtotal - Four Seasons Lift Station Tributary Area Improvements	**3,524,200**	**4,229,400**	**5,498,300**		
Other Wastewater System Improvements[6]														
	Lift Station Condition Assessment							-	-	-	-	3,600,000	Within City Limit	FY 2022/23 - FY 2030/31
	CCTV Program							-	-	-	-	300,000	Within City Limit	FY 2023/24 FY 2029/30
	On-going Pipeline Replacement Program							-	-	-	-	4,800,000	Within City Limit	FY 2023/24 - FY 2030/31
	Wastewater Treatment Plant Improvements							-	-	-	-	2,000,000	Within City Limit	FY 2021/22 - FY 2024/25 FY 2028/29 - FY 2030/31
									Subtotal - Other Wastewater System Improvements	**-**	**-**	**10,700,000**		
Total Costs														
									Gravity Main Improvements	**20,759,000**	**24,912,800**	**32,388,800**		
									Force Main Improvements	**10,742,400**	**12,891,200**	**21,208,700**		
									Lift Station Improvements	**18,899,400**	**22,679,700**	**34,634,000**		
									Other Wastewater System Improvements	**-**	**-**	**10,700,000**		
									Total Improvement Cost	**50,400,800**	**60,483,700**	**98,931,500**		

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6/16/2021

Notes:

1. Estimated Construction costs include 20 percent of baseline construction costs to account for unforeseen events and unknown field conditions.
2. Unless noted otherwise, Capital Improvement Costs also include an additional 30 percent of the estimated construction costs to account for administration, construction management, and legal costs.
3. Cost allocation for development related improvements to be reviewed as construction triggers are reached.
4. EDU triggers based on remaining pipeline and lift station capacity and assumes 235 gpd/EDUs, consistent with EMWD Wastewater Master Plan Criteria.
5. Beaumont Mesa force main and wet well expansion reflects City staff budgetary planning estimate provided by City staff June 1, 2021.
6. Other wastewater system improvements reflects City staff budgetary planning estimate provided by City staff June 1, 2021.

CHAPTER 1 - INTRODUCTION

This chapter provides a brief background of the City of Beaumont's (City) wastewater collection system, the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

1.1 BACKGROUND

The City of Beaumont (City) is located approximately 11 miles north of the City of Hemet, 12 miles east of the City of Monero Valley, and 7 miles southeast of the City of Yucaipa (**Figure 1.1**). The City provides wastewater collection service to approximately 50,000 residents, as well as a myriad of commercial, industrial, and institutional establishments. The City owns, operates, and maintains the wastewater collection system, which consists of more than 196 miles of gravity trunks and force mains up to 48-inches in diameter, which ultimately convey flows to the City's Wastewater Treatment Plant.

Recognizing the importance of planning, developing, and financing system facilities to provide reliable wastewater service to existing customers and for servicing anticipated growth within the sphere of influence, the City initiated the development of the 2021 Wastewater Master Plan.

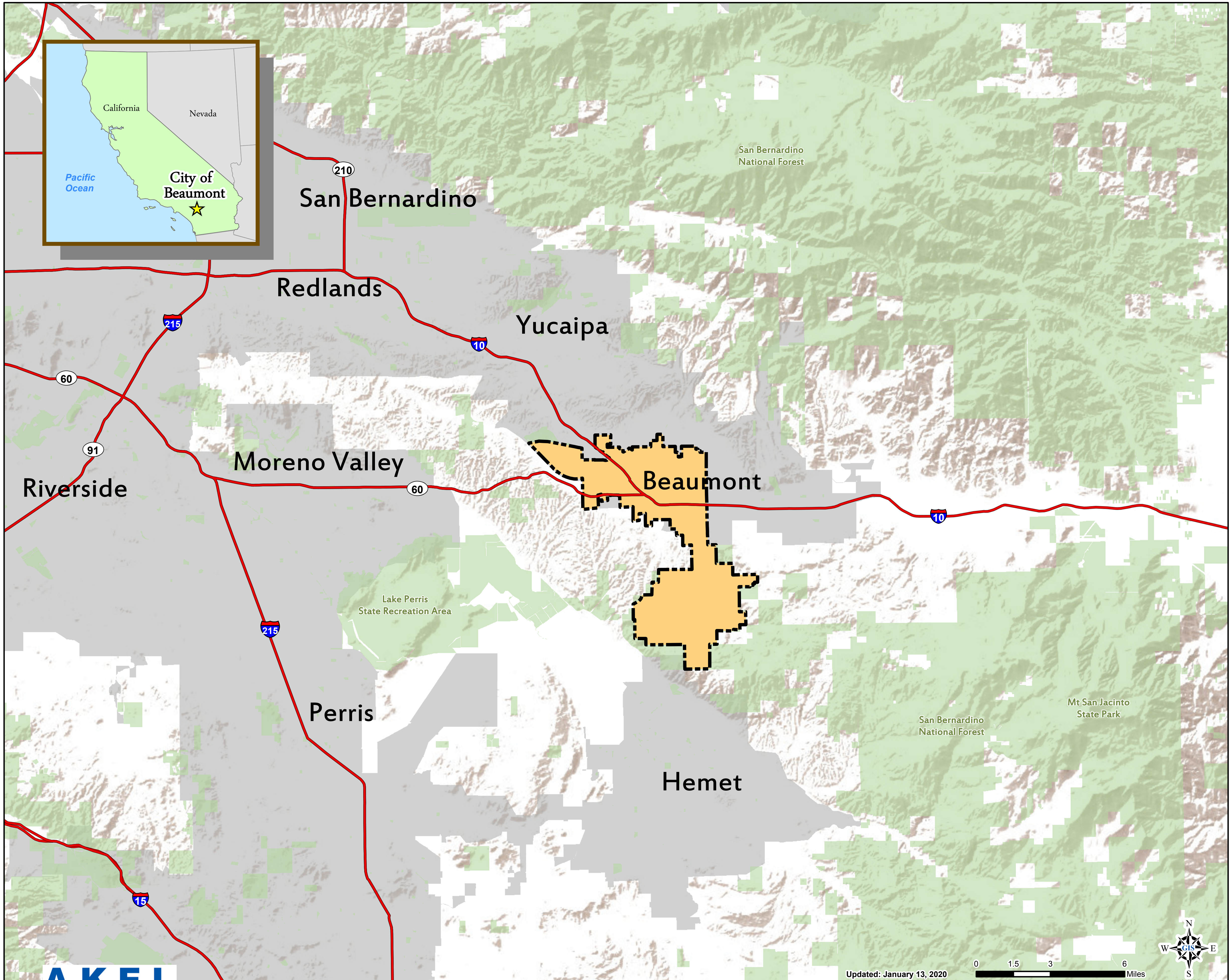
1.2 SCOPE OF WORK

City of Beaumont approved Akel Engineering Group Inc. to prepare this master plan in November of 2019. This 2021 Wastewater Master Plan (WWMP) is intended to serve as a tool for planning and phasing the construction of future wastewater system facilities for the projected buildout of the City of Beaumont. The 2021 WWMP evaluates the City's wastewater collection system and recommends capacity improvements necessary to service the needs of existing users and for servicing the future growth of the City.

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

This master plan includes the following tasks:

- Summarize the City's existing wastewater collection system facilities.
- Document growth planning assumptions and known future developments.
- Summarize the wastewater system performance criteria and design storm event.
- Project future wastewater flows.
- Develop and calibrate the physical characteristics of the hydraulic model (gravity mains, force mains, and lift stations).



Legend

- Major Highways
- City of Beaumont
- Urbanized Area
- Protected Open Space

PRELIMINARY

Figure 1.1
Regional Location Map
Wastewater Master Plan
City of Beaumont

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- Evaluate the adequacy of capacity for the sewer system facilities to meet existing and projected peak dry weather flows and peak wet weather flows.
- Recommend a capital improvement program (CIP) with an opinion of probable construction costs.
- Develop a 2021 Wastewater Master Plan Report.

1.3 REPORT ORGANIZATION

The Wastewater Master Plan report contains the following chapters:

Chapter 1 – Introduction. This chapter provides a brief background of the City of Beaumont's (City) wastewater collection system, the need for this master plan, and the objectives of the study. Abbreviations and definitions are also provided in this chapter.

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

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

Chapter 4 – Existing Wastewater Collection Facilities. This chapter provides a description of the City's existing wastewater collection system facilities including gravity trunks, force mains, lift stations, and wastewater collection basins. The chapter also includes a brief description of the City's WWTP, which treats and disposes of the wastewater for the City.

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

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

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

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

1.4 ACKNOWLEDGEMENTS

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

- Kristine Day, Assistant City Manager
- Jeff Hart, Public Works Director
- Thaxton Van Belle, Chief Plant Operator
- Kevin Lee, Wastewater Plant Supervisor

1.5 UNIT CONVERSIONS AND ABBREVIATIONS

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

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

Table 1.1 Unit Conversions

Wastewater Master Plan
City of Beaumont

PRELIMINARY

Volume Unit Calculations

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

Flow Rate Calculations

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

Table 1.2 Abbreviations and Acronyms

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Abbreviation	Expansion	Abbreviation	Expansion
10yr-24hr	10-Year 24-Hour	gpm	Gallons per Minute
AACE	Association for the Advancement of Cost Engineering	HE	Household equivalent
ADWF	Average Dry Weather Flow	HGL	Hydraulic Grade Line
AAF	Annual Average Flow	in/hr	Inch per Hour
Akel	Akel Engineering Group, Inc.	I&I	Infiltration and Inflow
AWWF	Average Wet Weather Flow	LF	Linear Feet
CCI	Construct Cost Index	LS	Lift Station
CIP	Capital Improvement Program	MDDWF	Maximum Day Dry Weather Flow
CIPP	Cured in Place Pipe	MDWWF	Maximum Day Wet Weather Flow
DDF	Depth Duration Frequency	MGD	Million Gallons per Day
d/D	depth of flow to pipe diameter	MMDWF	Maximum Month Dry Weather Flow
City	City of Beaumont	MMWWF	Maximum Month Wet Weather Flow
ENR	Engineering News Record	NASSCO	National Association of Sewer Service Companies
ft	Feet	NOAA	National Oceanic and Atmospheric Administration
fps	Feet per Second	PDWF	Peak Dry Weather Flow
FY	Fiscal Year	PWWF	Peak Wet Weather Flow
GIS	Geographic Information Systems	ROW	Right of Way
gpdc	Gallons per day per capita	UWMP	Urban Water Management Plan
gpd	Gallons per Day	WWTP	Wastewater Treatment Plant

1.6 GEOGRAPHIC INFORMATION SYSTEMS

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

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

CHAPTER 2 - PLANNING AREA CHARACTERISTICS

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

2.1 STUDY AREA DESCRIPTION

The City of Beaumont is located in Riverside County on the southern portion of California, east of the City of Banning. The City is located approximately 11 miles north of the City of Hemet, 5 miles east of the City of Banning, 12 miles east of City of Monero Valley, and 7 miles southeast of the City of Yucaipa. The City currently encompasses an area greater than 26,000 acres., with an approximate population of 50,000 residents.

The City's service area is generally bound to the north by Brookside Avenue, to the east by Highlands Springs Avenue, and to the southwest of Monero Valley Freeway. The topography is generally steep, with slopes increasing from north to south toward the Interstate 10. **Figure 2.1** displays the City's existing service area and the general plan boundary.

The City operates and maintains a wastewater collection system that covers the majority of the developable area within Planning Boundary. Currently, the wastewater flows are conveyed to the City of Beaumont Wastewater Treatment Plant (WWTP).

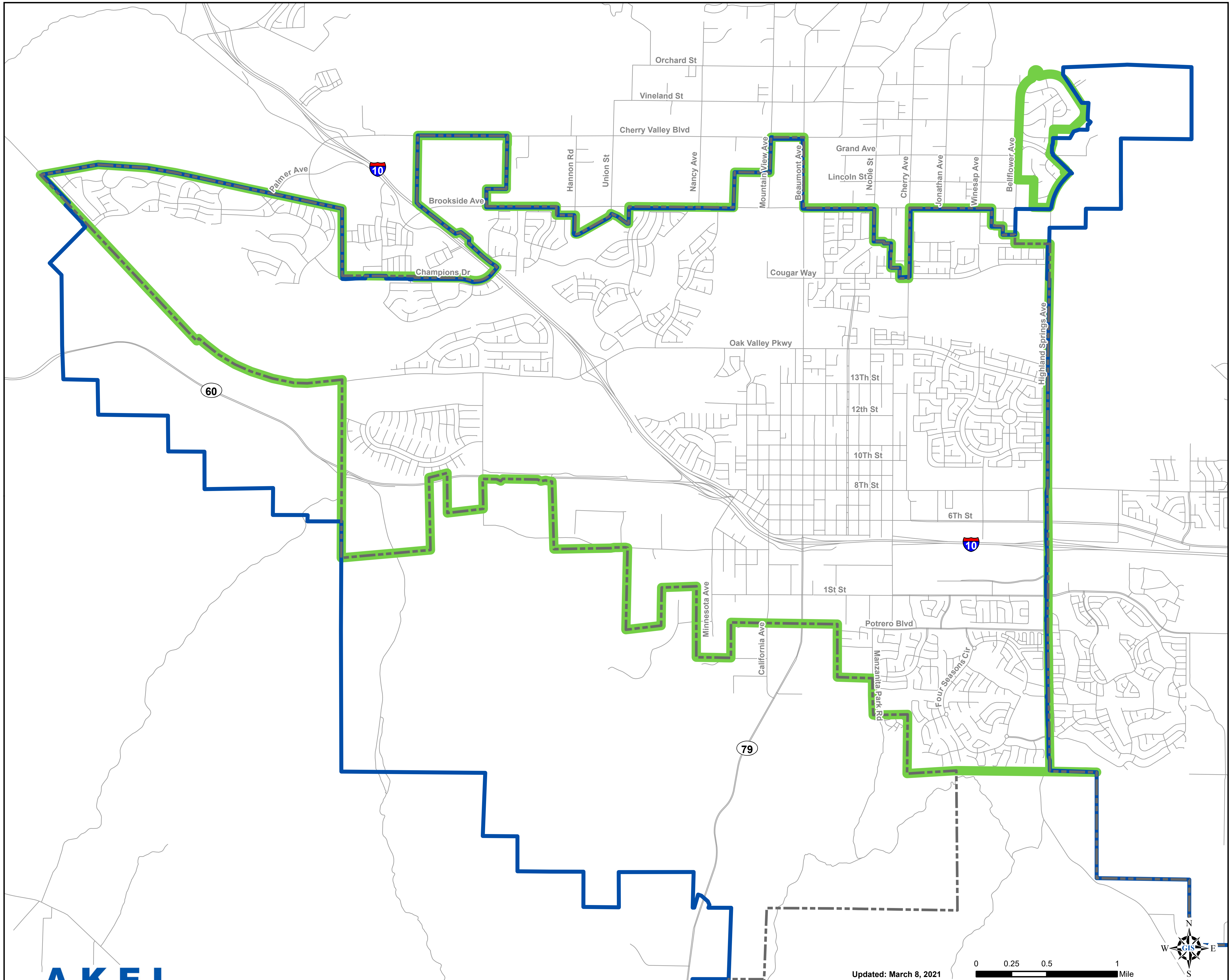
2.2 WASTEWATER COLLECTION SYSTEM SERVICE AREA

The City's wastewater collection system services residential and non-residential lands within the City limits, as summarized on **Table 2.1**, and shown graphically on **Figure 2.2**. Areas within the City's potential wastewater collection service area include:

- 3,205 acres of flow generating lands including residential and non-residential areas.
- 11,405 acres of non-flow generating areas.

The existing land use statistics were based on land use information received from City staff. Plan, however for the purposes of estimating wastewater flows, these acreages were assumed to retain their existing land use, such as residential or commercial. It should be noted that Cherry Valley operate own water and wastewater facilities; these users are not serviced by City's water system but do convey wastewater flows to the Beaumont WWTP. For planning purposes, most of the acreages are Single-Family Residential and included in **Table 2.1**.

An ultimate development of the General Plan, the City's wastewater collection system is anticipated to service approximately 6,793 acres of residential land use, 7,013 acres of non-residential land use, and 11,433 acres of non-flow generating land use, for a total of 25,239 acres inside the planning area, and including in **Table 2.1**. The land use designations utilized in this



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Legend

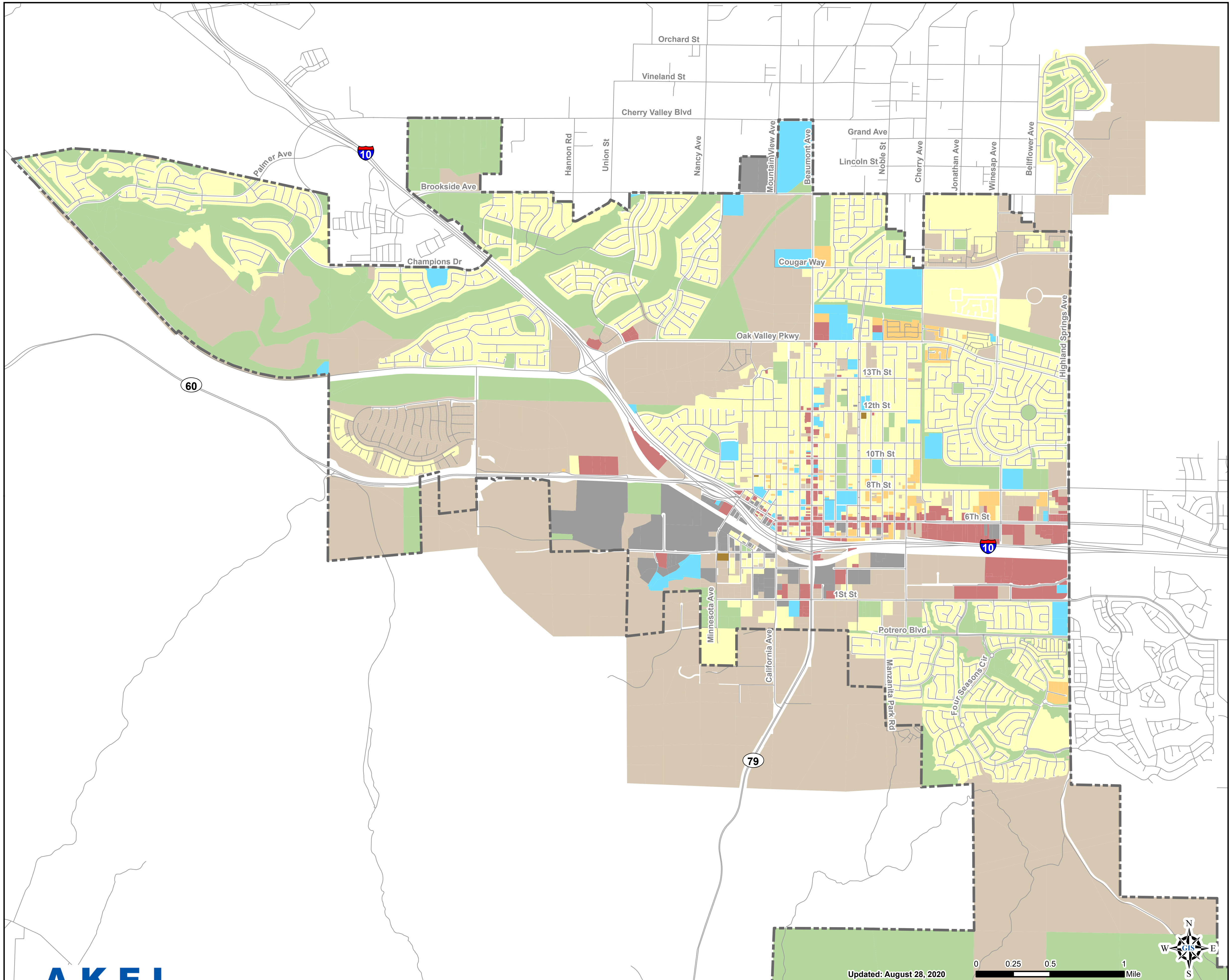
- Sewer Service Area
- General Plan Boundary
- City Limits
- Street Centerlines

PRELIMINARY

Figure 2.1
Service Area

Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA



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Legend

Existing Land Use

- Single Family Residential
- High Density Residential
- Public Facility
- General Commercial
- Industrial
- Open Space
- Utilities
- Vacant
- Street Centerlines
- City Limits

PRELIMINARY

Figure 2.2
Existing Land Use
Wastewater Master Plan
City of Beaumont

BEAUMONT
CALIFORNIA

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Table 2.1 Existing and Future Land Use
Wastewater Master Plan
City of Beaumont

PRELIMINARY

General Plan Land Use Classification[1]	Existing Land Use Classification[2]	Existing Development: Existing Development (acre)	Existing Development: Existing Lands - Redeveloping (acre)	Existing Development: Subtotal Existing Development - Unchanged (acre)	Future Development: New Lands - Redevelopment (acre)	Future Development: New development (acre)	Future Development: Subtotal Future Development (acre)	Total Development (acre)
1	2	3	4	5	6	7	8	9
Residential								
Single Family Residential	Single Family Residential Mobile Homes and Trailer Parks Mixed Residential	2,568	-178	2,389	118	588	706	3,096
High Density Residential	Multi-Family Residential	134	-51	83	6	276	282	364
Rural Residential	Rural Residential	0	0	0	2,446	312	2,758	2,758
Traditional Neighborhood	-	0	0	0	76	499	574	574
	Subtotal - Residential	**2,701**	**-229**	**2,472**	**2,645**	**1,676**	**4,321**	**6,793**
Non-Residential								
General Commercial	Commercial and Services General Office	389	-147	242	28	324	352	595
Neighborhood Commercial	-	0	0	0	34	11	46	46
Industrial	Industrial	280	-69	211	52	315	367	577
Public Facility	Facilities Education	293	-13	280	44	64	107	388
Downtown Mixed Use	-	0	0	0	321	64	386	386
Urban Village	-	0	0	0	107	536	643	643
Employment District	-	0	0	0	0	179	179	179
Specific Plans and Other Developments	-	0	0	0	0	4,200	4,200	4,200
	Subtotal - Non-Residential	**962**	**-229**	**733**	**586**	**5,693**	**6,280**	**7,013**
Non-Flow Generating								
Open Space	Open Space and Recreation	8,533	-221	8,312	0	28	28	8,341
	Agriculture	0	0	0	0	0	0	0
Vacant	Vacant	2,934	0	2,934	0	0	0	2,934
Utilities	Utilities	4	0	4	0	0	0	4
ROW	ROW	155	0	155	0	0	0	155
	Subtotal - Non-Flow	**11,626**	**-221**	**11,405**	**0**	**28**	**28**	**11,433**
	Total Developed Area	**15,289**	**-679**	**14,610**	**3,231**	**7,397**	**10,628**	**25,239**

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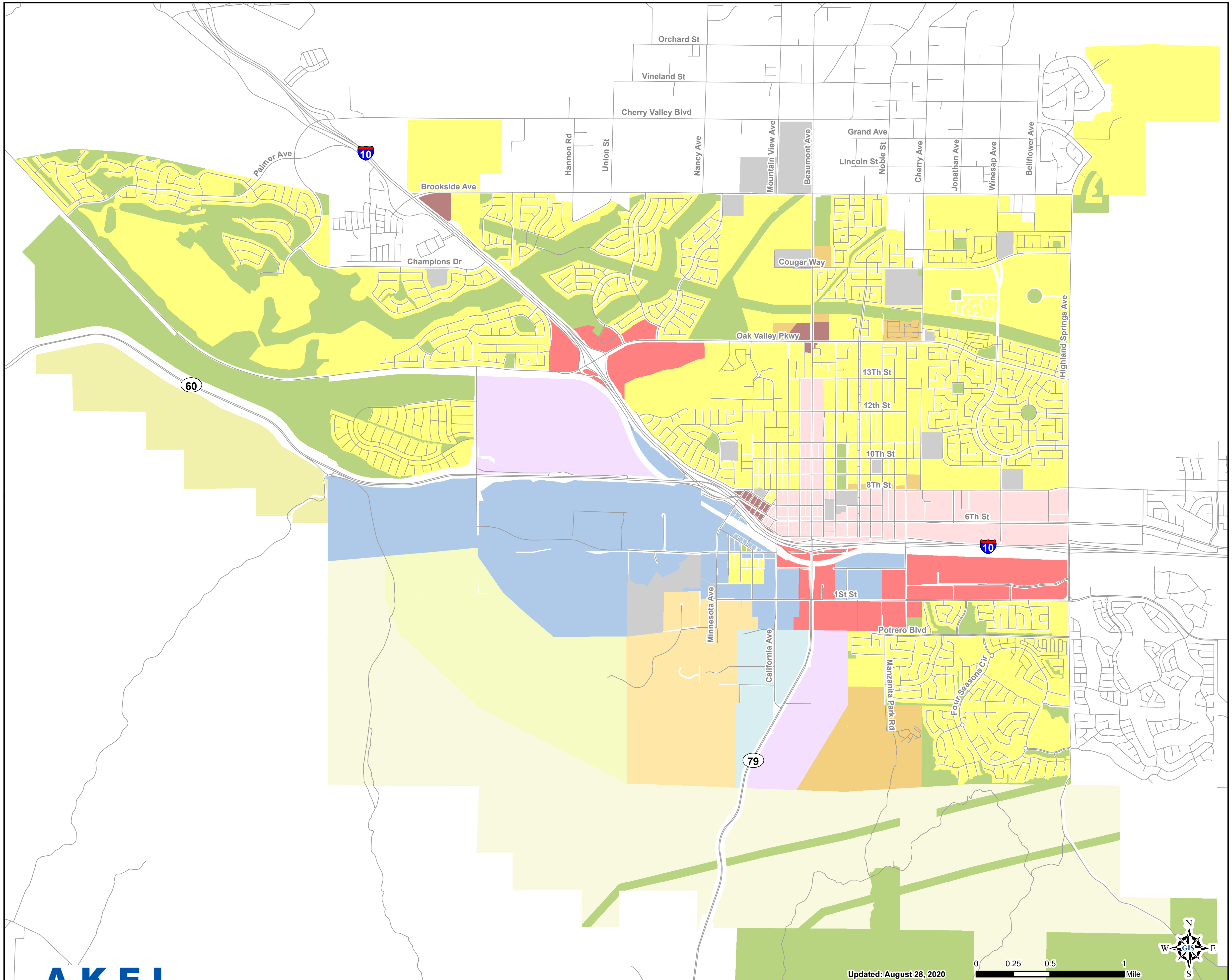
8/31/2020

Notes:
1. Source: City of Beaumont Public Draft General Plan (2020)
2. Source: Southern California Association of Governments (SCAG) 2016 Existing Land Use file extracted from City of Beaumont Planning Viewer online web application.

master plan are consistent with the Land Use Element of the City's General Plan, and as received from the City's planning division and shown on **Figure 2.3**.

In addition to the General Plan Land Use documented on **Figure 2.3** there are multiple areas of known development, which are defined by Specific Plans or other development planning information. These known development areas provide a more refined definition of planned land uses, which is used for estimating future flows. The known development areas are summarized on **Figure 2.4**, with the land use information shown on **Table 2.2**. Based on a review of aerial imagery and existing land use information some known development areas are partially developed or completely developed. The areas or remaining development area summarized on **Table 2.3**. The known development areas are briefly summarized in the following sections:

- **Amazon:** This development includes approximately 66 acres of industrial use.
- **ASM:** This development includes approximately 49 acres of industrial use.
- **Beaumont Commercial Center:** This development includes approximately 17 acres of commercial use.
- **Beaumont Crossroads II:** This development includes approximately 166 acres of industrial use.
- **Curtis Development:** This development includes approximately 67 acres of single-family residential use.
- **Fairway Canyon:** This development includes approximately 703 acres, which includes 661 acres of single-family residential, 12 acres of commercial and 30 acres of public facilities.
- **Four Seasons:** This development includes approximately 386 acres, which includes 366 acres of single-family residential, 3 acres of multi-family residential and 17 acres of commercial.
- **Hall:** This development includes approximately 11 acres of industrial use.
- **Heartland/Olivewood:** This development includes approximately 279 acres, which includes 208 acres of single-family residential, 12 acres of commercial, 50 acres of industrial and 9 acres of public facilities.
- **Home Depot:** This development includes approximately 22 acres of commercial use.
- **Jack Rabbit Trail:** This development includes approximately 255 acres, which includes 30 acres of commercial and 225 acres of industrial.
- **Kirkwood Ranch:** This development includes approximately 128 acres, which inlcudes 123 acres of single-family residential and 5 acres of multi-family residential.



Legend

2040 General Plan Land Use

- Open Space
- Employment District
- Industrial
- High Density Residential
- Traditional Neighborhood
- Single Family Residential
- Rural Residential 1
- Rural Residential 10
- Rural Residential 40
- Urban Village
- Downtown Mixed Use
- General Commercial
- Neighborhood Commercial
- Public Facilities
- Street Centerlines
- City Limits

PRELIMINARY

Figure 2.3
General Plan Land Use
Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA

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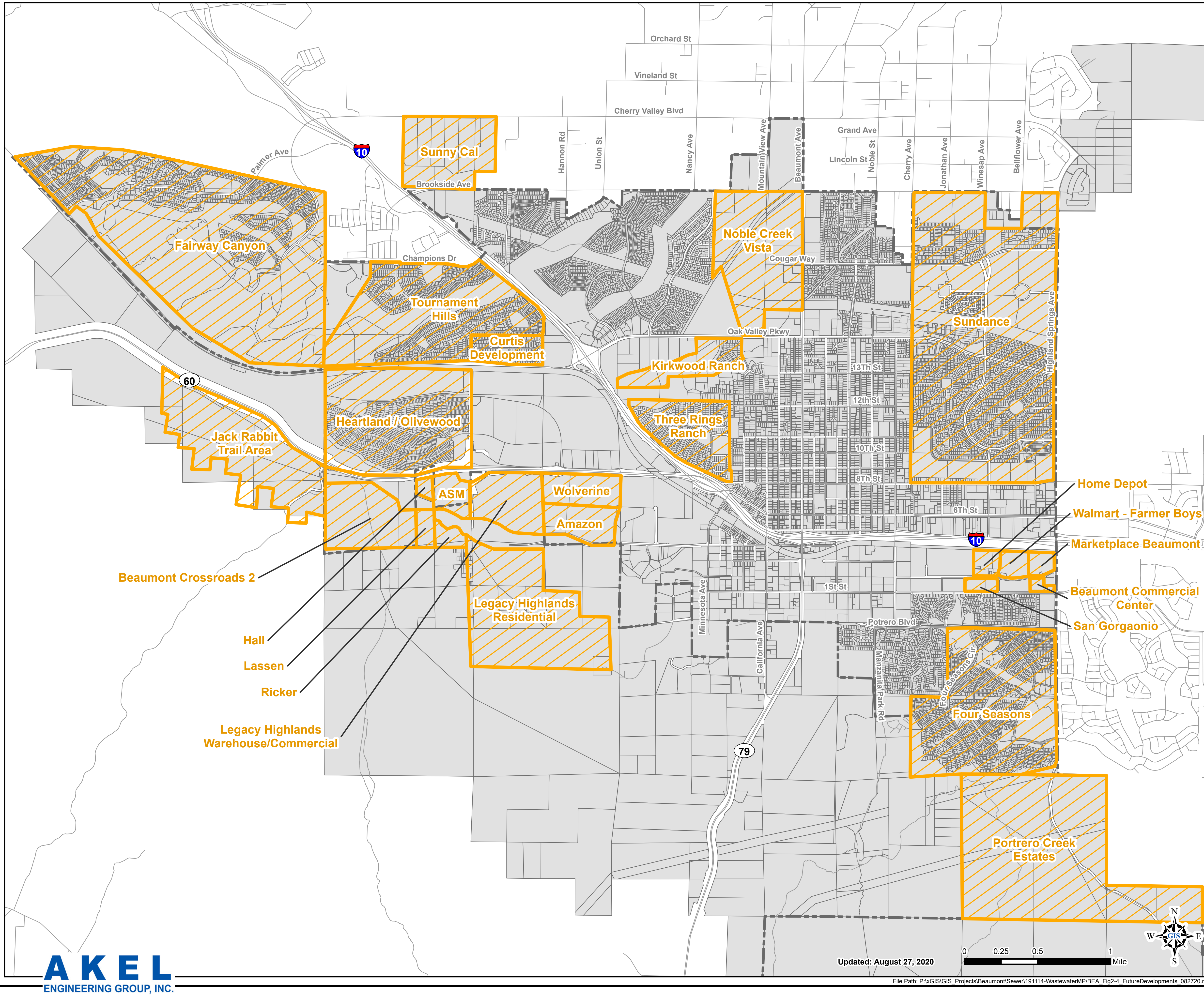
File Path: P:\xGIS\GIS_Projects\Beaumont\Sewer\191114-WastewaterMP\BEA_Fig2-3GeneralPlanLU_082820.mxd



Legend

- Development Areas
- Future Land Use
- Street Centerlines
- City Limits

PRELIMINARY

Figure 2.4
Specific Plans and Other Developments

Wastewater Master Plan
City of Beaumont

BEAUMONT
CALIFORNIA

Table 2.2 Specific Plans and Other Developments, Total Development Area

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Known Developments	Total Development Area, by Land Use Type[1]					
	Single Family Residential (acres)	Multi-Family Residential (acres)	Commercial (acres)	Industrial (acres)	Public Facilities (acres)	Total (acres)
Amazon	-	-	-	65.7	-	65.7
ASM	-	-	-	49.3	-	49.3
Beaumont Commercial Center	-	-	17.4	-	-	17.4
Beaumont Crossroads II	-	-	-	165.5	-	165.5
Curtis Development	66.7	-	-	-	-	66.7
Fairway Canyon	660.9	-	12.0	-	30.0	702.9
Four Seasons	365.3	3.3	17.0	-	-	385.6
Hall	-	-	-	11.2	-	11.2
Heartland/Olivewood	207.6	-	11.5	50.3	9.2	278.6
Home Depot	-	-	21.8	-	-	21.8
Jack Rabbit Trail	-	-	30.0	225.0	-	255.0
Kirkwood Ranch	123.0	5.0	-	-	-	128.0
Lassen	-	-	-	17.3	-	17.3
Legacy Highlands Residential	541.4	71.3	-	-	20.0	632.7
Legacy Highlands Warehouse	-	-	14.0	92.0	-	106.0
Marketplace Beaumont	-	-	17.4	-	-	17.4
Noble Creek Vistas	181.2	-	-	-	32.6	213.8
Portrero Creek Estates[2]	733.0	-	-	-	-	733.0
Ricker	-	-	-	18.0	-	18.0
San Gorgaonio	-	-	23.0	-	-	23.0
Sundance	874.4	39.0	14.0	-	39.0	966.3
Sunny Cal	112.1	-	-	-	-	112.1
Three Rings Ranch	143.2	10.0	-	-	-	153.2
Tournament Hills	305.4	-	34.4	-	10.0	349.8
Walmart - Farmer Boys	-	-	22.7	-	-	22.7
Wolverine	-	-	-	60.0	-	60.0
Total	**4,314**	**129**	**235**	**754**	**141**	**5,573**

10/19/2020

Notes:

1. Unless noted otherwise, development information shown based on planning documents provided by City staff on November 25, 2019 and December 5, 2019.
2. Source: City of Beaumont General Plan Public Draft, August 2020

Table 2.3 Specific Plans and Other Developments, Remaining Development Area

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Known Developments	Remaining Development Area, by Land Use Type[1]					
	Single Family Residential (acres)	Multi-Family Residential (acres)	Commercial (acres)	Industrial (acres)	Public Facilities (acres)	Total (acres)
Amazon	-	-	-	65.7	-	65.7
ASM	-	-	-	49.3	-	49.3
Beaumont Commercial Center	-	-	-	-	-	-
Beaumont Crossroads II	-	-	-	165.5	-	165.5
Curtis Development	-	-	-	-	-	-
Fairway Canyon	431.9	-	-	-	-	431.9
Four Seasons	216.3	-	-	-	-	216.3
Hall	-	-	-	11.2	-	11.2
Heartland/Olivewood	207.6	-	11.5	50.3	9.2	278.6
Home Depot	-	-	-	-	-	-
Jack Rabbit Trail	-	-	30.0	225.0	-	255.0
Kirkwood Ranch	123.0	5.0	-	-	-	128.0
Lassen	-	-	-	17.3	-	17.3
Legacy Highlands Residential	541.4	71.3	-	-	20.0	632.7
Legacy Highlands Warehouse	-	-	14.0	92.0	-	106.0
Marketplace Beaumont	-	-	-	-	-	-
Noble Creek Vistas	181.2	-	-	-	32.6	213.8
Portrero Creek Estates	733.0	-	-	-	-	733.0
Ricker	-	-	-	18.0	-	18.0
San Gorgaonio	-	-	4.3	-	-	4.3
Sundance	550.6	10.0	-	-	11.9	572.5
Sunny Cal	112.1	-	-	-	-	112.1
Three Rings Ranch	-	-	-	-	-	-
Tournament Hills	128.5	-	-	-	-	128.5
Walmart - Farmer Boys	-	-	-	-	-	-
Wolverine	-	-	-	60.0	-	60.0
Total	**3,226**	**86**	**60**	**754**	**74**	**4,200**

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10/19/2020

Notes:

1. Remaining development area based on a combination of SCAG 2016 Existing Land Use and aerial imagery review

Table 2.4 Specific Plans and Other Developments, Remaining Development Flows

Wastewater Master Plan
City of Beaumont

PRELIMINARY

Known Developments	Average Dry Weather Flows, by Land Use Type[1]					
	Single Family Residential (1,396 gpd/acre) (gpd)	Multi-Family Residential (2,609 gpd/acre) (gpd)	Commercial (1,175 gpd/acre) (gpd)	Industrial (1,763 gpd/acre) (gpd)	Public Facilities (1,175 gpd/acre) (gpd)	Total (gpd)
Amazon	-	-	-	115,900	-	115,900
ASM	-	-	-	86,828	-	86,828
Beaumont Commercial Center	-	-	-	-	-	-
Beaumont Crossroads II	-	-	-	291,847	-	291,847
Curtis Development	-	-	-	-	-	-
Fairway Canyon	602,932	-	-	-	-	602,932
Four Seasons	301,955	-	-	-	-	301,955
Hall	-	-	-	19,675	-	19,675
Heartland/Olivewood	289,810	-	13,513	88,679	10,810	402,811
Home Depot	-	-	-	-	-	-
Jack Rabbit Trail	-	-	35,250	396,675	-	431,925
Kirkwood Ranch	171,708	13,045	-	-	-	184,753
Lassen	-	-	-	30,570	-	30,570
Legacy Highlands Residential	755,794	186,022	-	-	23,500	965,316
Legacy Highlands Warehouse	-	-	16,450	162,196	-	178,646
Marketplace Beaumont	-	-	-	-	-	-
Noble Creek Vistas	253,011	-	-	-	38,305	291,316
Portrero Creek Estates	1,023,268	-	-	-	-	1,023,268
Ricker	-	-	-	31,734	-	31,734
San Gorgaonio	-	-	5,100	-	-	5,100
Sundance	768,652	26,090	-	-	13,983	808,724
Sunny Cal	156,464	-	-	-	-	156,464
Three Rings Ranch	-	-	-	-	-	-
Tournament Hills	179,316	-	-	-	-	179,316
Walmart - Farmer Boys	-	-	-	-	-	-
Wolverine	-	-	-	105,745	-	105,745
Total	**4,502,910**	**225,157**	**70,312**	**1,329,849**	**86,598**	**6,214,824**

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10/19/2020

Note:

1. Flows shown are based on remaining area to be developed for each known development.

- **Lassen:** This development includes approximately 17 acres of industrial use.
- **Legacy Highlands Residential:** This development includes approximately 633 acres, which includes 542 acres of single-family residential, 71 acres of multi-family residential and 20 acres of public facilities.
- **Legacy Highlands Warehouse:** This development includes approximately 106 acres, which includes 14 acres of commercial and 92 acres of industrial.
- **Marketplace Beaumont:** This development includes approximately 17 acres of commercial use.
- **Noble Creek Vistas:** This development includes approximately 214 acres, which includes includes 181 acres of single-family residential and 33 acres of public facilities.
- **Potrero Creek Estates:** This development includes approximately 733 acres of single-family residential use.
- **Ricker:** This development includes approximately 18 acres of industrial use.
- **San Gorgaonio:** This development includes approximately 23 acres of commercial use.
- **Sundance:** This development includes approximately 966 acres, which includes 874 acres of single-family residential, 39 acres of multi-family residential, 14 acres of commercial, and 39 acres of public facilities.
- **Sunny Cal:** This development includes approximately 112 acres of single-family residential use.
- **Three Rings Ranch:** This development includes approximately 153 acres, which includes 143 acres of single-family residential and 10 acres of multi-family residential.
- **Tournament Hills:** This development includes approximately 350 acres, which includes approximately 305 acres of single-family residential, 35 acres of commercial and 10 acres of public facilities.
- **Walmart – Farmer Boys:** This development includes approximately 23 acres of commercial use .
- **Wolverine:** This development includes approximately 60 acres of industrial use.

2.3 HISTORICAL AND FUTURE GROWTH

The City's historical and projected population data are provided by City staff and presented in **Table 2.5**. This table documents the historical population from 2007 to 2018 and the projected population by year to 2038. From 2009 to present the City's service area has observed an average annual growth rate of approximately 4.1 percent. Continuing with the downward growth trend projects the population of 2038 to increase from present 51,263 to 67,144 people.

Table 2.5 Historical and Projected Population

Wastewater Master Plan
City of Beaumont

PRELIMINARY

Year	Population City-Wide	Percent Growth (%)
Historical		
2007	28,250	10.9%
2008	31,317	10.9%
2009	32,403	5.3%
2010	36,877	5.3%
2011	38,201	5.3%
2012	39,317	5.3%
2013	40,472	5.3%
2014	41,659	3.6%
2015	43,370	3.6%
2016	44,821	3.6%
2017	46,179	3.6%
2018	48,237	3.6%
Projected		
2019	49,915	2.3%
2020	51,263	2.3%
2021	52,291	2.3%
2022	53,061	2.3%
2023	53,950	2.3%
2024	54,463	1.8%
2025	55,234	1.8%
2026	56,261	1.8%
2027	57,416	1.8%
2028	58,947	1.8%
2029	59,974	1.3%
2030	60,745	1.3%
2031	61,258	1.3%
2032	61,772	1.3%
2033	62,917	1.3%
2034	63,816	1.3%
2035	64,715	1.3%
2036	65,485	1.3%
2037	66,127	1.3%
2038	67,144	1.3%

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1/28/2020

Notes:

1. Historical and Projected Population provided by City staff on December 13, 2019.

CHAPTER 3 - SYSTEM PERFORMANCE AND DESIGN CRITERIA

This chapter presents the City's performance and design criteria that were used in this master plan for evaluating the adequacy of capacity for the existing wastewater collection system and for sizing improvements required to mitigate deficiencies and to accommodate future growth. The design criteria include: capacity requirements for the wastewater collection facilities, flow calculation methodologies for future users, flow peaking factors, and accounting for infiltration and inflows. The City has adopted the Eastern Municipal Water District wastewater system performance and design criteria for wastewater collection system planning and design.

3.1 HYDRAULIC CAPACITY CRITERIA

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

3.1.1 Gravity Mains

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

Manning's Equation for Pipe Capacity

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

- Continuity Equation: $Q = V A$

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

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

  Where:
  V = velocity, fps
  n = Manning's roughness coefficient

R = hydraulic radius (area divided by wetted perimeter), ft
S = slope of pipe, in feet per foot

St. Venant's Equation for Pipe Capacity

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

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

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

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

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

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

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

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

Manning's Roughness Coefficient (n)

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

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

Partial Flow Criteria (d/D)

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

When designing wastewater pipelines, it is common practice to use variable flow depth criteria that allow higher safety factors in larger sizes. Thus, design d/D ratios may range between 0.5 and 0.92, with the lower values used for smaller pipes. The smaller pipes may experience flow peaks greater than planned or may experience blockages from debris. The City's design standards pertaining to the d/D criteria are summarized in **Table 3.1**.

During peak dry weather flows (PDWF), the maximum allowable d/D ratio for gravity pipelines are summarized as follows:

- 12-inch diameter and smaller: 0.50
- 15-inch diameter and larger: 0.70

During peak wet weather flows (PWWF), the maximum allowable d/D ratio for proposed pipes (all diameters) is 0.75. The maximum allowable d/D ratio for all existing pipes (all diameters) is 1.00. The criterion for existing pipes is relaxed in order to maximize the use of the existing pipes before costly pipes improvements are required. This condition is evaluated using the dynamic hydraulic model and the criteria listed on **Table 3.1**.

Table 3.1 Wastewater System Performance and Design Criteria
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Dry Weather Flow Criteria	
Sewer Trunk	**d/D**
Diameter < 15 inches	0.50
Diameter ≥ 15 inches	0.70
Wet Weather Flow Criteria	
Sewer Trunk	**d/D**
Existing System	1.00
Future System	0.75
Pipe Slope Criteria	
Pipe Size	**Minimum Slope (ft/ft)**
8"	0.004
10"	0.0032
12"	0.0024
15"	0.0016
18"	0.0014
21"	0.0012
24" and Up	0.001
Pipe Velocity Criteria	
Pipe Type	**Minimum / Maximum Velocity (fps)**
Gravity Sewer	Minimum 2 / Maximum 10
Force Main	Desired 2 to 6.5 / Maximum 10

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3/2/2021

Notes:
1. Source: Eastern Municipal Water District Wastewater Collection System Master Plan
2. Wastewater Collection System performance criteria shall be in accordance with EMWD WCSMP.

Minimum Pipe Sizes and Design Velocities

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

Due to the hydraulics of a circular conduit, velocity of half-full flows approaches the velocity of nearly full flows. **Table 3.1** lists the minimum slopes, varying by pipe size, in accordance with the City's design standards. The design standards also specify minimum pipe sizes, depending on the peak dry weather flows, as shown on **Table 3.1**.

Changes in Pipe Size

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

3.1.2 Force Mains and Lift Stations

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

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

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

The value of the Hazen-Williams 'C' varies and depends on the pipe material and is also influenced by the type of construction and pipe age. A 'C' value of 130 was used in this analysis.

The minimum recommended velocity in force mains is at 2 feet per second. The economical pumping velocity in force mains ranges between 3 and 5 fps. A maximum desired velocity is typically around 7 fps and a maximum not-to-exceed velocity is at 10 fps.

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

3.2 DRY WEATHER FLOW CRITERIA

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

3.2.1 Unit Flow Factors Methodology

Wastewater unit factors are developed by using water consumption records and applying a return to sewer ratio for each land use to estimate wastewater flow coefficients. There are several methods for developing the unit factors. This analysis relied on the use of the City's water consumption billing records, which lists the monthly water consumption per customer account, by land use type, to estimate the unit factors within the service area.

3.2.2 Average Daily Sewer Unit Flow Factors

Wastewater flow factors were based on water demands as extracted from the City's water consumption billing records. These records provided geographical addresses and were part of the methodology used for distributing the wastewater flows in the hydraulic model. The methodology included applying a return to sewer ratio, applied to each unadjusted water demand factor by individual land use types. The system wide calculated wastewater flows were also balanced to match the flows recorded at the wastewater treatment plant. **Table 3.2** characterizes the existing wastewater flows, by land use classification.

Generally, non-residential land uses return the majority of the water demand to the wastewater collection system. These unit factors were estimated at 85 percent return to sewer ratios. The same concept can be applied to single family and multi-family residential lots, which are typically estimated at 50 percent and 75 percent return to sewer ratio respectively. Single family residential lots have the lowest return to sewer ratio due to water lost for landscape irrigation. Lastly, unit factors were adjusted to 100 percent occupancy, and rounded. This analysis generally indicates that existing non-residential land uses have higher flow generation factors than that of residential land uses.

For projecting future flows, The City of Beaumont has adopted using the design flow criteria used by the adjacent Eastern Municipal Water District (EMWD). **Table 3.3** documents the EMWD factors, and also lists some minor adjustments applied by City staff for the purpose of this wastewater master plan. Thus, the wastewater unit factors listed on **Table 3.3** were used for projecting buildout flows in this master plan.

3.2.3 Peaking Factors

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

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

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

Table 3.2 Existing Wastewater Flows by Land Use Classification

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Land Use Classification	Existing Development (acre)	2017 Average Daily Water Demand Unit Factors: 2017 Water Consumption[1]: Annual Consumption (gpd)	2017 Average Daily Water Demand Unit Factors: 2017 Water Consumption[1]: Unadjusted Water Unit Factors (gpd/acre)	2017 Average Dry Weather Sewer Flows: Return to Sewer Ratio	2017 Average Dry Weather Sewer Flows: Dry Weather Sewer Flows: Unadjusted Sewer Unit Factor (gpd/acre)	2017 Average Dry Weather Sewer Flows: Dry Weather Sewer Flows: Balance using Recommended Unit Factor (gpd)	2017 Average Dry Weather Sewer Flows: Sewer Flows at 100% Occupancy: Vacancy Rate[2,3]	2017 Average Dry Weather Sewer Flows: Sewer Flows at 100% Occupancy: Projected Flows at 100% Occupancy (gpd/acre)	2017 Average Dry Weather Sewer Flows: Sewer Flows at 100% Occupancy: Projected Flows at 100% Occupancy (gpd)	2017 Average Dry Weather Sewer Flows: Sewer Flow Balance: Unit Factor (gpd/acre)	2017 Average Dry Weather Sewer Flows: Sewer Flow Balance: Balance Using Unit Factor (gpd)
Residential											
Single Family Residential[4]	2,568	5,432,317	2,116	0.50	1,064	2,732,455	10.0%	1,171	3,005,701	1,200	3,081,236
Multi-Family Residential	134	315,111	2,358	0.70	1,660	221,838	10.0%	1,826	244,022	1,850	247,193
Subtotal Residential	**2,701**	**5,747,428**				**2,954,294**			**3,249,723**		**3,328,429**
Non-Residential											
Commercial and Services[5]	389	413,338	1,062	0.85	903	351,337	2.0%	921	358,364	925	360,038
Public Facilities[6]	293	286,703	979	0.85	832	243,698	2.0%	849	248,572	850	248,974
Industrial[7]	223	130,310	585	0.85	497	110,764	0.2%	498	110,985	500	111,360
Subtotal Non-Residential	**905**	**830,351**				**705,798**			**717,921**		**720,372**
Totals					**2017 Average Dry Weather Flows**						
	3,606	**6,577,779**			**Estimated Sewer Flows**	**3,660,092**			**3,967,644**		**4,048,800**
					Measured WWTP Flows[8]	**3,662,673**					

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Notes:

1. Water consumption extracted from water billing data received from City staff November 21, 2019.
2. Residential vacancy rate extracted from California Department of Finance E-5 Population estimates.
3. Office Commercial and Industrial vacancy rates extracted from "Beaumont Economic Development Strategic Plan". For planning purposes, Business Commercial vacancy rate assumed equal to Office Commercial.
4. "Single Family Residential" contains development and consumption for "Mobile Homes and Trailer Parks".
5. "Commercial And Services" contains development and consumption for "General Office".
6. "Public Facilities" contains development and consumption for "Educational Facilities"
7. Industrial consumption includes Perricone Juice (83,796 gpd), Dura Plastics Products (22,364 gpd), and Rudolph Food Company (3,728 gpd).
8. Measured WWTP flows provided by City staff February 18, 2020.

Table 3.3 Wastewater Unit Factors for Projecting Future Flows

Wastewater Master Plan
City of Beaumont

PRELIMINARY

Land Use[1] Classification	Density[1]	Eastern Municipal Water District[2]			Wastewater Unit Flow Factors (Used for projecting future flows in 2021 Wastewater Master Plan)
		Land Use Classification	Density	Unit Factor (gpd/net acre)	Unit Factor (gpd/net acre)
Residential					
Single Family Residential[3]	0-4 du/acre	Low Density	2 du/acre	611	1,396
		Medium Density	4.5 du/acre	1,058	
		Mobile Home Park	10 du/acre	1,528	
Multi-Family Residential	0-24 du/acre	Medium High Density	6 du/acre	1,269	2,609
		Very High Density	17 du/acre	2,609	
Rural Residential	0-2 du/acre	Estate Density	0.5 du/acre	188	611
Non-Residential					
Community Commercial	FAR up to 2.0	Commercial Retail	5 edu/acre	1,175	1,175
		Mixed Use Policy Area	5 edu/acre	1,175	
General Commercial	FAR up to 0.3	Commercial Office	5 edu/acre	1,175	1,175
Industrial	FAR up to 0.7	Business Park/Light Industrial	5 edu/acre	1,175	1,763
		Business Park/Light Industrial/Warehouse	1.25 edu/acre	294	
		Heavy Industrial	7.5 edu/acre	1,763	
Public Facilities	FAR up to 1.0	Public Facility	5 edu/acre	1,175	1,175
		Hospital	5 edu/acre	1,175	

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Notes:
1. Land Use classification and densities extracted from City of Beaumont General Plan.
2. Land use classifications, density and unit factors based on Eastern Municipal Water District 2015 Wastewater Collection System Master Plan.
3. Single Family Residential Factor includes a 10% contingency for potential Accessory Dwelling Unit construction per City staff direction via teleconference on October 15, 2020.

Typical values for peaking factors of 2.0 or less are generally used to estimate peak flows at treatment facilities where flow fluctuations are smoothed out during the time of travel in the wastewater collection system, while peaking factors between 3.0 and 4.0 are used to estimate peak flows in the smaller upstream areas of the system where low flow conditions are prone to greater fluctuations.

This master plan used 24-hour diurnal patterns for weekday and weekend dry weather flows tributary to each flow monitor, as shown on **Figure 3.1**, **Figure 3.2**, **Figure 3.3** and **Figure 3.4**.

3.3 WET WEATHER FLOW CRITERIA

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

3.3.1 Infiltration and Inflow

Groundwater infiltration and inflow is associated with extraneous water entering the wastewater collection system through defects in pipelines and manholes. Infiltration occurs when groundwater rises or the soil is saturated due to seasonal factors such as a storm event which causes an increase in flows in the wastewater collection system. The ground water will enter the wastewater collection system through cracks in the pipes or deteriorating manholes. Inflow occurs when surface water enters the wastewater collection system from storm drain cross connections, manhole covers, or roof/footing drains. **Figure 3.5** was developed by King County, Washington and was included in this chapter to illustrate the typical causes of infiltration and inflow.

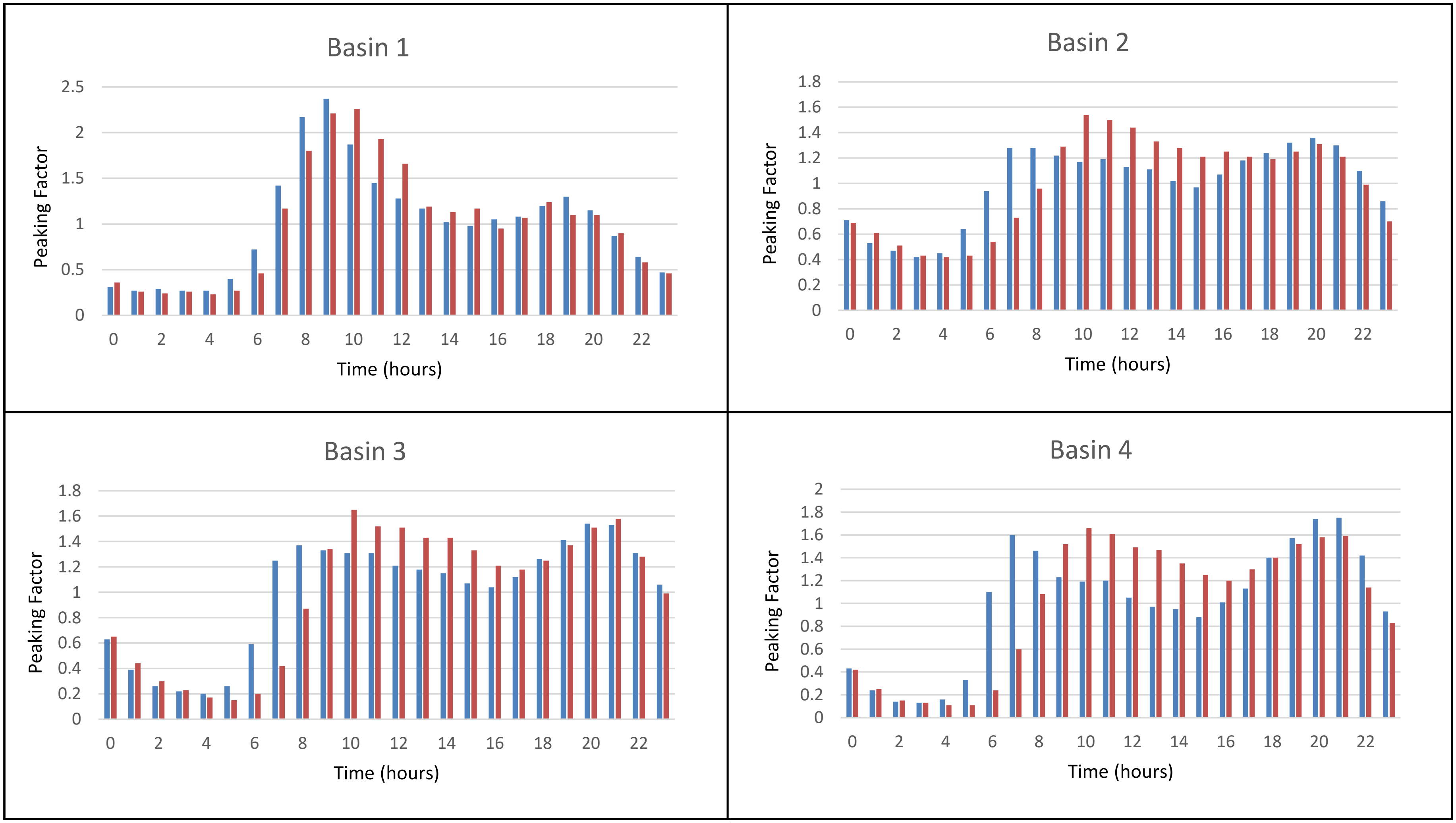
There are several accepted methodologies for estimating infiltration and inflows (I&I). These include:

- **Methodology 1.** Based on Acreages. In this methodology, factors that may range between 400 and 1,500 gallons per day (gpd) or more are applied to acreages for estimating the I&I component.

- **Methodology 2.** Based on Linear Feet of Pipe. In this methodology, factors that may range between 12 and 30 or more gallons per day per inch diameter per 100 linear feet (gpd/inch diameter/100LF) are applied to linear feet of gravity sewers.

- **Methodology 3**. Based on a percentage of Average Dry Weather Flows. In this methodology, Infiltration and Inflows (I&I) are calculated based on a percentage of the average dry weather flow.

- **Methodology 4**. Based on flow monitoring data. In this methodology, infiltration and inflows are determined by analyzing flow monitoring data of current and past flow monitoring efforts.



LEGEND

- Weekday Dry Weather Flow Diurnal
- Weekend Dry Weather Flow Diurnal

PRELIMINARY

Note: Detailed flow monitor locations provided in Appendix B

February 16, 2021

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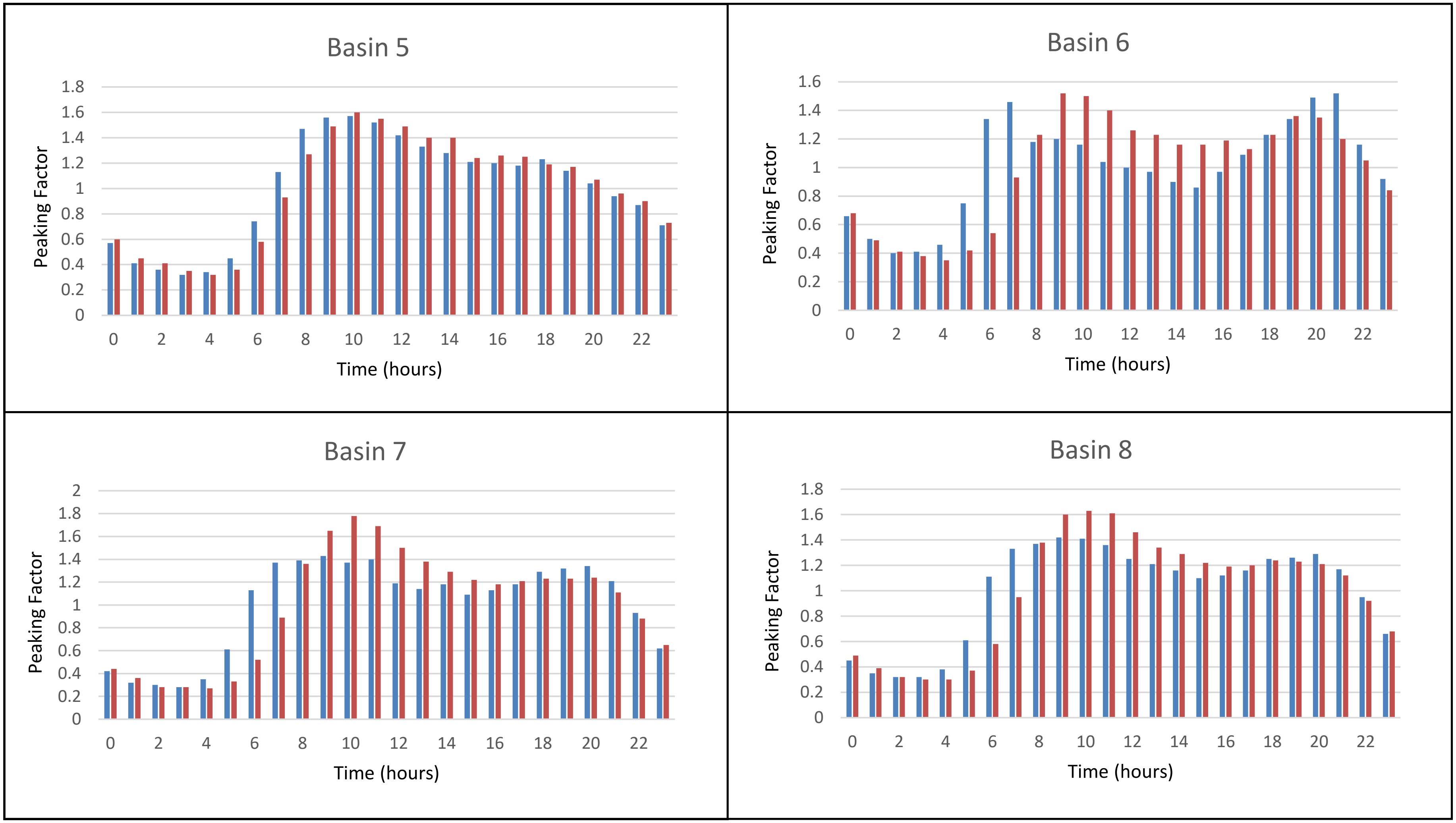
Figure 3.1
Hydraulic Model Diurnals
Wastewater Master Plan
City of Beaumont



LEGEND

Weekday Dry Weather Flow Diurnal

Weekend Dry Weather Flow Diurnal

PRELIMINARY

Note: Detailed flow monitor locations provided in Appendix B

February 16, 2021

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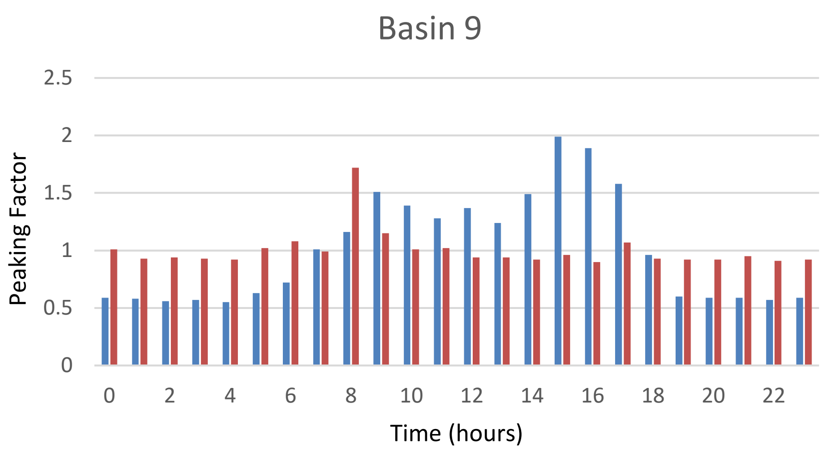
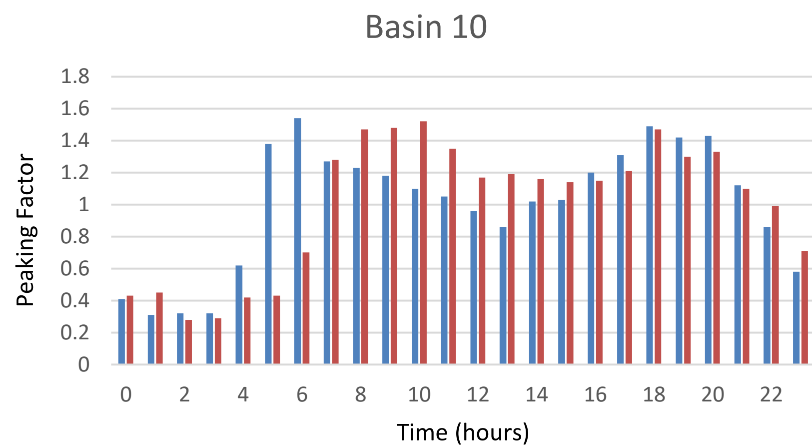
Figure 3.2

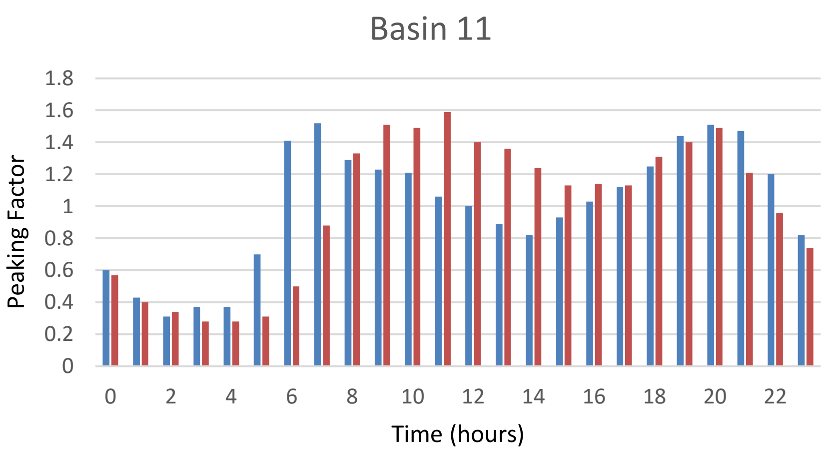
Hydraulic Model Diurnals

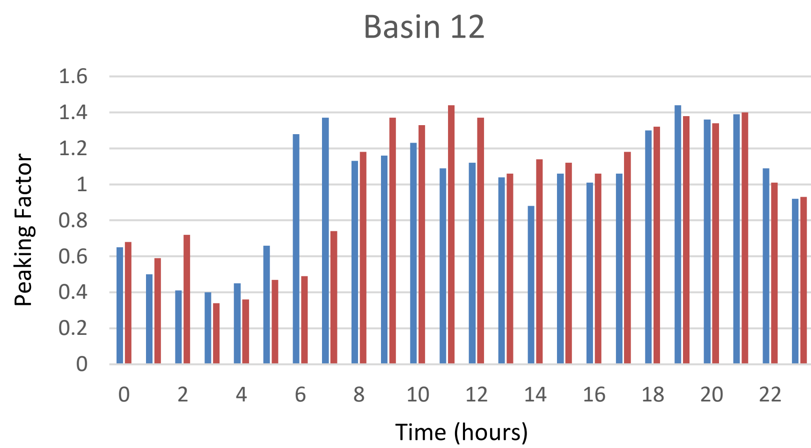
Wastewater Master Plan

City of Beaumont









LEGEND

- Weekday Dry Weather Flow Diurnal
- Weekend Dry Weather Flow Diurnal

PRELIMINARY

Note: Detailed flow monitor locations provided in Appendix B

February 16, 2021

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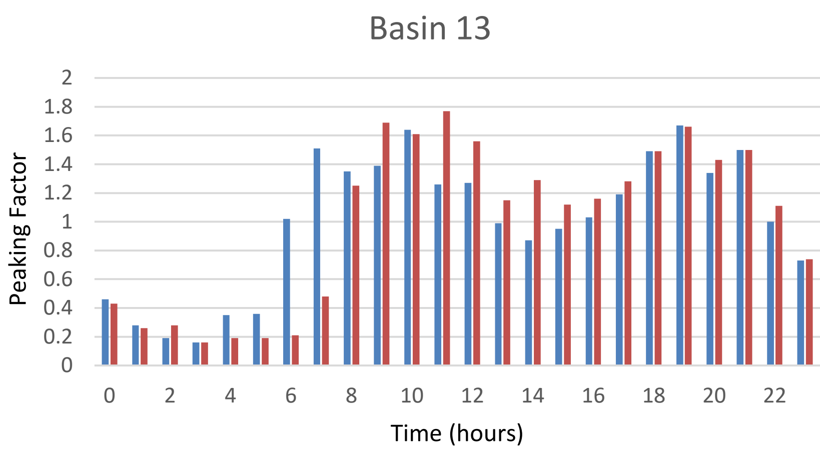
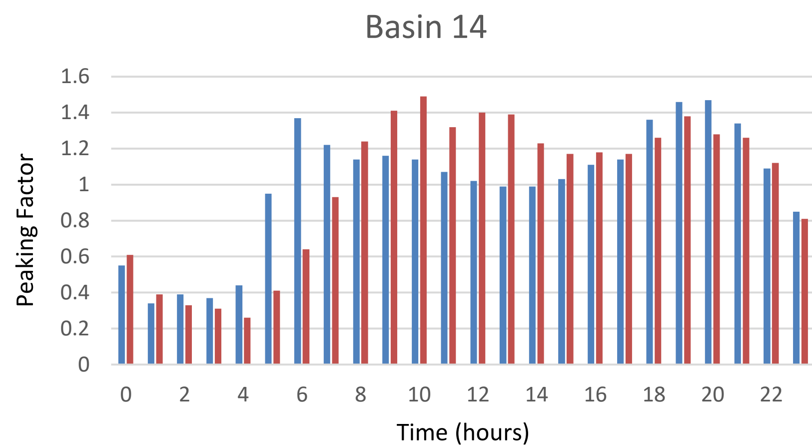
Figure 3.3

Hydraulic Model Diurnals

Wastewater Master Plan
City of Beaumont





LEGEND

Weekday Dry Weather Flow Diurnal

Weekend Dry Weather Flow Diurnal

PRELIMINARY

Note: Detailed flow monitor locations provided in Appendix B

February 16, 2021

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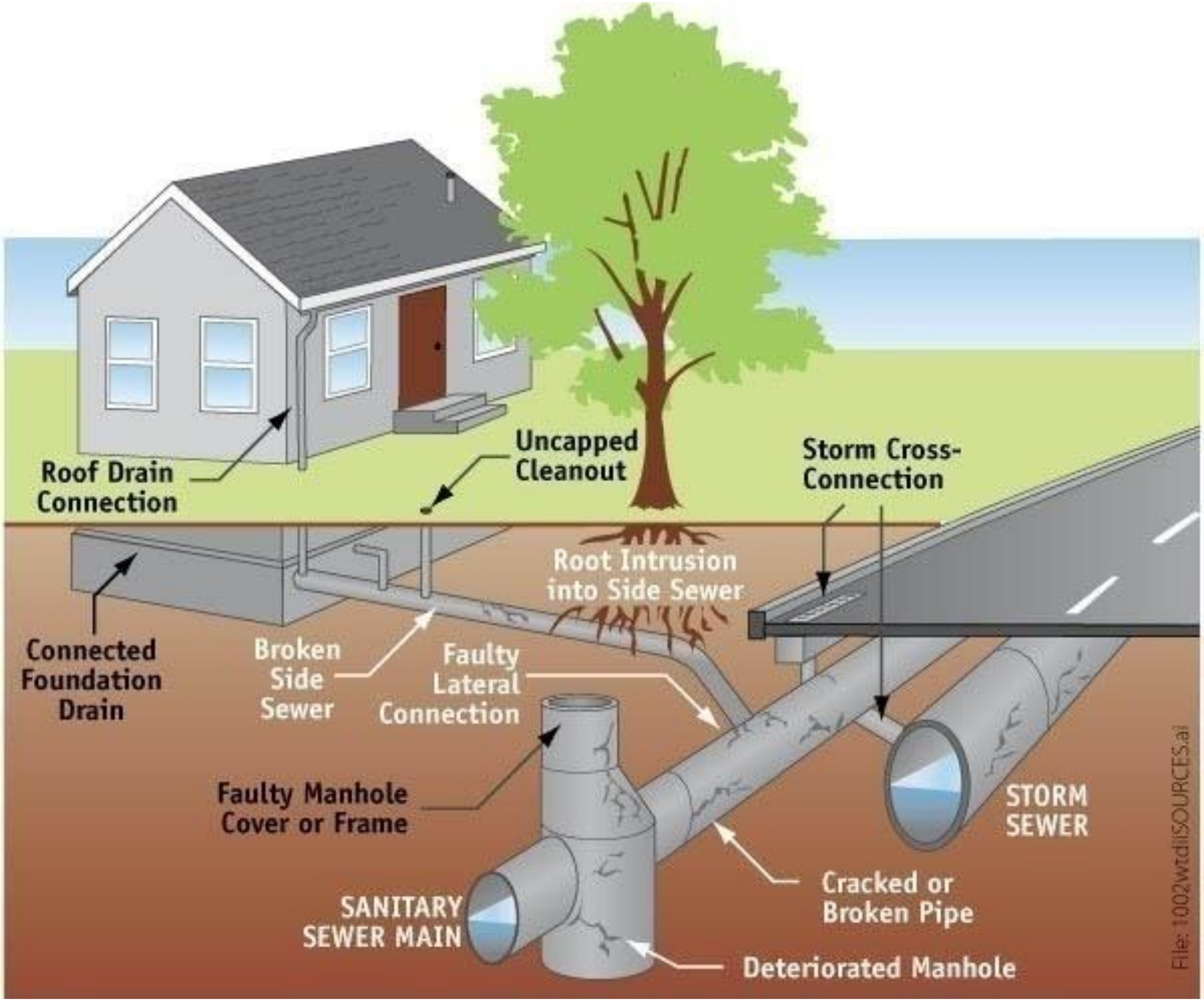
Figure 3.4

Hydraulic Model Diurnals

Wastewater Master Plan

City of Beaumont



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

February 3, 2020

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LEGEND

Inflow Sources (Black Text)

Infiltration Sources (White Text)

PRELIMINARY

Figure 3.5
Infiltration and Inflow Sources
Wastewater Master Plan
City of Beaumont

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This capacity analysis and master plan based the infiltration and inflow on specific flow monitoring data from the Villalobos and Associates (V&A) 2020 Flow Monitoring Program (**Appendix A**). Thus, the infiltration and inflows are reasonable and reflect the actual behavior of the wastewater collection system.

3.3.2 Wastewater Collection System Flow Monitoring

In 2020, V&A's services were used for a temporary flow monitoring program to capture 14 sites during dry and wet weather flows, which are summarized on **Figure 3.6**.

There were six rain gauges used for the wet weather analysis. The rainfall historical data was then determined by weighted average of those six rain gauges. The six rain gauges were located in the City of Beaumont as shown in **Figure 3.6**. The flow monitoring and rain data were used in this analysis to calibrate the computer hydraulic model to average dry weather flow and wet weather flow conditions.

3.3.3 10-Year 24-Hour Design Storm

A synthetic design storm is typically used to evaluate the sewer collection system's response during wet weather flow conditions. The design storm information was collected from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14 Volume 6 (**Table 3.4**).

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

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

The selected 10-year 24-hour design storm was further compared to historical storm events used for the calibration process, between February 2020 and April 2020, as shown on **Table 3.5**. The table lists the total rainfall volume, duration, peak hour intensity, and total rainfall depth (if available) for each storm event.

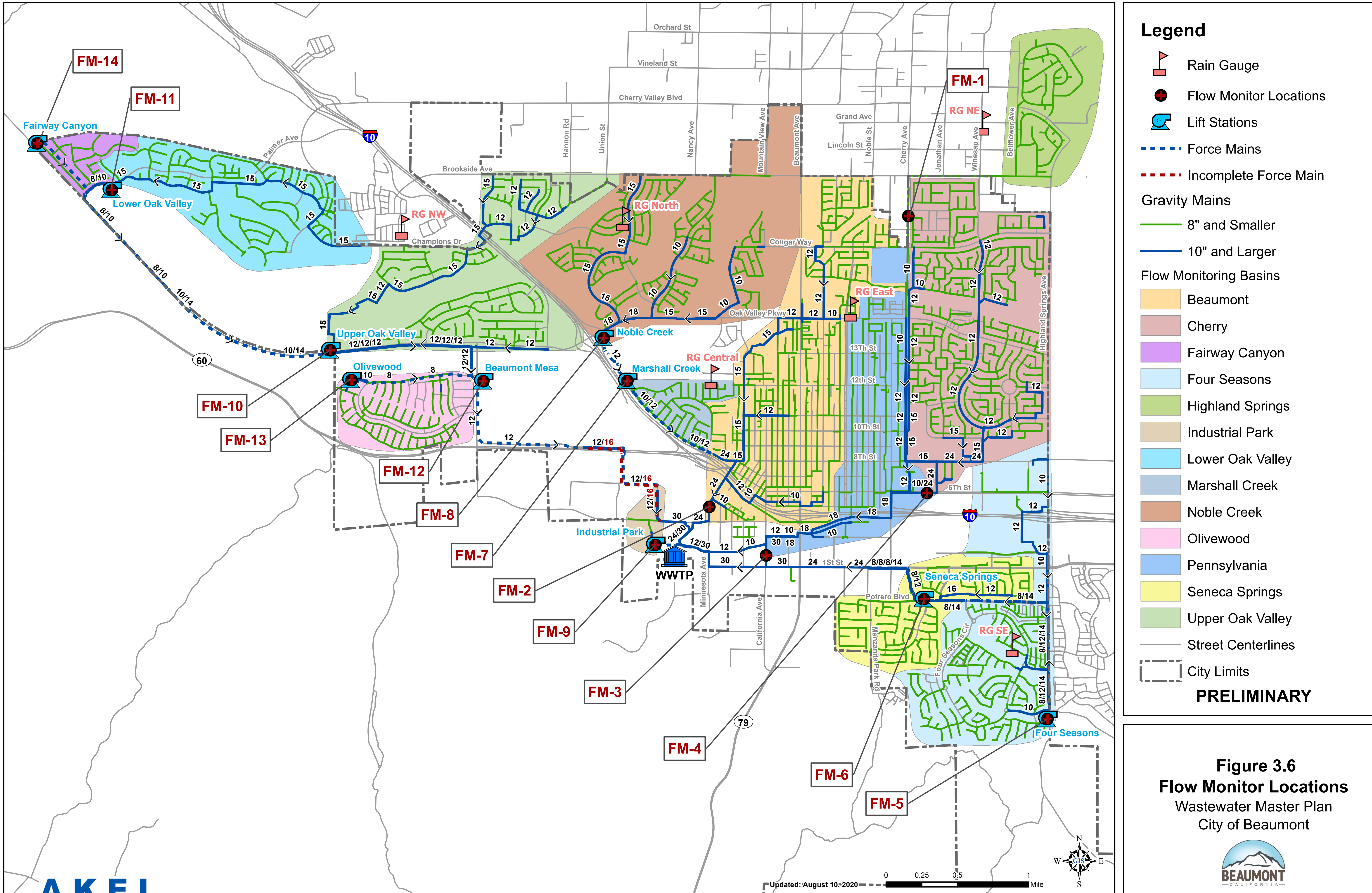

Figure 3.6
Flow Monitor Locations
Wastewater Master Plan
City of Beaumont

Table 3.4 Precipitation Depth-Duration-Frequency
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Duration	1-Year (in)	1-Year (in/hr)	2-Year (in)	2-Year (in/hr)	5-Year (in)	5-Year (in/hr)	10-Year (in)	10-Year (in/hr)	25-Year (in)	25-Year (in/hr)	100-Year (in)	100-Year (in/hr)
5-min	0.12	1.48	0.16	1.94	0.22	2.66	0.28	3.32	0.37	4.38	0.53	6.41
10-min	0.18	1.06	0.23	1.40	0.32	1.91	0.40	2.39	0.52	3.14	0.77	4.59
15-min	0.21	0.85	0.28	1.12	0.39	1.54	0.48	1.92	0.63	2.53	0.93	3.70
30-min	0.31	0.62	0.41	0.81	0.56	1.11	0.70	1.39	0.92	1.83	1.34	2.68
1-hr	0.45	0.45	0.60	0.60	0.82	0.82	1.02	1.02	1.34	1.34	1.96	1.96
2-hr	0.65	0.32	0.81	0.40	1.05	0.53	1.27	0.64	1.62	0.81	2.27	1.14
3-hr	0.79	0.26	0.97	0.32	1.24	0.41	1.48	0.49	1.85	0.62	2.54	0.85
6-hr	1.15	0.19	1.40	0.23	1.76	0.29	2.07	0.35	2.54	0.42	3.38	0.56
12-hr	1.57	0.13	1.96	0.16	2.48	0.21	2.92	0.24	3.55	0.30	4.58	0.38
24-hr	2.11	0.09	2.73	0.11	3.55	0.15	**4.21**	0.18	5.12	0.21	6.52	0.27

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1/3/2020

Note:

Source: Noaa Atlas 14 For City Of Beaumont Volume 6 Version 2.

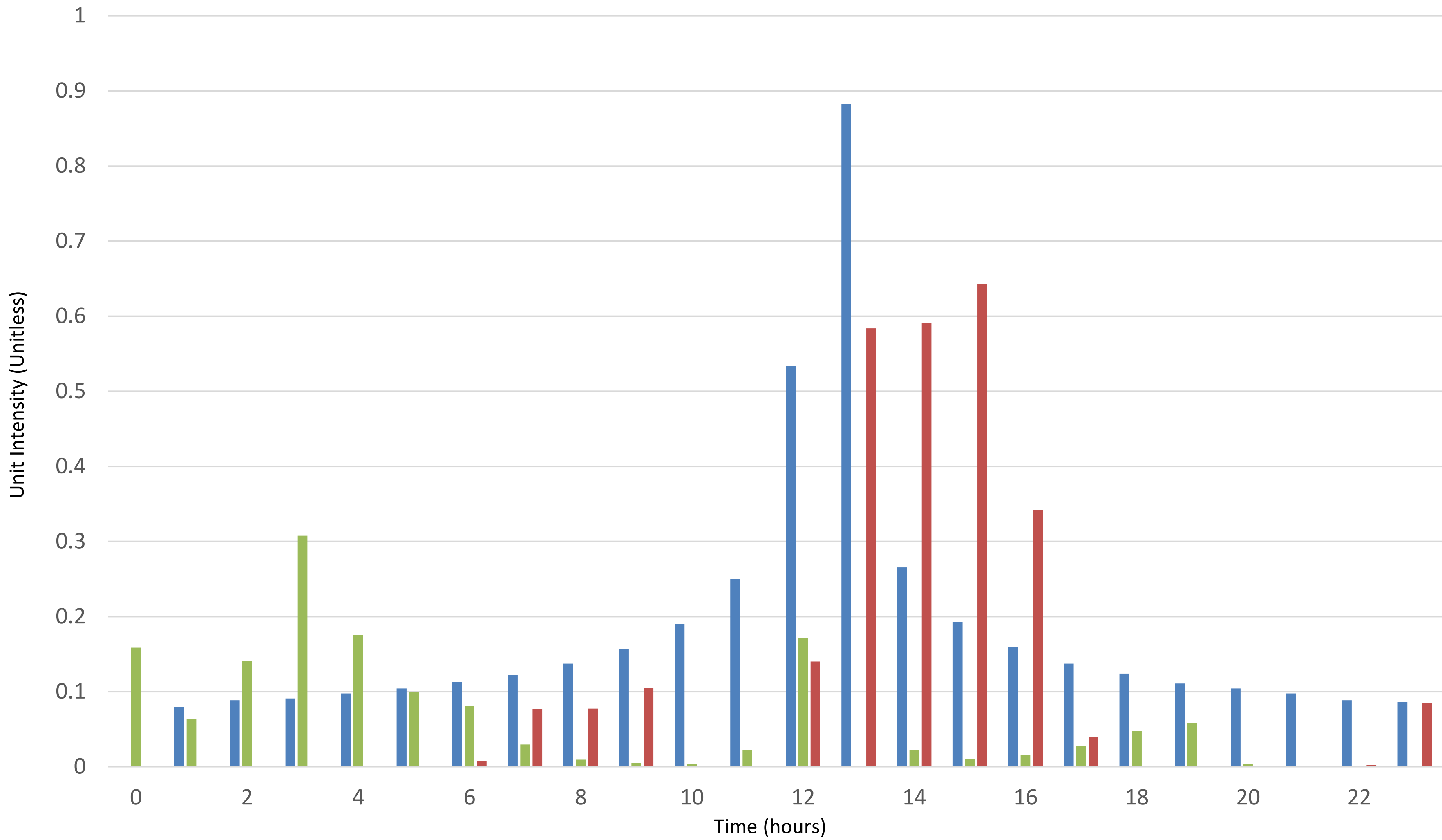
Table 3.5 Storm Events Analysis

Wastewater Master Plan
City of Beaumont

PRELIMINARY

Storm Event	Estimated Return Interval	Single Rainfall Event Volume and Intensity	
		Volume (in)	Peak Intensity (in//hr)
March 10 - March 11, 2020	2-Year 6-Hour	1.45	0.31
March 12 - March 13, 2020	5-Year 12-Hour	2.69	0.64
Design Storm	10-Year 24-Hour	4.21	0.88

Figure 3.7 is intended to show the diurnal comparison between the design storm and the two storm events experienced during March of 2020. The comparison indicates that, based on the balanced centered hyetograph, the design storm's peak hour value is at 0.89 inches per hour (in/hr), while the March 10th and 12nd storms peak values are respectively 0.31 and 0.64 in/hr respectively. This comparison illustrates the more conservative nature of the design storm.



LEGEND

PRELIMINARY

- Design Storm: 10-Year 24-Hour (4.21 in)
- Historical Storm Event: March 10, 2020 (1.45 in)
- Historical Storm Event: March 12, 2020 (2.69 in)

February 11, 2021

Figure 3.7

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

Wastewater Master Plan

City of Beaumont

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CHAPTER 4 - EXISTING WASTEWATER COLLECTION FACILITIES

This chapter provides a description of the City's existing wastewater collection system facilities including gravity trunks, force mains, lift stations, and sewer collection basins. The chapter also includes a brief description of the City's WWTP, which treats and disposes of the wastewater for the City.

4.1 WASTEWATER COLLECTION SYSTEM OVERVIEW

The City provides wastewater collection services to approximately 15,671 residential, commercial, public facilities and institutional accounts. The City's existing wastewater collection system consists of approximately 196 miles of gravity mains and force mains, and 10 lift stations that convey flows to the City's WWTP as summarized on **Table 4.1**.

The City's existing wastewater collection system is shown in **Figure 4.1**, which displays the existing system by pipe size. This figure provides a general color coding for the collection mains, as well as labeling the existing lift stations.

4.2 WASTEWATER COLLECTION BASINS AND TRUNKS

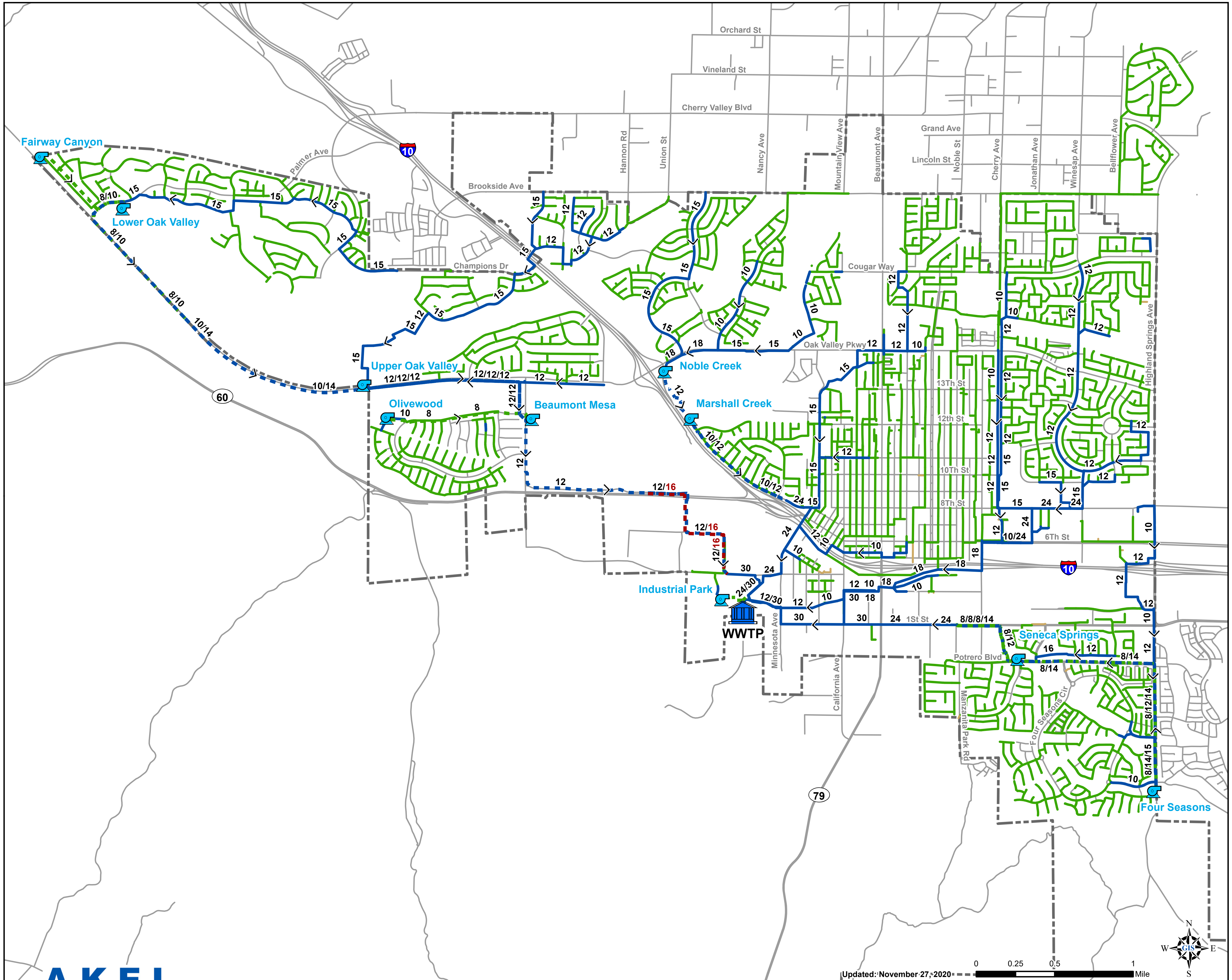
Based on the varying topography and numerous lift stations, the sewer system is divided into multiple collection basins that collect flows from smaller developments and route that flow to larger sewer trunk lines. These basins are based on the areas tributary to the flow monitors installed as part of the 2020 V&A flow monitoring program as discussed in a previous chapter. These collection basins are shown on **Figure 4.2** and summarized in the following section.

4.2.1 Fairway Canyon Collection Basin

The Fairway Canyon collection basin encompasses approximately 108 acres in the northwest portion of the City of Beaumont service area, north of Palmer Avenue and west of Armour Avenue. Flows are collected in an 8-inch gravity pipeline along Crenshaw Street before entering the Fairway Canyon Lift Station. This collection basin is discharged to the Lower Oak Valley Lift Station at Palmer Avenue via an 8-inch force main.

4.2.2 Lower Oak Valley Collection Basin

The Lower Oak Valley collection basin encompasses approximately 645 acres in the northwest portion of the City of Beaumont service area, generally north of Oak Valley Parkway and west of Plantation Drive. Flows are collected in a 15-inch pipeline along Champions Drive to Palmer Avenue before being conveyed to the Lower Oak Valley Lift Station. This collection basin also includes flows tributary to the Fairway Canyon Lift Station. This collection basin is discharged to the Upper Oak Valley Lift Station at Oak Valley Parkway via dual 10-inch and 14-inch force mains.



Legend

Existing System

Lift Stations

Force Mains

8" and Smaller

10" and Larger

Incomplete Force Main

Gravity Mains

6" and Smaller

8"

10" and Larger

Street Centerlines

City Limits

PRELIMINARY

Figure 4.1
Existing Wastewater Collection System

Wastewater Master Plan
City of Beaumont

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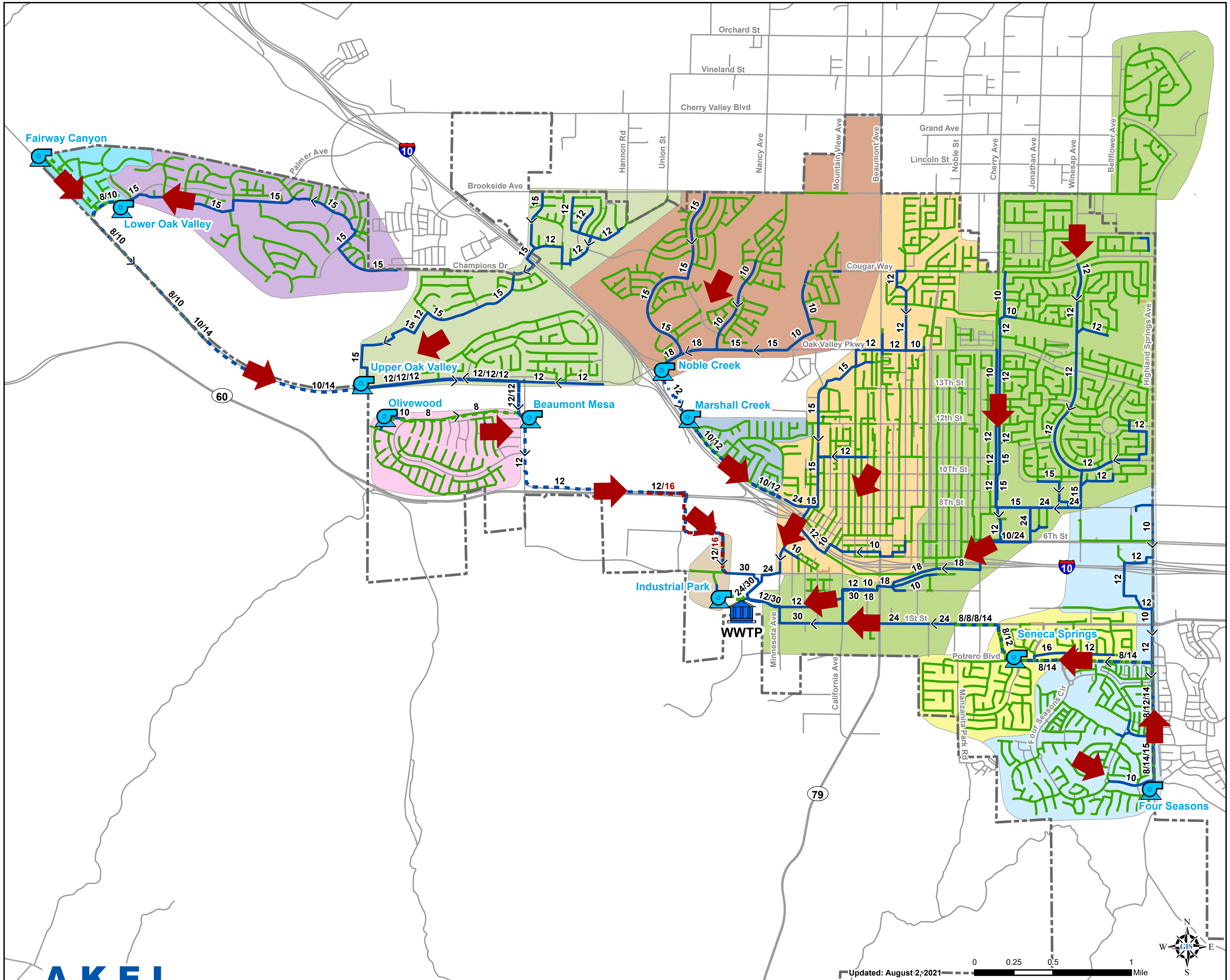
File Path: P:\xGIS\GIS_Projects\Beaumont\Sewer\191114-WastewaterMP\BEA_Fig4-1ExistingSystem_112720.mxd



Legend

Existing System

Lift Stations

Force Mains

8" and Smaller

10" and Larger

Incomplete Force Main

Gravity Mains

6" and Smaller

8"

10" and Larger

Collection Basins

Beaumont

Fairway Canyon

Four Seasons

Industrial Park

Lower Oak Valley

Marshall Creek

Noble Creek

Olivewood

Pennsylvania

Seneca Springs

Upper Oak Valley

Street Centerlines

City Limits

PRELIMINARY

Figure 4.2
Sewer Collection Basins

Wastewater Master Plan
City of Beaumont

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File Path: P:\xGIS\GIS_Projects\Beaumont\Sewer\191114-WastewaterMP\BEA_Fig4-2CollectionBasins_080221.mxd

Table 4.1 Existing Wastewater Pipeline Inventory

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Pipeline Diameter (in)	Length (ft)	Length (mi)	Percent Contribution % Total
Gravity Mains			
4	883	0.2	0.1%
6	2,612	0.5	0.3%
8	759,884	143.9	73.4%
10	28,526	5.4	2.8%
12	59,788	11.3	5.8%
15	48,929	9.3	4.7%
16	1,898	0.4	0.2%
18	7,782	1.5	0.8%
24	13,012	2.5	1.3%
30	8,890	1.7	0.9%
48	222	0.04	0.02%
Unknown	226	0.04	0.02%
Subtotal - Gravity Mains	**932,653**	**176.6**	90.1%
Force Mains			
6	1,060	0.2	0.1%
8	33,208	6.3	3.2%
10	17,254	3.3	1.7%
12	31,787	6.0	3.1%
14	18,776	3.6	1.8%
Subtotal - Force Mains	**102,086**	**19.3**	9.9%
Total Sewer Pipe			
Total	**1,034,739**	**196.0**	**100.0%**

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2/3/2020

Note:

Source: Sewer System GIS provided by City staff on November 20, 2019.

4.2.3 Upper Oak Valley Collection Basin

The Upper Oak Valley collection basin encompasses approximately 930 acres in the north portion of City of Beaumont service area and is generally divided into two sections. The first section collects flows north of Oak Valley Parkway west of Desert Lawn Drive, which are ultimately conveyed by a 12-inch gravity main on Oak Valley Parkway. The second section consists of two separate 12-inch and 15-inch gravity main along Deodar Road and Monte Verde Drive collects flows before combining into a 15-inch gravity main under Interstate-10 which are then discharged to an existing 15-inch gravity main on Bay Hill Drive. These flows are eventually conveyed to Upper Oak Valley Lift Station on Oak Valley Parkway. This collection basin also includes flows tributary to the Fairway Canyon Lift Station and Lower Oak Valley Lift Station. This collection basin is discharged to the Beaumont Mesa Lift Station at Potrero Boulevard via dual 12-inch force mains.

4.2.4 Olivewood Collection Basin

The Olivewood collection basin encompasses approximately 313 acres in the west portion of the City of Beaumont service area, generally south of Oak Valley Parkway and west of Potrero Boulevard. Flows are collected by an 8-inch gravity mains along Castello Lane and Artisan Place before entering Olivewood Lift Station. This collection basin is discharged to the Beaumont Mesa Lift Station at Potrero Boulevard via 8-inch force main.

4.2.5 Noble Creek Collection Basin

The Noble Creek collection basin encompasses approximately 1,210 acres in the north portion of the City of Beaumont service area, south of Brookside Avenue north of Oak Valley Parkway between Interstate-10 and Beaumont Avenue. Two separate 10-inch and 15-inch gravity mains along Oak View Drive and Golf Club Drive respectively collects flows before combining into 18-inch gravity main on Oak Valley Parkway. These flows are eventually conveyed to Noble Creek Lift Station. This collection basin is discharged to the Marshall Creek Lift Station at Ring Ranch Road via 12-inch force main.

4.2.6 Marshall Creek Collection Basin

The Marshall Creek collection basin encompasses approximately 136 acres in the central portion of the City of Beaumont service area, generally east of Interstate 10, west of Claiborne Avenue and south of Florence Street. Flows are collected by 8-inch gravity mains along Ring Ranch Road before entering Marshall Creek Lift Station. This collection basin also includes flows tributary to Noble Creek Lift Station. This collection basin is discharged to the existing wastewater manhole at 8th Street via dual 10-inch and 12-inch force mains.

4.2.7 Industrial Park Collection Basin

The Industrial Park collection basin encompasses approximately 63 acres in the central portion of the City of Beaumont service area, south of Highway 60 between Distribution Way and Minnesota Avenue. Two separate 8-inch gravity mains on Nicholas Road and 4th Street collect flows before combining into a 8-inch gravity main on Risco Circle. These flows are eventually conveyed to the Industrial Park Lift Station. This collection basin is discharged to the Beaumont Wastewater Treatment Plant at 4th Street via 6-inch force main.

4.2.8 Beaumont Collection Basin

The Beaumont collection basin encompasses approximately 1,155 acres in the north portion of the City of Beaumont service area, generally west of Palm Avenue, north of 4th Street and south of Brookside Avenue. Flows are collected by 12-inch and 15-inch pipelines along Luis Estrada Road and Elm Avenue before entering an existing 24-inch gravity main on Veile Avenue. This collection basin also includes flows tributary to Marshall Creek Lift Station.

4.2.9 Pennsylvania Collection Basin

The Pennsylvania collection basin encompasses approximately 1,810 acres in the north portion of the City of Beaumont service area, generally bound by Brookside Avenue and 1st Street from north to south and Palm Avenue to Highland Springs Avenue from west to east and divided into two sections. The first section collect flows by existing 12-inch gravity pipelines along Starlight Avenue. The second sections collected flows by existing 8-inch, 10-inch, and 15-inch gravity pipelines along Cherry Avenue before combining into a 24-inch gravity pipelines along American Avenue. This collection basin also includes flows from Highland Springs collection basin.

4.2.10 Highland Springs Collection Basin

The Highland Springs collection basin encompasses approximately 418 acres in the northeast portion of the City of Beaumont service area, generally west of Bellflower Avenue and north of Brookside Avenue. Existing 8-inch gravity pipelines collect flow along Brookside Avenue before being conveyed to existing 8-inch gravity pipelines along Cherry Avenue.

4.2.11 Seneca Springs Collection Basin

The Seneca Springs collection basin encompasses approximately 417 acres in the south portion of the City of Beaumont service area, generally west of Highland Springs Avenue, east of Beaumont Avenue, and south of 2nd Street. Two separate 8-inch and 16-inch gravity mains along Potrero Boulevard collects flows before combining into Seneca Springs Lift Station. This collection basin is discharged to the existing wastewater manhole at 1st Street and Michigan Avenue via dual 8-inch force mains.

4.2.12 Four Seasons Collection Basin

The Four Seasons collection basin encompasses approximately 869 acres in the southeast portion of the City of Beaumont service area, generally west of Highland Springs Avenue and south of 8th Street. Existing 10-inch, 12-inch and 15-inch gravity pipelines along Highland Springs Avenue collects flows before conveying into Four Seasons Lift Station. This collection basin is discharged to the existing wastewater manhole at 1st Street and Michigan Avenue via dual 8-inch and 14-inch force mains.

4.3 LIFT STATIONS

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

- **Fairway Canyon Lift Station.** The lift station is located at the northern end of Creenshaw Street. The lift station includes 2 canned pumps that are each rated at 400 gpm. The pumps discharges into an 8-inch force main that conveys flows southeast toward Lower Oak Valley Lift Station.

- **Lower Oak Valley Lift Station.** The lift station is located on Palmer Avenue, southwest of Morris Street and was built in 2005. The lift station includes 2 duty pumps and 1 standby pump that are rated at 650 gpm and 400 gpm respectively. The pump discharges into a parallel 8-inch and 10-inch force main that conveys flows southeast along Oak Valley Parkway toward Upper Oak Valley Lift Station.

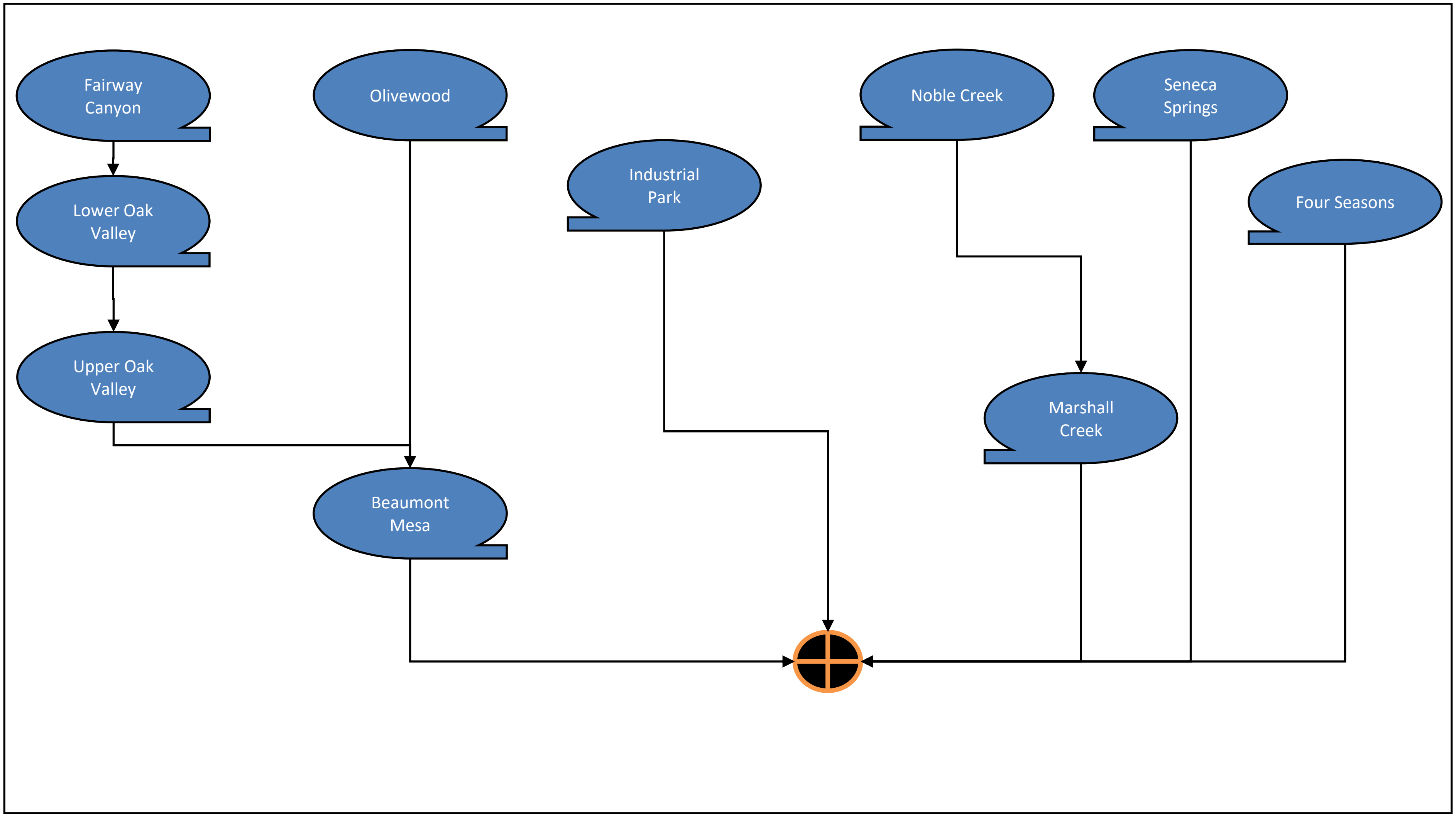
- **Upper Oak Valley Lift Station.** The lift station is located on Oak Valley Parkway, west of Apron Lane and was built in 2004. The lift station includes 2 duty pumps and 1 standby pump that are rated at 1,350 gpm and 2,300 gpm respectively. The pump discharges into a parallel 12-inch force main that conveys flows north toward Beaumont Mesa Lift Station.

- **Olivewood Lift Station.** This lift station is located approximately 675 feet northwest of the intersection of Artisan Place and Castello Lane. The lift station includes 2 duty pumps that are both rated at 310 gpm. The pump discharges into an 8-inch force main that conveys flows east along Castello Lane toward Beaumont Mesa Lift Station.

- **Beaumont Mesa Lift Station.** This lift station is located southeast corner of Castello Lane and Potrero Boulevard, constructed prior 2006 and was rehabilitated in 2020. While this lift station was originally designed to include four pumps, two at 3,500 gpm and two at 1,500 gpm, the current configuration includes 2 duty pumps that are both rated at 1,797 gpm. The pump discharges into a 12-inch force mains that convey flows southeast toward 4th Street.

- **Noble Creek Lift Station.** The lift station is located approximately 200 feet south of Oak Valley Parkway and was built in 2001. The lift station includes 2 duty pumps that are both rated at 1,865 gpm. The pump discharges into a 12-inch force main that conveys flows southeast along Interstate 10 toward Marshall Creek Lift Station.

- **Marshall Creek Lift Station.** The lift station is located at the northern end of Ring Ranch Road and was built in 2001. The lift station includes 2 duty pumps that are both rated at 1,150 gpm. The pump discharges into a 10-inch and 12-inch force main that conveys flows southeast along Ring Ranch Road toward Veile Avenue.



LEGEND

Wastewater Treatment Plant

Wastewater Lift Station

Wastewater Trunks

PRELIMINARY

February 3, 2020

Figure 4.3

Lift Station Connectivity Schematic

Wastewater Master Plan

City of Beaumont

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Table 4.2 Lift Station Inventory

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Lift Station Information		Pumps[1]				Pump Controls[2]						Wet Well Dimensions[2]		
No.	Location	Quantity	Full Capacity (gpm)	Firm Capacity (gpm)	Current Capacity (gpm)	High Level (ft)	Low Level (ft)	Lead On (ft)	Lag 1 Off (ft)	Lag 2 On (ft)	Lag 2 Off (ft)	Area (ft^2)	Depth (ft)	Volume (gal)
Beaumont Mesa	12940 Potrero Blvd.	2 @ 1,797 gpm	3,594	1,797	3,594	21.50	2.00	9.50	7.00	12.00	7.00	697.4	21.0	109,593
Fairway Canyon[3] (Little Lower Oak Valley)	34003 Crenshaw St.	2 @ 400 gpm	800	400	800	8.33	2.92	6.61	3.58	7.83	6.61	50.3	11.50	2,022
Lower Oak Valley	11246 Palmer Ave.	2 @ 650 gpm 1 @ 400 gpm	1,700	1,050	1,700	7.50	1.50	4.00	2.00	7.00	2.00	212.7	16.5	26,252
Marshall Creek	990 Ring Ranch Rd.	2 @ 1,150 gpm	2,300	1,150	2,300	10.75	8.08	9.75	8.25	10.50	8.25	223.9	18.0	30,149
Noble Creek	1899 W Oak Valley Pkwy.	2 @ 1,865 gpm	3,730	1,865	3,730	6.00	1.50	4.25	2.00	5.75	2.00	180.8	14.5	19,606
Seneca Springs	1390 Potrero Blvd.	3 @ 450 gpm	1,350	900	1,125	6.00	1.25	4.50	2.50	5.50	2.50	184.7	31.5	43,519
Upper Oak Valley	35980 Oak Valley Pkwy.	2 @ 1,350 gpm 1 @ 2,300 gpm	5,000	2,700	5,000	7.50	1.00	4.50	2.50	7.00	2.50	345.7	19.5	51,283
Four Seasons	1075 S Highland Springs Ave.	2 @ 1,675 gpm 1 @ 365 gpm	3,715	1,740	1,675	9.50	1.50	4.75	2.25	9.00	4.75	249.6	22.0	41,078
Industrial Park[4] (Coopers Creek)	715 W 4th St.	1 @ 112 gpm 1 @ 150 gpm	262	112	262	6.00	1.00	5.75	2.00	5.75	2.00	58.7	16.0	7,022
Olivewood	North of Artisan Pl.	2 @ 310gpm	620	310	620	6.25	2.00	5.25	3.00	5.75	3.00	50.3	19.5	7,332

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5/26/2021

Notes:

1. Source: Pumps information provided by City staff on December 13, 2019.
2. Unless noted otherwise, pump controls and wet well dimensions provided by City staff on March 04, 2020.
3. Fairway Canyon wet well dimensions provided by City staff on April 28, 2021.
4. Industrial Park pump information provided by City Staff on May 26, 2020.

- **Industrial Park (Coopers Creek) Lift Station.** The lift station is located at the end of Risco Circle southwest of Beaumont WWTP and was built in 2003. The lift station includes 2 duty pumps that are rated at 112 gpm and 150 gpm. The pump discharges into a 6-inch force main that conveys flows east toward Beaumont WWTP.

- **Seneca Springs Lift Station.** The lift station is located on Potrero Boulevard between Berkshire Avenue and Seneca Springs Parkway, and was built in 2005. The lift station includes 3 duty pumps that are both rated at 450 gpm. The pump discharges into a parallel 8-inch force main that conveys flows west toward 24-inch gravity pipeline on 1st Street.

- **Four Seasons Lift Station.** The lift station is located on Highland Springs Avenue approximately 300 ft south of Breckenridge Avenue Berkshire Avenue, and was built in 2005. The lift station includes 2 duty pumps and 1 standby pump that are rated at 1,675 gpm and 365 gpm respectively. The pump discharges into a 8-inch and 14-inch force main that conveys flows west toward existing 24-inch gravity pipeline on 1st Street.

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

4.4 BEAUMONT WASTEWATER TREATMENT PLANT

Beaumont Wastewater Treatment Plant (WWTP) treats on average 3.66 mgd of sewer flows, collected flows from 11 different tributary basins including: Fairway Canyon, Lower Oak Valley, Upper Oak Valley, Olivewood, Noble Creek, Marshall Creek, Industrial Park, Pennsylvania, Highland Springs, Beaumont, Seneca Springs, and Four Seasons. The wastewater treatment plant currently services approximately 52,000 people, in addition to non-residential users.

A recent expansion at the WWTP included constructing a 12-inch diameter brine waste disposal gravity pipeline extending 23 miles from the WWTP north to the nearest connection point of the Inland Empire Brine Line, located near the north side of E Street Bridge in the City of San Bernardino.

It should be noted that this wastewater master plan focuses on the capacity adequacy of the existing conveyance infrastructure, including gravity and force main pipelines, as well as lift stations. This wastewater master plan does not include any evaluations at the wastewater treatment plant, including treatment facilities, capacities, or redundancies.

CHAPTER 5 –WASTEWATER FLOWS

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

5.1 FLOWS AT THE BEAUMONT WWTP

The wastewater flows collected and treated at the City of Beaumont WWTP vary monthly, daily, and hourly. While the dry weather flows are influenced by customer uses, the wet weather flows are influenced by severity of storm events and the condition of the system. **Figure 5.1** shows the monthly flows versus rainfall at the Beaumont WWTP for 2019. August and November were the maximum months during 2019, with November also being higher than average due to the considerable amount of rain received that month.

Flow data influent to the City of Beaumont WWTP was obtained from City operation staff. The flow data covered a period from 2012 to 2019. From this data monthly, daily, and peak daily flows, were determined as summarized on **Table 5.1**.

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

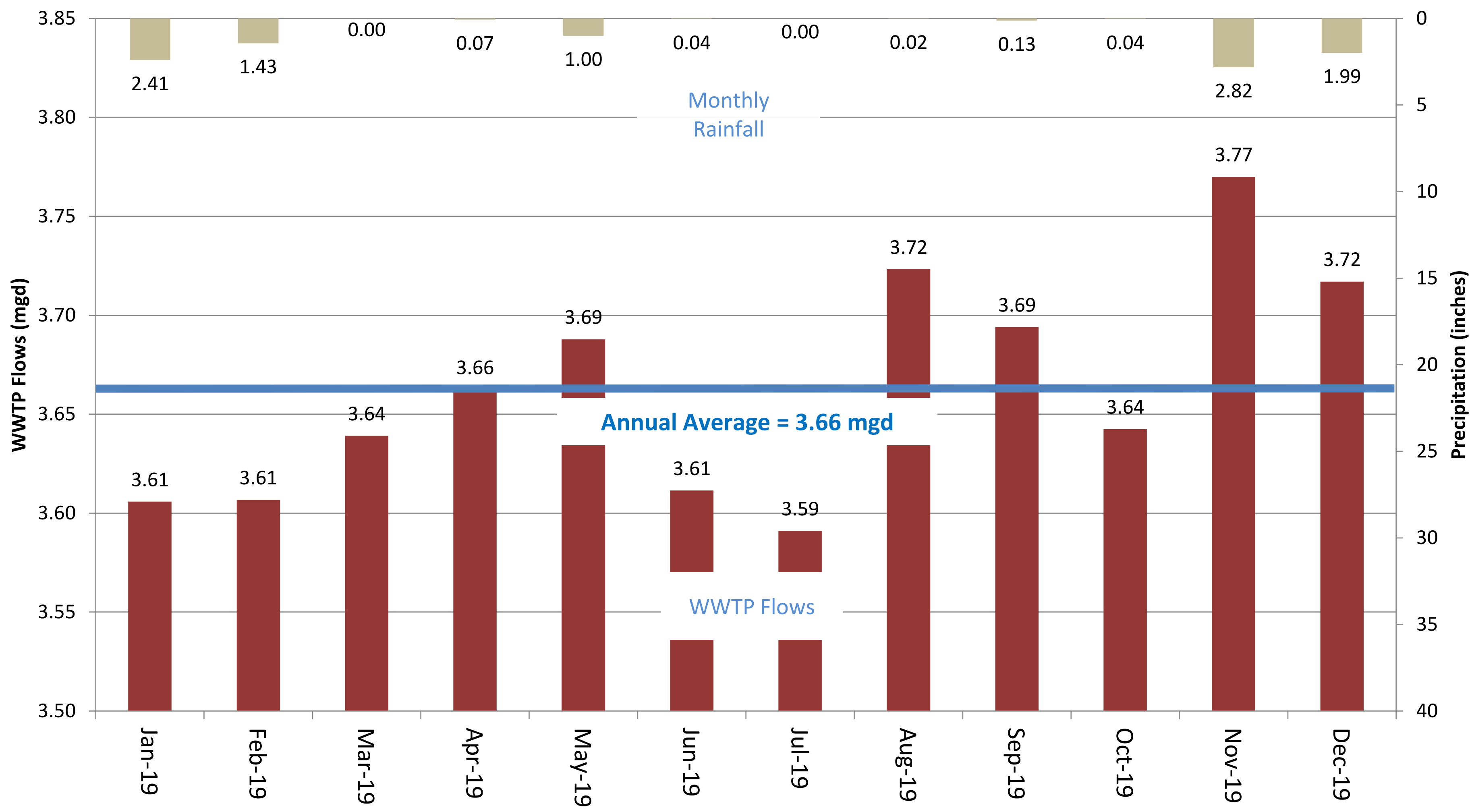
- **Average Annual Flow (AAF).** The average annual flow is the total annual flow, or average monthly flow, for a given year, expressed in daily or other time units. This flow includes the combined average of the average dry weather flow (ADWF) and average wet weather flow (AWWF).

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

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

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

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



LEGEND

- Monthly Flows
- Monthly Rainfall
- 2019 Average Flow

PRELIMINARY

Note: WWTP Flow data provided by City staff on February 18, 2020.
- Rainfall data extracted from CIMIS Station in Hemet (Year 2019)

February 17, 2021

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Figure 5.1

2019 WWTP Flows

Wastewater Master Plan

City of Beaumont

BEAUMONT CALIFORNIA

Table 5.1 Wastewater Treatment Plant - Historical Flow Data and Peaking Factors

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Year	Average Annual Flow (AAF) (mgd)	Percentage Change	Seasonal Average ADWF[1] (mgd)	Seasonal Average AWWF[2] (mgd)	Maximum Month MMDWF (mgd)	Maximum Month MMWWF (mgd)	Maximum Day MDDWF (mgd)	Maximum Day MDWWF (mgd)
2012	2.68		2.70	2.67	2.74	2.80	3.12	3.18
2013	2.79	3.9%	2.68	2.90	2.82	3.12	3.40	3.50
2014	2.98	6.9%	2.97	2.99	3.02	3.19	3.50	3.62
2015	2.92	-1.8%	2.91	2.94	2.97	3.05	3.86	3.58
2016	2.83	-3.4%	2.80	2.86	2.91	3.29	3.27	5.26
2017	3.27	15.8%	-	-	-	-	-	-
2018	3.39	3.7%	3.40	3.38	3.51	3.51	-	-
2019	3.66	8.0%	3.66	3.67	3.72	3.77	4.14	5.07
2020	-	-	-	-	-	4.01	-	4.57
Historical Peaking Factors (Applied to ADWF)								
2012	1.00		1.00	0.99	1.02	1.04	1.16	1.18
2013	1.04		1.00	1.08	1.05	1.17	1.27	1.31
2014	1.00		1.00	1.01	1.02	1.07	1.18	1.22
2015	1.00		1.00	1.01	1.02	1.05	1.33	1.23
2016	1.01		1.00	1.02	1.04	1.18	1.17	1.88
2017	-		-	-	-	-	-	-
2018	1.00		1.00	0.99	1.03	1.03	-	-
2019	1.00		1.00	1.00	1.02	1.03	1.13	1.39
2020	-		-	-	-	-	-	-
Recommended Evaluation Peaking Factor								
				1.08	1.05	1.18	1.33	1.88

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2/3/2020

Notes :

1. Source: 2012-2016 WWTP flows extracted from the City of Beaumont 2017 Inflow and Infiltration Study.
2. Source: 2017-2019 City Flow data provided by City staff on February 18, 2020.
3. Source: Hourly influent flows at the WWTP for the period of 02/20/20 to 04/09/20 provided by City staff on May 1, 2020.

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

Table 5.1 shows the average annual flows (AAF) collected at the City of Beaumont WWTP have increased from 2.68 mgd in 2012 to 3.66 mgd in 2019, which is an increase of approximately 37%.

In addition to listing the 2012-2019 flows, and for comparison purposes, the table calculates the peaking factors applied to the corresponding average dry weather flows (ADWF) for each year. During wet weather flows in 2019, the maximum daily volume (MDWWF) contributed by the City at the City of Beaumont WWTP was 1.39 times higher than the average dry weather flow for the same year.

5.2 BUILDOUT WASTEWATER FLOWS

The land use methodology was used to estimate the buildout wastewater flows from City's Planning Area and to be consistent with the General Plan. Table 5.2 documents the total acreages for residential and non-residential land use, and the undeveloped lands designated for urbanization. The undeveloped lands were multiplied by the corresponding unit flow factor to estimate the wastewater flows. The buildout average daily flows were calculated at 17.8 mgd. Figure 5.2 documents the general hydraulic model allocation locations and methodology for the areas of future development.

5.3 WASTEWATER COLLECTION SYSTEM DESIGN FLOWS

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

- **Peak Dry Weather Flow (PDWF).** The PDWF is used for evaluating the capacity adequacy of the wastewater collection system, and to meet the criteria set forth in the previous chapter and in the City standards.
- **Peak Wet Weather Flow (PWWF).** The PWWF is used for designing the capacity of the wastewater collection system, and to meet the criteria set forth in the previous chapter and in the City standards.

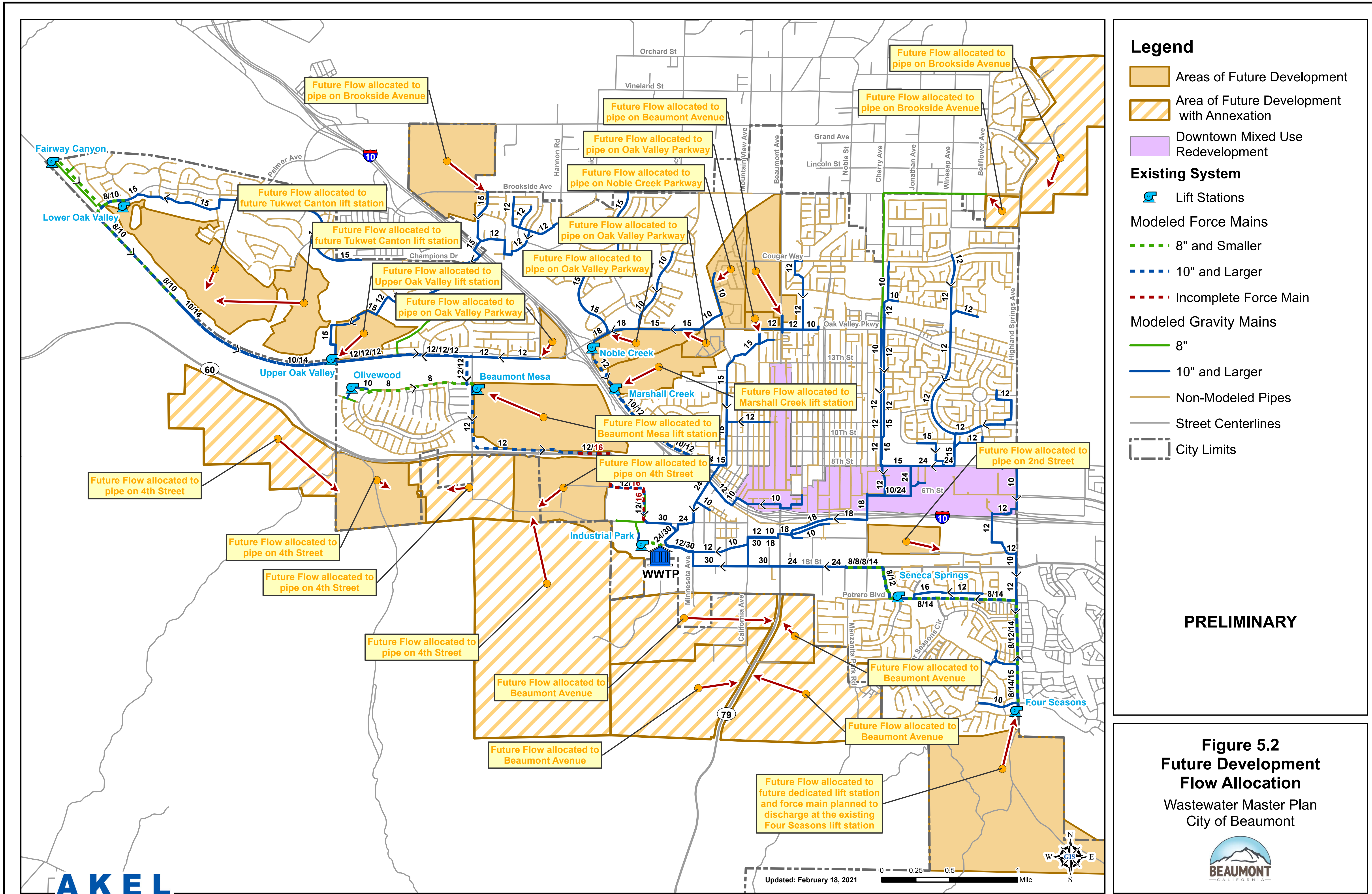

Figure 5.2
Future Development Flow Allocation
Wastewater Master Plan
City of Beaumont

Table 5.2 Future Wastewater Flow Summary
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Land Use Type	Existing Development			Future Development within Study Area					Total Development at Buildout of Study Area	Total Average Dry Weather Flow	
	Existing Lands, No Redevelopment (acre)	Sewer Unit Factor (gpd/acre)	Average Daily Flow (gpd)	Lands Planned for Redevelopment (acre)	New Development (acre)	Subtotal Future Development (acre)	Sewer Unit Factor (gpd/acre)	Average Dry Weather Flow (gpd)	(acre)	(gpd)	(gpd)
1	2	3	4	5	6	7	8	9	10	11	12
General Plan Residential											
Single Family Residential	2,389	1,396	3,335,391	118	588.3	706	1,396	986,125	3,096	4,321,516	4.32
High Density Residential	83	2,609	215,334	6	276.1	282	2,609	735,343	364	950,677	0.95
Rural Residential	0	611	0	2,446	312.3	2,758	611	1,685,107	2,758	1,685,107	1.69
Subtotal - General Plan Residential	2,472		3,550,725	2,570	1,176.7	3,746		3,406,575	6,218	6,957,301	6.96
General Plan Non-Residential											
General Commercial	242	1,175	284,837	28	323.8	352	1,175	413,753	595	698,590	0.70
Neighborhood Commercial	0	1,175	0	34	11.5	46	1,175	53,539	46	53,539	0.05
Industrial	211	1,763	371,281	52	315.2	367	1,763	646,780	577	1,018,062	1.02
Public Facility	280	800	224,260	44	63.6	107	800	85,932	388	310,191	0.31
Subtotal - General Plan Non-Residential	733		880,378	158	714.0	872		1,200,004	1,605	2,080,381	2.08
General Plan Overlays											
Traditional Neighborhood[1]	0	-	0	76	498.8	574	-	692,049	574	692,049	0.69
Downtown Mixed Use[1]	0	-	0	321	64.4	386	-	578,272	386	578,272	0.58
Urban Village[1]	0	-	0	107	536.0	643	-	1,041,439	643	1,041,439	1.04
Employment District[1]	0	-	0	0	179.1	179	-	216,814	179	216,814	0.22
Subtotal - General Plan Overlays	0		0	504	1,278.4	1,782		2,528,575	1,782	2,528,575	2.53
Known Developments											
Specific Plan and Other Developments[2]	0	-	0	0	4,199.7	4,200	-	6,214,824	4,200	6,214,824	6.21
Subtotal - Known Developments	0		0	0	4,199.7	4,200		6,214,824	4,200	6,214,824	6.21
Total											
	3,205		4,431,103	3,231	7,368.8	10,600		13,349,978	**13,805**	**17,781,081**	**17.78**

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10/19/2020

Notes:

1. Development flows for Overlay Areas documented in Table 2, General Plan Overlay Development and Flows
2. Specific Plan and Other Development flows documented in Table 5, Specific Plan and Other Development, Remaining Development Flows

The design flows used in evaluating the capacity adequacy of the wastewater collection system are summarized on **Table 5.3**. The table lists the maximum day and peak hour flows for dry and wet weather conditions. PDWF and PWWF used for evaluating the existing wastewater collection system were estimated at 9.3 mgd and 9.8 mgd respectively. The PDWF and PWWF used for designing the General Plan buildout system, including growth, were estimated at 31.2 mgd and 27.9 mgd respectively. It should be noted that the flows shown on **Table 5.3** are extracted from the wastewater system hydraulic model and reflect diurnal flow variations and flow attenuation.

Table 5.3 Design Flows

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Description	Flow	
	Maximum Day (mgd)	Peak Hour (mgd)
Existing Condition Scenarios		
Existing DWF	5.79	9.27
Existing WWF (10Yr-24HR Design Storm)	5.88	9.76
Ultimate Buildout Scenarios		
Buildout DWF	21.14	31.18
Buildout WWF (10Yr-24HR Design Storm)	18.98	27.85

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2/18/2021

Notes:

1. Flows shown are extracted from wastewater system hydraulic model and reflect diurnal flow variations and flow attenuation.

CHAPTER 6 - HYDRAULIC MODEL DEVELOPMENT

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

6.1 HYDRAULIC MODEL SOFTWARE SELECTION

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

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

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

6.2 HYDRAULIC MODEL DEVELOPMENT

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

6.2.1 Skeletonization

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

The hydraulic model for the City of Beaumont was skeletonized to include the pipelines essential to the hydraulic analysis. By comparison, skeletonizing was necessary to reduce the model from

4,300 pipes extracted from GIS to 800 pipes; the total system includes approximately 196 miles of pipe, whereas the hydraulic model includes approximately 56 miles of pipelines. The modeled pipes included pipes 8-inches in a diameter and larger, in addition to some critical smaller gravity wastewater pipes.

Table 6.1 documents the inventory of pipelines included in the hydraulic model by diameter and is approximately 28 percent of the overall system. The modeled wastewater collection system is shown on Figure 6.1.

6.2.2 Digitizing and Quality Control

The City's existing wastewater collection system was digitized in GIS using several sources of data and various levels of quality control. The data sources included the City's existing system as documented in GIS drawings and schematics provided by City staff.

After reviewing the available data sources, the hydraulic model was built and verified by City staff. Using the available wastewater collection system data this master plan developed the wastewater collection system in GIS. Resolving discrepancies in data sources was accomplished by conducted manhole field surveys that recorded the rim elevations, pipe invert elevations, as well as the physical manhole location. Data received were incorporated in the verified model.

6.2.3 Pipes and Manholes

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

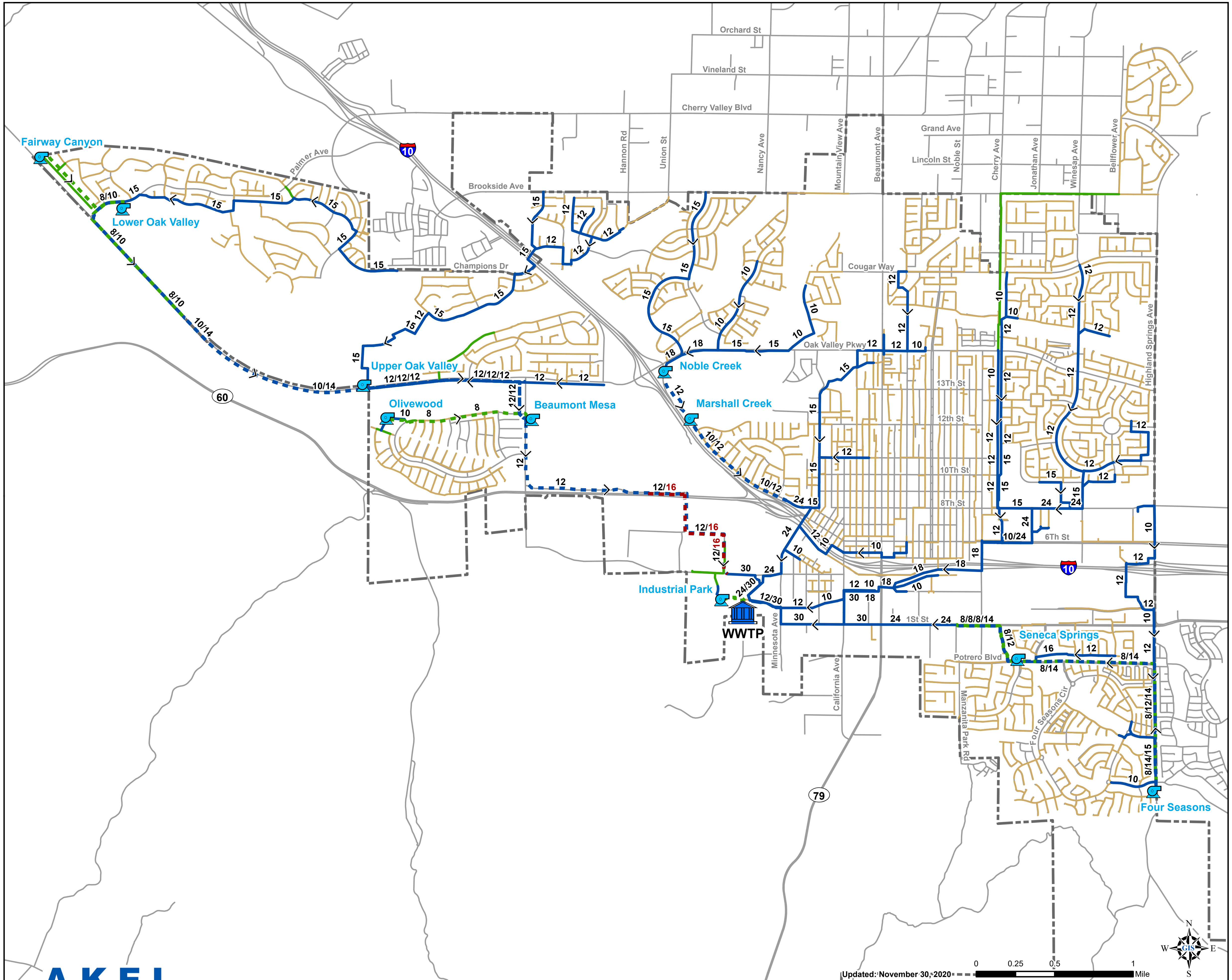
Pipes and manholes represent the physical aspect of the system within the model. A manhole is a computer representation of a place where wastewater flows may be allocated into the hydraulic system, while a pipe represents the conveyance aspect of the wastewater flows. In addition, selected lift station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

6.2.4 Load Allocation

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

The existing loading allocation was based off the water billing records. Using GIS, each customer account was geocoded and spatially joined within the existing wastewater collection system. Wastewater loads were developed by combining the flow factors developed in Chapter 3 with the water billing records for the City. The calculated loads were allocated to the nearest manhole that serves the corresponding customers.

Wastewater loads from each anticipated future development, as presented in previous chapters, were also allocated to the model for the purpose of sizing the required future facilities. The loads



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Legend

Existing System

Lift Stations

Modeled Force Mains

- 8" and Smaller
- 10" and Larger
- Incomplete Force Main

Modeled Gravity Mains

- 8"
- 10" and Larger
- Non-Modeled Pipes
- Street Centerlines
- City Limits

PRELIMINARY

Figure 6.1
Existing Modeled Sanitary Sewer System

Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA

File Path: P:\xGIS\GIS_Projects\Beaumont\Sewer\191114-WastewaterMP\BEA_Fig6-1ModeledSystem_113020.mxd

Table 6.1 Existing Modeled Pipeline Inventory

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Pipeline Diameter	Length		Percent Contribution
(in)	(ft)	(mi)	% Total
Gravity Mains			
8	18,847	3.6	6.4%
10	27,947	5.3	9.5%
12	59,569	11.3	20.3%
15	48,834	9.2	16.6%
16	1,898	0.4	0.6%
18	7,829	1.5	2.7%
24	12,336	2.3	4.2%
30	8,890	1.7	3.0%
Subtotal	**186,151**	**35.3**	63.4%
Force Mains			
6	1,060	0.2	0.4%
8	33,212	6.3	11.3%
10	17,260	3.3	5.9%
12	31,796	6.0	10.8%
14	18,941	3.6	6.5%
16	5,058	1.0	1.7%
Subtotal	**107,327**	**20.3**	36.6%
Total Modeled Pipe			
Total	**293,478**	**55.6**	**100.0%**

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2/19/2021

from the General Plan Boundary were allocated based on proposed land use and the land use acreages. As many of the areas were very large in size, the loads were allocated evenly to the loading manholes within each area. Infill areas, redevelopment areas, and vacant lands were also included in the future load allocation.

6.3 MODEL CALIBRATION

Calibration is intended to instill a level of confidence in the flows that are simulated, and it generally consists of comparing model predictions to the 2020 V&A flow monitoring program, and making necessary adjustments.

6.3.1 Calibration Plan

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

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

- Peak dry weather flows.
- Peak wet weather flows from storm rainfall Event No. 1(12 March 2020 -13 March 2020)
- Peak wet weather flows from storm rainfall Event No. 2(9 March 2020 - 10 March 2020)

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

6.3.2 2020 V&A Temporary Flow Monitoring Program

A temporary flow monitoring program was included in this project to validate the existing dry and wet weather flows from each wastewater collection basin. The program consisted of installing 14 flow meters, for a period of 8 weeks, from February 2020 to April 2020. Villalobos and Associates (V&A) was retained to install the flow meters, monitor rainfall, and perform an Infiltration and Inflow analysis. The selected flow monitoring sites are listed on **Table 6.2** and shown on **Figure 6.2**. Additionally, **Table 6.3** provided a calibration result summary for each of the respective sites monitored.

The 2020 V&A Flow Monitoring Program captured two rainfall events and included a summary report identifying areas of the City that were most affected by rain dependent infiltration and inflows. The two rainfall events experienced during the flow monitoring period varied in duration and intensity (**Table 3.5**), and provided an insight into the wastewater collection system response to storm conditions.

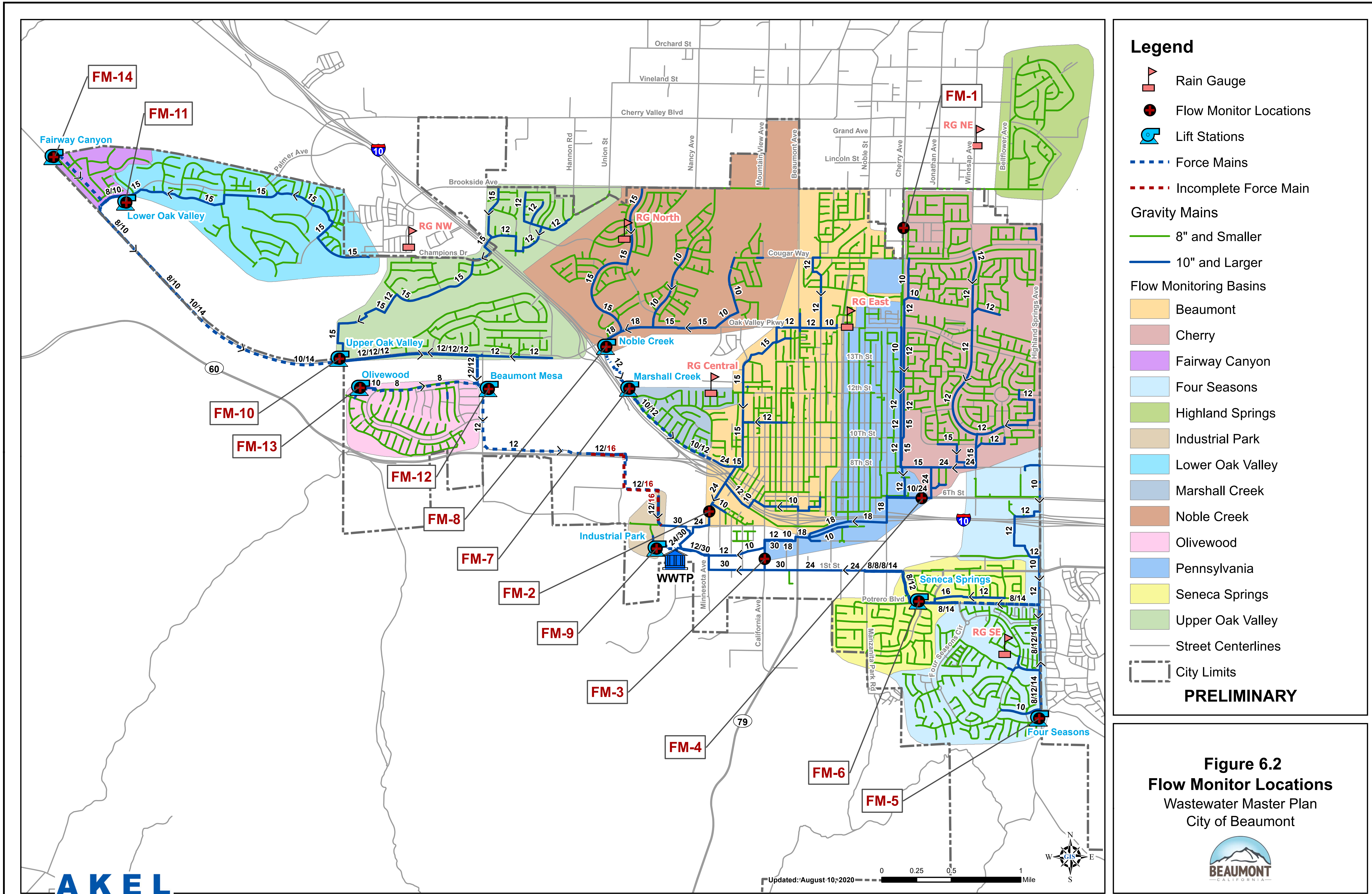

Figure 6.2
Flow Monitor Locations
Wastewater Master Plan
City of Beaumont

Table 6.2 Flow Monitor Locations

Wastewater Master Plan
City of Beaumont

PRELIMINARY

Site ID	Location Description	Pipe Size (in)	Manhole ID
Gravity Main Flow Monitors			
FM-1	Cherry Avenue north of Mary Lane	8" N (In Pipe)	SSMH01048
FM-2	Minnesota Avenue approx 500' north of 4th Street	24" N (In Pipe)	SSMH01728
FM-3	California Avenue approx 400' north of 1st Street	30" N (In Pipe)	SSMH00381
FM-4	6th Street approx 400' west of American Avenue	24" E (In Pipe)	SSMH00330
Lift Station Flow Monitors			
FM-5	1075 South Highland Springs Road	-	LS-1 (Four Seasons)
FM-6	1390 Potrero Boulevard	-	LS-2 (Seneca Springs)
FM-7	990 Ring Ranch Road	-	LS-3 (Marshall Creek)
FM-8	1899 West Oak Valley Parkway	-	LS-4 (Noble Creek)
FM-9	715 West 4th Street	-	LS-5 (Industrial Park)
FM-10	35980 Oak Valley Parkway	-	LS-6 (Upper Oak Valley)
FM-11	11246 Palmer Avenue	-	LS-7 (Lower Oak Valley)
FM-12	34003 Crenshaw Street	-	LS-8 (Beaumont Mesa)
FM-13	12940 Potrero Boulevard	-	LS-9 (Olivewood)
FM-14	Castello Lane approx 450' north of Artisan Place	-	LS-10 (Fairway Canyon)

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Notes:

1. GIS Manhole IDs based on GIS shapefiles provided by City staff November 18, 2019.

Table 6.3 Calibration Results Summary

Wastewater Master Plan
City of Beaumont

PRELIMINARY

Flow Monitoring ID		Units	Dry Period (Weekday)			Dry Period (Weekend)			Wet Weather (Event 1) (March 12- March 13)			Wet Weather (Event 2) (March 9 - March 10)		
			Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
S-1	Flow Monitored	(mgd)	0.018	0.156	0.066	0.017	0.166	0.073	0.017	0.351	0.127	0.014	0.191	0.084
	Model	(mgd)	0.018	0.155	0.066	0.018	0.163	0.069	0.018	0.313	0.109	0.018	0.163	0.078
	Difference	(mgd)	0.0002	-0.0009	0.0001	0.0009	-0.0024	-0.0043	0.0006	-0.0384	-0.0182	0.0035	-0.0288	-0.0059
		(%)	**1.36**	**-0.60**	**0.08**	**5.51**	**-1.43**	**-5.93**	**3.55**	**-10.94**	**-14.33**	**25.02**	**-15.03**	**-7.04**
S-2	Flow Monitored	(mgd)	0.334	1.077	0.791	0.329	1.202	0.783	0.319	1.955	0.965	0.290	1.407	0.872
	Model	(mgd)	0.302	1.055	0.788	0.287	1.262	0.794	0.302	1.805	0.963	0.302	1.220	0.856
	Difference	(mgd)	-0.0320	-0.0224	-0.0023	-0.0416	0.0601	0.0111	-0.0168	-0.1500	-0.0016	0.0116	-0.1865	-0.0158
		(%)	**-9.58**	**-2.08**	**-0.29**	**-12.64**	**5.00**	**1.42**	**-5.26**	**-7.67**	**-0.17**	**4.01**	**-13.26**	**-1.82**
S-3	Flow Monitored	(mgd)	0.195	1.471	0.955	0.150	1.687	1.026	0.169	2.839	1.240	0.194	2.102	1.055
	Model	(mgd)	0.171	1.543	0.955	0.153	1.718	1.048	0.171	2.607	1.259	0.171	1.691	1.049
	Difference	(mgd)	-0.0234	0.0713	0.0001	0.0030	0.0304	0.0230	0.0027	-0.2318	0.0189	-0.0222	-0.4111	-0.0060
		(%)	**-12.01**	**4.84**	**0.01**	**2.01**	**1.80**	**2.24**	**1.62**	**-8.17**	**1.53**	**-11.48**	**-19.56**	**-0.57**
S-4	Flow Monitored	(mgd)	0.063	0.854	0.488	0.058	0.917	0.551	0.064	1.084	0.573	0.066	1.147	0.531
	Model	(mgd)	0.067	0.852	0.489	0.064	0.903	0.552	0.067	1.100	0.588	0.067	0.910	0.521
	Difference	(mgd)	0.0040	-0.0024	0.0005	0.0063	-0.0147	0.0004	0.0025	0.0162	0.0152	0.0010	-0.2368	-0.0095
		(%)	**6.40**	**-0.28**	**0.11**	**10.82**	**-1.60**	**0.07**	**3.81**	**1.49**	**2.65**	**1.53**	**-20.65**	**-1.79**
S-5	Flow Monitored	(mgd)	0.082	0.399	0.254	0.078	0.390	0.243	0.083	0.549	0.280	0.084	0.404	0.251
	Model	(mgd)	0.085	0.397	0.254	0.082	0.380	0.241	0.085	0.537	0.282	0.085	0.410	0.266
	Difference	(mgd)	0.0032	-0.0022	-0.0001	0.0044	-0.0094	-0.0019	0.0025	-0.0118	0.0016	0.0012	0.0052	0.0147
		(%)	**3.93**	**-0.56**	**-0.05**	**5.66**	**-2.42**	**-0.79**	**2.98**	**-2.15**	**0.55**	**1.38**	**1.30**	**5.85**
S-6	Flow Monitored	(mgd)	0.057	0.217	0.143	0.057	0.247	0.163	0.060	0.236	0.154	0.047	0.306	0.146
	Model	(mgd)	0.058	0.216	0.143	0.059	0.244	0.163	0.058	0.232	0.159	0.058	0.228	0.149
	Difference	(mgd)	0.0015	-0.0014	0.0001	0.0014	-0.0027	-0.0003	-0.0018	-0.0039	0.0056	0.0109	-0.0776	0.0034
		(%)	**2.65**	**-0.66**	**0.09**	**2.48**	**-1.09**	**-0.19**	**-3.03**	**-1.67**	**3.68**	**22.99**	**-25.37**	**2.35**
S-7	Flow Monitored	(mgd)	0.118	0.595	0.416	0.115	0.768	0.431	0.080	1.062	0.521	0.113	0.711	0.455
	Model	(mgd)	0.126	0.586	0.416	0.123	0.711	0.423	0.129	0.958	0.493	0.123	0.666	0.448
	Difference	(mgd)	0.0077	-0.0085	0.0002	0.0079	-0.0562	-0.0080	0.0485	-0.1046	-0.0284	0.0101	-0.0452	-0.0076
		(%)	**6.54**	**-1.43**	**0.04**	**6.92**	**-7.33**	**-1.85**	**60.59**	**-9.85**	**-5.44**	**8.98**	**-6.36**	**-1.66**
S-8	Flow Monitored	(mgd)	0.076	0.341	0.241	0.072	0.394	0.242	0.069	0.560	0.286	0.074	0.375	0.257
	Model	(mgd)	0.077	0.340	0.241	0.072	0.390	0.241	0.077	0.572	0.284	0.077	0.387	0.258
	Difference	(mgd)	0.0009	-0.0006	0.0002	0.0005	-0.0043	-0.0011	0.0077	0.0122	-0.0023	0.0029	0.0126	0.0011
		(%)	**1.18**	**-0.16**	**0.08**	**0.66**	**-1.10**	**-0.45**	**11.03**	**2.18**	**-0.79**	**3.90**	**3.36**	**0.42**
S-9	Flow Monitored	(mgd)	0.030	0.108	0.054	0.027	0.052	0.030	0.008	0.205	0.058	0.009	0.132	0.054
	Model	(mgd)	0.029	0.107	0.055	0.027	0.050	0.030	0.029	0.143	0.063	0.029	0.109	0.058
	Difference	(mgd)	-0.0004	-0.0011	0.0006	-0.0003	-0.0014	-0.0005	0.0208	-0.0620	0.0050	0.0206	-0.0224	0.0037
		(%)	**-1.20**	**-1.04**	**1.13**	**-0.97**	**-2.73**	**-1.81**	**246.44**	**-30.20**	**8.70**	**236.48**	**-17.02**	**6.91**
S-10	Flow Monitored	(mgd)	0.213	1.070	0.696	0.204	1.117	0.734	0.154	1.451	0.864	0.159	1.475	0.777
	Model	(mgd)	0.208	1.036	0.716	0.222	1.178	0.777	0.240	1.436	0.818	0.236	1.126	0.760
	Difference	(mgd)	-0.0057	-0.0334	0.0198	0.0174	0.0616	0.0432	0.0855	-0.0148	-0.0461	0.0768	-0.3488	-0.0175
		(%)	**-2.67**	**-3.12**	**2.84**	**8.54**	**5.52**	**5.89**	**55.36**	**-1.02**	**-5.33**	**48.25**	**-23.65**	**-2.25**
S-11	Flow Monitored	(mgd)	0.116	0.564	0.371	0.116	0.664	0.416	0.109	0.627	0.400	0.107	0.603	0.378
	Model	(mgd)	0.130	0.560	0.379	0.119	0.639	0.421	0.130	0.642	0.413	0.130	0.585	0.395
	Difference	(mgd)	0.0139	-0.0041	0.0078	0.0027	-0.0245	0.0045	0.0210	0.0152	0.0133	0.0238	-0.0174	0.0165
		(%)	**11.92**	**-0.73**	**2.11**	**2.36**	**-3.69**	**1.09**	**19.19**	**2.43**	**3.32**	**22.36**	**-2.89**	**4.36**
S-12	Flow Monitored	(mgd)	0.294	1.065	0.739	0.255	1.092	0.756	0.198	1.370	0.910	0.253	1.283	0.800
	Model	(mgd)	0.228	1.071	0.735	0.212	1.156	0.780	0.248	1.505	0.847	0.225	1.143	0.778
	Difference	(mgd)	-0.0662	0.0066	-0.0044	-0.0427	0.0640	0.0236	0.0491	0.1347	-0.0626	-0.0279	-0.1401	-0.0213
		(%)	**-22.51**	**0.62**	**-0.59**	**-16.78**	**5.86**	**3.12**	**24.77**	**9.83**	**-6.88**	**-11.01**	**-10.92**	**-2.66**
S-13	Flow Monitored	(mgd)	0.003	0.036	0.022	0.002	0.021	0.012	0.007	0.057	0.032	0.000	0.000	0.000
	Model	(mgd)	0.004	0.036	0.022	0.002	0.021	0.012	0.004	0.068	0.031	0.004	0.045	0.026
	Difference	(mgd)	0.0008	-0.0002	0.0000	0.0006	0.0003	0.0000	-0.0023	0.0112	-0.0003	0.0043	0.0450	0.0256
		(%)	**23.44**	**-0.64**	**0.09**	**33.44**	**1.37**	**0.20**	**-34.88**	**19.73**	**-0.93**	**0.00**	**0.00**	**0.00**
S-14	Flow Monitored	(mgd)	0.021	0.090	0.061	0.017	0.096	0.064	0.020	0.087	0.043	0.016	0.110	0.064
	Model	(mgd)	0.023	0.090	0.061	0.018	0.095	0.064	0.023	0.090	0.062	0.023	0.090	0.061
	Difference	(mgd)	0.0023	-0.0002	0.0000	0.0007	-0.0009	0.0000	0.0026	0.0033	0.0183	0.0068	-0.0206	-0.0027
		(%)	**11.30**	**-0.24**	**0.00**	**3.87**	**-0.89**	**0.00**	**12.70**	**3.80**	**42.14**	**42.02**	**-18.65**	**-4.16**

During the V&A flow monitoring program six rain gauges were set up within the City service area to record storm events during the monitoring period and are shown on **Figure 6.1**. Data from the V&A flow monitoring effort, as documented in the 2020 V&A Flow Monitoring Program, was used in this analysis to calibrate the computer hydraulic model to average dry weather flow (ADWF) and peak wet weather flow (PWWF) conditions.

6.3.3 Dynamic Model Calibration

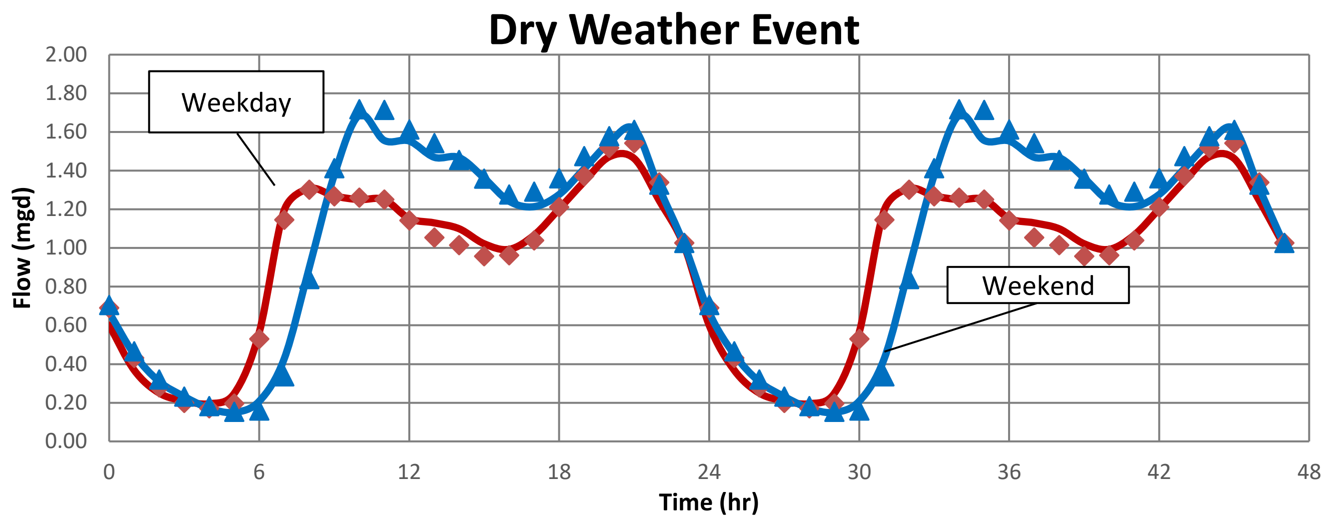
The calibration process was iterative as it involved calibrating each of the 14 flow monitored sites and for the three calibration conditions: 1) peak dry weather flow, 2) peak wet weather flows from storm rainfall Event No. 1, and 3) peak wet weather flows from storm rainfall Event No. 2.

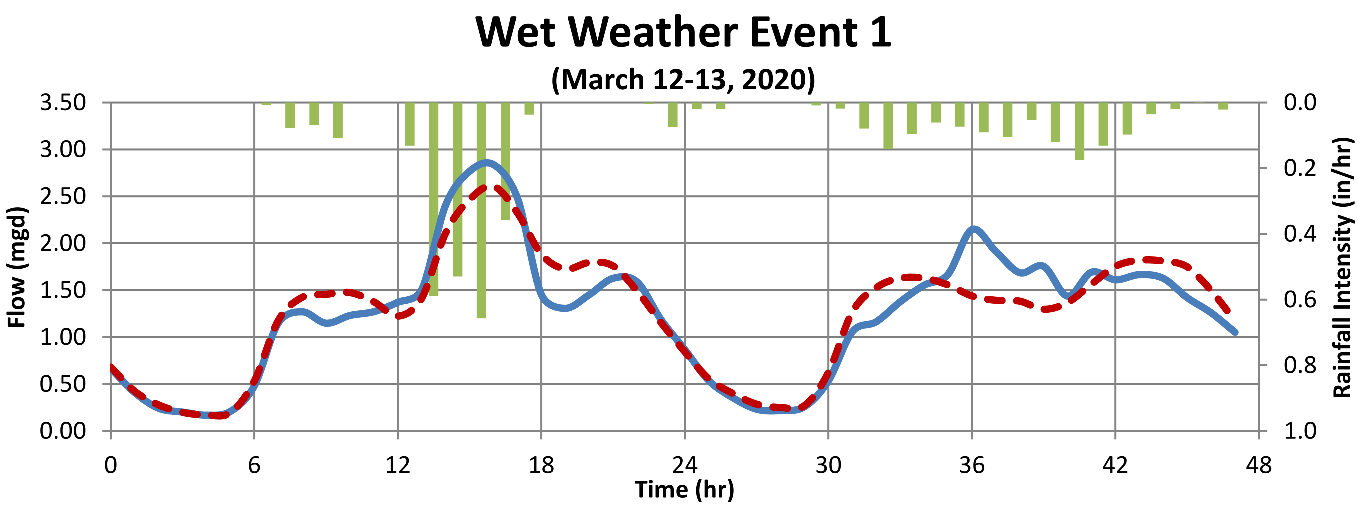
The rain events of March 12-13, 2020 (Event No. 1) and March 10-11, 2020 (Event No. 2), as listed on **Table 3.5**, were used to calibrate the hydraulic model to the wet weather conditions. The diurnal curves for each of the 14 sites were extracted from the 2020 V&A Flow Monitoring Program and the data was used for comparison purposes with the hydraulic model predictions. The calibration effort is an iterative process and continues until it yields acceptable results for each site and for each of the three calibration conditions.

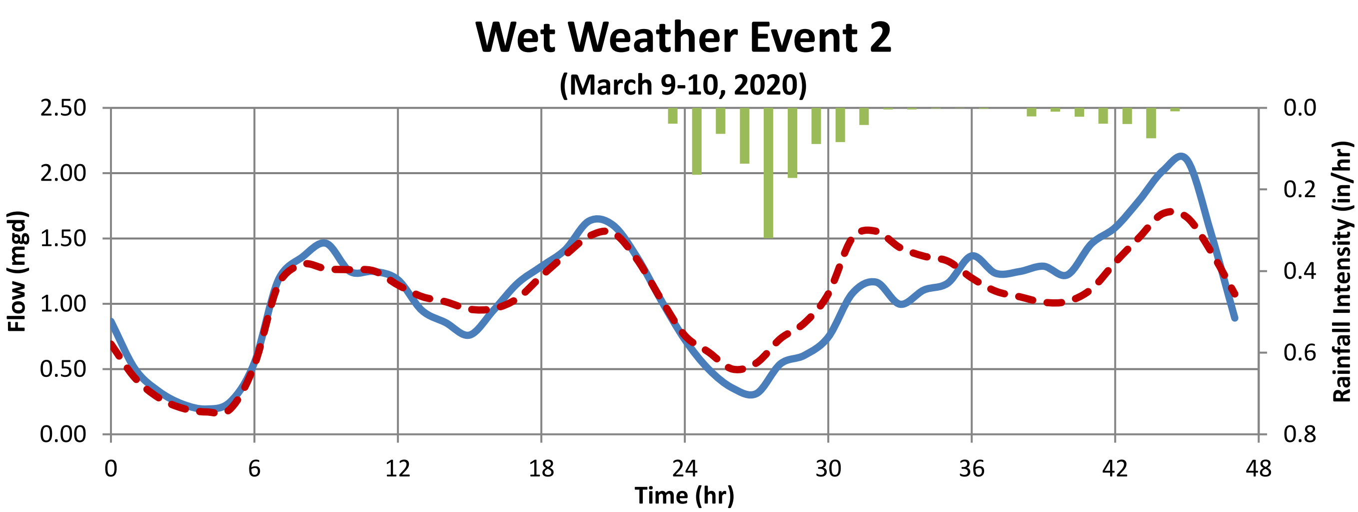
The calibration results for each flow monitoring site are documented in **Appendix B** and briefly summarized on **Table 6.3**. These results indicate the calibration effort yielded reasonable comparisons between the flow monitoring data and the hydraulic model predictions at the 14 sites. The calibration results were reviewed and approved by City staff, and representative extracts from **Appendix B** are shown on **Figures 6.3** and **Figure 6.4**. After each of the calibration process has been completed, the hydraulic model was benchmarked for further analysis and evaluation.

6.3.4 Use of the Calibrated Model

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







LEGEND **PRELIMINARY**

Dry Weather Event

- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event

- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

Figure 6.3

S-3

Wastewater Master Plan

City of Beaumont

BEAUMONT CALIFORNIA

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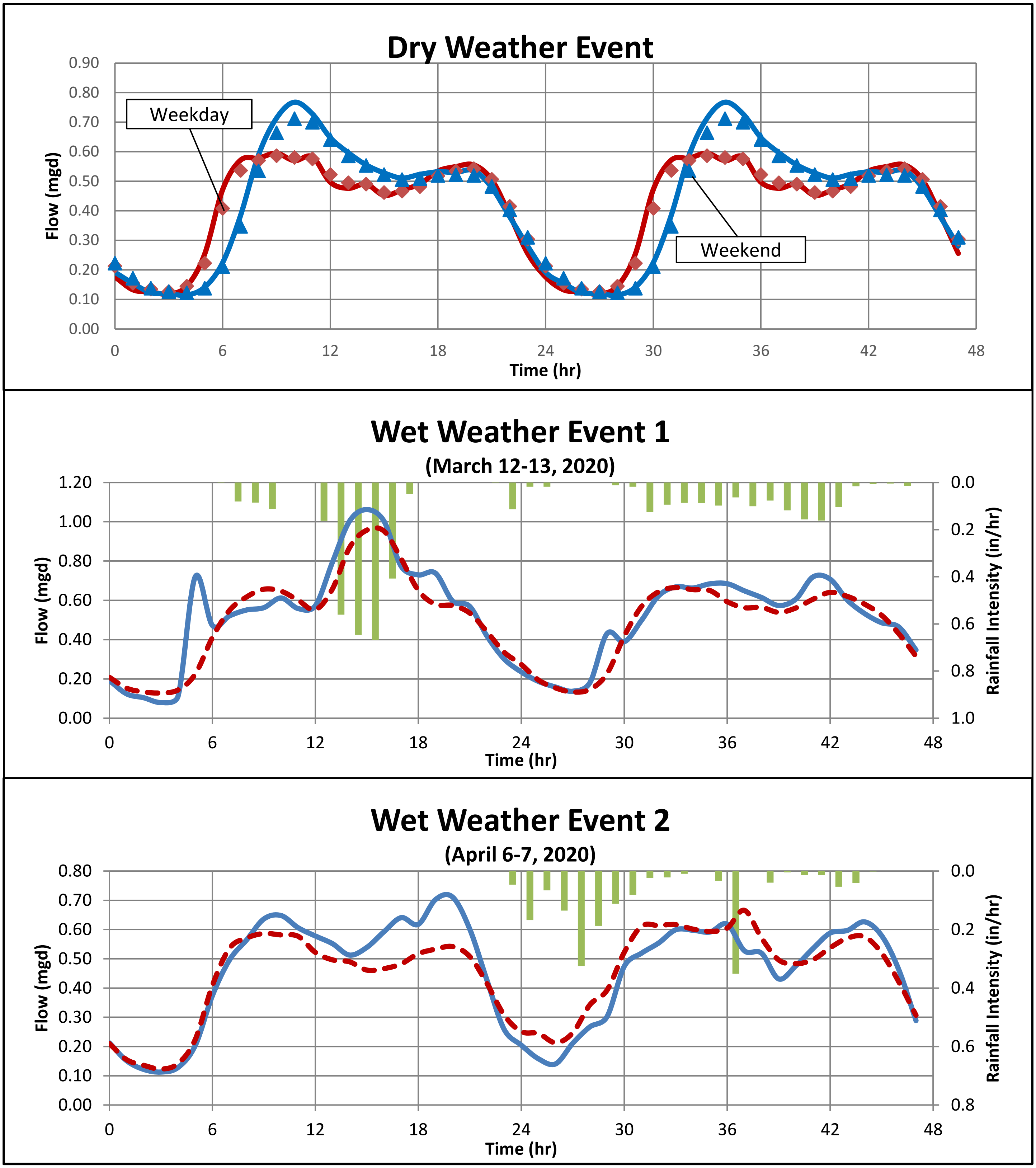

LEGEND **PRELIMINARY**

Dry Weather Event

- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event

- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

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Figure 6.4

S-7

Wastewater Master Plan

City of Beaumont

BEAUMONT CALIFORNIA

CHAPTER 7 - EVALUATION AND PROPOSED IMPROVEMENTS

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

7.1 OVERVIEW

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

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

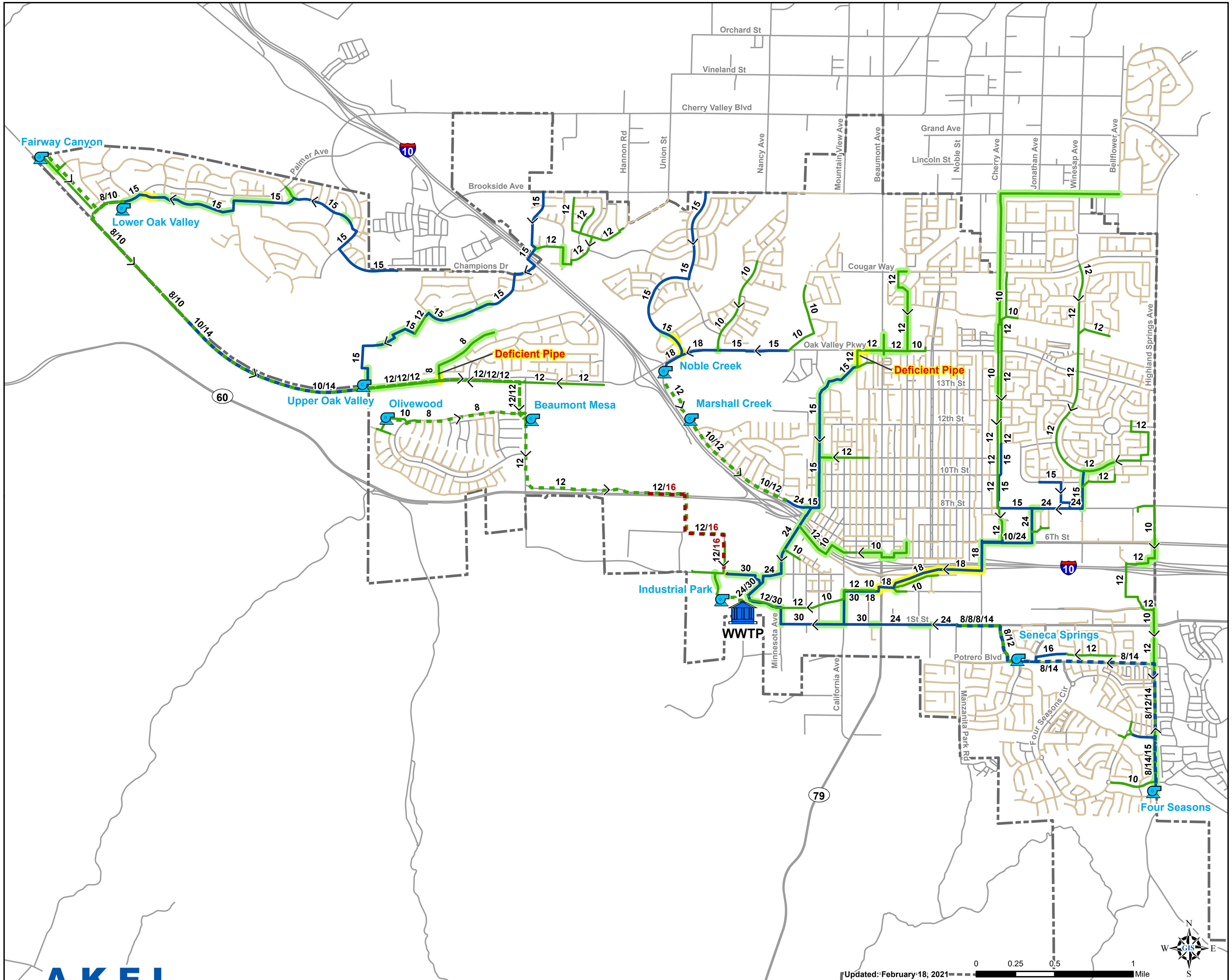
7.2 EXISTING SYSTEM CAPACITY EVALUATION

The system performance and design criteria summarized on **Table 3.1** were used as a basis to judge the adequacy of capacity for the existing wastewater collection system. The design flows simulated in the hydraulic model for existing conditions were summarized on **Table 5.3** and are listed as follows:

- Existing PDWF = 9.3 mgd
- Existing PWWF = 9.8 mgd

During the peak dry weather simulations, the maximum allowable pipe d/D criteria for gravity pipelines (0.50 for wastewater mains less than or equal to 12-inch or, 0.70 for wastewater mains greater than 12-inch) was used. During the peak wet weather simulations, the existing wastewater mains are allow to reach the full capacity of 1.0 while the future wastewater mains are allow to 75 percent full.

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



Legend

Pipe d/D

- Surcharged
- d/D 0.7 - 1.0
- d/D 0.5 - 0.7
- d/D 0.25 - 0.5

Existing System

- Lift Stations

Modeled Force Mains

- 12" and Smaller
- 14" and Larger
- Incomplete Force Main

Modeled Gravity Mains

- 12" and Smaller
- 15" and Larger
- Non-Modeled Pipes
- Street Centerlines
- City Limits

PRELIMINARY

Figure 7.1
Existing Modeled System Analysis for PDWF
Wastewater Master Plan
City of Beaumont

AKEL ENGINEERING GROUP, INC.

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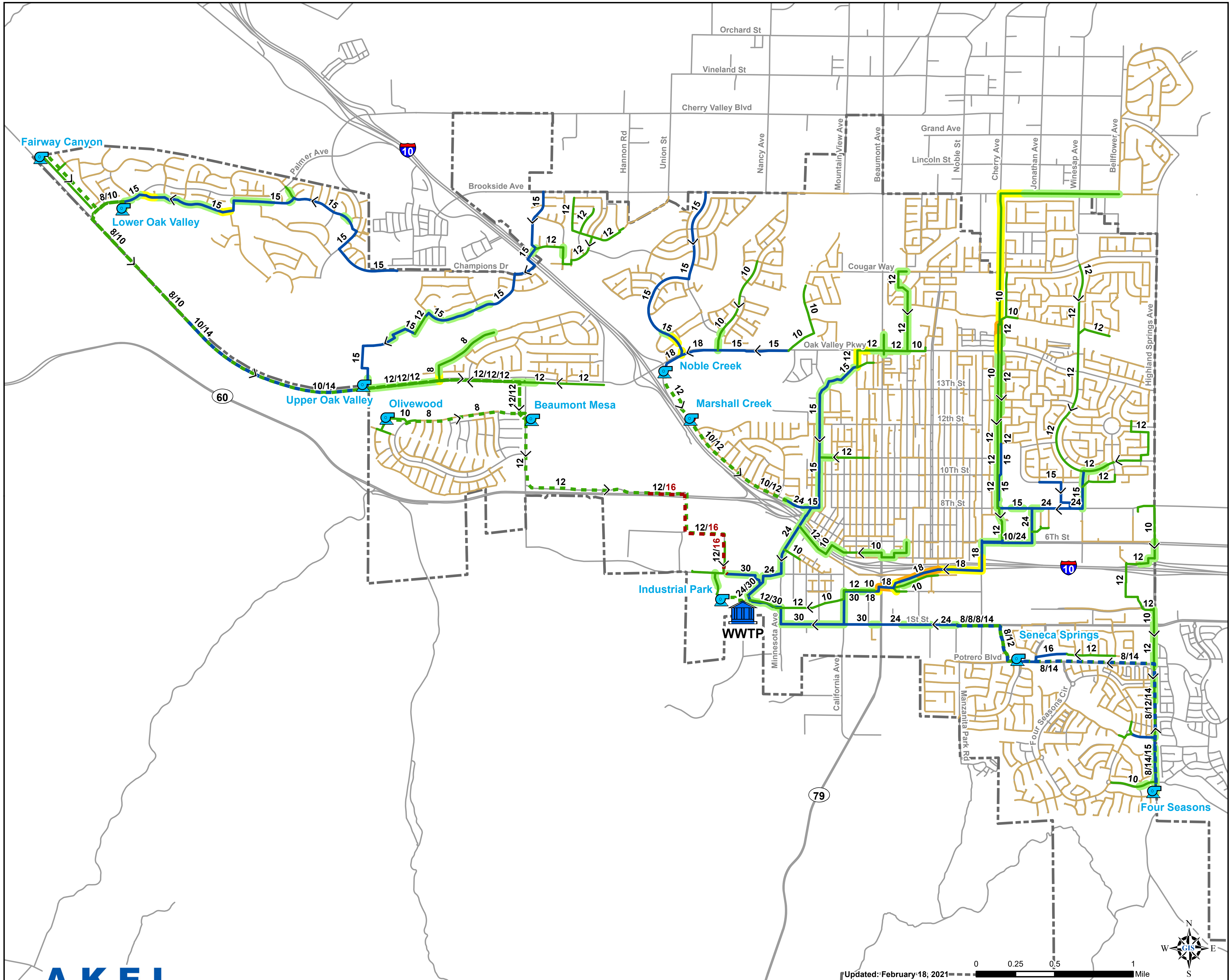

Legend

Pipe d/D

- Surcharged
- d/D 0.7 - 1.0
- d/D 0.5 - 0.7
- d/D 0.25 - 0.5

Existing System

- Lift Stations

Modeled Force Mains

- 12" and Smaller
- 14" and Larger
- Incomplete Force Main

Modeled Gravity Mains

- 12" and Smaller
- 15" and Larger
- Non-Modeled Pipes
- Street Centerlines
- City Limits

No Deficient Pipes Observed

PRELIMINARY

Figure 7.2
Existing Modeled System
Analysis for PWWF

Wastewater Master Plan
City of Beaumont

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Beaumont\Sewer\191114-WastewaterMP\BEA_Fig7-2_PWWF_021821.mxd

7.2.1 Existing Peak Dry Weather Flows Capacity Evaluation

The existing dry weather flow analysis indicated that the existing wastewater collection system exhibited acceptable performance to service existing customers during peak dry weather flows, as documented on **Figure 7.1**, with the following exception:

- Apron Lane from Stableford Court to Oak Valley Parkway. This existing 8-inch pipeline experiences d/D ratios over 0.5 under peak dry weather flow conditions.
- Edgar Avenue from Oak Valley Parkway to approximately 580-feet south of Oak Valley Parkway. This existing 12-inch pipeline experiences d/D ratios over 0.5 under peak dry weather flow conditions.

7.2.2 Existing Peak Wet Weather Flows Capacity Evaluation

The existing wet weather flow analysis is intended to document the impact of rainfall events on the existing system, and to identify the improvements necessary to limit wastewater overflows. The design criteria for wet weather events allows pipeline to approach maximum allowable capacity criteria (d/D Ratio of 1.0). The hydraulic analysis indicates no existing deficient pipes observed, as shown on **Figure 7.2**.

7.3 BEAUMONT MESA LIFT STATION SPECIAL STUDIES

The Beaumont Mesa Lift Station serves as the critical lift station that conveys flows form the north reaches of the City's wastewater system to the WWTP. During the preparation of the WMP several special studies were performed for this lift station. These additional reviews included the following:

- Lift Station As-Built Preparation
- Offline Force Main Exploration
- Wet Well Expansion Site Constraints Analysis

These special studies are summarized in detail in the following sections.

7.3.1 Lift Station As-Built Preparation

City staff requested that detailed schematic drawings be prepared for the Beaumont Mesa Lift station, which would aid staff in reviewing the lift station and provide an updated record drawing source. Cannon completed a detailed survey of the lift station, which included imaging of the dry well interior and a detailed site plan. These updated record drawings are included in **Appendix C**.

7.3.2 Offline Force Main Exploration

The Beaumont Mesa Lift Station currently conveys flows to the City's WWTP via a single 12-inch force main. Additionally, an incomplete 16-inch force main exists between Highway 60 and the WWTP. However, prior to the WMP it was unknown if the incomplete force main crossed beneath Highway 60 or was only constructed up to the Highway's southern edge. In coordination with

Cannon and C-Below a field survey was completed to confirm the presence of the force main on the north side of the freeway. This field survey discovered approximately 5,220 feet of 16-inch force main on the north side of Highway 60, parallel to the existing 12-inch force main. The existence of this segment beneath the freeway mitigates the need for costly bore and jack construction to connect the 16-inch force main to the Beaumont Mesa Lift station. The survey report is included in **Appendix D**.

7.3.3 Wet Well Capacity Expansion

In order to provide emergency storage capacity at the lift station a wet well capacity analysis was performed. Following discussion with City staff it was determined that the wet well would be expanded to hold a volume equal to a one-hour duration of the peak inflow rate. **Table 7.1** summarizes the results of the capacity analysis, which indicates that an additional volume of 0.25 MG is required to provide this emergency storage capacity. Additionally, a cost comparison was performed between constructing this expansion capacity and a no-action alternative. This cost comparison, summarized on **Table 7.1**, shows that the estimated cost to expand the wet well is less than the minimum possible fine should a sanitary sewer overflow occur.

Following the estimation of the volume expansion a review of the site constraints was performed. Based on the existing site layout and configuration of the existing lift station facilities, as shown on **Figure 7.3**, there is sufficient area within the existing site to construct the recommended additional volume. **Table 7.2** summarizes the Beaumont Mesa available wet well expansion volume excluding concrete volume.

7.4 BEAUMONT MESA LIFT STATION OPERATION

The Beaumont Mesa wet well analysis summarized on **Table 7.1** were used to size the volume of the new wet well with 30 minutes inflow and 60 minutes inflow assuming no wastewater pumping out. During the general plan buildout conditions, the spill duration for 60 minutes inflow are 49.2 minutes and 49.3 minutes under peak hour dry weather and peak hour wet weather events respectively.

The estimated minimum spill fine is $2,501,400 dollar for 60 minutes wastewater inflows with possible spill fine rate range from minimum $10 to $ 1,000 dollars based on the fine rate provided by City staff. The estimated CIP cost for the new wet well is $ 3,326,000 dollar based on Cannon’s preliminary wet well design cost estimate.

7.5 OTHER SPECIAL STUDIES

This Wastewater Master Plan included several special studies requested by City staff and are included in the following:

- Fairway Canyon Preliminary Design Report (PDR) Review
- Wastewater Hydraulic Analysis for McClure Industrial Building

These special studies are summarized in detail in the following sections.

File Path: P:\xGIS\GIS_Projects\Beaumont\Sewer\191114-WastewaterMP\SpecialStudy\BeaumontMesaLS\BEA_Fig_PotentialWetWellExpansion_051921.mxd

Legend

Existing System

- Lift Station
- Force Mains
- Gravity Mains
- Potential Expansion Extents (green)
- Potential Expansion Extents (red)

PRELIMINARY

Figure 7.3
Potential Wet Well Expansion
Wastewater Master Plan
City of Beaumont

BEAUMONT
CALIFORNIA

Table 7.1 Beaumont Mesa LS - Estimated Time to Spill

Wastewater Master Plan

City of Beaumont

PRELIMINARY

	Future Flow Conditions			
	Average Flow Conditions		Peak Flow Conditions	
	Dry Weather	Wet Weather	Dry Weather	Wet Weather
Beamont Mesa LS Inflow (gpm)				
Upper Oak Valley LS[1]	1,850	1,850	3,700	3,700
Olivewood LS[2]	650	650	650	650
Gravity Drainage[3]	331	412	650	719
Maximum Infow	2,831	2,912	5,000	5,069
Estimated time to Spill				
Maximum Wet Well Volume (gallon)[4]	54,000	54,000	54,000	54,000
Time to Spill, (mins)[5]	19.1	18.5	10.8	10.7
30 Minutes Inflow				
Required Total Volume (gallon)	84,927	87,369	150,000	152,070
Existing Wet Well Volume	54,000	54,000	54,000	54,000
Required Remaining Volume (gallon)	30,927	33,369	96,000	98,070
Spill duration (mins)	10.9	11.5	19.2	19.3
Min. Estimated Spill Fine ($10/gallon)[6]	$309,265	$333,690	$960,000	**$980,700**
New Wet Well				
Recommended Volume	31,000	34,000	96,000	99,000
Estimated CIP Cost ($8.50/gallons)[7,8]	$410,800	$450,600	$1,272,100	**$1,311,900**
60 Minutes Inflow				
Required Total Volume (gallon)	169,853	174,738	300,000	304,140
Existing Wet Well Volume	54,000	54,000	54,000	54,000
Required Remaining Volume (gallon)	115,853	120,738	246,000	250,140
Spill time (mins)	40.9	41.5	49.2	49.3
Min. Estimated Spill Fine ($10/gallon)[6]	$1,158,530	$1,207,380	$2,460,000	**$2,501,400**
New Wet Well				
Recommended Volume	116,000	121,000	246,000	251,000
Estimated CIP Cost ($8.50/gallons)[7,8]	$1,537,200	$1,603,400	$3,259,800	**$3,326,000**

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3/8/2021

Notes:

1. Flow based on recommended pump improvements and assumes the following pump operations:
   Average Flow: One duty pump active
   Peak Flow Conditions: Two duty pumps active
2. Flow based on recommended pump improvements and assumes the following pump operations:
   Average/Peak Flow: One duty pump active
3. Peak flows extracted from wastewater hydraulic model. Average flows estimated based on peak flows and associated peaking factors.
4. Volume estimated based on 21.0 wet well level and total wet well area estimated based on drawings provided by Cannon May 12, 2020.
5. Time to spill estimated based on maximum wet well volume and maximum inflow.
6. Spill fine cost shown reflected the minimum fine rate. Possible spill fine rate range from $10 to $1,000 dollars.
7. Wet Well costs estimated based on cost provided by Cannon August 12, 2020.
8. Cost includes additional Master Plan Contingencies of 20% for Construction Contingencies and 30% for Capital Improvement Contingencies

Table 7.2 Potential Beaumont Mesa Wet Well Expansion

Wastewater Master Plan
City of Beaumont

PRELIMINARY

Potential Expansion Extents		7-Foot Clearance	12-Foot Clearance
Wet Well Interior	**Units**		
Maximum Depth[1]	ft	9	9
Freeboard[1]	ft	1	1
Available Depth[1]	ft	8	8
Interior Slope[2]	%	6.76%	7.25%
Available Wet Well Volume			
Total Volume With Sloped Concrete	gal	500,988	428,512
Volume of Sloped Concrete	gal	182,049	155,923
Available Wet Well Volume	gal	**318,938**	**272,589**

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5/19/2021

Notes:

1. Wet well expansion maximum depth and available depth based on drawings provided by Cannon August 12, 2020.
2. Wet well expansion interior slope assumed 7-feet drop across wet well.

7.5.1 Fairway Canyon Preliminary Design Report (PDR) Review

City staff requested Akel Engineering Group to review the PDR prepared by Proactive Engineering Consultants West, Inc. for consistency with criteria documented in the City's in-progress 2021 Wastewater Master Plan. Fairway Canyon development is a four-phase residential development consists of 1,312 total dwelling units spread over approximately 310 acres in the northwest portion of the City of Beaumont (City). The PDR estimated the average flows using per capita sewer flow generation rates based on Eastern Municipal Water District (EMWD) standards while the in-progress City of 2021 Wastewater Master Plan estimated average flows for the study area that is based on EMWD unit flow factors applied to overall site acreage.

The review also included a lift station and force main capacity evaluation. Based on the findings, this study indicated that the PDR flow estimation methodology results are slightly higher than the flows estimated in the 2021 Wastewater Master Plan. The review indicates this PDR assumptions meet the 2021 Wastewater Master Plan criteria, as documented in the technical memorandum included in **Appendix E**.

7.5.2 Wastewater Hydraulic Analysis for McClure Industrial Building

McClure Industrial building is a 1.02 acres lot size development located at the northeast corner of Minnesota Avenue and 1st Street. The estimated average flows are based on EMWD unit flow factors on per acres basis, and uses daily peaking factors based on historical flow data and hourly peaking factors based on flow monitoring data. This study evaluates the capacity adequacy of the existing wastewater collection system to service the development flows and if necessary, improvements to mitigate capacity deficiencies. Based on the findings, this study indicates that the existing wastewater collection system is adequate to serve development flow. The hydraulic analysis package is included in **Appendix F**.

7.6 LIFT STATION ASSESSMENT

This Wastewater Master Plan included a review of the City's exiting wastewater lift stations, which included the following analyses:

- **Pumping Capacity Evaluation:** The pumping capacity of each modeled lift station was reviewed to ensure each station is capable of conveying wastewater flows under existing and buildout development conditions. This evaluation compared peak lift station inflows under peak wet weather conditions against the existing lift station firm capacities and documented any recommended improvements. The results of the pump station capacity evaluation are documented on **Table 7.3**.

- **Force Main Capacity Evaluation:** The existing lift station force mains were evaluated to determine capacity adequacy for both existing and buildout development conditions. This evaluation analyzed the pipeline velocity for the existing force mains and determined if a larger pipeline is required to convey either existing or buildout sewer flows. The results of the force main evaluation are documented on **Table 7.4**.

Table 7.3 Lift Station Capacity Analysis

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Pump Station	Design Firm Capacity	Total Capacity (Includes Standby)	Existing System Analysis			Future System Analysis			Recommended Improvements
			Peak Wet Weather Flows[1]		Surplus/ Deficiency	Peak Wet Weather Flows[1]		Surplus/ Deficiency	
	(gpm)	(gpm)	(gpm)	(mgd)	(gpm)	(gpm)	(mgd)	(gpm)	
Existing System									
Beaumont Mesa[3]	1,797	3,594	2,020	2.91	-223	4,530	6.52	-2,733	Construct two 3,500 gpm and two 1,500 gpm pumps, three duty and one standby, for total capacity of 10,000 gpm.
Fairway Canyon[2]	400	800	77	0.11	323	90	0.13	310	
Lower Oak Valley	1,050	1,700	965	1.39	85	1,217	1.75	-167	Construct three 625 gpm pumps, two duty and one standby, for total capacity of 1,875 gpm
Marshall Creek	1,150	2,300	778	1.12	372	1,696	2.44	-546	Construct two 1,700 gpm pumps, one duty and one standby, for total capacity of 3,400 gpm
Noble Creek	1,865	3,730	465	0.67	1,400	958	1.38	907	
Seneca Springs	900	1,350	201	0.29	699	378	0.54	522	
Upper Oak Valley	2,700	5,000	1,914	2.76	786	3,634	5.23	-934	Construct three 1,850 gpm pumps, two duty and one standby, for total capacity of 5,550 gpm
Four Seasons	1,740	3,715	442	0.64	1,298	2,616	3.77	-876	Construct three 1,350 gpm pumps, two duty and one standby, for total capacity of 4,050 gpm
Industrial Park	112	262	106	0.15	6	288	0.41	-176	Construct two 300 gpm pumps, one duty and one standby, for total capacity of 600 gpm
Olivewood	310	620	53	0.08	257	612	0.88	-302	Construct two 625 gpm pumps, one duty and one standby, for total capacity of 1,250 gpm
Future System									
Beaumont Ave South	-	-	-	-	-	1,788	2.57	-1,788	Construct three 900 gpm pumps, two duty and one standby, for total capacity of 2,700 gpm
Beaumont Crossroads	-	-	-	-	-	4,659	6.71	-4,659	Construct three 2,350 gpm pumps, two duty and one standby, for total capacity of 7,050 gpm
Brookside Ave	-	-	-	-	-	278	0.40	-278	Construct two 300 gpm pumps, one duty and one standby, for total capacity of 600 gpm
Tukwet Canyon	-	-	-	-	-	709	1.02	-709	Construct three 375 gpm pumps, two duty and one standby, for total capacity of 1,125 gpm

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6/8/2021

Notes:

1. Maximum average hour flows extracted from sewer system hydraulic model.
2. Lift station current capacity is different than Design Capacity as directed by City staff December 15, 2020.
3. Pump information provided by Xylem staff March 02, 2021.

Table 7.4 Force Main Capacity Analysis

Wastewater Master Plan
City of Beaumont

PRELIMINARY

Lift Station ID	Force Main Length	Force Main Diameter	Existing Peak Wet Weather Flows[1]		Future Peak Wet Weather Flows[1]		Recommended Improvements
			Flow	Velocity	Flow	Velocity	
	(ft)	(in)	(mgd)	(ft/s)	(mgd)	(ft/s)	
Existing System							
Beaumont Mesa	11,750	12	2.91	5.7	2.09	4.1	
	5,250	16	-	-	4.46	4.9	Connect to currently incomplete force main
Faiway Canyon	3,800	8	0.11	0.5	0.13	0.6	-
Lower Oak Valley[2]	13,000	Varies 8-inch/10-inch	0.50	2.2	0.99	4.4	-
	13,000	Varies 10-inch/14-inch	0.89	2.5	1.77	5.0	-
Marshall Creek	4,300	10	0.43	1.2	0.93	2.6	-
	4,300	12	0.69	1.4	1.51	3.0	-
Noble Creek	1,950	12	0.67	1.3	1.38	2.7	-
Seneca Springs	3,150	8	0.14	0.6	0.27	1.2	-
	3,100	8	0.14	0.6	0.27	1.2	-
Upper Oak Valley	6,950	12	1.38	2.7	2.65	5.2	-
	6,950	12	1.38	2.7	2.65	5.2	-
Four Seasons	12,000	8	0.12	0.5	0.70	3.1	-
	12,000	14	0.52	0.7	3.06	4.4	-
Industrial Park	1,100	6	0.15	1.2	0.41	3.3	-
Olivewood	5,100	8	0.08	0.3	0.88	3.9	-
Future System							
Beaumont Ave	5,050	10	-	-	2.57	7.3	-
Beaumont Crossroads	9,150	6	-	-	0.47	3.7	-
	9,200	16	-	-	6.24	6.9	-
Brookside Ave	2,850	6	-	-	0.40	3.2	-
Tukwet Canyon	6,250	8	-	-	0.51	2.3	-
	6,250	8	-	-	0.51	2.3	-

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2/19/2021

Notes:
1. Maximum average hour flows extracted from sewer system hydraulic model.
2. The maximum velocities shown are based on the peak wet weather flow in the smaller of the two force main diameters.

- **Condition Assessment:** V&A conducted a condition assessment of the 10 lift stations, which included documentation of the existing physical conditions, a condition rating of 1 (Very Good) to 5 (Very Poor) for various onsite components, and an opinion of probable cost for potential improvements. The condition assessment did not review the condition of the lift station pumps or the electrical, mechanical, and control elements of the lift stations.

The report completed by V&A for the condition assessment is included in **Appendix G**, while the following sections include a brief summary of the information prepared for each lift station. It should be noted that the discussion in the following sections only includes a summary of the condition assessment results for components that received a score of 4 (Poor) or 5 (Very Poor).

7.6.1 Fairway Canyon Lift Station

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

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 77 gpm and 90 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.

- **Force Main Evaluation:** As documented on **Table 7.4** the existing 8-inch Fairway Canyon force main is adequate to convey flows under existing and buildout development conditions.

- **Condition Assessment:** Leak observed on the second duty pump, immediate repair is recommended to prevent further corrosion.

7.6.2 Lower Oak Valley Lift Station

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

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 965 gpm and 1,217 gpm under buildout PWWF conditions. This lift station is under capacity during buildout development conditions and is recommended for replacement.

- **Force Main Evaluation:** As documented on **Table 7.4** the existing parallel of 8-inch, 10-inch and 10-inch, 14-inch combination force main are adequate to convey flows under existing and buildout development conditions.

- **Condition Assessment:** The condition assessment indicated that replacement of heavily corroded pump discharge pipeline is necessary.

7.6.3 Upper Oak Valley Lift Station

The following sections document the pumping capacity evaluation and force main evaluation for the Upper Oak Valley Lift Station.

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 1,914 gpm and 3,634 gpm under buildout PWWF conditions. This lift station is under capacity during buildout development conditions and is recommended for replacement.

- **Force Main Evaluation:** As documented on Table 7.4 the existing parallel 12-inch force main are adequate to convey flows under existing and buildout development conditions.

- **Condition Assessment:** The condition assessment indicated that replacement of heavily corroded pump discharge pipeline is necessary. Additionally, repair cracking on pipe supports spanning concrete base to protect from moisture.

7.6.4 Olivewood Lift Station

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

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 53 gpm and 612 gpm under buildout PWWF conditions. This lift station is under capacity during buildout development conditions and is recommended for replacement.

- **Force Main Evaluation:** As documented on Table 7.4 the existing 8-inch force main is adequate to convey flows under existing and buildout development conditions

- **Condition Assessment:** The condition assessment recommended paving site surface to reduce risk of animals hiding.

7.6.5 Beaumont Mesa Lift Station

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

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 2,020 gpm and 4,530 gpm under buildout PWWF conditions. This lift station is under capacity during existing and buildout development conditions. It is recommended that the originally design pumps be installed, which will provide sufficient capacity under existing and buildout PWWF conditions.

- **Force Main Evaluation:** As documented on Table 7.4 the existing 12-inch force main is under capacity during buildout development conditions. It is recommended that the existing incomplete force main be extended to the lift station. and is recommended to complete the existing 16-inch incomplete force main.

- **Condition Assessment:** The condition assessment recommended repair heavily corroded conduit (instrumentation) at top of wet well structure.

7.6.6 Noble Creek Lift Station

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

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 465 gpm and 958 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.

- **Force Main Evaluation:** As documented on **Table 7.4** the existing 12-inch force main is adequate to convey flows under existing and buildout development conditions.

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

7.6.7 Marshall Creek Lift Station

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

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 778 gpm and 1,696 gpm under buildout PWWF conditions. This lift station is under capacity during buildout development conditions and is recommended for replacement.

- **Force Main Evaluation:** As documented on **Table 7.4** the existing parallel 10-inch and 12-inch force main are adequate to convey flows under existing and buildout development conditions.

- **Condition Assessment:** The condition assessment recommended that pump discharge piping should be replace; additionally, lid and cover frame replacement are necessary.

7.6.8 Industrial Park Lift Station

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

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 106 gpm and 288 gpm under buildout PWWF conditions. This lift station is under capacity during buildout development conditions and is recommended for replacement.

- **Force Main Evaluation:** As documented on Table 7.4 the existing 6-inch force main is adequate to convey flows under existing and buildout development conditions.

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

7.6.9 Seneca Springs Lift Station

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

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 201 gpm and 378 gpm under buildout PWWF conditions. The existing lift station capacity is sufficient for existing and buildout conditions.

- **Force Main Evaluation:** As documented on Table 7.4 the existing parallel 8-inch force mains are adequate to convey flows under existing and buildout development conditions.

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

7.6.10 Four Seasons Lift Station

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

- **Pumping Capacity Evaluation:** The maximum modeled lift station inflow under existing PWWF conditions is 442 gpm and 2,616 gpm under buildout PWWF conditions. This lift station is under capacity during buildout development conditions and is recommended for replacement.

- **Force Main Evaluation:** As documented on Table 7.4 the existing parallel 8-inch and 14-inch force mains are adequate to convey flows under existing and buildout development conditions.

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

7.7 ULTIMATE BUILDOUT CAPACITY IMPROVEMENTS

The system performance and design criteria summarized on **Table 3.1** were used as a basis to evaluate the capacity adequacy of the existing wastewater collection system. The design flows simulated in the hydraulic model for the General Plan buildout were summarized on **Table 5.3** and are documented as follows:

- Buildout PDWF = 31.2 mgd
- Buildout PWWF = 27.9 mgd

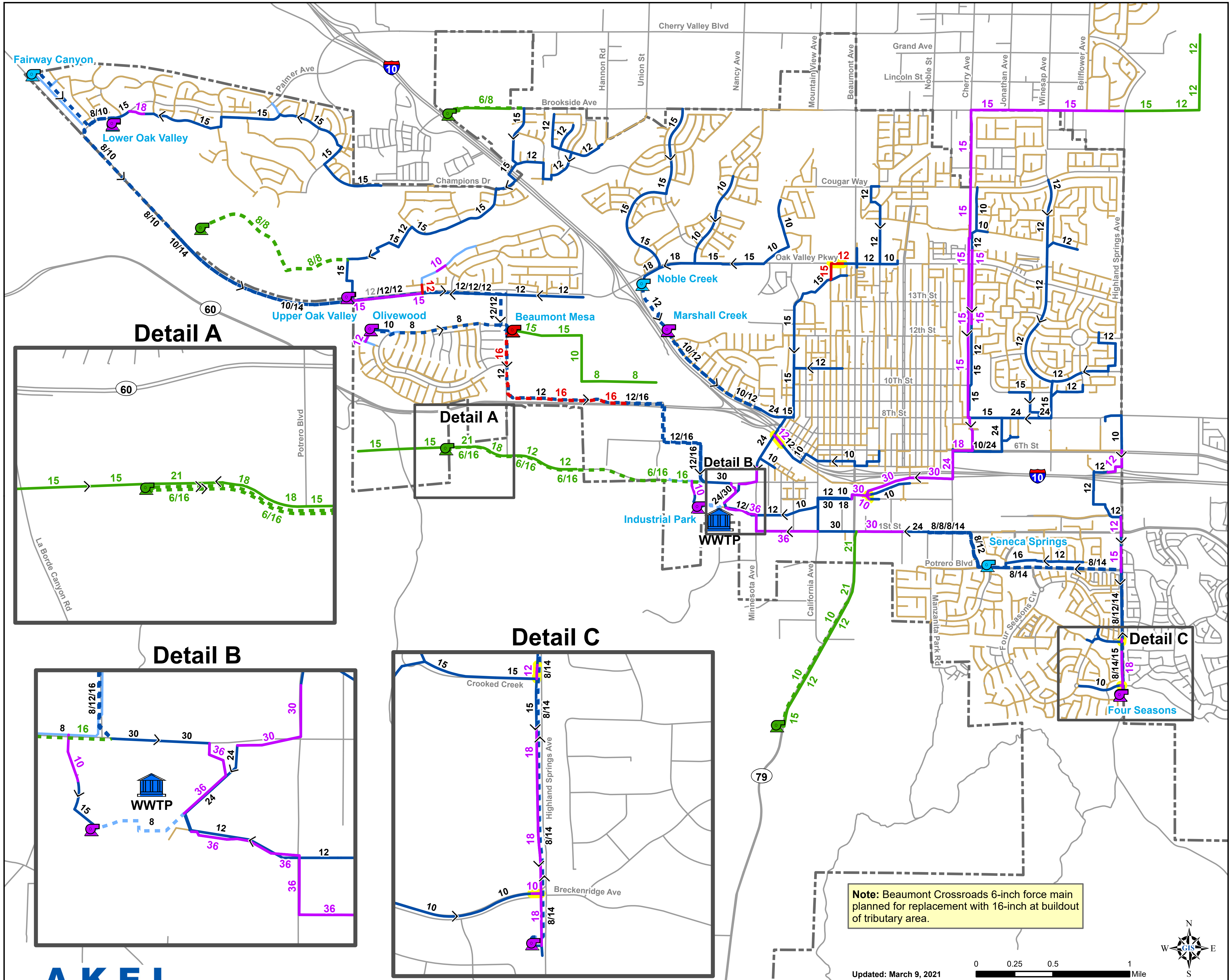
During the peak dry weather simulations, the maximum allowable pipe d/D criteria (0.5 for 12-inch or smaller and 0.70 for larger than 12-inches) was used. During the peak wet weather simulations, the maximum allowable pipe d/D criteria for new pipes 0.75 was used. For existing pipes, the criteria were relaxed to allow a maximum d/D ratio of 1.0 to prevent unnecessary pipe replacements.

The proposed capacity improvements for the wastewater collection system are shown graphically on **Figure 7.4** and summarized on **Table 7.5**, which includes lift station, force main, and gravity main improvements. This table lists the master plan assigned improvement number (e.g., P-1), along with other relevant information including alignment description, capacity or pipe size, and pipe length. These improvements are also summarized on the following pages. As shown on **Figure 7.4**, the improvements are separated into three categories, which are described as follows:

- **Existing Pipeline – Existing Capacity Deficiency:** These improvements are intended to mitigate a capacity deficiency in an existing pipeline. The proposed improvement is sized to address this deficiency.
- **Existing Pipeline – Capacity Deficiency Triggered by Future Development:** These improvements reflect existing system pipeline alignment that become deficient due to future developments. The proposed improvement is sized to address this future deficiency, when it is triggered. City staff are currently completing special studied for future developments, as they happen, to identify the triggers for these improvements.
- **New Pipeline – Triggered by Future Development:** These improvements are intended to extend the wastewater collection system to serve future growth in new areas. City staff are currently completing special studied for future developments, as they happen, to identify the final alignments and final pipeline size requirements.

7.7.1 Lift Station Capacity Improvements

This section documents lift station improvements for the wastewater collection system. Lift station improvements were identified based on the results of the capacity analysis shown on **Table 7.3** and summarized in a previous section.



Legend

Future Improvements

Lift Stations
- Existing Deficiency
- Capacity Increase for Future Dev.
- Future Development Only

Force Mains
- Existing Deficiency
- Future Development Only

Gravity Mains
- Existing Deficiency
- Capacity Increase for Future Dev.
- Future Development Only
- Pipe Slope Reconstruction

Existing System
- Lift Stations

Modeled Force Mains
- 8" and Smaller
- 10" and Larger

Modeled Gravity Mains
- 8"
- 10" and Larger
- Non-Modeled Pipes
- Street Centerlines
- City Limits

PRELIMINARY

Figure 7.4
Recommended Improvements
Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA

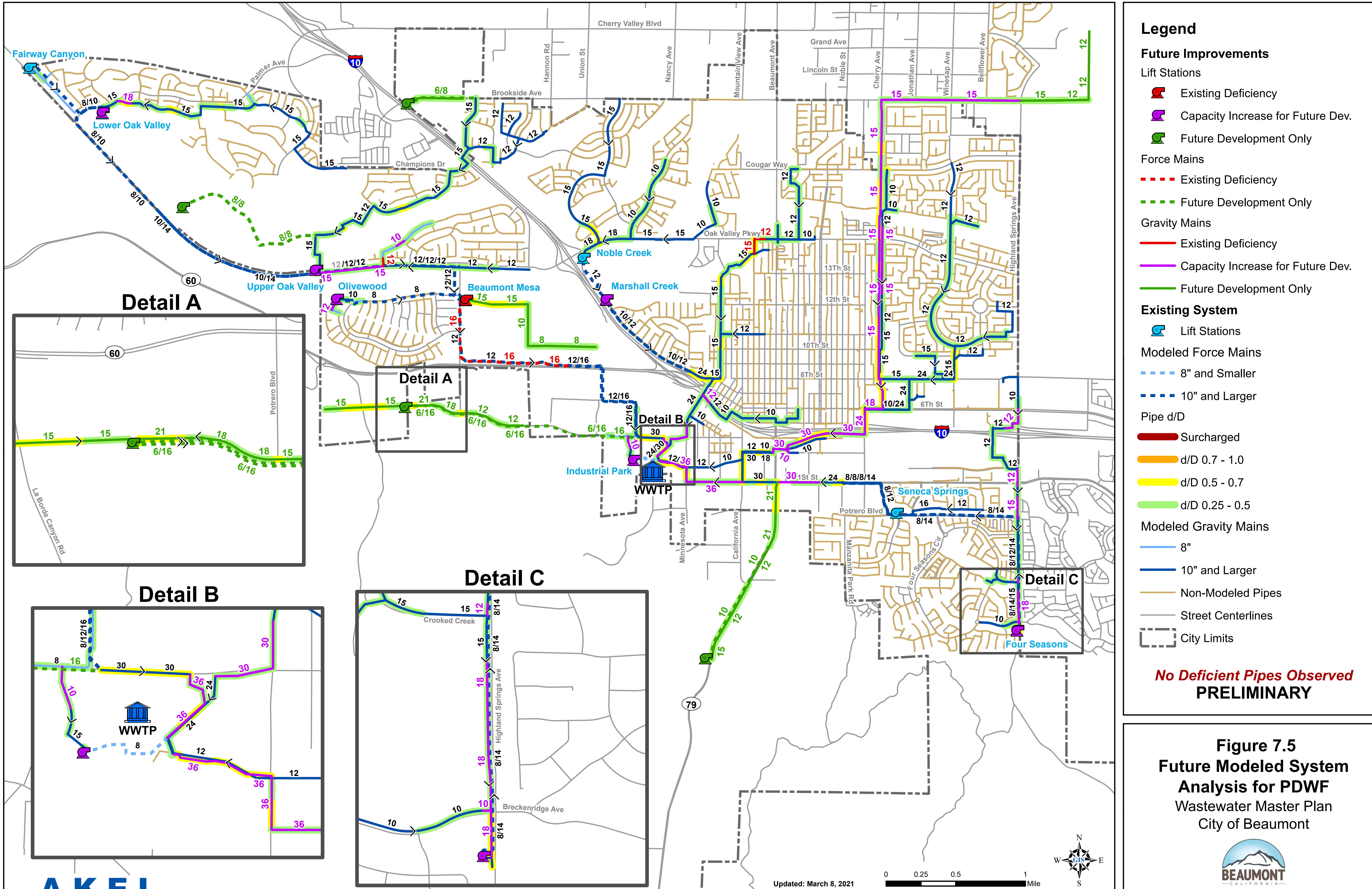


Figure 7.5
Future Modeled System Analysis for PDWF
Wastewater Master Plan
City of Beaumont

AKEL ENGINEERING GROUP, INC.

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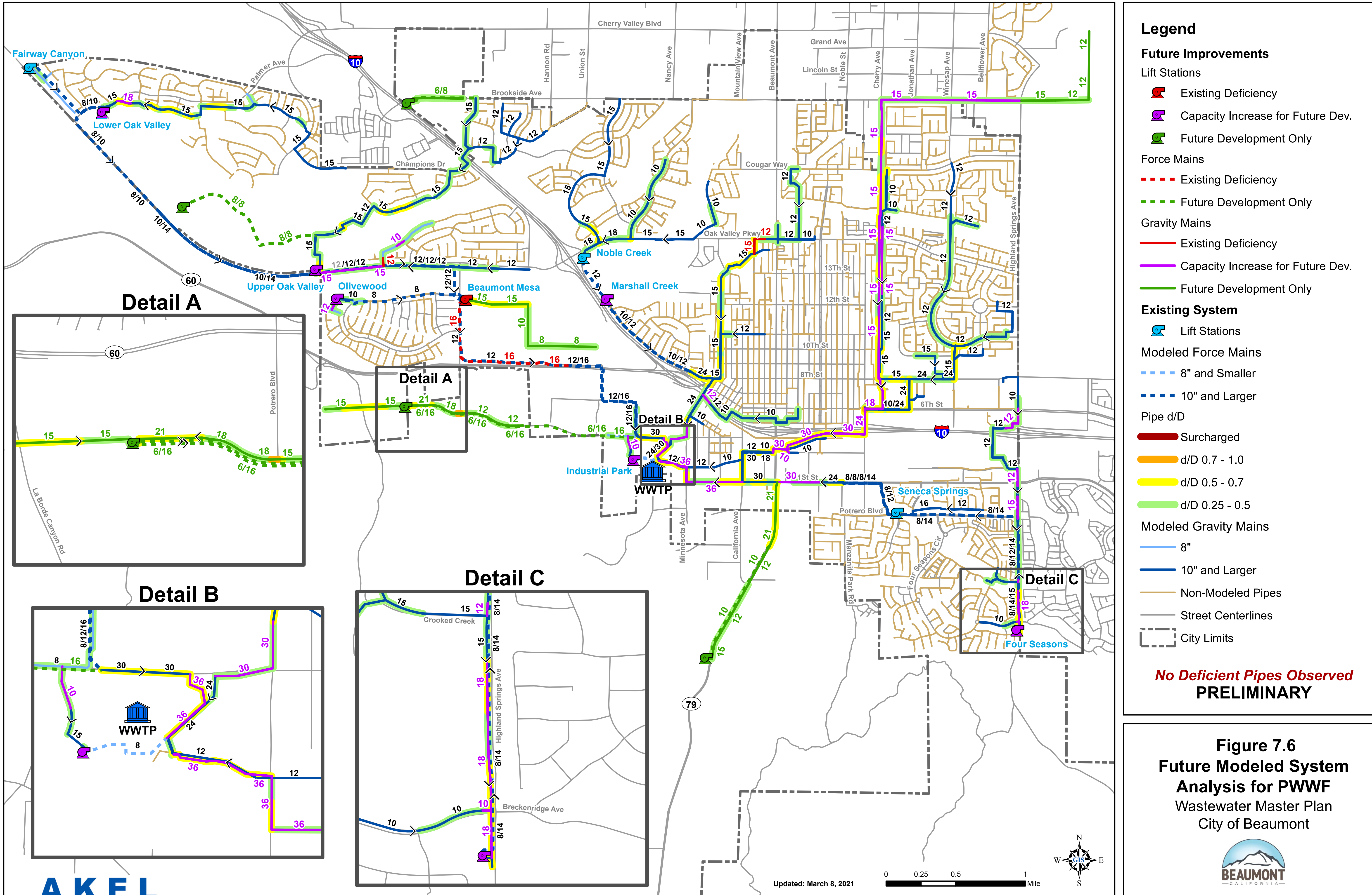

Figure 7.6
Future Modeled System Analysis for PWWF
Wastewater Master Plan
City of Beaumont

Table 7.5 Schedule of Improvements
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Existing Diameter (in)	Pipeline Improvements New/ Replace	Diameter (in)	Length (ft)
Lower Oak Valley Lift Station Tributary Area							
Gravity Main Improvements							
LOV-P1	Future Capacity Increase	Irwin St	From Floyd Cir to Palmer Ave	15	Replace	18	525
Lift Station Improvements							
LOV-LS	Lift Station Replacement	Lower Oak Valley Lift Station			Replace	3 @ 625 gpm	
Tukwet Canyon (New) Lift Station Tributary Area							
Force Main Improvements							
TC-FM1	New Force Main	Sorenstam Dr/Price St	From Tukwet Canyon lift station to approx. 1,000' n/o Upper Oak Valley lift station	-	New	8	6,250
TC-FM2	New Force Main	Sorenstam Dr/Price St	From Tukwet Canyon lift station to approx. 1,000' n/o Upper Oak Valley lift station	-	New	8	6,250
Lift Station Improvements							
TC-LS	New Lift Station	Tukwet Canyon Lift Station			New	3 @ 375 gpm	
Upper Oak Valley Lift Station Tributary Area							
Gravity Main Improvements							
UOV-P1	Future Capacity Increase	Straightaway Dr	From Balata St to 350' sw/o Balata St	8	Replace	10	350
UOV-P2	Existing Capacity Deficiency	Apron Ln	From Stableford Ct to Oak Valley Pkwy	8	Replace	12	300
UOV-P3	Future Capacity Increase	Oak Valley Pkwy	From Apron Ln to 2,450' w/o Apron Ln	12	Replace	15	2,500
Lift Station Improvements							
UOV-LS	Lift Station Replacement	Upper Oak Valley Lift Station			Replace	3 @ 1,850 gpm	
Olivewood Lift Station Tributary Area							
Gravity Main Improvements							
O-P1	Future Capacity Increase	ROW	From Artisan Pl to approx. 500' n/o Artisan Pl	10	Replace	12	525
Lift Station Improvements							
O-LS	Lift Station Replacement	Olivewood Lift Station			Replace	2 @ 625 gpm	
Brookside Avenue (New) Lift Station Tributary Area							
Gravity Main Improvements							
BR-P1	New Capacity	Brookside Ave	From 480' w/o Deodar Dr to Brookside Ave lift station	-	New	8	2,200
Force Main Improvements							
BR-FM1	New Force Main	Brookside Ave	From Brookside Ave lift station to Deodar Dr	-	New	6	2,825
Lift Station Improvements							
BR-LS	New Lift Station	Brookside Ave Lift Station			New	2 @ 300 gpm	
Beaumont Mesa Lift Station Tributary Area							
Gravity Main Improvements							
BM-P1	New Capacity	ROW	From 800' n/o Monero Valley Fwy to 2,600' e/o Potrero Blvd	-	New	8	2,575

Table 7.5 Schedule of Improvements
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Existing Diameter (in)	Pipeline Improvements New/ Replace	Diameter (in)	Length (ft)
BM-P2	New Capacity	ROW	From 2,600' e/o Potrero Blvd to 1,400' s/o Oak Valley Pkwy	-	New	10	1,600
BM-P3	New Capacity	ROW	From 1,400' s/o Oak Valley Pkwy to Beaumont Mesa lift station	-	New	15	2,350
Force Main Improvements							
BM-FM1	New Force Main	Potrero Blvd/Western Knolls Ave	From Beaumont Mesa lift station to 1,300' w/o Western Knolls Ave	-	New	16	6,500
Lift Station Improvements							
BM-LS	New Pump	Beaumont Mesa Lift Station			New	2 @ 3,500 gpm 2 @ 1,500 gpm	
BM-WW	New Wet Well	Beaumont Mesa Lift Station			New		
Beaumont Crossroads (New) Lift Station Tributary Area							
Gravity Main Improvements							
BC-P1	New Capacity	W 4th St	From 1,875' s/o Moreno Valley Fwy to Beaumont Crossroads lift station	-	New	15	3,125
BC-P2	New Capacity	W 4th St	From 275' w/o of Prosperity Way to 400' e/o Potrero Blvd	-	New	12	2,100
BC-P3	New Capacity	W 4th St	From 400' e/o Potrero Blvd to Potrero Blvd	-	New	15	375
BC-P4	New Capacity	W 4th St	From Potrero Blvd to 1,350' w/o Potrero Blvd	-	New	18	1,450
BC-P5	New Capacity	W 4th St	From 1,350' w/o Potrero Blvd to Beaumont Crossroads lift station	-	New	21	800
Force Main Improvements							
BC-FM1	New Force Main	W 4th St	From Beaumont Crossroads lift station to 100' e/o Nicholas Rd	-	New	16	9,175
BC-FM2	New Force Main	W 4th St	From Beaumont Crossroads lift station to 100' e/o Nicholas Rd	-	New	6	9,175
Lift Station Improvements							
BC-LS	New Lift Station	Beaumont Crossroads Lift Station			New	3 @ 2,350 gpm	
Marshall Creek Lift Station Tributary Area							
Lift Station Improvements							
MC-LS	Lift Station Replacement	Marshall Creek Lift Station			Replace	2 @ 1,700 gpm	
Industrial Park Lift Station Tributary Area							
Gravity Main Improvements							
IP-P1	Future Capacity Increase	Risco Cir	From W 4th St to 425' s/o W 4th St	8	Replace	10	475
Lift Station Improvements							
IP-LS	Lift Station Replacement	Industrial Park Lift Station			Replace	2 @ 300 gpm	
Beaumont Avenue South (New) Lift Station Tributary Area							
Gravity Main Improvements							
BAS-P1	New Capacity	Beaumont Ave	From 1,200' n/o Laird Rd to 2,775' sw/o Laird Rd	-	New	12	4,125
BAS-P2	New Capacity	Beaumont Ave	From 2,775' sw/o Laird Rd to Beaumont Avenue lift station	-	New	15	875
Force Main Improvements							
BAS-FM1	New Force Main	Beaumont Ave	From Beaumont Avenue lift station to 2,450' s/o E 1st St	-	New	10	5,025

Table 7.5 Schedule of Improvements
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Existing Diameter (in)	Pipeline Improvements New/ Replace	Pipeline Improvements Diameter (in)	Pipeline Improvements Length (ft)
Lift Station Improvements							
BAS-LS	New Lift Station	Beaumont Avenue South Lift Station			New	3 @ 900 gpm	
Wastewater Treatment Plant Tributary Area							
Gravity Main Improvements							
WWTP-P1	Future Capacity Increase	Oak Valley Pkwy	From 550' w/o San Miguel Dr to 150' w/o San Miguel Dr	12	Replace	12	425
WWTP-P2	Existing Capacity Deficiency	Edgar Ave	From Oak Valley Pkwy to 575' s/o Oak Valley Pkwy	12	Replace	15	575
WWTP-P3	Future Capacity Increase	Luis Estrada Rd	From 400' se/o Veile Ave to Veile Ave	12	Replace	12	425
WWTP-P4	Future Capacity Increase	Minnesota Ave/W 4th St	From 525' n/o W 4th St to 600' w/o Minnesota Ave	24	Replace	30	1,125
WWTP-P5	Future Capacity Increase	ROW	From 4th St to 1,100' w/o Minnesota Ave	30	Replace	36	950
WWTP-P6	New Capacity	ROW	From 2,300 ne/o Highland Springs Ave to 1,300 e/o Highland Springs Ave	-	New	12	3,875
WWTP-P7	New Capacity	ROW	From 1,300' e/o Highland Springs Ave to Highland Springs Ave	-	New	15	1,300
WWTP-P8	Future Capacity Increase	Brookside Ave	From Highland Springs Ave to Orchard Heights Ave	8	Replace	15	2,650
WWTP-P9	Future Capacity Increase	Brookside Ave	From Orchard Heights Ave to Cherry Ave	8	Replace	15	2,700
WWTP-P10	Future Capacity Increase	Cherry Ave	From Brookside Ave to Cougar Way	8	Replace	15	2,650
WWTP-P11	Future Capacity Increase	Cherry Ave	From Cougar Way to Oak Valley Pkwy	8	Replace	15	2,675
WWTP-P12	Future Capacity Increase	Cherry Ave	From oak Valley Pkwy to Antonell Ct	10	Replace	15	1,700
WWTP-P13	Future Capacity Increase	Cherry Ave	From Antonell Ct to E 8th St	12	Replace	15	3,675
WWTP-P14	Future Capacity Increase	Illinois Ave	From E 8th St to E 6th St	12	Replace	15	1,175
WWTP-P15	Future Capacity Increase	E 6th St	From Illinois Ave to Pennsylvania Ave	15	Replace	18	700
WWTP-P16	Future Capacity Increase	Pennsylvania Ave	From E 6th St to 175' s/o Interstate 10	18	Replace	24	975
WWTP-P17	Future Capacity Increase	ROW	From Pennsylvania Ave to 75' w/o Beaumont Ave	18	Replace	30	3,800
WWTP-P18	Future Capacity Increase	ROW	From 125' n/o 3rd St to 400' e/o Beaumont Ave	10	Replace	10	125
WWTP-P19	Future Capacity Increase	ROW	From 3rd St to 400' e/o Beaumont Ave	10	Replace	10	175
WWTP-P20	Future Capacity Increase	ROW	From Rover Ln to 350' w/o Houstonia Ln	12	Replace	15	2,550
WWTP-P21	Future Capacity Increase	E 1st St	From Palm Ave to Beaumont Ave	24	Replace	30	1,600
WWTP-P22	Future Capacity Increase	E 1st st	From California Ave to Minnesota Ave	30	Replace	36	2,125
WWTP-P23	Future Capacity Increase	Minnesota Ave	From E 1st St to 575' n/o E 1st St	30	Replace	36	575
WWTP-P24	Future Capacity Increase	ROW	From 575' n/o E 1st St to 1,025' w/o Minnesota Ave	30	Replace	36	1,100
WWTP-P25	New Capacity	Beaumont Ave	From E 1st St to 1,275' n/o Laird Rd	-	New	21	2,475

Table 7.5 Schedule of Improvements
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Existing Diameter (in)	Pipeline Improvements New/ Replace	Diameter (in)	Length (ft)
Four Seasons Lift Station Tributary Area							
Gravity Main Improvements							
FS-P1	Future Capacity Increase	Highland Springs Ave	From E 6th St to 450' w/o Highland Springs Ave	10	Replace	12	1,225
FS-P2	Future Capacity Increase	Highland Springs Ave	From 550' n/o E 1st St to 100' s/o E 1st St	10	Replace	12	650
FS-P3	Future Capacity Increase	Highland Springs Ave	From 800' n/o Potrero Blvd to 50' s/o Potrero Blvd	12	Replace	15	850
FS-P4	Pipe Slope Reconstruction	Highland Springs Ave	From 100' n/o Crooked Creek to Crooked Creek	12	Replace	12	100
FS-P5	Future Capacity Increase	Highland Springs Ave	From 350' s/o Crooked Creek to 375' s/o Breckenridge Ave	15	Replace	18	1,525
FS-P6	Future Capacity Increase	Breckenridge Ave	From 75' w/o Highland Springs Ave to Highland Springs Ave	10	Replace	10	75
Lift Station Improvements							
FS-LS	Lift Station Replacement	Four Seasons Lift Station			Replace	3 @ 1,350 gpm	

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Note:
1. Beaumont Crossroads 6-inch force main planned for replacement with 16-inch at buildout of tributary area.

- **Lower Oak Valley:** As documented on **Table 7.3** the buildout flow requirement for the Lower Oak Valley lift station is 1,217 gpm. A new lift station is recommended for construction with three 625 gpm pumps, two duty and one standby, for a total lift station capacity of 1,875 gpm.

- **Upper Oak Valley:** As documented on **Table 7.3** the buildout flow requirement for the Upper Oak Valley lift station is 3,634 gpm. A new lift station is recommended for construction with three 1,850 gpm pumps, two duty and one standby, for a total lift station capacity of 5,550 gpm.

- **Olivewood:** As documented on **Table 7.3** the buildout flow requirement for the Olivewood lift station is 612 gpm. A new lift station is recommended for construction with two 625 gpm pumps, one duty and one standby, for a total lift station capacity of 1,250 gpm.

- **Industrial Park:** As documented on **Table 7.3** the buildout flow requirement for the Industrial Park lift station is 288 gpm. A new lift station is recommended for construction with two 300 gpm pumps, one duty and one standby, for a total lift station capacity of 600 gpm.

- **Beaumont Mesa:** As documented on **Table 7.3** the buildout flow requirement for the Beaumont Mesa lift station is 4,530 gpm. A new lift station is recommended for construction with two 1,500 gpm and two 3,500 gpm pumps, three duty and one standby, for a total lift station capacity of 10,000 gpm.

- **Marshall Creek:** As documented on **Table 7.3** the buildout flow requirement for the Marshall Creek lift station is 1,696 gpm. A new lift station is recommended for construction with two 1,700 gpm pumps, one duty and one standby, for a total lift station capacity of 3,400 gpm.

- **Four Seasons:** As documented on **Table 7.3** the buildout flow requirement for the Four Seasons lift station is 2,616 gpm. A new lift station is recommended for construction with three 1,350 gpm pumps, two duty and one standby, for a total lift station capacity of 4,050 gpm.

- **Beaumont Ave South:** In order to convey the future flows from the South urban development, a new lift station is recommended. This lift station is planned to have three 900 gpm pumps, two duty and one standby, for a total lift station capacity of 2,700 gpm.

- **Beaumont Crossroads:** In order to convey the future flows from the Beaumont Crossroads, a new lift station is recommended. This lift station is planned to have three 2,350 gpm pumps, two duty and one standby, for a total lift station capacity of 7,050 gpm.

- **Brookside Ave:** In order to convey the future flows from north of Brookside Avenue and west of Interstate 10, a new lift station is recommended. This lift station is planned to have two 300 gpm pumps, one duty and one standby, for a total lift station capacity of 600 gpm.

- **Tukwet Canyon:** In order to convey future flows from Tukwet Canyon development, a new lift station is recommended. This lift station is planned to have three 375 gpm pumps, two duty and one standby, for a total lift station capacity of 1,125 gpm.

7.7.2 Force Main Improvements

This section documents the recommended force main capacity improvements.

- **BR-FM1:** Construct a new 6-inch force main in Brookside Avenue from future Brookside Avenue lift station to Deodar Drive.

- **BM-FM1:** Connect a new 16-inch force main connecting to the incomplete 16-inch force main in Potrero Boulevard and Western Knolls Avenue from Beaumont Mesa lift station to 1,300 feet west of Western Knolls Avenue.

- **BC-FM1:** Construct a new 16-inch force main in 4th Street from future Beaumont Crossroads lift station to Nicholas Road.

- **BC-FM2:** Construct a new 6-inch force main in 4th Street from future Beaumont Crossroads lift station to Nicholas Road.

- **BAS-FM1:** Construct a new 10-inch force main in Beaumont Avenue from future Beaumont Avenue lift station to approximately 2,450 feet south of 1st Street.

7.7.3 Gravity Main Improvements

This section documents the gravity main improvements. This section documents pipeline improvements within the City of Beaumont wastewater collection service area.

7.7.3.1 Lower Oak Valley

This section documents pipeline improvements within the Lower Oak Valley collection basin.

- **LOV-P1:** Replace existing 15-inch gravity main with a new 18-inch gravity main in Irwin Street from Floyd Circle to Palmer Avenue.

7.7.3.2 Upper Oak Valley

This section documents pipeline improvements within the Upper Oak Valley collection basin.

- **UOV-P1:** Replace existing 8-inch gravity main with a new 10-inch gravity main in Straightway Drive from Balata Street to 350 feet southwest of Balata Street.

- **UOV-P2:** Replace existing 8-inch gravity main with a new 12-inch gravity main in Apron Lane from Stableford Court to Oak Valley Parkway.

- **UOV-P3:** Replace existing 12-inch gravity main with a new 15-inch gravity main in Oak Valley Parkway from Apron Lane to 2,450 feet west of Apron Lane.

7.7.3.3 Olivewood

This section documents pipeline improvements within the Olivewood collection basin.

- **O-P1:** Replace existing 10-inch gravity main with a new 12-inch gravity main in Right-Of-Way from Artisan Place to 525 feet north of Artisan Place.

7.7.3.4 Brookside Avenue

This section documents pipeline improvements within the Brookside Avenue collection basin.

- **BR-P1:** Construct a new 8-inch gravity main in Brookside Avenue from 480 feet west of Deodar Drive to new Brookside Avenue lift station.

7.7.3.5 Beaumont Mesa

This section documents pipeline improvements within the Beaumont Mesa collection basin.

- **BM-P1:** Construct a new 8-inch gravity main in Right-Of-Way from 800 feet north of Monero Valley Freeway to 2,600 feet east of Potrero Boulevard.

- **BM-P2:** Construct a new 10-inch gravity main in Right-Of-Way from 2,600 feet east of Potrero Boulevard to 1,400 feet south of Oak Valley Parkway.

- **BM-P3:** Construct a new 15-inch gravity main in Right-Of-Way from 1,400 feet south of Oak Valley Parkway to Beaumont Mesa lift station.

7.7.3.6 Beaumont Crossroads

This section documents pipeline improvements within the Beaumont Crossroads collection basin.

- **BC-P1:** Construct a new 15-inch gravity main in 4th Street from 1,875 feet south of Monero Valley Freeway to Beaumont Crossroads lift station.

- **BC-P2:** Construct a new 12-inch gravity main in 4th Street from 275 feet west of Prosperity Way to 400 feet east of Potrero Boulevard.

- **BC-P3:** Construct a new 15-inch gravity main in 4th Street from 400 feet east of Potrero Boulevard to Potrero Boulevard.

- **BC-P4:** Construct a new 18-inch gravity main in 4th Street from Potrero Boulevard to 1,350 feet west of Potrero Boulevard.

- **BC-P5:** Construct a new 21-inch gravity main in 4th Street from 1,350 feet west of Potrero Boulevard to future Beaumont Crossroads lift station.

7.7.3.7 Industrial Park

This section documents pipeline improvements within the Industrial Park collection basin.

- **IP-P1:** Replace existing 8-inch gravity main with a new 10-inch gravity main in Risco Circle from 4th Street to 425 feet south of 4th Street.

7.7.3.8 Beaumont Avenue South

This section documents pipeline improvements within the Beaumont Avenue South collection basin.

- **BAS-P1:** Construct a new 12-inch gravity main in Beaumont Avenue from 1,200 feet north of Laird Road to 2,775 southwest of Laird Road.

- **BAS-P2:** Construct a new 15-inch gravity main in Beaumont Avenue from 2,775 feet southwest of Laird Road to future Beaumont Avenue South lift station.

7.7.3.9 Wastewater Treatment Plant

This section documents pipeline improvements within the Wastewater Treatment Plant collection basin.

- **WWTP-P1:** Reconstruct existing 12-inch gravity main with a steeper slope in Oak Valley Parkway from 550 feet west of San Miguel Drive to 150 feet west of San Miguel Drive.

- **WWTP-P2:** Replace existing 12-inch gravity main with a new 15-inch gravity main in Edgar Avenue from Oak Valley Parkway to 575 feet south of Oak Valley Parkway.

- **WWTP-P3:** Reconstruct existing 12-inch gravity main with a steeper slope in Luis Estrada Road from 400 feet southeast of Veile Avenue to Veile Avenue. Prior to project initialization, it is recommended that this improvement section be surveyed by a licensed professional surveyor to determine the feasibility of reconstructing the pipe slope to meet necessary grade and corresponding capacity requirements.

- **WWTP-P4:** Replace existing 24-inch gravity main with a new 30-inch gravity main in Minnesota Avenue and 4th Street from 525 feet north of 4th Street to 600 feet west of Minnesota Avenue.

- **WWTP-P5:** Replace existing 30-inch gravity main with a new 36-inch gravity main in Right-Of-Way from 4th Street to 1,100 feet west of Minnesota Avenue.

- **WWTP-P6:** Construct a new 12-inch gravity main in Right-Of-Way from 2,300 feet northeast of Highland Springs Avenue to 1,300 feet east of Highland Springs Avenue.

- **WWTP-P7:** Construct a new 15-inch gravity main in Right-Of-Way from 1,300 feet east of Highland Springs Avenue to Highland Springs Avenue.

- **WWTP-P8:** Replace existing 8-inch gravity main with a new 15-inch gravity main in Brookside Avenue from Highland Springs Avenue to Orchard Heights Avenue.

- **WWTP-P9:** Replace existing 8-inch gravity main with a new 15-inch gravity main in Brookside Avenue from Orchard Heights Avenue to Cherry Avenue.

- **WWTP-P10:** Replace existing 8-inch gravity main with a new 15-inch gravity main in Cherry Avenue from Brookside Avenue to Cougar Way.

- **WWTP-P11:** Replace existing 8-inch gravity main with a new 15-inch gravity main in Cherry Avenue from Cougar Way to Oak Valley Parkway.

- **WWTP-P12:** Replace existing 10-inch gravity main with a new 15-inch gravity main in Cherry Avenue from Oak Valley Parkway to Antonell Court.

- **WWTP-P13:** Replace existing 12-inch gravity main with a new 15-inch gravity main in Cherry Avenue from Antonell Court 8th Street.

- **WWTP-P14:** Replace existing 12-inch gravity main with a new 15-inch gravity main in Illinois Avenue from 8th Street to 6th Street.

- **WWTP-P15:** Replace existing 15-inch gravity main with a new 18-inch gravity main in 6th Street from Illinois Avenue to Pennsylvania Avenue.

- **WWTP-P16:** Replace existing 18-inch gravity main with a new 24-inch gravity main in Pennsylvania Avenue from 6th Street to 175 feet south of Interstate 10.

- **WWTP-P17:** Replace existing 18-inch gravity main with a new 30-inch gravity main in Right-Of-Way from Pennsylvania Avenue to 75 feet west of Beaumont Avenue.

- **WWTP-P18:** Reconstruct existing 10-inch gravity main with a steeper slope in Right-Of-Way from 125 feet north of 3rd Street to 400 feet east of Beaumont Avenue. Prior to project initialization, it is recommended that this improvement section be surveyed by a licensed professional surveyor to determine the feasibility of reconstructing the pipe slope to meet necessary grade and corresponding capacity requirements.

- **WWTP-P19:** Reconstruct existing 10-inch gravity main with a steeper slope in Right-Of-Way from 3rd Street to 400 feet east of Beaumont Avenue. Prior to project initialization, it is recommended that this improvement section be surveyed by a licensed professional surveyor to determine the feasibility of reconstructing the pipe slope to meet necessary grade and corresponding capacity requirements.

- **WWTP-P20:** Replace existing 12-inch gravity main with a new 15-inch gravity main in Right-Of-Way from Rover Lane to 350 feet west of Houstonia Lane.

- **WWTP-P21:** Replace existing 24-inch gravity main with a new 30-inch gravity main in 1st Street from Palm Avenue to Beaumont Avenue.

- **WWTP-P22:** Replace existing 30-inch gravity main with a new 36-inch gravity main in 1st Street from California Avenue to Minnesota Avenue.

- **WWTP-P23:** Replace existing 30-inch gravity main with a new 36-inch gravity main in Minnesota Avenue from 1st Street to 575 feet north of 1st Street.

- **WWTP-P24:** Replace existing 30-inch gravity main with a new 36-inch gravity main in Right-Of-Way from 575 feet north of 1st Street to 1,025 feet west of Minnesota Avenue.

- **WWTP-P25:** Construct a new 21-inch gravity main in Beaumont Avenue from 1st Street to 1,275 feet north of Laird Road.

7.7.3.10 Four Seasons

This section documents pipeline improvements within the Four Seasons collection basin.

- **FS-P1:** Replace existing 10-inch gravity main with a new 12-inch gravity main in Highlands Springs Avenue from 6th Street to 450 feet west of Highland Springs Avenue.

- **FS-P2:** Replace existing 10-inch gravity main with a new 12-inch gravity main in Highlands Springs Avenue from 550 feet north of 1st Street to 100 feet south of 1st Street.

- **FS-P3:** Replace existing 12-inch gravity main with a new 15-inch gravity main in Highlands Springs Avenue from 800 feet north of Potrero Boulevard to 50 feet south of Potrero Boulevard.

- **FS-P4:** Reconstruct existing 12-inch gravity main with a steeper slope in Highland Springs Avenue from 100 feet north of Crooked Creek to Crooked Creek. Prior to project initialization, it is recommended that this improvement section be surveyed by a licensed professional surveyor to determine the feasibility of reconstructing the pipe slope to meet necessary grade and corresponding capacity requirements.

- **FS-P5:** Replace existing 15-inch gravity main with a new 18-inch gravity main in Highlands Springs Avenue from 350 feet south of Crooked Creek to 375 feet south of Breckenridge Avenue.

- **FS-P6:** Reconstruct existing 10-inch gravity main with a steeper slope in Breckenridge Avenue from 75 feet west of Highland Spring Avenue to Highland Springs Avenue. Prior to project initialization, it is recommended that this improvement section be surveyed by a licensed professional surveyor to determine the feasibility of reconstructing the pipe slope to meet necessary grade and corresponding capacity requirements.

CHAPTER 8 - CAPITAL IMPROVEMENT PROGRAM

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

8.1 COST ESTIMATE ACCURACY

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

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

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

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

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

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

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

8.2 COST ESTIMATE METHODOLOGY

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

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

8.2.1 Unit Costs

The unit cost estimates used in developing the Capital Improvement Program are summarized on **Table 8.1**. Wastewater pipeline unit costs are based on length of pipe per chosen diameter. Lift station costs are based on capacity, per million gallons per day (MGD). The unit costs are intended for developing the Order of Magnitude estimate, and do not account for site specific conditions, labor or material costs during the time of construction, final project scope, implementation schedule, detailed utility and topography surveys, investigation of alternative routings for pipes, and other various factors. The capital improvement program included in this report accounts for construction and project-related contingencies as described in this chapter.

8.2.2 Construction Cost Index

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

The costs in this Wastewater Master Plan were benchmarked using a 20-City national average ENR CCI of 11,849, reflecting a date of April 2021.

8.2.3 Land Acquisition

Construction of pipelines is assumed to generally be within existing or future street right-of-ways. Lift station land acquisition costs are included in the lift station unit costs.

8.2.4 Construction Contingency Allowance

Knowledge about site-specific conditions for each proposed project is limited at the master planning stage; therefore construction contingencies were used. The estimated construction costs in this master plan include a **20 percent** contingency allowance to account for unforeseen events and unknown field conditions.

Table 8.1 Unit Costs

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Pipeline	
Gravity Main[1]	
Pipe Size (in)	**Cost[1]** ($/lineal foot)
8	$191
10	$200
12	$208
15	$230
18	$247
21	$331
24	$396
27	$468
30	$526
36	$670
Force Main[1]	
6	$216
8	$264
10	$278
16	$376
Operational and Maintenance[2]	
Sewer Pipeline CCTV	$2.10
Sewer Pipeline Cleaning	$1.80
Lift Station[3]	
Estimated Lift Station Project Cost = $9{,}665 \cdot Q^2 + 314{,}097 \cdot Q + 365{,}718$, where Q is in mgd	

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Notes :

1. Unit costs indexed using the Engineering News Record (ENR) Construction Cost Index of 11,849 for April 2021.
2. Sewer pipeline operational and maintenance costs based on Akel Engineering Group experience on similar projects.
3. Lift Station costs based on Akel Engineering Group experience on similar projects and escalated using the Engineering News Record (ENR) Construction Cost Index of 11,849 for April 2021.

8.2.5 Project Related Costs

The capital improvement costs also account for project-related costs, comprising of engineering design, project administration (developer and District staff), construction management and inspection, and legal costs. The project related costs in this master plan were estimated by applying an additional **30 percent** to the estimated construction costs.

8.3 LIFT STATION CONDITION ASSESSMENT COSTS

The lift station condition assessment, completed by V&A, included condition improvement recommendations for deficiencies identified during the assessment. An estimated opinion of probable costs for these improvements was prepared and submitted to City staff for review and approval. The recommended improvements and associated costs are documented in **Table 8.2**.

8.4 CAPITAL IMPROVEMENT PROGRAM

This section documents the capital improvement program, including estimated costs and recommended construction phasing.

8.4.1 Capital Improvement Costs

The Capital Improvement Program costs for the projects identified in this master plan for mitigating existing deficiencies and for servicing anticipated future growth throughout the City are summarized on **Table 8.3**.

Each improvement was assigned a unique coded identifier associated with the improvement type and is summarized graphically on **Figure 8.1**. The estimated construction costs include the baseline costs plus **20 percent** contingency allowance to account for unforeseen events and unknown filed conditions, as described in a previous section. Capital improvement costs include the estimated construction costs plus **30 percent** projected-related costs (engineering design, project administration, construction management and inspection, and legal costs).

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

8.4.2 Pipelines

The recommended pipeline improvements are grouped by collection basin and listed on **Table 8.3**. Each improvement includes a general description of the street alignment and limits as well as existing pipe diameter and length.

The Capital Improvement Program generally includes the following three types of improvements:

- **Replacement Pipeline, Existing Capacity Deficiency.** An existing pipeline is recommended for replacement to mitigate an existing system deficiency. This type of

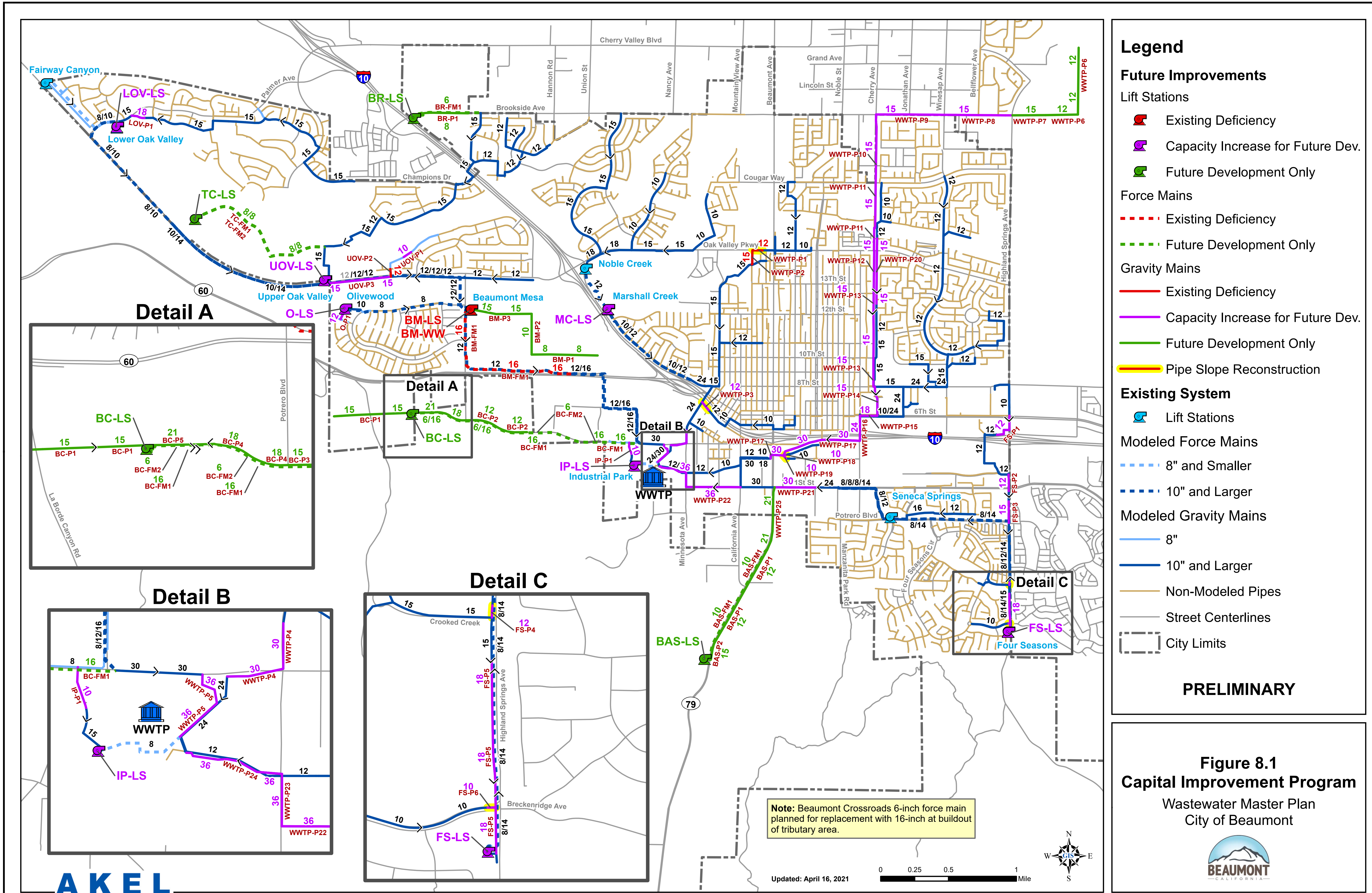

Figure 8.1
Capital Improvement Program
Wastewater Master Plan
City of Beaumont

Table 8.2 Lift Station Condition Assessment Improvements

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Lift Station	Specific Facility	Lift Station Component	Recommended Timeline	Infrastructure Costs Unit Cost ($/unit)	Unit	Amount (unit)	Baseline Construction Cost	Estimated Construction Cost[1]	Capital Improvement Cost[2]
Fairway Canyon									
FC-1	Pump	Repair leak from Pump #2	Immediately				0	0	0
FC-2	Wet Well	Apply mortar	2 to 5 years	30	Square Foot	30	900	1,100	1,500
FC-3	Dry Well	Repair Liner	2 to 5 years	30	Square Foot	100	3,000	3,600	4,700
FC-4	Dry Well	Touch up pipe coating	2 to 5 years	30	Square Foot	130	3,900	4,700	6,200
				Subtotal - Fairway Canyon Lift Station Improvements			**7,800**	**9,400**	**12,400**
Lower Oak Valley									
LOV-1	Wet Well	Replace pump discharge piping	Immediately	5,200	Lump	-	5,200	6,300	8,200
LOV-2	Concrete	Monitor the state of degradation	2 to 5 years		No cost		0	0	0
LOV-3	Concrete	Repair cracked/broken concrete	2 to 5 years	2,600	Lump	-	2,600	3,200	4,200
LOV-4	Liner	Bond liner to concrete	2 to 5 years	30	Square Foot	30	900	1,100	1,500
LOV-5	Piping	Re-coat piping	2 to 5 years	30	Square Foot	100	3,000	3,600	4,700
				Subtotal - Lower Oak Valley Lift Station Improvements			**11,700**	**14,200**	**18,600**
Upper Oak Valley									
UOV-1	Wet Well	Replace pump discharge piping	Immediately	5,200	Lump	-	5,200	6,300	8,200
UOV-2	Connection	Replace threaded tap connection	Immediately	1,000	Lump	-	1,000	1,200	1,600
UOV-3	Concrete	Repair cracked/broken concrete	2 to 5 years	2,600	Lump	-	2,600	3,200	4,200
UOV-4	Bypass Manhole	Replace liner	2 to 5 years	30	Square Foot	500	15,000	18,000	23,400
UOV-5	Piping	Re-coat piping	2 to 5 years	30	Square Foot	100	3,000	3,600	4,700
				Subtotal - Upper Oak Valley Lift Station Improvements			**26,800**	**32,300**	**42,100**
Olivewood									
O-1	Piping	New coating	2 to 5 years	30	Square Foot	100	3,000	3,600	4,700
				Subtotal - Olivewood Lift Station Improvements			**3,000**	**3,600**	**4,700**
Beaumont Mesa									
BM-1	Piping	New coating	Immediately	30	Square Foot	100	3,000	3,600	4,700
BM-2	Concrete	Repair cracked/broken concrete	2 to 5 years	2,600	Lump	-	2,600	3,200	4,200
BM-3	Wet Well	Repair liner	2 to 5 years	30	Square Foot	100	3,000	3,600	4,700
BM-4	Manhole	Replace liner	2 to 5 years	45	Square Foot	500	22,500	27,000	35,100
BM-5	Dry Well	Touch up pipe coating	2 to 5 years	30	Square Foot	130	3,900	4,700	6,200

Table 8.2 Lift Station Condition Assessment Improvements

Wastewater Master Plan

City of Beaumont

PRELIMINARY

Lift Station	Specific Facility	Lift Station Component	Recommended Timeline	Infrastructure Costs Unit Cost ($/unit)	Unit	Amount (unit)	Baseline Construction Cost	Estimated Construction Cost[1]	Capital Improvement Cost[2]
BM-6	Wet Well	Coat the inlet pipe	2 to 5 years	30	Square Foot	130	3,900	4,700	6,200
				Subtotal - Beaumont Mesa Lift Station Improvements			**38,900**	**46,800**	**61,100**
Noble Creek									
NC-1	Wet Well	Replace pump discharge piping	2 to 5 years	5,200	Lump	-	5,200	6,300	8,200
NC-2	Piping	Re-coat piping	2 to 5 years	30	Square Foot	100	3,000	3,600	4,700
				Subtotal - Noble Creek Lift Station Improvements			**8,200**	**9,900**	**12,900**
Marshall Creek									
MC-1	Wet Well	Replace pump discharge piping	Immediately	5,200	Lump	-	5,200	6,300	8,200
MC-2	Piping	Re-coat piping	Immediately	30	Square Foot	100	3,000	3,600	4,700
MC-3	Manhole	Patch-repair liner	2 to 5 years	30	Square Foot	100	3,000	3,600	4,700
MC-4	Manhole	Repair/replace lid and cover frame	2 to 5 years	1,500	Lump	-	1,500	1,800	2,400
				Subtotal - Marshall Creek Lift Station Improvements			**12,700**	**15,300**	**20,000**
Cooper Creek									
CC-1	Piping	Re-coat piping	2 to 5 years	30	Square Foot	100	3,000	3,600	4,700
				Subtotal - Cooper Creek Lift Station Improvements			**3,000**	**3,600**	**4,700**
Seneca Springs									
SS-1	Couplings	Replace couplings showing damage	Immediately	1,500	Lump	-	1,500	1,800	2,400
SS-2	Concrete	Monitor state of corrosion	2 to 5 years		No cost		0	0	0
SS-3	Piping	Touch up pipe coating	2 to 5 years	30	Square Foot	100	3,000	3,600	4,700
				Subtotal - Seneca Springs Lift Station Improvements			**4,500**	**5,400**	**7,100**
Four Seasons									
FS-1	Manhole	Patch-repair liner	2 to 5 years	30	Square Foot	100	3,000	3,600	4,700
FS-2	Piping	Touch up pipe coating	2 to 5 years	30	Square Foot	100	3,000	3,600	4,700
FS-3	Couplings	Replace couplings showing damage	2 to 5 years	1,500	Lump	-	1,500	1,800	2,400
				Subtotal - Four Seasons Lift Station Improvements			**7,500**	**9,000**	**11,800**
Total Costs									
							124,100	**149,500**	**195,400**

AKEL ENGINEERING GROUP, INC.

2/24/2021

Notes:

1. Estimated Construction costs include 20 percent of baseline construction costs to account for unforeseen events and unknown field conditions.
2. Capital Improvement Costs also include an additional 30 percent of the estimated construction costs to account for administration, construction management, and legal costs.

Table 8.3 Capital Improvement Program
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvements Details				Infrastructure Costs		Baseline Constr. Cost	Estimated Const. Cost[1]	Capital Impro. Cost[2,3]	Future Flow Service Location	Construction Trigger[4]
				Existing Diameter (in)	New/ Replace	Diameter (in)	Length (ft)	Unit Cost ($)	Infr. Cost ($)	($)	($)	($)		
Lower Oak Valley Lift Station Tributary Area														
Gravity Main Improvements														
LOV-P1	Future Capacity Increase	Irwin St	From Floyd Cir to Palmer Ave	15	Replace	18	525	247	129,621	129,700	155,700	202,500	Within City Limit	Approximately 200 EDUs
Lift Station Improvements														
LOV-LS	Lift Station Replacement	Lower Oak Valley Lift Station		-	Replace	3 @ 625 gpm		-	1,284,238	1,284,300	1,541,200	2,003,600	Within City Limit	Approximately 260 EDUs
				Subtotal - Lower Oak Valley Lift Station Tributary Area Improvements						**1,414,000**	**1,696,900**	**2,206,100**		
Tukwet Canyon (New) Lift Station Tributary Area														
Force Main Improvements														
TC-FM1	New Force Main	Sorenstam Dr/Price St	From Tukwet Canyon lift station to approx. 1,000' n/o Upper Oak Valley lift station	-	New	8	6,250	264	1,652,656	1,652,700	1,983,300	2,578,300	Within City Limit	As Development Occurs
TC-FM2	New Force Main	Sorenstam Dr/Price St	From Tukwet Canyon lift station to approx. 1,000' n/o Upper Oak Valley lift station	-	New	8	6,250	264	1,652,656	1,652,700	1,983,300	2,578,300	Within City Limit	As Development Occurs
Lift Station Improvements														
TC-LS	New Lift Station	Tukwet Canyon Lift Station		-	New	3 @ 375 gpm		-	899,920	900,000	1,080,000	1,404,000	Within City Limit	As Development Occurs
				Subtotal - Tukwet Canyon (New) Lift Station Tributary Area Improvements						**4,205,400**	**5,046,600**	**6,560,600**		
Upper Oak Valley Lift Station Tributary Area														
Gravity Main Improvements														
UOV-P1	Future Capacity Increase	Straightaway Dr	From Balata St to 350' sw/o Balata St	8	Replace	10	350	200	69,910	70,000	84,000	109,200	Within City Limit	Approximately 70 EDUs
UOV-P2	Existing Capacity Deficiency	Apron Ln	From Stableford Ct to Oak Valley Pkwy	8	Replace	12	300	208	62,342	62,400	74,900	97,400	Within City Limit	FY 2023/24
UOV-P3	Future Capacity Increase	Oak Valley Pkwy	From Apron Ln to 2,450' w/o Apron Ln	12	Replace	15	2,500	230	575,740	575,800	691,000	898,300	Within City Limit	Approximately 1,360 EDUs
Lift Station Improvements														
UOV-LS	Lift Station Replacement	Upper Oak Valley Lift Station		-	Replace	3 @ 1,850 gpm		-	3,493,305	3,493,400	4,192,100	5,449,800	Within City Limit	Approxiamtely 2,360 EDUs
				Subtotal - Upper Oak Valley Lift Station Tributary Area Improvements						**4,201,600**	**5,042,000**	**6,554,700**		
Olivewood Lift Station Tributary Area														
Gravity Main Improvements														
O-P1	Future Capacity Increase	ROW	From Artisan Pl to approx. 500' n/o Artisan Pl	10	Replace	12	525	208	109,099	109,100	131,000	170,300	Within City Limit	Approximately 750 EDUs
Lift Station Improvements														
O-LS	Lift Station Replacement	Olivewood Lift Station		-	Replace	2 @ 650 gpm		-	987,577	987,600	1,185,200	1,540,800	Within City Limit	Approximately 710 EDUs
				Subtotal - Olivewood Lift Station Tributary Area Improvements						**1,096,700**	**1,316,200**	**1,711,100**		

Table 8.3 Capital Improvement Program
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvements Details				Infrastructure Costs		Baseline Constr. Cost	Estimated Const. Cost[1]	Capital Impro. Cost[2,3]	Future Flow Service Location	Construction Trigger[4]
				Existing Diameter (in)	New/ Replace	Diameter (in)	Length (ft)	Unit Cost ($)	Infr. Cost ($)	($)	($)	($)		
Brookside Avenue (New) Lift Station Tributary Area														
Gravity Main Improvements														
BR-P1	New Capacity	Brookside Ave	From 480' w/o Deodar Dr to Brookside Ave lift station	-	New	8	2,200	191	420,656	420,700	504,900	656,400	Within City Limit	As Development Occurs
Force Main Improvements														
BR-FM1	New Force Main	Brookside Ave	From Brookside Ave lift station to Deodar Dr	-	New	6	2,825	216	609,832	609,900	731,900	951,500	Within City Limit	As Development Occurs
Lift Station Improvements														
BR-LS	New Lift Station	Brookside Ave Lift Station		-	New	2 @ 300 gpm		-	644,313	644,400	773,300	1,005,300	Within City Limit	As Development Occurs
			Subtotal - Brookside Avenue (New) Lift Station Tributary Area Improvements							**1,675,000**	**2,010,100**	**2,613,200**		
Beaumont Mesa Lift Station Tributary Area														
Gravity Main Improvements														
BM-P1	New Capacity	ROW	From 800' n/o Monero Valley Fwy to 2,600' e/o Potrero Blvd	-	New	8	2,575	191	492,359	492,400	590,900	768,200	Within City Limit	As Development Occurs
BM-P2	New Capacity	ROW	From 2,600' e/o Potrero Blvd to 1,400' s/o Oak Valley Pkwy	-	New	10	1,600	200	319,588	319,600	383,600	498,700	Within City Limit	As Development Occurs
BM-P3	New Capacity	ROW	From 1,400' s/o Oak Valley Pkwy to Beaumont Mesa lift station	-	New	15	2,350	230	541,196	541,200	649,500	844,400	Within City Limit	As Development Occurs
Force Main Improvements[5]														
BM-FM1	Force Main Design and Pump Design			-	New			-	-	-	-	450,000	Within City Limit	FY 2021/22
BM-FM1	New Force Main	Potrero Blvd/Western Knolls Ave	From Beaumont Mesa lift station to 1,300' w/o Western Knolls Ave	-	New	16	6,500	-	-	-	-	4,000,000	Within City Limit	FY 2022/23
Lift Station Improvements[5]														
BM-LS	Pump Replacement/Addition Construction			-	New	2 @ 3,500 gpm 2 @ 1,500 gpm		-	-	-	-	750,000	Within City Limit	FY 2022/23
BM-WW	Wet Well Design			-	New			-	-	-	-	400,000	Within City Limit	FY 2021/22
BM-WW	New Wet Well			-	New			-	-	-	-	4,000,000	Within City Limit	FY 2024/25
			Subtotal - Beaumont Mesa Lift Station Tributary Area Improvements							**1,353,200**	**1,624,000**	**11,711,300**		
Beaumont Crossroads (New) Lift Station Tributary Area														
Gravity Main Improvements														
BC-P1	New Capacity	W 4th St	From 1,875' s/o Moreno Valley Fwy to Beaumont Crossroads lift station	-	New	15	3,125	230	719,676	719,700	863,700	1,122,900	Within City Limit	As Development Occurs
BC-P2	New Capacity	W 4th St	From 275' w/o of Prosperity Way to 400' e/o Potrero Blvd	-	New	12	2,100	208	436,397	436,400	523,700	680,900	With Annexation	As Development Occurs
BC-P3	New Capacity	W 4th St	From 400' e/o Potrero Blvd to Potrero Blvd	-	New	15	375	230	86,361	86,400	103,700	134,900	With Annexation	As Development Occurs
BC-P4	New Capacity	W 4th St	From Potrero Blvd to 1,350' w/o Potrero Blvd	-	New	18	1,450	247	358,001	358,100	429,800	558,800	With Annexation	As Development Occurs
BC-P5	New Capacity	W 4th St	From 1,350' w/o Potrero Blvd to Beaumont Crossroads lift station	-	New	21	800	331	264,625	264,700	317,700	413,100	With Annexation	As Development Occurs

Table 8.3 Capital Improvement Program
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvements Details: Existing Diameter (in)	New/ Replace	Diameter (in)	Length (ft)	Infrastructure Costs: Unit Cost ($)	Infr. Cost ($)	Baseline Constr. Cost ($)	Estimated Const. Cost[1] ($)	Capital Impro. Cost[2,3] ($)	Future Flow Service Location	Construction Trigger[4]
Force Main Improvements														
BC-FM1	New Force Main	W 4th St	From Beaumont Crossroads lift station to 100' e/o Nicholas Rd	-	New	16	9,175	376	3,447,614	3,447,700	4,137,300	5,378,500	With Annexation	As Development Occurs
BC-FM2	New Force Main	W 4th St	From Beaumont Crossroads lift station to 100' e/o Nicholas Rd	-	New	6	9,175	216	1,980,605	1,980,700	2,376,900	3,090,000	With Annexation	As Development Occurs
Lift Station Improvements														
BC-LS	New Lift Station	Beaumont Crossroads Lift Station		-	New	3 @ 2,350 gpm		-	4,550,536	4,550,600	5,460,800	7,099,100	With Annexation	As Development Occurs
Subtotal - Beaumont Crossroads (New) Lift Station Tributary Area Improvements										**11,844,300**	**14,213,600**	**18,478,200**		
Marshall Creek Lift Station Tributary Area														
Lift Station Improvements														
MC-LS	Lift Station Replacement	Marshall Creek Lift Station		-	Replace	2 @ 1,700 gpm		-	2,135,215	2,135,300	2,562,400	3,331,200	Within City Limit	Approximately 1,200 EDUs
Subtotal - Marshall Creek Lift Station Tributary Area Improvements										**2,135,300**	**2,562,400**	**3,331,200**		
Industrial Park Lift Station Tributary Area														
Gravity Main Improvements														
IP-P1	Future Capacity Increase	Risco Cir	From W 4th St to 425' s/o W 4th St	8	Replace	10	475	200	94,878	94,900	113,900	148,100	Within City Limit	Approximately 190 EDUs
Lift Station Improvements														
IP-LS	Lift Station Replacement	Industrial Park Lift Station		-	Replace	2 @ 300 gpm		-	644,313	644,400	773,300	1,005,300	Within City Limit	Approximately 20 EDUs
Subtotal - Industrial Park Lift Station Tributary Area Improvements										**739,300**	**887,200**	**1,153,400**		
Beaumont Avenue South (New) Lift Station Tributary Area														
Gravity Main Improvements														
BAS-P1	New Capacity	Beaumont Ave	From 1,200' n/o Laird Rd to 2,775' sw/o Laird Rd	-	New	12	4,125	208	857,209	857,300	1,028,800	1,337,500	With Annexation	As Development Occurs
BAS-P2	New Capacity	Beaumont Ave	From 2,775' sw/o Laird Rd to Beaumont Avenue lift station	-	New	15	875	230	201,509	201,600	242,000	314,600	With Annexation	As Development Occurs
Force Main Improvements														
BAS-FM1	New Force Main	Beaumont Ave	From Beaumont Avenue lift station to 2,450' s/o E 1st St	-	New	10	5,025	278	1,398,669	1,398,700	1,678,500	2,182,100	With Annexation	As Development Occurs
Lift Station Improvements														
BAS-LS	New Lift Station	Beaumont Avenue South Lift Station		-	New	3 @ 900 gpm		-	1,733,029	1,733,100	2,079,800	2,703,800	With Annexation	As Development Occurs
Subtotal - Beaumont Avenue South (New) Lift Station Tributary Area Improvements										**4,190,700**	**5,029,100**	**6,538,000**		
Wastewater Treatment Plant Tributary Area														
Gravity Main Improvements														
WWTP-P1	Future Capacity Increase	Oak Valley Pkwy	From 550' w/o San Miguel Dr to 150' w/o San Miguel Dr	12	Replace	12	425	208	88,319	88,400	106,100	138,000	Within City Limit	Approximately 370 EDUs

Table 8.3 Capital Improvement Program
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvements Details: Existing Diameter (in)	Improvements Details: New/ Replace	Improvements Details: Diameter (in)	Improvements Details: Length (ft)	Infrastructure Costs: Unit Cost ($)	Infrastructure Costs: Infr. Cost ($)	Baseline Constr. Cost ($)	Estimated Const. Cost[1] ($)	Capital Impro. Cost[2,3] ($)	Future Flow Service Location	Construction Trigger[4]
WWTP-P2	Existing Capacity Deficiency	Edgar Ave	From Oak Valley Pkwy to 575' s/o Oak Valley Pkwy	12	Replace	15	575	230	132,420	132,500	159,000	206,700	Within City Limit	FY 2022/23
WWTP-P3	Future Capacity Increase	Luis Estrada Rd	From 400' se/o Veile Ave to Veile Ave	12	Replace	12	425	208	88,319	88,400	106,100	138,000	Within City Limit	Approximately 3,830 EDUs
WWTP-P4	Future Capacity Increase	Minnesota Ave/W 4th St	From 525' n/o W 4th St to 600' w/o Minnesota Ave	24	Replace	30	1,125	526	592,178	592,200	710,700	924,000	Within City Limit	Approximately 5,890 EDUs
WWTP-P5	Future Capacity Increase	ROW	From 4th St to 1,100' w/o Minnesota Ave	30	Replace	36	950	670	636,064	636,100	763,400	992,500	Within City Limit	Approximately 8,820 EDUs
WWTP-P6	New Capacity	ROW	From 2,300 ne/o Highland Springs Ave to 1,300 e/o Highland Springs Ave	-	New	12	3,875	208	805,257	805,300	966,400	1,256,400	With Annexation	As Development Occurs
WWTP-P7	New Capacity	ROW	From 1,300' e/o Highland Springs Ave to Highland Springs Ave	-	New	15	1,300	230	299,385	299,400	359,300	467,100	With Annexation	As Development Occurs
WWTP-P8	Future Capacity Increase	Brookside Ave	From Highland Springs Ave to Orchard Heights Ave	8	Replace	15	2,650	230	610,285	610,300	732,400	952,200	With Annexation	As Development Occurs
WWTP-P9	Future Capacity Increase	Brookside Ave	From Orchard Heights Ave to Cherry Ave	8	Replace	15	2,700	230	621,800	621,800	746,200	970,100	Within City Limit With Annexation	Approximately 320 EDUs
WWTP-P10	Future Capacity Increase	Cherry Ave	From Brookside Ave to Cougar Way	8	Replace	15	2,650	230	610,285	610,300	732,400	952,200	Within City Limit With Annexation	Approximately 300 EDUs
WWTP-P11	Future Capacity Increase	Cherry Ave	From Cougar Way to Oak Valley Pkwy	8	Replace	15	2,675	230	616,042	616,100	739,400	961,300	Within City Limit With Annexation	Approximately 210 EDUs
WWTP-P12	Future Capacity Increase	Cherry Ave	From oak Valley Pkwy to Antonell Ct	10	Replace	15	1,700	230	391,504	391,600	470,000	611,000	Within City Limit With Annexation	Approximately 1,170 EDUs
WWTP-P13	Future Capacity Increase	Cherry Ave	From Antonell Ct to E 8th St	12	Replace	15	3,675	230	846,338	846,400	1,015,700	1,320,500	Within City Limit With Annexation	Approximately 2,430 EDUs
WWTP-P14	Future Capacity Increase	Illinois Ave	From E 8th St to E 6th St	12	Replace	15	1,175	230	270,598	270,600	324,800	422,300	Within City Limit With Annexation	Approximately 2,300 EDUs
WWTP-P15	Future Capacity Increase	E 6th St	From Illinois Ave to Pennsylvania Ave	15	Replace	18	700	247	172,828	172,900	207,500	269,800	Within City Limit With Annexation	Approximately 4,070 EDUs
WWTP-P16	Future Capacity Increase	Pennsylvania Ave	From E 6th St to 175' s/o Interstate 10	18	Replace	24	975	396	385,811	385,900	463,100	602,100	Within City Limit With Annexation	Approximately 1,940 EDUs
WWTP-P17	Future Capacity Increase	ROW	From Pennsylvania Ave to 75' w/o Beaumont Ave	18	Replace	30	3,800	526	2,000,246	2,000,300	2,400,400	3,120,600	Within City Limit With Annexation	Approximately 380 EDUs
WWTP-P18	Future Capacity Increase	ROW	From 125' n/o 3rd St to 400' e/o Beaumont Ave	10	Replace	10	125	200	24,968	25,000	30,000	39,000	Within City Limit	Approximately 2,680 EDUs
WWTP-P19	Future Capacity Increase	ROW	From 3rd St to 400' e/o Beaumont Ave	10	Replace	10	175	200	34,955	35,000	42,000	54,600	Within City Limit	Approximately 1,760 EDUs
WWTP-P20	Future Capacity Increase	ROW	From Rover Ln to 350' w/o Houstonia Ln	12	Replace	15	2,550	230	587,255	587,300	704,800	916,300	Within City Limit	Approximately 2,070 EDUs
WWTP-P21	Future Capacity Increase	E 1st St	From Palm Ave to Beaumont Ave	24	Replace	30	1,600	526	842,209	842,300	1,010,800	1,314,100	Within City Limit	Approximately 6,350 EDUs
WWTP-P22	Future Capacity Increase	E 1st st	From California Ave to Minnesota Ave	30	Replace	36	2,125	670	1,422,776	1,422,800	1,707,400	2,219,700	Within City Limit With Annexation	Approximately 15,780 EDUs
WWTP-P23	Future Capacity Increase	Minnesota Ave	From E 1st St to 575' n/o E 1st St	30	Replace	36	575	670	384,986	385,000	462,000	600,600	Within City Limit With Annexation	Approximately 23,390 EDUs
WWTP-P24	Future Capacity Increase	ROW	From 575' n/o E 1st St to 1,025' w/o Minnesota Ave	30	Replace	36	1,100	670	736,496	736,500	883,800	1,149,000	Within City Limit With Annexation	Approximately 2,500 EDUs
WWTP-P25	New Capacity	Beaumont Ave	From E 1st St to 1,275' n/o Laird Rd	-	New	21	2,475	331	818,683	818,700	982,500	1,277,300	With Annexation	As Development Occurs
				Subtotal - Wastewater Treatment Plant Tributary Area Improvements						**14,021,100**	**16,826,200**	**21,875,400**		

Table 8.3 Capital Improvement Program
Wastewater Master Plan
City of Beaumont

PRELIMINARY

Improv. No.	Type of Improvement	Alignment	Limits	Improvements Details: Existing Diameter (in)	New/ Replace	Diameter (in)	Length (ft)	Infrastructure Costs: Unit Cost ($)	Infr. Cost ($)	Baseline Constr. Cost ($)	Estimated Const. Cost[1] ($)	Capital Impro. Cost[2,3] ($)	Future Flow Service Location	Construction Trigger[4]
Four Seasons Lift Station Tributary Area														
Gravity Main Improvements														
FS-P1	Future Capacity Increase	Highland Springs Ave	From E 6th St to 450' w/o Highland Springs Ave	10	Replace	12	1,225	208	254,565	254,600	305,600	397,300	Within City Limit	Approximately 640 EDUs
FS-P2	Future Capacity Increase	Highland Springs Ave	From 550' n/o E 1st St to 100' s/o E 1st St	10	Replace	12	650	208	135,075	135,100	162,200	210,900	Within City Limit	Approximately 690 EDUs
FS-P3	Future Capacity Increase	Highland Springs Ave	From 800' n/o Potrero Blvd to 50' s/o Potrero Blvd	12	Replace	15	850	230	195,752	195,800	235,000	305,500	Within City Limit	Approximately 1,340 EDUs
FS-P4	Pipe Slope Reconstruction	Highland Springs Ave	From 100' n/o Crooked Creek to Crooked Creek	12	Replace	12	100	208	20,781	20,800	25,000	32,500	Within City Limit	Approximately 1,470 EDUs
FS-P5	Future Capacity Increase	Highland Springs Ave	From 350' s/o Crooked Creek to 375' s/o Breckenridge Ave	15	Replace	18	1,525	247	376,518	376,600	452,000	587,600	Within City Limit	Approximately 1,840 EDUs
FS-P6	Future Capacity Increase	Breckenridge Ave	From 75' w/o Highland Springs Ave to Highland Springs Ave	10	Replace	10	75	200	14,981	15,000	18,000	23,400	Within City Limit	Approximately 1,830 EDUs
Lift Station Improvements														
FS-LS	Lift Station Replacement	Four Seasons Lift Station		-	Replace	3 @ 1,350 gpm		-	2,526,260	2,526,300	3,031,600	3,941,100	Within City Limit	Approximately 3,810 EDUs
				Subtotal - Four Seasons Lift Station Tributary Area Improvements						**3,524,200**	**4,229,400**	**5,498,300**		
Other Wastewater System Improvements[6]														
	Lift Station Condition Assessment							-	-	-	-	3,600,000	Within City Limit	FY 2022/23 - FY 2030/31
	CCTV Program							-	-	-	-	300,000	Within City Limit	FY 2023/24 FY 2029/30
	On-going Pipeline Replacement Program							-	-	-	-	4,800,000	Within City Limit	FY 2023/24 - FY 2030/31
	Wastewater Treatment Plant Improvements							-	-	-	-	2,000,000	Within City Limit	FY 2021/22 - FY 2024/25 FY 2028/29 - FY 2030/31
				Subtotal - Other Wastewater System Improvements						**-**	**-**	**10,700,000**		
Total Costs														
				Gravity Main Improvements						**20,759,000**	**24,912,800**	**32,388,800**		
				Force Main Improvements						**10,742,400**	**12,891,200**	**21,208,700**		
				Lift Station Improvements						**18,899,400**	**22,679,700**	**34,634,000**		
				Other Wastewater System Improvements						**-**	**-**	**10,700,000**		
				Total Improvement Cost						**50,400,800**	**60,483,700**	**98,931,500**		

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Notes:
1. Estimated Construction costs include 20 percent of baseline construction costs to account for unforeseen events and unknown field conditions.
2. Unless noted otherwise, Capital Improvement Costs also include an additional 30 percent of the estimated construction costs to account for administration, construction management, and legal costs.
3. Cost allocation for development related improvements to be reviewed as construction triggers are reached.
4. EDU triggers based on remaining pipeline and lift station capacity and assumes 235 gpd/EDUs, consistent with EMWD Wastewater Master Plan Criteria.
5. Beaumont Mesa force main and wet well expansion reflects City staff budgetary planning estimate provided by City staff June 1, 2021.
6. Other wastewater system improvements reflects City staff budgetary planning estimate provided by City staff June 1, 2021.

improvement is listed as *Existing Capacity Deficiency* on **Table 8.3**. The recommended size for these improvements are based on buildout flow requirements.

- **Replacement Pipeline, Capacity Deficiency Triggered by Future Development.** An existing pipeline is recommended for replacement where additional flow due to future development will create a capacity deficiency. This type of improvement is listed as *Future Capacity Increase* on **Table 8.3**.

- **New Pipeline, Triggered by Future Development.** A new pipeline is proposed to serve future growth. This type of improvement is listed as *New Capacity* on **Table 8.3**.

The opinion of probable construction costs, for the projects included in this master plan, are based on the pipe unit costs summarized on **Table 8.1**.

It is assumed that in general any replacement pipes will be in the same alignment and the same slope as the existing pipe. However, this study recommends an investigation of the alignment during the pre-design stage of each project.

8.4.3 Improvement Service Location

The Capital Improvement Program on **Table 8.3** classifies the improvements based on the future flow service location. These classifications are summarized as follows:

- **Within City Limits:** This improvement will convey existing and future flows from development within the existing City limits.

- **With Annexation:** This improvement will convey future flows from development outside of the existing City limits but within the General Plan Boundary, which would require future annexation.

It should be noted that some improvements convey flows from both service location classifications, as shown on **Table 8.2**.

8.4.4 Construction Triggers

The CIP improvements are prioritized based on their urgency to mitigate existing deficiencies and to serve future growth. The construction triggers for each improvement are classified as:

- **Fiscal Year:** For improvements included in the 10-Year Capital Improvement Program (**Table 8.4**) the fiscal year for planned implementation is shown on **Table 8.3**.

- **Equivalent Dwelling Unit:** A equivalent dwelling unit (EDU) construction trigger is provided for improvements designated as capacity increases for future development. This trigger is based on remaining capacity in the existing facility planned for future improvement. The remaining capacity is converted to EDUs assuming 235 gpd/EDU.

Table 8.4 10-Year Improvement Phasing
Wastewater Master Plan
City of Beaumont

PRELIMINARY

CIP ID	Funding Type	Type of Improvement	Project Name	Project Description	Fiscal Year Improvement Phasing										Total Improvement Cost
					FY 2021/22 ($)	FY 2022/23 ($)	FY 2023/24 ($)	FY 2024/25 ($)	FY 2025/26 ($)	FY 2026/27 ($)	FY 2027/28 ($)	FY 2028/29 ($)	FY 2029/30 ($)	FY 2030/31 ($)	($)
Gravity Main Improvements[2]															
UOV-P2		Existing Capacity Deficiency	Apron Lane Pipeline Replacement	Replace existing 8-inch gravity main with new 12-inch gravity main in Apron Ln			97,400								97,400
WWTP-P2		Existing Capacity Deficiency	Edgar Ave Pipeline Replacement	Replace existing 12-inch gravity main with new 15-inch gravity main in Edgar Ave		206,700									206,700
				Subtotal - Gravity Main Improvements	**0**	**206,700**	**97,400**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**304,100**
Beaumont Mesa Improvements															
		New Force Main	Force Main Design and Pump Design	Design of new force main and pump additions	450,000										450,000
			Pump Replacement/Addition Construction	Construction of replacement pumps and additional pumps for LS		750,000									750,000
			Force Main Construction	Construction of new 16-inch force main		4,000,000									4,000,000
		New Wet Well	Wet Well Design	Design of New Wet Well	400,000										400,000
			Wet Well Construction	Construction of New Wet Well				4,000,000							4,000,000
				Subtotal - Beaumont Mesa Improvements	**850,000**	**4,750,000**	**0**	**4,000,000**	**0**	**0**	**0**	**0**	**0**	**0**	**9,600,000**
Lift Station Condition Assessment Improvements															
		Lift Station Condition		Ongoing lift station improvements to include new electrical, new pumps, repairs to wetwells, repairs to components at the LS, etc		400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	400,000	3,600,000
				Subtotal - Lift Station Condition Assessment Improvements	**0**	**400,000**	**400,000**	**400,000**	**400,000**	**400,000**	**400,000**	**400,000**	**400,000**	**400,000**	**3,600,000**
Operation and Maintenance Improvements															
			CCTV Program	CCTV Wastewater System every 3-years (approx. 59 miles/year) - camera & truck			150,000						150,000		300,000
			On-going Pipeline Replacement Program	As-needed pipeline replacement for ongoing system improvements			500,000	500,000	500,000	600,000	600,000	600,000	750,000	750,000	4,800,000
				Subtotal - Operation and Maintenance Improvements	**0**	**0**	**650,000**	**500,000**	**500,000**	**600,000**	**600,000**	**600,000**	**900,000**	**750,000**	**5,100,000**
Wastewater Treatment Plant															
		Study	Wastewater Rate Study	Rate Study for FY24 - FY28	200,000										200,000
		Construction	I&I Project - Flow Meters	Installation of Flow Meters at LS	200,000										200,000
		Construction	I&I System Repairs - Phase 3	Various needed repairs system wide		200,000									200,000
		Design/ Construction	Office Expansion	WWTP office and staff workspace building			500,000								500,000
		Construction	UV Bulb Replacement	WWTP UV bulb replacement			50,000	50,000	50,000			50,000	50,000	50,000	300,000
		Construction	RO Module Replacement	WWTP RO module replacement					300,000					300,000	600,000
				Subtotal - Wastewater Treatment Plant	**400,000**	**200,000**	**550,000**	**50,000**	**350,000**	**0**	**0**	**50,000**	**50,000**	**350,000**	**2,000,000**
Total Improvement Costs															
				Fiscal Year Total	1,250,000	5,556,700	1,697,400	4,950,000	1,250,000	1,000,000	1,000,000	1,050,000	1,350,000	1,500,000	-
				Cumulative Total	**1,250,000**	**6,806,700**	**8,504,100**	**13,454,100**	**14,704,100**	**15,704,100**	**16,704,100**	**17,754,100**	**19,104,100**	**20,604,100**	**20,605,000**

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6/2/2021

Notes:
1. Unless noted otherwise, budgetary planning estimate provided by City staff on June 01, 2021.
2. Existing Wastewater System capacity deficiency Capital Improvement Program.

- **As Development Occurs:** New infrastructure required to serve future growth is to be constructed on an as-needed basis as development occurs.

8.5 10-YEAR IMPROVEMENT PHASING

This section discusses the 10 Year Capital Improvement Program (10 Year CIP) and recommended improvement phasing. This 10-Year CIP includes capacity improvements for the existing wastewater collection system, as identified as part of the existing system capacity evaluation, as well as other improvements and planning efforts for the ongoing operations and maintenance of the collection system. The improvements included in the 10 Year CIP are summarized as follows:

- **Gravity Main Improvements:** These improvements reflect the required pipeline upgrades to mitigate existing system deficiencies.

- **Beaumont Mesa Improvements:** These improvements consist of the design and construction of a wet well expansion and new force main for the Beaumont Mesa Lift Station. This also includes new and replacement lift station pumps.

- **Lift Station Condition Assessment Improvements:** This reflects ongoing lift station improvements including new electrical equipment, replacement pumps, wet well repairs, component repairs, and other as-needed improvements identified by City staff.

- **Operation and Maintenance Improvements:** This reflects the acquisition of a new CCTV camera and truck as well as an allowance for as-needed pipeline replacement

- **Wastewater Treatment Plant:** This reflects currently planned improvements related to the wastewater treatment plant, including flow meters and system-wide improvements to identify and mitigate I/I issues and on-site improvements. This also includes a wastewater race study for FY2024-28.

The 10-Year CIP is intended to provide general guidance for implementing the capital improvement projects listed in this master plan. Additional improvements may be constructed as developments occurs and the phasing and implementation of a sequence of construction is subject to the approval of the City Engineer.

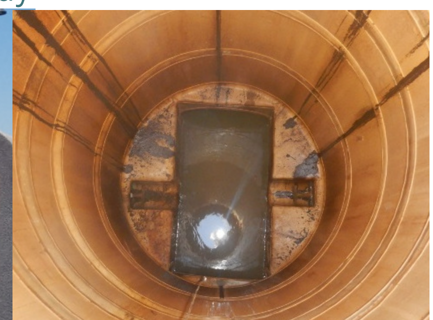
APPENDICES

APPENDIX A

Sewer Flow Monitoring and Inflow/Infiltration Study, 2020
(V&A)

City of Beaumont

Sewer Flow Monitoring and Inflow/Infiltration Study




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

Report Date: August 2020

Prepared by: V&A consulting engineers

V&A Project No. 19-0280

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Tables

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Abbreviations and Acronyms

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

Terms and Definitions

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

Executive Summary

Scope and Purpose

V&A Consulting Engineers (V&A) was retained by Akel Engineering Group (AEG) to perform sanitary sewer flow monitoring for the City of Beaumont, CA (City) in support of the City's Sewer System Master Plan. Flow monitoring was performed for approximately seven weeks from February 20 to April 8, 2020 at 14 sites, which included four open-channel gravity sewer mains and 10 pump stations. There were three general purposes for this study.

1. Establish the baseline sanitary sewer flows at the flow monitoring sites.
2. Measure the peak flow characteristics of the subject pipes during the monitoring period.
3. Isolate infiltration and inflow (I/I) and run analyses pertaining to I/I response levels.

Monitoring Sites and Basins

The flow monitoring site locations were selected and approved by the City and AEG and are listed in Table ES-1, and shown in Figure ES-1. The isolated basins are illustrated in Figure ES-2.

Table ES-1. List of Flow Monitoring Sites

Monitoring Site	Structure ID	Monitored Pipe	Pipe Dia. (in)	Location
FM-01	SSMH01061	North Inlet	24	Cherry Avenue north of Mary Lane
FM-02	SSMH01725	West Inlet	30	Veile Avenue north of West 4th Street
FM-03	SSMH00381	West Inlet	24	California Avenue north of East 1st Street
FM-04	SSMH00450	North Inlet	57	East 6th Street east of Illinois Avenue
FM-05	Four Seasons LS			Highland Springs, 320 feet south of Breckenridge Ave
FM-06	Seneca Springs LS			Potrero Blvd and Seneca Springs Blvd
FM-07	Marshall Creek LS			Northwest end of Ring Ranch Road
FM-08	Noble Creek LS			Northbound I-10 off-ramp to Oak Valley Parkway, 265 feet south of Oak Valley Pkwy
FM-09	Industrial Park LS			Off road, 540 feet south of end of Risco Circle
FM-10	Upper Oak Valley LS			Oak Valley Parkway, 0.48 miles west of Apron Lane
FM-11	Lower Oak Valley LS			Palmer Avenue, 300 feet west of Morris Street
FM-12	Beaumont Mesa LS			Potrero Blvd, just south of Costello Way
FM-13	Olivewood LS			Northwest end of Olivewood Gated Community, off of Costello Way
FM-14	Fairway Canyon LS			Northwest end of Crenshaw Street

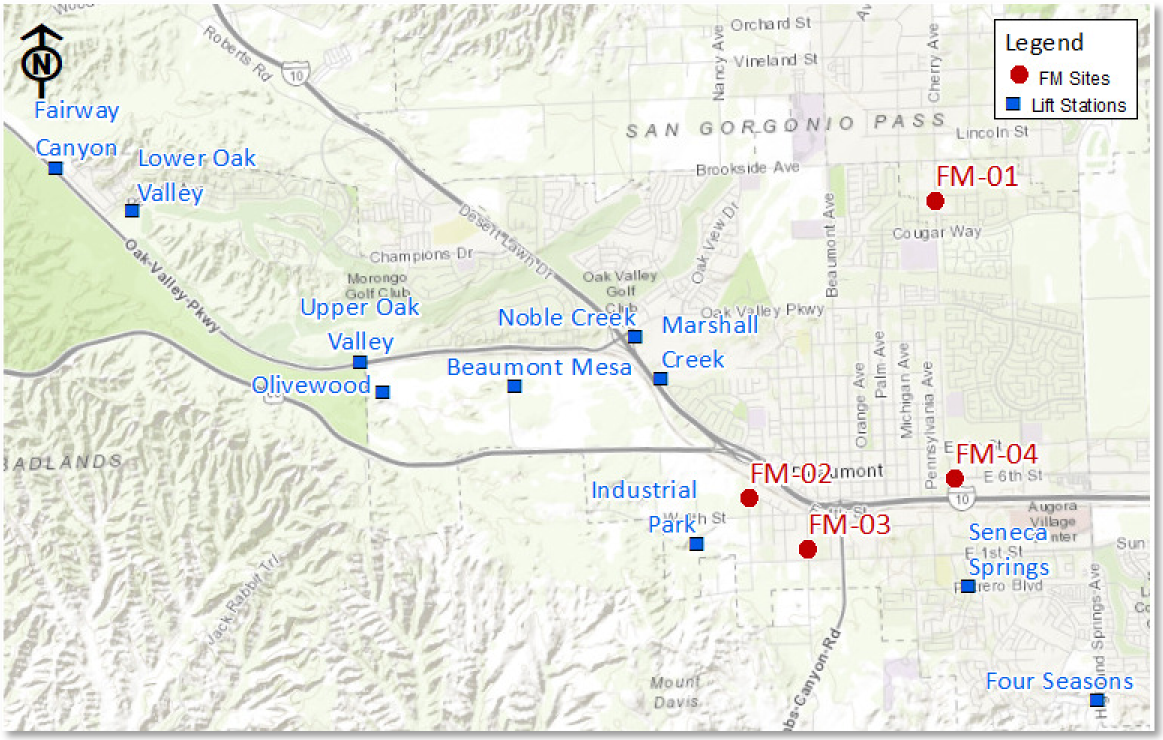

Figure ES-1. Map of Flow Monitoring Sites – Overall

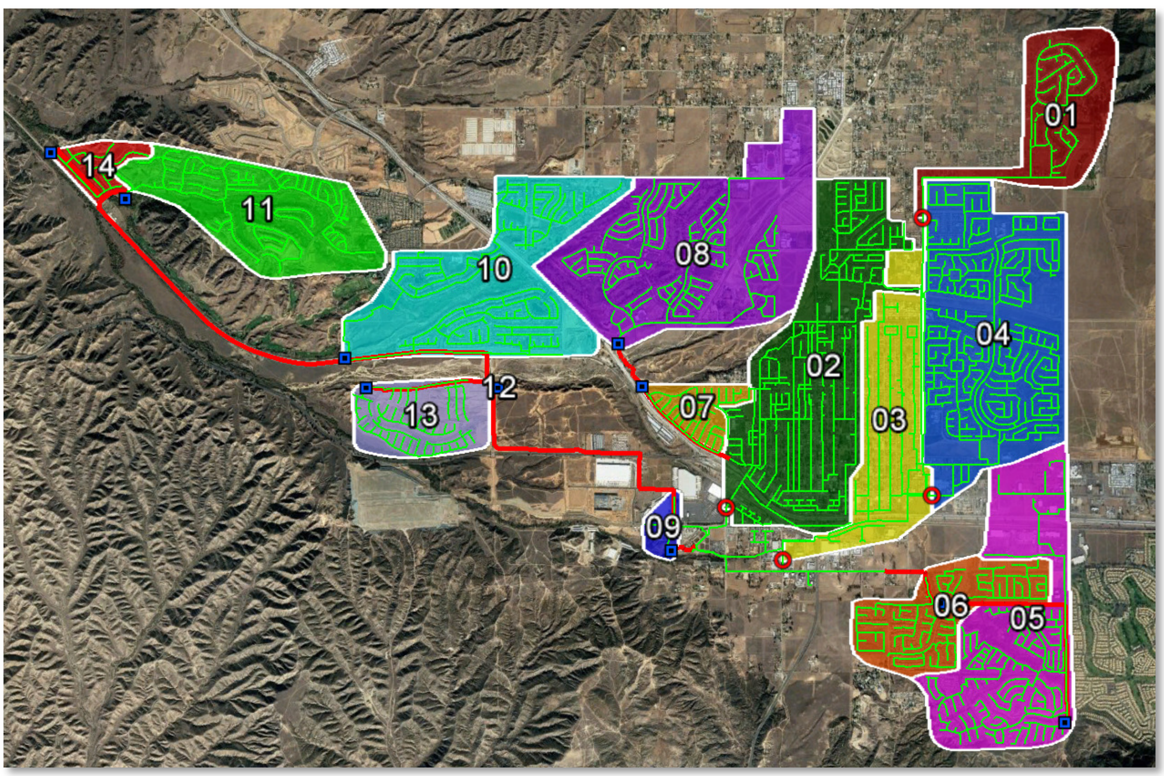

Figure ES-2. Map of Flow Monitoring Basins

Rainfall Monitoring

There was approximately 13.18 inches of rainfall during the flow monitoring study (average of Beaumont rainfall gauges) as shown in Figure ES-3. The cumulative precipitation was approximately 2.5 times higher than historical averages over the flow monitoring period.

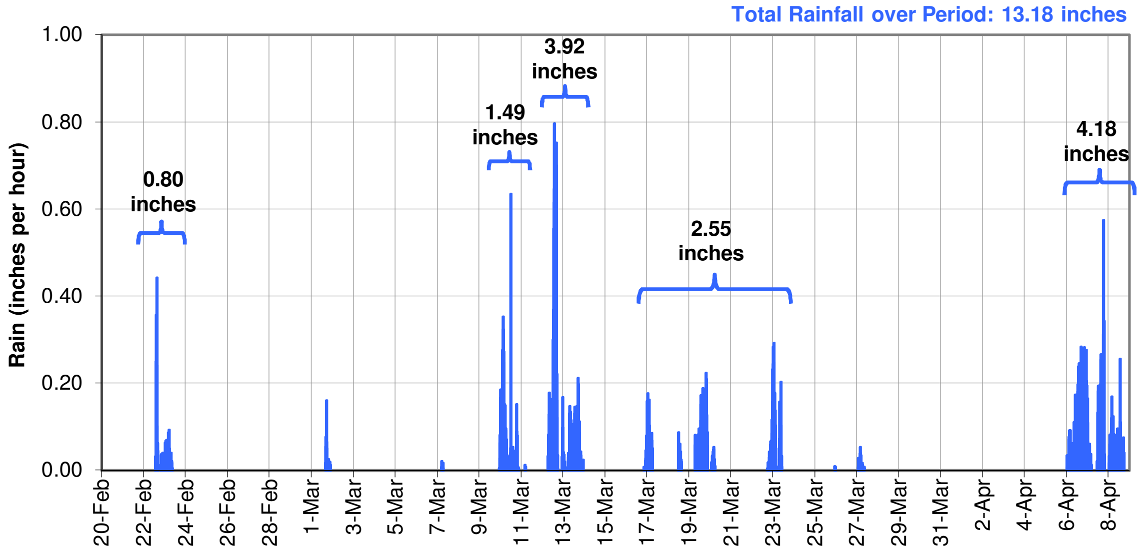

Figure ES-3. Rainfall Over Monitoring Period, Average of Beaumont Rain Gauges

There were four classifiable rainfall events during the flow monitoring period:

- **March 9/10, 2020**: Classified as approximately a 1-year, 12-hour event at two of six rain gauges.
- **March 12/13, 2020**: The strongest rainfall event of the flow monitoring period, classified as between a 15-year and 35-year, 3-hour event across the region. This event elicited the strongest I/I response system-wide, and also had the highest intensity rain over the flow monitoring period. This rain event will be used for the I/I analyses.
- **March 22/23, 2020**: Classified as a 2-year, 3-hour event at one rain gauge.
- **April 6/7/8, 2020**: Classified as between a 2-year and 3-year, 12-hour event at five of six rain gauges.
- **Long-Term**: The 30 days between March 10 and April 9, 2020, were classified as between a 4.5-year and 15-year, 30-day rain event.

The highest classification over the period and for all rain gauges was a three-hour period (from approximately 1:15 pm to 4:15pm) on March 12, 2020. Figure ES-4 illustrates this classification regionally.

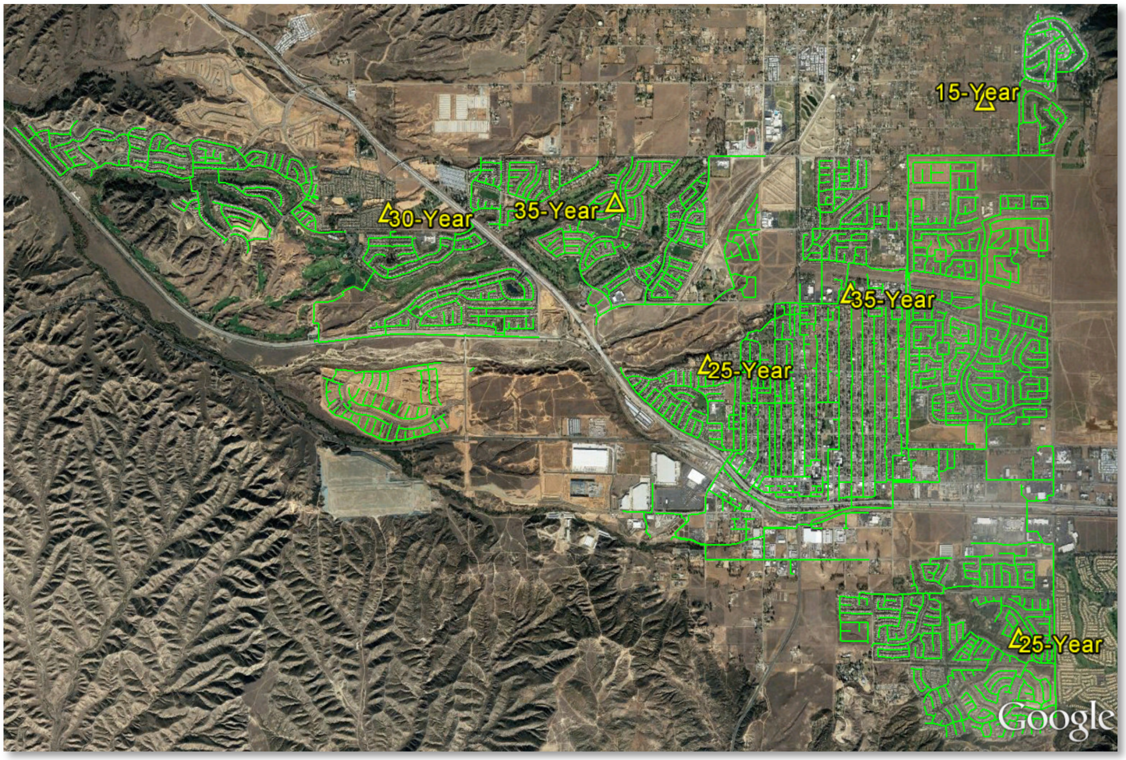

Figure ES-4. March 12 Storm Event, Peak Classification (per rain gauge, duration = 3-hours)

Average Flow Analysis

Two sets of average dry weather flow (ADWF) curves were established due to the "shelter-in-place" (SIP) order for Covid-19. Table ES-2 summarizes the ADWF values per site during the flow monitoring period.

Table ES-2. Dry Weather Flow

Site	Pre-SIP ADWF (mgd)					Post-SIP ADWF (mgd)					SIP Delta
	Mon-Thu	Fri	Sat	Sun	Overall	Mon-Thu	Fri	Sat	Sun	Overall	
FM-01	0.066	0.066	0.073	0.074	0.068	0.072	0.073	0.084	0.081	0.075	10%
FM-02	0.811	0.770	0.823	0.743	0.797	0.820	0.811	0.802	0.753	0.806	1%
FM-03	1.005	0.904	0.978	1.073	0.996	1.127	1.153	1.191	1.139	1.142	15%
FM-04	0.497	0.480	0.511	0.591	0.510	0.612	0.617	0.623	0.674	0.623	22%
FM-05	0.253	0.256	0.243	0.244	0.251	0.217	0.230	0.226	0.222	0.221	-12%
FM-06	0.140	0.145	0.156	0.170	0.147	0.142	0.144	0.145	0.158	0.145	-2%
FM-07	0.414	0.418	0.425	0.438	0.419	0.426	0.423	0.435	0.433	0.428	2%
FM-08	0.241	0.241	0.237	0.247	0.241	0.237	0.239	0.245	0.246	0.240	0%
FM-09	0.056	0.052	0.032	0.028	0.048	0.063	0.072	0.026	0.015	0.052	8%
FM-10	0.707	0.686	0.712	0.756	0.712	0.827	0.856	0.842	0.871	0.840	18%
FM-11	0.381	0.361	0.393	0.439	0.388	0.441	0.444	0.459	0.441	0.444	14%
FM-12	0.745	0.734	0.735	0.778	0.747	0.853	0.907	0.906	0.893	0.874	17%
FM-13	0.022	0.022	0.022	0.024	0.022	0.025	0.026	0.026	0.028	0.026	15%
FM-14	0.060	0.062	0.062	0.067	0.062	0.064	0.064	0.065	0.064	0.064	4%

Peak Measured Flows and Pipeline Capacity Analysis

Peak measured flows and the hydraulic grade line data (flow depths) are important to understanding the capacity limitations of a collection system. The capacity analysis terms used in the text below are defined as follows:

- **Peaking Factor**: Peaking factor is defined as the peak measured flow divided by the average dry weather flow (ADWF). Peaking factors are influenced by many factors, including size and topography of the tributary area, flow attenuation, flow restrictions, and characteristics of I/I entering the collection system. Municipal standards for peaking factor vary agency by agency; the City should refer to jurisdictional standards when evaluating peaking factors[1]. For this study, peaking factors over 5.0 are highlighted RED.
- **d/D Ratio**: The d/D ratio is the peak measured depth of flow (d) divided by the pipe diameter (D). The d/D ratio for each site was computed based on the maximum depth of flow for the study. Standards for d/D ratio vary from agency to agency, but typically range between d/D ≤ 0.5 and d/D ≤ 0.75. The City should refer to jurisdictional standards when evaluating d/D ratios. For this study, d/D ratios over 0.75 are highlighted ORANGE. Surcharged sites are highlighted RED.

Table ES-3 summarizes the peak recorded flows, levels, d/D ratios, and peaking factors per site during the flow monitoring period. Capacity analysis data is presented on a site-by-site basis and represents the hydraulic conditions only at the site locations; hydraulic conditions in other areas of the collection system will differ.

Table ES-3. Capacity Analysis Summary

Monitored Site	ADWF pre-SIP [A] (mgd)	Peak Measured Flow (mgd)	Peaking Factor	Pipe Diameter, *D* (in)	Max Depth, *d* (in)	*Max d/D* Ratio	Surcharge above pipe crown (ft)
FM-01	0.068	0.39	5.7	8	3.3	0.42	-
FM-02	0.797	1.97	2.5	24	4.1	0.17	-
FM-03	0.996	3.21	3.2	30	18.6	0.62	-
FM-04	0.510	1.57	3.1	21	6.8	0.33	-
FM-05	0.251	0.62	2.5	n/a	n/a	n/a	n/a
FM-06	0.147	0.48	3.2	n/a	n/a	n/a	n/a
FM-07	0.419	1.40	3.3	n/a	n/a	n/a	n/a
FM-08	0.241	0.57	2.4	n/a	n/a	n/a	n/a
FM-09	0.048	0.25	5.1	n/a	n/a	n/a	n/a
FM-10	0.712	1.76	2.5	n/a	n/a	n/a	n/a
FM-11	0.388	0.87	2.2	n/a	n/a	n/a	n/a
FM-12	0.747	1.94	2.6	n/a	n/a	n/a	n/a
FM-13	0.022	0.070	3.1	n/a	n/a	n/a	n/a
FM-14	0.062	0.12	2.0	n/a	n/a	n/a	n/a

[A] Pre-SIP ADWF was used for this analysis.

[1] WEF Manual of Practice FD-6 and ASCE Manual No. 62 suggests typical peaking factor ratios range between 3 and 4, with higher values possibly indicative of pronounced I/I flows.

The following capacity analysis results are noted:

- **Peaking Factors**: Only two sites had peaking factors over 5.0.
  - **Site FM-01**: Site FM-01 was an open-channel flow monitoring site and was not influenced by pump station operations. Peak flows occurred during the March 12 rainfall event.
  - **Site FM-09**: FM-09 is the Industrial Park LS, and peak flows did not occur corresponding to I/I contribution of a large rainfall event. The higher peaking factor for this site is attributed to pump station operations and the type of service (industrial flows).
- **d/D Ratio**: All open-channel flow monitoring sites had d/D ratios less than 0.75 for the entirety of the flow monitoring period.

Figure ES-5 shows a schematic diagram of the peak measured flows at the flow monitoring sites, with peak flow levels shown for open-channel flow monitoring sites.

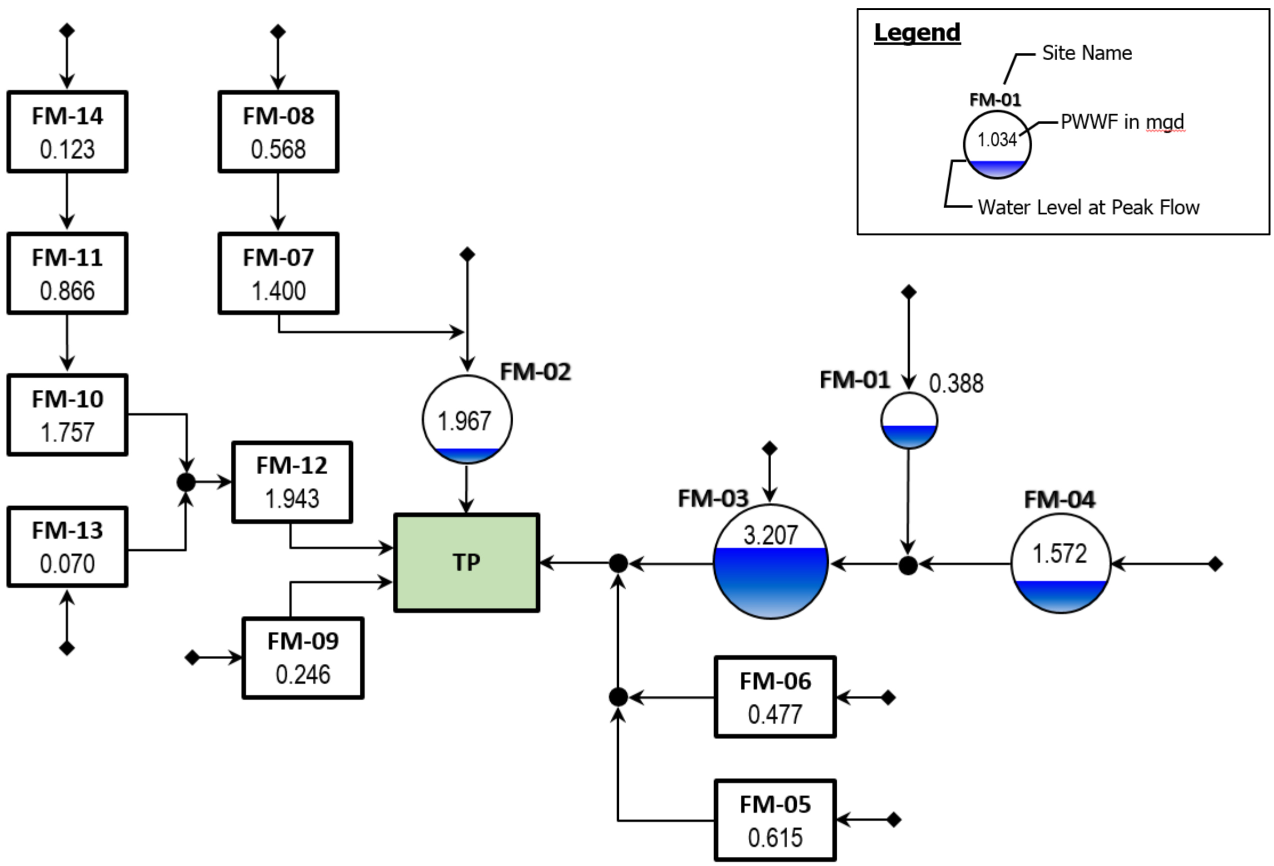

Figure ES-5. Peak Measured Flow (Flow Schematic)

Infiltration and Inflow

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

I/I results were taken from the March 12/13 rainfall event, the highest classified rainfall event of the season which also elicited the strongest I/I response. Table ES-4 summarizes the I/I results for this study; the top 3 and next 3 ranked basins have been shaded RED and ORANGE. Please refer to the I/I Methods section for more information on inflow and infiltration analysis methods and ranking methods.

Temperature maps for inflow and total I/I are shown in Figure ES-6 and Figure ES-7.

Table ES-4. Inflow/Infiltration Analysis Summary

Basin	ADWF (mgd)	Inflow Rate (mgd)	Peak I/I per ADWF Ratio	Total I/I (gallons)	Total I/I per-ADWF (MG/adwf/ inch-rain)	Final Inflow Ranking	Final Total I/I Ranking
Basin 01	0.068	0.290	4.28	120,553	0.45	1	1
Basin 02	0.377	0.530	1.40	289,648	0.19	5	5
Basin 03	0.418	1.234	2.95	335,977	0.20	2	3
Basin 04	0.510	0.448	0.88	189,565	0.09	8	9
Basin 05	0.251	0.301	1.20	117,106	0.14	6	7
Basin 06	0.147	0.033	0.22	26,709	0.05	11	12
Basin 07	0.179	0.266	1.49	142,914	0.20	4	2
Basin 08	0.241	0.258	1.07	85,298	0.08	7	10
Basin 09	0.048	0.006	0.13	18,854	0.10	12	8
Basin 10	0.324	0.208	0.64	246,795	0.19	10	4
Basin 11	0.326	0.250	0.77	94,206	0.08	9	11
Basin 13	0.022	0.035	1.56	13,305	0.16	3	6
Basin 14	0.062	0.006	0.09	9,059	0.04	13	13

The following I/I results are noted:

- **Inflow**: Basins 1, 3, and 13 had the highest normalized peak I/I rates, an indicator of high inflow within the flow monitoring basin.
- **RDI**: Throughout the region, for the rainfall events monitored, there was minimal RDI[2]. Systemwide, flows returned to near-baseline levels within 24 hours. Given the scale of the rainfall events that occurred during this study, RDI does not appear to be an issue for the City.
- **Total I/I**: Basins 1, 3, and 7 had the highest normalized combined I/I rates, an indicator of high combined inflow and infiltration within the flow monitoring basin

[2] Basins 5 and 7 may have shown a hint of a sustained RDI component.

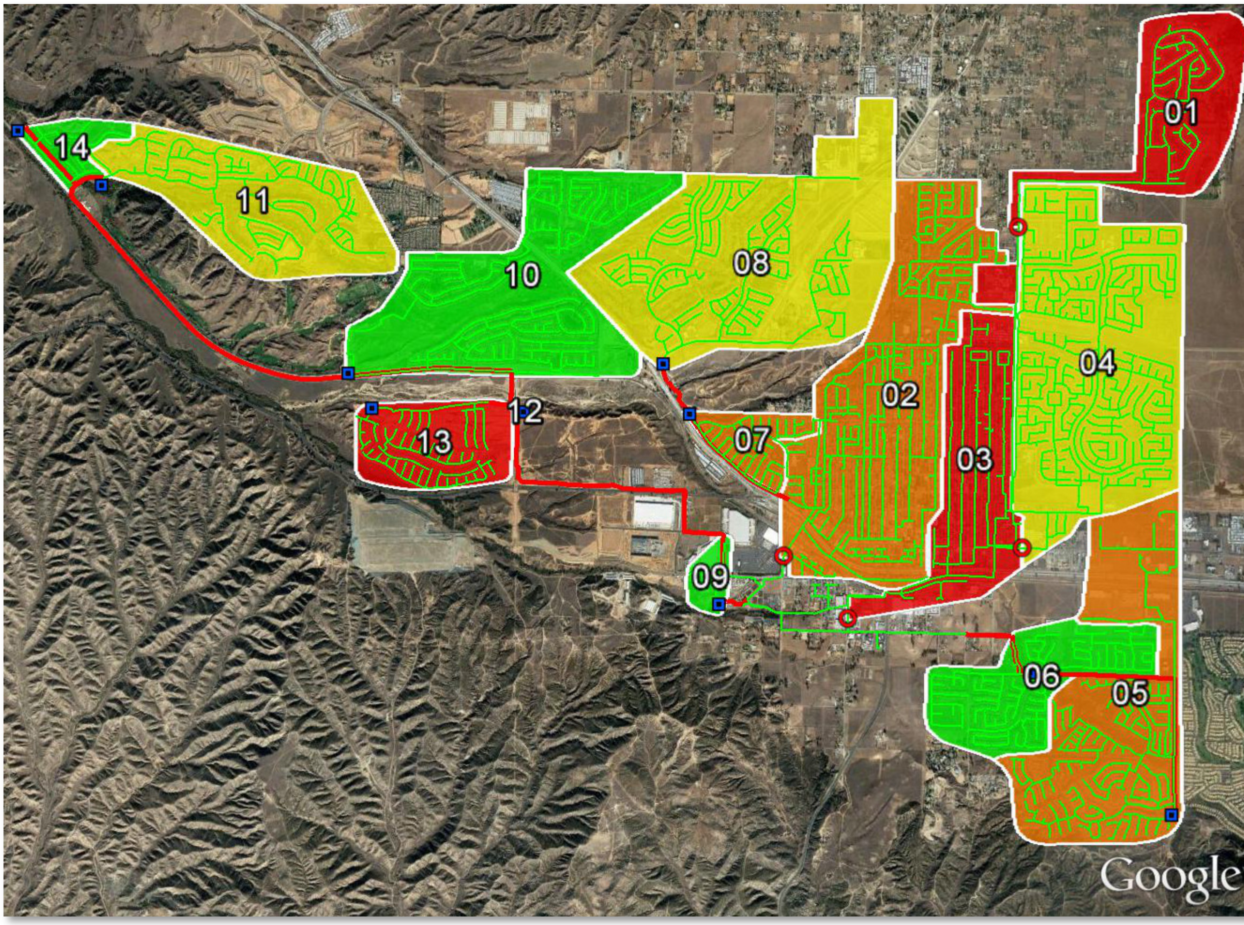

Figure ES-6. Temperature Map: Inflow Final Basin Rankings

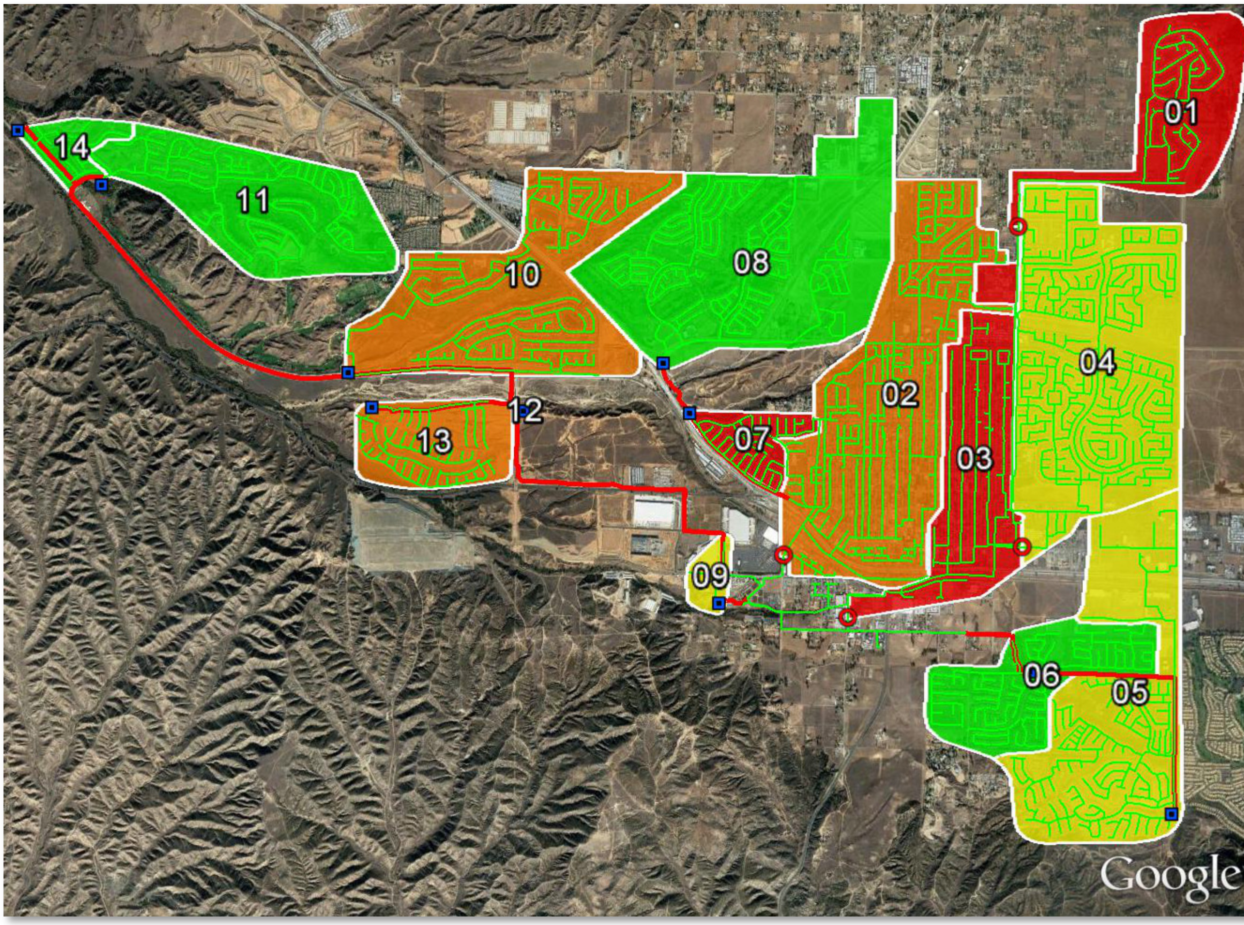

Figure ES-7. Temperature Map: Total I/I Final Basin Rankings

Note: There was uncertainty as to whether using IDM and ACRE normalization methods were the most appropriate means of normalization for this study for some basins. For example, the full Basin 13 (Olivewood LS) areas and IDMs were reported, but the development is still in construction and only approximately 15% to 20% occupied. Using the reported IDM and ACRE values for Basin 13 may under-represent the I/I within that basin. Conversely, Basin 09 (Industrial LS) has sporadic flows due to the type of service, and few pipelines shown within its service area. Using reported IDM and ACRE values may have over-represented I/I in this basin.

For the purposes of basin I/I rankings, the per-ADWF normalization method was used; however, the inflow and infiltration normalization values for the per-IDM and per-ACRE are also reported. It is noted that construction repairs and I/I reduction and mitigation methods are most typically priced on pipe length basis. The reviewing engineer may wish to review the rankings made in this report and consider the IDM metric when making CIP decisions.

Recommendations

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

1. **Master Plan and Model Implementation**: This study focuses on inflow and infiltration generation; however, the capacity deficiencies of the collection system may be of greater concern relative to I/I response during peak wet weather events. The City may wish to have a model designed and/or a master plan study conducted to determine the overall needs of the City relative to I/I. Or simply, the study results can be used to update the master plan and compare with previous model assumptions and flow monitoring results.
2. **Determine I/I Reduction Program**: The City should examine its I/I reduction needs to determine their needs and goals for a future I/I reduction program.
    a. If peak flows, sanitary sewer overflows, and pipeline capacity issues are of greater concern, then priority can be given to investigate and reduce sources of inflow within the basins with the greatest inflow problems.
    b. If total infiltration and general pipeline deterioration are of greater concern, then the program can be weighted to investigate and reduce sources of infiltration within the basins with the greatest infiltration problems. Generally, RDI rates and hence total I/I were relatively low for this system.
    c. Basins 1 and 3 ranked in the top 3 for both inflow and total combined I/I. An I/I reduction program could begin within these basins.
3. **I/I Reduction Cost Effective Analysis**: The City should conduct a study to determine which is more cost-effective: (1) locating the sources of inflow/infiltration and systematically rehabilitating or replacing the faulty pipelines; or (2) continued treatment of the additional rainfall dependent I/I flow.

1 Introduction

1.1 Scope and Purpose

V&A Consulting Engineers (V&A) was retained by Akel Engineering Group (AEG) to perform sanitary sewer flow monitoring for the City of Beaumont, CA (City) in support of the City's Sewer System Master Plan. Flow monitoring was performed for approximately seven weeks from February 20 to April 8, 2020 at 14 sites, which included four open-channel gravity sewer mains and 10 pump stations[3]. There were three general purposes for this study.

1. Establish the baseline sanitary sewer flows at the flow monitoring sites.
2. Measure the peak flow characteristics of the subject pipes during the monitoring period.
3. Isolate infiltration and inflow (I/I) and run analyses pertaining to I/I response levels.

1.2 Flow Monitoring Sites

Open-channel flow monitoring sites are identified from the manholes where the flow monitors were secured and the pipelines in which the flow sensors were placed. Pump station flow monitoring measured flows into the pump station wet wells. Capacity analysis and flow rate information is presented on a site-by-site basis. The flow monitoring site locations were selected and approved by the City and AEG. Information regarding the flow monitoring locations is listed in Table 1-1. Figure 1-1 illustrates the flow monitoring locations. Detailed descriptions of the individual flow monitoring sites, including photographs, are included in *Appendix A*.

1.3 Flow Monitoring Basins

Flow monitoring site data may include the flows of one or many drainage basins. Flow monitoring basins are localized areas of a sanitary sewer collection system upstream of a given location (often a flow meter), including all pipelines, inlets, and appurtenances. The basin refers to the ground surface area near and enclosed by the pipelines. A basin may refer to the entire collection system upstream from a flow meter or may exclude separately monitored basins upstream, requiring basin isolation (subtraction of upstream flows). One of the primary issues that arises as a result is that it is necessary to subtract flows in order to isolate basins. For more details on problems that arise from subtraction of flows, see *Section 2.4 Measurement Error and Uncertainty*.

Information regarding the isolated flow monitoring basins are summarized in Table 1-2 and illustrated in Figure 1-2.

[3] Initially 13 sites and 9 pump stations were planned for installation; however, Olivewood LS was not accessible during installation. V&A and AEG instead installed equipment at Fairway Canyon LS ("added as Site 14"). Mid-study, and before the March 12, 2020 rain event, Olivewood was made accessible, and V&A/AEG was able to collect data from Site 13 Olivewood LS.

Table 1-1. List of Monitoring Locations

Monitoring Site	Structure ID	Monitored Pipe	Pipe Dia. (in)	Location
FM-01	SSMH01061	North Inlet	24	Cherry Avenue north of Mary Lane
FM-02	SSMH01725	West Inlet	30	Veile Avenue north of West 4th Street
FM-03	SSMH00381	West Inlet	24	California Avenue north of East 1st Street
FM-04	SSMH00450	North Inlet	57	East 6th Street east of Illinois Avenue
FM-05	Four Seasons LS			Highland Springs, 320 feet south of Breckenridge Ave
FM-06	Seneca Springs LS			Potrero Blvd and Seneca Springs Blvd
FM-07	Marshall Creek LS			Northwest end of Ring Ranch Road
FM-08	Noble Creek LS			Northbound I-10 off-ramp to Oak Valley Parkway, 265 feet south of Oak Valley Pkwy
FM-09	Industrial Park LS			Off road, 540 feet south of end of Risco Circle
FM-10	Upper Oak Valley LS			Oak Valley Parkway, 0.48 miles west of Apron Lane
FM-11	Lower Oak Valley LS			Palmer Avenue, 300 feet west of Morris Street
FM-12	Beaumont Mesa LS			Potrero Blvd, just south of Costello Way
FM-13	Olivewood LS			Northwest end of Olivewood Gated Community, off of Costello Way
FM-14	Fairway Canyon LS			Northwest end of Crenshaw Street

Table 1-2. Isolated Flow Monitoring Basins

Basin	Size (Acres)	Pipe Length (IDM)	Basin Flow Equation
1	459	54.4	$= Q_{FM\text{-}01}$
2	1148	285.2	$= Q_{FM\text{-}02} - Q_{FM\text{-}07}$
3	581	165.9	$= Q_{FM\text{-}03} - Q_{FM\text{-}01} - Q_{FM\text{-}04}$
4	1230	301.9	$= Q_{FM\text{-}04}$
5	869	152.6	$= Q_{FM\text{-}05}$
6	417	88.3	$= Q_{FM\text{-}06}$
7	136	35.8	$= Q_{FM\text{-}07} - Q_{FM\text{-}08}$
8	1212	164.6	$= Q_{FM\text{-}08}$
9	63	26.2	$= Q_{FM\text{-}09}$
10	927	164.2	$= Q_{FM\text{-}10} - Q_{FM\text{-}11}$
11	644	104.3	$= Q_{FM\text{-}11} - Q_{FM\text{-}14}$
12	0.8	1.3	$= Q_{FM\text{-}12} - Q_{FM\text{-}10} - Q_{FM\text{-}13}$
13	312	55.3	$= Q_{FM\text{-}13}$
14	108	18.8	$= Q_{FM\text{-}14}$

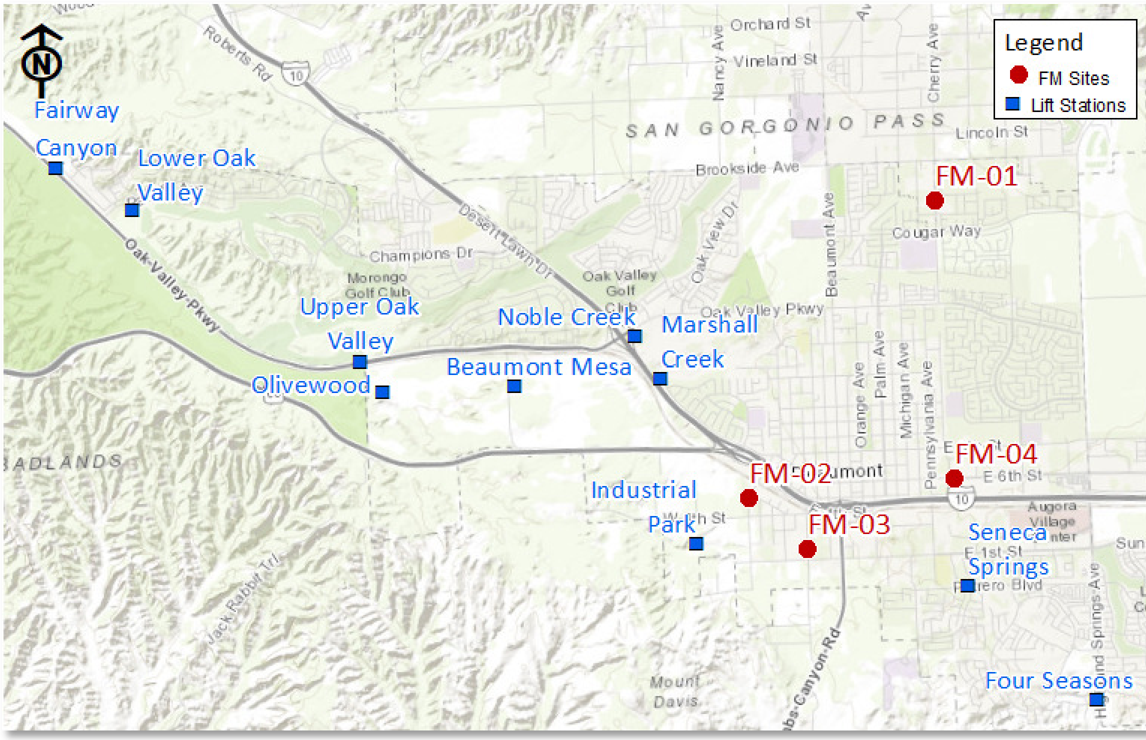

Figure 1-1. Map of Flow Monitoring Sites

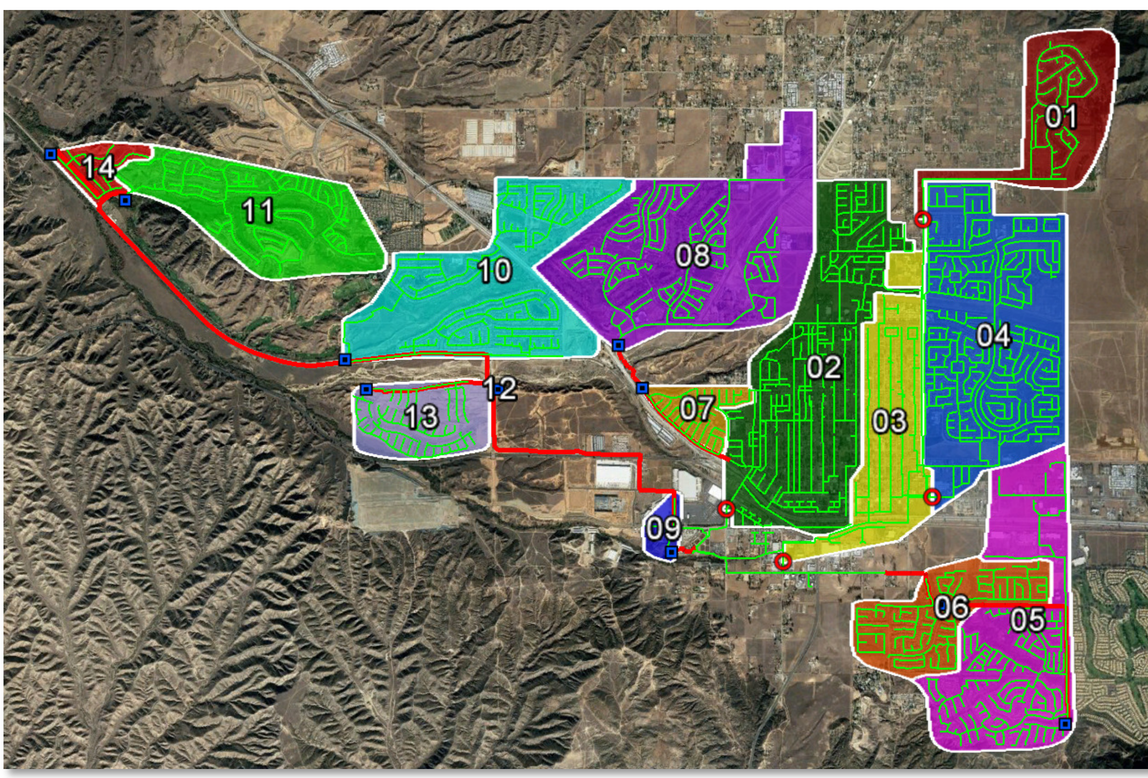

Figure 1-2. Map of Flow Monitoring Basins

2 Methods and Procedures

2.1 Confined Space Entry

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

Photo 2-1. Confined Space Entry

Photo 2-2. Typical Personal Four-Gas Monitor

2.2 Flow Meter Installation

V&A installed twenty-one (21) Isco 2150 and Hach 902 flow meters for temporary monitoring within the collection system. Both types of meters use submerged sensors with a pressure transducer to collect depth readings and an ultrasonic Doppler sensor to determine the average fluid velocity. The ultrasonic sensor emits high-frequency sound waves, which are reflected by air bubbles and suspended particles in the flow. The sensor receives the reflected signal and determines the Doppler frequency shift, which indicates the estimated average flow velocity. The sensor is typically mounted at a manhole inlet to take advantage of smoother upstream flow conditions. The sensor may be offset to one side to lessen the chances of fouling and sedimentation where these problems are expected to occur. Manual level and velocity measurements were taken during the installation of the flow meters and again when they were removed and compared to simultaneous level and velocity readings from the flow meters to ensure proper calibration and accuracy. Figure 2-1 shows a typical installation for a flow meter with a submerged sensor.

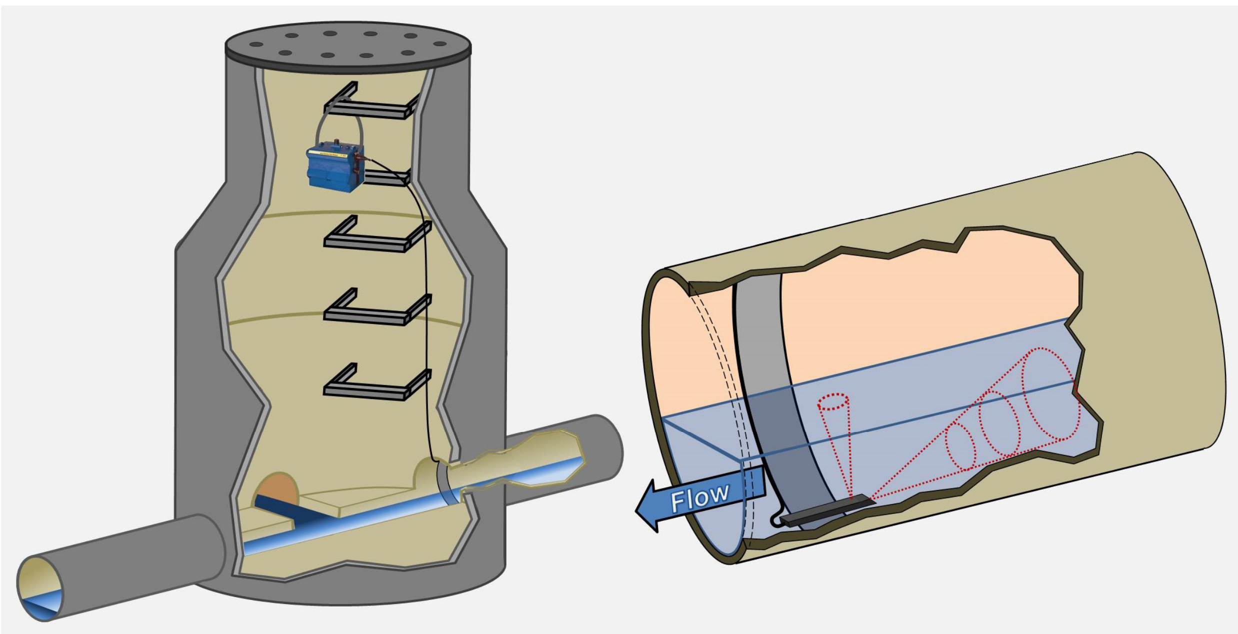

Figure 2-1. Typical Installation for Isco 2150 Flow Meter with Submerged Sensor

2.3 Flow Calculation

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

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

where Q: volume flow rate

v: average velocity as determined by the ultrasonic sensor

A: cross-sectional area available to carry the flow

A_T: total cross-sectional area with both wastewater and sediment

A_S: cross-sectional area of sediment.

For circular pipe,

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

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

where d_W: distance between wastewater level and pipe invert

d_S: depth of sediment

D: pipe diameter

2.4 Measurement Error and Uncertainty

For traditional engineering applications, measurement "error" is explained as a difference between a computed, estimated, or measured value and the generally accepted true or theoretically correct value. It can also be thought of as a difference between the desired and the actual performance of equipment. For equipment, error is usually expressed as a percentage relative to accuracy (i.e., "…the velocity sensor has an accuracy of ±2% of the reading…").

However, for this study and flow monitoring applications, the cause of the measurement difference is important and a distinction will be made between the equipment not performing to industry standards ("error") and expected inaccuracies ("uncertainty") associated with monitoring technology limitations.

Gauging **"error"** occurs when the equipment is not performing to industry standards. This can occur as a result of the following common categories of conditions that can be encountered at a wastewater monitoring site.

- Malfunctioning equipment (i.e. a sensor is damaged, battery life ends, or a desiccant canister becomes saturated)
- Improper equipment choice or maintenance (i.e. the selected gauging equipment technologies are incompatible with hydraulic conditions within the sewer, or excessive gravel deposits are allowed to accumulate around the sensors without being removed)
- Improper equipment calibration (i.e. depth and/or velocity measurements are incorrectly taken within the sewer, or equipment is allowed to drift out of calibration)
- Field conditions within the sewer, (i.e. foaming at the water surface that "blinds" an ultrasonic depth sensor, or toilet paper catching and accumulating on a combination sensor, blinding the acoustic Doppler velocity meter)

For flow monitoring applications, gauging **"uncertainty"** is used to describe and quantify the expected inaccuracies that result from the limitations of the technologies that utilize indirect measurements to quantify wastewater flow.

It is important to try and install flow meters in "ideal" flow conditions. Ideal flow conditions are generally defined by as laminar flow in a straight-through, constant-slope pipeline with no disturbances (elbows, tees, hydraulic shifts, etc.) 10 diameters upstream and 5 diameters downstream from the flow monitoring location. If ideal flow conditions are met, then an expected uncertainty of final flow calculation from an open-channel flow meter may be approximately ±5%. For many situations, ideal flow conditions cannot be met and uncertainties increase.

2.4.1 Flow Addition versus Flow Subtraction

Due to the uncertainties involved in subtracting flows of similar magnitudes, the addition of flows at multiple monitoring sites is usually preferred over subtraction of flows. Subtraction becomes an issue especially when the flow difference from the subtraction falls within the measurement uncertainty range of the two larger flow data sets (i.e. subtracting a large flow from another large flow to obtain a small difference).

This concept is best demonstrated per the following example:

1. Meter A measures 2.00 MGD of flow and has an expected uncertainty of ±5%, thus the uncertainty range of the flow measurement is ±0.10 MGD.

2. Meter B measures 2.50 MGD of flow and has an expected uncertainty of ±6%, thus the uncertainty range of the flow measurement is ±0.15 MGD.
3. Meter C measures 0.50 MGD of flow and has an expected uncertainty of ±8%, thus the uncertainty range of the flow measurement is ±0.04 MGD.

- <u>Scenario 1 – Flow Addition</u>
- Meter A + Meter B = 2.00 MGD (±0.10) + 2.50 MGD (±0.15) = 4.50 MGD (±0.25)
- Overall uncertainty = ±0.25 / 4.50 = ±5.6%
- For flow addition, the final uncertainty is essentially a weighted average of the component uncertainties.

- <u>Scenario 2 – Flow Subtraction, Large Flow less Small Flow</u>
- Meter B - Meter C = 2.50 MGD (±0.15) - 0.50 MGD (±0.04) = 2.00 MGD (±0.19)
- Overall uncertainty = ±0.19 / 2.00 = ±9.5%
- For flow subtraction, the final uncertainty will always be greater than the component uncertainties.
- When subtracting a small flow from a large flow, the resulting uncertainties can still be manageable.

- <u>Scenario 3 – Flow Subtraction, Large Flow less a similarly Large Flow</u>
- Meter B - Meter A = 2.50 MGD (±0.15) – 2.00 MGD (±0.10) = 0.50 MGD (±0.25)
- Overall uncertainty = ±0.25 / 0.50 = ±50%
- When subtracting a similarly sized flow rates, the resulting uncertainties may not be manageable. In this example, an uncertainty of ±50% may be considered unacceptable for confident analyses.

Scenario 3 is a very "real-world" situation. The uncertainties for Meter A and Meter B are extremely reasonable (indeed, most flow monitoring service providers would be extremely pleased with true meter uncertainties of ±5% to ±6%). However, the reality of the math is clear and the above example demonstrates the concept of flow subtraction and compounding or inflating uncertainty ranges.

The following points are emphasized in relation to the items of this section:

- For subtraction of flows, the overall uncertainty can be an inflated value that far exceeds the component uncertainties.
- The smaller the resultant flow from the subtraction equation, the larger the percentage uncertainty.
- Whenever possible, basins flows should be directly measured, rather than calculated as a subtraction of two or more flow meters.
- If flow subtraction cannot be avoided, it is better to have the magnitudes of the component flows be as dissimilar as possible.

2.5 Average Dry Weather Flow Determination

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

- Mondays – Thursdays
- Fridays
- Saturdays
- Sundays

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

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

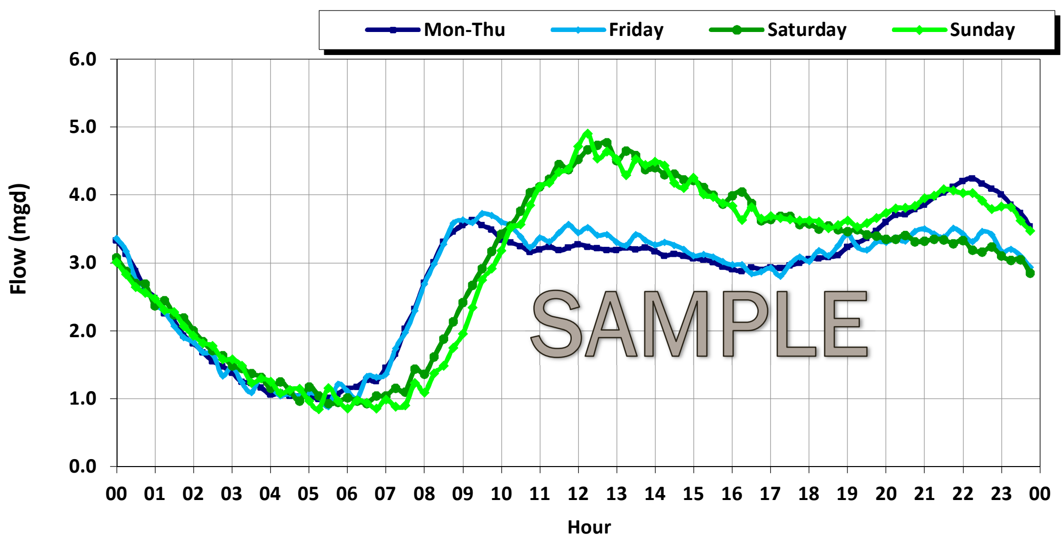

Figure 2-2. Sample ADWF Diurnal Flow Patterns

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

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

2.6 Flow Attenuation

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

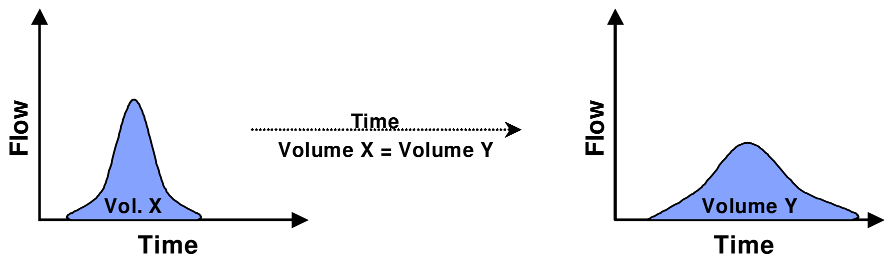

Figure 2-3. Attenuation Illustration

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

2.7 Inflow / Infiltration Analysis: Definitions and Identification

Inflow and infiltration (I/I) consists of storm water and groundwater that enter the sewer system through pipe defects and improper storm drainage connections and is defined as follows:

2.7.1 Inflow / Infiltration Analysis: Definitions and Identification

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

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

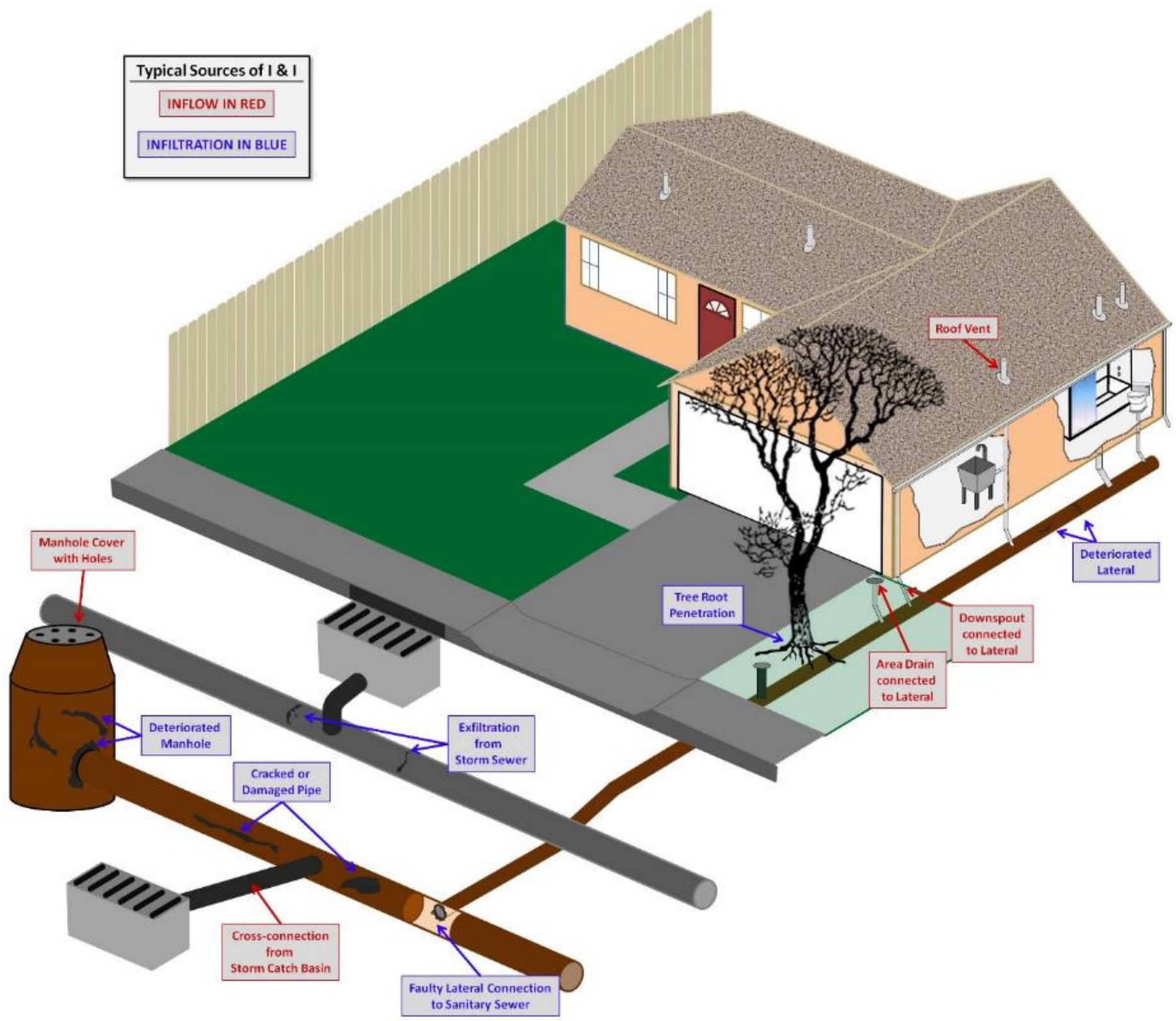

Figure 2-4. Typical Sources of Infiltration and Inflow

2.7.2 Infiltration Components

Infiltration can be further subdivided into components as follows:

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

2.7.3 Impact and Cost of Source Detection and Removal

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

2.7.4 Graphical Identification of I/I

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

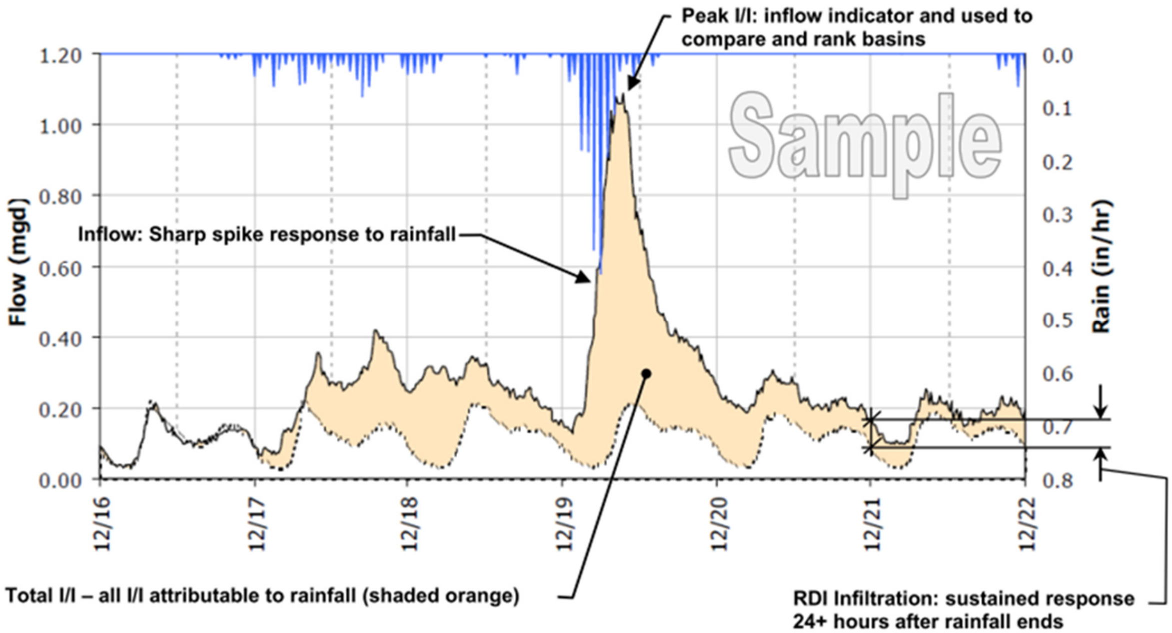

Figure 2-5. Sample Infiltration and Inflow Isolation Graph

2.7.5 Analysis Metrics

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

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

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

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

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

2.7.6 Normalization Methods

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

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

The infiltration and inflow indicators were normalized by all methods in this report and these results will be shown in the following I/I analysis results sections. For the purposes of basin rankings, however, only the per-ACRE normalization method will be used. This is due to some amount of uncertainty regarding the true IDM and ACRE measurements for some basins:

- **Basin 13 (Olivewood LS)**: The entirety of the housing division has been included for IDM and ACRE measurements; however, it appears that this development is only 15% to 20% occupied and there is still much construction occurring. The safest metric for normalization in this case is the ADWF measurement.
- **Basin 09 (Industrial LS)**: Given the industrial nature of this location and sporadic flows, it was uncertain if the IDM and ACRE measurements were representative of this basin. The safest metric for normalization in this case is the ADWF measurement.

It is noted that construction repairs and I/I reduction and mitigation methods are most typically priced on pipe length basis. The reviewing engineer may wish to review the rankings made in this report and consider the IDM metric when making CIP decisions.

3 Results and Analysis

3.1 Rainfall

V&A captured rainfall data from publicly available private weather stations (PWS[5]), allowing for good coverage over the flow monitoring area. Rain gauge locations are shown in Figure 3-1.

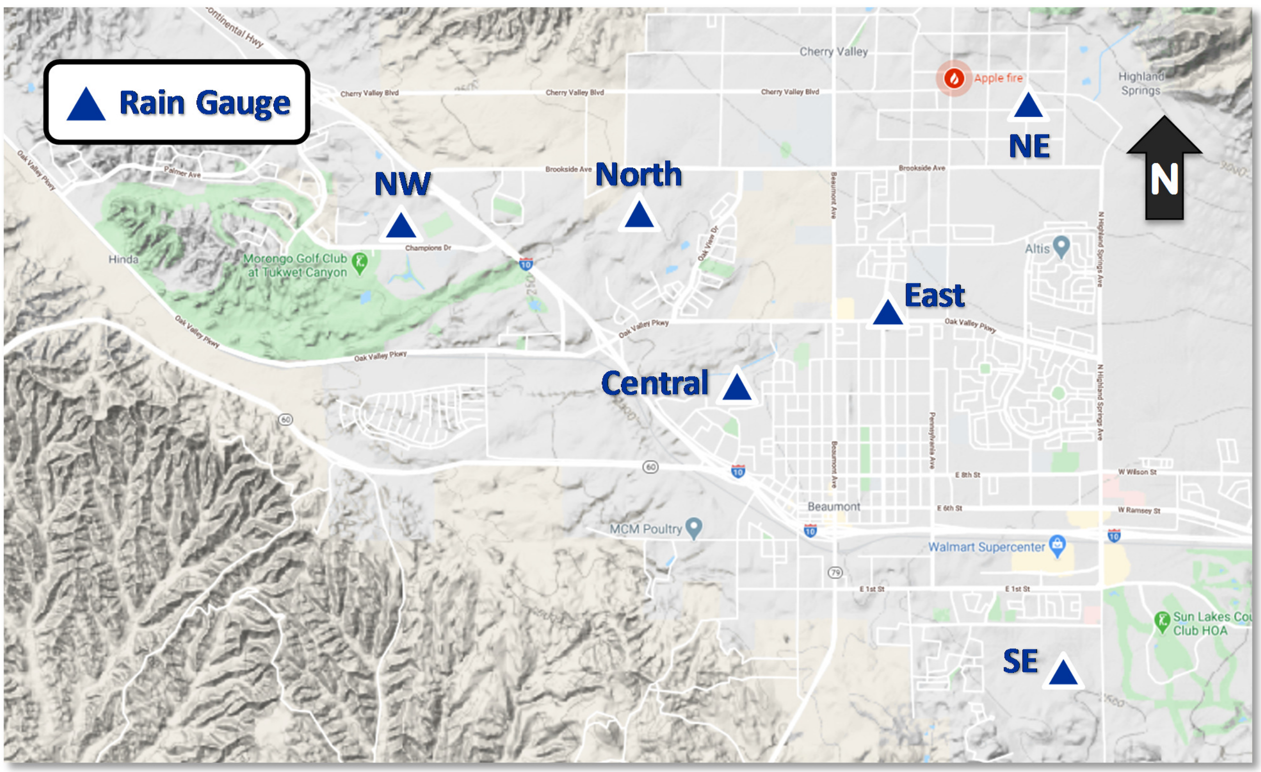

Figure 3-1. Map of Rain Gauge Locations

Figure 3-2 shows the rainfall during the flow monitoring period, averaged between the six rain gauges. Table 3-1 summarizes the rainfall that fell for all rain gauges for key rainfall events and overall for the flow monitoring period. Figure 3-3 shows the rain accumulation plot versus historical average[6] period rainfalls for these same six rain gauges; rainfall for this study was approximately 2.5 times higher than historical normal precipitation for the days of the flow monitoring period.

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

[6] Historical data taken from the WRCC (Station 040409 in Beaumont): http://www.wrcc.dri.edu/summary/climsmsca.html

Table 3-1. Summary of Rainfall

Dates	Avg.	Northwest	North	Northeast	Central	East	Southeast
February 22/23, 2020	0.80	0.54	0.76	0.97	0.72	0.82	1.01
March 9/10, 2020	1.49	1.75	1.92	1.10	1.36	1.47	1.36
March 12/13, 2020	3.92	3.76	4.39	3.88	4.04	4.20	3.26
March 16 – 23, 2020	2.55	2.46	3.19	2.43	2.73	2.14	2.34
April 6/7/8, 2020	4.18	3.96	4.62	3.64	4.43	4.46	3.96
Period Total:	13.18	12.71	15.15	12.30	13.53	13.34	12.06

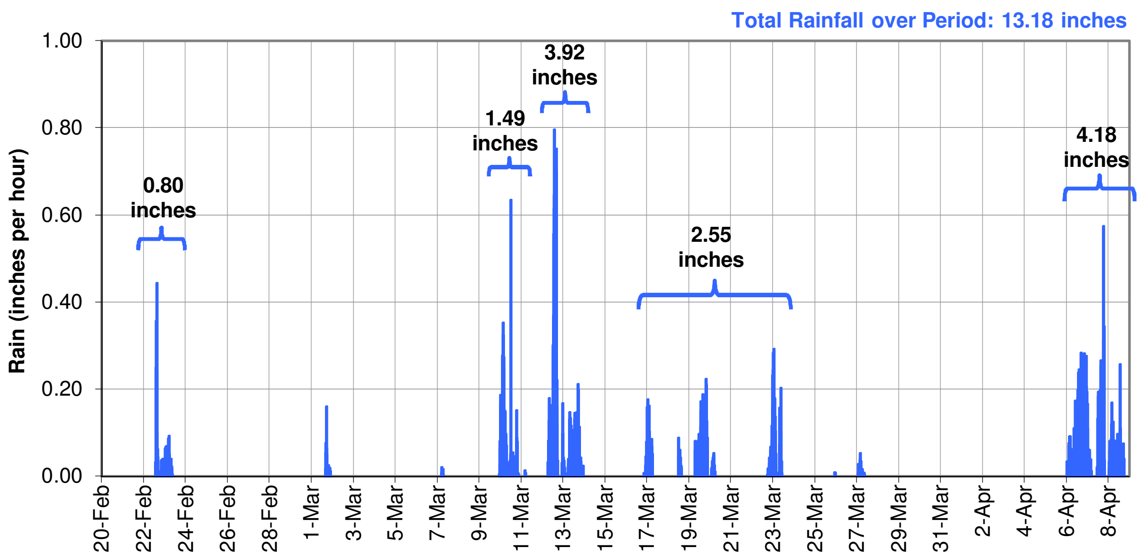

Figure 3-2. Rainfall during Flow Monitoring Period – Average of Beaumont Rain Gauges

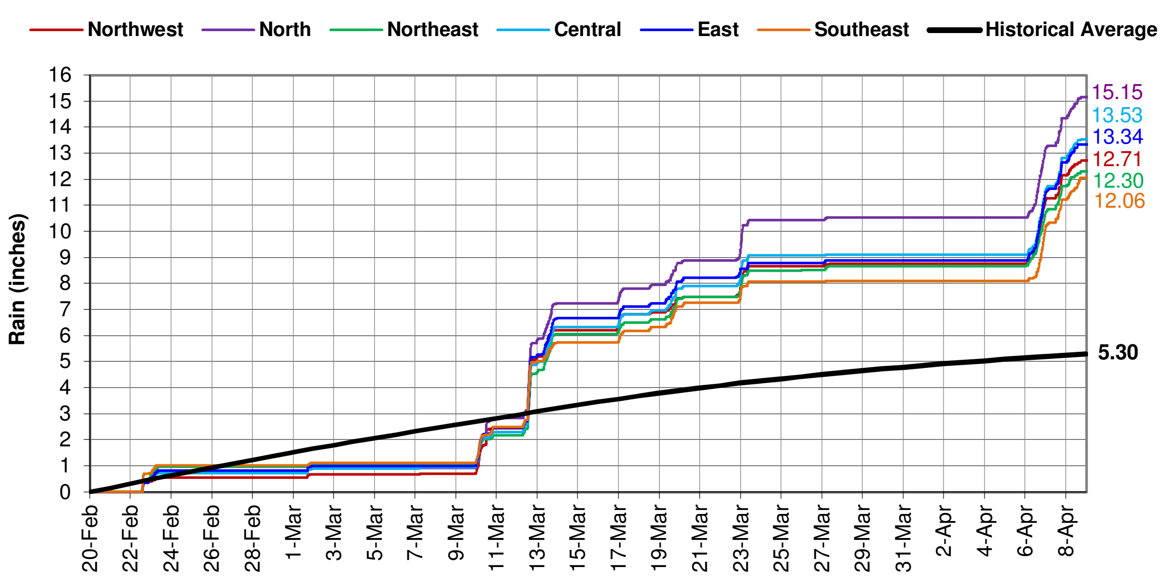

Figure 3-3. Rainfall Accumulation Plot

3.1.1 Regional Rainfall Event Classification

It is important to classify the relative size of a major storm event that occurs over the course of a flow monitoring period[7]. Rainfall events are classified by intensity and duration. Based on historical data, frequency contour maps for storm events of given intensity and duration have been developed by the NOAA for all areas within the continental United States (Figure 3-4).

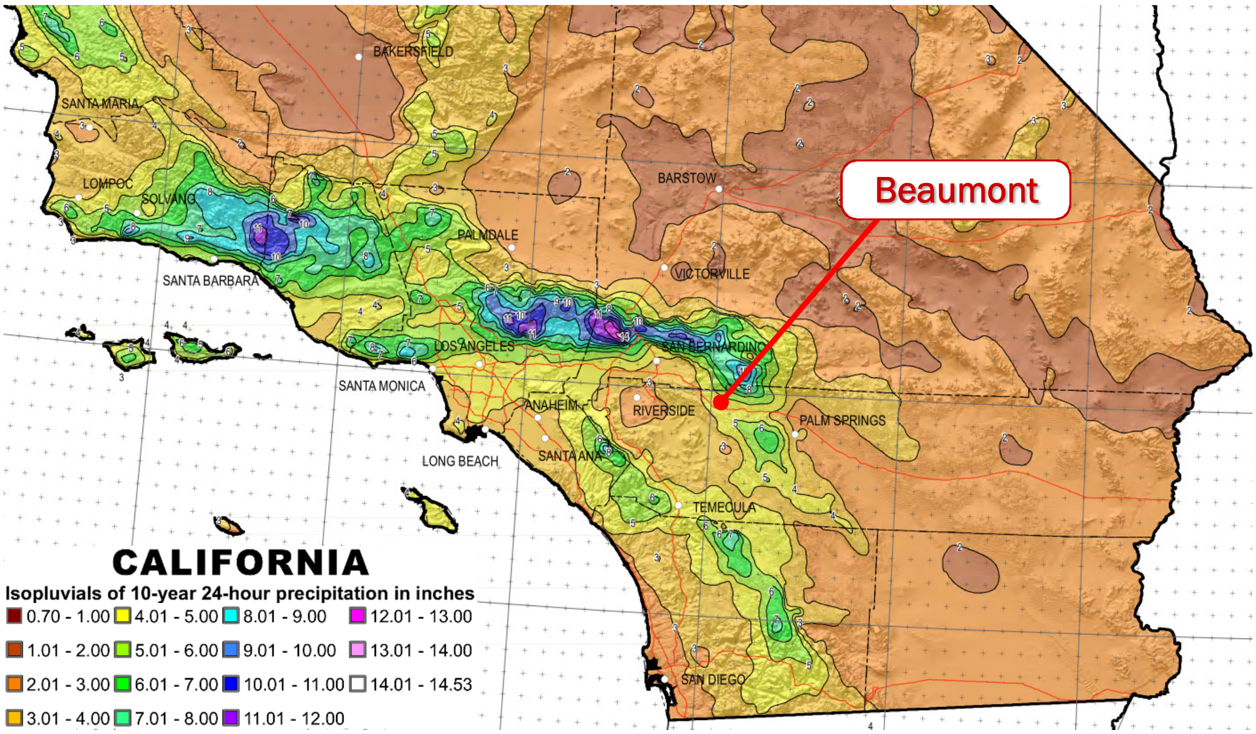

Figure 3-4. NOAA Southern California Rainfall Frequency Map

For example, the NOAA Rainfall Frequency Atlas[8] classifies a 10-year, 24-hour storm event at the 'Central' rain gauge location as 4.21 inches. This means that in any given year, at this specific location, there is a 10% chance that 4.21 inches of rain will fall in any 24-hour period.

From the NOAA frequency maps, for a specific latitude and longitude, the rainfall densities for period durations ranging from 1 hour to 60 days are known for rain events ranging from 1-year to 100-year intensities. These are plotted to develop a rain event frequency map specific to each rainfall monitoring site. Superimposing the peak measured densities for the rainfall events on the rain event frequency plot determines the classification of the rainfall event.

Figure 3-5 and Figure 3-6 illustrate the rain event classification plots at the Central Rain Gauge for both short-term and long-term rainfall, respectively. On these plots, for example, the March 12/13 rainfall event was classified as a 25-year, 3-hour rainfall event and the 30-day period from March 10 to April 9 was classified as a 10-year, 30-day event.

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

[8] NOAA Western U.S. Precipitation Frequency Maps Atlas 14, Volume 6, 2011: ftp://hdsc.nws.noaa.gov/pub/hdsc/data/sw/ca10y24h.pdf

Table 3-2 summarizes the classifications for the main storm events of this study at each rain gauge location. The highest classification for all rain gauges was a three-hour period (from approximately 1:15 pm to 4:15pm) on March 12, 2020. Figure 3-7 illustrates this classification regionally.

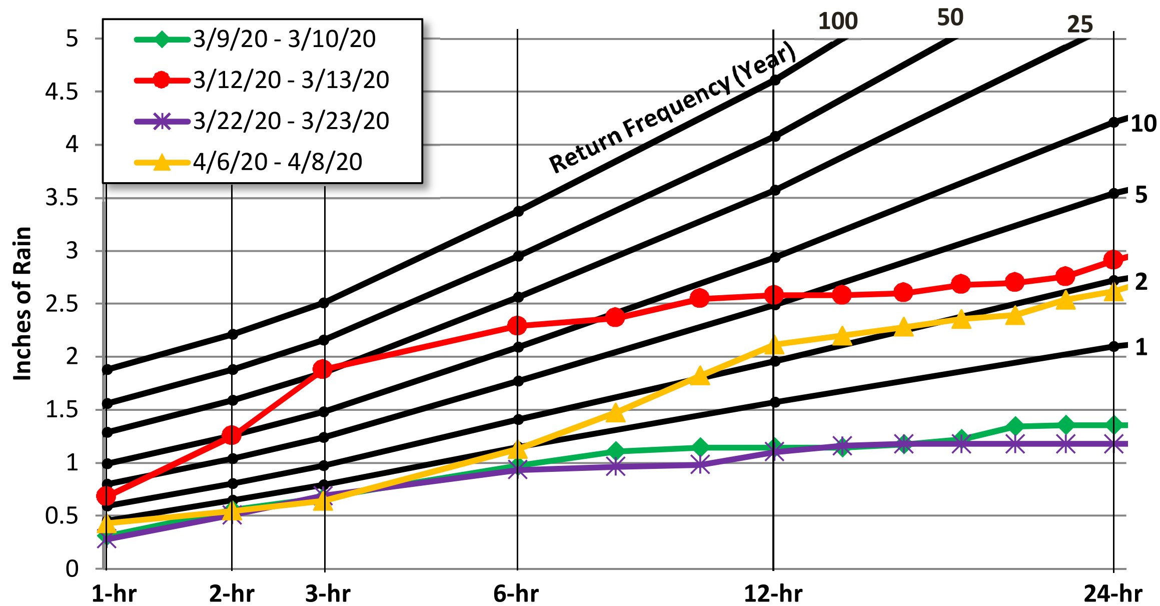


Figure 3-5. Short-Term Rainfall Event Classification – Central Rain Gauge

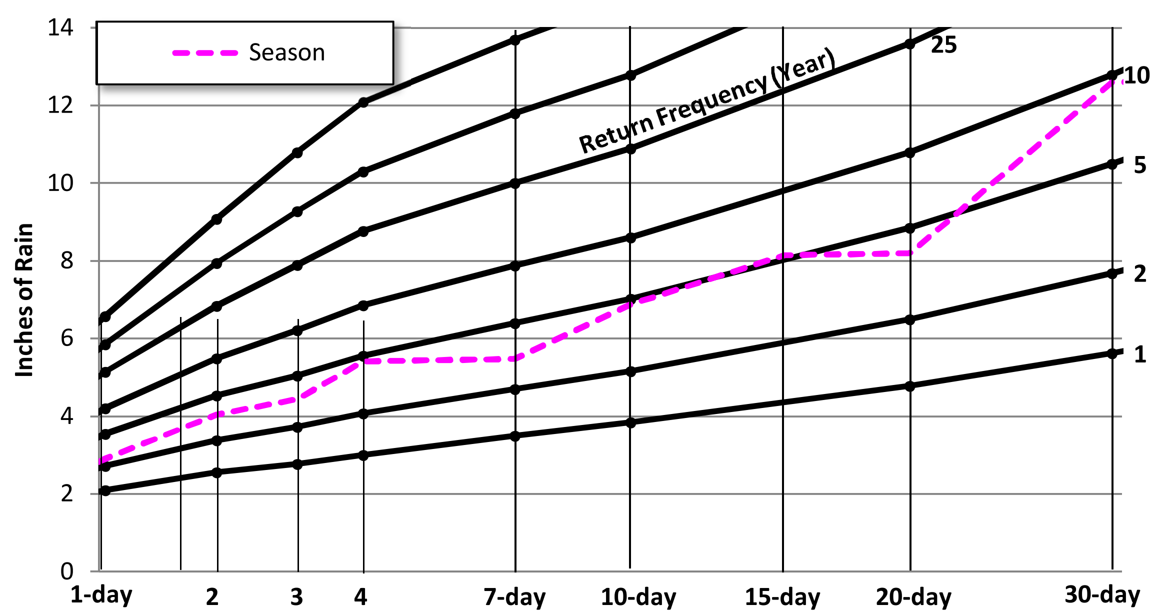


Figure 3-6. Long-Term Rainfall Event Classification – Central Rain Gauge

Table 3-2. Rainfall Event Classification

Rain Gauge	March 9/10	March 12/13	March 22/23	April 6/7/8	March 10 – April 9, 2020
Northwest	1.1-year, 12-hr	30-year, 3-hour 3.5-year, 24-hr	< 1-year	2-year, 12-hour 1.6-year, 24-hr	8-year, 30-day
North	1-year, 12-hour	35-year, 3-hour 4-year, 24-hour	2-year, 3-hour	2.5-year, 12-hr 1.9-year, 24-hr	15-year, 30-day
Northeast	< 1-year	15-year, 3-hour 1.6-year, 24-hr	< 1-year	< 1-year	4.5-year, 30-day
Central	< 1-year	25-year, 3-hour 3-year, 24-hour	< 1-year	3-year, 12-hour 1.8-year, 24-hr	10-year, 30-day
East	< 1-year	35-year, 3-hour 3-year, 24-hour	< 1-year	2.2-year, 12-hr 1.8-year, 24-hr	8-year, 30-day
Southeast	< 1-year	25-year, 3-hour 1.8-year, 24-hr	< 1-year	2-year, 12-hour 1.1-year, 24-hr	6-year, 30-day

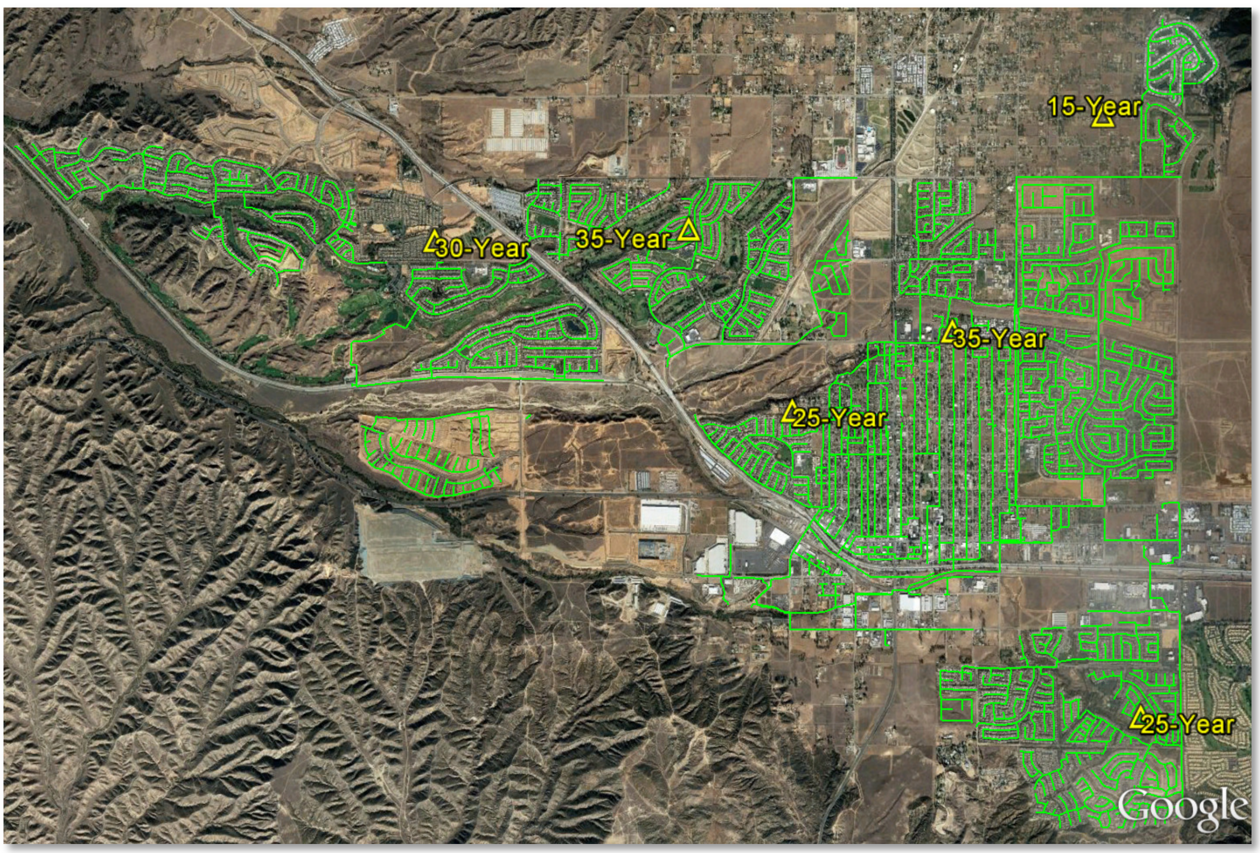


Figure 3-7. March 12 Peak Storm Event Classification (per rain gauge, duration = 3-hours)

3.1.2 Rain Gauge Triangulation Distribution

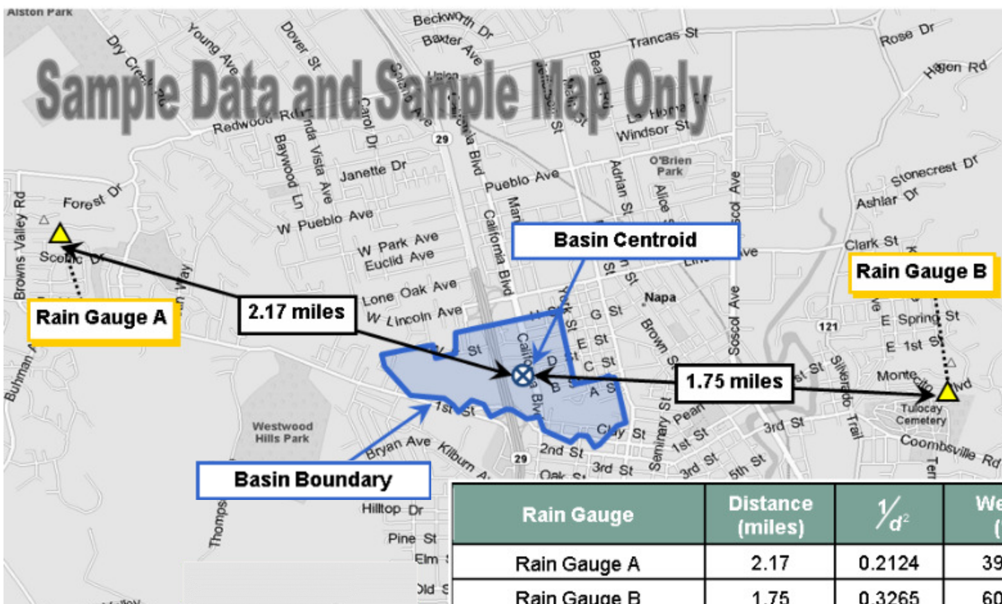
The rainfall affecting the sanitary sewer collection system basins must be calculated based on the proximity to the rain gauge locations. The mean precipitation for each site's upstream basin was calculated by taking data from the rain gauges and using the inverse distance weighting (IDW) method. IDW is an interpolation method that assumes the influence of each rain gauge location diminishes with distance. The center of an upstream basin[9] is identified, and a weighted triangulated average is taken of the precipitation data from nearby rain gauge locations.

The IDW function is as follows:

$$weight(d) = \frac{1/d^p}{\sum 1/d^p}, \qquad \text{where:} \qquad d = \text{distance} \qquad p = \text{power } (p > 0)$$

The value of *p* is user defined. The most common choice for hydrological studies of watershed areas is *p* = 2.

Figure 3 6 illustrates the IDW method with sample data. The rain gauge distribution as calculated for each flow monitoring basin is shown in Table 3-3.



Rain Gauge	Distance (miles)	$1/d^2$	Weight (%)
Rain Gauge A	2.17	0.2124	39.4%
Rain Gauge B	1.75	0.3265	60.6%
Totals		**0.5389**	**100%**

Figure 3-8. Rainfall Inverse Distance Weighting Method

[9] Note that the full basin upstream of the site was used instead of the isolated basins as the rain data will be compared to the flow at each site

Table 3-3. Rain Gauge Distribution per Monitoring Site

Site	Northwest	North	Northeast	Central	East	Southeast
FM-01	0%	2.1%	92.8%	0%	5.2%	0%
FM-02	1.7%	36.9%	2.6%	26.2%	31.5%	1.1%
FM-03	0%	0.4%	30.5%	13.9%	47.4%	7.8%
FM-04	0%	0%	21.8%	12.8%	56.0%	9.4%
FM-05	0%	0%	0%	0.7%	0.9%	98.4%
FM-06	0%	0%	0%	6.9%	7.5%	85.6%
FM-07	3.1%	63.9%	2.2%	23.7%	7.1%	0%
FM-08	3.5%	71.0%	2.4%	15.2%	7.9%	0%
FM-09	12.6%	0%	0%	75.0%	0%	12.4%
FM-10	83.8%	12.1%	0%	4.1%	0%	0%
FM-11	100.0%	0%	0%	0.0%	0%	0%
FM-12	82.3%	10.2%	0%	7.6%	0%	0%
FM-13	74.0%	0%	0%	26.0%	0%	0%
FM-14	100.0%	0%	0%	0%	0%	0%

3.2 Flow Monitoring: Average Dry Weather

For this study, two sets of average dry weather flow (ADWF) curves were established due to the advent of "shelter-in-place" (SIP) order for Covid-19. There were generally three time-periods during this study, as detailed below and shown in Figure 3-9.

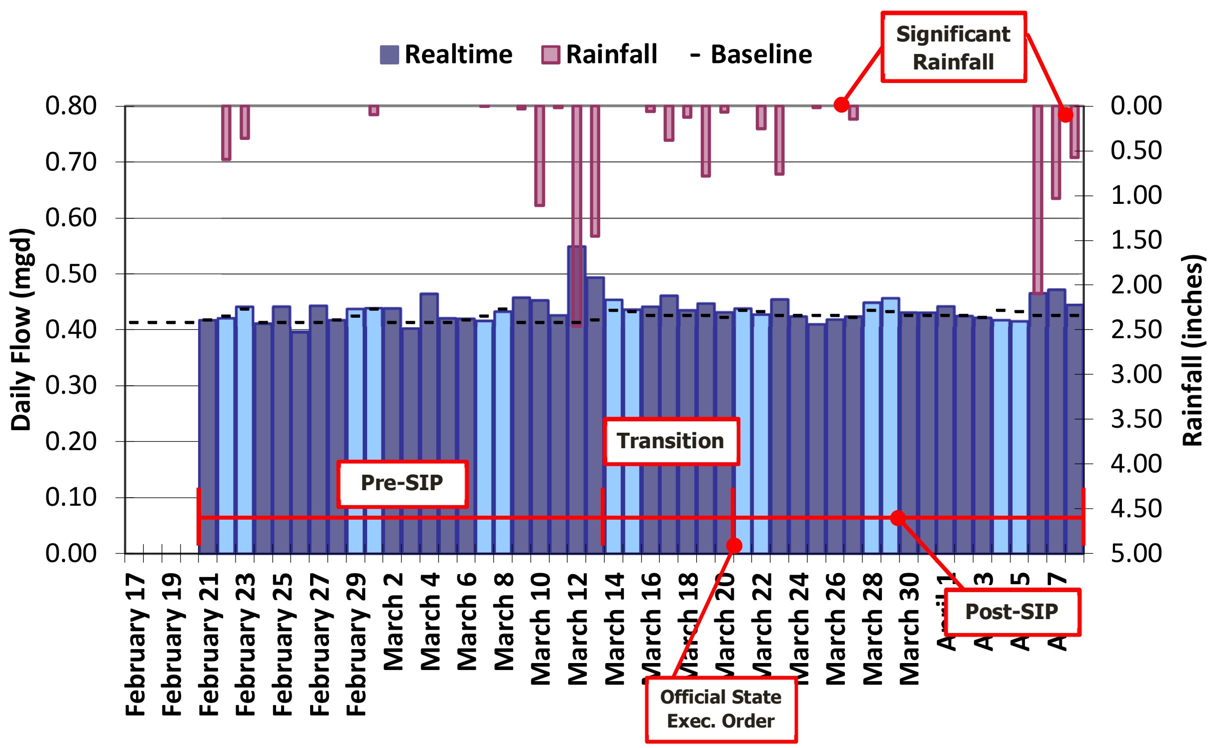


Figure 3-9. Shelter-in-Place Illustration (FM-07 [Marshall Creek LS] flows shown)

1. **Pre-SIP:** Sets of ADWF curves were established during "typical" dry days prior to SIP and can be used for modelling purposes.
2. **Transition period:** On March 13, schools were closed statewide. Although "Shelter-in-Place" was officially announced on March 20, 2020, it is clear from the flow monitoring data that people were already transitioning (in terms of sewage) towards SIP behavior starting from March 13. Saturday, March 14, was already a transition day, and by Sunday, March 15, people were mostly in SIP mode.

   The true predicted ADWF curves during the transition period would be speculative at best. When looking at the transition period, the safer analyses would be to review I/I response during the early-morning hours when human behavior is more predictable. However, even during this period, we are observing more flows from midnight to 3 am hours, presumably people shifting schedules and working late.

   - The main large rainfall event (March 12) occurred prior to the transition period when ADWF curves were still generally stable. I/I analyses for three different rain events were analyzed and shown in the Appendix; however, the March 12 I/I analyses was used for the ranking metrics later in this report.
3. **Post-SIP:** Second sets of ADWF curves were established during "typical" dry days post-SIP and were used for I/I analysis that occurred during the transition period and during the post-SIP period (April 6/7/8).

There were clear differences in ADWF patterns and volumes before and after the 'shelter-in-place' order. Daily peaks are delayed by 1-2 hours and without the sharp early-morning peak.

Figure 3-10 shows the sets of pre-SIP ADWF, post-SIP curves for Site FM-07, and a direct comparison of the pre- and post-SIP curves for weekday diurnal patterns. Table 3-4 summarizes the dry weather flow data measured for this study. Figure 3-11 illustrates a flow schematic of the ADWF values (pre-SIP) for the flow monitoring sites of this study. ADWF curves for each site pre- and post-SIP can be found in *Appendix A*.

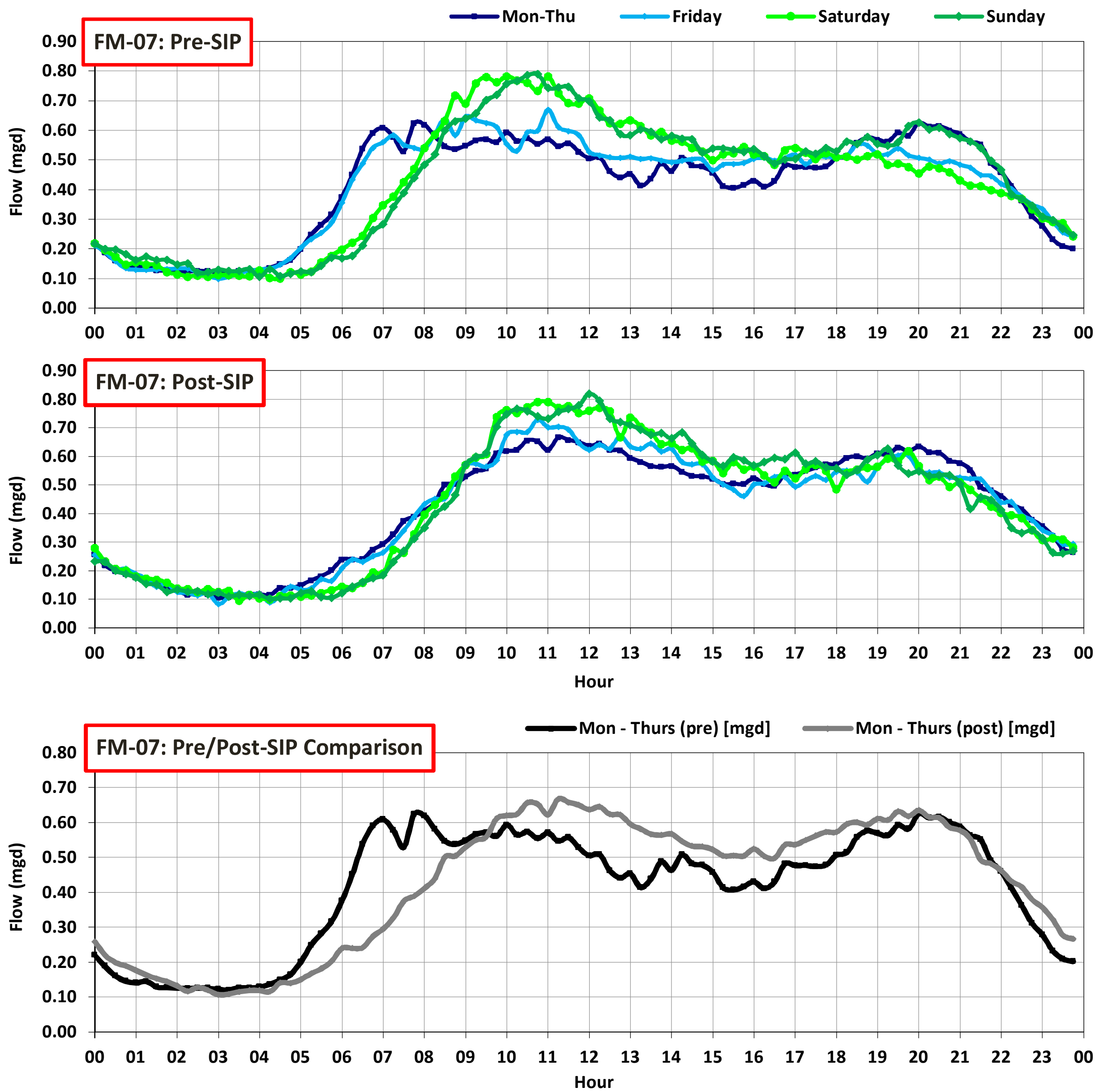


Figure 3-10. FM-07: pre-SIP and post-SIP Average Dry Weather Flow Curves with Comparison

Table 3-4. Dry Weather Flow

Site	Pre-SIP ADWF (mgd)					Post-SIP ADWF (mgd)					SIP Delta
	Mon-Thu	Fri	Sat	Sun	Overall	Mon-Thu	Fri	Sat	Sun	Overall	
FM-01	0.066	0.066	0.073	0.074	0.068	0.072	0.073	0.084	0.081	0.075	10%
FM-02	0.811	0.770	0.823	0.743	0.797	0.820	0.811	0.802	0.753	0.806	1%
FM-03	1.005	0.904	0.978	1.073	0.996	1.127	1.153	1.191	1.139	1.142	15%
FM-04	0.497	0.480	0.511	0.591	0.510	0.612	0.617	0.623	0.674	0.623	22%
FM-05	0.253	0.256	0.243	0.244	0.251	0.217	0.230	0.226	0.222	0.221	-12%
FM-06	0.140	0.145	0.156	0.170	0.147	0.142	0.144	0.145	0.158	0.145	-2%
FM-07	0.414	0.418	0.425	0.438	0.419	0.426	0.423	0.435	0.433	0.428	2%
FM-08	0.241	0.241	0.237	0.247	0.241	0.237	0.239	0.245	0.246	0.240	0%
FM-09	0.056	0.052	0.032	0.028	0.048	0.063	0.072	0.026	0.015	0.052	8%
FM-10	0.707	0.686	0.712	0.756	0.712	0.827	0.856	0.842	0.871	0.840	18%
FM-11	0.381	0.361	0.393	0.439	0.388	0.441	0.444	0.459	0.441	0.444	14%
FM-12	0.745	0.734	0.735	0.778	0.747	0.853	0.907	0.906	0.893	0.874	17%
FM-13	0.022	0.022	0.022	0.024	0.022	0.025	0.026	0.026	0.028	0.026	15%
FM-14	0.060	0.062	0.062	0.067	0.062	0.064	0.064	0.065	0.064	0.064	4%

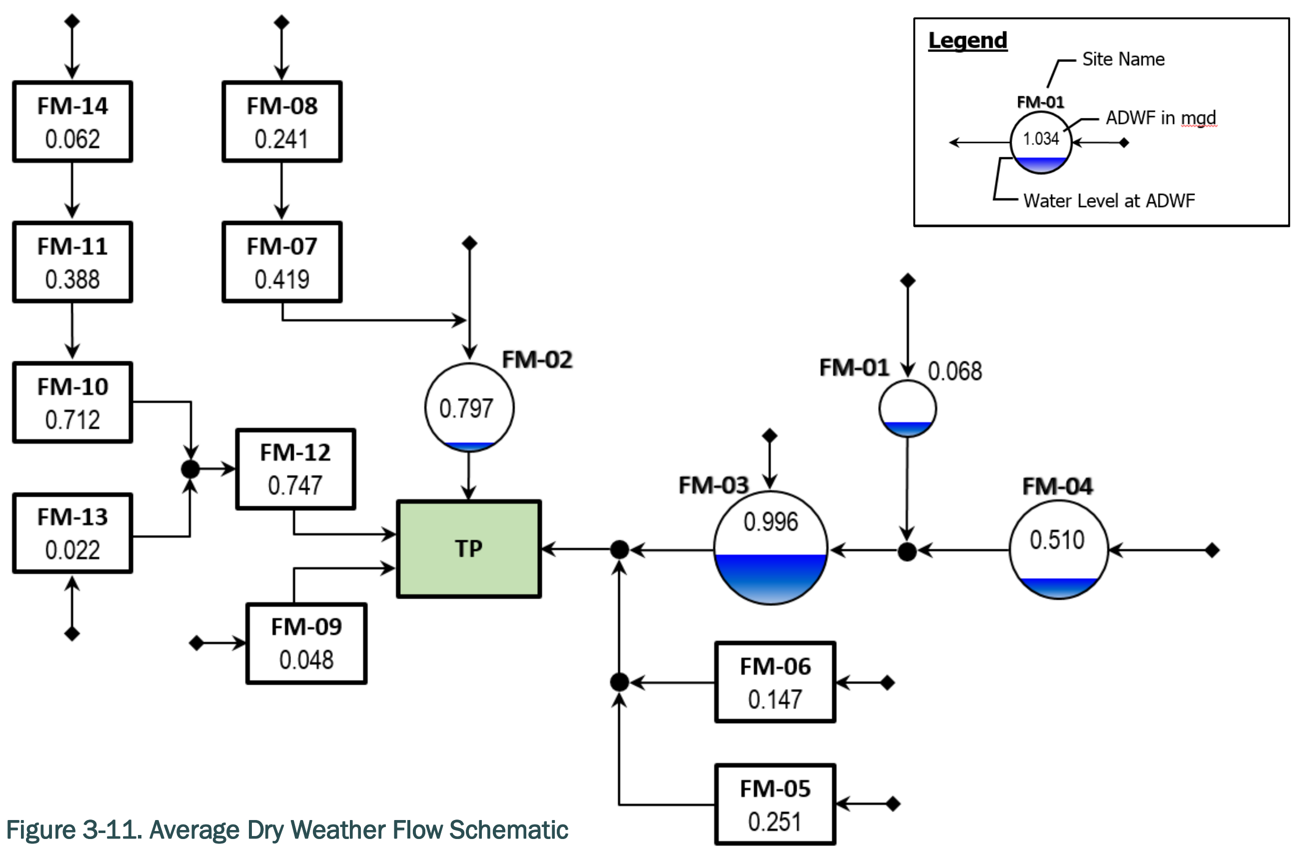


Figure 3-11. Average Dry Weather Flow Schematic

3.3 Flow Monitoring: Peak Measured Flows / Pipeline Capacity

Peak measured flows and the hydraulic grade line data (flow depths) are important to understanding the capacity limitations. The capacity analysis terms used in the text below are defined as follows:

- **Peaking Factor**: Peaking factor is defined as the peak measured flow divided by the average dry weather flow (ADWF). Peaking factors are influenced by many factors, including size and topography of the tributary area, flow attenuation, flow restrictions, and characteristics of I/I entering the collection system. Municipal standards for peaking factor vary agency by agency; the City should refer to jurisdictional standards when evaluating peaking factors[10]. For this study, peaking factors over 5.0 are highlighted RED.
- **d/D Ratio**: The d/D ratio is the peak measured depth of flow (d) divided by the pipe diameter (D). The d/D ratio for each site was computed based on the maximum depth of flow for the study. Standards for d/D ratio vary from agency to agency, but typically range between d/D ≤ 0.5 and d/D ≤ 0.75. The City should refer to jurisdictional standards when evaluating d/D ratios. For this study, d/D ratios over 0.75 are highlighted ORANGE. Surcharged sites are highlighted RED.

Table 3-5 summarizes the peak flows, levels, d/D ratios, and peaking factors during the flow monitoring period. Capacity analysis data are presented on a site-by-site basis and represents the hydraulic conditions only at the site nodes; hydraulic conditions in other areas of the collection system will differ.

Table 3-5. Capacity Analysis Summary

Monitored Site	ADWF pre-SIP [A] (mgd)	Peak Measured Flow (mgd)	Peaking Factor	Pipe Diameter, *D* (in)	Max Depth, *d* (in)	*Max d/D* Ratio	Surcharge above pipe crown (ft)
FM-01	0.068	0.39	5.7	8	3.3	0.42	-
FM-02	0.797	1.97	2.5	24	4.1	0.17	-
FM-03	0.996	3.21	3.2	30	18.6	0.62	-
FM-04	0.510	1.57	3.1	21	6.8	0.33	-
FM-05	0.251	0.62	2.5	n/a	n/a	n/a	n/a
FM-06	0.147	0.48	3.2	n/a	n/a	n/a	n/a
FM-07	0.419	1.40	3.3	n/a	n/a	n/a	n/a
FM-08	0.241	0.57	2.4	n/a	n/a	n/a	n/a
FM-09	0.048	0.25	5.1	n/a	n/a	n/a	n/a
FM-10	0.712	1.76	2.5	n/a	n/a	n/a	n/a
FM-11	0.388	0.87	2.2	n/a	n/a	n/a	n/a
FM-12	0.747	1.94	2.6	n/a	n/a	n/a	n/a
FM-13	0.022	0.070	3.1	n/a	n/a	n/a	n/a
FM-14	0.062	0.12	2.0	n/a	n/a	n/a	n/a

[A] Pre-SIP ADWF was used for this analysis.

[10] WEF Manual of Practice FD-6 and ASCE Manual No. 62 suggests typical peaking factor ratios range between 3 and 4, with higher values possibly indicative of pronounced I/I flows.

The following capacity analysis results are noted:

- **Peaking Factors**: Only two sites had peaking factors over 5.0.
    - **Site FM-01**: Site FM-01 was an open-channel flow monitoring site and was not influenced by pump station operations. Peak flows occurred during the March 12 rainfall event.
    - **Site FM-09**: FM-09 is the Industrial Park LS, and peak flows did not occur corresponding to I/I contribution of a large rainfall event. The higher peaking factor for this site is attributed to pump station operations and the type of service (industrial flows).
- **d/D Ratio**: All open-channel flow monitoring sites had d/D ratios less than 0.75 for the entirety of the flow monitoring period.

Figure 3-12 shows bar graph summaries of the peaking factors and d/D ratios. Figure 3-13 shows the schematic diagram of the peak measured flows of the whole monitoring period, with peak flow levels shown for open-channel flow monitoring sites.

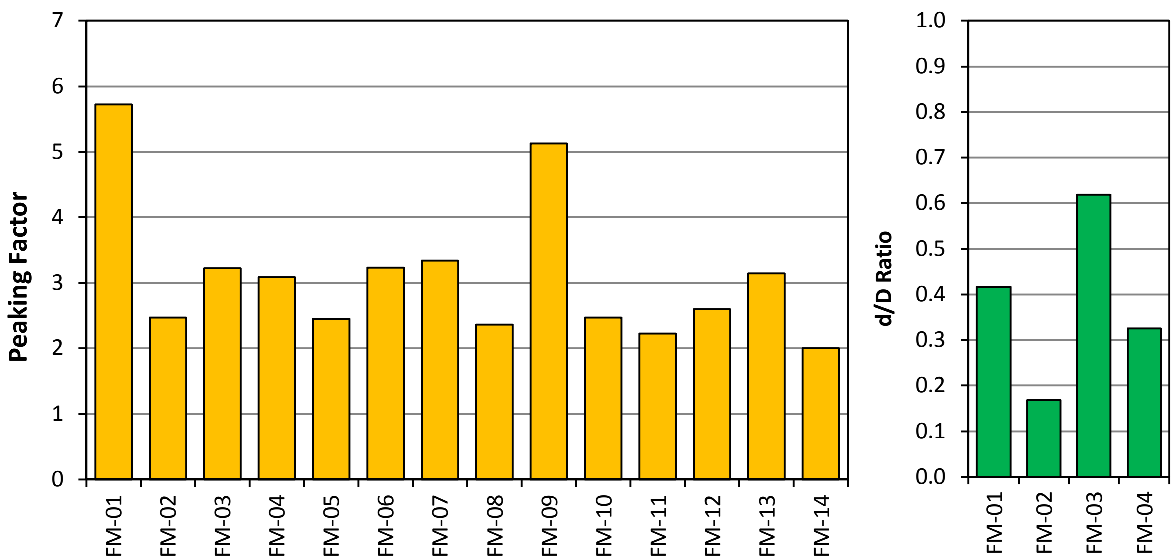


Figure 3-12. Peaking Factors and Max d/D Ratios

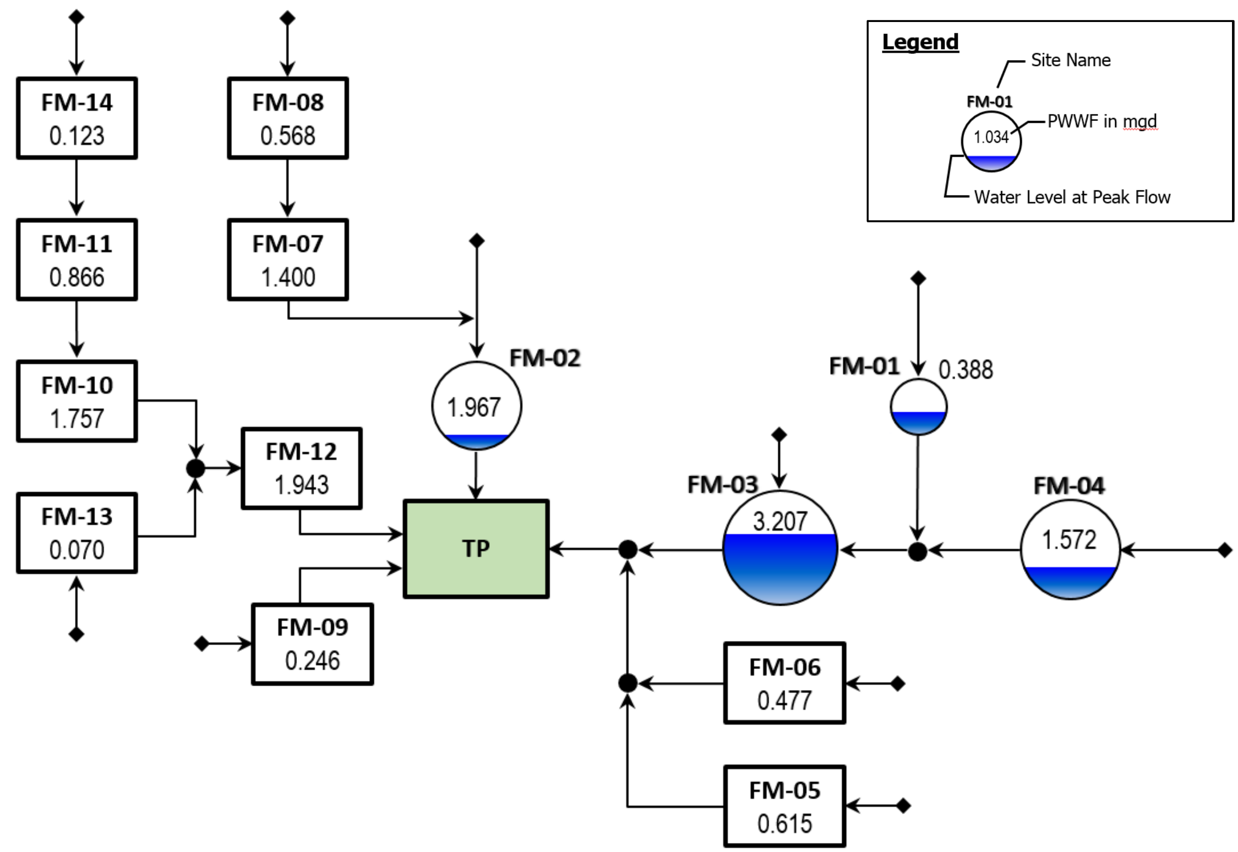


Figure 3-13. Peak Measured Flow (Flow Schematic)

3.4 Inflow and Infiltration

3.4.1 Preface

I/I analyses are presented on a basin-by-basin basis. Items relevant to the analysis in this study are noted below and referenced in Figure 3-14:

- **Basin 12**: FM-12 (Beaumont Mesa LS) schematically operates as the sum of flow from FM-10 and FM-13; the isolated "Basin 12" does not have a substantial collection area and is not analyzable due to flow subtraction (see Section 2.4). Basin 12 will not be evaluated.
- **Pump Stations and Peak Flows**: There are several pump stations within the collection system. Basins downstream from ON/OFF (constant speed) pump stations are subject to attenuation (Section 2.6) and forced peak flows. Peak flows can be dampened due to being throttled while held in wet wells. Conversely, peak flows out of a pump station are typically higher than flows into a pump station and are strictly based on the pumping rates (not influent rates) from the pump station. Peak flows downstream from pump stations should be evaluated appropriately.
- **I/I Isolation**: The I/I flow rate is the real-time flow less the estimated average dry weather flow rate (shown below as the RED line).
- **Inflow**: Inflow is usually recognized graphically by large-magnitude, short-duration spikes immediately following a rain event. The peak inflow rate is the highest spike in the isolated I/I hydrograph immediately following the evaluated rainfall event.
- **RDI**: RDI is typically taken as the average I/I flow rate measured approximately 24 to 36 hours after the rainfall event has concluded. Throughout the region, for the rainfall events monitored, there was minimal RDI; systemwide, flows returned to near-baseline levels within 24 hours. Basins 5 and 7 may have shown a hint of a sustained RDI component; however, n RDI analysis will not be made for this study. Given the scale of the rainfall events that occurred during this study, RDI does not appear to be an issue for the City.
- **Combined I/I**: the totalized volume (in gallons) of both inflow and RDI over the course of a rainfall event (shown below as the orange area).

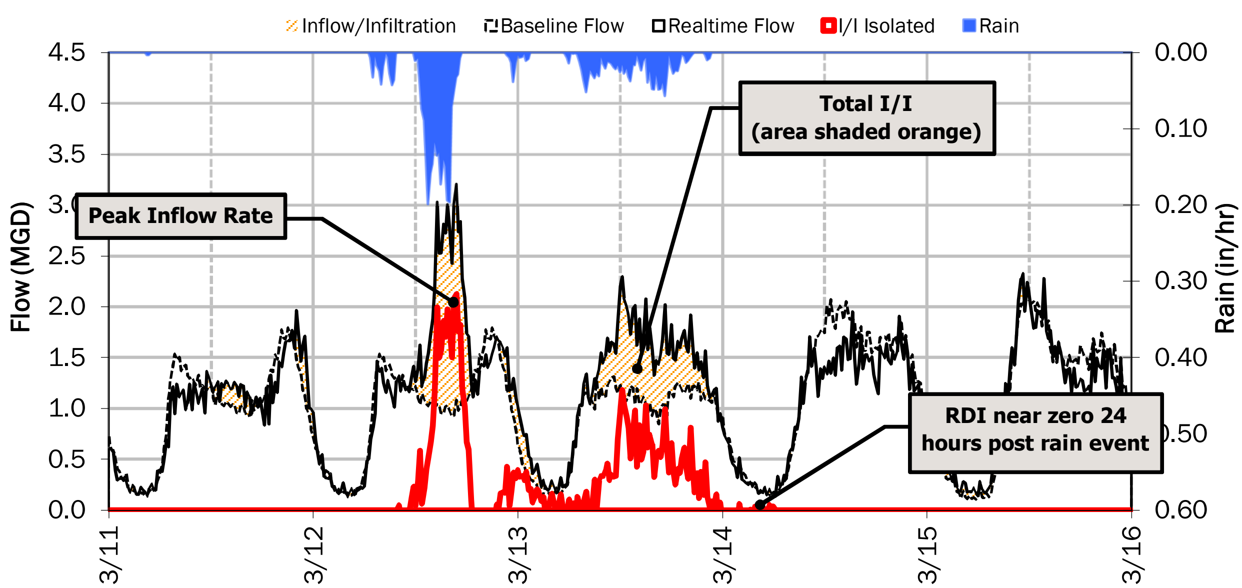


Figure 3-14. I/I Isolation, Site FM-03, March 12/13 Rainfall Event

Inflow above Noise: For sites with clean and repeatable daily flow measurements, the peak I/I calculation is clear and straight-forward measurement (refer to FM-03 in Figure 3-14). However, for some sites the daily flows are more atypical and sporadic. This could be due to pump station operations (common in this study), or due to atypical usage (for example, FM-09, industrial usage). This can result in daily instantaneous spikes above the smoothed average dry weather flow curves. These spikes could be misinterpreted as inflow during a rainfall event, even if inflow is not prevalent. To account for this, the measured inflow can be evaluated against the typical daily spikes or 'noise' on a site-by-site basis.

For example, for FM-10, a large component of the flows into the pump station are connected directly from upstream flow meter FM-11, the Lower Oak Valley Lift Station force main. The resulting spikes are obvious and occur daily; the exact timing is random and cannot be predicted (refer to Figure 3-15). During the March 12 storm event, there is also a clear inflow response. To best comparatively measure this inflow versus other flow monitoring sites, the inflow above expected noise is measured to prevent an exaggerated and misinterpreted inflow measurement.

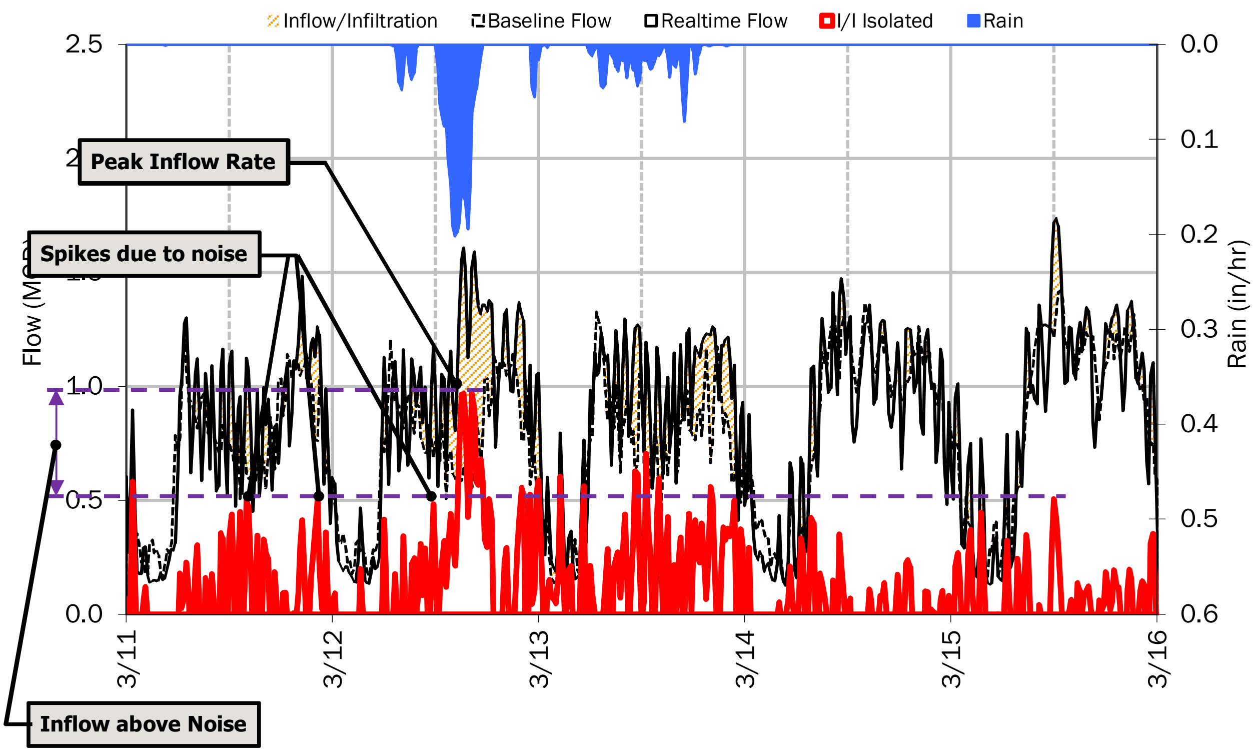


Figure 3-15. I/I Isolation, Site FM-10, March 12/13 Rainfall Event

3.4.2 Inflow Results Summary

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

Inflow results were taken from the March 12/13 rainfall event and considered potential noise due to spikes from pump stations or service type. Table 3-6 summarizes the peak measured inflow and inflow analysis results for the relevant flow monitoring basins; the "top 3" ranked basins have been shaded RED; basins ranked 4-6 have been shaded ORANGE. Figure 3-16 shows a temperature map summary of the inflow analysis results per basin. The following inflow results are noted:

- Basins 1, 3, and 13 had the highest normalized peak I/I rates, an indicator of high inflow within the flow monitoring basin.

Table 3-6. Results and Rankings, Inflow Analysis

Basin	ADWF (mgd)	Inflow Rate (mgd)	Peak I/I per IDM (gpd/IDM)	Peak I/I per ACRE (gpd/ACRE)	Peak I/I per ADWF Ratio	Final Inflow Ranking
Basin 01	0.068	0.290	5,337	632	4.28	1
Basin 02	0.377	0.530	1,858	462	1.40	5
Basin 03	0.418	1.234	7,440	2,124	2.95	2
Basin 04	0.510	0.448	1,485	365	0.88	8
Basin 05	0.251	0.301	1,973	347	1.20	6
Basin 06	0.147	0.033	369	78	0.22	11
Basin 07	0.179	0.266	7,418	1,955	1.49	4
Basin 08	0.241	0.258	1,569	213	1.07	7
Basin 09	0.048	0.006	234	97	0.13	12
Basin 10	0.324	0.208	1,268	225	0.64	10
Basin 11	0.326	0.250	2,396	388	0.77	9
Basin 13	0.022	0.035	628	111	1.56	3
Basin 14	0.062	0.006	305	53	0.09	13

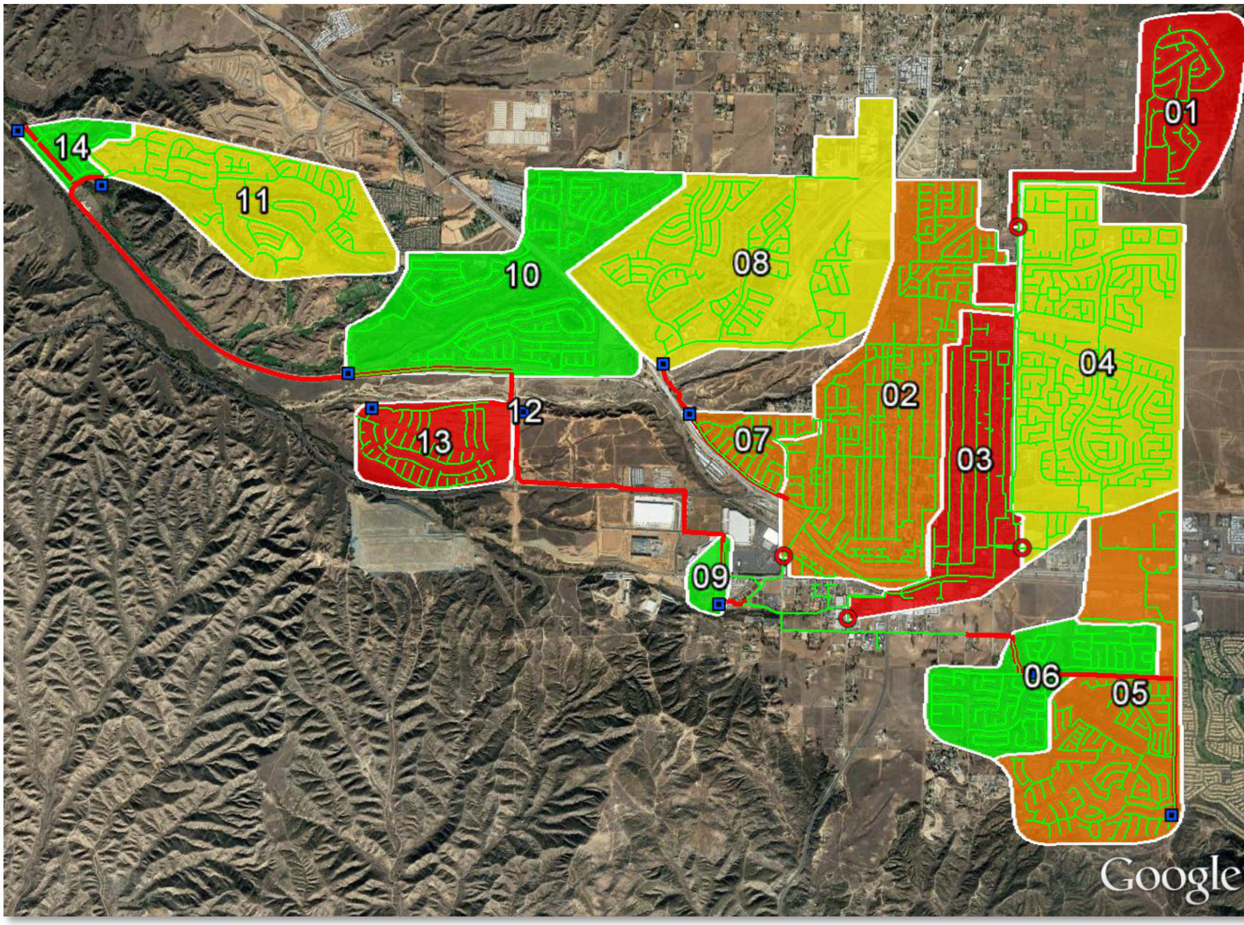


Figure 3-16. Temperature Map: Inflow Final Basin Rankings

3.4.3 Combined I/I Results

Combined I/I analysis considers the totalized volume (in gallons) of both inflow and rainfall-dependent infiltration over the course of a storm event. Table 3-7 summarizes the combined I/I flow results from the March 12/13 rain event. The "top 3" ranked basins have been shaded RED; basins ranked 4-6 have been shaded ORANGE. A temperature map is shown in Figure 3-17.

The following total I/I results are noted:

- Basins 1, 3, and 7 had the highest normalized combined I/I rates, an indicator of high combined inflow and infiltration within the flow monitoring basin.

Table 3-7. Results and Rankings, Total I/I Analysis

Basin	Total I/I (gallons)	Total I/I per-IDM (gal/IDM/ inch-rain)	Total I/I per-ACRE (R-Value)	Total I/I per-ADWF (MG/adwf/ inch-rain)	Final Total I/I Ranking
Basin 01	120,553	566	0.25%	0.45	1
Basin 02	289,648	144	0.10%	0.19	5
Basin 03	335,977	158	0.13%	0.20	3
Basin 04	189,565	156	0.14%	0.09	9
Basin 05	117,106	234	0.15%	0.14	7
Basin 06	26,709	89	0.07%	0.05	12
Basin 07	142,914	177	0.10%	0.20	2
Basin 08	85,298	121	0.06%	0.08	10
Basin 09	18,854	184	0.28%	0.10	8
Basin 10	246,795	219	0.14%	0.19	4
Basin 11	94,206	203	0.12%	0.08	11
Basin 13	13,305	63	0.04%	0.16	6
Basin 14	9,059	128	0.08%	0.04	13

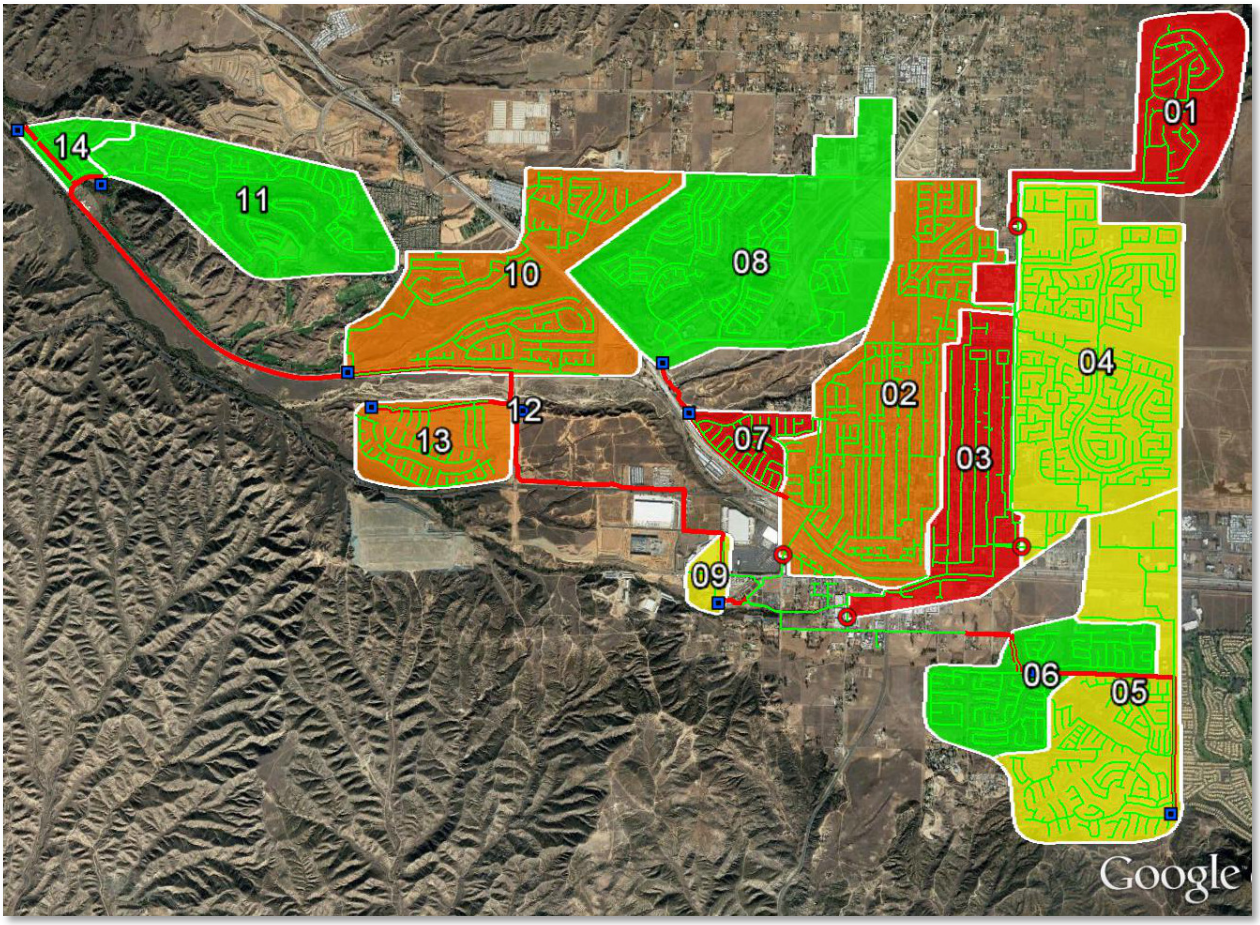


Figure 3-17. Temperature Map: Combined I/I Final Basin Rankings

4 Recommendations

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

1. **Master Plan and Model Implementation**: This study focuses on inflow and infiltration generation; however, the capacity deficiencies of the collection system may be of greater concern relative to I/I response during peak wet weather events. The City may wish to have a model designed and/or a master plan study conducted to determine the overall needs of the City relative to I/I. Or simply, the study results can be used to update the master plan and compare with previous model assumptions and flow monitoring results.
2. **Determine I/I Reduction Program**: The City should examine its I/I reduction needs to determine their needs and goals for a future I/I reduction program.
    a. If peak flows, sanitary sewer overflows, and pipeline capacity issues are of greater concern, then priority can be given to investigate and reduce sources of inflow within the basins with the greatest inflow problems.
    b. If total infiltration and general pipeline deterioration are of greater concern, then the program can be weighted to investigate and reduce sources of infiltration within the basins with the greatest infiltration problems. Generally, RDI rates were very low for this system.
    c. Basins 1 and 3 ranked in the top 3 for both inflow and total combined I/I. An I/I reduction program could begin within these basins.
3. **I/I Reduction Cost Effective Analysis**: The City should conduct a study to determine which is more cost-effective: (1) locating the sources of inflow/infiltration and systematically rehabilitating or replacing the faulty pipelines; or (2) continued treatment of the additional rainfall dependent I/I flow.

Appendix A
Flow Monitoring Sites: Data, Graphs, and Information

City of Beaumont

Sanitary Sewer Flow Monitoring

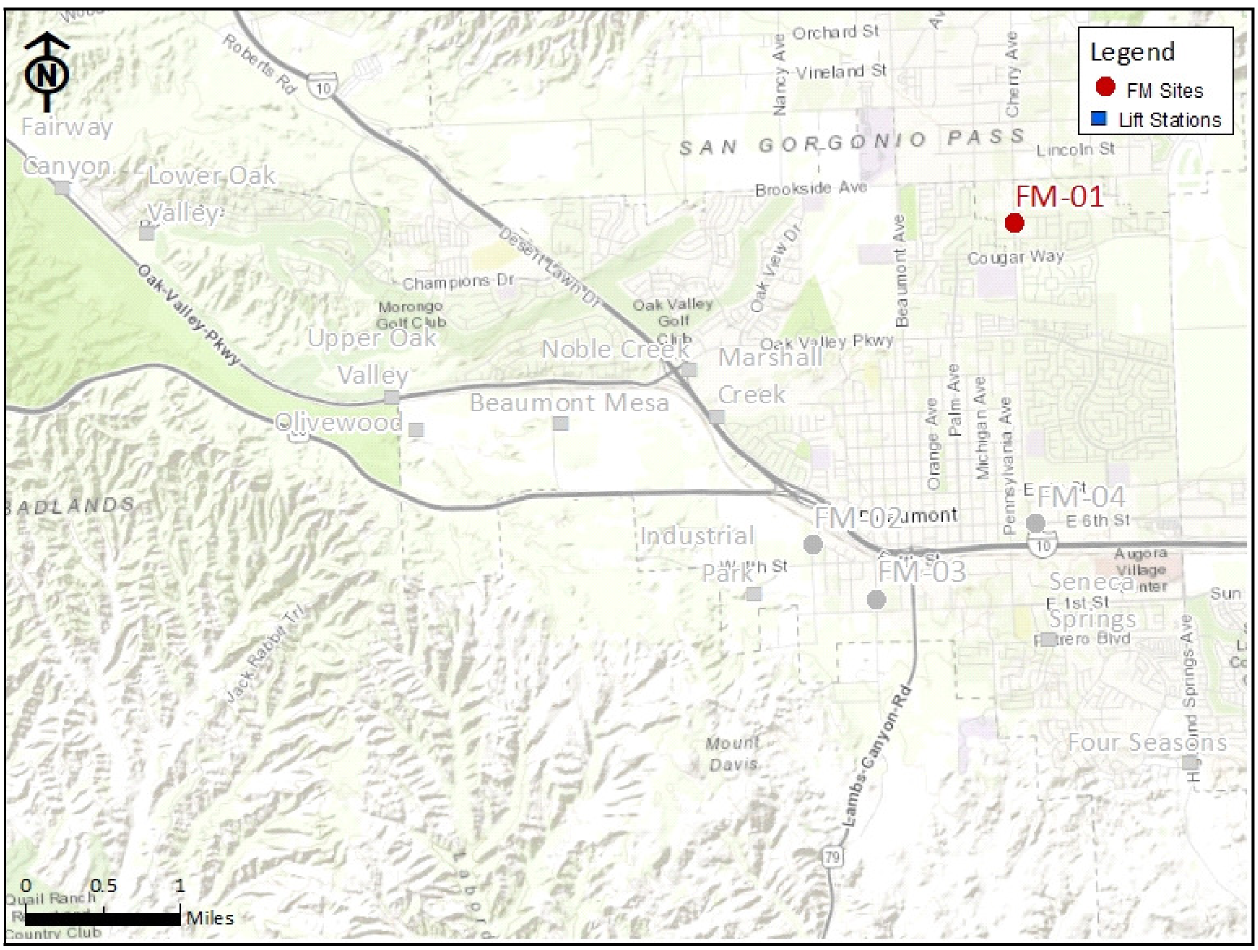
February 20 - April 09, 2020

Monitoring Site: FM-01

City Structure: SSMH01061

Location: Cherry Avenue north of Mary Lane

Data Summary Report



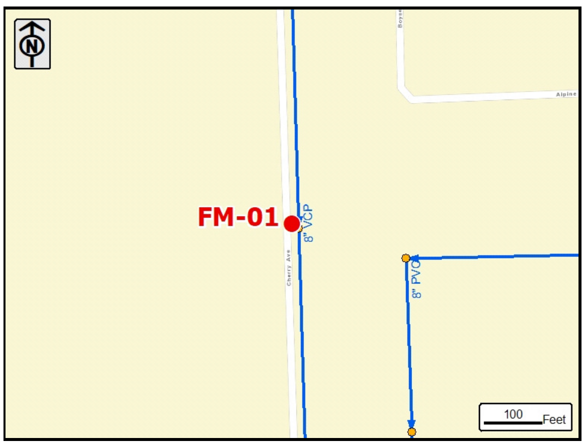
Vicinity Map: FM-01

FM-01

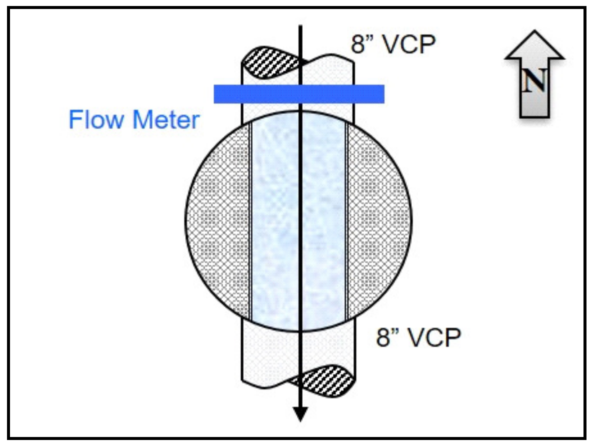
Site Information

Location:	Cherry Avenue north of Mary Lane
City Manhole:	SSMH01061
Coordinates:	116.9642° W, 33.9574° N
Rim Elevation (Earth):	2750 feet
Pipe Diameter:	8 inches
ADWF:	0.072 mgd
Peak Measured Flow:	0.388 mgd

Satellite Map



Sanitary Map



Flow Sketch


Street View


Plan View

FM-01

Additional Site Photos

Effluent Pipe

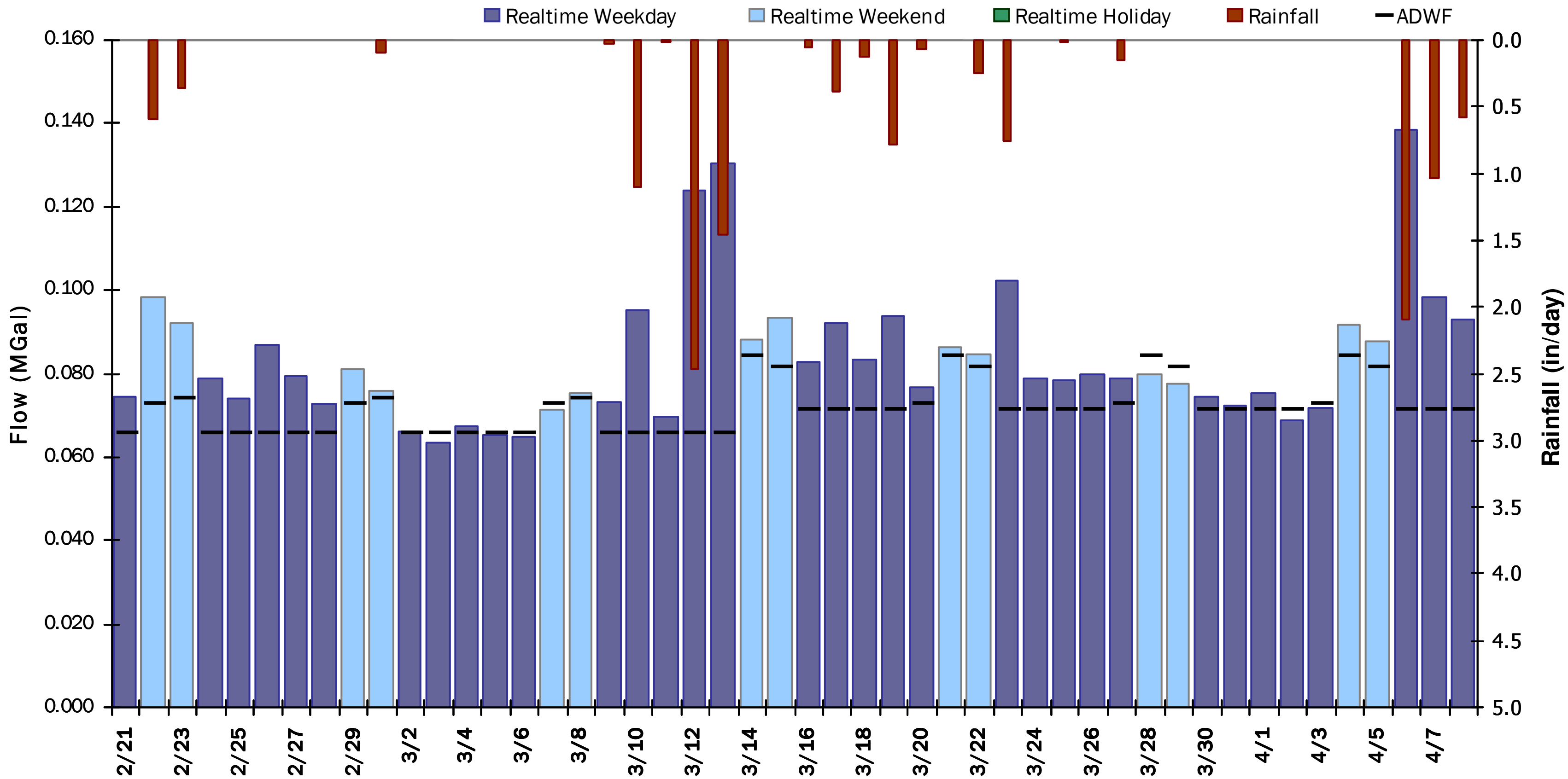
Monitored Influent Pipe

FM-01

Period Flow Summary: Daily Flow Totals

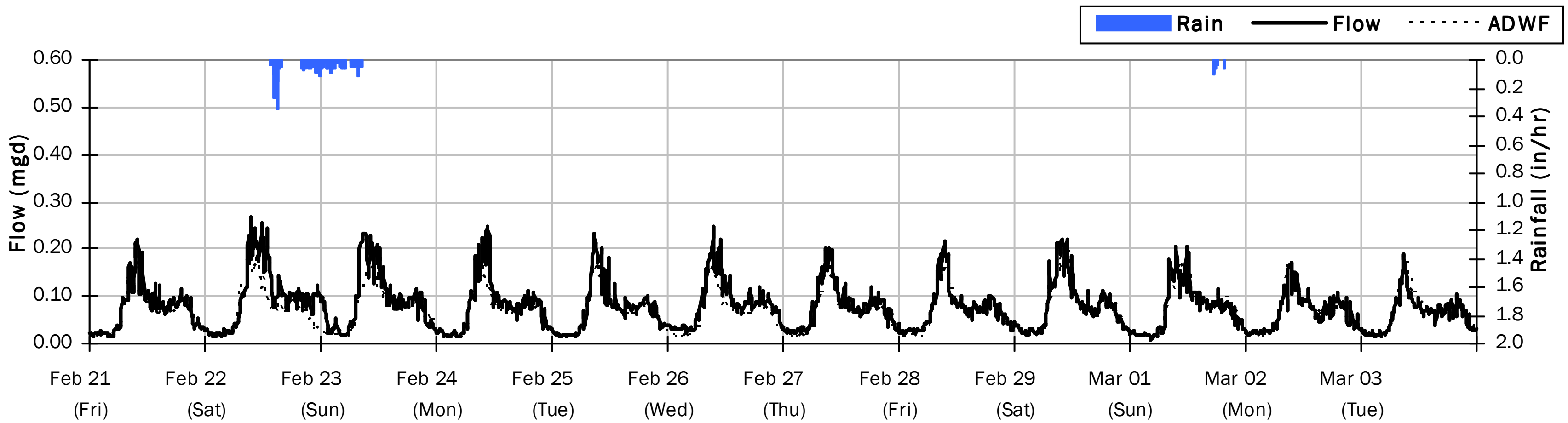
Avg Period Flow: 0.084 MGal **Peak Daily Flow: 0.138 MGal** **Min Daily Flow: 0.064 MGal**

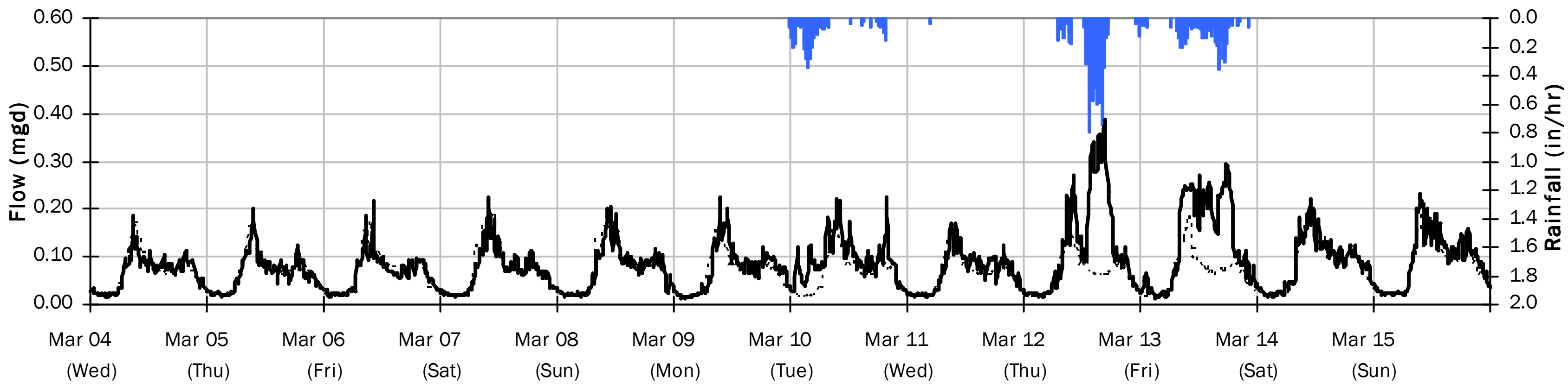
Total Period Rainfall: 12.42 inches



FM-01
Flow Summary: 2/21/2020 to 3/15/2020

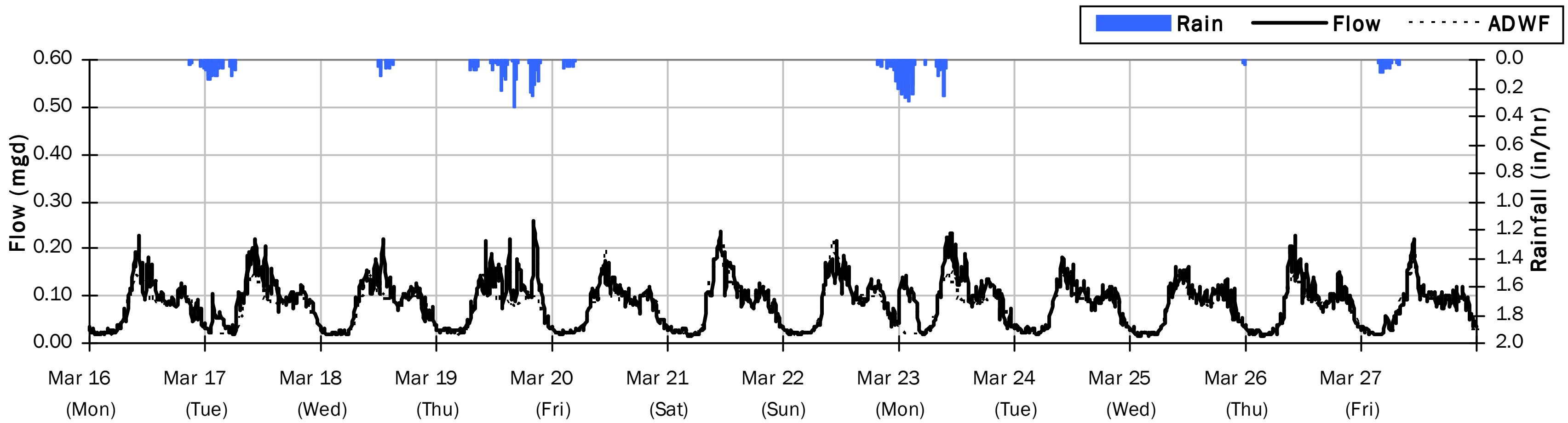
Total Period Rainfall: 6.13 inches   **Avg Flow: 0.082 mgd   Peak Flow: 0.388 mgd   Min Flow: 0.009 mgd**

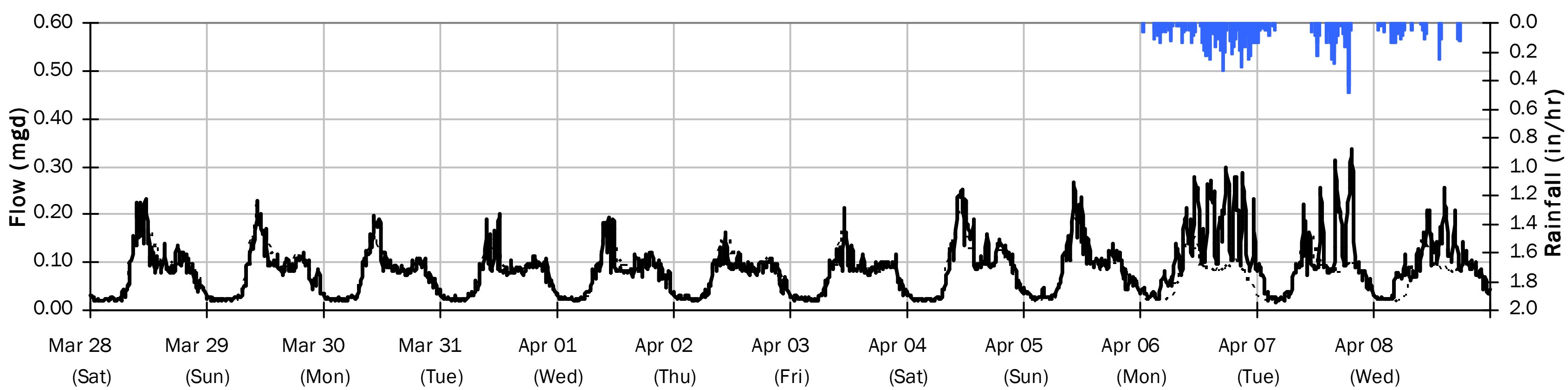




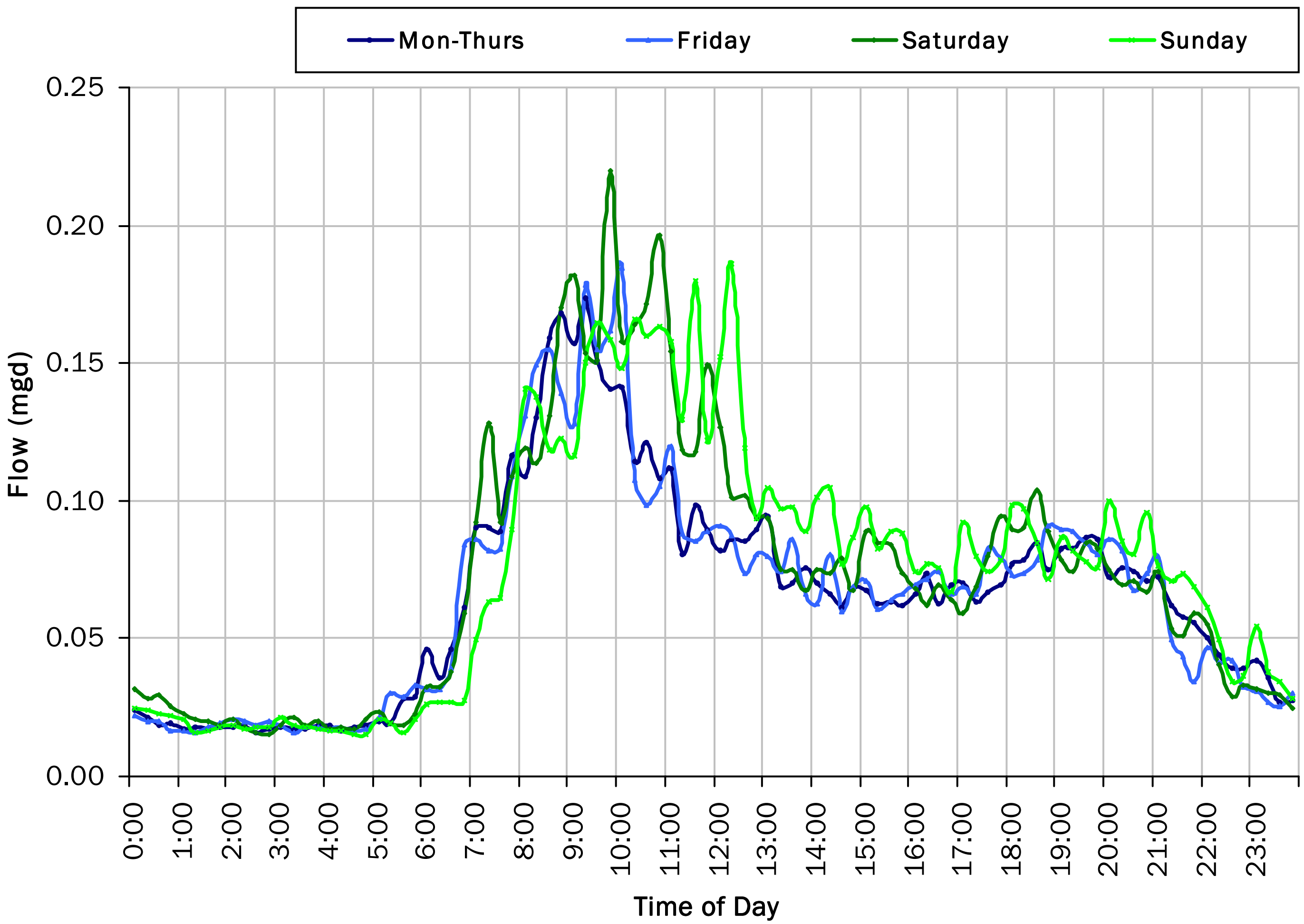
FM-01
Flow Summary: 3/16/2020 to 4/8/2020

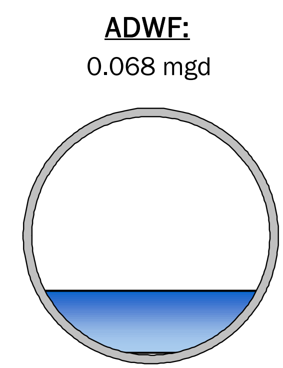
Total Period Rainfall: 6.30 inches **Avg Flow: 0.085 mgd** **Peak Flow: 0.338 mgd** **Min Flow: 0.016 mgd**



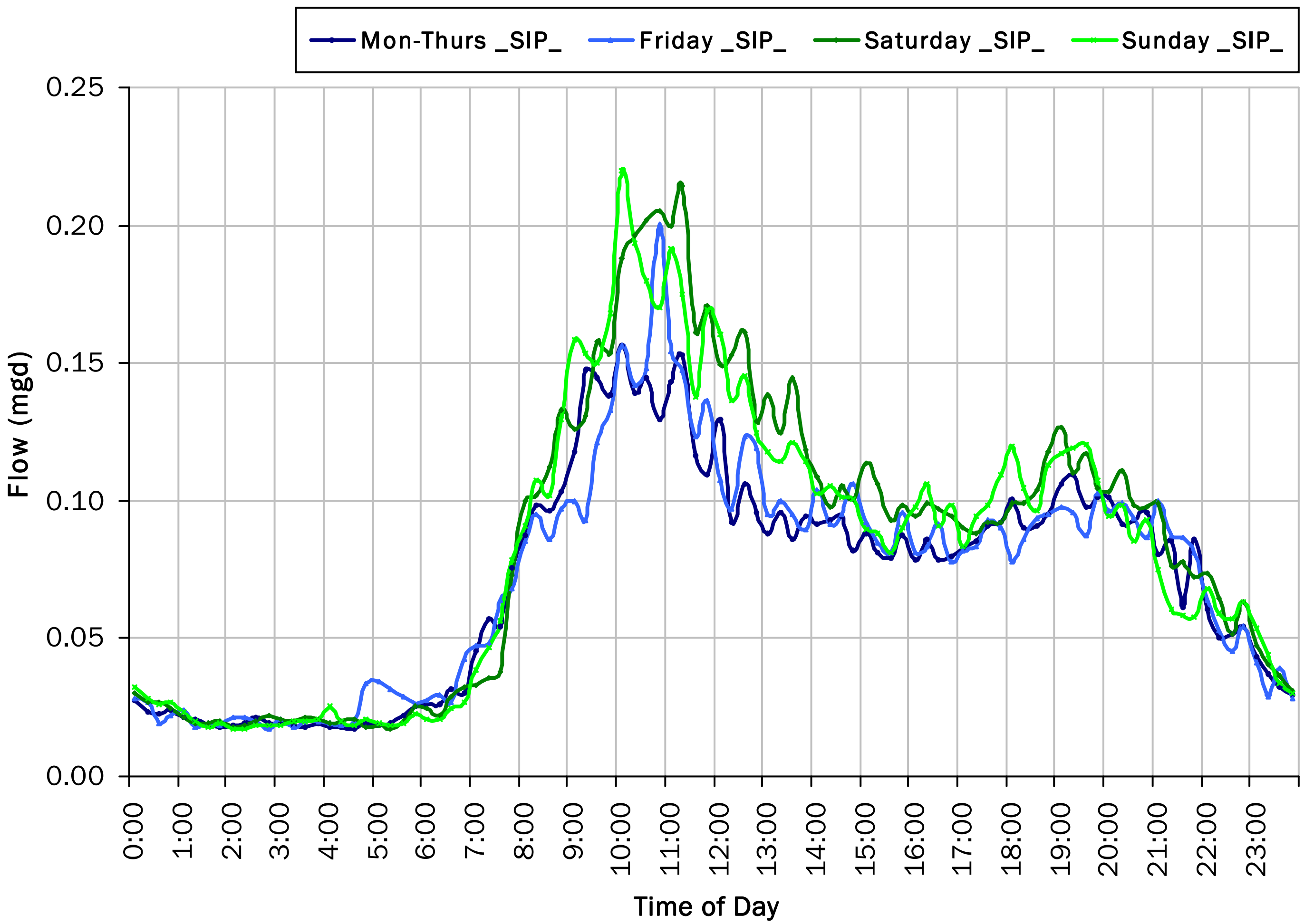


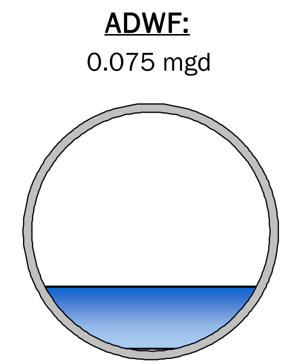
FM-01
Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)





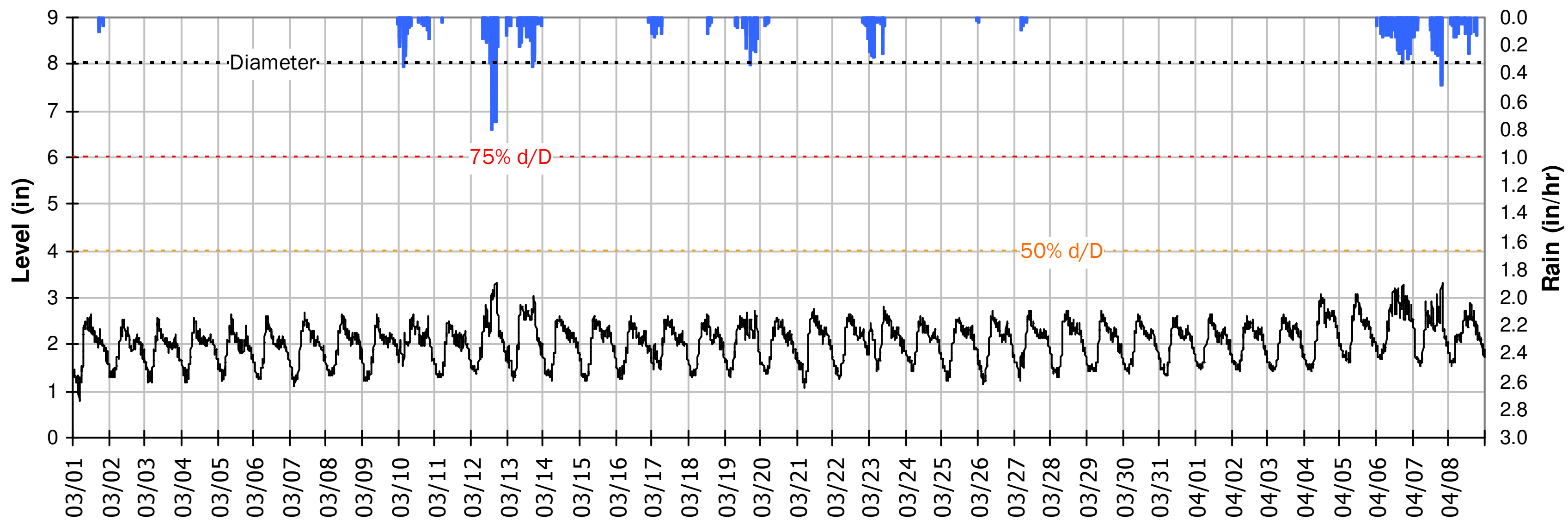
FM-01
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)

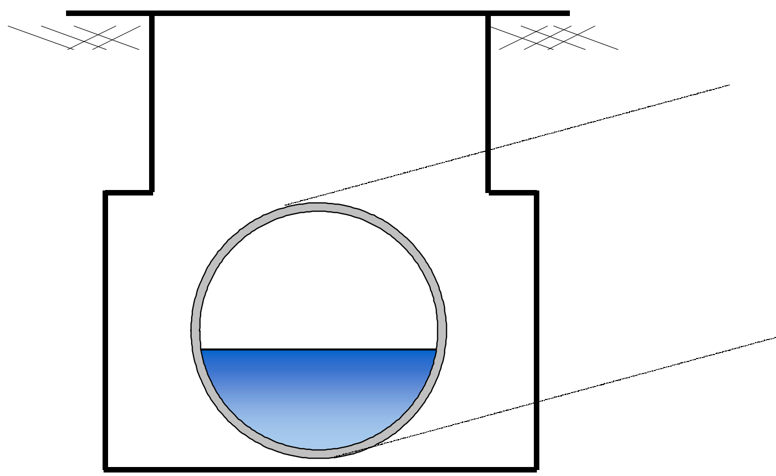




FM-01
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

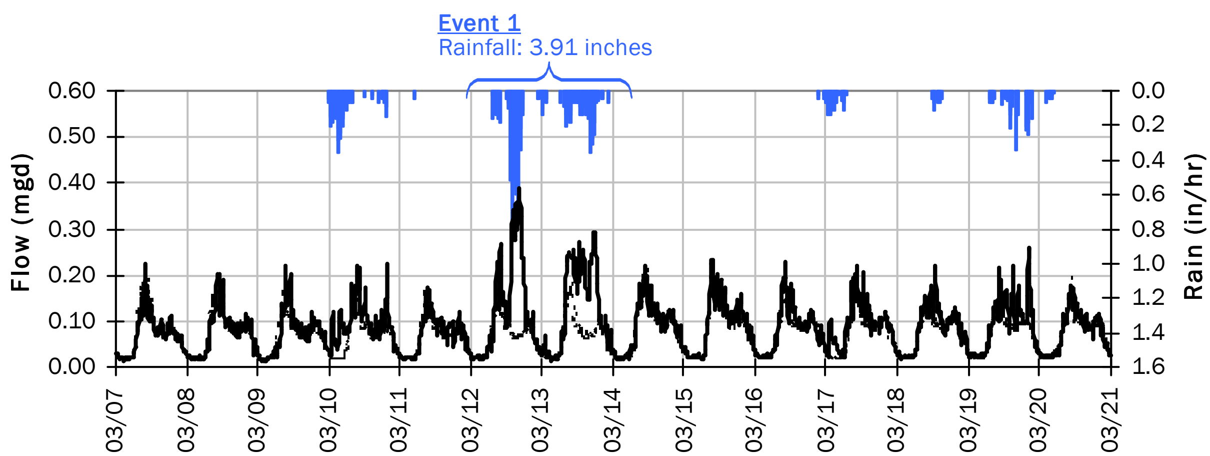




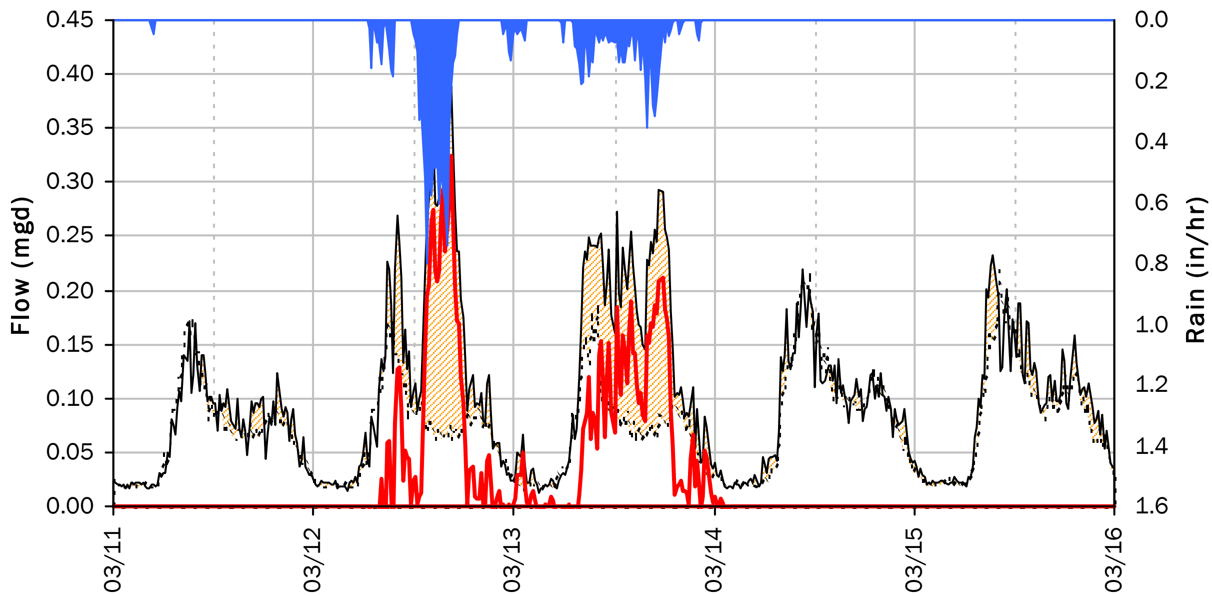
Pipe Diameter:	8	*inches*
Peak Measured Level:	3.33	*inches*
Peak d/D Ratio:	0.42	

FM-01
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

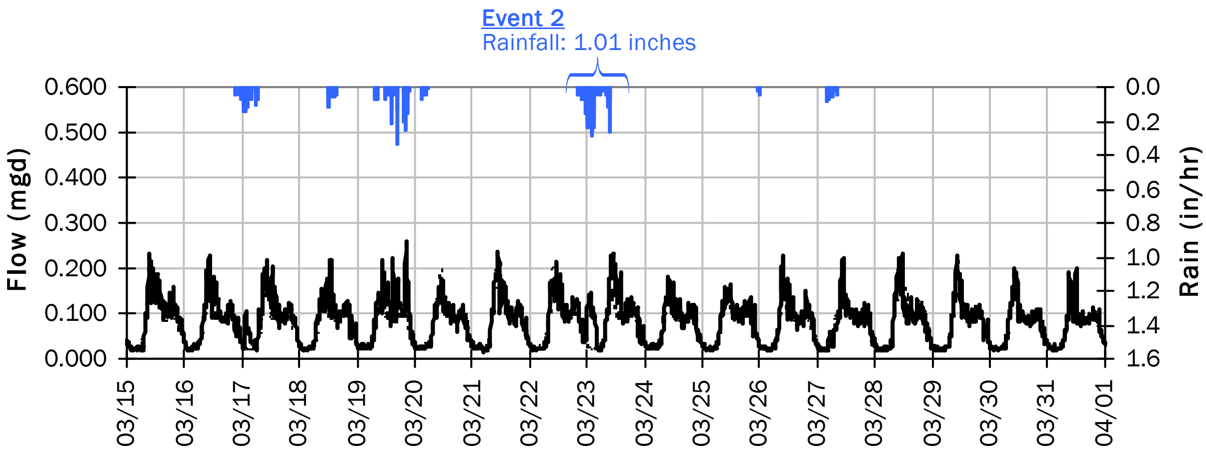


Storm Event I/I Analysis (Rain = 3.91 inches)

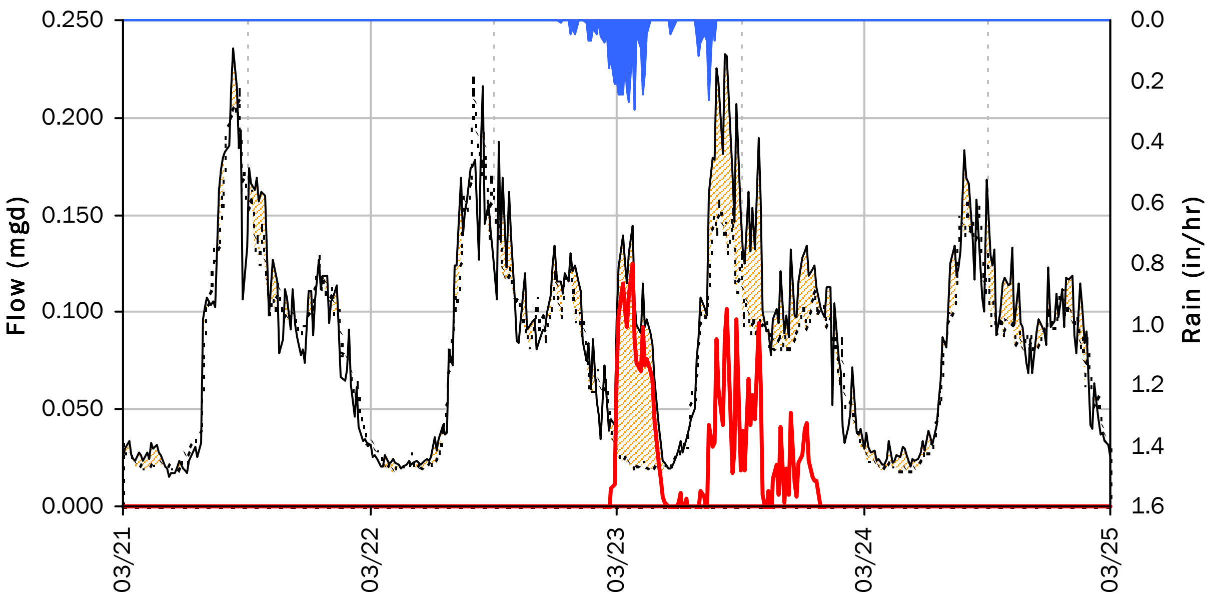
Capacity		**Inflow / Infiltration**	
Peak Flow:	0.39 *mgd*	**Peak I/I Rate:**	0.33 *mgd*
PF:	5.41	**Total I/I:**	121,000 *gallons*
Peak Level:	3.33 *in*		
d/D Ratio:	0.42		

FM-01
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

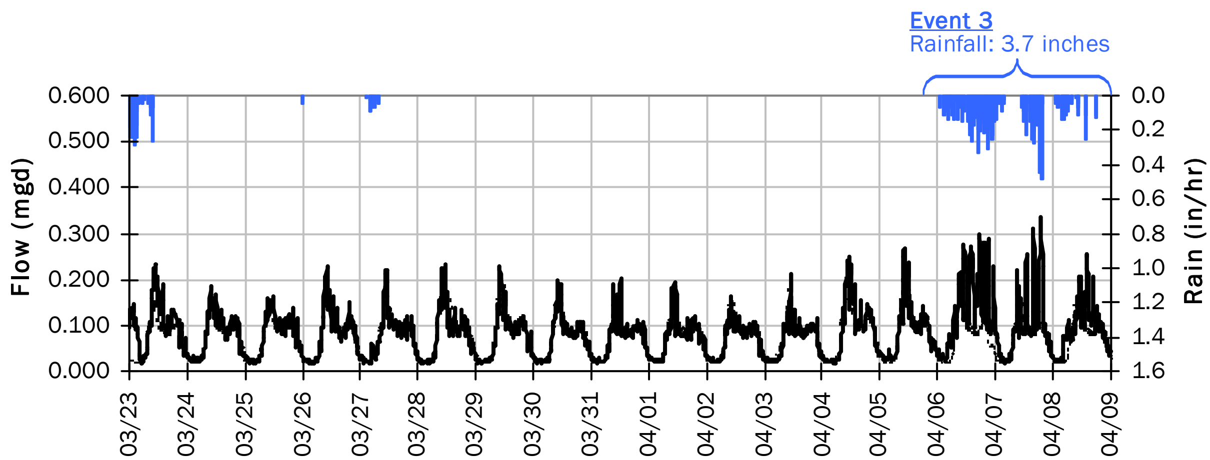


Storm Event I/I Analysis (Rain = 1.01 inches)

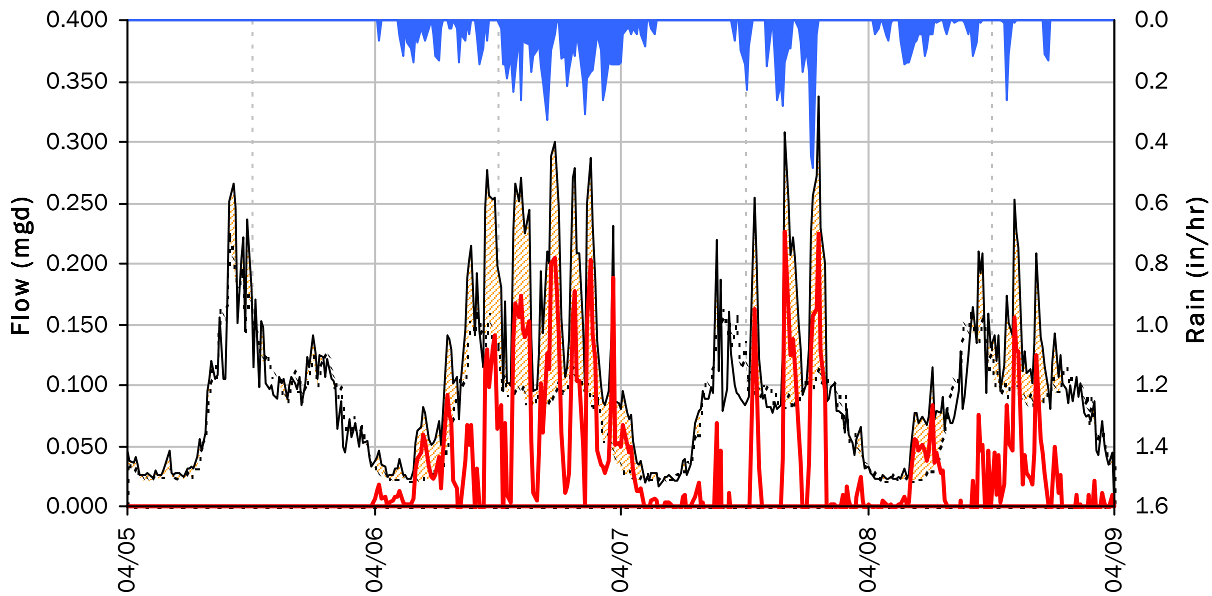
Capacity		Inflow / Infiltration	
Peak Flow:	0.23 *mgd*	**Peak I/I Rate:**	0.13 *mgd*
PF:	3.24	**Total I/I:**	30,000 *gallons*
Peak Level:	2.79 *in*		
d/D Ratio:	0.35		

FM-01
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



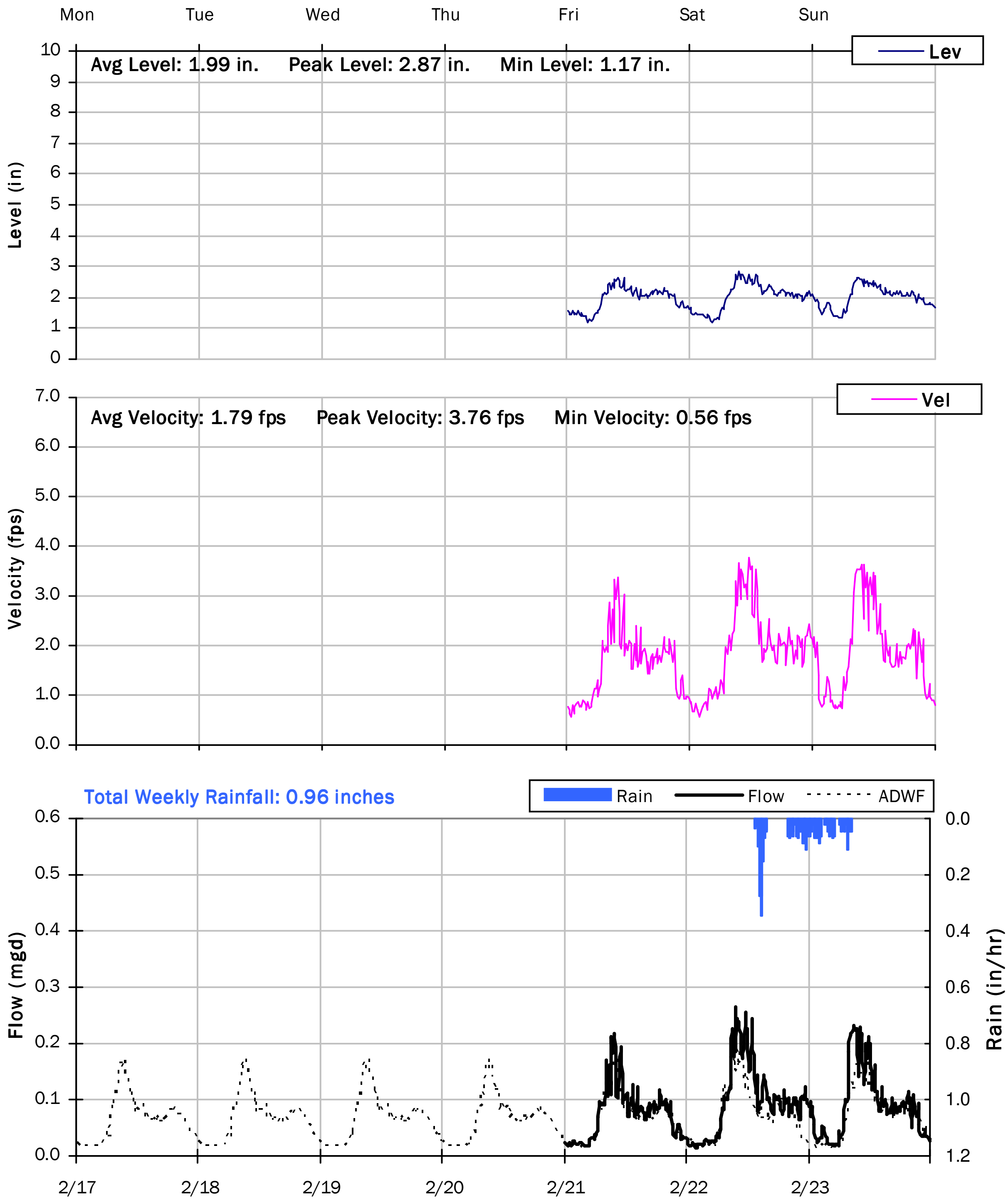
Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 3.70 inches)

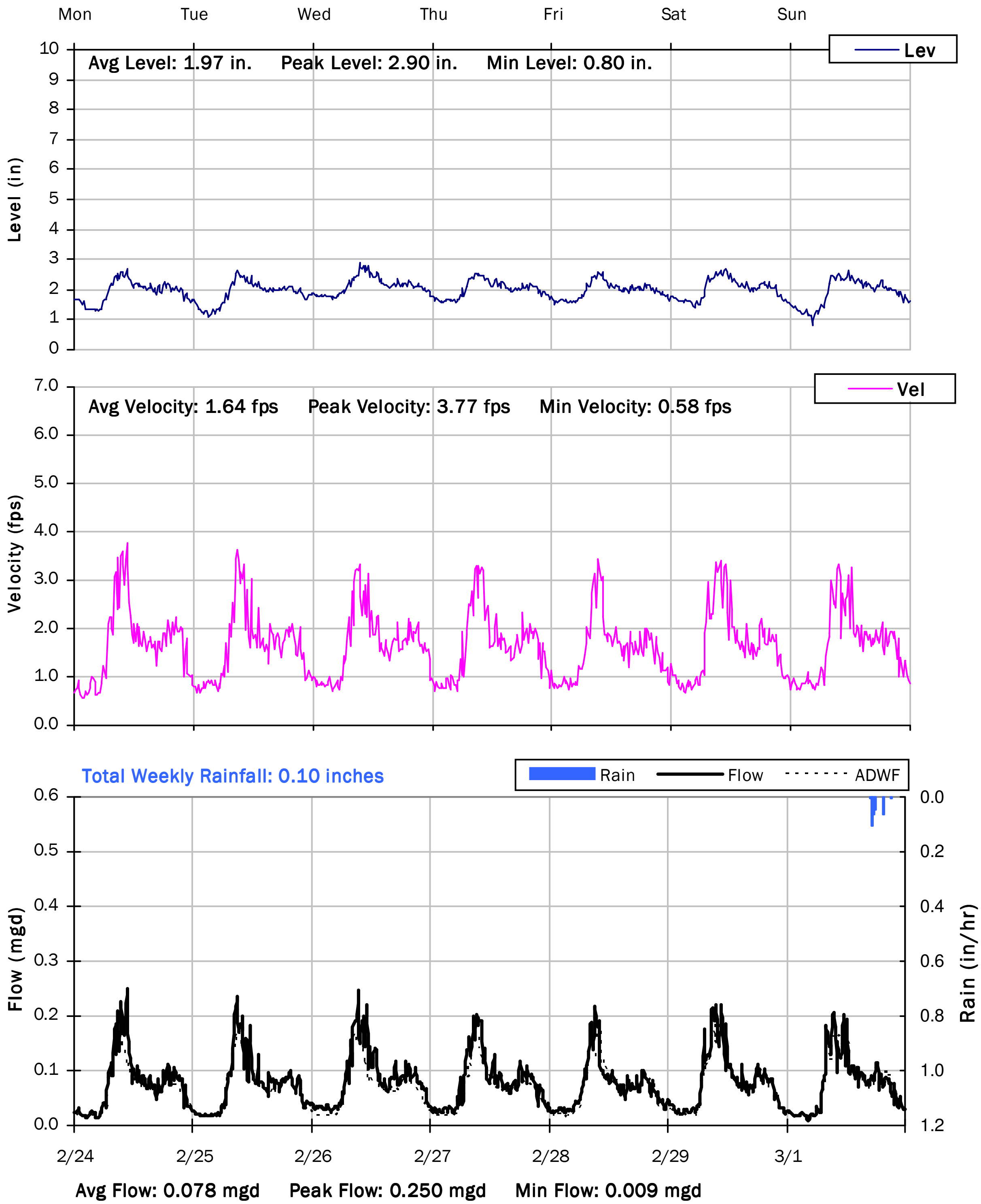
Capacity		Inflow / Infiltration	
Peak Flow:	0.34 *mgd*	**Peak I/I Rate:**	0.23 *mgd*
PF:	4.71	**Total I/I:**	103,000 *gallons*
Peak Level:	3.32 *in*		
d/D Ratio:	0.42		

FM-01
Weekly Level, Velocity and Flow Hydrographs
2/17/2020 to 2/24/2020

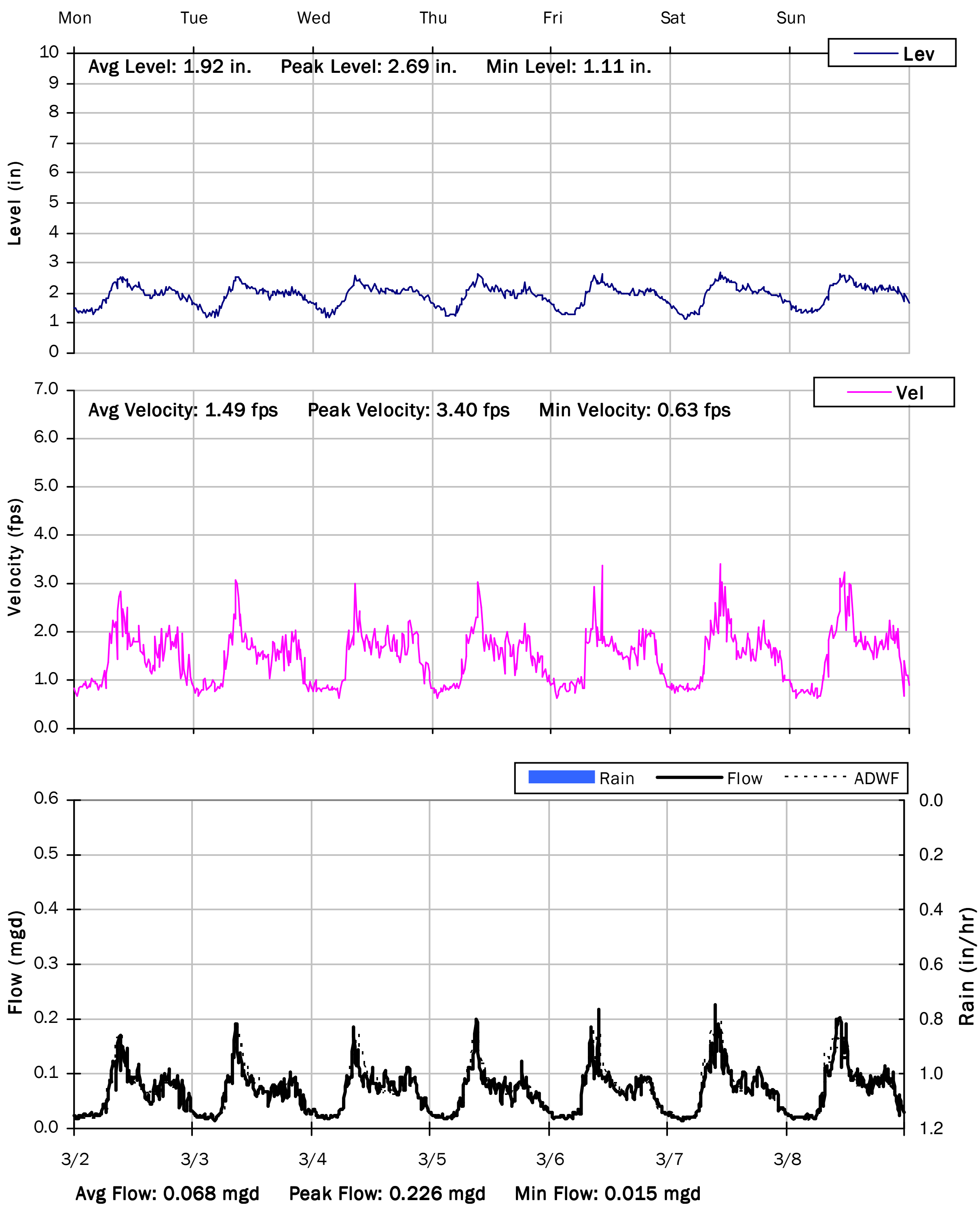


Avg Flow: 0.088 mgd **Peak Flow: 0.266 mgd** **Min Flow: 0.015 mgd**

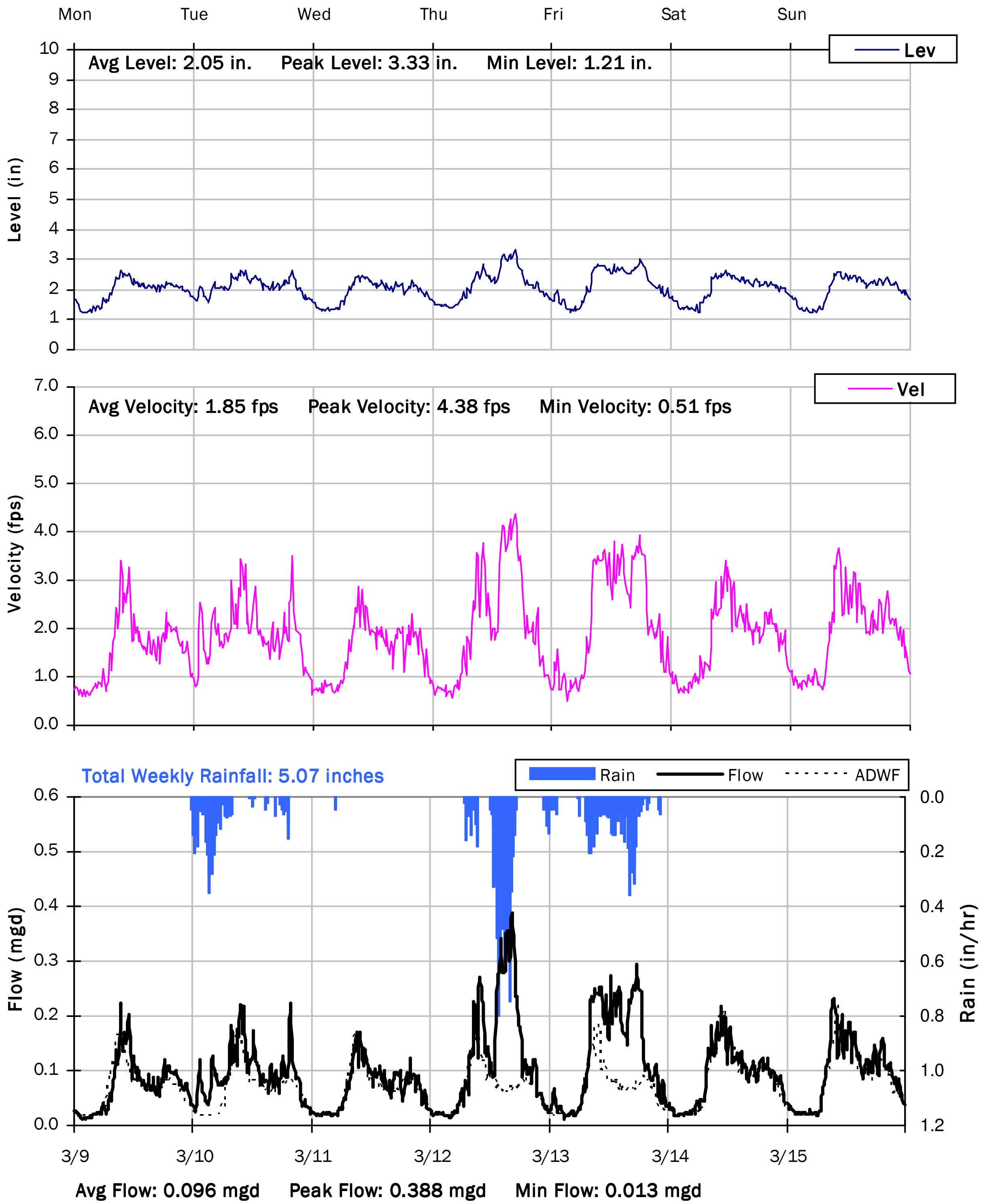
FM-01
Weekly Level, Velocity and Flow Hydrographs
2/24/2020 to 3/2/2020



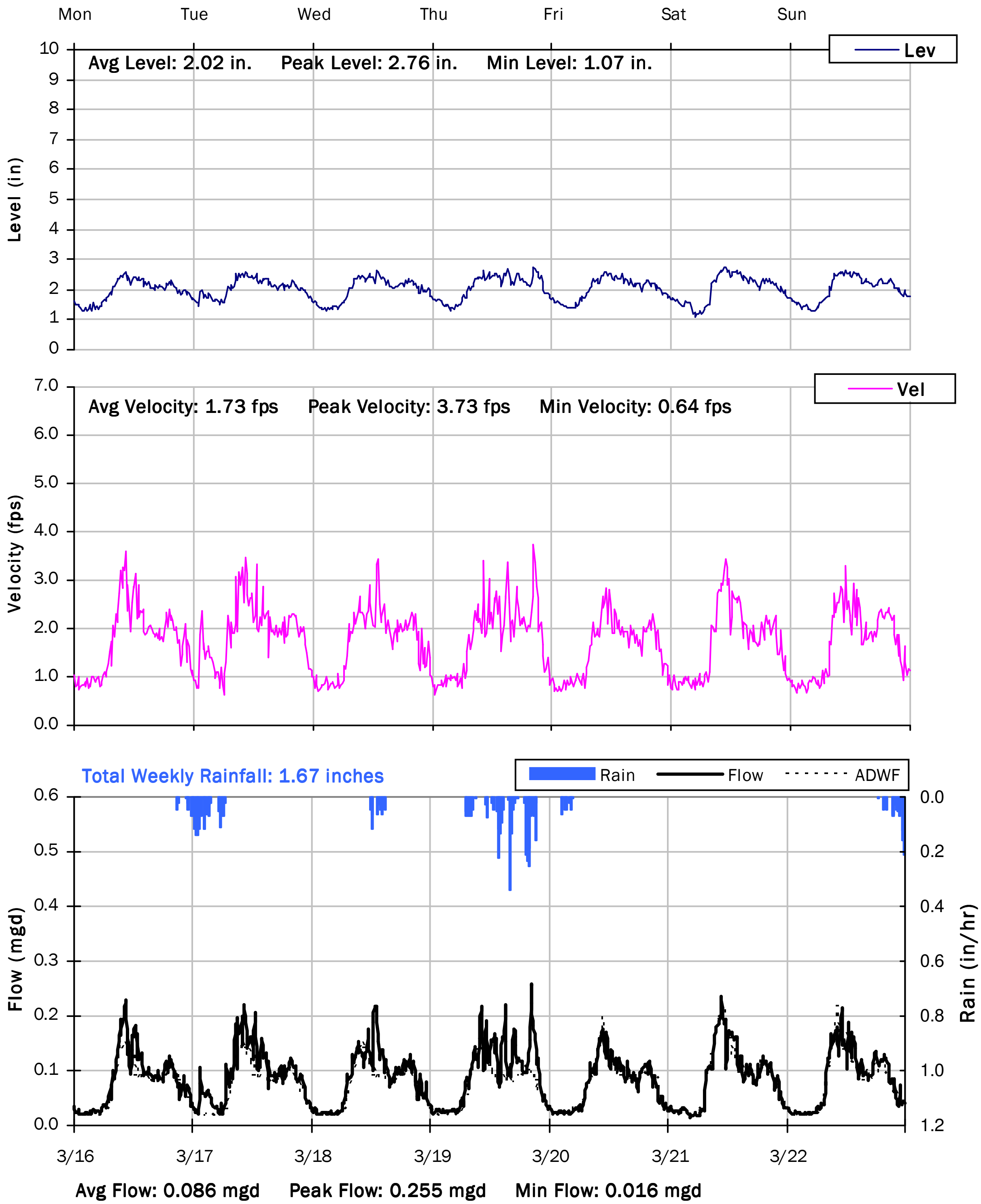
FM-01
Weekly Level, Velocity and Flow Hydrographs
3/2/2020 to 3/9/2020



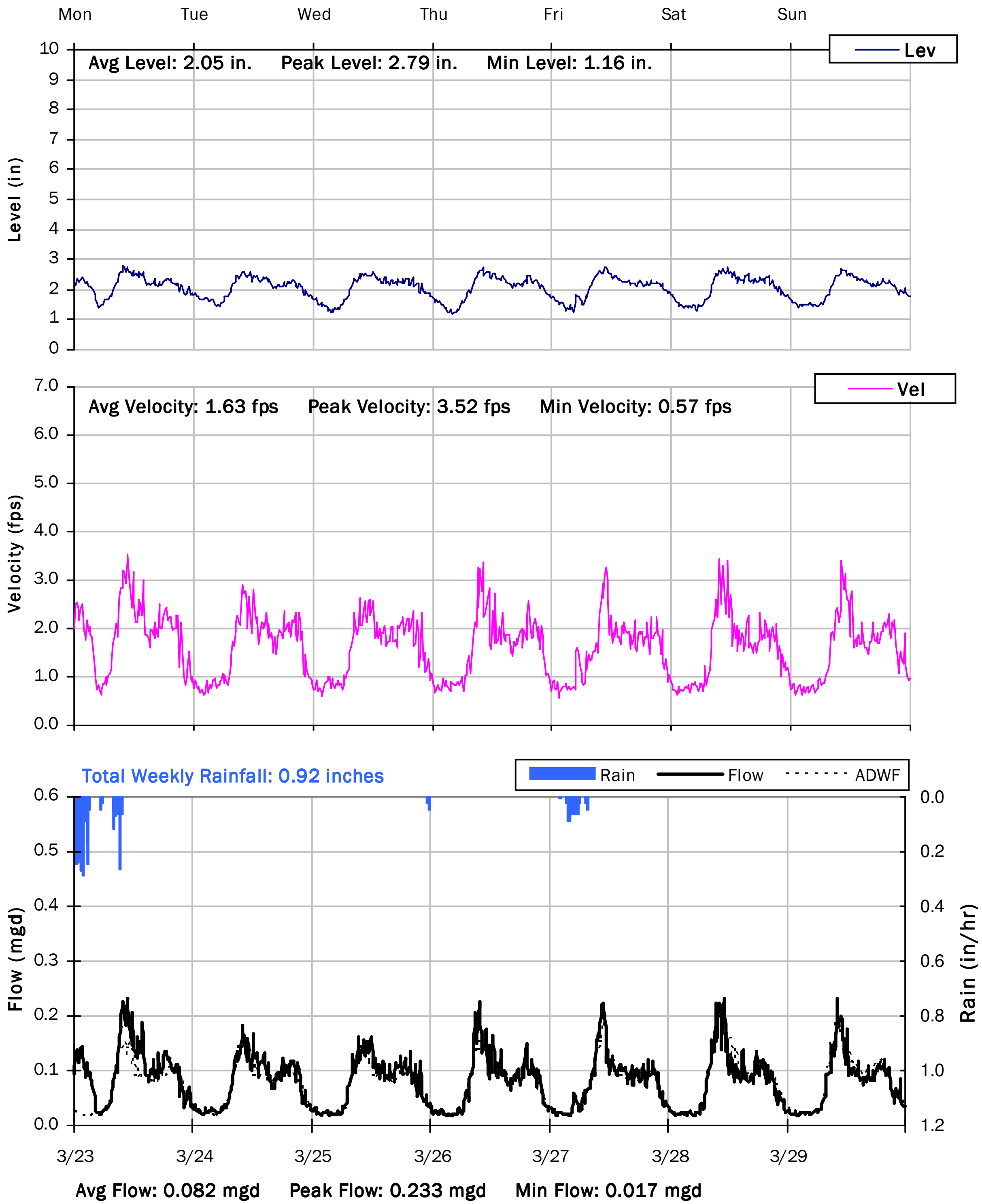
FM-01
Weekly Level, Velocity and Flow Hydrographs
3/9/2020 to 3/16/2020



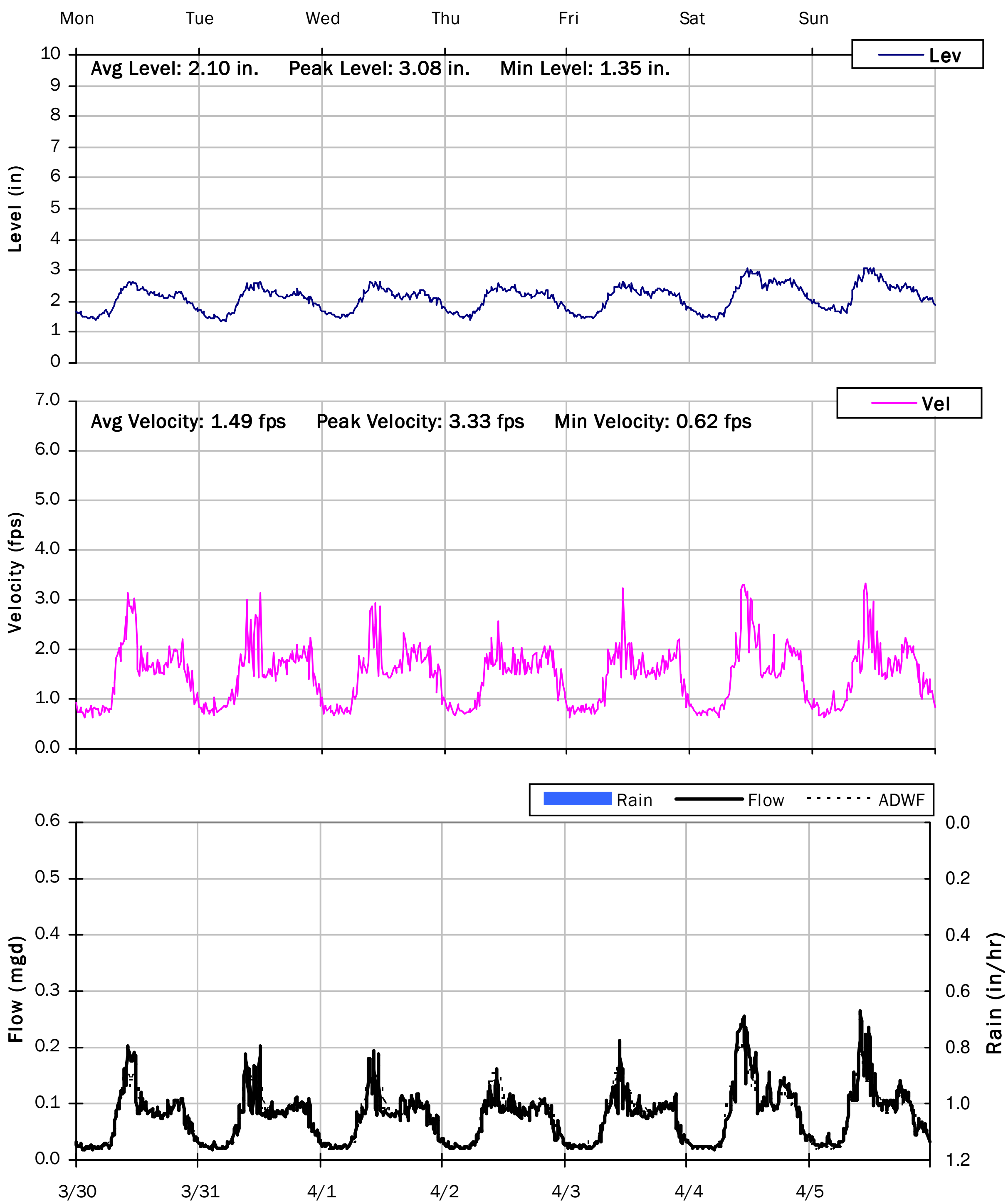
FM-01
Weekly Level, Velocity and Flow Hydrographs
3/16/2020 to 3/23/2020



FM-01
Weekly Level, Velocity and Flow Hydrographs
3/23/2020 to 3/30/2020

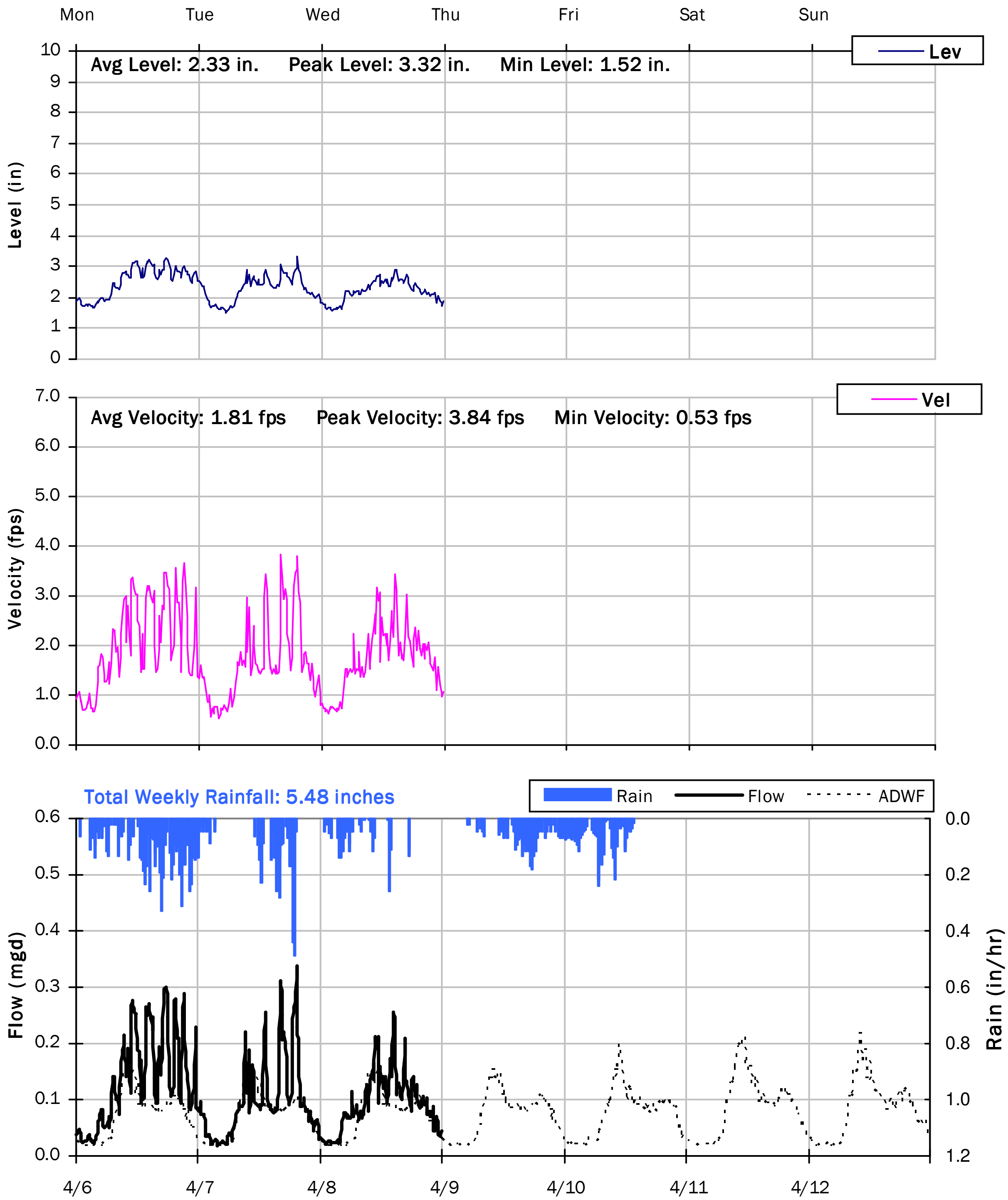


FM-01
Weekly Level, Velocity and Flow Hydrographs
3/30/2020 to 4/6/2020



Avg Flow: 0.078 mgd Peak Flow: 0.266 mgd Min Flow: 0.018 mgd

FM-01
Weekly Level, Velocity and Flow Hydrographs
4/6/2020 to 4/13/2020



Avg Flow: 0.110 mgd **Peak Flow: 0.338 mgd** **Min Flow: 0.017 mgd**

City of Beaumont

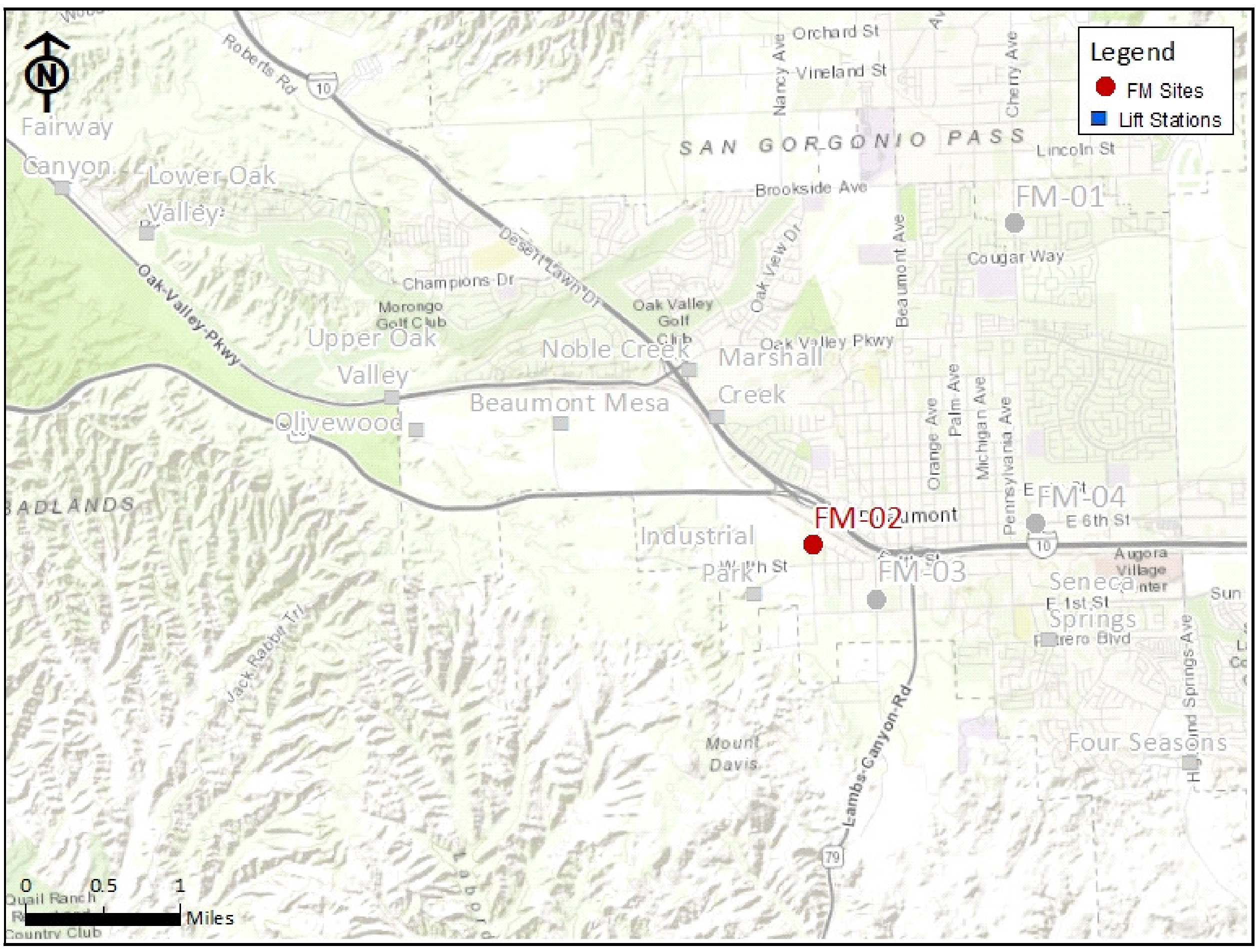
Sanitary Sewer Flow Monitoring
February 20 - April 09, 2020

Monitoring Site: FM-02

City Structure: SSMH01725

Location: Veile Avenue north of West 4th Street

Data Summary Report



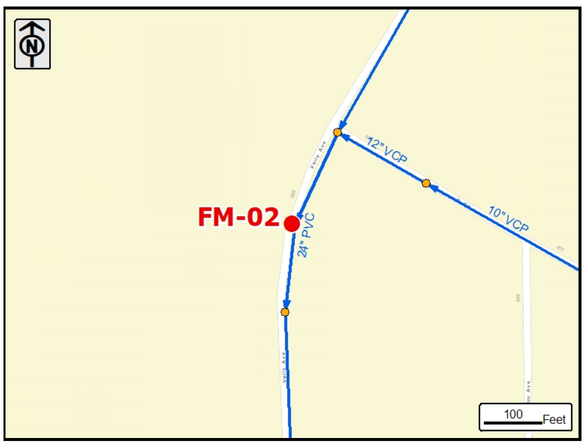
Vicinity Map: FM-02

FM-02

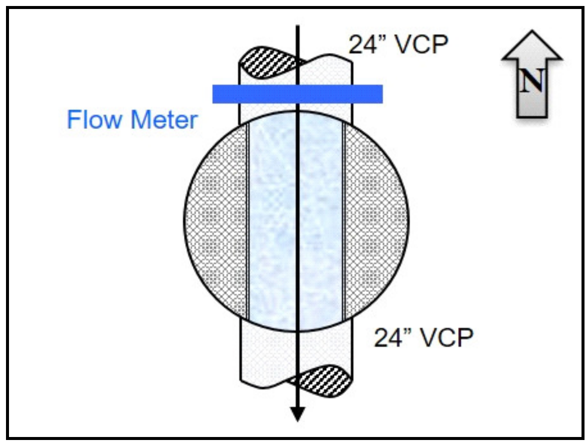
Site Information

Location:	Veile Avenue north of West 4th Street
City Manhole:	SSMH01725
Coordinates:	116.9882° W, 33.9281° N
Rim Elevation (Earth):	2554 feet
Pipe Diameter:	24 inches
ADWF:	0.802 mgd
Peak Measured Flow:	1.967 mgd

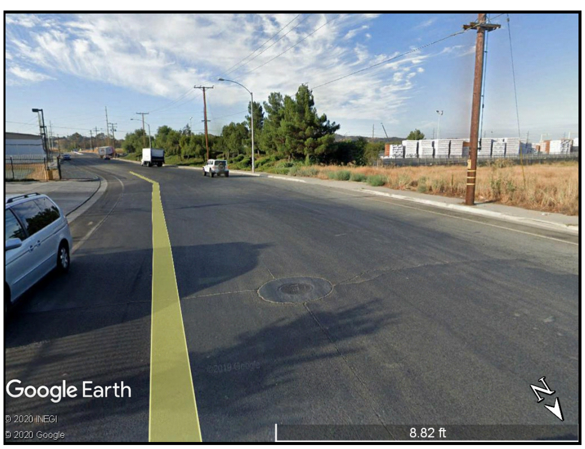
Satellite Map



Sanitary Map



Flow Sketch



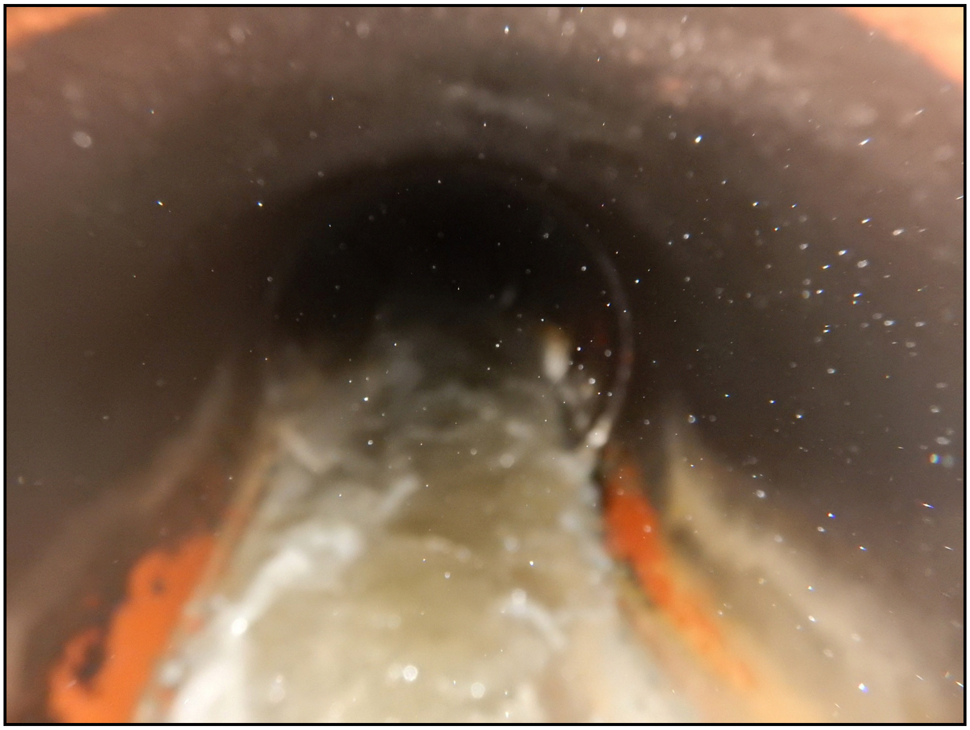
Street View


Plan View

FM-02

Additional Site Photos

Effluent Pipe



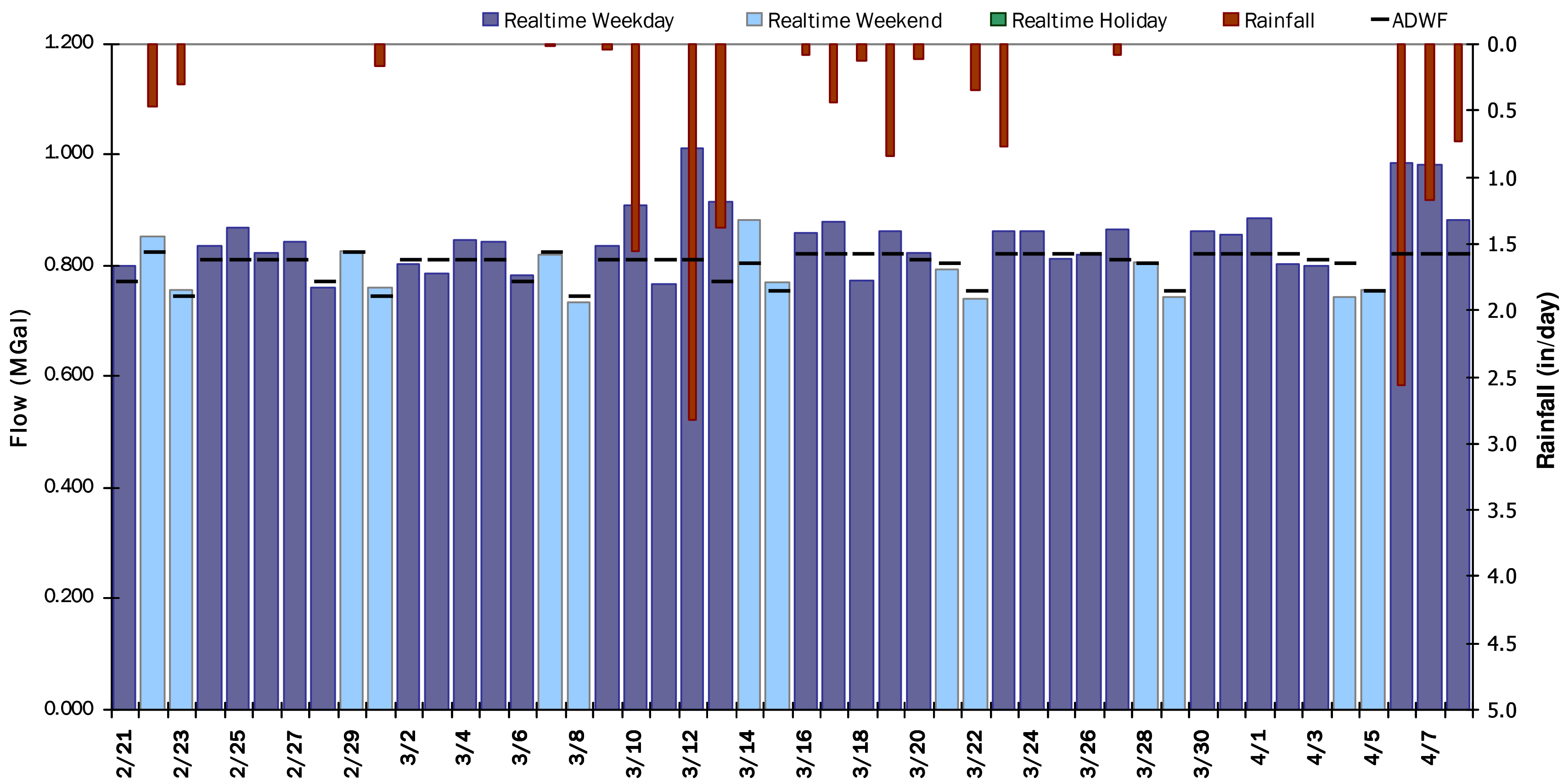
Monitored Influent Pipe

FM-02

Period Flow Summary: Daily Flow Totals

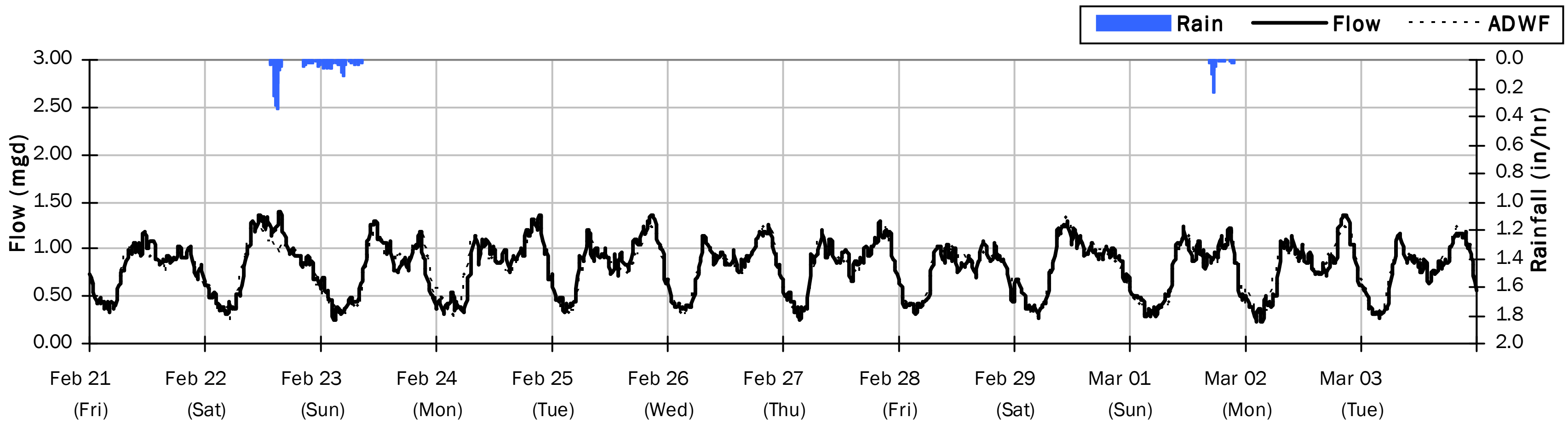
Avg Period Flow: 0.832 MGal **Peak Daily Flow: 1.013 MGal** **Min Daily Flow: 0.735 MGal**

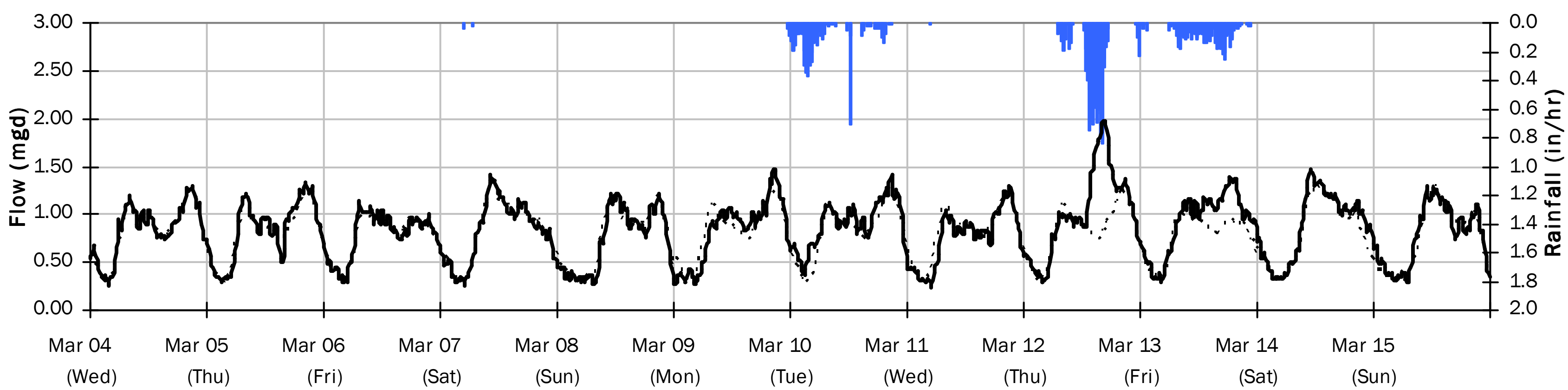
Total Period Rainfall: 14.00 inches



FM-02
Flow Summary: 2/21/2020 to 3/15/2020

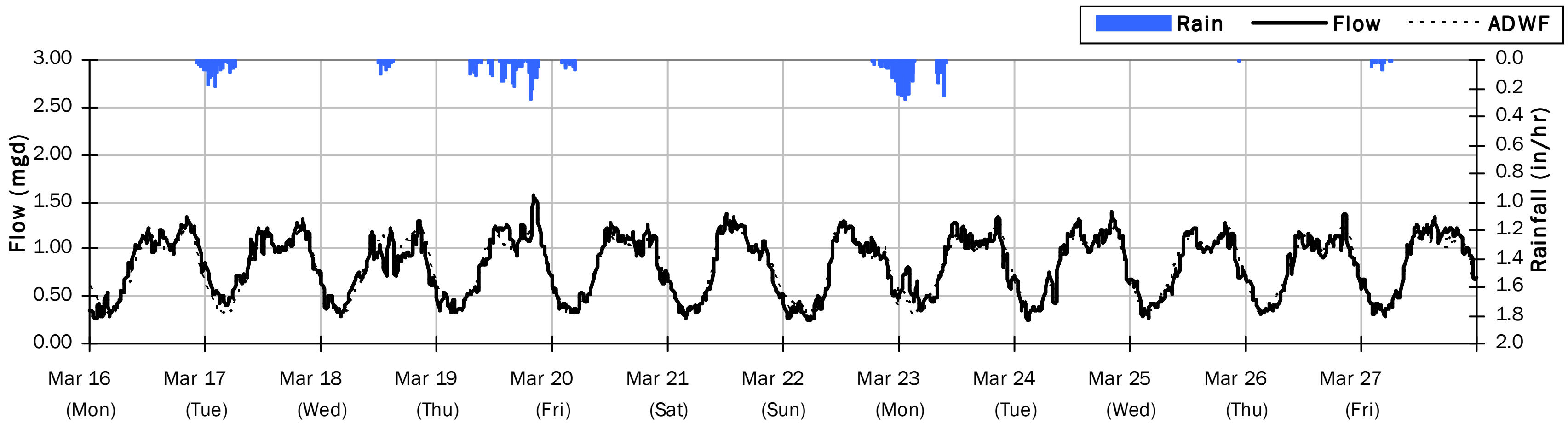
Total Period Rainfall: 6.75 inches   **Avg Flow: 0.827 mgd**   **Peak Flow: 1.967 mgd**   **Min Flow: 0.229 mgd**

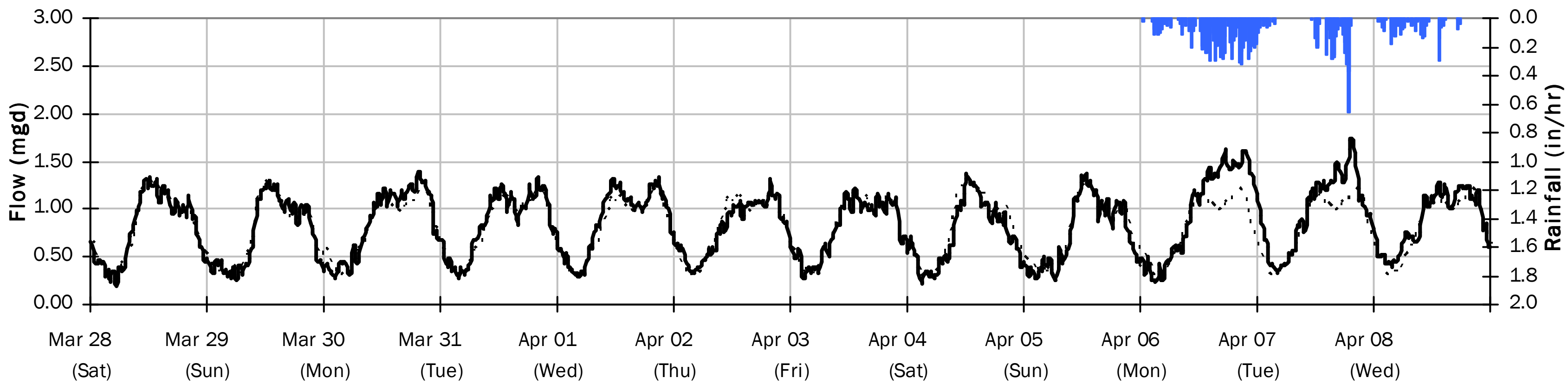




FM-02
Flow Summary: 3/16/2020 to 4/8/2020

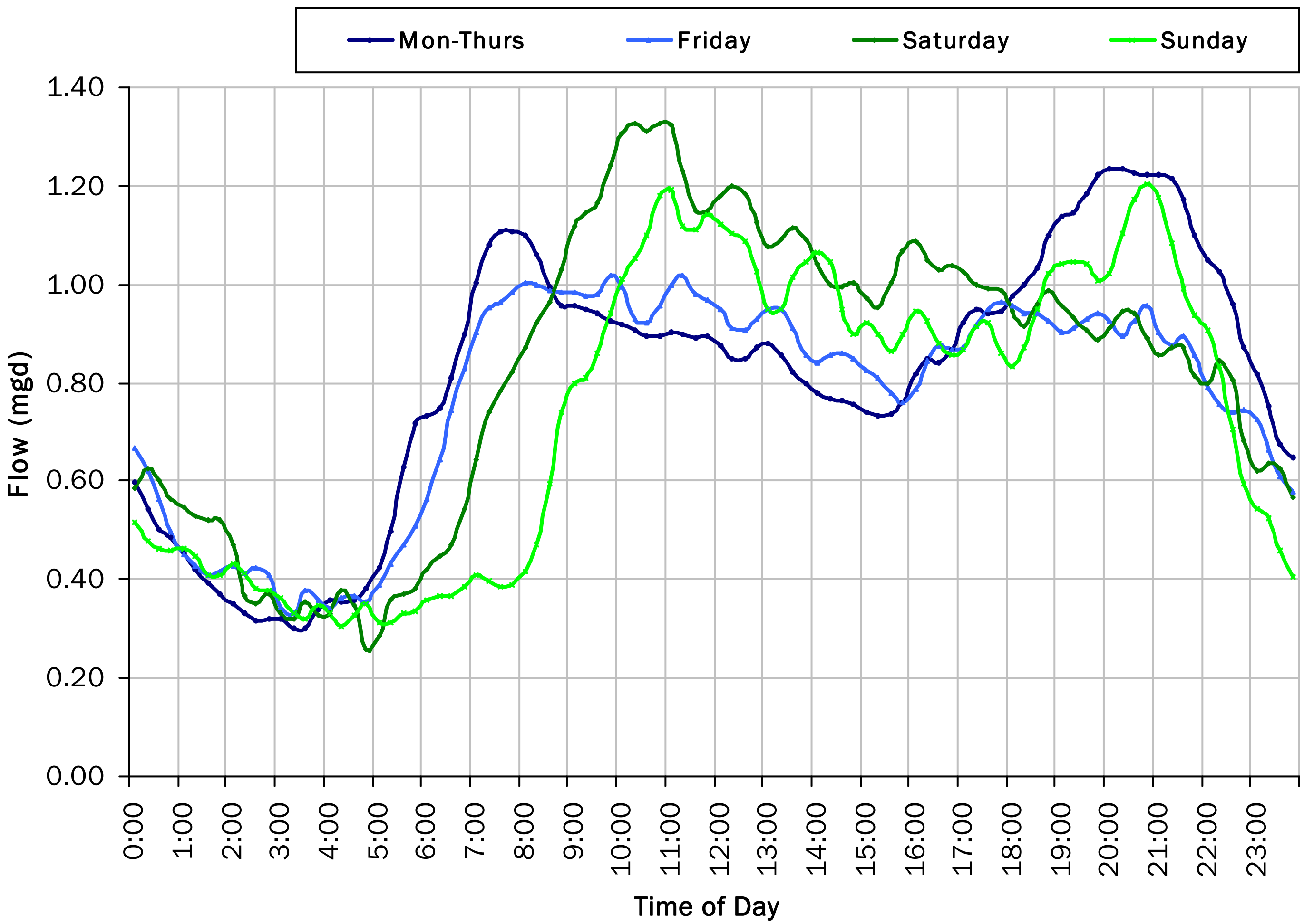
Total Period Rainfall: 7.25 inches   **Avg Flow: 0.836 mgd**   **Peak Flow: 1.744 mgd**   **Min Flow: 0.200 mgd**





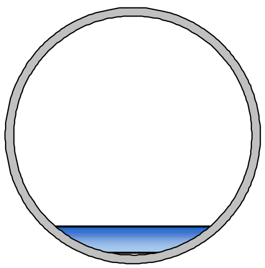
FM-02

Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)

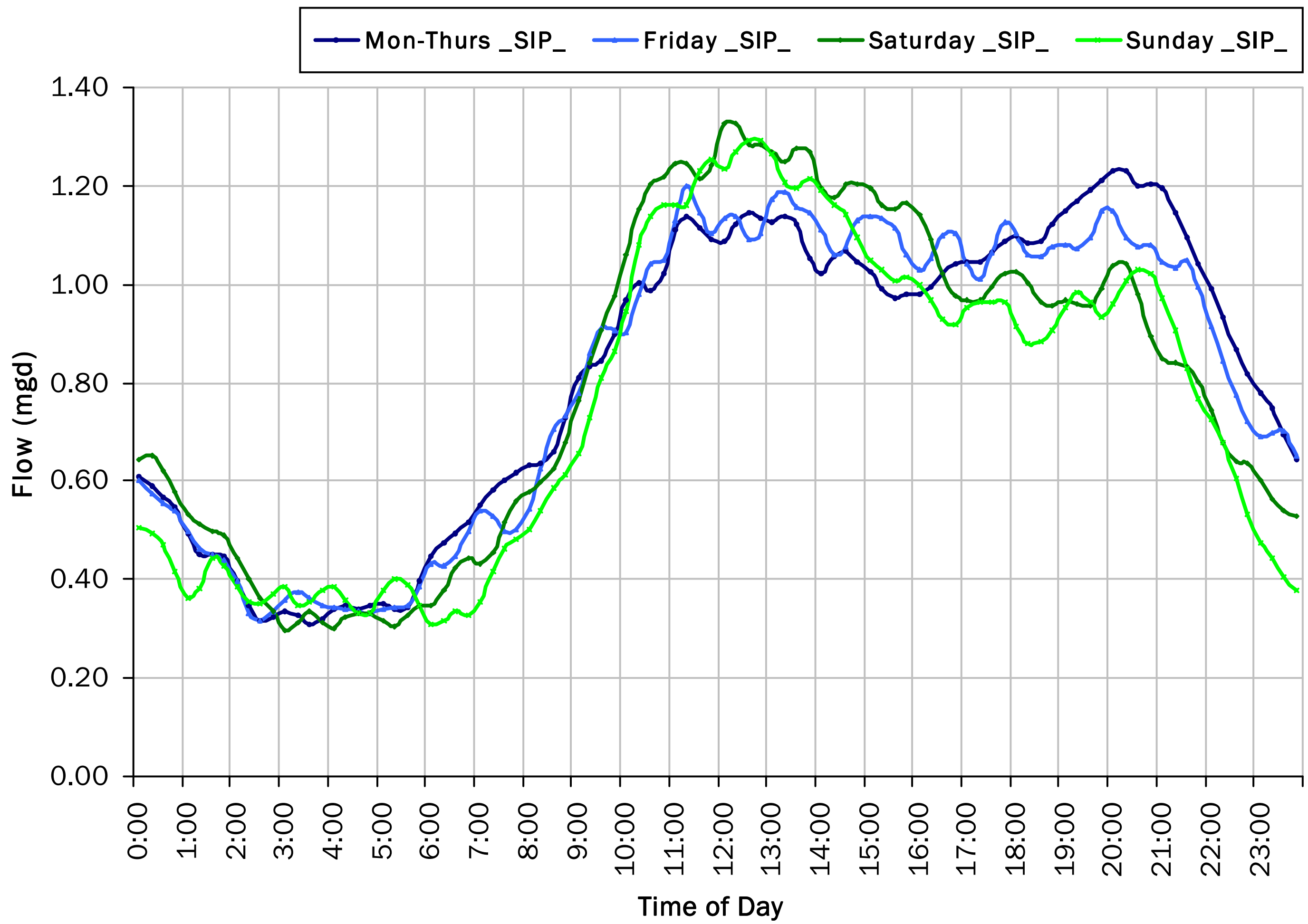


ADWF:

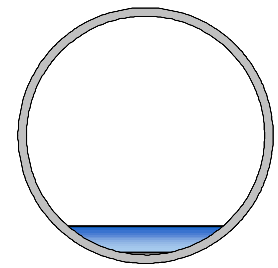
0.797 mgd



FM-02
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)

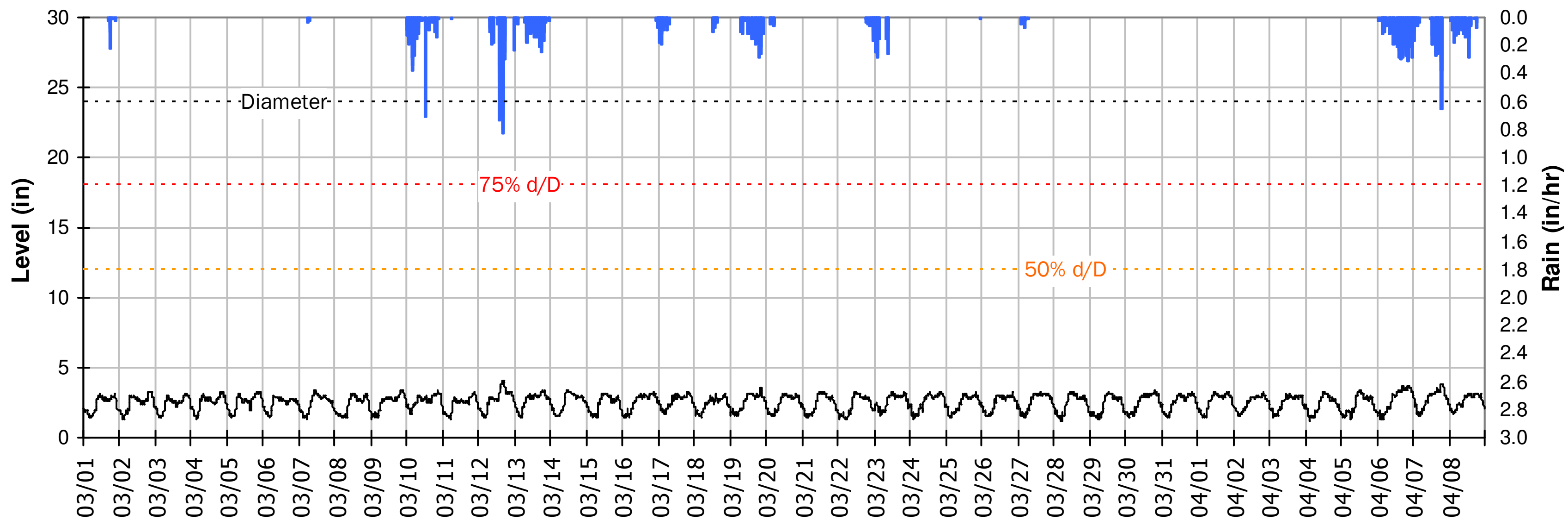


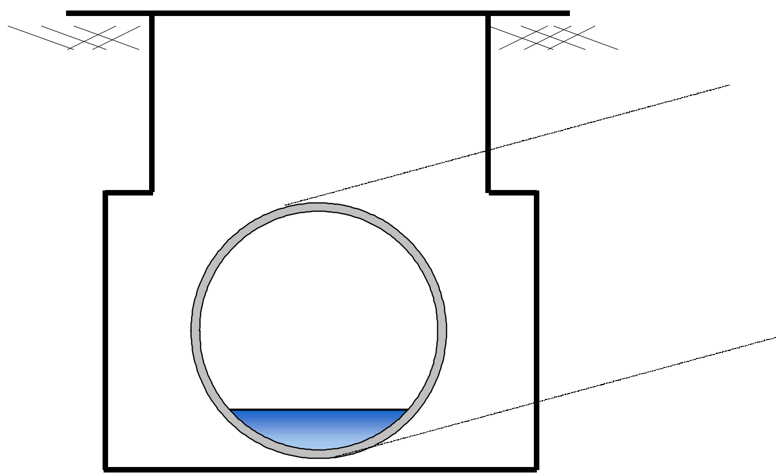
ADWF:
0.806 mgd



FM-02
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

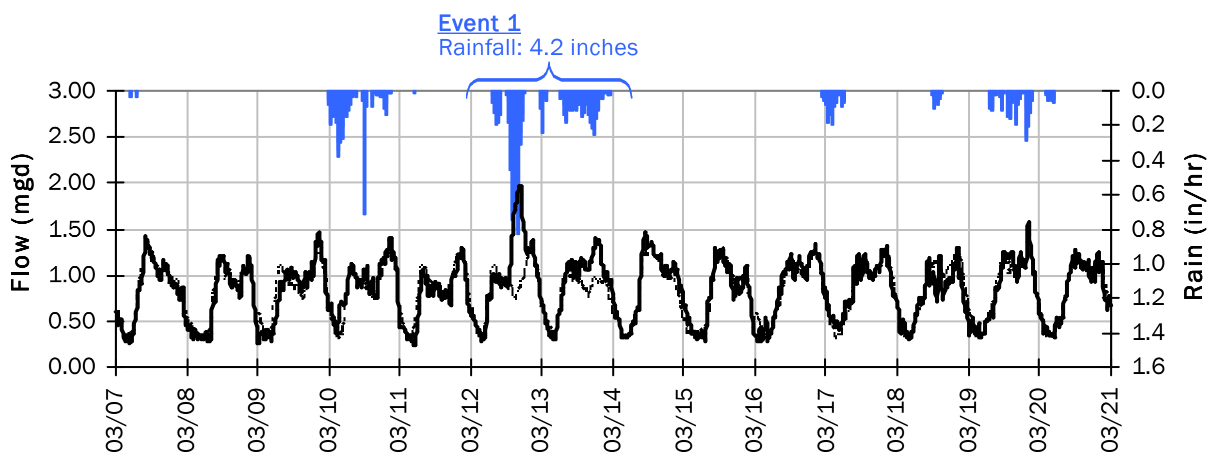




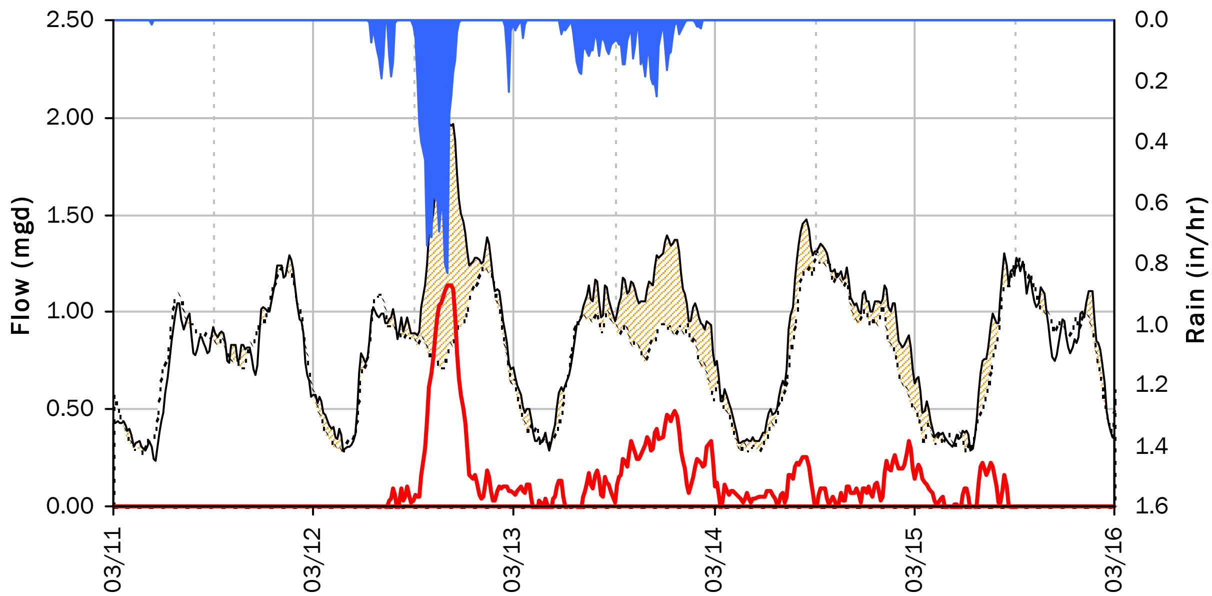
Pipe Diameter:	24	*inches*
Peak Measured Level:	4.05	*inches*
Peak d/D Ratio:	0.17	

FM-02
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

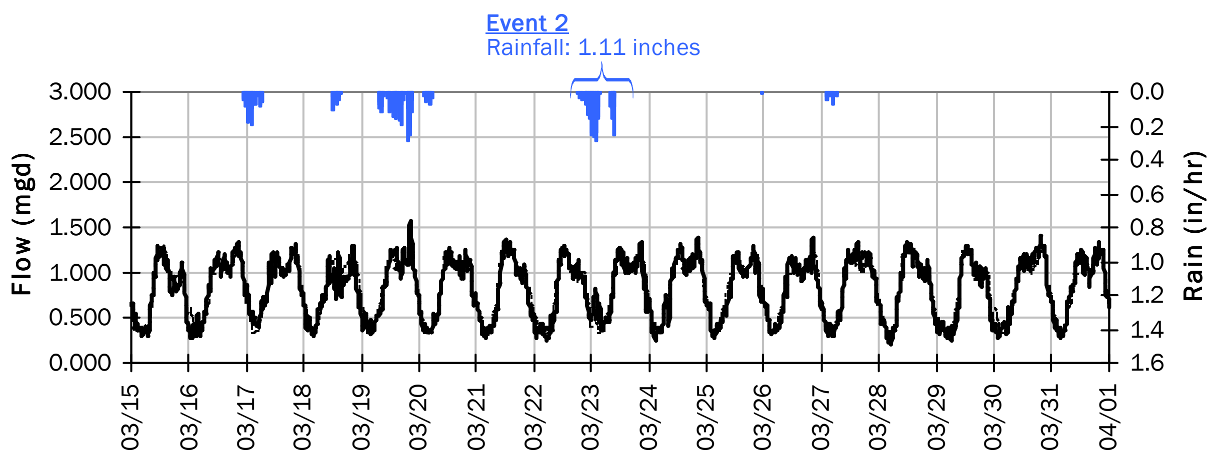


Storm Event I/I Analysis (Rain = 4.20 inches)

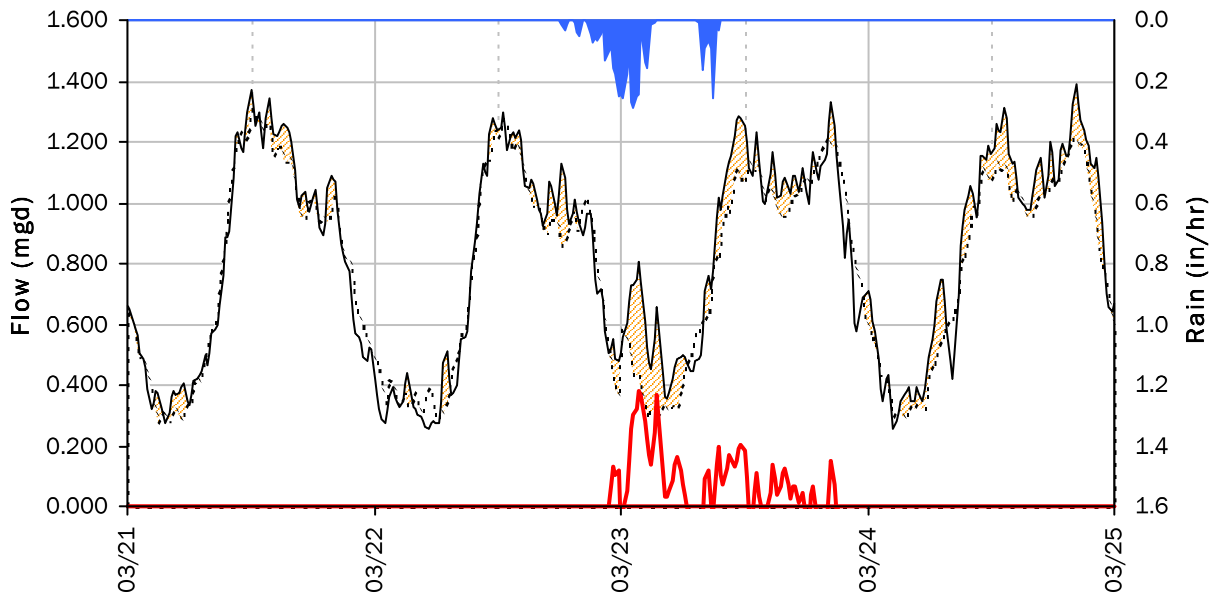
Capacity		Inflow / Infiltration	
Peak Flow:	1.97 *mgd*	**Peak I/I Rate:**	1.14 *mgd*
PF:	2.45	**Total I/I:**	518,000 *gallons*
Peak Level:	4.05 *in*		
d/D Ratio:	0.17		

FM-02
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

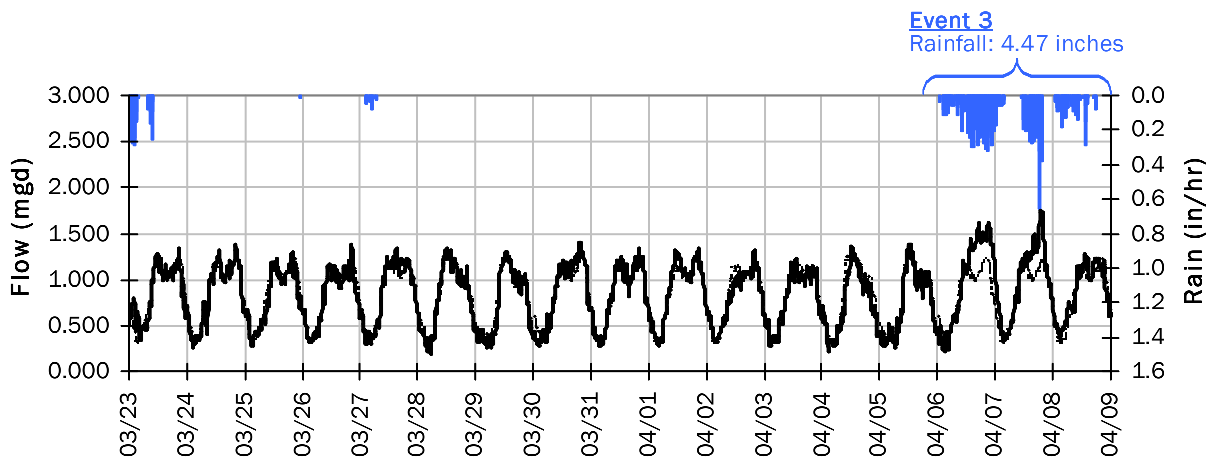


Storm Event I/I Analysis (Rain = 1.11 inches)

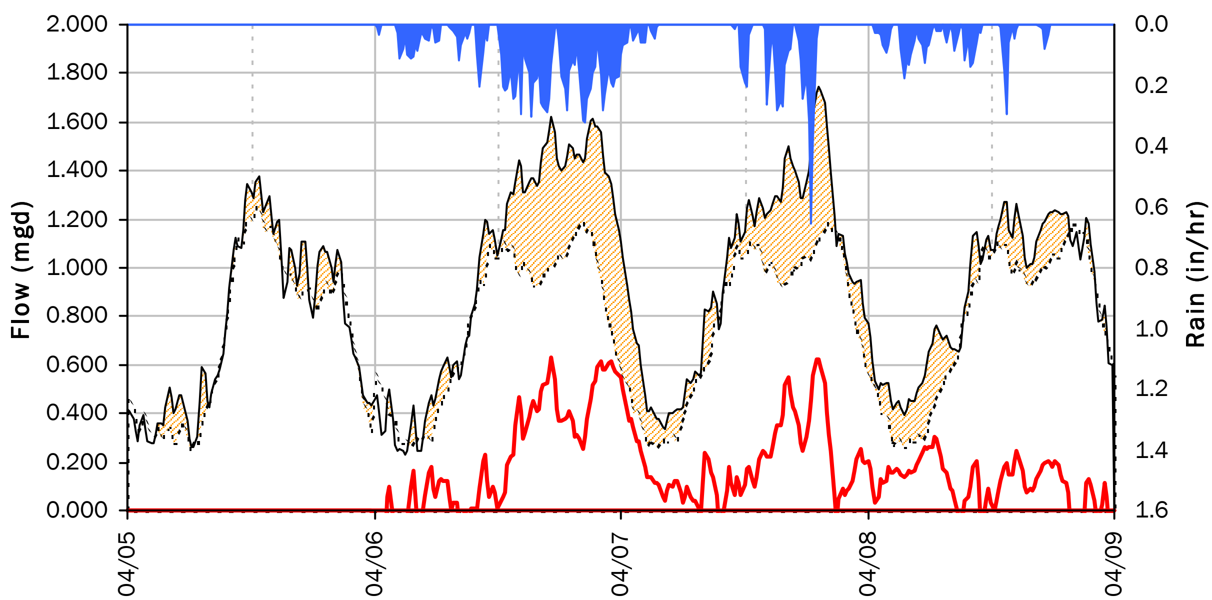
Capacity		Inflow / Infiltration	
Peak Flow:	1.33 *mgd*	**Peak I/I Rate:**	0.38 *mgd*
PF:	1.66	**Total I/I:**	77,000 *gallons*
Peak Level:	3.30 *in*		
d/D Ratio:	0.14		

FM-02
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



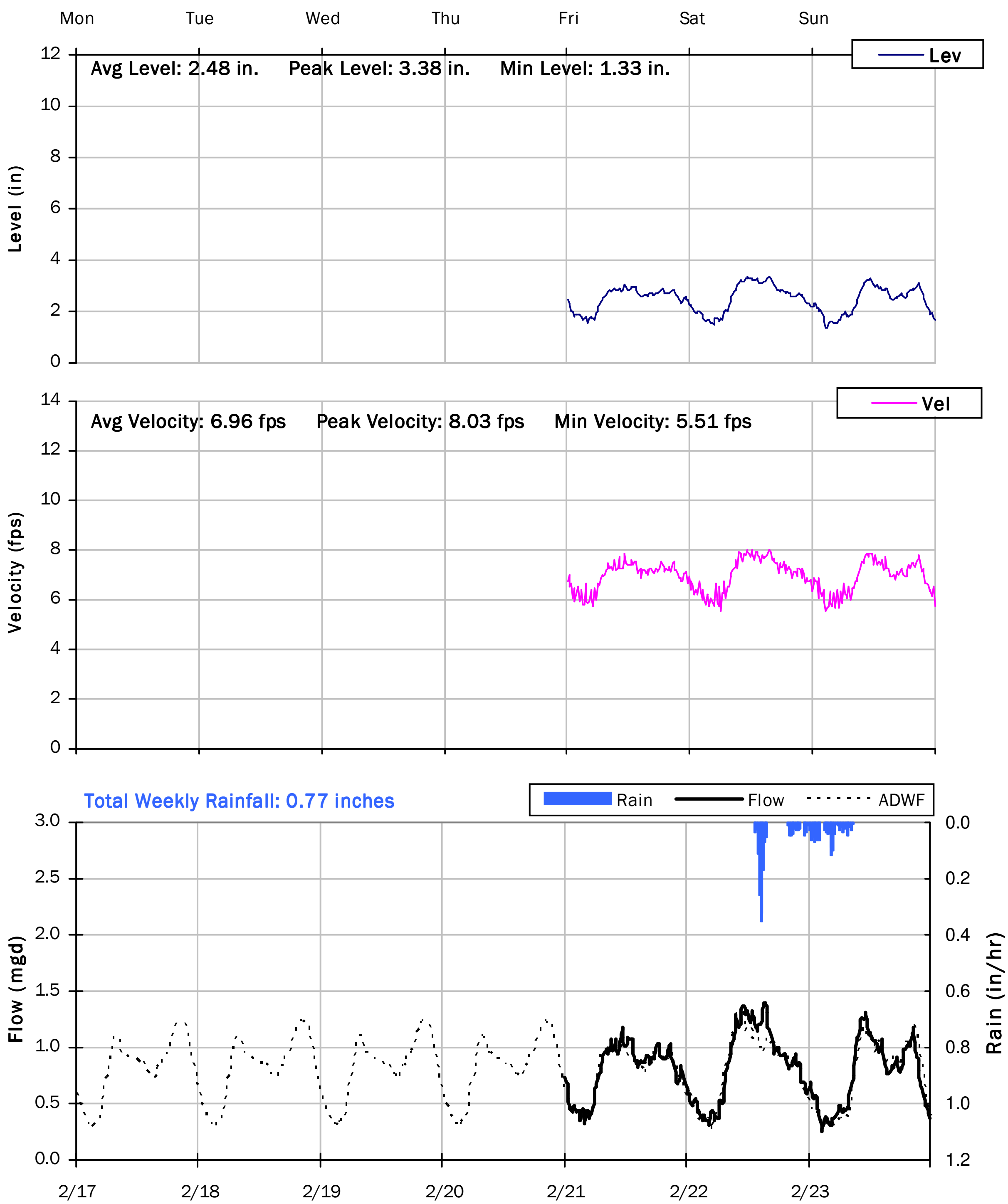
Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 4.47 inches)

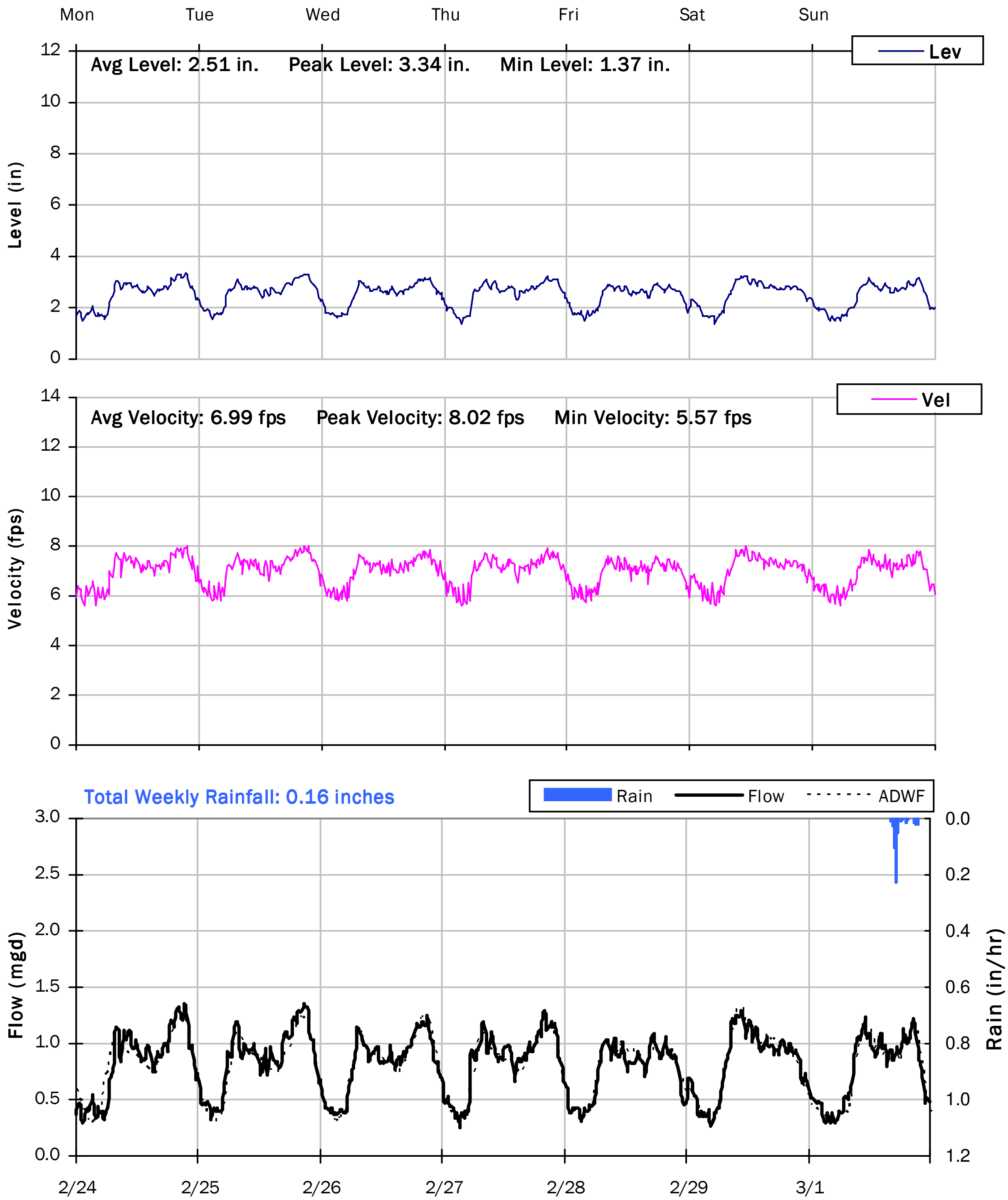
Capacity		Inflow / Infiltration	
Peak Flow:	1.74 *mgd*	**Peak I/I Rate:**	0.63 *mgd*
PF:	2.18	**Total I/I:**	542,000 *gallons*
Peak Level:	3.80 *in*		
d/D Ratio:	0.16		

FM-02
Weekly Level, Velocity and Flow Hydrographs
2/17/2020 to 2/24/2020



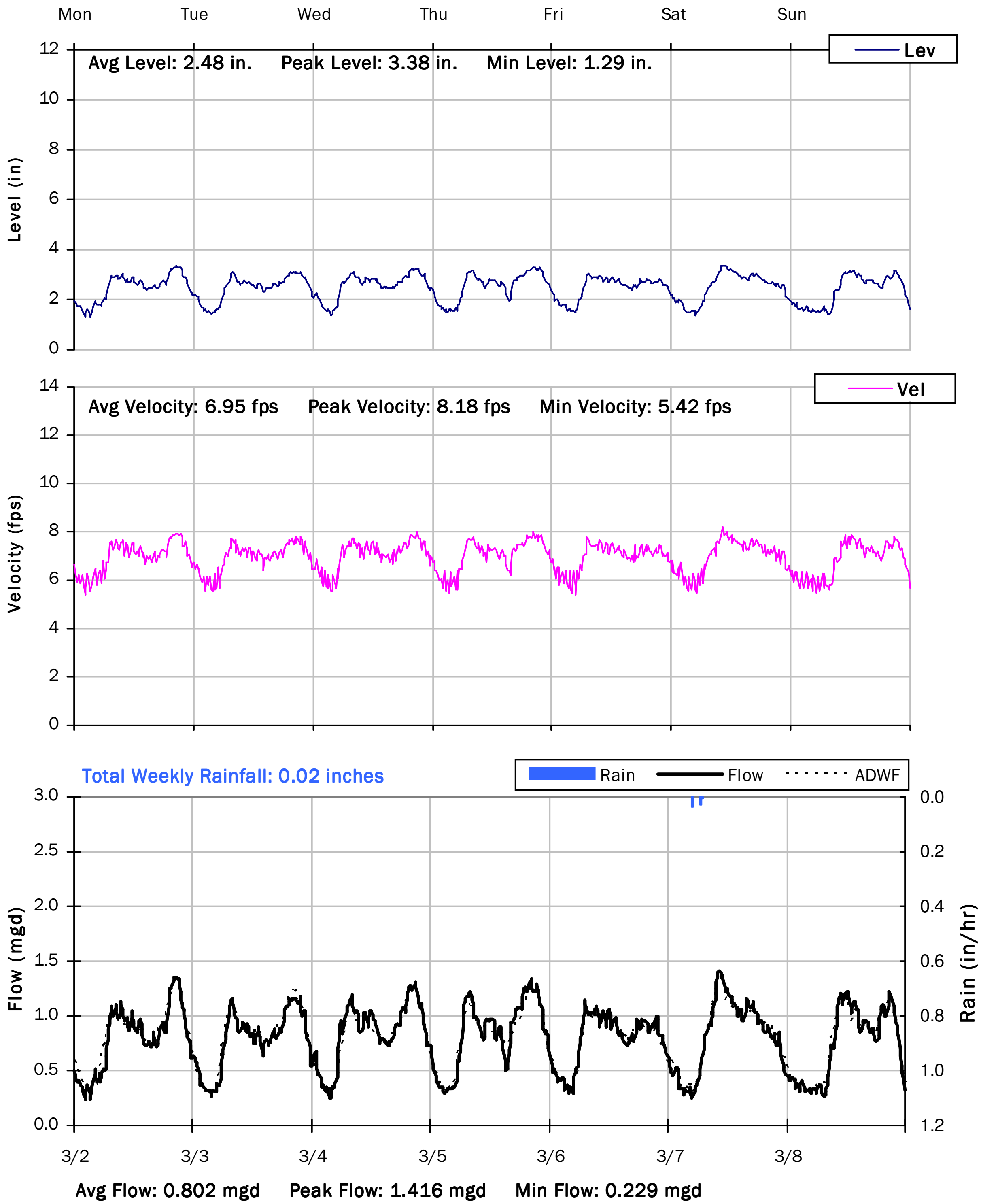
Avg Flow: 0.803 mgd **Peak Flow: 1.398 mgd** **Min Flow: 0.250 mgd**

FM-02
Weekly Level, Velocity and Flow Hydrographs
2/24/2020 to 3/2/2020

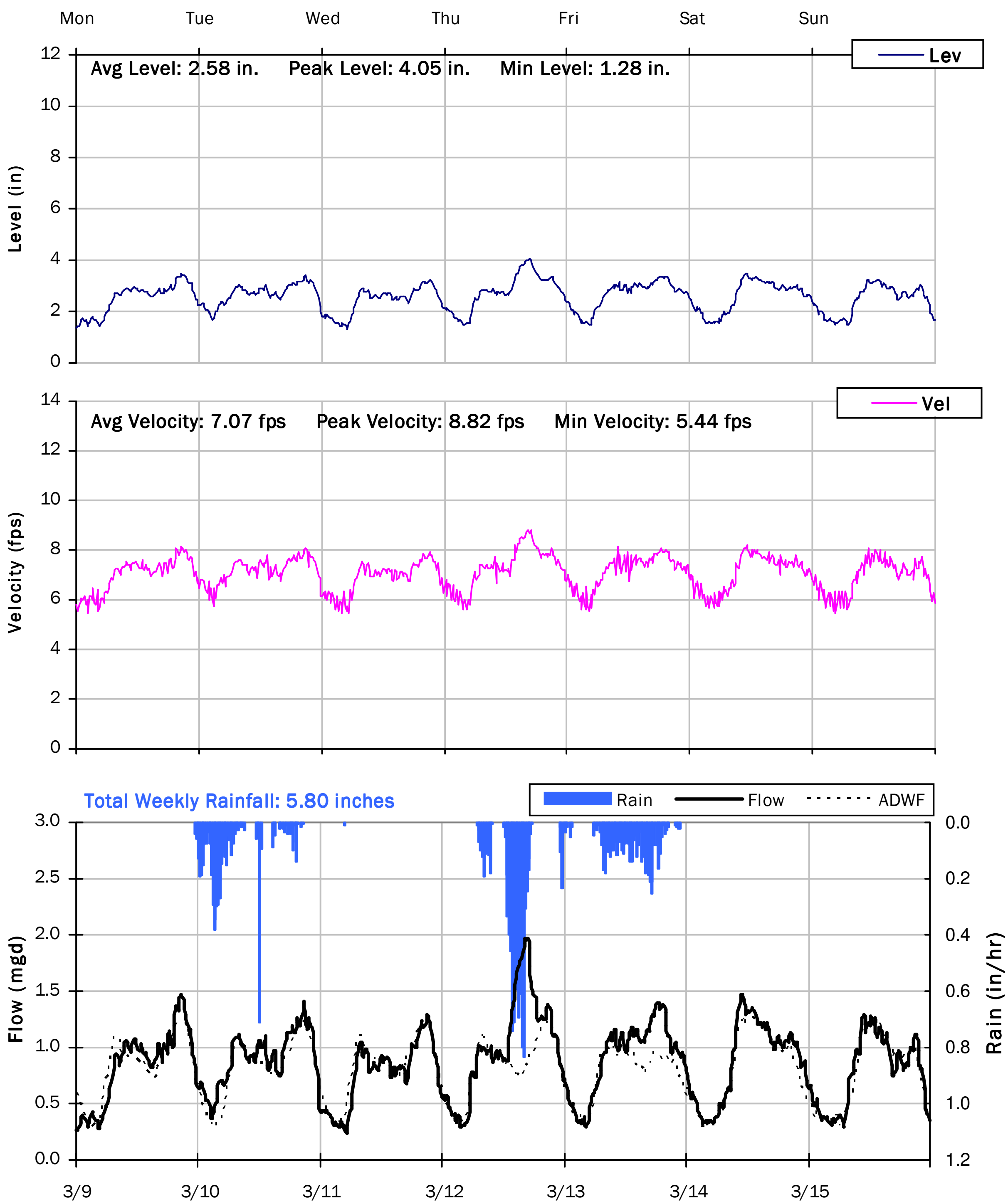


Avg Flow: 0.817 mgd Peak Flow: 1.359 mgd Min Flow: 0.257 mgd

FM-02
Weekly Level, Velocity and Flow Hydrographs
3/2/2020 to 3/9/2020

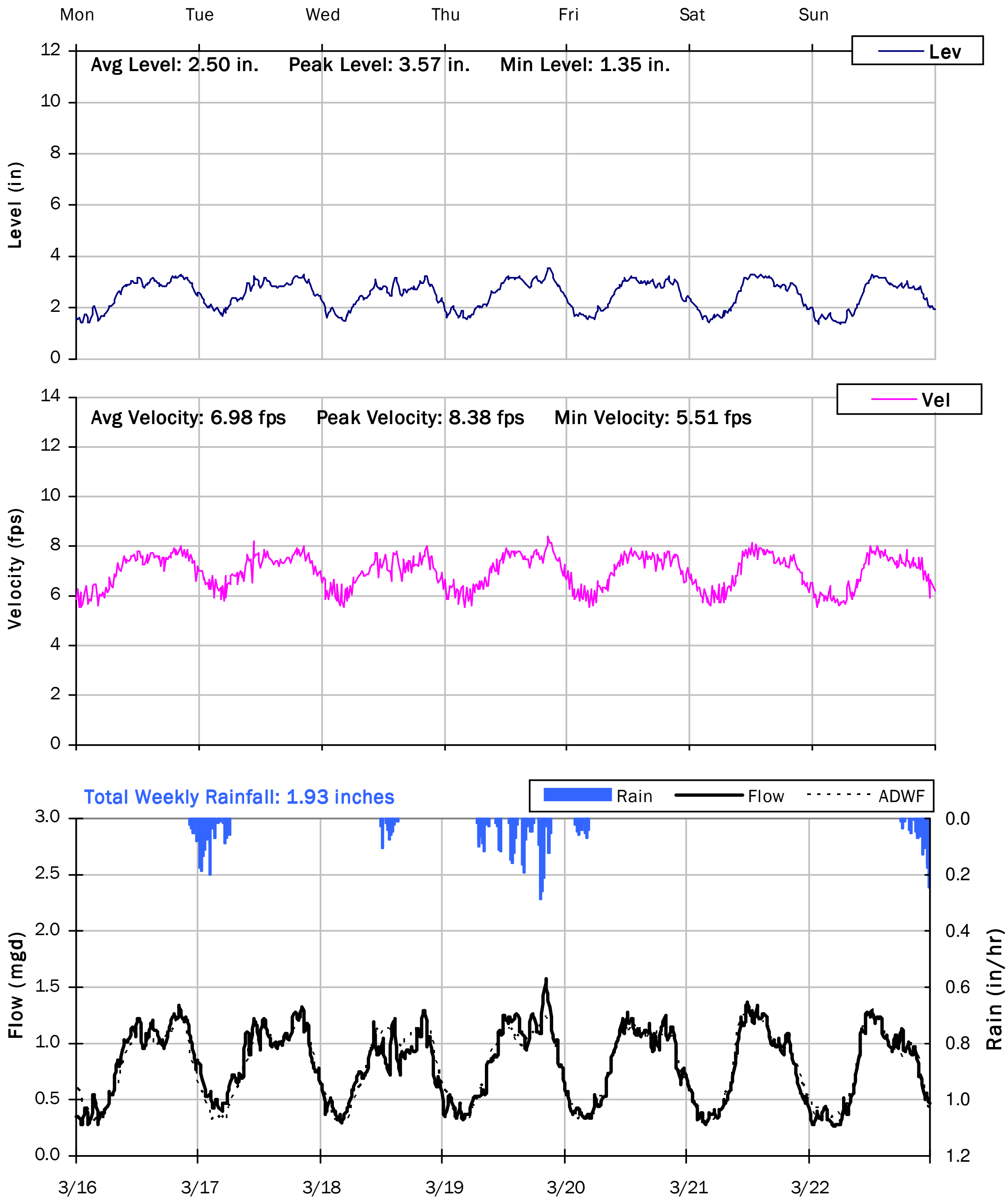


FM-02
Weekly Level, Velocity and Flow Hydrographs
3/9/2020 to 3/16/2020



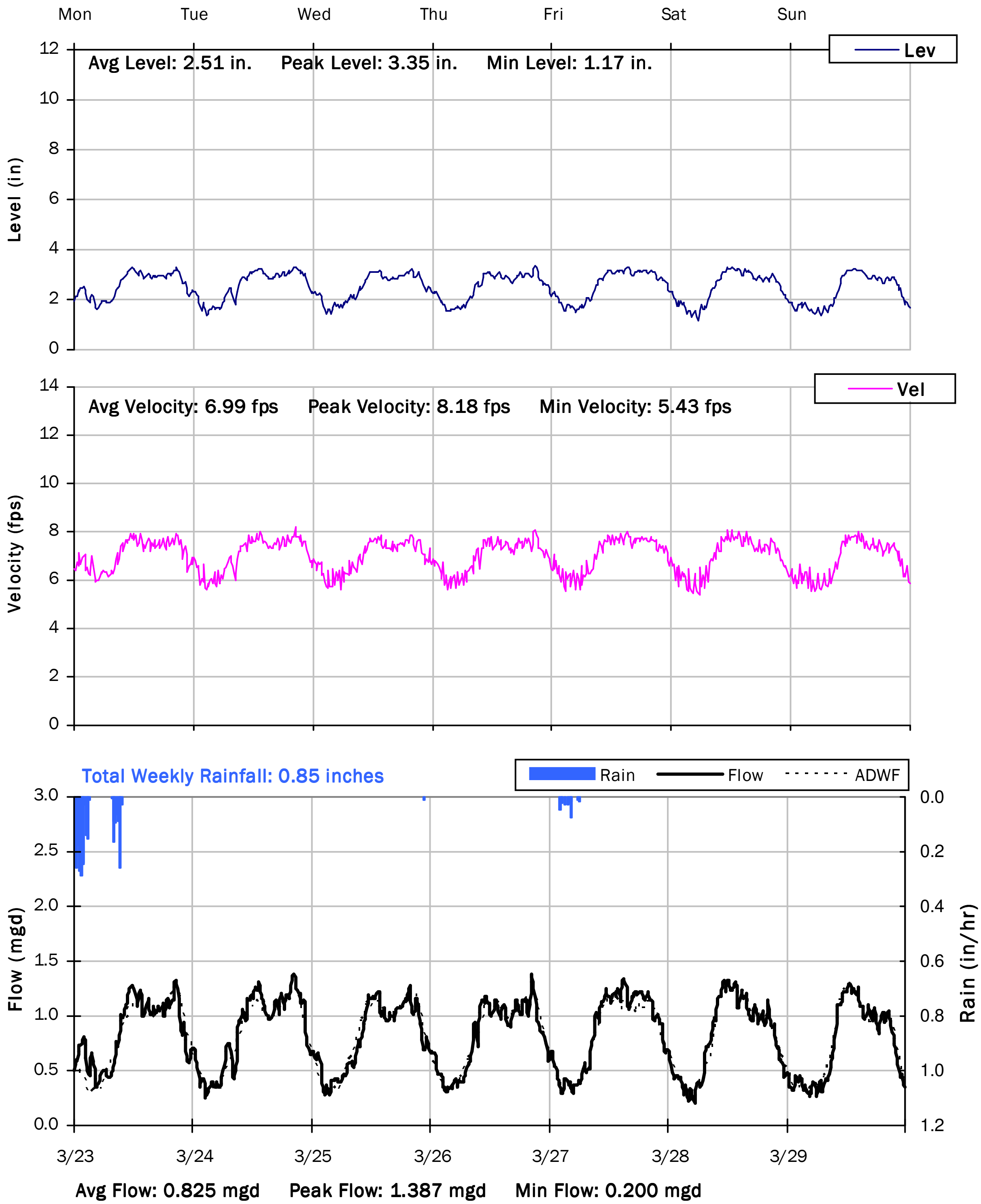
Avg Flow: 0.870 mgd **Peak Flow: 1.967 mgd** **Min Flow: 0.240 mgd**

FM-02
Weekly Level, Velocity and Flow Hydrographs
3/16/2020 to 3/23/2020

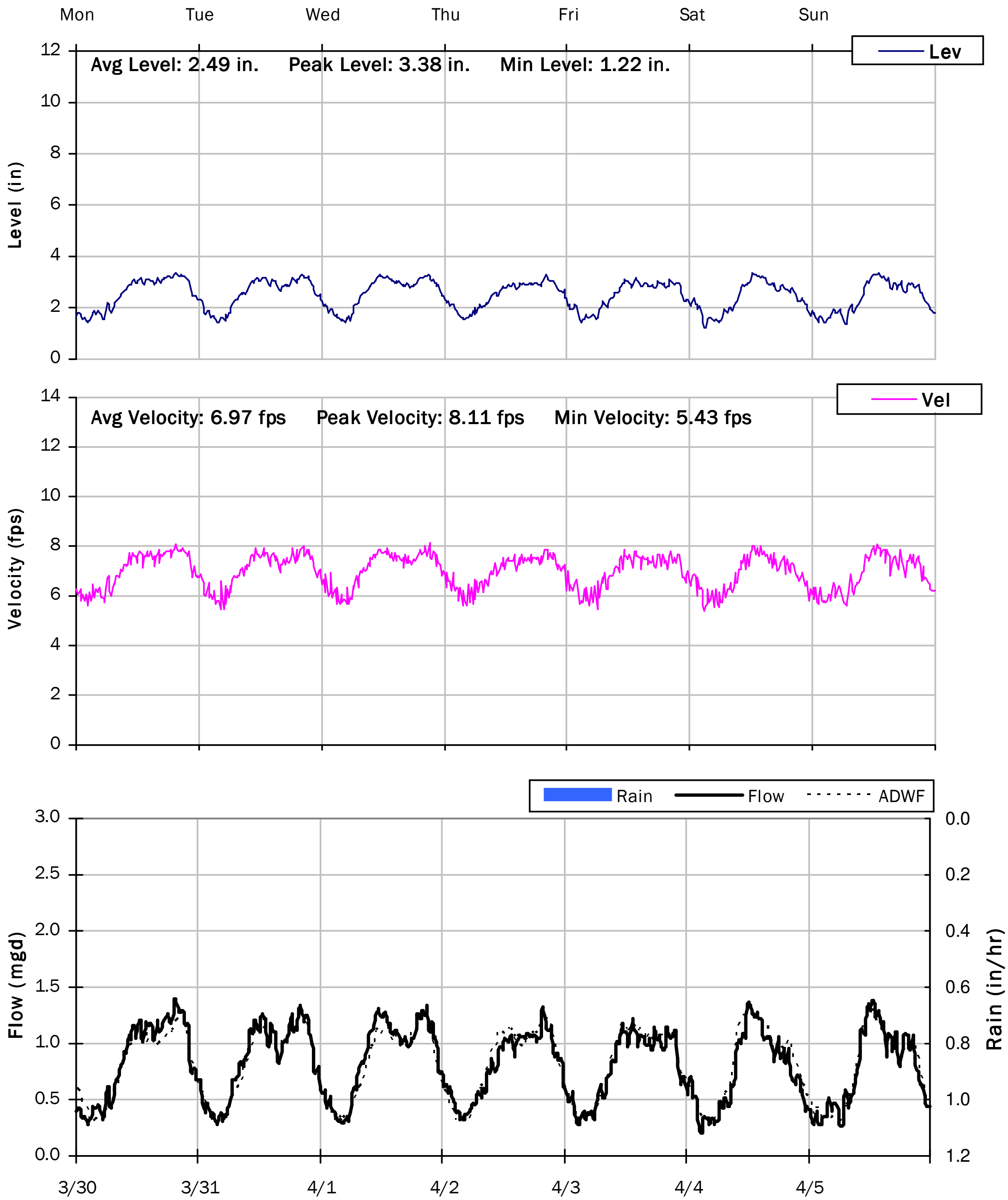


Avg Flow: 0.820 mgd Peak Flow: 1.572 mgd Min Flow: 0.257 mgd

FM-02
Weekly Level, Velocity and Flow Hydrographs
3/23/2020 to 3/30/2020

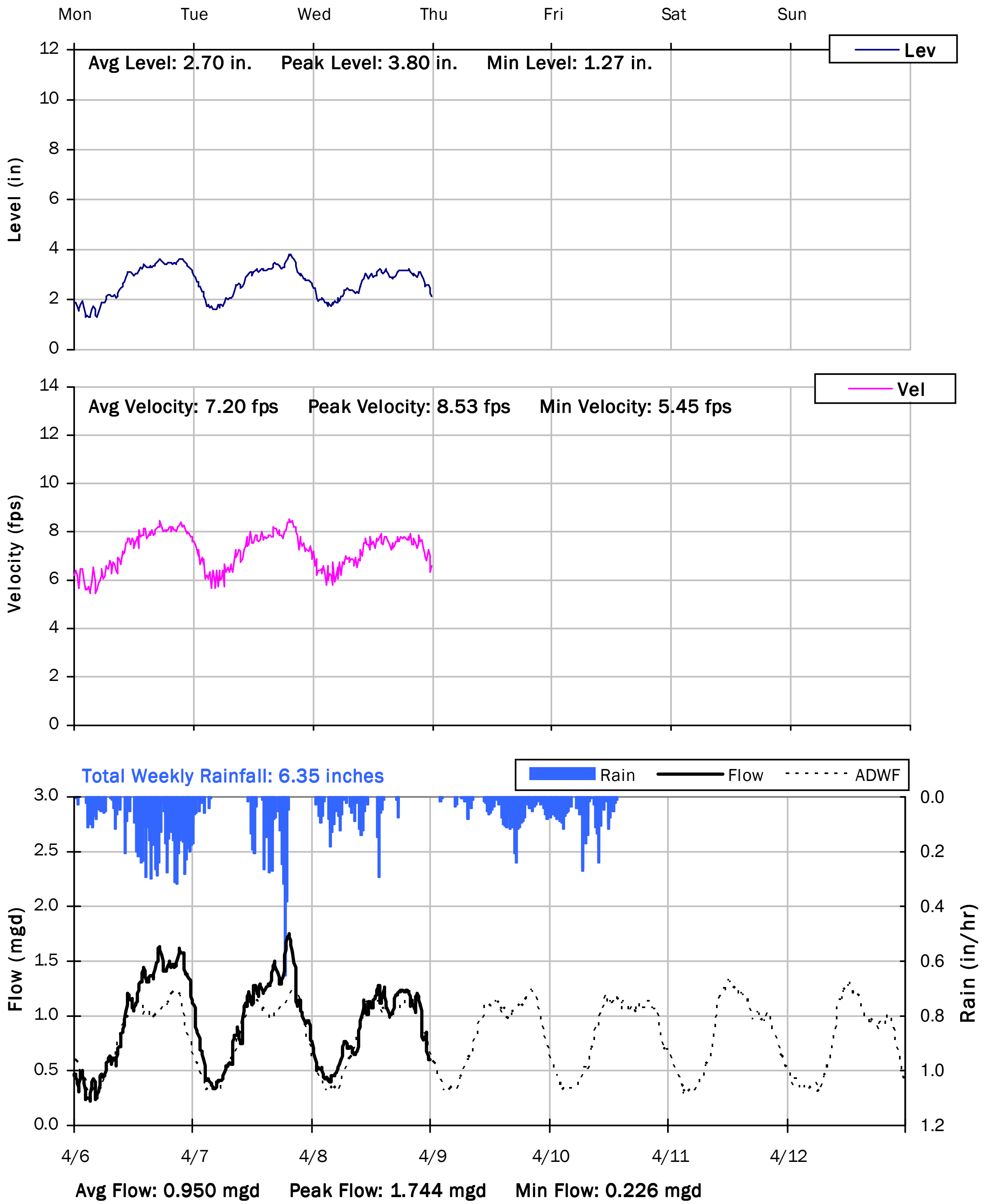


FM-02
Weekly Level, Velocity and Flow Hydrographs
3/30/2020 to 4/6/2020



Avg Flow: 0.816 mgd **Peak Flow: 1.401 mgd** **Min Flow: 0.212 mgd**

FM-02
Weekly Level, Velocity and Flow Hydrographs
4/6/2020 to 4/13/2020



City of Beaumont

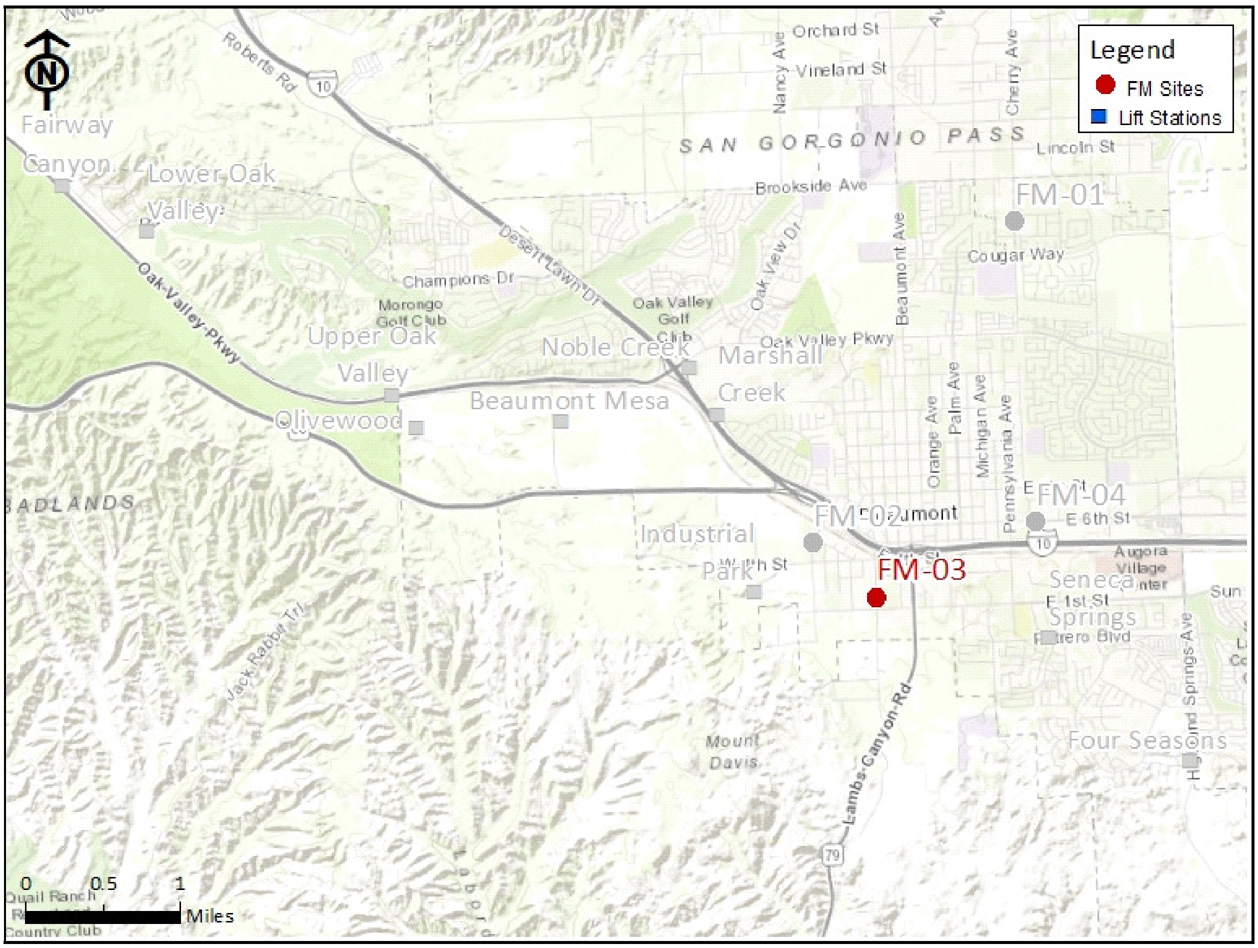
Sanitary Sewer Flow Monitoring
February 20 - April 09, 2020

Monitoring Site: FM-03

City Structure: SSMH00381

Location: California Avenue north of East 1st Street

Data Summary Report



Vicinity Map: FM-03

FM-03

Site Information

Location: California Avenue north of East 1st Street

City Manhole: SSMH00381

Coordinates: 116.9813° W, 33.9228° N

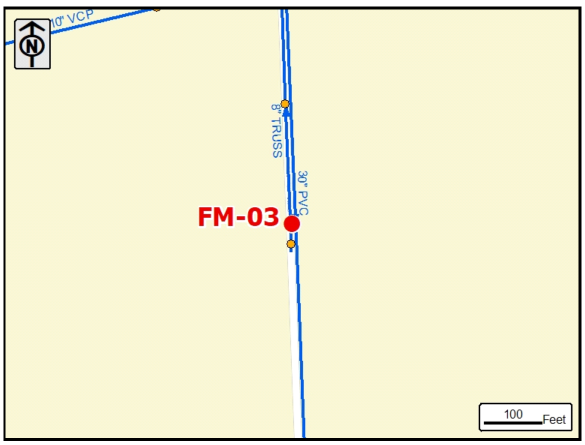
Rim Elevation (Earth): 2576 feet

Pipe Diameter: 31 inches

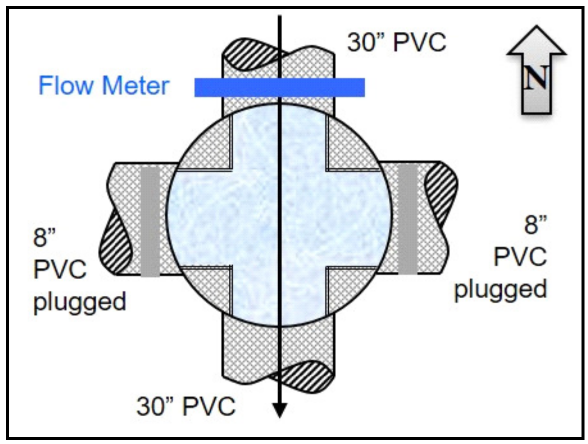
ADWF: 1.074 mgd

Peak Measured Flow: 3.207 mgd

Satellite Map

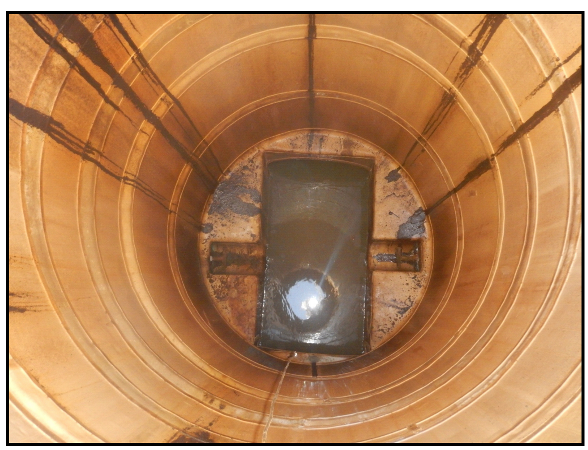


Sanitary Map



Flow Sketch

Street View

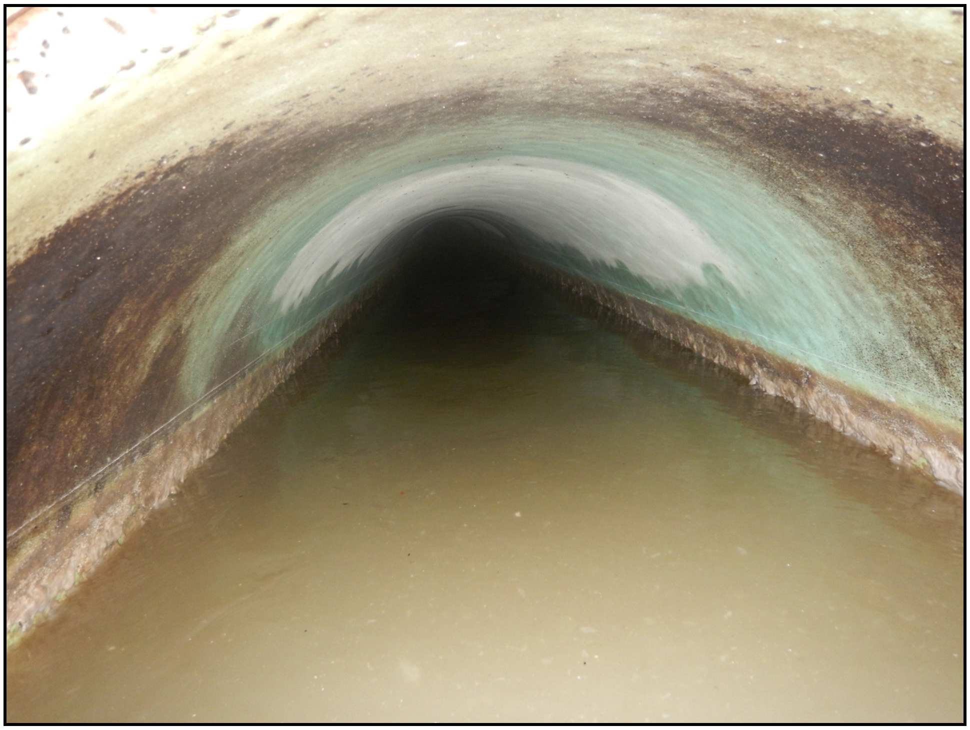


Plan View

FM-03

Additional Site Photos

Effluent Pipe



Monitored Influent Pipe

FM-03

Additional Site Photos

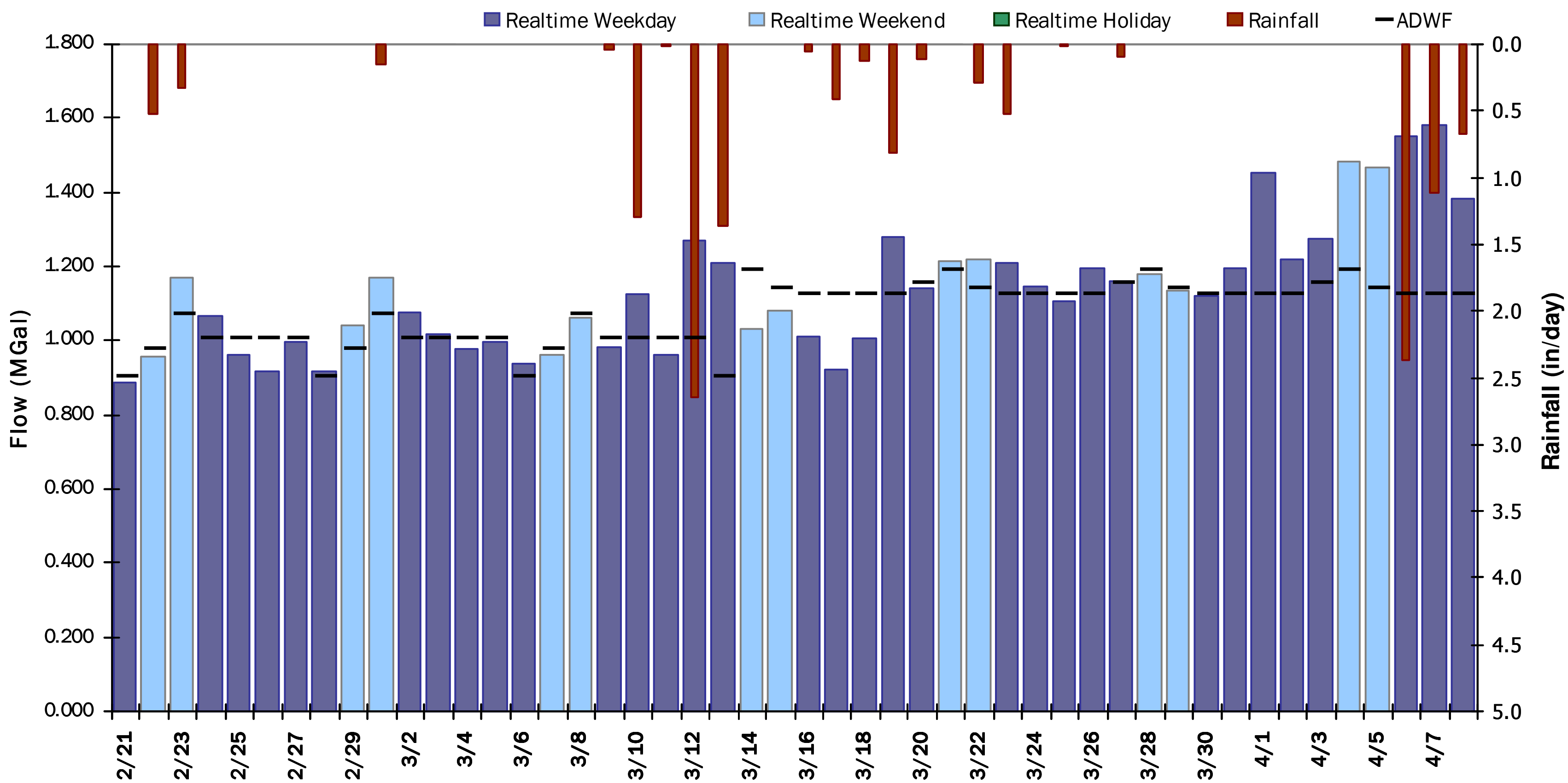
Lateral Pipe

FM-03

Period Flow Summary: Daily Flow Totals

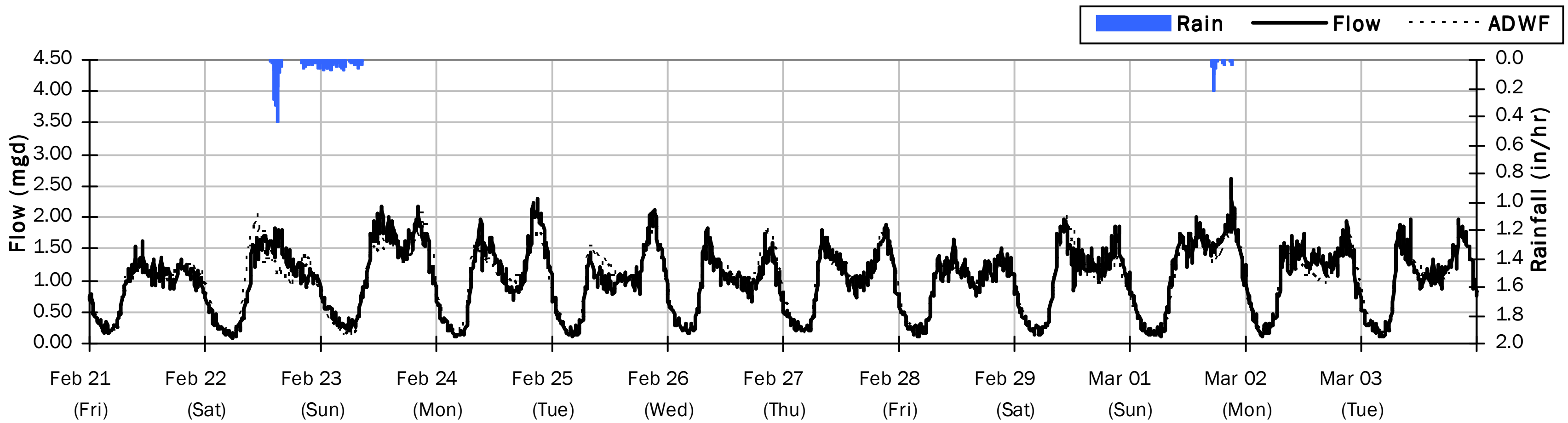
Avg Period Flow: 1.134 MGal **Peak Daily Flow: 1.582 MGal** **Min Daily Flow: 0.888 MGal**

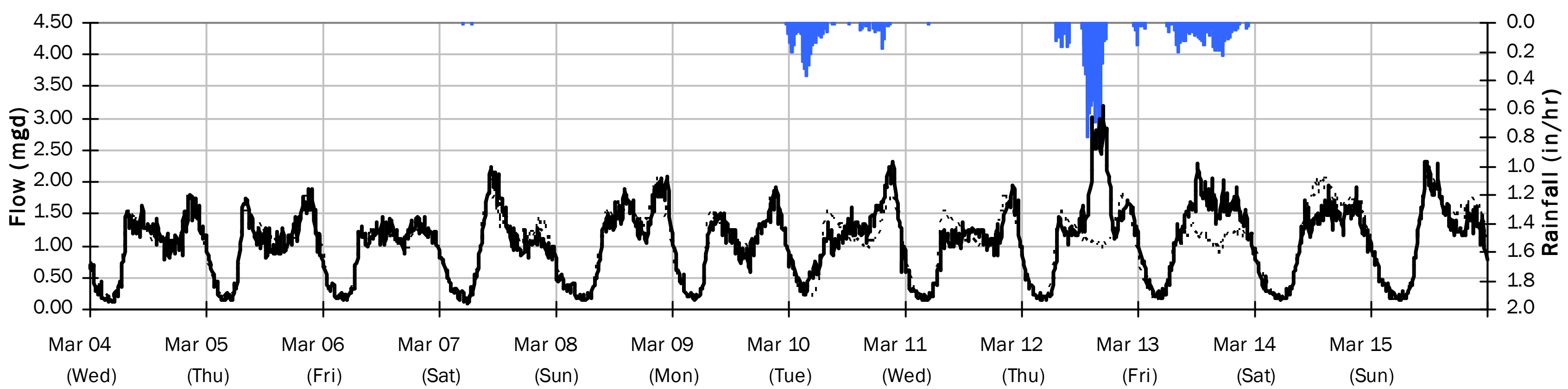
Total Period Rainfall: 12.96 inches



FM-03
Flow Summary: 2/21/2020 to 3/15/2020

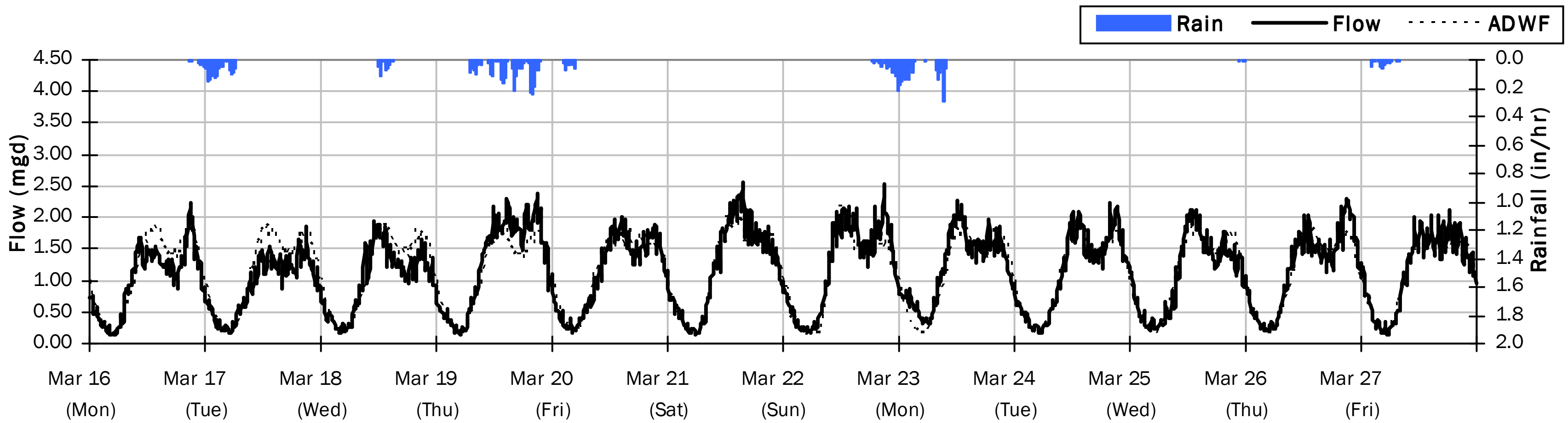
Total Period Rainfall: 6.37 inches   **Avg Flow: 1.033 mgd**   **Peak Flow: 3.207 mgd**   **Min Flow: 0.095 mgd**

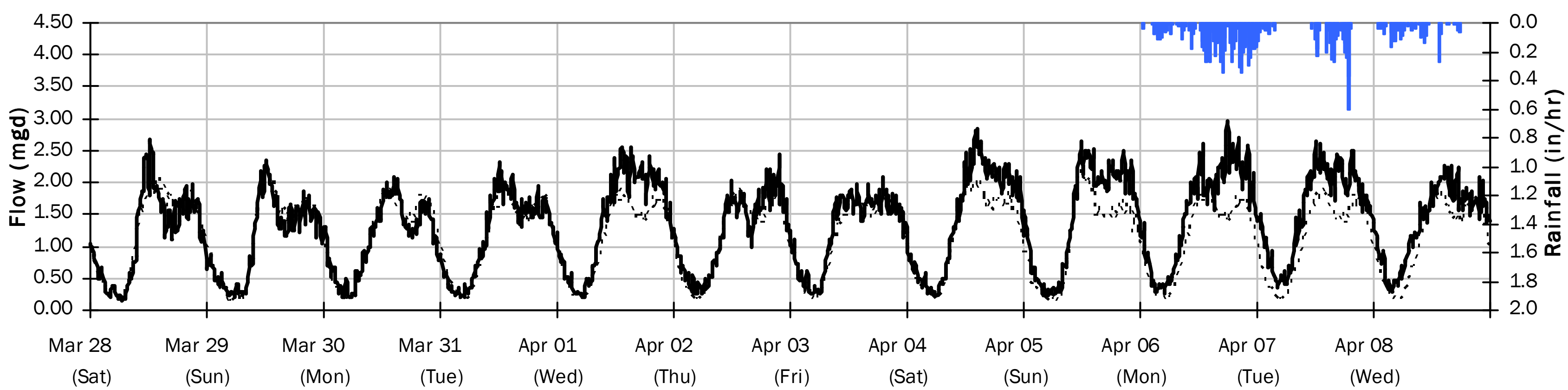




FM-03
Flow Summary: 3/16/2020 to 4/8/2020

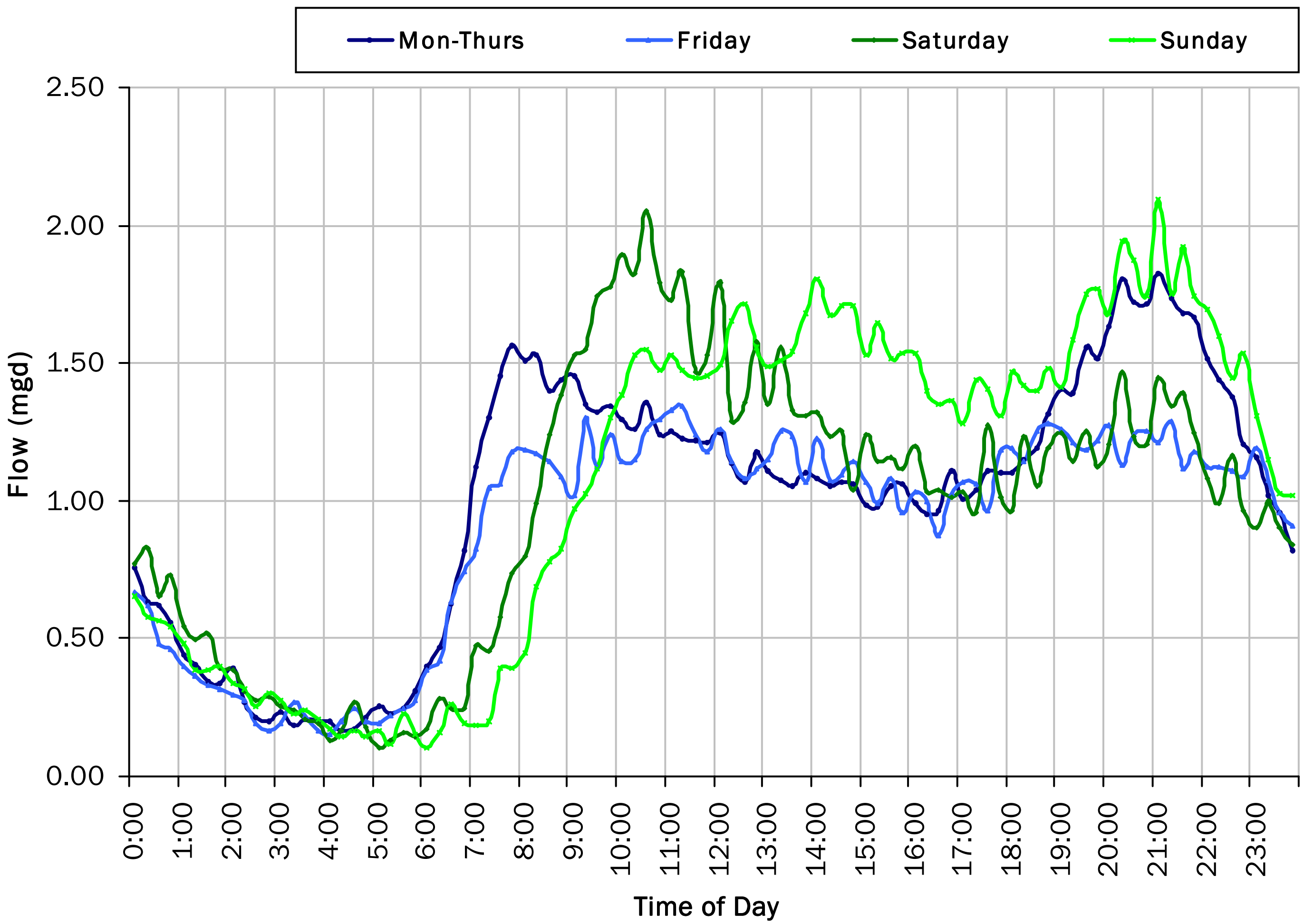
Total Period Rainfall: 6.59 inches   **Avg Flow: 1.236 mgd**   **Peak Flow: 2.973 mgd**   **Min Flow: 0.141 mgd**



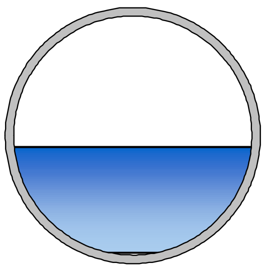


FM-03

Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)

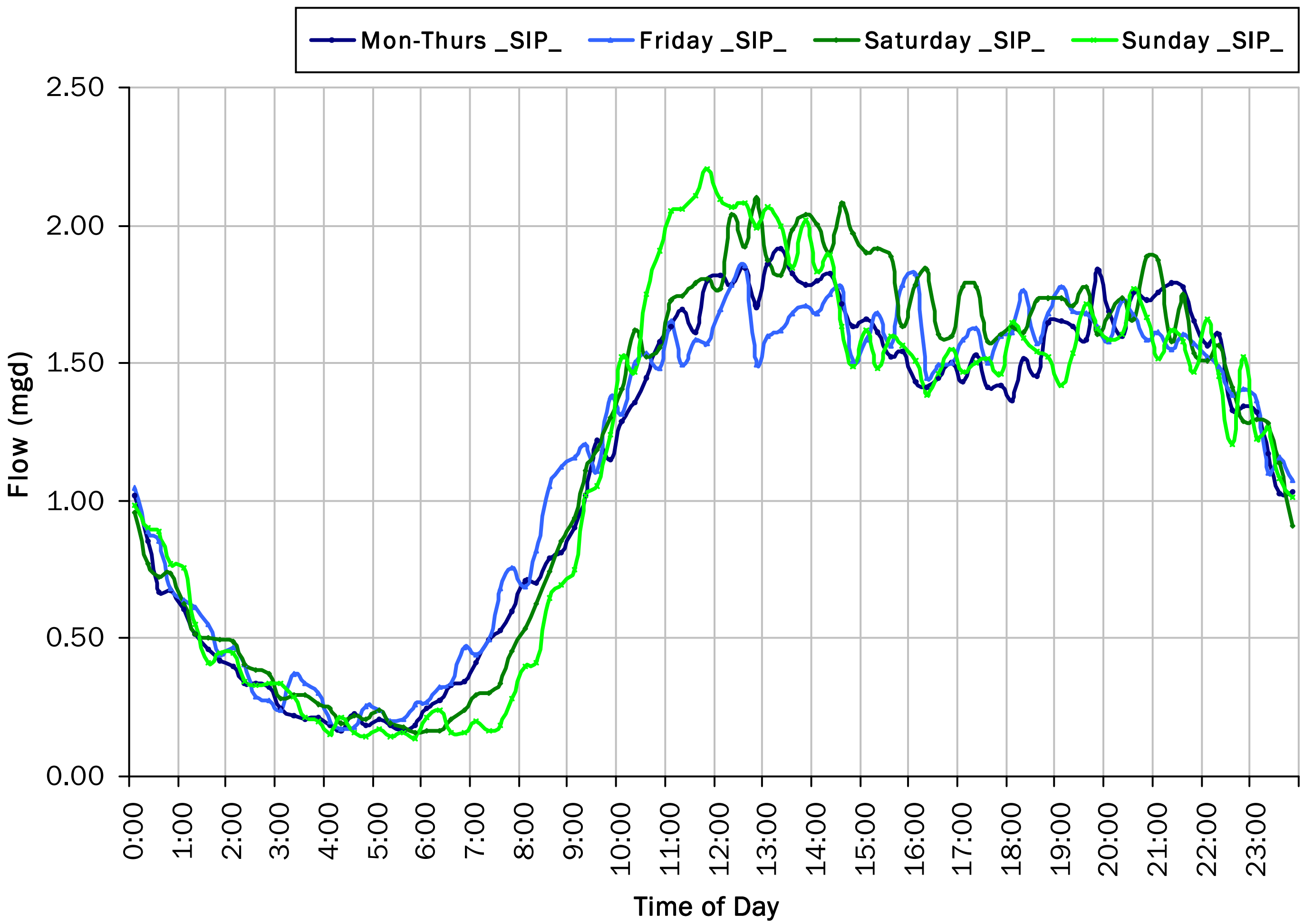


ADWF:
0.996 mgd

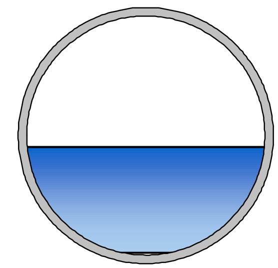


FM-03

Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)



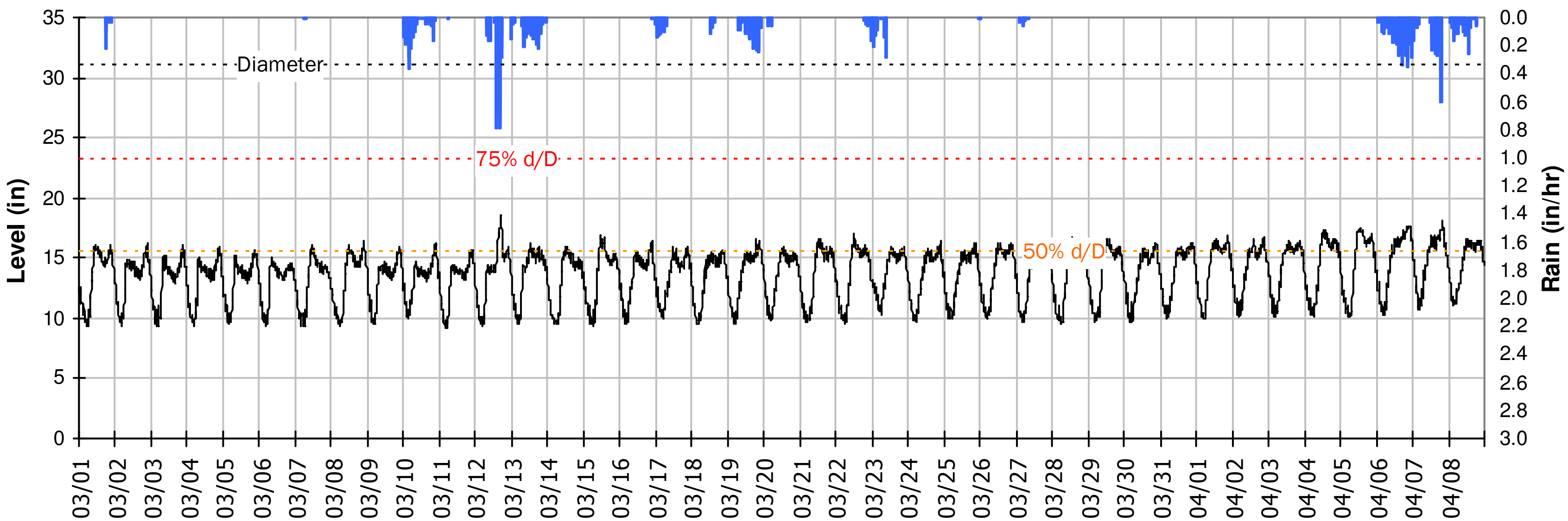
ADWF:
1.142 mgd

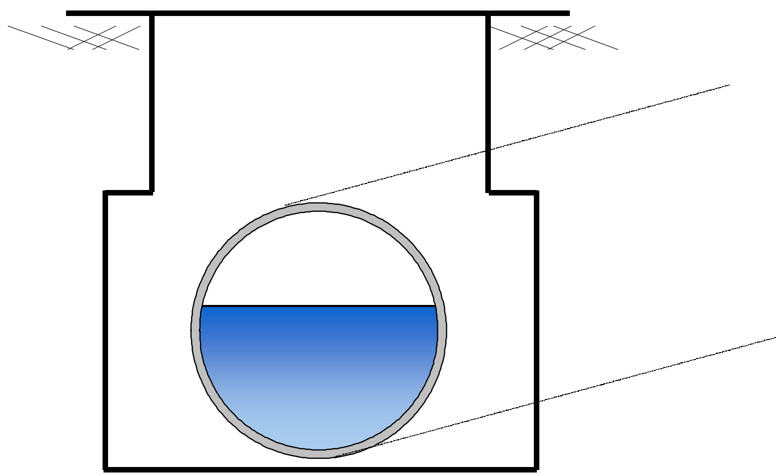


FM-03

Site Capacity and Surcharge Summary

__Realtime Flow Levels with Rainfall Data over Monitoring Period__

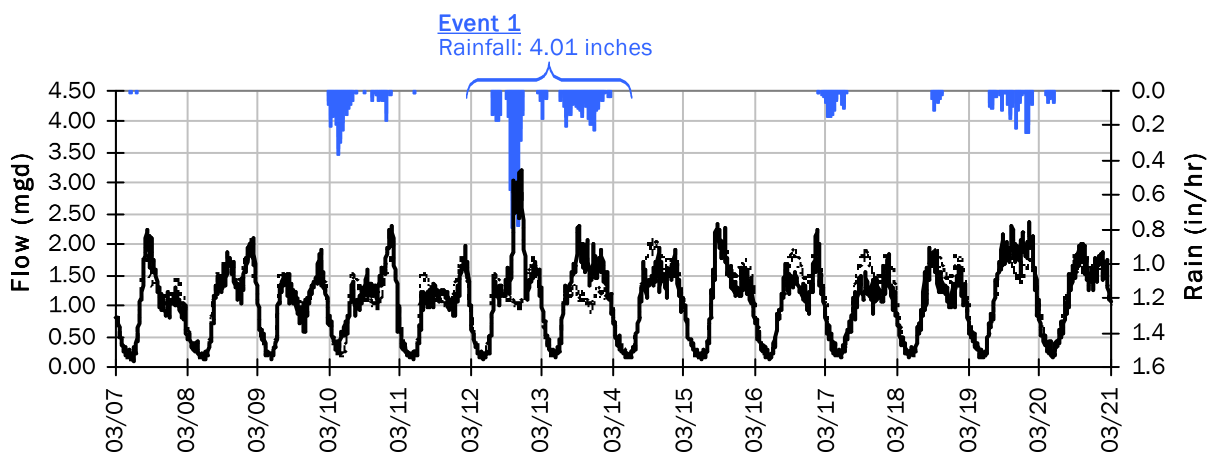




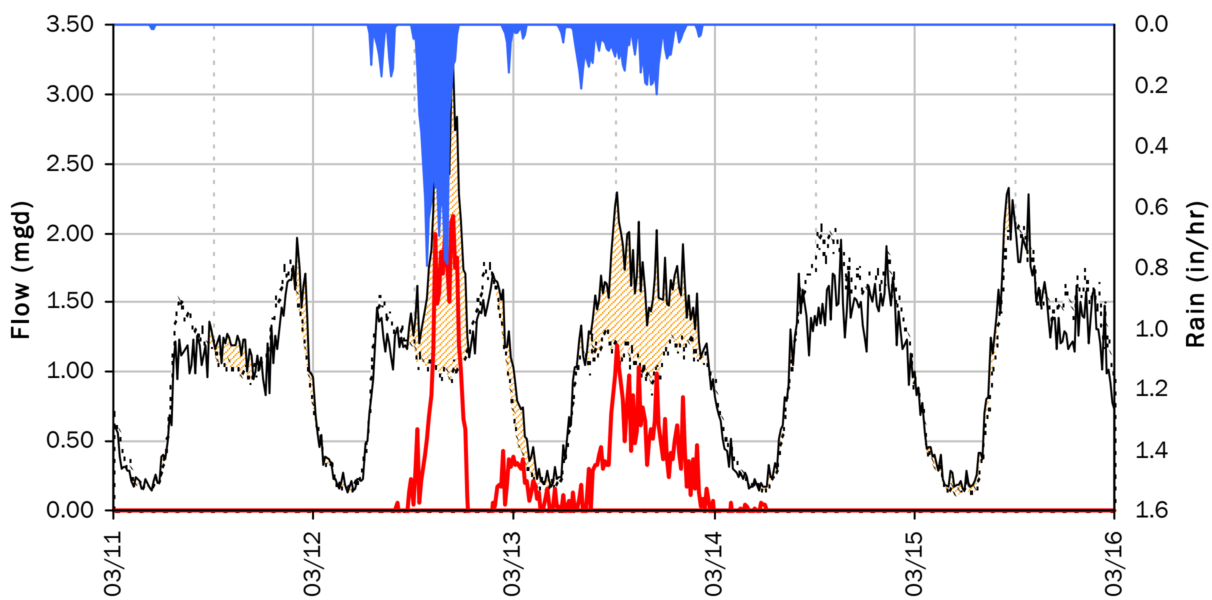
Pipe Diameter:	31	*inches*
Peak Measured Level:	18.6	*inches*
Peak d/D Ratio:	0.60	

FM-03
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

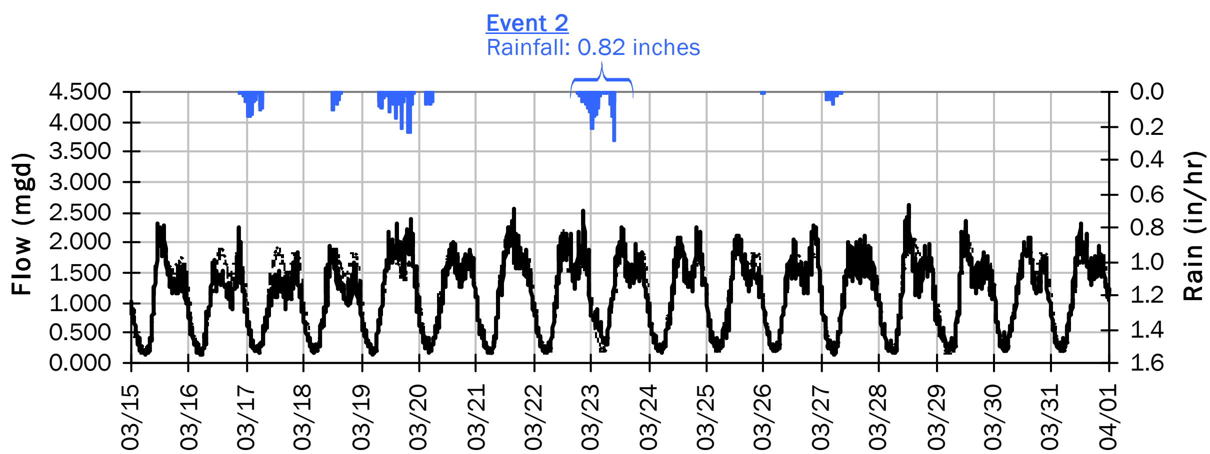


Storm Event I/I Analysis (Rain = 4.01 inches)

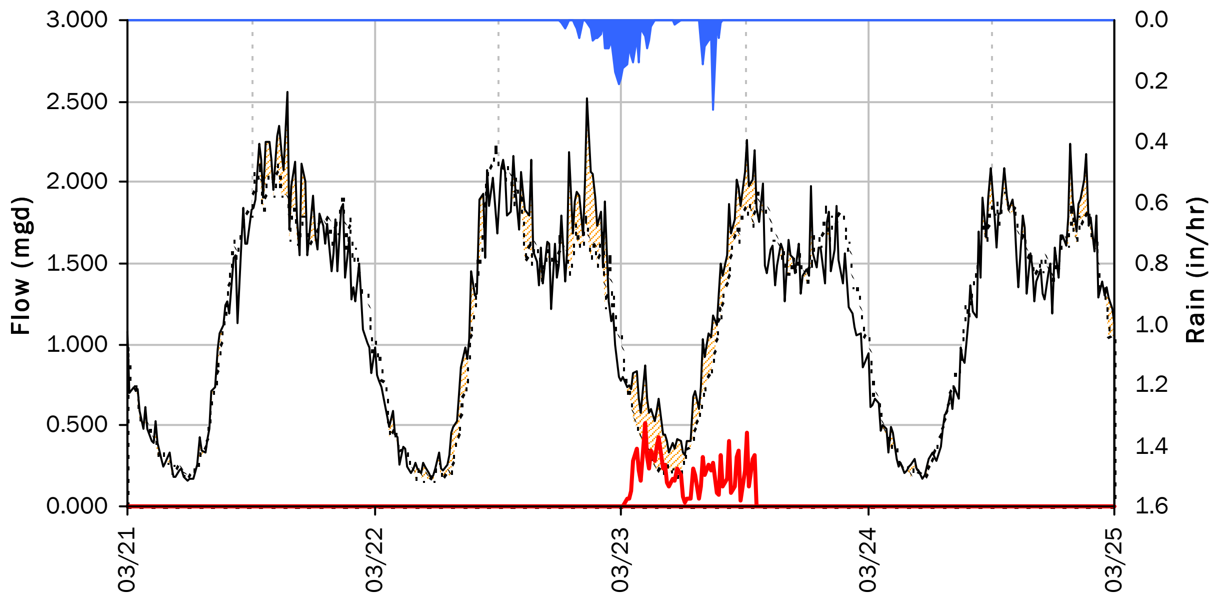
Capacity		**Inflow / Infiltration**	
Peak Flow:	3.21 *mgd*	**Peak I/I Rate:**	2.13 *mgd*
PF:	2.99	**Total I/I:**	646,000 *gallons*
Peak Level:	18.56 *in*		
d/D Ratio:	0.60		

FM-03
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

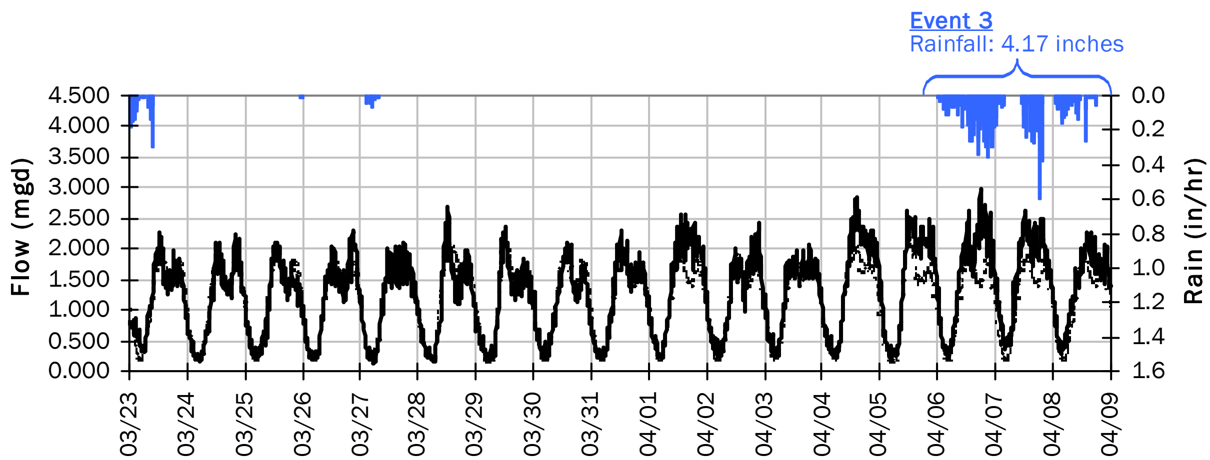


Storm Event I/I Analysis (Rain = 0.82 inches)

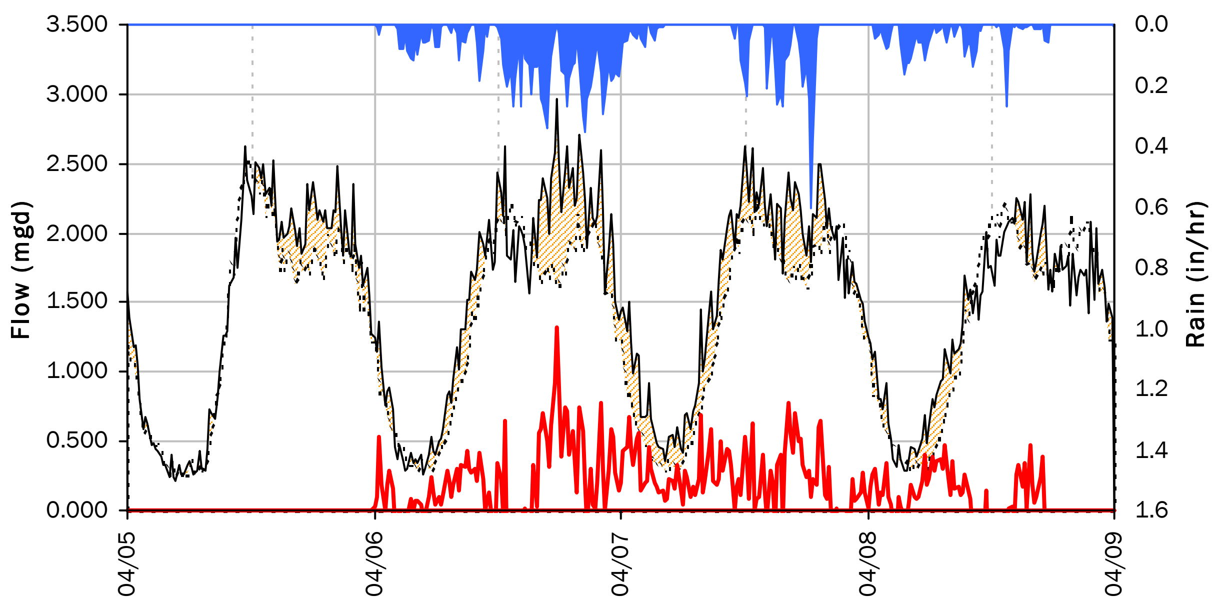
Capacity		Inflow / Infiltration	
Peak Flow:	2.26 *mgd*	**Peak I/I Rate:**	0.52 *mgd*
PF:	2.11	**Total I/I:**	112,000 *gallons*
Peak Level:	16.04 *in*		
d/D Ratio:	0.52		

FM-03
I/I Summary: Event 3

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



<u>Event 3 Detail Graph</u>

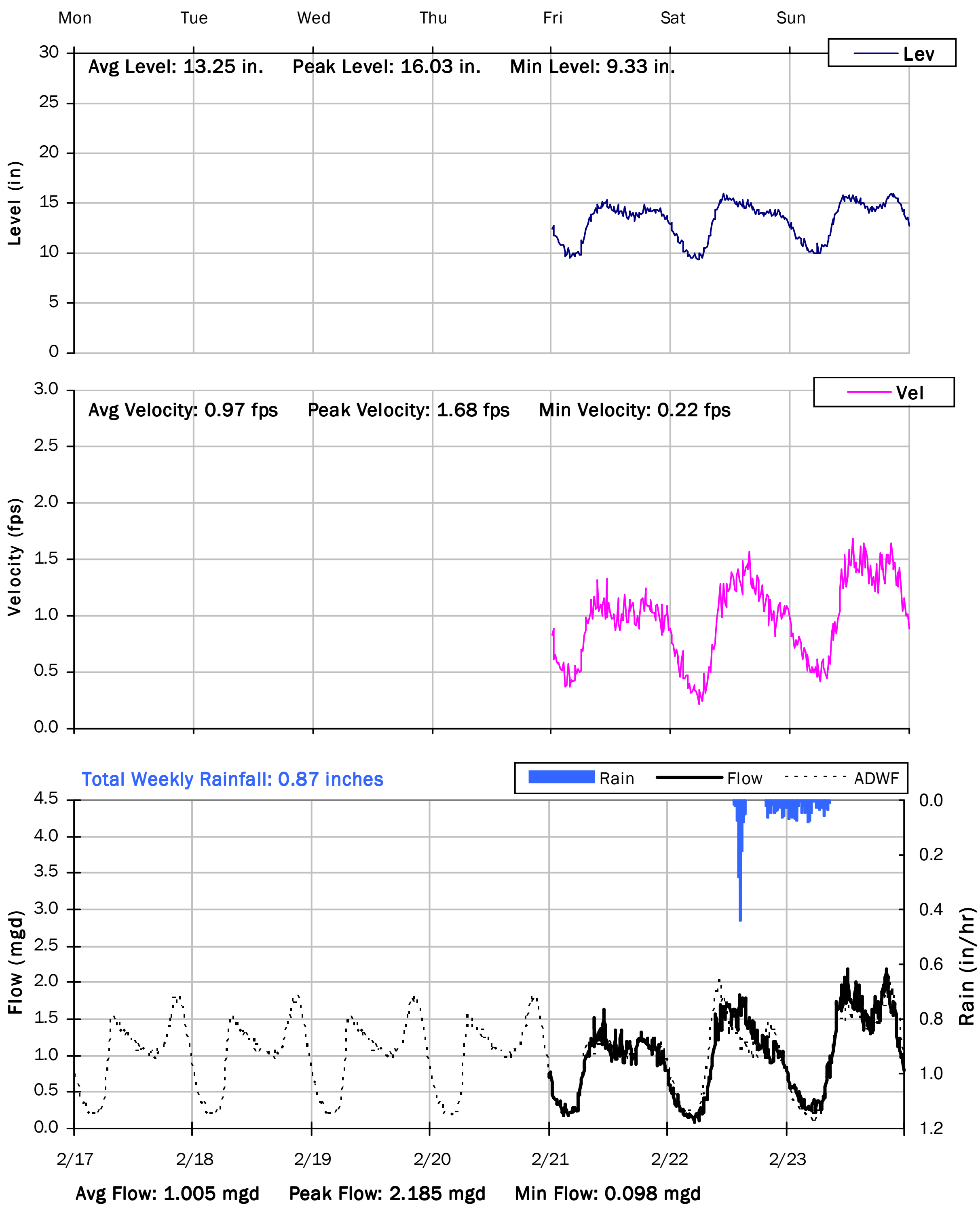


Storm Event I/I Analysis (Rain = 4.17 inches)

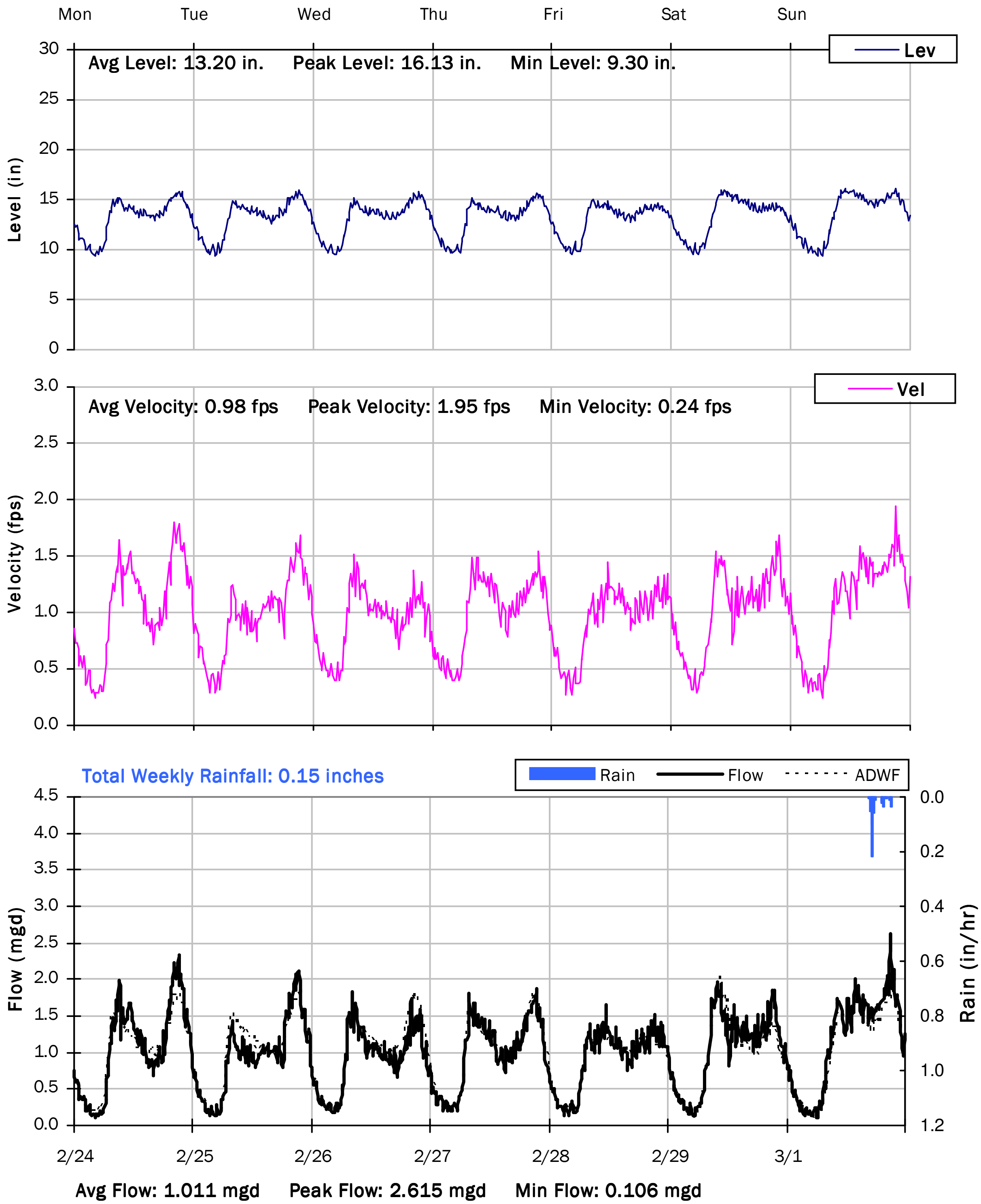
Capacity		Inflow / Infiltration	
Peak Flow:	2.97 *mgd*	**Peak I/I Rate:**	1.31 *mgd*
PF:	2.77	**Total I/I:**	519,000 *gallons*
Peak Level:	18.06 *in*		
d/D Ratio:	0.58		

FM-03

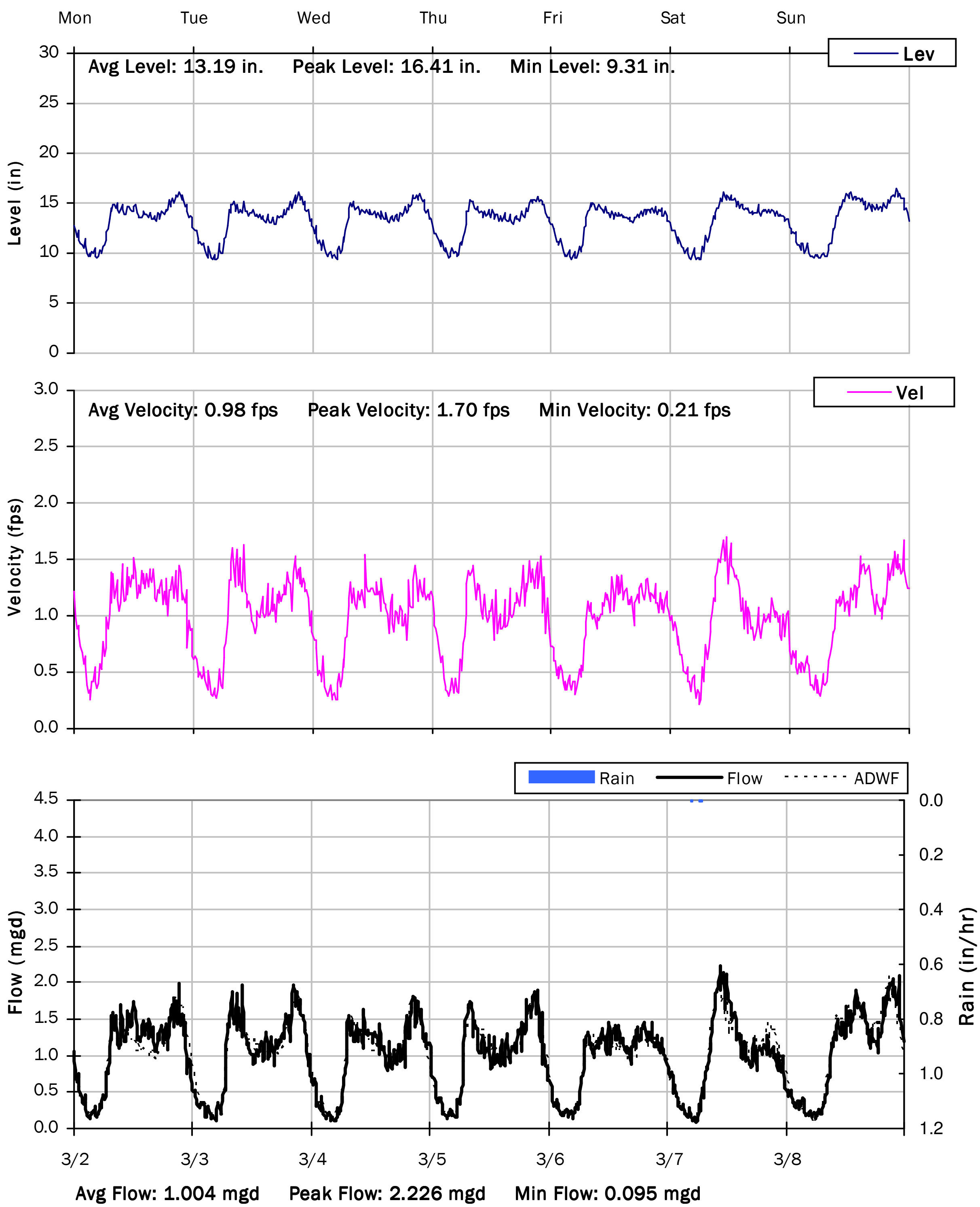
Weekly Level, Velocity and Flow Hydrographs
2/17/2020 to 2/24/2020



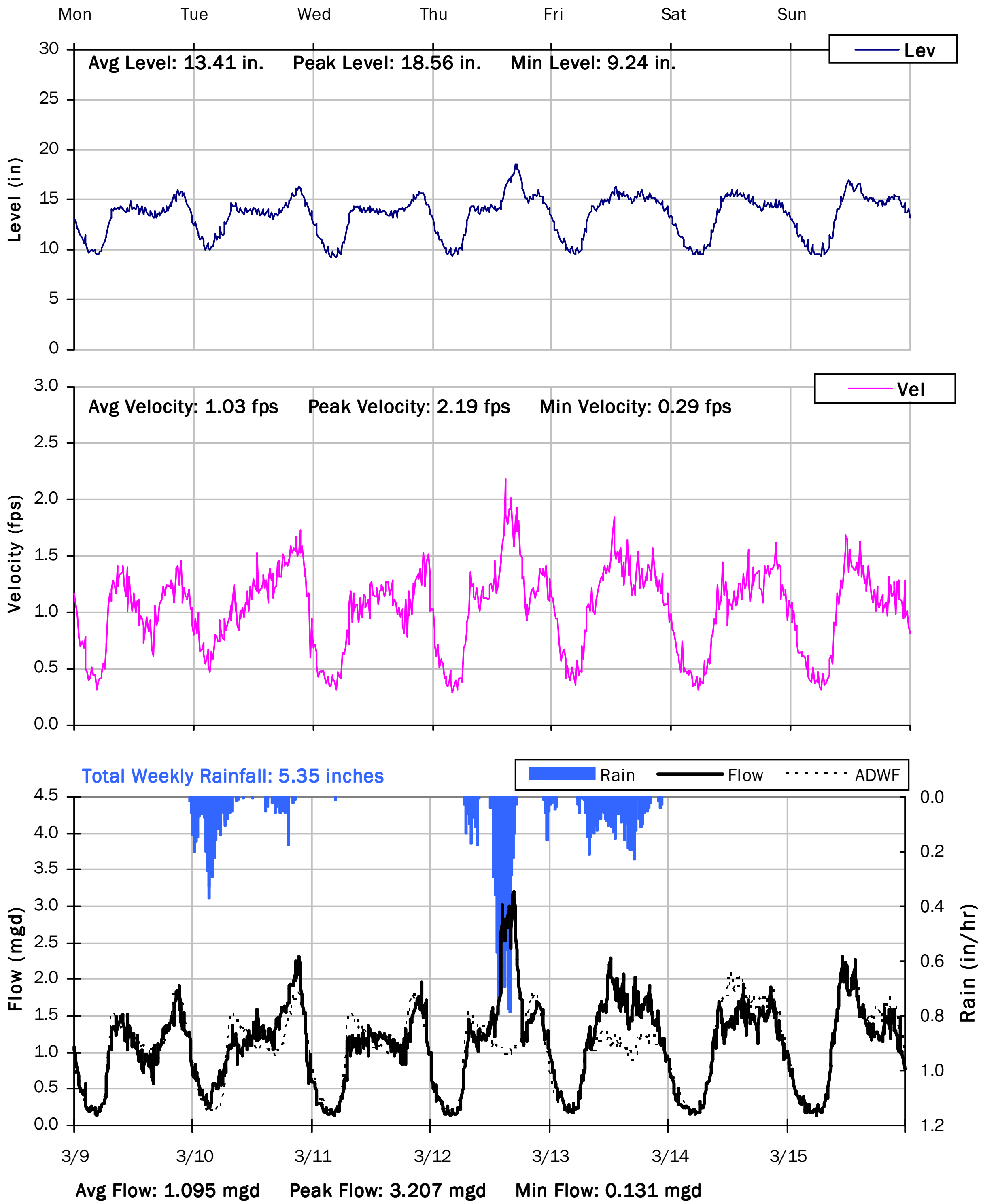
FM-03
Weekly Level, Velocity and Flow Hydrographs
2/24/2020 to 3/2/2020



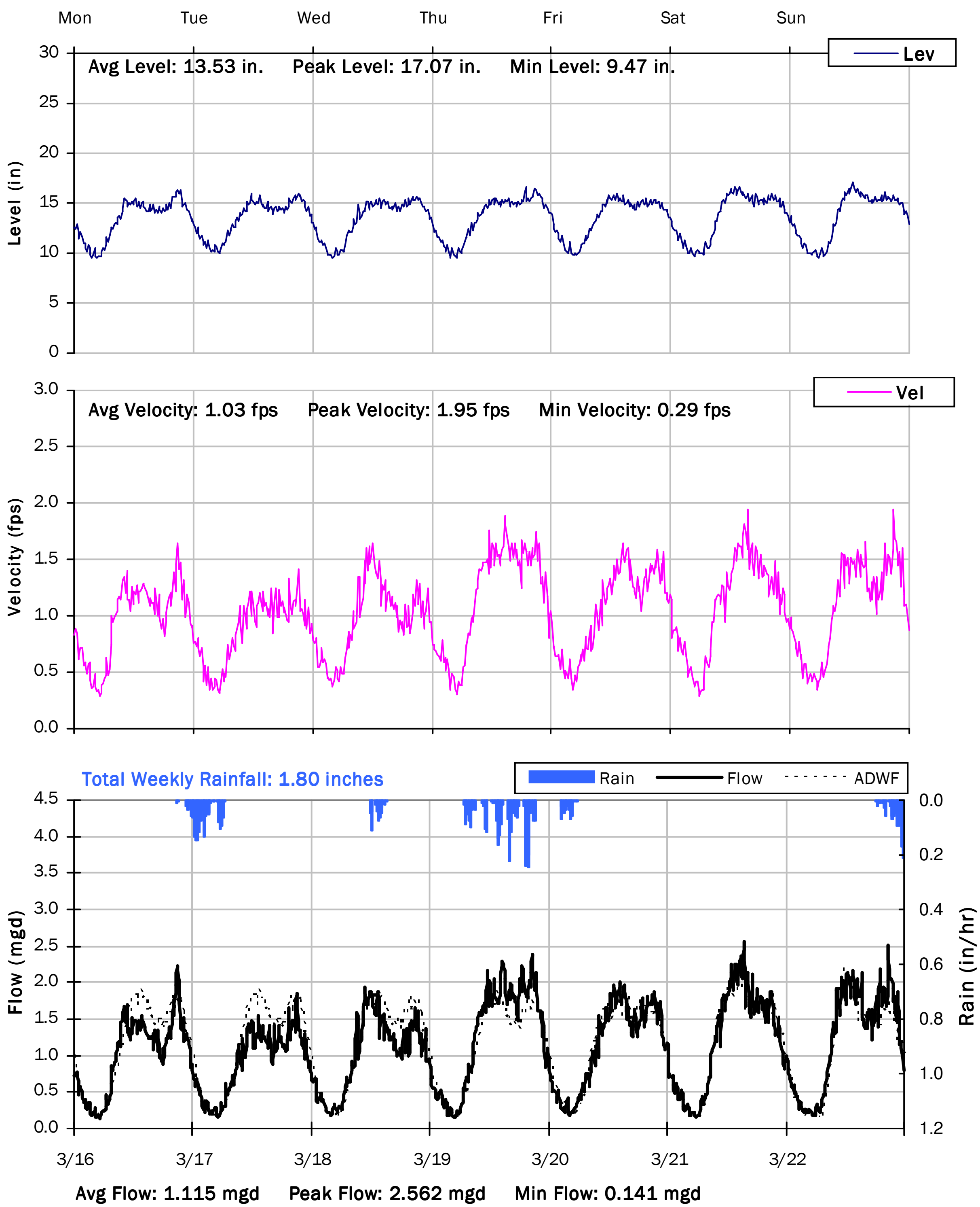
FM-03
Weekly Level, Velocity and Flow Hydrographs
3/2/2020 to 3/9/2020



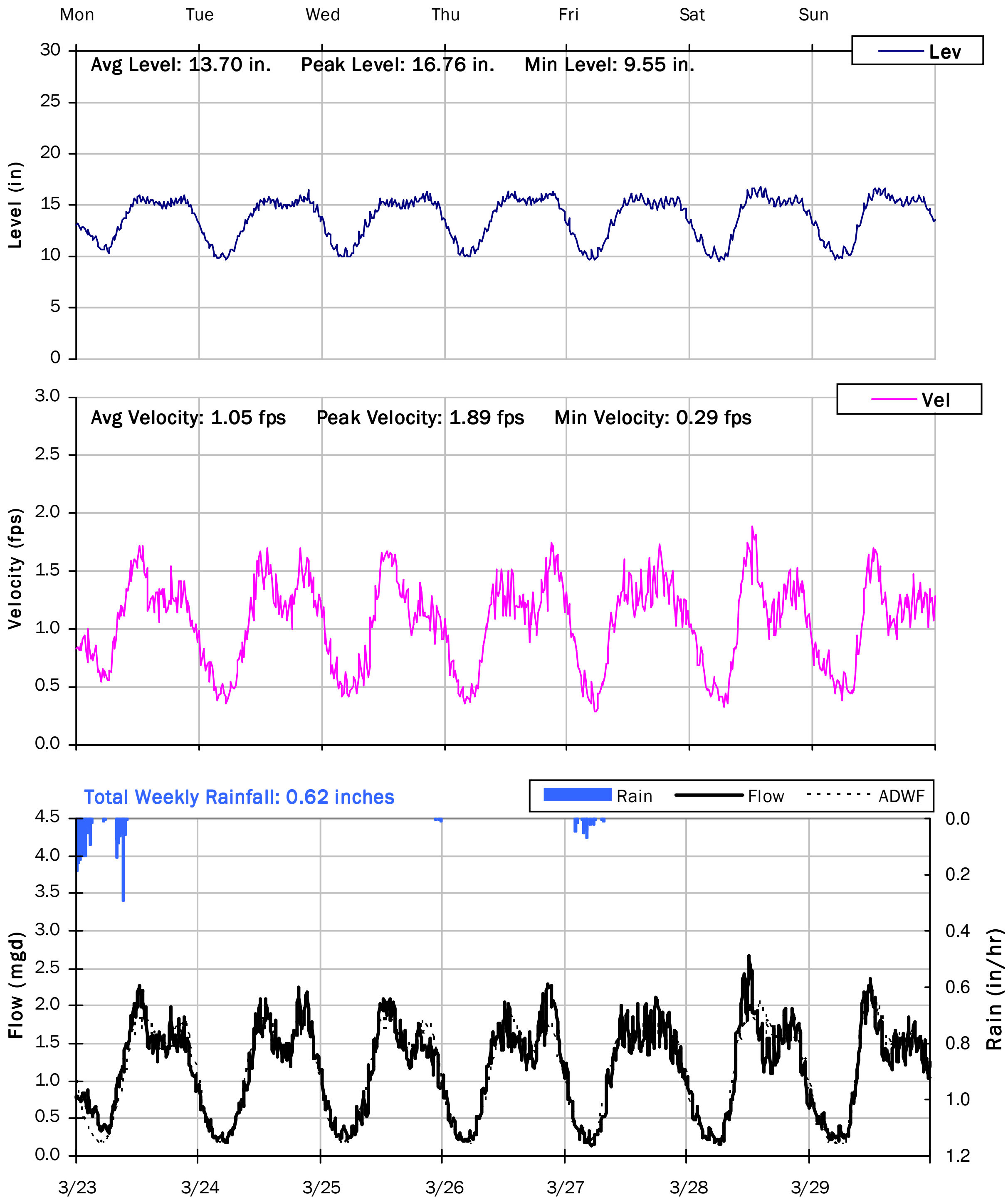
FM-03
Weekly Level, Velocity and Flow Hydrographs
3/9/2020 to 3/16/2020



FM-03
Weekly Level, Velocity and Flow Hydrographs
3/16/2020 to 3/23/2020

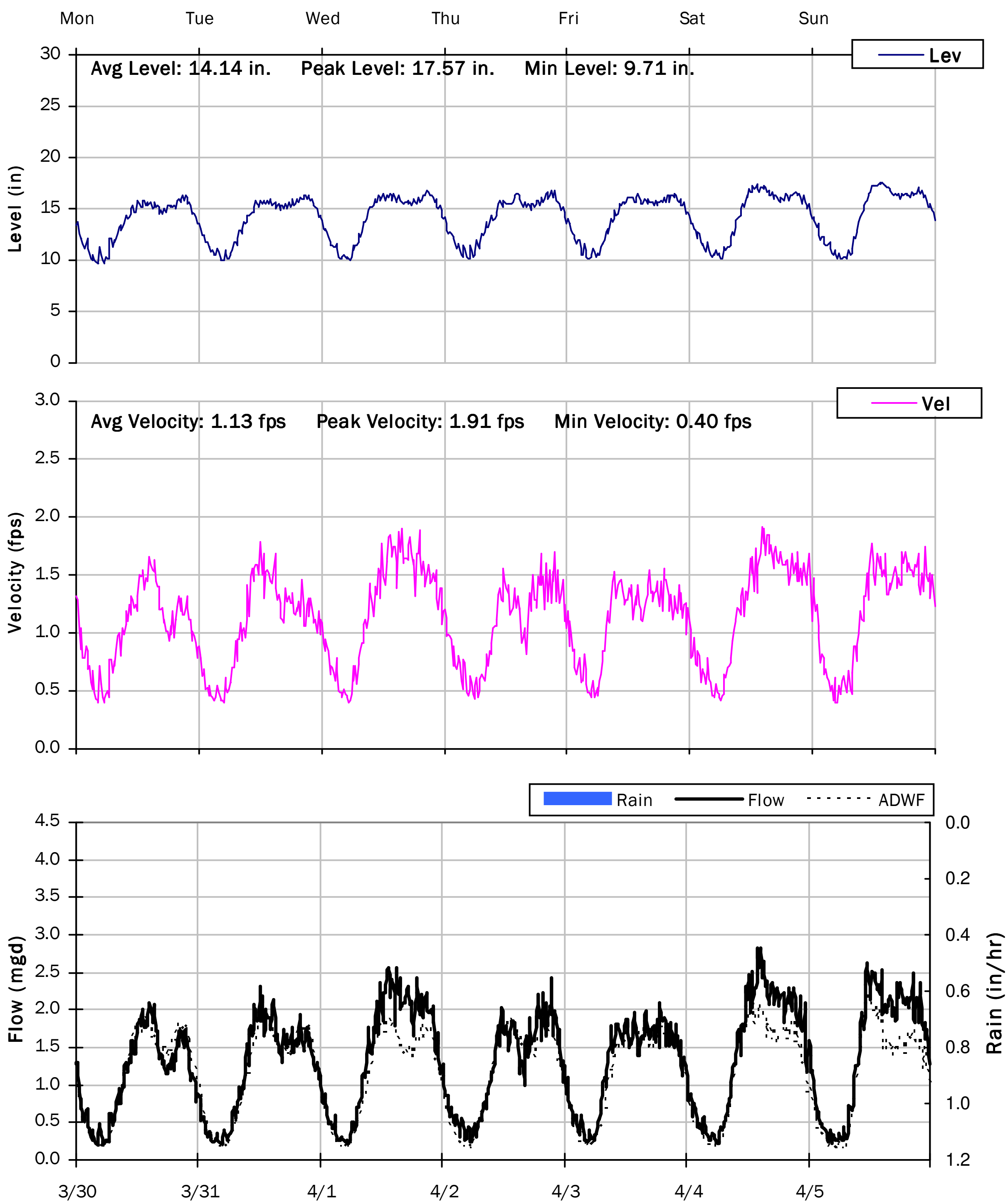


FM-03
Weekly Level, Velocity and Flow Hydrographs
3/23/2020 to 3/30/2020



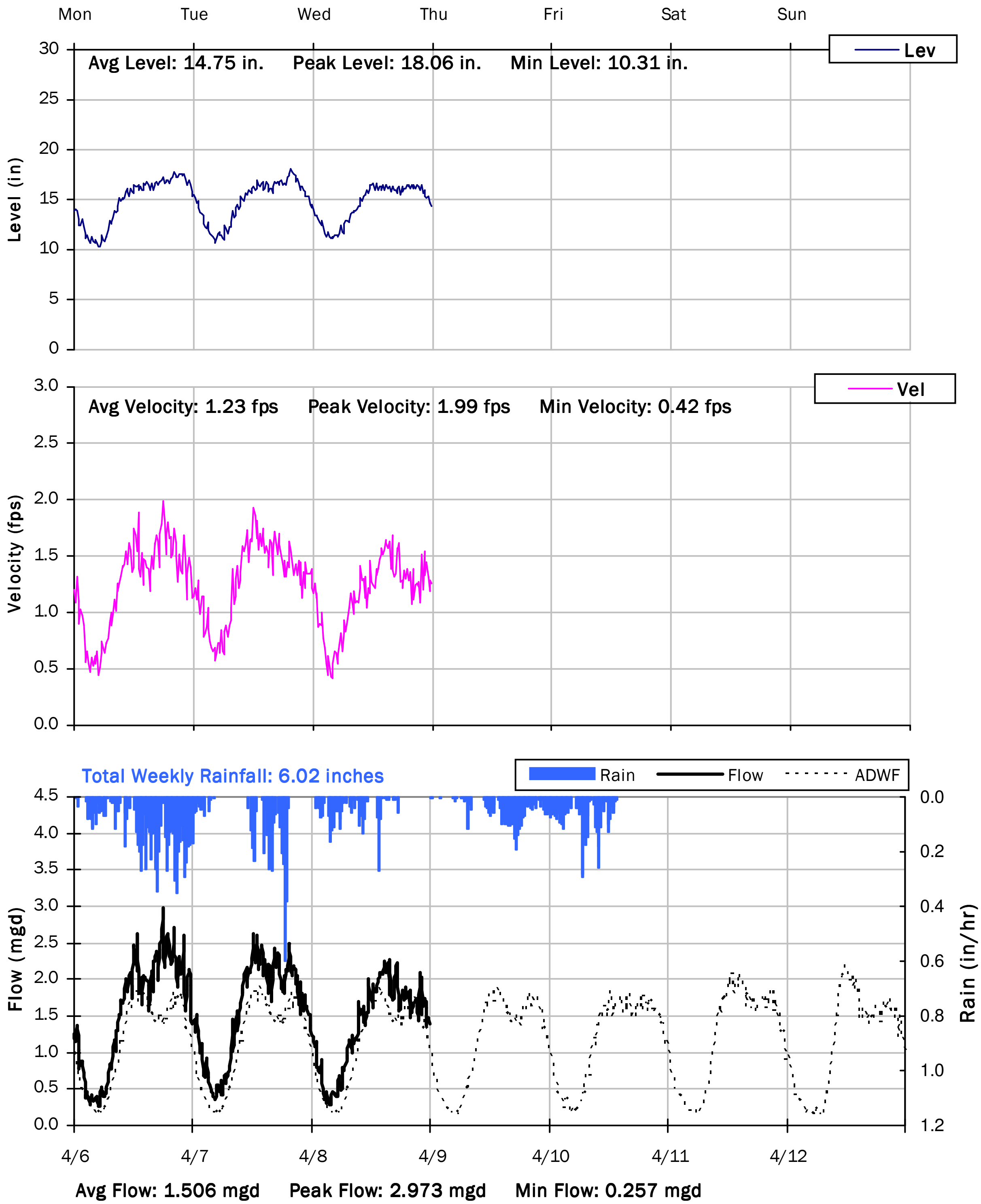
Avg Flow: 1.161 mgd **Peak Flow: 2.640 mgd** **Min Flow: 0.141 mgd**

FM-03
Weekly Level, Velocity and Flow Hydrographs
3/30/2020 to 4/6/2020



Avg Flow: 1.316 mgd Peak Flow: 2.833 mgd Min Flow: 0.195 mgd

FM-03
Weekly Level, Velocity and Flow Hydrographs
4/6/2020 to 4/13/2020



City of Beaumont

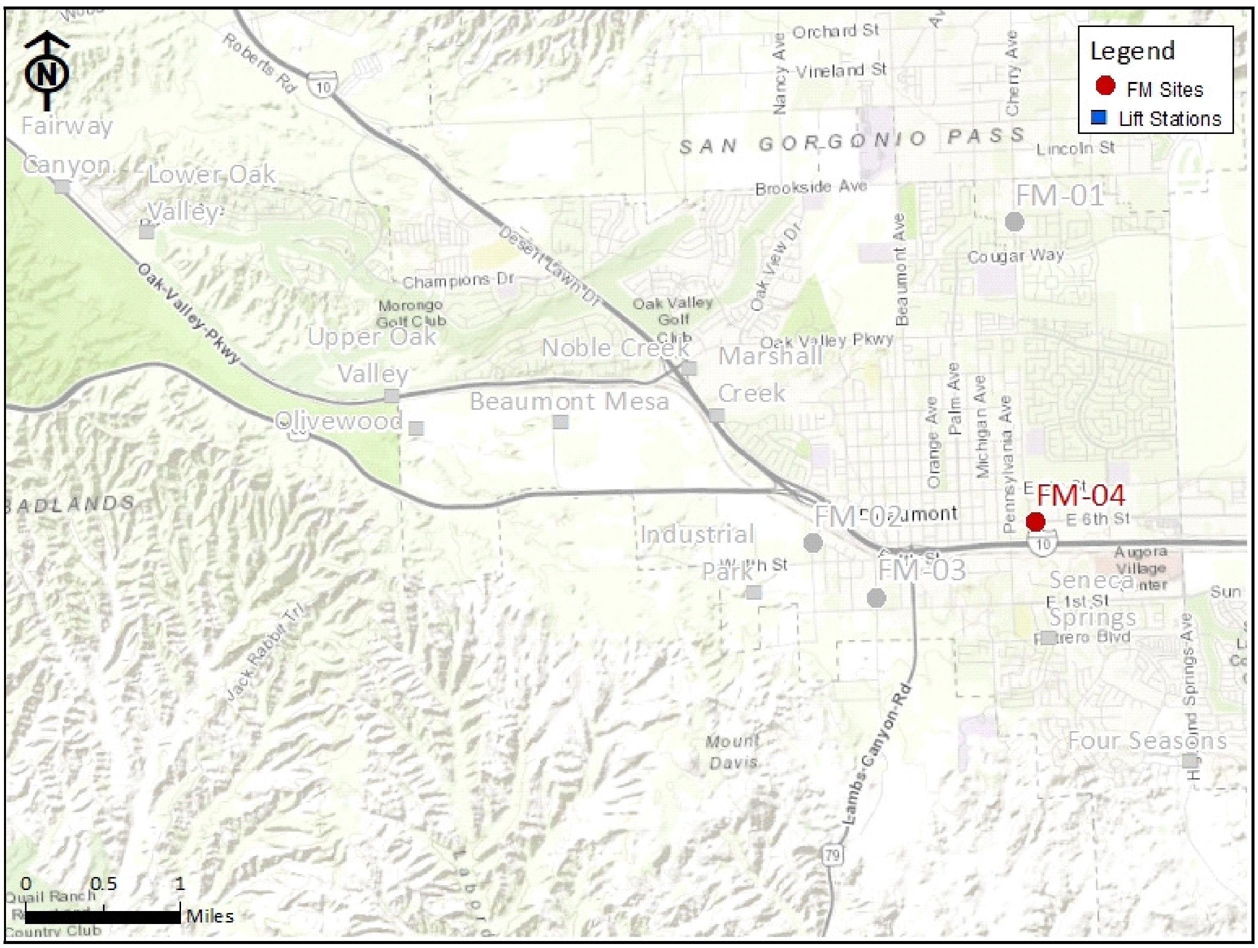
Sanitary Sewer Flow Monitoring
February 20 - April 09, 2020

Monitoring Site: FM-04

City Structure: SSMH00450

Location: East 6th Street east of Illinois Avenue

Data Summary Report



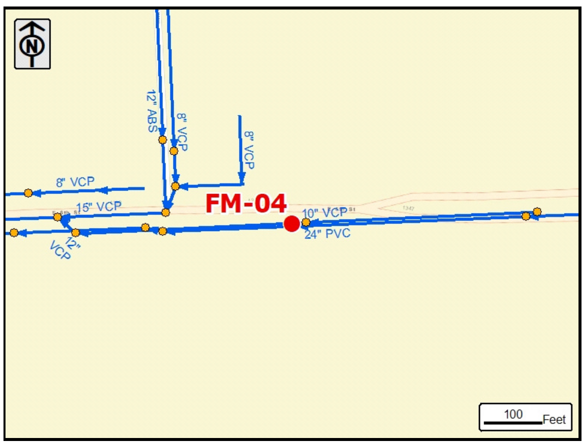
Vicinity Map: FM-04

FM-04

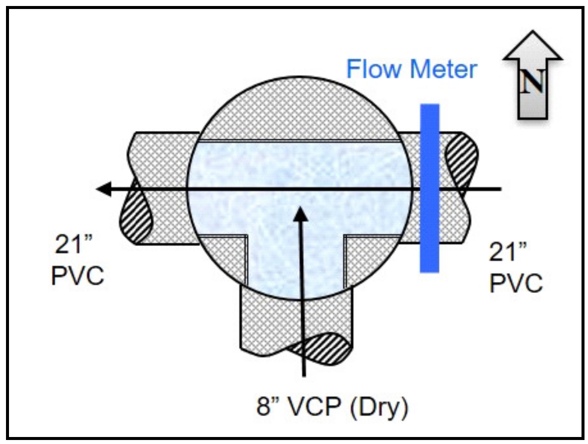
Site Information

Location:	East 6th Street east of Illinois Avenue
City Manhole:	SSMH00450
Coordinates:	116.9631° W, 33.9293° N
Rim Elevation (Earth):	2612 feet
Pipe Diameter:	21 inches
ADWF:	0.570 mgd
Peak Measured Flow:	1.572 mgd

Satellite Map

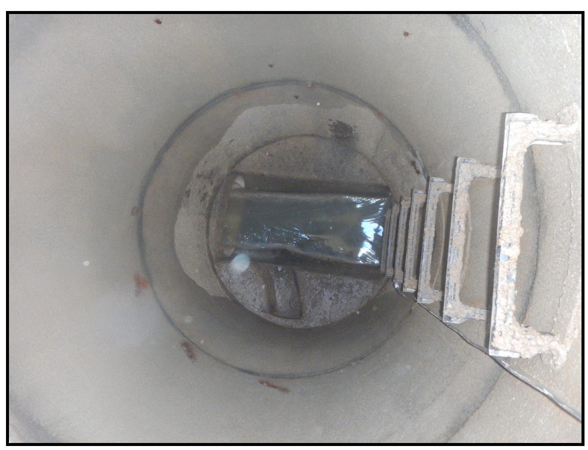


Sanitary Map



Flow Sketch

Street View



Plan View

FM-04

Additional Site Photos

Effluent Pipe

Monitored Influent Pipe

FM-04

Additional Site Photos

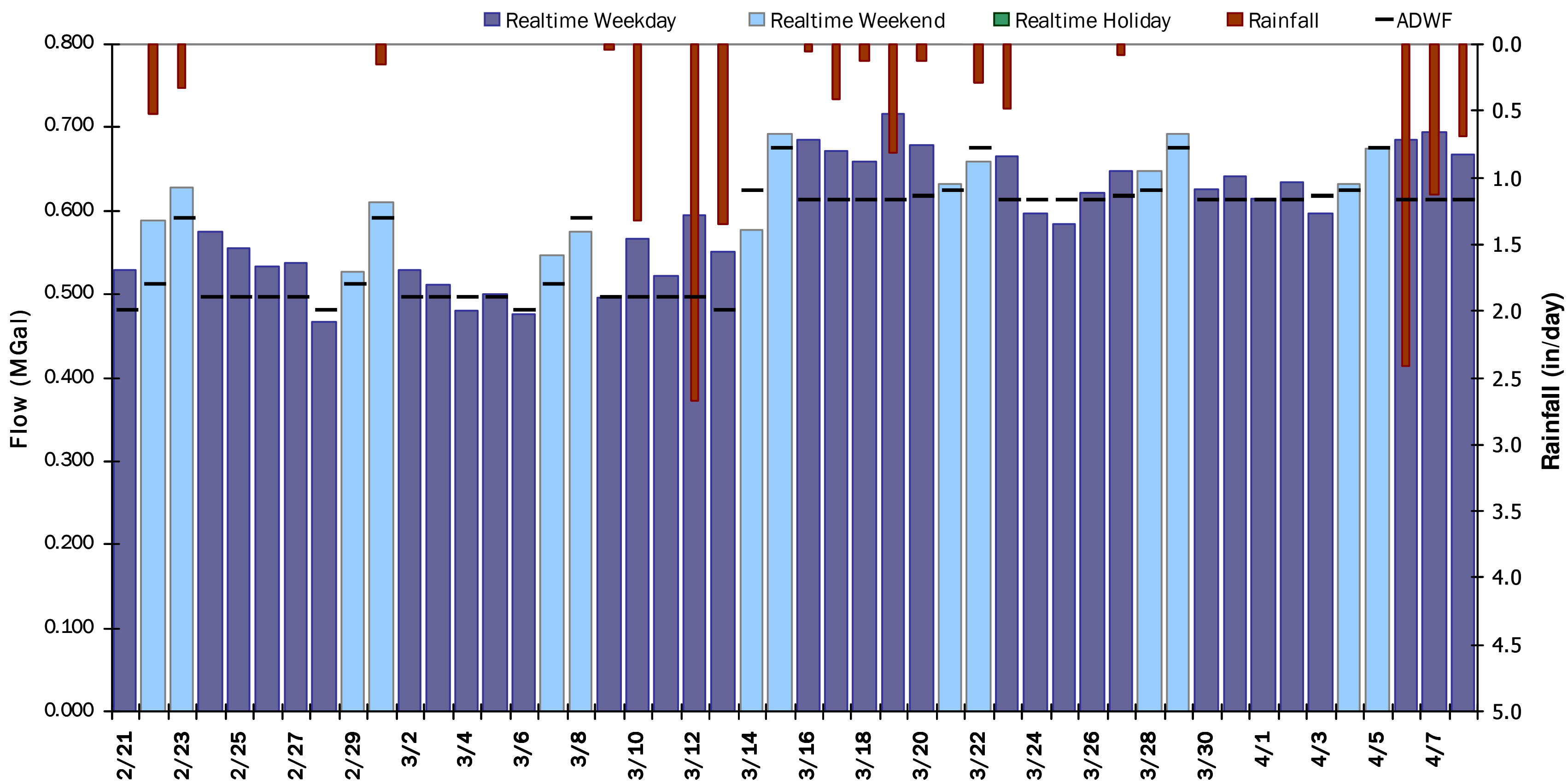
Lateral Pipe

FM-04

Period Flow Summary: Daily Flow Totals

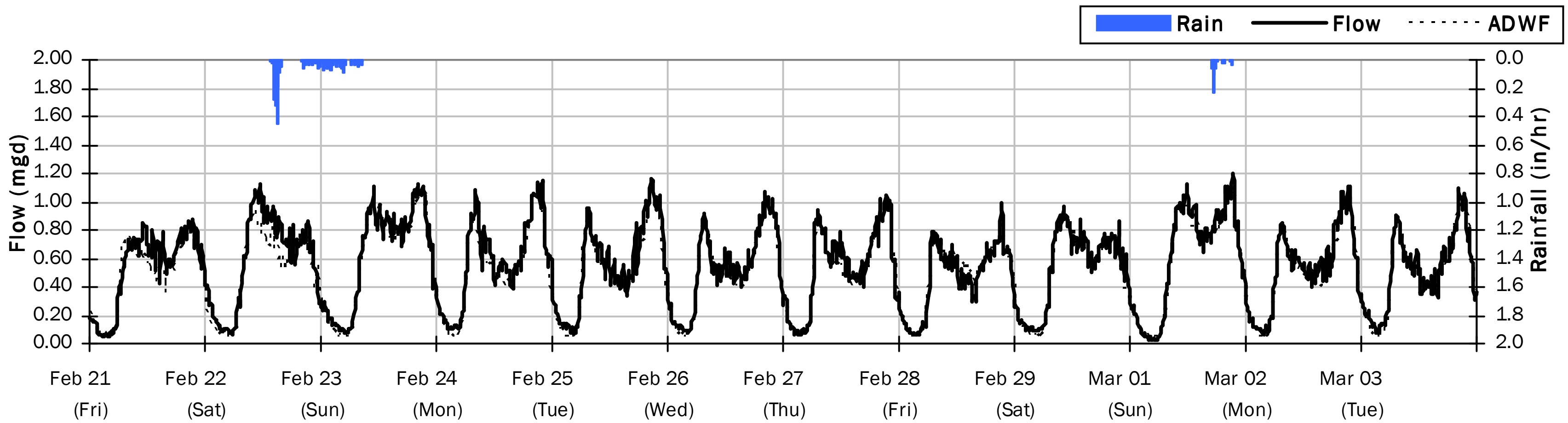
Avg Period Flow: 0.600 MGal **Peak Daily Flow: 0.715 MGal** **Min Daily Flow: 0.466 MGal**

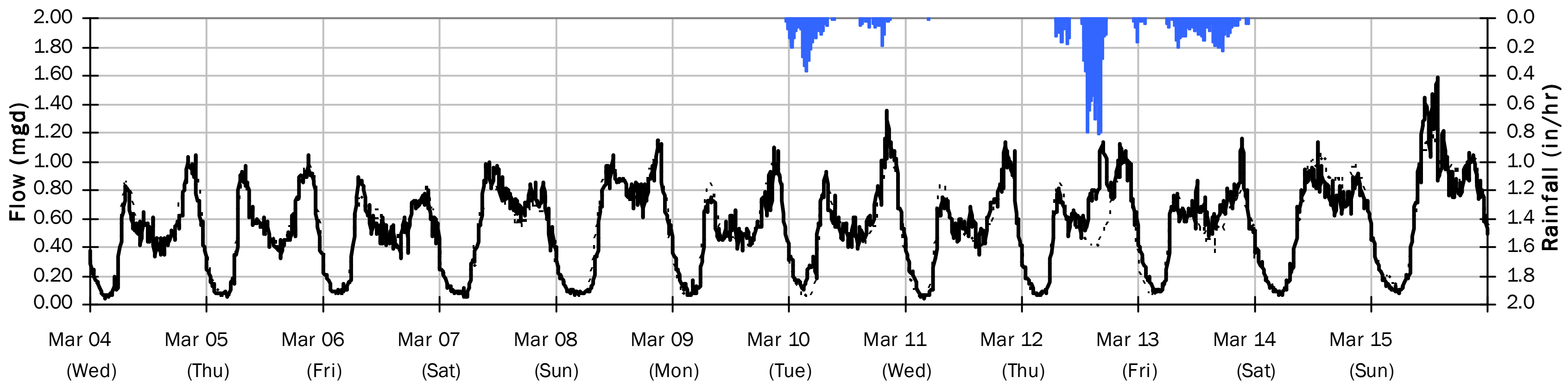
Total Period Rainfall: 13.02 inches



FM-04
Flow Summary: 2/21/2020 to 3/15/2020

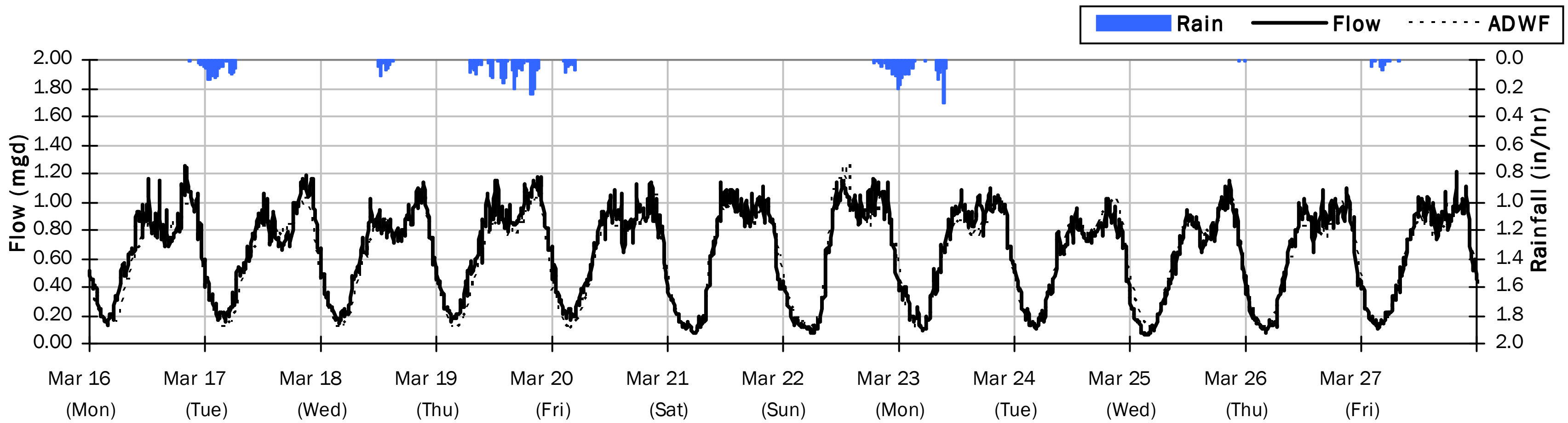
Total Period Rainfall: 6.41 inches   **Avg Flow: 0.548 mgd   Peak Flow: 1.572 mgd   Min Flow: 0.021 mgd**

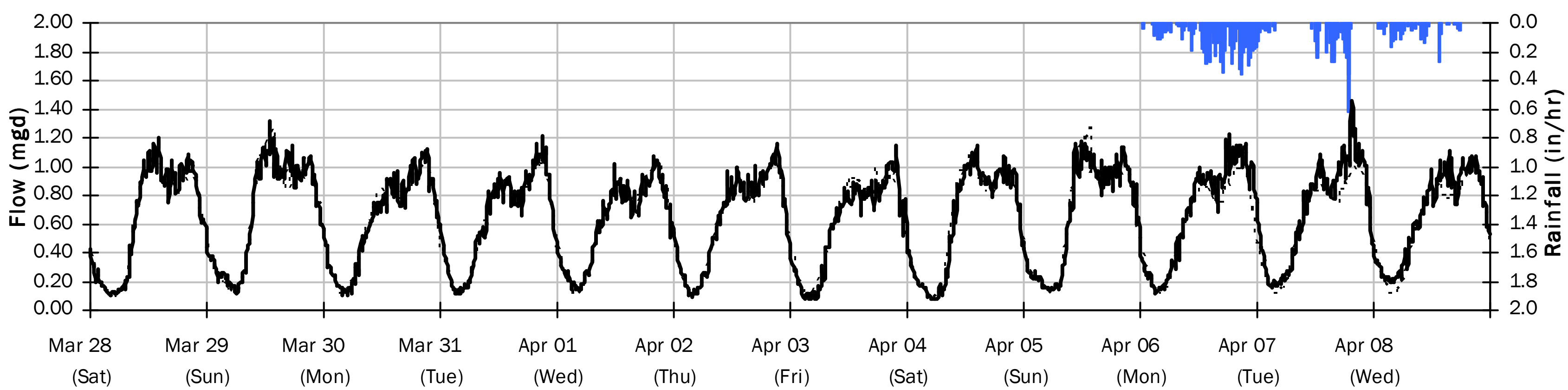




FM-04
Flow Summary: 3/16/2020 to 4/8/2020

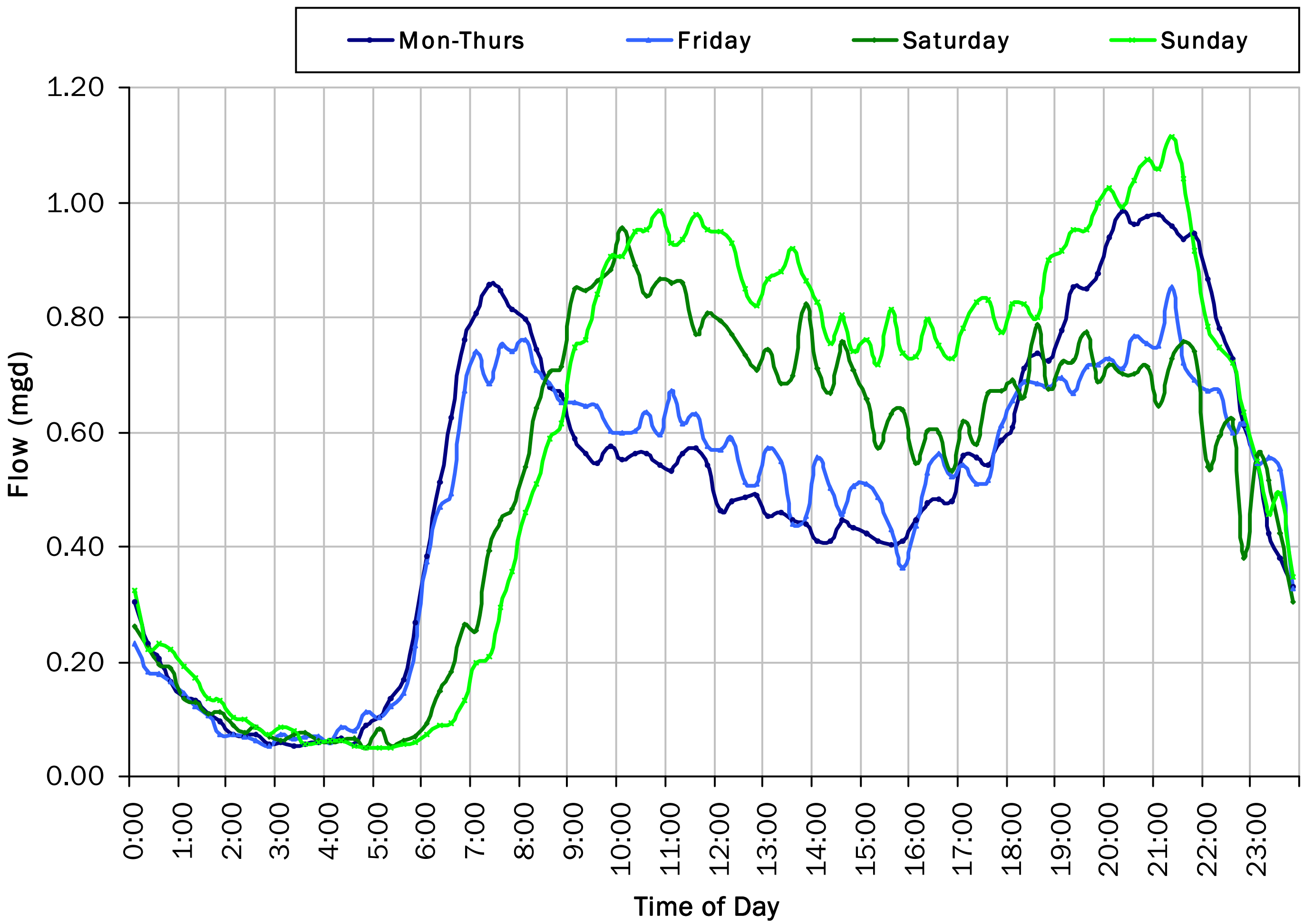
Total Period Rainfall: 6.61 inches   **Avg Flow: 0.651 mgd**   **Peak Flow: 1.452 mgd**   **Min Flow: 0.061 mgd**



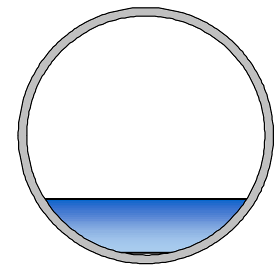


FM-04

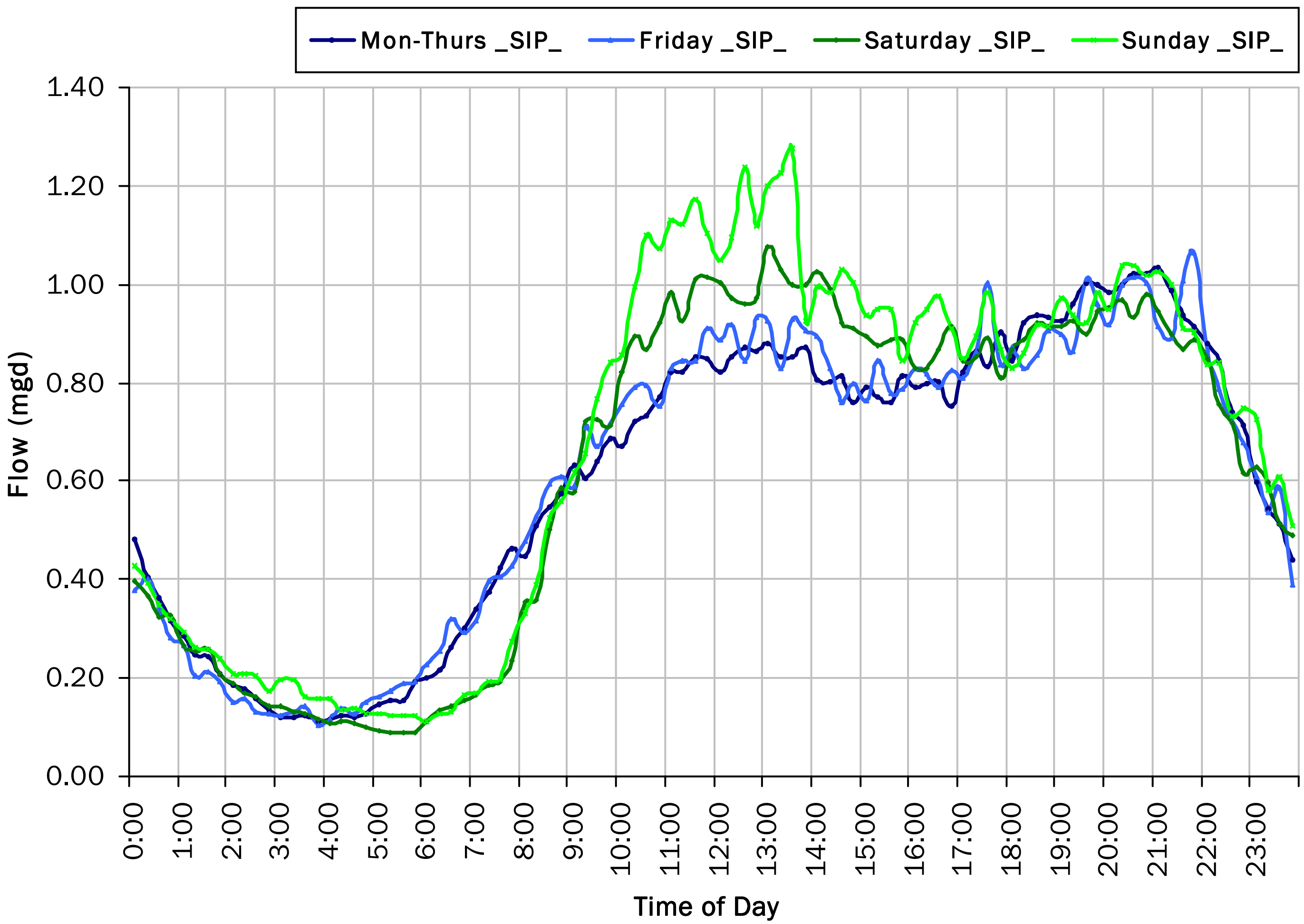
Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)



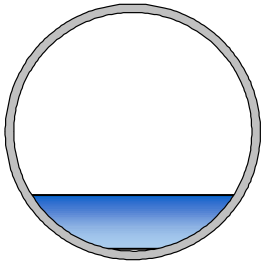
ADWF:
0.510 mgd



FM-04
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)

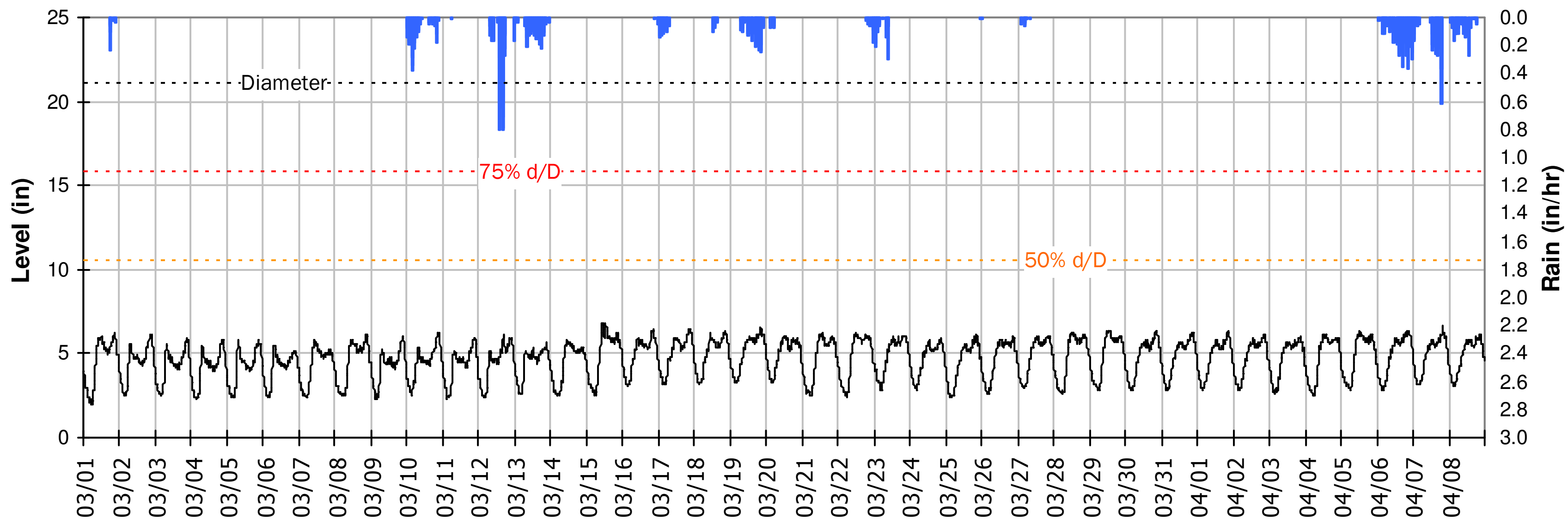


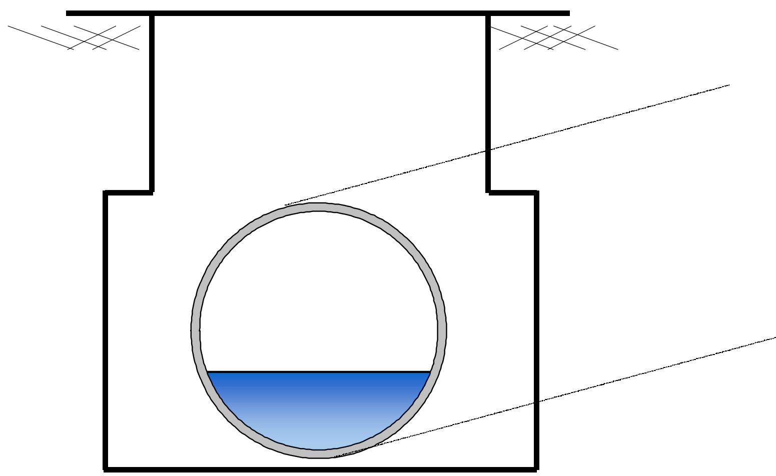
ADWF:
0.623 mgd



FM-04
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

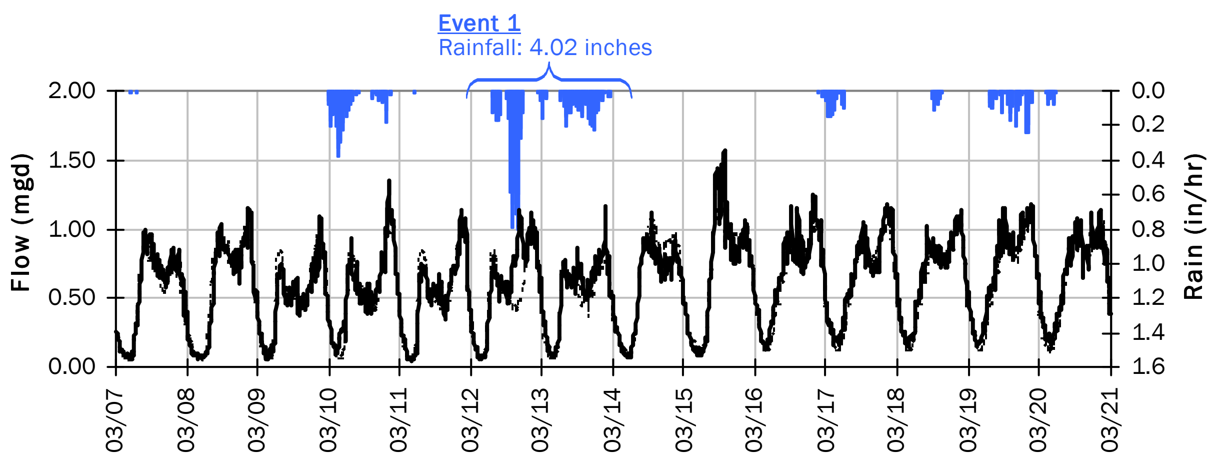




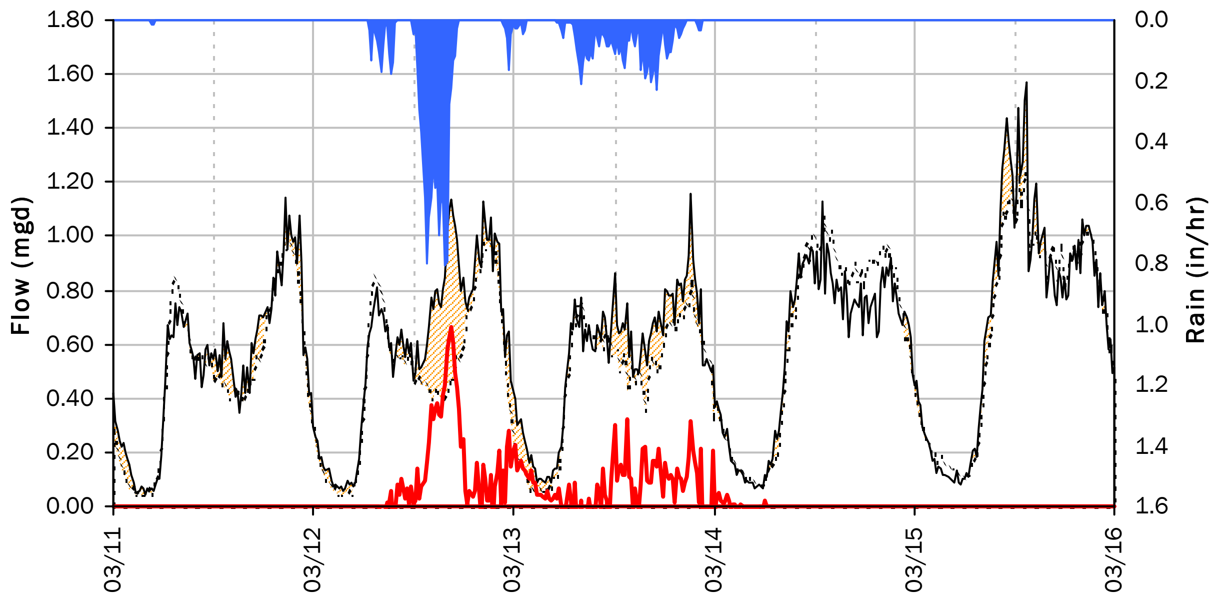
Pipe Diameter:	21	*inches*
Peak Measured Level:	6.83	*inches*
Peak d/D Ratio:	0.33	

FM-04
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 4.02 inches)

Capacity

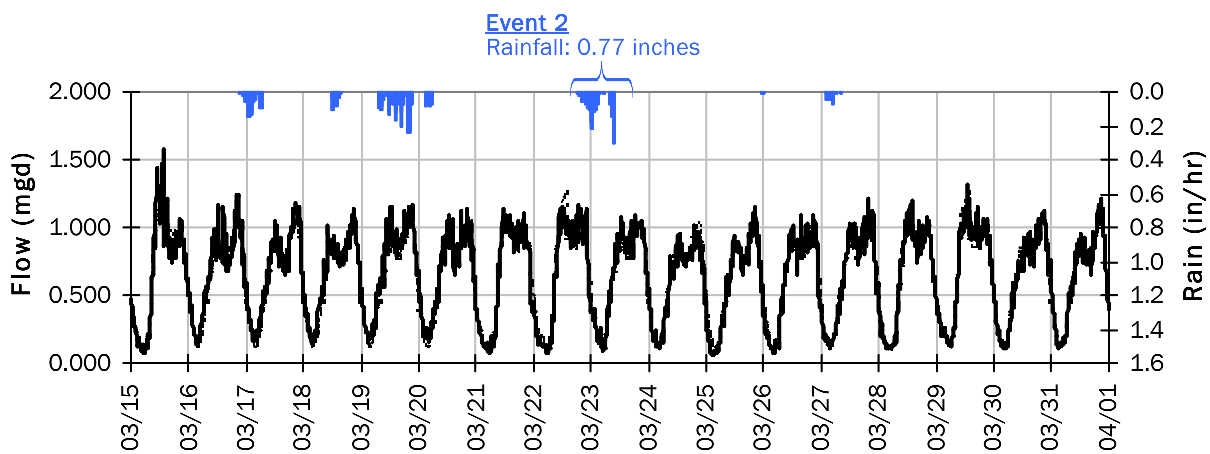
Peak Flow:	1.16 *mgd*
PF:	2.03
Peak Level:	6.10 *in*
d/D Ratio:	0.29

Inflow / Infiltration

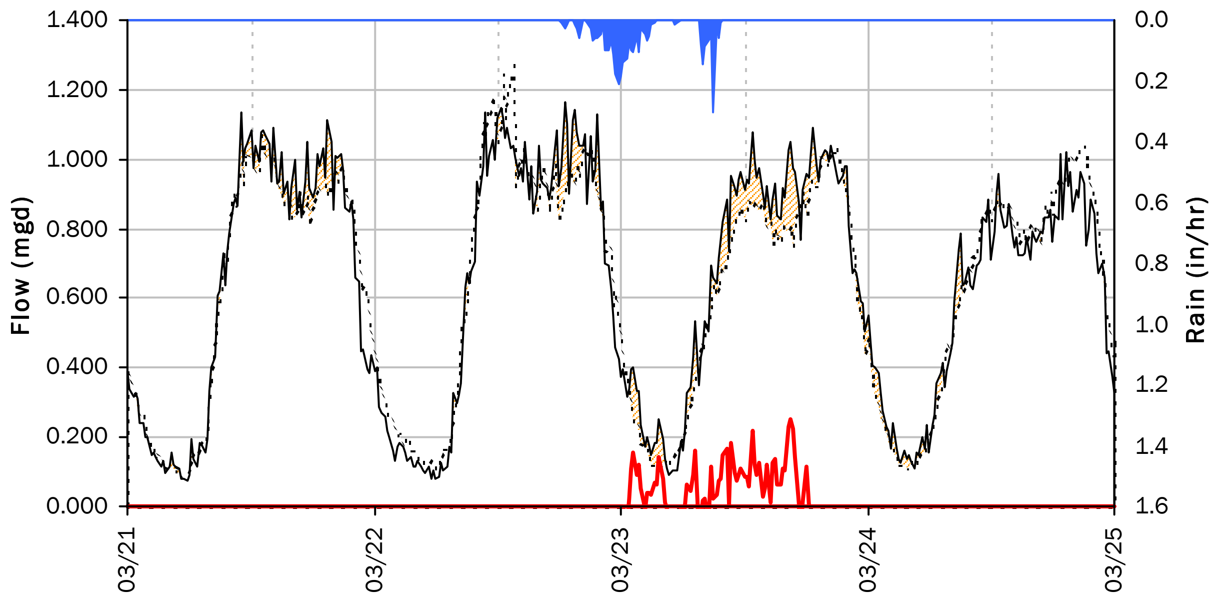
Peak I/I Rate:	0.67 *mgd*
Total I/I:	190,000 *gallons*

FM-04
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

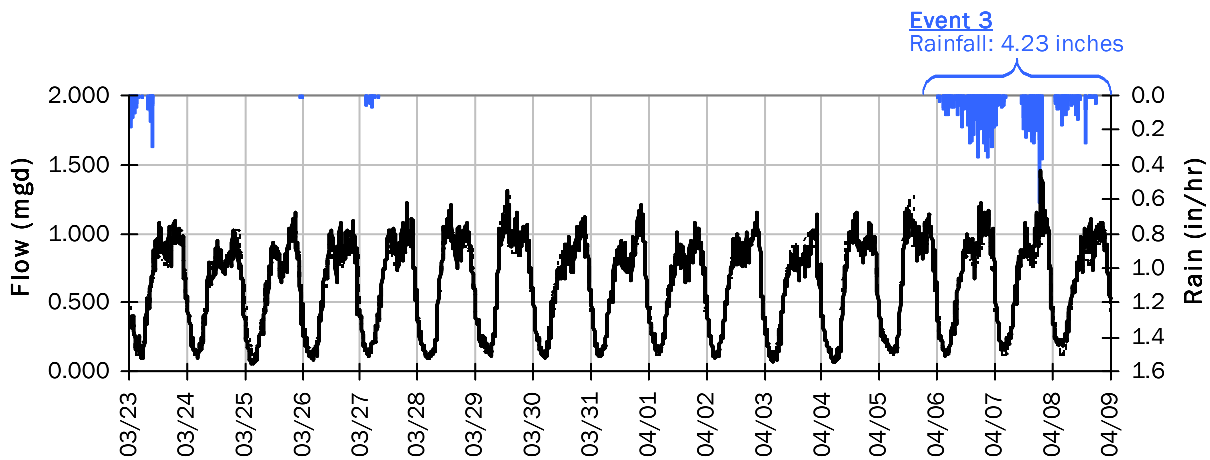


Storm Event I/I Analysis (Rain = 0.77 inches)

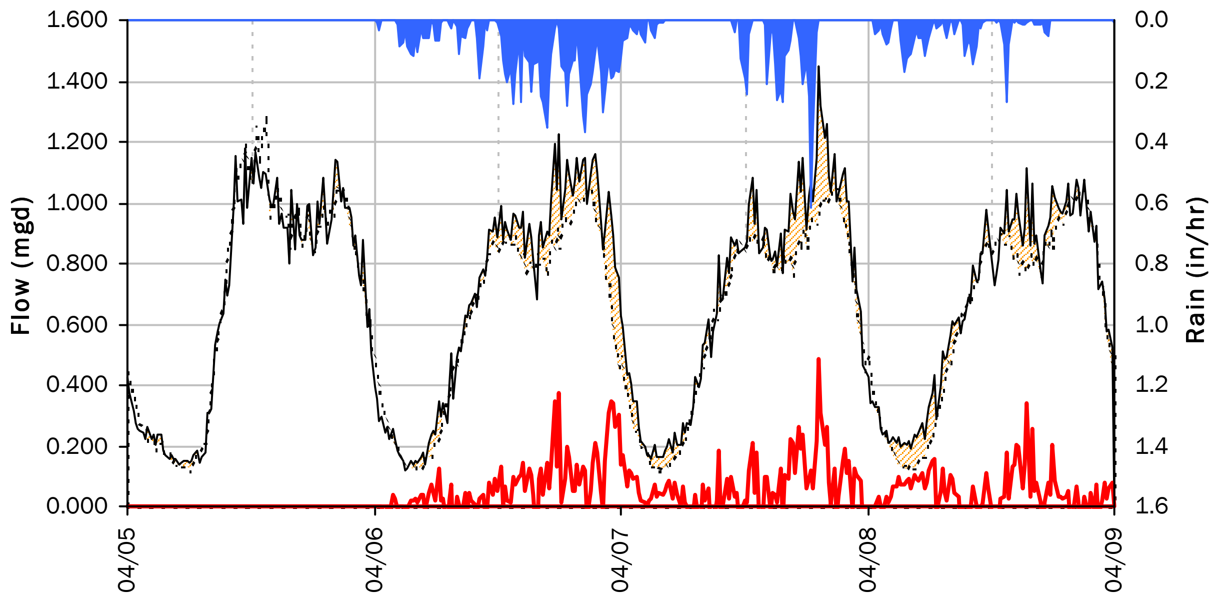
Capacity		Inflow / Infiltration	
Peak Flow:	1.08 *mgd*	**Peak I/I Rate:**	0.25 *mgd*
PF:	1.90	**Total I/I:**	49,000 *gallons*
Peak Level:	6.02 *in*		
d/D Ratio:	0.29		

FM-04
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



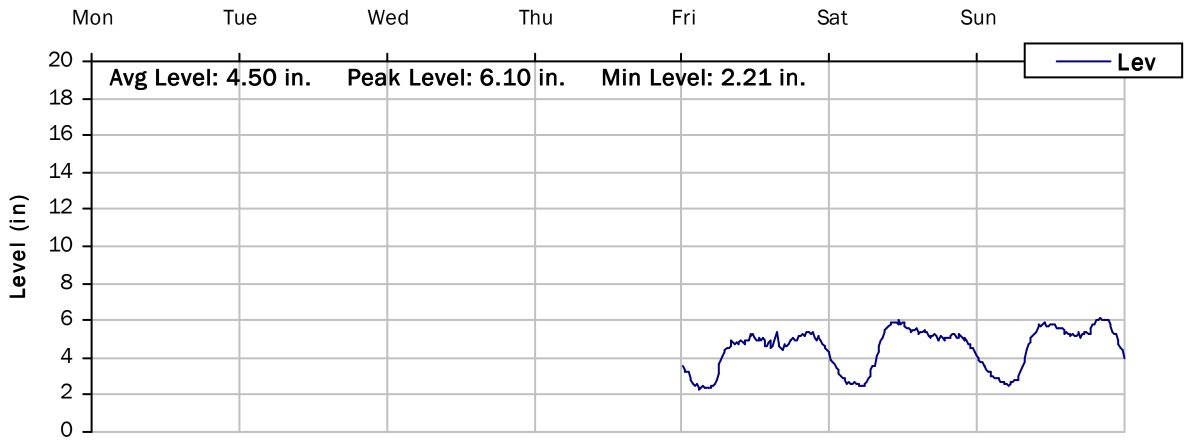
Event 3 Detail Graph

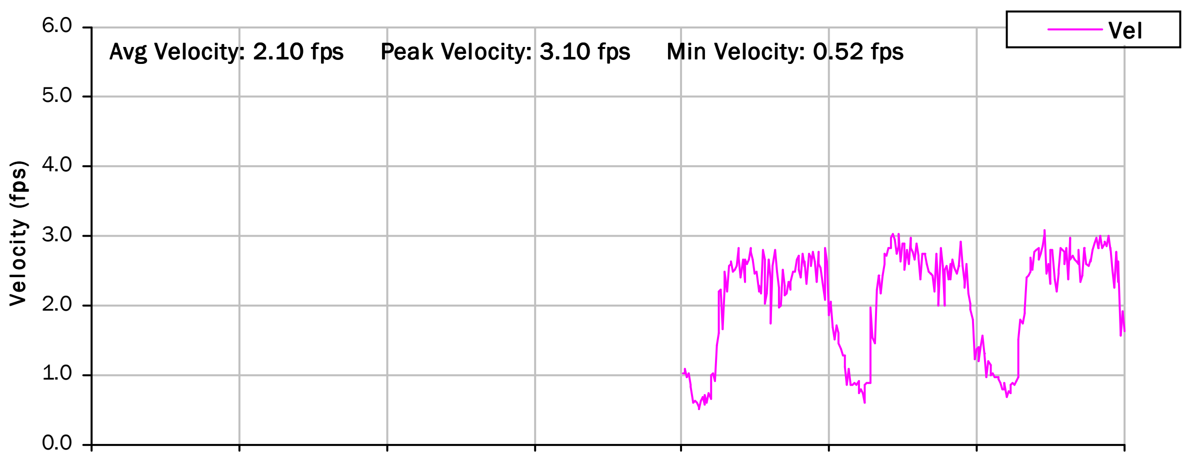


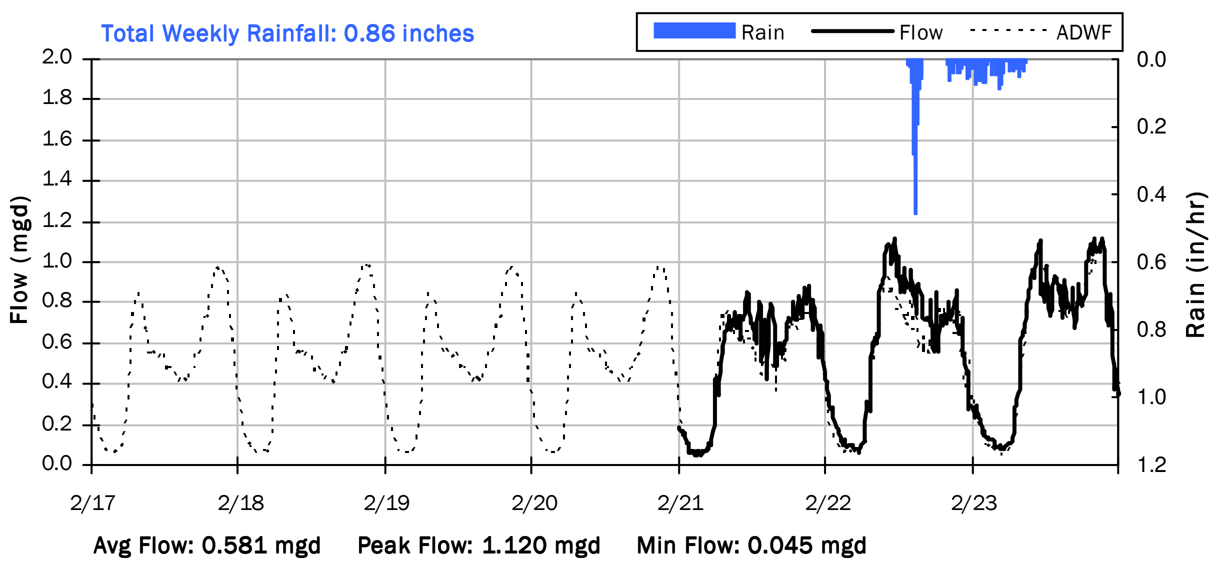
Storm Event I/I Analysis (Rain = 4.23 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	1.45 *mgd*	**Peak I/I Rate:**	0.48 *mgd*
PF:	2.55	**Total I/I:**	185,000 *gallons*
Peak Level:	6.73 *in*		
d/D Ratio:	0.32		

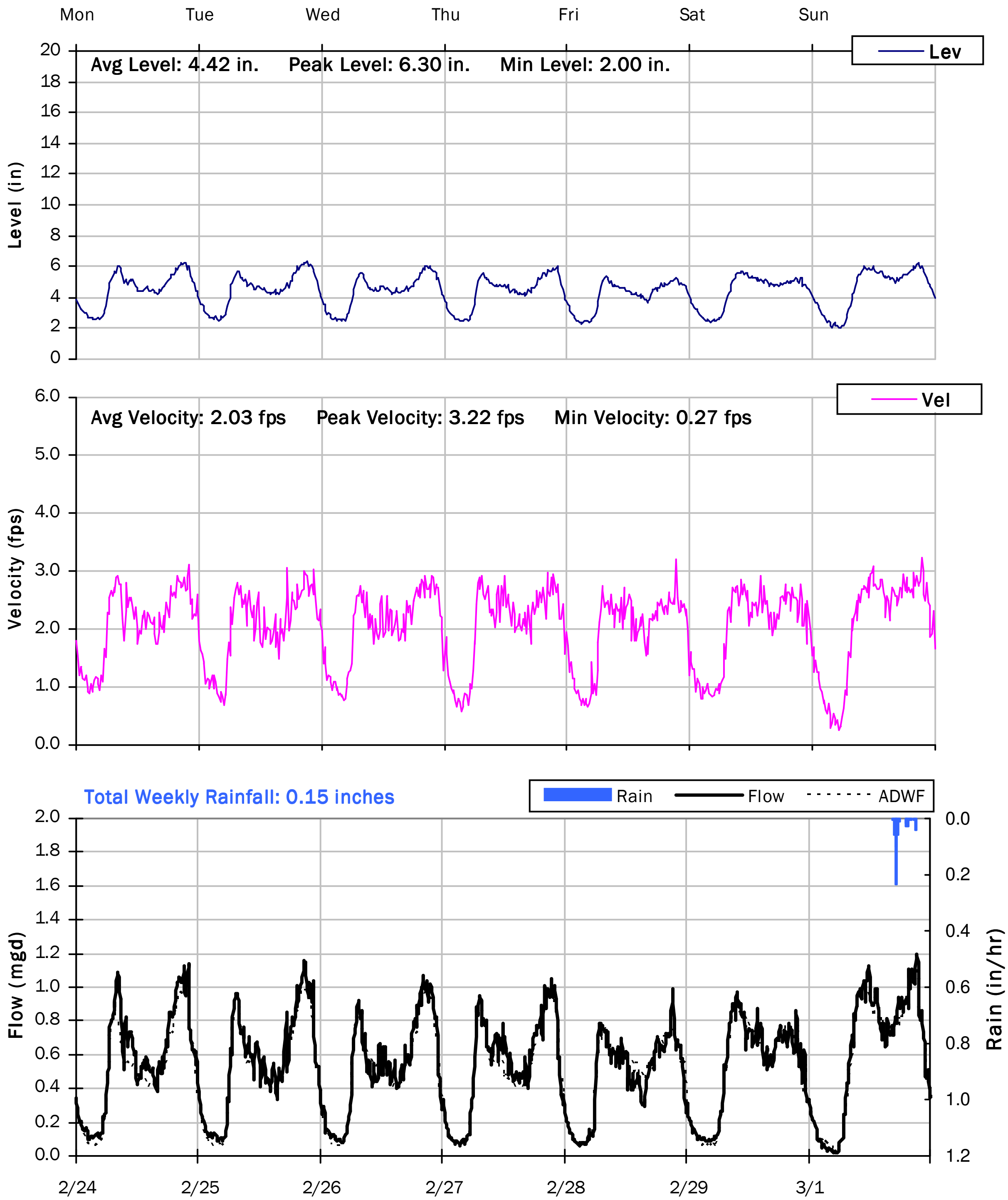
FM-04
Weekly Level, Velocity and Flow Hydrographs
2/17/2020 to 2/24/2020





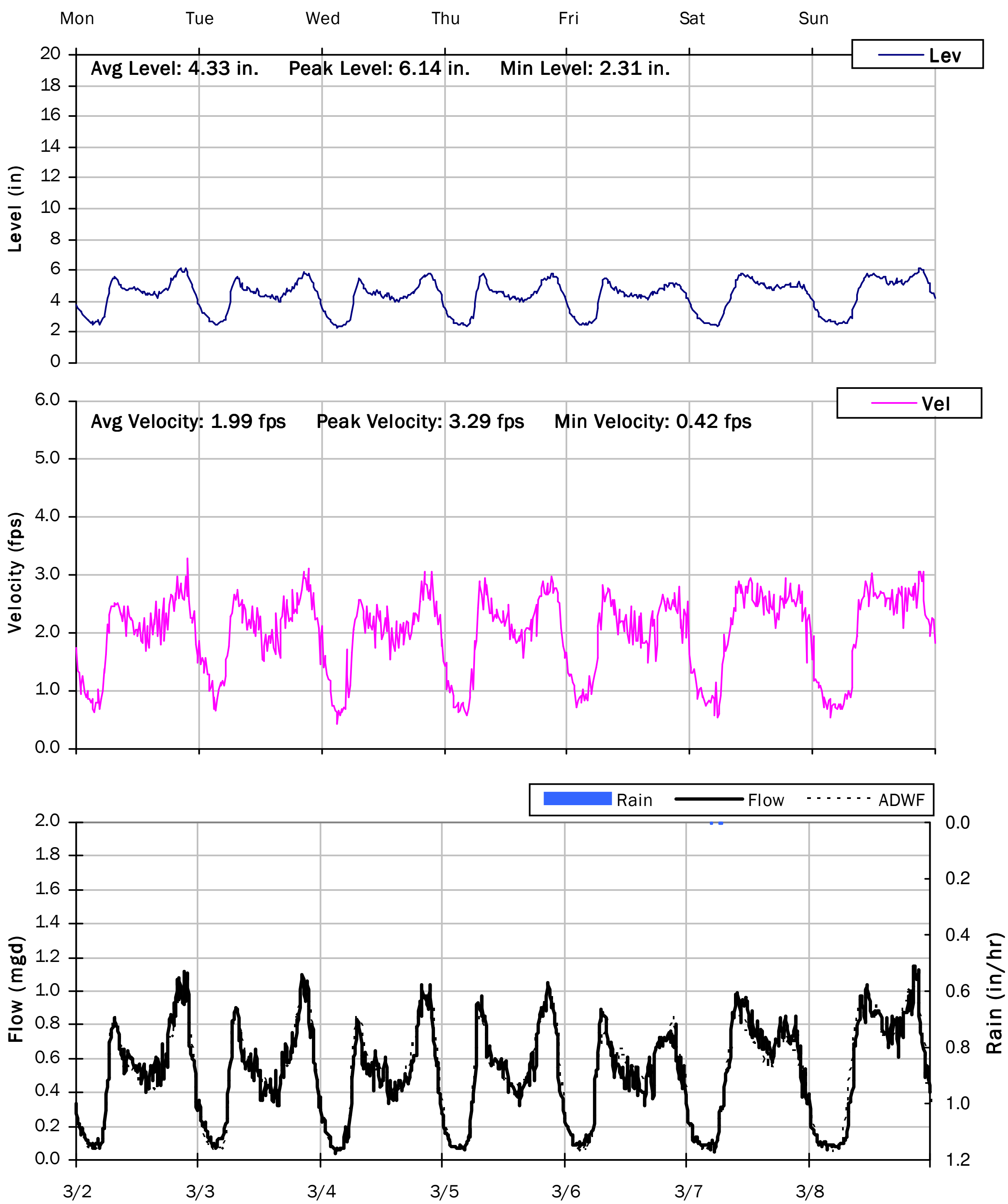


FM-04
Weekly Level, Velocity and Flow Hydrographs
2/24/2020 to 3/2/2020



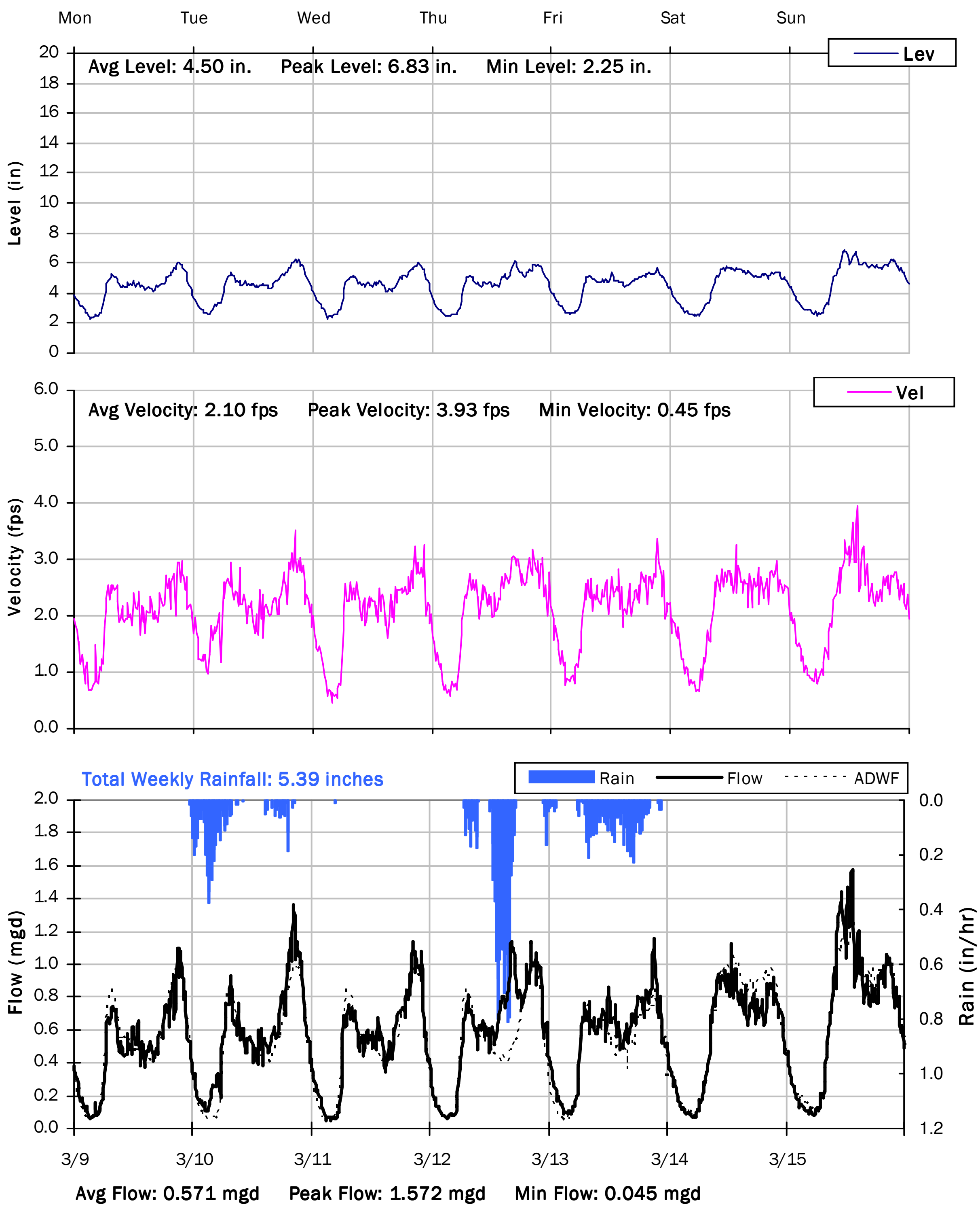
Avg Flow: 0.543 mgd Peak Flow: 1.194 mgd Min Flow: 0.021 mgd

FM-04
Weekly Level, Velocity and Flow Hydrographs
3/2/2020 to 3/9/2020

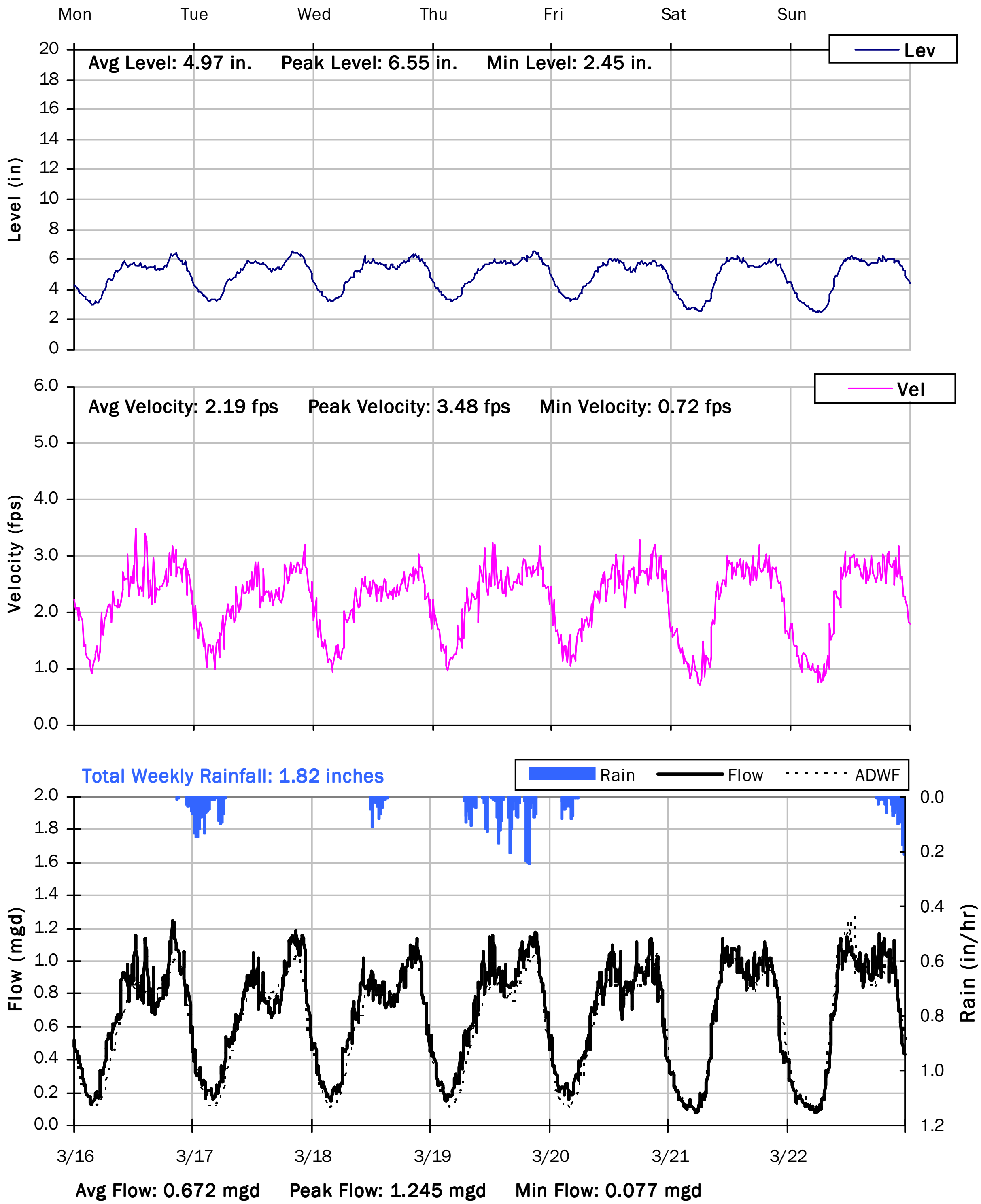


Avg Flow: 0.517 mgd **Peak Flow: 1.152 mgd** **Min Flow: 0.039 mgd**

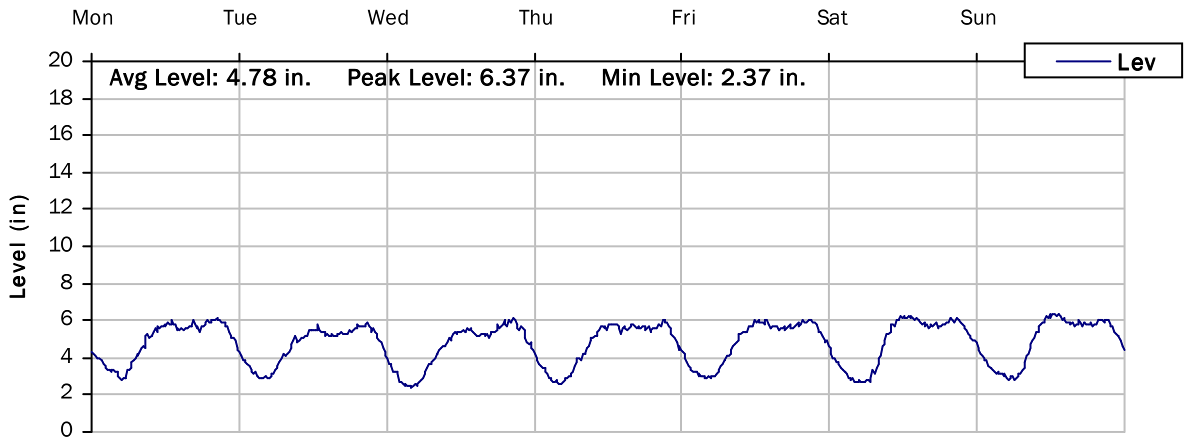
FM-04
Weekly Level, Velocity and Flow Hydrographs
3/9/2020 to 3/16/2020

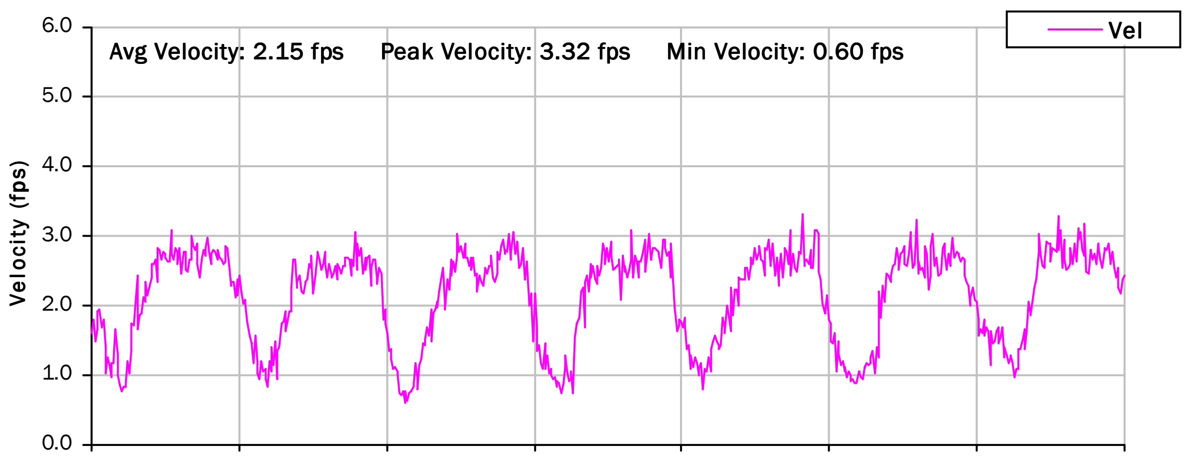


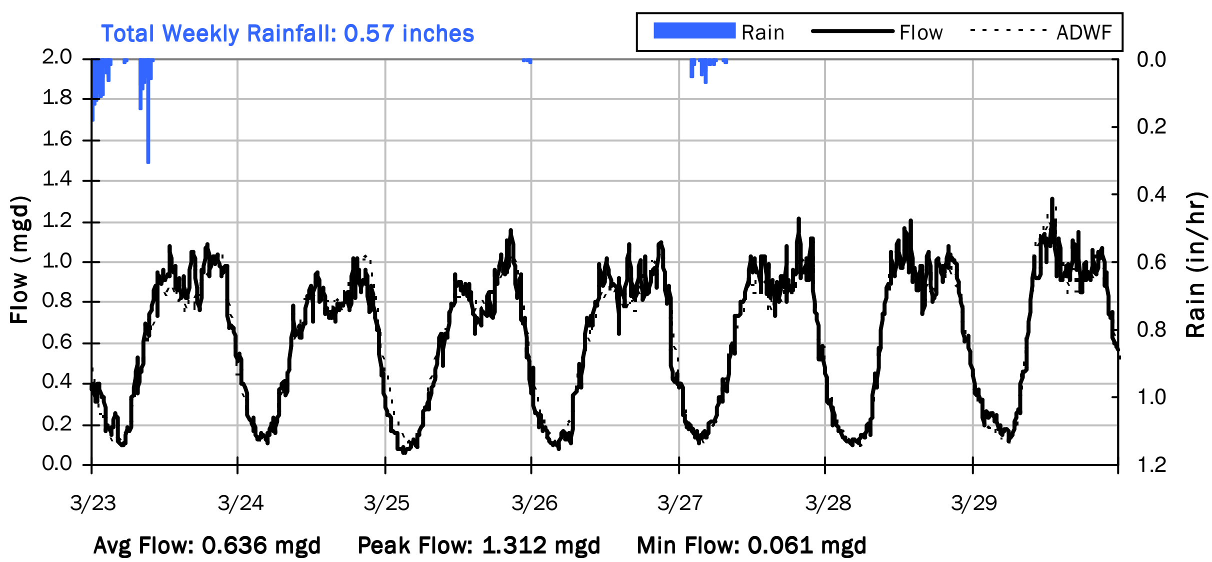
FM-04
Weekly Level, Velocity and Flow Hydrographs
3/16/2020 to 3/23/2020



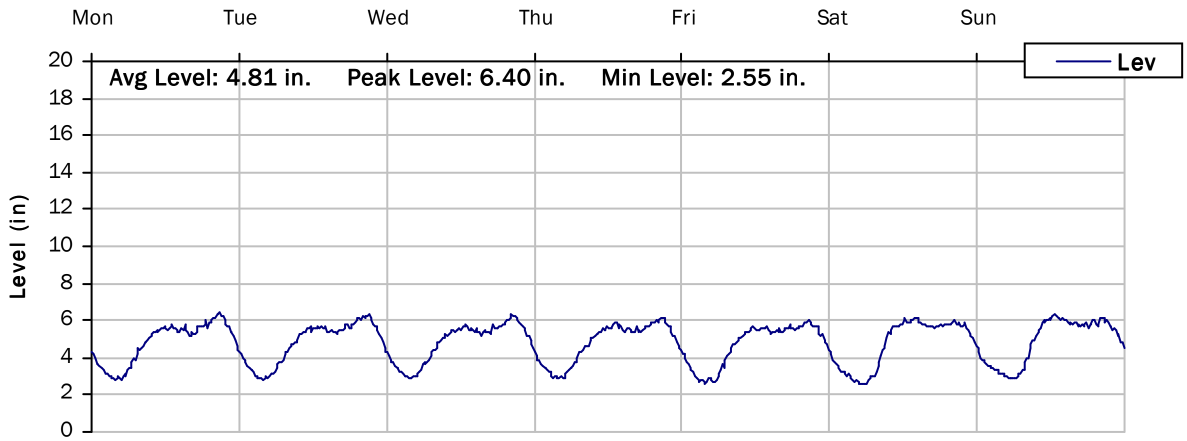
FM-04
Weekly Level, Velocity and Flow Hydrographs
3/23/2020 to 3/30/2020

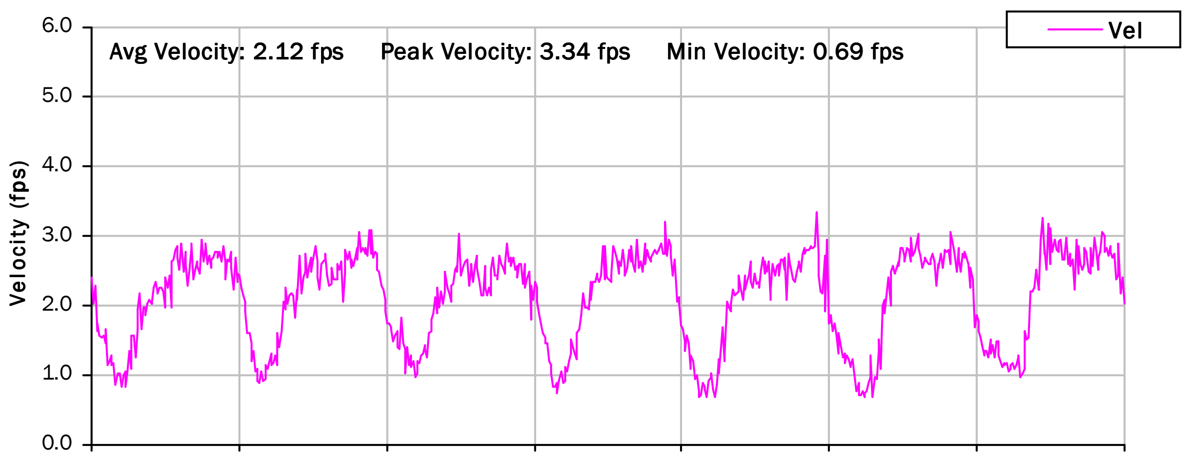


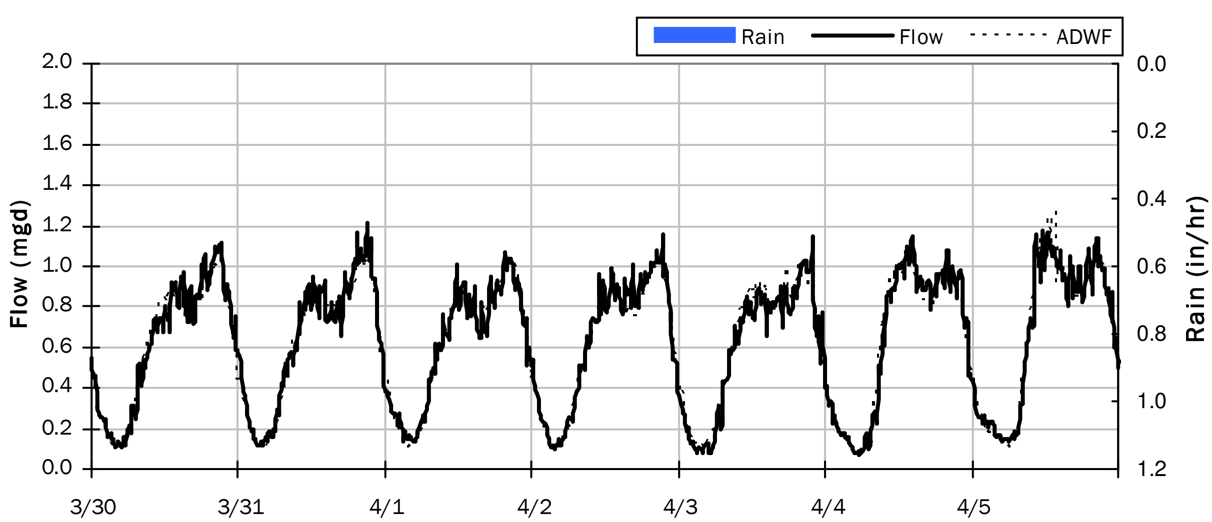




FM-04
Weekly Level, Velocity and Flow Hydrographs
3/30/2020 to 4/6/2020

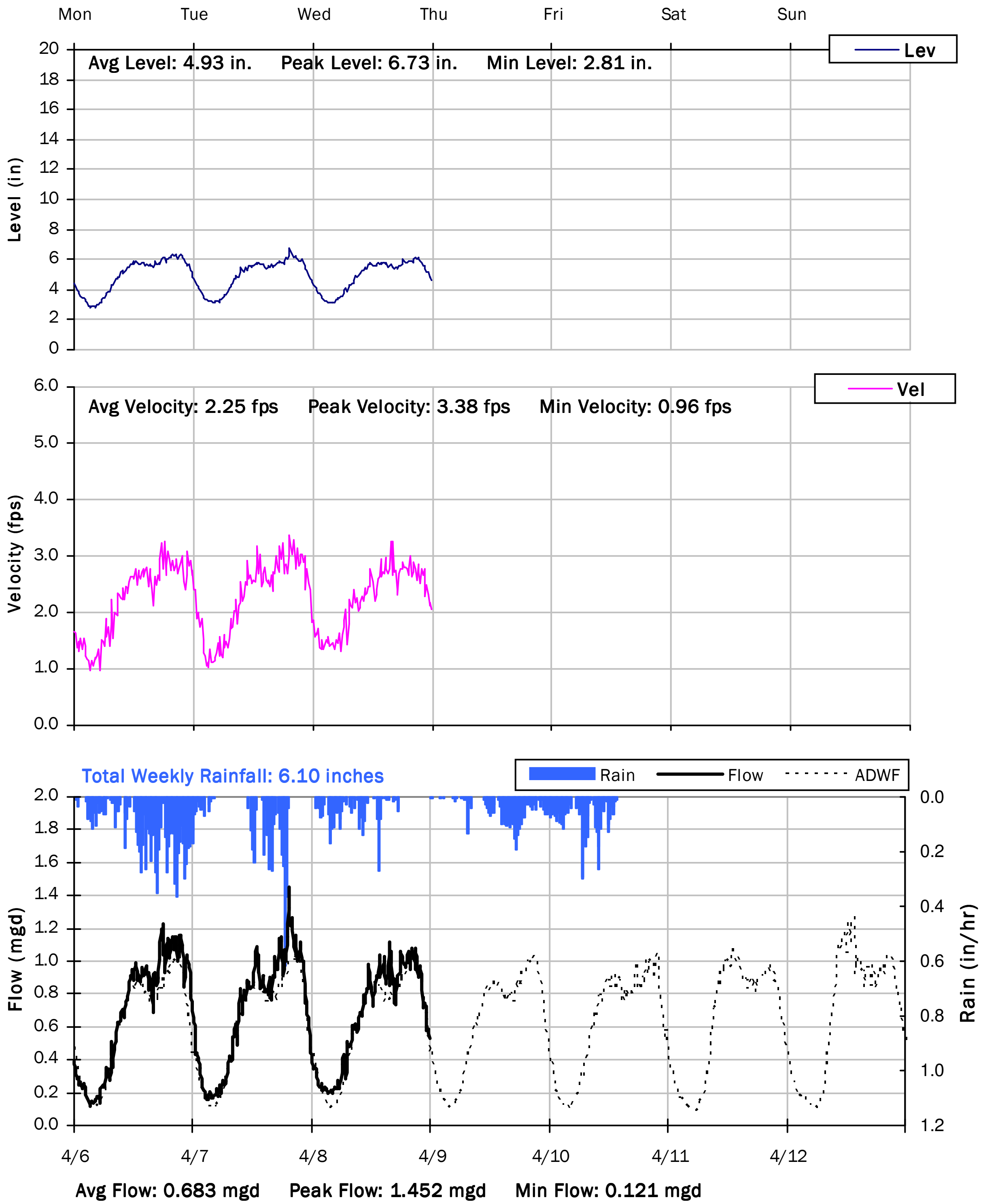






Avg Flow: 0.632 mgd **Peak Flow: 1.213 mgd** **Min Flow: 0.073 mgd**

FM-04
Weekly Level, Velocity and Flow Hydrographs
4/6/2020 to 4/13/2020



City of Beaumont

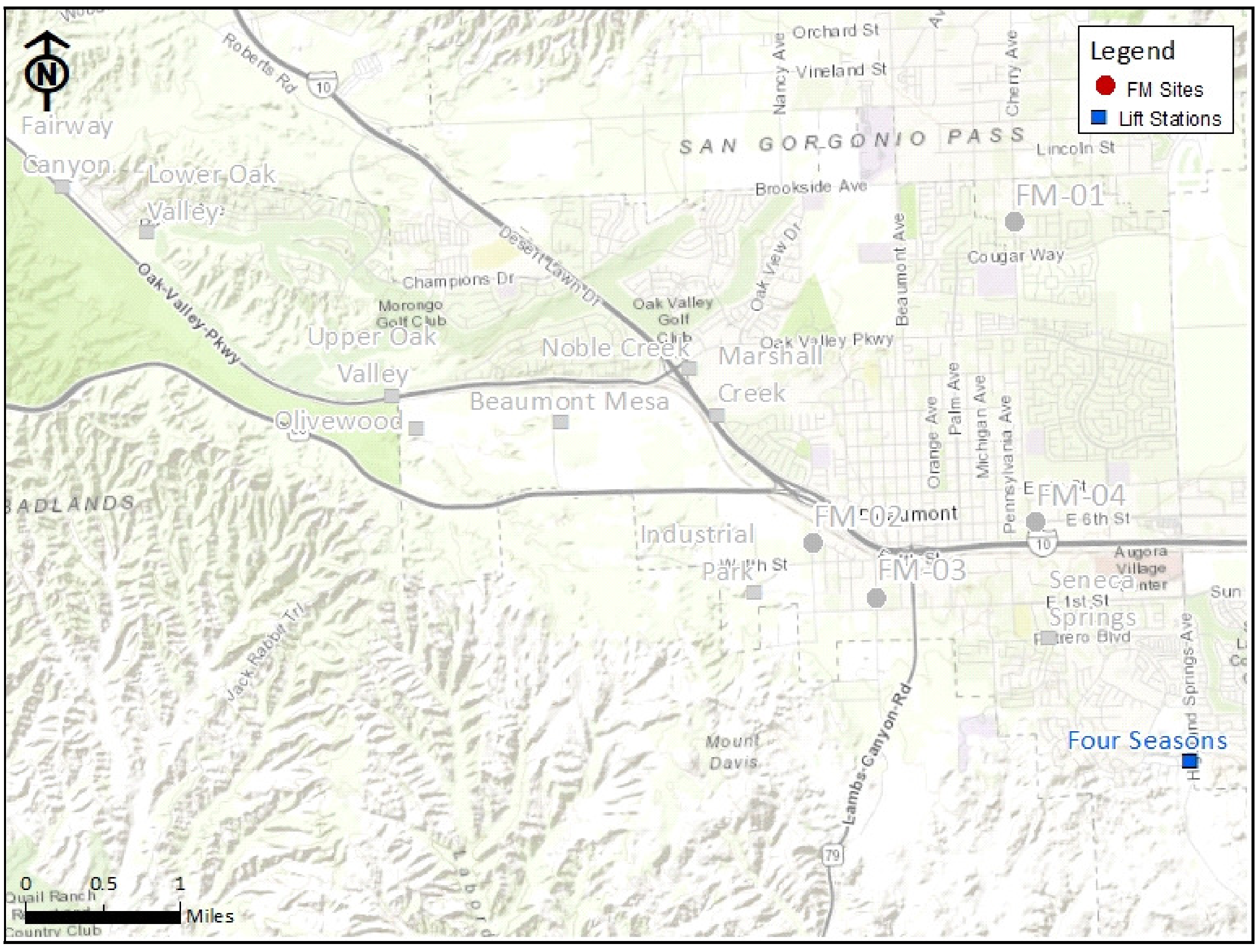
Sanitary Sewer Flow Monitoring
February 20 - April 09, 2020

Monitoring Site: FM-05

City Structure: Four Seasons LS

Location: Highland Springs, 320 feet south of Breckenridge Ave

Data Summary Report



Vicinity Map: FM-05

FM-05

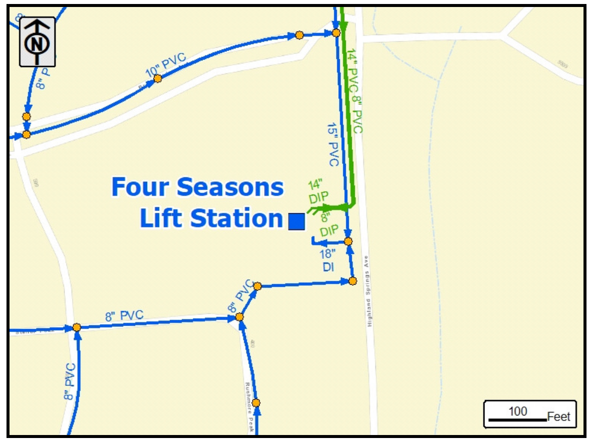
Site Information

City Structure: Four Seasons LS **Coordinates:** 116.9468° W, 33.9064° N **Rim Elev:** 2480 feet

Location: Highland Springs, 320 feet south of Breckenridge Ave

ADWF: 0.235 mgd **Peak Measured Flow:** 0.615 mgd

Satellite Map



Sanitary Map

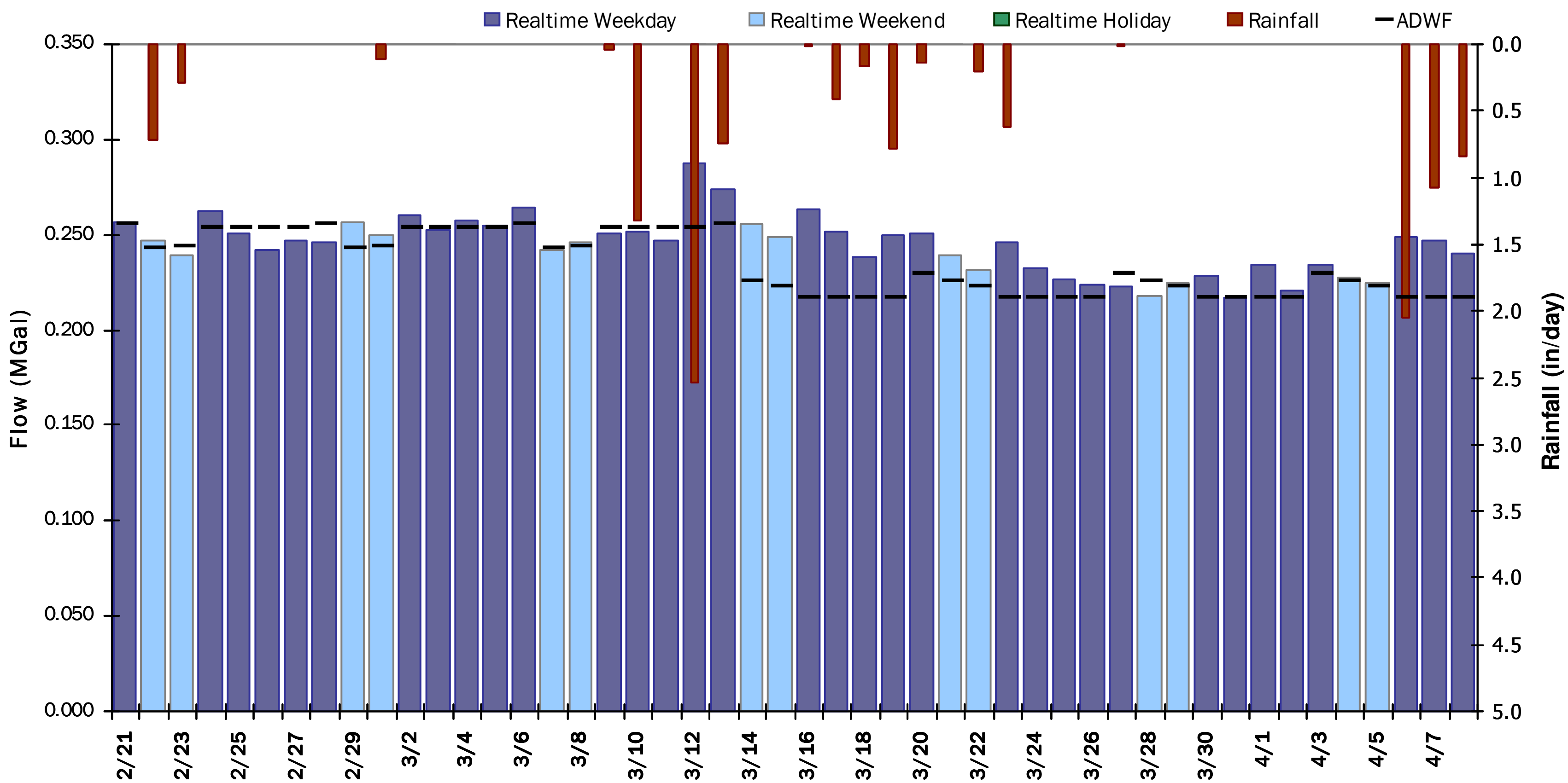
Street View

FM-05

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.244 MGal **Peak Daily Flow: 0.287 MGal** **Min Daily Flow: 0.217 MGal**

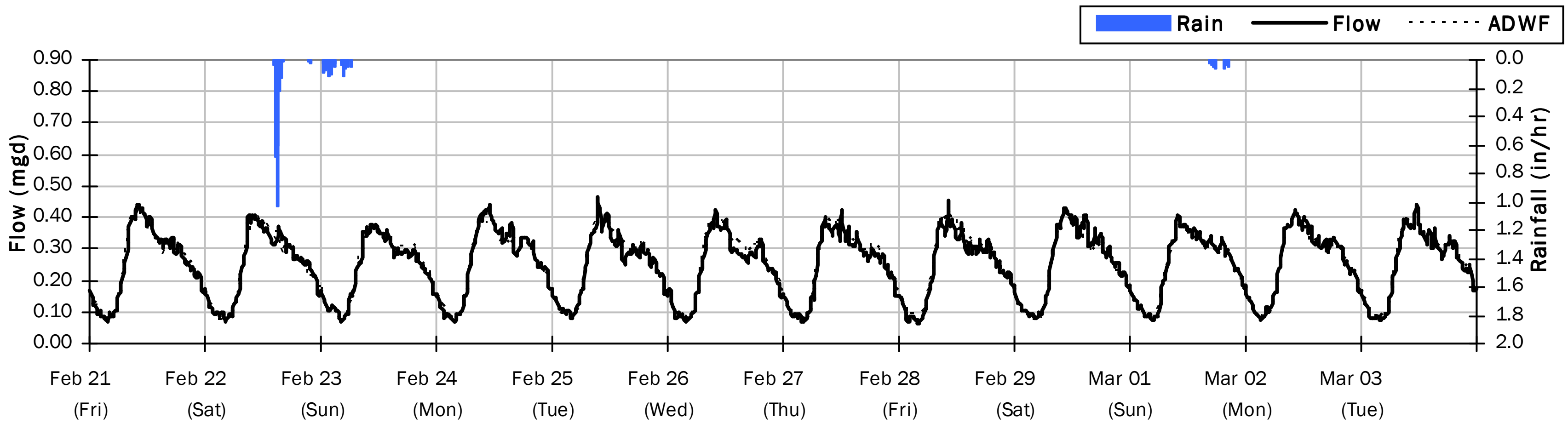
Total Period Rainfall: 12.09 inches

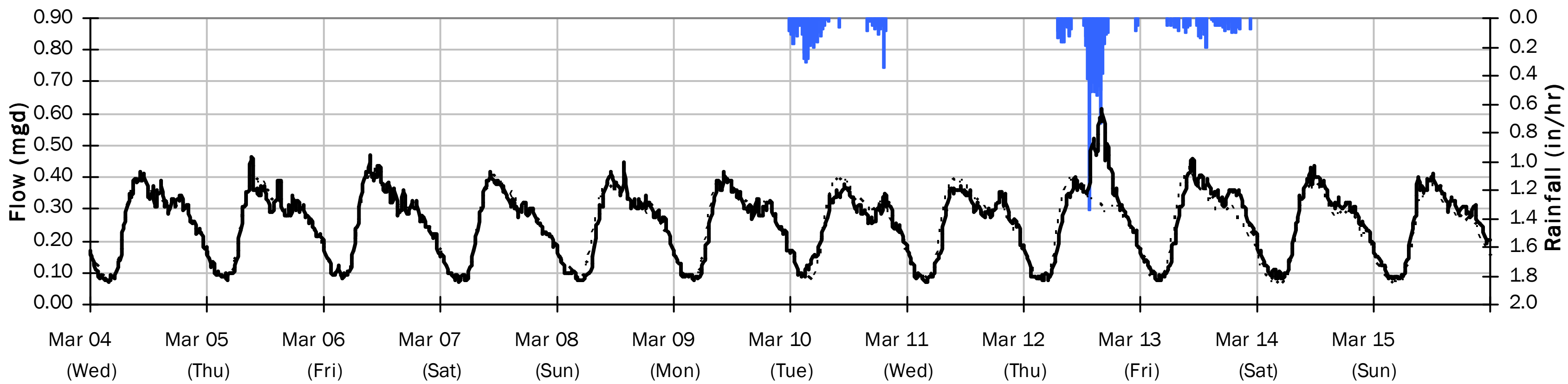


FM-05

Flow Summary: 2/21/2020 to 3/15/2020

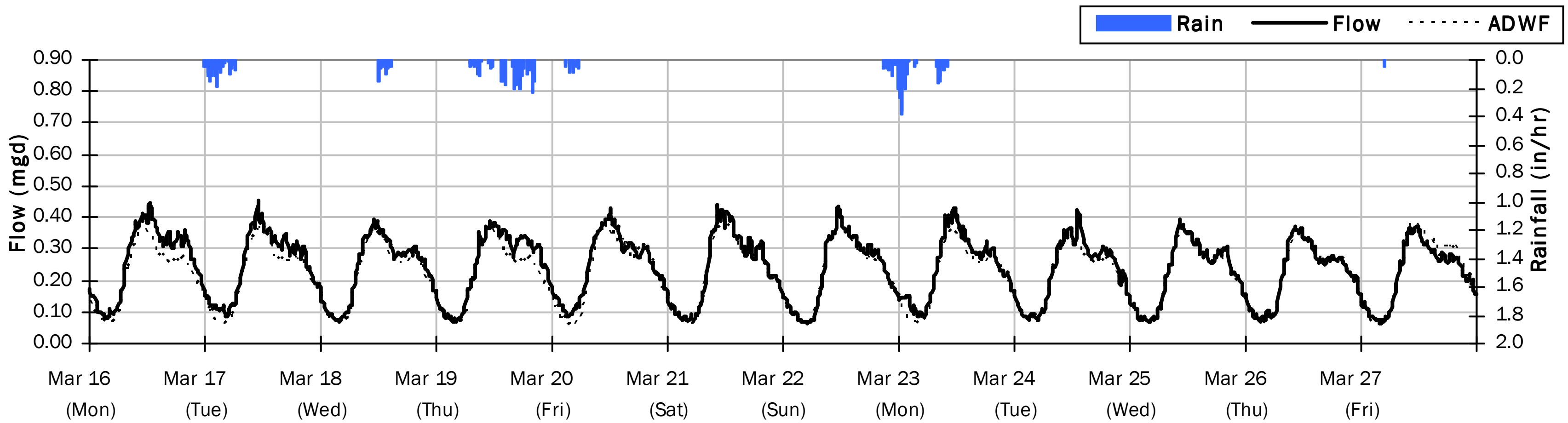
Total Period Rainfall: 5.76 inches   **Avg Flow: 0.254 mgd**   **Peak Flow: 0.615 mgd**   **Min Flow: 0.065 mgd**

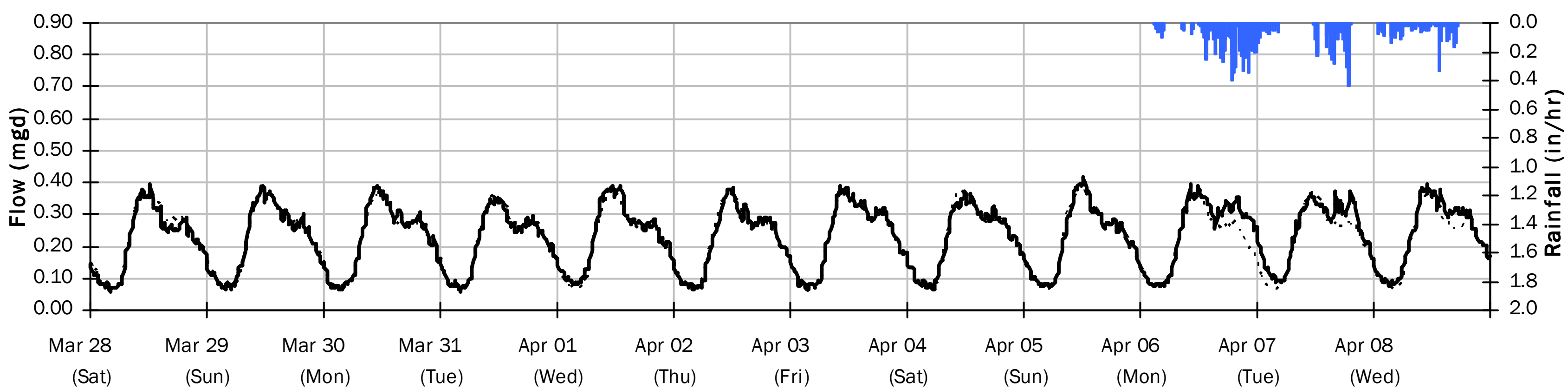




FM-05
Flow Summary: 3/16/2020 to 4/8/2020

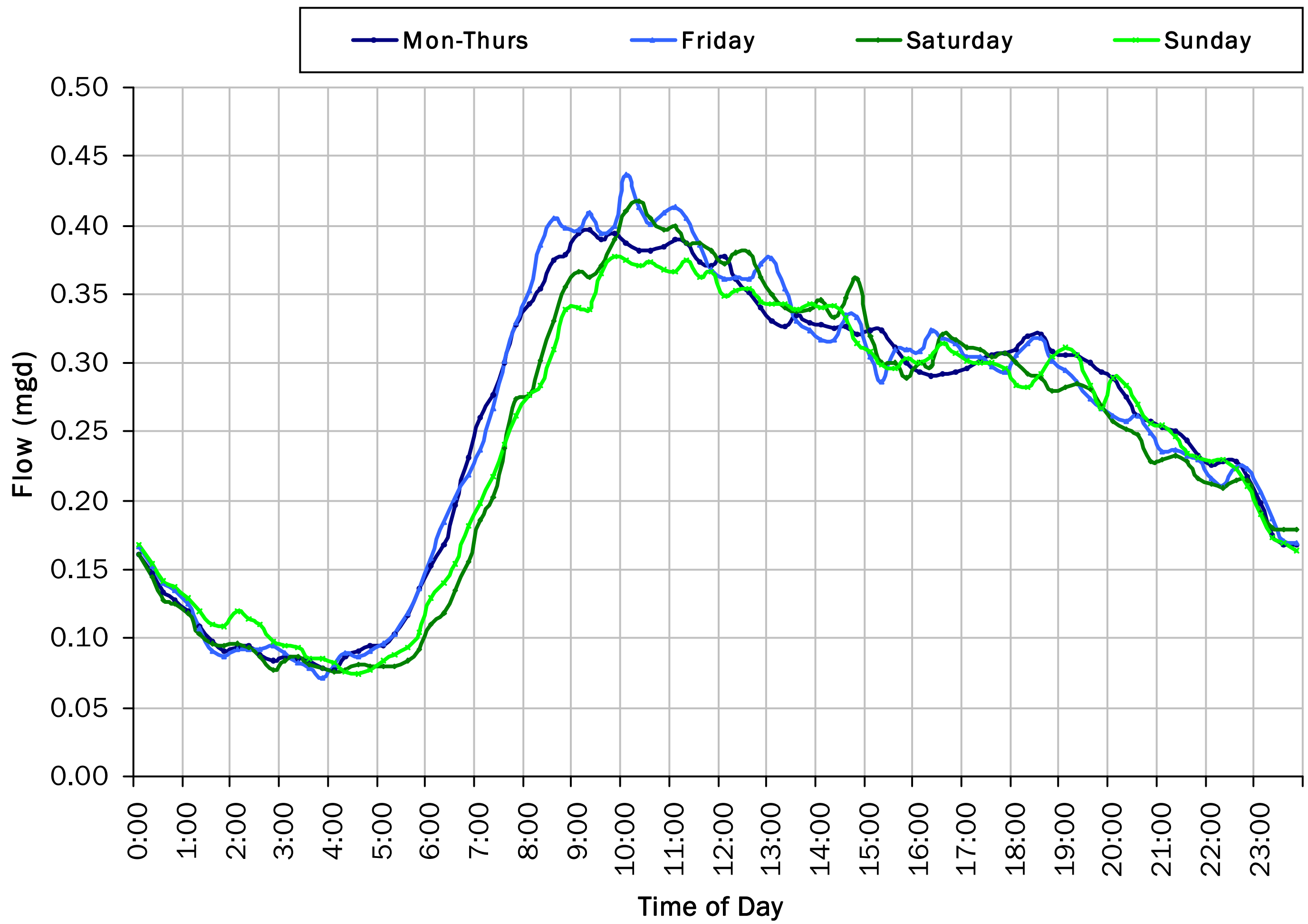
Total Period Rainfall: 6.32 inches   **Avg Flow: 0.235 mgd**   **Peak Flow: 0.451 mgd**   **Min Flow: 0.060 mgd**





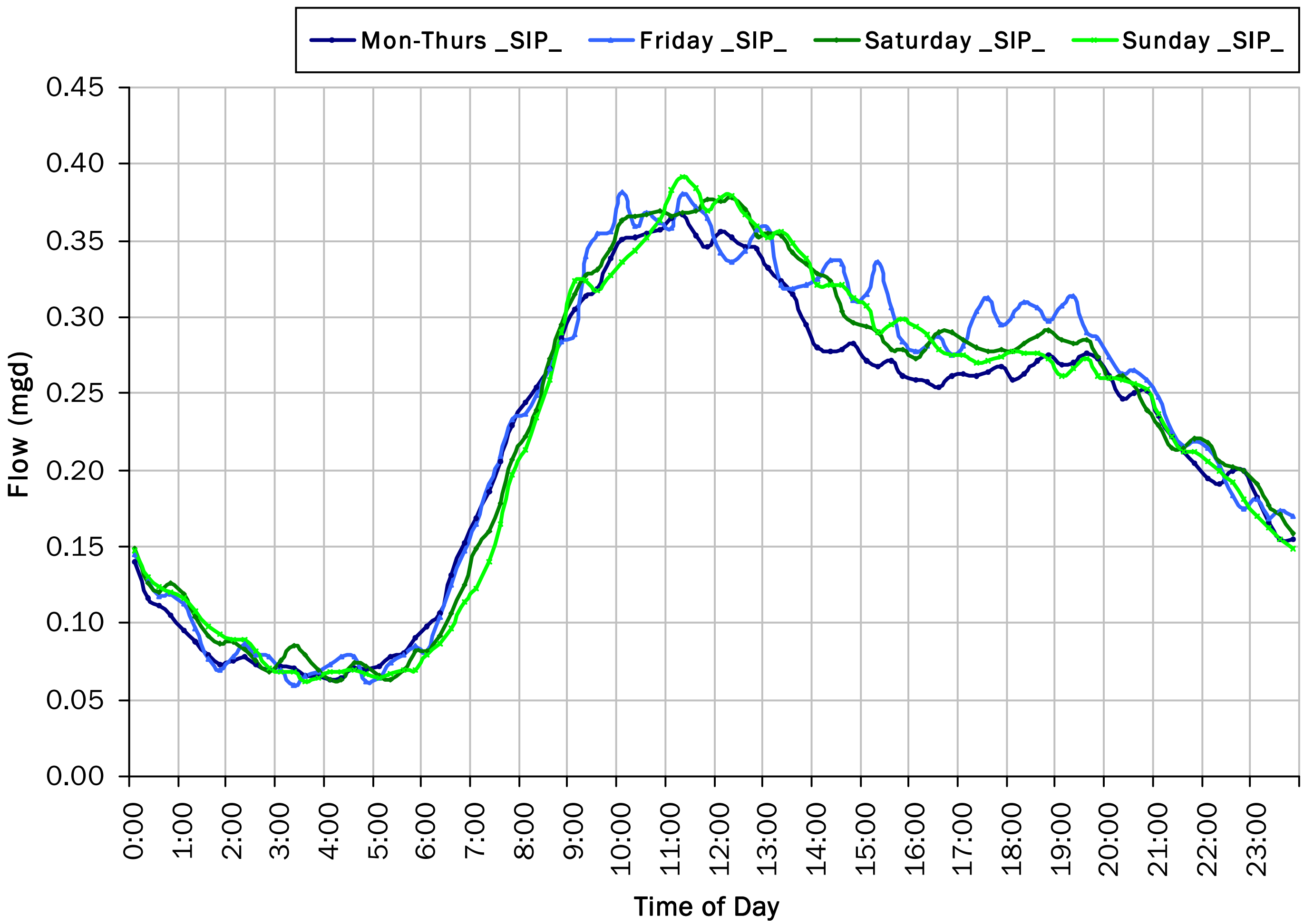
FM-05

Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)



ADWF:
0.251 mgd

FM-05
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)

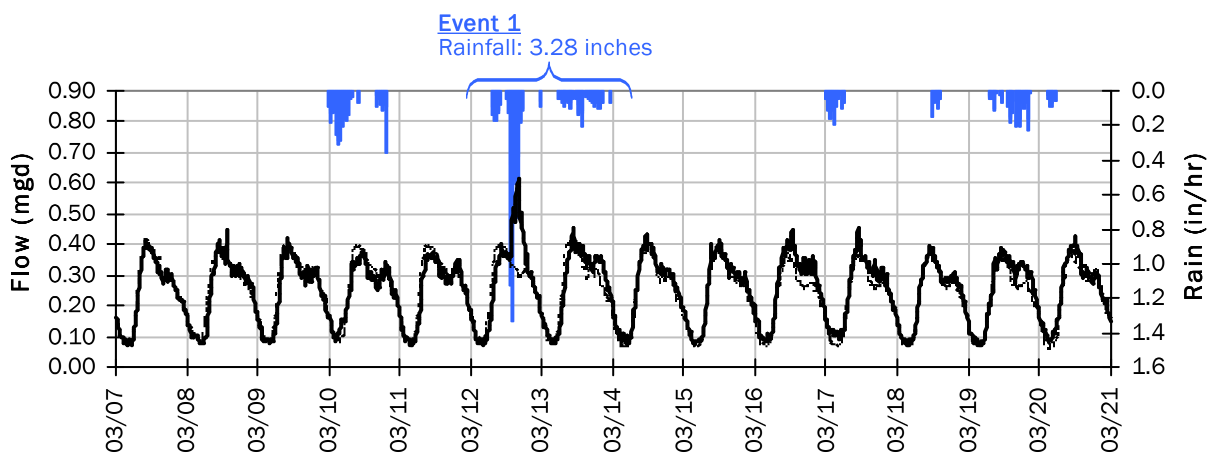


ADWF:
0.221 mgd

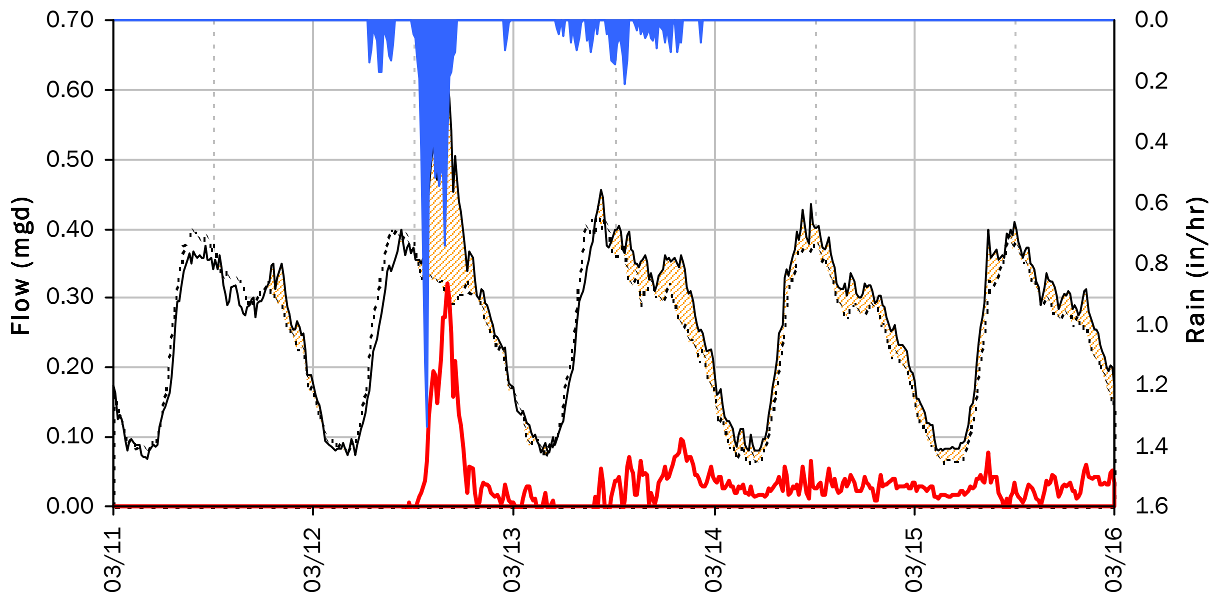
FM-05

I/I Summary: Event 1

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



<u>Event 1 Detail Graph</u>

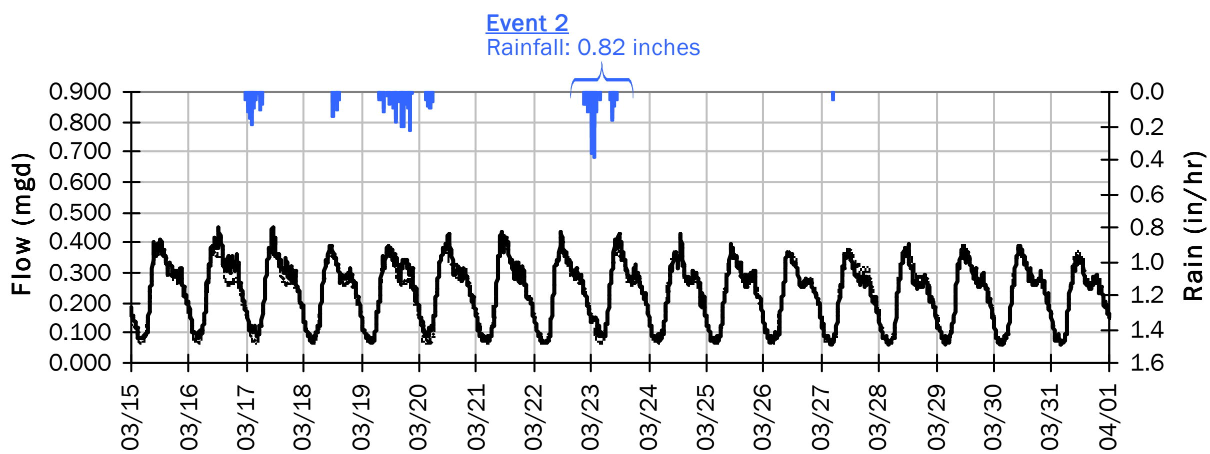


Storm Event I/I Analysis (Rain = 3.28 inches)

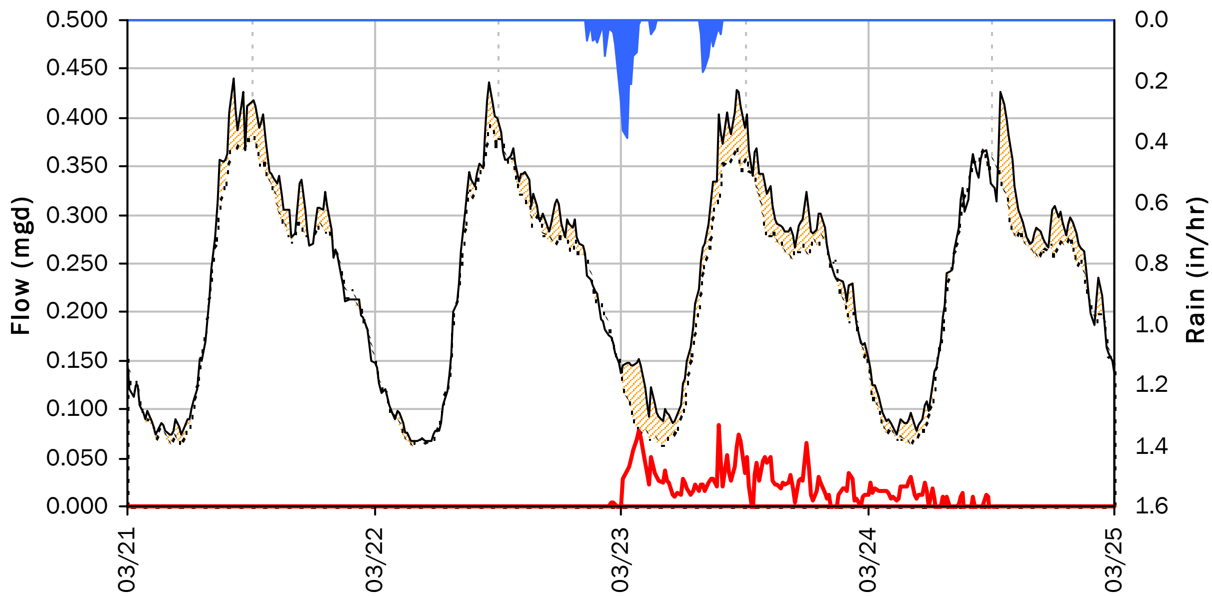
<u>Capacity</u>		**<u>Inflow / Infiltration</u>**	
Peak Flow:	0.62 *mgd*	**Peak I/I Rate:**	0.32 *mgd*
PF:	2.62	**Total I/I:**	117,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-05
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

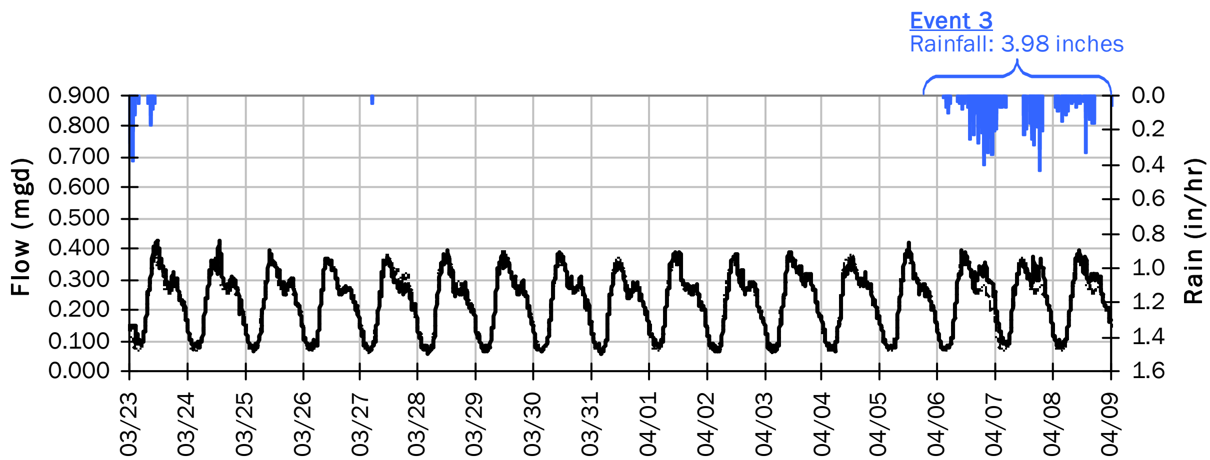


Storm Event I/I Analysis (Rain = 0.82 inches)

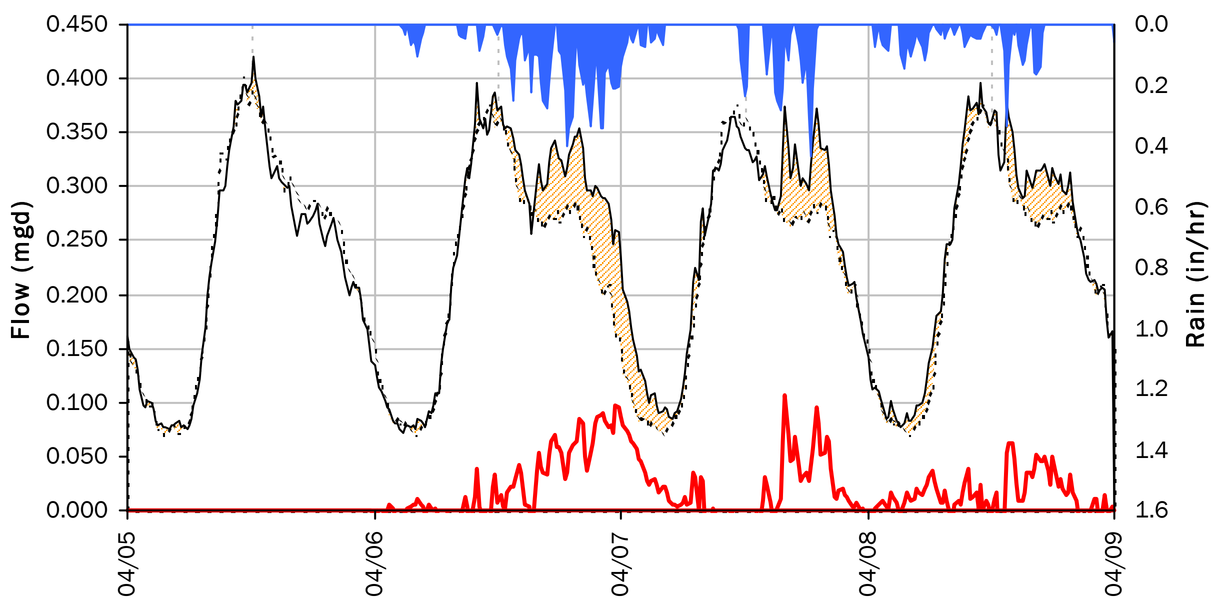
Capacity		Inflow / Infiltration	
Peak Flow:	0.43 *mgd*	**Peak I/I Rate:**	0.09 *mgd*
PF:	1.82	**Total I/I:**	32,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-05
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 3.98 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.40 *mgd*	**Peak I/I Rate:**	0.11 *mgd*
PF:	1.69	**Total I/I:**	60,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

City of Beaumont

Sanitary Sewer Flow Monitoring

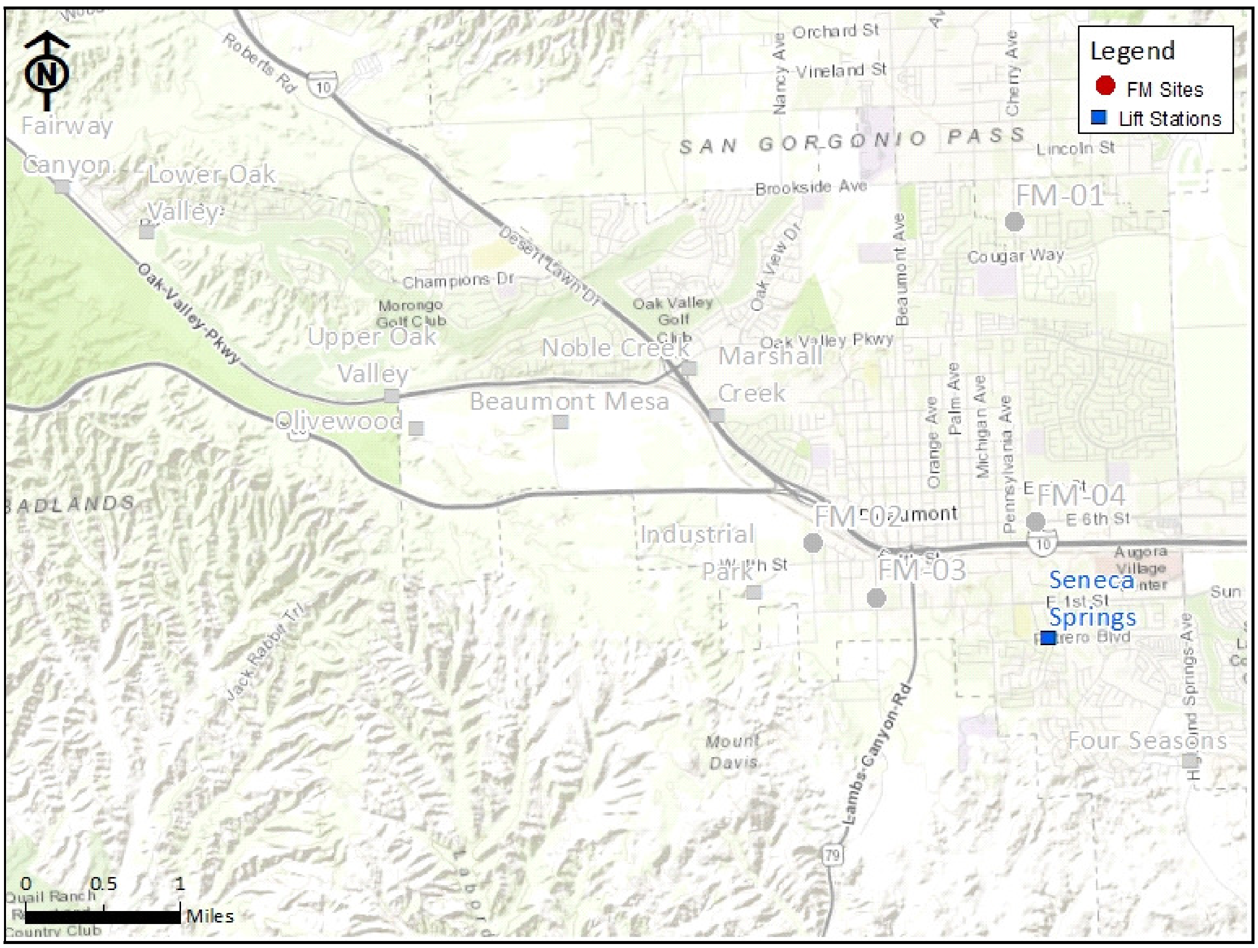
February 20 - April 09, 2020

Monitoring Site: FM-06

City Structure: Seneca Springs LS

Location: Potrero Blvd and Seneca Springs Blvd

Data Summary Report



Vicinity Map: FM-06

FM-06

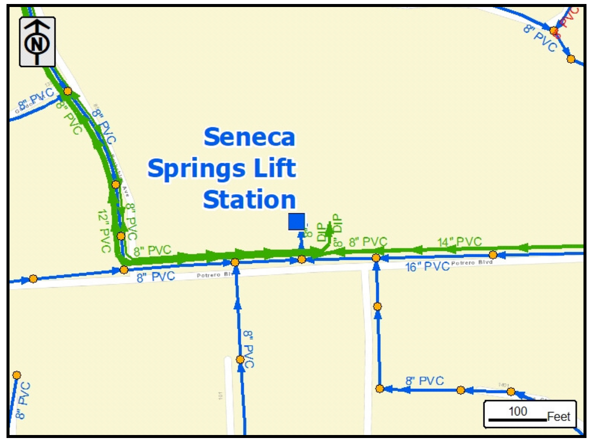
Site Information

City Structure: Seneca Springs LS **Coordinates:** 116.9619° W, 33.9185° N **Rim Elev:** 2564 feet

Location: Potrero Blvd and Seneca Springs Blvd

ADWF: 0.146 mgd **Peak Measured Flow:** 0.477 mgd

Satellite Map



Sanitary Map

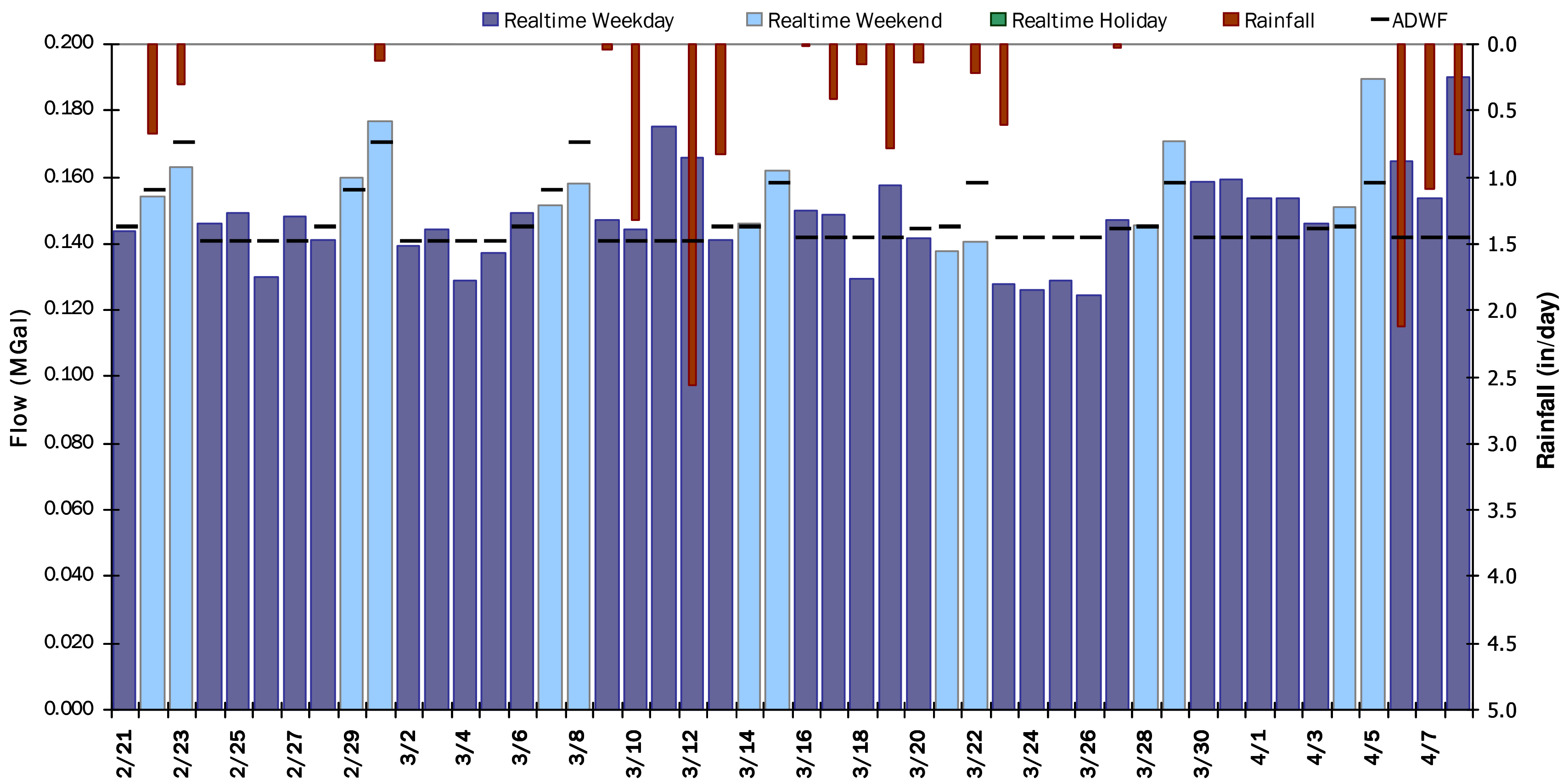
Street View

FM-06

Period Flow Summary: Daily Flow Totals

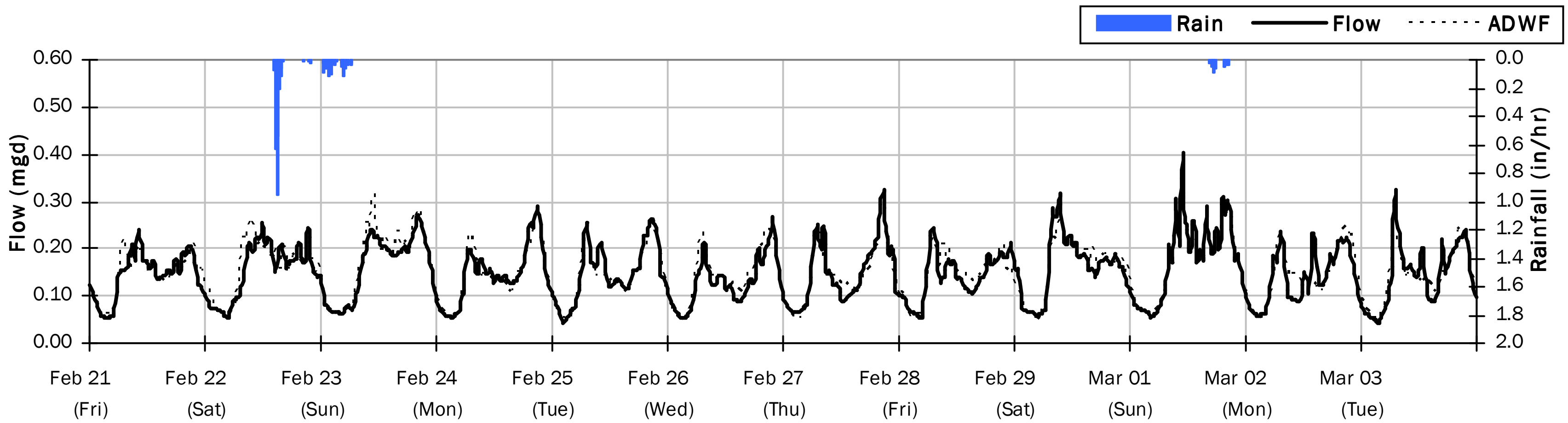
Avg Period Flow: 0.150 MGal **Peak Daily Flow: 0.190 MGal** **Min Daily Flow: 0.124 MGal**

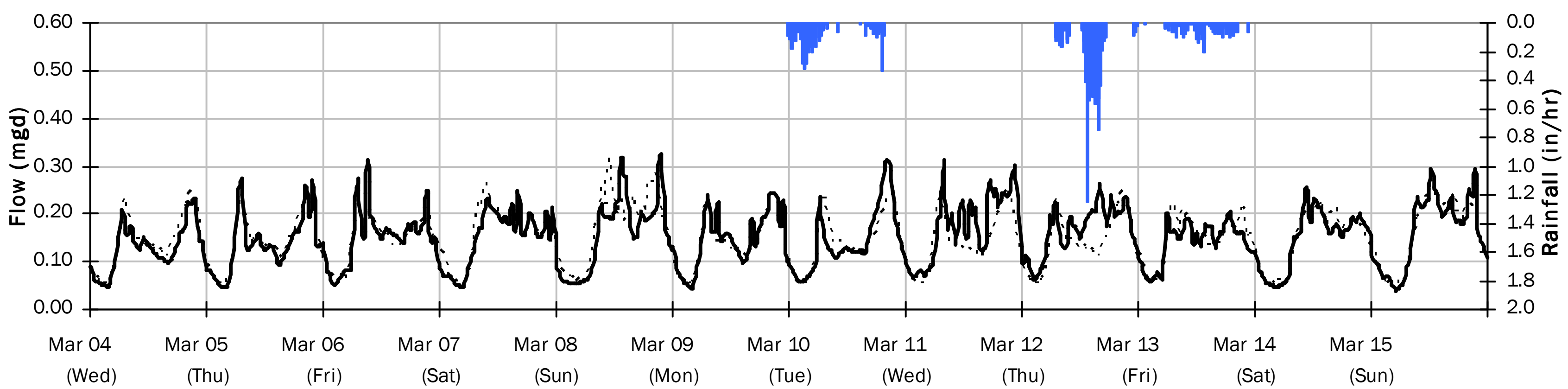
Total Period Rainfall: 12.26 inches



FM-06
Flow Summary: 2/21/2020 to 3/15/2020

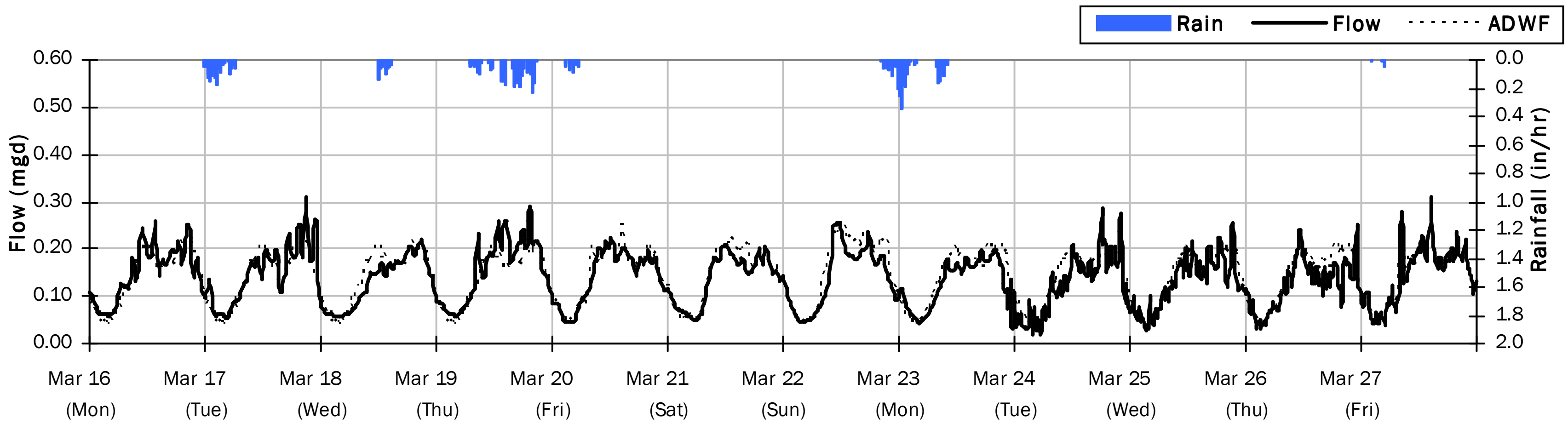
Total Period Rainfall: 5.86 inches   **Avg Flow: 0.150 mgd**   **Peak Flow: 0.403 mgd**   **Min Flow: 0.040 mgd**

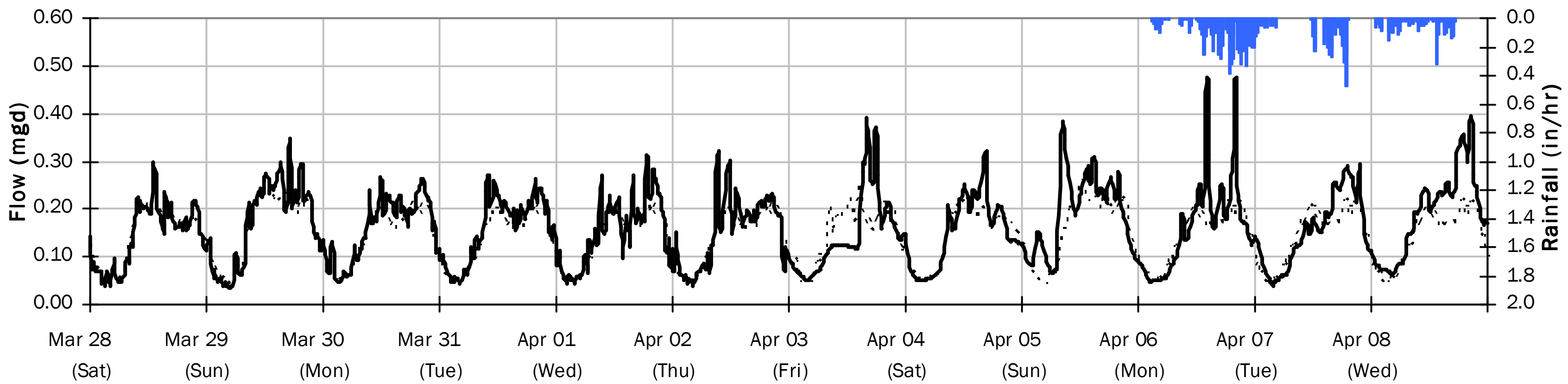




FM-06
Flow Summary: 3/16/2020 to 4/8/2020

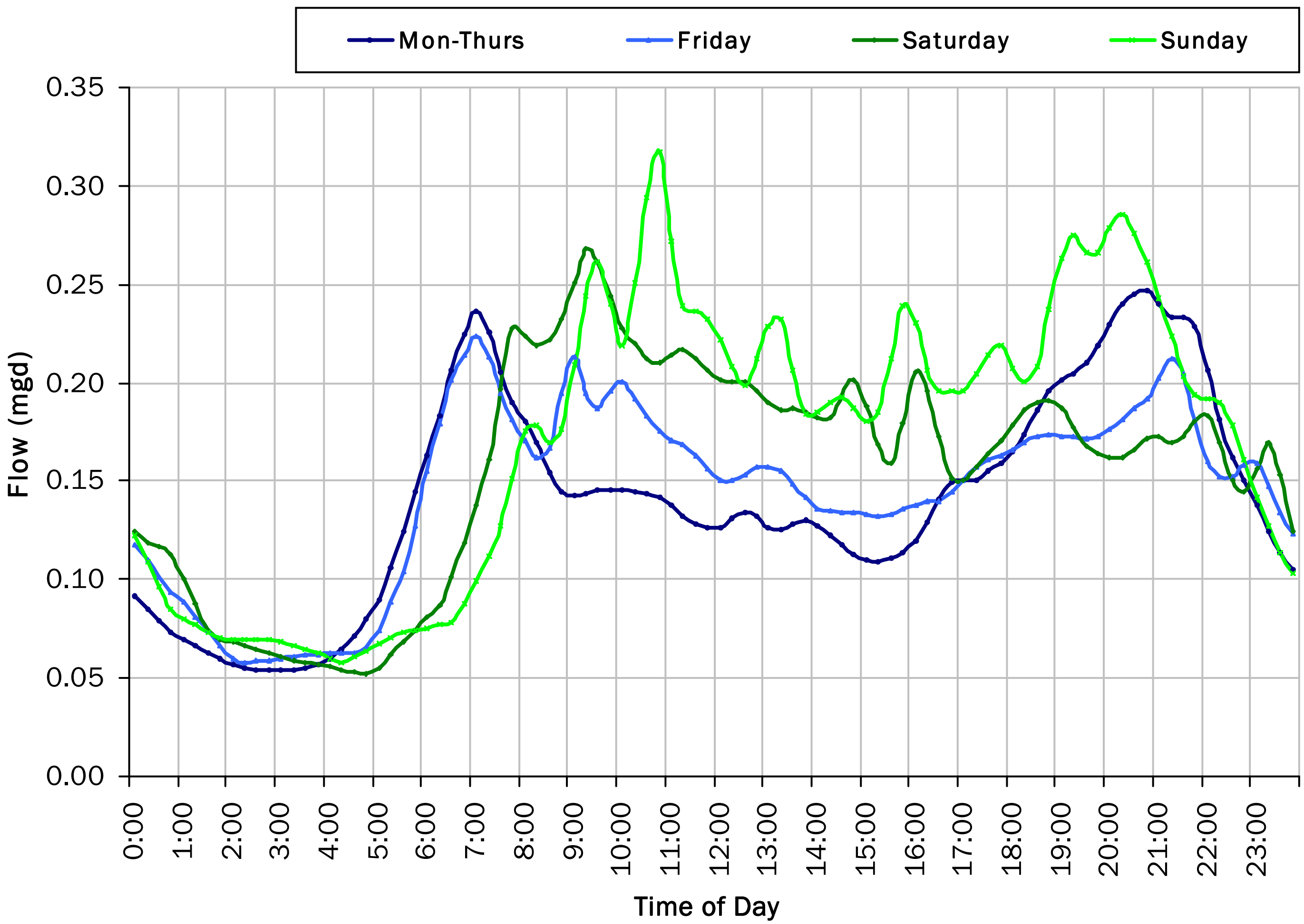
Total Period Rainfall: 6.40 inches   **Avg Flow: 0.150 mgd**   **Peak Flow: 0.477 mgd**   **Min Flow: 0.018 mgd**





FM-06

Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)

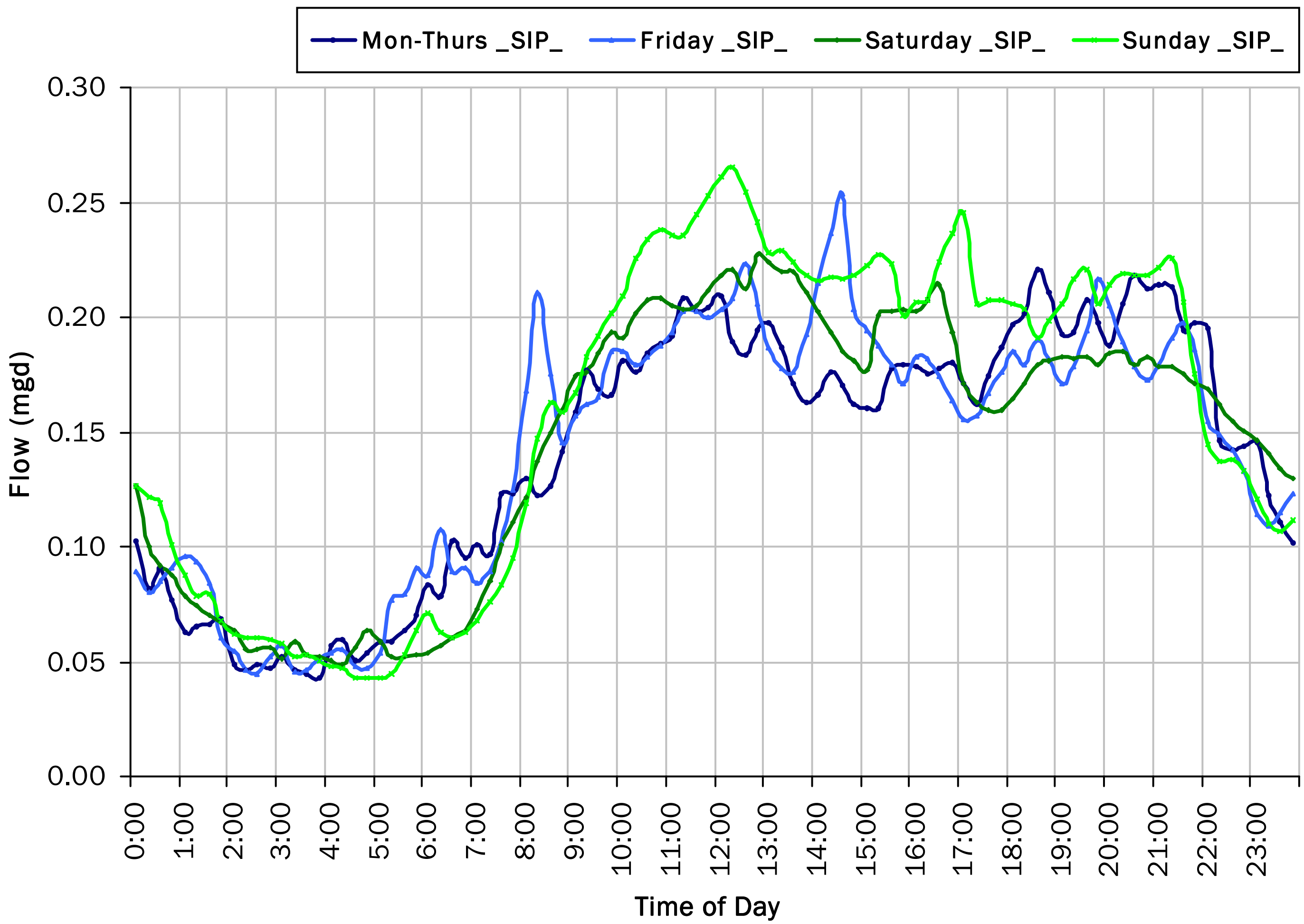


ADWF:

0.147 mgd

FM-06

Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)

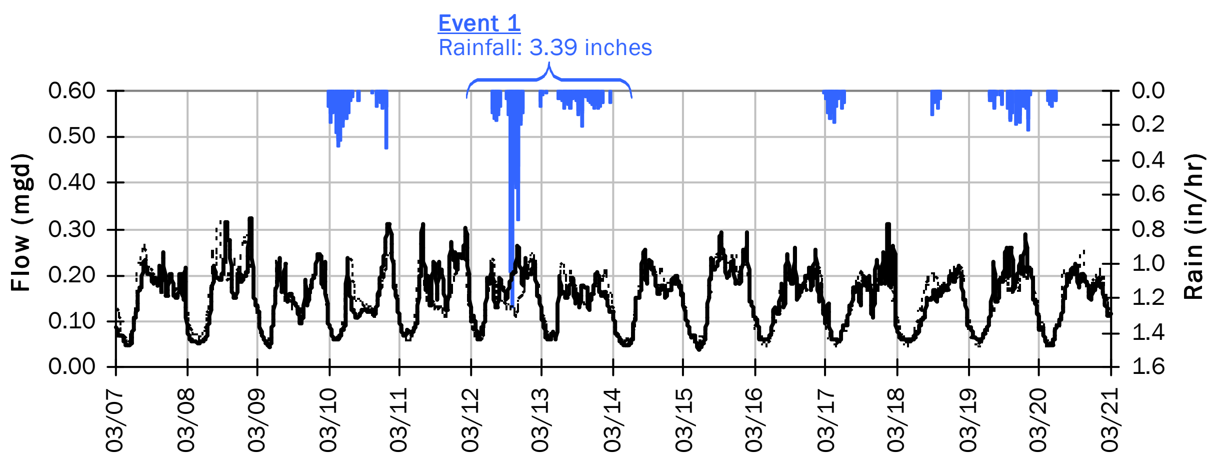


ADWF:

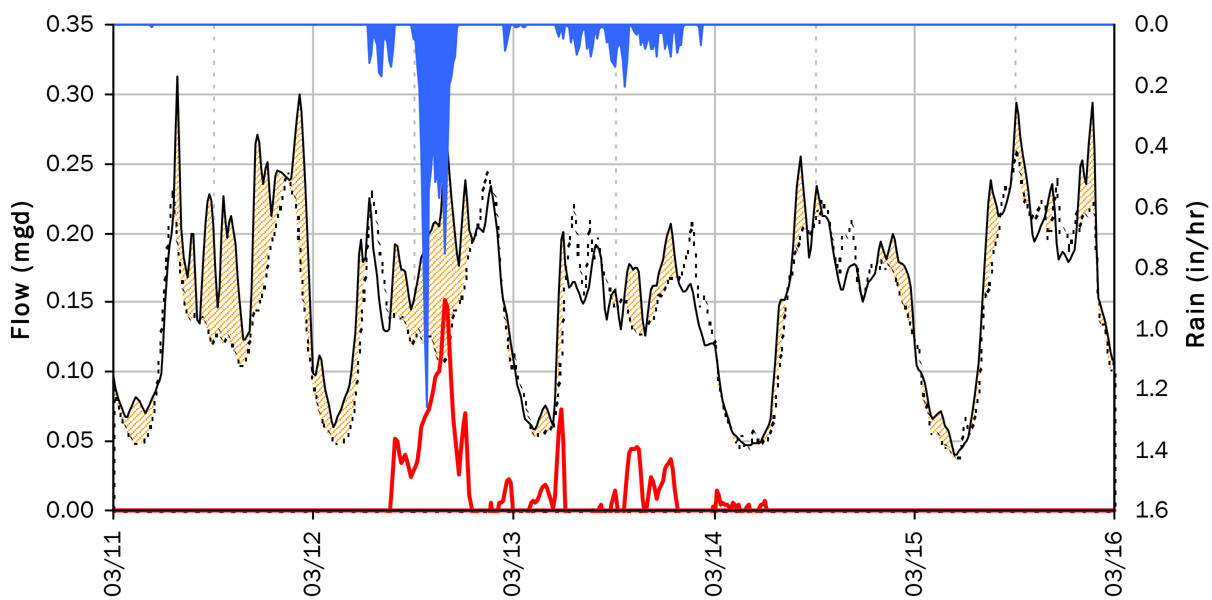
0.145 mgd

FM-06
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

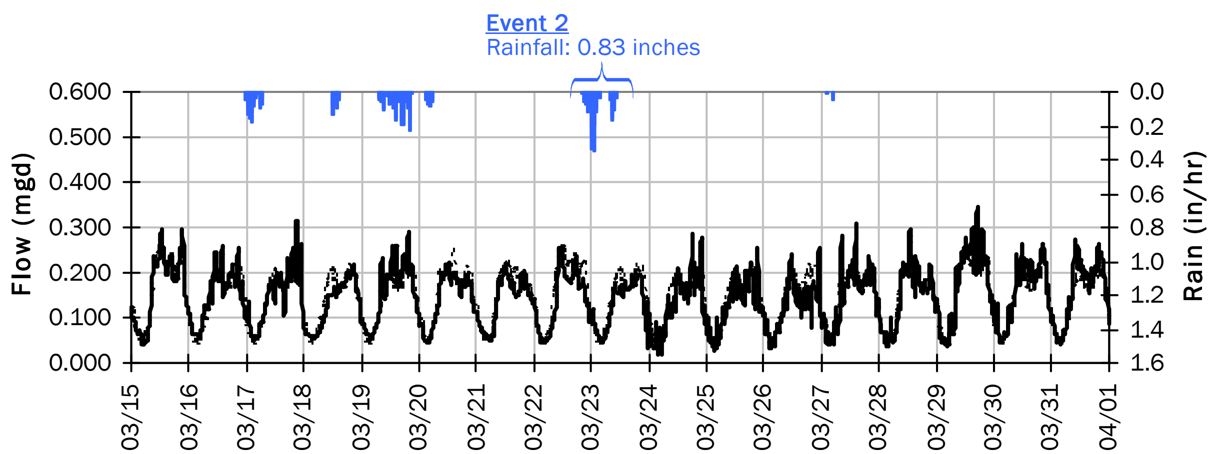


Storm Event I/I Analysis (Rain = 3.39 inches)

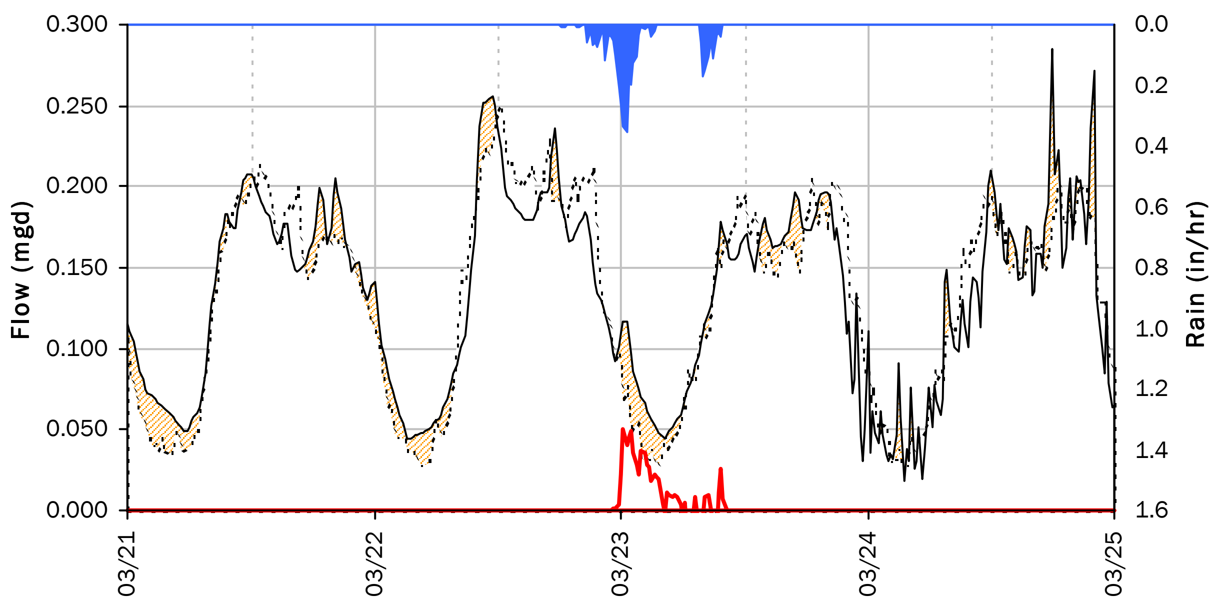
Capacity		Inflow / Infiltration	
Peak Flow:	0.26 *mgd*	**Peak I/I Rate:**	0.15 *mgd*
PF:	1.80	**Total I/I:**	27,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-06
I/I Summary: Event 2

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



<u>Event 2 Detail Graph</u>

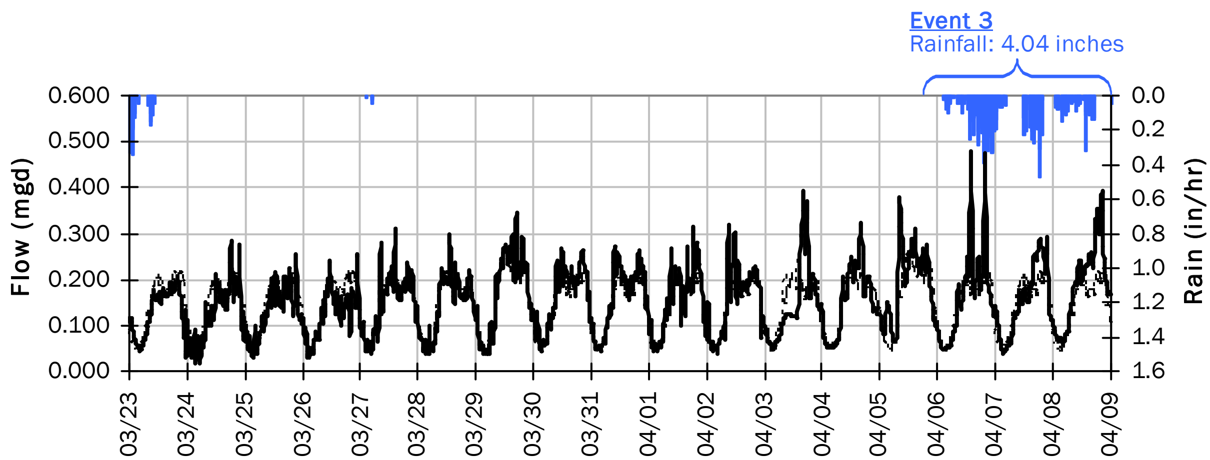


Storm Event I/I Analysis (Rain = 0.83 inches)

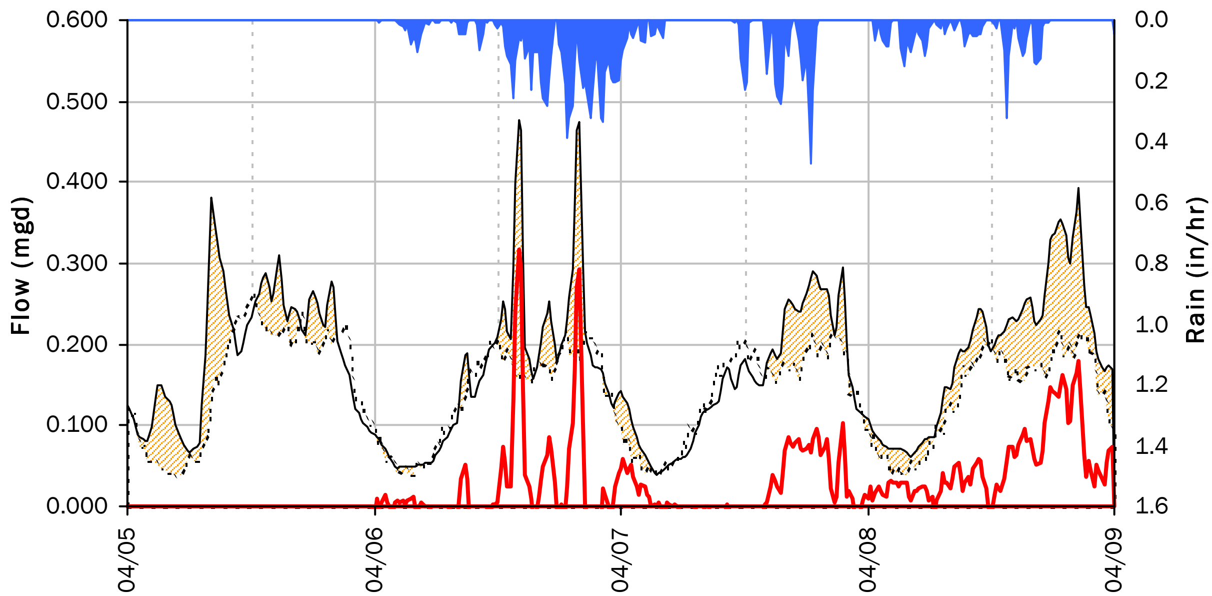
<u>Capacity</u>		<u>Inflow / Infiltration</u>	
Peak Flow:	0.18 *mgd*	**Peak I/I Rate:**	0.05 *mgd*
PF:	1.22	**Total I/I:**	6,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-06
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 4.04 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.48 *mgd*	**Peak I/I Rate:**	0.32 *mgd*
PF:	3.27	**Total I/I:**	98,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

City of Beaumont

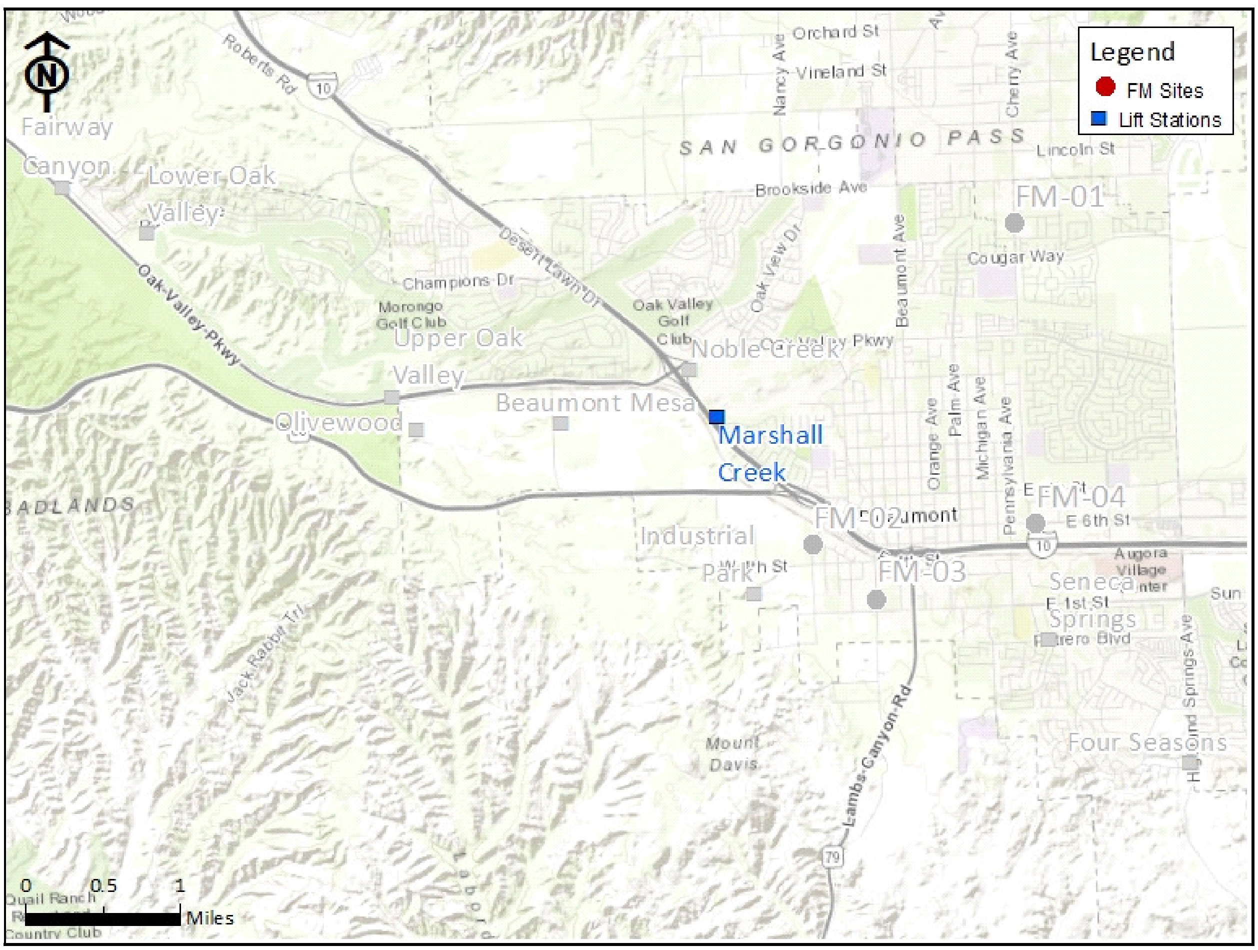
Sanitary Sewer Flow Monitoring
February 20 - April 09, 2020

Monitoring Site: FM-07

City Structure: Marshall Creek LS

Location: Northwest end of Ring Ranch Road

Data Summary Report



Vicinity Map: FM-07

FM-07

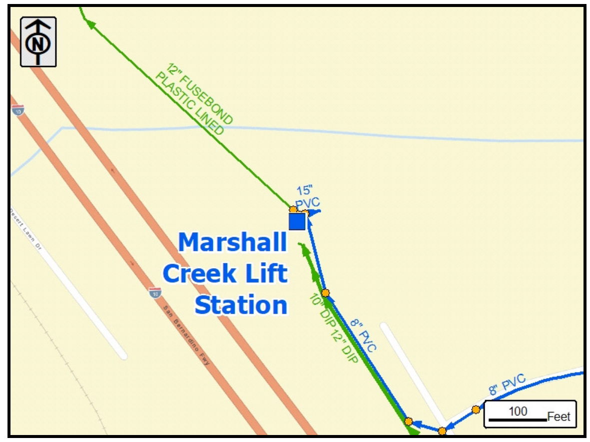
Site Information

City Structure: Marshall Creek LS **Coordinates:** 116.9984° W, 33.9405° N **Rim Elev:** 2499 feet

Location: Northwest end of Ring Ranch Road

ADWF: 0.424 mgd **Peak Measured Flow:** 1.400 mgd

Satellite Map



Sanitary Map

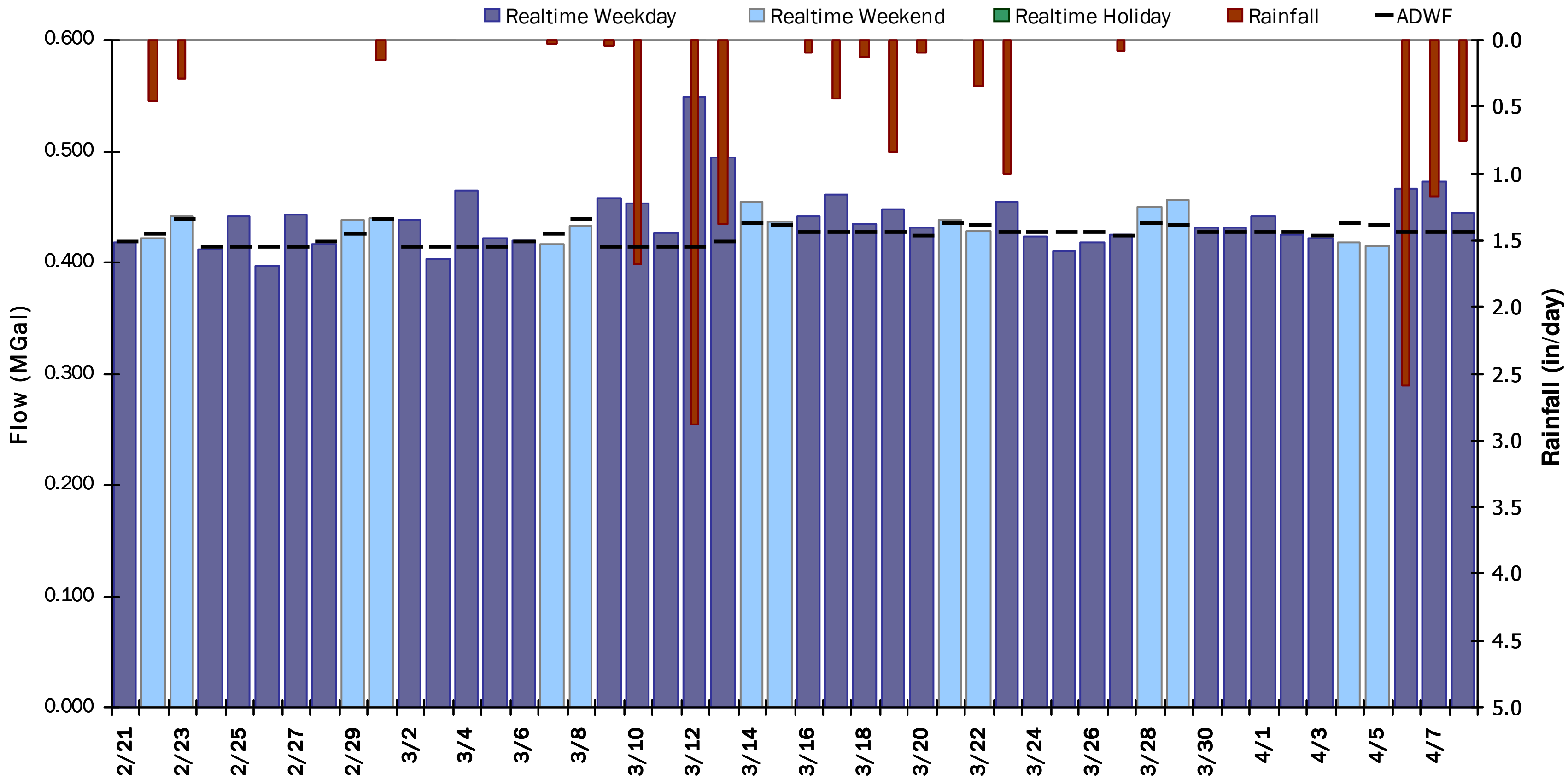
Street View

FM-07

Period Flow Summary: Daily Flow Totals

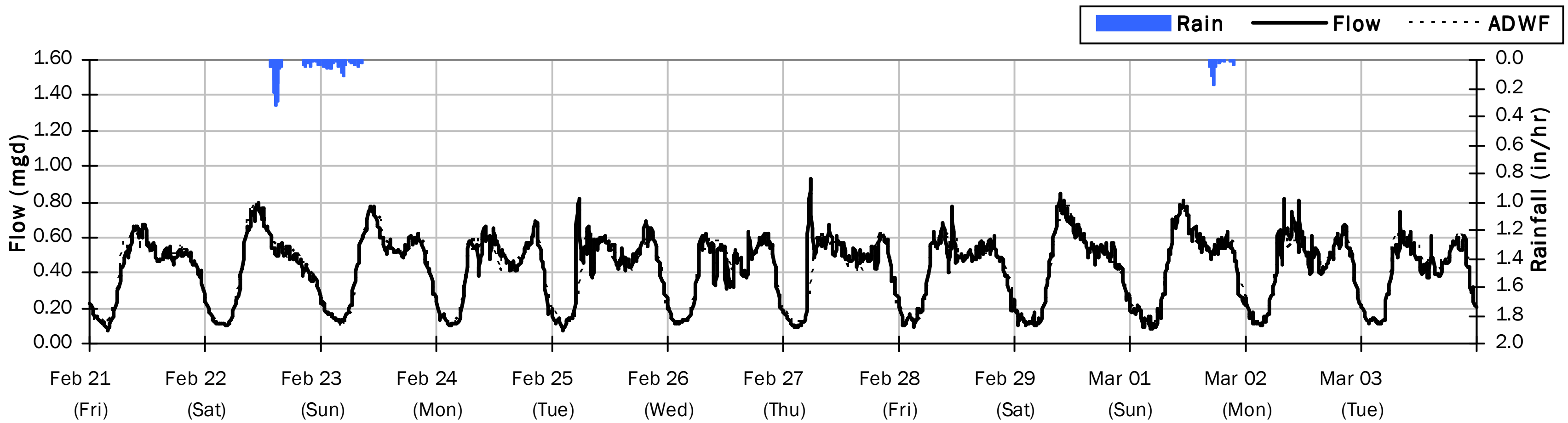
Avg Period Flow: 0.438 MGal **Peak Daily Flow: 0.549 MGal** **Min Daily Flow: 0.396 MGal**

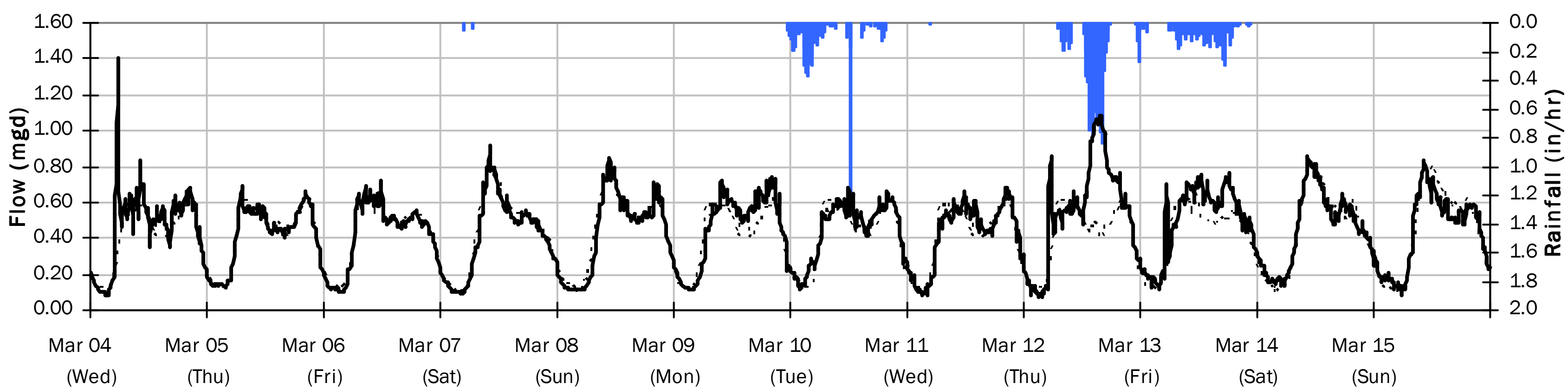
Total Period Rainfall: 14.49 inches



FM-07
Flow Summary: 2/21/2020 to 3/15/2020

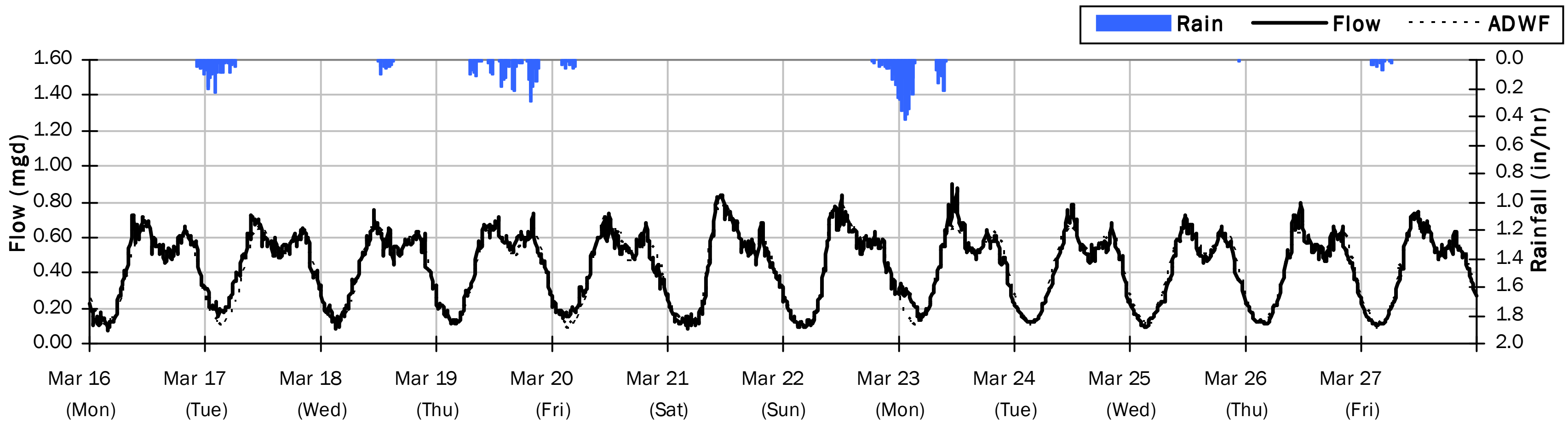
Total Period Rainfall: 6.92 inches **Avg Flow: 0.439 mgd** **Peak Flow: 1.400 mgd** **Min Flow: 0.070 mgd**

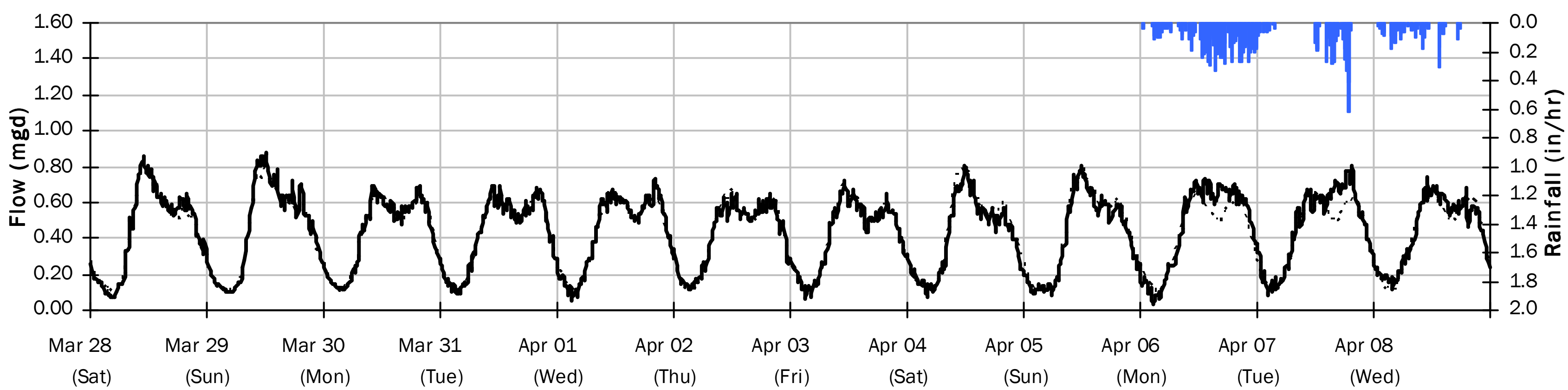




FM-07
Flow Summary: 3/16/2020 to 4/8/2020

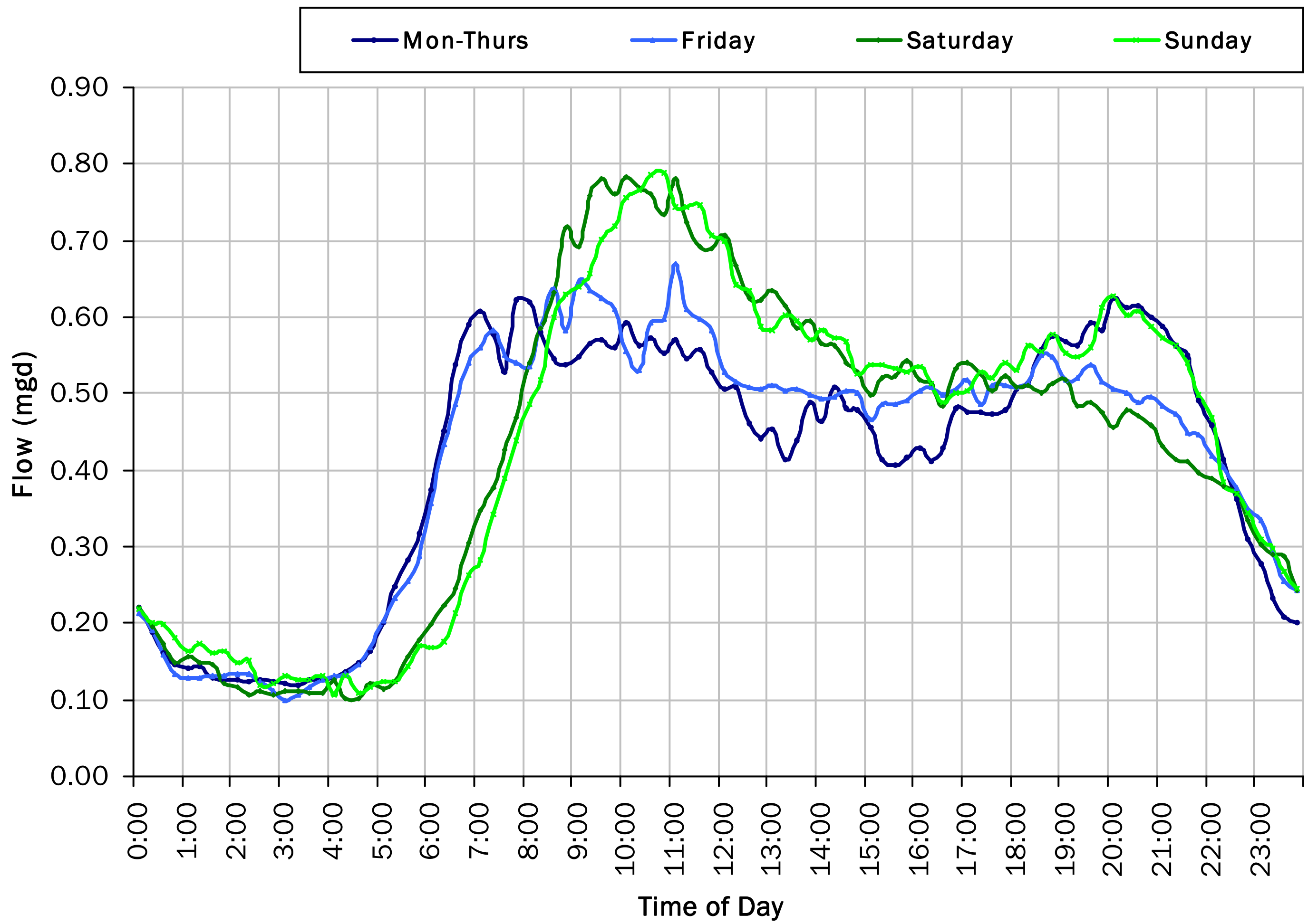
Total Period Rainfall: 7.58 inches   **Avg Flow: 0.437 mgd**   **Peak Flow: 0.899 mgd**   **Min Flow: 0.034 mgd**





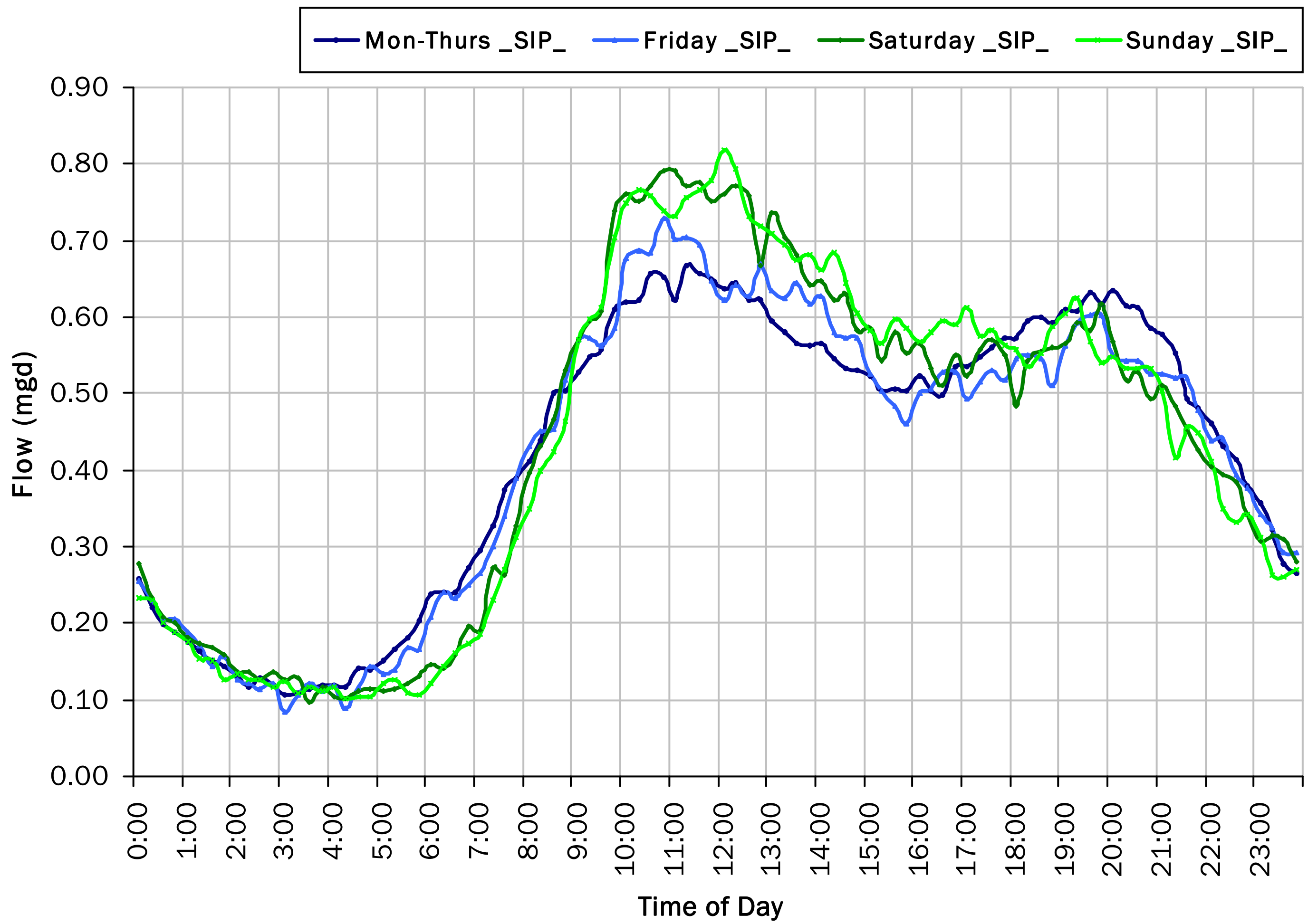
FM-07

Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)



ADWF:
0.419 mgd

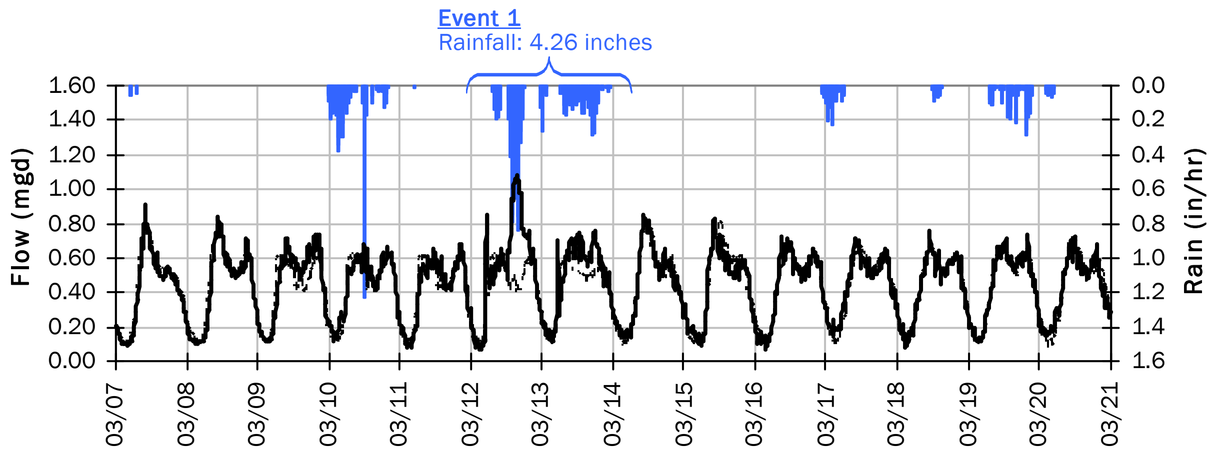
FM-07
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)



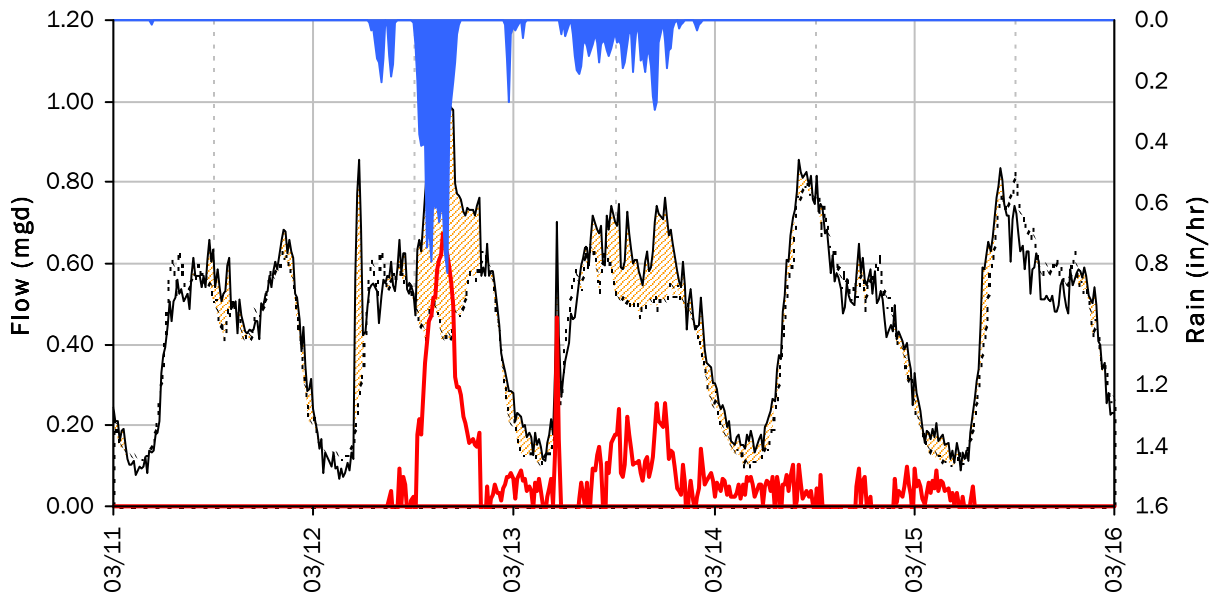
ADWF:
0.428 mgd

FM-07
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

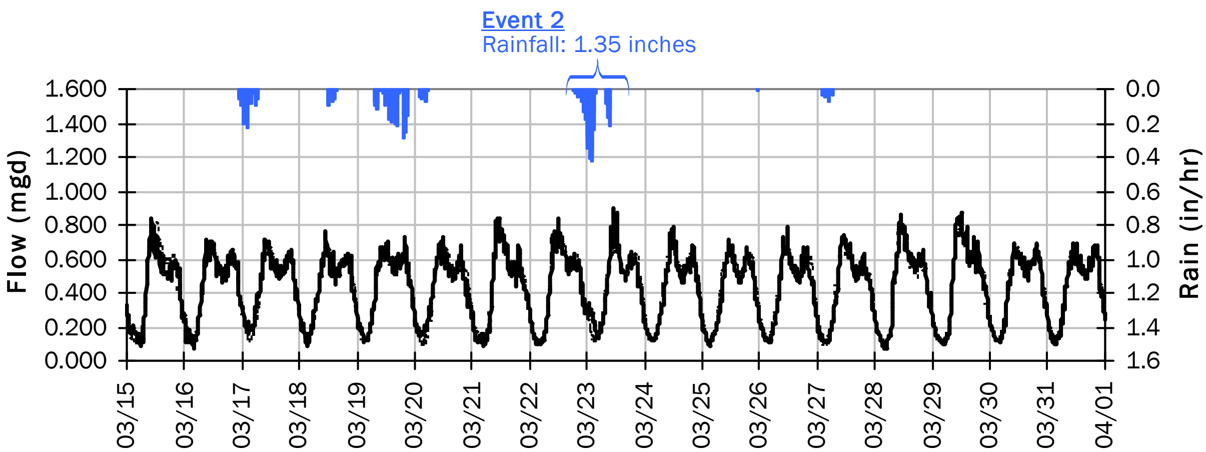


Storm Event I/I Analysis (Rain = 4.26 inches)

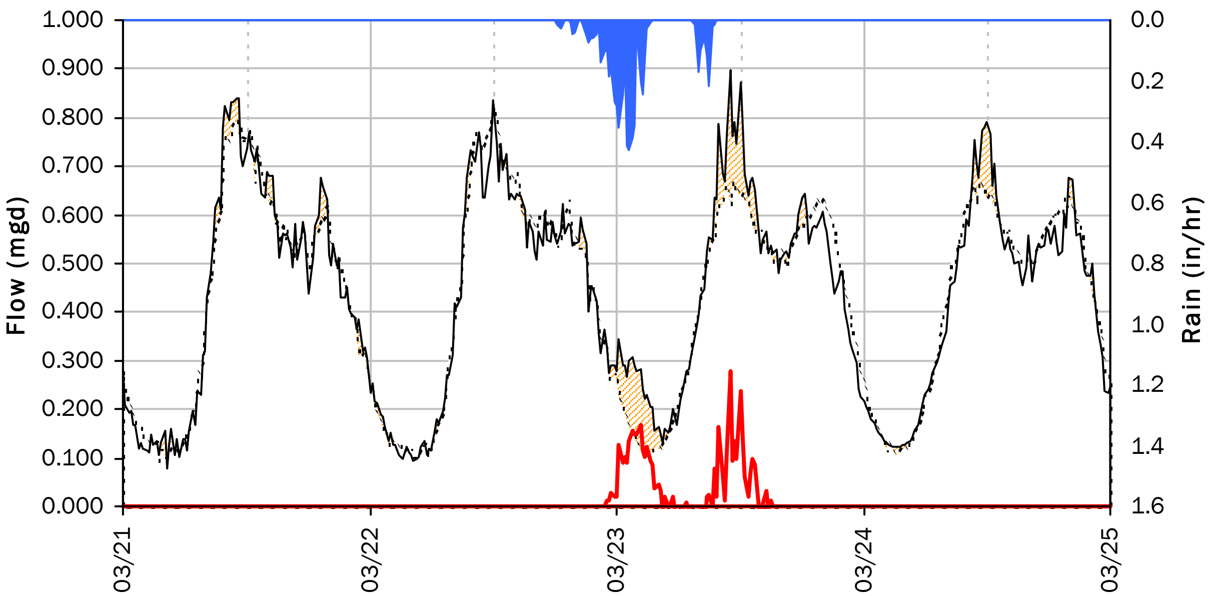
Capacity			Inflow / Infiltration		
Peak Flow:	1.08	*mgd*	**Peak I/I Rate:**	0.67	*mgd*
PF:	2.55		**Total I/I:**	228,000	*gallons*
Peak Level:		*in*			
d/D Ratio:					

FM-07
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

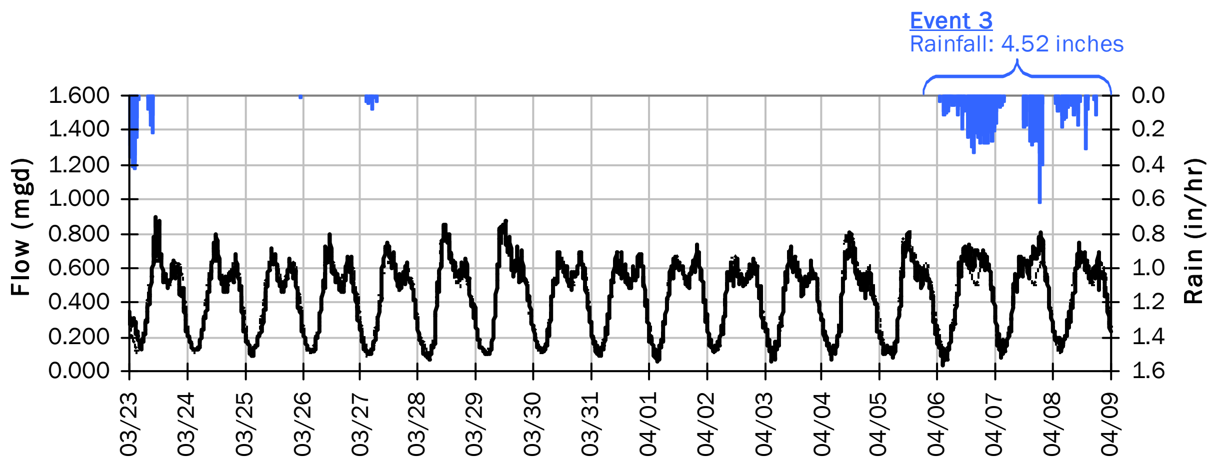


Storm Event I/I Analysis (Rain = 1.35 inches)

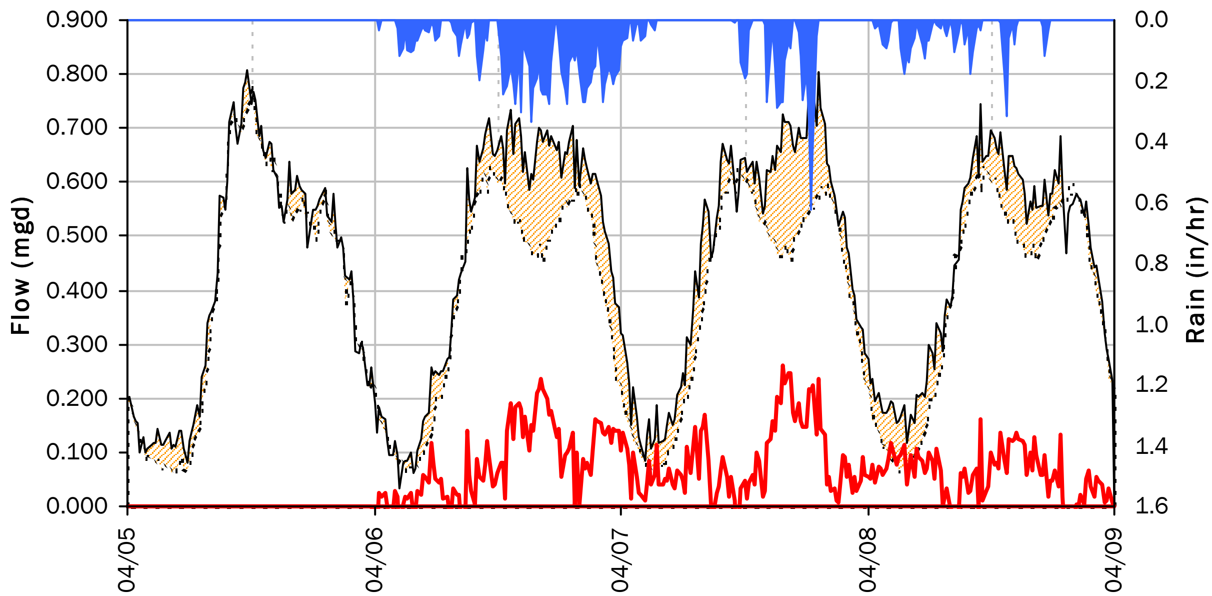
Capacity		Inflow / Infiltration	
Peak Flow:	0.90 *mgd*	**Peak I/I Rate:**	0.28 *mgd*
PF:	2.12	**Total I/I:**	36,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-07
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 4.52 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.80 *mgd*	**Peak I/I Rate:**	0.26 *mgd*
PF:	1.89	**Total I/I:**	224,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

City of Beaumont

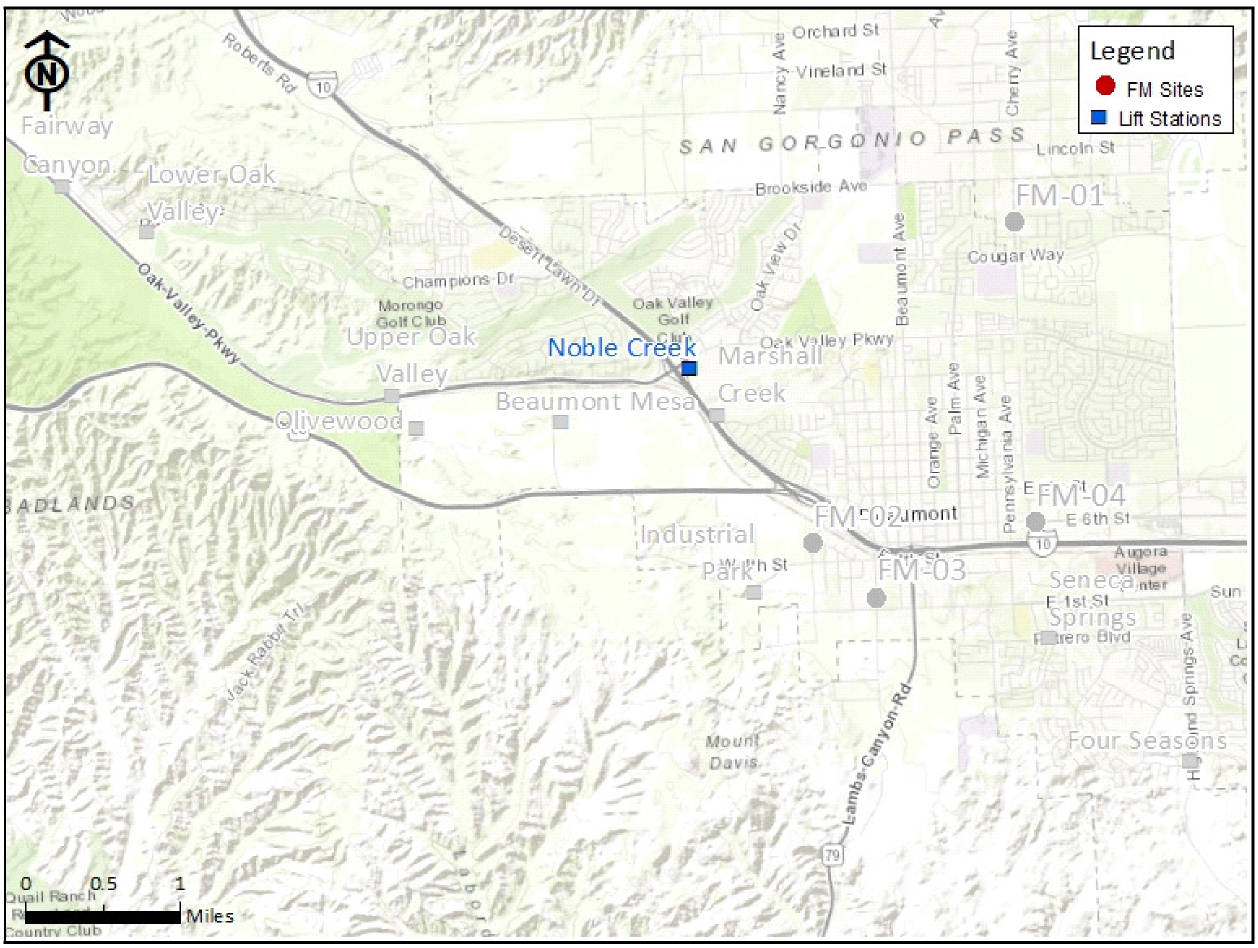
Sanitary Sewer Flow Monitoring
February 20 - April 09, 2020

Monitoring Site: FM-08

City Structure: Noble Creek LS

Location: Northbound I-10 off-ramp to Oak Valley Parkway, 265 feet south of Oak Valley Pkwy

Data Summary Report



Vicinity Map: FM-08

FM-08

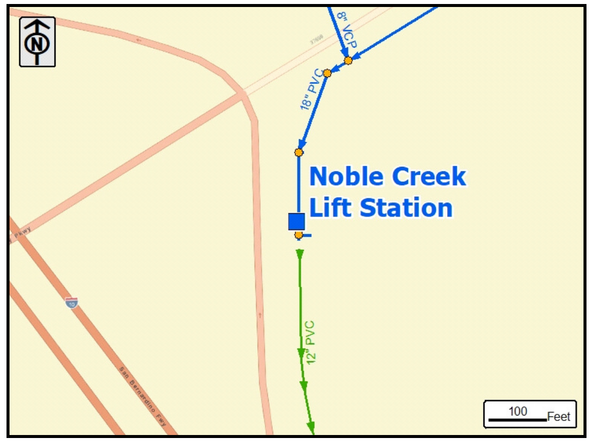
Site Information

City Structure: Noble Creek LS **Coordinates:** 117.0013° W, 33.9449° N **Rim Elev:** 2485 feet

Location: Northbound I-10 off-ramp to Oak Valley Parkway, 265 feet south of Oak Valley Pkwy

ADWF: 0.240 mgd **Peak Measured Flow:** 0.568 mgd

Satellite Map



Sanitary Map

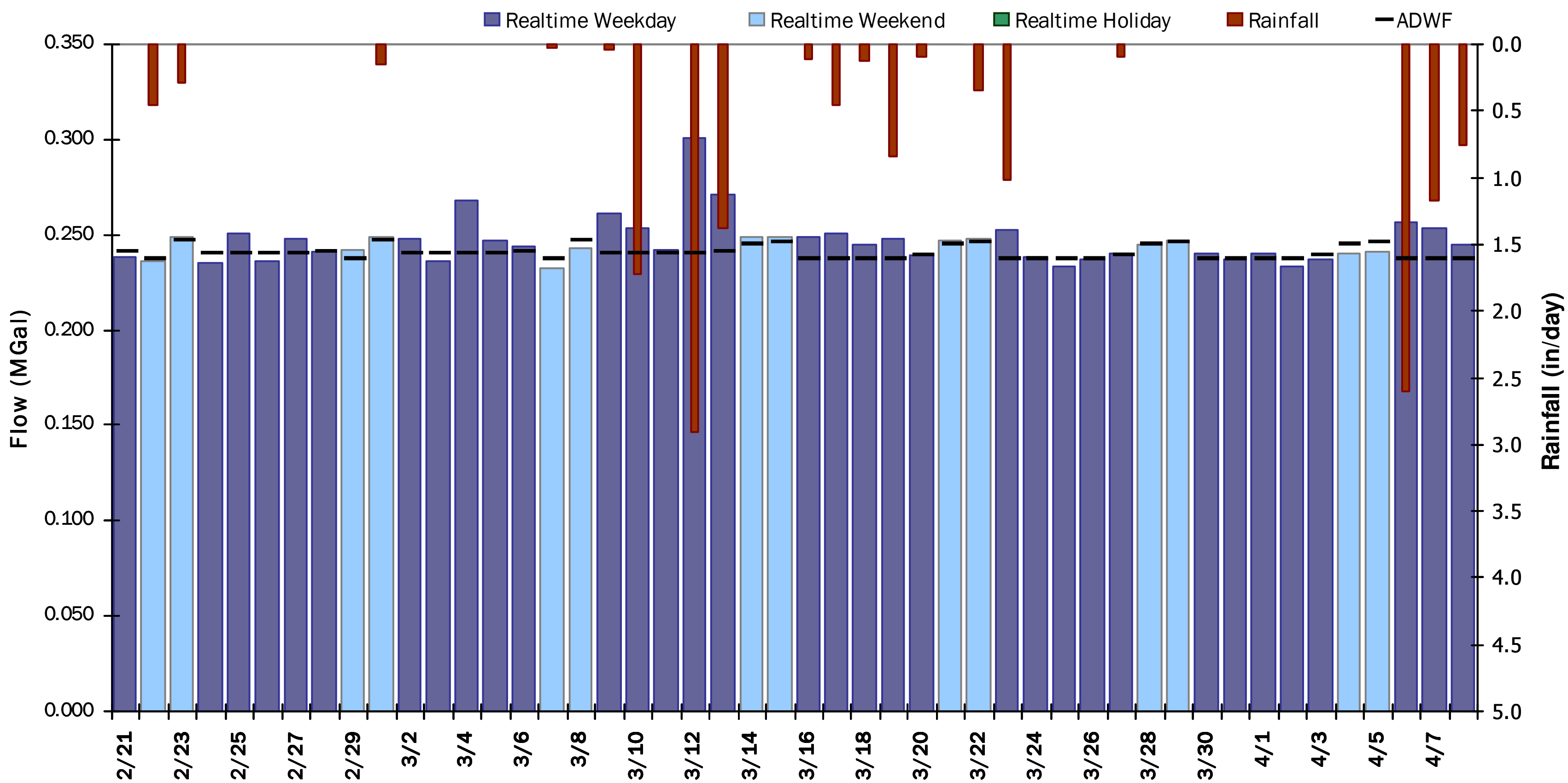
Street View

FM-08

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.246 MGal **Peak Daily Flow: 0.301 MGal** **Min Daily Flow: 0.232 MGal**

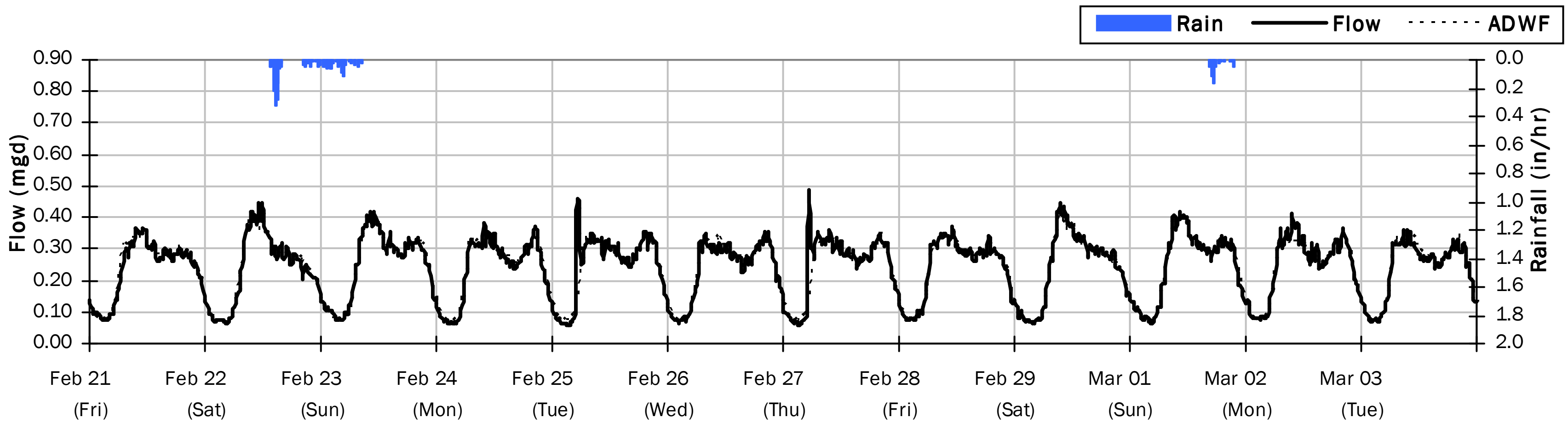
Total Period Rainfall: 14.60 inches

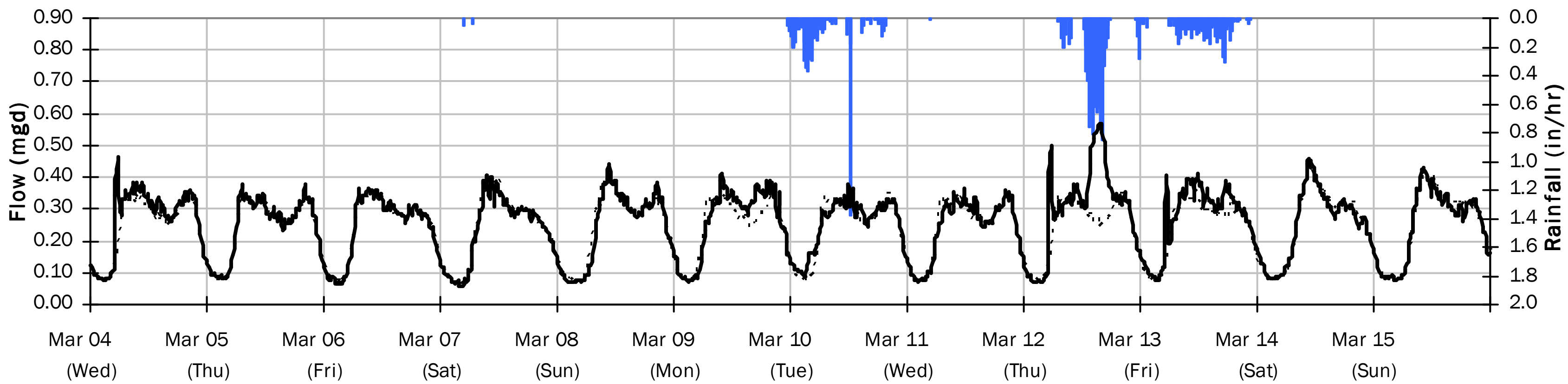


FM-08

Flow Summary: 2/21/2020 to 3/15/2020

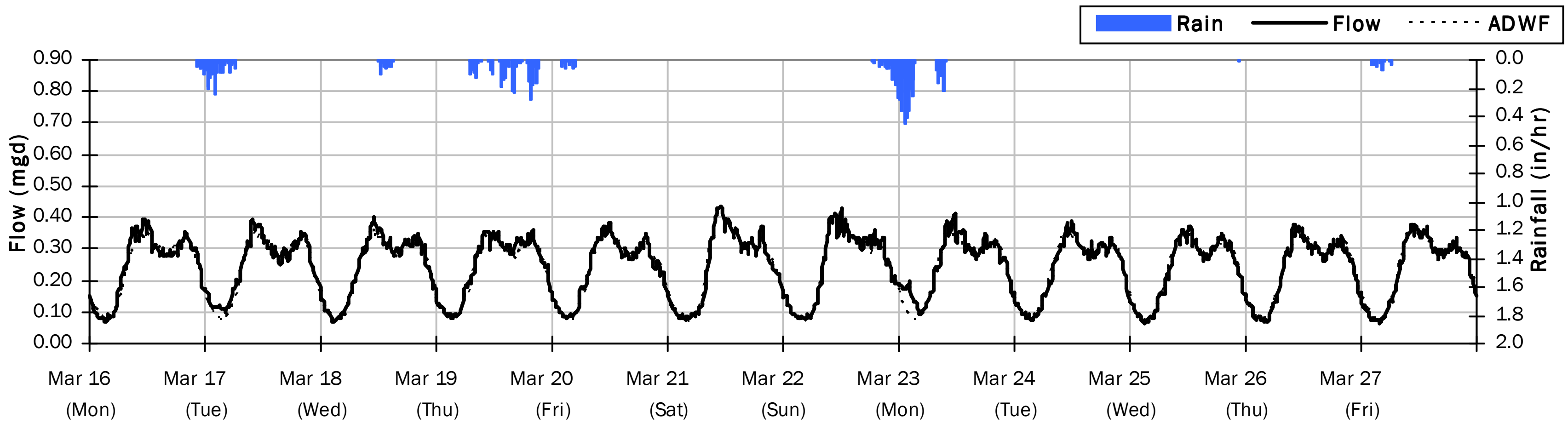
Total Period Rainfall: 6.98 inches   **Avg Flow: 0.249 mgd**   **Peak Flow: 0.568 mgd**   **Min Flow: 0.057 mgd**

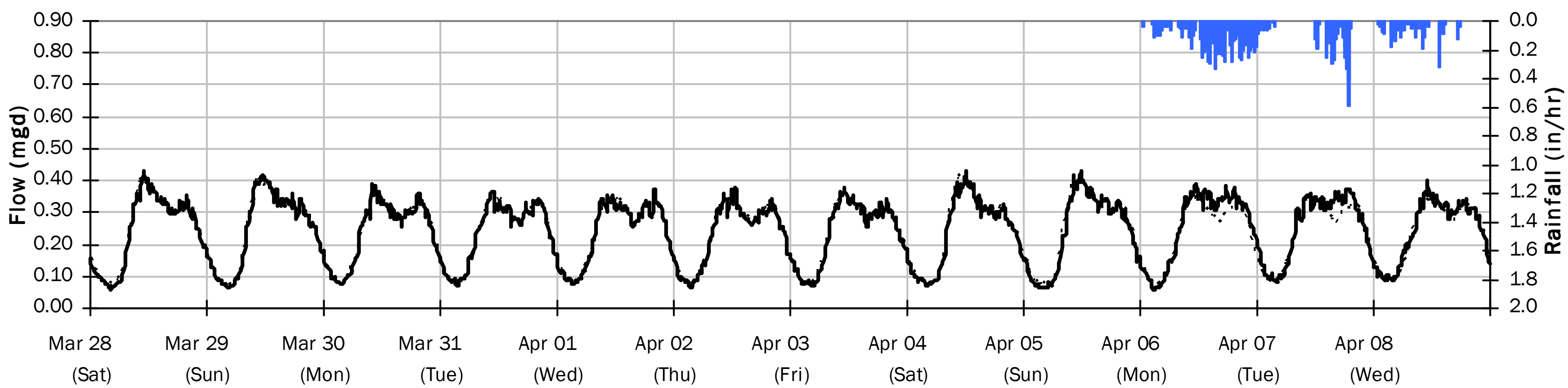




FM-08
Flow Summary: 3/16/2020 to 4/8/2020

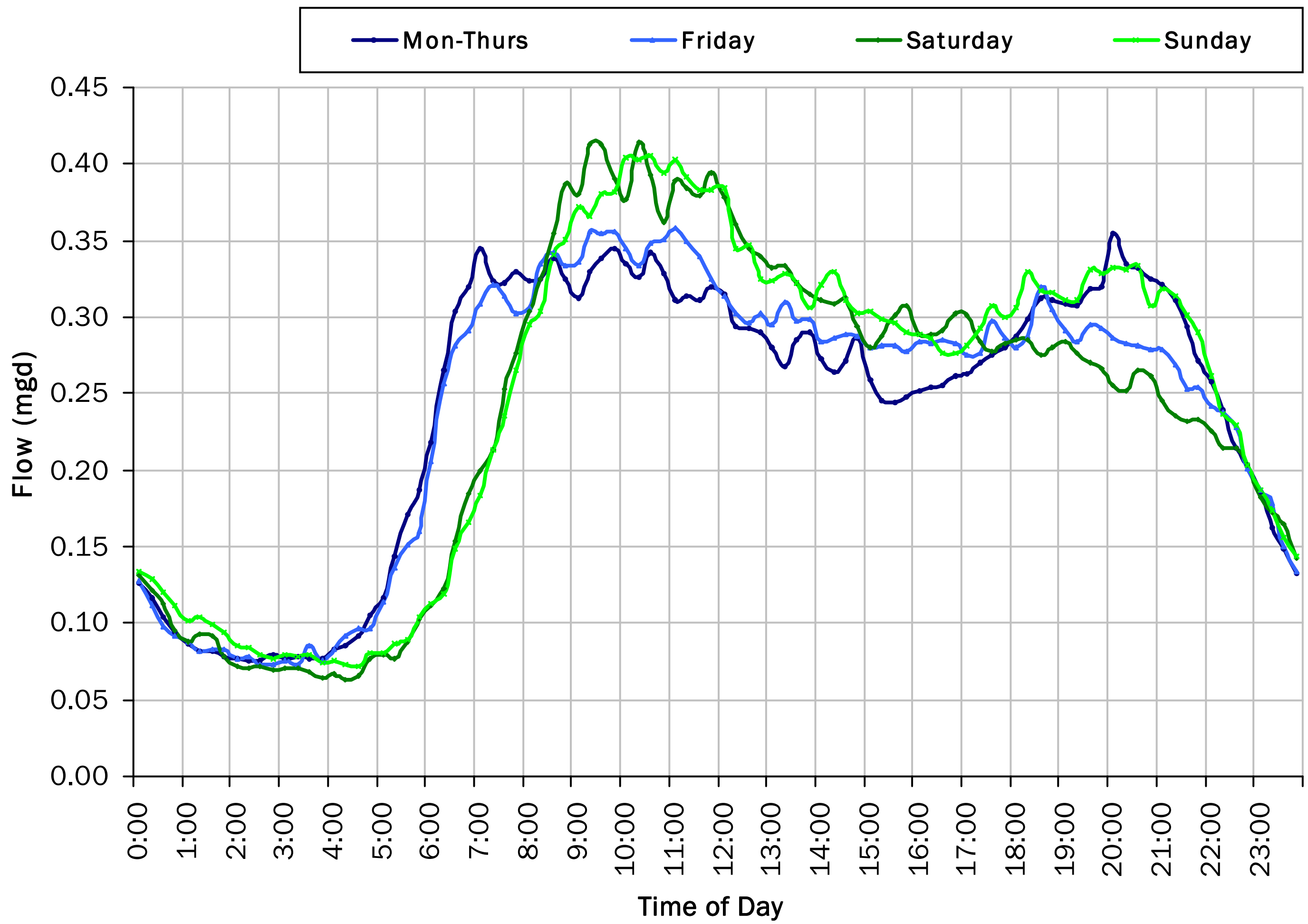
Total Period Rainfall: 7.62 inches   **Avg Flow: 0.243 mgd**   **Peak Flow: 0.437 mgd**   **Min Flow: 0.059 mgd**





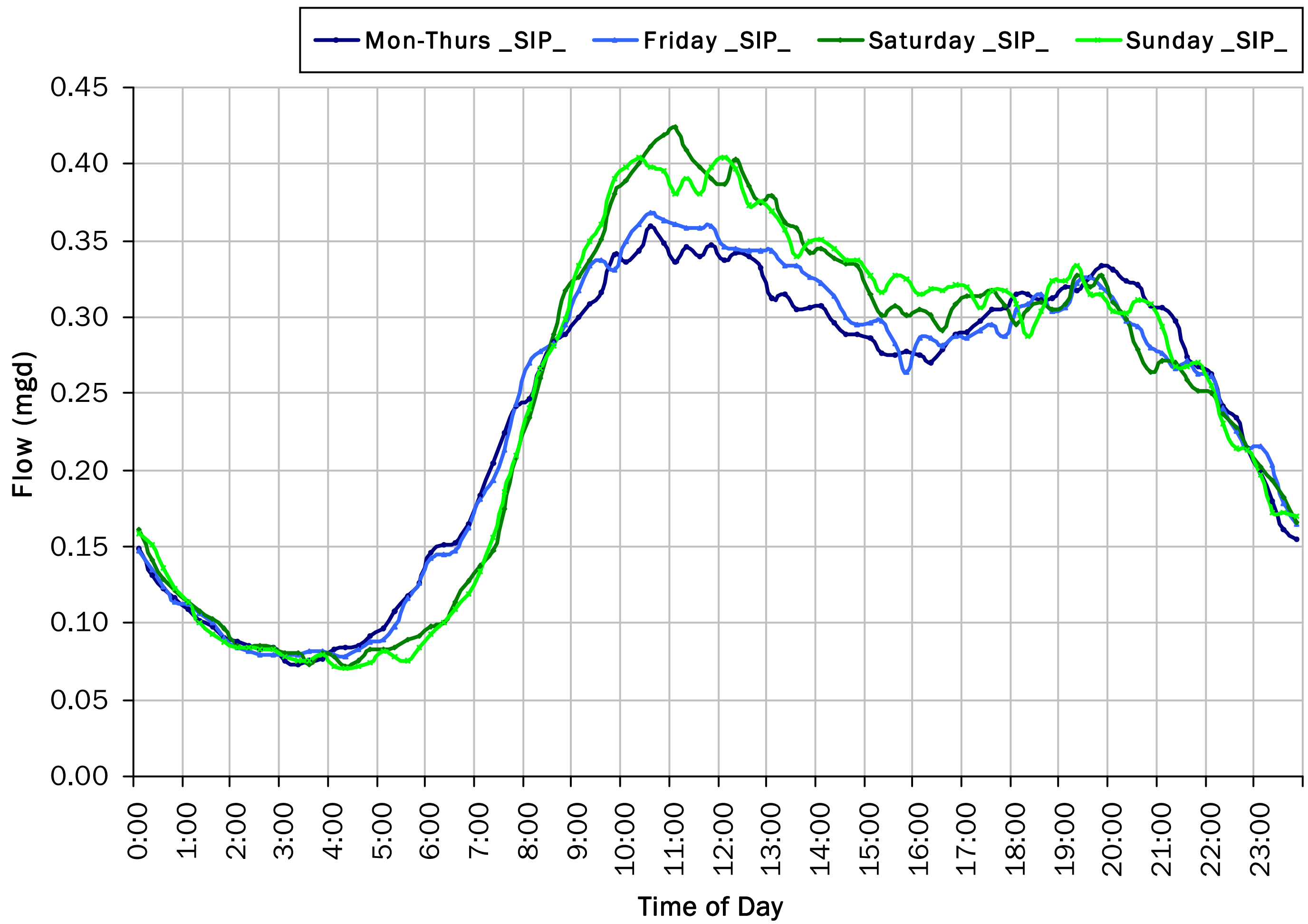
FM-08

Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)



ADWF:
0.241 mgd

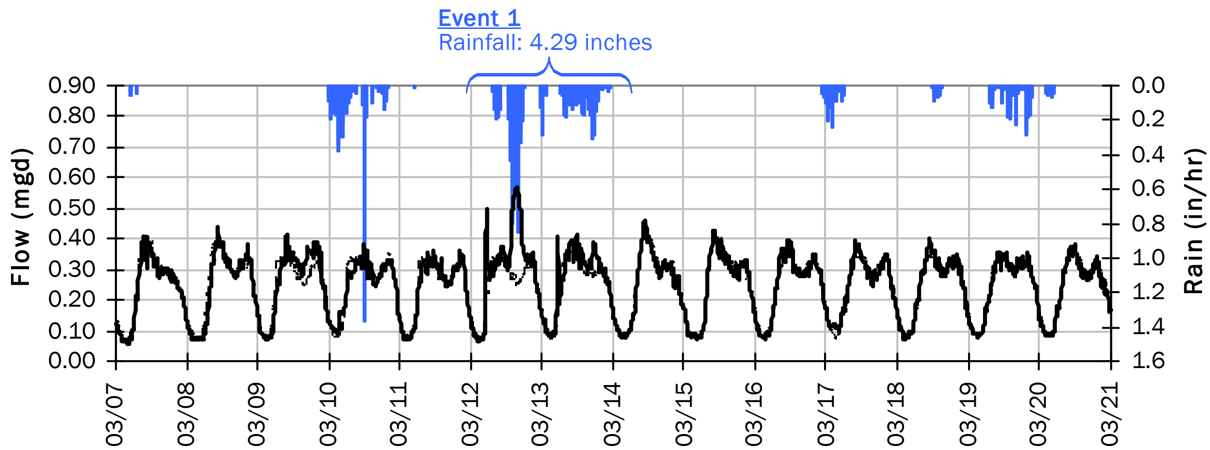
FM-08
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)



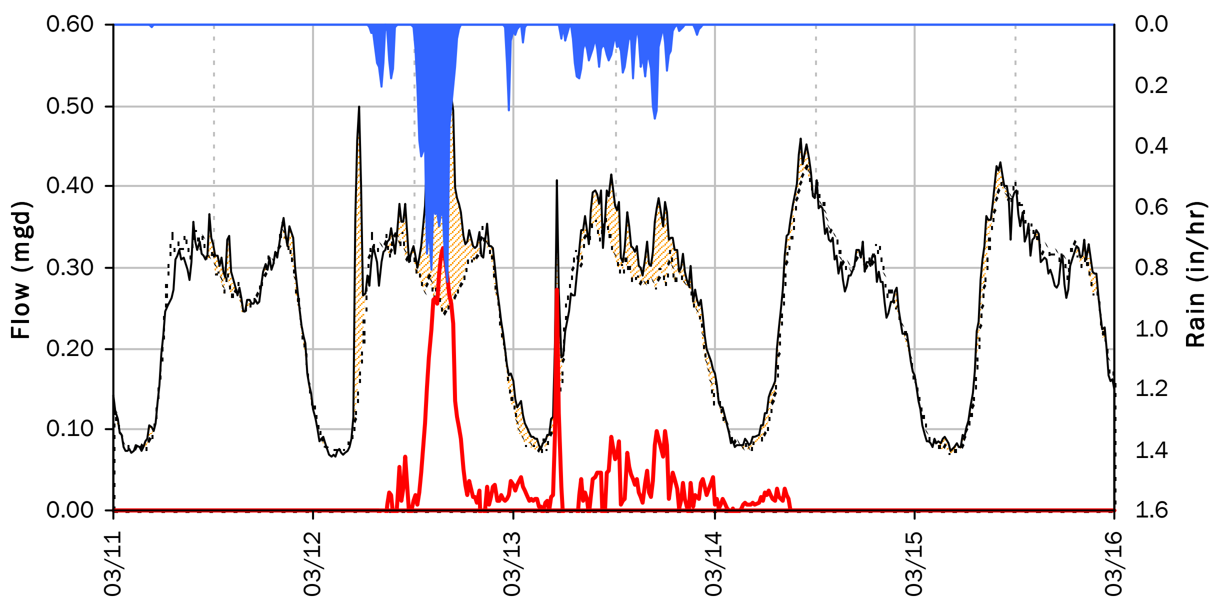
ADWF:
0.240 mgd

FM-08
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

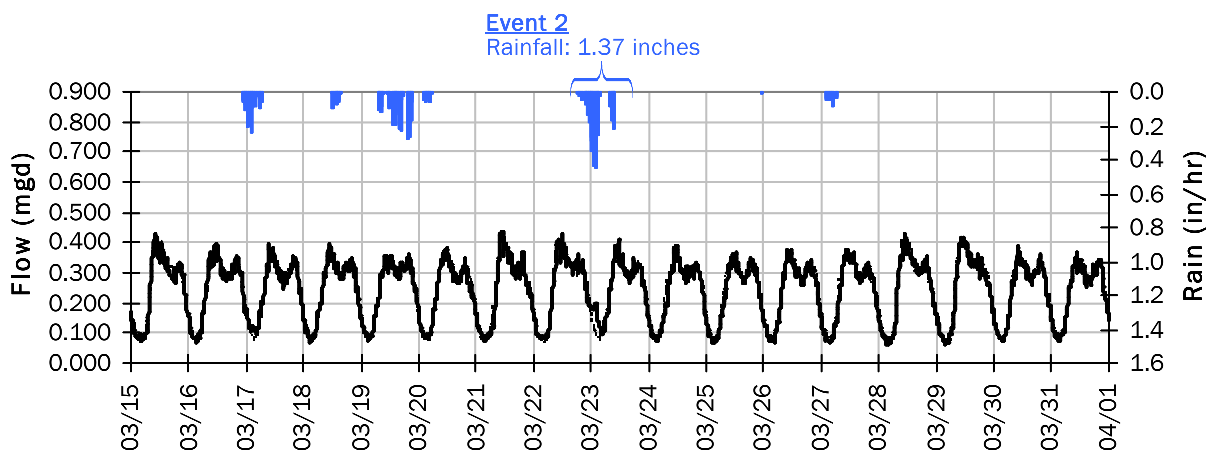


Storm Event I/I Analysis (Rain = 4.29 inches)

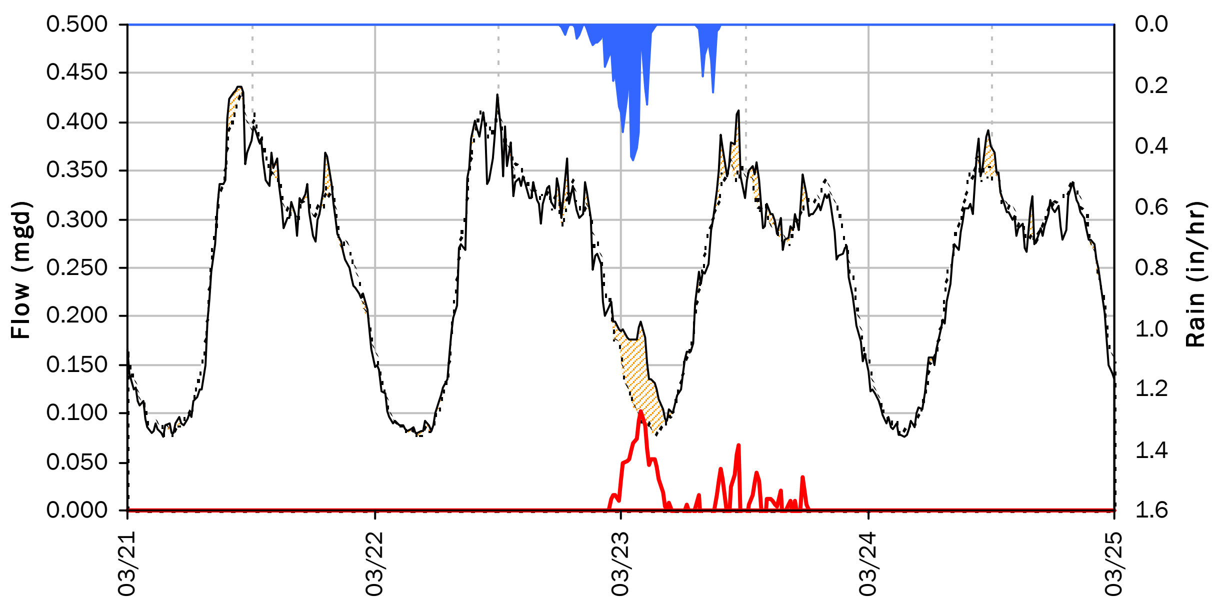
Capacity			Inflow / Infiltration		
Peak Flow:	0.57	*mgd*	**Peak I/I Rate:**	0.32	*mgd*
PF:	2.36		**Total I/I:**	85,000	*gallons*
Peak Level:		*in*			
d/D Ratio:					

FM-08
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

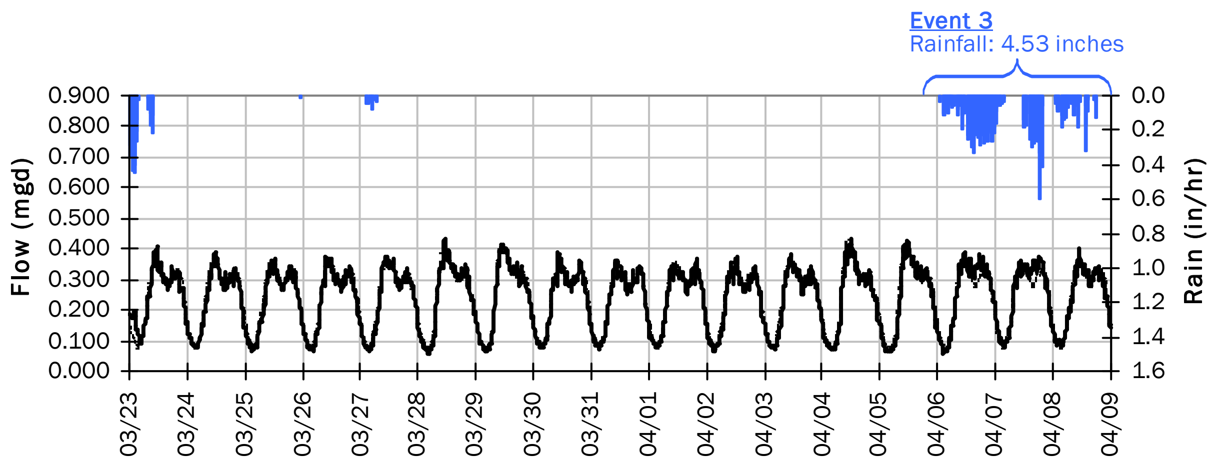


Storm Event I/I Analysis (Rain = 1.37 inches)

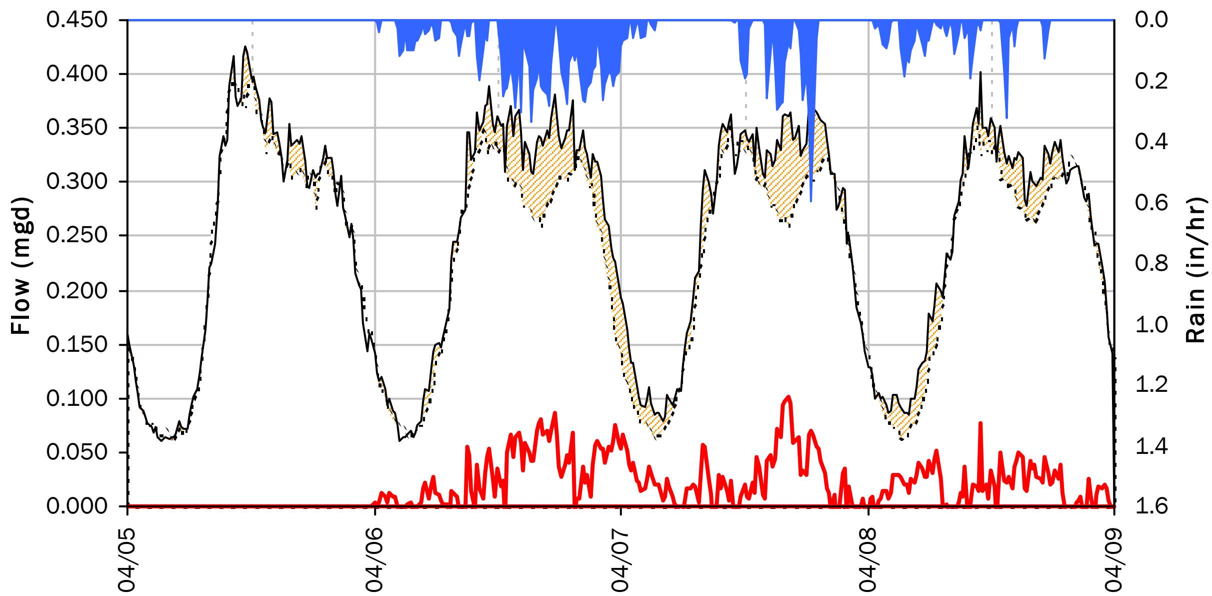
Capacity		Inflow / Infiltration	
Peak Flow:	0.41 *mgd*	**Peak I/I Rate:**	0.10 *mgd*
PF:	1.71	**Total I/I:**	14,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-08
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 4.53 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.40 *mgd*	**Peak I/I Rate:**	0.10 *mgd*
PF:	1.67	**Total I/I:**	73,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

City of Beaumont

Sanitary Sewer Flow Monitoring

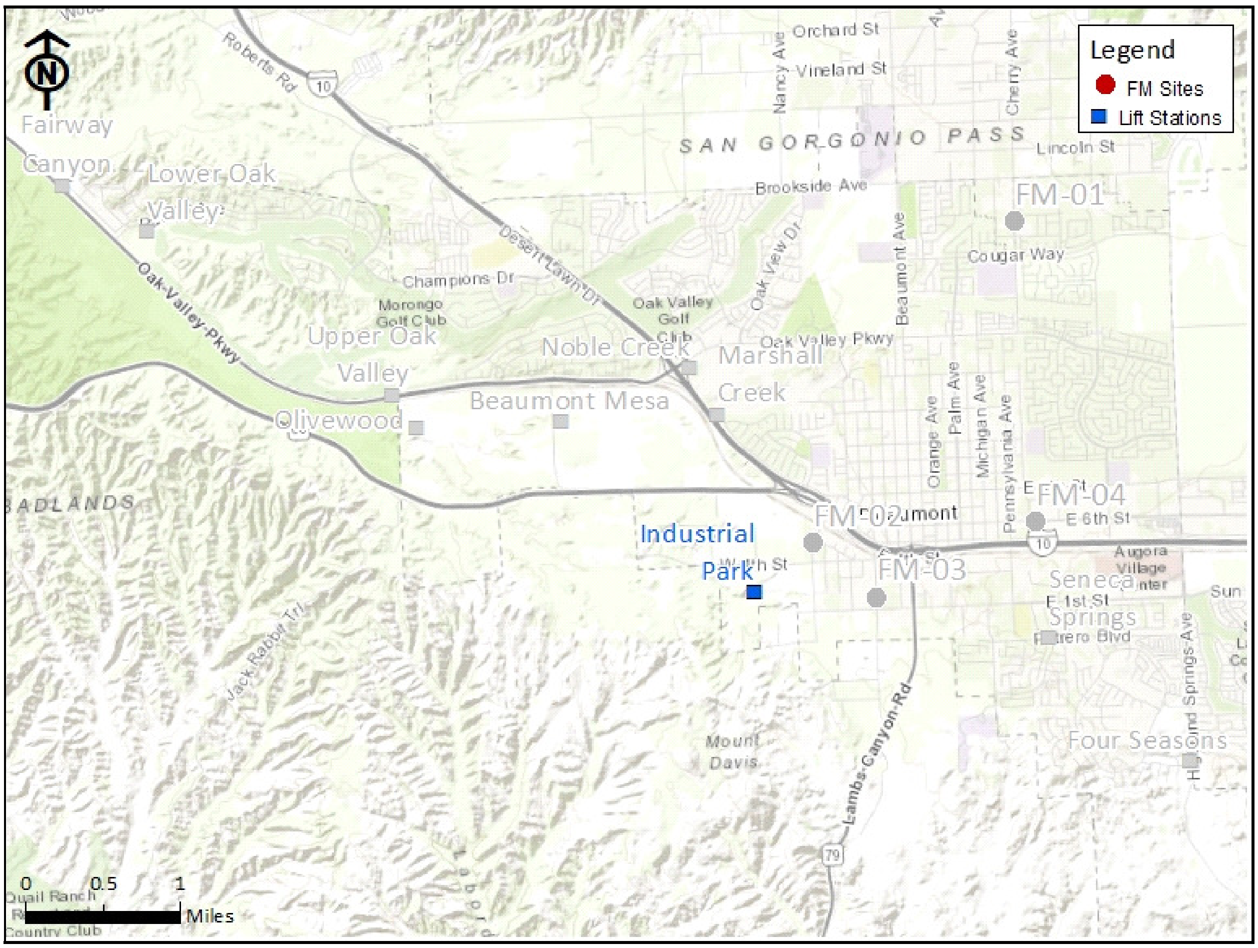
February 20 - April 09, 2020

Monitoring Site: FM-09

City Structure: Industrial Park LS

Location: Off road, 540 feet south of end of Risco Circle

Data Summary Report



Vicinity Map: FM-09

FM-09

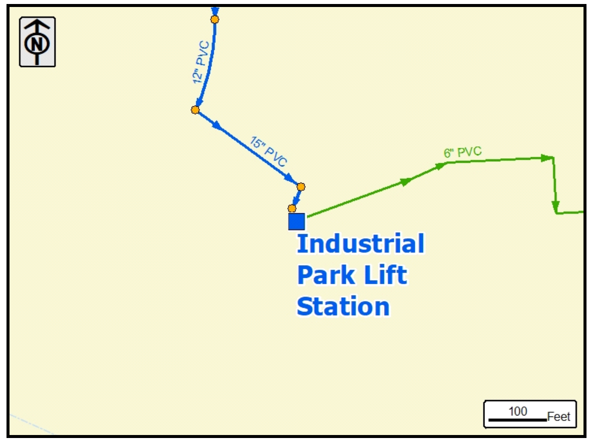
Site Information

City Structure: Industrial Park LS **Coordinates:** 116.9948° W, 33.9239° N **Rim Elev:** 2522 feet

Location: Off road, 540 feet south of end of Risco Circle

ADWF: 0.050 mgd **Peak Measured Flow:** 0.246 mgd

Satellite Map



Sanitary Map

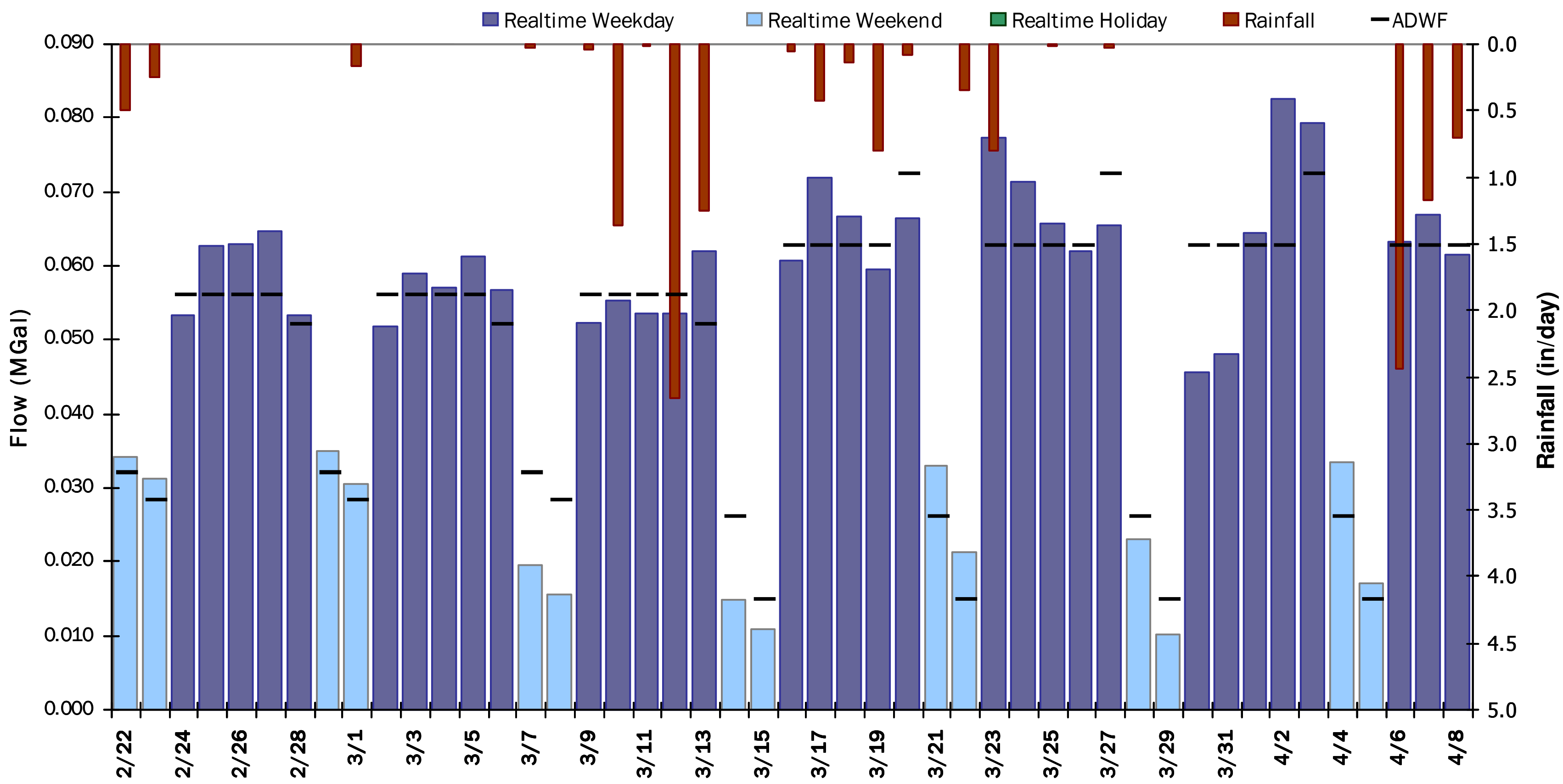
Street View

FM-09

Period Flow Summary: Daily Flow Totals

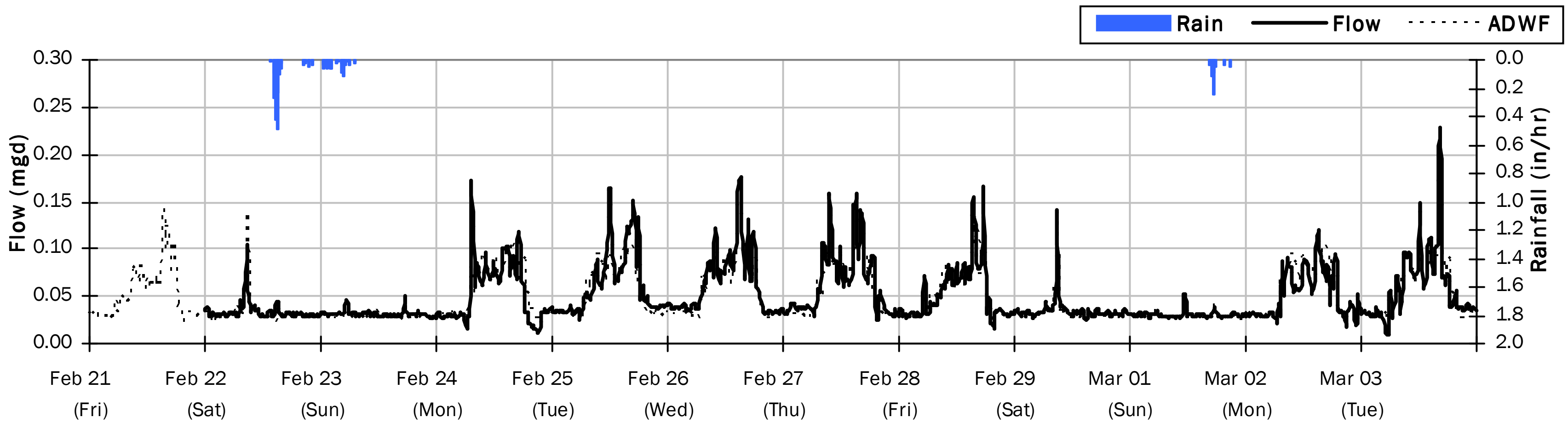
Avg Period Flow: 0.050 MGal **Peak Daily Flow: 0.082 MGal** **Min Daily Flow: 0.010 MGal**

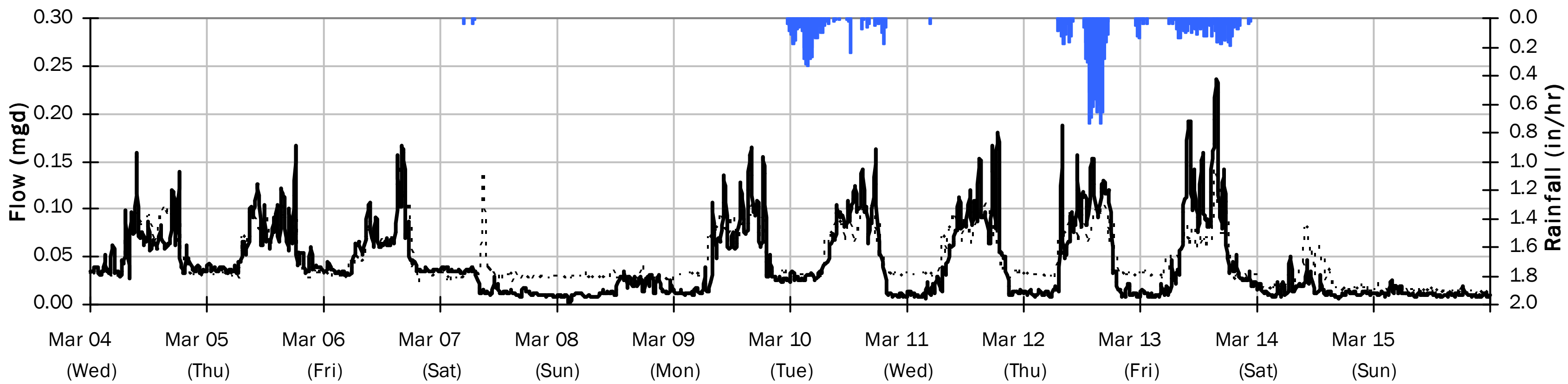
Total Period Rainfall: 13.25 inches



FM-09
Flow Summary: 2/21/2020 to 3/15/2020

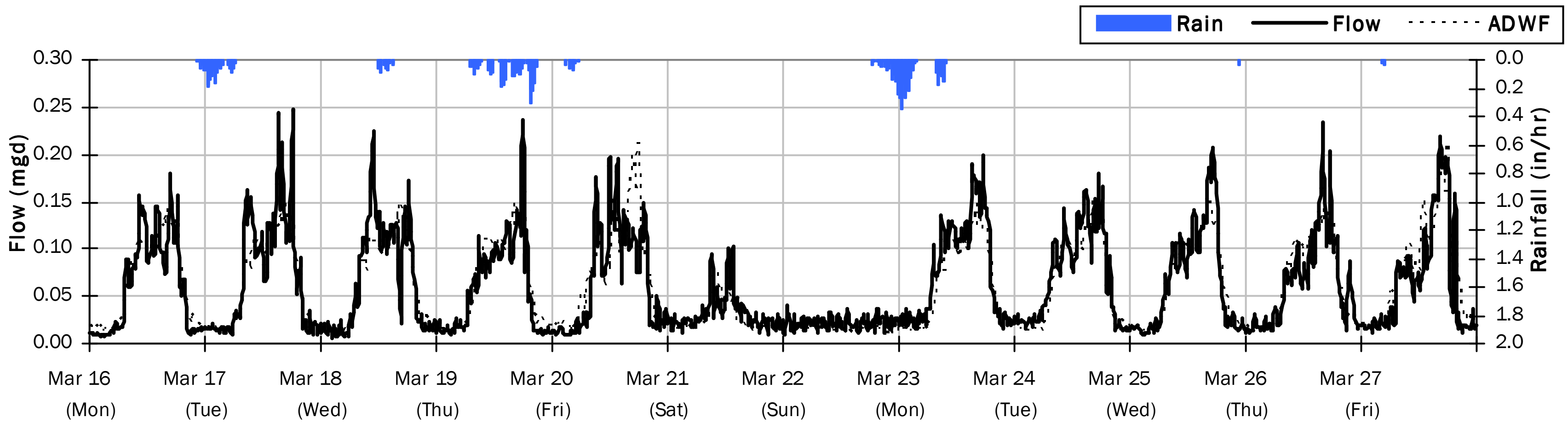
Total Period Rainfall: 6.25 inches   **Avg Flow: 0.046 mgd**   **Peak Flow: 0.237 mgd**   **Min Flow: 0.003 mgd**

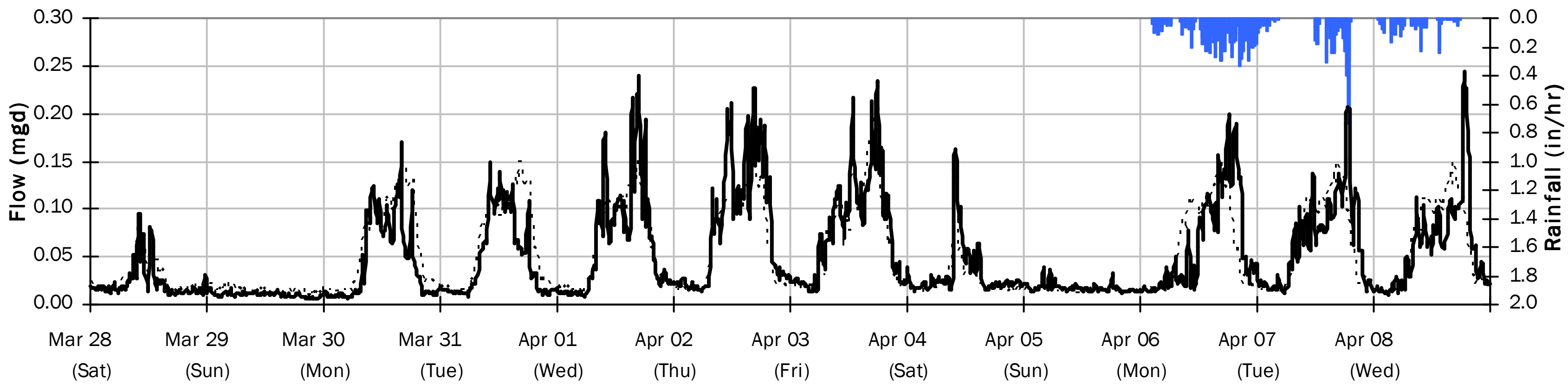




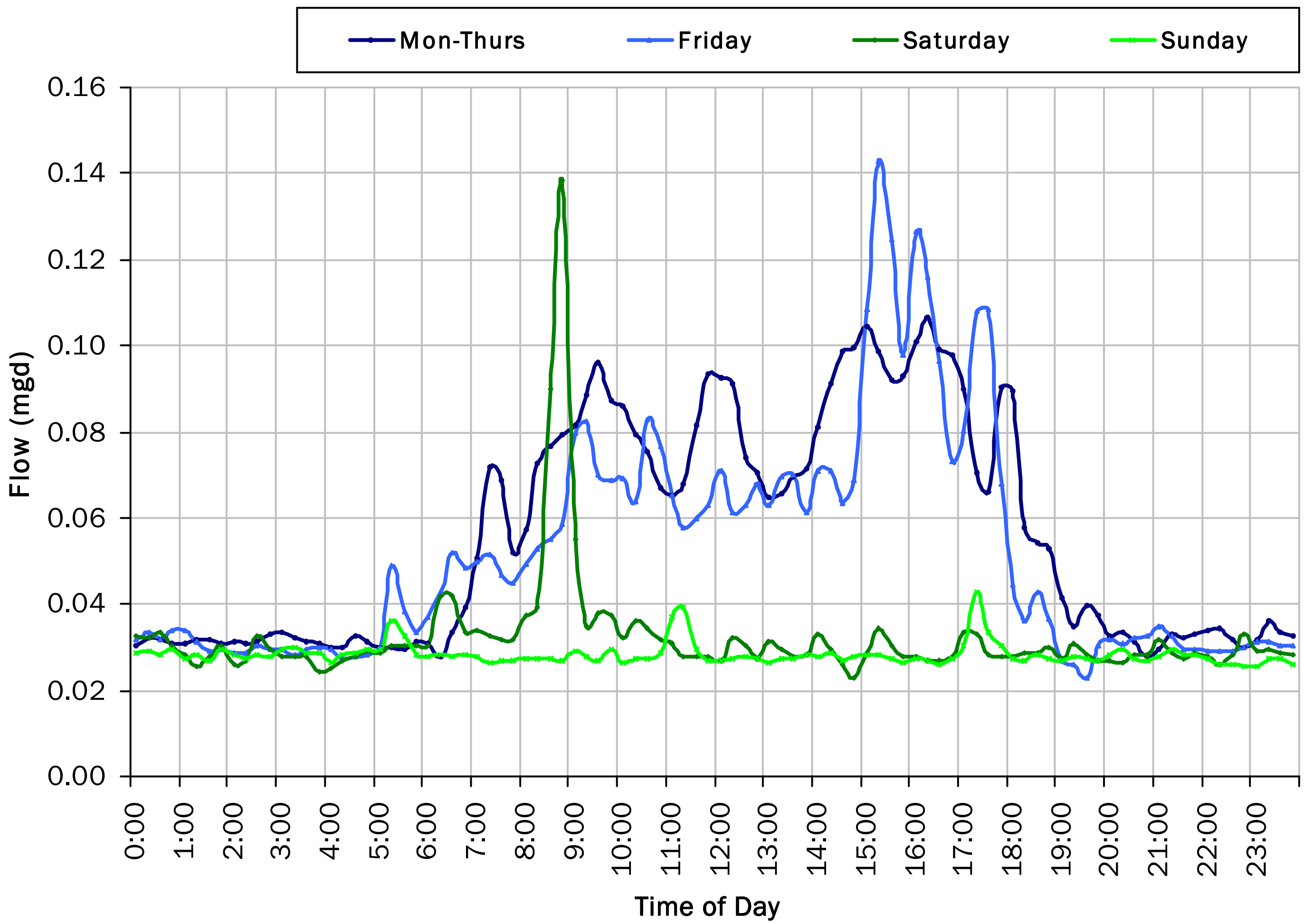
FM-09
Flow Summary: 3/16/2020 to 4/8/2020

Total Period Rainfall: 7.00 inches Avg Flow: 0.055 mgd Peak Flow: 0.246 mgd Min Flow: 0.005 mgd



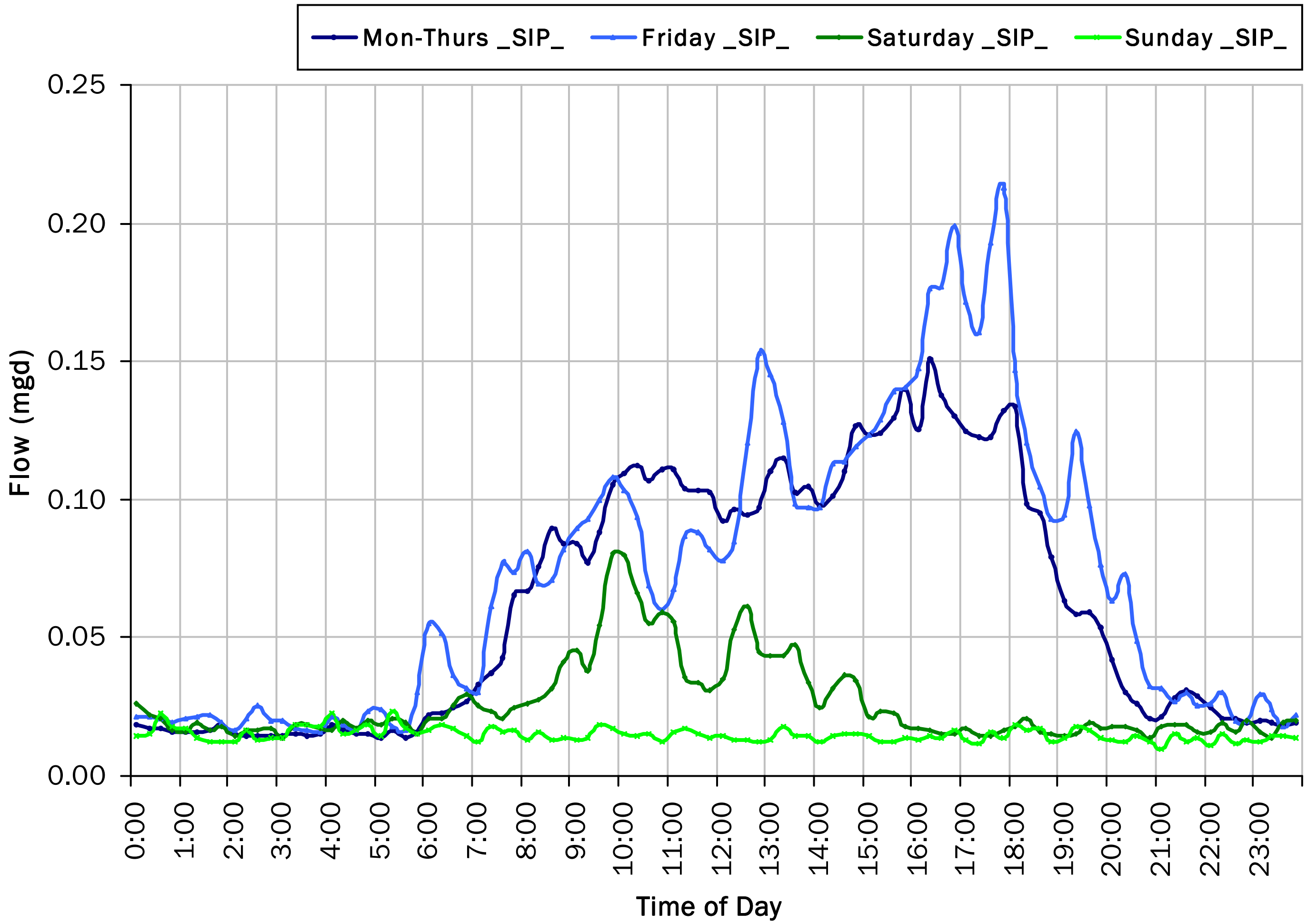


FM-09
Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)



ADWF:
0.048 mgd

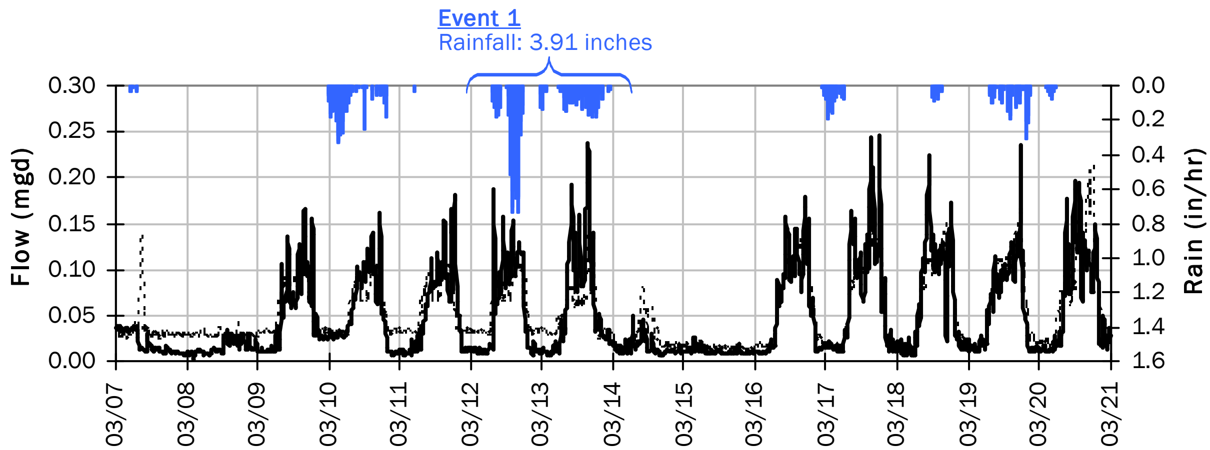
FM-09
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)



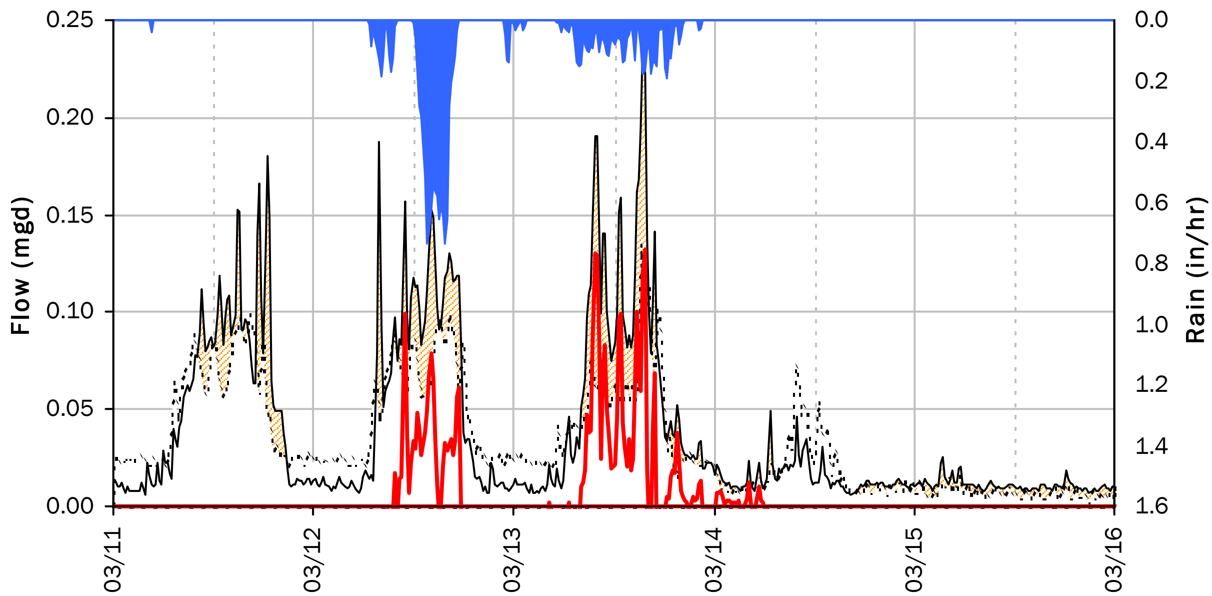
ADWF:
0.052 mgd

FM-09
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



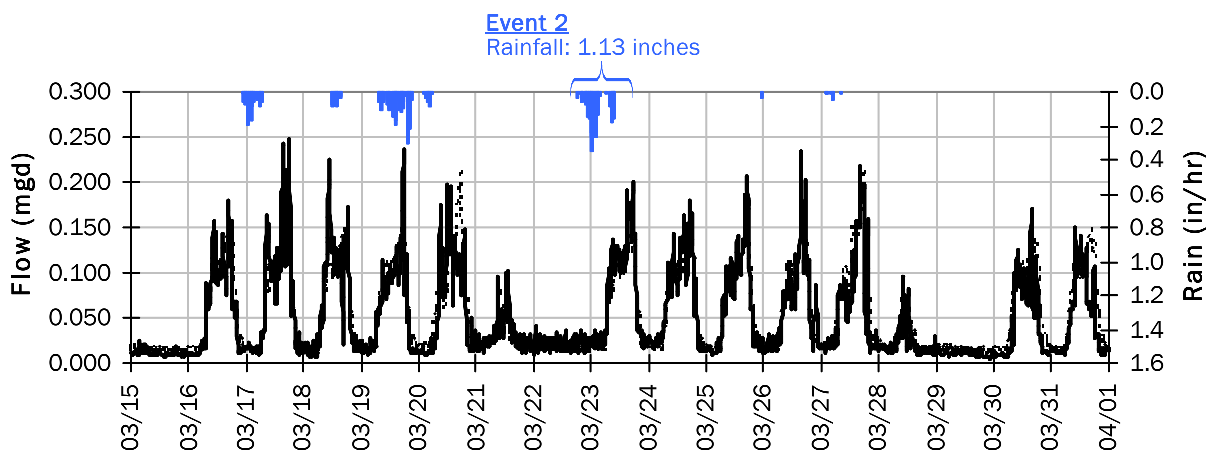
Storm Event I/I Analysis (Rain = 3.91 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.24 *mgd*	**Peak I/I Rate:**	0.13 *mgd*
PF:	4.76	**Total I/I:**	26,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

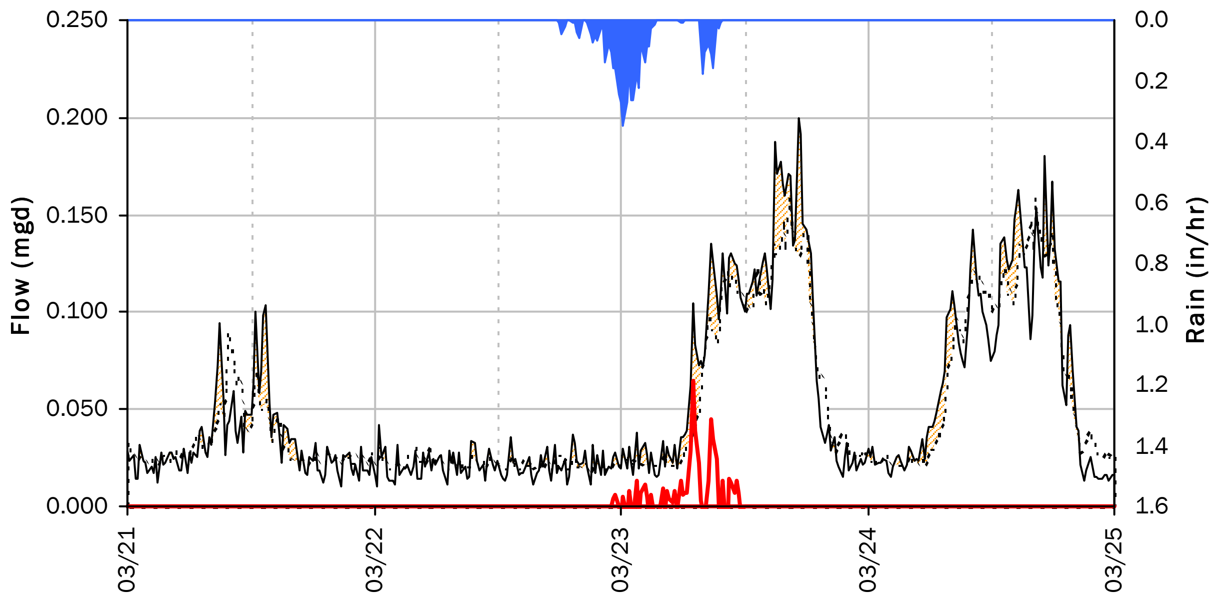
FM-09

I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

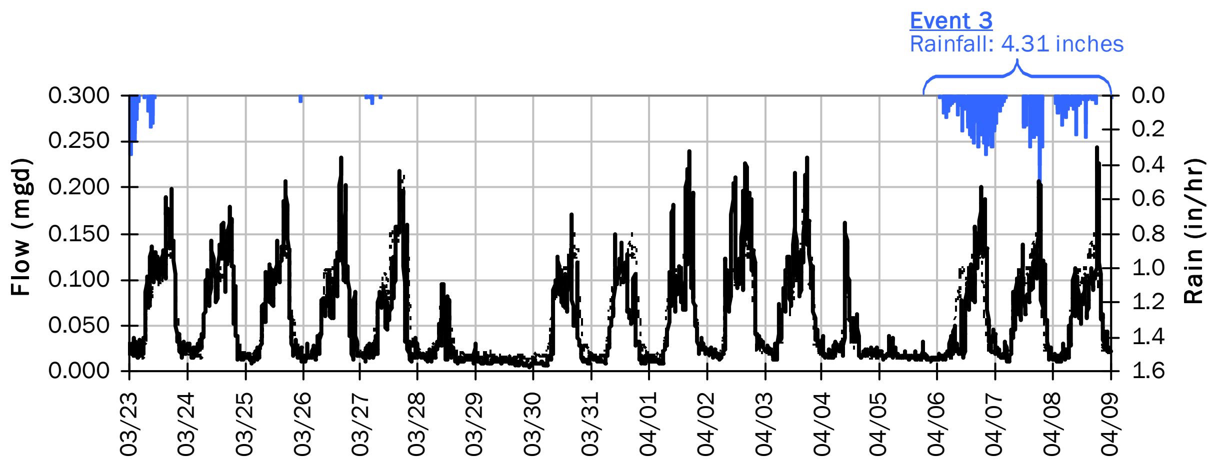


Storm Event I/I Analysis (Rain = 1.13 inches)

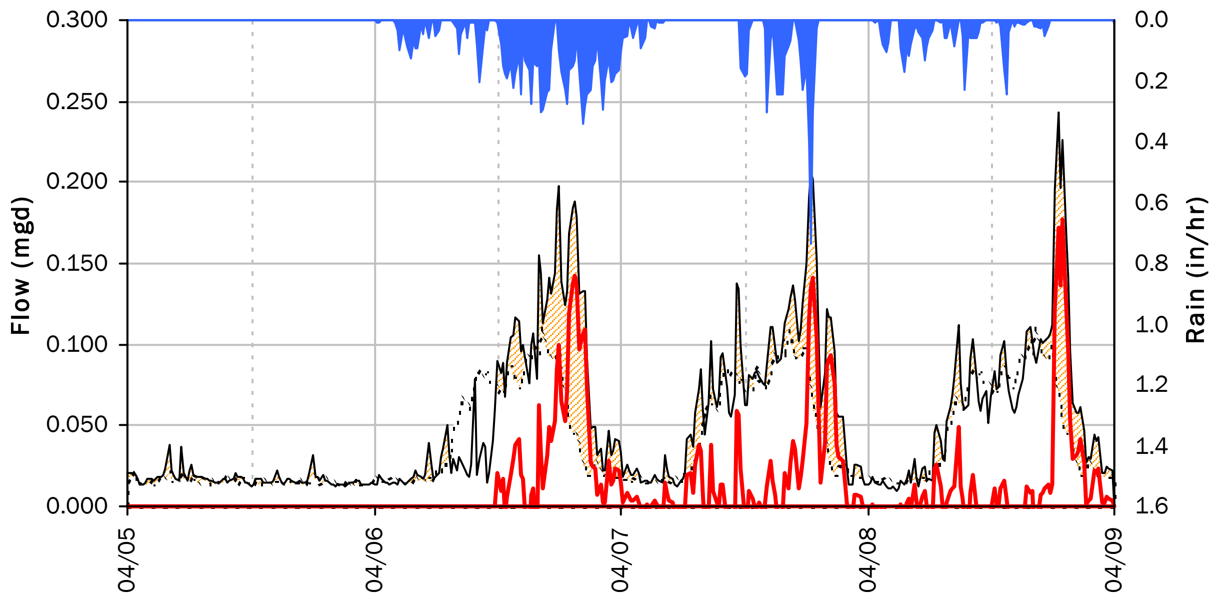
Capacity		Inflow / Infiltration	
Peak Flow:	0.14 *mgd*	**Peak I/I Rate:**	0.06 *mgd*
PF:	2.73	**Total I/I:**	4,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-09
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 4.31 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.24 *mgd*	**Peak I/I Rate:**	0.18 *mgd*
PF:	4.89	**Total I/I:**	51,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

City of Beaumont

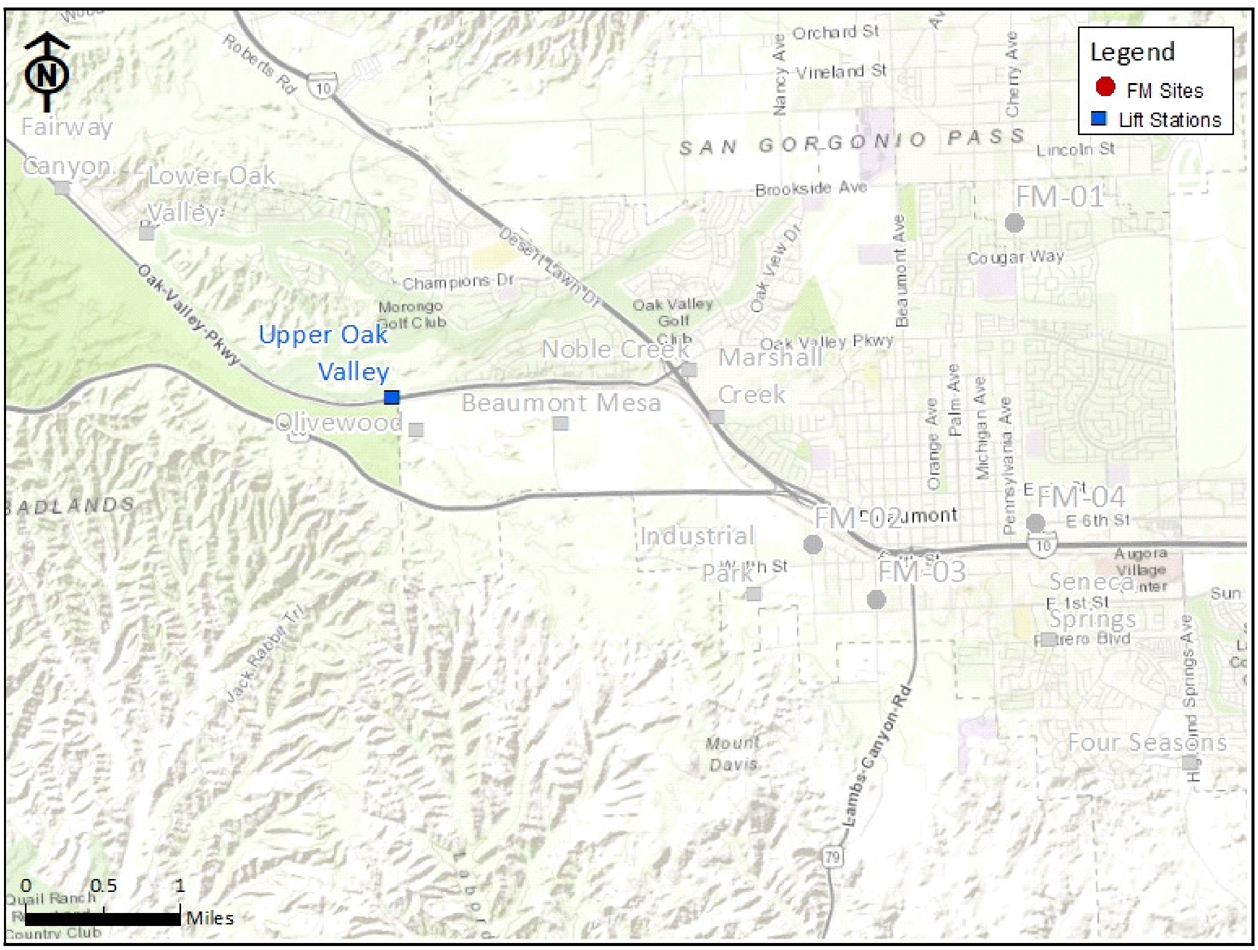
Sanitary Sewer Flow Monitoring
February 20 - April 09, 2020

Monitoring Site: FM-10

City Structure: Upper Oak Valley LS

Location: Oak Valley Parkway, 0.48 miles west of Apron Lane

Data Summary Report



Vicinity Map: FM-10

FM-10

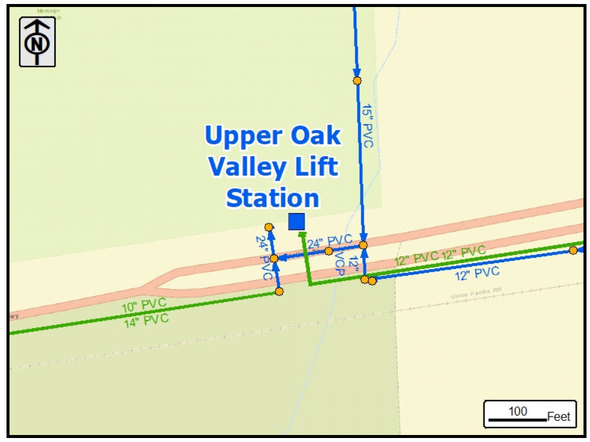
Site Information

City Structure: Upper Oak Valley LS **Coordinates:** 117.0347° W, 33.9434° N **Rim Elev:** 2301 feet

Location: Oak Valley Parkway, 0.48 miles west of Apron Lane

ADWF: 0.780 mgd **Peak Measured Flow:** 1.757 mgd

Satellite Map



Sanitary Map

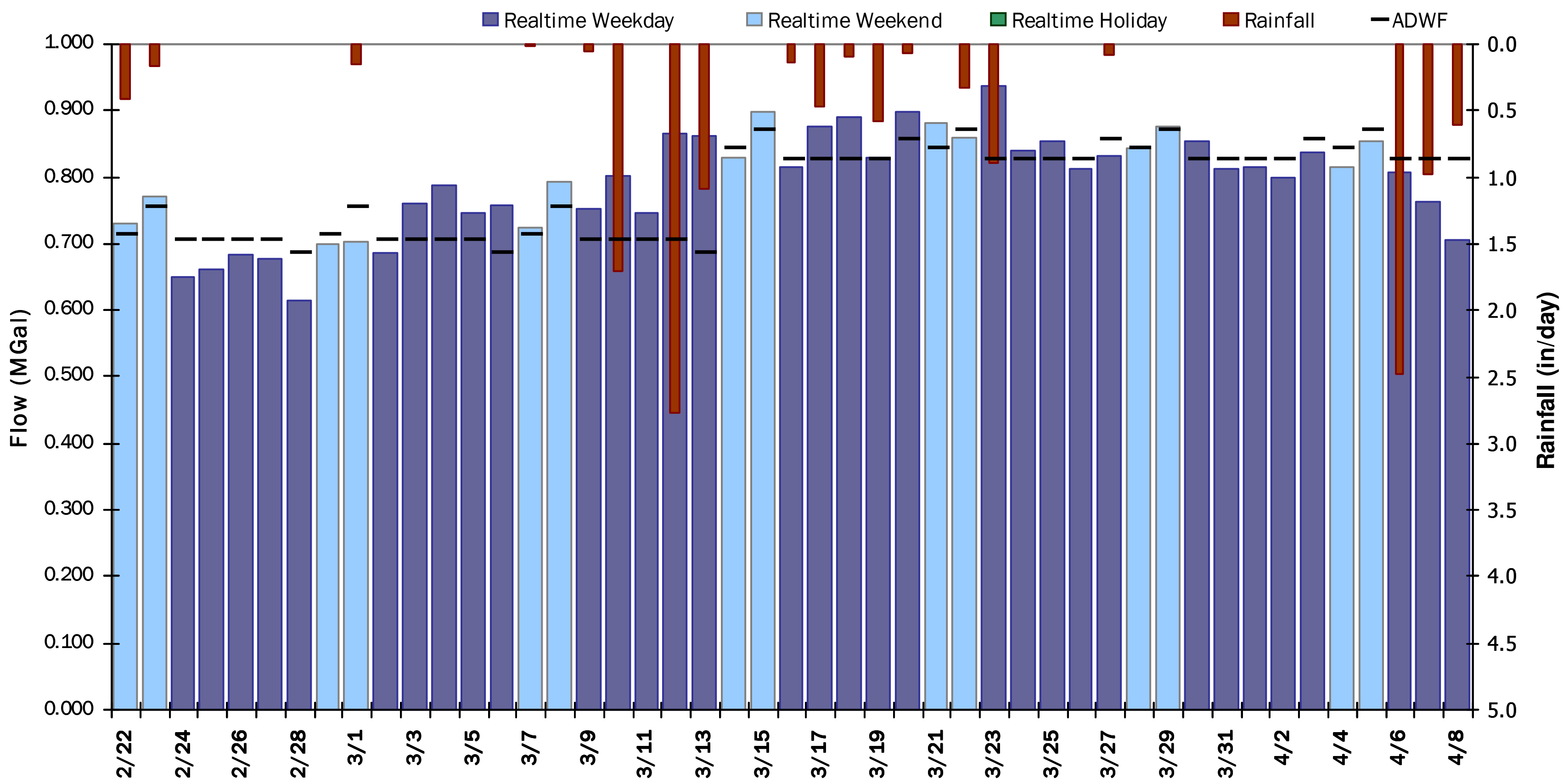
Street View

FM-10

Period Flow Summary: Daily Flow Totals

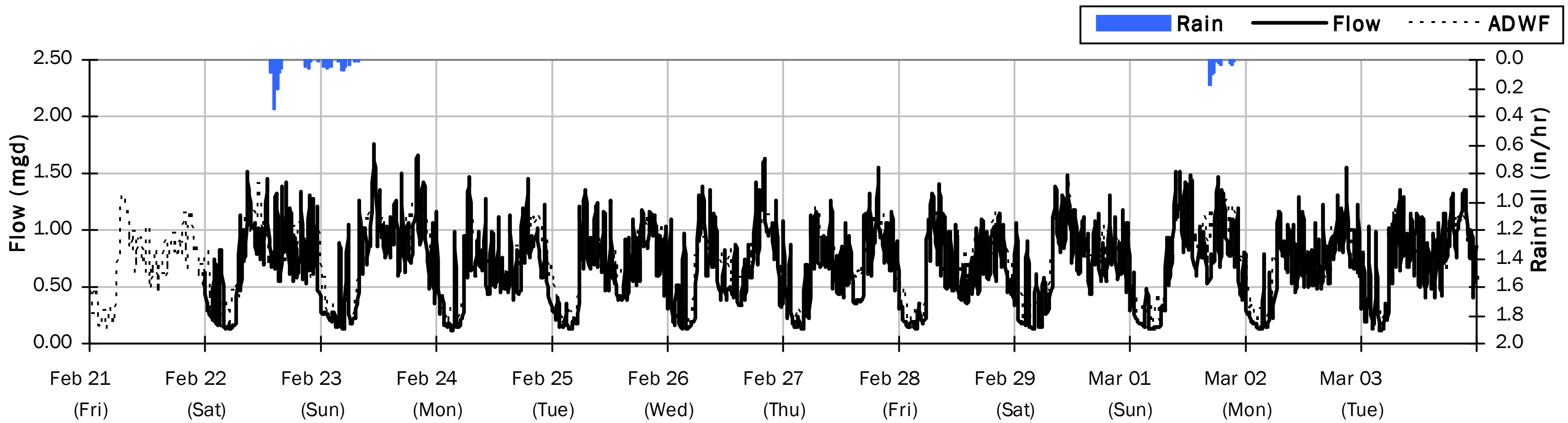
Avg Period Flow: 0.794 MGal **Peak Daily Flow: 0.936 MGal** **Min Daily Flow: 0.615 MGal**

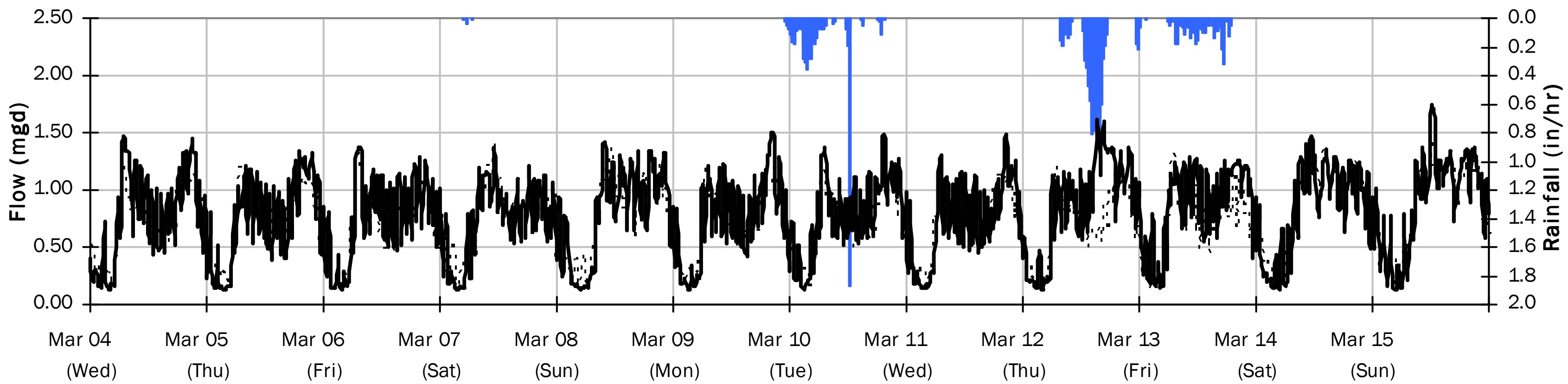
Total Period Rainfall: 13.05 inches



FM-10
Flow Summary: 2/21/2020 to 3/15/2020

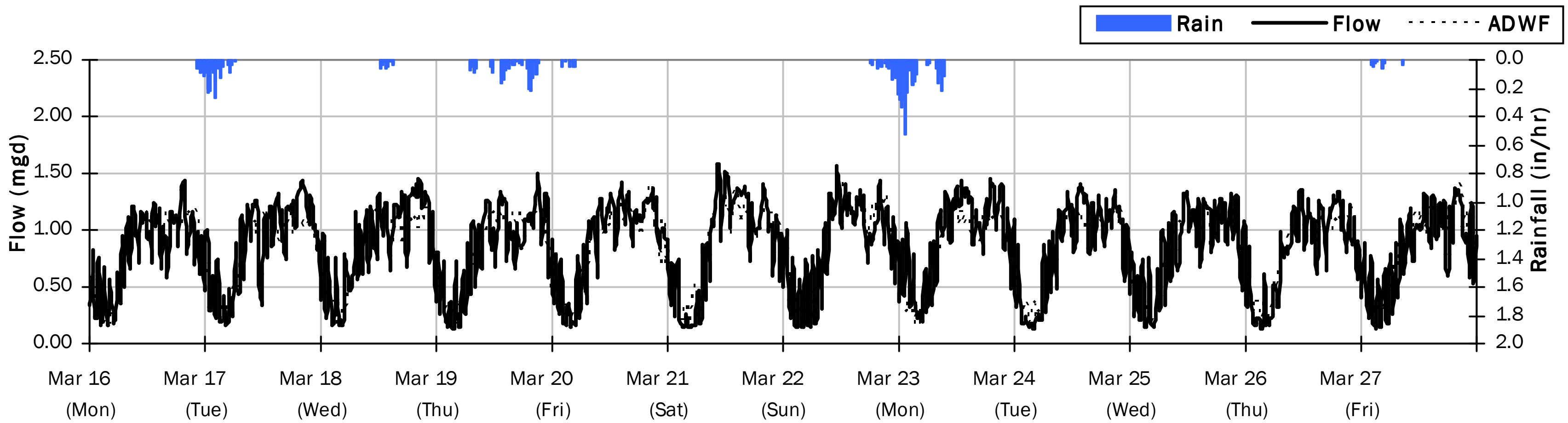
Total Period Rainfall: 6.34 inches   **Avg Flow: 0.748 mgd**   **Peak Flow: 1.757 mgd**   **Min Flow: 0.116 mgd**

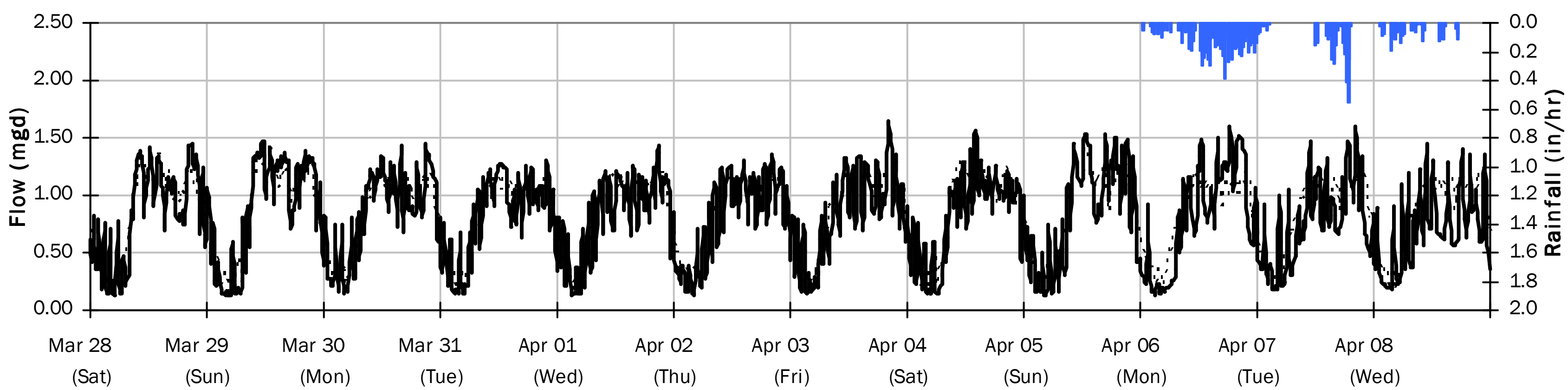




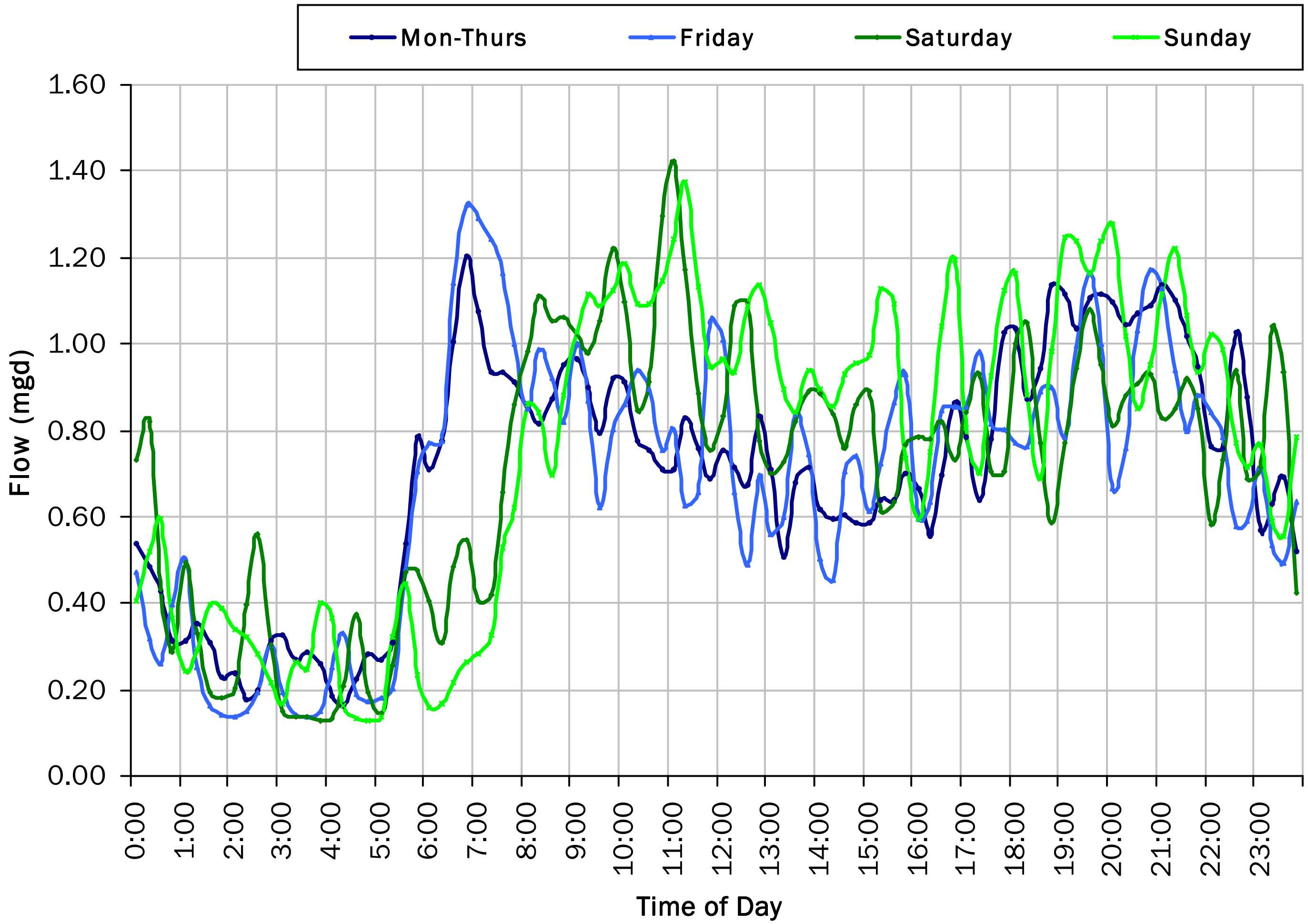
FM-10
Flow Summary: 3/16/2020 to 4/8/2020

Total Period Rainfall: 6.71 inches   **Avg Flow: 0.838 mgd   Peak Flow: 1.643 mgd   Min Flow: 0.121 mgd**



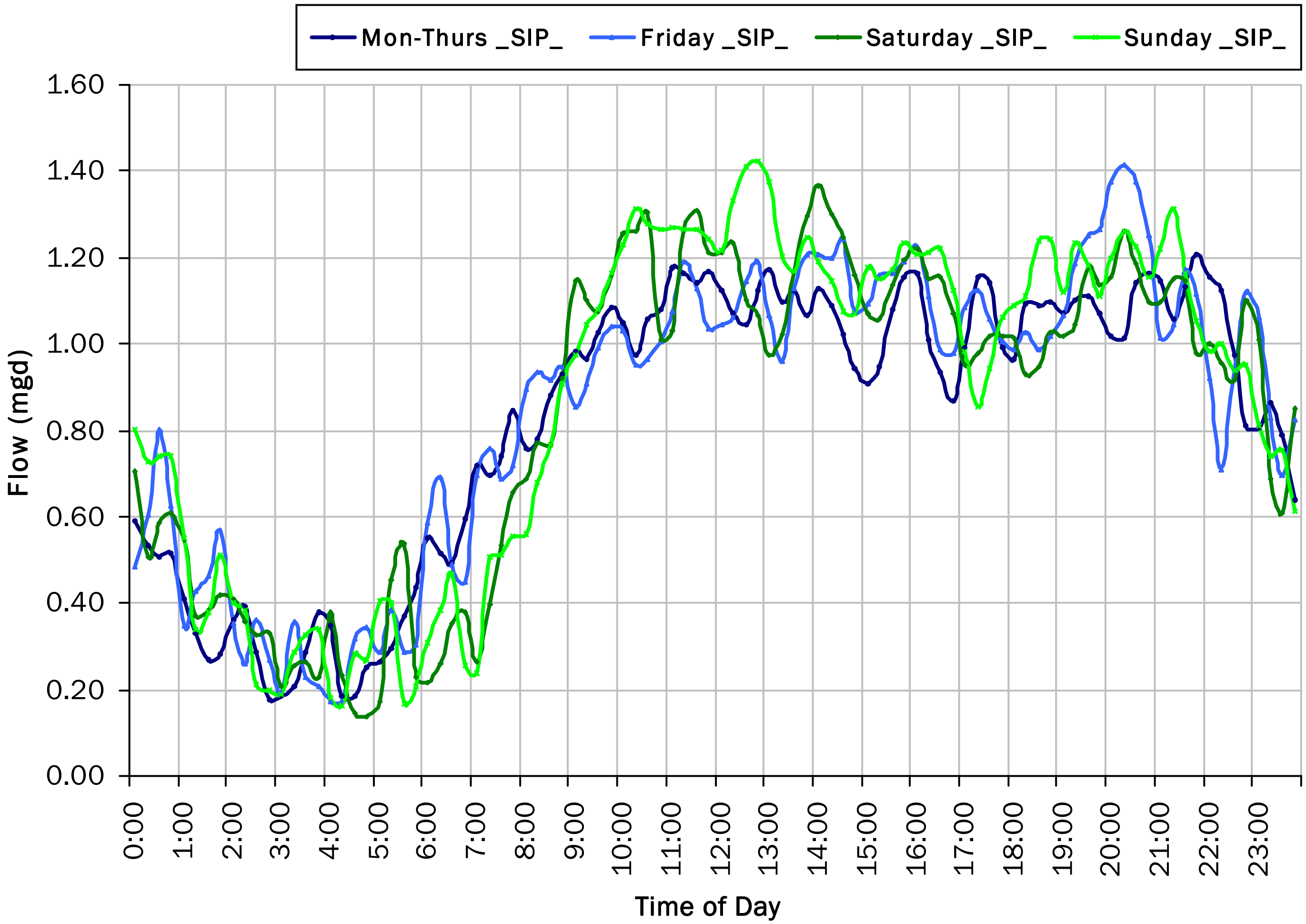


FM-10
Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)



ADWF:
0.712 mgd

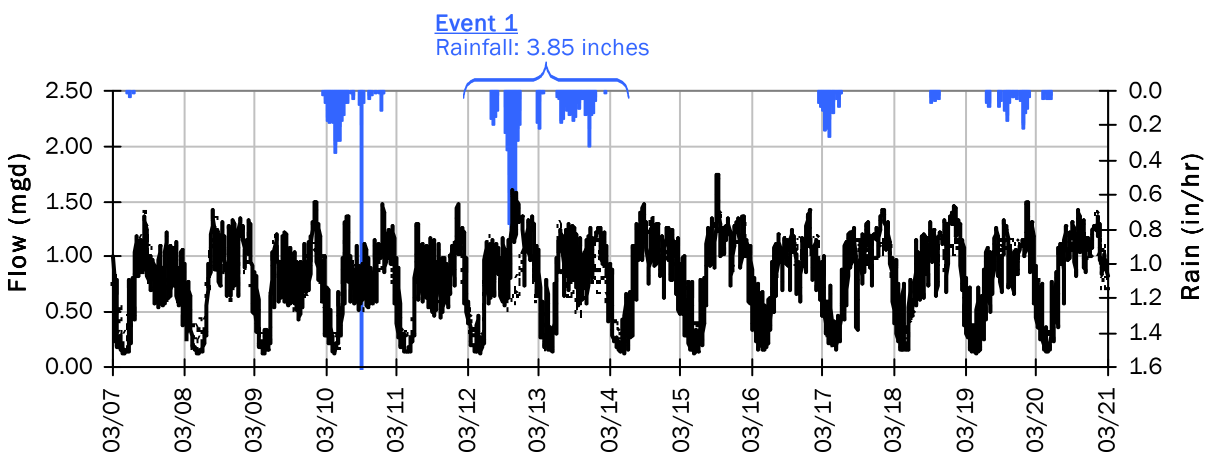
FM-10
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)



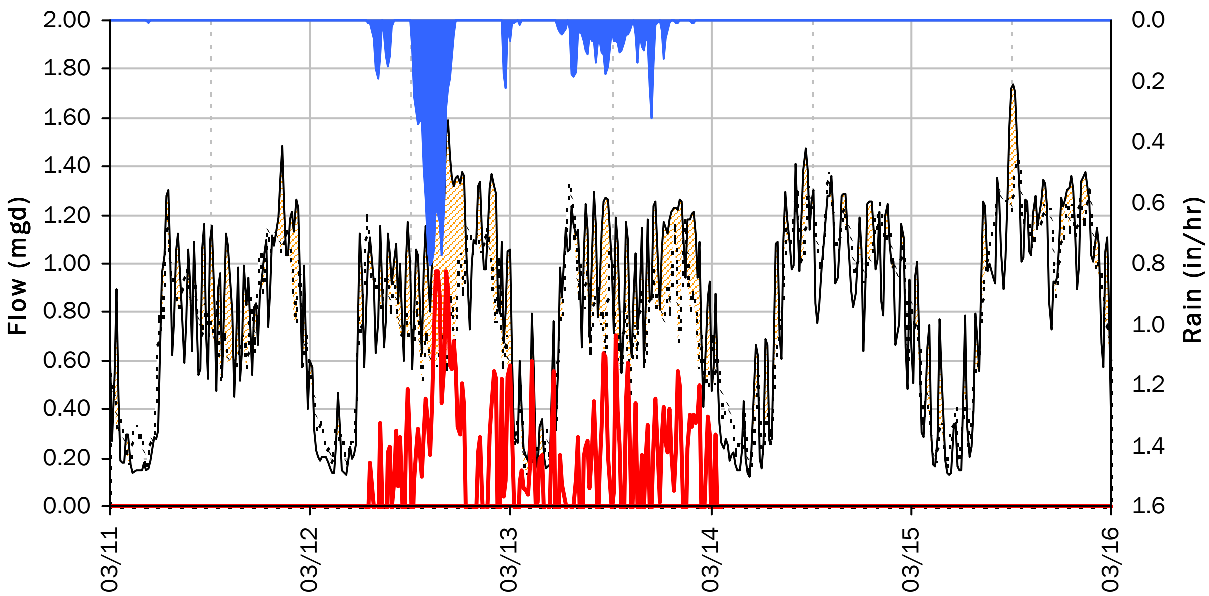
ADWF:
0.840 mgd

FM-10
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

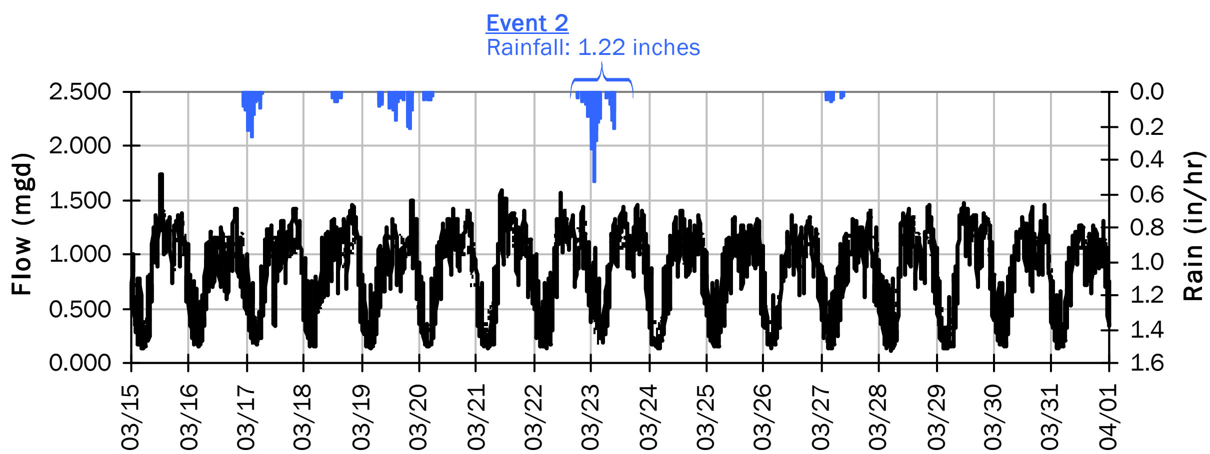


Storm Event I/I Analysis (Rain = 3.85 inches)

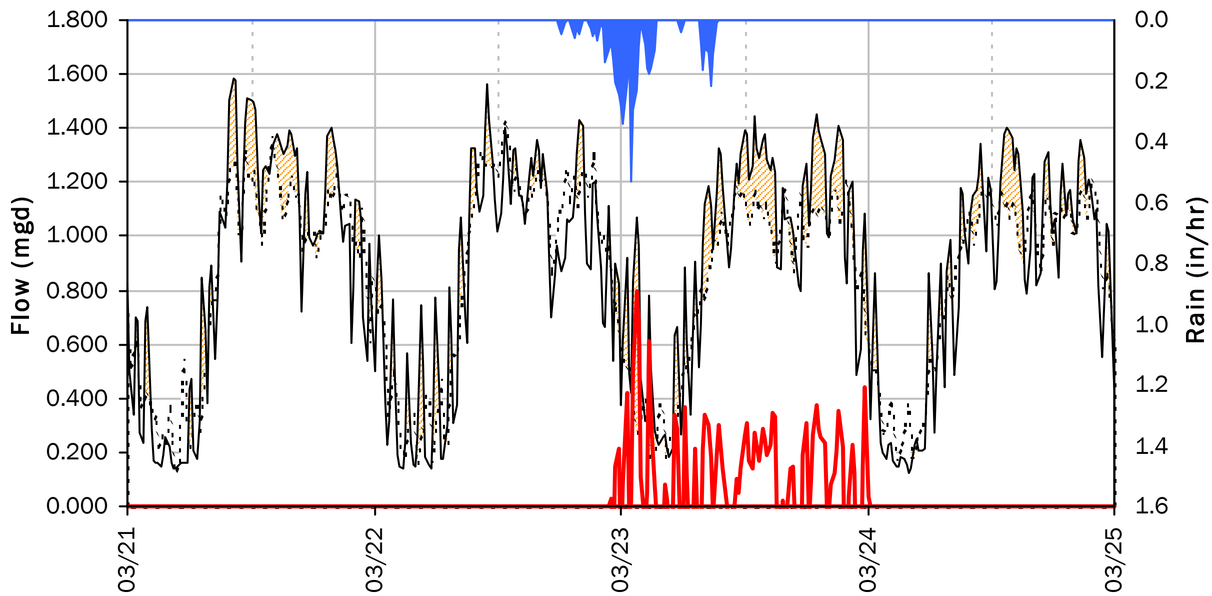
Capacity		Inflow / Infiltration	
Peak Flow:	1.61 *mgd*	**Peak I/I Rate:**	0.97 *mgd*
PF:	2.06	**Total I/I:**	350,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-10
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

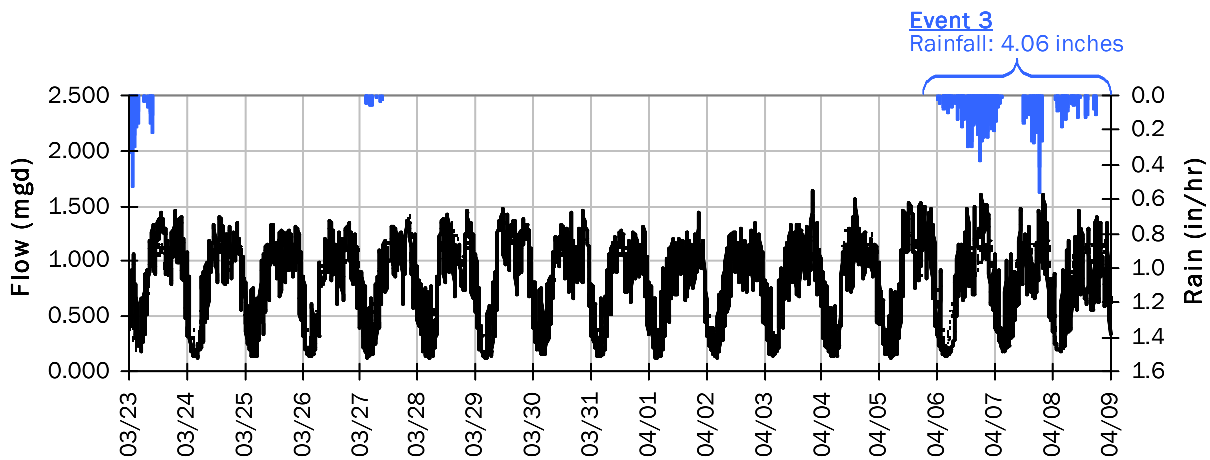


Storm Event I/I Analysis (Rain = 1.22 inches)

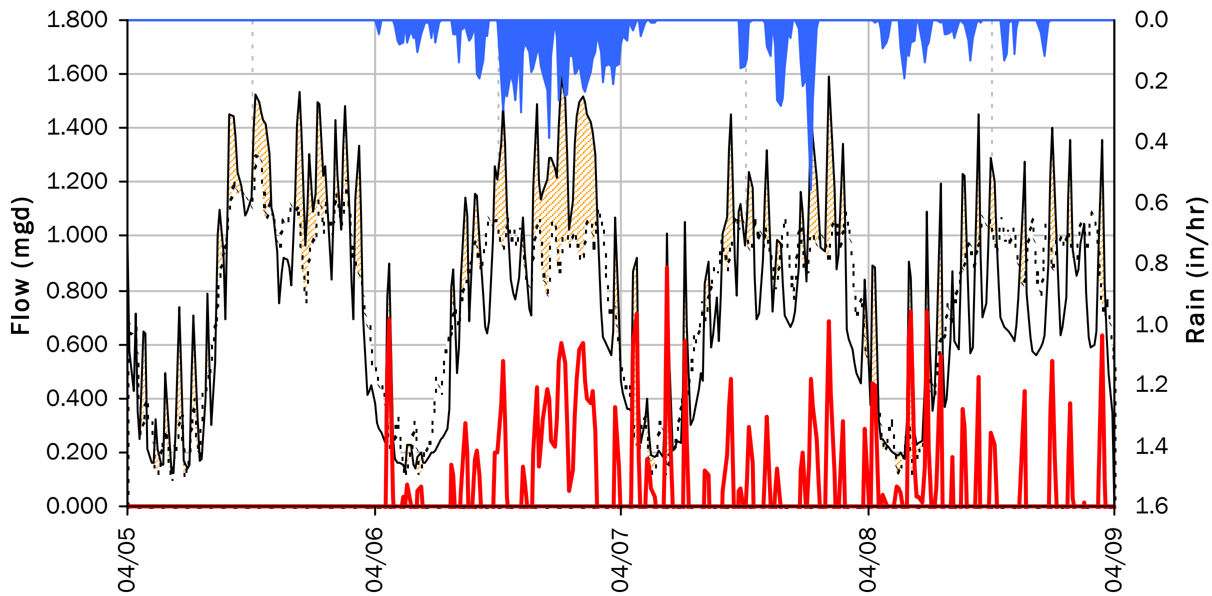
Capacity			Inflow / Infiltration		
Peak Flow:	1.45	*mgd*	**Peak I/I Rate:**	0.80	*mgd*
PF:	1.86		**Total I/I:**	111,000	*gallons*
Peak Level:		*in*			
d/D Ratio:					

FM-10
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 4.06 inches)

Capacity			Inflow / Infiltration		
Peak Flow:	1.60	*mgd*	**Peak I/I Rate:**	0.88	*mgd*
PF:	2.04		**Total I/I:**	69,000	*gallons*
Peak Level:		*in*			
d/D Ratio:					

City of Beaumont

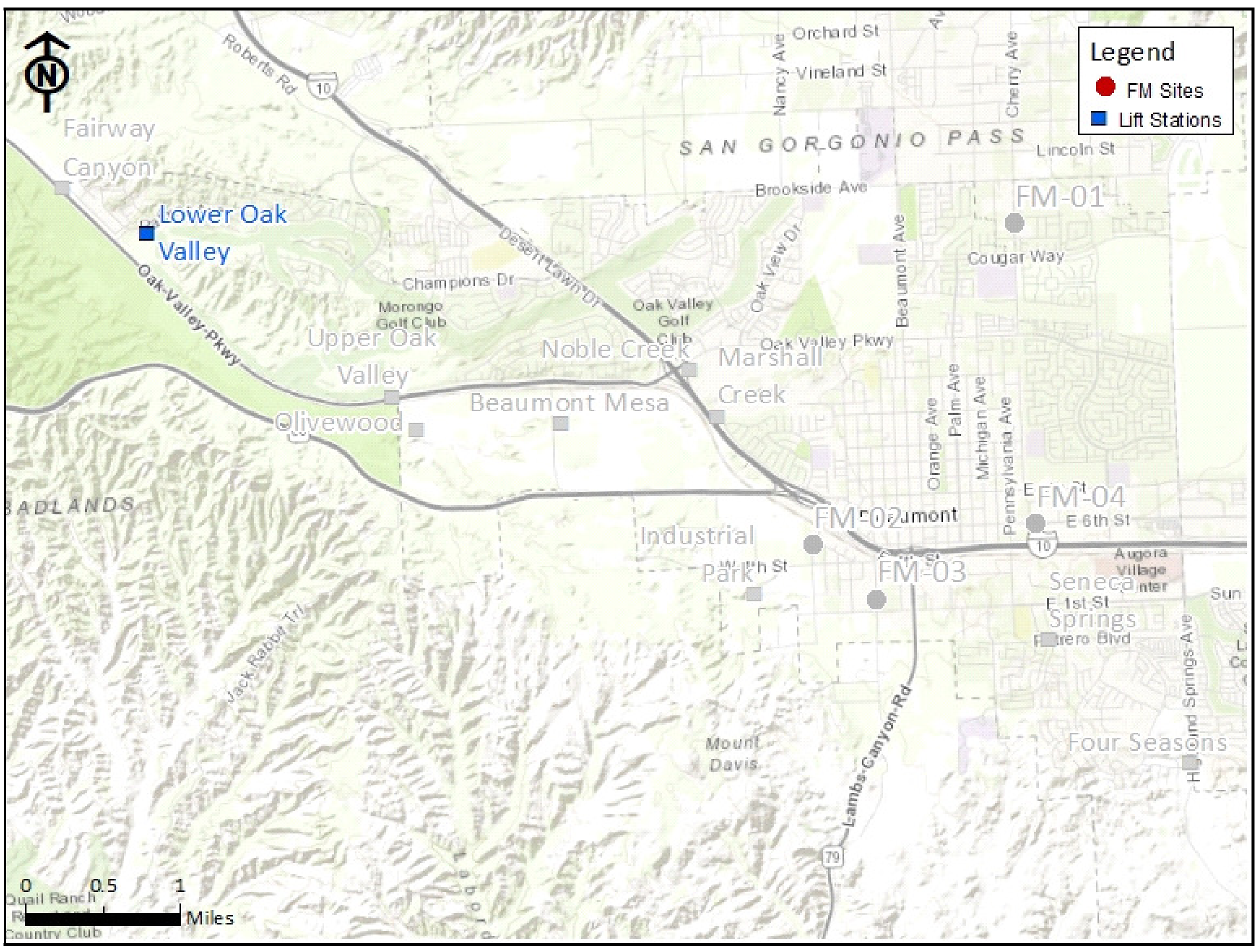
Sanitary Sewer Flow Monitoring
February 20 - April 09, 2020

Monitoring Site: FM-11

City Structure: Lower Oak Valley LS

Location: Palmer Avenue, 300 feet west of Morris Street

Data Summary Report



Vicinity Map: FM-11

FM-11

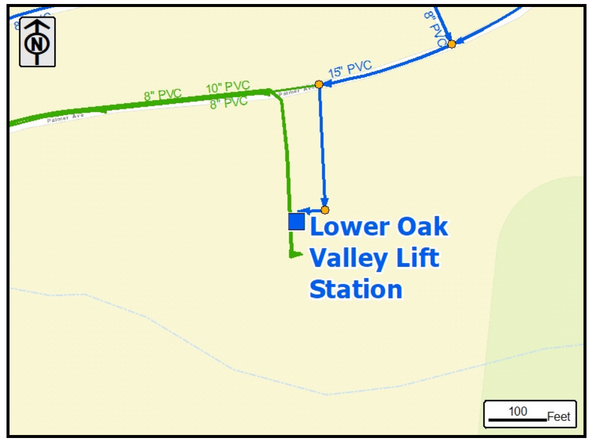
Site Information

City Structure: Lower Oak Valley LS **Coordinates:** 117.0616° W, 33.9595° N **Rim Elev:** 2157 feet

Location: Palmer Avenue, 300 feet west of Morris Street

ADWF: 0.417 mgd **Peak Measured Flow:** 0.866 mgd

Satellite Map



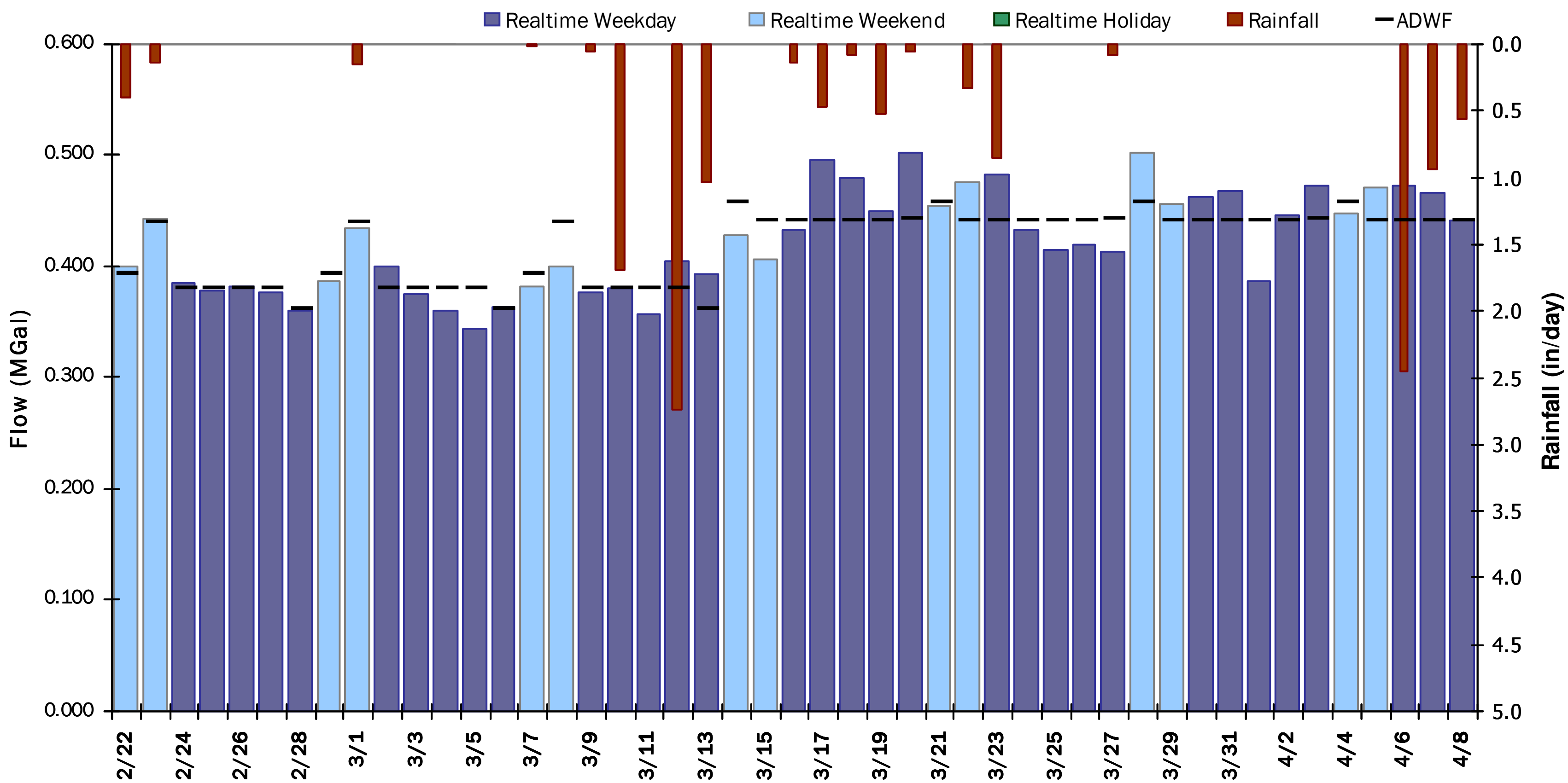
Sanitary Map

Street View

FM-11
Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.423 MGal **Peak Daily Flow: 0.503 MGal** **Min Daily Flow: 0.345 MGal**

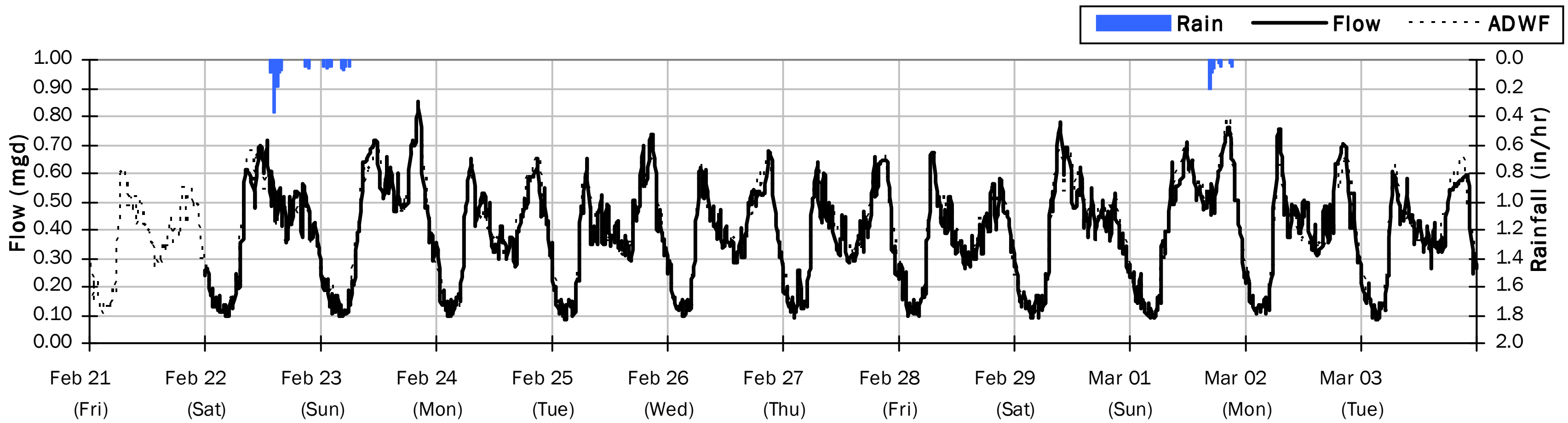
Total Period Rainfall: 12.73 inches

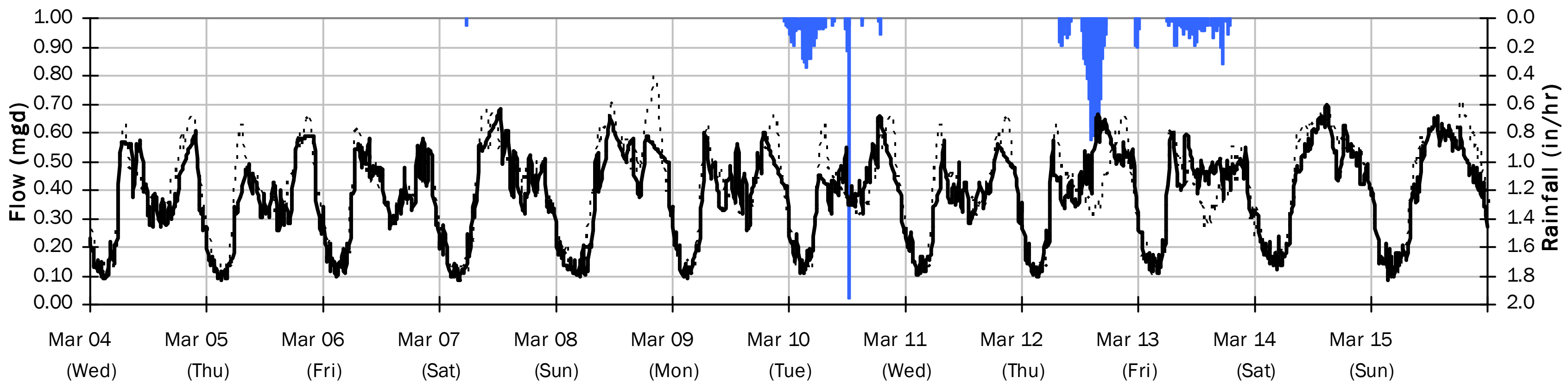


FM-11

Flow Summary: 2/21/2020 to 3/15/2020

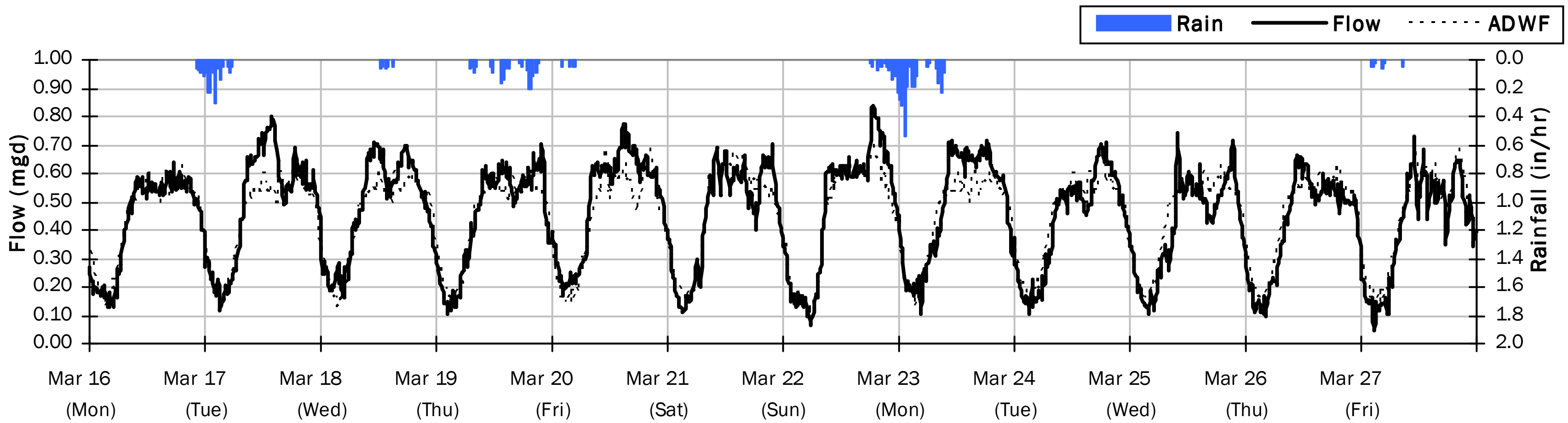
Total Period Rainfall: 6.21 inches   **Avg Flow: 0.388 mgd**   **Peak Flow: 0.851 mgd**   **Min Flow: 0.081 mgd**

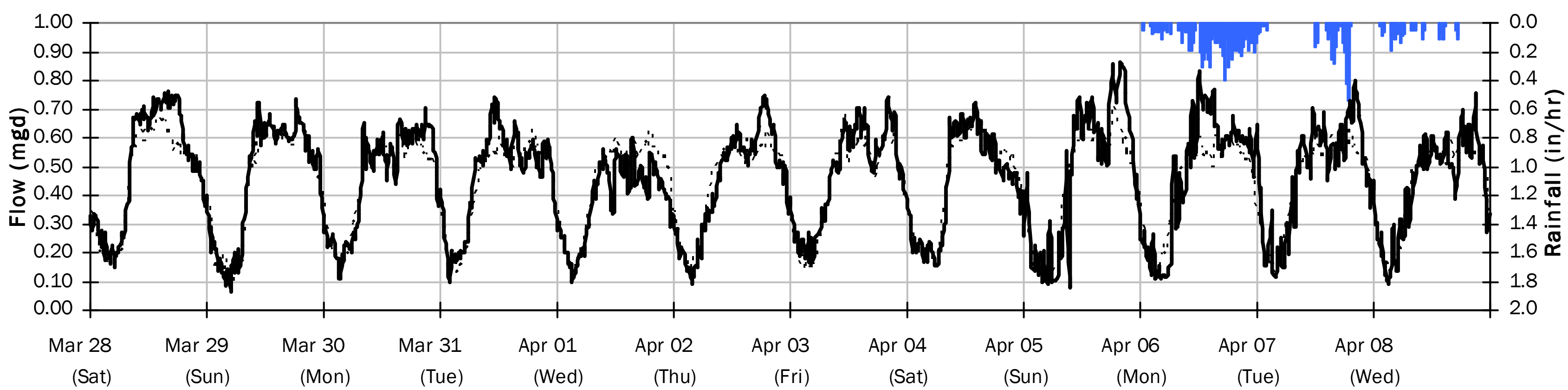




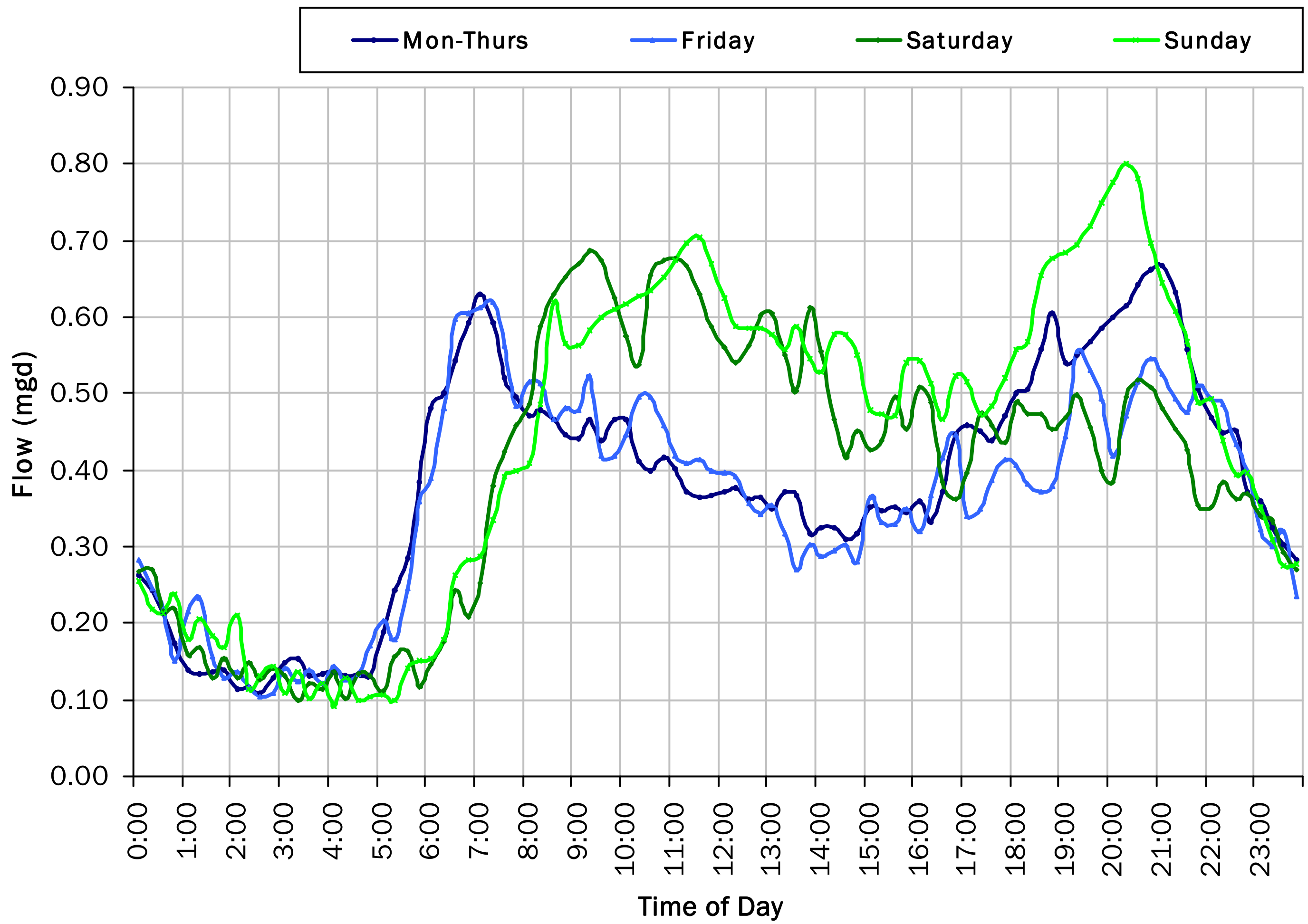
FM-11
Flow Summary: 3/16/2020 to 4/8/2020

Total Period Rainfall: 6.51 inches Avg Flow: 0.456 mgd Peak Flow: 0.866 mgd Min Flow: 0.044 mgd



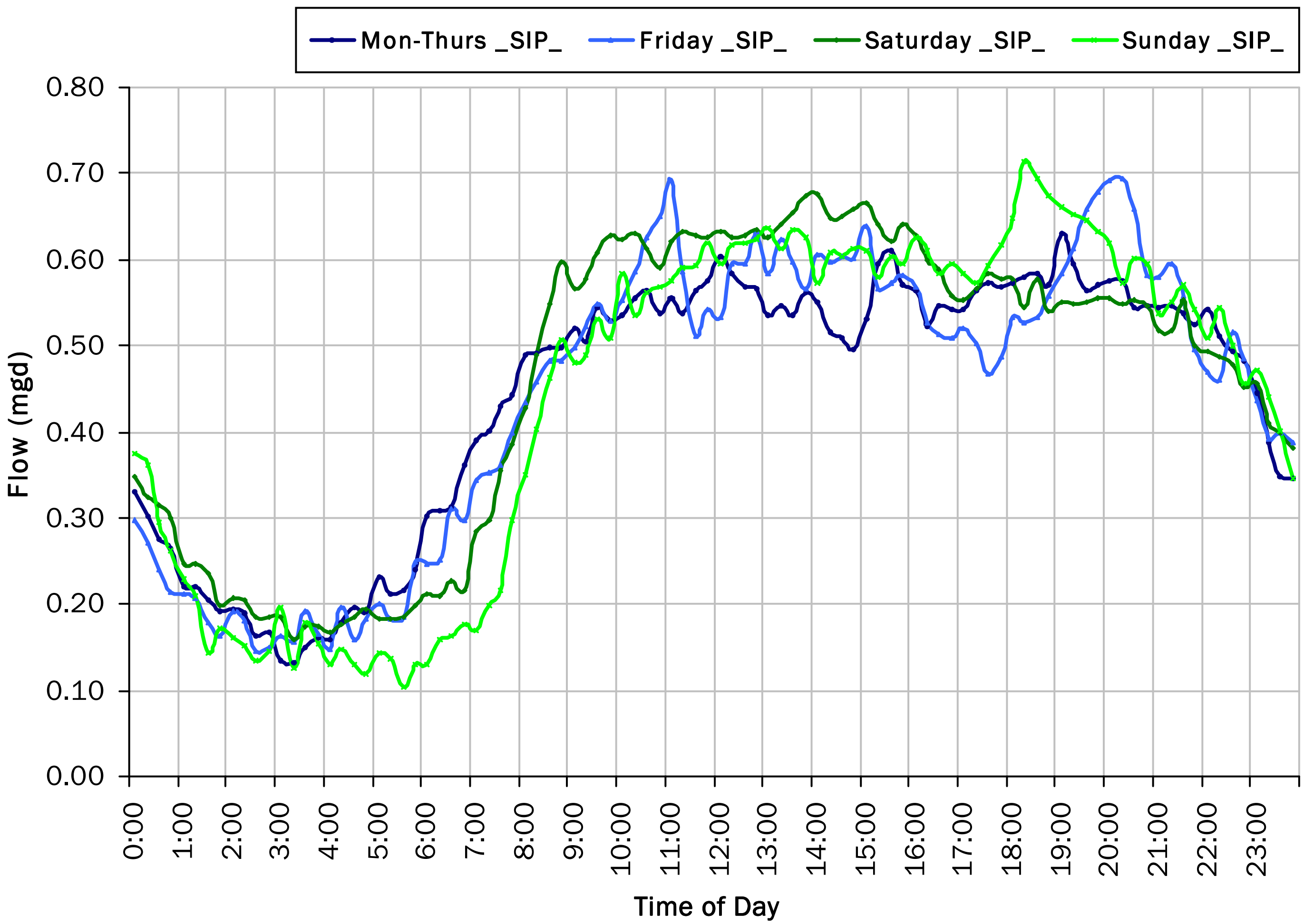


FM-11
Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)



ADWF:
0.388 mgd

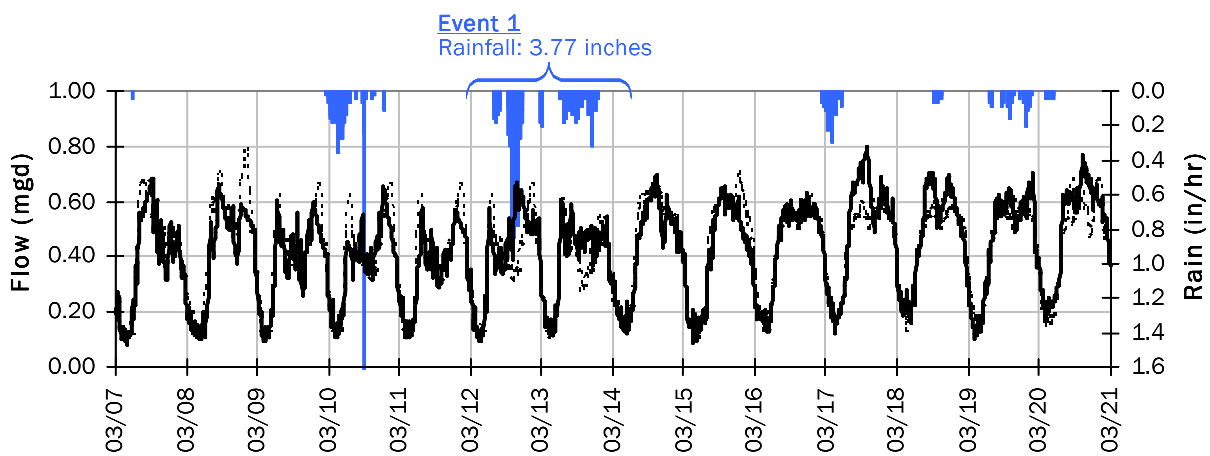
FM-11
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)



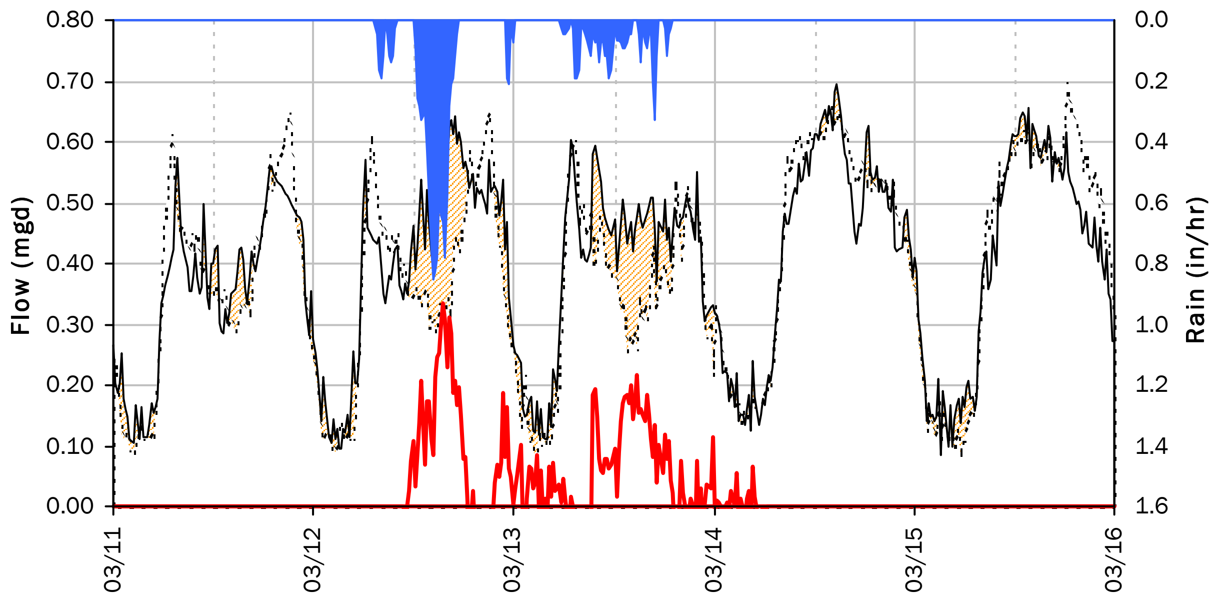
ADWF:
0.444 mgd

FM-11
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

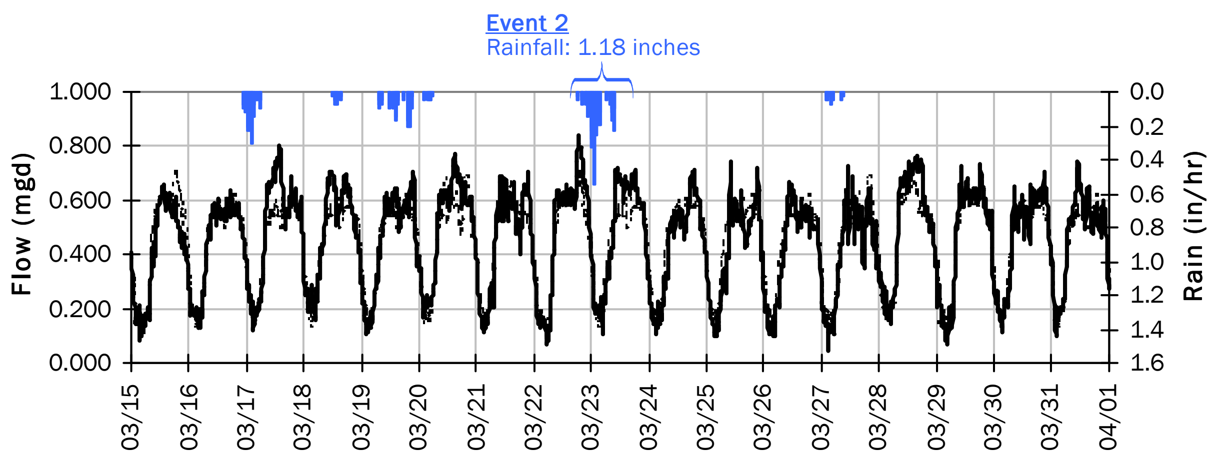


Storm Event I/I Analysis (Rain = 3.77 inches)

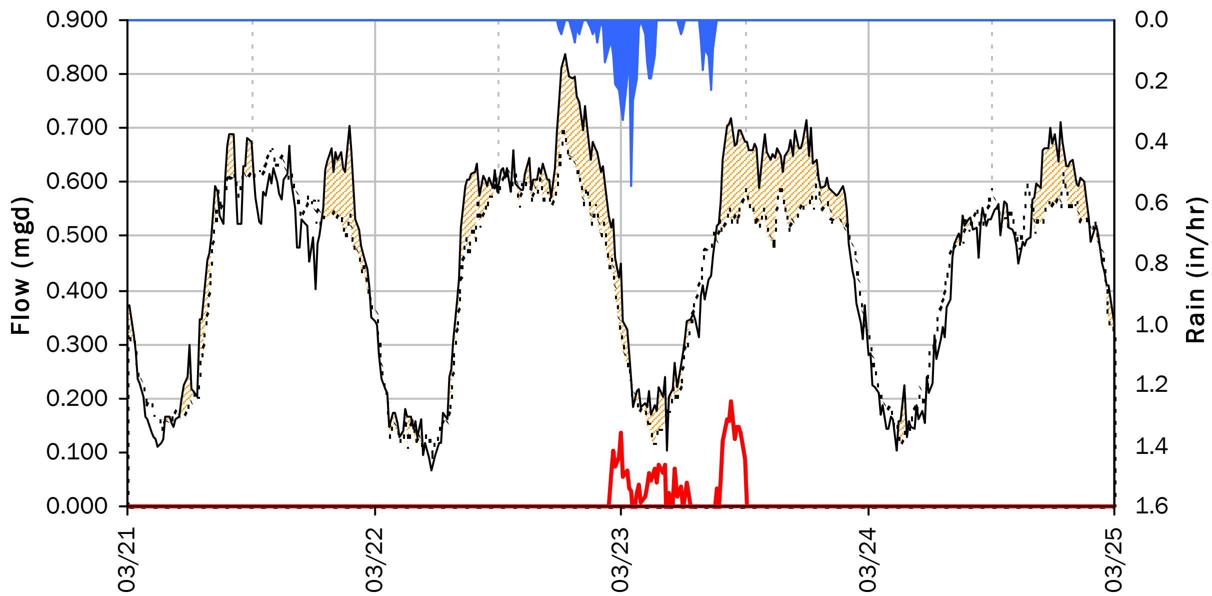
Capacity		Inflow / Infiltration	
Peak Flow:	0.67 *mgd*	**Peak I/I Rate:**	0.33 *mgd*
PF:	1.60	**Total I/I:**	103,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-11
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

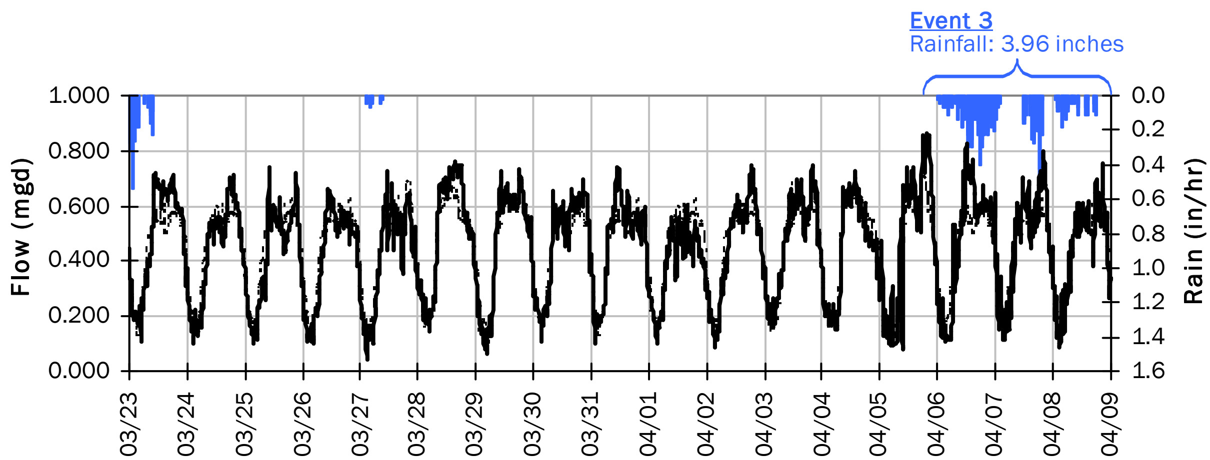


Storm Event I/I Analysis (Rain = 1.18 inches)

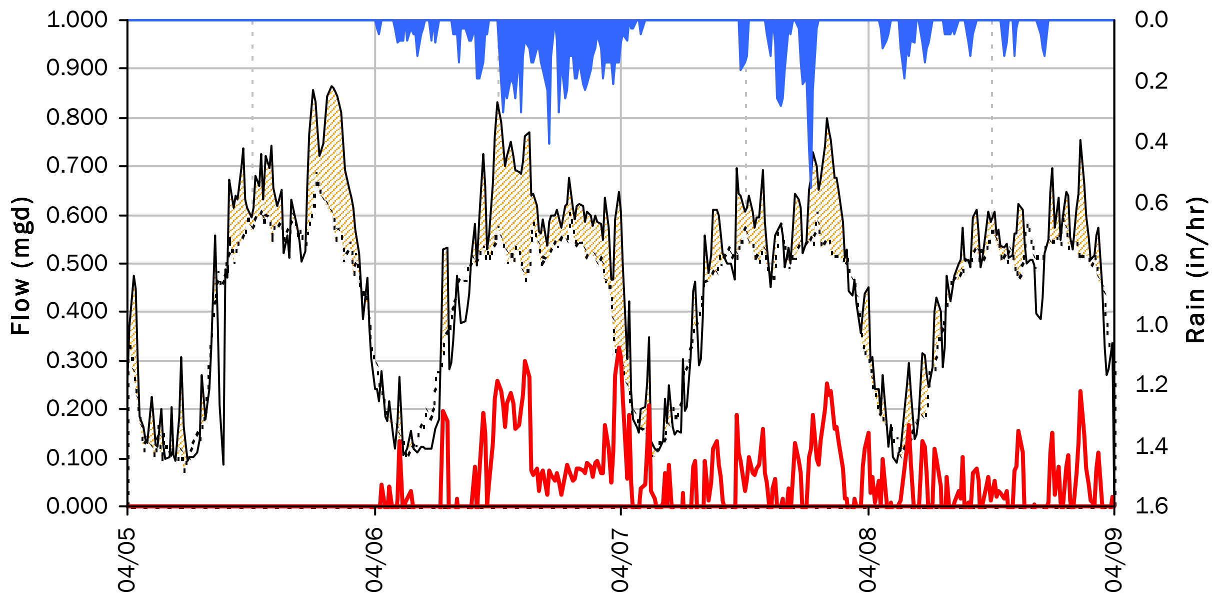
Capacity		Inflow / Infiltration	
Peak Flow:	0.72 *mgd*	**Peak I/I Rate:**	0.20 *mgd*
PF:	1.72	**Total I/I:**	23,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-11
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 3.96 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.83 *mgd*	**Peak I/I Rate:**	0.33 *mgd*
PF:	1.99	**Total I/I:**	149,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

City of Beaumont

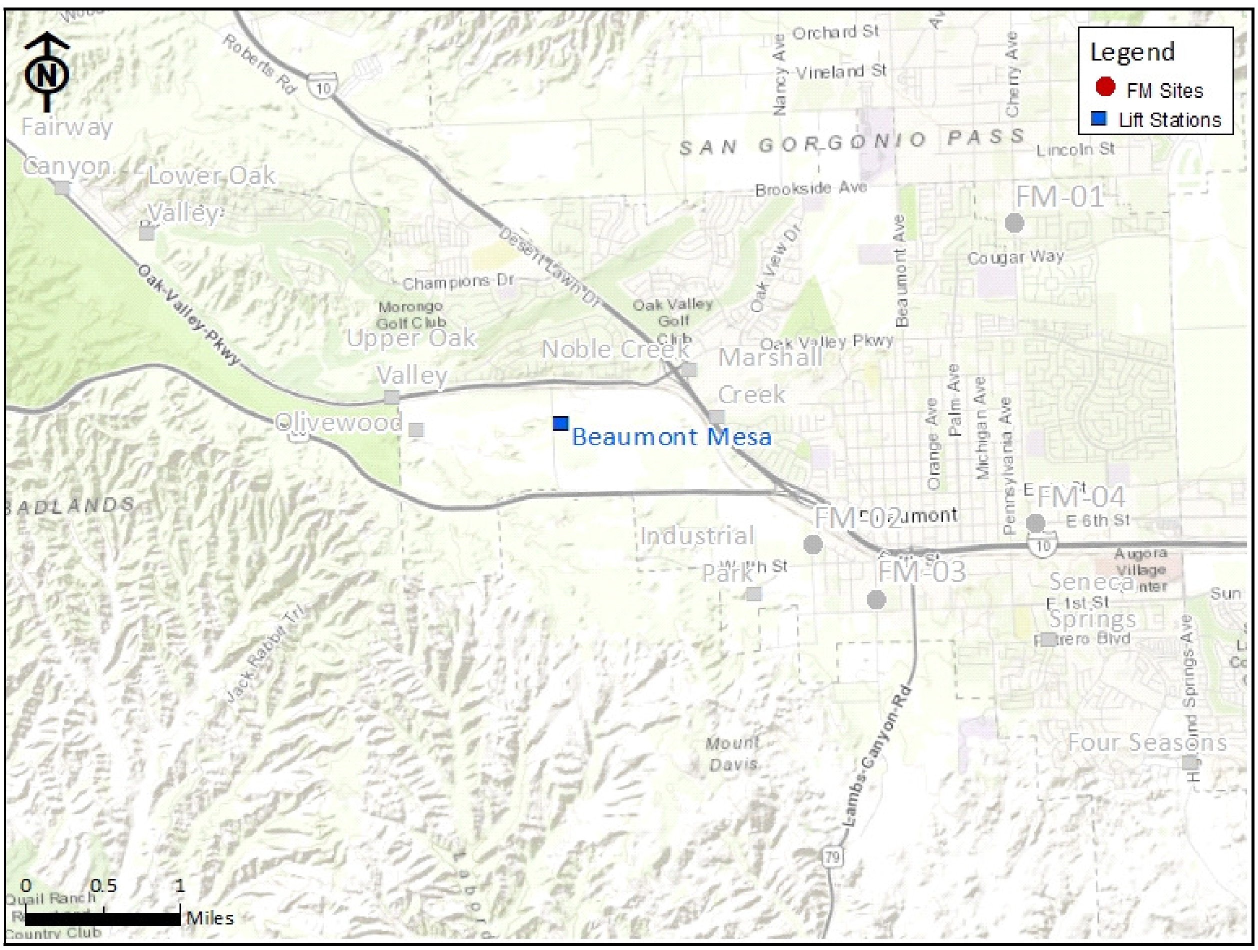
Sanitary Sewer Flow Monitoring
February 20 - April 09, 2020

Monitoring Site: FM-12

City Structure: Beaumont Mesa LS

Location: Potrero Blvd, just south of Costello Way

Data Summary Report



Vicinity Map: FM-12

FM-12

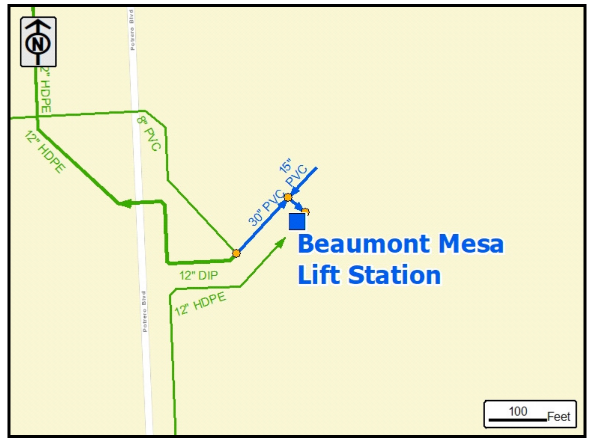
Site Information

City Structure: Beaumont Mesa LS **Coordinates:** 117.0160° W, 33.9404° N **Rim Elev:** 2425 feet

Location: Potrero Blvd, just south of Costello Way

ADWF: 0.816 mgd **Peak Measured Flow:** 1.943 mgd

Satellite Map



Sanitary Map

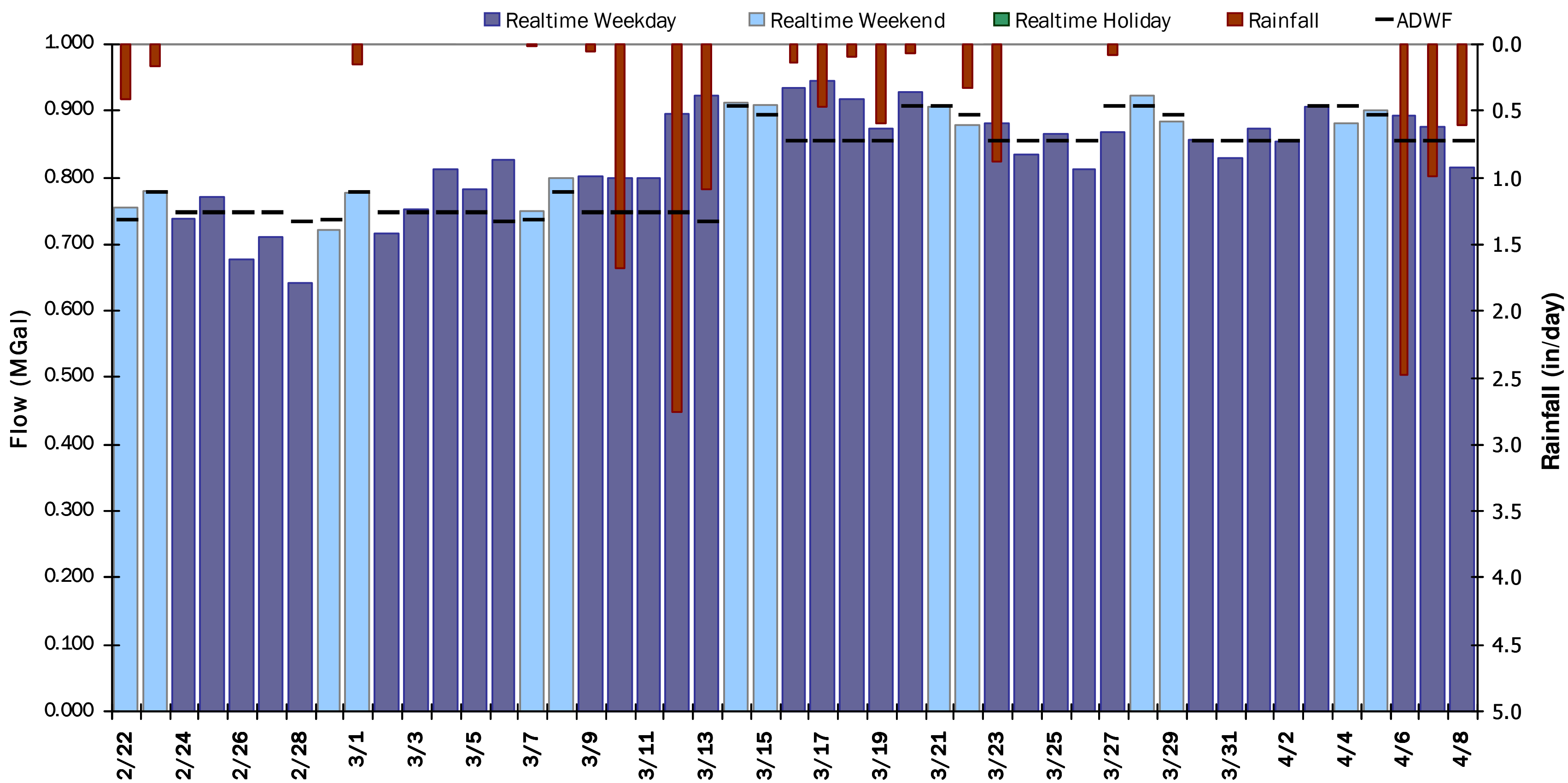
Street View

FM-12

Period Flow Summary: Daily Flow Totals

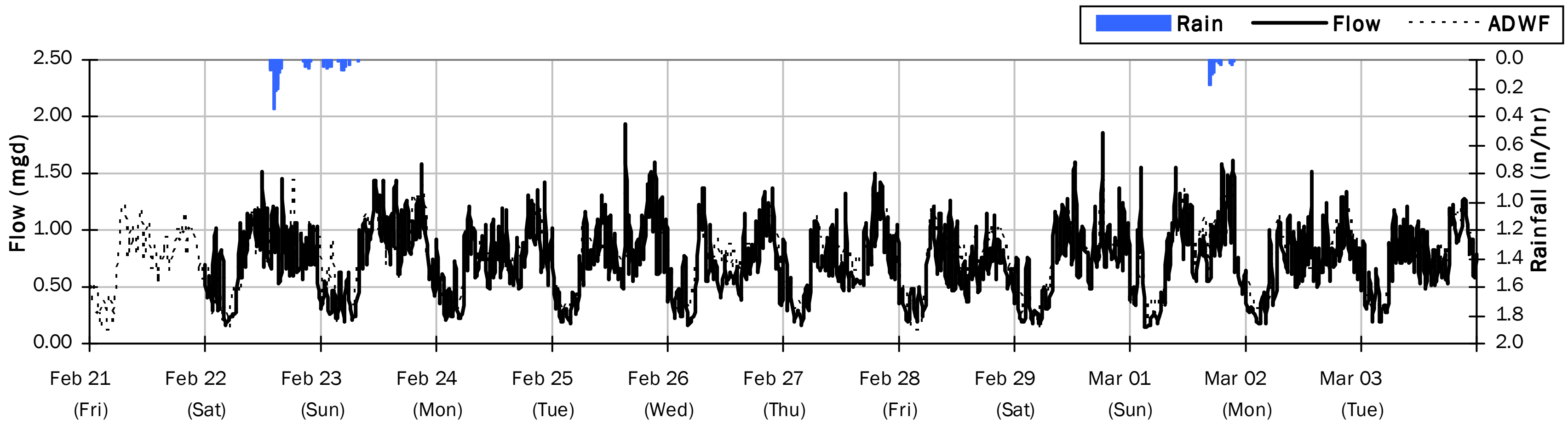
Avg Period Flow: 0.834 MGal **Peak Daily Flow: 0.945 MGal** **Min Daily Flow: 0.641 MGal**

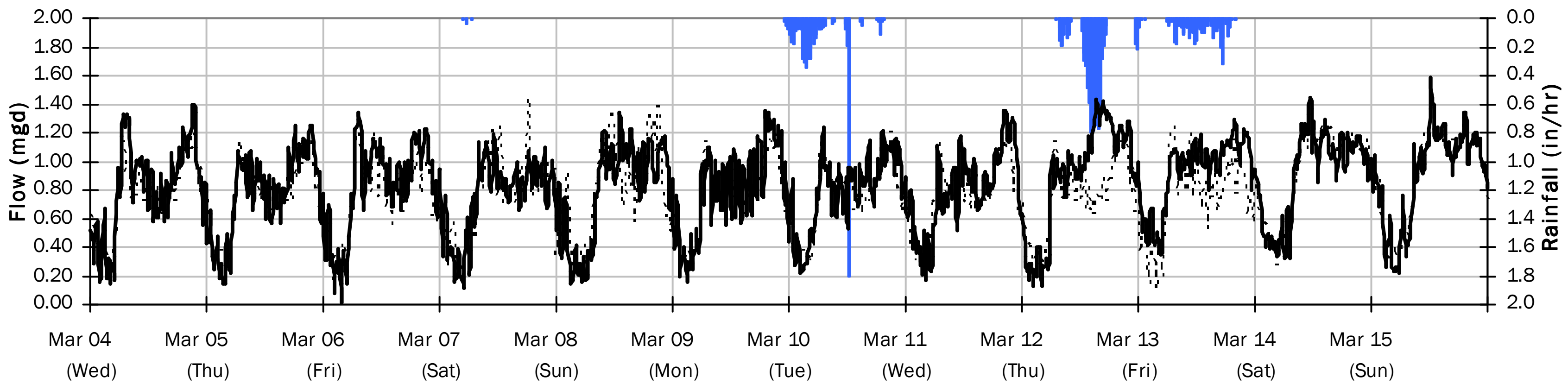
Total Period Rainfall: 13.03 inches



FM-12
Flow Summary: 2/21/2020 to 3/15/2020

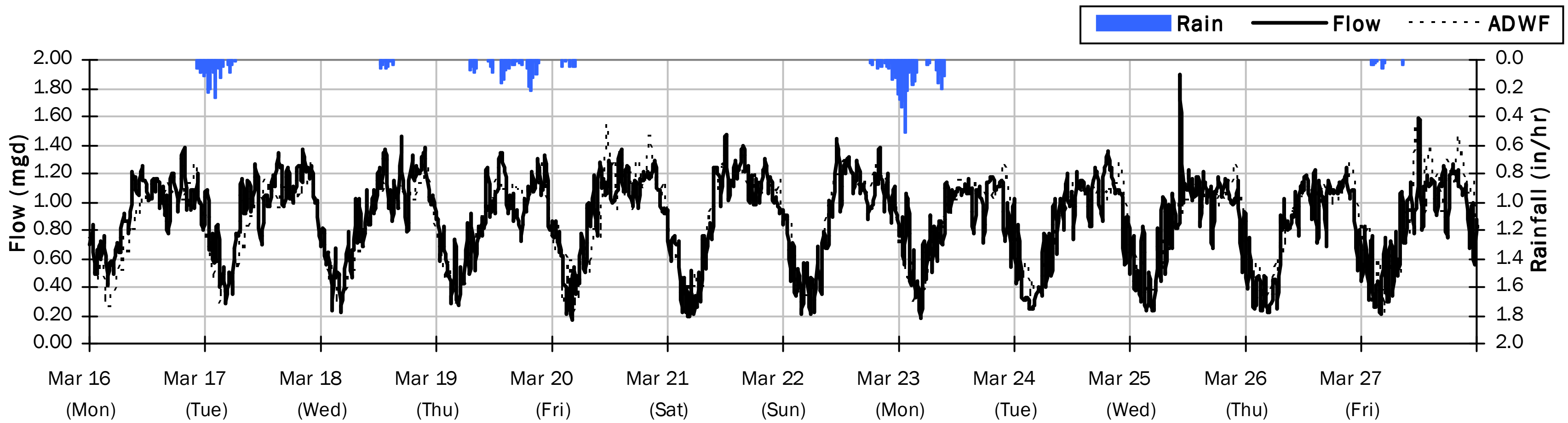
Total Period Rainfall: 6.33 inches   **Avg Flow: 0.785 mgd**   **Peak Flow: 1.943 mgd**   **Min Flow: 0.015 mgd**

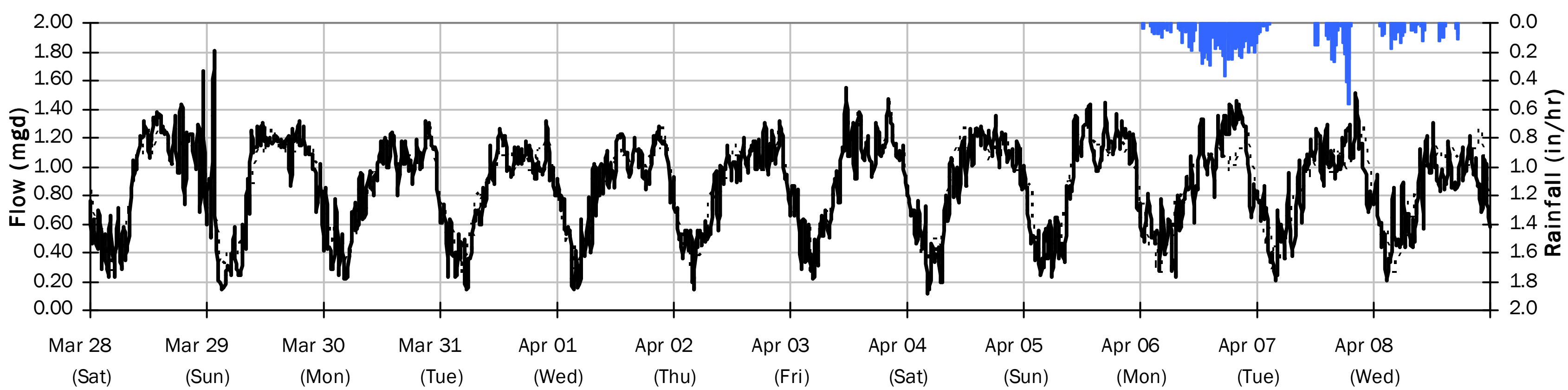




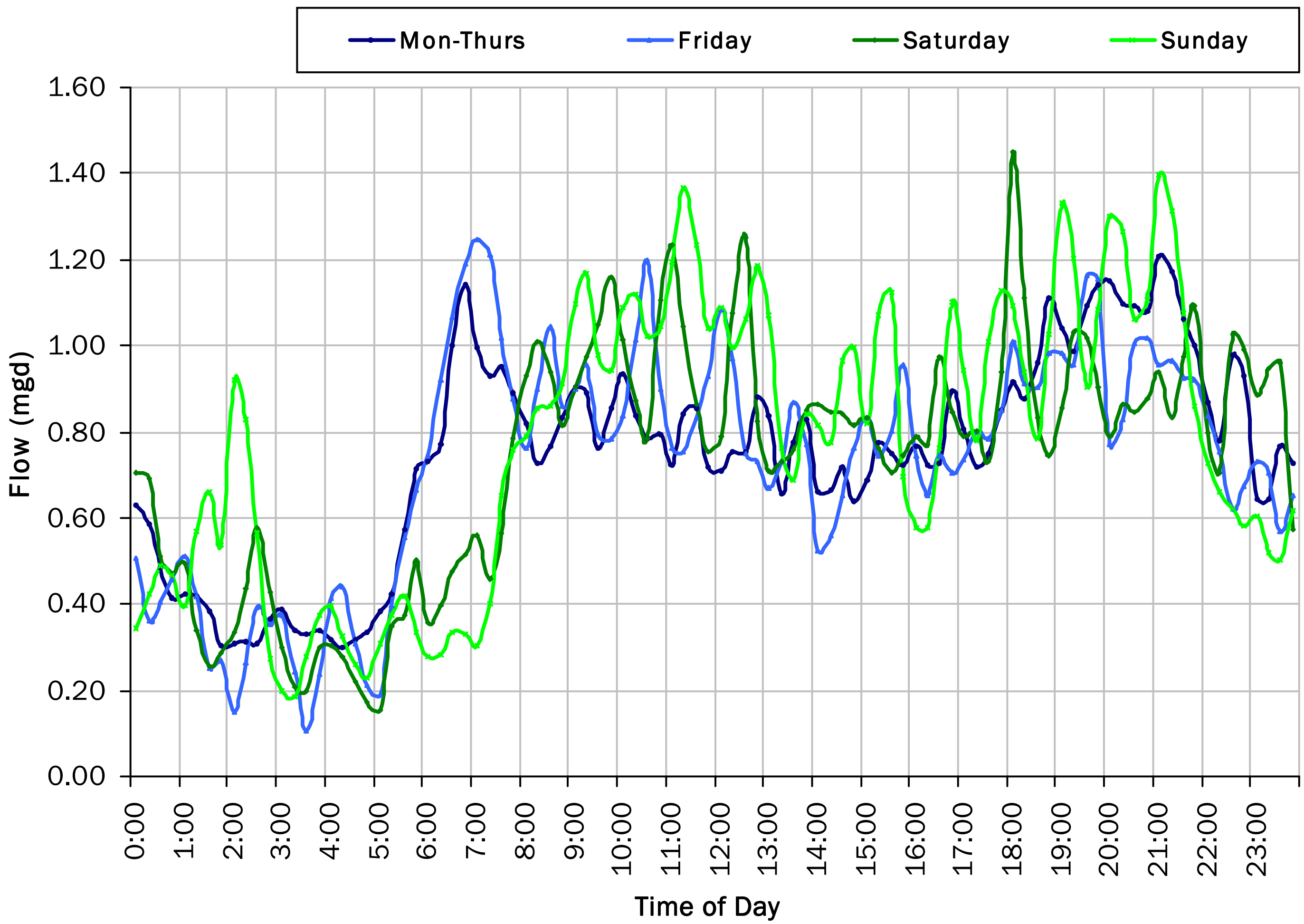
FM-12
Flow Summary: 3/16/2020 to 4/8/2020

Total Period Rainfall: 6.71 inches **Avg Flow: 0.881 mgd** **Peak Flow: 1.885 mgd** **Min Flow: 0.131 mgd**



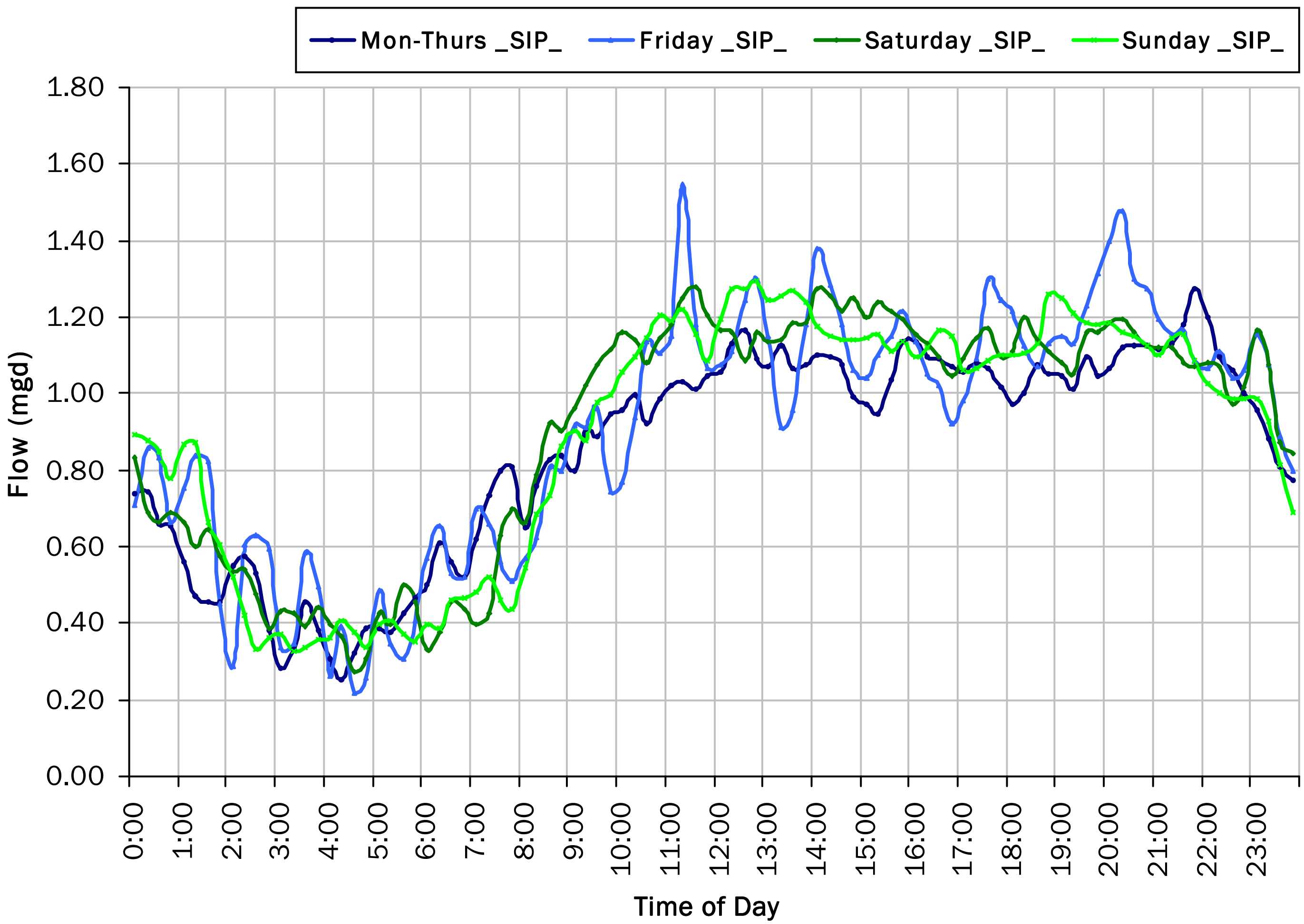


FM-12
Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)



ADWF:
0.747 mgd

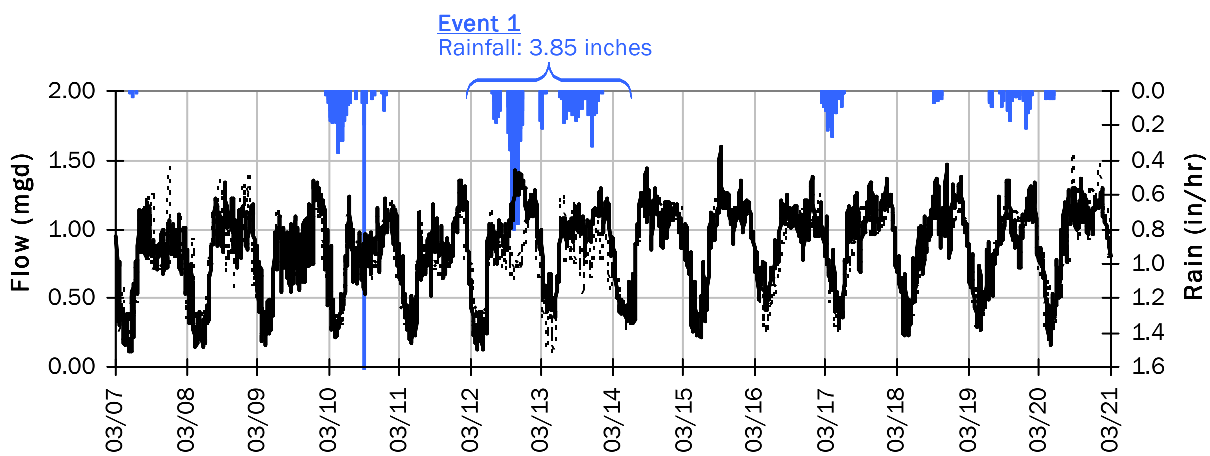
FM-12
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)



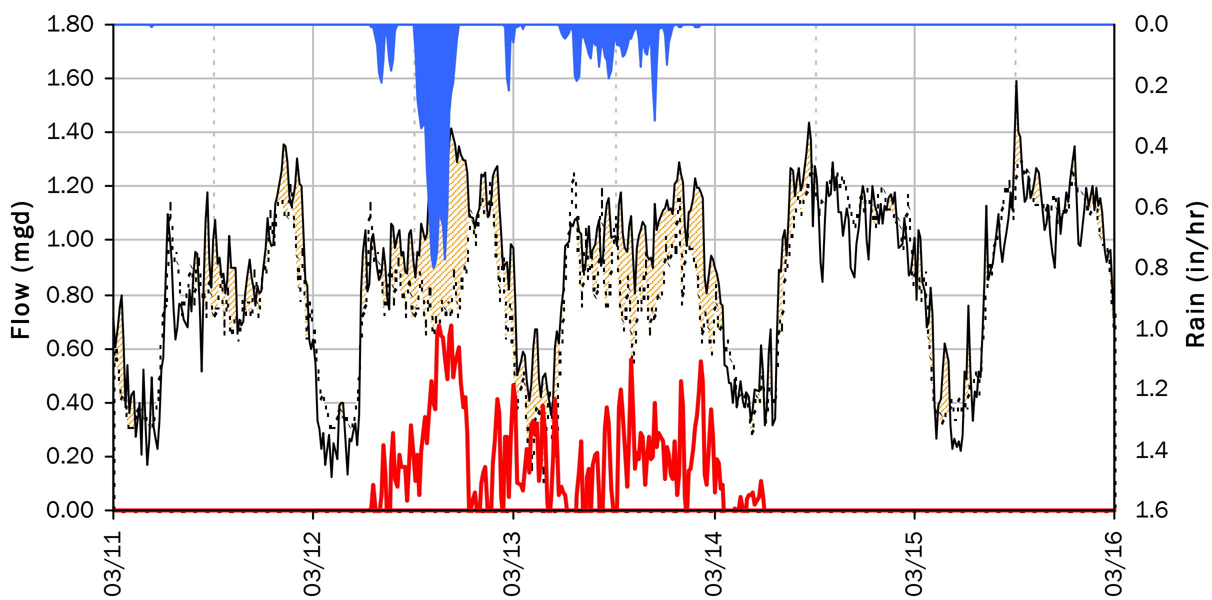
ADWF:
0.874 mgd

FM-12
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

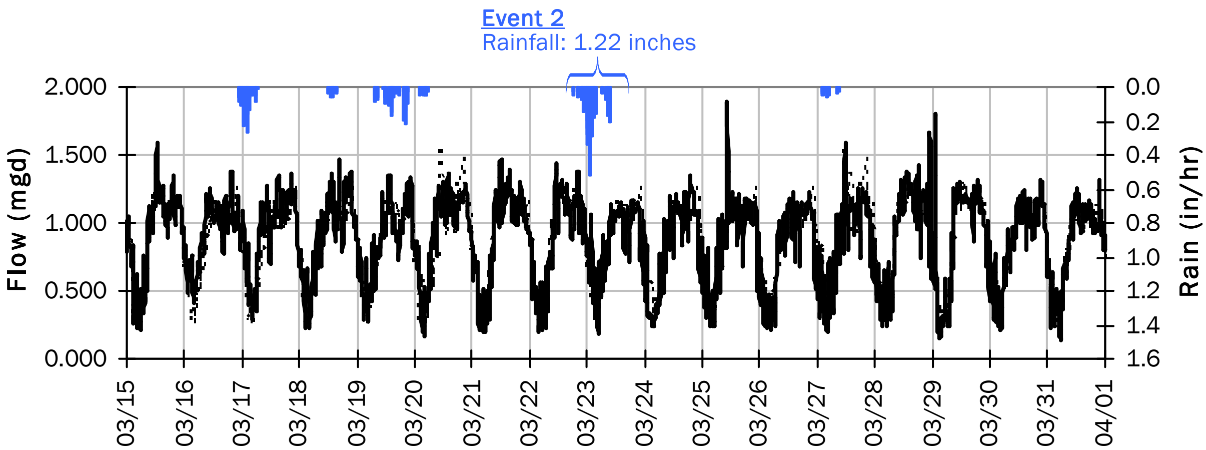


Storm Event I/I Analysis (Rain = 3.85 inches)

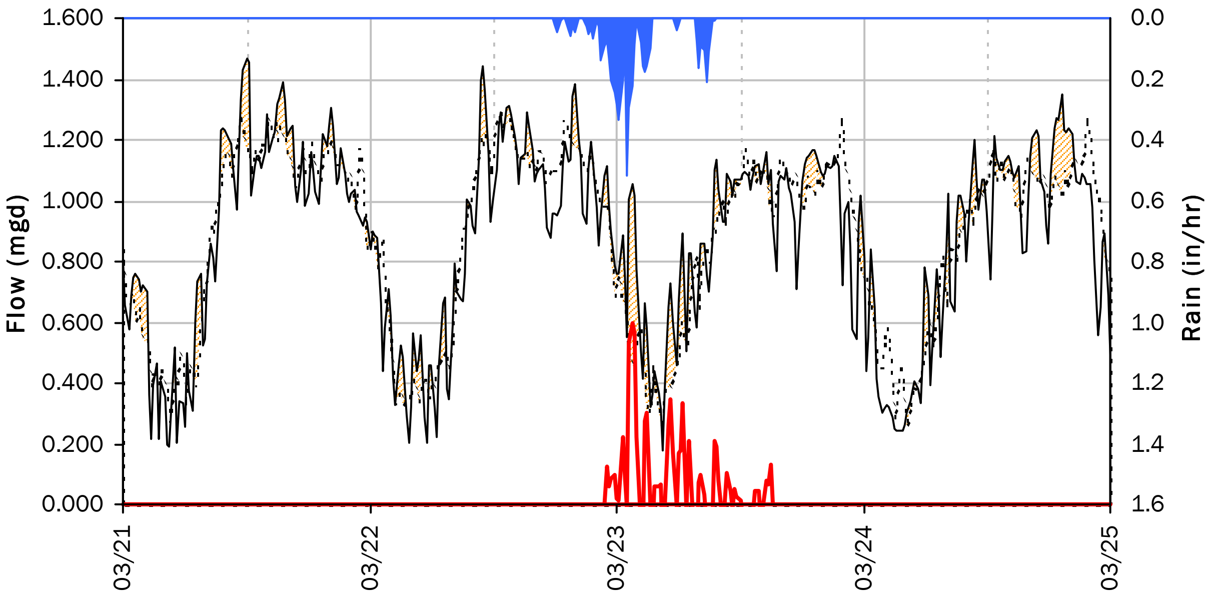
Capacity		Inflow / Infiltration	
Peak Flow:	1.43 *mgd*	**Peak I/I Rate:**	0.69 *mgd*
PF:	1.75	**Total I/I:**	367,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-12
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

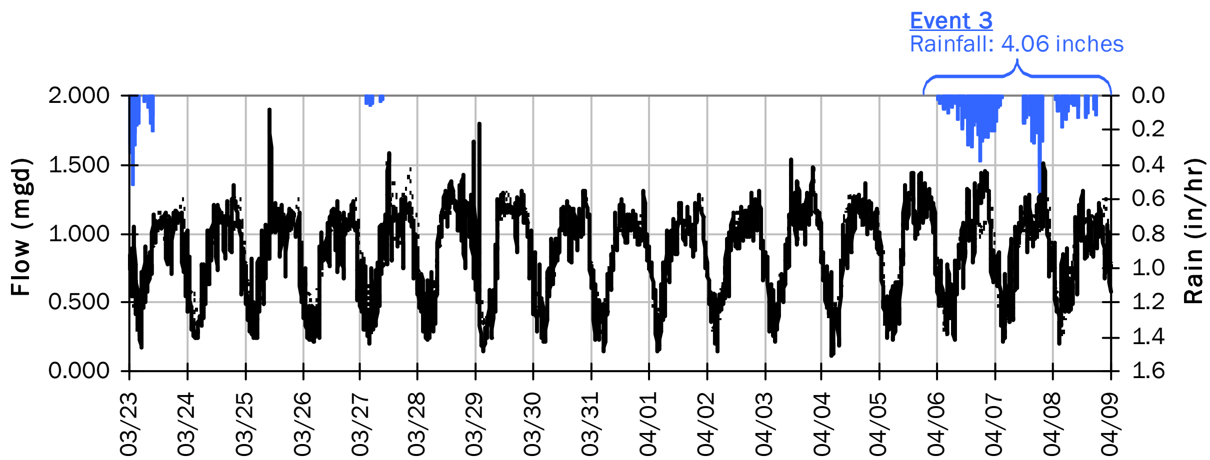


Storm Event I/I Analysis (Rain = 1.22 inches)

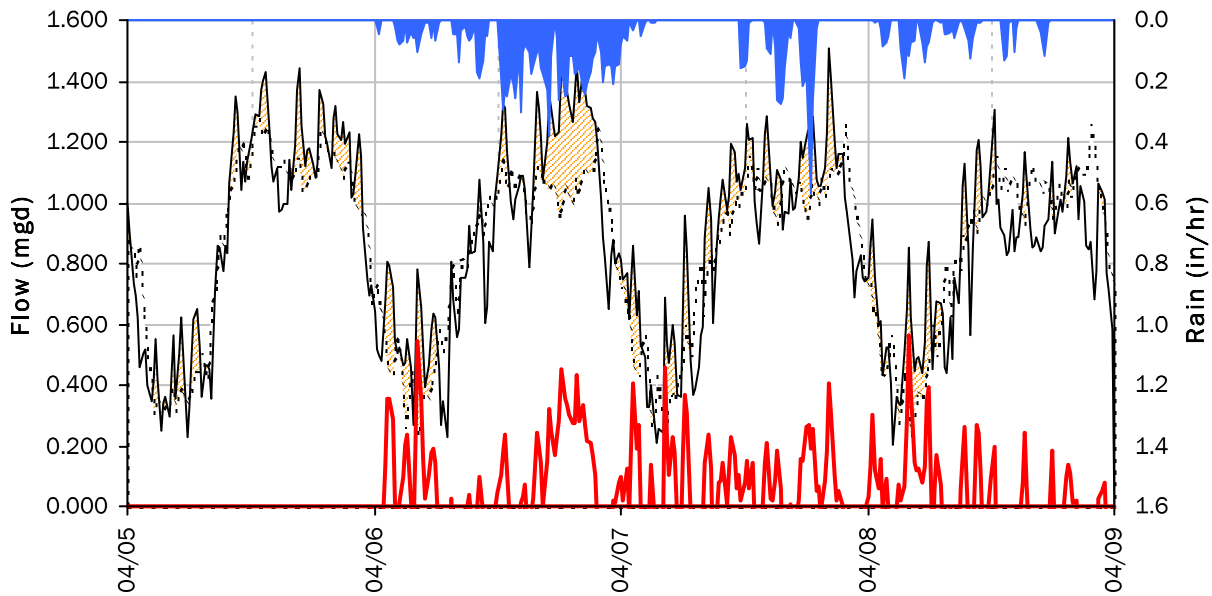
Capacity		Inflow / Infiltration	
Peak Flow:	1.16 *mgd*	**Peak I/I Rate:**	0.60 *mgd*
PF:	1.42	**Total I/I:**	52,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-12
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 4.06 inches)

Capacity			Inflow / Infiltration		
Peak Flow:	1.51	*mgd*	**Peak I/I Rate:**	0.57	*mgd*
PF:	1.85		**Total I/I:**	86,000	*gallons*
Peak Level:		*in*			
d/D Ratio:					

City of Beaumont

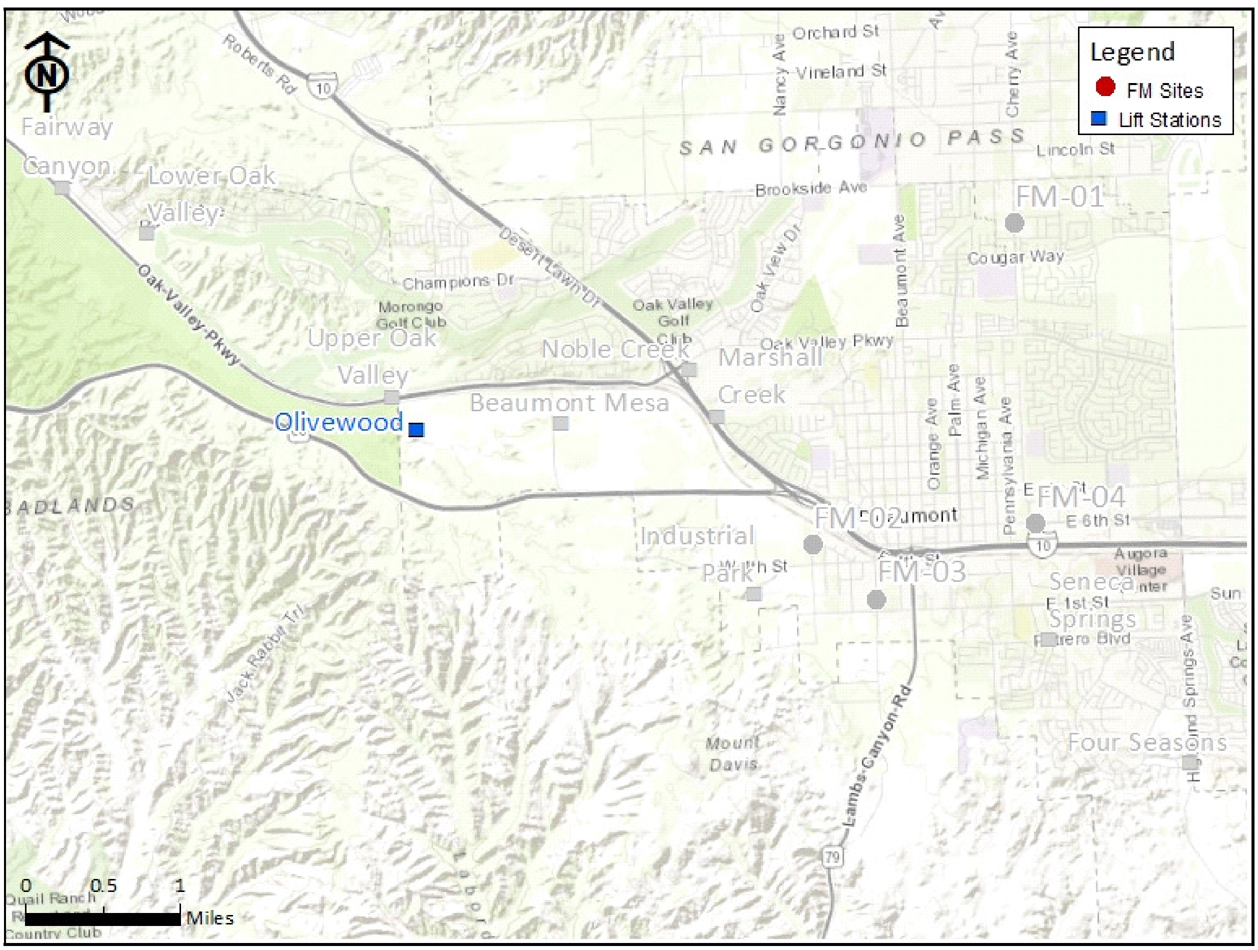
Sanitary Sewer Flow Monitoring
February 20 - April 09, 2020

Monitoring Site: FM-13

City Structure: Olivewood LS

Location: Northwest end of Olivewood Gated Community, off of Costello Way

Data Summary Report



Vicinity Map: FM-13

FM-13

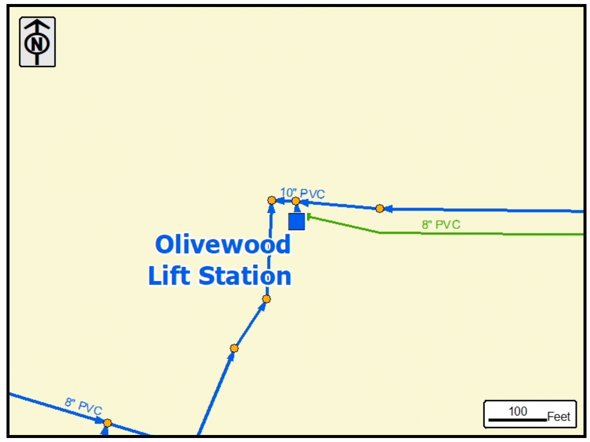
Site Information

City Structure: Olivewood LS **Coordinates:** 117.0321° W, 33.9404° N **Rim Elev:** 2319 feet

Location: Northwest end of Olivewood Gated Community, off of Costello Way

ADWF: 0.015 mgd **Peak Measured Flow:** 0.070 mgd

Satellite Map



Sanitary Map

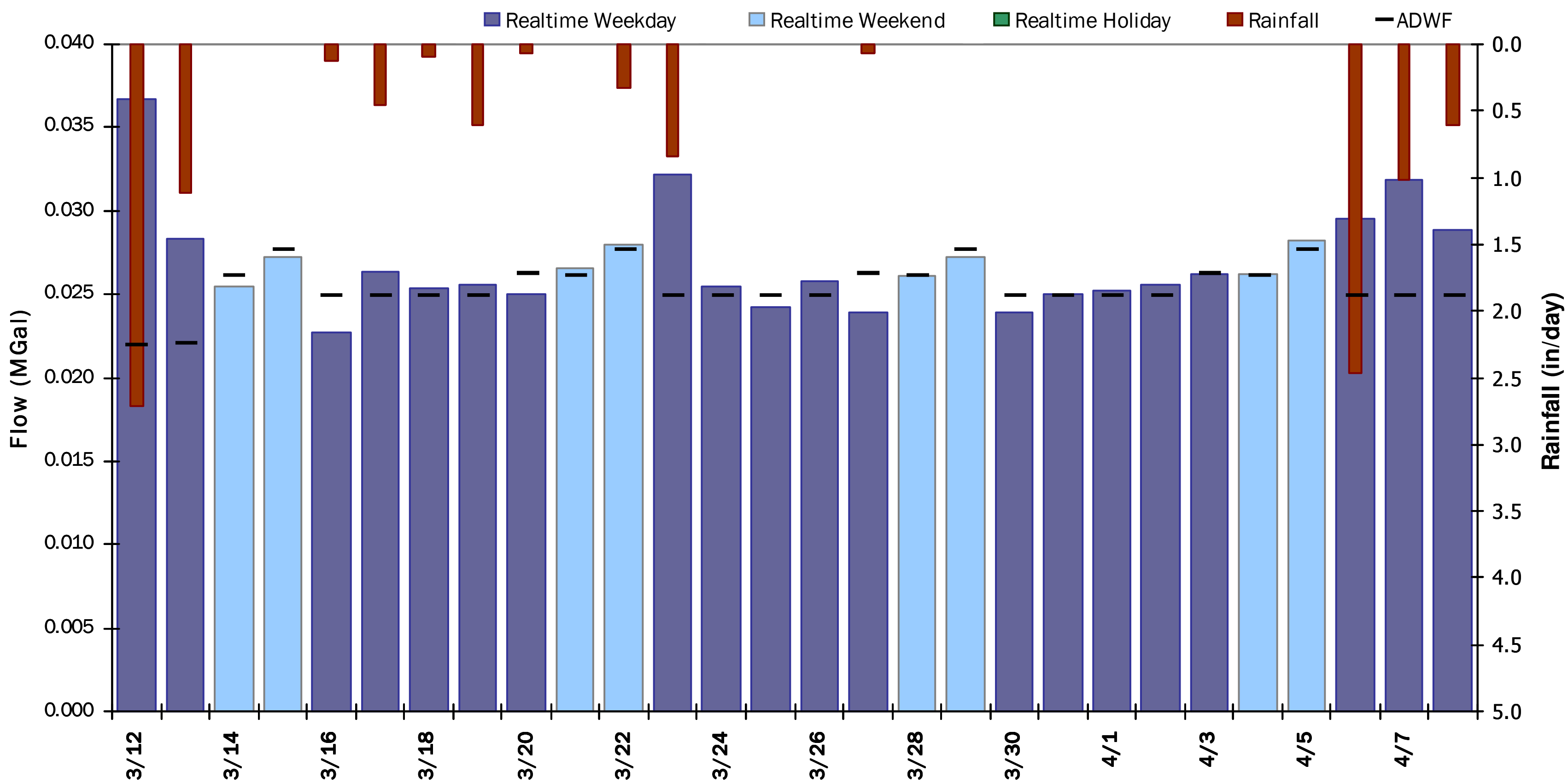
Street View

FM-13

Period Flow Summary: Daily Flow Totals

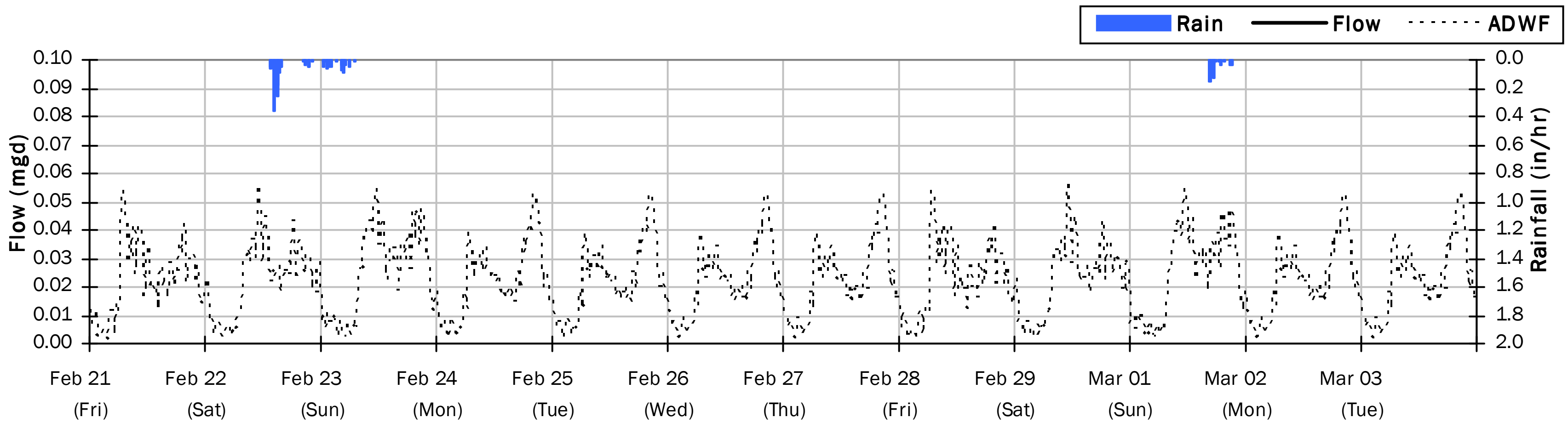
Avg Period Flow: 0.027 MGal **Peak Daily Flow: 0.037 MGal** **Min Daily Flow: 0.023 MGal**

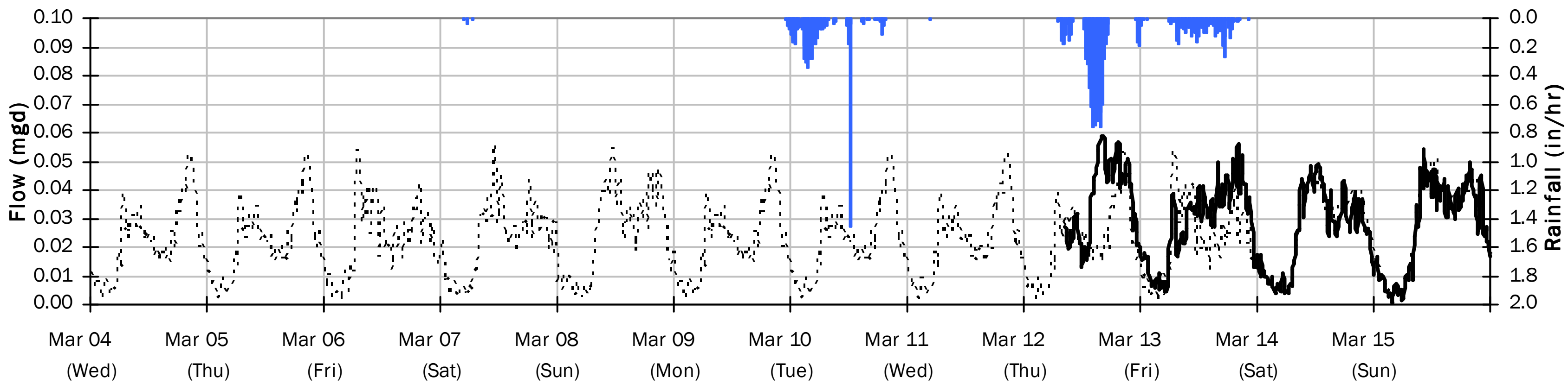
Total Period Rainfall: 10.42 inches



FM-13
Flow Summary: 2/21/2020 to 3/15/2020

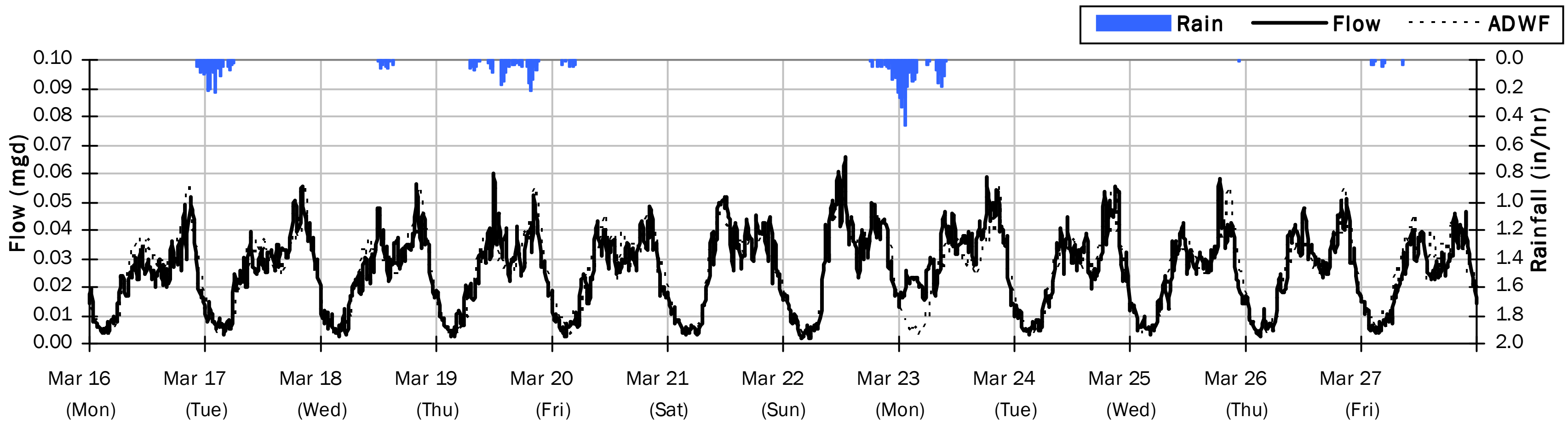
Total Period Rainfall: 6.25 inches **Avg Flow: 0.029 mgd** **Peak Flow: 0.058 mgd** **Min Flow: 0.001 mgd**

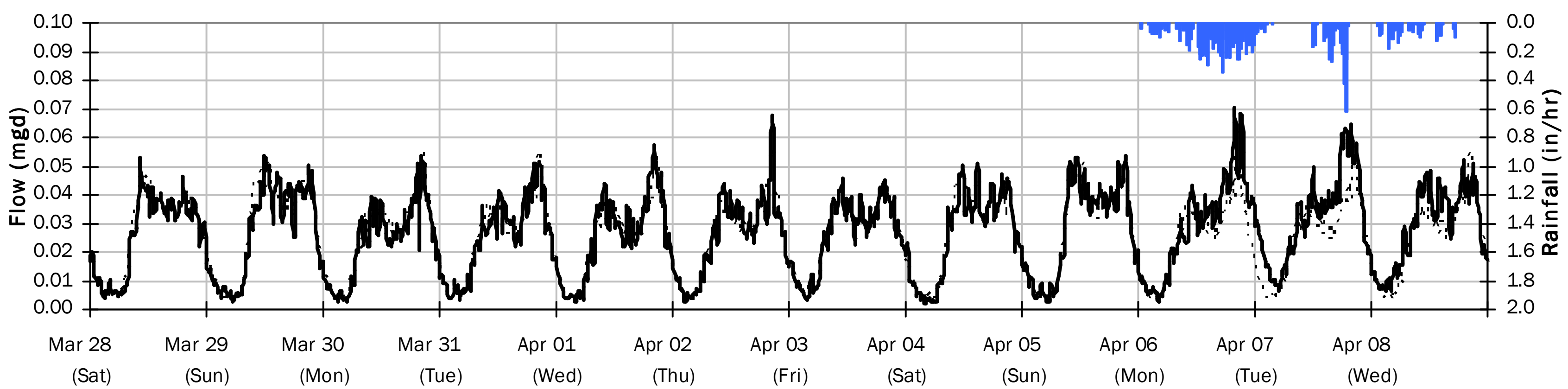




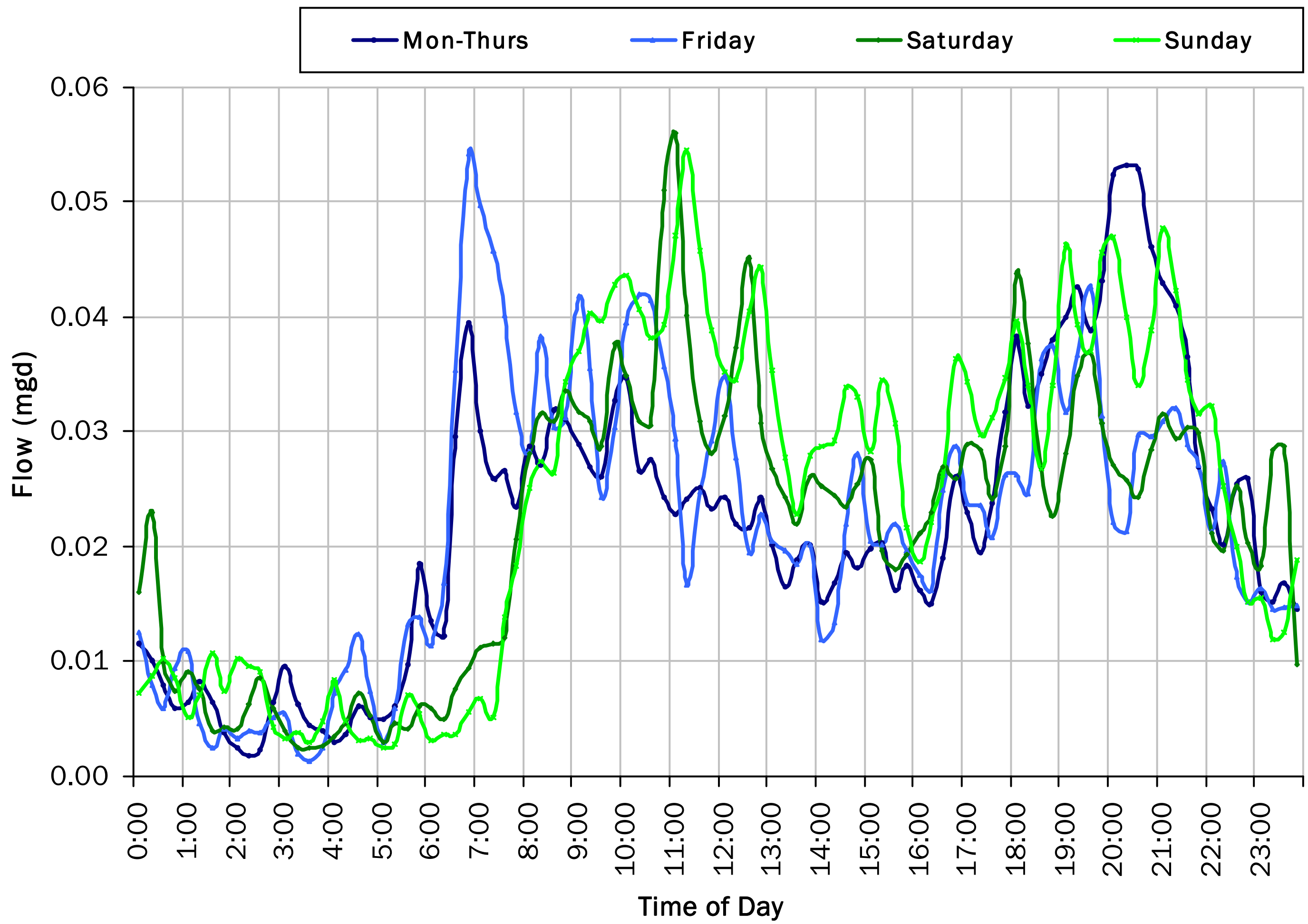
FM-13
Flow Summary: 3/16/2020 to 4/8/2020

Total Period Rainfall: 6.69 inches **Avg Flow: 0.026 mgd** **Peak Flow: 0.070 mgd** **Min Flow: 0.002 mgd**



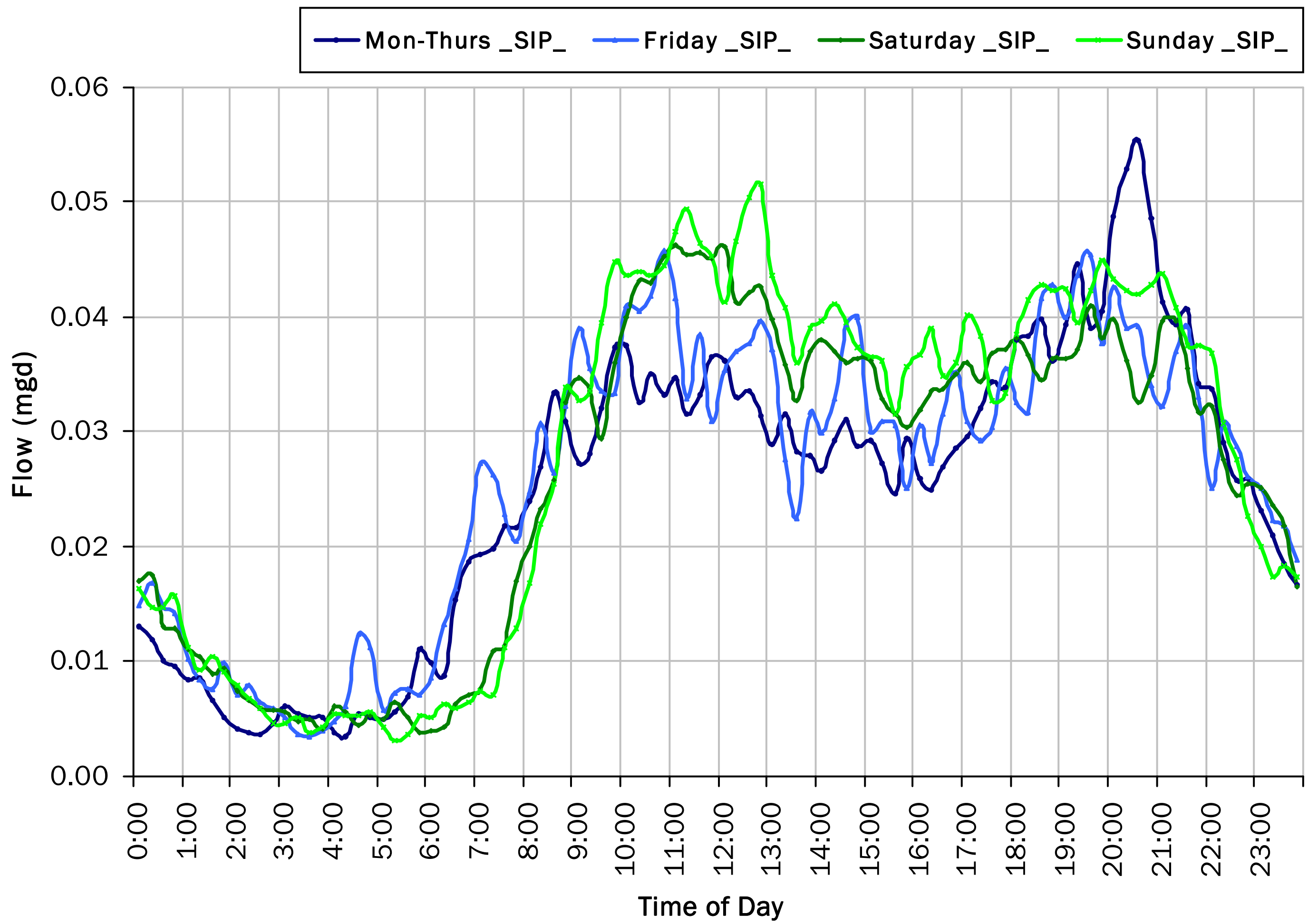


FM-13
Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)



ADWF:
0.022 mgd

FM-13
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)

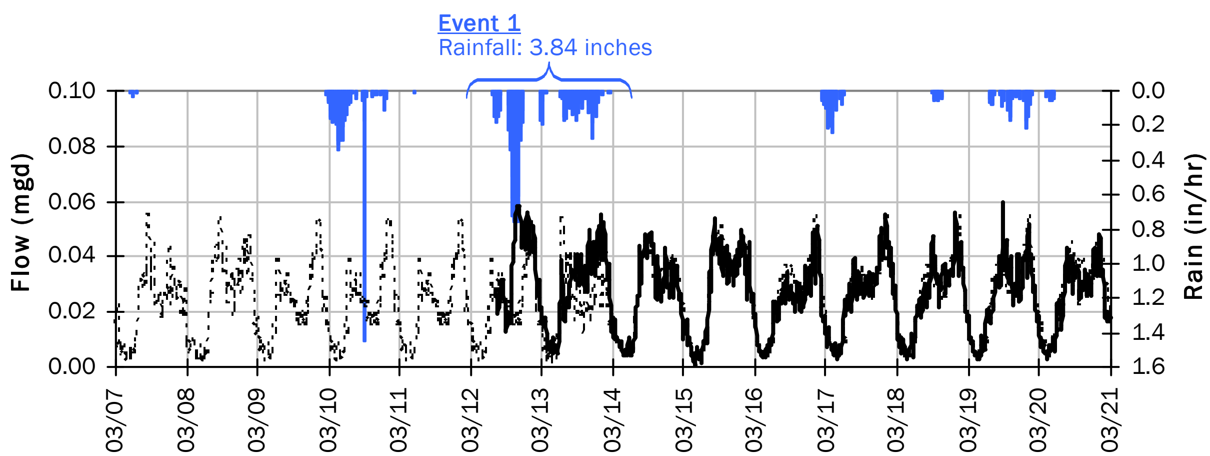


ADWF:
0.026 mgd

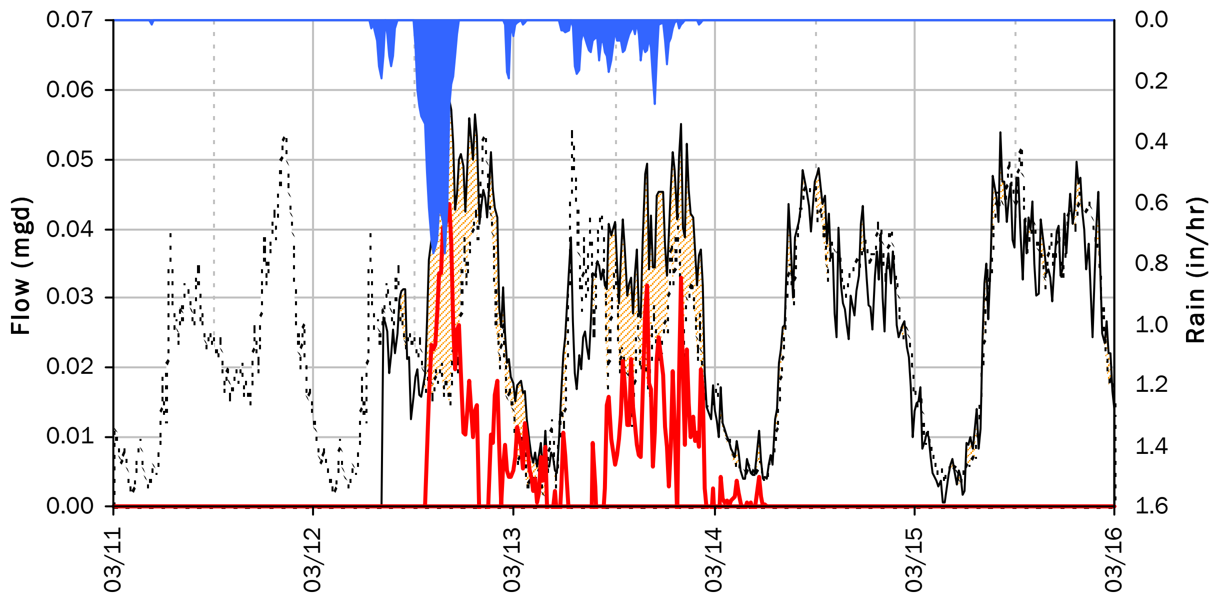
FM-13

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

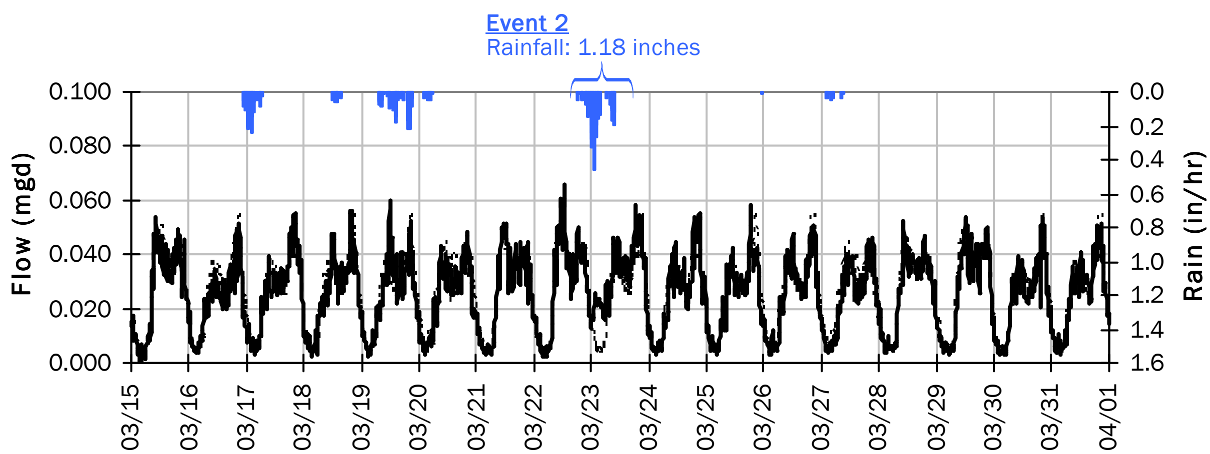


Storm Event I/I Analysis (Rain = 3.84 inches)

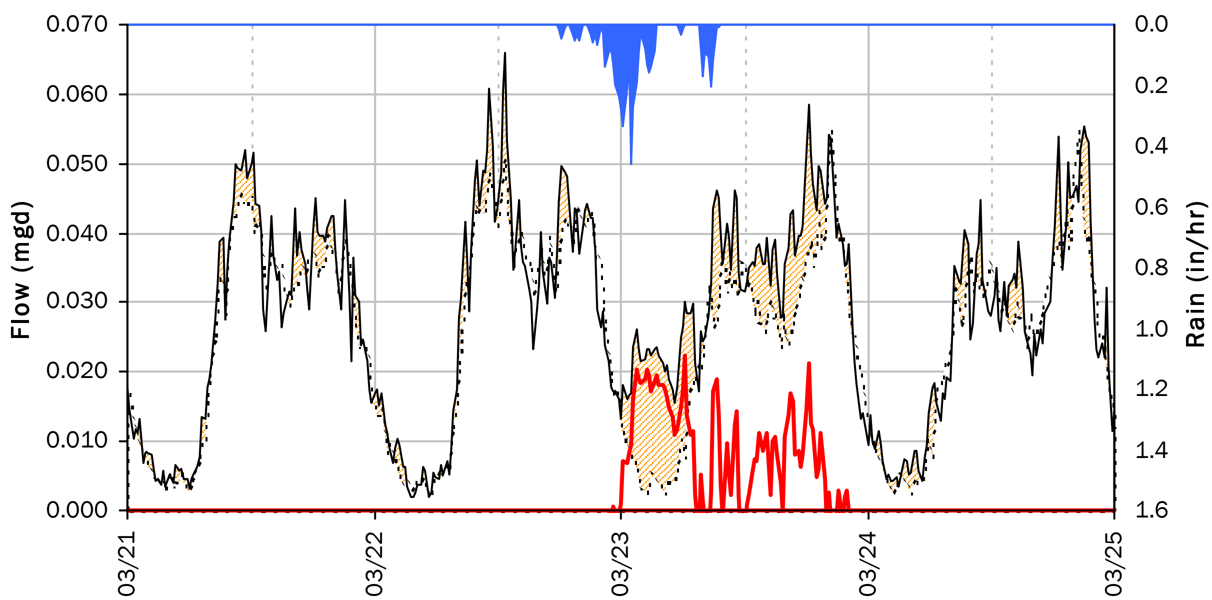
Capacity		Inflow / Infiltration	
Peak Flow:	0.06 *mgd*	**Peak I/I Rate:**	0.04 *mgd*
PF:	2.43	**Total I/I:**	13,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-13
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph



Storm Event I/I Analysis (Rain = 1.18 inches)

Capacity

Peak Flow: 0.06 *mgd*
PF: 2.43

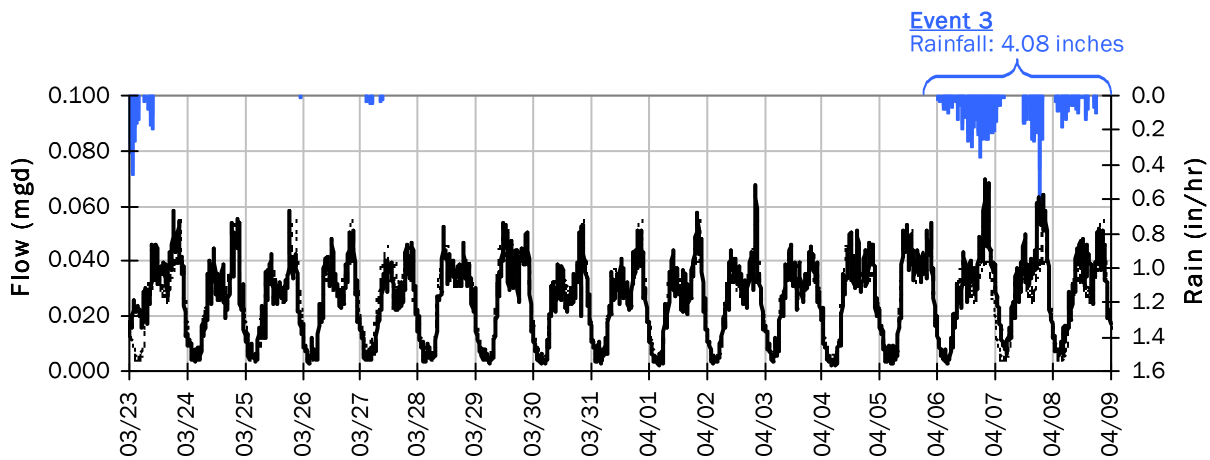
Peak Level: *in*
d/D Ratio:

Inflow / Infiltration

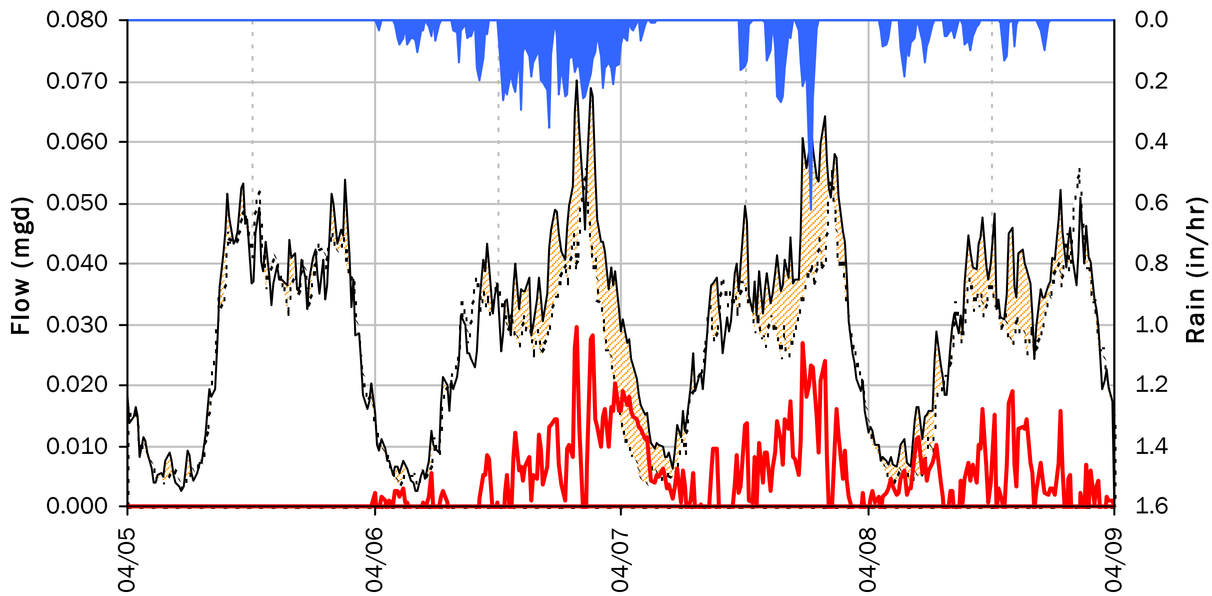
Peak I/I Rate: 0.02 *mgd*
Total I/I: 8,000 *gallons*

FM-13
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 4.08 inches)

Capacity

Peak Flow: 0.07 *mgd*

PF: 2.91

Peak Level: *in*

d/D Ratio:

Inflow / Infiltration

Peak I/I Rate: 0.03 *mgd*

Total I/I: 15,000 *gallons*

City of Beaumont

Sanitary Sewer Flow Monitoring

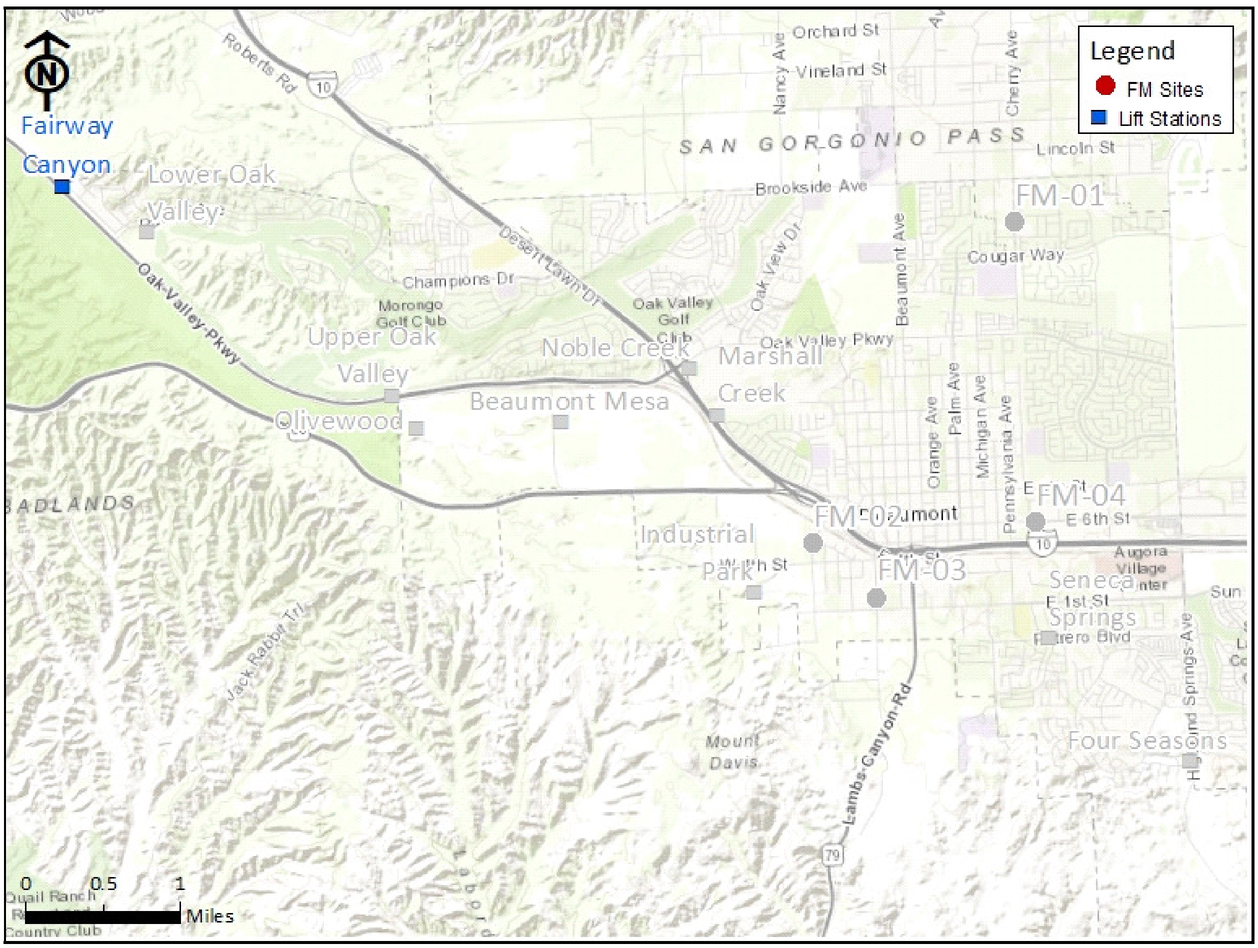
February 20 - April 09, 2020

Monitoring Site: FM-14

City Structure: Fairway Canyon LS

Location: Northwest end of Crenshaw Street

Data Summary Report



Vicinity Map: FM-14

FM-14

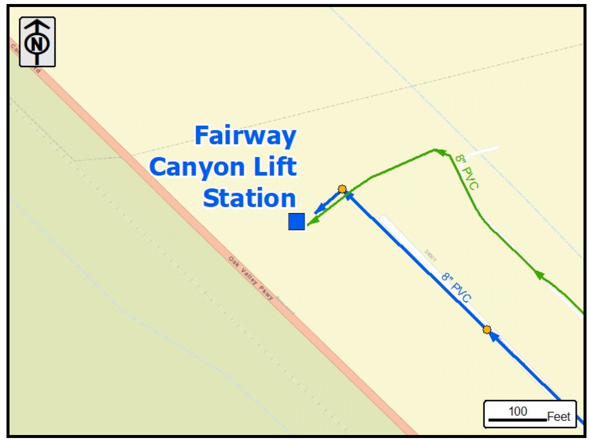
Site Information

City Structure: Fairway Canyon LS **Coordinates:** 117.0707° W, 33.9642° N **Rim Elev:** 2095 feet

Location: Northwest end of Crenshaw Street

ADWF: 0.063 mgd **Peak Measured Flow:** 0.123 mgd

Satellite Map



Sanitary Map

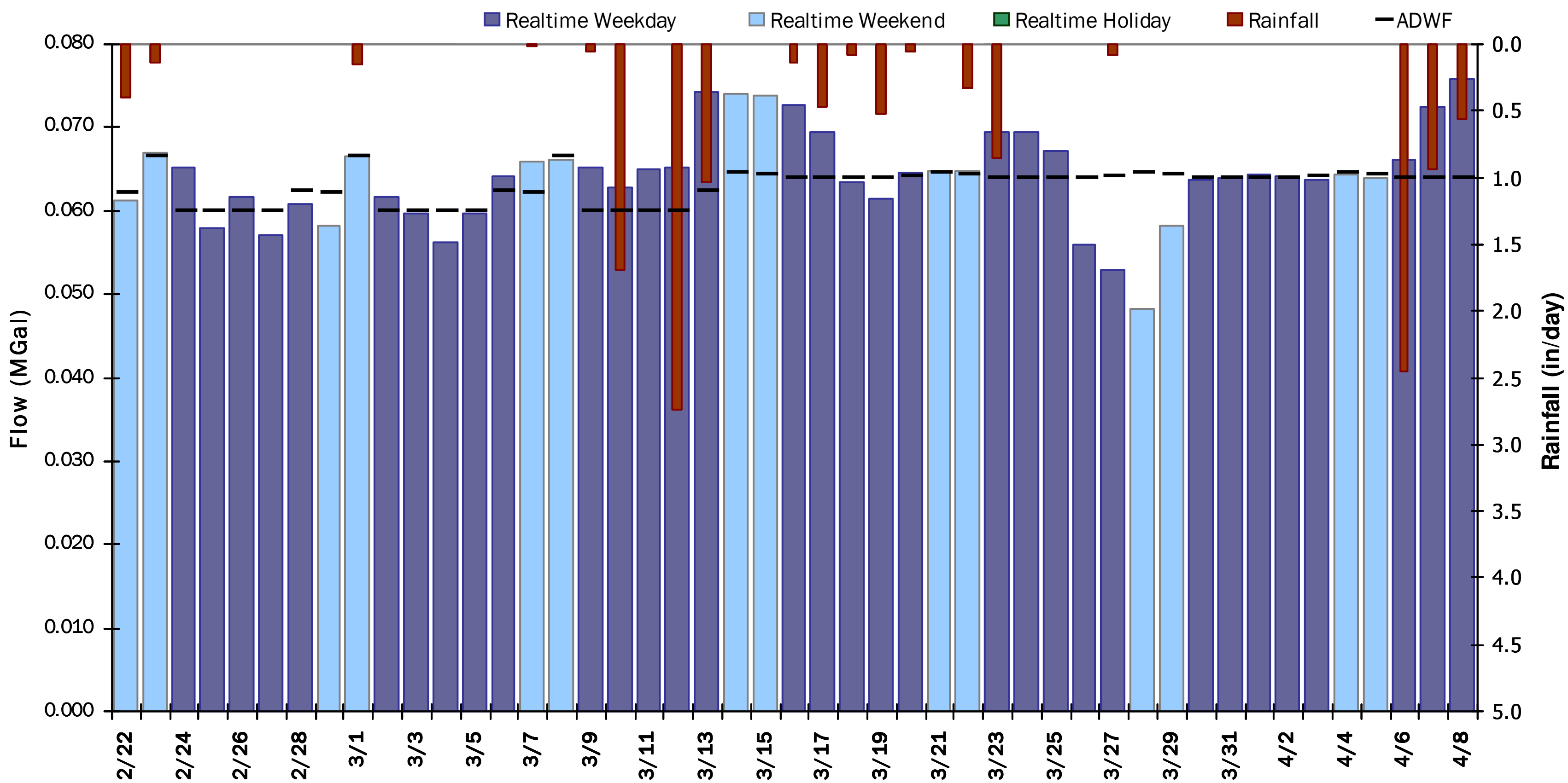

Street View

FM-14

Period Flow Summary: Daily Flow Totals

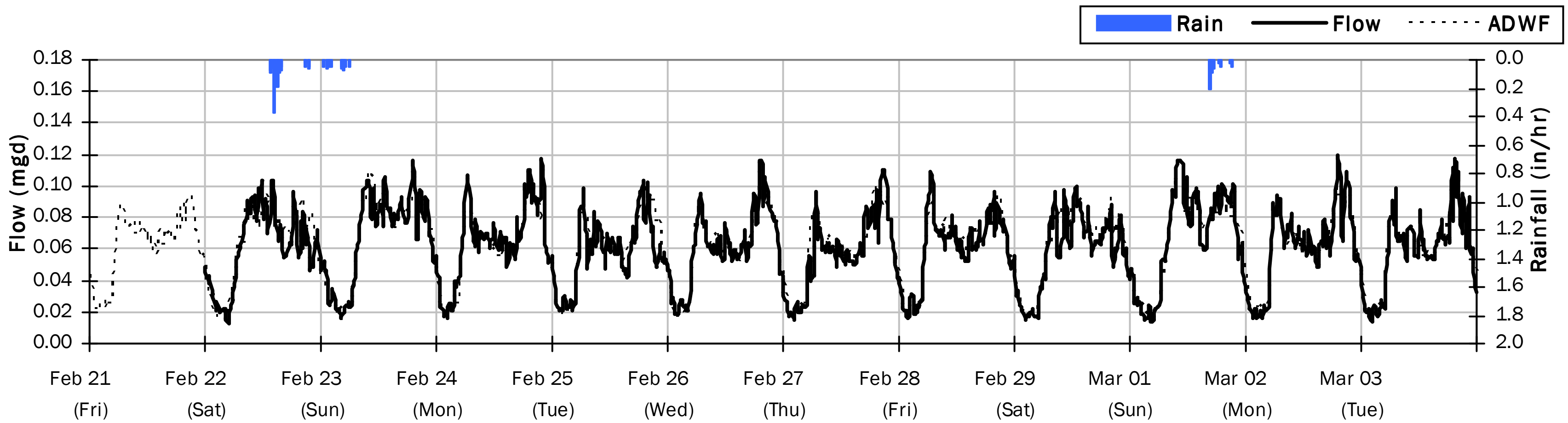
Avg Period Flow: 0.064 MGal **Peak Daily Flow: 0.076 MGal** **Min Daily Flow: 0.048 MGal**

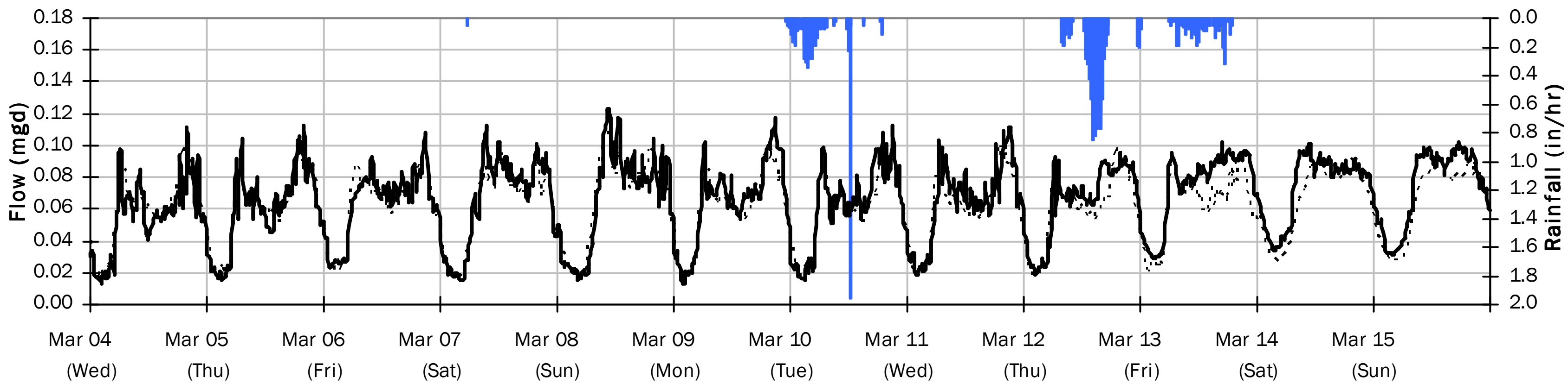
Total Period Rainfall: 12.73 inches



FM-14
Flow Summary: 2/21/2020 to 3/15/2020

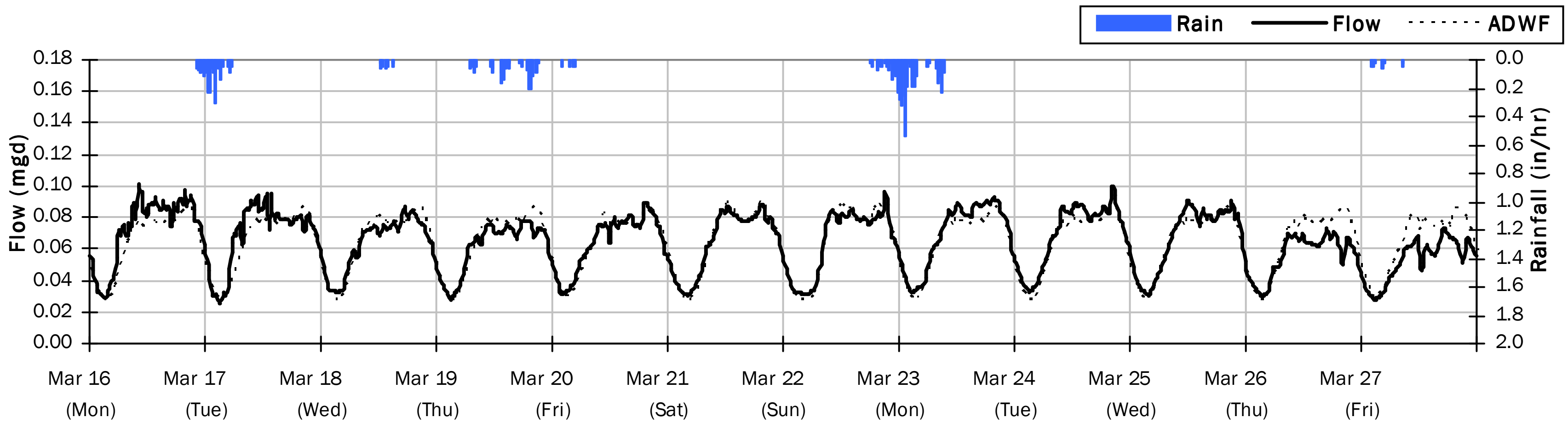
Total Period Rainfall: 6.21 inches   **Avg Flow: 0.064 mgd**   **Peak Flow: 0.123 mgd**   **Min Flow: 0.012 mgd**

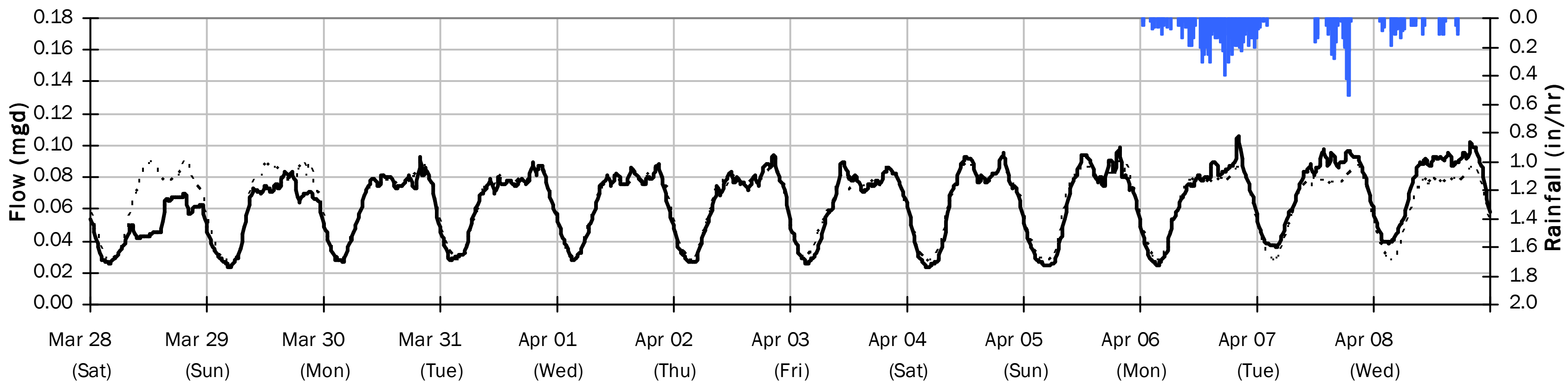




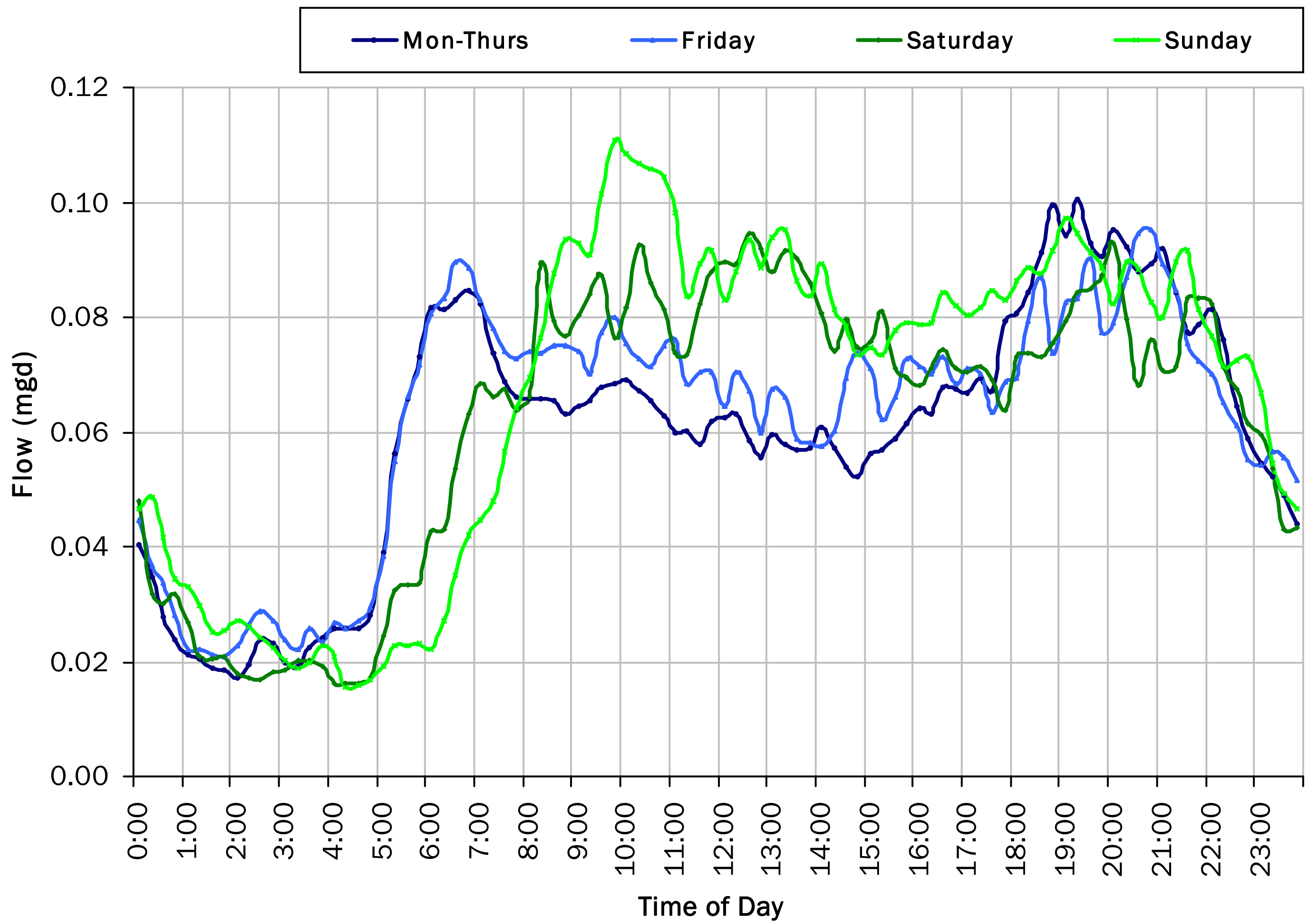
FM-14
Flow Summary: 3/16/2020 to 4/8/2020

Total Period Rainfall: 6.51 inches   **Avg Flow: 0.064 mgd**   **Peak Flow: 0.106 mgd**   **Min Flow: 0.023 mgd**



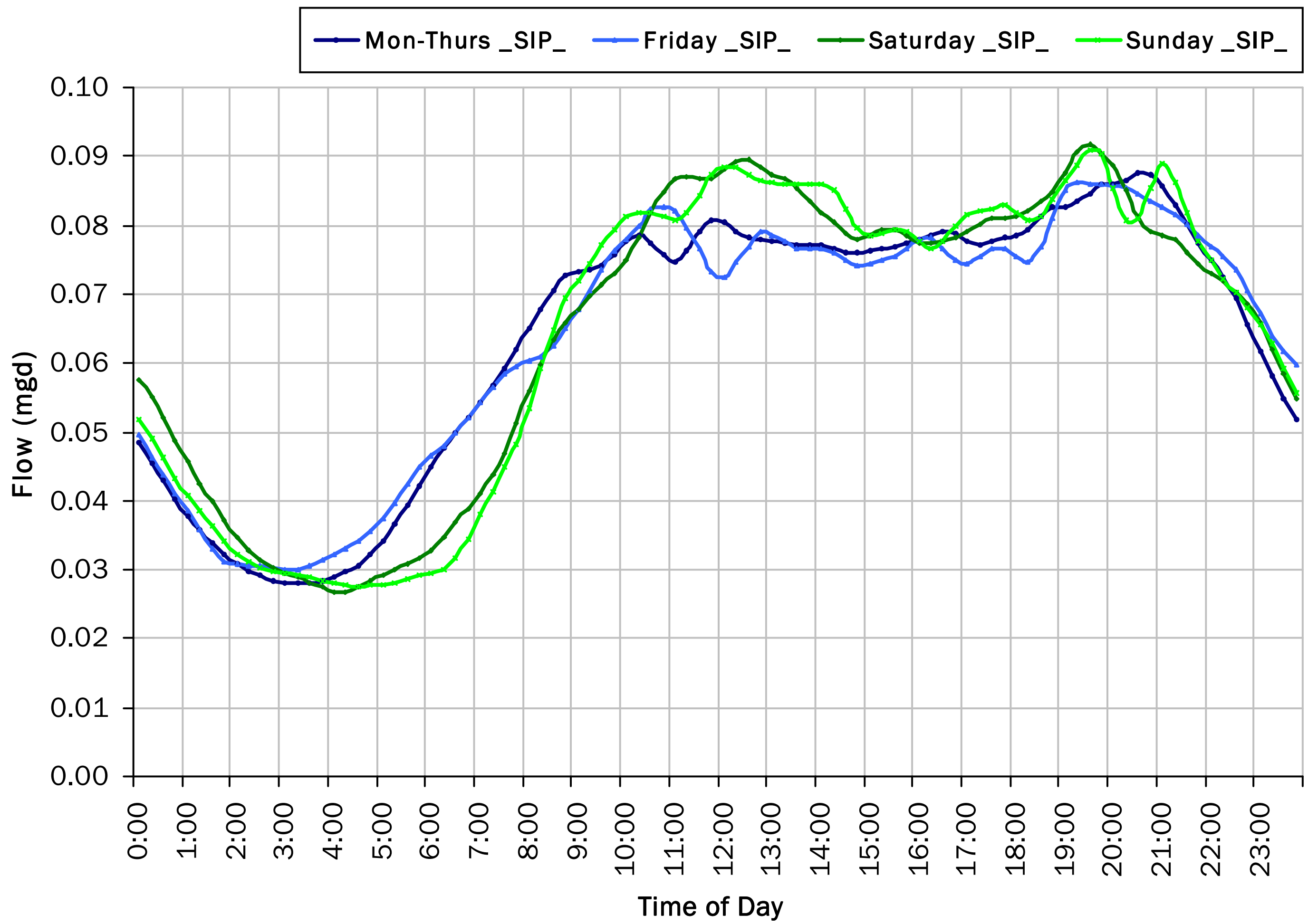


FM-14
Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)



ADWF:
0.062 mgd

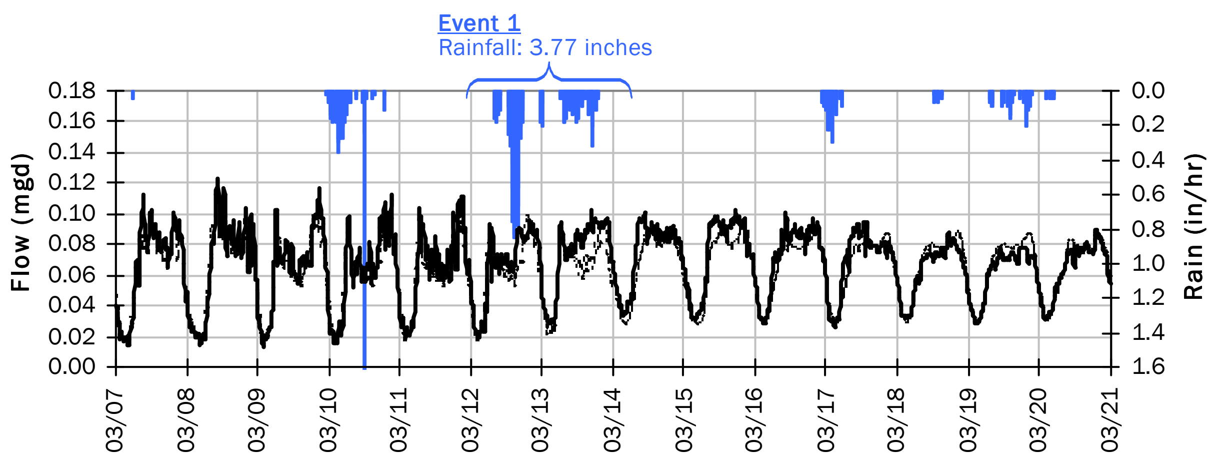
FM-14
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)



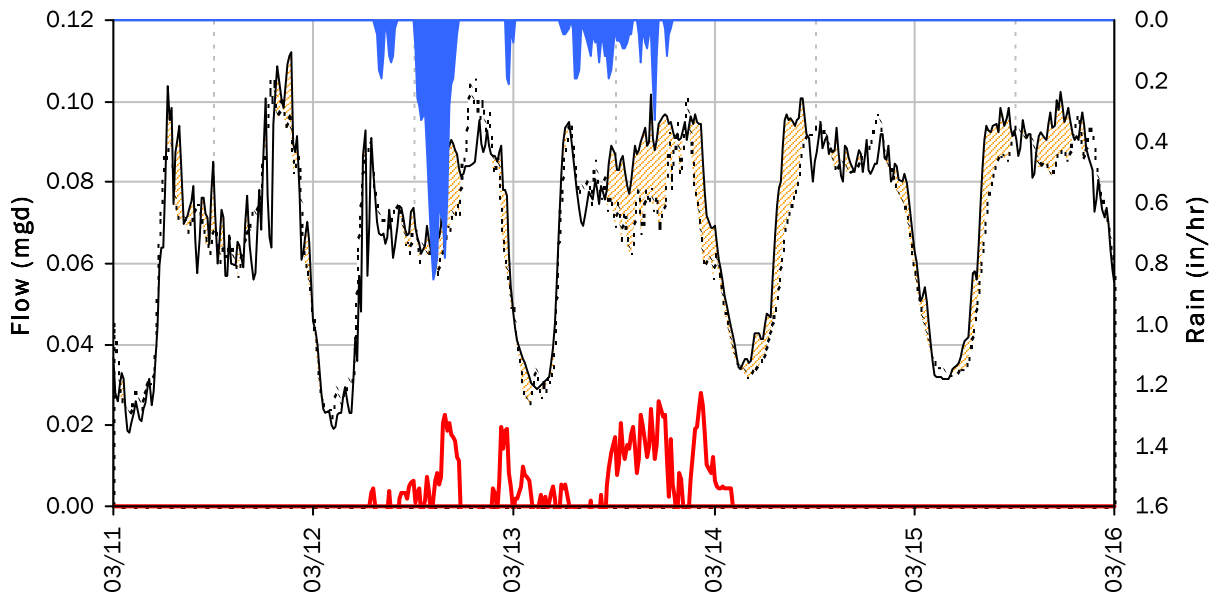
ADWF:
0.064 mgd

FM-14
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

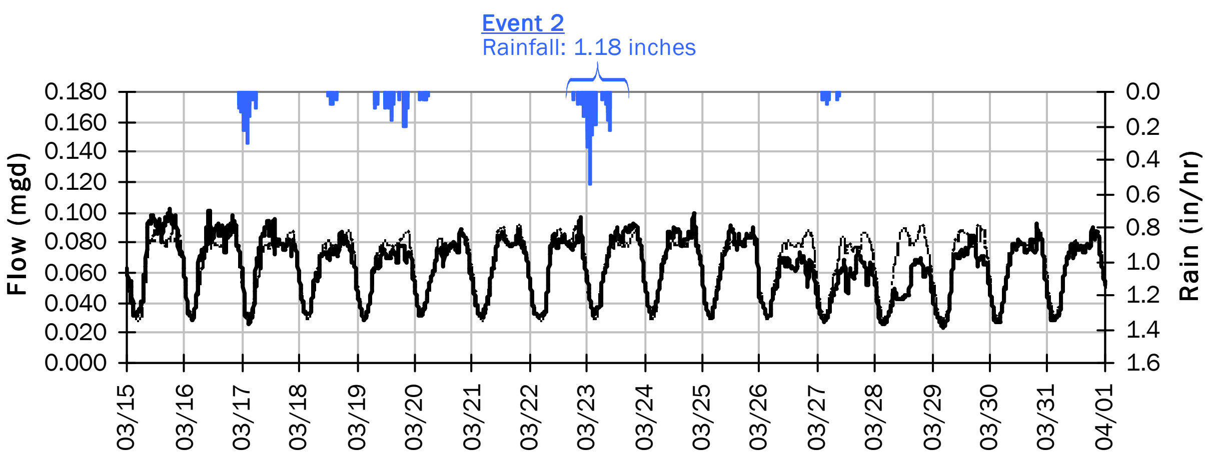


Storm Event I/I Analysis (Rain = 3.77 inches)

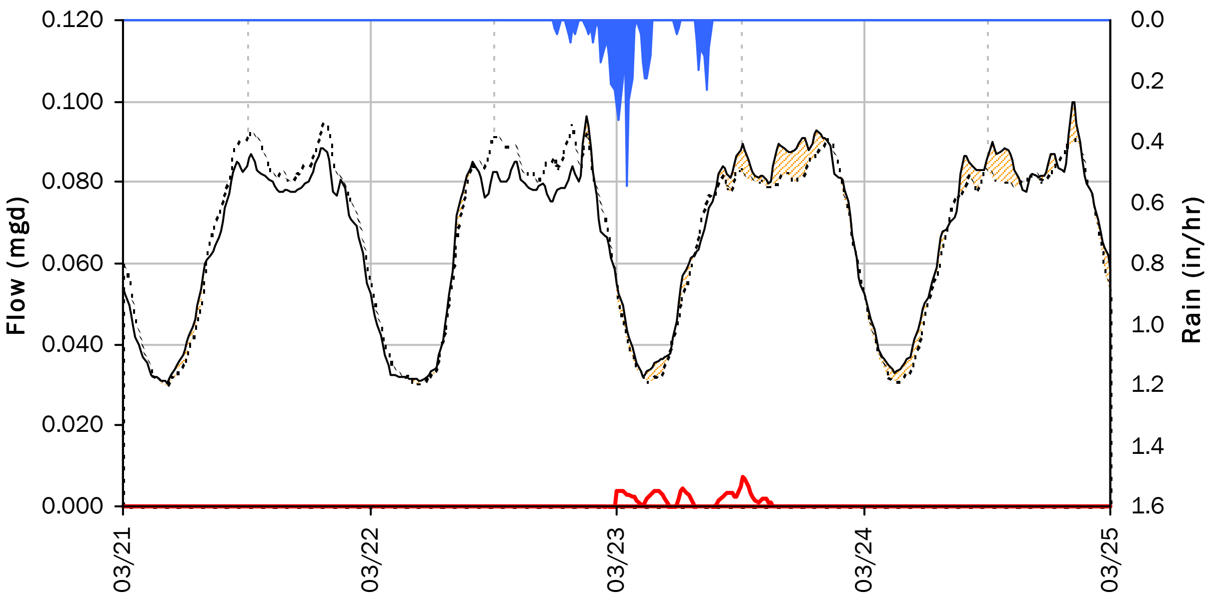
Capacity			Inflow / Infiltration		
Peak Flow:	0.10	*mgd*	**Peak I/I Rate:**	0.03	*mgd*
PF:	1.62		**Total I/I:**	9,000	*gallons*
Peak Level:		*in*			
d/D Ratio:					

FM-14
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

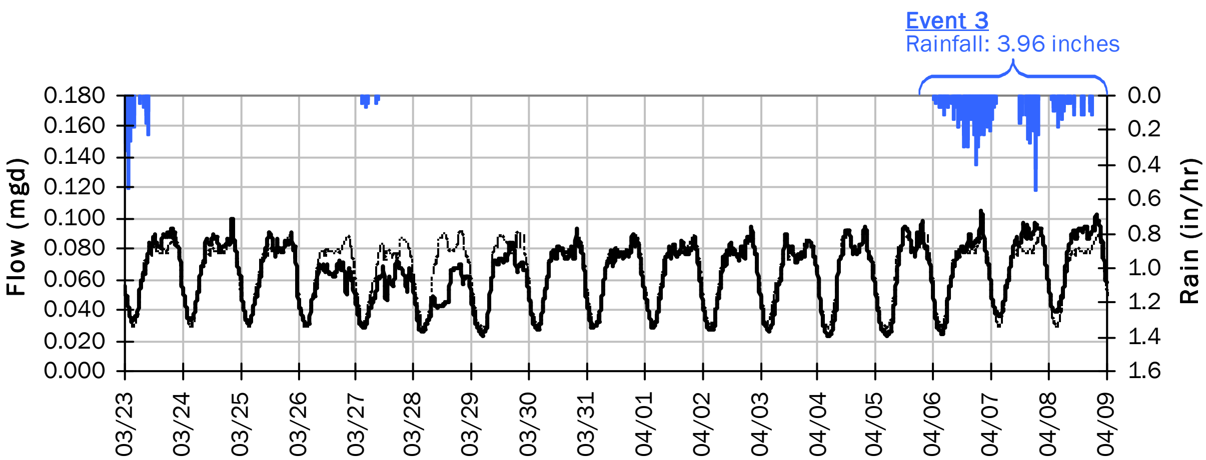


Storm Event I/I Analysis (Rain = 1.18 inches)

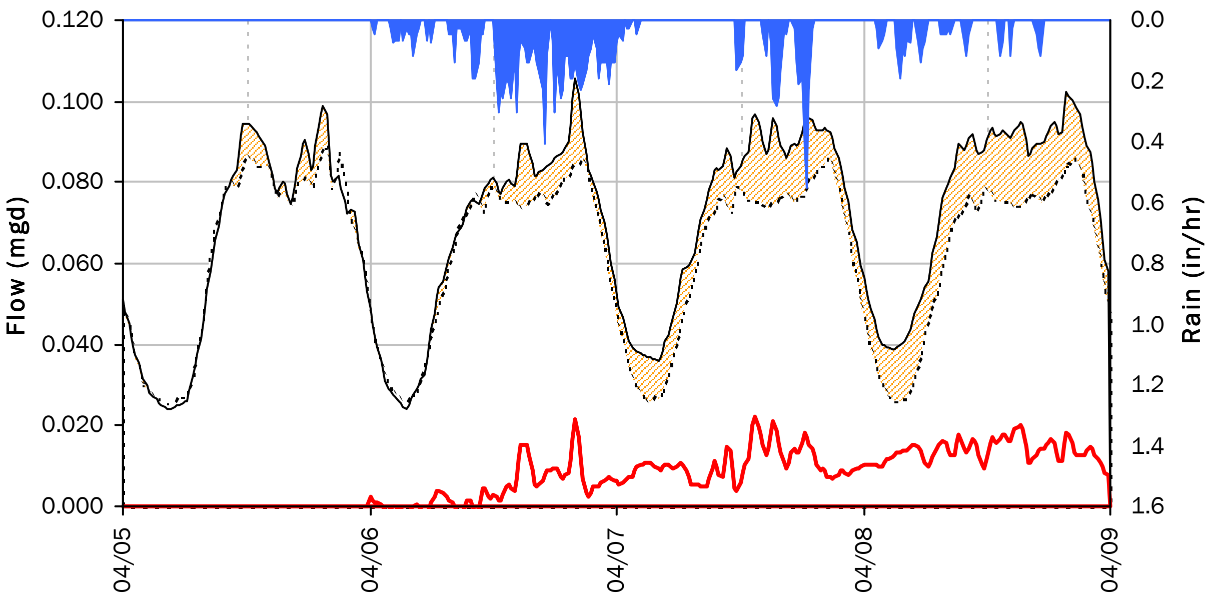
Capacity		Inflow / Infiltration	
Peak Flow:	0.09 *mgd*	**Peak I/I Rate:**	0.01 *mgd*
PF:	1.42	**Total I/I:**	1,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

FM-14
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 3.96 inches)

<u>Capacity</u>		<u>Inflow / Infiltration</u>	
Peak Flow:	0.11 *mgd*	**Peak I/I Rate:**	0.02 *mgd*
PF:	1.68	**Total I/I:**	28,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

City of Beaumont

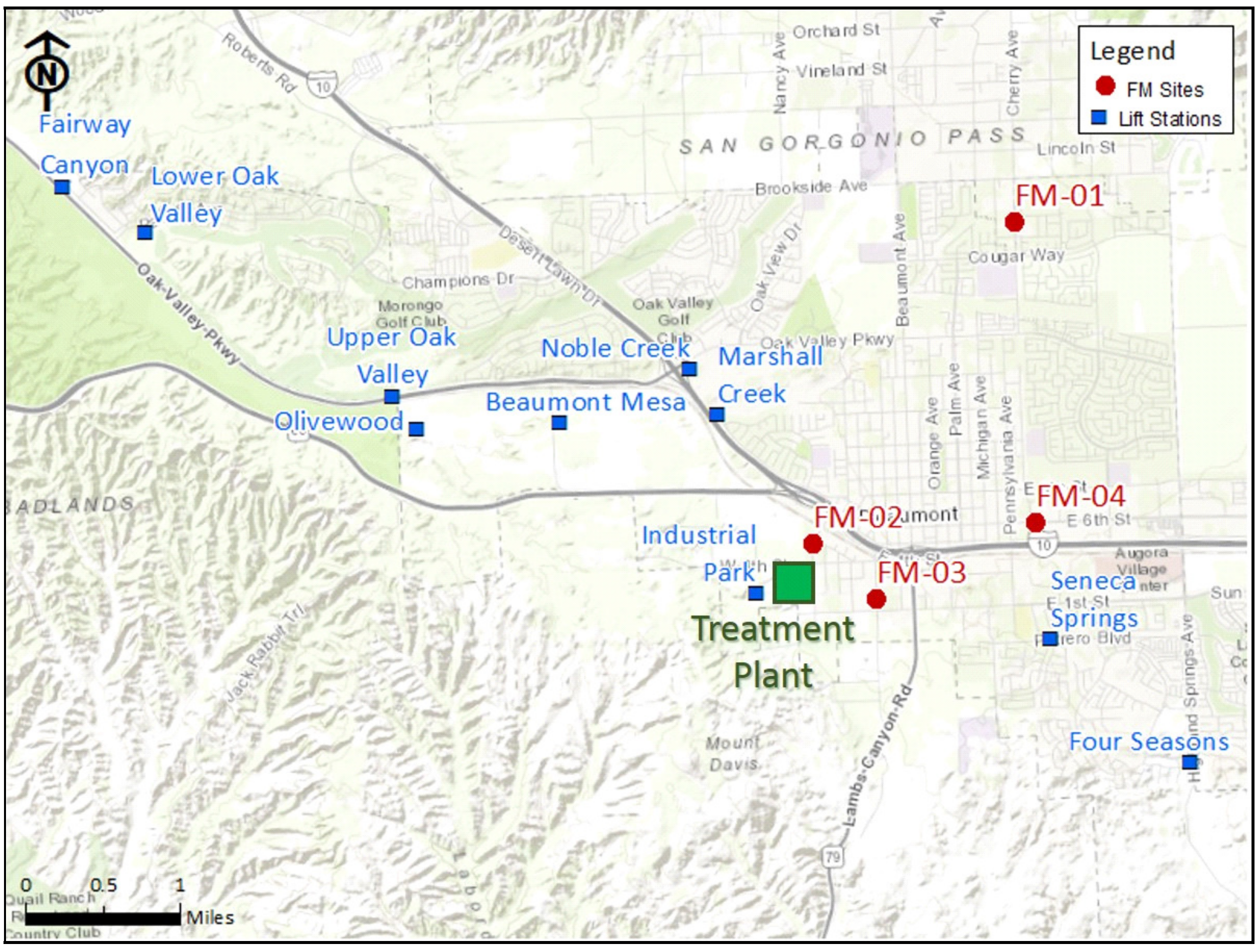
Sanitary Sewer Flow Monitoring

February 20 - April 09, 2020

Monitoring Site: WWTP

Location: Wastewater Treatment Plant

Data Summary Report



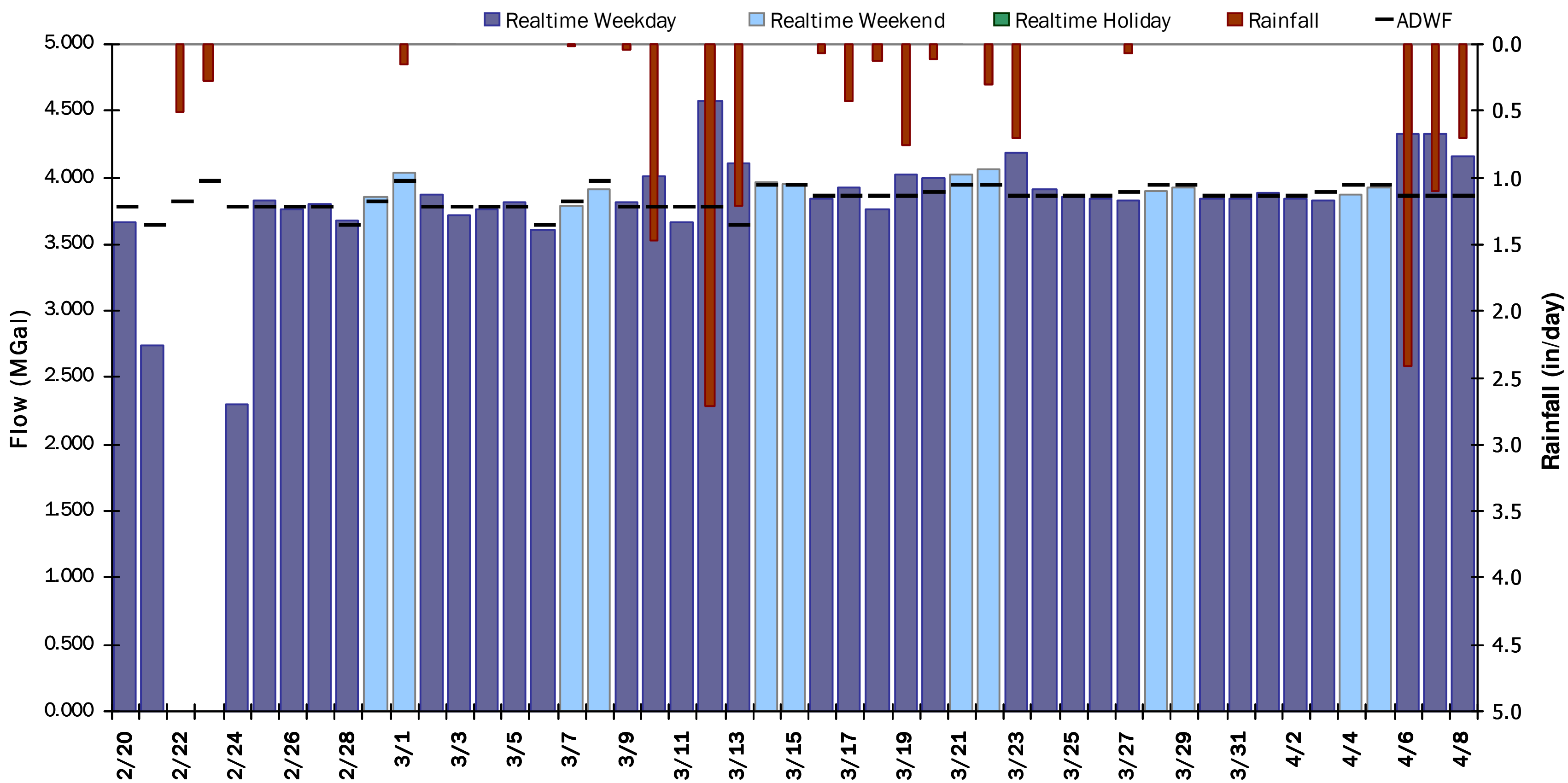
Vicinity Map: WWTP

WWTP

Period Flow Summary: Daily Flow Totals

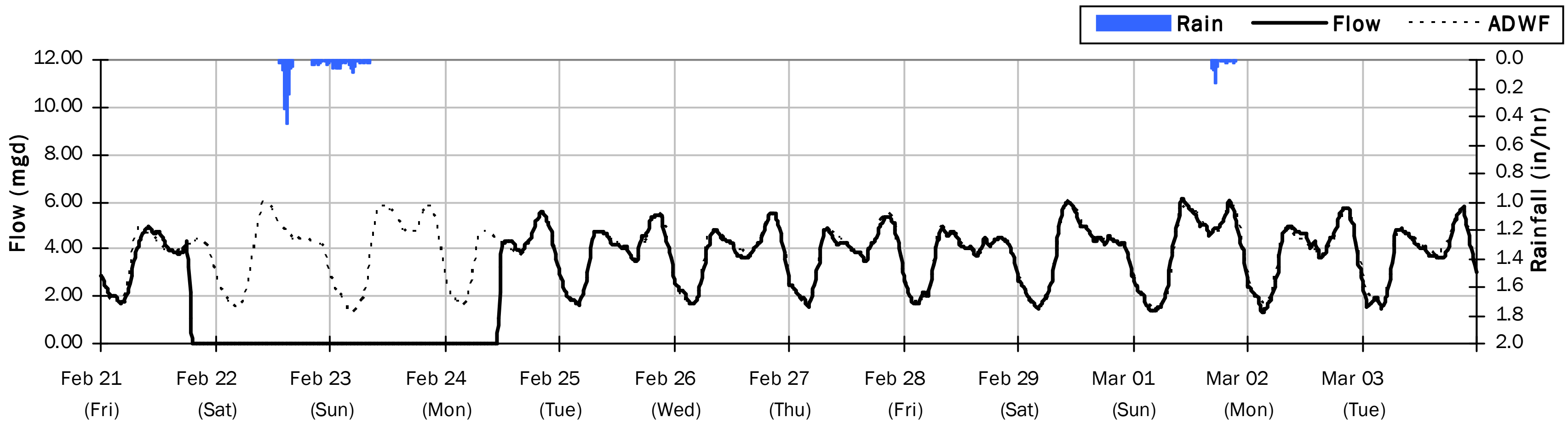
Avg Period Flow: 3.696 MGal   Peak Daily Flow: 4.570 MGal   Min Daily Flow: 0.000 MGal

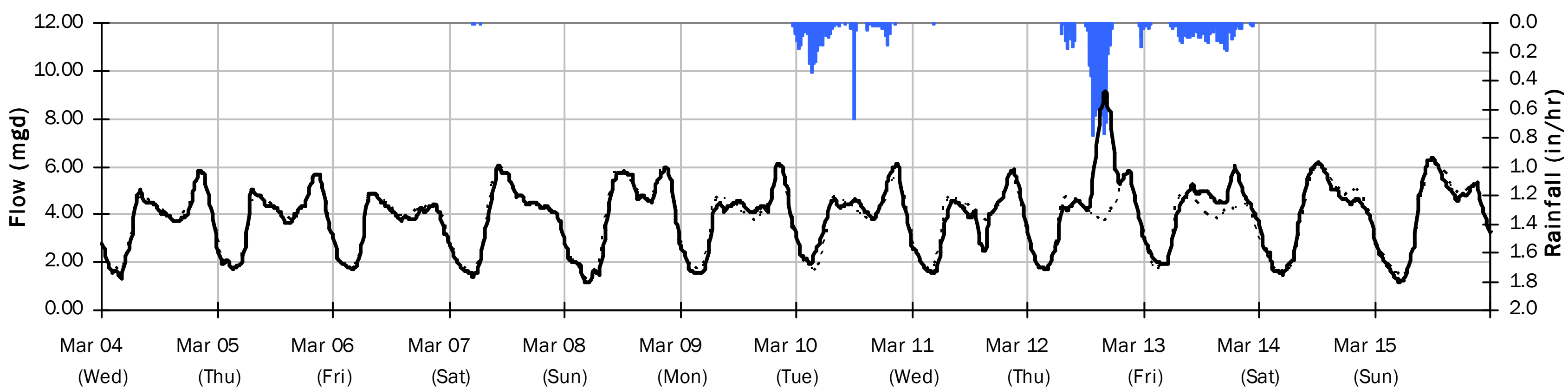
Total Period Rainfall: 13.17 inches



WWTP
Flow Summary: 2/21/2020 to 3/15/2020

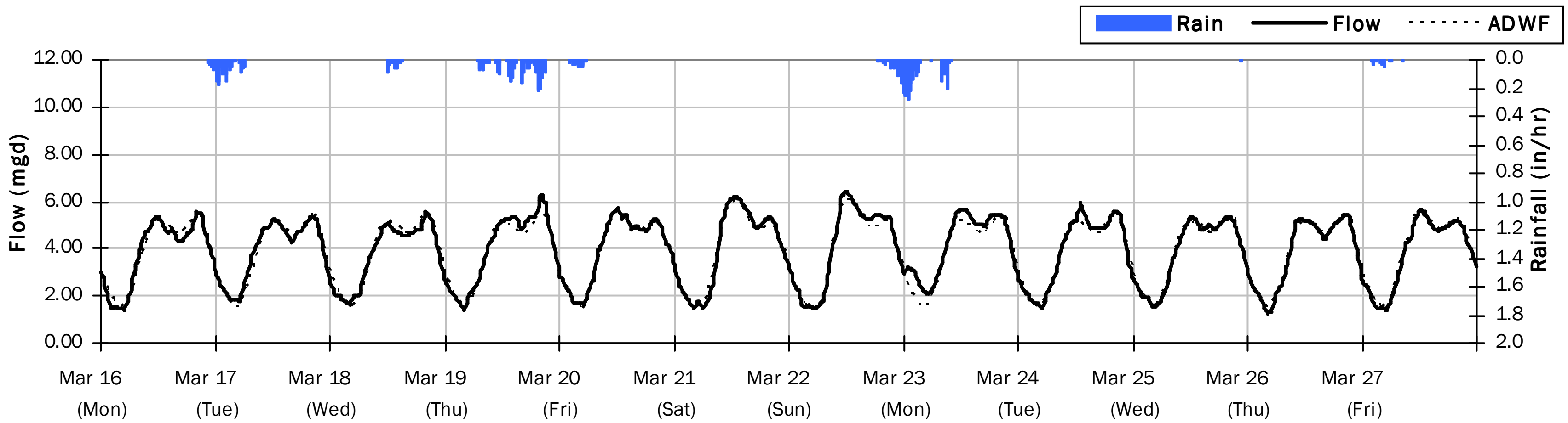
Total Period Rainfall: 6.38 inches **Avg Flow: 3.439 mgd** **Peak Flow: 9.173 mgd** **Min Flow: 0.000 mgd**

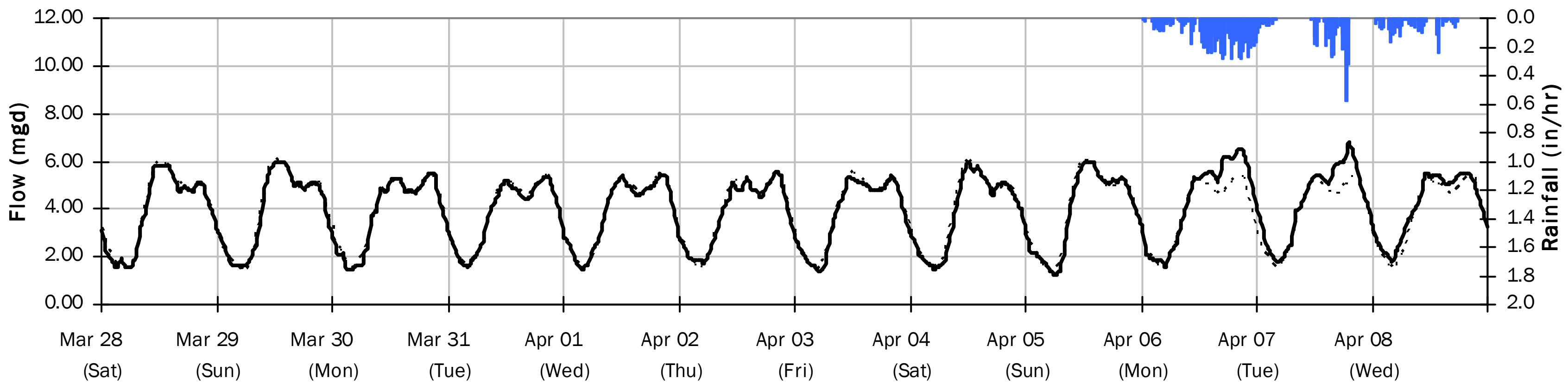




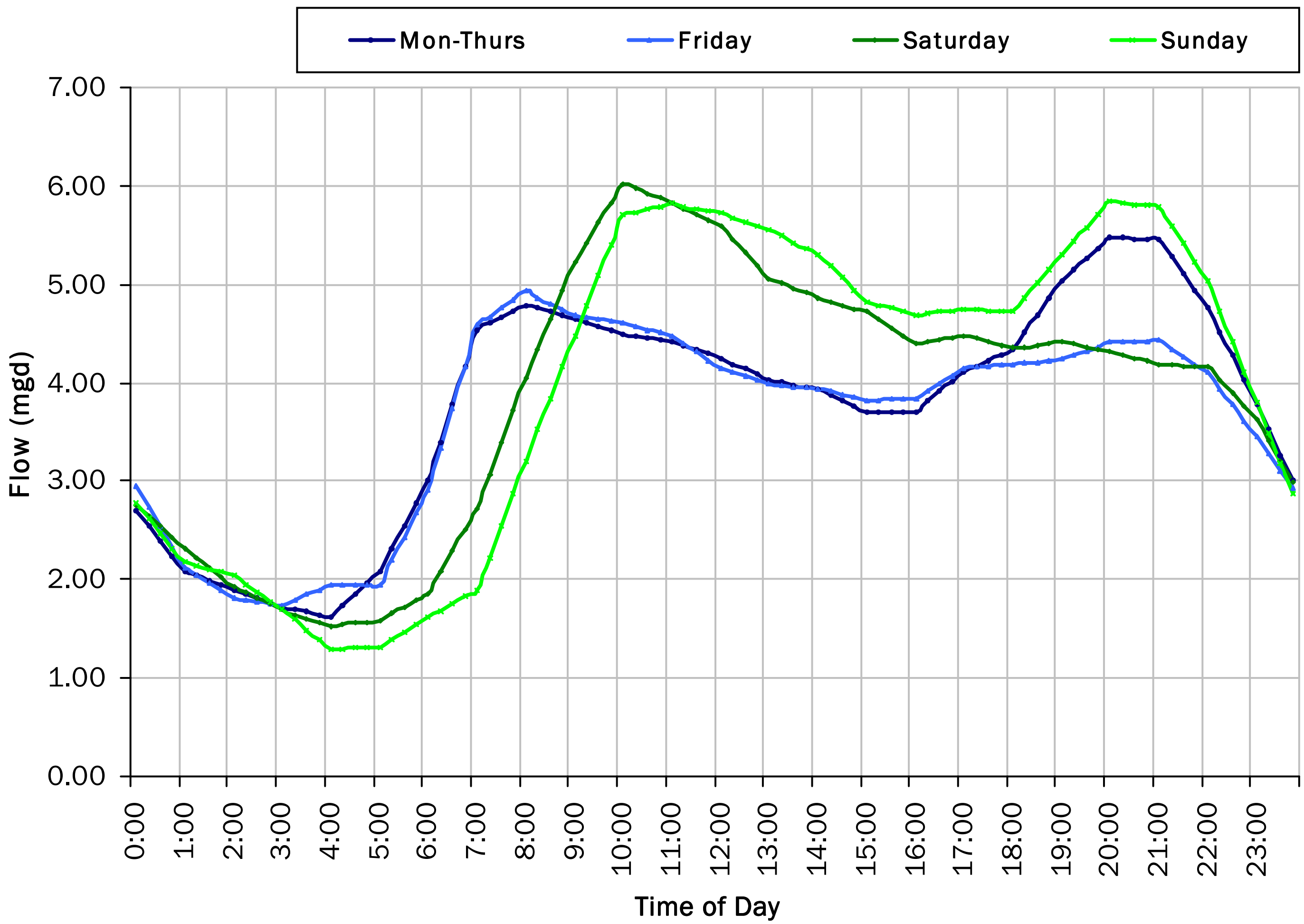
WWTP
Flow Summary: 3/16/2020 to 4/8/2020

Total Period Rainfall: 6.79 inches   **Avg Flow: 3.954 mgd**   **Peak Flow: 6.790 mgd**   **Min Flow: 1.210 mgd**



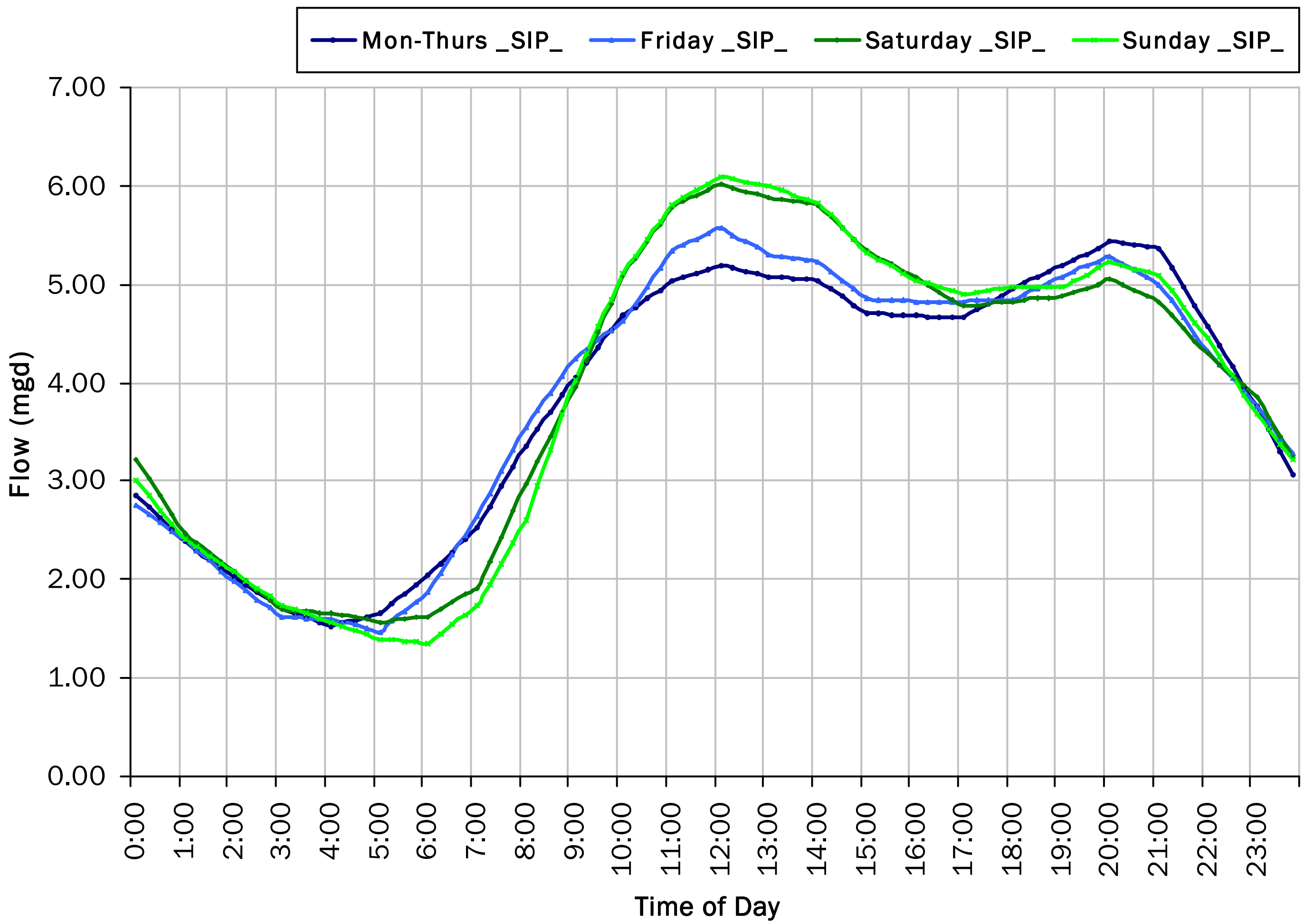


WWTP
Average Dry Weather Flow Hydrographs - Pre Shelter-In-Place (< 03/14/20)



ADWF:
0.379 mgd

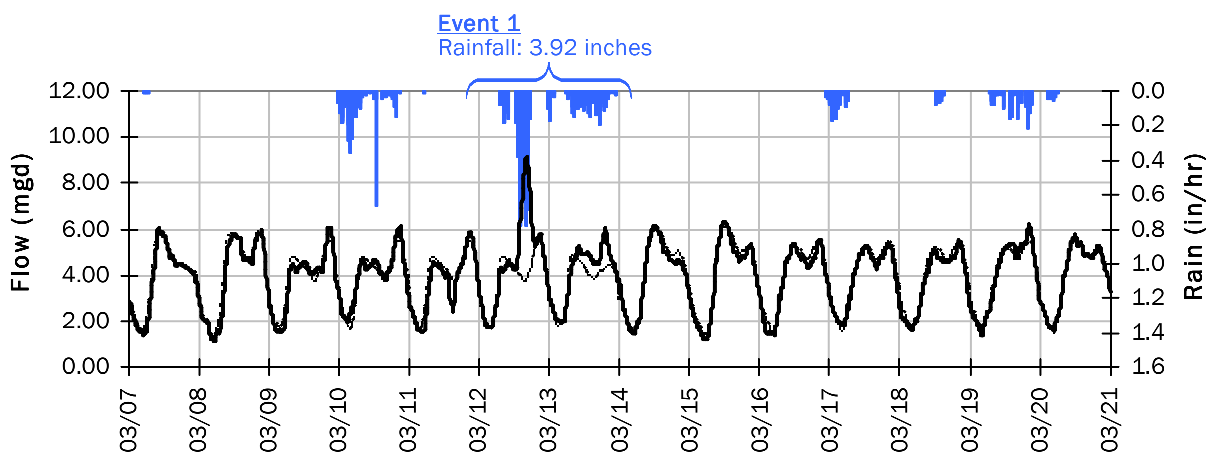
WWTP
Average Dry Weather Flow Hydrographs - Shelter In Place (> 3/16/20)



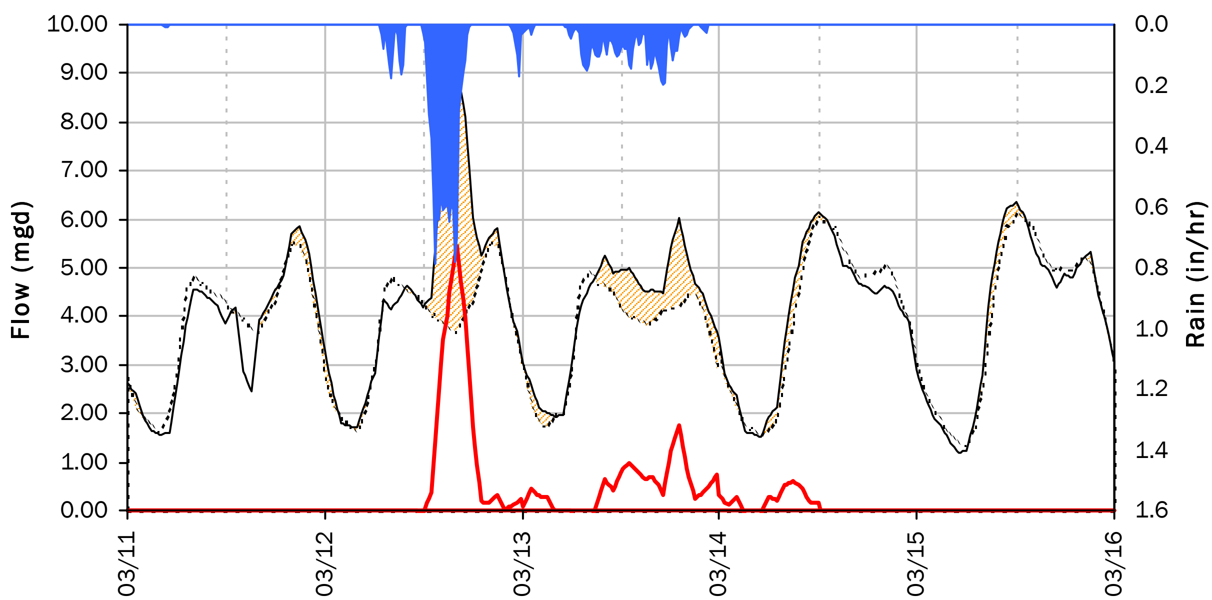
ADWF:
3.881 mgd

WWTP
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

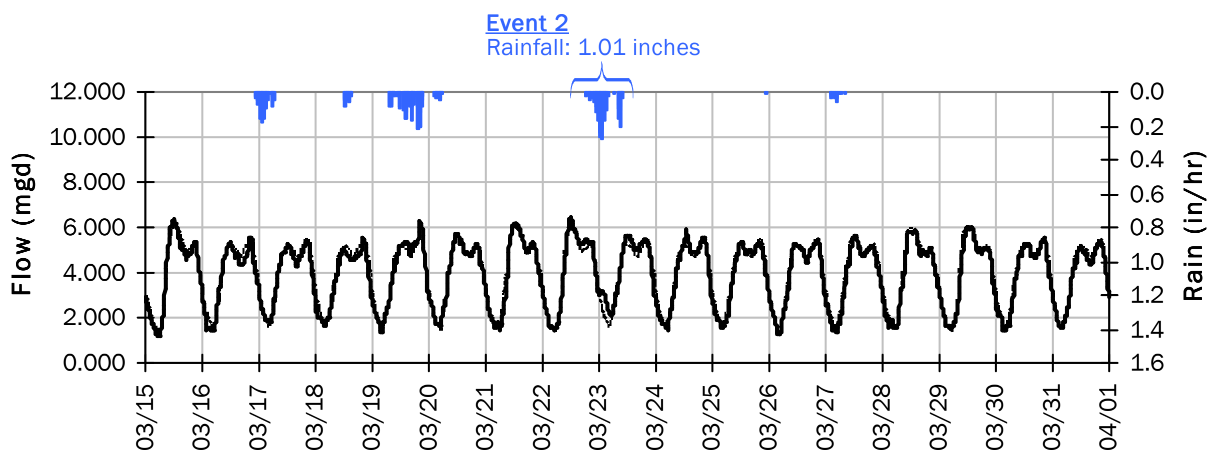


Storm Event I/I Analysis (Rain = 3.92 inches)

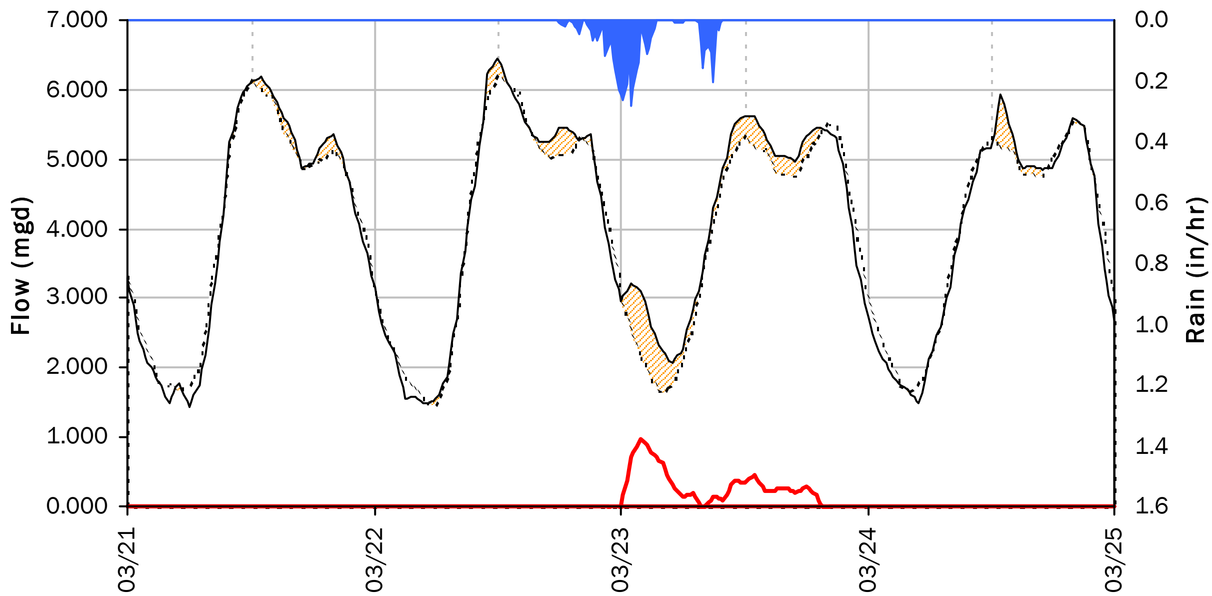
Capacity		Inflow / Infiltration	
Peak Flow:	9.17 *mgd*	**Peak I/I Rate:**	5.47 *mgd*
PF:	2.39	**Total I/I:**	1,385,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

WWTP
I/I Summary: Event 2

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 2 Detail Graph

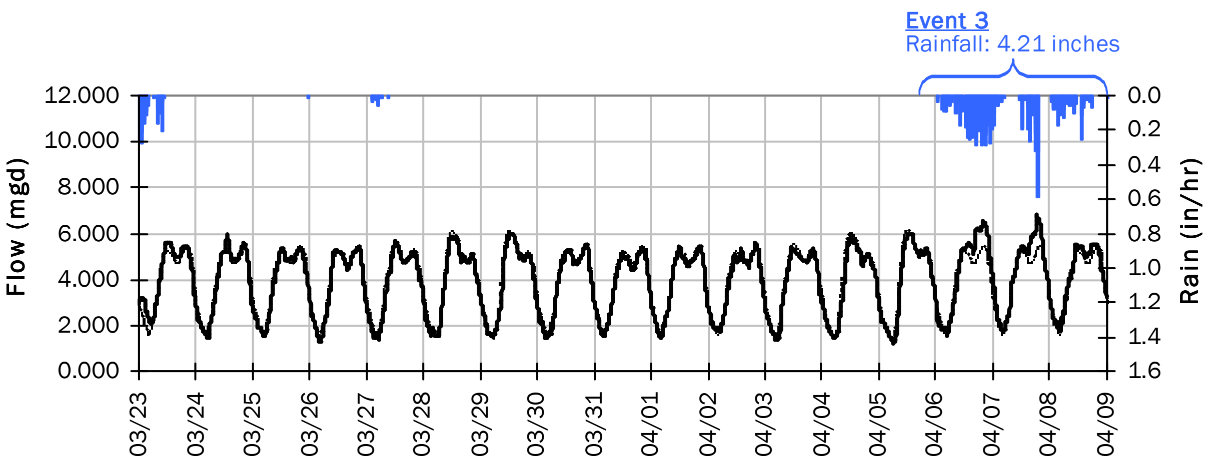


Storm Event I/I Analysis (Rain = 1.01 inches)

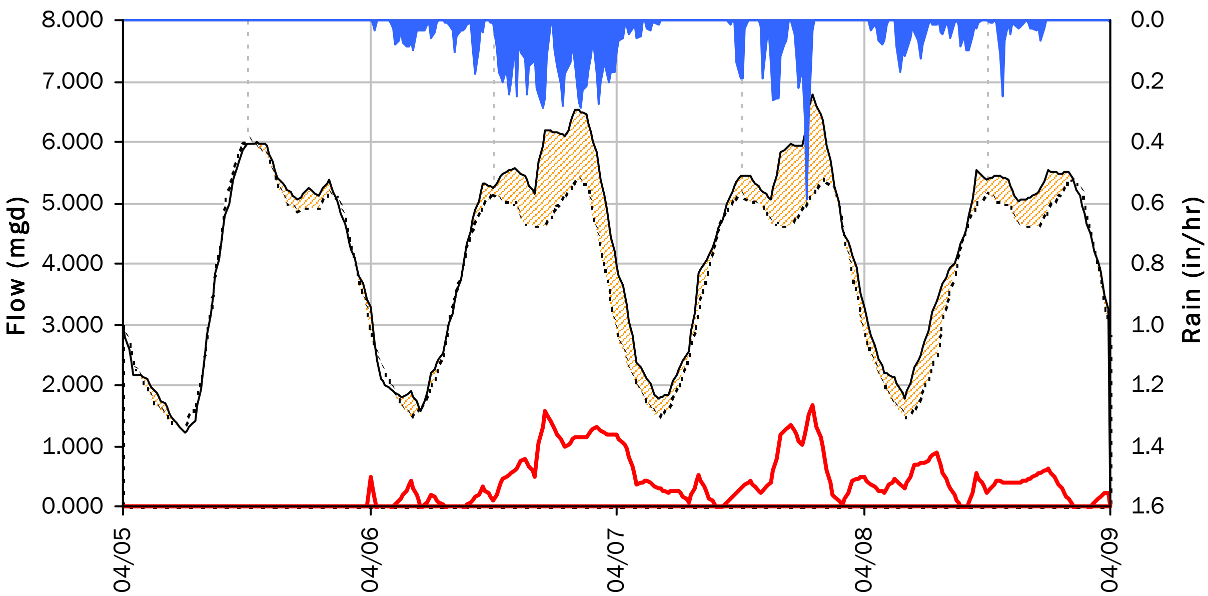
Capacity		**Inflow / Infiltration**	
Peak Flow:	5.63 *mgd*	**Peak I/I Rate:**	0.97 *mgd*
PF:	1.47	**Total I/I:**	258,000 *gallons*
Peak Level:	*in*		
d/D Ratio:			

WWTP
I/I Summary: Event 3

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 3 Detail Graph



Storm Event I/I Analysis (Rain = 4.21 inches)

Capacity			Inflow / Infiltration		
Peak Flow:	6.79	*mgd*	**Peak I/I Rate:**	1.66	*mgd*
PF:	1.77		**Total I/I:**	1,396,000	*gallons*
Peak Level:		*in*			
d/D Ratio:					

APPENDIX B

Hydraulic Model Calibration Exhibits

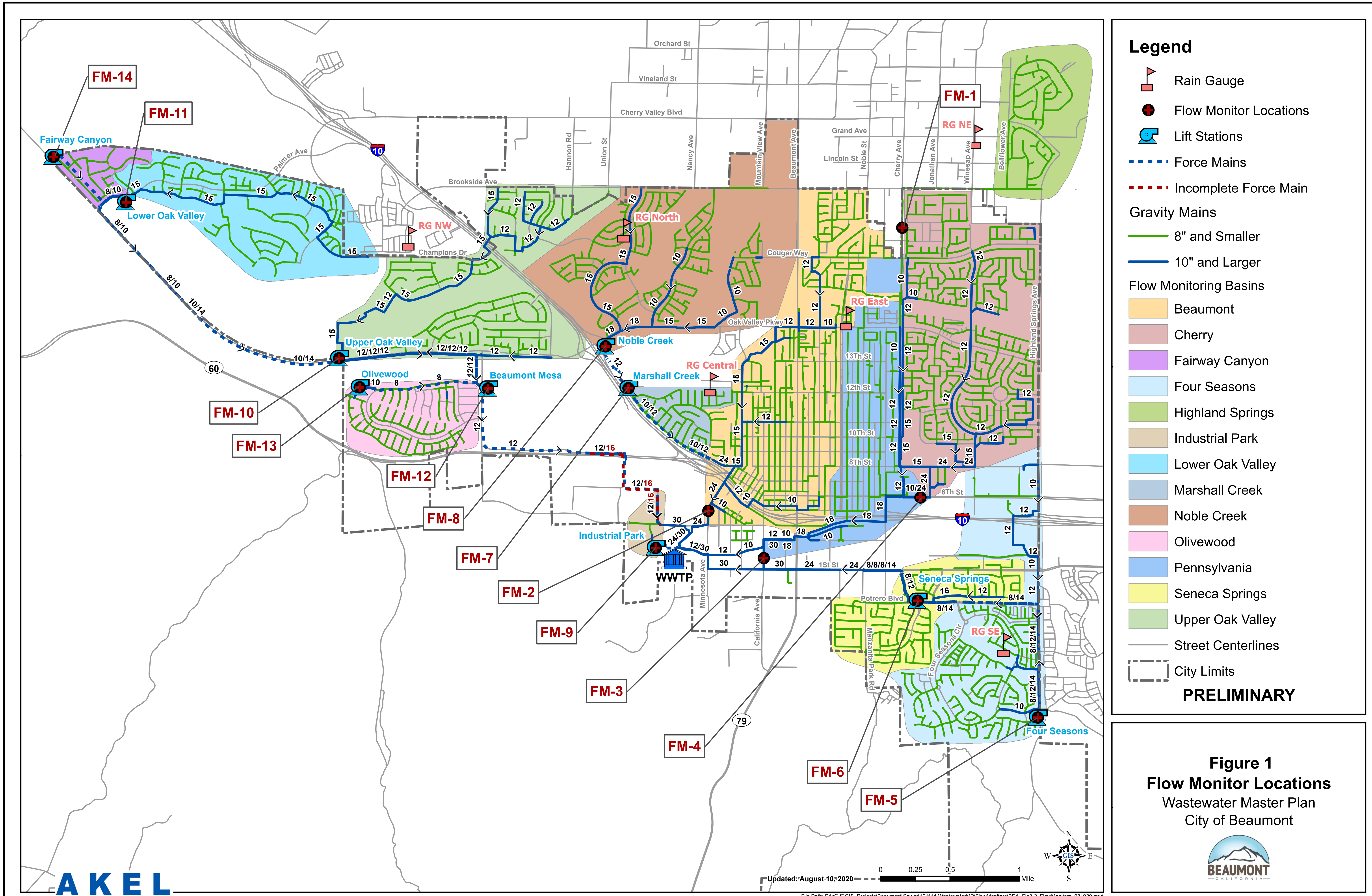
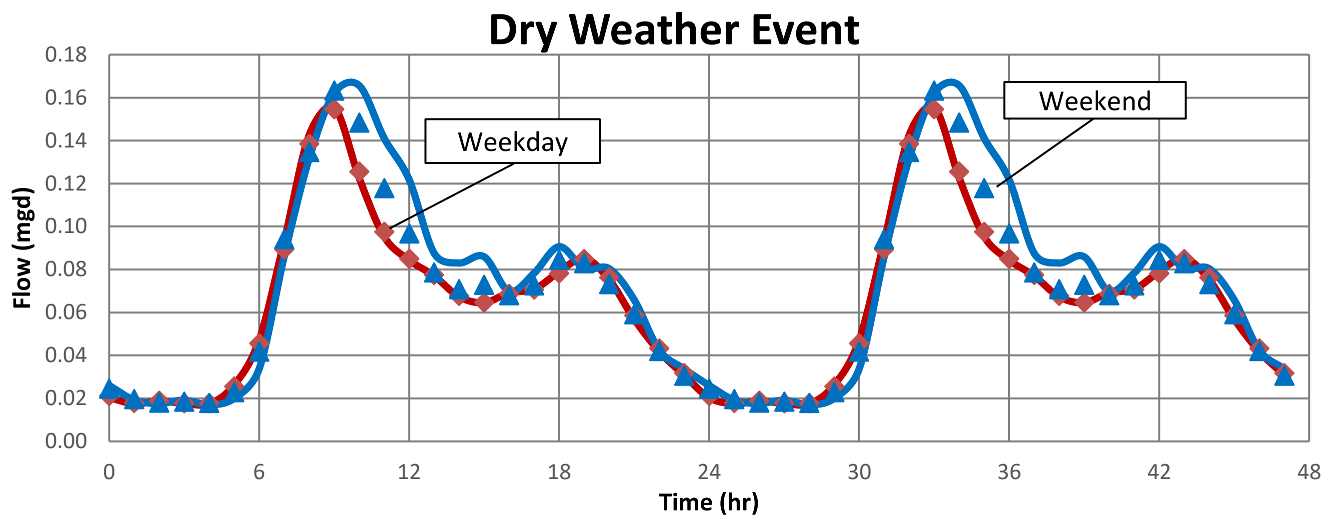
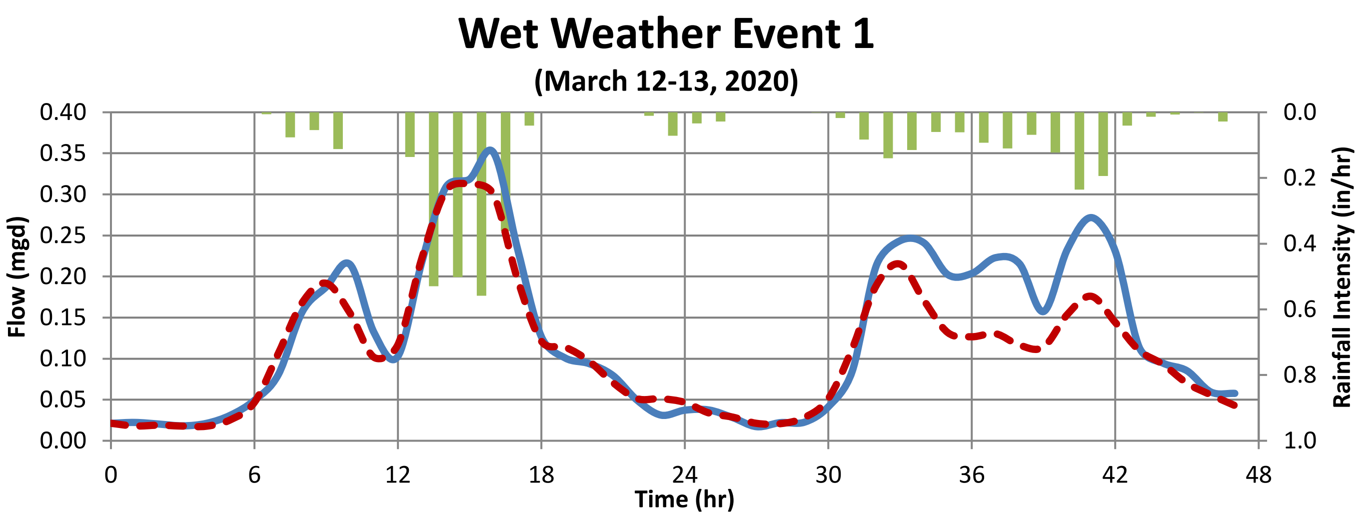
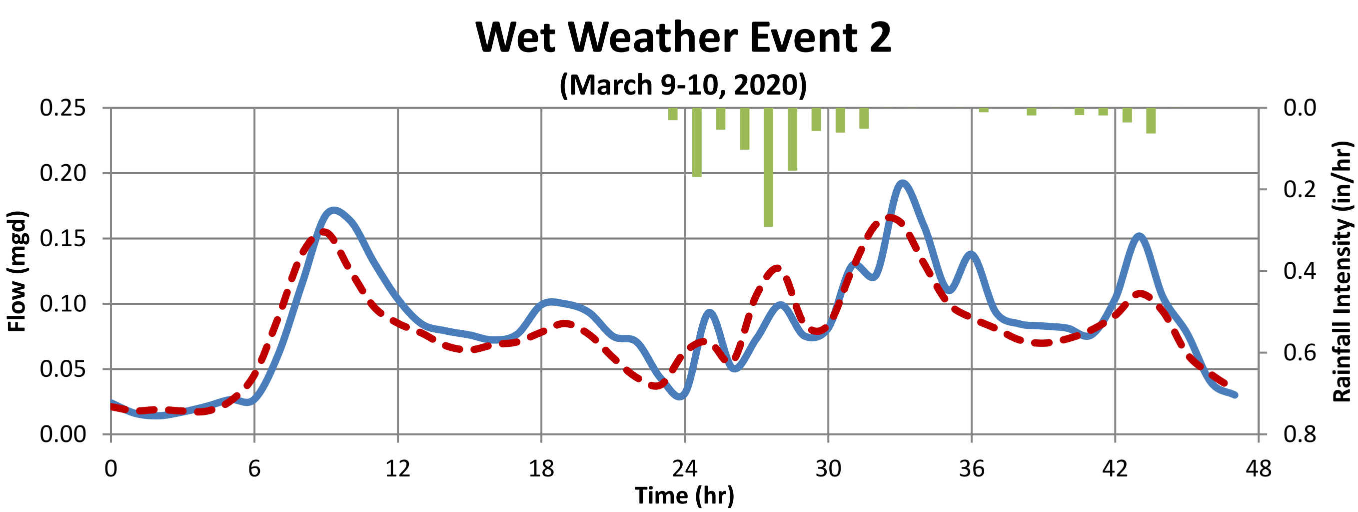


Figure 1
Flow Monitor Locations
Wastewater Master Plan
City of Beaumont







LEGEND

PRELIMINARY

Dry Weather Event

- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event

- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

AKEL ENGINEERING GROUP, INC.

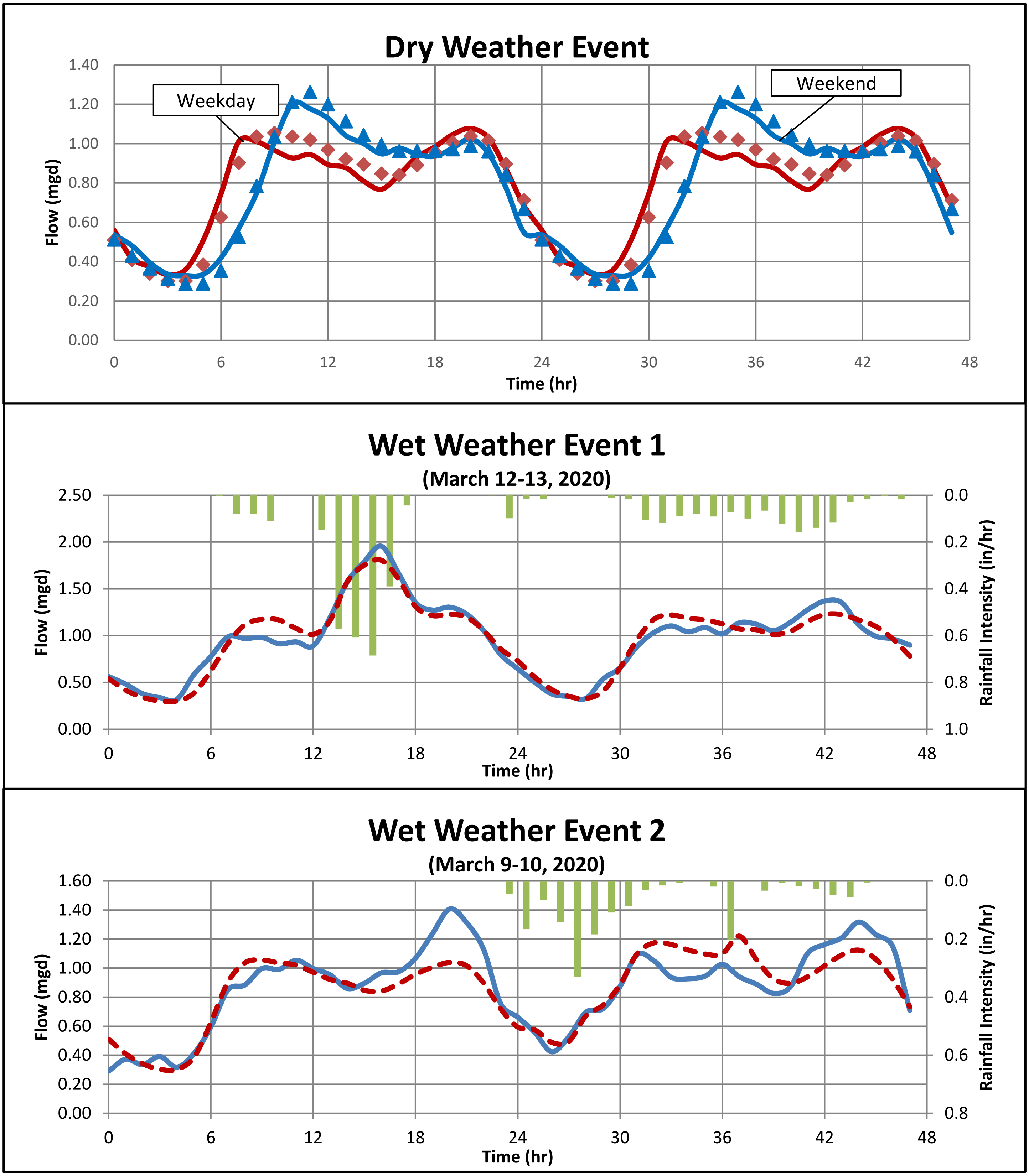
Figure 2

S-1

Wastewater Master Plan

City of Beaumont

BEAUMONT CALIFORNIA



LEGEND

PRELIMINARY

Dry Weather Event

- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event

- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

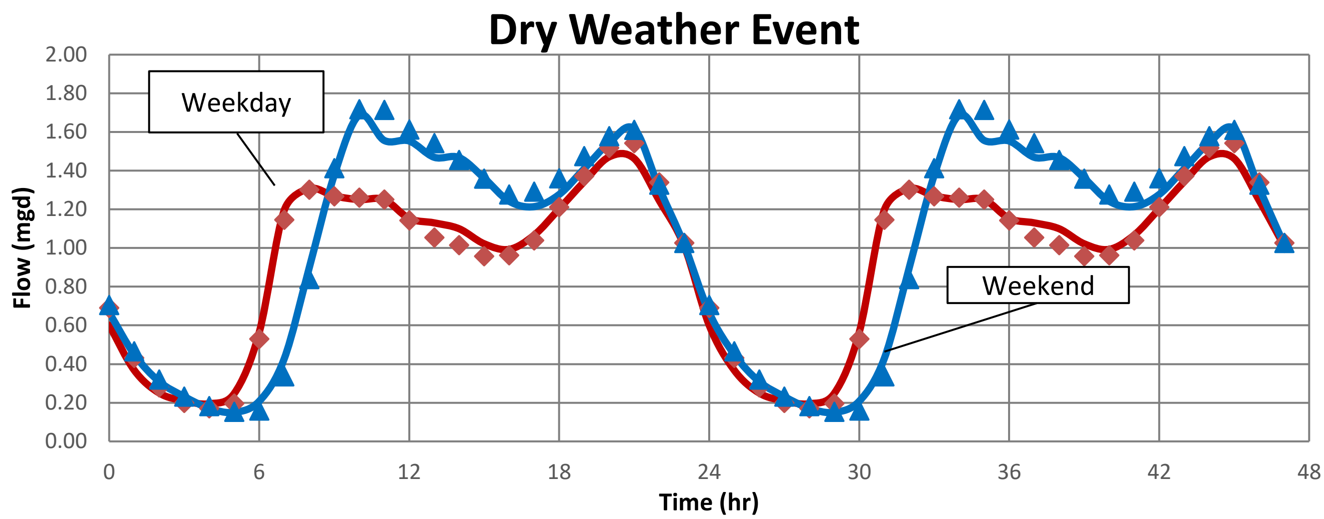
AKEL ENGINEERING GROUP, INC.

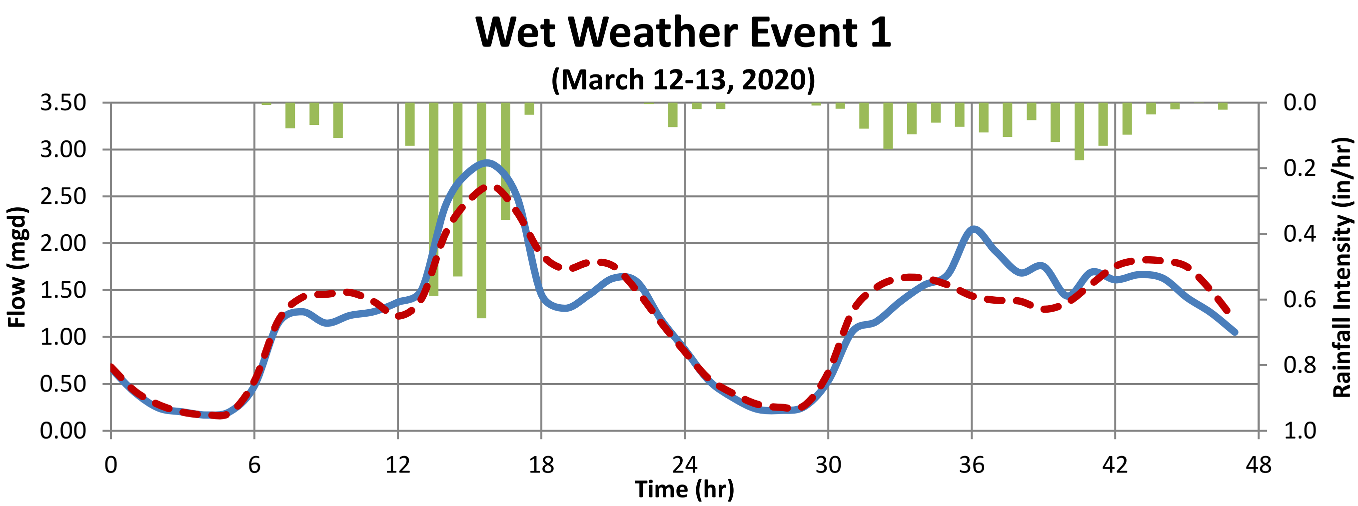
Figure 3

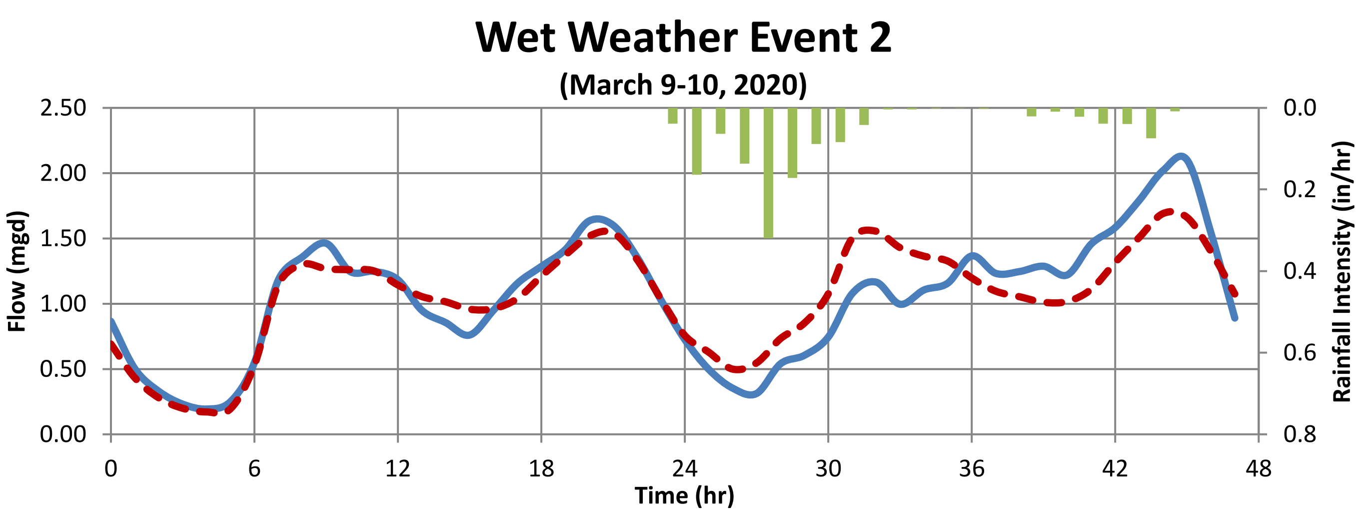
S-2

Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA







LEGEND

PRELIMINARY

Dry Weather Event

- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event

- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

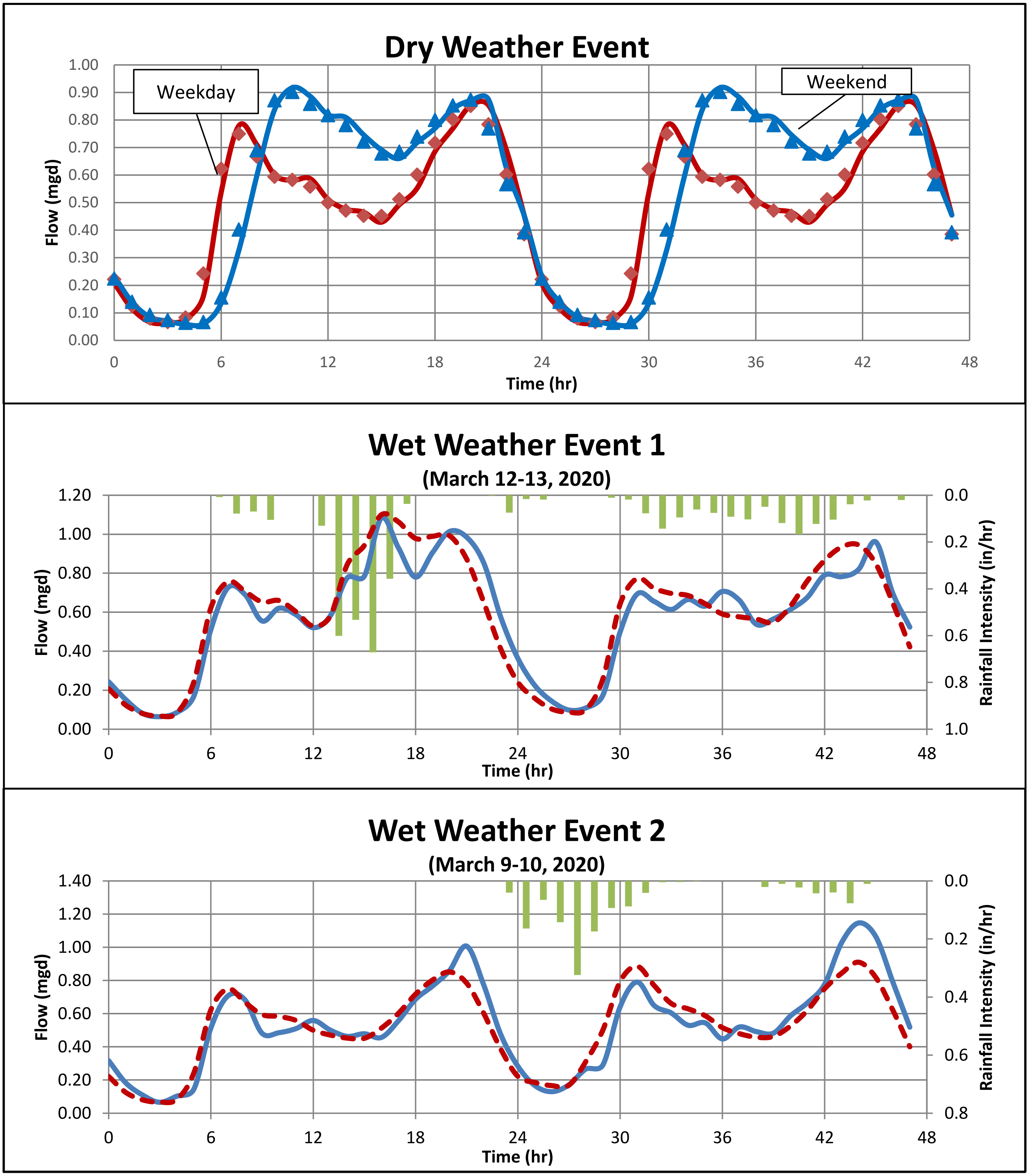
AKEL ENGINEERING GROUP, INC.

Figure 6.3

S-3

Wastewater Master Plan

City of Beaumont



LEGEND

PRELIMINARY

Dry Weather Event

- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event

- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

AKEL ENGINEERING GROUP, INC.

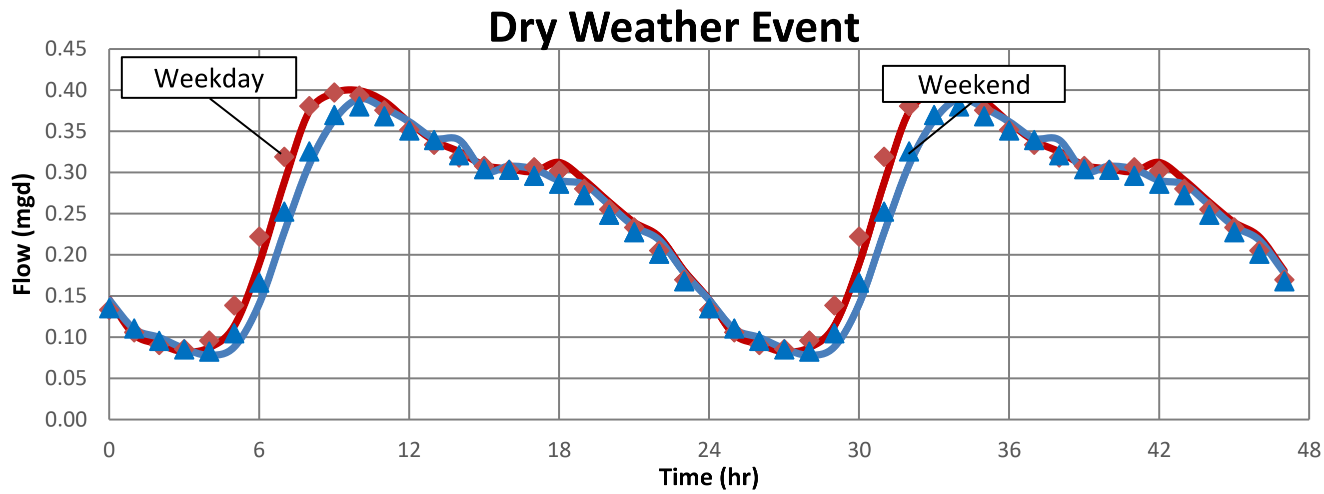
Figure 5

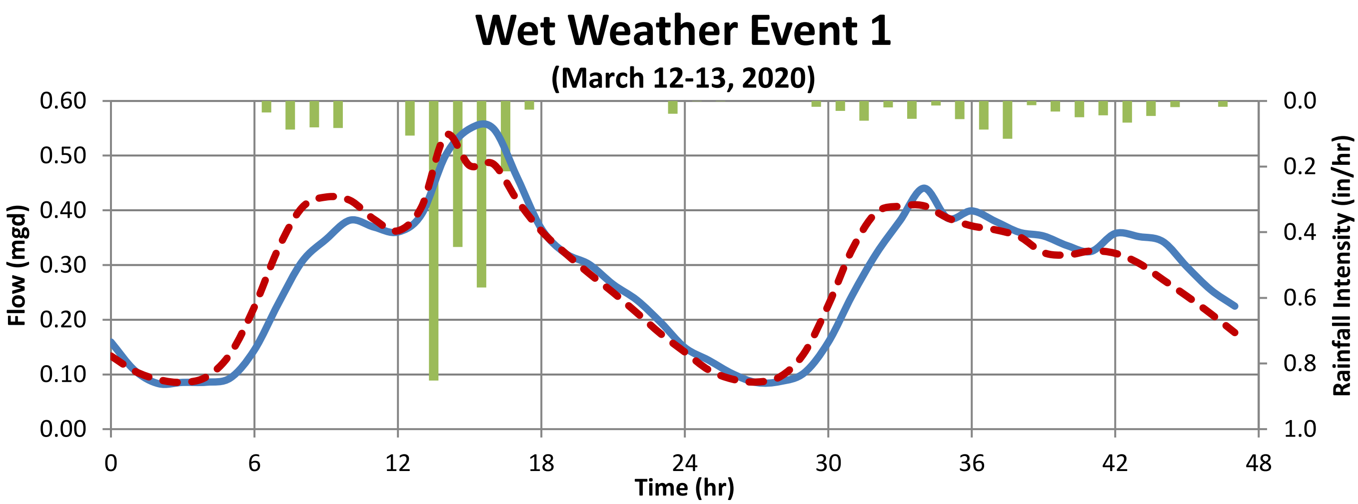
S-4

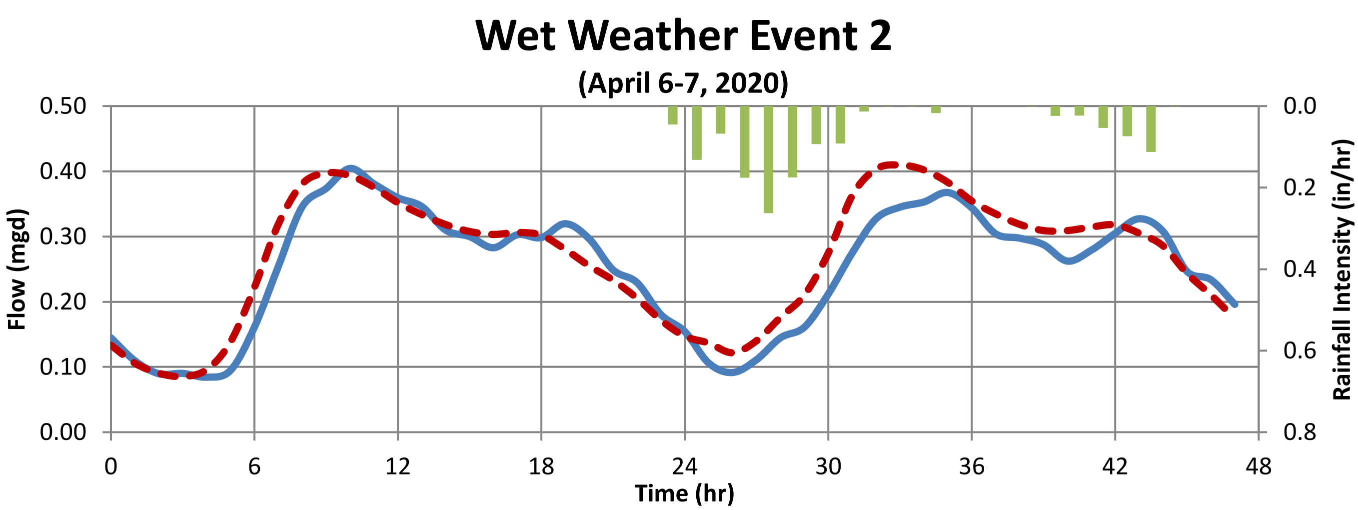
Wastewater Master Plan

City of Beaumont

BEAUMONT CALIFORNIA







LEGEND **PRELIMINARY**

Dry Weather Event
- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event
- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

Figure 6

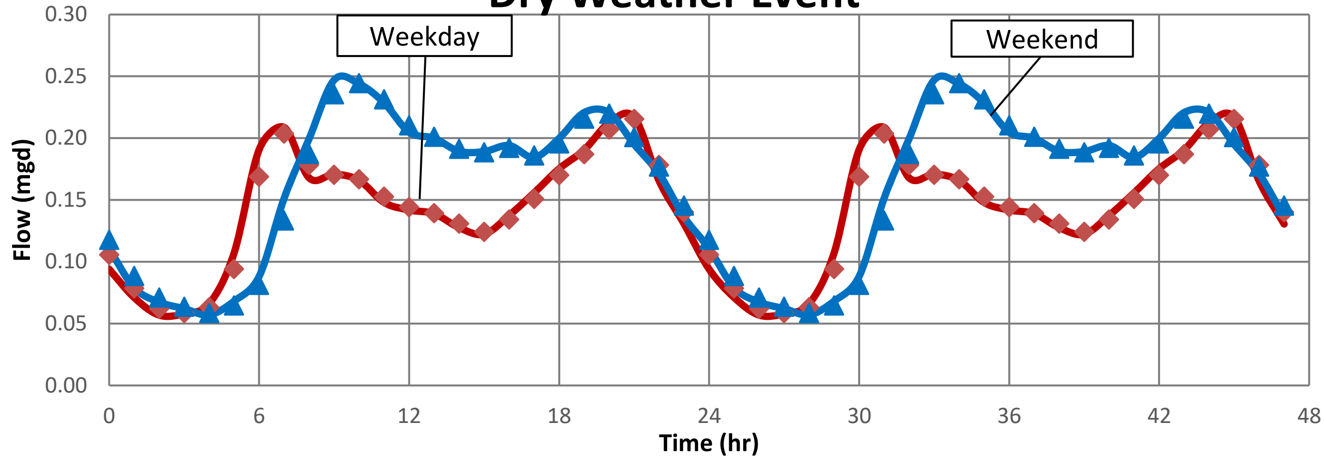
S-5

Wastewater Master Plan
City of Beaumont

BEAUMONT
CALIFORNIA

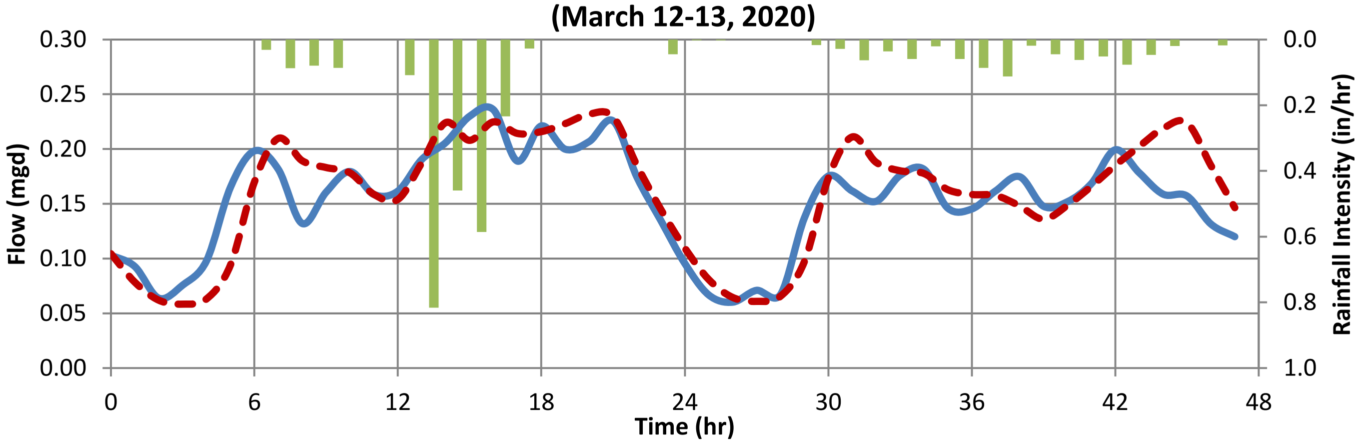
AKEL
ENGINEERING GROUP, INC.

Dry Weather Event



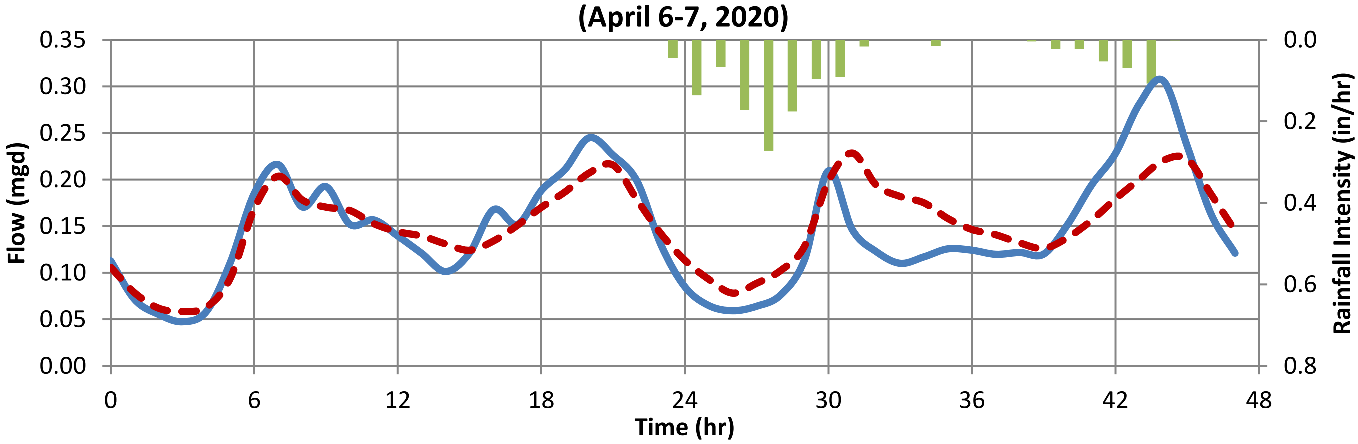
Wet Weather Event 1

(March 12-13, 2020)



Wet Weather Event 2

(April 6-7, 2020)



LEGEND **PRELIMINARY**

Dry Weather Event
- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event
- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

Figure 7

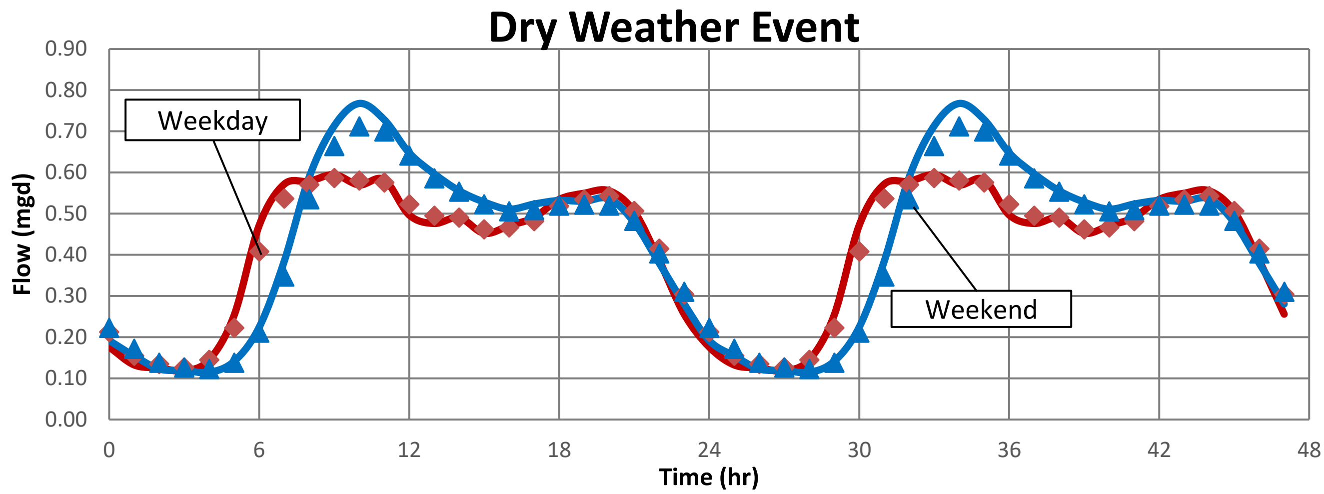
S-6

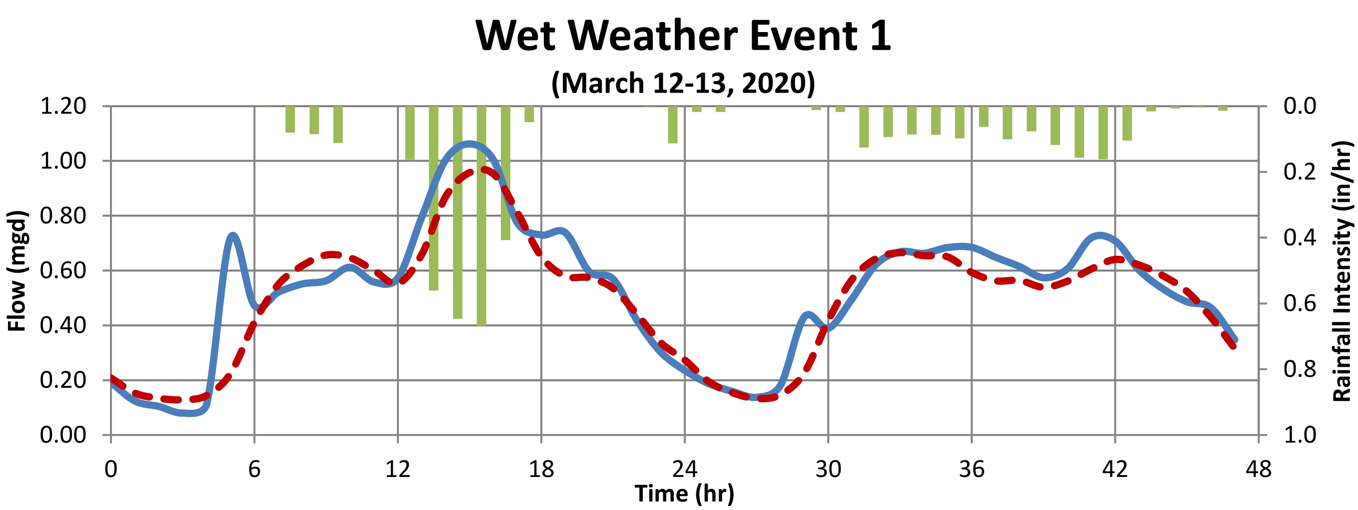
Wastewater Master Plan

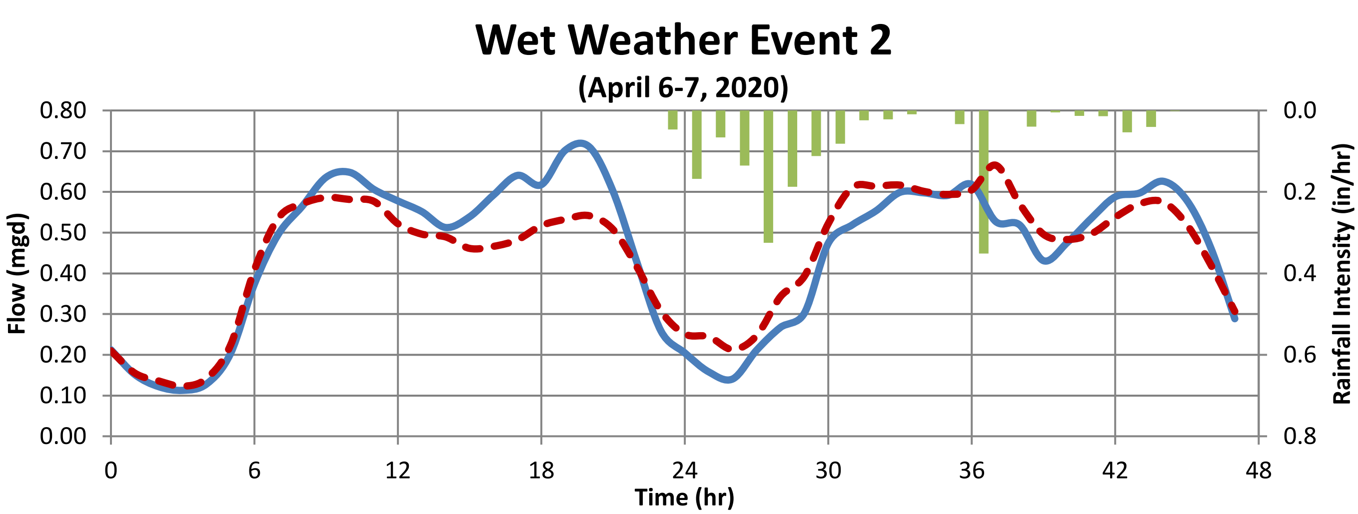
City of Beaumont

BEAUMONT CALIFORNIA

AKEL ENGINEERING GROUP, INC.







LEGEND

PRELIMINARY

Dry Weather Event

- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event

- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

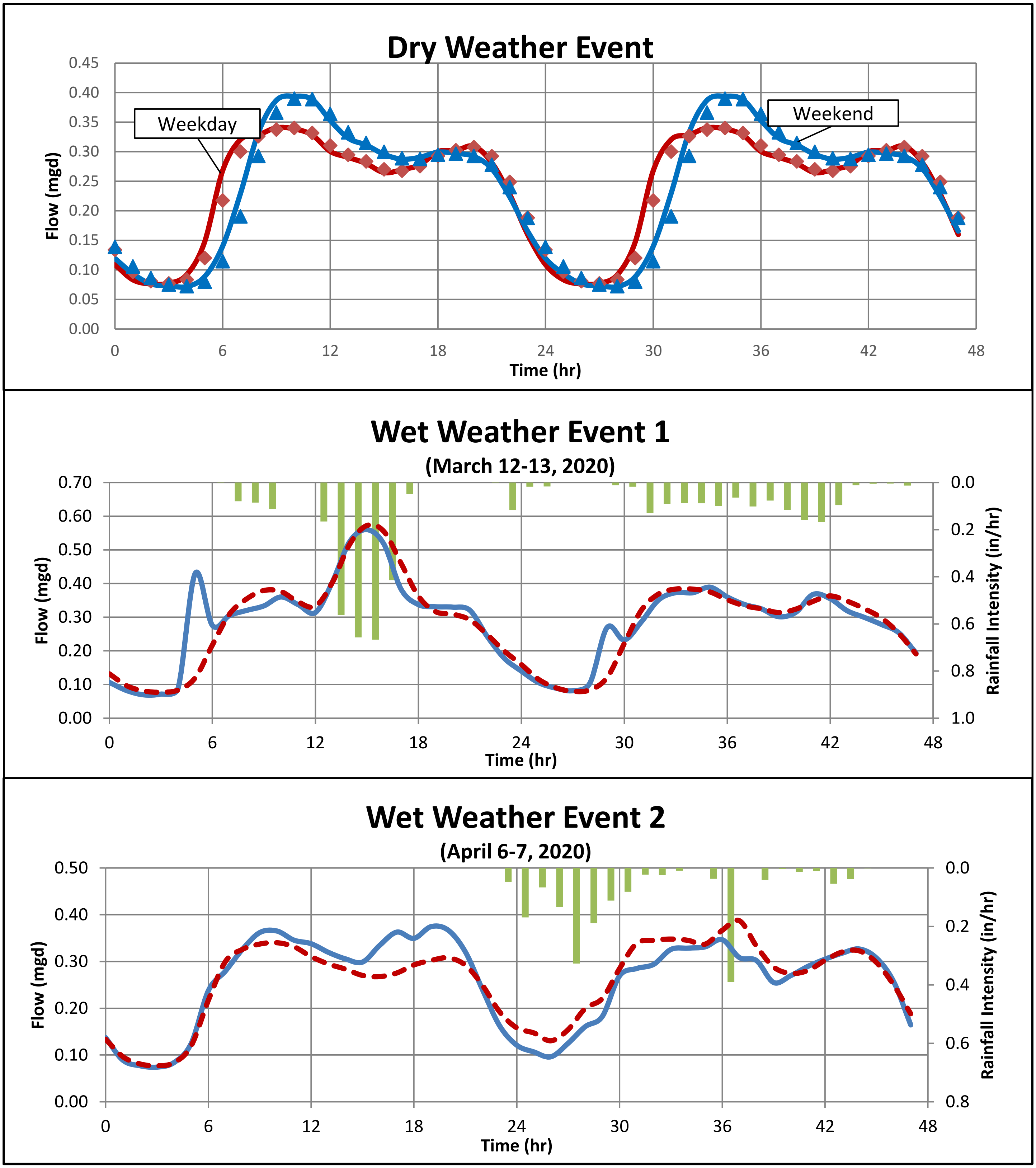
AKEL ENGINEERING GROUP, INC.

Figure 6.4

S-7

Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA



LEGEND **PRELIMINARY**

Dry Weather Event

- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event

- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

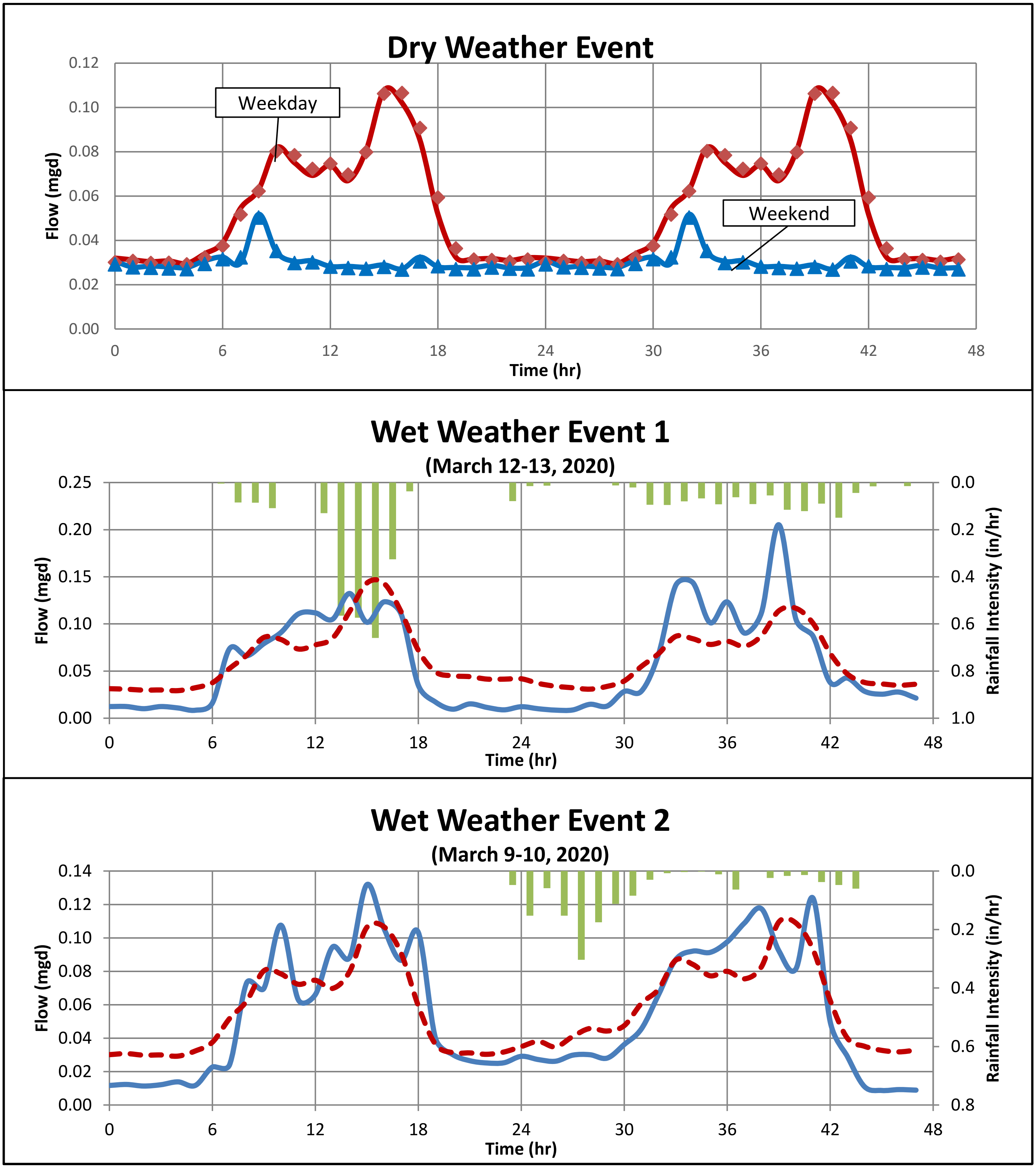
AKEL
ENGINEERING GROUP, INC.

Figure 9

S-8

Wastewater Master Plan
City of Beaumont

BEAUMONT
CALIFORNIA



LEGEND **PRELIMINARY**

Dry Weather Event
- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event
- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

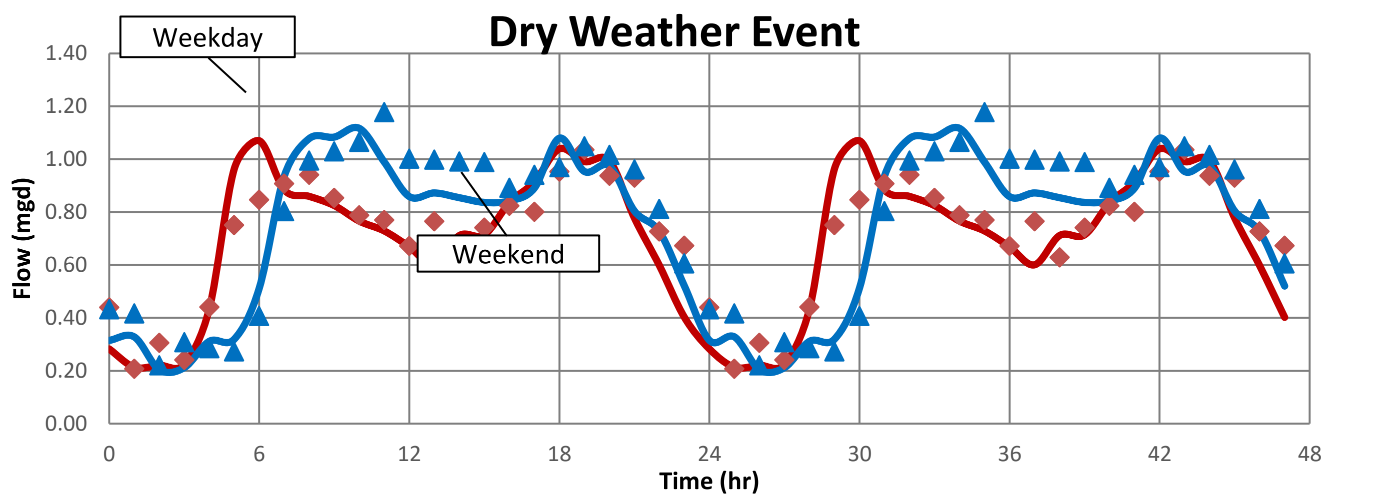
AKEL ENGINEERING GROUP, INC.

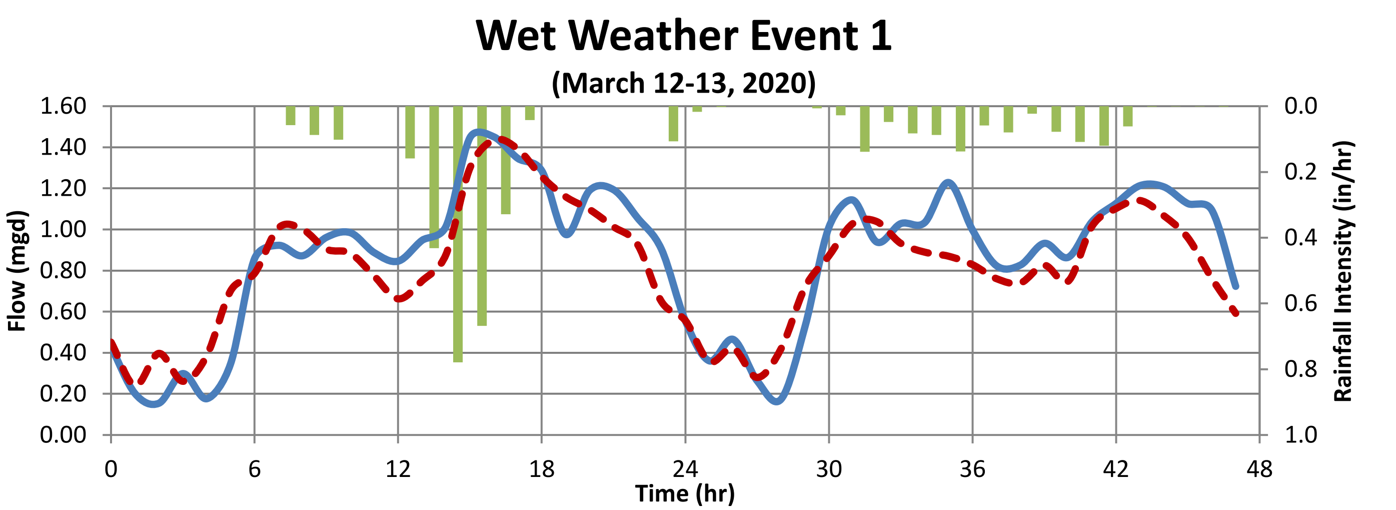
Figure 10

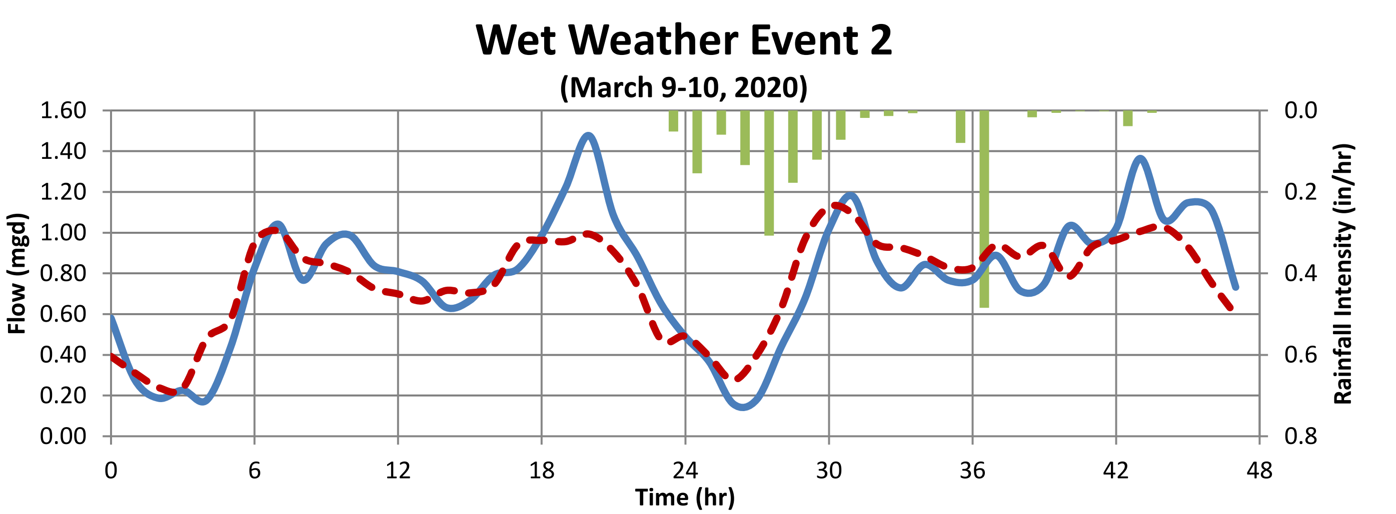
S-9

Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA







LEGEND

PRELIMINARY

Dry Weather Event
- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event
- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

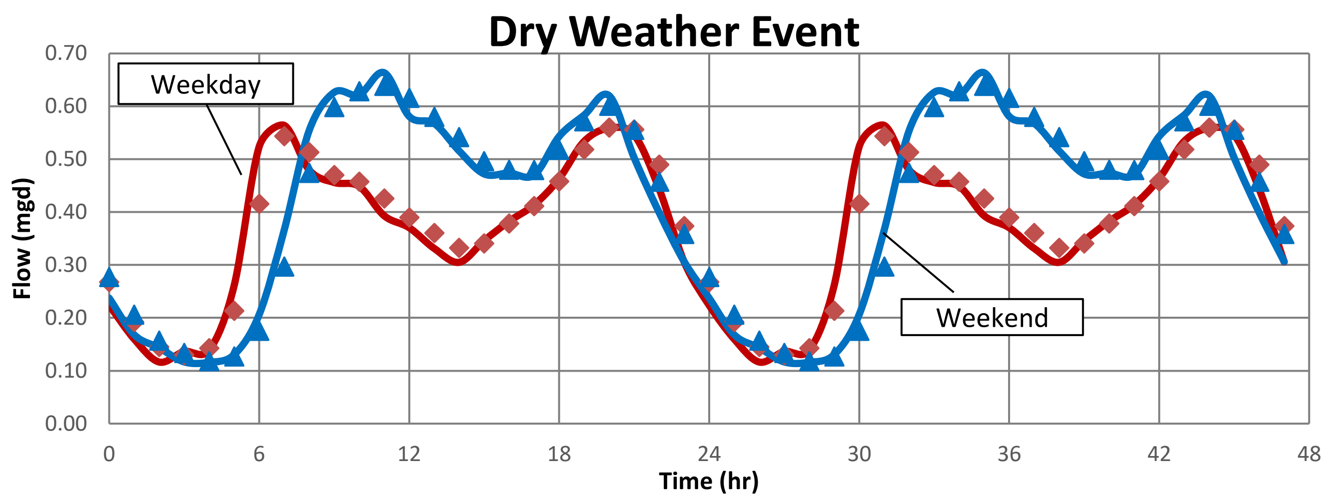
AKEL ENGINEERING GROUP, INC.

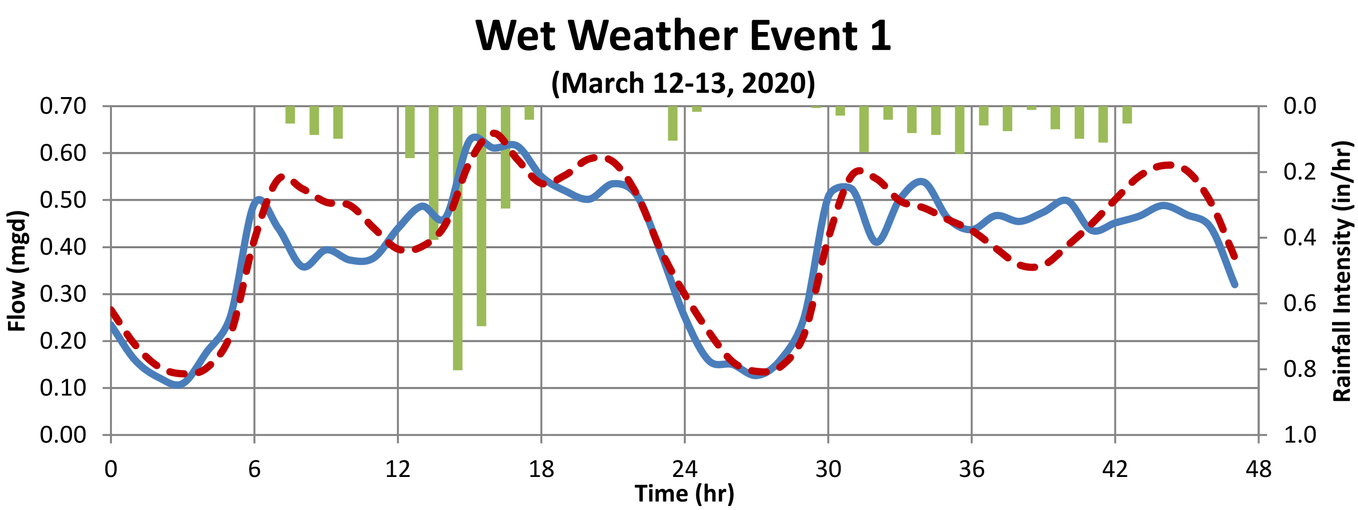
Figure 11

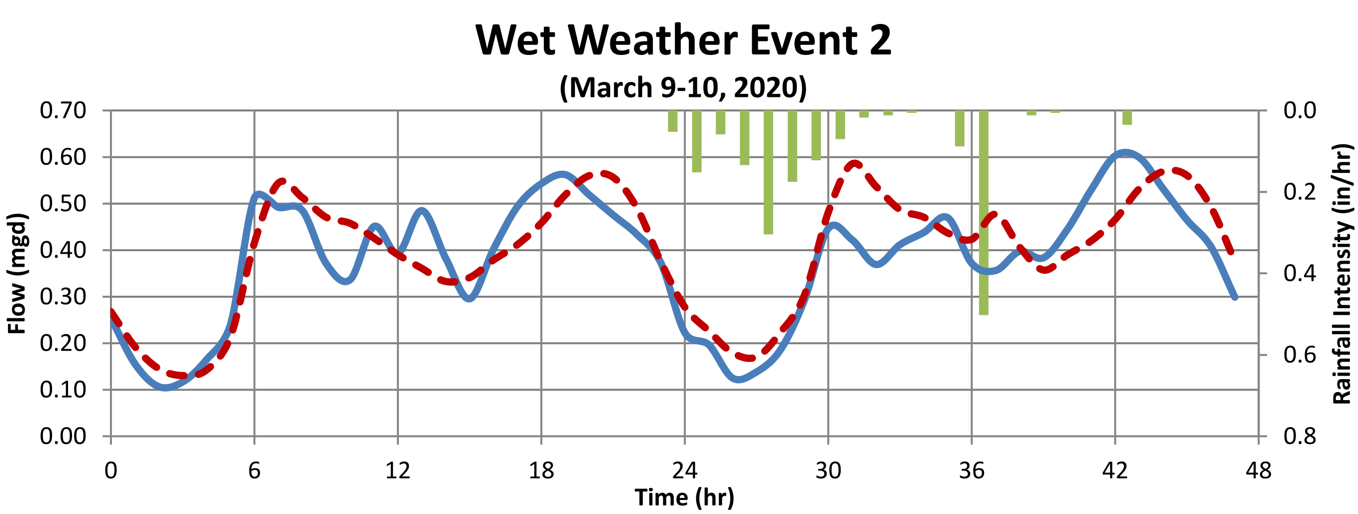
S-10

Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA







LEGEND **PRELIMINARY**

Dry Weather Event
- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event
- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

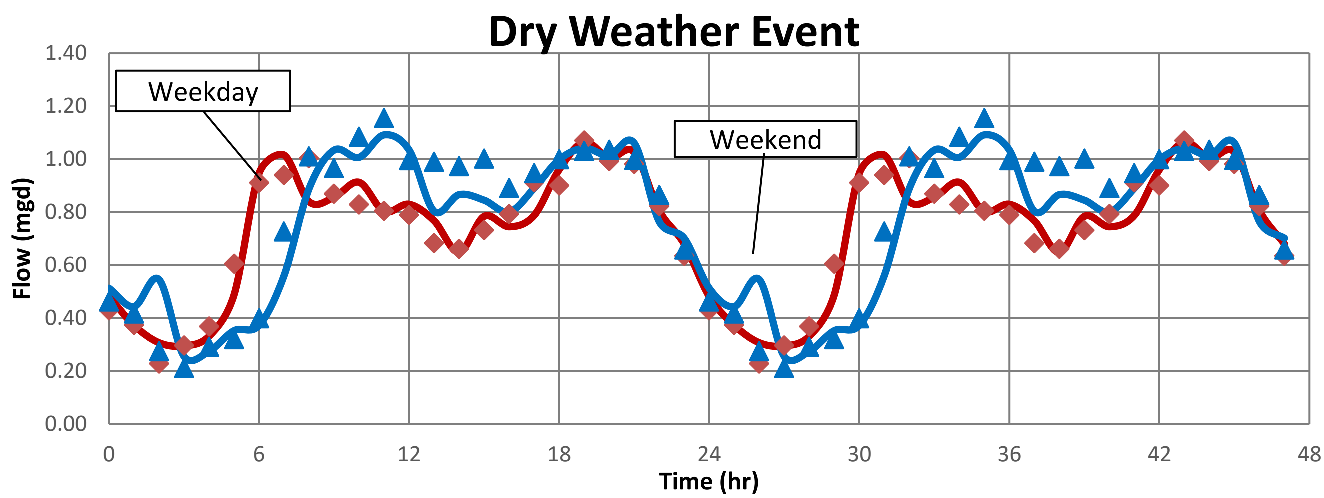
Figure 12

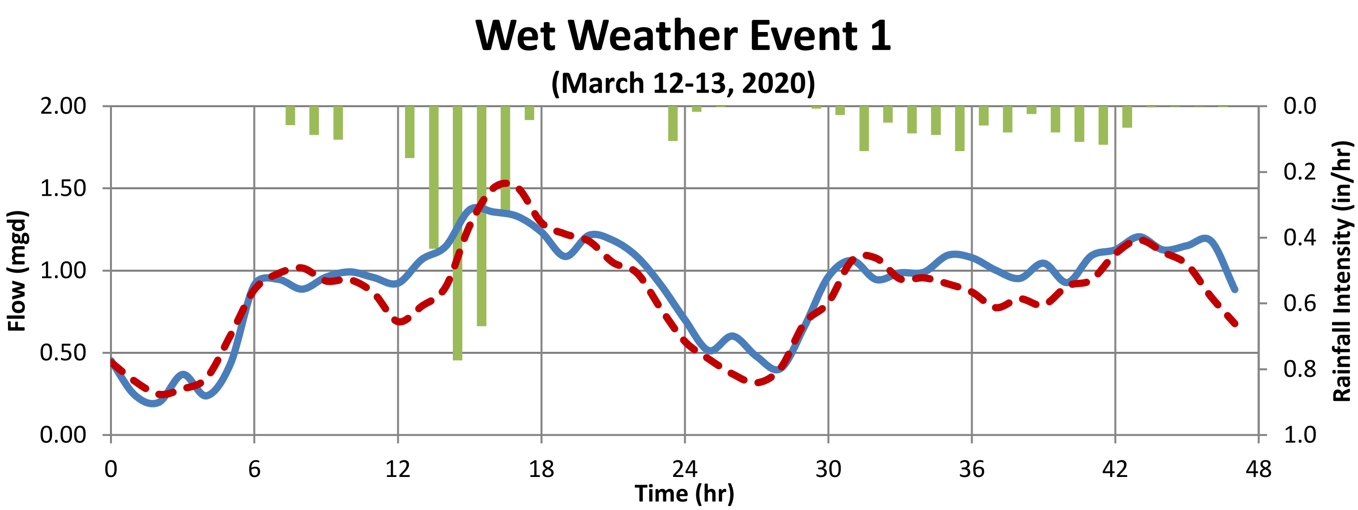
S-11

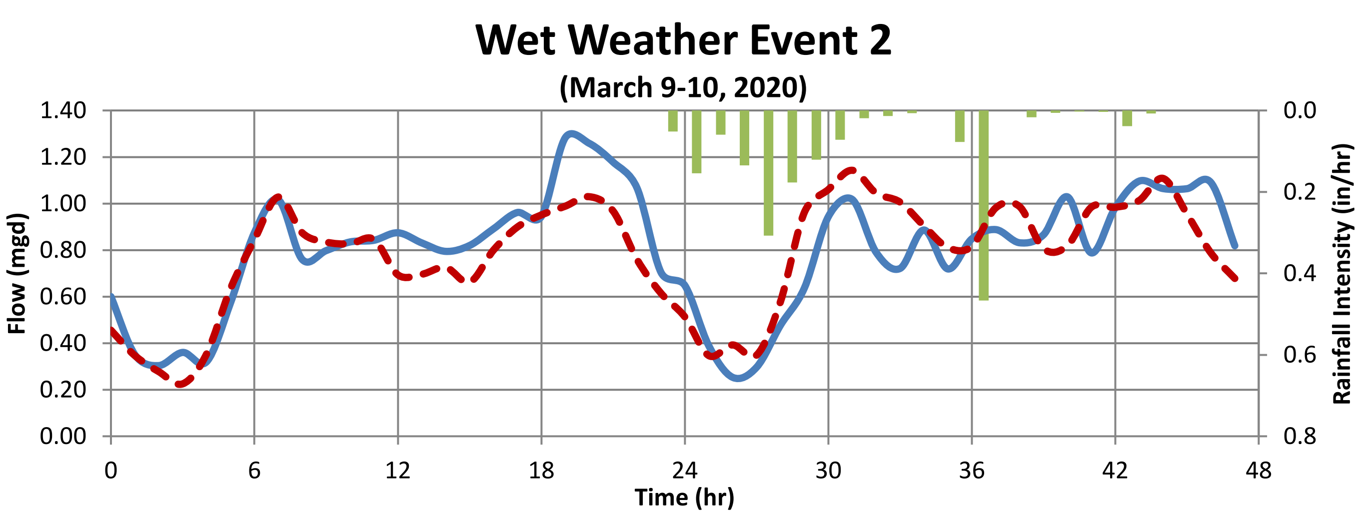
Wastewater Master Plan
City of Beaumont

BEAUMONT
CALIFORNIA

AKEL
ENGINEERING GROUP, INC.







LEGEND

PRELIMINARY

Dry Weather Event

- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event

- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

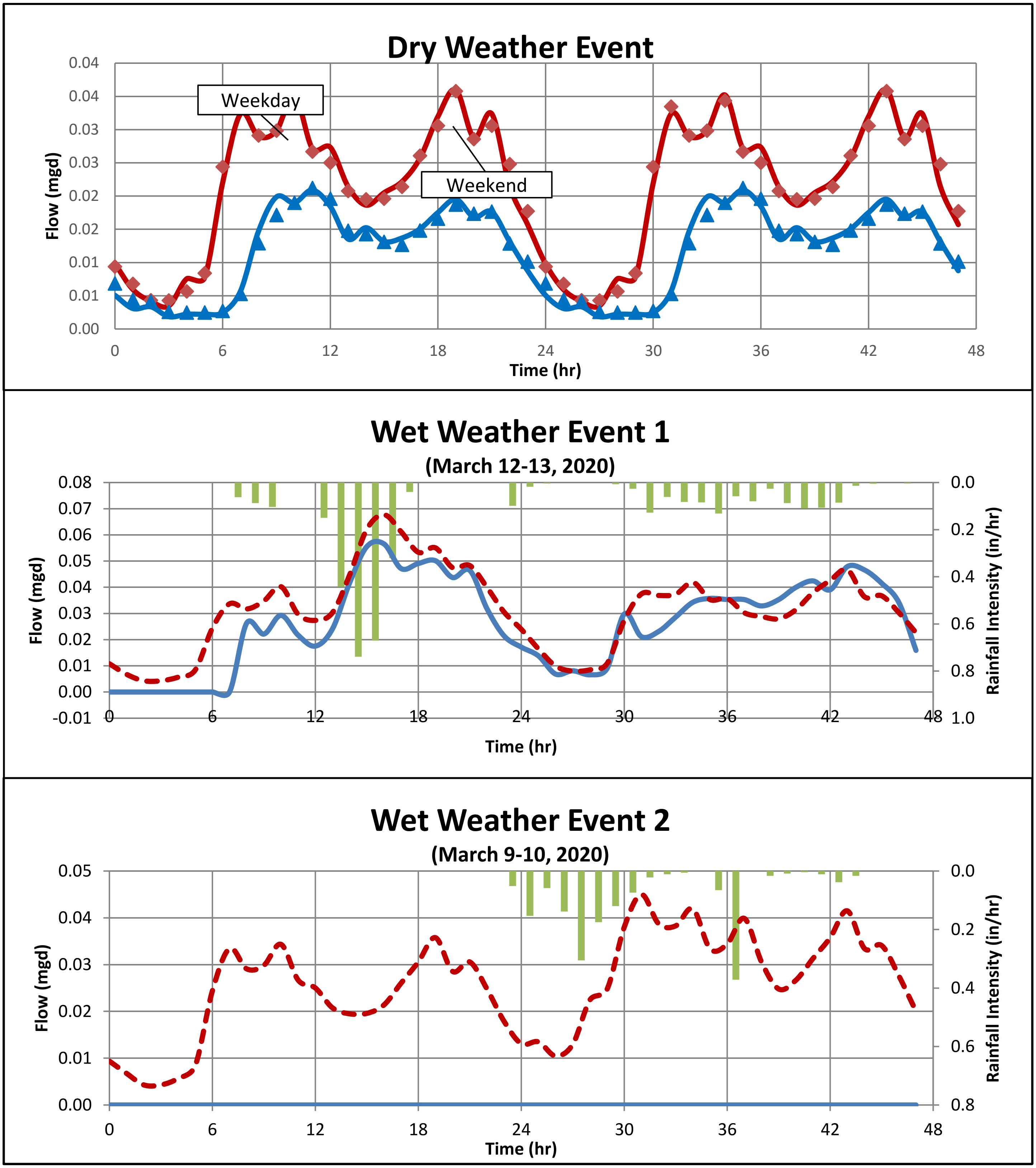
AKEL ENGINEERING GROUP, INC.

Figure 13

S-12

Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA



LEGEND **PRELIMINARY**

Dry Weather Event
- ▲◆ - Hydraulic Model
- - V&A Flow Monitoring

Wet Weather Event
- - Rainfall Intensity
- - V&A Flow Monitoring
- - Hydraulic Model

May 20,2020

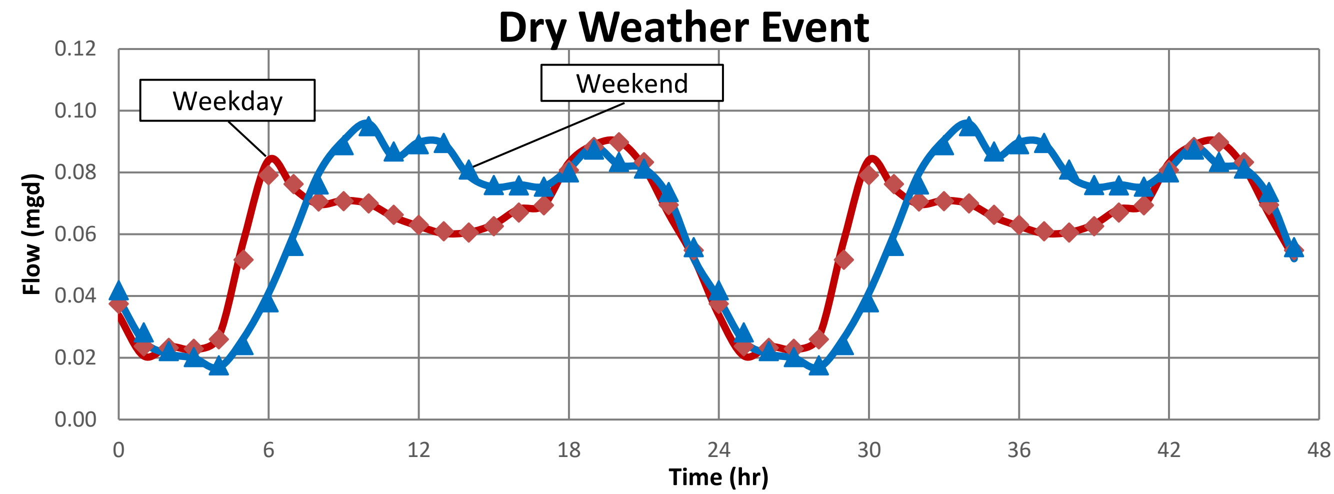
AKEL ENGINEERING GROUP, INC.

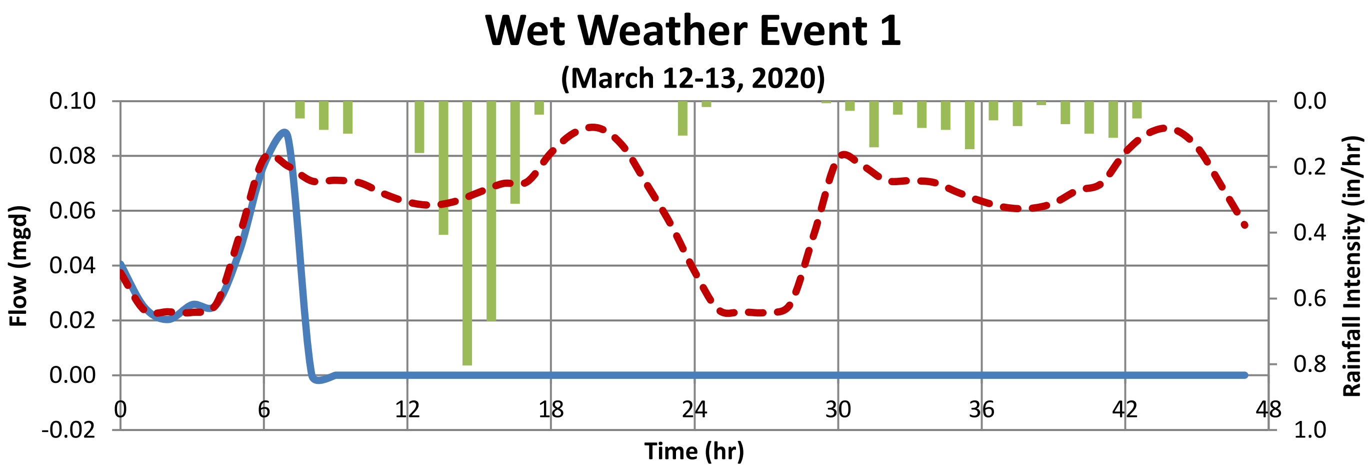
Figure 14

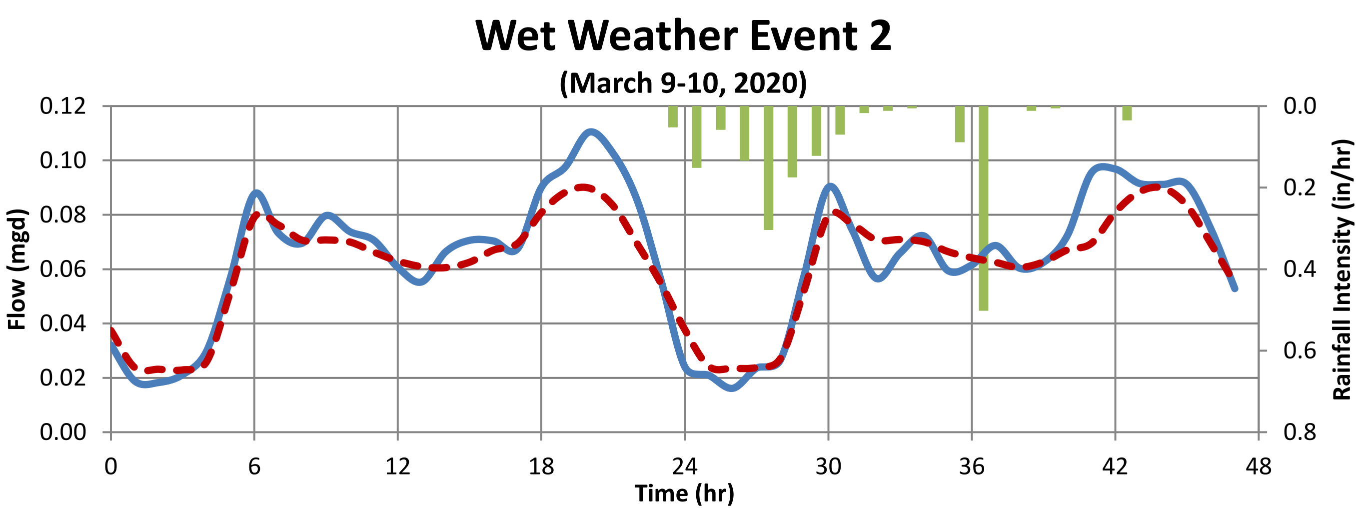
S-13

Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA







LEGEND **PRELIMINARY**

Dry Weather Event

- Hydraulic Model
- V&A Flow Monitoring

Wet Weather Event

- Rainfall Intensity
- V&A Flow Monitoring
- Hydraulic Model

May 20,2020

AKEL ENGINEERING GROUP, INC.

Figure 15

S-14

Wastewater Master Plan
City of Beaumont

BEAUMONT CALIFORNIA

APPENDIX C

Beaumont Mesa Lift Station Dry Well Grading Plan –
Prepared by Cannon

Avail. Ht	Freeboard	Mobilization	Shoring SW Side	Excavation	Concrete	Equipment	Subtotal	Engineering 15%	Tax, Permit, Fees 10%	Contingency 25%	Overhead /Profit 15%	Sprvsn/Mngmnt 10%	DeMob. Fixed	Total
8	1	$60,000	$24,216	$27,674	$596,246	$60,000	$768,136	$115,220.41	$76,814	$192,034	$115,220	$76,814	$40,000	**$1,384,238**
7	2	$60,000	$25,890	$31,148	$639,857	$60,000	$816,895	$122,534.18	$81,689	$204,224	$122,534	$81,689	$40,000	**$1,469,565**
6.5	2.5	$60,000	$26,868	$33,271	$666,403	$60,000	$846,541	$126,981.21	$84,654	$211,635	$126,981	$84,654	$40,000	**$1,521,447**
6	3	$60,000	$27,966	$35,736	$697,144	$60,000	$880,846	$132,126.90	$88,085	$220,212	$132,127	$88,085	$40,000	**$1,581,481**

Freeboard (ft)	Width (ft)	Length (ft)
1	40.36	40.36
2	43.15	43.15
2.5	44.78	44.78
3	46.61	46.61

Available height (ft)	Freeboard (ft)	Total Depth of Wet Well Inside (ft)	Freeboard Volume (gal.)	Percentage of Total Storage	Inside Width (ft)	Inside Length (ft)	T & B Area (sq. ft)	Wall Length (ft)	Volume of Walls 12-inch (cu.yds)	Volume of T & B Slab 12-inch (cu.yds)	Total Concrete (cu. Yds)
8	1	9	12,188	16.3%	40.36	40.36	1795	161.45	53.82	132.93	186.75
7	2	9	27,857	37.1%	43.15	43.15	2038	172.60	57.53	151.00	208.53
6.5	2.5	9	37,500	50.0%	44.78	44.78	2188	179.11	59.70	162.09	221.79
6	3	9	48,750	65.0%	46.61	46.61	2363	186.43	62.14	175.01	237.15

VOLUME OF SLOPED CONCRETE = 97,500 - 75,000 = 22,500 GALLONS / 7.481 = 3,007 CU.FT / 27 = 111 CU. YDS

Underground Service Alert
Call: TOLL FREE
1-800-227-2600
TWO WORKING DAYS BEFORE YOU DIG

The private engineer signing these plans is responsible for the accuracy and acceptability of the design hereon. In the event of discrepancies arising after city approval or during construction, the private engineer shall be responsible for determining an acceptable solution and revising the plans for approval by the city.

DATE	BY	MARK	REVISIONS	APPR.	DATE
03/07/08	KP	R4	REMOVED PLATFORM, STAIRS, AND REPLACED WITH CAGE LADDER. REVISE GRATE AND CONC. OPENING		
12/12/07	ZR	R2	REDESIGNED PUMP STATION. CHANGED SUBMERSIBLE PUMPS TO DRY PIT PUMPS		
06/11/07	JJS	R1	PUMP STATION RELOCATED		

ENGINEER — CITY
DESIGNED BY: ZR DRAWN BY: KMC CHECKED BY: ZR

RECOMMENDED FOR APPROVAL ZR DATE
CHECKED BY: ZR DATE

SEAL
PROFESSIONAL ENGINEER ZUZANNA M. RAND NO. C65967 Exp. 6-30-08 CIVIL STATE OF CALIFORNIA
Z Rand 3-7-08

APPROVED BY DATE 3-7-08
DIRECTOR OF PUBLIC WORKS

Urban Logic Consultants
43517 Ridge Park Drive, Suite 200
Temecula, California 92590
Tel: (951) 676-1944 Fax (951) 676-2054

SCALE: AS NOTED
DATE: 12-12-2007
BENCHMARK
SEE TITLE SHEET

CITY OF BEAUMONT
BEAUMONT MESA SEWER LIFT STATION
SAN TIMOTEO SEWER SYSTEM
PRECISE GRADING AND SITE PIPING PLAN

FOR W.O.

SHEET NO. 6
C-2
OF 36 SHTS.
FILE NO.
1540-D

PROJECT: BEAUMONT MESA SEWER LIFT STATION PROJECT - SAN TIMOTEO SEWER SYSTEM

APPENDIX D

Beaumont Mesa Force Main Pothole Report – Prepared by C-Below

Utility Locating
Radiography
Potholing
Mapping
GPR

Pothole Report

C BELOW
SUBSURFACE IMAGING

Date:	**October 3, 2020**
Technician:	**Jacob Bankston**
Project Name:	**City of Beaumont/Force main Pothole Report**
Project Address:	**Potrero Blvd & Western Knolls Ave. Beaumont, CA 92223**
C Below Project No.	**20-2491**

www.cbelow.com

1-888-90-BELOW

14280 Euclid Ave.
Chino, CA 91710

14280 Euclid Ave
Chino, CA 91710
1-888-90-BELOW

Date: **October 3, 2020**
Technician: **Jacob Bankston**
Project Name: **City of Beaumont/Force main Pothole Report**
Project Address:
Potrero Blvd & Western Knolls Ave. Beaumont, CA 92223
C Below Project No. **20-2491**

Project Summary

No.	Utility	Size (in)	Material	Top Depth (ft)	Direction	Location	Surface
ST1	Sewer	12	Plastic	7.28	NE-SW	West Bound on Western Knolls Ave., South West of Property 1280	Soil
ST2	Sewer	12	Plastic	6.03	E-W	West of 630 Nicholas Rd. in Field	Soil
ST2.1	Sewer	16	Plastic	5.70	E-W	West of 630 Nicholas Rd. in Field	Soil

Comments: Top depth is measured from ground surface to top of utility. Potholes were performed at locations specified by the client. Utility size and material are based on visual estimates and may vary.

C BELOW
SUBSURFACE IMAGING

POTHOLING DATA SHEET

14280 EUCLID AVE., CHINO, CA 91710
OFFICE: (888) 902-3569
FAX: (909) 606-6555

Technician Name	Date	C Below Project No.
Jacob Bankston	10-03-2020	20-2491

Project Name	Project Address
City of Beaumont | Force main Utility Locating Investigation	Potrero Blvd & Western Knolls Avenue Beaumont, CA 92223
Client Company	**Contact**
Cannon Corp. | Los Angeles	Eric

Pothole No.	Location
ST1	West Bound on Western Knolls Ave., South West of Property 1280

Surface Type: Soil

Thickness: N/A (feet)

Profile View (not to scale)
Measured Distance from Finished Surface

Top: 7.28 (feet)

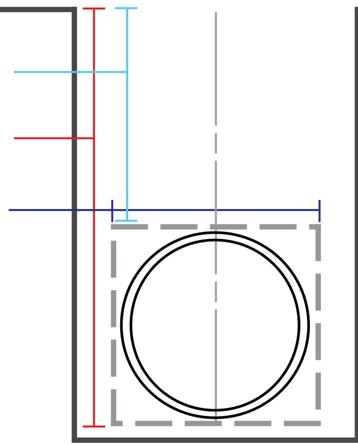
Bottom: 8.28 (feet)

Size: 12 (in)

Utility: Sewer

Material: Plastic

Direction: NE-SW



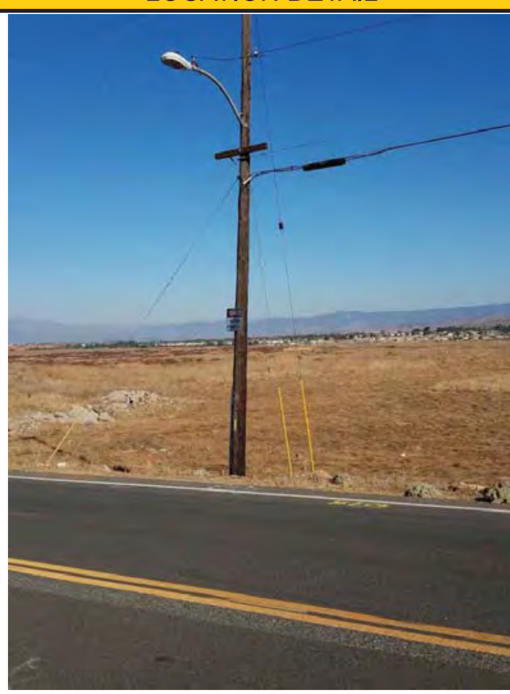
Notes:

Approximate coordiates: 33.933883°N 117.007647°W
19.50 ft. east of the Force main vault lid.

PHYSICAL SWING TIE INFORMATION

No.	Distance (ft)	Dir.	From Permanent Existing Fixture
1	19.50	E	Force Main Vault
2	63.40	SE	Power Pole
3	22.60	E	Chain Link Fence

LOCATION DETAIL



No.	Utility	Size (in)	Material	Top Depth (ft)	Direction	Location	Surface
ST1	Sewer	12	Plastic	7.28	NE-SW	West Bound on Western Knolls Ave., South West of Property 1280	Soil

Photo 1

Photo 2

Photo 3

Photo 4

Comments:

POTHOLING DATA SHEET

C BELOW SUBSURFACE IMAGING
14280 EUCLID AVE., CHINO, CA 91710
OFFICE: (888) 902-3569
FAX: (909) 606-6555

Technician Name	Date	C Below Project No.
Jacob Bankston	10-03-2020	20-2491

Project Name	Project Address
City of Beaumont | Force main	Potrero Blvd & Western Knolls Avenue Beaumont, CA 92223
Client Company	**Contact**
Cannon Corp. | Los Angeles	Eric

Pothole No.	Location
ST2	West of 630 Nicholas Rd. in Field

Surface Type: Soil

Thickness: N/A (feet)

Profile View (not to scale)

Measured Distance from Finished Surface

Top: 6.03 (feet)

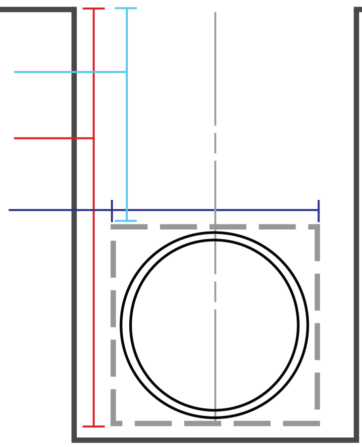
Bottom: 7.03 (feet)

Size: 12 (in)

Utility: Sewer

Material: Plastic

Direction: E-W



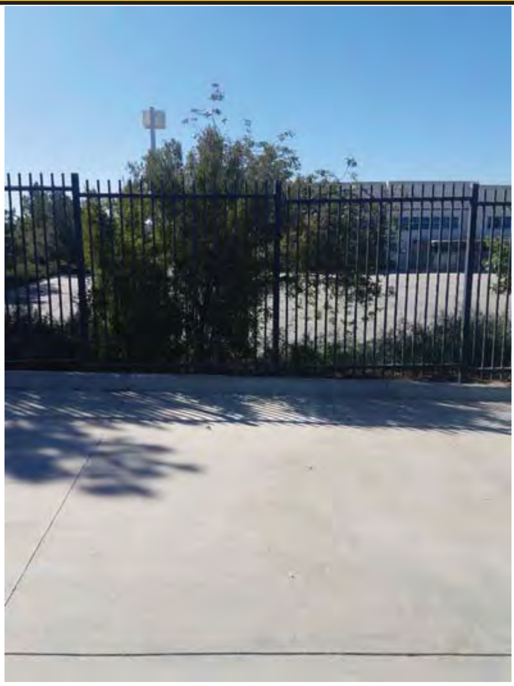
Notes:

Approximate Coordinates 33.9300501, -116.9950839

PHYSICAL SWING TIE INFORMATION

No.	Distance (ft)	Dir.	From Permanent Existing Fixture
1	8.10	E	Force Main Breather tube
2	58.10	N	Fence
3	N/A	N/A	N/A

LOCATION DETAIL



No.	Utility	Size (in)	Material	Top Depth (ft)	Direction	Location	Surface
ST2	Sewer	12	Plastic	6.03	E-W	West of 630 Nicholas Rd. in Field	Soil

Photo 1

Photo 2

Photo 3

Photo 4

Comments:

POTHOLING DATA SHEET

C BELOW SUBSURFACE IMAGING
14280 EUCLID AVE., CHINO, CA 91710
OFFICE: (888) 902-3569
FAX: (909) 606-6555

Technician Name	Date	C Below Project No.
Jacob Bankston	10-03-2020	20-2491

Project Name	Project Address
City of Beaumont | Force main	Potrero Blvd & Western Knolls Avenue Beaumont, CA 92223
Client Company	**Contact**
Cannon Corp. | Los Angeles	Eric
Pothole No.	**Location**
ST2.1	West of 630 Nicholas Rd. in Field

Surface Type: Soil

Thickness: N/A (feet)

Profile View (not to scale)
Measured Distance from Finished Surface

Top: 5.70 (feet)

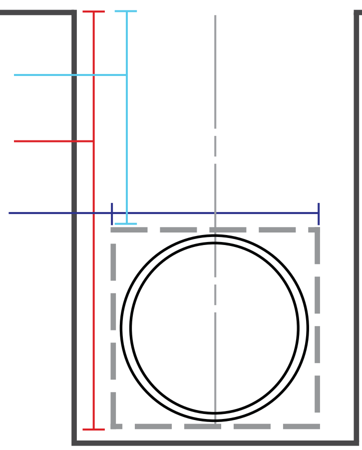
Bottom: 7.00 (feet)

Size: 16 (in)

Utility: Sewer

Material: Plastic

Direction: E-W



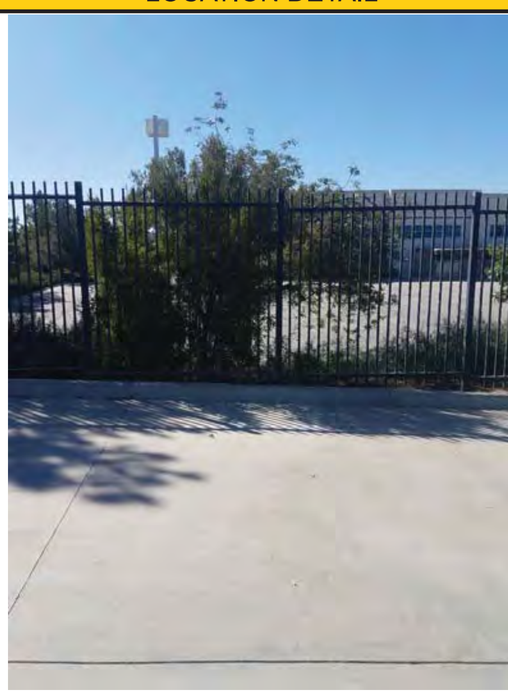
Notes:

Approximate Coordinates 33.9300501, -116.9950839

PHYSICAL SWING TIE INFORMATION

No.	Distance (ft)	Dir.	From Permanent Existing Fixture
1	8.00	E	Force Main Breather tube
2	55.40	N	Fence
3	N/A	N/A	N/A

LOCATION DETAIL



No.	Utility	Size (in)	Material	Top Depth (ft)	Direction	Location	Surface
ST2.1	Sewer	16	Plastic	5.70	E-W	West of 630 Nicholas Rd. in Field	Soil

Photo 1

Photo 2

Photo 3

Photo 4

Comments:

APPENDIX E

Fairway Canyon Preliminary Design Report (PDR) Review Memorandum

AKEL
ENGINEERING GROUP, INC.

April 15, 2021

City of Beaumont
550 E. 6th Street
Beaumont, CA 92223

Attention: Sue Foxworth
Solid Waste & Recycling Manager

Subject: Fairway Canyon Preliminary Design Report (PDR) Review Memorandum

Dear Sue:

We are pleased to submit this letter memorandum for the Fairway Canyon Preliminary Design Report Review. This letter memorandum includes the following sections:

- Study Area
- Flow Comparison
- Capacity Evaluation Review
- Conclusion

The purpose of this Technical Memorandum is to document the review of the Fairway Canyon Preliminary Design Report (PDR) as prepared by Proactive Engineering Consultants West, Inc. The PDR documents development dwelling units, estimation of future average, peak and design flows, design pumping capacity, force main size, and pump selection.

The City requested that Akel Engineering Group review the PDR for consistency with criteria documented in the City's in-progress 2021 Wastewater Master Plan. The remaining sections of the Technical Memorandum document the results of this review.

1.0 STUDY AREA

The Fairway Canyon development is a four-phase residential development in the northwest portion of the City of Beaumont (City), as shown on **Figure 1**. Three of the four planned phases have been completed; the final phase (Phase 4) is currently in the planning process. Phase 4 consists of 1,312 total dwelling units spread over approximately 310 acres. In addition to summarizing the layout of the final phase residential dwelling units, the PDR estimates average and peak design sewer flows that are used to estimate required lift station capacity and force main sizes.

It should be noted that the 2021 WMP evaluated the buildout of the City's general plan and included additional residential development east of San Timoteo Canyon Road between Hogan Drive and the northern boundary of the currently planned Phase 4 Fairway Canyon development. The flows from this additional residential development were also assumed tributary to the currently planned Fairway Canyon lift station. Should these future residential lands develop it is recommended City staff reevaluate the capacity of the planned Fairway Canyon lift station.

2.0 FLOW COMPARISON

The PDR estimated the average sewer flows using per capita sewer flow generation rates based on Eastern Municipal Water District (EMWD) standards. The in-progress City of 2021 Wastewater Master Plan (WMP) prepared an estimate of average sewer flows for the study area that is based on EMWD unit flow factors applied to overall site acreage. A comparison of the flow factors, peaking factors, and estimated flows is shown on **Table 1** and summarized below.

2.1 PDR Flow Estimation

The PDR estimated average flows on a dwelling unit basis and used peaking factor and additional safety factors based on EMWD standards. The estimated average, peak, and design flows are summarized below.

- **Average Flows:** According to the PDR, EMWD planning standards specify an average household occupancy of 3.5 persons per dwelling unit and an average per capita sewer flow generation rate of 100 gallons per day. The PDR combines these two factors for a per DU sewer flow generation rate of 350 gpd/DU.

  Based on the total of 1,312 total dwelling units and an average sewer flow generation rate of 350 gpd/DU, the total average sewer flow for Phase 4 of the Fairway Canyon Development is 319 gpm.

- **Peak Flows:** Assuming a peaking factor of 2.02, based on EMWD standards, the estimated peak flow from the future development is 644 gpm.

- **Design Flows:** Based on an additional factor of safety 20 percent the design flow is 773 gpm.

2.2 In-Progress 2021 WMP

The in-progress 2021 WMP estimates average flows on a per acres basis and uses daily peaking factors based on historical flow data and hourly peaking factors based on flow monitoring data. The estimated average and peak flows using this methodology are summarized on the following page.

- **Average Flows:** Based on a total site acreage of 307 acres, and using the WMP Single Family Residential flow factor of 1,396 gpd/acre consistent with EMWD planning standards, the total average sewer flow for planned development is 298 gpm.

- **Peak flows:** Using a peak day peaking factor of 1.33, based on historical flow records, and an hourly peaking factor of 1.54 based on flow monitoring data, the estimated development peak flow is 610 gpm.

The PDR flow estimation methodology results in a more conservative design flow and is an acceptable basis for sewer system planning.

3.0 CAPACITY EVALUATION REVIEW

The PDR documented required lift station pump and force main sizes based on the estimated design flow. The locations of the planned lift station and force mains are summarized on **Figure 2**. The following sections document the capacity evaluation for the planned lift stations and force mains and review for consistency with the in-progress 2021 WMP criteria.

3.1 Lift Station Capacity

The plans for Phase 4 of the Fairway Canyon development include a temporary lift station to collect and convey flows as the first part of the development phase is completed, with a final lift station planned as the remainder of the Phase 4 units are constructed. The PDR documented the capacity estimation for the permanent lift station, which is reflected in this review.

Based on an estimated design flow of 773 gpm the PDR specifies the future lift station to include two pumps at 803 gpm each. This results in a firm and total lift station design capacity of 803 gpm and 1,606 gpm, respectively, which meets the 2021 WMP criteria.

3.2 Force Main Capacity

The PDR includes two parallel 8-inch force mains, each approximately 6,200 feet in length, to convey flows from the planned permanent lift station to the City's existing gravity system. According to EMWD lift station design standards force main lengths in excess of 6,000 feet require two parallel force mains for reliability purposes. For the purpose of this capacity review, it was assumed that only one force main will be active at any time.

Based on planned lift station pump flow of 803 gpm and assuming a single 8-inch force main in service the maximum force main velocity is approximately 4.9 feet per second (ft/s) (**Table 1**), which meets the 2021 WMP criteria.

4.0 SUMMARY

Phase 4 of the Fairway Canyon development includes more than 1,300 residential dwelling units distributed over more than 300 acres. The Preliminary Design Report prepared by Proactive

Engineering Consultants West, Inc documents the planned development information, estimates average and peak design flows, and includes recommendations for future lift station pump and force main facilities.

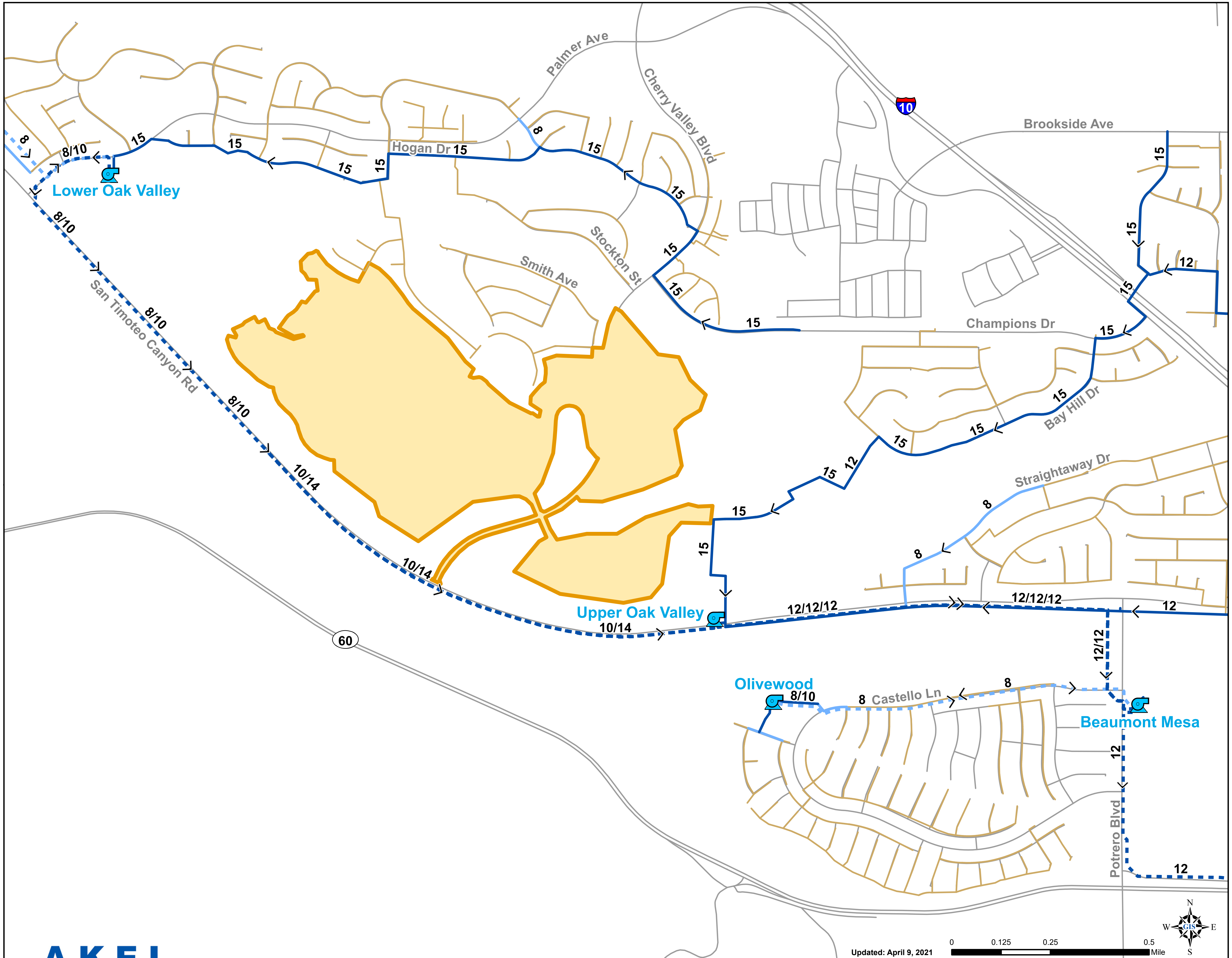
The findings of this review indicate that the flow estimation methodology results in a slightly more conservative design flow than what is reflected in the 2021 WMP for the same area. Based on this flow, the recommended lift station pump and force mains are within the criteria set forth in the 2021 WMP.

We are extending our thanks to you and other City of Beaumont Staff whose courtesy and cooperation were valuable components in completing this study and producing this report.

Sincerely,

AKEL ENGINEERING GROUP, INC.

Tony Akel, P.E.
Principal



Legend

Fairway Canyon Development

Existing System

Lift Stations

Modeled Force Mains

8" and Smaller

10" and Larger

Modeled Gravity Mains

8"

10" and Larger

Non-Modeled Pipes

Street Centerlines

City Limits

PRELIMINARY

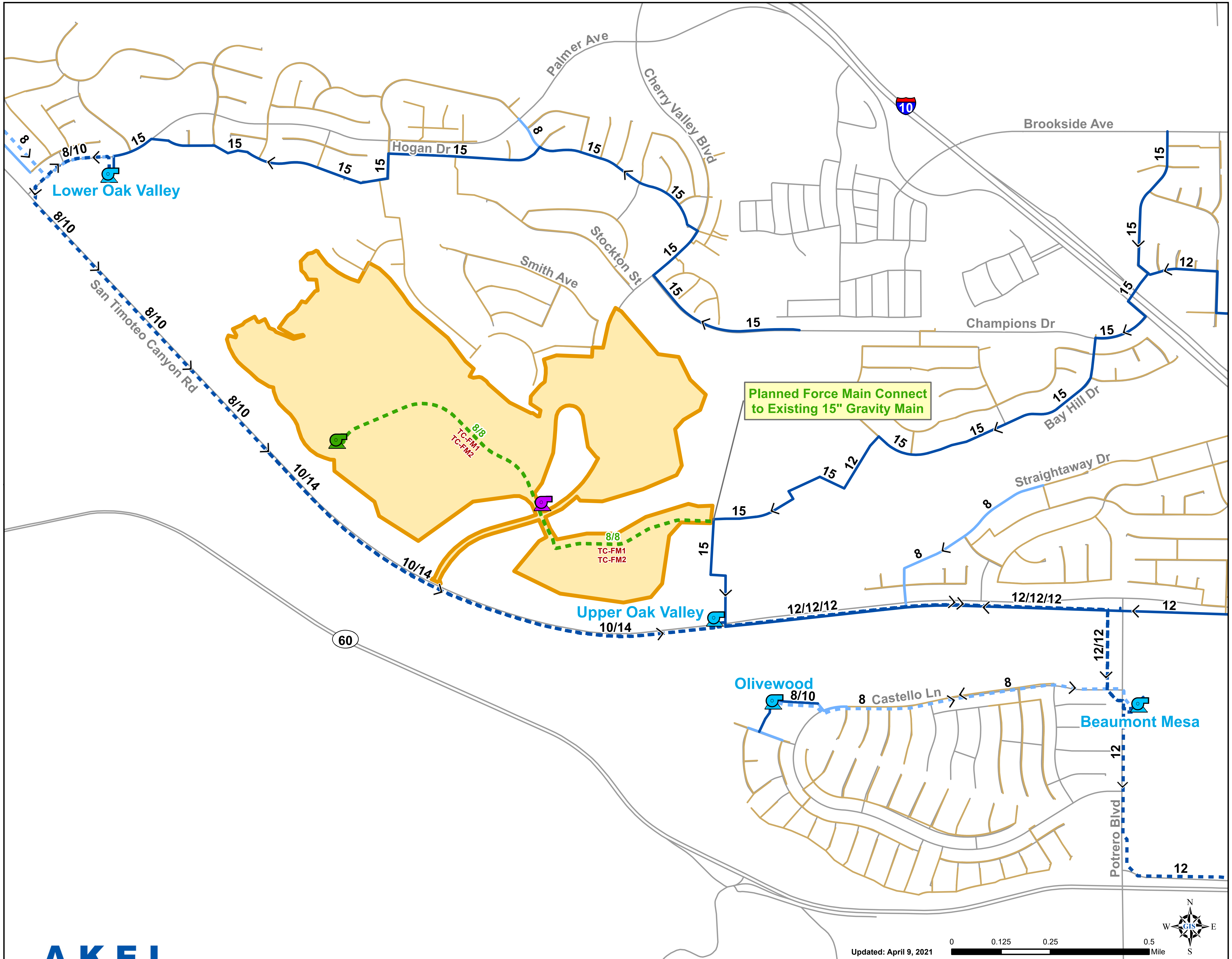
Figure 1
Existing Wastewater Collection System

Fairway Canyon
Preliminary Design Report Review
City of Beaumont

BEAUMONT
CALIFORNIA

AKEL
ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Beaumont\Sewer\210409-FairwayCanyonLS\BEA_Fig1_ExistingSystem_040921.mxd



Legend

Future Improvements

Lift Stations

- Temporary Lift Station
- Permanent Lift Station
- Force Mains
- Fairway Canyon Development

Existing System

- Lift Stations

Modeled Force Mains

- 8" and Smaller
- 10" and Larger

Modeled Gravity Mains

- 8"
- 10" and Larger
- Non-Modeled Pipes
- Street Centerlines
- City Limits

PRELIMINARY

Figure 2
Future Improvements
Fairway Canyon
Preliminary Design Report Review
City of Beaumont

BEAUMONT
CALIFORNIA

AKEL
ENGINEERING GROUP, INC.

Table 1 Development Summary and Capacity Evaluation

Fairway Canyon Preliminary Design Report Review
City of Beaumont

PRELIMINARY

Development and Flow Summary Summary		
Development Information[1]		
Land Use Type	Single Family Residential	
Total Dwelling Units, DUs	1,312 DU	
Total Area, acres	307 acres	
Sewer Flow Estimation		
	Methodology 1 Proactive Engineering Consultants West, Inc.[1]	**Methodology 2** 2021 In-progress Wastewater Master Plan[2]
Average Flow Factor	350 gpd/DU	1,396 gpd/acre
Average Flow, gpm	319	298
Peak Design Sewer Flow, gpm	644	610[3]
Design flows, gpm	773	610
Lift Station Capacity Evaluation		
Peak Design Sewer Flow, gpm	773	610
Required Firm Capacity, gpm	773	610
Minimum Total Capacity	1,546	1,220
Evaluation Result		
Preliminary design report specifies two 803 gpm pumps for a total station capacity of 1,606 gpm, which **meets the minimum capacity requirements.**		
Force Main Capacity Evaluation		
Force Main Criteria Desired Velocity: 2 ft/s to 6.5 ft/s Maximum Velocity: 10 ft/s		
Peak Sewer Flow, gpm	773	610
Single Force Main Size[4], inch	8	8
Maximum Velocity, ft/s	4.9	3.9
Evaluation Result		
The currently planned 8-inch force main will convey the peak devleopment flows **within master plan criteria of 10 ft/s.**		

AKEL ENGINEERING GROUP, INC.

4/15/2021

Notes:

1. Source: Sewer Design Calculation Preliminary Design Report provided by City staff March 17, 2021.
2. Average flow factor based on in-progress 2021 WMP, which is consistent with current EMWD standards.
3. Peak sewer flow reflects the following peaking factors:
   - Peak Day Flow = 1.33 x Average Annual Flow (Based on Historical Flow Data)
   - Peak Hour Flow = 1.54 x Peak Day Flow (Based on 2021 WMP City-Wide Flow Monitoring Data)
4. Current development plans indicate the construction of parallel 8-inch force mains for reliability purposes. For the purposes of the capacity evaluation a single force main is considered operational to convey the full peak flow.

APPENDIX F

Wastewater Hydraulic Analysis for McClure Industrial Building

CITY OF BEAUMONT

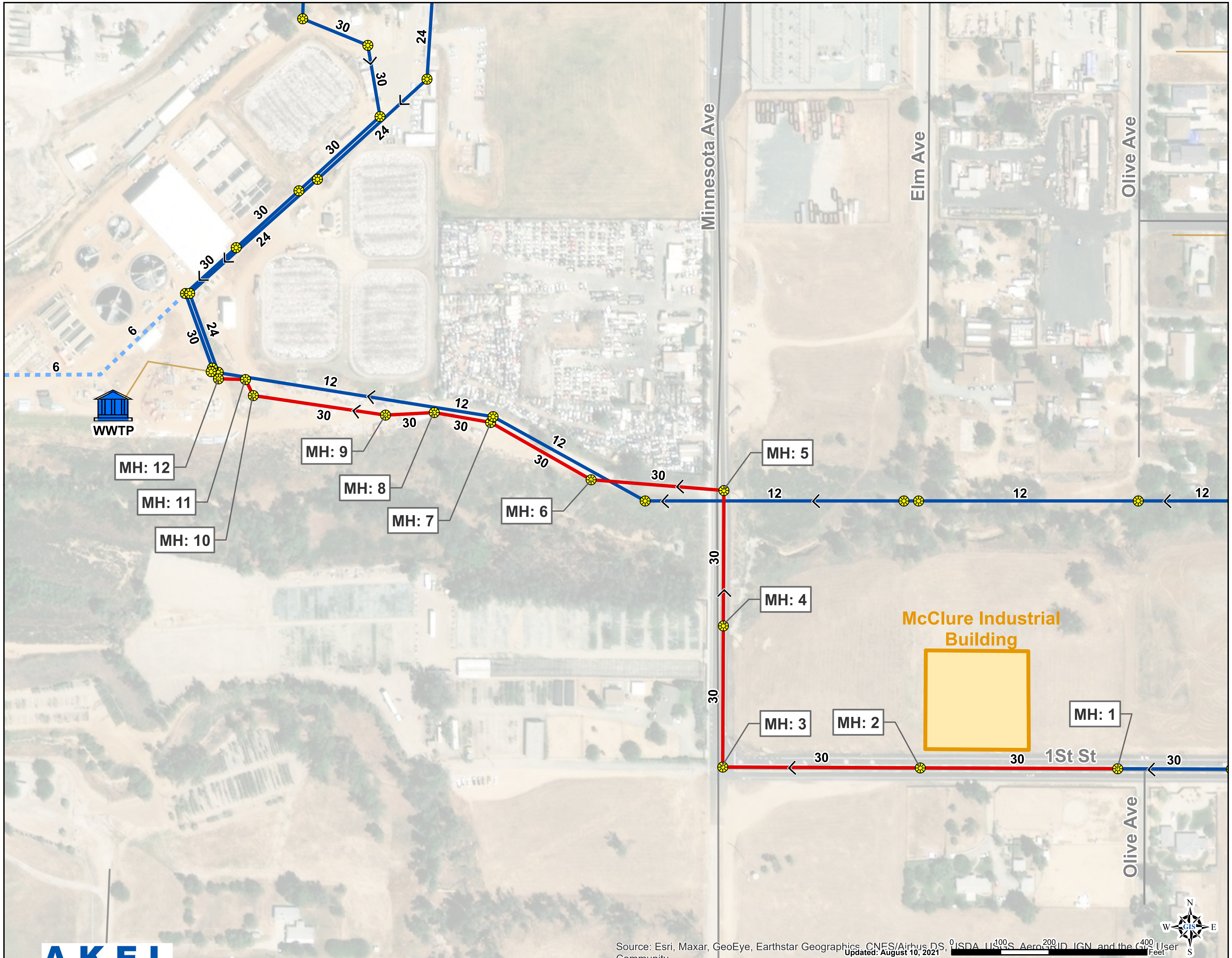
WASTEWATER HYDRAULIC ANALYSIS FOR MCCLURE INDUSTRIAL BUILDING

Hydraulic Analysis Package

PRELIMINARY

August 2021

AKEL ENGINEERING GROUP, INC.



Legend

Study Pipe

McClure Industrial Building

Existing System

Lift Stations

Manholes

Modeled Force Mains

8" and Smaller

10" and Larger

Modeled Gravity Mains

8"

10" and Larger

Non-Modeled Pipes

Street Centerlines

PRELIMINARY

Figure 1
Wastewater Study Area
Wastewater Hydraulic Analysis
for McClure Industrial Building
City of Beaumont

BEAUMONT CALIFORNIA

AKEL ENGINEERING GROUP, INC.

File Path: P:\xGIS\GIS_Projects\Beaumont\Sewer\191114-WastewaterMP\SpecialStudy\BEA_Fig_McClureIndustrial_081021.mxd

Table 1 Development Summary and Capacity Evaluation

Wastewater Hydraulic Analysis for McClure Industrial Building
City of Beaumont

PRELIMINARY

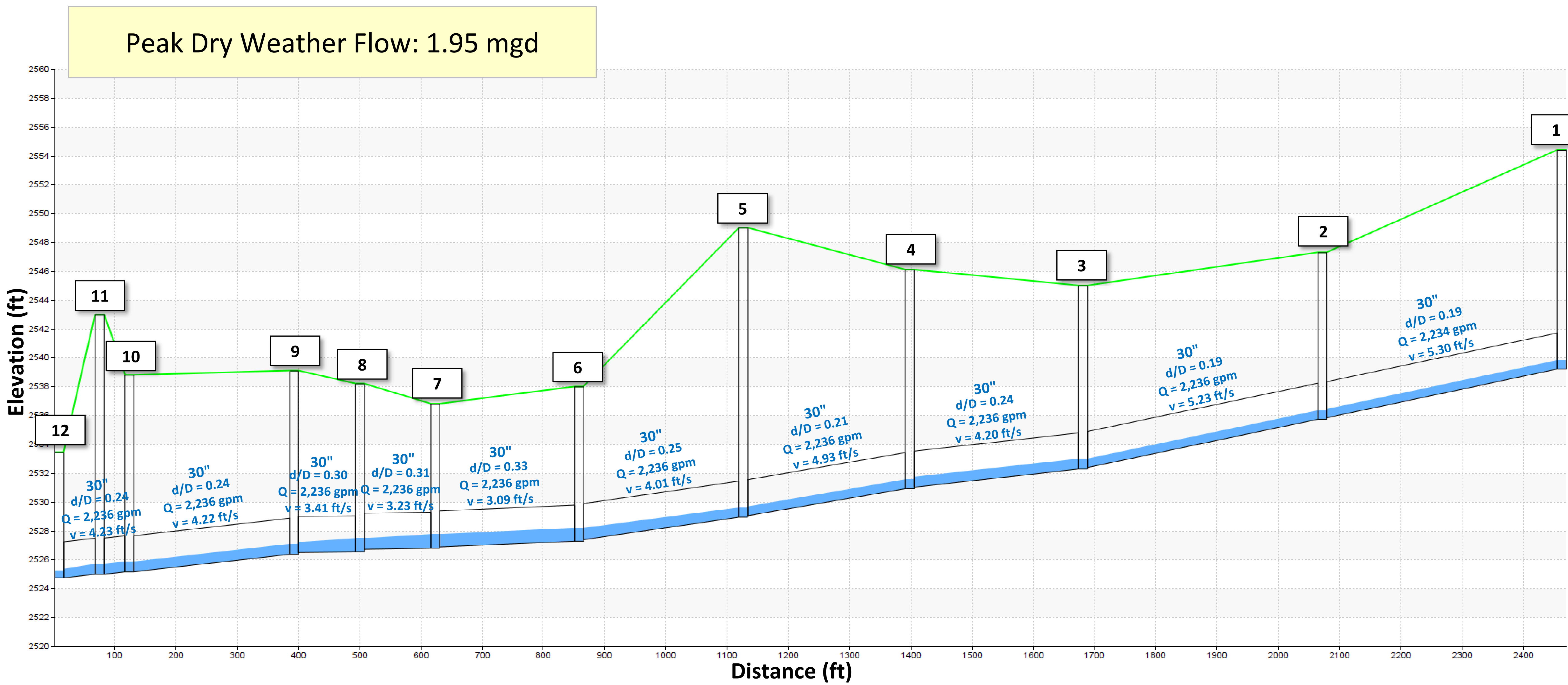
Development Information and Flow Summary		
Development Information[1]		
Land Use Type	Industrial	
Total Area	1.02	acres
Sewer Flow Estimation[2,3]		
Average Flow Factor	1763	gpd/acre
Average Flow	1.2	gpm
Peak Design Sewer Flow	2.6	gpm
Evaluation Results[4]		
Gravity Main Criteria		
- Dry Weather Flow d/D Criteria: Diameter ≥ 15 inches < 0.70		
- Wet Weather Flow d/D Criteria: < 1.00		
- Minimum Velocity: 2 ft/s		
- Maximum Velocity: 10 ft/s		
Existing Condition[5,6]		
	PDWF	**PWWF**
d/D	0.33	0.40
Pipeline Velocity, ft/s	3.09	3.35
Existing Condition + McClure Industrial Building[5,6]		
	PDWF	**PWWF**
d/D	0.33	0.40
Pipeline Velocity, ft/s	3.09	3.35
Evaluation Result		
The hydraulic analysis indicates that the peak devleopment flows **within master plan criteria**.		

AKEL ENGINEERING GROUP, INC.

8/10/2021

Notes:

1. Source: Development information provided by City staff August 8, 2021.
2. Average flow factor based on in-progress 2021 WMP, which is consistent with current EMWD standards.
3. Peak sewer flow reflects the following peaking factors:
   - Peak Day Flow = 1.33 x Average Annual Flow (Based on Historical Flow Data)
   - Peak Hour Flow = 1.57 x Peak Day Flow (Based on 2021 WMP City-Wide Flow Monitoring Data)
4. Wastewater System Design Criteria extracted from City of Beaumont in-progress 2021 Wastewater Master Plan.
5. Depth/Diameter shown reflect the maximum value in the alignment extracted from hydraulic model.
6. Pipeline velocity shown reflect the minimum value in the alignment extracted from the hydraulic model.



Legend

30" Pipeline Diameter

1 Manhole IDs

Note:

1. Existing flows represent Average Annual Flows consistent with the In-progress 2021 Wastewater Master Plan and reflect seasonal peaking factors.

PRELIMINARY

August 10,2021

AKEL ENGINEERING GROUP, INC.

Figure 2

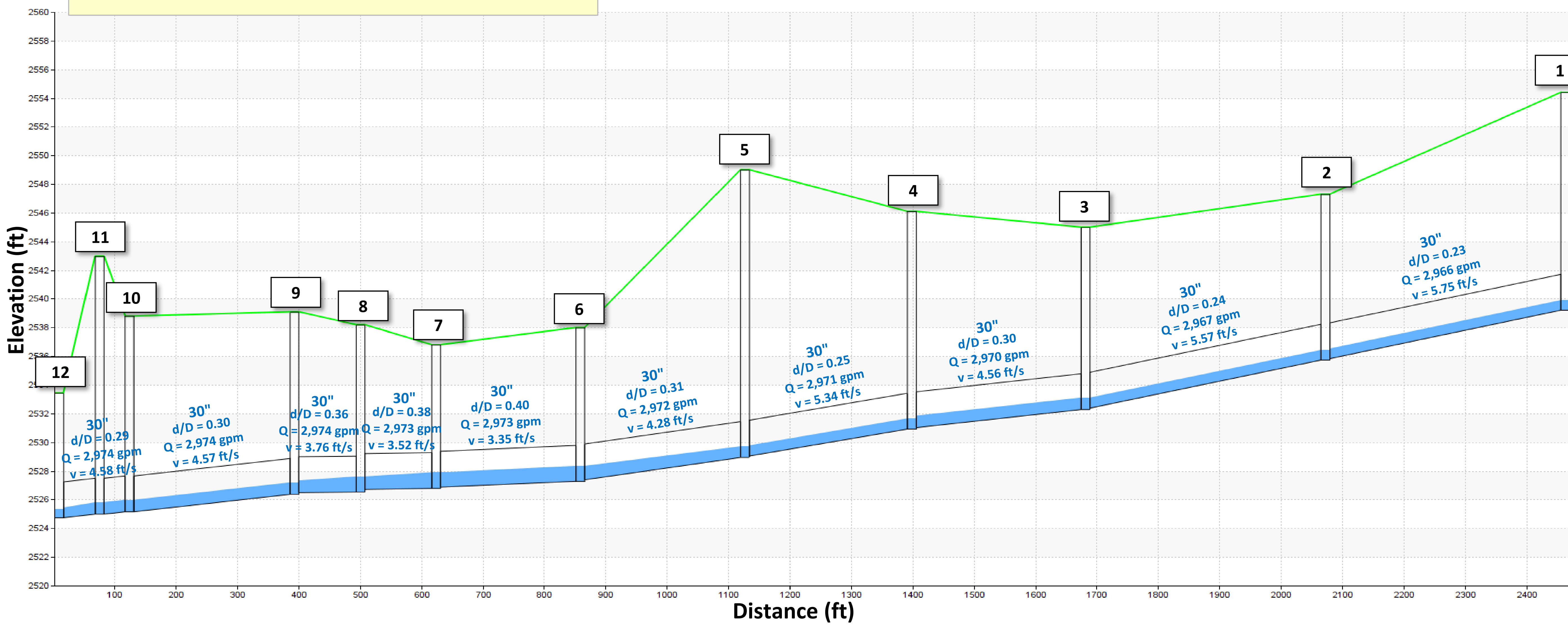
Existing System Hydraulic Profile - PDWF

Wastewater Hydraulic Analysis for McClure Industrial Building

City of Beaumont

BEAUMONT

Peak Wet Weather Flow: 2.30 mgd



Legend

30" Pipeline Diameter

1 Manhole IDs

Note:

1. Existing flows represent Average Annual Flows consistent with the In-progress 2021 Wastewater Master Plan and reflect seasonal peaking factors.

PRELIMINARY

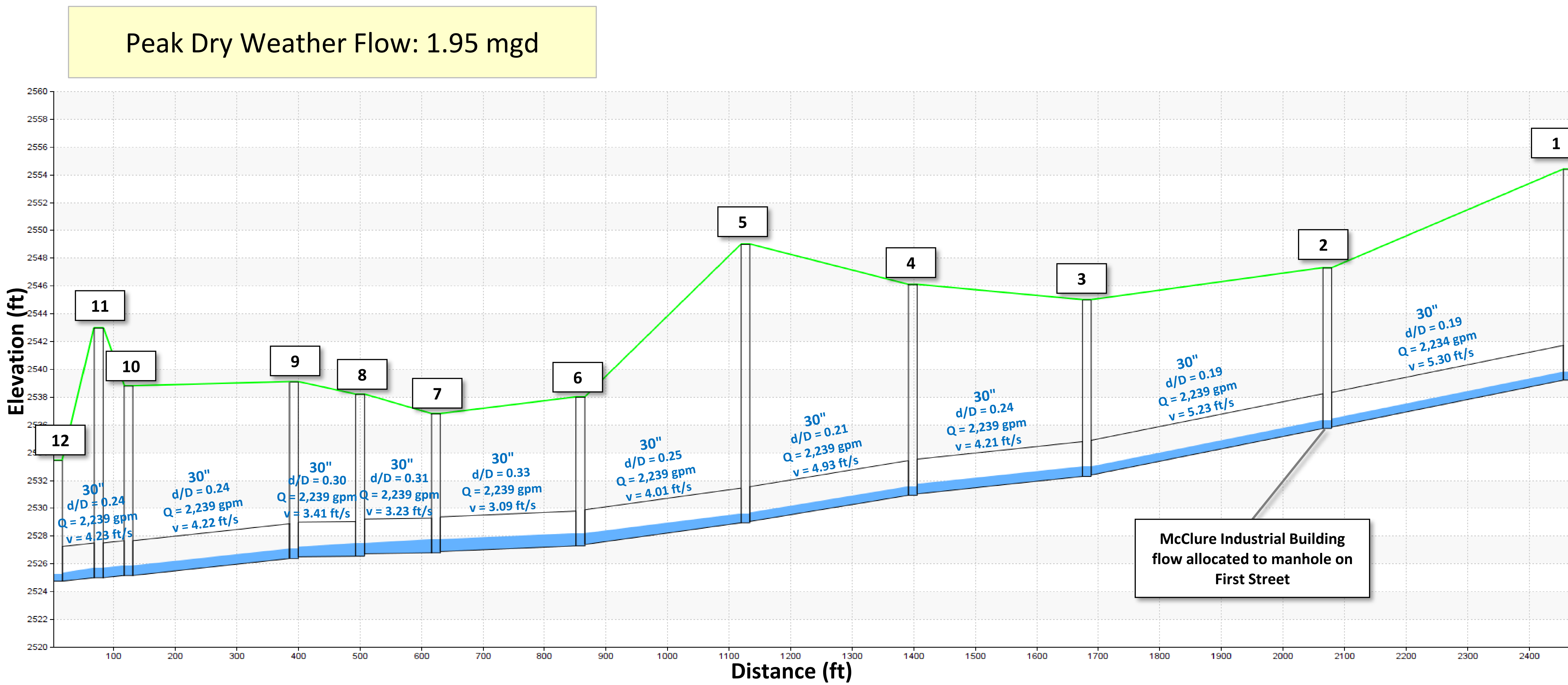
August 10,2021

Figure 3

Existing System Hydraulic Profile - PWWF

Wastewater Hydraulic Analysis for McClure Industrial Building
City of Beaumont

AKEL ENGINEERING GROUP, INC.



Legend

30" Pipeline Diameter

1 Manhole IDs

Note:

1. Existing flows represent Average Annual Flows consistent with the In-progress 2021 Wastewater Master Plan and reflect seasonal peaking factors.

PRELIMINARY

August 10,2021

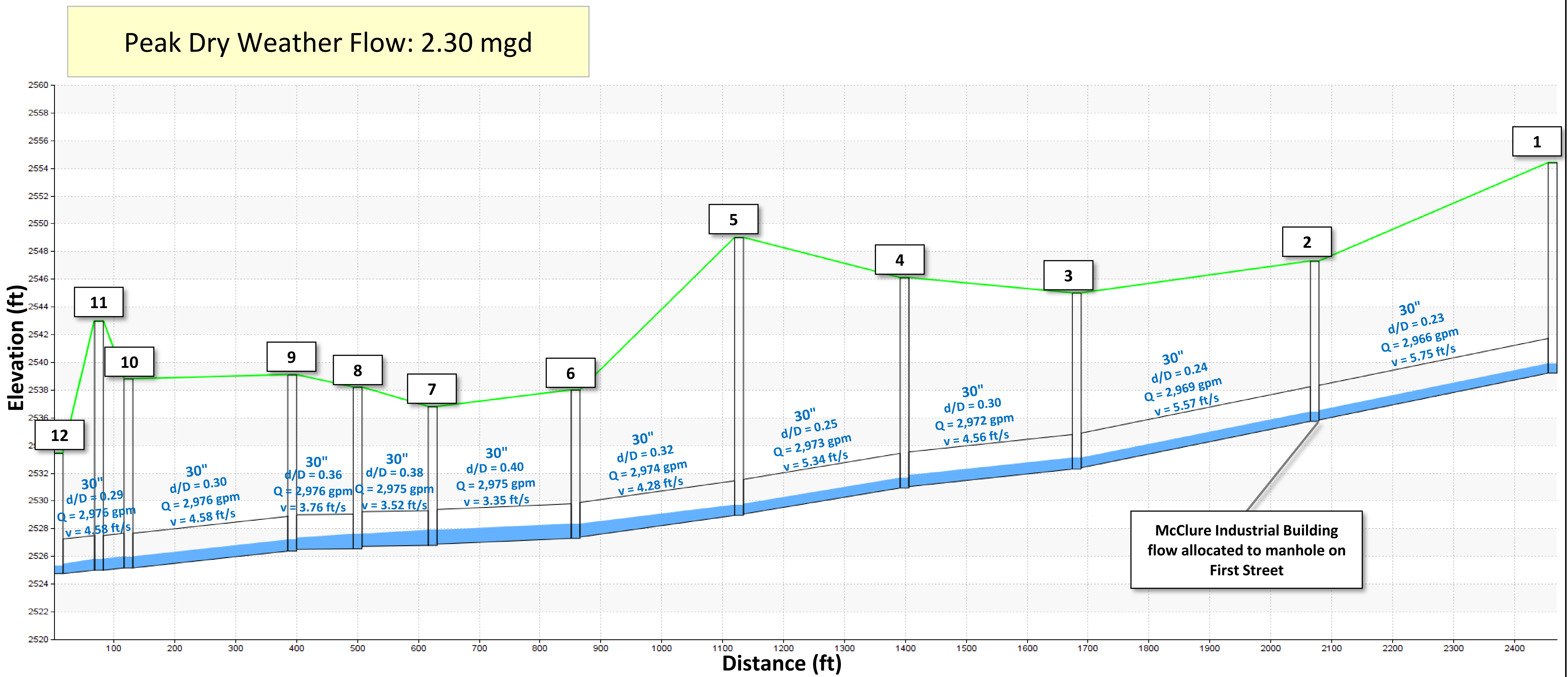
AKEL ENGINEERING GROUP, INC.

Figure 4

Ex. Sys + McClure Industrial Hydraulic Profile - PDWF

Wastewater Hydraulic Analysis for McClure Industrial Building

City of Beaumont



Legend

30" Pipeline Diameter

1 Manhole IDs

PRELIMINARY

Note:

1. Existing flows represent Average Annual Flows consistent with the In-progress 2021 Wastewater Master Plan and reflect seasonal peaking factors.

August 10,2021

AKEL ENGINEERING GROUP, INC.

Figure 5

Ex. Sys + McClure Industrial Hydraulic Profile - PWWF

Wastewater Hydraulic Analysis for McClure Industrial Building

City of Beaumont

APPENDIX G

Lift Station Condition Assessment – Prepared by V&A

Technical Memorandum

Akel Engineering Group, Inc.
City of Beaumont (Wastewater)
LIFT STATION CONDITION ASSESSMENT

Prepared for:	Tony Akel, P.E. Akel Engineering Group 7433 N. First Street, Suite 103 Fresno, CA 93720
Prepared by:	Farshad Malek, P.E.
Reviewed by:	Noy Phannavong, P.E.
Date:	May 2020

V&A consulting engineers

V&A Project No. 19-0280

In the promotion of environmental consciousness, this document is designed to be printed double-sided, if at all. V&A strives to do all it can to be a green company. Think twice before printing. Reduce. Reuse. Recycle.

1 INTRODUCTION

V&A Consulting Engineers, Inc. (V&A) was retained by Akel Engineering Group, Inc. (Akel) to support the City of Beaumont (City) with a structural and corrosion assessment of ten sanitary sewer lift stations (LS) located throughout the City's service area. The scope of the assessment included visual evaluation and supplementary non-destructive testing of concrete and metallic components of the major structural and mechanical equipment at each site. The findings will be used to provide input towards the City's Wastewater Master Plan Project. The sanitary sewer lift stations listed below were included in the assessment. Figure 1-1 shows an overview map of the lift station locations.

1. Fairway Canyon LS
2. Lower Oak Valley LS
3. Upper Oak Valley LS
4. Olivewood LS
5. Beaumont Mesa LS
6. Noble Creek LS
7. Marshall Creek LS
8. Cooper Creek (Industrial Park) LS
9. Seneca Springs LS
10. Four Seasons LS

Figure 1-1 Lift Station Location Map

2 APPROACH

2.1 VANDA® Concrete Condition Index

V&A created the VANDA Concrete Condition Index (Table 2-1) to provide consistent reporting of corrosion damage based on objective criteria. Concrete condition is rated from Level 1 to Level 5 based upon field observations and measurements, with Level 1 indicating the best case and Level 5 indicating severe damage. The individual criteria are applied based on engineering judgment to arrive at the overall rating.

Table 2-1. VANDA® Concrete Condition Index

Condition Rating	Description	Representative Photograph
Level 1	**Little or no damage to concrete** ▪ Hardness.............. hard surface ▪ Surface profile ...... smooth, apparently intact ▪ Cracks .... hairline width, minimal frequency ▪ Spalling .... none ▪ Reinforcement...... not exposed or damaged	
Level 2	**Minor surface damage** ▪ Hardness.............. soft surface layer to 1/8-inch depth ▪ Surface profile ...... fine aggregate exposed ▪ Cracks .... hairline width, moderate frequency ▪ Spalling .... shallow spalling, minimal frequency ▪ Reinforcement...... not exposed or damaged	
Level 3	**Moderate surface damage** ▪ Hardness.............. soft surface layer to 1/4-inch depth ▪ Surface profile ...... large aggregate exposed or protruding ▪ Cracks .... up to 1/32-inch width, moderate frequency ▪ Spalling .... shallow spalling, minimal frequency ▪ Reinforcement...... exposed; minor damage, minimal frequency	
Level 4	**Loss of concrete mortar and damage to reinforcement** ▪ Hardness.............. soft paste beyond 1/4-inch depth ▪ Surface profile ...... large aggregate exposed, loose, or missing ▪ Cracks .... 1/8- to 1/4-inch width, moderate frequency ▪ Spalling .... deep spalling, moderate frequency ▪ Reinforcement...... exposed with damage, moderate frequency	
Level 5	**Bulk loss of concrete and reinforcement** ▪ Hardness.............. soft paste beyond 1-inch depth ▪ Surface profile ...... large aggregate exposed, loose, or missing ▪ Cracks .... over 1/2-inch width, or narrower and frequent ▪ Spalling .... deep spalling, high frequency ▪ Reinforcement...... consumed; loss of structural integrity	

2.2 VANDA® Metal Condition Index

V&A created the VANDA Metal Condition Index (Table 2-2) to provide consistent reporting of corrosion damage based on objective criteria. Metal condition is rated from Level 1 to Level 5 based upon field observations and measurements, with Level 1 indicating the best case and Level 5 indicating severe damage. The individual criteria are applied based on engineering judgment to arrive at the overall rating.

Table 2-2. VANDA® Metal Condition Index

Condition Rating	Description	Representative Photograph
Level 1	**Little or no corrosion** ▪ Wall thickness loss, general ......none ▪ Wall thickness loss, pitting.........none to minimal ▪ Extent (area) of corrosion...........may be widespread but superficial	
Level 2	**Minor corrosion** ▪ Wall thickness loss, general ......up to 20% ▪ Wall thickness loss, pitting.........up to 20% ▪ Extent (area) of corrosion...........localized	
Level 3	**Moderate corrosion** ▪ Wall thickness loss, general ......20% to 40% ▪ Wall thickness loss, pitting.........20% to 60% ▪ Extent (area) of corrosion...........up to half of surface	
Level 4	**Severe corrosion** ▪ Wall thickness loss, general ......40% to 60% ▪ Wall thickness loss, pitting.........60% to 100% (pinholes) ▪ Extent (area) of corrosion...........most of surface	
Level 5	**Failure or imminent failure** ▪ Wall thickness loss, general ......greater than 60% ▪ Wall thickness loss, pitting.........100% (holes) ▪ Extent (area) of corrosion...........most or all of surface	

2.3 Concrete Assessment Methods

2.3.1 Concrete Surface Evaluation

Several methods were used to evaluate the condition of the concrete surfaces and its exposure environment. The methods used for these assessments are described in this section.

2.3.1.1 Sounding

Sounding was performed on accessible concrete slabs and walls at the evaluator's discretion to investigate for shallow, subsurface discontinuities. Using a hammer to strike accessible concrete surfaces, the sound can indicate if defects such as voids, delamination, or honeycombing are present. The sound returned from solid concrete without subsurface discontinuities is a sharp "ping" noise. A "hollow" sound generally means that a discontinuity exists beneath the sounding location. A soft "thud" typically results from deteriorated concrete.

2.3.1.2 Penetration Testing

Penetration testing was performed in concrete dry wells to estimate the depth of degradation from the existing surface of concrete. Penetration testing could not be performed in wet wells without conducting a confined space entry. Typically, as concrete deteriorates the cement paste begins to lose alkalinity. A chipping hammer was used to remove loose and degraded material from the concrete surface until highly alkaline concrete is reached where practical, and then the depth of the resulting cavity is measured. Unless the concrete is soft and chalky, V&A will typically not chip away more than 1/2-inch deep. In this case, if the pH in the cavity is not greater than 10, then the extent of degradation has not been reached and concrete coring is recommended. The correlation between penetration measurements and concrete surface hardness is presented in Table 2-3.

Table 2-3 Concrete Surface Hardness Index

Penetration Depth (in.)	Surface Texture	Scaling (1)
< 1/16	Hard surface, no scaling (1)	No scaling
1/16 – 1/8	Softened surface and/or loose cementitious material, light scaling	Light scaling
1/8 – 1/4	Soft surface and/or exposed and loose fine aggregate, medium scaling	Medium scaling
> 1/4	Soft paste and/or exposed and loose coarse aggregate, severe scaling	Severe scaling

(1) Scaling is defined by flaking or peeling away of near surface portion of hardened concrete or mortar, per ACI 201R, Condition Survey Guide.

2.3.1.3 Surface pH Measurements

V&A performed in-situ pH measurements on exposed concrete surfaces in concrete dry wells using a pH sensitive pencil. Surface pH testing could not be performed in wet wells without conducting a confined space entry. The pH of concrete exposed to wastewater is commonly altered by carbonation and hydrogen sulfide induced acid-attack (biogenic corrosion). Concrete carbonation refers to the reaction of atmospheric CO_2 with cement hydrates in concrete, which can lower the pH of the concrete to as low as 8.5. Carbonation is typically a slow process and is harmless until its depth reaches embedded reinforcing steel. Hydrogen sulfide induced corrosion, on the other hand, can be an aggressive mechanism of concrete degradation, where gaseous hydrogen sulfide is oxidized to sulfuric acid on surfaces within the sewer headspace. This process can severely deteriorate concrete and reduce the surface pH to as low as pH 1.

The surface pH of the concrete can indicate the rate of concrete deterioration due to environment exposure. In general, with conventional concrete mix designs using common Type II and Type V Portland cements, concrete has the ability to withstand moderately low pH surfaces (≈ 6.0) for long periods of time. The generally accepted ranges for corrosion categories and surface pH values are listed below:

- **Severe Corrosion.** This category of concrete corrosion is characterized by significant measurable concrete loss or active corrosion. There is exposed aggregate and occasional exposed reinforcing steel. The original concrete surface is not distinguishable. The surface is covered with soft, pasty corrosion products where active scouring is not present. There is generally a depressed wall pH (< 3.0) indicating active corrosion.
- **Moderate Corrosion.** This category of concrete corrosion is characterized by some concrete loss with aggregate slightly exposed, but the original concrete surface is still distinguishable. The surface may have a thin covering of pasty material which is easily penetrated. There is generally a depressed wall pH (< 5.0) indicating moderately corrosive conditions.
- **Light Corrosion.** This category of concrete corrosion is characterized by a slightly depressed pH (< 6.0) and a concrete surface that can be scratched with a sharp instrument under moderate hand pressure with the removal of some concrete material. The original concrete surface is fully recognizable, and aggregate may or may not be exposed.
- **Negligible Corrosion.** This category of concrete corrosion is characterized by normal pH ranges (>6.0) and a normal concrete surface which cannot be penetrated or removed by a sharp instrument under moderate hand pressure. The surface of the concrete may have biological growth and moisture, but the concrete is normal, and the aggregate is not exposed.

Concrete pH levels below 10 at the depth of reinforcing steel bars can cause corrosion of the bars.

2.4 Coating Assessment

2.4.1 Dry Film Thickness

Dry film thickness (DFT) is the thickness of a coating after it has cured. A DFT gauge uses electromagnetic induction or eddy current technology to measure the thickness of a wide variety of coatings on metal surfaces. V&A used a gauge that can measure coatings up to 0.2 inches (200 mils) in thickness. Measurements were taken on metallic components in the same manner as described for ultrasonic testing in Section 2.5.1.

2.5 Metal Assessment Methods

2.5.1 Ultrasonic Testing

Ultrasonic testing (UT) is a non-destructive evaluation technique used for the determination of metal wall thickness. High-frequency sound waves are transmitted through one side of a metal wall from a transducer. When the sound waves reach the other side of the metal wall, a fraction of the waves will echo back to the transducer. The metal thickness is determined by recording the time it takes for the sound wave to travel through the metal and return.

Measurements were recorded for various piping. For pipes, measurements were made around the pipe circumference and were referenced to four clock positions (12:00, 3:00, 6:00, and 9:00) viewed in the downstream direction (Figure 2-1). If pitting, or extremely localized corrosion is found, a pit depth gauge will be used since UT may not provide acceptable readings due to the rough surface.

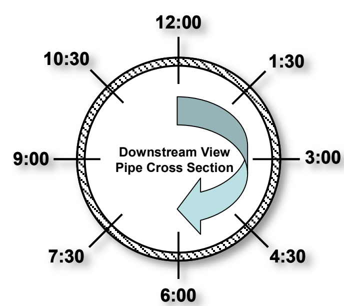


Figure 2-1 Clock Positions on Pipe Looking Downstream

3 CONCLUSIONS/RECOMMENDATIONS

Table 3-1 (below) provides a color-coded summary of the overall VANDA® ratings assigned to the various major components at each respective lift station. Table 3-2 provides a summary of recommendations resulting from V&A's corrosion assessment. Observations are supplemented with photographs and more detailed recommendations in the appendices. The appendices are provided as follows:

- A-1. Fairway Canyon LS
- A-2. Lower Oak Valley LS
- A-3. Upper Oak Valley LS
- A-4. Olivewood LS
- A-5. Beaumont Mesa LS
- A-6. Noble Creek LS
- A-7. Marshall Creek LS
- A-8. Cooper Creek (Industrial Park) LS
- A-9. Seneca Springs LS
- A-10. Four Seasons LS

Table 3-1 VANDA Condition Ratings Summary Table

	VANDA® Ratings (Overall)							
	Concrete (Structural)					Metal (Piping)		
Lift Station	CMU Wall	Equipment Pads[(1)]	Dry Well	Wet Well[(2)]	Bypass MH[(2)]	Aboveground	Belowground	Wet Well
1. Fairway Canyon LS	2	2	2	3	- [(3)]	-	2	3
2. Lower Oak Valley LS	2	3	-	2	2	2	-	4
3. Upper Oak Valley LS	2	2	-	2	3	2	-	4
4. Olivewood LS	2	2	-	2	-	2	-	2
5. Beaumont Mesa LS	2	2	2	2	4	2	2	4
6. Noble Creek LS	-	2	-	2	1	3	-	4
7. Marshall Creek LS	2	2	-	2	2	3	-	4
8. Cooper Creek (Industrial Park) LS	-	2	-	2	-	2	-	3
9. Seneca Springs LS	3	2	-	1	1	2	-	3
10. Four Seasons LS	3	3	-	2	2	2	-	3

(1) Includes roof slab of wet well structures.
(2) VANDA® ratings for lined structures assume liner is providing adequate protection against deterioration.
(3) Not applicable.

Table 3-2 Recommendation Summary Table

	Recommendation							
Lift Station	**Mortar (CMU)**	**Concrete repair**	**Repair Liner**	**New Liner**	**Replace Piping (Wet Well)**	**Touch up Coating**	**New Coating**	**Other**
1. Fairway Canyon LS	x		x		x	x		x
2. Lower Oak Valley LS	x	x	x		x	x		
3. Upper Oak Valley LS		x		x	x		x	x
4. Olivewood LS							x	
5. Beaumont Mesa LS		x	x	x		x		x
6. Noble Creek LS					x		x	
7. Marshall Creek LS			x		x		x	x
8. Cooper Creek (Industrial Park) LS							x	
9. Seneca Springs LS	x					x		x
10. Four Seasons LS			x			x		x

APPENDICES

A-1

Lift Station

Lift Station ID:	Fairway Canyon LS
Location:	33.964192°; -117.070813°
Assessment Date:	04.27.2020
Assessed by:	Farshad Malek
Lift Station Type:	Non-submersible
Pumps:	Duty: Pump #1, Pump #2
Discharge Piping:	9" DIP

Sanitary Sewer / Location Map

Condition Summary:

Site

- CMU perimeter wall, split face on external and shot-blast on the interior (VANDA 2)
  - There is no mortar on the vertical joints
  - Limited efflorescence observed, typically 0"-12" around the perimeter, presumably where there is less direct sunlight (moisture evaporation)
  - Spalling block on lower interior wall, near entrance
- Asphalt cracking throughout the site (0.25" width)
- Equipment concrete pads in good overall condition (VANDA 2)
  - Light exposed aggregate on generator equipment pad

Dry Well

- Steel can structure well lined in overall good condition (VANDA 2)
- (2x) 6" pump assemblies
  - Minor surface corrosion typical at bolts and flanges throughout piping (VANDA 2)
  - Pump #2: leak from pump/motor onto flange resulting in VANDA 3 level corrosion; leak then continues to bottom of dry well (1/4" to 1/2" deep standing water)
- Pipe supports are in good condition, however the bottom is likely to develop corrosion due to constant submersion (leak from Pump #2)
- Corrosion in northwest wall where liner has failed
- Corrosion where conduit clamps have been fastened into the cone section

Wet Well

- Concrete collar: VANDA 3 rating with spalling concrete showing exposed aggregate (~6" x 3" area)
- PVC liner and concrete structure are in good condition overall
- Moderate grease layer covering interior of wet well
- Stainless steel ladder in good condition

Site Photo 1

Site Photo 2

Missing mortar at vertical CMU joints (typical)

Efflorescence typical along bottom 0”–12”

Spalling block wall near entrance

Spalling block (closeup)

Dry well interior

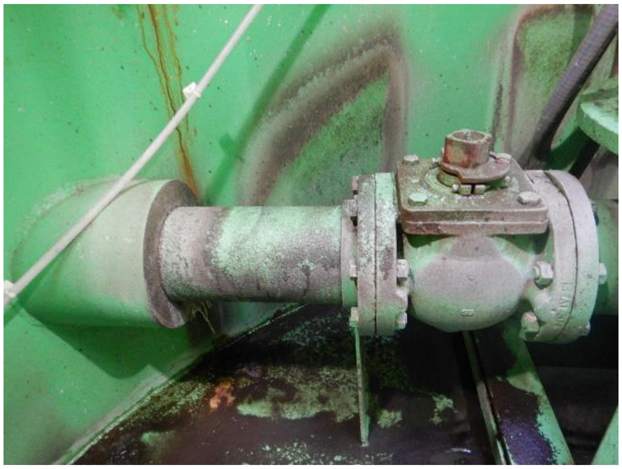
Dry well interior

Pump #1

Pump #1 corrosion at bolts

Pump #2, leak at pump/motor

Pump #2 corrosion due to leak (closeup)


Degraded liner and coating


Pump #2 corrosion at bolts/flanges


1-1/2" Sump Pump piping


Air blower


Corrosion where lined has failed (NW wall)


Corroded hardware at conduit supports

Exposed aggregate at wet well concrete collar

Exposed conduit outlet body

Wet well interior

Wet well interior (closeup)

Wet well interior (closeup)

Wet well interior (closeup)

UT Data:

Band	Piping	Minimum (inches)	Maximum (inches)	Average (inches)	Max. Wall Loss (%)	Max. Wall Loss (in.)	Maximum Metal Loss (%)
1	Pump 1 (suction)	0.370	0.389	0.376	0.030	8%	0.370
2	Pump 1 (discharge)	0.396	0.437	0.410	0.004	1%	0.396
3	Pump 2 (discharge)	0.391	0.396	0.394	0.009	2%	0.391

DFT Data:

Band	Piping	Minimum (mils)	Maximum (mils)	Average (mils)	Recommended thickness (mils)
1	Pump 1 (suction)	6.9	10.4	8.8	8 to 12
2	Pump 1 (discharge)	19.0	35.7	28.1	8 to 12
3	Pump 2 (discharge)	23.5	39.3	29.9	8 to 12

(1) Piping not exposed to sunlight is recommended to have 8 to 12 mils of epoxy coating

Recommendations

1. Repair leak from Pump #2 as soon as possible to prevent further corrosion and ensure longevity of other equipment.

2. Touch up pipe coating as needed in dry well with two coats at 4 to 6 mils each of a surface tolerant epoxy. Acceptable products include Carboline Carboguard 891 VOC, PPG Amerlock 400, or Tnemec L69 Hi Build Epoxoline II. The surfaces will have to be prepared per SSPC SP11 Power Tool Cleaning to Bare Metal for proper adhesion and coating longevity.

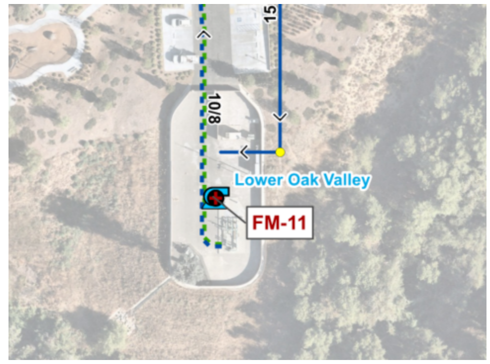
3. Repair liner in dry well at locations identified and replace conduit support hardware; provide proper isolation of dissimilar metals to prevent future corrosion.

4. Apply mortar (Sika 223 or equal) to cover exposed aggregate on wet well concrete collar; provide a smooth finish to protect the concrete from moisture. Application shall not exceed the maximum application thickness specified by the manufacturer to prevent feathering (thin layers that will lead to cracking and delamination).

A-2

Lift Station

Lift Station ID:	Lower Oak Valley LS
Location:	33.959571°; -117.061583°
Assessment Date:	04.27.2020
Assessed by:	Farshad Malek
Lift Station Type:	Submersible Pump
Pumps:	Duty: Pump #1, Pump #2 Note: Pump #3 will not keep up with flow (50-hp)
Discharge Piping:	6" & 10" DIP



Sanitary Sewer / Location Map

Condition Summary:

Site

- CMU perimeter wall in good condition (VANDA 2) with minor efflorescence typical throughout
- Pointing in poor condition, either missing or depressed in most vertical joints on exterior, split-face side
- Asphalt in fair condition, minor cracks near entrance
- Concrete pads in overall fair condition (VANDA 3) with multiple cracks observed
  - Cracked concrete at Pump 1 discharge header

Aboveground Piping

- Surface corrosion observed throughout piping where coating has failed (VANDA 2)
- Cracking on external rubber seals, presumably from UV damage and differential settlement of pipe supports
- Corrosion typical at threaded connections for ARVs and Air-Vac Valves
- Cracked concrete collar at 4" flange-mounts on top of concrete supports
- Cracked concrete pipe supports (x2) at Pump #3 ARVs; piping appears to have laterally shifted by 1 - 2 inches
- Corrosion at valve handle for 2" Industrial Water line (note: staff has noted this line is not in service, typical throughout District)

Wet Well

- T-lock liner appears to be in good condition with staining; concrete beneath is presumed to be in good condition (VANDA 2)
- Liner appears to have air pockets on inlet side of wall
- Coating is flaking off the safety grating at the opening
- Vent piping moderately corroded throughout (VANDA 3)
- Pump discharge piping is heavily corroded (VANDA 4)

Bypass Manhole

- Corrosion at manhole frame (VANDA 3)

- Liner is disbonding from the concrete at the cone; concrete beneath in good condition (VANDA 2)
- Pinholes in liner (x2) roughly halfway from the bench

<u>Additional findings</u>

- Minor corrosion observed on electrical panels

Site Photo 1

Site Photo 2

Missing mortar at vertical CMU joints (typical)

Efflorescence typical throughout interior CMU

Aboveground piping

Corrosion typical where coating has flaked

Corrosion typical where coating has flaked

Corrosion at ARV threaded connections (typical)

Cracking external rubber seals (typical)

Crack in concrete at Pump 1 discharge header

Cracked concrete collar at 4-in flange-mounted pipe support (typical)

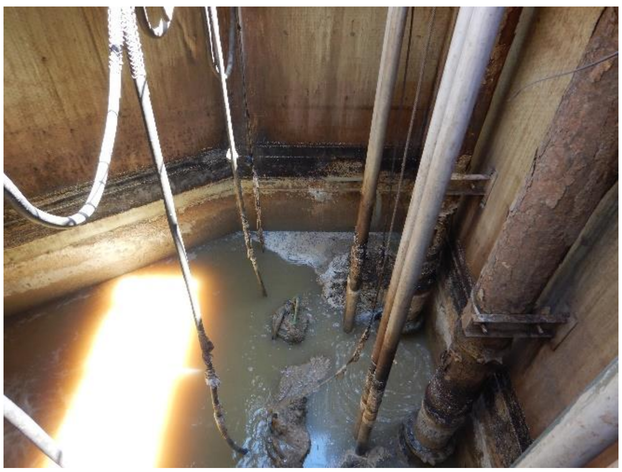
Cracked concrete pipe supports at Pump #3 ARVs; pipe shifted to left in photo

Wet well exterior

Peeling/flaking coating from grating

Wet well interior

Wet well interior



Wet well interior

Heavy corrosion on pump discharge piping (VANDA 4; typical)

Pump discharge piping (closeup)

Pump discharge piping (closeup)

Bypass MH exterior, corrosion at rim

Bypass MH liner disbonding from cone

Bypass MH interior, pinholes in liner

EPDM ladder rungs in good condition

UT Data:

Band	Piping	Minimum (inches)	Maximum (inches)	Average (inches)	Max. Wall Loss (in.)	Max. Wall Loss (%)
1	Pump 1 (spool)	0.377	0.392	0.383	0.043	10%
2	Pump 2 (spool)	0.365	0.380	0.370	0.015	4%
3	Pump 3 (spool)	0.358	0.399	0.379	0.022	6%

DFT Data:

Band	Piping	Minimum (mils)	Maximum (mils)	Average (mils)	Recommended thickness (mils)
1	Pump 1 (spool)	8.3	15.1	11.8	6 to 9
2	Pump 2 (spool)	7.3	10.6	9.1	6 to 9
3	Pump 3 (spool)	9.9	11.1	10.5	6 to 9

(1) Piping exposed to sunlight is recommended to have 4 to 6 mils of epoxy coating with an additional 2 to 3 mils of aliphatic polyurethane

Recommendations

1. Monitor the state of degradation of the CMU wall mortar annually; if condition worsens, rake out mortared joints to a ¼-in to a ½-in depth and pack with new mortar with the finish slightly recessed from the face of the block. Mortar vertical joints as well.

2. Touch up above-ground pipe coating as needed with 4 to 6 mils of epoxy coating and 2 to 3 mils of aliphatic polyurethane. The surfaces shall be prepared per SSPC SP11 Power Tool Cleaning to bare metal for proper adhesion and coating longevity.

3. Coat surfaces of galvanized steel piping and threaded connections

4. Repair cracked/broken concrete with Sika 223 or equal; provide a smooth finish to protect the concrete from moisture. Application shall not exceed the maximum application thickness specified by the manufacturer to prevent feathering (thin layers that will lead to cracking and delamination). Concrete repairs include the concrete at the Pump 1 discharge header, the concrete collars at the flange-mounted pipe supports (3 to 4 locations), and the cracked concrete pipe supports for Pump #3.

5. Monitor piping and supports for lateral movement and differential settlement.

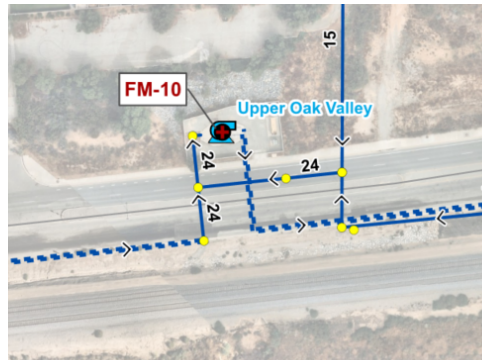
6. Replace submersible pump discharge piping with fusion bonded epoxy-coated and lined steel piping.

7. Fully bond liner to the concrete at the cone of the bypass manhole, and repair pinholes. Acceptable products include Sancon 100 or equal.

A-3

Lift Station

Lift Station ID:	Upper Oak Valley LS
Location:	33.943414°; -117.034672°
Assessment Date:	04.28.2020
Assessed by:	Farshad Malek
Lift Station Type:	Submersible Pump
Pumps:	Duty: Pump #1, Pump #5 Standby/High Level: Pump #3 Future: Pump #2, Pump #4
Discharge Piping:	6" split (x2)



Sanitary Sewer / Location Map

Condition Summary:

Site

- CMU perimeter wall in good condition (VANDA 2) with minor efflorescence typical
  - Spalling pocket on interior of south wall
  - Pointing in fair condition
- Asphalt in good overall condition, one large crack (0.2") spanning from the wet well structure to the entrance gate
- Concrete pads in overall good condition (VANDA 2)

Aboveground Piping

- Moderate surface corrosion typical throughout (VANDA 2)
- Significant corrosion at Pump #1 ARV tap to 10" discharge (VANDA 4)
- Corrosion at combination air valves for both discharge lines (VANDA 2)
- Cracked concrete at the first pipe support for all three assemblies due to spanning over an expansion joint

Wet Well

- T-lock liner appears to be in good condition with staining; concrete beneath is presumed to be in good condition (VANDA 2)
- Pump discharge piping is heavily corroded (VANDA 4)
- Vent piping moderately corroded throughout (VANDA 2)

Bypass Manhole

- Corrosion at manhole frame (VANDA 3)
- Liner is degraded and disbonding throughout, concrete appears to be moderately deteriorated (VANDA 3)
- No mortar at cone section, exposed aggregate

Site Photo 1

Site Photo 2

Spalling pocket on interior of south CMU wall

Efflorescence typical throughout interior CMU

Aboveground piping

Surface corrosion typical throughout piping

Corrosion staining from tap connection

Corrosion at ARV tap connection (Pump 1)

Corrosion at CAVs (typical)

Corrosion at CAVs (typical)

Cracked concrete base at pipe supports spanning over expansion joint

Crack in asphalt spanning from wet well structure towards the entrance gate (0.2")


Wet well exterior


Wet well interior


Wet well interior


Wet well interior


Heavy corrosion on pump discharge piping (VANDA 4; typical)


Pump discharge piping

Pump discharge piping (closeup)

Pump discharge piping (closeup)

Bypass MH exterior, corrosion at rim

Non-mortared joints with exposed aggregate

Bypass MH interior

Liner disbonding from concrete (typical)

UT Data:

Band	Piping	Minimum (inches)	Maximum (inches)	Average (inches)	Max. Wall Loss (in.)	Max. Wall Loss (%)
1	Pump 1 (spool)	0.291	0.347	0.320	0.059	17%
2	Pump 3 (spool)	0.339	0.352	0.345	0.011	3%
3	Pump 1-2 discharge (spool)	0.437	0.456	0.446	0.023	5%
4	Pump 2-3 discharge (spool)	0.409	0.456	0.429	0.051	11%

DFT Data:

Band	Piping	Minimum (mils)	Maximum (mils)	Average (mils)	Recommended thickness (mils)
1	Pump 1 (spool)	2.7	15.9	10.0	6 to 9
2	Pump 3 (spool)	3.8	18.7	11.4	6 to 9
3	Pump 1-2 discharge (spool)	3.3	12.0	7.7	6 to 9
4	Pump 2-3 discharge (spool)	3.8	15.6	8.9	6 to 9

(1) Piping exposed to sunlight is recommended to have 4 to 6 mils of epoxy coating with an additional 2 to 3 mils of aliphatic polyurethane

Recommendations

1. Replace the corroded threaded tap connection at Pump 1 ARV while ensuring proper isolation of dissimilar metals.

2. Re-coat aboveground piping with 4 to 6 mils of epoxy coating and 2 to 3 mils of aliphatic polyurethane. The surfaces shall be prepared per SSPC SP11 Power Tool Cleaning to bare metal for proper adhesion and coating longevity.

3. Repair cracked/broken concrete with Sika 223 or equal; provide a smooth finish to protect the concrete from moisture. Application shall not exceed the maximum application thickness specified by the manufacturer to prevent feathering (thin layers that will lead to cracking and delamination). Concrete repairs include the cracked concrete pipe supports for Pump #1-3 spanning over the expansion joint. Consider moving the pipe supports downstream to the opposite end of the spool.

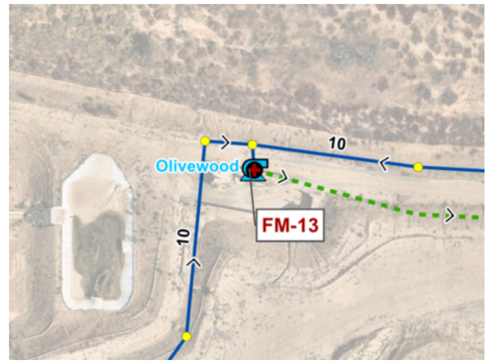
4. Replace submersible pump discharge piping with fusion bonded epoxy-coated and lined steel piping.

5. Replace liner in the bypass manhole with a 100% solids epoxy or polyurethane coating. Acceptable products include Endura Flex 1200 and 1988 or Raven 155 and 405.

A-4

Lift Station

Lift Station ID:	Olivewood LS
Location:	33.940344°; -117.032122°
Assessment Date:	04.28.2020
Assessed by:	Farshad Malek
Lift Station Type:	Submersible Pump
Pumps:	Duty: Pump #1, Pump #2 Future: Pump #3
Discharge Piping:	6" DIP



Sanitary Sewer / Location Map

Condition Summary:

Site
- CMU perimeter wall in good condition (VANDA 2) with minor efflorescence observed at the lower sections
- Pointing in fair condition
- Muddy, dirt ground surface with lots of tall weeds, good hiding spots for snakes.
- Equipment concrete pads in overall good condition (VANDA 2)

Aboveground Piping
- There is only factory coating applied to the piping, with only minimal surface corrosion observed (VANDA 2)
- Pipe supports are in good condition (VANDA 1)

Wet Well
- T-lock liner in good condition, moderate staining below waterline; concrete beneath is presumed to be in good condition (VANDA 2).
- Pump discharge piping in good condition (VANDA 2)


Site Photo 1


Site Photo 2

Pointing in fair condition

Concrete pads in good condition

Aboveground piping

Aboveground piping

Only factory coating applied

Minimal surface corrosion typical at flanges

Cracking external rubber seals (typical)

Wet well exterior

Wet well interior

Pump discharge piping, minor corrosion at bolts/flanges

Wet well interior (closeup)

Wet well interior (closeup)

UT Data:

Band	Piping	Minimum (inches)	Maximum (inches)	Average (inches)	Max. Wall Loss (in.)	Max. Wall Loss (%)
1	Pump 1 (spool)	0.249	0.301	0.275	0.031	11%
2	Pump 2 (spool)	0.311	0.335	0.321	0.029	8%
3	Common discharge	0.293	0.348	0.315	0.047	14%

DFT Data:

Band	Piping	Minimum (mils)	Maximum (mils)	Average (mils)	Recommended thickness (mils)
1	Pump 1 (spool)	5.0	15.3	9.3	6 to 9
2	Pump 2 (spool)	6.8	14.2	9.4	6 to 9
3	Common discharge	2.7	7.8	5.5	6 to 9

(1) Piping exposed to sunlight is recommended to have 4 to 6 mils of epoxy coating with an additional 2 to 3 mils of aliphatic polyurethane

Recommendations

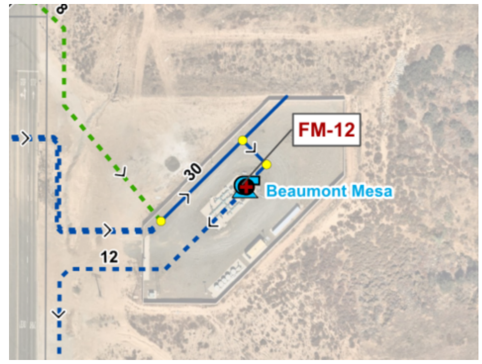
1. Consider paving the surface of the site and/or providing site maintenance to keep weeds short and reduce risk of snakes and other animals in hiding.

2. Apply 4 to 6 mils of epoxy coating and 2 to 3 mils of aliphatic polyurethane to the aboveground piping (SST not included). The surfaces shall be prepared per SSPC SP11 Power Tool Cleaning to bare metal for proper adhesion and coating longevity.

A-5

Lift Station

Lift Station ID:	Beaumont Mesa LS
Location:	33.940400°; -117.015966°
Assessment Date:	04.28.2020
Assessed by:	Farshad Malek
Lift Station Type:	Non-Submersible Pump
Pumps:	Duty: Pump #1, Pump #2
	Out of Service: Pump #3, Pump #4
Discharge Piping:	10”, 14”



Sanitary Sewer / Location Map

Condition Summary:

Site

- CMU perimeter wall in good condition (VANDA 2) with efflorescence typical throughout
  - Pointing in good condition
- Gravel surface with lots of tall weeds, good hiding spots for snakes.
- Concrete pads in overall good condition (VANDA 2)

Aboveground Piping

- Overall good condition with surface corrosion typical at bolts/flanges (VANDA 2)
- Moderate corrosion throughout all four combination air valves (VANDA 2)
- Cracked concrete pipe supports
  - Pump 1 beneath ARV
  - Pump 2 beneath ARV
  - Pump 2 from bolts going into concrete base
- Aboveground Biofilter with PVC piping and plastic storage tanks, SST hardware in good condition

Dry Well/Belowground Piping

- Cracked/peeling coating with corrosion evident throughout the swinging gate atop the Dry Well structure
- Sounding indicated solid concrete; delamination or shallow subsurface anomalies were not indicated (VANDA 2)
- Piping in overall good condition (VANDA 2). Corrosion at stainless steel flanges and tie rods typical throughout piping due to contact between dissimilar metals
- Corrosion at Flygt Pump/Motor base plates, Pump #1 and Pump #2
- Mild corrosion Pump 3 shaft
- Sump pumps completely submerged and appear heavily corroded (VANDA 4)
- Shallow spalling observed from 0” – 16” away from finished floor, east wall
- Efflorescence observed on the ceiling around each of the three large grated openings, presumably resulting from infiltration into small cracks
- pH measurements indicated atmospheric conditions inside of dry well to be negligible with respect to corrosion

Wet Well

- T-lock liner is disbonding at the top of the structure at opening
- Heavily corroded conduit (instrumentation) at top of wet well structure (VANDA 5)
- T-lock liner in fair condition, stained in some areas below the waterline; concrete beneath is presumed to be in good condition (VANDA 2)
- Liner is warped in some areas however no punctures or tears were observed
- Influent piping is heavily corroded (VANDA 4)
- Corrosion product from influent piping 3” to 4” bleeding down the southwest wall

Bypass Manholes

- Bypass MH #1 (westernmost, closes to entrance gate)
  - Heavy corrosion on underside of lid (VANDA 4)
  - Aged liner disbonding from the concrete near the rim
  - Exposed aggregate typical throughout unlined bench (VANDA 4)
- Bypass MH #2
  - High H2S alarm from gas meter while standing over opened manhole
  - Liner is disbonding from the concrete
  - Joints are not mortared
- Bypass MH #3
  - Liner in fair condition
  - Exposed aggregate typical throughout unlined bench (VANDA 4)
- Bypass MH #4
  - Liner in fair condition
  - Exposed aggregate typical throughout unlined bench (VANDA 4)


Site Photo 1


Site Photo 2

Efflorescence typical throughout CMU (typical)

Pointing in good condition

Aboveground piping

Aboveground piping

Corrosion typical where there is contact between dissimilar metals

Corrosion typical at bolts/flanges (likely due to dissimilar metals)


Corrosion at CAVs (typical)


Corrosion at CAVs (closeup)


Cracked concrete pipe support (Pump 1)


Cracked concrete pipe support (Pump 2)


Cracking at pipe support concrete bases (typical)


Aboveground Biofilter

Biofilter SST hardware in good condition

Dry well access swing gate corroded throughout

Dry well interior

Dry well interior

Pump Assembly #1

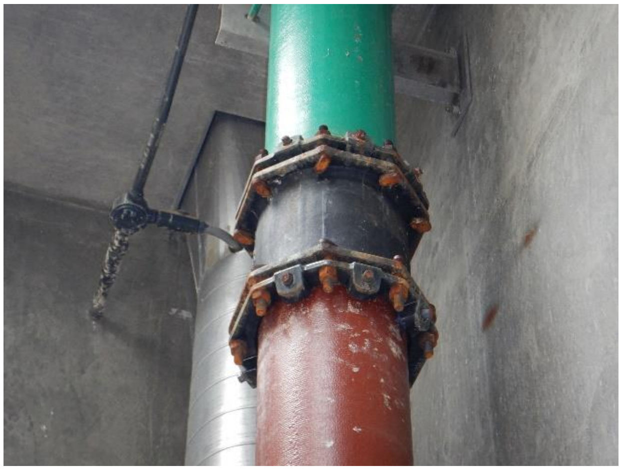
Pump Assembly #2


Pump Assembly #3 & #4


Corrosion typical at SST flanges and tie rods, dissimilar metals

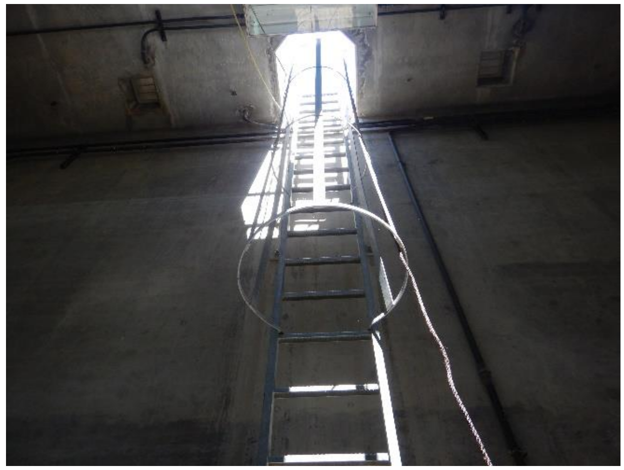

Corrosion at pump/motor base plates (Pumps #1-2)


Corrosion on pump shaft (Pump 4)

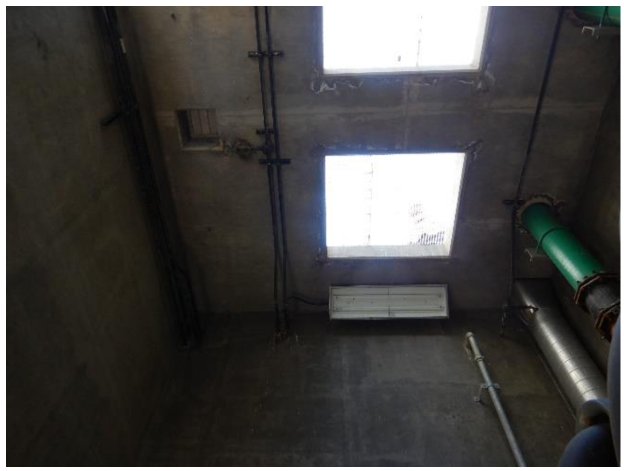

Corrosion typical on hardware at flexible couplings


Pipe supports in good condition


Sump pumps submerged, corroded


Steel ladder in good condition


Spalling typical at 0” – 16” AFF, east wall


Efflorescence on ceiling around openings


Liner disbonding at top of the structure


Corroded instrumentation conduit


Wet well interior


Wet well interior


Wet well influent pipe


Influent pipe, heavy corrosion (closeup)


Corrosion staining on southwest wall


Bypass MH #1 location


Heavy corrosion on underside of lid


Aged liner disbonding near the rim


Exposed aggregate typical throughout bench


Bypass MH #2 exterior


Liner disbonding from the concrete


Bypass MH #3 location

Bypass MH #3 interior

Bypass MH #4 location

Bypass MH #4 interior

Bypass MH #4 interior (closeup)

Concrete Penetration Testing Results:

Location	Penetration Depth (in.)	Surface pH	Depth pH	Remarks
Center of West Wall 5.5-ft AFF, Dry Well	1/16	11	12	Atmospheric conditions were negligible with respect to effect on corrosion

UT Data:

Band	Piping	Minimum (inches)	Maximum (inches)	Average (inches)	Max. Wall Loss (in.)	Max. Wall Loss (%)
1	South discharge, 10" (spool); aboveground	0.349	0.355	0.352	0.001	0%
2	North discharge, 14" (spool); aboveground	0.434	0.448	0.442	0.016	4%
3	Pump 2 suction, 10" (spool); dry well	0.406	0.440	0.421	0.034	8%
4	Pump 3 suction, 16" (spool); dry well	0.442	0.468	0.450	0.018	4%

DFT Data:

Band	Piping	Minimum (mils)	Maximum (mils)	Average (mils)	Recommended thickness (mils)
1	South discharge, 10" (spool); aboveground	13.5	18.9	16.4	6 to 9 (1)
2	North discharge, 14" (spool); aboveground	7.1	13.7	10.8	6 to 9 (1)
3	Pump 2 suction, 10" (spool); dry well	17.3	28.1	22.5	8 to 12 (2)
4	Pump 3 suction, 16" (spool); dry well	12.9	13.5	13.2	8 to 12 (2)

(1) Piping exposed to sunlight is recommended to have 4 to 6 mils of epoxy coating with an additional 2 to 3 mils of aliphatic polyurethane
(2) Piping not exposed to sunlight is recommended to have 8 to 12 mils of epoxy coating

Recommendations

1. Consider paving the surface of the site and/or providing site maintenance to keep weeds short and reduce risk of snakes and other animals in hiding.

2. Touch up aboveground pipe coating as needed with 4 to 6 mils of epoxy coating and 2 to 3 mils of aliphatic polyurethane. The surfaces shall be prepared per SSPC SP11 Power Tool Cleaning to bare metal for proper adhesion and coating longevity.

3. Repair cracked/broken concrete pipe supports with Sika 223 or equal; provide a smooth finish to protect the concrete from moisture. Application shall not exceed the maximum application thickness specified by the manufacturer to prevent feathering (thin layers that will lead to cracking and delamination).

4. Touch up pipe coating as needed in dry well with two coats at 4 to 6 mils each of a surface tolerant epoxy. Acceptable products include Carboline Carboguard 891 VOC, PPG Amerlock 400, or Tnemec L69 Hi Build Epoxoline II. The surfaces will have to be prepared per SSPC SP11 Power Tool Cleaning to Bare Metal for proper adhesion and coating longevity.

5. Chip away damaged concrete on lower east wall inside of the dry well and patch with Sika 223 or similar cementitious patching material; provide a smooth finish to protect the concrete from moisture. Application shall not exceed the maximum application thickness specified by the manufacturer to prevent feathering (thin layers that will lead to cracking and delamination).

6. Repair liner at the top of the wet well with Sancon 100 or similar.

7. Replace corroded instrumentation conduit inside of the wet well.

8. Coat the wet well inlet pipe with a 100% solids epoxy or polyurethane coating. Acceptable products include Endura Flex 1200 and 1988 or Raven 155 and 405.

9. Replace liner in the Bypass MH #1 and MH #2 with a 100% solids epoxy or polyurethane coating. Acceptable products include Endura Flex 1200 and 1988 or Raven 155 and 405.

10. Mortar the bench of Bypass MH #3 and MH #4 to cover exposed aggregate and provide a smooth watertight seal to protect the concrete from moisture, Acceptable products include Sika 223 or equal. Application shall not exceed the maximum application thickness specified by the manufacturer to prevent feathering (thin layers that will lead to cracking and delamination). Apply a 100% solids epoxy or polyurethane coating to the repaired area. Acceptable products include Endura Flex 1200 and 1988 or Raven 155 and 405

A-6

Lift Station

Lift Station ID:	Noble Creek LS
Location:	33.944963°; -117.001321°
Assessment Date:	04.29.2020
Assessed by:	Farshad Malek
Lift Station Type:	Submersible Pump
Pumps:	Duty: Pump #2, Pump #3 Future: Pump #1
Discharge Piping:	12" DIP

Sanitary Sewer / Location Map

Condition Summary:

Site
- Fencing in good condition, 3-layer barbed wire with minimal surface corrosion (VANDA 2)
- Asphalt in overall fair condition, large cracks (0.2") spanning east-west near the entrance, from the corners of the wet well pad, and from the bypass MH
- Concrete pads in overall good condition (VANDA 2)

Aboveground Piping
- Moderate surface corrosion typical throughout (VANDA 3)
- Surface corrosion covering surface of flowmeter (VANDA 3)
- Pipe supports are in good condition, well coated

Wet Well
- T-lock liner appears to be in good condition with staining and debris; concrete beneath is presumed to be in good condition (VANDA 2)
- High density of small patchwork applied to wall, indicative of an aged structure.
- Pump discharge piping is heavily corroded (Pump #1: VANDA 4, Pumps #2-3: VANDA 3)

Bypass Manhole
- T-lock liner in good condition, no defects noted; concrete beneath is presumed to be in good condition (VANDA 1)
- EPDM ladder rungs

Site Photo 1

Site Photo 2

Perimeter fencing, barbed wire with minimal corrosion

Cracking in asphalt near entrance

Cracking in asphalt from Wet Well and Bypass MH

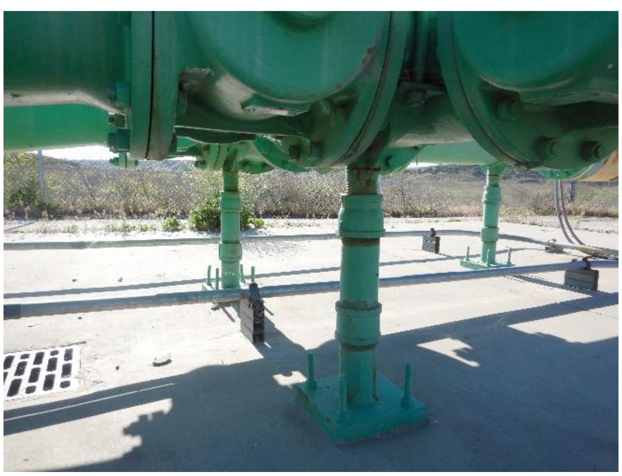
Aboveground piping


Surface corrosion typical throughout piping


Surface corrosion typical throughout piping

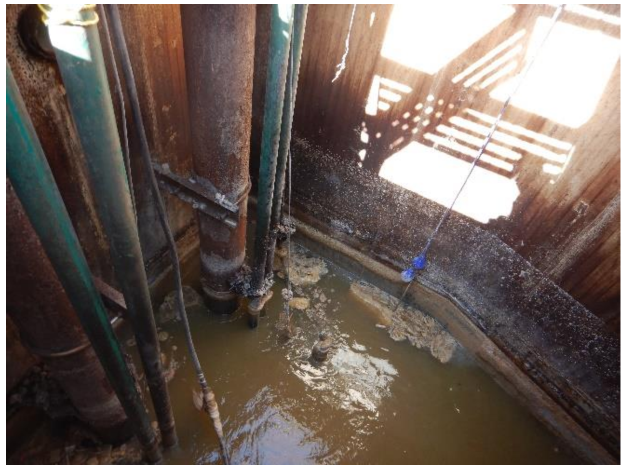

Surface corrosion (closeup)

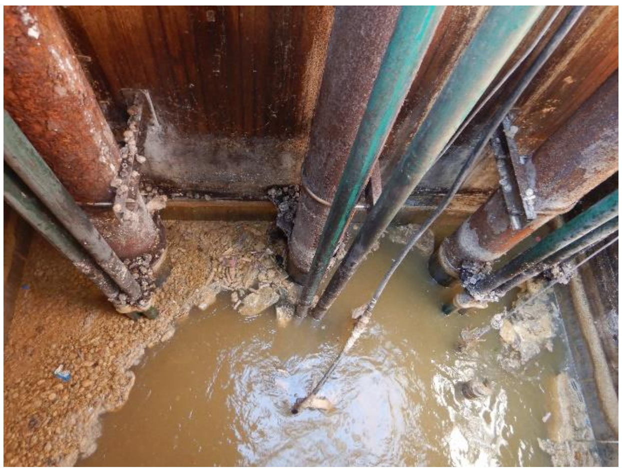

Corrosion throughout flowmeter


Pipe supports in good condition

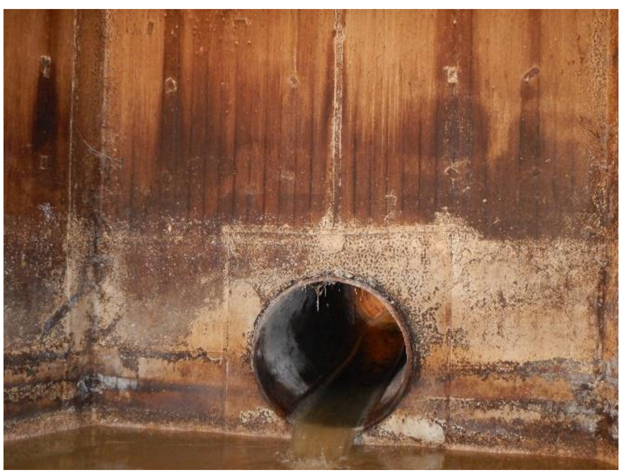

Surface corrosion on transformer

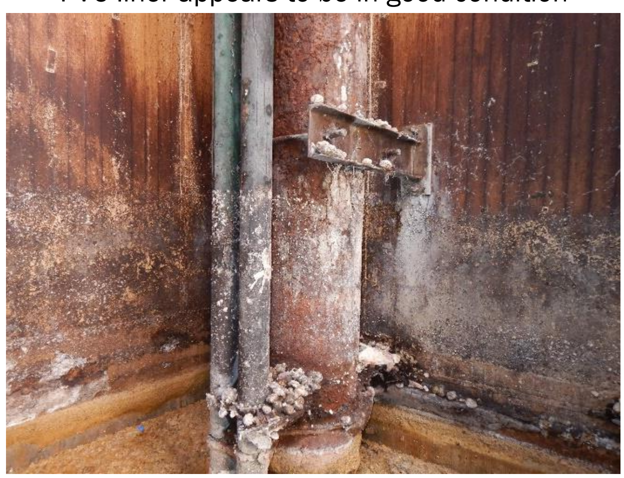

Wet well exterior


Wet well interior


Wet well interior


PVC liner appears to be in good condition


Wet well inlet (closeup)


Pump #1 discharge piping (closeup)


Pump #2 discharge piping (closeup)


Pump #3 discharge piping (closeup)


Bypass MH exterior


Manhole rim


Bypass MH interior


Bypass MH interior

UT Data:

Band	Piping	Minimum (inches)	Maximum (inches)	Average (inches)	Max. Wall Loss (in.)	Max. Wall Loss (%)
1	Pump 2 (spool)	0.308	0.358	0.334	0.062	17%
2	Pump 3 (spool)	0.350	0.365	0.357	0.020	5%
3	Common discharge	0.438	0.472	0.455	0.052	11%
4	Discharge flowmeter(1)	-	-	0.117	-	-

(1) Single point reading taken at crown of flowmeter

DFT Data:

Band	Piping	Minimum (mils)	Maximum (mils)	Average (mils)	Recommended thickness (mils)
1	Pump 2 (spool)	7.5	12.0	9.3	6 to 9
2	Pump 3 (spool)	8.1	9.5	8.5	6 to 9
3	Common discharge	6.3	9.5	8.4	6 to 9

(1) Piping exposed to sunlight is recommended to have 4 to 6 mils of epoxy coating with an additional 2 to 3 mils of aliphatic polyurethane

Recommendations

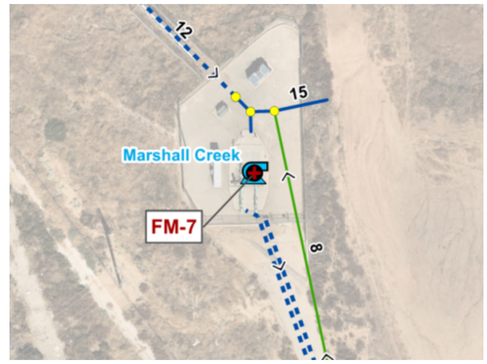
1. Re-coat aboveground piping with 4 to 6 mils of epoxy coating and 2 to 3 mils of aliphatic polyurethane. The surfaces shall be prepared per SSPC SP11 Power Tool Cleaning to bare metal for proper adhesion and coating longevity.

2. Replace submersible pump discharge piping with fusion bonded epoxy-coated and lined steel piping.

A-7

Lift Station

Lift Station ID:	Marshall Creek LS
Location:	33.940554°; -116.998411°
Assessment Date:	04.29.2020
Assessed by:	Farshad Malek
Lift Station Type:	Submersible Pump
Pumps:	Pump #1: Out of service Pump #2: Abandoned Pump #3: In service
Discharge Piping:	10" & 12" DIP



Sanitary Sewer / Location Map

Condition Summary:

Site

- Perimeter fencing in good condition (VANDA 2)
- ~3-ft tall retaining wall on east perimeter minor efflorescence (VANDA 2)
- Asphalt in overall fair condition, large cracks (0.2") typical leading from corners of structures (wet well pad, generator pad, transformer pad)
- Concrete pads in overall good condition (VANDA 2)

Aboveground Piping

- Moderate surface corrosion typical throughout (VANDA 3), covering roughly 10% of the surface area
- Minor surface corrosion observed on pipe supports (VANDA 2)

Wet Well

- T-lock liner appears to be in good condition with staining and debris below waterline; concrete beneath is presumed to be in good condition (VANDA 2)
- High density of small patchwork applied to wall, indicative of an aged structure.
- Pump discharge piping is heavily corroded (VANDA 4)

Bypass Manholes

- Bypass MH #1 (south):
  - Unlined, concrete is in overall good condition (VANDA 2)
  - Exposed circumferential reinforcement in cone section
- Bypass MH #2 (mid)
  - Liner is in good overall condition, however there appears to be small tears exposed concrete within 3-ft of the bench; concrete beneath is presumed to be in good condition (VANDA 2)
- Bypass MH #3 (north) is welded shut, could not be opened


Site Photo 1


Site Photo 2


Aboveground piping


Aboveground piping


Cracked/peeling coating with corrosion typical throughout piping


Aboveground piping

Surface corrosion typical throughout piping

Surface corrosion (closeup)

Wet well exterior

Wet well interior

Wet well interior (closeup)

Pump discharge piping

Pump discharge piping (closeup)

Pump discharge piping (closeup)

Pump discharge piping (closeup)

Pump discharge piping

Bypass MH #1 (south) location

Manhole rim


Spiral reinforcement breaching concrete


Bypass MH #2 (mid) interior


Bypass MH #2 interior, small tears within 3-ft of the bench


Bypass MH #3 (north) welded shut with corrosion

UT Data:

Band	Piping	Minimum (inches)	Maximum (inches)	Average (inches)	Max. Wall Loss (in.)	Max. Wall Loss (%)
1	Pump 1 (spool)	0.302	0.329	0.311	0.048	14%
2	Pump 2 (spool)	0.362	0.428	0.404	0.098	21%
3	Common discharge (east)	0.334	0.391	0.358	0.126	27%
4	Common discharge (west)	0.209	0.250	0.226	0.061	23%

DFT Data:

Band	Piping	Minimum (mils)	Maximum (mils)	Average (mils)	Recommended thickness (mils)
1	Pump 1 (spool)	5.9	13.1	8.1	6 to 9
2	Pump 2 (spool)	4.6	10.5	8.7	6 to 9
3	Common discharge (east)	10.7	14.4	12.4	6 to 9
4	Common discharge (west)	2.1	4.1	3.2	6 to 9

(1) Piping exposed to sunlight is recommended to have 4 to 6 mils of epoxy coating with an additional 2 to 3 mils of aliphatic polyurethane

Recommendations

1. Re-coat aboveground piping with 4 to 6 mils of epoxy coating and 2 to 3 mils of aliphatic polyurethane. The surfaces shall be prepared per SSPC SP11 Power Tool Cleaning to bare metal for proper adhesion and coating longevity.

2. Replace submersible pump discharge piping with fusion bonded epoxy-coated and lined steel piping.

3. Patch-repair liner in Manhole #2 (mid). Acceptable products include Sancon 100 or equal.

4. Repair/replace lid and cover frame for Manhole #3 (north) so that it may be safely accessed. The lid would not budge after multiple attempts; the rim was moving with the lid during attempted removal.

A-8

Lift Station

Lift Station ID:	Cooper Creek (Industrial Park) LS
Location:	Beaumont WWTP 33.923845°; -116.994839°
Assessment Date:	04.27.2020
Assessed by:	Farshad Malek
Lift Station Type:	Submersible Pump
Pumps:	Duty: Pump #2, Pump #3 Future: Pump #1
Discharge Piping:	6" DIP

Sanitary Sewer / Location Map

Condition Summary:

Aboveground Piping

- Coating is thin throughout the piping assemblies with minor surface corrosion (VANDA 2) as well as factory coating visible through peeling/flaking top-coat
- Concrete pad is in good condition (VANDA 1)
- Pipe supports are in good condition

Wet Well

- T-lock liner is in good overall condition, no defects evident; concrete beneath is presumed to be in good condition (VANDA 2)
- Surface corrosion typical throughout pump discharge piping (VANDA 3)


Site Photo 1


Site Photo 2


Aboveground piping


Surface corrosion typical throughout piping


Coating peeling/flaking at riser sections (typical)


Factory coating evident through thinned coating (typical)


Wet well pad in good condition


Wet well interior, topside

Wet well inlet

Pump discharge piping

Pump discharge piping (closeup)

Pump discharge piping (closeup)

UT Data:

Band	Piping	Minimum (inches)	Maximum (inches)	Average (inches)	Max. Wall Loss (in.)	Max Wall Loss (%)
1	Pump 1 (spool)	0.311	0.335	0.323	0.029	9%
2	Pump 2 (spool)	0.309	0.334	0.319	0.031	9%
3	Pump 3 (spool)	0.334	0.343	0.339	0.006	2%
4	Common header	0.333	0.338	0.336	0.007	2%

DFT Data:

Band	Piping	Minimum (mils)	Maximum (mils)	Average (mils)	Recommended thickness (mils)
1	Pump 1 (spool)	3.7	10.9	6.2	6 to 9
2	Pump 2 (spool)	4.5	12.0	7.8	6 to 9
3	Pump 3 (spool)	7.6	10.0	9.1	6 to 9
4	Common header	5.1	9.1	7.7	6 to 9
5	Pump 1 Check Valve, factory coating	2.1	2.5	2.3	6 to 9

(1) Piping exposed to sunlight is recommended to have 4 to 6 mils of epoxy coating with an additional 2 to 3 mils of aliphatic polyurethane

Recommendations

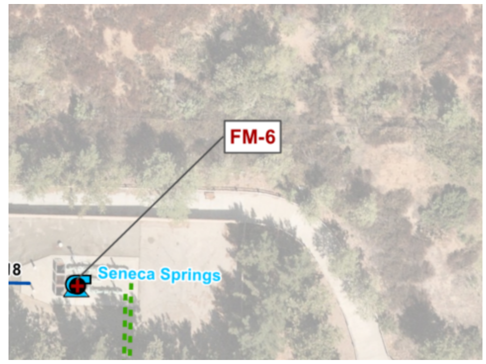
1. Re-coat aboveground piping with 4 to 6 mils of epoxy coating and 2 to 3 mils of aliphatic polyurethane. The surfaces shall be prepared per SSPC SP11 Power Tool Cleaning to bare metal for proper adhesion and coating longevity.

2. Monitor state of corrosion of discharge piping and plan to replace with fusion bonded epoxy-coated and lined steel piping within the next 5 to 10 years.

A-9

Lift Station

Lift Station ID:	Seneca Springs LS
Location:	33.918558°; -116.962058°
Assessment Date:	04.29.2020
Assessed by:	Farshad Malek
Lift Station Type:	Submersible Pump
Pumps:	Duty: Pump #1, Pump #2, Pump #3 Standby: Pump #3, Pump #2, Pump #1
Discharge Piping:	8” DIP (x2)



Sanitary Sewer / Location Map

Condition Summary:

Site

- CMU perimeter wall, overall fair condition (VANDA 3)
  - Pointing in fair to poor condition, cracking typical throughout
  - Minor efflorescence typical throughout
- Asphalt in overall fair condition with cracking (0.2”) typical leading from major equipment
- Groundwater is reportedly causing differential settlement throughout the site which is in turn causing strain on equipment including piping, hose connections, a tilting transformer, and a ~3-inch deep pothole west of the wet well pad.
- Concrete pads in overall good condition (VANDA 2)

Aboveground Piping

- Minor surface corrosion at bolts and flanges (VANDA 2)
- 2” brass backflow prevented in good condition (VANDA 2)
- 2” GSP Industrial Water in good condition (VANDA 2)
  - Line is dry, no tie-in to city water system (typical at all lift stations)
- Pipes are sagging heavily due to differential ground settlement
  - Additional supports are needed mid-span on Pump #1 and Pump #3 discharge piping ASAP
- Pipe support concrete bases for Pump #3 discharge piping broken
- Cracking typical at rubber flexible couplings due to stress and UV damage

Wet Well

- T-lock liner is in overall good condition, no significant defects noted; concrete beneath is presumed to be in good condition (VANDA 1)
- Submersible pump discharge piping moderately corroded throughout (VANDA 3)

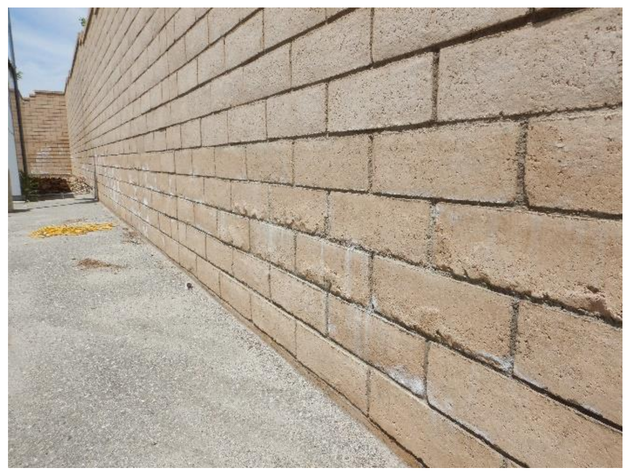
Bypass Manhole

- Liner is in overall good condition; concrete beneath is presumed to be in good condition (VANDA 1)
- Large joints left un-mortared at the cone

Site Photo 1

Site Photo 2

Cracked/depressed mortar



Minor efflorescense (typical)

Cracking in asphalt leading from major equipment

Pothole west of wet well

Aboveground piping, sagging in the center
(Pump Assembly #1)

Aboveground piping, sagging in the center
(Pump Assembly #3)

Aboveground piping

Minor corrosion at bolts, flanges, plug valves

Cracking in rubber flexible couplings (typical)

Pump discharge piping


Wet well exterior


Wet well interior


Wet well interior


Pump discharge piping


Pump discharge piping


Pump discharge piping (closeup)

Bypass manhole exterior

Bypass MH rim, remnants of plastic film, unmortared joints

Bypass MH interior

Bypass MH interior (closeup)

UT Data:

Band	Piping	Minimum (inches)	Maximum (inches)	Average (inches)	Max. Wall Loss (in.)	Max. Wall Loss (%)
1	Pump 1 (spool)	0.345	0.350	0.348	0.015	4%
2	Pump 2 (spool)	0.318	0.340	0.328	0.042	12%
3	Pump 3 (spool)	0.317	0.337	0.325	0.043	12%

DFT Data:

Band	Piping	Minimum (mils)	Maximum (mils)	Average (mils)	Recommended thickness (mils)
1	Pump 1 (spool)	8.3	14.2	11.2	6 to 9
2	Pump 2 (spool)	12.4	15.7	14.1	6 to 9
3	Pump 3 (spool)	7.8	14.7	11.3	6 to 9

(1) Piping exposed to sunlight is recommended to have 4 to 6 mils of epoxy coating with an additional 2 to 3 mils of aliphatic polyurethane

Recommendations

1. Touch up aboveground piping as needed with 4 to 6 mils of epoxy coating and 2 to 3 mils of aliphatic polyurethane. The surfaces shall be prepared per SSPC SP11 Power Tool Cleaning to bare metal for proper adhesion and coating longevity.

2. Replace rubber flexible couplings showing cracks/UV damage.

3. Monitor state of corrosion of pump discharge piping within the wet well and plan to replace with fusion bonded epoxy-coated and lined steel piping within the next 5 to 10 years.

4. Mortar joints at the cone at the rim of the Bypass MH. Acceptable products include Sika 223 or similar. Provide a smooth finish to protect the concrete from moisture. Application shall not exceed the maximum application thickness specified by the manufacturer to prevent feathering (thin layers that will lead to cracking and delamination)

5. Investigate the extent and nature of the differential ground settlement. It appears piping is near a breaking point despite the use of flexible couplings; additional supports are needed ASAP. Differential settlement in electrical equipment may cause some connections to break – consult with an electrical engineer.

A-10

Lift Station

Lift Station ID:	Four Seasons LS
Location:	33.906442°; -116.946850°
Assessment Date:	04.29.2020
Assessed by:	Farshad Malek
Lift Station Type:	Submersible Pump
Pumps:	Duty: Pump #1, Pump #2 Note: Pump #3 does not keep up with flow
Discharge Piping:	14" & 8" DIP

Sanitary Sewer / Location Map

Condition Summary:

Site

- CMU perimeter wall
  - Face of block is in fair condition, pointing is cracked with voids typical throughout (VANDA 3)
  - The interior of the first half of the south wall was never grouted, caps for blocks can be easily lifted and inside of the CMU is empty. Due to the missing grout, the south wall shakes when the access gate is closed
- Asphalt in overall fair condition with cracking (0.2") leading from major equipment
- Concrete pads in overall fair condition (VANDA 3), cracking and localized areas with minor surface profile loss observed

Aboveground Piping

- Overall good condition, minor surface corrosion at bolts and flanges (VANDA 2)
- Localized corrosion where there is contact between dissimilar metals, multiple locations including at SST flanges
- Minor cracking at pipe supports
  - Pump #1 under 2nd ARV concrete support
  - Pump #2 under 1st ARV concrete support
  - Concrete base for metallic supports
- Minor wear typical at rubber flexible couplings presumably from UV damage

Wet Well

- T-lock liner stained throughout, particularly below the waterline (VANDA 2); concrete beneath is presumed to be in good condition (VANDA 2)
- Surface corrosion typical throughout pump discharge piping (VANDA 3)
- Vent piping corroded throughout (VANDA 3)

Bypass Manhole

- Liner is in overall good condition; concrete beneath is presumed to be in good condition (VANDA 2)
- Staining on the wall indicates a pinhole in the liner roughly 3 to 5 feet from the bench


Site Photo 1


Site Photo 2


Masonry wall cap loose


Missing grout inside of south wall


Mortared joints cracked with voids (typical)


Aboveground piping

Aboveground piping

Corrosion typical at bolts/flanges

Corrosion typical at bolts/flanges due to contact between dissimilar metals (including SST)

Dissimilar metal bolts/nuts used on SST pipe

Minor wear on rubber flexible couplings

Cracking under Pump #1 pipe support


Cracking under Pump #2 pipe support


Concrete base for metallic pipe supports


Wet well exterior


Wet well interior


Wet well interior


Wet well interior (closeup)


Surface corrosion typical throughout pump discharge piping


Surface corrosion typical throughout pump discharge piping


Pump discharge piping (closeup)


Pump discharge piping (closeup)


Pump discharge piping (closeup)


Bypass Manhole exterior


Bypass Manhole rim/cone section


Bypass Manhole bench and invert

UT Data:

Band	Piping	Minimum (inches)	Maximum (inches)	Average (inches)	Max. Wall Loss (in.)	Max. Wall Loss (%)
1	Pump 1 (spool)	0.418	0.448	0.432	0.032	7%
2	Pump 2 (spool)	0.376	0.380	0.378	0.014	4%
3	Pump 3 (spool)	0.307	0.375	0.348	0.053	15%

DFT Data:

Band	Piping	Minimum (mils)	Maximum (mils)	Average (mils)	Recommended thickness (mils)
1	Pump 1 (spool)	10.3	13.8	12.3	6 to 9
2	Pump 2 (spool)	9.5	8.0	8.5	6 to 9
3	Pump 3 (spool)	10.1	8.9	11.9	6 to 9

(1) Piping exposed to sunlight is recommended to have 4 to 6 mils of epoxy coating with an additional 2 to 3 mils of aliphatic polyurethane

Recommendations

1. Provide proper isolation where dissimilar metals are in contact.

2. After isolation has been provided, touch up aboveground piping as needed with with 4 to 6 mils of epoxy coating and 2 to 3 mils of aliphatic polyurethane. The surfaces shall be prepared per SSPC SP11 Power Tool Cleaning to bare metal for proper adhesion and coating longevity.

3. Replace rubber flexible couplings showing cracks/UV damage.

4. Monitor state of corrosion of pump discharge piping within the wet well and plan to replace with fusion bonded epoxy-coated and lined steel piping within the next 5 to 10 years.

5. Patch-repair the pinhole in the liner inside of the bypass manhole. Acceptable products include Sancon 100 or equal.

APPENDIX H

Capital Improvement Program Project Sheets

City of Beaumont Wastewater Master Plan

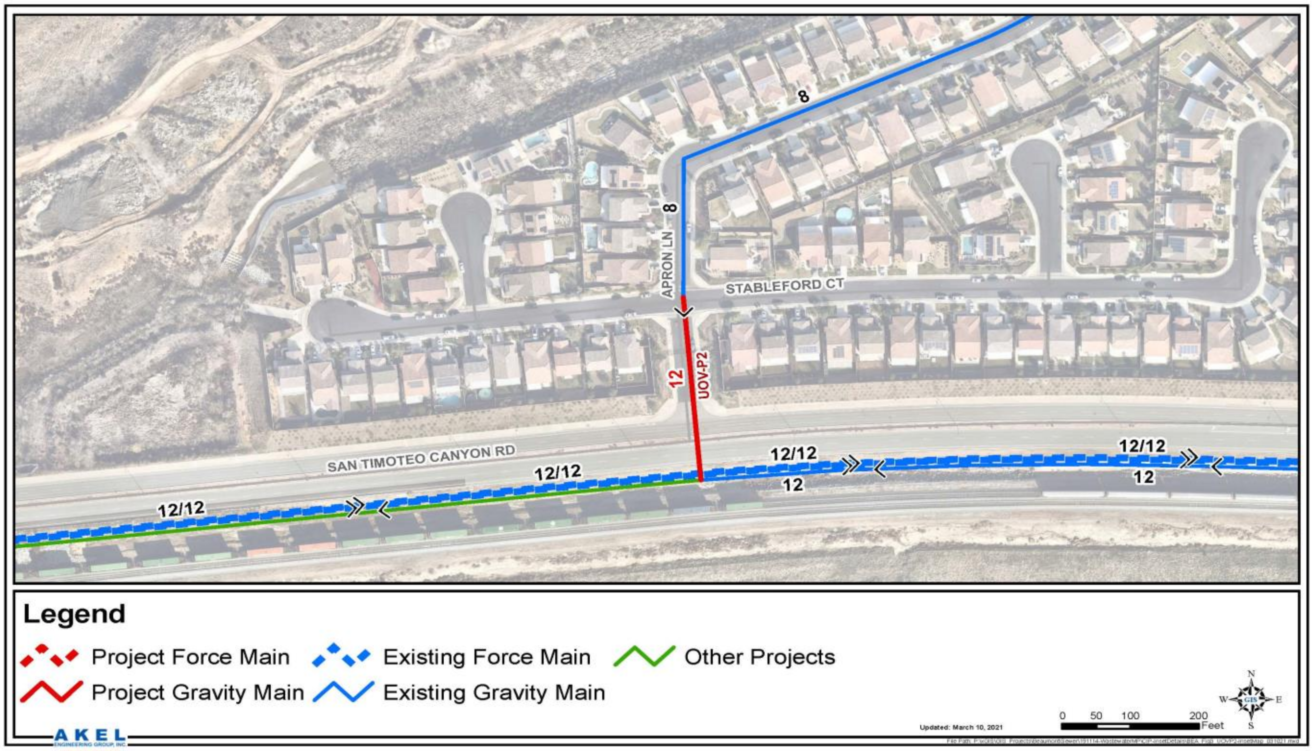
PROJECT S1

Apron Lane Pipeline Replacement

Project Background

This project includes the replacement of existing 8-inch gravity main with a new 12-inch gravity main along Apron Lane from Stableford Court to San Timoteo Canyon Road. This project is intended to mitigate an existing system deficiency.

Project Description



Service Area	Recommended Implementation	Project Component(s)
Upper Oak Valley Lift Station Tributary Area	FY 2023/24	Pipeline

Project Trigger	Project Need
Immediate	Capacity

Project Cost Breakdown (2021 Dollars)

Base Construction:	**62,400**
Constr. Contingency (20%):	12,500
Construction Total	**74,900**
Engr., CM, Legal/Admin (30%):	22,500
Total Project Cost:	**97,400**

City of Beaumont Wastewater Master Plan

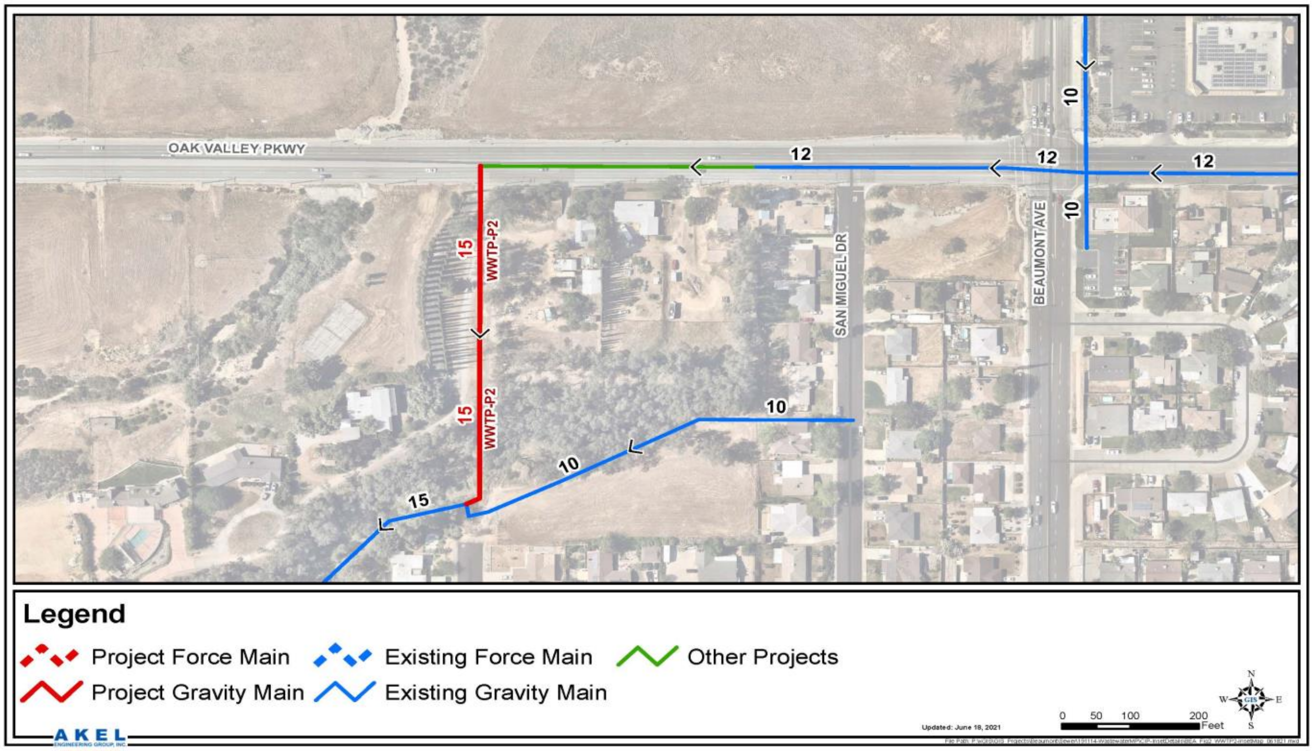
PROJECT S2

Oak Valley Parkway/Edgar Avenue Pipeline Replacement

Project Background

This project includes the replacement of an existing 12-inch gravity with new 15-inch gravity mains in Edgar Avenue from Oak Valley Parkway to approximately 575-feet south of Oak Valley Parkway . This project is intended to mitigate an existing system deficiency.

Project Description



Service Area	Recommended Implementation	Project Component(s)
Wastewater Treatment Plant Tributary Area	FY 2022/23	Pipeline

Project Trigger	Project Need
Immediate	Capacity

Project Cost Breakdown (2021 Dollars)

Base Construction:	**132,500**
Constr. Contingency (20%):	26,500
Construction Total	**159,000**
Engr., CM, Legal/Admin (30%):	47,700
Total Project Cost:	**206,700**

AKEL ENGINEERING GROUP, INC.

PRELIMINARY

6/16/2021

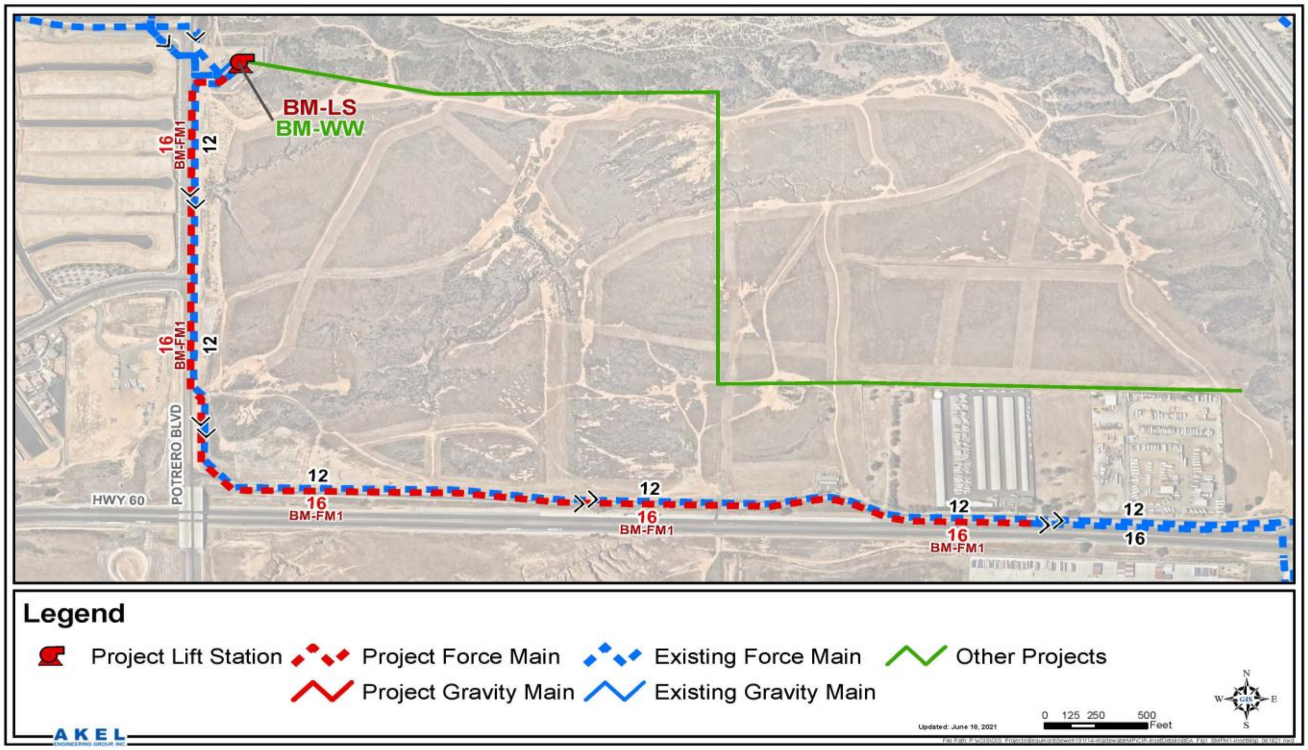
PROJECT S3

Beaumont Mesa Lift Station and Force Main Improvements

Project Background

This project includes the force main and pump design, construction of a new 16-inch force main, replacement of new pumps. The new 16-inch force main, constructed along Potrero Boulevard and Western Knolls Avenue, will connect the Beaumont Mesa Lift Station to a partially completed 16-inch force main. This project is intended to mitigate an existing system deficiency. This project cost reflects City staff budgetary planning estimate provided by City staff on June 1, 2021.

Project Description



Service Area	Recommended Implementation	Project Component(s)
Beaumont Mesa Lift Station Tributary Area	FY 2021/22, FY 2022/23	Pumps, Force Main

Project Trigger	Project Need
Immediate	Capacity

Project Cost Breakdown (2021 Dollars)

Base Construction:	-
Constr. Contingency (20%):	-
Construction Total	-
Engr., CM, Legal/Admin (30%):	-
Total Project Cost:	**5,200,000**

City of Beaumont Wastewater Master Plan

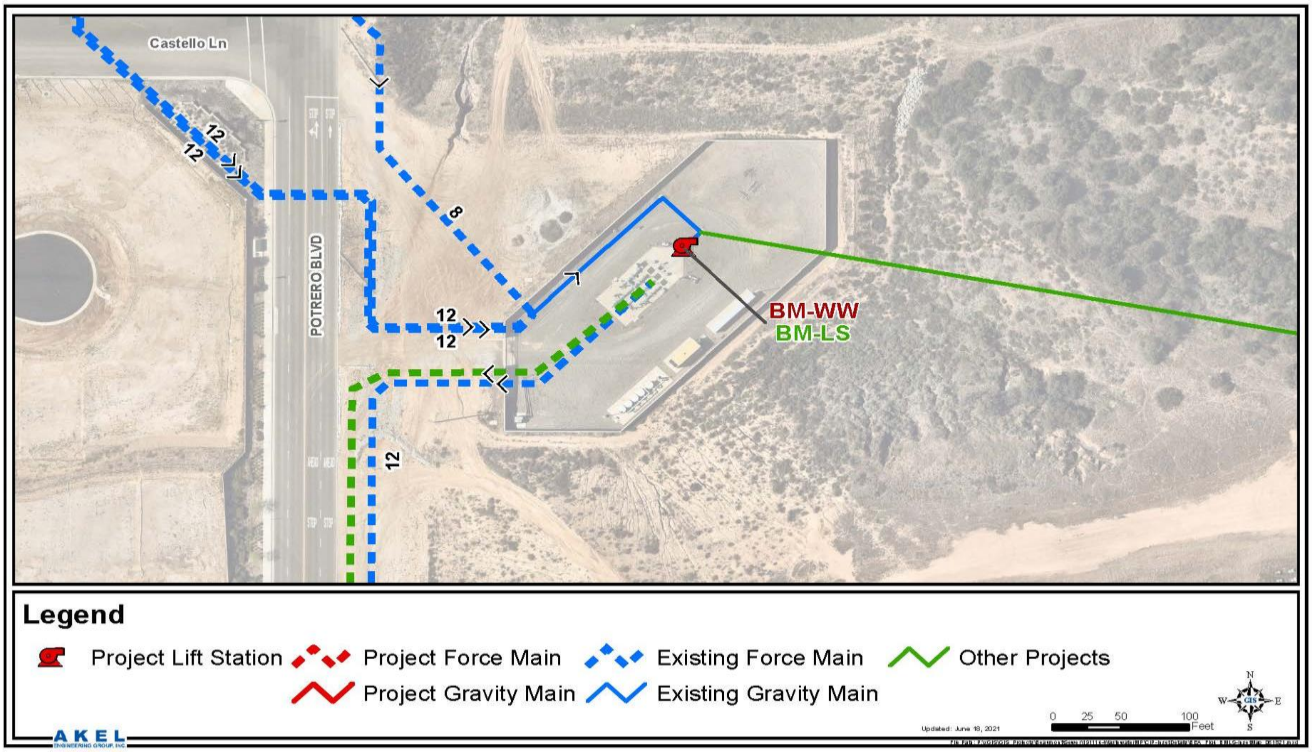
PROJECT S4

Beaumont Mesa Wet Well Improvement

Project Background

This project includes the wet well design, and construction of a new wet well. This project is intended to accommodate for future growth. This project cost reflects City staff budgetary planning estimate provided by City staff on June 1, 2021.

Project Description



Service Area
Beaumont Mesa Lift Station Tributary Area

Recommended Implementation
FY 2021/22, FY 2024/25

Project Component(s)
Wet Well

Project Trigger
Immediate

Project Need
Capacity

Project Cost Breakdown (2021 Dollars)

Base Construction:	-
Constr. Contingency (20%):	-
Construction Total	-
Engr., CM, Legal/Admin (30%):	-
Total Project Cost:	**4,400,000**

City of Beaumont Wastewater Master Plan

PROJECT S5

CCTV Program

Project Background

This project reflects performing CCTV review of the City's Wastewater System every three years, which is equivalent to an annual pipeline amount of approximately 59 miles per year. This project cost reflects City staff budgetary planning estimate provided by City staff on June 1, 2021.

Project Description

Service Area	Recommended Implementation	Project Component(s)
System Wide	FY 2023/24, FY 2029/30	Pipeline

Project Trigger	Project Need
-	Condition

Project Cost Breakdown (2021 Dollars)

Base Construction:	-
Constr. Contingency (20%):	-
Construction Total	-
Engr., CM, Legal/Admin (30%):	-
Total Project Cost:	**300,000**

City of Beaumont Wastewater Master Plan

PROJECT S6

On-going Pipeline Replacement Program

Project Background

This project plans for as needed pipeline replacement and reflects a project cost equivalent to replacing one mile of 8-inch pipeline per year. This project cost reflects City staff budgetary planning estimate provided by City staff on June 1, 2021.

Project Cost Breakdown (2021 Dollars)

Service Area	Recommended Implementation	Project Component(s)
System Wide	FY 2023/24 - FY 2030/31	Pipeline

Project Trigger	Project Need
-	Condition

Project Cost Breakdown (2021 Dollars)

Base Construction:	-
Constr. Contingency (20%):	-
Construction Total	-
Engr., CM, Legal/Admin (30%):	-
Total Project Cost:	**4,800,000**

City of Beaumont Wastewater Master Plan

PROJECT S7

Lift Station Condition Assessment Improvement

Project Background

This project reflects performing lift station improvements to include new electrical, new pumps, repairs to wet wells, repairs to components at the lift station, etc. This project cost reflects City staff budgetary planning estimate provided by City staff on June 1, 2021.

Project Description

Service Area	Recommended Implementation	Project Component(s)
System Wide	FY 2022/23 - FY 2030/31	Lift Station

Project Trigger	Project Need
-	Condition

Project Cost Breakdown (2021 Dollars)

Base Construction:	-
Constr. Contingency (20%):	-
Construction Total	-
Engr., CM, Legal/Admin (30%):	-
Total Project Cost:	**3,600,000**

City of Beaumont Wastewater Master Plan

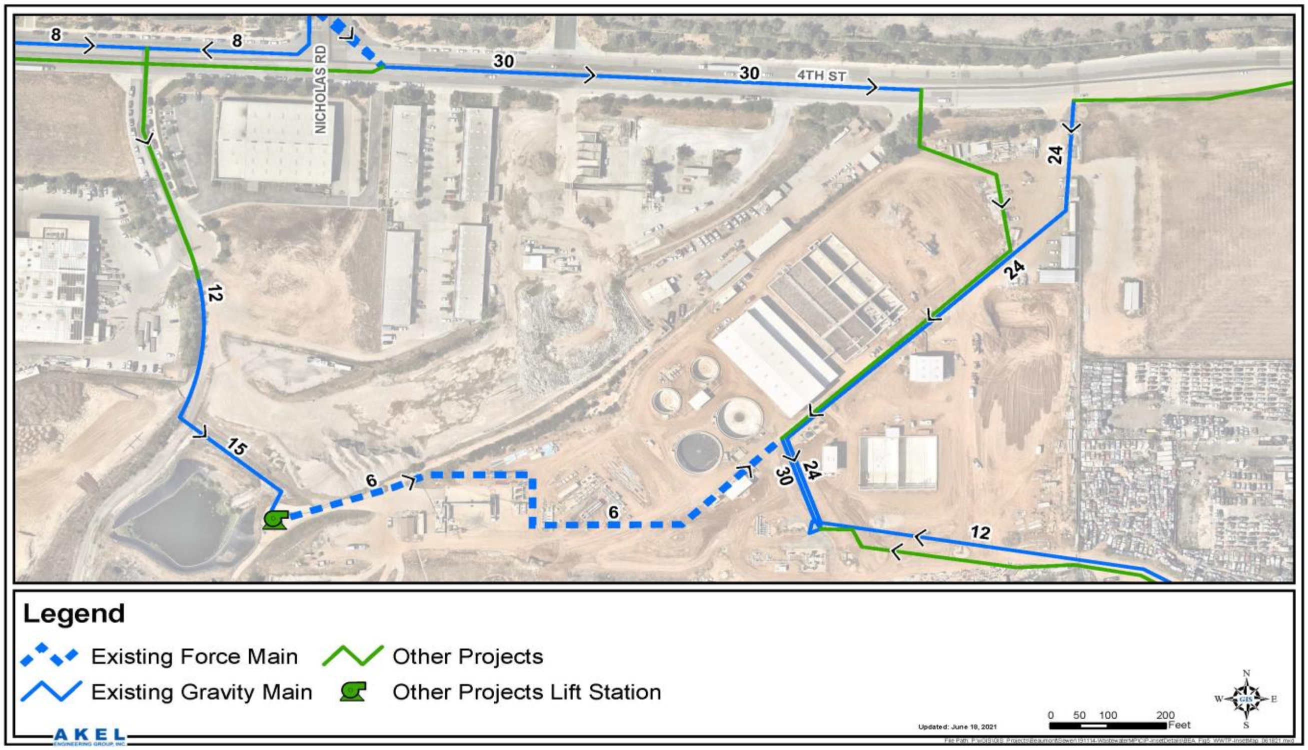
PROJECT S8

Wastewater Treatment Plant Improvements

Project Background

This project includes the wastewater rate study for FY2024 through FY2028, installation of flow meters at lift stations for I&I project, I&I system repairs, construction of new WWTP office and staff workspace building, replacement of WWTP UV bulb and RO module. This project cost reflects City staff budgetary planning estimate provided by City staff on June 1, 2021.

Project Description



Service Area
System Wide

Recommended Implementation
FY 2021/22 - FY 2025/26
FY 2028/29 - FY 2030/31

Project Component(s)
Wastewater Treatment Plant

Project Trigger
-

Project Need
Miscellaneous

Project Cost Breakdown (2021 Dollars)

Base Construction:	-
Constr. Contingency (20%):	-
Construction Total	-
Engr., CM, Legal/Admin (30%):	-
Total Project Cost:	**2,000,000**