City of Visalia

SANITARY SEWER SYSTEM MASTER PLAN

FINAL | June 2025

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Digitally signed by Ryan F. Orgill
Contact Info: Carollo Engineers, Inc.
Date: 2025.06.12 15:51:44-07'00'

REGISTERED PROFESSIONAL ENGINEER
RYAN F. ORGILL
No. 75802
CIVIL
STATE OF CALIFORNIA

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Abbreviations

A	Agricultural
AAF	average annual flow
AB	Assembly Bill
ADWF	average dry weather flow
BRP	Business Research Park
BWF	base wastewater flow
C	Conservation
Carollo	Carollo Engineers
CDP	Census Designated Place
CIP	capital improvement plan
City	City of Visalia
CMU	Commercial Mixed Use
CN	Commercial Neighborhood
CR	Commercial Regional
CS	Commercial Service
d/D	flow depth to pipe diameter ratio
DMU	Downtown Mixed Use
DWF	dry weather flow
EDU	equivalent dwelling unit
ENR	Engineering News-Record
EPA	Environmental Protection Agency
F	Fahrenheit
ft/s	feet per second
GIS	geographic information system
Goshen CPU	Goshen Community Plan 2018 Update
gpcd	gallons per capita per day
gpd	gallons per day
gpd/ac	gallons per day per acre
gpm	gallons per minute
gpud	gallons per unit per day
GWI	groundwater infiltration
I	Industrial
I/I	infiltration/inflow
IL	Light Industrial
Master Plan	Sanitary Sewer Master Plan Update
MDDWF	maximum day dry weather flow
mgd	million gallons per day
NA	not applicable

O	Office
PDWF	peak dry weather flow
PI	Public/Institutional
PR	Parks/Recreation
PWWF	peak wet weather flow
R	Reserve
RDII	rain-derived infiltration and inflow
RHD	Residential High Density
RLD	Residential Low Density
RMD	Residential Medium Density
RVLD	Residential Very Low Density
SOI	sphere of influence
SSO	sanitary sewer overflow
SWMM	Storm Water Management Model
UGB	Urban Growth Boundary
V&A	V&A Consulting Engineers
WaPUG	Wastewater Planning Users Group
WRF	water reclamation facility
WWF	wet weather flow
WWFF	wastewater flow factors

EXECUTIVE SUMMARY

This Executive Summary presents a brief background of the City of Visalia (City) sanitary sewer collection system. It describes the need for this Sanitary Sewer Master Plan Update (Master Plan), proposed improvements to mitigate system deficiencies, and improvements to serve future growth. A summary of capital improvement project costs is also included.

ES.1 Objectives

The purpose of this Master Plan is to provide an updated planning document for the City's wastewater collection system. Overall, the Master Plan will assist the City in their approach to optimize their collection system infrastructure. The objectives include:

- Update the City's existing hydraulic model.
- Determine existing and future wastewater flows.
- Define planning and evaluation criteria for the City's wastewater collection system.
- Perform capacity analyses and identify deficiencies in the collection system under existing and future conditions.
- Identify preliminary infrastructure to serve future growth.
- Prepare a capital improvement plan (CIP) for the collection system.

ES.2 Scope and Authorization

In September 2018, the City approved a professional service agreement with Carollo Engineers (Carollo) to prepare an update to the Master Plan. The professional services agreement included the following main tasks:

- Task 1 – Review of Existing Data and Collection of New Data (RFP Section A).
- Task 2 – Model Development (RFP Section B).
- Task 3 – Development of Master Plan Update (RFP Main Goal Sections C and D).
- Task 4 – Nexus Study (RFP Section E).
- Task 5 – Stakeholder Involvement Program (RFP Section F).
- Task 6 – Project Management.

Carollo performed a Nexus Study to update the sanitary sewer impact fees for new development in compliance with Assembly Bill (AB) 1600 and other California legal requirements. This document is a standalone report and is not included in the Master Plan.

ES.3 Study Area

In accordance with the City's 2014 General Plan, the main study area consists of the Tier 3 Urban Growth Boundary (UGB) plus the Community of Goshen Urban Development Boundary. The area beyond Tier 3 UGB was analyzed as part of this Master Plan. Outside of Tier 3 UGB, farmland is the most prominent land use within the City's Planning Area. The future land use between Tier 3 and the Planning Area will need a broader analysis to determine future use of this area. Depending on future land use of the Planning Area, sizing and sanitary sewer alignments may be impacted.

The City's current General Plan assumes that through the year 2030, the annual average growth rate will be 2.6 percent, resulting in a Tier 3 UGB buildout population of 210,000.

The City's study area consists of multiple boundaries that are shown on Figure ES.1 and Figure ES.2. Area for the boundaries is based on geographic information system (GIS) data provided by the City and are described below:

- City Limits: The City limits encompass roughly 24,000 acres (37.74 square miles). Figure ES.1 shows the City limits. The City has septic users within county islands and within City limits.
- Service Area: Sewer services are provided to residential, commercial, and industrial customers within the City limits and nearby Goshen, which is northwest of the City.
- UGB: The General Plan defines this area as an administrative boundary which urban development is not allowed beyond during the time period for which it is effective. The total area consists of approximately 32,000 acres (49 square miles) and could support a target future population of 210,000. Figure ES.1 illustrates the UGB.
- Sphere of Influence (SOI): The SOI is a planning boundary outside of an agency's legal boundary (such as the city limit line) that designates the agency's probable future boundary and service area.
- Planning Area: The Planning Area encompasses the UGB, SOI, and provides an open space buffer around the City. The area beyond the UGB is mainly comprised of agricultural land use. Long-term planning for this area is not considered in the General Plan. However, the previous master plan considered portions of the planning area (generally north of UGB) as potentially developable. For the purposes of this Master Plan the Planning Area will be considered, and preliminary infrastructure will be recommended. This Master Plan will continue the preliminary analysis of the Planning Area. Figure ES.2 shows the Planning Area, as well as the areas considered developable for the purposes of this Master Plan.

ES.4 Projected Sanitary Sewer Service Area Population

This Master Plan assumes a growth rate of 2.6 percent per year for the City (based on input from City staff) and 1.3 percent for Goshen (per Goshen Community Plan 2018 Update [Goshen CPU]), under the assumption that the service area population will match the City-wide growth rate. Figure ES.3 shows the projected water service area population according to a growth rate of 2.6 percent. The projected population growth is summarized in Table ES.1.

Table ES.1 Historic and

Year	Visalia Population	Goshen Population	Total Population	Visalia Growth (%)
2020	141,276	3,420	144,697	-
2025	160,622	3,649	164,271	2.6
2030	182,617	3,892	186,510	2.6
2035	207,625	4,152	211,776	2.6
2040	236,056	4,429	240,485	2.6

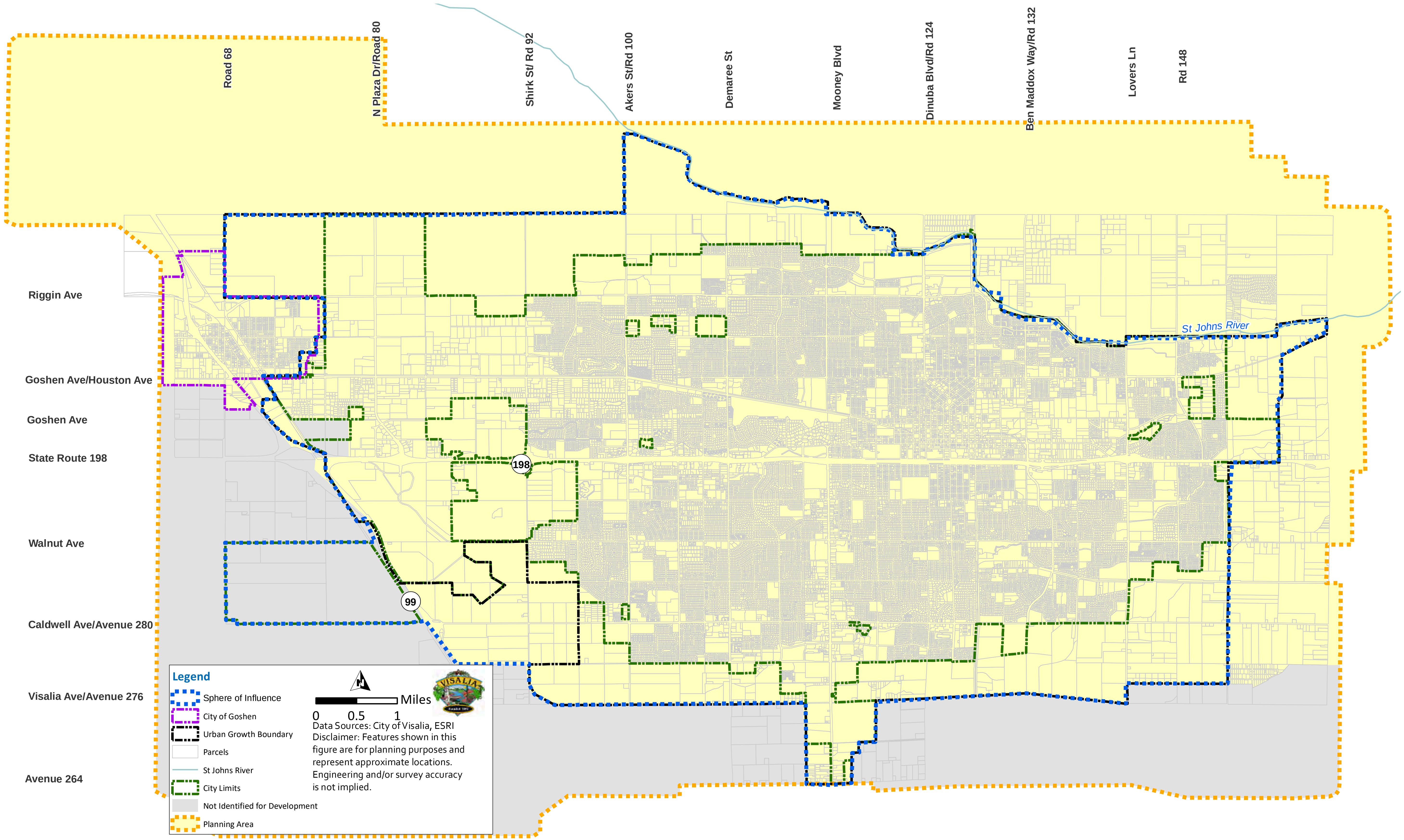

Figure ES.1 Study Area

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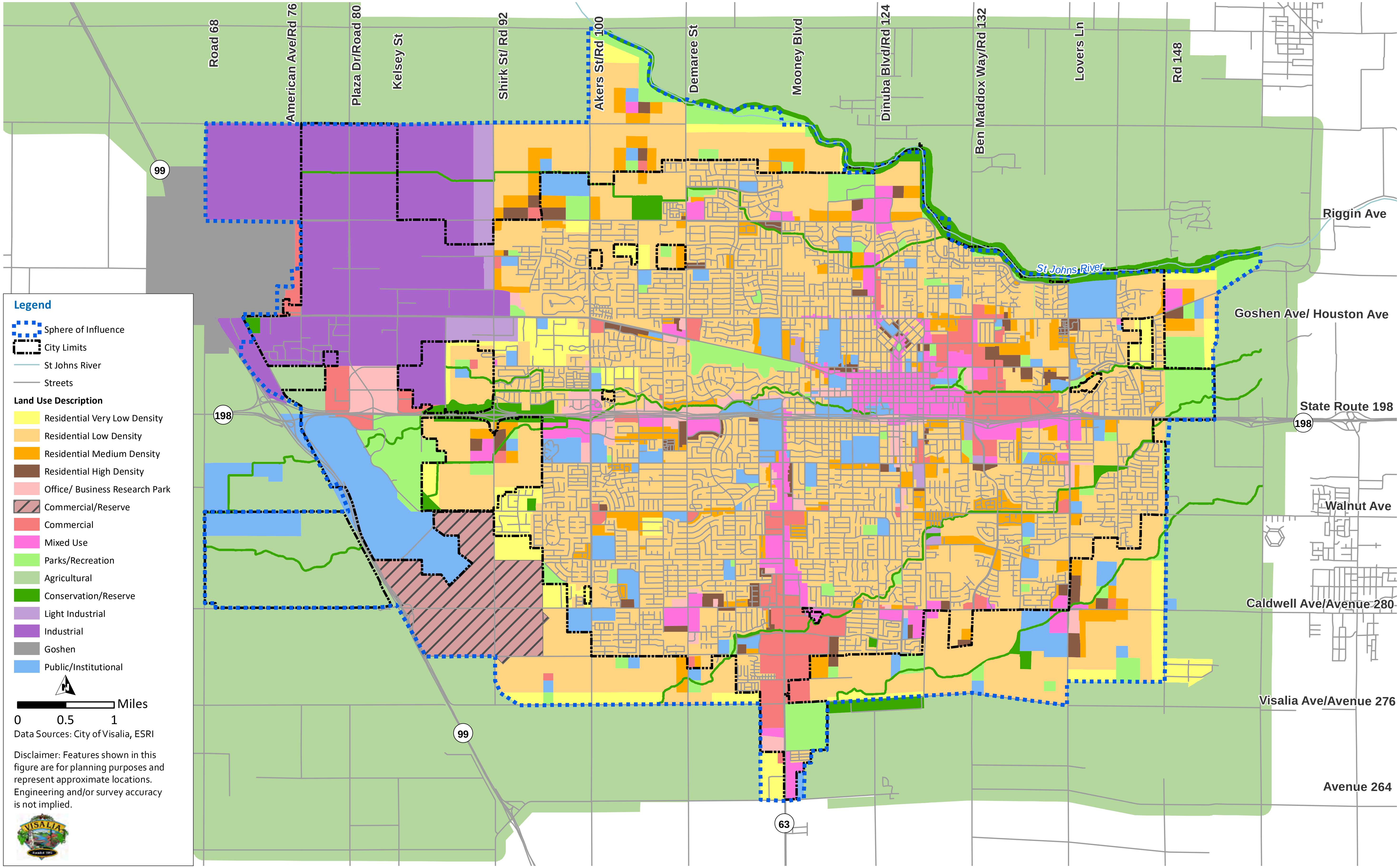

Figure ES.2 General Plan Land Use

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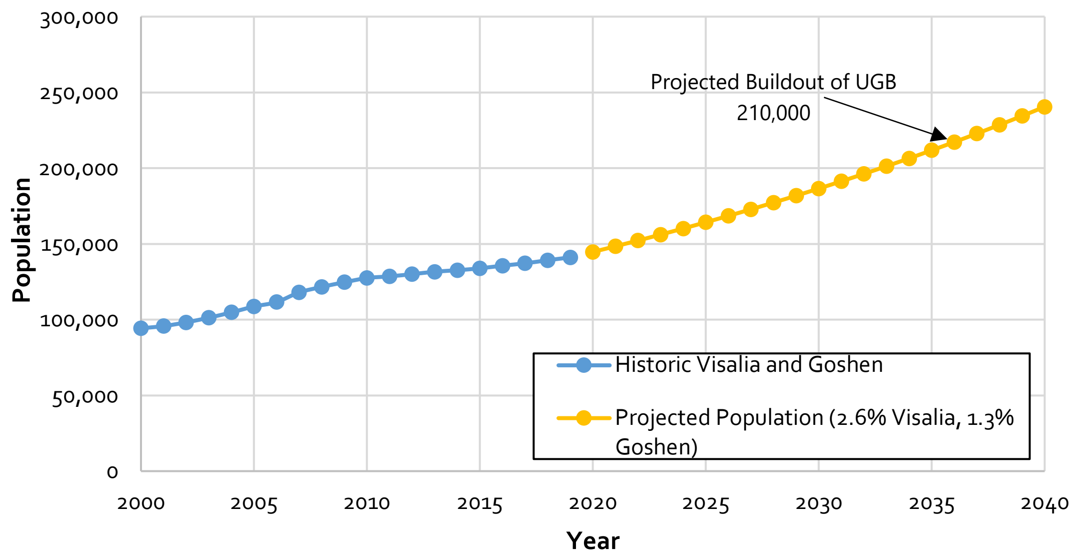

Figure ES.3 Historic and Projected Population Growth

ES.5 Existing Sanitary Sewer Collection System

The existing wastewater collection system consists of approximately 493 miles of gravity sanitary sewer pipelines. Pipelines range in diameter from 4 inches to 48 inches. The City operates 13 wastewater lift stations and associated force mains. Wastewater discharge from residential, commercial, industrial, and other users are conveyed to the City's Water Reclamation Facility (WRF). In addition, Goshen, a Census Designated Place (CDP) located northwest of the City, conveys wastewater flows to the WRF via a lift station and 24-inch pipeline. Figure ES.4 presents the City's existing wastewater collection system.

A small portion of wastewater generated in the service area is disposed of through private septic systems. These septic systems are located in county islands and within City Limits.

ES.6 Sanitary Sewer Flows

Peak wet weather flow (PWWF) typically defines the peak flow within a sanitary sewer collection system. However, wet weather data and hydraulic model calibration show peak flow during the dry months was greater. Therefore, peak dry weather flow (PDWF) represents peak flow with the collection system.

The design maximum day dry weather flow (MDDWF) was established by reviewing the historic data and a flow rate of 13.0 million gallons per day (mgd) was selected. The hydraulic model was updated to reflect the MDDWF. Projected MDDWF was determined by applying a peaking factor to the future average flow. Within the model, 24-hour diurnal patterns were applied to the MDDWF and the PDWF was established. The diurnal patterns were developed from the flow monitoring data and reflect real-time flow patterns.

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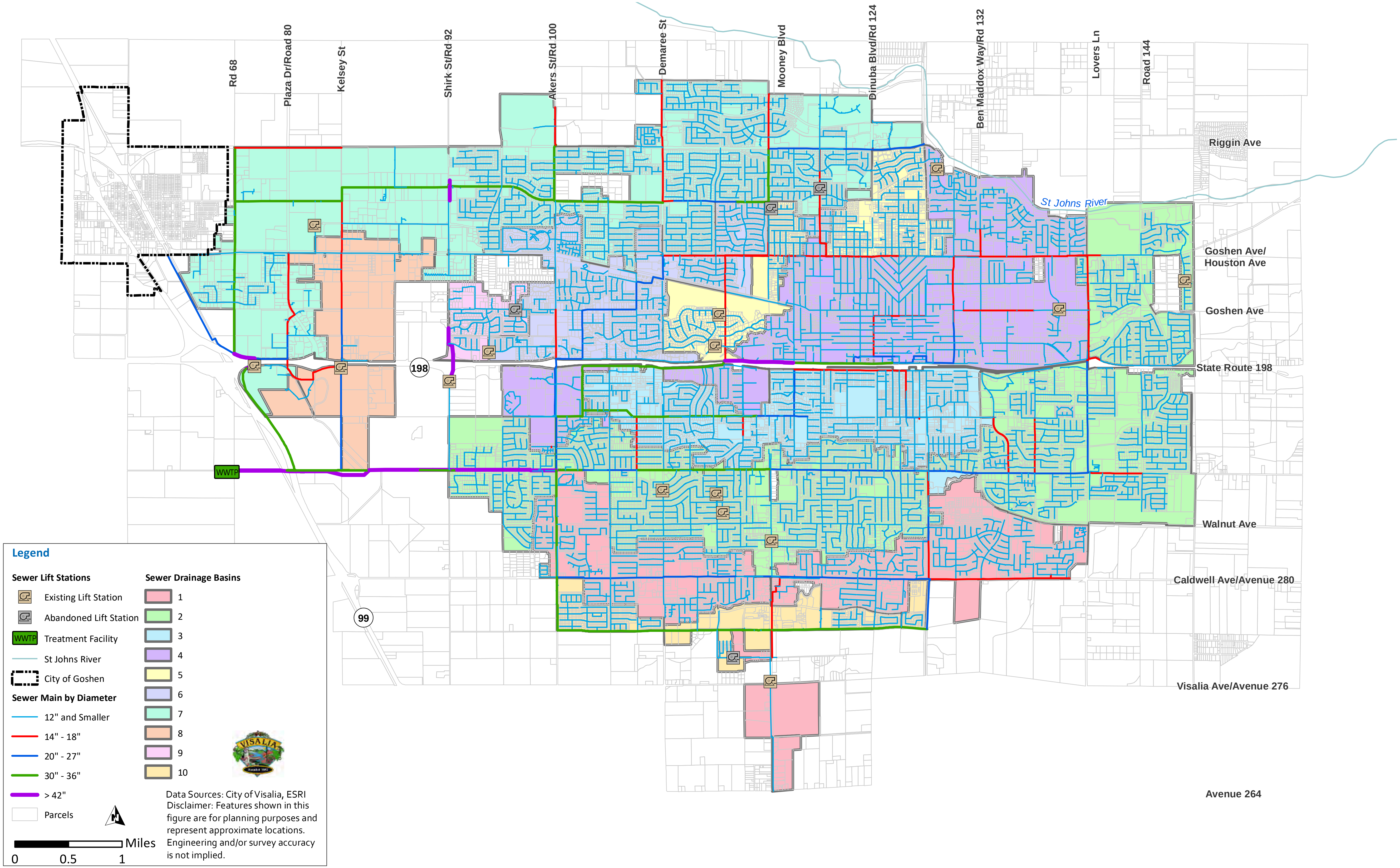

Figure ES.4 Existing Sanitary Sewer Collection System

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Table ES.2 presents a summary of existing and projected flows for average annual flow (AAF), MDDWF, and PDWF. As shown, the existing PDWF is estimated at 17.4 mgd and is projected to increase to 30.0 mgd at buildout of the UGB. Ultimate buildout is estimated to increase flows by 9.3 mgd

Table ES.2 Design Flows

Flow Condition	AAF (mgd)	MDDWF Peaking Factor	MDDWF (mgd)	PDWF (mgd)
Existing	10.5	1.24	13.0	17.4
UGB Buildout	18.5	1.24	22.9	30.0
SOI	19.4	1.24	24.1	32.3
Ultimate Buildout	28.7	1.24	35.6	47.8

ES.7 Sanitary Sewer Hydraulic Model Development

The City's previous hydraulic model was developed by Carollo using H_2OMAP Sewer, by Innovyze. The H_2OMAP Sewer modeling platform was retired in 2017.

InfoSWMM®, developed by Innovyze, was selected as the new software platform for the City's updated hydraulic model. The hydraulic modeling engine for InfoSWMM® uses the Environmental Protection Agency's (EPA) Storm Water Management Model (SWMM), which is widely used throughout the world for planning, analysis, and design related to stormwater runoff, combined sewers, sanitary sewers, and other drainage systems. InfoSWMM® routes flow through the model using the Dynamic Wave method, which solves the complete Saint Venant, one dimensional equations of fluid flow.

The existing collection system was mainly transferred from the previous model and updated with available drawings, as-builts, and GIS data. For the City's hydraulic model, pipelines 10 inches in diameter or larger were included as well as some smaller diameter pipelines for connectivity. Otherwise, pipelines 8 inches or smaller were excluded.

ES.8 Sanitary Sewer System Improvements

ES.8.1 Available Capacity in the Existing System

This section summarizes the capacity analysis performed for the City's collection system and provides recommendations to mitigate deficiencies. To calculate the timing of these improvements it's necessary to determine the available capacity in the collection system. The equivalent dwelling units (EDUs) provide capacity in terms of remaining dwelling units that can be served before capacity expansion is required.

For the City, 150 gallons per unit per day (gpud) was used to estimate sewage flows from a single-family detached residential home. To calculate the available capacity in terms of EDUs, the difference between the maximum capacity (based on size, slope, and maximum flow depth to pipe diameter ratio [d/D]), and the existing design flow was calculated and reduced to average flows. The average flow was then divided by 150 gpud to quantify remaining EDUs. This method only applies to existing infrastructure.

ES.8.1.1 Existing System

One existing system deficiency was identified. This deficiency (located on West Goshen Avenue and North Ranch Street) has been observed by City maintenance staff, and is associated with the peak discharge rates from an upstream industrial customer. To mitigate this deficiency, the following is recommended:

- North Ranch Street/Visalia Country Club (Project WWGM-0A): This project will replace approximately 3,400 feet of 18-inch diameter pipeline in North Ranch Street and through the Visalia Country Club with a new 24-inch sewer, extending from West Mineral King Avenue to West Goshen Avenue.
- West Goshen Avenue (Project WWGM-0B): This project will replace approximately 3,200 feet of 12-inch diameter pipeline in West Goshen Avenue with an 18-inch sewer, extending from the Visalia Country Club to approximately 400 feet east of North Leslie Street.

ES.8.1.2 Urban Growth Boundary Buildout

Following the completion of the future capacity analysis under buildout of the UGB, no additional capacity deficiencies were identified.

ES.8.1.3 Sphere of Influence Buildout

Following the completion of the future capacity analysis under buildout of the SOI, no additional capacity deficiencies were identified.

ES.8.1.4 Ultimate Buildout

The proposed improvements to address ultimate buildout deficiencies are shown on Figure ES.5 and are summarized below. These projects are preliminary and recommended to serve buildout of the Planning Area.

- North American Street (Project WWGM-1): The pipeline currently has more than half its capacity remaining. With construction of the Shirk Avenue Trunk, flows would be split between the two trunks and extend the pipeline's ability to convey future flows. Existing average flows within the trunk are estimated at approximately 2.95 mgd. It's estimated that the pipeline has capacity for an additional average flow of 3.6 mgd. This equates to approximately 10,000 additional EDUs and buildout of the industrial park. Given the project's location, most of the remaining capacity would be taken by industrial users and the available residential EDUs would be significantly reduced. This project will replace approximately 7,500 feet of 36-inch diameter pipeline in American Street, extending from Ferguson Avenue to Camp Drive. Under ultimate peak flow conditions, the 36-inch pipeline surcharges and exceeds the maximum d/D criteria. To mitigate the capacity deficiency, it is recommended that the existing pipeline be replaced with a 42-inch diameter pipeline.
- Frontage Road (Project WWGM-2): The pipeline currently has more than half its capacity remaining. With construction of the Shirk Avenue Trunk, flows would be split between the two trunks and extend the pipelines ability to convey future flows. Existing average flows within the trunk are estimated at approximately 3.29 mgd. It's

estimated that the pipeline has capacity for an additional average flow of 3.9 mgd. This equates to approximately 9,900 additional EDUs and buildout of industrial park. Given the project's location, most of the remaining capacity would be taken by industrial users.

This project will replace approximately 6,200 feet of 36-inch diameter pipeline along an unimproved area and in Frontage Road. The existing pipeline parallels Highway 99 and is west of the airport. The project extends from downstream of the Airport Lift Station to Walnut Avenue. Under ultimate peak flow conditions, the 36-inch pipeline surcharges and exceeds the maximum d/D criteria. To mitigate the capacity deficiency, it is recommended that the existing pipeline be replaced with a 42-inch diameter pipeline.

- Walnut Trunk Bypass (Project WWGM-3): The existing 42-inch pipeline crossing Highway 99 has capacity to serve approximately 12,000 additional EDUs.
  This project includes the installation of a 24-inch diameter pipeline extending from the Walnut Lovers Lane Trunk to the Walnut Outfall Trunk. The overflow is recommended to alleviate surcharging within the 42-inch pipeline crossing Highway 99 and minimize the backwater effect occurring upstream. This project would eliminate capacity improvement projects extending under Highway 99. The Walnut Outfall Trunk has capacity to allow for overflow from the parallel trunk.
  An alternative location to this project is located at the intersection of Walnut and Akers which would allow the City to divert flows upstream.
- Airport Lift Station (Project WWLS-1): The existing lift station has capacity to serve approximately 1,700 additional EDUs and buildout of industrial park.
  Modeling results project the firm capacity of this lift station is not adequate to convey peak ultimate buildout flows. The City's Airport Lift Station will need to be replaced in the future to accommodate growth in the planning area. This lift station provides service to Sewer Drainage Basin 7, which includes Industrial Park. In addition, the CDP Goshen discharges upstream of the lift station. This project is considered long term and would be required after buildout of the UGB. It is recommended to increase the firm capacity to 17.0 mgd.
- Airport Lift Station Force Main (Project WWFM-1): The Airport Lift Station's 20-inch diameter force main exceeds velocity criteria under ultimate buildout conditions. It is recommended to parallel the 20-inch diameter pipeline with an additional 21-inch pipeline.

ES.8.2 Collection System Expansion to Serve Future Growth

The following recommendations are preliminary sewer trunk alignments and lift stations that will serve future growth. The location of the new trunks and lift stations are conceptual and should be refined as more data becomes available.

ES.8.2.1 Ultimate Growth Boundary Tier 1

- American Street Trunk Extension (Project WWGM-6): This project consists of 5,200 feet of 30-inch diameter pipeline in American Street. The project extends from Avenue 320 to Riggin Avenue. The pipeline is sized to convey projected flows from ultimate buildout of UGB and Planning Area.

ES.8.2.2 Ultimate Growth Boundary Tier 2

- North Shirk Trunk Extension (Project WWGM-7): This project will extend the Shirk Trunk to the northern UGB Tier 2 boundary. The project is recommended under buildout of the UGB Tier 2 and consists of 2,600 feet of 42-inch diameter pipeline in Shirk Street. The pipeline is sized to convey projected flows from ultimate buildout.
- South Lovers Lane Main (Project WWGM-8): This project consists of 2,500 feet of 12-inch diameter pipeline in Avenue 280 and 2,500 feet of 12-inch pipeline in Lovers Lane. The project would extend the Caldwell Trunk east and require crossing a ditch. A preliminary analysis shows the pipeline has depth to cross the waterway and maintain spacing.

ES.8.2.3 Ultimate Growth Boundary Tier 3

- Visalia Parkway Trunk Extension (Project WWGM-9): This project consists of 5,300 feet of 24-inch diameter pipeline in Visalia Parkway. The project extends from Road 148 to Lovers Lane. The pipeline is sized to convey projected flows from ultimate buildout.
- North Shirk Trunk Extension (Project WWGM-10): This project will extend the Shirk Trunk North to Avenue 320. The project is recommended under buildout of the UGB Tier 3 and consists of 2,700 feet of 42-inch diameter pipeline in Shirk Street. The pipeline is sized to convey projected flows from ultimate buildout.
- Avenue 320 Trunk: This project will construct a new trunk in Avenue 320 and serve future growth within the UGB. The pipelines are sized to convey projected flows from ultimate buildout.
  - (Project WWGM-11A): This project consists of 10,500 feet of 30-inch diameter pipeline in Avenue 320. The project extends from North Demaree Street (Road 108) to Shirk Street.
  - (Project WWGM-11B): This project consists of 5,200 feet of 27-inch diameter in 320 Avenue. The project extends west of the St. Johns River to North Demaree Street (Road 108).
- North Akers Main (Project WWGM-12): This project consists of 4,600 feet of 12-inch diameter pipeline in Akers Street. The project extends south of Avenue 328 to Avenue 320.
- Houston-Ivanhoe Main: The project is recommended to serve growth in Tier 3 boundaries and growth within the Planning Area:
  - (Project WWGM-13A): This project consists of 3,600 feet of new 12-inch diameter pipeline in Houston Avenue and Ivanhoe Drive. The project extends from Road 152 to Citrus Court. The pipeline is sized to convey projected flows from buildout of the Planning Area.

  - (Project WWGM-13B): This project will replace approximately 2,300 feet of existing 10-inch diameter pipeline in East Houston Avenue and in the alignment of East Auburn Drive. The project extends from Comstock Road to McAuliff Street. It is recommended that the existing pipeline be replaced with a 12-inch diameter pipeline. The pipeline is sized to convey projected flows from buildout of the Planning Area.

ES.8.2.4 Sphere of Influence Buildout

- South Shirk Main: This project extends from Caldwell Avenue to Walnut Avenue. The project is recommended to serve future growth within the SOI:
  - (Project WWGM-14A): This project consists of 3,600 feet of new 12-inch diameter pipeline in Shirk Street. The project extends from north from Caldwell Avenue to south of Wagner Avenue.
  - (Project WWGM-14B): This project consists of 600 feet of new 15-inch diameter pipeline in Shirk Road. The project extends from Wagner Avenue to Walnut Avenue.
- Visalia Parkway Extension (Project WWGM-15A): This project consists of 5,700 feet of new 30-inch diameter pipeline. This segment of the project is located on the west side of Highway 99. The project continues west along Whitendale Avenue and extends north across an unimproved surface owned by the City. The pipeline is sized to convey buildout flows from the surrounding SOI and as a bypass for the Visalia Parkway trunk, with capacity to convey all buildout flow of the Visalia Parkway Trunk basin.
- Visalia Parkway Extension (Project WWGM-15B): This project consists of 500 feet of 30-inch diameter pipeline, crosses Highway 99 and Railroad tracks. It is estimated the project will require trenchless technology to cross the highway and railroad. Due to crossing of the Highway and railroad, a steel casing would be required.
- Visalia Parkway Extension (Project WWGM-15C): This project consists of 10,300 feet of 30-inch diameter pipeline. The project extends from the existing system at the intersection of Visalia Parkway and Akers Street. The project continues west to Shirk Street, west on Caldwell Avenue, and runs parallel to Highway 99. The project would connect to WWGM-15B.

ES.8.2.5 Ultimate Buildout

- Avenue 320 Trunk Extension: This project will extend the proposed Avenue 320 Trunk east. The project is recommended to serve future growth within the Planning Area. This project has been carried forward from previous master plans. These projects require crossing the St. Johns River and will need trenchless construction. A lift station may be required to avoid construction of a siphon when crossing the river:
  - (Project WWGM-16A): Will consist of 5,300 feet of 27-inch diameter pipeline in Avenue 320. The project will extend from Road 124 to the St. Johns River.
  - (Project WWGM-16B): This project will consist of 5,400 feet of 24-inch diameter pipeline in Avenue 320. The project extends from Ben Maddox Way (Road 132) to Dinuba Boulevard.

  - (Project WWGM-16C): This project will consist of 5,300 feet of 21-inch diameter pipeline in Avenue 320. The project extends from a future extension of Lovers Lane to Ben Maddox Way.
  - (Project WWGM-16D): This project will consist of 9,300 feet of 15-inch diameter pipeline in Avenue 320. The project extends west from Road 156 to the future extension of Lovers Lane.
  - (Project WWGM-16E): This project consists of 4,500 feet of 12-inch diameter pipeline in north Shirk Street. The project extends from Avenue 328 to Avenue 320.
  - (Project WWGM-16F): This project will consist of 4,500 feet of 12-inch diameter pipeline in Road 108 (Demaree Street). The project extends from Avenue 328 to Avenue 320.
  - (Project WWGM-16G): This project will consist of 5,700 feet of 12-inch diameter pipeline in an unimproved area. The project extends from Avenue 328 to Avenue 320, with a segment parallel to the St Johns River.
  - (Project WWGM-16H): This project will consist of 4,500 feet of 12-inch diameter pipeline in Road 124 (Dinuba Boulevard). The project extends from Avenue 328 to Avenue 320.
  - (Project WWGM-16I): This project will consist of 4,500 feet of 12-inch diameter pipeline in Ben Maddox Way. The project extends from Avenue 328 to Avenue 320.
  - (Project WWGM-16J): This project will consist of 4,500 feet of 12-inch diameter pipeline in Lovers Lane (Future Extension), north of the St. Johns River. The project extends from Avenue 328 to Avenue 320.
  - (Project WWLS-2): This project will consist of a new lift station with a firm capacity of 3.6 mgd. The project is located in Avenue 320, east of the St. Johns River. A preliminary analysis estimates a lift station will be required to cross the St. Johns River. Further analysis is recommended to determine flood zone and best method to cross the river.
  - (Project WWFM-2): This project consists of 1,900 feet of 14-inch diameter force main crossing the St. Johns River. The project will convey flows for project WWLS-2.
- Kelsey Street Main (Project WWGM-17): This project consists of 10,000 feet of 12-inch diameter pipeline in Kelsey Street and Avenue 320.
- Highway 99 - West Avenue 320 Trunk: This project will construct a new trunk parallel to Highway 99 and extend to Avenue 320. The project will serve future growth within the northwest Planning Area. This project has been carried forward from previous master plans with adjustments made to the alignment:
  - (Project WWGM-18A): This project will consist of 8,000 feet of 24-inch diameter pipeline in Avenue 320. The project extends from Highway 99 to American Street.
  - (Project WWGM-18B): This project will consist of 11,000 feet of 18-inch diameter pipeline and runs parallel to Highway 99. The project extends north of Avenue 328 to Avenue 320.

  - (Project WWGM-18C): This project consists of 1,000 feet of 18-inch diameter pipeline and crosses Highway 99 along Avenue 320. It is estimated the project will require a 30-inch steel casing.
  - (Project WWGM-18D): This project consists of 6,400 feet of 18-inch diameter pipeline in Avenue 320. The project extends from Highway 99 to Road 52.
  - (Project WWGM-18E): This project will consist of 9,800 feet of 21-inch diameter pipeline in American Street. The project extends from Avenue 328 to Avenue 320.
  - (Project WWLS-4): This project will consist of a new lift station with a firm capacity of 6.0 mgd. The project is located at the intersection Avenue 320 and American Street. The lift station will serve the northwest quadrant of the planning area.
  - (Project WWFM-4): This project consists of 100 feet of 21-inch diameter force main in American Street. The project will convey flows for project WWLS-4.
- East Riggin Extension Trunk: This project will construct a new trunk, lift station, and force main in the northeastern quadrant of the City and extend the Riggin trunk. This project has been carried forward from previous master plans with adjustments made to the alignment:
  - (Project WWGM-19A): This project consists of 800 feet of 24-inch diameter pipeline in the Santa Fe Street/trail alignment, west of the St. Johns River and downstream of the proposed lift station WWLS-3. The project connects to the existing system in Riggin Avenue.
  - (Project WWGM-19B): This project consists of 6,000 feet of 24-inch diameter pipeline in an unimproved area east of St. Johns River. This project is upstream of the proposed lift station WWLS-3.
  - (Project WWGM-19C): This project consists of 2,600 feet of 21-inch diameter pipeline in an unimproved area. The project extends west from Lovers Lane.
  - (Project WWGM-19D): This project consists of 5,800 feet of 18-inch diameter pipeline in an unimproved area. The project extends from Road 148 to Lovers Lane (future extension).
  - (Project WWGM-19E): This project consists of 3,400 feet of 15-inch diameter pipeline in Avenue 313. The project extends west of Oak Ranch Drive to Road 148.
  - (Project WWLS-3): This project will consist of a new lift station with a firm capacity of 3.0 mgd. The project is located in an unimproved area, east of the St. Johns River. A preliminary analysis estimates a lift station will be required to cross the St. Johns River. Further analysis is recommended to determine the surrounding flood zone, and best method to cross the river.
  - (Project WWFM-3): This project consists of 600 feet of 12-inch diameter force main crossing the St. Johns River. The project will convey flows for project WWLS-4.
- Road 148 Trunk: This project will construct a new trunk in the southeastern quadrant of the City. This project has been carried forward from previous master plans with adjustments made to the alignment:
  - (Project WWGM-20A): This project consists of 7,900 feet of 21-inch diameter pipeline in Road 148. The project extends from Walnut Avenue to Visalia Parkway.

- (Project WWGM-20B): This project consists of 5,100 feet of 15-inch diameter pipeline in Road 148. The project extends from Mineral King Avenue to Walnut Avenue.
- (Project WWGM-20C): This project consists of 4,000 feet of 12-inch diameter pipeline in Caldwell Avenue. The project extends from Road 156 to Road 148.
- (Project WWGM-20D): This project consists of 5,000 feet of 12-inch diameter pipeline in Walnut Avenue. The project extends from Road 156 to Road 148.
- (Project WWGM-20E): This project consists of 5400 feet of 15-inch diameter pipeline in Noble Avenue. The project extends from Road 156 to Road 148.
- (Project WWGM-20F): This project consists of 500 feet of 15-inch diameter pipeline in Road 156 with 30-inch steel casing. The project connects from WWGM-20E and extends from Noble Avenue to Avenue 296. The alignment crosses under Highway 198 bridge and is estimated to be open trench. This project will be serving users north of Highway 198.

- Houston-Ivanhoe Main Extension (Project WWGM-21): This project consists of 2,800 feet of 12-inch diameter pipeline in Ivanhoe Drive. The project extends east from Road 152.

ES.8.3 City of Visalia's Ongoing Sanitary Sewer Related Projects

The City's current five-year CIP has a number of sanitary sewer projects listed. The following projects are related to the sanitary sewer collection system and include pipeline/lift station construction and maintenance.

- Shirk Capacity Enhancement (CP0369): The project includes installation of 8,200 feet of 48-inch diameter pipeline in Shirk Avenue. The project will increase sanitary sewer capacity and accommodate future development. This project is shown in Figure ES.5.
- Caldwell Widening (CP8268): This project will extend the 15-inch diameter pipeline in Caldwell across the Lovers Lane intersection and provide a stub to the north. A preliminary analysis shows the pipeline has depth to cross the waterway and maintain spacing.
- Shirk Street and Walnut Avenue (CP0045): The project will extend the sanitary sewer trunk line in Shirk Street approximately 200 feet north. This project is in conjunction with the installation of a traffic signal and will prevent retrenching the street for future expansion of the Shirk Trunk. This project is shown in Figure ES.5.
- Sanitary Sewer Developer Reimbursement (CP9318): The annual project reimburses developers for additional costs incurred when constructing sanitary sewer infrastructure.
- Sewer Line Preliminary Engineering (CP9324): The annual project will accommodate preliminary engineering and design work necessary to provide developers and engineers with adequate information to construct master planned sewer lines.
- Shirk Street Sanitary Sewer Trunkline (CP0567): The project will install a 48-inch trunk in Shirk Avenue, south of Highway 198. The project will extend from Noble Avenue to Walnut Avenue. The project also includes removal of the Shirk Lift Station and 6-inch force main. This project is shown in Figure ES.5.

- Visalia Parkway Trunkline – Santa Fe to Lovers Lane (CPNew): The project will construct a new 30-inch diameter sanitary sewer pipeline between Santa Fe Street and Lovers Lane. This project will extend the existing pipeline in Visalia parkway. This project is shown in Figure ES.5.
- Riggin Widening – Kelsey to Shirk (CPO398): This project consists of 4,000 feet of 15-inch diameter pipeline in Riggin Avenue and extends from east of Kelsey Street to Shirk Road. The project is located in Industrial Park and would serve industrial users.

ES.8.3.1 Maintenance Related Projects

The following projects are in the City's CIP as maintenance related projects and are included to avoid any duplication of projects from the Master Plan. These projects are not included in the CIP.

- Replace and Relocate Sanitary Sewer Mains (CP9456): The annual program will replace mains that have deteriorated and relocate pipelines as necessary to accommodate development.
- Sanitary Sewer Lift Station Rehabilitation (CP8266): The project will rehabilitate two lift stations with new piping, valves, pump bases, entry hatches, and concrete surface. The Golf Course and Mooney/Ave 272 lift stations have been identified for this project. This project is shown in Figure ES.5.
- Sanitary Pump Replacement (CP0324): The annual project will provide for replacement of sanitary sewer lift station pumps with greater efficiency. Pumps will be replaced once life expectancy has been exceeded.
- Sewer Lateral Connection/Replacement/Installation (CP9228): The annual project will provide customer requested hookups to the sanitary sewer.
- Sanitary Sewer Manhole Repair Citywide (CP0580): The annual project will repair and raise manholes throughout the City sanitary sewer system. The project is budgeted to allow for replacement of one brick and mortar manhole per year.

Capital projects related to the WRF are not included in this Master Plan.

ES.8.4 Additional Recommendations

- Septic Removal by Sewer Extension: These projects provide a preliminary alignment to extend sanitary sewer service to residents currently on septic and located in the City limits or county islands. These projects were identified due to their proximity to existing sewer lines. Residents who connect would pay connection fee to reimburse construction fees. These projects would not be incorporated into development impact fees.

  Areas outside of the City limits and located in Tier 1 of the UGB have several septic users; however, septic removal projects in these areas were not identified. These areas are expected to connect as new development/redevelopment extends. Projects located within county islands would not occur until the area was annexed into City limits. These projects are shown on Figure ES.5, with detail maps in Appendix F.

- (Project WWO-1): This project consists of 2,600 feet of 8-inch diameter pipeline in Linwood Road, Oakridge Court, and Kent Street. The project extends to the intersection of West Ferguson Avenue. This project is currently a county island.
- (Project WWO-2A): This project consists of 1,400 feet of 8-inch diameter pipeline in El Cajon Street at the intersection of Goshen Avenue.
- (Project WWO-2B): This project consists of 2,600 feet of 8-inch diameter pipeline in Mae Carden Street and Pershing Avenue the project extends to the intersection of South Goshen Avenue and Mae Carden Street.
- (Project WWO-2C): This project consists of 4,700 feet of 8-inch diameter pipeline. The project extends from West Steward Avenue to Tommy Street, and west in Pershing Avenue to the intersection of Akers. To maintain a minimum recommended slope, a lift station is required.
- (Project WWO-2D): A preliminary analysis shows to maintain a minimum slope upstream a lift station is required. This project would serve existing users transitioning from septic to the collection system. The lift station is recommended to have a firm capacity of 0.031 mgd (21.2 gallons per minute [gpm]).
- (Project WWO-3A): This project consists of 1,300 feet of 8-inch diameter pipeline in South Peppertree Court. The project extends to the intersection of Caldwell Avenue.
- (Project WWO-3B): This project consists of 300 feet of 8-inch diameter pipeline in South Aspen Street.
- (Project WWO-4): This project consists of 800 feet of 8-inch diameter pipeline in James Avenue. The project extends to an existing pipeline at the intersection of Divisadero Street.
- (Project WWO-5A): This project consists of 1,300 feet of 8-inch diameter pipeline in Tulare Avenue at the intersection Ben Maddox Way.
- (Project WWO-5B): This project consists of 500 feet of 8-inch diameter pipeline in an access road located south of Pinkham Road and Tulare Avenue intersection.
- (Project WWO-6): This project consists of 1,200 feet of 8-inch diameter pipeline in Noble Avenue and would connect to the existing system in McAuliff Street.
- (Project WWO-7): This project consists of 600 feet of 8-inch diameter pipeline in an access road south of Goshen Avenue and Lovers Lane.
- (Project WWO-8A): This project consists of 2,600 feet of 8-inch diameter pipeline in Sol Road. Based on preliminary data, the pipeline would not maintain a minimum recommended slope. Therefore, a lift station is recommended.
- (Project WWO-8B): A preliminary analysis shows to maintain a minimum slope upstream a lift station is required. This project would serve existing users transitioning from septic to the collection system. The lift station is recommended to have a firm capacity of 0.02 mgd (15.7 gpm) and would provide service to residential very low density.
- (Project WWO-9): Connection of this area would likely occur as the surrounding area is developed or redeveloped. Vista Del Sol has begun development on the adjacent lot west of the septic area and would likely be the point of connection.
- (Project WWO-10): This project consists of 400 feet of 8-inch diameter pipeline in South Dans Street.

- Sewer Master Plan Update (WWO-11): It is recommended that the City undergoes a Sewer Master Plan Update every five years to evaluate the wastewater collection system.
- Collection System GIS Update (Project WWO-12): The City may consider updating their GIS data to include pipeline inverts, diameter, material, and installation dates. A pipeline age and material summary can be accomplished with a combination of installation dates and approved dates outlined in drawings. To further expand on probable installation dates, the City may utilize upstream and downstream pipelines with known data to approximate or review nearby utilities such as water lines. Having this data available will assist the City in identifying pipelines approaching their probable useful life. An age-based analysis can be performed to provide a statistical evaluation of decay and potential failure of pipelines based on material. This type of analysis typically uses assumed “useful life” values, which are based on industry literature.

ES.8.5 Project Prioritization

Prioritizing the required capital improvements for the City’s sanitary sewer system is an important part of this study. The improvement projects were prioritized in the following order:

- Upgrade existing facilities to mitigate current capacity deficiencies.
- Plans for pipeline and lift station rehabilitation projects.
- Upgrade existing facilities and plan for future facilities to accommodate increased wastewater flows associated with buildout of the UGB Tiers.
- Upgrade existing facilities and plan for future facilities to convey flows associated with buildout of the SOI area.
- Upgrade existing facilities and plan for future facilities to convey flows associated with buildout of the Planning Area.

Implementation of future projects ultimately depends on growth. Phasing assumptions presented are estimates and changes in growth projections or planning assumptions may change the priority of each improvement. Figure ES.6 shows the project phasing.

- Phase 1 Projects (2026 - 2030): Improvements target for Phase 1 include projects to address existing capacity deficiencies and projects identified by the City. These include pipeline capacity improvements, rehabilitation projects, and pump replacements.
- Phase 2 Projects(2031 - 2035): Improvements targeted for Phase 2 include projects to address buildout of UGB Tier 1, buildout of Tier 2, and City identified projects.
- Phase 3 Projects (2036 - 2040): Improvements targeted for Phase 3 include projects to address buildout of UGB Tier 3.
- Phase 4 Projects (2041 - 2045): Improvements targeted for Phase 4 include projects to address buildout of UGB Tier 3 and buildout of SOI.
- Phase 5 Projects (2046 And Beyond): Improvements targeted for Phase 5 include projects to address buildout of the Planning Area.

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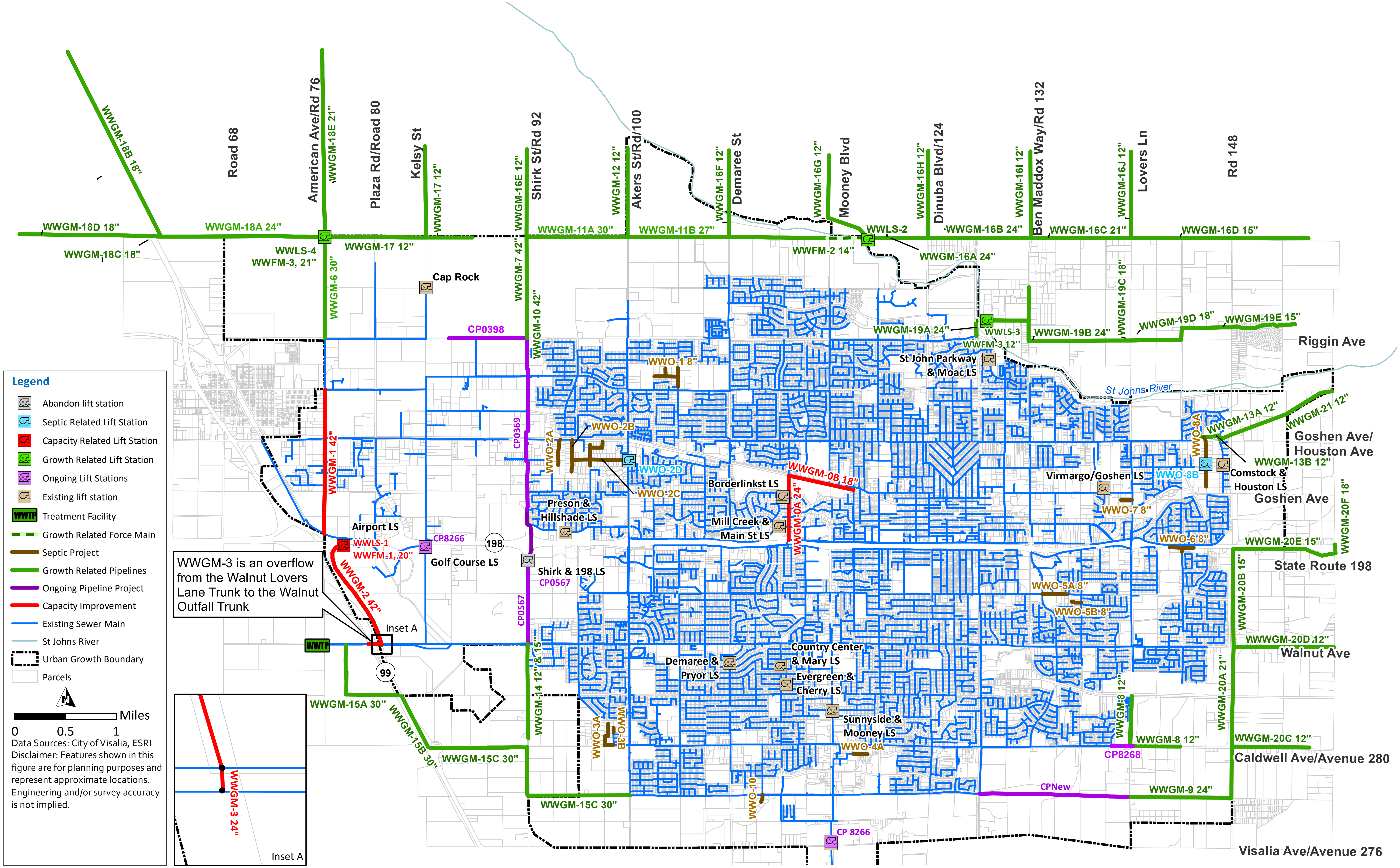

Figure ES.5 Capacity Improvements

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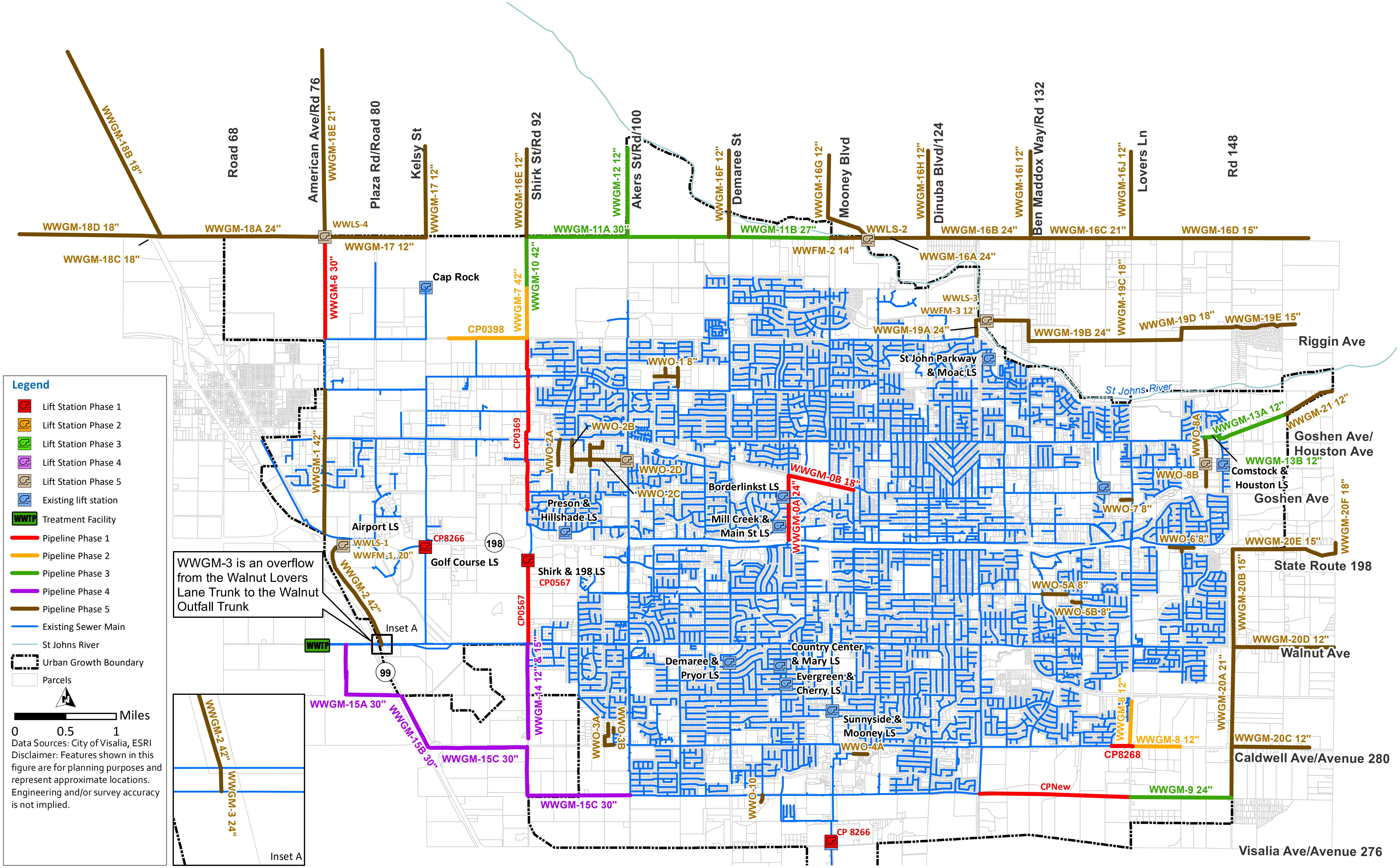

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Figure ES.6 Project Phasing

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This section presents the City's CIP, a summary of the capital costs, and a basic assessment of the possible financial impacts on the City. The CIP is based on the evaluation of the City's sanitary sewer system.

ES.8.6 Capital Improvement Project Implementation

The proposed capital improvements are prioritized based on their urgency to mitigate existing deficiencies and other factors. The capital improvements were phased into one of the following phases:

- Phase 1 Projects (2026 - 2030): Improvements targeted for Phase 1 include projects to address existing capacity deficiencies and projects identified by the City. These include pipeline capacity improvements, rehabilitation projects, and pump replacements.
- Phase 2 Projects (2031 - 2035): Improvements targeted for Phase 2 include projects to address buildout of UGB Tier 1, UGB Tier 2, and City identified projects.
- Phase 3 Projects (2036 - 2040): Improvements targeted for Phase 3 include projects to address buildout of UGB Tier 3.
- Phase 4 Projects (2041 -2045): Improvements targeted for Phase 4 include projects to address buildout of UGB Tier 3 and address buildout of the SOI.
- Phase 5 Projects (2046 And Beyond): Improvements targeted for Phase 5 include projects to address the Planning Area.

ES.8.7 Existing Versus Future User Cost Share

Improvement costs within this study can be categorized as beneficial to existing users or future users, with some of the costs distributed between both categories. Costs are assigned to existing users if the improvement is related to an existing deficiency. Existing projects also benefit future users, which are assigned a portion of the cost. Projects that solely benefit future users such as new development will be assigned 100 percent of the cost. For Visalia, existing user costs are also referred to as "operational costs" and future user costs are referred to as "development related." For the purposes of this Master Plan, "existing user costs" and "operational costs" are interchangeable, as are "future user costs" and "development related costs."

The hydraulic modeling results were used to determine the ratio of existing average flows and future average flows. With the ratio, project costs are divided between existing and future users. For example, the Shirk Capacity Project (CP0369) will convey flows from existing users and flows from future users. Cost was assigned based on the percentage of total flows contributed by existing users and future users. Capacity projects created by future users are assigned to future customers.

Projects assigned to existing users include City related projects for the Shirk capacity enhancement and master plan updates. Shirk capacity projects replace existing infrastructure required to serve existing users and will increase capacity for future users. Future master planning is a benefit to existing and future users.

A summary of existing and future user cost share for the proposed projects by phase is summarized in Table ES.3, while Table ES.4 summarizes user cost by project type.

A summary of the CIP costs is provided in Table ES.4 and Figure ES.5 which shows the distribution of capital costs by project type. As shown in Table ES.4, out of the total $245.3 million in capital projects, $26.8 million is targeted for implementation in Phase 1 (2026-2030), and another $16.3 million is targeted for Phase 2 (2031-2035). Phase 3 projects (2036-2040) account for $26.2 million and Phase 4 (2041-2045) projects account for $23.7 million.

Table ES.3 Sanitary Sewer CIP Cost by Reimbursement Category

Reimbursement Category	Phase 1 (2026-2030) ($)	Phase 2 (2031-2035) ($)	Phase 3 (2036-2040) ($)	Phase 4 2041-2045 ($)	Phase 5 2046-Beyond ($)	Total ($)
Existing Users	$9,054,000	$155,000	$155,000	$155,000	$-	$9,519,000
Future Users	$17,749,000	$16,147,000	$26,001,000	$23,582,000	$152,315,000	$235,794,000
Total	**$26,803,000**	**$16,302,000**	**$26,156,000**	**$23,737,000**	**$152,315,000**	**$245,313,000**

Table ES.4 Sanitary Sewer Collection System CIP Summary

Project Type	Existing User ($)	Future User ($)	Total ($)
Capacity Improvements			
Gravity Mains	$6,276,000	$16,083,000	$22,359,000
Lift Stations	$-	$25,360,000	$25,360,000
Force Mains	$-	$58,000	$58,000
Subtotal	$6,276,000	$41,501,000	$47,777,000
New Service Related Improvements			
Gravity Mains	$-	$139,822,000	$139,822,000
Lift Stations	$-	$18,796,000	$18,796,000
Force Mains	$-	$1,218,000	$1,218,000
Subtotal	$-	$159,836,000	$159,836,000
City Related Projects			
Ongoing Projects	$2,627,000	$25,227,000	$27,854,000
Other Projects			
Sewer Master Plan Update	$619,000	$617,000	$1,236,000
Septic Removal by Sewer Extension	$-	$8,607,000	$8,607,000
Subtotal	$619,000	$9,224,000	$9,843,000
Total	**$9,522,000**	**$235,788,000**	**$245,310,000**

Notes:
(1) Engineering News-Record (ENR) 20 City Average Construction Cost Index for March 2025 is 13,782.
(2) Estimated Construction Cost includes a 30 percent contingency of the baseline construction cost.
(3) Total project costs include a 10 percent markup for engineering, a 10 percent markup for construction management and a 7.5 percent markup for project administration of the estimated construction cost.
(4) The total markup is 65.8 percent of the baseline construction cost.

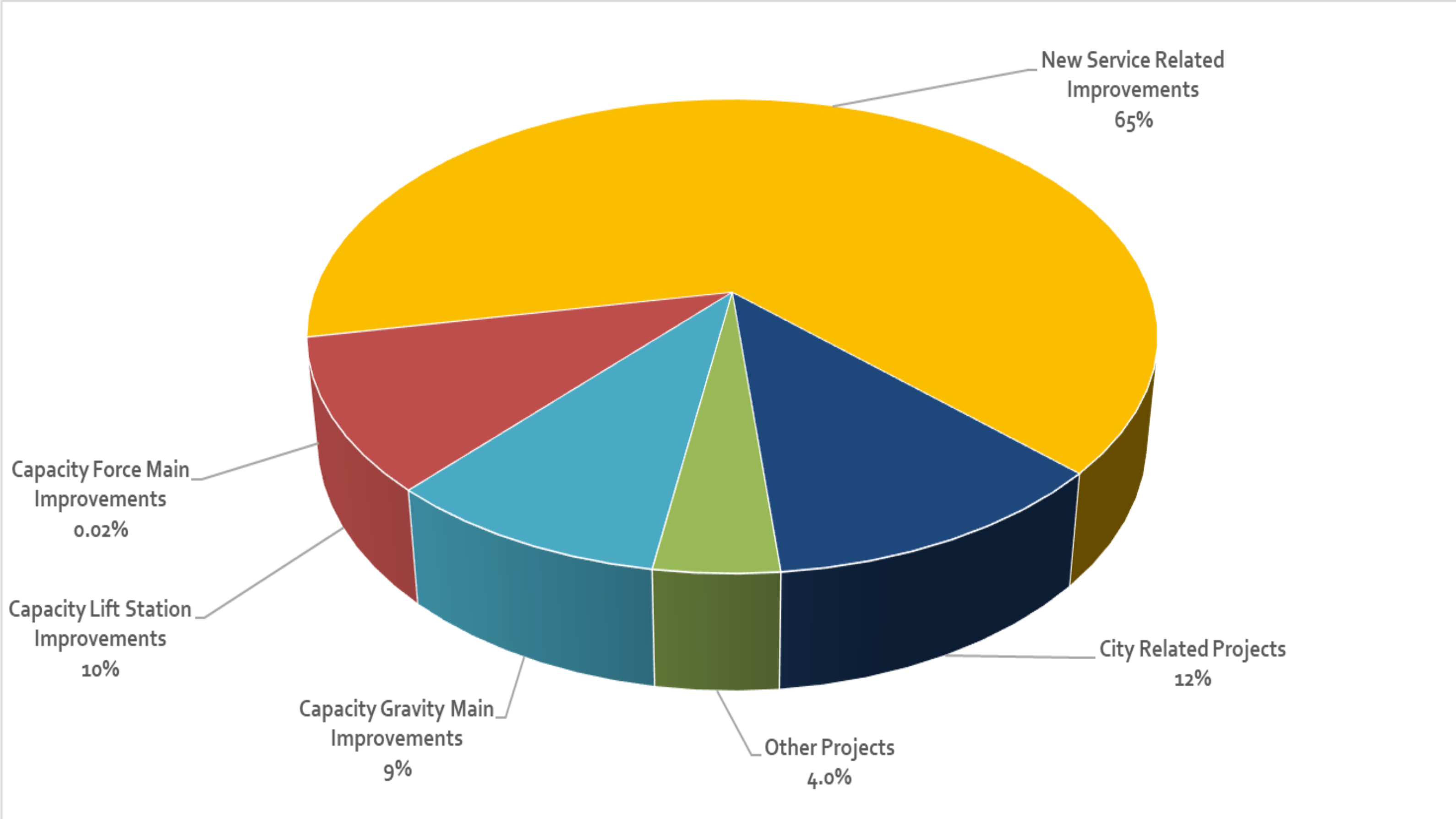

Figure ES.7 Sanitary Sewer Collection System CIP by Project Type

Chapter 1

INTRODUCTION

This Master Plan has been prepared by Carollo. This document is intended to help the City develop an integrated approach to prioritizing wastewater infrastructure improvements and upgrades. The Master Plan identifies constraints within the existing system, provides recommendations, and prioritizes improvements thought the development of a CIP.

1.1 City Location

The City is located within the San Joaquin Valley of California approximately 40 miles south of the City of Fresno and 70 miles north of the City of Bakersfield. State Route 198 bisects the City in an east-west direction and State Route 99 runs along the western edge of the City (see Figure 1.1).

Visalia was incorporated in 1874. The City provides wastewater and storm drainage service to its customers within the City limits, as well as some small areas outside of the City limits. California Water Service Company provides potable water to the City. The City is home to approximately 138,000 residents and the City limits encompass 35 square miles.

1.2 Previous Master Plan

The City's previous sewer system Master Plan was completed in 2005 by Carollo. The objective of the 2005 Master Plan was to review the existing capacity of the sewer collection system and recommend improvements needed to service anticipated future growth. The 2005 Master Plan included the development of a water system hydraulic model, developed in H_2OMAP Sewer, and a capital improvement program for the City's sewer system.

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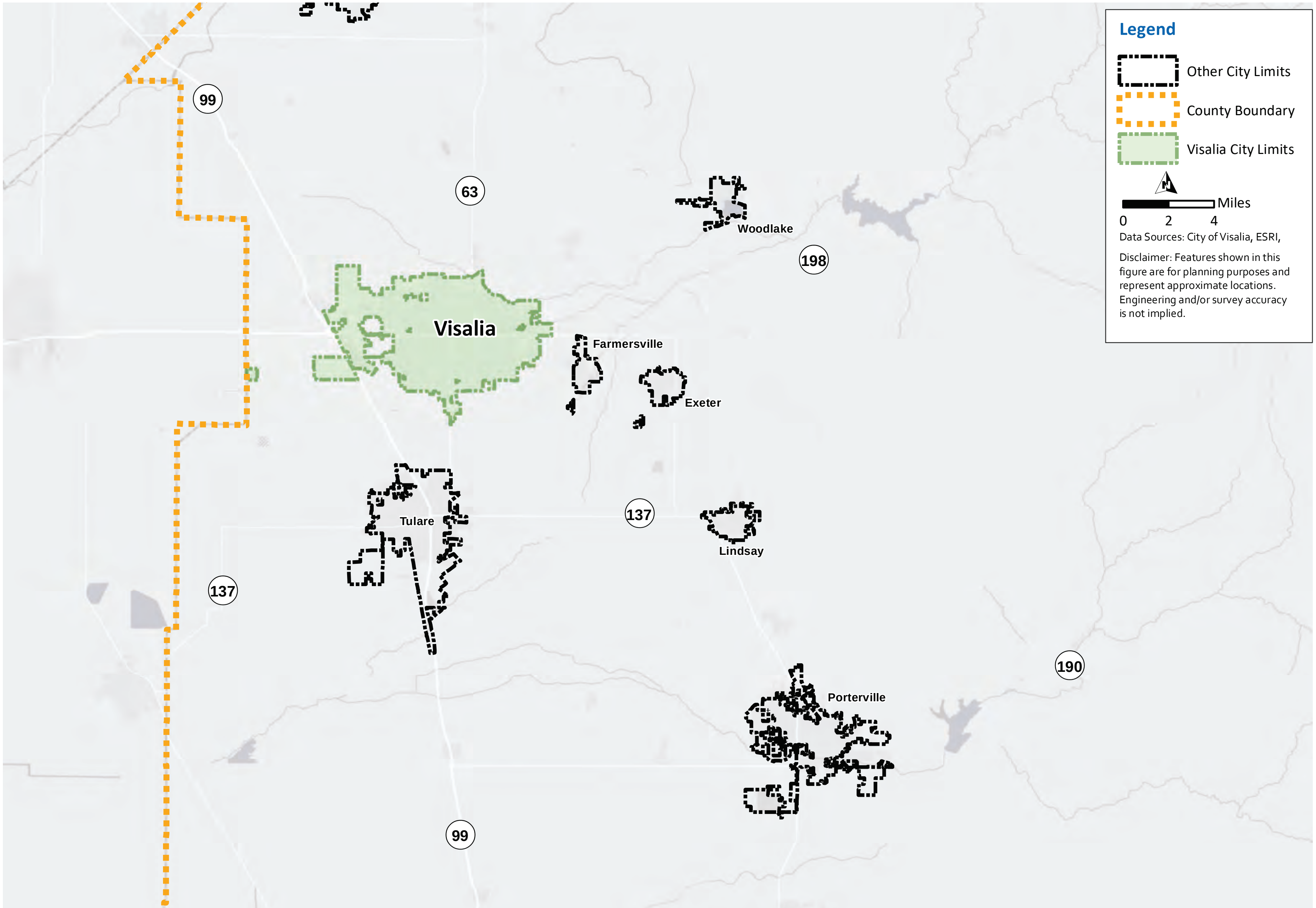

Figure 1.1 Regional Location Map

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1.3 Objectives

The purpose of this Master Plan is to provide an updated planning document for the City's wastewater collection system. Overall, the Master Plan will assist the City in their approach to optimize their collection system infrastructure. The objectives include:

- Update the City's existing hydraulic model.
- Determine existing and future wastewater flows.
- Define planning and evaluation criteria for the City's wastewater collection system.
- Perform capacity analyses and identify deficiencies in the collection system under existing and future conditions.
- Identify preliminary infrastructure to serve future growth.
- Prepare a CIP for the collection system.

1.4 Scope and Authorization

In September 2018, the City approved a professional service agreement with Carollo to prepare an update to the Master Plan. The professional services agreement included the following main tasks:

- Task 1 – Review of Existing Data and Collection of New Data (RFP Section A).
- Task 2 – Model Development (RFP Section B).
- Task 3 – Development of Master Plan Update (RFP Main Goal Sections C and D).
- Task 4 – Nexus Study (RFP Section E).
- Task 5 – Stakeholder Involvement Program (RFP Section F).
- Task 6 – Project Management.

Carollo performed a Nexus Study to update the sanitary sewer impact fees for new development in compliance with AB 1600 and other California legal requirements. This document is a standalone report and is not included in the Master Plan.

1.5 Report Organization

The Master Plan contains seven chapters, followed by appendices that provide supporting documentation for the information presented in the report. The chapters are briefly described below:

- Chapter 1 - Introduction. This chapter presents the need for this Master Plan and the objectives of the study.
- Chapter 2 - Study Area Description. This chapter presents a description of the study area, defines the planning horizon for this study, and summarizes the land use classifications and future development of the study area.
- Chapter 3 - Existing Collection System. This chapter provides an overview of the collection system and existing treatment facility.
- Chapter 4 - Wastewater Flows. This chapter summarizes the City's historical and projected wastewater flows. This chapter also defines the typical components of wastewater in a collection system as they pertain to this Master Plan. The flow monitoring data and results from the flow monitoring program are summarized and discussed.

- Chapter 5 - Wastewater Collection System Hydraulic Model. This chapter describes the update and calibration of the City's collection system hydraulic model. A detailed summary of the hydraulic model calibration steps, standards, and results for both dry weather flow (DWF) and wet weather flow (WWF) conditions is also provided.
- Chapter 6 - Wastewater Collection System evaluation Criteria and System Analysis. This chapter discusses the hydraulic evaluation of the sanitary sewer collection system and the proposed projects that correct capacity deficiencies and serve future users.
- Chapter 7 - Capital Improvement Plan. This chapter presents the capital improvement projects, a summary of the capital costs, and a basic assessment of the possible financial impacts on the City. This chapter presents the recommended CIP for the City's sanitary sewer collection system and a summary of the capital costs.

1.6 Acknowledgments

Carollo would like to thank the following City staff for their assistance and oversight of this project:

- Christopher Crawford, P.E.; City Engineer.
- Katherine Woodhull-Fuget, EIT; Associate Civil Engineer.

The following Carollo staff members were principally involved in this project:

- Tim Loper, P.E.; Principal In Charge.
- Ryan Orgill, P.E.; Project Manager.
- Joaquin Ramirez, P.E.; Project Engineer.
- Kevin Christensen; GIS/Graphics.
- Candice Padilla; Document Processing.

1.7 Reference Material

The following documents were referenced in the preparation of this Master Plan:

- California Regional Water Quality Control Board Central Valley Region, Water Discharge Requirements for the City of Visalia Water Conservation Plant Tulare County.
- City of Visalia Sewer System Master Plan, Carollo, December 2005.
- Alden, D. (2019, March). Visalia's new wastewater facility is greener, safer. Valley Voice https://www.ourvalleyvoice.com/2019/03/22/visalias-new-wastewater-facility-is-greener-safer/.
- Goshen CPU, Tulare County Resource Management Agency, Economic Development and Planning Branch.

Chapter 2

STUDY AREA DESCRIPTION

This chapter presents a discussion of the City's planning area characteristics, the land use classifications, and historical and projected population trends.

2.1 Study Area

In accordance with the City's 2014 General Plan, the main study area consists of the Tier 3 Urban Growth Boundary (UGB) plus the Community of Goshen Urban Development Boundary. The area beyond Tier 3 UGB is classified as the Planning Area and was analyzed as part of this Master Plan. Outside of Tier 3 UGB, farmland is the most prominent land use within the City's Planning Area. The future land use between Tier 3 and the Planning Area will need a broader analysis to determine future use of this area. Depending on future land use of the Planning Area, sizing and sanitary sewer alignments may be impacted.

The City's current General Plan assumes that through the year 2030, the annual average growth rate will be 2.6 percent, resulting in a Tier 3 UBG buildout population of 210,000.

The City's study area consists of multiple boundaries that are shown on Figure 2.1 and Figure 2.2. Area for the boundaries is based on GIS data provided by the City and are described below:

- City Limits: The City limits encompass approximately 32,000 acres (49 square miles). Figure 2.1 shows the City limits.
- Service Area: Sewer services are provided to residential, commercial, and industrial customers within city limits and nearby Goshen, which is northwest of the City.
- UGB: The General Plan defines this area as an administrative boundary which urban development is not allowed beyond during the time period for which it is effective. The total area consists of approximately 32,000 acres (49 acres) and could support a target future population of 210,000. Figure 2.1 illustrates the UGB.
- Sphere of Influence (SOI): The SOI is a planning boundary outside of an agency's legal boundary (such as the city limit line) that designates the agency's probable future boundary and service area.
- Planning Area: The Planning Area encompasses the UGB, SOI, and provides an open space buffer around the City. The area beyond the UGB is mainly comprised of agricultural land use. Long-term planning for this area is not considered in the General Plan. However, the previous master plan considered portions of the planning area (generally north of UGB) as potentially developable. For the purposes of this Master Plan the Planning Area will be considered, and preliminary infrastructure will be recommended. This Master Plan will continue the preliminary analysis of the Planning Area. Figure 2.1 shows the Planning Area, as well as the areas considered developable for the purposes of this Master Plan.

2.2 Climate and Topography

The City is characterized as a cold semi-arid (steppe) climate with warm, dry summers, and short, moderately cold winters. The low humidity leads to a wide daily range in temperatures, with an average difference between maximum and minimum daily temperatures of 19 to 34 degrees Fahrenheit (°F). Table 2.1 summarizes the average maximum and average minimum monthly temperatures as well as the average monthly precipitation for the City. The average high temperature varies throughout the year, with averages ranging between 36.9 °F and 97.5 °F. July is the City's hottest month, with an average high temperature of 97.5 °F and an average low temperature of 63.5 °F. January is the wettest month with an average 1.97 inches of precipitation. The average annual rainfall is 10.15 inches, with approximately 80 percent occurring between December and April.

The study area terrain slopes from higher elevation in the western reaches of the Sierra Nevada to the low flatlands of the San Joaquin Valley. The surface elevations within the study area are, on average, approximately 330 feet above mean sea level.

Table 2.1 Study Area Climate

Month	Average Maximum Temperature(1) (°F)	Average Minimum Temperature(1) (°F)	Average Monthly Rainfall(1) (inches)	Average Monthly ETo(2) (inches)
January	56.0	36.9	1.97	1.55
February	62.6	40.8	1.83	2.24
March	68.0	43.7	1.72	3.10
April	74.6	47.5	0.98	4.50
May	82.6	53.1	0.36	5.89
June	91.1	59.0	0.09	7.20
July	97.5	63.5	0.01	8.06
August	96.2	61.6	0.01	7.44
September	90.1	57.3	0.13	5.70
October	80.2	50.2	0.48	3.72
November	67.3	41.6	0.98	2.10
December	56.8	36.8	1.57	1.55
Annual	**76.9**	**49.3**	**10.15**	**53.1**

Notes:
(1) Source: Western Regional Climate Center, Visalia, California (049367).
(2) Source: CIMIS Reference ETo Zones, Zone 11. Visalia, CA (36.338, -119.2929).

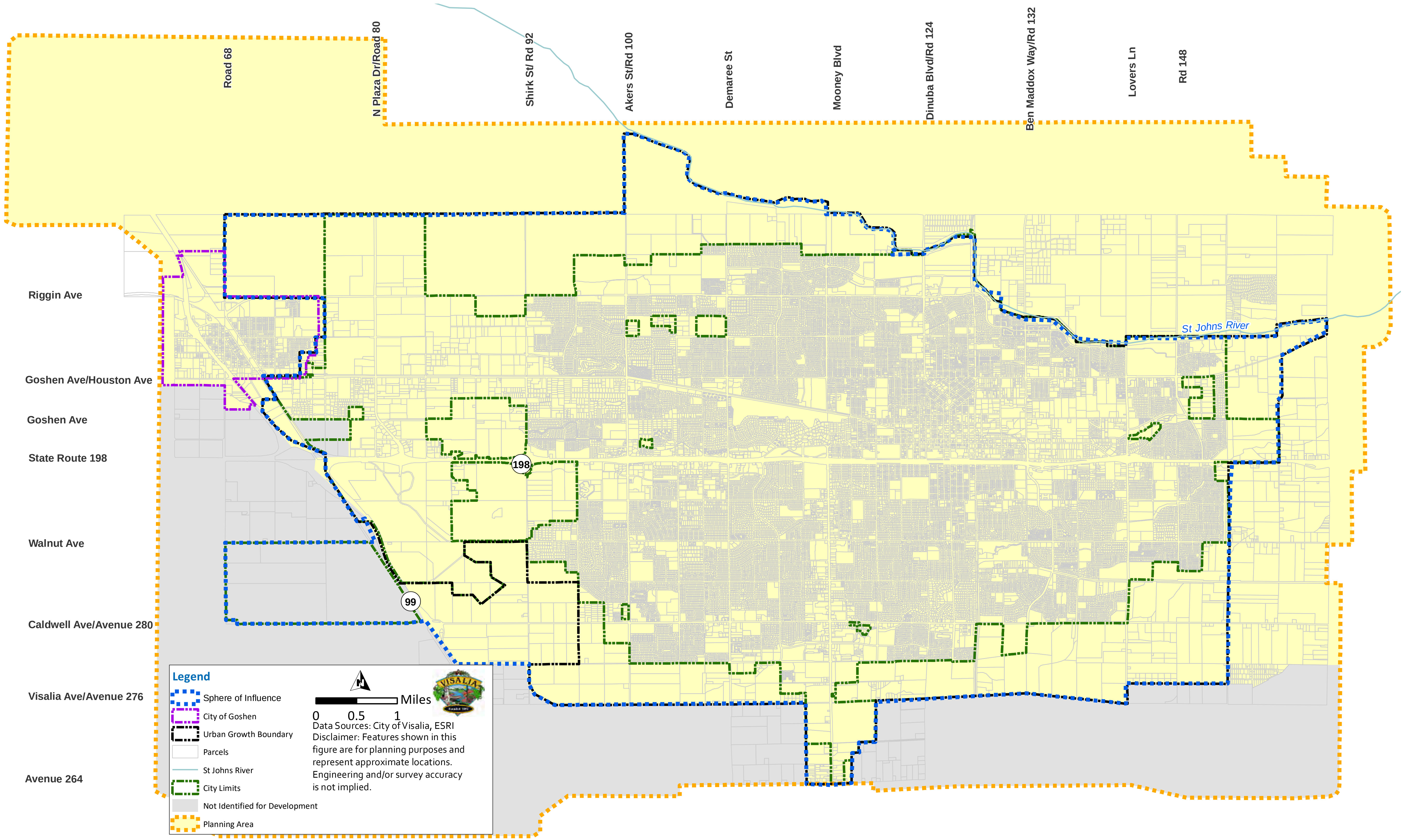

Figure 2.1 Study Area

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2.3 Land Use

Land use information is an integral component in determining the sewer generation within a given service area. The type of land use in an area will affect the volume and character of the wastewater generated. Therefore, adequately estimating wastewater loads from various land use types is important in sizing and maintaining the sanitary sewer collection system facilities. An important tool for determining land use projections is the City's General Plan. The land use assumption provided in the General Plan were used for the purpose of the Master Plan. The General Plan identifies 18 land use categories which are listed in Table 2.2. The General Plan identifies a southwestern area as Reserve; however, the City is in the process of allowing this area to be changed to commercial use. This area is listed as Commercial/Reserve in Table 2.2. Figure 2.2 shows the land use within the City's Planning Area. Land use descriptions from the General Plan are included in Appendix A for reference.

Table 2.2 General Plan Land Use

Land Use Category	Area Within the SOI(1)(2)(acres)			
	Land Use Code	Developed	Vacant	Total
Residential				
Residential Very Low Density	RVLD	307	1,033	1,339
Residential Low Density	RLD	10,700	4,809	15,509
Residential Medium Density	RMD	788	764	1,552
Residential High Density	RHD	267	270	538
Commercial/Industrial				
Business Research Park	BRP	61	88	148
Commercial Mixed Use	CMU	820	315	1,135
Commercial Neighborhood	CN	148	77	225
Commercial Regional	CR	307	233	539
Commercial/Reserve		-	870	870
Commercial Service	CS	446	76	522
Industrial	I	1,336	2,455	3,792
Light Industrial	IL	226	167	392
Office	O	386	55	441
Other				
Downtown Mixed Use	DMU	215	2	218
Public/Institutional	PI	1,351	1,046	2,397
Parks/Recreation	PR	844	789	1,633
Reserve	R	1	10	11
Conservation	C	604	417	1,021
Agricultural	A	-	435	435
Total		**18,805**	**13,889**	**32,694**

Notes:
(1) Land use areas based on GIS data and aerial analysis of the City's current service area (as of October 2021).
(2) The land use totals in this table exclude Goshen.

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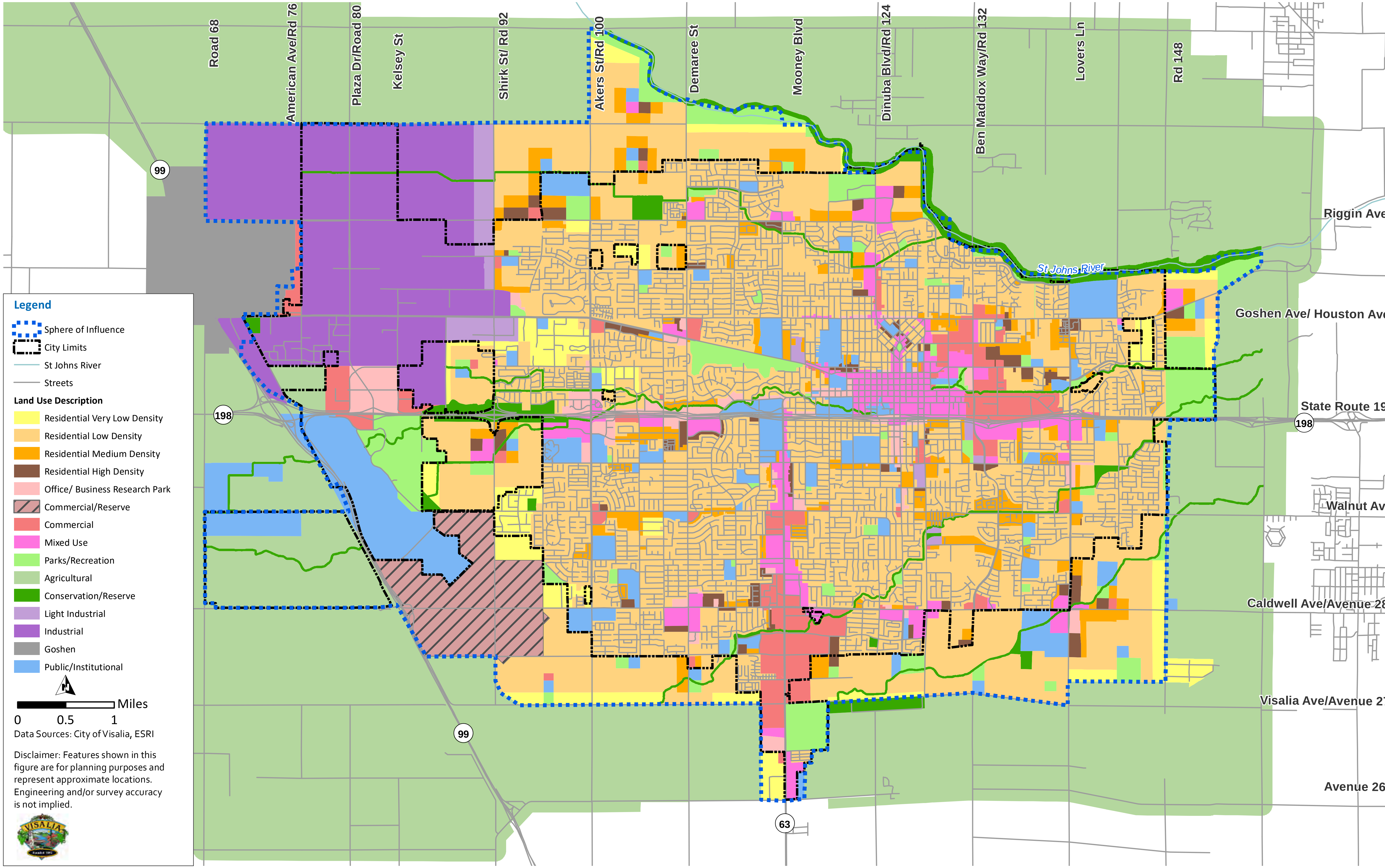

Figure 2.2 General Plan Land Use

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2.3.1 Future Land Use

Urban Growth Boundary Land Use

Future land use includes the development of vacant or underdeveloped areas. This includes growth outside the current City limits and encompassed by Tier 3 UGB. It is assumed that development and redevelopment will occur according to the land use designations as depicted on Figure 2.2.

Sphere of Influence

Land use within the SOI extends beyond Tier 3 UGB. This boundary includes the Reserve area which is modeled as commercial in compliance with the City's 2014 General Plan Environmental Impact Report. The SOI area south of the WRF is owned by the City and currently designated as agriculture. This area was not considered in the analysis.

Planning Area

Land use within the Planning Area is currently designated as predominately agriculture. The City's General Plan has not evaluated specific land use for this area. The Planning Area is considered ultimate buildout and occurs beyond development of the UGB. Development within this area is considered 70 percent residential, 20 percent commercial, and 10 percent open space. These percentages were developed from existing users which are estimated at 60 percent residential, 30 percent commercial and industrial. Future development in the Planning Area was assumed to have greater residential users, while industrial users remain within the City limits.

Known Developments

The City has plans for development of new residential communities as shown in Table 2.3. The City has currently identified 70 residential developments. Figure 2.3 shows the location of each development, which is expected to result in 3,126 new single- and multi-family residential units. The information provided in Table 2.3 and shown on Figure 2.3 was obtained from the City's Planning Division, Residential Development Activity – Final Maps. An aerial review of each development was performed in GIS to determine if lots are vacant during the hydraulic model calibration period. Existing land use is based on the General Plan and may vary from actual use.

Table 2.3 Planned Development Summary

No.	Planned Development Name(1)	Type	Existing Land Use	Single-Family Units	Multi-Family Units	Acreage
1	Wood Ranch	Duplexes/ Triplexes	Low Density	0	38	3.59
2	Luisi Acres	Single-Family	Medium Density	56	0	12.24
3	Lance Lane Estates	Single-Family	Low Density	84	0	19.95
4	Willow Springs	Single-Family	Low Density	140	0	39.66
5	Walnut Park Estates	Single-Family	Low Density	34	0	11.97
6	Highland Park Estates at Shannon Ranch	Single-Family	Medium Density	223	0	14.34

No.	Planned Development Name(1)	Type	Existing Land Use	Single-Family Units	Multi-Family Units	Acreage
7	Highland Park Estates	Single-Family	Low Density	54	0	38.80
8	River Run Ranch 5-7	Single-Family	Low Density	104	0	28.28
9	Visalia Palms	Senior Citizen Duplexes	Medium Density	0	66	4.16
10	Maddox at Caldwell VII	Single-Family	Medium Density	43	0	8.35
11	Shannon Ranch 3	Single-Family	Low Density	182	0	14.01
12	Diamond Oaks	Single/ Multi-Family	Medium Density	124	0	29.55
13	Campo Estates	Single-Family	Low Density	51	0	10.19
14	The Grove	Single-Family/ Apartments	Medium Density	53	44	11.22
15	Houdini Acres	Single-Family/ Duplexes	Low Density	8	4	2.15
16	Lowery West	Single-Family	Low Density	60	0	14.16
17	Cherry Creek	Single-Family	Low Density	45	0	9.7
18	Rose Estates	Single-Family	Low Density	6	0	3.0
19	Teagan Ranch	Single-Family	Low Density	8	0	1.58
20	River Island Ranch	Single-Family	Low Density	239	0	61.4
21	Quintana De Oro	Single-Family	Low Density	14	0	5.0
22	Orchard Walk	Single-Family	Low Density	104	0	24.7
23	Diamond Oaks Unit 1	Single-Family	Low Density	44	24	13.89
24	Luisi Acres Unit 5 Phase 2	Single-Family	Low Density	24	0	5.1
25	Los Pinos	Senior Citizen Duplexes	Low Density	21	0	7.0
26	Quail River Apartments	Apartments	Medium Density	0	146	7.1
27	Diamond Oaks Multi-Family	Apartments	Low Density	0	182	13.2
28	East Haven Duplexes	Duplexes	Low Density	0	14	1.78
29	Visalia Apartments	Apartments	Medium Density	0	200	15.9

No.	Planned Development Name(1)	Type	Existing Land Use	Single-Family Units	Multi-Family Units	Acreage
30	Bonadventure Unit 2 Phase 2(2)	Single-Family	Low Density	3	0	1.5
31	La Valencia(2)	Single-Family	Low Density	3	0	1.5
32	Northgate Estates(2)	Single-Family	Low Density	4	0	2.0
33	Da Vinci at Bella Sera(1)	Single-Family	Low Density	6	0	3
35	Oak Meadow Estates No. 5(2)	Single-Family	Very Low Density	2	0	1.5
36	Riggin Ranch(2)	Single-Family	Low Density	5	0	2.5
37	Stonegate Estates(1)	Single-Family	Low Density	1	0	0.5
38	Hall Estates	Single-Family	Low Density	30	0	8.3
39	Pinkham Ranch(1)	Single-Family	Low Density	7	0	1.4
40	Los Gatos(2)	Single-Family	Low Density	5	0	2.2
41	Oakglen Estates(2)	Single-Family	Low Density	3	0	0.7
42	Cobblestone Estates II, Unit 3	Single-Family	Low Density	18	0	7.1
43	Pheasant Ridge Unit No. 2, Phase 1(1)	Single-Family	Low Density	4	0	1
44	Quail River	Single-Family	Low Density	323	0	45.3
45	Shannon Ranch 3 Units 1-4 & 6(2)	Single-Family	Low Density	14	0	2.0
47	Pine River Ranch Estates Phase 1(2)	Single-Family	Low Density	5	0	1.2
48	Rancho Santa Fe Estates Unit 3 Phase 1(2)	Single-Family	Low Density	5	0	1
50	Shannon Ranch 3 Units 13 & 14	Duplexes/ Triplexes	Low Density	63	38	10.1
51	Kayenta Crossing	Single-Family	Low Density	90	0	19.95
55	San Sebastian III	Single-Family	Low Density	9	0	1.5
56	Eagle Meadows	Single-Family	Low Density	94	0	13.8
57	Shannon Ranch 3 Units 5, 7-8	Single-Family	Low Density	81	0	17.2
58	Luisi Acres Unit 5 Phase 1	Single-Family	Low Density	30	0	4.7

No.	Planned Development Name(1)	Type	Existing Land Use	Single-Family Units	Multi-Family Units	Acreage
59	Quail Park Senior Independent Living	Senior Citizen Independent Living	Medium Density	0	100	3.7
60	Sterling Oaks Unit 1	Single-Family	Low Density	91	0	36.3
64	Emerald Creek	Single/Multi-Family	Low Density	40	18	10.2
65	Willow Springs Unit 1	Single-Family	Low Density	26	0	3.7
66	Lowery West Phase 1A	Single-Family	Low Density	65	0	16.3
67	Lowery West Phase 1B	Single-Family	Low Density	93	0	17.5
68	Southern Highlands/ Rancho Verde	Single/Multi-Family	Low Density	71	48	14.3
69	Candelas	Single-Family	Low Density	149	0	32.8
70	Reimer	Single-Family	Low Density	65	0	11.2
	Total	**-**	**-**	**3,126**	**922**	**728**

Notes:
(1) Known development list as of October 2021.
(2) Based on an aerial analysis in GIS, a number of units have been developed as of 2021. The remaining units and approximate acreage during the sewer loading of the hydraulic model are shown in units column.

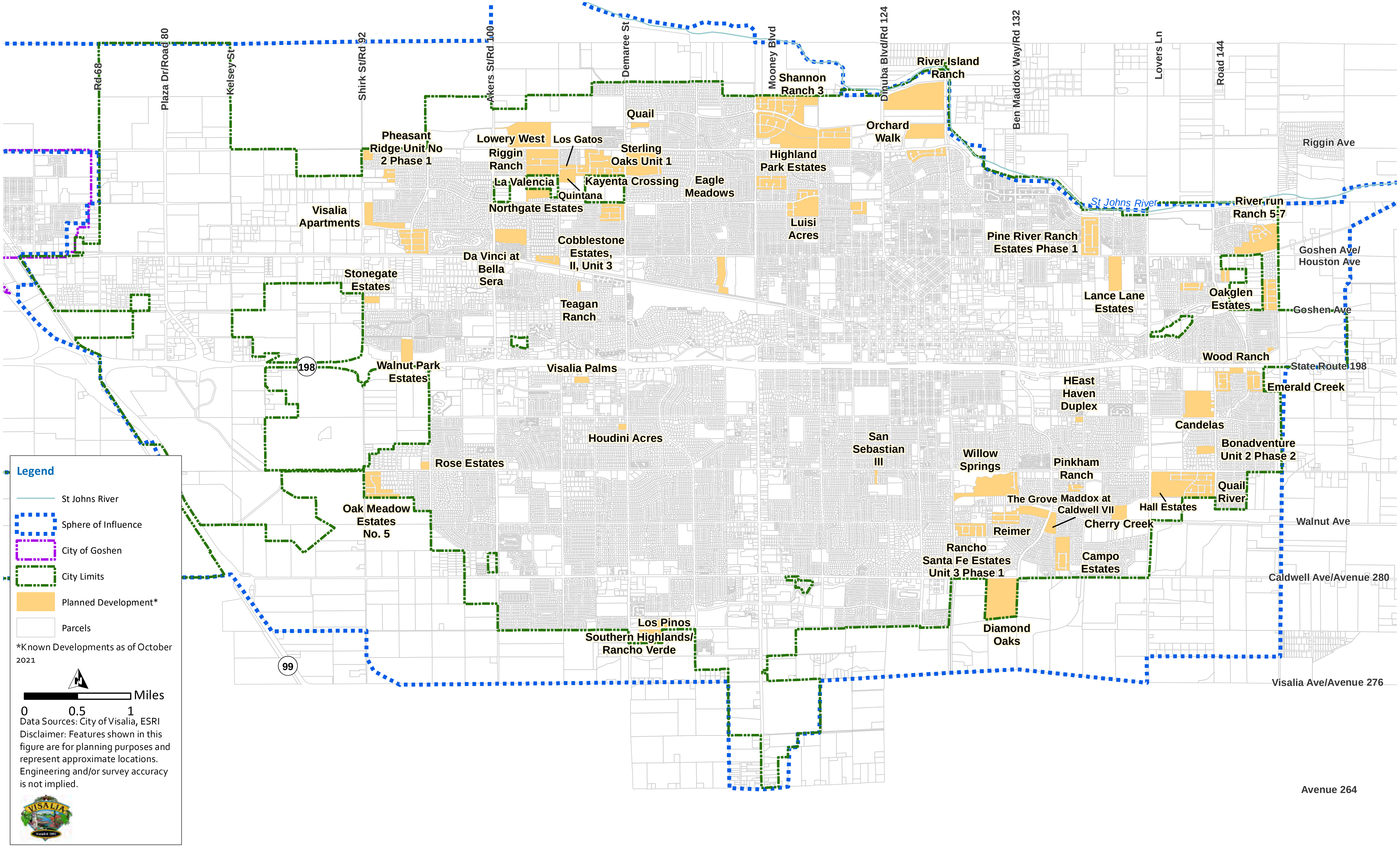

Figure 2.3 Known Developments

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2.3.2 Historical and Existing Sanitary Sewer Service Area Population

Historical population estimates are from the California Department of Finance. Table 2.4 shows the historical population for the City of Visalia and the City of Goshen. The total existing population within the service area (Visalia and Goshen) boundaries was estimated at 141,073 people. From 2000 to 2019 (20 years) the growth rate for Visalia has averaged 2.15 percent.

Table 2.4 Historic and Existing Population

Year	Visalia Population	Goshen Population	Total Population	Visalia Growth (%)
1999	90,072	2,351	92,423	--
2000	91.891	2,394	94,285	2.02
2001	93,309	2,435	95,744	1.54
2002	95,730	2,476	98,206	2.59
2003	98,740	2,518	101,258	3.14
2004	102,236	2,561	104,797	3.54
2005	106,054	2,605	108,659	3.73
2006	108,950	2,649	111,599	2.73
2007	115,243	2,694	117,937	5.78
2008	118,848	2,740	121,588	3.13
2009	121,885	2,786	124,671	2.56
2010	124,442	3,006	127,448	2.10
2011	125,531	3,045	128,576	0.88
2012	126,926	3,085	130,011	1.11
2013	128,500	3,125	131,625	1.24
2014	129,470	3,165	132,635	0.75
2015	130,660	3,207	133,867	0.92
2016	132,397	3,248	135,645	1.33
2017	133,872	3,290	137,162	1.11
2018	135,892	3,333	139,225	1.51
2019	137,696	3,377	141,073	1.33
20-Year Average				**2.15**
10-Year Average				**1.23**
5-Year Average				**1.24**

2.3.3 Projected Sanitary Sewer Service Area Population

This Master Plan assumes a growth rate of 2.6 percent per year for the City of Visalia (based on input from City staff) and 1.3 percent for Goshen (per Goshen Community Plan 2018 Update [Goshen CPU]), under the assumption that the service area population will match the City-wide growth rate. Figure 2.4 shows the projected service area population according to a growth rate of 2.6 percent. The projected population growth is summarized in Table 2.5.

Table 2.5 Historic and Existing Population

Year	Visalia Population	Goshen Population	Total Population	Visalia Growth (%)
2020	141,276	3,420	144,697	-
2025	160,622	3,649	164,271	2.6
2030	182,617	3,892	186,510	2.6
2035	207,625	4,152	211,776	2.6
2040	236,056	4,429	240,485	2.6

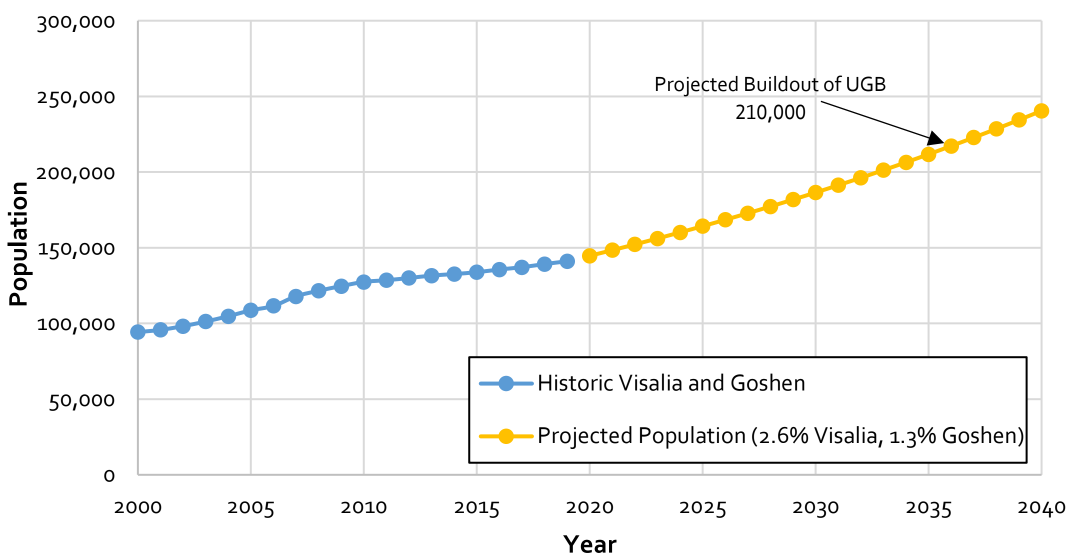

Figure 2.4 Historic and Projected Population Growth

Chapter 3

EXISTING SANITARY SEWER COLLECTION SYSTEM

This chapter presents an overview of the City's existing sanitary sewer collection system and a brief summary of the WRF.

3.1 Existing Sanitary Sewer Collection System

The existing wastewater collection system consists of approximately 493 miles of gravity sanitary sewer pipelines. Pipelines range in diameter from 4 inches to 48 inches. The City operates 13 wastewater lift stations and associated force mains. Wastewater discharge from residential, commercial, industrial, and other users are conveyed to the City's WRF. In addition, Goshen, a CDP located northwest of the City, conveys wastewater flows to the WRF via a lift station and 24-inch pipeline. Figure 3.1 presents the City's existing wastewater collection system.

A small portion of wastewater generated in the service area is disposed of through private septic systems. These septic systems are located in former county islands.

3.1.1 Sewer Basins

The existing sanitary sewer collection system is divided into 10 sewer basins. Each basin is served by a trunk line which identifies with a major street alignment. Figure 3.1 shows the general area for each sewer basin. Wastewater from Goshen is conveyed to the WRF; however, a sewer basin was not developed for the area. The trunk sewers are described from upstream to downstream. The sewer basins differ from the temporary flow monitoring basins outlined in Chapter 4.

Basin 1 – Caldwell Akers Trunk

Basin 1 is served by the Caldwell Akers Trunk and sub trunks. The trunk begins in Caldwell Avenue, west of Lovers Lane with a 15-inch pipeline and extends west. The pipeline transitions to an 18-inch at Ben Maddox Way, then a 24-inch at Santa Fe Street. The 24-inch segment continues to Mooney Boulevard and increases to a 27-inch. The remainder of the Caldwell segment consists of a 27-inch pipeline from Mooney Boulevard to Akers Street. In Akers Street the trunk transitions to a parallel 12-inch and 36-inch pipeline. The Caldwell Akers Trunk terminates at Walnut Avenue with the 36-inch connection to a 48-inch and the 12-inch connecting to a 36-inch .

Basin 2 – Walnut Lovers Lane Trunk (Walnut Outfall)

Basin 2 is served by the Walnut Lovers Lane Trunk, a parallel Walnut Outfall Trunk, and sub trunks. The Walnut Lovers Lane trunk begins in Lovers Lane and Houston Avenue with a 15-inch pipeline. The trunk extends south on Lovers Lane and transitions to an 18-inch at Race Avenue. The pipeline cross highway 198 and transitions to a 21-inch, which extends to Walnut Avenue. The Trunk continues west on Walnut Avenue and transitions from 21-inch to a 36-inch pipeline.

The pipeline crosses Highway 99 as a 42-inch and terminates at the WRF. The Walnut Lovers Lane Trunk is downstream of tributary Basins 2, 3, 4, 7, 8, and portions of 1, 5, and 10.

The Walnut Outfall is a 48-inch pipeline that extends west from Akers Street to the WRF. The pipeline runs parallel to the Walnut Avenue Lovers Lane Trunk and is downstream of tributary Basins 6, 9, and portions of 1, 5, and 10.

Basin 3 – Tulare Trunk

Basin 3 is served by the Tulare Trunk and sub trunks. The trunk begins in Tulare Avenue and Ben Maddox Way with a 12-inch pipeline. The trunk extends west to Church Street, transitioning from 12-inch to a 21-inch pipeline. Pipeline turns north onto Church Street, transitions from 21 inches to 18 inches at the intersection of Church Street and Sequoia Avenue, turns west at Noble Avenue and decreases to a 15-inch until Encina Street where it goes back to 18-inch until Divisadero. The pipeline continues south in Divisadero Street as a 21-inch and West on Tulare Avenue, transition from 27 inches to 33 inches in pipeline diameter. The Basin terminates at the intersection of Laurel Avenue and Noyes Street.

Basin 4 – Akers Mineral King Trunk

Basin 4 is served by the Akers Mineral King Trunk and sub trunks. The trunk begins in the intersection of Houston Avenue and Lovers Lane with a 15-inch diameter pipeline. The trunk extends west in Houston Avenue, where it transitions to an 18-inch diameter pipeline at Cain Street. The trunk continues west on Houston Avenue then goes south on Burke Street, where it transitions to a 21-inch just north of Center Avenue. The 21-inch trunk continues south on Burke Street, then heads west on Mineral King Avenue, north on Santa Fe Avenue, west on Willow Street (where it transitions to a 24-inch diameter pipeline), and then south again to Mineral King Avenue at the Marriott Hotel. The 24-inch trunk continues west on Mineral King Avenue where it transitions to a 36-inch diameter at Locust Street, and a 42-inch at Divisadero Street. The trunk decreases in size to a 30-inch as it crosses south across Highway 198, west of Woodland Drive. The 30-inch trunk then continues west along Noble Avenue and then south to Tulare Avenue, and then along Akers Street, where it connects to the Walnut Lovers Lane Trunk on Walnut Avenue.

Basin 5 – Ranch Houston Trunk

Basin 5 is served by the Ranch Houston Trunk and sub trunks. The trunk begins east of the Houston Avenue and Burkes Street intersection with a 12-inch diameter pipeline. The trunk extends west in Houston Avenue transitioning to an 18-inch at the intersection of Conyer Street and continuing to Ranch Street. The Trunk extends south in Ranch Street to Mineral King Trunk.

Basin 6 – Akers Houston Trunk

Basin 6 is served by the Akers Houston Trunk and sub trunks. The trunk begins in Giddings Street and Vine Avenue, south of the abandoned Sunnyview/Giddings lift station with a 15-inch. The trunk extends south in Demaree, then east in Goshen Avenue. The pipeline zigzags through a residential area to Chinowth Street, then to Hurley Avenue, south on Crenshaw Street. The pipeline continues south to Mineral King as a 21-inch pipeline and parallels the Mineral King Trunk. The trunk crosses Highway 198 as a 24-inch and continues south to Akers Street and Walnut Street.

Basin 7 – Road 76 Ferguson Trunk

Basin 7 is served by the Road 76 Ferguson Trunk and sub trunks. The trunk begins east of Riggin Avenue and Dinuba Avenue, with a 24-inch pipeline. The pipeline extends west on Riggin Avenue and continues south on Mooney Boulevard as a 30-inch pipeline. The 30-inch pipeline continues south on Mooney to Ferguson Avenue. The 30-inch pipeline extends east on Ferguson and transitions to a 27-inch at Zachary Street intersection and back to a 33-inch at Demaree Street. The 33-inch pipeline continues east on Ferguson Avenue and transitions to Sunnyview Avenue, reducing to a 30-inch at Shirk Street intersection, to Road 76. The segment in Road 76 extends south, crosses Highway 198 and continues to the Airport Lift Station, with diameters varying from 30 inches to 42 inches. Downstream of the lift station the pipeline reduces to a 36-inch and terminates in the Walnut Lovers Lane Trunk.

Basin 8 – Kelsey Street Trunk

Basin 8 is served by the Kelsey Street Trunk and sub trunks. The trunk begins near Kelsey Street and Goshen Avenue intersection with an 18-inch pipeline. The trunk continues south, transitions to a 21-inch, crosses Highway 198 and enters the Golf Course Lift Station. Downstream of the lift station the 21-inch trunk terminates at the Walnut Lovers Lane Trunk.

Basin 9 – Shirk Street Trunk

Basin 9 is served by the Shirk Street Trunk and sub trunks. The trunk begins at the intersection of Shirk and School Avenue with a 48-inch pipeline. The trunk continues south in Shirk Avenue, crosses Highway 198 and enters the Shirk Lift Station. Downstream of the lift station a 6-inch force main extends to Walnut Street and terminates at the Walnut Outfall Trunk.

The Shirk Capacity Enhancement Project will extend this trunk north and expand the basin in the future.

Basin 10 – Visalia Parkway Akers Trunk

Basin 10 is served by the Visalia Parkway Trunk and sub trunks. The trunk begins at the intersection of Visalia Parkway and Santa Fe Street with a 33-inch pipeline. The trunk extends west, transitioning to a 36-inch south of Mooney Boulevard. The pipeline continues to Akers Street and heads north to Caldwell Avenue. The trunk terminates at the Caldwell Akers Trunk. The Parkway Trunkline Project will extend the trunk to Lovers Lane.

3.1.2 Septic Users

Septic users within the City limits have been identified. Properties that are located inside county islands were also identified. Areas outside of the city limits and located in Tier 1 of the UGB have several septic users, however, these users were not identified. These areas are expected to be connected as new development/redevelopment extends. Figure 3.2 shows the location of septic users within the service area and located within county islands. Septic users were identified by reviewing an overlay of the City's sewer pipelines on GIS onto an imagery map. Areas where pipelines don't extend are identified as septic users. Judgement was used on areas where GIS did not indicate pipelines; however, the imagery map showed new development, then this area was not considered septic.

Method shortcomings could occur with areas where pipelines do extend through, but the existing unit is not connected. Nevertheless, this scenario was not common, and any misrepresentation of septic users would be minimal and not impact the hydraulic analysis. Figure 3.2 shows the location of septic users that were identified for this master plan.

3.1.3 Pipeline Distribution by Diameter

Table 3.1 summarizes the total length of gravity pipeline for each diameter in the domestic collection system. The table is based on GIS data and available drawings provided by City staff. The table excludes private sewer pipelines within the study area and does not account for pipelines within the WRF.

As shown in Table 3.1 , the majority of the City's gravity sewers are 8 inches in diameter, with the largest being 48 inches in diameter. Figure 3.2 illustrates the distribution of all pipeline diameters.

GIS data provided by the City did not contain pipeline material and age. The City should update the GIS to include installation dates and pipeline material, if possible, which will allow the City to perform an age-based analysis to provide an evaluation of pipeline decay and potential failure. This knowledge will assist the City in identifying critical areas.

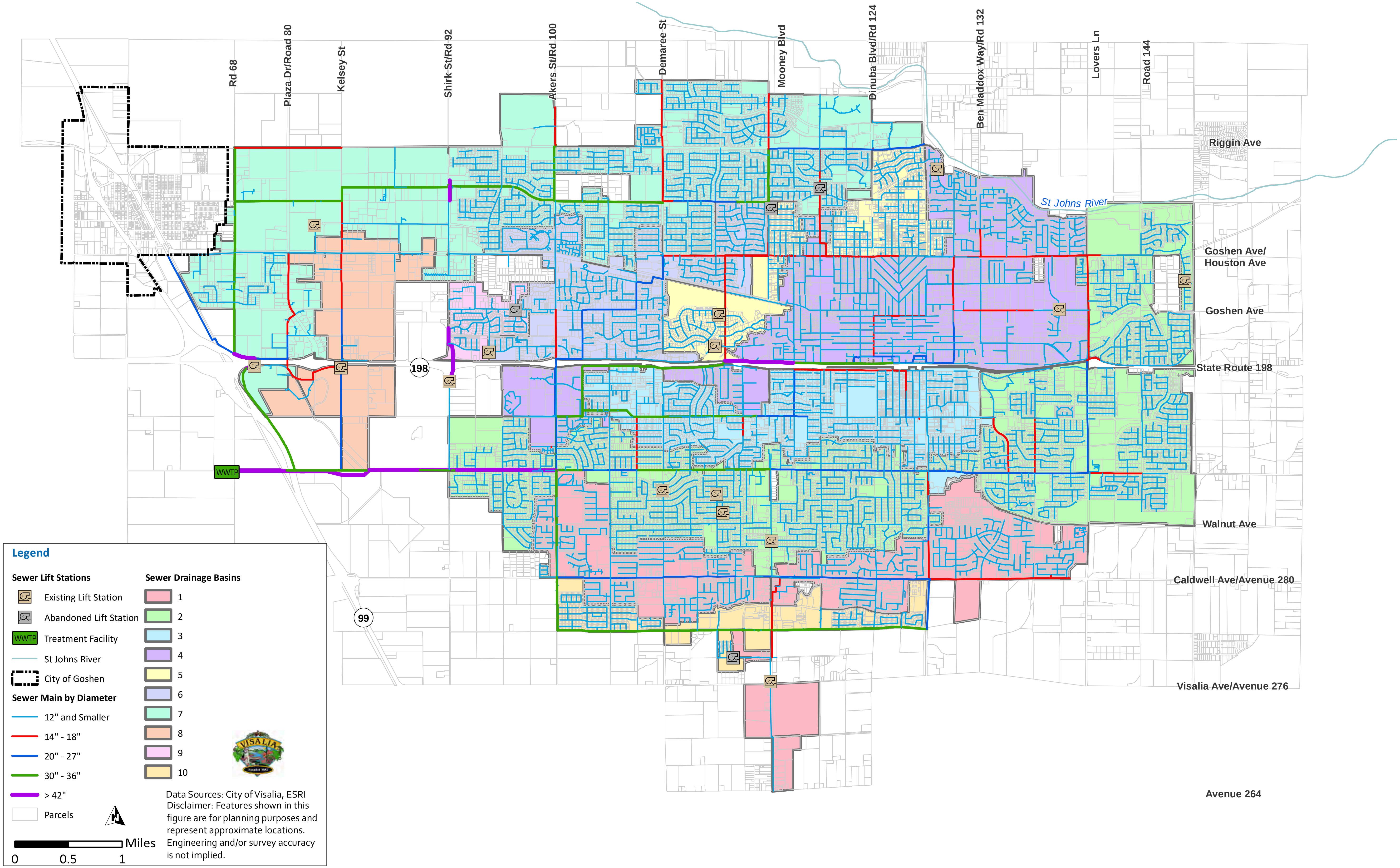

Figure 3.1 Existing Sanitary Sewer Collection System

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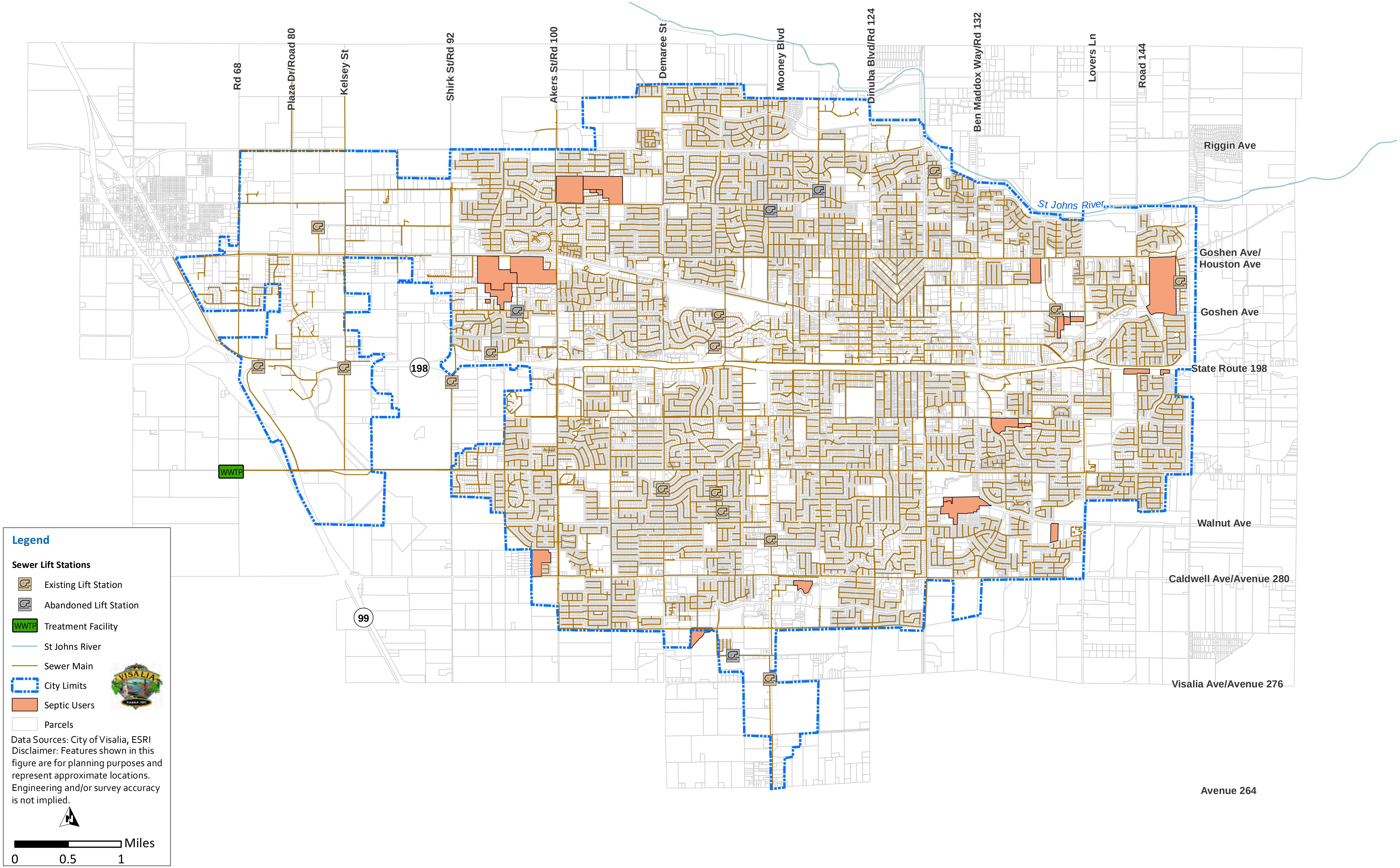

Figure 3.2 Septic Users

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Table 3.1 Pipeline Diameter Overview

Diameter	Length (feet)	Length (miles)	Percent (%)
Gravity			
4	7,100	1.3	0.27
5	700	0.1	0.03
6	191,900	36.3	7.37
8	1,766,900	334.6	67.86
10	124,800	23.6	4.79
12	144,500	27.4	5.55
14	2,700	0.5	0.10
15	59,900	11.3	2.30
18	55,000	10.4	2.11
20	2,800	0.5	0.11
21	34,700	6.6	1.33
24	36,200	6.9	1.39
27	27,900	5.3	1.07
30	39,700	7.5	1.52
33	31,000	5.9	1.19
36	50,200	9.5	1.93
42	7,600	1.4	0.29
48	20,000	3.8	0.77
Total	**2,603,600**	**493.1**	**100**

Notes:
(1) Total only includes City owned pipelines, Goshen and abandoned pipelines are excluded.
(2) Pipeline length in feet rounded to nearest hundred.
(3) Force main data was not available.

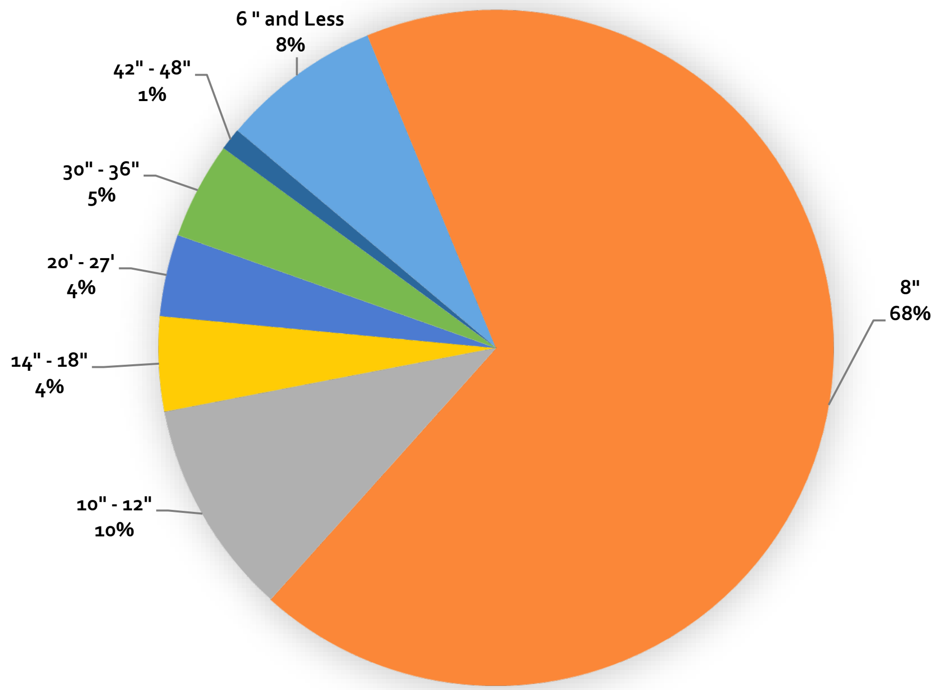

Figure 3.3 Pipelines by Diameter

3.1.4 Lift Stations

The City owns and operates 15 lift stations that pump wastewater from low points in the collection system to manholes at higher elevation. Table 3.2 summarizes the available information on each lift station. Airport lift station includes four pumps, while the other lift stations include one duty pump and one standby pump.

Table 3.2 Lift Station Information

No.	Lift Station Name	No. of Pumps	Firm Capacity (gpm)	Firm Capacity (mgd)
1	Airport	4	6,100	8.78
2	Golf Course	2	1,200	1.73
3	Shirk & 198	2	950	1.37
4	Preston & Hillsdale	2	400	0.58
5	Mill Creek & Main Street	2	175	0.25
6	Border Links	2	180	0.26
7	St John's Parkway and Modoc(1)	2	-	-
8	Comstock & Houston(1)	2	-	-
9	Demaree & Pryor	2	480	0.69
10	County Center & Mary	2	180	0.26
11	Evergreen & Cherry	2	480	0.69
12	Sunnyside & Mooney	2	580	0.84
13	Mooney and 272	2	190	0.27
-	Caprock(1)	2	-	-
-	Virmargo/Goshen	2	-	-

Notes:

Capacity of lift station is unknown.

3.2 Existing Water Conservation Plant

The City owns and operates the WRF which provides service to the City and the unincorporated community of Goshen. The City completed upgrades to the WRF in January 2017. The WRF now consists of:

- Two Parshall flumes.
- Two bar screens.
- Four grit tanks.
- Five rectangular primary clarifiers.
- Four fine screens.
- Four rectangular aeration basins.
- Ten membrane bioreactor tanks.
- Recirculation lines.
- Ultraviolet light.

Figure 3.3 shows a process flow diagram of the WRF. The plant currently has a permitted capacity of 18 mgd. The plant has the capability to produce recycled water that meets Title 22 standards. Currently, the City is permitted to discharge to City owned land and contracted users.

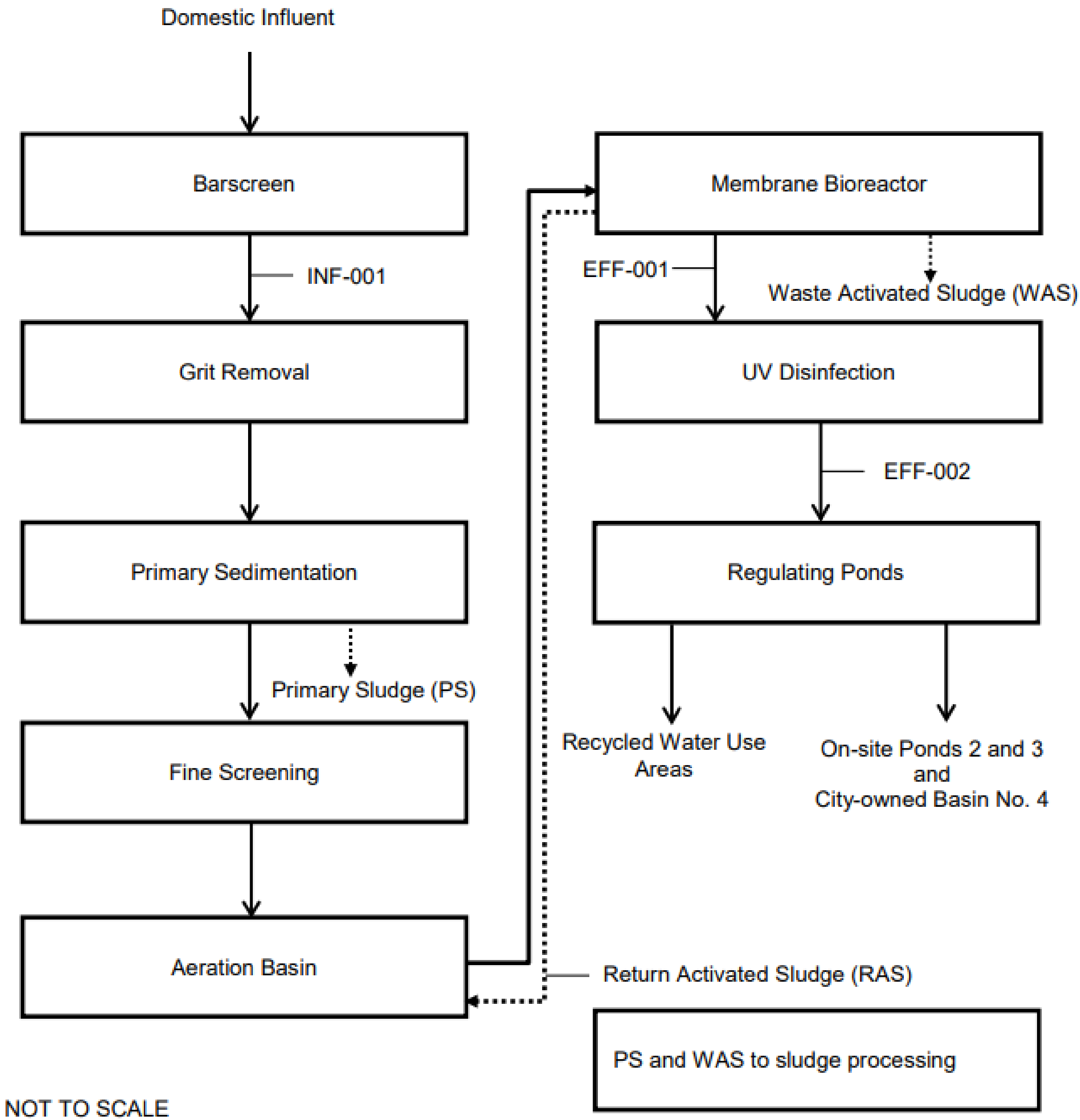

Figure 3.4 City Wastewater Treatment Facility Process Flow Diagram (Source: CRWQCB)

Chapter 4

SANITARY SEWER FLOWS

This chapter summarizes the flow monitoring program and establishes the flows characteristics that will be used to evaluate the collection system.

4.1 Sanitary Sewer Flow Components

This section describes the terminology used for the hydraulic analysis of the sanitary sewer collection system. Wastewater flows vary according to season and generally consist of DWF and WWF.

Groundwater infiltration (GWI) is an additional component of DWF. GWI enters the sewer system when the pipeline depth is lower than the groundwater. Because the water table is several hundred feet below the ground surface, GWI in the Central Valley should not be a significant contributor to the collection system under DWF conditions.

WWF includes inflow from storm water runoff and infiltration from saturated soil conditions. The storm water inflow and infiltration comprise the WWF component termed infiltration/inflow (I/I). The response in the sewer system to rainfall is seen immediately (as with inflow) or within hours after the storm (as with infiltration).

Base Wastewater Flow

The base wastewater flow (BWF) is synonymous with DWF and is generated by the City's customers independent of wet weather influences. BWF is estimated by measuring flows during dry weather conditions. The flow has a diurnal pattern that varies depending on the type of use. Commercial and industrial flows, though they vary depending on the type of use, are typically higher during business hours and lower at night. Furthermore, the diurnal flow pattern experienced during a weekend may vary from the diurnal flow experienced during a weekday.

Average Annual Flow

The AAF is the average flow that occurs on a daily basis throughout the year, including both periods of dry and wet weather conditions.

Average Dry Weather Flow

The average dry weather flow (ADWF) is the average flow that occurs on a daily basis during the dry weather season, considered May through October. The ADWF includes the BWF generated by the City's residential, commercial, and industrial users during the dry season.

Maximum Day Dry Weather Flow

The MDDWF is the highest daily average influent flow during the dry weather months.

Peak Dry Weather Flow

PDWF is the maximum hourly influent flow during the dry weather months.

Peak Wet Weather Flow

PWWF is the maximum influent flow during the wet weather months.

4.2 Flow Monitoring Data

This section describes the temporary flow monitoring program conducted as part of this study. The data and results from the flow monitoring program are summarized and discussed.

4.2.1 Flow Monitoring Program

As part of the Scope of Services for this Master Plan, Carollo contracted with V&A Consulting Engineers (V&A) to conduct a temporary flow monitoring program within the City's sanitary sewer collection system. The purpose of the flow monitoring program was to assist in the development of design flow criteria and to correlate actual collection system flows to the hydraulic model predicted flows. The temporary flow monitoring program was conducted for a period of 42 days, from November 28, 2018, to January 08, 2019. The "City of Visalia 2018/2019 Sewer Flow Monitoring Study" prepared by V&A summarizes the flow monitoring program. A copy of the report is included in Appendix B.

4.2.2 Flow Monitoring Sites and Tributary Areas

A total of 15 open-channel flowmeters were installed at locations selected by Carollo and the City. The meter sites were selected to best isolate and model critical areas and subareas within the sewer system. Table 4.1 lists the flow monitoring locations and the sewer diameters where the meters were installed. The 15 flow monitoring locations, as well as the tributary area to each site, are shown on Figure 4.1. Figure 4.2 provides a schematic illustration of the flow monitoring locations.

Table 4.1 Flow Monitoring Locations

Site	Pipe Diameter (inches)	Location
FM-01	36	End of Drive 85
FM-02	21	Valley Oaks Golf Course
FM-03	48	West Walnut Avenue west of Road 92
FM-04	36	West Walnut Avenue and South Savannah Street
FM-05	36	3498 Akers Street north of West Caldwell Avenue
FM-06	33	South Noyes Street and West Laurel Avenue
FM-07	30	South Akers Street north of West Cambridge Avenue
FM-08	24	South Akers Street south of West Cambridge Avenue
FM-09	27	West Walnut Avenue and South San Joaquin Drive
FM-10	27	West Caldwell Avenue and Road 100
FM-11	42	West Mineral King Avenue west of South Woodland Drive
FM-12	28	East Walnut Avenue and South Church Street
FM-13	18	Houston Avenue and North County Center Street
FM-14	18	West Cecil Avenue and North Ranch Court
FM-15	28.5	4425 West Ferguson Avenue west of North Chinowth Street

4.2.3 Flowmeter Installation and Flow Calculation

Teledyne Isco 2150 flowmeters were used for this project. Isco 2150 meters use a pressure transducer to collect depth readings and ultrasonic Doppler sensors on the probe 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 installation of the flowmeters and again when they were removed and were compared to simultaneous level and velocity readings from the flowmeters to verify proper calibration and accuracy. The pipeline diameter was also verified in order to accurately calculate the flow cross-section. The continuous depth and velocity readings were recorded by the flowmeters on 5-minute intervals. The flow at each meter was calculated at 5-minute intervals based on the continuity equation:

$$Q = V \times A$$

where,

Q = Pipeline flow rate, cubic feet per second

V = Average velocity, feet per second (ft/s)

A = Cross sectional flow area, square feet

Finally, the 5-minute flow, velocity, and level data were aggregated into 15-minute increments.

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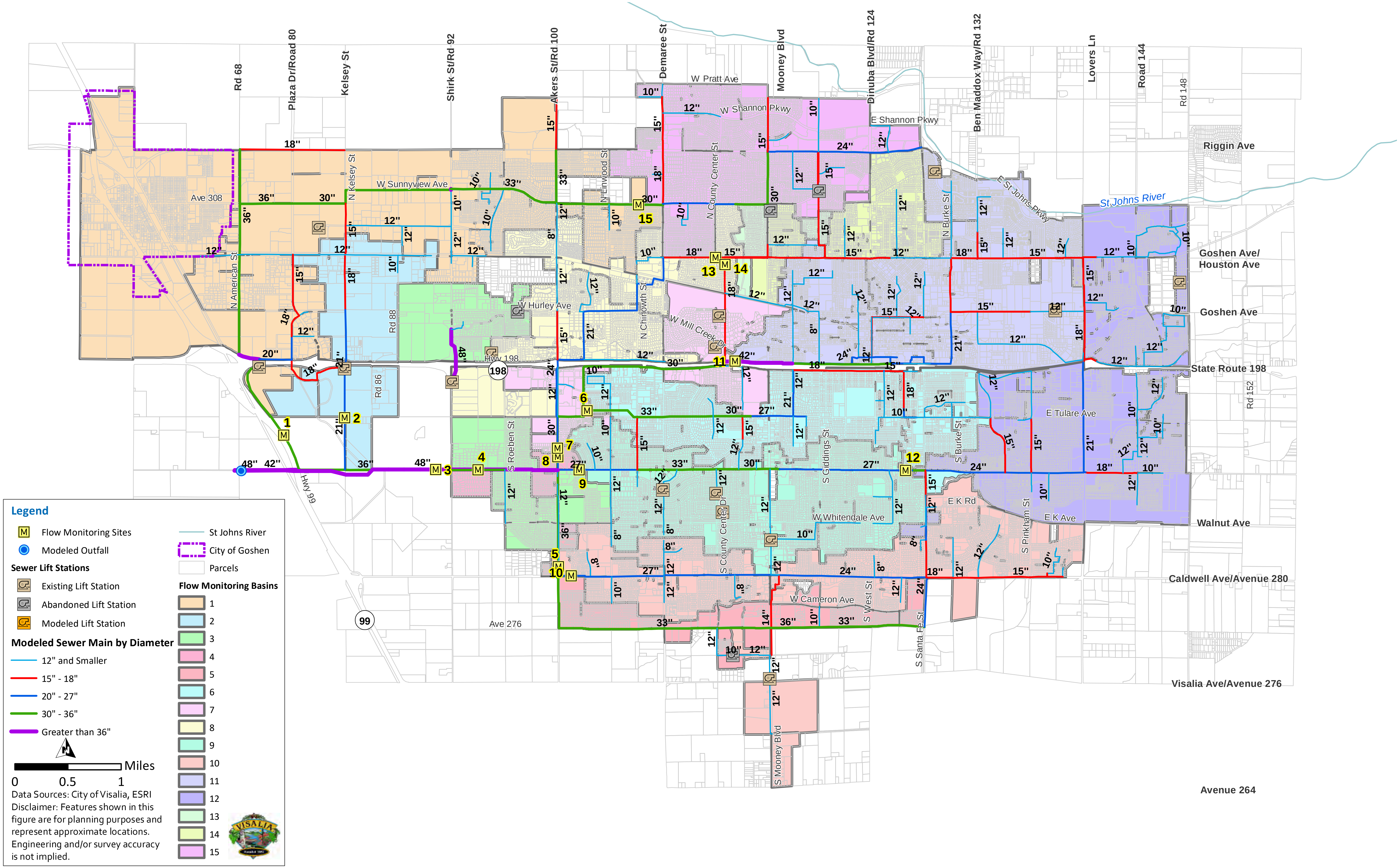

Figure 4.1 Temporary Flow Monitoring Locations

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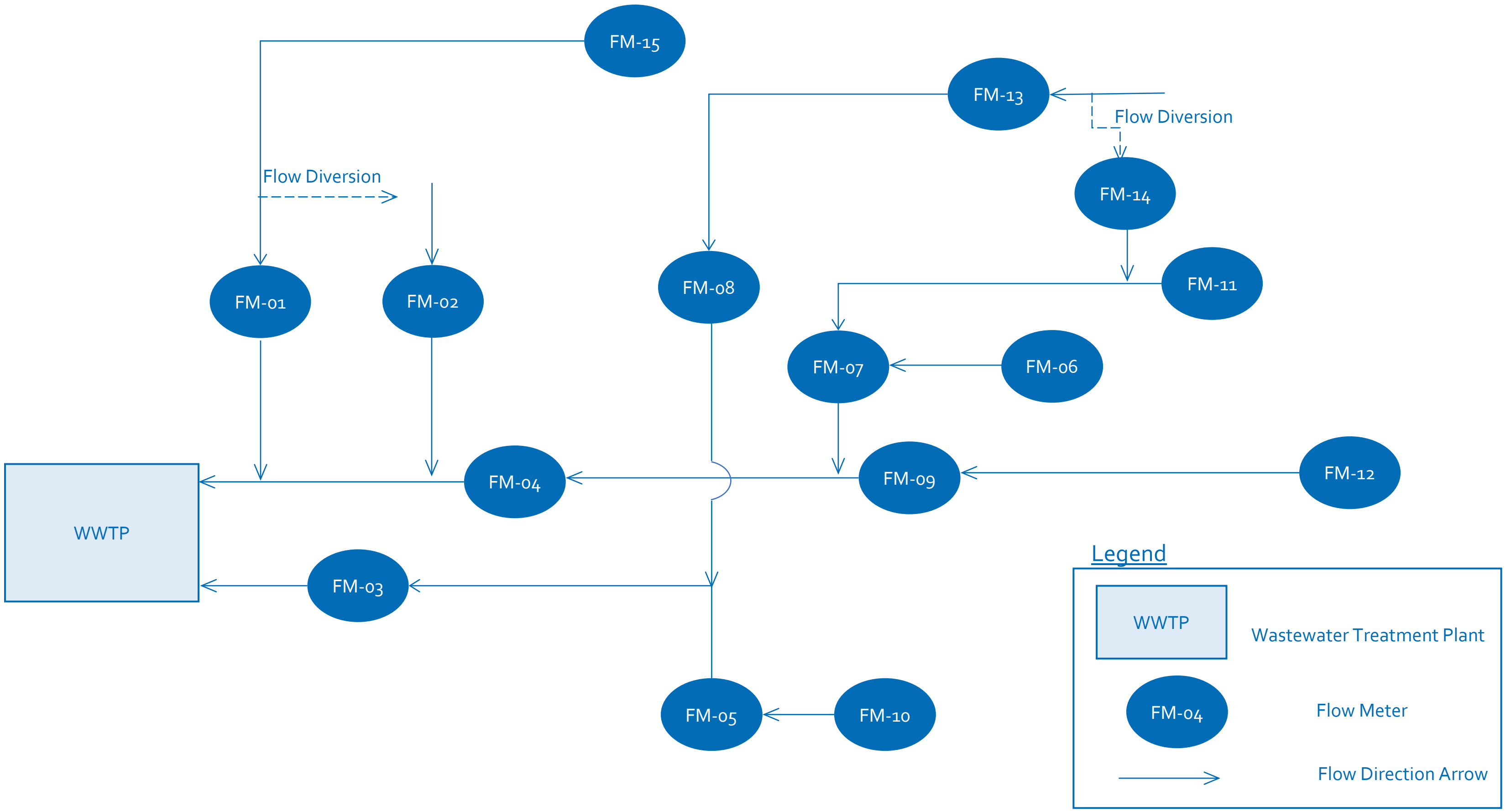

Figure 4.2 Flow Monitoring Schematic

4.2.4 Flow Monitoring Results (V&A Consulting Engineers)

This section summarizes the results of the flow monitoring program. Meter FM-09 is presented throughout this chapter as an example.

Dry Weather Flow Data

Characteristic dry weather 24-hour diurnal flow patterns for each site were developed based on the hourly data. This hourly flow data was then used to calibrate the hydraulic model for the observed DWFs during the flow monitoring period.

Hourly patterns for weekday and weekend flows were analyzed separately to better understand DWF. V&A provided estimates for the average weekday and weekend levels and velocities at each site, which are used in DWF calibration. Table 4.2 summarizes the DWFs at each meter.

Figure 4.3 illustrates a typical variation of wastewater flows in the City, which is based on the data collected from Meter 09. Similar graphics associated with the remaining sites are included in Appendix B.

As shown on Figure 4.3, flow patterns differ according to the day of the week. DWF for Monday through Thursday experienced the greatest peak during evening hours, while Saturday and Sunday show peaks later in the day. A majority of the dry weather hydrographs display a similar pattern to Meter FM-09.

Table 4.2 Dry Weather Flow Summary

Monitoring Site	DWF				
	(Mon - Thur) (mgd)	(Friday) (mgd)	(Saturday) (mgd)	(Sunday) (mgd)	Overall (mgd)
FM-01	3.39	3.51	3.37	3.32	3.39
FM-02	0.07	0.05	0.04	0.04	0.06
FM-03	2.14	2.08	2.28	2.26	2.17
FM-04	5.69	5.81	5.83	5.69	5.73
FM-05	1.06	1.03	1.09	1.12	1.07
FM-06	1.23	1.21	1.22	1.22	1.23
FM-07	3.85	3.99	3.94	3.88	3.89
FM-08	0.62	0.63	0.67	0.66	0.64
FM-09	1.61	1.60	1.70	1.76	1.64
FM-10	0.71	0.71	0.74	0.78	0.72
FM-11	1.39	1.44	1.41	1.34	1.39
FM-12	0.85	0.78	0.88	0.86	0.85
FM-13	0.14	0.12	0.15	0.15	0.14
FM-14	0.57	0.55	0.57	0.58	0.57
FM-15	0.96	0.93	0.98	1.02	0.97
Total Influent	**11.29**	**11.45**	**11.51**	**11.31**	**11.35**

Notes:
(1) Source: Sanitary Sewer Flow Monitoring, V&A Consulting Engineers, Inc. (2018).
(2) Overall DWF = ((4 x Monday - Thursday) +(Friday)+(2 x Weekend))/7.
(3) Total influent is flow entering wastewater treatment plant and is equal to Sites 1+2+3+4.

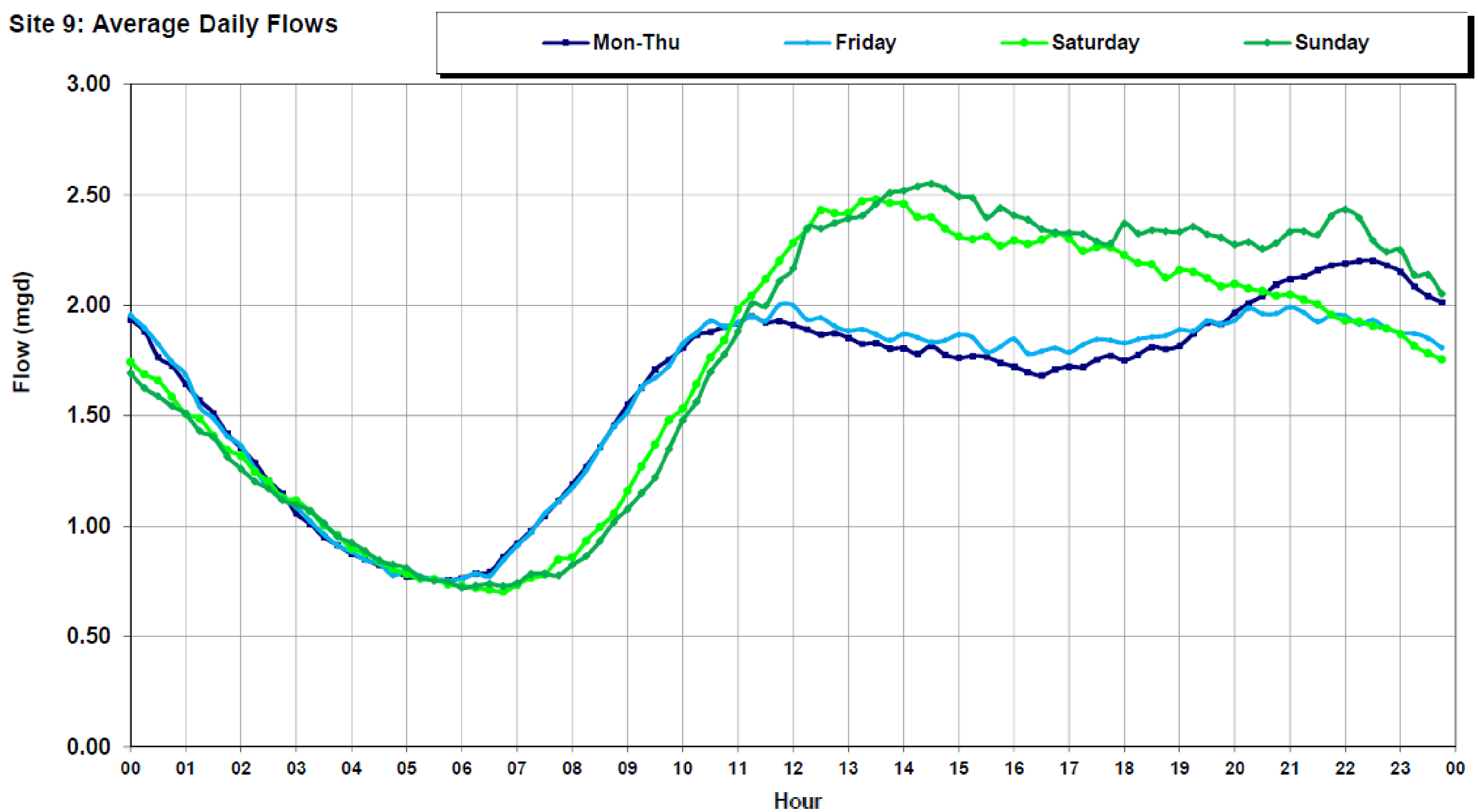

Figure 4.3 Typical Dry Weather Flow Variation (Meter FM-09)

Rainfall Data

V&A received rainfall data from three private weather stations throughout the City. Even though V&A had no control over these gauges, V&A performed a quality assurance, and quality control review of the data from the rain gauge to ensure their accuracy for the purposes of this study. Appendix B shows the location of the rain gauges utilized for this study.

The rainfall data collected by V&A was used to correlate the I/I response observed in the collection to specific storm recurrence intervals. Minor rainfall events occurred during the flow monitoring period. The November 28, 2018, to December 1, 2018, rainfall event was the largest event captured and elicited the greatest I/I response throughout the collection system. The rain gauges recorded an average of 1.09 inches during the largest storm event and a total of 1.85 inches to during the entire flow monitoring program. Table 4.3 summarizes the rainfall amount for each rain gauge for the largest storm event along with the total rainfall captured during the flow monitoring program.

Table 4.3 Summary of Rainfall Data (V&A)

Rain Gage	Rain Event 1 Nov 28 – Dec 1, 2018	Total Over Monitoring Period
North	1.14	1.93
East	1.12	1.93
South	1.00	1.67
Average	**1.09**	**1.85**

It is important to classify the size of any major storm events captured during the flow monitoring period. National Oceanic and Atmospheric Administration Atlas 14 provides precipitation frequency estimates for the United States based on historical rainfall data and serves as the industry standard for determining total rainfall depth at specified frequencies and durations. The Atlas provides precipitation frequency estimates for 5-minute through 60-day durations at average recurrence intervals of 1-year through 1,000-year. For example, the Atlas classifies a 10-year, 24-hour storm event for Visalia as 2.28 inches. This means that in any given year, there is a 10 percent chance that 2.28 inches of rain will fall within a 24-hour period.

The largest storm event classifications for storm event 1 is classified as less than a 1-year storm event.

Wet Weather Flow Data

The flow monitoring data was also evaluated to determine how the collection system responds to wet weather events. As mentioned above, the flow monitoring program captured one significant rainfall event. The rainfall event that occurred on November 28, 2018, was associated with the largest I/I response during the flow monitoring period, and was used for the I/I analysis and model calibration.

Figure 4.4 shows an example of the wet weather response at flowmeter FM-11 during the November 28, 2018, storm event. The dashed line is the calculated BWF (baseline flow) while the dark blue line is the measured flow from the flow monitoring period (real-time flow). As shown on Figure 4.4, the amount of inflow entering the collection system during wet weather event 1 is discernable, but not significant. Additional wet weather monitoring results for all meters can be found in Appendix B.

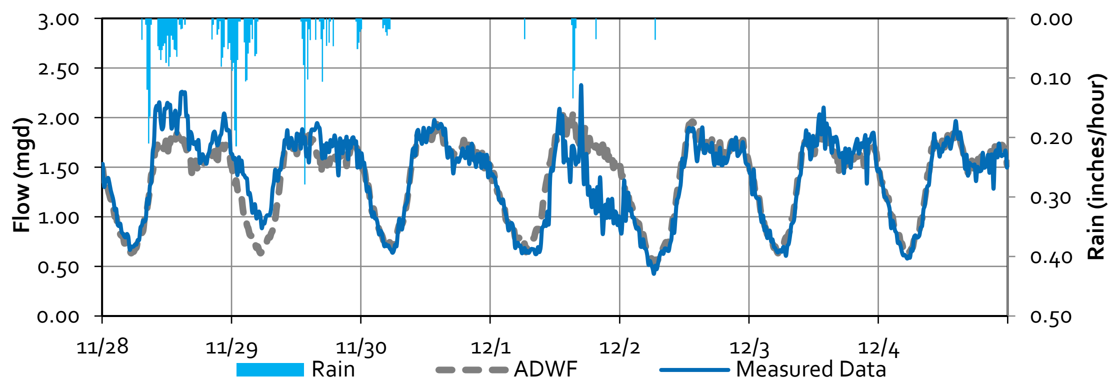

Figure 4.4 Example Wet Weather Flow Response (FM-11)

4.2.5 Flow Monitoring Capacity Analysis (V&A Consulting Engineers)

V&A conducted a capacity analysis of each flow monitoring site during the monitoring period. Table 4.4 presents a site-by-site anlaysis and shows the hydraulic condition of the pipeline under peak flow conditions during the flow monitoring period.

Table 4.4 Capacity Analysis Summary (V&A)

Monitoring Site	ADWF (mgd)	Peak Measured Flow (mgd)	Peaking Factor	Pipe Diameter (inches)	Peak Measured Depth (inches)	Max d/D
FM-01	3.39	4.33	1.18	36	12.5	0.33
FM-02	0.06	0.25	4.51	21	8.46	0.40
FM-03	2.17	3.64	1.68	48	12.64	0.26
FM-04	5.73	8.77	1.41	36	17.95	0.46
FM-05	1.07	1.98	1.42	36	12.27	0.3
FM-06	1.23	1.94	1.46	33	9.48	0.27
FM-07	3.89	6.95	1.44	30	15.69	0.48
FM-08	0.64	1.17	0.62	24	7.36	0.17
FM-09	1.64	2.79	1.36	27	11.94	0.39
FM-10	0.72	1.72	1.71	27	9.38	0.29
FM-11	1.39	2.39	1.62	42	11.87	0.27
FM-12	0.85	1.95	1.83	28	13.17	0.36
FM-13	0.14	0.33	0.91	18	6.63	0.20
FM-14	0.57	0.98	1.46	18	10.91	0.56
FM-15	0.97	1.73	1.74	28.5	5.53	0.19
Total	**11.35**	**16.26**	**1.29**	-	-	-

Notes:
(1) Source: Sanitary Sewer Flow Monitoring, V&A Consulting Engineers, Inc. (2018).
(2) Overall DWF = ((4 x Monday - Thursday) +(Friday)+(2 x Weekend))/7.

As shown in Table 4.4, FM-02 had a significant peak. After reviewing the flow data and site photos, the following was observed:

- FM-02 is downstream of the Golf Course Lift Station and the large flucuation in Peak flow/ADWF is likely related to the pump. In addition the flows from FM-02 are small relative to the system analysis and do not have a large influence.
- Review of FM-01 hydrograph is not reflective of a typical ADWF curve. This site is downstream of the Airport Lift Station. The basin for FM-01 serves Industrial Park and may reflect heavy industrial use.
- With exception to FM-02, peaking factors for each basin do not exceed a value of 2. Typical peaking factor ratios range between 3 and 4, with higher values possibly indicative of pronounced I/I flows (V&A).

4.2.6 Inflow and Infiltration Analysis (V&A Consulting Engineers)

V&A conduced a detailed inflow and infiltration analysis which is based on the flow monitoring data (Appendix B). To summarize the I/I analysis, flow monitoring basins 2, 6, and 11 had the highest inflow rates. However, I/I is generally not a significant issue for the City's system.

4.3 Historic and Design Flows

This section summarizes historic flows and establishes design flows used to model existing and projected flows for the City's sanitary sewer collection system.

4.3.1 Historic Sanitary Sewer Flow

The City provided historical daily influent flow data at the WRF from 2014 through 2018. The data included daily flow rates, which allowed Carollo to establish AAF, ADWF, and MDDWF. Historic flow data at the WRF is summarized in Table 4.5.

Review of the data shows that the ADWF is roughly equivalent to the AAF for a majority of the years. This is not uncommon for cities in the Central Valley with minimal GWI.

Table 4.5 Historical WRF Flows

Year	AAF (mgd)	ADWF (mgd)	MDDWF (mgd)
2014	10.48	10.50	11.90
2015	9.81	9.81	11.99
2016	9.93	10.15	12.04
2017	10.10	10.15	11.49
2018	10.05	10.05	13.00

4.3.2 Per Capita Sanitary Sewer Generation

Table 4.6 summarizes the residential per capita wastewater generation. The residential per capita rate was developed with 2020 census block data and the 2018 flow data. The census block data was available in GIS format and trimmed to the City's sewer basin. Areas on septic and Goshen were removed. An estimated population within the sewer basin was then established. 2018 flow data was utilized as the flow data was separated according to land use. Table 4.6 shows that the City's residential per capita rate is 45 gallons per capita per day (gpcd). As a conservative approach, the recommended residential per capita rate is 50 gpcd.

Table 4.6 Per Capita Generation

	Visalia Sewer Basin Population(1)	Average Residential Flow(2) (mgd)	Visalia Residential Per Capita Generation (gpcd)
Observed	141,213	6.36	45
Recommended Existing	-	-	50
Recommended Future	-	-	50

Notes:
(1) Source: 2020 Census block data.
(2) Source: 2018 V&A Flow Monitoring Program and Table 4.8. Sum of all residential users.

4.3.3 Equivalent Dwelling Units

An EDU is an approximate measurement of wastewater generated by a single-family residence. One EDU is equal to the average amount of wastewater generated by a single-family unit. EDUs for the City are a product of the residential per capita rate and persons per housing unit. Table 4.7 outlines the City's EDUs.

The City's General Plan land classification identifies single-family residential housing as very low density residential detached housing and low density residential detached housing. Therefore, flows identified in Table 4.7 as single-family residential represent very low density residential and low density residential. As shown in Table 4.7, one single-family residential EDU is equal to 150 gallons per day (gpd).

Table 4.7 Average Flow Generation Per Unit

Nomenclature	Persons Per Housing Unit(1)	Visalia Residential Per Capita Generation (gpcd)	Wastewater Generation Per Unit(3) (gpud)	EDU
Single-Family Residential	3	50	150	1
Multi-Family Residential	2	50	100	0.67

Notes:
(1) Source: City of Visalia Housing Element 2020 - 2023. Report noted average of 3 per household.
(2) Source: 2018 V&A Flow Monitoring Program and Table 4.8.
(3) Gallons per unit per day.

4.3.4 Goshen Base Flows

Goshen's existing wastewater flows are based on recorded daily average flow rate. Data for future Goshen wastewater generation was limited. The Goshen CPU was used to establish future base flows. The Goshen CPU states that the capacity of the existing pump station will need to be increased in the near future. The Goshen CPU recommends a design capacity of 790,000 gpd. The report states that the ultimate design flow rate is 1,451,170 gpd and would require a new pump station and larger diameter force main. Based on review of Goshen's historic flow, a peak flow rate of 790,000 gpd is considered a conservative estimate for the planning horizon of this master plan. For planning purposes, Goshen was estimated to have a future base flow of 500,000 gpd and peak flow of 790,000 gpd. Within the hydraulic model, Goshen wastewater was applied as a point load.

4.3.5 Wastewater Unit Flow Factors

To estimate the amount of flow per acre generated by each land use category, wastewater flow factors (WWFF) were developed and are a correlation between land use and sewer generation. These flow factors are based on the average wastewater flow generated for each land use type and were developed to project the ADWF for buildout of the City's General Plan.

WWFF provide a method to estimate the average quantity of flow per acre for each type of land use. The flow factors are expressed in gallons per day per acre (gpd/ac). The flow factors were developed using the following procedure:

- Average flows for each flow metering tributary area were derived from the flow monitoring data.
- Using GIS information, the acres for each existing land use type contained in each flow monitoring tributary area were calculated. Land use identified as vacant or on septic were excluded from existing estimates and added under future scenarios.
- Preliminary WWFF for each land use type were estimated based on similar cities and previous experience.
- The WWFF for each flow metering tributary were then balanced (adjusted up or down) to match the calculated average flows from each tributary to the measured flows during the flow monitoring period.
- Once the WWFF for each flowmeter tributary area were balanced, the weighted average of the coefficients for each existing land use type was calculated based on the acreage contribution from each metering tributary area.
- The weighted average WWFF were then adjusted for the entire developed sewer service area until they matched the baseline DWF. The adjusted WWF are considered representative of the wastewater generation by land use for the entire City and are used to project buildout average wastewater flows of the UGB.
- The WWFF for the Planning Area was developed under the assumption that 70 percent is residential, 20 percent is commercial, and 10 percent is parks. An average of 520 gpd/ac was developed.

To summarize the process, WWFF were developed from the flow monitoring data as well as the base City-wide flow of 10.5 mgd. The WWFF are shown in Table 4.8.

Over the years, these factors can vary due to drought conditions, promotion of efficient plumbing fixtures, ongoing water restrictions, and water rate increases. It is recommended to continuously update these factors.

Table 4.8 Wastewater Flow Factors by Land Use Category

Land Use Category	Wastewater Factors		
	Developed Total (acres)	Wastewater Flow Coefficients (gpd/ac)	Existing Wastewater Flow (gpd)
Residential			
Residential Very Low Density	307	280	85,900
Residential Low Density	10,700	470	5,029,000
Residential Medium Density	788	1,000	788,000
Residential High Density	267	1,700	454,400
Commercial/Industrial			
Business Research Park	61	450	27,300
Commercial Mixed Use	820	750	614,700
Commercial Neighborhood	148	900	133,100
Commercial Regional	307	650	199,500
Commercial Service	446	650	289,700
Industrial	1,336	1,100	1,469,800
Light Industrial	226	600	135,300
Office	386	700	270,300
Other			
Downtown Mixed Use	215	850	183,000
Public/Institutional	1,351	450	607,800
Parks/Recreation	844	0	0
Reserve	1	0	0
Conservation	604	0	0
Agricultural	0	0	0
Goshen	-	-	250,000(1)
Total	**18,805**	**-**	**10,537,800**

Notes:
(1) Goshen existing wastewater flows are based on an average flow rate of observed data.

As with most cities in California, residential land use accounts for a majority of development and wastewater flow. For the City, residential customers account for 60 percent of current flow, commercial and industrial users account for 30 percent, public facilities account for 8 percent, and Goshen 2 percent of flows.

4.3.6 Existing Base Flow

To estimate existing base flow, a combination of historical flow data from the WRF, 2018 water billing data, and the temporary monitoring program were used (details provided in Section 5.2). During the flow monitoring program DWFs averaged 11.35 mgd (Table 4.2). This flow rate was somewhat higher than the previous measured five-year ADWF. Therefore, baseline flows were decreased to 10.5 mgd for planning purposes. This is consistent with previous data (Table 4.5).

4.3.7 Future Base Flow

Urban Growth Boundary Buildout

Based on the projected buildout of the UGB occurring prior to 2040, it was determined that the most accurate forecasting methodology for future sewer flow included land use within the UGB and wastewater flow factors (land use (acre) x WWFF (gpd/ac)).

Sphere of Influence Buildout

Buildout of the SOI applied to land in the southwest and required changing land use from reserve to commercial. Forecasting the future sewer flows included the use of a commercial flow factor of 900 gpd/ac.

Ultimate Buildout (Buildout of Planning Area)

Ultimate buildout was considered to remain consistent with previous master plans and to provide a preliminary analysis of required infrastructure and size. Ultimate projected flows consist of areas expected to develop north and east of the UGB. The land use within the Planning Area assumes 70 percent residential, 20 percent commercial, and 10 percent open space. Wastewater flow projections for this area are based on average WWFFs for residential and commercial. Appendix C provides a summary of projected flows for ultimate buildout.

Known Development

Known residential development flow projections were based on WWFFs to project AAF. As shown in Table 4.9, known developments within the UGB are projected to have an AAF of 0.4 mgd. Wastewater generation from known development is approximately 5 percent of estimated future flow, therefore land use and WWFF were used for known development to remain consisted with loading of each future scenario.

Table 4.9 Known Development Flow Projections

No.	Planned Development Name	Land Use(1)	WWFF	Acreage(2)	AAF (gpd)(3)(4)
1	Wood Ranch	Low Density	470	3.59	1,700
2	Luisi Acres	Medium Density	1,000	12.24	12,200
3	Lance Lane Estates	Low Density	470	19.95	9,400
4	Willow Springs	Low Density	470	39.66	18,600
5	Walnut Park Estates	Low Density	470	11.97	5,600
6	Highland Park Estates at Shannon Ranch	Medium Density	1,000	14.34	14,300
7	Highland Park Estates	Low Density	470	38.8	18,200
8	River Run Ranch 5-7	Low Density	470	28.28	13,300
9	Visalia Palms	Medium Density	1,000	4.16	4,200
10	Maddox at Caldwell VII	Medium Density	1,000	8.35	8,400
11	Shannon Ranch 3	Low Density	470	14.01	6,600
12	Diamond Oaks	Medium Density	1,000	29.55	29,600

No.	Planned Development Name	Land Use[1]	WWFF	Acreage[2]	AAF (gpd)[3][4]
13	Campo Estates	Low Density	470	10.19	4,800
14	The Grove	Medium Density	1,000	11.22	11,200
15	Houdini Acres	Low Density	470	2.15	1,000
16	Lowery West	Low Density	470	14.16	6,700
17	Cherry Creek	Low Density	470	9.7	4,600
18	Rose Estates	Low Density	470	3	1,400
19	Teagan Ranch	Low Density	470	1.58	700
20	River Island Ranch	Low Density	470	61.4	28,900
21	Quintana De Oro	Low Density	470	5	2,400
22	Orchard Walk	Low Density	470	24.7	11,600
23	Diamond Oaks Unit 1	Low Density	470	13.89	6,500
24	Luisi Acres Unit 5 Phase 2	Low Density	470	5.1	2,400
25	Los Pinos	Low Density	470	7	3,300
26	Quail River Apartments	Medium Density	1,000	7.1	7,100
27	Diamond Oaks Multi-Family	Low Density	470	13.2	6,200
28	East Haven Duplexes	Low Density	470	1.78	800
29	Visalia Apartments	Medium Density	1,000	15.9	15,900
30	Bonadventure Unit 2 Phase 2[1]	Low Density	470	1.5	700
31	La Valencia[1]	Low Density	470	1.5	700
32	Northgate Estates[1]	Low Density	470	2	900
33	Da Vinci at Bella Sera[1]	Low Density	470	3	1,400
35	Oak Meadow Estates No. 5[1]	Very Low Density	280	1.5	400
36	Riggin Ranch[1]	Low Density	470	2.5	1,200
37	Stonegate Estates[1]	Low Density	470	0.5	200
38	Hall Estates	Low Density	470	8.3	3,900
39	Pinkham Ranch[1]	Low Density	470	1.4	700
40	Los Gatos[1]	Low Density	470	2.2	1,000
41	Oakglen Estates[1]	Low Density	470	0.7	300
42	Cobblestone Estates II, Unit 3	Low Density	470	7.1	3,300
43	Pheasant Ridge Unit No. 2, Phase 1[1]	Low Density	470	1	500
44	Quail River	Low Density	470	45.3	21,300
45	Shannon Ranch 3 Units 1-4 & 6[1]	Low Density	470	2	900
47	Pine River Ranch Estates Phase 1[1]	Low Density	470	1.2	600

No.	Planned Development Name	Land Use[1]	WWFF	Acreage[2]	AAF (gpd)[3][4]
48	Rancho Santa Fe Estates Unit 3 Phase 1[1]	Low Density	470	1	500
50	Shannon Ranch 3 Units 13 & 14	Low Density	470	10.1	4,700
51	Kayenta Crossing	Low Density	470	19.95	9,400
55	San Sebastian III	Low Density	470	1.5	700
56	Eagle Meadows	Low Density	470	13.8	6,500
57	Shannon Ranch 3 Units 5, 7-8	Low Density	470	17.2	8,100
58	Luisi Acres Unit 5 Phase 1	Low Density	470	4.7	2,200
59	Quail Park Senior Independent Living	Medium Density	1,000	3.7	3,700
60	Sterling Oaks Unit 1	Low Density	470	36.3	17,100
64	Emerald Creek	Low Density	470	10.2	4,800
65	Willow Springs Unit 1	Low Density	470	3.7	1,700
66	Lowery West Phase 1A	Low Density	470	16.3	7,700
67	Lowery West Phase 1B	Low Density	470	17.5	8,200
68	Southern Highlands/ Rancho Verde	Low Density	470	14.3	6,700
69	Candelas	Low Density	470	32.8	15,400
70	Reimer	Low Density		11.2	5,300
	Total	**-**	**-**	**727.92**	**398,300**

Notes:
(1) General Plan GIS data was used to determine land use.
(2) Acreage is based on current development size. If construction had started, GIS was utilized to review and update approximate area (as of October 2021).
(3) Flows rounded to nearest hundred.
(4) WWFF and acreage were used to determine flow rate.

4.3.8 Existing and Projected Design Flows

PWWF typically defines the peak flow within a sanitary sewer collection system. However, wet weather data and hydraulic model calibration show peak flow during the dry months was greater. Therefore, PDWF represents peak flow within the collection system.

The design MDDWF was established by reviewing the historic data and a flow rate of 13.0 mgd was selected. The hydraulic model was updated to reflect the MDDWF. Projected MDDWF was determined by applying a peaking factor to the future average flow. Within the model, 24-hour diurnal patterns were applied to the MDDWF and the PDWF was established. The diurnal patterns were developed from the flow monitoring data and reflects real-time flow patterns.

Table 4.10 presents a summary of existing and projected flows at the WRF. As shown, the existing PDWF is estimated at 17.4 mgd and is projected to increase to 30.0 mgd at buildout of the UGB. SOI flows are estimated to increase flows from UGB by 0.9 mgd.

Table 4.10 System Flows

Flow Condition	ADWF (mgd)	MDDWF Peaking Factor	MDDWF (mgd)	PDWF (mgd)
Existing	10.5	1.24	13.0	17.4
UGB Buildout	18.5	1.24	22.9	30.0
SOI	19.4	1.24	24.1	32.3
Ultimate Buildout	28.7	1.24	35.6	47.8

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Chapter 5

COLLECTION SYSTEM HYDRAULIC MODEL DEVELOPMENT AND CALIBRATIONS

This chapter summarizes the hydraulic model update process, including a summary of the modeling software selection, a description of the modeled collection system, the hydraulic model elements, and the model calibration process.

5.1 Sanitary Sewer Collection System Hydraulic Model Update

A sewer collection system model is a simplified representation of the real sewer system. Sewer system models can assess the conveyance capacity for a collection system. In addition, sewer system models can perform "what if" scenarios to assess the impacts of future developments and land use changes. The City's collection system hydraulic model was updated using a multi-step process utilizing data from a variety of sources.

5.1.1 Hydraulic Modeling Software

The City's previous hydraulic model was developed by Carollo using H_2OMAP Sewer, by Innovyze. The City's previous hydraulic model was developed as part of the previous Master Plan using the City's utility mapping information supplemented by as-built drawings and other available data sources. The H_2OMAP Sewer modeling platform was retired in 2017.

InfoSWMM®, developed by Innovyze was selected as the new software platform for the City's updated hydraulic model. The hydraulic modeling engine for InfoSWMM® uses the EPA's SWMM, which is widely used throughout the world for planning, analysis, and design related to stormwater runoff, combined sewers, sanitary sewers, and other drainage systems. InfoSWMM® routes flows through the model using the Dynamic Wave method, which solves the complete Saint Venant, one dimensional equations of fluid flow.

InfoSWMM® consists of multiple products that work together to bring a graphical approach to the analysis and design of wastewater and stormwater collection systems. The program includes integration with GIS data.

5.1.2 Data Collection and Validation

The existing collection system was mainly transferred from the previous model and updated with available drawings, as-builts, and GIS data. Figure 5.1 shows the skeletonized modeled sanitary sewer collection system.

5.1.3 Skeletonizing

Skeletonizing is the process of removing pipelines not considered to be essential for the purpose of the analysis. While skeletonizing a system minimizes the number of pipelines analyzed, an accurate representation of the collection system is maintained. For the City's hydraulic model, pipelines 10 inches in diameter or larger were included as well as some smaller diameter pipelines for connectivity. Otherwise, pipelines 8 inches or smaller were excluded.

5.1.4 Elements of the Hydraulic Model

The following provides a brief overview of the major elements of the City's hydraulic model and the required input parameters associated with each:

- Junctions: Sewer manholes, cleanouts, as well as other locations where pipe sizes change or where pipelines intersect are represented by junctions in the hydraulic model. Required inputs for junctions include rim elevation, invert elevation, and surcharge depth (used to represent pressurized systems). Junctions are also used to represent locations where flows are split or diverted between two or more downstream links.
- Pipes: Gravity sewers and force mains are represented as pipes in the hydraulic model. Input parameters for pipes include length, friction factor (e.g., Manning's n for gravity mains, Hazen Williams C for force mains), invert elevations, diameter, and if the pipe is a force main or gravity main.
- Storage Nodes: For sewer system modeling, storage nodes typically are used to represent lift station wet wells (although other storage basins, etc. can be modeled as storage nodes). Input parameters for storage nodes include invert elevation, wet well depth, and wet well cross section.
- Pumps: Pumps are included in the hydraulic model as links. Input parameters for pumps include pump curves and operational controls.
- Outfalls: Outfalls represent areas where flow leaves the system. For sewer system modeling, an outfall typically represents the connection to the influent pump station or headworks of a WRF.
- Patterns: Diurnal patterns are used to simulate the variation in flow throughout the day. Patterns can be established for any time period, including multi-day patterns (48-hour, 72-hour, etc.).
- Inflows: The following are the two types of wastewater flow sources that can be injected into individual model junctions (and storage nodes):
  - Loads: Loads simulate base sanitary wastewater flows and represent the average flow. The base flows are multiplied by a pattern that varies the flow temporally. The base flow diurnal patterns are adjusted during the dry weather calibration process. Sanitary loads can be applied to manholes, wet wells, and pressure junctions.
  - Stormwater Flows: Rain-derived infiltration and inflow (RDII) are applied in the model by assigning a unit hydrograph and a corresponding catchment to a given loading manhole. The unit hydrographs consist of several parameters that are used to adjust the volume of RDII that enters the system at a given location. These parameters are adjusted during the wet weather calibration process.

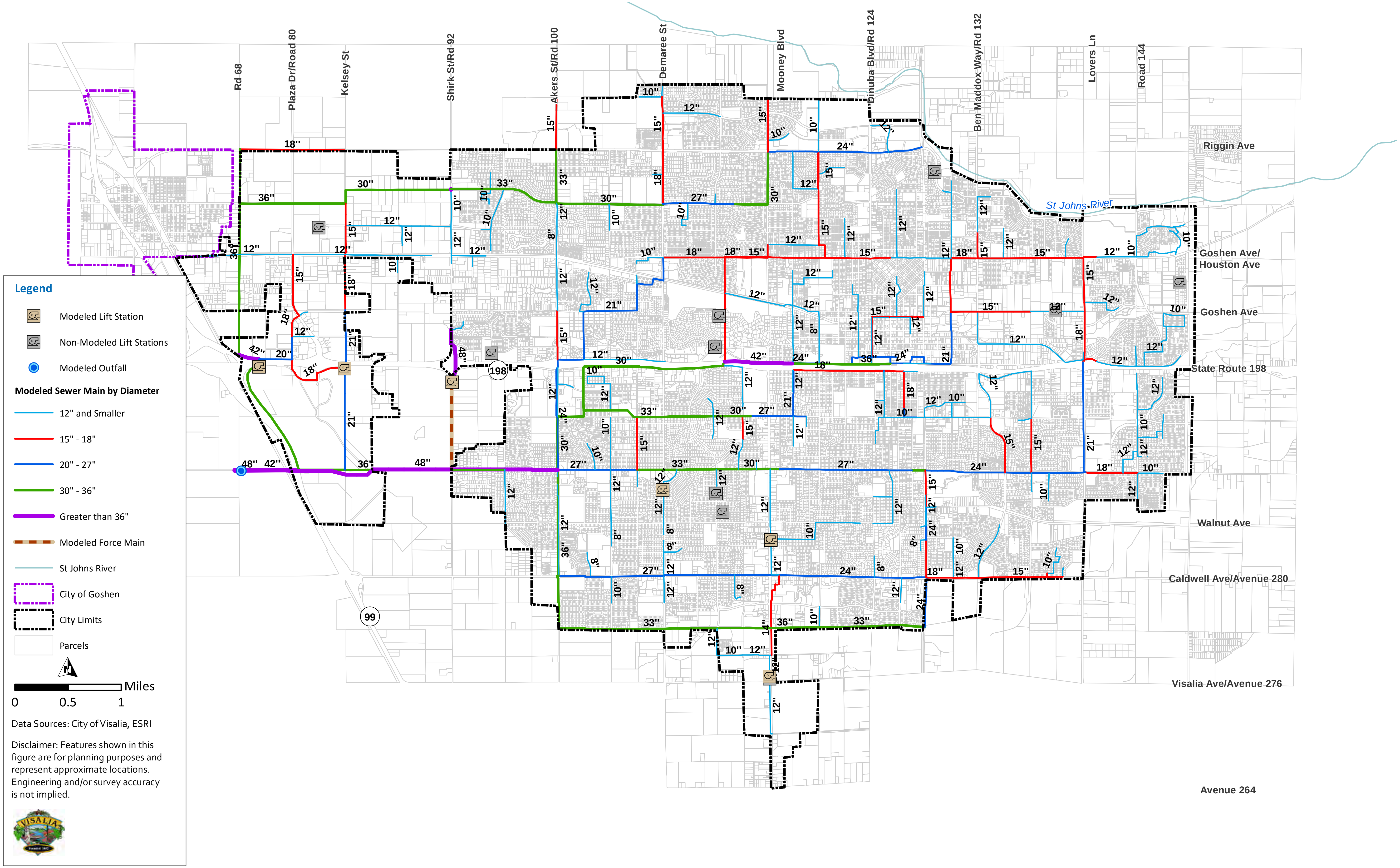

Figure 5.1 Modeled Collection System

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5.1.5 Hydraulic Model Conversion, Update, and Review

Model conversion, update, and review was a multi-step process. Once the model was converted to InfoSWMM, Carollo reviewed the hydraulic model against industry standards to identify discrepancies and to determine which aspects of the model needed to be updated. The model review process is summarized below:

- Step 1: H_2OMAP Sewer and InfoSWMM were offered by the same software vendor. The two packages allow for the transfer of H_2OMAP Sewer files to InfoSWMM. The files transferred included the sewer system as of 2005 and pipelines planned for future growth.
- Step 2: Some of the physical and operational data within H_2OMAP Sewer model is incompatible with InfoSWMM. These features were input manually.
- Step 3: Verify that the model data (i.e., inverts, diameters, etc.) were transferred correctly and that the flow direction, size, and layout of the modeled pipelines were logical. Because the model was last updated in 2005, pipeline drawings and as-built plans were reviewed and used to update the model to reflect the recent configuration.
- Step 4: Review pipeline connectivity to determine, in a general sense, how flows are routed through collection system basins, and to identify the locations of potential overflows.
- Step 5: Review the model/GIS facilities database to determine which portions of the existing City limits are currently served and which are not currently connected to the wastewater collection system.
- Step 6: Review baseline wastewater flows in the existing hydraulic model to determine the need to develop new wastewater flow factors and reallocate the model.
- Step 7: Review other miscellaneous model parameters (including calculation options).

In general, the City's hydraulic model was constructed well and there were very few discrepancies with the physical configuration and invert elevations of the existing modeled collection system facilities. There were major trunk segments that were added to the model due to new construction and expansion of the City.

5.2 Sanitary Sewer Load Allocation

Determining the quantity of BWFs generated by a municipality and how they are distributed throughout the collection system is a critical component of the hydraulic modeling process.

Various techniques can be used to assign wastewater flows to individual model junctions, depending on the type of data that is available. Adequate estimates of the volume of wastewater are important in maintaining and sizing sewer system facilities, both for present and future conditions. Baseline wastewater loads were allocated (assigned to specific nodes) in the hydraulic model based on land use data provided by the City, as well as the flow data from the temporary flow monitoring program. The following steps outline the wastewater load allocation process:

- Step 1: The City's service area was broken up into 913 individual loading polygons. In a "skeletonized" (i.e., truncated model) model, a loading polygon will usually encompass a particular subdivision or grouping of lots. However, a loading polygon could be as small as a few parcels. Each loading polygon represents the geographic area that contributes flows into a single model node (i.e., manhole), and was developed using GIS based on the City's parcel and sewer pipeline shapefiles.

- Step 2: One approach for estimating the existing ADWF associated with each loading polygon is based on land use designations, flow coefficients, and land use area. In reality, the wastewater generation rates of each existing customer will vary from an average flow coefficient (significantly in some cases). For this reason, water billing records can be considered as an alternative to the land use based load allocation method for existing DWFs. For this project, water consumption billing records by parcel were available. Thus, the billing records were used. Billing records were assigned point loads in GIS. Loading polygons were developed based on the parcels that discharge into certain manholes. InfoSWMM's "Load Allocator" was used to calculate and assign the loads in the model. The land use method was used for future 2040 loads. WWFF were developed by balancing typical wastewater flow coefficients with the flow monitoring data. Connected parcels were assigned a land use in GIS. Loading polygons were developed based on the parcels that discharge into certain manholes. InfoSWMM's "Load Allocator" tool used the WWFF, parcel data, and the loading polygons to calculate the ADWF and assign the loads in the model.
- Step 3: Once the existing wastewater flows were allocated into the model, they were adjusted as needed during model calibration to closely match the DWFs recorded during the flow monitoring program.

5.3 Hydraulic Model Calibration

Hydraulic model calibration is a crucial component of the hydraulic modeling effort. Calibrating the model to match data collected during the flow monitoring program is necessary to achieve the most accurate results possible. The calibration process typically consists of calibrating to both dry and wet weather conditions.

For this project, flow monitoring was conducted at 15 metering sites for a period of 42 days. DWF and WWF calibration provides an accurate depiction of BWF generated within the study area. The WWF calibration consists of calibrating the hydraulic model to a specific storm event(s) to accurately simulate the peak and volume of I/I into the sewer system. The amount of I/I is essentially the difference between the WWF and DWF components.

The WWF calibration consisted of a single storm event captured during the flow monitoring program (November 28 through December 3, 2018).

5.3.1 Wastewater Calibration Standards

The hydraulic model was calibrated in accordance with international modeling standards. The Wastewater Planning Users Group (WaPUG), a section of the Chartered Institution of Water and Environmental Management, has established generally agreed upon principles for model verification. The dry weather and wet weather calibration focused on meeting the recommendations on model verification contained in the "Code of Practice for the Hydraulic Modeling of Sewer Systems," published by the WaPUG (WaPUG, 2002), as summarized below:

- Dry Weather Calibration Standards: Dry weather calibration should be carried out for a minimum of two dry weather days and the modeled flows and depths should be compared to the field measured flows and depths. Both the modeled and field measured flow hydrographs should closely follow each other in both shape and magnitude. In addition to the shape, the flow hydrographs should also meet the following criteria as a general guide:

  - The timing of flow peaks and troughs should be within 1 hour.
  - The peak flow rate should be within the range of ±10 percent.
  - The volume of flow (or the average rate of flow) should be within the range of ±10 percent. If applicable, care should be taken to exclude periods of missing or inaccurate data.

- Wet Weather Calibration Standards: The model simulated flows should be compared to the field measured flows. The flow hydrographs for storm events should closely follow each other in both shape and magnitude. In addition to the shape, the flow hydrographs should also meet the following criteria as a general guide:
  - The timing of the peaks and troughs should be similar with regard to the duration of the events.
  - The peak flow rates at significant peaks should be in the range of +25 percent to -15 percent and should be generally similar throughout.
  - The volume of flow (or the average flow rate) should be within the range of +20 percent to -10 percent.

5.3.2 Dry Weather Flow Calibration

The DWF calibration process consists of several elements, as outlined below:

- Divide the system into flowmeter tributaries. The first step in the calibration process was to divide the City into flowmeter tributary areas. Fifteen tributary areas were created, one for each flowmeter from the temporary flow monitoring program. A map showing the locations of each flow monitoring site and their associated tributary area are provided in Chapter 4 along with a schematic of the flowmeters.
- Define flow volumes within each area. The next step was to define the flow volumes within each area, which was accomplished in the flow allocation step.
- Create diurnal patterns to match the temporal distribution of flow. A diurnal curve is a pattern of hourly multipliers that are applied to the base flow to simulate the variation in flow that occurs throughout the day. Two diurnal curves were developed for each flow monitoring tributary area, one representing weekday flow and one representing weekend flow. The diurnal patterns were initially developed based on the flow monitoring data and adjusted as part of the calibration process until the model simulated flows matched the field measured flows as closely as possible. Figure 5.2 shows the calibrated weekday and weekend diurnal patterns for the area tributary to FM-09. Similar diurnal curves were developed for each of the meters and its tributary area. The DWF calibration curves are provided in Appendix D.

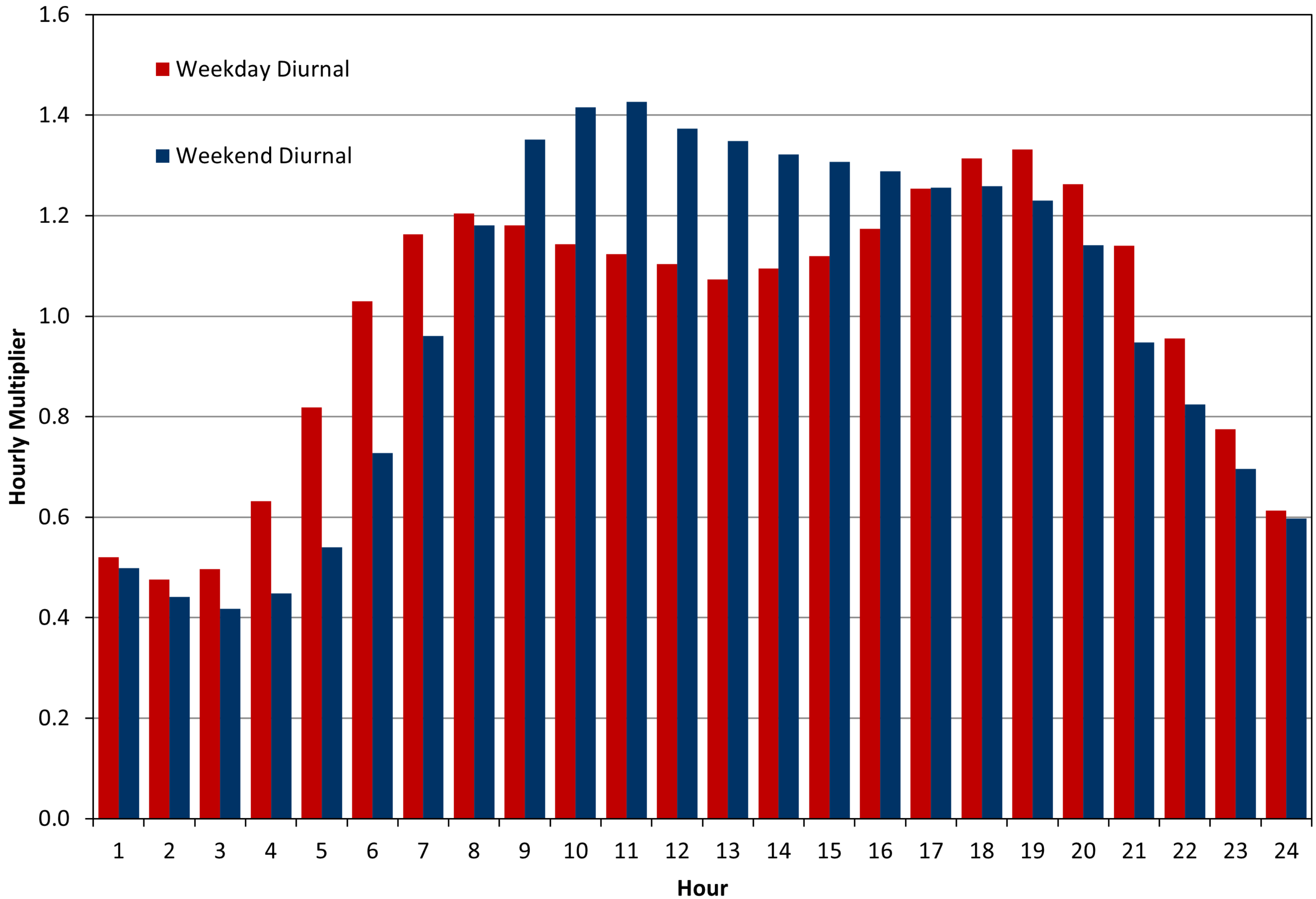

Figure 5.2 Example Weekday and Weekend ADWF Diurnal Patterns (Site FM-09)

- Adjust model variables to match field-measured velocity and flow depths. After the model-simulated flows satisfactorily matched the field-measured flows, the model-simulated velocity and flow depth were compared to the field-measured velocity and flow depth. Adjustments were then made to various model parameters until the modeled and measured velocity and depth closely matched each other. For this process, the primary varied parameters were pipeline roughness (Manning's n) and sediment buildup in the pipe, although other parameters can also be adjusted as calibration results are generated.
  - Manning's roughness coefficients, or n values, have industry-accepted ranges based on a number of variables. Roughness coefficients increase over time depending on the construction methods, installation quality, system maintenance, and other environmental factors. Additionally, certain factors within the City's collection system can result in roughness coefficients that differ from the typical range. For example, pipeline bellies, joint misalignment, cracks, and debris (e.g., root intrusion) lead to increased turbulence in a pipe, which in turn increases the apparent Manning's n factor.
  - If the model is unable to reasonably match the field-measured flow depth and velocity without leaving the acceptable range of Manning's roughness coefficients, further investigation is conducted to determine the cause of the discrepancy. Causes of the discrepancy can include errors in a pipeline's slope or diameter, downstream blockages, pipeline sags, and, in some cases, influences from downstream lift station operations.

Table 5.1 provides a summary of the DWF calibration using the average and daily peak flow results for both weekday and weekend conditions. As shown in Table 5.1, the model simulated average flows for both weekday and weekend DWF within 10 percent.

- FM-02: The modeled velocity was approximately 26 percent higher than the measured velocity from the flow monitoring program. It is suspected that sediment buildup within the system is more significant than what the hydraulic model simulates. With flow and depth within range and considering the flow is relatively small this site is considered acceptable.
- FM-15: The modeled velocity was approximately 32 percent lower than the measured velocity and the modeled depth was approximately 32 percent higher than the measured depth. It is suspected that pipe inverts are not correct in the model due to potential pipe defects. The model inverts in this area were checked against the drawings and found no discrepancy. It is recommended for future modeling efforts that pipeline inverts are checked during meter installation to determine the slope. The flow data was match and allowed the model to accurately determine flows generated upstream of the flowmeter.

Appendix D contains a detailed DWF calibration summary sheet for each of the 15 metering sites. Each calibration sheet provides plots that compare the model simulated and field measured flow, velocity, and level data for both weekday and weekend conditions. Figure 5.3 shows an example of the dry weather calibration.

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Table 5.1 Dry Weather Flow Calibration Summary

		Weekday									Weekend									Overall ADWF		
		Measured Data(1)			Modeled Data			Percent Error			Measured Data(1)			Modeled Data			Percent Error					
Meter Number	Pipe Diameter (inches)	Avg. Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (inches)	Avg. Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (inches)	Avg. Flow (%)	Avg. Velocity (%)	Avg. Level (%)	Avg. Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (inches)	Avg. Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (inches)	Avg. Flow (%)	Avg. Velocity (%)	Avg. Level (%)	Measured (mgd)	Modeled (mgd)	Percent Error (%)
Site 1	36	3.41	2.73	11.4	3.483	2.65	11.9	2.1	-3.0	3.6	3.35	2.69	11.4	3.51	2.66	11.9	5.0	-1.2	4.4	3.39	3.49	2.9
Site 2	21	0.06	0.28	6.5	0.065	0.36	6.9	7.4	25.9	6.4	0.04	0.22	6.0	0.04	0.28	6.6	8.6	26.4	10.3	0.05	0.06	7.6
Site 3	48	2.13	1.91	9.2	2.138	1.91	9.3	0.5	0.0	0.3	2.27	1.93	9.4	2.31	1.94	9.5	1.8	0.1	0.9	2.17	2.19	0.9
Site 4	36	5.72	3.42	14.0	5.592	3.46	13.7	-2.2	1.3	-2.3	5.76	3.40	14.0	5.69	3.46	13.8	-1.1	1.8	-1.9	5.73	5.62	-1.9
Site 5	36	1.06	1.13	9.2	1.028	1.18	8.7	-2.7	4.4	-4.9	1.10	1.12	9.4	1.09	1.19	8.9	-0.7	5.9	-4.6	1.07	1.05	-2.1
Site 6	33	1.23	1.76	7.7	1.292	1.82	7.8	5.1	3.7	1.4	1.22	1.76	7.6	1.29	1.81	7.8	5.6	2.7	2.5	1.23	1.29	5.3
Site 7	30	3.87	3.21	12.0	3.772	3.22	11.8	-2.6	0.4	-2.1	3.91	3.21	12.0	3.77	3.20	11.7	-3.6	-0.4	-2.5	3.89	3.77	-2.9
Site 8	24	0.63	1.70	5.6	0.644	1.83	5.4	2.8	7.9	-2.5	0.67	1.73	5.7	0.69	1.86	5.6	3.8	7.7	-1.8	0.64	0.66	3.1
Site 9	27	1.61	2.07	9.1	1.698	2.12	9.4	5.7	2.1	3.5	1.73	2.11	9.3	1.80	2.14	9.6	4.2	1.2	3.5	1.64	1.73	5.3
Site 10	27	0.71	1.72	5.7	0.730	1.76	5.8	3.1	2.3	1.5	0.76	1.75	5.8	0.78	1.78	5.9	2.8	1.5	2.0	0.72	0.74	3.0
Site 11	42	1.40	1.45	8.8	1.441	1.44	9.0	3.0	-0.9	3.0	1.37	1.46	8.6	1.43	1.43	9.0	3.8	-1.6	4.2	1.39	1.44	3.2
Site 12	28	0.84	1.16	8.4	0.888	1.26	8.4	5.8	8.8	0.5	0.87	1.14	8.6	0.93	1.27	8.6	6.9	11.9	-0.6	0.85	0.90	6.1
Site 13	18	0.14	0.70	3.9	0.132	0.68	4.0	-2.2	-4.0	1.6	0.15	0.73	4.1	0.15	0.70	4.1	-2.6	-3.8	1.4	0.14	0.14	-2.3
Site 14	18	0.57	1.01	8.6	0.604	1.05	8.9	6.1	3.3	3.4	0.57	1.01	8.6	0.61	1.05	8.9	6.2	3.9	3.2	0.57	0.60	6.1
Site 15	28.5	0.95	3.96	3.9	0.991	2.70	5.1	4.1	-31.9	31.8	1.00	3.98	3.9	1.04	2.73	5.2	3.9	-31.4	32.8	0.97	1.01	4.0

Notes:
(1) Source: City of Visalia 2018 Temporary Flow Monitoring Program, V&A Consulting Engineers. Average flows are calculated from flow monitoring data.

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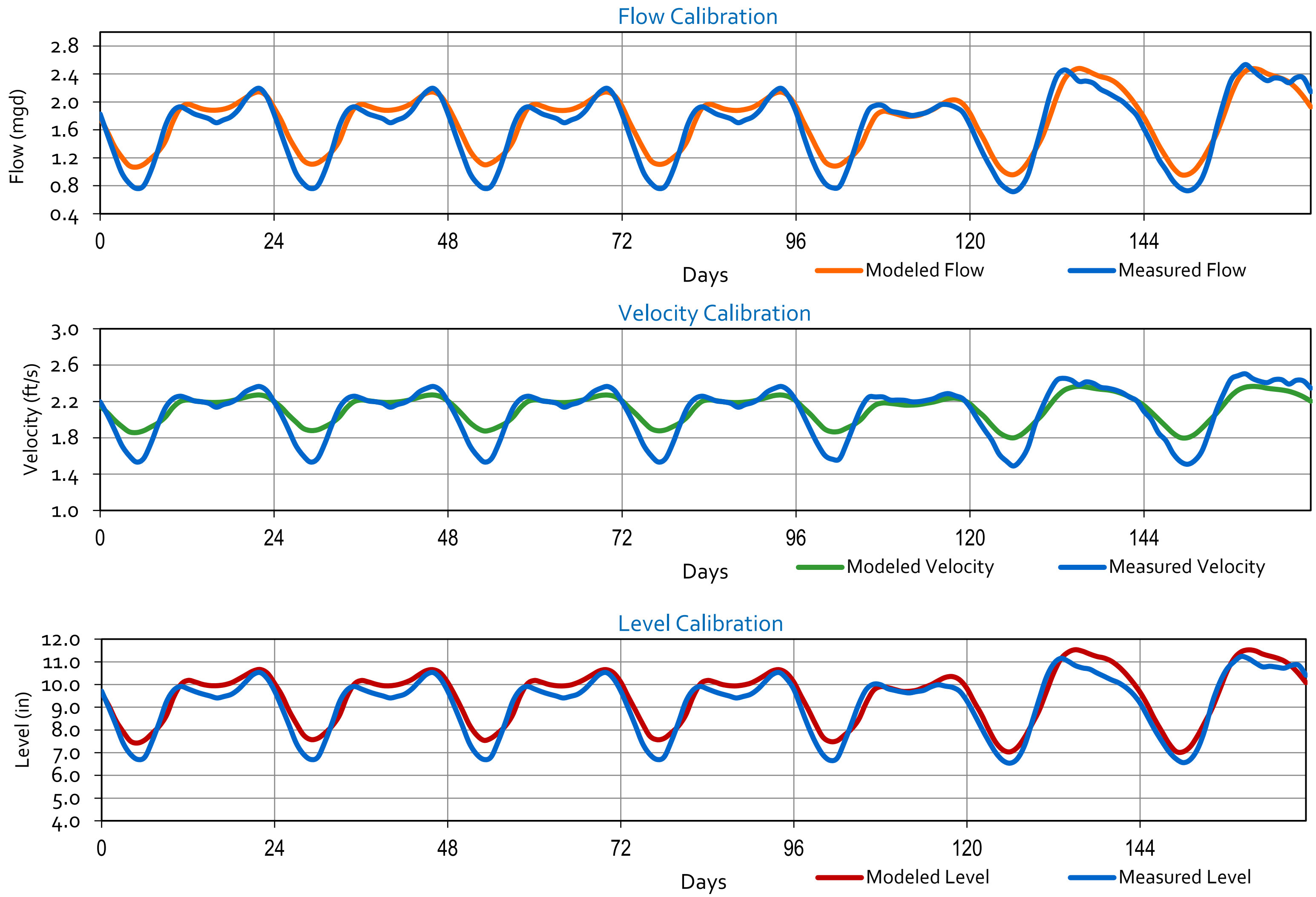

Figure 5.3 Example of Dry Weather Calibration (FM-09)

5.3.3 Wet Weather Flow Calibration

The wet weather calibration enables the hydraulic model to accurately simulate I/I entering the collection system during a large storm event. As outlined below, the WWF calibration process consists of several elements:

- Identify calibration rainfall events. For this project, the WWF calibration process consists of running model simulations of a historic rainfall event. The goal of any WWF calibration is to capture and characterize a system's response to a significant rainfall event, preferably during wet antecedent moisture conditions. During the temporary flow monitoring program, one major storm event was captured on November 28 to December 03, 2018. This storm event was used for wet weather calibration.
- Define RDII tributary areas. For the WWF calibration, RDII flows are superimposed on top of the DWF. The model calculates RDII by assigning "RDII Inflows" to each node in the model. RDII inflows consist of both a unit hydrograph and the total area that is tributary to the model node. The RDII tributary areas were calculated in GIS using the loading polygons. The tributary area provides a means to transform hourly rainfall depth from the rainfall hyetographs into a rainfall volume. The rainfall volume is transformed into actual RDII flows using the unit hydrograph, as described in the next step.
- Create I/I parameter database and modify to match field measured flows. The main step in the WWF calibration process involved creating a custom unit hydrograph for the study area using the "RTK Method," which is widely used in collection system master planning. Using the RTK Method, the RDII unit hydrograph is the summation of three separate triangular hydrographs (short term, medium term, and long term), which are each defined by three parameters: R, T, and K. R represents the fraction of rainfall over the sewer basin that enters the collection system; T represents the time to peak of the of the hydrograph; and K represents the ratio of time to recession to the time to peak. Therefore, there are a total of nine separate variables associated with a unit hydrograph. Figure 5.4 shows the shape of an example unit hydrograph.

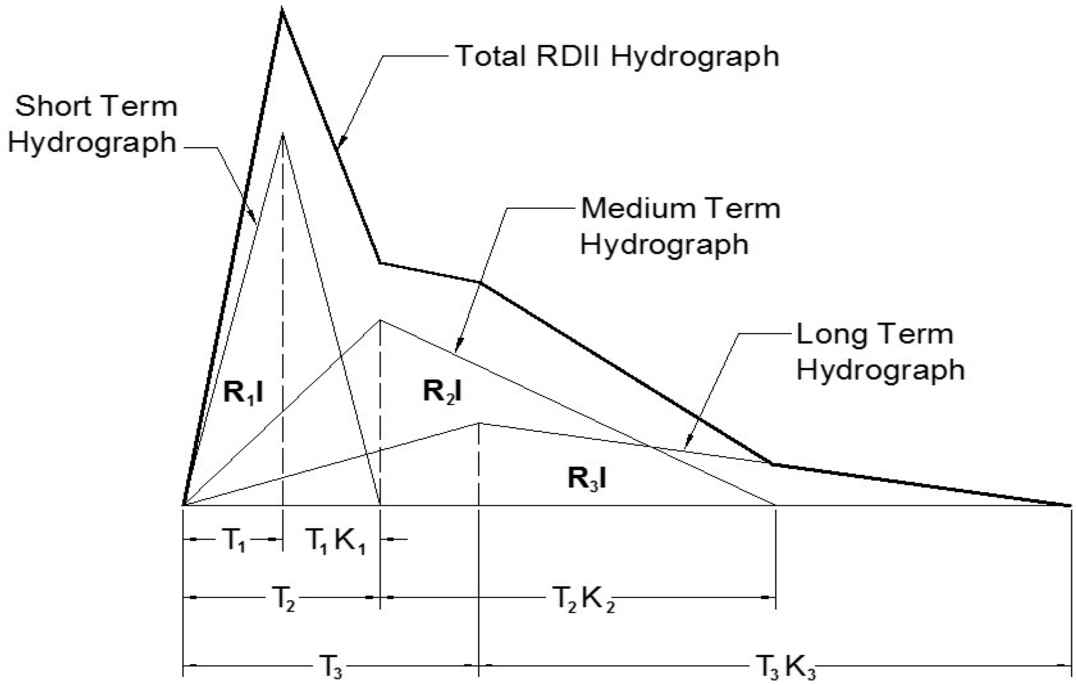

Figure 5.4 Example RDII Unit Hydrograph

The hydrograph utilizes the R-values (percent of rainfall that enters the collection system) calculated for each basin to simulate I/I. The nine variables in each unit hydrograph were initially set based on engineering judgment and then adjusted until the model simulated flows (both peak flows and average flows) matched closely with the field measured flows.

As with the dry weather calibration, the wet weather calibration process compared the measured flow data with the model output. Comparisons were made for average and peak flows as well as the temporal distribution of flow until flows returned to their baseline levels.

Figure 5.5 is an example WWF calibration sheet for flowmeter site FM-06. The WWF calibration sheets show figures comparing the measured data and model results for flow, velocity, and level in response to rainfall. The WWF calibrations sheets for all sites are provided in Appendix E. There is good correlation between the model-simulated flows and the flows that were measured at each meter location.

- FM-02: The modeled velocity was approximately 27 percent higher than the measured velocity from the flow monitoring program. It is suspected that sediment buildup within the system is more significant than what the hydraulic model simulates.
- FM-15: The modeled velocity was approximately 31 percent lower than the measured velocity and the modeled depth was approximately 34 percent higher than the measured depth. This issue was previously identified under dry weather calibration, and any variation from dry weather will carry over to wet weather.

Overall, the model accurately simulated the effects of wet weather events and was considered calibrated and ready to use for capacity analysis purposes.

5.3.4 Collection System Hydraulic Model Calibration Summary

In summary, the calibration results indicate the model predicts conditions similar to those observed in the field. Within a few isolated areas of the model, there are some very minor discrepancies, but the overall collection system is very well represented in the model.

Based on the results presented in this chapter, it can be concluded that the model is calibrated to dry and wet weather flow conditions. The model provides an accurate representation of the City's sanitary collection system to a level suitable for this Master Plan and for the City's future hydraulic modeling needs.

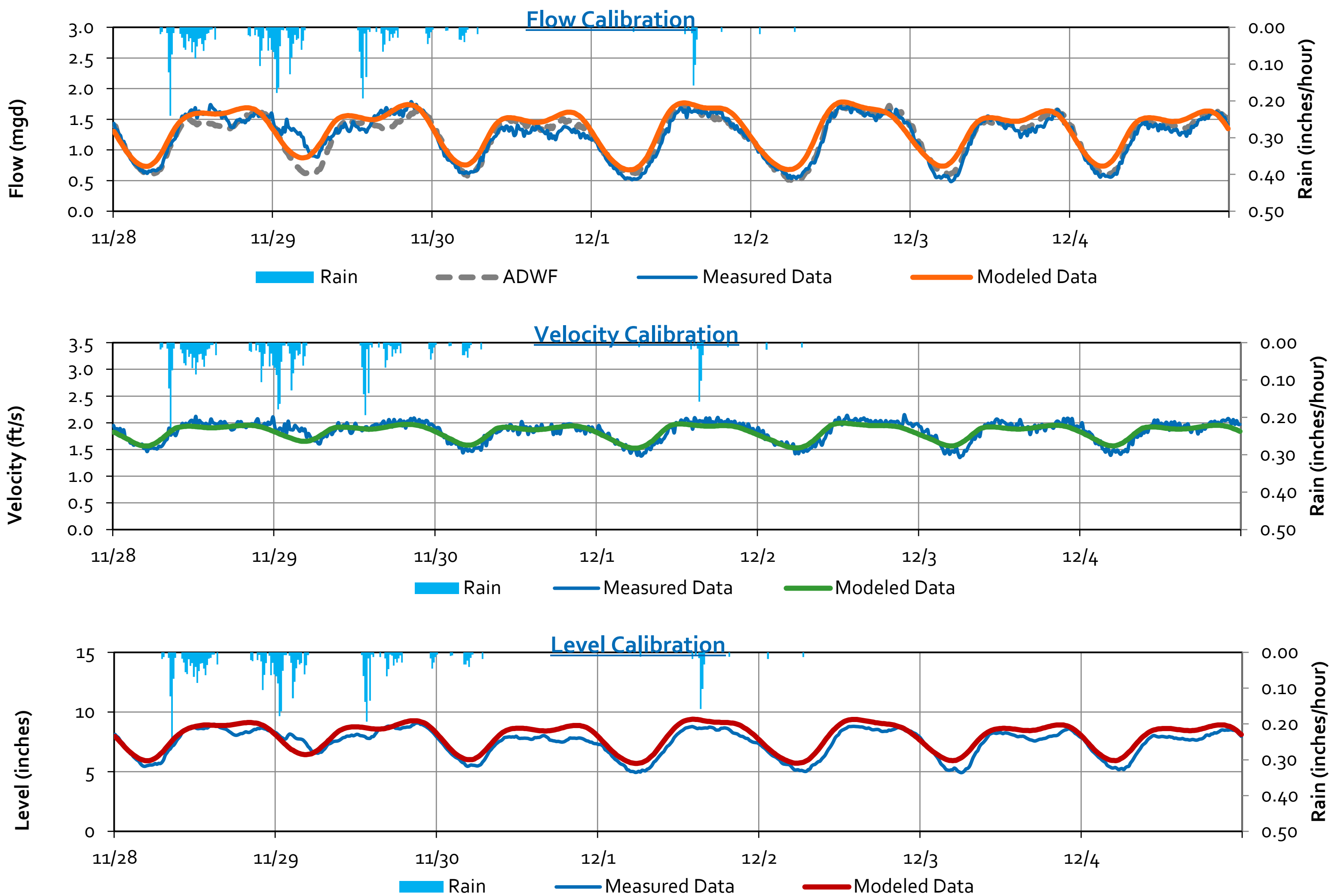

Figure 5.5 Example WWF Calibration Sheet (Site FM-06)

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Chapter 6

SYSTEM EVALUATION AND PROPOSED IMPROVEMENTS

This chapter presents the planning criteria used to evaluate the existing infrastructure and size future improvements. Results of the capacity evaluation and recommended improvements to mitigate system deficiencies and serve future users are also presented in this chapter.

6.1 Gravity Sewer Criteria

The capacity of the City's sanitary sewer collection system was evaluated based on the planning criteria defined in this section. The planning criteria addresses the collection system capacity, gravity sewer pipe slopes, and maximum allowable depth of flow within a sewer. The evaluation criteria used for the evaluation of the City's sewer system are summarized in Table 6.1.

6.1.1 Manning's Coefficient (n)

The Manning's coefficient "n" is a friction coefficient that varies with respect to pipe material, size of pipe, depth of flow, smoothness of joints, root intrusion, and other factors. For sewer pipes, the Manning's coefficient typically ranges between 0.011 and 0.017, with 0.013 being a representative value used for system planning purposes. Due to unknown conditions of existing pipelines, a conservative Manning's "n" factor of 0.013 was initially used for the evaluation of all existing collection system pipelines. Pipe roughness values were then adjusted during calibration. The evaluation of all proposed pipelines used a Manning's "n" factor of 0.013.

6.1.2 Peak Flow Depth Criteria

The primary criterion used to identify capacity-deficient sewers or to size new sewer improvements is the maximum d/D. The d/D value is defined as the depth of flow (d) in a pipe during peak (design) flow conditions divided by the pipe's diameter (D). Based on Carollo's experience and industry standards, the following criteria were recommended:

- Flow Depth for Existing Sewers: Maximum flow-depth criteria for existing sanitary sewers are established based on a number of factors, including the acceptable risk tolerance of the utility, local standards and codes, and other factors. Using a conservative d/D ratio when evaluating existing sewers may lead to unnecessary replacement of existing pipelines. Conversely, lenient flow-depth criteria could increase the risk of sanitary sewer overflows (SSOs). Ultimately, the maximum allowable flow-depth criteria should be established to be as cost-effective as possible, while at the same time reducing the risk of SSOs to the greatest extent possible. The maximum flow depth for an existing sewer was defined as 0.92 for this Master Plan.
- Flow Depth for New Sewers: When sizing new sewer pipelines, it is common practice to adopt variable flow-depth criteria for various pipe sizes. Design d/D ratios typically range from 0.5 to 0.92, with the lower values typically used for smaller pipes, which may experience flow peaks greater than design flow or blockages from debris, paper, or rags.

For pipelines 12 inches in diameter and smaller, the maximum d/D value is 0.67 or 67 percent of the pipeline depth. For Pipelines 15 inches and larger, the maximum d/D is 0.75.

Table 6.1 Sanitary Sewer Collection System Peak Flow Depth Criteria

Flow Depth, d/D		
Maximum Flow Depth for Existing Sewers		
Pipe Diameter		Maximum d/D Ratio (Peak Flow)
12-inches and Smaller		0.92
15-inches and Larger		0.92
Maximum Flow Depth for New Sewers		
Pipe Diameter		Maximum d/D Ratio (Peak Flow)
10-inches and Smaller		0.5
12-inches to 15-inches		0.67
Larger than 15-inches		0.75
Head Loss in Pipelines		
New Gravity Pipeline	Manning's n =	0.013
Pressure Pipelines	Hazen William's C =	120
Lift Station and Force Mains		
Minimum Velocity		2 ft/s
Maximum Velocity		6.5 ft/s
Lift Station Capacity(1)		Firm Capacity Under Peak flows

Notes:
(1) Firm capacity represents the lift stations capacity with the largest pump out of service.

6.1.3 Design Velocities and Minimum Slopes

To minimize the settlement of sewage solids, it is industry standard to specify a minimum velocity of 2 ft/s be maintained. At this velocity, the sewer flow will provide self-cleaning of the pipe. Table 6.2 lists the recommended minimum slopes and their corresponding maximum flows for maintaining self-cleaning velocities (equal to or greater than 2 ft/s) when the pipe is flowing at its maximum design depth (d/D ratio). In order to minimize the need to install lift stations, the City can accept flatter slopes when the preferred slopes are not practical.

Table 6.2 Minimum Slope for New Pipes

Pipe Diameter (inches)	Minimum Slope(1) (feet/feet)	d/D = 0.50		d/D = 0.92	
		Pipe Capacity (mgd)	Pipe Velocity (ft/s)	Pipe Capacity (mgd)	Pipe Velocity (ft/s)
8	0.0033	0.22	2.0	0.45	2.0
10	0.0025	0.35	2.0	0.71	2.0
12	0.0019	0.50	2.0	1.00	2.0
15	0.0015	0.81	2.0	1.62	2.0
18	0.0011	0.93	2.0	2.25	2.0

Pipe Diameter (inches)	Minimum Slope(1) (feet/feet)	d/D = 0.50		d/D = 0.92	
		Pipe Capacity (mgd)	Pipe Velocity (ft/s)	Pipe Capacity (mgd)	Pipe Velocity (ft/s)
21	0.0009	1.54	1.9	3.07	2.0
24	0.0008	2.07	2.0	4.14	2.0
27	0.0007	2.65	2.1	5.30	2.1
30	0.0006	3.25	2.1	6.49	2.1
36	0.0005	4.82	2.1	9.64	2.1
42	0.0005	7.27	2.3	15.6	2.6

Notes:
(1) Minimum slopes reflect the City's recommended slopes when the pipe is flowing half-full; obtained from the 2005 Master Plan.
(2) Approval by the City Engineer is required if designed slopes are flatter than the minimum slopes.

6.1.4 Changes in Pipe Size

When a smaller sewer joins a large one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 80 percent depth point of both sewers at the same elevation. For planning purposes and designing new pipes, and in the absence of field data, sewer crowns are typically matched at the manholes. Additionally, it is recommended that a drop of 0.1 feet through manholes be maintained for any pipelines that do not go straight through a manhole (i.e., pipelines where the inlet pipe is angled away from the outlet pipe), unless otherwise approved by City staff.

6.1.5 Lift Stations and Force Mains

Industry standard practice is to require that sewage lift stations have sufficient capacity to pump peak flows with the largest pump out of service (firm capacity). Force main piping should be sized to provide a minimum velocity of 2 ft/s at the design flow rate of the lift station and no more than 6.5 ft/s to avoid scouring. For the determination of head loss, the Hazen-Williams equation is used with a C-factor of 120, which is typical for sewer system master planning purposes.

6.2 Sanitary Sewer Collection System Capacity Evaluation

The analysis involved identifying areas within the collection system where pipe capacity is inadequate to convey design flows. Sewers that lack sufficient capacity create bottlenecks in the sewer and potentially contribute to SSOs. The City's sewer system was evaluated with a hydraulic computer model, which provides a platform for effectively identifying and managing capacity deficiencies within the sewer system.

This section discusses the locations of current and projected hydraulic deficiencies resulting from flows exceeding the maximum allowable flow depth criteria.

6.2.1 Gravity Collection System Evaluation

In accordance with the established flow depth criteria for existing sewers, pipelines with a maximum d/D ratio greater than 0.92 were identified as capacity deficient.

It is important to understand that not all of the existing pipelines with a d/D greater than 0.92 are necessarily capacity deficient. In some cases, a surcharged condition within a given pipeline segment is due to backwater effects created by a downstream bottleneck (i.e., upstream surcharging is caused by downstream pipeline deficiencies). An illustration of backwater effects is shown on Figure 6.1. For this reason, the hydraulic model was analyzed to identify the pipeline segments that are the cause of the surcharged conditions.

6.2.1.1 Existing System

The existing capacity analysis was performed under PDWF conditions. One deficiency, which is shown on Figure 6.2, was identified. This deficiency (located on West Goshen Avenue and North Ranch Street) has been observed by City maintenance staff, and is associated with the peak discharge rates from an upstream industrial customer.

6.2.1.2 Future System

The goal of the future system analysis is to evaluate the collection system under projected future peak flow and to ensure existing improvements are sized to convey buildout flows. As part of the future system analysis, the planning includes buildout of the UGB, the SOI, and ultimate buildout of the Planning Area.

- UGB: The UGB is the planning boundary outlined in the City's General Plan. Land use within the UGB boundary is defined by the City's General Plan. Projected wastewater flows are based on specific land use and WWFF outlined in Chapter 4.
- SOI: The SOI is a planning boundary outside of an agency's legal boundary (such as the city limit line) that designates the agency's probable future boundary and service area.
- Ultimate Buildout: The Planning Area encompasses the UGB and provides an open space buffer around the City. The General Plan identifies the majority of the land in the Planning Area as agriculture and does not provide long-term plans for area development. The previous Master Plan identified infrastructure to support buildout of this area north of the UGB. This Master Plan will continue the preliminary analysis of this boundary and provide recommendations for supporting infrastructure. The land use within the planning area assumes 70 percent residential, 20 percent commercial, and 10 percent open space. Wastewater flow projections for this area are based on average WWFF for residential and commercial.

The future system analysis of the gravity system was performed in a manner similar to the existing system evaluation. Figure 6.2 shows the locations of deficiencies under future flow conditions for the planning horizon of the Master Plan. Preliminary projects for expansion to serve future growth are also summarized, with conceptual locations for new trunks and lift stations. These preliminary projects are identified in Section 6.4.3.

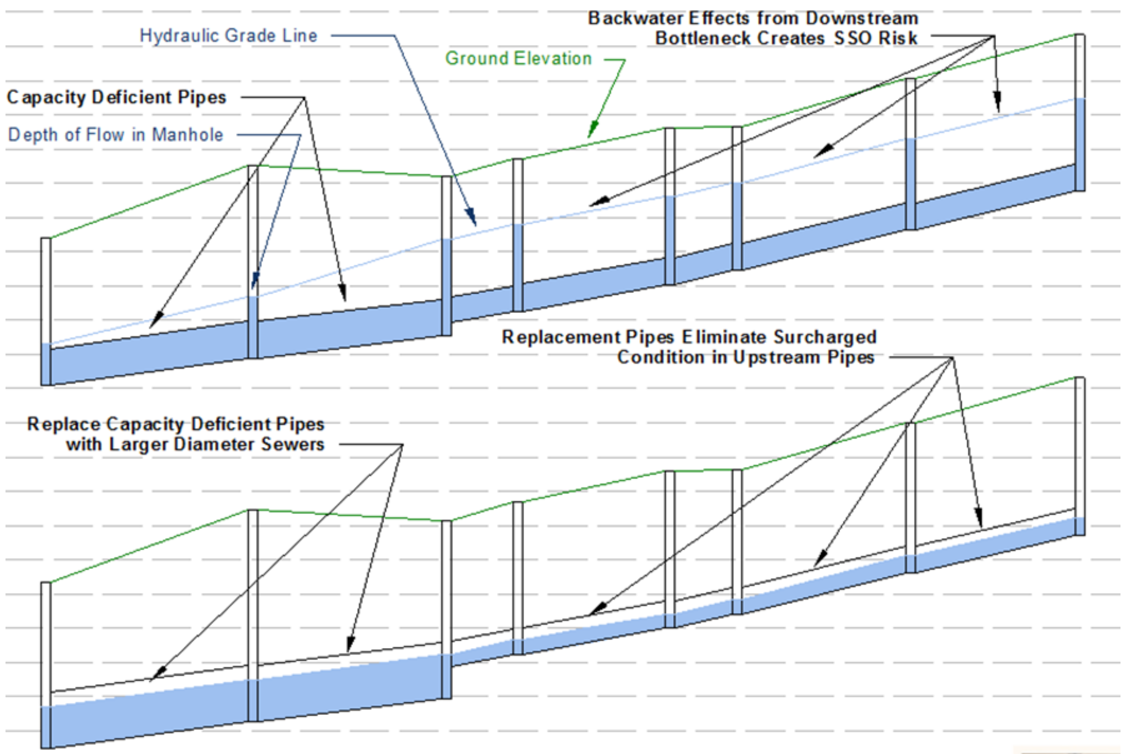

Figure 6.1 Sample Illustration of Backwater Effects in a Sewer

6.2.2 Lift Station and Force Main Evaluation

The City's hydraulic model includes six operational lift stations. The lift stations were evaluated to determine if they have capacity to convey peak flow. Lift stations with an influent peak flow above the existing firm capacity were flagged as deficient. Not all lift station deficiencies will result from an improvement project if considered minor. Table 6.3 summarizes the results of the City's lift stations. Peak flows entering the Airport Lift Station are estimated to be below the firm capacity under buildout of the UGB. This estimation assumes that the Shirk Trunk is completed and flows are split at the intersection of Shirk Street and Ferguson Avenue. Without the Shirk Trunk, the Airport Lift Station is projected to become capacity deficit prior to buildout of the UGB.

Table 6.3 Lift Station Capacity Analysis

Lift Station	Existing Firm Capacity(1) (mgd)	Existing Peak Flow (mgd)	Existing Balance (mgd)	UGB Peak Flow (mgd)	UGB Balance (mgd)	Ultimate Peak Flow (mgd)	Ultimate Balance (mgd)
Airport	8.78	4.65	4.10	8.60	0.18	17.1	(8.32)
Golf Course	1.73	0.13	1.6	0.64	1.09	0.64	1.09
Shirk & 198(2)	1.37	0.31	1.06	NA	NA	NA	NA
Demaree & Pryor	0.69	0.15	0.54	0.15	0.54	0.15	0.54

Lift Station	Existing Firm Capacity(1) (mgd)	Existing Peak Flow (mgd)	Existing Balance (mgd)	UGB Peak Flow (mgd)	UGB Balance (mgd)	Ultimate Peak Flow (mgd)	Ultimate Balance (mgd)
Sunnyside & Mooney	0.84	0.24	0.60	0.25	0.59	0.25	0.59
Mooney and 272	0.27	0.04	0.23	0.16	0.11	0.16	0.11

Notes:
Abbreviations: NA - not applicable.
(1) Firm capacity assumes the largest pump is out of service.
(2) Lift station will be abandoned due to the installation of a gravity main as part of planned CIP project CP0567.

In accordance with the established planning criteria, the City's existing force mains were evaluated to determine if the velocity in the force main fell within the range of 2 ft/s and 6.5 ft/s. Table 6.4 shows no force mains were observed exceeding maximum velocity under buildout of the UGB. However, buildout of the Planning Area is estimated to result in a capacity deficiency for the Airport Lift Station's force main.

Table 6.4 Lift Station Capacity

Lift Station	Force Main Diameter (inches)	Existing Velocity >6.5 ft/s?	UGB Velocity >6.5 ft/s?	Ultimate Velocity >6.5 ft/s?
Airport	20	No	No	Yes
Golf Course	8	No	No	No
Shirk & 198(1)	6	No	NA	NA
Demaree & Pryor	6	No	No	No
Sunnyside & Mooney	No Data	-	-	-
Mooney and 272	8	No	No	No

Notes:
(1) Lift station will be abandoned in the future due to the installation of a gravity main as part of planned CIP project CP0567.

As shown in Table 6.4, the Airport Lift Station's force main will exceed velocity criteria. The following lift stations' associated force mains were observed outside of the velocity criteria:

- Airport Lift Station: Under ultimate conditions the lift station exceeded the maximum velocity criteria.
- Golf Course Lift Station: The lift station velocity was observed as below the minimum velocity criteria.
- Mooney and 272 Lift Station: The lift velocity was observed as below the minimum velocity criteria.

With low velocities, issues to consider include accumulation of solids/oils, reduction in pipeline cross sectional area, and corrosion. The City may consider a program to provide scheduled maintenance for their force mains if one does not exist.

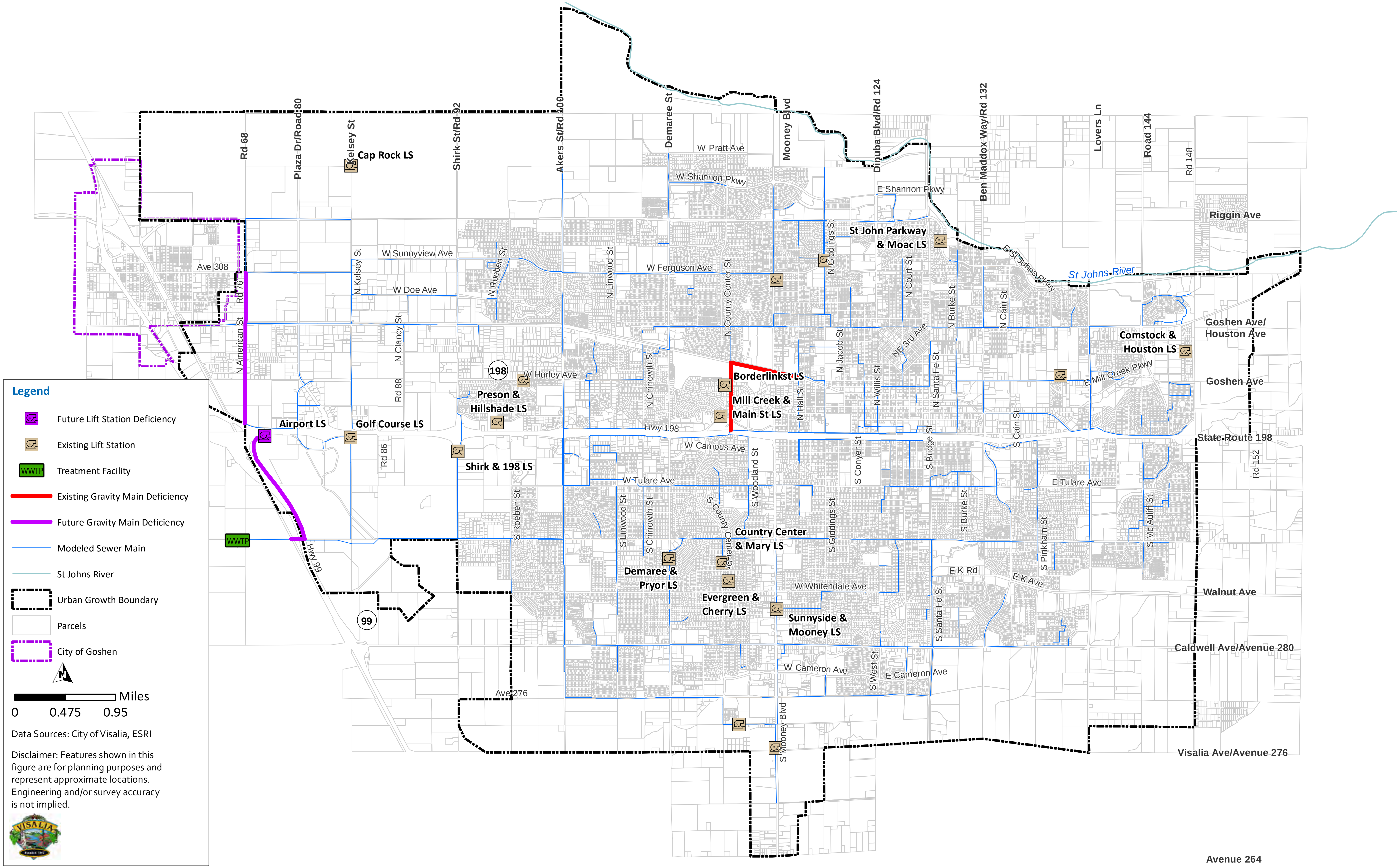

Figure 6.2 Capacity Deficiencies

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6.3 Available Capacity in the Existing System

This chapter summarizes the capacity analysis performed for the City's collection system and provides recommendations to mitigate deficiencies. To calculate the timing of these improvements it is necessary to determine the available capacity in the collection system. The EDUs provide capacity in terms of remaining dwelling units that can be served before capacity expansion is required.

For the City, 150 gpud was used to estimate sewage flows from a single-family detached residential home. To calculate the available capacity in terms of EDUs, the difference between the maximum capacity (based on size, slope, and maximum d/D), and the existing design flow was calculated and reduced to average flows. The average flow was then divided by 150 gpud to quantify remaining EDUs. This method only applies to existing infrastructure.

6.4 Recommended Improvements

Figure 6.3 illustrates the recommended improvements to mitigate the collection system deficiencies. This section provides a detailed description of each recommended wastewater collection system improvement project. Detailed sheets for the recommended improvements can be found in Appendix F.

6.4.1 Existing Versus Future Improvements

An existing deficiency is one where the existing facility's capacity is insufficient to meet the planning criteria (e.g., pipeline upgrades required to prevent severe surcharging during the design peak flow) for existing users. If a project was proposed to exclusively correct an existing deficiency, then existing users would be assigned 100 percent of the project's benefit, and therefore, 100 percent of the costs.

In some cases, a project is needed to correct an existing capacity deficiency but is sized to accommodate additional flows from future development. Projects are sized to accommodate existing and future flows to avoid future capital projects for the same pipelines. The hydraulic modeling results were used to determine the ratio of existing average flows and future average flows. With the ratio, project costs are divided between existing and future users.

6.4.2 Existing Capacity Improvements

As previously mentioned, one capacity deficiency was identified as part of the existing system analysis. To mitigate this deficiency, the following is recommended:

- North Ranch Street/Visalia Country Club (Project WWGM-0A): This project will replace approximately 3,400 feet of 18-inch diameter pipeline in North Ranch Street and through the Visalia Country Club with a new 24-inch sewer, extending from West Mineral King Avenue to West Goshen Avenue. This project is needed to mitigate existing capacity deficiencies associated with historical peak discharge rates associated with the milk processing plant upstream of this sewer main.

- West Goshen Avenue (Project WWGM-0B): This project will replace approximately 3,200 feet of 12-inch diameter pipeline in West Goshen Avenue with an 18-inch sewer, extending from the Visalia Country Club to approximately 400 feet east of North Leslie Street. This project is needed to mitigate existing capacity deficiencies associated with historical peak discharge rates associated with the milk processing plant upstream of this sewer main.

6.4.3 Future Capacity Improvements

This section summarizes the proposed improvements that will serve future users. The locations of the new trunk sewers are conceptual and are likely to change during the design phase of each project.

6.4.3.1 Urban Growth Boundary Buildout

Following the completion of the future capacity analysis under buildout of the UGB, no capacity deficiencies aside from those identified in Section 6.4.2 were identified.

6.4.3.2 Sphere of Influence Buildout

Following the completion of the future capacity analysis under buildout of the SOI, no capacity deficiencies aside from those identified in Section 6.4.2 were identified.

6.4.3.3 Ultimate Buildout

The proposed improvements to address ultimate buildout deficiencies are shown on Figure 6.3 and are summarized below. These projects are preliminary and recommended to serve buildout of the Planning Area.

- North American Street (Project WWGM-1): The pipeline currently has more than half its capacity remaining. With construction of the Shirk Trunk, flows would be split between the two trunks and extend the pipeline's ability to convey future flows. Existing average flows within the trunk are estimated at approximately 2.95 mgd. It's estimated that the pipeline has capacity for an additional average flow of 3.6 mgd. This equates to approximately 10,000 additional EDUs and buildout of the industrial park. Given the project's location, most of the remaining capacity would be taken by industrial users.

  This project will replace approximately 7,500 feet of 36-inch diameter pipeline in American Street, extending from Ferguson Avenue to Camp Drive. Under ultimate peak flow conditions, the 36-inch pipeline surcharges and exceeds the maximum d/D criteria. To mitigate the capacity deficiency, it is recommended that the existing pipeline be replaced with a 42-inch diameter pipeline.

- Frontage Road (Project WWGM-2): The pipeline currently has more than half its capacity remaining. With construction of the Shirk Trunk, flows would be split between the two trunks and extend the pipelines ability to convey future flows. Existing average flows within the trunk are estimated at approximately 3.29 mgd. It's estimated that the pipeline has capacity for an additional average flow of 3.9 mgd. This equates to approximately 9,900 additional EDUs and buildout of industrial park. Given the project's location, most of the remaining capacity would be taken by industrial users.

This project will replace approximately 6,200 feet of 36-inch diameter pipeline along an unimproved area and in Frontage Road. The existing pipeline parallels Highway 99 and is west of the Airport. The project extends from downstream of the Airport Lift Station to Walnut Avenue. Under ultimate peak flow conditions, the 36-inch pipeline surcharges and exceeds the maximum d/D criteria. To mitigate the capacity deficiency, it is recommended that the existing pipeline be replaced with a 42-inch diameter pipeline.

- Walnut Trunk Bypass (Project WWGM-3): The existing 42-inch pipeline crossing Highway 99 has capacity to serve approximately 12,000 additional EDUs.

  This project includes the installation of a 24-inch diameter pipeline extending from the Walnut Lovers Lane Trunk to the Walnut Outfall Trunk. The overflow is recommended to alleviate surcharging within the 42-inch pipeline crossing Highway 99 and minimize the backwater effect occurring upstream. This project would eliminate capacity improvement projects extending under Highway 99. The Walnut Outfall Trunk has capacity to allow for overflow from the parallel trunk.

  An alternative location to this project is located at the intersection of Walnut and Akers, which would allow the City to divert flows upstream.
- Airport Lift Station (Project WWLS-1): The existing lift station has capacity to serve approximately 1,700 additional EDUs and buildout of industrial park.
  Modeling results project the firm capacity of this lift station is not adequate to convey peak ultimate buildout flows. The City's Airport Lift Station will need to be replaced in the future to accommodate growth in the planning area. This lift station provides service to Sewer Drainage Basin 7, which includes Industrial Park. In addition, the CDP, Goshen, discharges upstream of the lift station. This project is considered long term and would be required after buildout of the UGB. It is recommended to increase the firm capacity to 17.0 mgd.
- Airport Lift Station Force Main (Project WWFM-1): The Airport Lift Station's 20-inch diameter force main exceeds velocity criteria under ultimate buildout conditions. It is recommended to parallel the 20-inch diameter pipeline with an additional 21-inch pipeline.

6.4.4 Collection System Expansion to Serve Future Growth

The following recommendations are preliminary sewer trunk alignments and lift stations that will serve future growth. The location of the new trunks and lift stations are conceptual and should be refined as more data becomes available.

6.4.4.1 Urban Growth Boundary Tier 1

- American Street Trunk Extension (Project WWGM-6): This project consists of 5,200 feet of 30-inch diameter pipeline in American Street. The project extends from Avenue 320 to Riggin Avenue. The pipeline is sized to convey projected flows from ultimate buildout of UGB and Planning Area.

6.4.4.2 Urban Growth Boundary Tier 2

- North Shirk Trunk Extension (Project WWGM-7): This project will extend the Shirk Trunk to the northern UGB Tier 2 boundary. The project is recommended under buildout of the UGB Tier 2 and consists of 2,600 feet of 42-inch diameter pipeline in Shirk Street. The pipeline is sized to convey projected flows from ultimate buildout.

- South Lovers Lane Main (Project WWGM-8): This project consists of 2,500 feet of 12-inch diameter pipeline in Avenue 280 and 2,500 feet of 12-inch pipeline in Lovers Lane. The project would extend the Caldwell Trunk east and require crossing a ditch. A preliminary analysis shows the pipeline has depth to cross the waterway and maintain spacing.

6.4.4.3 Urban Growth Boundary Tier 3

- Visalia Parkway Trunk Extension (Project WWGM-9): This project consists of 5,300 feet of 24-inch diameter pipeline in Visalia Parkway. The project extends from Road 148 to Lovers Lane. The pipeline is sized to convey projected flows from ultimate buildout.
- North Shirk Trunk Extension (Project WWGM-10): This project will extend the Shirk Trunk North to Avenue 320 The project is recommended under buildout of the UGB Tier 3 and consists of 2,700 feet of 42-inch diameter pipeline in Shirk Street. The pipeline is sized to convey projected flows from ultimate buildout.
- Avenue 320 Trunk: This project will construct a new trunk in Avenue 320 and serve future growth within the UGB. The pipelines are sized to convey projected flows from ultimate buildout:
  - (Project WWGM-11A): This project consists of 10,500 feet of 30-inch diameter pipeline in Avenue 320. The project extends from North Demaree Road to Shirk Street.
  - (Project WWGM-11B): This project consists of 5,200 feet of 27-inch diameter in 320 Avenue. The project extends west of the St. Johns River to North Demaree Road.
- North Akers Main (Project WWGM-12): This project consists of 4,600 feet of 12-inch diameter pipeline in Akers Street. The project extends south of Avenue 328 to Avenue 320.
- Houston-Ivanhoe Main: The project is recommended to serve growth in Tier 3 boundaries and growth within the Planning Area:
  - (Project WWGM-13A): This project consists of 3,600 feet of new 12-inch diameter pipeline in Houston Avenue and Ivanhoe Drive. The project extends from Road 152 to Citrus Court. The pipeline is sized to convey projected flows from buildout of the Planning Area.
  - (Project WWGM-13B): This project will replace approximately 2,300 feet of existing 10-inch diameter pipeline in East Houston Avenue and in the alignment of East Auburn Drive. The project extends from Comstock Road to McAuliff Street. It is recommended that the existing pipeline be replaced with a 12-inch diameter pipeline. The pipeline is sized to convey projected flows from buildout of the Planning Area.

6.4.4.4 Sphere of Influence Buildout

- South Shirk Main: This project extends from Caldwell Avenue to Walnut Avenue. The project is recommended to serve future growth within the SOI:
  - (Project WWGM-14A): This project consists of 3,600 feet of new 12-inch diameter pipeline in Shirk Street. The project extends from north from Caldwell Avenue to south of Wagner Avenue.

  - (Project WWGM-14B): This project consists of 600 feet of new 15-inch diameter pipeline in Shirk Street. The project extends from Wagner Avenue to Walnut Avenue.
- Visalia Parkway Extension (Project WWGM-15A): This project consists of 5,700 feet of new 30-inch diameter pipeline. This segment of the project is located on the west side of Highway 99. The project continues west along Whitendale Avenue and extends north across an unimproved surface owned by the City. The pipeline is sized to convey buildout flows from the surrounding SOI and as a bypass for the Visalia Parkway trunk, with capacity to convey all buildout flow of the Visalia Parkway Trunk basin.
- Visalia Parkway Extension (Project WWGM-15B): This project consists of 500 feet of 30-inch diameter pipeline, crosses Highway 99 and Railroad tracks. It is estimated the project will require trenchless technology to cross the highway and railroad. Due to crossing of the highway and railroad, a steel casing would be required.
- Visalia Parkway Extension (Project WWGM-15C): This project consists of 10,300 feet of 30-inch diameter pipeline. The project extends from the existing system at the intersection of Visalia Parkway and Akers Street west to Shirk Road, west on Caldwell Avenue, and then runs parallel to Highway 99. The project would connect to WWGM-15B.

6.4.4.5 Ultimate Buildout

- Avenue 320 Trunk Extension: This project will extend the proposed Avenue 320 Trunk east. The project is recommended to serve future growth within the Planning Area. This project has been carried forward from previous master plans. These projects require crossing the St. Johns River and will need trenchless construction. A lift station may be required to avoid construction of a siphon when crossing the river:
  - (Project WWGM-16A): Will consist of 5,300 feet of 27-inch diameter pipeline in Avenue 320. The project will extend from Road 124 to the St. Johns River.
  - (Project WWGM-16B): This project will consist of 5,400 feet of 24-inch diameter pipeline in Avenue 320. The project extends from Ben Maddox Way to Dinuba Boulevard.
  - (Project WWGM-16C): This project will consist of 5,300 feet of 21-inch diameter pipeline in Avenue 320. The project extends from a future extension of Lovers Lane to Ben Maddox Way.
  - (Project WWGM-16D): This project will consist of 9,300 feet of 15-inch diameter pipeline in Avenue 320. The project extends west from Road 156 to the future extension of Lovers Lane.
  - (Project WWGM-16E): This project consists of 4,500 feet of 12-inch diameter pipeline in north Shirk Street. The project extends from Avenue 328 to Avenue 320.
  - (Project WWGM-16F): This project will consist of 4,500 feet of 12-inch diameter pipeline in Road 108 (Demaree Street). The project extends from Avenue 328 to Avenue 320.
  - (Project WWGM-16G): This project will consist of 5,700 feet of 12-inch diameter pipeline in an unimproved area. The project extends from Avenue 328 to Avenue 320, with a segment parallel to the St. Johns River.
  - (Project WWGM-16H): This project will consist of 4,500 feet of 12-inch diameter pipeline in Road 124 (Dinuba Boulevard). The project extends from Avenue 328 to Avenue 320.

  - (Project WWGM-16I): This project will consist of 4,500 feet of 12-inch diameter pipeline in Ben Maddox Way. The project extends from Avenue 328 to Avenue 320.
  - (Project WWGM-16J): This project will consist of 4,500 feet of 12-inch diameter pipeline in Lovers Lane (Future Extension), north of the St. Johns River. The project extends from Avenue 328 to Avenue 320.
  - (Project WWLS-2): This project will consist of a new lift station with a firm capacity of 3.6 mgd. The project is located in Avenue 320, east of the St. Johns River. A preliminary analysis estimates a lift station will be required to cross the St. Johns River. Further analysis is recommended to determine flood zone, and best method to cross the river.
  - (Project WWFM-2): This project consists of 1,900 feet of 14-inch diameter force main crossing the St. Johns River. The project will convey flows for project WWLS-2.
- Kelsey Street Main (Project WWGM-17): This project consists of 10,000 feet of 12-inch diameter pipeline in Kelsey Street and Avenue 320.
- Highway 99 - West Avenue 320 Trunk: This project will construct a new trunk parallel to Highway 99 and extend to Avenue 320. The project will serve future growth within the northwest Planning Area. This project has been carried forward from previous master plans with adjustments made to the alignment.
  - (Project WWGM-18A): This project will consist of 8,000 feet of 24-inch diameter pipeline in Avenue 320. The project extends from Highway 99 to American Street.
  - (Project WWGM-18B): This project will consist of 11,000 feet of 18-inch diameter pipeline and runs parallel to Highway 99. The project extends north of Avenue 328 to Avenue 320.
  - (Project WWGM-18C): This project consists of 1,000 feet of 18-inch diameter pipeline and crosses Highway 99 along Avenue 320. It is estimated the project will require a 30-inch steel casing.
  - (Project WWGM-18D): This project consists of 6,400 feet of 18-inch diameter pipeline in Avenue 320. The project extends west from Highway 99 to Road 52.
  - (Project WWGM-18E): This project will consist of 9,800 feet of 21-inch diameter pipeline in American Street. The project extends from Avenue 328 to Avenue 320.
  - (Project WWLS-4): This project will consist of a new lift station with a firm capacity of 6.0 mgd. The project is located at the intersection Avenue 320 and American Street. The lift station will serve the northwest quadrant of the planning area.
  - (Project WWFM-4): This project consists of 100 feet of 21-inch diameter force main for in American Street. The project will convey flows for project WWLS-4.
- East Riggin Extension Trunk: This project will construct a new trunk, lift station and force main in the northeastern quadrant of the City and extend the Riggin trunk. This project has been carried forward from previous master plans with adjustments made to the alignment.
  - (Project WWGM-19A): This Project consists of 800 feet of 24-inch diameter pipeline in the Santa Fe Street/trail alignment, west of the St. Johns River and downstream of the proposed lift station WWLS-3. The project connects to the existing system in Riggin Avenue.
  - (Project WWGM-19B): This project consists of 6,000 feet of 24-inch diameter pipeline in an unimproved area east of St. Johns River. This project is upstream of the proposed lift station WWLS-3.

- (Project WWGM-19C): This project consists of 2,600 feet of 21-inch diameter pipeline in an unimproved area. The project extends west from Lovers Lane.
- (Project WWGM-19D): This project consists of 5,800 feet of 18-inch diameter pipeline in an unimproved area. The project extends from Road 148 to Lovers Lane (future extension).
- (Project WWGM-19E): This project consists of 3,400 feet of 15-inch diameter pipeline in Avenue 313. The project extends west of Oak Ranch Drive to Road 148.
- (Project WWLS-3): This project will consist of a new lift station with a firm capacity of 3.0 mgd. The project is located in an unimproved area, east of the St. Johns River. A preliminary analysis estimates a lift station will be required to cross the St. Johns River. Further analysis is recommended to determine the surrounding flood zone, and best method to cross the river.
- (Project WWFM-3): This project consists of 600 feet of 12-inch diameter force main crossing the St. Johns River. The project will convey flows for project WWLS-4.

- Road 148 Trunk: This project will construct a new trunk in the southeastern quadrant of the City. This project has been carried forward from previous master plans with adjustments made to the alignment:
  - (Project WWGM-20A): This project consists of 7,900 feet of 21-inch diameter pipeline in Road 148. The project extends from Walnut Avenue to Visalia Parkway.
  - (Project WWGM-20B): This project consists of 5,100 feet of 15-inch diameter pipeline in Road 148. The project extends from Mineral King Avenue to Walnut Avenue.
  - (Project WWGM-20C): This project consists of 4,000 feet of 12-inch diameter pipeline in Caldwell Avenue. The project extends from west of Road 156 to Road 148.
  - (Project WWGM-20D): This project consists of 5,000 feet of 12-inch diameter pipeline in Walnut Avenue. The project extends from Road 156 to Road 148.
  - (Project WWGM-20E): This project consists of 5400 feet of 15-inch diameter pipeline in Noble Avenue. The project extends from Road 156 to Road 148.
  - (Project WWGM-20F): This project consists of 500 feet of 15-inch diameter pipeline in Road 156 with 30-inch steel casing. The project connects from WWGM-20E and extends from Noble Avenue to Avenue 296. The alignment crosses under Highway 198 bridge and is estimated to be open trench. This project will be serving users north of Highway 198.
- Houston-Ivanhoe Main Extension (Project WWGM-21): This project consists of 2,800 feet of 12-inch diameter pipeline in Ivanhoe Drive. The project extends east from Road 152.

6.4.5 City's Ongoing Sanitary Sewer Related Projects

The City's current five-year CIP has a number of sanitary sewer projects listed. The following projects are related to the sanitary sewer collection system and include pipeline/lift station construction and maintenance.

- Shirk Capacity Enhancement (CP0369): The project includes installation of 8,200 feet of 48-inch diameter pipeline in Shirk Street. The project will increase sanitary sewer capacity and accommodate future development. This project is shown in Figure 6.3.

- Caldwell Widening (CP8268): The project will extend the 15-inch diameter pipeline in Cadwell across the Lovers Lane intersection and provide a stub to the north. A preliminary analysis shows the pipeline has depth to cross the waterway and maintain spacing.
- Shirk Street and Walnut Avenue (CP0045): The project will extend the sanitary sewer trunk line in Shirk Street approximately 200 feet north. This project is in conjunction with the installation of a traffic signal and will prevent retrenching the street for future expansion of the Shirk Trunk. This project is shown in Figure 6.3.
- Sanitary Sewer Developer Reimbursement (CP9318): The annual project reimburses developers for additional costs incurred when constructing sanitary sewer infrastructure.
- Sewer Line Preliminary Engineering (CP9324): The annual project will accommodate preliminary engineering and design work necessary to provide developers and engineers with adequate information to construct master planned sewer lines.
- Shirk Street Sanitary Sewer Trunkline (CP0567): The project will install a 48-inch trunk in Shirk Avenue, south of Highway 198. The project will extend from Noble Avenue to Walnut Avenue. The project also includes removal of the Shirk Lift Station and 6-inch force main. This project is shown in Figure 6.3.
- Visalia Parkway Trunkline – Santa Fe to Lovers Lane (CPNew): The project will construct a new 30-inch diameter sanitary sewer pipeline between Santa Fe Street and Lovers Lane. This project will extend the existing pipeline in Visalia Parkway. This project is shown in Figure 6.3.
- Riggin Widening – Kelsey to Shirk (CPO398): This project consists of 4,000 feet of 15-inch diameter pipeline in Riggin Avenue and extends from east of Kelsey Street to Shirk Street. The project is located in Industrial Park and would serve industrial users

6.4.5.1 Maintenance Related Projects

The following projects are in the City's CIP as maintenance related projects and are included to avoid any duplication of projects from the Master Plan. These projects are not included in the CIP.

- Replace and Relocate Sanitary Sewer Mains (CP9456): The annual program will replace mains that have deteriorated and relocate pipelines as necessary to accommodate development.
- Sanitary Sewer Lift Station Rehabilitation (CP266): The project will rehabilitate two lift stations with new piping, valves, pump bases, entry hatches, and concrete surface. The Golf Course and Mooney/Ave 272 lift station have been identified for this project This project is shown in Figure 6.3.
- Sanitary Pump Replacement (CP0324): The annual project will provide for replacement of sanitary sewer lift station pumps with greater efficiency. Pumps will be replaced once life expectancy has been exceeded.
- Sewer Lateral Connection/Replacement/Installation (CP9228): The annual project will provide customer requested hookups to the sanitary sewer.
- Sanitary Sewer Manhole Repair Citywide (CP0580): The annual project will repair and raise manholes throughout the City sanitary sewer system. The project is budgeted to allow for replacement of one brick and mortar manhole per year.

Capital projects related to the WRF and maintenance are not included in this Master Plan.

6.4.6 Additional Recommendations

- Septic Removal by Sewer Extension: These projects provide a preliminary alignment to extend sanitary sewer service to residents currently on septic and located in the City limits or county islands. These projects were identified due to their proximity to an existing sewer line. Residents who connect would pay connection fee to reimburse construction fees. These projects would not be incorporated into the development impact fee.

  Areas outside of the City limits and located in Tier 1 of the UGB have several septic users, however, septic removal projects in these areas were not identified. These areas are expected to connect as new development/redevelopment extends. These projects are shown on Figure 6.3, with detail maps in Appendix F. Projects located within county islands would not occur until the area was annexed into city limits.
  - (Project WWO-1): This project consists of 2,600 feet of 8-inch diameter pipeline in Linwood Road, Oakridge Court, and Kent Street. The project extends to the intersection of West Ferguson Avenue. This project is currently a county island.
  - (Project WWO-2A): This project consists of 1,400 feet of 8-inch diameter pipeline in El Cajon Street at the intersection of Goshen Avenue.
  - (Project WWO-2B): This project consists of 2,600 feet of 8-inch diameter pipeline in Mae Carden Street and Pershing Avenue the project extends to the intersection of south Goshen Avenue and Mae Carden Street.
  - (Project WWO-2C): This project consists of 4,700 feet of 8-inch diameter pipeline. The project extends from West Steward Avenue to Tommy Street, and West in Pershing Avenue to the intersection of Akers. To maintain a minimum recommended slope, a lift station is required.
  - (Project WWO-2D): A preliminary analysis shows to maintain a minimum slope upstream a lift station is required. This project would serve existing users transitioning from septic to the collection system. The lift station is recommended to have a firm capacity of 0.031 mgd (21.2 gpm).
  - (Project WWO-3A): This project consists of 1,300 feet of 8-inch diameter pipeline in South Peppertree Court. The project extends to the intersection of Caldwell Avenue.
  - (Project WWO-3B): This project consists of 300 feet of 8-inch diameter pipeline in South Aspen Street.
  - (Project WWO-4): This project consists of 800 feet of 8-inch diameter pipeline in James Avenue. The project extends to an existing pipeline at the intersection of Divisadero Street.
  - (Project WWO-5A): This project consists of 1,300 feet of 8-inch diameter pipeline in Tulare Avenue at the intersection Ben Maddox Way.
  - (Project WWO-5B): This project consists of 500 feet of 8-inch diameter pipeline in an access road located south of Pinkham Road and Tulare Avenue intersection.
  - (Project WWO-6): This project consists of 1,200 feet of 8-inch diameter pipeline in Noble Avenue and would connect to the existing system in McAuliff Street.
  - (Project WWO-7): This project consists of 600 feet of 8-inch diameter pipeline in an access road south of Goshen Avenue and Lovers Lane.

  - (Project WWO-8A): This project consists of 2,600 feet of 8-inch diameter pipeline in Sol Road. Based on preliminary data, the pipeline would not maintain a minimum recommended slope. Therefore, a lift station is recommended.
  - (Project WWO-8B): A preliminary analysis shows to maintain a minimum slope upstream a lift station is required. This project would serve existing users transitioning from septic to the collection system. The lift station is recommended to have a firm capacity of 0.02 mgd (15.7 gpm) and would provide service to residential very low density.
  - (Project WWO-9): Connection of this area would likely occur as the surrounding area is developed or redeveloped. Vista Del Sol has begun development on the adjacent lot west of the septic area and would likely be the point of connection.
  - (Project WWO-10): This project consists of 400 feet of 8-inch diameter pipeline in South Dans Street.
- Sewer Master Plan Update (WWO-11): It is recommended that the City undergoes a Sewer Master Plan Update every five years to evaluate the wastewater collection system.
- Collection System GIS Update (Project WWO-12): The City may consider updating their GIS data to include pipeline inverts, diameter, material, and installation dates. A pipeline age and material summary can be accomplished with a combination of installation dates and approved dates outlined in drawings. To further expand on probable installation dates, the City may utilize upstream and downstream pipelines with known data to approximate or review nearby utilities such as water lines. Having this data available will assist the City in identifying pipelines approaching their probable useful life. An age-based analysis can be performed to provide a statistical evaluation of decay and potential failure of pipelines based on material. This type of analysis typically uses assumed "useful life" values, which are based on industry literature.

6.5 Project Prioritization

Prioritizing the required capital improvements for the City's sanitary sewer system is an important part of this study. The improvement projects were prioritized in the following order:

- Upgrade existing facilities to mitigate current capacity deficiencies.
- Plans for pipeline and lift station rehabilitation projects.
- Upgrade existing facilities and plan for future facilities to accommodate increased wastewater flows associated with buildout of the UGB Tiers.
- Upgrade existing facilities and plan for future facilities to convey flows associated with buildout of the SOI area.
- Upgrade existing facilities and plan for future facilities to convey flows associated with buildout of the Planning Area.

Implementation of future projects ultimately depends on growth. Phasing assumptions presented are estimates and changes in growth projections or planning assumptions may change the priority of each improvement. Figure 6.4 shows the project phasing and Table 6.5 summarizes each project.

- Phase 1 Projects (2026 - 2030): Improvements targeted for Phase 1 include projects to address existing capacity deficiencies and projects identified by the City. These include pipeline capacity improvements, rehabilitation projects, and pump replacements.

- Phase 2 Projects (2031 - 2035): Improvements targeted for Phase 2 include projects to address buildout of UGB Tier 1, buildout of Tier 2, and City identified projects.
- Phase 3 Projects (2036-2040): Improvements targeted for Phase 3 include projects to address buildout of UGB Tier 3.
- Phase 4 Projects (2040 - 2045): Improvements targeted for Phase 4 include projects to address buildout of UGB Tier 3 and buildout of SOI.
- Phase 5 Projects (2046 And Beyond): Improvements targeted for Phase 5 include projects to address buildout of the Planning Area.

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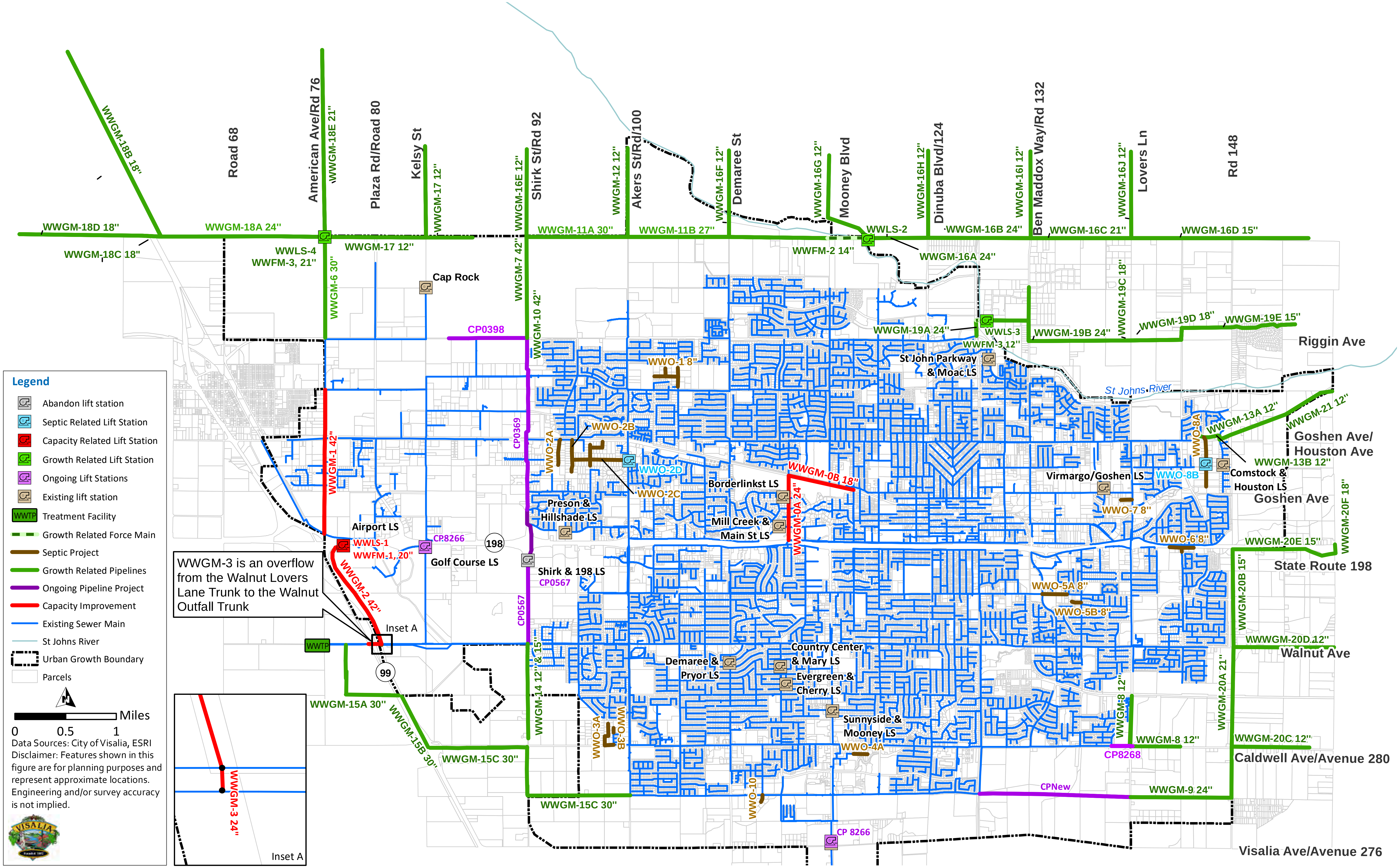

Figure 6.3 Capacity Improvements

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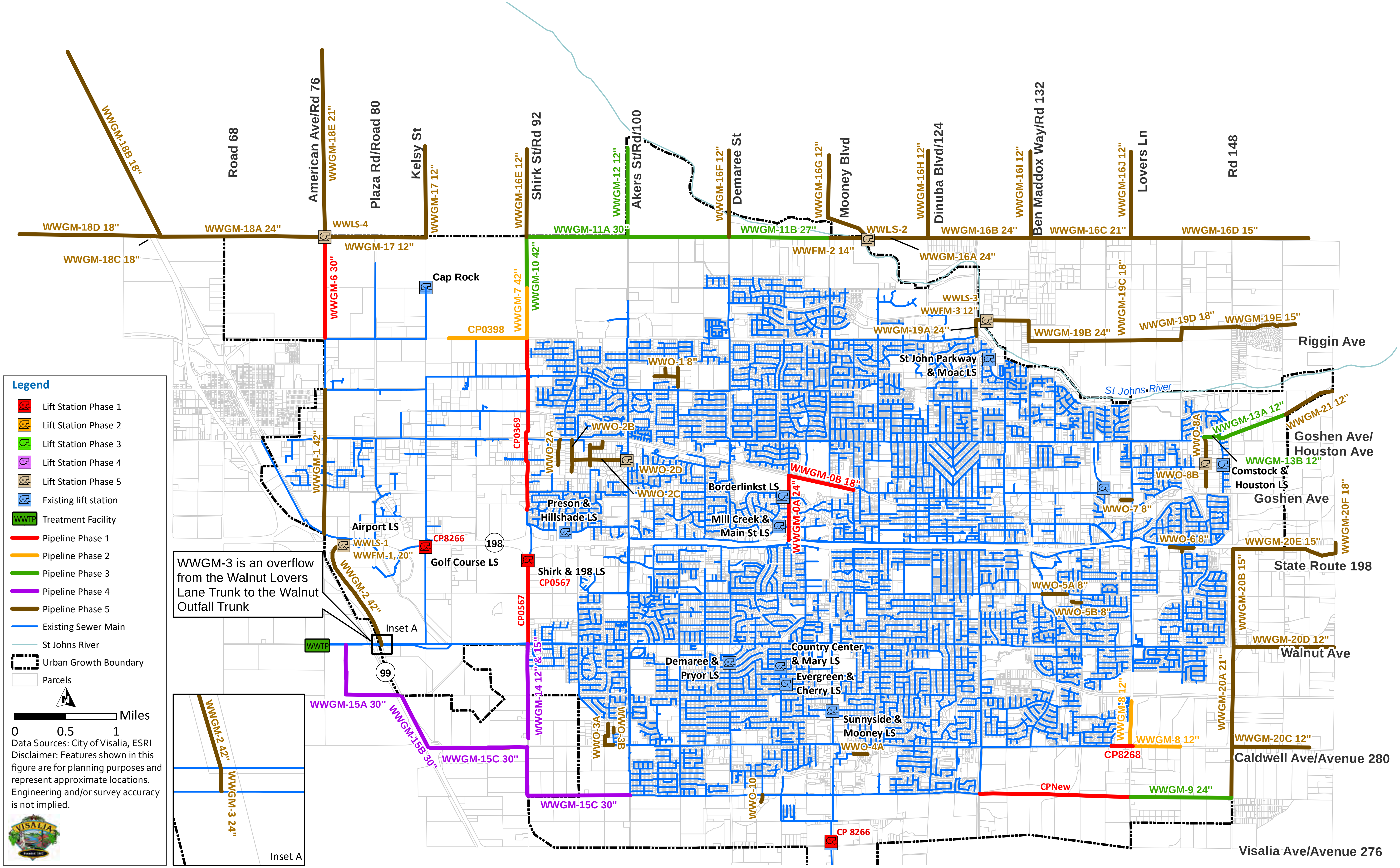

Figure 6.4 Project Phasing

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TABLE 6.5 WASTEWATER COLLECTION SYSTEM CAPITAL IMPROVEMENT PLAN PHASING

Project ID	Description/Street	Existing Size/Type	Proposed Size/Type	Proposed Amount	CIP Phasing: Phase 1 2026	2027	2028	2029	2030	Phase 2 2031-2035	Phase 3 2036-2040	Phase 4 2041-2045	Phase 5 2046 & beyond
Capacity Related Improvements													
Gravity Mains		Diameter (in)	Diameter (in)	Length (ft)									
WWGM-0A	North Ranch St./Visalia Country Club	18	24	3600					X				
WWGM-0B	West Goshen Avenue Pipeline Replacement	12	18	3200					X				
WWGM-1	North American Street	36	42	7,500									X
WWGM-2	Frontage Road	36	42	6,200									X
WWGM-3	Walnut Trunk Bypass	-	24	100									X
Lift Stations		Capacity (mgd)	Capacity (mgd)										
WWLS-1	Airport Lift Station	12.4	26	N/A									X
Force Main		Diameter (in)	Diameter (in)	Length (ft)									
WWFM-1	Airport Lift Station Force Main	-	21	100									X
New Service Related Improvements													
Gravity Mains		Diameter (in)	Diameter (in)	Length (ft)									
WWGM-6	American Street Trunk Extension	-	30	5,200			X						
WWGM-7	North Shirk Trunk Extension	-	42	2,600						X			
WWGM-8	South Lovers Lane Main	-	12	5,000						X			
WWGM-9	Visalia Parkway Trunk Extension	-	24	5,300							X		
WWGM-10	North Shirk Trunk Extension	-	42	2,700							X		
WWGM-11A	Avenue 320 Trunk	-	30	10,500							X		
WWGM-11B	Avenue 320 Trunk	-	27	5,200							X		
WWGM-12	North Akers Main	-	12	4,600							X		
WWGM-13A	Houston-Ivanhoe Main	-	12	3,600							X		
WWGM-13B	Houston-Ivanhoe Main	10	12	2,300							X		
WWGM-14A	South Shirk Main	-	12	3,600								X	
WWGM-14B	South Shirk Main	-	15	1,400								X	
WWGM-15A	Visalia Parkway Extension	-	30	5,700								X	
WWGM-15B	Visalia Parkway Extension	-	30/48	500								X	
WWGM-15C	Visalia Parkway Extension	-	30	10,300								X	
WWGM-16A	Avenue 320 Trunk Extension	-	27	5,300									X
WWGM-16B	Avenue 320 Trunk Extension	-	24	5,400									X
WWGM-16C	Avenue 320 Trunk Extension	-	21	5,300									X
WWGM-16D	Avenue 320 Trunk Extension	-	15	9,300									X
WWGM-16E	Avenue 320 Trunk Extension	-	12	4,500									X
WWGM-16F	Avenue 320 Trunk Extension	-	12	4,500									X
WWGM-16G	Avenue 320 Trunk Extension	-	12	5,700									X
WWGM-16H	Avenue 320 Trunk Extension	-	12	4,500									X
WWGM-16I	Avenue 320 Trunk Extension	-	12	4,500									X
WWGM-16J	Avenue 320 Trunk Extension	-	12	4,500									X
WWGM-17	Kelsey Street Main	-	12	10,000									X
WWGM-18A	Highway 99 - West Avenue 320 Trunk	-	24	8,000									X
WWGM-18B	Highway 99 - West Avenue 320 Trunk	-	18	11,000									X
WWGM-18C	Highway 99 - West Avenue 320 Trunk	-	18/30	1,000									X
WWGM-18D	Highway 99 - West Avenue 320 Trunk	-	18	6,400									X
WWGM-18E	Highway 99 - West Avenue 320 Trunk	-	21	9,800									X
WWGM-19A	East Riggin Extension Trunk	-	24	800									X
WWGM-19B	East Riggin Extension Trunk	-	24	6,000									X
WWGM-19C	East Riggin Extension Trunk	-	21	2,600									X
WWGM-19D	East Riggin Extension Trunk	-	18	5,800									X
WWGM-19E	East Riggin Extension Trunk	-	15	3,400									X
WWGM-20A	Road 148 Trunk	-	21	7,900									X

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TABLE 6.5 WASTEWATER COLLECTION SYSTEM CAPITAL IMPROVEMENT PLAN PHASING

					CIP Phasing								
					Phase 1					Phase 2	Phase 3	Phase 4	Phase 5
Project ID	Description/Street	Existing Size/Type	Proposed Size/Type	Proposed Amount	2026	2027	2028	2029	2030	2031-2035	2036-2040	2041-2045	2046 & beyond
WWGM-20B	Road 148 Trunk	-	15	5,100									X
WWGM-20C	Road 148 Trunk	-	12	4,000									X
WWGM-20D	Road 148 Trunk	-	12	5,000									X
WWGM-20E	Road 148 Trunk	-	15	5,400									X
WWGM-20F	Road 156 Trunk	-	15/30	500									X
WWGM-21	Houston-Ivanhoe Main Extension	-	12	2,800									X
Lift Stations		Capacity (mgd)	Capacity (mgd)										
WWLS-2	Avenue 320 Trunk Extension Lift Station	--	5	-									X
WWLS-3	East Riggin Extension Trunk	--	5	-									X
WWLS-4	West Avenue 320 Lift Station	--	9	-									X
Force Main		Diameter (in)	Diameter (in)	Length (ft)									
WWFM-2	Avenue 320 Trunk Extension Lift Station Force Main	-	14	1,900									X
WWFM-3	East Riggin Trunk Extension Lift Station Force Main	-	12	600									X
WWFM-4	West Avenue 320 Lift Station Force Main	-	21	100									X
Ongoing City Related Projects													
Sanitary Sewer		Diameter (in)	Diameter (in)	Length (ft)									
CP0369	Shirk Capacity Enhancement	-	48	8,200		X							
CP8268	Caldwell Avenue Widening	-	15	1,150		X							
CP0045	Shirk Street and Walnut Avenue	-	48	200			X						
CP9318	Sanitary Sewer Developer Reimbursement	-	-	-	X	X	X	X	X	X	X	X	
CP9234	Sewer Line Preliminary Engineering	-	-	-	X	X	X	X	X	X	X	X	
CP0567	Shirk Street Sanitary Sewer Trunkline	-	48	-			X	X	X				
CPNEW	Visalia Parkway Trunkline	-	30	-						X			
CP0398	Riggin widening- Kelsey to Shirk	-	15	4,000		X							
Other Projects													
WWO-1	Septic Removal by Sewer Extension	-	8.0	2,600									X
WWO-2A	Septic Removal by Sewer Extension	-	8.0	1,400									X
WWO-2B	Septic Removal by Sewer Extension	-	8.0	2,600									X
WWO-2C	Septic Removal by Sewer Extension	-	8.0	4,700									X
WWO-2D	Septic Removal by Sewer Extension	-	0.1	-									X
WWO-3A	Septic Removal by Sewer Extension	-	8.0	1,300									X
WWO-3B	Septic Removal by Sewer Extension	-	8.0	300									X
WWO-4	Septic Removal by Sewer Extension	-	8.0	800									X
WWO-5A	Septic Removal by Sewer Extension	-	8.0	1,300									X
WWO-5B	Septic Removal by Sewer Extension	-	8.0	500									X
WWO-6	Septic Removal by Sewer Extension	-	8.0	1,200									X
WWO-7	Septic Removal by Sewer Extension	-	8.0	600									X
WWO-8A	Septic Removal by Sewer Extension	-	8.0	2,600									X
WWO-8B	Septic Removal by Sewer Extension	-	0.05	-									X
WWO-9	Septic Removal by Sewer Extension	-	8.0	1,000									X
WWO-10	Septic Removal by Sewer Extension	-	8.0	400									X
WWO-11	Sewer Master Plan Update	-	-	-					X	X	X	X	

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Chapter 7

CAPITAL IMPROVEMENT PLAN

This chapter presents the City CIP, a summary of the capital costs, and a basic assessment of the possible financial impacts on the City. This chapter is organized to assist the City in making financial decisions. The CIP is based on the evaluation of the City's sanitary sewer collection system as described in Chapter 6.

7.1 Project Prioritization

As discussed in Chapter 6, the capital projects identified will allow the City to provide reliable service to its customers through buildout of Urban Development Boundary. A preliminary analysis was also performed for buildout of the Planning Area. The improvement projects were prioritized based on the following factors:

- Wastewater collection system improvements:
  - Reducing the risk on SSOs in the collection system.
  - Implementing projects to serve future growth.

Based on these factors, each project was assigned an implementation year. Critical projects were phased in the earlier phases (years) of the CIP. Less critical projects were phased into later phases of the CIP.

7.2 Capital Improvement Project Costs

The capacity upgrades and other system capital improvements set the foundation of the City's wastewater collection system CIPs. The cost estimates presented in this study are opinions developed from bid tabulations, cost curves, information obtained from previous studies, and Carollo's experience on other projects. The costs are based on an ENR Construction Cost Index 20-City Average of 13,782 (March 2025).

7.3 Cost Estimating Accuracy

The cost estimates presented in the CIPs have been prepared for general master planning purposes and for guidance in project evaluation and implementation. Final costs of a project will depend on actual labor and materials costs, competitive market conditions, final project scope, implementation schedule, and other variable factors such as preliminary alignment generation, investigation of alternative routings, and detailed utility and topography surveys.

The Association for the Advancement of Cost Engineering defines an Order of Magnitude Estimate, deemed appropriate for master plan studies, as an approximate estimate made without detailed engineering data. It is normally expected that an estimate of this type would be accurate within plus 50 percent to minus 30 percent. This section presents the assumptions used in developing order of magnitude cost estimates for recommended facilities.

7.4 Construction Unit Costs

The construction costs are representative of water distribution system facilities, sewer collection system facilities, and storm drainage facilities under normal construction conditions and schedules. Costs have been estimated for public works construction.

7.4.1 Pipeline Unit Costs

This section summarizes the unit costs for wastewater collection pipelines. All of the unit costs presented in this section include pipeline costs, excavation, and other appurtenances (e.g., valves, manholes, etc.)

7.4.1.1 Wastewater Collection System Pipelines

Sewer pipeline improvements range in size from 12 inches to 42 inches in diameter in this study. Unit costs for the construction of pipelines and appurtenances (e.g., manholes) are shown in Table 7.1. The construction cost estimates are based upon these unit costs. The unit costs are for "typical" field conditions with construction in stable soil at a depth ranging between 10 feet to 15 feet.

Table 7.1 Sewer Pipeline Unit Costs

Pipe Size (inches)	Replacement Unit Construction Cost(1) ($/linear foot)
Gravity Main Unit Costs	
12	$285
15	$315
18	$345
21	$390
24	$435
27	$475
30	$520
36	$605
42	$705
Force Main Unit Costs	
6	$252
8	$252
10	$270
12	$276
14	$282
18	$287
21	$346
24	$463

Notes:
(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

7.4.2 Lift Station Unit Cost

The estimated costs for projects to increase the pumping capacity of a lift station assume complete replacement of the lift station. Lift station cost estimates are based on a rate of $0.60 per gallon.

7.4.3 Baseline Construction Cost

Baseline Construction Cost is the total estimated construction cost, in dollars, of the proposed improvements for pipelines, lift stations, and force mains. Baseline Construction Costs were developed using the following criteria:

- Pipelines/Force Mains: Calculated by multiplying the estimated length by the unit cost.
- Lift Stations: Calculated by multiplying the estimated total capacity in gallons by the unit cost.

7.4.4 Estimated Construction Cost

Contingency costs must be reviewed on a case-by-case basis because they will vary considerably with each project. Consequently, it is appropriate to allow for uncertainties associated with the preliminary layout of a project. Factors such as unexpected construction conditions, the need for unforeseen mechanical items, and variations in final quantities are a few of the items that can increase project costs for which it is wise to make allowances in preliminary estimates. To assist the City in making financial decisions for these future construction projects, contingency costs will be added to the planning budget as percentages of the total construction cost, divided into two categories—Estimated Construction Cost and Capital Improvement Cost.

Since knowledge about site-specific conditions of each proposed project is limited at the master planning stage, a 30 percent contingency was applied to the Baseline Construction Cost to account for unforeseen events and unknown conditions. A 30 percent contingency was used to account for unknown site conditions such as unforeseen conditions, environmental mitigations, and other unknowns is typical for master planning projects.

7.4.5 Capital Improvement Cost

Other project construction contingency costs include costs associated with project engineering, construction phase professional services, and project administration. Engineering services associated with new facilities include preliminary investigation and reports, right-of-way acquisition, foundation explorations, preparation of drawings and specifications during construction, surveying and staking, sampling of testing material, and start-up services. Construction phase professional services cover items such as construction management, engineering services, materials testing, and inspection during construction. Finally, there are project administration costs, which cover items such as legal fees, environmental/California Environmental Quality Act compliance requirements, financing expenses, administrative costs, and interest during construction.

The cost of these items can vary, but for the purpose of this study, it is assumed that the other project contingency costs will equal approximately 27.5 percent of the Estimated Construction Cost.

As shown in the following simple calculation of the Capital Improvement Cost, the total cost of all project construction contingencies (construction, engineering services, construction management, and project administration) is 65.8 percent of the Baseline Construction Cost. Note that contingencies were not applied to land acquisition costs. Calculation of the 65.8 percent is the overall mark-up on the Baseline Construction Cost to arrive at the Capital Improvement Cost. It is not an additional contingency.

Example:

Baseline Construction Cost	**$1,000,000**
Construction Contingency (30%)	$300,000
Estimated Construction Cost	**$1,300,000**
Engineering Cost (10%)	$130,000
Construction Management (10%)	$130,000
Project Administration (7.5%)	$97,500
Capital Improvement Cost	**$1,657,500**

7.5 Capital Improvement Project Implementation

The proposed capital improvements are prioritized based on their urgency to mitigate existing deficiencies and other factors. The capital improvements were phased into one of the following phases:

- Phase 1 Projects (2026 - 2030): Improvements targeted for Phase 1 include projects to address existing capacity deficiencies and projects identified by the City. These include pipeline capacity improvements, rehabilitation projects, and pump replacements.
- Phase 2 Projects (2031 - 2035): Improvements targeted for Phase 2 include projects to address buildout of UGB Tier 1, buildout of Tier 2, and City identified projects.
- Phase 3 Projects (2036 - 2040): Improvements targeted for Phase 3 include projects to address buildout of UGB Tier 3.
- Phase 4 Projects (2041 - 2045): Improvements targeted for Phase 4 include projects to address buildout of UGB Tier 3 and buildout of SOI.
- Phase 5 Projects (2046 And Beyond): Improvements targeted for Phase 5 include projects to address buildout of the Planning Area.

A summary of the capital project costs is presented in Table 7.2. This table identifies the projects, provides a brief description of the project, identifies facility size (e.g., pipe diameter and length), and provides capital improvement cost. The table also shows the probable phase in which the project would be implemented. The implementation timeframe was based on the priority of each project to correct existing deficiencies or to serve future users. Detailed improvement sheets can be found in Appendix F. The columns used in Table 7.2 refer to the following (existing user cost versus future user cost explained in Section 7.5.1):

- Project ID: Assigned number that corresponds to the Proposed Improvement Table. This is an alphanumeric number that starts with identifying letter indicating the type of improvement (WWGM = Sewer Gravity Main; WWLS = Sewer Lift Station; WWFM = Sewer Force Main; WWRR = Sewer Rehabilitation/Replacement) and continues with a number.
- Description/Street: Street in which the improvement is proposed.

- Existing Size/Type: This is the size of the existing pipeline/facility. It represents the diameter of the existing pipelines (in inches) or the size of the facility (e.g., storage tanks in million gallons, size of booster stations in gpm, etc.).
- Proposed Size/Type: This is the size of the proposed improvement. It represents the diameter of the proposed pipeline (in inches) or the size of the proposed facility.
- Replace/New: Indicates whether the proposed improvement is a replacement pipeline, parallel pipeline, or a new facility.
- Length: Estimated length of the proposed improvement (in feet), if applicable. It should be noted that the length estimates do not account for re-routing the alignments to avoid unknown conditions.
- CIP Phasing: This is an estimated improvement project start year.

The projects listed in Table 7.2 are organized by capacity related improvements, new service related improvements, City related projects, and others. Capacity improvements are recommended to mitigate capacity deficiencies, while new service projects are to address new growth as the City expands. City related projects are identified in the City's CIP and limited to the collection system. Other projects include additional recommendations to update the Master Plan every five years.

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TABLE 7.2 WASTEWATER COLLECTION SYSTEM CAPITAL IMPROVEMENT PLAN SUMMARY

Project ID	Description/Street	Existing Size/Type	Proposed Size/Type	Proposed Amount	CIP Cost Estimate(1)(2)(3)(4) ($)	Existing User Cost ($)	Future User Cost ($)	CIP Phasing ($)								
								Phase 1					Phase 2	Phase 3	Phase 4	Phase 5
								2026	2027	2028	2029	2030	2031-2035	2036-2040	2041-2045	2046 & beyond
Capacity Related Improvements					$ 47,777,000	$ 6,276,000	$ 41,501,000	$ 6,276,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 41,501,000
Gravity Mains		Diameter (in)	Diameter (in)	Length (ft)	$ 22,359,000	$ 6,276,000	$ 16,083,000	$ 6,276,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,083,000
WWGM-0A	North Ranch St./Visalia Country Club	18	24	3,400	$ 3,776,000	$ 3,776,000	$ -	$ 3,776,000	$ -	$ -	$ -	$ -	$ -	$ -		$ -
WWGM-0B	West Goshen Avenue Pipeline Replacement	12	18	3,200	$ 2,500,000	$ 2,500,000	$ -	$ 2,500,000	$ -	$ -	$ -	$ -	$ -	$ -		$ -
WWGM-1	North American Street	36	42	7,500	$ 8,765,000	$ -	$ 8,765,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ 8,765,000
WWGM-2	Frontage Road	36	42	6,200	$ 7,245,000	$ -	$ 7,245,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ 7,245,000
WWGM-3	Walnut Trunk Bypass	-	24	100	$ 73,000	$ -	$ 73,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ 73,000
Lift Stations		Capacity (mgd)	Capacity (mgd)		$ 25,360,000	$ -	$ 25,360,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ 25,360,000
WWLS-1	Airport Lift Station	12.4	25.5 mgd	N/A	$ 25,360,000	$ -	$ 25,360,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ 25,360,000
Force Main		Diameter (in)	Diameter (in)	Length (ft)	$ 58,000	$ -	$ 58,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ 58,000
WWFM-1	Airport Lift Station Force Main	-	21	100	$ 58,000	$ -	$ 58,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -		$ 58,000
New Service Related Improvements					$ 159,836,000	$ -	$ 159,836,000	$ -	$ -	$ 4,482,000	$ -	$ -	$ 5,400,000	$ 25,083,000	$ 22,664,000	$ 102,207,000
Gravity Mains		Diameter (in)	Diameter (in)	Length (ft)	$ 139,822,000	$ -	$ 139,822,000	$ -	$ -	$ 4,482,000	$ -	$ -	$ 5,400,000	$ 25,083,000	$ 22,664,000	$ 82,193,000
WWGM-6	American Street Trunk Extension	-	30	5,200	$ 4,482,000	$ -	$ 4,482,000	$ -	$ -	$ 4,482,000	$ -	$ -	$ -	$ -	$ -	$ -
WWGM-7	North Shirk Trunk Extension	-	42	2,600	$ 3,038,000	$ -	$ 3,038,000	$ -	$ -	$ -	$ -	$ -	$ 3,038,000	$ -	$ -	$ -
WWGM-8	South Lovers Lane Main	-	12	5,000	$ 2,362,000	$ -	$ 2,362,000	$ -	$ -	$ -	$ -	$ -	$ 2,362,000	$ -	$ -	$ -
WWGM-9	Visalia Parkway Trunk Extension	-	24	5,300	$ 3,822,000	$ -	$ 3,822,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,822,000	$ -	$ -
WWGM-10	North Shirk Trunk Extension	-	42	2,700	$ 3,156,000	$ -	$ 3,156,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,156,000	$ -	$ -
WWGM-11A	Avenue 320 Trunk	-	30	10,500	$ 9,050,000	$ -	$ 9,050,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,050,000	$ -	$ -
WWGM-11B	Avenue 320 Trunk	-	27	5,200	$ 4,094,000	$ -	$ 4,094,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,094,000	$ -	$ -
WWGM-12	North Akers Main	-	12	4,600	$ 2,173,000	$ -	$ 2,173,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,173,000	$ -	$ -
WWGM-13A	Houston-Ivanhoe Main	-	12	3,600	$ 1,701,000	$ -	$ 1,701,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,701,000	$ -	$ -
WWGM-13B	Houston-Ivanhoe Main	10	12	2,300	$ 1,087,000	$ -	$ 1,087,000	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,087,000	$ -	$ -
WWGM-14A	South Shirk Main	-	12	3,600	$ 1,701,000	$ -	$ 1,701,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,701,000	$ -
WWGM-14B	South Shirk Main	-	15	1,400	$ 731,000	$ -	$ 731,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 731,000	$ -
WWGM-15A	Visalia Parkway Extension	-	30	5,700	$ 4,913,000	$ -	$ 4,913,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,913,000	$ -
WWGM-15B	Visalia Parkway Extension	-	30/48	500	$ 2,267,000	$ -	$ 2,267,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,267,000	$ -
WWGM-15C	Visalia Parkway Extension	-	30	10,300	$ 8,878,000	$ -	$ 8,878,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,878,000	$ -
WWGM-16A	Avenue 320 Trunk Extension	-	27	5,300	$ 4,174,000	$ -	$ 4,174,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,174,000	$ -
WWGM-16B	Avenue 320 Trunk Extension	-	24	5,400	$ 3,893,000	$ -	$ 3,893,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,893,000
WWGM-16C	Avenue 320 Trunk Extension	-	21	5,300	$ 3,426,000	$ -	$ 3,426,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,426,000
WWGM-16D	Avenue 320 Trunk Extension	-	15	9,300	$ 4,856,000	$ -	$ 4,856,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,856,000
WWGM-16E	Avenue 320 Trunk Extension	-	12	4,500	$ 2,127,000	$ -	$ 2,127,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,127,000
WWGM-16F	Avenue 320 Trunk Extension	-	12	4,500	$ 2,127,000	$ -	$ 2,127,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,127,000
WWGM-16G	Avenue 320 Trunk Extension	-	12	5,700	$ 2,693,000	$ -	$ 2,693,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,693,000
WWGM-16H	Avenue 320 Trunk Extension	-	12	4,500	$ 2,127,000	$ -	$ 2,127,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,127,000
WWGM-16I	Avenue 320 Trunk Extension	-	12	4,500	$ 2,127,000	$ -	$ 2,127,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,127,000
WWGM-16J	Avenue 320 Trunk Extension	-	12	4,500	$ 2,127,000	$ -	$ 2,127,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,127,000
WWGM-17	Kelsey Street Main	-	12	10,000	$ 4,724,000	$ -	$ 4,724,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,724,000
WWGM-18A	Highway 99 - West Avenue 320 Trunk	-	24	8,000	$ 5,768,000	$ -	$ 5,768,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,768,000
WWGM-18B	Highway 99 - West Avenue 320 Trunk	-	18	11,000	$ 6,290,000	$ -	$ 6,290,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,290,000
WWGM-18C	Highway 99 - West Avenue 320 Trunk	-	18/30	1,000	$ 1,417,000	$ -	$ 1,417,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,417,000
WWGM-18D	Highway 99 - West Avenue 320 Trunk	-	18	6,400	$ 3,660,000	$ -	$ 3,660,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,660,000
WWGM-18E	Highway 99 - West Avenue 320 Trunk	-	21	9,800	$ 6,335,000	$ -	$ 6,335,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,335,000
WWGM-19A	East Riggin Extension Trunk	-	24	800	$ 577,000	$ -	$ 577,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 577,000
WWGM-19B	East Riggin Extension Trunk	-	24	6,000	$ 4,326,000	$ -	$ 4,326,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,326,000
WWGM-19C	East Riggin Extension Trunk	-	21	2,600	$ 1,681,000	$ -	$ 1,681,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,681,000
WWGM-19D	East Riggin Extension Trunk	-	18	5,800	$ 3,317,000	$ -	$ 3,317,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,317,000
WWGM-19E	East Riggin Extension Trunk	-	15	3,400	$ 1,775,000	$ -	$ 1,775,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,775,000
WWGM-20A	Road 148 Trunk	-	21	7,900	$ 5,107,000	$ -	$ 5,107,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,107,000
WWGM-20B	Road 148 Trunk	-	15	5,100	$ 2,664,000	$ -	$ 2,664,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,664,000
WWGM-20C	Road 148 Trunk	-	12	4,000	$ 1,890,000	$ -	$ 1,890,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,890,000
WWGM-20D	Road 148 Trunk	-	12	5,000	$ 2,362,000	$ -	$ 2,362,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,362,000
WWGM-20E	Road 148 Trunk	-	15	5,400	$ 2,819,000	$ -	$ 2,819,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,819,000
WWGM-20F	Road 156 Trunk	-	15/30	500	$ 655,000	$ -	$ 655,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 655,000
WWGM-21	Houston-Ivanhoe Main Extension	-	12	2,800	$ 1,323,000	$ -	$ 1,323,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,323,000

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TABLE 7.2 WASTEWATER COLLECTION SYSTEM CAPITAL IMPROVEMENT PLAN SUMMARY

Project ID	Description/Street	Existing Size/Type	Proposed Size/Type	Proposed Amount	CIP Cost Estimate[(1)(2)(3)(4)] ($)	Existing User Cost ($)	Future User Cost ($)	CIP Phasing ($)								
								Phase 1					Phase 2	Phase 3	Phase 4	Phase 5
								2026	2027	2028	2029	2030	2031-2035	2036-2040	2041-2045	2046 & beyond
Lift Stations		Capacity (mgd)	Capacity (mgd)		$ 18,796,000	$ -	$ 18,796,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18,796,000
WWLS-2	Avenue 320 Trunk Extension Lift Station	--	5.4 mgd	-	$ 5,370,000	$ -	$ 5,370,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,370,000
WWLS-3	East Riggin Extension Trunk	--	4.5 mgd	-	$ 4,475,000	$ -	$ 4,475,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,475,000
WWLS-4	West Avenue 320 Lift Station	--	9. mgd	-	$ 8,951,000	$ -	$ 8,951,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,951,000
Force Main		Diameter (in)	Diameter (in)	Length (ft)	$ 1,218,000	$ -	$ 1,218,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,218,000
WWFM-2	Avenue 320 Trunk Extension Lift Station Force Main	-	14	1,900	$ 887,000	$ -	$ 887,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 887,000
WWFM-3	East Riggin Trunk Extension Lift Station Force Main	-	12	600	$ 273,000	$ -	$ 273,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 273,000
WWFM-4	West Avenue 320 Lift Station Force Main	-	21	100	$ 58,000	$ -	$ 58,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 58,000
Ongoing City Related Projects					$ 27,854,000	$ 2,627,000	$ 25,227,000	$ -	$ 3,858,000	$ 4,558,000	$ 3,660,000	$ 3,660,000	$ 10,592,000	$ 763,000	$ 763,000	$ -
Sanitary Sewer		Diameter (in)	Diameter (in)	Length (ft)	$ 27,854,000	$ 2,627,000	$ 25,227,000	$ -	$ 3,858,000	$ 4,558,000	$ 3,660,000	$ 3,660,000	$ 10,592,000	$ 763,000	$ 763,000	$ -
CP0369	Shirk Capacity Enhancement	-	48	8,200	$ 3,402,000	$ 782,000	$ 2,620,000		$ -	$ 3,402,000	$ -	$ -	$ -	$ -	$ -	$ -
CP8268	Caldwell Avenue Widening	-	15	1,150	$ 919,000	$ -	$ 919,000		$ 919,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
CP0045	Shirk Street and Walnut Avenue	-	48	200	$ 551,000	$ 126,000	$ 425,000		$ -	$ 551,000	$ -	$ -	$ -	$ -	$ -	$ -
CP9318	Sanitary Sewer Developer Reimbursement	-	-	-	$ 2,451,000	$ -	$ 2,451,000		$ 129,000	$ 129,000	$ 129,000	$ 129,000	$ 645,000	$ 645,000	$ 645,000	$ -
CP9234	Sewer Line Preliminary Engineering	-	-	-	$ 450,000	$ 3,000	$ 447,000		$ 24,000	$ 24,000	$ 24,000	$ 24,000	$ 118,000	$ 118,000	$ 118,000	$ -
CP0567	Shirk Street Sanitary Sewer Trunkline	-	48	-	$ 7,466,000	$ 1,716,000	$ 5,750,000		$ -	$ 452,000	$ 3,507,000	$ 3,507,000	$ -	$ -	$ -	$ -
CPNEW	Visalia Parkway Trunkline	-	30	-	$ 9,829,000	$ -	$ 9,829,000		$ -	$ -	$ -	$ -	$ 9,829,000	$ -	$ -	$ -
CP0398	Riggin widening- Kelsey to Shirk	-	15	4,000	$ 2,786,000	$ -	$ 2,786,000		$ 2,786,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other Projects					$ 9,843,000	$ 619,000	$ 9,224,000	$ -	$ -	$ -	$ -	$ 309,000	$ 309,000	$ 309,000	$ 309,000	$ 8,607,000
WWO-1	Septic Removal by Sewer Extension	-	8.0	2,600	$ 1,034,000	$ -	$ 1,034,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,034,000
WWO-2A	Septic Removal by Sewer Extension	-	8.0	1,400	$ 557,000	$ -	$ 557,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 557,000
WWO-2B	Septic Removal by Sewer Extension	-	8.0	2,600	$ 1,034,000	$ -	$ 1,034,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,034,000
WWO-2C	Septic Removal by Sewer Extension	-	8.0	4,700	$ 1,870,000	$ -	$ 1,870,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,870,000
WWO-2D	Septic Removal by Sewer Extension	-	0.06 mgd	-	$ 62,000	$ -	$ 62,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 62,000
WWO-3A	Septic Removal by Sewer Extension	-	8.0	1,300	$ 517,000	$ -	$ 517,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 517,000
WWO-3B	Septic Removal by Sewer Extension	-	8.0	300	$ 119,000	$ -	$ 119,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 119,000
WWO-4	Septic Removal by Sewer Extension	-	8.0	800	$ 318,000	$ -	$ 318,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 318,000
WWO-5A	Septic Removal by Sewer Extension	-	8.0	1,300	$ 517,000	$ -	$ 517,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 517,000
WWO-5B	Septic Removal by Sewer Extension	-	8.0	500	$ 199,000	$ -	$ 199,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 199,000
WWO-6	Septic Removal by Sewer Extension	-	8.0	1,200	$ 477,000	$ -	$ 477,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 477,000
WWO-7	Septic Removal by Sewer Extension	-	8.0	600	$ 239,000	$ -	$ 239,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 239,000
WWO-8A	Septic Removal by Sewer Extension	-	8.0	2,600	$ 1,034,000	$ -	$ 1,034,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,034,000
WWO-8B	Septic Removal by Sewer Extension	-	0.05 mgd	-	$ 45,000	$ -	$ 45,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 45,000
WWO-9	Septic Removal by Sewer Extension	-	8.0	1,000	$ 418,000	$ -	$ 418,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 418,000
WWO-10	Septic Removal by Sewer Extension	-	8.0	400	$ 167,000	$ -	$ 167,000	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 167,000
WWO-11	Sewer Master Plan Update	-	-	-	$ 1,236,000	$ 619,000	$ 617,000	$ -	$ -	$ -	$ -	$ 309,000	$ 309,000	$ 309,000	$ 309,000	$ -
CIP Total					**$ 245,310,000**	**$ 9,522,000**	**$ 235,788,000**	**$ 6,276,000**	**$ 3,858,000**	**$ 9,040,000**	**$ 3,660,000**	**$ 3,969,000**	**$ 16,301,000**	**$ 26,155,000**	**$ 23,736,000**	**$ 152,315,000**
Annual Cost					**N/A**	**N/A**	**N/A**	**$ 6,276,000**	**$ 3,858,000**	**$ 9,040,000**	**$ 3,660,000**	**$ 3,969,000**	**$ 3,260,000**	**$ 5,231,000**	**$ 4,747,000**	**N/A**

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

(4) Total Mark-Up is 65.8% of the baseline construction costs.

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7.5.1 Existing Versus Future User Cost Share

Improvement costs within this study can be categorized as beneficial to existing users or future users, with some of the costs distributed between both categories. Costs are assigned to existing users if the improvement is related to an existing deficiency. Existing projects also benefit future users, which are assigned a portion of the cost. Projects that solely benefit future users such as new development or projects due to future users will be assigned 100 percent of the cost. For Visalia, existing user costs are also referred to as "operational costs" and future user costs are referred to as "development related." For the purposes of this Master Plan, "existing user costs" and "operational costs" are interchangeable, as are "future user costs" and "development related costs."

The hydraulic modeling results were used to determine the ratio of existing average flows and future average flows. With the ratio, project costs are divided between existing and future users. For example, the Shirk Capacity Project (CP0369) will convey flows from existing users and flows from future users. Cost was assigned based on the percentage of total flows contributed by existing users and future users. Capacity projects created by future users are assigned to future customers.

Projects assigned to existing users include City related projects for the Shirk capacity enhancement and master plan updates. Shirk capacity projects replace existing infrastructure required to serve existing users and will increase capacity for future users. Future master planning is a benefit to existing and future users.

A summary of existing and future user cost share for the proposed projects by phase is summarized in Table 7.3, while Table 7.4 summarizes user cost by project type.

Table 7.3 Sanitary Sewer CIP Cost by Reimbursement Category

Reimbursement Category	Phase 1 (2026-2030) ($)	Phase 2 (2031-2035) ($)	Phase 3 (2036-2040) ($)	Phase 4 2041-2045 ($)	Phase 5 2046-Beyond ($)	Total ($)
Existing Users	$9,054,000	$155,000	$155,000	$155,000	$-	$9,519,000
Future Users	$17,749,000	$16,147,000	$26,001,000	$23,582,000	$152,315,000	$235,794,000
Total	$26,803,000	$16,302,000	$26,156,000	$23,737,000	$152,315,000	$245,313,000

Table 7.4 Sanitary Sewer CIP Cost by Project Type and Reimbursement Category

Project Type	Existing User ($)	Future User ($)	Total ($)
Capacity Improvements			
Gravity Mains	$6,276,000	$16,083,000	$22,359,000
Lift Stations	$-	$25,360,000	$25,360,000
Force Mains	$-	$58,000	$58,000
Subtotal	**$6,276,000**	**$41,501,000**	**$47,777,000**
New Service Related Improvements			
Gravity Mains	$-	$139,822,000	$139,822,000
Lift Stations	$-	$18,796,000	$18,796,000
Force Mains	$-	$1,218,000	$1,218,000
Subtotal	**$-**	**$159,836,000**	**$159,836,000**
City Related Projects			
Ongoing Projects	$2,627,000	$25,227,000	$27,854,000
Other Projects			
Sewer Master Plan Update	$619,000	$617,000	$1,236,000
Septic Removal by Sewer Extension	$-	$8,607,000	$8,607,000
Subtotal	**$619,000**	**$9,224,000**	**$9,843,000**
Total	**$9,522,000**	**$235,788,000**	**$245,310,000**

Notes:
(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.
(2) Estimated construction cost includes a 30 percent contingency of the baseline construction cost.
(3) Total project costs includes a 10 percent markup for engineering, a 10 percent markup for construction management, and a 7.5 percent markup for project administration of the estimated construction cost.
(4) Total markup is 65.8 percent of the baseline construction cost.

7.6 Summary

A summary of the CIP costs is provided in Table 7.5 and Figure 7.1 which show the distribution of capital costs by project type. As shown in Table 7.5, out of the total $245.3 million in capital projects, $26.8 million is targeted for implementation in Phase 1 (2026-2030), and another $16.3 million is targeted for Phase 2 (2031-2035). Phase 3 projects (2036-2040) account for $26.2 million and Phase 4 (2041-2045) projects account for $23.7 million.

Table 7.5 Sanitary Sewer Collection System CIP Summary

Improvement Type	CIP Cost Estimate(1)(2)(3)(4) ($)	Project Cost Phasing ($)				
		2026 - 2030	2031-2035	2036-2040	2041 - 2045	2046 & Beyond
Capacity Improvement						
Gravity Mains	$22,359,000	$6,276,000	$-	$-		$16,083,000
Lift Stations	$25,360,000	$-	$-	$-		$25,360,000
Force Mains	$58,000	$-	$-	$-		$58,000
Capacity Subtotal	**$47,777,000**	**$6,276,000**	**$-**	**$-**		**$41,501,000**
New Service Related Improvements						
Gravity Mains	$139,822,000	$4,482,000	$5,400,000	$25,083,000	$22,664,000	$82,193,000
Lift Station	$18,796,000	-	$-	-	$-	$18,796,000
Force Main	$1,218,000	-	$-	-	$-	$1,218,000
New Service Subtotal	**$159,836,000**	**$4,482,000**	**$5,400,000**	**$25,083,000**	**$22,664,000**	**$102,207,000**
City Related Projects						
Ongoing Projects	$27,854,000	$15,736,000	$10,592,000	$763,000	$763,000	-
Other Projects						
Sewer Master Plan Update	$1,236,000	$309,000	$309,000	$309,000	$309,000	$-
Septic Removal by Sewer Extension	$8,607,000	$-	$-	$-	$309,000	$8,607,000
Other Projects Subtotal	**$9,843,000**	**$309,000**	**$309,000**	**$309,000**	**$618,000**	**$8,607,000**
Total CIP	**$245,310,000**	**$26,803,000**	**$16,301,000**	**$26,155,000**	**$24,045,000**	**$152,315,000**

Notes:
(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.
(2) Estimated construction cost includes a 30 percent contingency of the baseline construction cost.
(3) Total project costs includes a 10 percent markup for engineering, a 10 percent markup for construction management, and a 7.5 percent markup for project administration of the estimated construction cost.
(4) Total markup is 65.8 percent of the baseline construction cost.

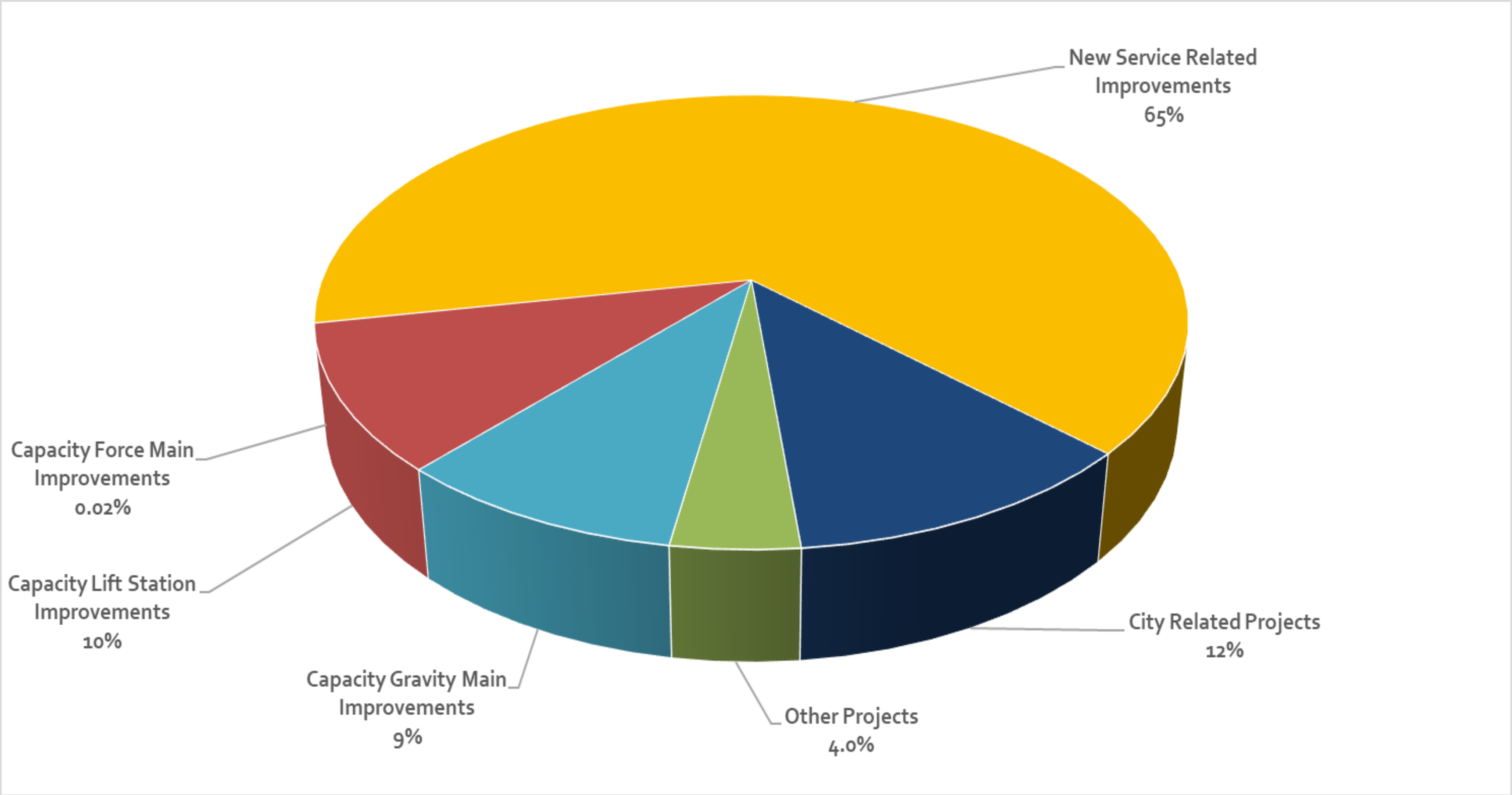

Figure 7.1 Sanitary Sewer Collection System CIP by Project Type

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APPENDIX A LAND USE CLASIFICATION

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with General Plan policies to be and/or site conditions may reduce development potential within the stated ranges.

Table 2-3 summarizes the density and intensity ranges of the land use categories. More detailed characteristics of each land use category are described in the next section.

Land Use Classifications

The land use designations shown in the General Plan Land Use Diagram provide the basis for new development. They are generally broad in scope, in order to provide flexibility while creating a vibrant and varied urban environment. The classifications are organized into five categories: Residential, Mixed Use, Commercial/Office, Industrial, and Public.

Residential

Very Low Density Residential. This designation is intended to provide for single family detached housing on large lots. Residential densities are typical of rural residential environments. The typical residential density for this designation ranges from 0.1 to two housing units per gross acre. Buildout is assumed at two units per gross acre.

Low Density Residential. This designation is intended to provide for single family detached housing. Residential densities are typical of single-family subdivisions. The typical residential density for this designation ranges from two to 10 housing units per gross acre. Buildout is assumed at four units per gross acre.

Medium Density Residential. This designation can accommodate a mix of housing types, from small-

Table 2-3: Density and Intensity Standards by Land Use Classification

		Intensity	
Land Use Classification	*Density (DU / gross acre)*	*Minimum FAR*	*Maximum FAR*[2]
Residential			
Very Low Density Residential	0.1 to 2	–	–
Low Density Residential	2 to 10	–	–
Medium Density Residential	10 to 15	–	–
High Density Residential	15 to 35	–	–
Mixed Use[1]			
Commercial Mixed Use	Up to 35	0.25	2.0
Downtown Mixed Use	Minimum 20	1.0, including 0.25 Retail	5.0
Commercial and Office			
General/Service Commercial	–	–	0.6
Regional Commercial	–	–	0.6
Neighborhood Commercial	10 to 15	NA[3]	NA[3]
Office	–	–	1.0
Industrial			
Light Industrial	–	–	0.5
Business Research Park	–	–	0.5
Industrial	–	–	0.6

(1) Mixed Use designations do not require residential use, but when residential uses are provided, minimum densities apply. Minimum ground floor retail FAR of 0.25 is required for sites designated Downtown Mixed Use.

(2) Maximum FAR refers to non-residential and residential floor area combined.

(3) Intensity limits to be set by two story height limits and coverage standards in the zoning ordinance.

Source: Dyett & Bhatia, 2011

Residential land use classifications allow housing at a variety of densities and configurations.

lot starter homes, zero-lot-line developments, and duplexes, to townhouses and garden apartments. Pedestrian-oriented design and clustering can support higher density. The typical residential density for this designation ranges from 10 to 15 housing units per gross acre. Buildout is assumed at 10 units per gross acre.

High Density Residential. This designation is intended to accommodate attached homes, two- to four-plexes, and apartment buildings. High density residential development is typically found at neighborhood centers and along corridors. The typical residential density for this designation ranges from 15 to 35 housing units per gross acre. Buildout is assumed at 16.5 units per gross acre.

Mixed Use

Downtown Mixed Use. This new designation characterizes development in the Downtown Core and replaces the existing Central Business District designation in the General Plan. It permits the highest density and intensity of development in the city in order to keep Downtown a vibrant, walkable environment. Vertical mixed use is strongly encouraged. Commercial, personal service, office, and residential uses are allowed. The typical residential density for this designation ranges from 20 to 35 housing units per gross acre. Buildout is assumed at 20 units per gross acre for residential uses and 0.5 FAR for non-residential uses. The maximum allowable combined FAR is 5.0.

Commercial Mixed Use. This new designation allows for either horizontal or vertical mixed use development, and permits commercial, service, office, and residential uses. Any combination of these uses, including a single use, is permitted. This designation is found both at key activity nodes and along corridors, including locations currently designated Shopping/Office Commercial or Community Center. Residential density for this designation is permitted at up to 35 housing units per gross acre; buildout is assumed at 12.5 units per gross acre for residential uses. Allowable FAR ranges from 0.25 to 2.0, with buildout assumed at 0.25. The maximum allowable combined FAR for all uses is 2.0.

Commercial and Office

Neighborhood Commercial. This new designation builds on the existing Neighborhood Center and Convenience Center designations in the General Plan, by also permitting residential uses. It provides for small-scale commercial development that primarily serves local neighborhoods such as convenience shopping and small offices. Horizontal or vertical residential mixed use is also permitted. Typical FAR for commercial uses is assumed at 0.25; actual intensity limits are to be set by two story height limits and coverage standards in the zoning ordinance. Residential uses ranging from 10 to 15 housing units per gross acre are also allowed, but are not assumed in the buildout.

Service Commercial. This new designation builds on the existing General Plan's Service Commercial designation. It is intended for a range of retail and service uses that meet local and regional demand, such as auto sales and repair, storage facilities, equipment rental, wholesale businesses, and retail not typically located in shopping centers. Ancillary office spaces that support commercial development are also allowed. Maximum FAR for this designation is 0.8; buildout is assumed at 0.3.

Regional Commercial. This new land use designation is similar to the existing Regional Center use in the General Plan, and also incorporates areas previously designated Highway Commercial. It is intended to accommodate retail establishments that serve residents and businesses of the region at large. Shopping malls, large format, or "big-box" retail are allowed, as are supporting uses such as gas stations and hotels. Maximum FAR for this designation is 0.6; buildout is assumed at 0.25.

Office. This designation is intended for office complex development, including medical offices. General office uses also include administrative, financial, business, and professional operations. Ancillary supporting uses, such as restaurants, copy shops, and convenience retail, are also permitted. Maximum FAR for this designation is 1.0; buildout is assumed at 0.35.

Industrial

Business Research Park. This designation builds on the existing General Plan's Business Research Park category and emphasizes research and development uses. Land with this designation is intended for research and development enterprises, educational, and office (limited customer access) uses. Maximum FAR for this designation is 0.5; buildout is assumed at 0.1.

Light Industrial. Land with this designation is intended for light manufacturing, warehousing, storage, distribution, research and development enterprises, and secondary office (limited customer access) uses. Maximum FAR for this designation is 0.5; buildout is assumed at 0.2.

Industrial. This designation allows primary manufacturing, processing, refining, and similar activities including those with outdoor facilities. It also accommodates warehousing and distribution with supporting commercial services and office space. Retail is not permitted. Maximum FAR for this designation is 0.6; buildout is assumed at 0.15.

Public

Public/Institutional. The public/institutional classification applies to lands owned by public entities, including City Hall and other City buildings, County buildings, schools, the Municipal Airport, and hospitals. It also includes public facilities such as fire and police stations, recycling centers, and sewage treatment. There is no maximum FAR specified for this land use designation; buildout is assumed at an FAR of 0.3.

Parks and Open Space. The park designation applies to both public and private recreational sites and facilities, including neighborhood, community, and regional parks; recreation centers; golf courses; and other open space areas.

Conservation. The conservation designation applies to open space areas that are not intended to be improved with park and recreation facilities, though public access is permitted. The conservation designation typically applies to creek buffers, areas along the St. Johns River, and in the West Highway 198 Corridor setback area.

Reserve. The Reserve designation applies to lands that are outside of the Urban Growth Boundary (UGB) for which future planned development may be appropriate under criteria as stated in LU-P-26.

APPENDIX B

SEWER FLOW MONITORING AND INFLOW/INFILTRATION STUDY

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City of Visalia
2018/19 Sewer Flow Monitoring Study

Prepared for:

Carollo Engineers, Inc.
1 East Liberty, Suite 424
Reno, NV 89501

carollo
Engineers...Working Wonders With Water™

Date: July 2019

Prepared by:

V&A

V&A Project No. 17-0314

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

Terms and Definitions

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

Executive Summary

Scope and Purpose

V&A Consulting Engineers, Inc. (V&A) has completed sanitary sewer flow monitoring within the City of Visalia (City). Flow monitoring was performed over a period of over one month from November 28, 2018 to January 08, 2019 at 15 open-channel flow monitoring sites. Many of the sites were previously monitored by V&A from March 12, 2004 through April 1, 2004 (V&A Project Number 04-030). There were three general purposes of this study:

1. Establish the baseline sanitary flows at the flow monitoring sites
2. Establish the peak flow condition during the rainfall events
3. Quantify inflow/infiltration (I/I) at the applicable flow monitoring sites

Rainfall Monitoring

The cumulative precipitation over the flow monitoring period was **lower** than the historical average. There were a series of rainfall events that occurred from November 2018 through January 2019 as shown in Figure ES-1, of which one rainfall event was defined. Rainfall Event 1 from November 28, 2018 through December 1, 2018 was the main rainfall event and elicited the strongest I/I response throughout the system. This event was classified as a less than 1-year, 24-hour rainfall event at most of the rain gauges. This rainfall event was of sufficient strength to elicit an I/I response from the flow monitoring sites suitable for I/I analysis.

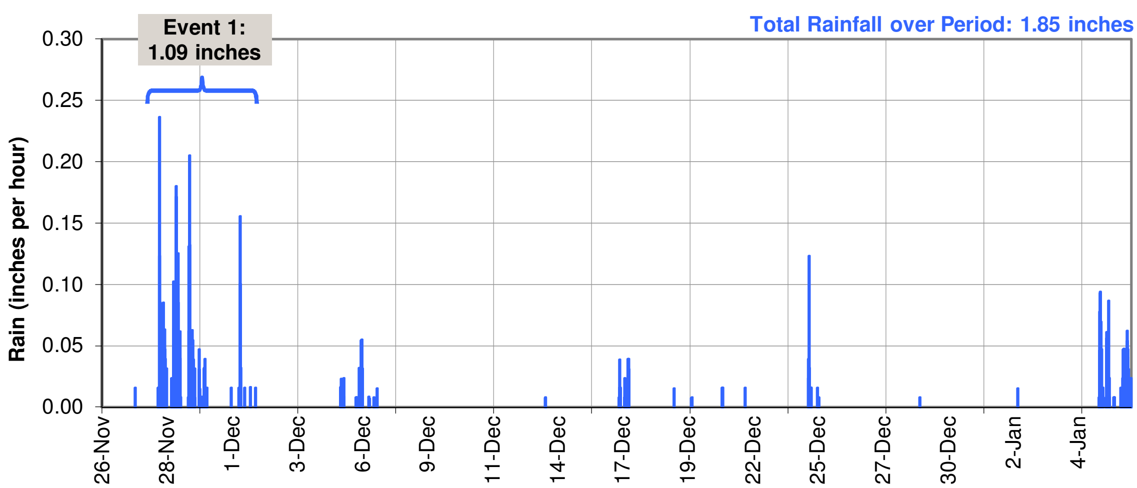

Figure ES-1. Rainfall Over Monitoring Period, Average of 3 Rain Gauges

Monitoring Sites

The flow monitoring site locations were selected and approved by the City and are listed in Table ES-1 and shown in Figure ES-2. Rain gauge locations are also shown.

Table ES-1. List of Monitoring Sites

Monitoring Site	Measured Pipe Diameter (in.)	Monitoring Pipe	Manhole Location
FM 1	36	Northwest Inlet	End of Drive 85
FM 2	21	North Inlet	Valley Oaks Golf Course
FM 3	48	East Inlet	W Walnut Ave w/o Rd 92
FM 4	36	East Inlet	W Walnut Ave & S Savannah St
FM 5	36	South Inlet	3498 Akers St n/o W Caldwell Ave
FM 6	33	East Inlet	S Noyes St & W Laurel Ave
FM 7	30	North Inlet	S Akers St n/o W Cambridge Ave
FM 8	24	North Inlet	S Akers St s/o W Cambridge Ave
FM 9	27	East Inlet	W Walnut Ave & S San Joaquin Dr
FM 10	27	East Inlet	W Caldwell Ave & Rd 100
FM 11	42	East Inlet	W Mineral King Ave, w/o S Woodland Dr
FM 12	28	East Inlet	E Walnut Ave & S Church St
FM 13	18	East Inlet	Houston Ave & N County Center St
FM 14	18	North Inlet	W Cecil Ave & N Ranch Ct
FM 15	28.5	East Inlet	4425 W Ferguson Ave, w/o N Chinowth St

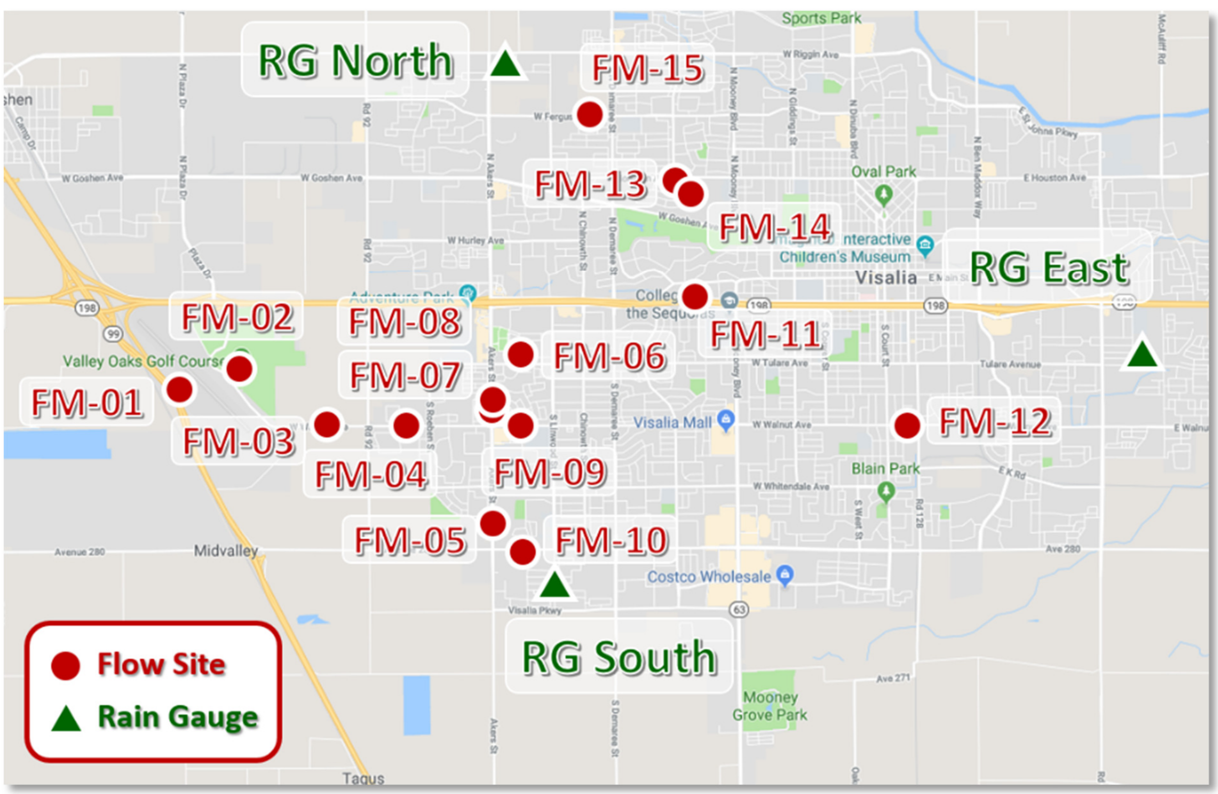

Figure ES-2. Map of Flow Monitoring Sites and Rain Gauges

Site Flow Monitoring and Capacity Results

Table ES-2 summarizes the peak recorded flows, levels, *d/D* ratios, and peaking factors per site 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 locations; hydraulic conditions in other areas of the collection system will differ. The following capacity analysis results are noted:

- **Peaking Factor:** Peaking factor is defined as the peak measured flow divided by the average dry weather flow (ADWF). Peaking factors are influenced by many factors including size and topography of tributary area, flow attenuation, flow restrictions, characteristics of I/I entering the collection system, and hydraulic features such as pump stations.

  For this report, peaking factors are reported and PF > 4 are highlighted in RED[1]; however, the City should refer to City standards when evaluating peaking factors.

- **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.

  For this report, d/D ratio > 0.5 are highlighted in RED; however, the City should refer to City standards when evaluating d/D ratios, to be used at the discretion of the City Engineer.

The following capacity analysis results are noted:

- Peaking Factors
  - Site 2 had the largest peaking factor of all sites at 4.51.
  - No other site had a peaking factor that exceeded 2.0.
- d/D Ratio:
  - No sites surcharged during the flow monitoring study.
  - Only Site 14 had a d/D ratio that exceeded 0.50.

Figure ES-3 shows a schematic diagram of the peak measured flows with peak flow levels.

[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.

Table ES-2. Capacity Analysis Summary

Monitoring Site	ADWF (MGD)	Peak Measured Flow (MGD)	Peaking Factor	Pipe Diameter, *D* (IN)	Peak Measured Depth, *d* (IN)	Max d/D Ratio
FM 1	3.39	4.33	1.18	36	12.52	0.33
FM 2	0.06	0.25	4.51	21	8.46	0.40
FM 3	2.17	3.64	1.68	48	12.64	0.26
FM 4	5.73	8.77	1.41	36	17.95	0.46
FM 5	1.07	1.98	1.42	36	12.27	0.30
FM 6	1.23	1.94	1.46	33	9.48	0.27
FM 7	3.89	6.95	1.44	30	15.69	0.48
FM 8	0.64	1.17	0.62	24	7.36	0.17
FM 9	1.64	2.79	1.36	27	11.94	0.39
FM 10	0.72	1.72	1.71	27	9.38	0.29
FM 11	1.39	2.39	1.62	42	11.87	0.27
FM 12	0.85	1.95	1.83	28	13.17	0.36
FM 13	0.14	0.33	0.91	18	6.63	0.20
FM 14	0.57	0.98	1.46	18	10.91	0.56
FM 15	0.97	1.73	1.74	28.5	5.53	0.19
System	*11.35*	*16.26*	*1.29*			

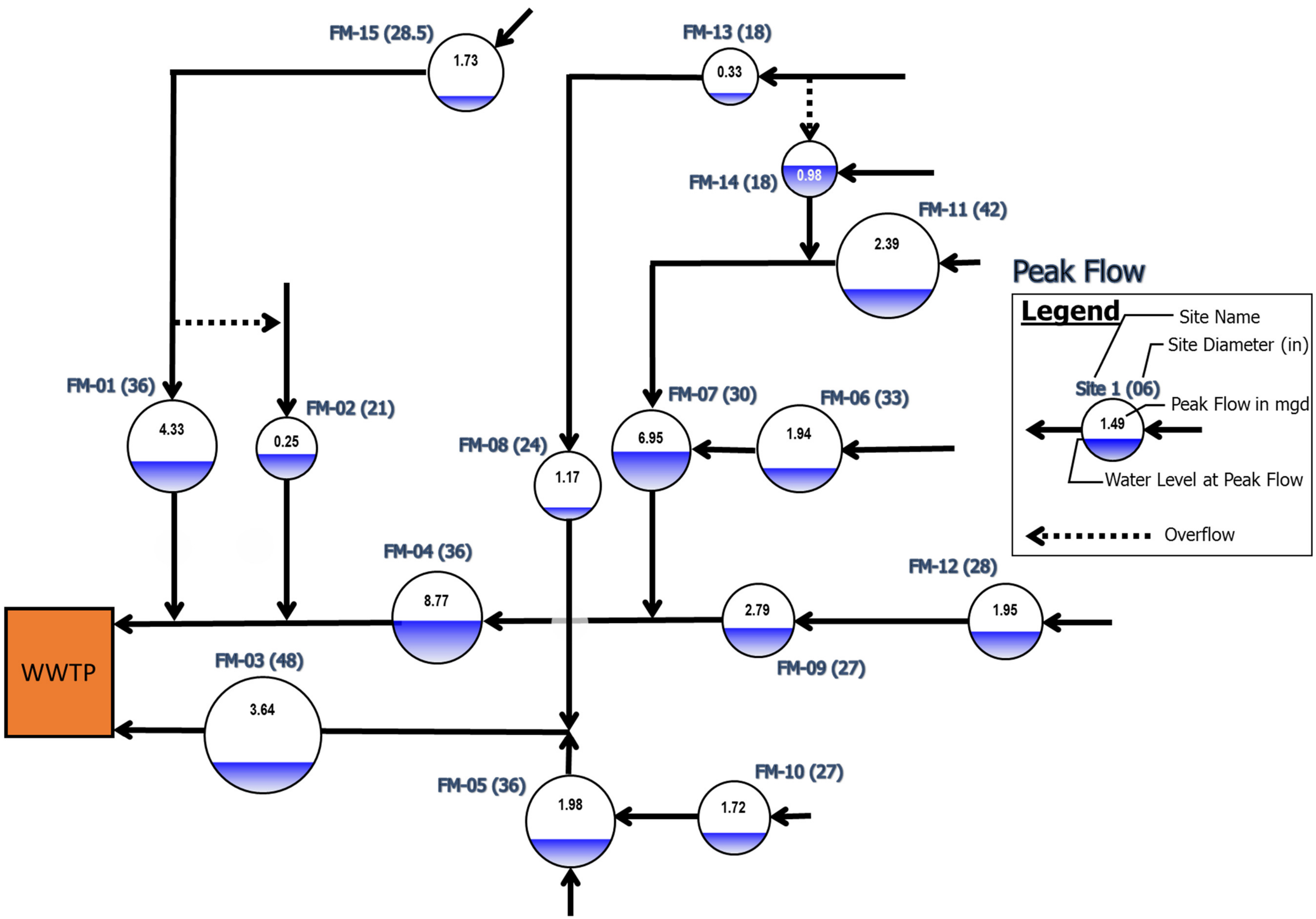

Figure ES-3. Peak Measured Flow Schematic

Infiltration and Inflow Analysis

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 basin-by-basin basis. For this study subtraction of flows was required to isolate the drainage areas of some flow monitoring basins. The flow monitoring basins and basin isolation equations are listed in Table ES-3.

The basin boundaries were assumed from the available mapbook pages, 2004 flow monitoring basins given from Carollo Engineers (V&A Project No. 04-030), general topography and ADWF. In particular, Basin 3 and Basin 4 were difficult to separate. However, Basin 3 and Basin 4 could not be used for I/I analysis due to the phenomena of inflating uncertainties from subtracting large flows to obtain flows of a relatively small downstream basin. I/I analyses for Basins 3 and 4 were not conducted.

Additionally, I/I analysis for Basin 1 should be used at the discretion of the City engineer due to the atypical ADWF pattern of Site 1.

Table ES-3. I/I Analysis Summary

Isolated Basin	Flow Isolation Calculation	Area (Acres)
Basin 1	$= Q_1 - Q_{15}$	4021
Basin 2*	$= Q_2$	1179
Basin 3	$= Q_3 - (Q_8 + Q_5)$	619
Basin 4	$= Q_4 - (Q_7 + Q_9)$	
Basin 5	$= Q_5 - Q_{10}$	315
Basin 6	$= Q_7$	1666
Basin 7	$= Q_7 - Q_6$	865
Basin 8	$= Q_8 - Q_{13}$	1158
Basin 9	$= Q_9 - Q_{12}$	1846
Basin 10	$= Q_{10}$	2378
Basin 11	$= Q_{11}$	2561
Basin 12	$= Q_{12}$	2555
Basin 13	$= Q_{13}$	374
Basin 14*	$= Q_{14}$	685
Basin 15	$= Q_{15}$	988

* Basins had overflow connections, but the overflow did not activate during the flow monitoring study.

Table ES-4 summarizes the I/I results for all basins in the study. The highest three ranked basins have been shaded in RED. Please refer to the I/I Methods section for more information on rainfall-dependent infiltration (RDI) and inflow analysis and ranking methods.

Figure ES-4 and Figure ES-5 illustrate temperature maps of the final inflow and RDI rankings, respectively.

Table ES-4. I/I Analysis Summary

Basin	ADWF (mgd)	Basin Acreage	Peak Inflow Rate (mgd)	RDI Rate (mgd)	Total I/I (gallons)	Overall Inflow Rank	Overall RDI Rank	Overall Total I/I Rank
Basin 1	2.426	4,021	0.282	ND	40,800	9	-	9
Basin 2	0.056	1,179	0.166	0.045	94,000	2	1	4
Basin 5	0.347	315	ND	0.040	0	12	2	11
Basin 6	1.226	1,666	0.601	ND	195,700	1	-	2
Basin 7	0.696	865	ND	ND	0	12	-	11
Basin 8	0.498	1,158	0.025	ND	0	10	-	11
Basin 9	0.793	1,846	0.006	0.046	80,700	11	3	7
Basin 10	0.723	2,378	0.347	0.002	184,600	5	5	3
Basin 11	1.393	2,561	0.498	ND	247,600	3	-	1
Basin 12	0.849	2,555	0.215	ND	78700	7	-	8
Basin 13	0.140	374	0.021	ND	1400	8	-	10
Basin 14	0.570	685	0.172	ND	58500	4	-	5
Basin 15	0.967	988	0.181	0.036	87500	6	4	6

The following I/I analysis results are noted:

- **Inflow**: Basins 2, 6, and 11 ranked highest for normalized inflow contribution.
- **Rainfall-Dependent Infiltration**: Generally, the RDI rates measured within the City collection system were low. Only Basins 2, 5, 9, 10 and 15 had detectable levels of RDI contribution. Basins 2 and 5 ranked highest for normalized RDI contribution.
- **Combined I/I**: Basins 6, 10, and 11 ranked highest for normalized combined I/I contribution.
- **Groundwater Infiltration**: Sites 5 and 15 could be noted as having the possibility of higher than typical GWI rates. V&A does not draw any conclusions from this analysis.

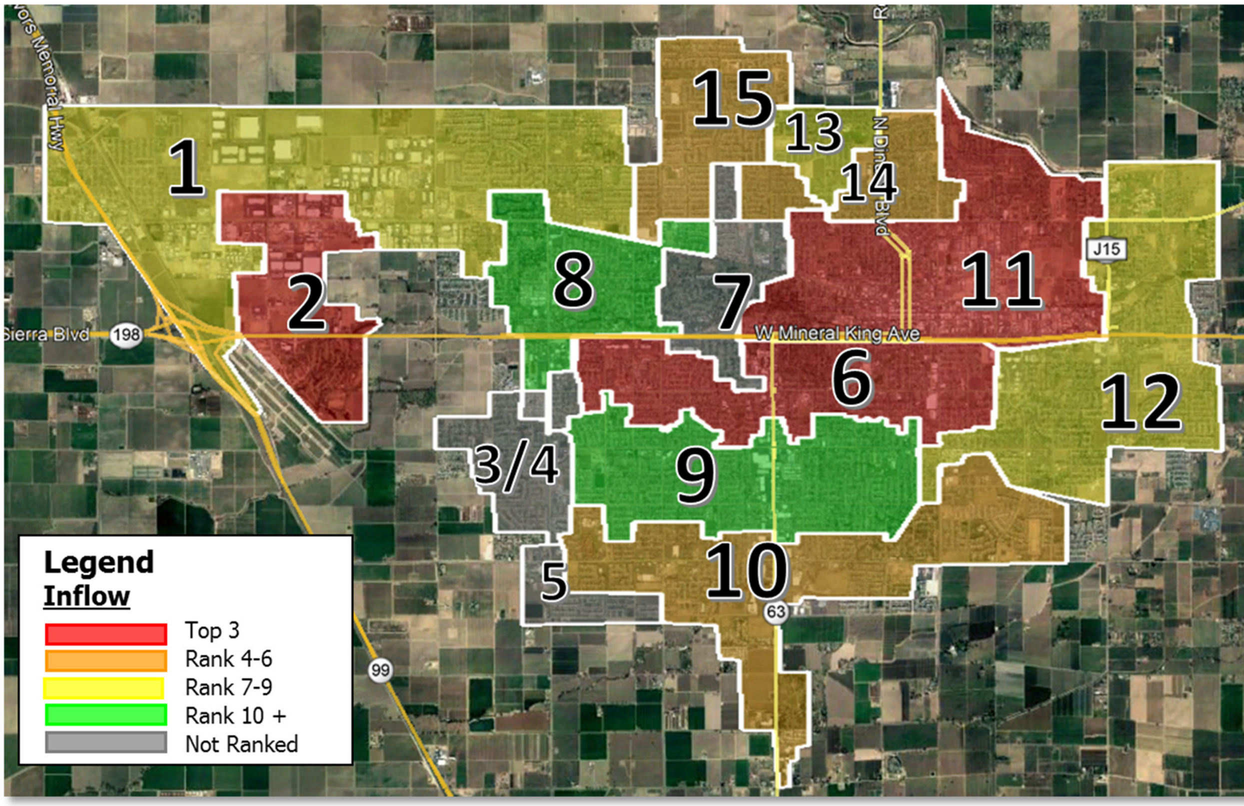

Figure ES-4. Temperature Map: Inflow Final Rankings

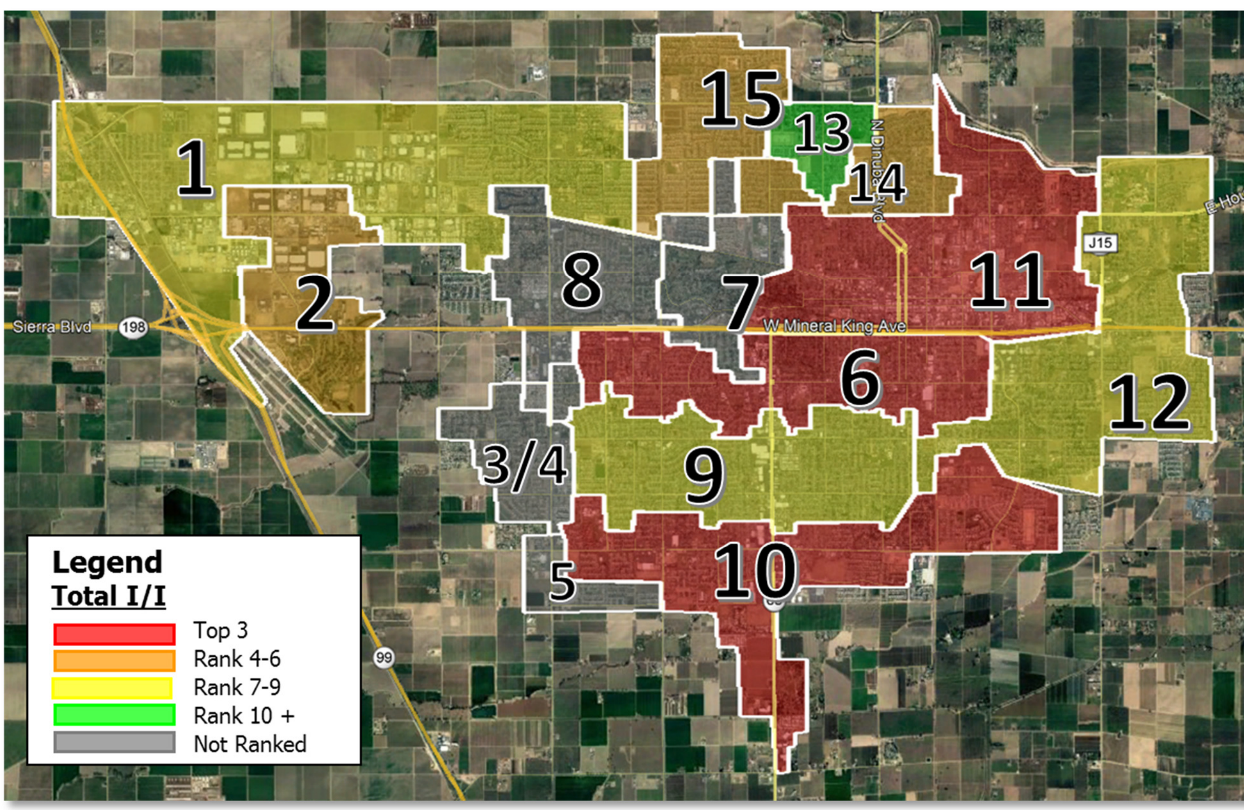

Figure ES-5. Temperature Map: Total I/I Final Rankings

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. The highest inflow occurs in Basins 2, 6, and 11.
    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. RDI rates were relatively low; there may not be a cost-effective reason to pursue sources of RDI.
3. **I/I Investigation Methods**: Potential I/I investigation methods include the following:
    a. Smoke testing can be effective for locating sources of inflow. Smoke testing can be considered for Basins 2, 6, and 11 which had the highest normalized inflow rates.
    b. Mini-basin or sub-basin flow monitoring can be used to better determine the distribution of I/I within a particular sub-basin. Basins 2, 6, and 11 may be good candidates mini-basin flow monitoring to better locate the distribution of inflow and infiltration within these basins.
    c. Night-time I/I reconnaissance can be conducted within basins with high RDI rates to better determine on a pipe reach by pipe reach basis where the RDI is occurring within particular sub-basin. This method may be utilized to determine candidate neighborhoods for potential CIP projects to mitigate and reduce I/I within the collection system. Night-time I/I reconnaissance is not recommended for this system.
4. **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, Inc. (V&A) has completed sanitary sewer flow monitoring within the City of Visalia (City). Flow monitoring was performed over a period of over one month from November 28, 2018 to January 08, 2019 at 15 open-channel flow monitoring sites. Many of the sites were previously monitored by V&A from March 12, 2004 through April 1, 2004 (V&A Project Number 04-030). There were three general purposes of this study:

1. Establish the baseline sanitary flows at the flow monitoring sites
2. Establish the peak flow condition during the rainfall events
3. Quantify inflow/infiltration (I/I) at the applicable flow monitoring sites

1.2 Flow Monitoring Sites and Sewerage Basins

The flow monitoring sites were selected and approved by the City. Flow monitoring sites are identified as the manholes where the flow monitors were secured and the pipelines wherein the flow sensors were placed. Capacity analysis and flow rate information is presented on a site-by-site basis. Information regarding the flow monitoring locations are listed in Table 1-1 and shown in Figure 1-1. Discrepancies to expected pipe diameters have been shaded in RED. Detailed descriptions of the individual flow monitoring sites, including photographs, are included in Appendix A.

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). The basin boundaries were assumed from the available mapbook pages, 2004 flow monitoring basins given from Carollo Engineers (V&A Project No. 04-030), general topography and measured ADWF values.

The I/I analysis results will be presented on an isolated basin basis. The basins, basin attributes and basin isolation equations are listed in Table 1-2 and shown in Figure 1-2. Rain gauge locations in relation to the drainage basins are also shown in Figure 1-2.

Table 1-1. List of Flow Monitoring Locations

Monitoring Site	Expected Pipe Dia (in)	Measured Pipe Dia (in)	Monitoring Pipe	Manhole Location	Latitude	Longitude
FM 1	36	36	NW Inlet	End of Drive 85	36.3174	-119.3959
FM 2	21	21	North Inlet	Valley Oaks Golf Course	36.3199	-119.3856
FM 3	48	48	East Inlet	W Walnut Ave w/o Rd 92	36.3128	-119.3702

Monitoring Site	Expected Pipe Dia (in)	Measured Pipe Dia (in)	Monitoring Pipe	Manhole Location	Latitude	Longitude
FM 4	36	36	East Inlet	W Walnut Ave & S Savannah St	36.3127	-119.3631
FM 5	36	36	South Inlet	3498 Akers St n/o W Caldwell	36.3001	-119.3494
FM 6	33	33	East Inlet	S Noyes St & W Laurel Ave	36.3208	-119.3447
FM 7	30	30	North Inlet	S Akers St n/o W Cambridge	36.3152	-119.3496
FM 8	24	24	North Inlet	S Akers St s/o W Cambridge	36.3146	-119.3496
FM 9	36	27	East Inlet	W Walnut Ave & S San Joaquin	36.3128	-119.3459
FM 10	27	27	East Inlet	W Caldwell Ave & Rd 100	36.2983	-119.3472
FM 11	30	42	East Inlet	W Mineral King Ave, w/o S Woodland Dr	36.3277	-119.3198
FM 12	27	28	East Inlet	E Walnut Ave & S Church St	36.3129	-119.2908
FM 13	18	18	East Inlet	Houston Ave & N County Center St	36.3420	-119.3230
FM 14	18	18	North Inlet	W Cecil Ave & N Ranch Ct	36.3409	-119.3215
FM 15	30	28.5	East Inlet	4425 W Ferguson Ave, w/o N Chinowth St	36.3491	-119.3361

Table 1-2. Isolated Flow Monitoring Basin Characteristics

Isolated Basin	Flow Isolation Calculation	Area (Acres)
Basin 1	$= Q_1 - Q_{15}$	4021
Basin 2*	$= Q_2$	1179
Basin 3	$= Q_3 - (Q_8 + Q_5)$	619
Basin 4	$= Q_4 - (Q_7 + Q_9)$	
Basin 5	$= Q_5 - Q_{10}$	315
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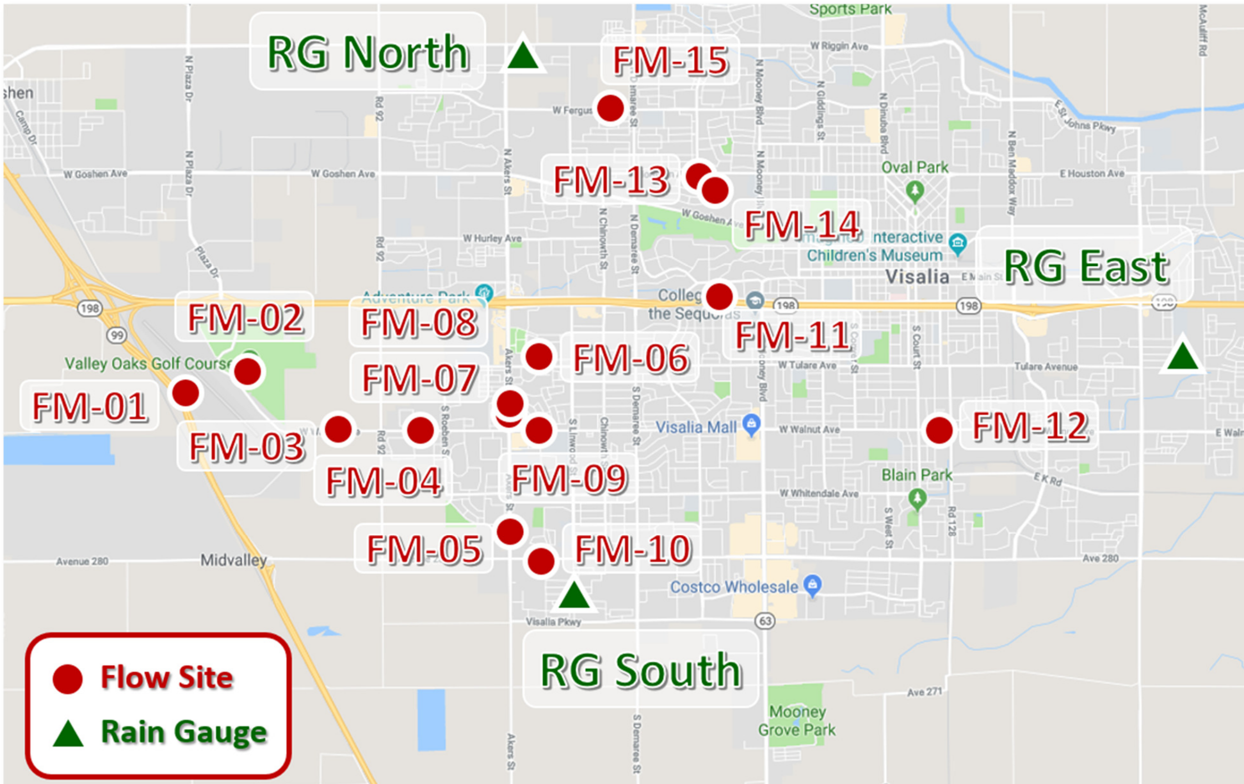

Figure 1-1. Map of Flow Monitoring Sites

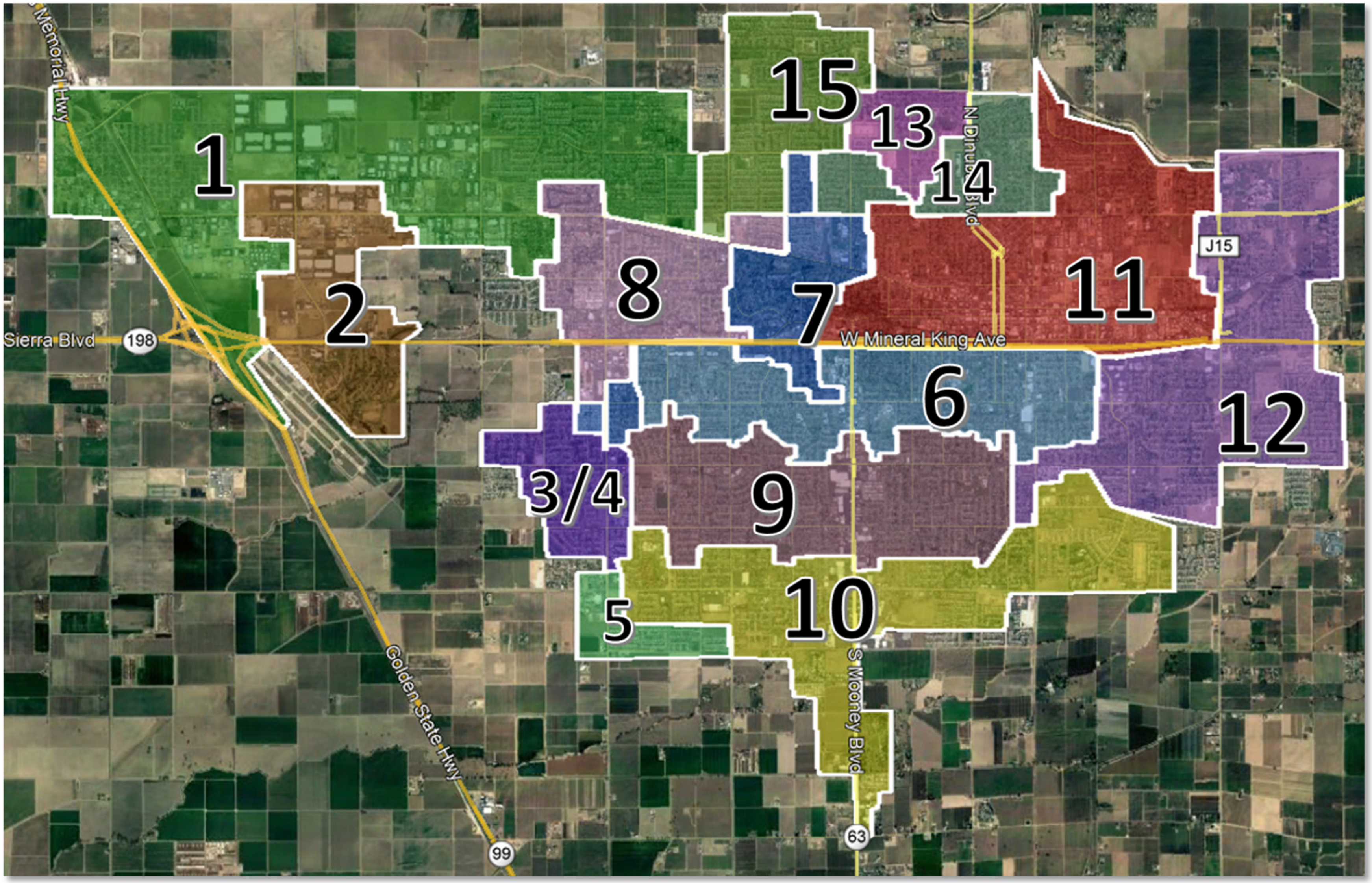

Figure 1-2. Map of Flow Monitoring Basins

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

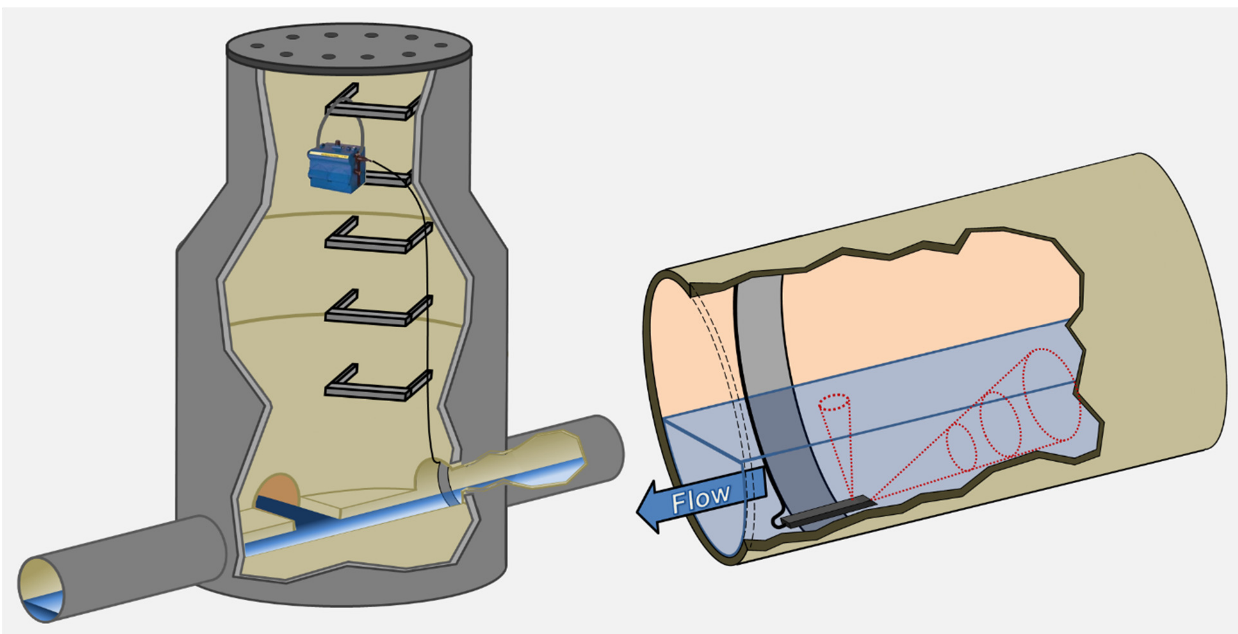

Figure 2-1. Typical Installation for Flow Meter with Submerged Sensor

2.3 Flow Calculation

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

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

where Q : volume flow rate

v: average velocity as determined by the ultrasonic sensor

A: cross-sectional area available to carry flow

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

A_S: cross-sectional area of sediment.

For circular pipe,

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

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

where d_W: distance between wastewater level and pipe invert

d_S: depth of sediment

D: pipe diameter

2.4 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:

- 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.

- 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.
- 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 (ADWF) curves were established for each Basin location:

- Mondays – Thursdays
- Fridays
- Saturdays
- Sundays

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

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

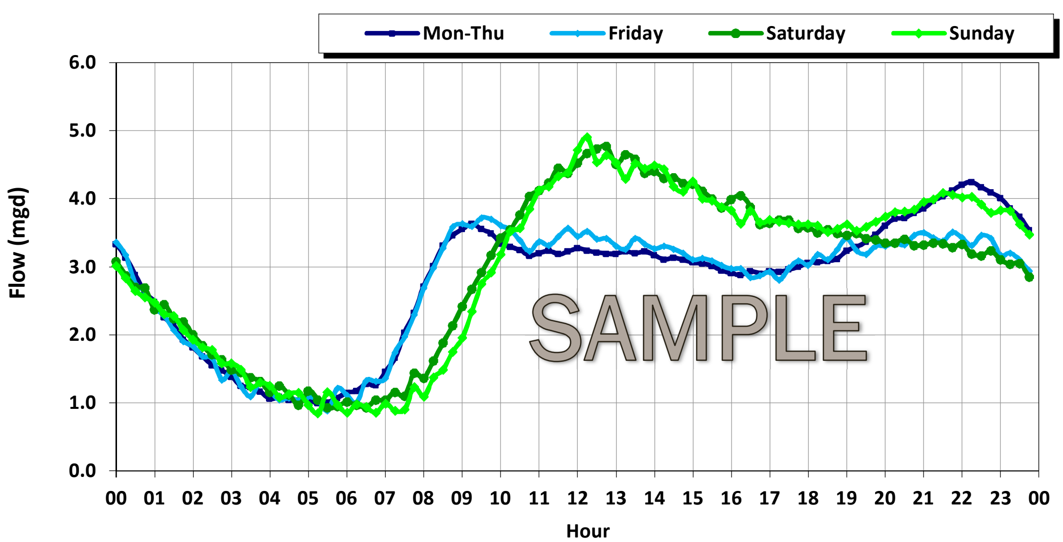

Figure 2-2. Sample ADWF Diurnal Flow Patterns

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] Holiday flows can be extremely variable. Christmas flows are different from Thanksgiving flows and different from MLK Day flows. V&A does not establish ADWF curves for holidays unless required for I/I analysis, which was not the case for this project. A “typical” holiday (Monday holidays like MLK Day, Presidents’ Day, Memorial Day and Labor Day) can be roughly estimated as a weighted average of 80% Sunday flow and 20% Mon-Thu Flow.

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.

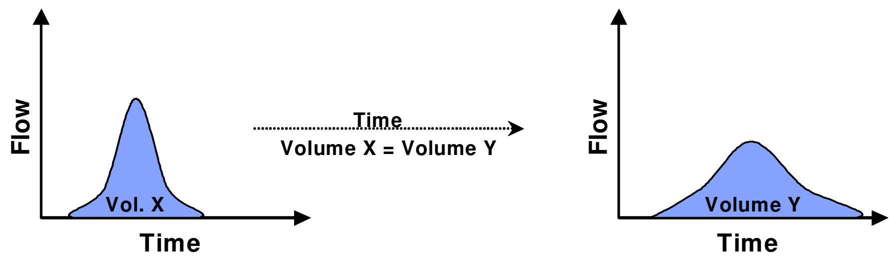

Figure 2-3. Attenuation Illustration

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.

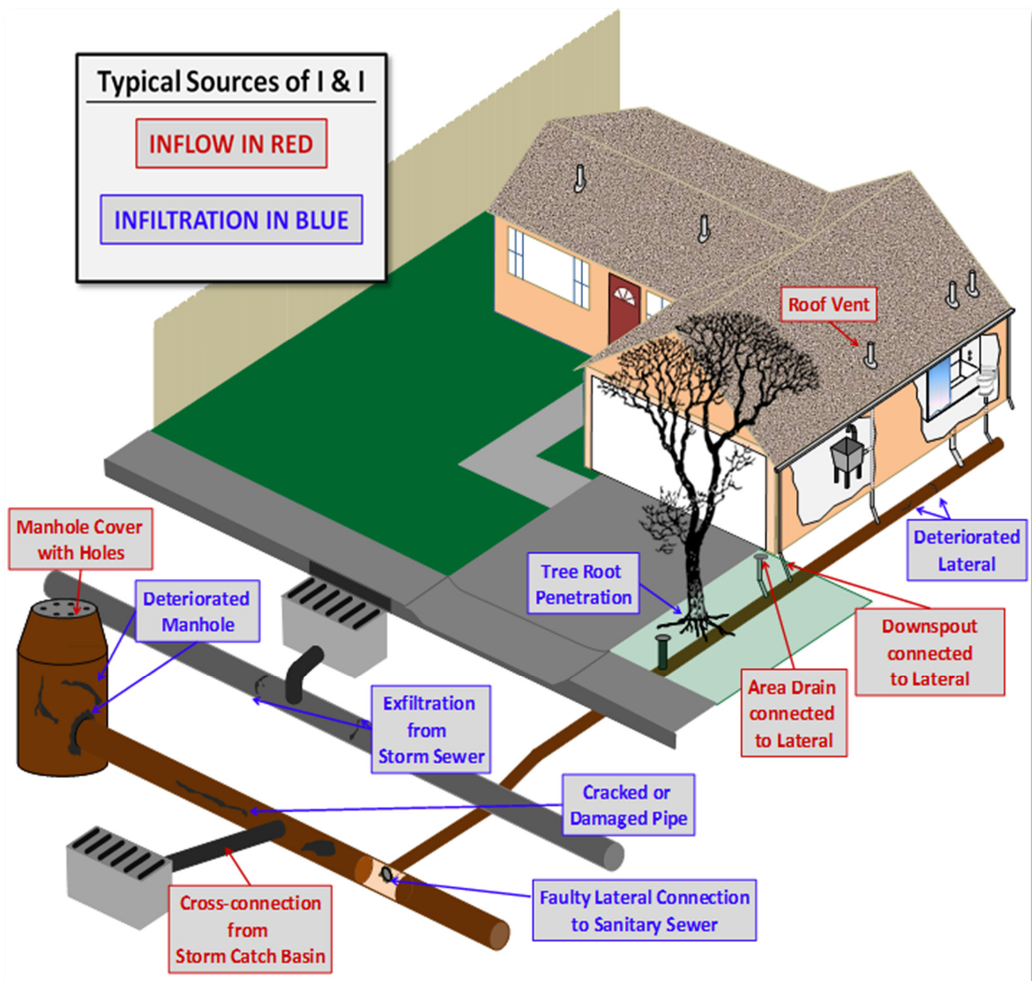

Figure 2-4. Typical Sources of Infiltration and Inflow

2.7.2 Infiltration Components

Infiltration can be further subdivided into components as follows:

- **Groundwater Infiltration**: Groundwater infiltration (GWI) depends on the depth of the groundwater table above the pipelines as well as the percentage of the system submerged. The variation of groundwater levels and subsequent groundwater infiltration rates is seasonal by nature. On a day-to-day basis, groundwater infiltration rates are relatively steady and will not fluctuate greatly.
- **Rainfall-Dependent Infiltration**: 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 Basins and can be found in Appendix A.

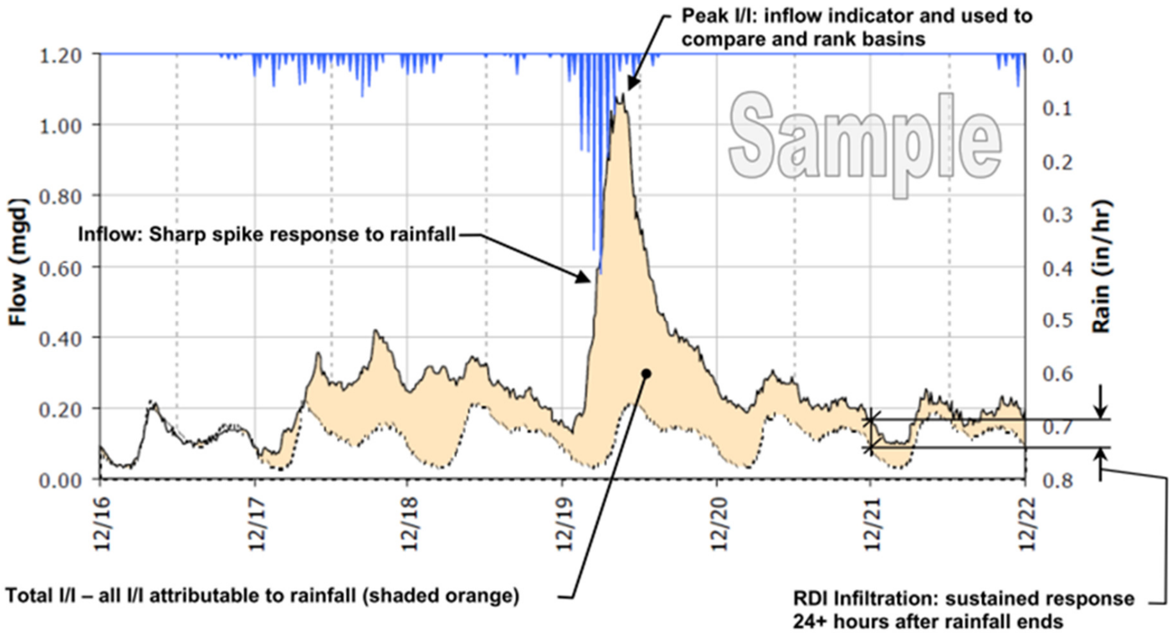

Figure 2-5. Sample Infiltration and Inflow Isolation Graph

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 Basin 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.[3]
- **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 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.
- **Total I/I:** The total inflow and infiltration is measured in gallons per Basin and per storm event. Because it is based on total I/I volume, it is an indicator of combined inflow and infiltration and is used to identify the overall volumetric influence of I/I within the monitoring basin.

2.7.6 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 Basins.
- **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 the per-ADWF and per-ACRE methods in this report and these results will be shown in the following I/I analysis results sections. For the purposes of basin rankings, the following weighting decisions are given:

- **per-ADWF:** City of Visalia includes agricultural and industrial areas of which sewerage usage is atypical and seasonal. It is noted that abnormal waste usage could result in low ADWF values, which could skew results and lend for possible misinterpretation of data. However, in lieu of accurate basin boundaries and IDM data, ADWF is an actual measured data. Per-ADWF metrics will be assigned 51% weighting towards final rankings.
- **per-IDM:** Per-IDM values were not provided.
- **per-ACRE:** The topography is flat and consistent across the metering basins which should results in valid per-ACRE analyses. However, the basin boundaries were assumed from the available mapbook pages, 2004 flow monitoring basins given from Carollo Engineers (V&A Project No. 04-030), and general topography. Per-ACRE metrics will be assigned 49% weighting towards final rankings.

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[3] 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. Peak measured flow rates are not used because they are inclusive of ADWF and can be skewed higher or lower depending on whether the storm event I/I response occurs during low-flow or high-flow hours.

3 Results and Analysis

3.1 Rainfall Monitoring

3.1.1 Flow Study Rainfall Data

V&A captured rainfall data from a total of three publicly available private weather station (PWS[4]), allowing for good coverage over the fairly large flow monitoring area. Refer to Figure 1-2 for the locations of the rain gauges.

There was one primary rainfall event that occurred from November 28, 2018 to December 1, 2018 and used for I/I analysis. Table 3-1 and Figure 3-1 show the duration and precipitation of the rainfall event.

Table 3-1. Summary of Rainfall Data

Rain Gauge	Rain Event 1 Nov 28 – Dec 1, 2018	Total over Monitoring Period
North	1.14	*1.93*
East	1.12	*1.93*
South	1.00	*1.67*
Average:	***1.09***	**1.85**

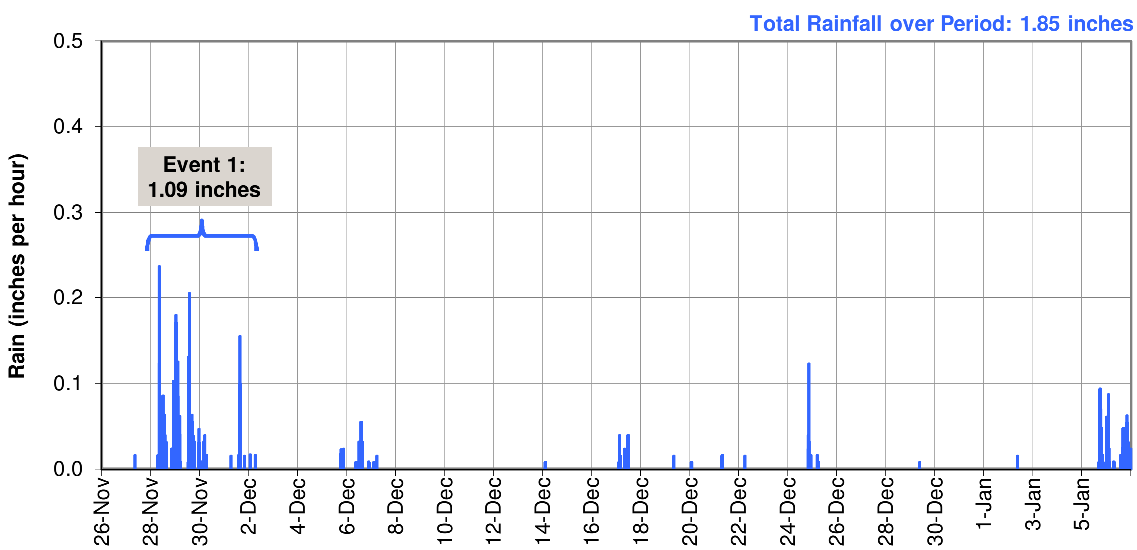

Figure 3-1. Rainfall Over Monitoring Period, Average of 3 Rain Gauges

Figure 3-2 shows the rain accumulation plot of the period rainfall, as well as the historical average

[4] National Oceanic and Atmospheric Administration (NOAA) Citizen Weather Observer Program (CWOP) members send data 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.

rainfall in the City during this project duration. The historical data was taken from WRCC Station 049367 located in Visalia[5]. The cumulative precipitation for the average of the rain gauges **was lower** than the historical average precipitation for the duration of the flow monitoring.

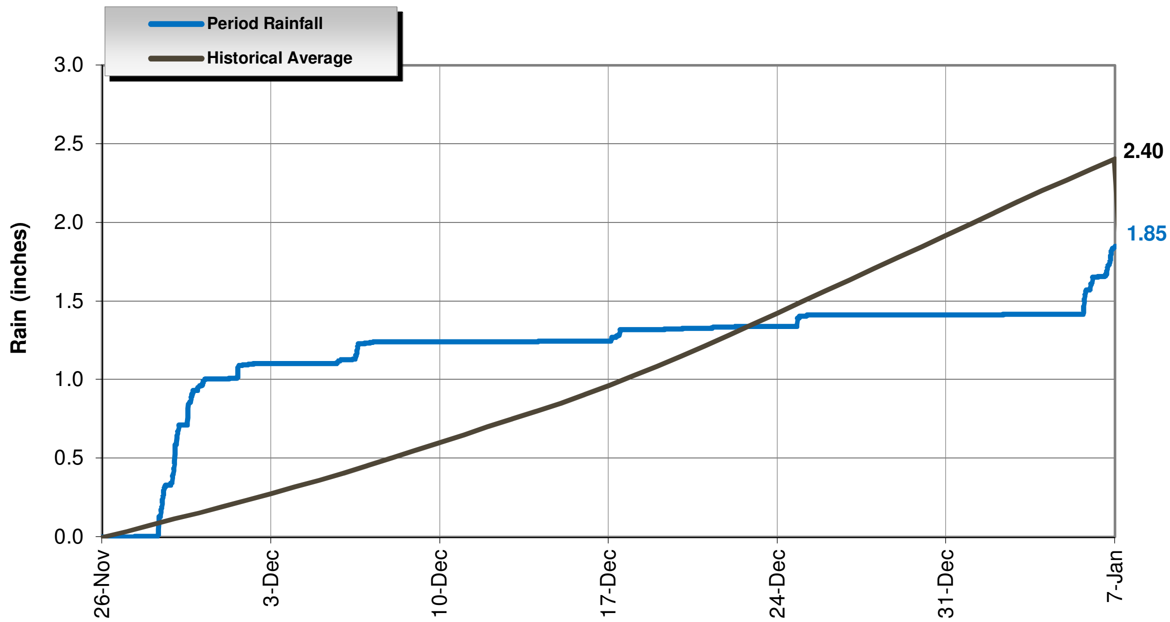

Figure 3-2. Rainfall Accumulation Plot, Average of 3 Rain Gauges

[5] https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?ca9367

3.1.2 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[6] 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 3-3).

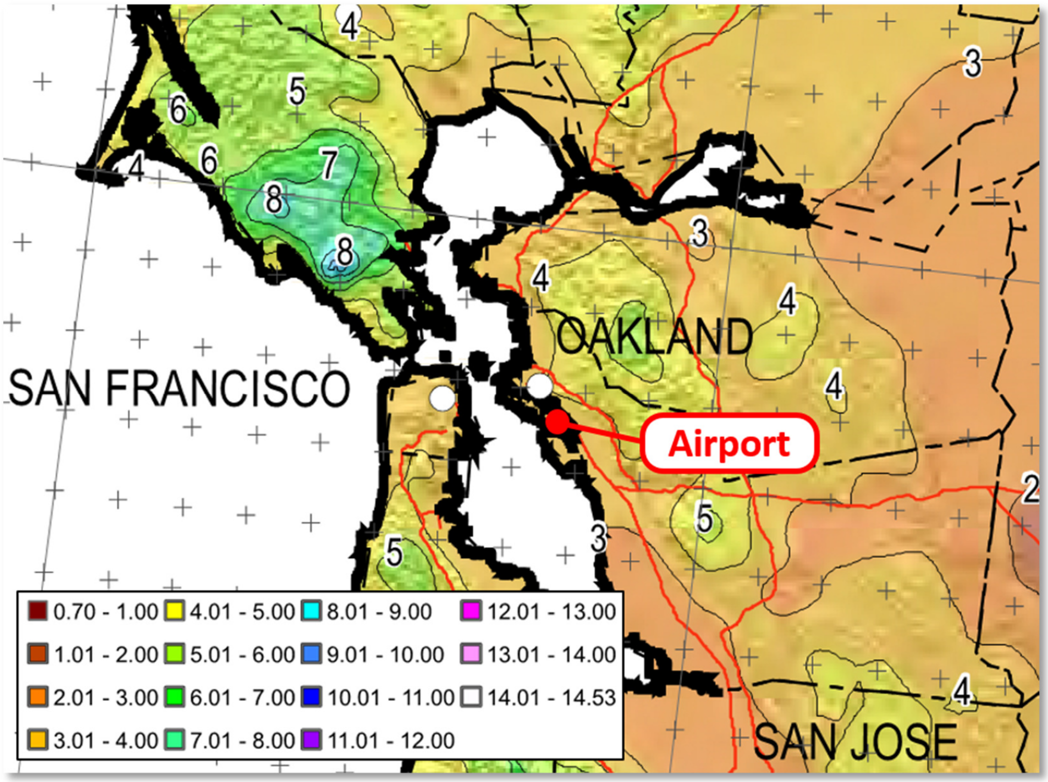

Figure 3-3. NOAA Northern California Rainfall Frequency Map

For example, the NOAA Rainfall Frequency Atlas[7] classifies a 10-year, 24-hour storm event at the North rain gauge location as **2.24** inches. This means that in any given year, at this specific location, there is a 10% chance that **2.24** 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 20 days are known for rain events ranging from 1-year to 10-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, shown in Figure 3-4.

This event was classified as a less than 1-year, 24-hour rainfall event at all 3 rain gauges. This rainfall event was of sufficient strength to elicit an I/I response from the flow monitoring sites suitable for I/I analysis.

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

[7] NOAA Western U.S. Precipitation Frequency Maps Atlas 14, 2011: https://hdsc.nws.noaa.gov/hdsc/pfds/pfds_maps.html

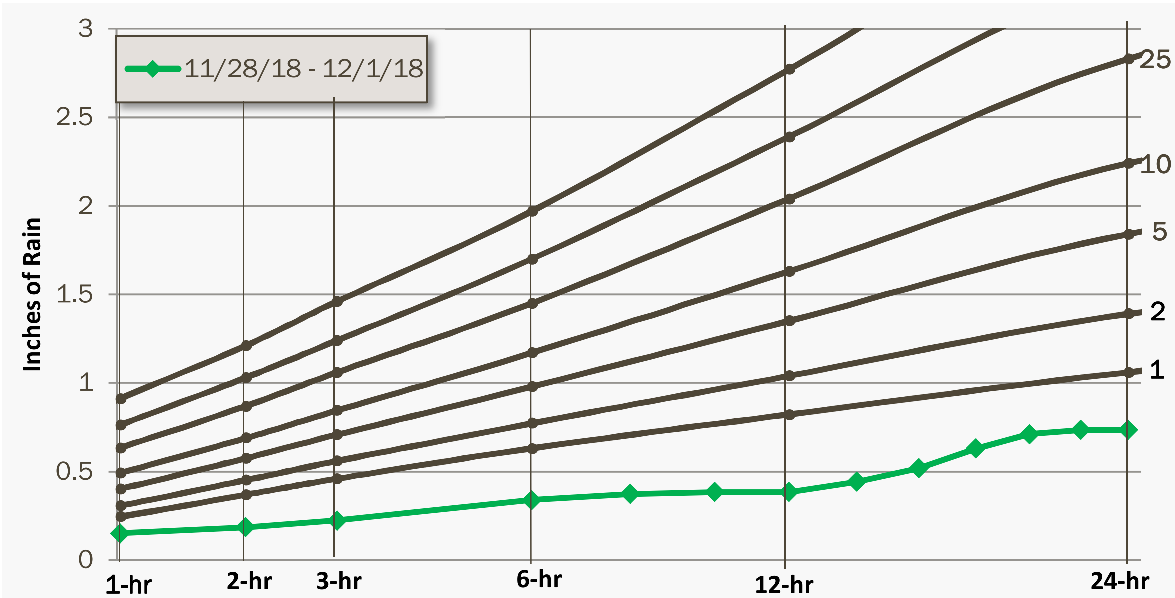


Figure 3-4. Rainfall Event Classification – 24-Hour Period (North RG)

3.1.2.1 Rain Gauge Triangulation

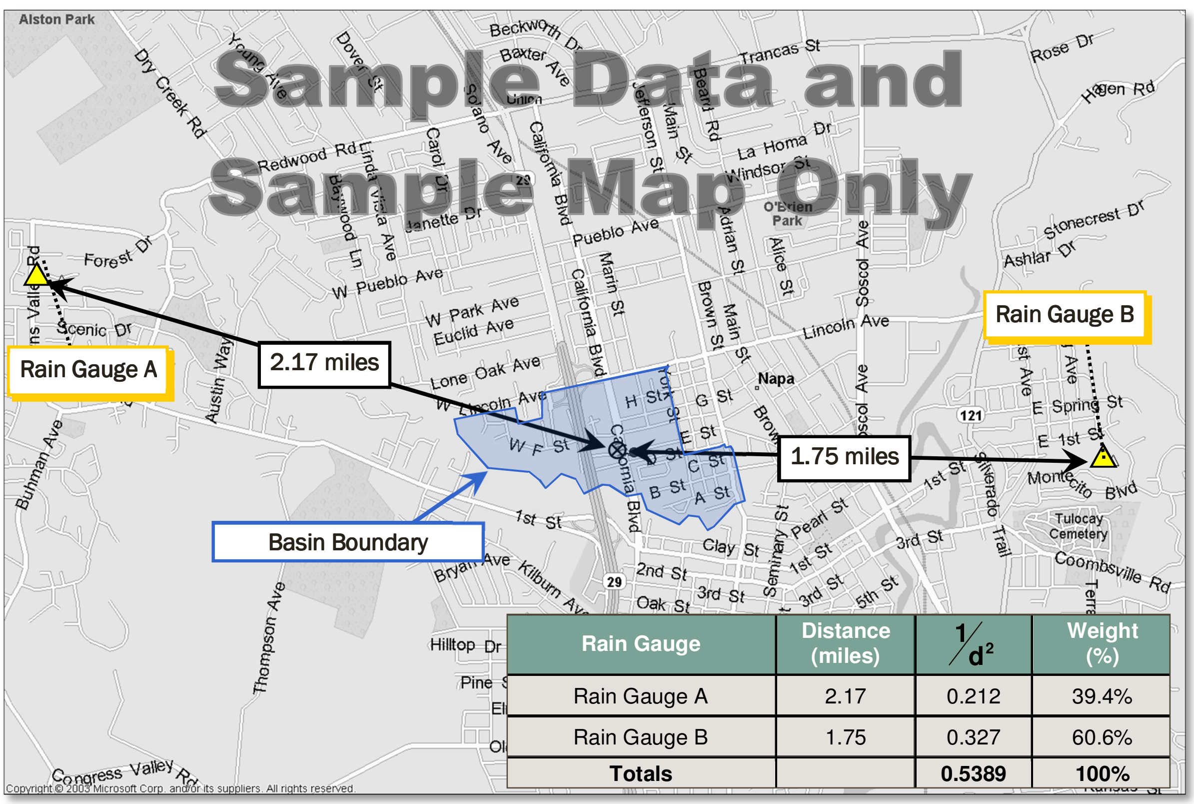
The rainfall affecting the sanitary sewer collection system basins must be calculated based on the proximity to the rain gauge locations. The mean precipitation for each upstream basin was calculated by taking data from three local rain gauges and using the Inverse Distance Weighting (IDW) method. The IDW is an interpolation method that assumes the influence of each rain gauge location diminishes with distance. The center of an upstream basin[8] is identified, and a weighted triangulated average is taken of the precipitation data from nearby rain gauge locations.

The IDW function is as follows:

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

The value of *p* is user defined. The most common choice for hydrological studies of watershed areas is *p* = 2. Figure 3-5 illustrates the IDW method (sample data).

The rain gauge distribution as calculated for each flow monitoring basin is shown in Table 3-2.



Rain Gauge	Distance (miles)	$1/d^2$	Weight (%)
Rain Gauge A	2.17	0.212	39.4%
Rain Gauge B	1.75	0.327	60.6%
Totals		**0.5389**	**100%**

Figure 3-5. Rainfall Inverse Distance Weighting Method

[8] 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 3-2. Rain Gauge Weighted Distribution by Flow Monitoring Basin

Basin	RG North	RG East	RG South
Basin 1	83.9%	0.0%	16.1%
Basin 2	66.8%	0.0%	33.2%
Basin 3	23.0%	0.0%	77.0%
Basin 4	23.0%	0.0%	77.0%
Basin 5	0.0%	0.0%	100.0%
Basin 6	34.1%	27.2%	38.7%
Basin 7	62.2%	14.3%	23.5%
Basin 8	84.6%	3.7%	11.7%
Basin 9	19.9%	16.0%	64.1%
Basin 10	0.0%	16.3%	83.7%
Basin 11	23.5%	76.5%	0.0%
Basin 12	0.4%	99.6%	0.0%
Basin 13	60.1%	39.9%	0.0%
Basin 14	60.1%	39.9%	0.0%
Basin 15	89.9%	10.1%	0.0%

3.2 Flow Monitoring

3.2.1 Average Flow Analysis

Average dry weather flow (ADWF) curves were established during dry days when I/I had the least impact on the baseline flow. Table 3-3 summarizes the dry weather flow data measured for this study. ADWF curves for each site can be found in *Appendix A*. Figure 3-8 shows a flow schematic highlighting the average daily flows and levels.

Table 3-3. Dry Weather Flow

Site	Sediment (in.)	Mon-Thurs ADWF (MGD)	Friday ADWF (MGD)	Saturday ADWF (MGD)	Sunday ADWF (MGD)	Overall ADWF (MGD)
Site 01	0	3.39	3.51	3.37	3.32	3.39
Site 02	4.0	0.066	0.053	0.038	0.038	0.056
Site 03	0	2.14	2.08	2.28	2.26	2.17
Site 04	0	5.69	5.81	5.83	5.69	5.73
Site 05	0	1.06	1.03	1.09	1.12	1.07
Site 06	0	1.23	1.21	1.22	1.22	1.23
Site 07	0	3.85	3.99	3.94	3.88	3.89
Site 08	0	0.62	0.63	0.67	0.66	0.64
Site 09	0	1.61	1.60	1.70	1.76	1.64
Site 10	0	0.71	0.71	0.74	0.78	0.72
Site 11	0	1.39	1.44	1.41	1.34	1.39
Site 12	0	0.85	0.78	0.88	0.86	0.85
Site 13	0	0.14	0.12	0.15	0.15	0.14
Site 14	0	0.57	0.55	0.57	0.58	0.57
Site 15	0	0.96	0.93	0.98	1.02	0.97
System	N/A	11.29	11.45	11.51	11.31	11.35

The following ADWF analysis results are noted (refer to Figure 3-6 on the following page):

- All sites were less than 50% full during ADWF conditions
- Only Sites 7 and 14 exceeded 40% during ADWF conditions.
- Site 2 had sediment.
- Site 1 had a steady flow throughout all times of day, instead of a typical diurnal curve that varies with time (refer to Figure 3-6). The basis or origin of this curve is unknown at this point but could be the result of a unique agricultural and industrial predominant service area or a hydraulic structure that acts as a flow equalizer. The assumed sewershed basin associated with Site 1 is shown in Figure 3-7.

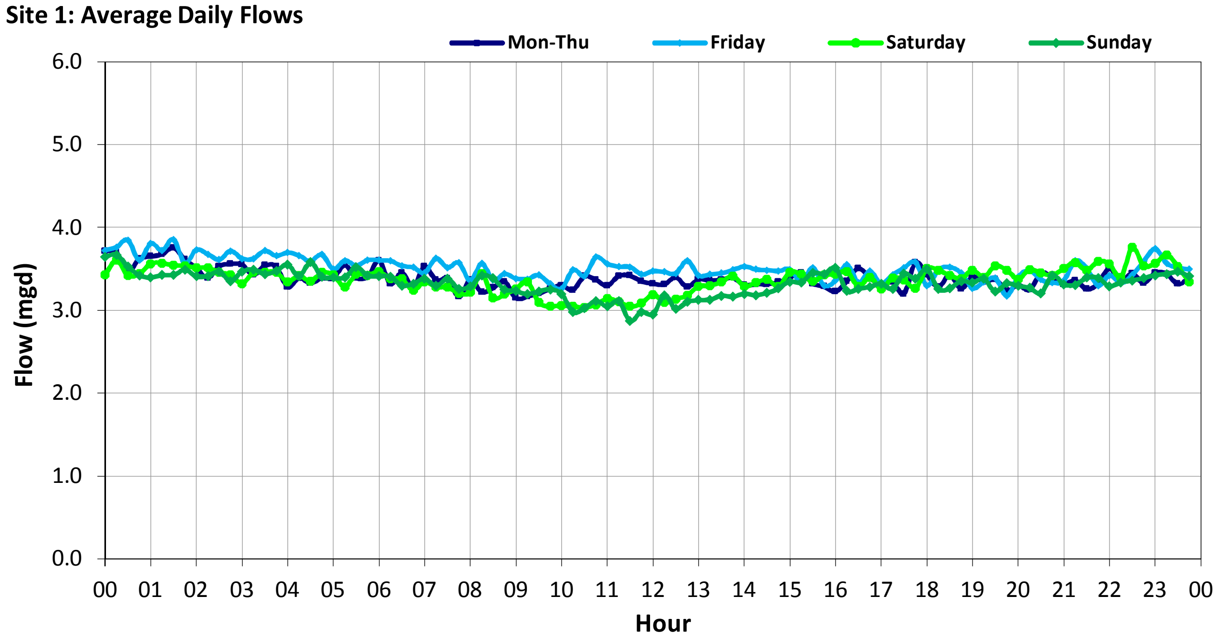


Figure 3-6. Site 1 ADWF Curve

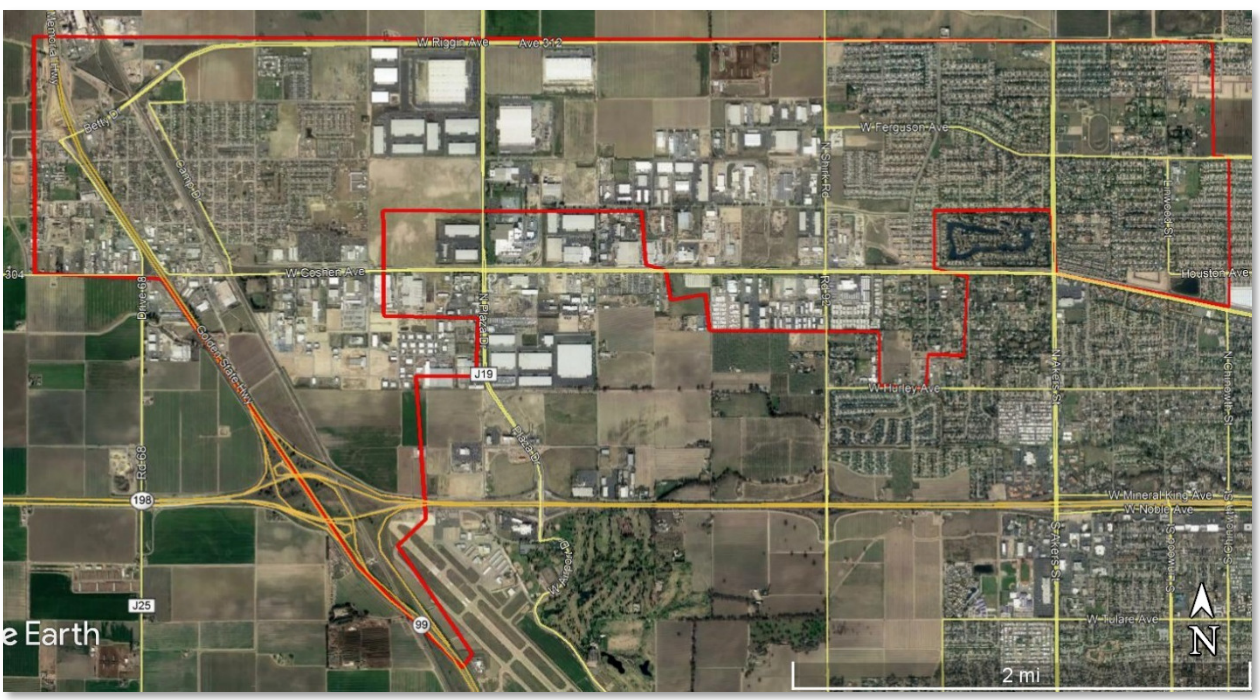


Figure 3-7. Basin 1 Satellite View

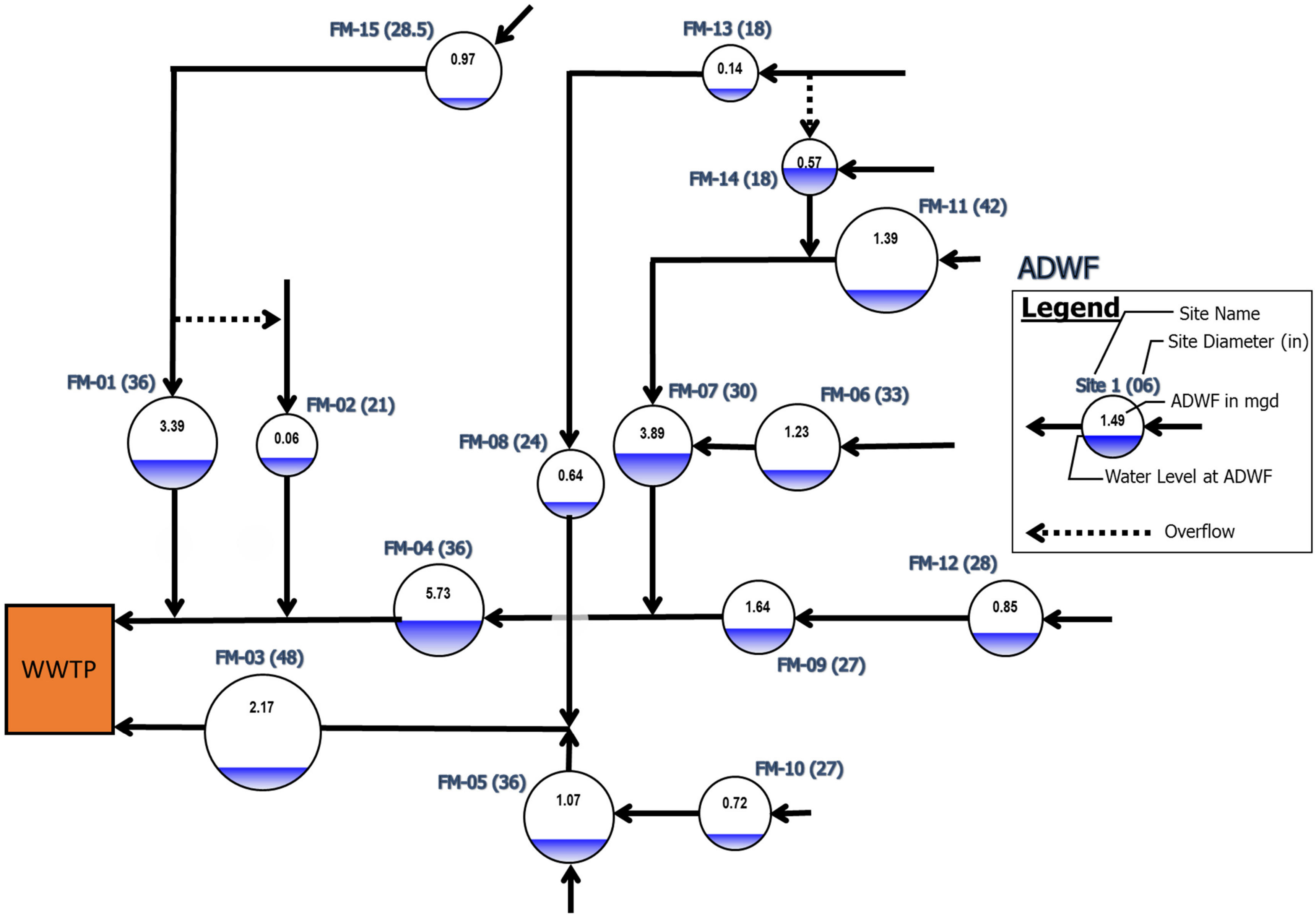


Figure 3-8. Dry Weather Flow Schematic

3.2.2 Peak Measured Flows and Pipeline Capacity Analysis

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

- **Peaking Factor:** Peaking factor is defined as the peak measured flow divided by the average dry weather flow (ADWF). Peaking factors are influenced by many factors including size and topography of tributary area, flow attenuation, flow restrictions, characteristics of I/I entering the collection system, and hydraulic features such as pump stations.

  For this report, peaking factors are reported and PF > 4 are highlighted in RED[9]; however, the City should refer to City standards when evaluating peaking factors.

- **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.

  For this report, d/D ratios > 0.5 are highlighted in RED; however, the City should refer to City standards when evaluating d/D ratios, to be used at the discretion of the City Engineer.

Table 3-4 summarizes the peak recorded flows, levels, *d/D* ratios, and peaking factors per site during the flow monitoring period. Figure 3-9 shows a schematic diagram of the peak measured flows with peak flow levels. Figure 3-10 and Figure 3-11 show the peaking factors and d/D ratios, respectively.

Capacity analysis data are presented on a site-by-site basis and represents the hydraulic conditions only at the site locations; hydraulic conditions in other areas of the collection system will differ. The following capacity analysis results are noted:

- <u>Peaking Factors</u>
  - Site 2 had the largest peaking factor of all sites at 4.51.
  - No other site had a peaking factor that exceeded 2.0.
- <u>d/D Ratio:</u>
  - No sites surcharged during the flow monitoring study.
  - Only Site 14 had a d/D ratio that exceeded 0.50.

[9] 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.

Table 3-4. Capacity Analysis Summary

Monitoring Site	ADWF (MGD)	Peak Measured Flow (MGD)	Peaking Factor	Pipe Diameter, *D* (IN)	Peak Measured Depth, *d* (IN)	Max d/D Ratio
FM 1	3.39	4.33	1.18	36	12.52	0.33
FM 2	0.06	0.25	4.51	21	8.46	0.40
FM 3	2.17	3.64	1.68	48	12.64	0.26
FM 4	5.73	8.77	1.41	36	17.95	0.46
FM 5	1.07	1.98	1.42	36	12.27	0.30
FM 6	1.23	1.94	1.46	33	9.48	0.27
FM 7	3.89	6.95	1.44	30	15.69	0.48
FM 8	0.64	1.17	0.62	24	7.36	0.17
FM 9	1.64	2.79	1.36	27	11.94	0.39
FM 10	0.72	1.72	1.71	27	9.38	0.29
FM 11	1.39	2.39	1.62	42	11.87	0.27
FM 12	0.85	1.95	1.83	28	13.17	0.36
FM 13	0.14	0.33	0.91	18	6.63	0.20
FM 14	0.57	0.98	1.46	18	10.91	0.56
FM 15	0.97	1.73	1.74	28.5	5.53	0.19
System	*11.35*	*16.26*	*1.29*			

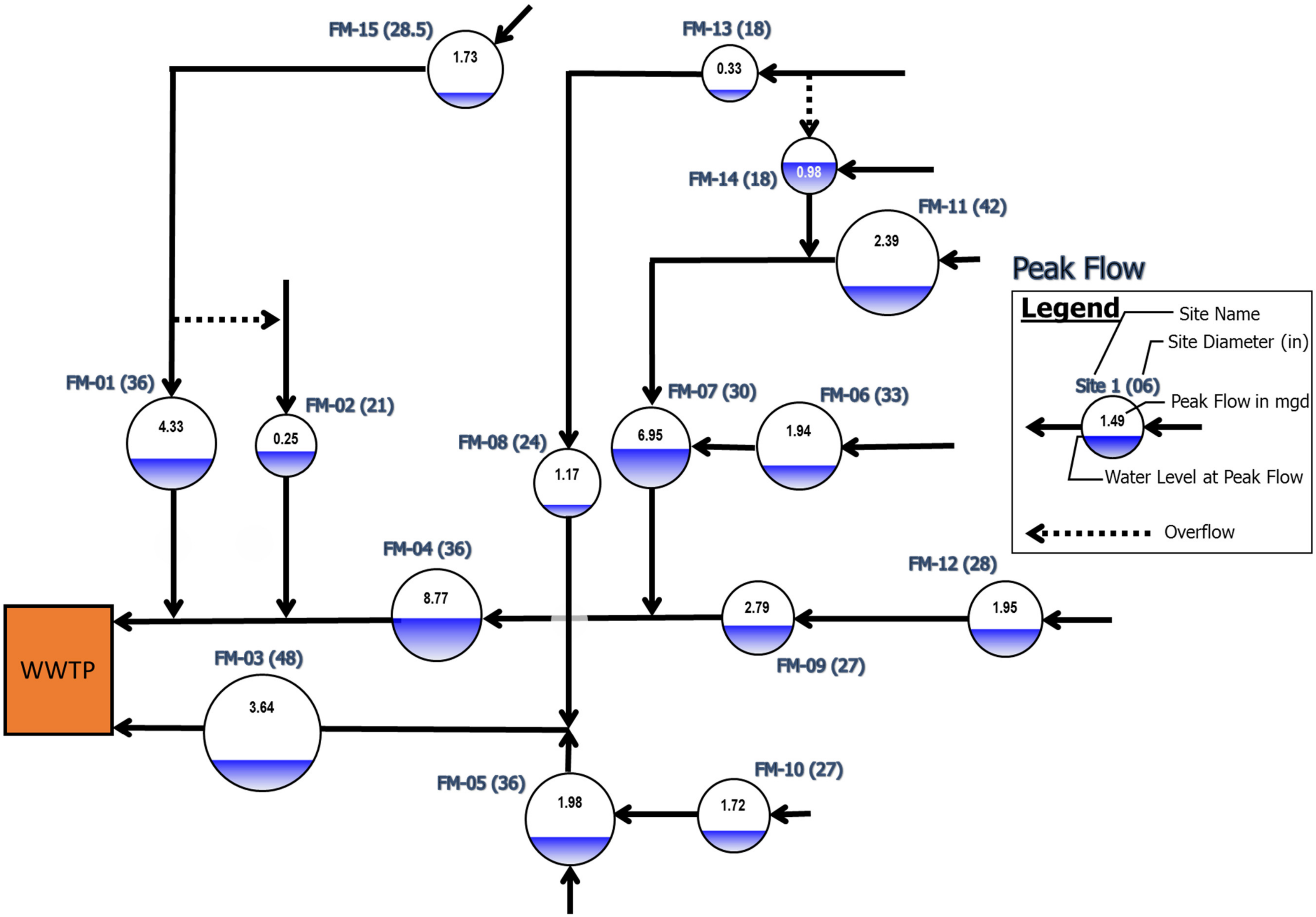


Figure 3-9. Peak Measured Flow Schematic

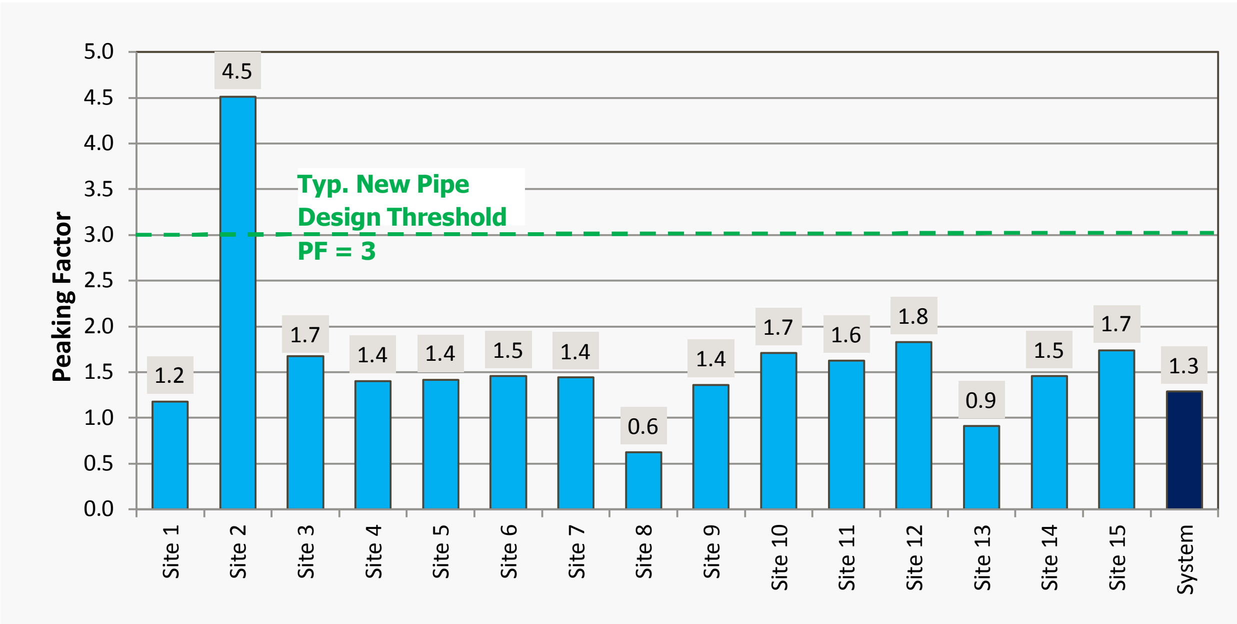


Figure 3-10. Peaking Factors

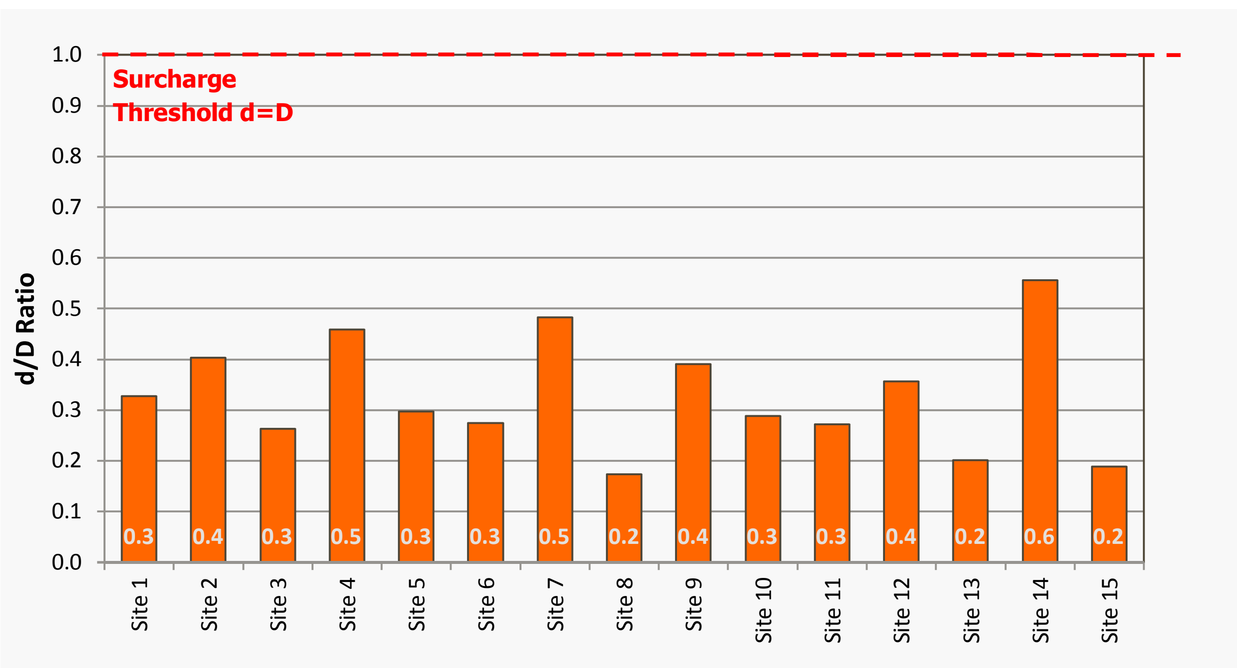


Figure 3-11. Max d/D Ratios

3.3 Inflow and Infiltration: Results

3.3.1 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:

- **Downstream Basins:** Basin 3 and Basin 4 could not be used for I/I analysis due to the phenomena of inflating uncertainties from subtracting large flows to obtain flows of a relatively small downstream basin. Please reference Section 2.4 for information on this subject. A check was made by examining the Basin 3 + Basin 4 flows = $Q_3 + Q_4 - (Q_8 + Q_5) - (Q_7 + Q_9)$; no clear I/I response could be detected. I/I analyses for Basins 3 and 4 were not conducted.
- **Basin 1:** I/I analysis for Basin 1 should be used at the discretion of the City engineer due to the atypical ADWF pattern of Site 1 (see Figure 3-6).
- **Overflow connections:** Basins 2 and 14 had overflow connections, but the overflows did not activate during the flow monitoring period. Basin 2 and 14 could be isolated for I/I analysis.
    - The distance between the overflow pipe to Basin 14 and the pipe channel invert at site 13 was measured. The levels metered at Site 13 never reached the overflow pipe.
    - The flows at Site 15, 1 and 2 indicated the overflow between Basin 1 and Basin 2 never activated.

3.3.2 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.

I/I flow rate is the real-time flow less the estimated average dry weather flow rate (shown below as the **RED** line). 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 largest rain event, illustrated in Figure 3-12 for Site 6.

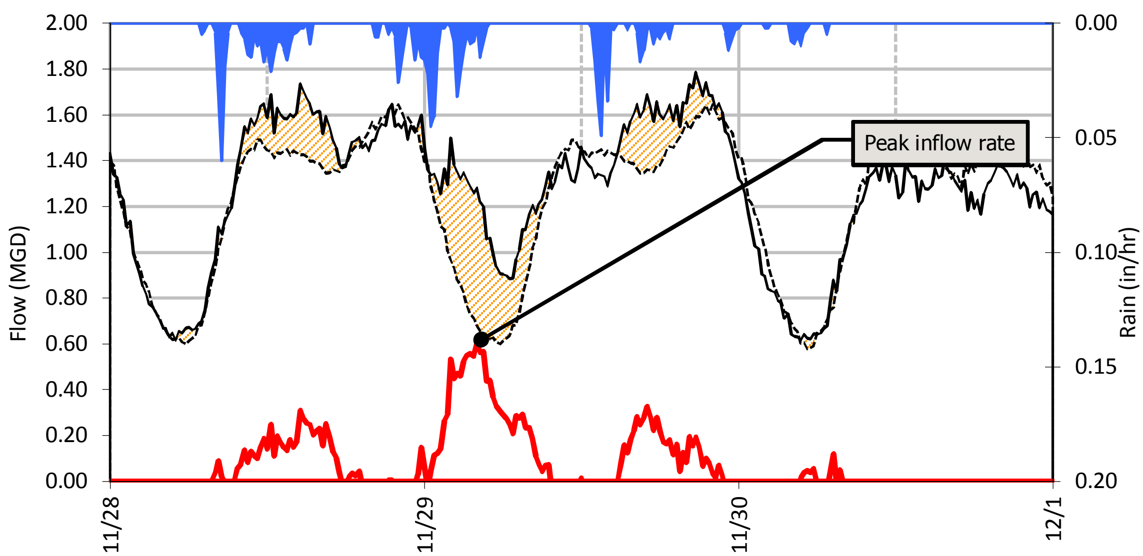


Figure 3-12. Peak Inflow Rate, Site 6

Inflow results were taken from Event 1 (November 28 to December 1, 2018), as this was the most intensive short-term rainfall event. Table 3-5, Figure 3-13, and Figure 3-14 summarize the peak measured inflow and inflow analysis results for the relevant flow monitoring basins. The "Top 3" ranked basins have been shaded in RED. Figure 3-15 shows a temperature map of the final basin rankings. The following inflow results are noted:

- **Inflow**: Basins 2, 6, and 11 had the highest normalized peak I/I rates, an indicator of high inflow upstream from the flow monitoring basin.

Table 3-5. Results and Rankings of Inflow Analysis

Metering Basin	ADWF (mgd)	Basin Acreage	Peak Inflow Rate (mgd)	Peak Inflow per Acreage Ranking	Peak Inflow/ADWF Ranking	Final Inflow Ranking
Basin 1	2.426	4,021	0.282	8	9	9
Basin 2	0.056	1,179	0.166	6	1	2
Basin 5	0.347	315	ND	12	12	12
Basin 6	1.226	1,666	0.601	1	2	1
Basin 7	0.696	865	ND	12	12	12
Basin 8	0.498	1,158	0.025	10	10	10
Basin 9	0.793	1,846	0.006	11	11	11
Basin 10	0.723	2,378	0.347	5	3	5
Basin 11	1.393	2,561	0.498	3	4	3
Basin 12	0.849	2,555	0.215	7	6	7
Basin 13	0.140	374	0.021	9	8	8
Basin 14	0.570	685	0.172	2	5	4
Basin 15	0.967	988	0.181	4	7	6
System	*11.345*	*21,210*	*2.224*			

ND = not determined. The peak I/I rate was too minimal to quantify.

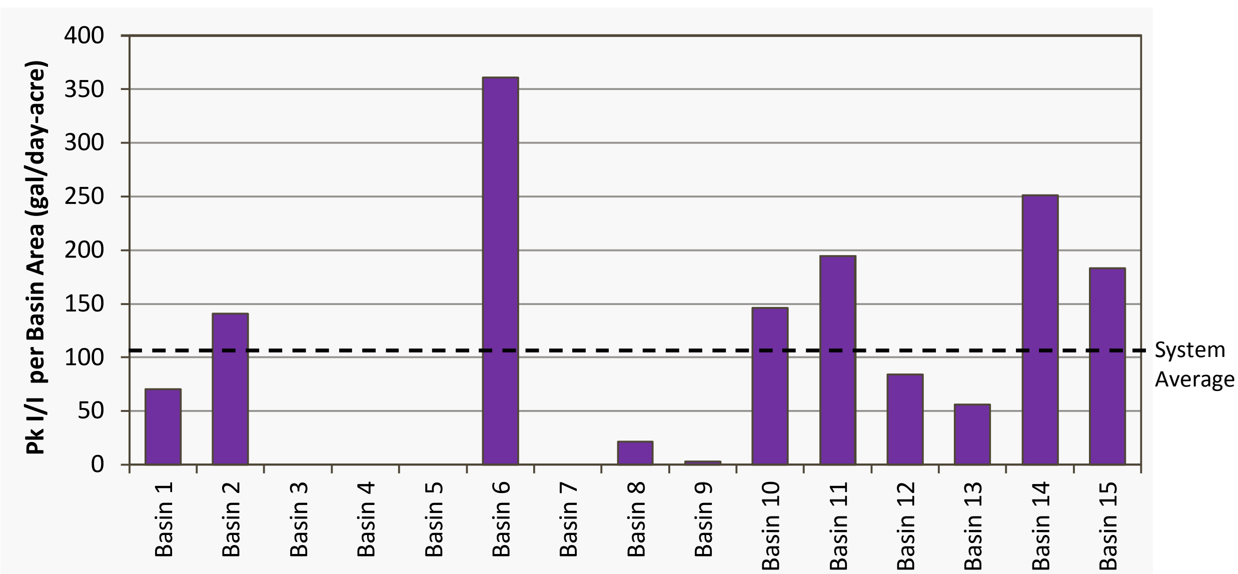


Figure 3-13. Inflow Analysis Summary – Peak I/I Rate to Acreage

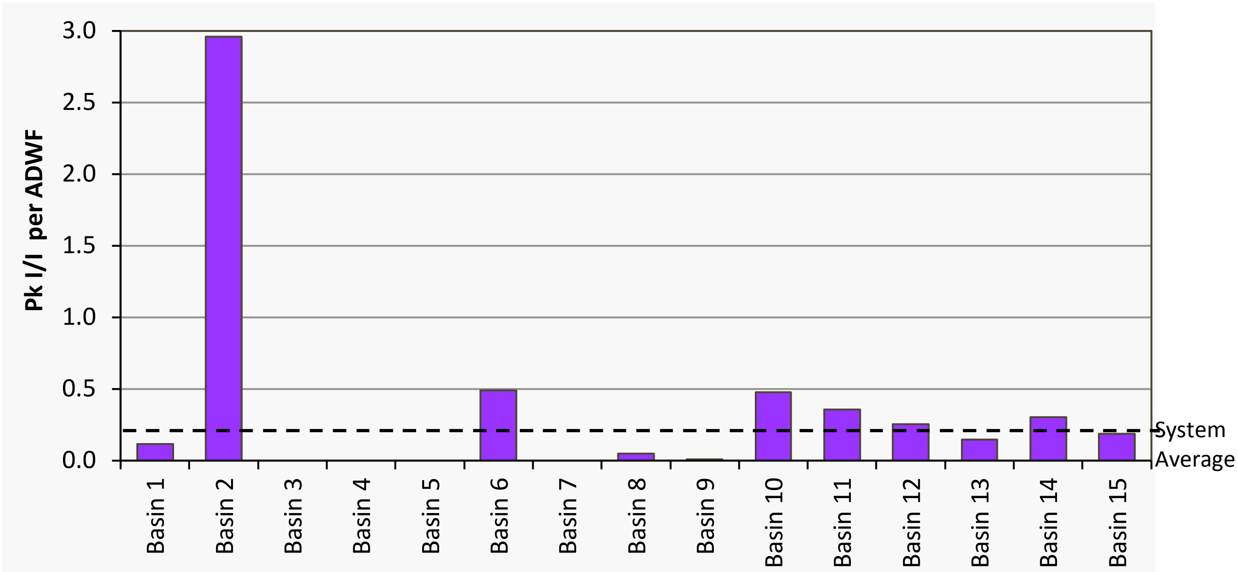


Figure 3-14. Inflow Analysis Summary – Peak I/I Rate to ADWF

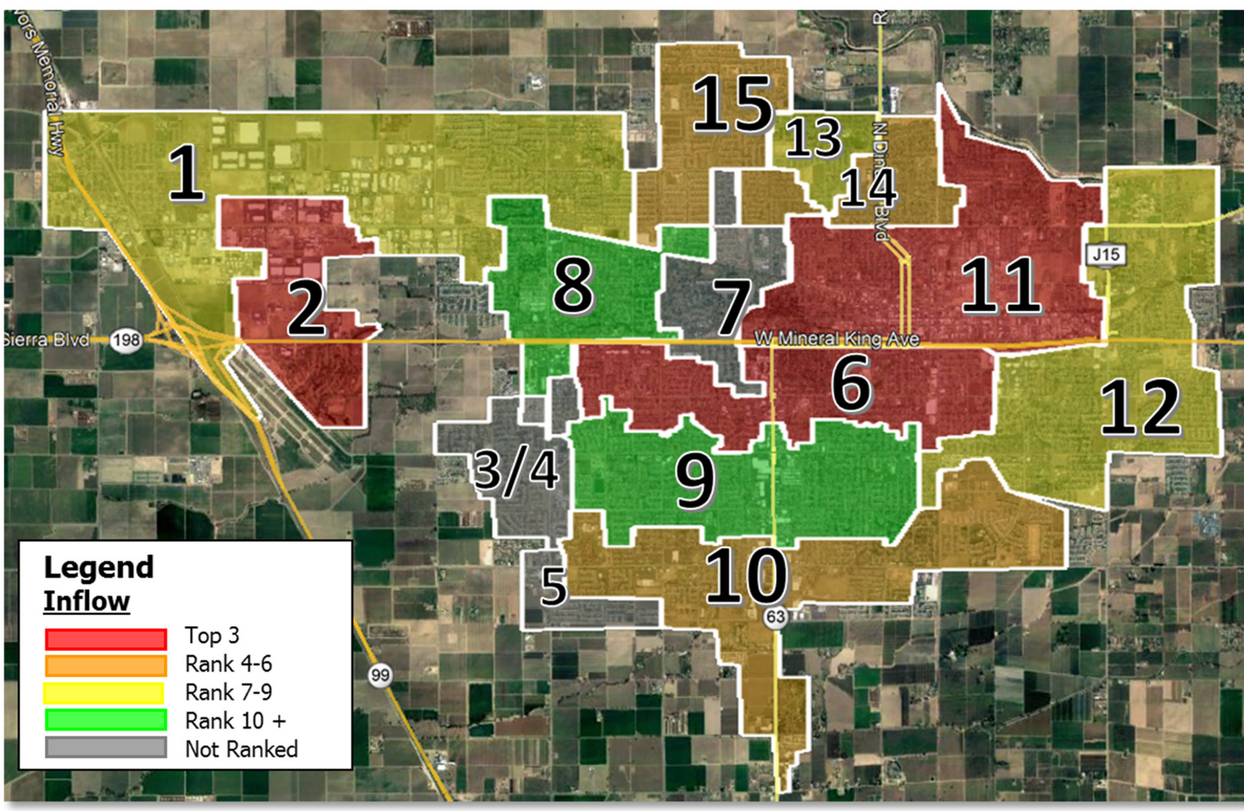


Figure 3-15. Temperature Map: Inflow Final Basin Rankings

3.3.3 RDI Results Summary

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. Increased flows into the sanitary sewer system are usually tied to groundwater levels and soil saturation levels. Infiltration sources transport rain water into the system *indirectly*; flow levels in the sanitary system increase gradually, are typically sustained for a period after rainfall has stopped, and then gradually drop off as soils become less saturated and as groundwater levels recede to normal. 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).

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 (shown in below graphs as the red line).

For this study, the RDI rate used for comparative analysis was measured as the average I/I rate from November 30, 2018 at 12:00 midnight to December 1, 2018 at 12:00 midnight. Figure 3-16 illustrates this for Site 3.

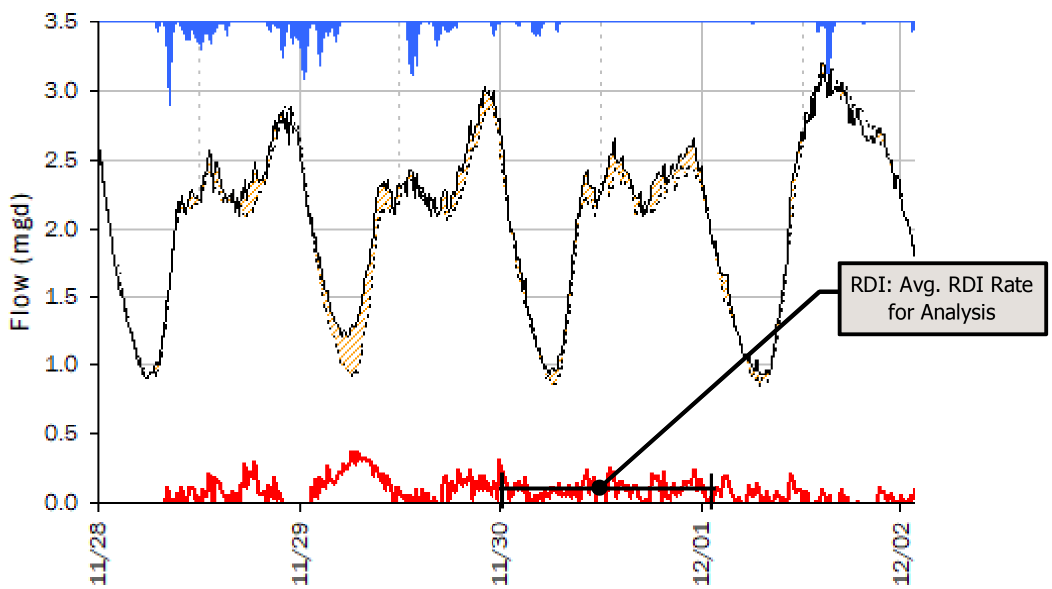


Figure 3-16. RDI Measurement, Site 3

Generally, there was not much RDI measured in the City collection system. Only 5 of 13 basins had quantifiable RDI rates. For this analysis, the "Top 2" overall rankings for this analysis have been shaded in RED. Table 3-6 summarizes the calculated RDI flow rates for Event 1 (refer to the I/I Analysis Methods section for more information on RDI analysis methods).

Figure 3-17 and Figure 3-18 show the bar graph results of the per Basin RDI analysis. Figure 3-19 shows a temperature map of the final basin rankings. The following RDI results are noted:

- **RDI**: Only Basins 2, 5, 9, 10 and 15 had detectable levels of RDI contribution. Basins 2 and 5 ranked highest for normalized RDI contribution.

Table 3-6. Results and Rankings of RDI Analysis

Metering Basin	ADWF (mgd)	Basin Acreage	RDI Rate (mgd)	Peak RDI/Acreage (gpd/acre)	Peak RDI/ADWF	Final RDI Ranking
Basin 1	2.426	4,021	ND	ND	ND	6
Basin 2	0.056	1,179	0.045	39	0.81	1
Basin 5	0.347	315	0.040	128	0.12	2
Basin 6	1.226	1,666	ND	ND	ND	6
Basin 7	0.696	865	ND	ND	ND	6
Basin 8	0.498	1,158	ND	ND	ND	6
Basin 9	0.793	1,846	0.046	25	0.06	3
Basin 10	0.723	2,378	0.002	1	0.00	5
Basin 11	1.393	2,561	ND	ND	ND	6
Basin 12	0.849	2,555	ND	ND	ND	6
Basin 13	0.140	374	ND	ND	ND	6
Basin 14	0.570	685	ND	ND	ND	6
Basin 15	0.967	988	0.036	37	0.04	4

ND = not determined. RDI rate was too minimal to quantify. All these basins were ranked the lowest as rank 6.

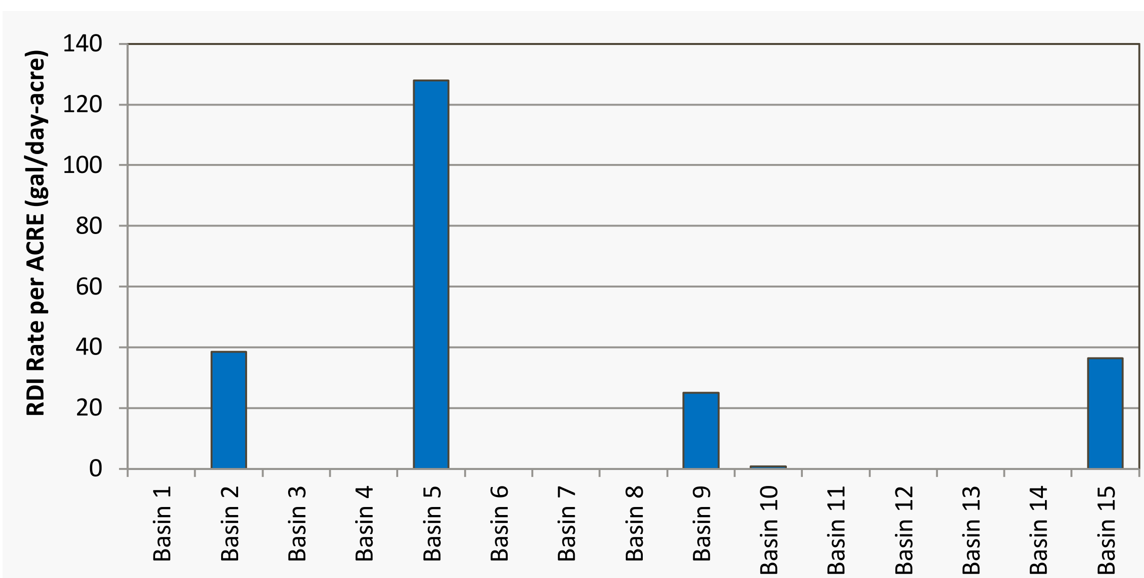


Figure 3-17. RDI Analysis Summary – RDI Rate to ACRE

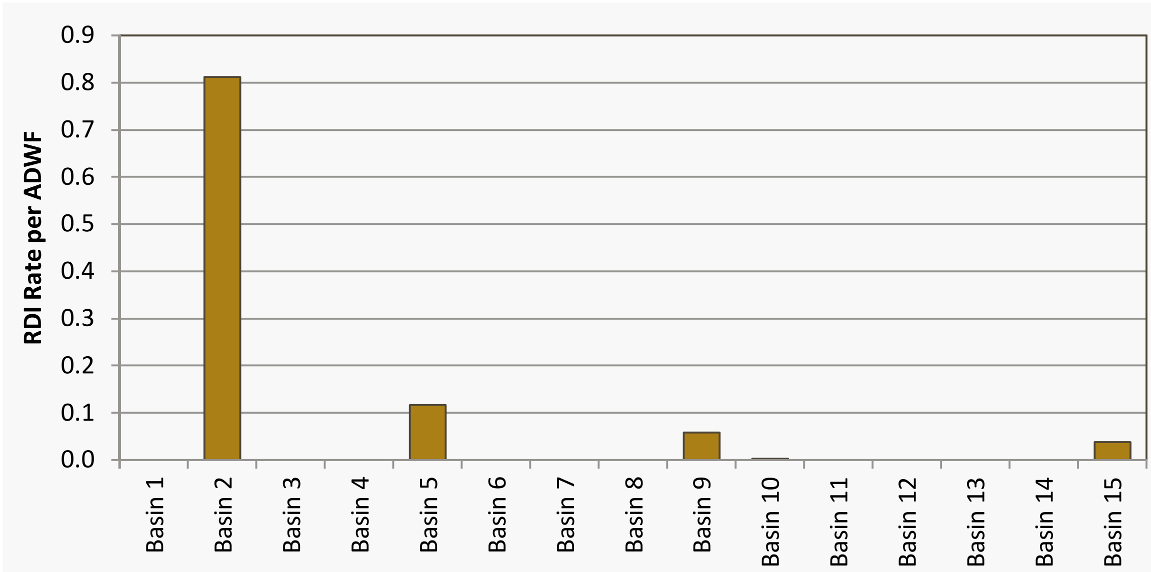


Figure 3-18. RDI Analysis Summary – RDI Rate to ADWF

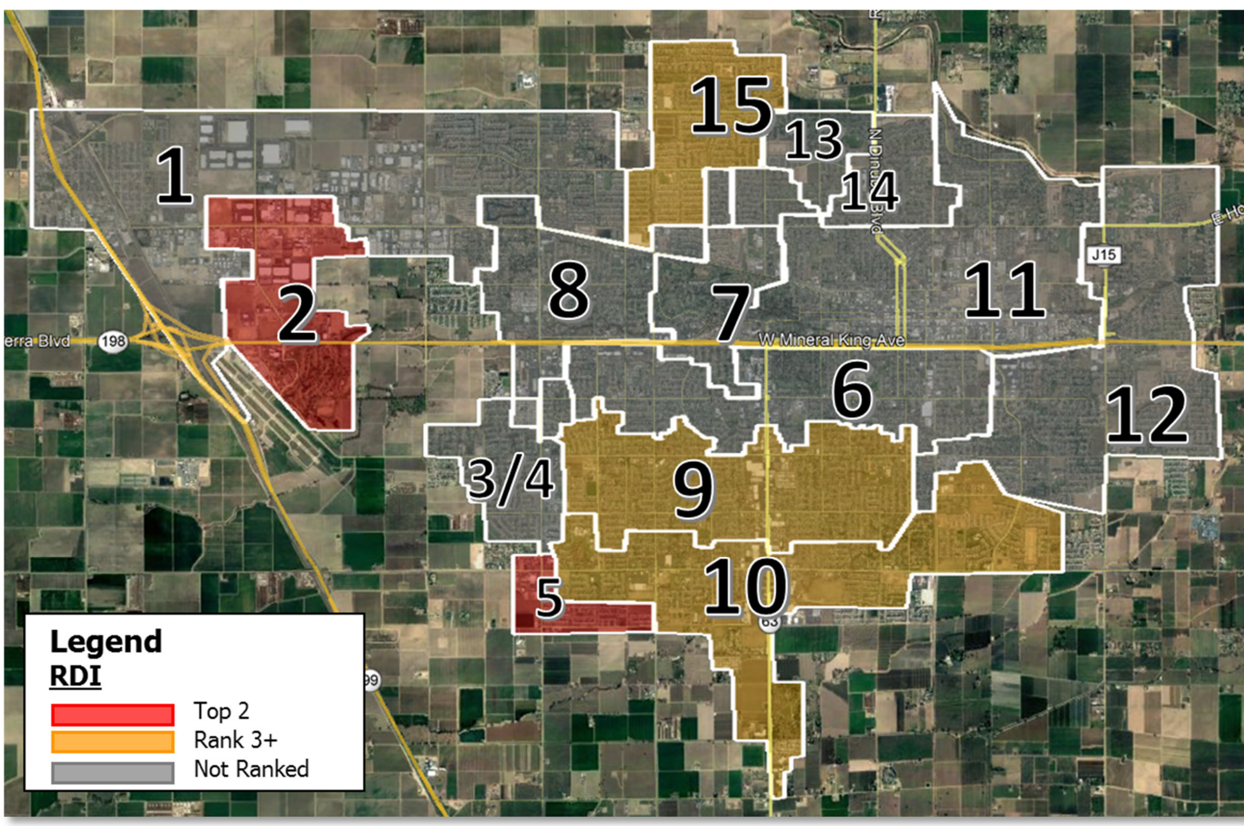


Figure 3-19. Temperature Map: RDI Final Basin Rankings

3.3.4 Total I/I Results

Total 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 total I/I flow results for the November 28 – December 1, 2018 rain event. The "Top 3" overall rankings for this analysis have been shaded in RED. Figure 3-20 and Figure 3-21 show a bar graph summary of the results. Figure 3-22 shows a temperature map of the final basin rankings. The following total I/I results are noted:

- **Total I/I**: Basins 6, 10, and 11 had the highest normalized total I/I rates, an indicator of high inflow and rain-dependent infiltration upstream from the flow monitoring basin.

Table 3-7. Total I/I Analysis Summary

Basin	ADWF (mgd)	Basin Acreage	Total I/I (gallons)	Total I/I per ADWF, per inch rain	Ranking (Total I/I per ADWF)	Ranking (Total I/I per Acre)	Final Total I/I Ranking
Basin 1	2.426	4,021	40,800	0.02	9	9	9
Basin 2	0.056	1,179	94,000	1.67	6	1	4
Basin 5	0.347	315	ND	ND	11	12	11
Basin 6	1.226	1,666	195,700	0.16	1	4	2
Basin 7	0.696	865	ND	ND	11	12	11
Basin 8	0.498	1,158	ND	ND	11	12	11
Basin 9	0.793	1,846	80,700	0.10	7	6	7
Basin 10	0.723	2,378	184,600	0.27	4	2	3
Basin 11	1.393	2,561	247,600	0.17	2	3	1
Basin 12	0.849	2,555	78,700	0.09	8	8	8
Basin 13	0.140	529	1,400	0.01	10	11	10
Basin 14	0.570	529	58,500	0.10	5	7	5
Basin 15	0.967	988	87,500	0.09	3	9	6
System	*11.35*	-	*1,360,700*	-	-	-	-

ND = not determined. Basin Total I/I rate was too minimal to quantify. All these basins were ranked the lowest rank.

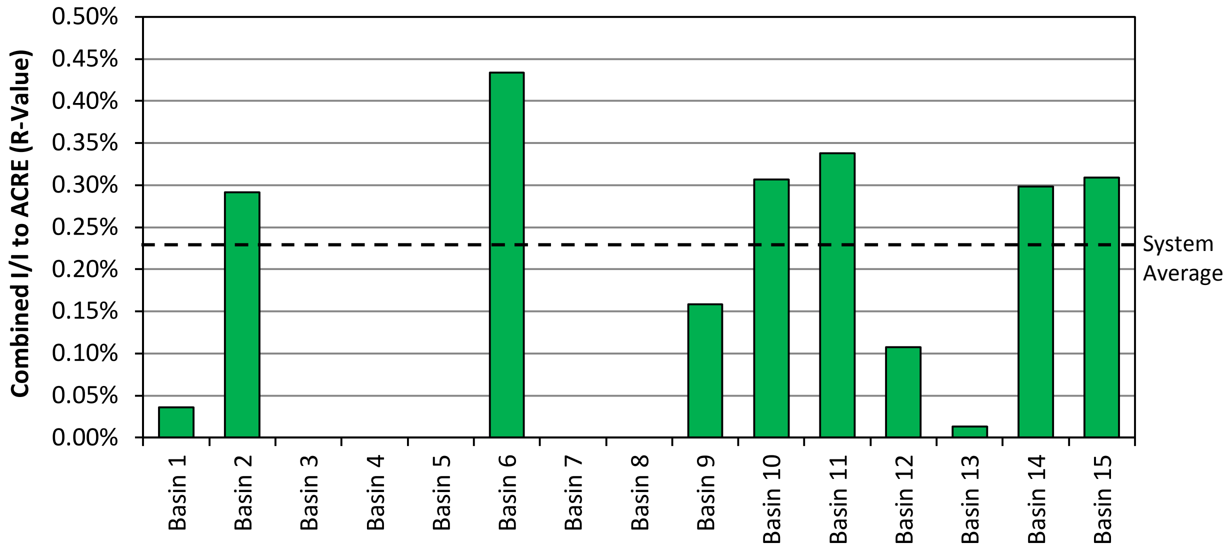


Figure 3-20. Combined I/I Analysis Summary – Total I/I to ACRE (R-Value)

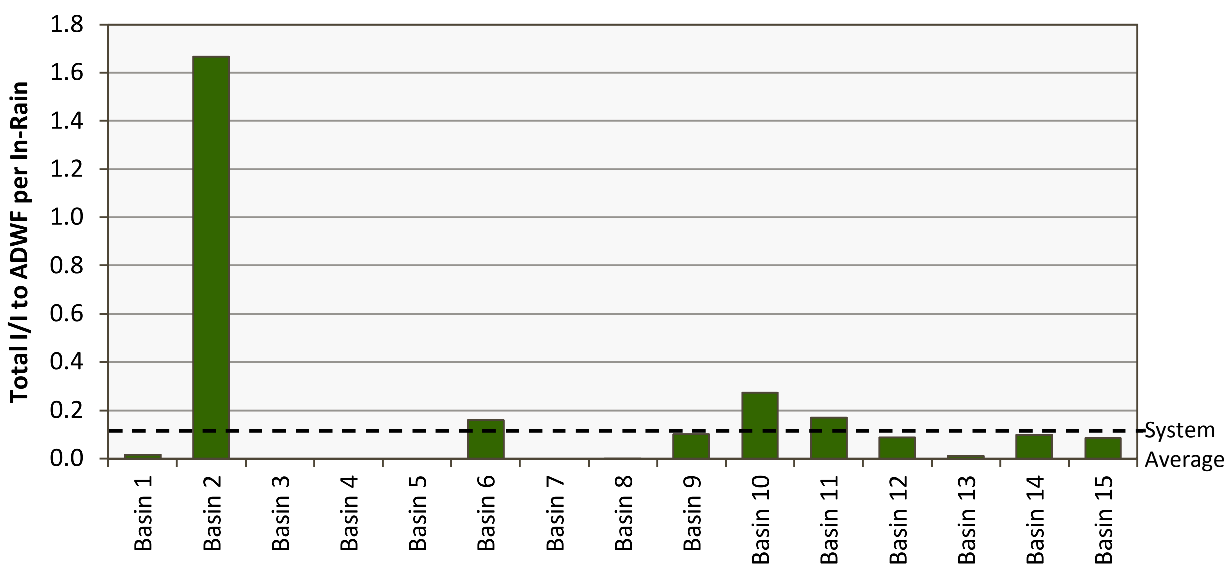


Figure 3-21. Combined I/I Analysis Summary – Total I/I to ADWF

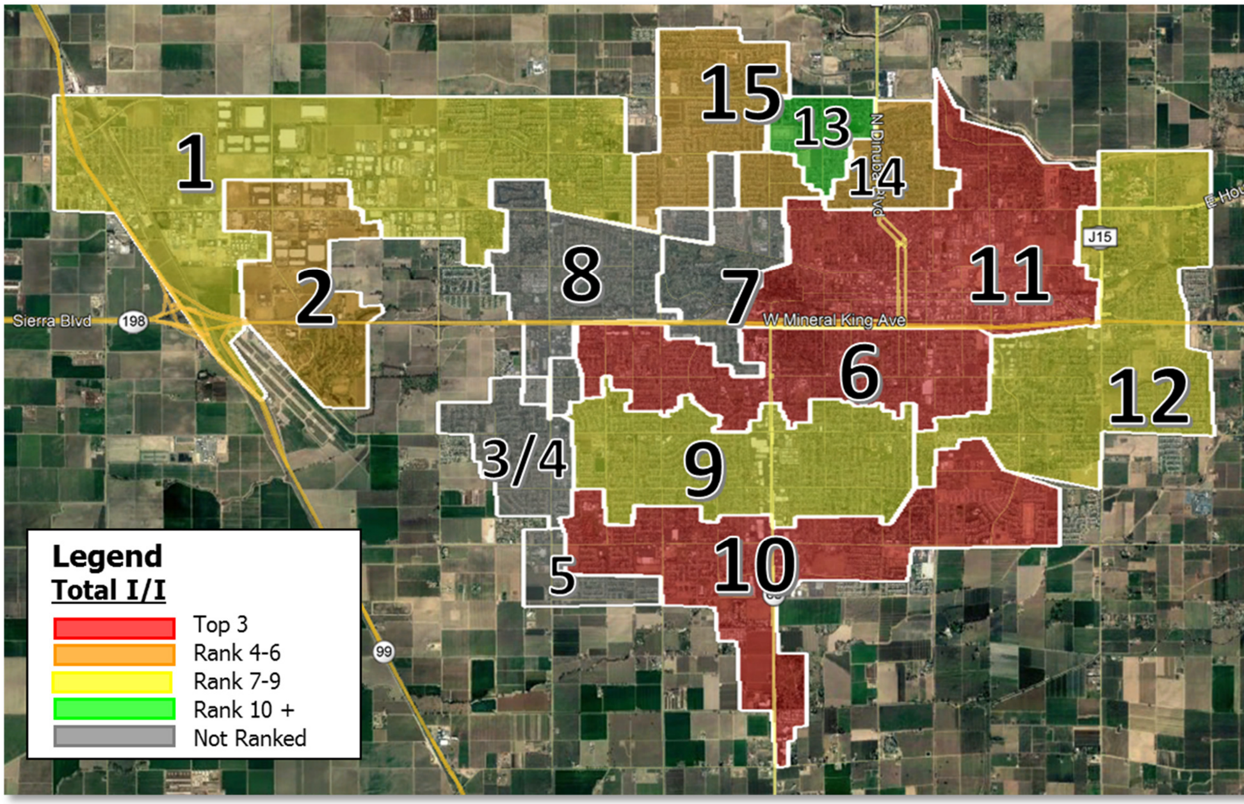


Figure 3-22. Temperature Map: Total I/I Final Basin Rankings

3.3.5 Groundwater Infiltration Results Summary

Dry weather (ADWF) flow can be expected to have a predictable diurnal flow pattern. While each Basin is unique, experience has shown that, given a reasonable volume of flow and typical loading conditions, the daily flows fall into a predictable range when compared to the daily average flow. If a Basin has a large percentage of groundwater infiltration occurring during the periods of dry weather flow measurement, the amplitudes of the peak and low flows will be dampened[10]. Figure 3-23 shows a sample of two flow monitoring Basins, both with nearly the same average daily flow, but with considerably different peak and low flows. In this *sample* case, Basin B1 may have a considerable volume of groundwater infiltration.

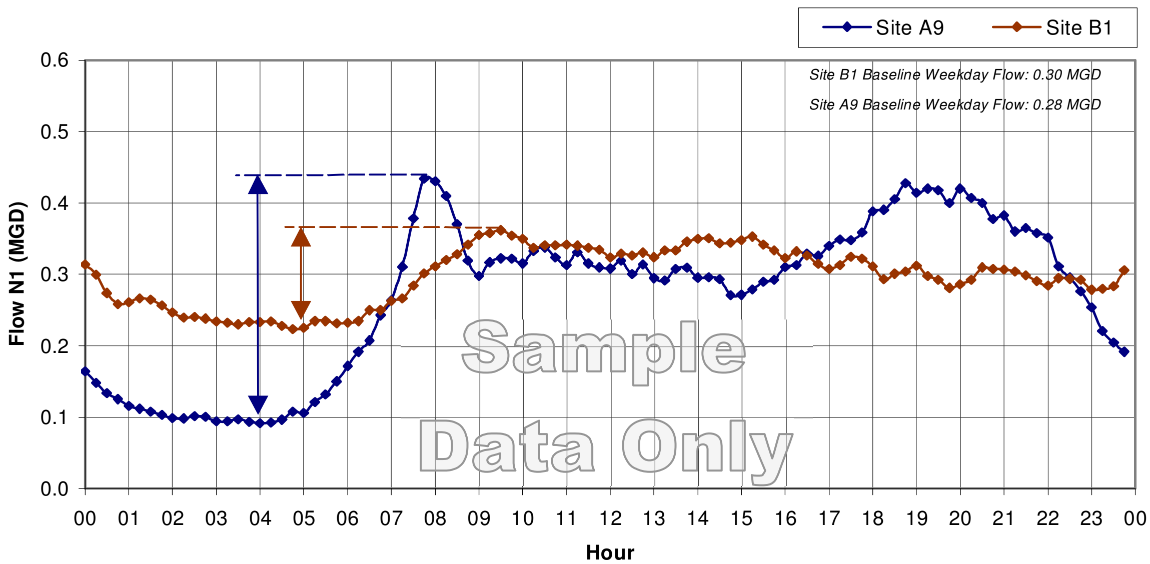


Figure 3-23. Groundwater Infiltration Sample Figure

It can be useful to compare the low-to-ADWF flow ratios for the flow metering sites. A site with abnormal ratios, and with no other reasons to suspect abnormal flow patterns (such as proximity to a pump station, treatment facilities, etc.), has a possibility of higher levels of groundwater infiltration in comparison to the rest of the collection system.

Figure 3-24 plots the low-to-ADWF flow ratios[11] against the ADWF flows for the relevant flow monitoring Sites. The brown dashed line shows “typical” low-to-ADWF ratios per the Water Environment Federation (WEF).

WEF derived these ratios from residential sanitary sewer data. It is noted that the type of service in this project (airport and shipping) is not residential, and there exists the possibility of excessive early-morning flows due to abnormal working hours. This analysis is presented for reference only.

[10] In an extreme case, perhaps 0.2 mgd of ADWF flow and 2.0 mgd of groundwater infiltration, the peaks and lows would be barely recognizable; the ADWF flow would be nearly a straight line.

[11] The Minimum to Average flow ratio is calculated by taking the minimum flow and dividing by the ADWF value (using the Mon-Thu ADWF curve).

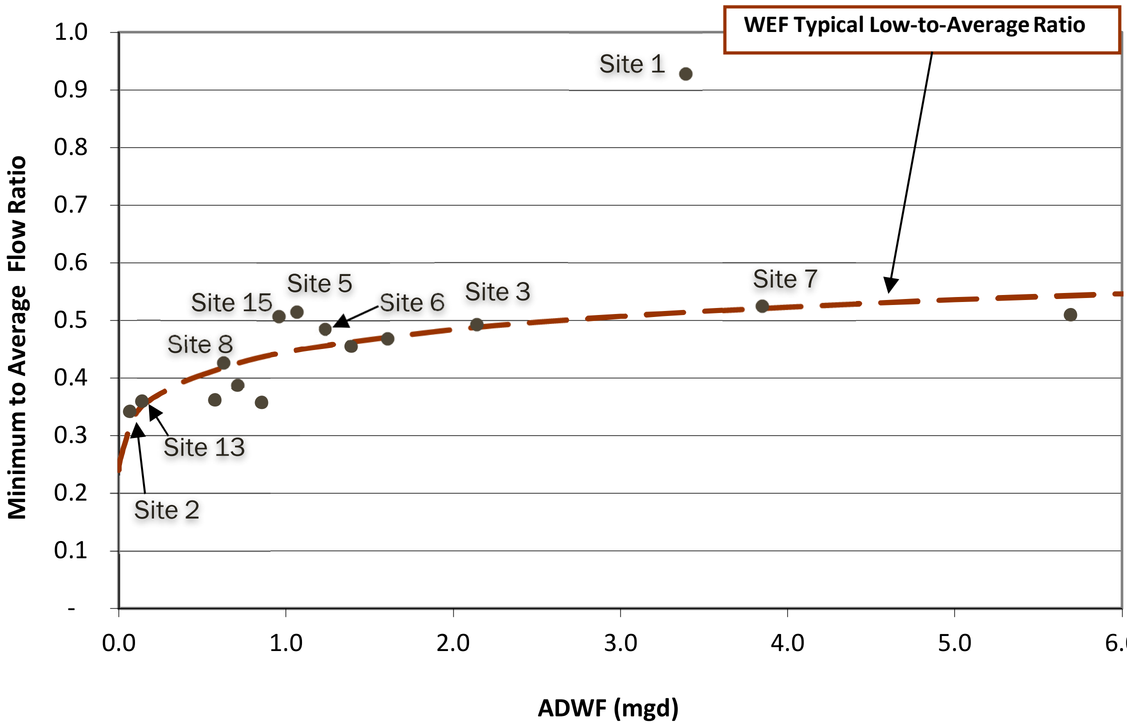


Figure 3-24. Minimum Flow Ratios vs ADWF[12]

The following GWI results are noted:

- **Groundwater Infiltration**: 8 of 15 monitoring sites were suitable for GWI analysis.
  - **Site 1**: Site 1 would appear to have large amounts of GWI, but this is likely actually the result of an odd ADWF curve (Figure 3-6). The basis or origin of this curve is unknown at this point but could be the result of a unique service area.
  - **Sites 5 and 15**: these two sites could be noted as having the possibility of higher than typical GWI rates. However, given the agricultural and industrial areas, these two sites could be within the range of uncertainty of the WEF curve. This analysis is presented <u>for reference only</u>. V&A does not draw any conclusions from this analysis.

[12] Due to attenuation, it should be expected that sites with larger flow volumes should not have quite the peak-to-average and low-to-average flow ratios as sites with lesser flow volumes. This is why the WEF typical trend line's slope is closer to 1.0 as the ADWF increases, as shown in the figure.

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. The highest inflow occurs in Basins 2, 6, and 11.
    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. RDI rates were relatively low; there may not be a cost-effective reason to pursue sources of RDI.
3. **I/I Investigation Methods**: Potential I/I investigation methods include the following:
    a. Smoke testing can be effective for locating sources of inflow. Smoke testing can be considered for Basins 2, 6, and 11 which had the highest normalized inflow rates.
    b. Mini-basin or sub-basin flow monitoring can be used to better determine the distribution of I/I within a particular sub-basin. Basins 2, 6, and 11 may be good candidates mini-basin flow monitoring to better locate the distribution of inflow and infiltration within these basins.
    c. Night-time I/I reconnaissance can be conducted within basins with high RDI rates to better determine on a pipe reach by pipe reach basis where the RDI is occurring within particular sub-basin. This method may be utilized to determine candidate neighborhoods for potential CIP projects to mitigate and reduce I/I within the collection system. Night-time I/I reconnaissance is not recommended for this system.
4. **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 Basin Reports: Data, Graphs, Information

City of Visalia

Sanitary Sewer Flow Monitoring

November 28, 2018 - January 06, 2019

Monitoring Site: Site 1

Location: End of Drive 85

Data Summary Report

Vicinity Map: Site 1

SITE 1

Site Information

Location: End of Drive 85

Coordinates: 119.3959° W, 36.3174° N

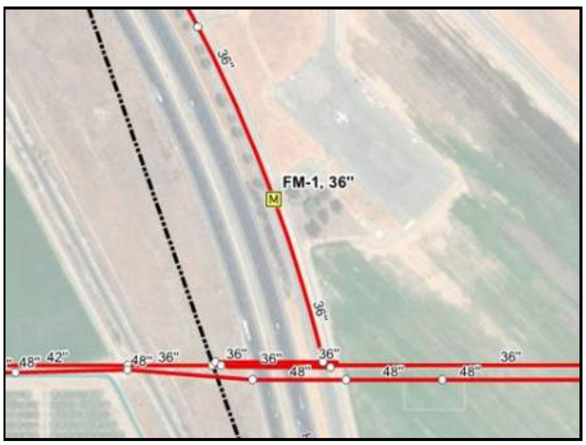
Rim Elevation (Earth): 290 feet

Pipe Diameter: 36 inches

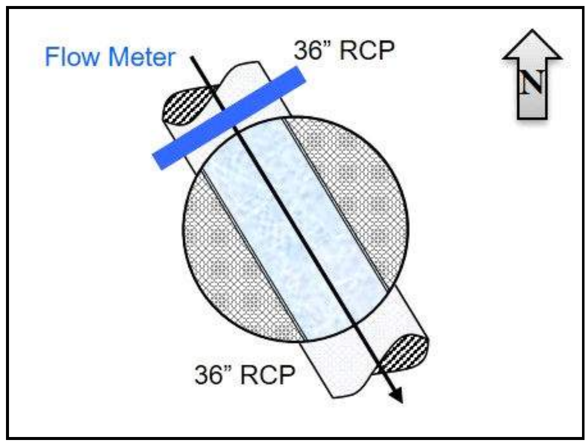
ADWF: 3.393 mgd

Peak Measured Flow: 4.332 mgd

Satellite Map



Sewer Map



Flow Sketch


Street View


Plan View

SITE 1

Additional Site Photos

Effluent Pipe

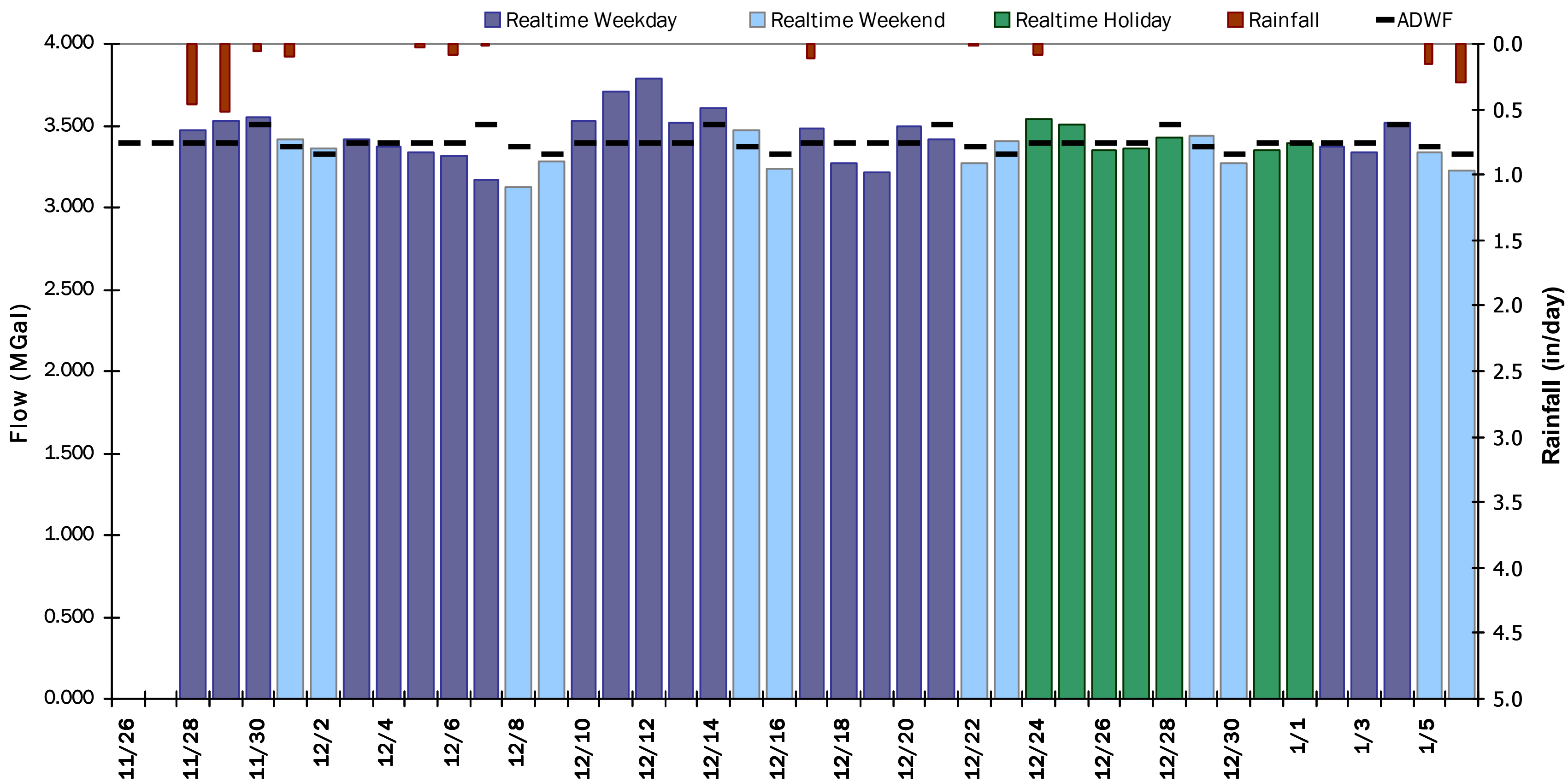
Influent Pipe

SITE 1

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 3.403 MGal **Peak Daily Flow: 3.784 MGal** **Min Daily Flow: 3.121 MGal**

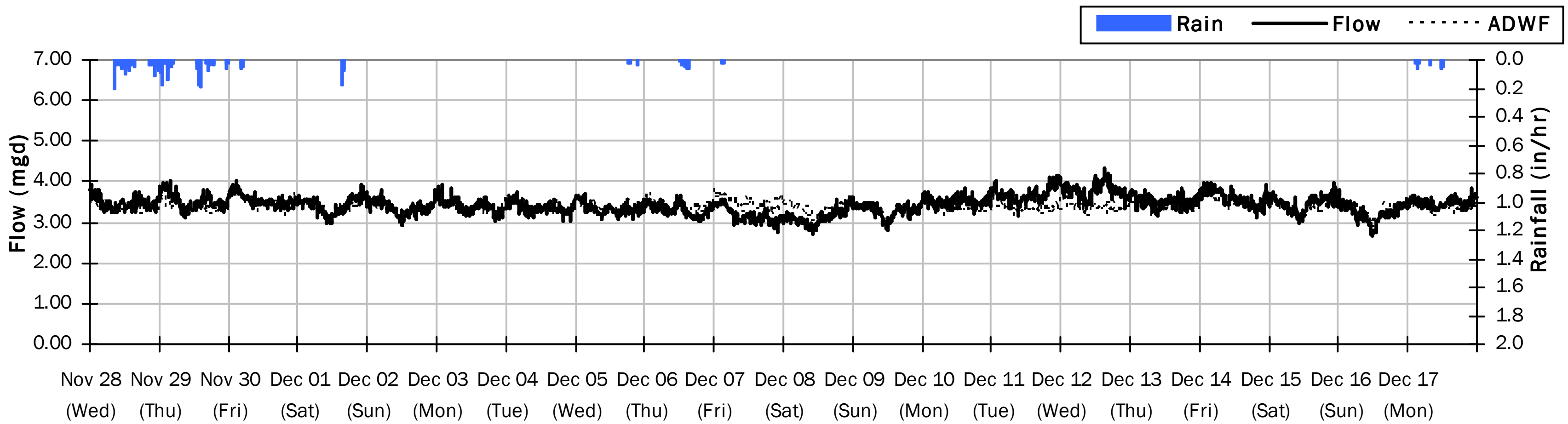
Total Period Rainfall: 1.91 inches

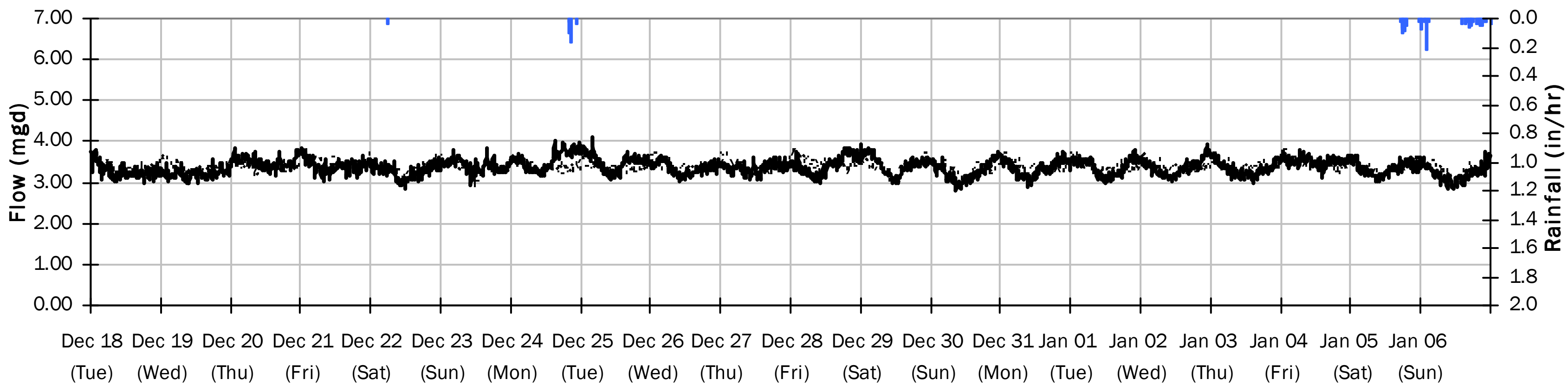


SITE 1

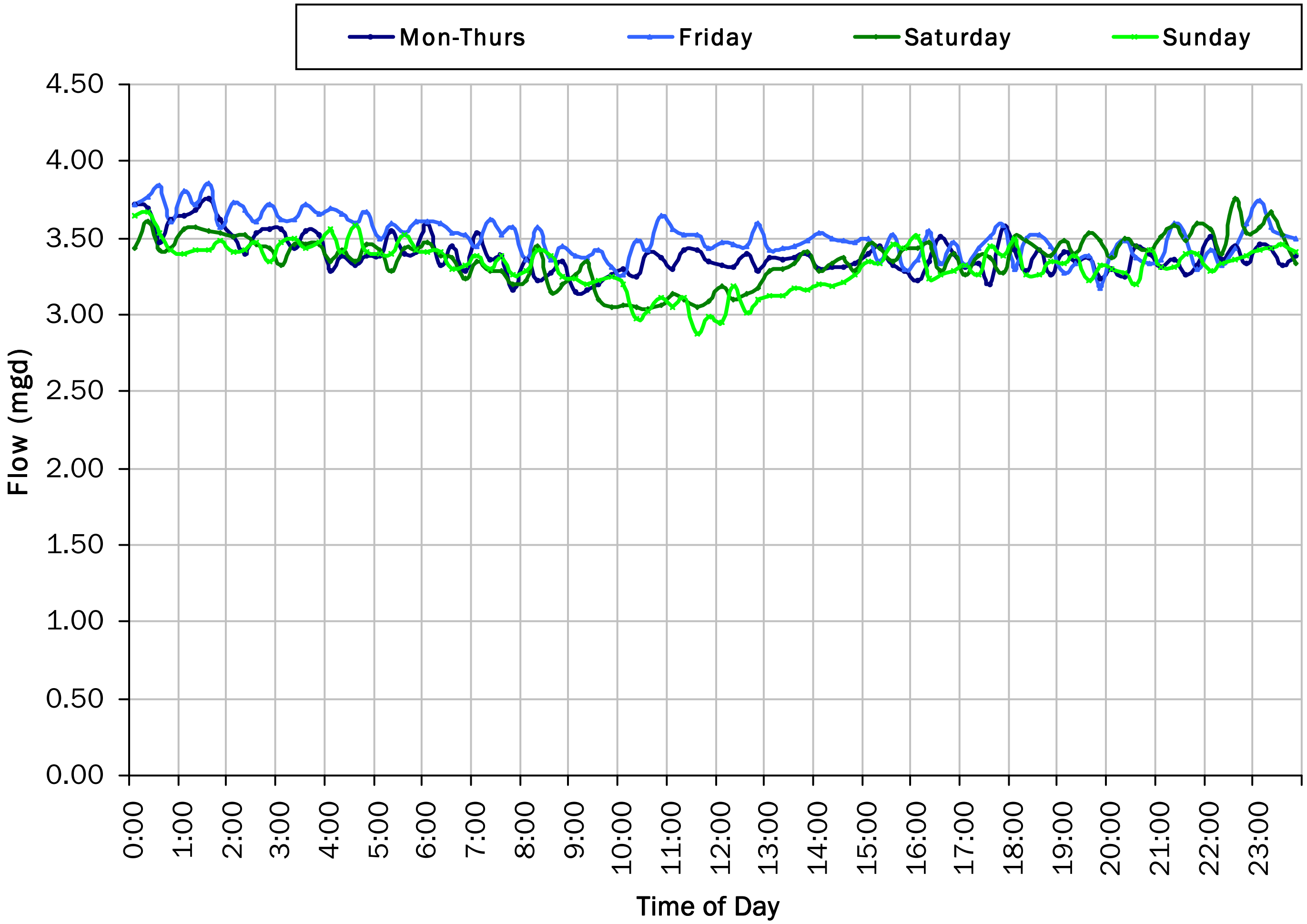
Flow Summary: 11/28/2018 to 1/6/2019

Total Period Rainfall: 1.91 inches Avg Flow: 3.403 mgd Peak Flow: 4.332 mgd Min Flow: 2.680 mgd



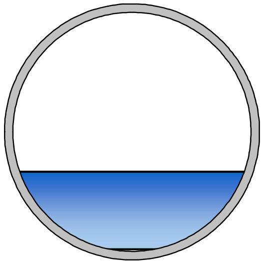


SITE 1
Average Dry Weather Flow Hydrographs



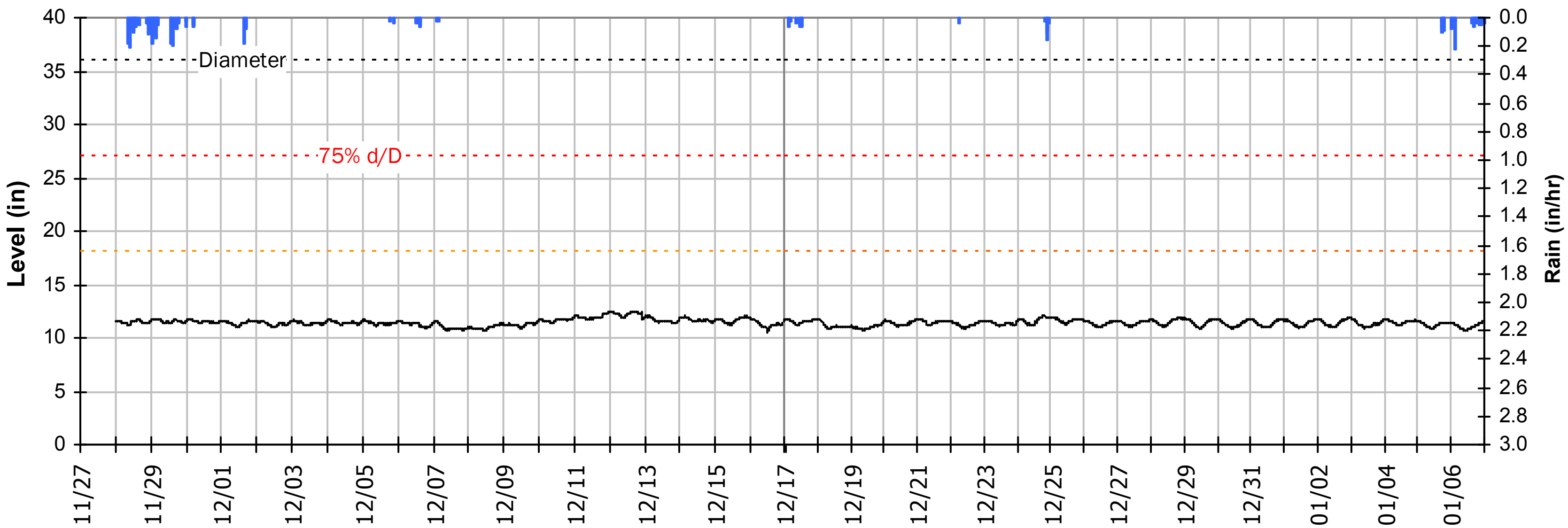
ADWF:

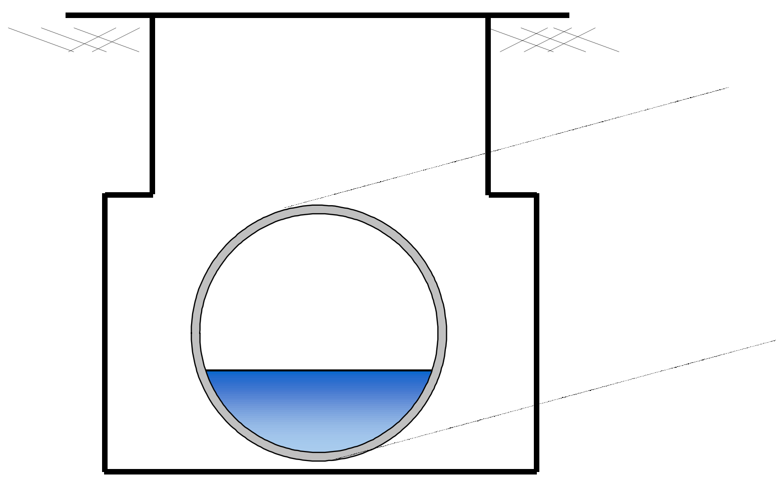
3.393 *mgd*



SITE 1
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

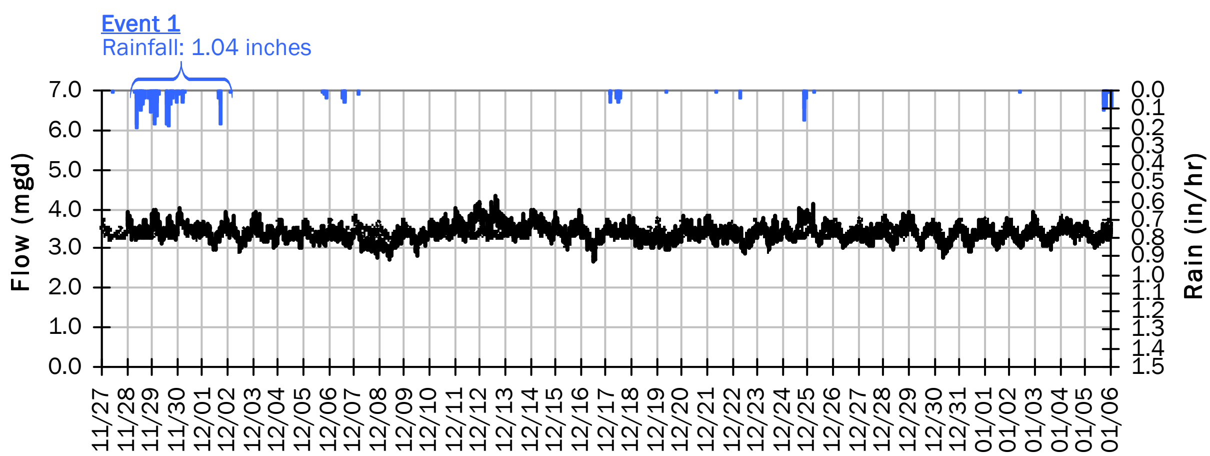




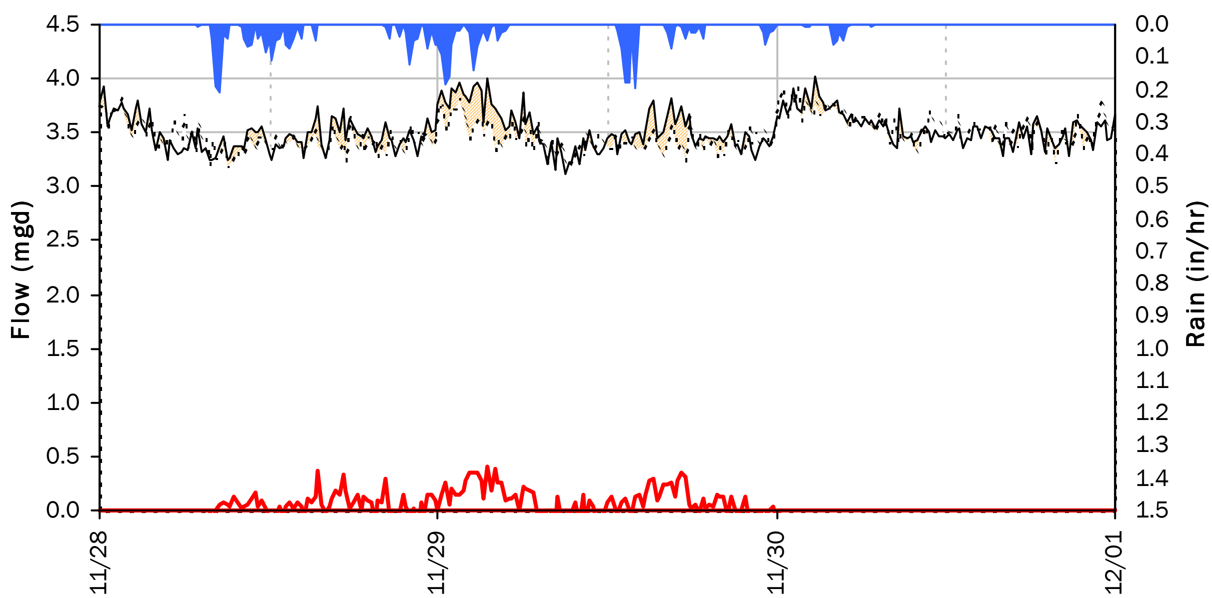
Pipe Diameter:	36	*inches*
Peak Measured Level:	12.5	*inches*
Peak d/D Ratio:	0.35	

SITE 1
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



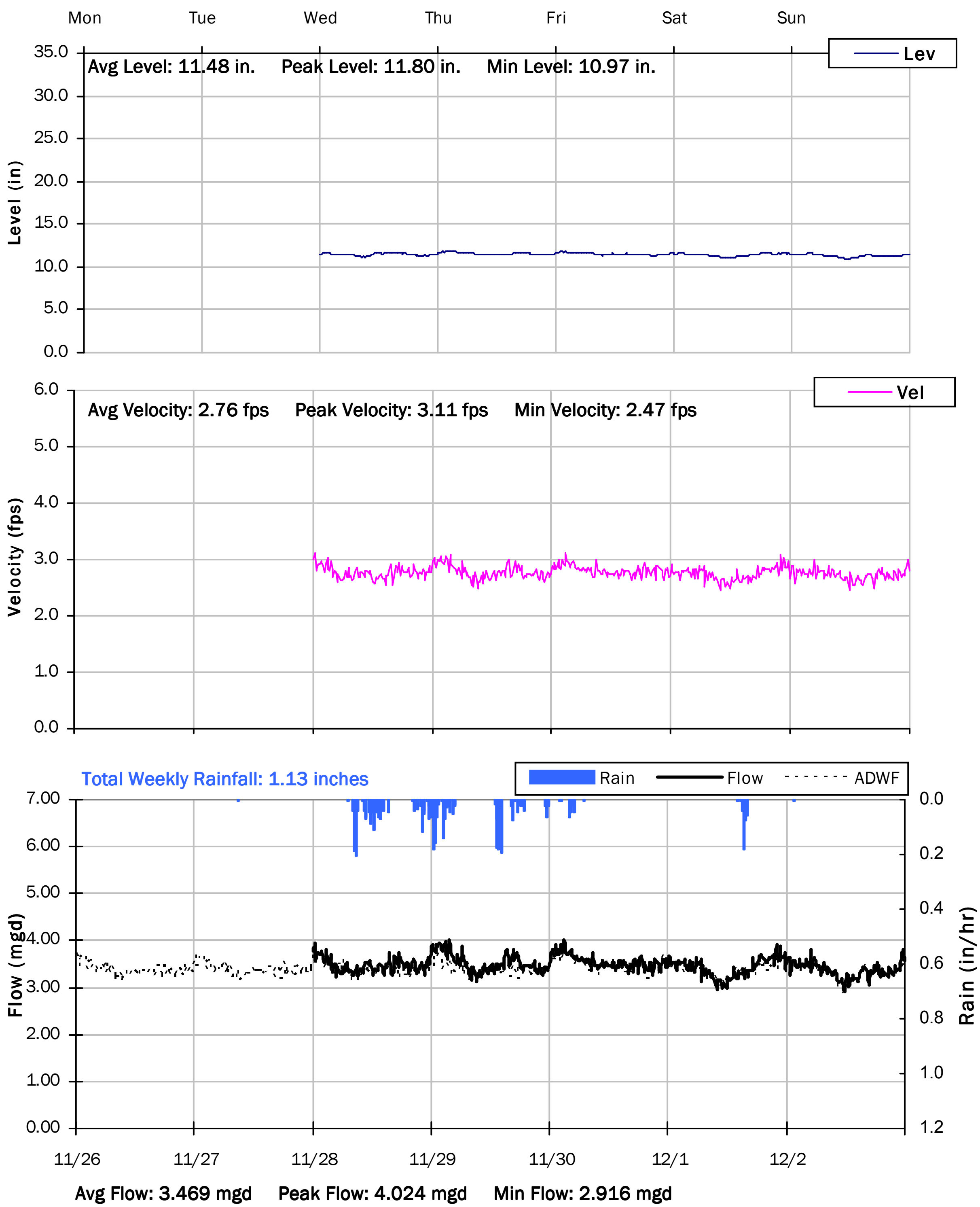
Event 1 Detail Graph



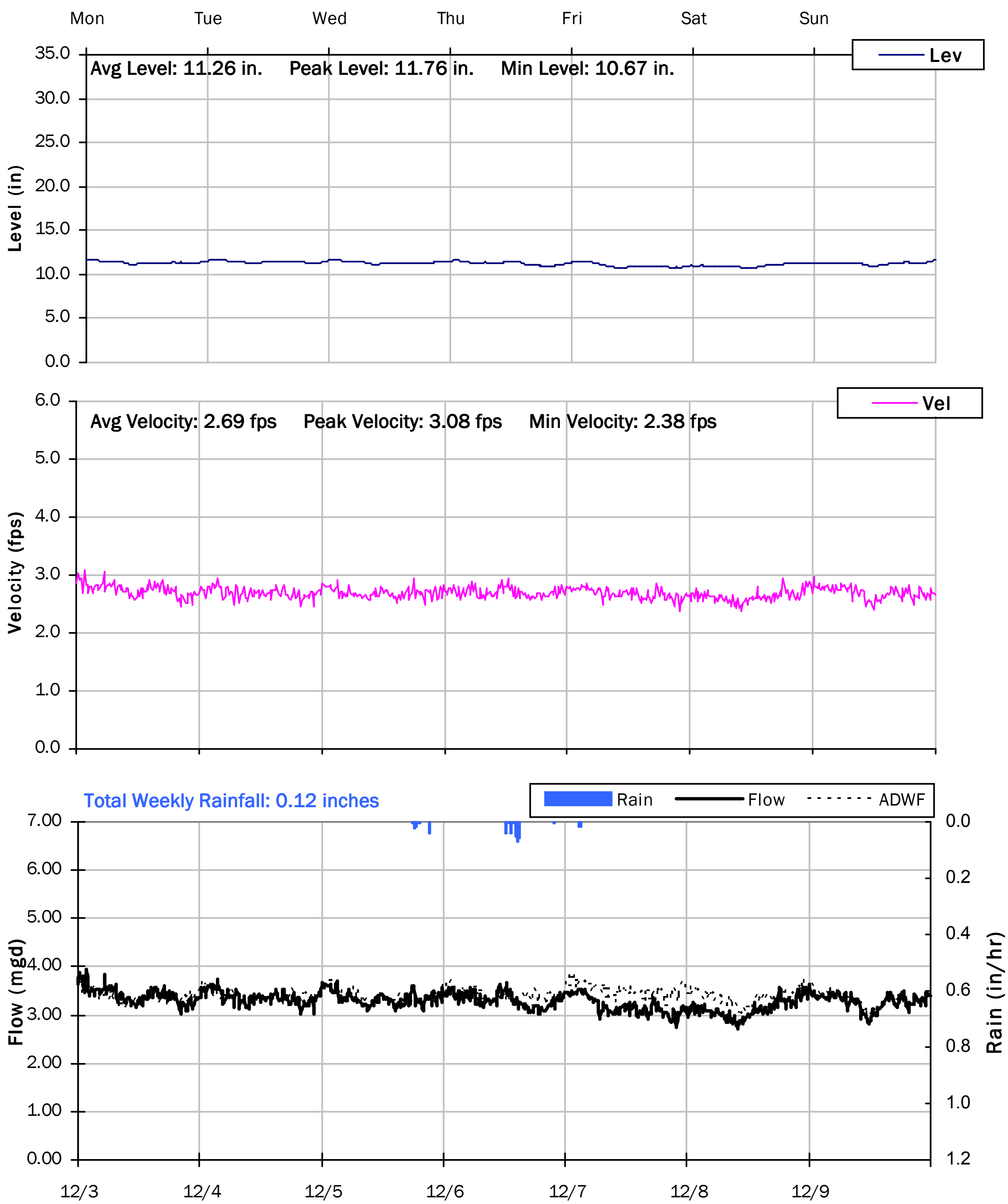
Storm Event I/I Analysis (Rain = 1.04 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	4.00 *mgd*	**Peak I/I Rate:**	0.41 *mgd*
PF:	1.18	**Total I/I:**	128,000 *gallons*
Peak Level:	11.80 *in*		
d/D Ratio:	0.33		

SITE 1
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018



SITE 1
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018

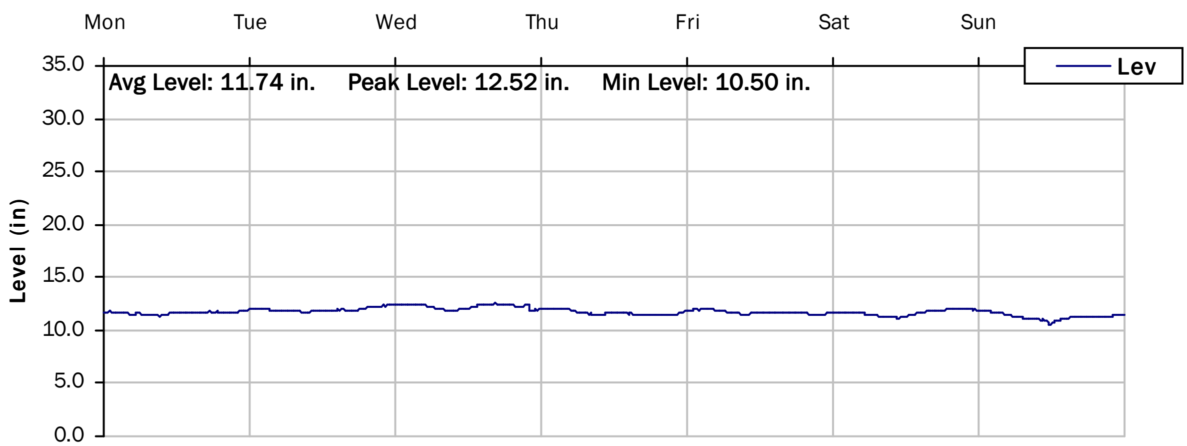


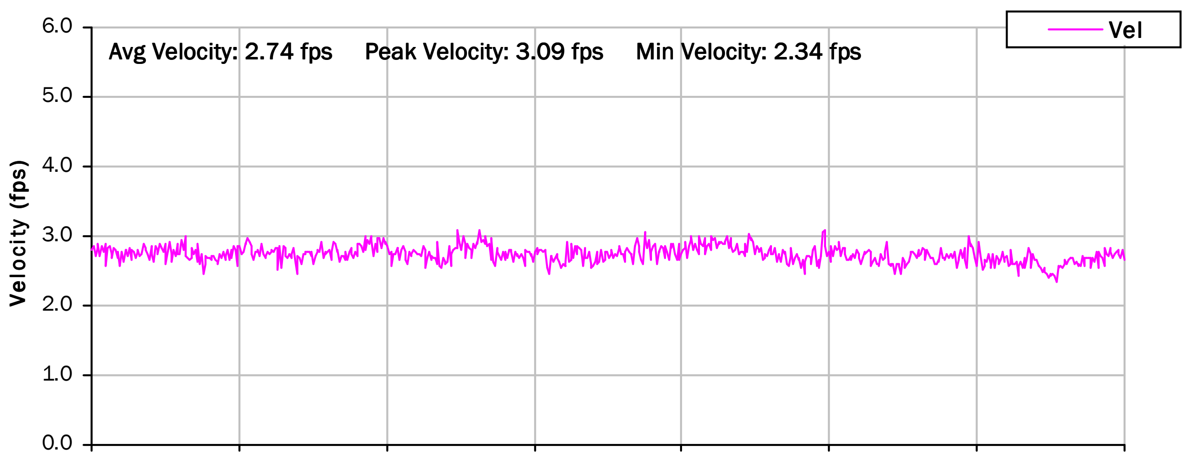
Avg Flow: 3.287 mgd **Peak Flow: 3.940 mgd** **Min Flow: 2.703 mgd**

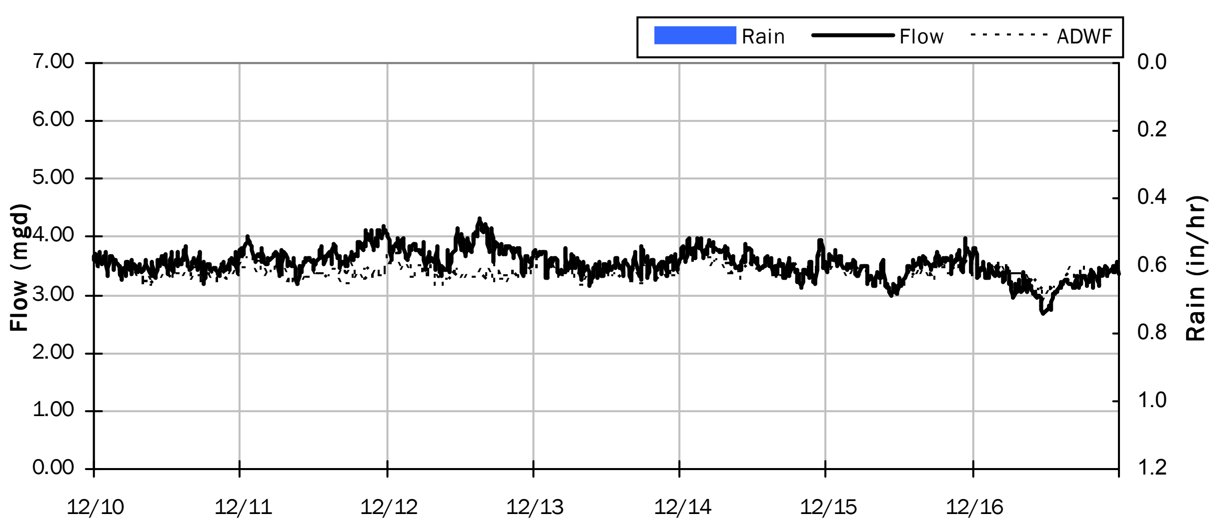
SITE 1

Weekly Level, Velocity and Flow Hydrographs

12/10/2018 to 12/17/2018





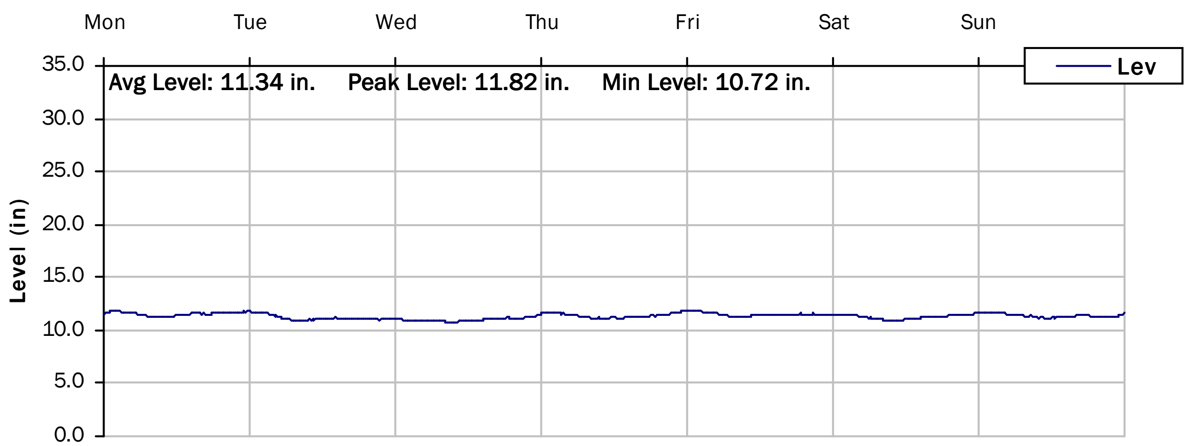


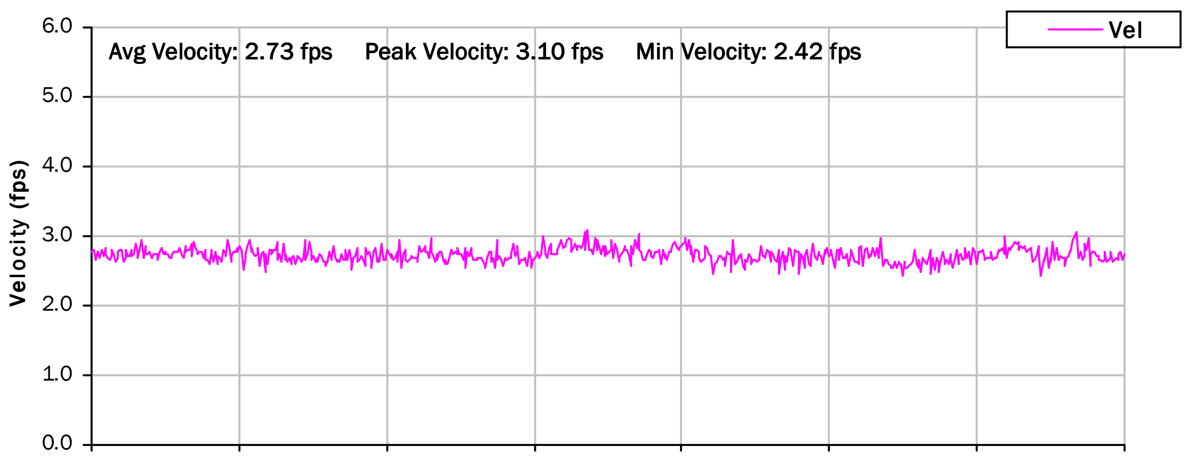
Avg Flow: 3.547 mgd **Peak Flow: 4.332 mgd** **Min Flow: 2.680 mgd**

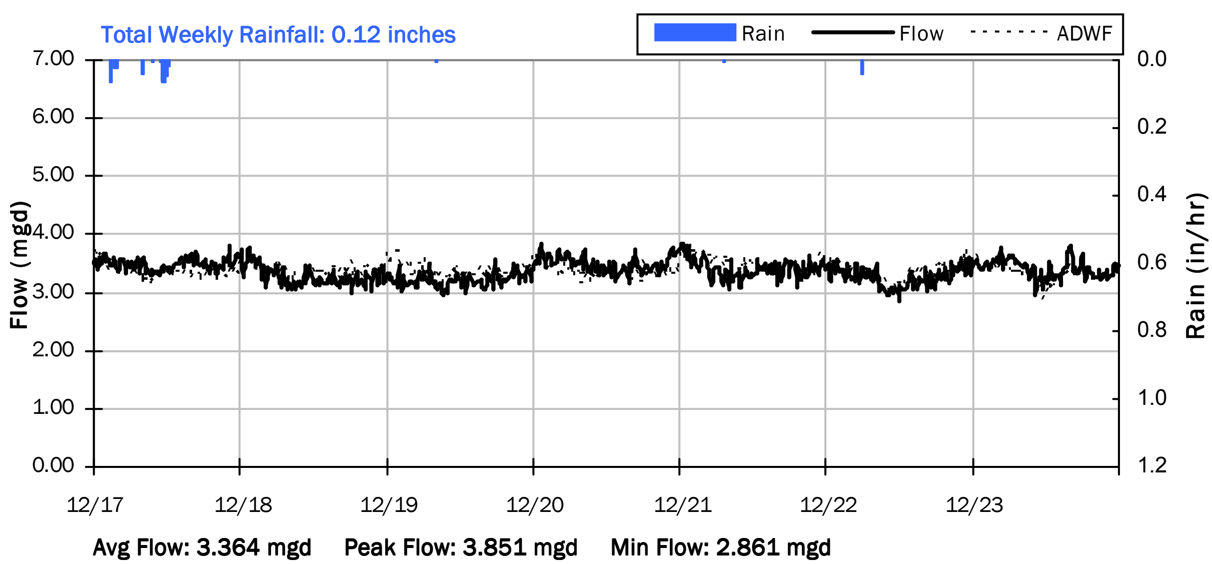
SITE 1

Weekly Level, Velocity and Flow Hydrographs

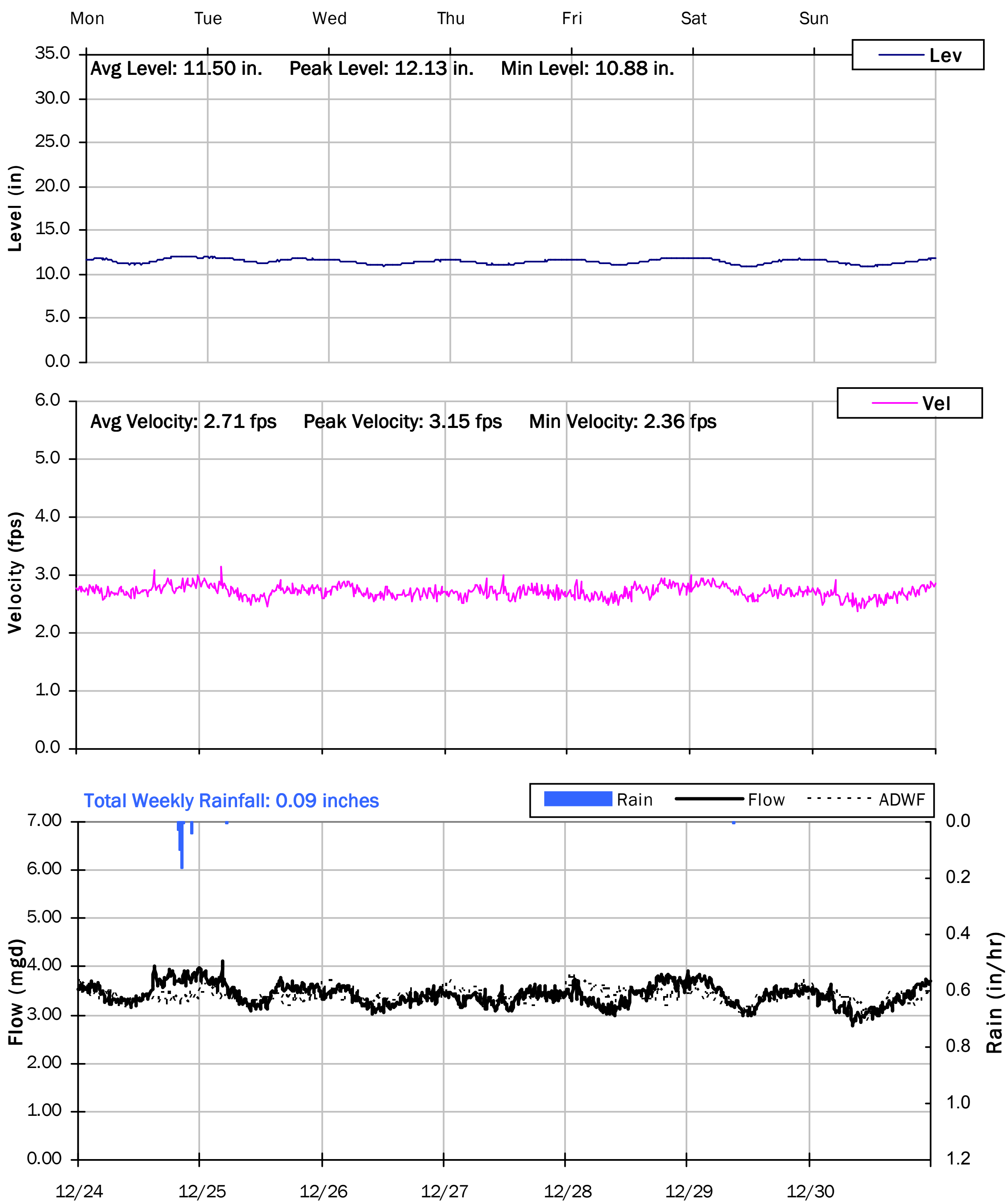
12/17/2018 to 12/24/2018





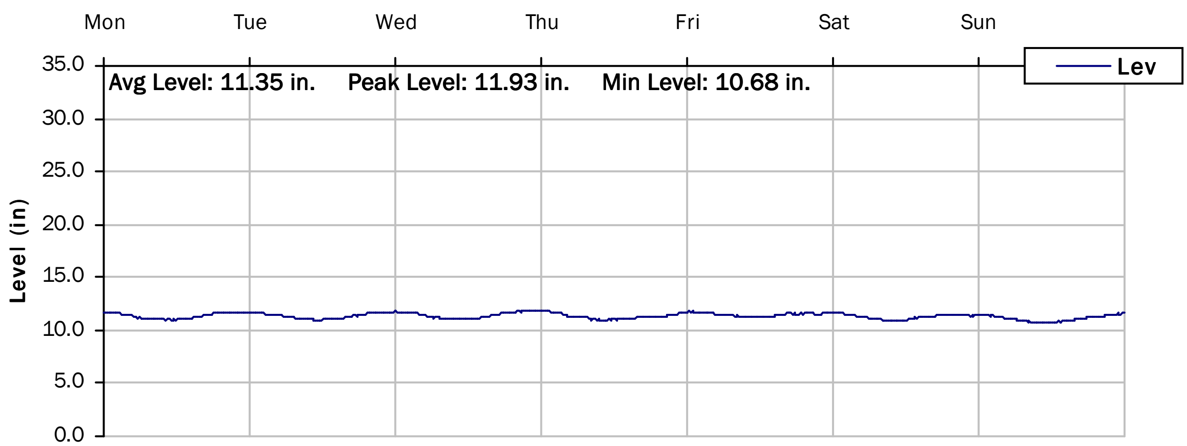


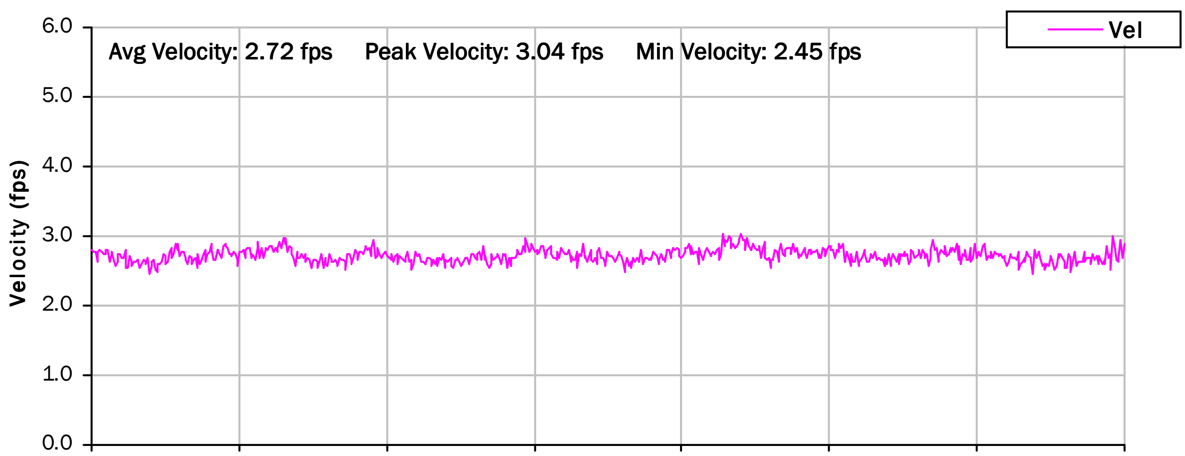
SITE 1
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018

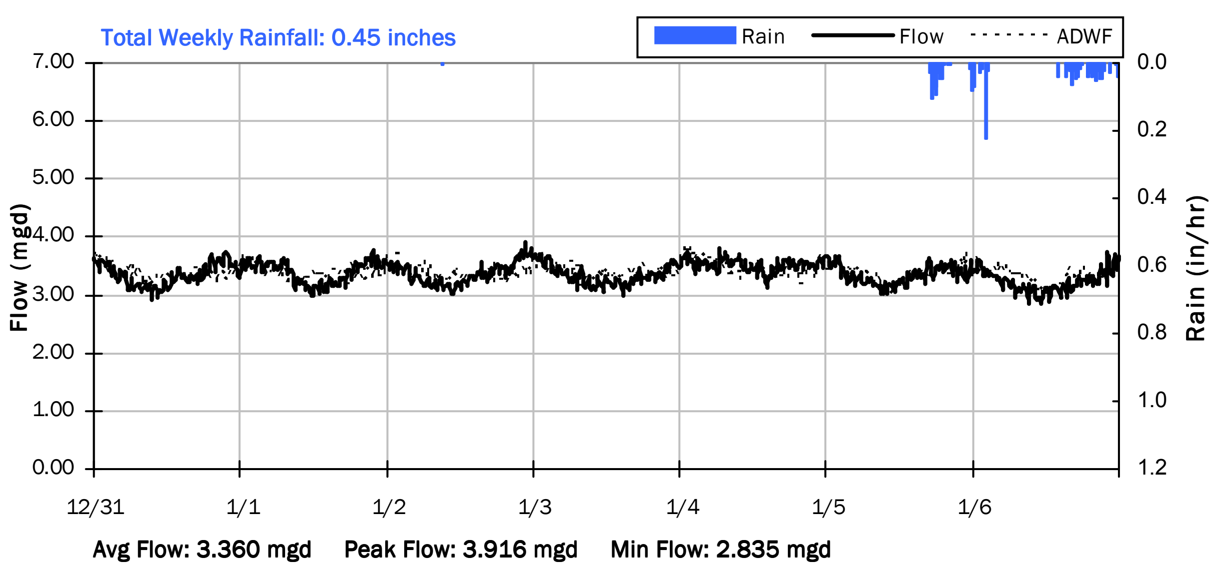


Avg Flow: 3.413 mgd **Peak Flow: 4.120 mgd** **Min Flow: 2.795 mgd**

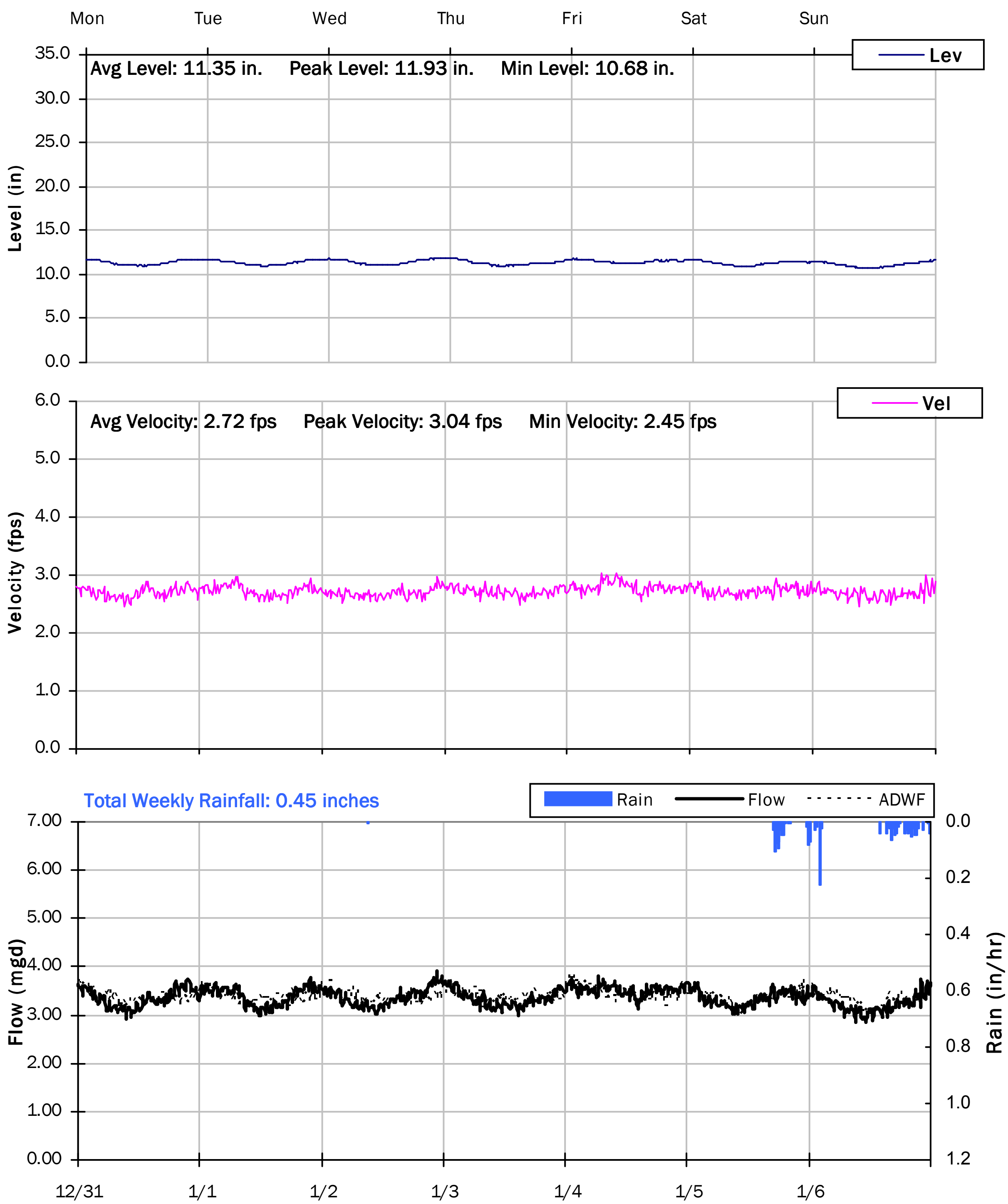
SITE 1
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019







SITE 1
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



Avg Flow: 3.360 mgd **Peak Flow: 3.916 mgd** **Min Flow: 2.835 mgd**

City of Visalia

Sanitary Sewer Flow Monitoring
November 28, 2018 - January 06, 2019

Monitoring Site: Site 2

Location: Valley Oaks Golf Course

Data Summary Report

Vicinity Map: Site 2

SITE 2

Site Information

Location: Valley Oaks Golf Course

Coordinates: 119.3856° W, 36.3199° N

Rim Elevation (Earth): 296 feet

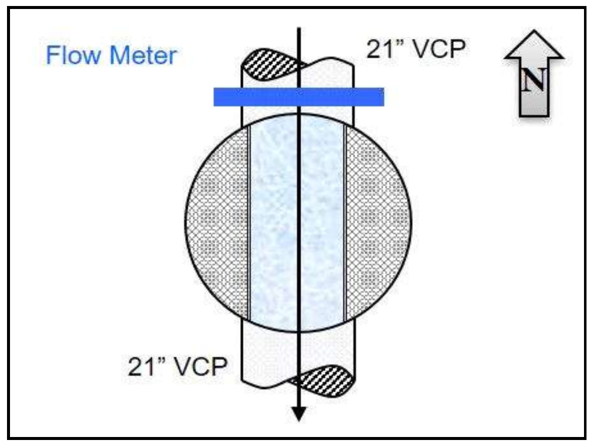
Pipe Diameter: 21 inches

ADWF: 0.056 mgd

Peak Measured Flow: 0.252 mgd

Satellite Map

Sewer Map



Flow Sketch


Street View


Plan View

SITE 2

Additional Site Photos

Effluent Pipe

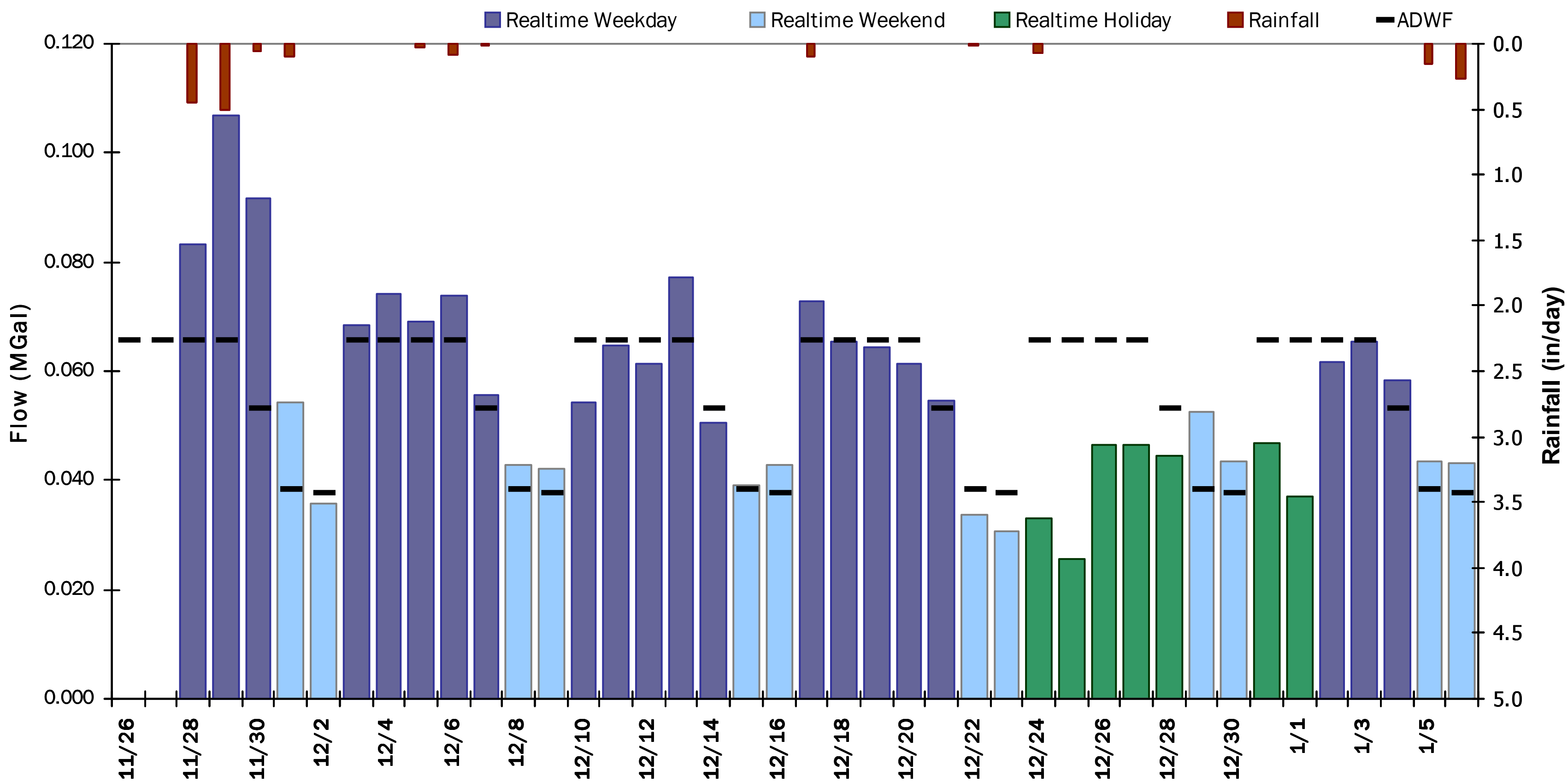
Influent Pipe

SITE 2

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.055 MGal **Peak Daily Flow: 0.107 MGal** **Min Daily Flow: 0.026 MGal**

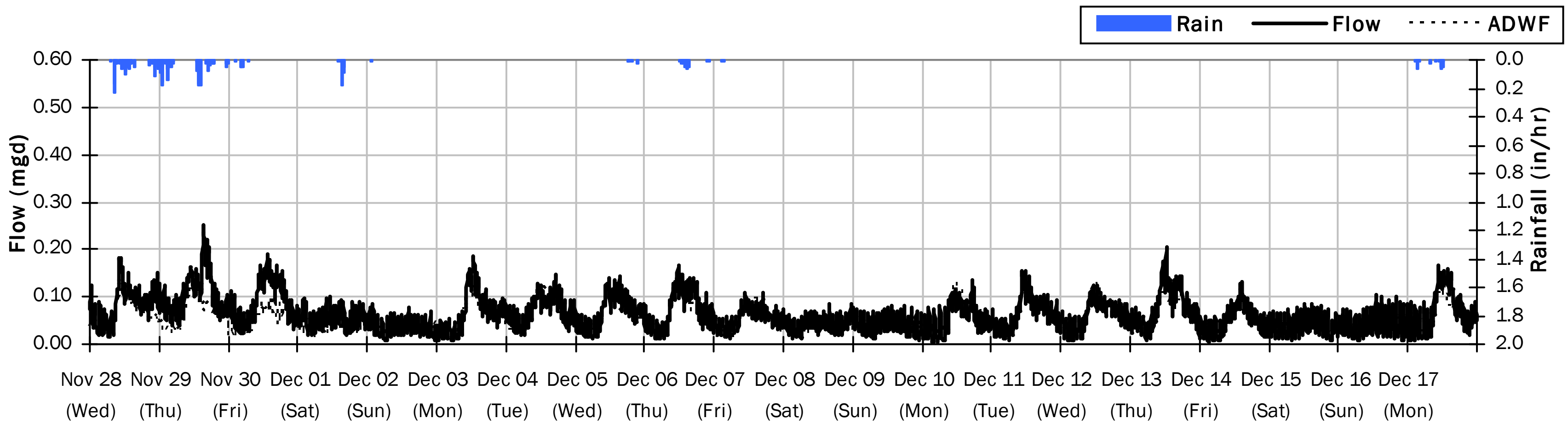
Total Period Rainfall: 1.86 inches

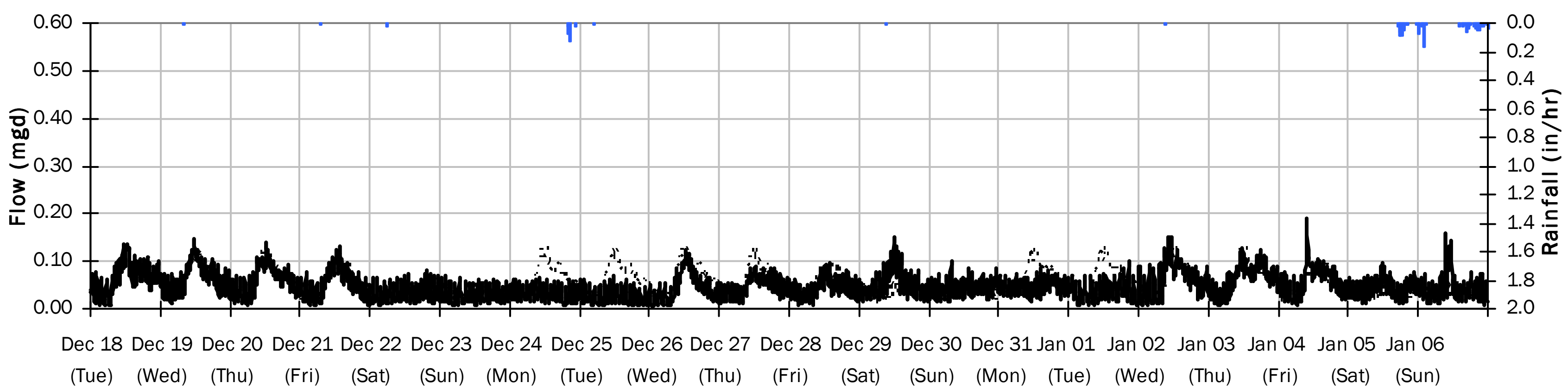


SITE 2

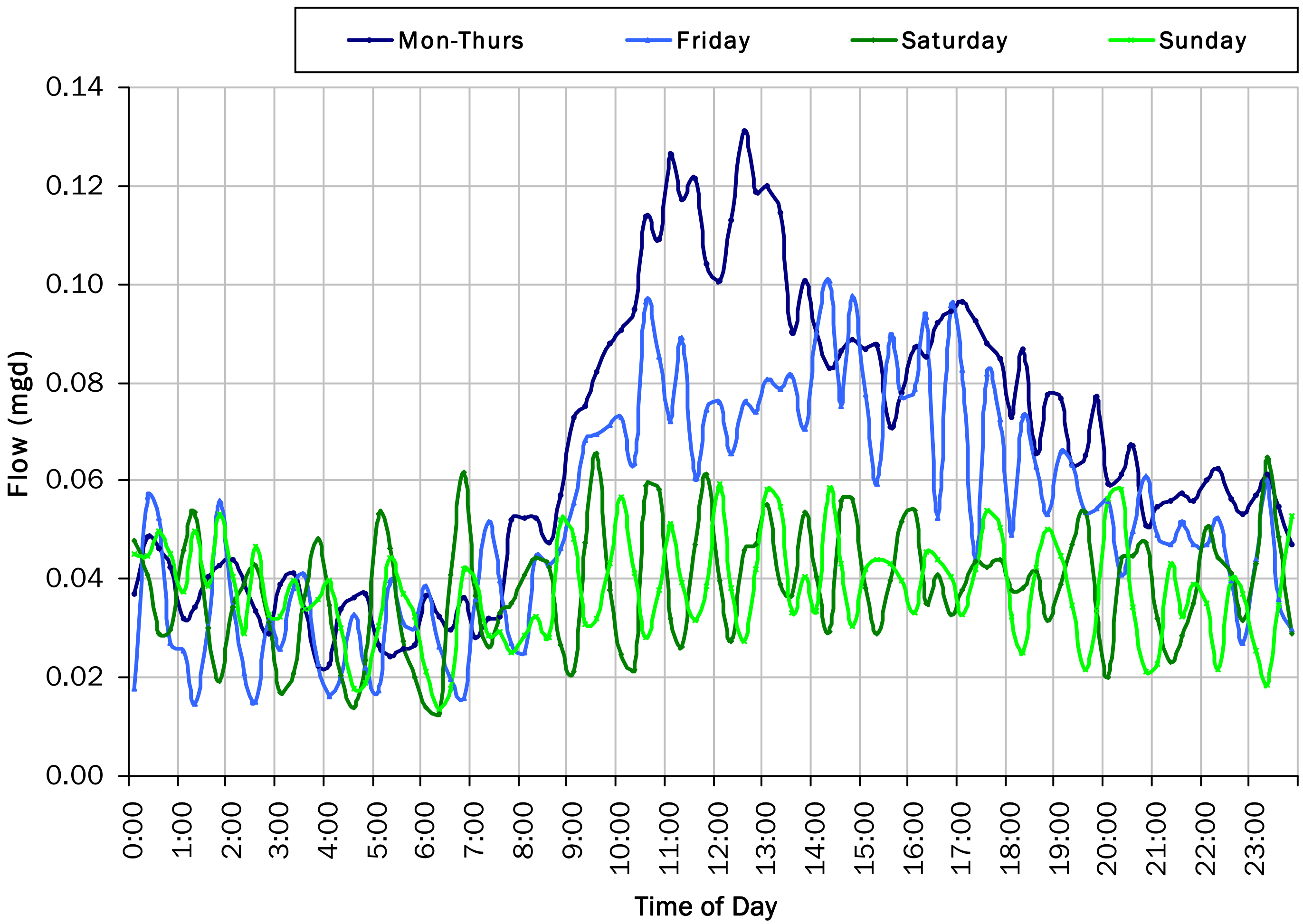
Flow Summary: 11/28/2018 to 1/6/2019

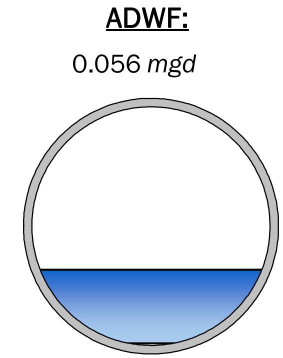
Total Period Rainfall: 1.86 inches   Avg Flow: 0.055 mgd   Peak Flow: 0.252 mgd   Min Flow: 0.005 mgd





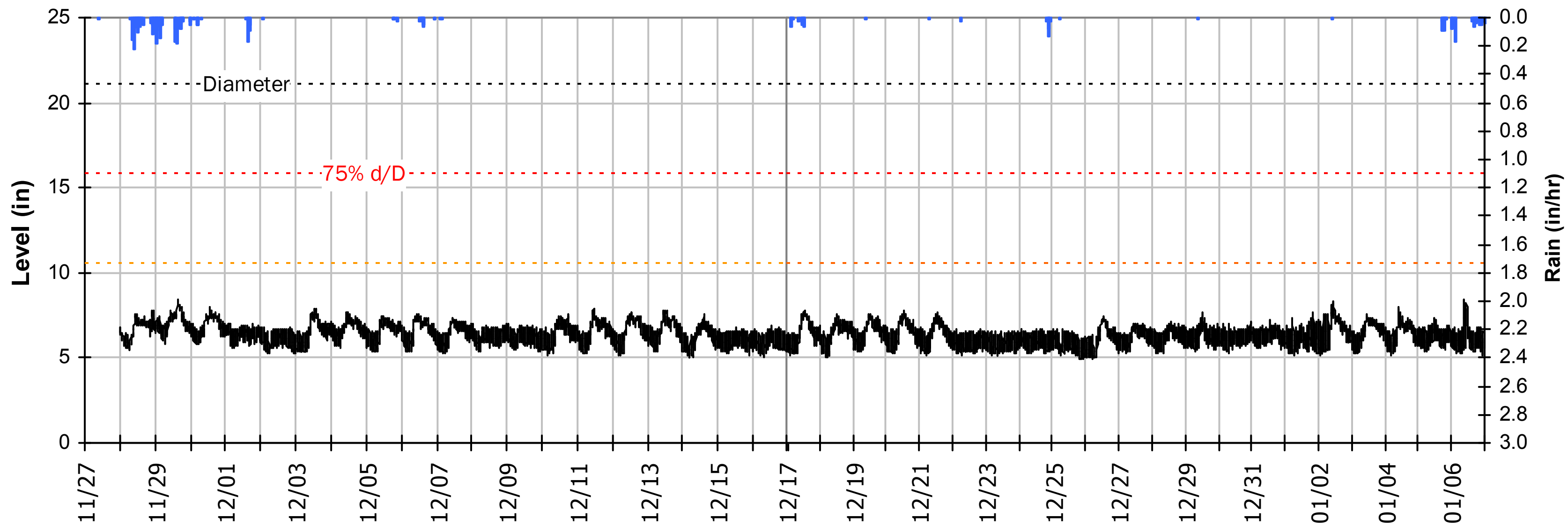
SITE 2
Average Dry Weather Flow Hydrographs

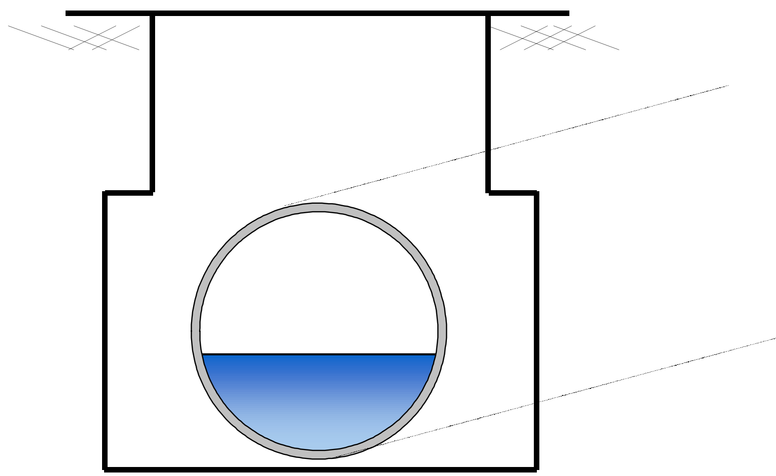




SITE 2
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

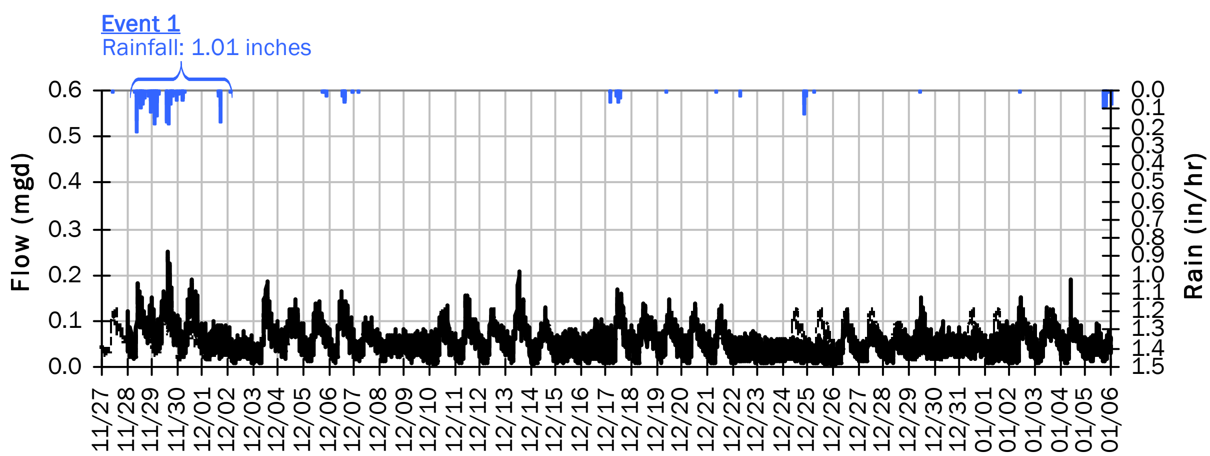




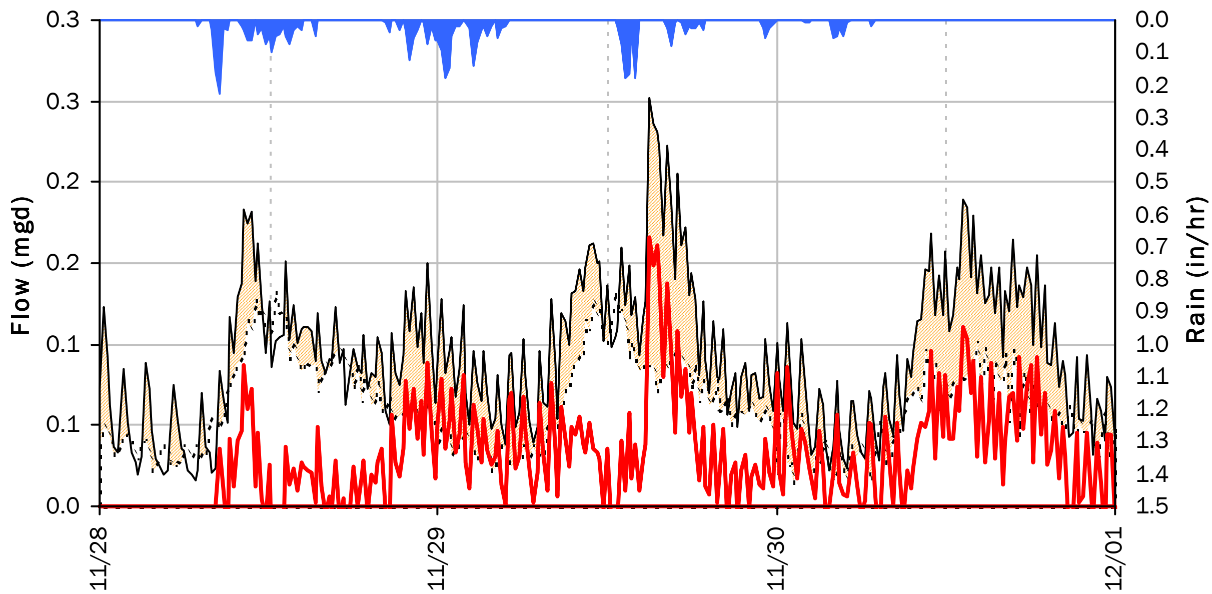
Pipe Diameter:	21	*inches*
Peak Measured Level:	8.46	*inches*
Peak d/D Ratio:	0.40	

SITE 2
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



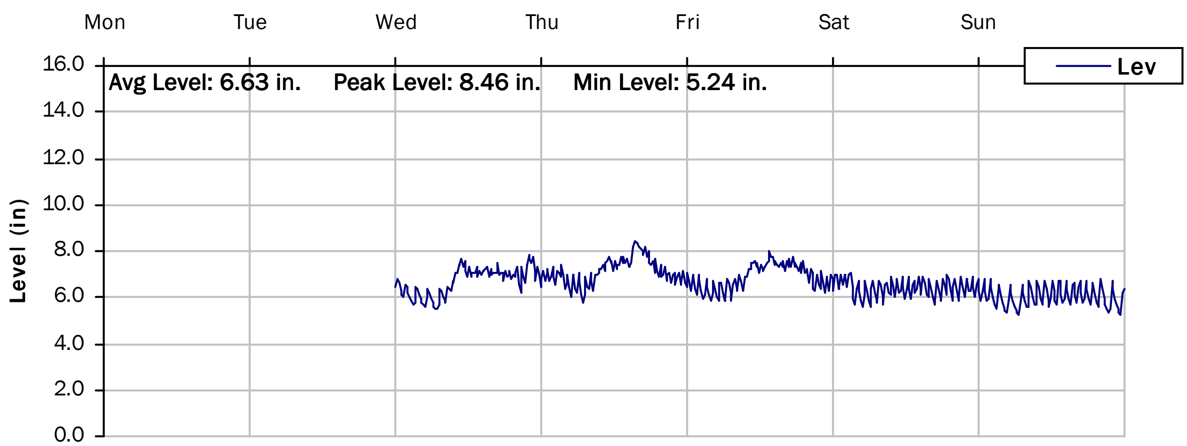
Event 1 Detail Graph

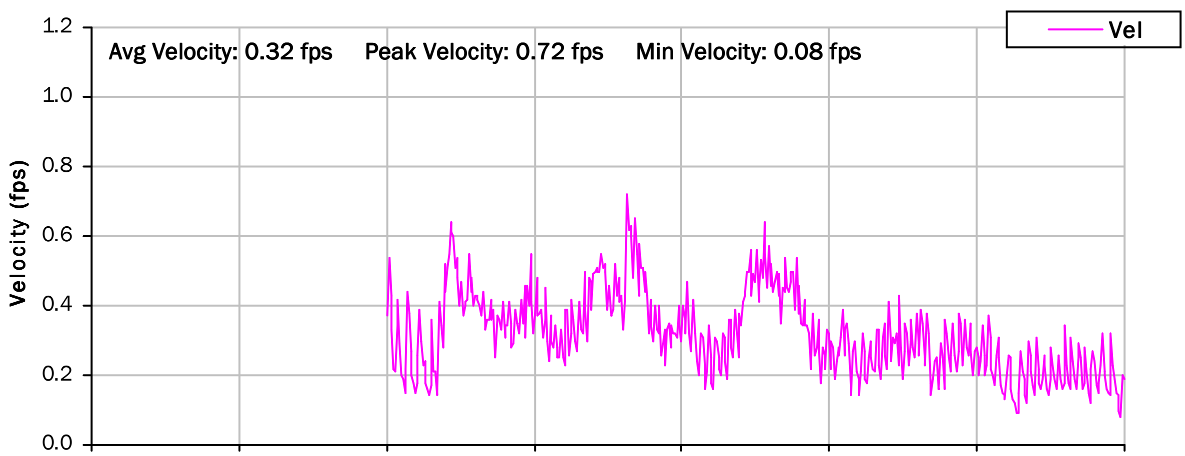


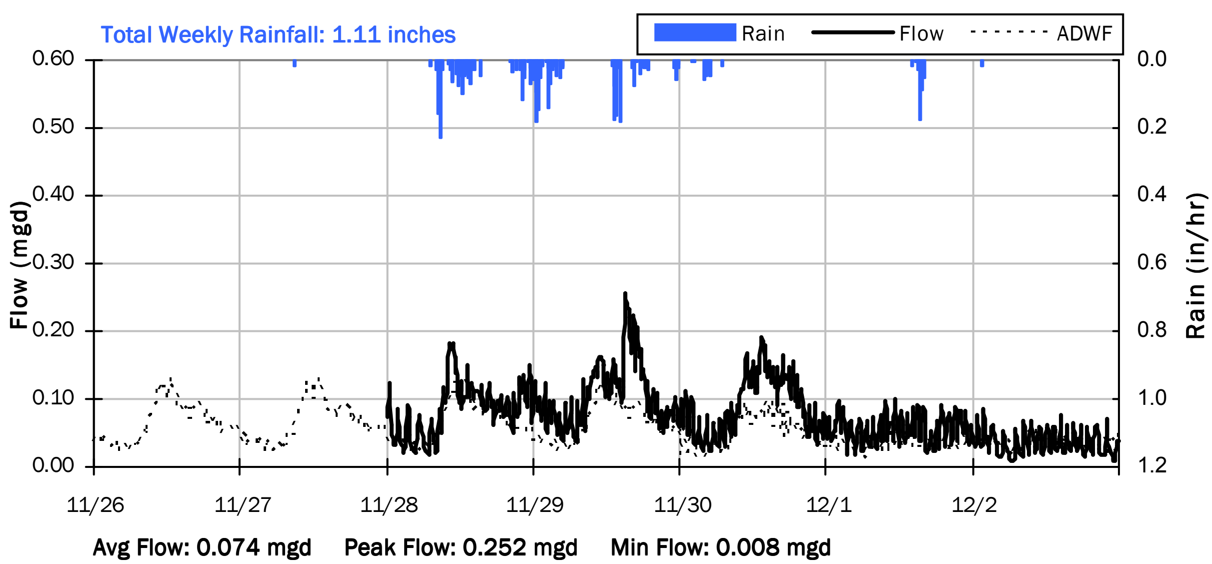
Storm Event I/I Analysis (Rain = 1.01 inches)

Capacity		**Inflow / Infiltration**	
Peak Flow:	0.25 *mgd*	**Peak I/I Rate:**	0.17 *mgd*
PF:	4.51	**Total I/I:**	94,000 *gallons*
Peak Level:	8.46 *in*		
d/D Ratio:	0.40		

SITE 2
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018



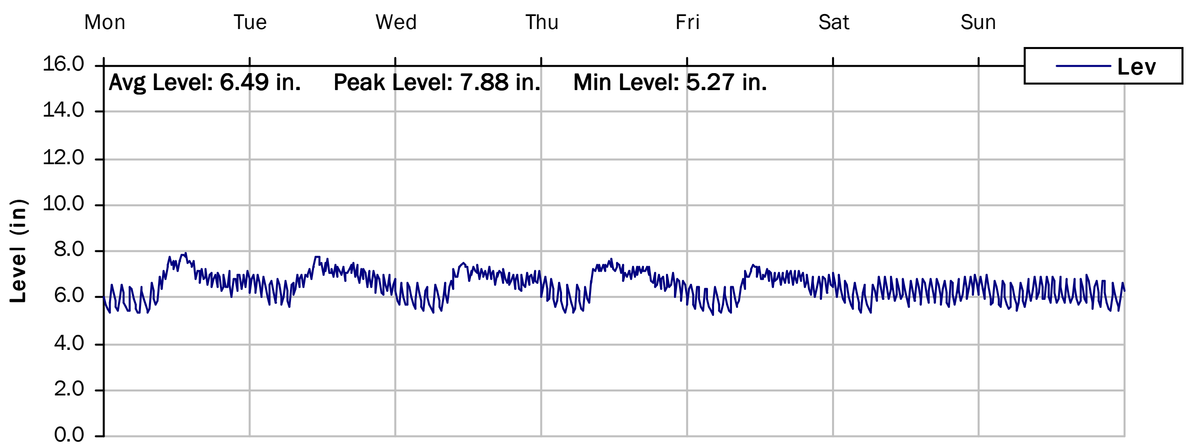


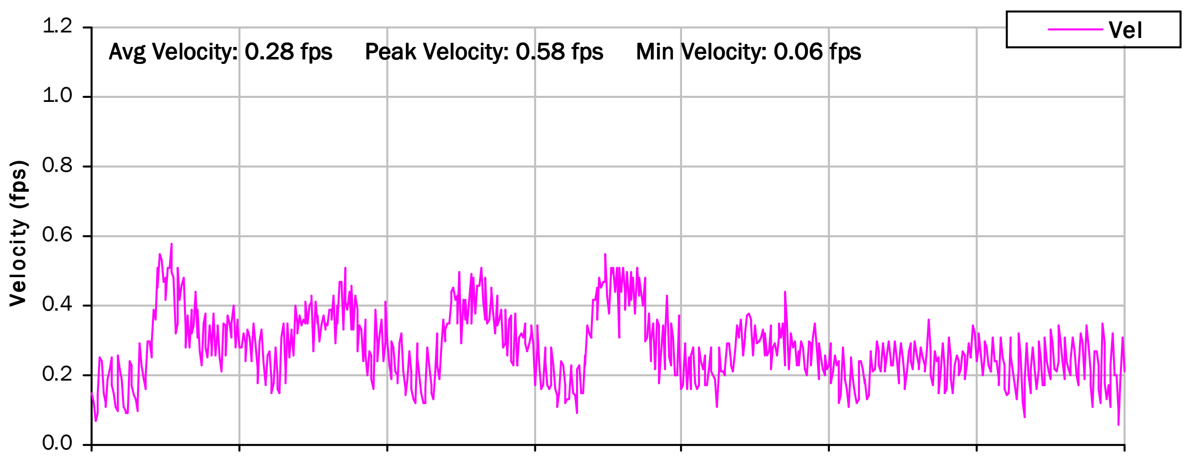


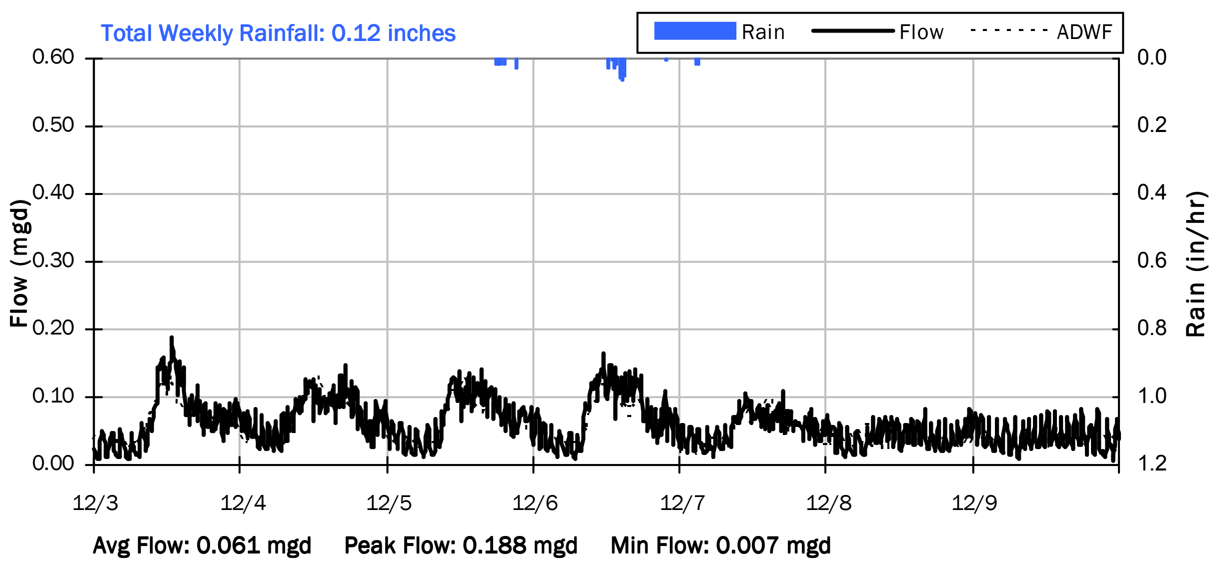
SITE 2

Weekly Level, Velocity and Flow Hydrographs

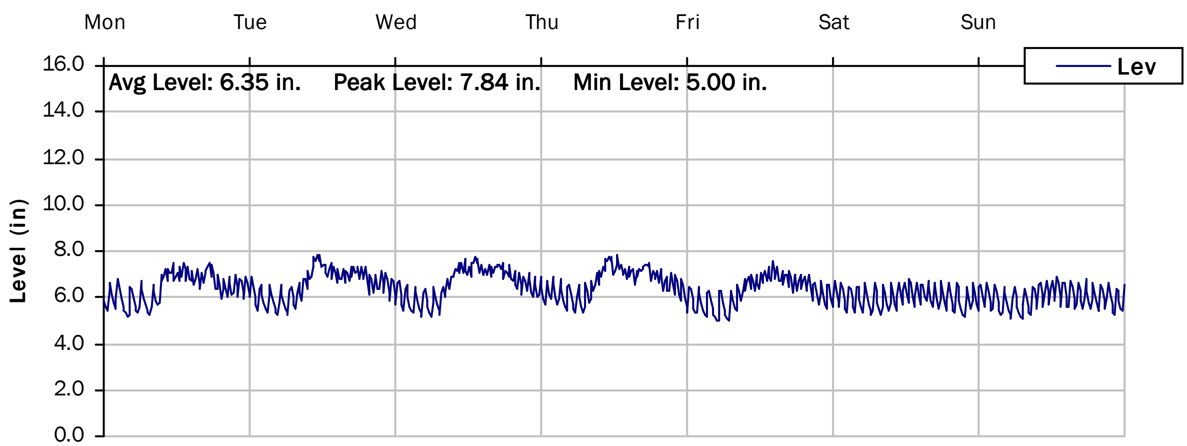
12/3/2018 to 12/10/2018

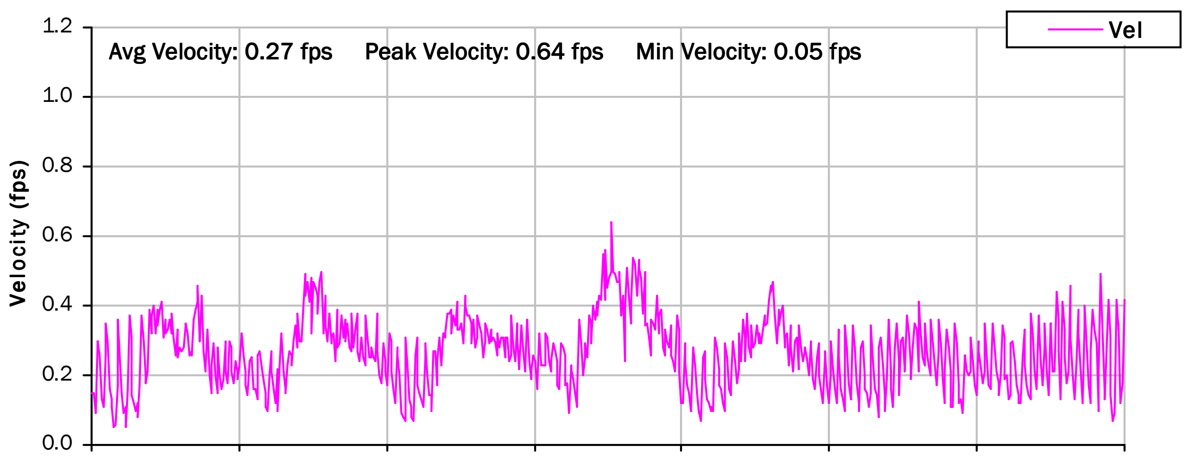


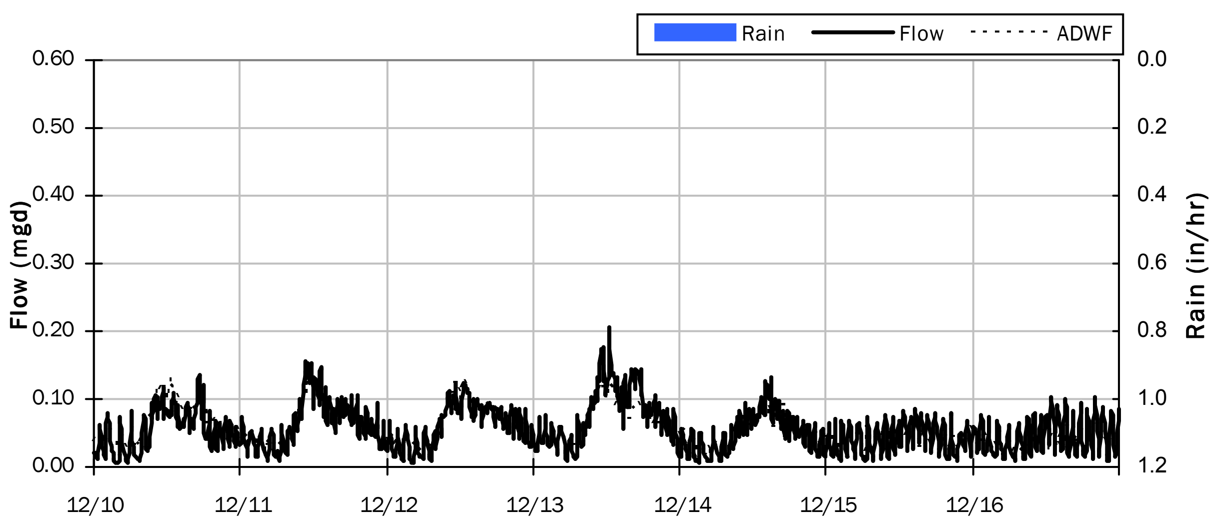




SITE 2
Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018

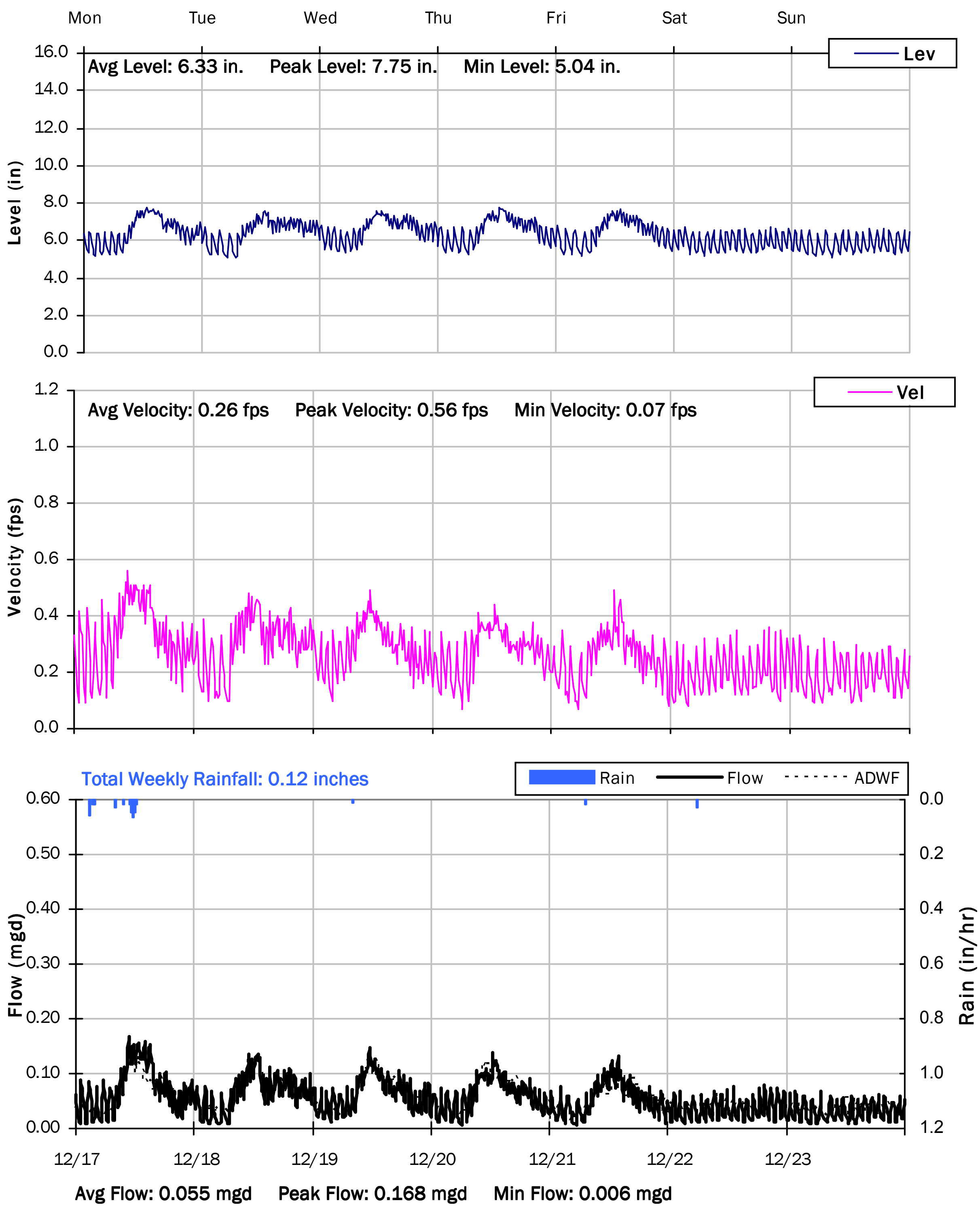




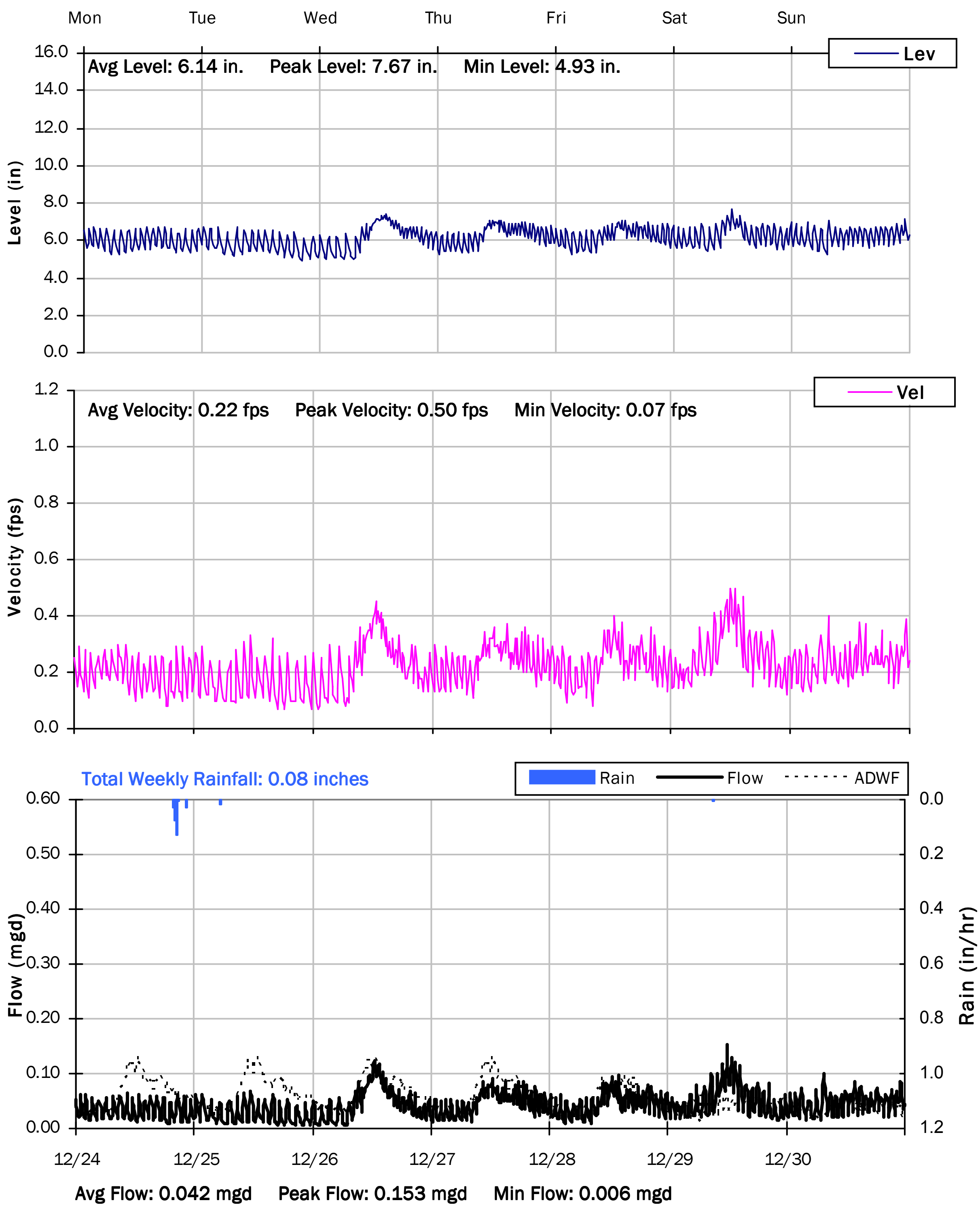


Avg Flow: 0.056 mgd Peak Flow: 0.207 mgd Min Flow: 0.005 mgd

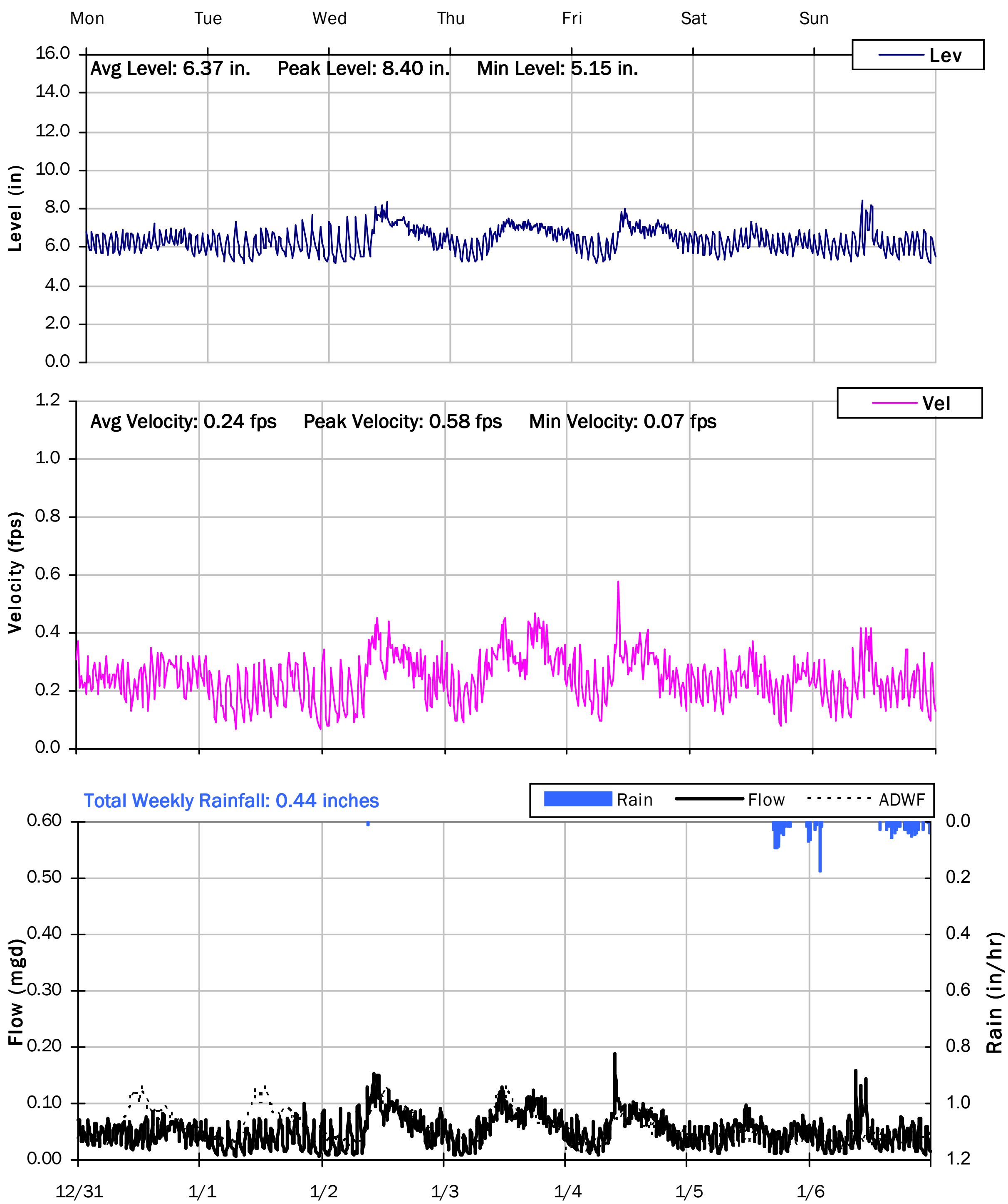
SITE 2
Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018



SITE 2
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018

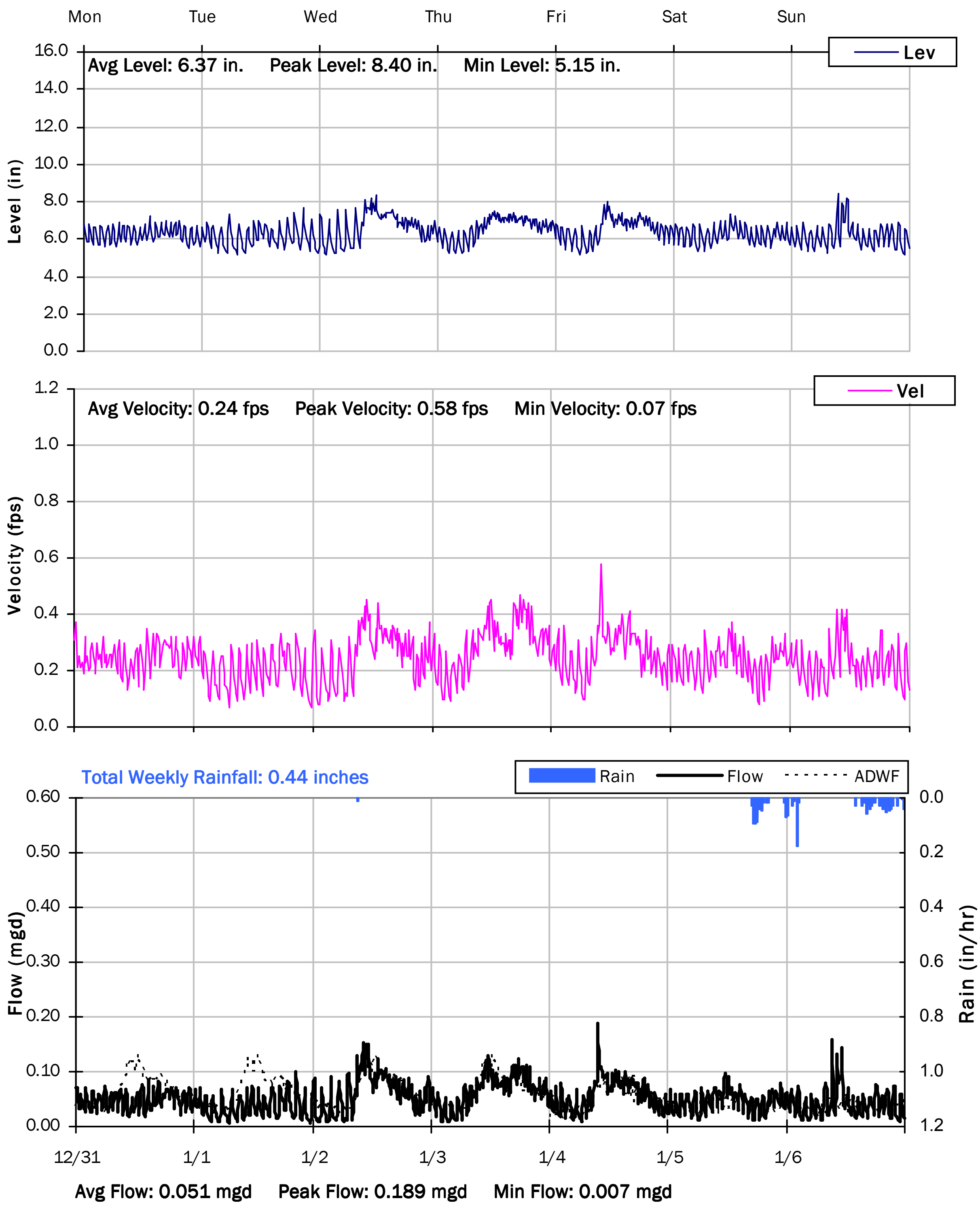


SITE 2
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



Avg Flow: 0.051 mgd Peak Flow: 0.189 mgd Min Flow: 0.007 mgd

SITE 2
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



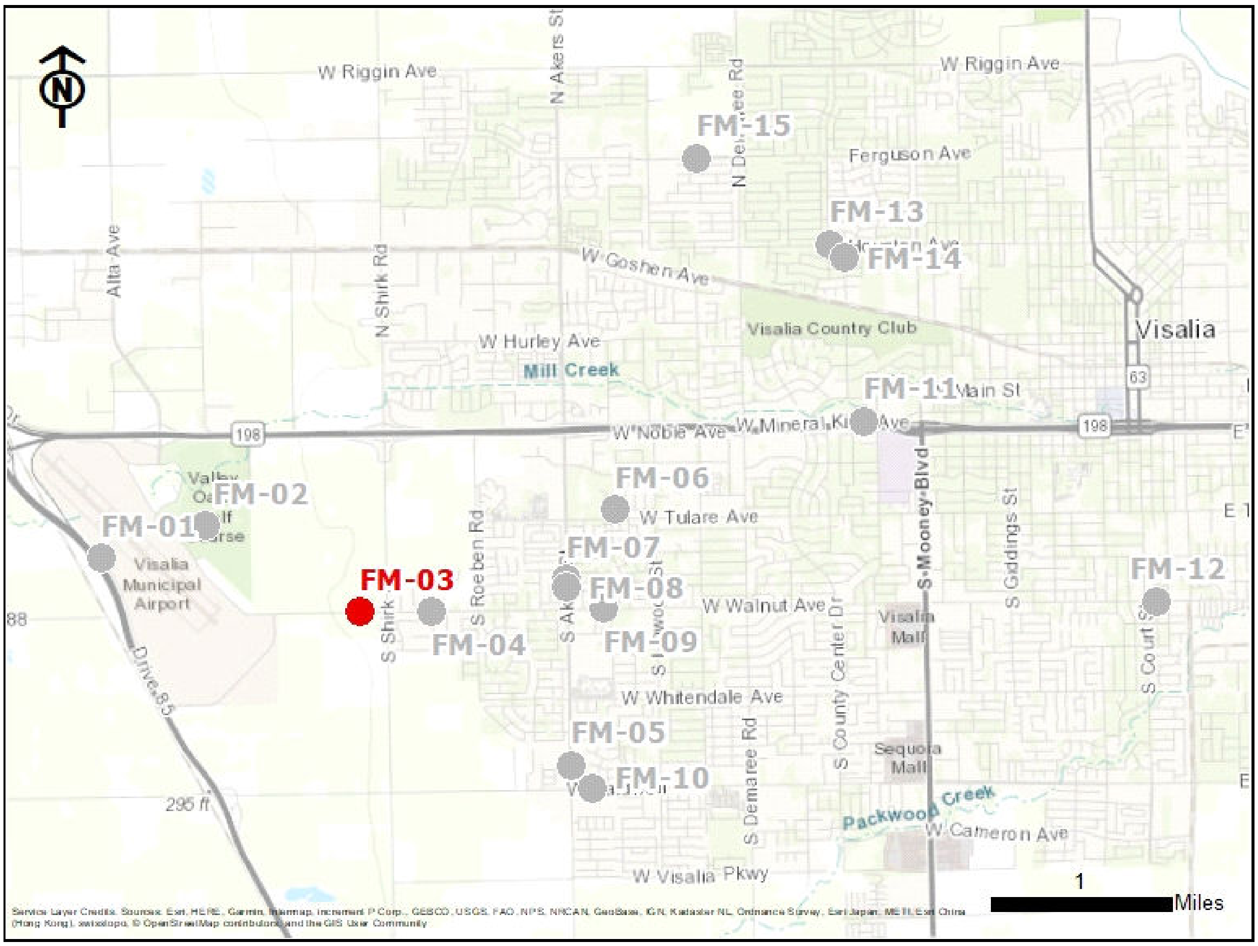
City of Visalia

Sanitary Sewer Flow Monitoring
November 28, 2018 - January 06, 2019

Monitoring Site: Site 3

Location: W Walnut Ave w/o Rd 92

Data Summary Report



Vicinity Map: Site 3

SITE 3

Site Information

Location: W Walnut Ave w/o Rd 92

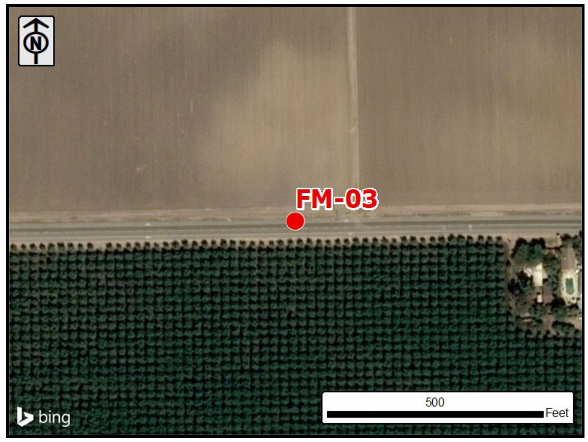
Coordinates: 119.3702° W, 36.3128° N

Rim Elevation (Earth): 300 feet

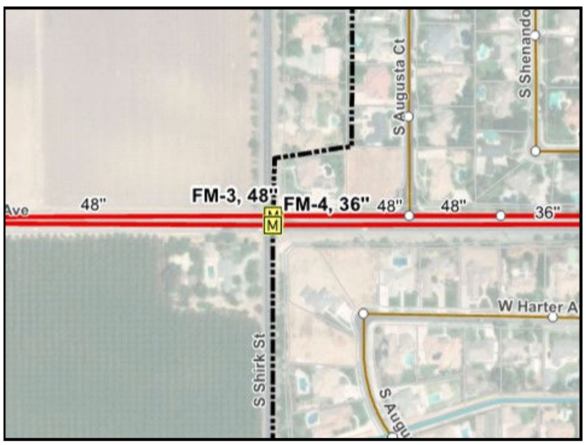
Pipe Diameter: 48 inches

ADWF: 2.168 mgd

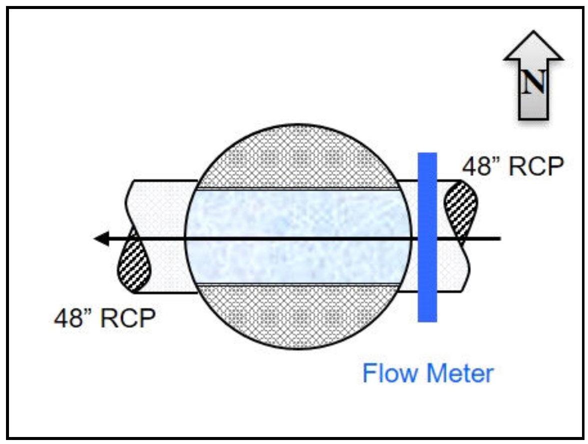
Peak Measured Flow: 3.636 mgd



Satellite Map



Sewer Map



Flow Sketch


Street View


Plan View

SITE 3

Additional Site Photos

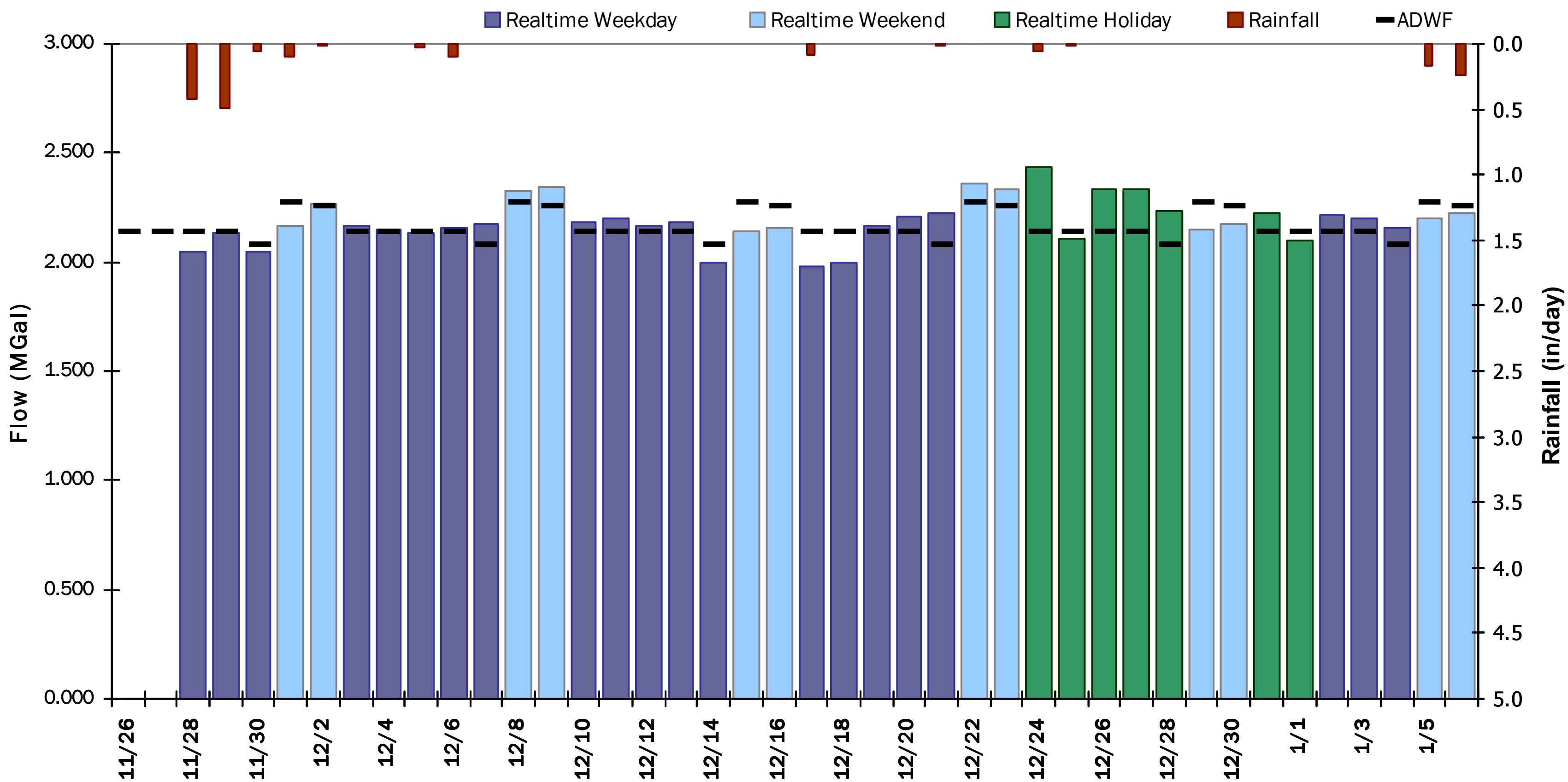
Effluent Pipe

Influent Pipe

SITE 3
Period Flow Summary: Daily Flow Totals

Avg Period Flow: 2.187 MGal Peak Daily Flow: 2.431 MGal Min Daily Flow: 1.984 MGal

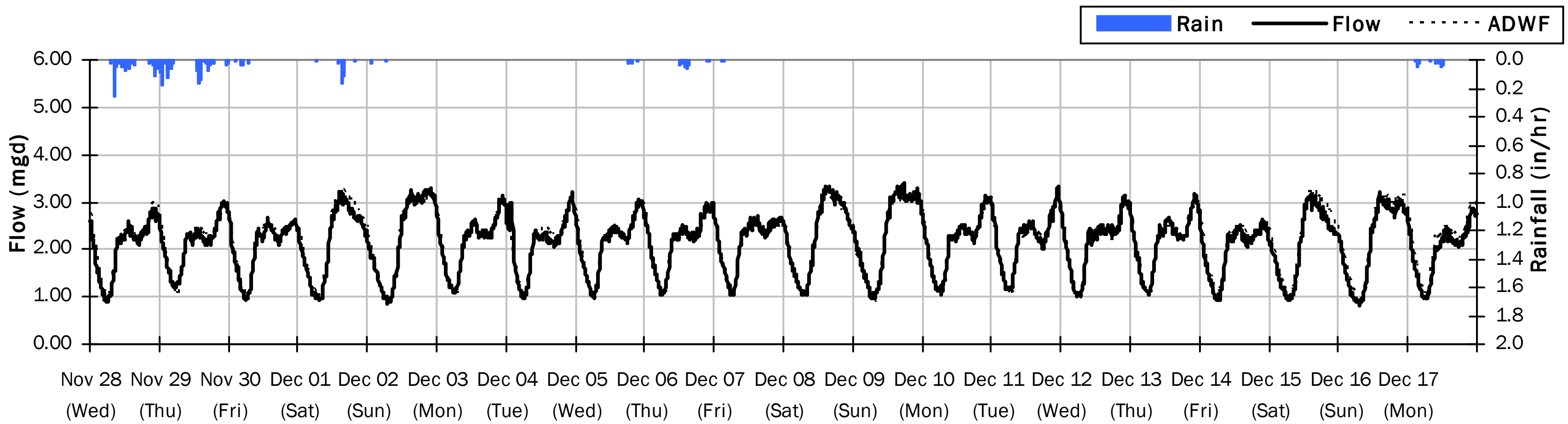
Total Period Rainfall: 1.79 inches

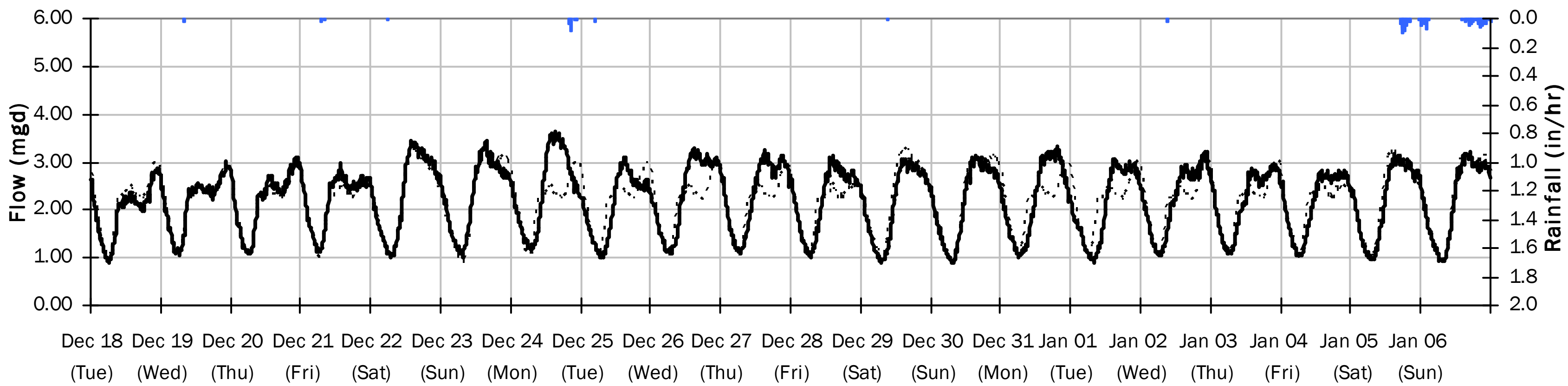


SITE 3

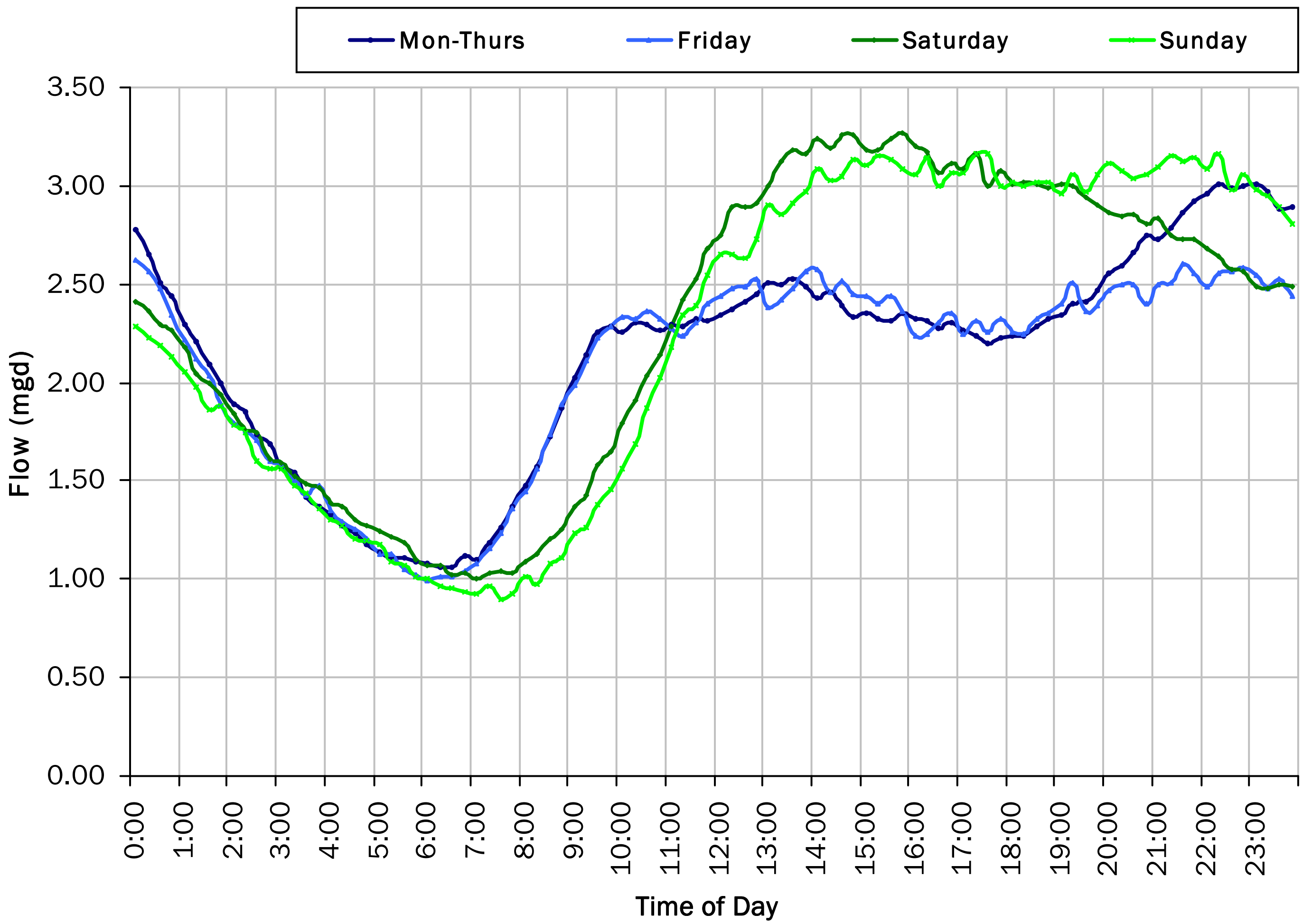
Flow Summary: 11/28/2018 to 1/6/2019

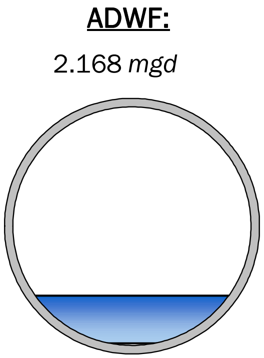
Total Period Rainfall: 1.79 inches   **Avg Flow: 2.187 mgd**   **Peak Flow: 3.636 mgd**   **Min Flow: 0.817 mgd**





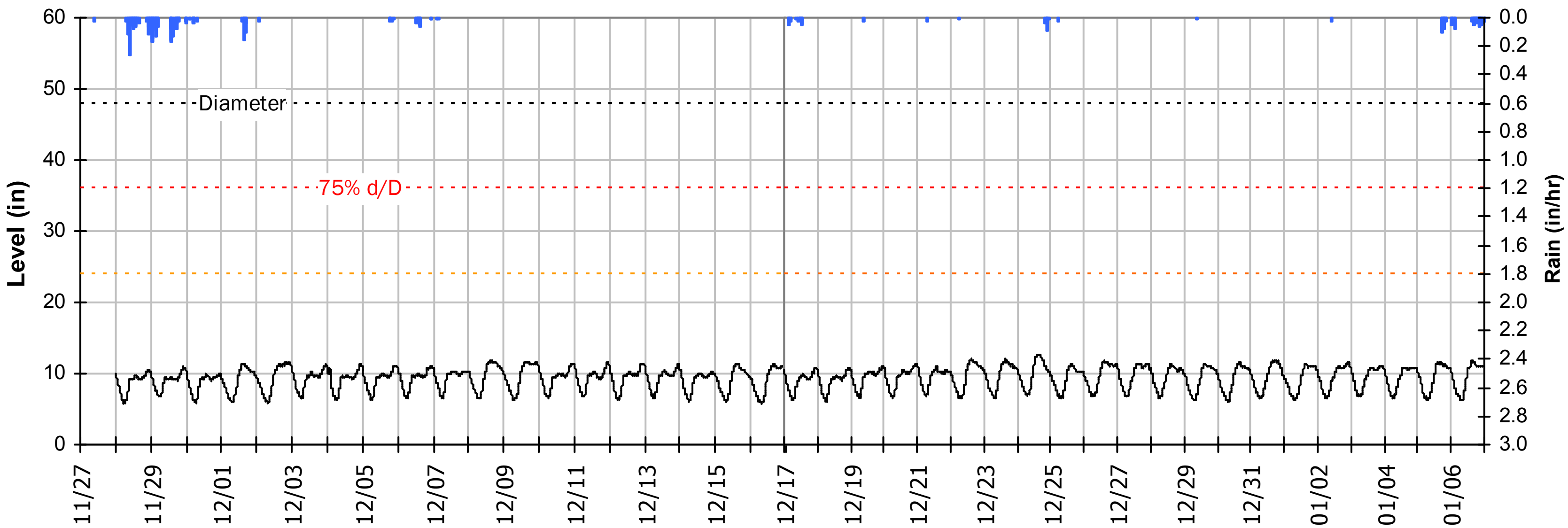
SITE 3
Average Dry Weather Flow Hydrographs

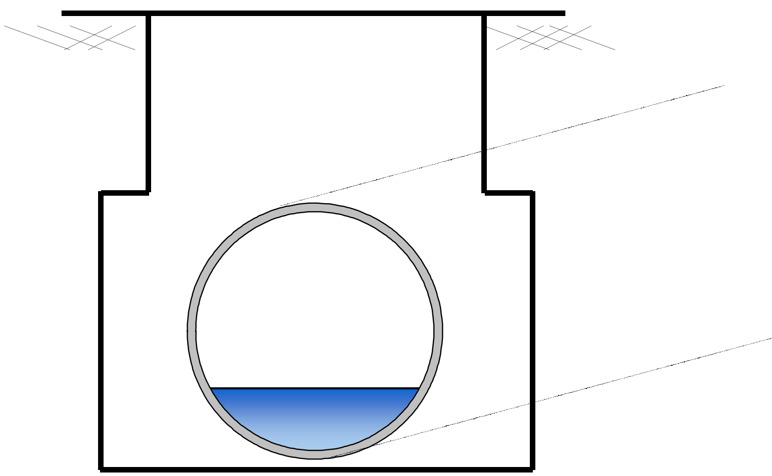




SITE 3
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

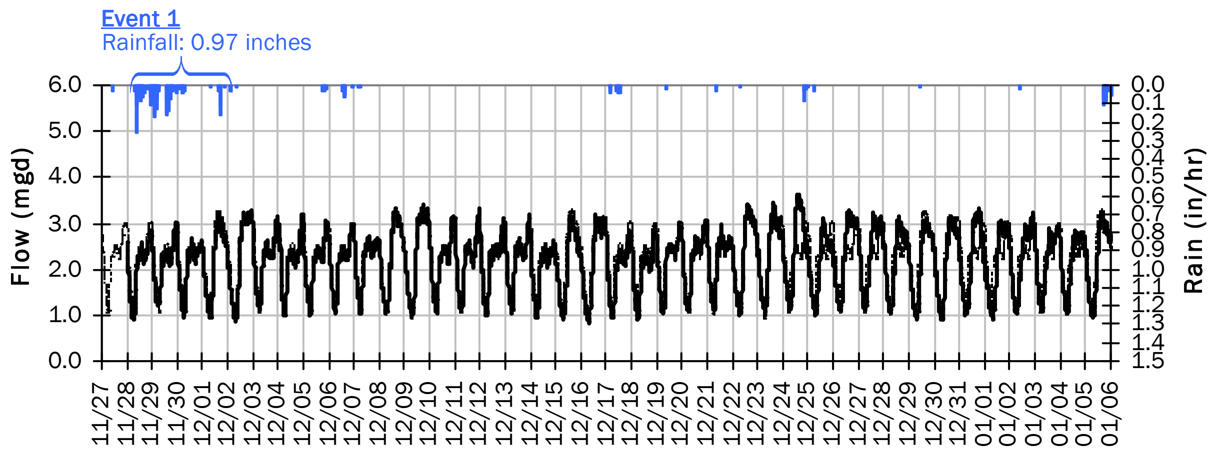




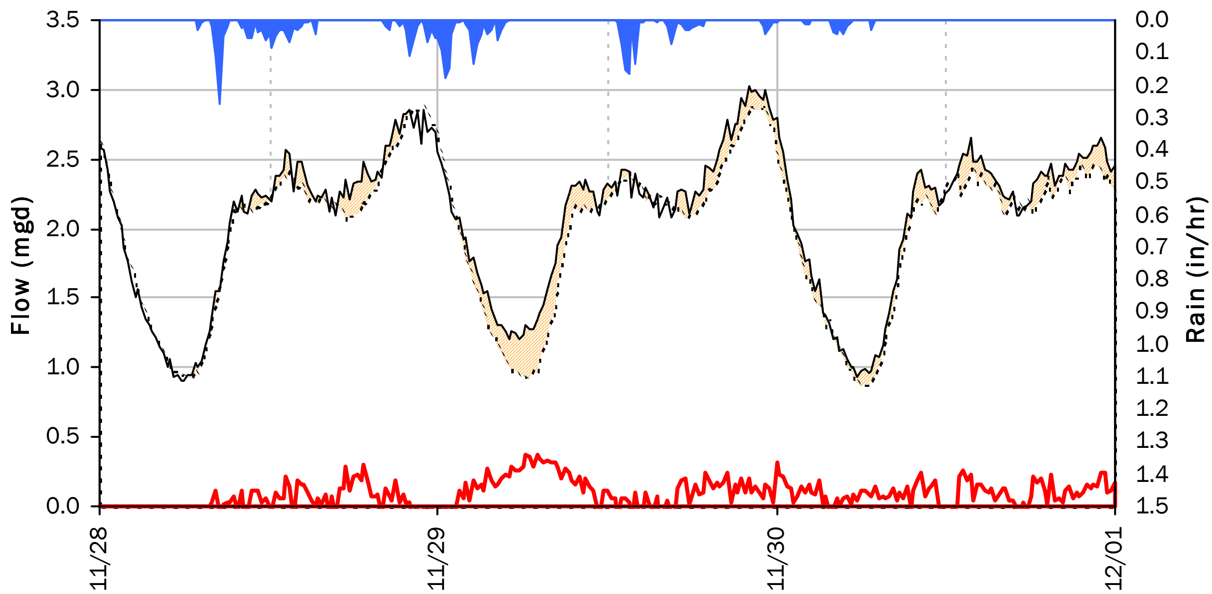
Pipe Diameter:	48	*inches*
Peak Measured Level:	12.6	*inches*
Peak d/D Ratio:	0.26	

SITE 3
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



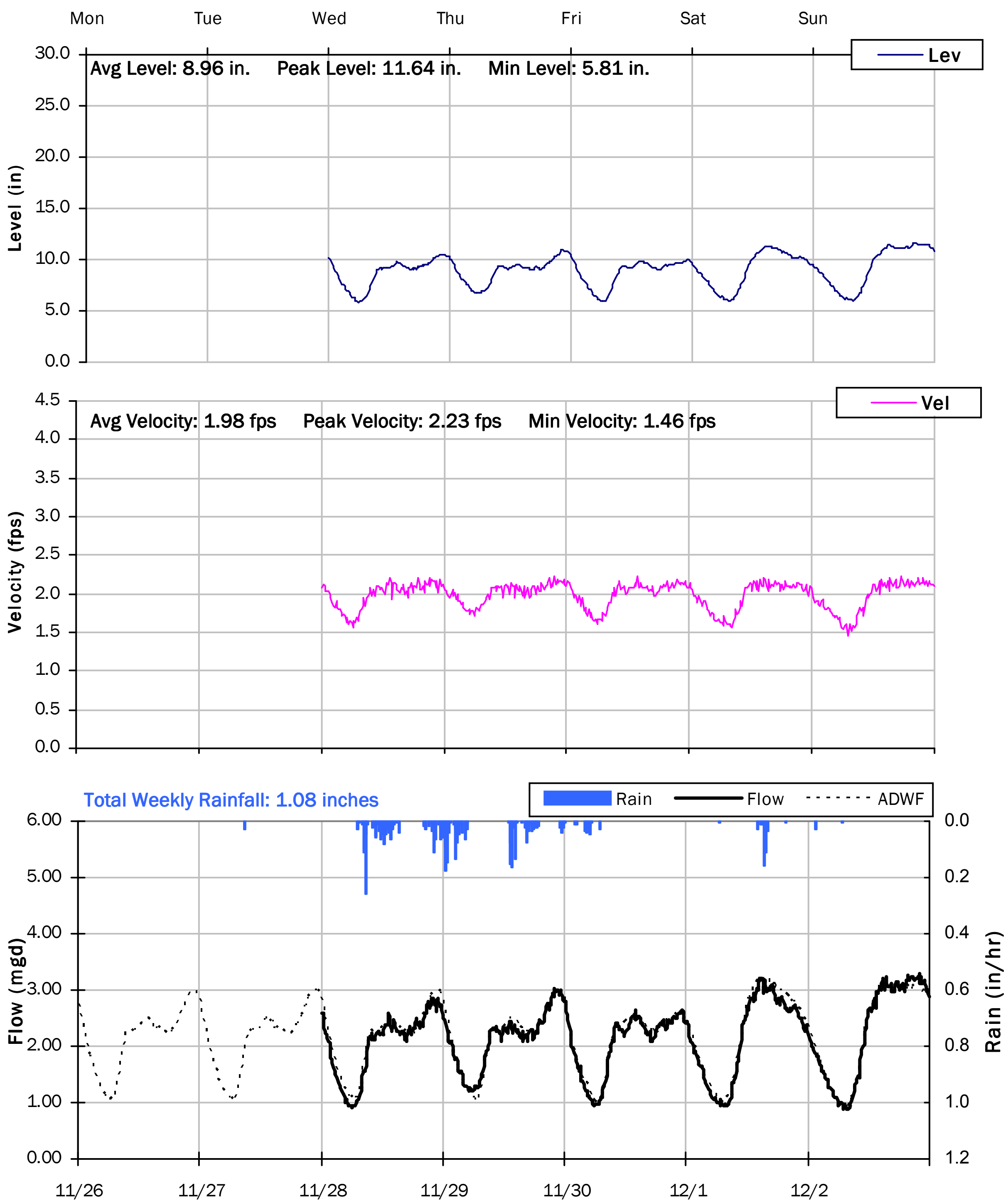
Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 0.97 inches)

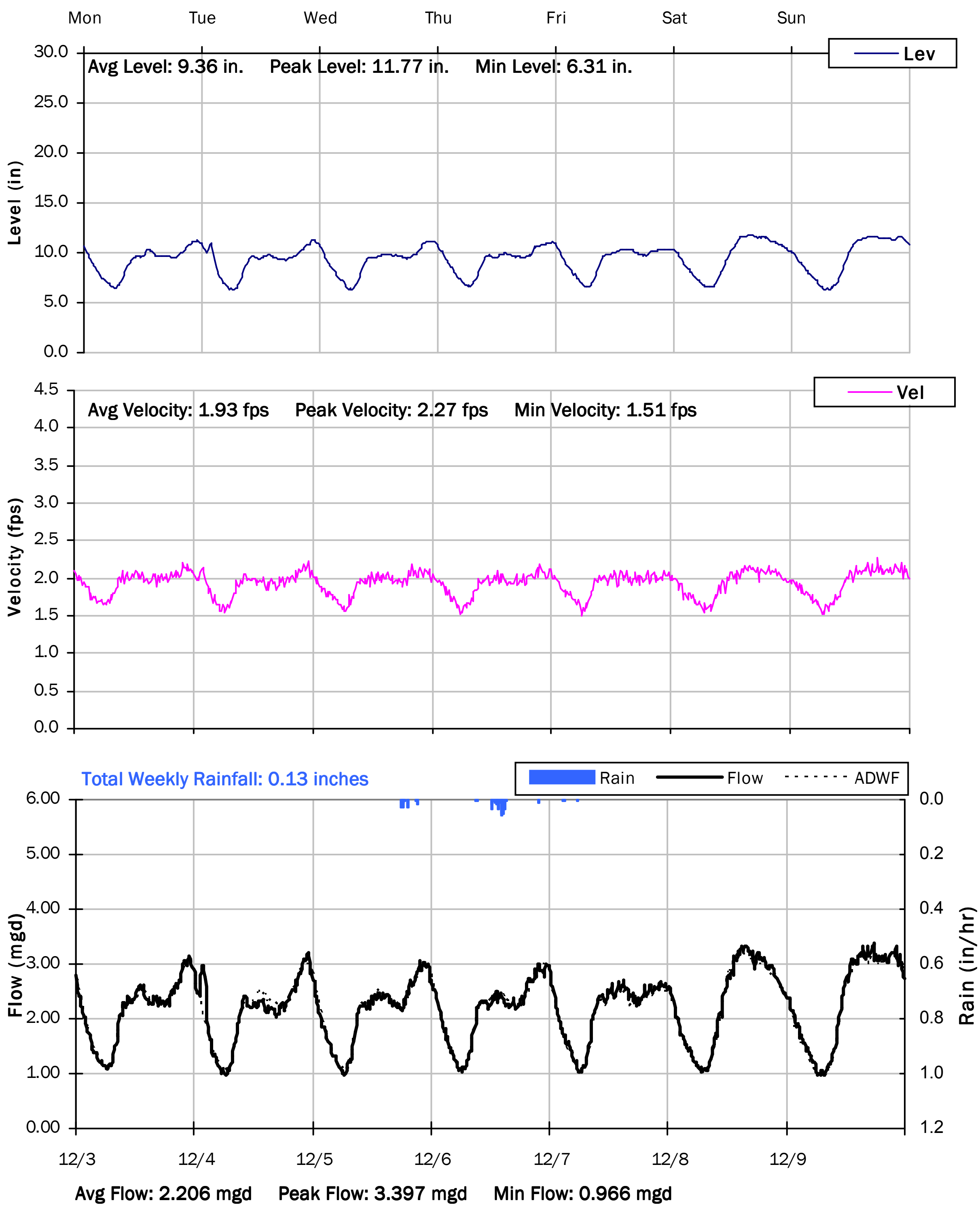
Capacity		Inflow / Infiltration	
Peak Flow:	3.03 *mgd*	**Peak I/I Rate:**	0.38 *mgd*
PF:	1.40	**Total I/I:**	267,000 *gallons*
Peak Level:	10.93 *in*		
d/D Ratio:	0.23		

SITE 3
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018

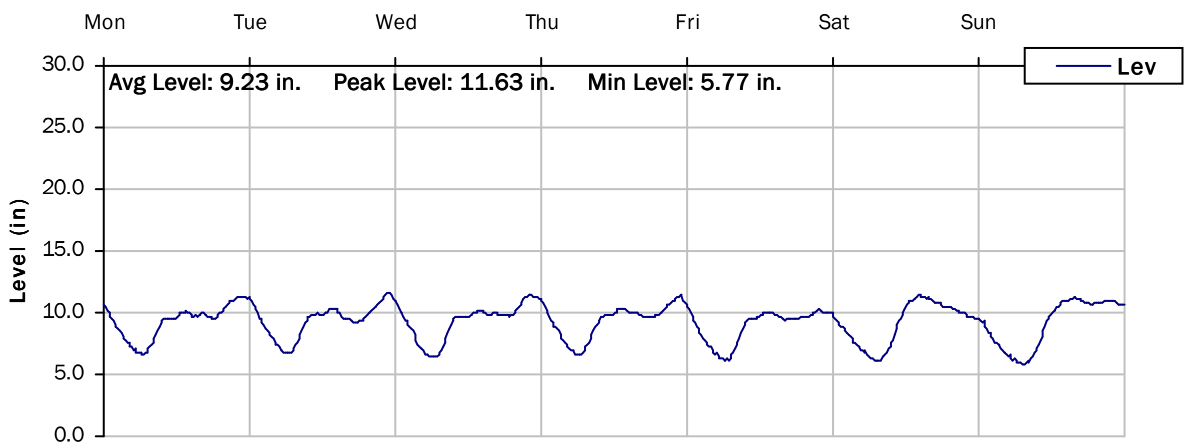


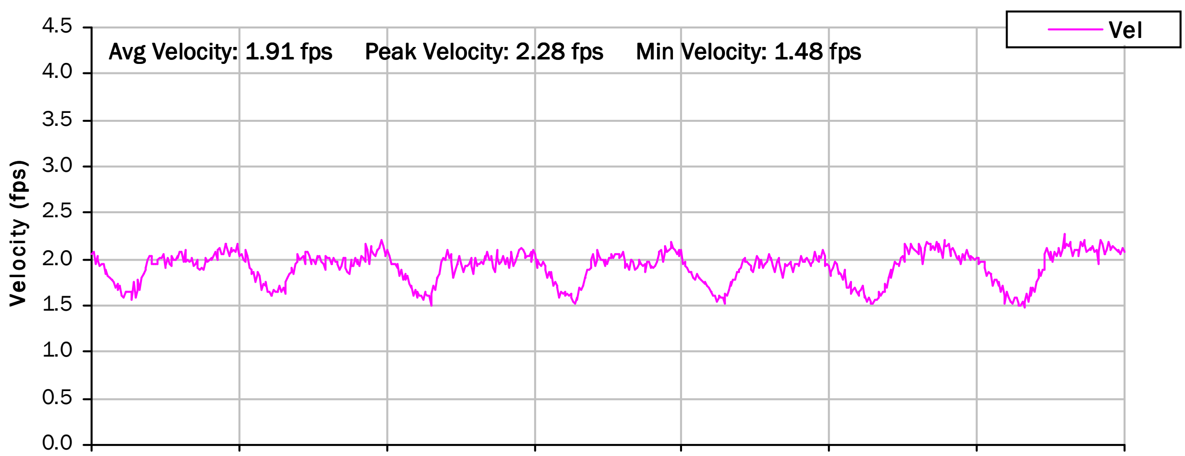
Avg Flow: 2.131 mgd Peak Flow: 3.284 mgd Min Flow: 0.868 mgd

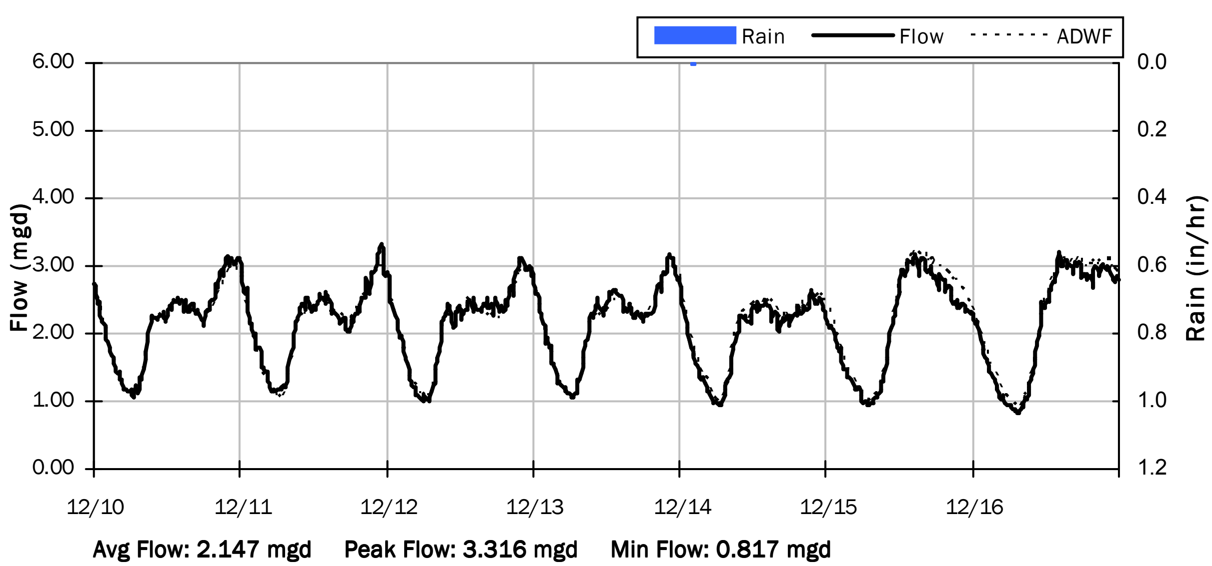
SITE 3
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018



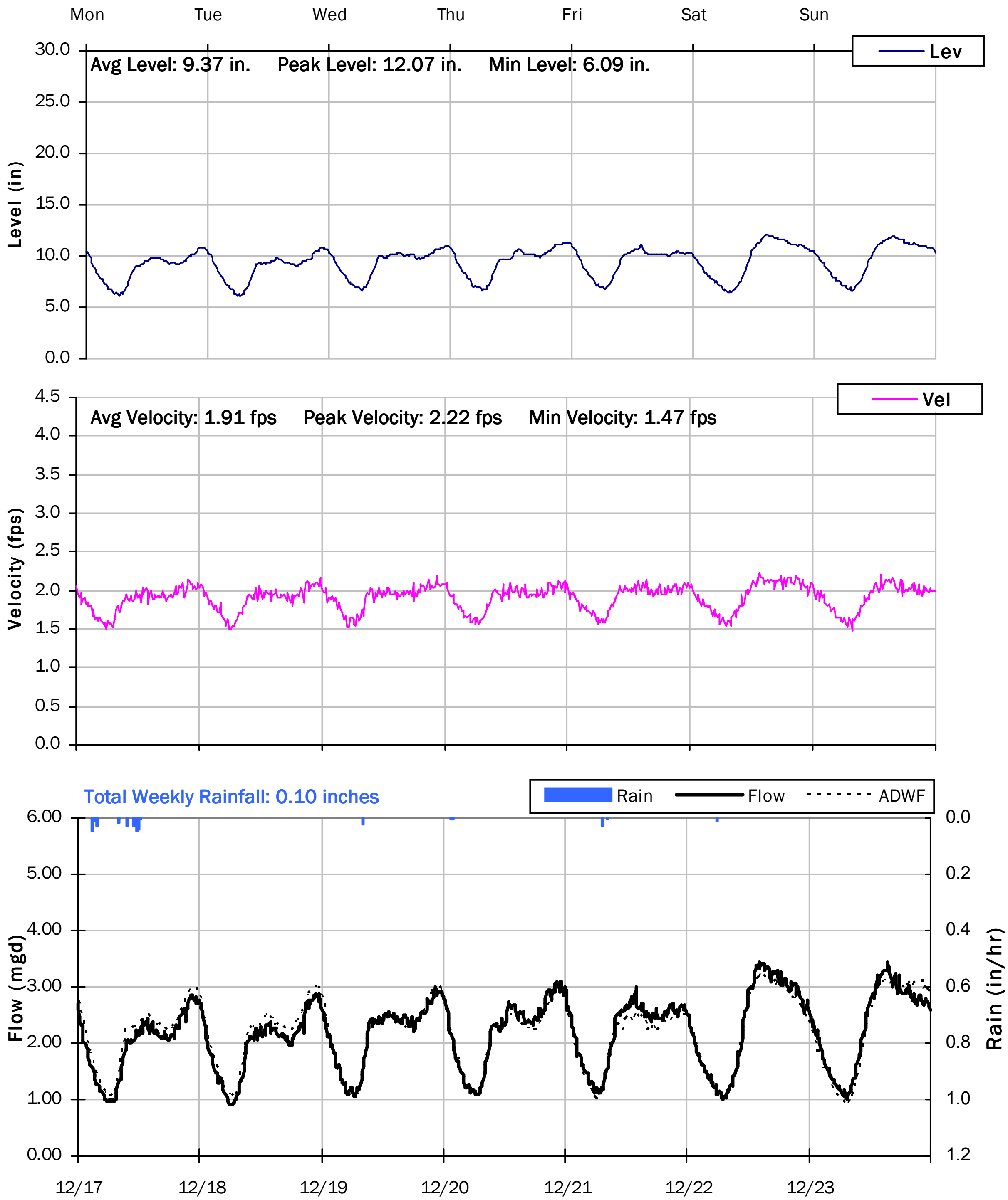
SITE 3
Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018





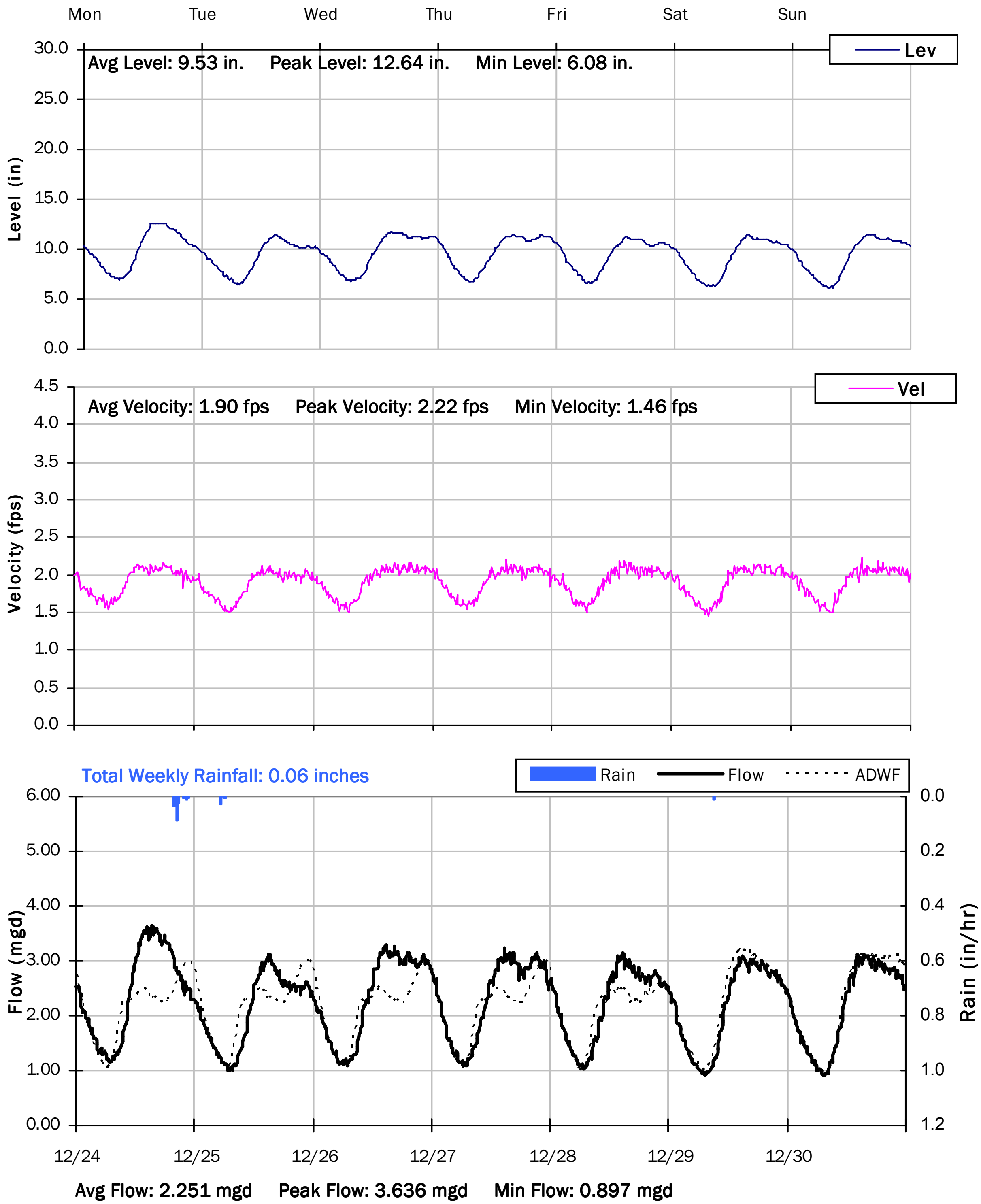


SITE 3
Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018

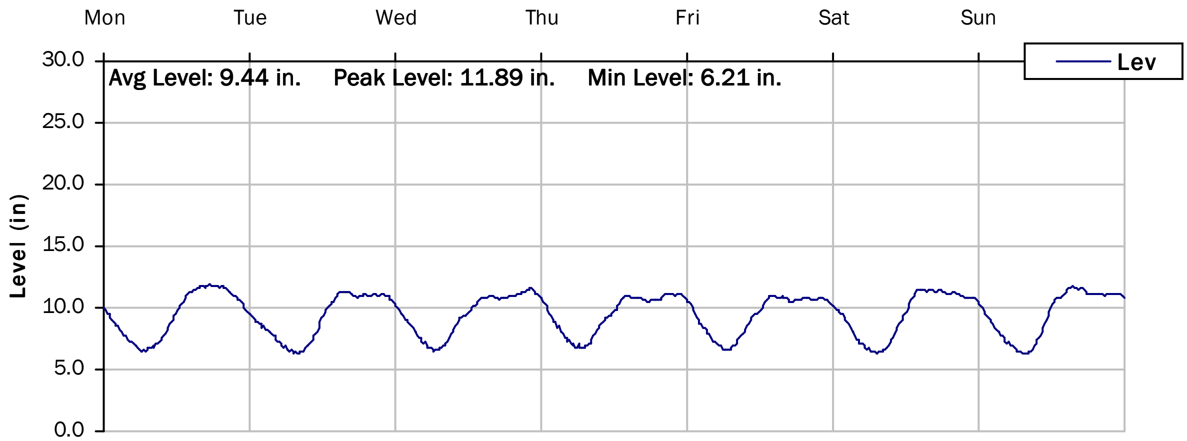


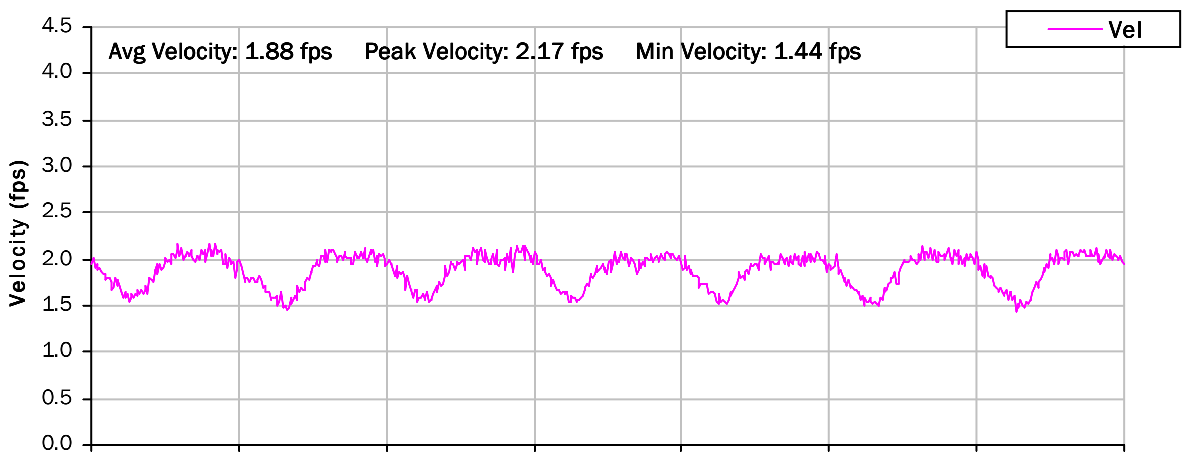
Avg Flow: 2.183 mgd Peak Flow: 3.443 mgd Min Flow: 0.902 mgd

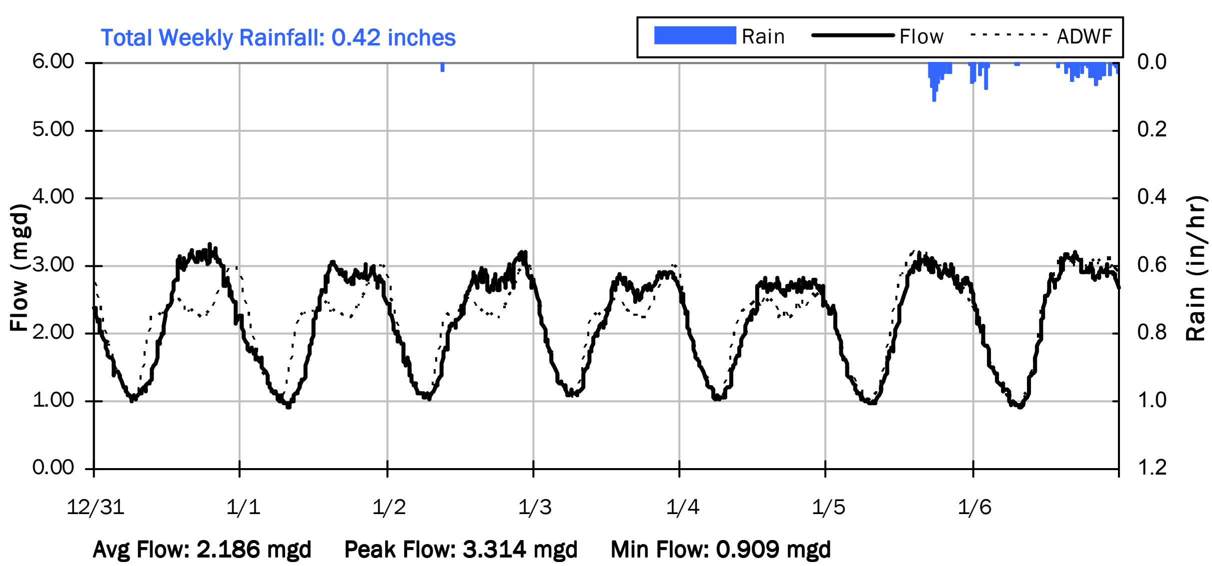
SITE 3
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018



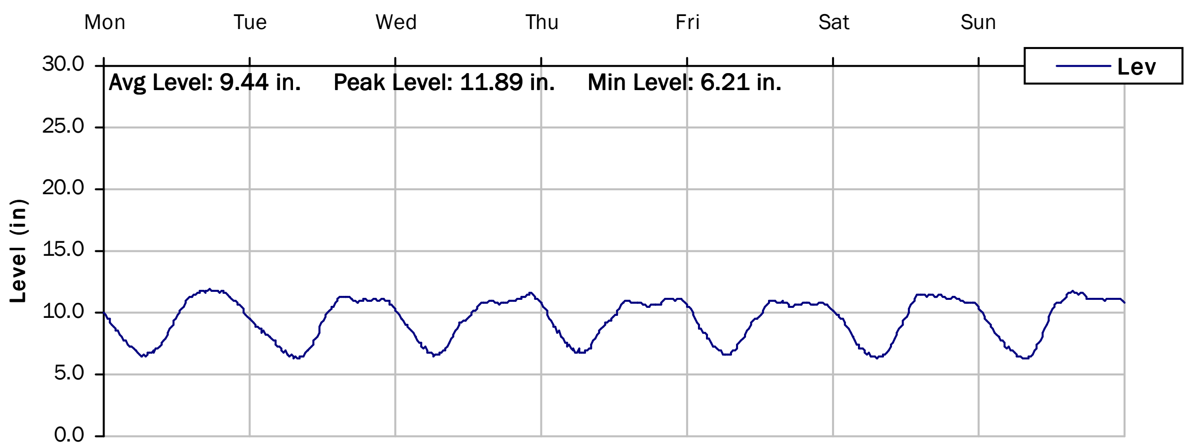
SITE 3
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019

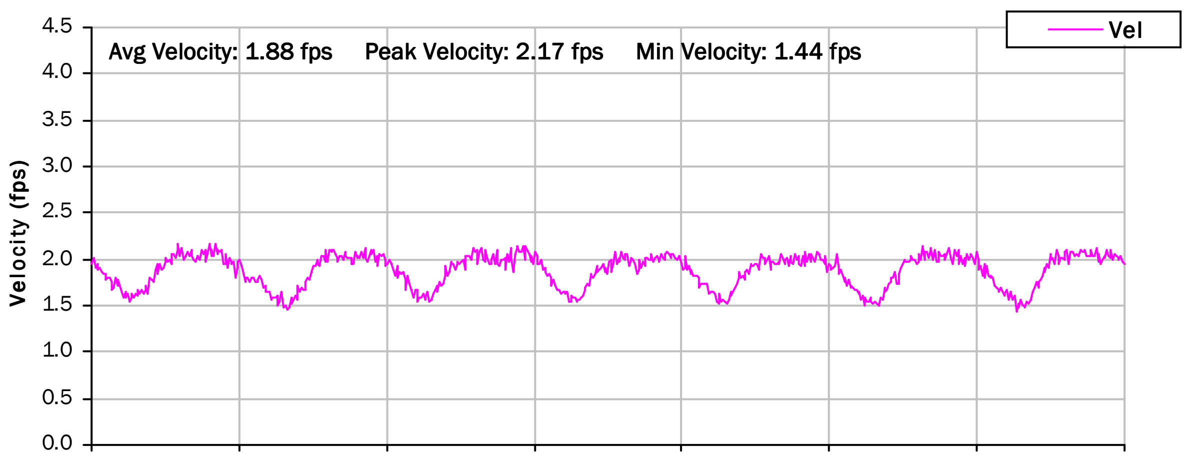


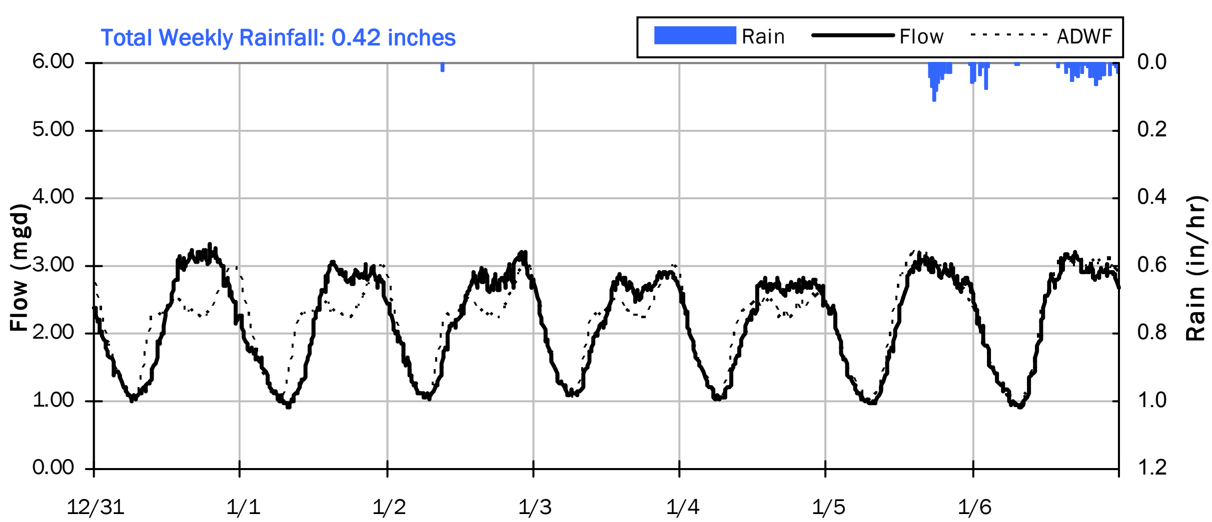




SITE 3
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019







Avg Flow: 2.186 mgd   Peak Flow: 3.314 mgd   Min Flow: 0.909 mgd

City of Visalia

Sanitary Sewer Flow Monitoring

November 28, 2018 - January 06, 2019

Monitoring Site: Site 4

Location: W Walnut Ave & S Savannah St

Data Summary Report

Vicinity Map: Site 4

SITE 4

Site Information

Location: W Walnut Ave & S Savannah St

Coordinates: 119.3631° W, 36.3127° N

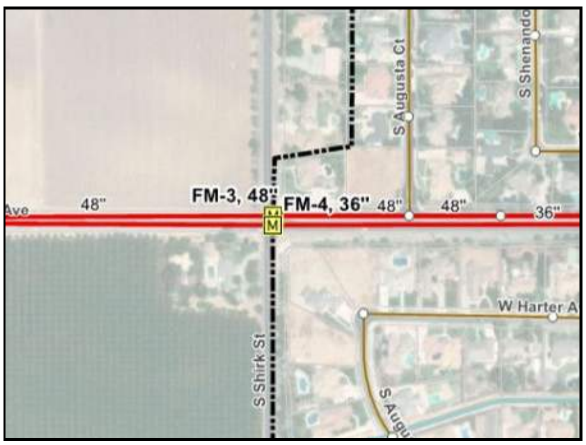
Rim Elevation (Earth): 303 feet

Pipe Diameter: 36 inches

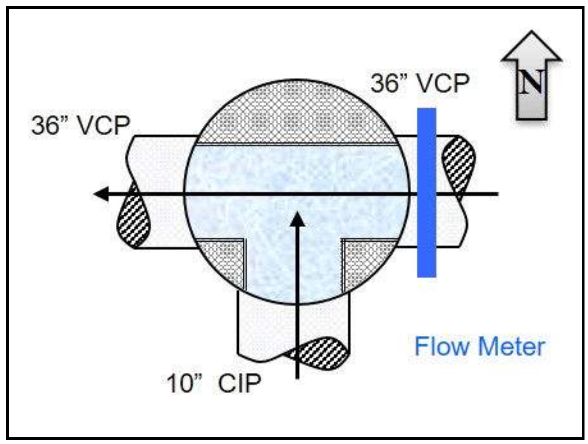
ADWF: 5.728 mgd

Peak Measured Flow: 8.773 mgd

Satellite Map



Sewer Map



Flow Sketch

Street View

Plan View

SITE 4

Additional Site Photos

Effluent Pipe

East Influent Pipe

SITE 4

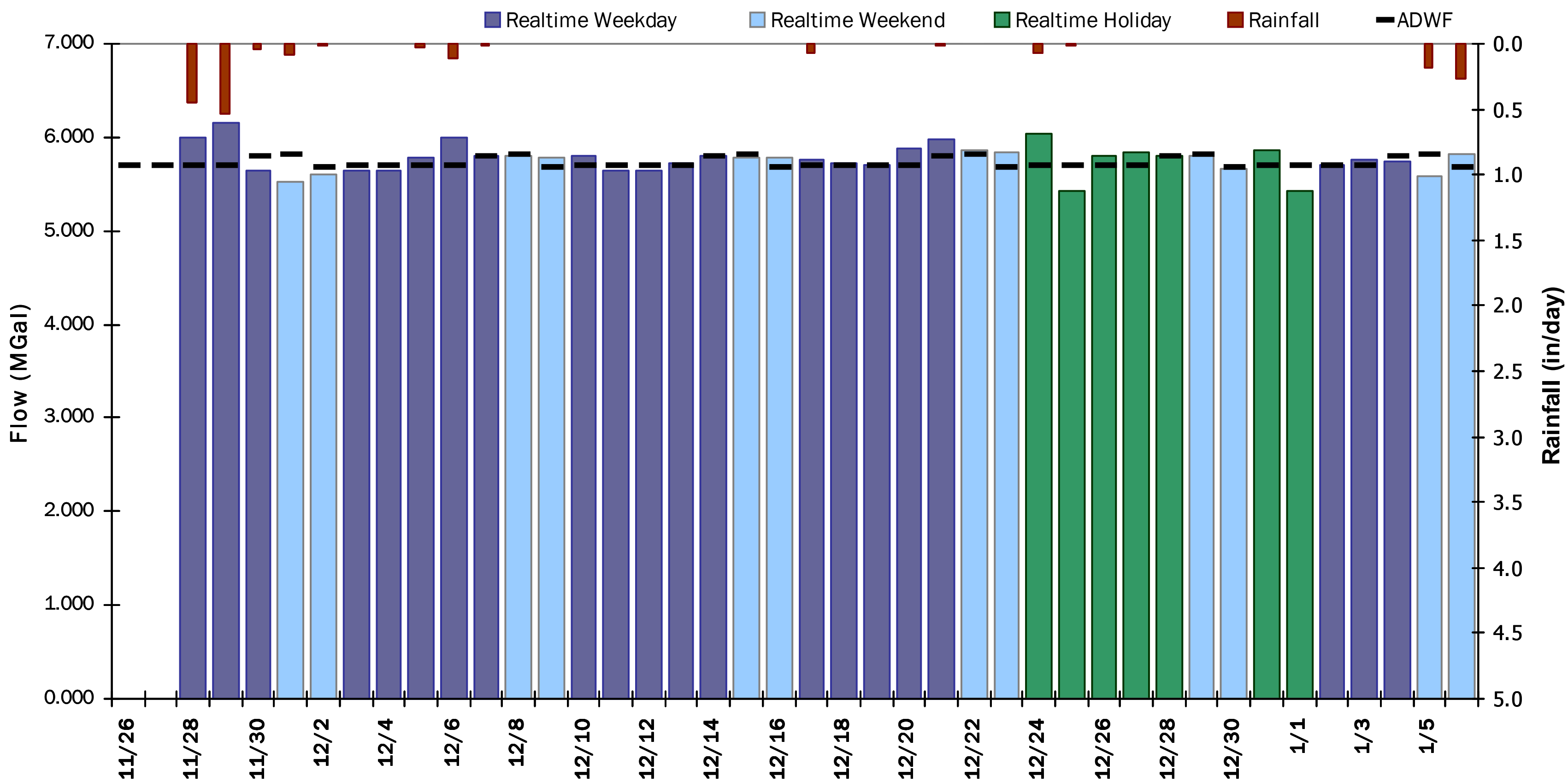
Additional Site Photos

South Influent Pipe

SITE 4
Period Flow Summary: Daily Flow Totals

Avg Period Flow: 5.764 MGal **Peak Daily Flow: 6.161 MGal** **Min Daily Flow: 5.420 MGal**

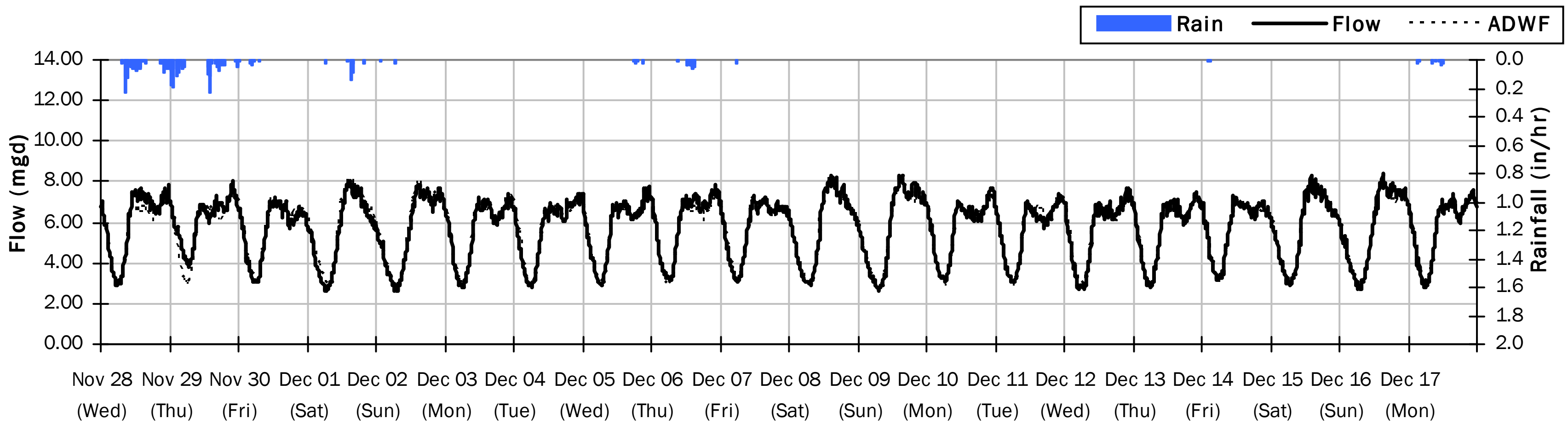
Total Period Rainfall: 1.89 inches

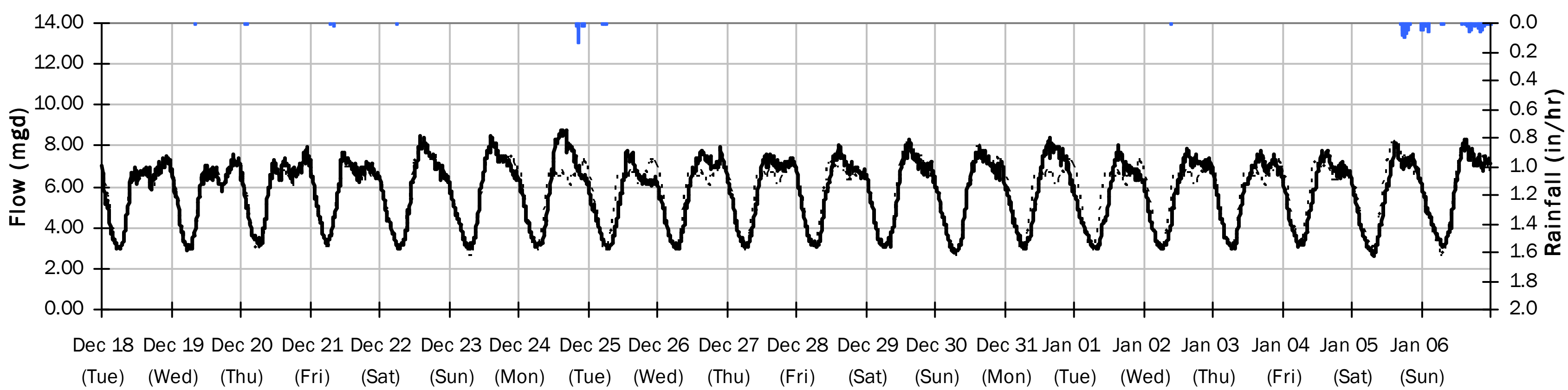


SITE 4

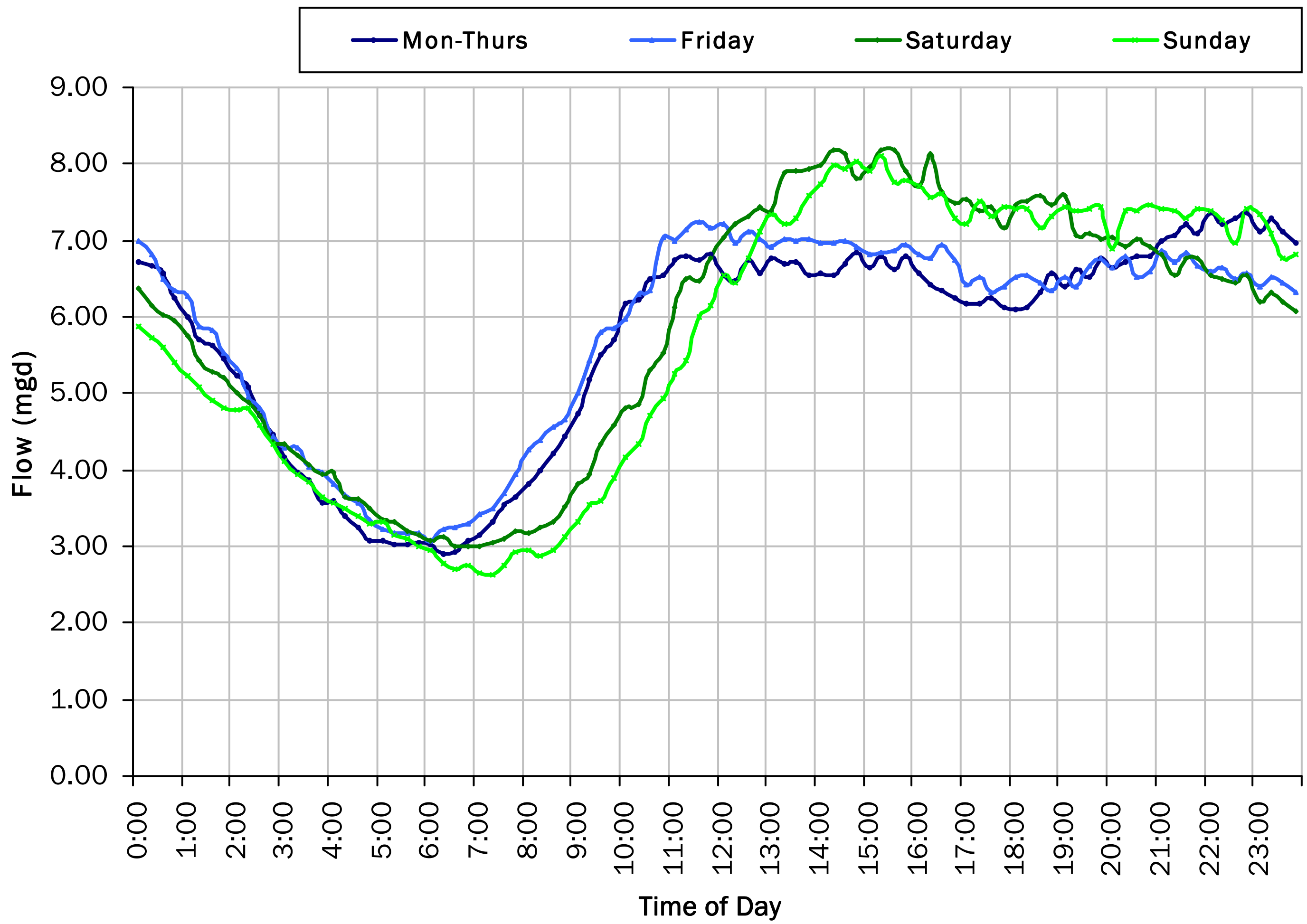
Flow Summary: 11/28/2018 to 1/6/2019

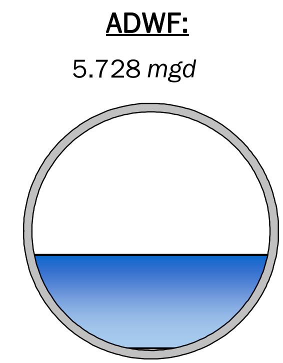
Total Period Rainfall: 1.89 inches   Avg Flow: 5.764 mgd   Peak Flow: 8.773 mgd   Min Flow: 2.623 mgd





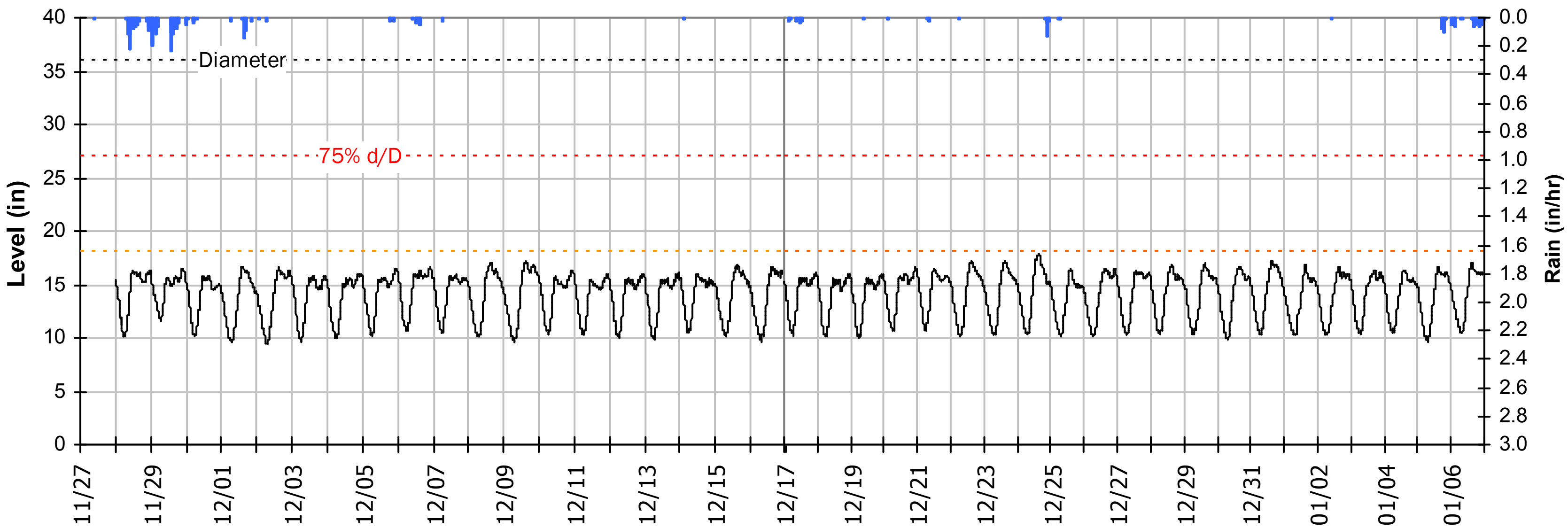
SITE 4
Average Dry Weather Flow Hydrographs

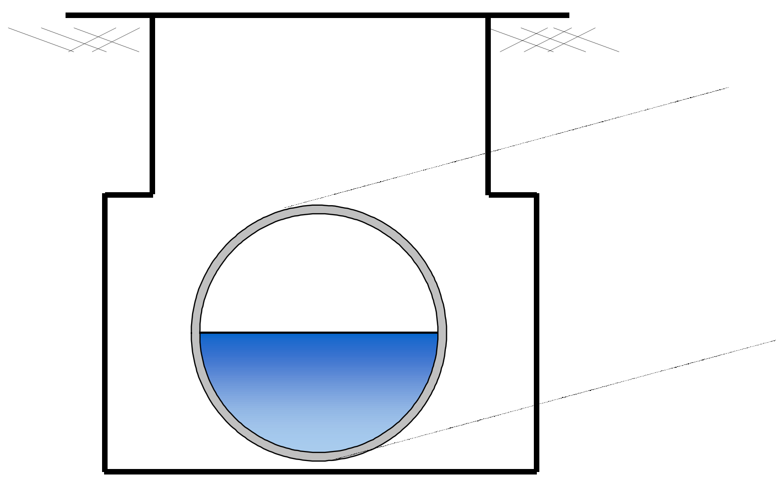




SITE 4
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

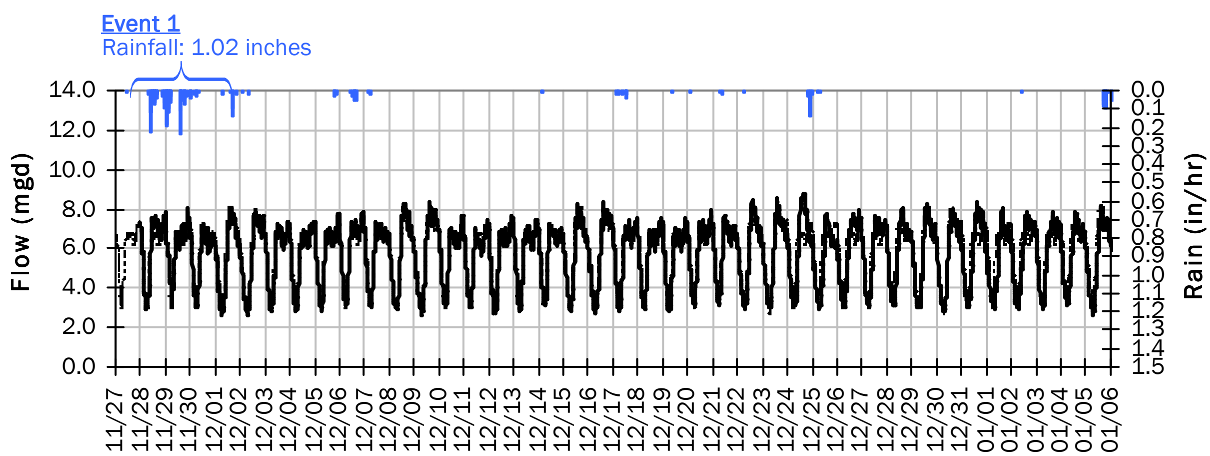




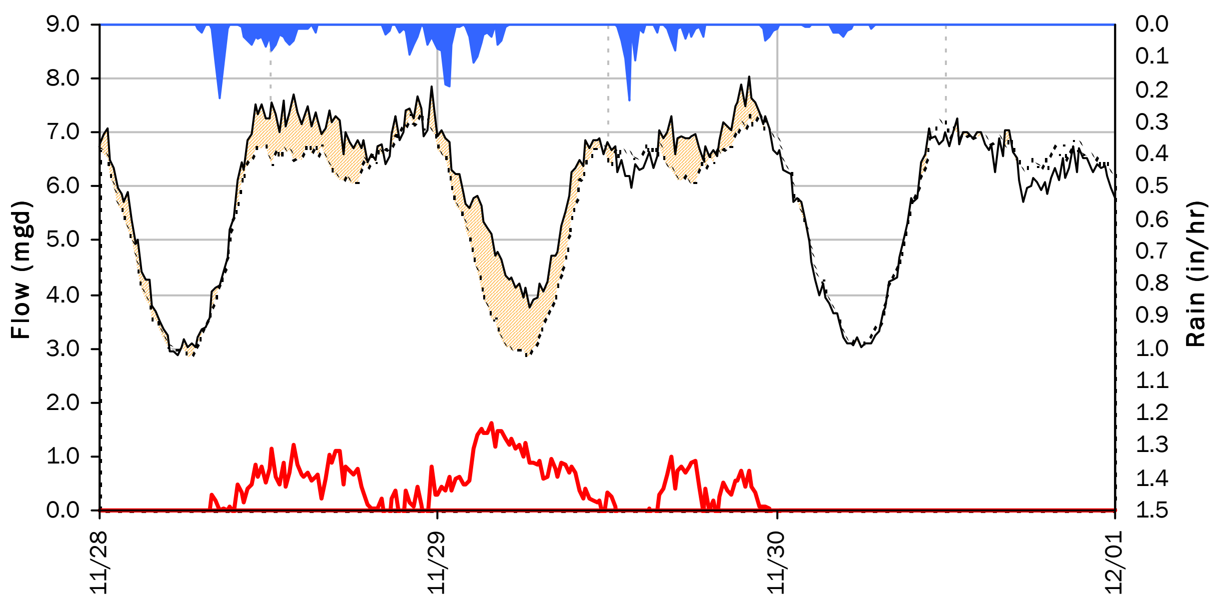
Pipe Diameter:	36	*inches*
Peak Measured Level:	18	*inches*
Peak d/D Ratio:	0.50	

SITE 4
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



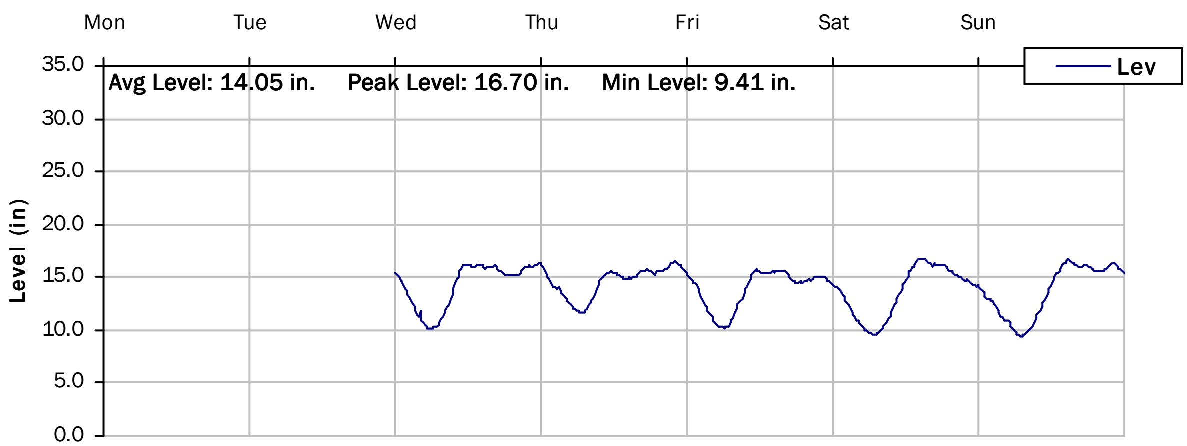
Storm Event I/I Analysis (Rain = 1.02 inches)

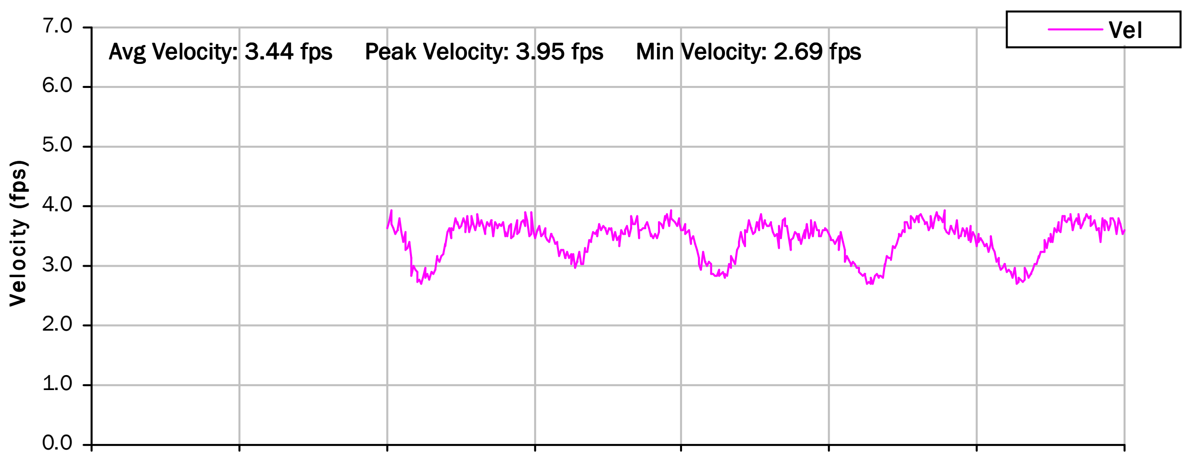
Capacity		Inflow / Infiltration	
Peak Flow:	8.05 *mgd*	**Peak I/I Rate:**	1.62 *mgd*
PF:	1.41	**Total I/I:**	802,000 *gallons*
Peak Level:	16.50 *in*		
d/D Ratio:	0.46		

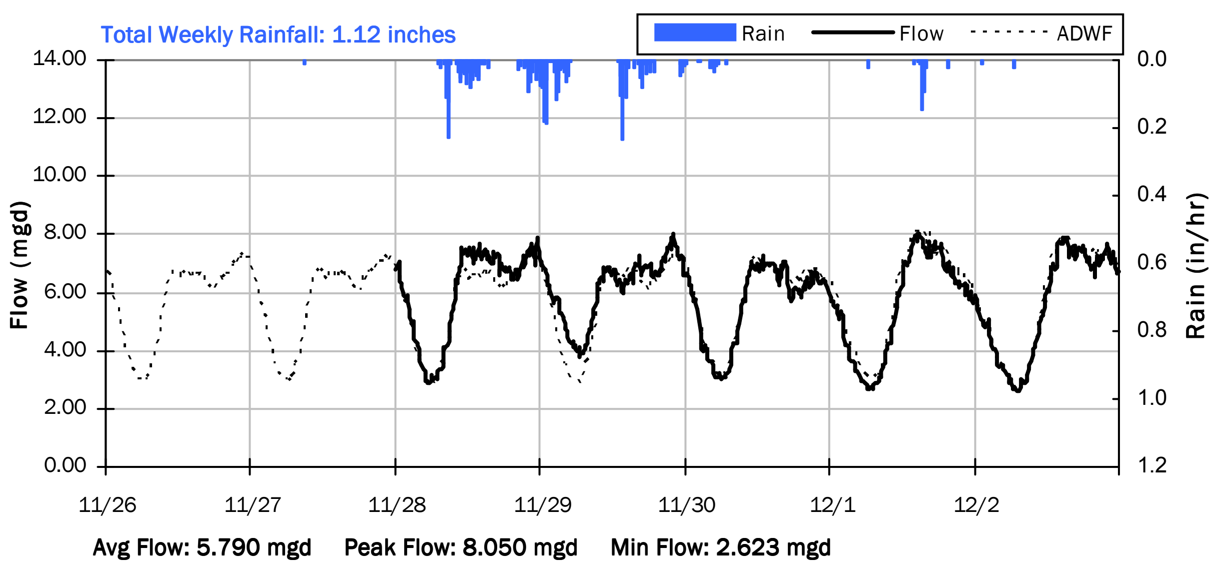
SITE 4

Weekly Level, Velocity and Flow Hydrographs

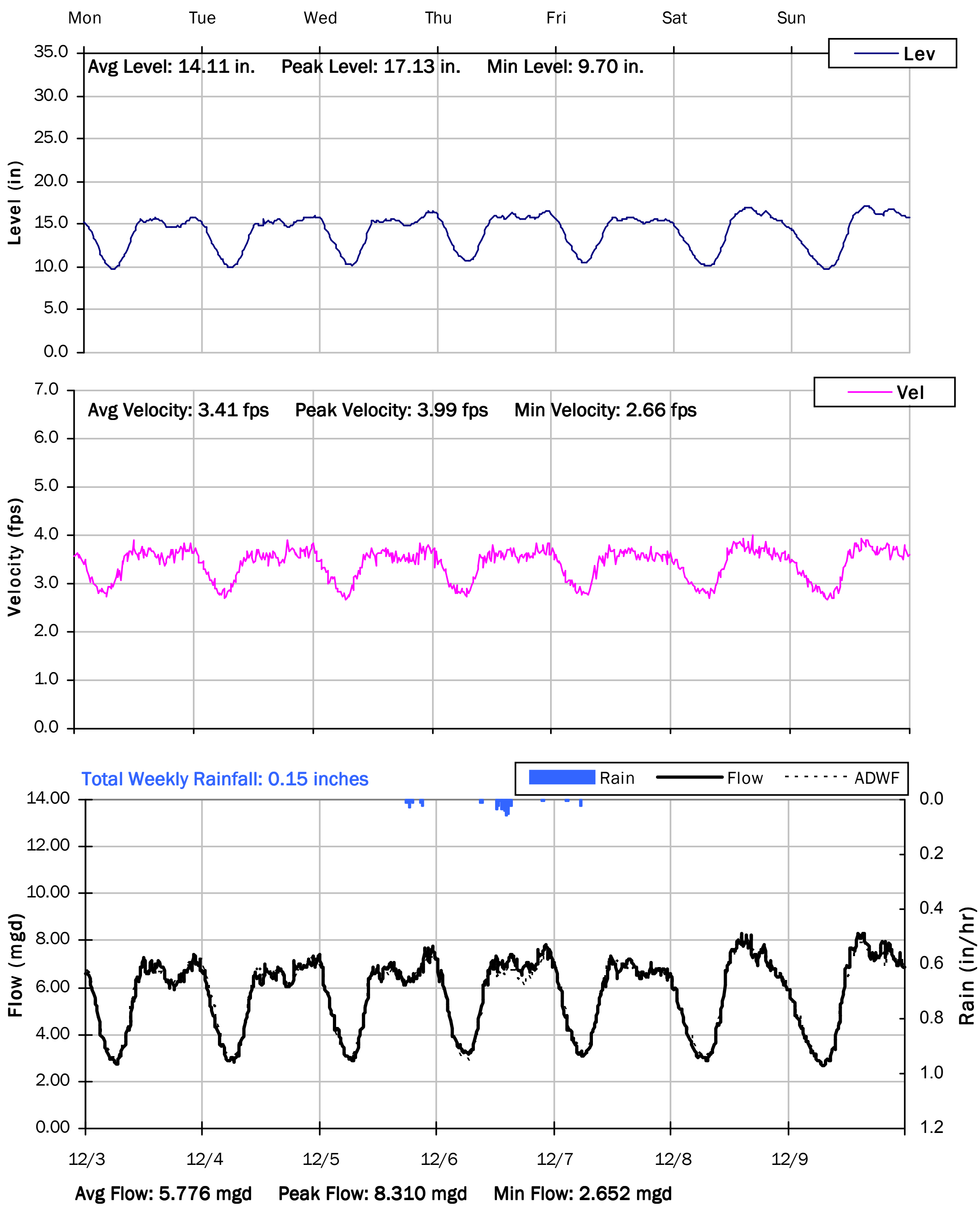
11/26/2018 to 12/3/2018







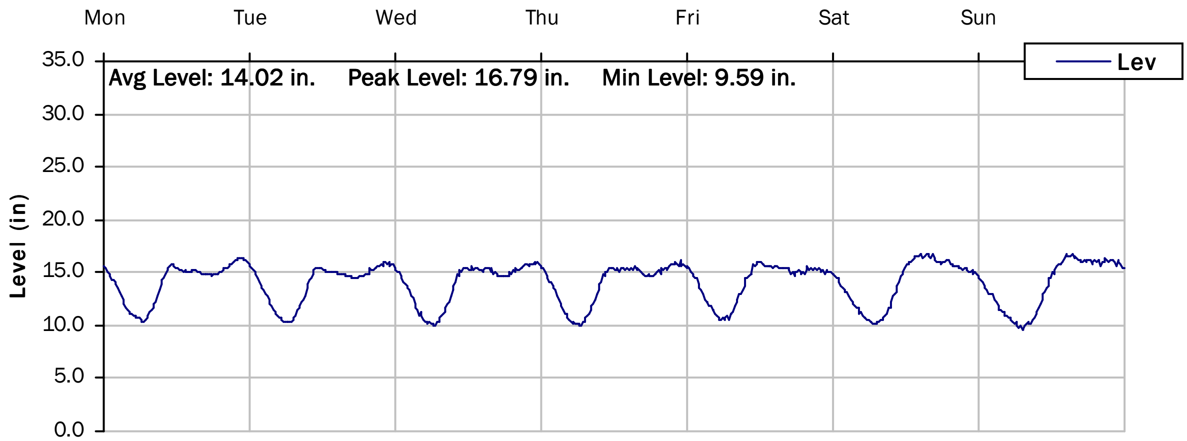
SITE 4
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018

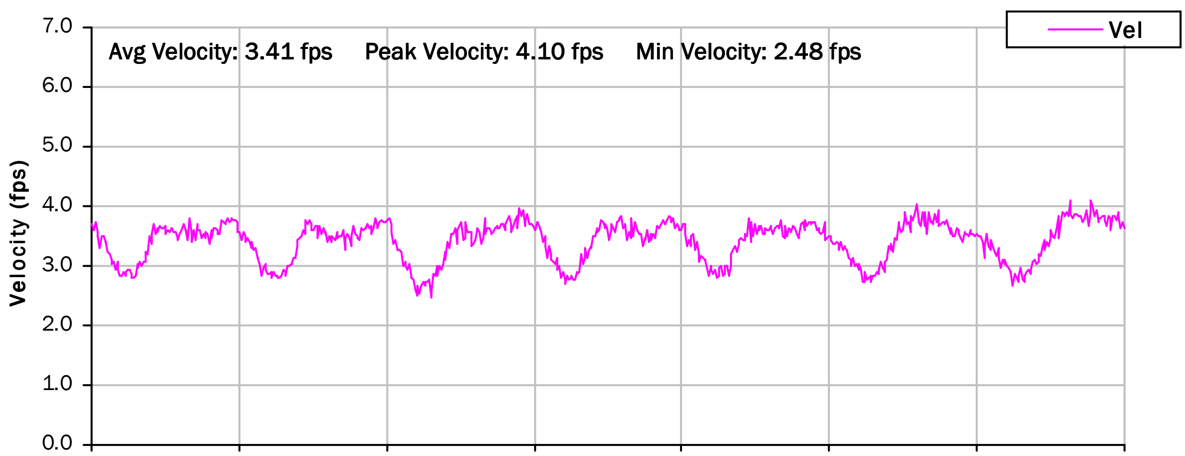


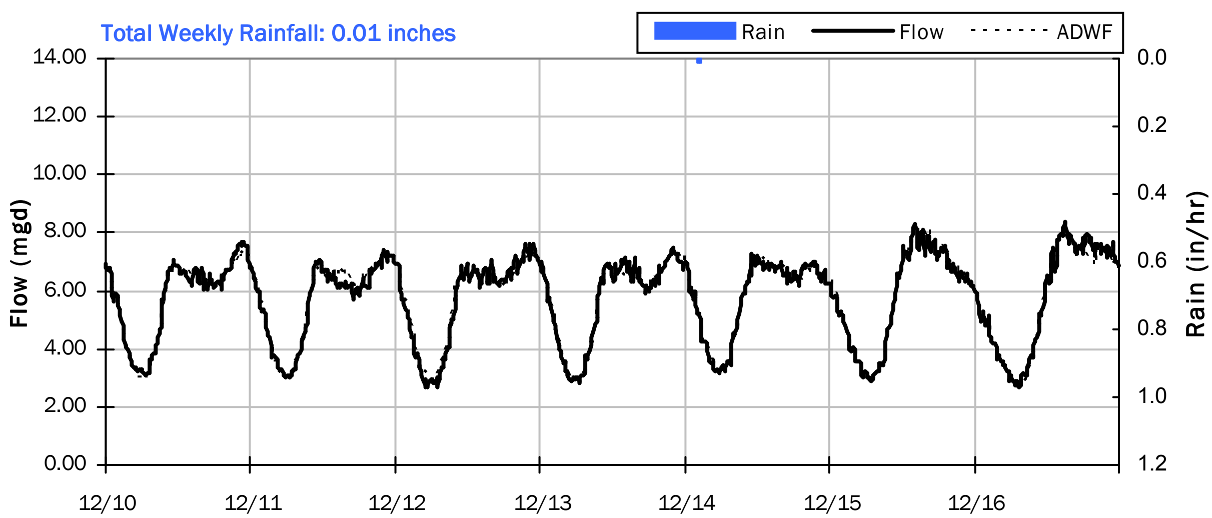
SITE 4

Weekly Level, Velocity and Flow Hydrographs

12/10/2018 to 12/17/2018



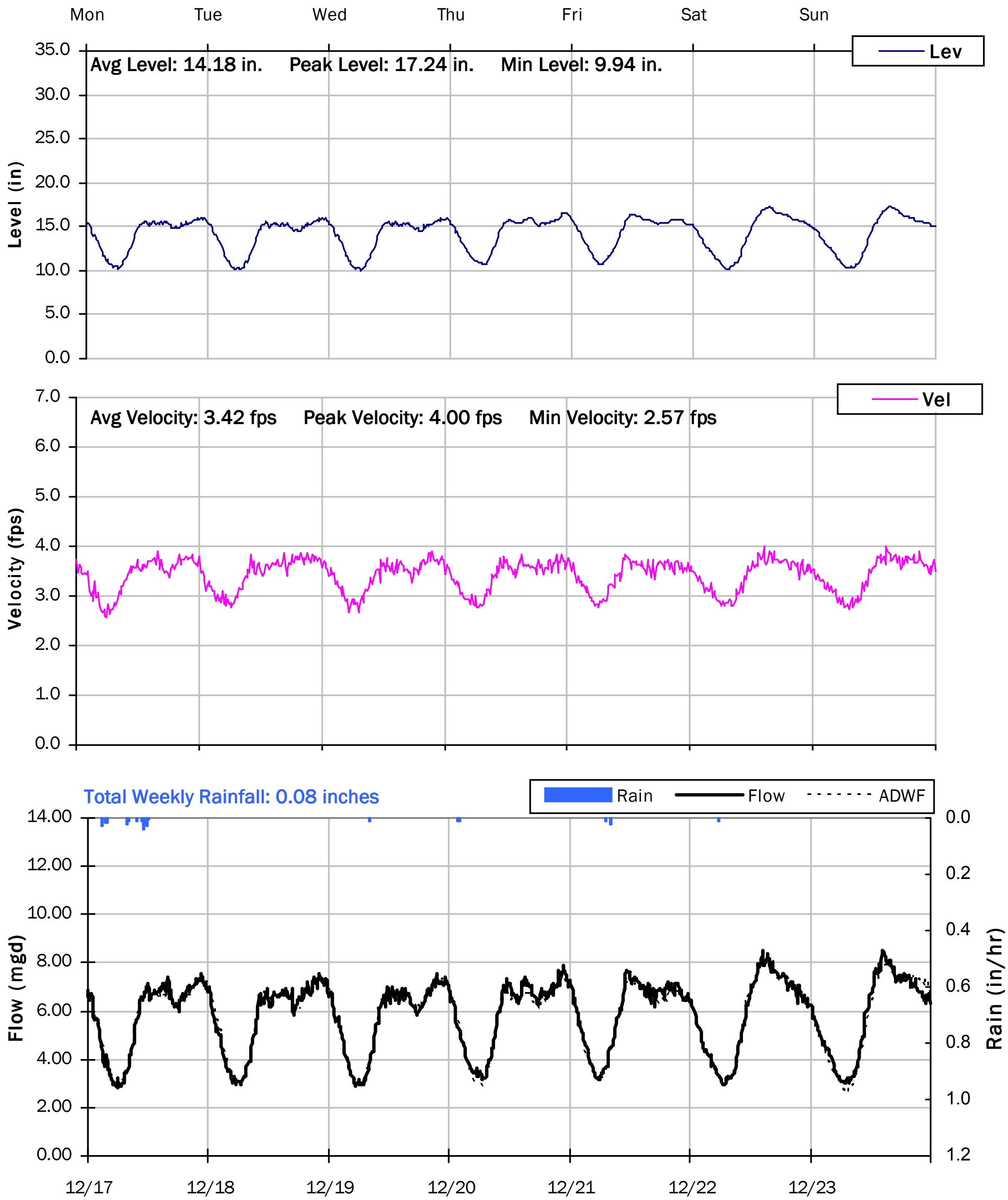




Avg Flow: 5.737 mgd Peak Flow: 8.374 mgd Min Flow: 2.693 mgd

SITE 4

Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018

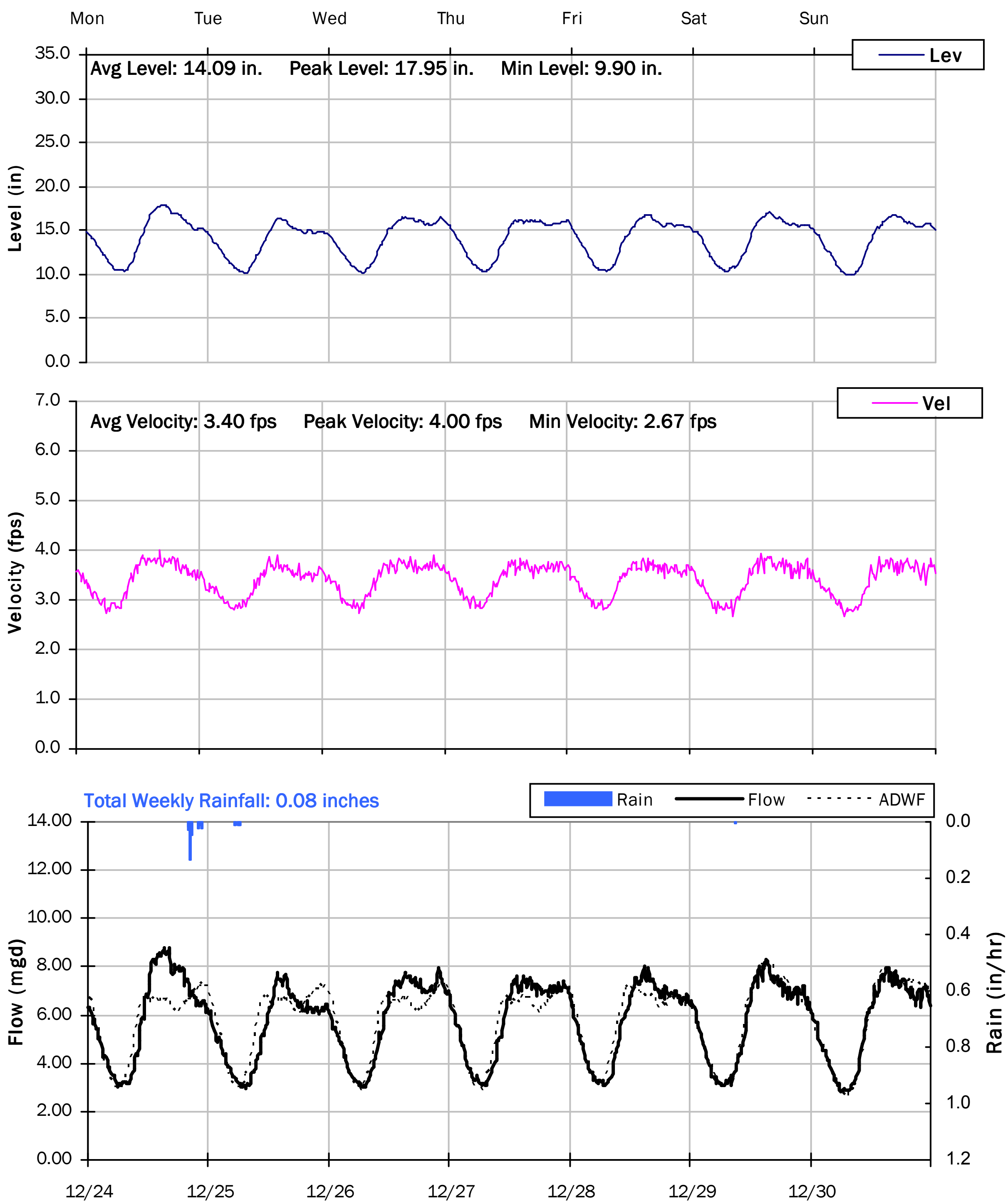


Avg Flow: 5.822 mgd Peak Flow: 8.525 mgd Min Flow: 2.836 mgd

SITE 4

Weekly Level, Velocity and Flow Hydrographs

12/24/2018 to 12/31/2018

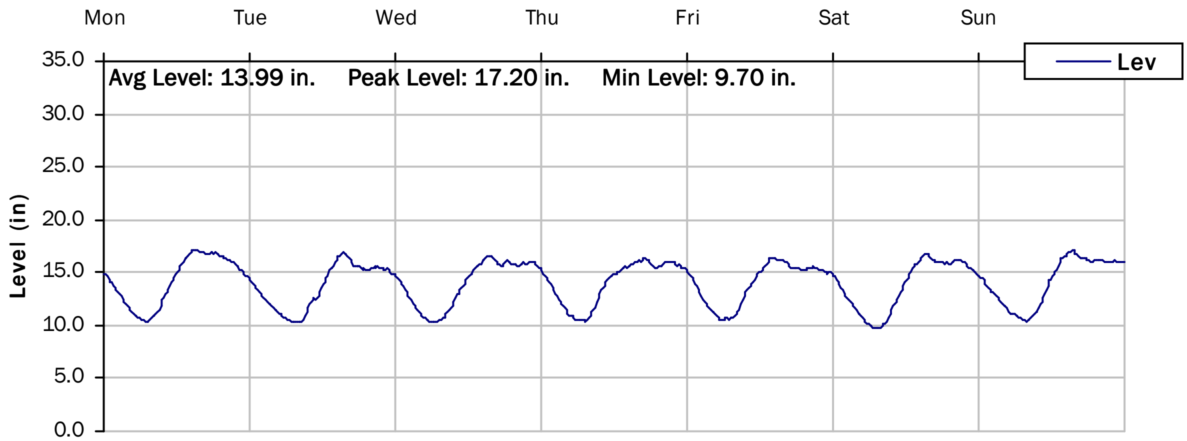


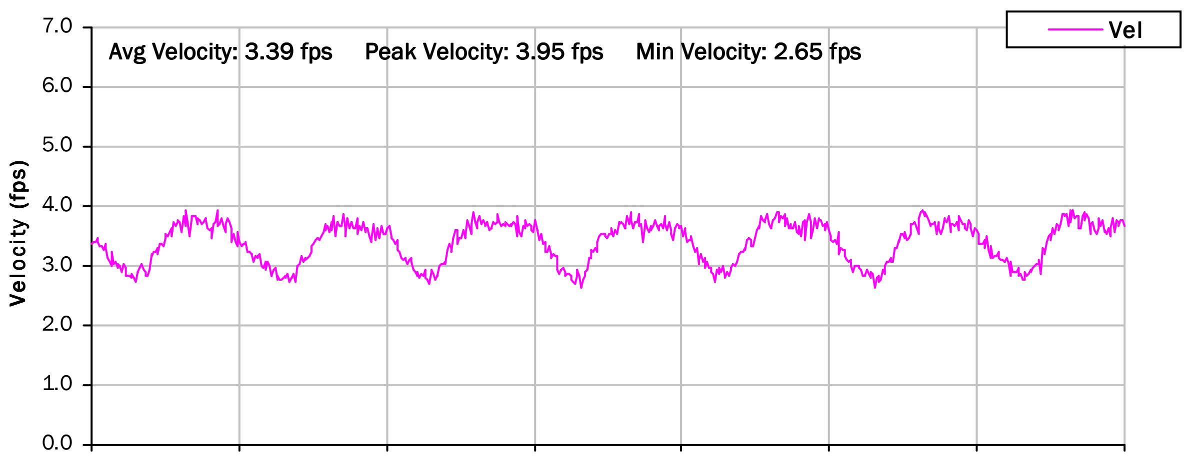
Avg Flow: 5.769 mgd **Peak Flow: 8.773 mgd** **Min Flow: 2.794 mgd**

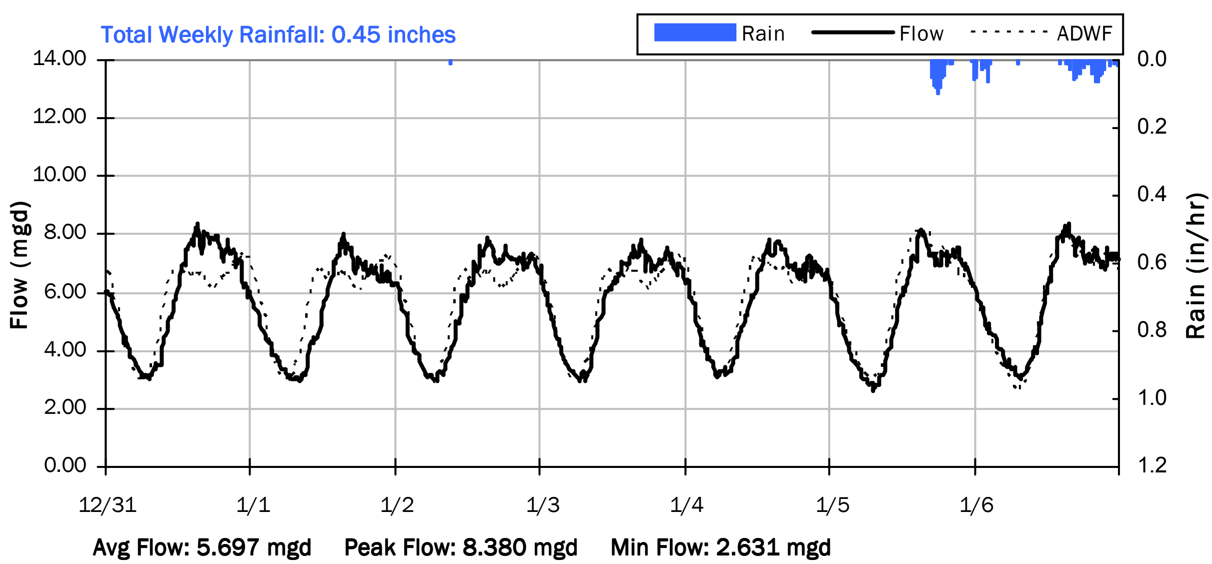
SITE 4

Weekly Level, Velocity and Flow Hydrographs

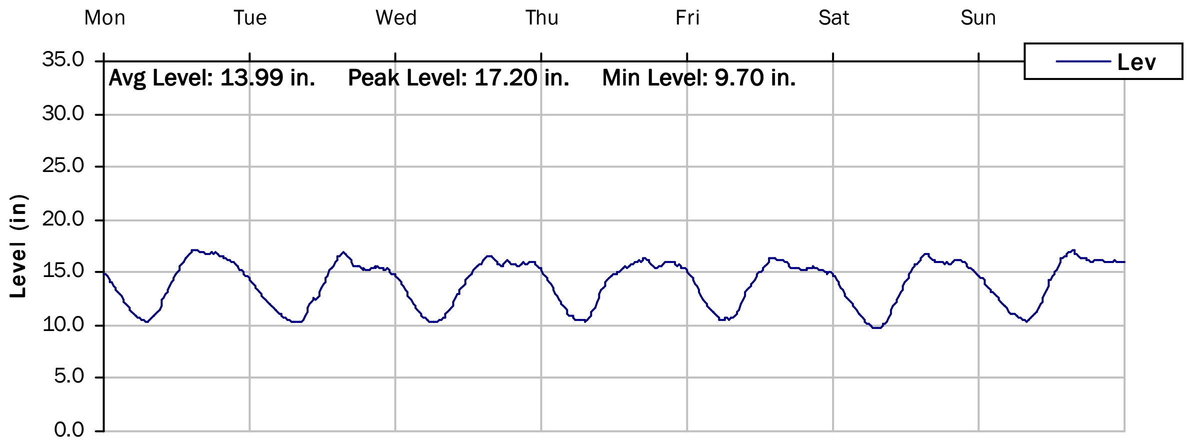
12/31/2018 to 1/7/2019

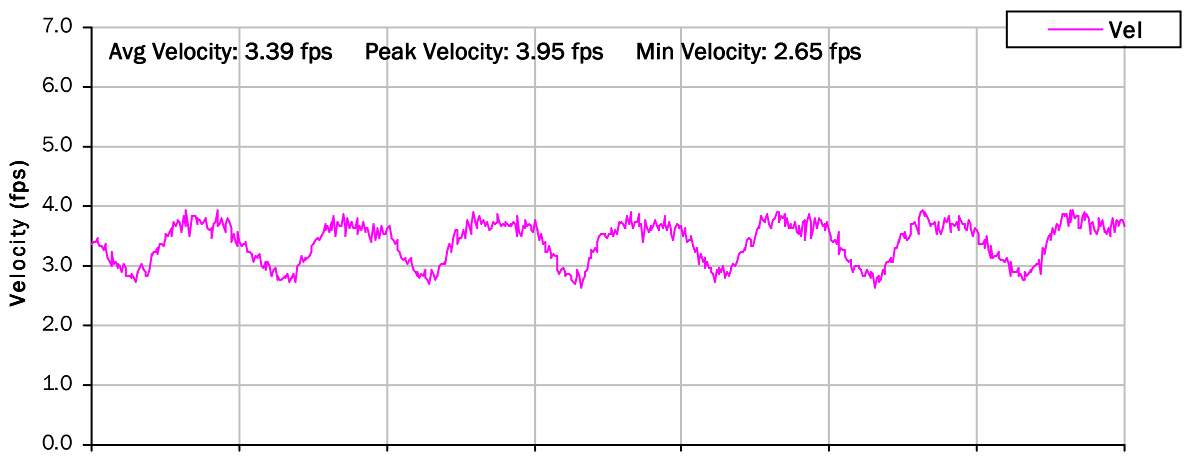


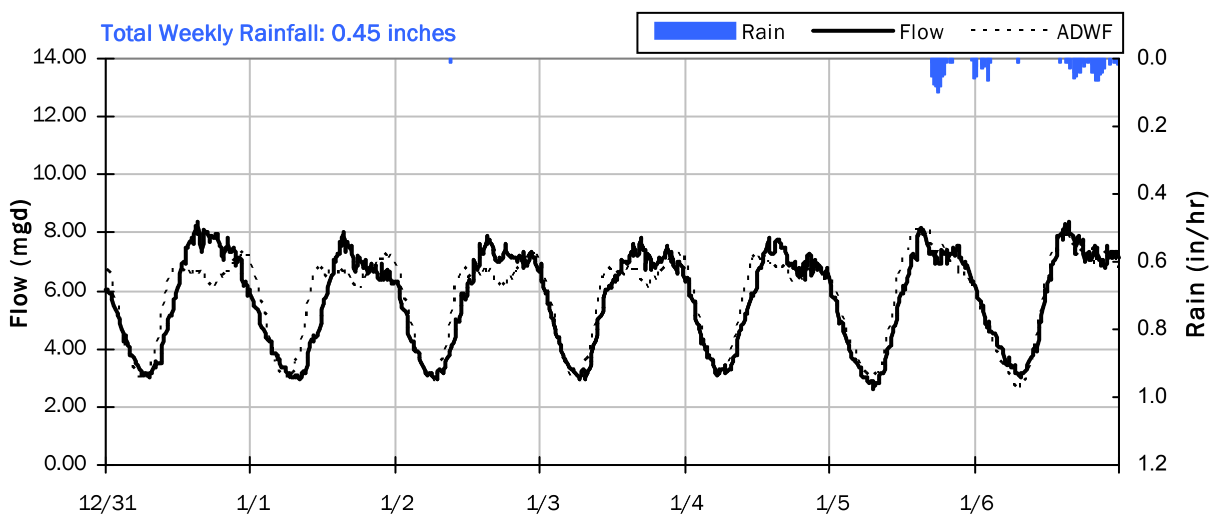




SITE 4
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019







Avg Flow: 5.697 mgd   Peak Flow: 8.380 mgd   Min Flow: 2.631 mgd

City of Visalia

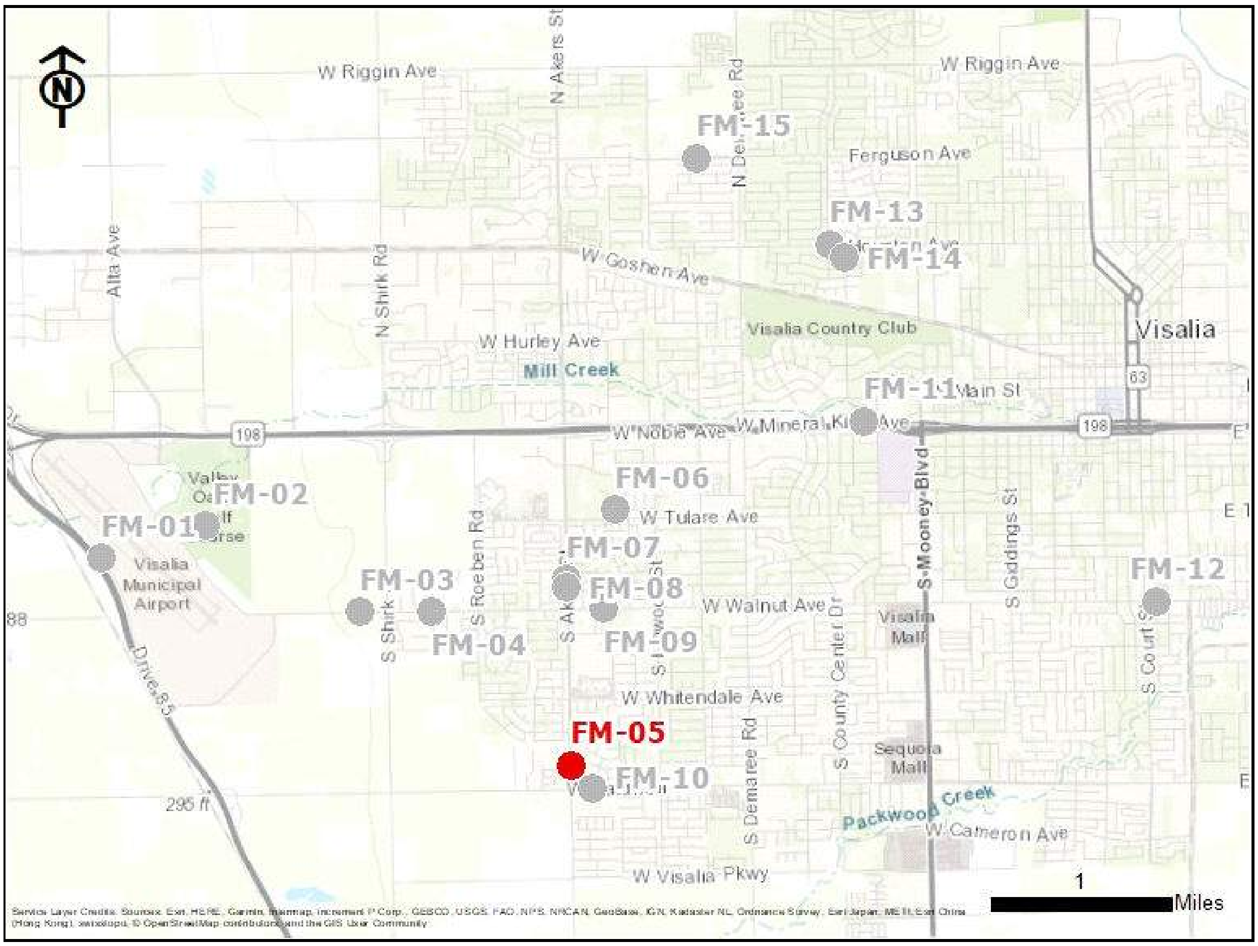
Sanitary Sewer Flow Monitoring

November 28, 2018 - January 06, 2019

Monitoring Site: Site 5

Location: 3498 Akers St n/o W Caldwell Ave

Data Summary Report



Vicinity Map: Site 5

SITE 5

Site Information

Location: 3498 Akers St n/o W Caldwell Ave

Coordinates: 119.3494° W, 36.3001° N

Rim Elevation (Earth): 310 feet

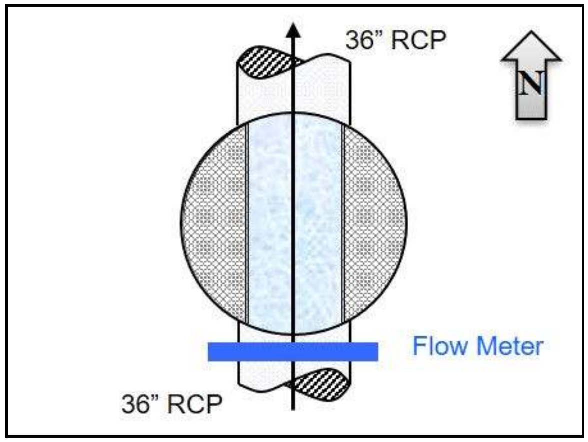
Pipe Diameter: 36 inches

ADWF: 1.070 mgd

Peak Measured Flow: 1.979 mgd

Satellite Map

Sewer Map



Flow Sketch

Street View

Plan View

SITE 5

Additional Site Photos

Effluent Pipe

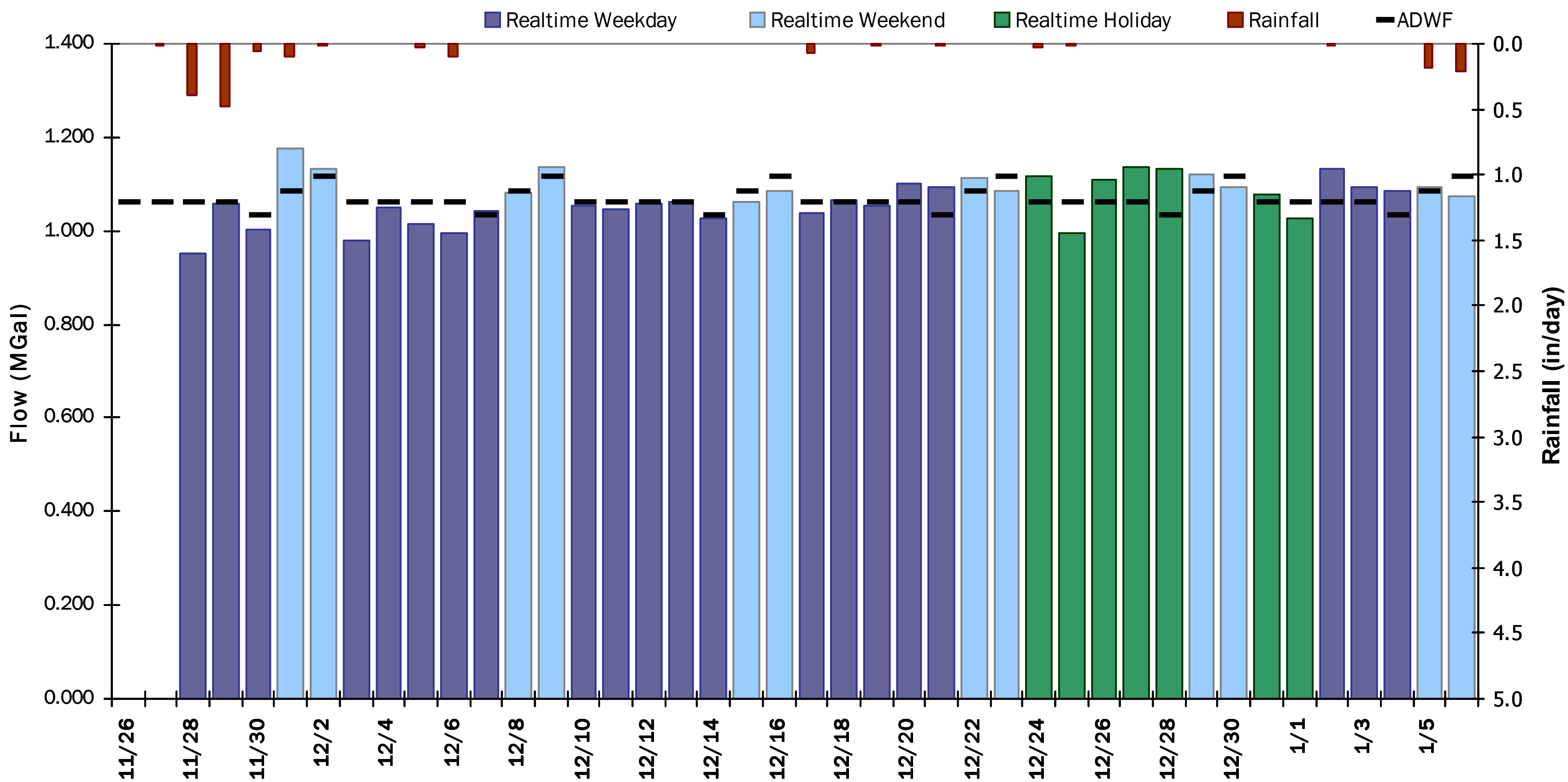
Influent Pipe

SITE 5

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 1.071 MGal **Peak Daily Flow: 1.176 MGal** **Min Daily Flow: 0.952 MGal**

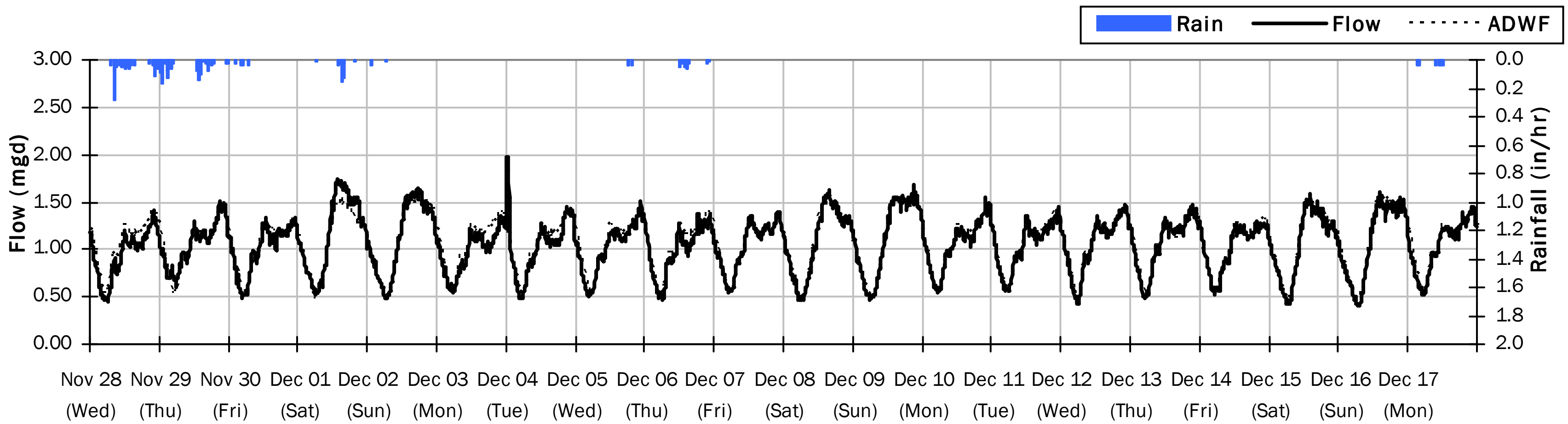
Total Period Rainfall: 1.71 inches

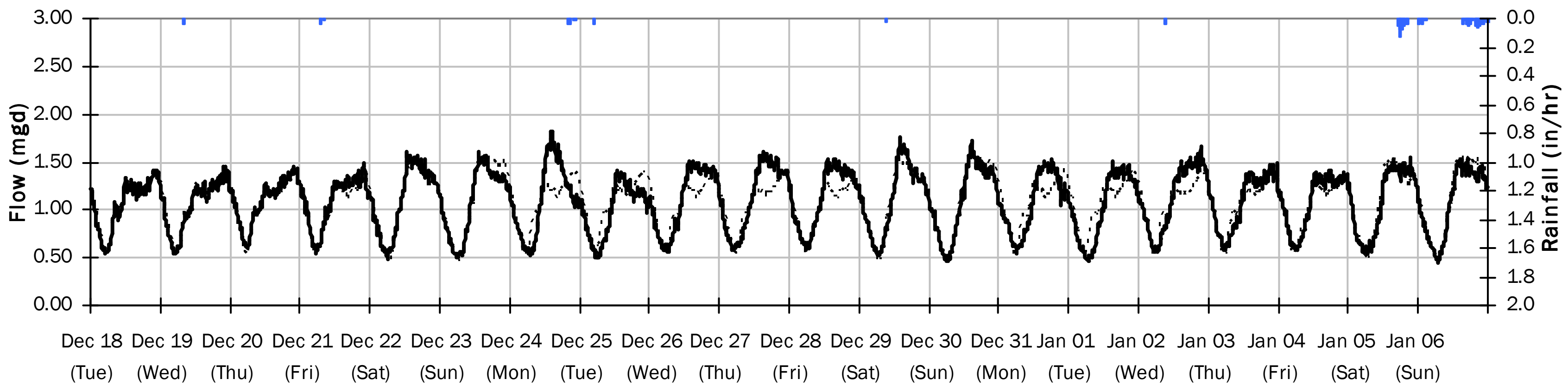


SITE 5

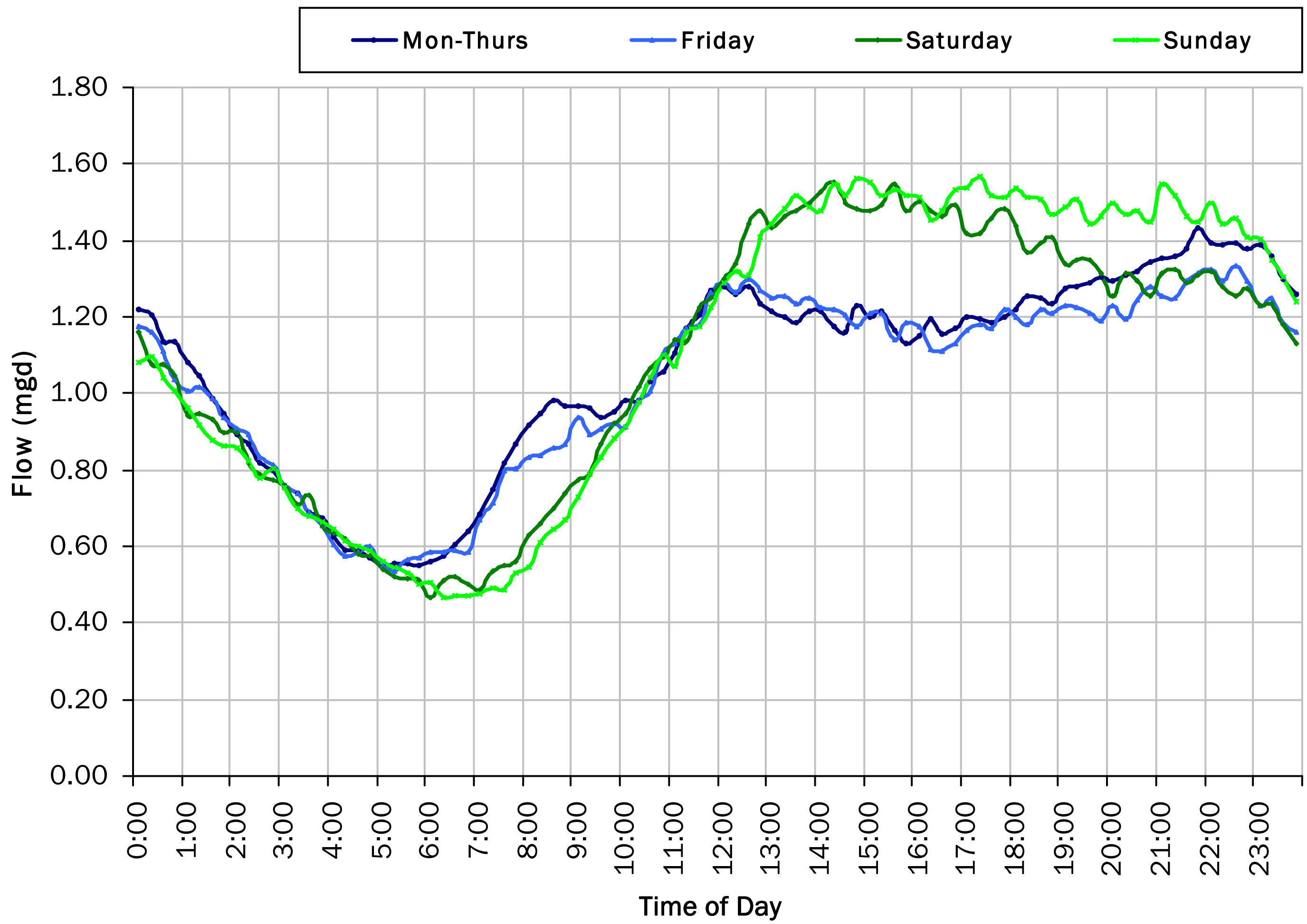
Flow Summary: 11/28/2018 to 1/6/2019

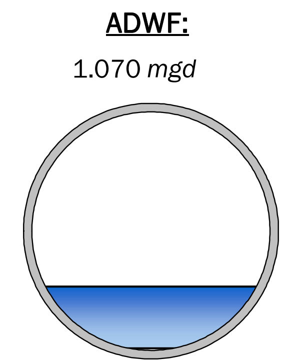
Total Period Rainfall: 1.71 inches   Avg Flow: 1.071 mgd   Peak Flow: 1.979 mgd   Min Flow: 0.408 mgd





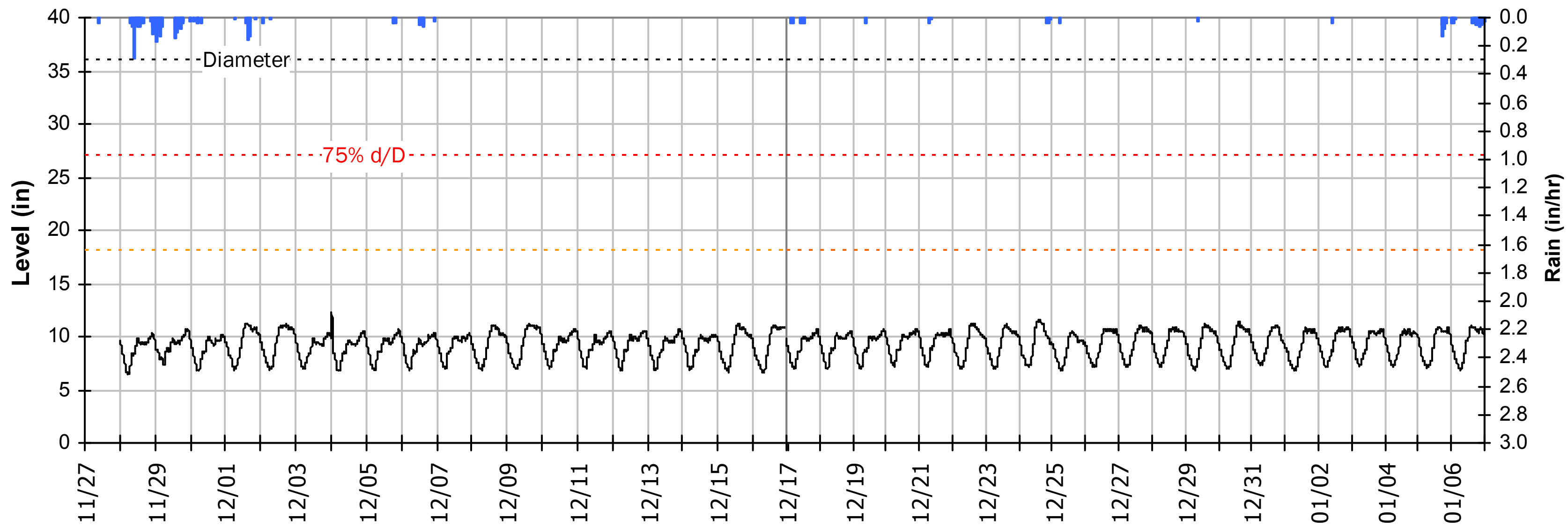
SITE 5
Average Dry Weather Flow Hydrographs

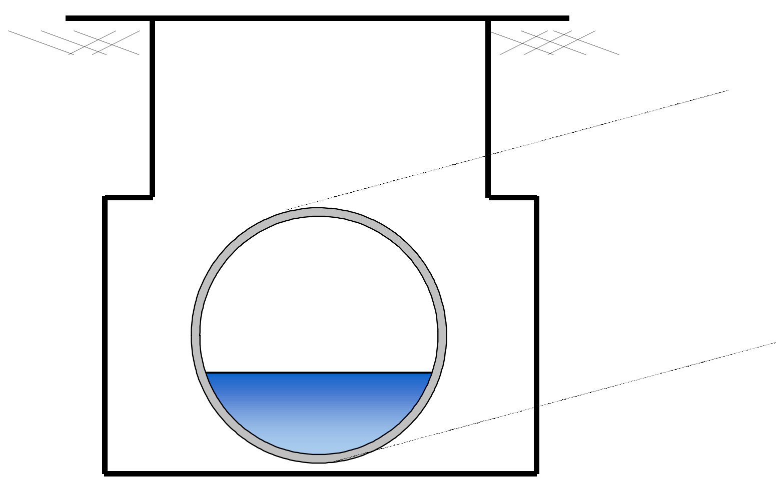




SITE 5
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

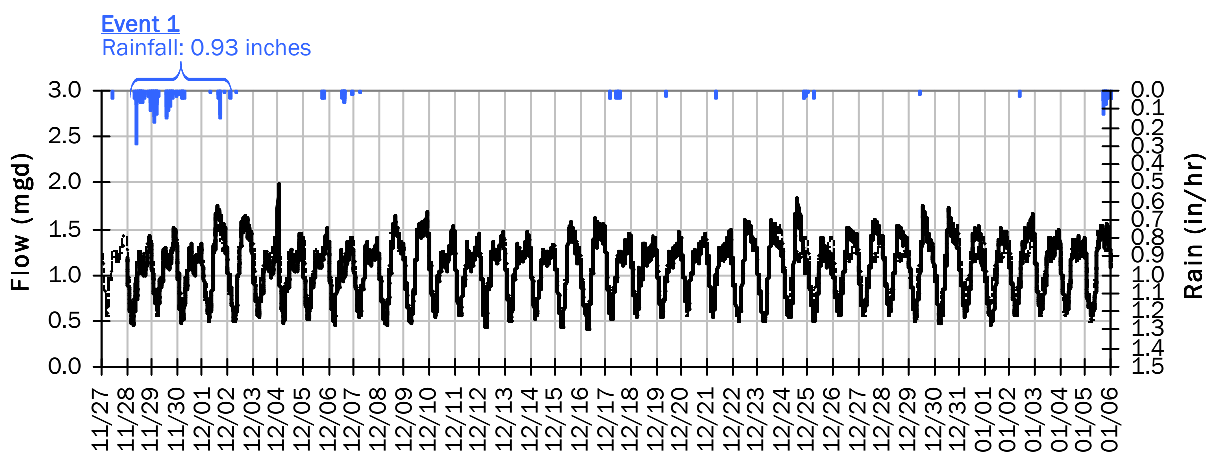




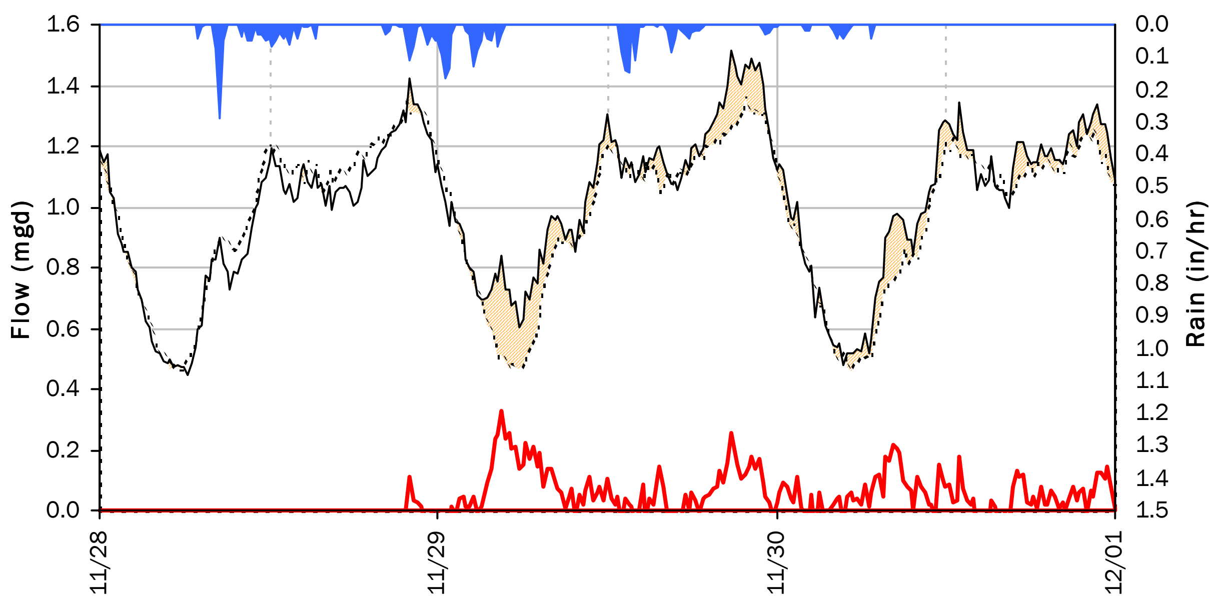
Pipe Diameter:	36	*inches*
Peak Measured Level:	12.3	*inches*
Peak d/D Ratio:	0.34	

SITE 5
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 = 0.93 inches)

Capacity

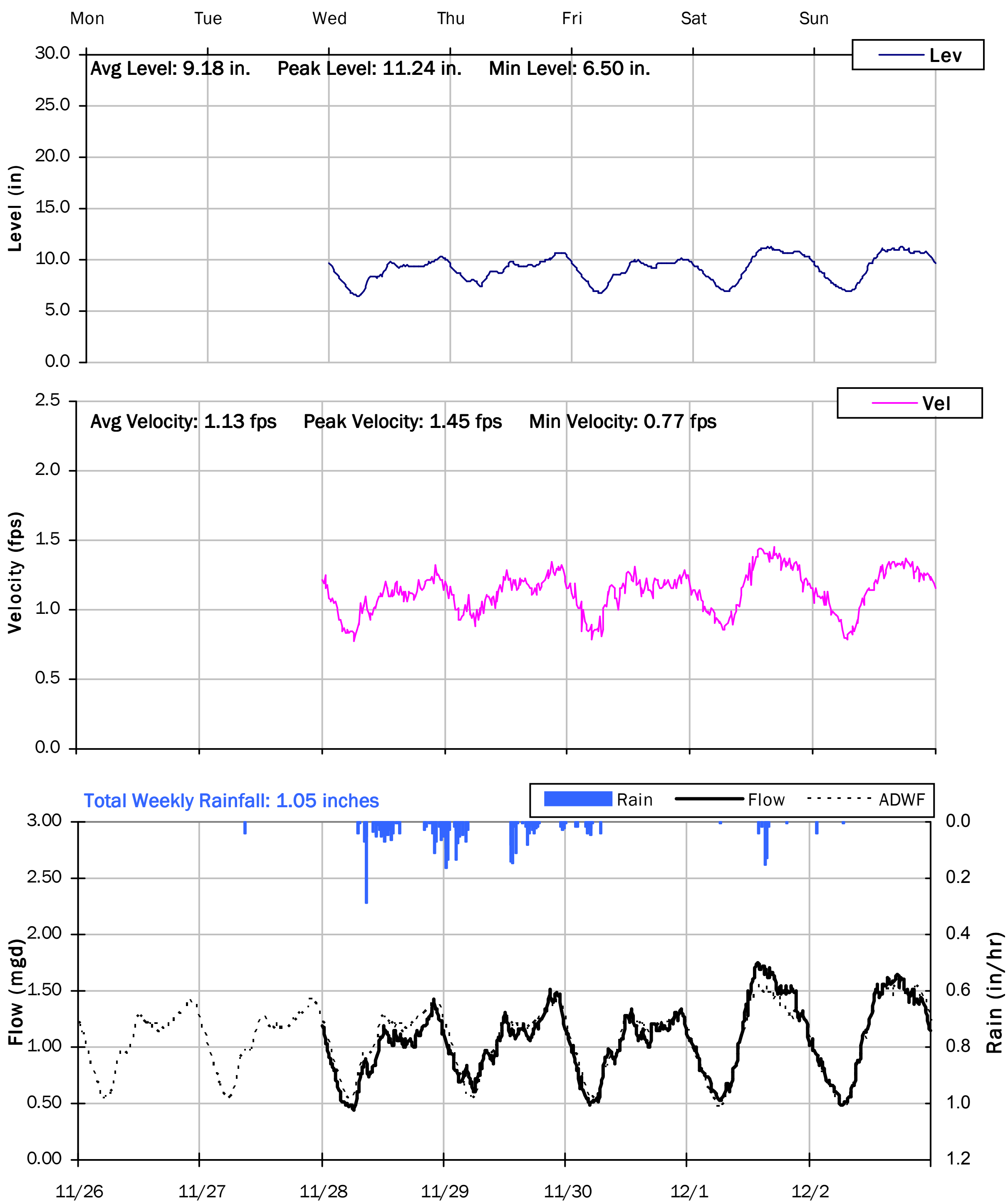
Peak Flow: 1.52 *mgd*
PF: 1.42

Peak Level: 10.70 *in*
d/D Ratio: 0.30

Inflow / Infiltration

Peak I/I Rate: 0.33 *mgd*
Total I/I: 126,000 *gallons*

SITE 5
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018

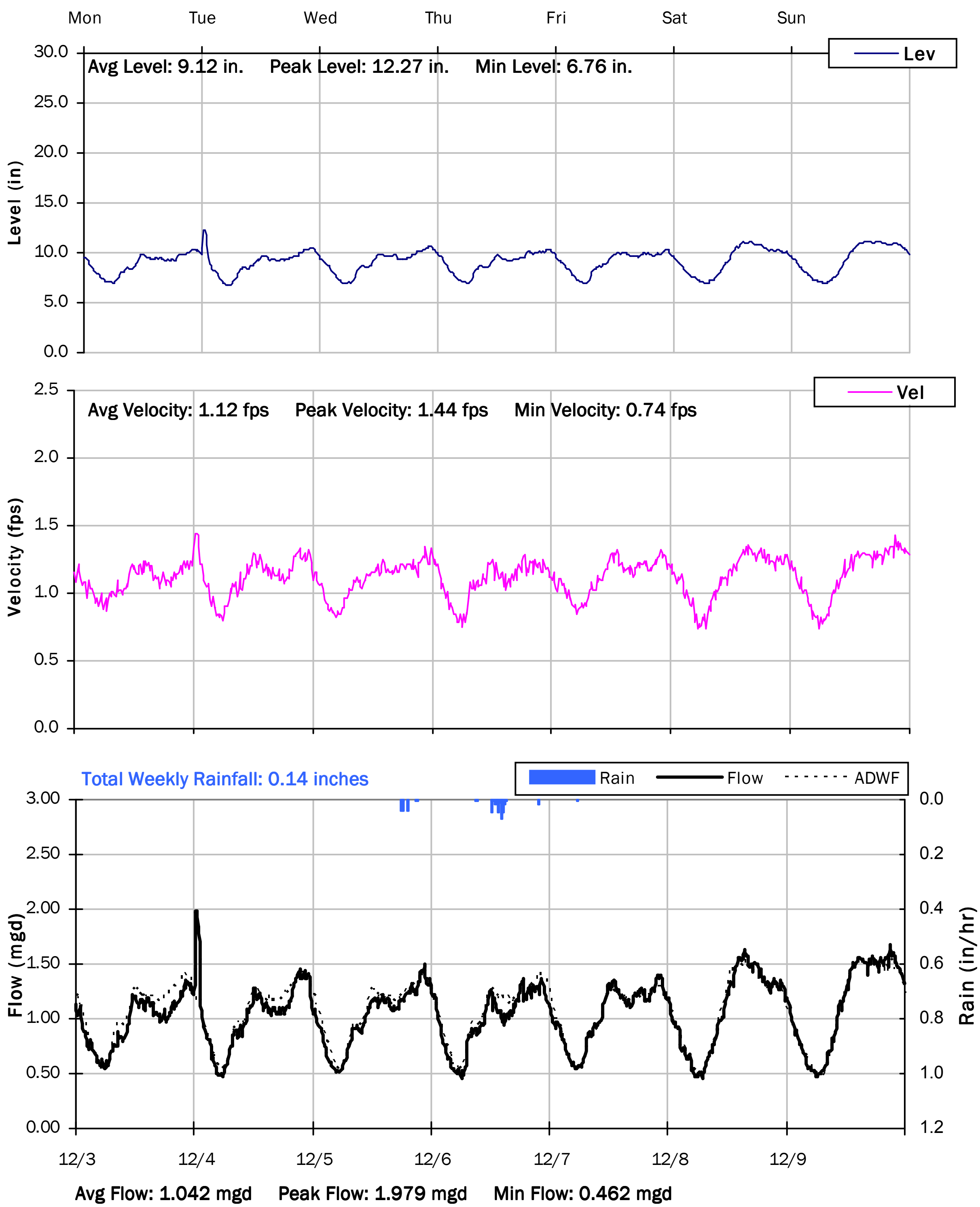


Avg Flow: 1.064 mgd **Peak Flow: 1.745 mgd** **Min Flow: 0.444 mgd**

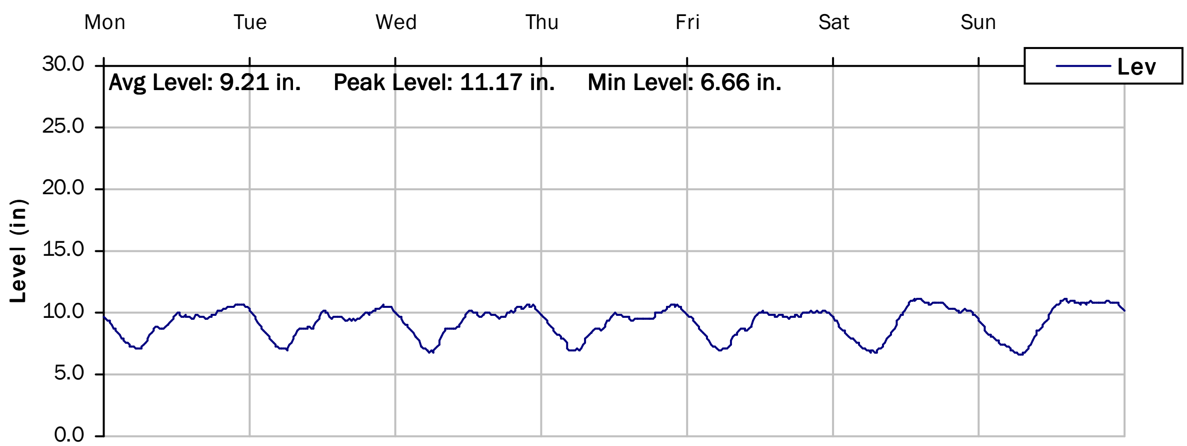
SITE 5

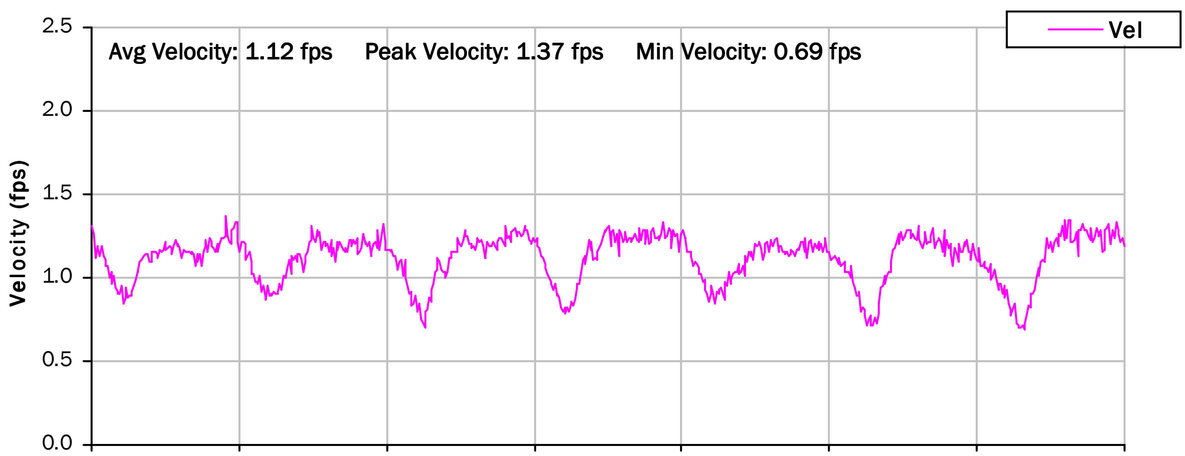
Weekly Level, Velocity and Flow Hydrographs

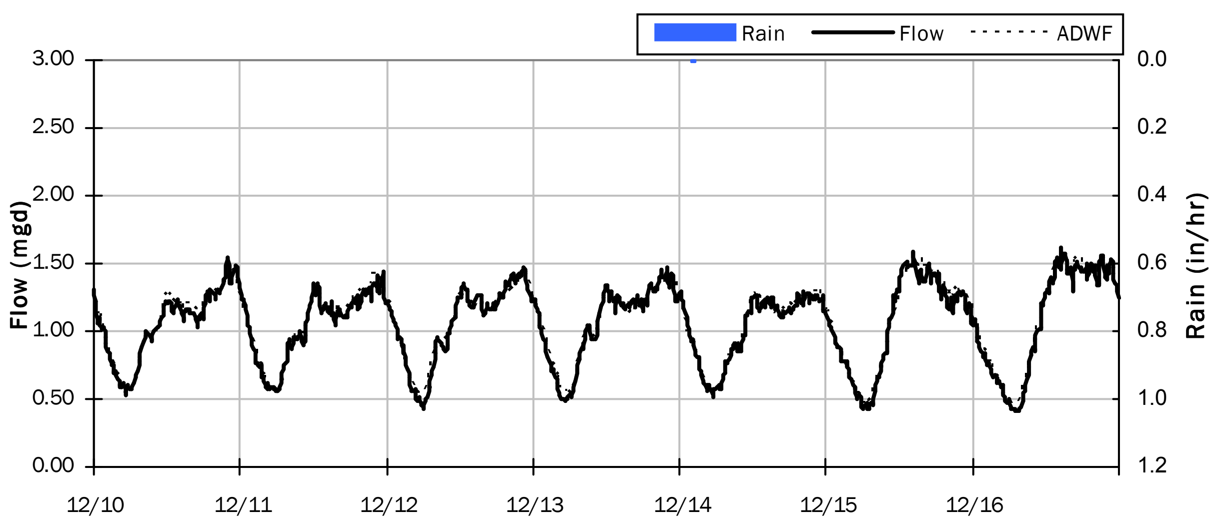
12/3/2018 to 12/10/2018



SITE 5
Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018

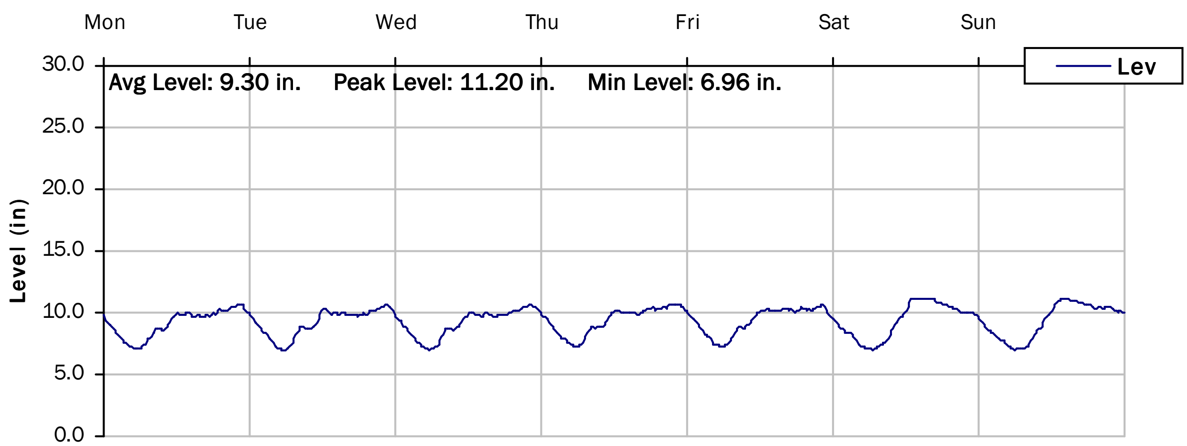


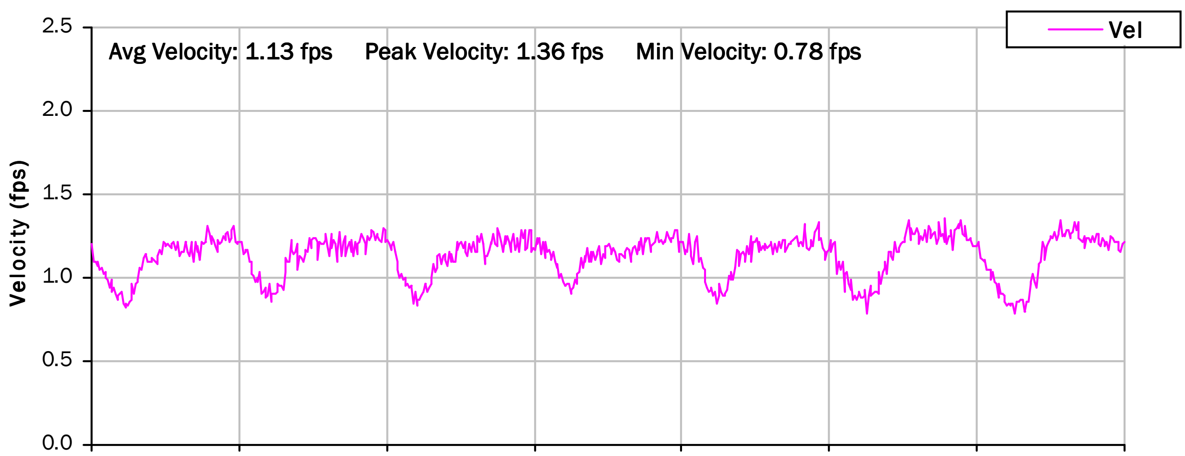


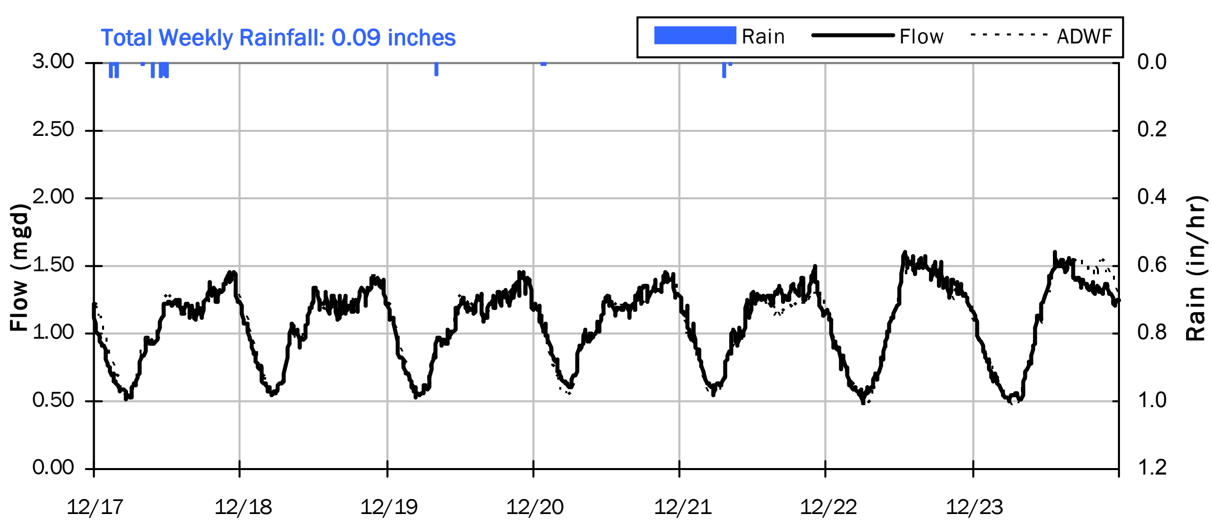


Avg Flow: 1.056 mgd Peak Flow: 1.610 mgd Min Flow: 0.408 mgd

SITE 5
Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018

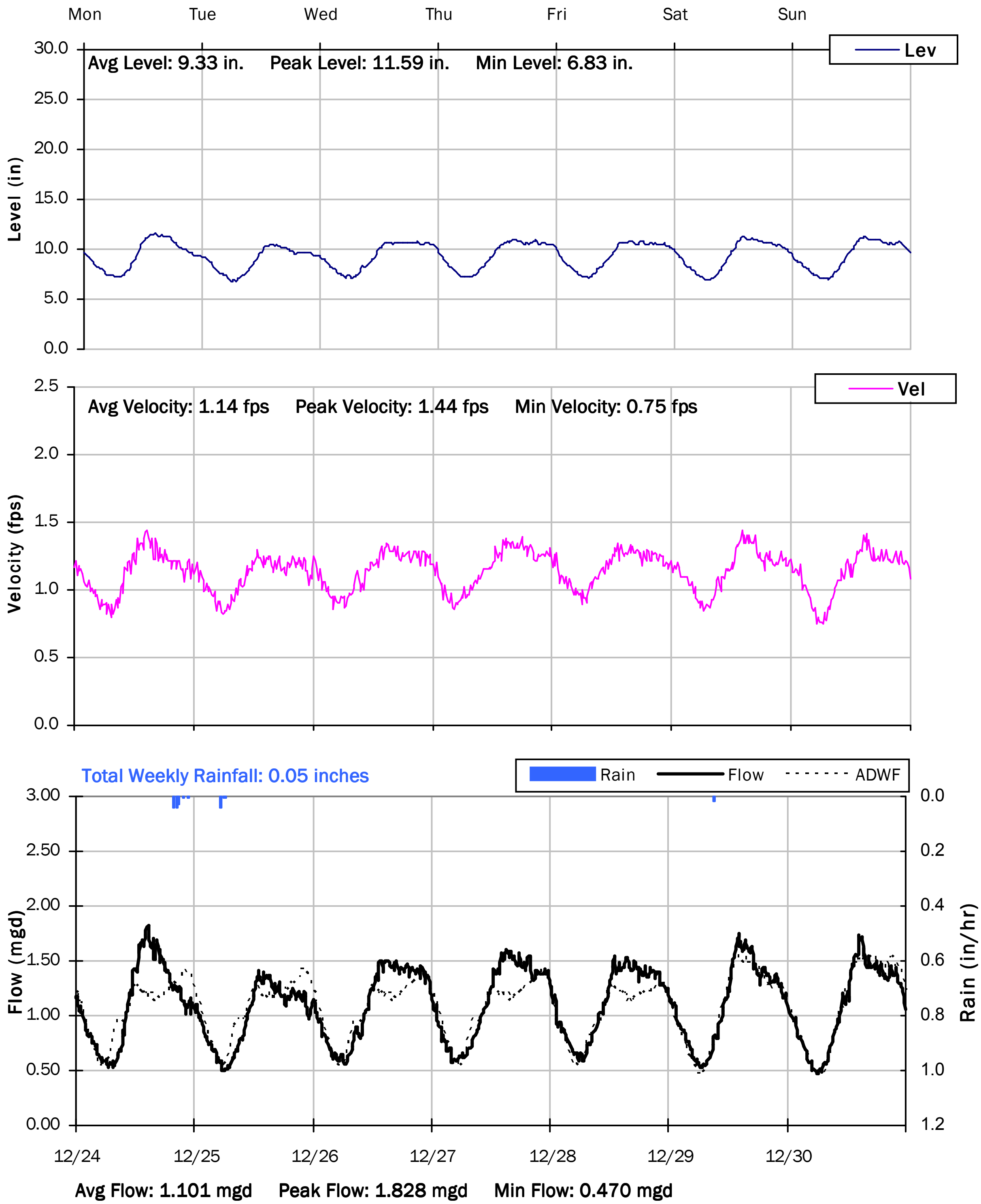




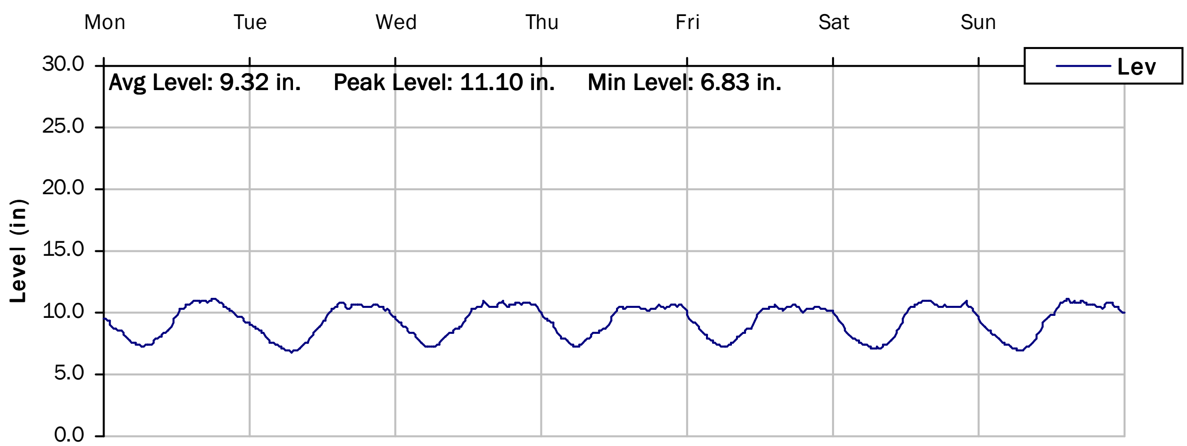


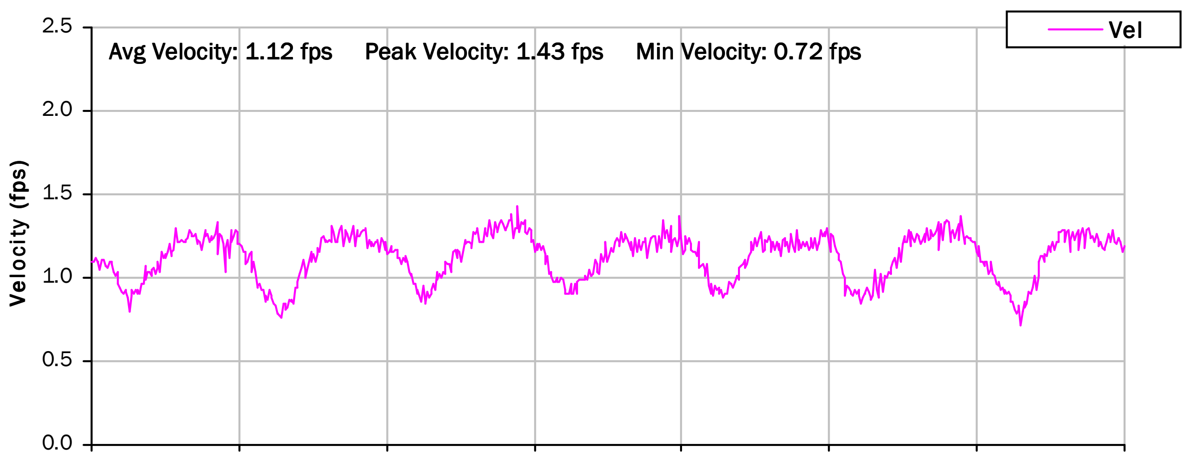
Avg Flow: 1.079 mgd Peak Flow: 1.605 mgd Min Flow: 0.491 mgd

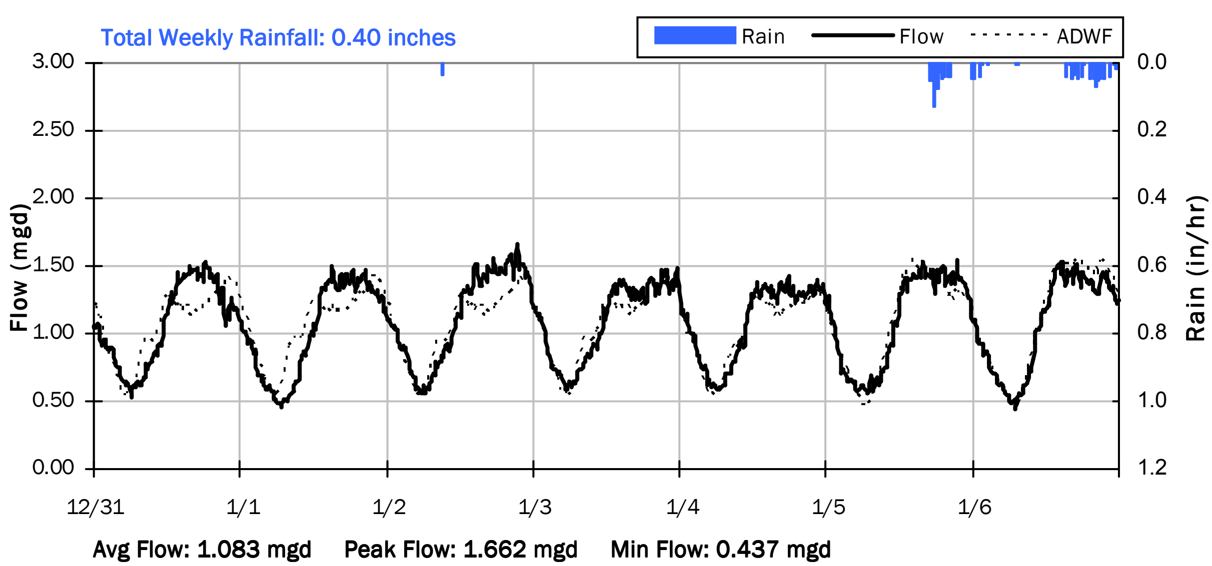
SITE 5
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018



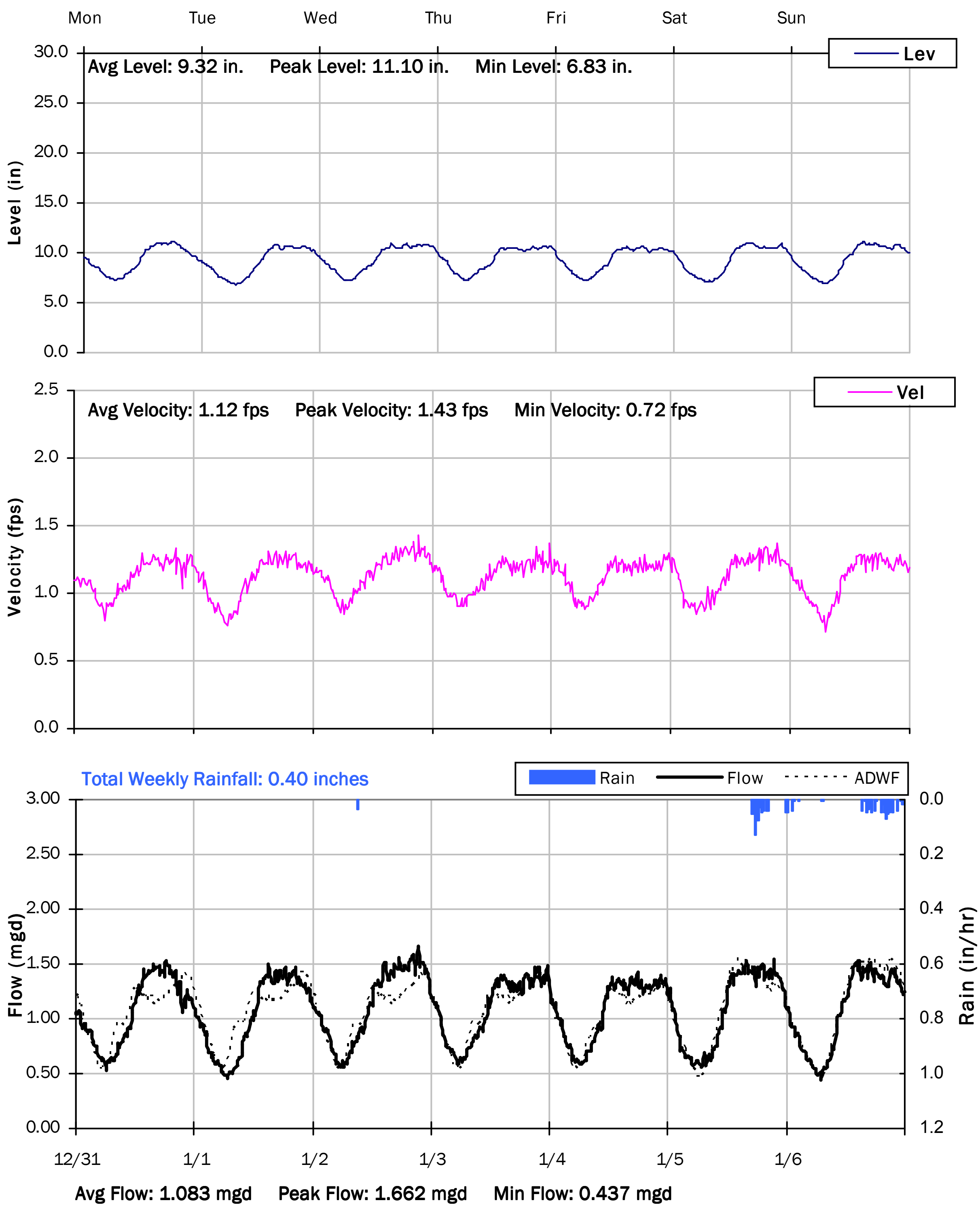
SITE 5
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019







SITE 5
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



City of Visalia

Sanitary Sewer Flow Monitoring
November 28, 2018 - January 06, 2019

Monitoring Site: Site 6

Location: S Noyes St & W Laurel Ave

Data Summary Report

Vicinity Map: Site 6

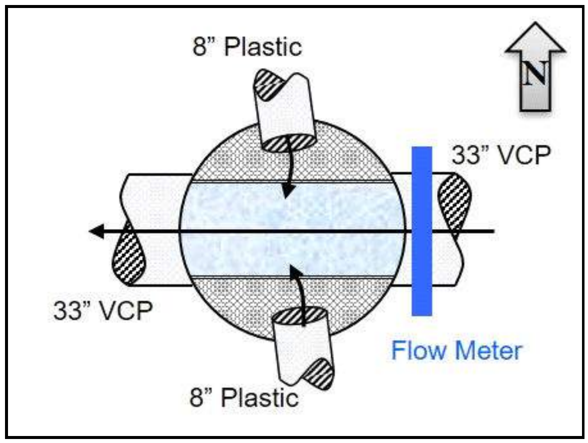
SITE 6

Site Information

Location:	S Noyes St & W Laurel Ave
Coordinates:	119.3447° W, 36.3208° N
Rim Elevation (Earth):	312 feet
Pipe Diameter:	33 inches
ADWF:	1.226 mgd
Peak Measured Flow:	1.938 mgd

Satellite Map

Sewer Map



Flow Sketch

Street View

Plan View

SITE 6

Additional Site Photos

Effluent Pipe

East Influent Pipe

SITE 6

Additional Site Photos

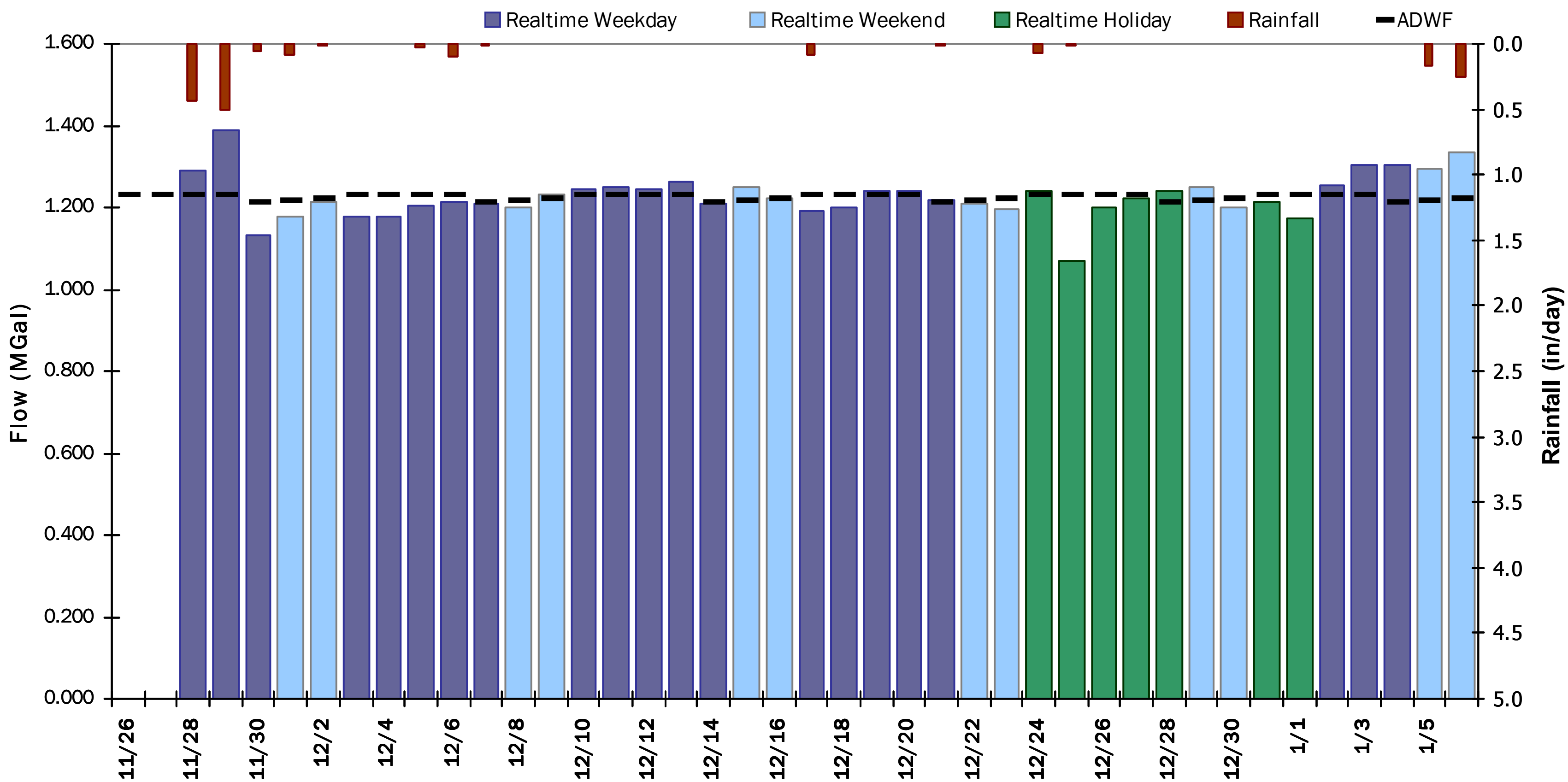
North Influent Pipe

South Influent Pipe

SITE 6
Period Flow Summary: Daily Flow Totals

Avg Period Flow: 1.227 MGal **Peak Daily Flow: 1.388 MGal** **Min Daily Flow: 1.070 MGal**

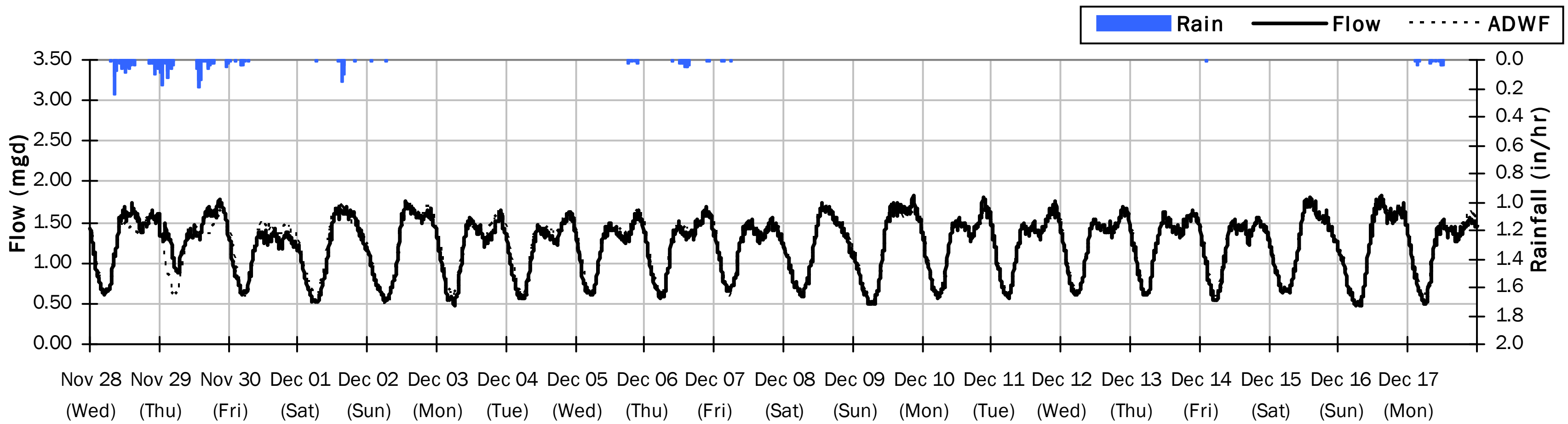
Total Period Rainfall: 1.84 inches

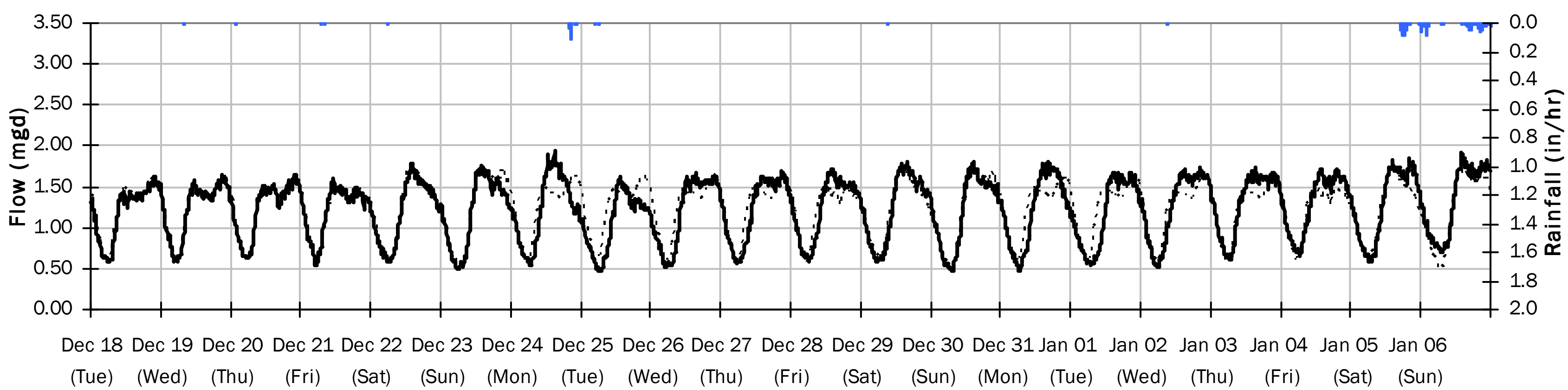


SITE 6

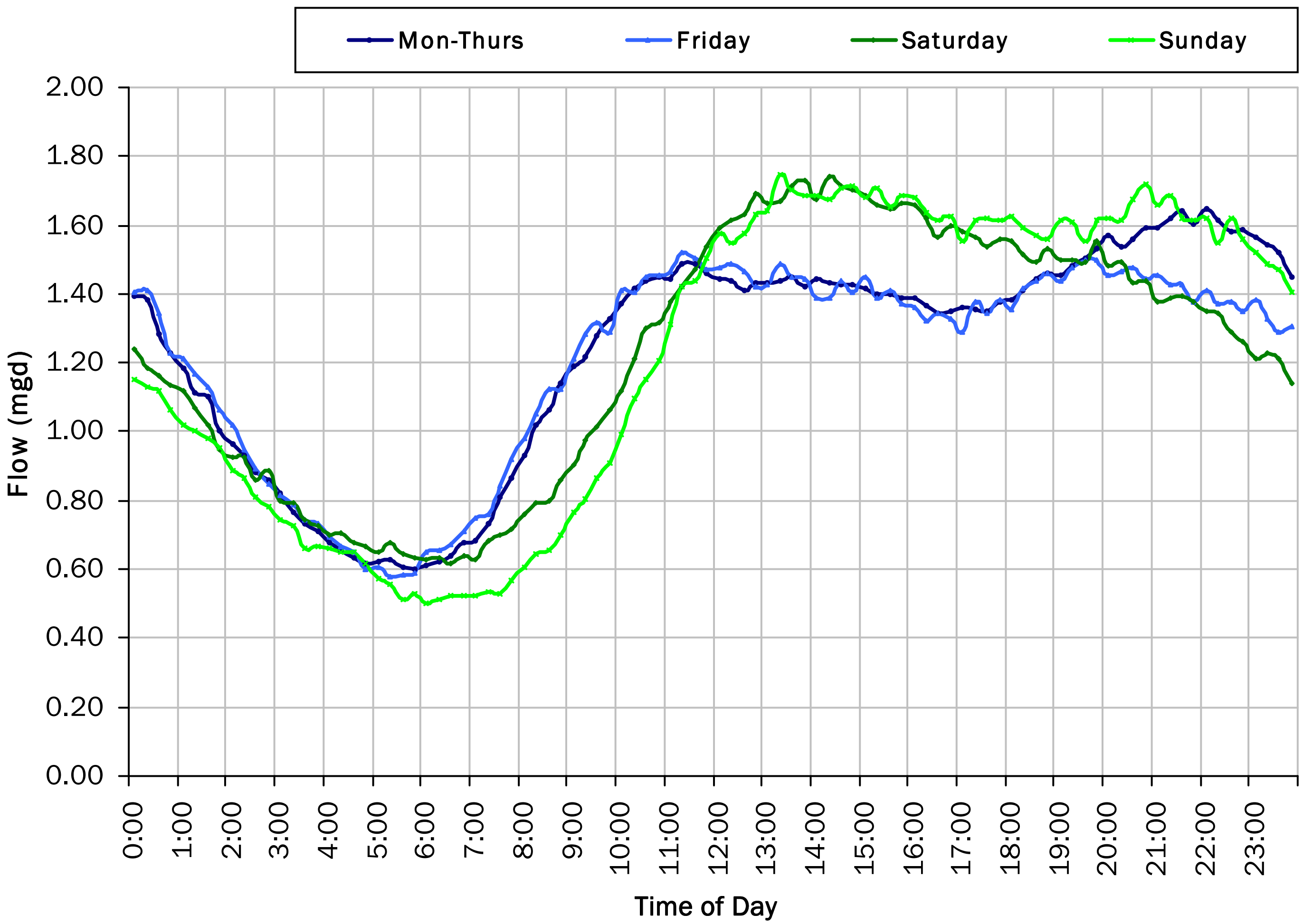
Flow Summary: 11/28/2018 to 1/6/2019

Total Period Rainfall: 1.84 inches   Avg Flow: 1.227 mgd   Peak Flow: 1.938 mgd   Min Flow: 0.473 mgd



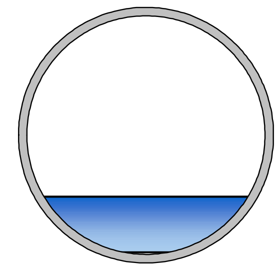


SITE 6
Average Dry Weather Flow Hydrographs



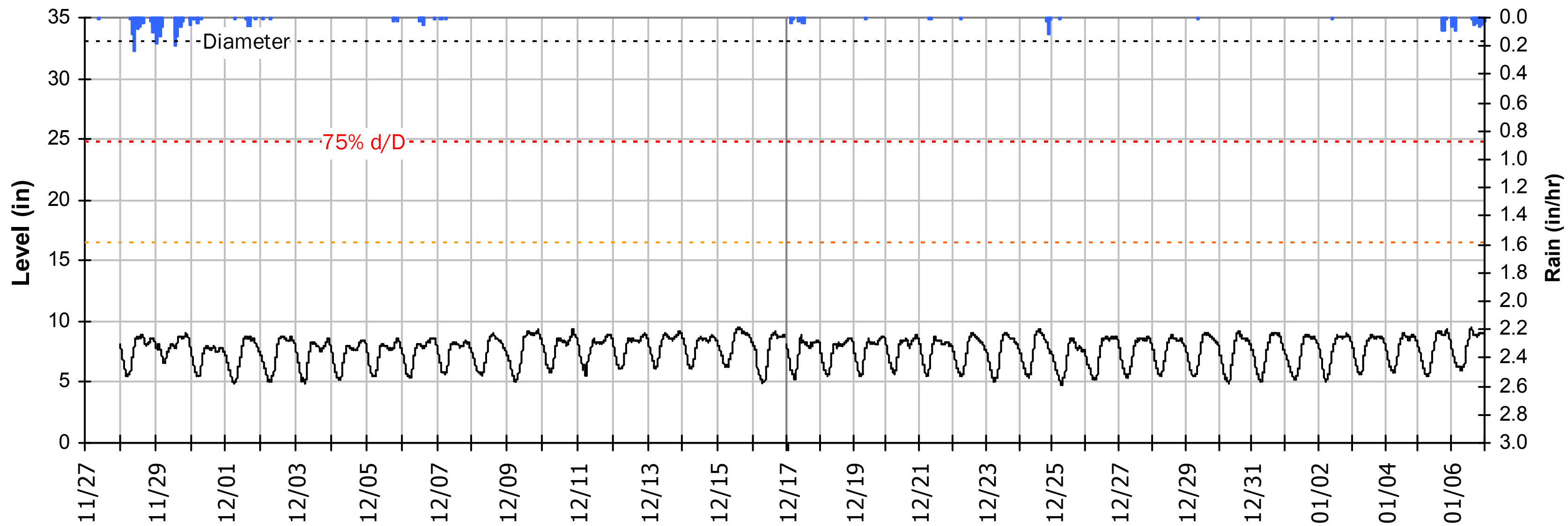
ADWF:

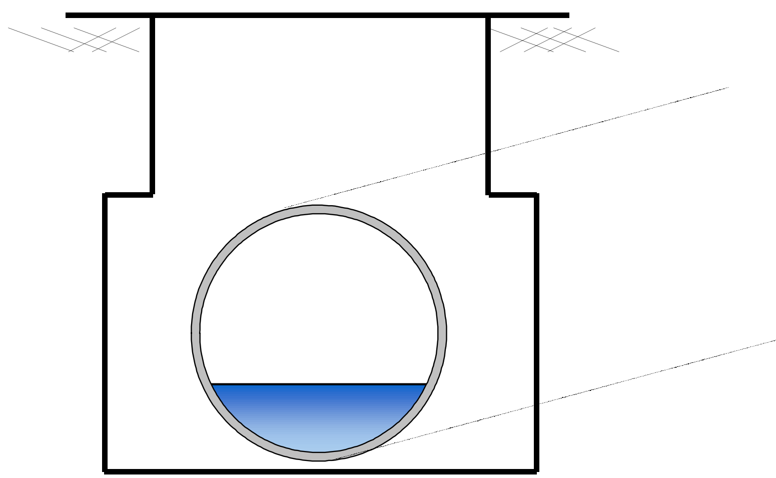
1.226 *mgd*



SITE 6
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

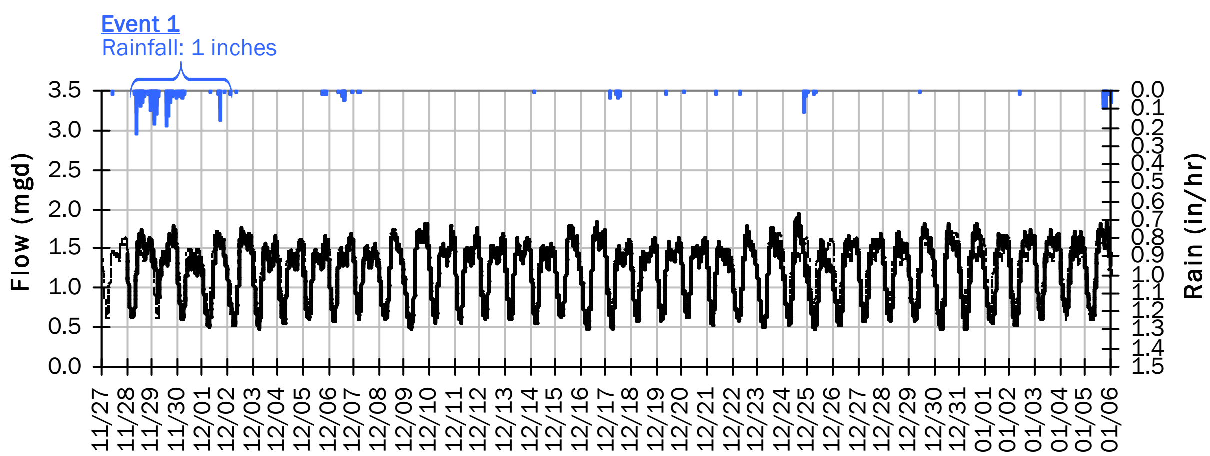




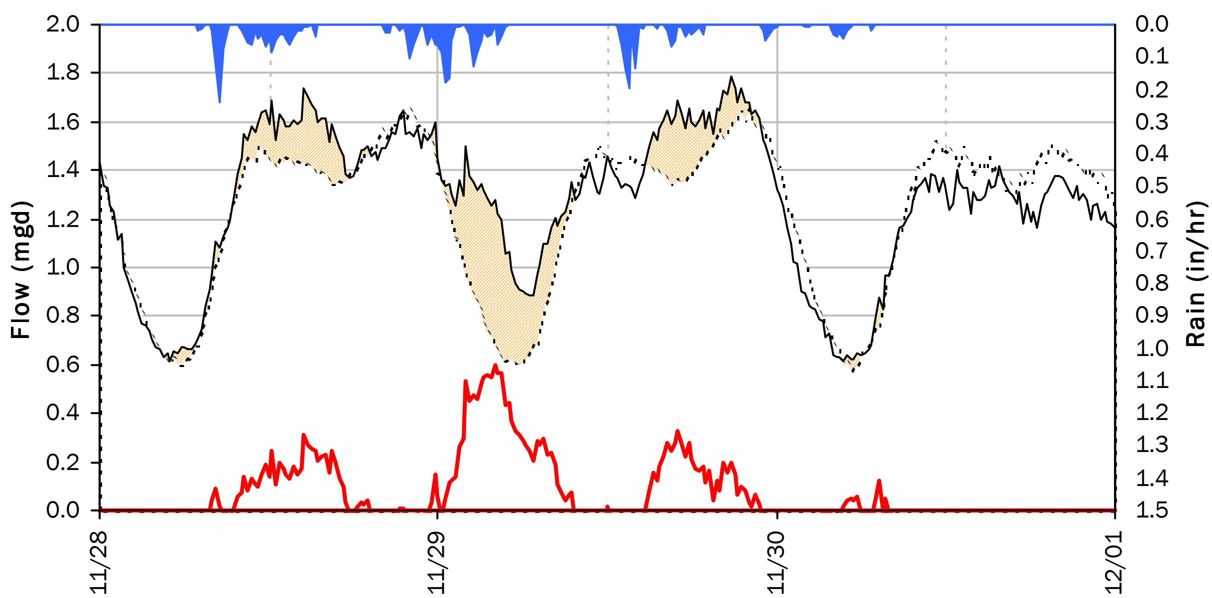
Pipe Diameter:	33	*inches*
Peak Measured Level:	9.48	*inches*
Peak d/D Ratio:	0.29	

SITE 6
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



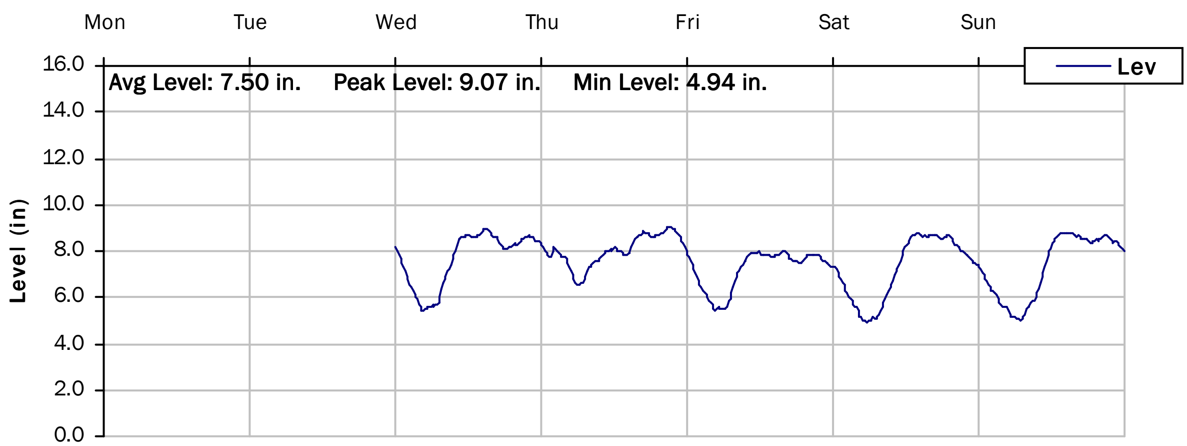
Event 1 Detail Graph

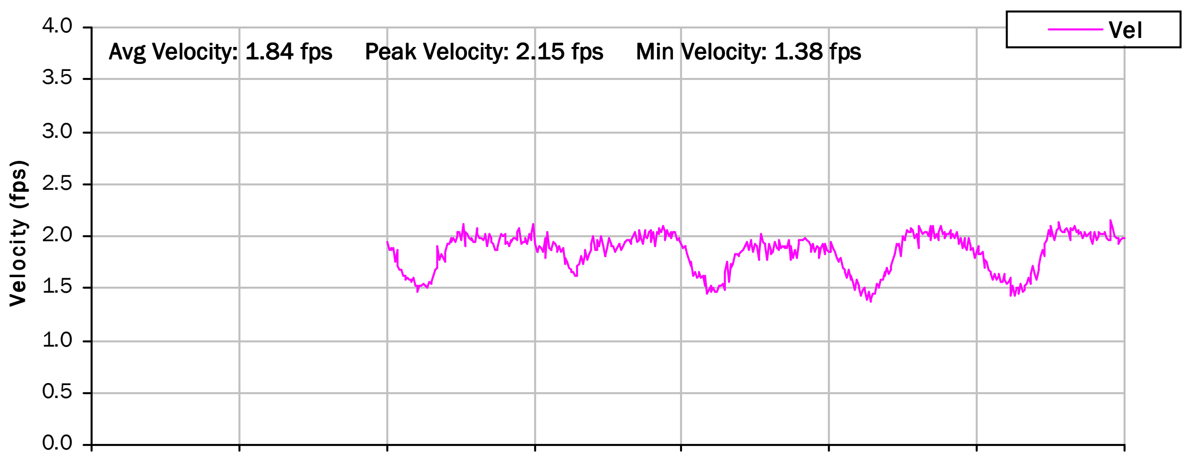


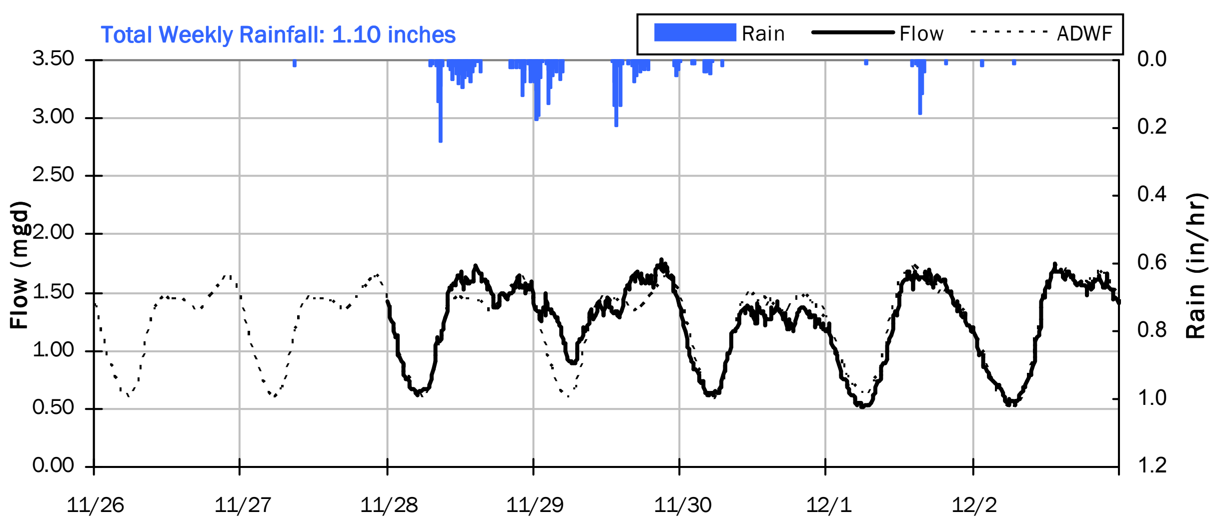
Storm Event I/I Analysis (Rain = 1.00 inches)

Capacity		**Inflow / Infiltration**	
Peak Flow:	1.79 *mgd*	**Peak I/I Rate:**	0.60 *mgd*
PF:	1.46	**Total I/I:**	196,000 *gallons*
Peak Level:	9.07 *in*		
d/D Ratio:	0.27		

SITE 6
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018

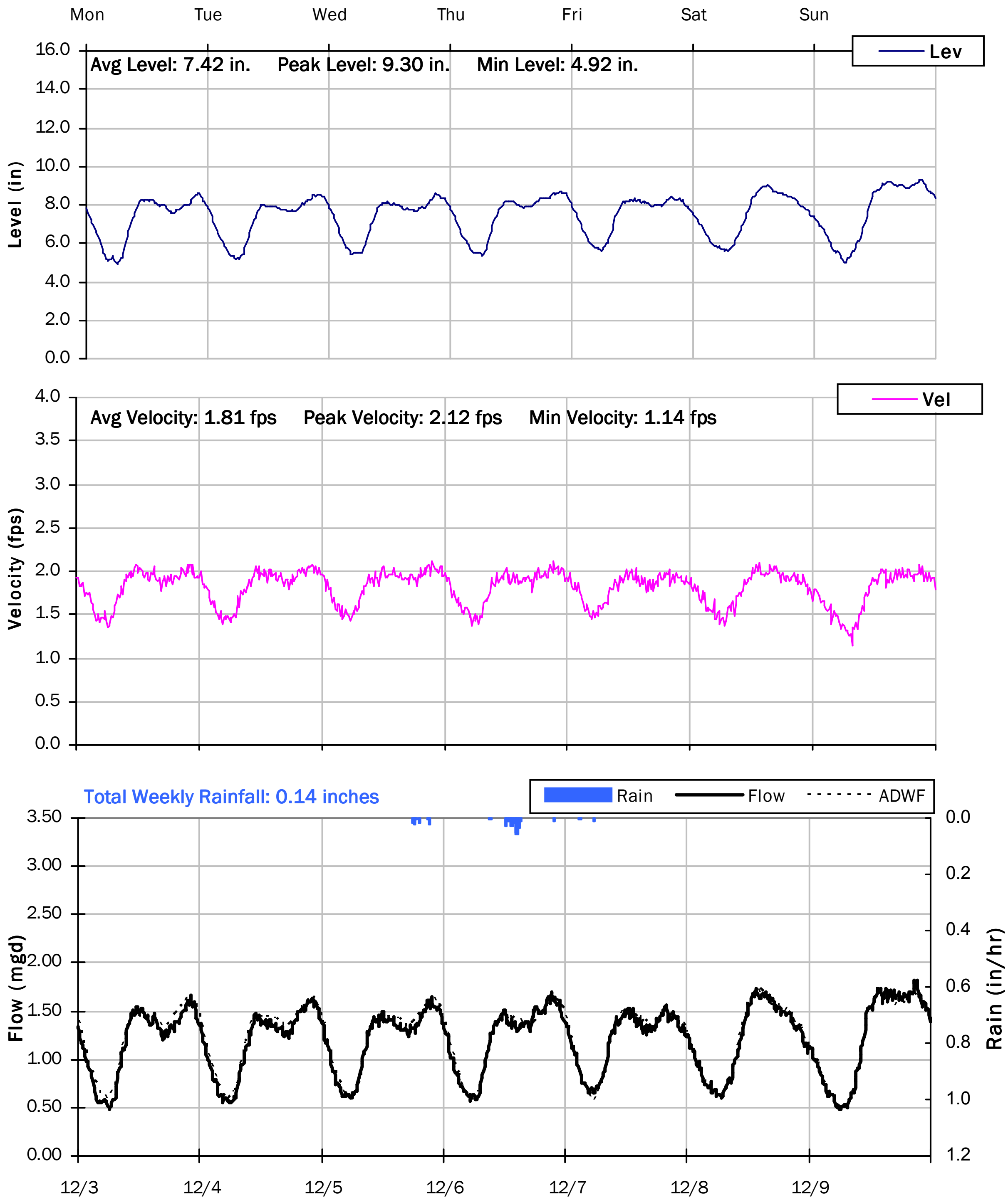






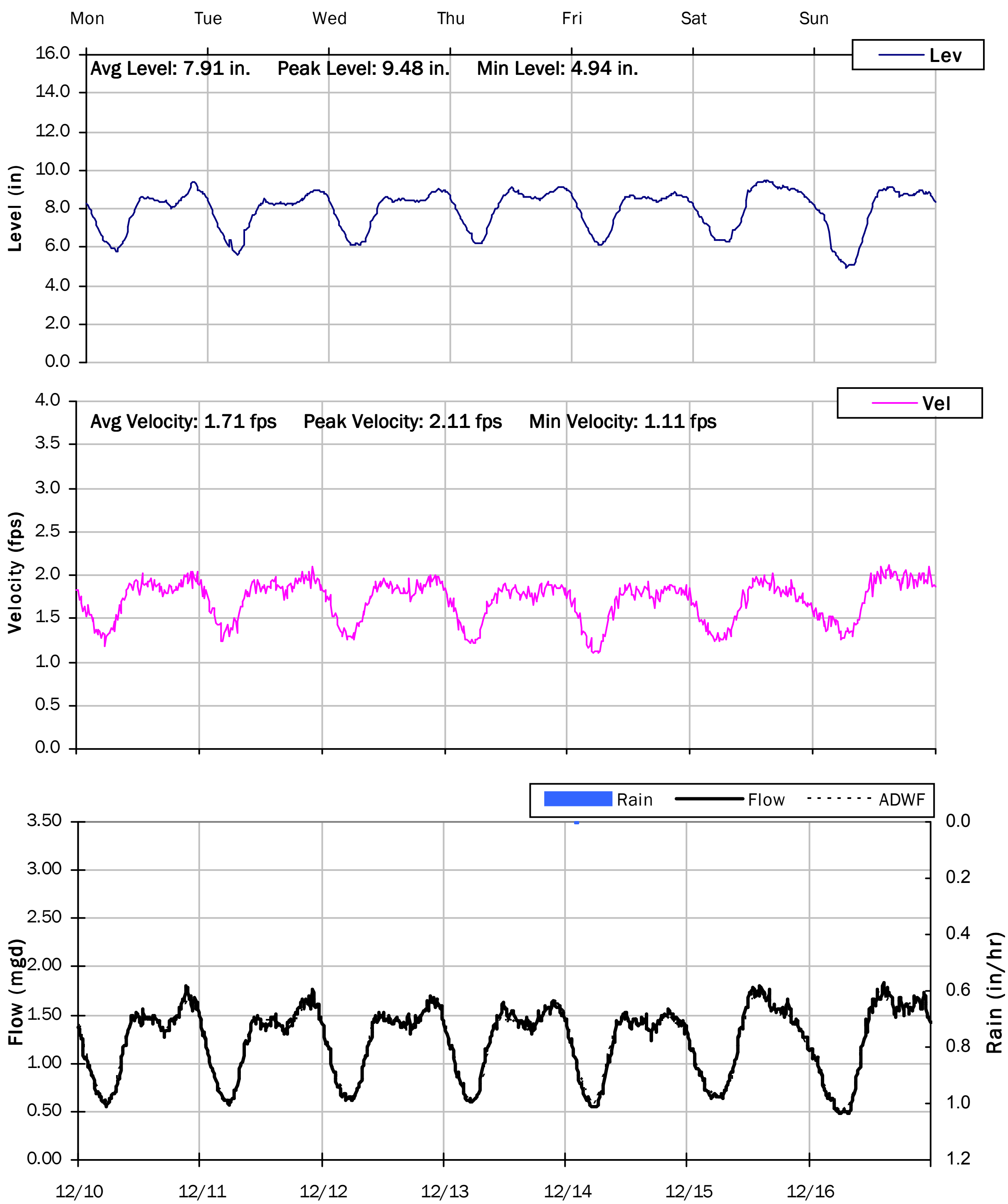
Avg Flow: 1.239 mgd **Peak Flow: 1.787 mgd** **Min Flow: 0.513 mgd**

SITE 6
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018



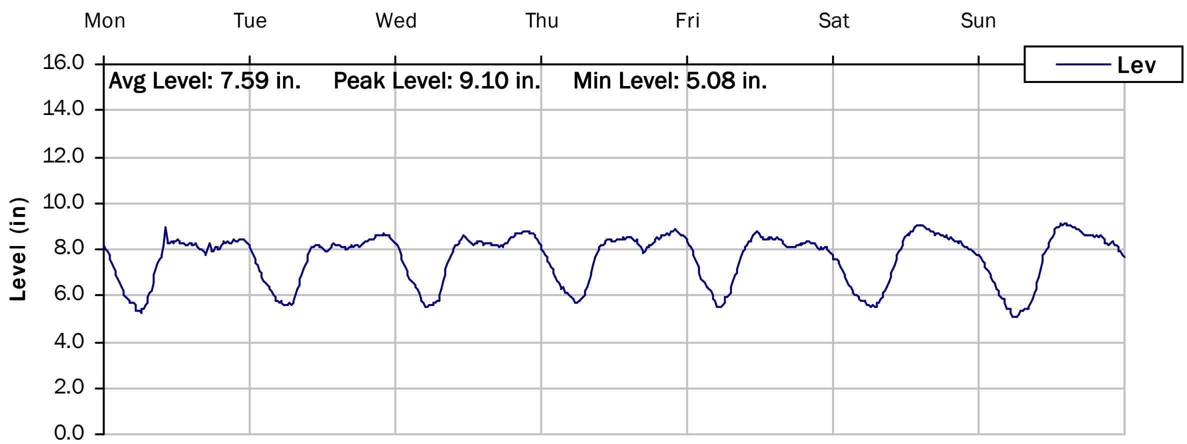
Avg Flow: 1.202 mgd Peak Flow: 1.825 mgd Min Flow: 0.483 mgd

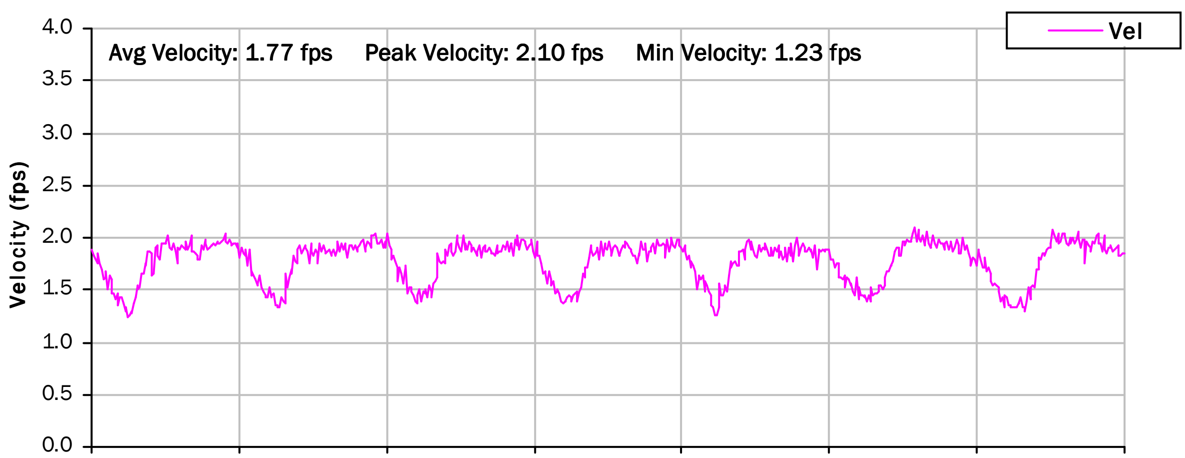
SITE 6
Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018

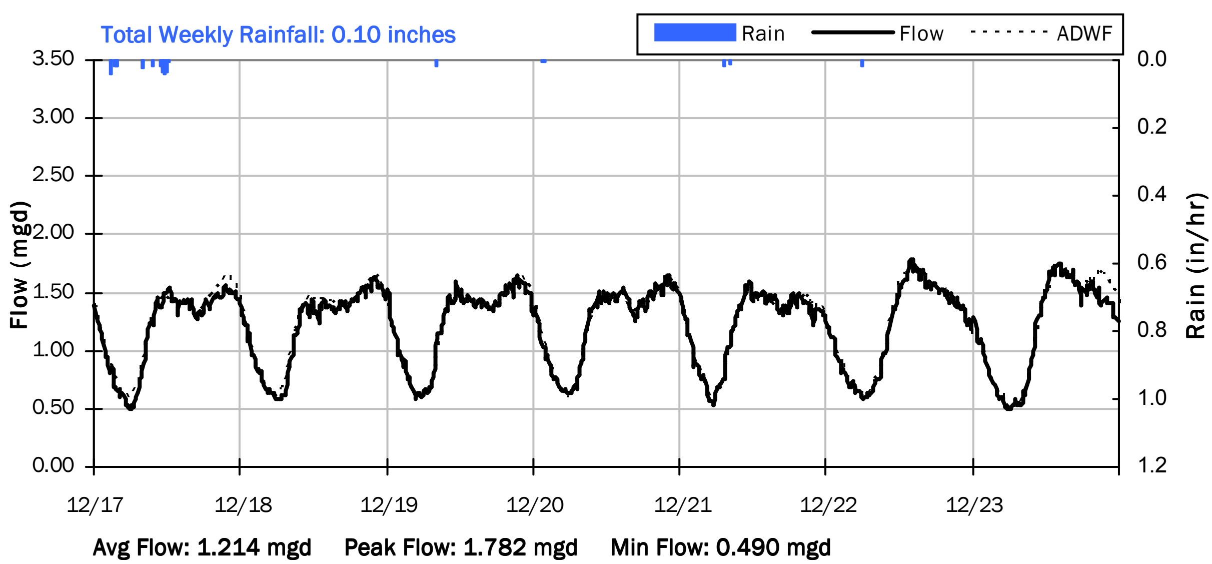


Avg Flow: 1.240 mgd **Peak Flow: 1.828 mgd** **Min Flow: 0.473 mgd**

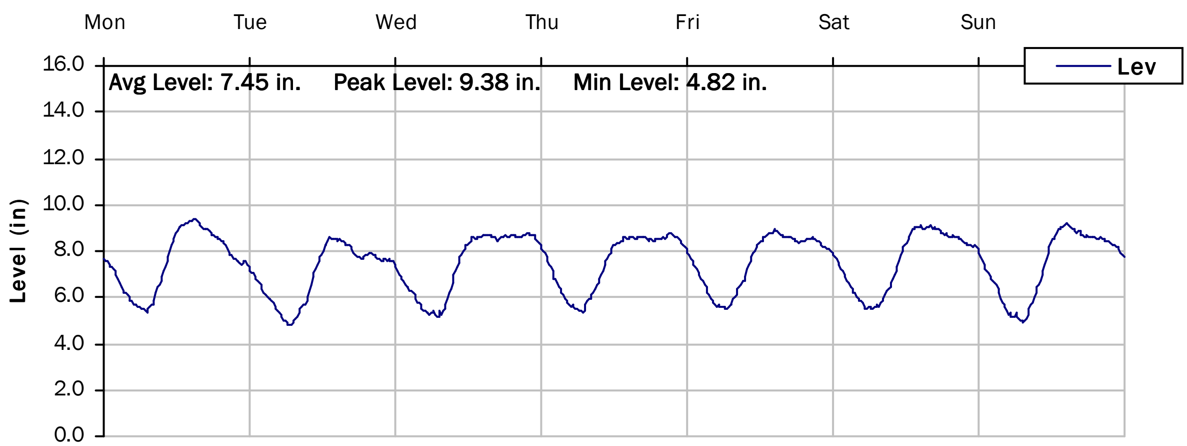
SITE 6
Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018

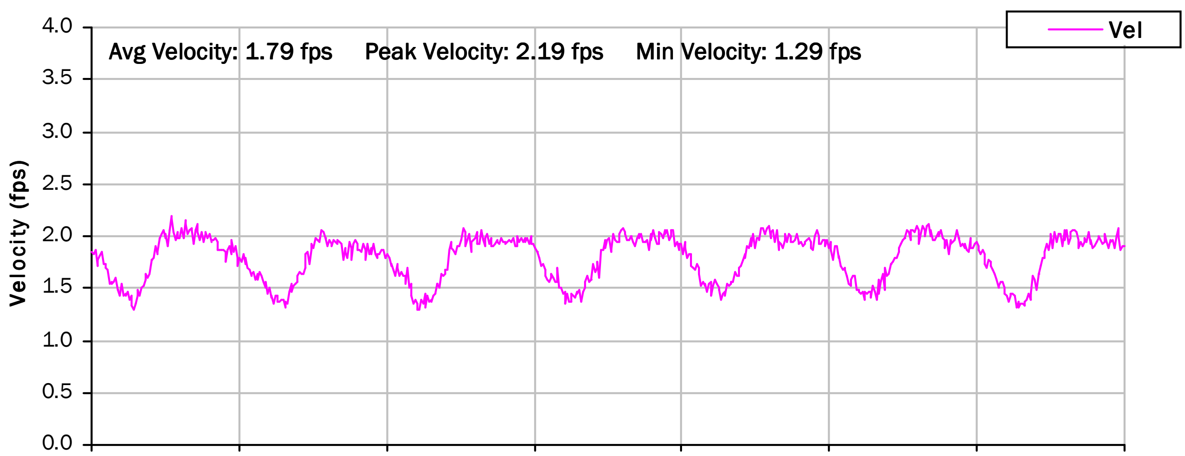


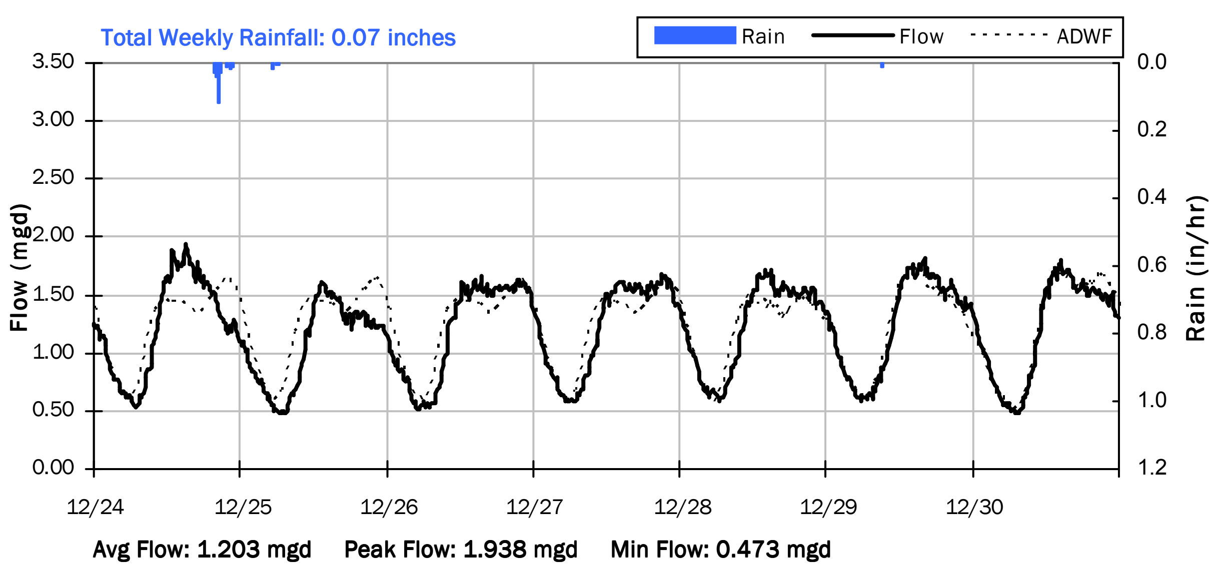




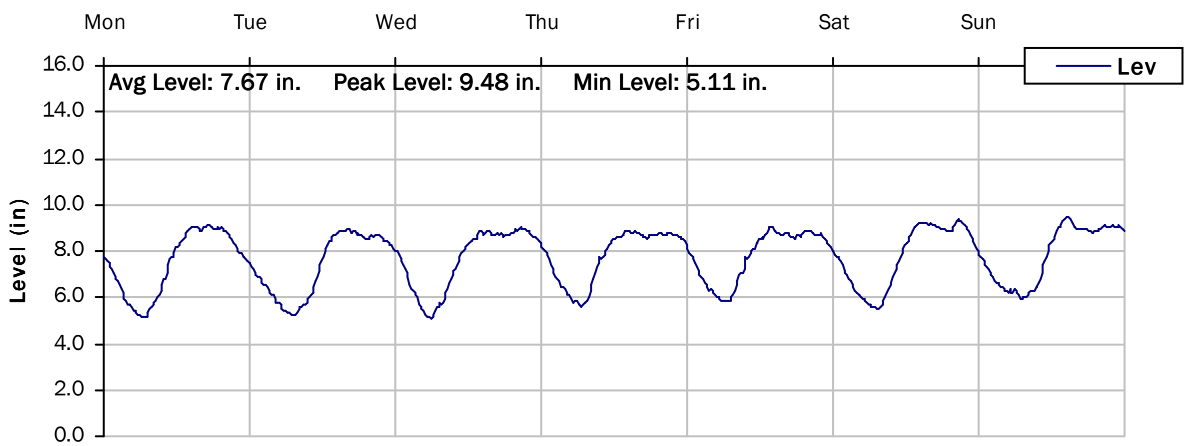
SITE 6
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018

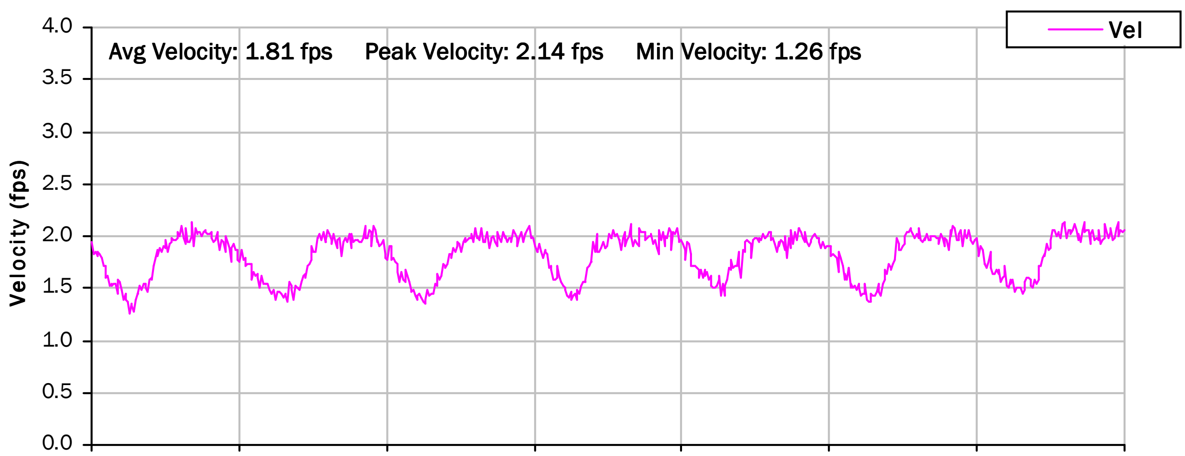


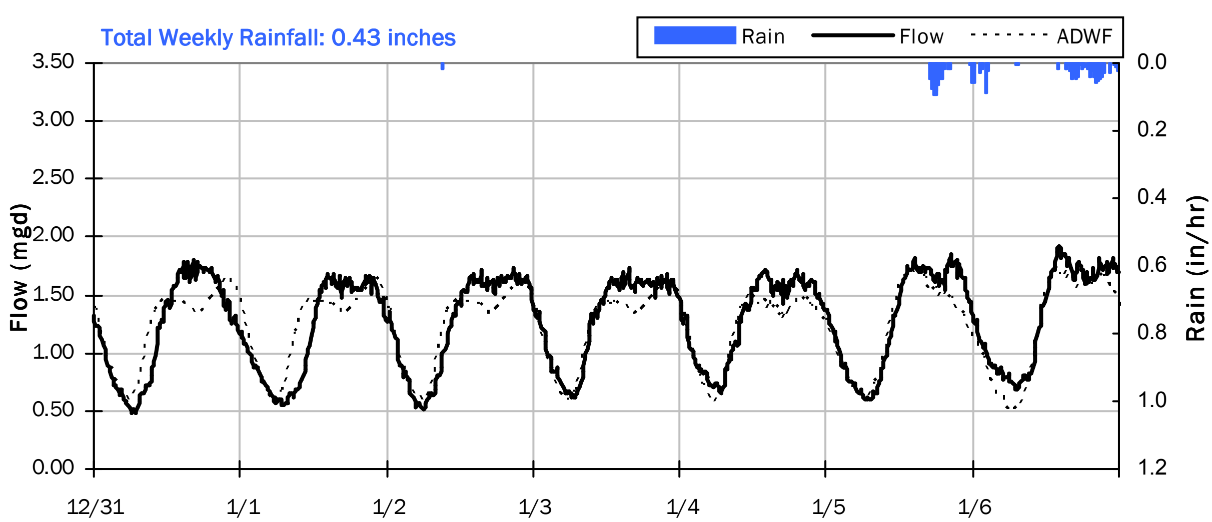




SITE 6
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019

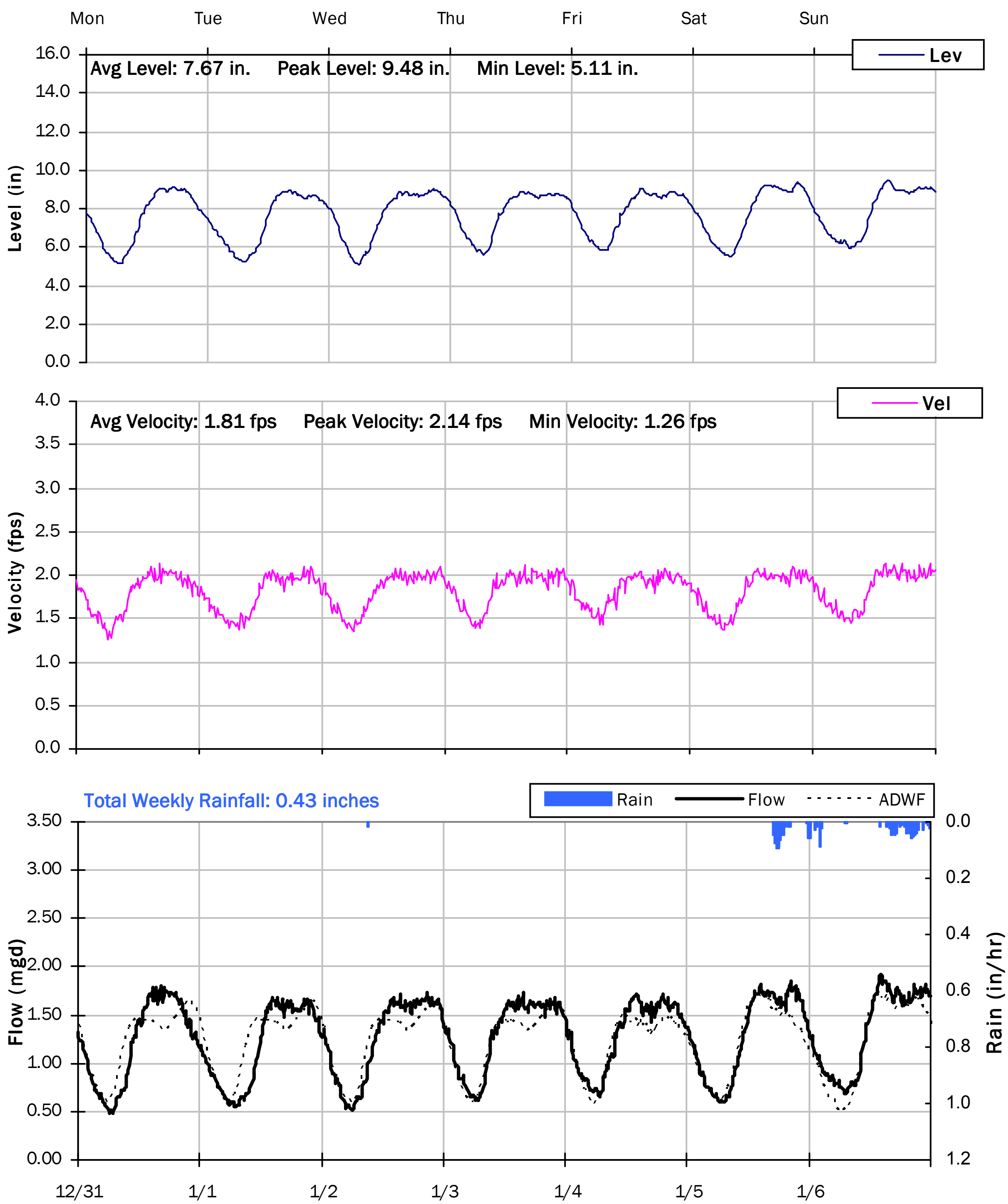






Avg Flow: 1.268 mgd **Peak Flow: 1.916 mgd** **Min Flow: 0.479 mgd**

SITE 6
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



Avg Flow: 1.268 mgd
Peak Flow: 1.916 mgd
Min Flow: 0.479 mgd

City of Visalia

Sanitary Sewer Flow Monitoring
November 28, 2018 - January 06, 2019

Monitoring Site: Site 7

Location: S Akers St n/o W Cambridge Ave

Data Summary Report

Vicinity Map: Site 7

SITE 7

Site Information

Location: S Akers St n/o W Cambridge Ave

Coordinates: 119.3496° W, 36.3152° N

Rim Elevation (Earth): 309 feet

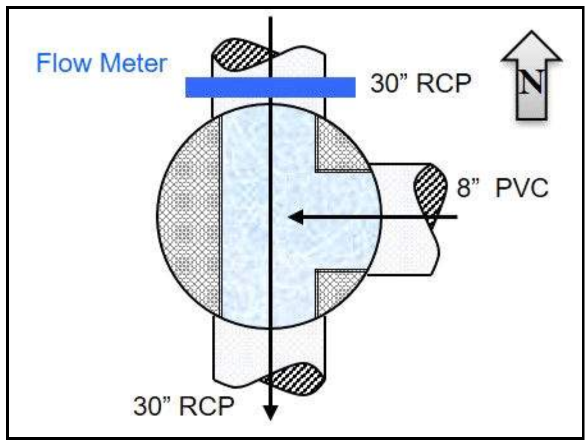
Pipe Diameter: 30 inches

ADWF: 3.885 mgd

Peak Measured Flow: 6.955 mgd

Satellite Map

Sewer Map



Flow Sketch

Street View

Plan View

SITE 7

Additional Site Photos

Effluent Pipe

North Influent Pipe

SITE 7

Additional Site Photos

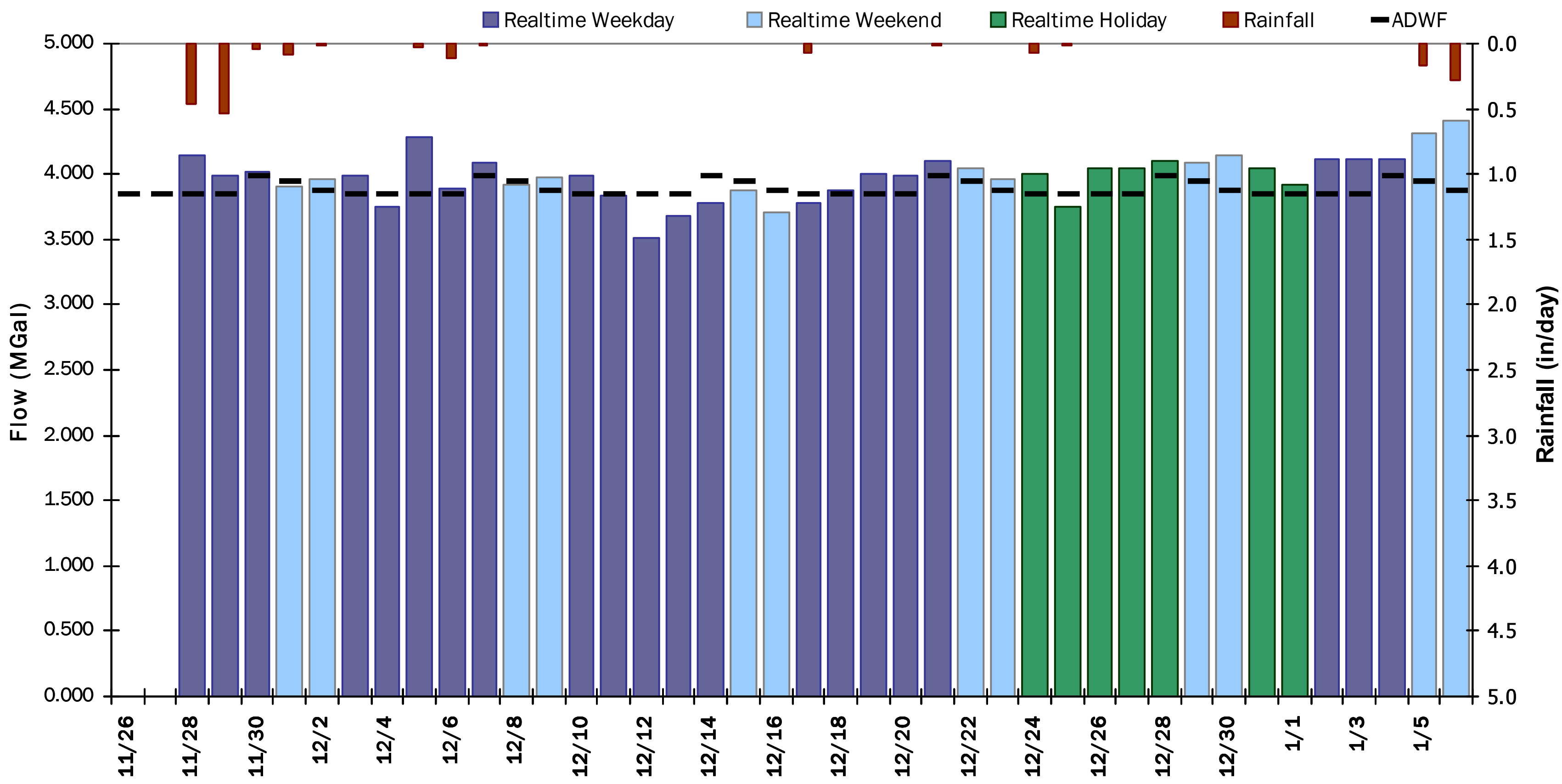
East Iinfluent Pipe

SITE 7

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 3.981 MGal   Peak Daily Flow: 4.414 MGal   Min Daily Flow: 3.513 MGal

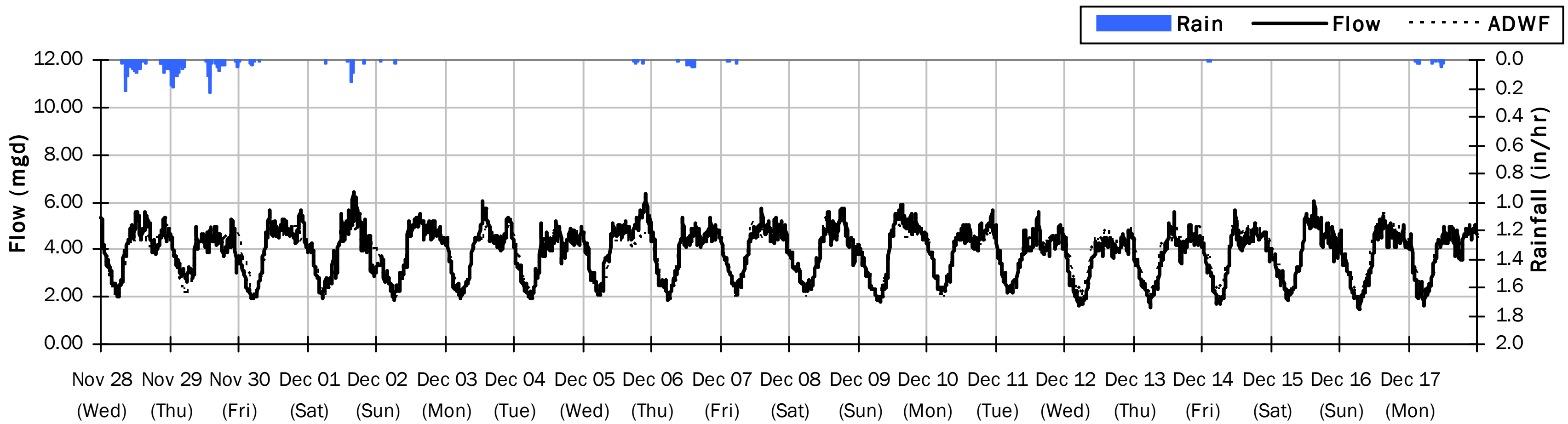
Total Period Rainfall: 1.91 inches

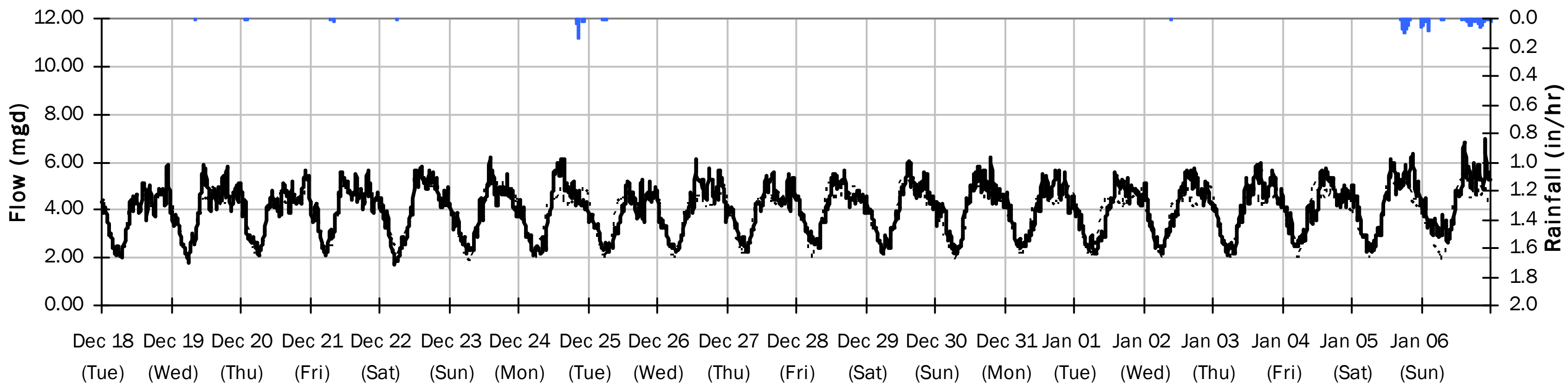


SITE 7

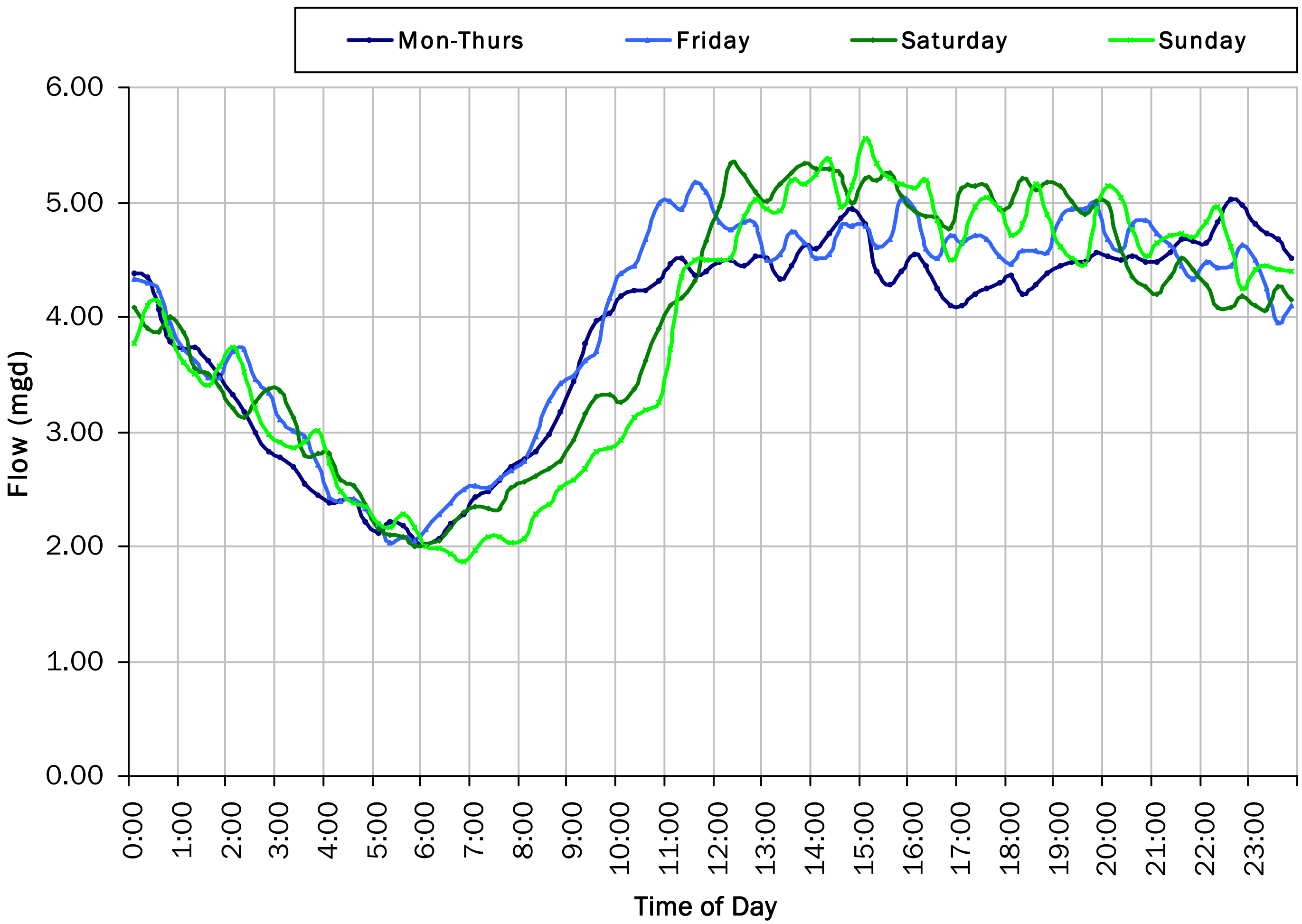
Flow Summary: 11/28/2018 to 1/6/2019

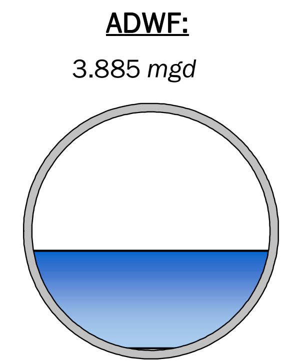
Total Period Rainfall: 1.91 inches   Avg Flow: 3.981 mgd   Peak Flow: 6.955 mgd   Min Flow: 1.491 mgd





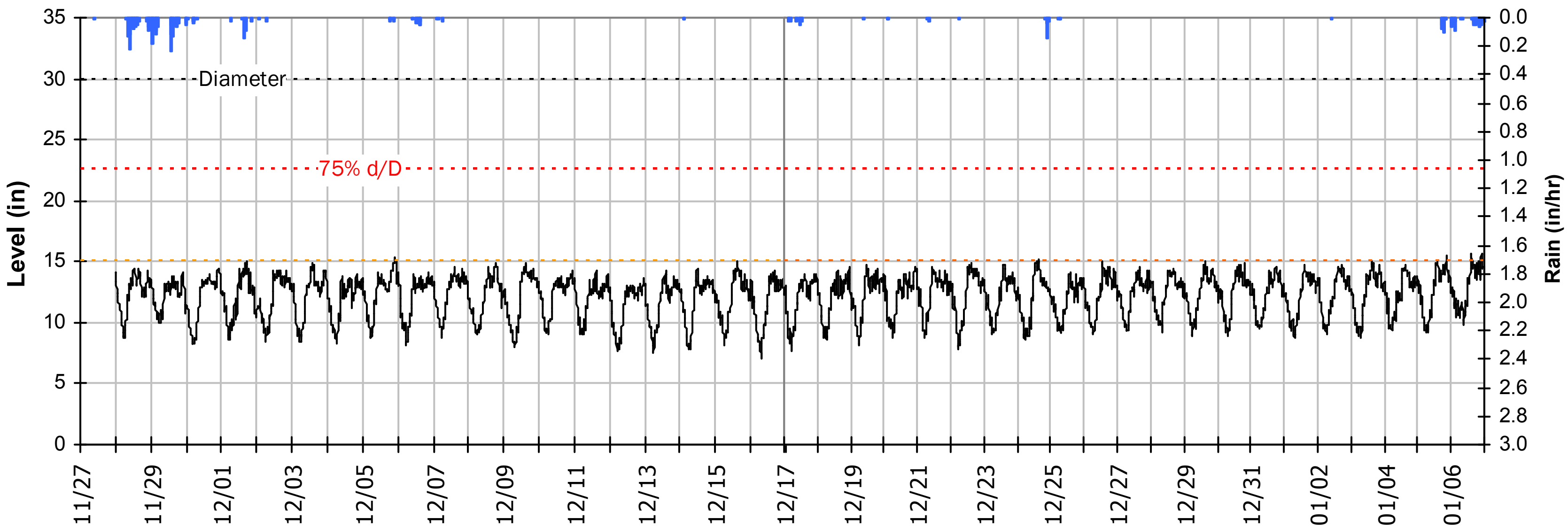
SITE 7
Average Dry Weather Flow Hydrographs

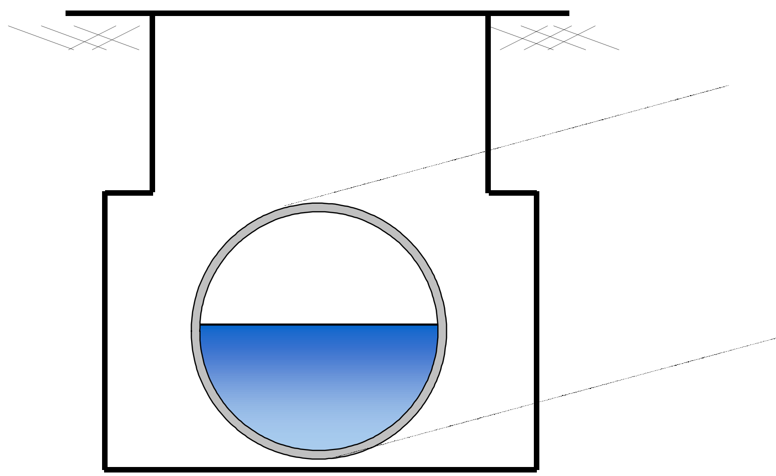




SITE 7
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

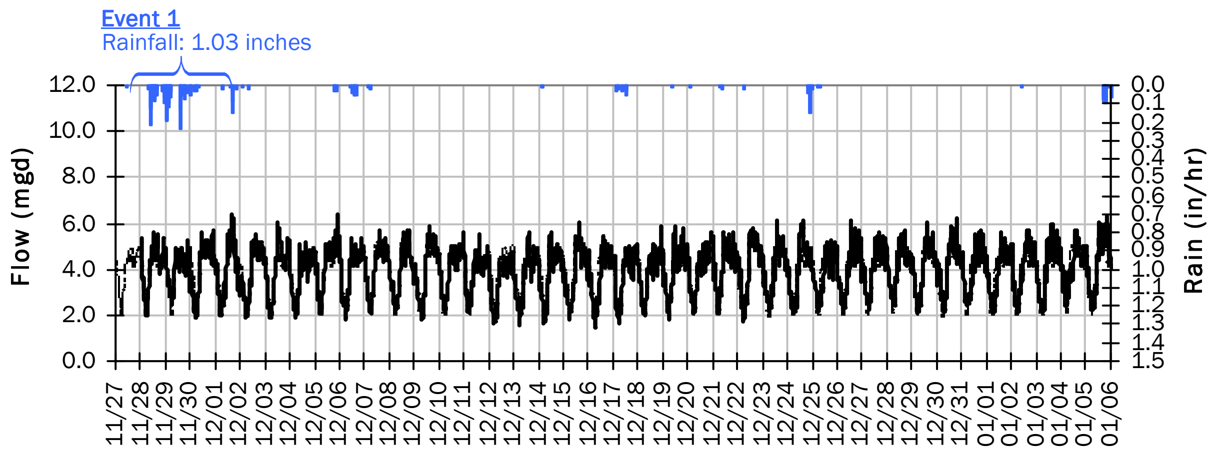




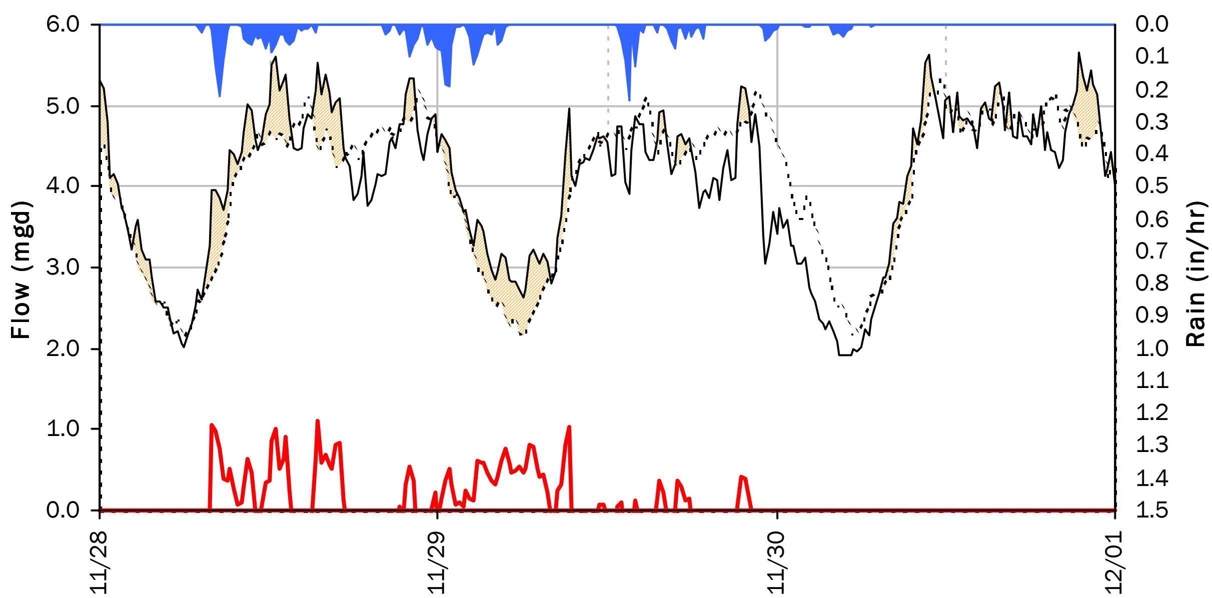
Pipe Diameter:	30	*inches*
Peak Measured Level:	15.7	*inches*
Peak d/D Ratio:	0.52	

SITE 7
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 = 1.03 inches)

Capacity

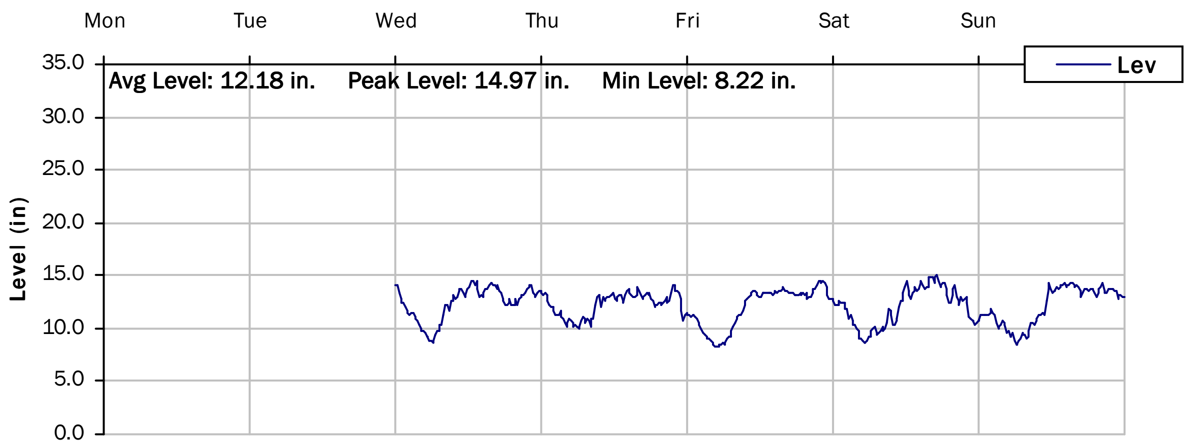
Peak Flow: 5.61 *mgd*
PF: 1.44

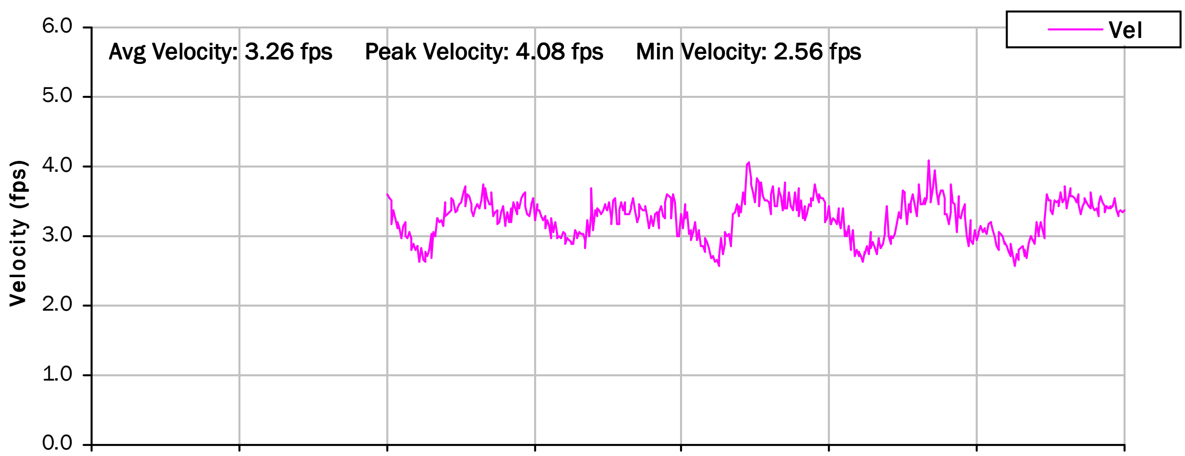
Peak Level: 14.50 *in*
d/D Ratio: 0.48

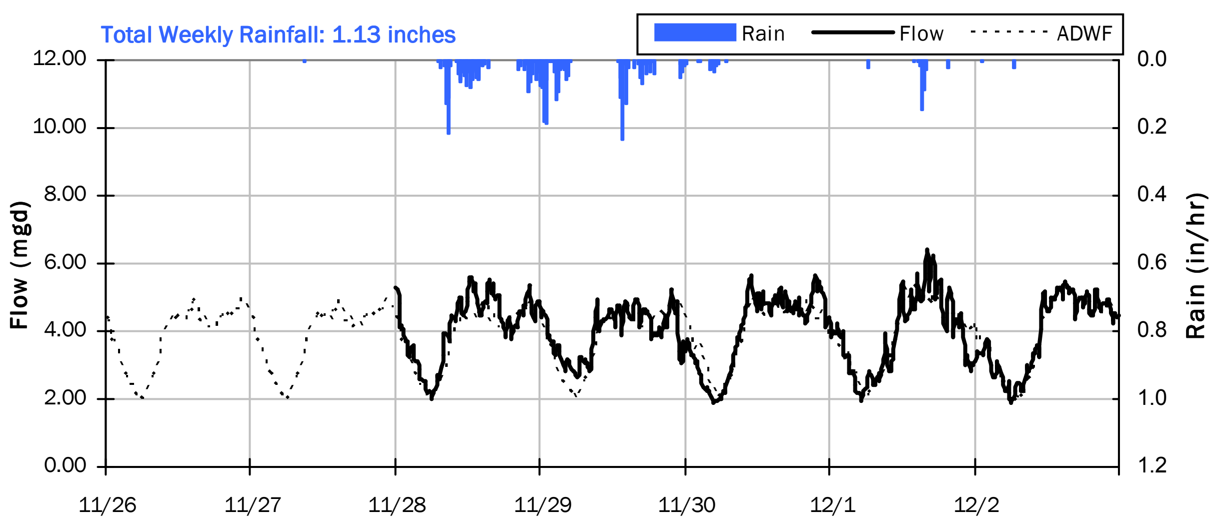
Inflow / Infiltration

Peak I/I Rate: 1.12 *mgd*
Total I/I: 156,000 *gallons*

SITE 7
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018

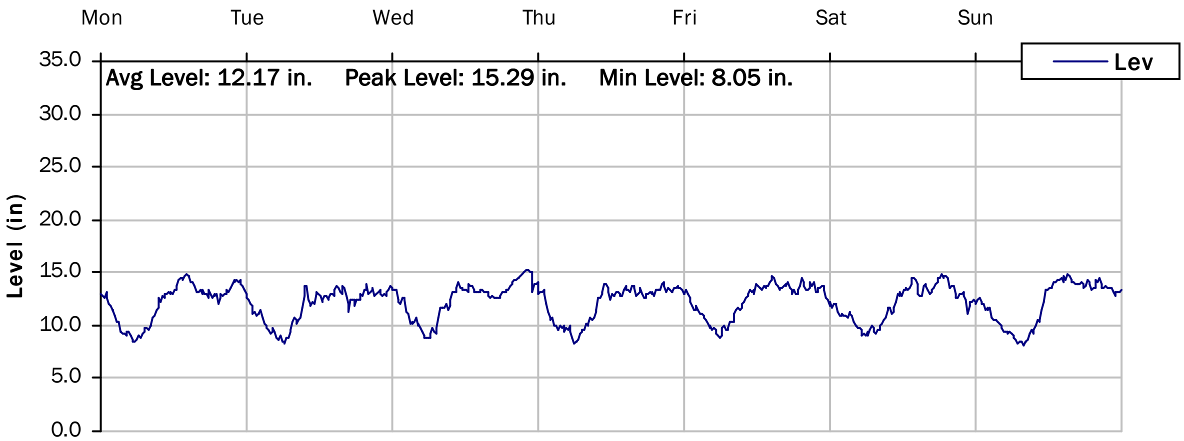


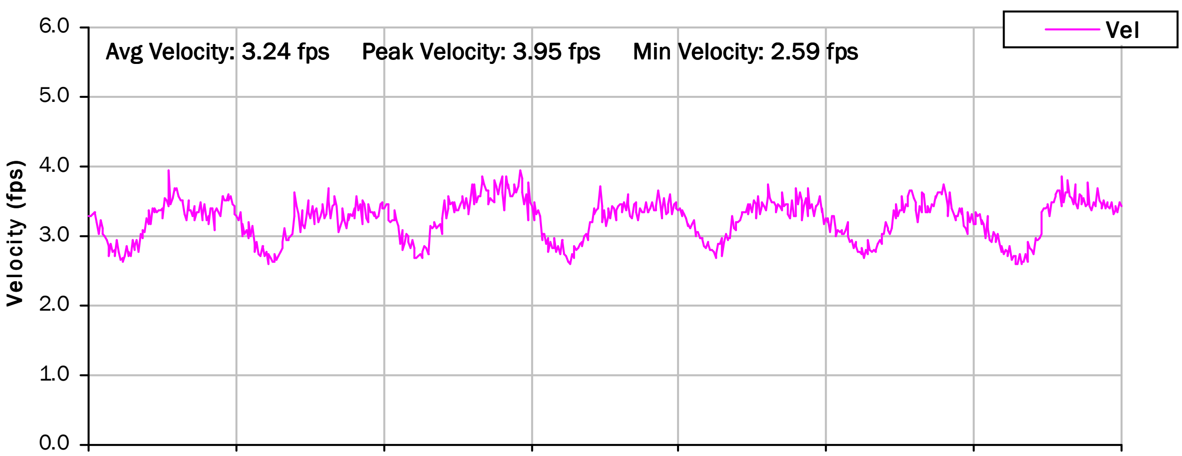


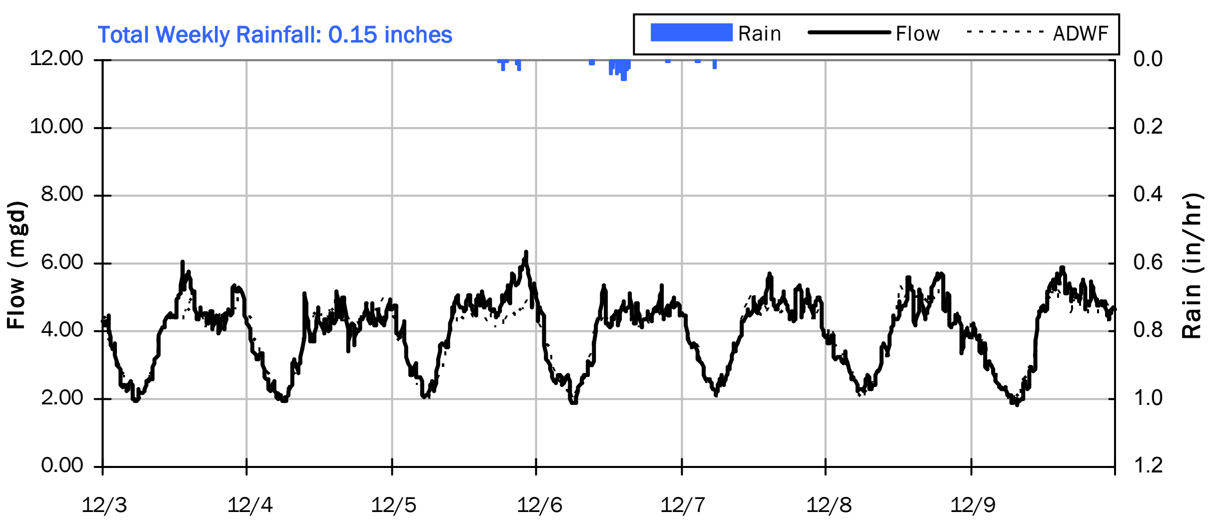


Avg Flow: 4.002 mgd **Peak Flow: 6.401 mgd** **Min Flow: 1.896 mgd**

SITE 7
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018

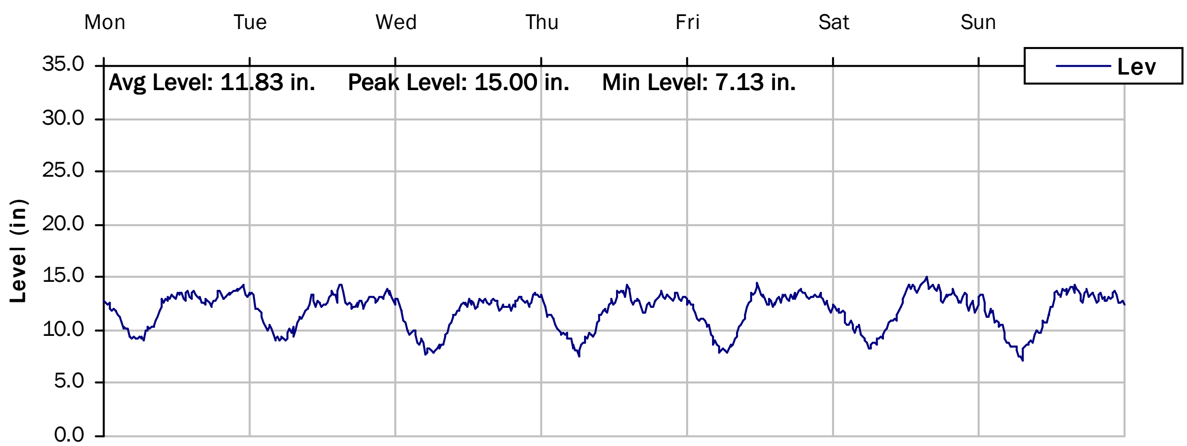


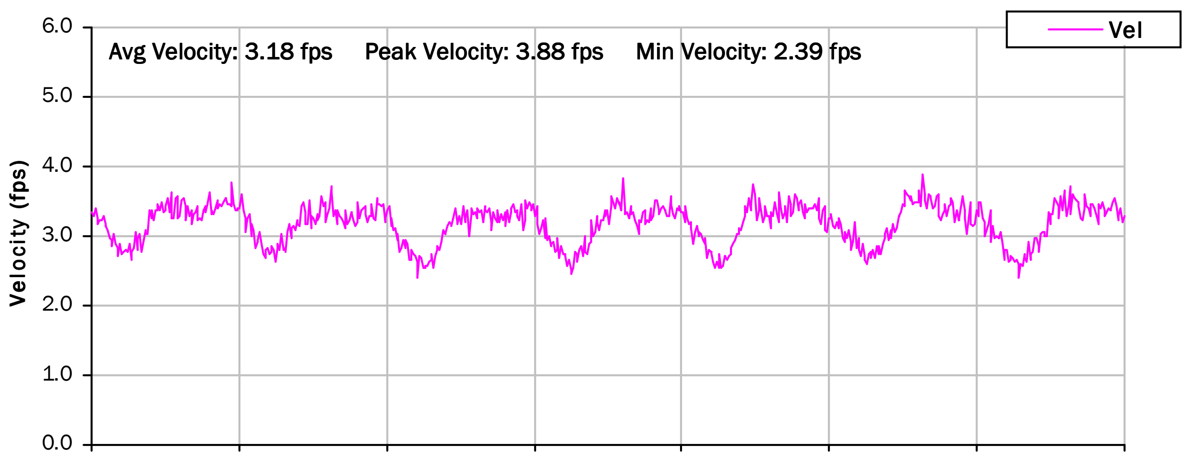


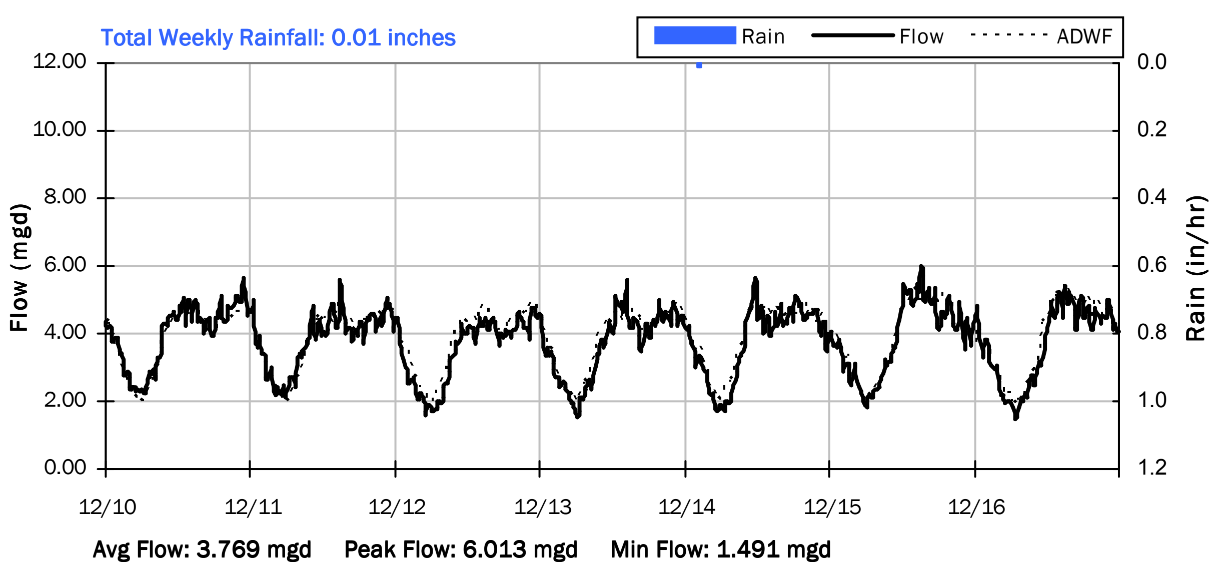


Avg Flow: 3.984 mgd Peak Flow: 6.371 mgd Min Flow: 1.803 mgd

SITE 7
Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018



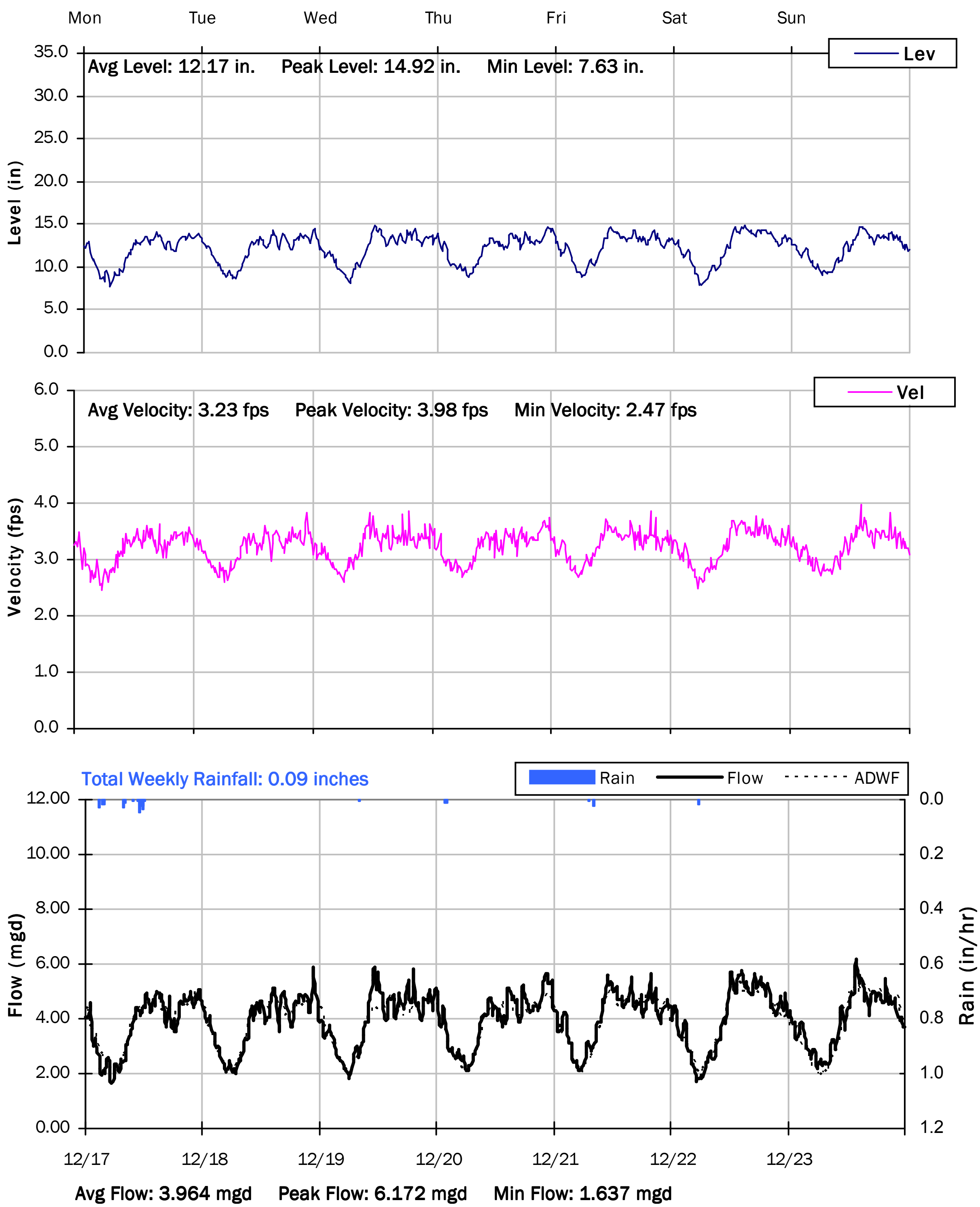




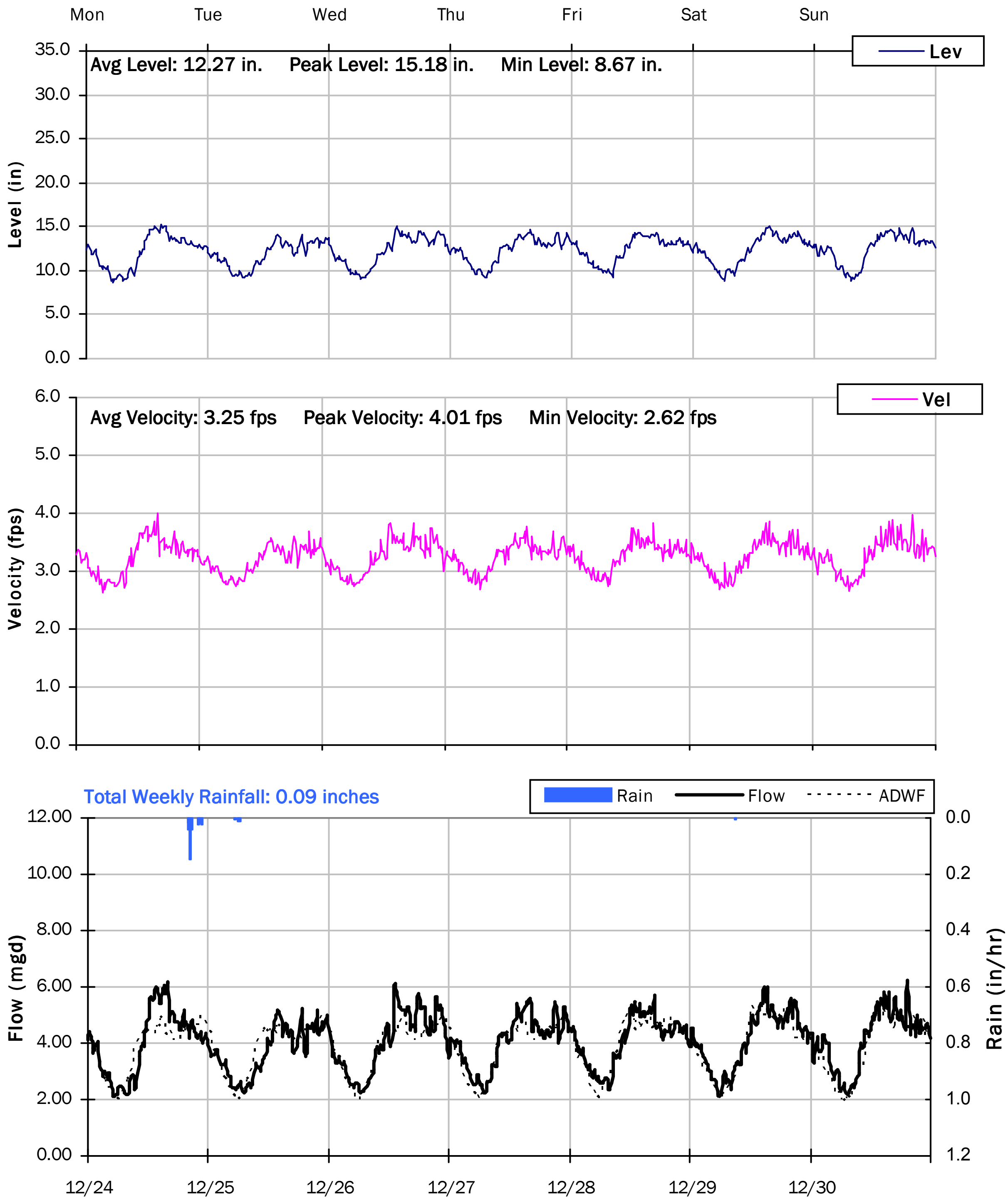
SITE 7

Weekly Level, Velocity and Flow Hydrographs

12/17/2018 to 12/24/2018

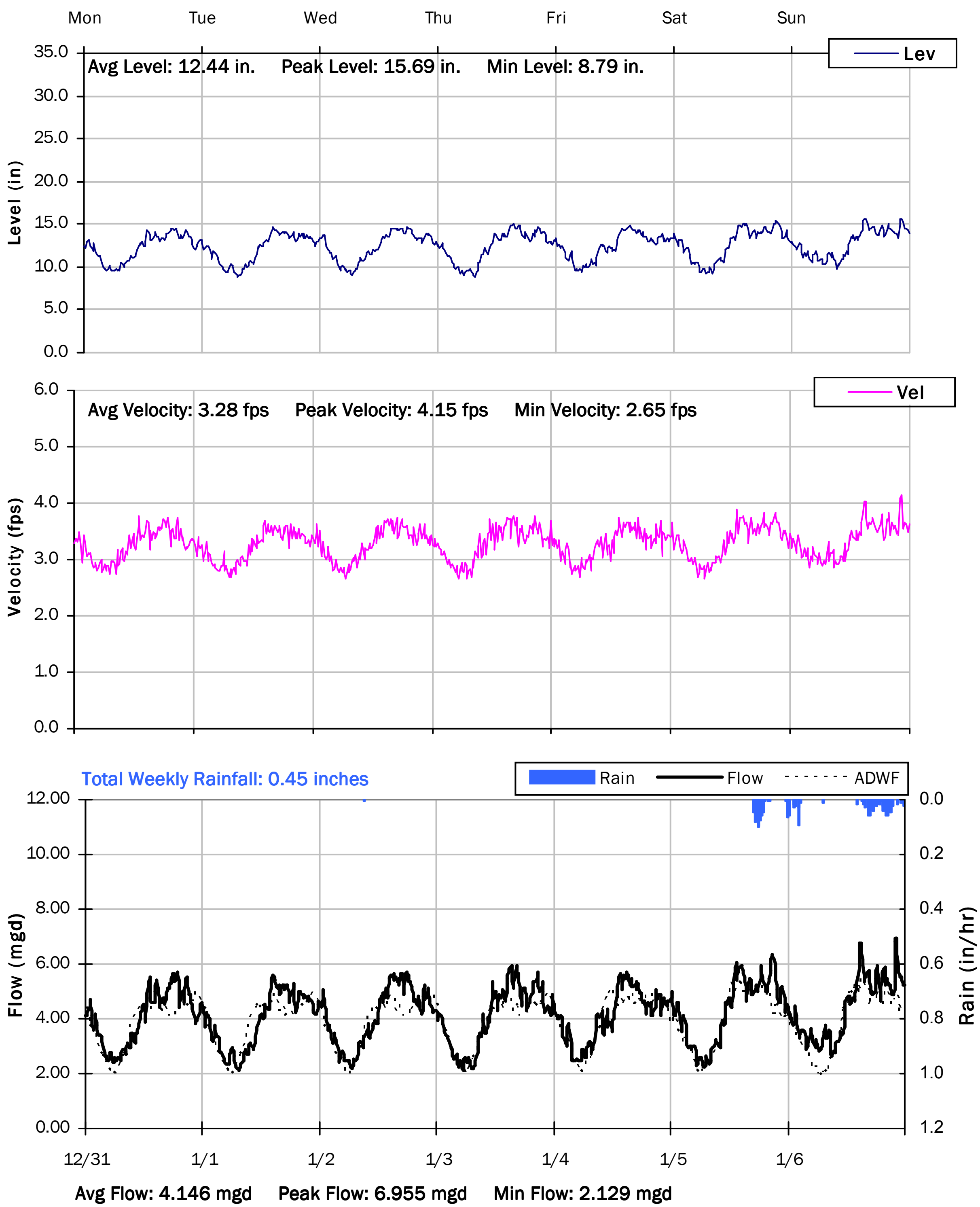


SITE 7
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018

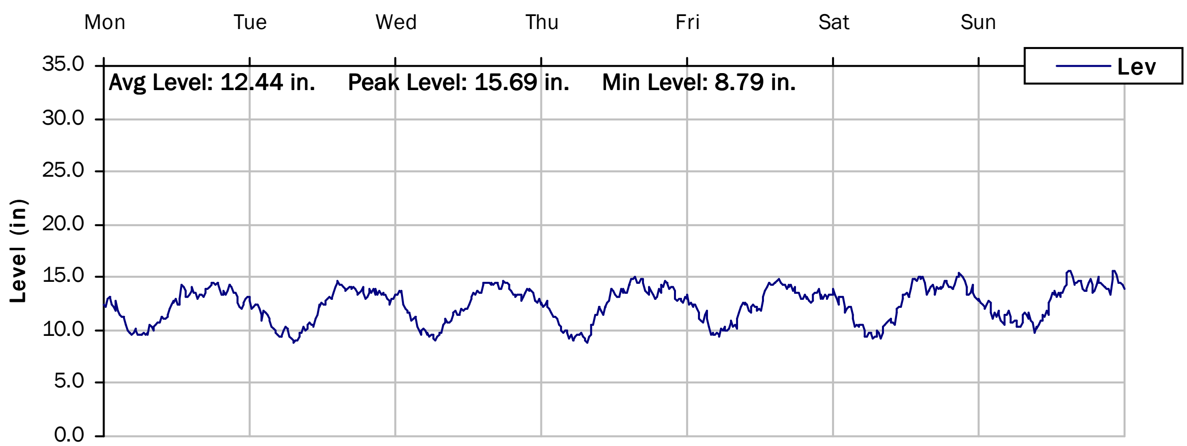


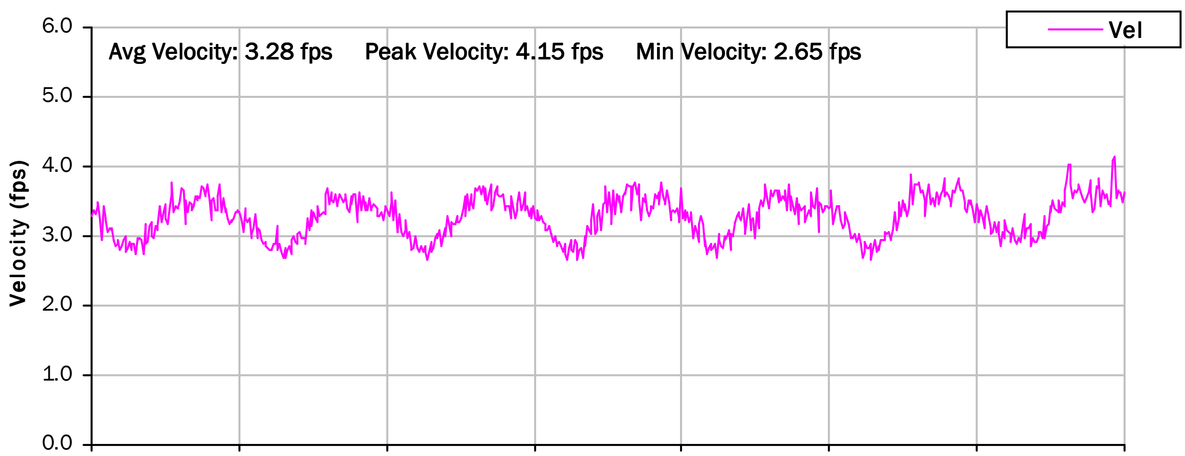
Avg Flow: 4.028 mgd **Peak Flow: 6.207 mgd** **Min Flow: 2.100 mgd**

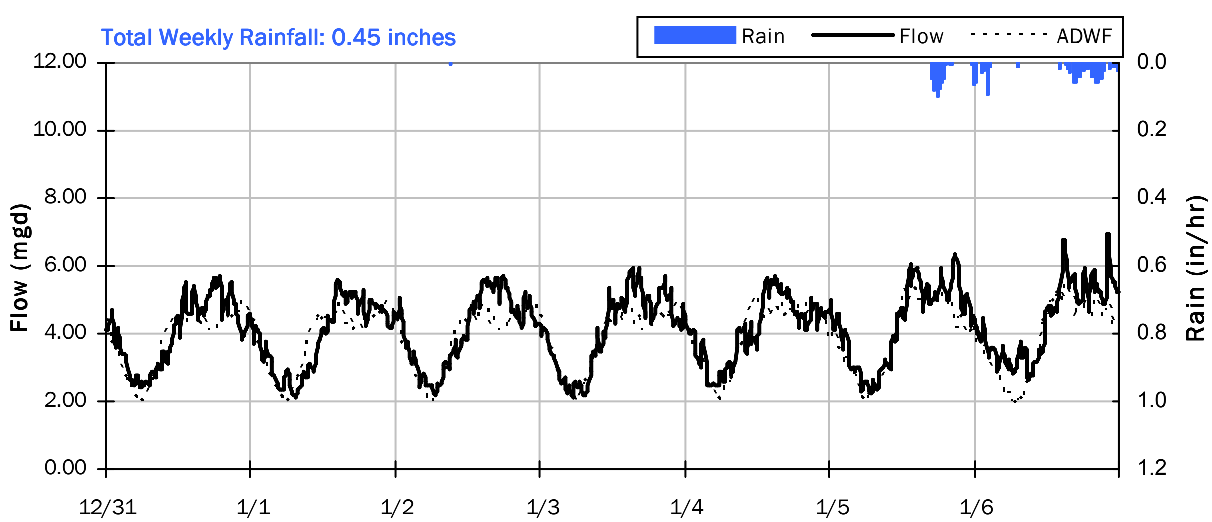
SITE 7
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



SITE 7
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019







Avg Flow: 4.146 mgd **Peak Flow: 6.955 mgd** **Min Flow: 2.129 mgd**

City of Visalia

Sanitary Sewer Flow Monitoring
November 28, 2018 - January 06, 2019

Monitoring Site: Site 8

Location: S Akers St s/o W Cambridge Ave

Data Summary Report

Vicinity Map: Site 8

SITE 8

Site Information

Location: S Akers St s/o W Cambridge Ave

Coordinates: 119.3496° W, 36.3146° N

Rim Elevation (Earth): 309 feet

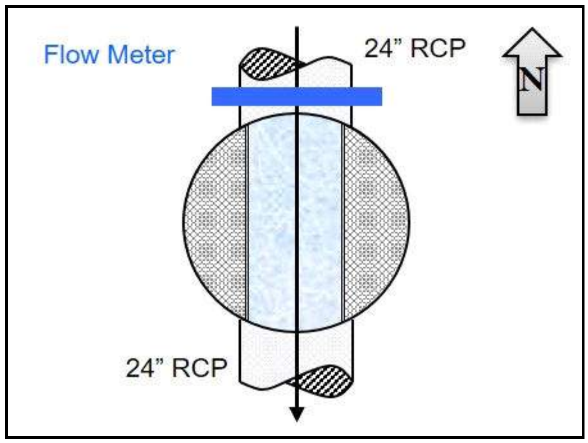
Pipe Diameter: 24 inches

ADWF: 0.638 mgd

Peak Measured Flow: 1.168 mgd

Satellite Map

Sewer Map



Flow Sketch

Street View

Plan View

SITE 8

Additional Site Photos

Effluent Pipe

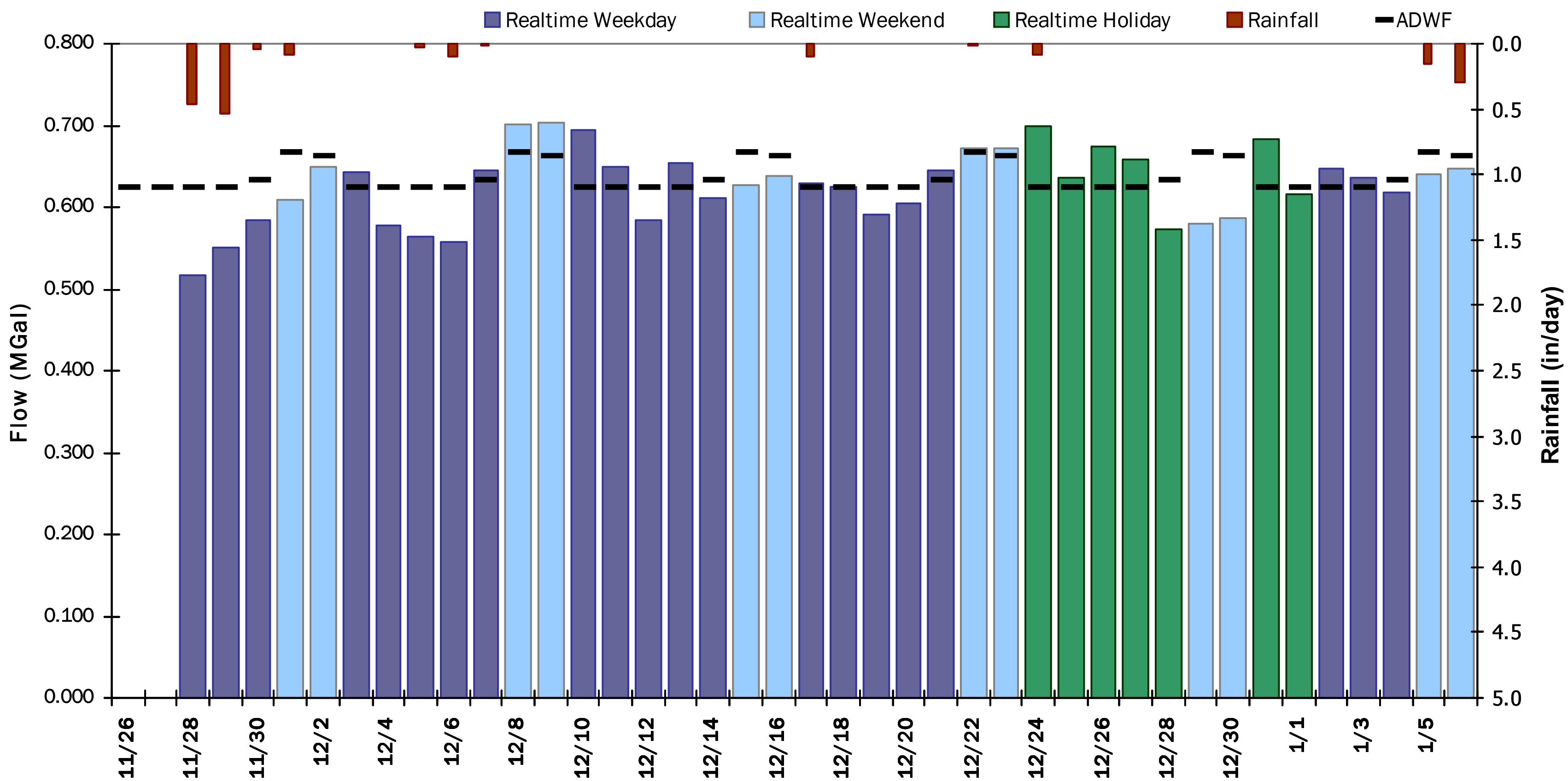
Influent Pipe

SITE 8

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.627 MGal **Peak Daily Flow: 0.703 MGal** **Min Daily Flow: 0.517 MGal**

Total Period Rainfall: 1.93 inches

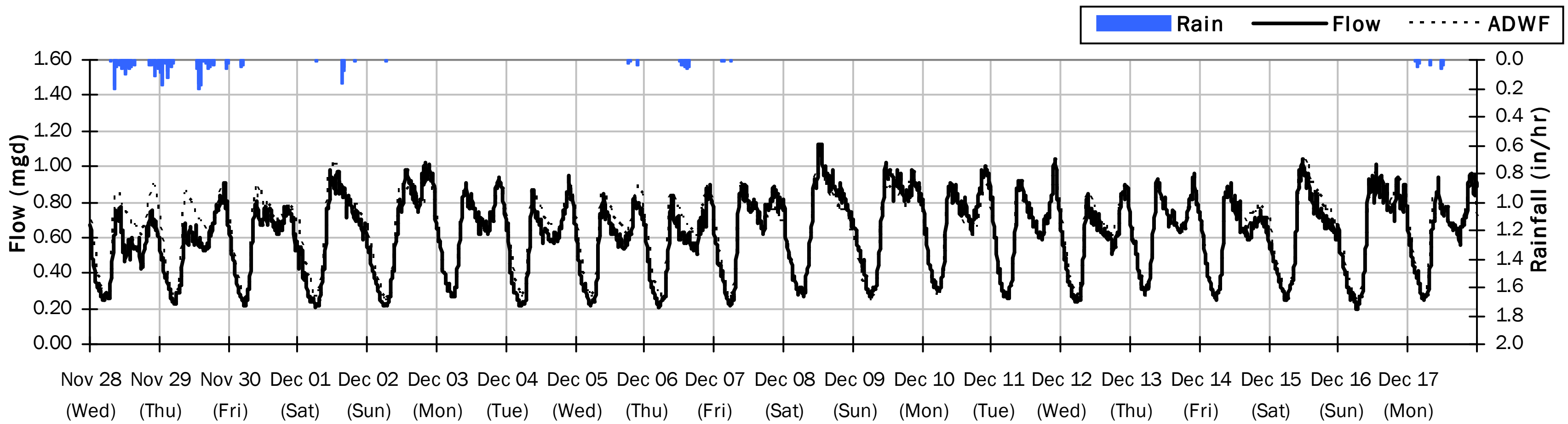


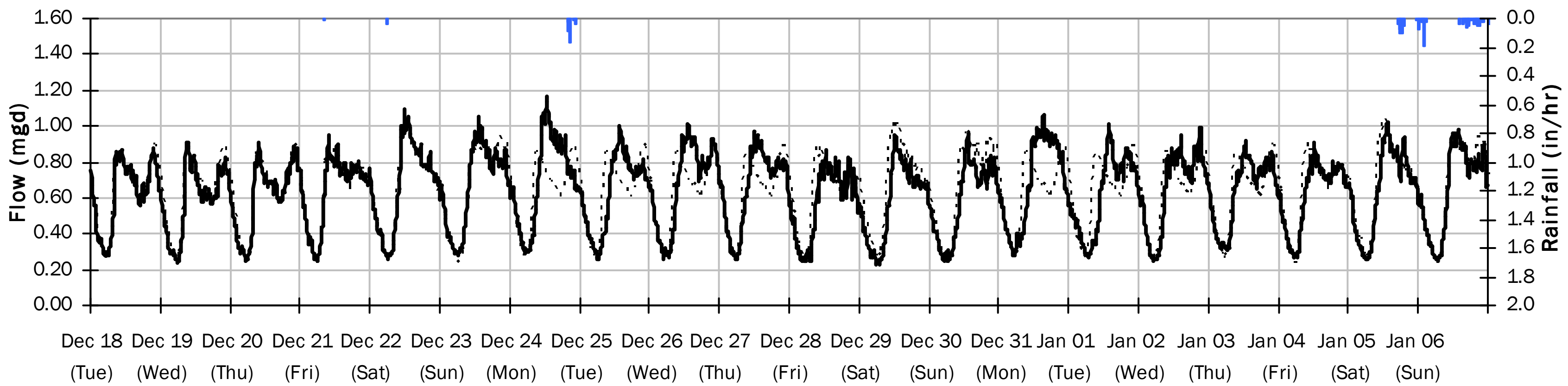
SITE 8

Flow Summary: 11/28/2018 to 1/6/2019

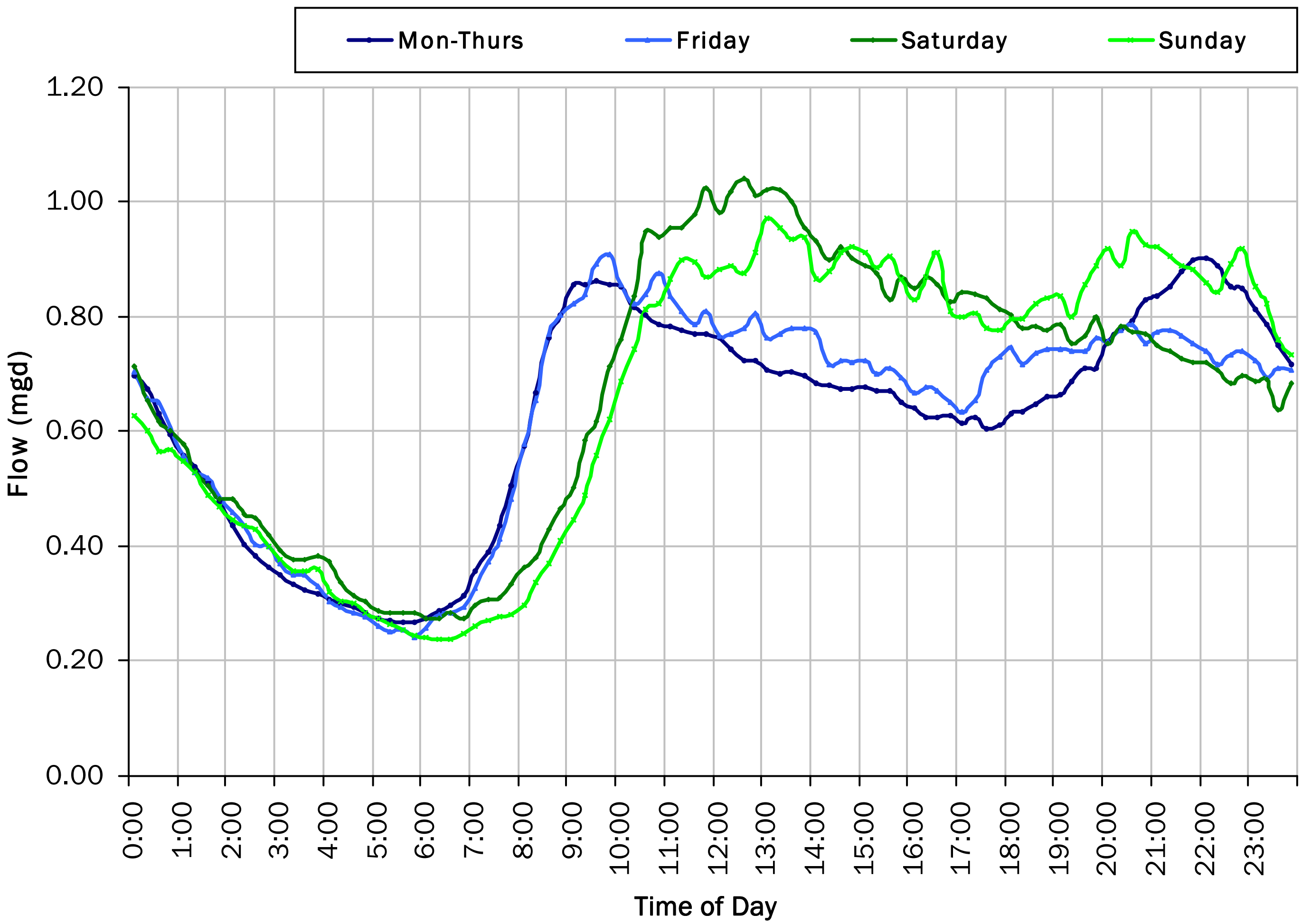
Total Period Rainfall: 1.93 inches

Avg Flow: 0.627 mgd   Peak Flow: 1.168 mgd   Min Flow: 0.201 mgd



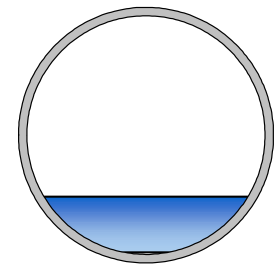


SITE 8
Average Dry Weather Flow Hydrographs



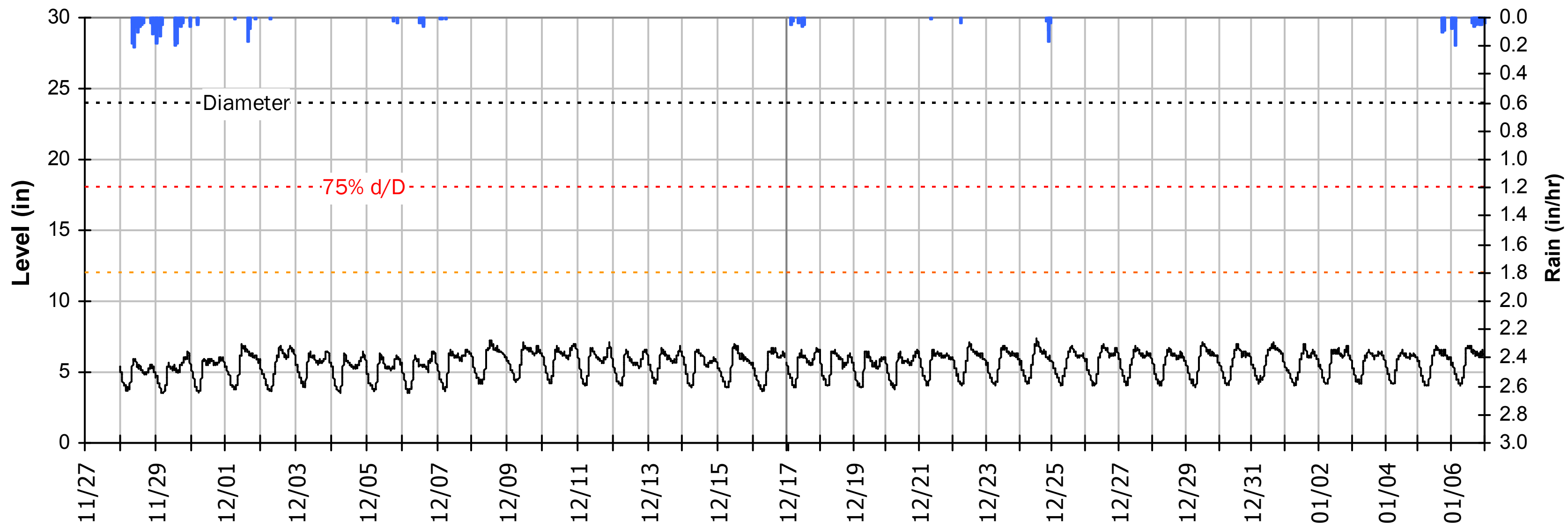
ADWF:

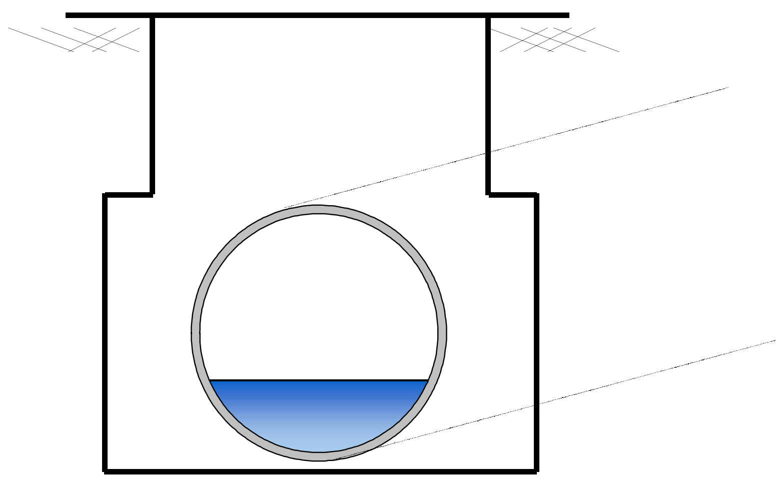
0.638 *mgd*



SITE 8
Site Capacity and Surcharge Summary

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

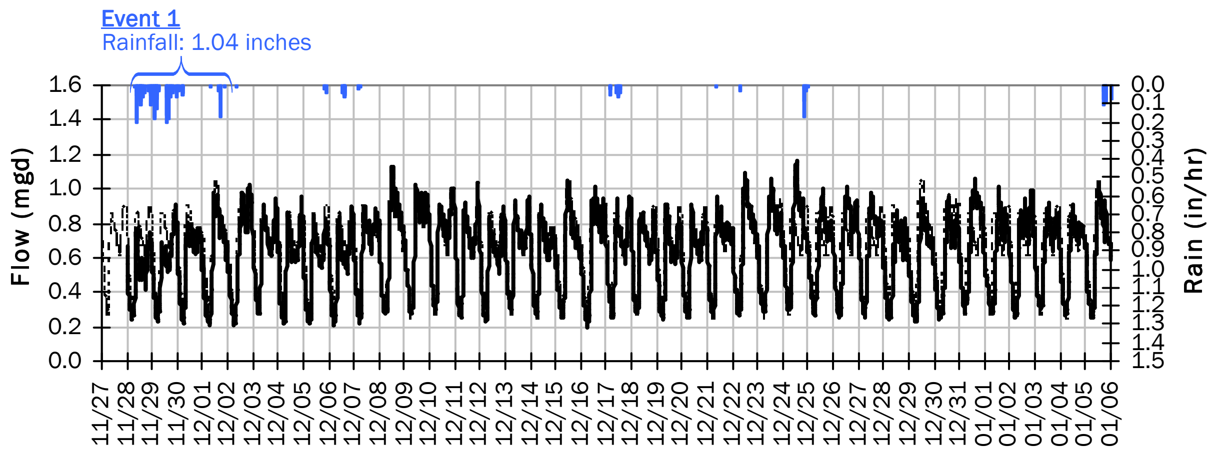




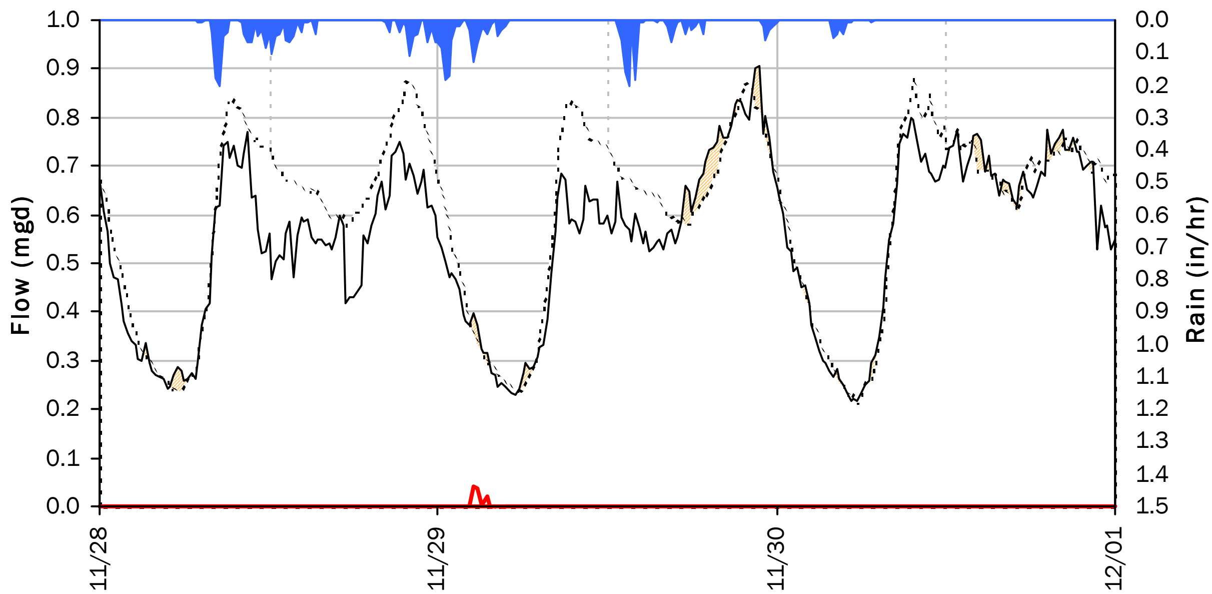
Pipe Diameter:	24	*inches*
Peak Measured Level:	7.36	*inches*
Peak d/D Ratio:	0.31	

SITE 8
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



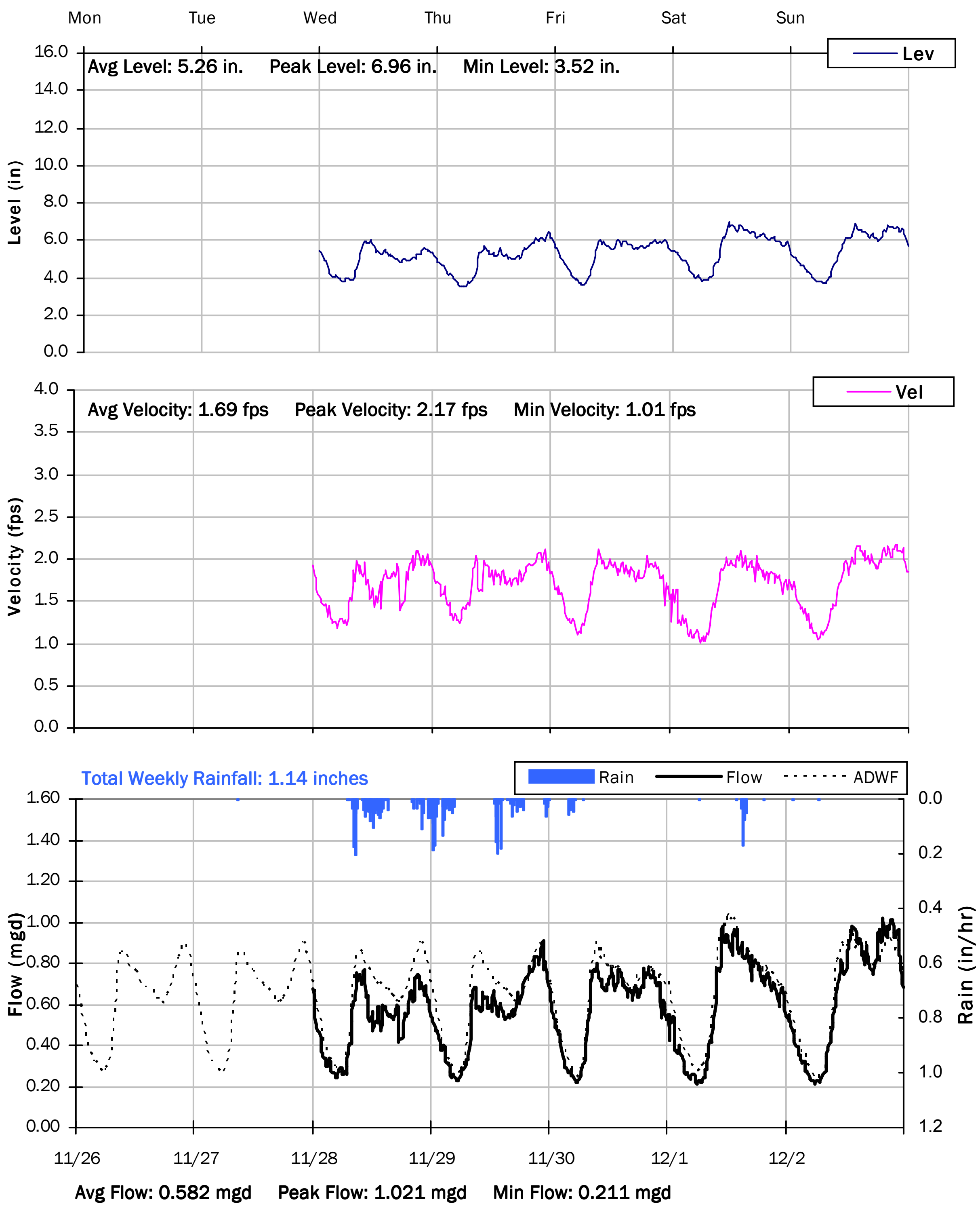
Event 1 Detail Graph



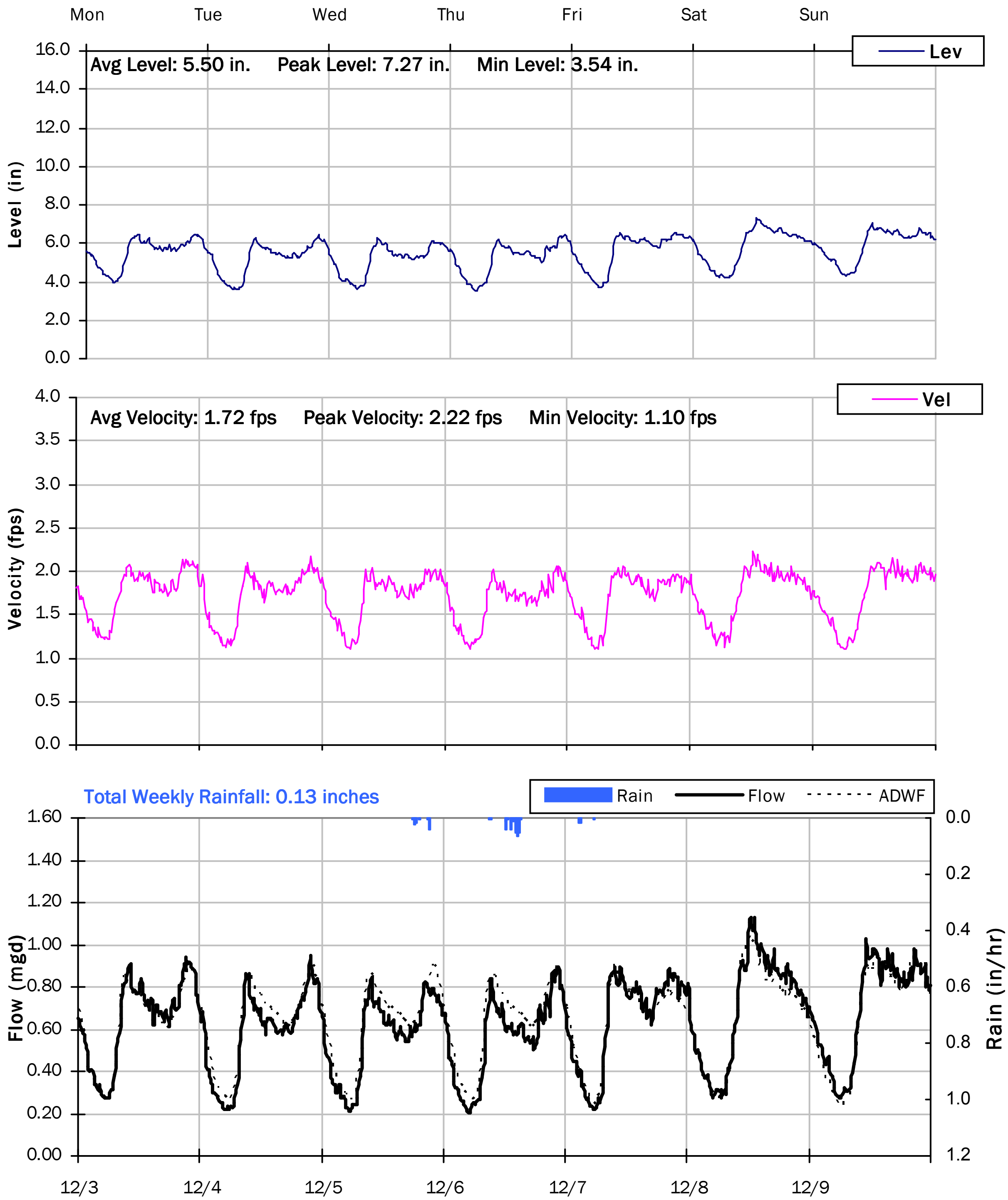
Storm Event I/I Analysis (Rain = 1.04 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	0.40 *mgd*	**Peak I/I Rate:**	0.04 *mgd*
PF:	0.62	**Total I/I:**	1,000 *gallons*
Peak Level:	4.18 *in*		
d/D Ratio:	0.17		

SITE 8
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018



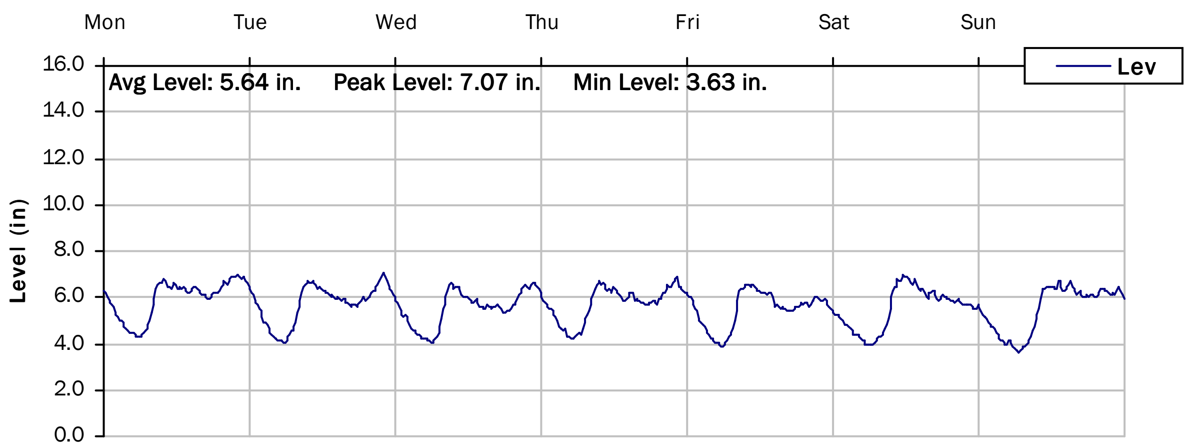
SITE 8
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018

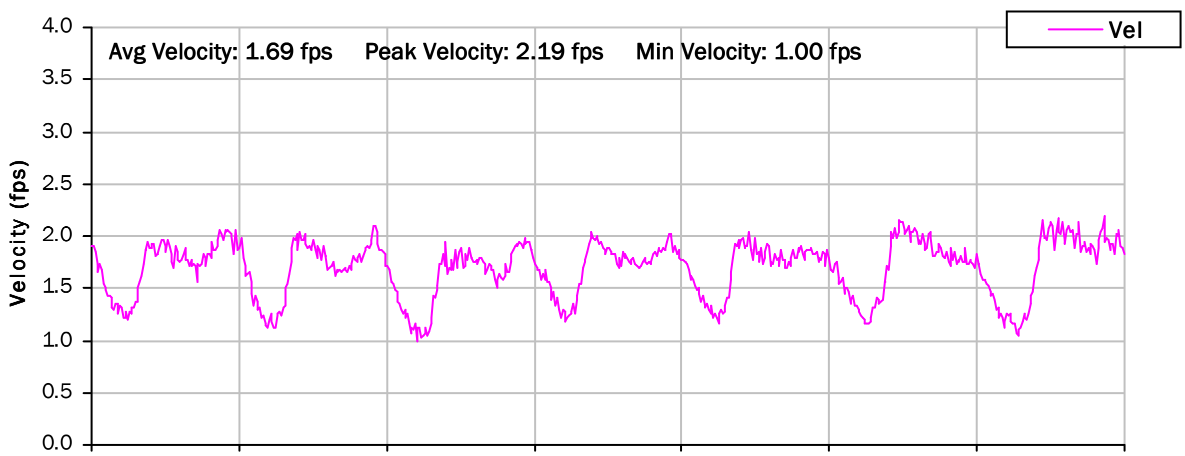


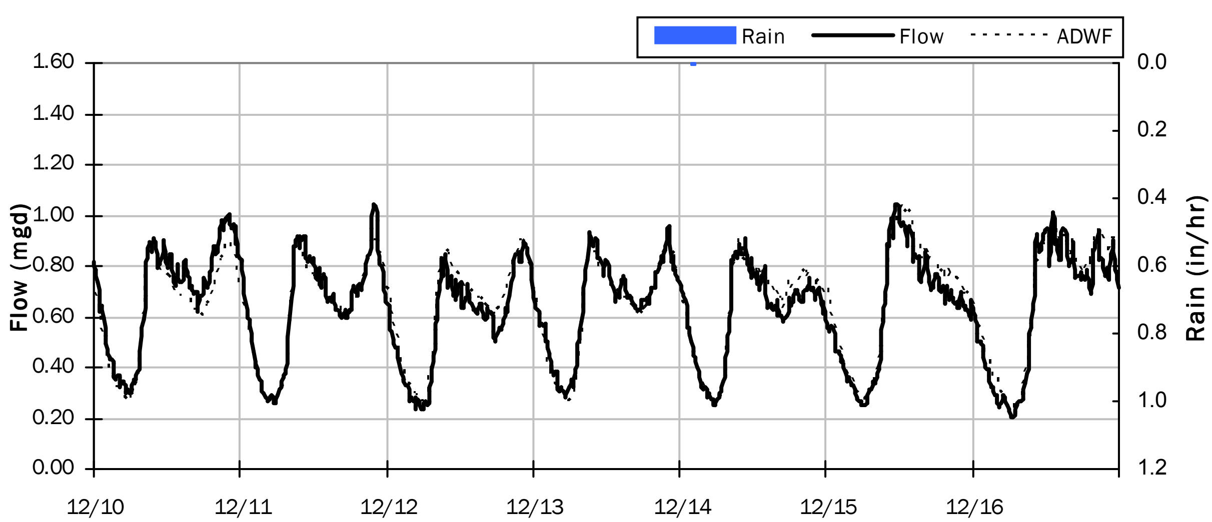
Avg Flow: 0.627 mgd Peak Flow: 1.129 mgd Min Flow: 0.206 mgd

SITE 8

Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018

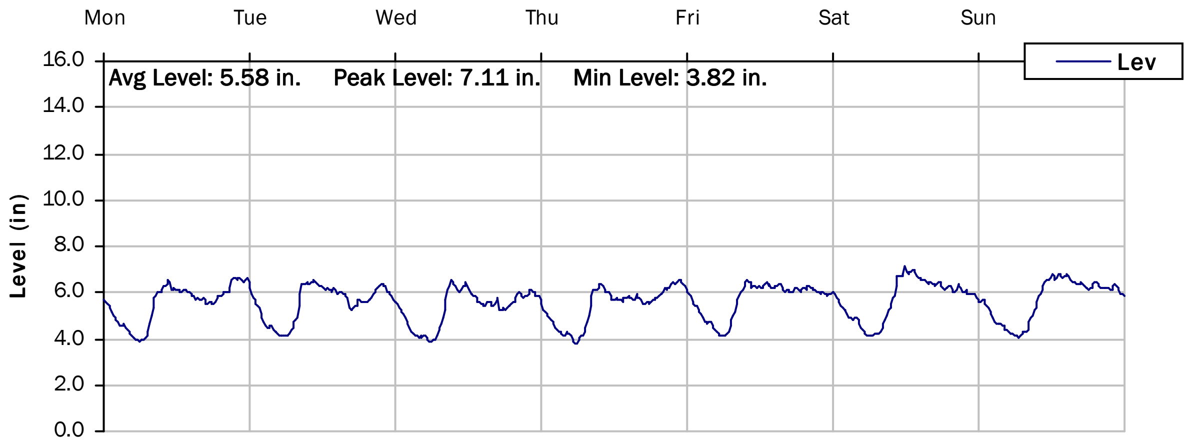


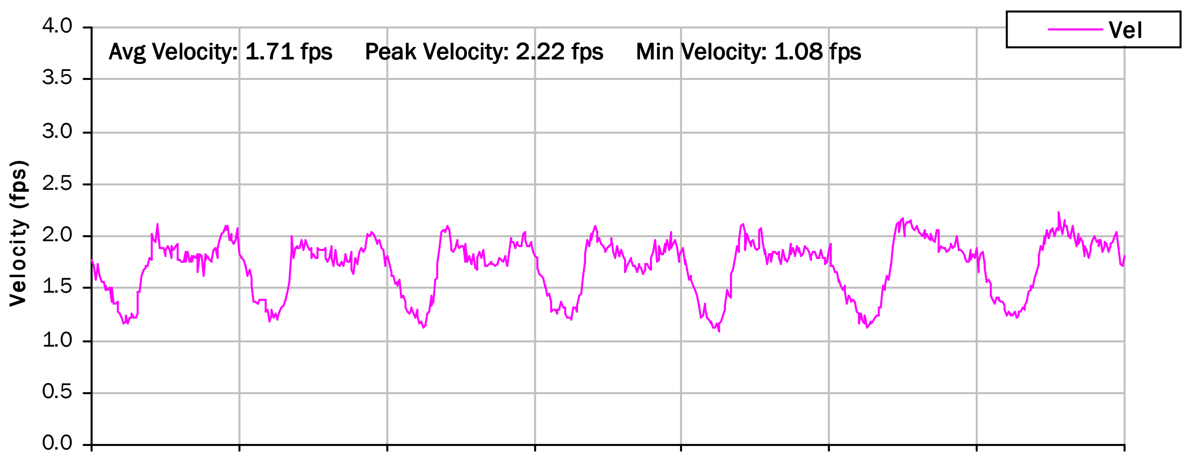


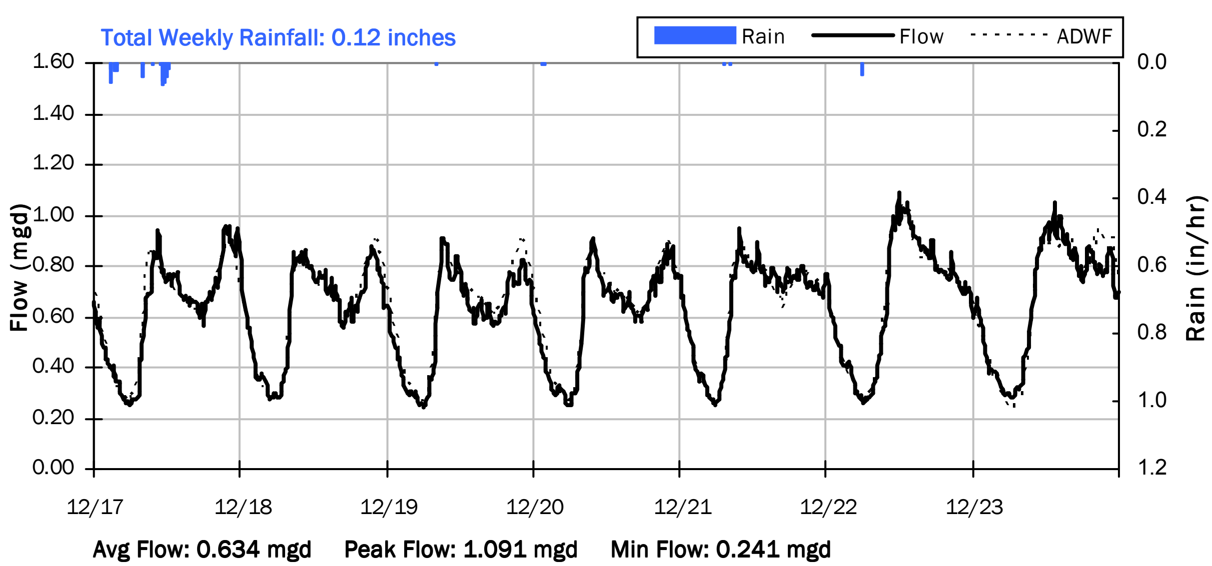


Avg Flow: 0.637 mgd Peak Flow: 1.047 mgd Min Flow: 0.201 mgd

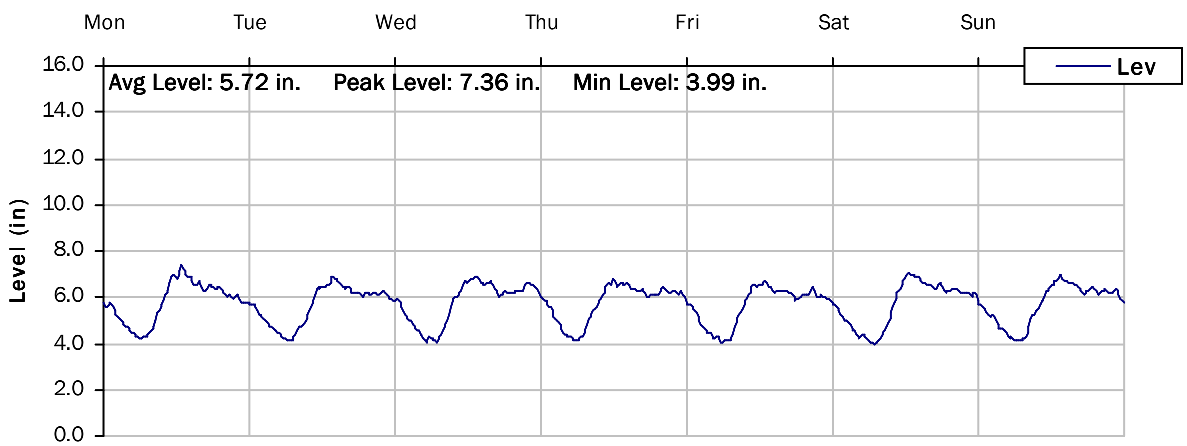
SITE 8
Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018

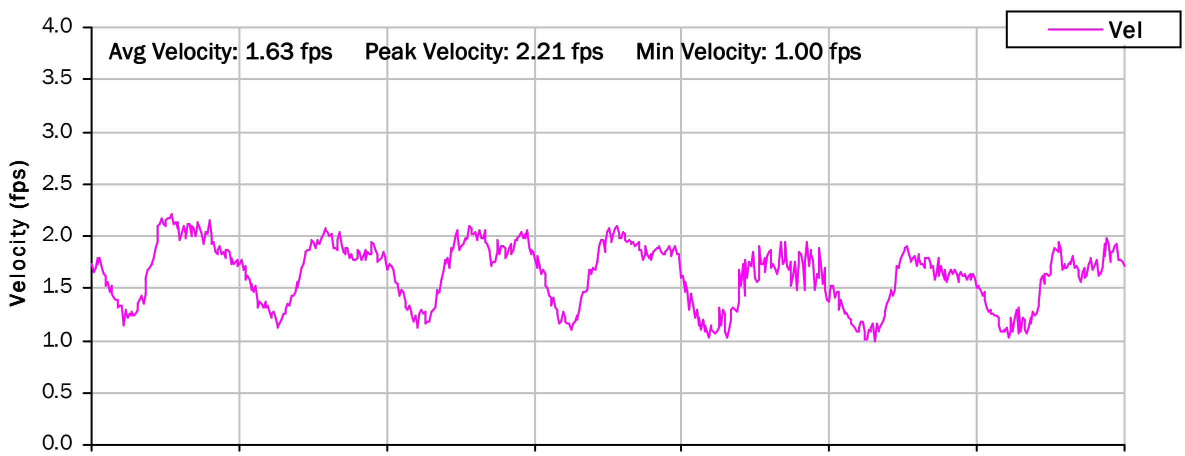


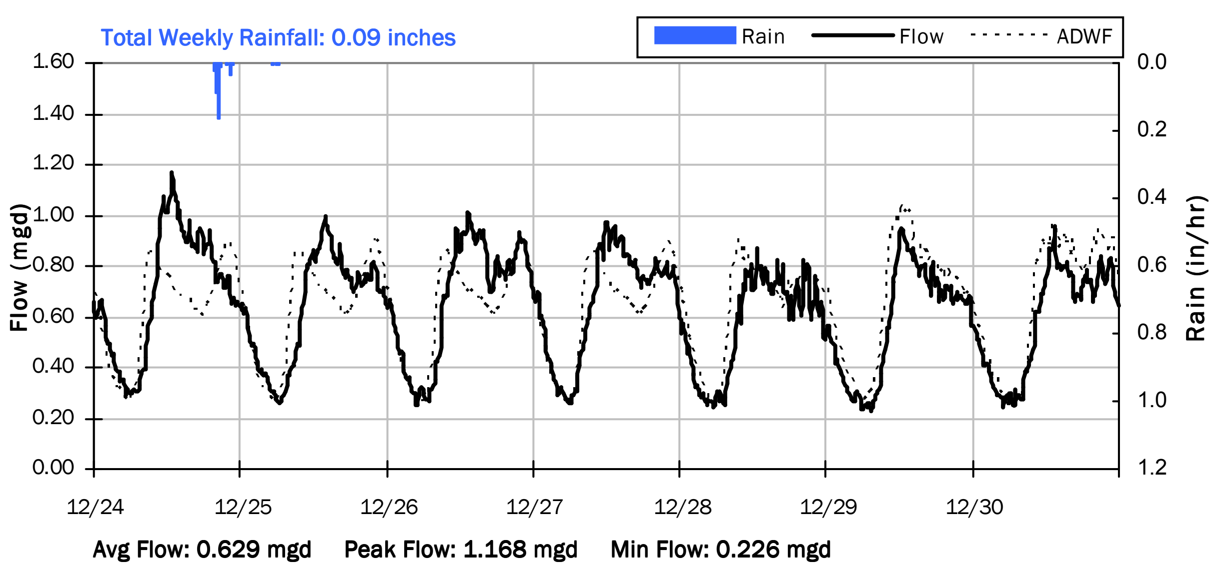




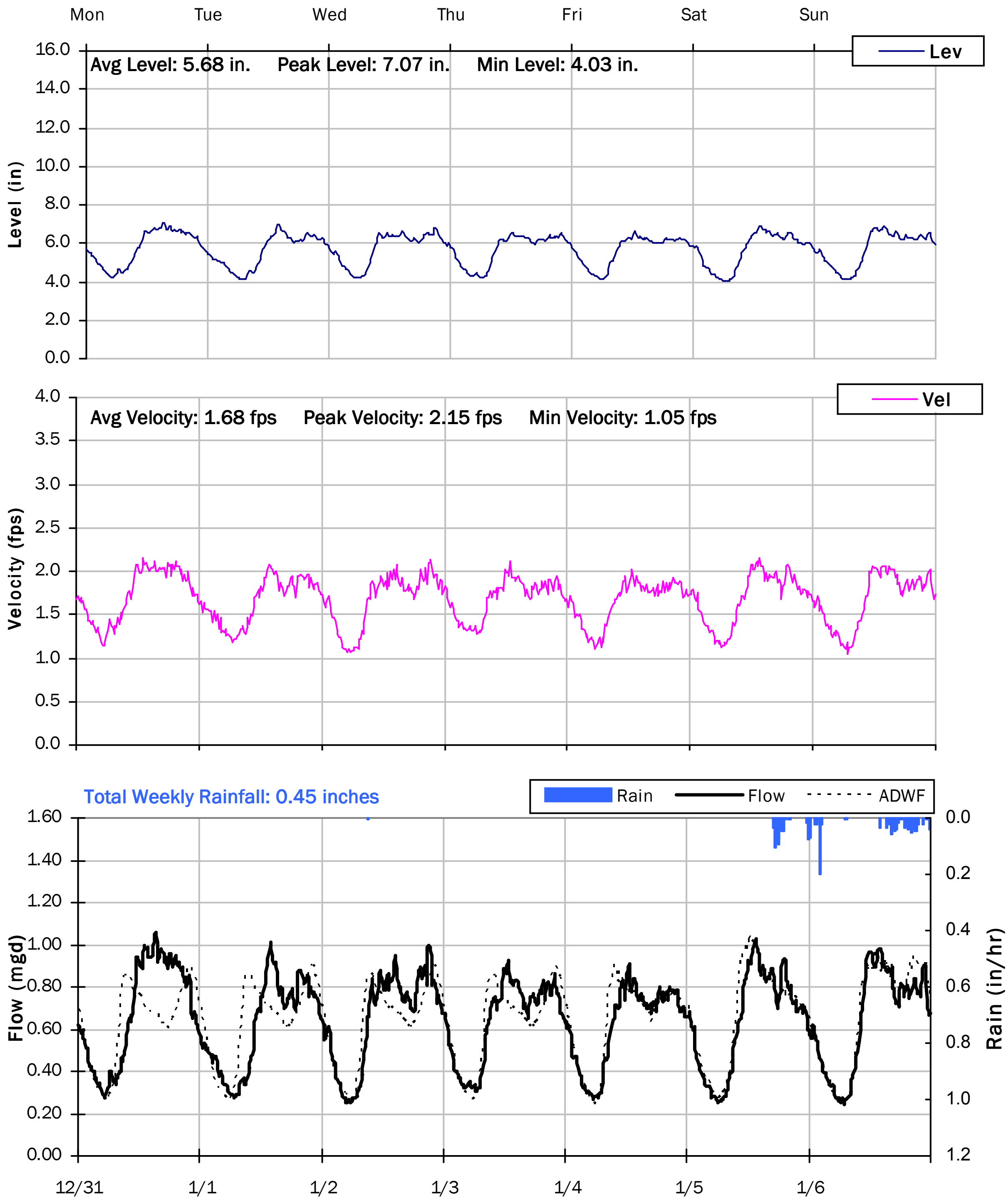
SITE 8
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018





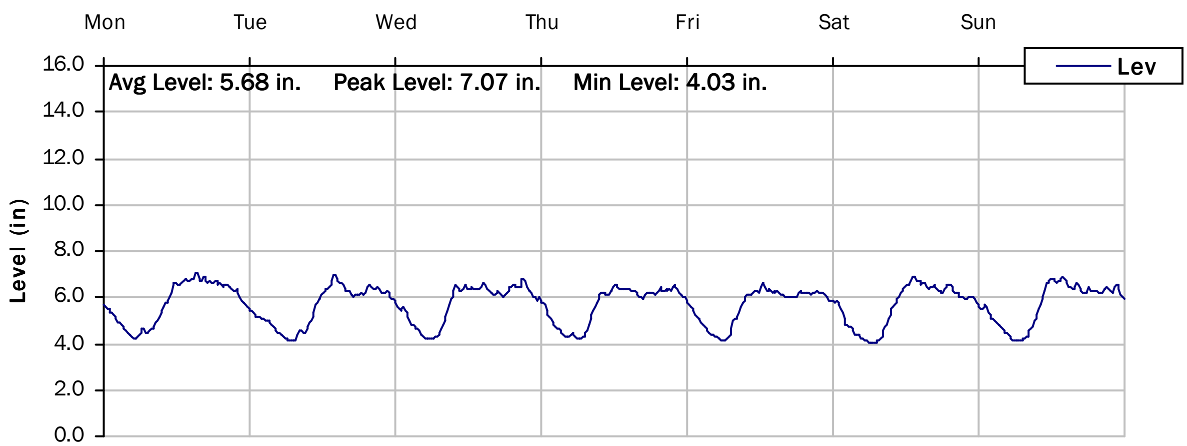


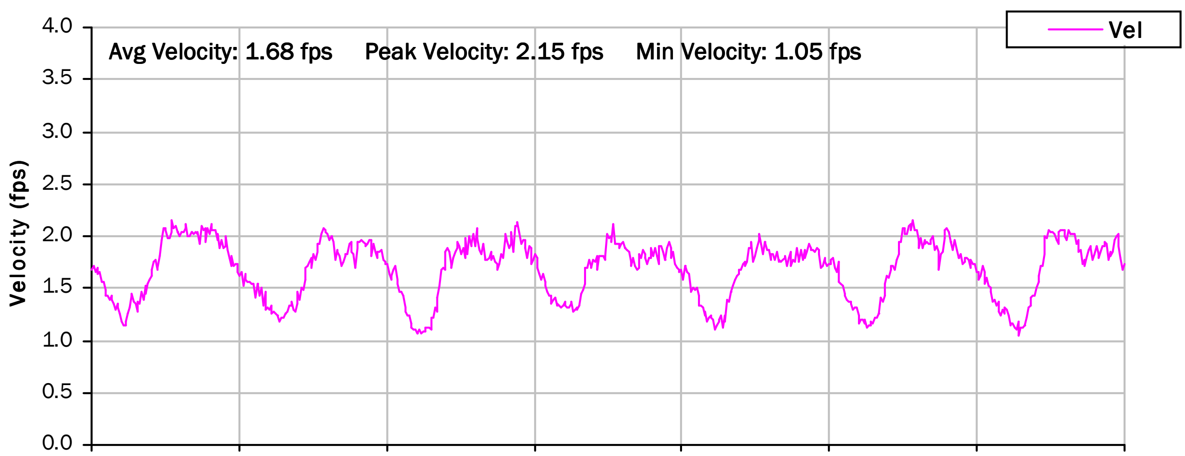
SITE 8
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019

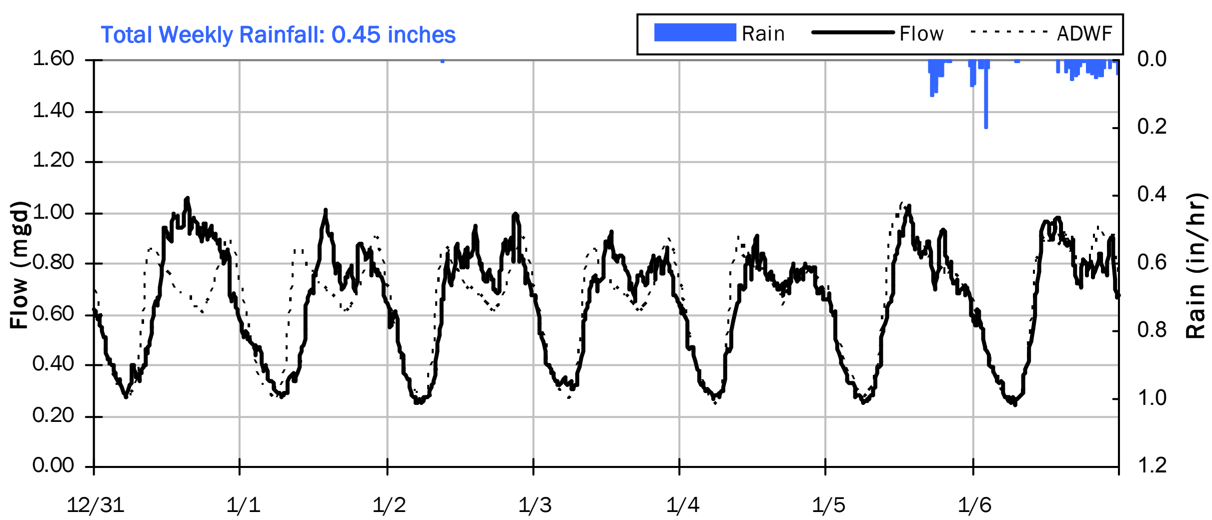


Avg Flow: 0.642 mgd **Peak Flow: 1.059 mgd** **Min Flow: 0.244 mgd**

SITE 8
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019







Avg Flow: 0.642 mgd **Peak Flow: 1.059 mgd** **Min Flow: 0.244 mgd**

City of Visalia

Sanitary Sewer Flow Monitoring

November 28, 2018 - January 06, 2019

Monitoring Site: Site 9

Location: W Walnut Ave & S San Joaquin Dr

Data Summary Report

Vicinity Map: Site 9

SITE 9

Site Information

Location: W Walnut Ave & S San Joaquin Dr

Coordinates: 119.3459° W, 36.3128° N

Rim Elevation (Earth): 308 feet

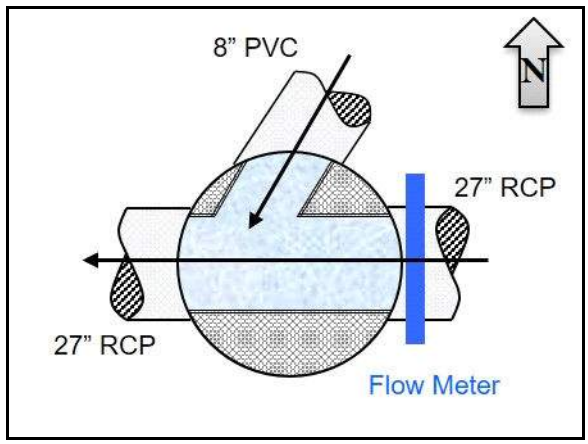
Pipe Diameter: 27 inches

ADWF: 1.642 mgd

Peak Measured Flow: 2.792 mgd

Satellite Map

Sewer Map



Flow Sketch


Street View


Plan View

SITE 9

Additional Site Photos

Effluent Pipe

East Influent Pipe

SITE 9

Additional Site Photos

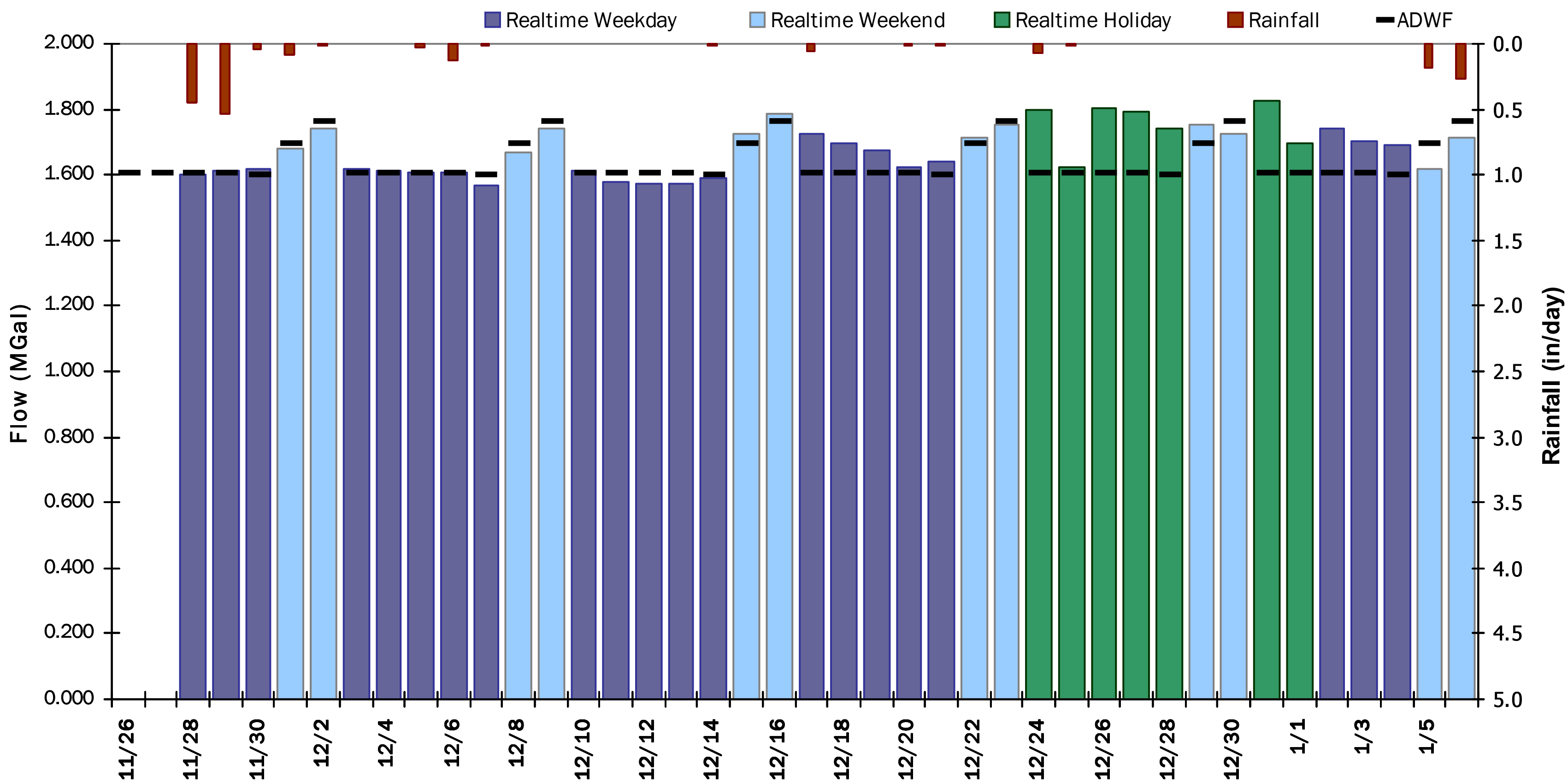
North Influent Pipe

SITE 9

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 1.679 MGal **Peak Daily Flow: 1.828 MGal** **Min Daily Flow: 1.567 MGal**

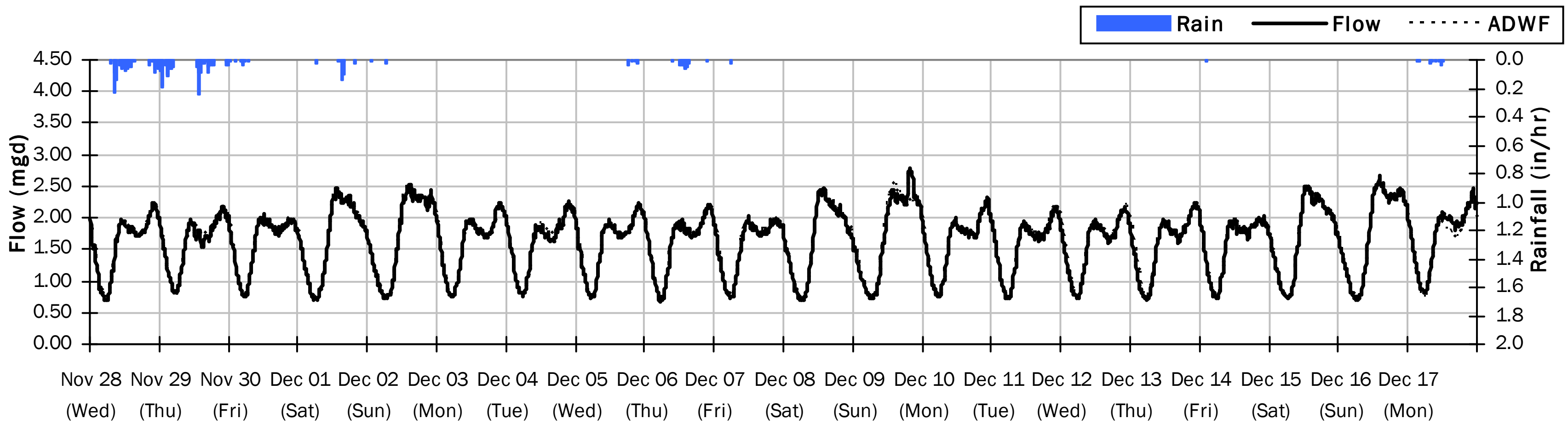
Total Period Rainfall: 1.88 inches

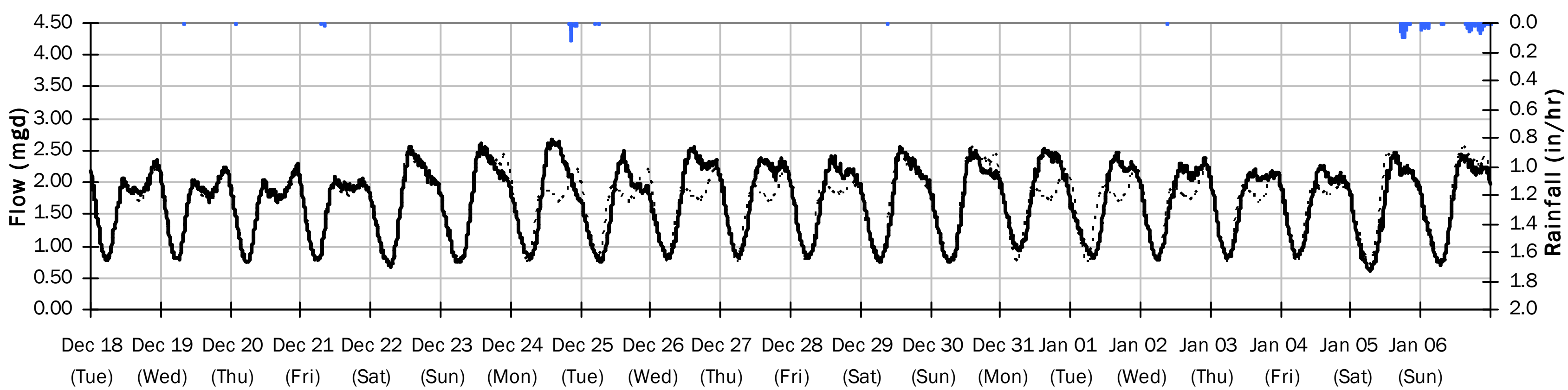


SITE 9

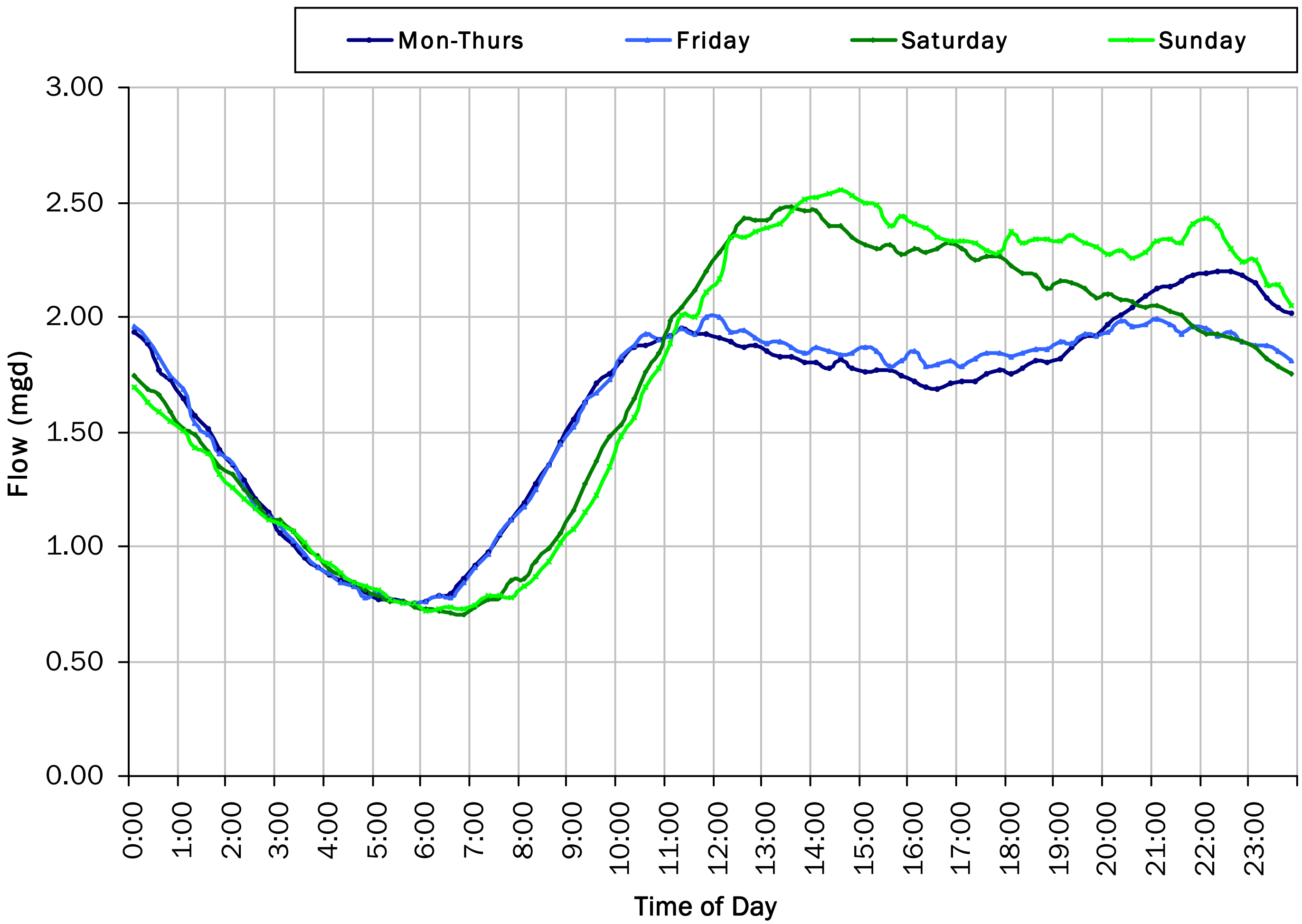
Flow Summary: 11/28/2018 to 1/6/2019

Total Period Rainfall: 1.88 inches   Avg Flow: 1.679 mgd   Peak Flow: 2.792 mgd   Min Flow: 0.599 mgd



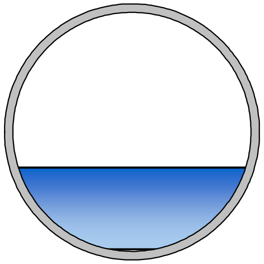


SITE 9
Average Dry Weather Flow Hydrographs



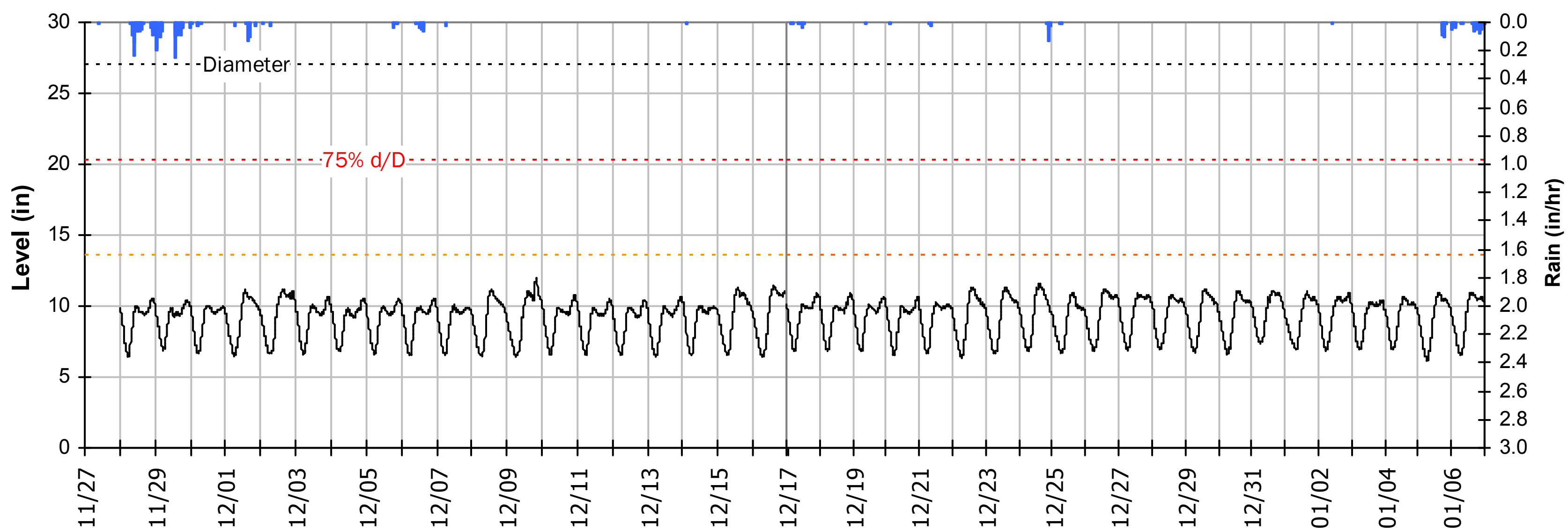
ADWF:

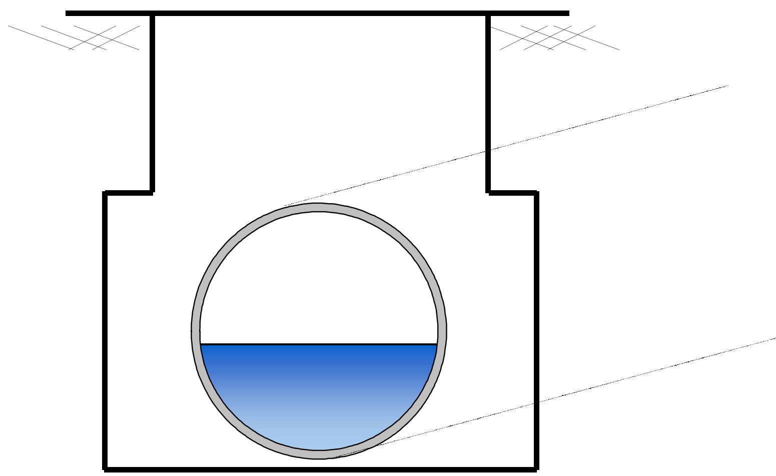
1.642 *mgd*



SITE 9
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





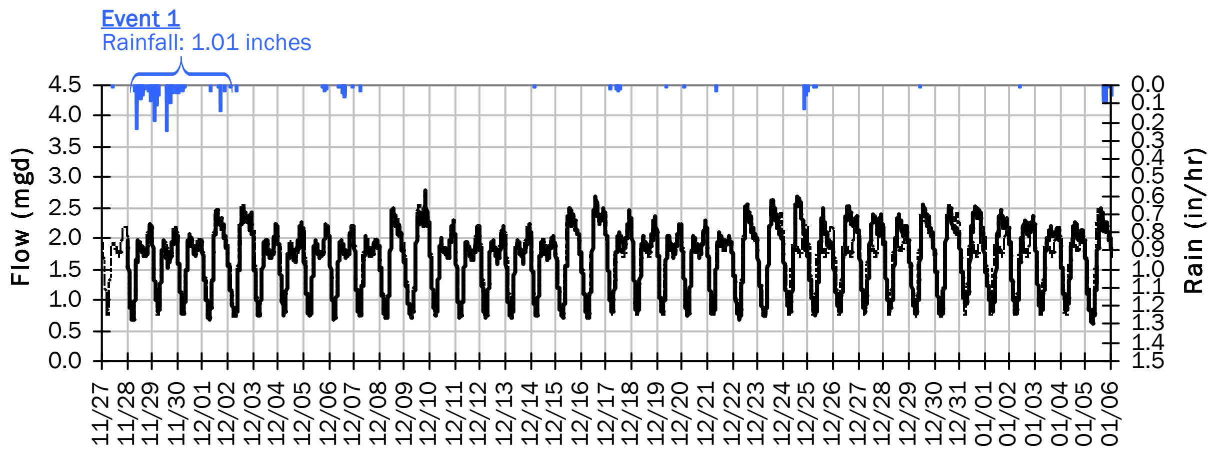
Pipe Diameter: 27 *inches*

Peak Measured Level: 11.9 *inches*

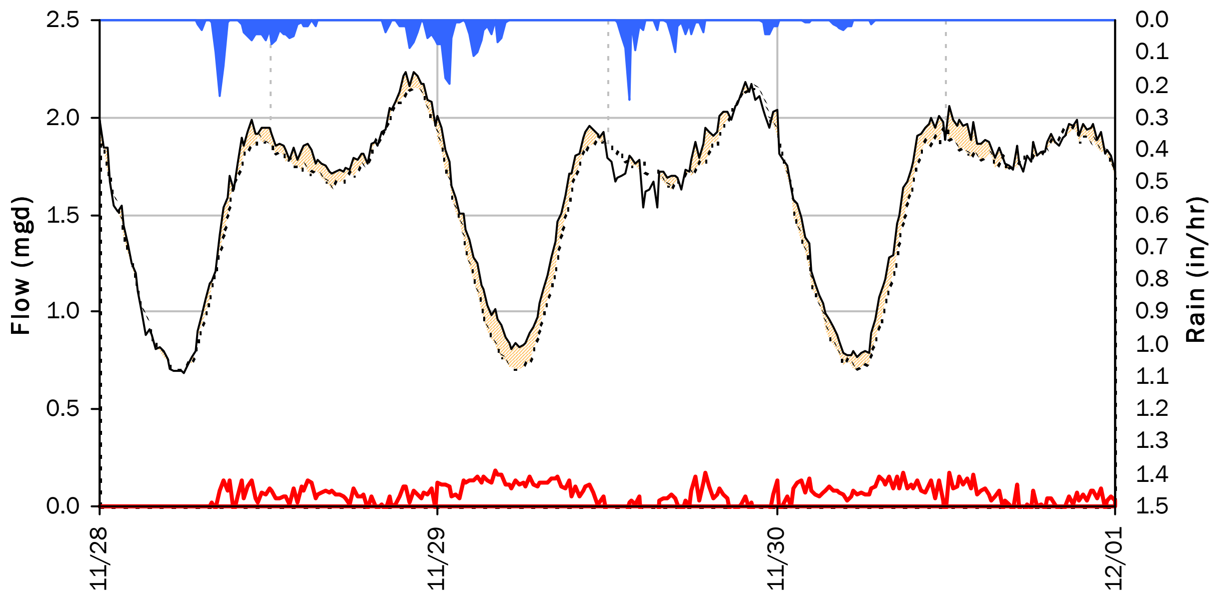
Peak d/D Ratio: 0.44

SITE 9
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



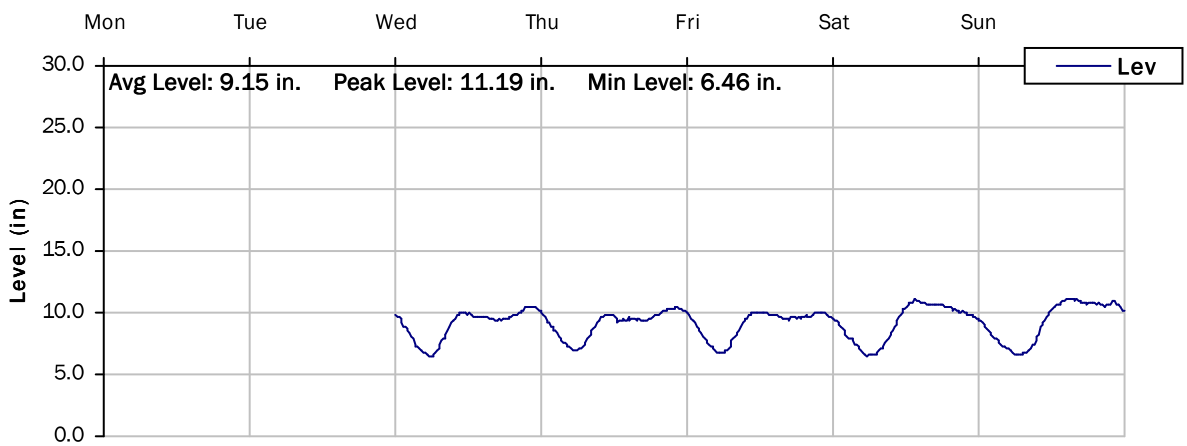
Event 1 Detail Graph

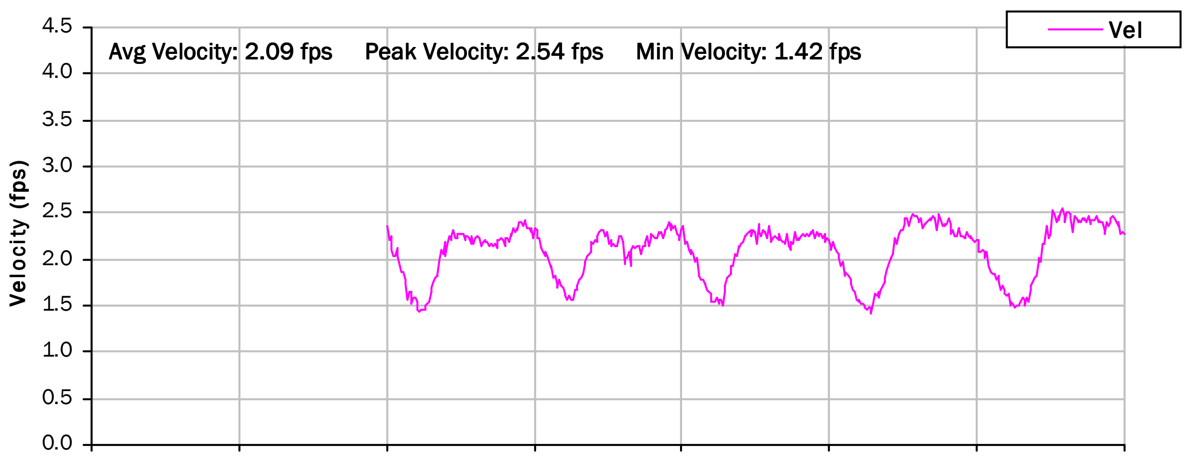


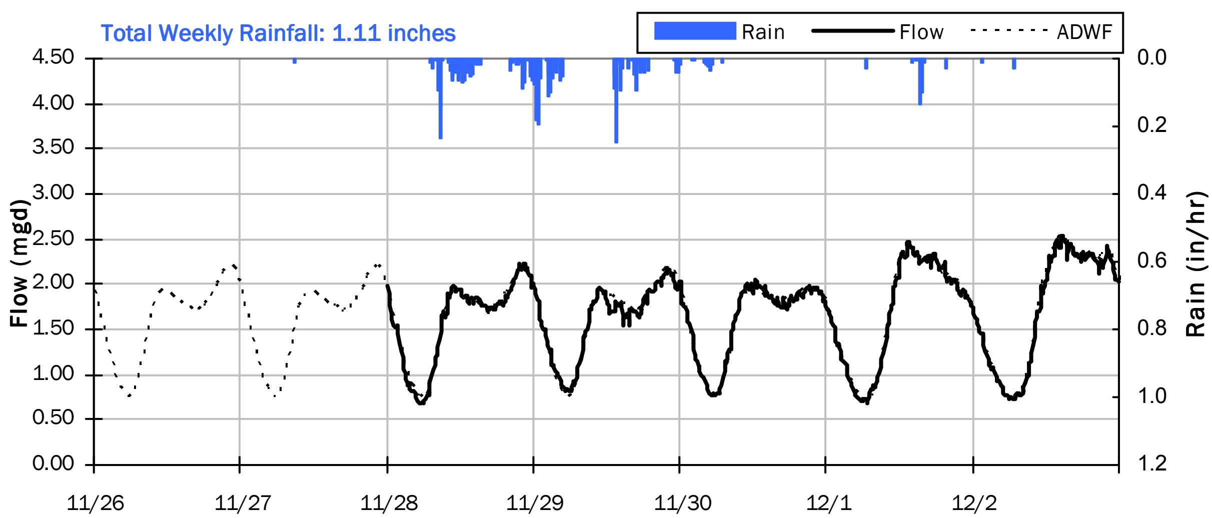
Storm Event I/I Analysis (Rain = 1.01 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	2.24 *mgd*	**Peak I/I Rate:**	0.19 *mgd*
PF:	1.36	**Total I/I:**	159,000 *gallons*
Peak Level:	10.55 *in*		
d/D Ratio:	0.39		

SITE 9
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018

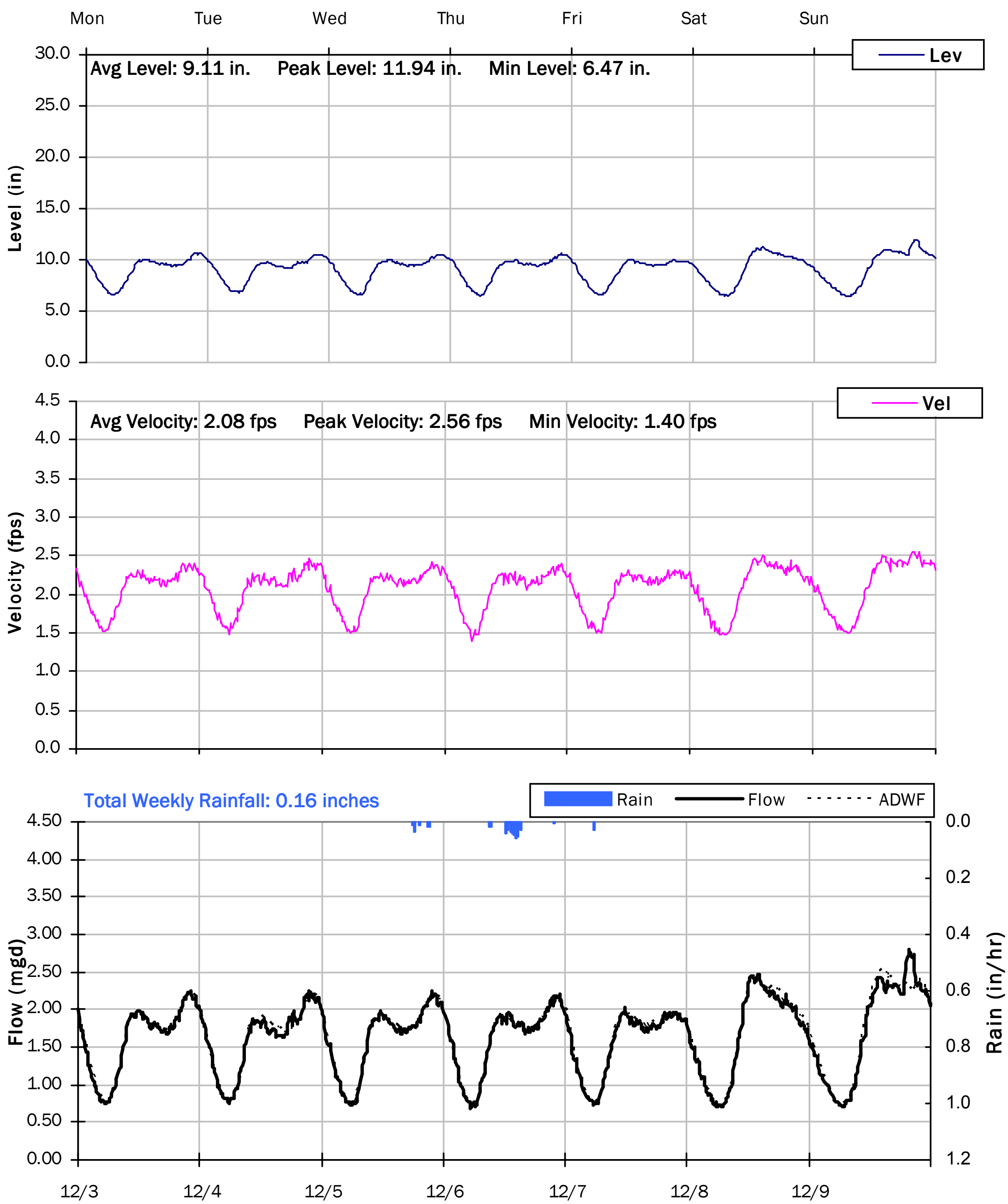






Avg Flow: 1.650 mgd **Peak Flow: 2.528 mgd** **Min Flow: 0.690 mgd**

SITE 9
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018

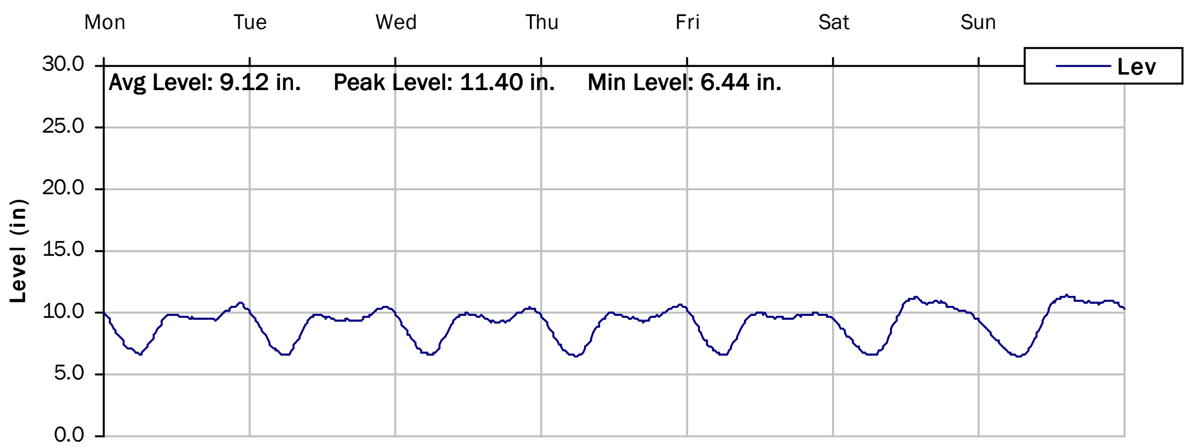


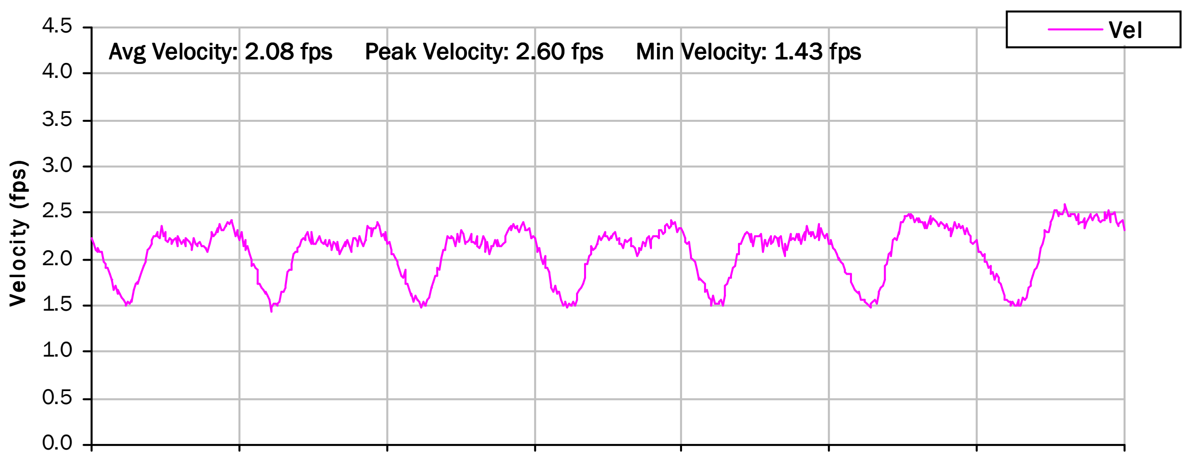
Avg Flow: 1.632 mgd   Peak Flow: 2.792 mgd   Min Flow: 0.682 mgd

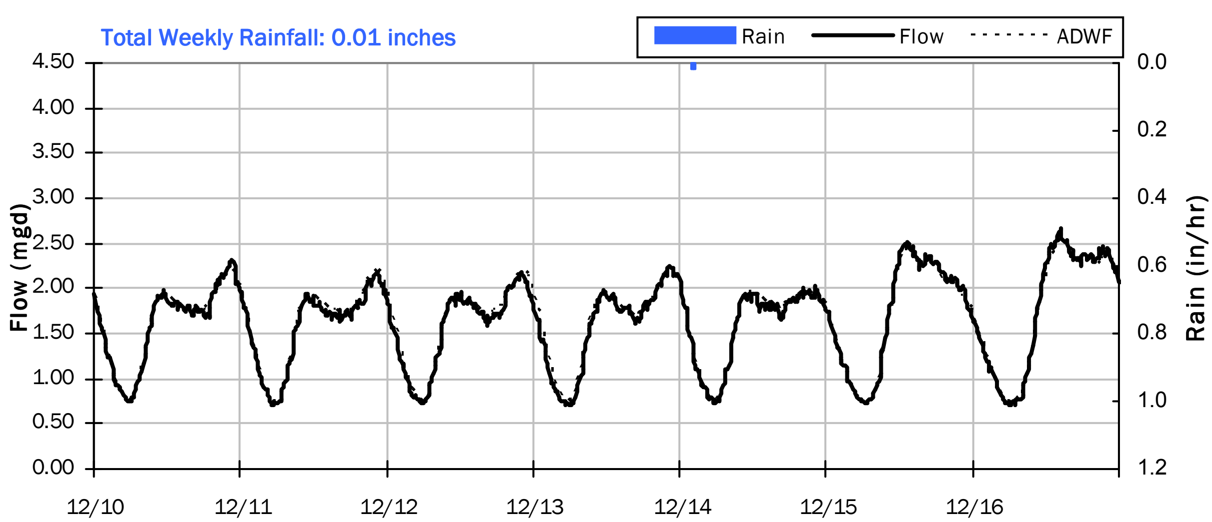
SITE 9

Weekly Level, Velocity and Flow Hydrographs

12/10/2018 to 12/17/2018





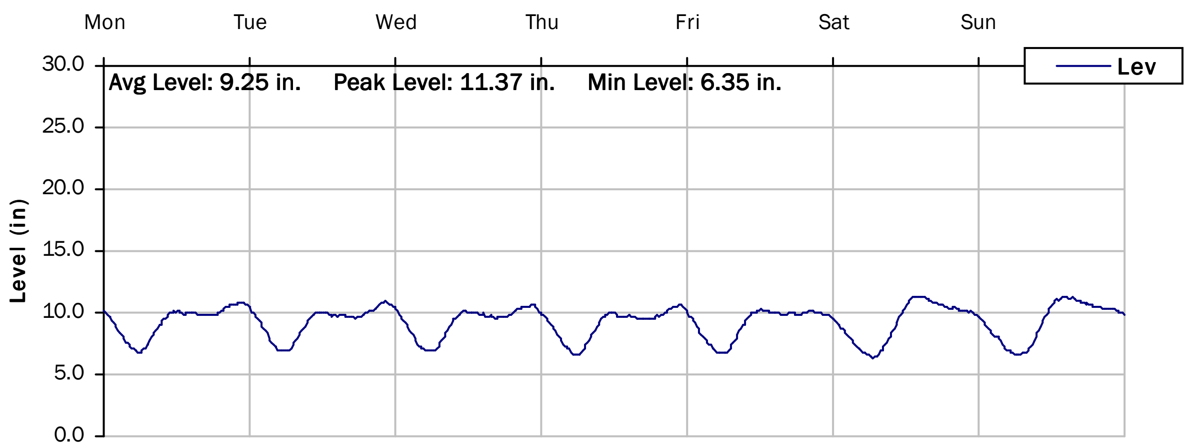


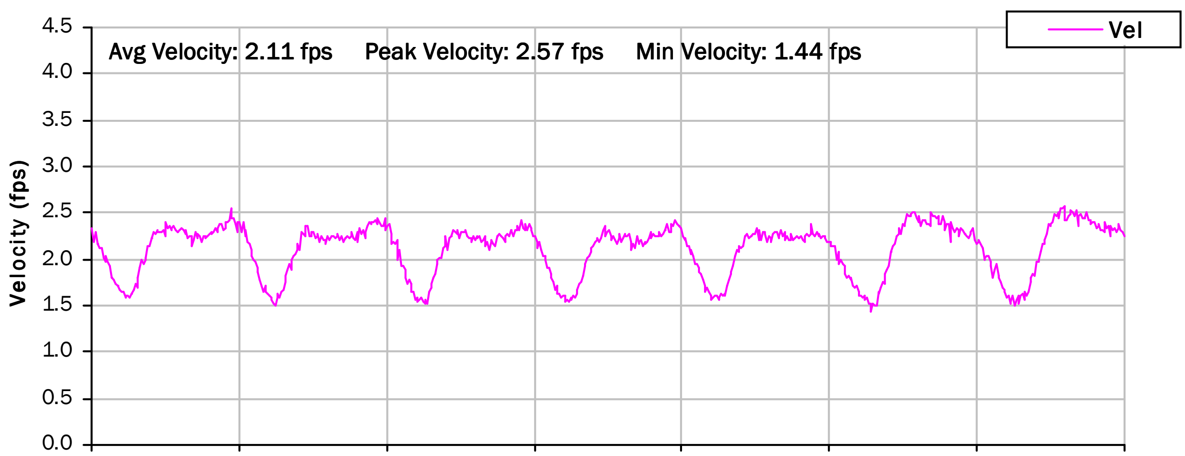
Avg Flow: 1.635 mgd Peak Flow: 2.680 mgd Min Flow: 0.702 mgd

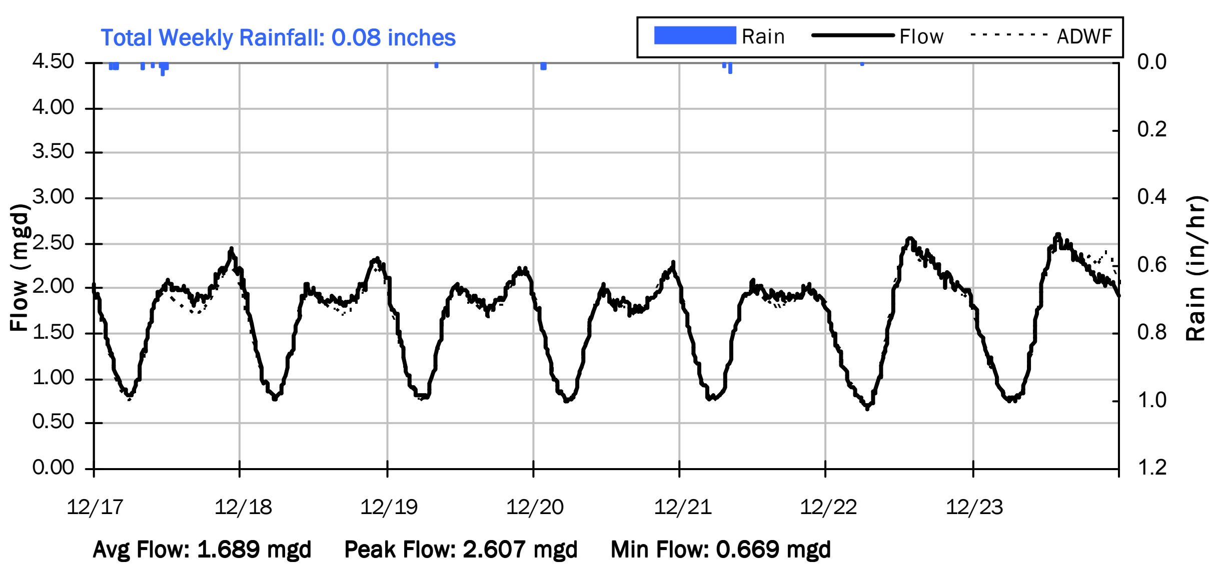
SITE 9

Weekly Level, Velocity and Flow Hydrographs

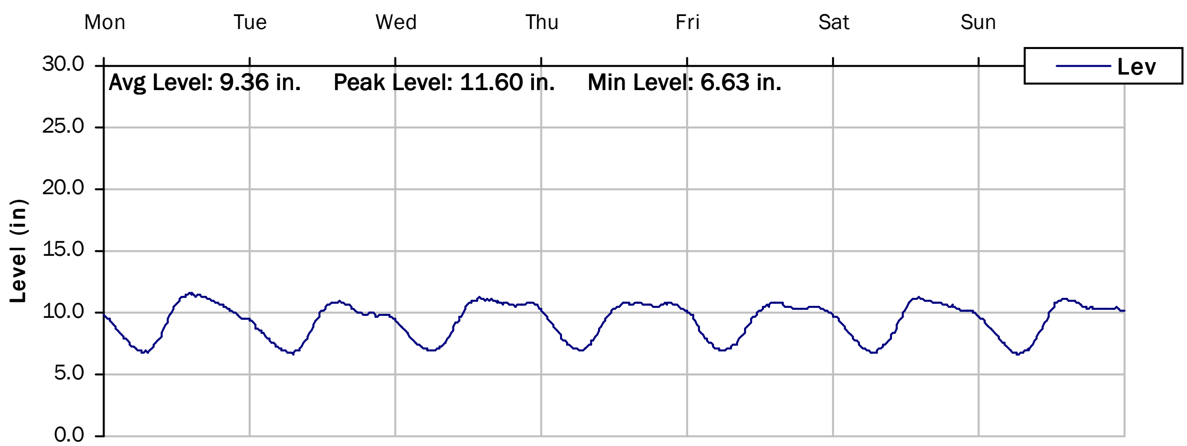
12/17/2018 to 12/24/2018

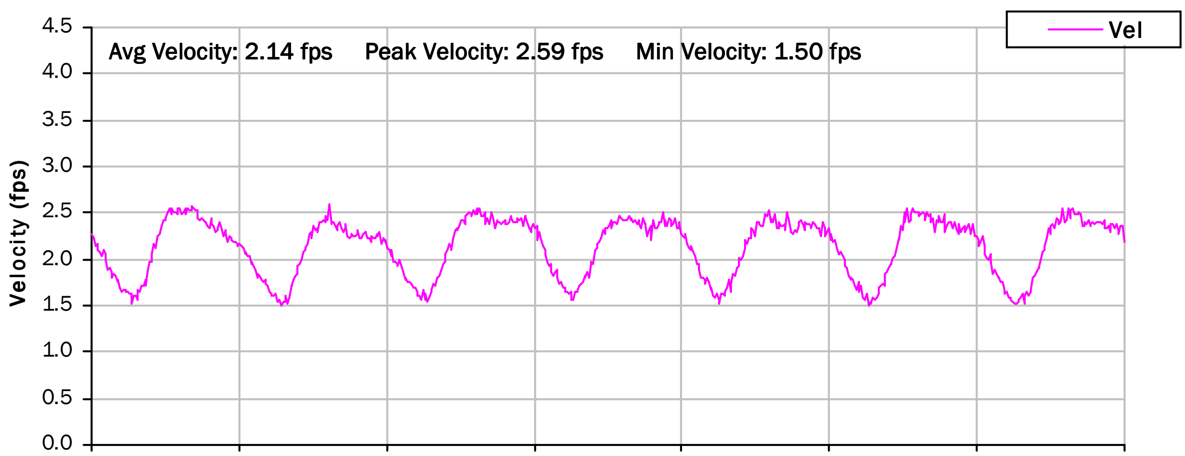


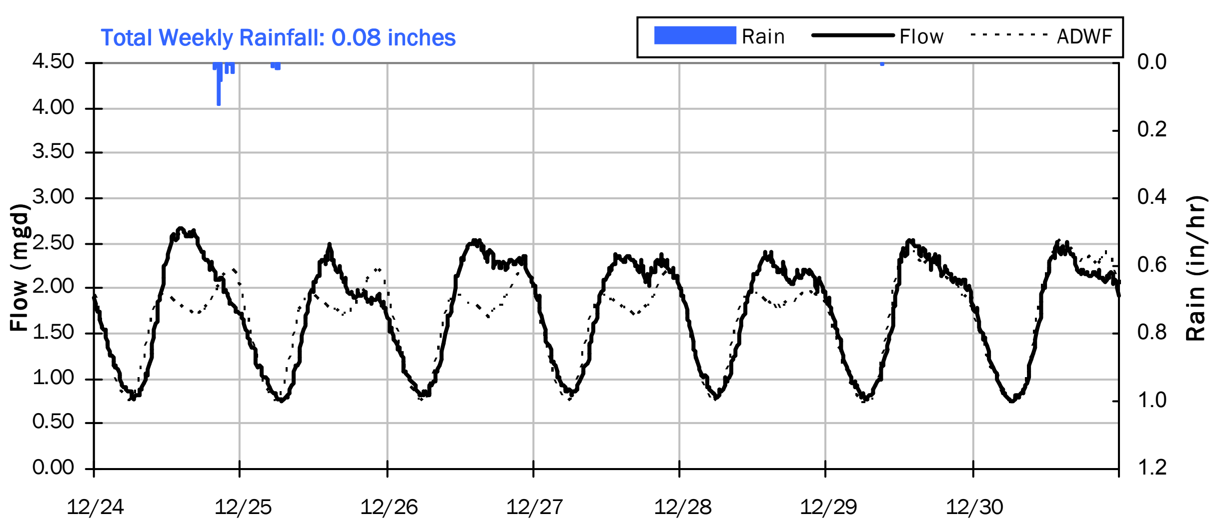




SITE 9
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018

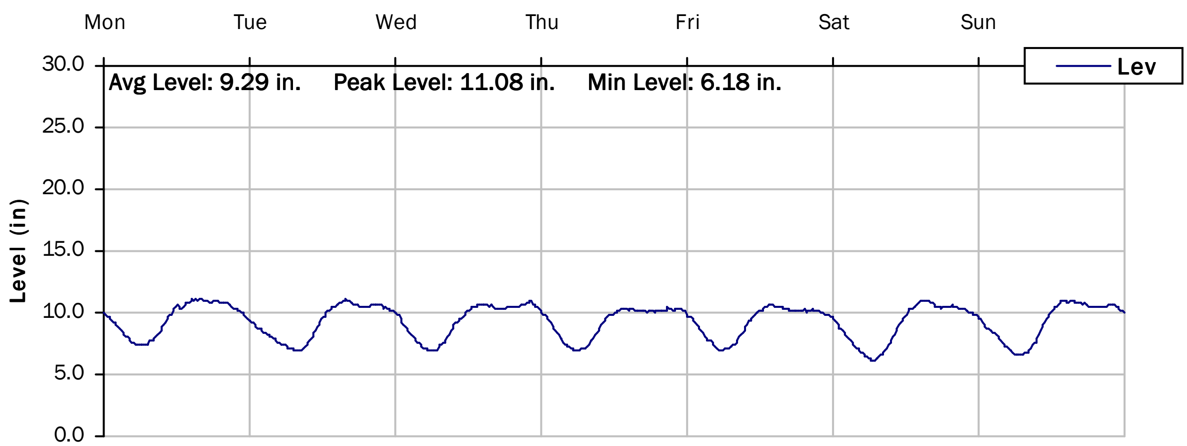


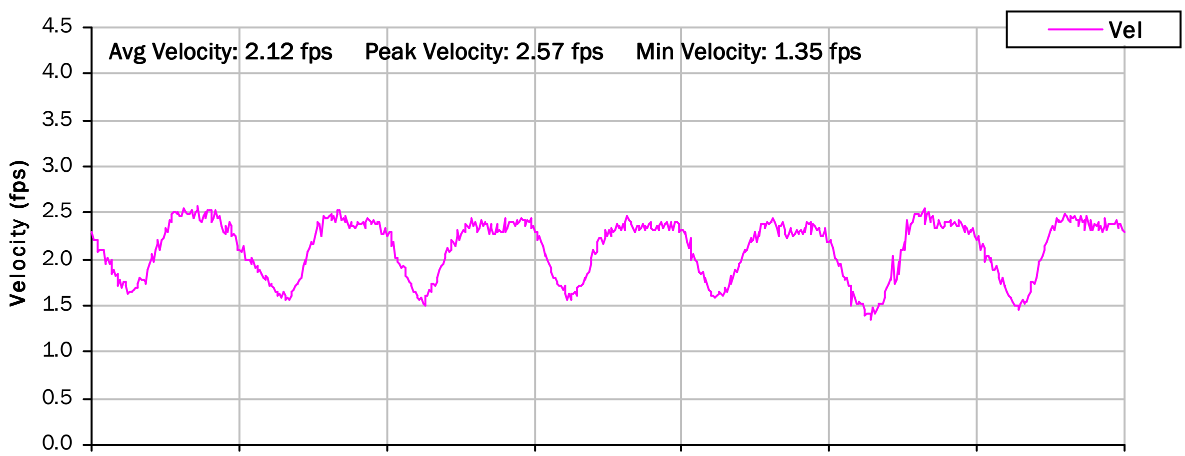


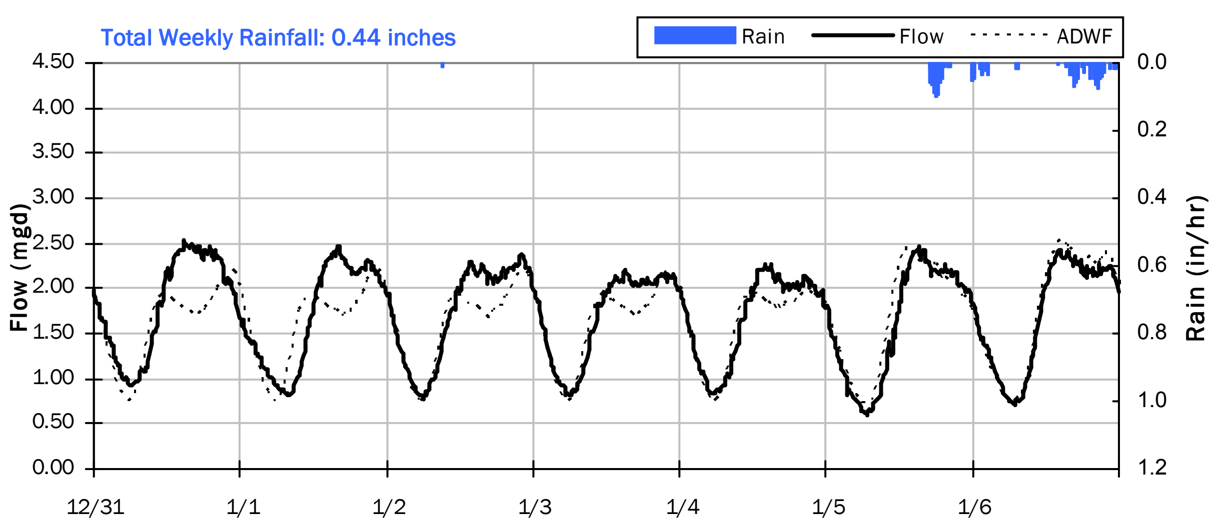


Avg Flow: 1.748 mgd Peak Flow: 2.677 mgd Min Flow: 0.757 mgd

SITE 9
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019

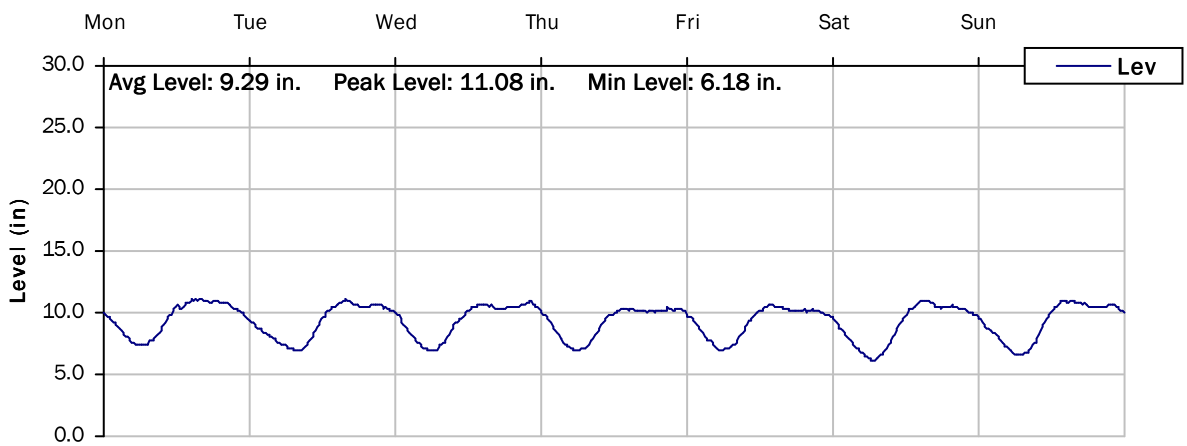


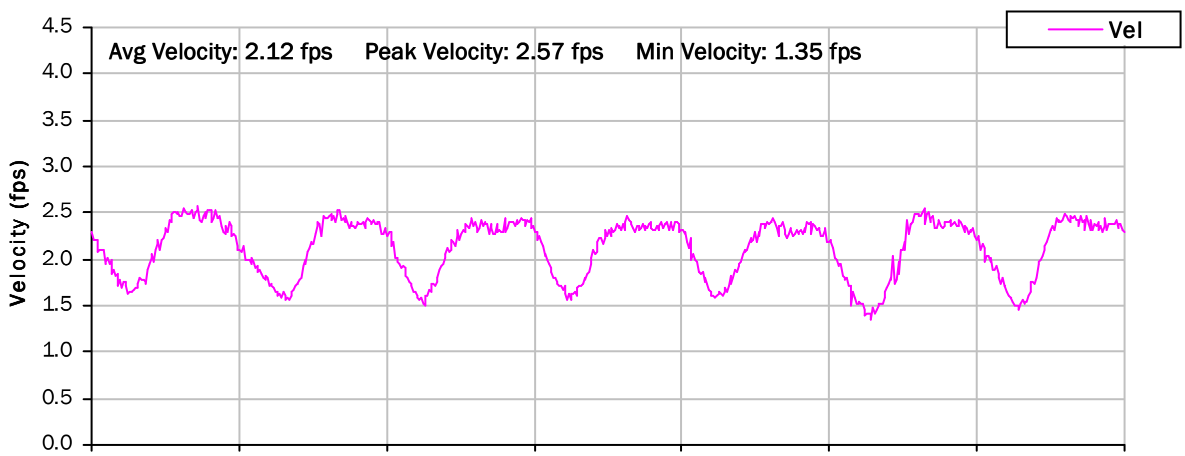


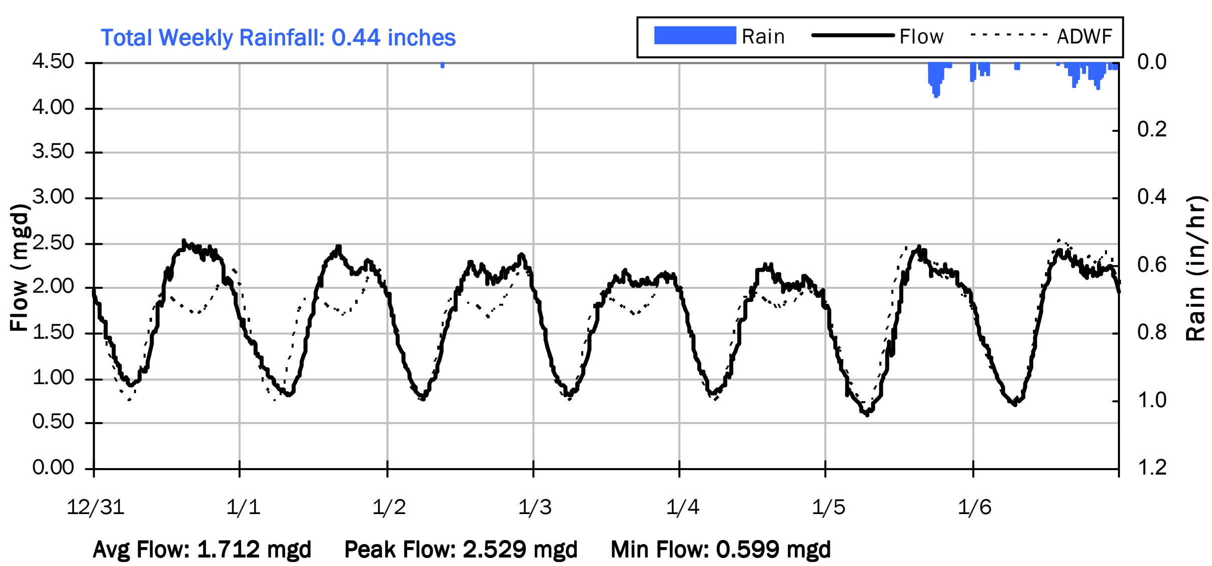


Avg Flow: 1.712 mgd Peak Flow: 2.529 mgd Min Flow: 0.599 mgd

SITE 9
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019







City of Visalia

Sanitary Sewer Flow Monitoring

November 28, 2018 - January 06, 2019

Monitoring Site: Site 10

Location: W Caldwell Ave & Rd 100

Data Summary Report

Vicinity Map: Site 10

SITE 10

Site Information

Location: W Caldwell Ave & Rd 100

Coordinates: 119.3472° W, 36.2983° N

Rim Elevation (Earth): 306 feet

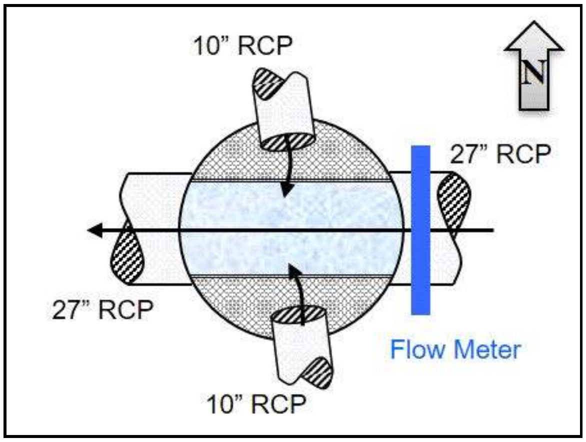
Pipe Diameter: 27 inches

ADWF: 0.723 mgd

Peak Measured Flow: 1.723 mgd

Satellite Map

Sewer Map



Flow Sketch

Street View

Plan View

SITE 10

Additional Site Photos

Effluent Pipe

East Influent Pipe

SITE 10

Additional Site Photos

North Influent Pipe

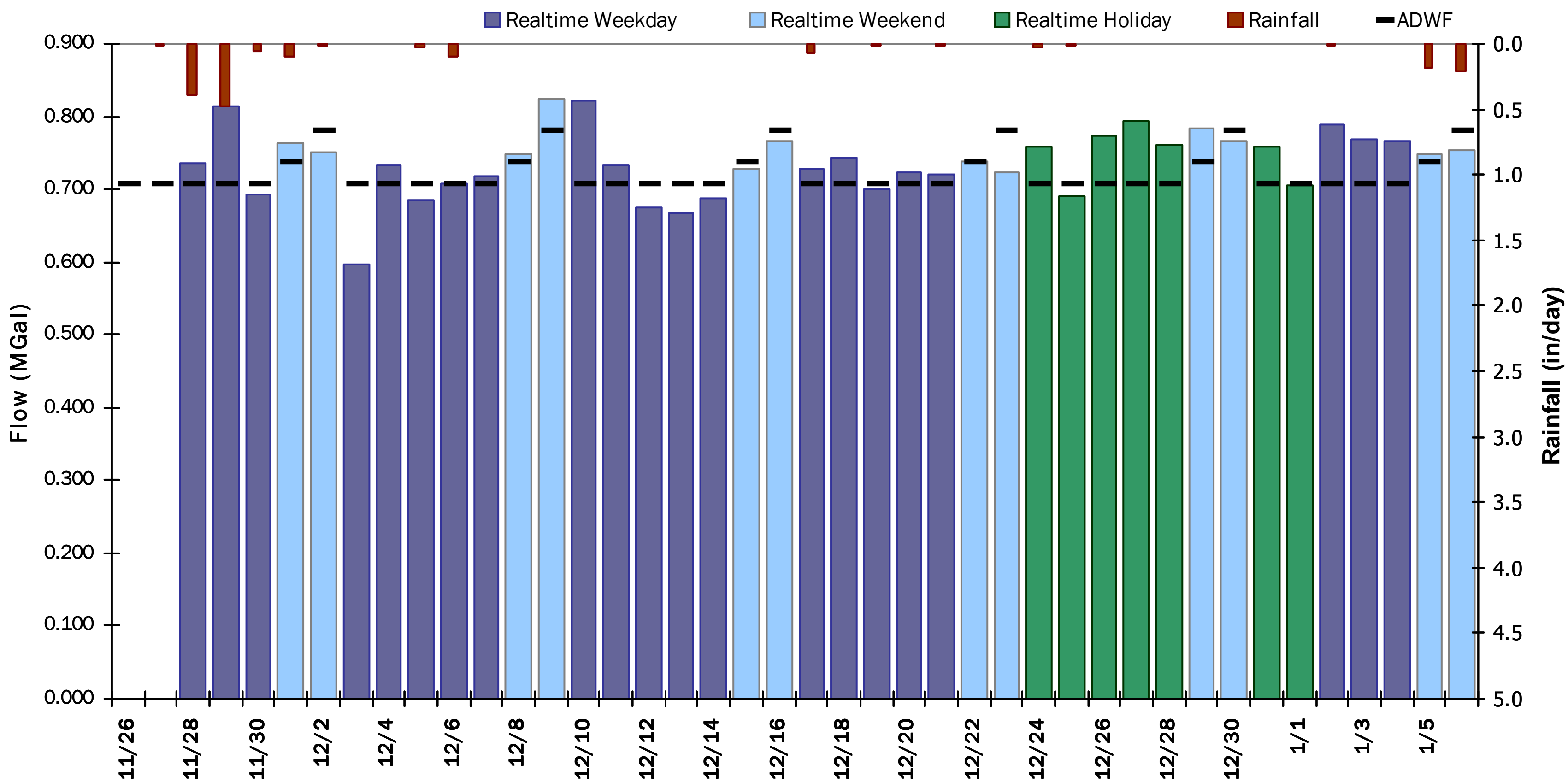
South Influent Pipe

SITE 10

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.739 MGal **Peak Daily Flow: 0.824 MGal** **Min Daily Flow: 0.597 MGal**

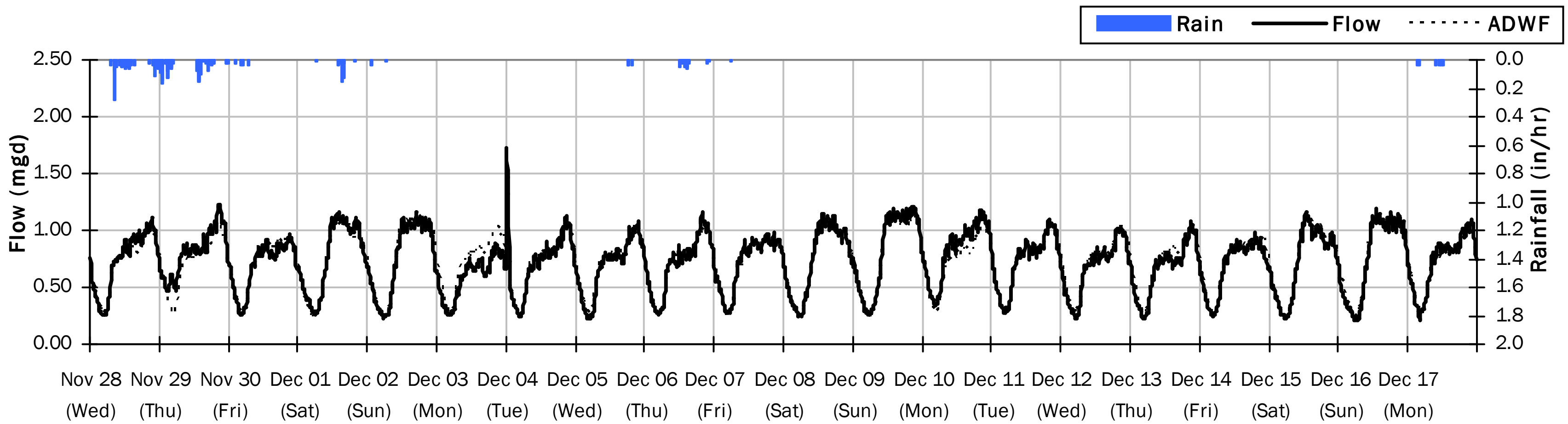
Total Period Rainfall: 1.72 inches

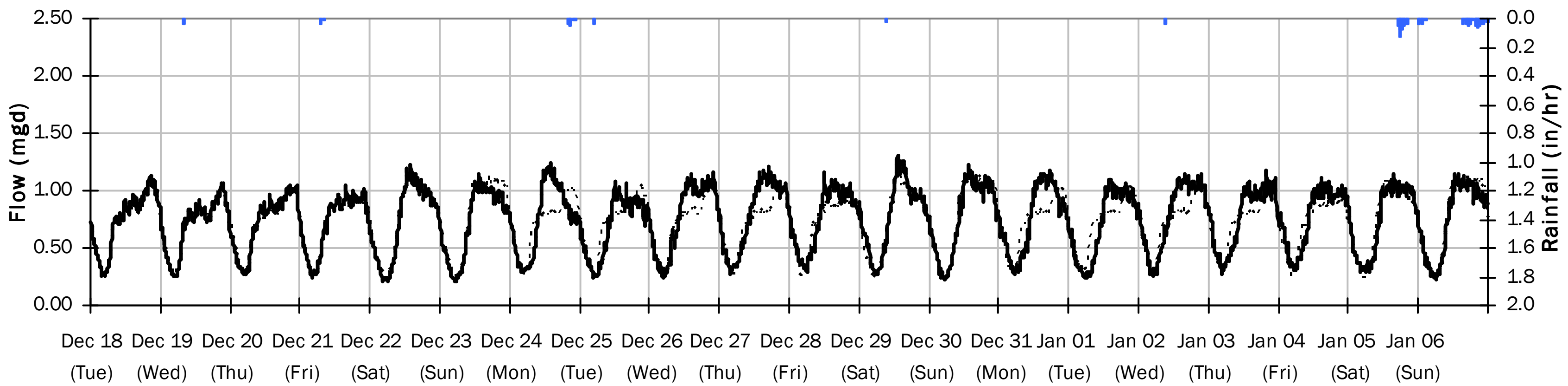


SITE 10

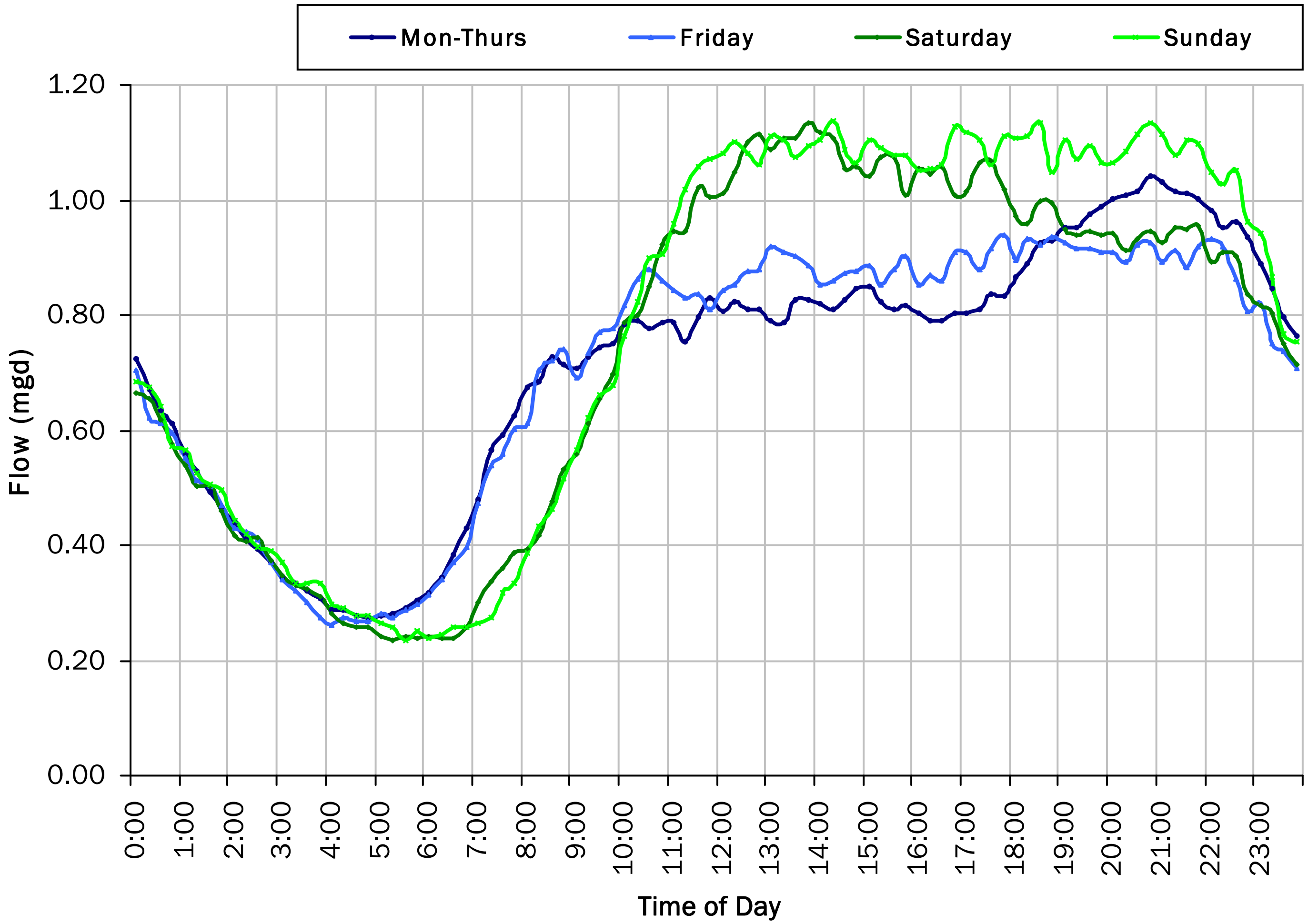
Flow Summary: 11/28/2018 to 1/6/2019

Total Period Rainfall: 1.72 inches   Avg Flow: 0.739 mgd   Peak Flow: 1.723 mgd   Min Flow: 0.205 mgd



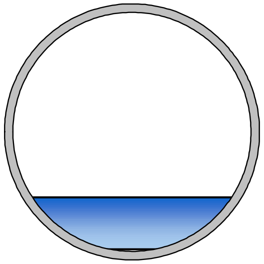


SITE 10
Average Dry Weather Flow Hydrographs



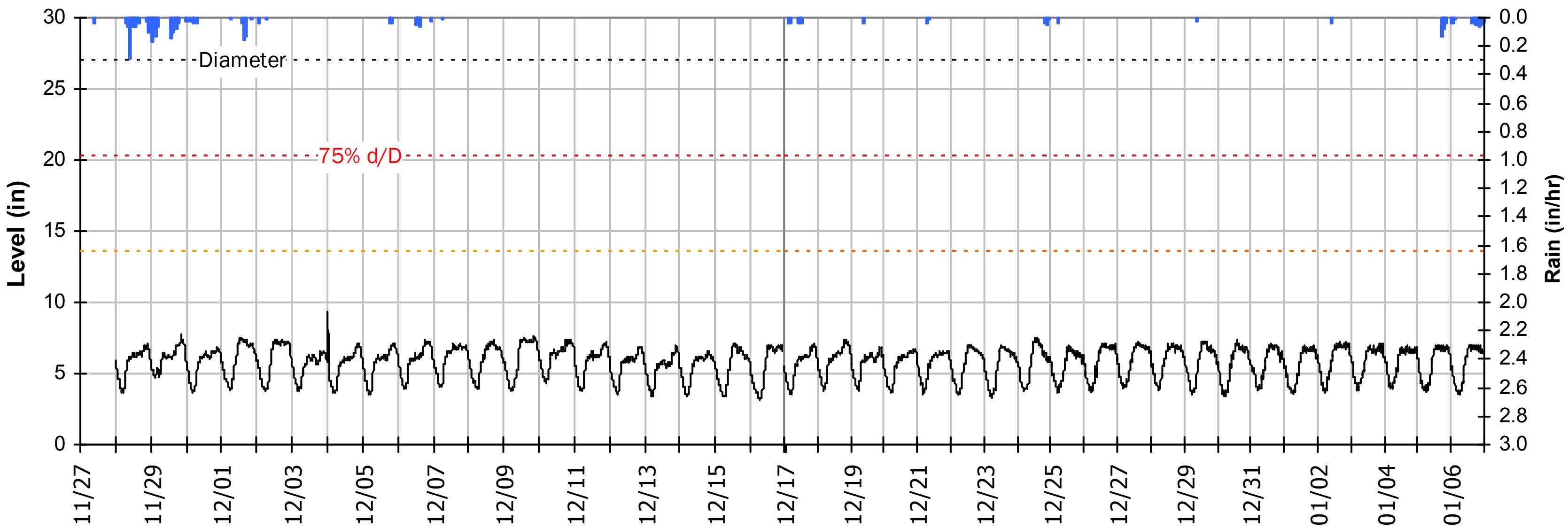
ADWF:

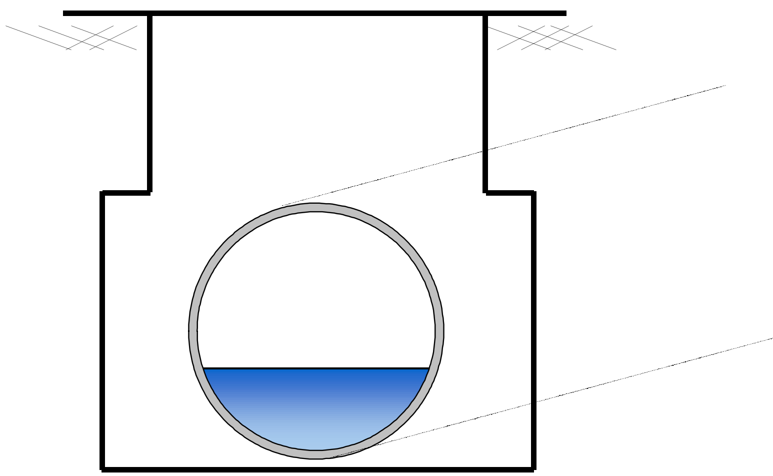
0.723 *mgd*



SITE 10
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

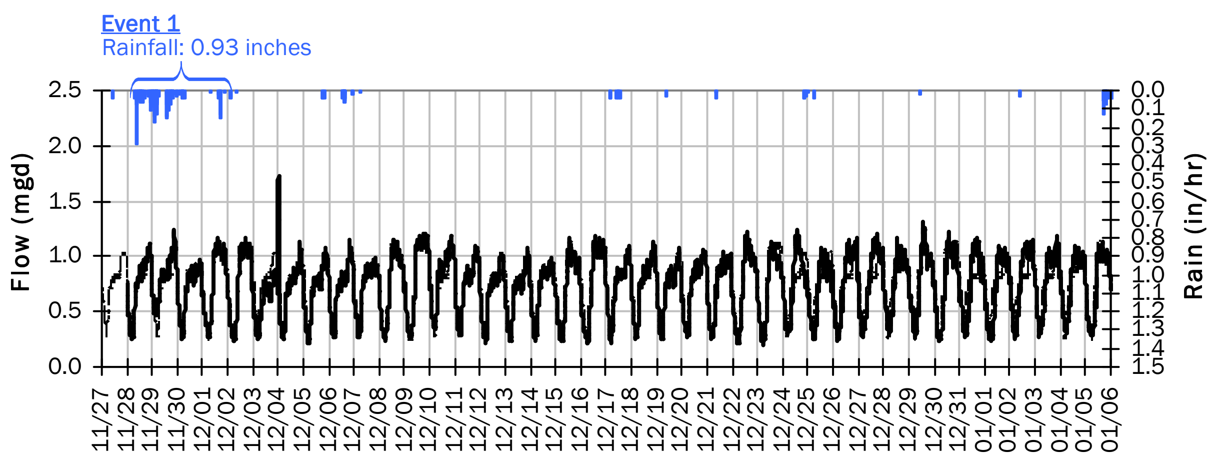




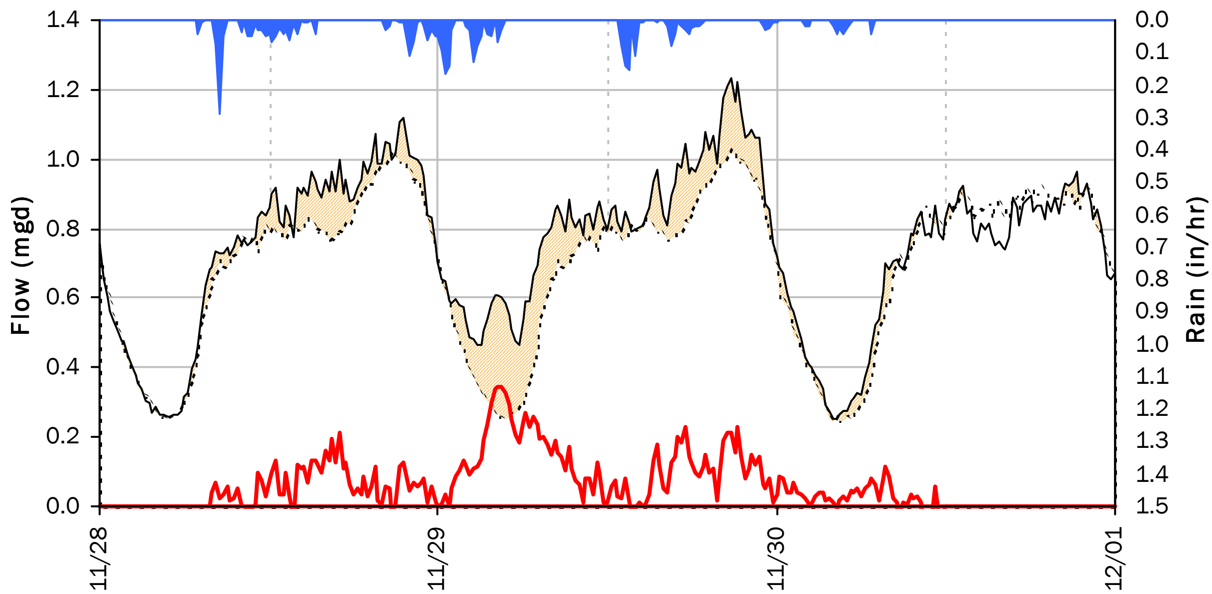
Pipe Diameter:	27	*inches*
Peak Measured Level:	9.38	*inches*
Peak d/D Ratio:	0.35	

SITE 10
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph

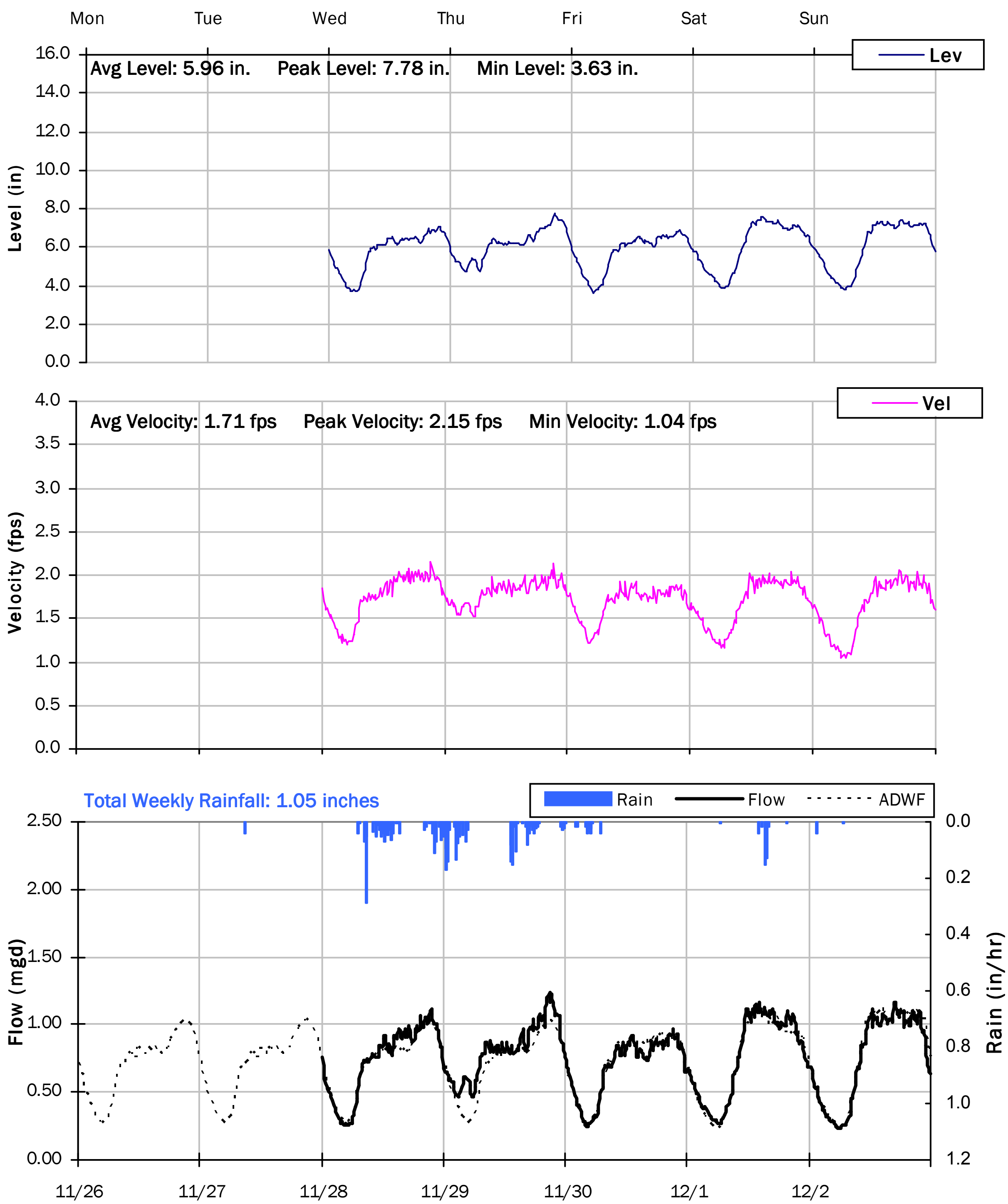


Storm Event I/I Analysis (Rain = 0.93 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	1.23 *mgd*	**Peak I/I Rate:**	0.35 *mgd*
PF:	1.71	**Total I/I:**	185,000 *gallons*
Peak Level:	7.78 *in*		
d/D Ratio:	0.29		

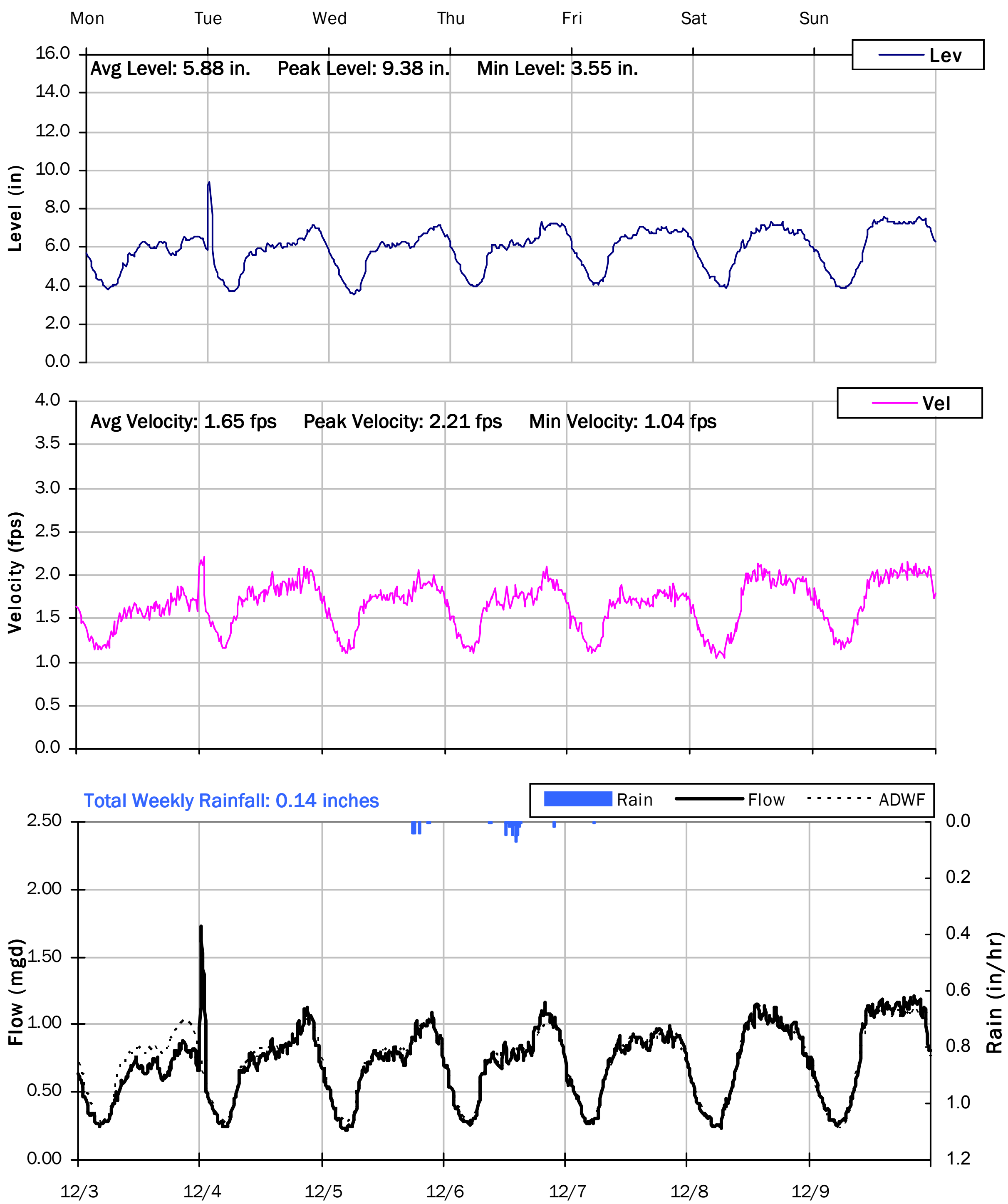
SITE 10

Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018



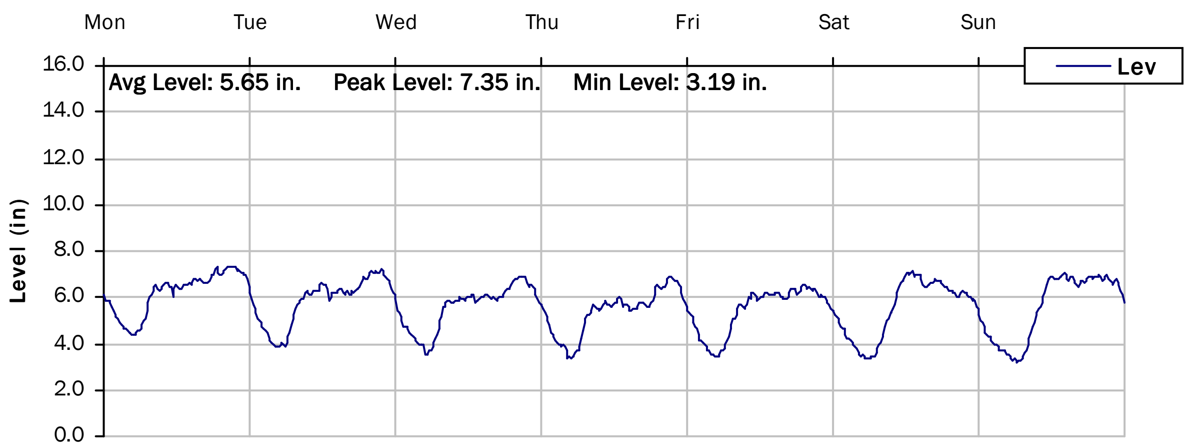
Avg Flow: 0.751 mgd Peak Flow: 1.233 mgd Min Flow: 0.232 mgd

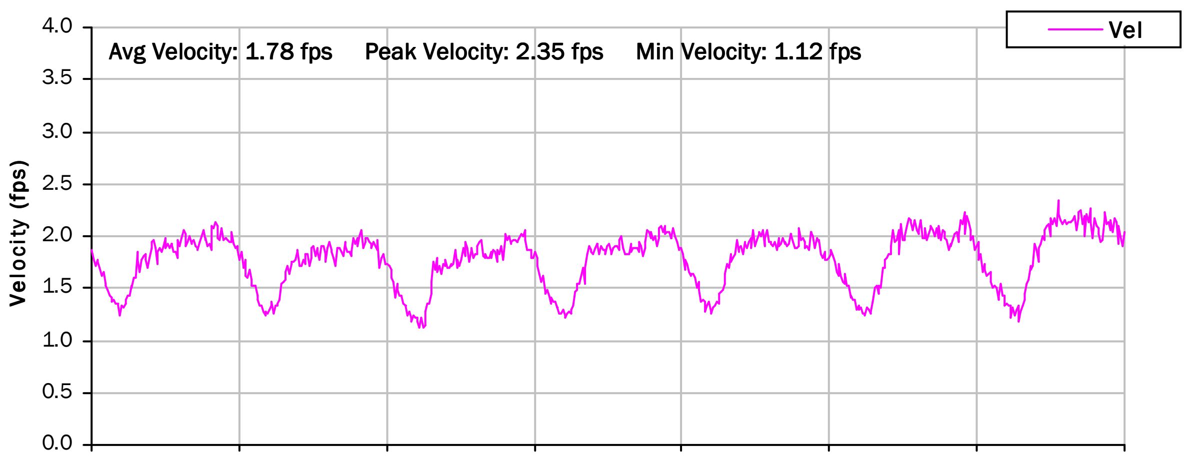
SITE 10
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018

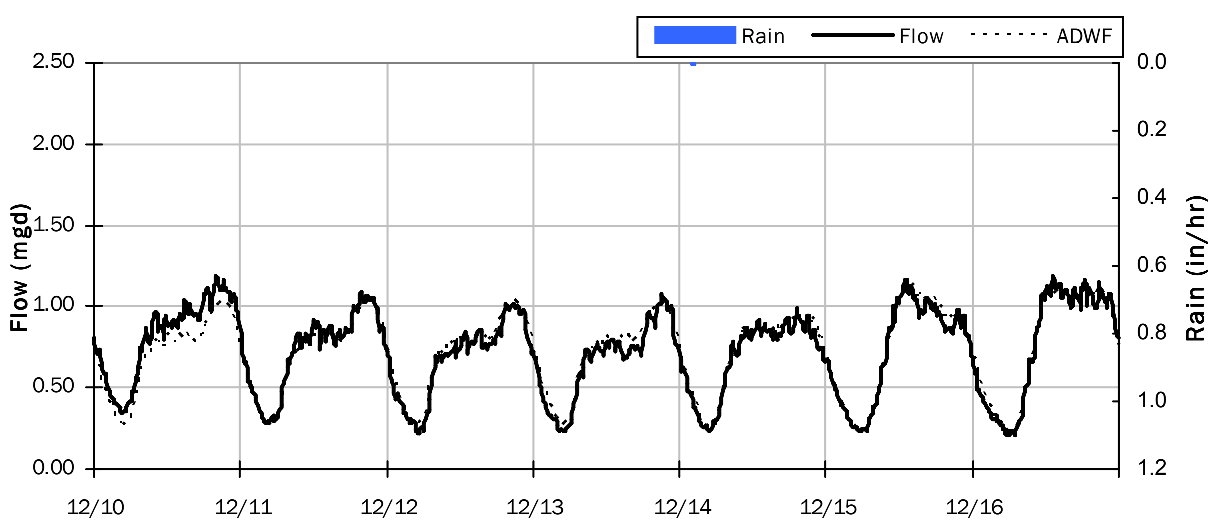


Avg Flow: 0.716 mgd **Peak Flow: 1.723 mgd** **Min Flow: 0.221 mgd**

SITE 10
Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018

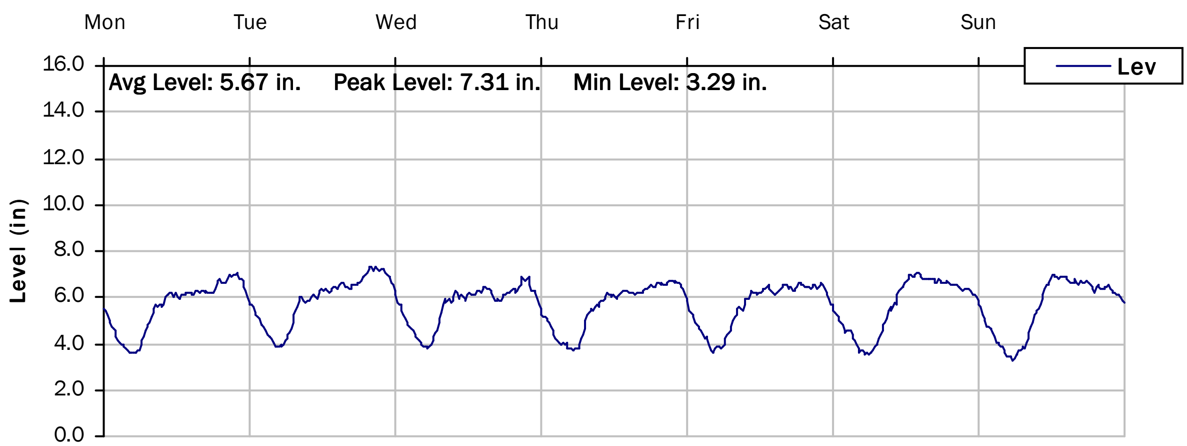


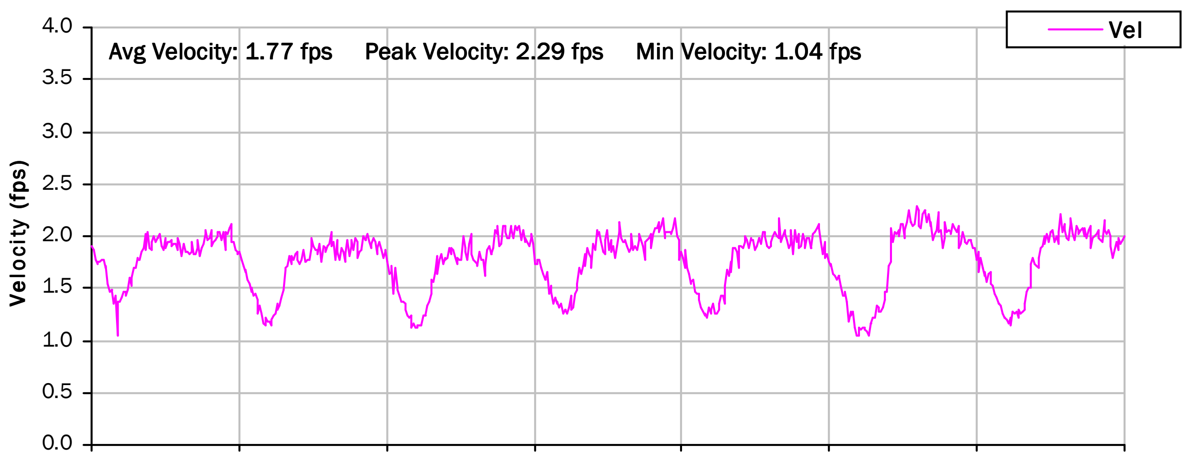


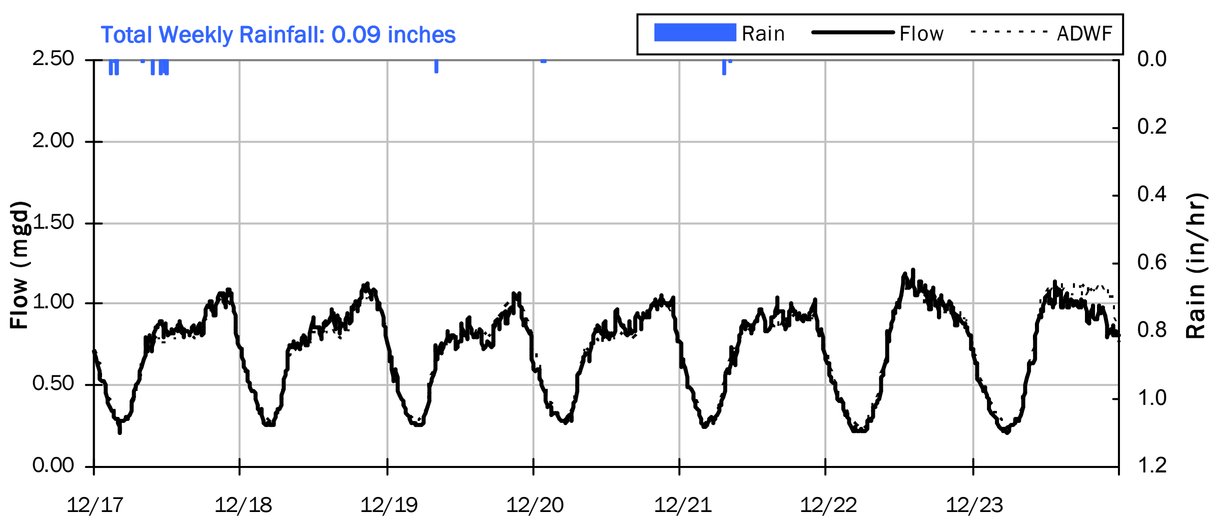


Avg Flow: 0.725 mgd **Peak Flow: 1.186 mgd** **Min Flow: 0.209 mgd**

SITE 10
Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018

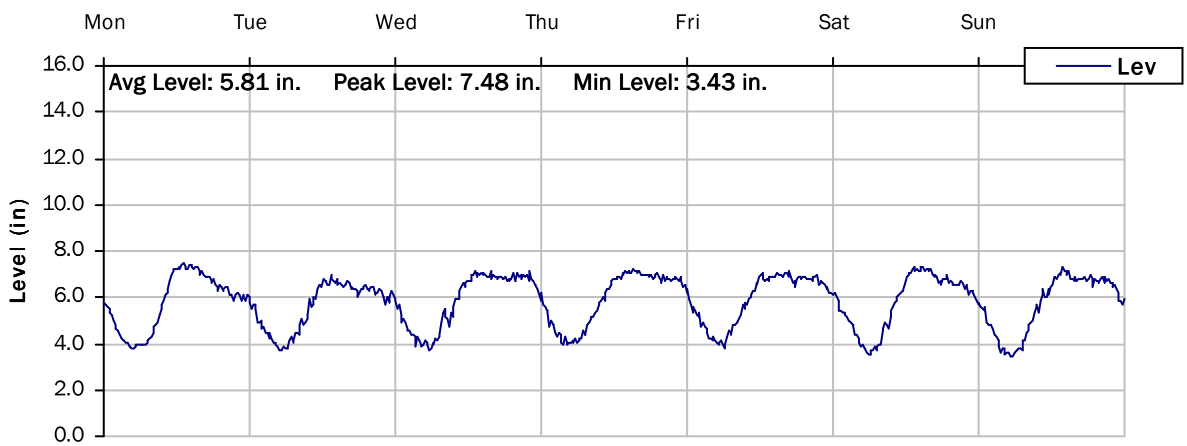


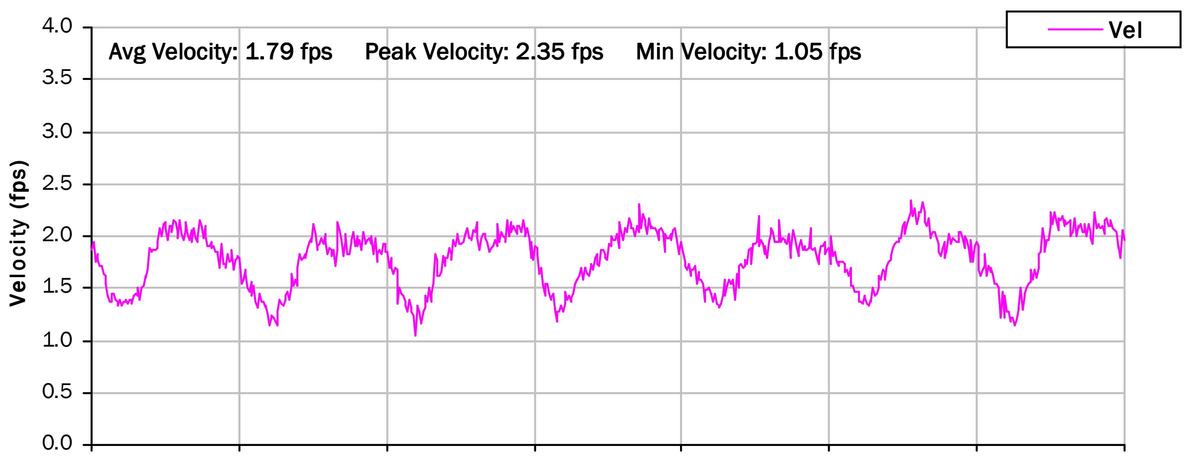


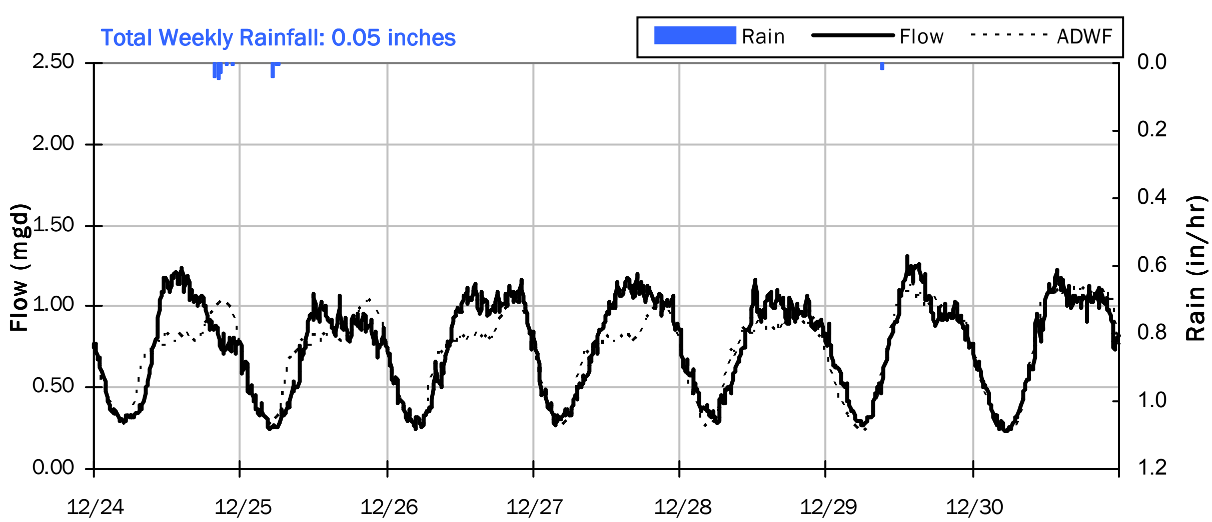


Avg Flow: 0.725 mgd   Peak Flow: 1.218 mgd   Min Flow: 0.205 mgd

SITE 10
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018

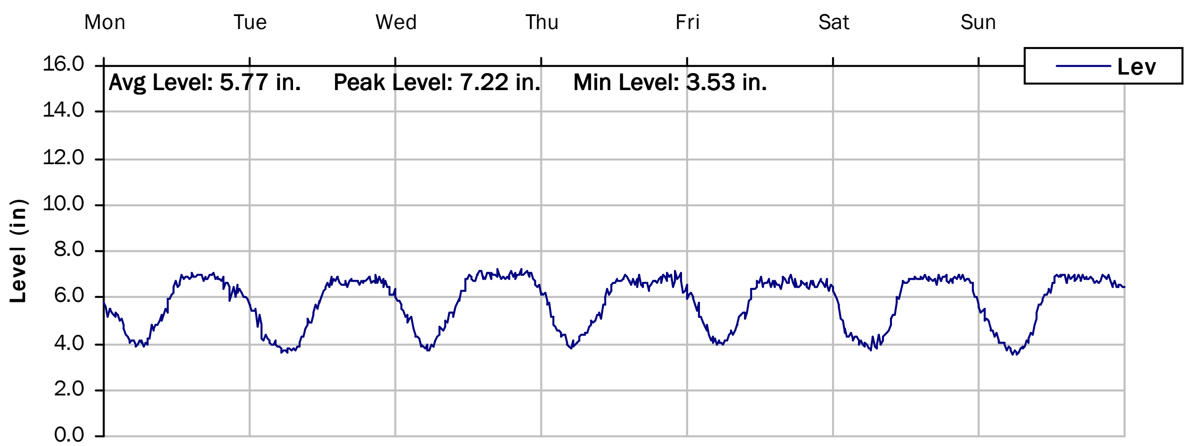


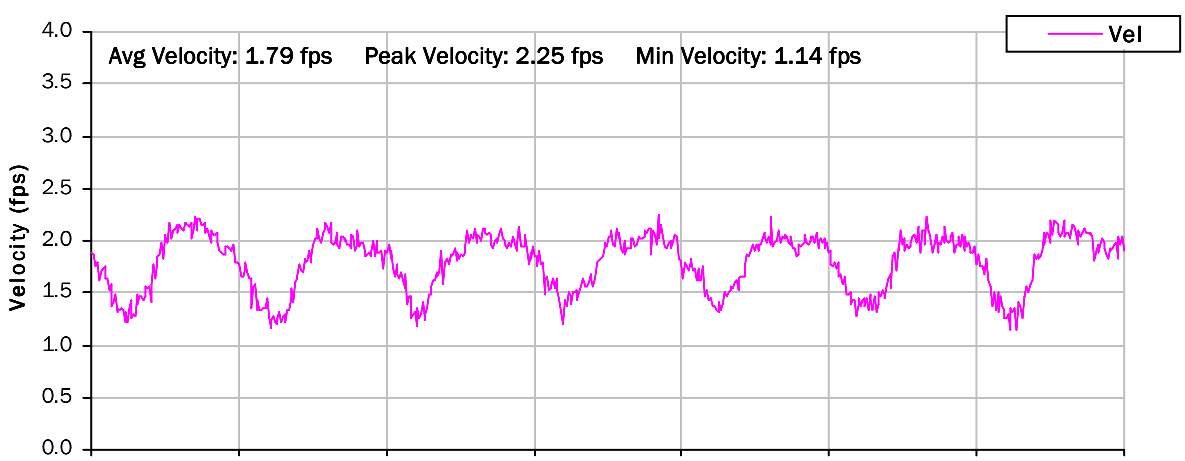


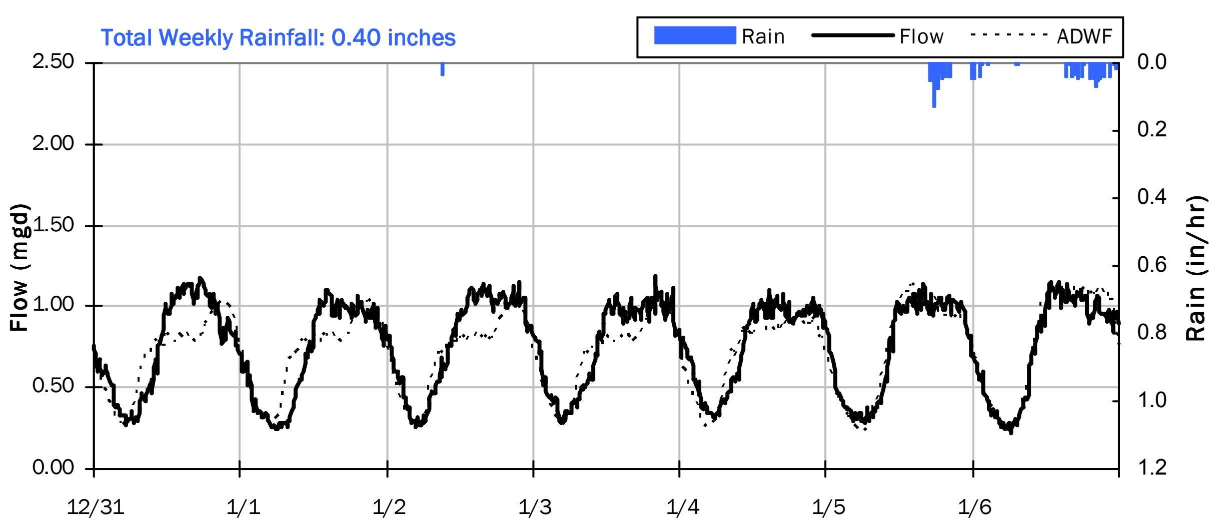


Avg Flow: 0.761 mgd **Peak Flow: 1.313 mgd** **Min Flow: 0.229 mgd**

SITE 10
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019

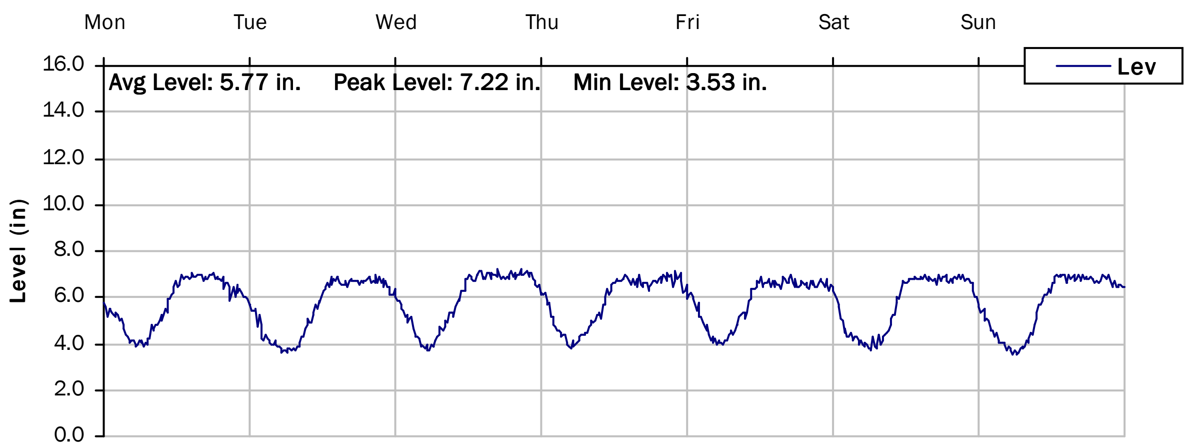


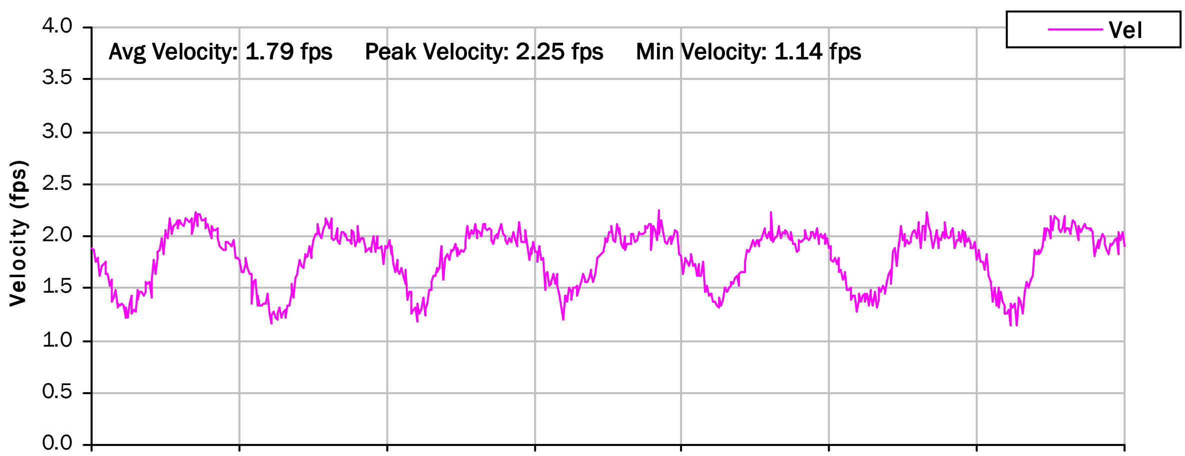


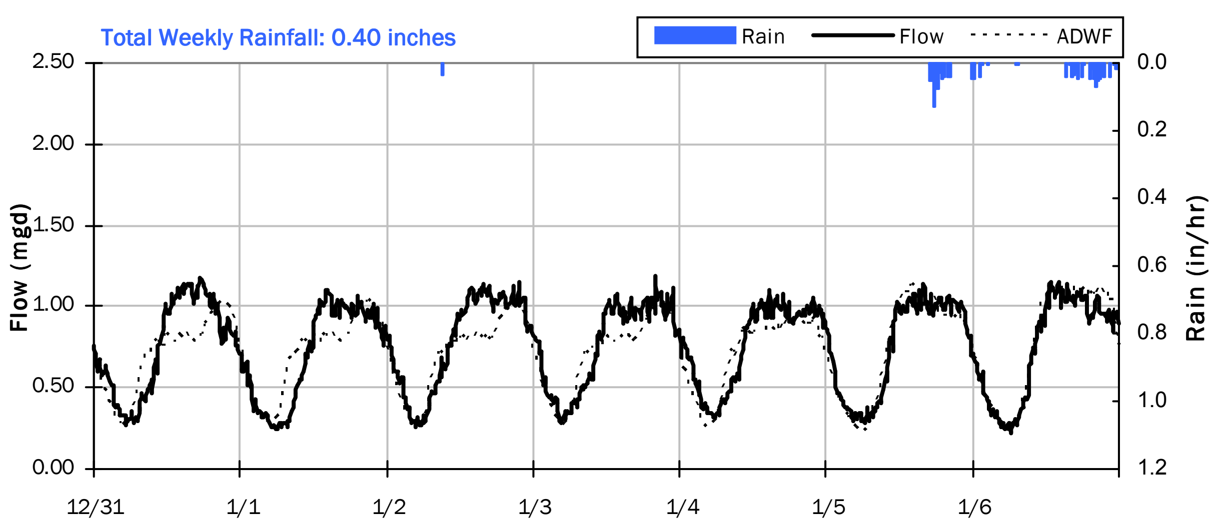


Avg Flow: 0.756 mgd **Peak Flow: 1.184 mgd** **Min Flow: 0.225 mgd**

SITE 10
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019







Avg Flow: 0.756 mgd Peak Flow: 1.184 mgd Min Flow: 0.225 mgd

City of Visalia

Sanitary Sewer Flow Monitoring

November 28, 2018 - January 06, 2019

Monitoring Site: Site 11

Location: W Mineral King Ave, w/o S Woodland Dr

Data Summary Report

Vicinity Map: Site 11

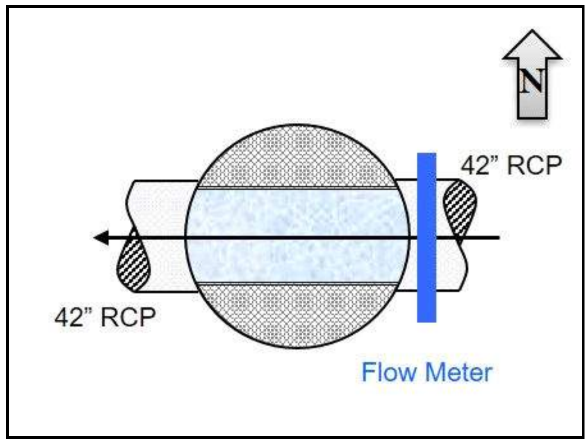
SITE 11

Site Information

Location:	W Mineral King Ave, w/o S Woodland Dr
Coordinates:	119.3198° W, 36.3277° N
Rim Elevation (Earth):	321 feet
Pipe Diameter:	42 inches
ADWF:	1.393 mgd
Peak Measured Flow:	2.394 mgd

Satellite Map

Sewer Map



Flow Sketch

Street View

Plan View

SITE 11

Additional Site Photos

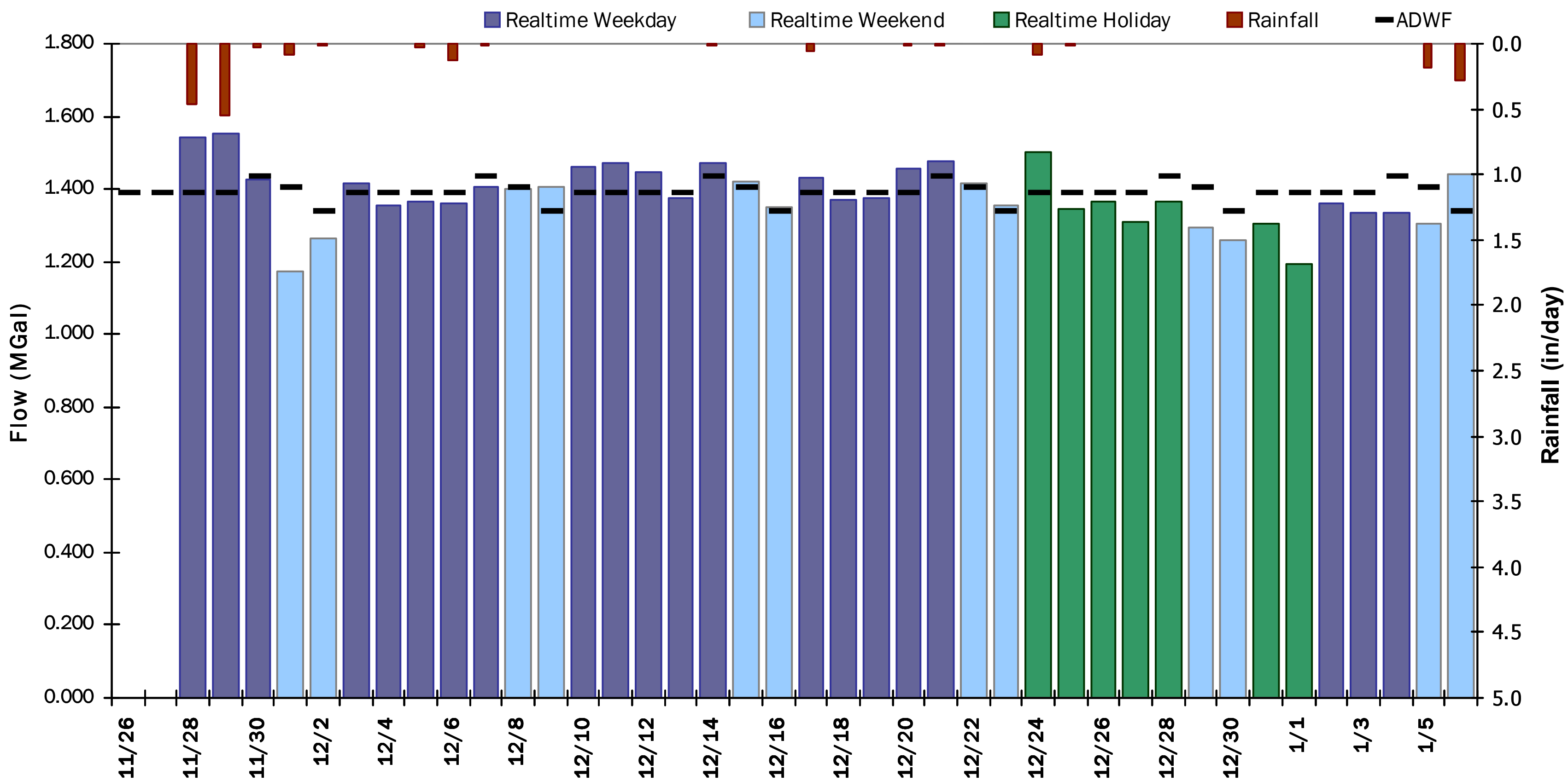
Effluent Pipe

Influent Pipe

SITE 11
Period Flow Summary: Daily Flow Totals

Avg Period Flow: 1.381 MGal **Peak Daily Flow: 1.551 MGal** **Min Daily Flow: 1.175 MGal**

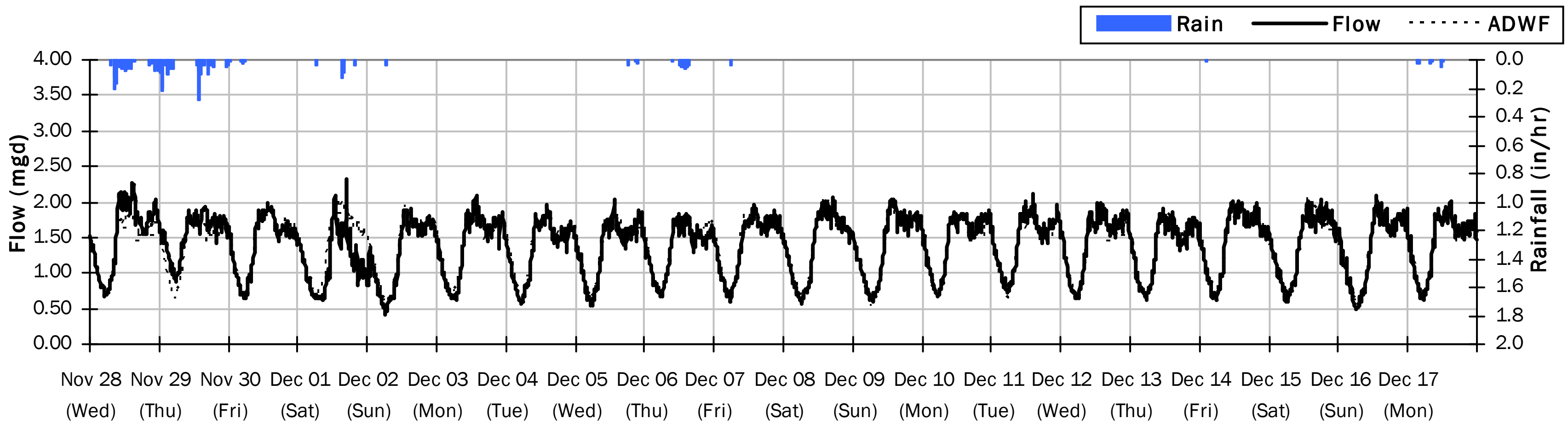
Total Period Rainfall: 1.95 inches

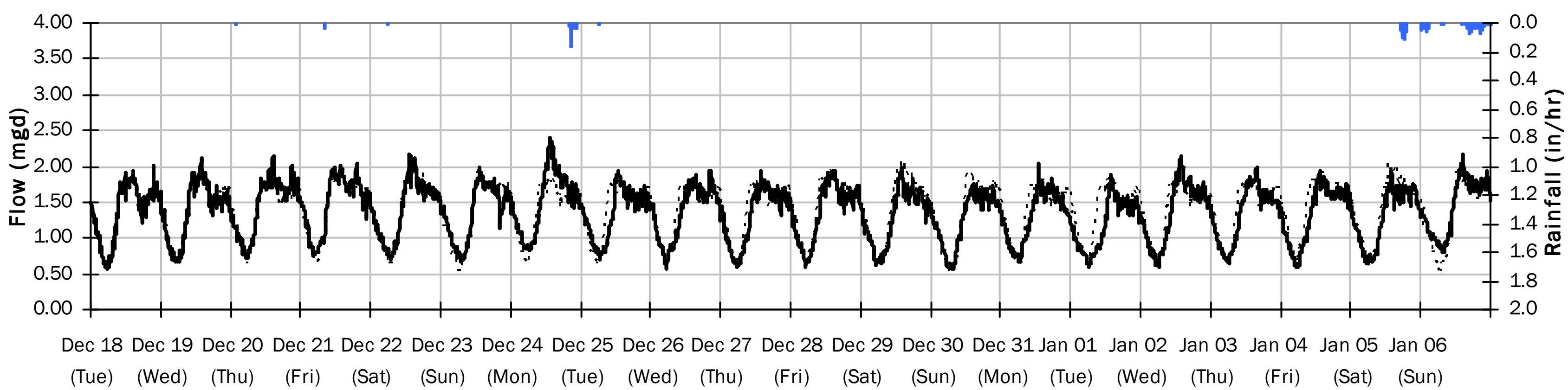


SITE 11

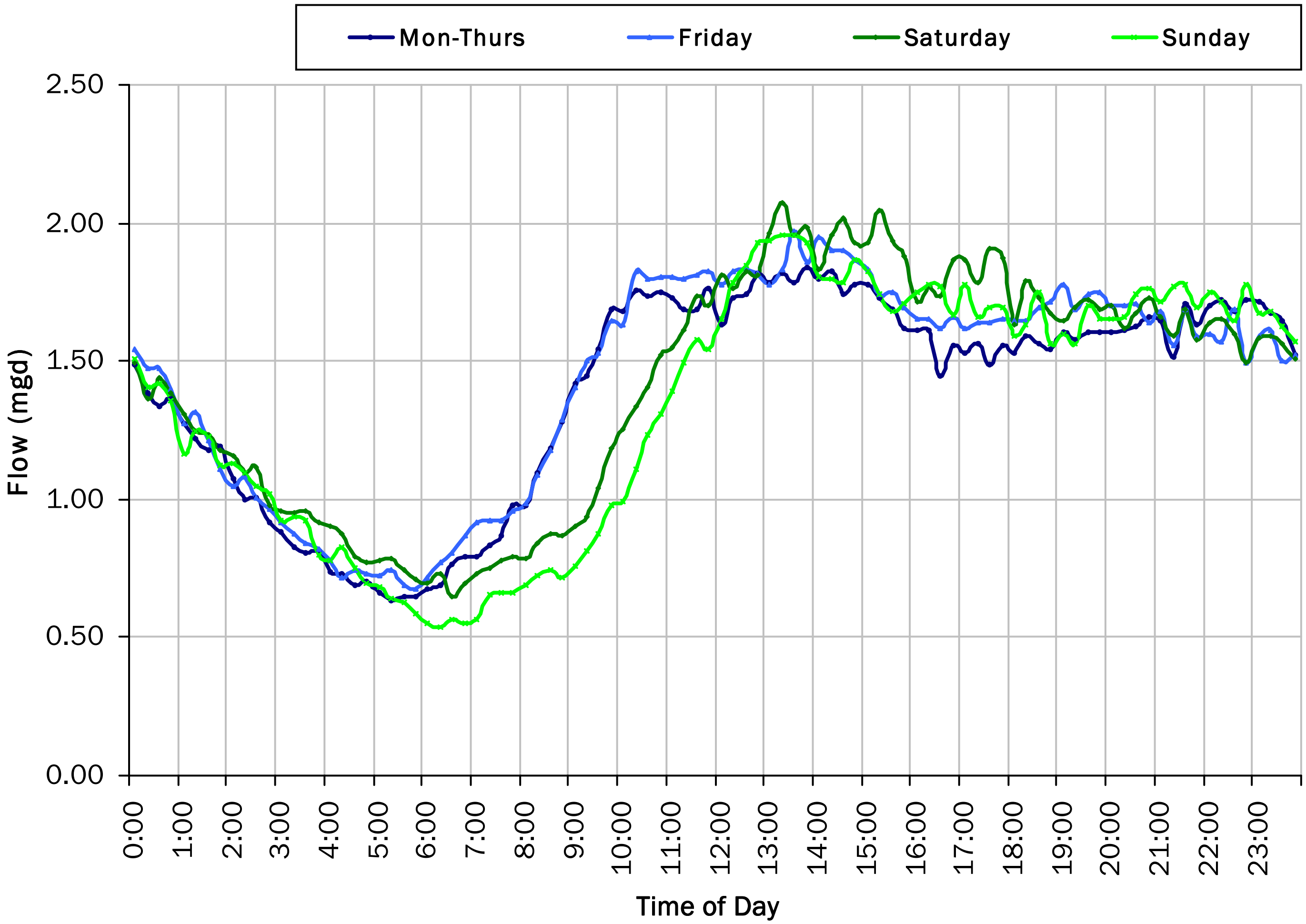
Flow Summary: 11/28/2018 to 1/6/2019

Total Period Rainfall: 1.95 inches   **Avg Flow: 1.381 mgd   Peak Flow: 2.394 mgd   Min Flow: 0.425 mgd**



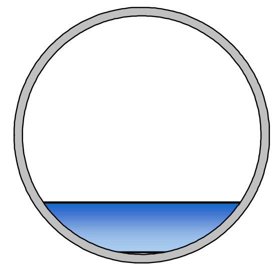


SITE 11
Average Dry Weather Flow Hydrographs



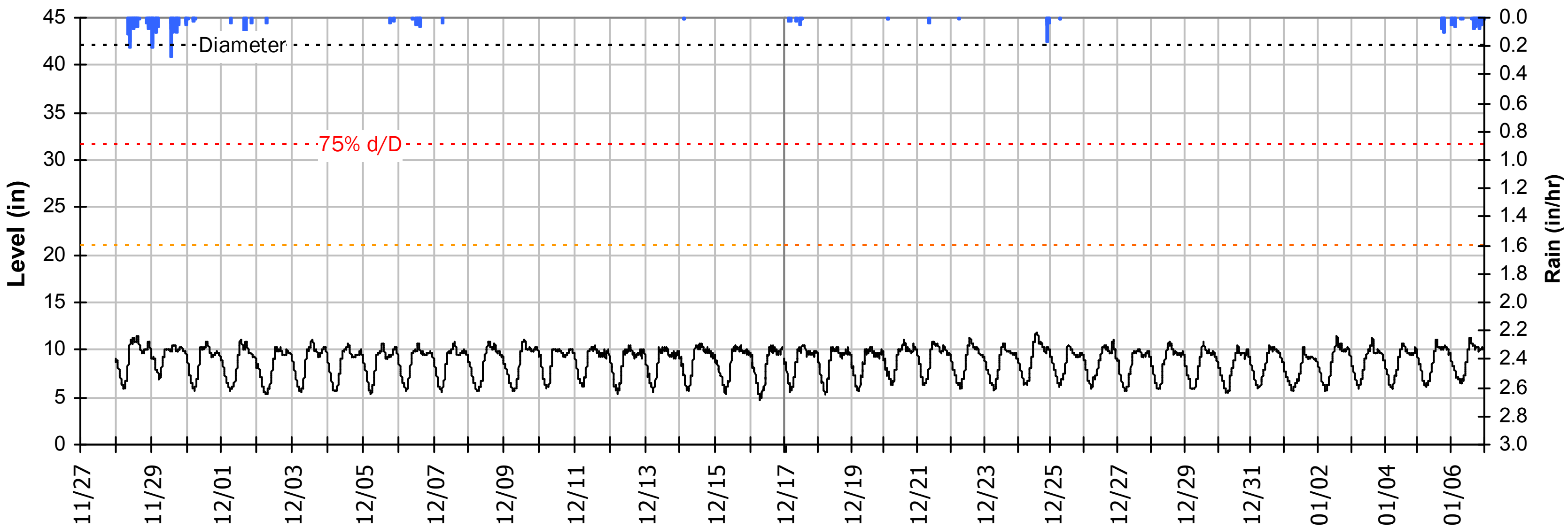
ADWF:

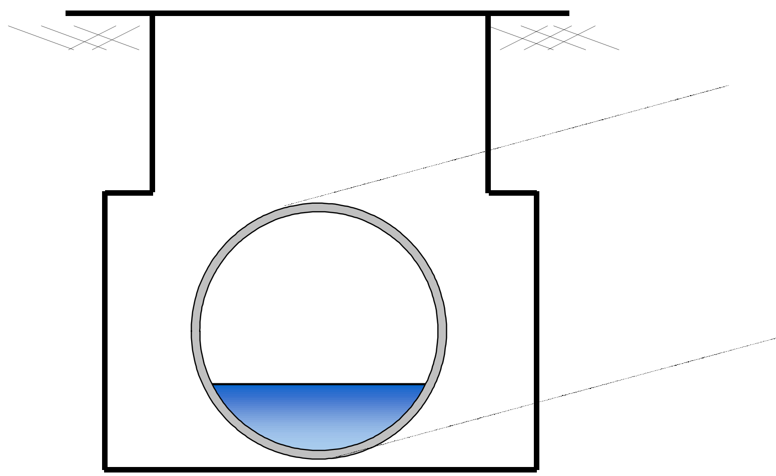
1.393 *mgd*



SITE 11
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



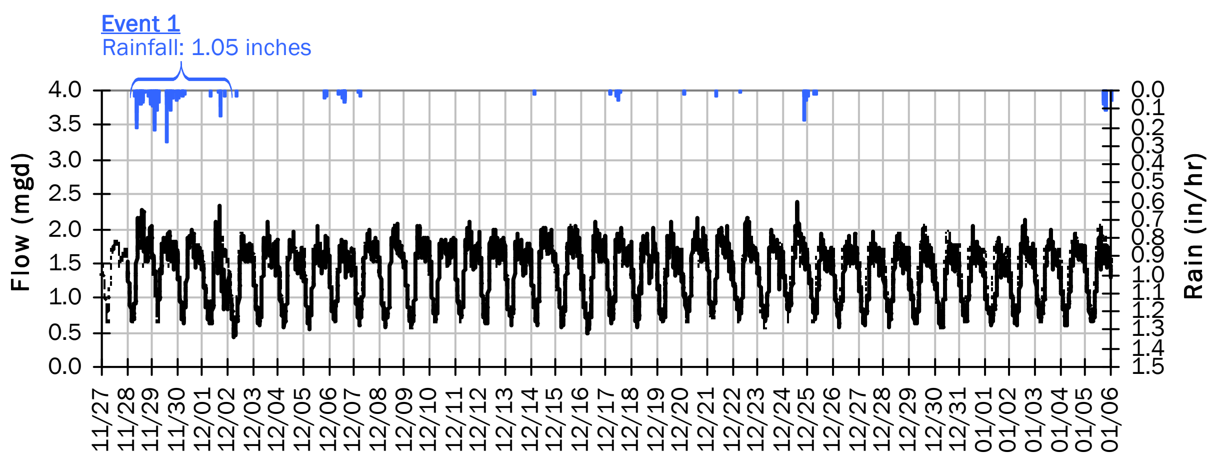


Pipe Diameter:	42	*inches*
Peak Measured Level:	11.9	*inches*
Peak d/D Ratio:	0.28	

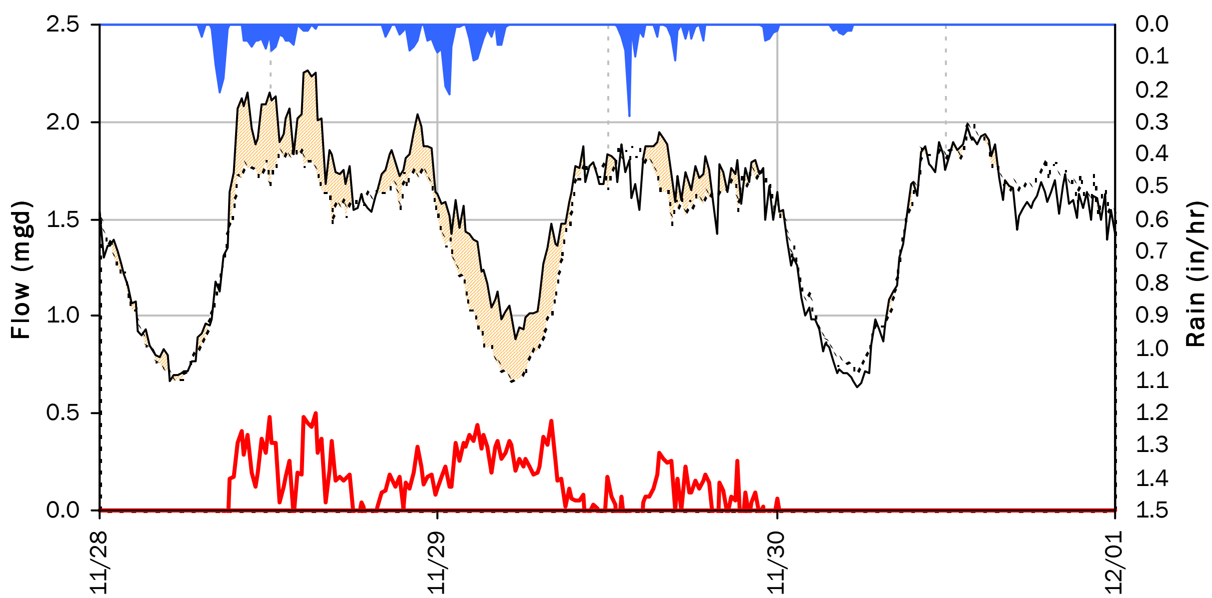
SITE 11

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



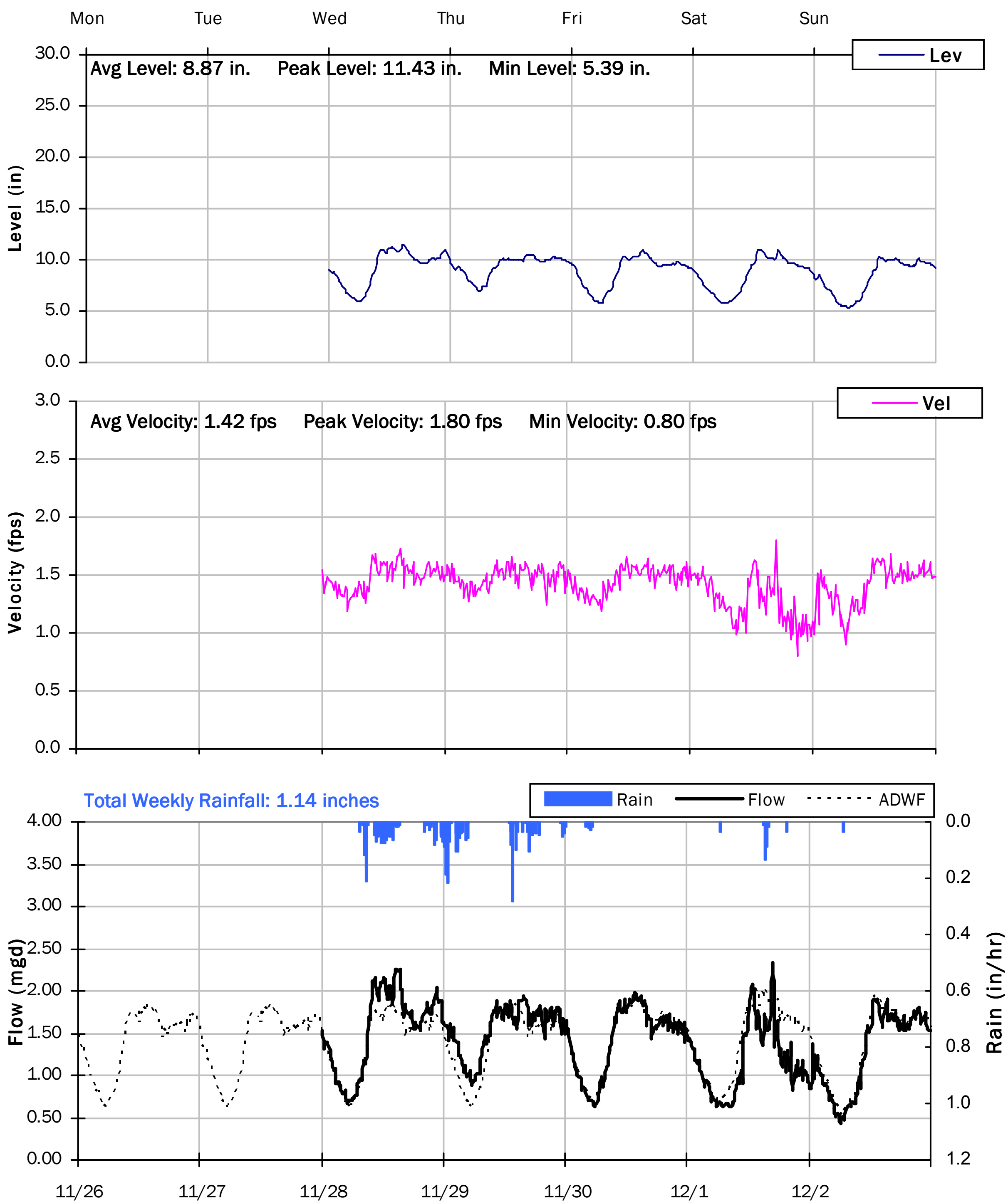
Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 1.05 inches)

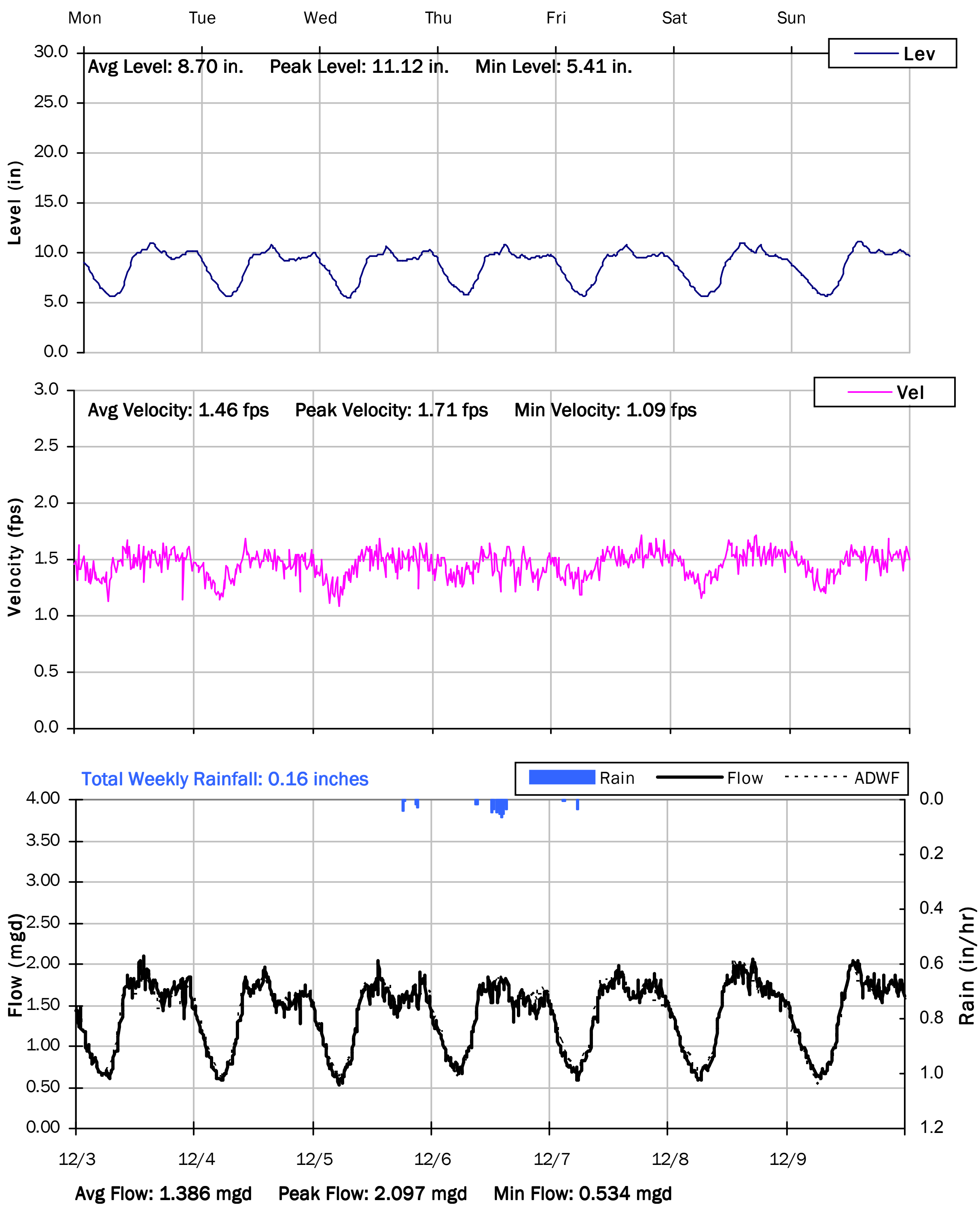
Capacity		Inflow / Infiltration	
Peak Flow:	2.26 *mgd*	**Peak I/I Rate:**	0.50 *mgd*
PF:	1.62	**Total I/I:**	248,000 *gallons*
Peak Level:	11.43 *in*		
d/D Ratio:	0.27		

SITE 11
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018

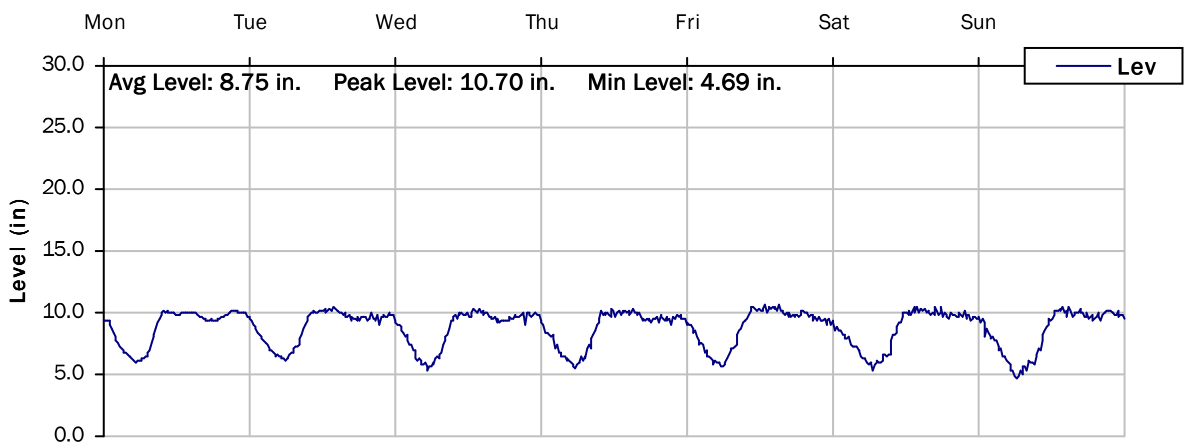


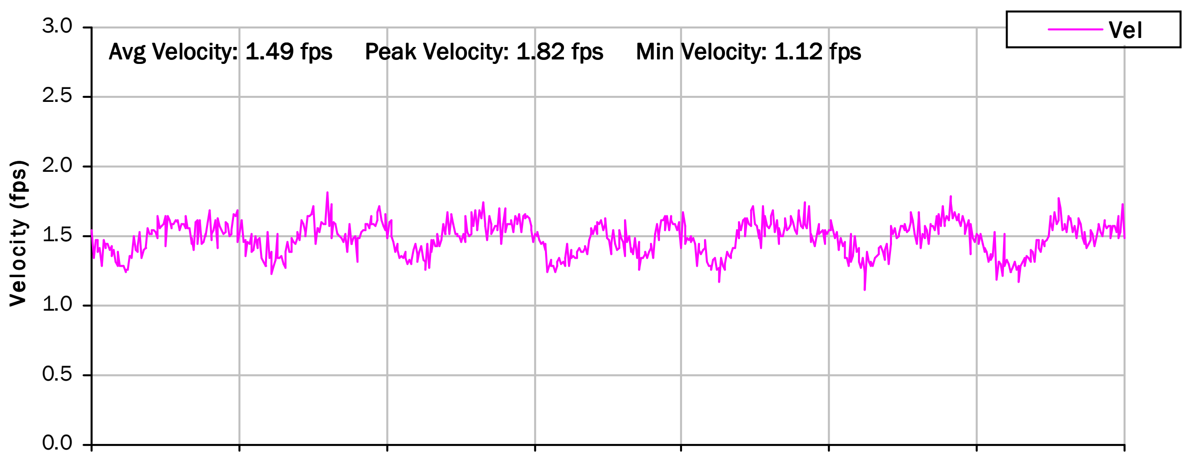
Avg Flow: 1.392 mgd Peak Flow: 2.328 mgd Min Flow: 0.425 mgd

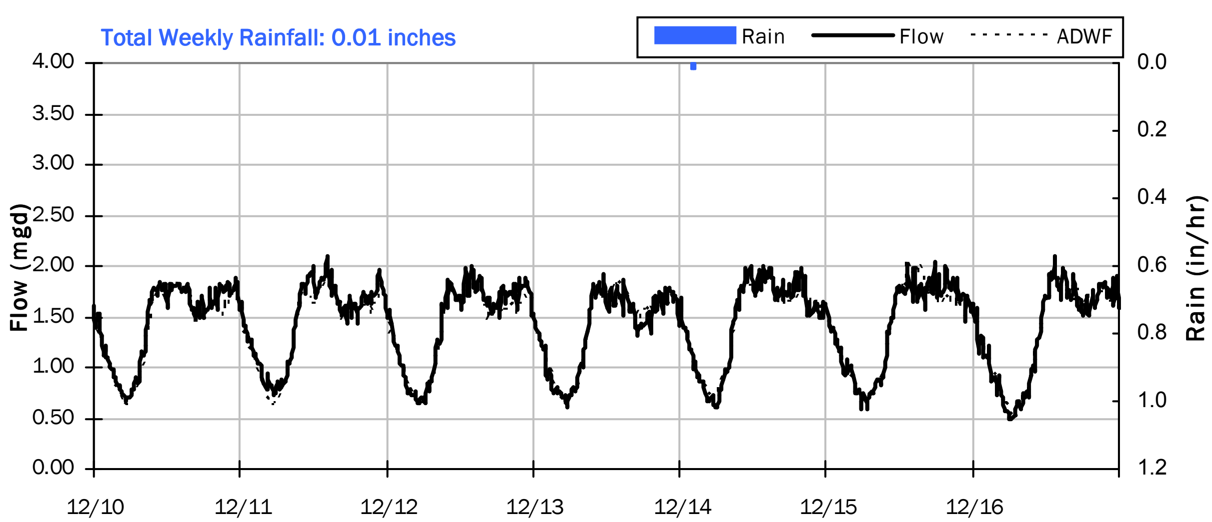
SITE 11
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018



SITE 11
Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018

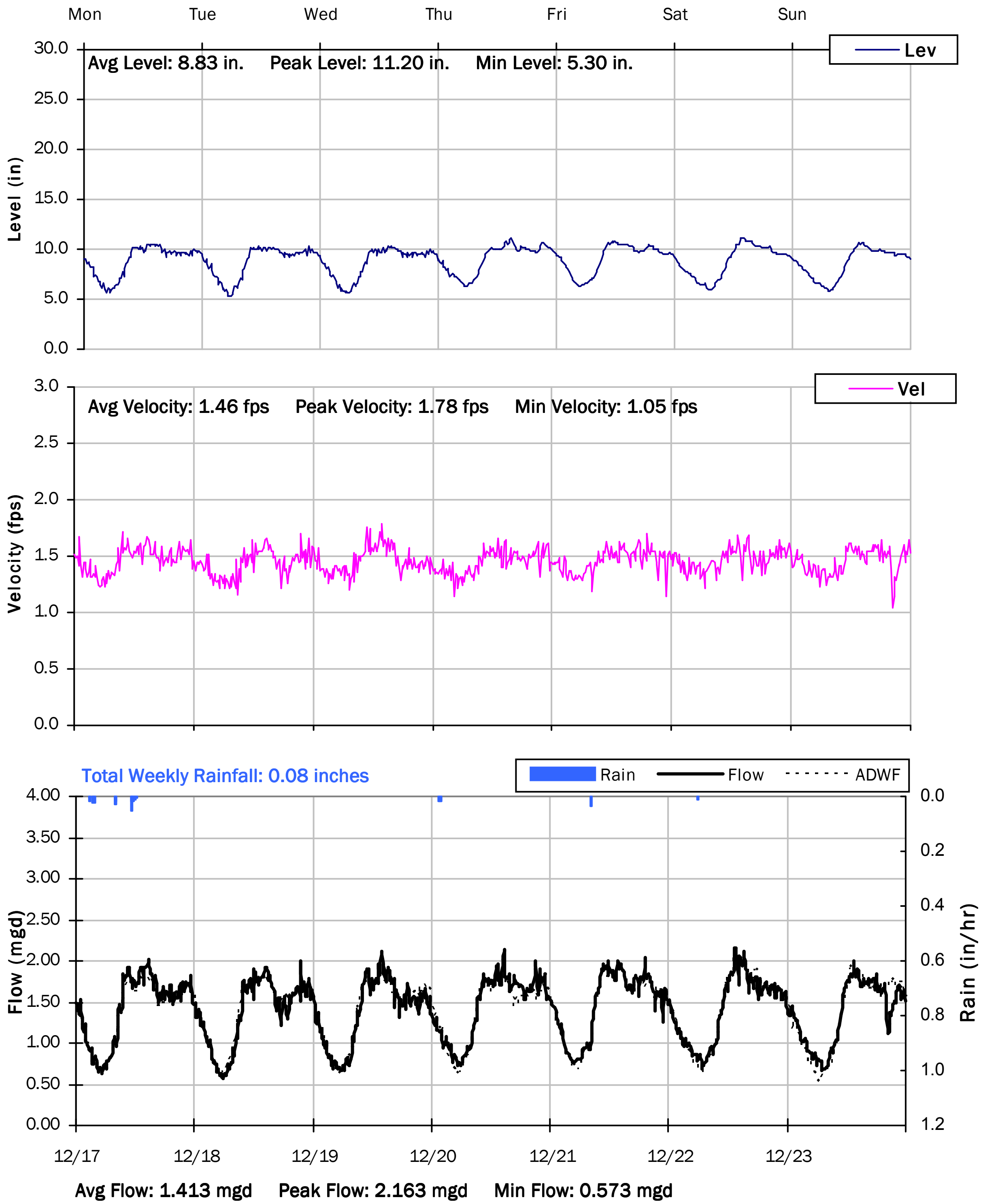




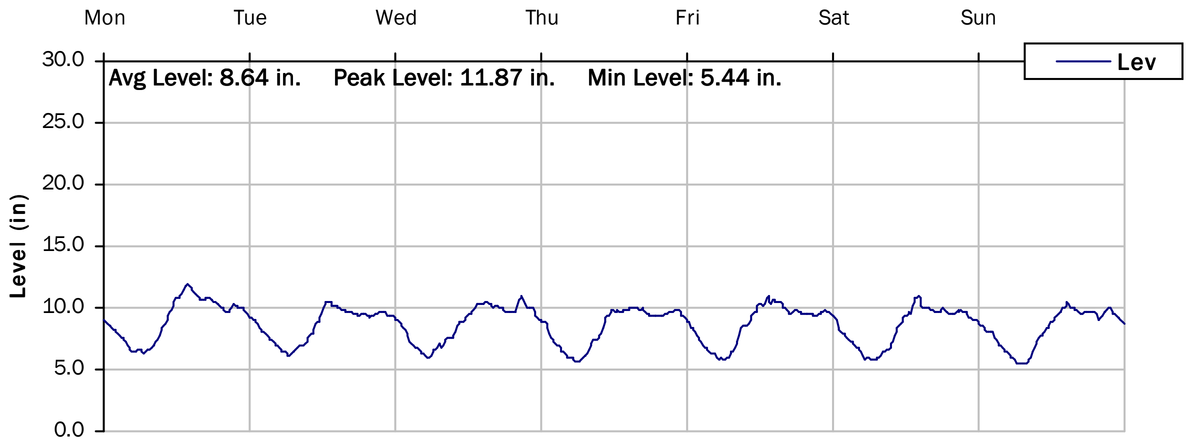


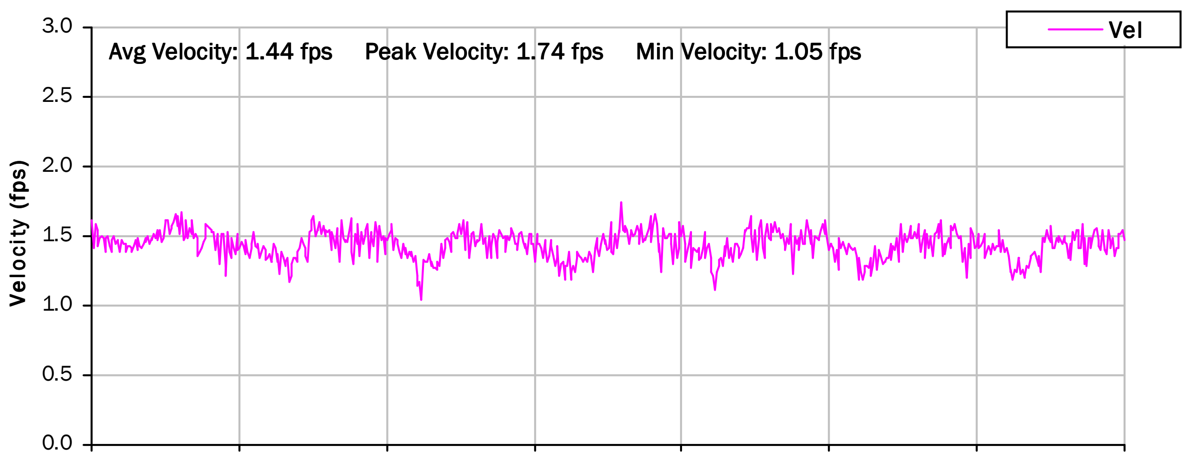
Avg Flow: 1.427 mgd **Peak Flow: 2.104 mgd** **Min Flow: 0.484 mgd**

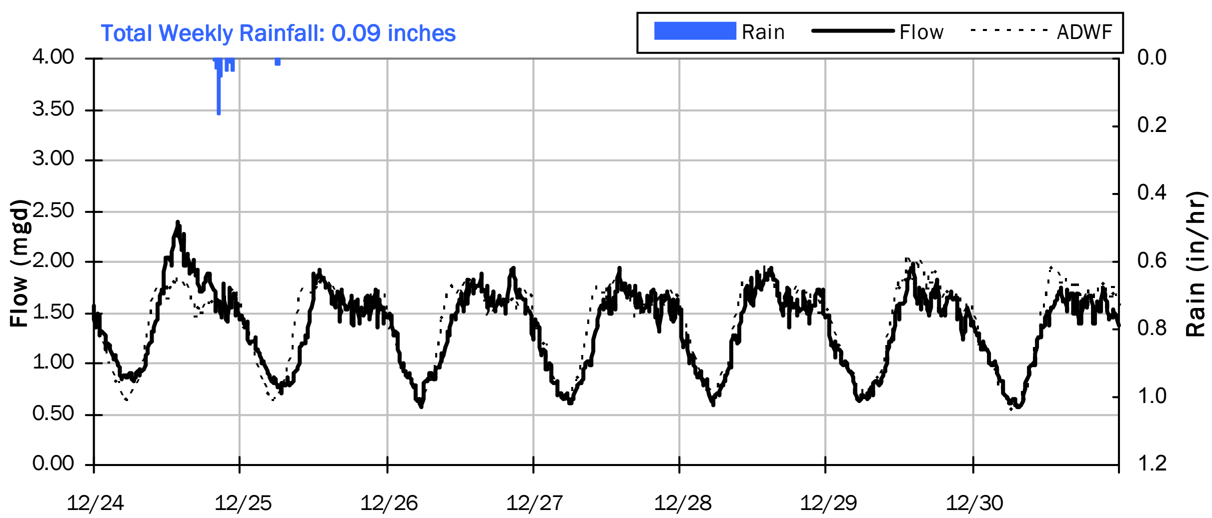
SITE 11
Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018



SITE 11
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018

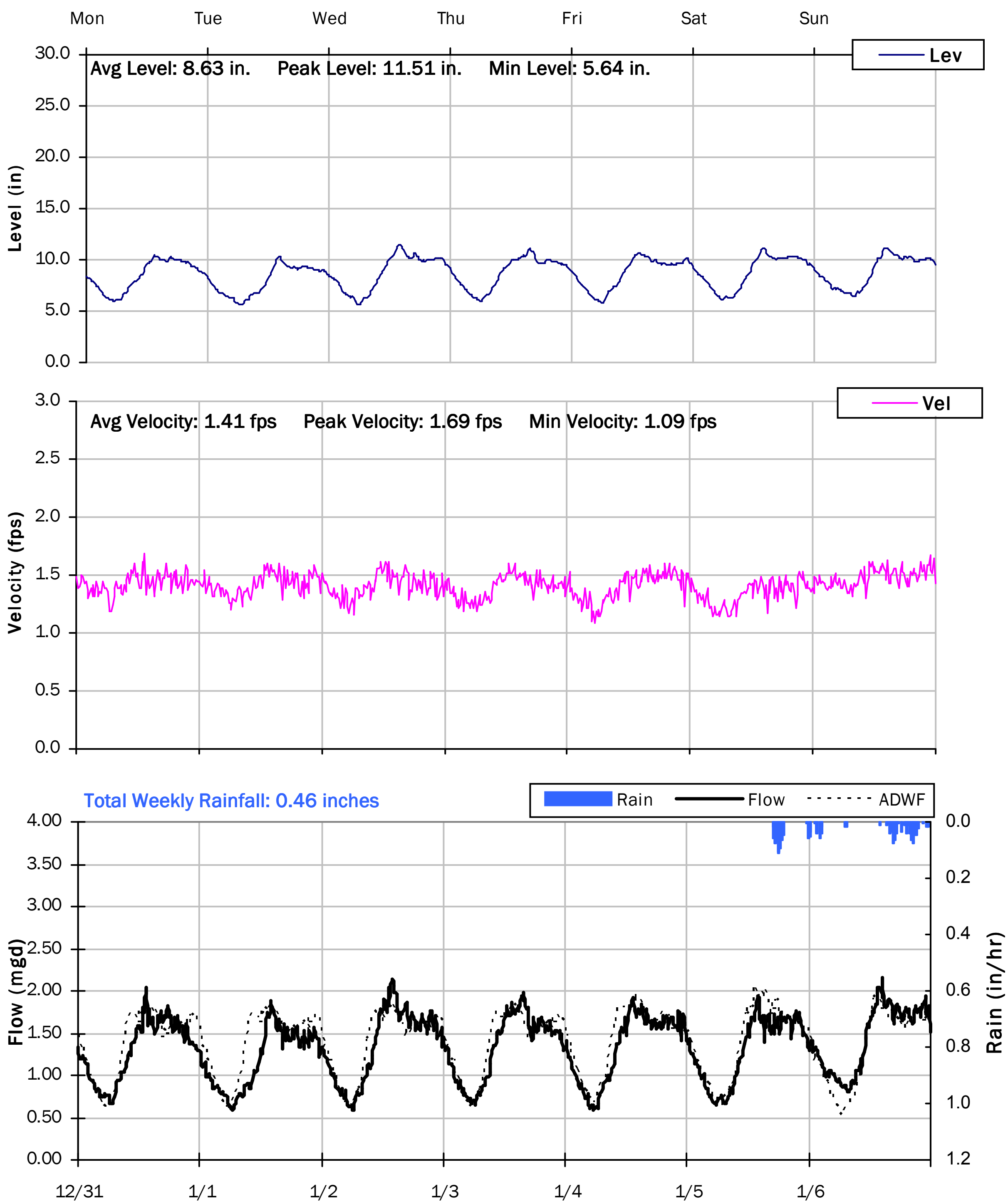






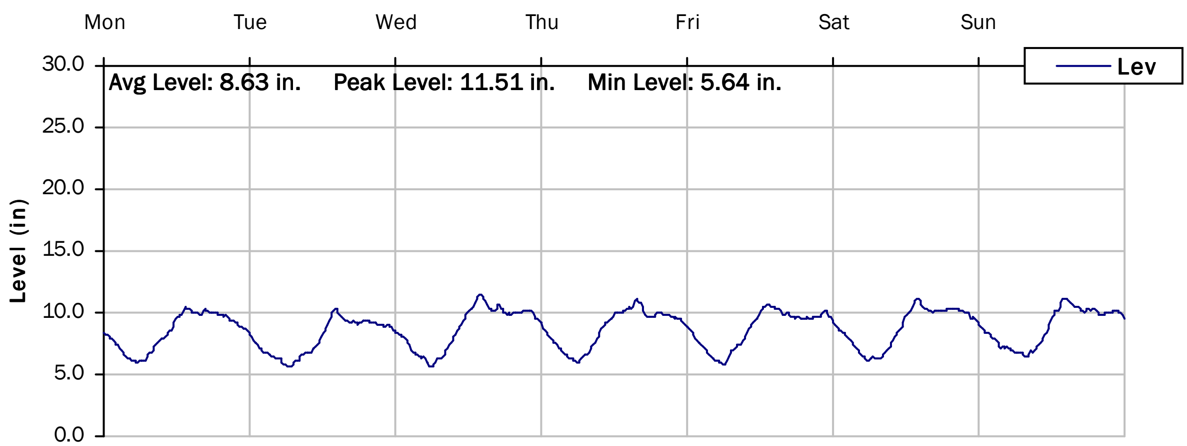
Avg Flow: 1.350 mgd **Peak Flow: 2.394 mgd** **Min Flow: 0.566 mgd**

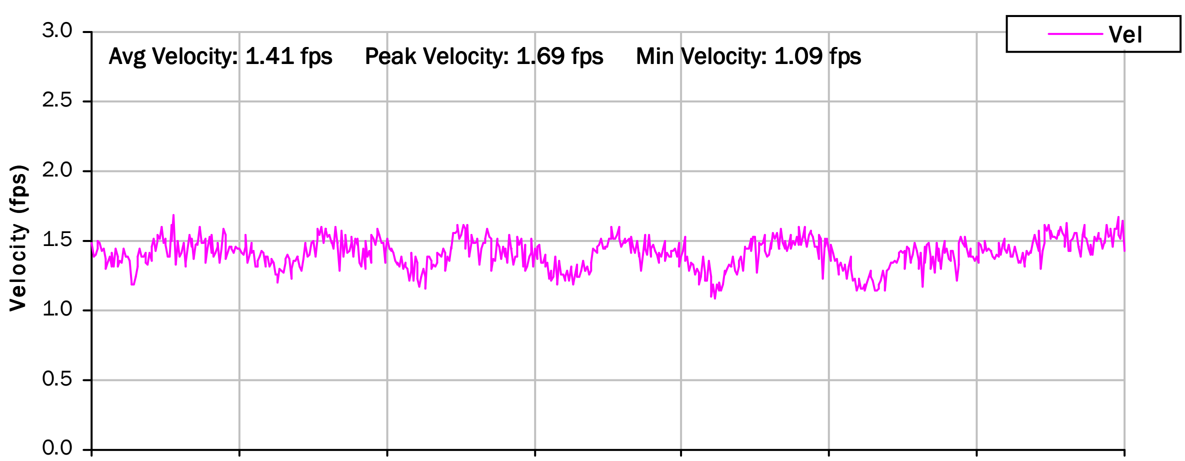
SITE 11
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019

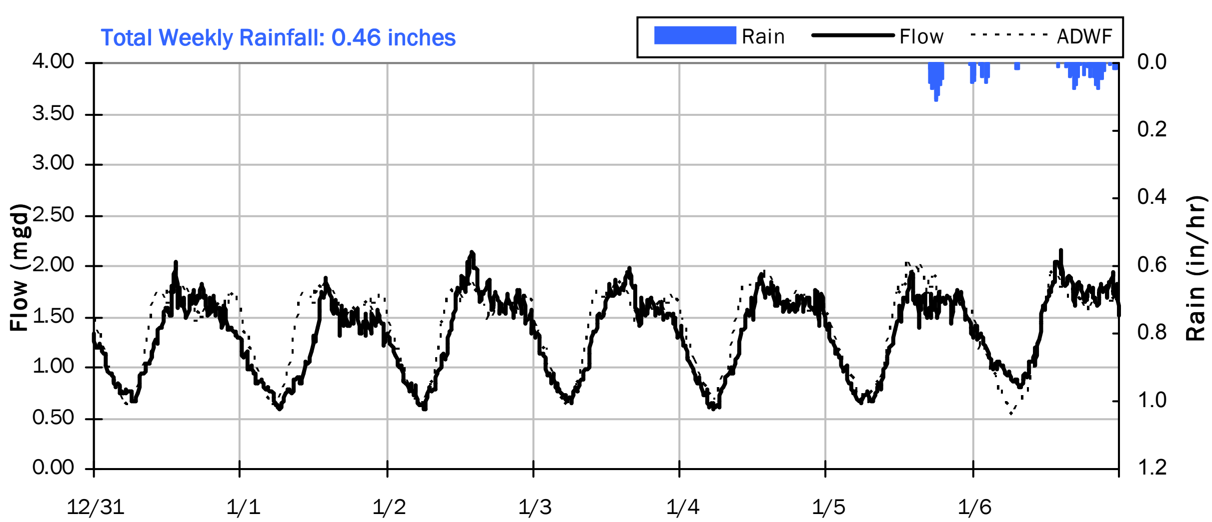


Avg Flow: 1.324 mgd Peak Flow: 2.163 mgd Min Flow: 0.592 mgd

SITE 11
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019







Avg Flow: 1.324 mgd Peak Flow: 2.163 mgd Min Flow: 0.592 mgd

City of Visalia

Sanitary Sewer Flow Monitoring

November 28, 2018 - January 06, 2019

Monitoring Site: Site 12

Location: E Walnut Ave & S Church St

Data Summary Report

Vicinity Map: Site 12

SITE 12

Site Information

Location: E Walnut Ave & S Church St

Coordinates: 119.2908° W, 36.3129° N

Rim Elevation (Earth): 330 feet

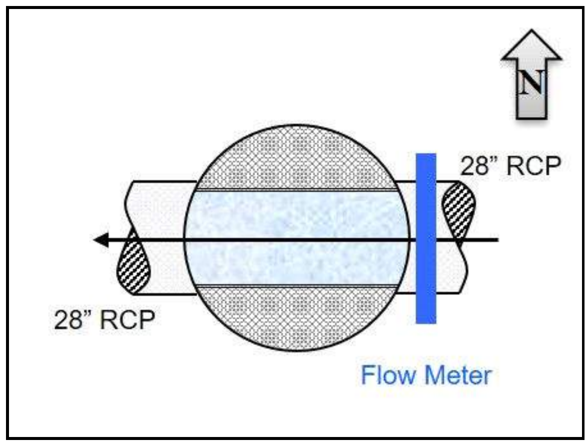
Pipe Diameter: 28 inches

ADWF: 0.849 mgd

Peak Measured Flow: 1.951 mgd

Satellite Map

Sewer Map



Flow Sketch

Street View

Plan View

SITE 12

Additional Site Photos

Effluent Pipe

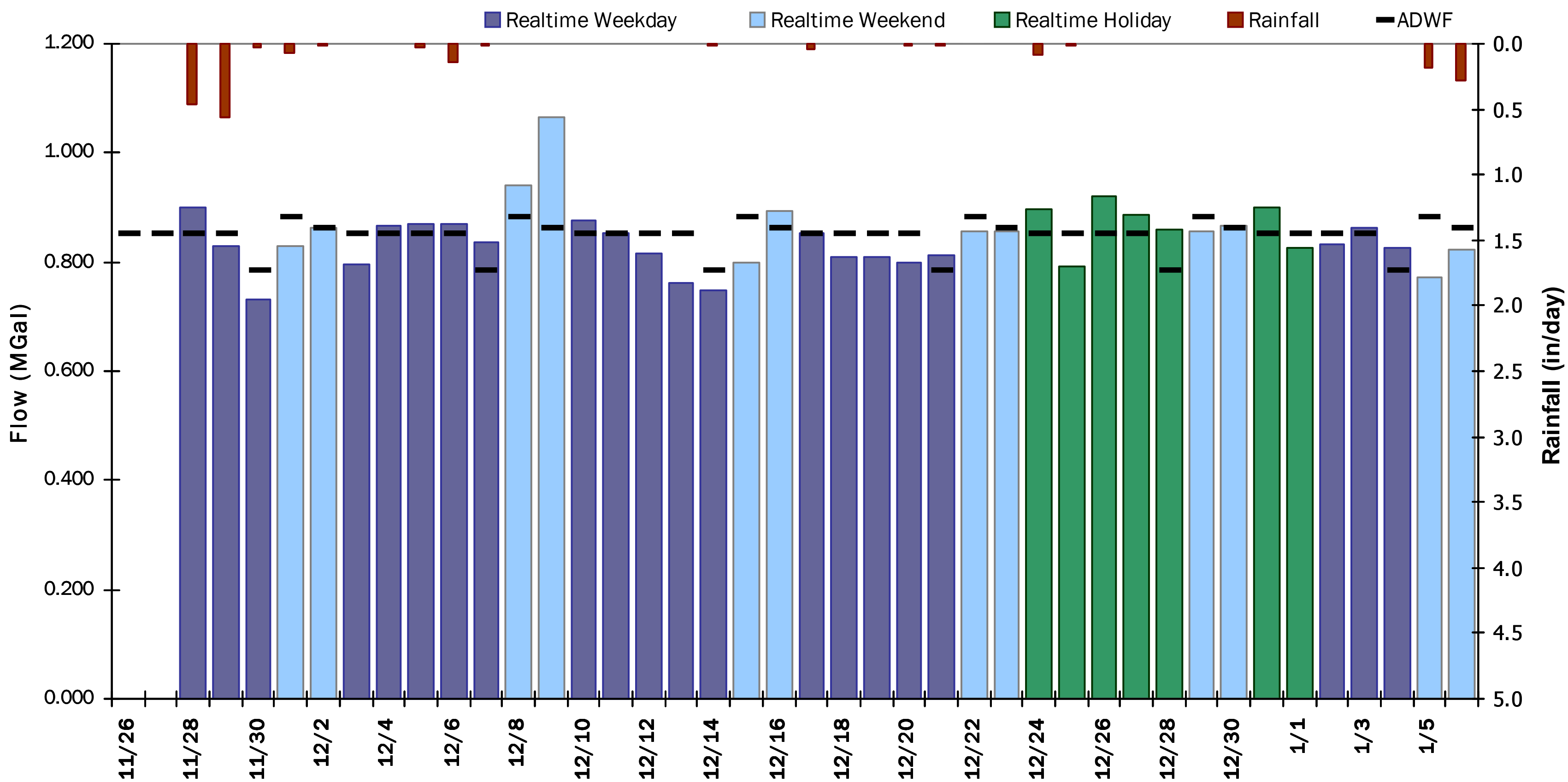
Influent Pipe

SITE 12

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.846 MGal **Peak Daily Flow: 1.066 MGal** **Min Daily Flow: 0.733 MGal**

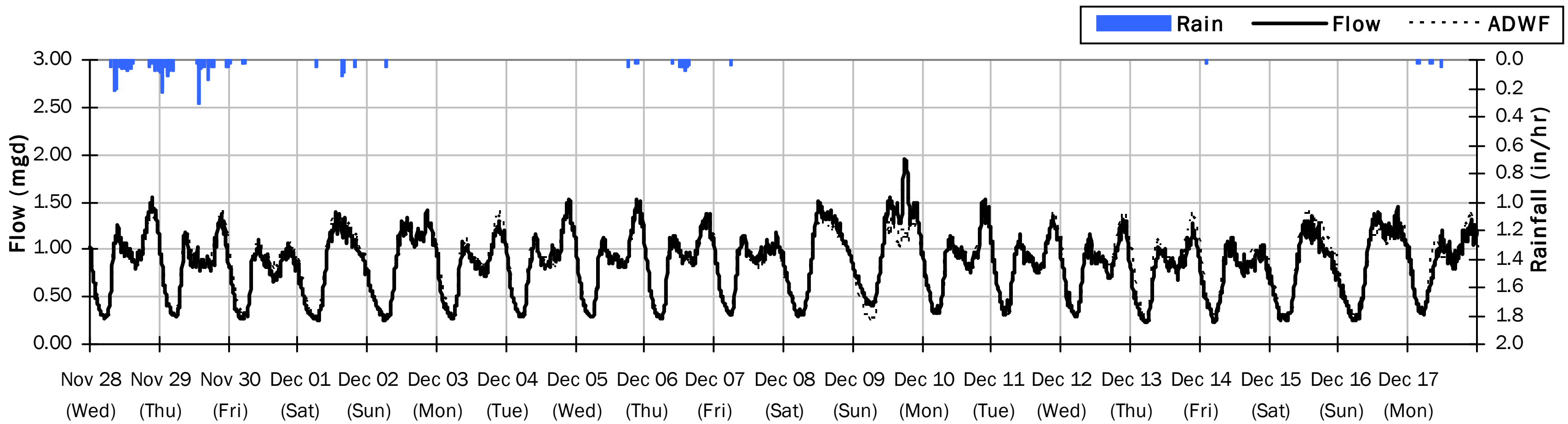
Total Period Rainfall: 1.95 inches

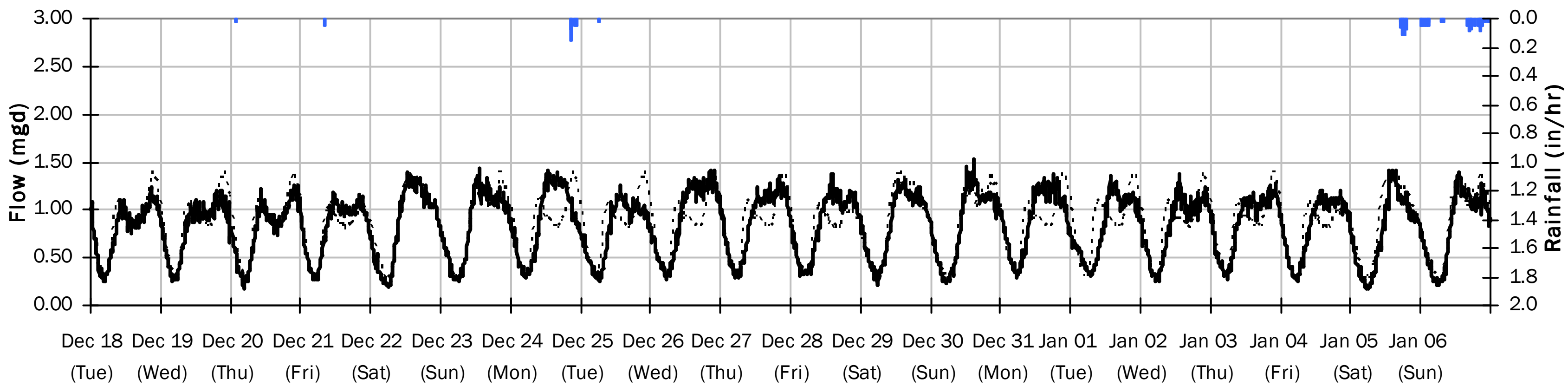


SITE 12

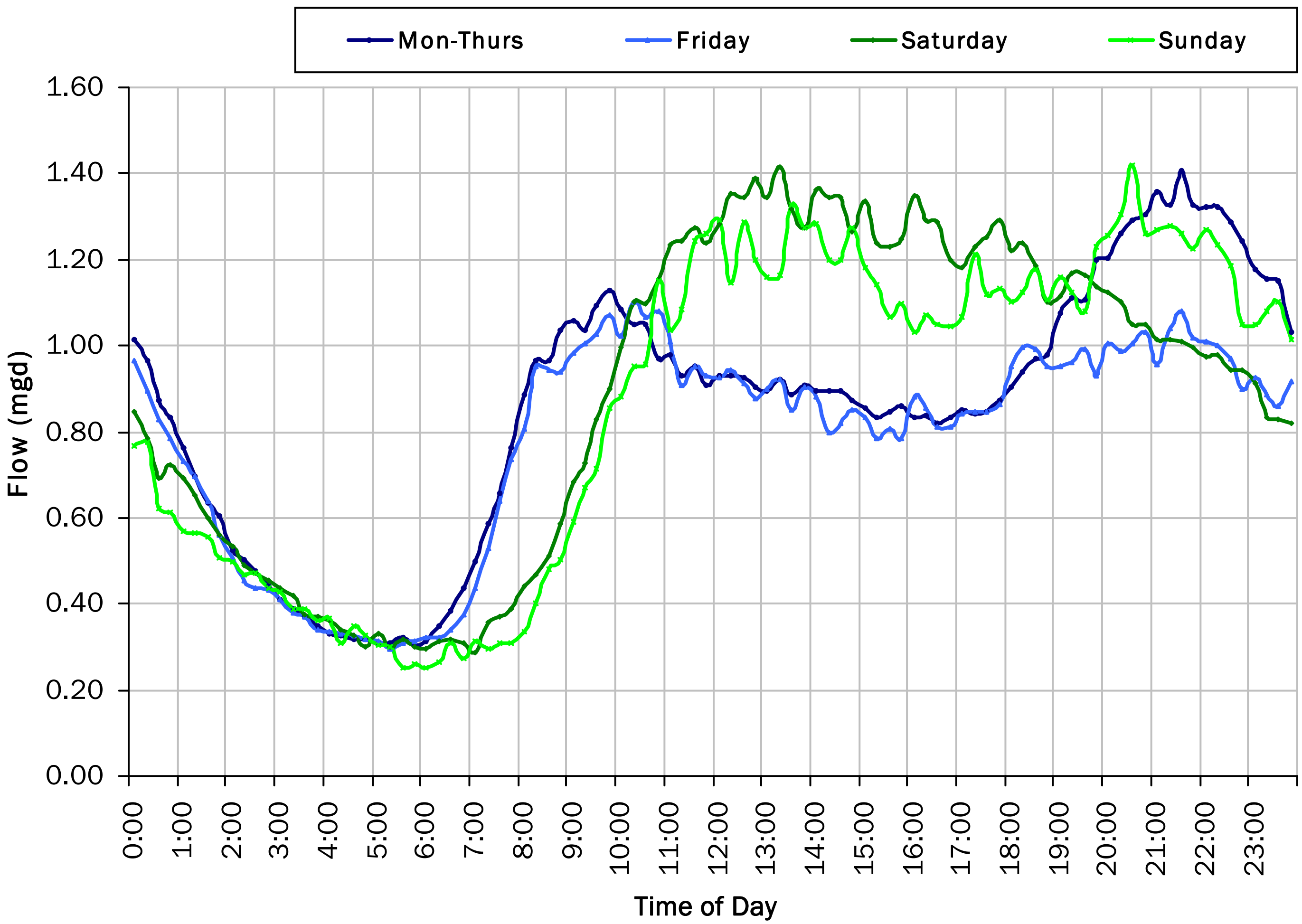
Flow Summary: 11/28/2018 to 1/6/2019

Total Period Rainfall: 1.95 inches   Avg Flow: 0.846 mgd   Peak Flow: 1.951 mgd   Min Flow: 0.174 mgd

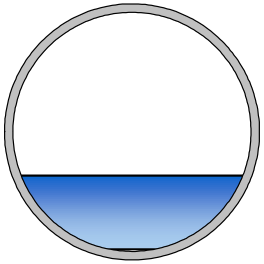




SITE 12
Average Dry Weather Flow Hydrographs

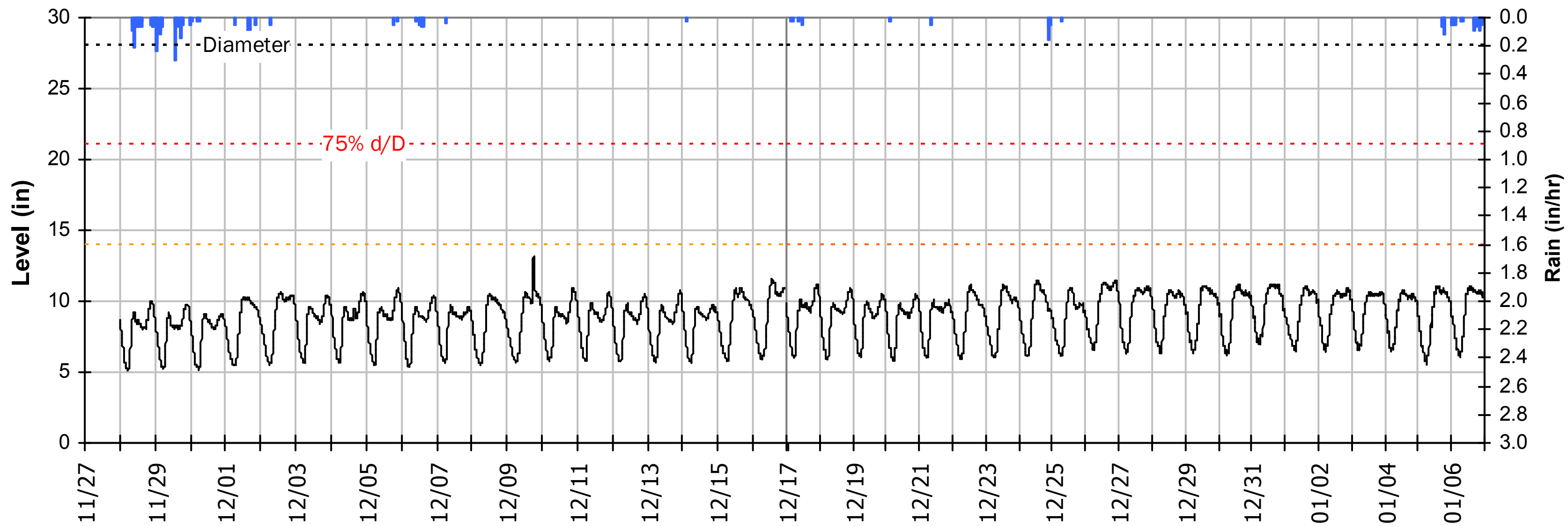


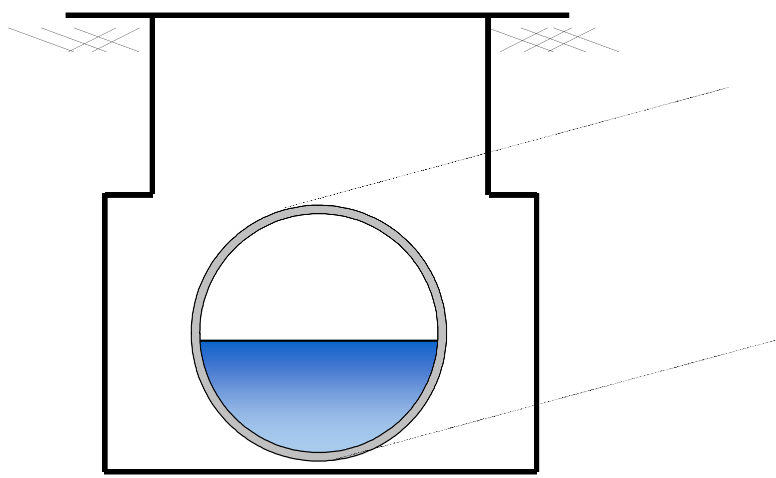
ADWF:
0.849 *mgd*



SITE 12
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



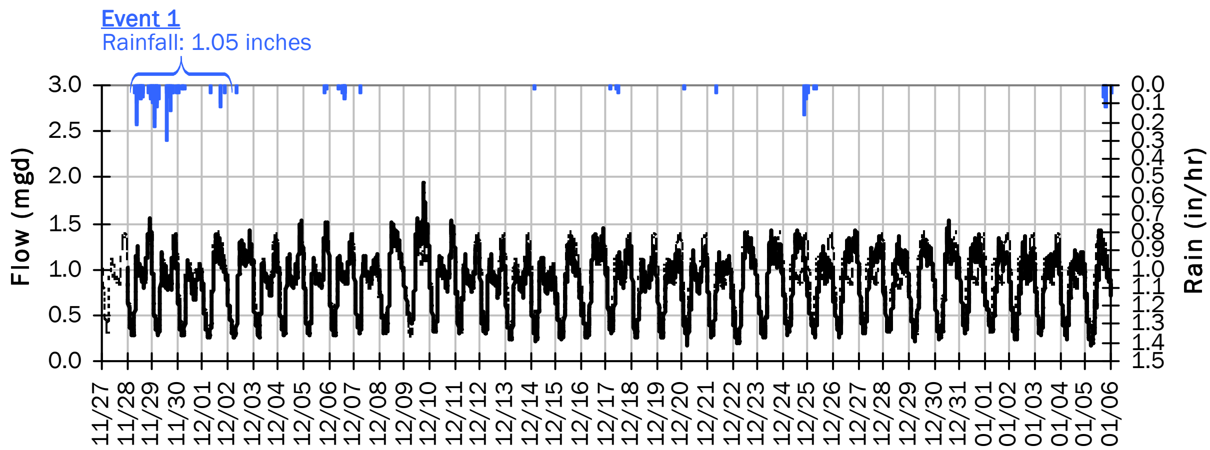


Pipe Diameter:	28	*inches*
Peak Measured Level:	13.2	*inches*
Peak d/D Ratio:	0.47	

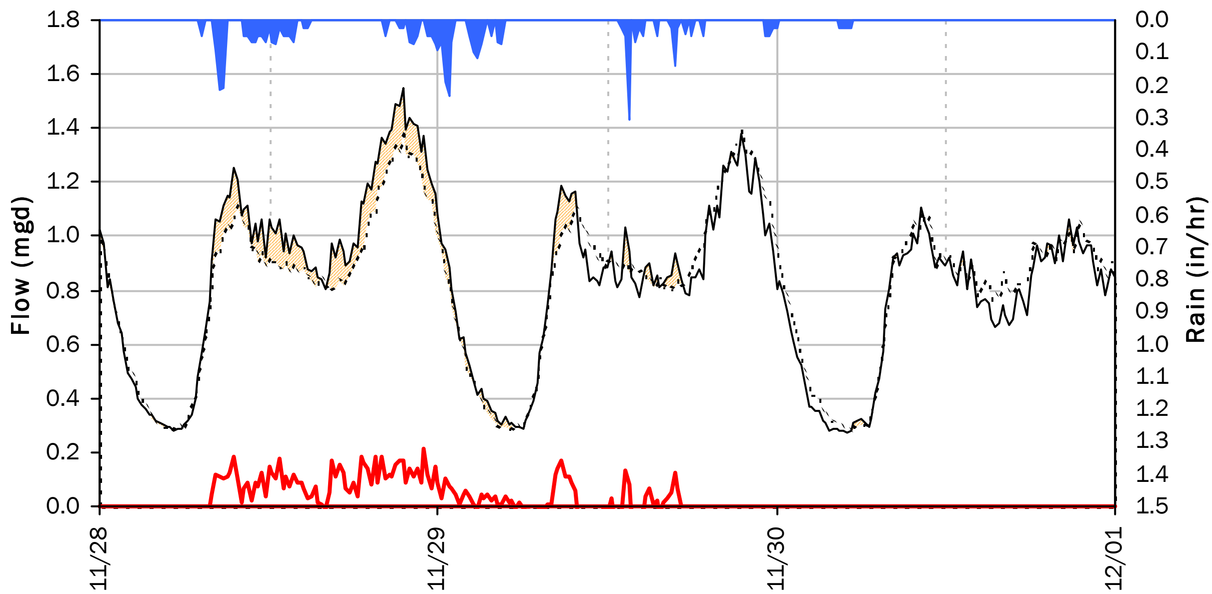
SITE 12

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



Event 1 Detail Graph



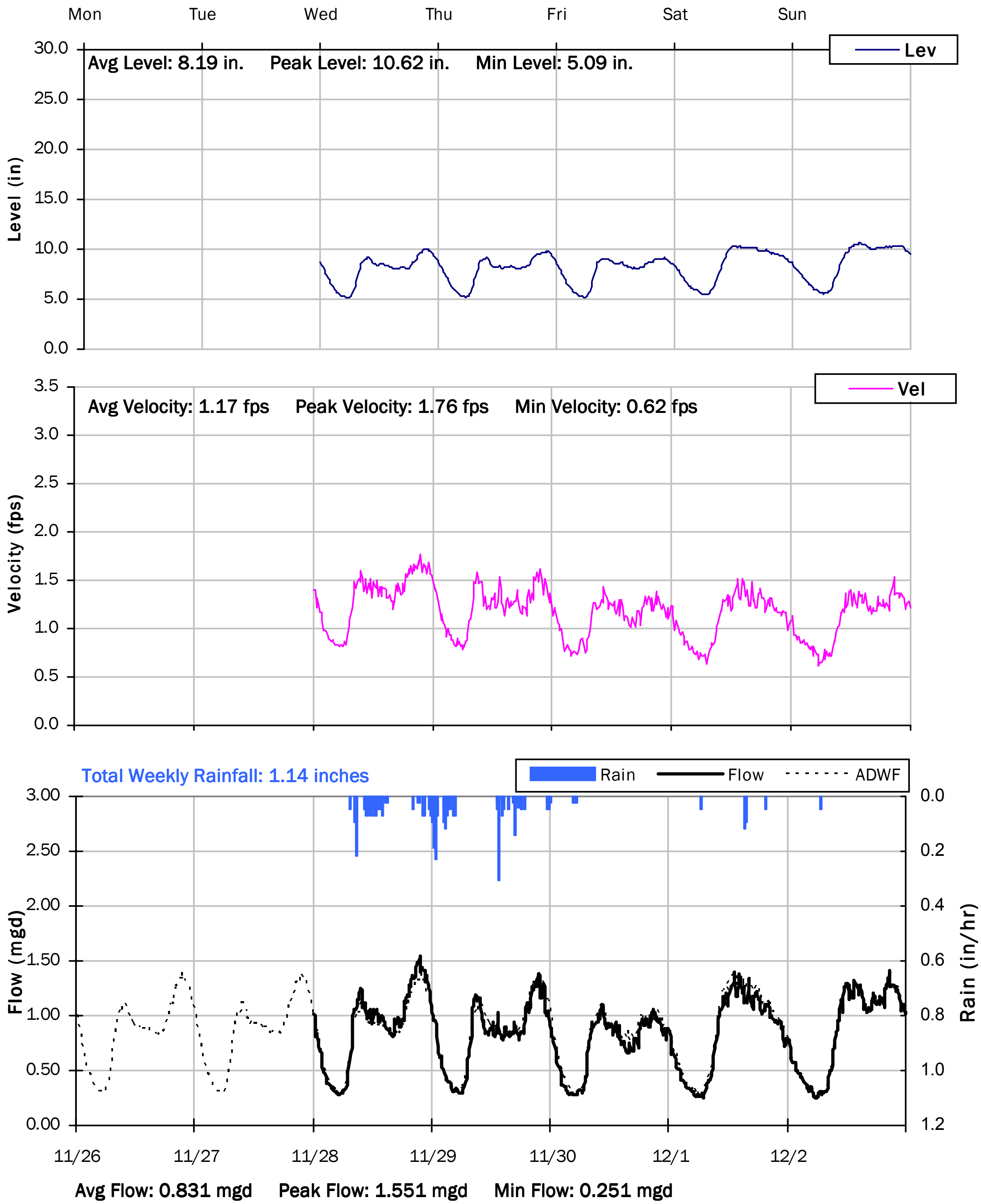
Storm Event I/I Analysis (Rain = 1.05 inches)

Capacity		Inflow / Infiltration	
Peak Flow:	1.55 *mgd*	**Peak I/I Rate:**	0.21 *mgd*
PF:	1.83	**Total I/I:**	79,000 *gallons*
Peak Level:	9.98 *in*		
d/D Ratio:	0.36		

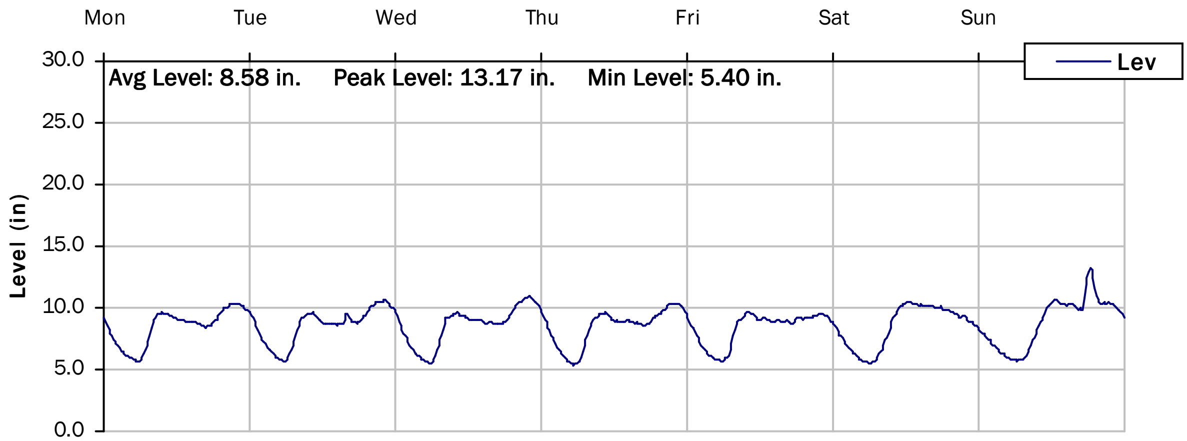
SITE 12

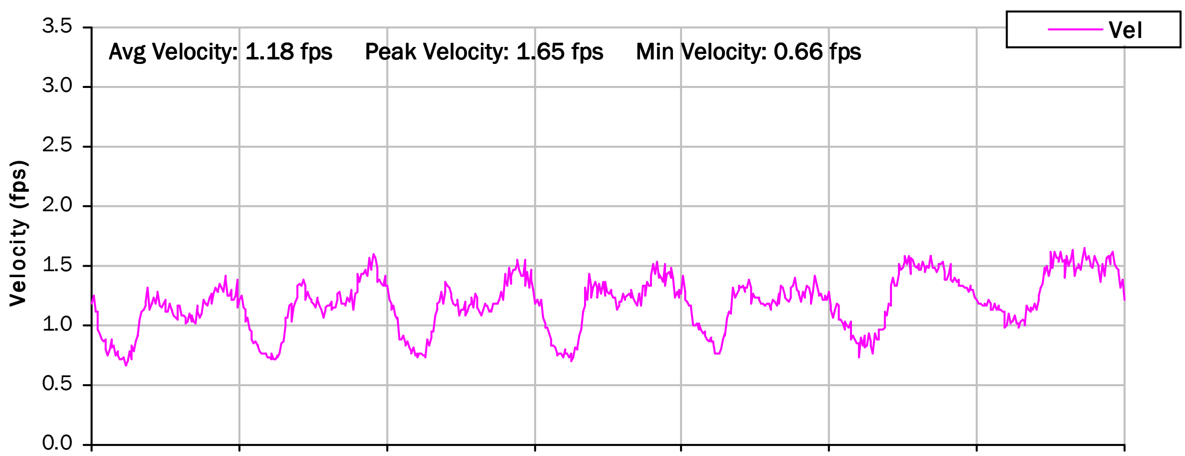
Weekly Level, Velocity and Flow Hydrographs

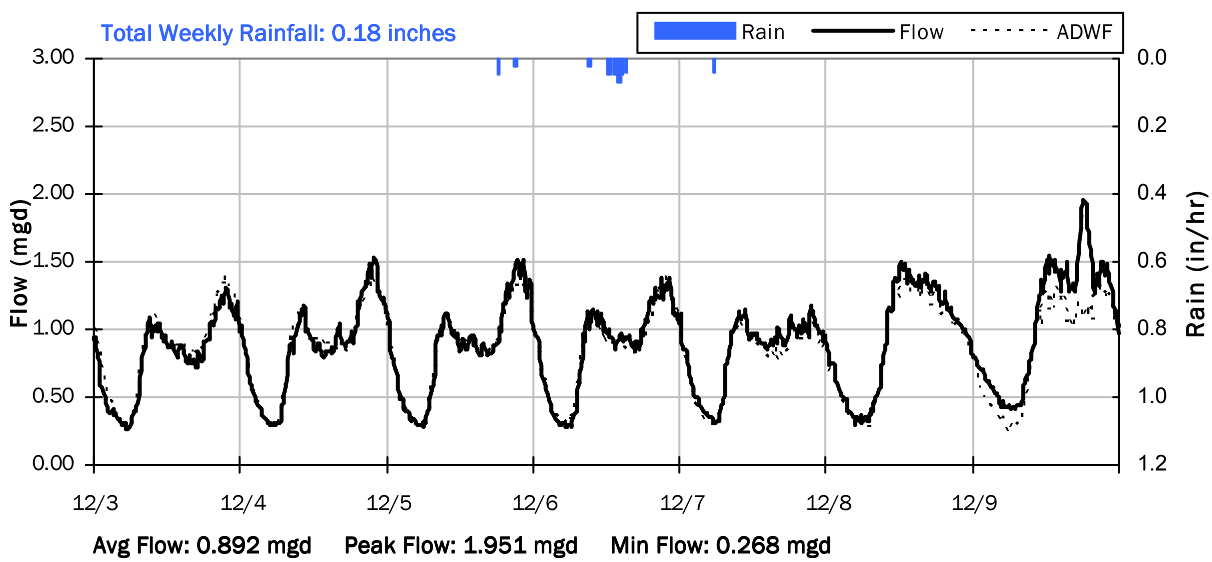
11/26/2018 to 12/3/2018



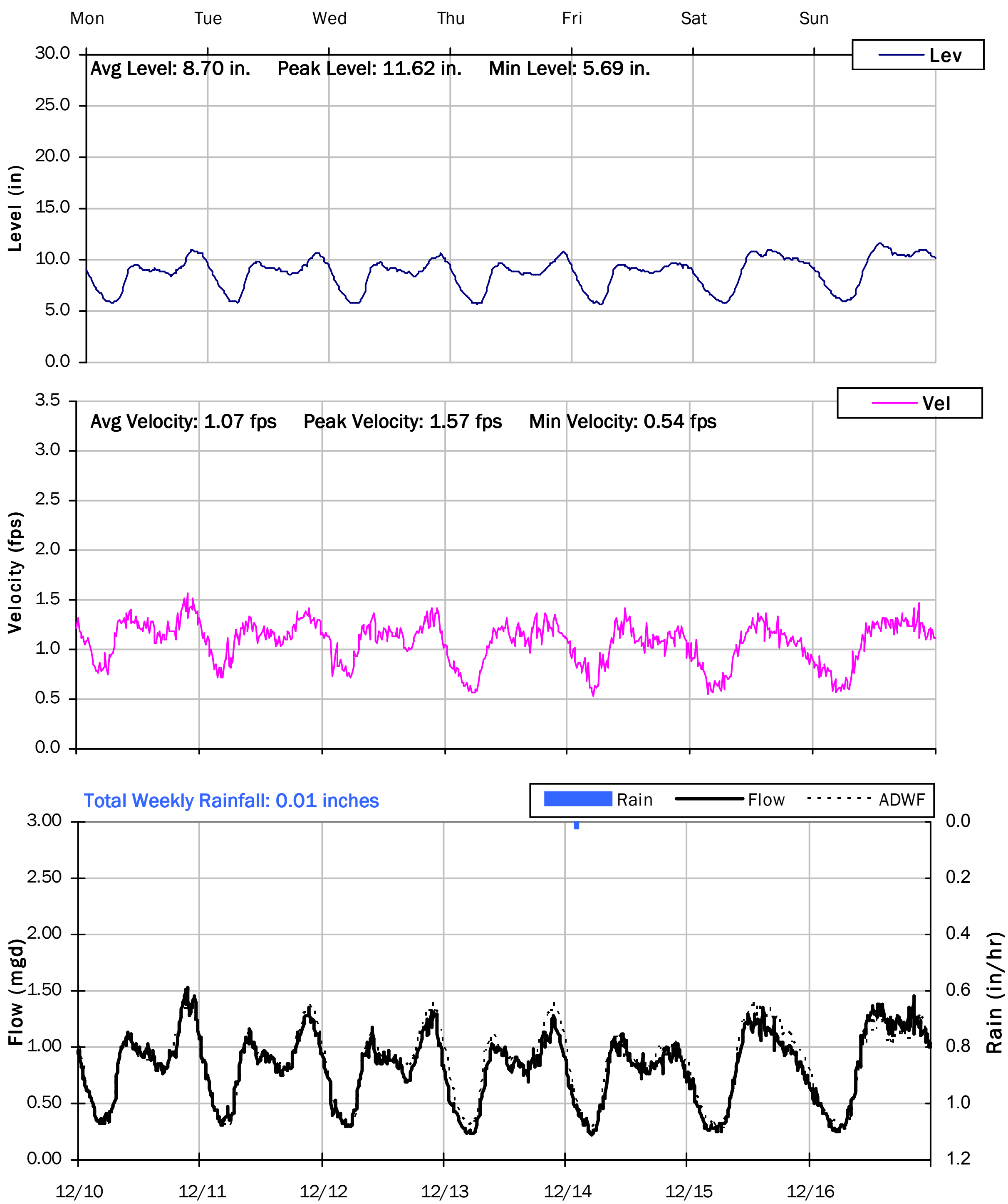
SITE 12
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018





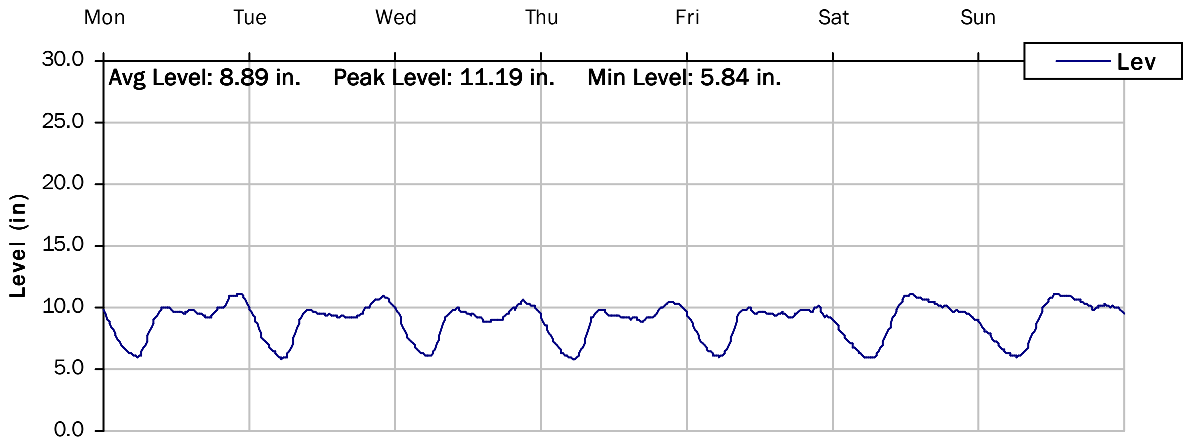


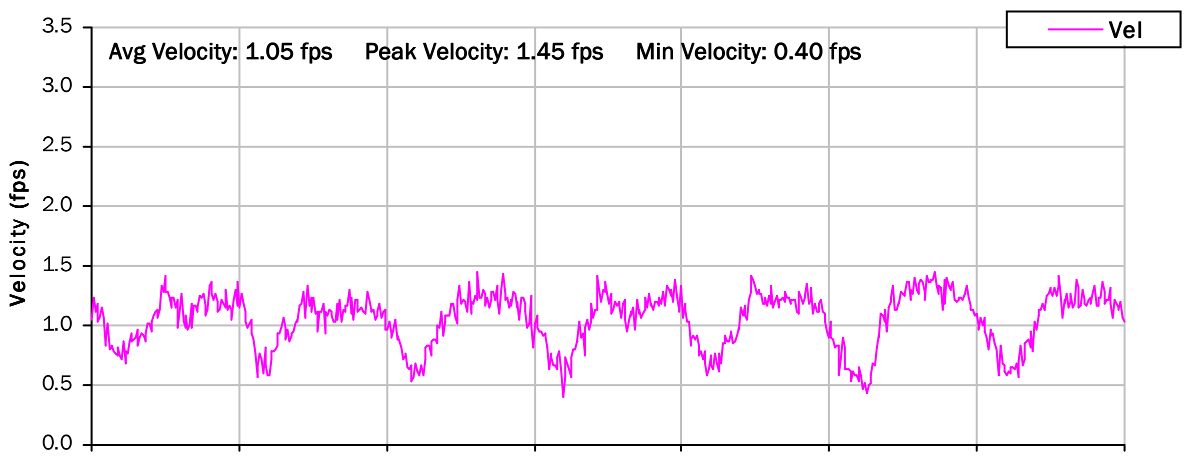
SITE 12
Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018

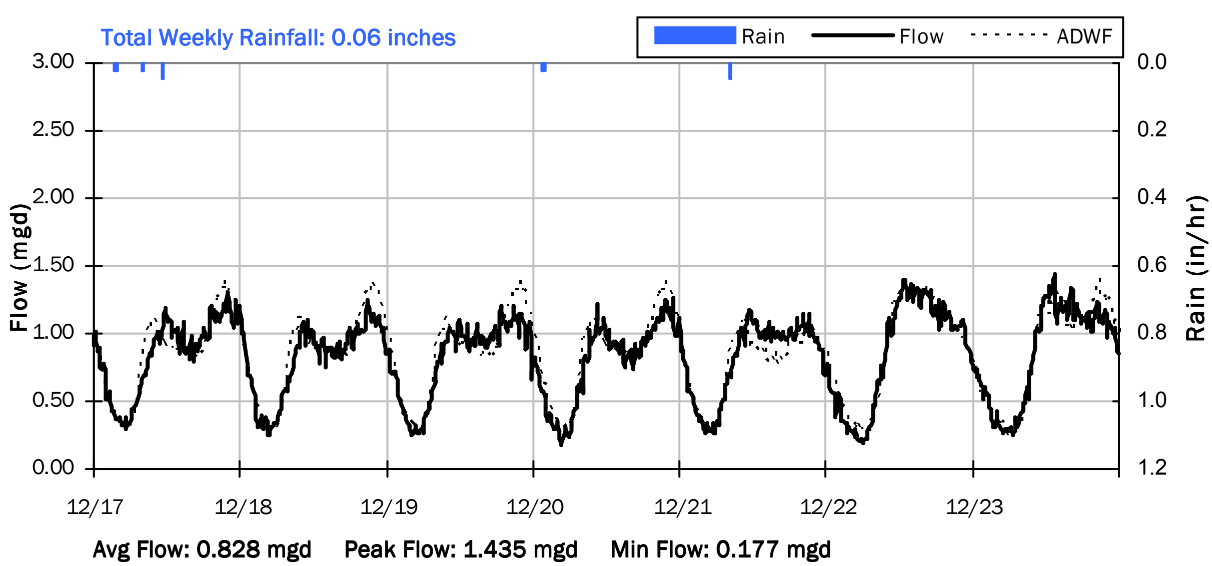


Avg Flow: 0.821 mgd **Peak Flow: 1.536 mgd** **Min Flow: 0.225 mgd**

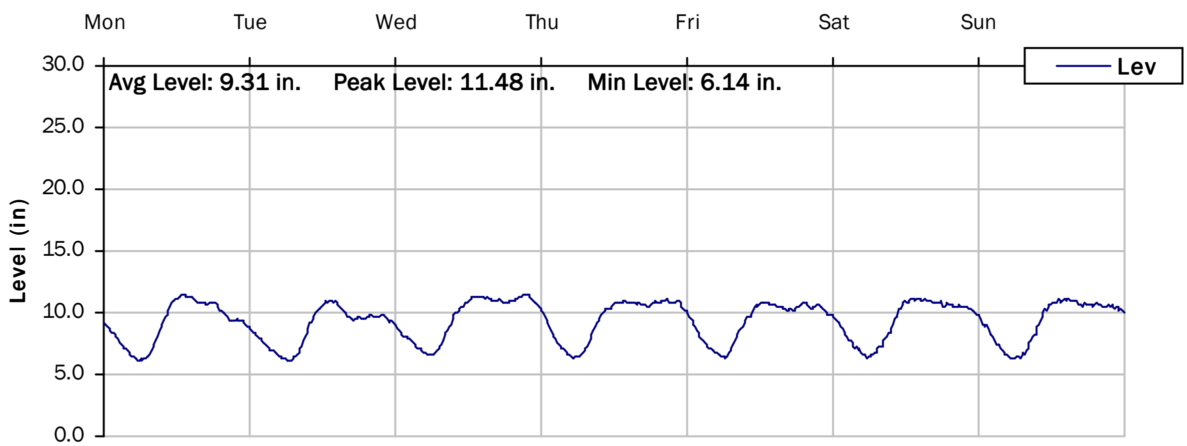
SITE 12
Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018

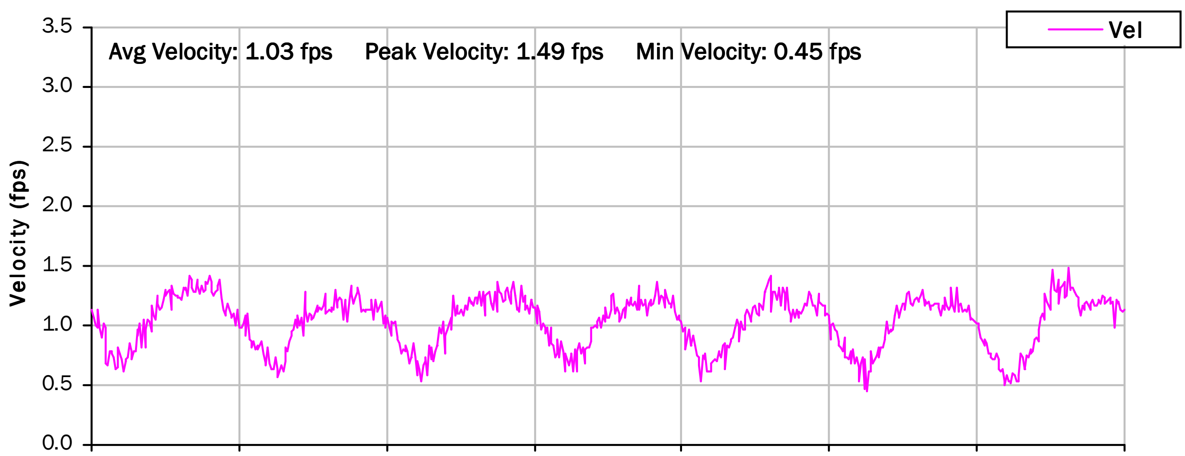


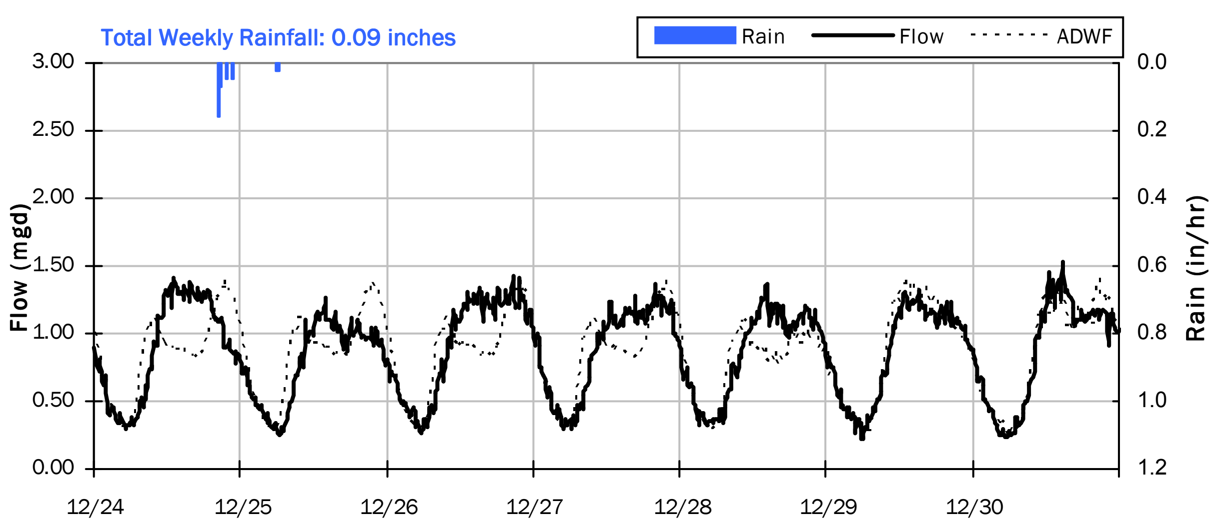




SITE 12
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018

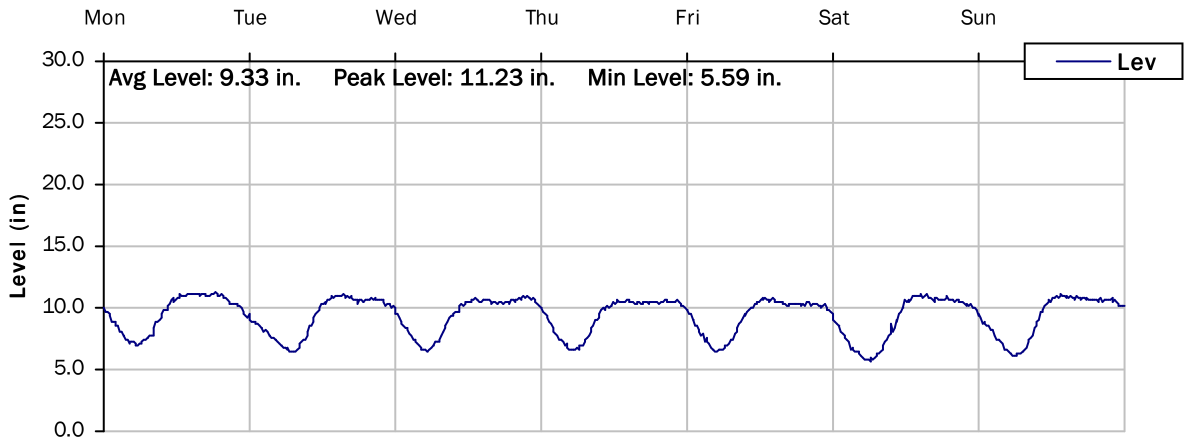


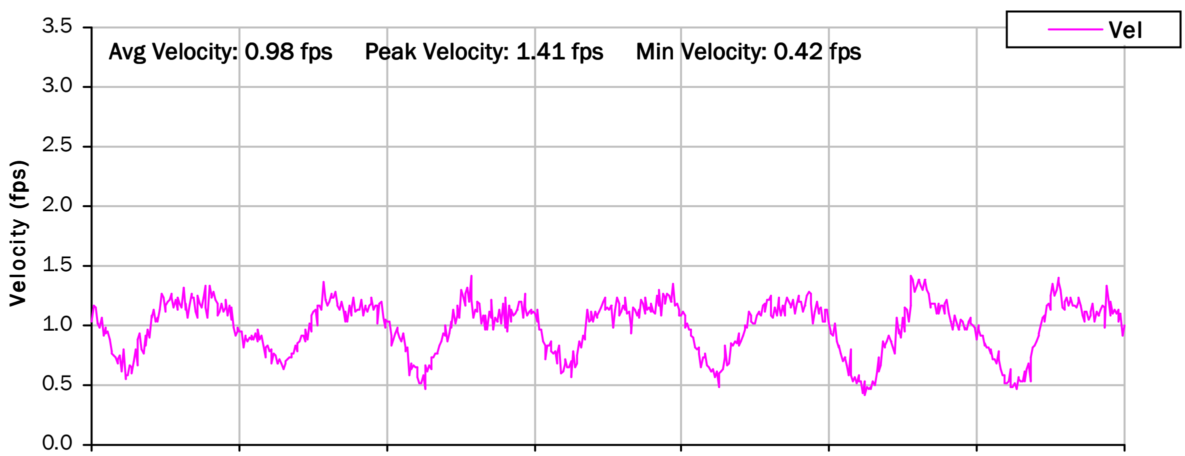


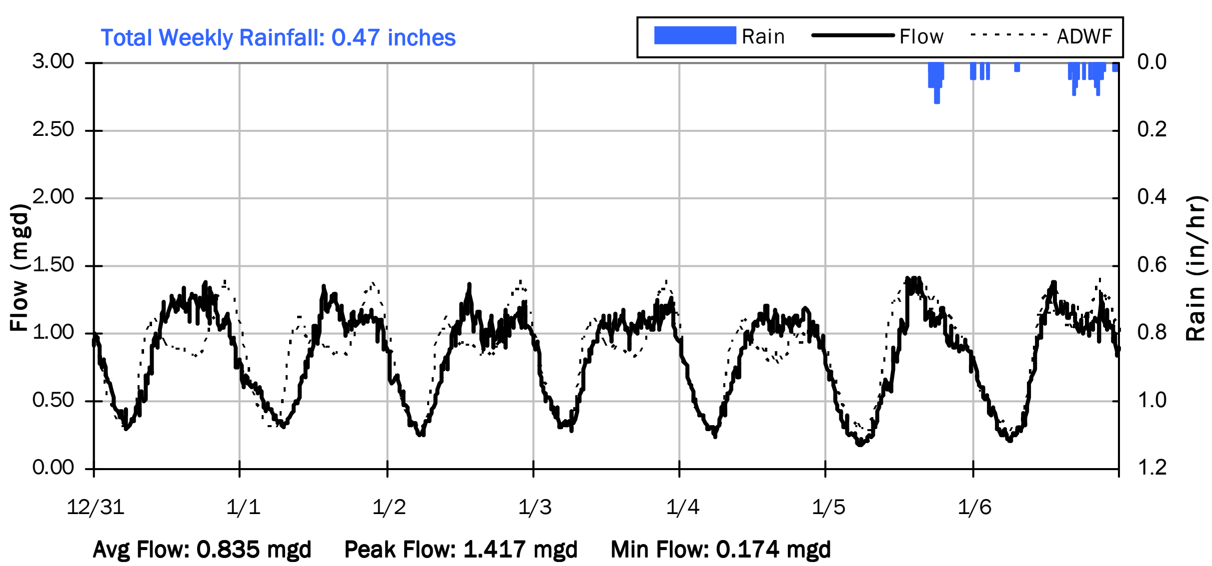


Avg Flow: 0.868 mgd **Peak Flow: 1.536 mgd** **Min Flow: 0.216 mgd**

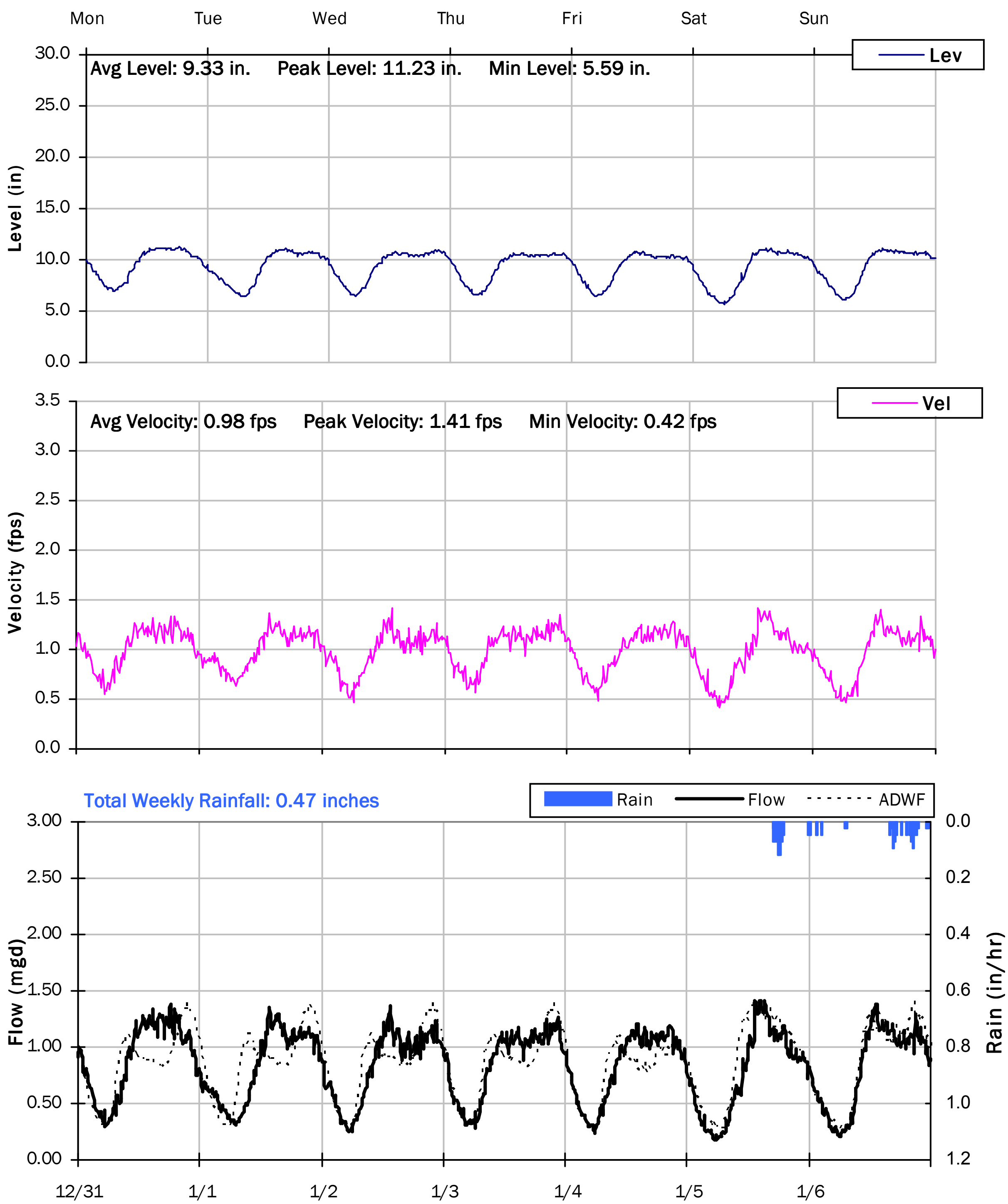
SITE 12
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019







SITE 12
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



Avg Flow: 0.835 mgd Peak Flow: 1.417 mgd Min Flow: 0.174 mgd

City of Visalia

Sanitary Sewer Flow Monitoring

November 28, 2018 - January 06, 2019

Monitoring Site: Site 13

Location: Houston Ave & N County Center St

Data Summary Report

Vicinity Map: Site 13

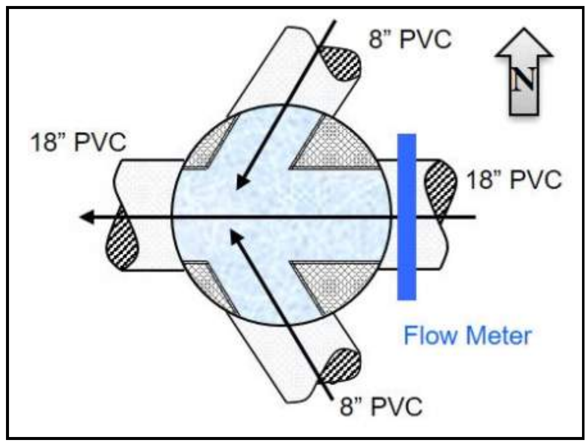
SITE 13

Site Information

Location:	Houston Ave & N County Center St
Coordinates:	119.3230° W, 36.3420° N
Rim Elevation (Earth):	320 feet
Pipe Diameter:	18 inches
ADWF:	0.140 mgd
Peak Measured Flow:	0.326 mgd

Satellite Map

Sewer Map



Flow Sketch


Street View


Plan View

SITE 13

Additional Site Photos

Effluent Pipe

East Influent Pipe

SITE 13

Additional Site Photos

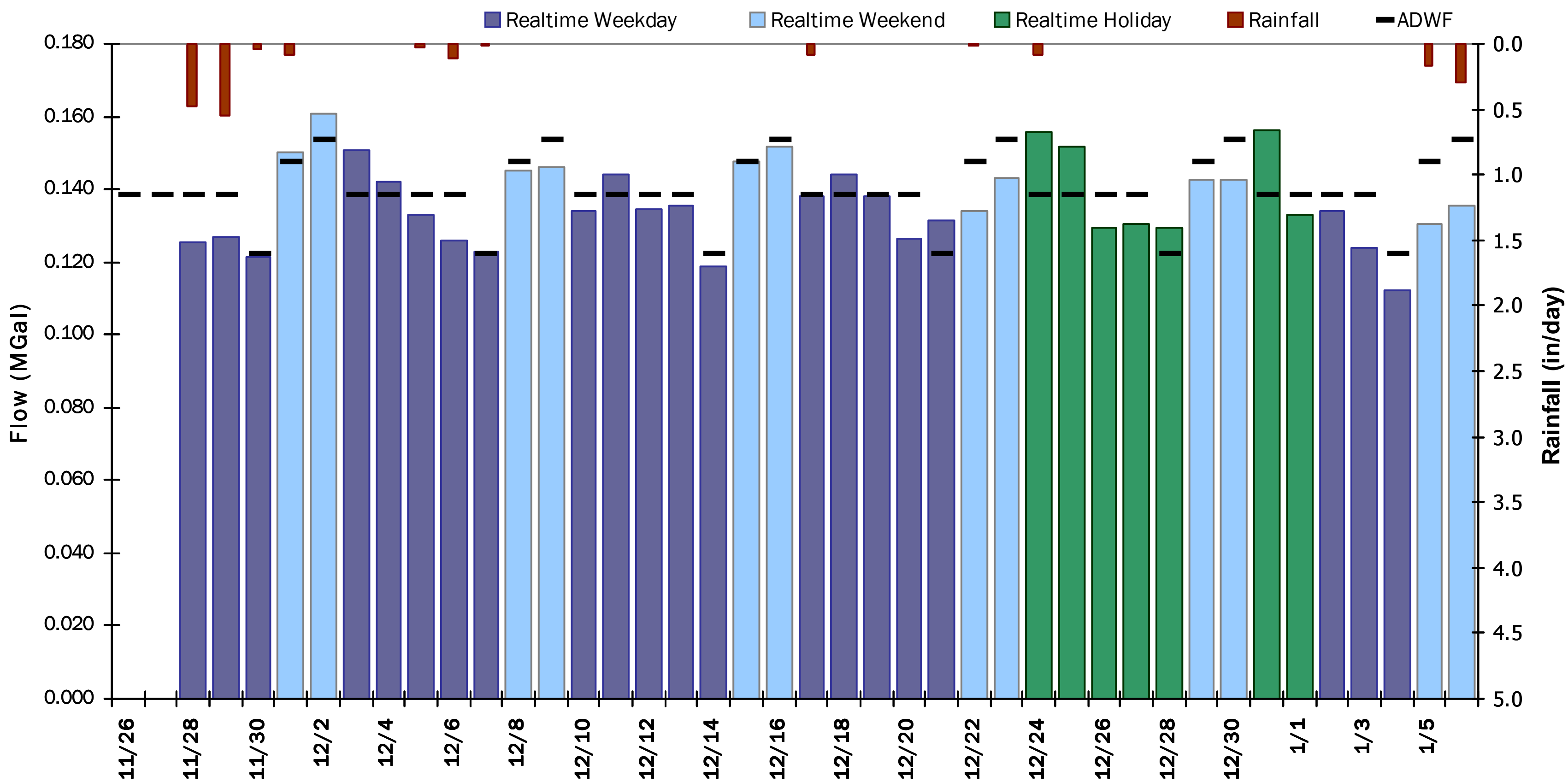
North Influent Pipe

South Influent Pipe

SITE 13
Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.137 MGal **Peak Daily Flow: 0.161 MGal** **Min Daily Flow: 0.112 MGal**

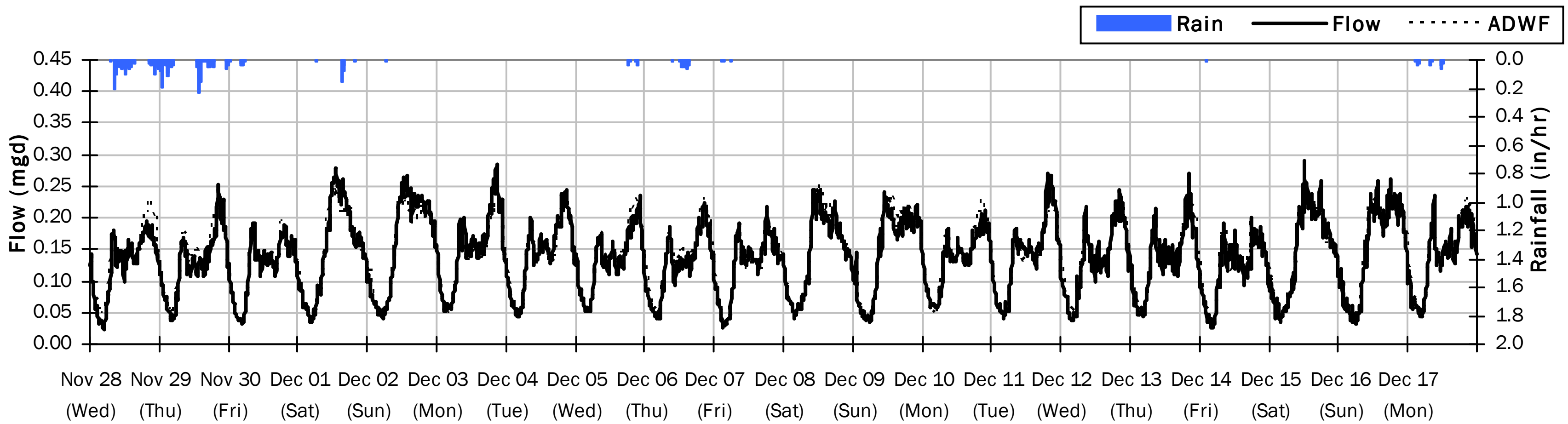
Total Period Rainfall: 1.95 inches

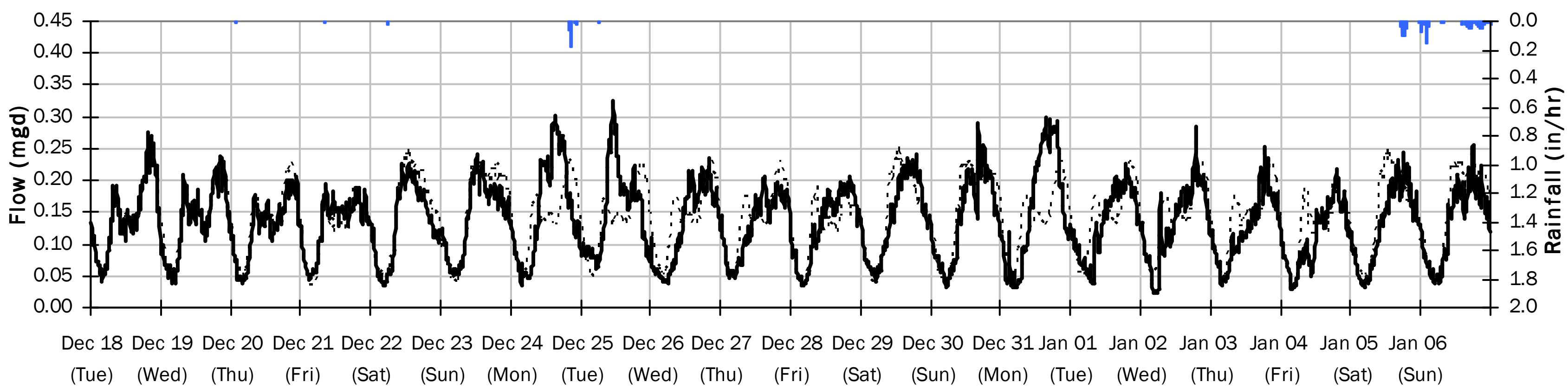


SITE 13

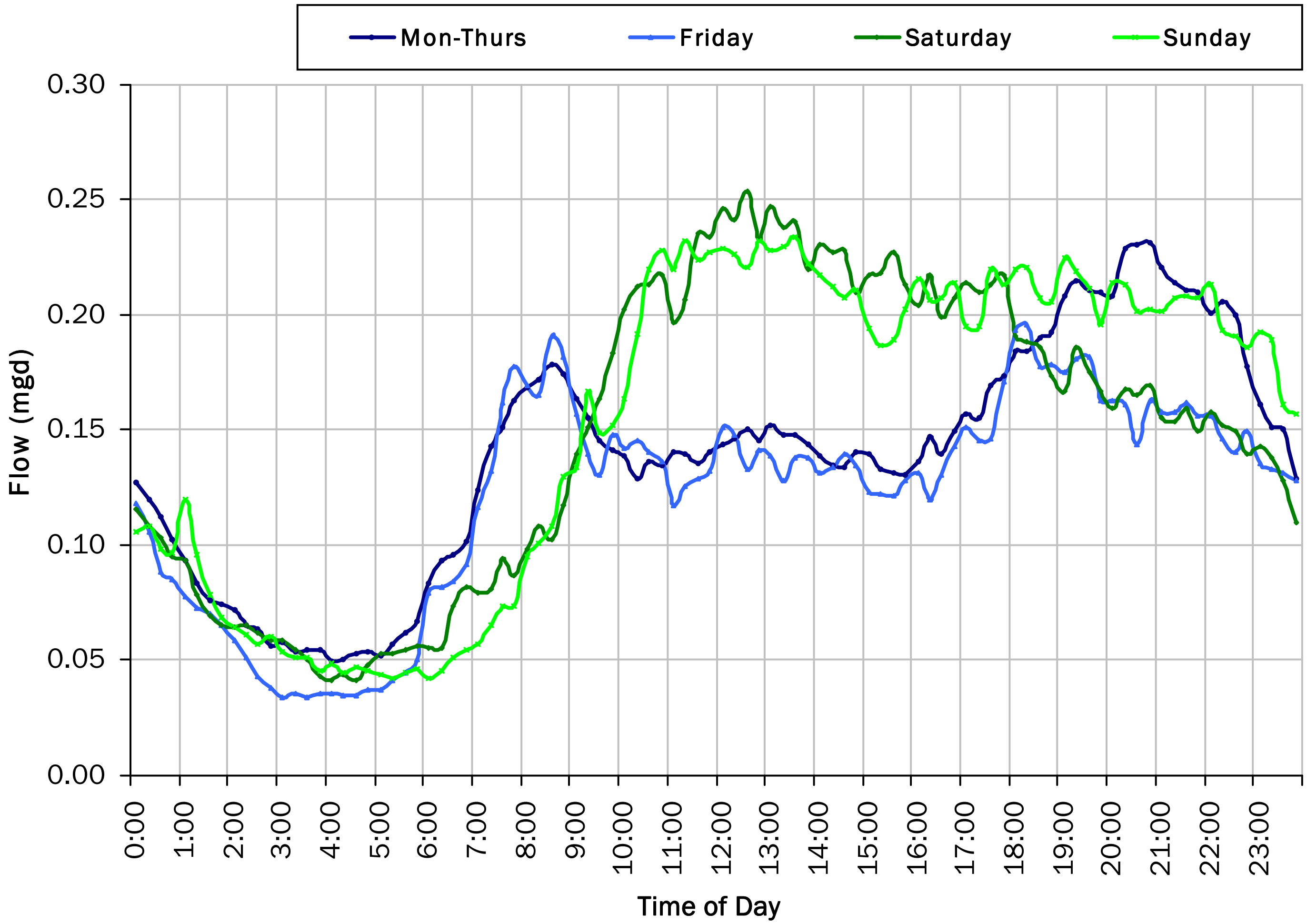
Flow Summary: 11/28/2018 to 1/6/2019

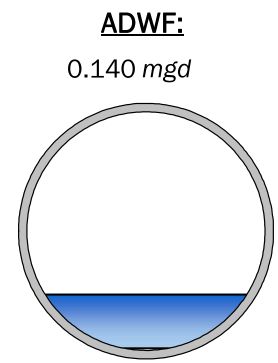
Total Period Rainfall: 1.95 inches   Avg Flow: 0.137 mgd   Peak Flow: 0.326 mgd   Min Flow: 0.022 mgd





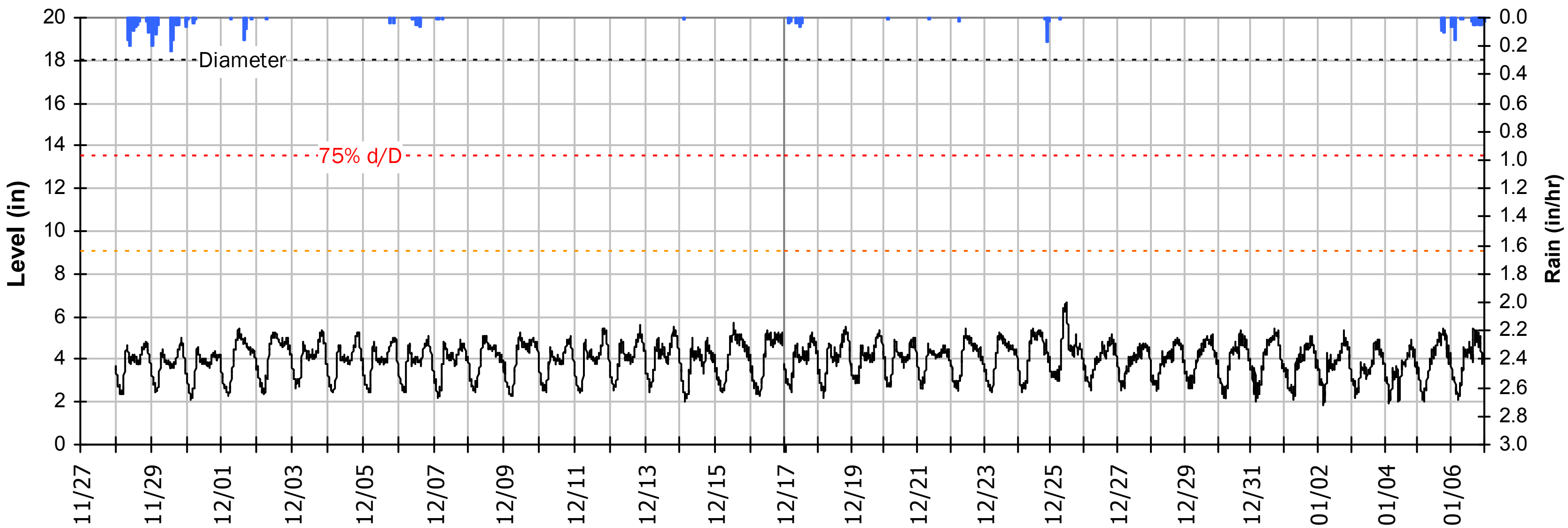
SITE 13
Average Dry Weather Flow Hydrographs

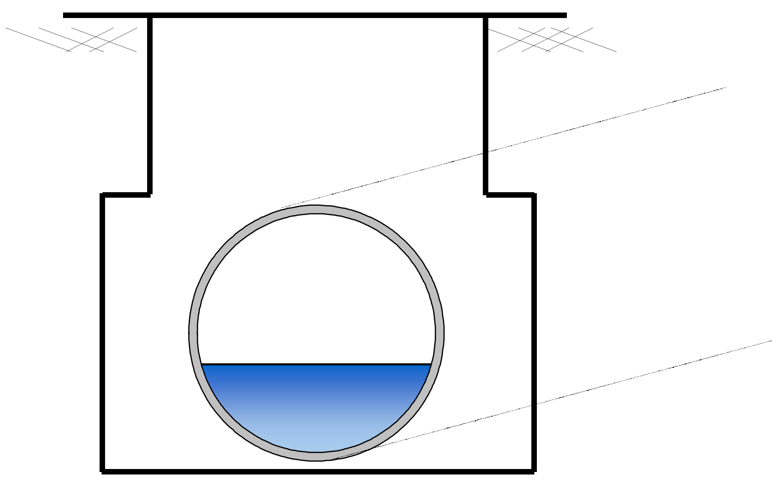




SITE 13
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period



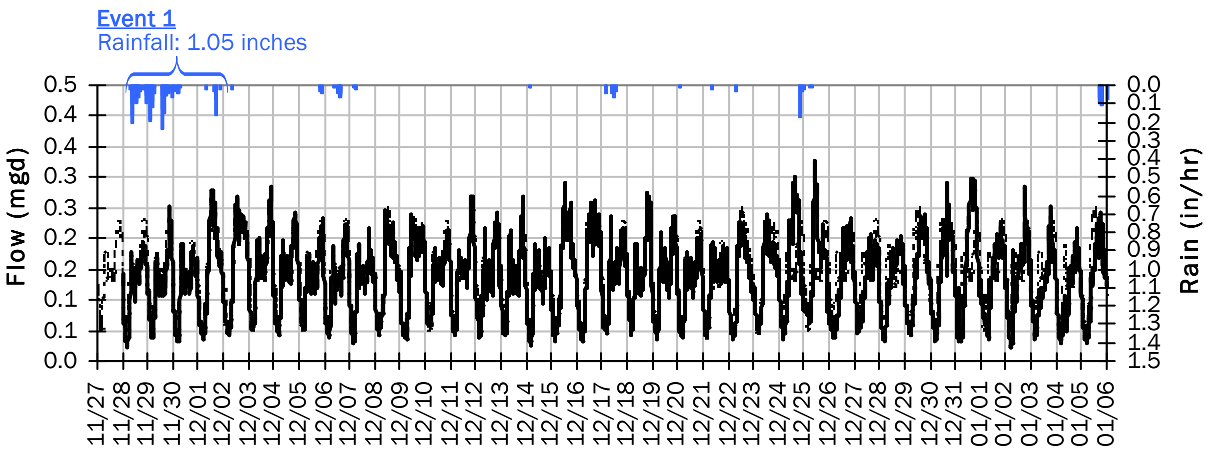


Pipe Diameter:	18	*inches*
Peak Measured Level:	6.63	*inches*
Peak d/D Ratio:	0.37	

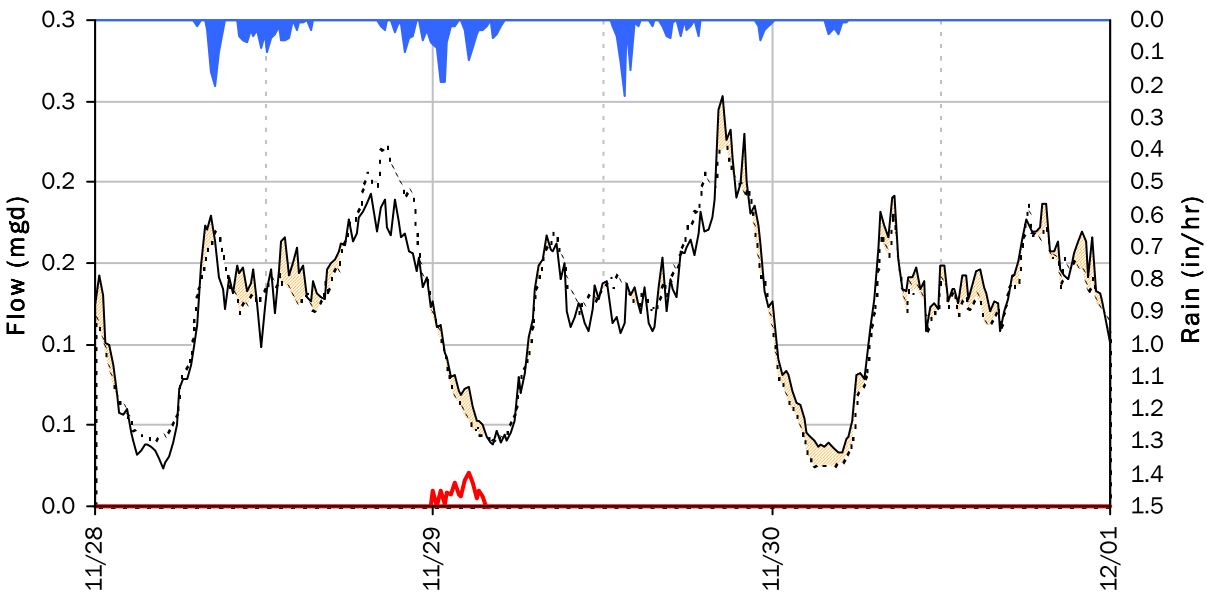
SITE 13

I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



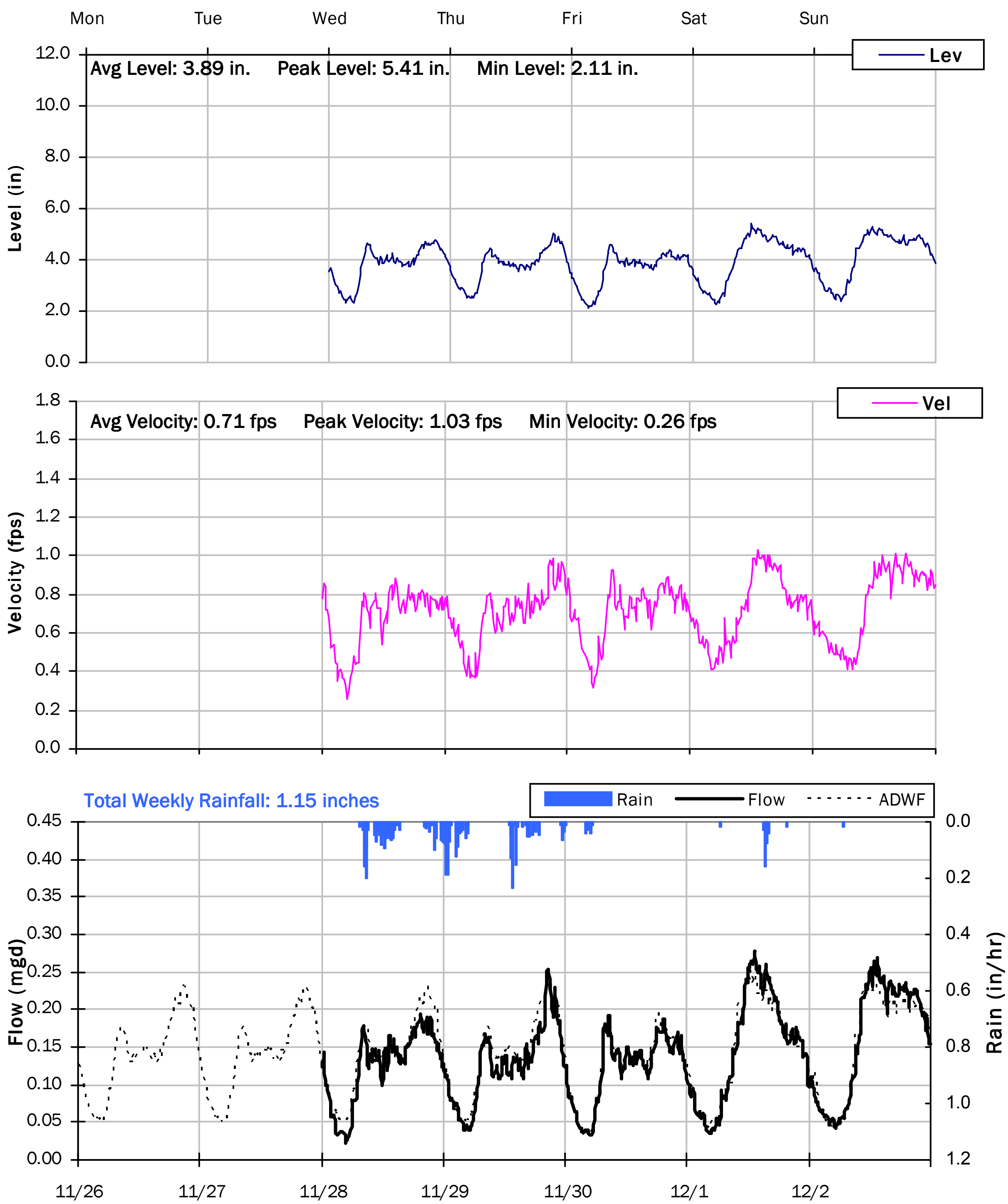
Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 1.05 inches)

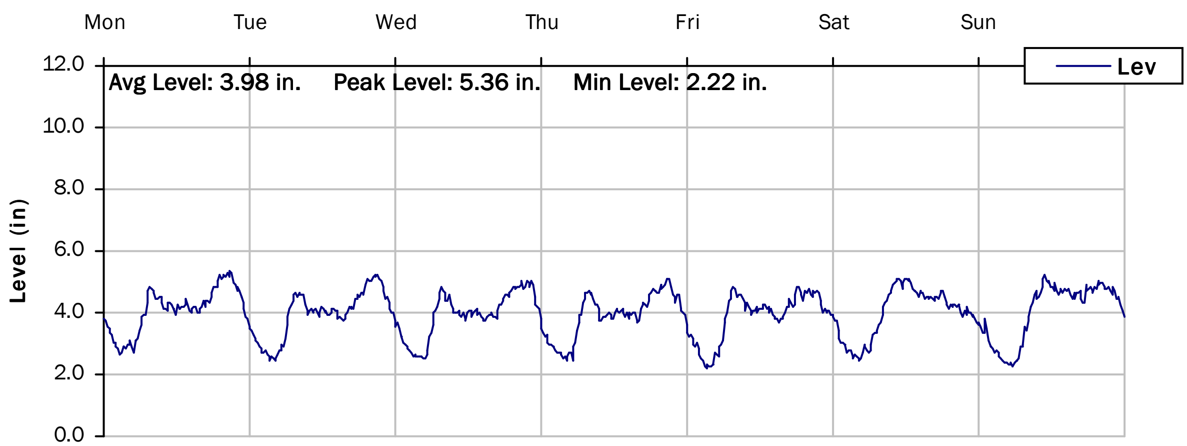
Capacity		**Inflow / Infiltration**	
Peak Flow:	0.13 *mgd*	**Peak I/I Rate:**	0.02 *mgd*
PF:	0.91	**Total I/I:**	1,000 *gallons*
Peak Level:	3.62 *in*		
d/D Ratio:	0.20		

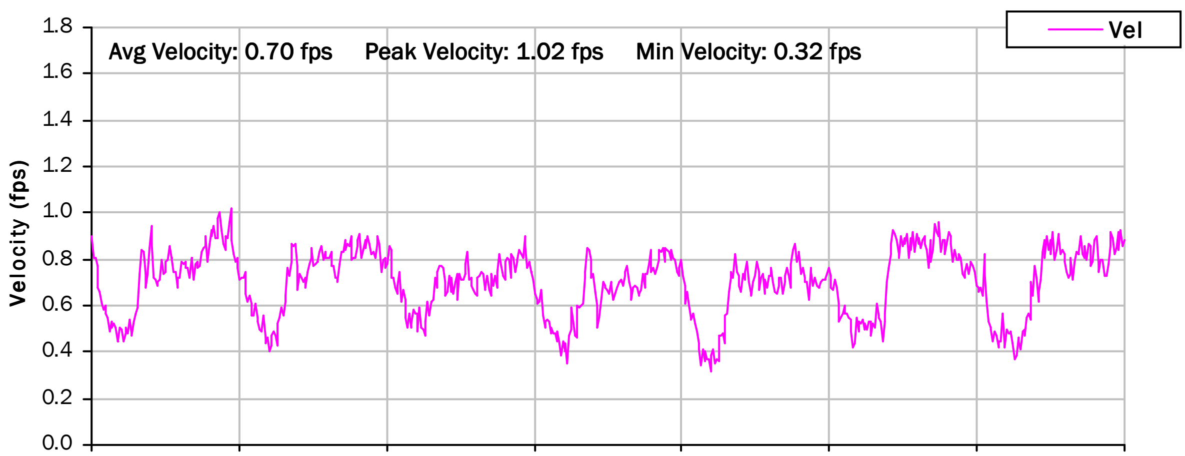
SITE 13
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018

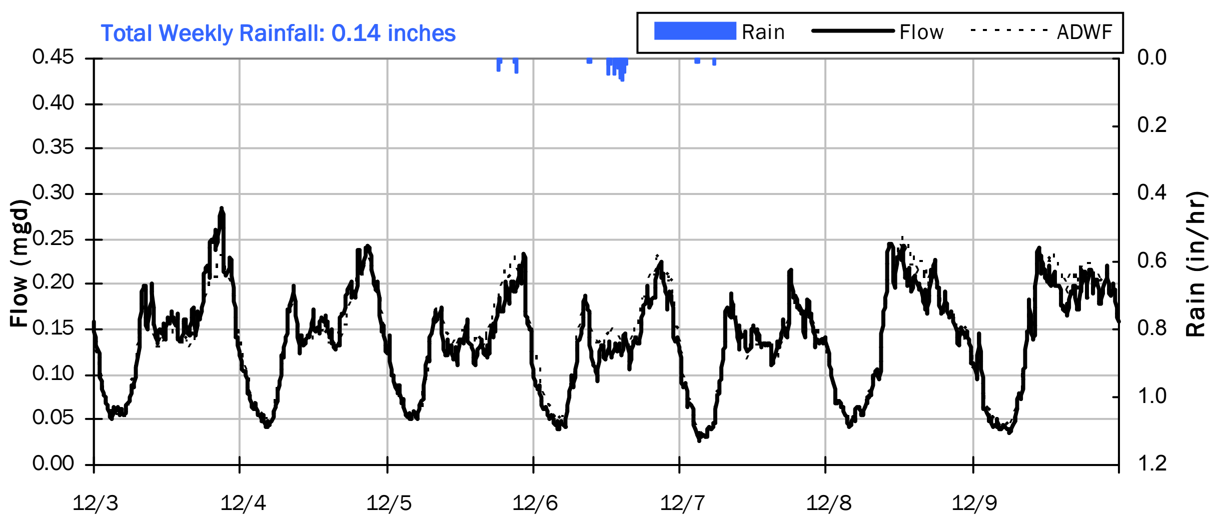


Avg Flow: 0.137 mgd **Peak Flow: 0.278 mgd** **Min Flow: 0.023 mgd**

SITE 13
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018

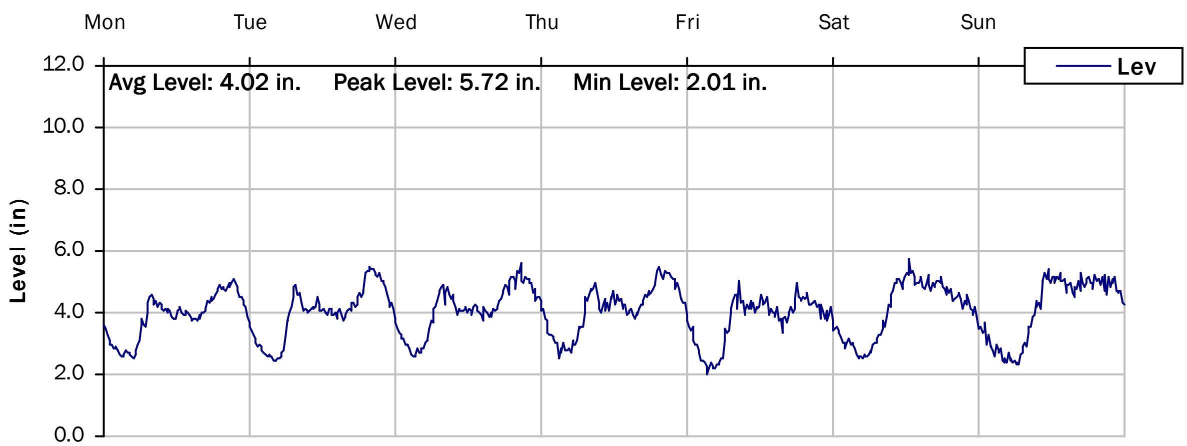


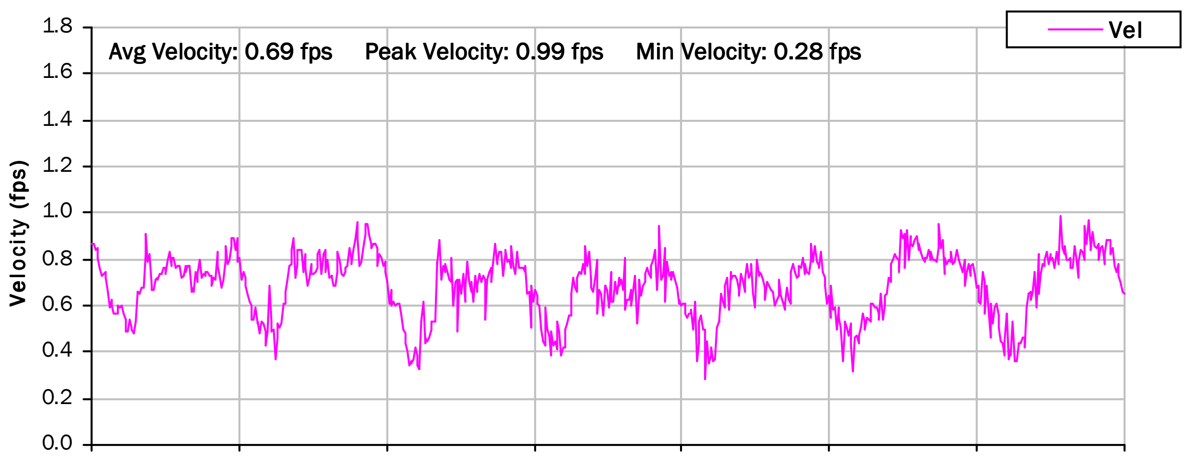


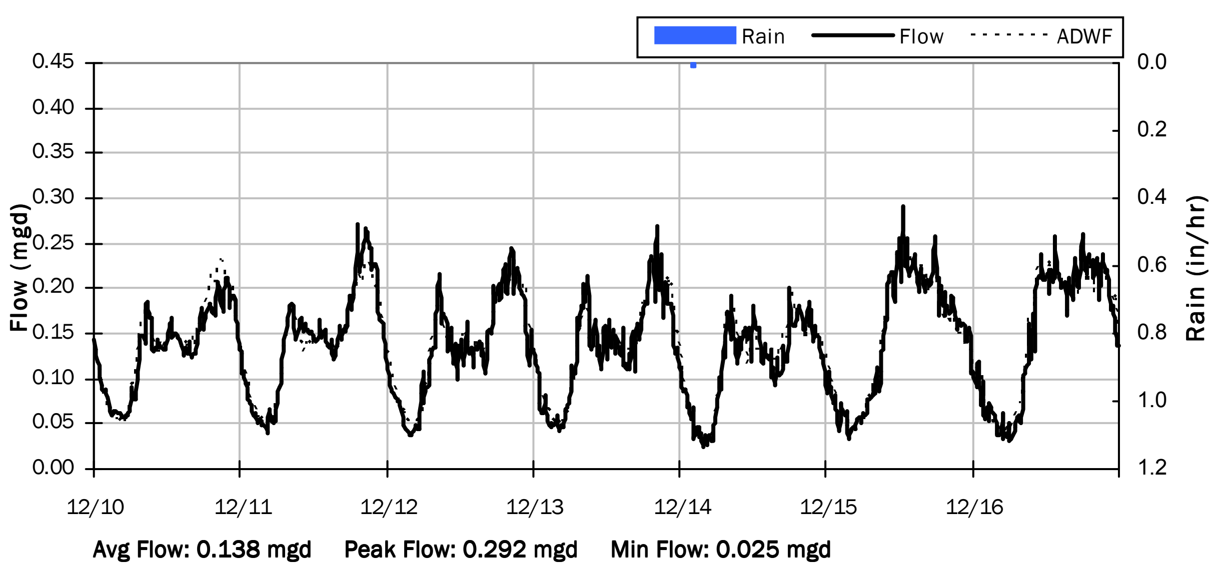


Avg Flow: 0.138 mgd Peak Flow: 0.284 mgd Min Flow: 0.028 mgd

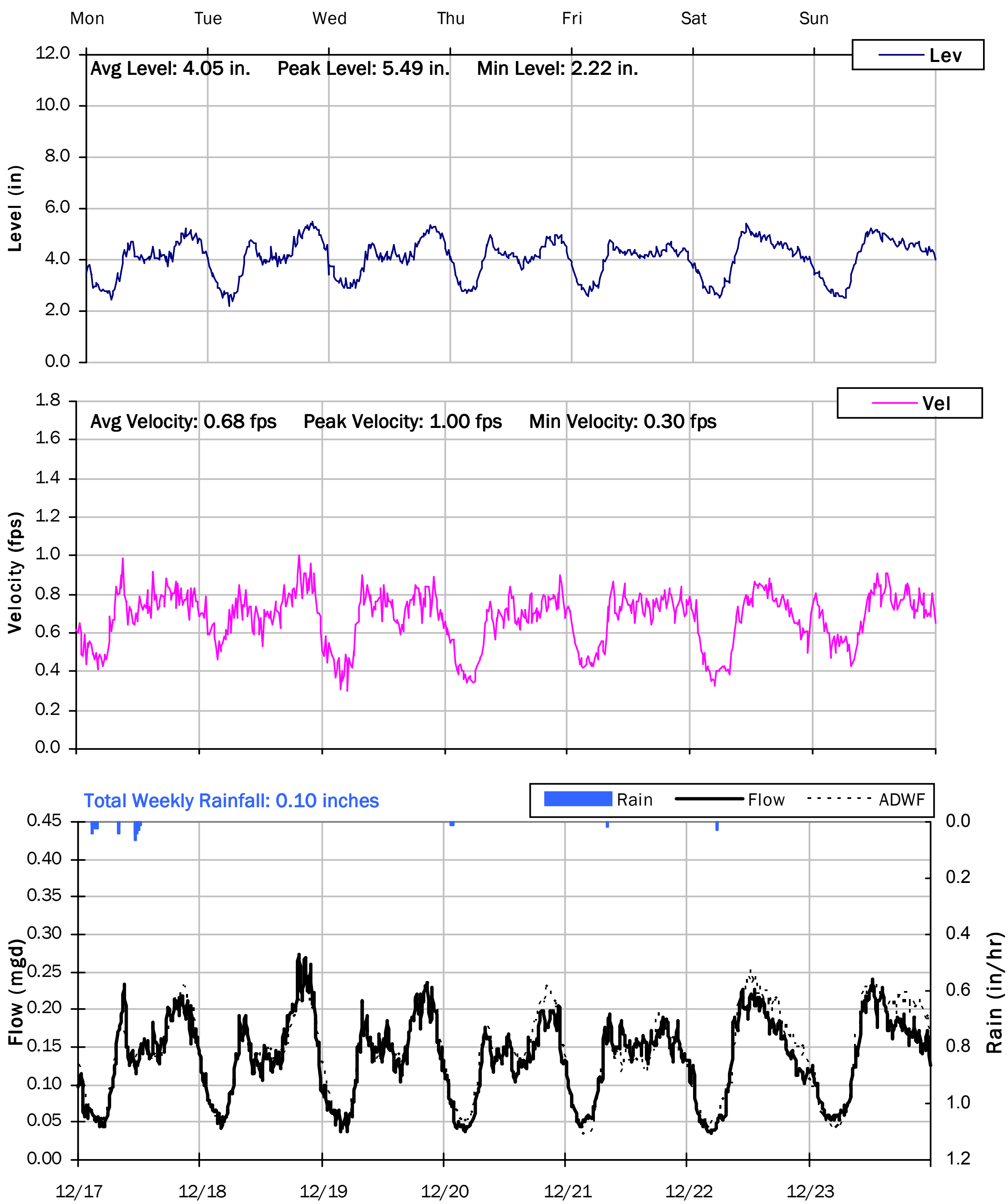
SITE 13
Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018





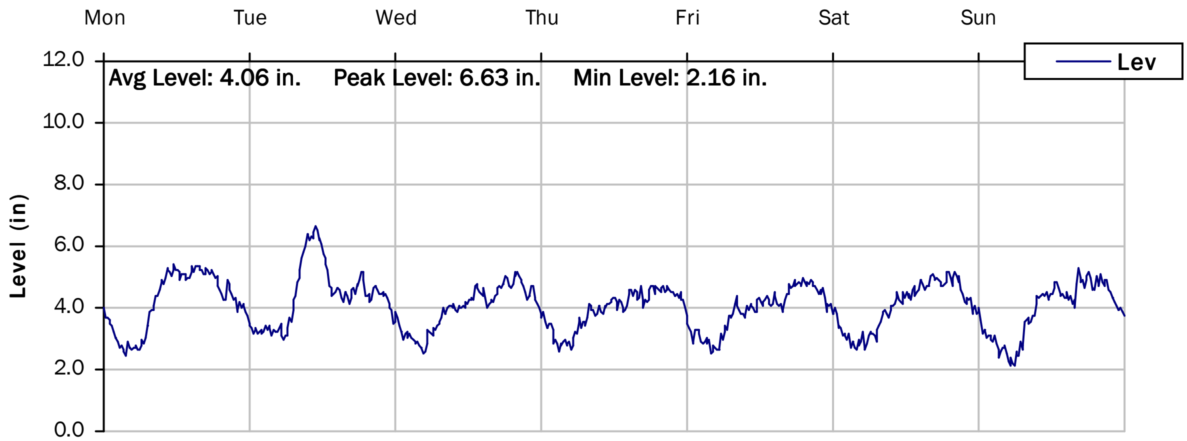


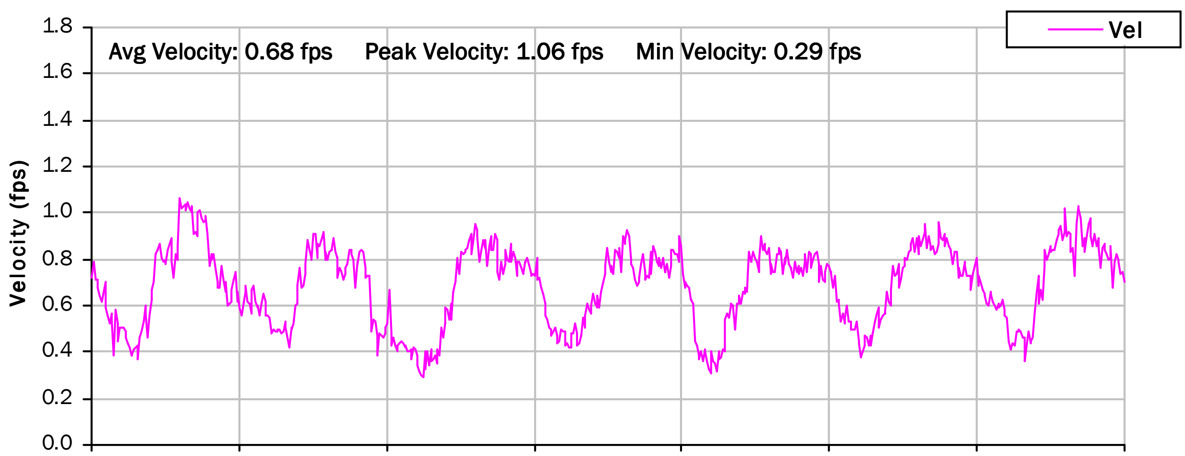
SITE 13
Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018

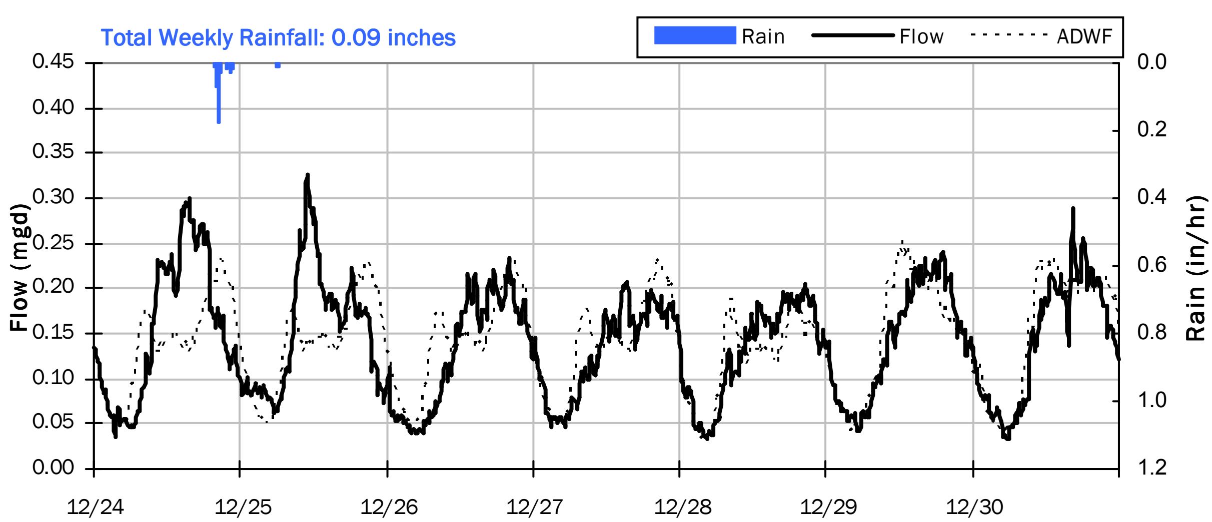


Avg Flow: 0.136 mgd Peak Flow: 0.275 mgd Min Flow: 0.035 mgd

SITE 13
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018

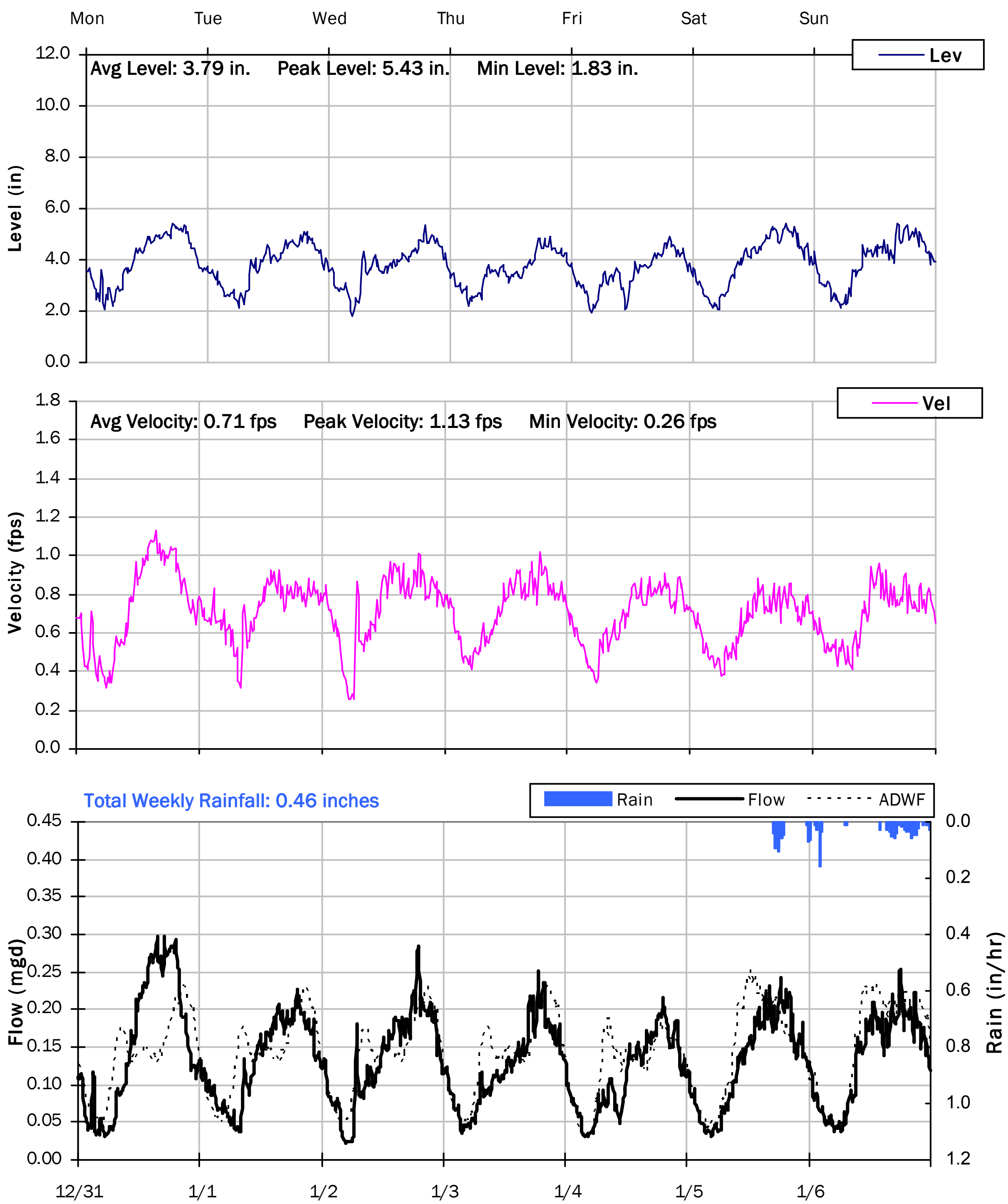






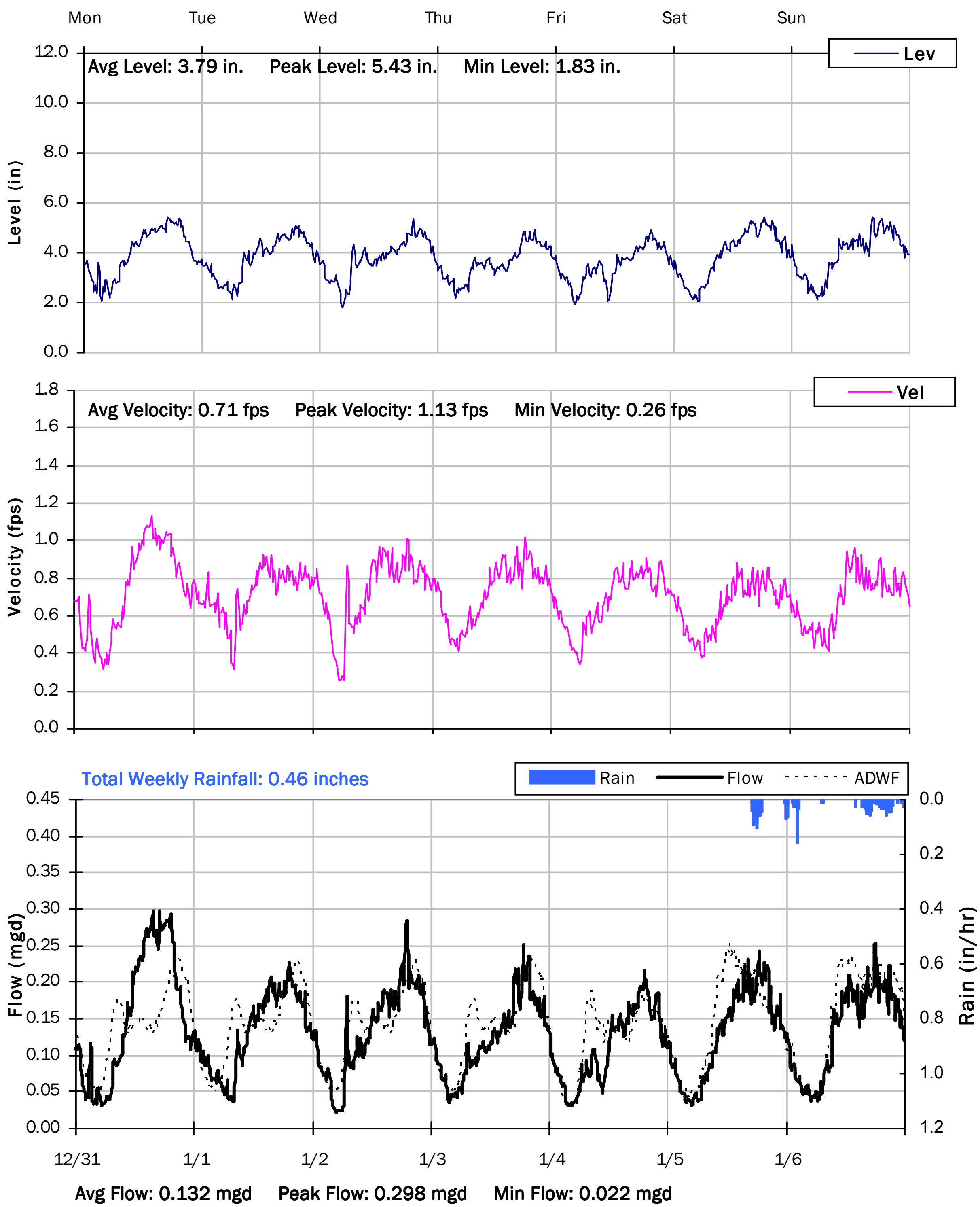
Avg Flow: 0.140 mgd **Peak Flow: 0.326 mgd** **Min Flow: 0.033 mgd**

SITE 13
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



Avg Flow: 0.132 mgd Peak Flow: 0.298 mgd Min Flow: 0.022 mgd

SITE 13
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



City of Visalia

Sanitary Sewer Flow Monitoring

November 28, 2018 - January 06, 2019

Monitoring Site: Site 14

Location: W Cecil Ave & N Ranch Ct

Data Summary Report

Vicinity Map: Site 14

SITE 14

Site Information

Location: W Cecil Ave & N Ranch Ct

Coordinates: 119.3215° W, 36.3409° N

Rim Elevation (Earth): 319 feet

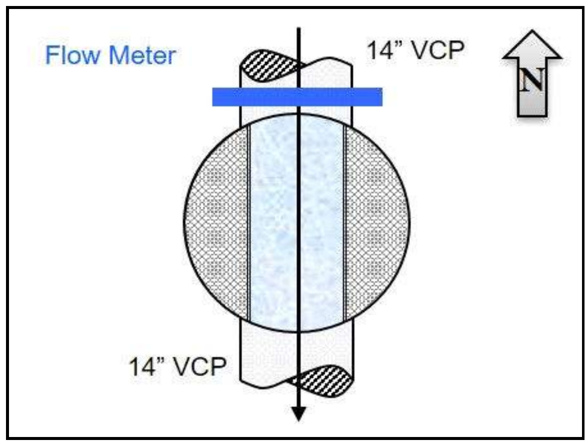
Pipe Diameter: 18 inches

ADWF: 0.570 mgd

Peak Measured Flow: 0.983 mgd

Satellite Map

Sewer Map



Flow Sketch


Street View


Plan View

SITE 14

Additional Site Photos

Effluent Pipe

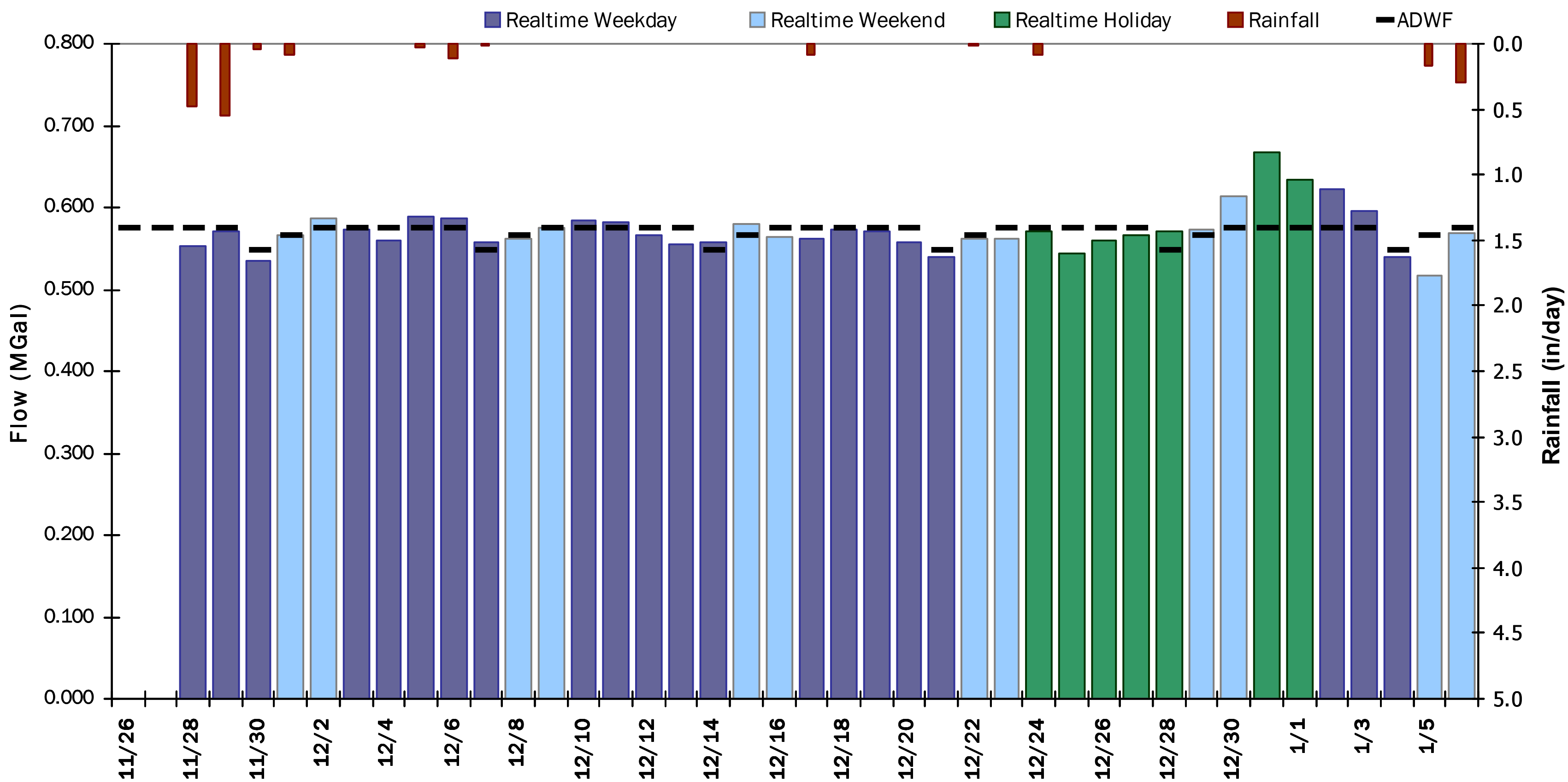
Influent Pipe

SITE 14

Period Flow Summary: Daily Flow Totals

Avg Period Flow: 0.572 MGal **Peak Daily Flow: 0.667 MGal** **Min Daily Flow: 0.518 MGal**

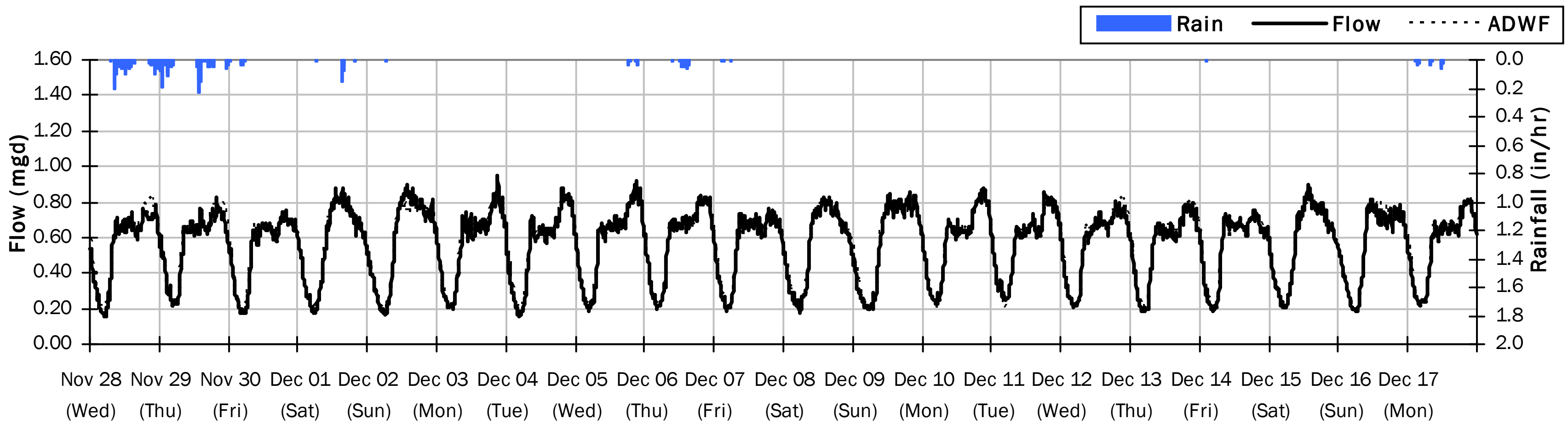
Total Period Rainfall: 1.95 inches

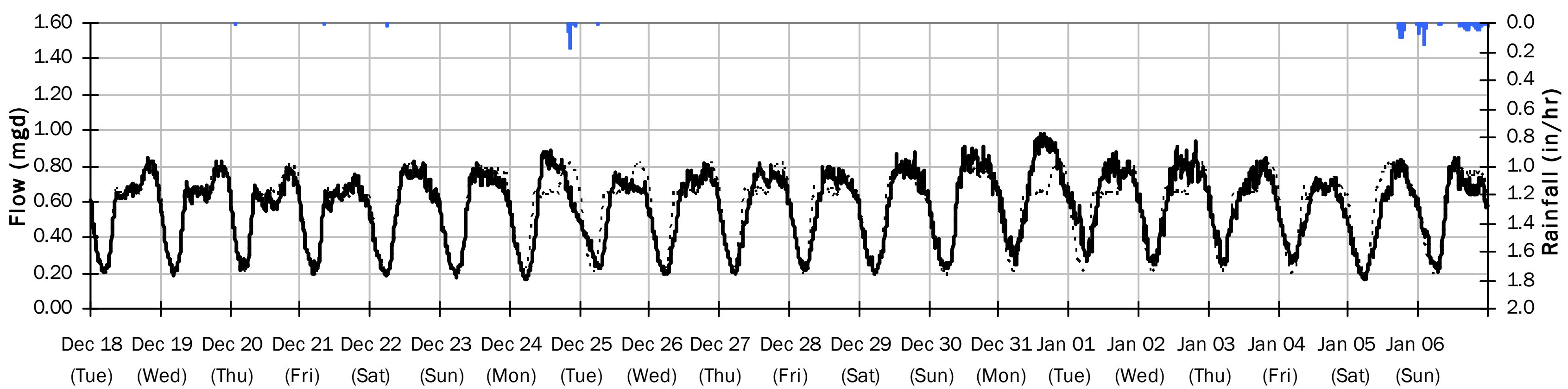


SITE 14

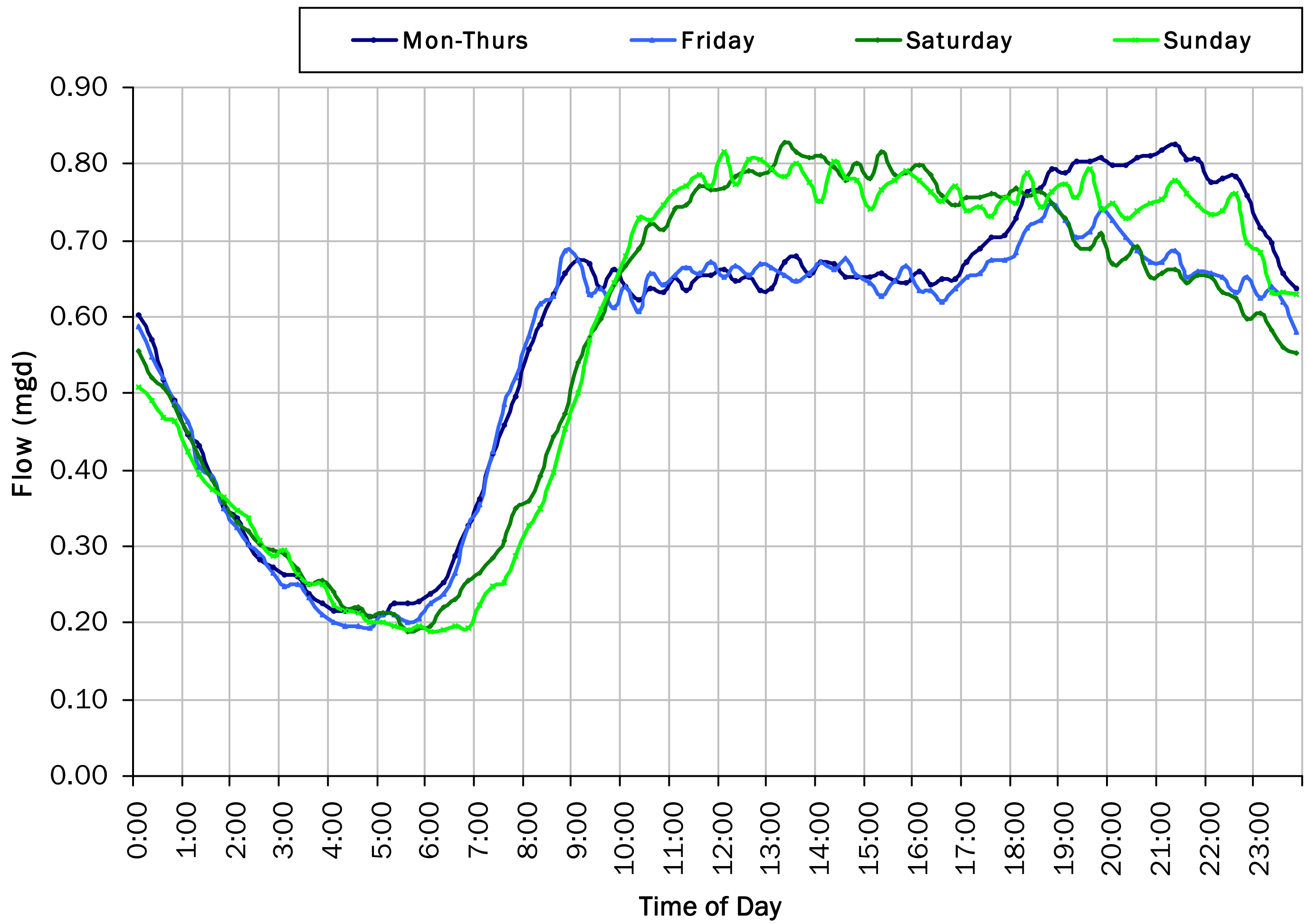
Flow Summary: 11/28/2018 to 1/6/2019

Total Period Rainfall: 1.95 inches Avg Flow: 0.572 mgd Peak Flow: 0.983 mgd Min Flow: 0.155 mgd



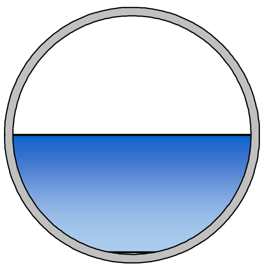


SITE 14
Average Dry Weather Flow Hydrographs



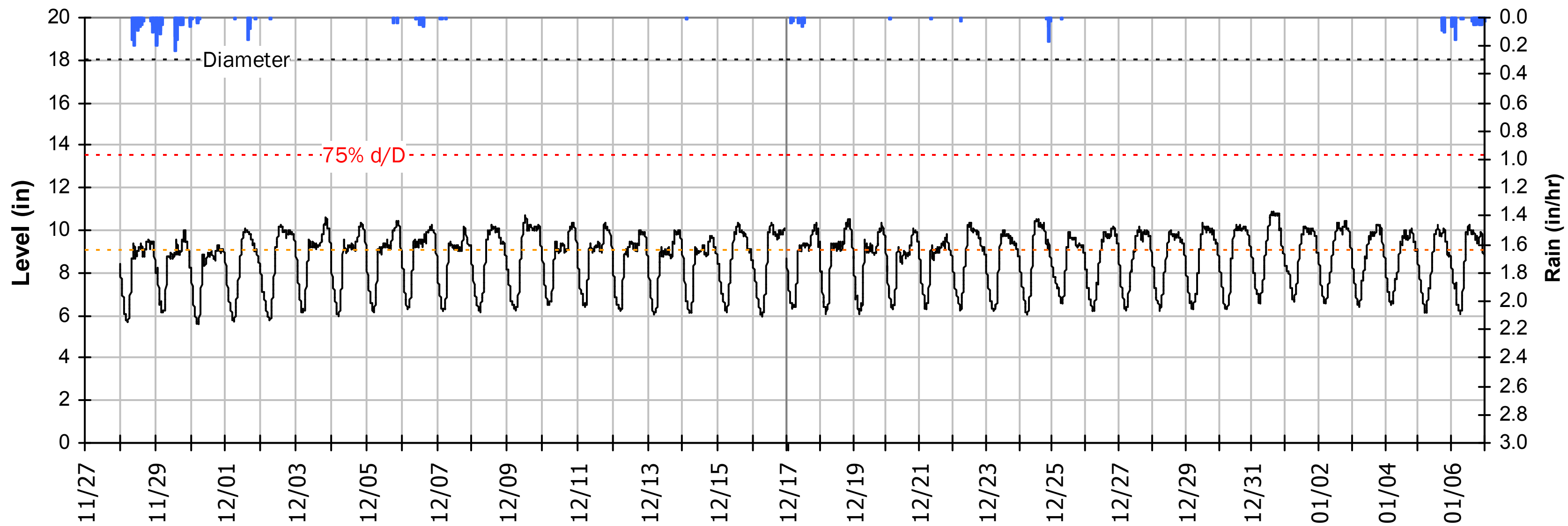
ADWF:

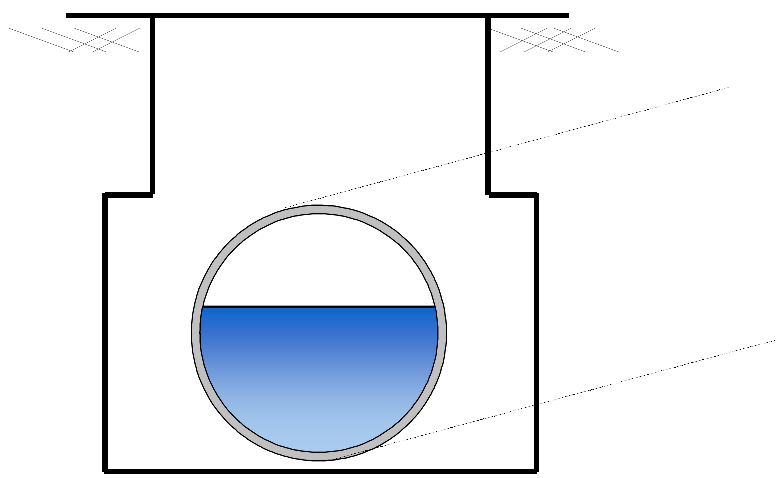
0.570 *mgd*



SITE 14
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period

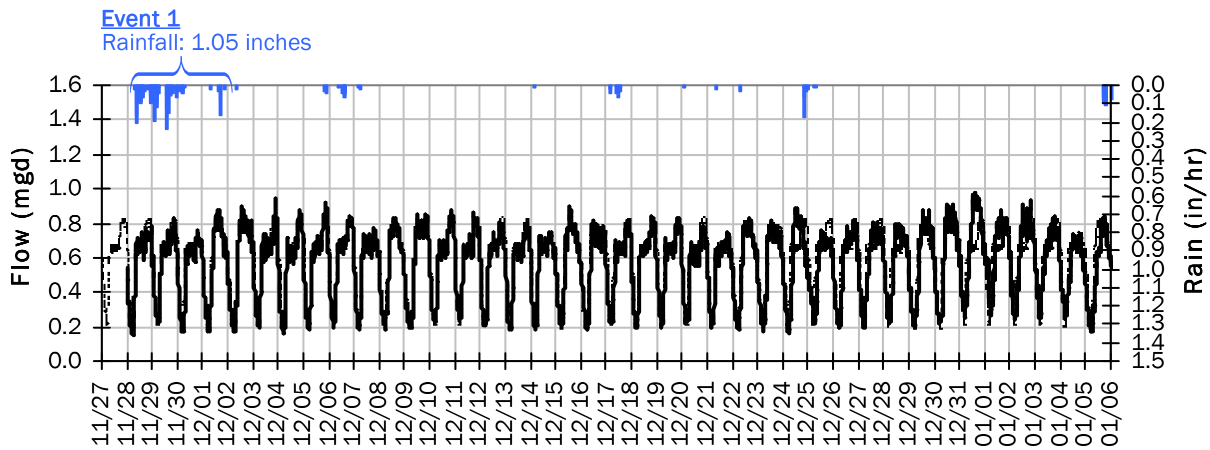




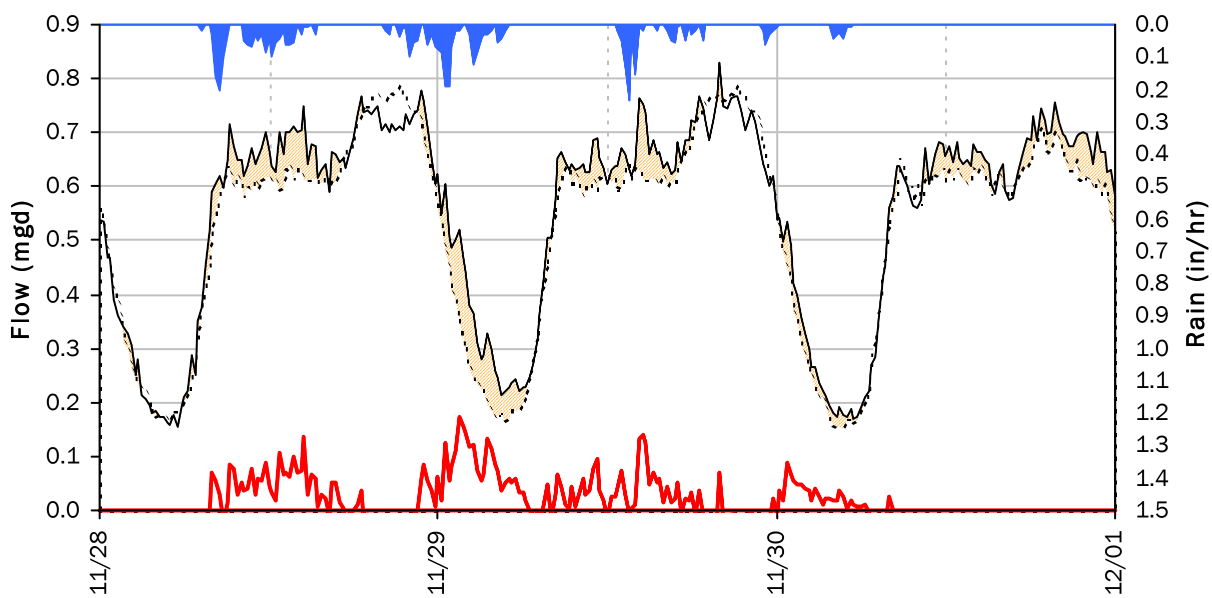
Pipe Diameter:	18	*inches*
Peak Measured Level:	10.9	*inches*
Peak d/D Ratio:	0.61	

SITE 14
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



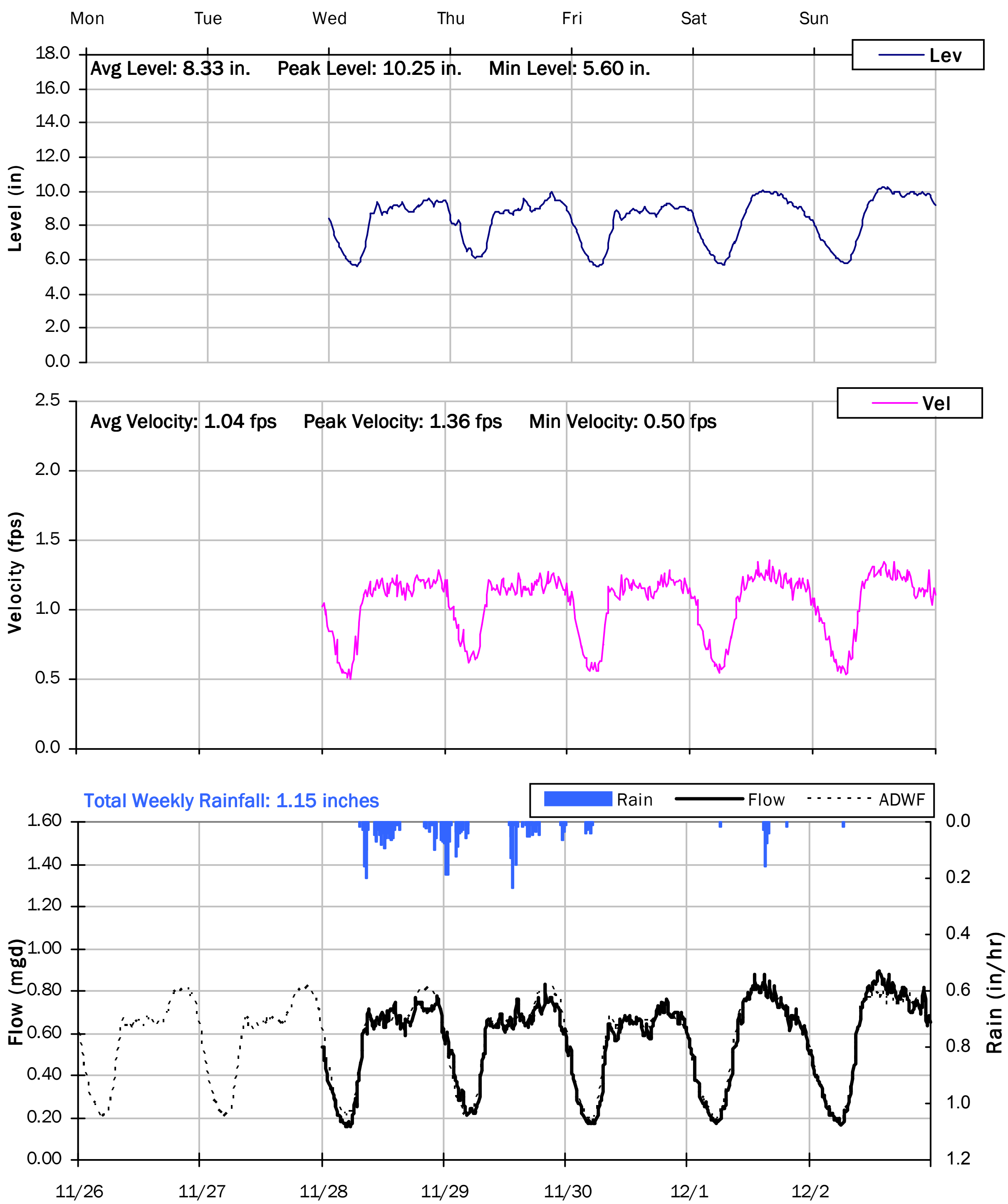
Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 1.05 inches)

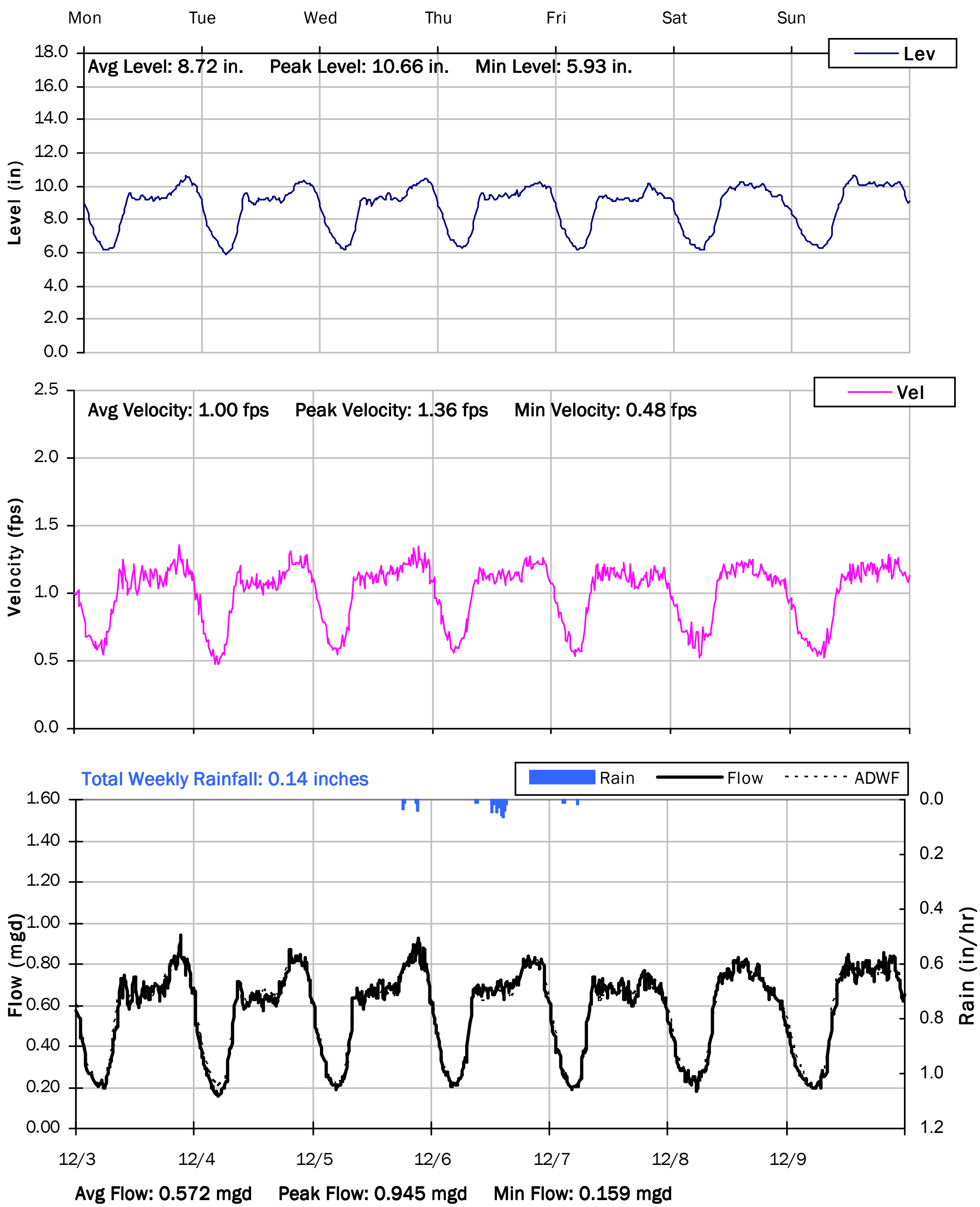
Capacity		**Inflow / Infiltration**	
Peak Flow:	0.83 *mgd*	**Peak I/I Rate:**	0.17 *mgd*
PF:	1.46	**Total I/I:**	59,000 *gallons*
Peak Level:	10.01 *in*		
d/D Ratio:	0.56		

SITE 14
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018

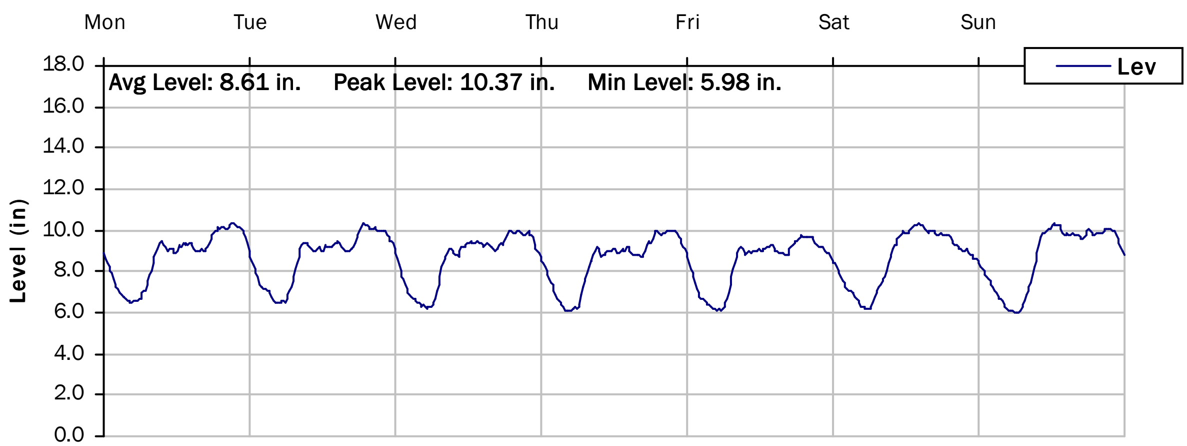


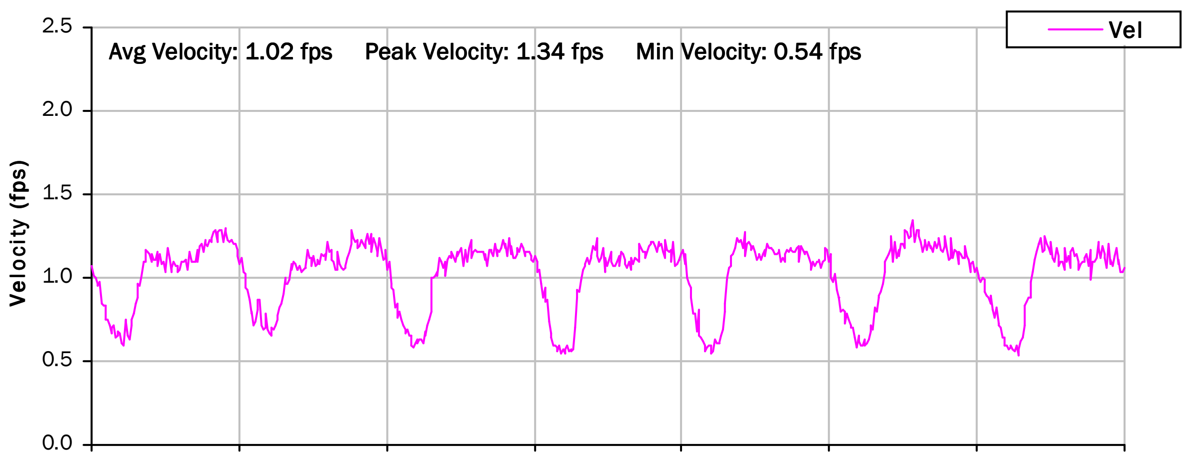
Avg Flow: 0.562 mgd **Peak Flow: 0.896 mgd** **Min Flow: 0.155 mgd**

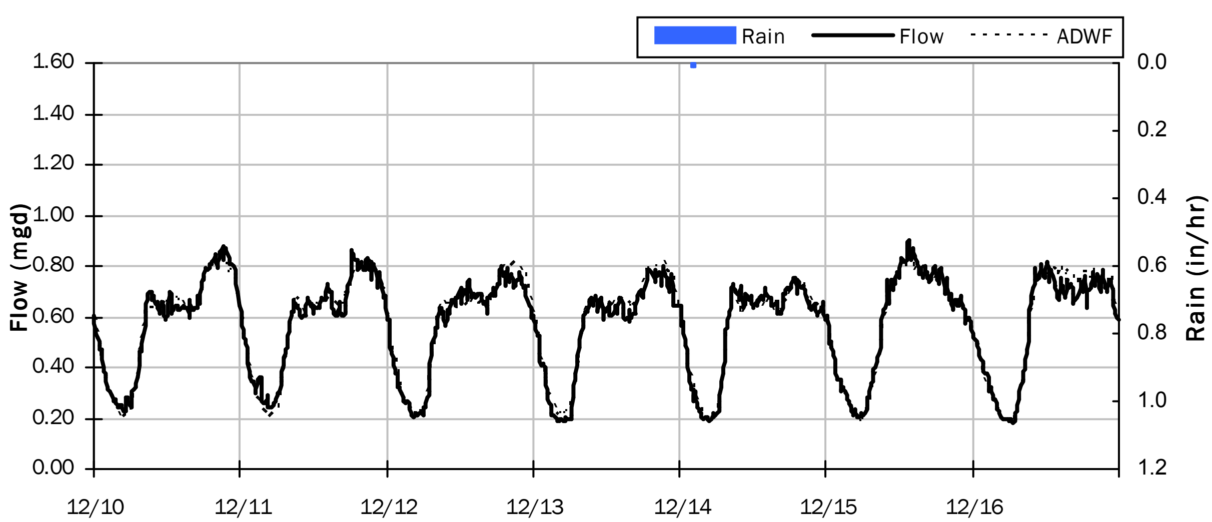
SITE 14
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018



SITE 14
Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018

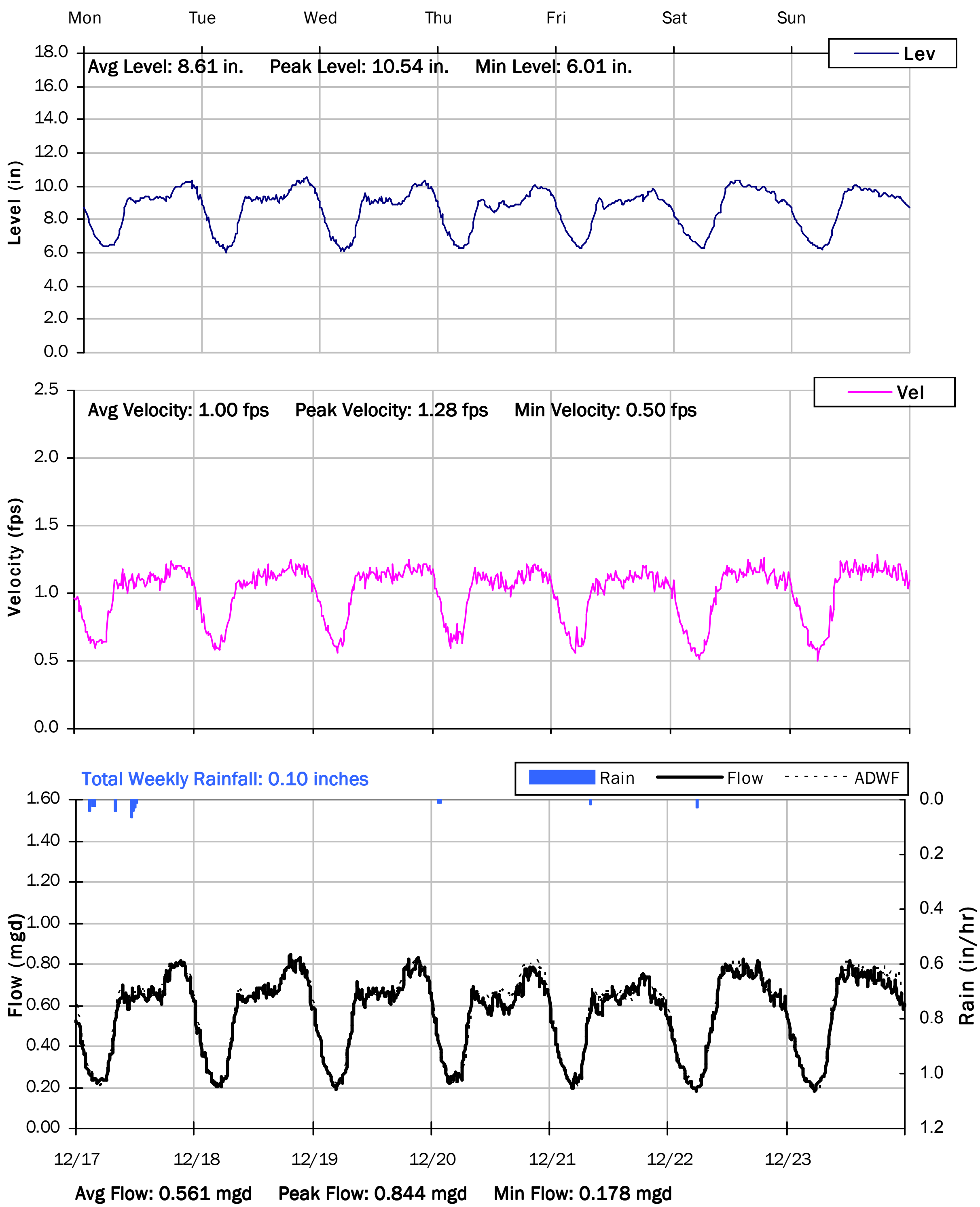




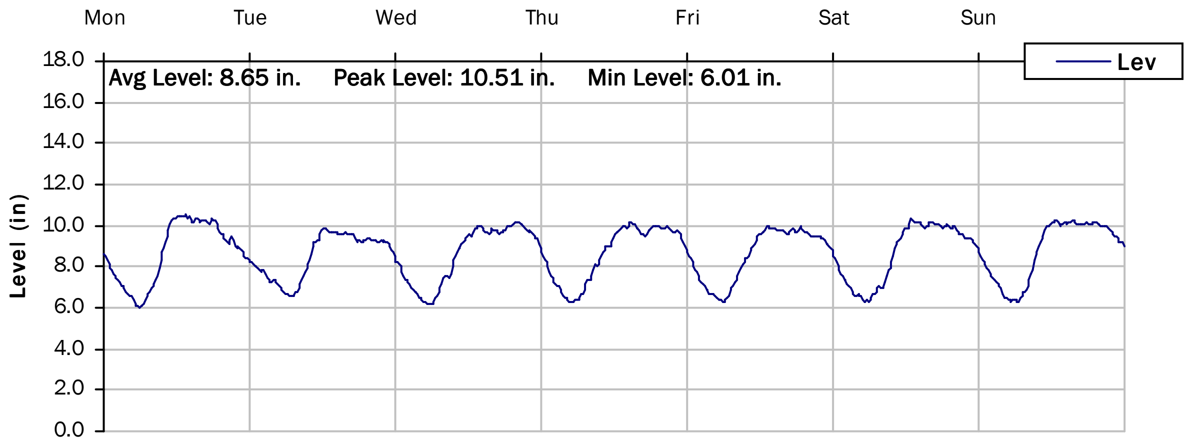


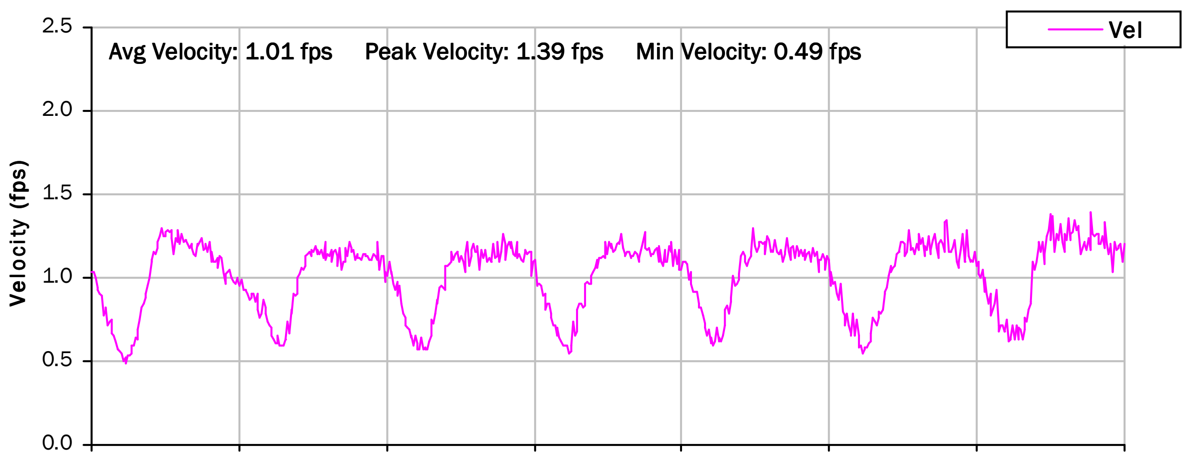
Avg Flow: 0.570 mgd **Peak Flow: 0.902 mgd** **Min Flow: 0.182 mgd**

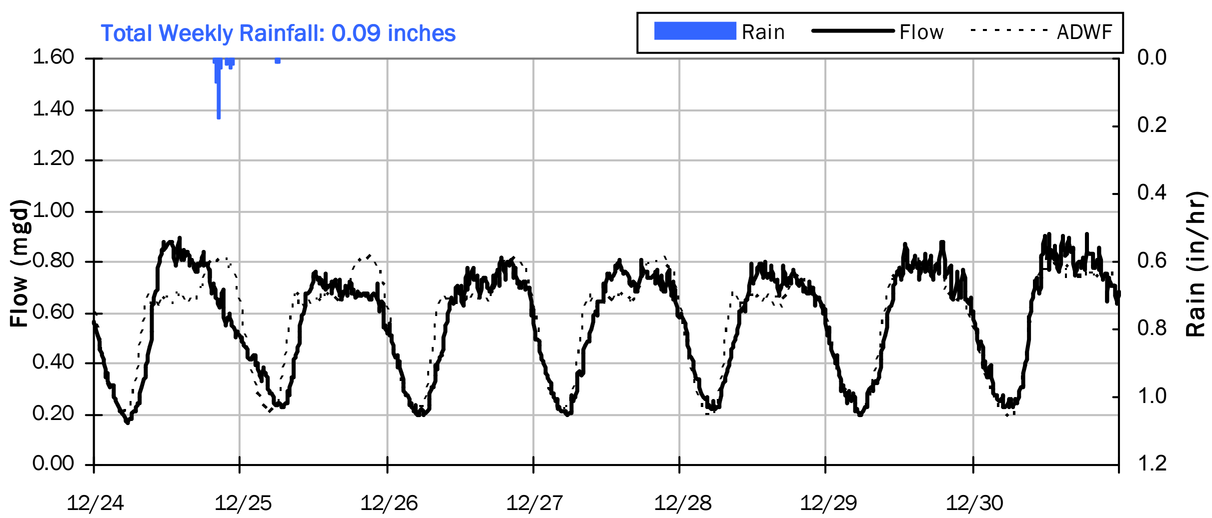
SITE 14
Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018



SITE 14
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018

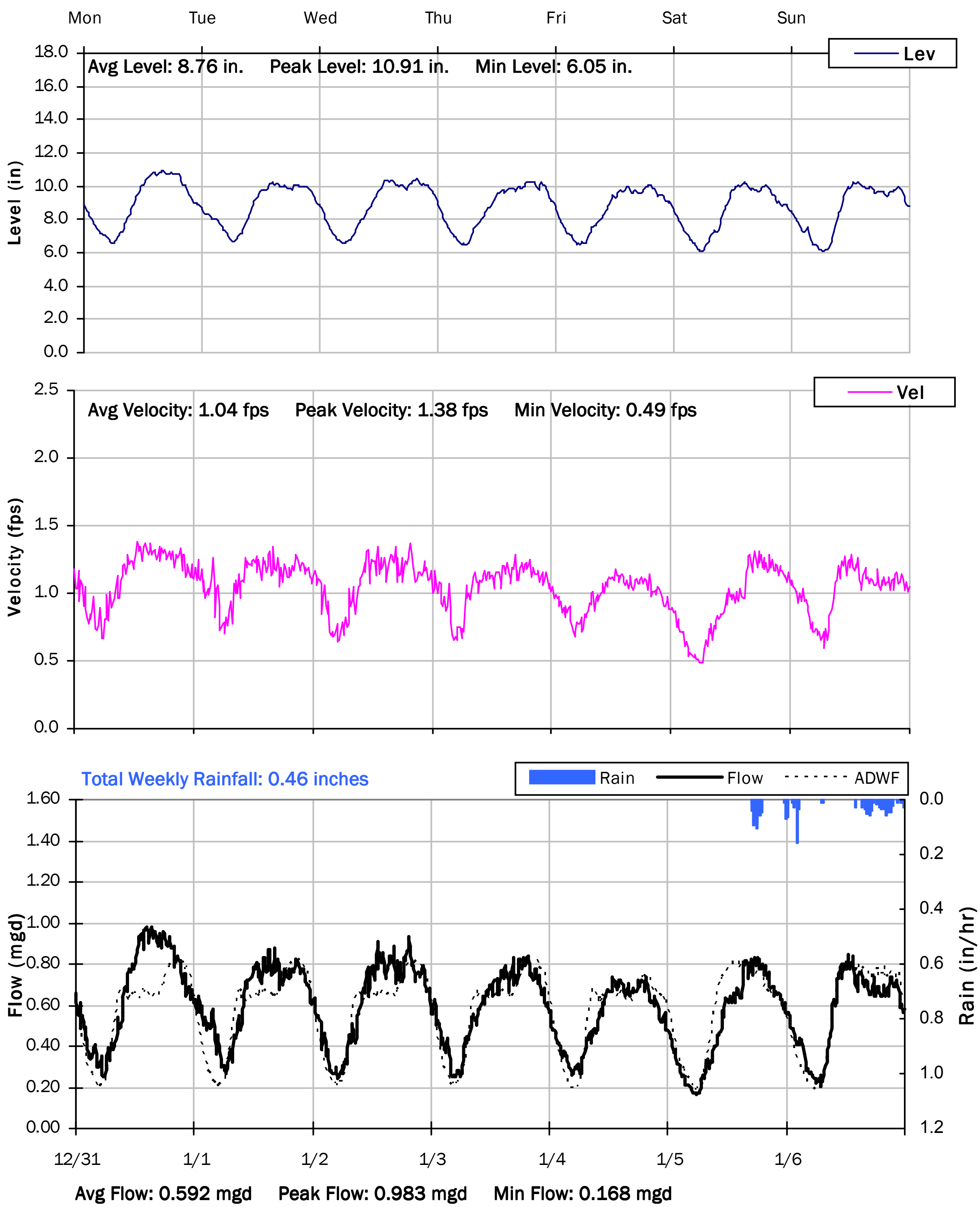




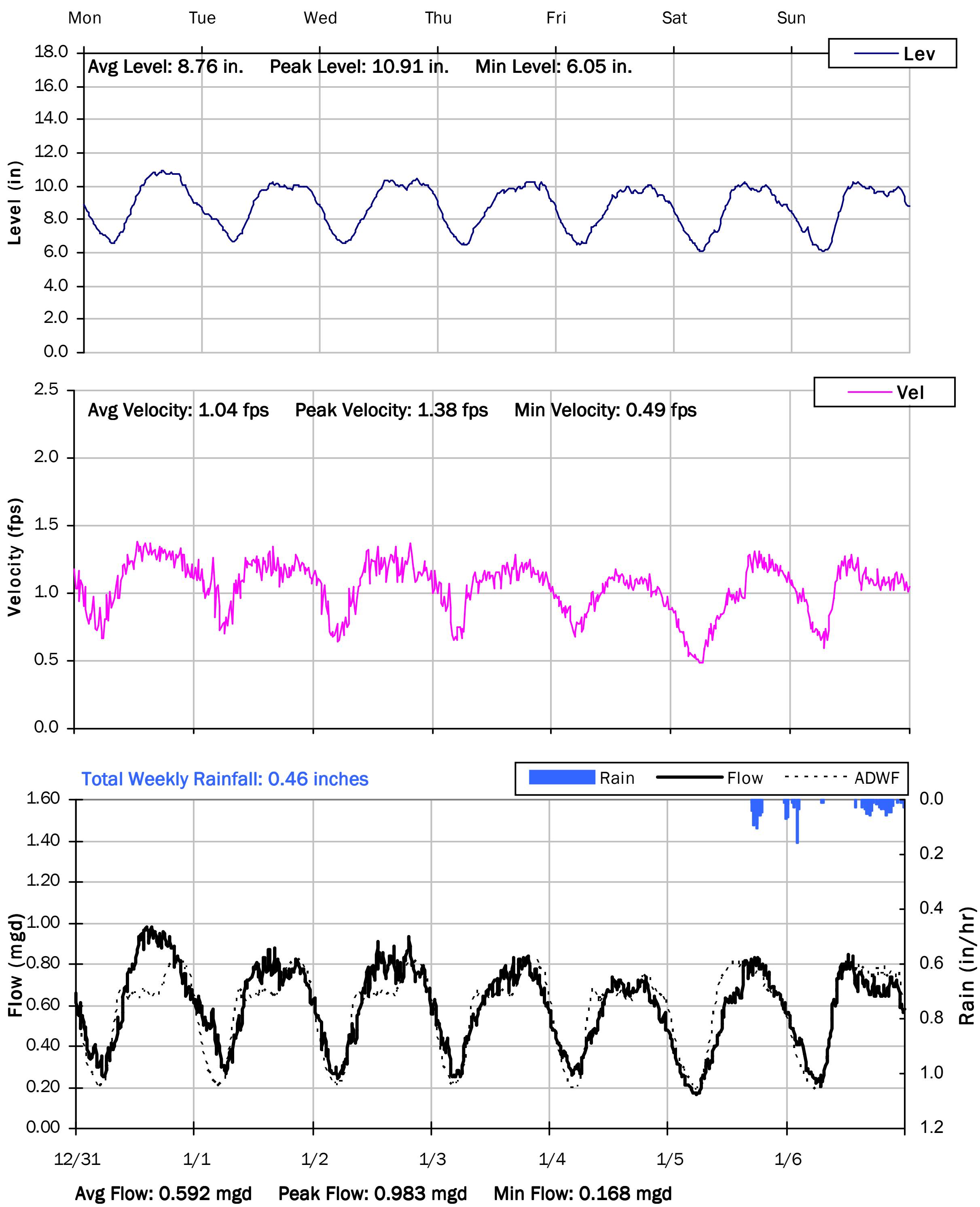


Avg Flow: 0.571 mgd **Peak Flow: 0.913 mgd** **Min Flow: 0.166 mgd**

SITE 14
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



SITE 14
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



City of Visalia

Sanitary Sewer Flow Monitoring

November 28, 2018 - January 06, 2019

Monitoring Site: Site 15

Location: 4425 W Ferguson Ave, w/o N Chinowth St

Data Summary Report

Vicinity Map: Site 15

SITE 15

Site Information

Location: 4425 W Ferguson Ave, w/o N Chinowth St

Coordinates: 119.3361° W, 36.3491° N

Rim Elevation (Earth): 315 feet

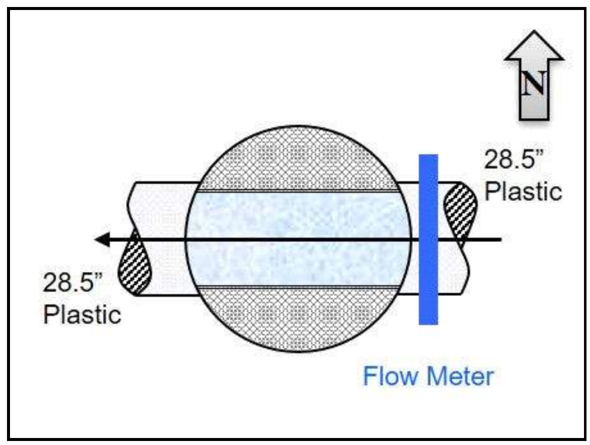
Pipe Diameter: 28.5 inches

ADWF: 0.967 mgd

Peak Measured Flow: 1.728 mgd

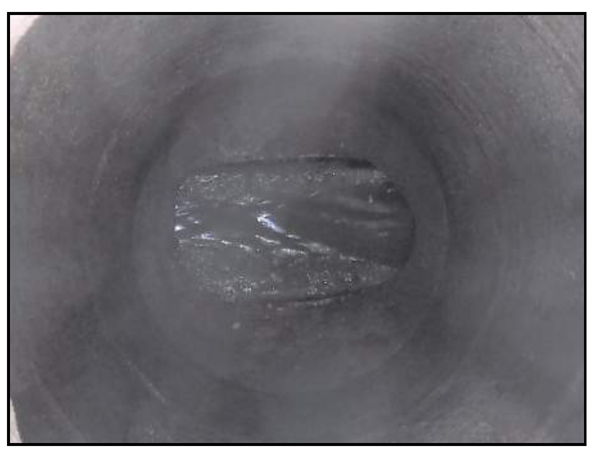
Satellite Map

Sewer Map



Flow Sketch

Street View



Plan View

SITE 15

Additional Site Photos

Effluent Pipe

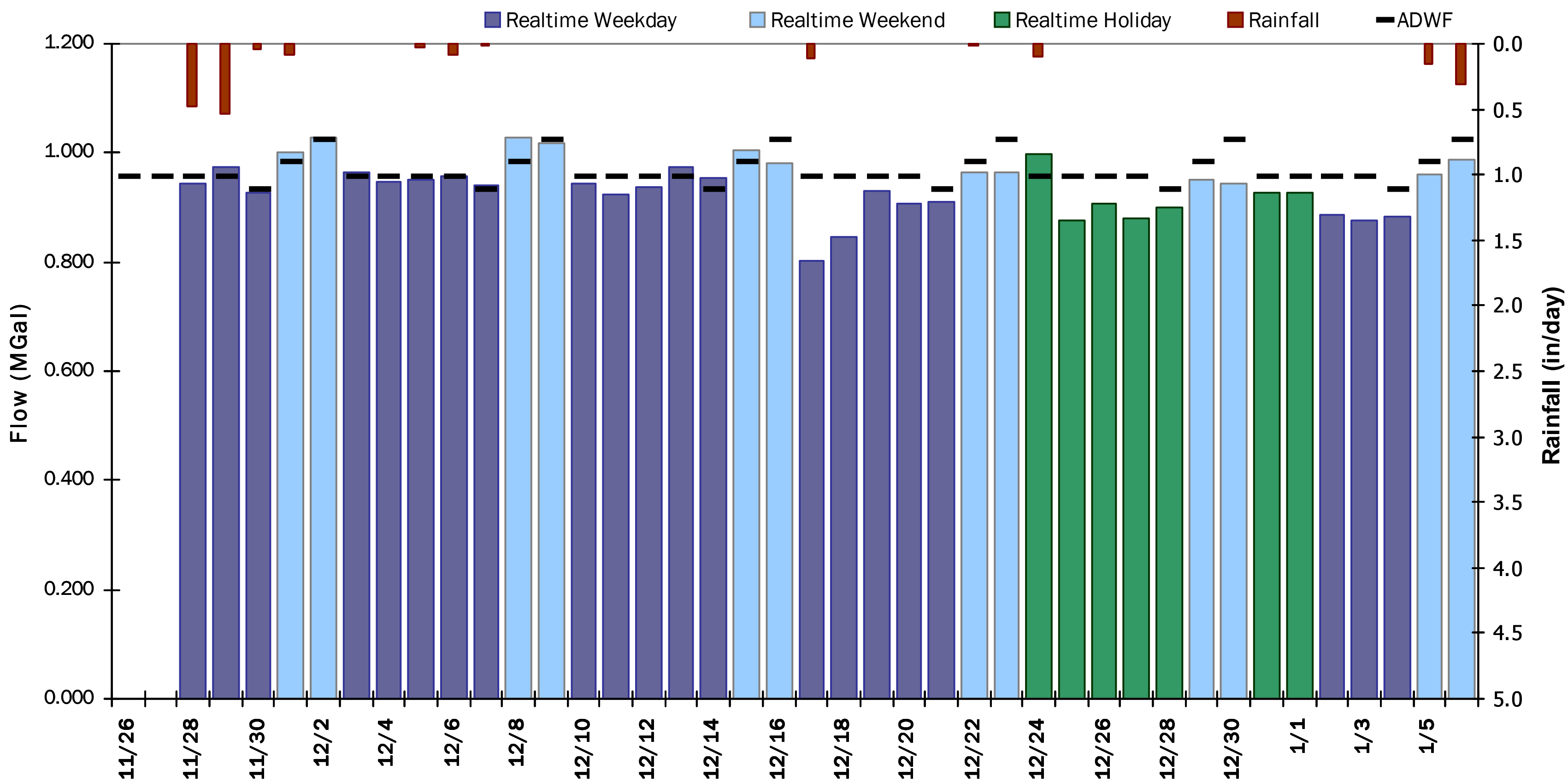
Influent Pipe

SITE 15

Period Flow Summary: Daily Flow Totals

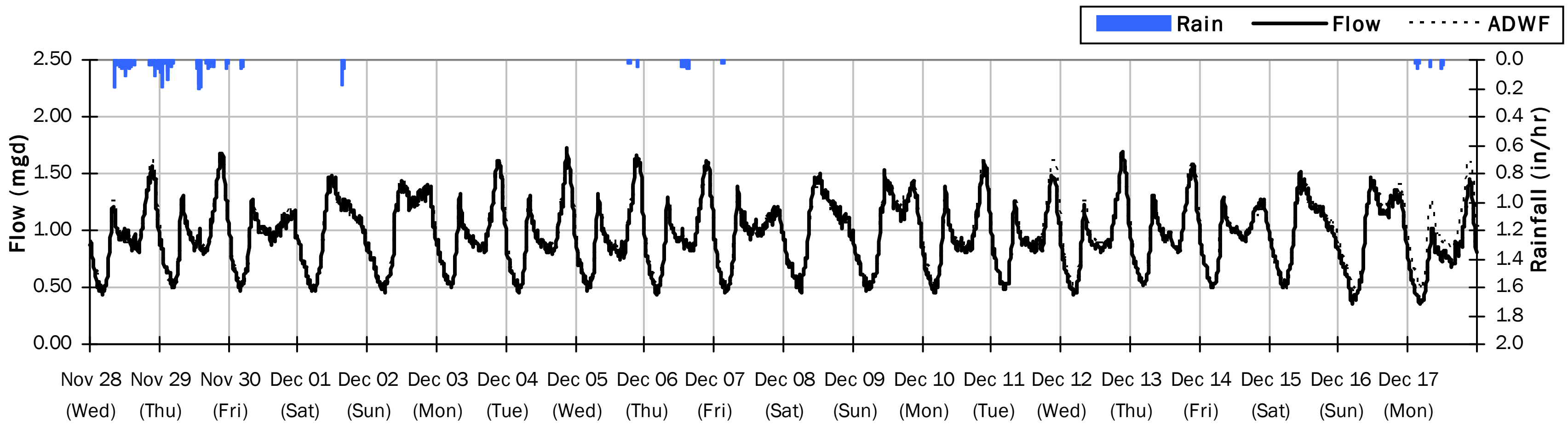
Avg Period Flow: 0.941 MGal **Peak Daily Flow: 1.027 MGal** **Min Daily Flow: 0.802 MGal**

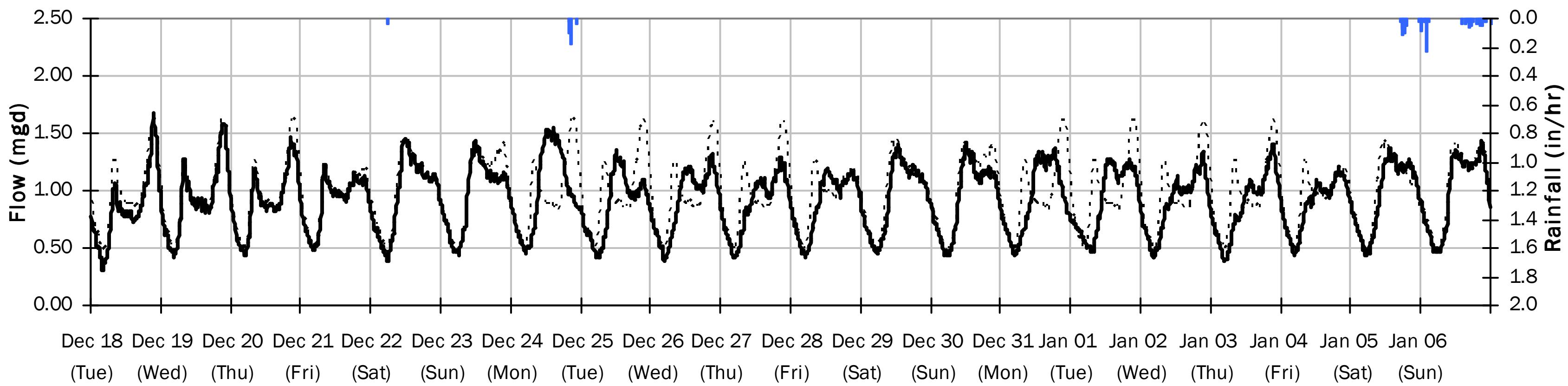
Total Period Rainfall: 1.95 inches



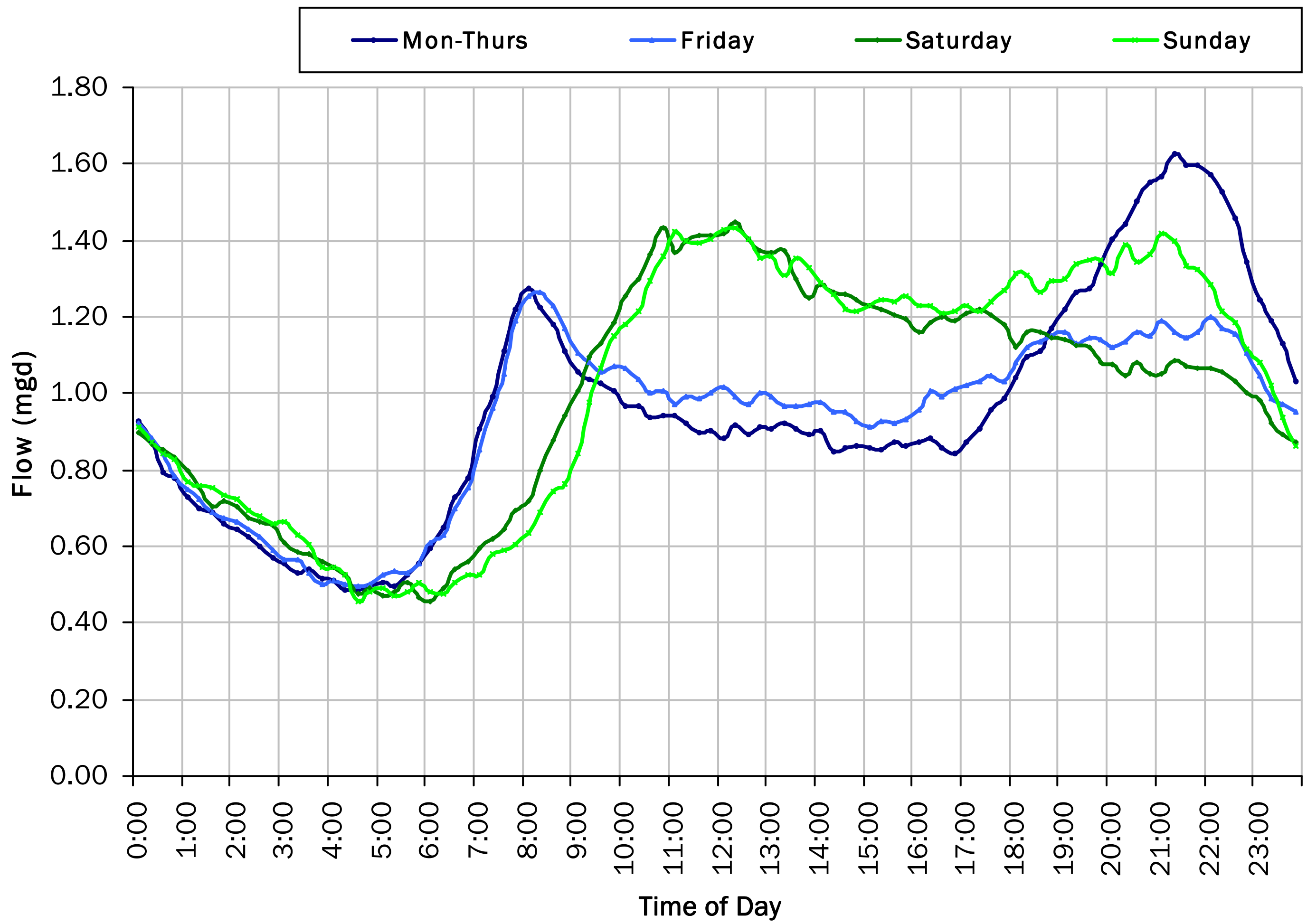
SITE 15
Flow Summary: 11/28/2018 to 1/6/2019

Total Period Rainfall: 1.95 inches Avg Flow: 0.941 mgd Peak Flow: 1.728 mgd Min Flow: 0.309 mgd



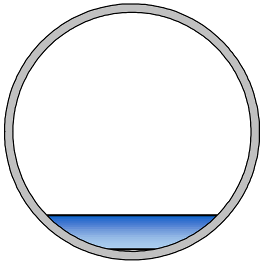


SITE 15
Average Dry Weather Flow Hydrographs



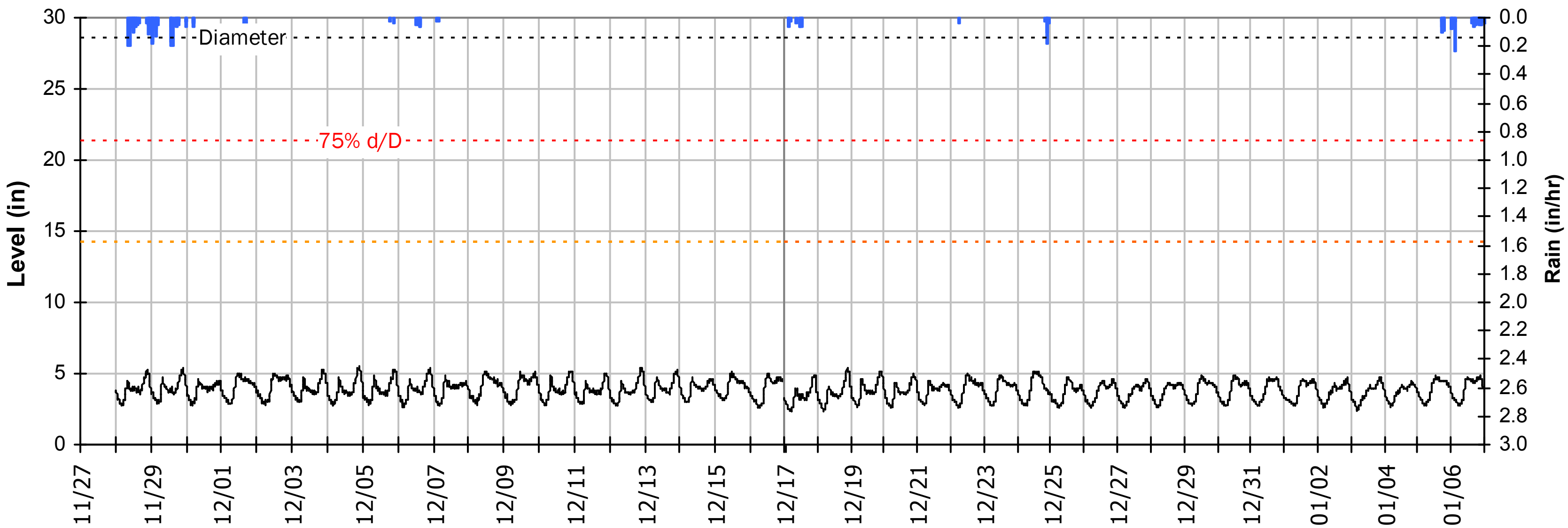
ADWF:

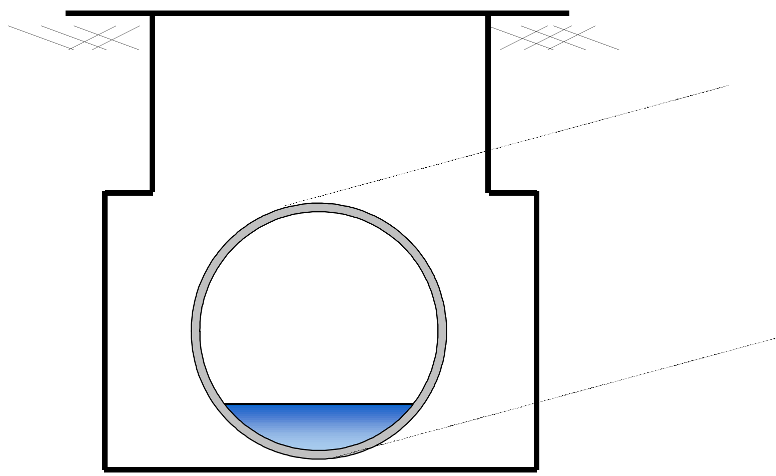
0.967 *mgd*



SITE 15
Site Capacity and Surcharge Summary

Realtime Flow Levels with Rainfall Data over Monitoring Period





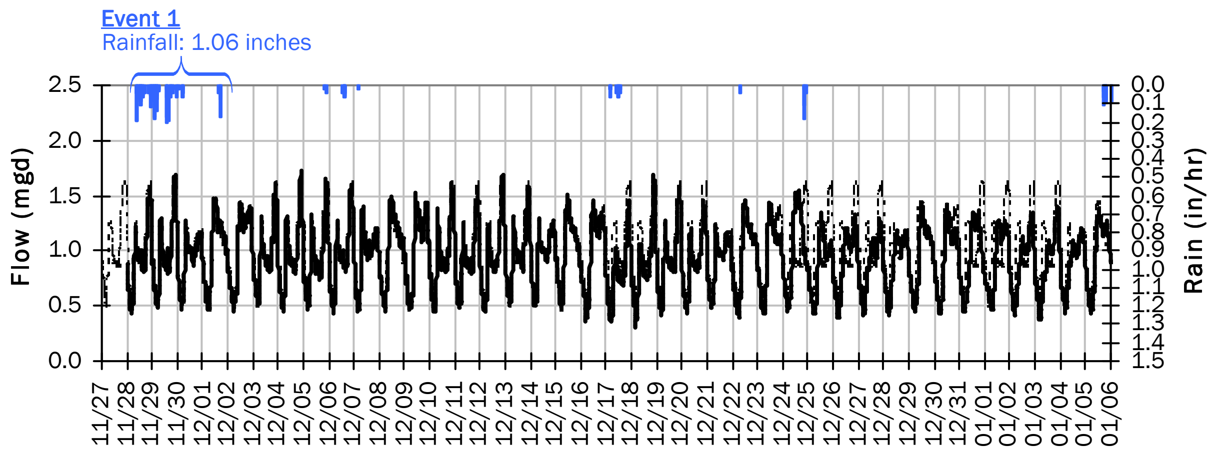
Pipe Diameter: 28.5 *inches*

Peak Measured Level: 5.53 *inches*

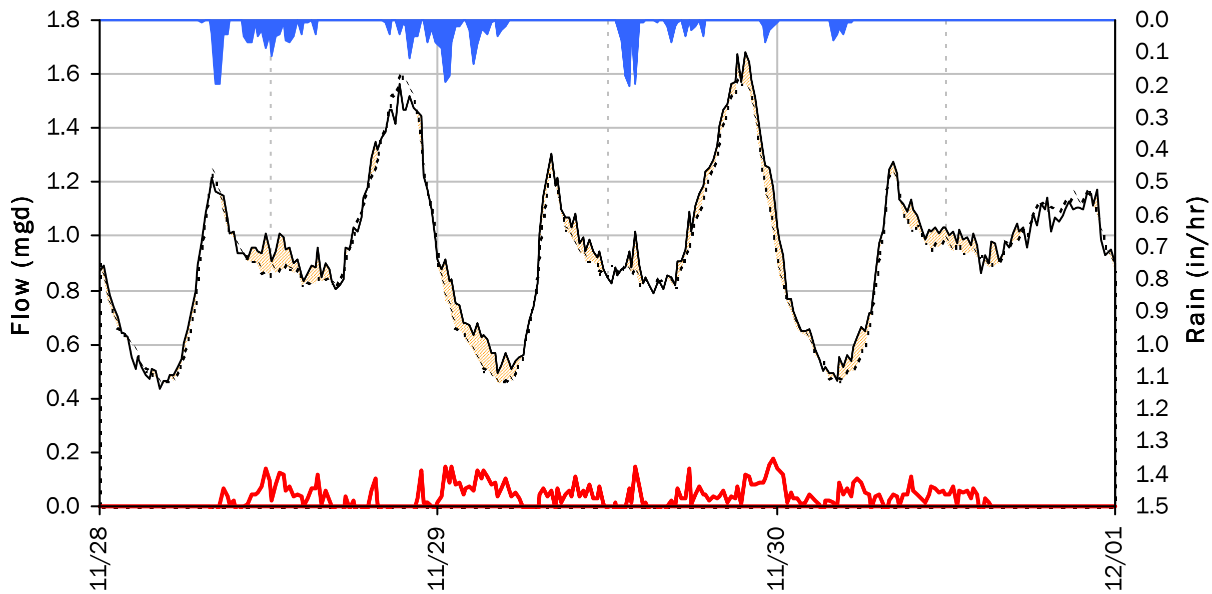
Peak d/D Ratio: 0.19

SITE 15
I/I Summary: Event 1

Baseline and Realtime Flows with Rainfall Data over Monitoring Period



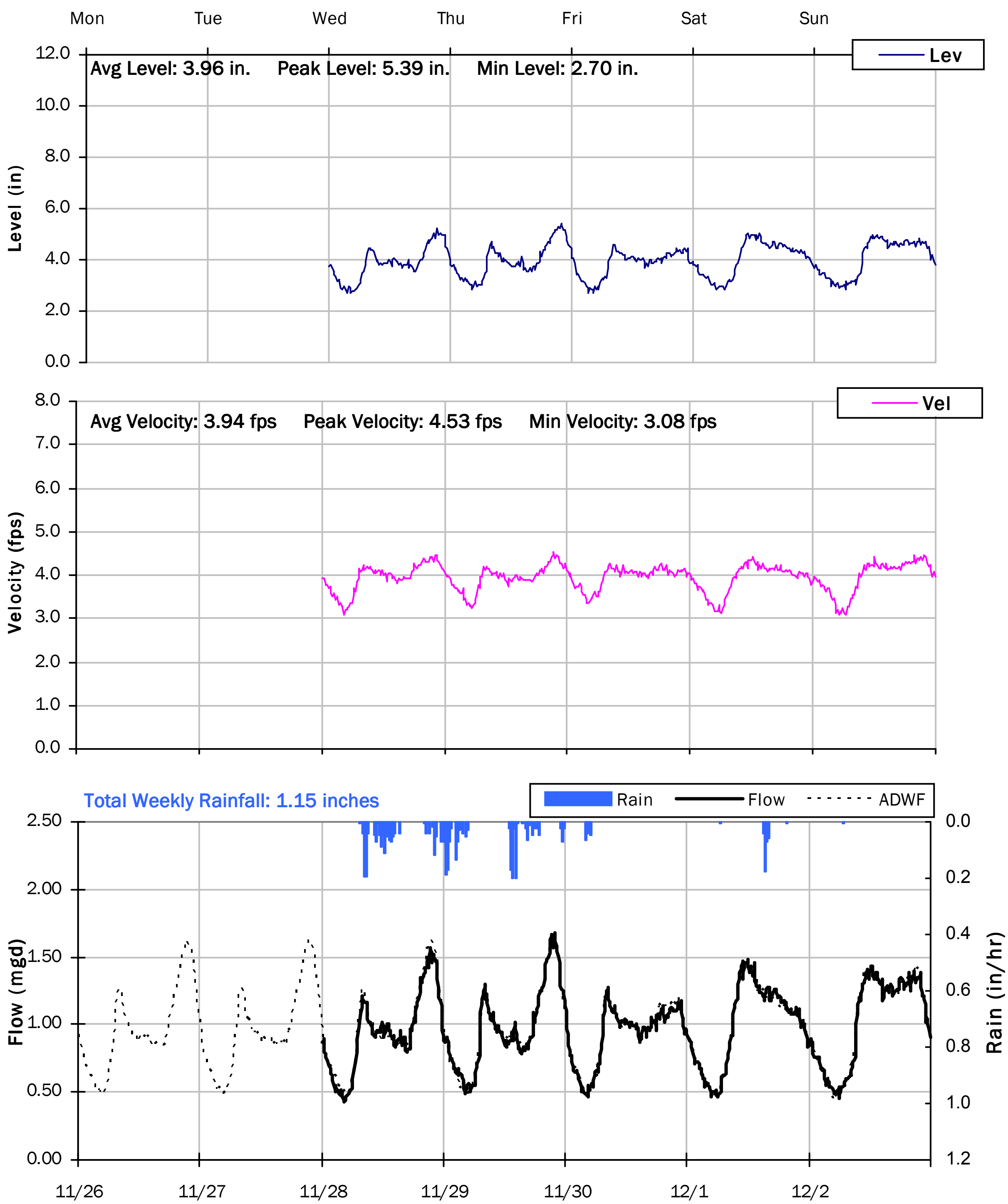
Event 1 Detail Graph



Storm Event I/I Analysis (Rain = 1.06 inches)

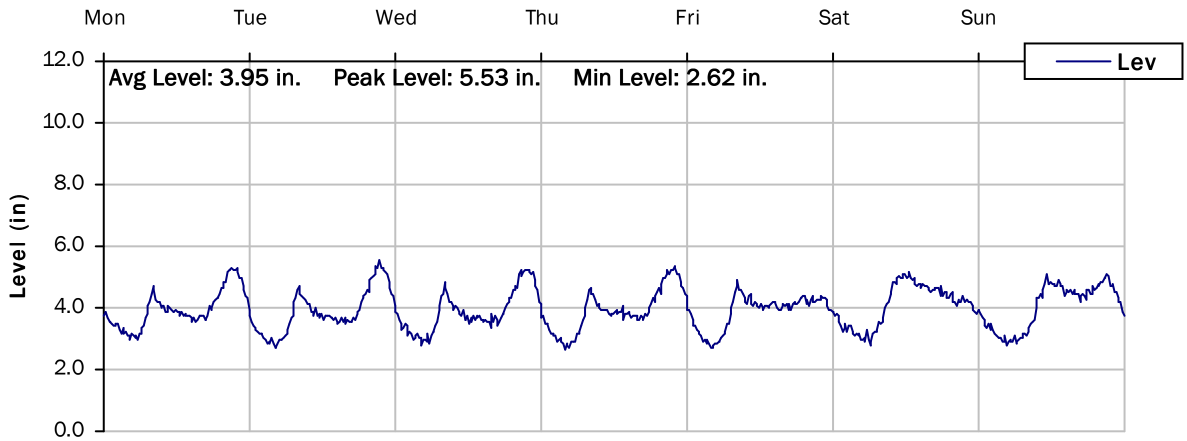
Capacity		**Inflow / Infiltration**	
Peak Flow:	1.68 *mgd*	**Peak I/I Rate:**	0.18 *mgd*
PF:	1.74	**Total I/I:**	88,000 *gallons*
Peak Level:	5.39 *in*		
d/D Ratio:	0.19		

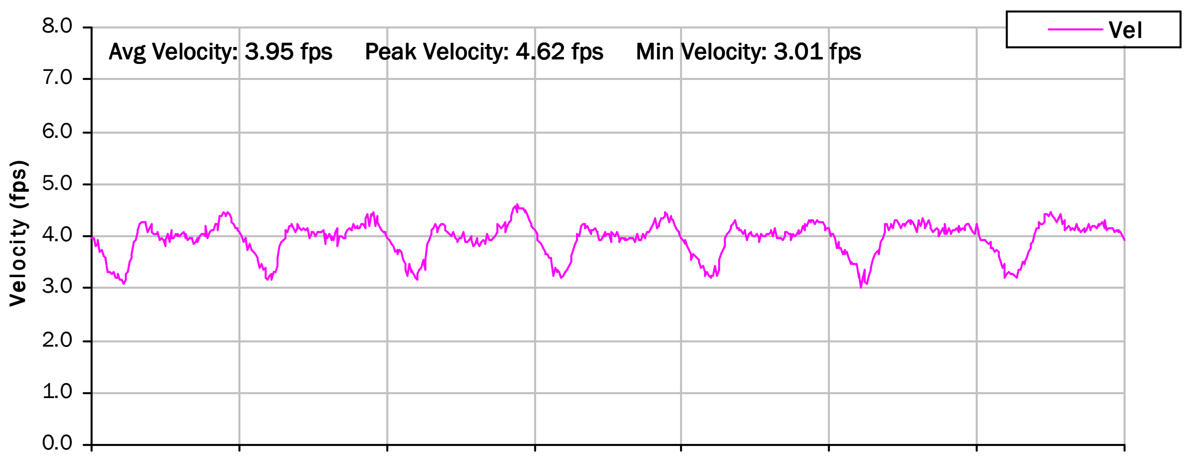
SITE 15
Weekly Level, Velocity and Flow Hydrographs
11/26/2018 to 12/3/2018

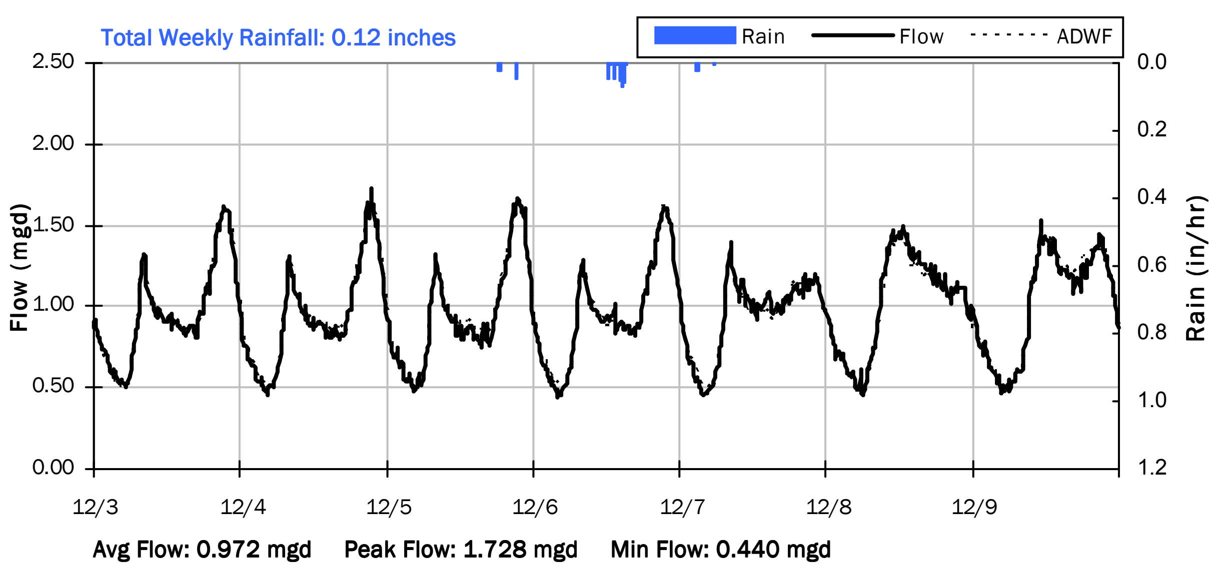


Avg Flow: 0.974 mgd **Peak Flow: 1.682 mgd** **Min Flow: 0.432 mgd**

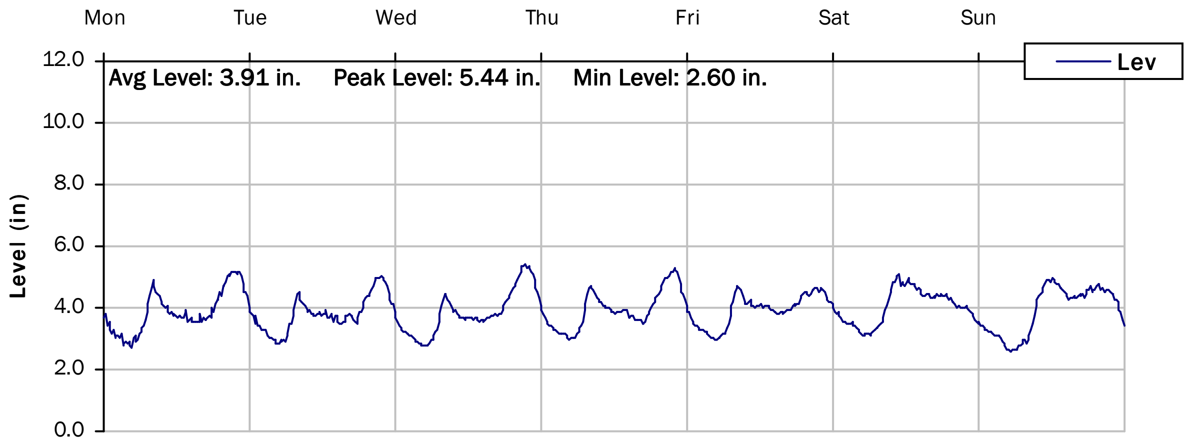
SITE 15
Weekly Level, Velocity and Flow Hydrographs
12/3/2018 to 12/10/2018

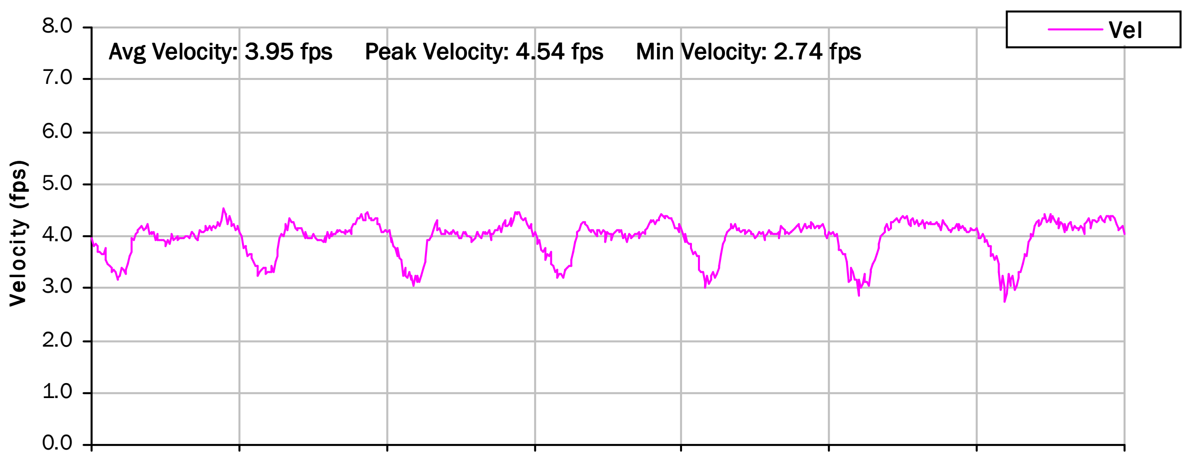


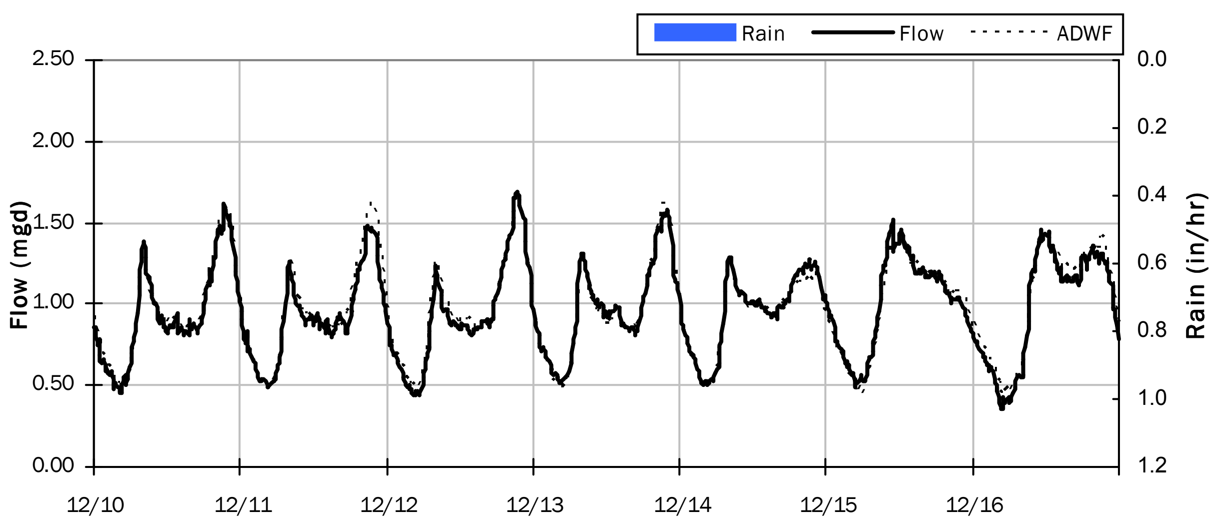




SITE 15
Weekly Level, Velocity and Flow Hydrographs
12/10/2018 to 12/17/2018

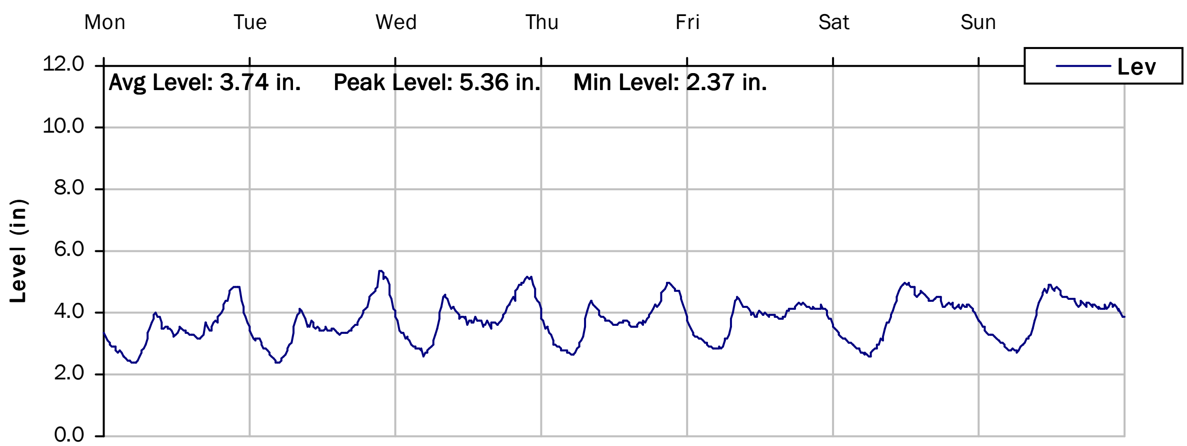


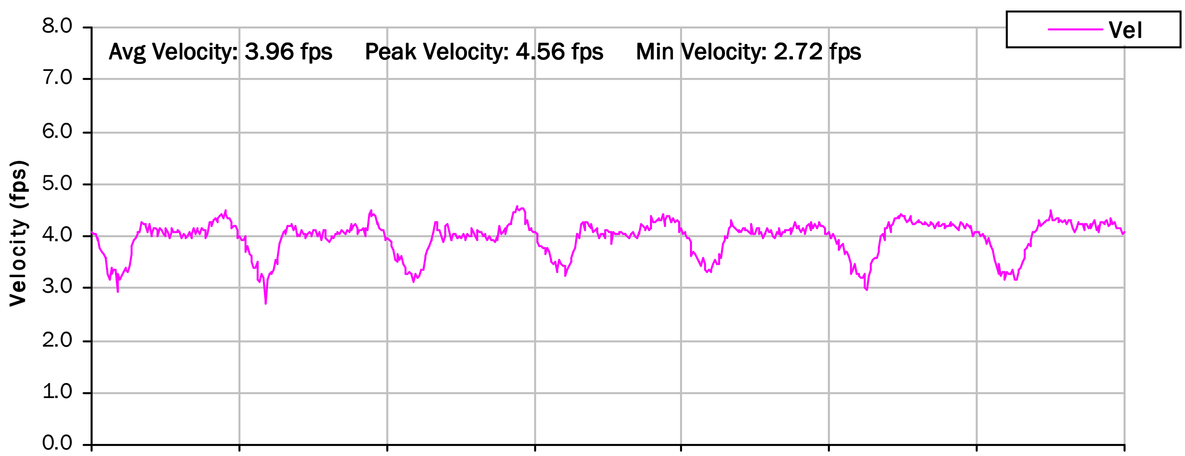


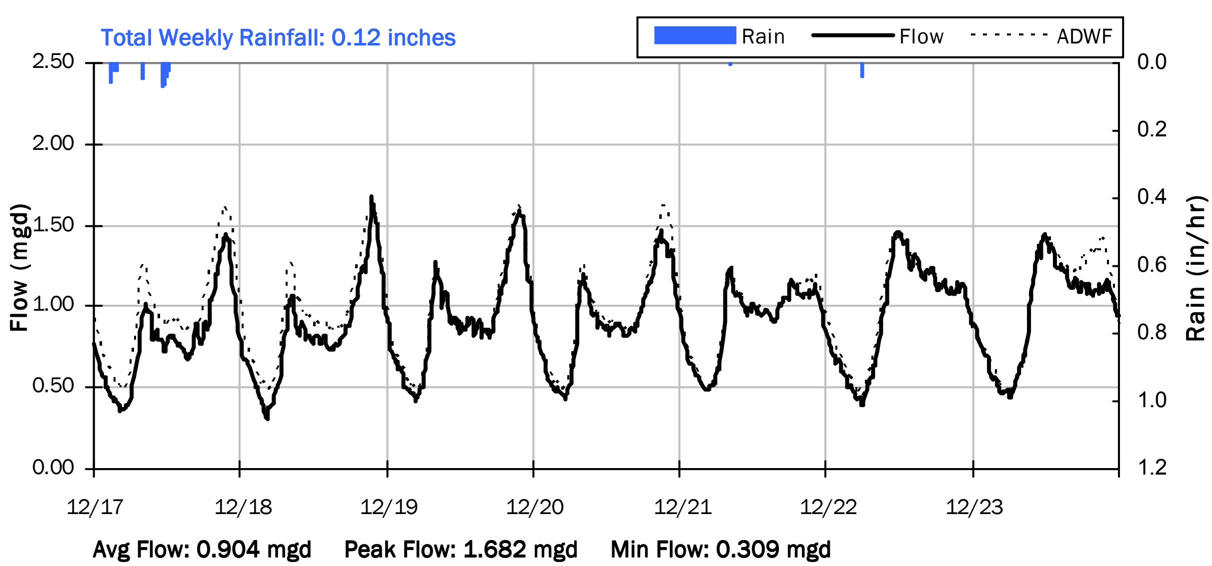


Avg Flow: 0.960 mgd **Peak Flow: 1.697 mgd** **Min Flow: 0.360 mgd**

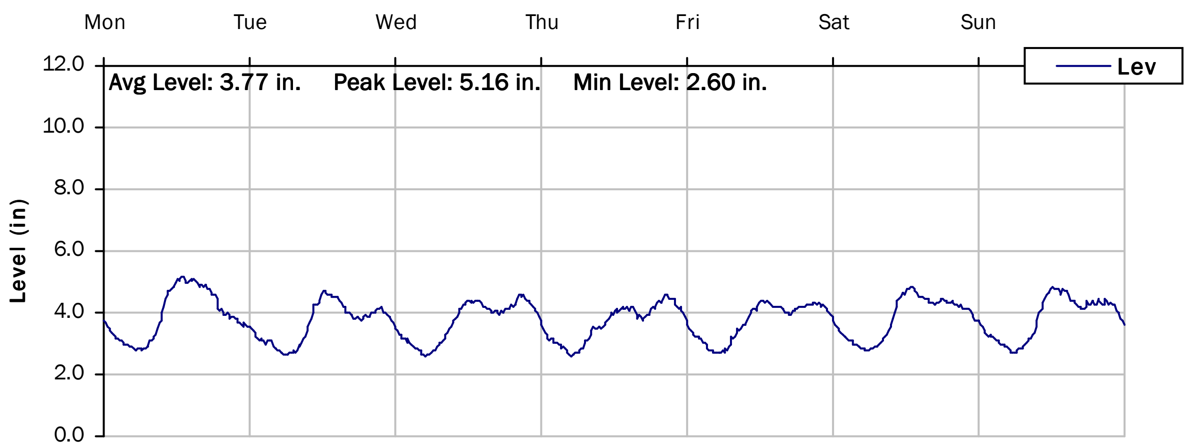
SITE 15
Weekly Level, Velocity and Flow Hydrographs
12/17/2018 to 12/24/2018

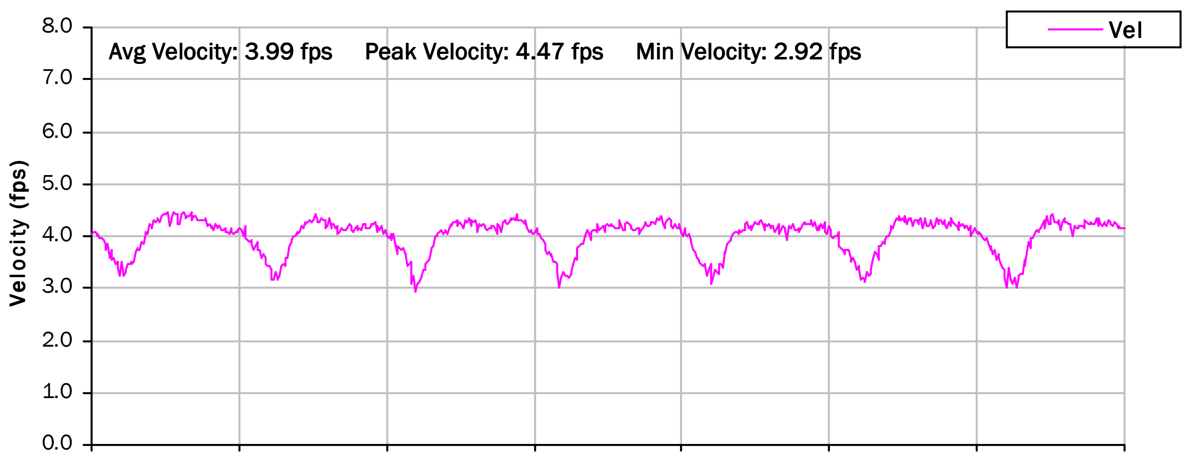


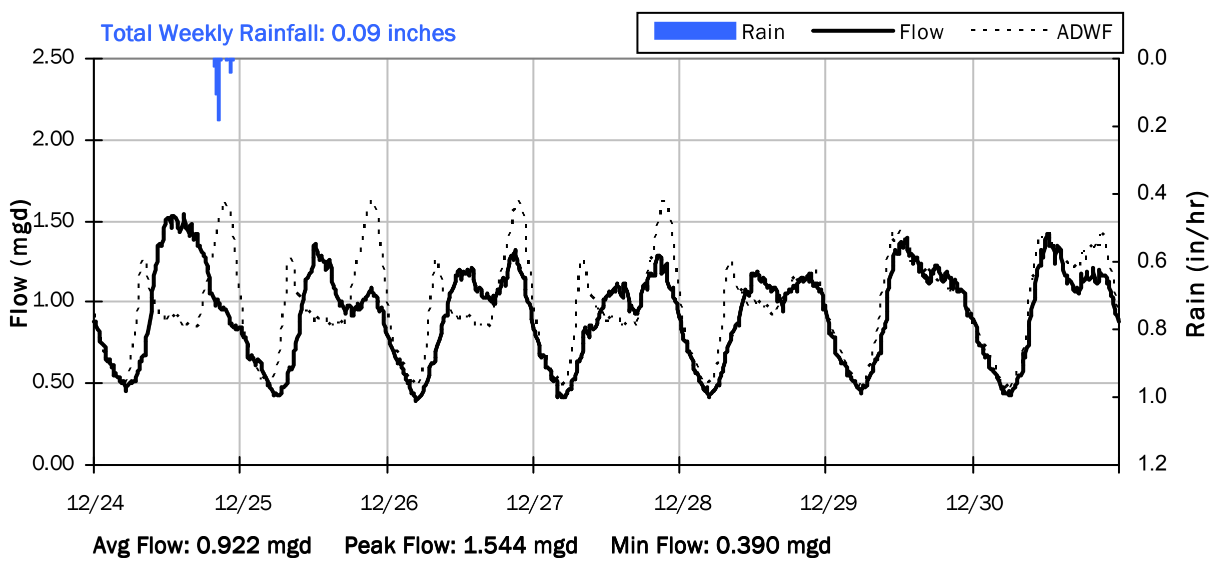




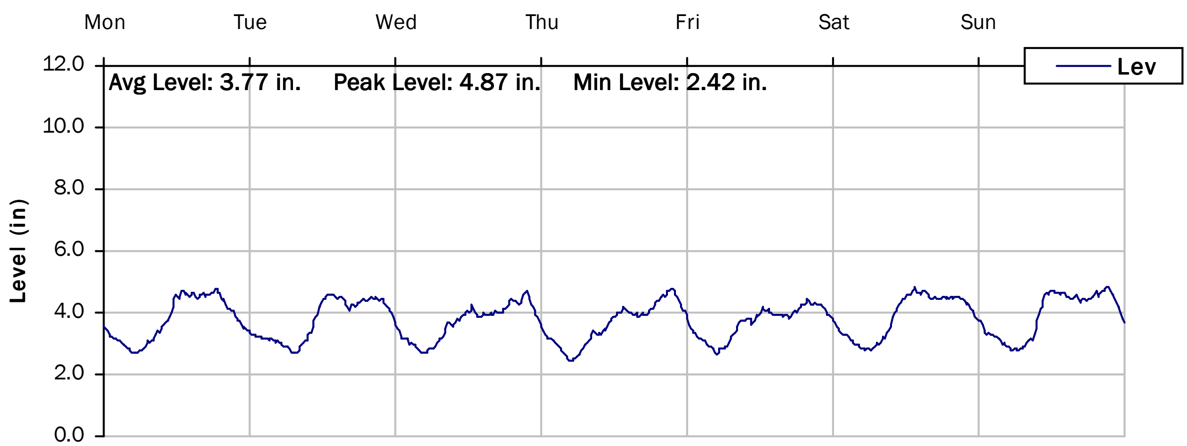
SITE 15
Weekly Level, Velocity and Flow Hydrographs
12/24/2018 to 12/31/2018

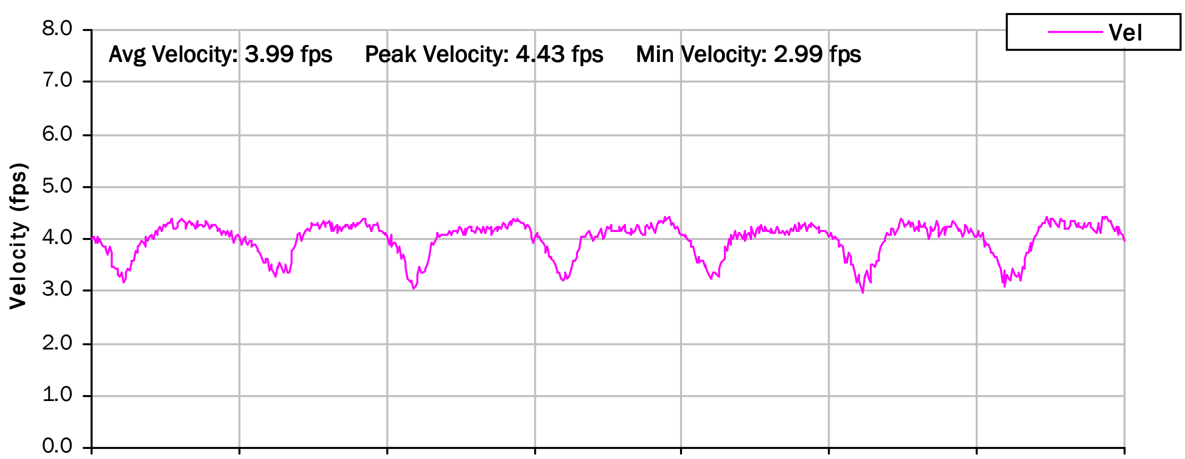


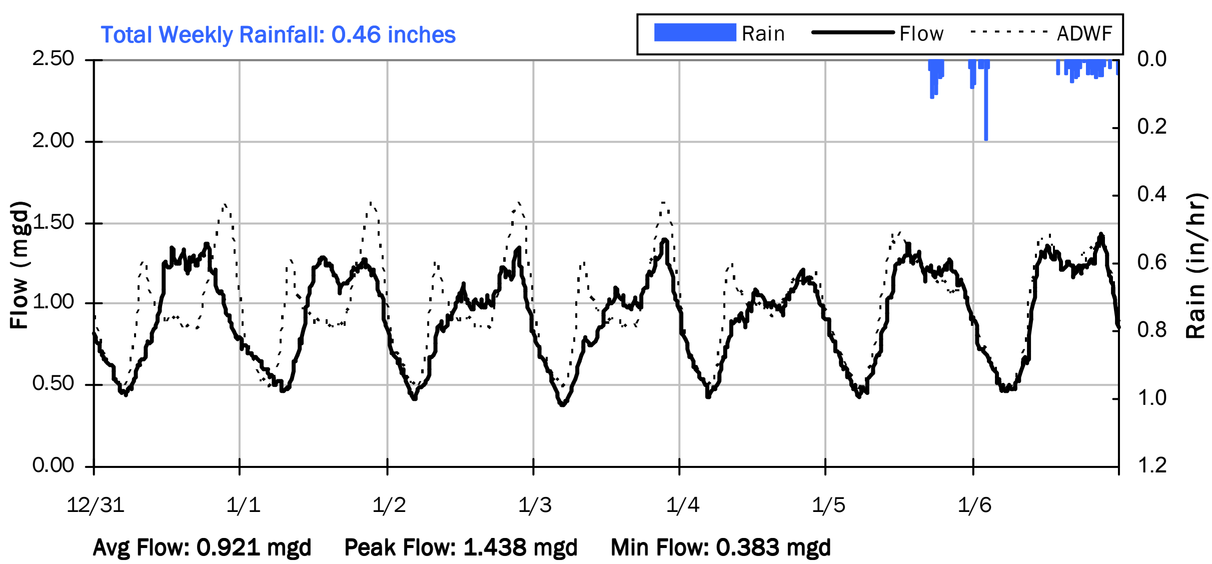




SITE 15
Weekly Level, Velocity and Flow Hydrographs
12/31/2018 to 1/7/2019



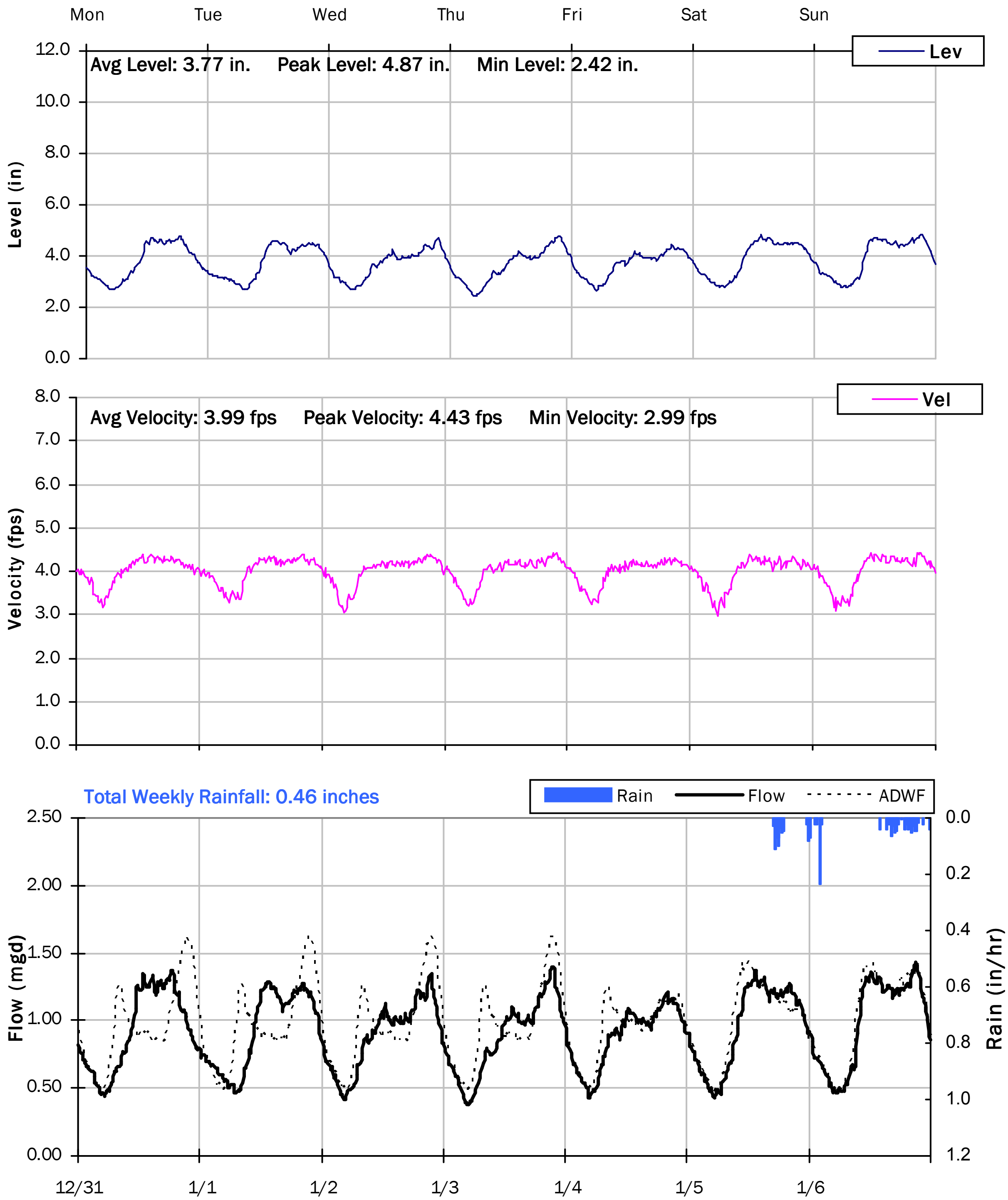




SITE 15

Weekly Level, Velocity and Flow Hydrographs

12/31/2018 to 1/7/2019



Avg Flow: 0.921 mgd Peak Flow: 1.438 mgd Min Flow: 0.383 mgd

V&A Project No. 17-0314

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

510.903.6601, Fax

APPENDIX C WASTEWATER FLOW PROJECTIONS

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Land Use Category	Land Use Code	Existing Sewer Service Area			Urban Growth Boundary (UGB)			Planning Area (Ultimate Buildout)		
		Developed (gr. acres)	Wastewater Flow Coefficients (gpd/gr. acres)	Existing Wastewater Flow gpd	Total UDB (gr. acres)	Wastewater Flow Coefficients (gpd/gr. acres)	Wastewater Flow gpd	Post UGB Development (gr. acres)	Wastewater Flow Coefficients (gpd/gr. acres)	Wastewater Flow gpd
Residential										
Residential Very Low Density	RVLD	307	280	85,900	1,339	280	375,000	-	-	-
Residential Low Density	RLD	10,700	470	5,029,000	15,509	470	7,289,300	-	-	-
Residential Medium Density	RMD	788	1,000	788,000	1,552	1,000	1,551,600	-	-	-
Residential High Density	RHD	267	1,700	454,400	538	1,700	913,900	-	-	-
Commercial/Industrial										
Business Research Park	BRP	61	450	27,300	148	450	66,800	-	-	-
Commercial Mixed Use	CMU	820	750	614,700	1,135	750	851,300	-	-	-
Commercial Neighborhood	CN	148	900	133,100	225	900	202,700	-	-	-
Commercial Regional	CR	307	650	199,500	539	650	350,700	-	-	-
Commercial Service	CS	446	650	289,700	522	650	339,200	-	-	-
Industrial	I	1,336	1,100	1,469,800	3,792	1,100	4,170,700	-	-	-
Light Industrial	IL	226	600	135,300	392	600	235,300	-	-	-
Office	O	386	700	270,300	441	700	308,600	-	-	-
Other										
Downtown Mixed Use	DMU	215	850	183,000	218	850	185,000	-	-	-
Public/Institutional	PI	1,351	450	607,800	2,397	450	1,078,700	-	-	-
Parks/Recreation	PR	844	0	0	1,633	0	0	-	-	-
Reserve	R	1	0	0	11	0	0	-	-	-
Conservation	C	604	0	0	1,021	0	0	-	-	-
Agricultural	A	0	0	0	281	0	0	-	-	-
Goshen		-	-	250,000	-	-	500,000	-	-	-
Post UGB Buildout		-	-	-	-			18,153	520	9,439,600
Total Existing ADWF		**18,805**		**10,537,800**						
Total UGB ADWF					**31,693**		**18,418,800**			
Total Buildout ADWF		**-**	**-**	**-**				**49,846**		**27,858,400**

Notes:

1. Study resumed planning methodology from 2005 Sewer Master Plan and included development beyond the UGB. The General Plan identied the area as the "Planning Area".

2. Flow coefficient for Planning Area assumes land development at 70% residential, 20% commercial, and 10% Open space.

3. The Planning Area located in the south was not considered in the develment of Ultimate Buildout Flows.

APPENDIX D

DRY WEATHER FLOW CALIBRATION SHEETS

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Table D.1 Dry Weather Calibration Summary

Meter Number	Pipe Diameter (in)	Weekday									Weekend									Overall ADWF			Comments
		Measured Data[1]			Modeled Data[2]			Percent Error[3]			Measured Data[1]			Modeled Data[2]			Percent Error[3]						
		Avg. Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Avg. Velocity (%)	Avg. Level (%)	Avg. Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Avg. Velocity (%)	Avg. Level (%)	Measured (mgd)	Modeled (mgd)	Percent Error (%)	
Site 1	36	3.41	2.73	11.4	3.483	2.65	11.9	2.1%	-3.0%	3.6%	3.35	2.69	11.4	3.51	2.66	11.9	5.0%	-1.2%	4.4%	3.39	3.49	2.9%	
Site 2	21	0.06	0.28	6.5	0.065	0.36	6.9	7.4%	25.9%	6.4%	0.04	0.22	6.0	0.04	0.28	6.6	8.6%	26.4%	10.3%	0.05	0.06	7.6%	
Site 3	48	2.13	1.91	9.2	2.138	1.91	9.3	0.5%	0.0%	0.3%	2.27	1.93	9.4	2.31	1.94	9.5	1.8%	0.1%	0.9%	2.17	2.19	0.9%	
Site 4	36	5.72	3.42	14.0	5.592	3.46	13.7	-2.2%	1.3%	-2.3%	5.76	3.40	14.0	5.69	3.46	13.8	-1.1%	1.8%	-1.9%	5.73	5.62	-1.9%	
Site 5	36	1.06	1.13	9.2	1.028	1.18	8.7	-2.7%	4.4%	-4.9%	1.10	1.12	9.4	1.09	1.19	8.9	-0.7%	5.9%	-4.6%	1.07	1.05	-2.1%	
Site 6	33	1.23	1.76	7.7	1.292	1.82	7.8	5.1%	3.7%	1.4%	1.22	1.76	7.6	1.29	1.81	7.8	5.6%	2.7%	2.5%	1.23	1.29	5.3%	
Site 7	30	3.87	3.21	12.0	3.772	3.22	11.8	-2.6%	0.4%	-2.1%	3.91	3.21	12.0	3.77	3.20	11.7	-3.6%	-0.4%	-2.5%	3.89	3.77	-2.9%	
Site 8	24	0.63	1.70	5.6	0.644	1.83	5.4	2.8%	7.9%	-2.5%	0.67	1.73	5.7	0.69	1.86	5.6	3.8%	7.7%	-1.8%	0.64	0.66	3.1%	
Site 9	27	1.61	2.07	9.1	1.698	2.12	9.4	5.7%	2.1%	3.5%	1.73	2.11	9.3	1.80	2.14	9.6	4.2%	1.2%	3.5%	1.64	1.73	5.3%	
Site 10	27	0.71	1.72	5.7	0.730	1.76	5.8	3.1%	N/A	N/A	0.76	1.75	5.8	0.78	1.78	5.9	2.8%	N/A	N/A	0.72	0.74	3.0%	
Site 11	42	1.40	1.45	8.8	1.441	1.44	9.0	3.0%	-0.9%	3.0%	1.37	1.46	8.6	1.43	1.43	9.0	3.8%	-1.6%	4.2%	1.39	1.44	3.2%	
Site 12	28	0.84	1.16	8.4	0.888	1.26	8.4	5.8%	8.8%	0.5%	0.87	1.14	8.6	0.93	1.27	8.6	6.9%	11.9%	-0.6%	0.85	0.90	6.1%	
Site 13	18	0.14	0.70	3.9	0.132	0.68	4.0	-2.2%	-4.0%	1.6%	0.15	0.73	4.1	0.15	0.70	4.1	-2.6%	-3.8%	1.4%	0.14	0.14	-2.3%	
Site 14	18	0.57	1.01	8.6	0.604	1.05	8.9	6.1%	3.3%	3.4%	0.57	1.01	8.6	0.61	1.05	8.9	6.2%	3.9%	3.2%	0.57	0.60	6.1%	
Site 15	28.5	0.95	3.96	3.9	0.991	2.70	5.1	4.1%	-31.9%	31.8%	1.00	3.98	3.9	1.04	2.73	5.2	3.9%	-31.4%	32.8%	0.97	1.01	4.0%	

Notes:

(1) Source: Temporary Flow Monitoring Program (V&A Consulting Engineers) and City of Visalia.

(2) Average flows are calculated from flow monitoring data and metered flow provided by the City. Maximum flow values are hourly peaks.

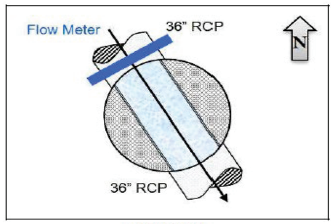
(3) Percent Difference = (Modeled - Measured)/Measured*100.

Flow Monitoring Site Site 1, Dry Weather Flow Calibration

Location: End of Drive 85
Pipeline Diameter: 36"
City Manhole ID: 3807
Model Pipe ID: 1018

Flow Monitor Location

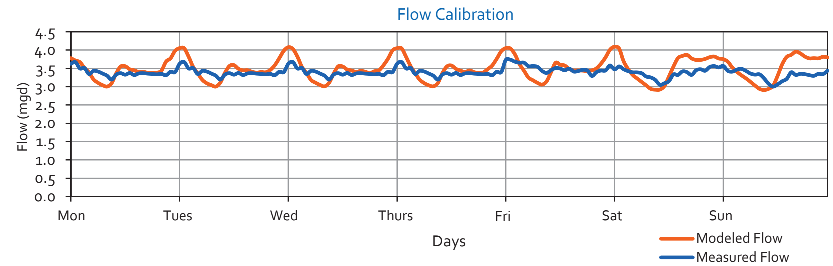
Satellite Map

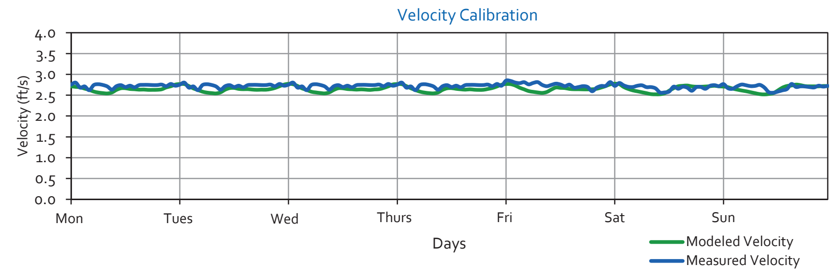


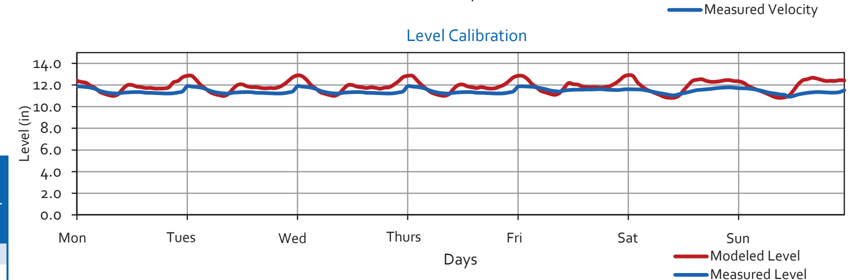
Flow Sketch

Street View

Plan View





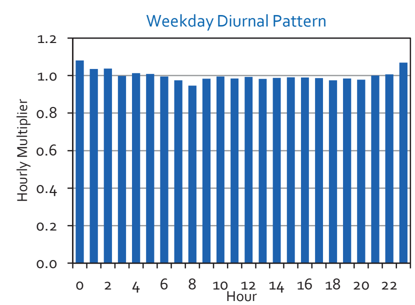


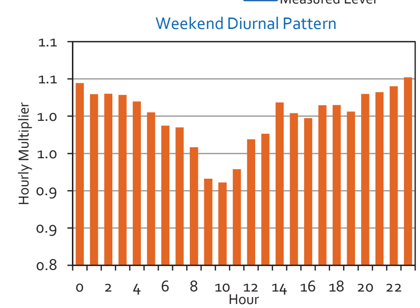
Model Calibration Summary

Day	Measured Data[1]				Modeled Data				Percent Error[3]			
	Avg. Flow (mgd)	Peak Flow[2] (mgd)	Avg. Level (in)	Avg. Vel. (ft/s)	Avg. Flow (mgd)	Peak Flow[2] (mgd)	Avg. Level (in)	Avg. Vel. (ft/s)	Avg. Flow (%)	Peak Flow (%)	Avg. Level (%)	Avg. Vel. (%)
Mon.	3.39	3.67	11.4	2.73	3.45	3.98	11.8	2.6	1.7%	8.3%	3.5%	-3.1%
Tues.	3.39	3.67	11.4	2.73	3.48	4.05	11.9	2.6	2.8%	10.3%	4.0%	-2.8%
Wed.	3.39	3.67	11.4	2.73	3.48	4.08	11.9	2.6	2.7%	11.0%	4.0%	-2.8%
Thur.	3.39	3.67	11.4	2.73	3.48	4.05	11.9	2.6	2.7%	10.3%	4.0%	-2.9%
Fri.	3.51	3.74	11.6	2.75	3.53	4.05	11.9	2.7	0.5%	8.5%	2.8%	-3.3%
Sat.	3.37	3.56	11.5	2.69	3.52	4.09	11.9	2.7	4.5%	14.9%	3.9%	-1.1%
Sun.	3.32	3.57	11.3	2.69	3.50	3.96	11.9	2.7	5.5%	11.0%	4.9%	-1.4%
Summary												
Weekday	3.41	--	11.4	2.73	3.48	--	11.9	2.65	2.1%	--	3.6%	-3.0%
Weekend	3.35	--	11.4	2.69	3.51	--	11.9	2.66	5.0%	--	4.4%	-1.2%
ADWF[4]	3.393	--	11.4	2.72	3.49	--	11.9	2.65	2.9%	--	3.9%	-2.5%

Notes:

1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7



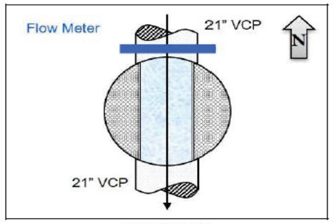


Flow Monitoring Site Site 2, Dry Weather Flow Calibration

Location: Valley Oaks Golf Course
Pipeline Diameter: 21"
City Manhole ID: 1525
Model Pipe ID: 966

Flow Monitor Location

Satellite Map



Flow Sketch

Street View

Plan View

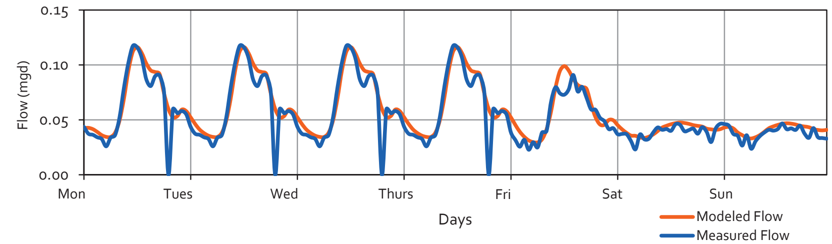
Model Calibration Summary

Day	Measured Data[1] Avg. Flow (mgd)	Peak Flow[2] (mgd)	Avg. Level (in)	Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Peak Flow[2] (mgd)	Avg. Level (in)	Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Peak Flow (%)	Avg. Level (%)	Avg. Vel. (%)
Mon.	0.06	0.12	6.6	0.29	0.07	0.12	7.0	0.4	6.4%	-1.0%	6.0%	24.6%
Tues.	0.06	0.12	6.6	0.29	0.07	0.12	7.0	0.4	7.1%	-1.0%	6.2%	25.3%
Wed.	0.06	0.12	6.6	0.29	0.07	0.12	7.0	0.4	7.1%	-1.0%	6.2%	25.3%
Thur.	0.06	0.12	6.6	0.29	0.07	0.12	7.0	0.4	7.1%	-1.0%	6.2%	25.3%
Fri.	0.05	0.09	6.4	0.26	0.06	0.10	6.9	0.3	9.4%	8.8%	7.7%	29.5%
Sat.	0.04	0.05	6.0	0.22	0.04	0.05	6.6	0.3	7.9%	2.7%	9.9%	26.5%
Sun.	0.04	0.05	6.0	0.22	0.04	0.05	6.6	0.3	9.4%	0.4%	10.6%	26.3%
Summary												
Weekday	0.06	--	6.5	0.28	0.07	--	6.9	0.36	7.4%	--	6.4%	25.9%
Weekend	0.04	--	6.0	0.22	0.04	--	6.6	0.28	8.6%	--	10.3%	26.4%
ADWF[4]	0.054	--	6.4	0.26	0.06	--	6.9	0.33	7.6%	--	7.5%	26.1%

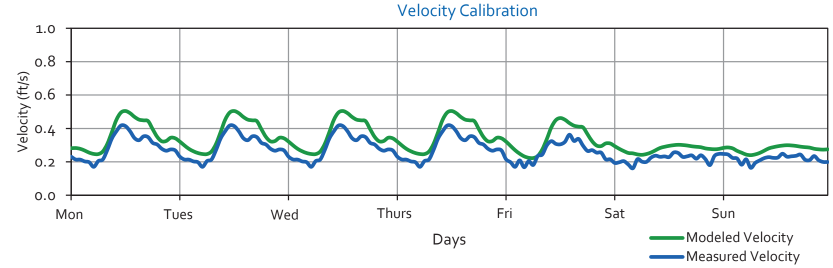
Notes:

1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

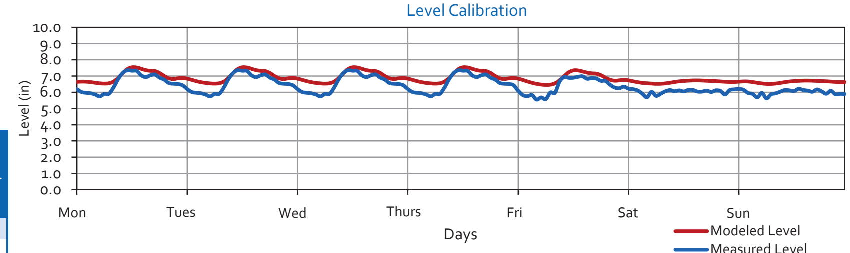
Flow Calibration



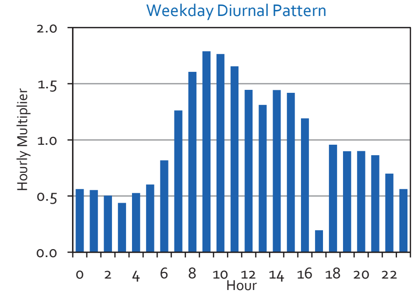
Velocity Calibration



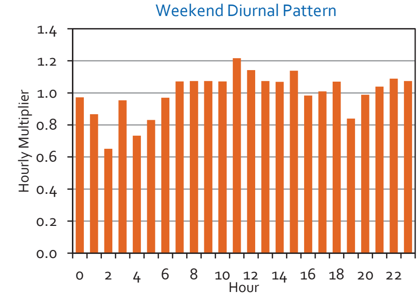
Level Calibration



Weekday Diurnal Pattern



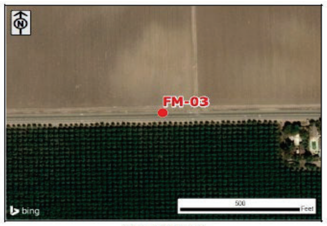
Weekend Diurnal Pattern



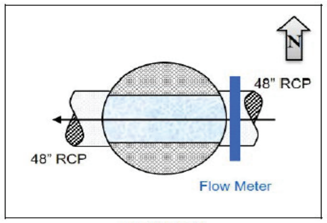
Flow Monitoring Site Site 3, Dry Weather Flow Calibration

Location: W Walnut Ave w/o Rd 92
Pipeline Diameter: 48"
City Manhole ID: 1371
Model Pipe ID: 250

Flow Monitor Location



Satellite Map



Flow Sketch


Street View

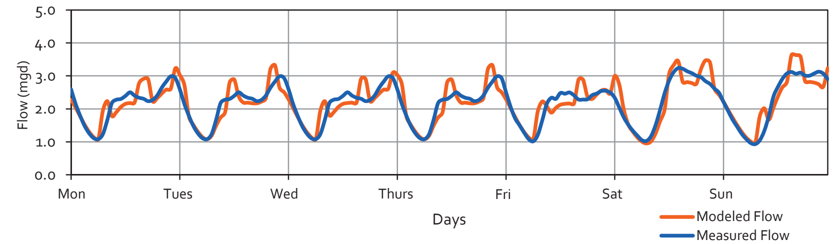

Plan View

Model Calibration Summary

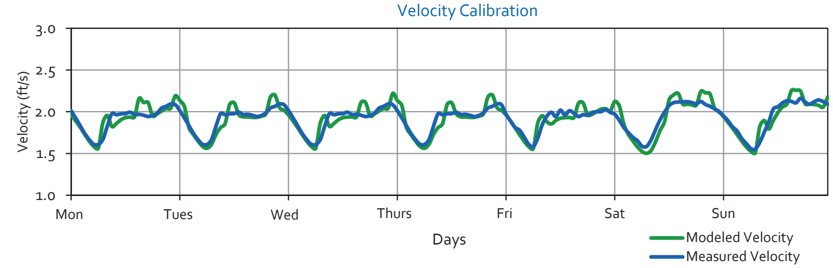
Day	Measured Data[1] Avg. Flow (mgd)	Measured Data[1] Peak Flow[2] (mgd)	Measured Data[1] Avg. Level (in)	Measured Data[1] Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Modeled Data Peak Flow[2] (mgd)	Modeled Data Avg. Level (in)	Modeled Data Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Percent Error[3] Peak Flow (%)	Percent Error[3] Avg. Level (%)	Percent Error[3] Avg. Vel. (%)
Mon.	2.14	2.99	9.2	1.91	2.15	3.23	9.3	1.9	0.4%	8.0%	0.2%	0.3%
Tues.	2.14	2.99	9.2	1.91	2.16	3.32	9.3	1.9	1.1%	11.2%	0.4%	-0.1%
Wed.	2.14	2.99	9.2	1.91	2.12	3.09	9.2	1.9	-0.9%	3.5%	-0.3%	-0.1%
Thur.	2.14	2.99	9.2	1.91	2.17	3.33	9.3	1.9	1.2%	11.3%	0.5%	0.0%
Fri.	2.08	2.55	9.1	1.90	2.09	2.89	9.2	1.9	0.6%	13.4%	0.7%	-0.1%
Sat.	2.28	3.24	9.5	1.93	2.32	3.47	9.5	1.9	1.8%	7.2%	0.2%	0.3%
Sun.	2.26	3.13	9.4	1.94	2.30	3.63	9.5	1.9	1.8%	16.1%	1.7%	0.0%
Summary												
Weekday	2.13	--	9.2	1.91	2.14	--	9.3	1.91	0.5%	--	0.3%	0.0%
Weekend	2.27	--	9.4	1.93	2.31	--	9.5	1.94	1.8%	--	0.9%	0.1%
ADWF[4]	2.168	--	9.3	1.92	2.19	--	9.3	1.92	0.9%	--	0.5%	0.0%

Notes:
1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

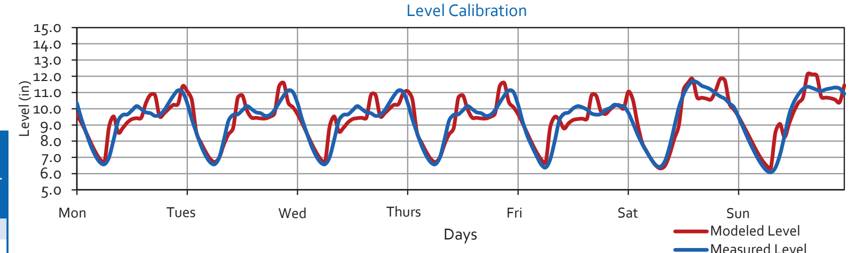
Flow Calibration



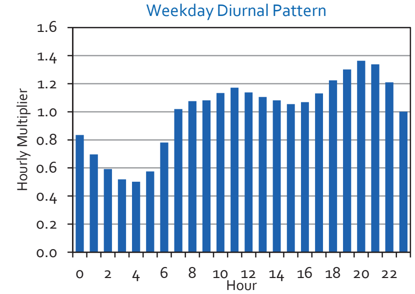
Velocity Calibration



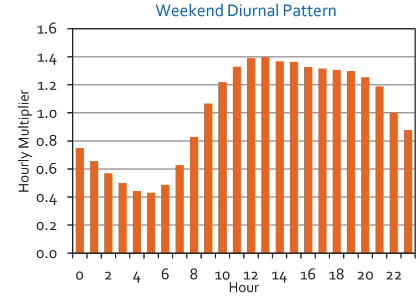
Level Calibration



Weekday Diurnal Pattern



Weekend Diurnal Pattern

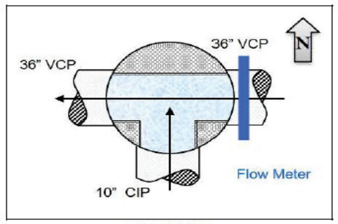


Flow Monitoring Site Site 4, Dry Weather Flow Calibration

Location: W Walnut Ave & S Savannah St
Pipeline Diameter: 36"
City Manhole ID: 1529
Model Pipe ID: 1194

Flow Monitor Location

Satellite Map



Flow Sketch


Street View

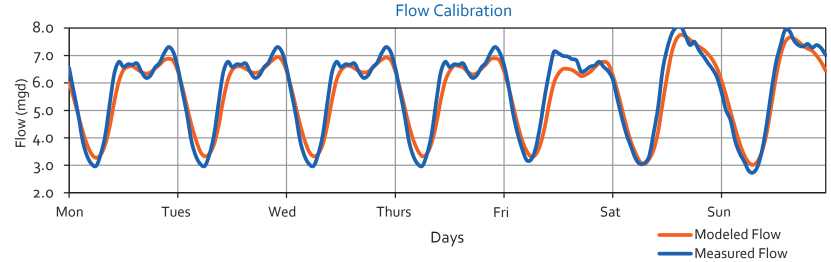

Plan View

Model Calibration Summary

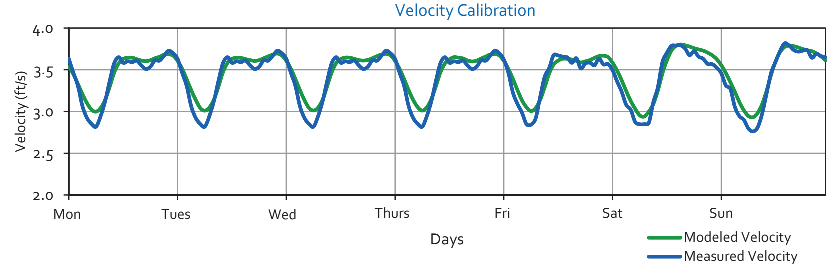
Day	Measured Data[1] Avg. Flow (mgd)	Measured Data[1] Peak Flow[2] (mgd)	Measured Data[1] Avg. Level (in)	Measured Data[1] Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Modeled Data Peak Flow[2] (mgd)	Modeled Data Avg. Level (in)	Modeled Data Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Percent Error[3] Peak Flow (%)	Percent Error[3] Avg. Level (%)	Percent Error[3] Avg. Vel. (%)
Mon.	5.69	7.31	14.0	3.42	5.54	6.88	13.6	3.5	-2.7%	-5.9%	-2.5%	1.0%
Tues.	5.69	7.31	14.0	3.42	5.62	6.95	13.7	3.5	-1.3%	-5.0%	-1.7%	1.5%
Wed.	5.69	7.31	14.0	3.42	5.63	6.93	13.7	3.5	-1.2%	-5.2%	-1.6%	1.5%
Thur.	5.69	7.31	14.0	3.42	5.62	6.90	13.7	3.5	-1.3%	-5.6%	-1.7%	1.5%
Fri.	5.81	7.13	14.2	3.42	5.56	6.77	13.6	3.5	-4.3%	-5.0%	-3.9%	1.2%
Sat.	5.83	8.06	14.2	3.41	5.73	7.75	13.8	3.5	-1.6%	-3.8%	-2.4%	1.8%
Sun.	5.69	7.92	13.9	3.39	5.65	7.65	13.7	3.5	-0.7%	-3.3%	-1.3%	1.9%
Summary												
Weekday	5.72	--	14.0	3.42	5.59	--	13.7	3.46	-2.2%	--	-2.3%	1.3%
Weekend	5.76	--	14.0	3.40	5.69	--	13.8	3.46	-1.1%	--	-1.9%	1.8%
ADWF[4]	5.728	--	14.0	3.41	5.62	--	13.7	3.46	-1.9%	--	-2.2%	1.5%

Notes:
1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

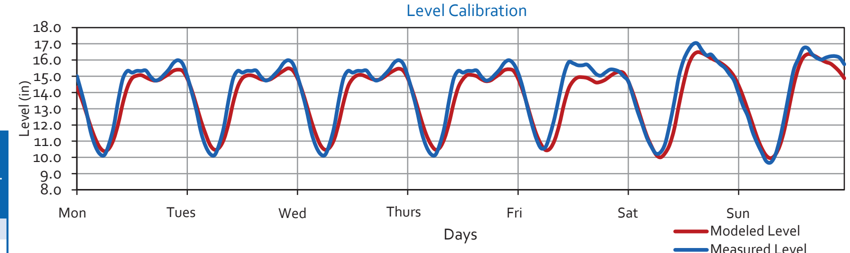
Flow Calibration



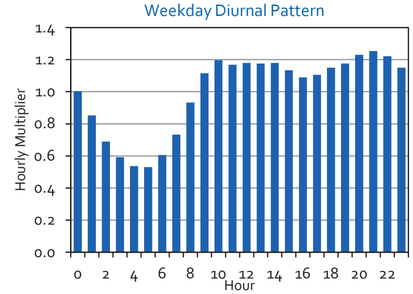
Velocity Calibration



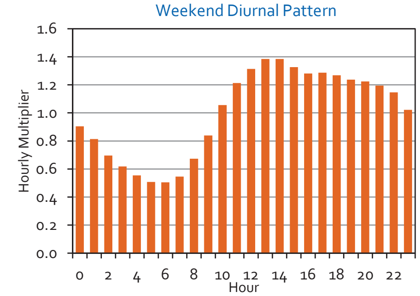
Level Calibration



Weekday Diurnal Pattern



Weekend Diurnal Pattern

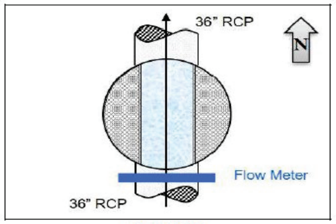


Flow Monitoring Site Site 5, Dry Weather Flow Calibration

Location: 3498 Akers St n/o W Caldwell Ave
Pipeline Diameter: 36"
City Manhole ID: 2888
Model Pipe ID: 10

Flow Monitor Location

Satellite Map



Flow Sketch

Street View

Plan View

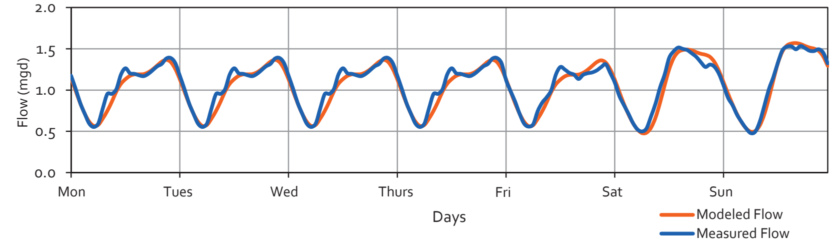
Model Calibration Summary

Day	Measured Data[1] Avg. Flow (mgd)	Measured Data Peak Flow[2] (mgd)	Measured Data Avg. Level (in)	Measured Data Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Modeled Data Peak Flow[2] (mgd)	Modeled Data Avg. Level (in)	Modeled Data Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Percent Error Peak Flow (%)	Percent Error Avg. Level (%)	Percent Error Avg. Vel. (%)
Mon.	1.06	1.39	9.2	1.13	1.03	1.37	8.7	1.2	-3.1%	-1.6%	-5.1%	4.2%
Tues.	1.06	1.39	9.2	1.13	1.03	1.37	8.7	1.2	-3.2%	-1.6%	-5.1%	4.2%
Wed.	1.06	1.39	9.2	1.13	1.03	1.37	8.7	1.2	-3.2%	-1.6%	-5.1%	4.2%
Thur.	1.06	1.39	9.2	1.13	1.03	1.37	8.7	1.2	-3.2%	-1.6%	-5.1%	4.2%
Fri.	1.03	1.31	9.1	1.12	1.02	1.36	8.7	1.2	-0.8%	3.6%	-4.3%	5.3%
Sat.	1.09	1.51	9.3	1.12	1.07	1.49	8.8	1.2	-1.4%	-1.6%	-5.1%	5.7%
Sun.	1.12	1.53	9.4	1.13	1.12	1.57	9.0	1.2	-0.1%	2.3%	-4.2%	6.0%
Summary												
Weekday	1.06	--	9.2	1.13	1.03	--	8.7	1.18	-2.7%	--	-4.9%	4.4%
Weekend	1.10	--	9.4	1.12	1.09	--	8.9	1.19	-0.7%	--	-4.6%	5.9%
ADWF[4]	1.070	--	9.2	1.13	1.05	--	8.8	1.18	-2.1%	--	-4.9%	4.8%

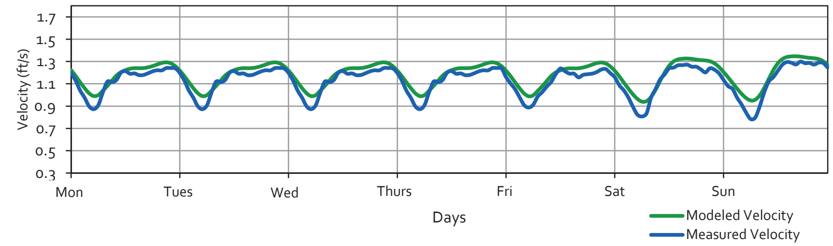
Notes:

1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

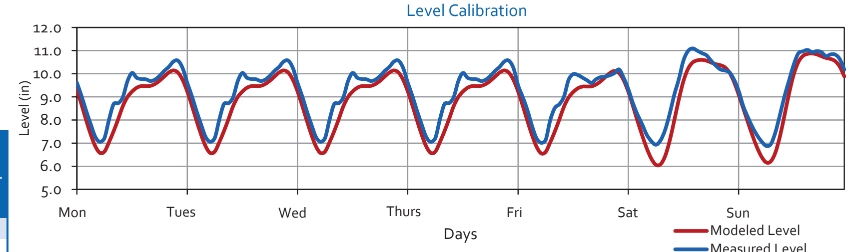
Flow Calibration



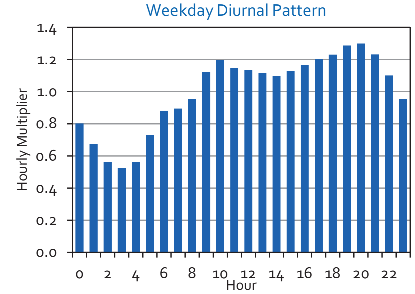
Velocity Calibration



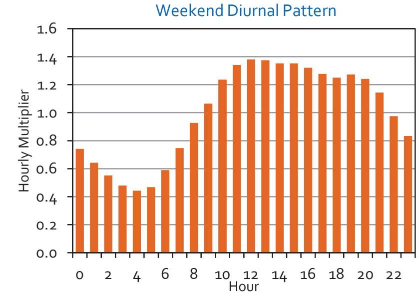
Level Calibration



Weekday Diurnal Pattern



Weekend Diurnal Pattern

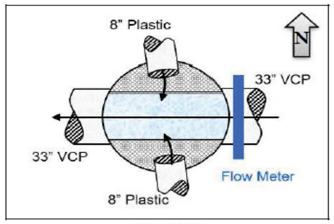


Flow Monitoring Site Site 6, Dry Weather Flow Calibration

Location: S Noyes St & W Laurel Ave
Pipeline Diameter: 33"
City Manhole ID: 102
Model Pipe ID: 370

Flow Monitor Location

Satellite Map



Flow Sketch


Street View

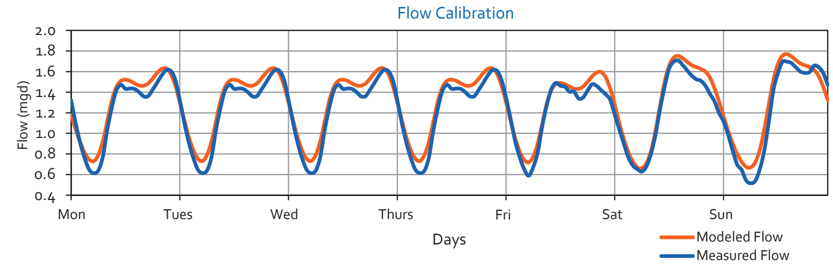

Plan View

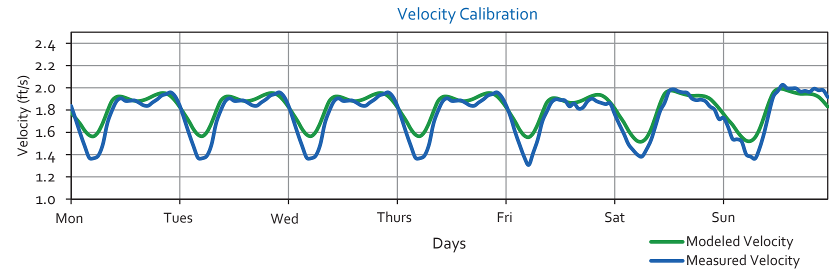
Model Calibration Summary

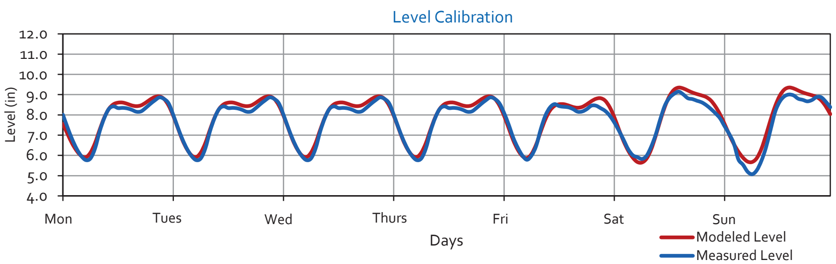
Day	Measured Data[1] Avg. Flow (mgd)	Measured Data[1] Peak Flow[2] (mgd)	Measured Data[1] Avg. Level (in)	Measured Data[1] Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Modeled Data Peak Flow[2] (mgd)	Modeled Data Avg. Level (in)	Modeled Data Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Percent Error[3] Peak Flow (%)	Percent Error[3] Avg. Level (%)	Percent Error[3] Avg. Vel. (%)
Mon.	1.23	1.61	7.7	1.76	1.29	1.63	7.8	1.8	4.4%	1.1%	1.1%	3.4%
Tues.	1.23	1.61	7.7	1.76	1.30	1.63	7.9	1.8	5.4%	1.1%	1.6%	3.7%
Wed.	1.23	1.61	7.7	1.76	1.30	1.63	7.9	1.8	5.4%	1.1%	1.6%	3.7%
Thur.	1.23	1.61	7.7	1.76	1.30	1.63	7.9	1.8	5.4%	1.1%	1.6%	3.7%
Fri.	1.21	1.49	7.7	1.75	1.27	1.60	7.8	1.8	5.2%	7.1%	1.2%	3.8%
Sat.	1.22	1.71	7.7	1.74	1.29	1.75	7.8	1.8	5.6%	2.6%	1.5%	3.5%
Sun.	1.22	1.70	7.5	1.78	1.29	1.77	7.8	1.8	5.5%	4.3%	3.6%	1.8%
Summary												
Weekday	1.23	--	7.7	1.76	1.29	--	7.8	1.82	5.1%	--	1.4%	3.7%
Weekend	1.22	--	7.6	1.76	1.29	--	7.8	1.81	5.6%	--	2.5%	2.7%
ADWF[4]	1.226	--	7.7	1.76	1.29	--	7.8	1.82	5.3%	--	1.7%	3.4%

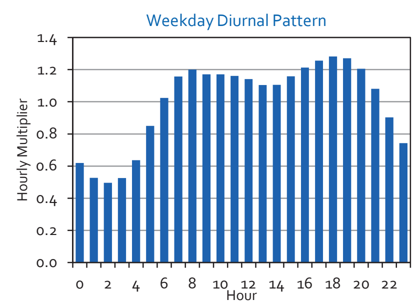
Notes:

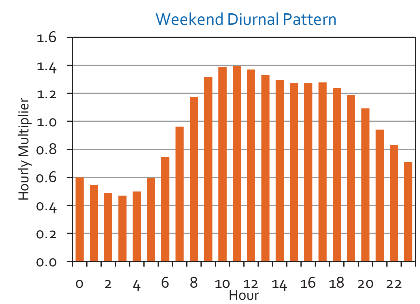
1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7









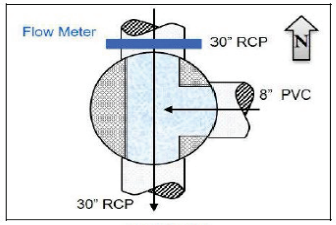


Flow Monitoring Site Site 7, Dry Weather Flow Calibration

Location: S Akers St n/o W Cambridge Ave
Pipeline Diameter: 30"
City Manhole ID: 1038
Model Pipe ID: 520

Flow Monitor Location

Satellite Map



Flow Sketch

Street View

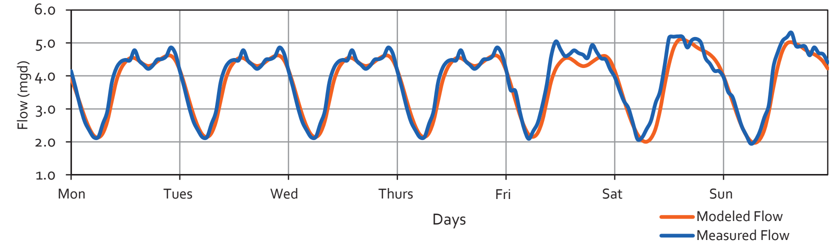
Plan View

Model Calibration Summary

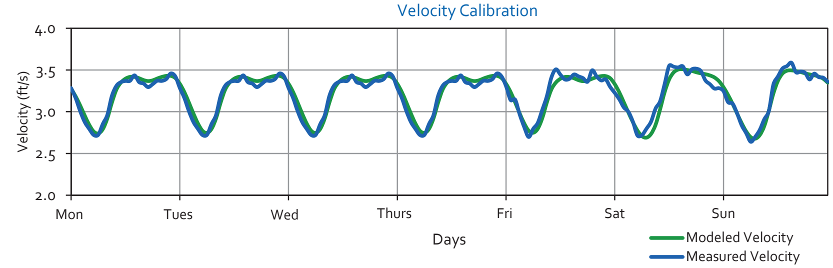
Day	Measured Data[1] Avg. Flow (mgd)	Measured Data[1] Peak Flow[2] (mgd)	Measured Data[1] Avg. Level (in)	Measured Data[1] Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Modeled Data Peak Flow[2] (mgd)	Modeled Data Avg. Level (in)	Modeled Data Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Percent Error[3] Peak Flow (%)	Percent Error[3] Avg. Level (%)	Percent Error[3] Avg. Vel. (%)
Mon.	3.85	4.86	12.0	3.20	3.75	4.61	11.7	3.2	-2.5%	-5.2%	-2.1%	0.5%
Tues.	3.85	4.86	12.0	3.20	3.78	4.61	11.8	3.2	-1.7%	-5.2%	-1.7%	0.7%
Wed.	3.85	4.86	12.0	3.20	3.78	4.61	11.8	3.2	-1.7%	-5.2%	-1.7%	0.7%
Thur.	3.85	4.86	12.0	3.20	3.78	4.61	11.8	3.2	-1.7%	-5.2%	-1.7%	0.7%
Fri.	3.99	5.05	12.2	3.24	3.78	4.60	11.8	3.2	-5.4%	-8.9%	-3.6%	-0.5%
Sat.	3.94	5.20	12.1	3.22	3.81	5.11	11.8	3.2	-3.5%	-1.7%	-2.5%	-0.4%
Sun.	3.88	5.31	12.0	3.20	3.74	5.02	11.7	3.2	-3.7%	-5.5%	-2.4%	-0.4%
Summary												
Weekday	3.87	--	12.0	3.21	3.77	--	11.8	3.22	-2.6%	--	-2.1%	0.4%
Weekend	3.91	--	12.0	3.21	3.77	--	11.7	3.20	-3.6%	--	-2.5%	-0.4%
ADWF[4]	3.885	--	12.0	3.21	3.77	--	11.8	3.21	-2.9%	--	-2.2%	0.2%

Notes:
1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

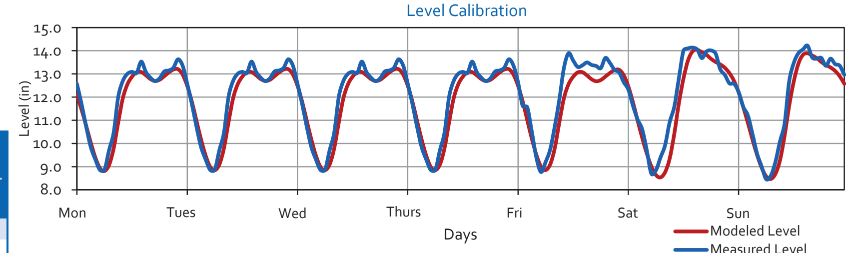
Flow Calibration



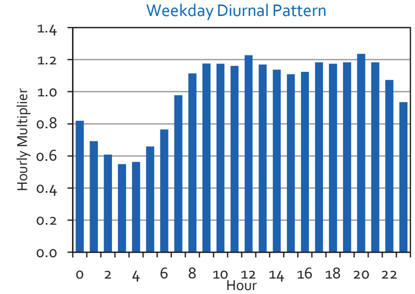
Velocity Calibration



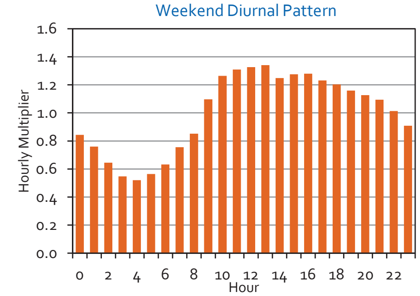
Level Calibration



Weekday Diurnal Pattern



Weekend Diurnal Pattern

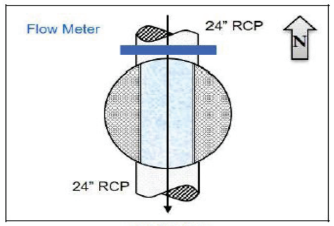


Flow Monitoring Site Site 8, Dry Weather Flow Calibration

Location: S Akers St s/o W Cambridge Ave
Pipeline Diameter: 24"
City Manhole ID: 1021
Model Pipe ID: 921

Flow Monitor Location

Satellite Map



Flow Sketch


Street View

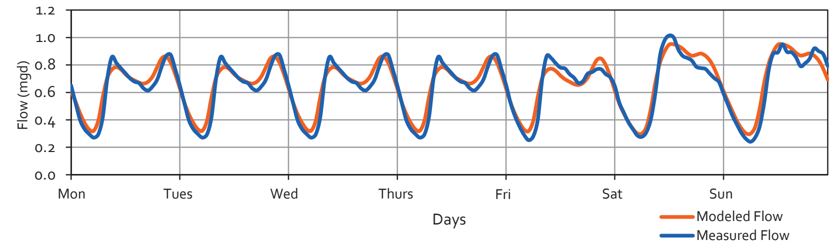

Plan View

Model Calibration Summary

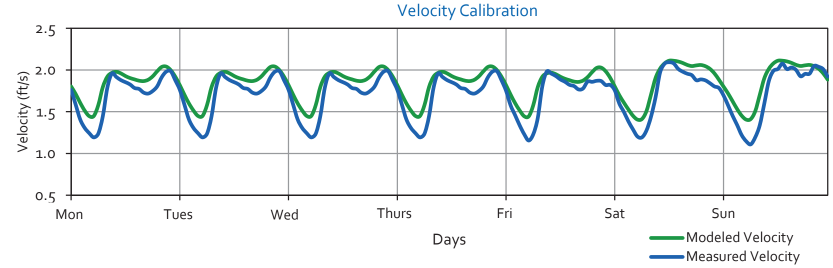
Day	Measured Data[1] Avg. Flow (mgd)	Measured Data[1] Peak Flow[2] (mgd)	Measured Data[1] Avg. Level (in)	Measured Data[1] Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Modeled Data Peak Flow[2] (mgd)	Modeled Data Avg. Level (in)	Modeled Data Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Percent Error[3] Peak Flow (%)	Percent Error[3] Avg. Level (%)	Percent Error[3] Avg. Vel. (%)
Mon.	0.62	0.87	5.6	1.70	0.65	0.86	5.4	1.8	3.3%	-1.4%	-2.2%	8.0%
Tues.	0.62	0.87	5.6	1.70	0.65	0.86	5.4	1.8	3.4%	-1.4%	-2.2%	8.0%
Wed.	0.62	0.87	5.6	1.70	0.65	0.86	5.4	1.8	3.4%	-1.4%	-2.2%	8.0%
Thur.	0.62	0.87	5.6	1.70	0.65	0.86	5.4	1.8	3.4%	-1.4%	-2.2%	8.0%
Fri.	0.63	0.87	5.6	1.70	0.64	0.85	5.4	1.8	0.8%	-2.4%	-3.4%	7.3%
Sat.	0.67	1.01	5.7	1.73	0.69	0.95	5.6	1.9	3.5%	-6.3%	-2.4%	7.6%
Sun.	0.66	0.95	5.6	1.73	0.69	0.95	5.6	1.9	4.2%	0.0%	-1.3%	7.7%
Summary												
Weekday	0.63	--	5.6	1.70	0.64	--	5.4	1.83	2.8%	--	-2.5%	7.9%
Weekend	0.67	--	5.7	1.73	0.69	--	5.6	1.86	3.8%	--	-1.8%	7.7%
ADWF[4]	0.638	--	5.6	1.71	0.66	--	5.5	1.84	3.1%	--	-2.3%	7.8%

Notes:
1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

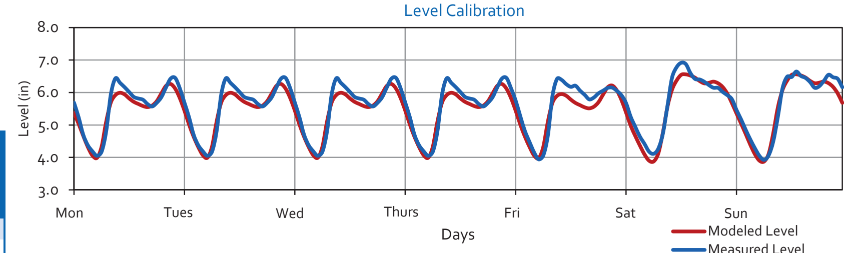
Flow Calibration



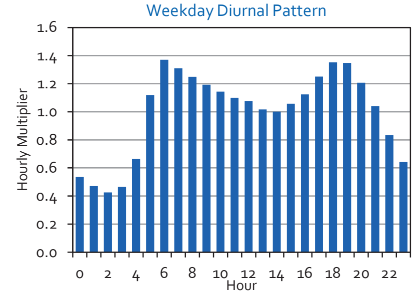
Velocity Calibration



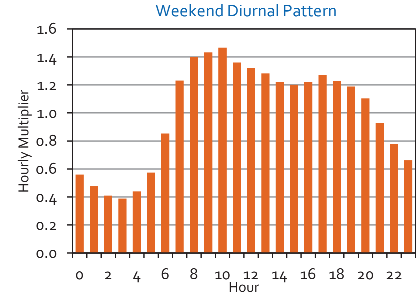
Level Calibration



Weekday Diurnal Pattern



Weekend Diurnal Pattern

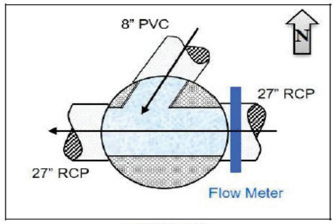


Flow Monitoring Site Site 9, Dry Weather Flow Calibration

Location: W Walnut Ave & S San Joaquin Dr
Pipeline Diameter: 27"
City Manhole ID: 1156
Model Pipe ID: 138

Flow Monitor Location

Satellite Map



Flow Sketch


Street View

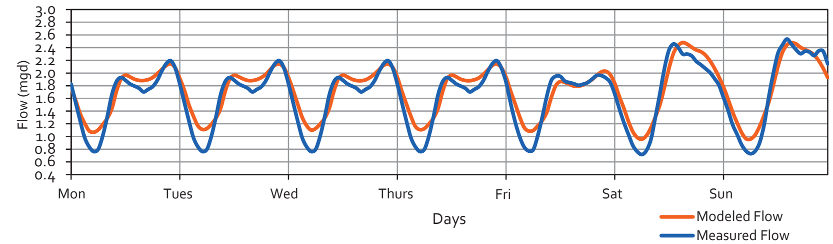

Plan View

Model Calibration Summary

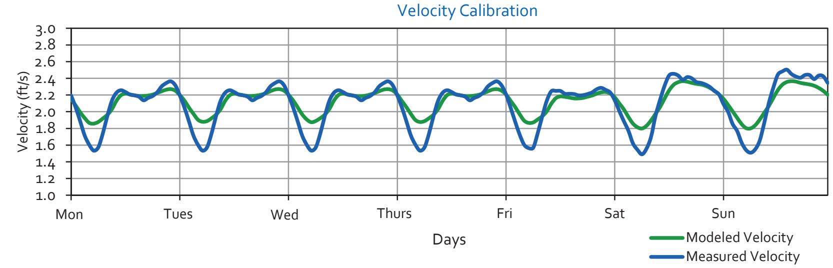
Day	Measured Data[1] Avg. Flow (mgd)	Measured Data[1] Peak Flow[2] (mgd)	Measured Data[1] Avg. Level (in)	Measured Data[1] Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Modeled Data Peak Flow[2] (mgd)	Modeled Data Avg. Level (in)	Modeled Data Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Percent Error[3] Peak Flow (%)	Percent Error[3] Avg. Level (%)	Percent Error[3] Avg. Vel. (%)
Mon.	1.61	2.19	9.1	2.07	1.69	2.14	9.3	2.1	4.9%	-2.3%	3.1%	1.8%
Tues.	1.61	2.19	9.1	2.07	1.72	2.14	9.4	2.1	6.7%	-2.4%	4.1%	2.4%
Wed.	1.61	2.19	9.1	2.07	1.72	2.14	9.4	2.1	6.8%	-2.4%	4.1%	2.4%
Thur.	1.61	2.19	9.1	2.07	1.72	2.14	9.4	2.1	6.7%	-2.4%	4.0%	2.4%
Fri.	1.60	1.96	9.0	2.07	1.65	2.03	9.3	2.1	3.4%	3.4%	2.4%	1.4%
Sat.	1.70	2.46	9.2	2.10	1.80	2.48	9.6	2.1	6.3%	0.9%	4.3%	1.8%
Sun.	1.76	2.53	9.4	2.13	1.80	2.48	9.6	2.1	2.2%	-2.3%	2.7%	0.5%
Summary												
Weekday	1.61	--	9.1	2.07	1.70	--	9.4	2.12	5.7%	--	3.5%	2.1%
Weekend	1.73	--	9.3	2.11	1.80	--	9.6	2.14	4.2%	--	3.5%	1.2%
ADWF[4]	1.642	--	9.1	2.08	1.73	--	9.5	2.12	5.3%	--	3.5%	1.8%

Notes:
1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

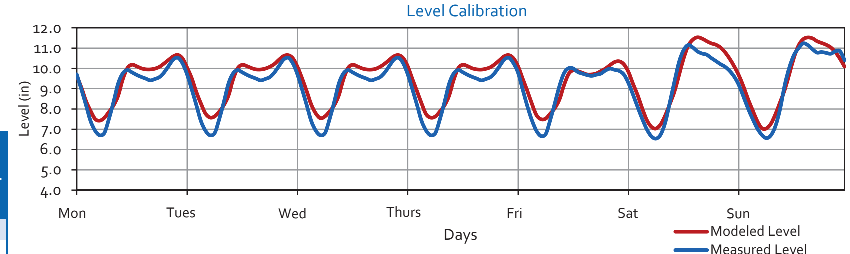
Flow Calibration



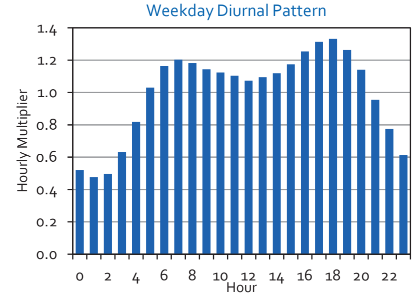
Velocity Calibration



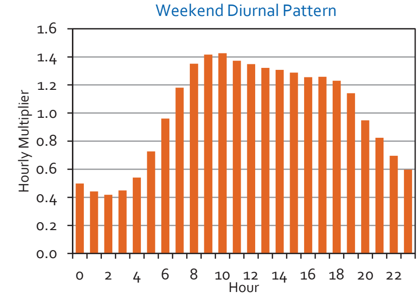
Level Calibration



Weekday Diurnal Pattern



Weekend Diurnal Pattern

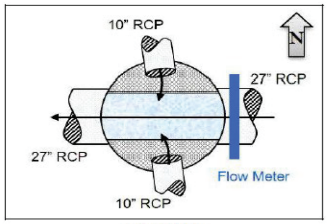


Flow Monitoring Site Site 10, Dry Weather Flow Calibration

Location: W Caldwell Ave & Rd 100
Pipeline Diameter: 27"
City Manhole ID: 2953
Model Pipe ID: 17

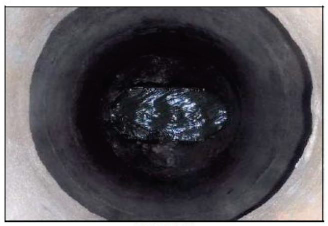
Flow Monitor Location

Satellite Map



Flow Sketch

Street View



Plan View

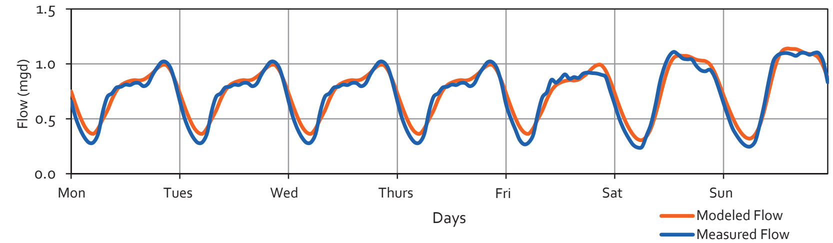
Model Calibration Summary

Day	Measured Data[1] Avg. Flow (mgd)	Peak Flow[2] (mgd)	Avg. Level (in)	Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Peak Flow[2] (mgd)	Avg. Level (in)	Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Peak Flow (%)	Avg. Level (%)	Avg. Vel. (%)
Mon.	0.71	1.02	5.7	1.72	0.73	0.99	5.8	1.8	3.3%	-2.7%	1.6%	2.4%
Tues.	0.71	1.02	5.7	1.72	0.73	0.99	5.8	1.8	3.1%	-2.7%	1.5%	2.3%
Wed.	0.71	1.02	5.7	1.72	0.73	0.99	5.8	1.8	3.1%	-2.7%	1.5%	2.3%
Thur.	0.71	1.02	5.7	1.72	0.73	0.99	5.8	1.8	3.1%	-2.7%	1.5%	2.3%
Fri.	0.71	0.92	5.7	1.72	0.73	0.99	5.8	1.8	2.9%	7.4%	1.5%	1.9%
Sat.	0.74	1.11	5.7	1.75	0.76	1.08	5.9	1.8	3.2%	-3.0%	2.6%	0.9%
Sun.	0.78	1.10	5.9	1.75	0.80	1.14	6.0	1.8	2.5%	3.7%	1.5%	2.1%
Summary												
Weekday	0.71	--	5.7	1.72	0.73	--	5.8	1.76	3.1%	--	1.5%	2.3%
Weekend	0.76	--	5.8	1.75	0.78	--	5.9	1.78	2.8%	--	2.0%	1.5%
ADWF[4]	0.723	--	5.7	1.73	0.74	--	5.8	1.76	3.0%	--	1.7%	2.0%

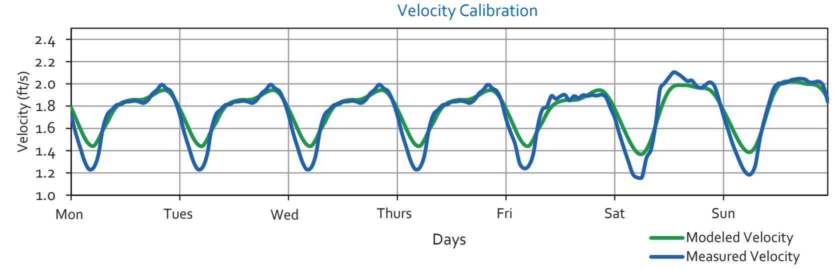
Notes:

1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

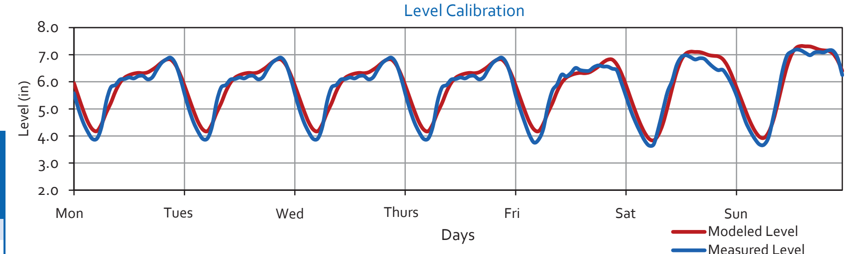
Flow Calibration



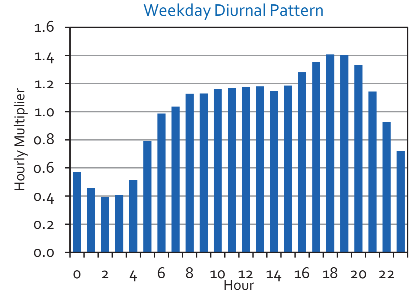
Velocity Calibration



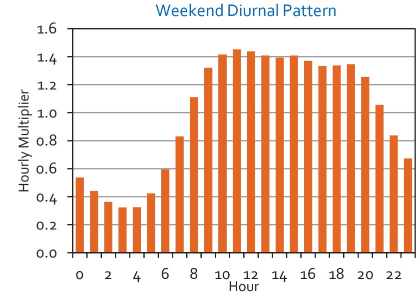
Level Calibration



Weekday Diurnal Pattern



Weekend Diurnal Pattern

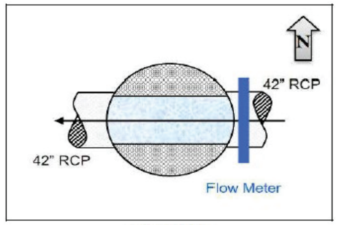


Flow Monitoring Site Site 11, Dry Weather Flow Calibration

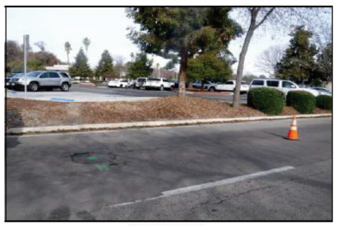
Location: W Mineral King Ave, w/o S Woodland Dr
Pipeline Diameter: 42"
City Manhole ID: PS2
Model Pipe ID: 651

Flow Monitor Location

Satellite Map



Flow Sketch


Street View

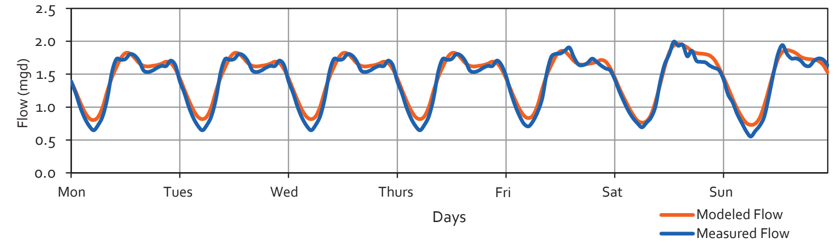

Plan View

Model Calibration Summary

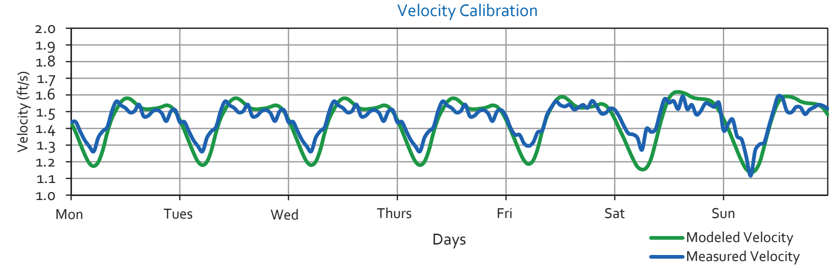
Day	Measured Data[1] Avg. Flow (mgd)	Measured Data[1] Peak Flow[2] (mgd)	Measured Data[1] Avg. Level (in)	Measured Data[1] Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Modeled Data Peak Flow[2] (mgd)	Modeled Data Avg. Level (in)	Modeled Data Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Percent Error[3] Peak Flow (%)	Percent Error[3] Avg. Level (%)	Percent Error[3] Avg. Vel. (%)
Mon.	1.39	1.80	8.7	1.45	1.43	1.82	9.0	1.4	2.9%	0.9%	2.9%	-1.0%
Tues.	1.39	1.80	8.7	1.45	1.44	1.82	9.0	1.4	3.4%	0.9%	3.2%	-0.8%
Wed.	1.39	1.80	8.7	1.45	1.44	1.82	9.0	1.4	3.4%	0.9%	3.2%	-0.8%
Thur.	1.39	1.80	8.7	1.45	1.44	1.82	9.0	1.4	3.4%	0.9%	3.2%	-0.8%
Fri.	1.44	1.90	8.9	1.47	1.46	1.85	9.1	1.4	1.7%	-2.9%	2.3%	-1.1%
Sat.	1.41	1.99	8.7	1.48	1.46	1.96	9.0	1.4	3.6%	-1.7%	3.9%	-2.3%
Sun.	1.34	1.94	8.5	1.44	1.40	1.87	8.9	1.4	4.1%	-4.0%	4.5%	-0.9%
Summary												
Weekday	1.40	--	8.8	1.45	1.44	--	9.0	1.44	3.0%	--	3.0%	-0.9%
Weekend	1.37	--	8.6	1.46	1.43	--	9.0	1.43	3.8%	--	4.2%	-1.6%
ADWF[4]	1.393	--	8.7	1.46	1.44	--	9.0	1.44	3.2%	--	3.3%	-1.1%

Notes:
1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

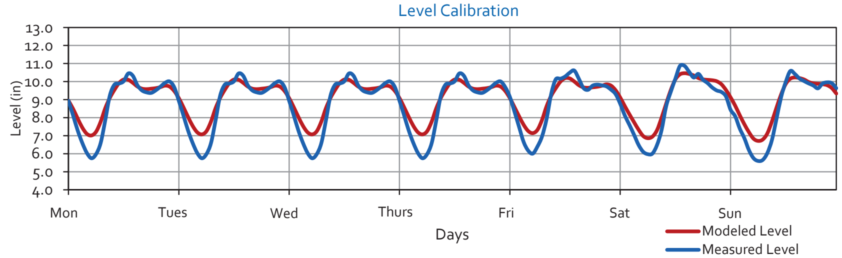
Flow Calibration



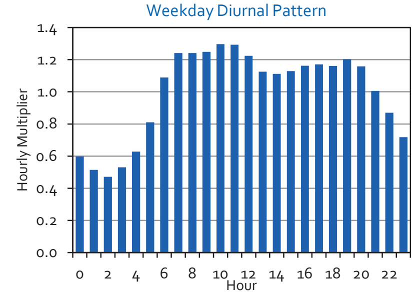
Velocity Calibration



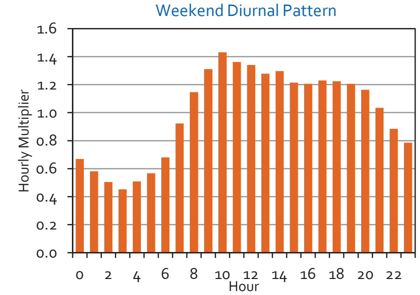
Level Calibration



Weekday Diurnal Pattern



Weekend Diurnal Pattern

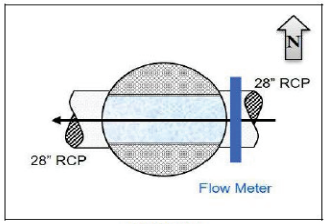


Flow Monitoring Site Site 12, Dry Weather Flow Calibration

Location: E Walnut Ave & S Church St
Pipeline Diameter: 28"
City Manhole ID: 1407
Model Pipe ID: 191

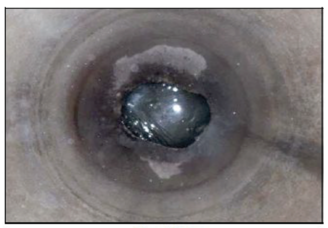
Flow Monitor Location

Satellite Map



Flow Sketch


Street View

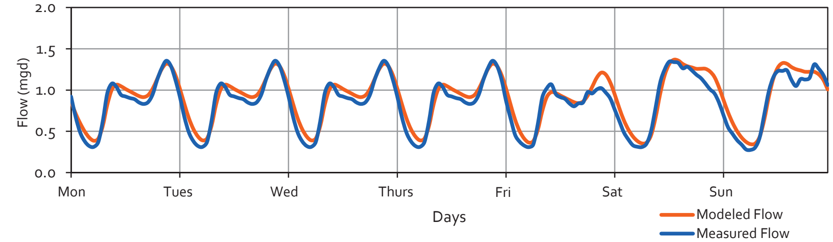

Plan View

Model Calibration Summary

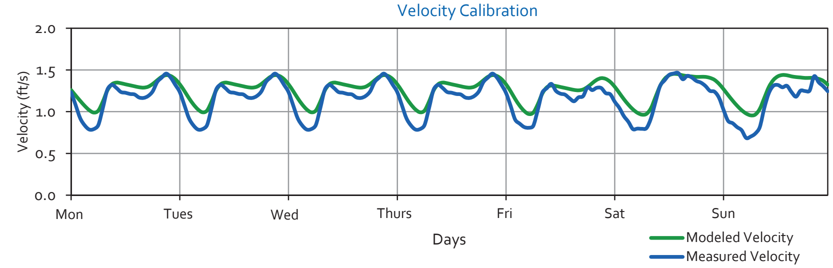
Day	Measured Data[1] Avg. Flow (mgd)	Measured Data[1] Peak Flow[2] (mgd)	Measured Data[1] Avg. Level (in)	Measured Data[1] Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Modeled Data Peak Flow[2] (mgd)	Modeled Data Avg. Level (in)	Modeled Data Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Percent Error[3] Peak Flow (%)	Percent Error[3] Avg. Level (%)	Percent Error[3] Avg. Vel. (%)
Mon.	0.85	1.35	8.4	1.17	0.89	1.32	8.4	1.3	4.1%	-2.6%	-0.3%	8.1%
Tues.	0.85	1.35	8.4	1.17	0.90	1.32	8.5	1.3	6.0%	-2.6%	0.7%	8.8%
Wed.	0.85	1.35	8.4	1.17	0.90	1.32	8.5	1.3	6.0%	-2.6%	0.7%	8.8%
Thur.	0.85	1.35	8.4	1.17	0.90	1.32	8.5	1.3	6.0%	-2.6%	0.7%	8.8%
Fri.	0.78	1.07	8.1	1.14	0.84	1.21	8.2	1.2	6.9%	13.3%	0.7%	9.4%
Sat.	0.88	1.34	8.5	1.17	0.95	1.37	8.6	1.3	7.3%	1.7%	1.7%	8.7%
Sun.	0.86	1.31	8.7	1.10	0.92	1.33	8.5	1.3	6.5%	1.2%	-2.8%	15.3%
Summary												
Weekday	0.84	--	8.4	1.16	0.89	--	8.4	1.26	5.8%	--	0.5%	8.8%
Weekend	0.87	--	8.6	1.14	0.93	--	8.6	1.27	6.9%	--	-0.6%	11.9%
ADWF[4]	0.849	--	8.4	1.15	0.90	--	8.5	1.26	6.1%	--	0.2%	9.7%

Notes:
1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

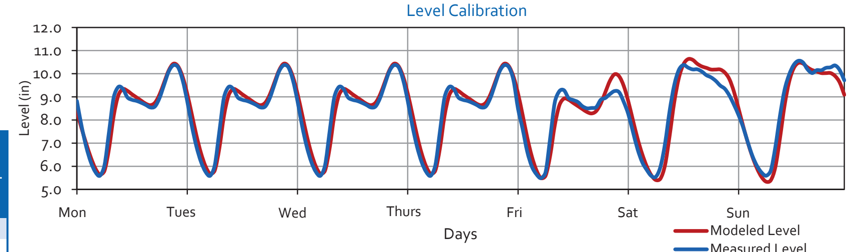
Flow Calibration



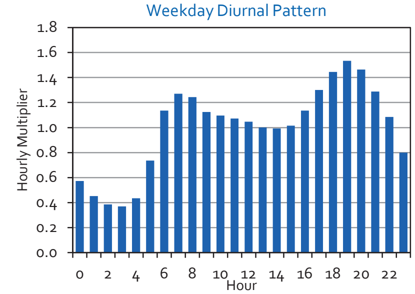
Velocity Calibration



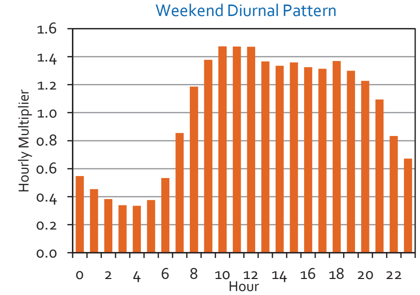
Level Calibration



Weekday Diurnal Pattern



Weekend Diurnal Pattern

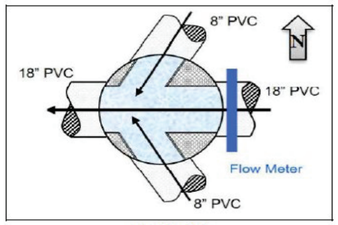


Flow Monitoring Site Site 13, Dry Weather Flow Calibration

Location: Houston Ave & N County Center St
Pipeline Diameter: 18"
City Manhole ID: 2766
Model Pipe ID: 883

Flow Monitor Location

Satellite Map



Flow Sketch

Street View

Plan View

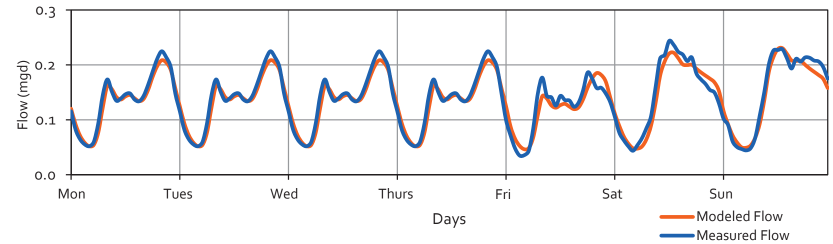
Model Calibration Summary

Day	Measured Data[1] Avg. Flow (mgd)	Measured Data[1] Peak Flow[2] (mgd)	Measured Data[1] Avg. Level (in)	Measured Data[1] Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Modeled Data Peak Flow[2] (mgd)	Modeled Data Avg. Level (in)	Modeled Data Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Percent Error[3] Peak Flow (%)	Percent Error[3] Avg. Level (%)	Percent Error[3] Avg. Vel. (%)
Mon.	0.14	0.22	4.0	0.71	0.13	0.21	4.0	0.7	-2.6%	-7.3%	1.2%	-4.1%
Tues.	0.14	0.22	4.0	0.71	0.13	0.21	4.0	0.7	-2.4%	-7.3%	1.3%	-3.9%
Wed.	0.14	0.22	4.0	0.71	0.13	0.21	4.0	0.7	-2.4%	-7.3%	1.3%	-3.9%
Thur.	0.14	0.22	4.0	0.71	0.13	0.21	4.0	0.7	-2.4%	-7.3%	1.3%	-3.9%
Fri.	0.12	0.19	3.8	0.67	0.12	0.19	3.9	0.6	-1.1%	-0.5%	3.0%	-4.1%
Sat.	0.15	0.24	4.0	0.73	0.14	0.22	4.1	0.7	-2.4%	-8.8%	2.1%	-5.0%
Sun.	0.15	0.23	4.1	0.73	0.15	0.23	4.1	0.7	-2.7%	0.9%	0.7%	-2.7%
Summary												
Weekday	0.14	--	3.9	0.70	0.13	--	4.0	0.68	-2.2%	--	1.6%	-4.0%
Weekend	0.15	--	4.1	0.73	0.15	--	4.1	0.70	-2.6%	--	1.4%	-3.8%
ADWF[4]	0.140	--	4.0	0.71	0.14	--	4.0	0.68	-2.3%	--	1.5%	-4.0%

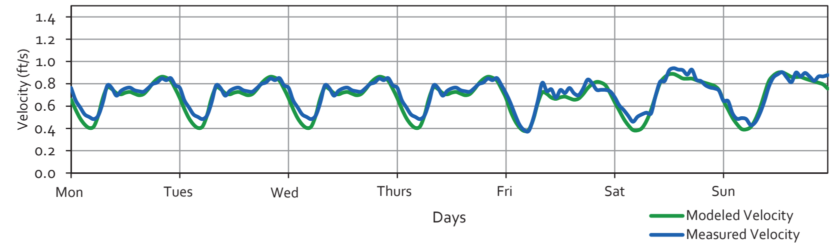
Notes:

1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

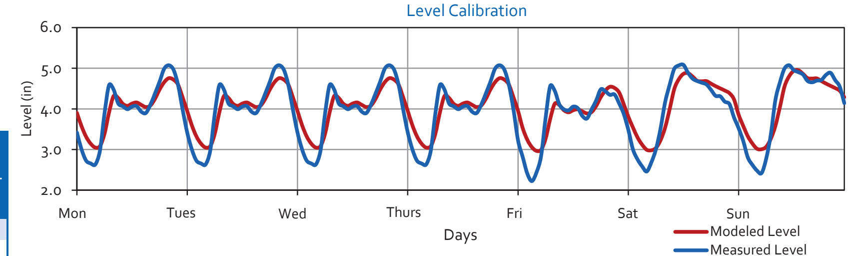
Flow Calibration



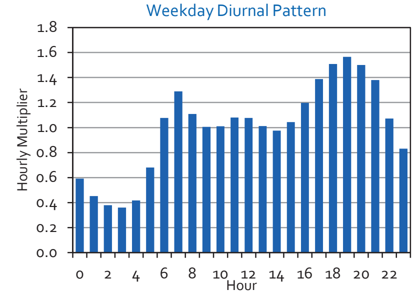
Velocity Calibration



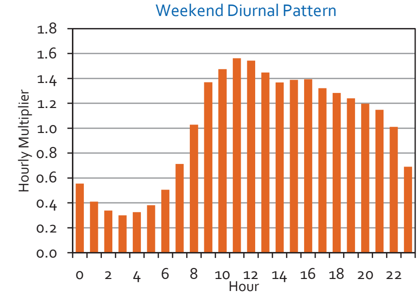
Level Calibration



Weekday Diurnal Pattern



Weekend Diurnal Pattern

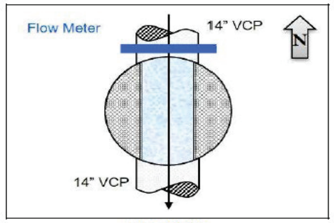


Flow Monitoring Site Site 14, Dry Weather Flow Calibration

Location: W Cecil Ave & N Ranch Ct
Pipeline Diameter: 18"
City Manhole ID: 7699
Model Pipe ID: 816

Flow Monitor Location

Satellite Map



Flow Sketch


Street View


Plan View

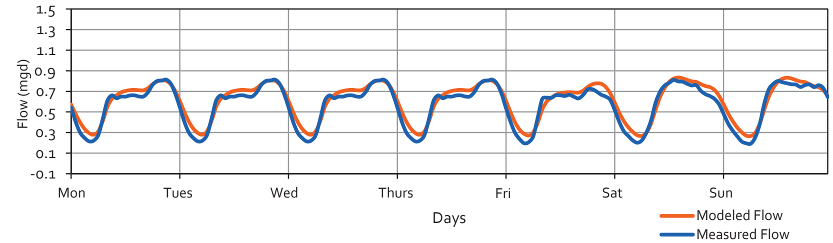
Model Calibration Summary

Day	Measured Data[1] Avg. Flow (mgd)	Peak Flow[2] (mgd)	Avg. Level (in)	Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Peak Flow[2] (mgd)	Avg. Level (in)	Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Peak Flow (%)	Avg. Level (%)	Avg. Vel. (%)
Mon.	0.57	0.81	8.7	1.02	0.61	0.81	8.9	1.0	5.4%	-0.9%	2.9%	3.3%
Tues.	0.57	0.81	8.7	1.02	0.61	0.81	9.0	1.0	5.9%	-0.9%	3.2%	3.4%
Wed.	0.57	0.81	8.7	1.02	0.61	0.81	9.0	1.0	5.9%	-0.9%	3.2%	3.4%
Thur.	0.57	0.81	8.7	1.02	0.61	0.81	9.0	1.0	5.9%	-0.9%	3.2%	3.4%
Fri.	0.55	0.72	8.4	1.01	0.59	0.78	8.8	1.0	7.6%	7.8%	4.7%	2.8%
Sat.	0.57	0.81	8.6	1.01	0.61	0.83	8.9	1.0	7.1%	2.8%	4.0%	3.4%
Sun.	0.58	0.80	8.7	1.00	0.61	0.83	8.9	1.0	5.3%	4.0%	2.5%	4.3%
Summary												
Weekday	0.57	--	8.6	1.01	0.60	--	8.9	1.05	6.1%	--	3.4%	3.3%
Weekend	0.57	--	8.6	1.01	0.61	--	8.9	1.05	6.2%	--	3.2%	3.9%
ADWF[4]	0.570	--	8.6	1.01	0.60	--	8.9	1.05	6.1%	--	3.4%	3.5%

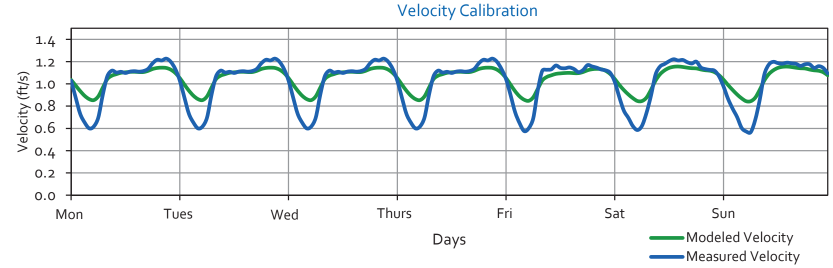
Notes:

1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

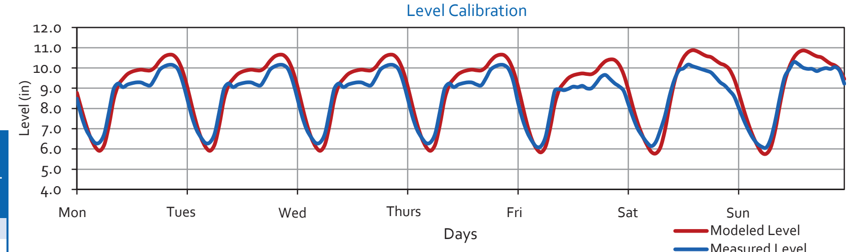
Flow Calibration



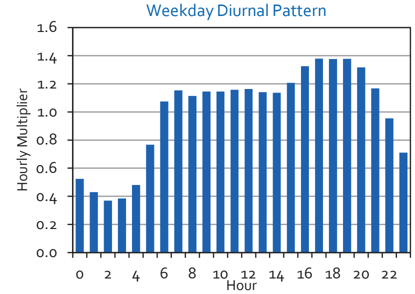
Velocity Calibration



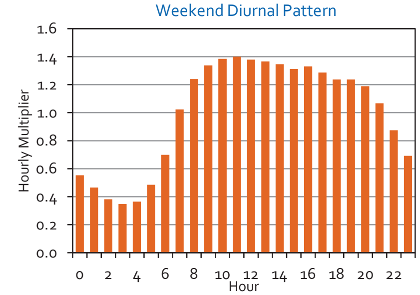
Level Calibration



Weekday Diurnal Pattern



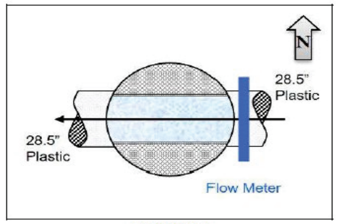
Weekend Diurnal Pattern



Flow Monitoring Site Site 15, Dry Weather Flow Calibration
Location: 4425 W Ferguson Ave, w/o N Chinowth St
Pipeline Diameter: 28.5"
City Manhole ID: 6447
Model Pipe ID: 1240

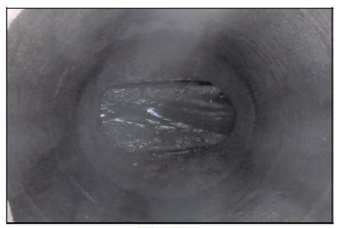
Flow Monitor Location

Satellite Map



Flow Sketch


Street View

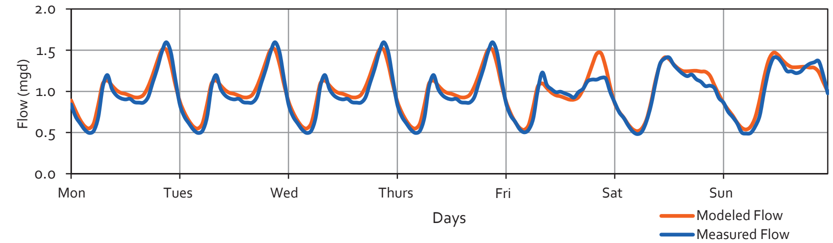

Plan View

Model Calibration Summary

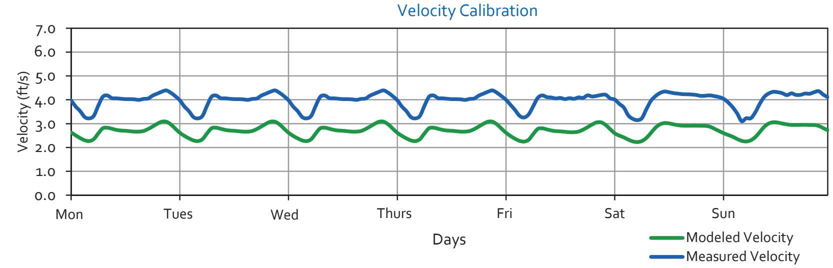
Day	Measured Data[1] Avg. Flow (mgd)	Peak Flow[2] (mgd)	Avg. Level (in)	Avg. Vel. (ft/s)	Modeled Data Avg. Flow (mgd)	Peak Flow[2] (mgd)	Avg. Level (in)	Avg. Vel. (ft/s)	Percent Error[3] Avg. Flow (%)	Peak Flow (%)	Avg. Level (%)	Avg. Vel. (%)
Mon.	0.96	1.60	3.9	3.96	1.00	1.51	5.1	2.7	4.4%	-5.6%	32.0%	-31.7%
Tues.	0.96	1.60	3.9	3.96	1.00	1.51	5.1	2.7	4.1%	-5.6%	31.9%	-31.8%
Wed.	0.96	1.60	3.9	3.96	1.00	1.51	5.1	2.7	4.1%	-5.6%	31.9%	-31.8%
Thur.	0.96	1.60	3.9	3.96	1.00	1.51	5.1	2.7	4.1%	-5.6%	31.9%	-31.8%
Fri.	0.93	1.23	3.9	3.96	0.97	1.46	5.1	2.7	3.8%	18.9%	31.4%	-32.3%
Sat.	0.98	1.41	4.0	3.97	1.02	1.41	5.2	2.7	4.0%	0.1%	31.0%	-31.6%
Sun.	1.02	1.40	3.9	3.98	1.06	1.47	5.3	2.7	3.8%	4.6%	34.5%	-31.1%
Summary												
Weekday	0.95	--	3.9	3.96	0.99	--	5.1	2.70	4.1%	--	31.8%	-31.9%
Weekend	1.00	--	3.9	3.98	1.04	--	5.2	2.73	3.9%	--	32.8%	-31.4%
ADWF[4]	0.967	--	3.9	3.96	1.01	--	5.2	2.71	4.0%	--	32.1%	-31.7%

Notes:
1. Source: V&A Temporary Flow Monitoring Program
2. Peak flow is the hourly average hourly peak flow, which was derived based on the 15-minute flow data from V&A.
3. Percent Error = (Modeled - Measured) /Measured x 100
4. ADWF = (5xWeekday Average + 2xWeekend Average)/7

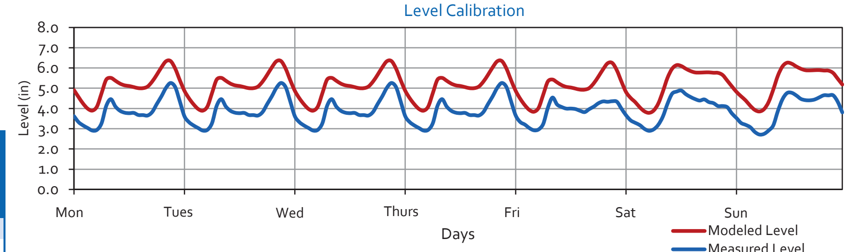
Flow Calibration



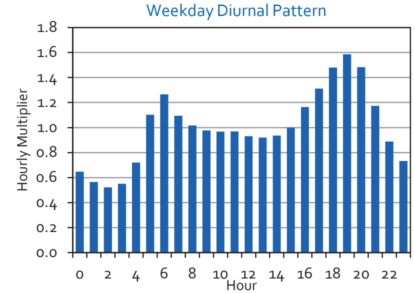
Velocity Calibration



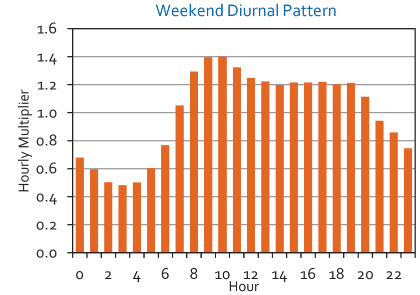
Level Calibration



Weekday Diurnal Pattern



Weekend Diurnal Pattern



APPENDIX E

WET WEATHER FLOW CALIBRATION SHEETS

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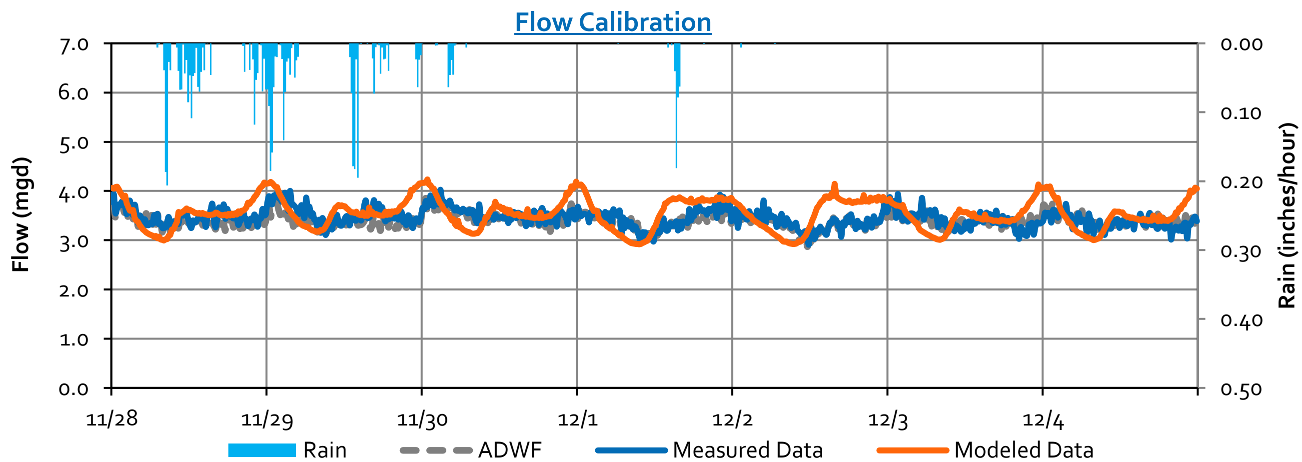
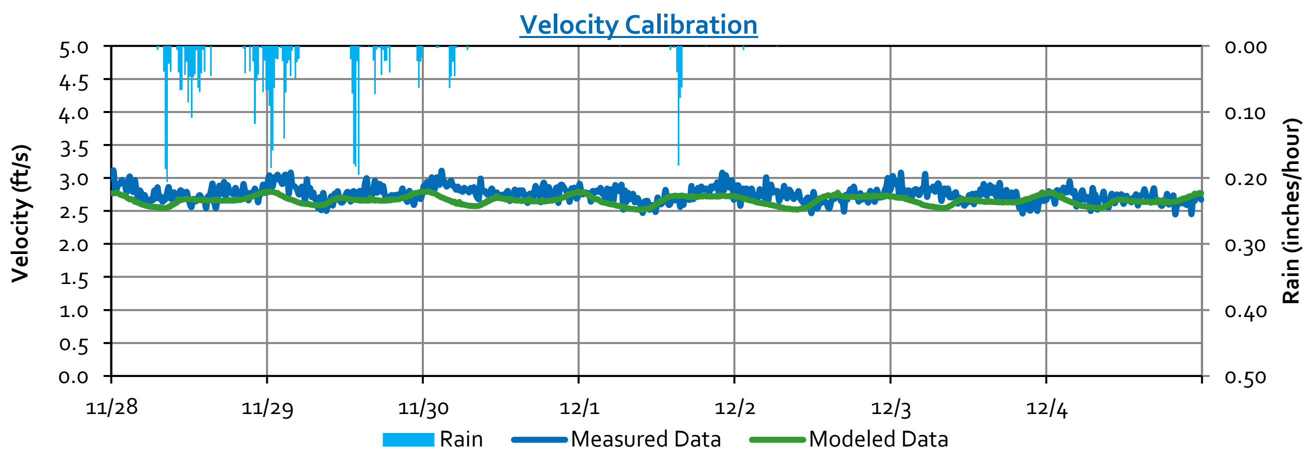
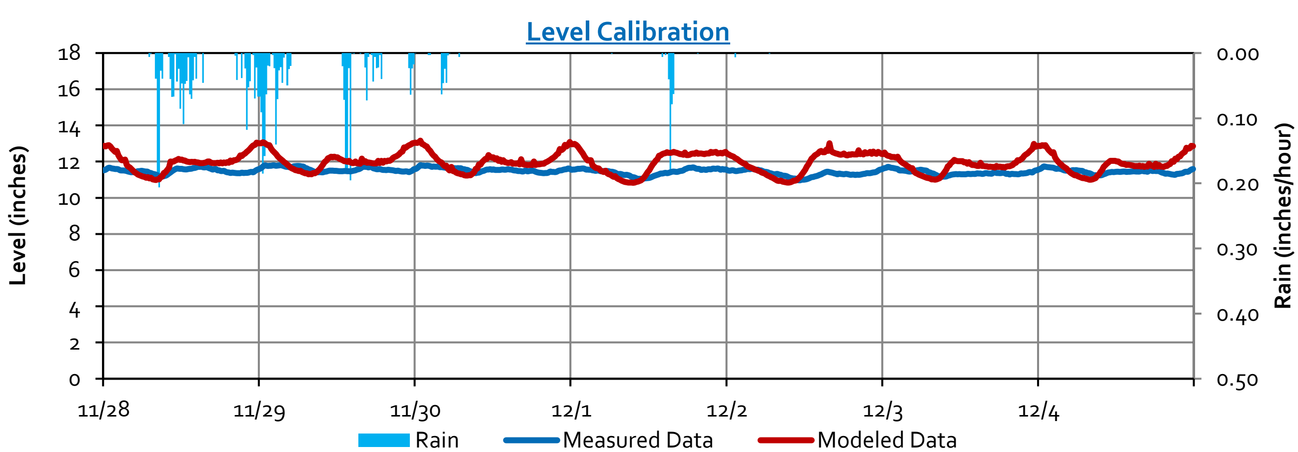
Flow Monitoring Site Site 1 Wet Weather Calibration
Location: End of Drive 85
Pipeline diameter: 36"
City Manhole ID: 3807
Model Pipe ID: 1018
Silt Level at Site: none"

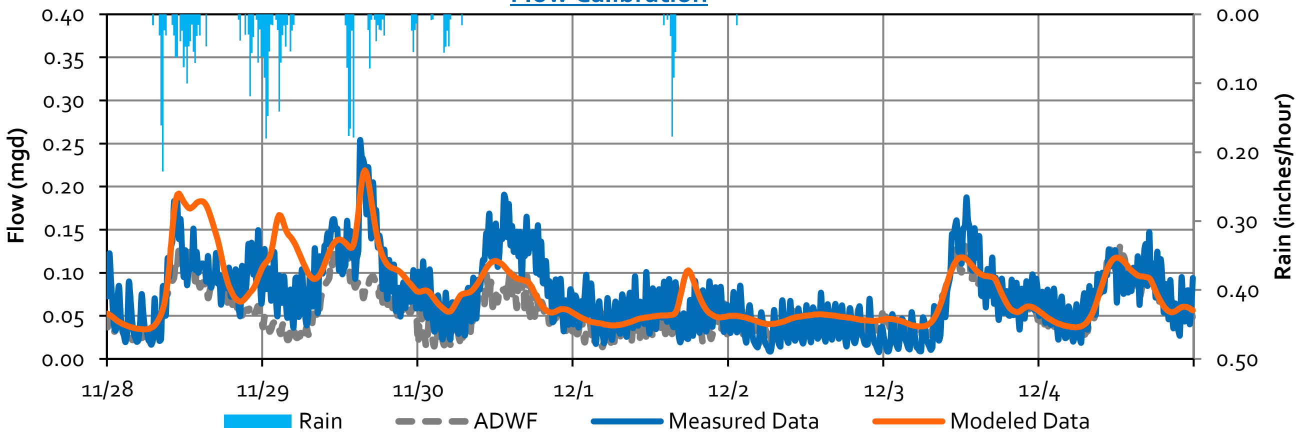




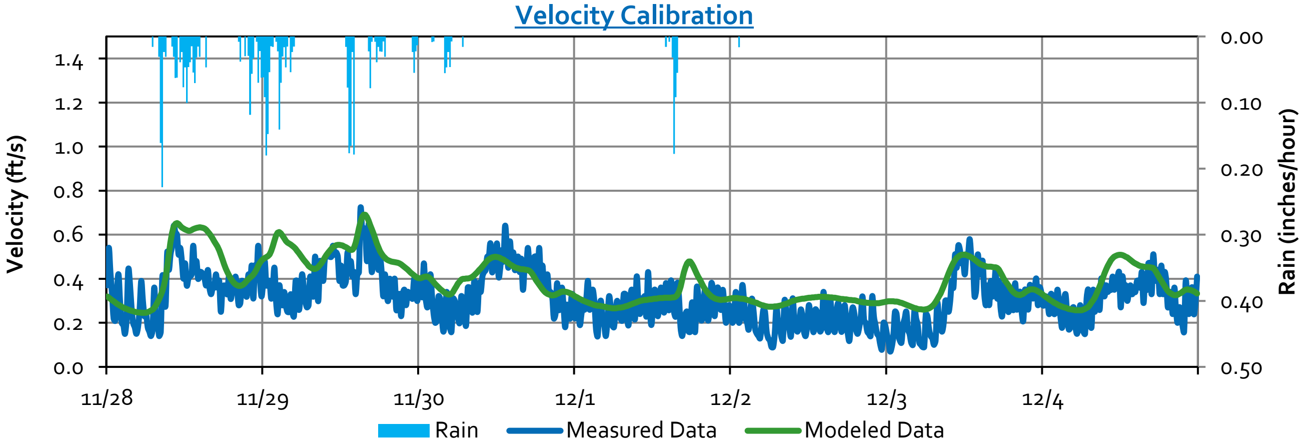


Flow Monitoring Site Site 2 Wet Weather Calibration
Location: Valley Oaks Golf Course
Pipeline diameter: 21"
City Manhole ID: 1525
Model Pipe ID: 966
Silt Level at Site: 4.0""

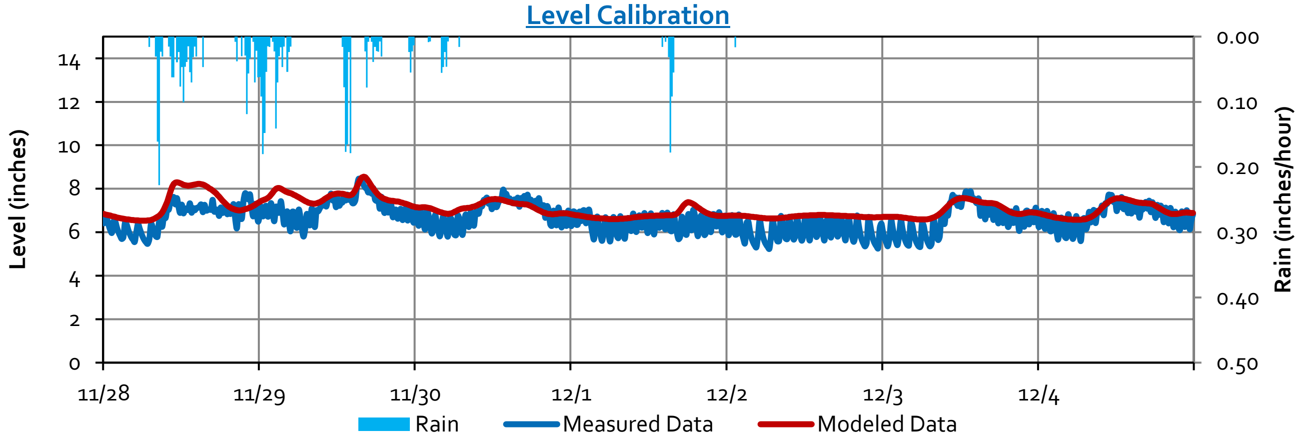
Flow Calibration



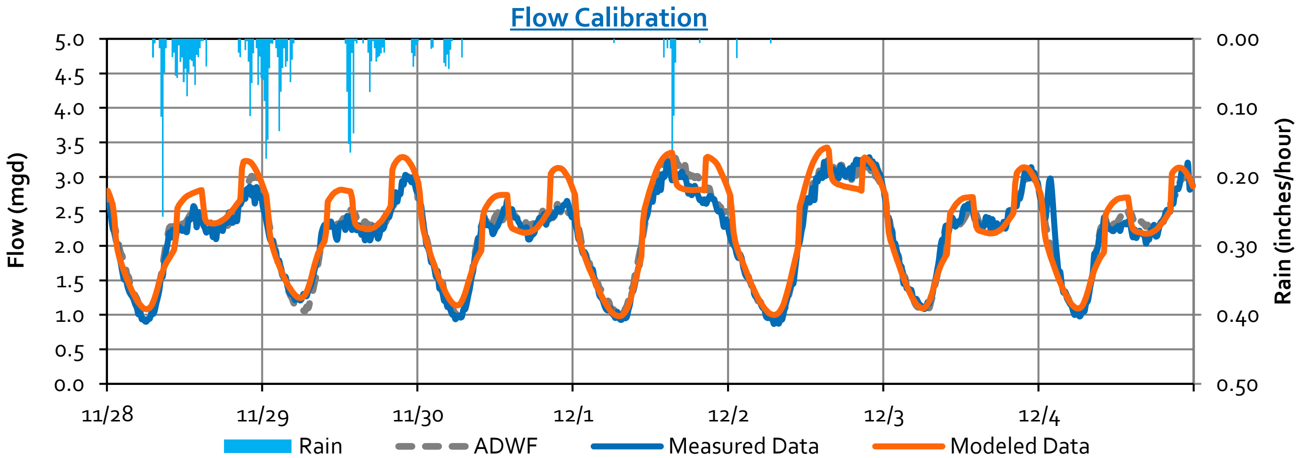
Velocity Calibration

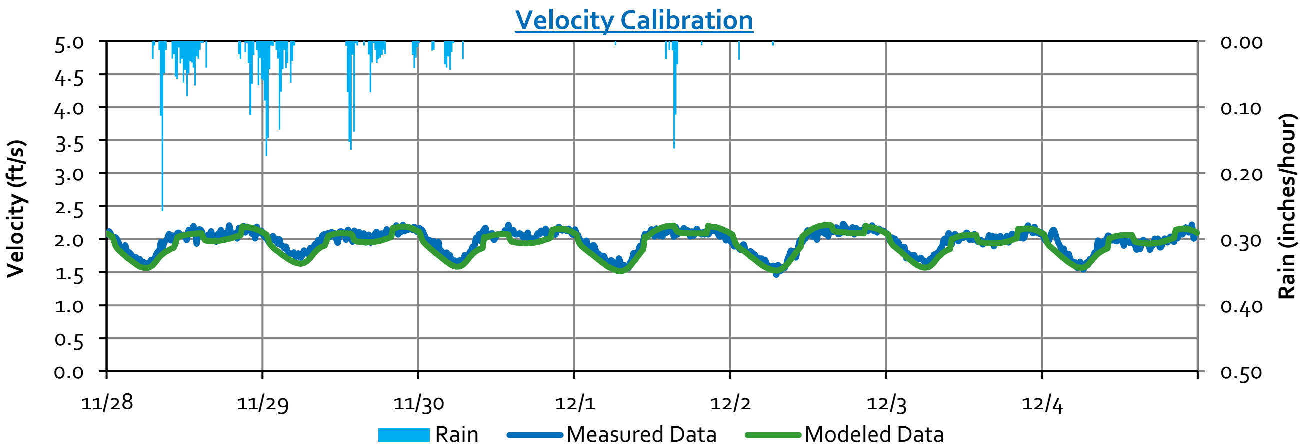


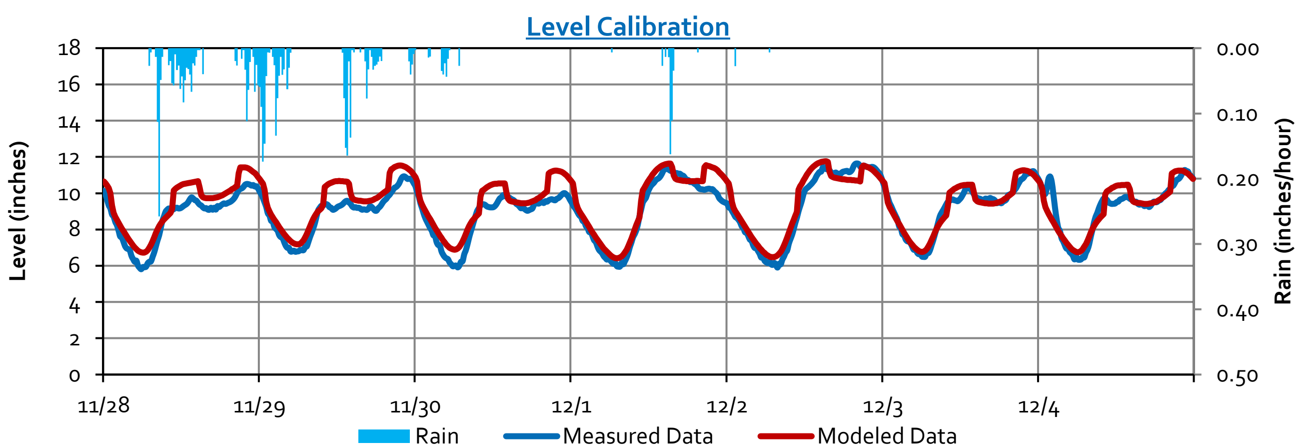
Level Calibration



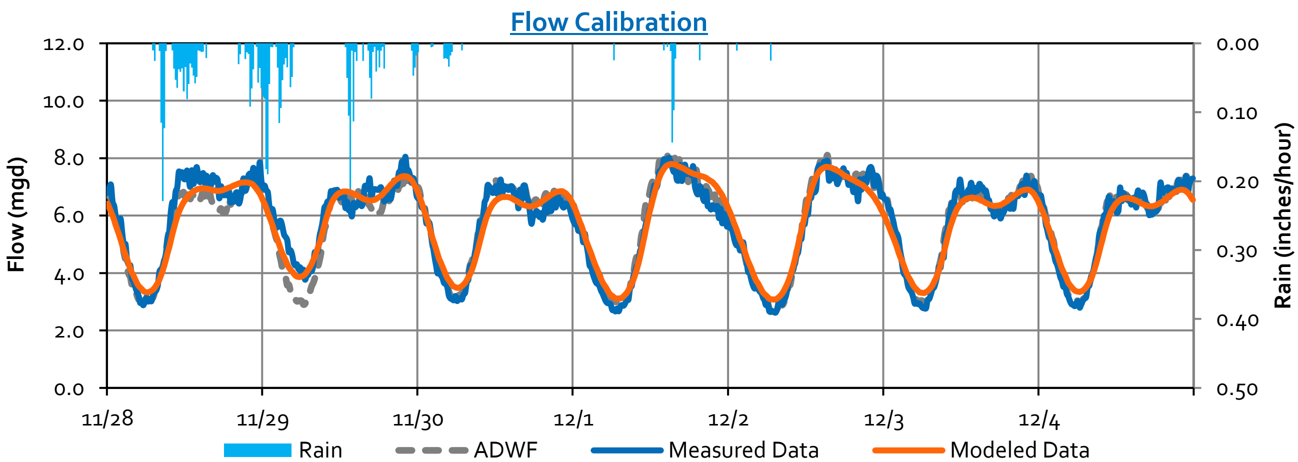
Flow Monitoring Site Site 3 Wet Weather Calibration
Location: W Walnut Ave w/o Rd 92
Pipeline diameter: 48"
City Manhole ID: 1371
Model Pipe ID: 250
Silt Level at Site: none"

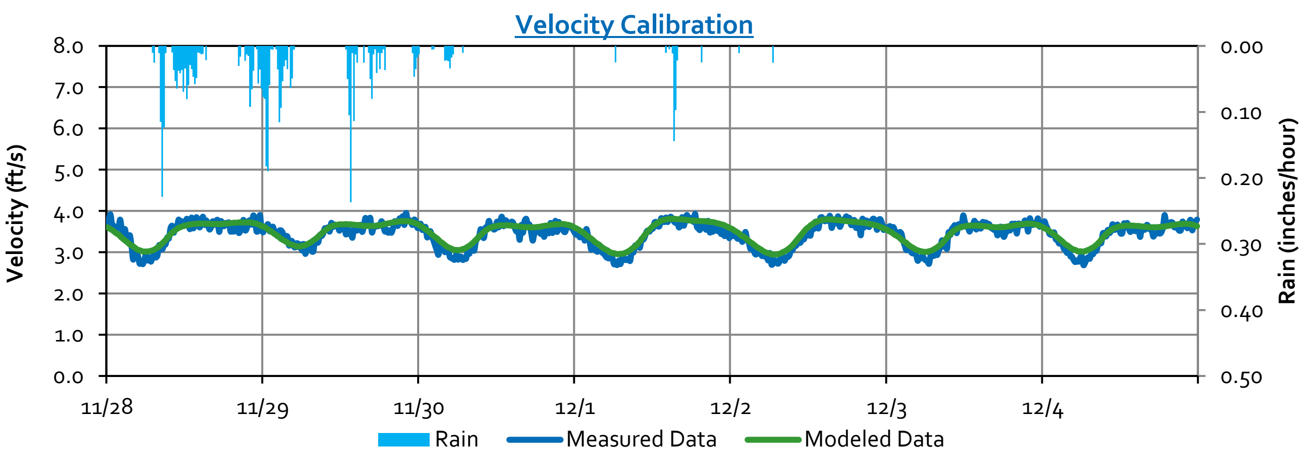


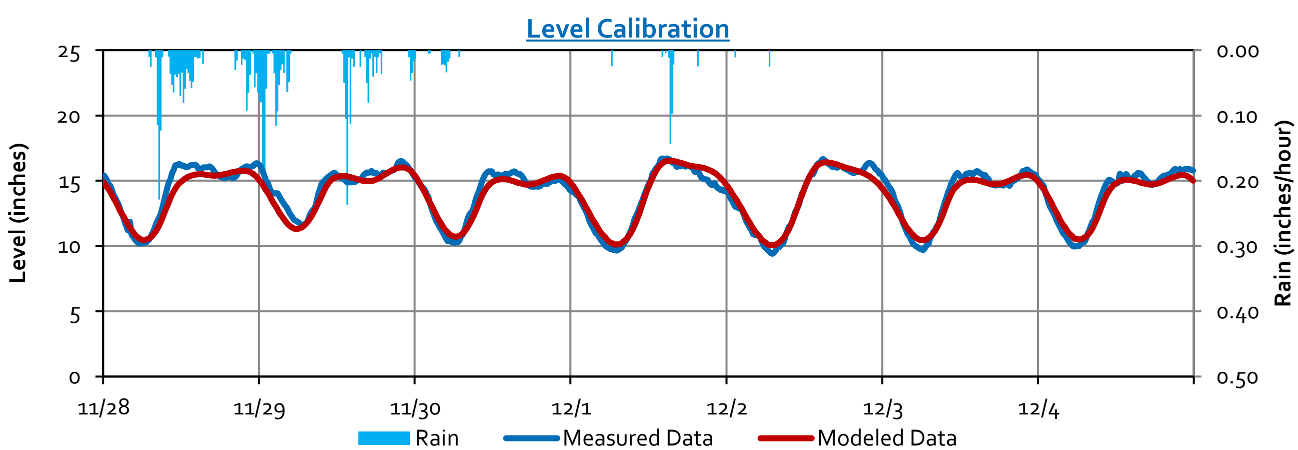




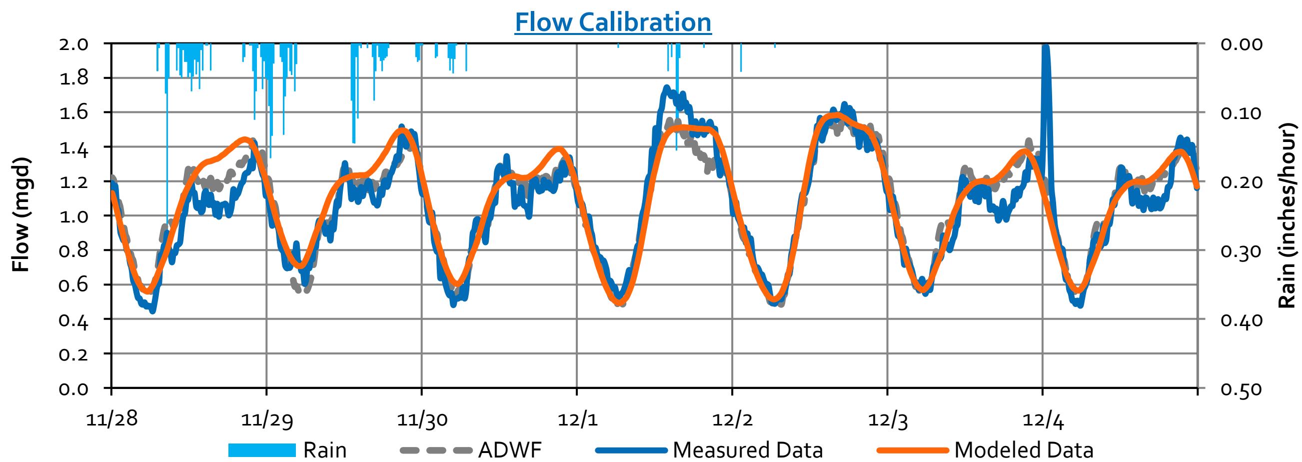
Flow Monitoring Site Site 4 Wet Weather Calibration
Location: W Walnut Ave & S Savannah St
Pipeline diameter: 36"
City Manhole ID: 1529
Model Pipe ID: 1194
Silt Level at Site: none"

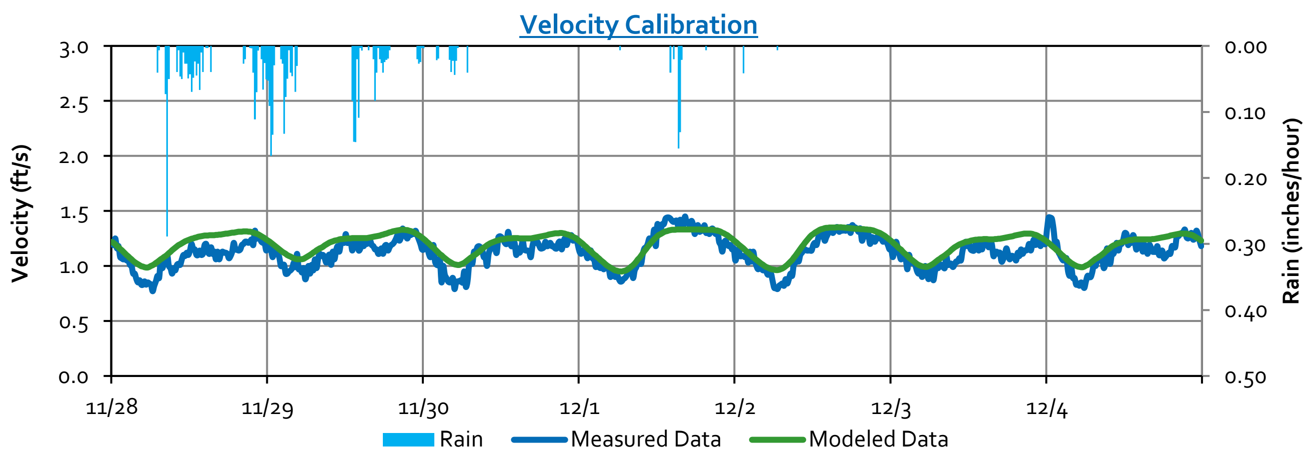


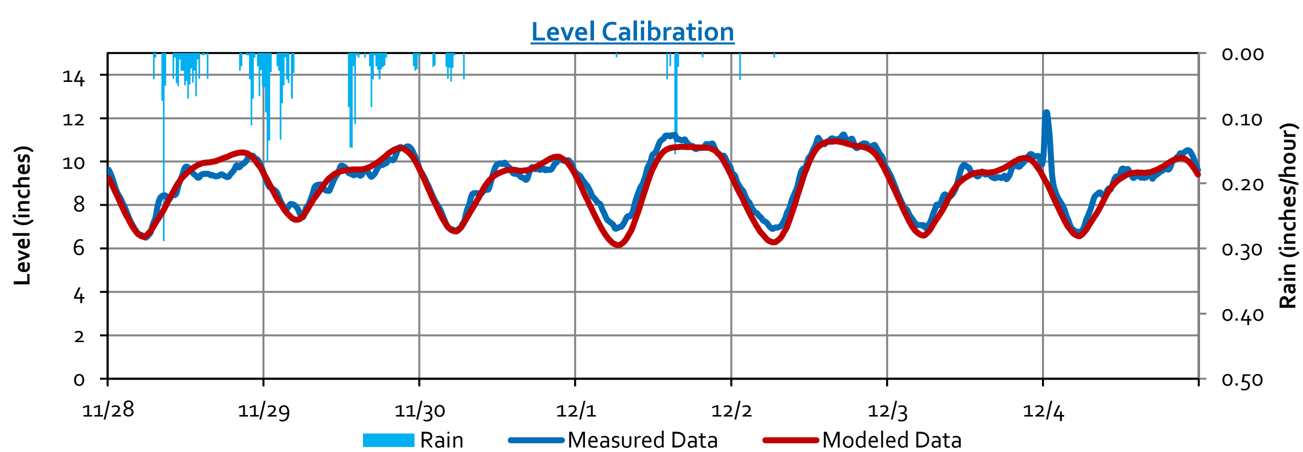




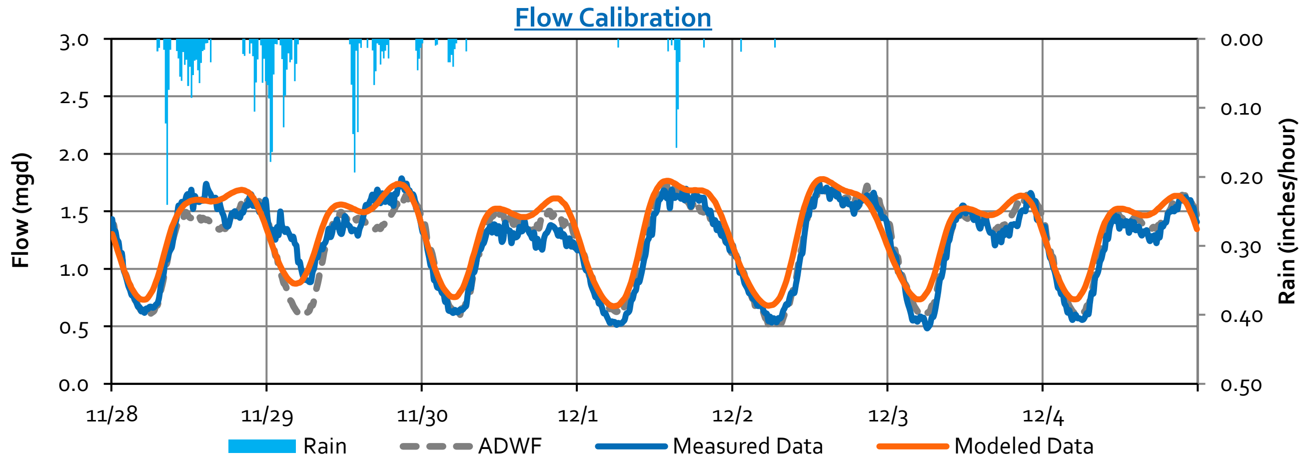
Flow Monitoring Site Site 5 Wet Weather Calibration
Location: 3498 Akers St n/o W Caldwell Ave
Pipeline diameter: 36"
City Manhole ID: 2888
Model Pipe ID: 10
Silt Level at Site: none"

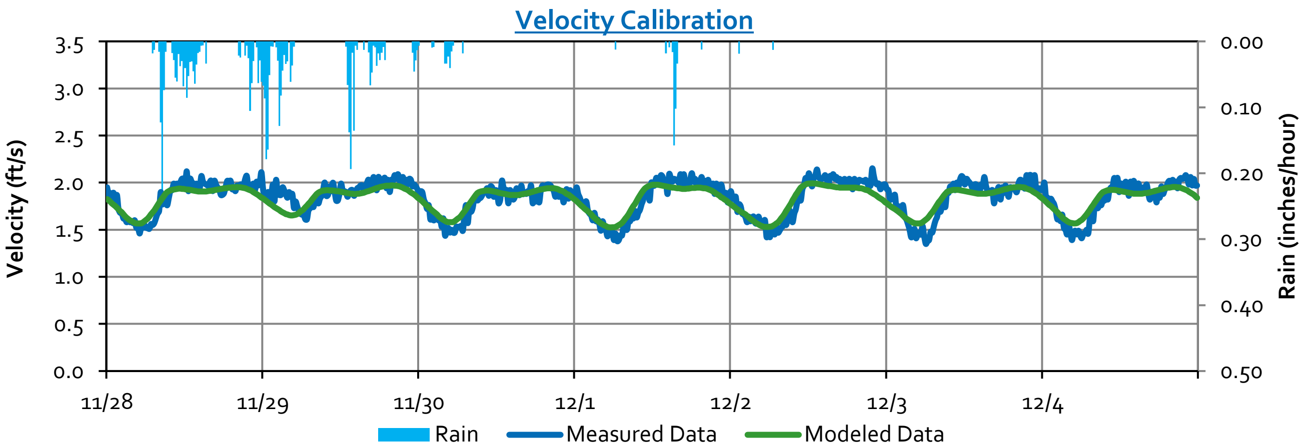


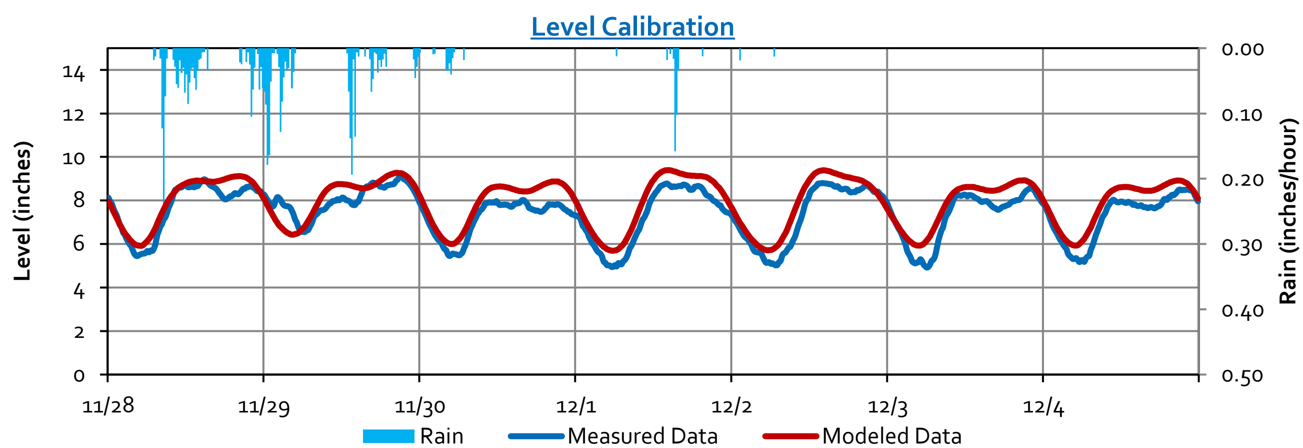




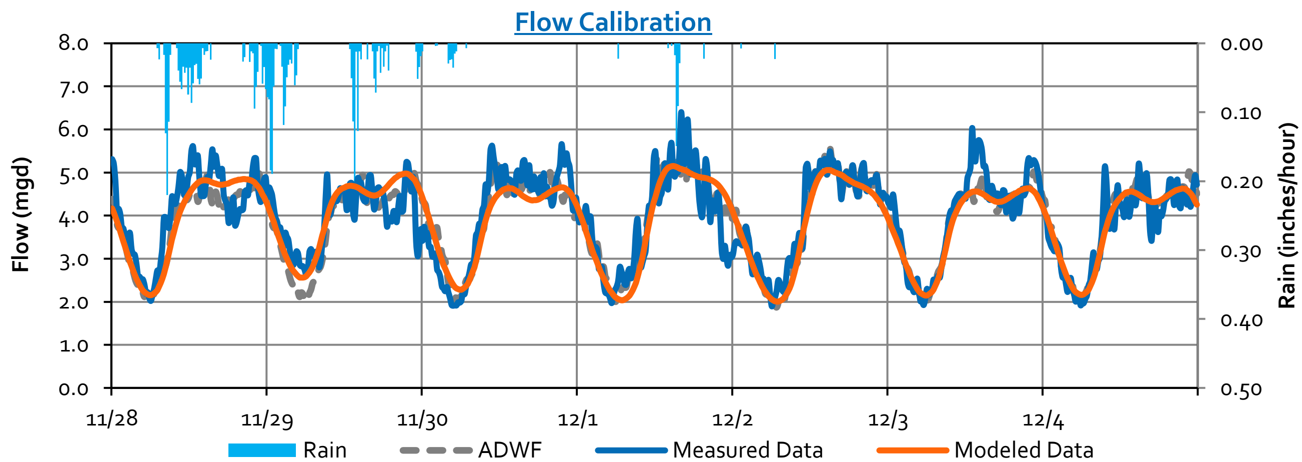
Flow Monitoring Site Site 6 Wet Weather Calibration
Location: S Noyes St & W Laurel Ave
Pipeline diameter: 33"
City Manhole ID: 102
Model Pipe ID: 370
Silt Level at Site: none"

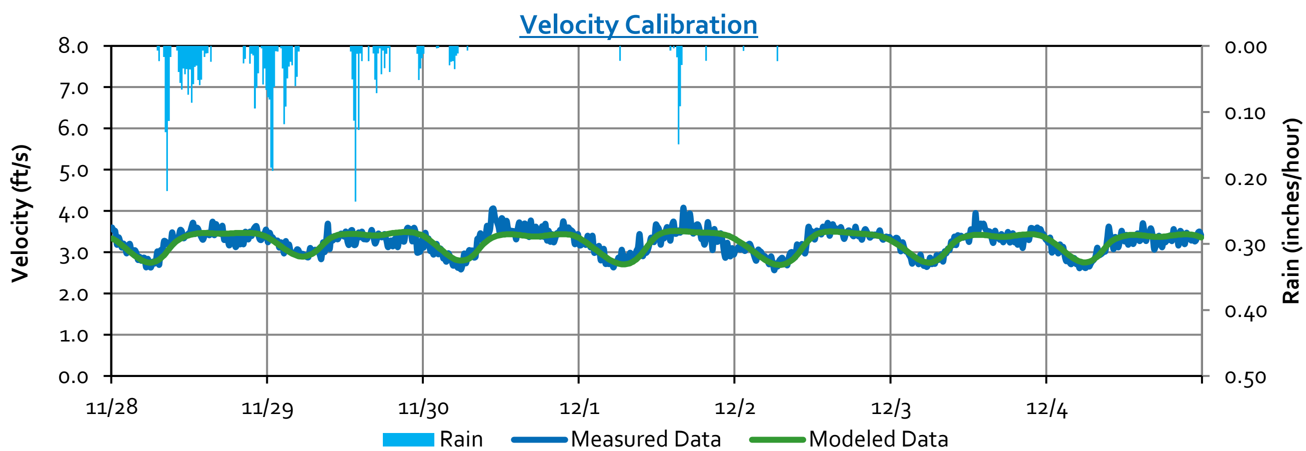


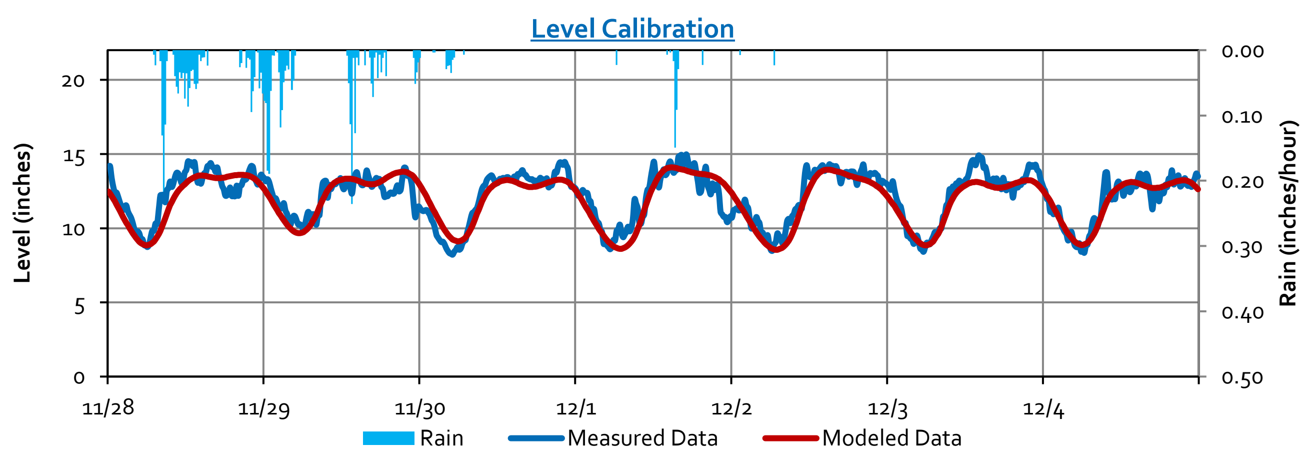




Flow Monitoring Site Site 7 Wet Weather Calibration
Location: S Akers St n/o W Cambridge Ave
Pipeline diameter: 30"
City Manhole ID: 1038
Model Pipe ID: 520
Silt Level at Site: none"

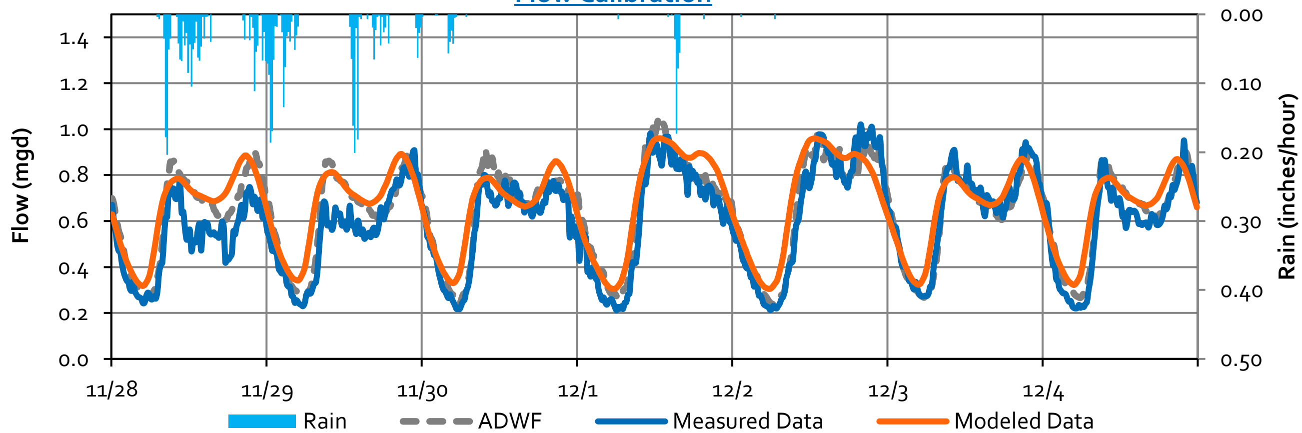




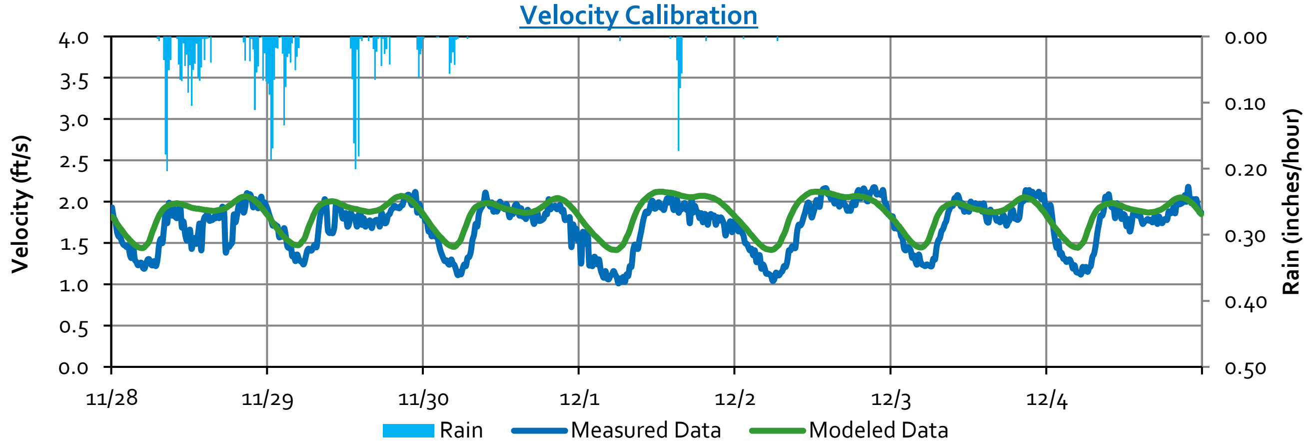


Flow Monitoring Site Site 8 Wet Weather Calibration
Location: S Akers St s/o W Cambridge Ave
Pipeline diameter: 24"
City Manhole ID: 1021
Model Pipe ID: 921
Silt Level at Site: none"

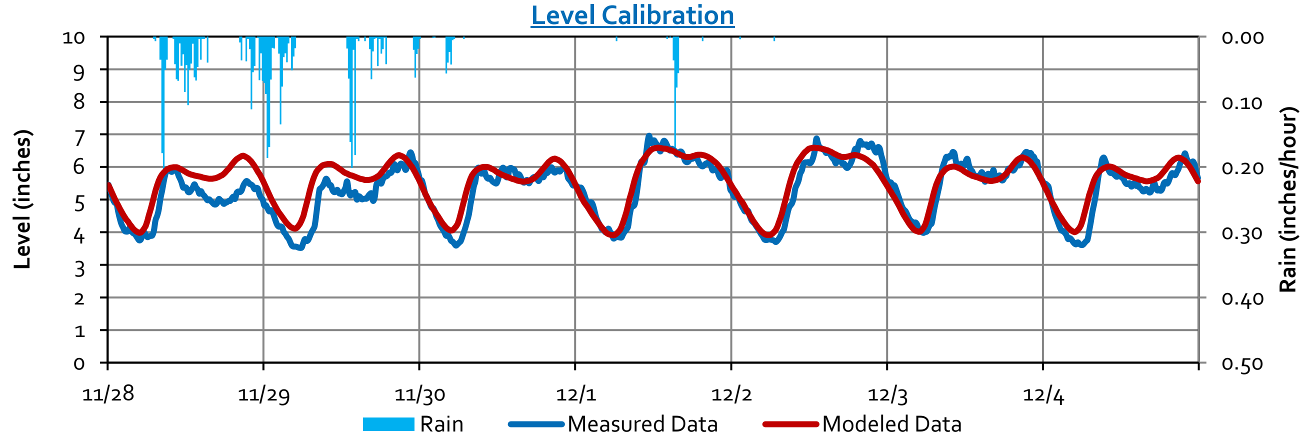
Flow Calibration



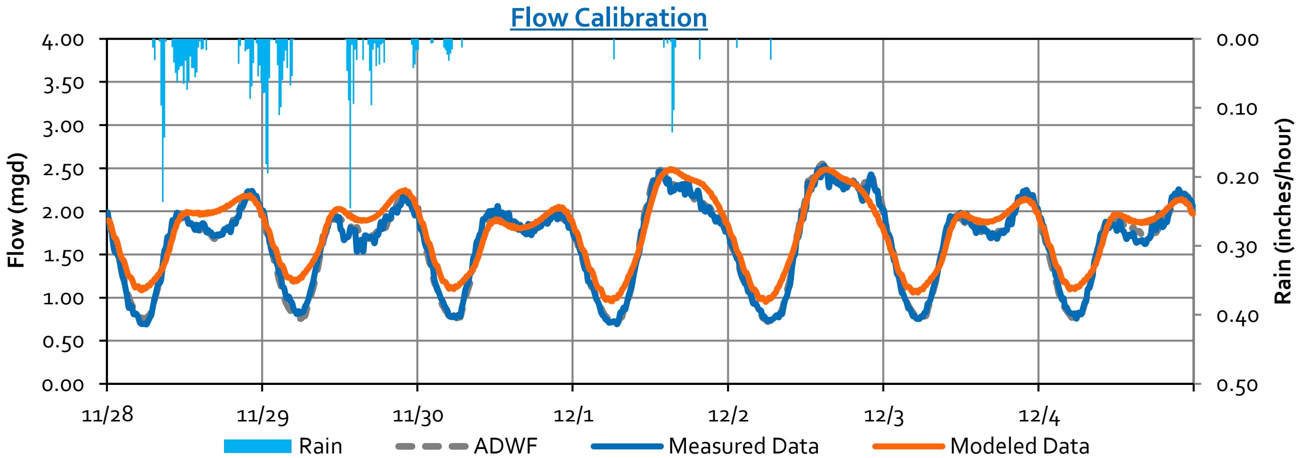
Velocity Calibration

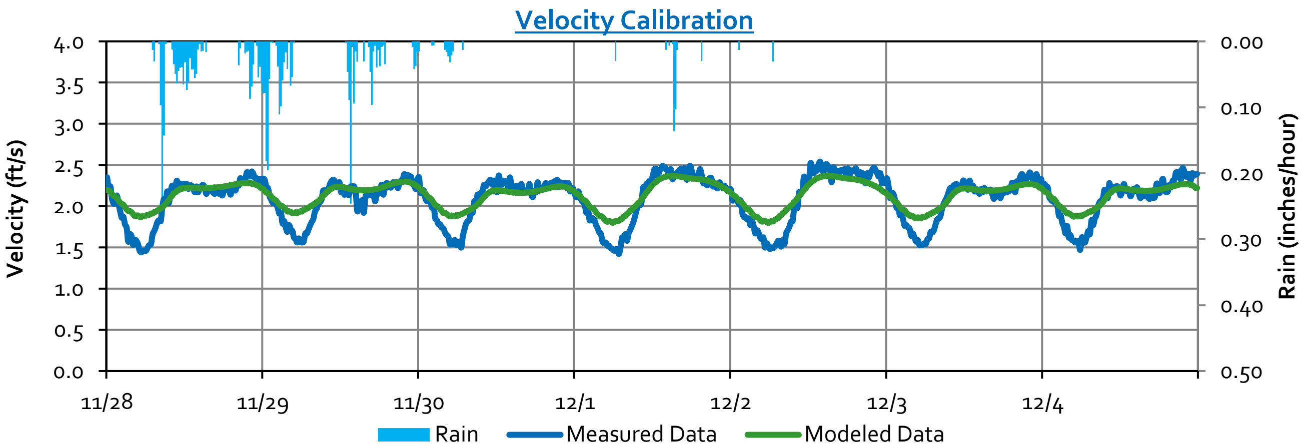


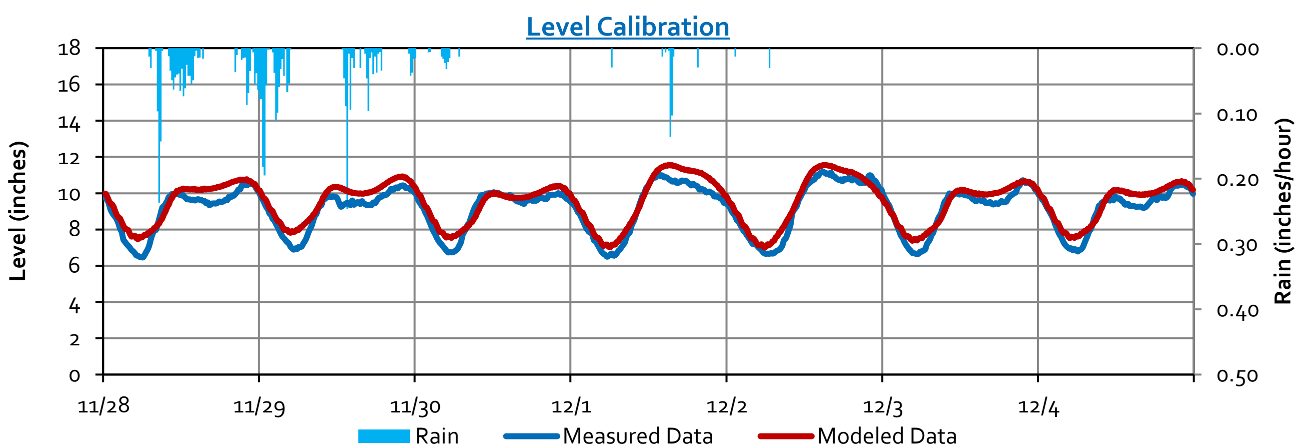
Level Calibration



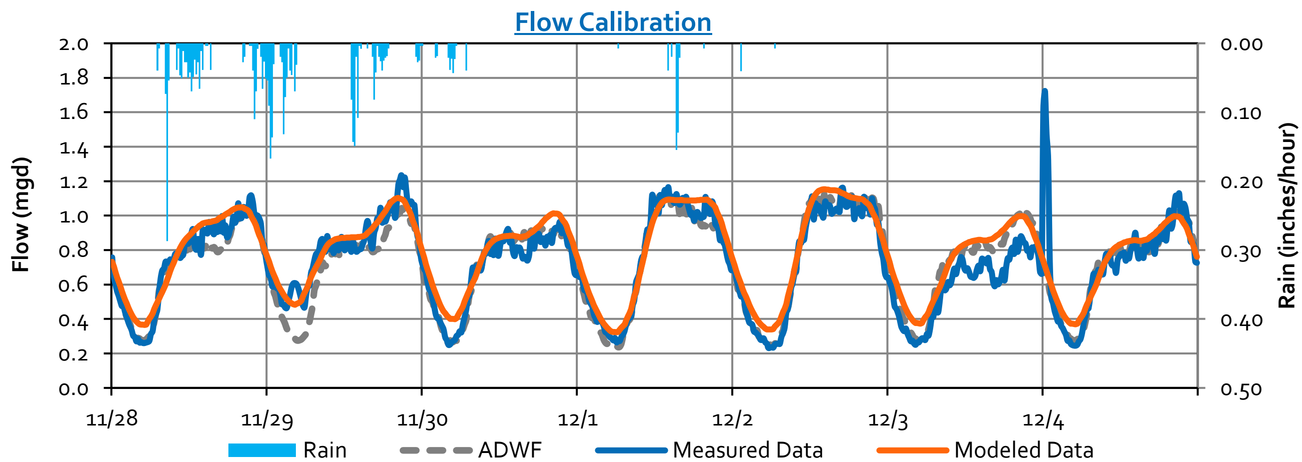
Flow Monitoring Site Site 9 Wet Weather Calibration
Location: W Walnut Ave & S San Joaquin Dr
Pipeline diameter: 27"
City Manhole ID: 1156
Model Pipe ID: 138
Silt Level at Site: none"

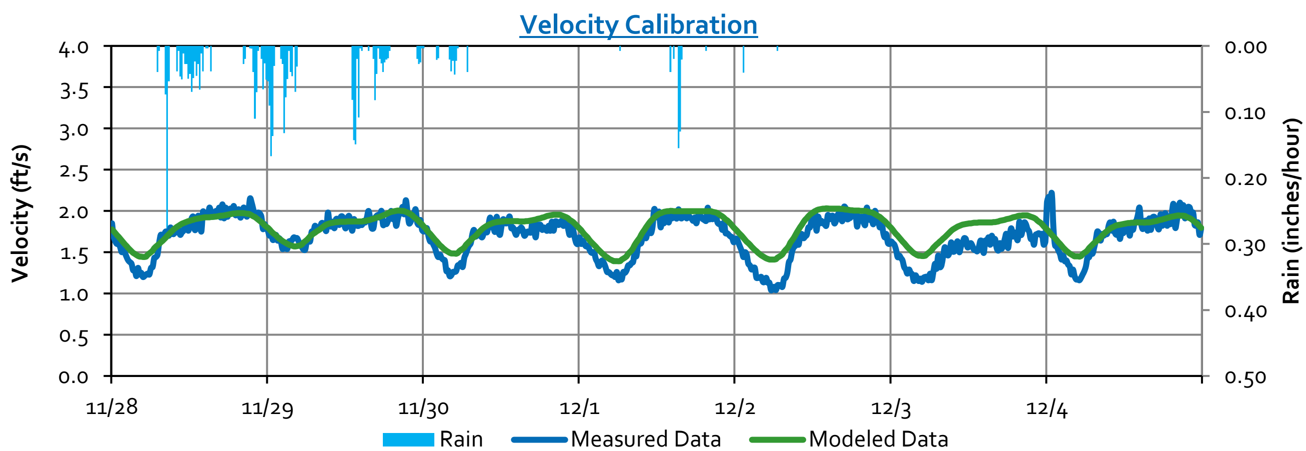


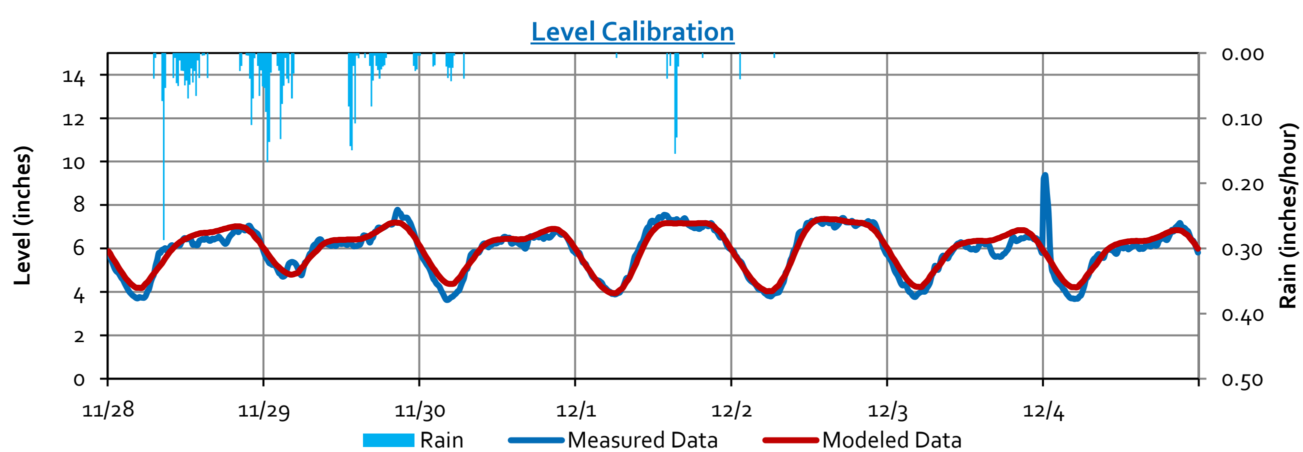




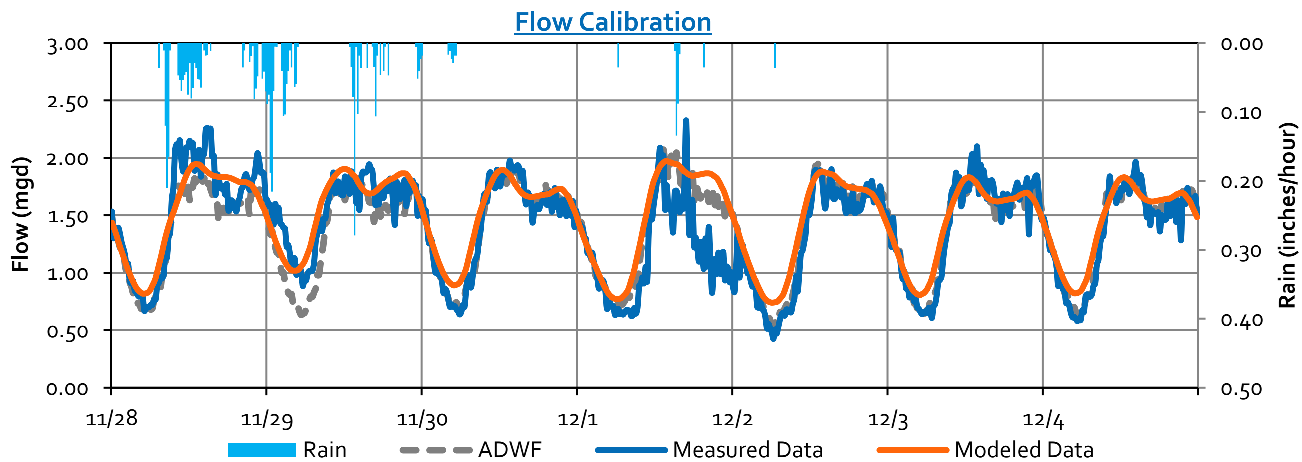
Flow Monitoring Site Site 10 Wet Weather Calibration
Location: W Caldwell Ave & Rd 100
Pipeline diameter: 27"
City Manhole ID: 2953
Model Pipe ID: 17
Silt Level at Site: none"

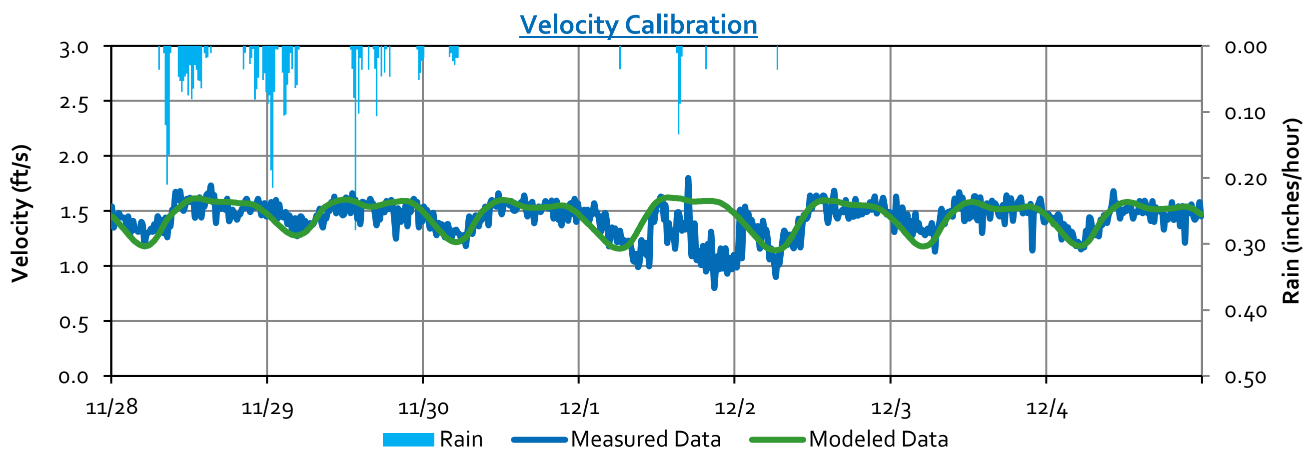


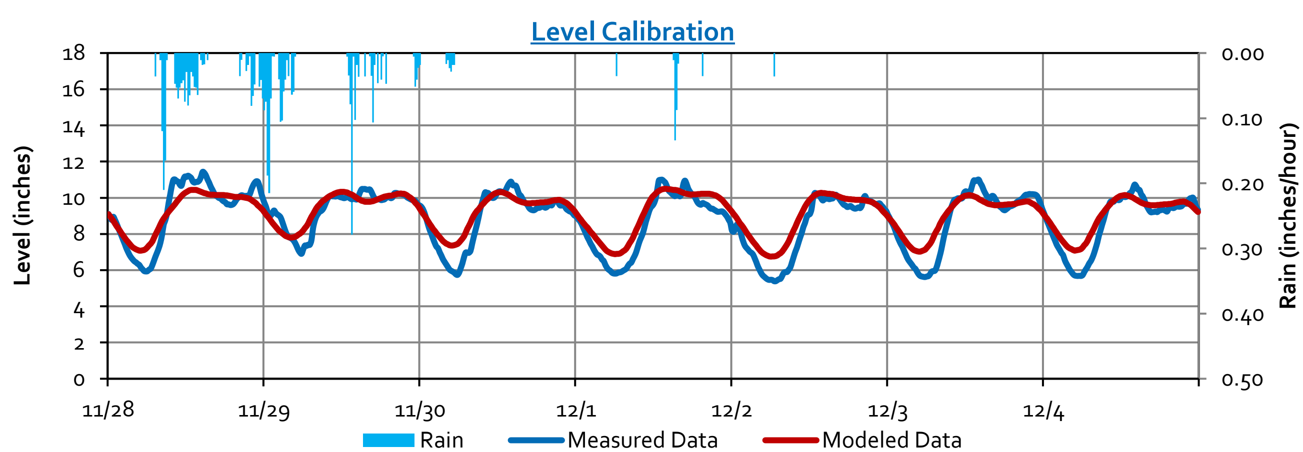




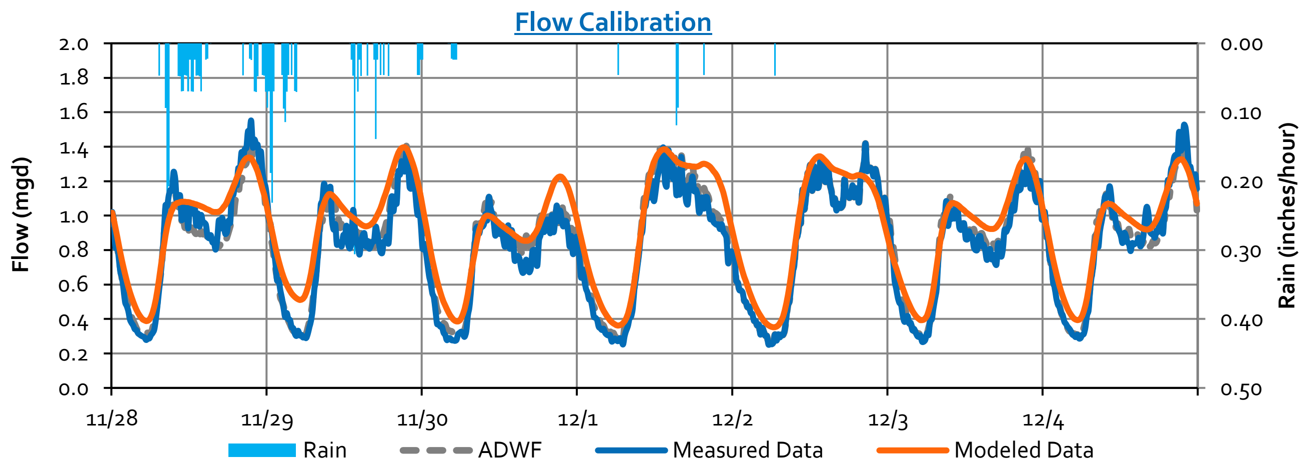
Flow Monitoring Site Site 11 Wet Weather Calibration
Location: W Mineral King Ave, w/o S Woodland Dr
Pipeline diameter: 42"
City Manhole ID: 2647
Model Pipe ID: 550
Silt Level at Site: none"

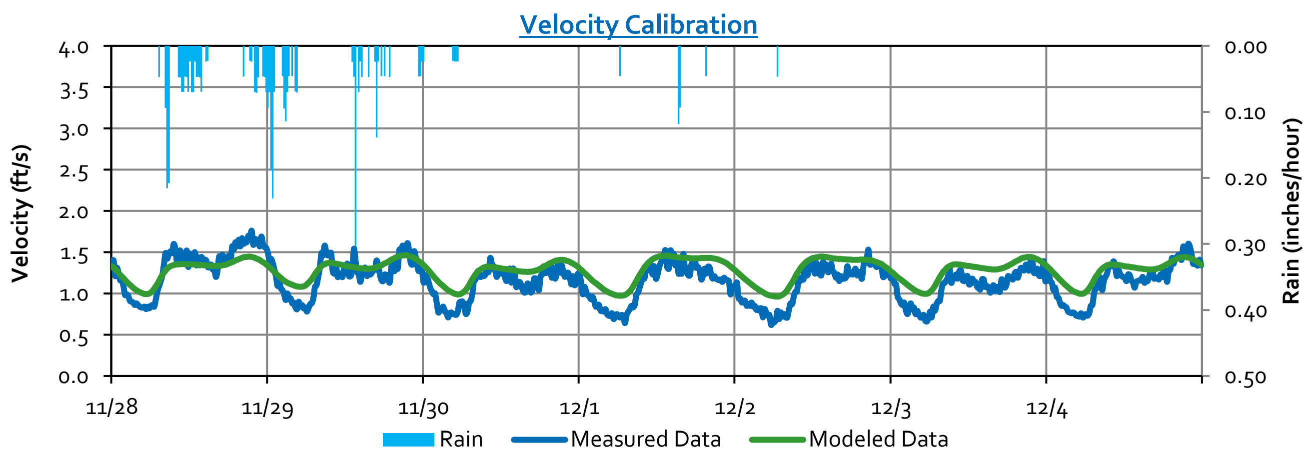


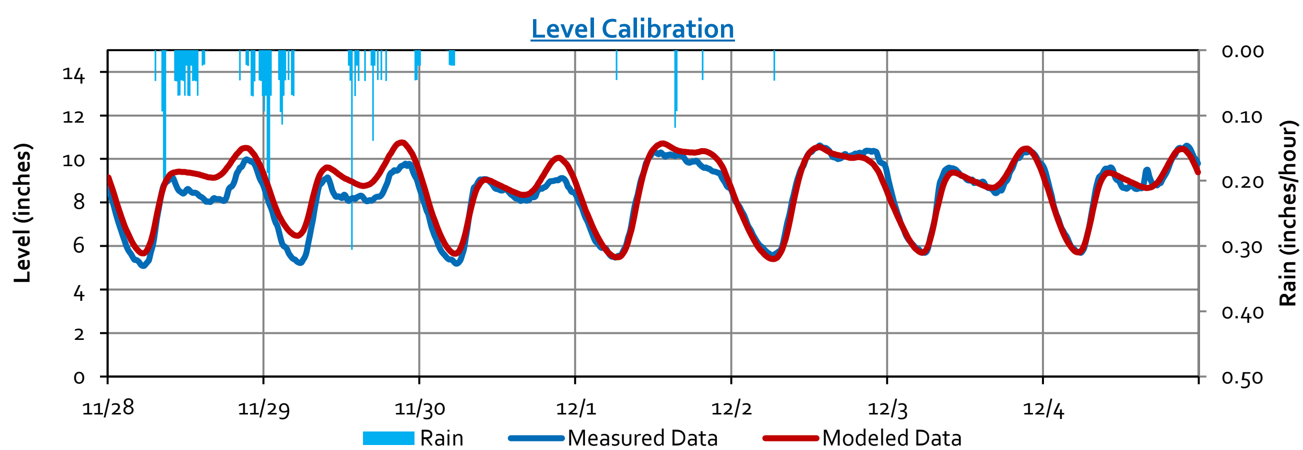




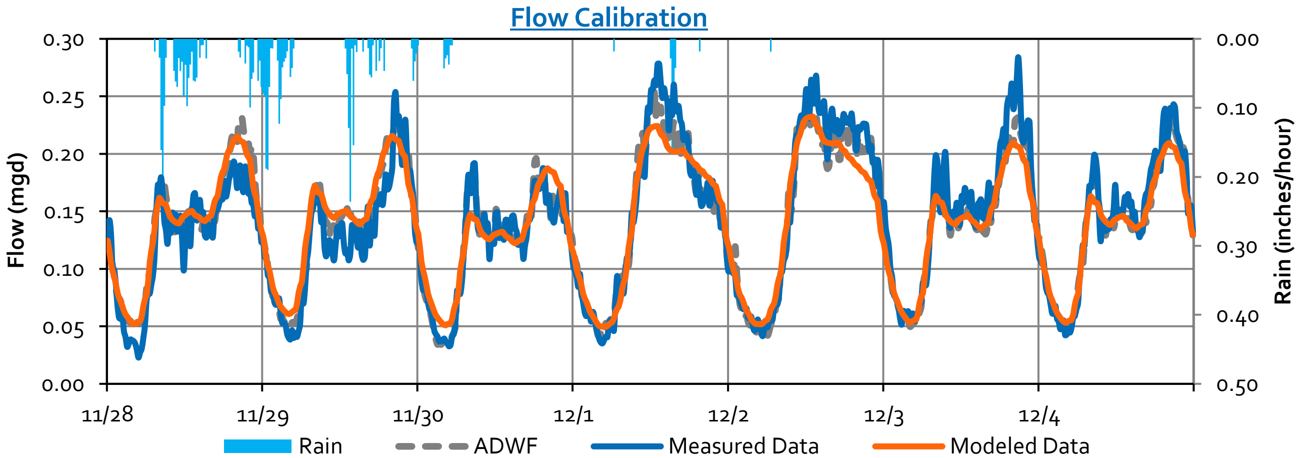
Flow Monitoring Site Site 12 Wet Weather Calibration
Location: E Walnut Ave & S Church St
Pipeline diameter: 28"
City Manhole ID: 1407
Model Pipe ID: 191
Silt Level at Site: none"

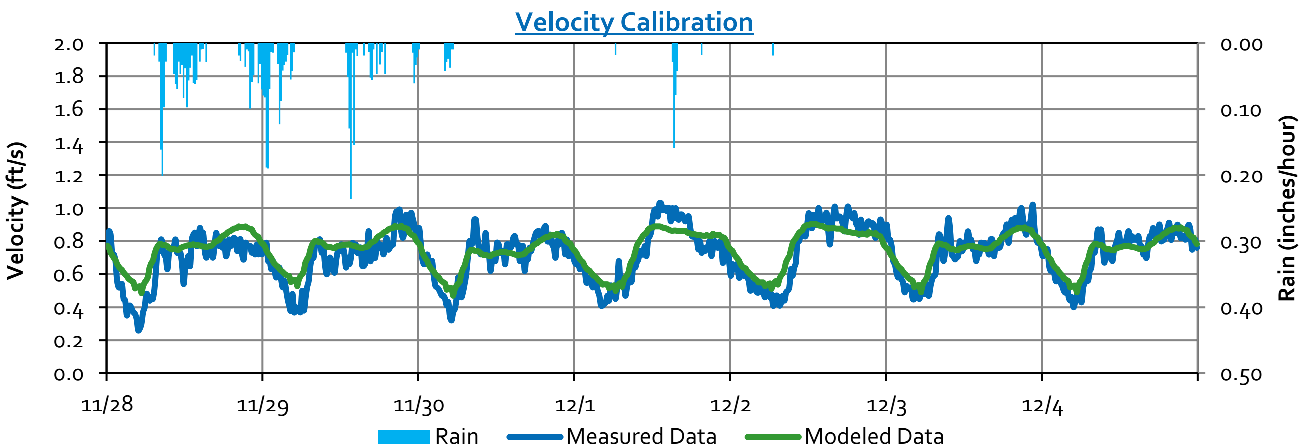


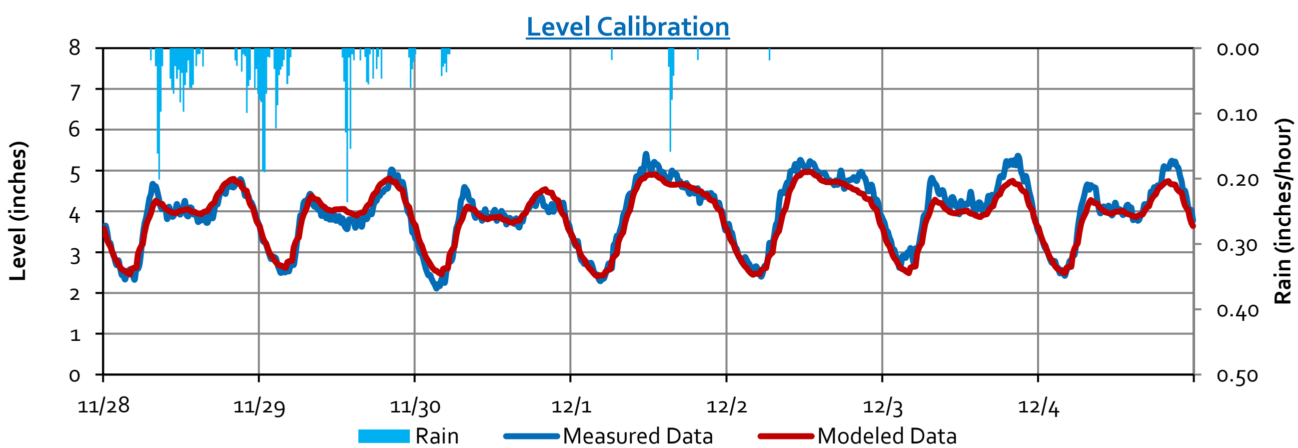




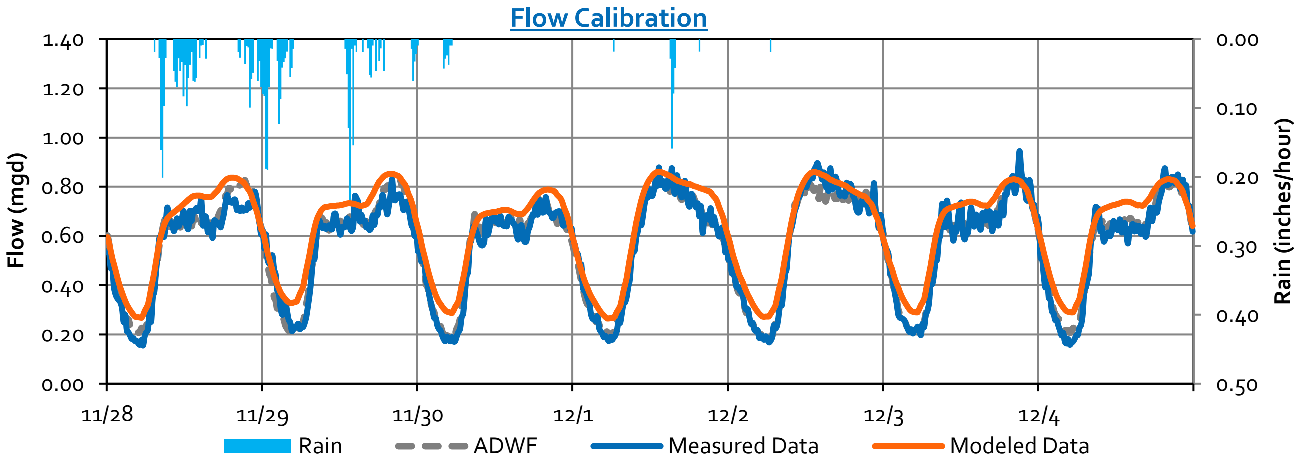
Flow Monitoring Site Site 13 Wet Weather Calibration
Location: Houston Ave & N County Center St
Pipeline diameter: 18"
City Manhole ID: 2766
Model Pipe ID: 883
Silt Level at Site: none"

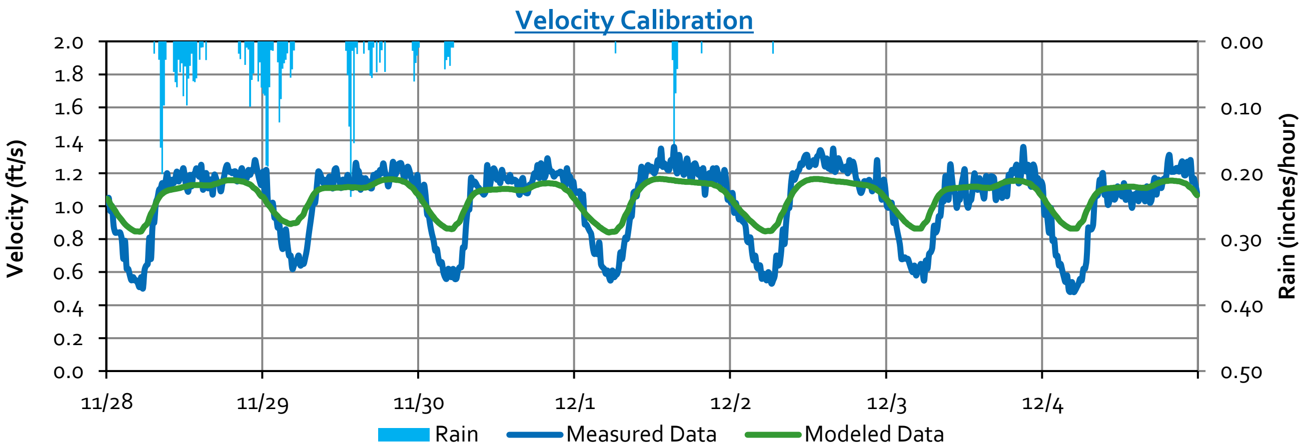


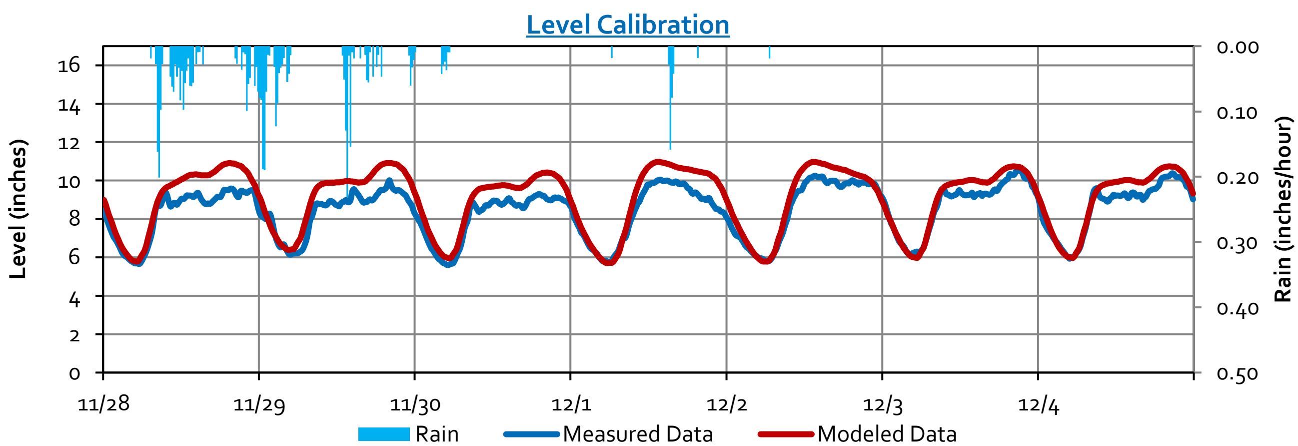




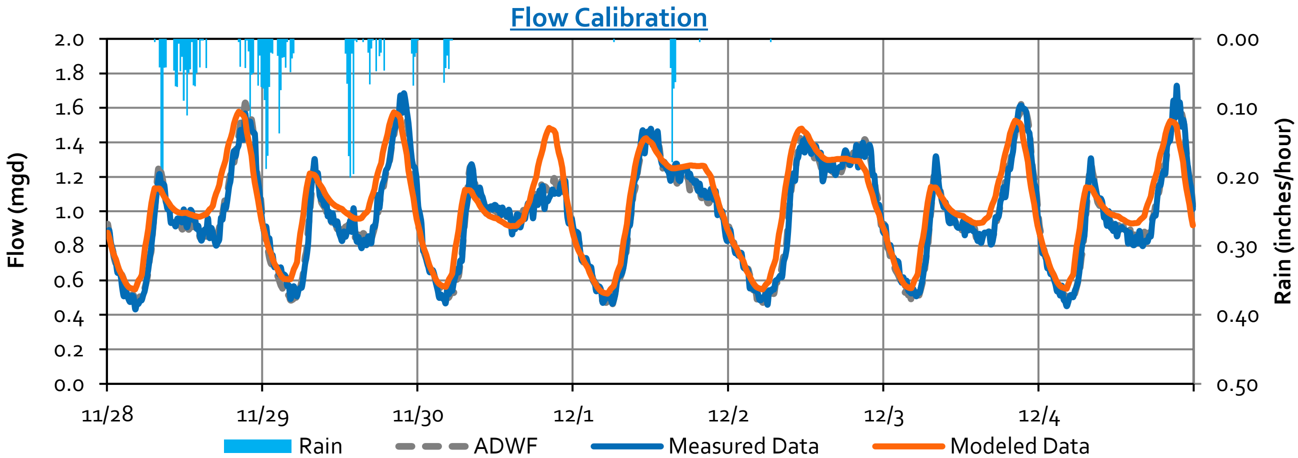
Flow Monitoring Site Site 14 Wet Weather Calibration
Location: W Cecil Ave & N Ranch Ct
Pipeline diameter: 18"
City Manhole ID: 7699
Model Pipe ID: 816
Silt Level at Site: none"

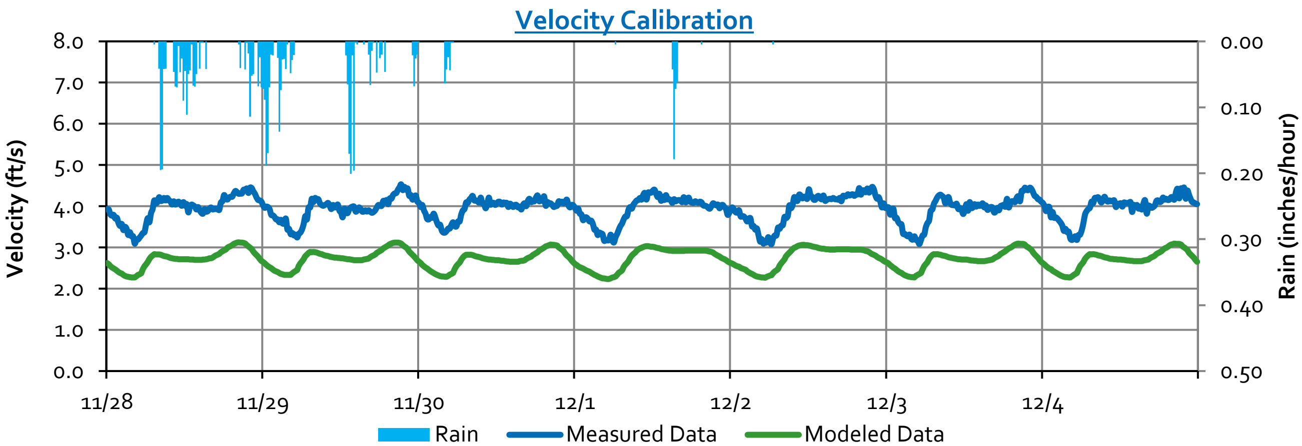


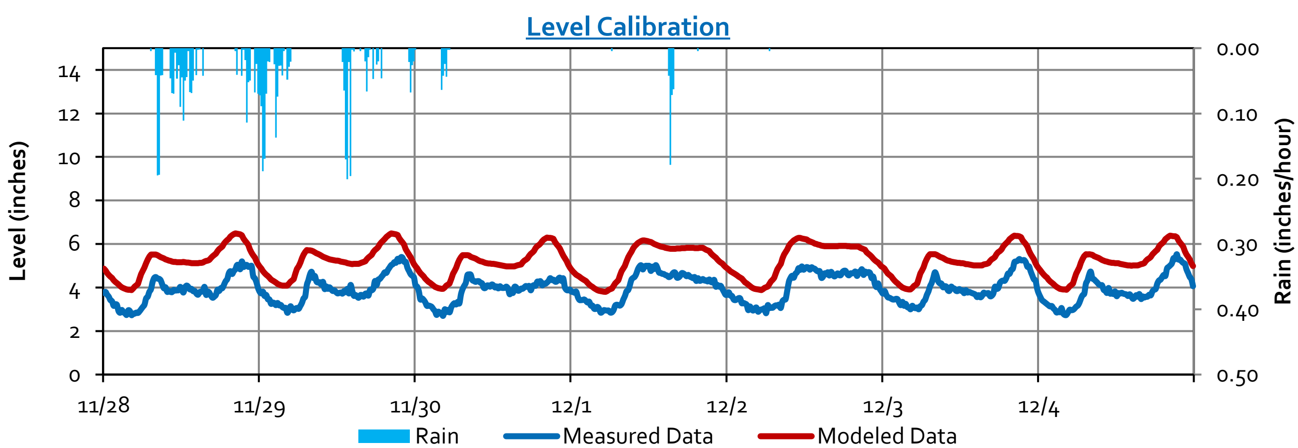




Flow Monitoring Site Site 15 Wet Weather Calibration
Location: 4425 W Ferguson Ave, w/o N Chinowth St
Pipeline diameter: 28.5"
City Manhole ID: 6447
Model Pipe ID: 1240
Silt Level at Site: none"







APPENDIX F

DETAILED CIP SHEETS

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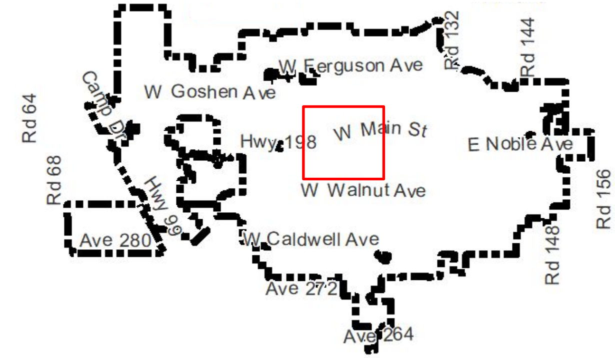


Project Number:	WWGM-0A
Project Name:	North Ranch St./Visalia Country Club
System Type:	Sanitary Sewer Collection System

Project Description:

This project will replace approximately 3,600 feet of 18-inch diameter pipeline in North Ranch Street and through the Visalia Country Club with a new 24-inch sewer, extending from West Mineral King Avenue to West Goshen Avenue. This project is needed to mitigate existing capacity deficiencies associated with historical peak discharge rates associated with the milk processing plant upstream of this sewer main.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost(4) ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	18	24	Replace	3,400	$ 670	$ 2,278,000	$ 2,961,000	$ 3,776,000	2026

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

(4) The CIP costs for this project are considered atypical due to bypass pumping requirements and challenging crossings, and were estimated saprately from the master plan unit costs.

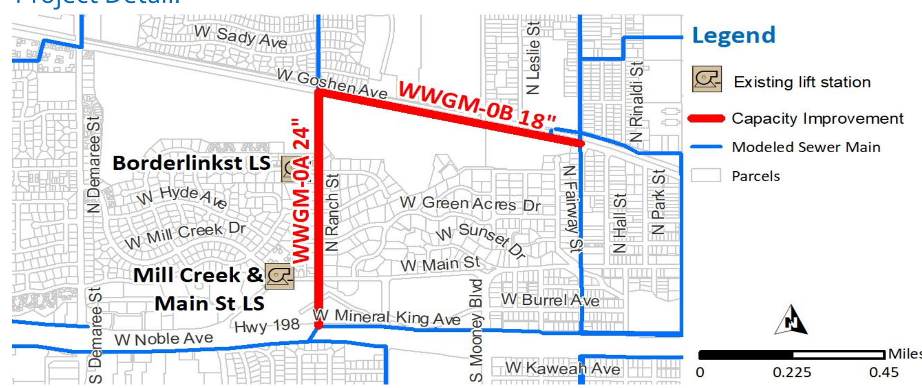
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	100%	$ 3,776,000
Future Users	0%	$ -
Total	100%	$ 3,776,000

Notes on Cost Estimation:

Project will address existing capacity deficiencies, therefore 0-percent of cost is assigned to future users.

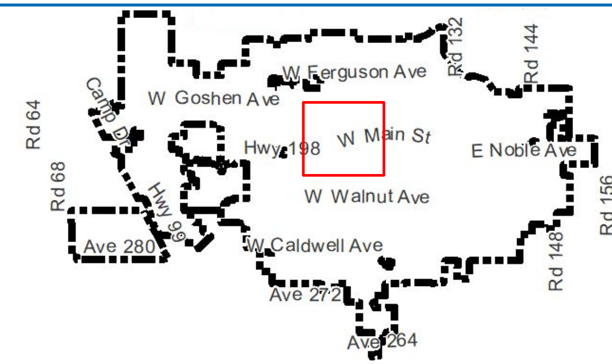
Project Detail:



Project Number: WWGM-0B

Project Name: West Goshen Avenue Pipeline Replacement

System Type: Sanitary Sewer Collection System



Project Description:

This project will replace approximately 3,200 feet of 12-inch diameter pipeline in West Goshen Avenue with an 18-inch sewer, extending from the Visalia Country Club to ~400' east of North Leslie Street. This project is needed to mitigate existing capacity deficiencies associated with historical peak discharge rates associated with the milk processing plant upstream of this sewer main.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost[4] ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	12	18	Replace	3,200	$ 471	$ 1,508,000	$ 1,960,000	$ 2,500,000	2026

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

(4) The CIP costs for this project are considered atypical due to bypass pumping requirements and challenging crossings, and were estimated saprately from the master plan unit costs.

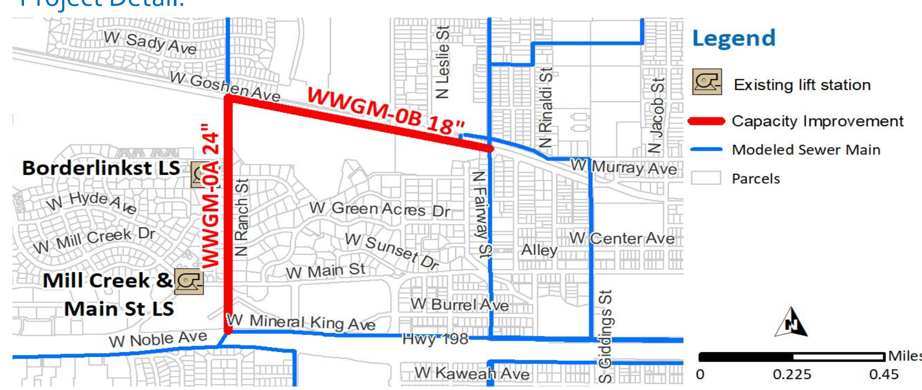
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	100%	$ 2,500,000
Future Users	0%	$ -
Total	100%	$ 2,500,000

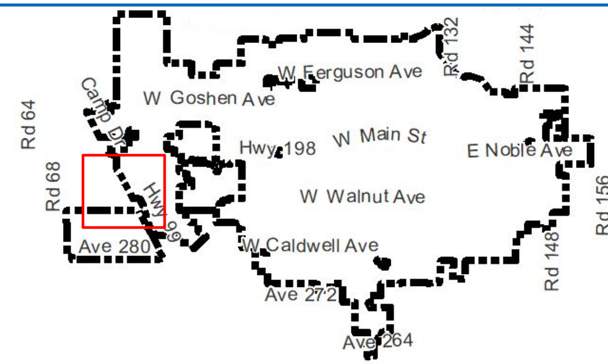
Notes on Cost Estimation:

Project will address exsiting capacity deficiencies, therefore 0-percent of cost is assigned to future users.

Project Detail:



Project Number: WWGM-1
Project Name: North American Street
System Type: Sanitary Sewer Collection System



Project Description:

This project will replace approximately 7,500 feet of 36-inch diameter pipeline in American Street, extending from Ferguson Avenue to Camp Drive. Under ultimate peak flow conditions the 36-inch pipeline surcharges and exceeds the maximum d/D criteria. To mitigate the capacity deficiency, it is recommended that the existing pipeline be replaced with a 42-inch diameter pipeline.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	36	42	Replace	7,500	$ 705	$ 5,288,000	$ 6,874,000	$ 8,765,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

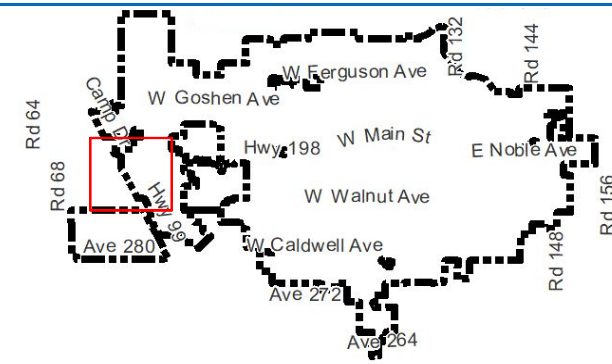
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 8,765,000
Total	100%	$ 8,765,000

Notes on Cost Estimation:

Project will address future capacity deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number: WWGM-2

Project Name: Frontage Road

System Type: Sanitary Sewer Collection System

Project Description:

This project will replace approximately 6,200 feet of 36-inch diameter pipeline along an unimproved area and in Frontage Road. The existing pipeline parallels Highway 99 and is west of the Airport. The project extends from downstream of the Airport Lift Station to Walnut Avenue. Under ultimate peak flow conditions the 36-inch pipeline surcharges and exceeds the maximum d/D criteria. To mitigate the capacity deficiency, it is recommended that the existing pipeline be replaced with a 42-inch diameter pipeline.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	36	42	Replace	6,200	$ 705	$ 4,371,000	$ 5,682,000	$ 7,245,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

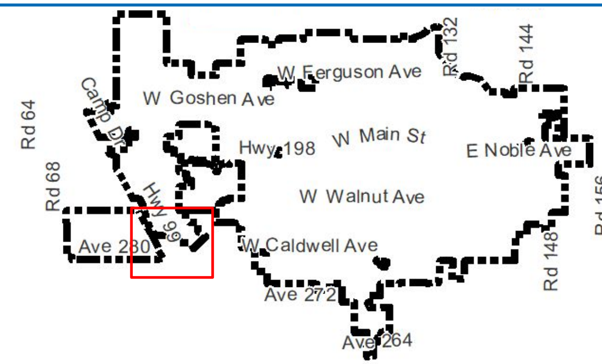
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 7,245,000
Total	100%	$ 7,245,000

Notes on Cost Estimation:

Project will address future capacity deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number: WWGM-3
Project Name: Walnut Trunk Bypass
System Type: Sanitary Sewer Collection System



Project Description:
This project includes the installation of a 24-inch diameter pipeline extending from the Walnut Lovers Lane Trunk to the Walnut Outfall Trunk. The overflow is recommended to alleviate surcharging within the 42-inch pipeline crossing Highway 99 and minimize the backwater effect occurring upstream. The Walnut Outfall Trunk has capacity to allow for overflow from the parallel trunk.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	24	Diversion	100	$ 435	$ 44,000	$ 57,000	$ 73,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

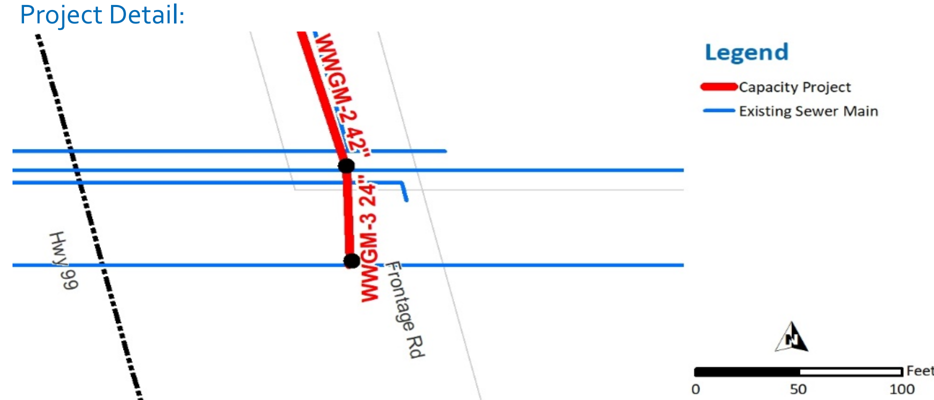
(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 73,000
Total	100%	$ 73,000

Notes on Cost Estimation:
Project will address future capacity deficiencies, therefore 100-percent of cost is assigned to future users.

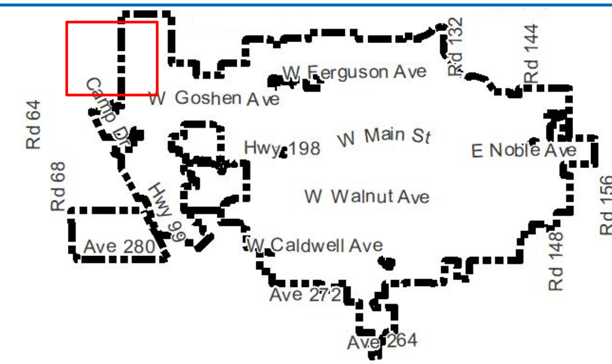
Project Detail:



Project Number: WWGM-6

Project Name: American Street Trunk Extension

System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 5,200 feet of 30-inch diameter pipeline in American Street. The project extends from Avenue 320 to Riggin Avenue. The pipeline is sized to convey projected flows from Ultimate Buildout.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	30	New	5,200	$ 520	$ 2,704,000	$ 3,515,000	$ 4,482,000	2028

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

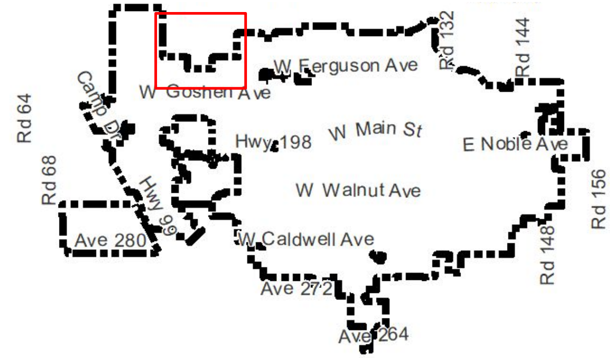
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 4,482,000
Total	100%	$ 4,482,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number:	WWGM-7
Project Name:	North Shirk Trunk Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project will extend the Shirk Trunk to the northern UGB Tier 2 boundary. The project is recommended under buildout of the UGB tier 2 and consists of 2,600 feet of 42-inch diameter pipeline in Shirk Avenue. The pipeline is sized to convey projected flows from Ultimate Buildout. This project will potentially be installed and is kept for reimbursement purposes.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	42	New	2,600	$ 705	$ 1,833,000	$ 2,383,000	$ 3,038,000	2031-2035

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

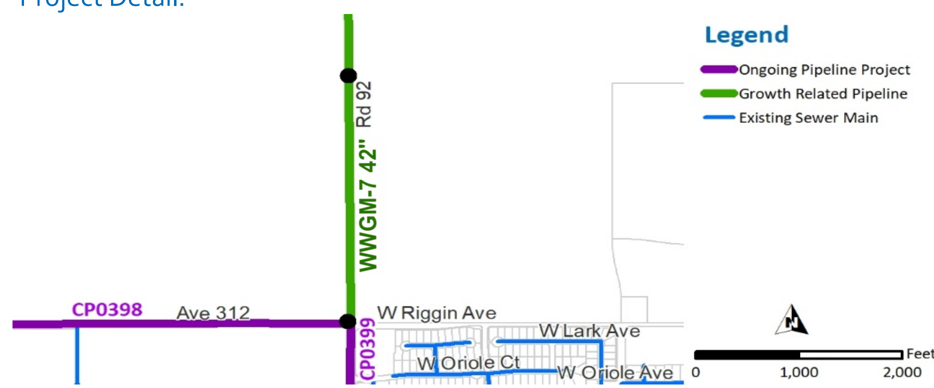
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 3,038,000
Total	100%	$ 3,038,000

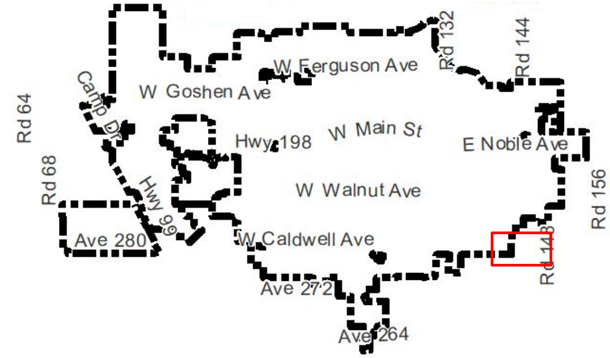
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-8
Project Name:	South Lovers Lane Main
System Type:	Sanitary Sewer Collection System



Project Description:

This project will connect a 12-inch to the 15-inch diameter pipeline in Caldwell across the Lovers Lane intersection and provide an alignment to the north along Lovers Lane. A preliminary analysis shows the pipeline has depth to cross the waterway and maintain spacing.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	5,000	$ 285	$ 1,425,000	$ 1,853,000	$ 2,362,000	2031-2035

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

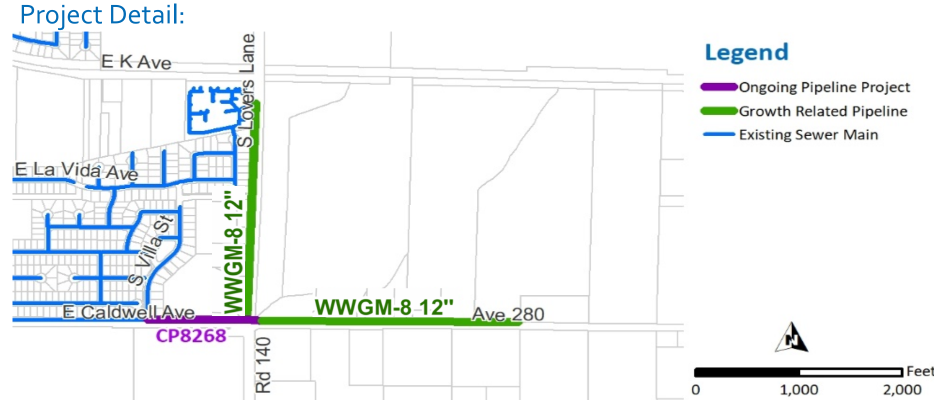
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,362,000
Total	100%	$ 2,362,000

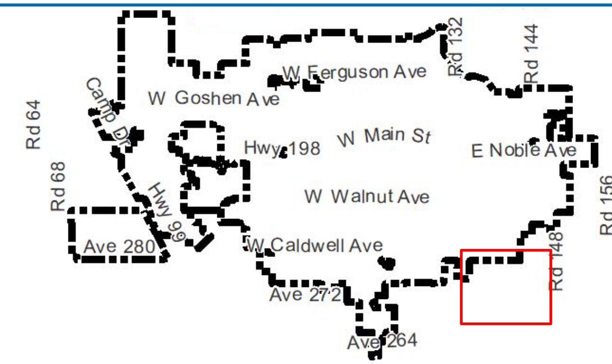
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-9
Project Name:	Visalia Parkway Trunk Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 5,300 feet of 24-inch diameter pipeline south of Caldwell Avenue. The project extends from Road 148 to Lovers Lane. The pipeline is sized to convey projected flows from Ultimate Buildout.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	24	New	5,300	$ 435	$ 2,306,000	$ 2,998,000	$ 3,822,000	2036-2040

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

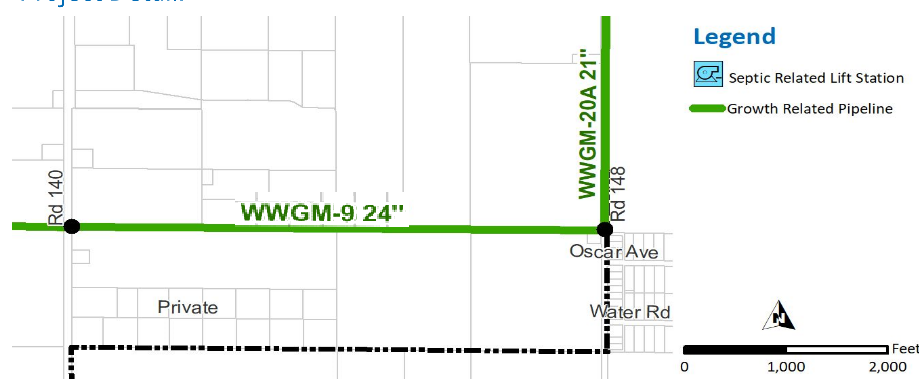
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 3,822,000
Total	100%	$ 3,822,000

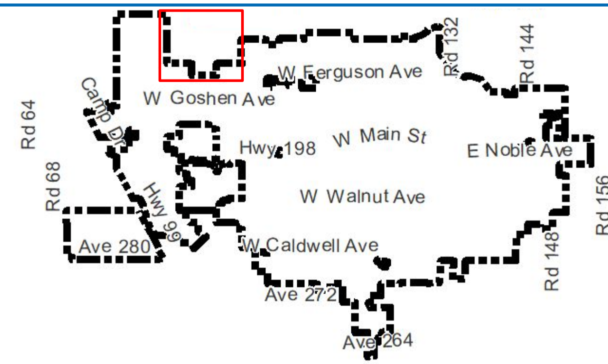
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number: WWGM-10
Project Name: North Shirk Trunk Extension
System Type: Sanitary Sewer Collection System



Project Description:

This project will extend the Shirk Trunk North to Avenue 320. The project is recommended under buildout of the UGB Tier 3 and consists of 2,700 feet of 42-inch diameter pipeline in Shirk Street. The pipeline is sized to convey projected flows from Ultimate Buildout.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	42	New	2,700	$ 705	$ 1,904,000	$ 2,475,000	$ 3,156,000	2036-2040

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

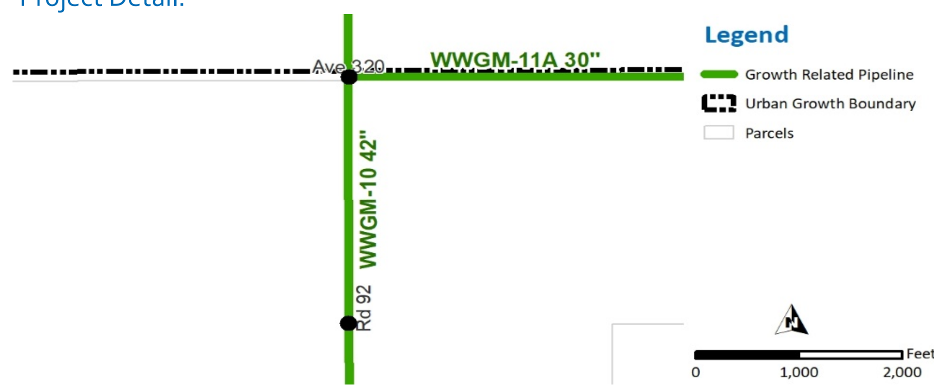
(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 3,156,000
Total	100%	$ 3,156,000

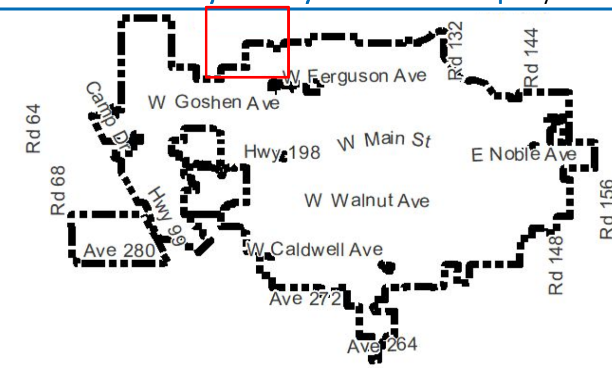
Project Detail:



Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Number: WWGM-11A
Project Name: Avenue 320 Trunk
System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 10,500 feet of 30-inch diameter pipeline in Avenue 320. The project extends from N. Demaree Road to Road 92.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	30	New	10,500	$ 520	$ 5,460,000	$ 7,098,000	$ 9,050,000	2036-2040

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

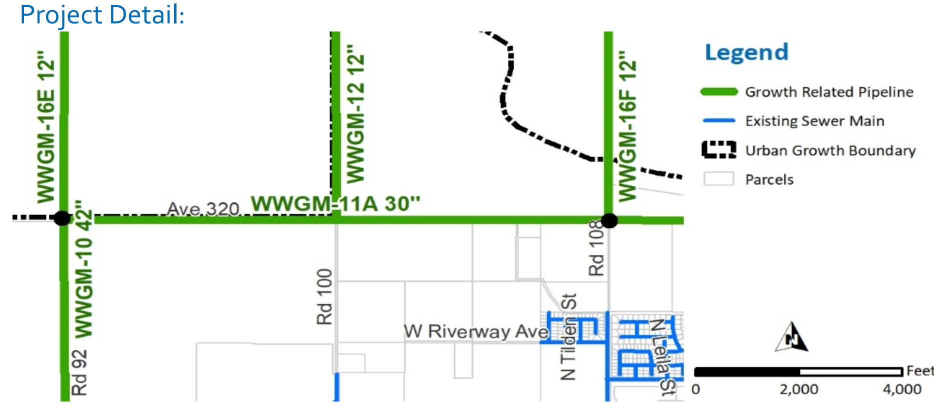
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 9,050,000
Total	100%	$ 9,050,000

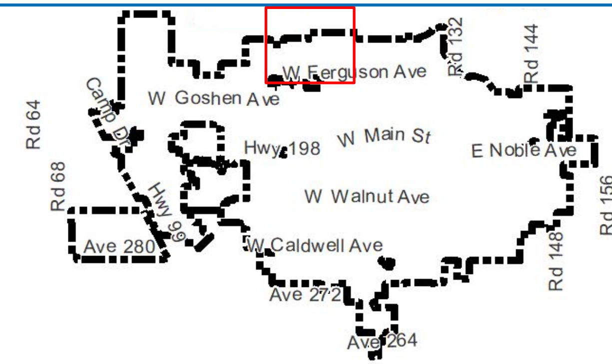
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-11B
Project Name:	Avenue 320 Trunk
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 5,200 feet of 27-inch diameter in 320 Avenue. The project extends west of the St. Johns River to Road 108.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	27	New	5,200	$ 475	$ 2,470,000	$ 3,211,000	$ 4,094,000	2036-2040

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

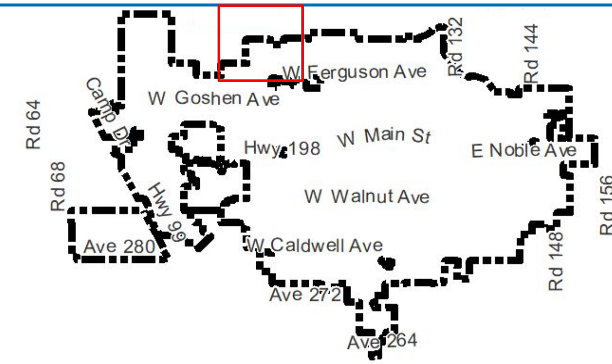
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 4,094,000
Total	100%	$ 4,094,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number: WWGM-12
Project Name: North Akers Main
System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 4,600 feet of 12-inch diameter pipeline in Akers Street. The project extends south of Avenue 328 to Avenue 320.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	4,600	$ 285	$ 1,311,000	$ 1,704,000	$ 2,173,000	2036-2040

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

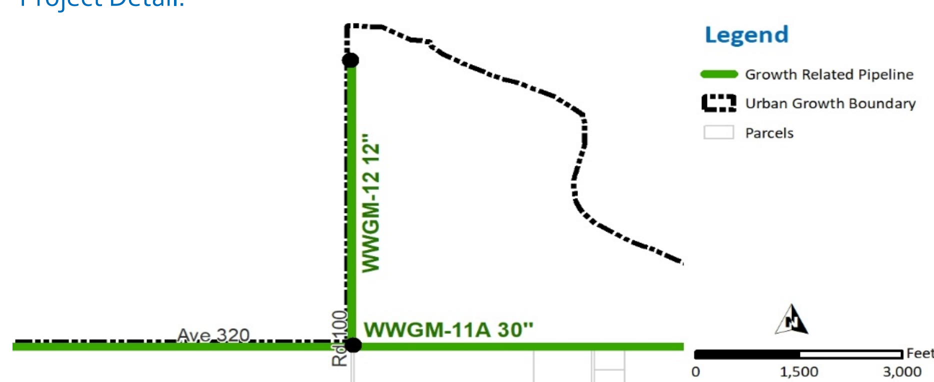
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,173,000
Total	100%	$ 2,173,000

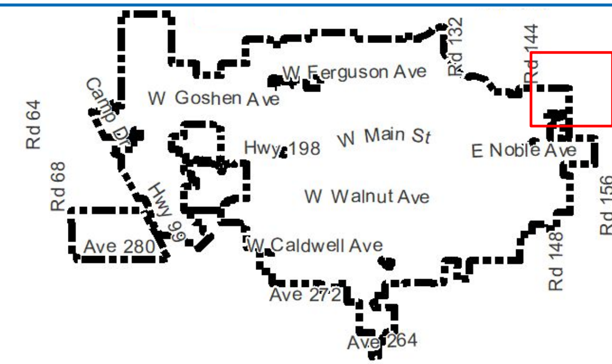
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-13A
Project Name:	Houston-Ivanhoe Main
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 3,600 feet of new 12 inch diameter pipeline in Houston Avenue and Ivanhoe Drive. The project extends from Road 152 to Comstock Street. The pipeline is sized to convey projected flows from Ultimate Buildout.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	3,600	$ 285	$ 1,026,000	$ 1,334,000	$ 1,701,000	2036-2040

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

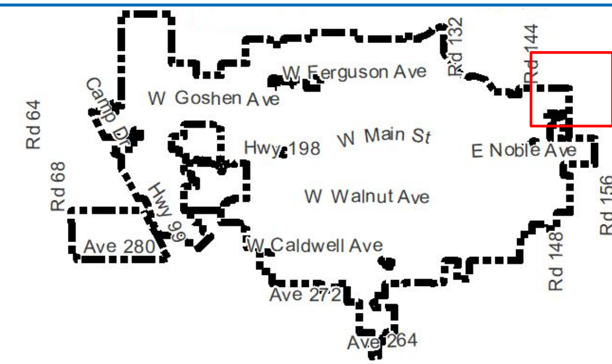
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,701,000
Total	100%	$ 1,701,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number: WWGM-13B
Project Name: Houston-Ivanhoe Main
System Type: Sanitary Sewer Collection System



Project Description:

This project will replace approximately 2,300 feet of existing 10-inch diameter pipeline in Houston Avenue, Citrus Court, and E Auburn Drive. The project extends from Comstock Road to McAuliff Street. It is recommended that the existing pipeline be replaced with a 12-inch diameter pipeline. The pipeline is sized to convey projected flows from Buildout of the Planning Area.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	10	12	New	2,300	$ 285	$ 656,000	$ 853,000	$ 1,087,000	2036-2040

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

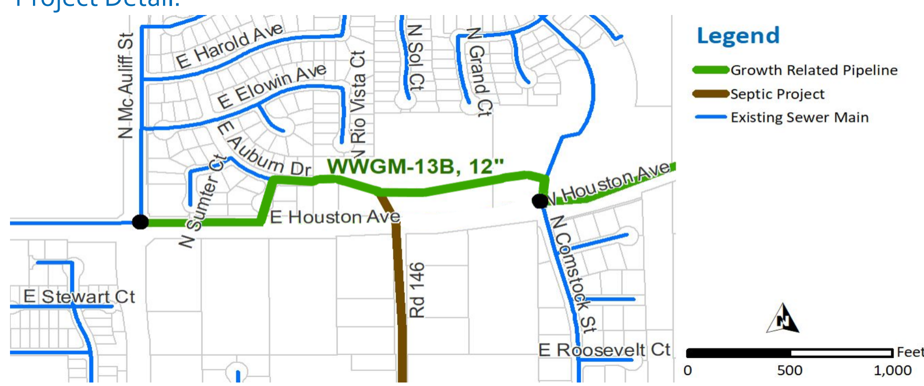
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,087,000
Total	100%	$ 1,087,000

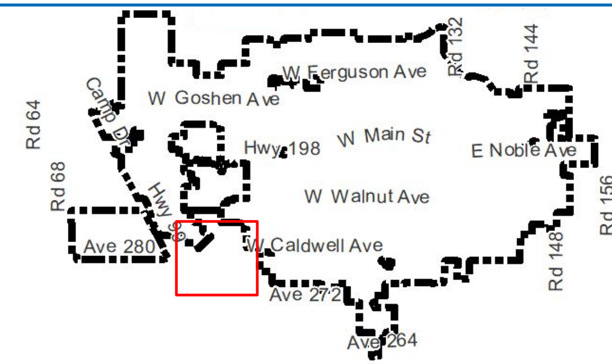
Notes on Cost Estimation:

Project is required due to future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number: WWGM-14A
Project Name: South Shirk Main
System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 3,600 feet of new 12-inch diameter pipeline in Shirk Road. The project extends north from Caldwell Avenue to south of Wagner Avenue.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	3,600	$ 285	$ 1,026,000	$ 1,334,000	$ 1,701,000	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

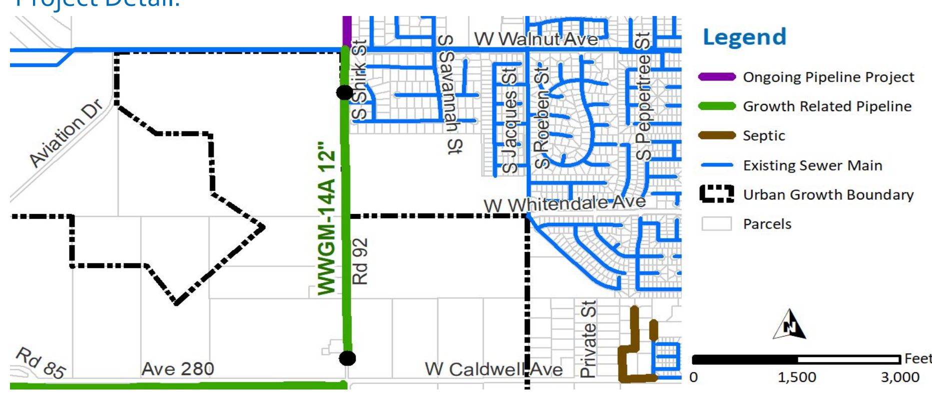
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,701,000
Total	100%	$ 1,701,000

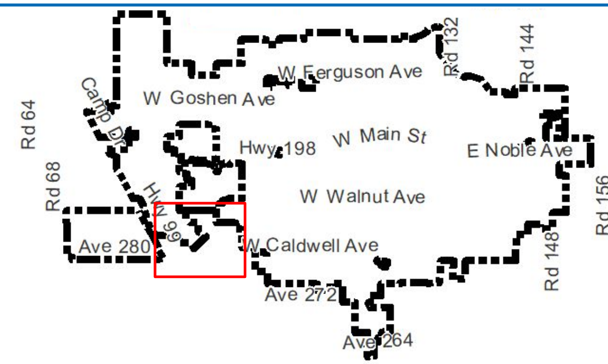
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-14B
Project Name:	South Shirk Main
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 1,400 feet of new 15-inch diameter pipeline in Shirk Road. The project extends from Wagner Avenue to Walnut Avenue.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	15	New	1,400	$ 315	$ 441,000	$ 573,000	$ 731,000	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

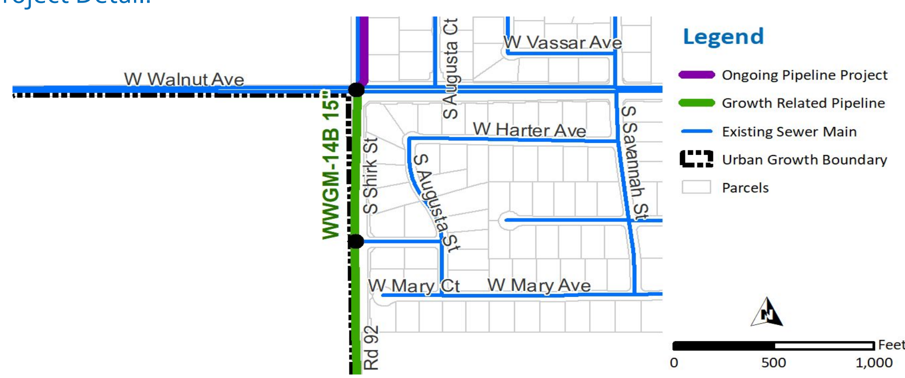
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 731,000
Total	100%	$ 731,000

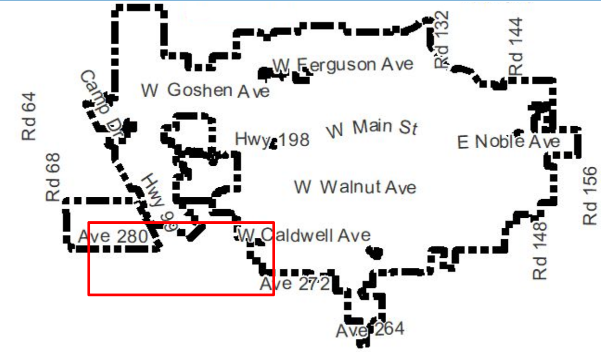
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number: WWGM-15A
Project Name: Visalia Parkway Extension
System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 5,750 feet of new 30 inch diameter pipeline. This segment of the project is located on the west side of Highway 99. The project continues west along Whitendale Avenue, and extends north across an unimproved surface owned by the City. The pipeline is sized to convey buildout flows from the surrounding SOI and as a bypass for the Visalia Parkway trunk, with capacity to convey all buildout flow of the Visalia Parkway Trunk basin.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	30	New	5,700	$ 520	$ 2,964,000	$ 3,853,000	$ 4,913,000	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

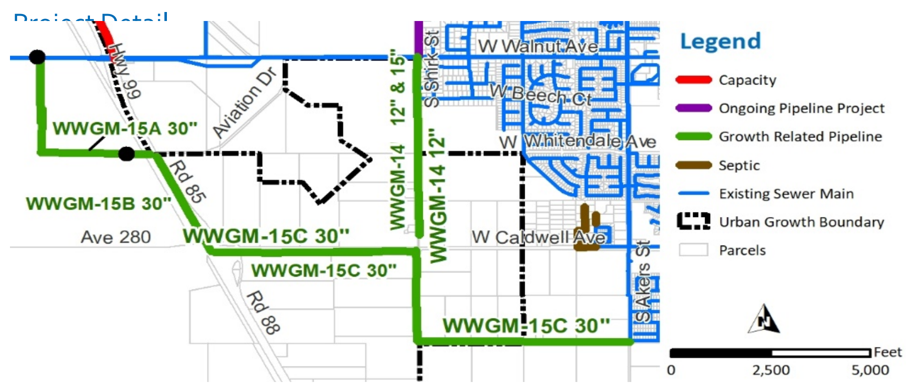
(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

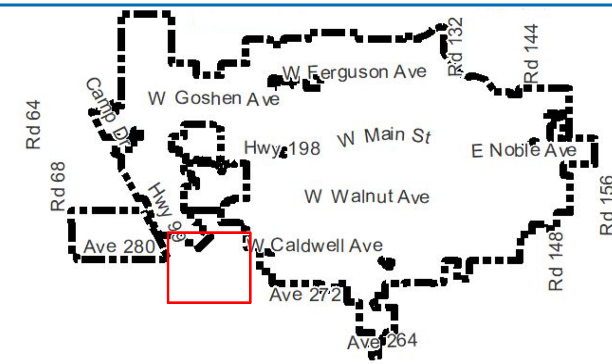
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 4,913,000
Total	100%	$ 4,913,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.



Project Number: WWGM-15B
Project Name: Visalia Parkway Extension
System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 500 feet of 30-inch diameter pipeline, crosses Highway 99 and Railroad tracks. It is estimated the project will require trenchless technology to cross the highway and railroad. Due to crossing of the Highway and railroad and steel casing would be required.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main and Interstate Crossing	-	30/48	New	500	$ 2,735	$ 1,368,000	$ 1,778,000	$ 2,267,000	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

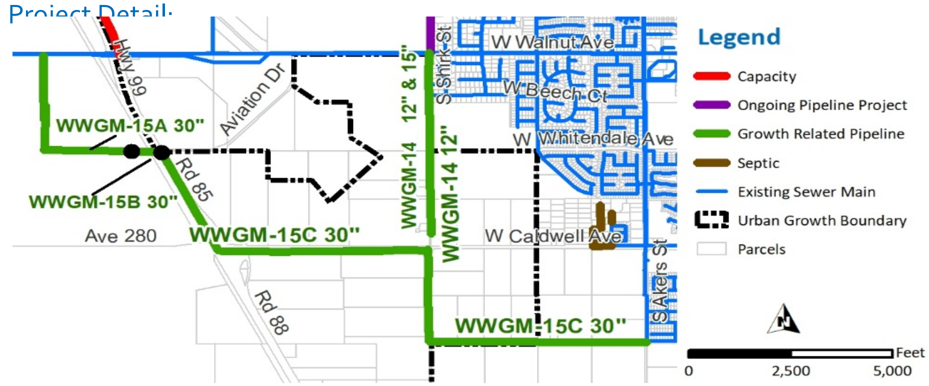
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,267,000
Total	100%	$ 2,267,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

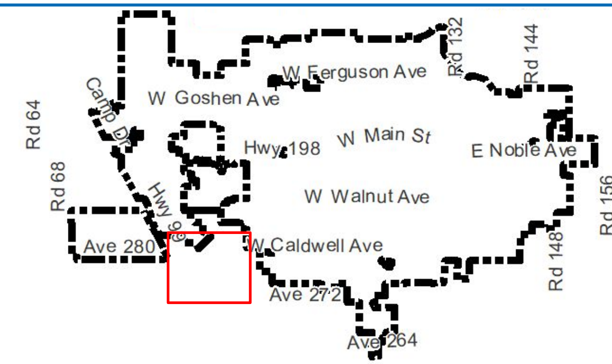
Project Detail:



Project Number: WWGM-15C

Project Name: Visalia Parkway Extension

System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 10,300 feet of 30-inch diameter pipeline. The project extends from the existing system at the intersection of Visalia Parkway and Akers Street west to Shirk Road, west on Caldwell Avenue, and then runs parallel to Highway 99. The project would connect to WWGM-15B.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	30	New	10,300	$ 520	$ 5,356,000	$ 6,963,000	$ 8,878,000	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

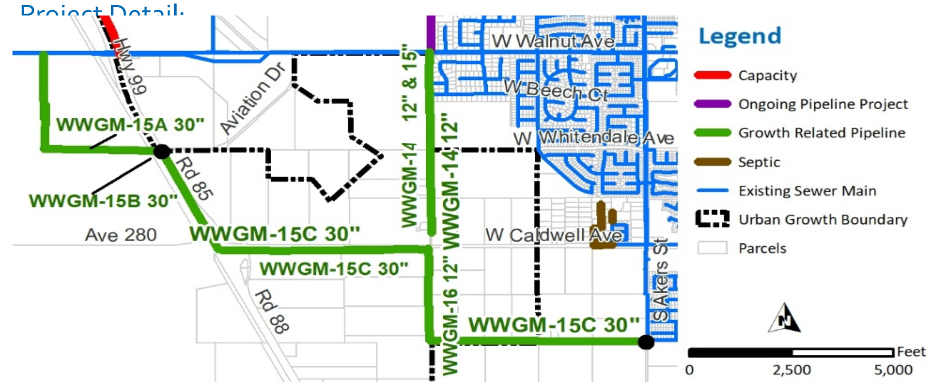
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 8,878,000
Total	100%	$ 8,878,000

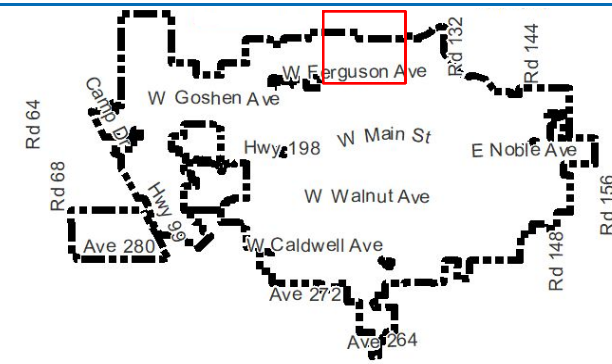
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-16A
Project Name:	Avenue 320 Trunk Extension
System Type:	Sanitary Sewer Collection System



Project Description:

The project is recommended to serve future growth within the Planning Area. This project has been carried forward from previous master plans. This project requires crossing the St. Johns River and will need trenchless construction. A lift station may be required to avoid construction of a siphon when crossing the River. Project 16A will consist of 5,300 feet of 27-inch diameter pipeline in Avenue 320. The project will extend from Road 124 to the St. Johns River.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	27	New	5,300	$ 475	$ 2,518,000	$ 3,273,000	$ 4,174,000	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

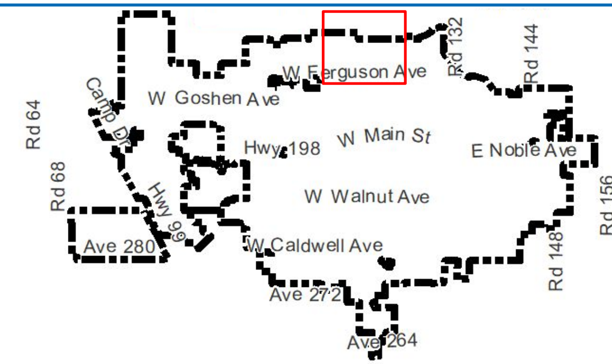
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 4,174,000
Total	100%	$ 4,174,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number: WWGM-16B
Project Name: Avenue 320 Trunk Extension
System Type: Sanitary Sewer Collection System



Project Description:

This project will consist of 5,400 feet of 24-inch diameter pipeline in Avenue 320. The project extends from Ben Maddox Way to Dinuba Boulevard.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	24	New	5,400	$ 435	$ 2,349,000	$ 3,054,000	$ 3,893,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

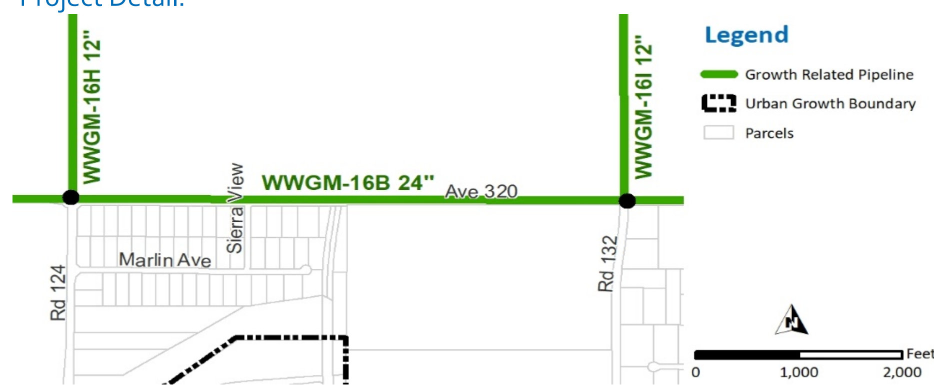
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 3,893,000
Total	100%	$ 3,893,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

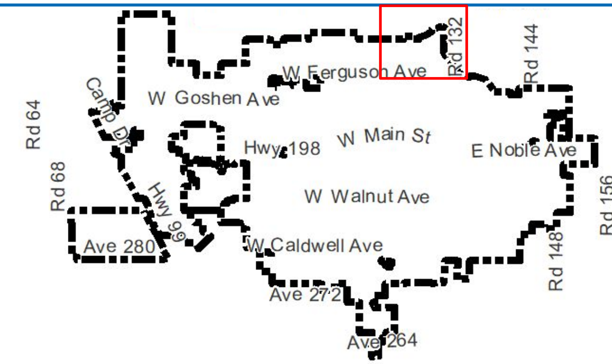
Project Detail:



Project Number: WWGM-16C

Project Name: Avenue 320 Trunk Extension

System Type: Sanitary Sewer Collection System



Project Description:

This project will consist of 5,300 feet of 21-inch diameter pipeline in Avenue 320. The project extends from a future extension of Lovers Lane to Ben Maddox Way.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	21	New	5,300	$ 390	$ 2,067,000	$ 2,687,000	$ 3,426,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

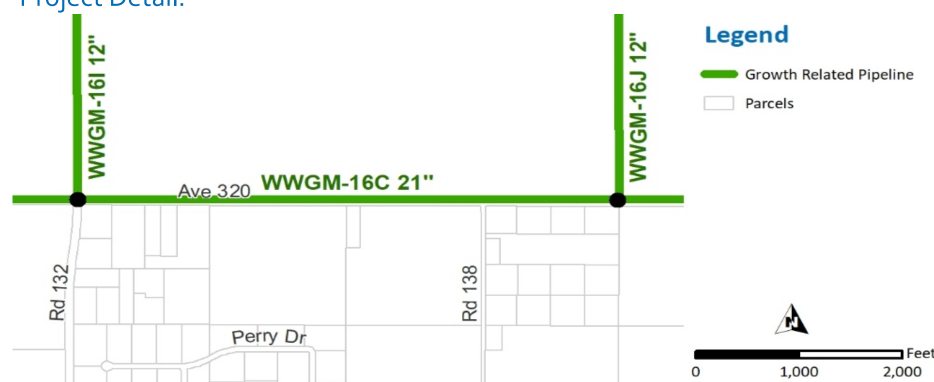
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 3,426,000
Total	100%	$ 3,426,000

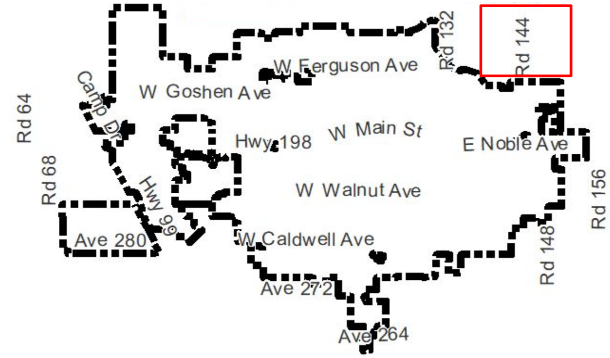
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number: WWGM-16D
Project Name: Avenue 320 Trunk Extension
System Type: Sanitary Sewer Collection System



Project Description:

This project will consist of 9,300 feet of 15-inch diameter pipeline in Avenue 320. The project extends west from Road 156 to the future extension of Lovers Lanes.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	15	New	9,300	$ 315	$ 2,930,000	$ 3,809,000	$ 4,856,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

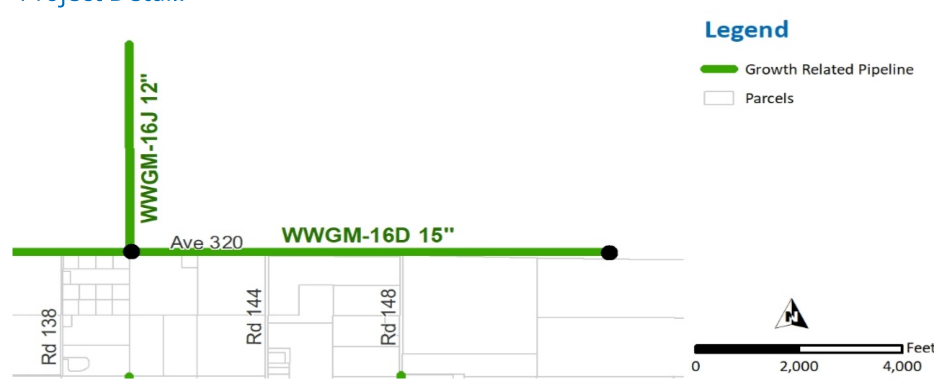
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 4,856,000
Total	100%	$ 4,856,000

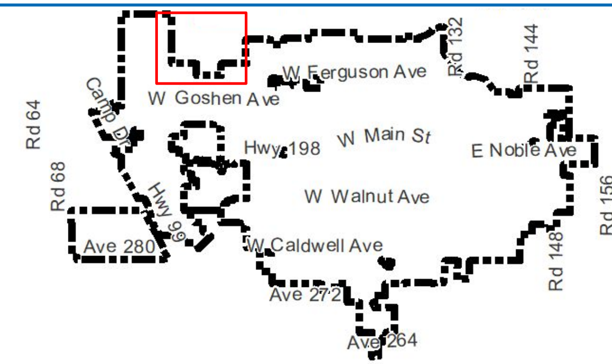
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-16E
Project Name:	Avenue 320 Trunk Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 4,500 feet of 12-inch diameter pipeline in north Shirk Street. The project extends from Avenue 328 to Avenue 320.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[(1)] ($)	Estimated Construction Cost[(2)] ($)	Capital Improvement Cost[(3)] ($)	Project Schedule
Gravity Main	-	12	New	4,500	$ 285	$ 1,283,000	$ 1,668,000	$ 2,127,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

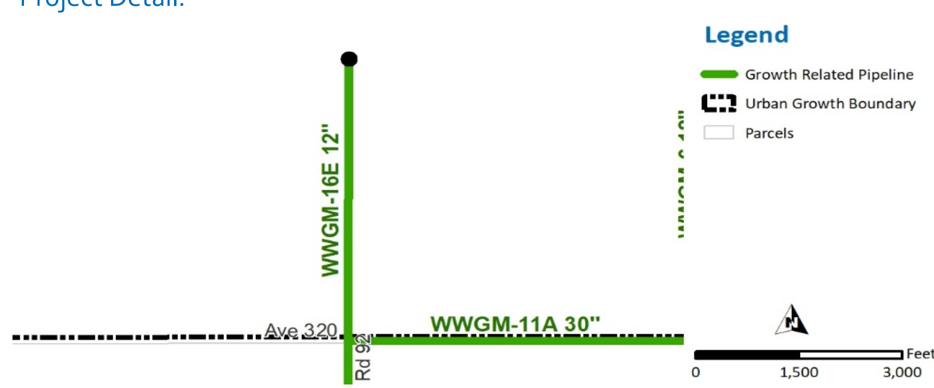
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,127,000
Total	100%	$ 2,127,000

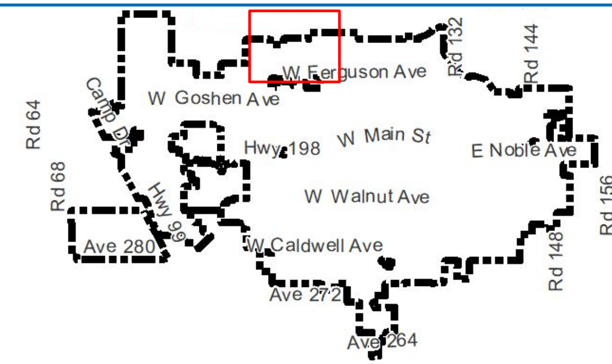
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-16F
Project Name:	Avenue 320 Trunk Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project will consist of 4,500 feet of 12-inch diameter pipeline in Road 108. The project extends from Avenue 328 to Avenue 320.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	4,500	$ 285	$ 1,283,000	$ 1,668,000	$ 2,127,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

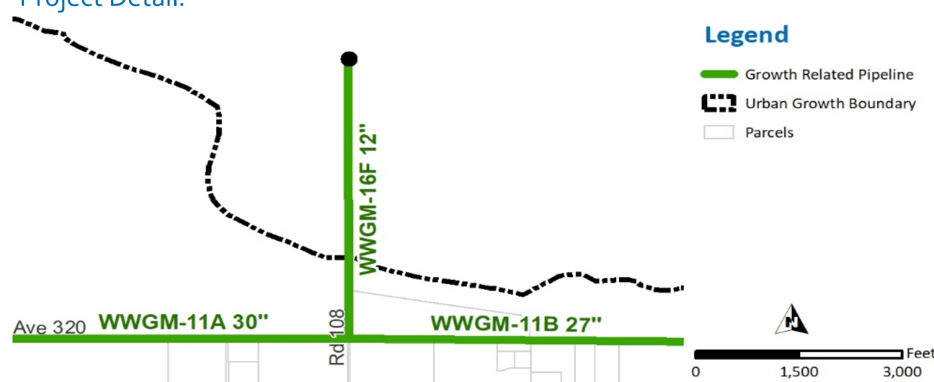
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,127,000
Total	100%	$ 2,127,000

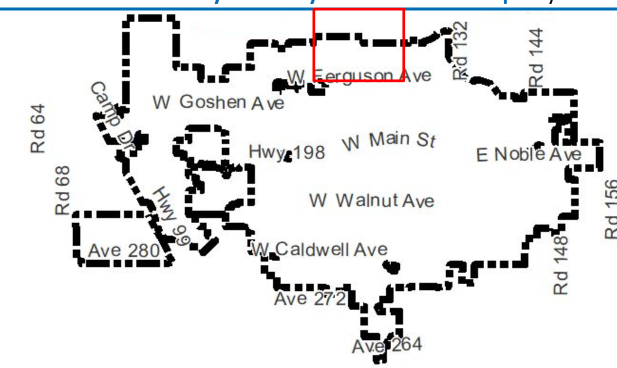
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-16G
Project Name:	Avenue 320 Trunk Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project will consist of 5,700 feet of 12-inch diameter pipeline in an unimproved area. The project extends from Avenue 328 to Avenue 320, with a segment parallel to the St Johns River.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	5,700	$ 285	$ 1,625,000	$ 2,113,000	$ 2,693,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

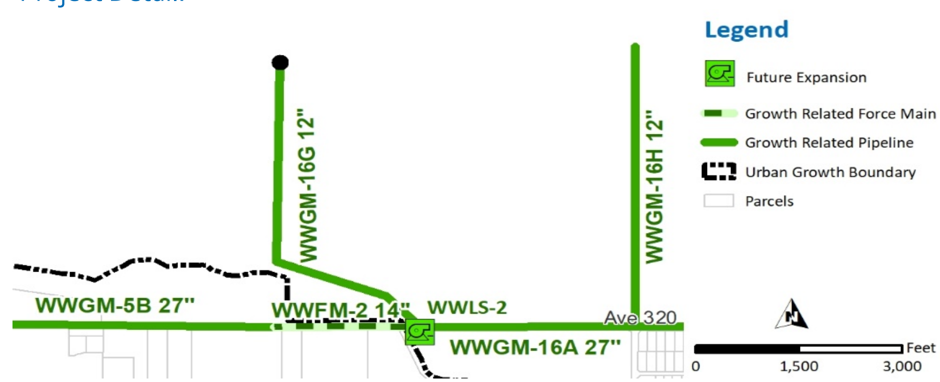
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,693,000
Total	100%	$ 2,693,000

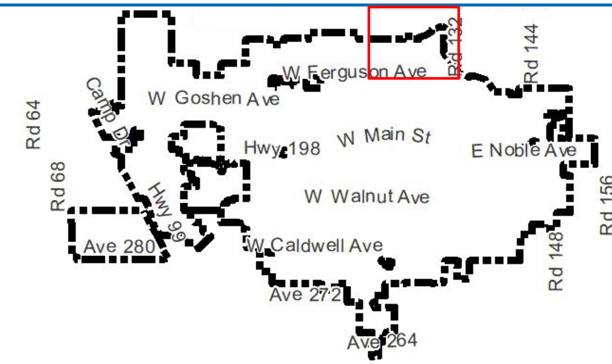
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number: WWGM-16H
Project Name: Avenue 320 Trunk Extension
System Type: Sanitary Sewer Collection System



Project Description:

This project will consist of 4,500 feet of 12-inch diameter pipeline in Dinuba Boulevard. The project extends from Avenue 328 to Avenue 320.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	4,500	$ 285	$ 1,283,000	$ 1,668,000	$ 2,127,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

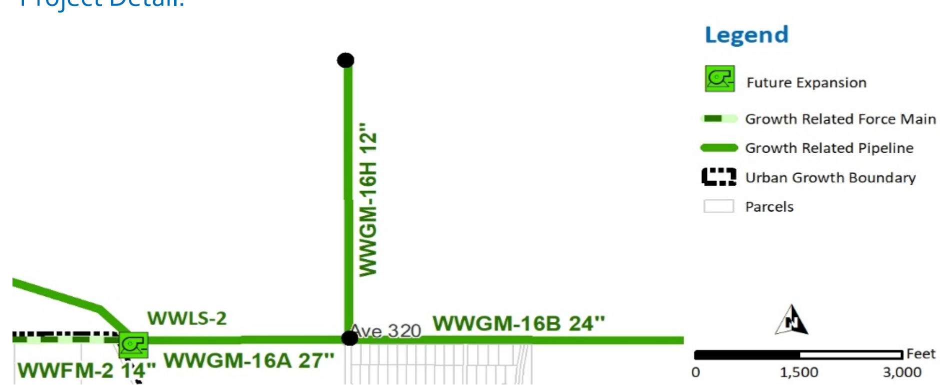
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,127,000
Total	100%	$ 2,127,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

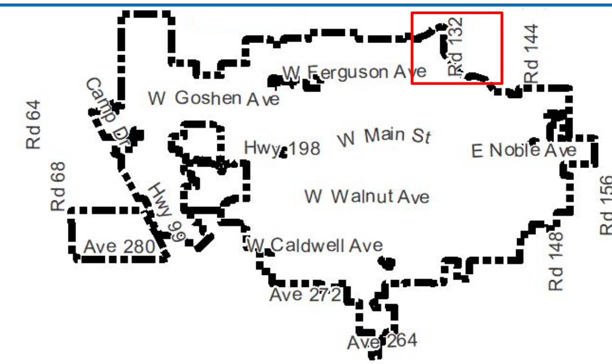
Project Detail:



Project Number: WWGM-16I

Project Name: Avenue 320 Trunk Extension

System Type: Sanitary Sewer Collection System



Project Description:

This project will consist of 4,500 feet of 12-inch diameter pipeline in Ben Maddox Way. The project extends from Avenue 328 to Avenue 320.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	4,500	$ 285	$ 1,283,000	$ 1,668,000	$ 2,127,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

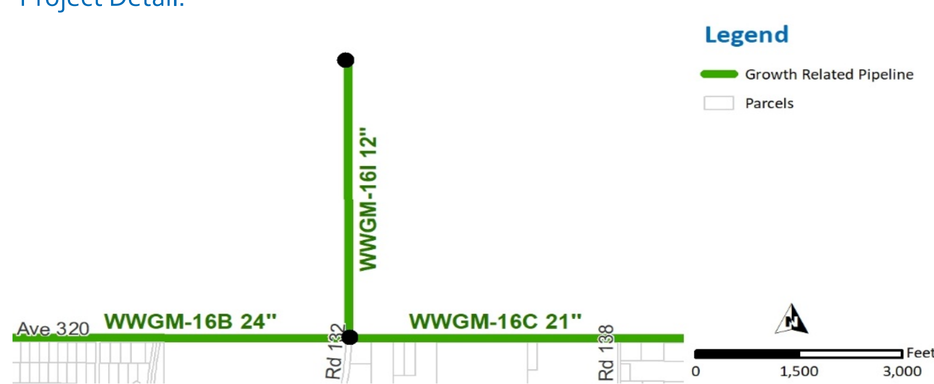
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,127,000
Total	100%	$ 2,127,000

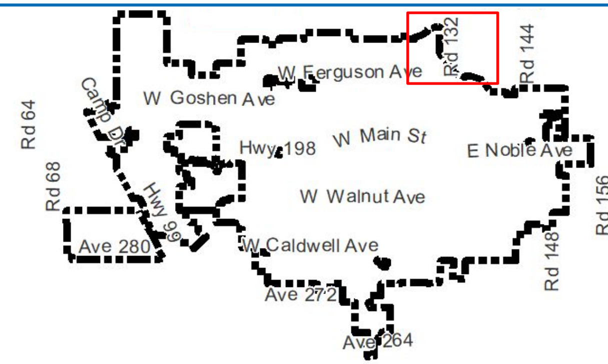
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number: WWGM-16J
Project Name: Avenue 320 Trunk Extension
System Type: Sanitary Sewer Collection System



Project Description:

This project will consist of 4,500 feet of 12-inch diameter pipeline in Lovers Lane (Future Extension), north of the St Johns River. The project extends from Avenue 328 to Avenue 320.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	4,500	$ 285	$ 1,283,000	$ 1,668,000	$ 2,127,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

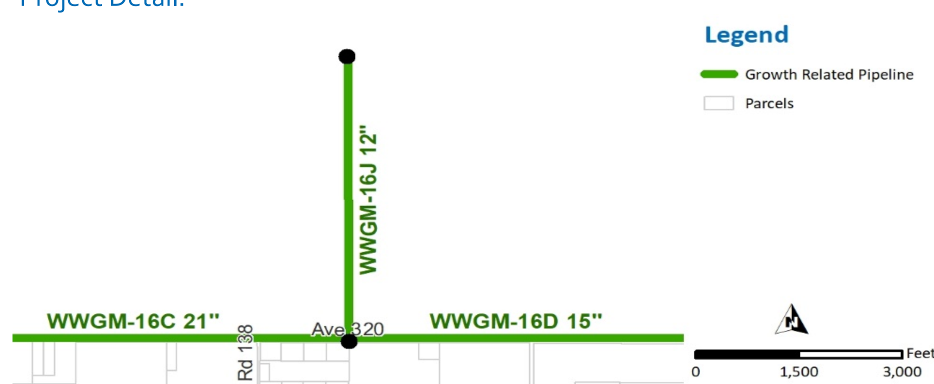
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,127,000
Total	100%	$ 2,127,000

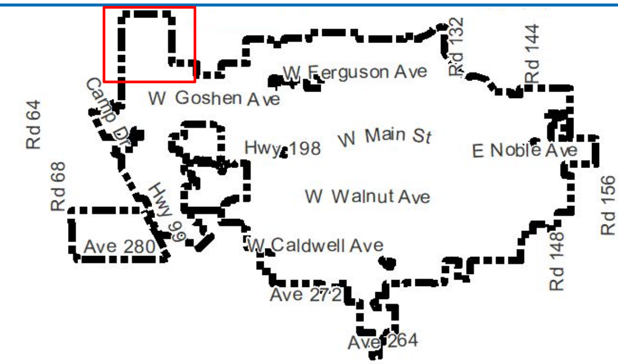
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-17
Project Name:	Kelsey Street Main
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 7,400 feet of 12-inch diameter pipeline in Kelsey Street and Avenue 320. The project would extend to Plaza Drive and connect to American.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	10,000	$ 285	$ 2,850,000	$ 3,705,000	$ 4,724,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

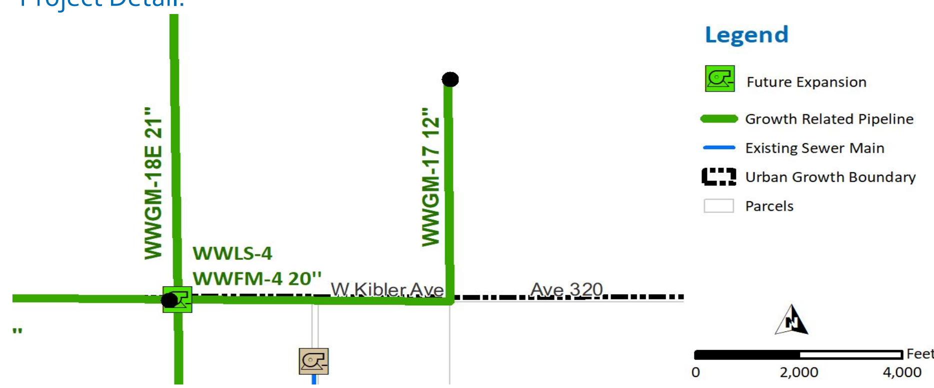
(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 4,724,000
Total	100%	$ 4,724,000

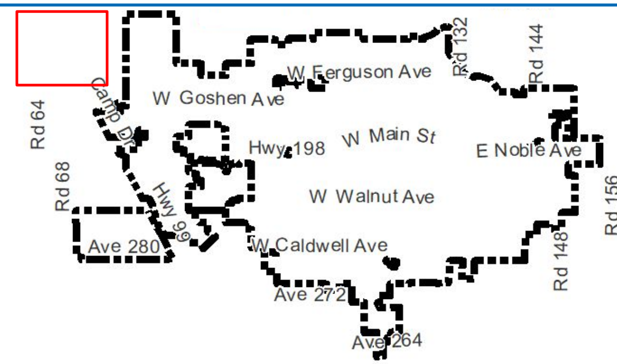
Project Detail:



Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Number: WWGM-18A
Project Name: Highway 99 - West Avenue 320 Trunk
System Type: Sanitary Sewer Collection System



Project Description:

This project will construct a new trunk parallel to Highway 99 and extend to West Avenue 320. The project will serve future growth within the northwest Planning Area. Projects 18A through 18D have been carried forward from previous master plans with adjustments made to the alignment. Project 18A will consist of 8,000 feet of 24-inch diameter pipeline in Avenue 320. The project extends from Highway 99 to American Street.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	24	New	8,000	$ 435	$ 3,480,000	$ 4,524,000	$ 5,768,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

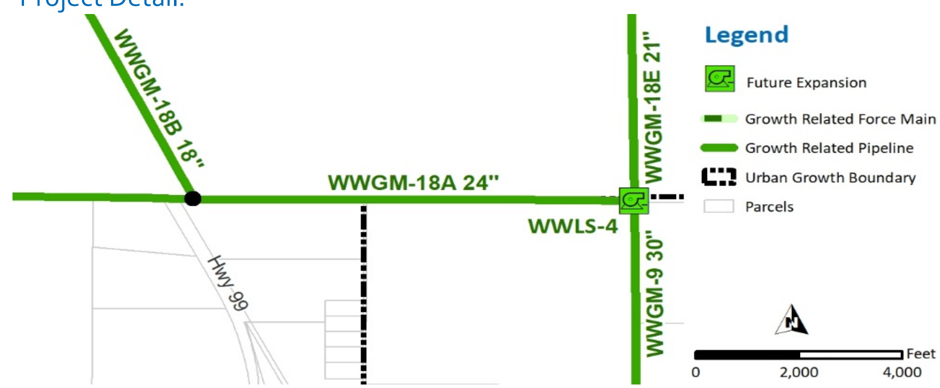
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 5,768,000
Total	100%	$ 5,768,000

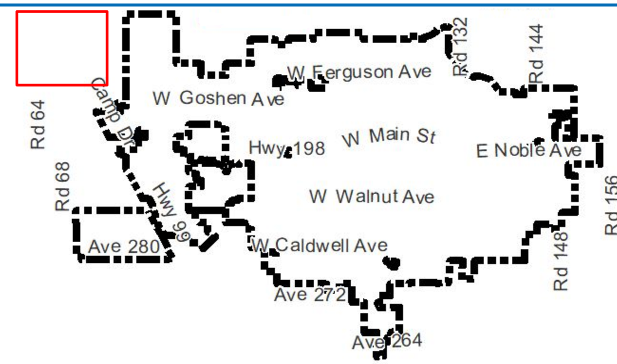
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-18B
Project Name:	Highway 99 - West Avenue 320 Trunk
System Type:	Sanitary Sewer Collection System



Project Description:

This project will consist of 11,000 feet of 18-inch diameter pipeline and runs parallel to Highway 99. The project extends from Avenue 328 to Avenue 320.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	18	New	11,000	$ 345	$ 3,795,000	$ 4,934,000	$ 6,290,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

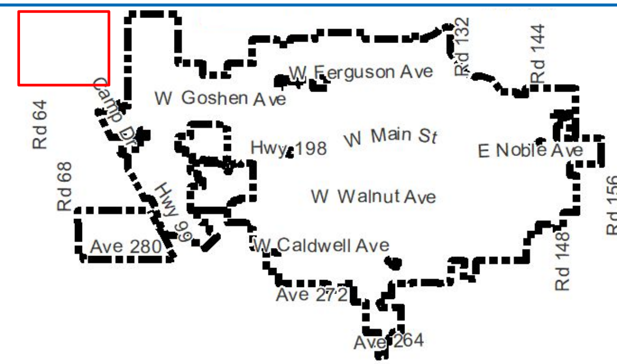
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 6,290,000
Total	100%	$ 6,290,000

Project Detail:

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Number: WWGM-18C
Project Name: Highway 99 - West Avenue 320 Trunk
System Type: Sanitary Sewer Collection System



Project Description:
This project consists of 1,000 feet of 18-inch diameter pipeline and crosses Highway 99 along Avenue 320. It is estimated the project will require a 30-inch steel casing.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main and Interstate Crossing	-	18/30	New	1,000	$ 855	$ 855,000	$ 1,112,000	$ 1,417,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

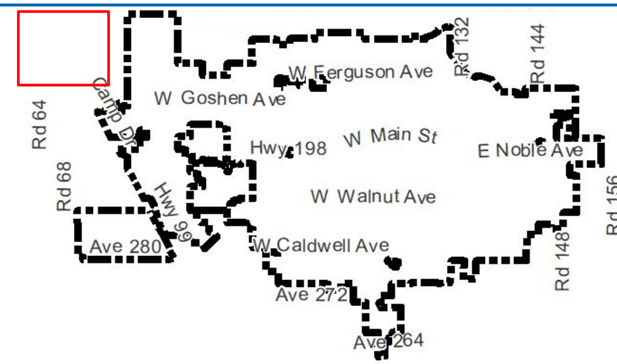
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,417,000
Total	100%	$ 1,417,000

Notes on Cost Estimation:
Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number:	WWGM-18D
Project Name:	Highway 99 - West Avenue 320 Trunk
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 6,400 feet of 18-inch diameter pipeline in Avenue 320. The project extends west from Highway 99 to Road 52.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	18	New	6,400	$ 345	$ 2,208,000	$ 2,870,000	$ 3,660,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

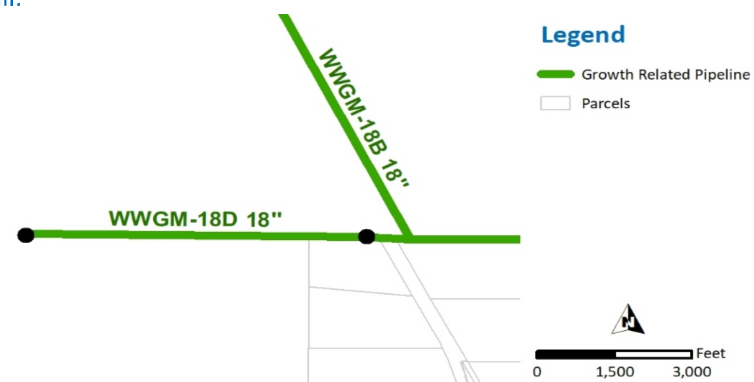
Project Cost Allocation:

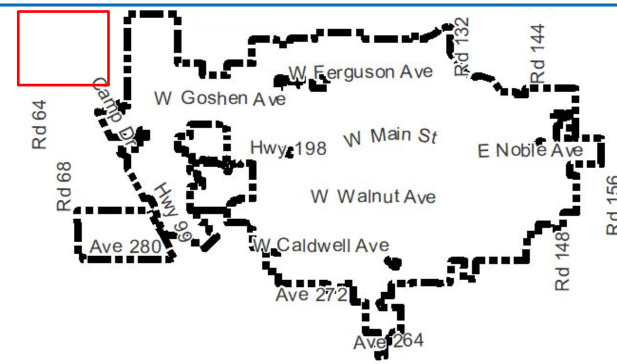
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 3,660,000
Total	100%	$ 3,660,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:





Project Number: WWGM-18E
Project Name: Highway 99 - West Avenue 320 Trunk
System Type: Sanitary Sewer Collection System

Project Description:

This project will consist of 9,800 feet of 21-inch diameter pipeline in American Street. The project extends from Avenue 328 to Avenue 320.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	21	New	9,800	$ 390	$ 3,822,000	$ 4,969,000	$ 6,335,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

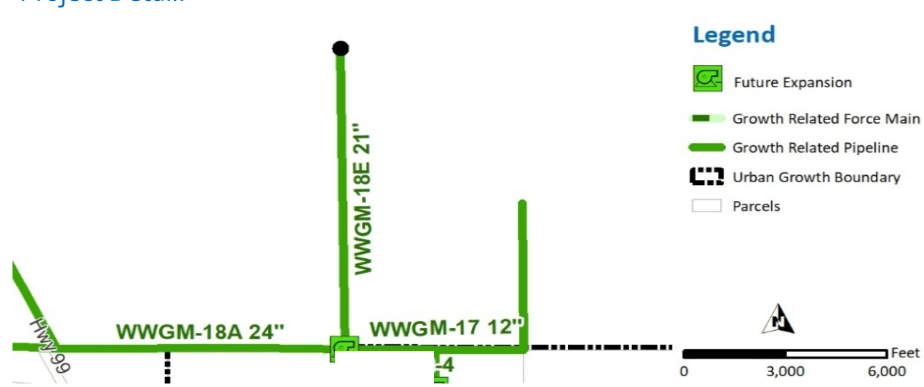
Project Cost Allocation:

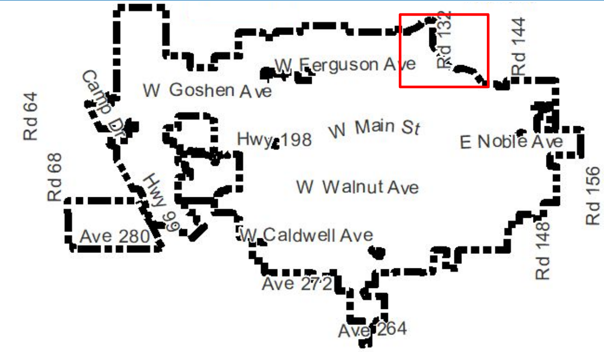
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 6,335,000
Total	100%	$ 6,335,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:





Project Number: WWGM-19A

Project Name: East Riggin Extension Trunk

System Type: Sanitary Sewer Collection System

Project Description:

Projects 19A through 19E will construct a new trunk in the northeastern quadrant of the City and extend the Riggin trunk. These Projects have been carried forward from previous master plans with adjustments made to the alignment. Project 19A consists of 800 feet of 24-inch diameter pipeline in the Santa Fe Street/Trail alignment west of the St Johns River and downstream of the proposed lift station WWLS-3. The project connects to the existing system in Riggin Avenue.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	24	New	800	$ 435	$ 348,000	$ 452,000	$ 577,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 577,000
Total	100%	$ 577,000

Notes on Cost Estimation:

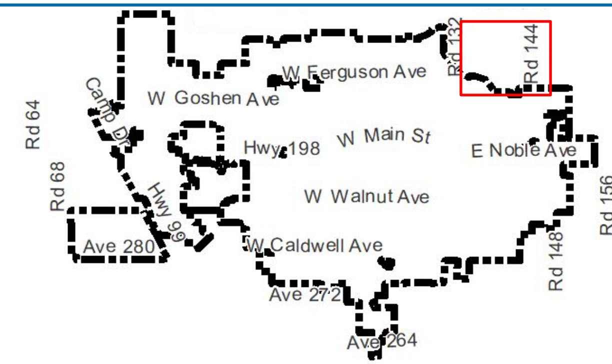
Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number: WWGM-19B

Project Name: East Riggin Extension Trunk

System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 6,000 feet of 24-inch diameter pipeline in an unimproved area east of St Johns River. This project is upstream of the proposed lift station WWLS-3.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	24	New	6,000	$ 435	$ 2,610,000	$ 3,393,000	$ 4,326,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

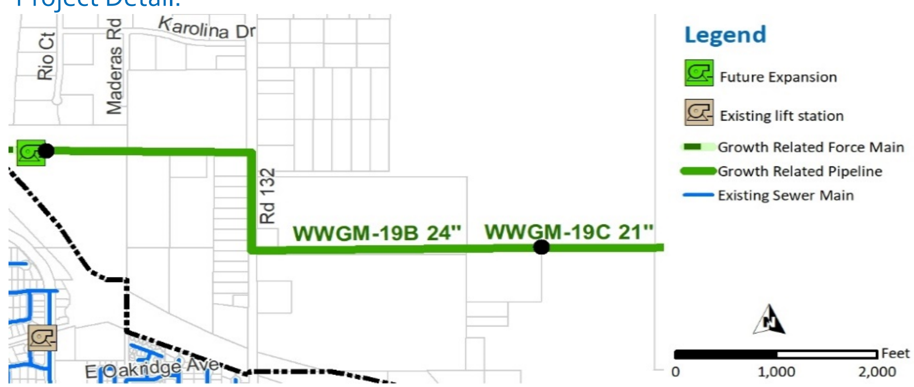
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 4,326,000
Total	100%	$ 4,326,000

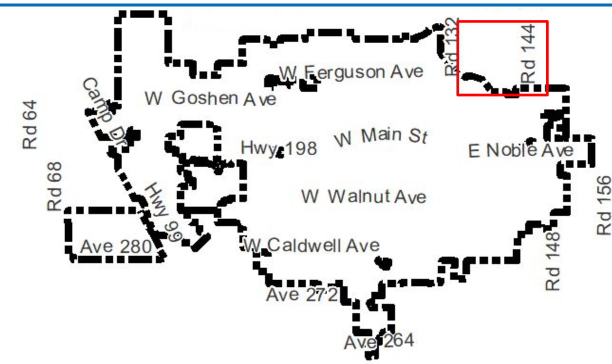
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-19C
Project Name:	East Riggin Extension Trunk
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 2,600 feet of 21-inch diameter pipeline in an unimproved area. The project extends west from the alignment of Lovers Lane.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	21	New	2,600	$390	$ 1,014,000	$ 1,318,000	$ 1,681,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

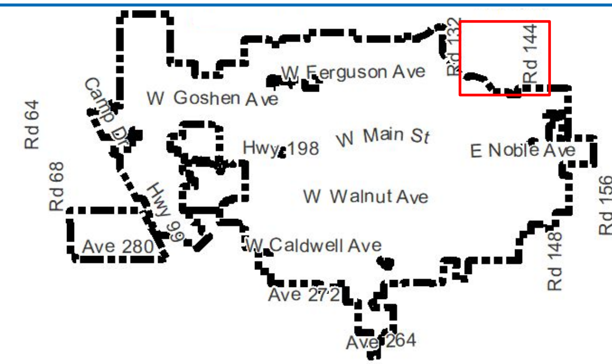
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,681,000
Total	100%	$ 1,681,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number:	WWGM-19D
Project Name:	East Riggin Extension Trunk
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 5,800 feet of 18-inch diameter pipeline in an unimproved area. The project extends from Road 148 to Lovers Lane (future extension).

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	18	New	5,800	$ 345	$ 2,001,000	$ 2,601,000	$ 3,317,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

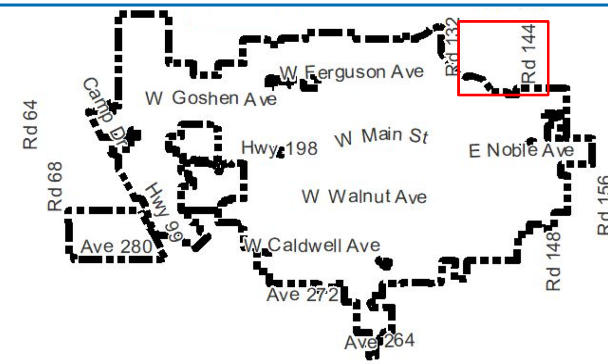
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 3,317,000
Total	100%	$ 3,317,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number: WWGM-19E
Project Name: East Riggin Extension Trunk
System Type: Sanitary Sewer Collection System



Project Description:
This project consists of 3,400 feet of 15-inch diameter pipeline in Avenue 313. The project extends west of Oak Ranch Drive to Road 148.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	15	New	3,400	$ 315	$ 1,071,000	$ 1,392,000	$ 1,775,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

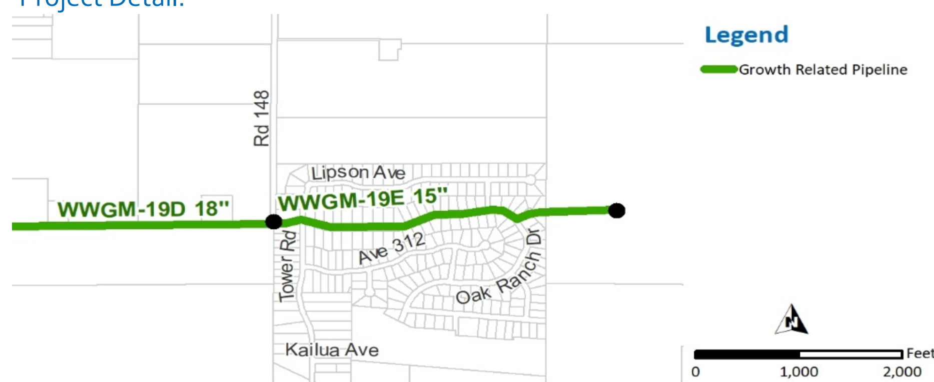
(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,775,000
Total	100%	$ 1,775,000

Notes on Cost Estimation:
Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



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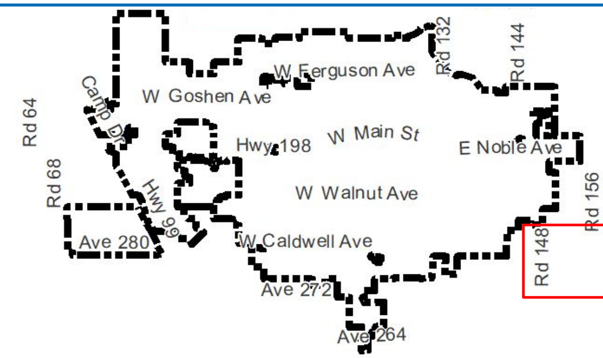
Project Number:	WWGM-20A
Project Name:	Road 148 Trunk
System Type:	Sanitary Sewer Collection System



Project Description:

Projects 20A through 20E will construct a new trunk in the southeastern quadrant of the City. This project has been carried forward from previous master plans with adjustments made to the alignment. Project WWGM-20A consists of 7,900 feet of 21-inch diameter pipeline in Road 148. The project extends from Walnut Avenue to Visalia Parkway.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	21	New	7,900	$ 390	$ 3,081,000	$ 4,005,000	$ 5,107,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

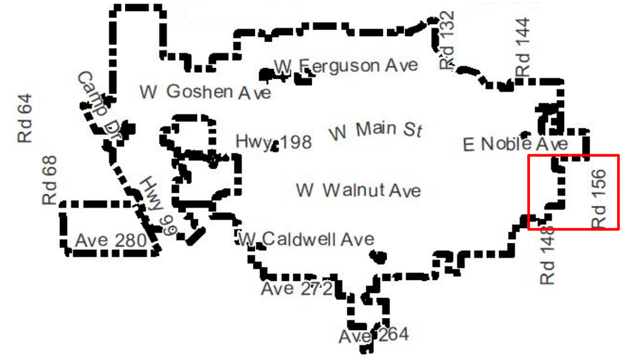
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 5,107,000
Total	100%	$ 5,107,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number: WWGM-20B
Project Name: Road 148 Trunk
System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 5,100 feet of 15-inch diameter pipeline in Road 148. The project extends from Noble Avenue to Walnut Avenue.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	15	New	5,100	$ 315	$ 1,607,000	$ 2,089,000	$ 2,664,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

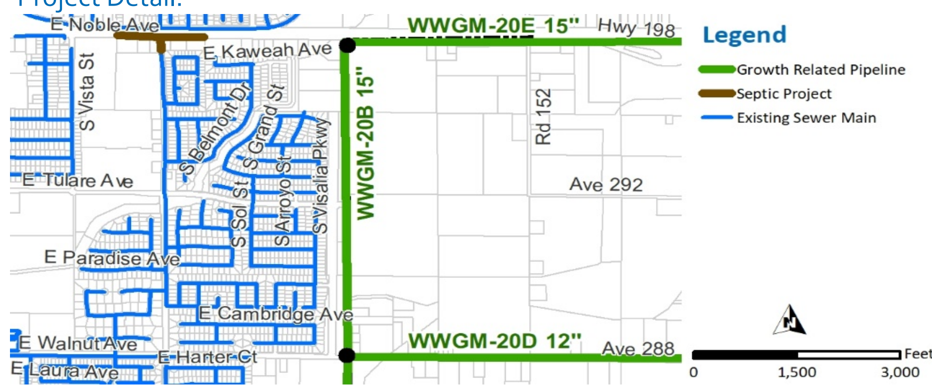
(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,664,000
Total	100%	$ 2,664,000

Project Detail:



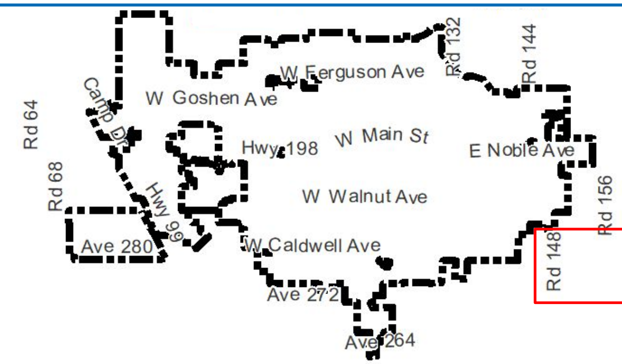
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Number: WWGM-20C

Project Name: Road 148 Trunk

System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 4,000 feet of 12-inch diameter pipeline in Caldwell Avenue. The project extends from 1,250 feet west of Mariposa Avenue to Road 148.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	4,000	$ 285	$ 1,140,000	$ 1,482,000	$ 1,890,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

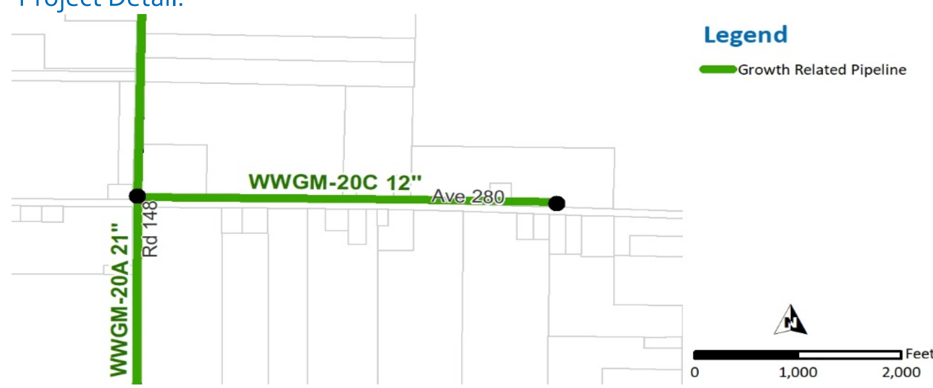
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,890,000
Total	100%	$ 1,890,000

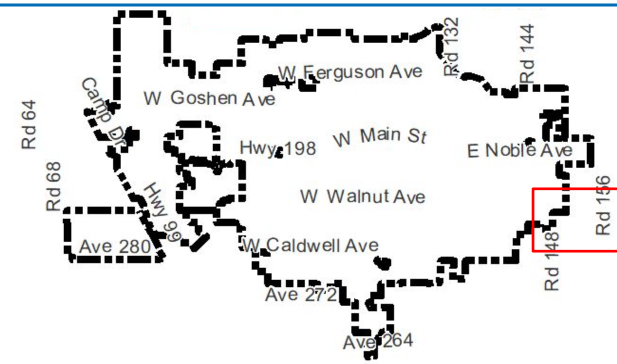
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number: WWGM-20D
Project Name: Road 148 Trunk
System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 5,000 feet of 12-inch diameter pipeline in Walnut Avenue. The project extends from Road 156 to Road 148.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	5,000	$ 285	$ 1,425,000	$ 1,853,000	$ 2,362,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

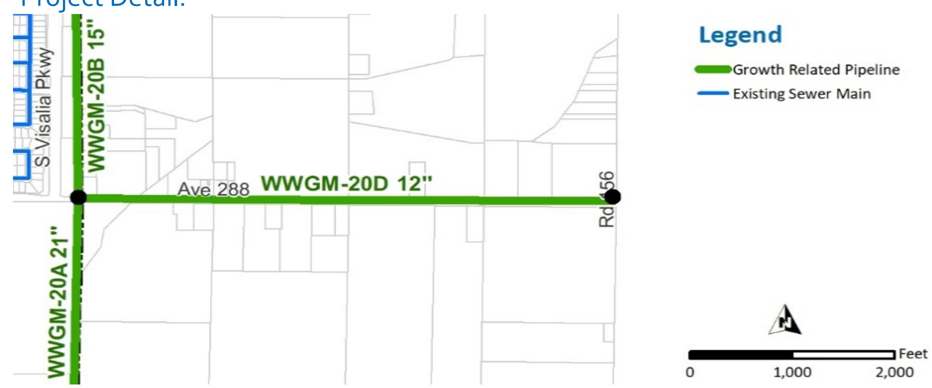
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,362,000
Total	100%	$ 2,362,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

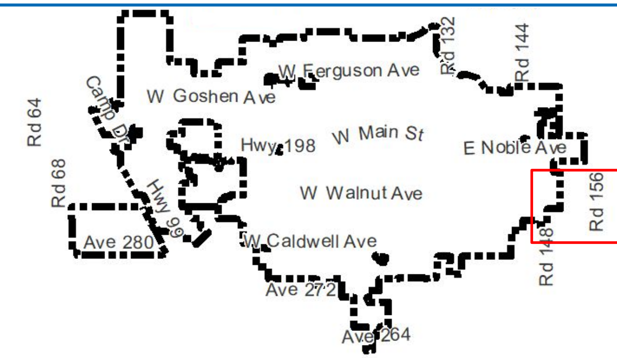
Project Detail:



Project Number: WWGM-20E

Project Name: Road 148 Trunk

System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 5,400 feet of 15-inch diameter pipeline in Noble Avenue. The project extends from Road 156 to Road 148. The alignment connects to WWGM-20F.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	15	New	5,400	$ 315	$ 1,701,000	$ 2,211,000	$ 2,819,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

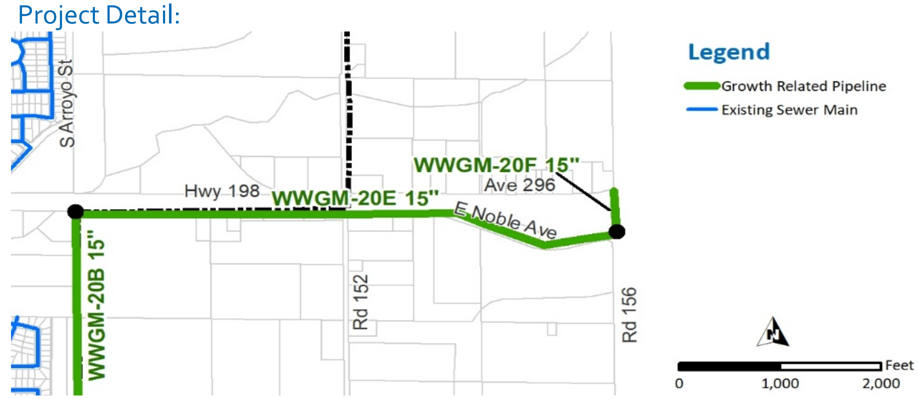
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,819,000
Total	100%	$ 2,819,000

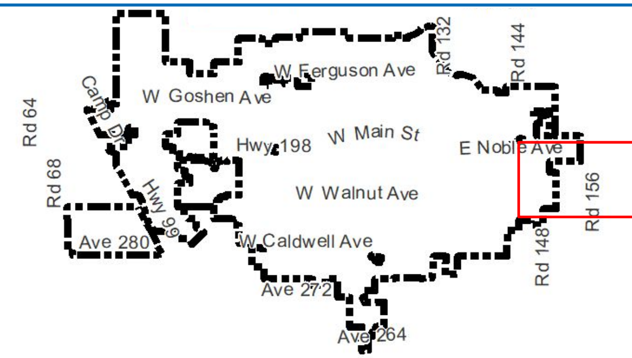
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWGM-20F
Project Name:	Road 156 Trunk
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 500 feet of 15-inch diameter pipeline with 30-inch steel casing in Road 156. The project connects from WWGM-20E and extends from Noble Avenue to Avenue 296. The alignment crosses under Highway 198 bridge and is estimated to be open trench. This project will be serving users north of Highway 198.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main and Interstate Crossing	-	15/30	New	500	$ 790	$ 395,000	$ 514,000	$ 655,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

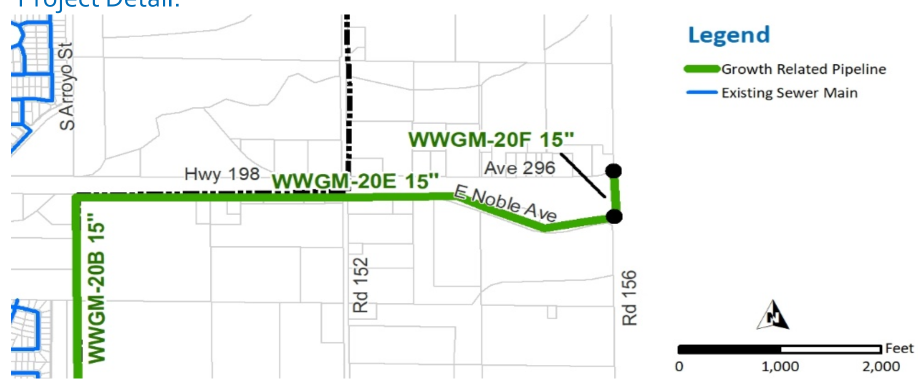
(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 655,000
Total	100%	$ 655,000

Project Detail:



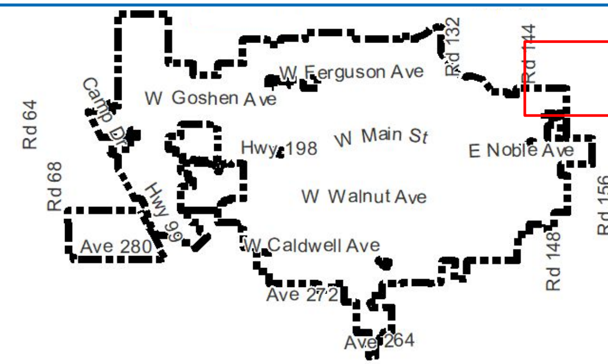
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Number: WWGM-21

Project Name: Houston-Ivanhoe Main Extension

System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 2,800 feet of 12-inch diameter pipeline in Ivanhoe Drive. The project extends east from Road 152.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	12	New	2,800	$ 285	$ 798,000	$ 1,037,000	$ 1,323,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

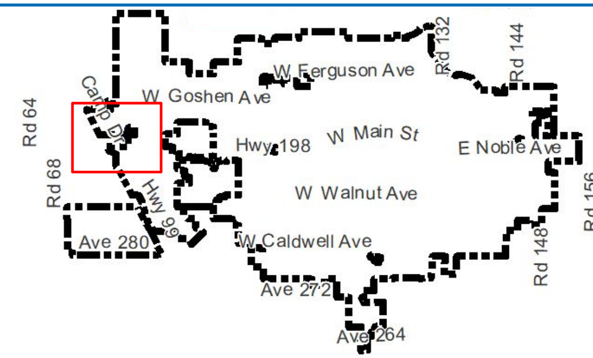
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,323,000
Total	100%	$ 1,323,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWLS-1
Project Name:	Airport Lift Station
System Type:	Sanitary Sewer Collection System

Project Description:

The firm capacity of this lift station is not adequate to convey Ultimate Buildout flows. The City's Airport Lift Station will need to be replaced in the future to accommodate growth in the planning area. This lift station provides service to Sewer Drainage Basin 7, which includes the Industrial Park. In addition, the Census Designated Place (CDP) Goshen discharges upstream of the lift station. This project is considered long term and would be required beyond buildout of the UGB. It is recommended to increase the firm capacity to 17.0 mgd. For planning a total capacity of 25.5 mgd with 3 pumps is assumed.

Project Details:

Project Element	Existing Total Capacity (mgd)	Proposed Total Capacity (mgd)	Replace/ New	No. of Pumps (Units)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Lift Station	12	25.5	Replace		$ 15,300,000	$ 19,890,000	$ 25,360,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

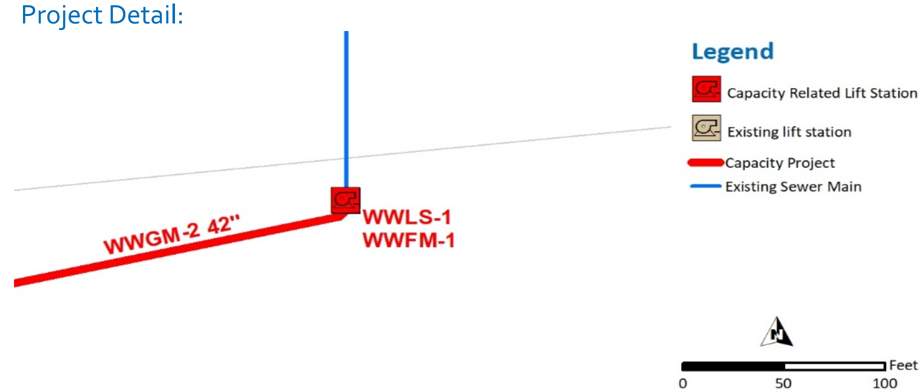
(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 25,360,000
Total	100%	$ 25,360,000

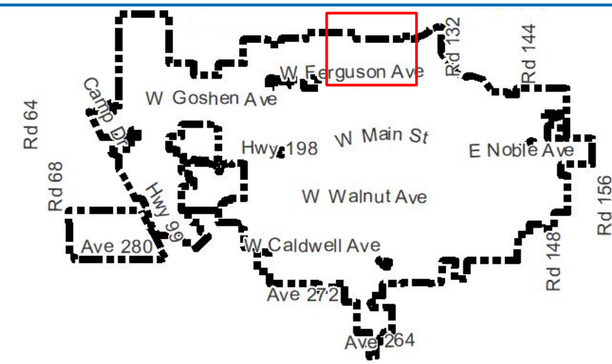
Project Detail:



Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Number: WWLS-2
Project Name: Avenue 320 Trunk Extension Lift Station
System Type: Sanitary Sewer Collection System



Project Description:
This project will consist of a new lift station with a firm capacity of 3.6 mgd. The project is located in Avenue 320, east of the St. Johns River. A preliminary analysis estimates a lift station will be required to cross the St Johns River. Further analysis is recommended to determine flood zone, and best method to cross the River. For planning purposes 3 pumps were assumed at a capacity of 1. 8 mgd.

Project Details:

Project Element	Existing Total Capacity (mgd)	Proposed Total Capacity (mgd)	Replace/ New	No. of Pumps (Units)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Lift Station	--	5.4	New	3	$ 3,240,000	$ 4,212,000	$ 5,370,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

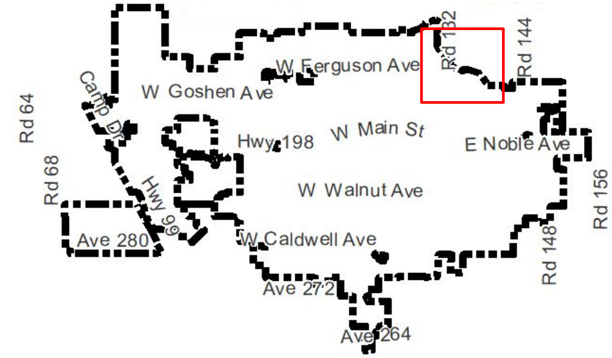
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 5,370,000
Total	100%	$ 5,370,000

Notes on Cost Estimation:
Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project [

Project Number: WWLS-3
Project Name: East Riggin Extension Trunk
System Type: Sanitary Sewer Collection System



Project Description:

This project will consist of a new lift station with a firm capacity of 3.0 mgd. The project is located in an unimproved area, east of the St. Johns River. A preliminary analysis estimates a lift station will be required to cross the St Johns River. Further analysis is recommended to determine the surrounding flood zone, and best method to cross the River.

Project Details:

Project Element	Existing Total Capacity (mgd)	Proposed Total Capacity (mgd)	Replace/ New	No. of Pumps (Units)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Lift Station	--	4.5	New	3	$ 2,700,000	$ 3,510,000	$ 4,475,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

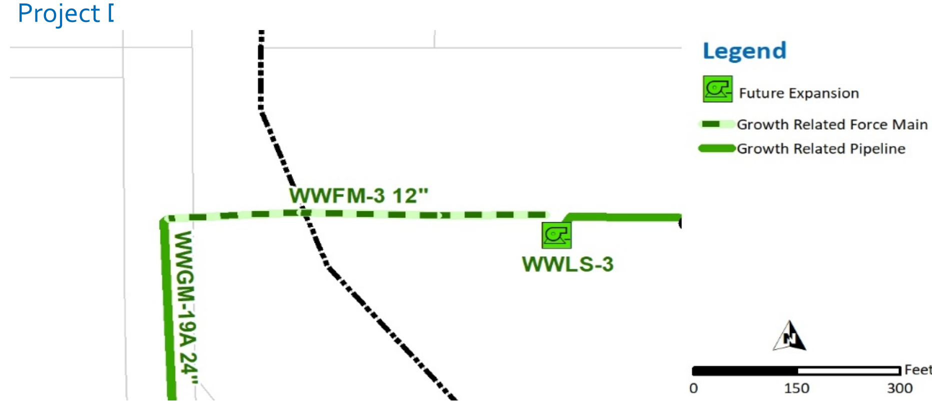
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 4,475,000
Total	100%	$ 4,475,000

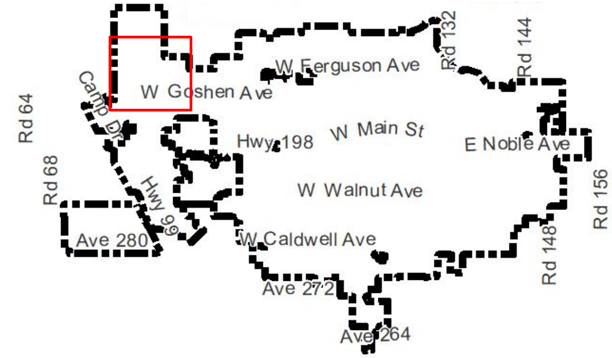
Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project I



Project Number: WWLS-4
Project Name: West Avenue 320 Lift Station
System Type: Sanitary Sewer Collection System



Project Description:

This project will consist of a new lift station with a firm capacity of 6.0 mgd. The project is located at the intersection Avenue 320 and American Street. The lift station will serve the northwest quadrant of the planning area.

Project Details:

Project Element	Existing Total Capacity (mgd)	Proposed Total Capacity (mgd)	Replace/ New	No. of Pumps (Units)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Lift Station	--	9	New	3	$ 5,400,000	$ 7,020,000	$ 8,951,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

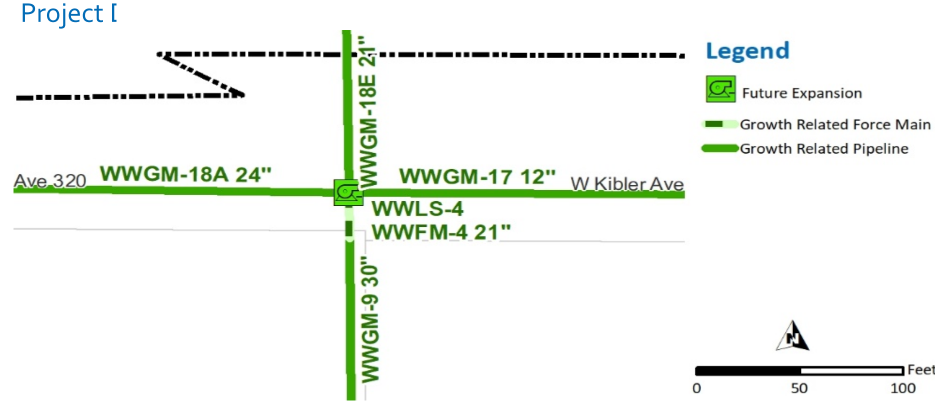
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 8,951,000
Total	100%	$ 8,951,000

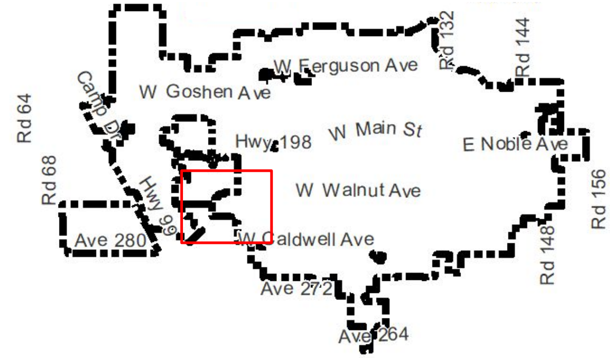
Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project [



Project Number:	WWFM-1
Project Name:	Airport Lift Station Force Main
System Type:	Sanitary Sewer Collection System



Project Description:

The Airport Lift Station's 20-inch diameter force main exceeds velocity criteria under Ultimate Buildout conditions. It is recommended to parallel the 20-inch diameter pipeline with an additional 21-inch pipeline.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Force Main	-	21	New	100	$ 346	$ 35,000	$ 46,000	$ 58,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

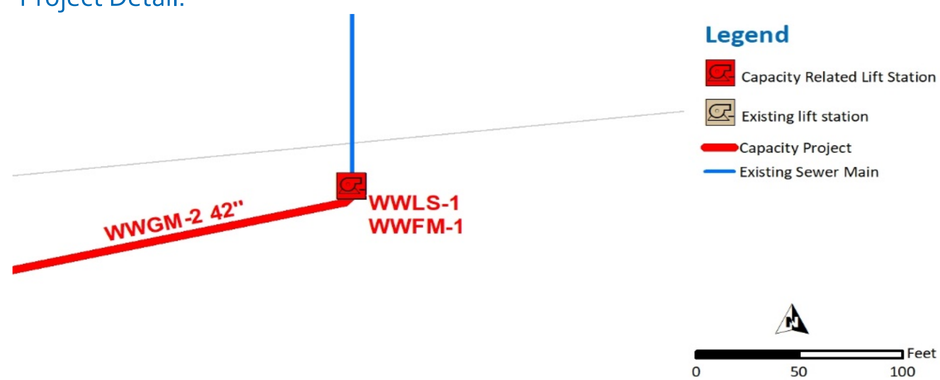
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 58,000
Total	100%	$ 58,000

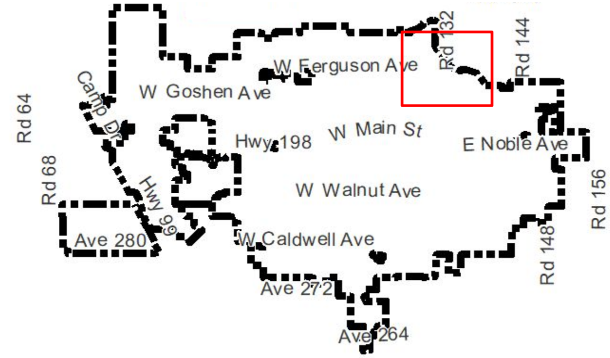
Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number: WWFM-2
Project Name: Avenue 320 Trunk Extension Lift Station Force Main
System Type: Sanitary Sewer Collection System



Project Description:

This project consist of 1,900 feet of 14-inch diameter force main crossing the St. Johns River. The project will convey flows for project WWLS-2.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Force Main	-	14	New	1,900	$ 282	$ 535,000	$ 696,000	$ 887,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

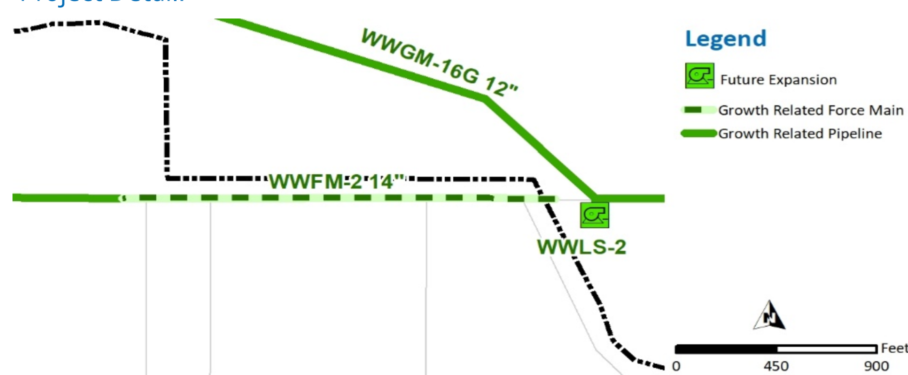
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 887,000
Total	100%	$ 887,000

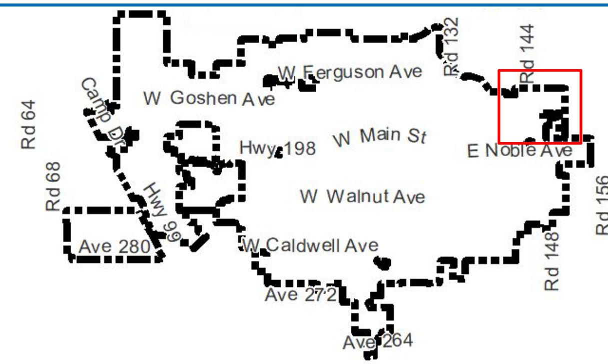
Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWFM-3
Project Name:	East Riggin Trunk Extension Lift Station Force Main
System Type:	Sanitary Sewer Collection System



Project Description:

This project consist of 600 feet of 12-inch diameter force main crossing the St. Johns River. The project will convey flows for project WWLS-3.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Force Main	-	12	New	600	$ 276	$ 165,000	$ 215,000	$ 273,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

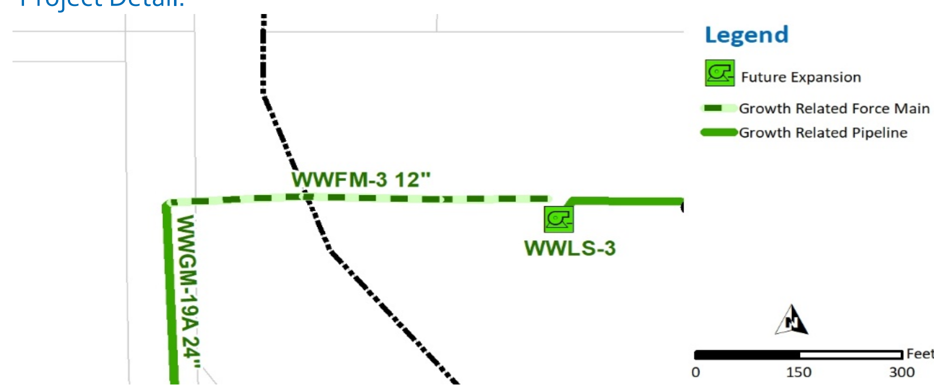
(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

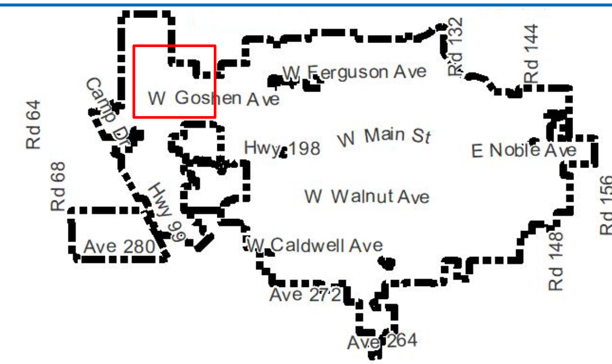
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 273,000
Total	100%	$ 273,000

Project Detail:



Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.



Project Number:	WWFM-4
Project Name:	West Avenue 320 Lift Station Force Main
System Type:	Sanitary Sewer Collection System

Project Description:

This project consist of 100 feet of 21-inch diameter force main in American Street. The project will convey flows for project WWLS-4.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Force Main	-	21	New	100	$ 346	$ 35,000	$ 46,000	$ 58,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

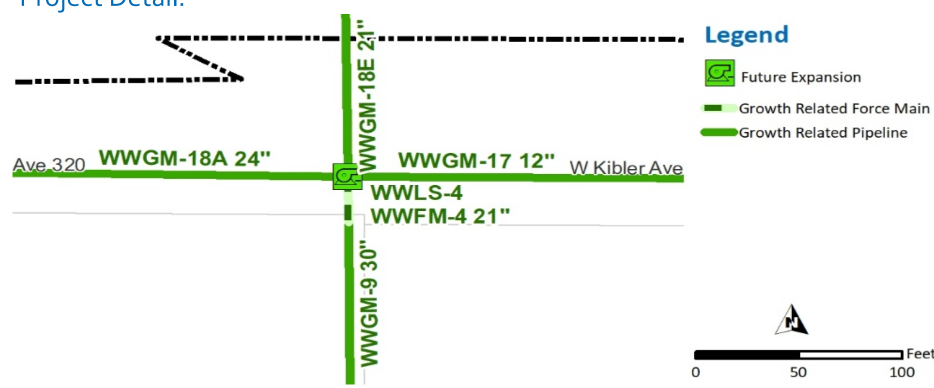
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 58,000
Total	100%	$ 58,000

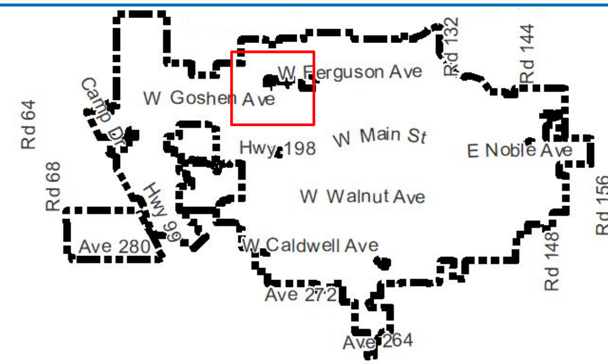
Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number: WWO-1
Project Name: Septic Removal by Sewer Extension
System Type: Sanitary Sewer Collection System



Project Description:
This project provides a preliminary alignment to extend sanitary sewer service to residents currently on septic and located in the City limits or county islands. Projects WWo-1 through WWo-12 were identified due to their proximity to existing sewer line. Project WWO-1 consists of 2,600 feet of 8-inch diameter pipeline in Linwood Road, Oakridge Court, and Kent Street. The project extends to the intersection of W Ferguson Avenue. This is a County Island project which is only likely to occur as a condition of Annexation.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	8	New	2,600	$ 240	$ 624,000	$ 811,000	$ 1,034,000	2046 & beyond

Notes:
(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.
(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.
(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

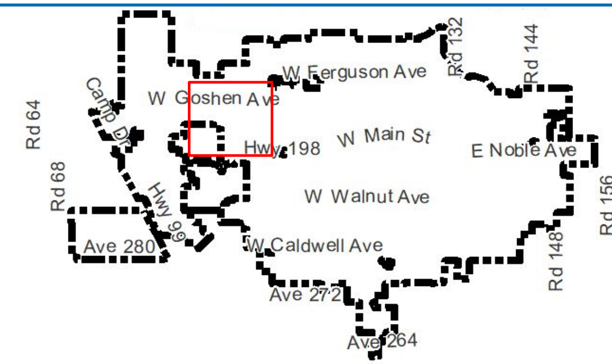
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,034,000
Total	100%	$ 1,034,000

Project Detail:

Notes on Cost Estimation:
Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Number:	WWO-2A
Project Name:	Septic Removal by Sewer Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 1,400 feet of 8-inch diameter pipeline in El Cajon Street at the intersection of Goshen Avenue.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[(1)] ($)	Estimated Construction Cost[(2)] ($)	Capital Improvement Cost[(3)] ($)	Project Schedule
Gravity Main	-	8	New	1,400	$ 240	$ 336,000	$ 437,000	$ 557,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

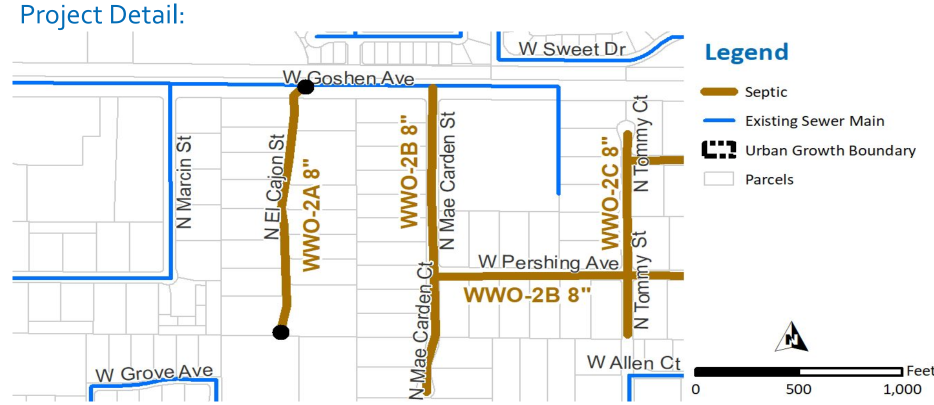
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 557,000
Total	100%	$ 557,000

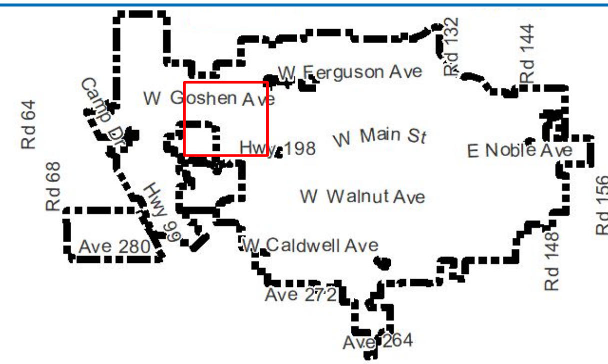
Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWO-2B
Project Name:	Septic Removal by Sewer Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 2,600 feet of 8-inch diameter pipeline in Mae Carden Street and Pershing Avenue the project extends to the intersection of south Goshen Avenue and Mae Carden Street.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	8	New	2,600	$ 240	$ 624,000	$ 811,000	$ 1,034,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

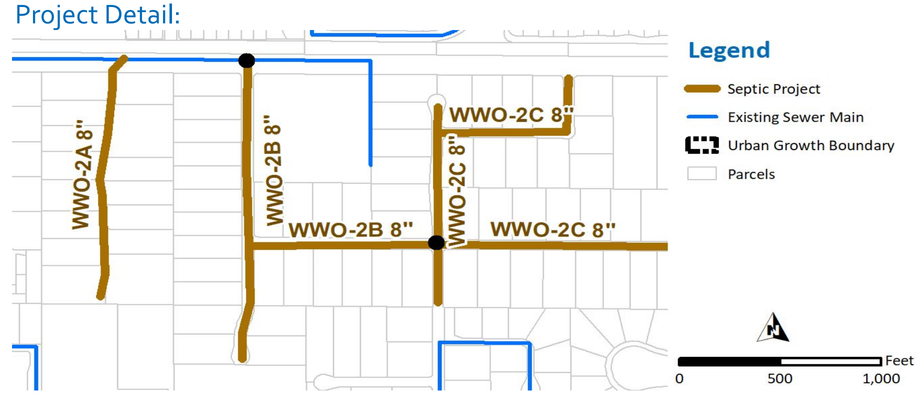
(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,034,000
Total	100%	$ 1,034,000

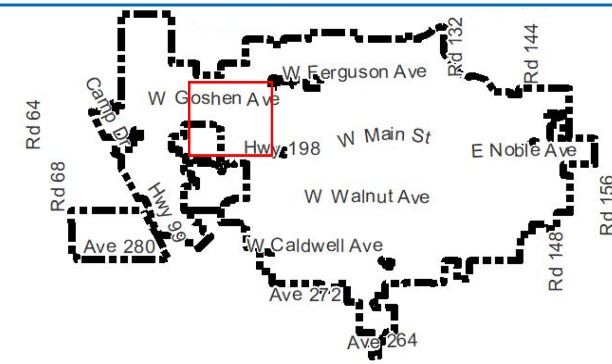
Project Detail:



Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Number:	WWO-2C
Project Name:	Septic Removal by Sewer Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 4,700 feet of 8-inch diameter pipeline. The project extends from W. Steward Avenue to Tommy Street, and West in Pershing Ave to the intersection of Akers. To maintain a minimum recommended slope, a lift station is required.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	8	New	4,700	$ 240	$ 1,128,000	$ 1,466,000	$ 1,870,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

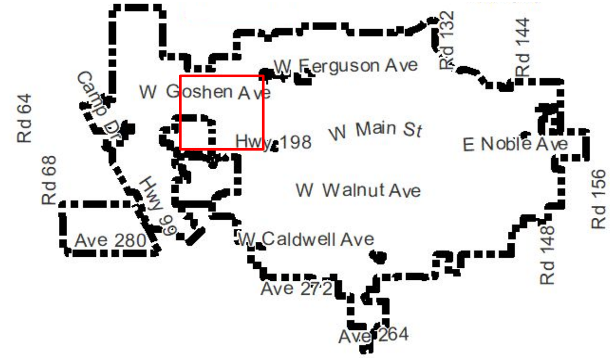
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,870,000
Total	100%	$ 1,870,000

Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number:	WWO-2D
Project Name:	Septic Removal by Sewer Extension
System Type:	Sanitary Sewer Collection System



Project Description:

A preliminary analysis shows to maintain a minimum slope upstream a lift station is required. This project would serve existing users transitioning from septic to the collection system. The lift station is recommended to have a firm capacity of 0.031 mgd (21.2 gpm).

Project Details:

Project Element	Existing Size (in)	Proposed Size	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Lift Station	-	0.06 mgd	New	-		$ 37,200	$ 48,000	$ 62,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

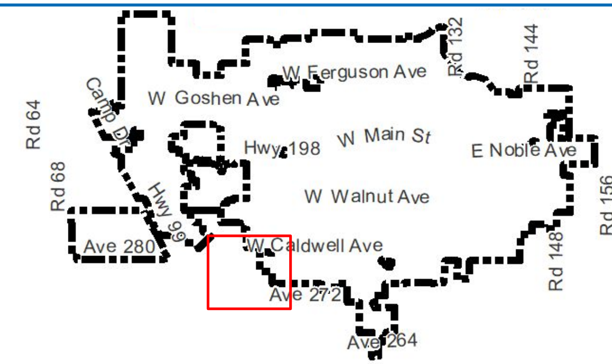
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 62,000
Total	100%	$ 62,000

Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number: WWO-3A
Project Name: Septic Removal by Sewer Extension
System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 1,300 feet of 8-inch diameter pipeline in S Peppertree Court. The project extends to the intersection of Caldwell Avenue.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	8	New	1,300	$ 240	$ 312,000	$ 406,000	$ 517,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

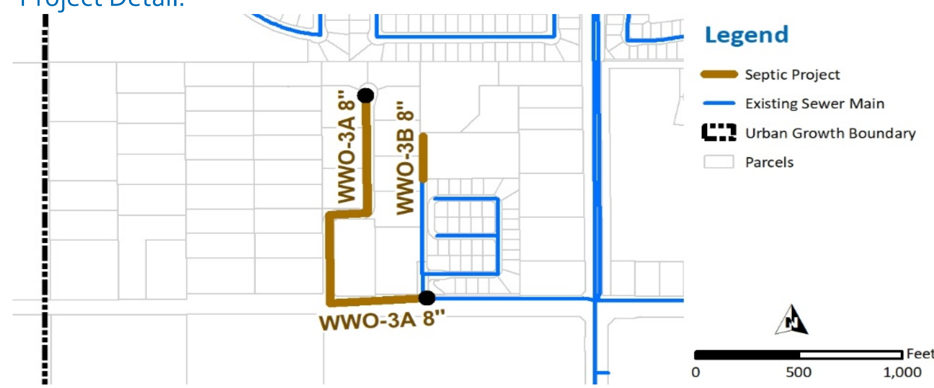
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 517,000
Total	100%	$ 517,000

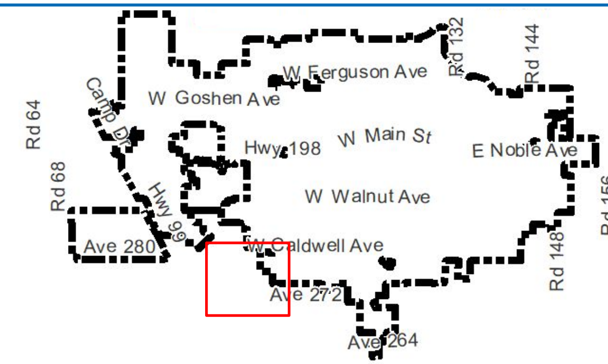
Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWO-3B
Project Name:	Septic Removal by Sewer Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 300 feet of 8-inch diameter pipeline in S Aspen Street.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	8	New	300	$ 240	$ 72,000	$ 94,000	$ 119,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

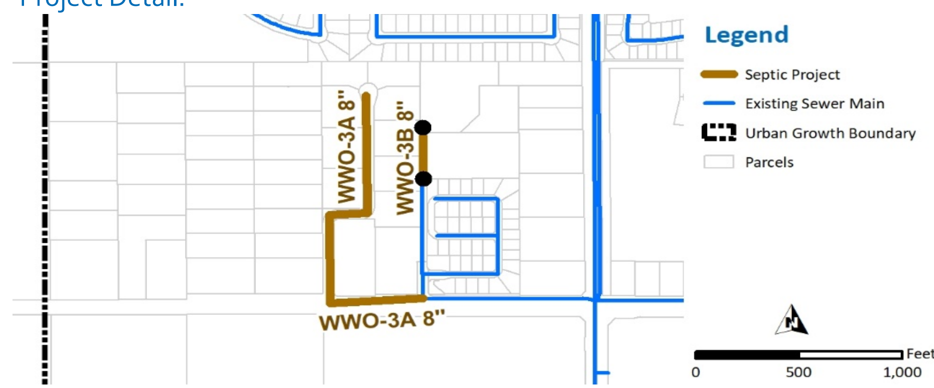
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 119,000
Total	100%	$ 119,000

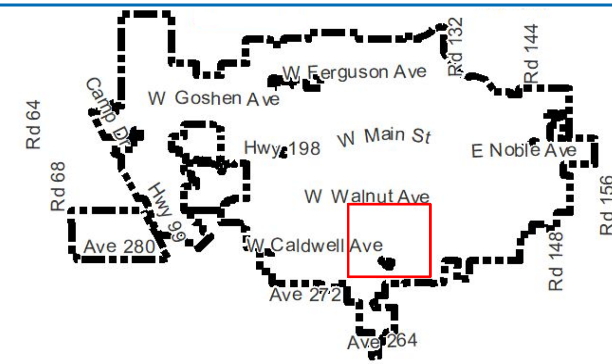
Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWO-4
Project Name:	Septic Removal by Sewer Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 800 feet of 8-inch diameter pipeline in James Avenue. The project extends to an existing pipeline at the intersection of Divisadero Street. This pipeline will not be installed unless there is redevelopment.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	8	New	800	$ 240	$ 192,000	$ 250,000	$ 318,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 318,000
Total	100%	$ 318,000

Project Detail:

Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

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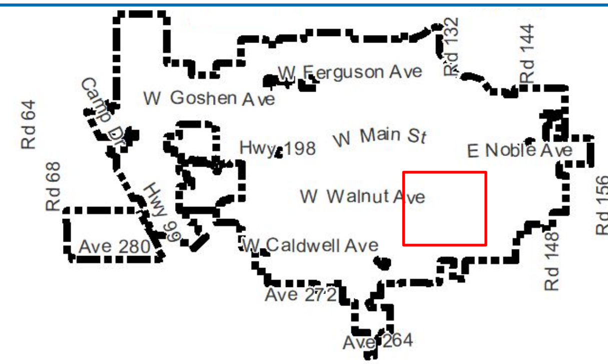
Project Number: WWO-5A
Project Name: Septic Removal by Sewer Extension
System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 1,300 feet of 8-inch diameter pipeline in Tulare Street at the intersection Ben Maddox Way. This project is unlikely to occur without further development.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	8	New	1,300	$ 240	$ 312,000	$ 406,000	$ 517,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

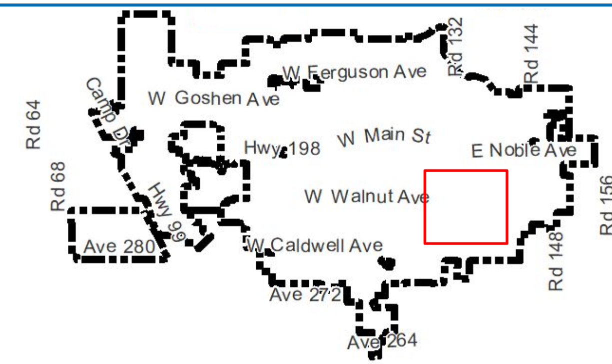
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 517,000
Total	100%	$ 517,000

Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number:	WWO-5B
Project Name:	Septic Removal by Sewer Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 500 feet of 8-inch diameter pipeline in an access road located south of Pinkham Road and Tulare Avenue intersection.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	8	New	500	$ 240	$ 120,000	$ 156,000	$ 199,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 199,000
Total	100%	$ 199,000

Project Detail:

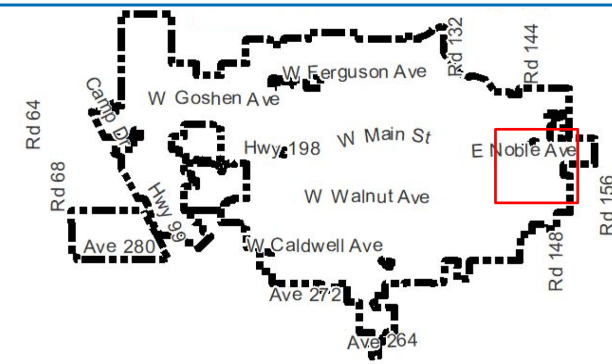
Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Number: WWO-6

Project Name: Septic Removal by Sewer Extension

System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 1,200 feet of 8-inch diameter pipeline in Noble Avenue and would connect to the existing system in McAuliff Street.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	8	New	1,200	$ 240	$ 288,000	$ 374,000	$ 477,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

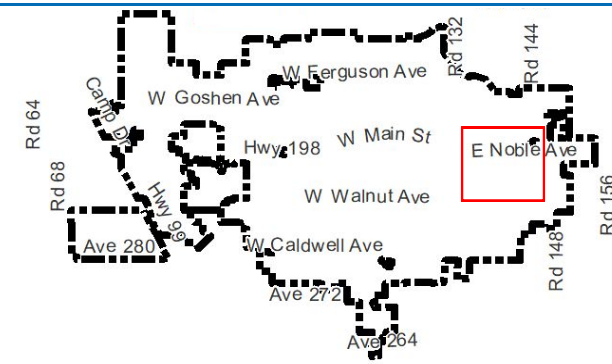
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 477,000
Total	100%	$ 477,000

Project Detail:

Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Number: WWO-7
Project Name: Septic Removal by Sewer Extension
System Type: Sanitary Sewer Collection System



Project Description:
This project consists of 600 feet of 8-inch diameter pipeline in an access road south of Goshen Avenue and Lover Lane.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	8	New	600	$ 240	$ 144,000	$ 187,000	$ 239,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

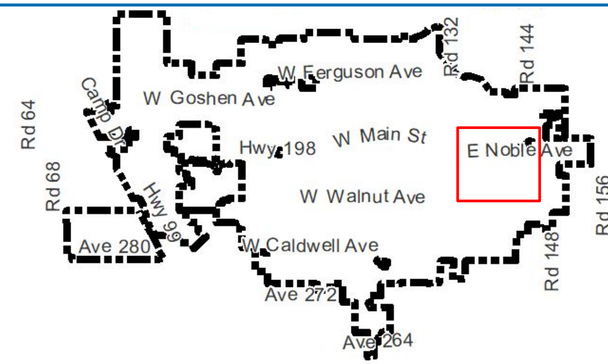
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 239,000
Total	100%	$ 239,000

Notes on Cost Estimation:
Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number:	WWO-8A
Project Name:	Septic Removal by Sewer Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 2,600 feet of 8-inch diameter pipeline in Sol Road. Based on preliminary data, the pipeline would not maintain a minimum recommended slope. Therefore a lift station is recommended.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	8	New	2,600	$ 240	$ 624,000	$ 811,000	$ 1,034,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,034,000
Total	100%	$ 1,034,000

Notes on Cost Estimation:

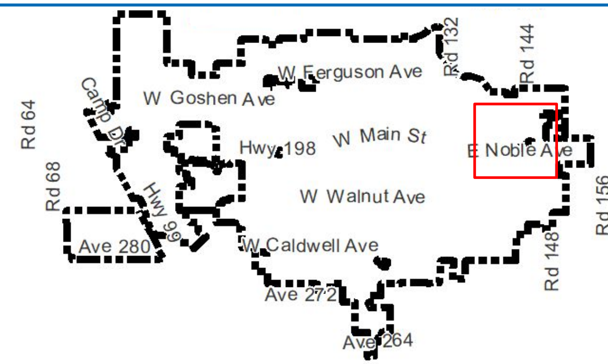
Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number: WWO-8B

Project Name: Septic Removal by Sewer Extension

System Type: Sanitary Sewer Collection System



Project Description:

A preliminary analysis shows to maintain a minimum slope upstream a lift station is required. This project would serve existing users transitioning from septic to the collection system. The lift station is recommended to have a firm capacity of 0.02 mgd (15.7 gpm) and would provide service to residential very low density.

Project Details:

Project Element	Existing Size (in)	Proposed Size	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Lift Station	-	0.05 mgd	New	-		$ 27,130	$ 35,000	$ 45,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

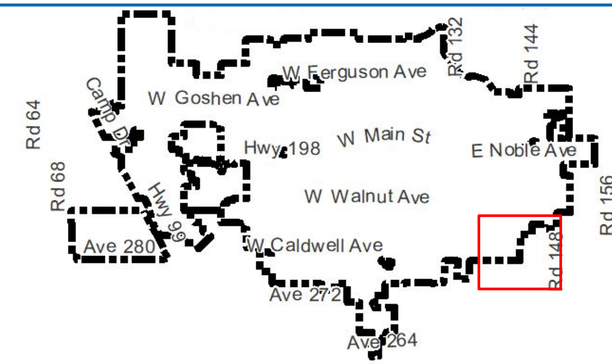
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 45,000
Total	100%	$ 45,000

Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number: WWO-9
Project Name: Septic Removal by Sewer Extension
System Type: Sanitary Sewer Collection System



Project Description:

Connection of this area would likely occur as the surrounding area is developed or redeveloped. Vista Del Sol has began development on the adjacent lot west of the septic area and would likely be the point of connection.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Force Main	-	8	New	1,000	$ 252	$ 252,000	$ 328,000	$ 418,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

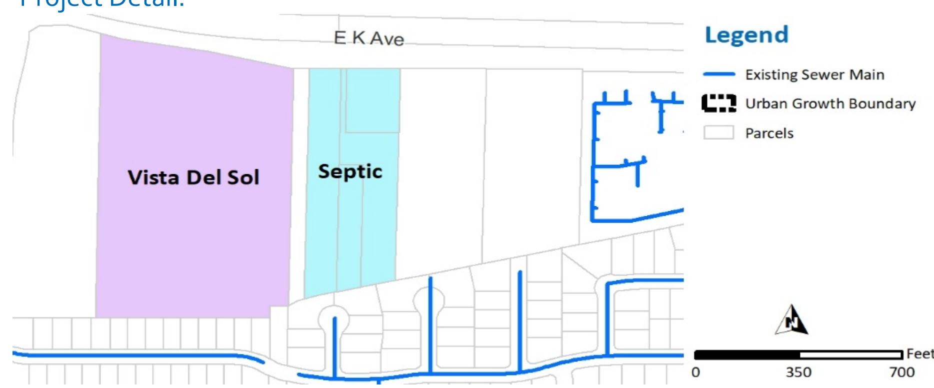
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 418,000
Total	100%	$ 418,000

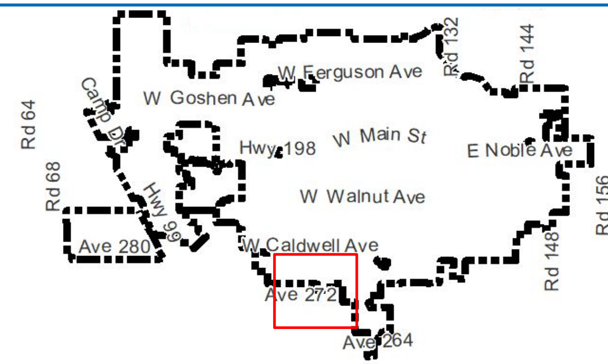
Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWO-10
Project Name:	Septic Removal by Sewer Extension
System Type:	Sanitary Sewer Collection System



Project Description:

This project consists of 400 feet of 8-inch diameter pipeline in S. Dans Street. This project is likely to occur as a condition of annexation.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[(1)] ($)	Estimated Construction Cost[(2)] ($)	Capital Improvement Cost[(3)] ($)	Project Schedule
Force Main	-	8	New	400	$ 252	$ 101,000	$ 131,000	$ 167,000	2046 & beyond

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

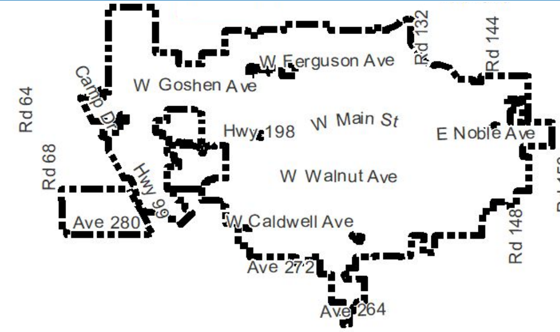
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 167,000
Total	100%	$ 167,000

Notes on Cost Estimation:

Project will address future capacity Deficiencies, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number:	WWO-11
Project Name:	Sewer Master Plan Update
System Type:	Sanitary Sewer Collection System

Project Description:

It is recommended that the City undergoes a Sewer Master Plan Update every 5-years to evaluate wastewater collection system.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Master Plan	-	-	New	-	-	-	-	$ 308,500	2030
Master Plan	-	-	New	-	-	-	-	$ 308,500	2031-2035
Master Plan	-	-	New	-	-	-	-	$ 308,500	2036-2040
Master Plan	-	-	New	-	-	-	-	$ 308,500	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

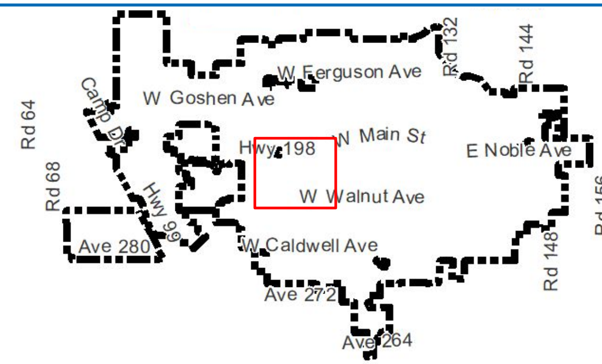
Reimbursement Category	Percent	Cost ($)
Existing Users	50%	$ 617,000
Future Users	50%	$ 617,000
Total	100%	$ 1,234,000

Project Detail:

Notes on Cost Estimation:

Project will address existing and future users.

Project Number: CP0369
Project Name: Shirk Capacity Enhancement
System Type: Sanitary Sewer Collection System



Project Description:

The project includes installation of 8,200 feet of 48-inch diameter pipeline in Shirk Street. The project will increase sanitary sewer capacity and accommodate future development.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	48	New	8,200	-	-	-	$ 3,401,500	2028

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

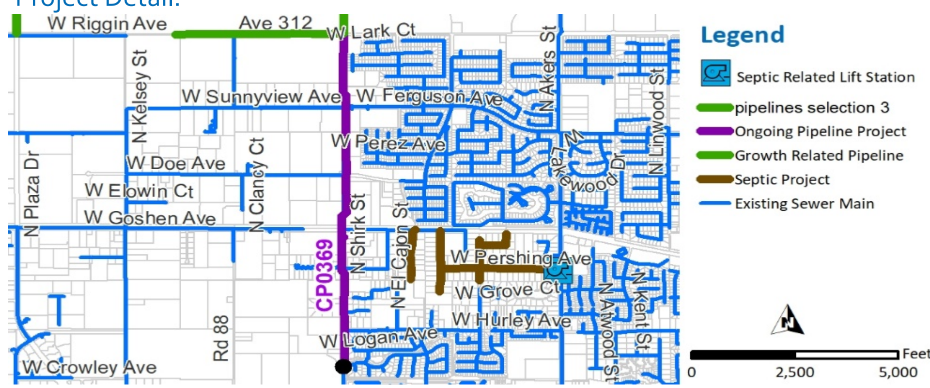
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	23%	$ 782,000
Future Users	77%	$ 2,620,000
Total	100%	$ 3,402,000

Notes on Cost Estimation:

This project will convey existing flows and future flows, cost was split between existing and future users.

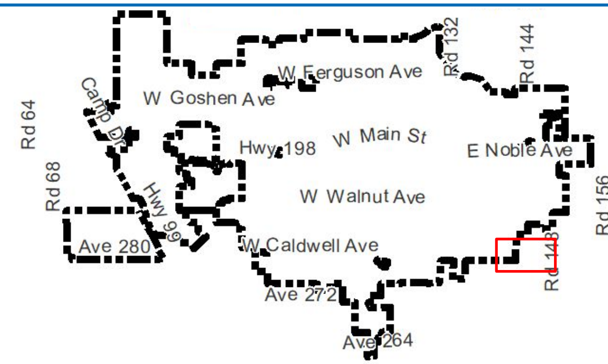
Project Detail:



Project Number: CP8268

Project Name: Caldwell Avenue Widening

System Type: Sanitary Sewer Collection System



Project Description:

This project will extend the 15-inch diameter pipeline in Caldwell across the Lovers Lane intersection and provide a stub to the north. A preliminary analysis shows the pipeline has depth to cross the waterway and maintain spacing.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	15	New	1,150		$ -	$ -	$ 918,800	2027

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

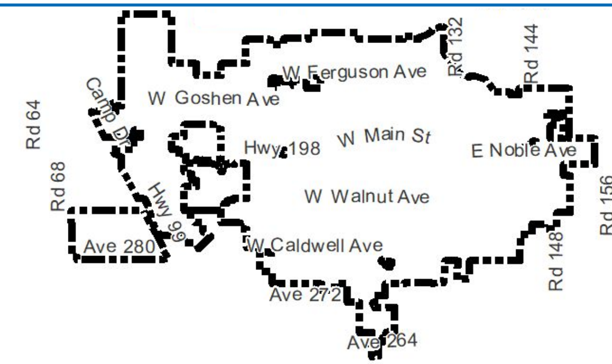
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 919,000
Total	100%	$ 919,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:

Project Number:	CP0045
Project Name:	Shirk Street and Walnut Avenue
System Type:	Sanitary Sewer Collection System



Project Description:

The will extend the sanitary sewer trunk line in Shirk Street approximately 200 feet north. This project is in conjunction with the installation of a traffic signal and will prevent retrenching the street for future expansion of the Shirk Trunk.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	48	New	200	-	-	-	$ 551,300	2028

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

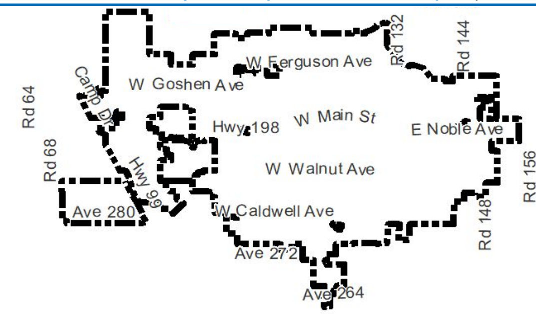
Reimbursement Category	Percent	Cost ($)
Existing Users	23%	$ 127,000
Future Users	77%	$ 425,000
Total	100%	$ 552,000

Project Detail:

Notes on Cost Estimation:

This project will convey existing flows and future flows, cost was split between existing and future users.

Project Number: CP9318
Project Name: Sanitary Sewer Developer Reimbursement
System Type: Sanitary Sewer Collection System



Project Description:

The annual project reimburses developers for additional costs incurred when constructing sanitary sewer infrastructure.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	-	New	-	-	-	-	$ 129,000	2027
Gravity Main	-	-	New	-	-	-	-	$ 129,000	2028
Gravity Main	-	-	New	-	-	-	-	$ 129,000	2029
Gravity Main	-	-	New	-	-	-	-	$ 129,000	2030
Gravity Main	-	-	New	-	-	-	-	$ 645,000	2031-2035
Gravity Main	-	-	New	-	-	-	-	$ 645,000	2036-2040
Gravity Main	-	-	New	-	-	-	-	$ 645,000	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

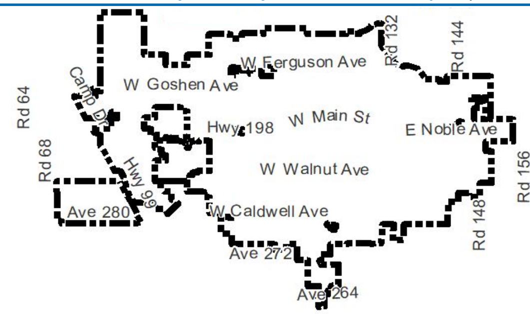
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,451,000
Total	100%	$ 2,451,000

Project Detail:

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Number: CP9234
Project Name: Sewer Line Preliminary Engineering
System Type: Sanitary Sewer Collection System



Project Description:

The annual project will accommodate preliminary engineering and design work necessary to provide developers and engineers with adequate information to construct master planned sewer lines.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	-	New	-	-	-	-	$ 23,500	2027
Gravity Main	-	-	New	-	-	-	-	$ 23,500	2028
Gravity Main	-	-	New	-	-	-	-	$ 23,500	2029
Gravity Main	-	-	New	-	-	-	-	$ 23,500	2030
Gravity Main	-	-	New	-	-	-	-	$ 117,500	2031-2035
Gravity Main	-	-	New	-	-	-	-	$ 117,500	2036-2040
Gravity Main	-	-	New	-	-	-	-	$ 117,500	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

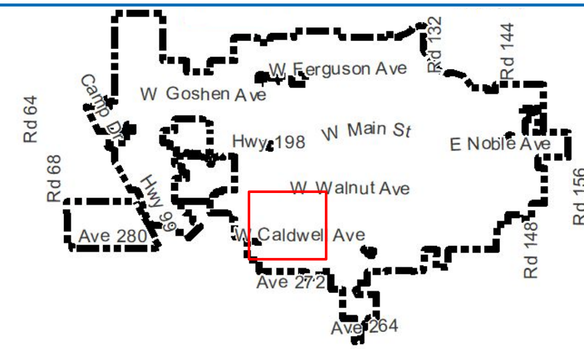
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 447,000
Total	100%	$ 447,000

Project Detail:

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.



Project Number: CP0567
Project Name: Shirk Street Sanitary Sewer Trunkline
System Type: Sanitary Sewer Collection System

Project Description:

The project will install a 48-inch trunk in Shirk Street, south of Highway 198. The project will extend from Noble Avenue to Walnut Avenue. The project also includes removal of the Shirk Lift Station and 6-inch force main.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[(1)] ($)	Estimated Construction Cost[(2)] ($)	Capital Improvement Cost[(3)] ($)	Project Schedule
Gravity Main	-	48	New	-	-	-	-	$ 451,600	2028
Gravity Main	-	48	New	5,000	-	-	-	$ 3,507,100	2029
Gravity Main	-	48	New	5,000	-	-	-	$ 3,507,100	2030

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

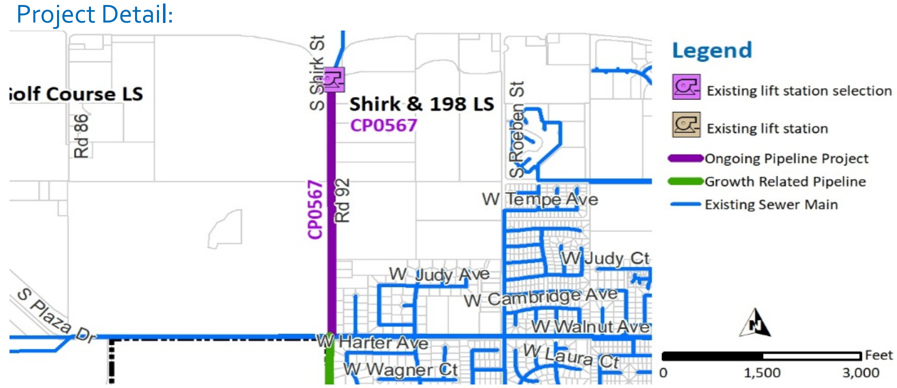
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	23%	$ 1,715,000
Future Users	77%	$ 5,750,000
Total	100%	$ 7,465,000

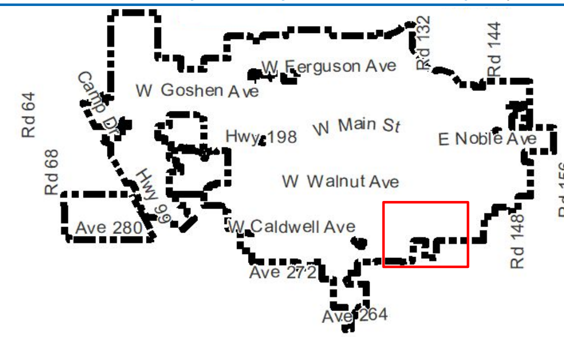
Notes on Cost Estimation:

This project will convey existing flows and future flows, cost was split between existing and future users.

Project Detail:



Project Number:	CPNew
Project Name:	Visalia Parkway Trunkline
System Type:	Sanitary Sewer Collection System



Project Description:

The project will construct a new 30-inch diameter sanitary sewer pipeline between Santa Fe Street and Lovers Lane. This project will extend the existing pipeline in Visalia parkway. Design is estimated at $ 3.12 M and construction at $5.26M for a total of $8.38M.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	30	New	-	-	-	-	$ 1,039,200	2031-2035
Gravity Main	-	30	New	-	-	-	-	$ 1,312,200	2031-2035
Gravity Main	-	30	New	-	-	-	-	$ 1,308,200	2031-2035
Gravity Main	-	30	New	7,900	-	-	-	$ 6,169,600	2031-2035

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

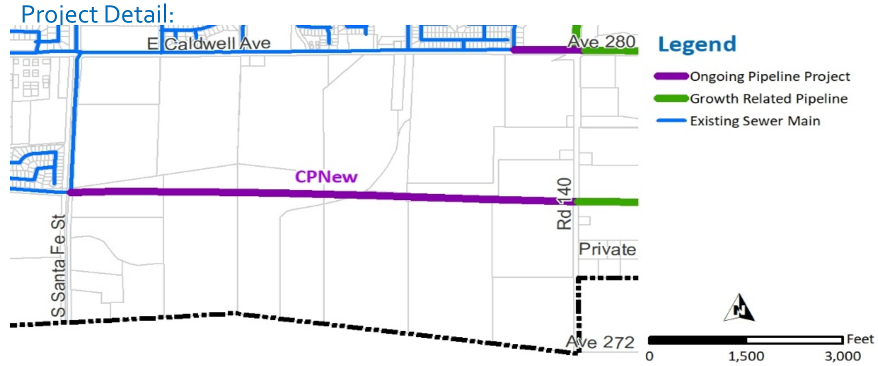
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 9,829,000
Total	100%	$ 9,829,000

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

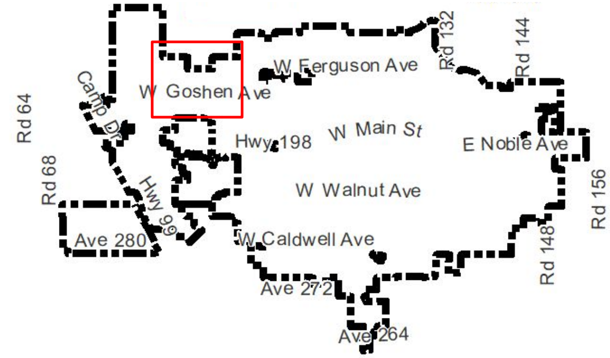
Project Detail:



Project Number: CP0398

Project Name: Riggin widening- Kelsey to Shirk

System Type: Sanitary Sewer Collection System



Project Description:

This project consists of 4,000 feet of 15-inch diameter pipeline in Riggin Avenue and extends from east of Kelsey Street to Shirk Road. The project is located in Industrial Park and would serve industrial users. Cost includes street widening and installation of lighting.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	15	New	4,000	-	-	-	$ 2,785,700	2027

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

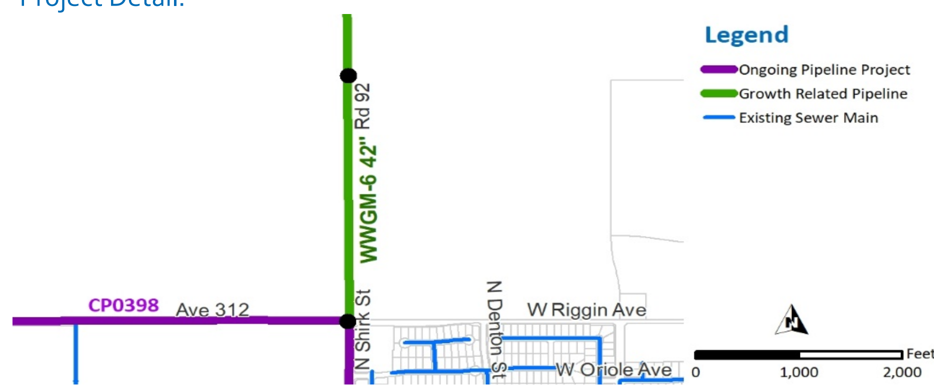
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 2,786,000
Total	100%	$ 2,786,000

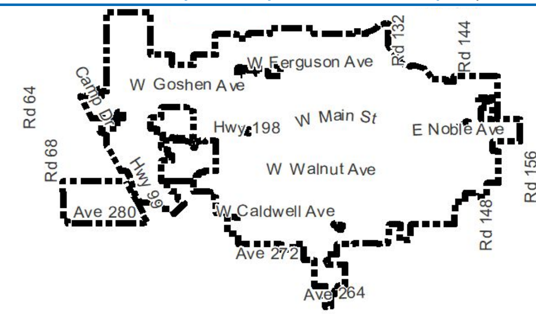
Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Detail:



Project Number: CP9456
Project Name: Replace and Relocate Sanitary Sewer Mains
System Type: Sanitary Sewer Collection System



Project Description:

The annual program will replace mains that have deteriorated and relocate pipelines as necessary to accommodate development.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	-	New	-	-	-	-	$ 1,759,400	2027
Gravity Main	-	-	New	-	-	-	-	$ 1,759,400	2028
Gravity Main	-	-	New	-	-	-	-	$ 1,759,400	2029
Gravity Main	-	-	New	-	-	-	-	$ 1,759,400	2030
Gravity Main	-	-	New	-	-	-	-	$ 8,797,000	2031-2035
Gravity Main	-	-	New	-	-	-	-	$ 8,797,000	2036-2040
Gravity Main	-	-	New	-	-	-	-	$ 8,797,000	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

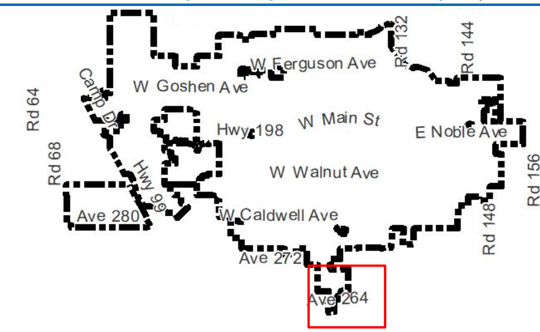
Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 33,429,000
Total	100%	$ 33,429,000

Project Detail:

Notes on Cost Estimation:

Project will address future growth, therefore 100-percent of cost is assigned to future users.

Project Number: CP8266
Project Name: Sanitary Sewer Lift Station Rehabilitation
System Type: Sanitary Sewer Collection System



Project Description:

The project will rehabilitate two lift stations with new piping, valves, pump bases, entry hatches, and concrete surface. The Golf Course and Mooney/Ave 272 lift station have been identified for this project. After completion, annual rehabilitation projects will continue.

Project Details:

Project Element	Existing Total Capacity (mgd)	Proposed Total Capacity (mgd)	Replace/ New	No. of Pumps (Units)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Lift Station	--	--	Rehab		--	--	--	$ 351,900	2027
Lift Station	--	--	Rehab		--	--	--	$ 117,300	2028
Lift Station	--	--	Rehab		--	--	--	$ 117,300	2029
Lift Station	--	--	Rehab		--	--	--	$ 117,300	2030
Lift Station	--	--	Rehab		--	--	--	$ 586,500	2031-2035
Lift Station	--	--	Rehab		--	--	--	$ 586,500	2036-2040
Lift Station	--	--	Rehab		--	--	--	$ 586,500	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

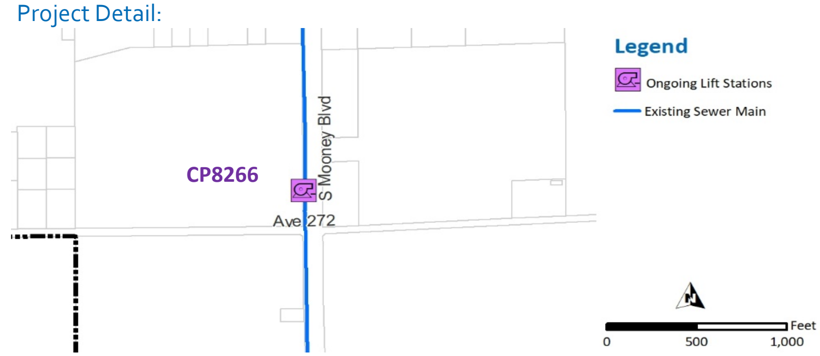
Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	100%	$ 2,463,000
Future Users	0%	$ -
Total	100%	$ 2,463,000

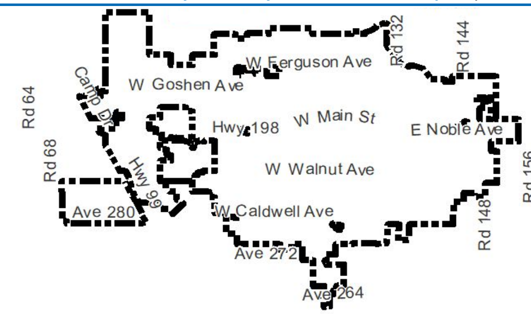
Notes on Cost Estimation:

This project will address existing deficiencies, therefore the project is assigned to existing users.

Project Detail:



Project Number: CP0324
Project Name: Sanitary Pump Replacement
System Type: Sanitary Sewer Collection System



Project Description:

The annual project will provide for replacement of sanitary sewer lift station pumps with greater efficiency. Pumps will be replaced once life expectancy has been exceeded.

Project Details:

Project Element	Existing Total Capacity (mgd)	Proposed Total Capacity (mgd)	Replace/ New	No. of Pumps (Units)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Lift Station	--	--	Rehab		--	--	--	$ 175,900	2027
Lift Station	--	--	Rehab		--	--	--	$ 175,900	2028
Lift Station	--	--	Rehab		--	--	--	$ 175,900	2029
Lift Station	--	--	Rehab		--	--	--	$ 175,900	2030
Lift Station	--	--	Rehab		--	--	--	$ 879,500	2031-2035
Lift Station	--	--	Rehab		--	--	--	$ 879,500	2036-2040
Lift Station	--	--	Rehab		--	--	--	$ 879,500	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

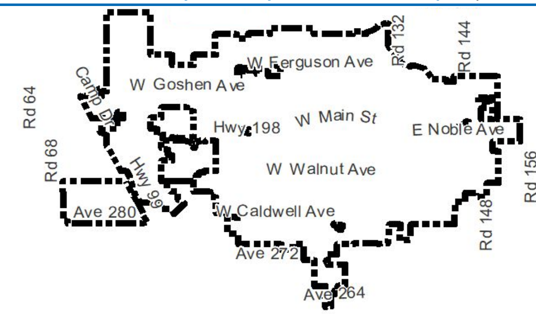
Reimbursement Category	Percent	Cost ($)
Existing Users	50%	$ 1,671,000
Future Users	50%	$ 1,671,000
Total	100%	$ 3,342,000

Project Detail:

Notes on Cost Estimation:

This project will convey existing flows and future flows, cost was split between existing and future users.

Project Number: CP9228
Project Name: Sewer Lateral Connection/Replacement/Installation
System Type: Sanitary Sewer Collection System



Project Description:
The annual project will provide customer requested hookups to the sanitary sewer. Cost are reimbursed by property owner.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost[1] ($)	Estimated Construction Cost[2] ($)	Capital Improvement Cost[3] ($)	Project Schedule
Gravity Main	-	-	New	-	-	-	-	$ 58,600	2027
Gravity Main	-	-	New	-	-	-	-	$ 58,600	2027
Gravity Main	-	-	New	-	-	-	-	$ 58,600	2027
Gravity Main	-	-	New	-	-	-	-	$ 58,600	2027
Gravity Main	-	-	New	-	-	-	-	$ 293,000	2031-2035
Gravity Main	-	-	New	-	-	-	-	$ 293,000	2036-2040
Gravity Main	-	-	New	-	-	-	-	$ 293,000	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	0%	$ -
Future Users	100%	$ 1,113,000
Total	100%	$ 1,113,000

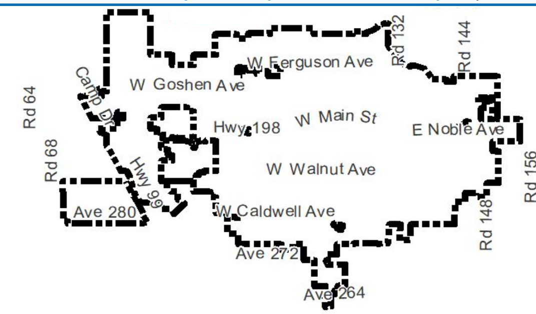
Project Detail:

Notes on Cost Estimation:
Project will address future users, therefore 100-percent of cost is assigned to future users.

Project Number: CP0580

Project Name: Sanitary Sewer Maintenance Access Repairs Citywide

System Type: Sanitary Sewer Collection System



Project Description:

The annual project will repair and raise manholes throughout the City sanitary sewer system. The project is budgeted to allow for replacement of one brick and mortar manhole per year.

Project Details:

Project Element	Existing Diameter (in)	Proposed Diameter (in)	Replace/ New	Length (ft)	Unit Cost ($)	Baseline Construction Cost(1) ($)	Estimated Construction Cost(2) ($)	Capital Improvement Cost(3) ($)	Project Schedule
Gravity Main	-	-	New	-	-	-	-	$ 29,300	2027
Gravity Main	-	-	New	-	-	-	-	$ 29,300	2028
Gravity Main	-	-	New	-	-	-	-	$ 29,300	2029
Gravity Main	-	-	New	-	-	-	-	$ 29,300	2030
Gravity Main	-	-	New	-	-	-	-	$ 146,500	2031-2035
Gravity Main	-	-	New	-	-	-	-	$ 146,500	2036-2040
Gravity Main	-	-	New	-	-	-	-	$ 146,500	2041-2045

Notes:

(1) ENR 20 City Average Construction Cost Index for March 2025 is 13,782.

(2) Estimated Construction Cost includes a 30% contingency of the baseline construction cost.

(3) Total project costs includes a 10% markup for engineering, a 10% markup for construction management and a 7.5% markup for project administration of the estimated construction cost.

Project Cost Allocation:

Reimbursement Category	Percent	Cost ($)
Existing Users	50%	$ 278,000
Future Users	50%	$ 278,000
Total	100%	$ 556,000

Project Detail:

Notes on Cost Estimation:

Project will address existing and future deficiencies, therefore the cost is split between existing and future users.