CITY OF
Grand Junction
COLORADO

2020 Comprehensive
WASTEWATER BASIN STUDY UPDATE

FINAL | June 2021

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CITY OF
Grand Junction
COLORADO

2020 Comprehensive
WASTEWATER BASIN STUDY UPDATE

FINAL | June 2021

COLORADO REGISTERED
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6/10/21
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Abbreviations

2008 WW Basin Update	2008 Comprehensive Wastewater Basin Study Update
2020 Comprehensive Plan	One Grand Junction 2020 Comprehensive Plan
2020 Master Plan	2020 Wastewater Facilities Master Plan
2020 WW Basin Update	2020 Comprehensive Wastewater Basin Study Update
AACE	AACE International
AEG	Ashton Engineering Group
BCC	baseline construction cost
Carollo	Carollo Engineers
CCC	construction cost contingency
CCTV	closed-circuit television
CIP	capital improvement plan
CIPP	cured-in-place pipe
City	City of Grand Junction
City Standard Specifications	City Standard Contract Documents for Capital Improvements Construction
CIWEM	Chartered Institution of Water and Environmental Management
CGVSD	Central Grand Valley Sanitation District
d/D	flow depth to pipe diameter (ratio)
DIP	ductile iron pipe
DWF	dry weather flow
ECC	estimated construction cost
ELA	engineering, legal, and administrative costs for implementing project
ENR CCI	Engineering News Record Construction Cost Index
ft/sec	feet per second
GIS	geographic information system
gpcd	gallons per capita per day
gpd	gallons per day
I-70	Interstate 70
I/I	infiltration and inflow
lf	linear feet
MG	million gallons
mgd	million gallons per day
OHP	contractor overhead, profit, insurance, bonds, etc.
OMSD	Orchard Mesa Sanitation District
PE	population equivalent
PVC	polyvinyl chloride

q/Q	peak flow to design capacity (ratio)
R&R	rehabilitation and replacement
RCP	reinforced concrete pipe
RDII	rainfall dependent infiltration and inflow
SCADA	supervisory control and data acquisition
SID	sewer improvement district
SSEP	Sewer System Elimination Program
TAZ	Traffic Analysis Zone
UDB	Urban Development Boundary
UDG	Urban Drainage Group
VCP	vitrified clay pipe
WFO	Walker Field Airport
WWF	wet weather flow
WWTP	wastewater treatment plant

2020 Comprehensive Wastewater Basin Study Update

Executive Summary

The City of Grand Junction's (City) Utilities Department jointly owns and operates the Persigo Wastewater Sewer System with Mesa County. The City is responsible for operating this system, which includes all of the regional wastewater collection and treatment facilities that serve the 201 Service Area.

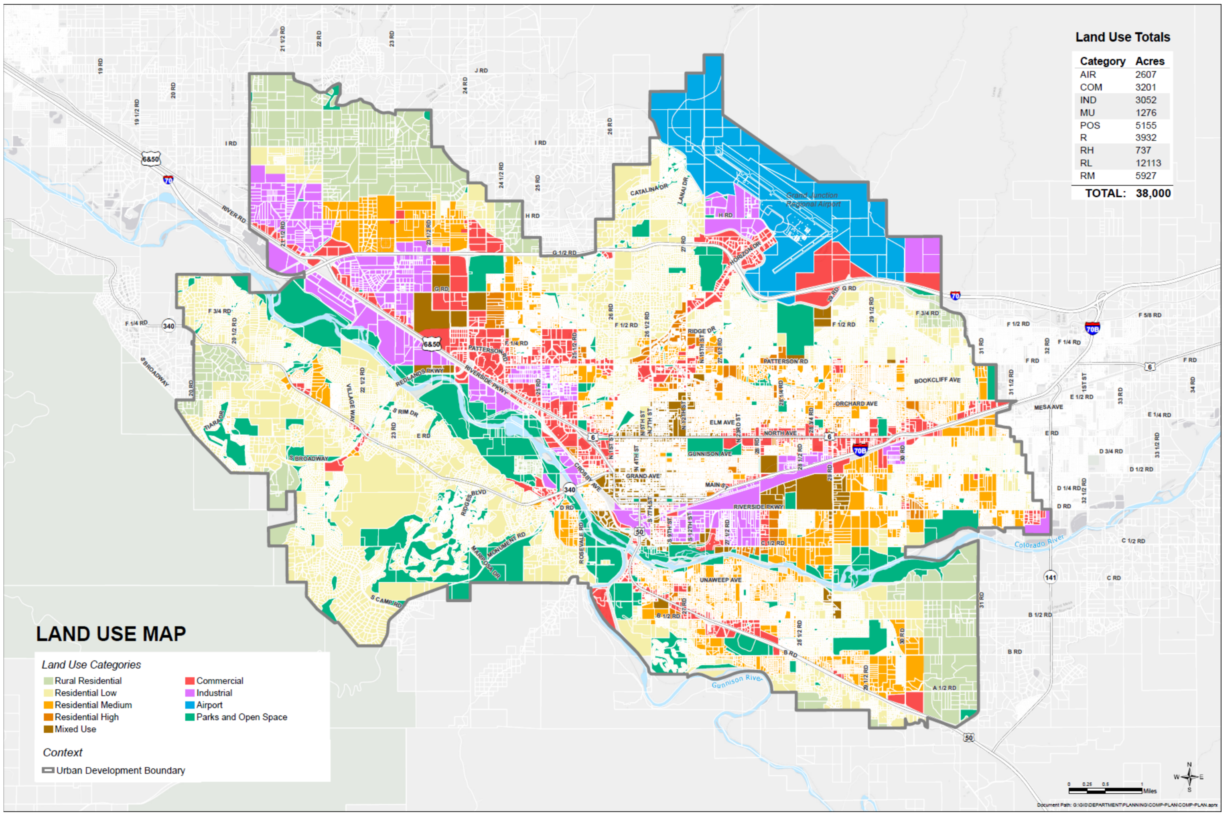
This *2020 Comprehensive Wastewater Basin Study Update* (2020 WW Basin Update) builds off the *2008 Comprehensive Wastewater Basin Study*, focusing updates and recommendations on the following three project areas used to organize the City's capital improvement plan (CIP):

- Conveyance capacity.
- Asset revitalization.
- Operational optimization.

This update modeled existing and future wastewater flows within the 201 Service Area's boundary and urban development boundary (UDB). Wastewater flows were projected through the 2040 planning horizon, consistent with the projections and land use developed as part of the City's *2020 Comprehensive Plan* (Figure ES.1).

Wastewater Collection System At-A-Glance:

- 584 miles of sewer pipes.
- 26 lift stations.
- Serves population of approximately 100,000.



Land Use Totals

Category	Acres
AIR	2607
COM	3201
IND	3052
MU	1276
POS	5155
R	3932
RH	737
RL	12113
RM	5927
TOTAL:	**38,000**

Figure ES.1 2020 Comprehensive Plan Land Use

The 2020 WW Basin Update identifies key infrastructure within the wastewater collection system, such as interceptors and lift stations, that are needed to serve the anticipated growth projections for future land uses and confirm that these facilities meet capacity demands, as well as current and future statutory requirements, as the City prepares to reinvest in their rehabilitation and replacement.

Capacity Improvements

Utilizing the City's UDB, the hydraulic capacity analysis evaluated the growth within the 201 Service Area and identified areas that require capacity expansions to overcome existing constraints.

Population Growth

Projected population growth within the 201 Service Area matched projections made in the City's *2020 Comprehen*sive Plan. Figure ES.2 illustrates the projected growth rate of 1.1 percent for the 20-year planning period.

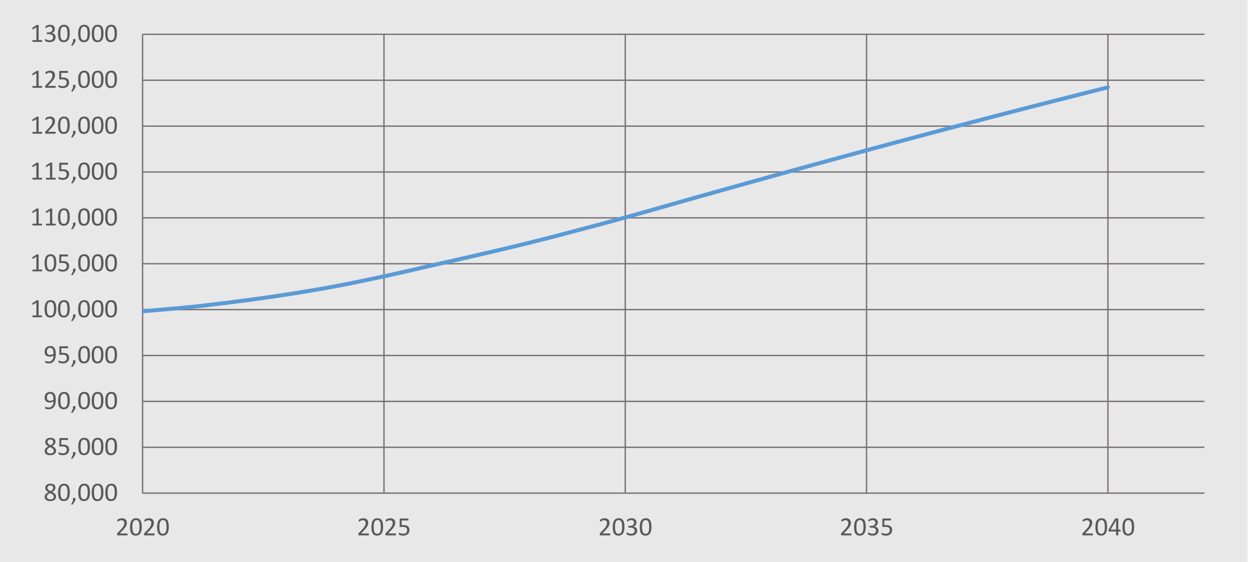


Figure ES.2 Service Area Population Growth

Hydraulic Modeling

A hydraulic model was developed using the City's geographical information system (GIS) and its infrastructure data for sewer pipes 10 inches and larger in diameter. After being calibrated using flow measurement data, survey data, and engineering assumptions, the model was employed to evaluate current and future system hydraulics and to identify potential CIP projects.

Capacity Improvement Areas

According to 2040 modeling results, 12 percent of the City's wastewater collection system has capacity constraints. Capacity improvements were identified, estimated, and included in the CIP for the following four key areas as shown in Figure ES.3:

- River Road North.
- Orchard Mesa.
- Fruitvale.
- Central Grand Valley Sanitation District.

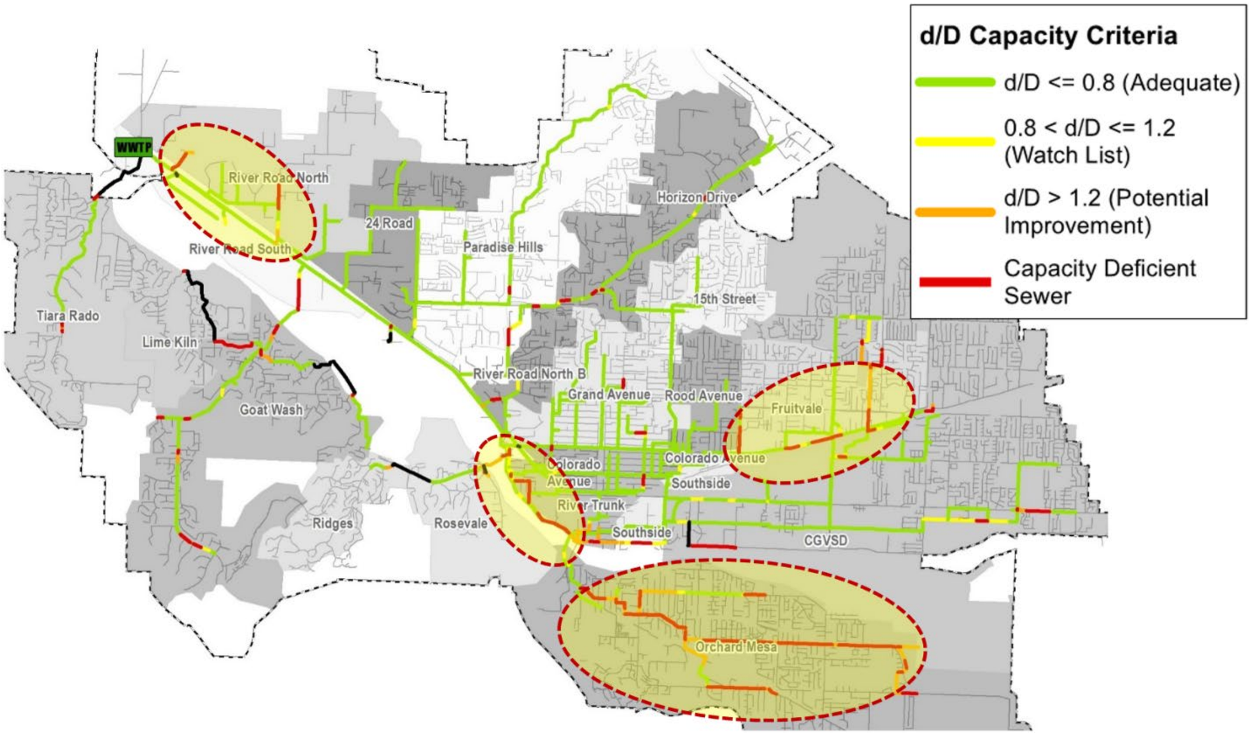


Figure ES.3 Capacity Deficiency Overview

Sewer System Extensions

This update also evaluated anticipated sewer extension projects to serve future customers. System extensions were classified into one of the following two categories.

- **Developer extensions**: Sewers constructed to serve a single development area and funded exclusively by developers. Not included in the City's CIP.
- **Trunk extensions**: Sewers constructed to serve multiple development areas within the City and the costs of which are shared by the City and developers.

Projects that require trunk extensions within the 2040 planning period were included in the City's CIP.

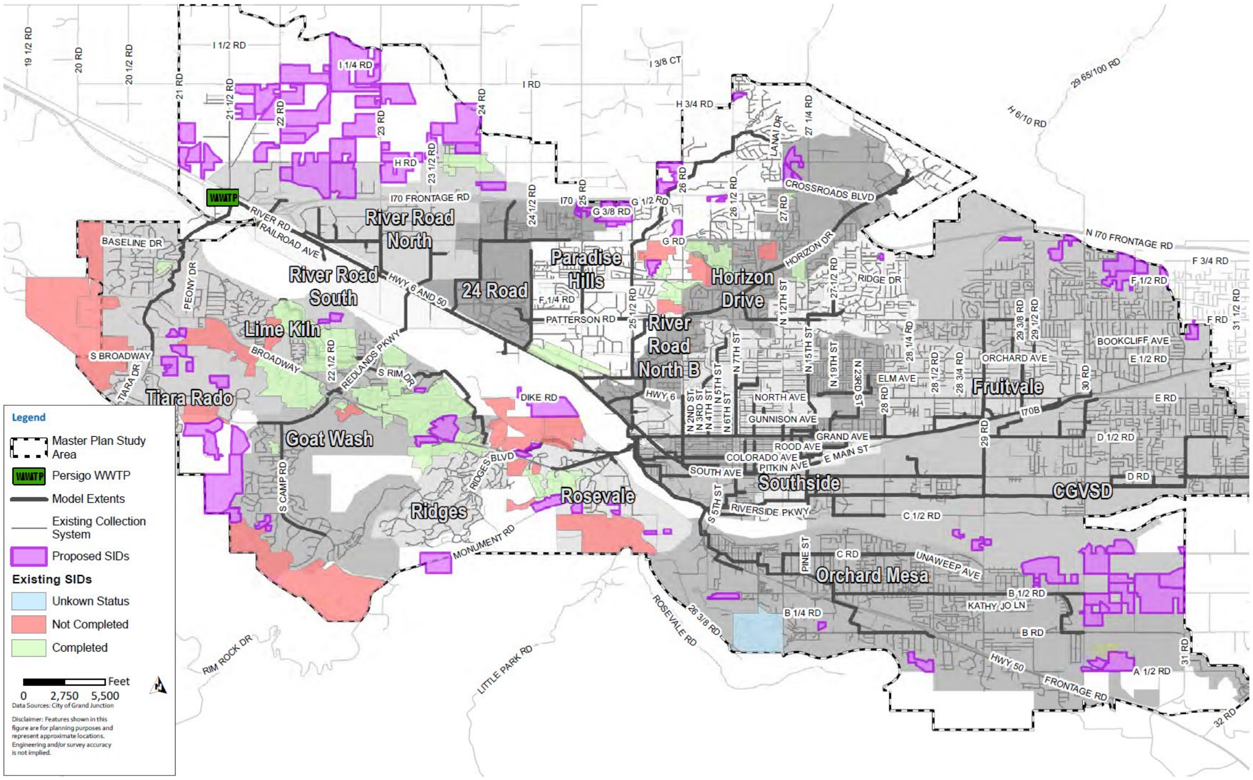
Septic System Elimination Program

The City has a goal to eliminate septic systems within the service area, and to replace them with connections to the City's wastewater collection system. As shown in Figure ES.4, the 2020 WW Basin Update identified a total of 1,555 septic systems. There are 1,046 septic systems identified in existing or proposed Sewer Improvement Districts (SID) that could be removed. The City has allocated up to $1 million annually to encourage and partially fund the elimination of existing septic systems within an existing or proposed SID. At this funding rate, program completion is anticipated at 17 years, although this timeline depends on property owners' willingness to abandon their septic systems and connect to City sewer service.

Asset Revitalization Program

Asset Management Program

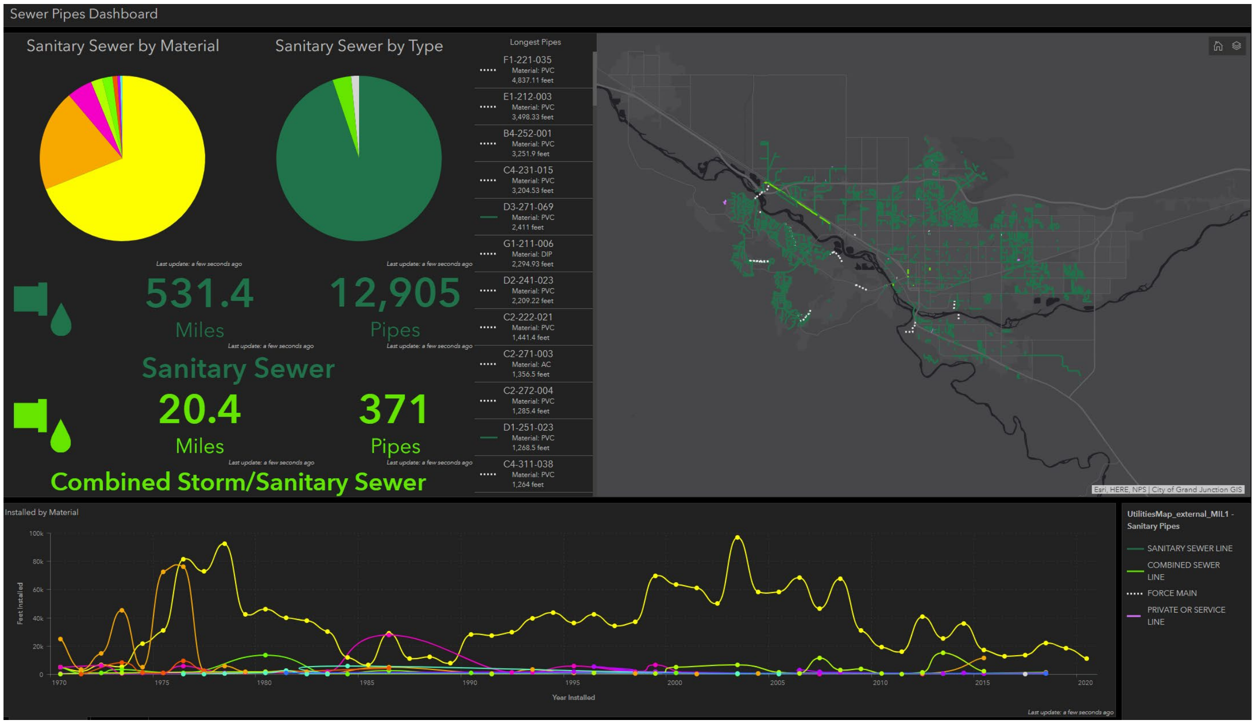
The City has developed a robust and comprehensive GIS database for all assets within their wastewater collection system. This information has been integrated with the City's asset management system, Lucity, to project future requirements for infrastructure asset rehabilitation and replacement. Dashboards from the City's Lucity asset management system illustrate and monitor the City's progress on rehabilitation and replacement of aging pipelines as shown in Figure ES.5.



Data Sources: City of Grand Junction

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure ES.4 Proposed Sewer Improvement District Overview


Sewer Pipes Dashboard

Sanitary Sewer by Material

Sanitary Sewer by Type

Longest Pipes

F1-221-035
Material: PVC
4,837.11 feet

E1-212-003
Material: PVC
3,498.33 feet

B4-252-001
Material: PVC
3,251.9 feet

C4-231-015
Material: PVC
3,204.53 feet

D3-271-069
Material: PVC
2,411 feet

G1-211-006
Material: DIP
2,294.93 feet

D2-241-023
Material: PVC
2,209.22 feet

C2-222-021
Material: PVC
1,441.4 feet

C2-271-003
Material: AC
1,356.5 feet

C2-272-004
Material: PVC
1,285.4 feet

D1-251-023
Material: PVC
1,268.5 feet

C4-311-038
Material: PVC
1,264 feet

Sanitary Sewer

531.4 Miles

12,905 Pipes

Combined Storm/Sanitary Sewer

20.4 Miles

371 Pipes

Last update: a few seconds ago

Installed by Material

Figure ES.5 Screen Shot of City's Sanitary Sewer Pipe Asset Management System

Pipeline Replacement Program

In 2016, the City initiated a program to replace high-priority pipelines according to their condition (assessed via video observations), age, material, and size. At this time, approximately 904,000 linear feet of the City's approximately 3,015,000 linear feet of piping are slated for rehabilitation or replacement (R&R). The City annually prioritizes these revitalization needs along with capacity improvement projects and other City efforts, such as road overlays. The City's pipeline inventory was used to identify the pipe materials and age to allocate funds for pipeline R&R. Replacement projects focused on removing vitrified clay pipe (VCP), unknow pipe materials, reinforced concrete pipe (RCP), truss pipe, ductile iron pipe (DIP), and steel pipe. Figure ES.6 summarizes the pipe materials for the entire collection system.

In 2021, $4.5 million was allocated to fund these replacements. This figure will be escalated annually.

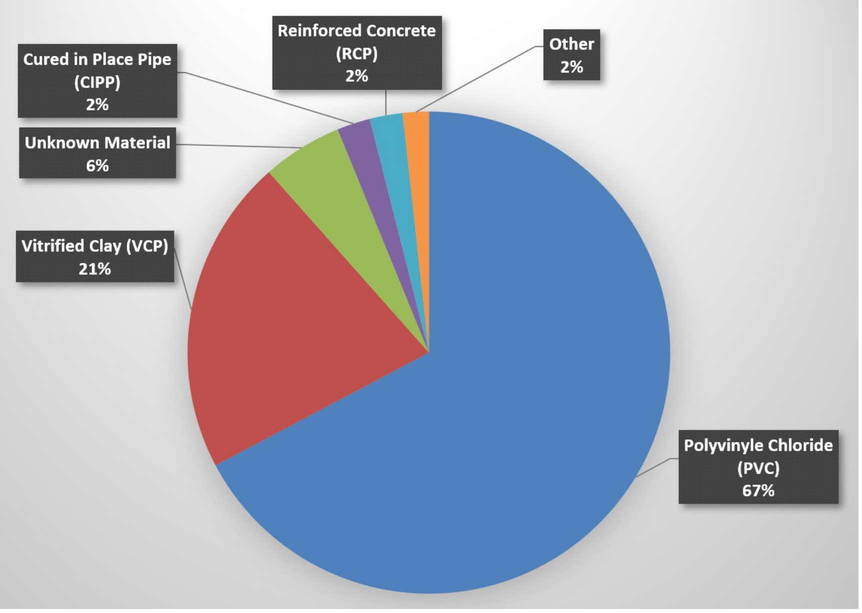


Figure ES.6 Summary of Existing Collection System Pipe Materials

Capital Implementation Plan

The CIP allocates funding for infrastructure improvements through 2040 according to the three project categories described thus far. The total costs for the 20-year CIP, as shown in 2020 dollars, equals a total of $172.0 million for all project types as shown in Figures ES.6.

Annual allocations of expenditures were determined according to system needs and priority order of the improvements. Table ES.7 illustrates the estimated annual expenditures from 2021 through 2030 in 2020 dollars, which equals $90.0 million.

As new information and system data become available, the City is recommended to evaluate each year's projects on an annual basis and to update their implementation plan.

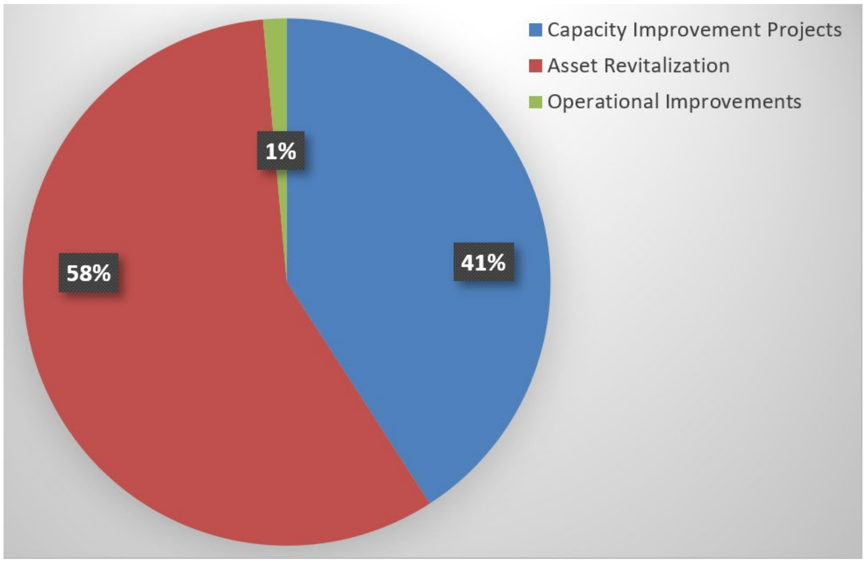


Figure ES.7 20-Year CIP by Project Category

Table ES.1 10-Year Collection System (2020 $ shown in millions)

2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
$8.0M	$8.6M	$11.5M	$9.9M	$10.3M	$8.3M	$8.3M	$8.3M	$8.3M	$8.3M

Figure ES.8 compares the 2020 WW Basin Update's projects against the City's 2021 budget for wastewater collection system's improvements. Compared to the budget, the 2020 WW Basin Update identifies $18.4 million more in funding needs over the next 5 years. Given the capacity constraints identified by the hydraulic model, further flow monitoring should be completed over the next two years to refine the timing of these capacity improvement projects. and updated.

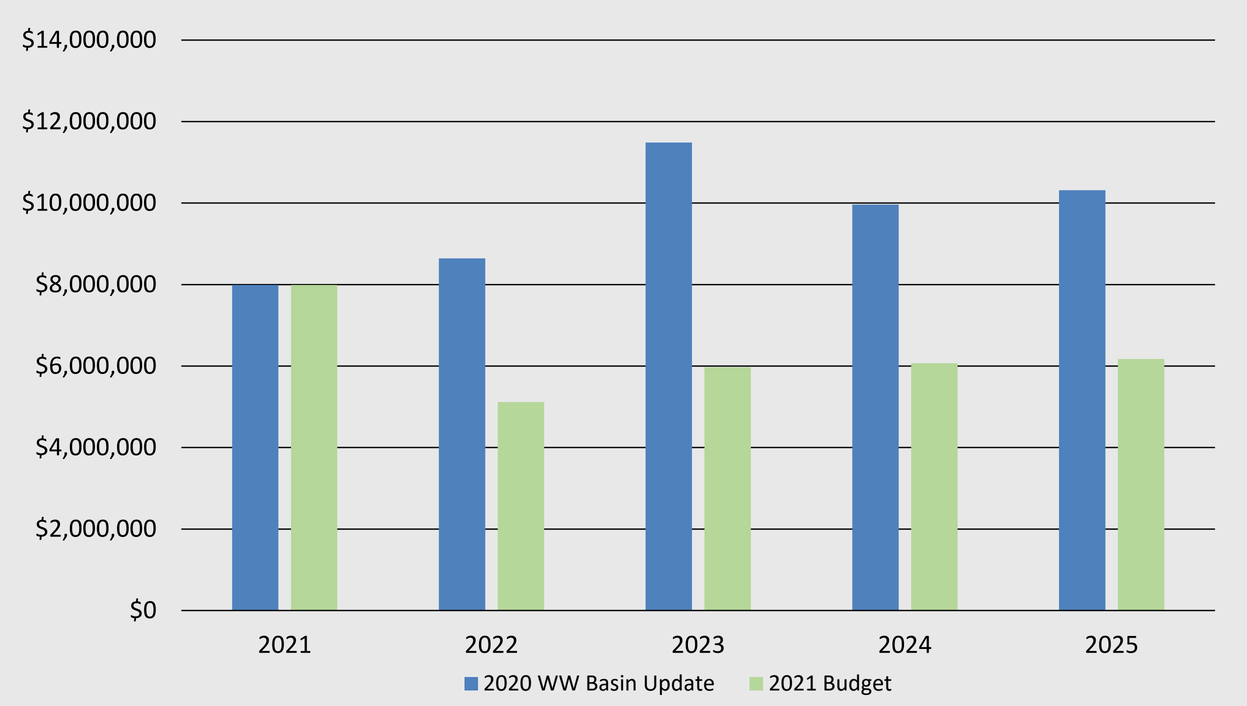


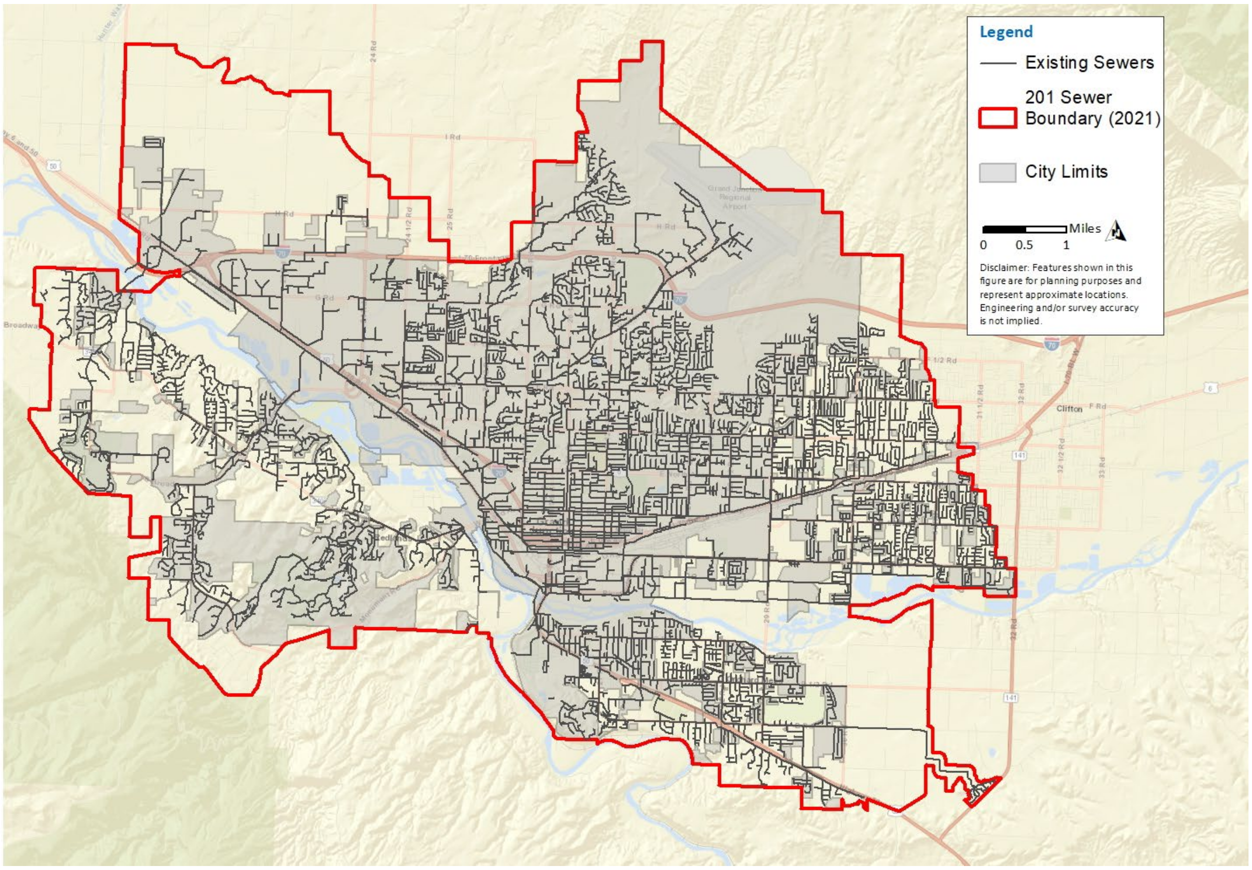
Figure ES.8 5-Year CIP Spending Comparison (Collection System)

Chapter 1

PROJECT BACKGROUND

1.1 Introduction

The City of Grand Junction (City) Utilities Department jointly owns and operates the Persigo Wastewater Sewer System with Mesa County, with the City as the responsible party for operation of the system. The system includes regional wastewater collection and treatment facilities that generally serve the City. These facilities are designed to service the 201 Service Area, which generally includes all of Grand Junction. The collection system includes 584 miles of active sanitary sewer lines ranging from 4 inches to 54 inches in diameter and 26 lift stations. A map of the sanitary collection system service area is included in Figure 1.1.



Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure 1.1 Study Area Boundary

This 2020 Comprehensive Wastewater Basin Study Update (2020 WW Basin Update) summarizes the following:

- Collection system flow monitoring.
- Construction and calibration of the updated collection system hydraulic model.
- Update to the wastewater basin boundaries, flow criteria, and peaking factors for the collection system.
- Existing and future system hydraulic evaluations including capacity limitations and service area extensions.
- Review of the City's Septic System Elimination Program (SSEP).
- Identifying collection system infrastructure requirements and costs through the 2040 planning period within the study area.

Some of the significant changes to the collection system since the last study are documented below:

- Lining of the south side interceptors.
- Tiara Rado Force Main Replacement Project (ongoing).
- Power Road Lift Station Project (ongoing).
- Additional connections along the 23 Road Extension (ongoing).
- Eliminated the River Bend Lift Station in 2020.

1.2 Previous Comprehensive Wastewater Basin Study Update

Previous master planning efforts are detailed below. These provide the basis for comparison and understanding previous infrastructure planning efforts.

In 2009, Black & Veatch completed the City's 2008 Comprehensive Wastewater Basin Study (2008 WW Basin Update). This study provided a planning document for the City's sanitary collection system through the year 2035. A majority of the information from the 2008 study was derived from or used as the basis for this 2020 WW Basin Update, which is discussed in the subsequent sections. Some of the key elements of the 2008 study included the following:

- Update to the basin boundaries, flow criteria, and collection system facilities.
- Development of a hydraulic model.
- Capital improvement plan (CIP) through year 2035.

Some of the significant changes to the collection system that were documented in the 2008 WW Basin Update included the following:

- Extending service to the Panorama Improvement District, which was located in the Tiara Rado basin.
- Extending the Orchard Mesa boundary to the south, east, and north to the edge of the 201 Service Area boundary.
- Replacement of the Duck Pond lift station with a gravity line.
- Dissolution of the Fruitvale Sanitation District on January 1, 2009, and conveyance of flows to the Persigo Wastewater Treatment Plant (WWTP).
- Replacement of the Scenic School and Redlands Parkway lift stations with the Connected Lakes lift station.

In 1992, HDR Engineering developed the original Comprehensive Wastewater Basin Study which documented the City's 201 Service Area and collection system infrastructure that would be needed to serve the City and areas of Mesa County.

In 1997, HDR Engineering updated the 1992 Comprehensive Wastewater Basin Study to reflect changes in the area north of Interstate 70 (I-70). This plan updated the population and employment values for the City based on current City comprehensive plans.

1.3 Planning Objectives, Goals, Period

This 2020 WW Basin Update is intended to develop a roadmap for achieving resiliency and reliability in meeting the wastewater collection, conveyance, and treatment needs of users within the 201 Service Area. The 2020 WW Basin Update will identify the collection system infrastructure, such as interceptors, lift stations, and other facilities needed to serve the anticipated growth projections for future land uses identified in the One Grand Junction 2020 Comprehensive Plan (2020 Comprehensive Plan). Additionally, the 2020 WW Basin Update will identify the facilities needed to meet the current and future statutory requirements while reinvesting in asset revitalization and replacement.

Consistent with these overarching goals, the following additional objectives were established for the 2020 WW Basin Update project. The main objectives are to:

- Protect the health and safety of the community and City employees.
- Be protective of and provide benefit to all environmental media (water, air, land).
- Ensure infrastructure is in service to connect all existing properties and meet future development needs.
- Manage risk and extend the life of existing assets through critical asset revitalization.
- Demonstrate fiscal responsibility.
- Demonstrate leadership by providing innovative solutions for future management, operation, and maintenance of the wastewater system while addressing issues of regional importance.

1.4 Planning Period

This 2020 WW Basin Update recommends several improvements to the City's collection system infrastructure through the 2040 time period for its 201 Service Area boundary. These improvements include the construction of additional facilities within specific tributary areas of the wastewater service area to mitigate identified existing system deficiencies and respond to growth. Prioritizing these improvements will be based on development projections determined by City planners as well as needs identified from the condition assessment.

1.5 Report Organization

This report includes the following chapters.

Executive Summary

Chapter 1 – Introduction. This chapter provides background of this report and the history of the previous wastewater basin updates.

Chapter 2 – Planning Area Characteristics. This chapter summarizes the 2020 WW Basin Update area, population projections, and land use.

Chapter 3 – Flow Monitoring Program. This chapter summarizes the flow monitoring program that was implemented as part of this 2020 WW Basin Update.

Chapter 4 – Collection System Facilities and Hydraulic Model. This chapter summarizes how the collection system was constructed and calibrated.

Chapter 5 – Planning Criteria and Design Flows. This chapter summarizes the planning (flow/design) criteria that were used to evaluate the sewer system for the existing and future conditions.

Chapter 6 – Capacity Evaluation and Proposed Improvements. This chapter summarizes the capacity evaluations, capacity improvements, and other studies/projects evaluated as part of this study.

Chapter 7 – Capital Improvement Plan. This chapter defines the CIP sequencing and illustrates the schedule for the various projects.

Chapter 2

PLANNING AREA CHARACTERISTICS

2.1 Study Area Overview

The Persigo WWTP and collection system service area is defined by the 201 Service Area boundary, which was used for hydraulic modeling in the 2008 WW Basin Update. As part of the City's 2020 Comprehensive Plan, the City proposed to modify the 201 Service Area boundary to include portions of the Urban Development Boundary (UDB). The primary modifications occurred in the northwest corner and in the southeast corner for the service area. This boundary was also coordinated with the Clifton Sanitation District to avoid extension of the boundary into Clifton's current or proposed service area. As of April 2021, the boundary modifications were pending final agency approval.

The Master Plan Study Area (Study Area) was identified at the beginning of the project to generally align with the 2020 Comprehensive Plan boundary. This included encompassing the revised 201 Service Area boundary, and portions of the UDB. This approach provides a more conservative assessment of the collection system hydraulic capacity. This boundary will serve as the basis for population, flow, and loading projections, for the 2020 WW Basin Update. The gross acreage included in the study area is 42,106 acres.

Modifications to the UDB and 201 Service Area boundary were proposed for agency approval in early 2021. As a result, the Study Area boundary in the 2020 WW Basin Update does not align with these revised boundaries in all locations. Due to the timing of the proposed changes to the UDB and 201 Service Area boundary, the Study Area was not modified. The UDB, Study Area, and 201 Service Area boundary are illustrated in Figure 2.1.

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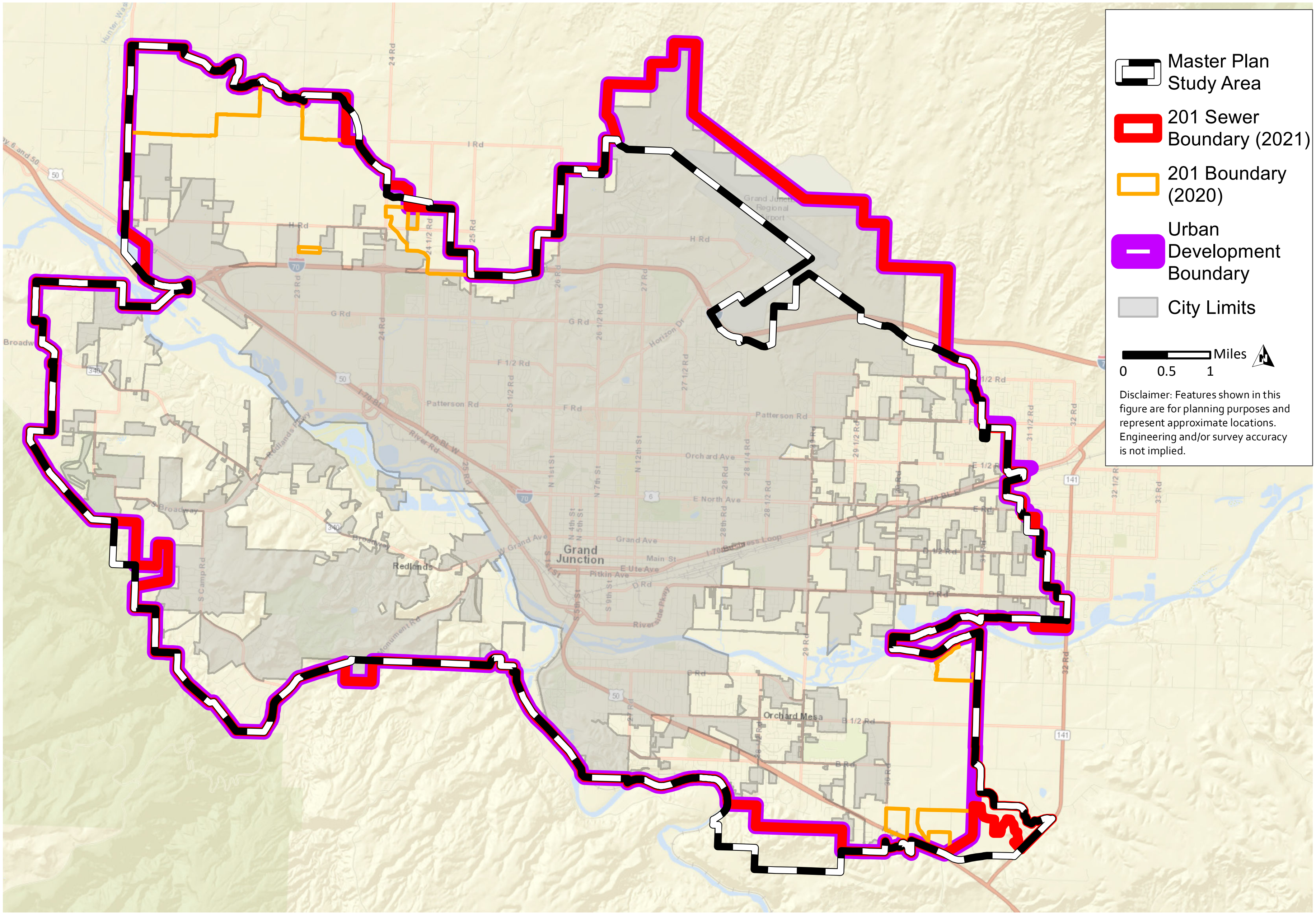

Figure 2.1 Study Area Boundary

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2.1.1 Existing Service Area

The existing collection service area includes the entire 201 Service Area boundary. This service area was divided into 20 sub-sewer basins, as established in the 2008 WW Basin Update. The existing service area and sewer basins are listed in Table 2.1 and illustrated in Figure 2.2. These basins were used to classify and define areas within the collection system, and generally corresponded to the interceptor or lift station serving each basin. Since the 2008 WW Basin Update, the Orchard Mesa Sanitation District (OMSD) and the Central Grand Valley Sanitation District (CGVSD) were incorporated into the service area and added as sewer basins.

Table 2.1 Sewer Basin Summary

Basin	Area, acre(1)	Total Area,%
15th Street	715	2%
24 Road	989	3%
CGVSD	7,820	23%
Colorado Avenue	322	1%
Fruitvale	1,248	4%
Goat Wash	2,869	8%
Grand Avenue	1,358	4%
Horizon Drive	1,677	5%
Lime Kiln	805	2%
OMSD	4,780	14%
Paradise Hills	2,960	9%
Ridges	644	2%
River Road North	1,865	6%
River Road North B	390	1%
River Road South	848	3%
River Trunk	638	2%
Rood Avenue	442	1%
Rosevale	1,087	3%
Southside	236	1%
Tiara Rado	2,175	6%

Notes:
(1) Areas based on total gross area within each sewer basin. Total acreage = 33,868.

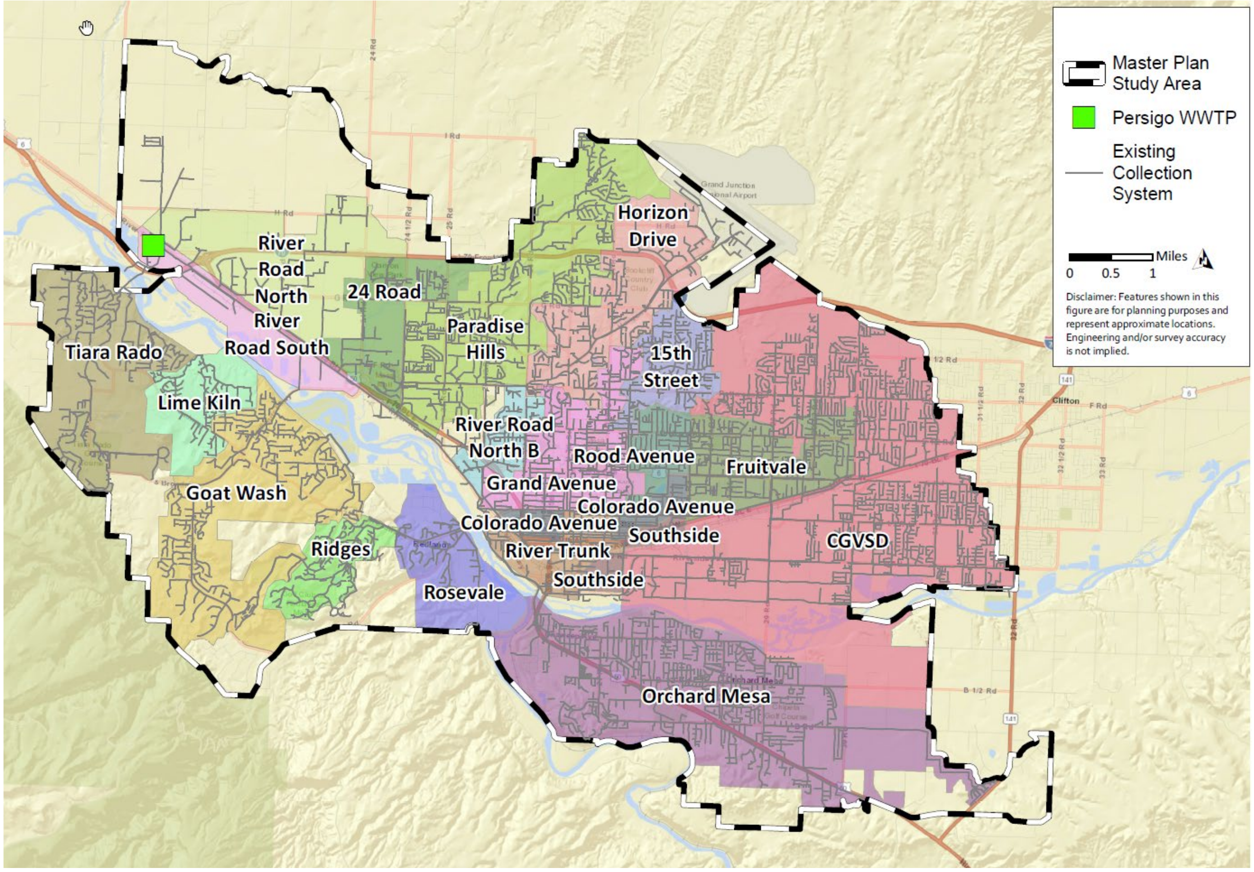

Figure 2.2 Existing Service Area

2.1.2 Growth or Service Extension Areas

As illustrated in Figure 2.2, there are areas within the 2020 WW Basin Update that are not developed. As part of this 2020 WW Basin Update, service extensions to these areas were evaluated. The extensions were designed to extend service to the entire study area. The City tracks where recent development has occurred to identify development hot spots, and where extensions may be needed in the near future. Figure 2.3 illustrates the recent development that City Planning has identified. As shown in Figure 2.3, the OMSD, 24 Road, and Paradise Hills basins have seen the most growth in the last few years. Also, through discussions with City Planning, the following development trends were noted.

- Future land use by neighborhood:
  - Lower Downtown: Developers are trending towards mixed use with residential.
  - Redlands Area: Low residential with a few neighborhood center areas.
  - OMSD: Some densification that will include low/medium residential.
  - Pear Park (CGVSD – south of I-70): New development will include medium and low residential.
  - Fruitvale: New development will include medium and low residential.
  - 25-29 Road, 10 square miles of "Downtown":
    - Densification will occur.
    - More apartment buildings on North Avenue.
    - Commercial allows for multi-family up to 24 units per acre; the City will encourage development in this zone because the City has ample commercial area.

- Overall, the goal of future land use is to encourage development and infill in the City boundary. The north and south "rural" areas were established using growth tiers to promote infill and redevelopment, and to prevent sprawl.
  - North: H 1/4 Road to I Road (north is rural/greater than 5-acre lots) south of that area is "urban."
  - South: 30 1/4 Road to 31 Road (east boundary) (east is rural/greater than 5-acre lots) west of that area is "urban."

In addition to the extensions, infill/redevelopment within the current service area were evaluated. This included identifying existing parcels that are served by septic systems, and how they can be connected to the collection system.

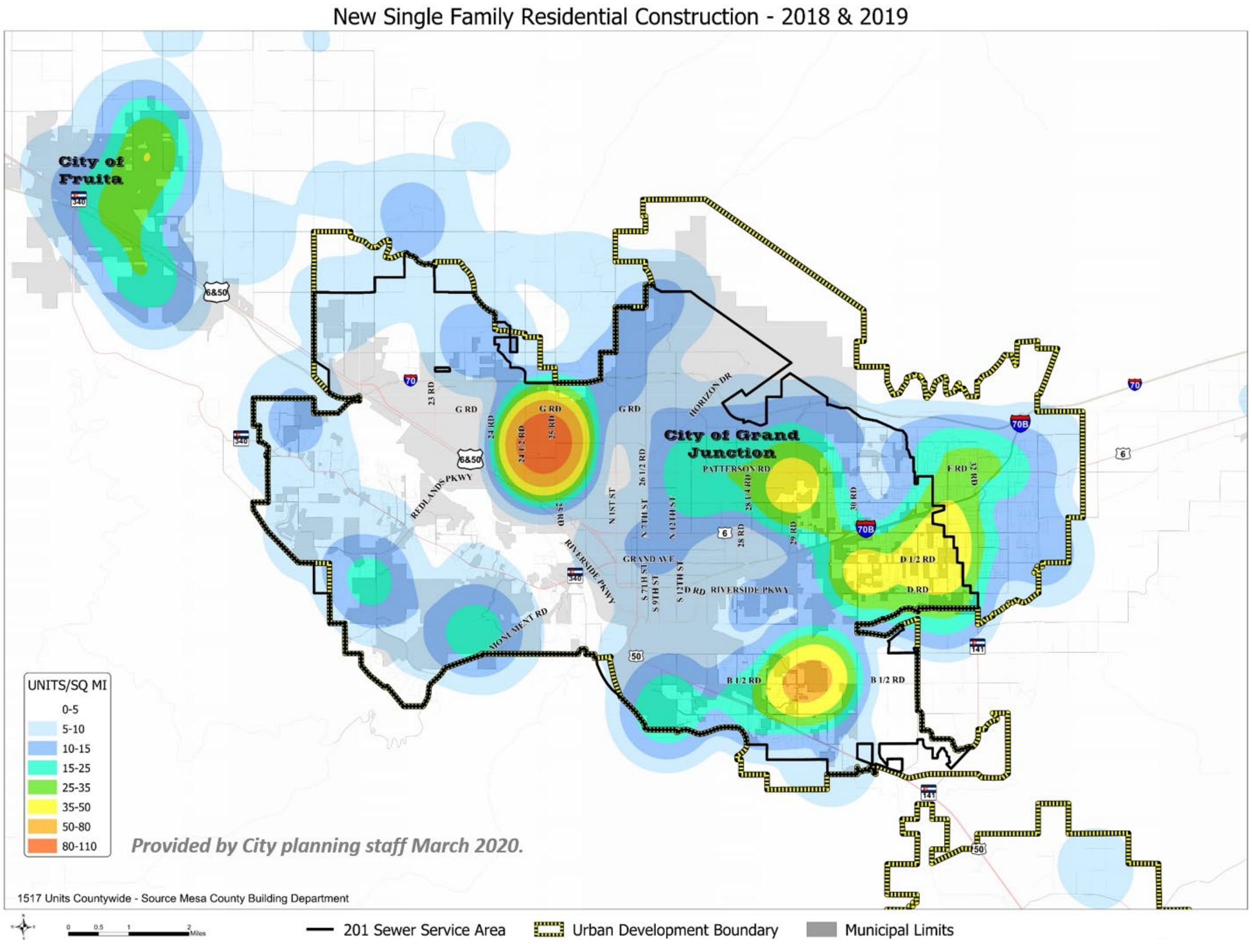

Figure 2.3 Development Hot Spot Overview

2.2 Climate and Topography

The climate in Grand Junction is particularly mild and less variable than most of Colorado. Table 2.2 summarizes the monthly and annual average maximum and minimum temperatures and precipitation data for Grand Junction. The topography varies near Grand Junction, as it is bisected by the Colorado River. Near the river, the topography is fairly flat but slopes upwards to the mesas and mountains that are located outside of town. The Colorado River flows from east to west on the southerly side of Grand Junction. The confluence with the Gunnison River (flows southeast to northwest) is located in the southern portion of the City.

Table 2.2 City of Grand Junction Climate Summary

Month	Maximum Temperatue, °F(2)	Minimum Temperatue, °F(2)	Average Total Precipitation, inch(2)	Average Percent of Total Precipitation
January	36.6	15.9	0.59	7%
February	44.6	23.3	0.57	7%
March	55.2	31.2	0.81	9%
April	65.2	39.2	0.79	9%
May	75.6	48.2	0.79	9%
June	87.0	57.2	0.44	5%
July	92.9	64.1	0.62	7%
August	89.5	62.0	0.98	11%
September	80.7	53.0	0.95	11%
October	67.3	41.0	0.91	10%
November	51.2	28.3	0.63	7%
December	38.9	18.6	0.59	7%
Annual	65.4	40.2	8.67	-

Notes:

(1) Data obtained from Western Regional Climate Center website for the Walker Field weather station. https://wrcc.dri.edu/cgi-bin/cliMAIN.pl?co3488

(2) Average based on data from 1/1/1900 through 6/9/2016.

2.3 City Trends for Water Supply

Within the 201 Service Area boundary, there are three water treatment/distribution utilities that provide drinking water. These include the City of Grand Junction, Clifton Water District, and Ute Water Conservancy District. Each utility has separate water sources. The City uses the Kannah Creek watershed as a primary source, Clifton Water will continue with Colorado River treated by a membrane plant, and Ute Water will continue with Plateau Creek and Colorado River as backup. For the planning period, it was anticipated all sources will be viable, and will not adversely impact the collection system flows or overall water quality.

2.4 Land Use and Land Use Criteria

Land use information was integral for understanding the current and future population and employment projections. As part of the 2020 Comprehensive Plan, the future land use categories were redefined. The updated categories were used in this 2020 WW Basin Update to provide consistency with the 2020 Comprehensive Plan.

2.4.1 Existing Land Use

The existing land-use mapping was compared to the future land use data to identify locations of infill and redevelopment, such as vacant properties being converted to multi-unit dwellings. The hydraulic modeling and infrastructure planning further evaluated those identified areas by sewer basin boundary. The existing land use types are summarized below in Table 2.3. An overview of the existing land use included within the existing service area is included in Figure 2.4.

Table 2.3 Existing Land Use Summary

Land Use Category	Area, acre(1)	Percent of Total
Agriculture	5,785	16.0%
Single-Family Detached	14,144	39.1%
Single-Family Attached	393	1.1%
Manufactured Homes	348	1.0%
Multi-Family	313	0.9%
Mixed Use	4	0.0%
Commercial	1,279	3.5%
Hotel	97	0.3%
Office	321	0.9%
Hospital	95	0.3%
Industrial	2,083	5.8%
Public/Semi-Public	1,260	3.5%
Parks and Open Space	5,082	14.0%
Transportation	845	2.3%
Utility	180	0.5%
Vacant	3,971	11.0%

Notes:
(1) Based on current land use classifications included in the 2020 Comprehensive Plan.

2.4.2 Future Land Use

The future land use, in conjunction with the population projections, was used to allocate future flows within the collection system. An overview of the future land use is included below in Figure 2.5 and Table 2.4.

Table 2.4 Future Land Use Summary

Land Use Category	Area, acre(1)	Percent of Total
Rural Residential	3,932	10%
Residential Low	12,113	32%
Residential Medium	5,927	16%
Residential High	737	2%
Mixed Use	1,276	3%
Commercial	3,201	8%
Airport	2,607	7%
Industrial	3,052	8%
Parks and Open Space	5,155	14%

Notes:
(1) Based on future land use classifications included in the 2020 Comprehensive Plan.

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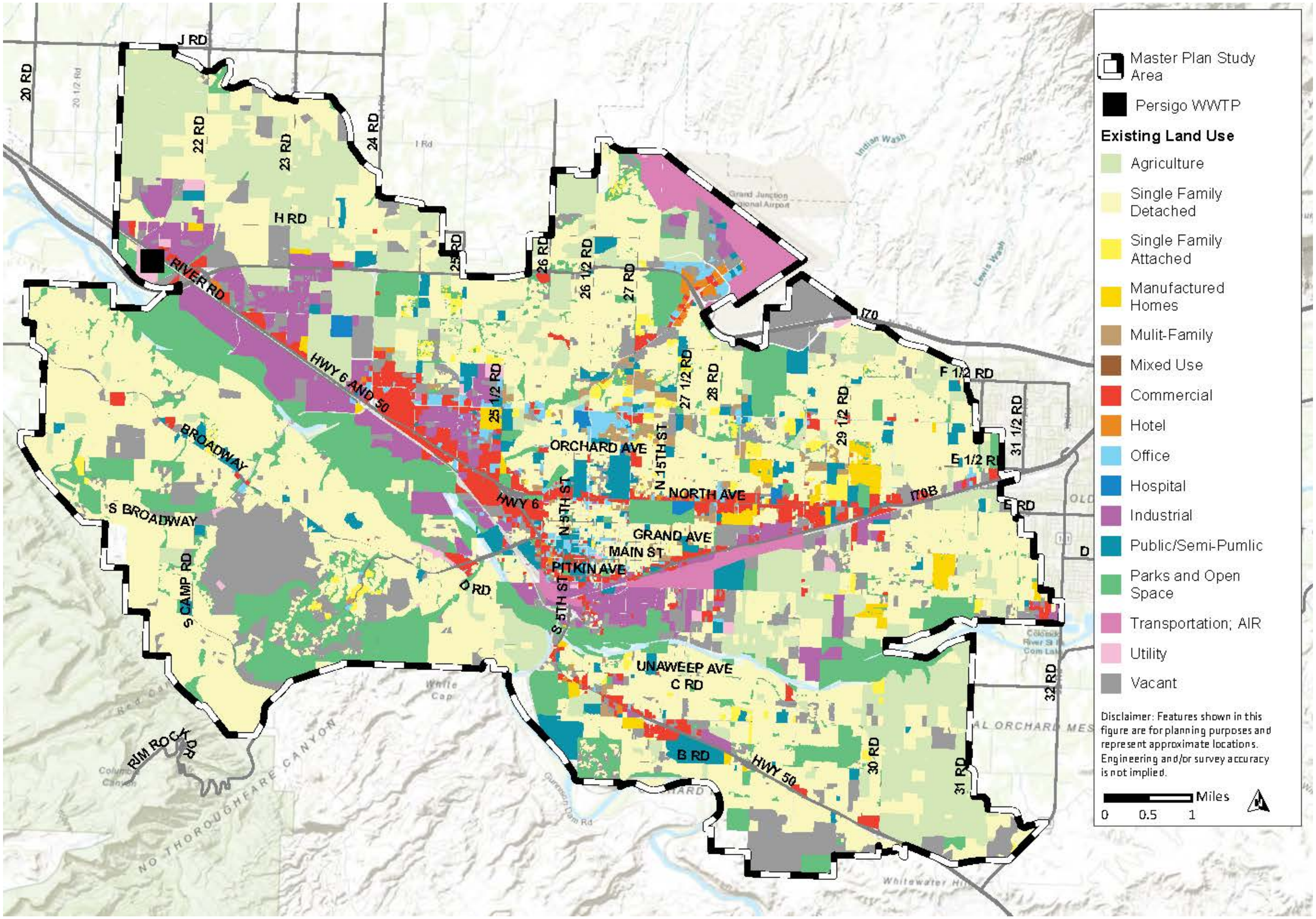

Figure 2.4 Existing Land Use Overview

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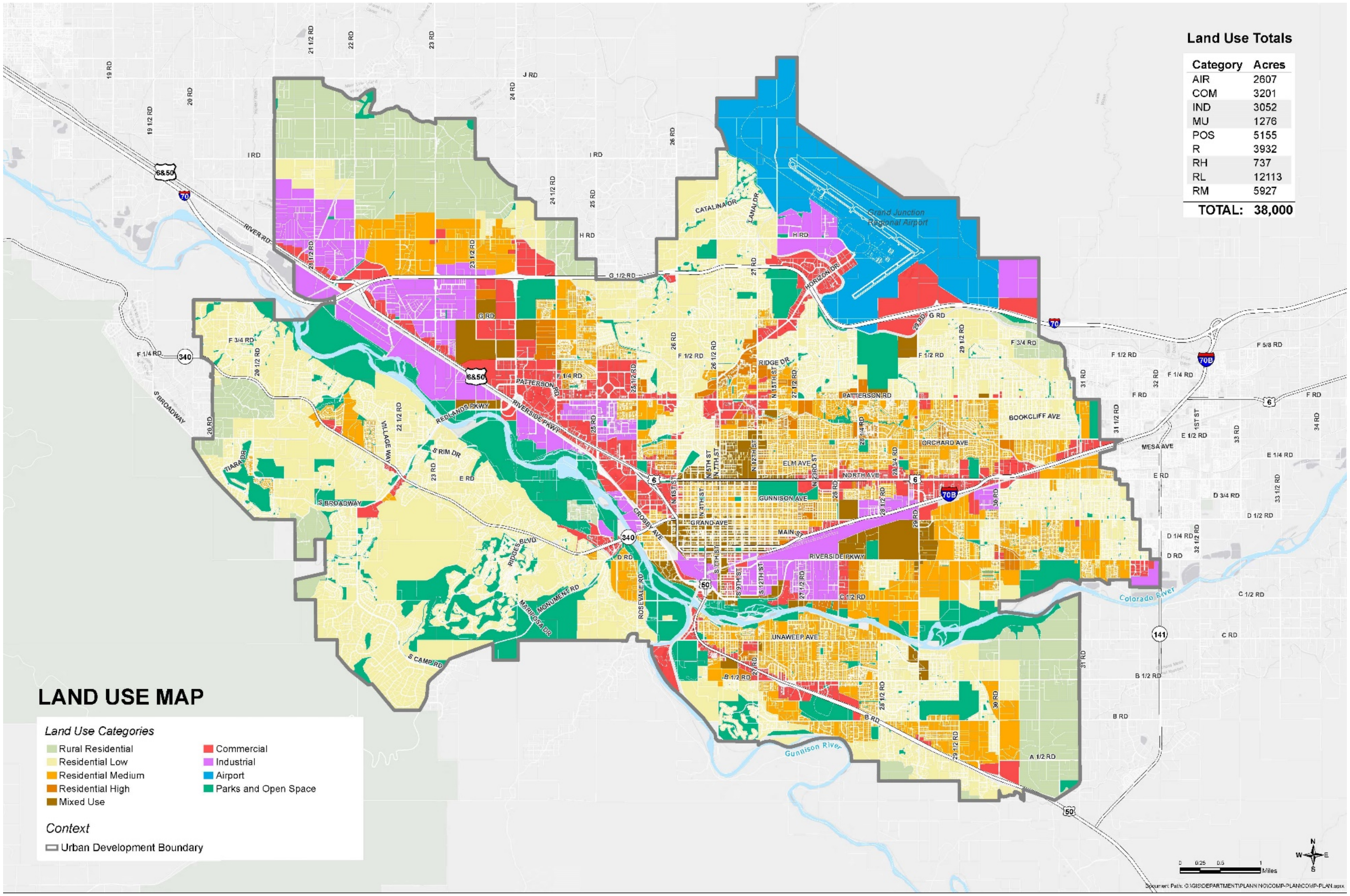

Land Use Totals

Category	Acres
AIR	2607
COM	3201
IND	3052
MU	1276
POS	5155
R	3932
RH	737
RL	12113
RM	5927
TOTAL:	38,000

Figure 2.5 Future Land Use Overview

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2.5 Population Projections

As detailed above, the land use data was used in conjunction with the population projections to allocate existing and future flows within the collection system. There were two sets of population projections that were evaluated as part of this 2020 WW Basin Update. These included projections from the 2020 Comprehensive Plan and Traffic Analysis Zone (TAZ)-based data. The 2020 Comprehensive Plan is a planning document that outlines the future land use of the study area through 2040. The projections from the 2020 Comprehensive Plan were provided by the City, and the study area has been aligned with this boundary for consistency.

The TAZ-based data was provided by the Grand Valley Metropolitan Planning Organization/Mesa County Regional Transportation Planning Office. The TAZ-based data covered all of Mesa County and was modified (clipped) to meet the boundaries of the study area as discussed below.

2.5.1 Historical Population Data

Historical population data from 2010 to present was provided in the 2020 Comprehensive Plan projection information. The population for each year is summarized below in Table 2.5. Over the past 4 years, the annual growth rate has averaged 1.25 percent.

Table 2.5 Historical Population Data

Year	Population	Percent Increase
2010	93,312	-
2011	93,861	0.59%
2012	93,849	-0.01%
2013	93,980	0.14%
2014	93,777	-0.22%
2015	94,963	1.27%
2016	96,110	1.21%
2017	97,286	1.22%
2018	98,549	1.30%

Notes:
(1) Data obtained from the 2020 Comprehensive Plan.

2.5.2 Population and Employment Projections

Both the 2020 Comprehensive Plan and the TAZ-based data were used to project the future populations for this 2020 WW Basin Update. The goal of the population projections is to define how much, and identify where growth will occur in the study area. The use of each dataset in meeting this goal was dictated by the dataset format.

2.5.3 2020 Comprehensive Plan

The 2020 Comprehensive Plan projections included study area totals for each year beginning in 2020 through the year 2040. The totals in 5-year increments from 2020 through 2040 are included in Table 2.6.

Table 2.6 Population Projection Summary

Planning Horizon	2020 Comprehensive Plan Projections[1]	Comprehensive Plan % Growth	TAZ-Based Projections[2]	Population Difference[3]	Population % Difference[4]
2020	99,819	-	100,600[5]	-782	-0.78%
2025	103,623	3.81%	104,574	-951	-0.92%
2030	110,036	6.19%	109,318[6]	719	0.65%
2035	117,360	6.66%	118,819	-1,460	-1.24%
2040	124,220	5.85%	128,152[6]	-3,932	-3.17%
2045			132,597		

Notes:

(1) Values obtained from 2020 Comprehensive Plan. Totals represent the projected future populations within the study area.

(2) Sum of projected population for each planning horizon based on TAZ data for the study area.

(3) Calculated as (Comprehensive Plan) – (TAZ) for each planning horizon.

(4) Percent difference as (Population Difference)/(Comprehensive Plan Projections). This percent difference was utilized to globally modify the TAZ-based projections within the geographic information system (GIS).

(5) Corresponds to 2018 planning horizon total.

(6) Linear interpolation utilized to determine 2030 and 2040 projections.

2.5.4 TAZ-Based Data

The TAZ-based data covered all of Mesa County, and included population and employment projections for the 2018, 2025, 2035, and 2045 planning horizons. The TAZ data was used to spatially allocate the growth within the collection system. The first step in utilizing the TAZ polygons was to clip the data to the study area. The data clip included an area weighting method to allocate projections for polygons that overlapped the study area boundary. After area weighting, the total population and employment were summed for each planning horizon. These totals are also included in Table 2.6. As summarized in Chapter 1, the planning horizons evaluated for this 2020 WW Basin Update include 2030 and 2040. To determine the TAZ-based projections for these years, a linear interpolation was applied which are included in Table 2.6.

2.5.5 Recommended Approach Population and Employment Projections

When comparing the two projections, the TAZ-based projections are generally greater than the 2020 Comprehensive Plan totals. Due to this variation, the TAZ-based projections were modified so the population totals for each planning horizon would match the 2020 Comprehensive Plan totals. This aligned the TAZ-based projections to match the 2020 Comprehensive Plan and provided a way to spatially distribute the projection populations within the collection system. For comparison purposes, the total 2035 population from the 2008 WW Basin Update was 201,315 and the current projection is 117,360 for 2035.

Chapter 3

FLOW MONITORING PROGRAM

3.1 Flow Monitoring Program

A flow monitoring program was implemented so the dry weather flow (DWF) and wet weather flow (WWF) parameters could be quantified and incorporated into the collection system model. The program included City-owned flow monitors, and rain gauges/flow monitors deployed by Ashton Engineering Group (AEG). The program lasted from April 27 through June 26, 2020, for a total of 61 monitored days. Details related to the monitoring program are summarized in this chapter. Additionally, AEG prepared a flow monitoring report which is included in Appendix A.

The flow monitoring program was performed during a statewide, government mandated, Stay-at-Home Order due to the COVID-19 pandemic, which began on March 26, 2020. The Stay-at-Home Order was in place for the duration of the flow monitoring program, which impacted the monitored flows. During the monitoring period, the influent flows to the Persigo WWTP were approximately 17 percent less than the 2019 historical data. A comparison of the 2019 and 2020 influent Persigo WWTP flows is included in Table 3.1.

Table 3.1 2019 and 2020 Historical Persigo WWTP Influent Flows

Year/Parameter	Daily Average Flow, mgd(1)	Maximum Daily Average Flow, mgd(1)	Minimum Daily Average Flow, mgd(1)
2019	9.86	12.29	9.04
2020	8.17	9.29	4.28
Difference(2)	-1.69	-2.99	-4.77
Percentage(3)	-17%	-	-

Notes:
(1) Daily flow statistics based on Persigo WWTP influent flow monitor.
(2) Values calculated based on differences in daily average flows for the duration of the monitoring period.
(3) Calculated as average flow difference/2019 daily average influent flow.
mgd million gallons per day

3.1.1 Flow Monitoring Sites and Tributary Areas

In total, there were 13 monitoring sites employed for the program in 2020. This included ten flow monitors deployed by AEG, two City-owned flow monitors, and the influent flow monitor at the Persigo WWTP. The monitoring locations are illustrated in Figure 3.1 and were established at key locations throughout the collection system to understand system hydraulics. The OMSD and CGVSD were high priority for this monitoring program as they were not modeled in detail during the 2008 WW Basin Update, and may be large contributors of wet weather infiltration and inflow (I/I). Some of the flow monitors are located in series, so a flow monitoring schematic was developed and is included in Figure 3.2. Additional details related to the flow monitoring locations are included below in Table 3.2. In addition to the 2020 monitoring, the City had two monitors deployed in the fall of 2019 which are also detailed below.

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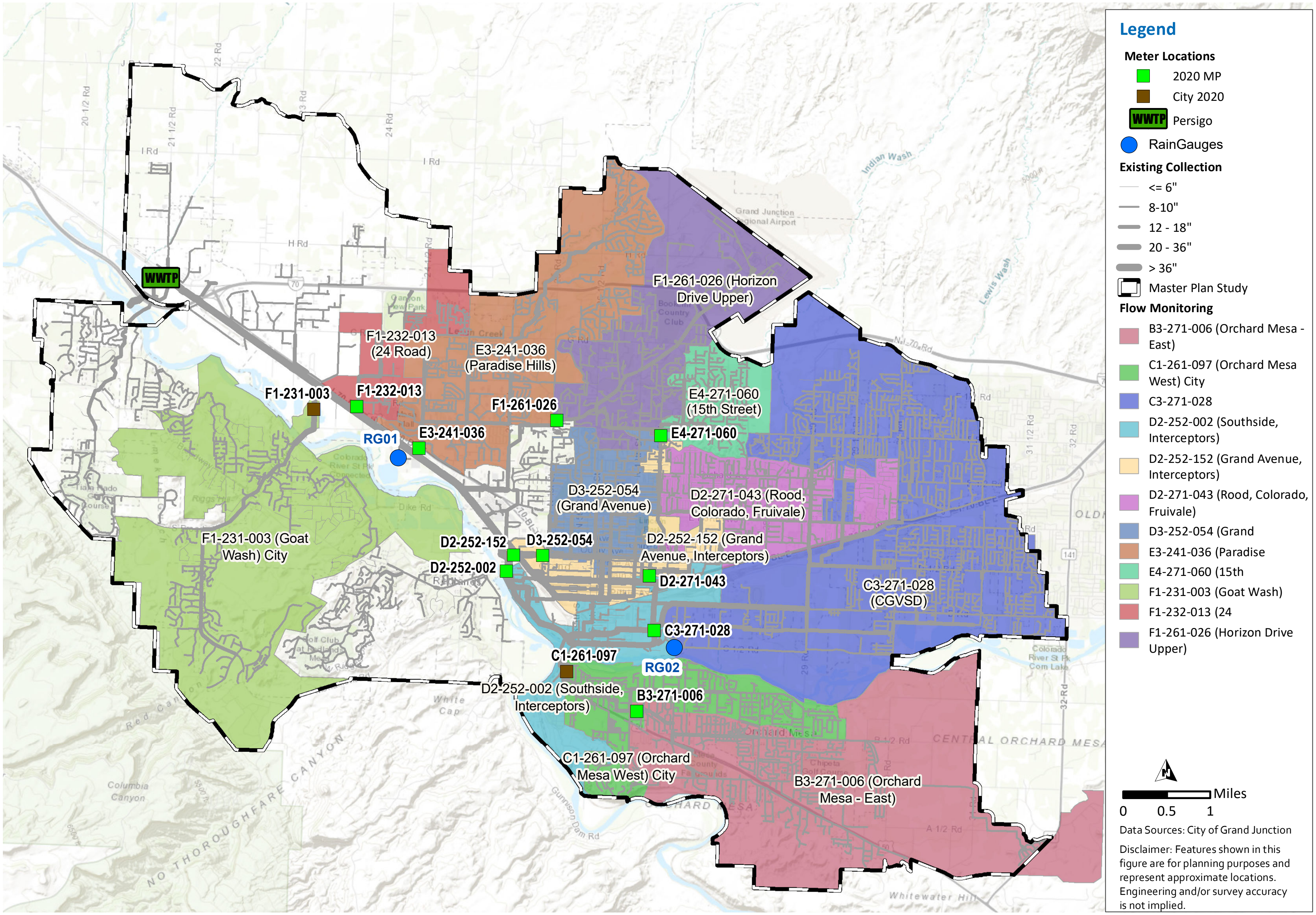

Figure 3.1 Flow Monitoring Overview

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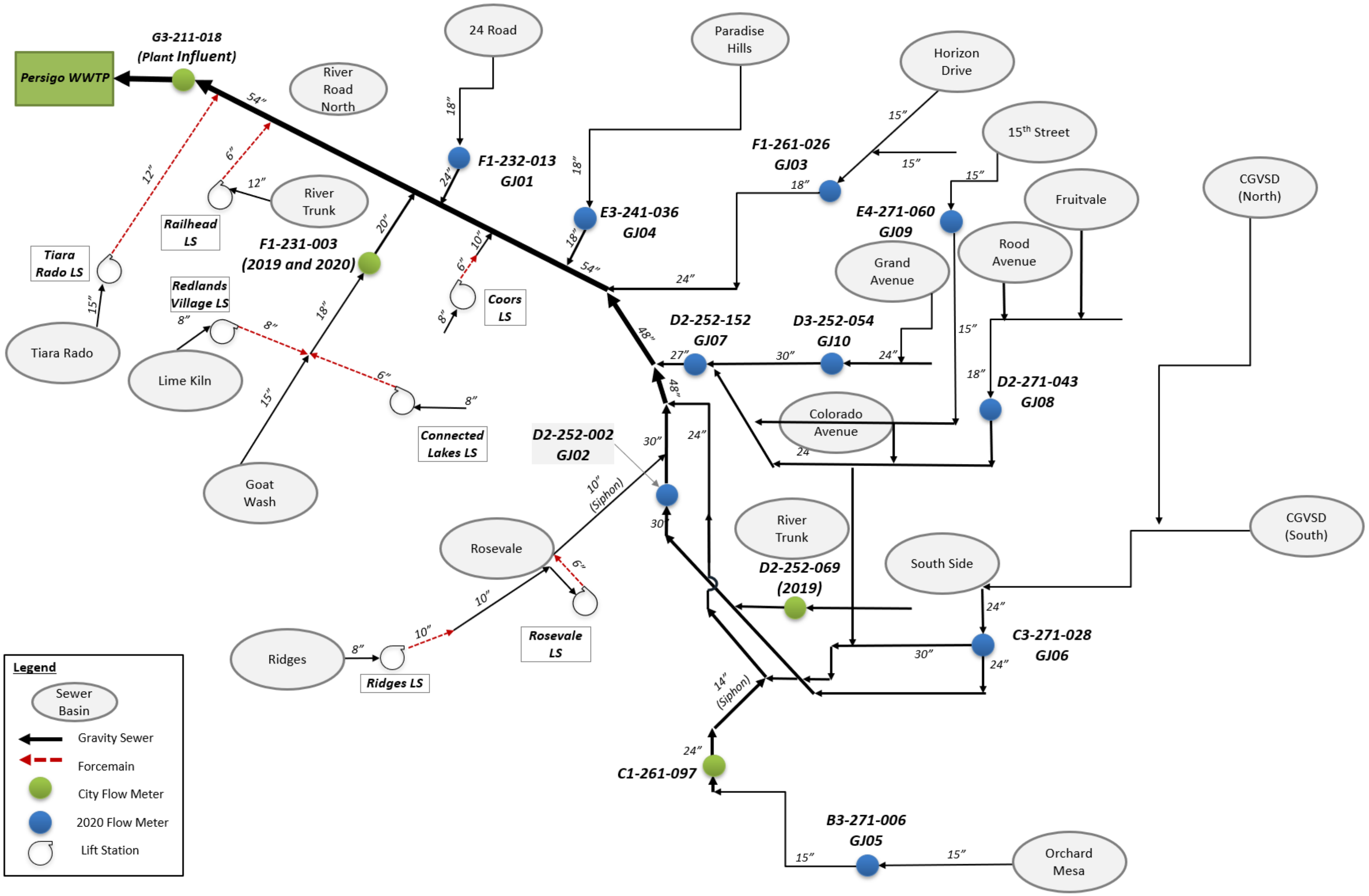

Figure 3.2 Flow Monitoring Schematic

Table 3.2 Flow Monitor Summary

Type	Monitor Location (Manhole ID)	Meter ID	Measured Pipe Diameter, inches	Monitored Area/Location	Monitored Dates
AEG Flow Monitors	F1-232-013	GJ01	24	24 Road	4/27/2020 - 6/26/2020
	D2-252-002	GJ02	30	Southside, Interceptors	4/27/2020 - 6/26/2020
	F1-261-026	GJ03	15	Horizon Drive Upper	4/27/2020 - 6/26/2020
	E3-241-036	GJ04	18	Paradise Hills	4/27/2020 - 6/26/2020
	B3-271-006	GJ05	15	OMSD - East	4/27/2020 - 6/26/2020
	C3-271-028	GJ06	30	CGVSD	4/27/2020 - 6/26/2020
	D2-252-152	GJ07	30	Grand Avenue, Interceptors	4/27/2020 - 6/26/2020
	D2-271-043	GJ08	18	Rood Avenue, Colorado Avenue, Fruitvale	4/27/2020 - 6/26/2020
	E4-271-060	GJ09	15	15th Street	4/27/2020 - 6/26/2020
	D3-252-054	GJ10	27	Grand Avenue	4/27/2020 - 6/26/2020
2020 City Flow Monitors	G3-211-017	Persigo WWTP Influent Flow Monitor	54		Ongoing(1)
	C1-261-097		24	OMSD - West	4/14/2020 - Ongoing(2)
	F1-231-003		20	Goat Wash	4/7/2020 - Ongoing(2)
2019 City Flow Monitors	D2-252-069	Courthouse	24	Rood Avenue, Colorado Avenue, Fruitvale, CGVSD	8/28/19 - 10/23/19
	F1-231-003		20	Goat Wash	8/22/19 - 10/23/19

Notes:

(1) The Persigo WWTP is a permanent flow monitor located upstream of the plant.

(2) The City left this monitor in the system to collect additional information.

3.1.2 Rainfall Monitoring and Data Results

Two rain gauges were installed by AEG as illustrated Figure 3.1. Both were in operation for the duration of the 2020 monitoring program. A tabular summary of the observed rainfall events is included in Table 3.3. Also included in Table 3.3 are rainfall totals observed at Grand Junction Regional Airport (WFO). From the recorded data, only four minor rain events were observed during the monitoring program.

Table 3.3 Rainfall Event Tabular Summary

Date	RG01 Cumulative Rainfall, inch(1)	RG02 Cumulative Rainfall, inch(2)	WFO Rainfall Total(3)	Storm Classification(4)
5/22/2020	0	0	0.08	Hourly data not available
6/6/2020	0	0	0.21	Hourly data not available
6/25/2020	0.11	0	0.12	Less than 2 years
6/26/2020	0	0.05	0.06	Less than 2 years

Notes:

(1) Daily rainfall totals based on AEG flow monitoring report. RG01 was located at the Coors Lift Station.

(2) Daily rainfall totals based on AEG flow monitoring report. RG02 was located at the Grand Valley By-Products Lift Station.

(3) Daily rainfall totals based on data obtained for the WFO rain gauge http://ccc.atmos.colostate.edu/data_access.html.

(4) Based on Grand Valley Area Intensity-Duration-Frequency Curves (Figure 616) obtained from the Stormwater Management Manual (December 2007).

3.2 Wastewater Flow Components and Modeling Parameters

The goal of the monitoring program was to collect flow data to define the DWF and WWF parameters within the collection system model. Correct estimation of these parameters allows the hydraulic model to accurately predict flows in the collection system. An overview of how the flow parameters were quantified using the monitoring data is summarized below. In general, input parameters were developed to define the DWF, and the rainfall dependent infiltration and inflow (RDII) within the model. An overview of the flow components and parameters is included in Figure 3.3.

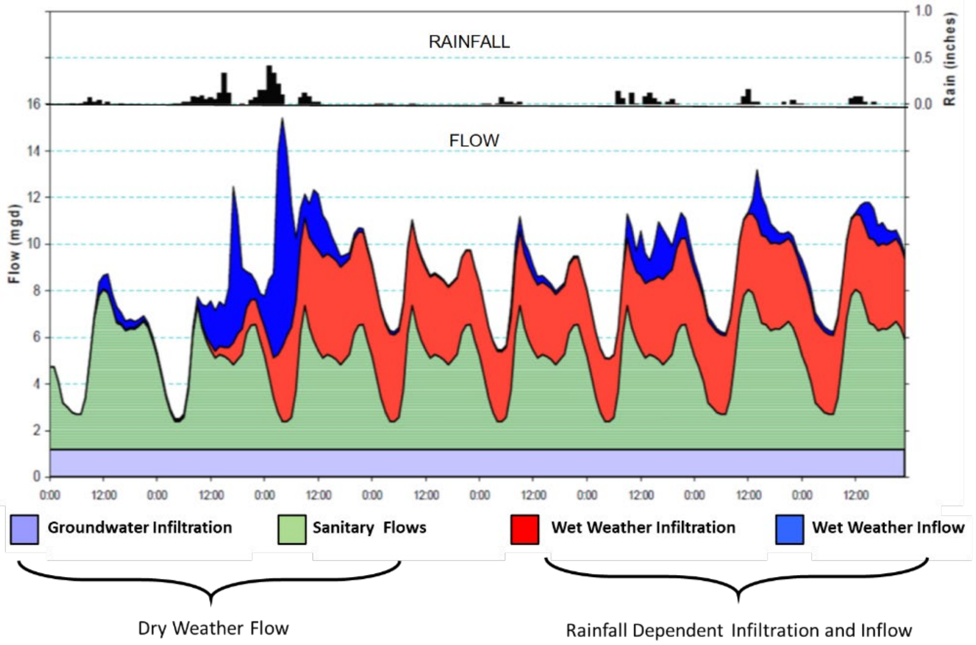

Figure 3.3 Flow Components

3.2.1 Dry Weather Flows

DWF is comprised of ground water infiltration and sanitary flows. Groundwater infiltration or permanent infiltration is extraneous flow that is conveyed through the ground to the collection system during dry weather periods. Sanitary flows are defined as the flow conveyed from homes, businesses, and other water users to the collection system. For this 2020 WW Basin Update, the ground water infiltration and sanitary flows were evaluated together as total DWF within the model. To allocate flows within the model, diurnal patterns and per capita flow rates were quantified based on the DWF period. The dry weather period lasted 2 weeks from June 8 through June 21. An overview of the dry weather monitoring data is included in Table 3.3. Diurnal patterns were developed for both weekday and weekend days for each monitoring site and are illustrated in Figures 3.4 and 3.5, respectively.

Table 3.4 Dry Weather Flow Data Summary

Manhole ID	Meter ID	Average Flow, mgd(1)	Peak Flow Rate, mgd(2)	Minimum Flow Rate, mgd(2)	DWF Peaking Factor(3)
F1-232-013	GJ01	0.22	0.35	0.11	1.59
D2-252-002	GJ02	3.20	4.27	1.59	1.33
F1-261-026	GJ03	0.69	0.97	0.36	1.41
E3-241-036	GJ04	1.11	1.5	0.64	1.35
B3-271-006	GJ05	0.69	0.97	0.38	1.41
C3-271-028	GJ06	1.21	2.01	0.40	1.66
D2-252-152	GJ07	1.05	1.35	0.61	1.29
D2-271-043	GJ08	0.92	1.3	0.47	1.41
E4-271-060	GJ09	0.42	0.58	0.14	1.38
D3-252-054	GJ10	0.79	1.16	0.26	1.47

Notes:
(1) Daily average flow rates for selected DWF period.
(2) Instantaneous flow rate for selected DWF period.
(3) Calculated as peak flow rate/average flow rate.

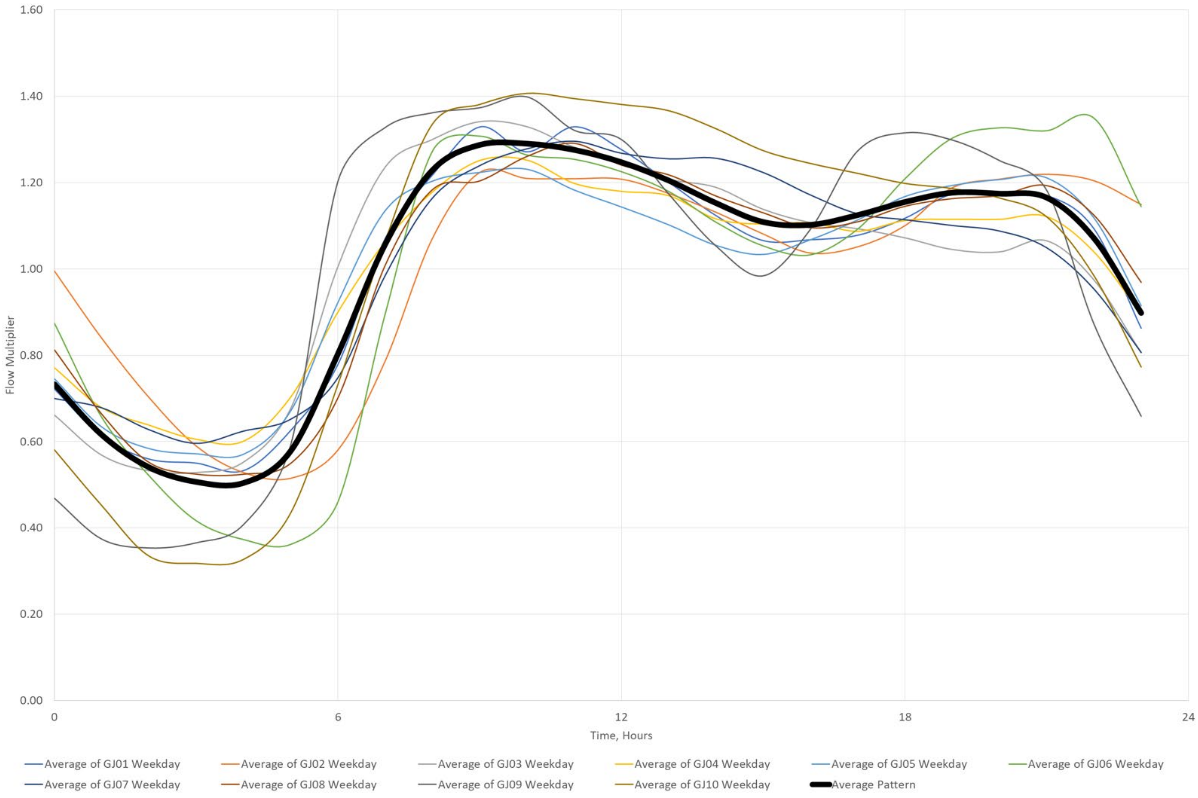

Figure 3.4 Weekday Diurnal Pattern

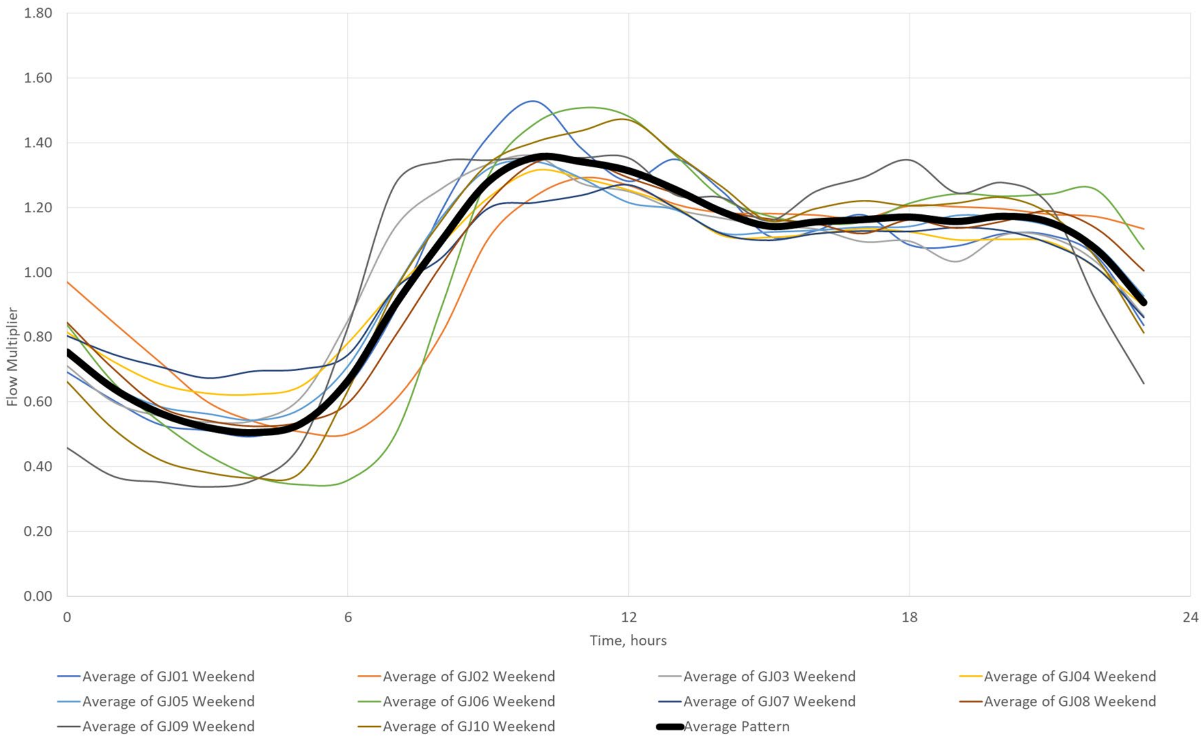

Figure 3.5 Weekend Diurnal Pattern

3.2.2 Wet Weather Flows

During wet weather events, additional flow enters the collection system, which is called RDII. RDII includes two flow components, inflows and infiltration. Wet weather inflows are due to direct connections (vented manhole covers, down spouts, area drains, etc.) to the collection system, and generally correspond to the initial wet weather response in the system. The longer-term elevated flows/levels are due to wet weather infiltration caused by rainwater entering the collection system through the ground. Pipe capacities are generally dictated by WWF in the system, so accurately quantifying these flow parameters are vital to model calibration. As documented above, minimal rainfall was observed during the monitoring period. Thus, there was little to no wet weather response observed at a majority of the flow monitors. A summary of the flow monitors that responded to the smaller events is detailed in Table 3.5. Based on a review of the flow data, it appears that there may be direct connections/inflows in the areas contributing flow to GJ10 (Grand Avenue), and the subcatchments between GJ10 and GJ07 (Colorado Avenue/River Trunk). Both areas are located in the old combined areas of the collection system, and some sewers are still classified as combined sewers based on the City's GIS data.

Table 3.5 Wet Weather Response Summary

Manhole ID	Meter ID	Monitored Area/Location	6/6	6/25 - 6/26	General Comments
F1-232-013	GJ01	24 Road	-	-	Large flow occurred after rainfall event ended.
D2-252-002	GJ02	Southside, Interceptors	-	-	
F1-261-026	GJ03	Horizon Drive Upper	-	-	
E3-241-036	GJ04	Paradise Hills	Yes	Yes, 6/25 Only	Smaller inflows.
B3-271-006	GJ05	OMSD - East	-	-	
C3-271-028	GJ06	CGVSD	-	-	
D2-252-152	GJ07	Grand Avenue, Interceptors	Yes	Yes, both days	Appears to be largest RDII response. Basin most likely contains inflow sources.
D2-271-043	GJ08	Rood Avenue, Colorado Avenue	-	Yes, 6/26 only	
E4-271-060	GJ09	15th Street	-	-	
D3-252-054	GJ10	Grand Avenue	Yes	Yes, both days	Area between GJ07 and GJ10 most likely contains inflow sources.
G3-211-017		Persigo WWTP Influent Flow Monitor	Yes	Yes	
C1-261-097		OMSD - West	-	-	
F1-231-003		Goat Wash	-	-	

Chapter 4

COLLECTION SYSTEM FACILITIES AND HYDRAULIC MODEL

This chapter presents an overview of the City's wastewater collection system and describes the update and calibration of the wastewater collection system hydraulic model. A summary of the hydraulic model calibration steps, standards, and results for both dry and wet weather conditions is provided.

4.1 Existing Collection System

The existing collection system is composed of a series of lift stations and sewers to convey all flows to the Persigo WWTP. The entire collection system includes approximately 3 million linear feet (lf) (584 miles) of sewers ranging from 6 to 54 inches in diameter, and 26 total lift stations based on the City's GIS collection system data and reported lift station information. Flows are generally conveyed to the large trunk sewers located on the north side of the Colorado River which conveys flows through the 54-inch interceptor to the plant. An overview of the existing collection system is included in Figure 4.1. The sewer basins illustrated in the figure are used to define areas within the collection system and were carried over from the 2008 WW Basin Update. A breakdown of the existing collection by pipe diameter and sewer basin is included in Table 4.1. Most of the existing system has a diameter of 8 inches and smaller as demonstrated in Table 4.1.

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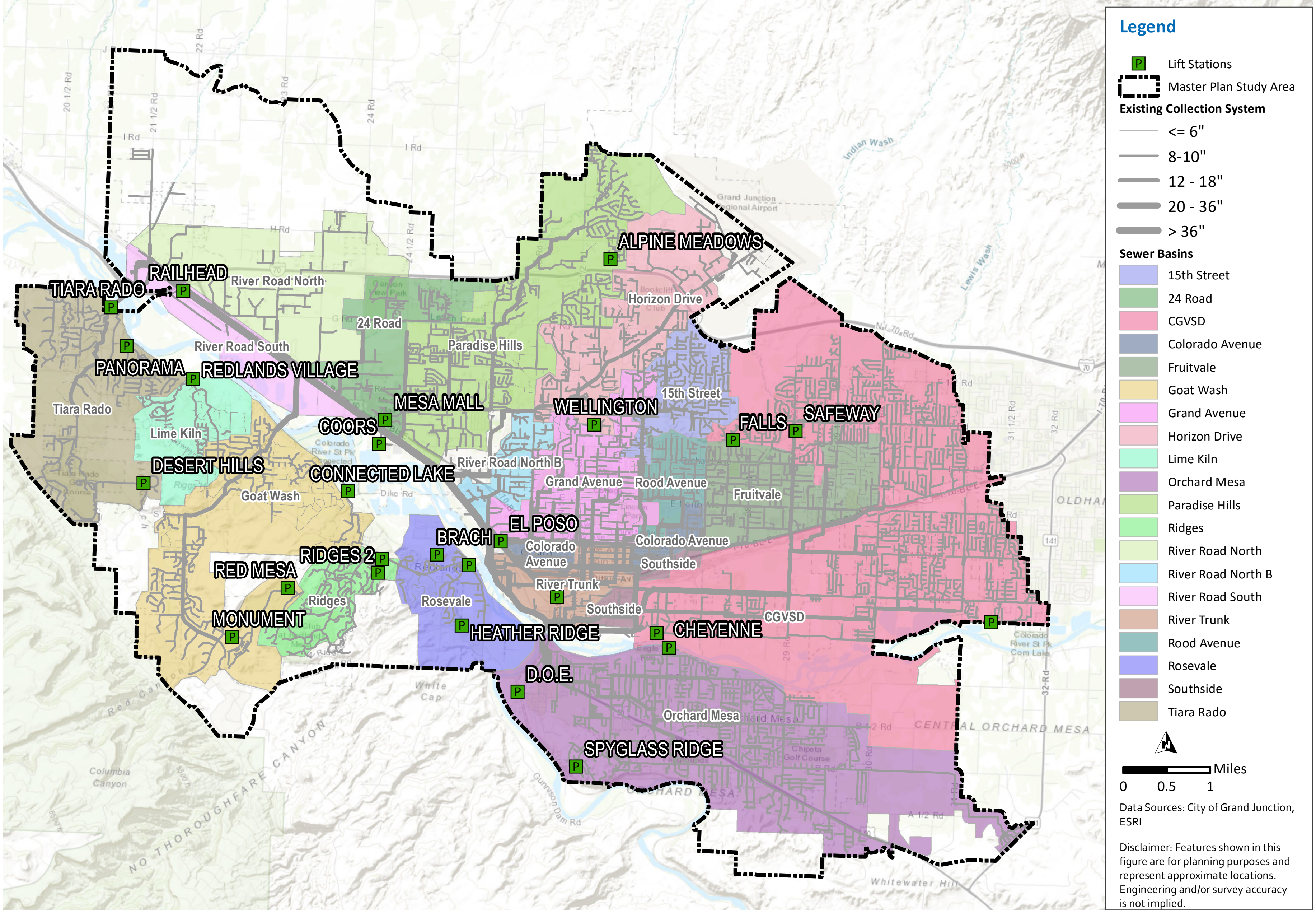

Data Sources: City of Grand Junction, ESRI

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure 4.1 Collection System Overview

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Table 4.1 Summary of Existing Collection System

Sewer Basin	Total Linear Foot by Pipe Size											
	Unk	<8"	8"	10"	12"	15"	18"	21-24"	27-30"	36-54"	Total lf	% of Total
15th Street	0	4,900	85,460	0	4,290	5,840	0	0	0	0	100,490	3%
24 Road	500	1,180	46,700	10,160	1,440	0	4,980	60	0	0	65,020	2%
CGVSD	17,970	9,210	519,090	42,110	20,320	18,420	22,380	10,820	660	140	661,120	22%
Colorado Avenue	150	16,130	24,470	3,260	60	6,560	4,820	7,360	2,010	0	64,830	2%
Fruitvale	39,080	4,280	116,560	16,400	11,240	170	0	0	0	0	187,730	6%
Goat Wash	5,640	47,030	126,600	3,850	11,070	2,340	3,590	250	0	0	200,360	7%
Grand Avenue	7,060	37,600	105,140	12,690	8,860	11,930	7,490	2,150	0	0	192,920	6%
Horizon Drive	2,580	4,100	115,140	980	550	15,300	330	0	0	0	138,980	5%
Lime Kiln	1,180	24,830	30,690	0	0	0	0	0	0	0	56,700	2%
OMSD	330	7,380	368,850	19,760	12,400	10,910	5,730	2,050	0	0	427,410	14%
Paradise Hills	1,770	10,690	219,350	8,130	15,780	12,610	4,230	0	0	0	272,560	9%
Ridges	730	1,450	65,600	1,620	830	550	0	0	0	0	70,770	2%
River Road North	0	980	44,850	13,700	2,480	830	0	0	0	0	62,840	2%
River Road North B	1,550	6,470	32,010	1,770	1,160	1,420	1,390	0	0	0	45,770	2%
River Road South	0	1,440	2,540	10,230	6,910	730	170	2,850	0	17,300	42,190	1%
River Trunk	570	16,190	34,810	4,800	5,230	14,800	2,950	21,530	6,620	0	107,500	4%
Rood Avenue	1,380	16,450	36,000	3,290	2,410	4,760	300	0	0	0	64,610	2%
Rosevale	1,370	10,020	33,620	3,040	200	0	0	0	0	0	48,240	2%
Southside	1,130	1,920	10,190	2,260	40	2,100	2,000	3,060	2,360	0	25,050	1%
Tiara Rado	1,380	12,060	120,620	1,150	2,540	5,280	0	0	0	0	143,020	5%
Total LF	84,390	234,310	2,138,270	159,200	107,810	114,550	60,350	50,130	11,650	17,440	2,978,110	-
% of Total	3%	8%	72%	5%	4%	4%	2%	2%	0%	1%	-	-

Notes:

(1) Based on City GIS information.

4.2 Hydraulic Model Development

This section summarizes the process for developing the hydraulic model, including a summary of the modeling software selection, a description of the modeled collection system, and elements of the hydraulic model.

4.2.1 Previous Hydraulic Model and Model Selection

A new collection system model was created for this 2020 WW Basin Update using InfoWorks ICM v10.5. The model for the 2008 WW Basin Update was developed using H_2OMap Sewer version 8.0, which is a product that has been discontinued by Innovyze. H_2OMAP Sewer was integrated with ArcMap and was not a fully dynamic hydraulic model. This meant the model had difficulty predicting complicated hydraulics resulting from capacity bottlenecks. To understand system hydraulics, a fully dynamic model is required. There are many different fully dynamic hydraulic models available. Based on Carollo Engineers' (Carollo) experience with collection system modeling, InfoWorks ICM was recommended for this 2020 WW Basin Update. InfoWorks ICM is an integrated hydrological and hydraulic model which is well suited for use with the Persigo system due to the following key differentiators:

- InfoWorks utilizes a robust, fully dynamic modeling engine. This allows the program to accurately predict complicated hydraulics including backwater, and surcharging throughout the system.
- The database functionality (data flags) allows users to track data sources within the model. This clarifies how the model was constructed, what refinements are needed in the future, and how model results should be interpreted.

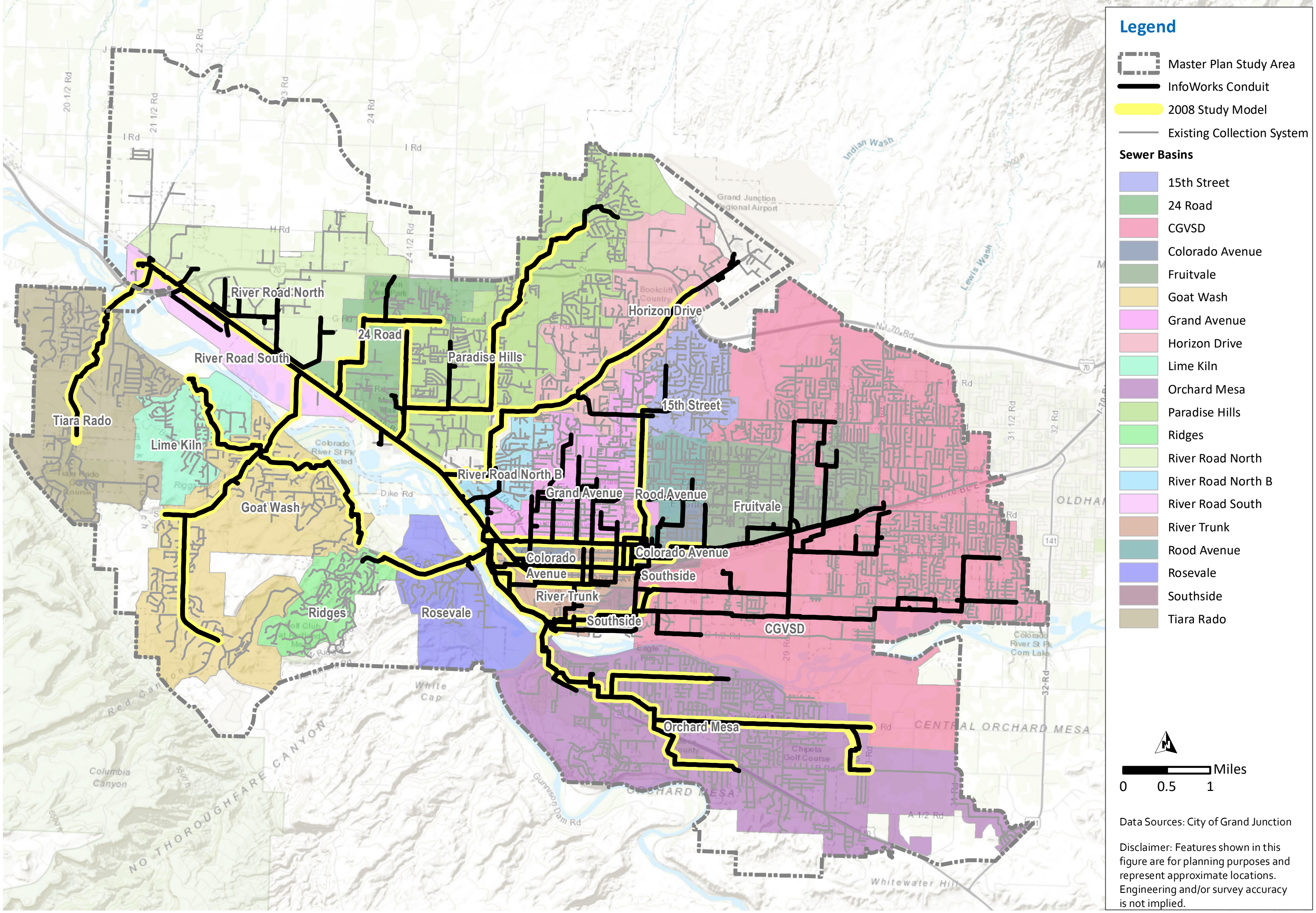
4.2.2 Modeled Collection System and Skeletonization

In sewer system master planning, it is common practice to use a skeletonized model, in which portions of the system are not included in the model. In practice, this means that some of the smaller diameter sewers are excluded. The purpose of skeletonizing a system is to develop a model that accurately simulates the hydraulics of a collection system while simultaneously simplifying a large and complex model. For this model build, pipelines 10 inches in diameter or larger were included, as well as some smaller diameter sewers (8 inches in diameter or smaller) where needed for connectivity. Otherwise, sewers 8 inches in diameter or smaller were excluded. The previous model generally included sewers that were 12 inches and larger, so the model was expanded as part of this 2020 WW Basin Update, but it still does not include all the sewers within the collection system. This also meant that not all lift stations were included in the model. In total, nine of the 28 lift stations were included. Details regarding the lift station model inputs are included in Table 4.2, and in Appendix B. An overview of the collection system model is included in Figure 4.2.

Table 4.2 Lift Station Details

Lift Station Name	Number of Pumps	Pump Capacity, mgd(1)	Firm Capacity, mgd(2)	Force Main Size, inch
El Poso	2	0.21	0.21	4
Connected Lakes	2	0.26(3)	0.26(3)	6
Ridges 1	2	0.43	0.43	10
Coors	2	0.46	0.46	6
Redlands Village	4	0.56	1.68	8
Grand Valley By-Products	2	0.56	0.56	6
Rosevale	2	0.68	0.68	6
Tiara Rado	2	3.27	3.27	12
Railhead	2	0.57(3)	0.57	6

Notes:
(1) Pump capacity based on fixed discharge included in model unless noted otherwise.
(2) Estimated firm capacity based on largest pump out of service.
(3) Pump capacity dictated by pump curves included in the model.



Data Sources: City of Grand Junction

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure 4.2 Hydraulic Model Overview

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4.2.3 Model Construction and Model Elements

To create an accurate hydraulic model, the physical modeling network must closely match the actual configuration of the collection system. This is achieved by carefully selecting the various input parameters and elements within the model. A brief overview of the modeled elements, and required inputs is included below in Table 4.2.

Table 4.3 Modeled Elements

InfoWorks Model Element	Typical Use	Data Inputs
Nodes	Manholes	• Ground elevation • Location
Conduits	Gravity sewers, force mains	• Connectivity • Diameter • Material • Roughness
Storage Nodes	Lift station wet wells	• Size • Elevations
Pumps	Lift station pumps	• Set points • Capacity • Quantity
Outfalls	Outfall to Persigo WWTP	• Location
Subcatchments	Sewer subbasins	• DWF diurnal pattern • DWF per capita flow rate • WWF contributing area and basin parameters • Existing and projected populations

To ensure the most up to date information is included in the model and track data sources, data flags within the InfoWorks model were used. Data flags are vital to understanding how a model is constructed, so refinements can be made when updating the model in the future. An overview of the various data flags and how they were applied is included in Table 4.3.

Table 4.4 InfoWorks Data Flag Summary

Data Flag	Meaning	Common Use
H_2O	Existing H_2Omap Sewer Model	Fill sewer invert data gaps.
MCON	Inferred from Mesa County 2-foot Contours (2015-2016)	Fill missing ground elevations.
CGIS	City GIS Data	All data from City GIS.
ASM	Assumed value by Carollo (2020 Comprehensive Plan)	Most of the assumed data was incorporated by inferences. Assumed data needs to be verified.
CDAT	Other City Data/Inputs	Other data provided by City (lift station data, review comments, etc.).
CAR	Updated by Carollo, 2020 Comprehensive Plan	Carollo values used for 2020 WW Basin Update.
AB	As-built data	Fill sewer invert, and lift station data gaps.

Data Flag	Meaning	Common Use
INF	Inferred data (assumed inverts, pipe sizes) between survey/GIS/City data.	Inferred data based on upstream/downstream information. Used to interpolate elevations between known upstream/downstream elevations.
CSUR	City Manhole Survey performed summer 2020	The City surveyed 20 manholes during the 2020 WW Basin Update to fill data gaps.
VER	Need to verify inverts.	Inverts need to be verified as the City GIS inverts appeared to be incorrect.
IMP	Improvement made to system.	Utilized to denote what model elements have been modified for the proposed conditions.

A brief summary of the model construction and how data flags were used during model construction is provided below.

- The first step in constructing the modeling network was to obtain and review the City's GIS shapefiles. The City's GIS data was used as the basis for most of the collection system model. This included the node/sewer ID, location, size, elevations, and connectivity for a majority of the collection system. A base network was created using the City's GIS, and a data gap analysis was performed to identify where additional data was needed. The data gaps were generally identified using the validation tools within InfoWorks. Data imported into the model from City's GIS was flagged using the "CGIS" data flag.
- A majority of the data gaps were due to missing invert information. To fill these gaps, the following data sources/hierarchy was used.
  - The first data source used to fill data gaps was the previous H_2OMap Sewer model. Data gaps filled from the previous model were flagged with the "H_2O" data flag.
    - In some areas, the elevations within the previous model when compared with the City's GIS data for adjacent manholes resulted in adverse sloped pipes. In these instances, the inverts were assumed and interpolated, and flagged with the "ASM" data flag. These inverts should be verified in the future.
  - The City performed survey on 20 manholes to fill some of the data gaps. Using the survey information, manhole inverts were interpolated and flagged with the "CSUR" data flag.
  - For new areas added to the model with significant data gaps, particularly in the CGVSD/OMSD sewer basins, as-built data was reviewed. The depths from the as-built data was used to try and establish sewer inverts. Data gaps filled with as-built data were flagged with the "AB" data flag.
    - However, in some areas, this resulted in adverse pipe slopes so inverts had to be assumed/interpolated using the "ASM" flag.
  - For the remaining data gaps, the inference tools within InfoWorks were used. Two methodologies used for data inferring are detailed below.
    - The "INF" data flag was used to infer data based on upstream and downstream information.
    - The "ASM" data flag was used if data had to be assumed with no information from the upstream/downstream infrastructure.
- The only other large data gap was in relation to the lift stations included in the model. The City provided additional information for the lift stations, and the modeling inputs/assumptions are summarized in Appendix B.

4.2.4 Subcatchment Delineation and DWF Allocation

After creation of the modeling network, subcatchments were delineated so flow could be allocated within the model. A subcatchment is similar to a sewershed/subbasin in that it defines an area where contributing flow is derived. InfoWorks predicts flow within the model based on information within each subcatchment. An overview of the subcatchment delineation is included below.

- The TAZ polygon shapefile was used as the basis for the subcatchments.
  - The TAZ polygons were delineated based on the existing network connectivity and assigned a Node ID where flow would be allocated within the model.
  - The polygons were then dissolved based on the Node ID, and an area weighting method was applied to allocate populations for TAZ polygons that were split during basin delineation.
  - Each polygon included the existing and future populations through 2040.
- The basin delineation resulted in a single subcatchment for each node where flow was allocated.

After subcatchment delineation, a per capita flow rate and diurnal pattern was specified for each subcatchment to predict DWFs. The per capita flow will represent the daily average per capita flow rate for each subcatchment, and the diurnal pattern will be utilized to dynamically route flow through the model.

4.2.5 Wet Weather Flow Development

WWF parameters are specified in each subcatchment. The flow parameters are adjusted so the desired peak RDII flows can be routed in the model. For this model, the RDII volume and peak flow rate are dictated by the contributing area percentage, and design storm event. The contributing area percentage is the ratio of the total subcatchment area to the area that contributes RDII flows to the collection system. This percentage is specified based on the WWF monitoring data, and the desired peak RDII flow rate. The lower this percentage, the lower quantity of RDII flow is contributed within the model and vice versa. Specific details related to the wet weather flow projections are included in Chapter 5.

4.3 Hydraulic Model Calibration

A key component of having an accurate hydraulic model is performing a detailed model calibration. Model calibration is performed by utilizing monitored/observed data and adjusting model parameters so the predicted flows/levels within the model generally match the observed data. Typically, model calibration involves both dry and wet weather calibrations. A DWF calibration effort allows the model to accurately predict wastewater flow generated within the study area, while a WWF calibration effort allows the model to predict the volume of RDII that enters the system during rain events. The flow monitoring data summarized in Chapter 3 was used for model calibration. As noted in Chapter 3, the flow monitoring was performed during a state-wide mandated Stay-at-Home Order, and there were only a few small rain events observed during the monitoring period. Both of these factors impacted how the monitored data was used, which is discussed below.

4.3.1 Calibration Standards

The hydraulic model was calibrated in accordance with the "Code of Practice for the Hydraulic Modeling of Urban Drainage Systems 2017". This document details best practices, calibrations standards, and provides an overall guide for creating collection system models. The document was developed by the Chartered Institution of Water and Environmental Management (CIWEM) Urban Drainage Group (UDG). These standards are generally agreed upon principles for model calibration/verification. Table 4.4 summarizes the DWF and WWF criteria employed during the calibration effort. Specific details regarding the modeling calibration effort are included below.

Table 4.5 Model Calibration Standards(1)

Parameter	DWF Criteria	WWF Criteria	Comments
Shape	Good Match	Good Match	General comparison of diurnal patterns.
Time of Peaks and Troughs	± 0.5 hour	± 0.5 hour	
Peak Depth (unsurcharged)	± 4" or ±10%, whichever is greater	± 4" or ±10%, whichever is greater	The timing of peaks and troughs should be similar having regard to the duration of the event.
Peak Depth (surcharged)	+ 20" to -4"	+ 20" to -4"	
Peak Flow	± 10%	+25% to 15%	
Flow Volume	± 10%	+20% to -10%	If applicable, care should be taken to exclude periods of missing or inaccurate data.

Notes:
(1) Based on Table 5-1 of the UDG Code of Practice for the Hydraulic Modeling of Urban Drainage Systems 2017.

4.3.2 Dry Weather Flow Calibration

DWF calibrations are performed to verify selection of the DWF parameters, and to verify construction of the model network/inputs. However, as noted previously, the influent flows to the Persigo WWTP were approximately 17 percent less than 2019 flow data and are therefore attributed to the impacts from the COVID-19 pandemic during the flow monitoring period. Due to this difference, the primary goal of the DWF calibration was to verify model construction, rather than verify selection of the DWF parameters. The calibration standards were followed to ensure the model could accurately predict flows within the collection system.

The DWF calibration was performed based on flow monitoring data from the selected DWF period as discussed in Chapter 3 (6/8 through 6/21). During this period, the daily average flow, and diurnal patterns were developed, and incorporated into the model. Based on the delineated subcatchments, the contributing population for each flow monitor was quantified to evaluate the estimated per capita flow rate for each flow monitor, which was also incorporated into the model. An overview of the initial DWF calibration, and per capita flow rates is included in Table 4.6, as well as a review of the calibration criteria and model results.

Table 4.6 Initial DWF Calibration Summary

Type	Monitor Location (Manhole ID)	Meter ID	Monitored Area/Location	Monitored Per Capita Flow Rate	Peak Depth, feet (unsurcharged)			Peak Flow, mgd				Flow Volume, MG			
					Observed	Predicted	Difference, feet	Observed	Predicted	Difference, mgd	Percent Difference	Observed	Predicted	Difference, MG	Percent Difference
AEG Flow Monitors	B3-271-006	GJ05	OMSD - East	77	0.79	0.54	-0.25	0.95	0.87	-0.08	-8%	4.78	4.81	0.03	1%
	C3-271-027	GJ06	CGVSD	48	0.66	0.91	0.25	2.02	1.83	-0.19	-9%	8.34	8.46	0.12	1%
	D2-252-002	GJ02	Southside, Interceptors	76	1.06	0.84	-0.22	4.37	2.34	-2.03	-46%	22.36	12.91	-9.45	-42%
	D2-252-152	GJ07	Grand Avenue, Interceptors	42	0.452	0.76	0.308	1.57	1.34	-0.23	-15%	6.98	6.37	-0.61	-9%
	D2-271-043	GJ08	Rood, Colorado, Fruitvale	88	0.65	0.48	-0.17	1.30	1.24	-0.06	-5%	6.36	6.43	0.07	1%
	D3-252-054	GJ10	Grand Avenue	121	0.49	0.33	-0.16	1.12	0.96	-0.17	-15%	5.54	4.45	-1.09	-20%
	E3-241-036	GJ04	Paradise Hills	133	0.52	0.51	-0.01	1.66	1.44	-0.22	-13%	7.88	7.76	-0.12	-2%
	E4-271-060	GJ09	15th Street	119	0.34	0.31	-0.03	0.63	0.59	-0.04	-6%	2.93	2.94	0.01	0%
	F1-232-013	GJ01	24 Road	161	0.36	0.32	-0.04	0.34	0.33	-0.01	-3%	1.43	1.54	0.11	8%
	F1-261-026	GJ03	Horizon Drive Upper	150	0.69	0.45	-0.24	1.00	0.93	-0.07	-7%	4.68	4.83	0.15	3%
2020 City Flow Monitors	C1-261-097		OMSD - West	85	0.87	1.02	0.15	1.97	1.72	-0.25	-13%	9.49	9.57	0.08	1%
	F1-231-003		Goat Wash	32	0.53	0.38	-0.15	0.54	0.43	-0.11	-20%	1.79	1.82	0.03	2%
	G3-211-017	Persigo WWTP	Persigo WWTP	85	-	-	-	12.50	10.95	-1.55	-12%	59.29	57.291	-2.00	-3%

Notes:
(1) Values in red do not conform to calibration criteria.
MG million gallons

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- **Flow Depth, Flow Volume, Peak Flow Rate, Flow Pattern:** The model generally aligns with the monitored data in terms of depth and volume, but the model under predicted peak flows. However, when reviewing the modeling output, it was apparent the discrepancies occurred due to short duration localized peaks that are most likely due to upstream lift stations. Since the predicted/observed flow patterns generally matched, the diurnal patterns were not adjusted to conform to the peak flows requirements.
- **Per Capita Flow Rates:** The per capita flow rates shown in the table range from 32 to 161 gallons per capita per day (gpcd). Details related to specific monitors are included below.
  - The lowest per capita flow rate was observed at the Goat Wash flow monitor. Based on the 2008 WW Basin Update and the 2019 monitoring data, the flows at this location historically have been low, which is most likely due to the number of residences in the subbasin still using septic systems.
  - Generally, the highest per capita flow rates are in areas with large water users which can include hospitals, large commercial areas, and industrial areas.
  - One specific issue observed with the initial DWF run was the low per capita flow rates at the GJ06 (CGVSD) flow monitor. Per capita flow rates for this monitor are low, and the model under predicts flow volumes at GJ02. Based on the system connectivity, GJ02 is located downstream of GJ06, GJ05, C1-261-097 (Orchard Mesa City) and GJ08, but not all flows from these monitors are conveyed to GJ02. Per capita flow rates are typical in meters upstream of GJ02, except for GJ06. The relatively low per capita flow rate calculated at GJ06, and the volume mismatch at GJ02 most likely means not all flow from CGVSD is conveyed through GJ06. Due to this difference, the per capita flow rate for the catchments contributing to GJ06 was adjusted to 85 gpcd, which is consistent with the influent Persigo WWTP data for the dry weather period.

The per capita flow rate was adjusted, and the revised calibration data is included in Table 4.6. With this adjustment, the peak flows at the Persigo WWTP are now accurately predicted in the model, although there is still a volume discrepancy at GJ02. Due to this issue, Carollo recommends reviewing the connectivity near GJ06 to determine where the flow from CGVSD is conveyed, and the source of the additional inflow. Overall, based on the updated dry weather calibration, it was concluded the model can accurately predict realistic flows within the collection system. This is demonstrated by the accurate level and volume prediction for a majority of the meter locations. Figures illustrating the predicted/observed flows based on the revised calibration are included in Appendix C.

During model development and project meetings, the potential interconnect between CGVSD and the Fruitvale basin was discussed/reviewed with City staff. Figure 4.3 illustrates some potential locations where this interconnect could be located. Portions of the CGVSD basin flow through the Fruitvale basin from the north, and there are parallel sewers along 29 1/2 Road, and 29 Road where the interconnect could be located.

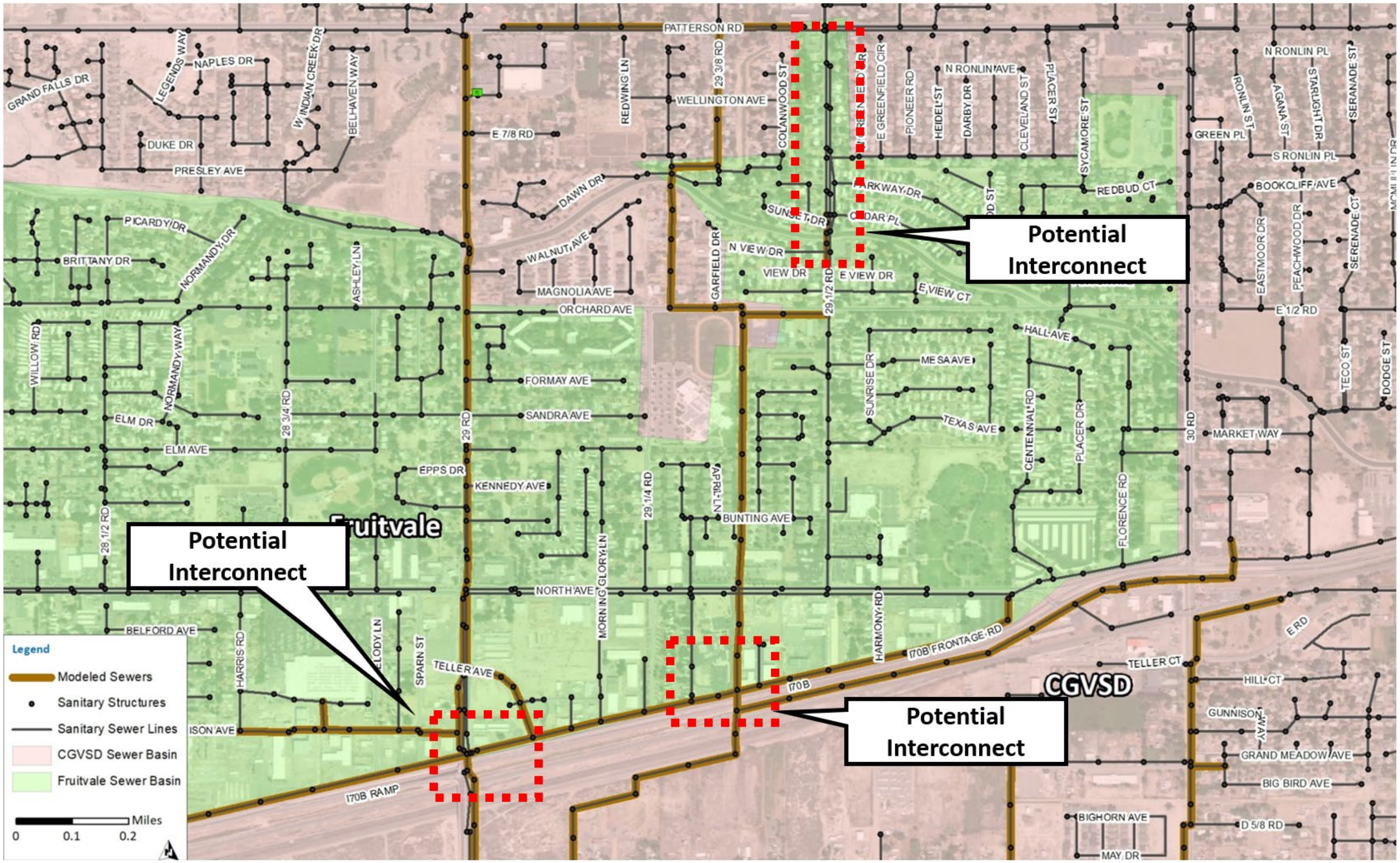

Figure 4.3 Potential CGVSD Interconnect Locations

Table 4.7 Revised DWF Calibration Summary

Type	Monitor Location (Manhole ID)	Meter ID	Monitored Area/Location	Peak Depth, feet			Peak Flow, mgd				Flow Volume, MG			
				Observed	Predicted	Difference, feet	Observed	Predicted	Difference, mgd	Percent Difference	Observed	Predicted	Difference, MG	Percent Difference
AEG Flow Monitors	B3-271-006	GJ05	24 Road	0.79	0.54	-0.25	0.95	0.87	-0.08	-8%	4.78	4.81	0.03	1%
	C3-271-027	GJ06	Southside, Interceptors	0.66	0.91	0.25	2.02	**3.27**	**1.25**	**62%**	8.34	**15.05**	**6.71**	**80%**
	D2-252-002	GJ02	Horizon Drive Upper	1.06	0.84	-0.22	4.37	**2.81**	**-1.56**	**-36%**	22.36	**15.04**	**-7.32**	**-33%**
	D2-252-152	GJ07	Paradise Hills	0.452	0.76	0.308	1.57	1.34	-0.23	-15%	6.98	6.37	-0.61	-9%
	D2-271-043	GJ08	OMSD - East	0.65	0.48	-0.17	1.3	1.24	-0.06	-5%	6.36	6.43	0.07	1%
	D3-252-054	GJ10	CGVSD	0.49	0.33	-0.16	1.12	0.955	-0.165	-15%	5.54	4.45	-1.09	-20%
	E3-241-036	GJ04	Grand Avenue, Interceptors	0.52	0.51	-0.01	1.66	1.44	-0.22	-13%	7.88	7.76	-0.12	-2%
	E4-271-060	GJ09	Rood, Colorado, Fruitvale	0.34	0.31	-0.03	0.63	0.59	-0.04	-6%	2.93	2.94	0.01	0%
	F1-232-013	GJ01	15th Street	0.36	0.32	-0.04	0.34	0.33	-0.01	-3%	1.43	1.54	0.11	8%
	F1-261-026	GJ03	Grand Avenue	0.69	0.45	-0.24	1	0.934	-0.066	-7%	4.68	4.83	0.15	3%
2020 City Flow Monitors	C1-261-097		OMSD - West	0.87	1.02	0.15	1.97	1.72	-0.25	-13%	9.49	9.57	0.08	1%
	F1-231-003		Goat Wash	0.53	0.38	-0.15	0.54	0.43	-0.11	-20%	1.79	1.82	0.03	2%
	G3-211-017	Persigo WWTP	Persigo WWTP	-	-	-	12.5	**12.32**	**-0.18**	**-1%**	59.29	**64.51**	**5.22**	**9%**

Notes:
(1) Values in red do not conform to calibration criteria.
(2) Bold values have changed as a result of the updated per capita flow rate.

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4.3.3 Wet Weather Flow Calibration

Typically, wet weather calibrations include calibrating and validating the model to a range of wet weather events. At least one calibration event is selected and used to adjust the model parameters, and then a validation event is used to verify model performance. However, as noted in Chapter 3, there were minimal wet weather events observed during the monitoring. As a result, the following steps were performed to calibrate the model for wet weather events.

- The subcatchments with inflow responses identified in Chapter 3 were calibrated based on the monitoring data. This included the areas contributing flow to GJ10 (Grand Avenue), and the subcatchments between GJ10 and GJ07 (Colorado Avenue/River Trunk). This generally meant 2.4 to 2.8 percent contributing area was specified for these subcatchments.
  - The wet weather hydrographs for the 6/24 to 6/25 wet weather event are included in Appendix D.
- For all remaining subcatchments, an assumed contributing area of 0.6 percent was incorporated into the model.
  - This assumed percentage was established to generally match the peaking factors established in the 2008 WW Basin Update based on the design storm event (PF = 3.4) at the Persigo WWTP.
  - The percent contributing was established to predict a peak flow of approximately 31 mgd at the Persigo WWTP. Based on discussions with City staff, this assumption provided a conservative estimate for planning purposes, and correlates to historical events.
  - Influent flow metering data at the Persigo WWTP is understood to potentially have inaccuracies as flow is backed up into the collection system during times of peak flow in order to limit influent flow to the Persigo WWTP to 20 mgd.

4.3.3.1 September 2020 Storm Event

As noted in Chapter 3, the City left the Goat Wash (F1-231-003) and OMSD - West (C1-261-097) flow monitors in operation. During early September 2020 (9/8 through 9/10), there were two wet weather events that were captured by the meters. A summary of the daily rainfall totals for the events is included in Table 4.4. The monitored data was incorporated into the model to determine if the data could be used to refine the weather parameters in the model. The monitored data at the OMSD - West flow monitor, and the predicted DWFs are illustrated in Figure 4.4. On 9/8/2020, there was not a significant increase in the peak flows, so the modeling parameters were not adjusted based on this data. Due the size of the event on 9/8/2020, and the minimal response in the model, more prolonged wet weather monitoring should be performed. The rain events in September were preceded by a long, dry period, which most likely minimized the amount of RDII that entered the system.

Table 4.8 September 2020 Wet Weather Event Summary

Date	24-Hour Rainfall Total, inch
9/7/2020	0.00
9/8/2020	0.95
9/9/2020	0.03
9/10/2020	0.24
9/11/2020	0.00

Notes:
(1) Daily rainfall totals based on data obtained for the WFO rain gauge http://ccc.atmos.colostate.edu/data_access.html.

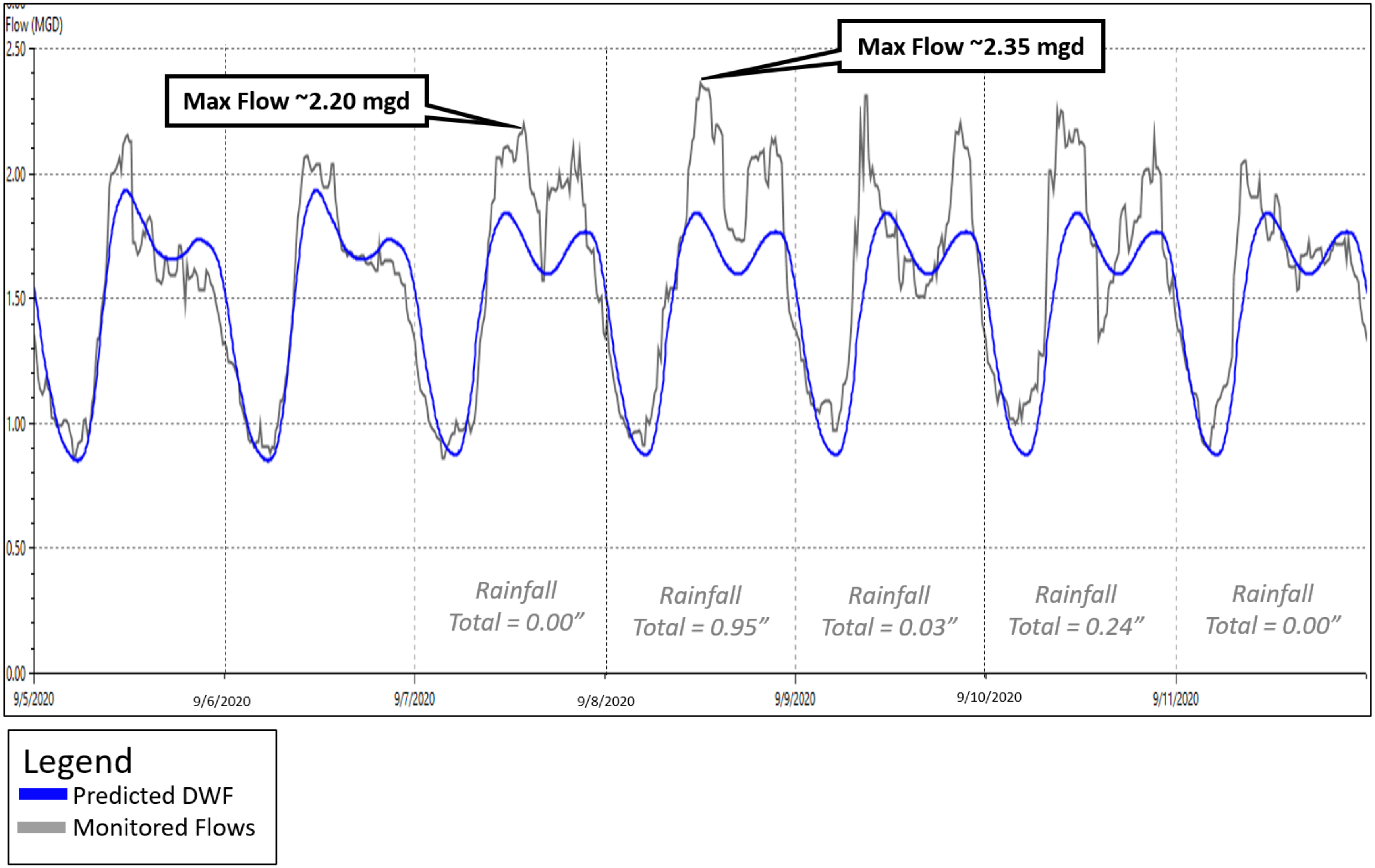

Figure 4.4 September 2020 Predicted/Observed Data (OMSD - West Flow Monitor)

4.3.4 Model Calibration Summary and Future Modeling Tasks

Overall, the DWF calibration was a success in that it demonstrated the model could accurately predict flow depths and volumes throughout the collection system. Due to the limited rainfall during the monitoring period, a true wet weather calibration could not be performed based on monitoring data. Thus, the wet weather parameters were established around a peaking factor of 3.4 at the Persigo WWTP. The following list summarizes how the model could be refined in the future.

- Verify connectivity in critical areas of the model such as Fruitvale/CGVSD, and upstream of the GJ06 (CGVSD) flow monitoring location.
- Perform additional flow monitoring during normal DWF conditions to calibrate per capita flow rates and refine diurnal patterns.
- Utilize water use data to validate per capita flow rates and identify large water users in the system during monitoring period.
- Perform additional flow/rainfall monitoring during the spring or fall wet weather seasons so the model could be calibrated to monitored rainfall and flow data.
    - Based on the September 2020 monitoring results, a more prolonged wet weather monitoring may be needed to refine the wet weather modeling parameters.

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Chapter 5

PLANNING CRITERIA AND DESIGN FLOW

5.1 Collection System Planning Criteria

The planning criteria outlined in this chapter were used to evaluate performance of the existing collection system, and size future capital improvements. It is important to have a defined set of planning criteria for the collection system so the desired level of service can be maintained through the 20-year planning horizon and beyond. The planning criteria are based on the City's Standard Contract Documents for Capital Improvements Construction (City Standard Specifications), the 2008 WW Basin Update, and from Carollo's past experience and engineering judgment.

5.1.1 Manning's Roughness Coefficient

The specified pipe roughness within the model is a key factor in the design capacity of each sewer. For sewer pipes, the Manning's coefficient (n) typically ranges from 0.011 to 0.017, with 0.013 being a representative value used for system planning. All existing sewers were assigned a Manning's n value of 0.013. Based on City design criteria, new sanitary sewers will be constructed using polyvinyl chloride (PVC) sewers. Due to this, new sewers will be sized with a Manning's n of 0.011. Additionally, some sewers have been recently rehabilitated using cured-in-place pipe (CIPP) lining so the Manning's n was reduced to 0.011.

5.1.2 Flow Depth Criteria (Gravity Sewers)

When evaluating system capacity, two maximum flow ratios are typically used. This includes the flow depth (d) to pipe diameter (D) ratio or d/D, and the peak flow (q) to design capacity (Q) ratio or q/Q. The d/D ratio is defined as the depth (d) of flow in a pipe during peak flow conditions compared to the pipe's diameter (D). The q/Q ratio is defined as the predicated peak flow (q) in a pipe during peak flow conditions compared to the pipes theoretical pipe capacity based on the Manning's equation (Q). For both ratios, a value less than 1.0 generally indicates the pipe has capacity to convey the peak flows. However, during dynamic model runs, predicted peak flows can exceed the theoretical Manning's design capacity before surcharging, which can be misleading and predict capacity limitations that are not observed in practice. Thus, the d/D ratio was used to define capacity-deficient trunk sewers and to determine the size of new improvements.

To determine sewer capacity using the model, the d/D will be evaluated for the predicted peak flows. The existing and proposed sewers will be evaluated using the same criteria as the 2008 WW Basin Update, which is included in Table 5.1. The existing sewer evaluation criteria are bracketed into three categories to help identify and prioritize CIP projects as summarized below.

- Sometimes a single sewer segment can be a bottleneck causing multiple upstream sewer segments to become surcharged. The greater the capacity deficiency, the higher the water levels will surcharge upstream of the bottleneck pipeline(s). The hydraulic model was used to identify these pipelines, known as "backwater" pipelines, to isolate specific pipelines that are the root causes of the capacity deficiency, rather than replacing all surcharged pipelines. Capital projects can then be proposed to increase flow capacity for the deficient sewers, which eliminates the backwater conditions that cause surcharging.

- Classifying segments/system bottlenecks into these categories can help identify flow balancing opportunities within the system. Flow balancing parallel systems fully utilizes the existing system capacity, which reduces the need for capital projects.
- The capacity/classification of each sewer was evaluated for each planning horizon to help identify triggers for capital projects.

The proposed sewers were designed for the specified d/D ratios included in Table 5.1 depending on the proposed pipe diameter. Typically, design d/D ratios for new sewer range from 0.5 to 0.92, with the lower values used for smaller pipes. Smaller pipes may experience flow peaks greater than the design flow and can be affected by blockages from debris, paper, or rags.

Table 5.1 Flow Depth Criteria

Location	Value	Meaning
Existing Sewer Evaluation	d/D ≤ 0.8	Adequate Capacity
	0.8 < d/D ≤ 1.2	Watch List
	d/D > 1.2	Review Improvement Need
Future Sewer Design	d/D ≤ 0.7	Interceptor Sewers (D ≥ 12 inches)
	d/D ≤ 0.6	Collector Sewers (D < 12 inches)

Notes:
(1) d/D evaluated at the predicted maximum flow rate. Criteria are consistent with the 2008 WW Basin Update.

5.1.3 Design Velocities and Minimum Slopes (Gravity Sewers)

To minimize the settlement of sewage solids, predicted velocities should be greater than or equal to 2.5 feet per second (ft/sec) for all sewers flowing at maximum depth (based on a roughness coefficient of 0.013). At this velocity, the sewer flow will typically self-clean the pipe. Table 5.2 lists the recommended minimum slopes to achieve the desired minimum velocity when the pipe flows at the design flow depth. Based on the City Standard Specifications, the minimum allowable pipe slope is 0.40 percent. When the identified capital projects are designed, the minimum slopes should be reviewed and evaluated to minimize future maintenance requirements.

Table 5.2 Flow Projection Parameters

Pipe Diameter, inch	Design d/D	Recommended Minimum Slope, ft/ft(1)	Slope, %
8	0.6	0.0045	0.45
10	0.6	0.0033	0.33
12	0.7	0.0024	0.24
15	0.7	0.0018	0.18
18	0.7	0.0014	0.14
21	0.7	0.0011	0.11
24	0.7	0.0010	0.10
27	0.7	0.0008	0.08
30	0.7	0.0007	0.07
36	0.7	0.0006	0.06
42	0.7	0.0005	0.05
48	0.7	0.0004	0.04
54	0.7	0.0003	0.03

Notes:
(1) Minimum slope corresponds to a desired minimum velocity of 2.5 ft/sec at the design d/D using a Manning's n = 0.013.

5.1.4 Lift Stations and Force Mains

The existing lift stations and force mains were evaluated to verify existing and future performance. The evaluation/design criteria are detailed in Table 5.3.

Table 5.3 Pumping System Evaluation Criteria

Criteria	Unit	Value	Comment
Minimum Force Main Velocity	ft/sec	3.0	Recommended operating velocity for normal operating conditions.
Maximum Force Main Velocity	ft/sec	8.0	Recommended maximum velocity.
Design Capacity(1)	--	Peak Flow	Can be managed through a combination of storage and pumping
Minimum Number of Pumps(2)	each	2	
Pumping Configuration(2)	-	n+1	Lift stations should convey design capacity with the largest pump out of service.

Notes:

(1) CDPHE design criteria (WPC-DR-1) for pumping and wet well sizing requires ability to accommodate peak instantaneous flow.

(2) Required per WPC-DR-2.

5.2 Design Flows

This section summarizes how the projected design flows were developed and implemented into the collection system model.

5.2.1 2008 Design Flow Summary

The 2008 WW Basin Update projected DWF and WWF through the year 2035. For DWF, the 2008 WW Basin Update utilized a population equivalent (PE) to project flows. A PE was equated as one resident or two employees. The total PE was multiplied by a unit flow rate of 85 gallons per day (gpd) to project the flows using the following equation:

$$Flow\ Rate = PE*85\ gpd = [(Employment * 0.5) + Population]*85\ gpd.$$

For the WWF, the 2008 WW Basin Update utilized a peaking factor of 3.5, which is consistent with this 2020 WW Basin Update. An overview of the projected flows from the 2008 WW Basin Update is included in Table 5.4.

Table 5.4 Flow Projection Parameters

Planning Horizon	Projected Population	Projected Employment Total	Total PE	Projected DWF, mgd
2008	78,150(1)	42,500(1)	99,400(1)	8.45(2)
2035	201,315(3)	91,819(3)	247,225(3)	21.01(2)

Notes:

(1) Obtained from Table TM3-1, 2008 Comprehensive Wastewater Basin Study Update (Black & Veatch).

(2) Projected DWF Calculated as PE*85 gpd. Represents projected DWF to the Persigo WWTP.

(3) Obtained from Table TM3-7, 2008 Comprehensive Wastewater Basin Study Update (Black & Veatch).

5.2.2 Dry Weather Flows

DWFs within the model are based on the total contributing population, average daily per capita flow rate, and a diurnal pattern specified within each subcatchment. A summary for each of these inputs, and how they were developed and implemented into the model are summarized in Table 5.5. The historical per capita flow rate (based on historical influent Persigo WWTP flows) was used in the collection system to generally align the flow projections between both WW Basin Updates.

Table 5.5 Dry Weather Flow Planning Parameters

Parameter	Value	Unit	Data Source	Comment
Dry Weather per Capita Flow Rate	90.5	gpcd	Historical influent Persigo WWTP flows. Refer to Chapter 2 of the 2020 Wastewater Treatment Facilities Master Plan (2020 Master Plan) for additional details.	Applied to all subcatchments.
Diurnal Pattern (Existing Service Area)	-	-	Monitored diurnal patterns collected during monitoring period.	Applied to existing subcatchments.
Diurnal Pattern (Future Service Area)	-	-	Historical influent Persigo WWTP flows.	Applied to future subcatchments.

5.2.3 Wet Weather Flows

WWFs predicted in the model are dictated by the rainfall depth, and total contributing area specified for each subcatchment. A brief overview of the wet weather parameters included in the model are detailed in Table 5.6. The selected design storm was the 5-year, 6-hour storm event with a depth of 0.73 inches based on the Grand Junction Stormwater Management Manual (2007). The storm distribution is included in Figure 5.1. The wet weather modeling parameters were setup around a wet weather peaking factor of 3.4 for the existing conditions at the Persigo WWTP as documented in Chapter 4.

Table 5.6 Wet Weather Flow Planning Parameters

Parameter	Value	Unit	Data Source/Comment
Design Storm Event	-	-	5-year, 6-hour storm.
Design Storm Event Depth	0.75	inch	Based on storm event depths included in Table 601 of the Grand Junction Stormwater Management Manual (2007).
Temporal Distribution			Soil Conservation Service 6-hour storm event.
Percent Contributing Existing Inflows	~2.5%		Applied to subcatchments contributing flow to GJ07 and GJ10.
Percent Contributing Existing System	0.60%		All existing subcatchments (except those noted above).
Percent Contributing Future System	0.60%		All future subcatchments.

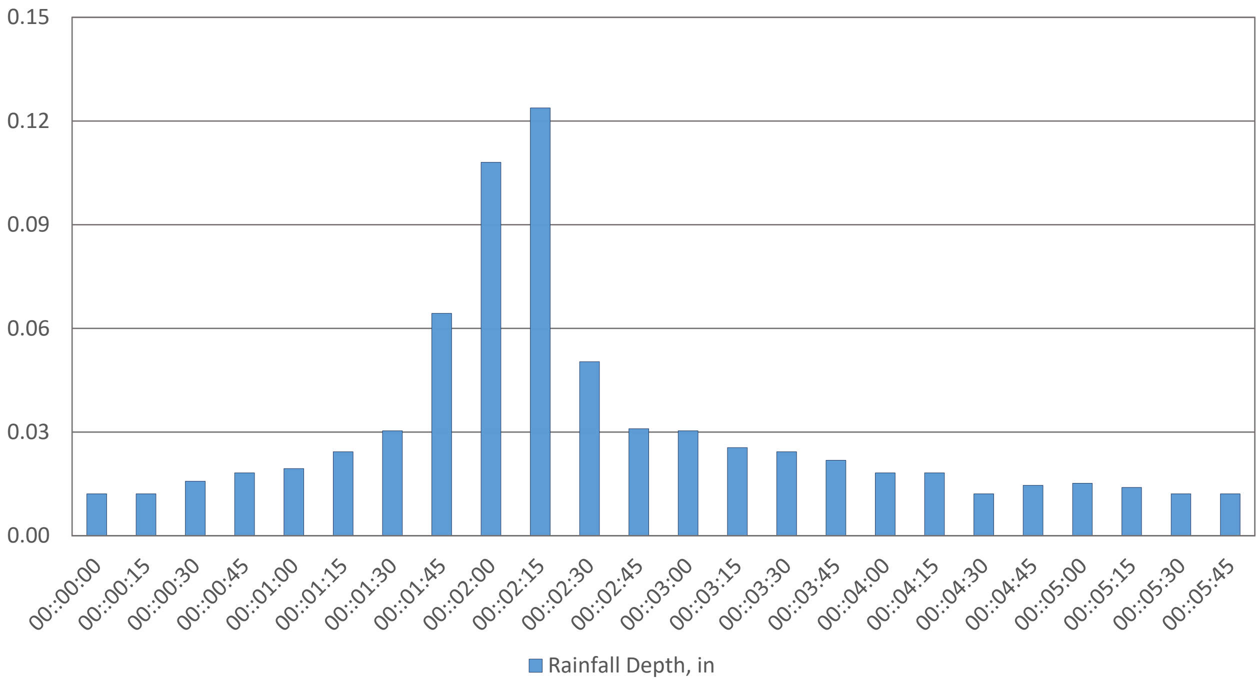

Figure 5.1 Wet Weather Design Storm Event Distribution (5-year, 6-hour)

5.2.4 Existing and Projected Peak Wet Weather Flow

Based on the flow inputs summarized above, the existing/future dry and wet weather peak flows were predicted in the model. An overview of the average DWF, peak DWF, and peak WWFs for each planning horizon are included in Table 5.7. These flows were used to identify existing system deficiencies, and evaluate the future capital improvements.

Table 5.7 Project Design Flows(1)

Planning Horizon	Daily Average DWF, mgd	Peak DWF, mgd	Peak WWF, mgd
Existing	9.07	11.75	30.96
2025	9.45	12.15	31.84
2030	10.02	12.84	33.20
2035	10.62	13.58	34.88
2040	11.25	14.41	36.20

Notes:
(1) Summary of total predicted flows to the Persigo WWTP within the dynamic collection system model. Modeled flows will be approximately equal to the planning values presented in the 2020 Master Plan.

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Chapter 6

CAPACITY EVALUATION AND PROPOSED IMPROVEMENTS

This chapter summarizes the collection system hydraulic capacity evaluation, a review of the proposed improvements, the planned system extensions, and some of the on-going system improvements/programs implemented by the City.

6.1 Capacity Evaluation

The collection system hydraulic capacity evaluation was performed to determine the system's capacity for current and projected flows. Both the DWFs and WWFs were evaluated for the existing, and 2040 planning horizons. The capacity of the gravity and pumping systems included in the hydraulic model were evaluated based on the existing system connectivity. The capacity evaluation was performed using the criteria and wastewater flow projections summarized in Chapter 5. Generally, the DWFs were evaluated for minimum velocity requirements, and the WWFs were evaluated for the overall system capacity based on the predicted d/D in each pipe segment.

6.1.1 Existing Conditions Capacity Evaluation

As indicated above, the DWF and WWFs were evaluated for the existing and future 2040 flows. To illustrate system capacity, a series of figures and tables were developed which are discussed in this section.

Figure 6.1 illustrates the existing system capacity for the existing DWFs and shows that almost every pipe has adequate capacity to convey the existing DWFs. The only pipes that are highlighted in the figure with elevated d/Ds are due to varying pipe sizes across manholes without matching crowns. In addition to the capacity, the predicted velocities were evaluated for the existing system. The results of this evaluation are illustrated in Figure 6.2. There are sewers that have DWF velocities less than 2.0 ft/sec. As noted in Chapter 5, the velocity requirements are specified around the peak flow. However, the system will generally convey DWFs so the DWF velocities may correlate to areas where preventative sewer maintenance may be needed. The two areas where a majority of the sewers operate at less than 2.0 ft/sec are the River Road North basin, and the old, combined areas near downtown.

The system was also evaluated for the existing peak WWFs which is illustrated in Figure 6.3. There are numerous segments that are classified as capacity deficient or need a potential improvement. A sewer is defined as capacity deficient when the predicted flow in the sewer is greater than the theoretical gravity flow capacity based on the Manning's equation. When this occurs, the sewer is most likely causing surcharging. Thus, a key factor in identifying which segments are causing the bottleneck, and may need improvements, was to focus on areas where there are both capacity deficient sewers and sewers with a d/D > 1.2 (Potential Improvement). There are capacity deficient sewers throughout the system, but in general, the OMSD, Fruitvale, and south side sewer basins were identified with the most capacity deficient sewers. These areas were the main focus of the capacity improvements.

6.1.2 Projected 2040 Flows Capacity Evaluation

The projected 2040 DWF/WWFs were also routed through the model to evaluate the existing system capacity in the future. Figure 6.4 illustrates the 2040 DWF capacity evaluation. Again, similar to the existing flows, there are minimal capacity concerns for the DWFs. Figure 6.5 illustrates the future DWF velocities. Overall, the predicted DWF velocities have increased across the system, but the River Road North sewer basin, and the old combined areas near downtown still have low predicted velocities. Lastly, Figure 6.6 illustrates the proposed capacity evaluation for the projected 2040 WWFs. Again, there are capacity concerns in the OMSD, Fruitvale, and south side areas. These areas will be targeted for the capacity improvement evaluation which is discussed below. To better illustrate the overall system capacity for the existing and proposed flows, Tables 6.1 and 6.2 include summaries of the DWF and WWF capacity performance, respectively.

Table 6.1 Existing and Future System Performance (DWFs)

Evaluation Criteria	Meaning	Existing Conditions(1)	Projected 2040 Flows(1)
d/D ≤ 0.8	Adequate Capacity	95.1%	94.5%
0.8 < d/D ≤ 1.2	Watch List	3.0%	3.2%
d/D > 1.2	Review Improvement Need	1.9%	2.2%
q/Q > 1.0	Capacity Deficient	0.5%	0.5%

Notes:
(1) Percent of total system defined by total linear foot per category.

Table 6.2 Existing and Future System Performance (WWFs)

Evaluation Criteria	Meaning	Existing Conditions(1)	Projected 2040 Flows(1)
d/D ≤ 0.8	Adequate Capacity	77.5%	71.3%
0.8 < d/D ≤ 1.2	Watch List	14.3%	19.5%
d/D > 1.2	Review Improvement Need	8.3%	9.2%
q/Q > 1.0	Capacity Deficient	8.3%	11.8%

Notes:
(1) Percent of total system defined by total linear foot per category.

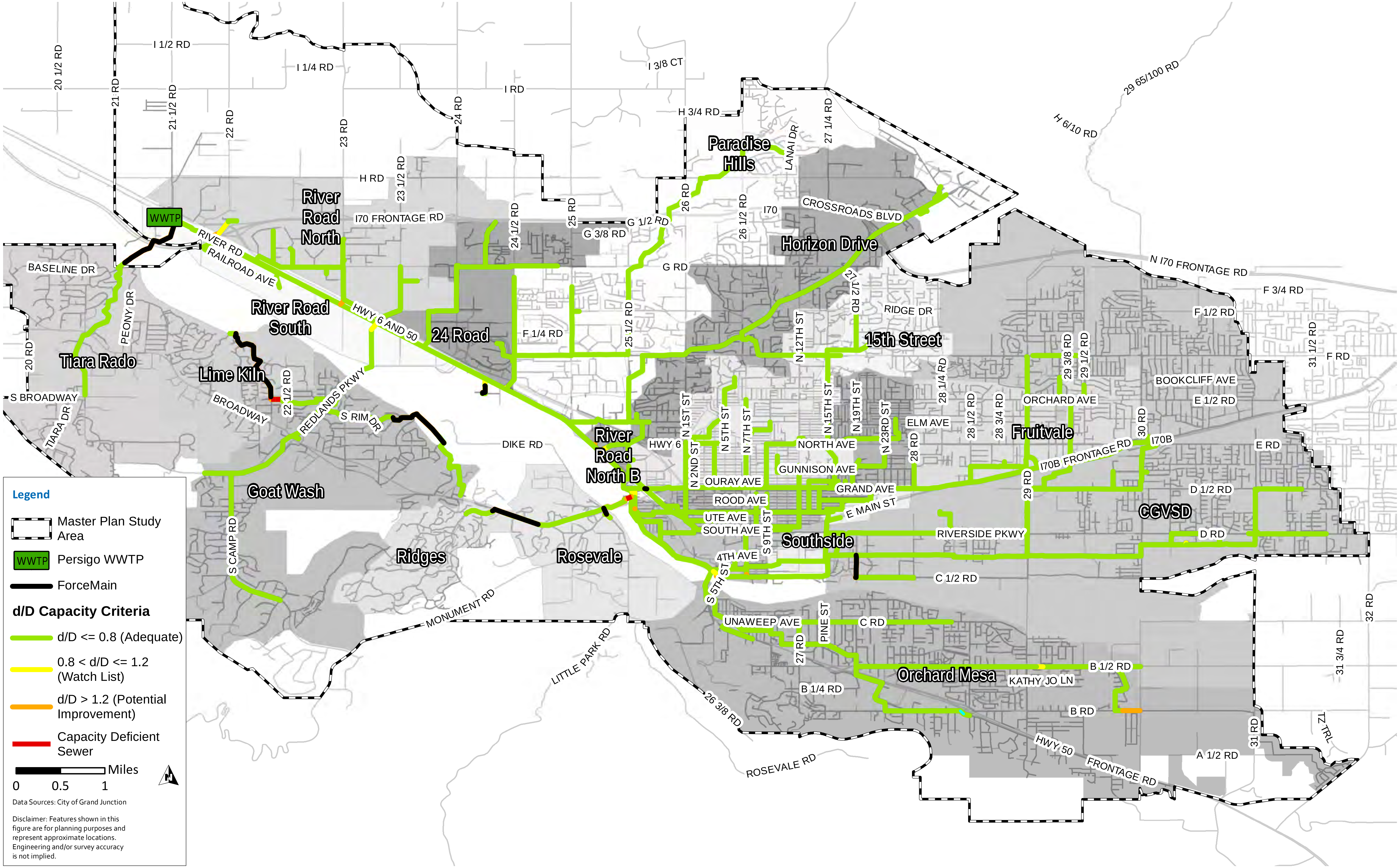

Figure 6.1 Existing DWF Capacity Evaluation

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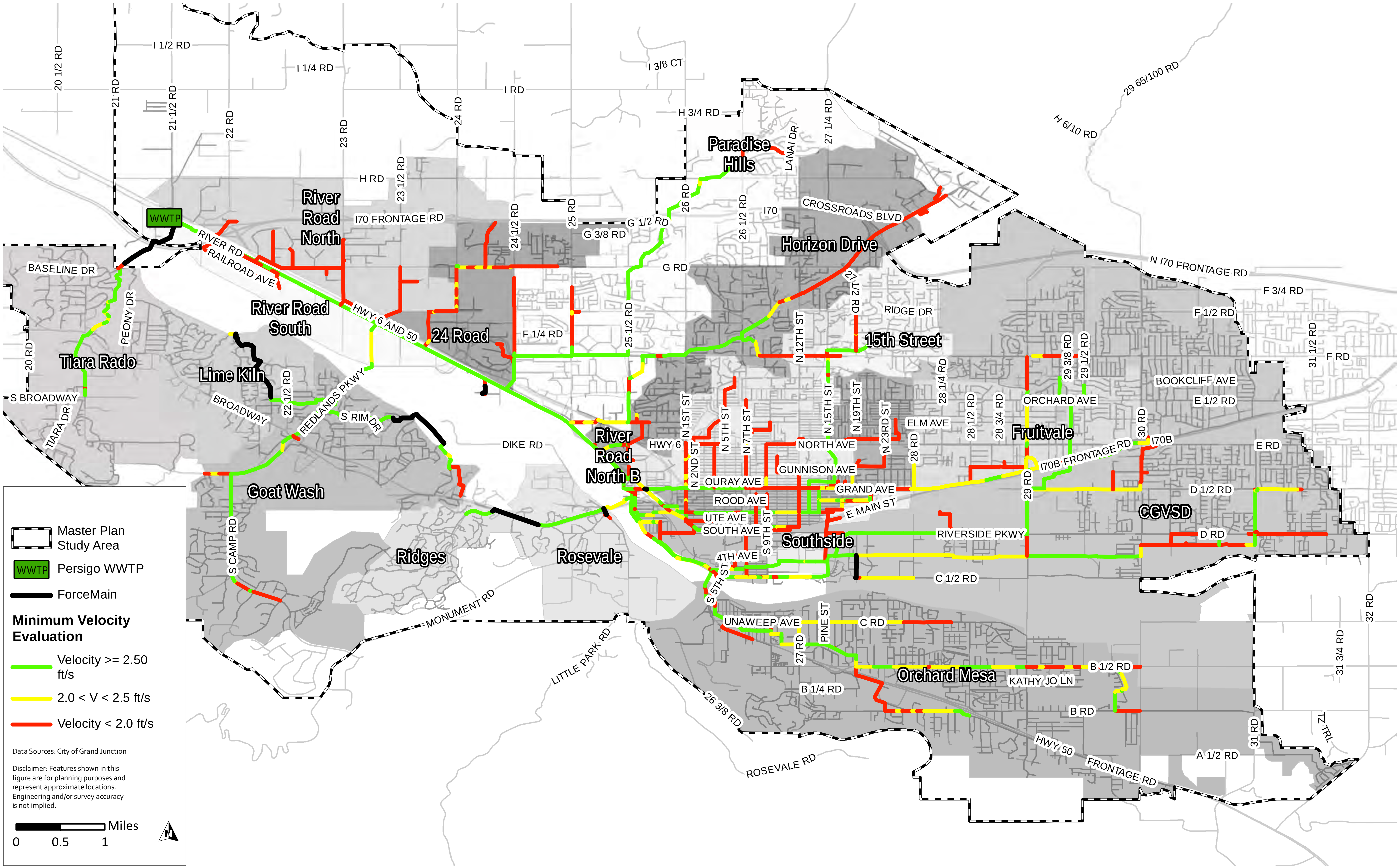

Figure 6.2 Existing DWF Velocity Evaluation

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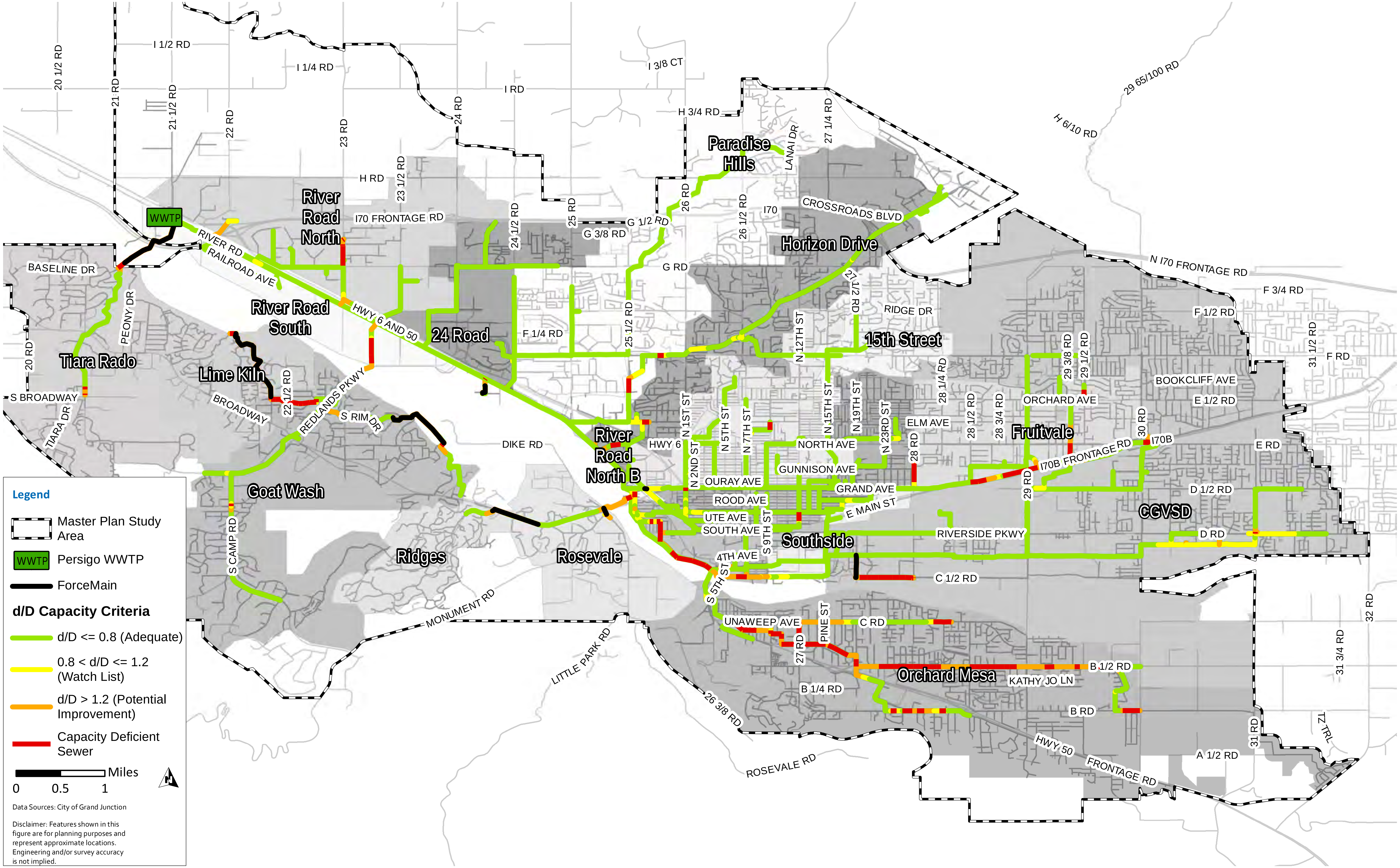

Figure 6.3 Existing WWF Capacity Evaluation

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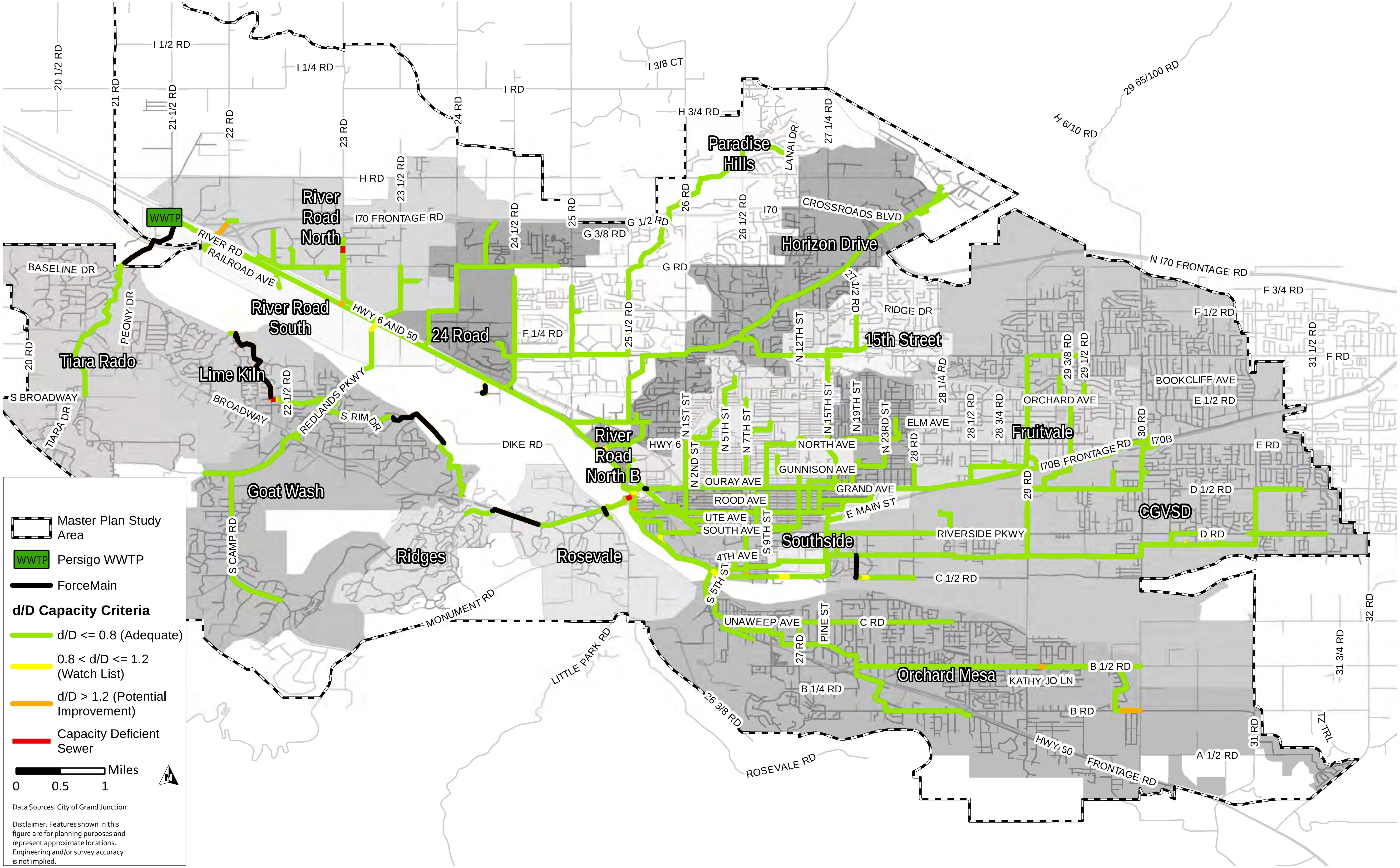

Figure 6.4 2040 DWF Capacity Evaluation

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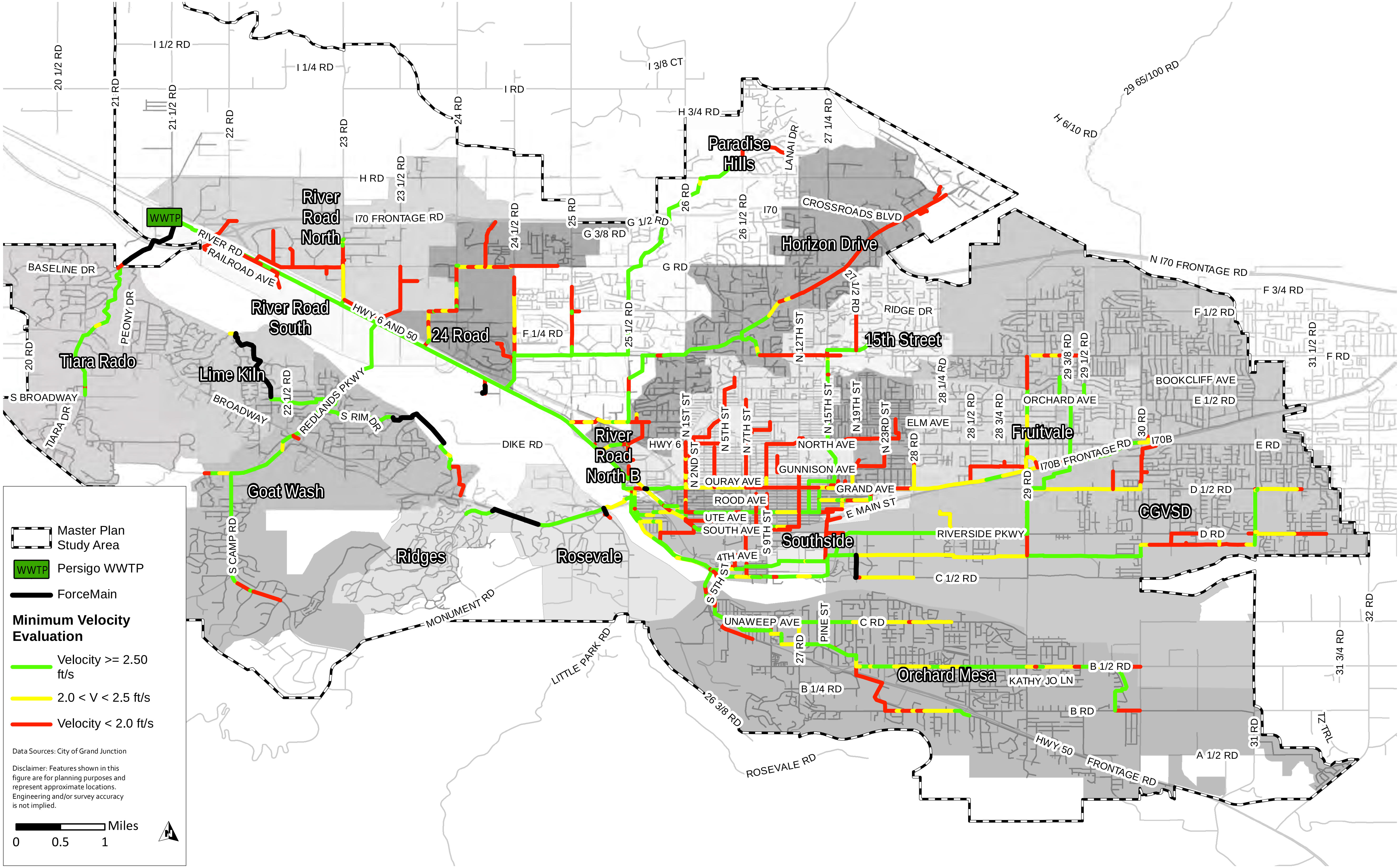

Data Sources: City of Grand Junction

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure 6.5 2040 DWF Velocity Evaluation

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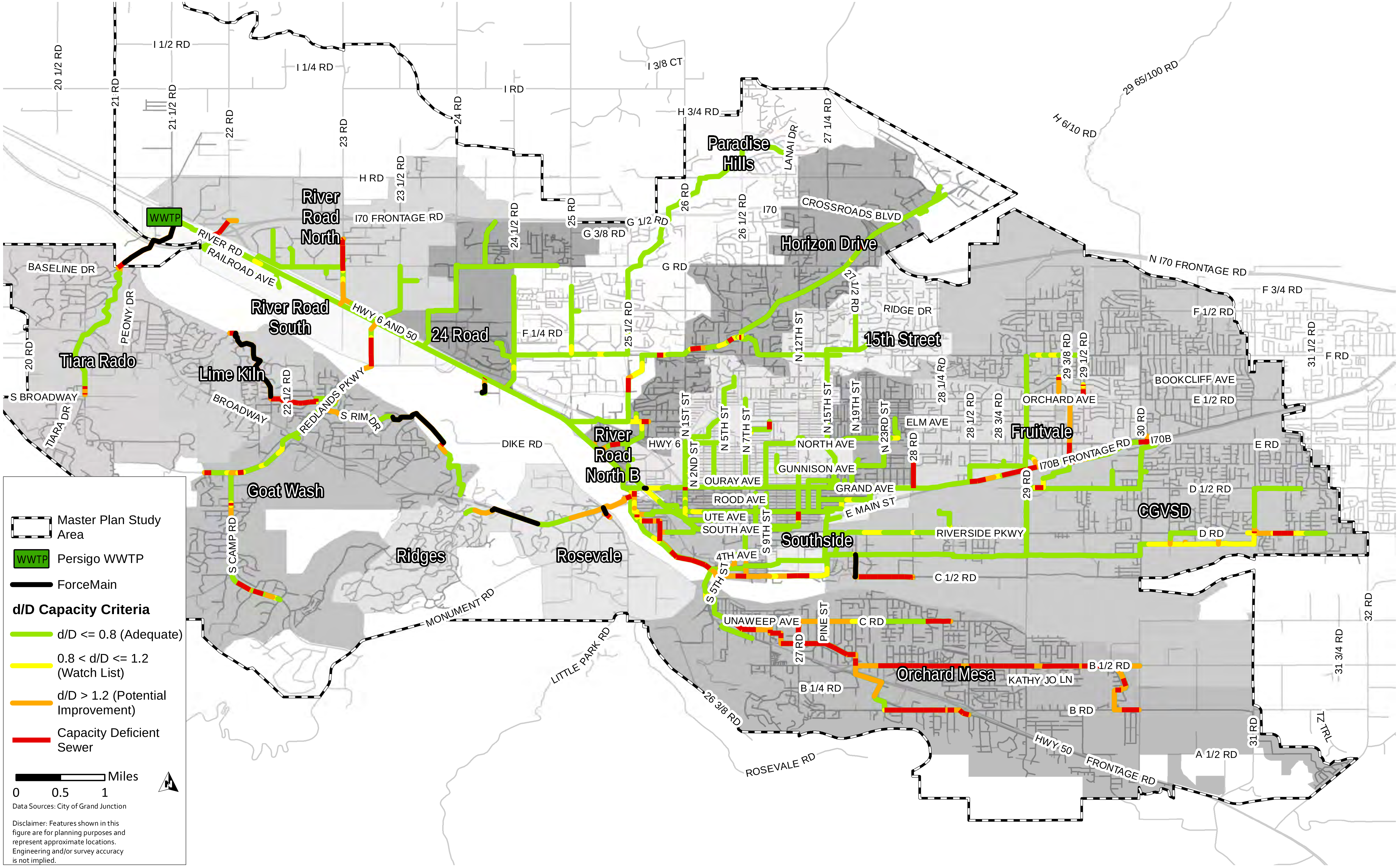

Figure 6.6 2040 WWF Capacity Evaluation

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6.1.3 Lift Station Capacity Evaluation (20-Year Planning Period)

The City has 26 existing lift stations and force mains in their collection system. As noted in chapter 4 only nine of the lift stations were included in the model and evaluated. Table 6.3 summarizes the results of the lift station capacity evaluations for the existing, 2030, and 2040 flows. A majority of the lift stations do not have the required firm capacity to convey the future peak WWFs.

Thus, the flow assumptions, desired level of service, contributing area, and total predicted flows should be verified prior to upsizing any lift station. Additional considerations regarding the lift station capacities are listed below.

- Conduct flow monitoring studies using internal equipment to determine appropriate peaking factor for each sewer/lift station basin based on 5-year or greater storm events.
- Complete physical inspection for those lift stations schedule for replacements (either based on condition or capacity) to understand scope of services.
- Use or add the lift station flow metering data to track DWF increases over the next 5 years.
- Verify DWF assumptions in the industrial areas using water use data.
- Verify lift station design capacity requirements/operations (firm versus total).

Real-time monitoring and control of the lift station operations is discussed in the 2020 Master Plan. The 2020 Master Plan recommends upgrading the communication devices and controls to provide cellular communications connected to the supervisory control and data acquisition (SCADA) system at Persigo WWTP. This will eliminate the existing radio system currently in use. Once this transition is started, additional real-time data can be collected to monitor flow, level, and pumping efficiencies during peak storm events. Using this data will provide further validation on the capacity constraints and needed capacity upgrades to meet the future 2040 WWF conditions.

Table 6.3 Lift Station Details

Lift Station Name	No. of Pumps	Pump Capacity, mgd(1)	Total Capacity, mgd	Firm Capacity, mgd(2)	Existing DWF, mgd	2030 DWF, mgd	2040 DWF, mgd	Existing WWF, mgd	2030 WWF, mgd	2040 WWF, mgd	Force Main Size, inch	Force Main Capacity, mgd(3)
Connected Lakes	4	0.26(4)	0.85	0.64(4)	0.18	0.17	0.16	1.23	1.23	1.22	6	1.02
Coors	2	0.46	0.92	0.46	0.00	0.00	0.00	0.75	0.75	0.75	6	1.02
El Poso	2	0.42	0.84	0.42	0.01	0.01	0.01	0.41	0.42	0.41	4	0.45
Grand Valley By-Products	2	0.56	1.12	0.56	0.51	0.50	0.64	1.22	1.23	1.26	6	1.02
Railhead	2	0.57(4)	1.14	0.57(4)	0.00	0.00	0.00	1.02	1.01	1.01	6	1.02
Redlands Village	4	0.56	2.24	1.68	0.30	0.30	0.30	1.94	1.92	1.92	8	1.81
Rosevale(8)	2	0.68	1.36	0.68	0.50	0.51	0.53	1.93	2.39	2.81	6	1.02
Tiara Rado	2	3.27	6.54	3.27	0.32	0.33	0.35	2.70	2.73	2.75	12	4.06

Notes:

(1) Pump capacity based on fixed discharge included in model unless noted otherwise. Pump sizing information provided by the City.

(2) Estimated firm capacity assumes the one pump is out of service.

(3) Force main capacity based on a max allowable velocity of 8 ft/sec. Values in red are less than projected future flows.

(4) Pump capacity dictated by pump curves included in the model.

(5) Projected flow values in red are greater than existing firm capacity. The City has not experienced any overflow events based on the existing conditions and capacities.

(6) DWF and WWF rates correspond to instantaneous peak flows predicted within the model for each planning horizon/flow.

(7) Future flows to the Rosevale Lift Station will be reduced due to the Power Road Lift Station project.

(8) DWFs were derived from population projections within the collection system. Some lift stations only serve industrial/commercial areas so there are no DWFs predicted in the model. Industrial flows should be verified during future evaluations.

6.2 Collection System Capacity Improvements

Existing system improvements were identified based on the capacity evaluation to increase the level of service in the collection system based on the criteria established in Chapter 5. This included new sewers and upsizing existing lift stations. This section provides and overview of the proposed improvements.

6.2.1 Capacity Improvements for 2040 WWF Conditions

For this 2020 WW Basin Update, it was assumed that capacity deficient sewers would be replaced with a new larger diameter sewer. The upsized pipelines generally followed the same slope as the existing pipeline to conform to the design criteria. The inverts and diameters of the existing sewers should be verified, and the final decision to replace, realign, or construct a parallel sewer should be made during preliminary design. Some of the improvements that are located at the very upstream edges of the model may need to be extended depending on the upstream capacity of the smaller diameter sewers.

Lift stations/force mains were upsized to convey the peak 2040 WWF as shown in Table 6.3. It was assumed that lift stations/force mains would be upsized if the 2040 WWF was greater than the total lift station capacity or the force main capacity. The final pumping capacity, and force main size needs to be verified during design.

Figure 6.7 illustrates a system wide overview of the proposed capacity improvements, which are detailed in Table 6.4. A comparison to the 2008 WW Basin Update shows similar level of capacity constraints; however, the 2020 WW Basin Update includes upsizing 10-inch diameter sewers, which were not included in the 2008 WW Basin Update.

- 2020 WW Basin Update identifies approximately 61,000 lf of new sewers.
- 2008 WW Basin Update identified approximately 65,000 lf of new sewers.

The proposed level of service that includes the identified system improvements based on the 2040 WWFs is illustrated in Figure 6.8. As shown in the figure, a majority of the capacity deficiencies have been addressed. However, not every single capacity deficient sewer was scheduled for replacement as part of this 2020 WW Basin Update.

The modeling results illustrate there could be localized deficiencies identified that are due to modeling assumptions that require further investigation. For example, the invert and ground level elevations need to be verified in some areas of the model as assumed values were utilized. The assumed and inferred values were flagged in the model using data flags. Through further evaluations, the City may accept some small pipeline surcharging, adjust pipe slopes based on actual data, and may decide not to upsize infrastructure. Additionally, the impacts of how the lift stations were modeled may cause some pipeline surcharging. This can be confirmed by the City conducting short-term flow monitoring studies.

Pipeline inverts will need to be verified and refined during the preliminary design phase to provide a consistent slope/capacity conforming to the design criteria. Lastly, the sewers/siphons crossing the Colorado River were not included in the improvement plan due to the unknowns associated with the river crossing even though they were surcharged during the modeling runs. If capacity concerns are discovered in the future, additional modeling and evaluations should be performed.

As noted above, three target areas were identified for a more refined capacity/improvement evaluation which are discussed separately below.

Table 6.4 Proposed Improvement Summary

Project ID	Type of Improvement	Project Description	Existing Size (inch/mgd)	Proposed Size (inch/mgd)	Action	Length (feet)	Reason
CGVSD Sewer Basin							
CGVSD-1	Gravity	Upsized gravity sewer upstream of CGVSD By-Products Lift Station along C 1/2 Road	10	15	Upsize	2,727	Surcharging over performance criteria
CGVSD-2	Pump station	Upsized CGVSD By-Products Lift Station	1.1	2.6	Upsize	-	Predicted flow is greater than total lift station capacity
	Force main	Upsized CGVSD By-Products Lift Station force main	6	10	Upsize	1,354	Exceeded maximum allowable force main velocity
Interceptor Flow Balance							
FB-1	Gravity	Flow diversion measures to balance flow along south side interceptors	Varies	Varies	Upsize	-	Surcharging over performance criteria
Fruitvale Sewer Basin							
FV-1	Gravity	Upsized sewer along 28 Road	10	15	Upsize	1,500	Surcharging over performance criteria
FV-2	Gravity	New sewer along Orchard Avenue to divert flow to the east away from 29 3/8 road sewer	-	10	New sewer	1,650	Surcharging over performance criteria
	Gravity	Upsized sewer along Frontage Road	10	12	Upsize	4,664	Surcharging over performance criteria
	Gravity	Upsized sewer adjacent to 29 3/8 Road	12	15	Upsize	1,204	Surcharging over performance criteria
FV-3	Gravity	Upsized sewer along 29 1/2 Road	10	12	Upsize	658	Surcharging over performance criteria

Project ID	Type of Improvement	Project Description	Existing Size (inch/mgd)	Proposed Size (inch/mgd)	Action	Length (feet)	Reason
Goat Wash Sewer Basin							
GW-1	Gravity	Upsized sewer along Tiffany Drive/El Rio Drive	8	15	Upsize	3,351	Surcharging over performance criteria
GW-2	Gravity	Upsized sewer along S. Rim Drive	8	12	Upsize	3,661	Surcharging over performance criteria
	Pump Station	Upsized Connected Lakes Lift Station	0.5	1.2	Upsize	-	Predicted flow is greater than total lift station capacity
	Force main	Upsized Connected Lakes Lift Station force main	6	8	Upsize	3,531	Exceeded maximum allowable force main velocity
OMSD Sewer Basin							
OM-1	Gravity	Upsized sewer along B 1/2 Road.	10/12	15	Upsize	2,980	Surcharging over performance criteria
	Gravity	Upsized sewer along B 1/2 Road	15	18	Upsize	4,892	Surcharging over performance criteria
	Gravity	Upsized sewer along B 3/4 Road	18	24	Upsize	8,766	Surcharging over performance criteria
OM-2	Gravity	Upsized sewer along B 1/2 Road	10	12	Upsize	2,033	Surcharging over performance criteria
	Gravity	Upsized sewer along Frontier Street	10	15	Upsize	4,079	Surcharging over performance criteria
OM-3	Gravity	Upsized sewer along B Road	10/12	15	Upsize	4,489	Surcharging over performance criteria
OM-4	Gravity	Upsized sewer along 27 Road	12	15	Upsize	1,334	Surcharging over performance criteria
OM-5	Gravity	Upsized sewer along Unaweep Avenue	10	15	Upsize	1,156	Surcharging over performance criteria
River Road North Sewer Basin							
RRN-1	Gravity	Upsized sewer along River Road North	8-12	15	Upsize	3,655	Surcharging over performance criteria

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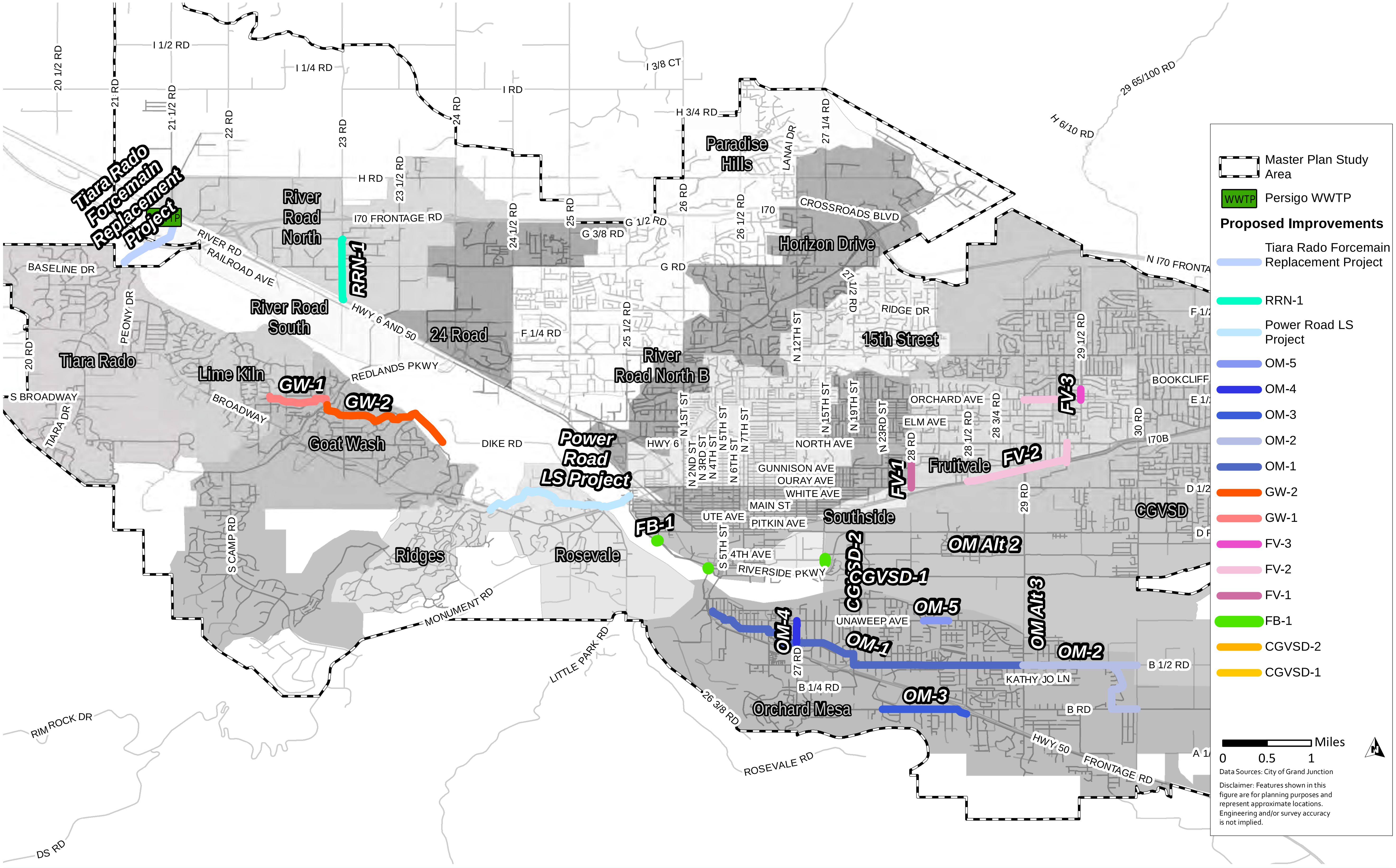

Figure 6.7 Proposed Improvement Overview

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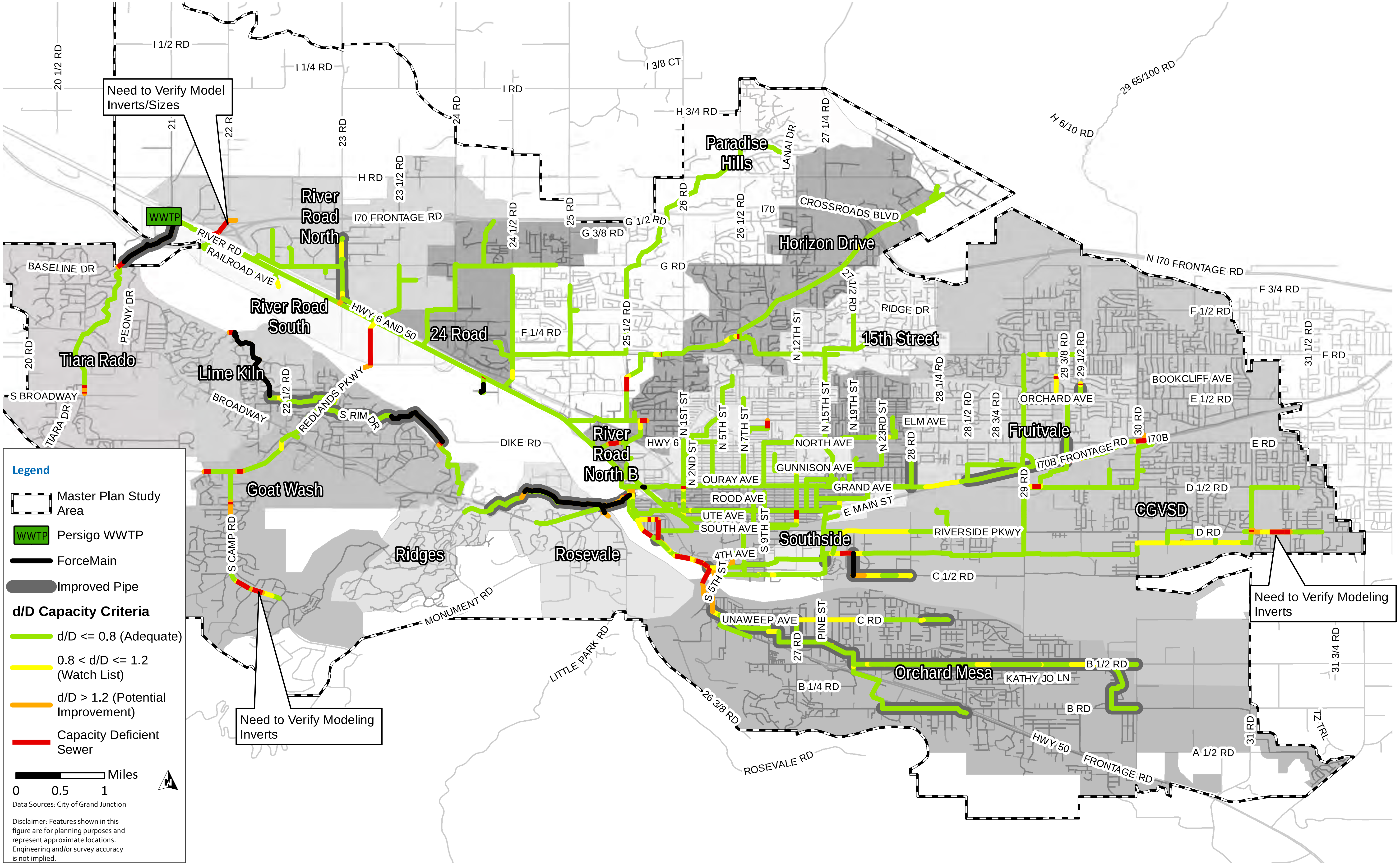

Figure 6.8 Proposed 2040 WWF Improved LOS

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6.2.1.1 Orchard Mesa

The OMSD Sewer Basin was targeted for a more detailed evaluation due to the quantity of capacity deficient sewers based on the 2040 flows. This was also an area identified as having capacity issues as part of the 2008 WW Basin Update. The proposed capacity improvements in this area include three scenarios which are illustrated in Figure 6.9 and summarized in Table 6.5. The three concepts were evaluated to minimize surcharging along the main trunk through the OMSD Sewer Basin, which was upsized as part of Project OM-1.

- **Alternative 1:** The base concept evaluated for OMSD was to upsize all sewers that were identified as capacity deficient following the existing trunk alignment (Project OM-1). Project OM-1 included upsizing all sewers downstream of 29 Road.
- **Alternative 2:** Includes an aerial crossing of the Colorado River along 29 Road and diverts flow away from the capacity deficient sewers in the OMSD Sewer Basin. Scenario 2 follows the same alignment as in the 2008 WW Basin Update. However, depending on piping elevations, this routing may not be viable. The ground elevations north of the bridge crossing is approximately 4,590 feet, and near the 29 and C 3/4 Road Intersection, the ground elevation is approximately 4,602 feet. This elevation difference results in a large portion of the C 3/4 Road sewer needing to be reconstructed at a lower elevation.
- **Alternative 3:** Includes an aerial crossing of the Colorado River along 29 Road and diverts flow away from the capacity deficient sewers in the OMSD Sewer Basin. This alternative conveys the OMSD flows to the existing CGVSD By-Products Lift Station. The two main advantages of this alternative include the ground elevations along C 1/2 Road slopes towards the existing CGVSD By-Products Lift Station, and the existing sewer/lift station are slated for replacement through projects CGVSD-1 and CGVSD-2.

A more detailed evaluation should be performed to refine the design flows and proposed alternatives as part of the preliminary design.

Table 6.5 OMSD Alternative Summary

Scenario	Infrastructure Requirements	Advantages	Disadvantages
1	• 2,980 lf 15" • 4,892 lf 18" • 8,766 lf 24" • Total lf = 16,638	• No aerial crossing • Potentially smallest overall project size/length	• Construct along existing, developed corridors • Increased construction costs due to constructability issues and other utilities
2	• Aerial crossing • 3,015 lf 15" • 20,549 lf 24" • Total lf = 23,563	• Minimizes improvements through OMSD Basin	• Aerial crossing • Constructing against grade • Potentially most expensive option (largest single project)
3	• Aerial crossing • 13,333 lf 18" • 8,987 lf 24" • Upsize CGVSD By-Products Lift Station • 1,354 lf 10" FM • Total lf = 23,674	• Minimizes improvements through OMSD Basin • CGVSD Lift Station, force main (1,354 lf), and ~2,700 lf of 18" sewer included as part of CGVSD-1 and CGVSD-2 projects • C 1/2 Road is mostly undeveloped at this time	• Increase capacity of CGVSD By-Products Lift station

6.2.1.2 River Trunk Interceptors

The River Trunk interceptors include a 21-inch northerly, and 27/30-inch southerly diameter sewers, and by integrating flow balancing between these interceptors, the City may alleviate capacity deficiencies. Flow balancing can be utilized in parallel sewers by shunting flow away from the capacity deficient sewer to maximize use of the existing system. The interceptors are located just north of the Colorado River near downtown. As illustrated in the capacity evaluations, the 21-inch northerly interceptor was identified as being capacity deficient, while there is capacity available in the 27/30-inch southerly interceptor.

The potential flow balancing improvements and proposed hydraulic grade line are illustrated in Figure 6.10. At the two interconnect locations, a new junction structure or sewer can be used to hydraulically connect the parallel sewers. Depending on the pipe/hydraulic grade line elevations, a check valve may be needed to isolate the capacity deficient sewer. Additionally, a third location located near 15th Street was identified where flow could be redirected towards the 27/30-inch sewer.

6.2.1.3 Fruitvale Area

The Fruitvale area was identified for further evaluations due to the location and number capacity deficient sewers. A more detailed view of the proposed/existing sewers is included in Figure 6.11. As shown in Figure 6.11, most of the existing Fruitvale interceptor may need to be upsized. As a further refinement of the proposed improvements in this area, flow could be diverted towards the CGVSD Sewer Basin near 29 Road. This would use the existing capacity of the adjacent sewers. When these improvements are designed, the flow split in this area needs to be evaluated. As documented in Chapter 4, there may already be an interconnect with the CGVSD sewers.

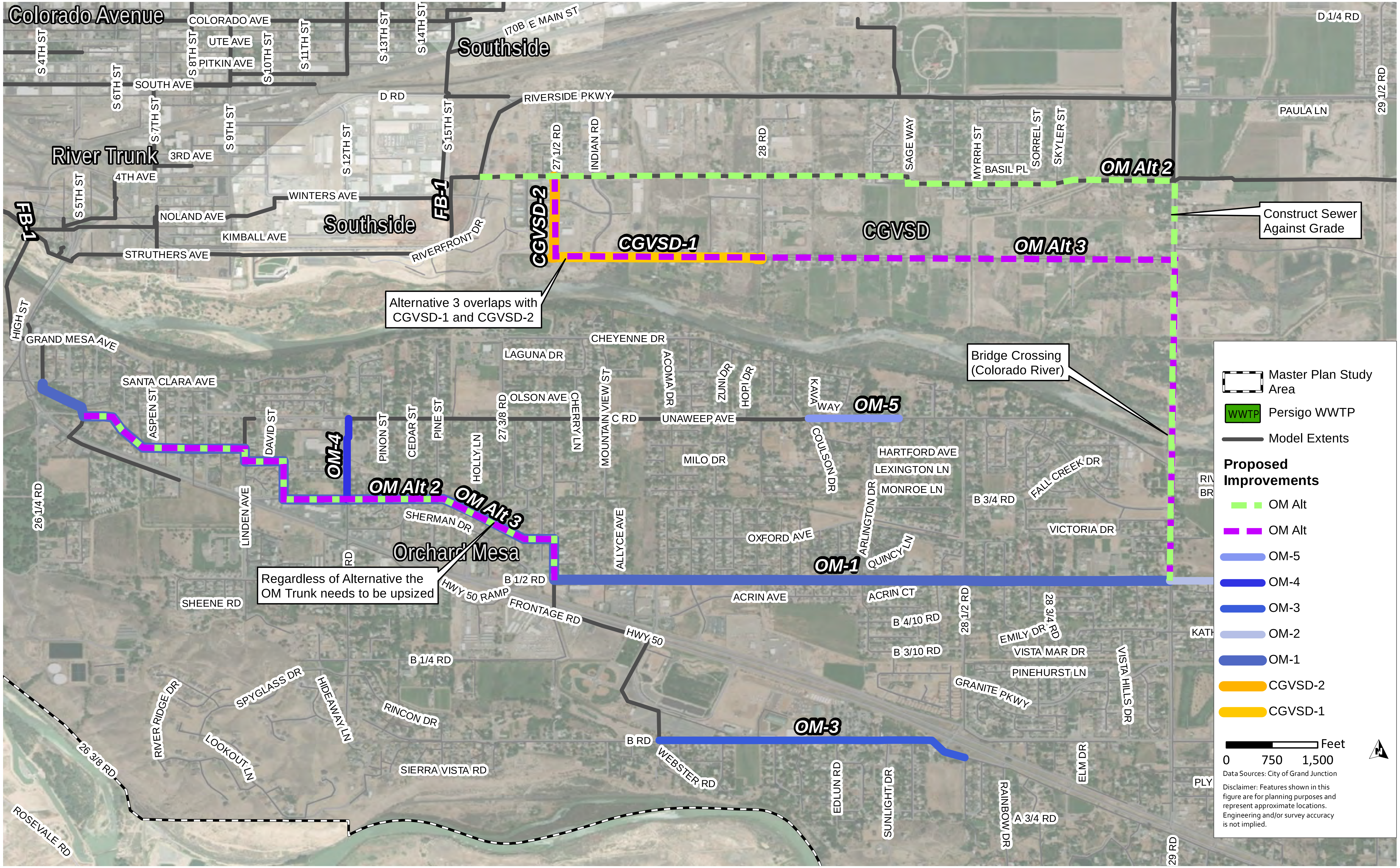

Figure 6.9 Orchard Mesa Capacity Improvement Overview

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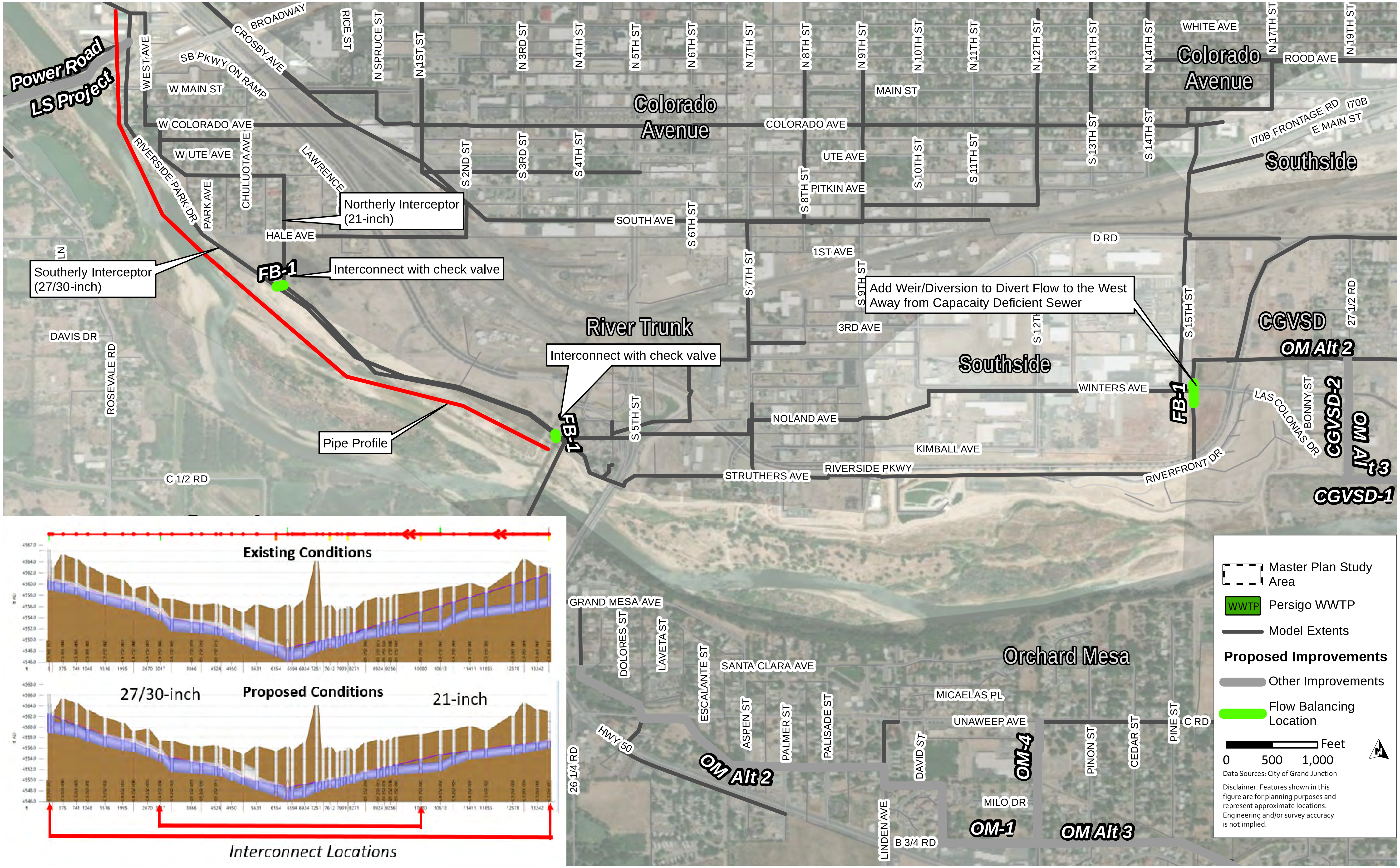

Northerly Interceptor (21-inch)

Southerly Interceptor (27/30-inch)

Interconnect with check valve

Interconnect with check valve

Add Weir/Diversion to Divert Flow to the West Away from Capacaity Deficient Sewer

Pipe Profile

Data Sources: City of Grand Junction

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure 6.10 Flow Balancing Capacity Improvement Overview

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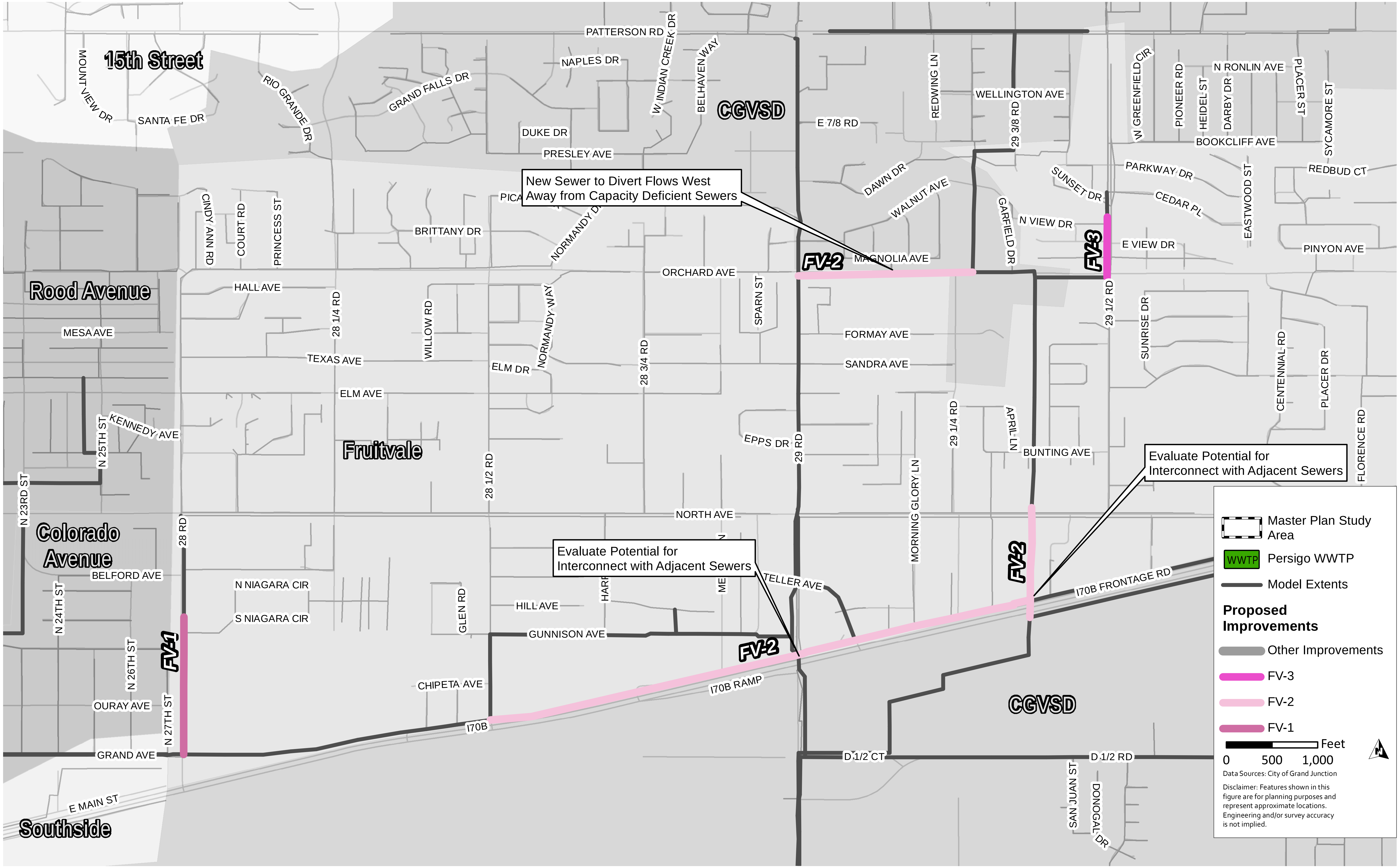

New Sewer to Divert Flows West Away from Capacity Deficient Sewers

Evaluate Potential for Interconnect with Adjacent Sewers

Evaluate Potential for Interconnect with Adjacent Sewers

Data Sources: City of Grand Junction

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure 6.11 Fruitvale Capacity Improvement Overview

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6.2.2 Future System Utilization

To evaluate where additional future growth could occur, the future system capacity was evaluated. This included quantifying the percent utilization of each sewer using the predicted d/D based on the improved system. An overview of this evaluation is included in Figure 6.12.

6.3 Collection System Expansion to Serve Future Growth

To serve future customers system expansion will be required. This will include extensions to new developments outside the existing service area and extensions to infill development and existing septic systems. This section describes how the extension projects were identified.

6.3.1 System Extension Classification

The system extensions were grouped into two categories as defined below. The classifications were based on the municipal code trunkline extension program, which was also referenced in the 2008 WW Basin Update. These designations are included for each extension project identified in the CIP. These criteria are used to define how funding is established for extension projects.

- **Developer Extensions:** New sewers constructed to service a single development area.
  - These extensions are typically 8 to 10 inches in diameter.
  - Developers would pay for this extension to serve their development.
- **Trunk Extensions:** Large extensions to serve multiple development/growth areas.
  - These extensions are sometimes larger than developer extensions.
  - The City would pay for these extensions unless cost sharing is provided.
  - Similar to the 2008 WW Basin Update, cost sharing between the City and developers may be available for these projects if the following criteria are met.
    - The extension is identified in this 2020 WW Basin Update.
    - The area is expected to see additional development within the next 3 years.
    - The developer pays for 15 percent of the total cost.

The City staff will be evaluating the City's policies and future classification of extension lines. Also, in early 2021, the City indicated the municipal code may be updated so the project classification and funding should be verified for each project.

6.3.2 System Extension Projects

The extension locations were based on information provided by the City on the future buildout areas. There are two locations, the River Road North area and the OMSD Basin, where preliminary alignments were created and analyzed using available ground surface elevations and existing system invert elevations. Table 6.6 provides information on the preliminary future sewer and force main extensions. The extensions are illustrated in Figures 6.13 and 6.14. An additional extension project was identified along Monument Road in early 2021. This extension is illustrated in Figure 6.14a.

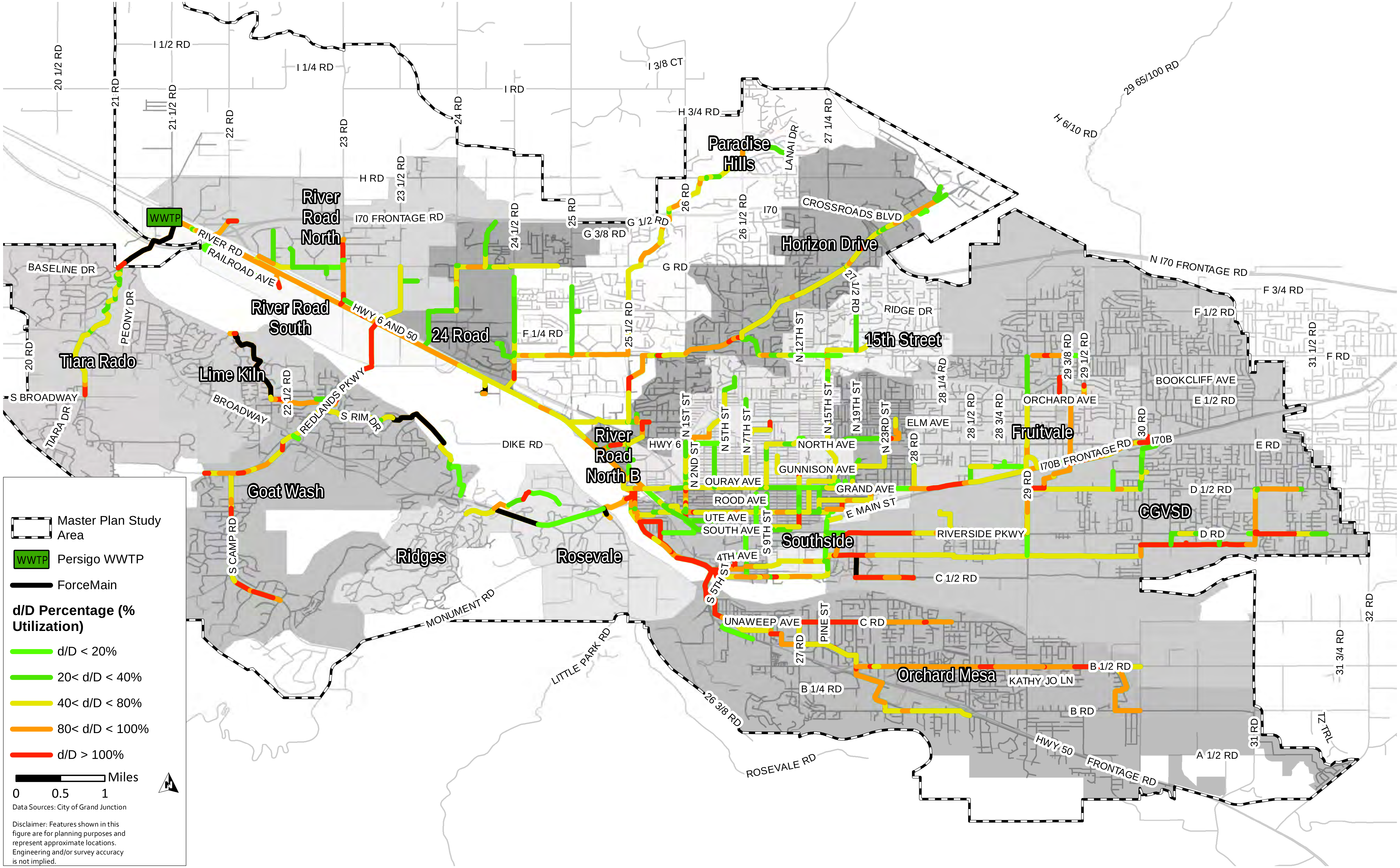
The City identified two additional areas that will require a system extension project in the future. As development occurs in these two areas a more detailed analysis will be required to identify the scope and routing to extend sewer service. Based on the limited information and uncertainty with physical routings, the costs for these two sewer extensions have not been included in the CIP. Figures 6.13 and 6.14b illustrate these two locations.

Table 6.6 Future Sewer and Force Main Extensions

Extension Name	Type	Diameter (in)	Length (ft)	Funding Source
21.5 Road	Gravity	8	4,700	Trunk
22 Road	Gravity	10	5,240	Trunk
22 Road	Gravity	8	2,705	Trunk
23 Road	Gravity	8	9,150	Trunk
23.5 Road	Gravity	8	2,025	Developer
24.5 Road	Gravity	8	1,340	Trunk
30 Road	Gravity	8	6,570	Trunk
31st Street	Gravity	8	3,805	Trunk
A 1/2 Road	Gravity	8	2,340	Trunk
A 1/2 Road	Gravity	8	865	Developer
B 1/2 Road	Gravity	8	1,170	Developer
B 1/2 Road	Gravity	8	2,635	Trunk
C Road	Gravity	8	3,875	Developer
C Road	Force main	8	2,655	Trunk
H Road	Gravity	8	2,645	Developer
Mesa Road	Gravity	8	7,080	Trunk
N 170 Crossing	Gravity	10	195	Trunk
N I70 E of 24.5 Road	Gravity	8	1,820	Developer
N I70 west of 24.5 Road	Gravity	10	1,890	Trunk
Monument Road	Gravity	8	12,600	Trunk

Notes:

(1) The capital costs associated with these extensions are provided in Chapter 7.



Data Sources: City of Grand Junction

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure 6.12 Future System Utilization (Improved 2040 WWF)

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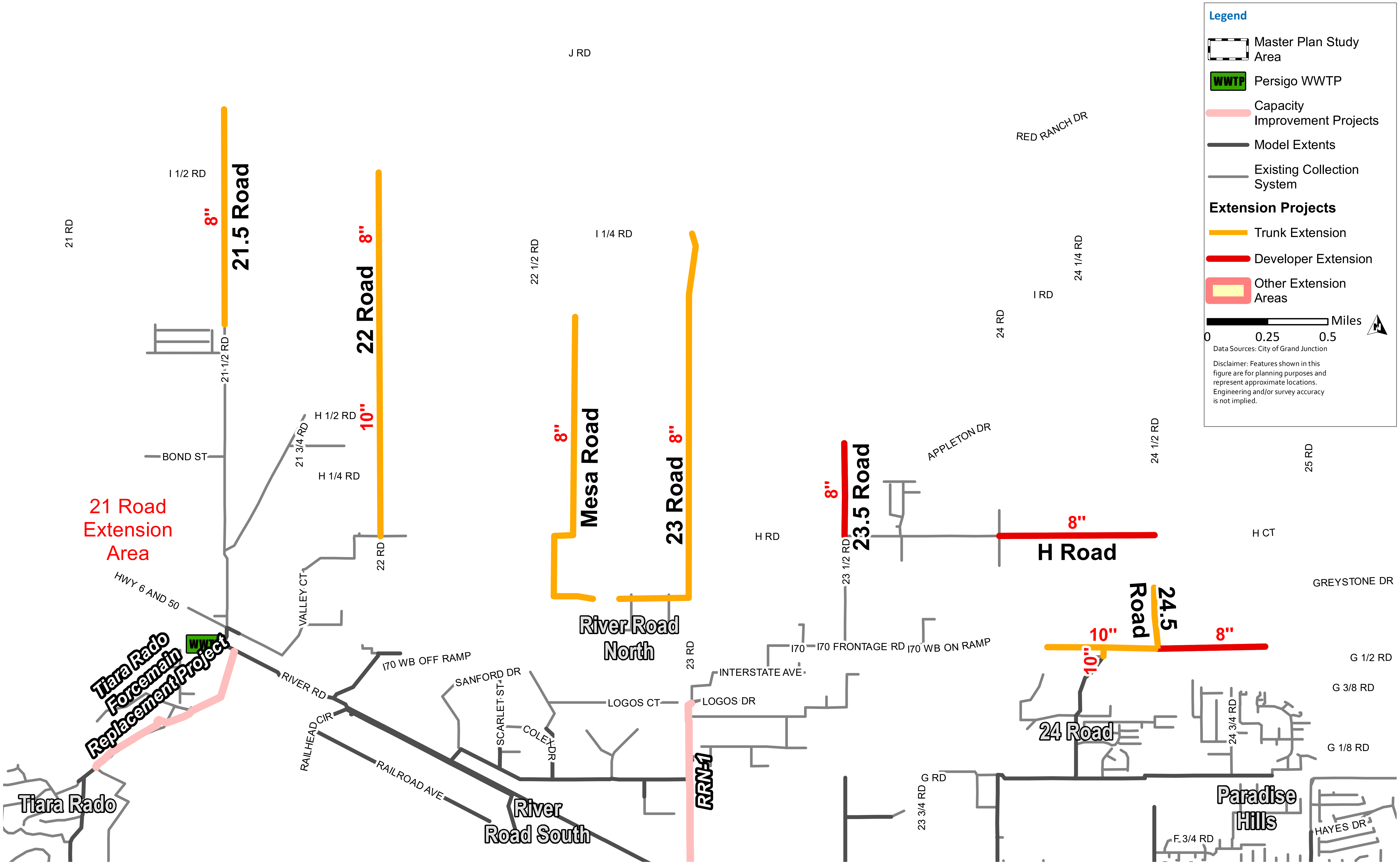

Figure 6.13 River Road North Extension Projects Overview

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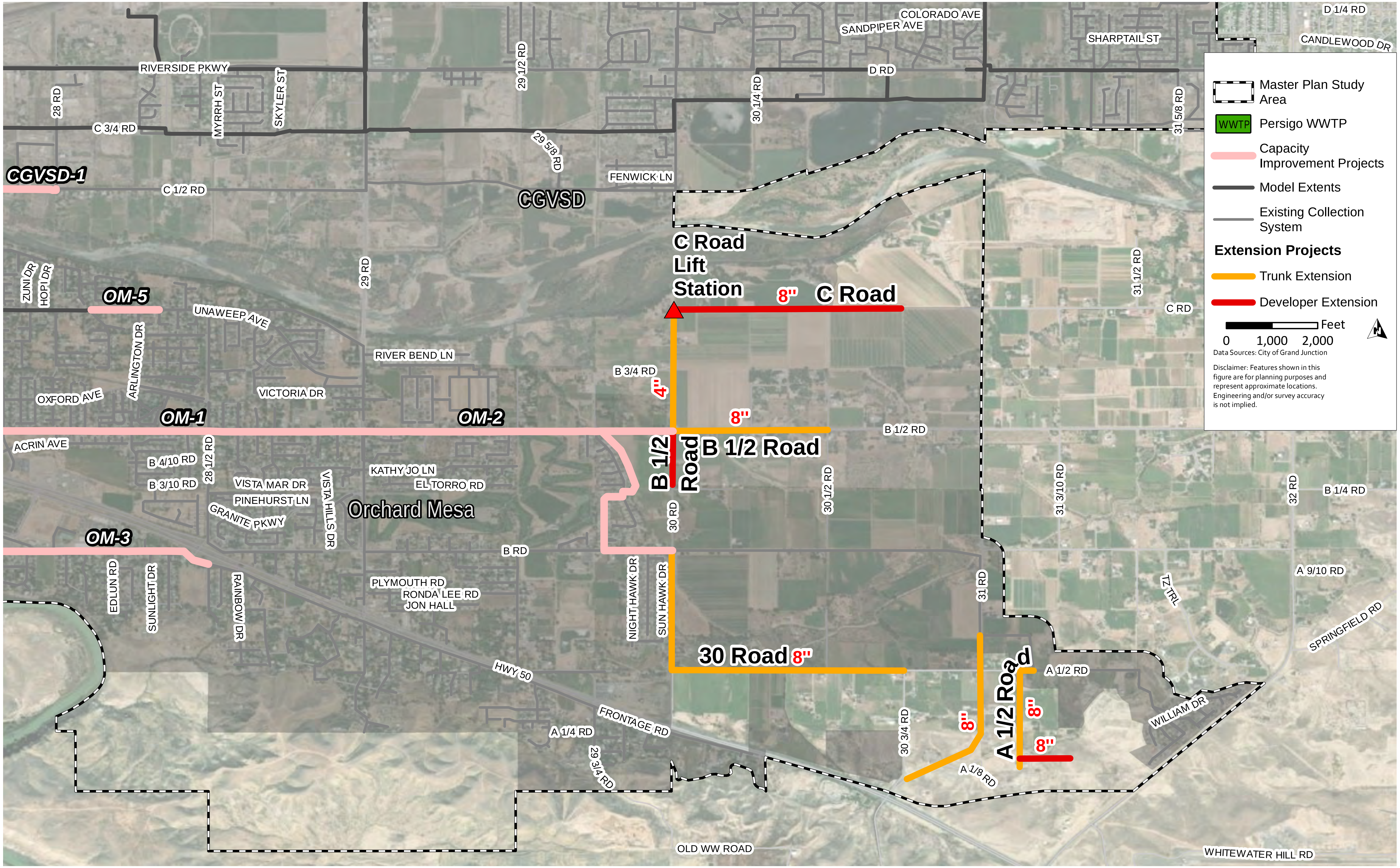

Figure 6.14 Orchard Mesa Extension Projects Overview

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6.3.3 Septic Removal

In an effort to remove septic systems within the 201 Service Area boundary, the City has created sewer improvement districts (SID). The purpose of the SIDs is to promote the removal of the septic systems and provide a means for the City to work with homeowners within these SIDs to finance extensions to the City's sanitary sewer system. At the time of this 2020 WW Basin Update, there were 53 SIDs identified with 30 completed, 22 not completed, and one SID not labeled based on the City's GIS information. The City also provided their existing sewer taps shapefile which illustrates which parcels are connected to the collection system.

The City's GIS data was compared to the Mesa County septic lot shapefile data, which includes parcels that were identified as having a septic system. Based on this comparison, it was discovered that some of the Mesa County septic service lots overlapped with the City sewer tap lots indicating that the Mesa County data was not current. Thus, the overlapping parcels were assumed to have been connected to the City's system.

Through discussions with the City, it was decided to conceptually identify new SIDs to address the septic systems outside of the existing SIDs. The existing and proposed SIDs are illustrated in Figure 6.15. Future trunk main extensions and improvements from the City's sanitary sewer system will be required to provide sewer service to the identified SIDs with septic systems. These sewer extensions would provide centralized sewer service allowing a means for abandonment of septic systems and promote groundwater and surface water quality improvements.

There were several septic lots that could be integrated or annexed into existing SIDs without a major extension or creation of a new SID. Furthermore, there are a number of single lots that will remain on septic service as City requires at least two lots to create an SID, and some lots are not located near sewer mains or other property. Tables 6.7 and 6.8 summarize City data showing the lot totals for the existing completed SIDS and not completed SIDs, and the existing septic lots outside of SIDs, respectively.

Table 6.7 Sewer Improvement Districts Information

SID Area(1)	Total # of Lots	Lots with Sewer Tap(2)	Lots with Septic Systems(3)	Undeveloped Lots(4)	Septic Systems to be Removed	Lots with both Sewer Tap and Septic System(5)
SIDs Identified as Not Complete	1,082	205	518	359	518(6)	35
SIDs Identified as Complete	1,415	1,050	218	147	218(7)	715
Septic Systems Outside SID(8)	819	0	819	0	819(8)	0

Notes:
(1) Identified as completed or not completed based on City GIS information.
(2) Total number of lots which were included in the City's sewer taps GIS shapefile.
(3) Total number of lots which were identified as having a septic system based on the Mesa County septic system GIS information, or not included in City's sewer taps shapefile.
(4) Lots not identified as having a sewer tap or septic system. Assumed these lots will need to be connected to City sewer system.
(5) Lots that were included in City's sewer tap shapefile, and the Mesa County septic system GIS information (overlapping parcels). These lots have most likely been connected to the system.
(6) Sum of identified septic systems does not include undeveloped lots.
(7) Connections to sanitary sewer system will be performed by property owner.
(8) See Table 6.8 for additional information.

Table 6.8 Septic Systems Outside of Existing Sewer Improvement Districts

Description	Count	Note
Proposed SIDs	81	See Figure 6.15 for map of proposed SID areas
Septic Lots within Proposed SIDs	528	
Septic Lots Near Sewer Main	278	Does not require a new SID and included within existing SID
Single Lot Not Near Sewer Main	13	
Total Septic Systems	**819**	Total septic systems (does not include overlapping lots) outside of SIDs

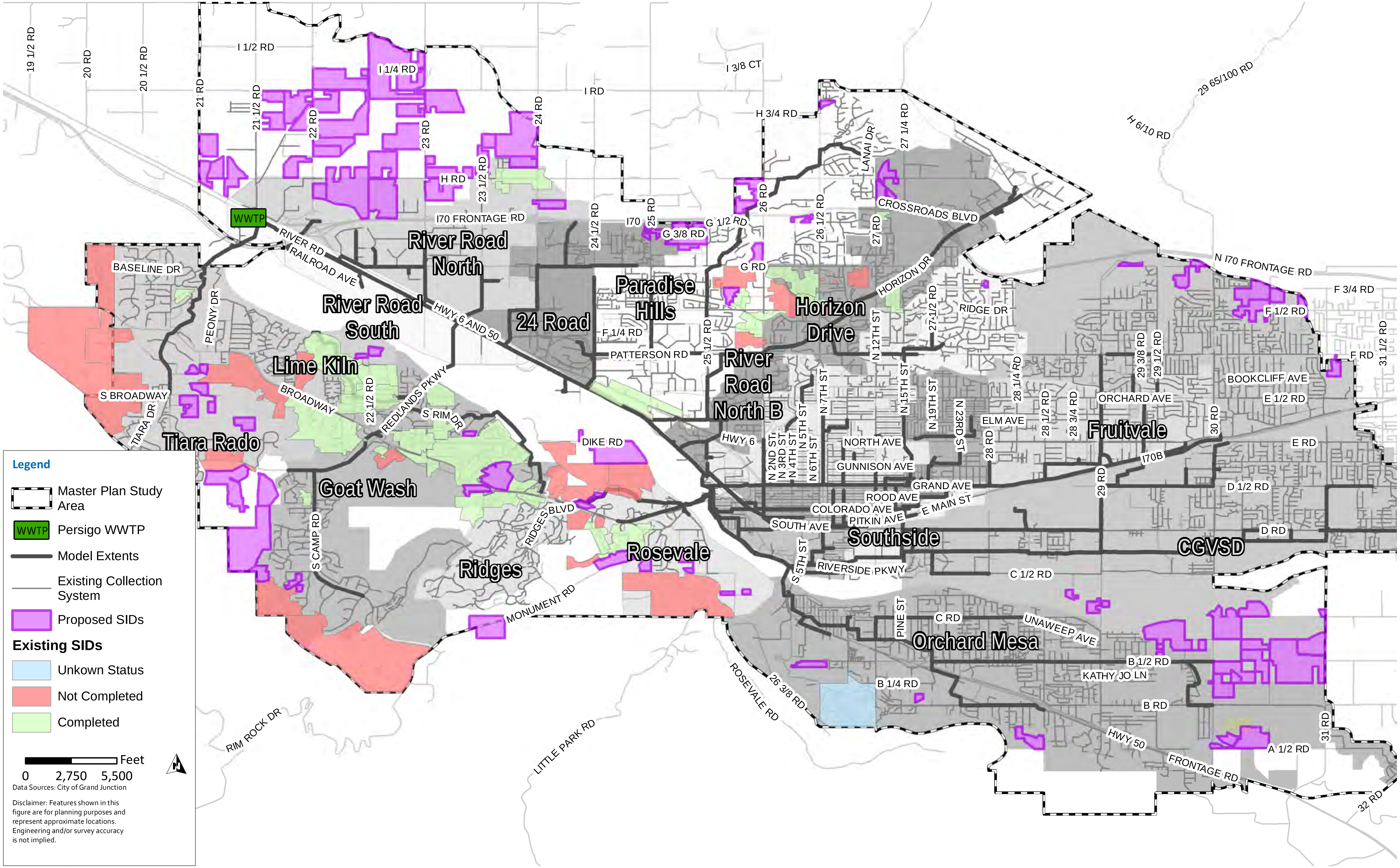
Table 6.9 summarizes the total number of septic systems that could be connected to the system. Based on the City's 2021 Ten-Year Capital Plan for sewer improvements, the City currently budgets $1,000,000 annually to support connections to City's sewer system and eliminating the septic systems. Based on the historical spending rate, this results in the identified septic systems being replaced in the next 17 years. The timing of these improvements is variable as it is the decision of the property owner to connect to the City's sewer service.

Table 6.9 Existing Septic System Summary

Parameter	Total # of Systems	Comment/Data Source
Septic Systems Inside SIDs Identified as Not Complete	518	Refer to Table 6.7.
Septic Lots in Proposed SIDs	528	Refer to Table 6.8.
Sub-Total	1,046	
Average Conversion Cost(1)	$16,100	
Total Budget	$16,841,000	Budget for total expenditure.
Reimbursement	$11,789,000	Reimbursement is 70% of total budget.

Notes:
(1) Value does not include 30% cost share from property owner.

As part of the annual budgeting for the Septic System Elimination Program, the City should continue to identify lots that can be converted easily to the sewer system. The City's existing GIS files can be used to identify size of properties, and distance to sewer service. Additionally, the City may want to consider additional incentives for property owners to accelerate the replacement schedule, if needed. The City's policy and goals for the Septic System Elimination Program should be evaluated in the future to be consistent with the findings presented.



Data Sources: City of Grand Junction

Disclaimer: Features shown in this figure are for planning purposes and represent approximate locations. Engineering and/or survey accuracy is not implied.

Figure 6.15 Proposed SID Overview

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6.4 Summary of Existing System Improvements

6.4.1 Tiara Rado Force Main Replacement Project

The Tiara Rado Interceptor sewer, lift station, and force main convey wastewater from the northern portion of the Tiara Rado Basin to the Persigo WWTP. The Tiara Rado Lift Station is located on the south side of the Colorado River at the bottom of a steep embankment below the Tiara Rado Basin. The Tiara Rado 12-inch ductile iron force main runs below the Colorado River and I-70 before connecting to the interceptor sewer in River Road on the north side of the river. The force main was installed between 1982 and 1984. Design and permitting for a new 12-inch force main from the existing lift station to the sewer interceptor in River Road is expected to be completed in early 2021. The new force main will be installed below the Colorado River and through the existing Persigo wash box culverts under I-70 to avoid boring beneath the busy highway. A redundant force main will be installed under the Colorado River, and the force mains will be concrete encased from the lift station to the north side of I-70. Construction of the new force main is planned for fall 2021.

This project is currently included in the City's 2021 Ten-Year Capital Plan.

6.4.2 Lift Station Elimination Study

In 2020 the City initiated a project to assess the feasibility of eliminating the Ridges #1 and Brach's Market Lift Stations, and replacing them with a new lift station, referred hereafter as the Power Road Lift Station.

This lift station elimination alternative would slightly reduce the overall flow to the existing Rosevale Lift Station, and allow the City to abandon the Ridges #1 and Brach's Market Lift Stations. The Ridges #1 Lift Station is nearing the end of its useful life and is located very close to a busy intersection, which poses both construction and operational challenges. The Brach's Market Lift Station is in adequate condition, but with its proximity to the proposed Power Road Lift Station, the Brach's Market Lift Station can also be eliminated in order to consolidate the two service areas to a single lift station. The proposed Power Road Lift Station location would also provide an opportunity to tie several nearby SIDs into the City's sewer system.

A sewer model for the Ridges and Rosevale service areas in Grand Junction was developed as part of the feasibility study. The modeling evaluation demonstrated it is feasible to replace the Ridges #1 and Brach's Market Lift Stations, and a new lift station can be located on the north side of the Redlands Power Canal.

The proposed Power Road Lift Station will convey wastewater east across the Colorado River to the gravity collection system feeding into the Persigo WWTP. Flows to the Rosevale Lift Station will be reduced slightly, and no improvements to that lift station were recommended at this time. The existing gravity siphon will be replaced with two new force mains: a 10-inch force main connected to the Power Road Lift Station and a 6-inch force main connected to the Rosevale Lift Station.

The City is beginning easement negotiations for the lift station, force main, and gravity sewer. Permitting, and design are expected to begin in January 2021. If easements are secured by the City, the service areas and model should be revised to reflect these changes in flows.

This project is currently included in the City's 2021 Ten-Year Capital Plan.

6.4.3 Odor Control Study

Garver and Perkins Engineering Consultants completed a wastewater system odor abatement study in 2019. The study included a review of historical odor complaints and issues, a field-testing program to assess the root causes of odor issues throughout the system, and an odor abatement plan. The study recommended the following improvements which have been carried forward into the implementation plan:

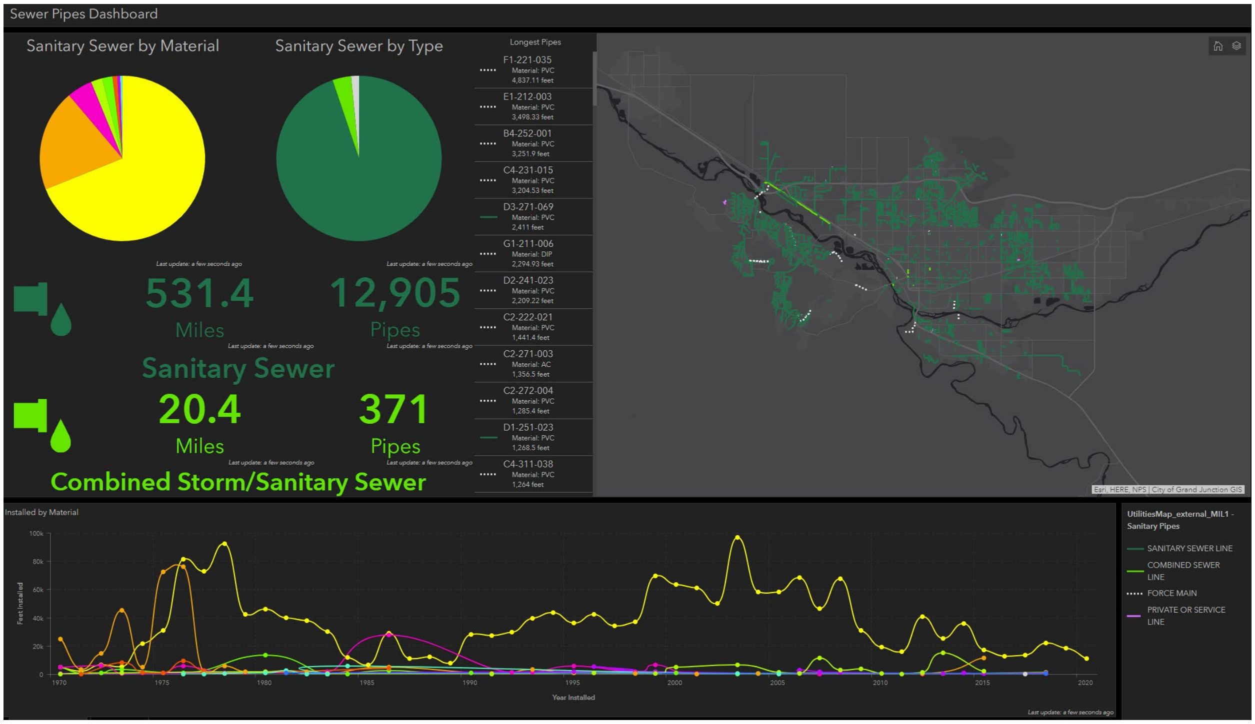
- Continued chemical dosing at City Shops.
- Chemical dosing to the Ridges and Redlands Village Lift Stations.
- Conducting forced ventilation at the Broadway Siphon and the Southside Interceptor.
- Installing biotrickling filters at the Broadway Siphon and the Southside Interceptor.
- Installing carbon units at Redlands Parkway, Canal, and the Tiara Rado Driving Range.
- Installing an air jumper over Persigo Wash (included in the 2020 Master Plan).
- Installing a biotrickling filter at the Persigo WWTP (included in the 2020 Master Plan).

The study also considered modifications to the Persigo WWTP's headworks and primary clarifier ventilation systems, which have been included in the 2020 Master Plan implementation.

Improvements recommended for implementation in 2020 and 2021 have been included in the City's 2021 Ten-Year Capital Plan. Other odor control study improvements are included in the implementation plan, as provided in Chapter 7.

6.5 Collection System Asset Management Program

The City has developed a comprehensive GIS database for all collection system assets, and this information has been integrated with the City's Lucity Asset Management system as shown in Figure 6.16. The following sections identify the rehabilitation and replacement needs developed using the City's data.



Longest Pipes

F1-221-035	Material: PVC	4,837.11 feet
E1-212-003	Material: PVC	3,498.33 feet
B4-252-001	Material: PVC	3,251.9 feet
C4-231-015	Material: PVC	3,204.53 feet
D3-271-069	Material: PVC	2,411 feet
G1-211-006	Material: DIP	2,294.93 feet
D2-241-023	Material: PVC	2,209.22 feet
C2-222-021	Material: PVC	1,441.4 feet
C2-271-003	Material: AC	1,356.5 feet
C2-272-004	Material: PVC	1,285.4 feet
D1-251-023	Material: PVC	1,268.5 feet
C4-311-038	Material: PVC	1,264 feet

Figure 6.16 Screen Shot of City's Sanitary Sewer Pipe Asset Management System

6.5.1 Lift Station Asset Management Program

The City developed a lift station replacement schedule to prioritize future rehabilitation projects, as shown in Table 6.10. Generally, these useful life assumptions are consistent with industry standards. Depending on the soil conditions and historical deterioration of assets, the City should evaluate the useful life assumptions again as part of the next master planning effort.

Table 6.10 Lift Station Asset Management Schedule

Component	Current Useful Life Frequency (years)
Lift Station Structure	50
Pumps, Building Mechanical, General Electrical	20
Motors and Programmable Logic Controllers Submersible pumps and equipment	10
Wear Parts (Impellers, Seals)	7
Valves	25
Force Main	50

Based on these useful life durations, many components of the lift stations are overdue for pump replacement or full replacement. However, the information provided in the City's asset management system should be updated and verified. Table 6.11 illustrates the replacement year for the lift station pump and controls. There may be other components in each of the lift stations that will need replaced such as the wear parts, valves, electrical equipment, and ventilation equipment.

Table 6.11 Lift Station Replacements from City's Lucity Asset Management Database

Lift Station Name	Year Put in Service(1)	Lift Station Rehabilitation(2)	Full Lift Station Replacement(2)	Lift Station Size (mgd)(4)
Wellington	1976	1996	2026	0.65
Ridges #1(3)	1978	1998	2028	NA
Falls	1982	2002	2032	0.70
Heather Ridge	1982	2002	2032	0.27
Tiara Rado	1983	2003	2033	6.55
El Poso	1984	2004	2034	0.84
Mesa Mall(3)	1984	2004	2034	0.52
CGVSD By-Products	1989	2009	2039	1.26(5)
Alpine Meadows	1991	2011	2041	0.24
Panorama	1991	2011	2041	0.49
Coors	1995	2015	2045	0.75(5)
Rosevale	1997	2017	2047	2.81(5)
Monument	1999	2019	2049	0.42
Doe	2001	2021	2051	0.61
Desert Hills	2001	2021	2051	0.66
Fifth Street Bridge	2002	2015	2052	0.18
Red Mesa	2002	2022	2052	0.28

Lift Station Name	Year Put in Service(1)	Lift Station Rehabilitation(2)	Full Lift Station Replacement(2)	Lift Station Size (mgd)(4)
Connected Lakes	2003	2023	2053	1.23(5)
Redlands Village	2003	2023	2053	1.94(5)
Ridges #2	2003	2019	2053	0.18
Spy Glass	2007	2027	2057	0.20
Railhead	2011	2031	2061	1.01(5)
River Trail	2011	2031	2061	0.76
Cheyenne Drive	2012	2032	2062	0.52
Brach's(3)	2013	1998	2028	NA

Notes:
(1) Year pump station put in service per City asset management information.
(2) Estimated year to replace pumping systems or replace entire lift station assumes useful life based as shown in Table 6.9.
(3) Being replaced as part of 2021 lift station elimination program. From City, Brach's LS will be relocated to Mesa Mall in future.
(4) Existing lift station capacity based on asset management data provided by the City. Assume or upgrade with existing size unless otherwise designated as a capacity increase.
(5) Lift station capacity increased based on capacity deficiencies identified in Table 6.3.
(6) Fifth Street Lift Stations is submersible type and should be rehabilitated every 10 years. Ridges is also submersible; however, this lift station will be decommissioned in 2021.

Lift Station Rehabilitation Costs

An annual budget for lift station rehabilitation provides the City a means to maintain the existing lift stations to meet the level of service goals and conveyance needs. The following pumping system costs were estimated based on the capacity, as shown in Table 6.12. The costs shown assume only the pump replacement or rehabilitation will occur once in a 20-year period.

Table 6.12 Lift Station Rehabilitation Costs

Lift Station Capacity (mgd)	Pump Replacement Costs ($)
0.25	$25,000
0.5	$45,000
0.75	$65,000
1	$80,000
2	$100,000

Using the replacement costs, shown in Table 6.12, and estimated timing, shown in Table 6.11, the annual pump replacement allowance equals $61,000. The costs assume the City will contract directly to replace the collection system pumps with similar model and capacity. To account for unknowns and additional assets requiring rehabilitation, such as control panels, heating, ventilation, and air conditioning, electrical, and instrumentation, a 50 percent contingency factor was added. As a result, the City should plan on budgeting an average of $92,000 annually for lift station rehabilitation needs. These investments will be prioritized by the City annually.

Full lift station replacement costs are included in the Chapter 7 implementation plan.

6.5.2 Sewer Interceptor and Main Rehab and Replacement Program

In May of 2020, the City implemented a 5-year priority-based sewer interceptor and main rehabilitation and replacement (R&R) program using sewer age, material, closed-circuit television inspection (CCTV) results, work order history and ease of access. After an initial analysis and prioritization, the list of sewer interceptors and mains was narrowed to 223 pipe segments to be rehabilitated within the system over the next 5 years.

The City evaluated the locations of the high priority pipes and created groupings by parses to allow for areas of the system to be updated rather than separate segments. The City identified 19 projects that were prioritized based on timing of road overlay/paving, and problem areas based on CCTV rating and work orders. A total of 58,000 lf of sewer has been identified to be in the R&R program. There are two identified phases with each project defined as a parse. Figures depicting the location of each of the parses are provided in Appendix E along with a summary table provided by the City.

Shown in Table 6.13 is a summary of the City's 5-year R&R program with costs and phasing. Budget cost for each line number are based on City developed unit costs and applied to the total linear feet of R&R sewer. The costs shown in Table 6.13 assume full replacement of the existing pipelines at an average cost per linear foot of $216, which includes direct construction costs, project contingency, contractor overhead and profit, engineering, and legal and administrative costs.

Table 6.13 City's 5-Year R&R Project Summary

Parse	Phase	Parse Description	Justification	LF	Budget
1	1	Clay Liners Crossing Unaweep Avenue	Road Overlay	4,400	$919,200
2	1	Pinion & Cedar (Truss & VCP)	Road Overlay	3,100	$691,800
3	1	Pine & Holly (Truss & VCP)	Road Overlay	6,300	$1,395,600
4	1	E & W Parkview (Truss & VCP)	Road Overlay	4,200	$933,600
5	1	Ally (Pitkin & Ute)	Alley Project	1,100	$234,100
6	2	4th to 5th & Hall	Priority, Problem Areas	800	$171,300
7	2	15th & Pinyon	Priority, Problem Areas	1,200	$269,800
8	2	Gunnison Street Extension	Priority, Problem Areas	2,500	$552,500
9	2	North Avenue & Sparn	Priority, Problem Areas	900	$185,900
10	2	Bunting to Elm, 15th to 18th Street	Priority, Problem Areas	4,400	$974,500
11	2	Nth 14th to 15th & Hall	Priority, Problem Areas	2,700	$601,200
12	2	Bunting to Elm, 19th to 23rd	Priority, Problem Areas	4,000	$881,000
13	2	N 16th to N 18th, Elm to Hall Avenue	Priority, Problem Areas	2,400	$518,800
14	2	Florence	Priority, Problem Areas	1,700	$375,000
16	2	North Avenue to Bunting, 18th to 21st Street	Priority, Problem Areas	2,200	$458,200
17	2	West Lake	Priority, Problem Areas	7,000	$1,398,000
18	2	Texas to Hall	Priority, Problem Areas	4,300	$852,300
19	2	Mantey Heights	Priority, Problem Areas	4,800	$959,000
			TOTAL	**58,000**	**$13,087,600**

Future Pipeline R&R Projects and Allowances

The City's GIS database captures pipeline asset information such as pipe age, condition assessment information from CCTV records, pipeline size, and pipe materials (see Table 6.14). Using this information, the City can forecast future replacement, and/or rehabilitation. Table 6.14 summarizes the information obtained from the GIS database used to develop an annual forecast for pipeline replacement or rehabilitation. Based on the estimated useful life for each of the pipeline material types, the City's future pipeline R&R program should include approximately 40,000 lf per year based on the current 30-year replacement program.

Table 6.14 City's Pipeline Inventory by Material (Based on GIS Output from August 2020)

Pipeline Material	LF of Pipeline	Percent of Replacements	LF Replaced per Year
Vitrified Clay Pipe (VCP)	639,688	71%	26,654
Unknown or Unclassified Pipe	161,819	18%	6,742
Reinforced Concrete Pipe (RCP)	66,443	7%	2,768
Truss Pipe	26,784	3%	1,116
Ductile Iron Pipe (DIP)	7,608	1%	317
Steel Pipe	1,343	0%	56
Total	**903,685**	**100%**	**37,654**

Notes:
(1) The estimated annual pipeline replacement or rehabilitation linear feet shown assumes pipeline will be replaced at estimated life.

In developing an annual financial forecast for the pipeline R&R program, a case by case assessment will be needed to determine if the pipeline can be rehabilitated or needs a full replacement. Based on these two options, the bookends for budgeting purposes would equal:

- $3,000,000 for pipeline rehabilitation assuming an average cost of $70 per linear foot, or
- $8,900,000 for full pipeline replacement at an average replacement cost of $216 per linear foot.

The City's 2021 Budget includes an annual allocation for the pipeline R&R program equal to $4,500,000, which will be carried forward in the Chapter 7 implementation plan. This funding allocation level was established using a 30-year accelerated replacement scheduled focused on highest priority needs (e.g. replacing Truss and VCP pipes). Based on this funding allocation, the City would be able to replace approximately 20,800 lf of pipeline annually. At the current spending rate, the City will not achieve it's 30-year goal for interceptor replacements. It is recommended the City continue to prioritize and re-evaluate the drivers for the 30-year goal and evaluate the following:

1. If complete replacement shown in Table 6.13 is required for all pipe materials.
2. Modify the scope by either removing pipe materials from the list or extending the duration of the project.

Chapter 7

CAPITAL IMPROVEMENT PLAN

This chapter presents the capital improvement plan (CIP) for the collection system. The CIP includes a summary of recommended projects, preliminary cost estimates, and an implementation plan. The CIP was developed for general planning purposes and to guide project evaluation and implementation through the 2040 planning horizon.

7.1 Project Cost Estimating Assumptions

Cost estimates were prepared for each project identified in Chapter 6. The cost estimates were developed based on unit costs derived from local experience and similar projects using November 2020 dollars when the 20-City Average Engineering News Record Construction Cost Index (ENR CCI) was 11,579. Final project construction costs will depend on actual labor and material costs, competitive market conditions, final project scope, implementation schedule, and other variable factors, such as detailed utility and topography surveys.

Cost estimates were prepared in accordance with the guidelines of the AACE International (AACE, 18R-97) for a Class 5 estimate. Of the five total estimates included in the AACE Cost Estimate Classification System, Class 5 estimates are most appropriate for planning projects before more definitive information (such as detailed designs) is available. For this reason, Class 5 estimates have wide accuracy ranges that vary from -20 to -50 percent on the low side to +30 to +100 percent on the high side. Class 5 estimates fluctuate based on the project's technological complexity, the availability and accuracy of appropriate reference information, and the inclusion of an appropriate contingency determination.

7.1.1 Pipeline Construction Cost (New and Replacement)

Pipeline baseline construction costs were developed for the new proposed gravity sewer and force main pipelines as shown in Table 7.1. It is assumed that the costs for gravity and force main piping replacements are equivalent. The costs shown in Table 7.1 represent the direct construction costs for the project, which includes pipeline, trenching, backfilling and compaction, minor restoration work, mobilization and demobilization, and general conditions costs.

Table 7.1 Pipeline Unit Cost Summary (New or Replacement)

Pipeline Diameter	Cost/lf(1)	$/in-lf
6	130	21.67
8	150	18.75
10	170	17.00
12	200	16.67
15	250	16.67
18	280	15.56
21	300	14.29
24	330	13.75
30	380	12.67
36	450	12.50

Notes:
(1) Cost factors include pipeline replacement, trenching, backfill and compaction, mobilization, and generational conditions.

7.1.2 Lift Station Construction Cost (New or Replacement)

Baseline construction cost estimates for replacement of existing or construction of new lift stations were calculated using firm pumping capacity and cost curve shown in Figure 7.1. The curve was validated using the recent Power Road lift station evaluation estimate. The Power Road Lift Station costs were estimated to be approximately $2.0 million for a 1.75-mgd lift station with submersible pumps.

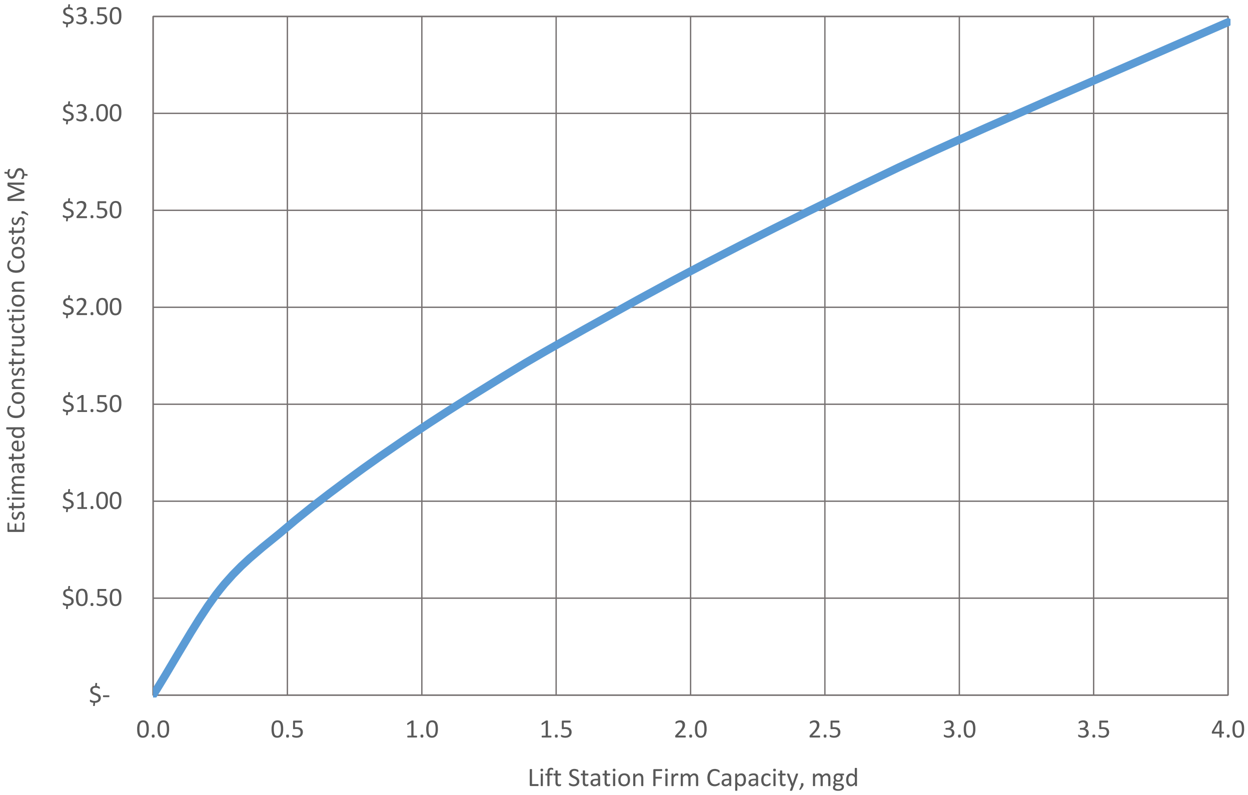


Figure 7.1 Lift Station Cost Curve

7.1.3 Project Contingencies and Allowances

For each project, a baseline construction cost was calculated using the unit cost and project size assumptions as discussed above. A 30 percent contingency was added to baseline construction costs of each project and a 20 percent contractor overhead and profit, insurance, bonding, and other costs allowance was also added. The contingency factor accounts for unexpected construction conditions, variations in final quantities, and other project considerations. Finally, the total project capital cost was calculated by applying a 25 percent allowance to account for engineering services, construction management, owner contingency, and project administration. Table 7.2 summarizes the approach for developing the total project cost.

Table 7.2 Unit Cost Summary

Item	Cost Formula
Baseline Construction Cost (BCC)	Unit Cost*Length, or Lift Station Cost Curve
Construction Cost Contingency (CCC)	CCC = 30 percent of BCC
Contractor Overhead, Profit, Insurance, Bonds, etc. (OHP)	OHP = 20 percent of BCC
Estimated Construction Cost (ECC)	ECC = BCC + CCC + OHP
Engineering, Legal, and Administrative Costs for Implementing Project (ELA)	ELA = 25 percent of ECC
Total CIP Cost	CIP Cost = ECC + ELA

Notes:

(1) Costs are provided as present value based on an ENR CCI number of 11,579, which corresponds with the 20-City Average Index in November 2020. Costs are not escalated to future years.

7.2 Recommended Capital Improvements and Implementation Plan

The projects identified from previous chapters have been grouped into the near-term and long-term implementation categories. These projects were grouped based on the project drivers such as addressing capacity deficiencies, growth or development extensions, and replacement and rehabilitation requirements. Table 7.3 summarizes the identified improvements.

Appendix F includes project summary sheets, which detail the recommended projects.

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Table 7.3 Detailed CIP Improvements

Capacity Improvement Projects				Project Size and Cost								Project Phasing	
Improvement ID	Improvement Type	Project Type	Description	Existing Size	Proposed Size (ft or mgd)	Replace/ New	Length (ft) or Capacity (mgd)	Unit Cost(1)	Baseline Construction Cost(2)	Estimated Construction Costs(3)	Total Capital Improvement Cost(4)	Near Term (2020-2030)	Long Term (2030-2040)
Central Grand Valley Sewer Basin													
CGVSD-1	Gravity	Capacity	Upsized gravity sewer upstream of CGVSD By-Products lift station along C 1/2 Rd.	10	15	Upsize	2,727	$250	$681,800	$1,023,000	$1,279,000	$1,279,000	
CGVSD-2	Lift Station	Capacity	Upsized CGVSD By-Products lift station.	1	2.60	Upsize	1	$2,604,000	$2,604,000	$3,906,000	$4,883,000	$4,883,000	
	Force Main	Capacity	Upsized CGVSD By-Products lift station force main.	6	10	Upsize	1,354	$170	$230,200	$345,000	$431,000	$431,000	
Subtotal Central Grand Valley Sewer Basin									**$3,516,000**	**$5,274,000**	**$6,593,000**	**$6,593,000**	**$0**
Interceptor Flow Balance													
FB-1	Gravity	Capacity	Flow diversion measures to balance flow along south side interceptors.	Varies	Varies	Upsize	-	-	$100,000	$150,000	$188,000	$188,000	
Subtotal Interceptor Flow Balance									**$100,000**	**$150,000**	**$188,000**	**$188,000**	**$0**
Fruitvale Sewer Basin													
FV-1	Gravity	Capacity	Upsized sewer along 28 Road.	10	15	Upsize	1,500	$250	$375,000	$563,000	$704,000		$704,000
FV-2	Gravity	Capacity	New sewer along Orchard Avenue to divert flow to the east away from 29 3/8 road sewer.	-	10	New Sewer	1,650	$170	$280,500	$421,000	$526,000		$526,000
	Gravity	Capacity	Upsized sewer along Frontage Road.	10	12	Upsize	4,664	$190	$886,200	$1,329,000	$1,661,000		$1,661,000
	Gravity	Capacity	Upsized sewer adjacent to 29 3/8 Road.	12	15	Upsize	1,204	$250	$301,000	$452,000	$565,000		$565,000
FV-3	Gravity	Capacity	Upsized sewer along 29 1/2 Road.	10	12	Upsize	658	$190	$125,000	$188,000	$235,000		$235,000
Subtotal Fruitvale Sewer Basin									**$1,967,700**	**$2,953,000**	**$3,691,000**	**$0**	**$3,691,000**

Table 7.3 Detailed CIP Improvements (continued)

Capacity Improvement Projects				Project Size and Cost								Project Phasing	
Improvement ID	Improvement Type	Project Type	Description	Existing Size	Proposed Size (ft or mgd)	Replace/ New	Length (ft) or Capacity (mgd)	Unit Cost(1)	Baseline Construction Cost(2)	Estimated Construction Costs(3)	Total Capital Improvement Cost(4)	Near Term (2020-2030)	Long Term (2030-2040)
Goat Wash Sewer Basin													
GW-1	Gravity	Capacity	Upsized sewer along Tiffany Drive/El Rio Drive.	8	15	Upsize	3,351	$250	$837,800	$1,257,000	$1,571,000	$1,571,000	
GW-2	Gravity	Capacity	Upsized sewer along S Rim Drive.	8	12	Upsize	3,661	$190	$695,600	$1,043,000	$1,304,000		$1,304,000
	Lift Station	Capacity	Upsized Connected Lakes Lift station	1	1.20	Upsize	1	$1,555,000	$1,555,000	$2,333,000	$2,916,000		$2,916,000
	Force Main	Capacity	Upsized Connected Lakes Lift station force main.	6	8	Upsize	3,531	$150	$529,700	$795,000	$994,000		$994,000
Subtotal Goat Wash Sewer Basin									**$3,618,100**	**$5,428,000**	**$6,785,000**	**$1,571,000**	**$5,214,000**
Orchard Mesa Sewer Basin													
OM-1	Gravity	Capacity	Upsized sewer along B 1/2 Road.	10/12	15	Upsize	2,980	$250	$745,000	$1,118,000	$1,398,000	$1,398,000	
	Gravity	Capacity	Upsized sewer along B 1/2 Road.	15	18	Upsize	4,892	$280	$1,369,800	$2,055,000	$2,569,000	$2,569,000	
	Gravity	Capacity	Upsized sewer along B 3/4 Road.	18	24	Upsize	8,766	$330	$2,892,800	$4,339,000	$5,424,000	$5,424,000	
OM-2	Gravity	Capacity	Upsized sewer along B 1/2 Road.	10	12	Upsize	5,585	$190	$1,061,200	$1,592,000	$1,990,000	$1,990,000	
	Gravity	Capacity	Upsized sewer along Frontier Street.	10	15	Upsize	4,079	$250	$1,019,800	$1,530,000	$1,913,000	$1,913,000	
OM-3	Gravity	Capacity	Upsized sewer along B Road.	10/12	15	Upsize	4,489	$250	$1,122,300	$1,683,000	$2,104,000	$2,104,000	
OM-4	Gravity	Capacity	Upsized sewer along 27 Road.	12	15	Upsize	1,334	$250	$333,500	$500,000	$625,000	$625,000	
OM-5	Gravity	Capacity	Upsized sewer along C Road.	10	15	Upsize	1,156	$250	$289,000	$434,000	$543,000	$543,000	
Subtotal Orchard Mesa Sewer Basin									**$8,833,400**	**$13,251,000**	**$16,566,000**	**$16,566,000**	**$0**
River Road North Sewer Basin													
RRN-1	Gravity	Capacity	Upsized sewer along River Road North.	8-12	15	Upsize	3,655	$250	$913,800	$1,371,000	$1,714,000	$1,714,000	
Subtotal River Road North Sewer Basin									**$913,800**	**$1,371,000**	**$1,714,000**	**$1,714,000**	**$0**
Capacity Improvement Projects Subtotal									**$18,949,000**	**$28,427,000**	**$35,537,000**	**$26,632,000**	**$8,905,000**

Table 7.3 Detailed CIP Improvements (continued)

Extension Improvements Projects				Project Size and Cost								Project Phasing	
Improvement ID	Improvement Type	Project Type	Description	Existing Size	Proposed Size (ft or mgd)	Replace/ New	Length (ft) or Capacity (mgd)	Unit Cost(1)	Baseline Construction Cost(2)	Estimated Construction Costs(3)	Total Capital Improvement Cost(4)	Near Term (2020-2030)	Long Term (2030-2040)
24 Road Sewer Basin													
24R Ext-1	Gravity	Extension	I70 crossing	-	10	Trunk	200	$170	$34,000	$51,000	$64,000		$64,000
24R Ext-2	Gravity	Extension	West of 24.5 Road	-	10	Trunk	1,890	$170	$321,300	$482,000	$603,000		$603,000
24R Ext-3	Gravity	Extension	24.5 Road	-	8	Trunk	1,340	$150	$201,000	$302,000	$378,000		$378,000
Subtotal 24 Road Sewer Basin									**$556,300**	**$835,000**	**$1,045,000**	**$0**	**$1,045,000**
Orchard Mesa Sewer Basin													
OM Ext-1	Gravity	Extension	31 Road Extension	-	8	Trunk	3,800	$150	$570,000	$855,000	$1,069,000		$1,069,000
OM Ext-2	Gravity	Extension	A 1/2 Road Extension	-	8	Trunk	2,340	$150	$351,000	$527,000	$659,000		$659,000
OM Ext-4	Gravity	Extension	30 Road Extension at B Road	-	8	Trunk	6,570	$150	$985,500	$1,478,000	$1,848,000		$1,848,000
OM Ext-7	Gravity	Extension	B 1/2 Road Extension to 30 1/2 Road	-	8	Trunk	2,630	$150	$394,500	$592,000	$740,000		$740,000
OM Ext-8	Force Main	Extension	Force main from C Road to B 1/2 Road	-	6	Trunk	2,650	$22	$57,400	$86,000	$108,000		$108,000
	Lift Station	Extension	New pump station.	-	0.50	Trunk	1	$868,000	$868,000	$1,302,000	$1,628,000		$1,628,000
Subtotal Orchard Mesa Sewer Basin									**$3,226,400**	**$4,840,000**	**$6,052,000**	**$0**	**$6,052,000**
River Road North Sewer Basin													
RRN Ext-3	Gravity	Extension	Mesa Road	-	8	Trunk	7,100	$150	$1,065,000	$1,598,000	$1,998,000		$1,998,000
RRN Ext-4	Gravity	Extension	H Road to I Road along 22 Road.	-	10	Trunk	5,240	$170	$890,800	$1,336,000	$1,670,000		$1,670,000
RRN Ext-5	Gravity	Extension	21.5 Road Extension	-	8	Trunk	4,700	$150	$705,000	$1,058,000	$1,323,000		$1,323,000
Subtotal River Road North Sewer Basin									**$2,660,800**	**$3,992,000**	**$4,991,000**	**$0**	**$4,991,000**
Rosevale Sewer Basin													
RV Ext-1	Gravity	Extension	Monument Road	-	8	Trunk	12,600	$150	**$1,890,000**	**$2,835,000**	**$3,544,000**	**$3,544,000**	
Subtotal for Rosevale Sewer Basin									**$1,890,000**	**$2,835,000**	**$3,544,000**	**$3,544,000**	$0
Septic Elimination Program													
	Gravity	Extension	Annual Septic Elimination Allowance	-		New		$1,000,000				$8,300,000	$8,700,000
Extension Project Subtotal									**$8,334,000**	**$12,502,000**	**$15,632,000**	**$11,844,000**	**$20,788,000**

Table 7.3 Detailed CIP Improvements (continued)

Rehabilitation and Replacement Projects				Project Size and Cost								Project Phasing	
Improvement ID	Improvement Type	Project Type	Address/Description	Existing Size	Proposed Size (ft or mgd)	Replace/ New	Length (ft) or Capacity (mgd)	Unit Cost(1)	Baseline Construction Cost(2)	Estimated Construction Costs(3)	Total Capital Improvement Cost(4)	Near Term (2020-2030)	Long Term (2030-2040)
On-Going R&R Program													
Varies	Gravity	R&R	Prioritized R&R Projects - Phase 1 and Phase 2 Projects (per Table 6.12)	Varies	Varies	Replace	58,000	Varies	$13,088,000	$13,088,000	$13,088,000	$13,088,000	
Varies	Gravity	R&R	System wide Rehabilitation and Replacement Program (2026-2030)	Varies	Varies	Replace	20,800/yr			$4,500,000	annually	$27,000,000	
Varies	Gravity	R&R	System wide Rehabilitation and Replacement Program (2031-2040)	Varies	Varies	Replace	20,800/yr			$4,500,000	annually		$45,000,000
Varies	Lift Station	R&R	Lift Station R&R Program (Pump Replacement only)	Varies	Varies	Replace	NA	NA		$92,000	annually	$920,000	$920,000
-	Lift Station	R&R	Ridges Lift Station Improvements (included in 2021 Budget)			Replace				$4,240,000	one-time	$4,240,000	
LSR2	Lift Station	R&R	Replace Falls and Heather Ridge Lift Stations (2032-2033)	Varies	Varies	Replace			$1,519,000	$2,279,000	$2,849,000		$2,849,000
LSR3	Lift Station	R&R	Replace El Poso Lift Stations (2034-2035)	Varies	Varies	Replace			$1,159,000	$1,739,000	$2,174,000		$2,174,000
Collection System R&R Project Subtotal									**$15,766,000**	**$30,438,000**	**$18,111,000**	**$45,248,000**	**$50,943,000**

Table 7.3 Detailed CIP Improvements (continued)

Other Projects				Project Size and Cost								Project Phasing	
Improvement ID	Improvement Type	Project Type	Description	**Existing Size**	Frequency	Replace/ New	Length (ft) or Capacity (mgd)	Unit Cost(1)	Baseline Construction Cost(2)	Estimated Construction Costs(3)	Total Capital Improvement Cost(4)	Near Term (2020-2030)	Long Term (2030-2040)
Master Planning and Odor Related Projects													
	Collection System	Master Plan	Future Flow Monitoring and Master Planning	-	5-7 years	Update	-	$350,000	-	-	-	$350,000	$700,000
	Odor Control	Master Plan	Future Odor Control Plans and Studies	-	5-7 years	Update	-	$150,000	-	-	-	$150,000	$300,000
	Odor Control	Odor Control	Chemical feed improvements at City Shops and Ridges LS for Chemical Feed	-	Varies	Upgrades	-	$75,000	-	-	-	$75,000	$75,000
	Odor Control	Odor Control	Chemical feed and odor improvements at Redlands Village LS	-	Varies	Upgrades	-	$310,000	-	-	-	$310,000	$310,000
	Odor Control	Odor Control	Odor control improvements - at Tiara Rado, Canal, other	-	Varies	Upgrades	-	$197,000	-	-	-	$197,000	$0
	Odor Control	Odor Control	Biotricking filters at Southside Interceptor and Broadway Siphon	-	Varies	Upgrades	-	$521,000	-	-	-	$521,000	$0
Collection System Other Project Subtotal												**$1,603,000**	**$1,385,000**
Total CIP (shown as 2020 $)									**$43,049,000**	**$71,367,000**	**$69,280,000**	**$85,327,000**	**$82,021,000**

Notes:
(1) ENR CCI = 11,579 (20-City Average, November 2020).
(2) Baseline Construction Costs = Length x Unit Cost.
(3) Estimated Construction Cost includes a 50% construction contingency and Contractor overhead, profit, insurance, and bonding allowance. This is applied to the Baseline Construction Cost.
(4) Capital Improvement Cost includes a 25% contingency applied to the Estimated Construction Cost to account for engineering services, construction management, and project administration.
(5) R&R costs based on 5-yr City program. Refer to Chapter 6 for additional details.

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7.2.1 Near-Term Projects (2020-2030)

The following near-term projects have been identified and planned for implementation between 2021 and 2030. The four categories of projects include: 1) Capacity Related Improvements, 2) Sewer Extension Improvements, 3) Rehabilitation and Replacement Projects, and 4) Other Improvements.

7.2.1.1 Capacity-Related Improvements

Tiara Rado Force Main Project

The Tiara Rado Interceptor sewer, lift station, and force main convey wastewater from the northern portion of the Tiara Rado Basin to the Persigo WWTP. The Tiara Rado Lift Station is located on the south side of the Colorado River at the bottom of a steep embankment below the Tiara Rado Basin. The Tiara Rado 12-inch ductile iron force main runs below the Colorado River and I-70 before connecting to the interceptor sewer in River Road on the north side of the river. The estimated costs for this project have been included in the capital improvement plan shown below.

CGVSD Sewer Basin

Two capacity improvement projects have been identified to upsize the gravity sewer along C 1/2 Road (CGVSD-1) and to increase the hydraulic capacity of the CGVSD By-Products Lift Station and force main (CGVSD-2). It is assumed these projects would be completed in the same period or project. The estimated total project costs for these capacity improvements equal $6,593,000.

Interceptor Flow Balance

Flow balancing improvements were identified to alleviate surcharging along the Southside interceptors. Multiple locations were identified to divert flow away from the capacity deficient sewer. The estimated total project costs for these capacity improvements equal $188,000.

OMSD Sewer Basin

As identified in Chapter 6, three scenarios were developed, and comparative costs were developed for each. Table 7.4 shows the cost differences for the three scenarios.

Table 7.4 OMSD Capital Cost Comparison

Scenario	Infrastructure Requirements	Summarized Scope	Capital Costs ($)
1	Upsize existing gravity sewers	Upsize 16,600 lf	$9,391,000
2	Divert flow from OMSD	Upsize 23,600 lf	$14,317,000
3	Divert flow to CGVSD Sewer Basin aerial crossing	Upsize 23,700 lf of pipe and increases capacity of lift station expansion(1)	$17,911,000

Notes:

(1) Costs include upsizing the CGVSD Sewer Basin By-Products Lift Station, which equal $5,314,000. Project extents and costs should be verified during design. Constructions costs for Scenario 1 may be impacted by other utilities through the developed corridor.

Based on the capital cost comparisons, it is recommended that Scenario 1 be included in the implementation plan. Scenario 1 has been identified as Project OM-1. Four other capacity related projects exist in the OMSD Sewer Basin, identified as Projects OM-2, OM-3, OM-4, and OM-5. The estimated total project costs for these four projects equal $7,175,000. Project descriptions have been provided in the Appendix, which provide additional information on scope.

Goat Wash Sewer Basin

Near-term capacity improvements in the Goat Wash Sewer Basin include upsizing the gravity sewer along Tiffany Drive, identified as Project GW-1. The estimated total project costs equal $1,571,000.

River Road North Sewer Basin

Near-term capacity improvements in the River Road North Sewer Basin were identified in Chapter 6, which include upsizing the existing gravity sewer lines along River Road North, identified as Project RRN-1. The estimated total project costs equal $1,714,000.

7.2.1.2 Extension Improvement Projects

The only near-term extension project identified in Chapter 6 was the Rosevale extension along Monument Road. This is an 8-inch trunk extension which was identified in early 2021 to serve an SID, and new development along Monument Road. The estimated total project cost for this extension is $3,544,000.

7.2.1.3 Rehabilitation and Replacement Projects

The specific rehabilitation and replacement projects identified are discussed below.

City's Current 5-Year R&R Projects

As stated in Chapter 6, the City has identified approximately 58,000 lf of sewer pipelines that need to be replaced between 2021 and 2025. The estimated total project costs equal $13,088,000.

Annual R&R Programs

For the City's pipeline R&R program, an estimated $4,500,000 will be allocated in 2021 and escalated annually.

For the City's lift station rehabilitation program, an estimated $92,000 will be allocated annually in 2021 and escalated annually.

Septic Elimination Program

Based on the number of septic systems remaining, Chapter 6 estimated to remove all the septic systems, it would require an annual capital expenditure of $1,000,000 for seventeen (17) years.

7.2.1.4 Other Improvements and Model Updates

The City should continue to collect flow monitoring and update the City's GIS/model as additional information is collected. Verifying and updating model/flow assumptions are key to maintaining an accurate and useful hydraulic model. Some specific tasks are detailed below.

- Perform additional flow, and rainfall monitoring during the spring or fall wet weather seasons so the model could be calibrated to monitored rainfall and flow data.
  - Based on the September 2020 monitoring results, a more prolonged wet weather monitoring may be needed to refine the wet weather modeling parameters.
- Perform additional flow monitoring during normal DWF conditions to calibrate per capita flow rates and refine diurnal patterns.
- Utilize water use data to validate per capita flow rates and identify large water users in the system during monitoring period.
- Verify assumed sewer inverts and pipe sizes.
- Verify connectivity and interconnects in critical areas including:
  - Fruitvale/CGVSD (refer to Figure 4.3).
  - CGVSD (GJ06) flow monitoring location.

Chapter 6 identified odor control improvements developed as part of the *Persigo WWTP and Collection System Odor Abatement Evaluation dated January 2020.*

7.2.2 Long-Term Projects (2031-2040)

The following long-term projects have been identified and planned for implementation between 2031 and 2040. The three categories of projects include: 1) Capacity Related Improvements; 2) Sewer Extension Improvements; and 3) Rehabilitation and Replacement Projects.

7.2.2.1 Capacity Related Projects

Fruitvale Sewer Basin

Three capacity related improvements were identified for the Fruitvale Sewer Basin which included upsizing existing sewer lines or installation of a new sewer line as identified in Projects FV-1, FV-2, and FV-3. The estimated total project costs for these three projects equal $3,691,000.

Goat Wash Sewer Basin

Additional capacity improvements are needed in the Goat Wash Sewer Basin to upsize gravity sewer lines, the Connected Lakes Lift Station and force main, identified as Project GW-2. It is recommended this project be completed with adjacent timing to GW-1 to simplify design and construction durations. The estimated total project costs for this capacity improvement equal $5,214,000.

7.2.2.2 Extension Improvement Projects

24 Road Sewer Basin

There are four projects identified to serve this basin in the future as growth occurs. Three of the extensions are classified as trunk extensions and one is categorized as a developer extension. These projects are identified as Projects 24R Ext-1, Ext-2, Ext-3, and Ext-4. Developer projects are not included in the CIP as they not funded by the City. The estimated total project costs for the City funded projects equal $1,045,000.

OMSD Sewer Basin

There are eight projects identified to serve this basin in the future as growth occurs. Five of the projects are classified as trunk extensions and three are categorized as a developer extension. These projects are identified as Project OM Ext-1 to Ext-8. Developer projects are not included in the CIP as they not funded by the City. The estimated total project costs for the City funded projects equal $6,052,000.

River Road North Sewer Basin

There are five projects identified to serve this basin in the future as growth occurs. Three of the projects are classified as trunk extensions and two are categorized as a developer extension. These projects are identified as Projects RRN Ext-1 to Ext-5. Developer projects are not included in the CIP as they not funded by the City. The estimated City funded project costs for these extension lines equal $4,991,000.

7.2.2.3 Rehabilitation and Replacement Projects

The long-term rehabilitation and replacement projects identified are discussed below.

Annual R&R Programs

For the City's pipeline R&R program, an estimated $4,500,000 will be allocated in 2021 and escalated annually.

For the City's lift station R&R program, an estimated $92,000 will be allocated annually in 2021 and escalated annually.

Lift Station Replacements

Based on the age of the Falls and Heather Ridge Lift Stations, these two facilities were slated for full replacement in the 2032 to 2033 timeframe. The lift station replacements costs were calculated using the cost curve shown in Figure 7.1. Prior to initiation of the project design efforts, an assessment of the infrastructure condition and review of flow assumptions should be completed. The estimated project costs for these lift station replacements equal $2,849,000.

Based on the age of the El Poso Lift Station it will be slated for full replacement in the 2034 to 2035 timeframe. The lift station replacements costs were calculated using the cost curve shown in Figure 7.1. Prior to initiation of the project design efforts, an assessment of the infrastructure condition and review of flow assumptions should be completed. The estimated project costs for this project equals $2,174,000.

7.3 Comparison to 2008 WW Basin Update

Table 7.5 compares the current recommended collection system improvements against the values proposed in the 2008 WW Basin Update. The capital improvement costs identified for the capacity improvements and trunk extension projects remained similar between these studies. However, it should be noted the 2008 WW Basin Update did not include rehabilitation and replacement costs.

Table 7.5 Comparison to 2008 WW Basin Update

	2020 WW Basin Update (2021-2040)(1)	2008 WW Basin Update (2008-2035)
Capacity Improvement Projects	$40.7M	$25M
Trunk Extension Projects	$15.6M	$23M
Pipeline R&R Improvements	$85.1M	NA
Lift Station R&R Improvements	$11.1M	NA
Septic Elimination Program	$17.0M	NA
Other Projects and Programs	$2.5M	
Total	**$172.3M**	**$48M**

Notes:
(1) Capital dollars show in 2020 values for the 2020 WW Basin Update, and in 2008 valves for the 2008 WW Basin Update.

7.4 Cash Flow Projections

The projected cash flow presented in Table 7.6 were developed using the recommended projects and implementation schedule discussed above. The cash flow in Table 7.6 was developed using 2020 dollars. The projected expenditures shown as a future valve are represented in Table 7.7. The dollars shown have been escalated to a future value representing the mid-point of construction using a 3 percent escalation factor. The forecasted capital improvement projects have been compared to the current budgeted capital improvement projects in the City's existing 2021 Ten-Year Capital Plan. Increases are mainly due to the near-term capacity improvement projects.

Table 7.6 Proposed CIP Overview – Dollars shown as Present Value

	Project Area / Name	Total	2021	2022	2023	2024	2025	2026 - 2030	2031 - 2035	2036 - 2040
Capacity Projects	Central Grand Valley Sewer Basin	**$6,782,000**		$814,000	$2,984,000	$2,984,000				
	Orchard Mesa Sewer Basin (Projects OM-1 to OM-5)	**$16,566,000**				$1,988,000	$4,373,000	$10,205,000		
	Goat Wash Sewer Basin	**$6,785,000**						$1,571,000	$5,214,000	
	River Road North Sewer Basin	**$1,714,000**						$1,714,000		
	Fruitvale Sewer Basin	**$3,691,000**							$3,691,000	
Extension Projects	24 Road Sewer Basin	**$1,045,000**							$1,045,000	
	Orchard Mesa Sewer Basin (Projects OM Ext-1 to OM Ext-8)	**$6,052,000**							$6,052,000	
	River Road North Sewer Basin	**$4,991,000**								$4,991,000
	Rosevale Sewer Basin	**$3,544,000**			$3,544,000					
	Sewer Improvement District (included in 2021 Budget as allowance)	**$17,000,000**	$50,000	$250,000	$1,000,000	$1,000,000	$1,000,000	$5,000,000	$5,000,000	$3,700,000
R&R Projects	Prioritized R&R Projects - Phase 1 and Phase 2 Projects (per Table 6.12)	**$13,088,000**	$2,000,000	$3,696,000	$3,696,000	$3,696,000				
	Tiara Rado Force Main Project	**$5,200,000**	$5,200,000							
	System wide Pipeline Rehabilitation Annual Allocation	**$72,000,000**					$4,500,000	$22,500,000	$22,500,000	$22,500,000
	System wide Lift Station R&R Program (pump replacements)	**$1,748,000**		$92,000	$92,000	$92,000	$92,000	$460,000	$460,000	$460,000
	Ridges Lift Station Improvements (included in 2021 Budget)	**$4,240,000**	$500,000	$3,740,000						
	Replace Falls and Heather Ridge Lift Stations (2032-2033)	**$2,849,000**							$2,849,000	
	Replace El Poso Lift Stations (2034-2035)	**$2,174,000**							$2,174,000	
Other Projects	Updated Hydraulic Modeling, Flow Surveys, and Master Plan	**$1,050,000**					$350,000		$350,000	$350,000
	Collection System Equipment	**$390,000**	$240,000	$50,000	$50,000	$50,000				
	Odor Control Projects and Evaluations	**$953,000**			$118,000	$150,000			$75,000	$610,000
	TOTAL	**$171,862,000**	**$7,990,000**	**$8,642,000**	**$11,484,000**	**$9,960,000**	**$10,315,000**	**$41,450,000**	**$49,410,000**	**$32,611,000**
	City's 2021 Ten-Year Capital Plan (Collection System Only)		**$7,990,000**	**$5,114,800**	**$5,966,800**	**$6,068,800**	**$6,170,800**	**$32,191,200**	**NA**	**NA**

Notes:
(1) Dollars shown in 2020 values.

Table 7.7 Proposed CIP Overview – Dollars shown as Future Value

	Project Area / Name	Total	2021	2022	2023	2024	2025	2026 - 2030	2031 - 2035	2036 - 2040
Capacity Projects	Central Grand Valley Sewer Basin	**$7,265,000**		$838,000	$3,166,000	$3,261,000				
	Orchard Mesa Sewer Basin (Projects OM-1 to OM-5)	**$19,832,000**				$2,172,000	$4,922,000	$12,738,000		
	Goat Wash Sewer Basin	**$9,506,000**						$1,961,000	$7,545,000	
	River Road North Sewer Basin	**$2,139,000**						$2,139,000		
	Fruitvale Sewer Basin	**$5,341,000**							$5,341,000	
Extension Projects	24 Road Sewer Basin	**$1,512,000**							$1,512,000	
	Orchard Mesa Sewer Basin (Projects OM Ext-1 to OM Ext-8)	**$8,757,000**							$8,757,000	
	River Road North Sewer Basin	**$8,372,000**								$8,372,000
	Rosevale Sewer Basin	**$3,760,000**			$3,760,000					
	Sewer Improvement District (annual allowance) (2)	**$23,271,000**	$50,000	$258,000	$1,061,000	$1,093,000	$1,126,000	$6,241,000	$7,235,000	$6,207,000
R&R Projects	Prioritized R&R Projects - Phase 1 and Phase 2 Projects (per Table 6.12)	**$13,767,000**	$2,000,000	$3,807,000	$3,921,000	$4,039,000				
	Tiara Rado Force Main Project	**$5,200,000**	$5,200,000							
	System wide Pipeline Rehabilitation Annual Allocation	**$103,449,000**					$5,065,000	$28,084,000	$32,557,000	$37,743,000
	System wide Lift Station R&R Program (pump replacements)	**$2,410,000**		$95,000	$98,000	$101,000	$104,000	$574,000	$666,000	$772,000
	Ridges Lift Station Improvements (included in 2021 Budget)	**$4,352,000**	$500,000	$3,852,000						
	Replace Falls and Heather Ridge Lift Stations (2032-2033)	**$4,122,000**							$4,122,000	
	Replace El Poso Lift Stations (2034-2035)	**$3,146,000**							$3,146,000	
Other Projects	Updated Hydraulic Modeling, Flow Surveys, and Master Plan	**$1,487,000**					$394,000		$506,000	$587,000
	Collection System Equipment	**$390,000**	$240,000	$50,000	$50,000	$50,000				
	Odor Control Projects and Evaluations	**$1,421,000**			$125,000	$164,000			$109,000	$1,023,000
	TOTAL	**$229,499,000**	**$7,990,000**	**$8,900,000**	**$12,181,000**	**$10,880,000**	**$11,611,000**	**$51,737,000**	**$71,496,000**	**$54,704,000**
	City's 2021 Ten-Year Capital Plan (Collection System Only)		**$7,990,000**	**$5,114,800**	**$5,966,800**	**$6,068,800**	**$6,170,800**	**$32,191,200**	**NA**	**NA**

Notes:

(1) Dollars shown have been escalated to future costs based on the mid-point of construction escalated at 3 percent annually.

(2) Sewer Improvement District annual allowances were not escalated to a future date.

Appendix A

FLOW MONITORING REPORT

City of Grand Junction Colorado

September 2020

City of Grand Junction, CO 2020 Persigo WWTP Master Plan Update

TEMPORARY WASTEWATER COLLECTION SYSTEM FLOW MONITORING

Technical Memorandum

prepared for Carollo Engineers

carollo

COLORADO LICENSED
NICK CARIS
52756
PROFESSIONAL ENGINEER

9/28/2020

prepared by

Ashton Engineering Group, LLC
4610 S. Ulster St., #150
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Ashton Engineering Group, LLC

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1

INTRODUCTION

In March 2020 Ashton Engineering Group, LLC (AEG) was retained by Carollo Engineers (Carollo) to perform wastewater collection system flow monitoring in the City of Grand Junction (COG). The flow monitoring study consisted of utilizing ten (10) flow monitors and two (2) rain gauges for a monitoring period of 61 days.

The purpose of the flow and rainfall monitoring was to assist COG's 2020 Persigo WWTP Master Plan update project. The goal of the flow monitoring study was to attain dry and wet-weather flows to determine dry weather patterns and to identify the contributed excesses flows from wet weather events into the sewer system. Due to zero significant rain events during the flow monitoring period, a wet-weather analysis was unable to be conducted.

During this flow monitoring study, a statewide government mandated stay-at-home order was enforced, beginning March 26th, 2020, due to the COVID-19 pandemic. Therefore, measured residential and non-residential flows may have varied from normal.

This report addresses the results of the flow monitoring activities.

PROJECT APPROACH

AEG performed a flow monitoring study between April 27 to June 26, 2020 of COG's wastewater collection system for the purpose of evaluating flow characteristics and to assist Carollo's wastewater master plan update efforts.

The project scope consisted of flow and rainfall monitoring for 61 days. Ten (10) flow meters and two (2) rain gauges were installed between the dates April 23 to April 25, 2020 with the flow monitoring period beginning on April 27. The flow meter and rain gauge locations were provided by Carollo.

Table 1-A, on the following page provides details of the meter locations used for this monitoring period. The meter locations on Table 1-A show the nearest address and longitude and latitude coordinates are shown on the field installation sheets Appendix A of this report. Additional information shown on Table 1-A are meter site ID's, host manhole ID's, pipe materials, and measured inside diameter of pipe openings.

The flow meters were used to record depth and velocity of flow at five-minute intervals. Engineering review and input of additional calibration data was used to finalize the metered flow data. Manual depth and velocity readings (velocity profiles) were taken bi-weekly to verify and calibrate the metered data. Average flow rates for one-hour intervals were determined for the monitoring locations. The average hourly flow rates were used to determine daily dry-weather flow rates.

Figure 1.1, on the following page, outlines the location of the flow meters and rain gauges.

Table 1-A
FLOW MONITORING LOCATIONS

METER ID	COG STRUCTURE ID	LOCATION (NEAREST ADDRESS)	PIPE MATERIAL	PIPE INSIDE DIAMETER (in)
GJ01	F1-232-013	2380 HWY 6 & 50	PVC	17.56
GJ02	D2-252-002	819 W MAIN ST.	RCP	28.88
GJ03	F1-261-026	140 WILLOWBROOK AVE.	CIPP	14.88
GJ04	E3-241-036	2449 HWY 6 & 40	PVC	17.50
GJ05	B3-271-006	2711 B ¾ RD.	VCP	14.63
GJ06	C3-271-028	1850 LAS COLONIAS DR.	PVC	29.44
GJ07	D2-252-152	633 W. WHITE AVE.	CIPP	28.00
GJ08	D2-271-043	1360 MAIN ST.	HDPE	17.00
GJ09	E4-271-060	2525 N. 15TH ST.	PVC	14.13
GJ10	D3-252-054	315 N SPRUCE ST.	VCP	15.00

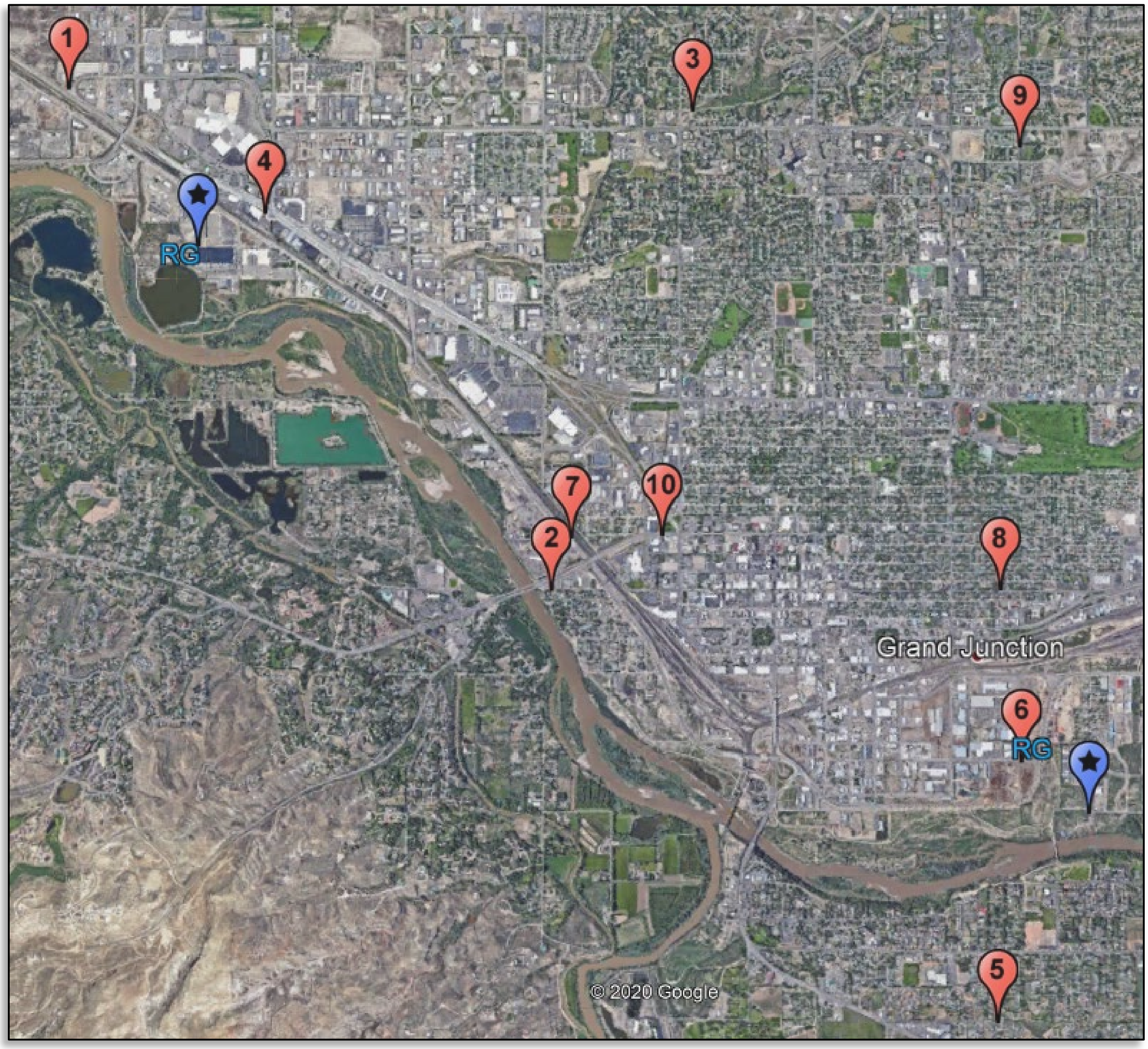


Figure 1.1: Overview of Flow Meter and Rain Gauge Locations (snapshot from Google Earth)

DEFINITIONS AND ABBREVIATIONS

This section contains definitions and abbreviations commonly used throughout flow monitoring studies and can be used as a reference for this report.

(1) Infiltration (as defined by USEPA) - the water entering a sewer system and service connections from the ground through such means as, but not limited to, defective pipes, pipe joints, service connections, service laterals, or manhole walls.

(2) Inflow (as defined by USEPA) - the water discharged into a sewer system, including service connections, from such sources as roof leaders; cellar, yard, and area drains; foundation drains; cooling water discharges; drains from springs and swampy areas; manhole covers; cross connections from storm sewers, combined sewers, or catch basins; storm waters; surface runoff; or drainage.

(3) Excessive infiltration and inflow (I/I) - the extraneous clean water that enters the sanitary sewer system, which can be eliminated, on a cost-effective basis.

(4) Base flow - wastewater flow exclusive of infiltration or inflow. Generally determined from water records during months when most of the water consumption is returned to the wastewater collection system.

(5) Permanent Infiltration - extraneous flow that enters the sewer system through the ground during periods of dry-weather/low-groundwater. Generally determined by subtracting base flow during winter months from the average daily dry-weather monitored flow.

(6) Peak Infiltration - the maximum extraneous flow that enters the wastewater collection system during high groundwater conditions after the inflow effects of a rain event have ended. Generally determined by subtracting dry-weather/low-groundwater flow (average daily dry weather monitored flow) from flow recorded during periods of high groundwater.

(7) Average Daily Dry-Weather flow - dry-weather/low-groundwater flow exclusive of dry-weather/high-groundwater (peak infiltration) and wet weather (inflow) flow. Includes base flow and permanent infiltration only.

(8) Average Daily Dry-Weather flow Peaking Factor - the ratio between the peak hourly flow rate and the average daily flow.

(9) 1-Year/60-Minute Storm - a storm event that produces *x.xx* inches of rain per hour in a given geographical area and is expected to occur once in any given year according to National Oceanic and Atmospheric Administration Atlas 14 Point Precipitation Frequency Estimates.

(10) Design Storm Event - a storm event selected for purposes of analyzing its effect on the wastewater collection system.

(11) gpd - gallons per day.

(12) mgd - million gallons per day.

(13) Surcharge Condition – When the sewer flow depth equals or exceeds the diameter of the discharging sewer lines. (WEF Manual of Practice FD-6)

(14) Sanitary Sewer Overflows (SSOs) (as defined by USEPA) – The discharge of untreated sewage from municipal sanitary sewer systems as a result of broken pipes, equipment failure, or system overload.

(15) Infiltration and Inflow (I/I) – A combination of infiltration and inflow in sanitary sewer.

(16) Rain-Derived Inflow and Infiltration (RDII) – Quantity of rain dependent inflow and infiltration that enters the sanitary sewer system.

2

DATA COLLECTION AND EQUIPMENT

SITE SELECTION

Once the preliminary locations were submitted by Carollo a site investigation was performed to determine if the site had good hydraulics for data collection. Generally, it is preferred to have a straight channel where flow is free of turbulence or backwater effects. Listed below are other considerations that were investigated:

- Installation constraints
- Pipe dimensions
- Site accessibility
- Site specific concerns
- Manhole accessibility
- Manhole configuration
- Flow depth range
- Velocity range
- Employee safety
- Surcharging evidence
- Silt deposition
- Maintainability
- Telemetry constraints
- Sensor survival

A copy of the Flow Meter and Rain Gauge Site Installation Form complete with photos and site details of the meter locations, is provided in Appendix A. The photos of the meter site include the site location, inside manhole, and pipe before and after sensor placement.

FLOW METER TYPE INFORMATION

HACH FL900 meters were selected as the gravity flow meter to complete the flow monitoring program. The average accuracy of the meters for the depth measurement is ±2.0 % and the average accuracy for velocity is ±0.05 fps.

Some information regarding the selected flow meters is included below and on the following pages:

Figure 2.1: HACH FL900 Sub AV Meter

HACH FL900 METER PRINCIPLES:

The flow meters are open channel flow meters that utilize Doppler ultrasonic technology to sense flow velocity and a differential pressure transducer for flow depth. The flow meters have four primary components: a logger unit that stores the collected data and houses the RTU, pressure and velocity sensors, and the integrated wireless modem. The pressure depth sensor utilizes a pressure transducer which will record level including full pipe and surcharge level. The sensors emit signals and receive returned signals from the flow to capture the characteristics of the flow velocity and depth.

Flows are calculated using the continuity equation, which is expressed as Q = AV, where Q is flow, A is the cross-sectional area, and V is the average velocity of the flow as illustrated in Figure 2.2. The meter records velocity and depth at five-minute intervals.

Calibration and Installation:

The HACH FL900 meter must be calibrated on site by entering physical offsets of the sensors and their positions in the meter as well as comparing the depth and velocity measurements recorded by the meter to manual measurements. Depth and velocity adjustments for the HACH meters are made directly to the meter as necessary.

The meter housing was secured with an eyebolt on the wall of the manhole. A stainless steel, expandable band secured the depth/velocity probe to the channel. The probes were positioned in the flow of the incoming pipe to minimize the effects of flow turbulence and debris buildup that may exist in the manhole.

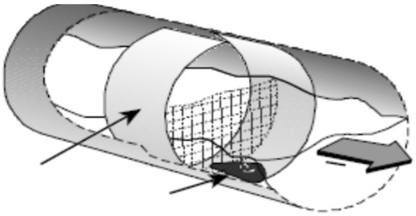


Figure 2.2: Flow is calculated using the Continuity Equation: Flow = Average Velocity x Area of Flow

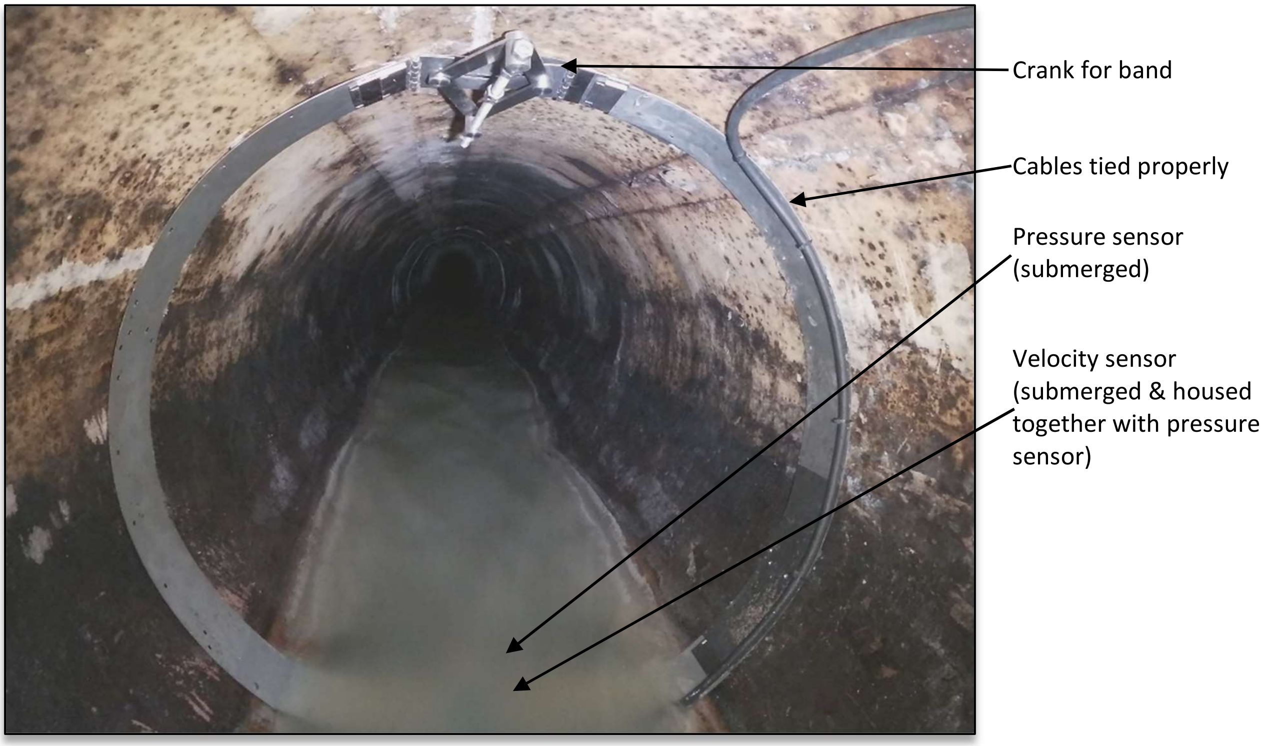


Figure 2.3: GJ07 Flow Meter Installation

TELEMETRY EQUIPMENT

The flow meter called into a central processing location during the project to perform a data dump for data collection and review. This process was performed through a Remote Transmission Unit (RTU) that collects data and sends the collected data by wireless telemetry to the central processing location. The data was then available for review on the website (FSDATA) hosted by HACH.

Each RTU initiated a call into the central location once every 1 hour. The RTU’s transmit all the 5-minute data points recorded during that day.

The antennas are typically located just outside the manhole because a cast-iron manhole cover would block the wireless signals otherwise. The antenna was buried just below the existing surface. A typical antenna installation is shown in Figure 2.4.

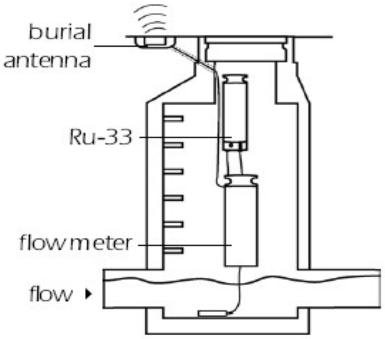
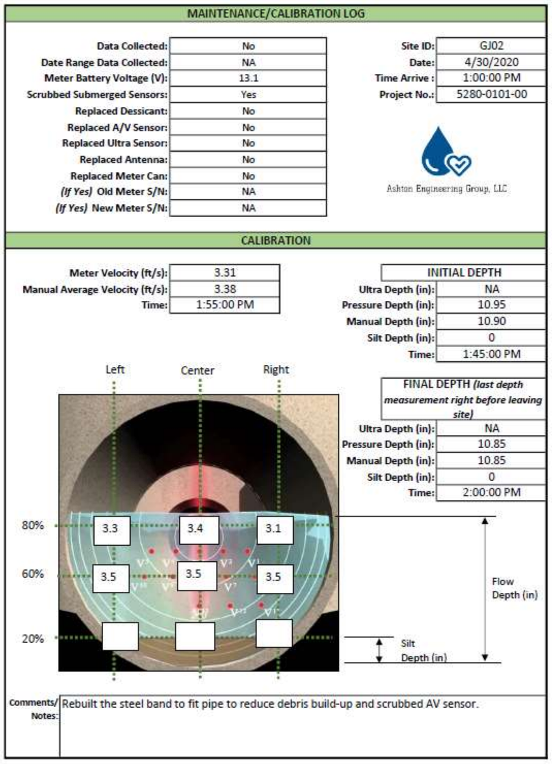


Figure 2.4: Typical meter installation

METER MAINTENANCE

During site visits, data stored in the meter was manually retrieved as a backup to the telemetry download and the meters were inspected to ensure proper operation. The meter depth and velocity readings were taken before and after maintenance/cleaning of the probes. Manual depth and velocity measurements were taken, silt deposit depths were recorded, and the batteries were changed, if necessary. An example maintenance log for flow meter GJ02 is shown in Figure 2.5.



MAINTENANCE/CALIBRATION LOG

Data Collected: No
Date Range Data Collected: NA
Meter Battery Voltage (V): 13.1
Scrubbed Submerged Sensors: Yes
Replaced Dessicant: No
Replaced A/V Sensor: No
Replaced Ultra Sensor: No
Replaced Antenna: No
Replaced Meter Can: No
(If Yes) Old Meter S/N: NA
(If Yes) New Meter S/N: NA

Site ID: GJ02
Date: 4/30/2020
Time Arrive : 1:00:00 PM
Project No.: 5280-0101-00

Ashton Engineering Group, LLC

CALIBRATION

Meter Velocity (ft/s): 3.31
Manual Average Velocity (ft/s): 3.38
Time: 1:55:00 PM

INITIAL DEPTH
Ultra Depth (in): NA
Pressure Depth (in): 10.95
Manual Depth (in): 10.90
Silt Depth (in): 0
Time: 1:45:00 PM

FINAL DEPTH *(last depth measurement right before leaving site)*
Ultra Depth (in): NA
Pressure Depth (in): 10.85
Manual Depth (in): 10.85
Silt Depth (in): 0
Time: 2:00:00 PM

Comments/Notes: Rebuilt the steel band to fit pipe to reduce debris build-up and scrubbed AV sensor.

RAINFALL MONITORING

Two (2) temporary Sigma brand rain gauges maintained by AEG were utilized to monitor rainfall during the April 27 through June 26 study period. Rainfall was recorded with a continuously recording rain gauge with an accuracy of 0.01 inches. The rain gauges were equipped with an HACH FL900 data logger and called in once per hour to relay data to the central database.

Figure 2.5: Flow Meter GJ02 Maintenance Log

One rain gauge (RG01) was installed on the west side of City of Grand Junction at Coors Lift Station located near 347 27 ½ Rd. and the other (RG02) was installed on the south side of the City of Grand Junction at Grand Valley By Products Lift Station located at 559 Sandhill Ln. Rain gauge site sheets can be viewed within Appendix A of this report.

RAINFALL RESULTS:

Both temporary rain gauges, RG01 and RG02, recorded one non-significant rainfall event of greater or equal than 0.05-inches of rainfall for a 24-hour period. The largest storm event occurred on between June 25 & June 27 for rain gauges RG01 and RG02, where the total rainfall was 0.11 inches and 0.05 inches, respectively.

In addition to the temporary rain gauges (RG01 and RG02) installed during this flow monitoring study, an additional permanent rain gauge at Grand Junction Regional Airport (GJRA) was also observed. Rainfall data at this site was retrieved from Weather Underground (WU, a commercial weather service providing real-time weather information over the Internet. Four (4) non-significant rainfall events of greater or equal than 0.05-inches of rainfall for a 24-hour period were observed. The largest storm event occurred on between June 6 & June 7, where the total rainfall was 0.19 inches and 0.17 inches, respectively.

Daily rainfall summaries are listed in Table 2-A on the following page.

Table 2-A

RAINFALL DAILY SUMMARIES

Date	Grand Junction Regional Airport Rain Gauge (in.)	RG01 Cumulative Rainfall (in.)	RG02 Cumulative Rainfall (in.)	Date	Grand Junction Regional Airport Rain Gauge (in.)	RG01 Cumulative Rainfall (in..)	RG02 Cumulative Rainfall (in)
4/27/2020	0	0	0	5/28/2020	0	0	0
4/28/2020	0	0	0	5/29/2020	0	0	0
4/29/2020	0	0	0	5/30/2020	0	0	0
4/30/2020	0	0	0	5/31/2020	0.01	0	0
5/1/2020	0	0	0	6/1/2020	0	0	0
5/2/2020	0	0	0	6/2/2020	0	0	0
5/3/2020	0	0	0	6/3/2020	0	0	0
5/4/2020	0	0	0	6/4/2020	0	0	0
5/5/2020	0	0	0	6/5/2020	0	0	0
5/6/2020	0	0	0	6/6/2020	0.19	0	0
5/7/2020	0	0	0	6/7/2020	0.17	0	0
5/8/2020	0	0	0	6/8/2020	0	0	0
5/9/2020	0	0	0	6/9/2020	0	0	0
5/10/2020	0	0	0	6/10/2020	0	0	0
5/11/2020	0	0	0	6/11/2020	0	0	0
5/12/2020	0.07	0	0	6/12/2020	0	0	0
5/13/2020	0	0	0	6/13/2020	0	0	0
5/14/2020	0	0	0	6/14/2020	0	0	0
5/15/2020	0	0	0	6/15/2020	0	0	0
5/16/2020	0	0	0	6/16/2020	0	0	0
5/17/2020	0	0	0	6/17/2020	0	0	0
5/18/2020	0	0	0	6/18/2020	0	0	0
5/19/2020	0	0	0	6/19/2020	0	0	0
5/20/2020	0	0	0	6/20/2020	0	0	0
5/21/2020	0	0	0	6/21/2020	0	0	0
5/22/2020	0	0	0	6/22/2020	0	0	0
5/23/2020	0	0	0	6/23/2020	0	0	0
5/24/2020	0	0	0	6/24/2020	0	0	0
5/25/2020	0	0	0	6/25/2020	0.08	0.11	0
5/26/2020	0	0	0	6/26/2020	0	0	0
5/27/2020	0	0	0	6/27/2020	0	0	0.05
				TOTALS	***0.52***	***0.11***	***0.05***

3

FLOW MONITORING AND DATA PROCESSING

TELEMETRY APPLICATION

The telemetry system provides a valuable tool to compliment scheduled meter maintenance visits. Telemetry provides a means to evaluate the performance of each meter and prioritize meter site visits.

With the assistance of telemetry, daily, each meter site was viewed to verify its performance and to determine critical issues that needed to be addressed. A priority listing was developed to prioritize critical issues and incorporate regular meter maintenance visit requests into a service priority listing.

DATA EVALUATION

SCATTERGRAPHS:

For each site, a scattergraph is created to compare the depth versus velocity relationship. In the following example for meter location GJ01, the pipe curve along the observed depth versus velocity points indicates an obstruction of approximately 2.35-inches in the downstream line. Examples of a restriction may be offset joints, debris, and other related conditions.

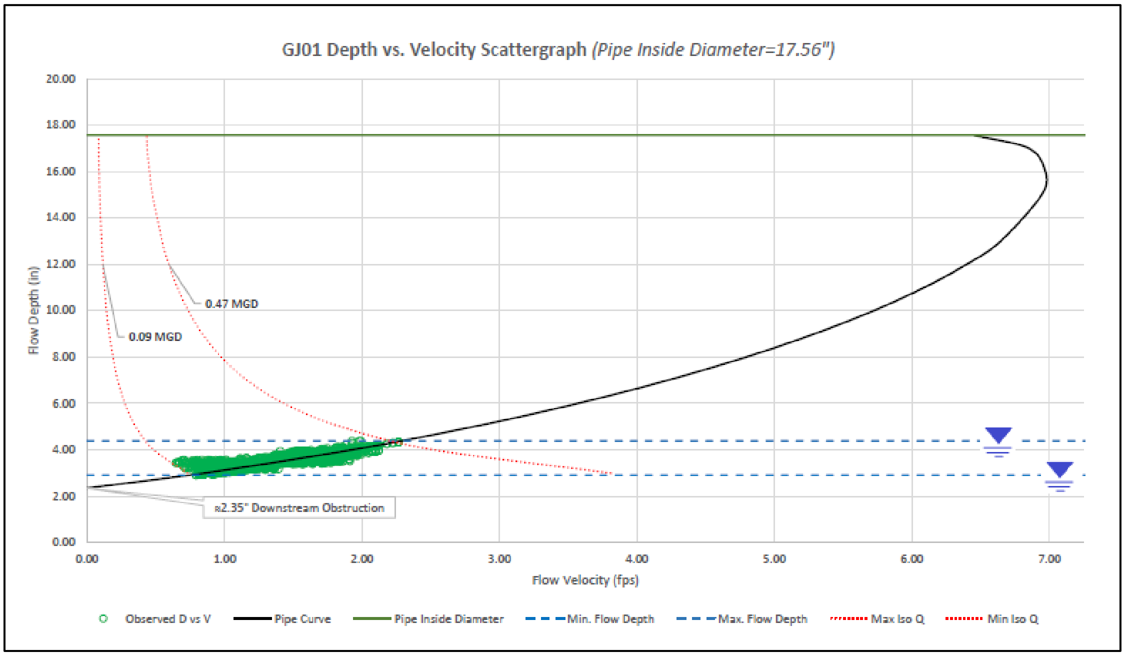


Figure 3.1: Flow meter GJ01 Scattergraph

On the scattergraphs, the pipe curve is developed utilizing the Steven-Schutzbach Method which uses an iterative curve fitting technique to fit the Manning Equation to flow monitor data. With this method, the pipe slope and roughness coefficient of the pipe are not required, which is especially useful because record drawings are sometimes inaccurate and non-existent. The scattergraphs for each meter site are shown in Appendix B of this report.

MANNING'S EQUATION:

For meter data quality, Manning's flow is used as a toll for data evaluation in developing a trend line relationship for comparison to flows derived by the continuity equation. The Manning equation and continuity equation graphs are overlaid for review if there are any significant variations. The Manning equation is also used for any periods where velocity readings are known to drop to zero due foul build-up or a faulty sensor and in this case, the depth value is utilized to calculate the Manning's velocity equation.

For slope and pipe material coefficients when utilizing Manning's equation, a pipe material coefficient is selected based on the observed pipe material (ex. PVC, RCP, etc.) and an average equivalent slope based on isolating the slope constant in the Manning's equation and calculating it based on each observed flow measurement.

Some exceptions for using Manning's include flow conditions where backwater or surcharging conditions are present. In these cases, the measured flow rates do not necessarily follow those predicted by the Manning's equation. Below in Figure 3.1 is an example of Manning flow versus the observed flow:

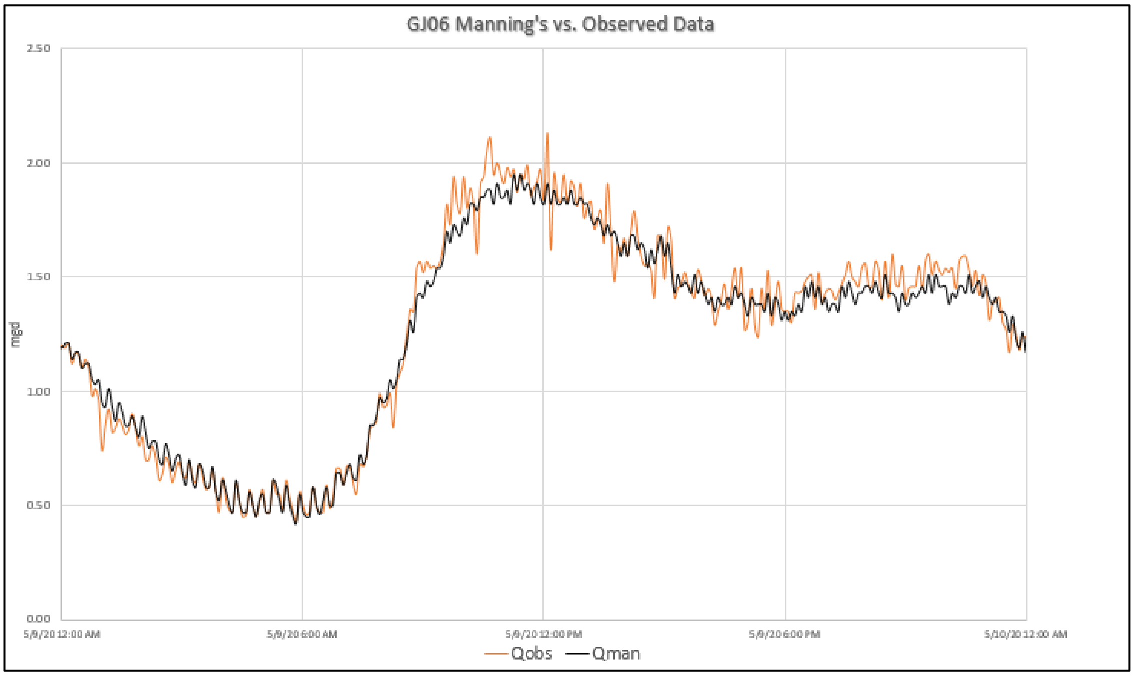


Figure 3.2: Flow meter GJ06 Manning's Flow vs. Observed Flow

HYDROGRAPHS:

Hydrographs were prepared to show the response that was present in each meter because of Inflow and Infiltration in the tributary basin. For this project, since there were no significant rain events, a wet-weather response is not visible on any of the hydrographs. Below in Figure 3.3 is an example of the flow, depth, and velocity versus the rainfall. Hydrographs for each meter are provided in Appendix C along with the daily average, minimum and maximum flow rates in Appendix D.

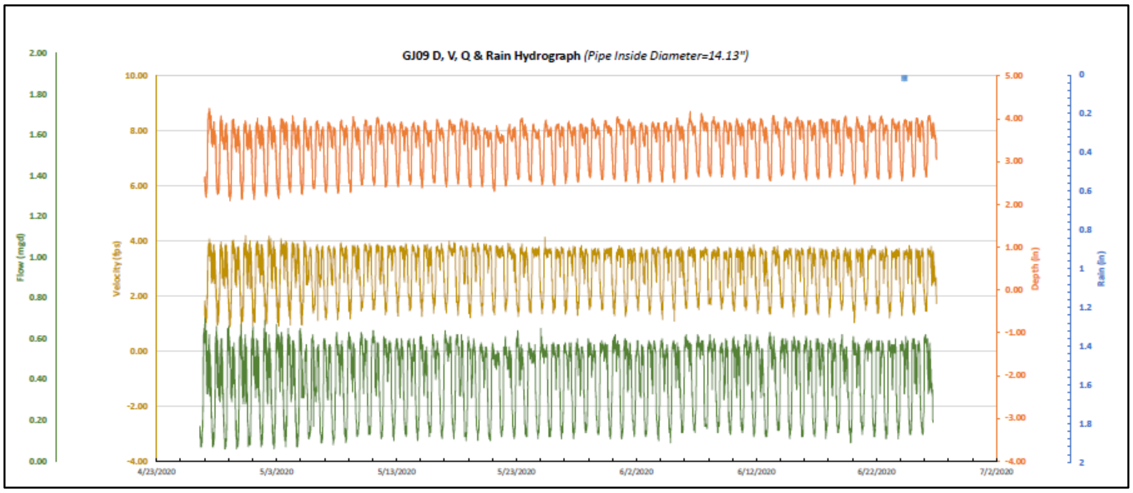


Figure 3.3: Flow meter GJ09 Hydrograph

4

DRY-WEATHER FLOW ANALYSIS

DETERMINATION OF AVERAGE DRY-WEATHER FLOWS

Flow data collected during dry-weather/low-groundwater periods was analyzed to determine the average daily dry-weather flows. The 2-week dry period used for analysis is June 8 through June 21.

AVERAGE DRY-WEATHER FLOW PEAKING FACTORS

Wastewater flow during dry-weather periods will vary during the day in response to water consumption. By examining the diurnal curves for the selected 2-week dry period as mentioned above, a dry-weather peaking factor was determined.

From a diurnal curve, a dry-weather peaking factor is the ratio of the peak flow rate and the average flow. Dry-weather peaking factors for each mater basin is shown in Table 4-A. Industry standards for peaking factors are less than 2.5 for dry-weather flows and all fall below.

An example dry-weather flow diurnal curve depicting GJ02 is shown in Figure 4.1 and similarly can be seen be for each meter site in Appendix E.

Table 4-A

AVERAGE DRY-WEATHER FLOW PEAKING FACTORS
June 8 - June 21, 2020

Meter Basin	Average (mgd)	Peak Flow Rate (mgd)	Dry-Weather Flow Peaking Factor
GJ01	0.22	0.35	1.59
GJ02	3.20	4.27	1.33
GJ03	0.69	0.97	1.41
GJ04	1.11	1.50	1.35
GJ05	0.69	0.97	1.41
GJ06	1.21	2.01	1.66
GJ07	1.05	1.35	1.29
GJ08	0.92	1.30	1.41
GJ09	0.42	0.58	1.38
GJ10	0.79	1.16	1.47

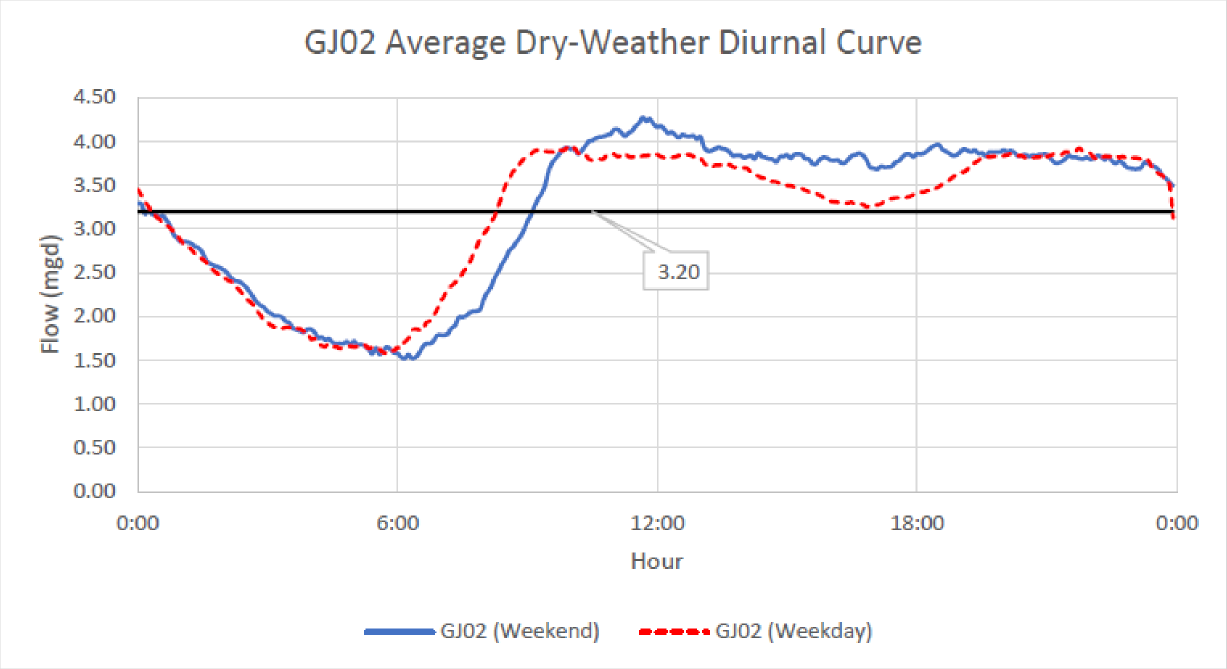


Figure 4.1: GJ01 Dry-Weather Flow Diurnal Curve

APPENDIX A

FLOW METER AND RAIN GAUGE SITE INSTALLATION SHEETS

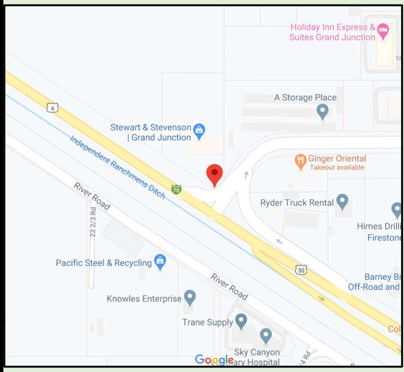
Ashton Engineering Group, LLC

	Client Name	**Site Name**
	Carollo Engineers	GJ01
	Project Description	**Site Code**
	2020 GJ Persigo WWTP Master Plan	Target
Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-24-2020/11:15 PM	5280-0101-00

System Information

Target Pipe Dia. (in.):	18	
Owner:	City of Grand Junction, CO	
Assigned Rain Gauge:		
Owner MH #:	F1-232-013	
U/S MH #:	F1-232-019	
System Characteristics: *(highlight all that apply)*	Residential Industrial	Commercial
Pump Station Influence:	No	
WWTP Influence:	No	

Location Map



Area Picture

Top View Picture

Access Notes: H2S over 10ppm and lower oxygen levels, use blower.

Location Information

Site Address:	2380 HWY 6 & 50
Site Access:	Off-road
Longitude:	-108.6128833
Lattitude:	39.0940111
MH Type:	Coated Pre-Cast Concrete
Manhole Depth (ft):	11.72
Manhohle Dimensions (ft):	6
Elevated Manhole:	No
Height Elevated:	
Structural Integrity:	Fair

Investigation Photo

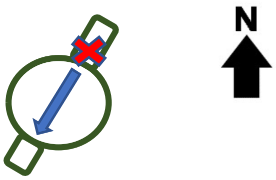
Installation Photo

Hydraulic Characteristics:		Install Notes:	

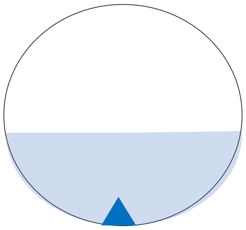
Site Information

Pipe Height (in):	17.56		
Pipe Width (in):	17.56		
Pipe Material:	PVC		
Pipe Shape:	Circular		
O_2:	19.5	LEL %:	0
H_2S:	11	CO:	0

Install Plan Sketch



Install Cross-Section Sketch



✖	This Meter	A/V Sensor & Clock Position:	6 o'clock ▲
▭	Pipe		
⬚	Elevated Pipe	Ultra Sensor & Clock Position:	■
⬅	Flow Direction		

Hydraulic Information

Flow Depth (in):	4.00
Instant Velocity (fps):	1.00
Surcharge Evidence (ft):	No
Silt Type:	Debris
Silt Depth (in):	2
Needs Cleaning:	Yes
Backwater:	No
Flow Path:	Straight
Drop Inlet:	No
Hydraulic Rating:	Fair

Installation Notes

Sensors:	Pressure, Velocity	Meter Type:	HACH FL902/AV9000
Telemetry:	Yes	Antenna Surface:	Non-Paved
Install Date:	4/24/2020	Location in Pipe:	1'
Meter S/N:	200400004034		

Ashton Engineering Group, LLC

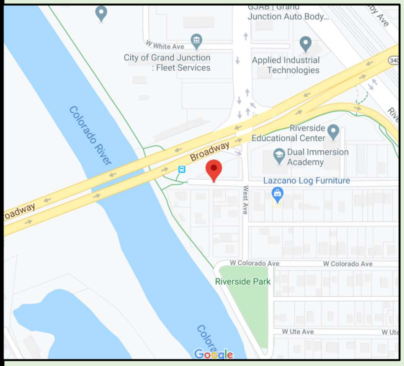
Client Name	**Site Name**
Carollo Engineers	GJ02
Project Description	**Site Code**
2020 GJ Persigo WWTP Master Plan	Target

Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-24-2020/1:10 PM	5280-0101-00

System Information

Target Pipe Dia. (in.):	30	
Owner:	City of Grand Junction, CO	
Assigned Rain Gauge:		
Owner MH #:	D2-252-002	
U/S MH #:	D1-252-001	
System Characteristics: *(highlight all that apply)*	Residential	Commercial
	Industrial	
Pump Station Influence:	No	
WWTP Influence:	No	

Location Map



Area Picture

Top View Picture

Access Notes: Very high H2S over 50ppm, use blower.

Location Information

Site Address:	819 W Main St.
Site Access:	Roadway, Low Traffic
Longitude:	-108.57965
Lattitude:	39.0673611
MH Type:	Coated Cast-In-Place Concrete
Manhole Depth (ft):	8.08
Manhohle Dimensions (ft):	5
Elevated Manhole:	No
Height Elevated:	
Structural Integrity:	Good

Investigation Photo

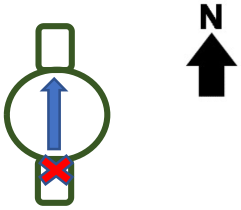
Installation Photo

Hydraulic Characteristics:		Install Notes:	

Site Information

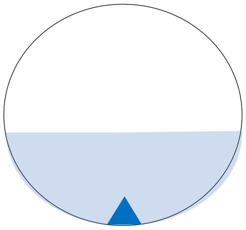
Pipe Height (in):	28.88		
Pipe Width (in):	28.88		
Pipe Material:	RCP		
Pipe Shape:	Circular		
O_2:	19.9	LEL %:	0
H_2S:	56	CO:	0

Install Plan Sketch



❌	This Meter
▭	Pipe
⬚	Elevated Pipe
←	Flow Direction

Install Cross-Section Sketch



A/V Sensor & Clock Position:	6 o'clock	▲
Ultra Sensor & Clock Position:		■

Hydraulic Information

Flow Depth (in):	12.00
Instant Velocity (fps):	3.30
Surcharge Evidence (ft):	0
Silt Type:	None
Silt Depth (in):	0
Needs Cleaning:	No
Backwater:	No
Flow Path:	Straight
Drop Inlet:	No
Hydraulic Rating:	Fair

Installation Notes

Sensors:	Pressure, Velocity	Meter Type:	HACH FL902/AV9000
Telemetry:	Yes	Antenna Surface:	Paved
Install Date:	4/24/2020	Location in Pipe:	1'
Meter S/N:	101200000317		

Ashton Engineering Group, LLC

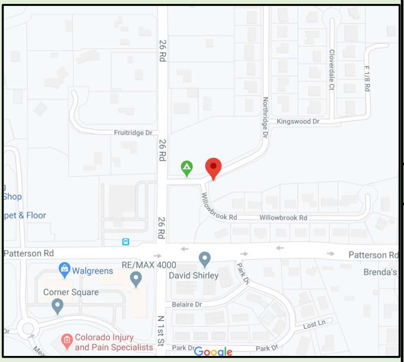
Client Name	Site Name
Carollo Engineers	GJ03
Project Description	**Site Code**
2020 GJ Persigo WWTP Master Plan	Target

Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-23-2020/1:00 PM	5280-0101-00

System Information

Target Pipe Dia. (in.):	15	
Owner:	City of Grand Junction, CO	
Assigned Rain Gauge:		
Owner MH #:	F1-261-026	
U/S MH #:	F1-261-040	
System Characteristics: *(highlight all that apply)*	Residential	Commercial
	Industrial	
Pump Station Influence:	No	
WWTP Influence:	No	

Location Map



Area Picture

Top View Picture

Access Notes: Existing meter brackets in place. Remove to install flow meter.

Location Information

Site Address:	140 Willowbrook Rd.
Site Access:	Off-Road
Longitude:	-108.5700139
Lattitude:	39.0927861
MH Type:	Coated Cast-In-Place Concrete
Manhole Depth (ft):	3.28
Manhohle Dimensions (ft):	4
Elevated Manhole:	No
Height Elevated:	
Structural Integrity:	Fair

Investigation Photo

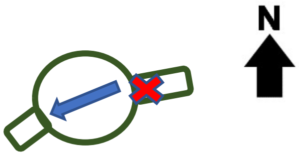
Installation Photo

Hydraulic Characteristics:		Install Notes:	

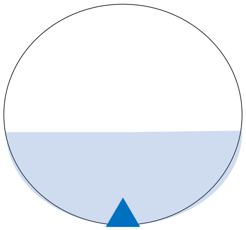
Site Information

Pipe Height (in):	14.88		
Pipe Width (in):	14.88		
Pipe Material:	CIPP		
Pipe Shape:	Circular		
O_2:	20.6	LEL %:	0
H_2S:	5	CO:	0

Install Plan Sketch



Install Cross-Section Sketch



❌	This Meter
▭	Pipe
⬚	Elevated Pipe
←	Flow Direction

A/V Sensor & Clock Position:	6 o'clock ▲
Ultra Sensor & Clock Position:	■

Hydraulic Information

Flow Depth (in):	6.00
Instant Velocity (fps):	1.75
Surcharge Evidence (ft):	No
Silt Type:	None
Silt Depth (in):	0
Needs Cleaning:	No
Backwater:	No
Flow Path:	Slight bend
Drop Inlet:	No
Hydraulic Rating:	Fair

Installation Notes

Sensors:	Pressure, Velocity	Meter Type:	HACH FL902/AV9000
Telemetry:	Yes	Antenna Surface:	Non-Paved
Install Date:	4/23/2020	Location in Pipe:	1'
Meter S/N:	200400004036		

Ashton Engineering Group, LLC

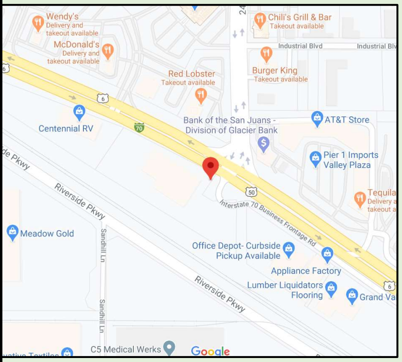
Client Name	Site Name
Carollo Engineers	GJ04
Project Description	**Site Code**
2020 GJ Persigo WWTP Master Plan	Target

Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-24-2020/8:54 AM	5280-0101-00

System Information

Target Pipe Dia. (in.):	18	
Owner:	City of Grand Junction, CO	
Assigned Rain Gauge:		
Owner MH #:	E3-241-036	
U/S MH #:	E3-241-049	
System Characteristics: *(highlight all that apply)*	Residential	Commercial
	Industrial	
Pump Station Influence:	No	
WWTP Influence:	No	

Location Map



Area Picture

Top View Picture

Access Notes:

Location Information

Site Address:	2449 HWY 6 & 50
Site Access:	Off-Road
Longitude:	-108.5992972
Lattitude:	39.0873611
MH Type:	Precast Concrete
Manhole Depth (ft):	14.5
Manhohle Dimensions (ft):	5
Elevated Manhole:	No
Height Elevated:	
Structural Integrity:	Fair

Investigation Photo

Hydraulic Characteristics:

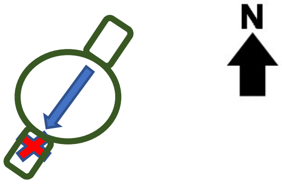
Installation Photo

Install Notes: Installed meter in downstream pipe because of "bad" hydraulics in corroded iron pipe.

Site Information

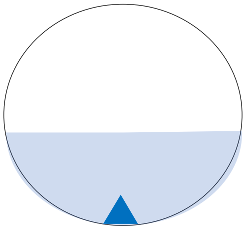
Pipe Height (in):	17.50		
Pipe Width (in):	17.50		
Pipe Material:	PVC		
Pipe Shape:	Circular		
O_2:	20.2	LEL %:	0
H_2S:	2	CO:	0

Install Plan Sketch



✖	This Meter
▭	Pipe
⬚	Elevated Pipe
←	Flow Direction

Install Cross-Section Sketch



A/V Sensor & Clock Position:	6 o'clock ▲
Ultra Sensor & Clock Position:	■

Hydraulic Information

Flow Depth (in):	7.20
Instant Velocity (fps):	2.75
Surcharge Evidence (ft):	No
Silt Type:	Debris & DIP Turberculation
Silt Depth (in):	2
Needs Cleaning:	Yes
Backwater:	No
Flow Path:	Straight
Drop Inlet:	No
Hydraulic Rating:	Fair

Installation Notes

Sensors:	Pressure, Velocity	Meter Type:	HACH FL902/AV9000
Telemetry:	Yes	Antenna Surface:	Non-paved
Install Date:	4/24/2020	Location in Pipe:	1'
Meter S/N:	200400004038		

Ashton Engineering Group, LLC

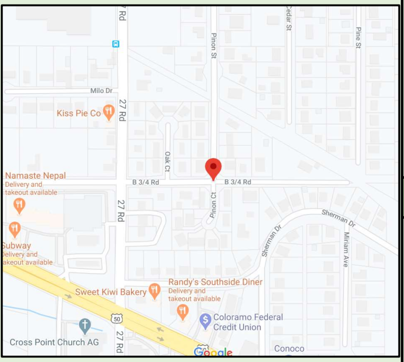
Client Name	Site Name
Carollo Engineers	GJ05
Project Description	**Site Code**
2020 GJ Persigo WWTP Master Plan	Downstream 1

Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-24-2020/5:30 PM	5280-0101-00

System Information

Target Pipe Dia. (in.):	15	
Owner:	City of Grand Junction, CO	
Assigned Rain Gauge:		
Owner MH #:	B3-271-006	
U/S MH #:	B3-271-018	
System Characteristics: *(highlight all that apply)*	Residential	Commercial
	Industrial	
Pump Station Influence:	No	
WWTP Influence:	No	

Location Map



Area Picture

Top View Picture

Access Notes: Target manhole is buried, moved to 1 downstream manhole. Downstream manhole has 2 drop incoming lines (north, south), hydraulics are fair.

Location Information

Site Address:	2711 B 3/4 Rd.
Site Access:	Roadway - Low Traffic
Longitude:	-108.550774
Lattitude:	39.044777
MH Type:	Precast Concrete
Manhole Depth (ft):	14.7
Manhohle Dimensions (ft):	4
Elevated Manhole:	No
Height Elevated:	
Structural Integrity:	Fair

Investigation Photo

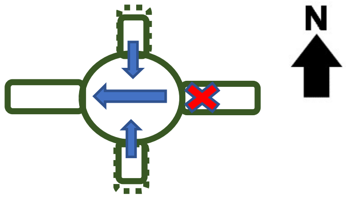
Installation Photo

Hydraulic Characteristics:		Install Notes:	

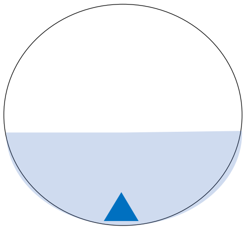
Site Information

Pipe Height (in):	14.63		
Pipe Width (in):	14.63		
Pipe Material:	VCP		
Pipe Shape:	Circular		
O_2:	20.5	LEL %:	0
H_2S:	2	CO:	0

Install Plan Sketch



Install Cross-Section Sketch



✗	This Meter	A/V Sensor & Clock Position:	6 o'clock ▲
▭	Pipe		
⬚	Elevated Pipe	Ultra Sensor & Clock Position:	■
←	Flow Direction		

Hydraulic Information

Flow Depth (in):	6.00
Instant Velocity (fps):	1.64
Surcharge Evidence (ft):	No
Silt Type:	Debris
Silt Depth (in):	2
Needs Cleaning:	Yes
Backwater:	No
Flow Path:	Straight with 2 inc. lines (E,W)
Drop Inlet:	Not target, but north & south lines.
Hydraulic Rating:	Fair

Installation Notes

Sensors:	Pressure, Velocity	Meter Type:	HACH FL902/AV9000
Telemetry:	Yes	Antenna Surface:	Paved
Install Date:	4/24/2020	Location in Pipe:	1'
Meter S/N:	130500002239		

Ashton Engineering Group, LLC

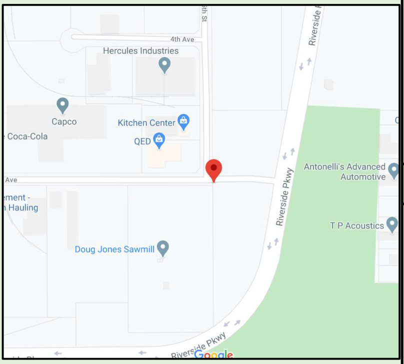
Client Name	Site Name
Carollo Engineers	GJ06
Project Description	**Site Code**
2020 GJ Persigo WWTP Master Plan	Target

Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-23-2020/4:25 PM	5280-0101-00

System Information

Target Pipe Dia. (in.):	30	
Owner:	City of Grand Junction, CO	
Assigned Rain Gauge:		
Owner MH #:	C3-271-028	
U/S MH #:	C3-271-027	
System Characteristics: *(highlight all that apply)*	Residential	Commercial
	Industrial	
Pump Station Influence:	No	
WWTP Influence:	No	

Location Map



Area Picture

Top View Picture

Access Notes: Behind curb and north side of fence. Split manhole, 2 outgoing pipes. Fair hydraulics. H2S over 10ppm and lower oxygen levels, use blower.

Location Information

Site Address:	1850 Las Colonias Dr.
Site Access:	Off-Road, Near Curb, & Low Traffic.
Longitude:	-108.5477056
Lattitude:	39.0583139
MH Type:	Precast Concrete
Manhole Depth (ft):	4.6
Manhohle Dimensions (ft):	4
Elevated Manhole:	No
Height Elevated:	
Structural Integrity:	Fair

Investigation Photo

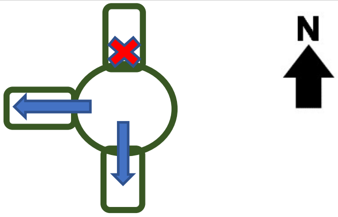
Installation Photo

Hydraulic Characteristics:		Install Notes:	

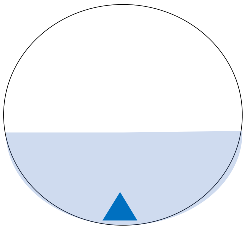
Site Information

Pipe Height (in):	29.44		
Pipe Width (in):	29.44		
Pipe Material:	PVC		
Pipe Shape:	Circular		
O_2:	20.6	LEL %:	0
H_2S:	15	CO:	0

Install Plan Sketch



Install Cross-Section Sketch



✗	This Meter
▭	Pipe
⬚	Elevated Pipe
←	Flow Direction

A/V Sensor & Clock Position:	6 o'clock ▲
Ultra Sensor & Clock Position:	■

Hydraulic Information

Flow Depth (in):	8.00
Instant Velocity (fps):	3.17
Surcharge Evidence (ft):	0
Silt Type:	None
Silt Depth (in):	0
Needs Cleaning:	No
Backwater:	No
Flow Path:	Split MH. 2 outgoing pipes.
Drop Inlet:	No
Hydraulic Rating:	Fair

Installation Notes

Sensors:	Pressure, Velocity	Meter Type:	HACH FL902/AV9000
Telemetry:	Yes	Antenna Surface:	Non-paved
Install Date:	4/23/2020	Location in Pipe:	1'
Meter S/N:	130700002330		

Ashton Engineering Group, LLC

Client Name	**Site Name**
Carollo Engineers	GJ07
Project Description	**Site Code**
2020 GJ Persigo WWTP Master Plan	Target

Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-23-2020/6:43 PM	5280-0101-00

System Information

Target Pipe Dia. (in.):	30	
Owner:	City of Grand Junction, CO	
Assigned Rain Gauge:		
Owner MH #:	D2-252-152	
U/S MH #:	D2-252-026	
System Characteristics: *(highlight all that apply)*	Residential	Commercial
	Industrial	
Pump Station Influence:	Yes - Design Capacity 146 gpm	
WWTP Influence:	No	

Location Information

Site Address:	633 W. White Ave.
Site Access:	Off-Road
Longitude:	-108.5782917
Lattitude:	39.0701194
MH Type:	Casti-In-Place Concrete
Manhole Depth (ft):	5.2
Manhohle Dimensions (ft):	4
Elevated Manhole:	No
Height Elevated:	
Structural Integrity:	Fair

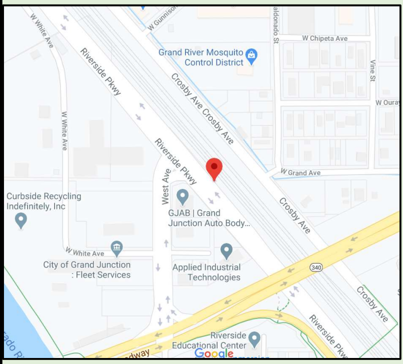
Site Information

Pipe Height (in):	28.00		
Pipe Width (in):	28.00		
Pipe Material:	CIPP		
Pipe Shape:	Circular		
O_2:	20.9	LEL %:	0
H_2S:	0	CO:	0

Hydraulic Information

Flow Depth (in):	3.60
Instant Velocity (fps):	3.70
Surcharge Evidence (ft):	0
Silt Type:	None
Silt Depth (in):	0
Needs Cleaning:	No
Backwater:	No
Flow Path:	Slight bend. Less than 11.25
Drop Inlet:	No
Hydraulic Rating:	Fair

Location Map



Area Picture

Top View Picture

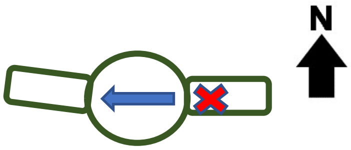
Access Notes: Target site located behind Union-Pacific gated fence. Gate is open for access.

Investigation Photo

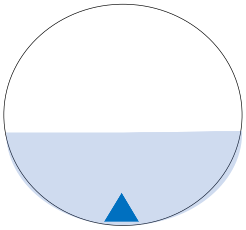
Installation Photo

Hydraulic Characteristics:		Install Notes:	

Install Plan Sketch



Install Cross-Section Sketch



✖	This Meter	A/V Sensor & Clock Position:	6 o'clock ▲
▭	Pipe		
⬚	Elevated Pipe	Ultra Sensor & Clock Position:	■
←	Flow Direction		

Installation Notes

Sensors:	Pressure, Velocity	Meter Type:	HACH FL902/AV9000
Telemetry:	Yes	Antenna Surface:	Non-paved
Install Date:	4/23/2020	Location in Pipe:	1'
Meter S/N:	110800000712		

Ashton Engineering Group, LLC

Client Name	Site Name
Carollo Engineers	GJ08
Project Description	**Site Code**
2020 GJ Persigo WWTP Master Plan	Target

Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-23-2020/9:30 AM	5280-0101-00

System Information

Target Pipe Dia. (in.):	18	
Owner:	City of Grand Junction, CO	
Assigned Rain Gauge:		
Owner MH #:	D2-271-043	
U/S MH #:	D2-271-042	
System Characteristics: *(highlight all that apply)*	Residential	Commercial
	Industrial	
Pump Station Influence:	No	
WWTP Influence:	No	

Location Information

Site Address:	1360 Main St.
Site Access:	Roadway - Low Traffic
Longitude:	-108.5490778
Lattitude:	39.0673917
MH Type:	Coated Cast-In-Place Concrete
Manhole Depth (ft):	7.32
Manhohle Dimensions (ft):	4
Elevated Manhole:	No
Height Elevated:	
Structural Integrity:	Fair

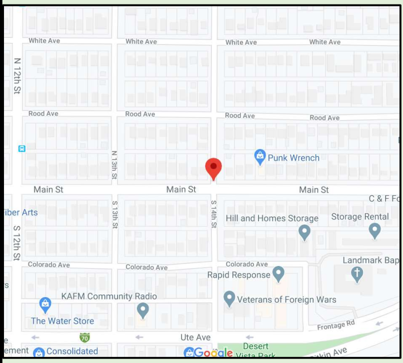
Site Information

Pipe Height (in):	17.00		
Pipe Width (in):	17.00		
Pipe Material:	HDPE		
Pipe Shape:	Circular		
O_2:	20.9	LEL %:	0
H_2S:	0	CO:	0

Hydraulic Information

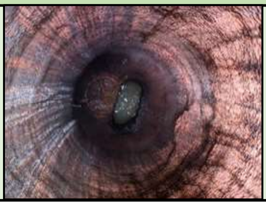
Flow Depth (in):	7.20
Instant Velocity (fps):	2.80
Surcharge Evidence (ft):	No
Silt Type:	None
Silt Depth (in):	0
Needs Cleaning:	No
Backwater:	No
Flow Path:	Straight
Drop Inlet:	No
Hydraulic Rating:	Fair

Location Map



Area Picture

Top View Picture



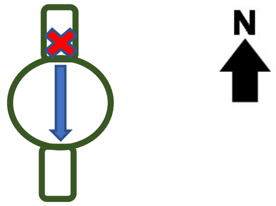
Access Notes:	

Investigation Photo

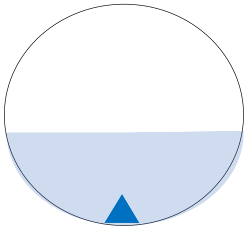
Installation Photo

Hydraulic Characteristics:		Install Notes:	

Install Plan Sketch



Install Cross-Section Sketch



✖	This Meter	A/V Sensor & Clock Position:	6 o'clock ▲
▭	Pipe		
⬚	Elevated Pipe	Ultra Sensor & Clock Position:	■
←	Flow Direction		

Installation Notes

Sensors:	Pressure, Velocity	Meter Type:	HACH FL902/AV9000
Telemetry:	Yes	Antenna Surface:	Paved
Install Date:	4/23/2020	Location in Pipe:	1'
Meter S/N:	200400004039		

Ashton Engineering Group, LLC

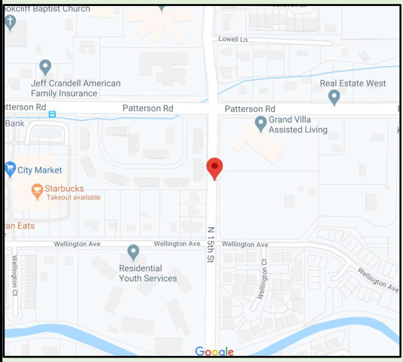
Client Name	Site Name
Carollo Engineers	GJ09
Project Description	**Site Code**
2020 GJ Persigo WWTP Master Plan	Target

Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-25-2020/1:00 PM	5280-0101-00

System Information

Target Pipe Dia. (in.):	15	
Owner:	City of Grand Junction, CO	
Assigned Rain Gauge:		
Owner MH #:	E4-271-060	
U/S MH #:	E4-271-058	
System Characteristics: *(highlight all that apply)*	Residential Industrial	Commercial
Pump Station Influence:	No	
WWTP Influence:	No	

Location Map



Area Picture

Top View Picture

Location Information

Site Address:	2525 N 15th St.
Site Access:	Roadway - Medium Traffic
Longitude:	-108.5476722
Lattitude:	39.0908361
MH Type:	Precast Concrete
Manhole Depth (ft):	11.72
Manhohle Dimensions (ft):	4
Elevated Manhole:	No
Height Elevated:	
Structural Integrity:	Fair

Access Notes:

Investigation Photo

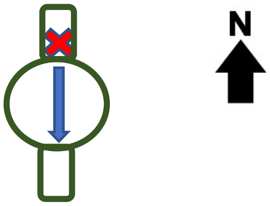
Installation Photo

Hydraulic Characteristics:		Install Notes:	

Site Information

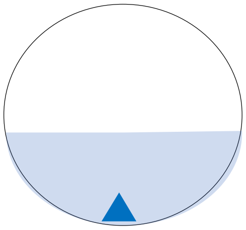
Pipe Height (in):	14.13		
Pipe Width (in):	14.13		
Pipe Material:	PVC		
Pipe Shape:	Circular		
O_2:	20.9	LEL %:	0
H_2S:	0	CO:	0

Install Plan Sketch



✗	This Meter
▭	Pipe
⬚	Elevated Pipe
←	Flow Direction

Install Cross-Section Sketch



A/V Sensor & Clock Position:	6 o'clock ▲
Ultra Sensor & Clock Position:	■

Hydraulic Information

Flow Depth (in):	4.00
Instant Velocity (fps):	2.18
Surcharge Evidence (ft):	No
Silt Type:	None
Silt Depth (in):	0
Needs Cleaning:	No
Backwater:	No
Flow Path:	Straight
Drop Inlet:	No
Hydraulic Rating:	Fair

Installation Notes

Sensors:	Pressure, Velocity	Meter Type:	HACH FL902/AV9000
Telemetry:	Yes	Antenna Surface:	Paved
Install Date:	4/25/2020	Location in Pipe:	1'
Meter S/N:	200400004037		

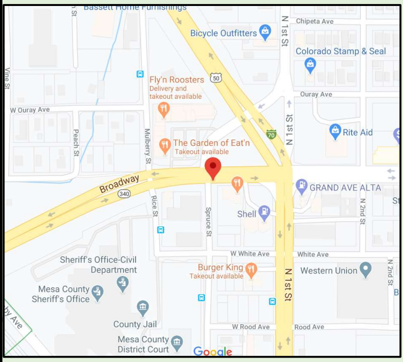
	Client Name	Site Name
Ashton Engineering Group, LLC	Carollo Engineers	GJ10
	Project Description	**Site Code**
	2020 GJ Persigo WWTP Master Plan	Target

Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-24-2020/3:55 PM	5280-0101-00

System Information

Target Pipe Dia. (in.):	27	
Owner:	City of Grand Junction, CO	
Assigned Rain Gauge:		
Owner MH #:	D3-252-054	
U/S MH #:	D3-252-057	
System Characteristics: *(highlight all that apply)*	Residential Industrial	Commercial
Pump Station Influence:	No	
WWTP Influence:	No	

Location Map



Area Picture

Top View Picture

Access Notes: North high-line appears dry (not in service).

Location Information

Site Address:	315 N Spruce St.
Site Access:	Roadway - Heavy Traffic
Longitude:	-108.5721028
Lattitude:	39.0702278
MH Type:	Brick
Manhole Depth (ft):	8.36
Manhohle Dimensions (ft):	5
Elevated Manhole:	No
Height Elevated:	
Structural Integrity:	Fair

Investigation Photo

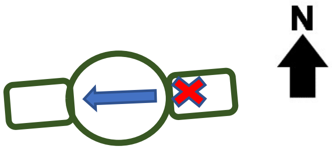
Installation Photo

Hydraulic Characteristics:		Install Notes:	

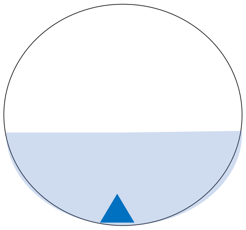
Site Information

Pipe Height (in):	27.13		
Pipe Width (in):	27.13		
Pipe Material:	VCP		
Pipe Shape:	Circular		
O_2:	19.6	LEL %:	0
H_2S:	6	CO:	0

Install Plan Sketch



Install Cross-Section Sketch



❌	This Meter	A/V Sensor & Clock Position:	6 o'clock ▲
▭	Pipe		
⬚	Elevated Pipe	Ultra Sensor & Clock Position:	■
⬅	Flow Direction		

Hydraulic Information

Flow Depth (in):	4.32
Instant Velocity (fps):	3.47
Surcharge Evidence (ft):	No
Silt Type:	None
Silt Depth (in):	0
Needs Cleaning:	No
Backwater:	No
Flow Path:	Straight with north incoming.
Drop Inlet:	Yes, north line. Not target pipe.
Hydraulic Rating:	Fair

Installation Notes

Sensors:	Pressure, Velocity	Meter Type:	HACH FL902/AV9000
Telemetry:	Yes	Antenna Surface:	Paved
Install Date:	4/24/2020	Location in Pipe:	1'
Meter S/N:	130600001898		

Ashton Engineering Group, LLC

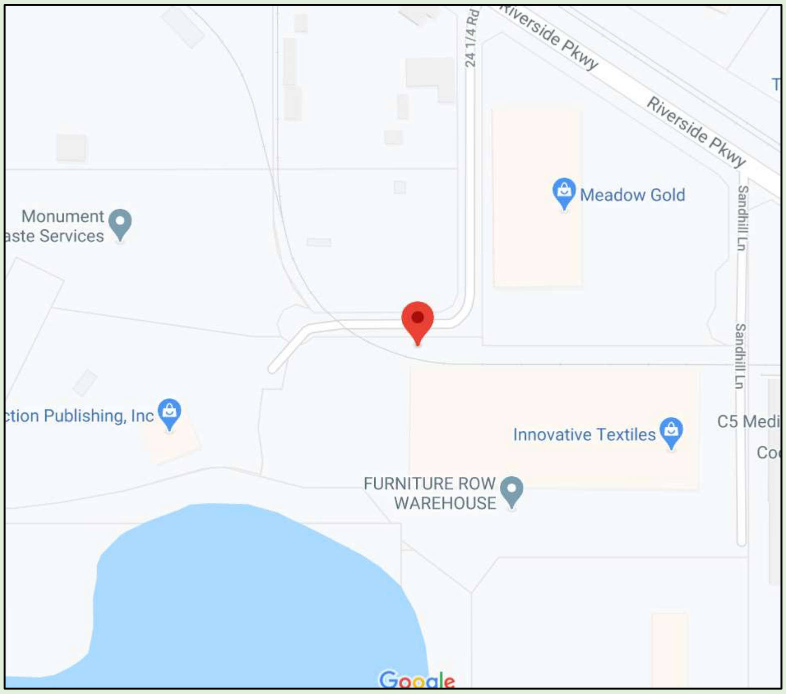
Client Name	Site Name
Carollo Engineers	RG01
Project Description	**Site Code**
2020 GJ Persigo WWTP Master Plan	Target

Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-23-2020/10:45 AM	5280-0101-00

System Information

Owner:	City of Grand Junction, CO
Owner Site ID:	Coors Lift Station
Tipping Buck et Type:	Sigma
Tipping Bucket Serial #:	
Data Logger Type:	Hach FL904
Data Logger Serial #:	11088000715
Longitude:	-108.60395
Lattitude:	39.085623

Location Map



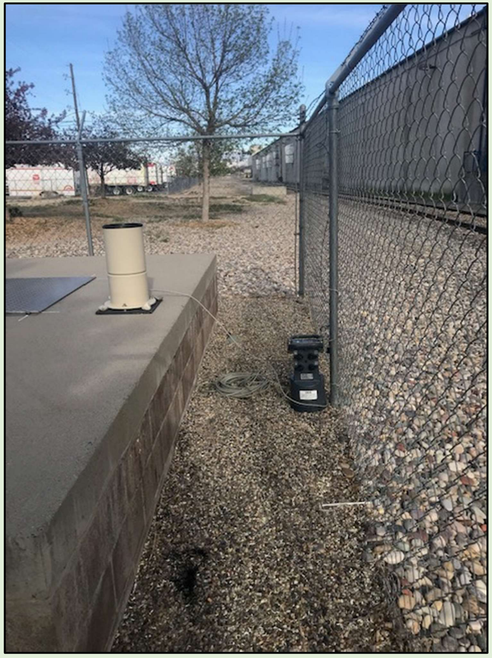
Installation Instructions

Installed a lock on meter for security.

Access Information

Installed an Ashton lock for access.

Area/Installation Photo



Appendix A-29

Ashton Engineering Group, LLC

Client Name	Site Name
Carollo Engineers	RG02
Project Description	**Site Code**
2020 GJ Persigo WWTP Master Plan	Target

Crew:	ncaris, triley	**AEG Project No.**
Date/Time:	4-23-2020/11:25 AM	5280-0101-00

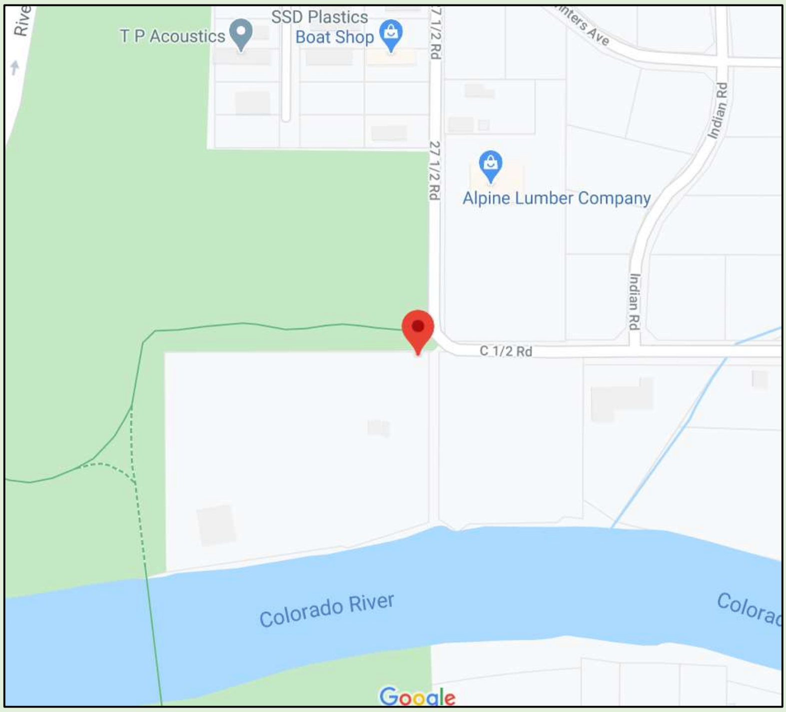
System Information

Owner:	City of Grand Junction, CO
Owner Site ID:	Grand Valley By-Products LS
Tipping Buck et Type:	Sigma
Tipping Bucket Serial #:	
Data Logger Type:	Hach FL904
Data Logger Serial #:	11088000715
Longitude:	-108.5431417
Lattitude:	39.0556139

Installation Instructions

Installed a lock on meter for security.

Location Map



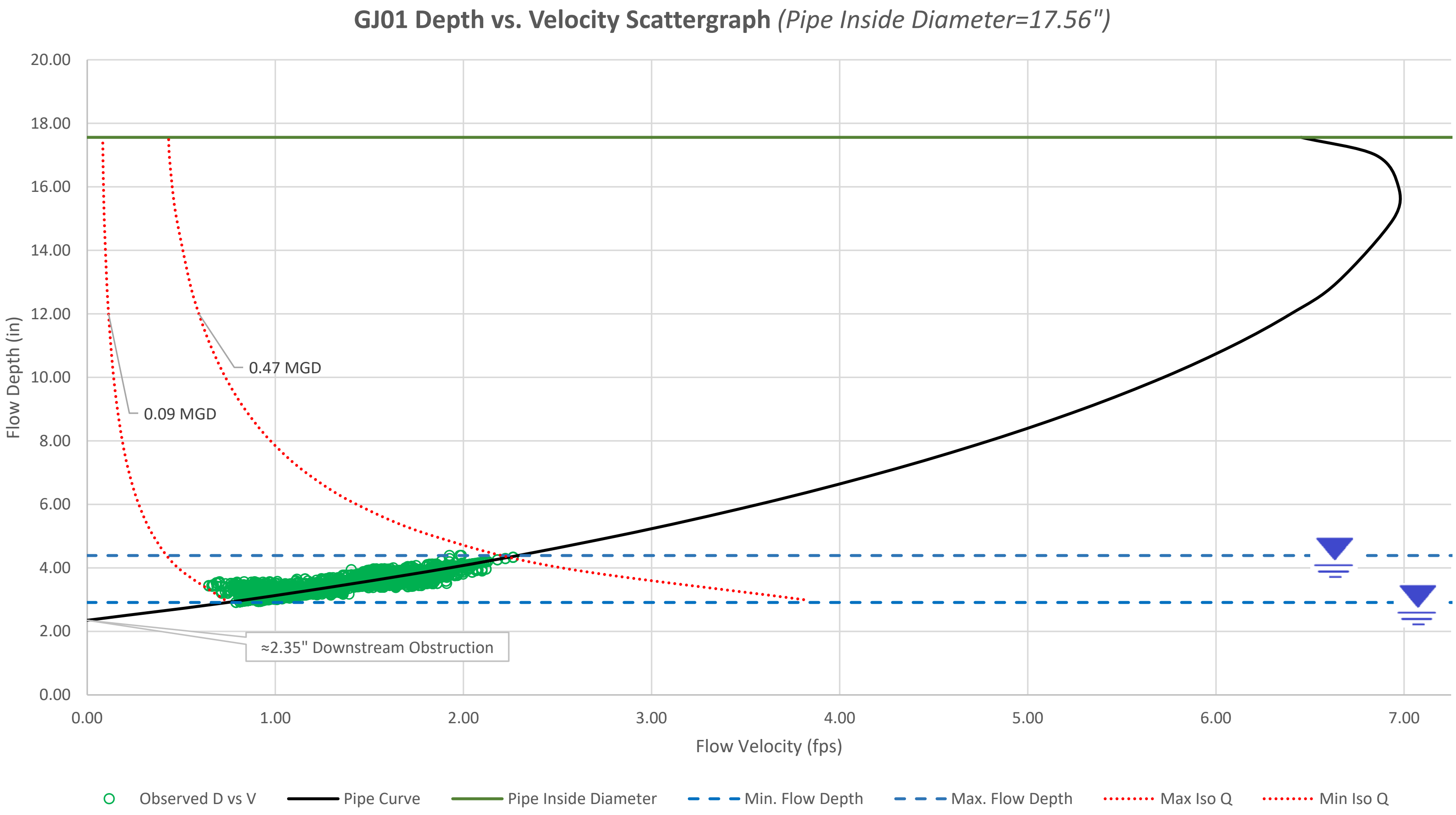
Access Information

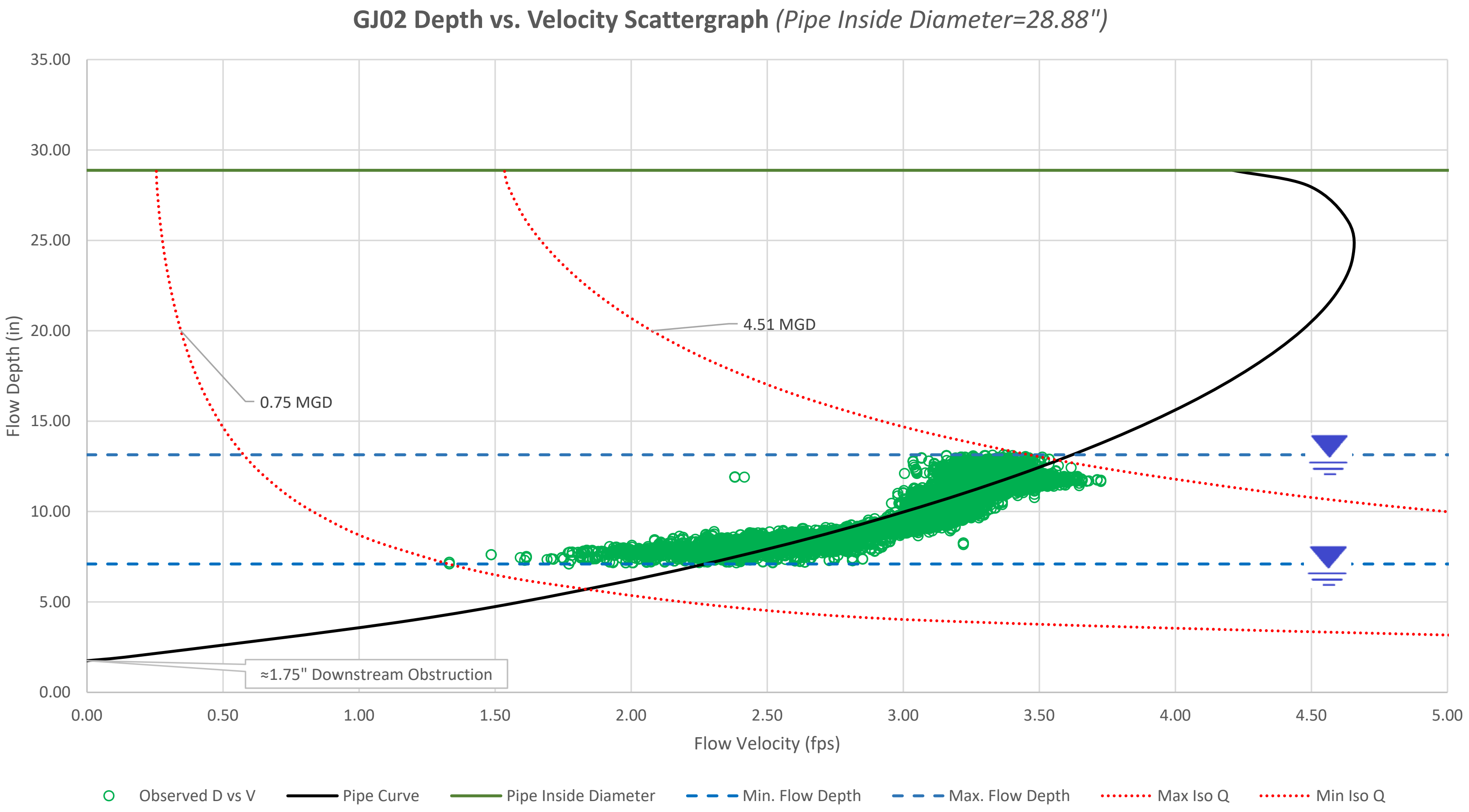
Installed an Ashton lock for access.

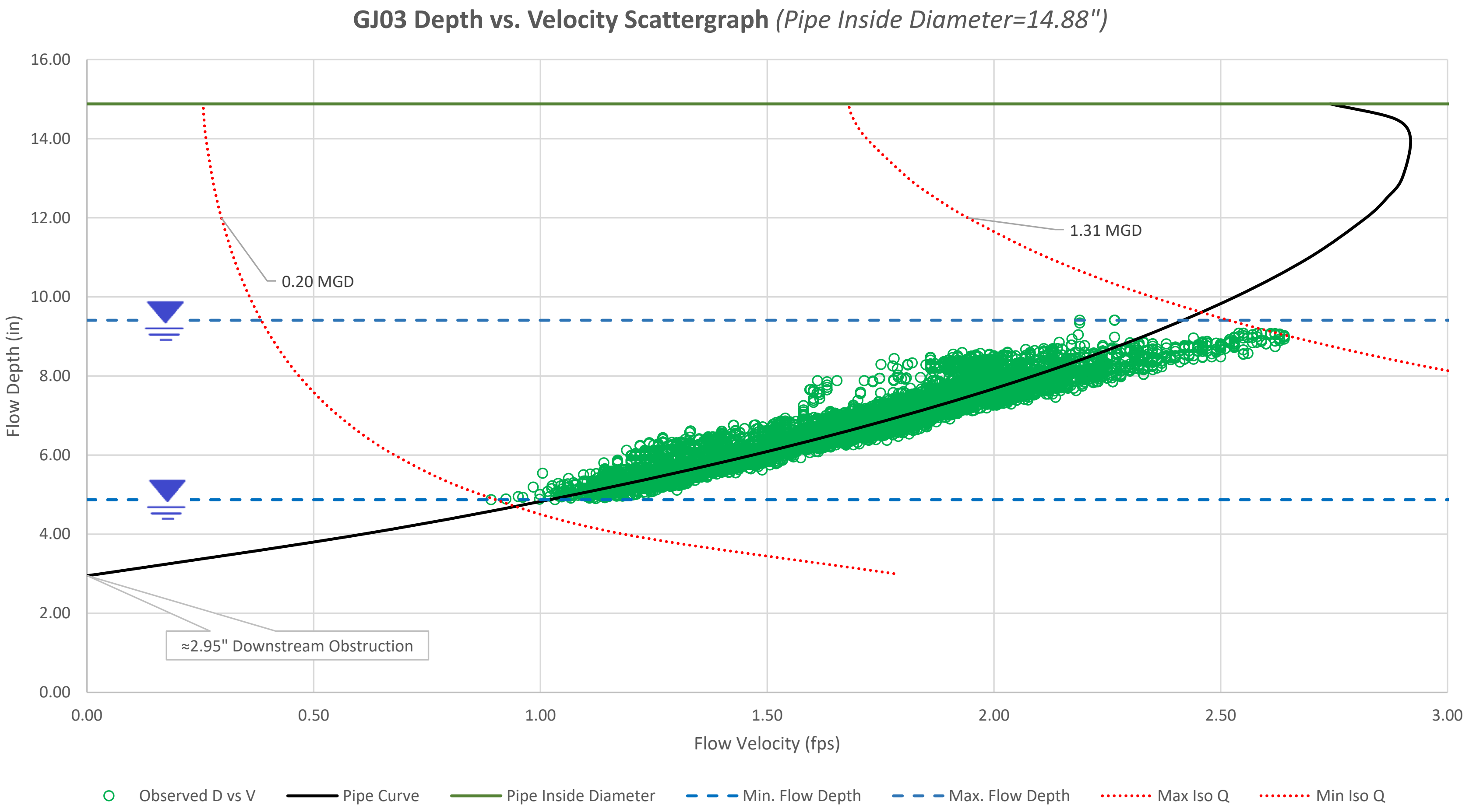
Area/Installation Photo

APPENDIX B

SCATTERGRAPHS

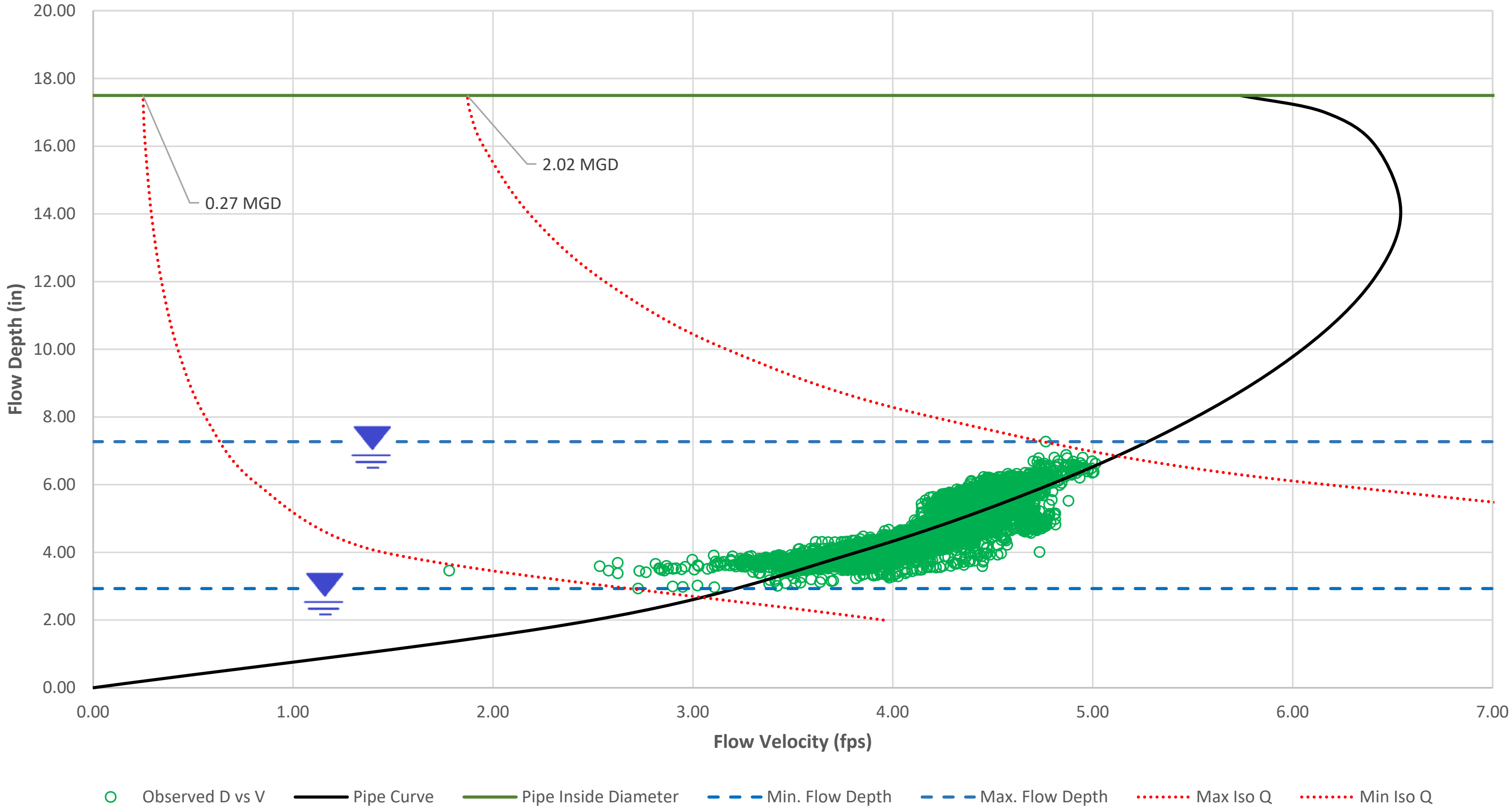

GJ01 Depth vs. Velocity Scattergraph *(Pipe Inside Diameter=17.56")*
Flow Depth (in)
20.00
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Flow Velocity (fps)
0.47 MGD
0.09 MGD
≈2.35" Downstream Obstruction
Observed D vs V
Pipe Curve
Pipe Inside Diameter
Min. Flow Depth
Max. Flow Depth
Max Iso Q
Min Iso Q

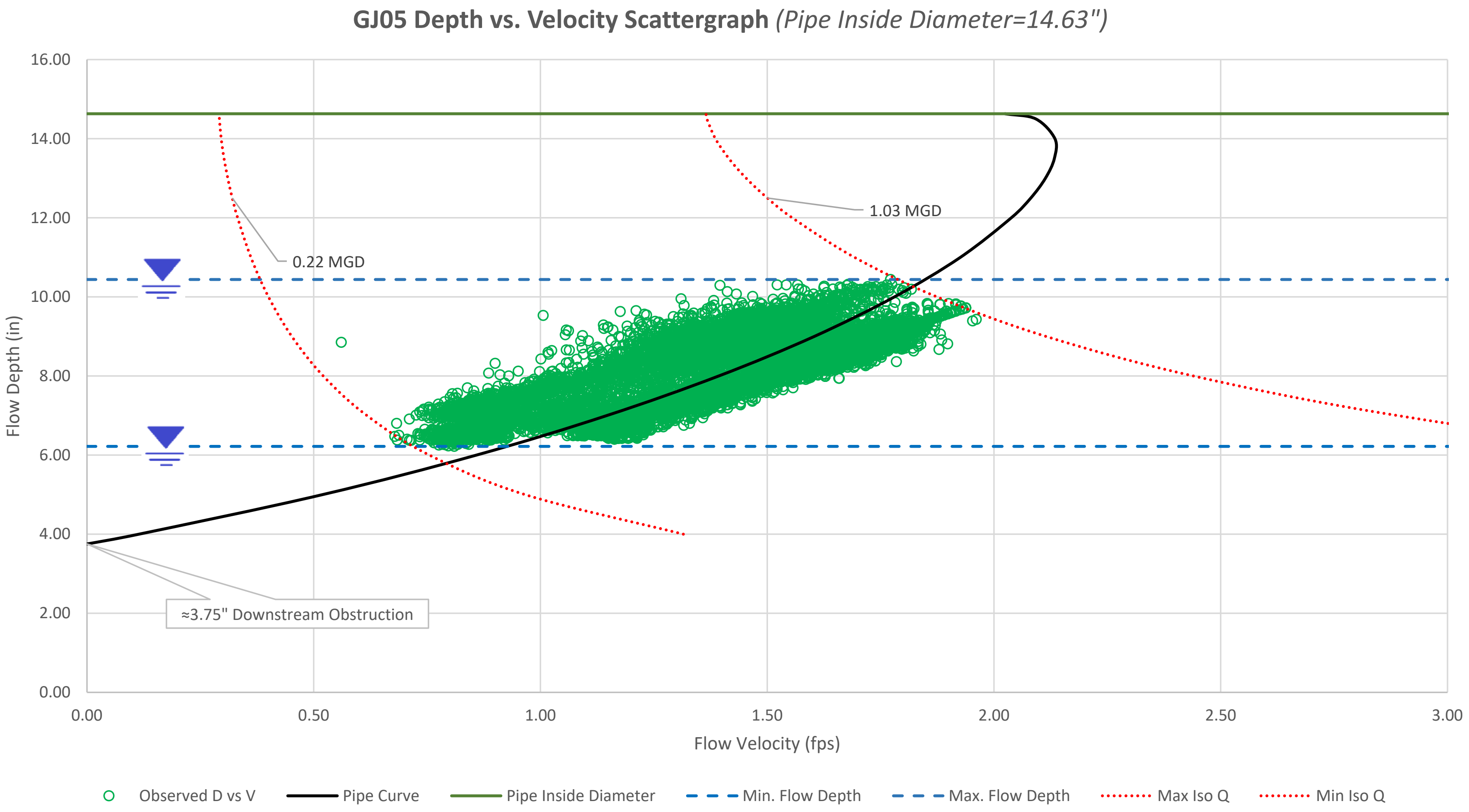

GJ02 Depth vs. Velocity Scattergraph (Pipe Inside Diameter=28.88")
Flow Depth (in)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
5.00
Flow Velocity (fps)
4.51 MGD
0.75 MGD
≈1.75" Downstream Obstruction
Observed D vs V
Pipe Curve
Pipe Inside Diameter
Min. Flow Depth
Max. Flow Depth
Max Iso Q
Min Iso Q



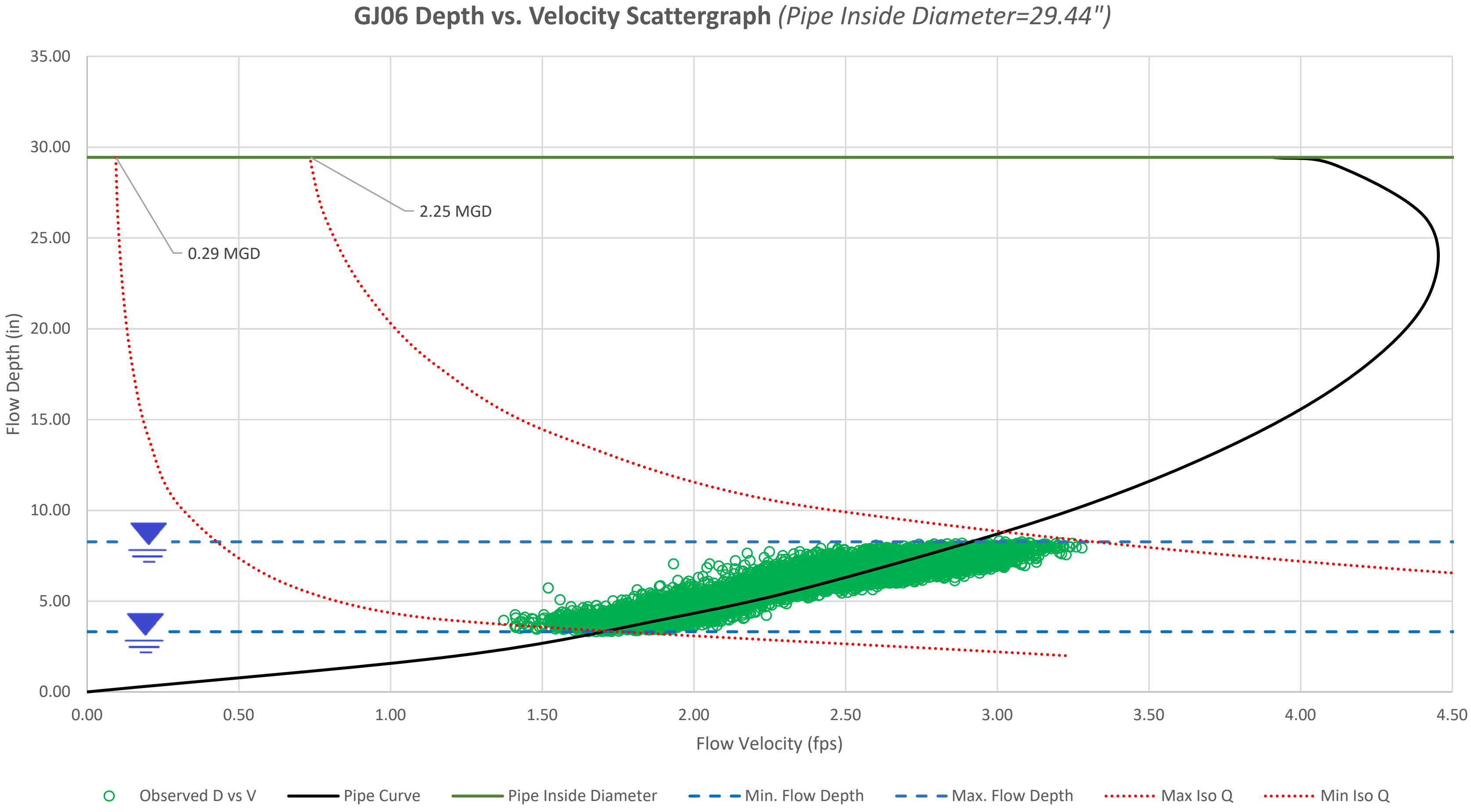
GJ03 Depth vs. Velocity Scattergraph *(Pipe Inside Diameter=14.88")*
Flow Depth (in)
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Flow Velocity (fps)
0.00
0.50
1.00
1.50
2.00
2.50
3.00
0.20 MGD
1.31 MGD
≈2.95" Downstream Obstruction
Observed D vs V
Pipe Curve
Pipe Inside Diameter
Min. Flow Depth
Max. Flow Depth
Max Iso Q
Min Iso Q

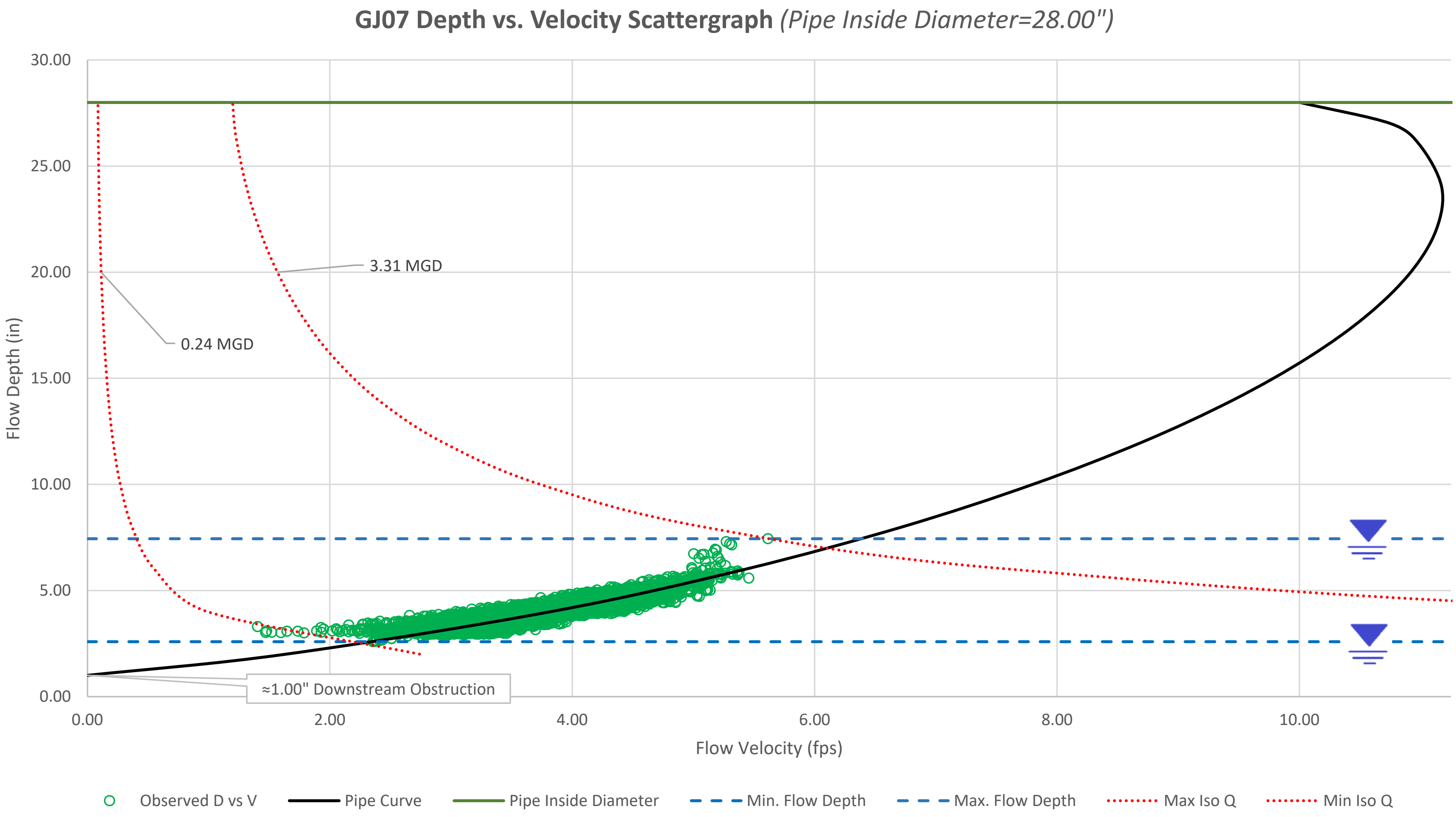
GJ04 Depth vs. Velocity Scattergraph *(Pipe Inside Diameter=17.50")*

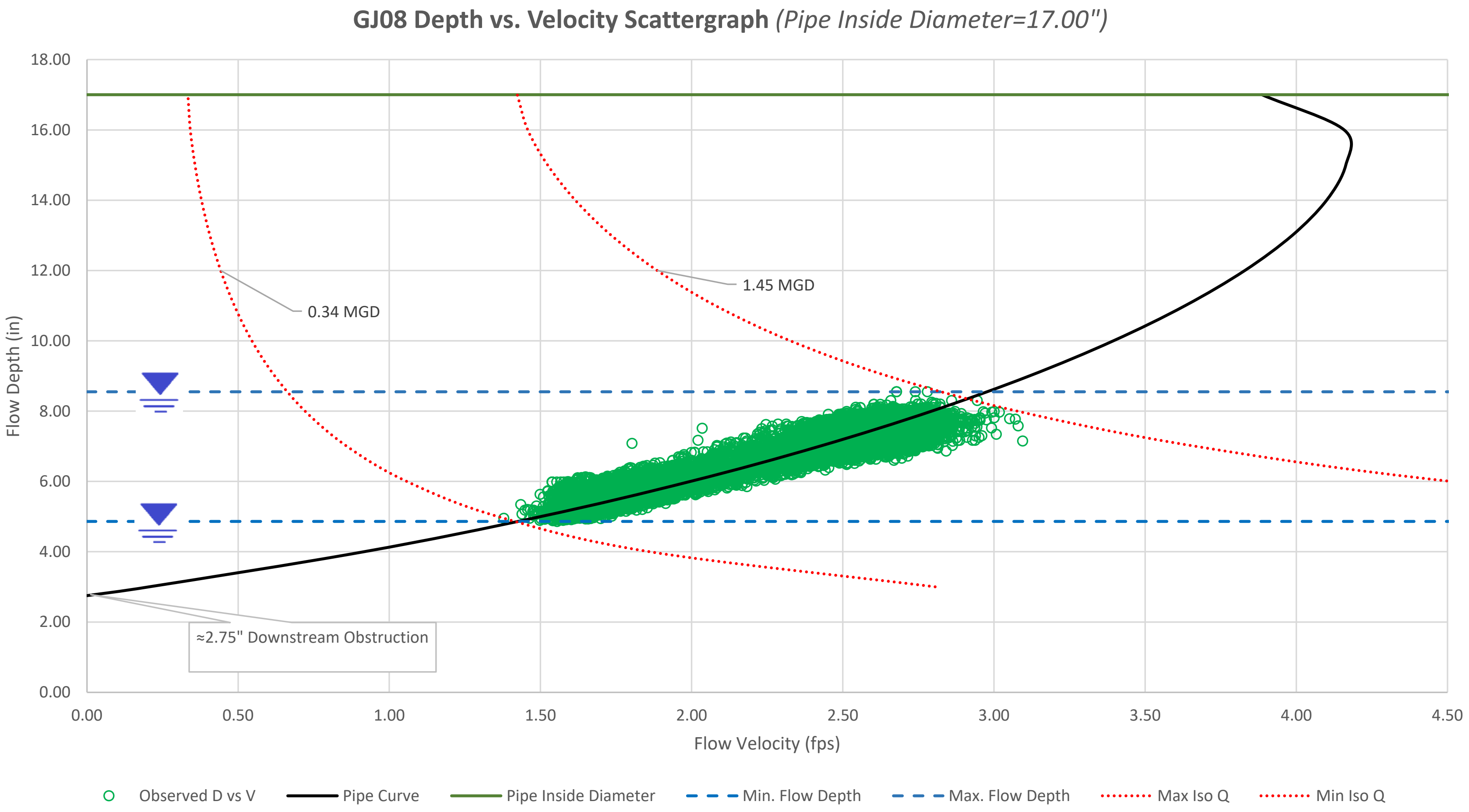


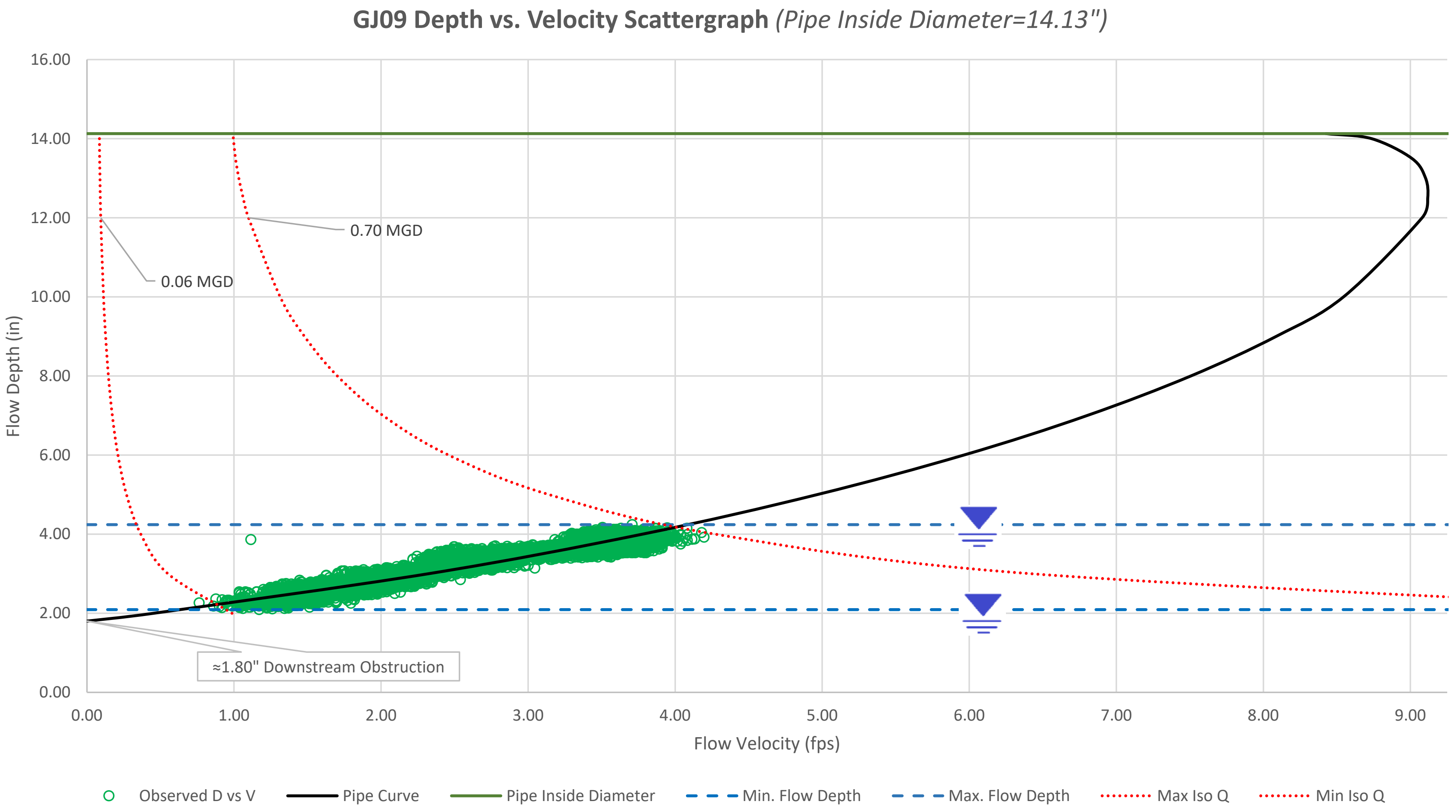


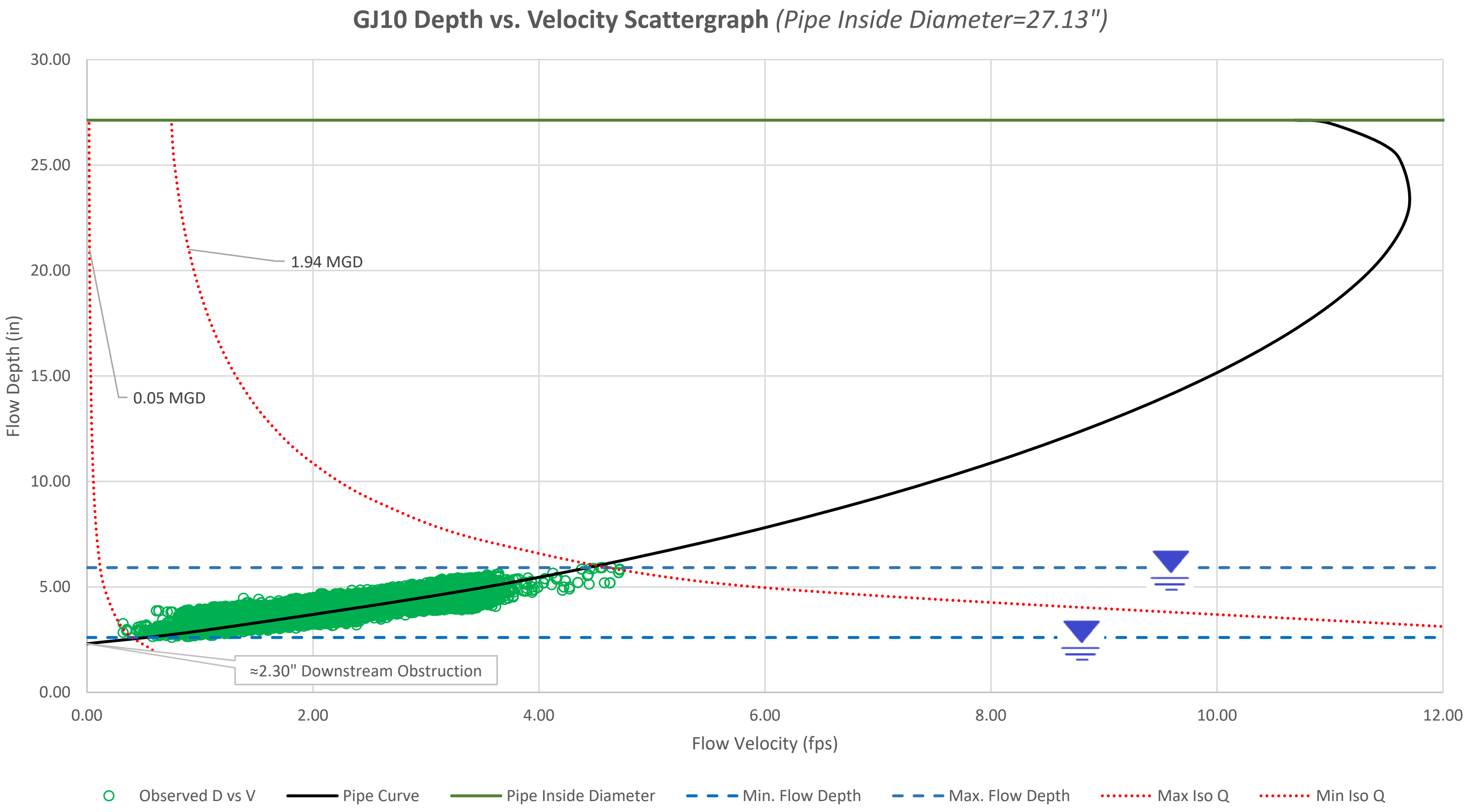
GJ05 Depth vs. Velocity Scattergraph *(Pipe Inside Diameter=14.63")*
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Flow Depth (in)
0.00
0.50
1.00
1.50
2.00
2.50
3.00
Flow Velocity (fps)
0.22 MGD
1.03 MGD
≈3.75" Downstream Obstruction
Observed D vs V
Pipe Curve
Pipe Inside Diameter
Min. Flow Depth
Max. Flow Depth
Max Iso Q
Min Iso Q


GJ06 Depth vs. Velocity Scattergraph (Pipe Inside Diameter=29.44")
Flow Depth (in)
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
Flow Velocity (fps)
2.25 MGD
0.29 MGD
Observed D vs V
Pipe Curve
Pipe Inside Diameter
Min. Flow Depth
Max. Flow Depth
Max Iso Q
Min Iso Q


GJ07 Depth vs. Velocity Scattergraph *(Pipe Inside Diameter=28.00")*
Flow Depth (in)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
Flow Velocity (fps)
0.00
2.00
4.00
6.00
8.00
10.00
3.31 MGD
0.24 MGD
≈1.00" Downstream Obstruction
○ Observed D vs V
Pipe Curve
Pipe Inside Diameter
Min. Flow Depth
Max. Flow Depth
Max Iso Q
Min Iso Q


GJ08 Depth vs. Velocity Scattergraph *(Pipe Inside Diameter=17.00")*
Flow Depth (in)
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
Flow Velocity (fps)
0.34 MGD
1.45 MGD
≈2.75" Downstream Obstruction
Observed D vs V
Pipe Curve
Pipe Inside Diameter
Min. Flow Depth
Max. Flow Depth
Max Iso Q
Min Iso Q

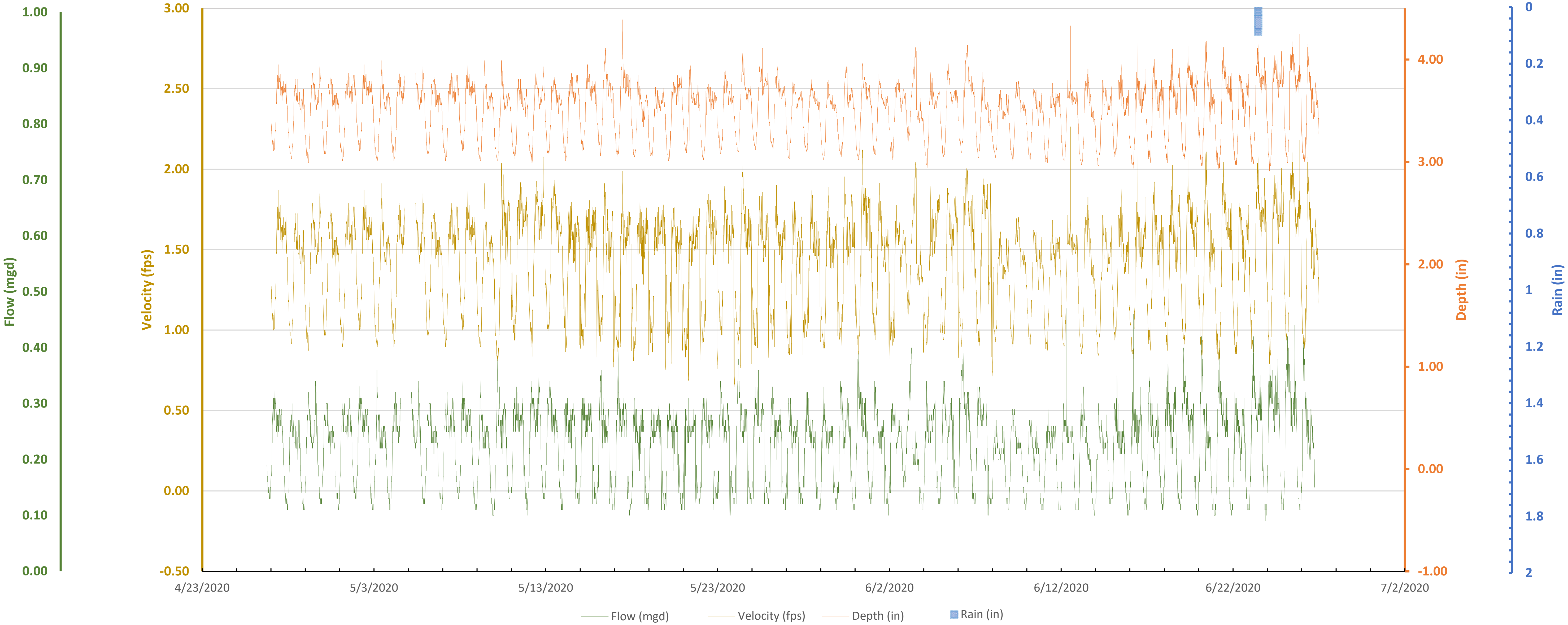

GJ09 Depth vs. Velocity Scattergraph *(Pipe Inside Diameter=14.13")*
Flow Depth (in)
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
Flow Velocity (fps)
0.70 MGD
0.06 MGD
≈1.80" Downstream Obstruction
Observed D vs V
Pipe Curve
Pipe Inside Diameter
Min. Flow Depth
Max. Flow Depth
Max Iso Q
Min Iso Q


GJ10 Depth vs. Velocity Scattergraph (Pipe Inside Diameter=27.13")
Flow Depth (in)
30.00
25.00
20.00
15.00
10.00
5.00
0.00
0.00
2.00
4.00
6.00
8.00
10.00
12.00
Flow Velocity (fps)
1.94 MGD
0.05 MGD
≈2.30" Downstream Obstruction
Observed D vs V
Pipe Curve
Pipe Inside Diameter
Min. Flow Depth
Max. Flow Depth
Max Iso Q
Min Iso Q

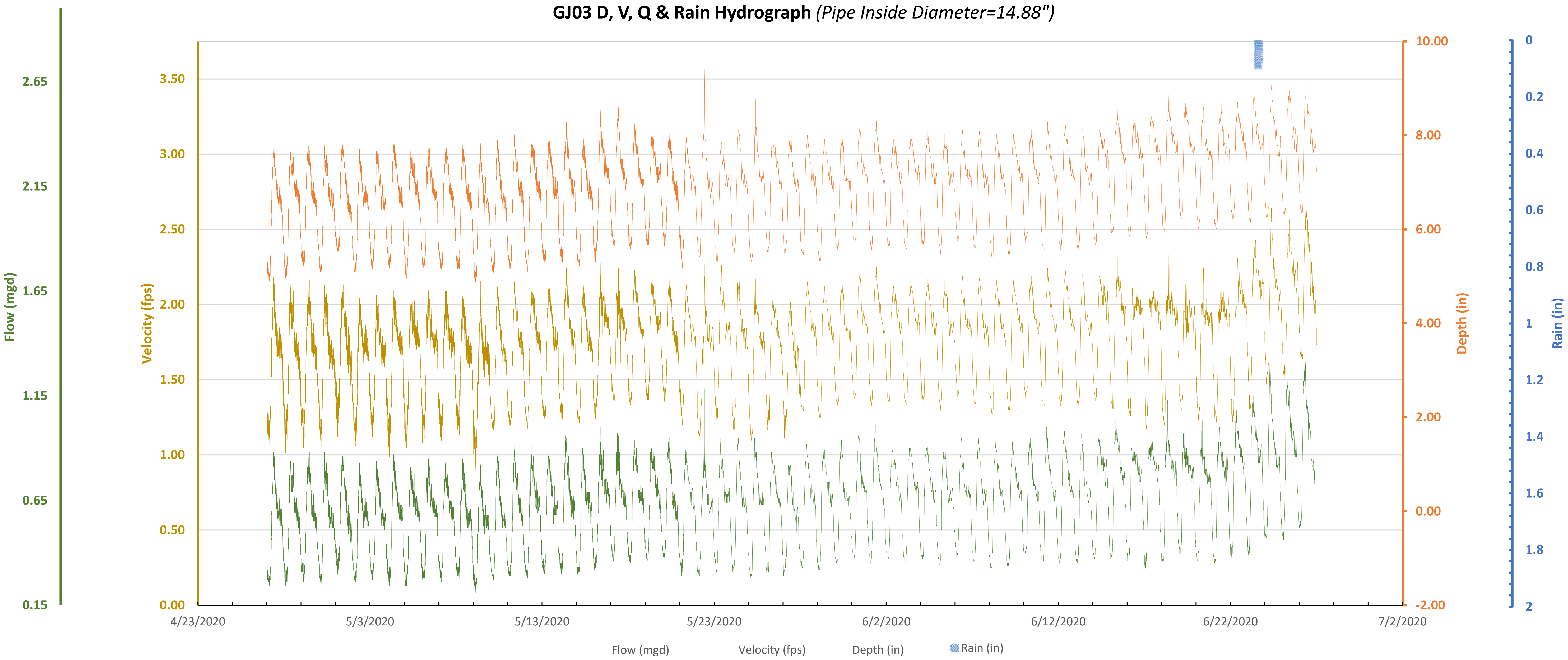
APPENDIX C

HYDROGRAPHS

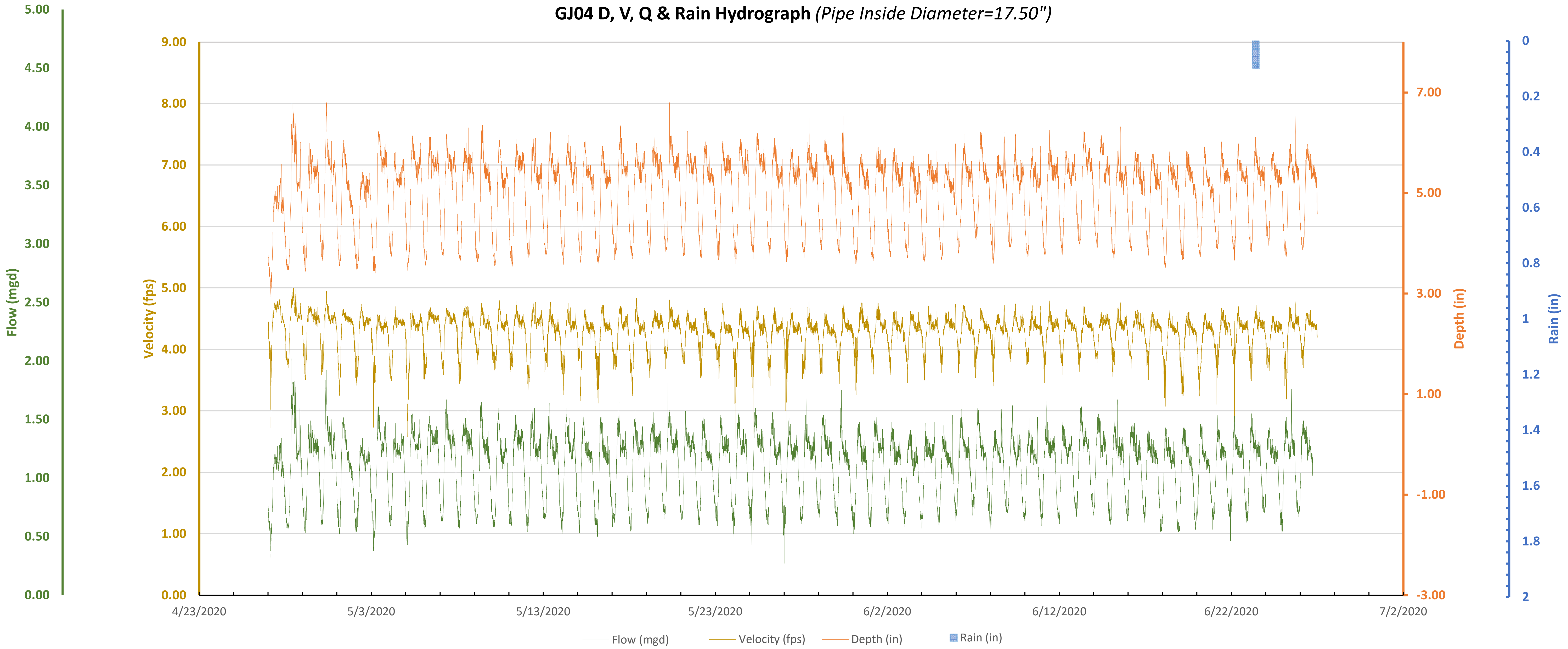
GJ01 D, V, Q & Rain Hydrograph *(Pipe Inside Diameter=17.56")*

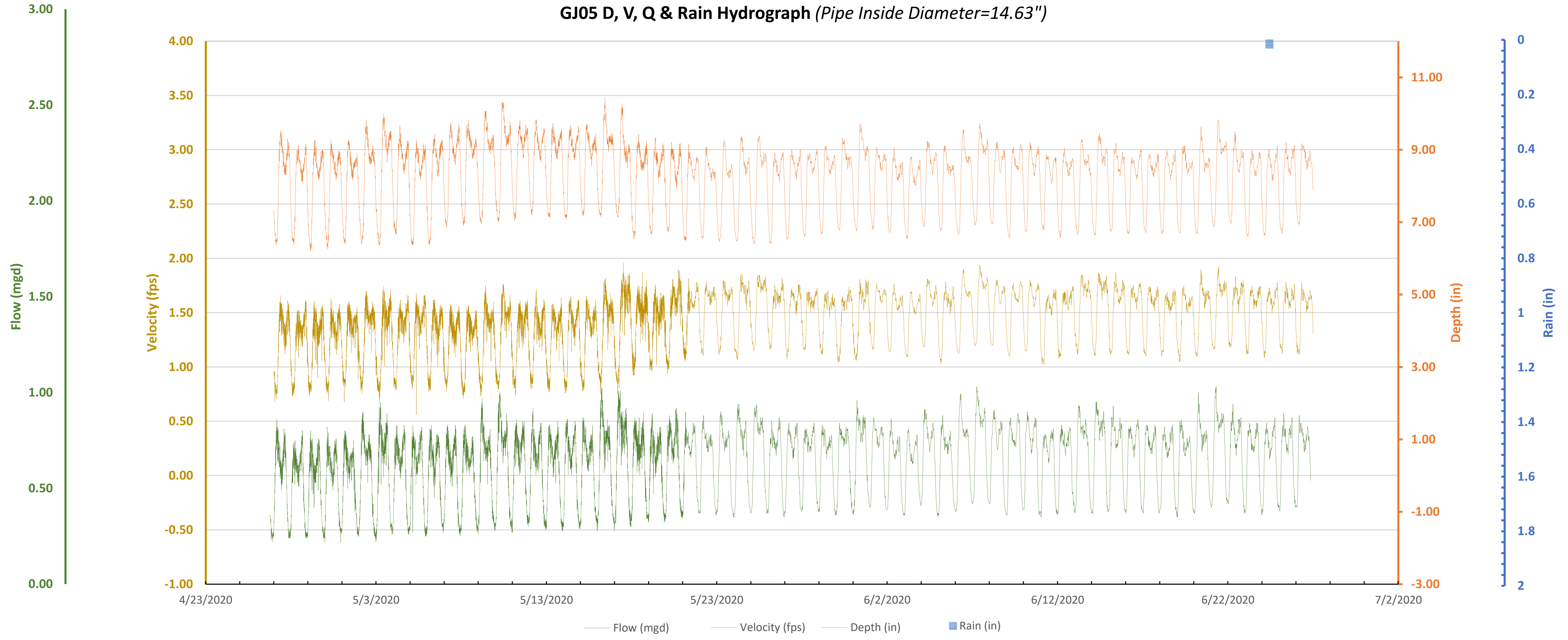


GJ02 D, V, Q & Rain Hydrograph *(Pipe Inside Diameter=28.88")*

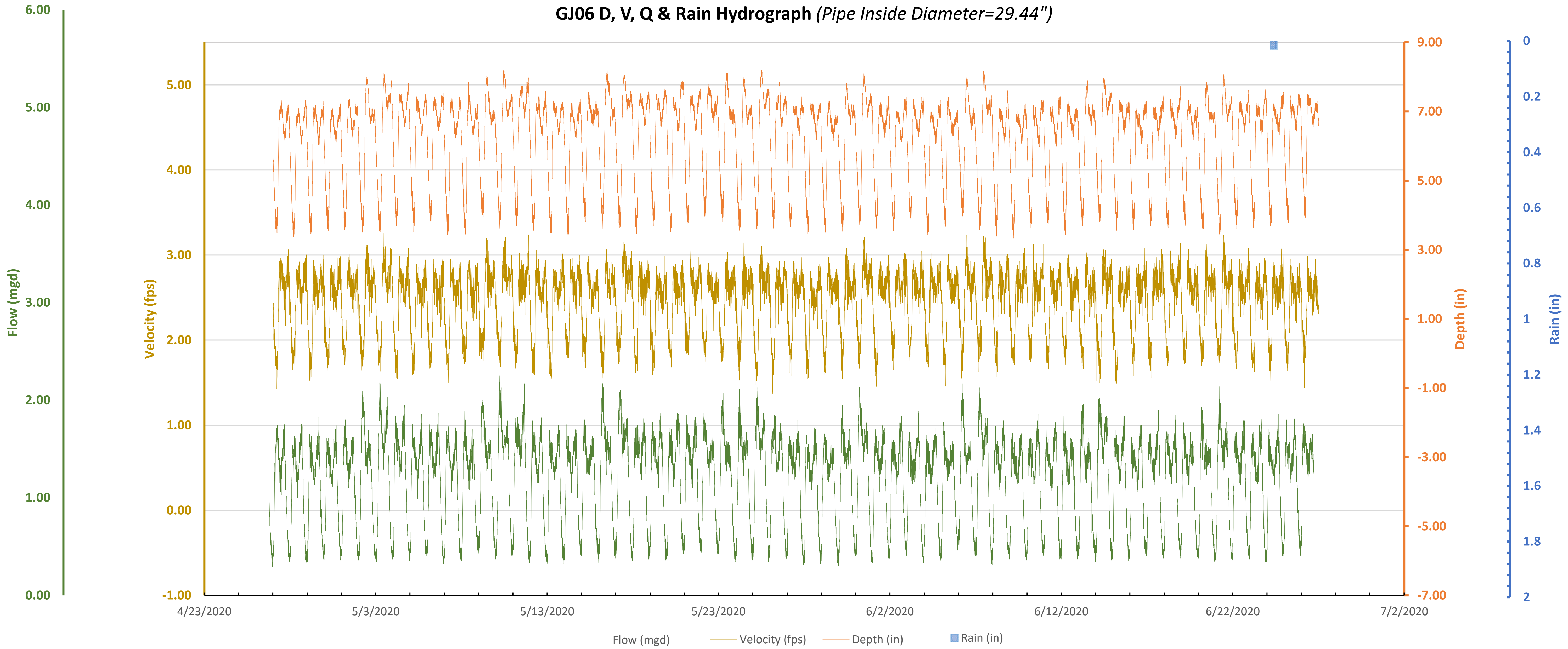

GJ03 D, V, Q & Rain Hydrograph *(Pipe Inside Diameter=14.88")*
Flow (mgd)
2.65
2.15
1.65
1.15
0.65
0.15
Velocity (fps)
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Depth (in)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
Rain (in)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/23/2020
5/3/2020
5/13/2020
5/23/2020
6/2/2020
6/12/2020
6/22/2020
7/2/2020
Flow (mgd)
Velocity (fps)
Depth (in)
Rain (in)

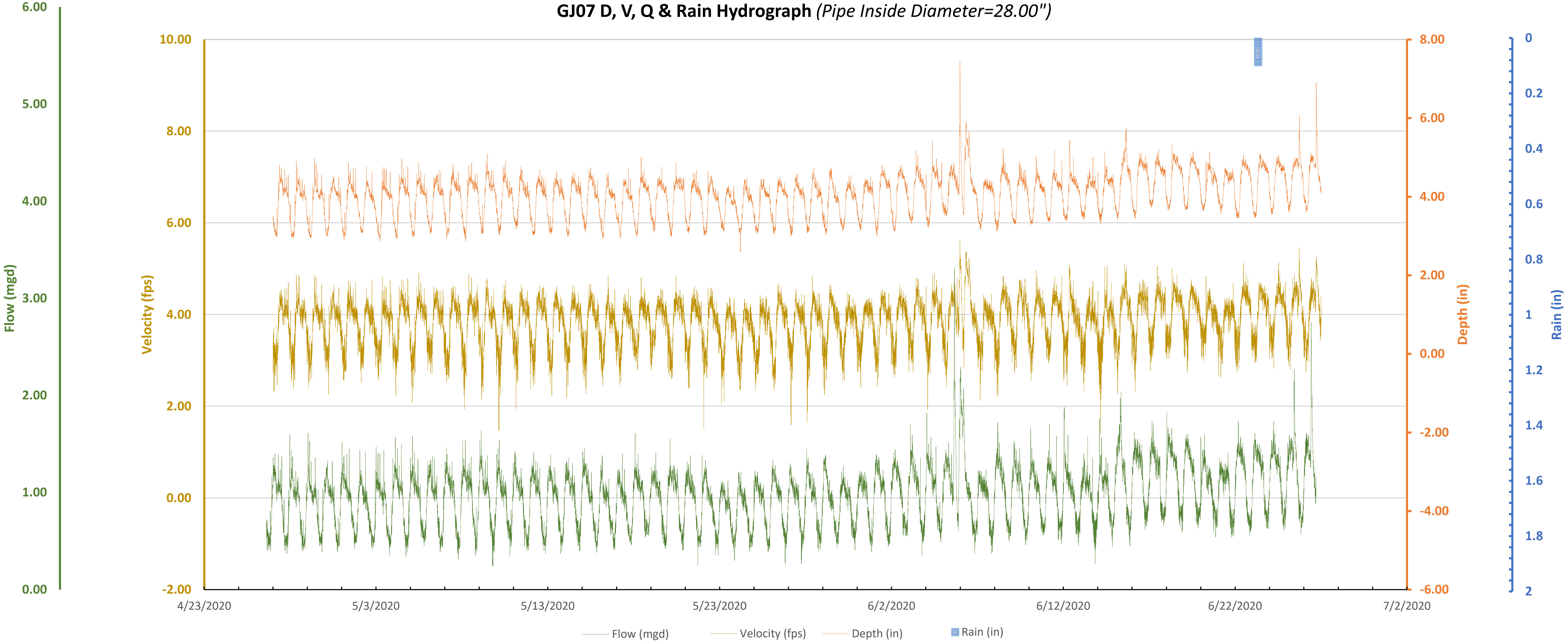
GJ04 D, V, Q & Rain Hydrograph *(Pipe Inside Diameter=17.50")*

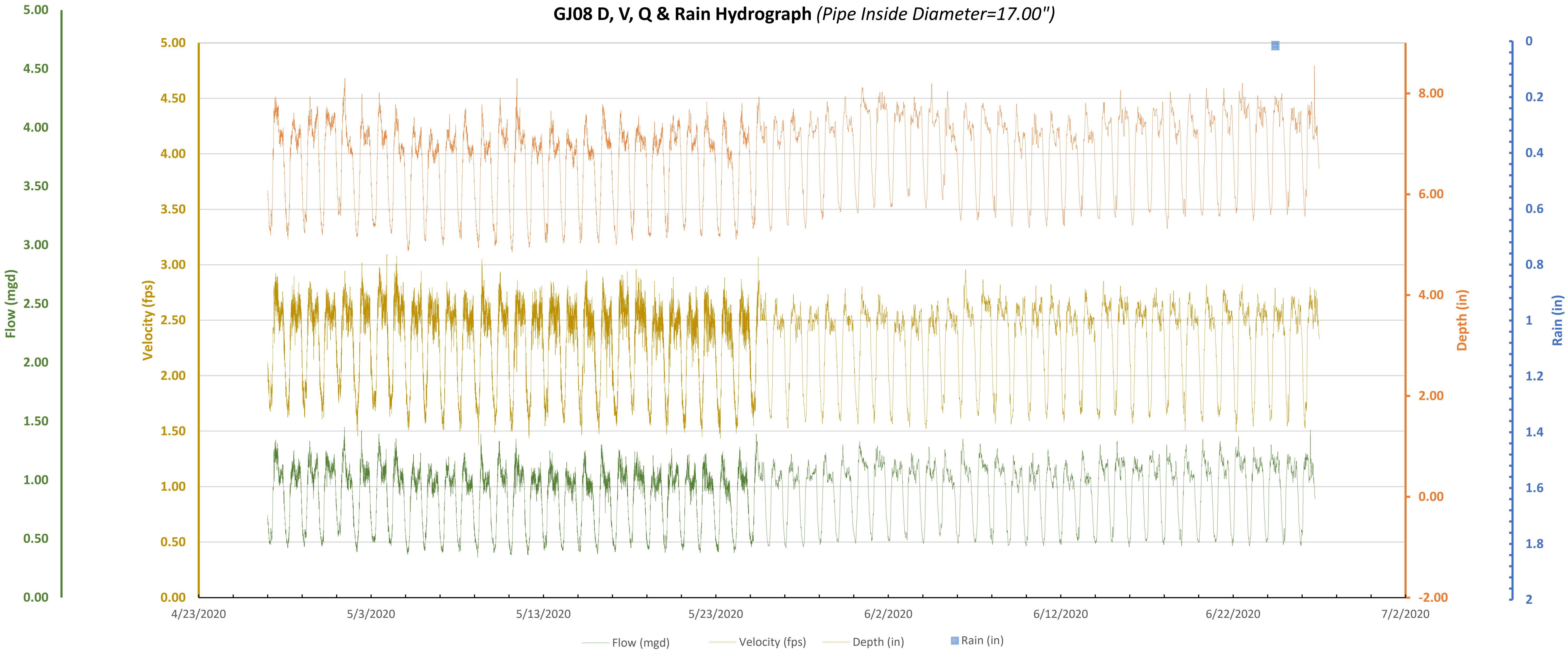



GJ05 D, V, Q & Rain Hydrograph *(Pipe Inside Diameter=14.63")*
Flow (mgd)
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Velocity (fps)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
-0.50
-1.00
Depth (in)
11.00
9.00
7.00
5.00
3.00
1.00
-1.00
-3.00
Rain (in)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/23/2020
5/3/2020
5/13/2020
5/23/2020
6/2/2020
6/12/2020
6/22/2020
7/2/2020
Flow (mgd)
Velocity (fps)
Depth (in)
Rain (in)

GJ06 D, V, Q & Rain Hydrograph *(Pipe Inside Diameter=29.44")*

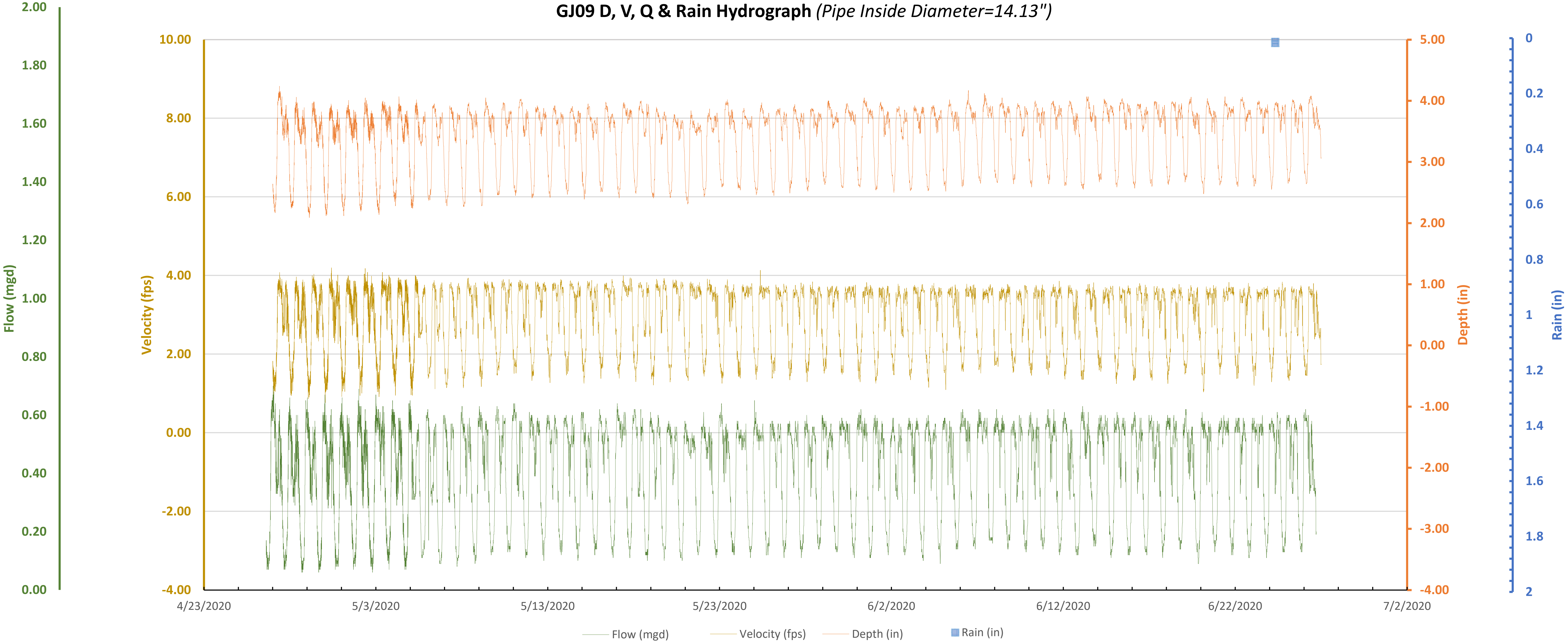


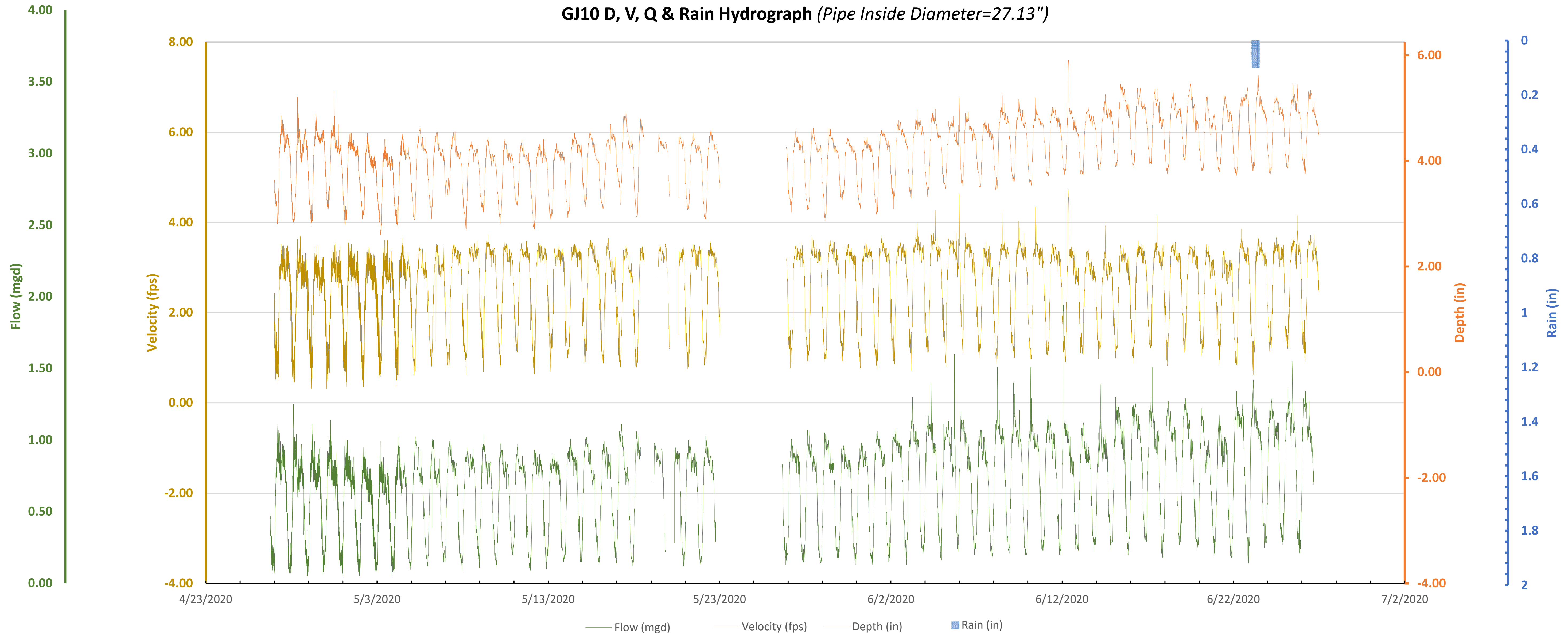

GJ07 D, V, Q & Rain Hydrograph *(Pipe Inside Diameter=28.00")*
Flow (mgd)
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Velocity (fps)
10.00
8.00
6.00
4.00
2.00
0.00
-2.00
Depth (in)
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
-6.00
Rain (in)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/23/2020
5/3/2020
5/13/2020
5/23/2020
6/2/2020
6/12/2020
6/22/2020
7/2/2020
Flow (mgd)
Velocity (fps)
Depth (in)
Rain (in)



GJ08 D, V, Q & Rain Hydrograph *(Pipe Inside Diameter=17.00")*

GJ09 D, V, Q & Rain Hydrograph *(Pipe Inside Diameter=14.13")*




GJ10 D, V, Q & Rain Hydrograph (Pipe Inside Diameter=27.13")
Flow (mgd)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
Velocity (fps)
8.00
6.00
4.00
2.00
0.00
-2.00
-4.00
Depth (in)
6.00
4.00
2.00
0.00
-2.00
-4.00
Rain (in)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
4/23/2020
5/3/2020
5/13/2020
5/23/2020
6/2/2020
6/12/2020
6/22/2020
7/2/2020
Flow (mgd)
Velocity (fps)
Depth (in)
Rain (in)

APPENDIX D

DAILY MIN, MAX, & AVERAGE FLOW SUMMARY TABLES

FLOW METER GJ01

DAILY MIN, MAX, & AVERAGE FLOW, AND TOTAL RAINFALL

4/27/20 to 6/26/20 *(flow values extracted from 5-minute data)*

Date	Minimum Flow (MGD)	Maximum Flow (MGD)	Average Flow (MGD)	Total Precipitation RG01 (inches)
4/27/2020	0.13	0.34	0.24	0.00
4/28/2020	0.11	0.30	0.21	0.00
4/29/2020	0.11	0.34	0.22	0.00
4/30/2020	0.12	0.30	0.22	0.00
5/1/2020	0.11	0.32	0.23	0.00
5/2/2020	0.13	0.34	0.24	0.00
5/3/2020	0.11	0.36	0.21	0.00
5/4/2020	0.11	0.32	0.22	0.00
5/5/2020	0.18	0.34	0.26	0.00
5/6/2020	0.12	0.30	0.22	0.00
5/7/2020	0.11	0.32	0.23	0.00
5/8/2020	0.13	0.34	0.24	0.00
5/9/2020	0.11	0.36	0.21	0.00
5/10/2020	0.10	0.38	0.22	0.00
5/11/2020	0.12	0.33	0.23	0.00
5/12/2020	0.10	0.38	0.24	0.00
5/13/2020	0.13	0.34	0.24	0.00
5/14/2020	0.11	0.31	0.23	0.00
5/15/2020	0.12	0.32	0.23	0.00
5/16/2020	0.12	0.36	0.22	0.00
5/17/2020	0.11	0.42	0.23	0.00
5/18/2020	0.10	0.31	0.22	0.00
5/19/2020	0.11	0.30	0.22	0.00
5/20/2020	0.11	0.30	0.22	0.00
5/21/2020	0.11	0.31	0.22	0.00
5/22/2020	0.11	0.31	0.22	0.00
5/23/2020	0.10	0.34	0.22	0.00
5/24/2020	0.12	0.38	0.23	0.00
5/25/2020	0.12	0.36	0.23	0.00
5/26/2020	0.12	0.33	0.23	0.00
5/27/2020	0.11	0.31	0.21	0.00
5/28/2020	0.12	0.32	0.22	0.00
5/29/2020	0.11	0.33	0.21	0.00
5/30/2020	0.11	0.34	0.23	0.00
5/31/2020	0.11	0.39	0.24	0.00
6/1/2020	0.12	0.34	0.22	0.00
6/2/2020	0.10	0.30	0.22	0.00
6/3/2020	0.12	0.40	0.23	0.00
6/4/2020	0.11	0.34	0.22	0.00
6/5/2020	0.12	0.34	0.23	0.00
6/6/2020	0.12	0.39	0.25	0.00
6/7/2020	0.10	0.33	0.22	0.00
6/8/2020	0.11	0.27	0.20	0.00
6/9/2020	0.11	0.29	0.21	0.00
6/10/2020	0.11	0.27	0.20	0.00
6/11/2020	0.11	0.29	0.20	0.00
6/12/2020	0.11	0.47	0.22	0.00
6/13/2020	0.11	0.33	0.20	0.00
6/14/2020	0.10	0.30	0.20	0.00
6/15/2020	0.12	0.35	0.21	0.00
6/16/2020	0.10	0.46	0.22	0.00
6/17/2020	0.11	0.36	0.23	0.00
6/18/2020	0.11	0.39	0.23	0.00
6/19/2020	0.11	0.40	0.24	0.00
6/20/2020	0.10	0.42	0.22	0.00
6/21/2020	0.10	0.40	0.23	0.00
6/22/2020	0.10	0.32	0.22	0.00
6/23/2020	0.11	0.42	0.25	0.00
6/24/2020	0.09	0.38	0.25	0.00
6/25/2020	0.11	0.44	0.26	0.11
6/26/2020	0.11	0.41	0.23	0.00

FLOW METER GJ02

DAILY MIN, MAX, & AVERAGE FLOW, AND TOTAL RAINFALL

4/27/20 to 6/26/20 *(flow values extracted from 5-minute data)*

Date	Minimum Flow (MGD)	Maximum Flow (MGD)	Average Flow (MGD)	Total Precipitation RG01 (inches)
4/27/2020	1.51	3.97	3.14	0.00
4/28/2020	1.55	3.72	3.05	0.00
4/29/2020	1.51	4.02	2.99	0.00
4/30/2020	1.59	3.69	2.94	0.00
5/1/2020	1.17	3.70	2.81	0.00
5/2/2020	0.75	4.12	2.88	0.00
5/3/2020	1.09	4.18	3.00	0.00
5/4/2020	1.01	3.81	2.91	0.00
5/5/2020	0.94	3.77	2.88	0.00
5/6/2020	1.20	3.75	2.87	0.00
5/7/2020	1.04	3.83	2.90	0.00
5/8/2020	1.34	3.87	2.91	0.00
5/9/2020	1.14	4.09	3.00	0.00
5/10/2020	1.01	4.45	3.11	0.00
5/11/2020	0.92	3.92	3.06	0.00
5/12/2020	1.04	3.81	2.98	0.00
5/13/2020	1.00	3.99	3.05	0.00
5/14/2020	0.96	3.99	3.05	0.00
5/15/2020	1.25	3.98	3.12	0.00
5/16/2020	1.43	4.20	3.14	0.00
5/17/2020	1.15	4.29	3.21	0.00
5/18/2020	1.30	4.06	3.20	0.00
5/19/2020	1.26	3.99	3.14	0.00
5/20/2020	1.35	4.12	3.11	0.00
5/21/2020	1.14	4.08	3.12	0.00
5/22/2020	1.27	4.01	3.15	0.00
5/23/2020	1.13	4.06	3.09	0.00
5/24/2020	1.12	4.36	3.11	0.00
5/25/2020	1.27	4.43	3.21	0.00
5/26/2020	1.32	4.11	3.24	0.00
5/27/2020	1.20	4.13	3.21	0.00
5/28/2020	1.50	4.08	3.18	0.00
5/29/2020	1.40	4.37	3.18	0.00
5/30/2020	1.29	4.28	3.19	0.00
5/31/2020	1.20	4.36	3.29	0.00
6/1/2020	1.58	4.16	3.35	0.00
6/2/2020	1.61	4.11	3.30	0.00
6/3/2020	1.57	4.23	3.22	0.00
6/4/2020	1.29	4.16	3.20	0.00
6/5/2020	1.29	4.12	3.22	0.00
6/6/2020	1.46	4.51	3.24	0.00
6/7/2020	1.40	4.37	3.22	0.00
6/8/2020	1.41	4.11	3.21	0.00
6/9/2020	1.30	4.06	3.14	0.00
6/10/2020	1.44	4.01	3.14	0.00
6/11/2020	1.21	4.09	3.18	0.00
6/12/2020	1.52	4.11	3.17	0.00
6/13/2020	1.57	4.19	3.22	0.00
6/14/2020	1.52	4.37	3.29	0.00
6/15/2020	1.53	4.09	3.25	0.00
6/16/2020	1.32	4.17	3.15	0.00
6/17/2020	1.62	3.99	3.19	0.00
6/18/2020	1.62	4.01	3.18	0.00
6/19/2020	1.57	4.10	3.12	0.00
6/20/2020	1.37	4.25	3.11	0.00
6/21/2020	1.36	4.49	3.28	0.00
6/22/2020	1.66	4.08	3.27	0.00
6/23/2020	1.56	4.12	3.19	0.00
6/24/2020	1.59	4.11	3.23	0.00
6/25/2020	1.38	4.18	3.23	0.11
6/26/2020	1.68	4.04	3.23	0.00

FLOW METER GJ03

DAILY MIN, MAX, & AVERAGE FLOW, AND TOTAL RAINFALL

4/27/20 to 6/26/20 *(flow values extracted from 5-minute data)*

Date	Minimum Flow (MGD)	Maximum Flow (MGD)	Average Flow (MGD)	Total Precipitation RG01 (inches)
4/27/2020	0.24	0.88	0.54	0.00
4/28/2020	0.24	0.84	0.55	0.00
4/29/2020	0.26	0.88	0.55	0.00
4/30/2020	0.25	0.88	0.55	0.00
5/1/2020	0.30	0.90	0.57	0.00
5/2/2020	0.25	0.83	0.53	0.00
5/3/2020	0.27	0.92	0.54	0.00
5/4/2020	0.24	0.87	0.56	0.00
5/5/2020	0.23	0.81	0.55	0.00
5/6/2020	0.27	0.85	0.56	0.00
5/7/2020	0.26	0.84	0.56	0.00
5/8/2020	0.28	0.85	0.54	0.00
5/9/2020	0.20	0.90	0.51	0.00
5/10/2020	0.27	0.89	0.54	0.00
5/11/2020	0.29	0.92	0.57	0.00
5/12/2020	0.28	0.92	0.59	0.00
5/13/2020	0.30	0.91	0.60	0.00
5/14/2020	0.30	1.00	0.62	0.00
5/15/2020	0.29	0.91	0.59	0.00
5/16/2020	0.30	1.06	0.65	0.00
5/17/2020	0.36	1.02	0.64	0.00
5/18/2020	0.35	0.99	0.65	0.00
5/19/2020	0.36	0.92	0.65	0.00
5/20/2020	0.36	0.95	0.62	0.00
5/21/2020	0.29	0.91	0.61	0.00
5/22/2020	0.29	1.18	0.60	0.00
5/23/2020	0.31	0.95	0.63	0.00
5/24/2020	0.31	0.95	0.61	0.00
5/25/2020	0.27	1.04	0.60	0.00
5/26/2020	0.31	0.88	0.61	0.00
5/27/2020	0.29	0.83	0.57	0.00
5/28/2020	0.33	0.92	0.63	0.00
5/29/2020	0.31	0.90	0.63	0.00
5/30/2020	0.35	0.94	0.63	0.00
5/31/2020	0.37	0.96	0.66	0.00
6/1/2020	0.35	1.01	0.67	0.00
6/2/2020	0.37	0.89	0.65	0.00
6/3/2020	0.36	0.90	0.67	0.00
6/4/2020	0.37	0.94	0.67	0.00
6/5/2020	0.34	0.93	0.65	0.00
6/6/2020	0.38	0.95	0.66	0.00
6/7/2020	0.36	0.95	0.65	0.00
6/8/2020	0.33	0.93	0.64	0.00
6/9/2020	0.34	0.93	0.65	0.00
6/10/2020	0.38	0.95	0.66	0.00
6/11/2020	0.35	1.00	0.66	0.00
6/12/2020	0.35	0.98	0.69	0.00
6/13/2020	0.35	0.97	0.66	0.00
6/14/2020	0.37	0.95	0.71	0.00
6/15/2020	0.37	1.08	0.73	0.00
6/16/2020	0.36	0.90	0.71	0.00
6/17/2020	0.32	0.93	0.72	0.00
6/18/2020	0.35	1.13	0.73	0.00
6/19/2020	0.39	1.02	0.73	0.00
6/20/2020	0.36	1.05	0.70	0.00
6/21/2020	0.35	1.00	0.71	0.00
6/22/2020	0.38	1.10	0.76	0.00
6/23/2020	0.39	1.15	0.81	0.00
6/24/2020	0.46	1.31	0.84	0.00
6/25/2020	0.46	1.26	0.87	0.11
6/26/2020	0.52	1.31	0.89	0.00

FLOW METER GJ04

DAILY MIN, MAX, & AVERAGE FLOW, AND TOTAL RAINFALL

4/27/20 to 6/26/20 *(flow values extracted from 5-minute data)*

Date	Minimum Flow (MGD)	Maximum Flow (MGD)	Average Flow (MGD)	Total Precipitation RG01 (inches)
4/27/2020	0.32	1.34	0.95	0.00
4/28/2020	0.53	2.02	1.19	0.00
4/29/2020	0.53	1.53	1.12	0.00
4/30/2020	0.60	1.92	1.18	0.00
5/1/2020	0.51	1.52	1.07	0.00
5/2/2020	0.53	1.34	1.01	0.00
5/3/2020	0.38	1.61	1.11	0.00
5/4/2020	0.59	1.47	1.09	0.00
5/5/2020	0.39	1.55	1.12	0.00
5/6/2020	0.57	1.57	1.16	0.00
5/7/2020	0.63	1.67	1.16	0.00
5/8/2020	0.57	1.64	1.14	0.00
5/9/2020	0.61	1.65	1.11	0.00
5/10/2020	0.58	1.61	1.08	0.00
5/11/2020	0.59	1.59	1.13	0.00
5/12/2020	0.54	1.60	1.12	0.00
5/13/2020	0.63	1.64	1.12	0.00
5/14/2020	0.52	1.60	1.12	0.00
5/15/2020	0.51	1.53	1.09	0.00
5/16/2020	0.50	1.52	1.06	0.00
5/17/2020	0.58	1.65	1.10	0.00
5/18/2020	0.54	1.58	1.12	0.00
5/19/2020	0.61	1.56	1.15	0.00
5/20/2020	0.65	1.86	1.18	0.00
5/21/2020	0.64	1.57	1.14	0.00
5/22/2020	0.60	1.52	1.10	0.00
5/23/2020	0.59	1.54	1.11	0.00
5/24/2020	0.40	1.55	1.11	0.00
5/25/2020	0.43	1.60	1.14	0.00
5/26/2020	0.59	1.56	1.11	0.00
5/27/2020	0.27	1.53	1.10	0.00
5/28/2020	0.60	1.74	1.12	0.00
5/29/2020	0.65	1.55	1.15	0.00
5/30/2020	0.59	1.75	1.07	0.00
5/31/2020	0.52	1.48	1.06	0.00
6/1/2020	0.58	1.52	1.12	0.00
6/2/2020	0.61	1.48	1.09	0.00
6/3/2020	0.58	1.41	1.06	0.00
6/4/2020	0.57	1.48	1.09	0.00
6/5/2020	0.60	1.54	1.07	0.00
6/6/2020	0.63	1.59	1.14	0.00
6/7/2020	0.68	1.60	1.14	0.00
6/8/2020	0.56	1.59	1.10	0.00
6/9/2020	0.68	1.62	1.11	0.00
6/10/2020	0.63	1.52	1.10	0.00
6/11/2020	0.59	1.66	1.13	0.00
6/12/2020	0.61	1.48	1.12	0.00
6/13/2020	0.67	1.61	1.17	0.00
6/14/2020	0.68	1.56	1.15	0.00
6/15/2020	0.60	1.67	1.10	0.00
6/16/2020	0.63	1.47	1.12	0.00
6/17/2020	0.60	1.42	1.09	0.00
6/18/2020	0.47	1.45	1.05	0.00
6/19/2020	0.54	1.43	1.05	0.00
6/20/2020	0.56	1.46	1.05	0.00
6/21/2020	0.56	1.54	1.09	0.00
6/22/2020	0.46	1.53	1.10	0.00
6/23/2020	0.59	1.55	1.12	0.00
6/24/2020	0.69	1.43	1.12	0.00
6/25/2020	0.53	1.76	1.12	0.11
6/26/2020	0.67	1.49	1.14	0.00

FLOW METER GJ05

DAILY MIN, MAX, & AVERAGE FLOW, AND TOTAL RAINFALL

4/27/20 to 6/26/20 *(flow values extracted from 5-minute data)*

Date	Minimum Flow (MGD)	Maximum Flow (MGD)	Average Flow (MGD)	Total Precipitation RG02 (inches)
4/27/2020	0.22	0.86	0.56	0.00
4/28/2020	0.24	0.80	0.54	0.00
4/29/2020	0.24	0.80	0.54	0.00
4/30/2020	0.22	0.82	0.55	0.00
5/1/2020	0.22	0.80	0.56	0.00
5/2/2020	0.25	0.90	0.59	0.00
5/3/2020	0.22	0.95	0.60	0.00
5/4/2020	0.26	0.83	0.58	0.00
5/5/2020	0.26	0.83	0.58	0.00
5/6/2020	0.25	0.83	0.58	0.00
5/7/2020	0.27	0.83	0.59	0.00
5/8/2020	0.25	0.83	0.58	0.00
5/9/2020	0.26	0.97	0.62	0.00
5/10/2020	0.28	1.00	0.65	0.00
5/11/2020	0.27	0.86	0.62	0.00
5/12/2020	0.30	0.92	0.62	0.00
5/13/2020	0.28	0.85	0.61	0.00
5/14/2020	0.28	0.86	0.61	0.00
5/15/2020	0.29	0.87	0.62	0.00
5/16/2020	0.28	1.02	0.66	0.00
5/17/2020	0.28	1.01	0.67	0.00
5/18/2020	0.30	0.90	0.64	0.00
5/19/2020	0.32	0.89	0.63	0.00
5/20/2020	0.32	0.92	0.66	0.00
5/21/2020	0.34	0.90	0.65	0.00
5/22/2020	0.37	0.88	0.66	0.00
5/23/2020	0.36	0.90	0.66	0.00
5/24/2020	0.35	0.94	0.67	0.00
5/25/2020	0.37	0.94	0.69	0.00
5/26/2020	0.37	0.87	0.66	0.00
5/27/2020	0.35	0.84	0.66	0.00
5/28/2020	0.38	0.84	0.67	0.00
5/29/2020	0.38	0.83	0.65	0.00
5/30/2020	0.36	0.84	0.66	0.00
5/31/2020	0.36	0.96	0.68	0.00
6/1/2020	0.40	0.87	0.69	0.00
6/2/2020	0.39	0.86	0.64	0.00
6/3/2020	0.36	0.81	0.62	0.00
6/4/2020	0.41	0.91	0.70	0.00
6/5/2020	0.35	0.88	0.65	0.00
6/6/2020	0.38	0.99	0.69	0.00
6/7/2020	0.42	1.03	0.75	0.00
6/8/2020	0.42	0.91	0.70	0.00
6/9/2020	0.36	0.89	0.68	0.00
6/10/2020	0.39	0.90	0.69	0.00
6/11/2020	0.35	0.81	0.64	0.00
6/12/2020	0.36	0.83	0.66	0.00
6/13/2020	0.37	0.93	0.70	0.00
6/14/2020	0.37	0.95	0.71	0.00
6/15/2020	0.38	0.93	0.69	0.00
6/16/2020	0.37	0.86	0.67	0.00
6/17/2020	0.37	0.83	0.66	0.00
6/18/2020	0.37	0.83	0.65	0.00
6/19/2020	0.35	0.86	0.65	0.00
6/20/2020	0.37	1.00	0.68	0.00
6/21/2020	0.40	1.03	0.73	0.00
6/22/2020	0.42	0.94	0.70	0.00
6/23/2020	0.37	0.84	0.67	0.00
6/24/2020	0.36	0.87	0.66	0.00
6/25/2020	0.38	0.89	0.68	0.00
6/26/2020	0.40	0.88	0.68	0.05

FLOW METER GJ06

DAILY MIN, MAX, & AVERAGE FLOW, AND TOTAL RAINFALL

4/27/20 to 6/26/20 *(flow values extracted from 5-minute data)*

Date	Minimum Flow (MGD)	Maximum Flow (MGD)	Average Flow (MGD)	Total Precipitation RG02 (inches)
4/27/2020	0.29	1.78	1.15	0.00
4/28/2020	0.30	1.81	1.13	0.00
4/29/2020	0.31	1.83	1.14	0.00
4/30/2020	0.36	1.75	1.13	0.00
5/1/2020	0.36	1.80	1.16	0.00
5/2/2020	0.36	2.09	1.22	0.00
5/3/2020	0.34	2.18	1.29	0.00
5/4/2020	0.32	2.01	1.24	0.00
5/5/2020	0.35	1.86	1.19	0.00
5/6/2020	0.39	1.87	1.22	0.00
5/7/2020	0.32	1.77	1.16	0.00
5/8/2020	0.32	1.89	1.17	0.00
5/9/2020	0.43	2.13	1.27	0.00
5/10/2020	0.37	2.25	1.32	0.00
5/11/2020	0.39	2.17	1.32	0.00
5/12/2020	0.33	1.85	1.20	0.00
5/13/2020	0.32	1.74	1.17	0.00
5/14/2020	0.32	1.75	1.18	0.00
5/15/2020	0.40	1.81	1.22	0.00
5/16/2020	0.33	2.17	1.26	0.00
5/17/2020	0.38	2.13	1.32	0.00
5/18/2020	0.35	1.86	1.25	0.00
5/19/2020	0.36	1.87	1.23	0.00
5/20/2020	0.36	1.92	1.24	0.00
5/21/2020	0.39	1.85	1.26	0.00
5/22/2020	0.44	1.87	1.26	0.00
5/23/2020	0.42	2.07	1.25	0.00
5/24/2020	0.32	2.11	1.23	0.00
5/25/2020	0.30	2.16	1.30	0.00
5/26/2020	0.34	1.92	1.26	0.00
5/27/2020	0.37	1.80	1.20	0.00
5/28/2020	0.31	1.72	1.15	0.00
5/29/2020	0.32	1.72	1.15	0.00
5/30/2020	0.30	2.00	1.21	0.00
5/31/2020	0.40	2.17	1.31	0.00
6/1/2020	0.32	1.82	1.19	0.00
6/2/2020	0.38	1.84	1.20	0.00
6/3/2020	0.41	1.89	1.21	0.00
6/4/2020	0.33	1.72	1.17	0.00
6/5/2020	0.34	1.82	1.16	0.00
6/6/2020	0.41	2.17	1.27	0.00
6/7/2020	0.40	2.21	1.30	0.00
6/8/2020	0.31	1.85	1.17	0.00
6/9/2020	0.33	1.72	1.15	0.00
6/10/2020	0.36	1.86	1.18	0.00
6/11/2020	0.37	1.78	1.18	0.00
6/12/2020	0.37	1.84	1.18	0.00
6/13/2020	0.37	1.96	1.20	0.00
6/14/2020	0.34	2.02	1.29	0.00
6/15/2020	0.31	1.87	1.20	0.00
6/16/2020	0.35	1.74	1.16	0.00
6/17/2020	0.37	1.90	1.21	0.00
6/18/2020	0.37	1.92	1.21	0.00
6/19/2020	0.38	1.79	1.18	0.00
6/20/2020	0.38	2.02	1.20	0.00
6/21/2020	0.34	2.17	1.25	0.00
6/22/2020	0.36	1.90	1.20	0.00
6/23/2020	0.36	1.82	1.19	0.00
6/24/2020	0.34	1.87	1.19	0.00
6/25/2020	0.40	1.81	1.22	0.00
6/26/2020	0.38	1.83	1.24	0.05

FLOW METER GJ07

DAILY MIN, MAX, & AVERAGE FLOW, AND TOTAL RAINFALL

4/27/20 to 6/26/20 *(flow values extracted from 5-minute data)*

Date	Minimum Flow (MGD)	Maximum Flow (MGD)	Average Flow (MGD)	Total Precipitation RG01 (inches)
4/27/2020	0.40	1.40	0.89	0.00
4/28/2020	0.37	1.59	0.88	0.00
4/29/2020	0.40	1.61	0.87	0.00
4/30/2020	0.39	1.33	0.88	0.00
5/1/2020	0.39	1.52	0.89	0.00
5/2/2020	0.42	1.44	0.85	0.00
5/3/2020	0.41	1.47	0.85	0.00
5/4/2020	0.35	1.57	0.90	0.00
5/5/2020	0.34	1.58	0.90	0.00
5/6/2020	0.45	1.37	0.91	0.00
5/7/2020	0.39	1.46	0.92	0.00
5/8/2020	0.31	1.54	0.94	0.00
5/9/2020	0.35	1.64	0.94	0.00
5/10/2020	0.24	1.54	0.91	0.00
5/11/2020	0.34	1.42	0.92	0.00
5/12/2020	0.40	1.41	0.91	0.00
5/13/2020	0.37	1.39	0.90	0.00
5/14/2020	0.37	1.36	0.92	0.00
5/15/2020	0.40	1.45	0.94	0.00
5/16/2020	0.38	1.38	0.85	0.00
5/17/2020	0.41	1.40	0.86	0.00
5/18/2020	0.46	1.61	0.92	0.00
5/19/2020	0.54	1.41	0.94	0.00
5/20/2020	0.42	1.55	0.94	0.00
5/21/2020	0.40	1.38	0.91	0.00
5/22/2020	0.25	1.38	0.87	0.00
5/23/2020	0.35	1.12	0.82	0.00
5/24/2020	0.30	1.21	0.81	0.00
5/25/2020	0.39	1.22	0.85	0.00
5/26/2020	0.39	1.33	0.90	0.00
5/27/2020	0.26	1.30	0.90	0.00
5/28/2020	0.27	1.45	0.91	0.00
5/29/2020	0.39	1.39	0.91	0.00
5/30/2020	0.43	1.27	0.88	0.00
5/31/2020	0.41	1.22	0.90	0.00
6/1/2020	0.39	1.39	0.97	0.00
6/2/2020	0.44	1.44	0.99	0.00
6/3/2020	0.55	1.70	1.02	0.00
6/4/2020	0.35	1.82	1.02	0.00
6/5/2020	0.49	3.31	1.10	0.00
6/6/2020	0.60	2.29	1.32	0.00
6/7/2020	0.37	1.23	0.91	0.00
6/8/2020	0.37	1.72	1.02	0.00
6/9/2020	0.50	1.53	1.01	0.00
6/10/2020	0.46	1.67	0.98	0.00
6/11/2020	0.56	1.70	1.01	0.00
6/12/2020	0.47	1.88	1.02	0.00
6/13/2020	0.45	1.58	0.95	0.00
6/14/2020	0.26	1.76	0.99	0.00
6/15/2020	0.44	2.04	1.16	0.00
6/16/2020	0.45	1.62	1.15	0.00
6/17/2020	0.62	1.74	1.17	0.00
6/18/2020	0.65	1.83	1.20	0.00
6/19/2020	0.59	1.60	1.17	0.00
6/20/2020	0.63	1.59	1.07	0.00
6/21/2020	0.54	1.41	1.04	0.00
6/22/2020	0.54	1.73	1.13	0.00
6/23/2020	0.57	1.61	1.15	0.00
6/24/2020	0.63	1.73	1.17	0.00
6/25/2020	0.61	2.27	1.22	0.11
6/26/2020	0.57	2.75	1.24	0.00

FLOW METER GJ08

DAILY MIN, MAX, & AVERAGE FLOW, AND TOTAL RAINFALL

4/27/20 to 6/26/20 *(flow values extracted from 5-minute data)*

Date	Minimum Flow (MGD)	Maximum Flow (MGD)	Average Flow (MGD)	Total Precipitation RG02 (inches)
4/27/2020	0.45	1.34	0.91	0.00
4/28/2020	0.42	1.25	0.89	0.00
4/29/2020	0.43	1.33	0.92	0.00
4/30/2020	0.43	1.25	0.93	0.00
5/1/2020	0.52	1.45	0.93	0.00
5/2/2020	0.39	1.42	0.88	0.00
5/3/2020	0.47	1.39	0.91	0.00
5/4/2020	0.44	1.35	0.89	0.00
5/5/2020	0.37	1.23	0.84	0.00
5/6/2020	0.40	1.14	0.85	0.00
5/7/2020	0.38	1.20	0.85	0.00
5/8/2020	0.39	1.23	0.85	0.00
5/9/2020	0.34	1.39	0.84	0.00
5/10/2020	0.38	1.33	0.86	0.00
5/11/2020	0.36	1.35	0.87	0.00
5/12/2020	0.36	1.15	0.83	0.00
5/13/2020	0.40	1.25	0.86	0.00
5/14/2020	0.40	1.15	0.83	0.00
5/15/2020	0.39	1.25	0.84	0.00
5/16/2020	0.37	1.30	0.84	0.00
5/17/2020	0.39	1.26	0.86	0.00
5/18/2020	0.42	1.24	0.89	0.00
5/19/2020	0.41	1.21	0.83	0.00
5/20/2020	0.38	1.27	0.87	0.00
5/21/2020	0.40	1.22	0.86	0.00
5/22/2020	0.38	1.23	0.86	0.00
5/23/2020	0.39	1.24	0.83	0.00
5/24/2020	0.38	1.28	0.84	0.00
5/25/2020	0.43	1.39	0.91	0.00
5/26/2020	0.44	1.18	0.87	0.00
5/27/2020	0.42	1.22	0.89	0.00
5/28/2020	0.43	1.17	0.89	0.00
5/29/2020	0.45	1.23	0.90	0.00
5/30/2020	0.47	1.30	0.91	0.00
5/31/2020	0.46	1.33	0.96	0.00
6/1/2020	0.48	1.29	0.98	0.00
6/2/2020	0.48	1.18	0.92	0.00
6/3/2020	0.49	1.23	0.94	0.00
6/4/2020	0.46	1.28	0.93	0.00
6/5/2020	0.52	1.26	0.93	0.00
6/6/2020	0.46	1.35	0.94	0.00
6/7/2020	0.47	1.31	0.94	0.00
6/8/2020	0.45	1.27	0.94	0.00
6/9/2020	0.44	1.21	0.88	0.00
6/10/2020	0.44	1.23	0.89	0.00
6/11/2020	0.44	1.26	0.90	0.00
6/12/2020	0.45	1.17	0.88	0.00
6/13/2020	0.48	1.25	0.90	0.00
6/14/2020	0.46	1.30	0.92	0.00
6/15/2020	0.47	1.33	0.96	0.00
6/16/2020	0.43	1.20	0.92	0.00
6/17/2020	0.48	1.25	0.96	0.00
6/18/2020	0.45	1.30	0.93	0.00
6/19/2020	0.44	1.30	0.93	0.00
6/20/2020	0.47	1.35	0.94	0.00
6/21/2020	0.47	1.33	0.94	0.00
6/22/2020	0.44	1.37	0.99	0.00
6/23/2020	0.44	1.28	0.96	0.00
6/24/2020	0.47	1.30	0.96	0.00
6/25/2020	0.45	1.22	0.95	0.00
6/26/2020	0.44	1.43	0.94	0.05

FLOW METER GJ09

DAILY MIN, MAX, & AVERAGE FLOW, AND TOTAL RAINFALL

4/27/20 to 6/26/20 *(flow values extracted from 5-minute data)*

Date	Minimum Flow (MGD)	Maximum Flow (MGD)	Average Flow (MGD)	Total Precipitation RG02 (inches)
4/27/2020	0.07	0.70	0.39	0.00
4/28/2020	0.07	0.66	0.36	0.00
4/29/2020	0.06	0.66	0.37	0.00
4/30/2020	0.06	0.67	0.38	0.00
5/1/2020	0.07	0.66	0.38	0.00
5/2/2020	0.07	0.69	0.38	0.00
5/3/2020	0.06	0.67	0.40	0.00
5/4/2020	0.07	0.65	0.39	0.00
5/5/2020	0.07	0.65	0.36	0.00
5/6/2020	0.11	0.62	0.38	0.00
5/7/2020	0.09	0.60	0.38	0.00
5/8/2020	0.08	0.63	0.40	0.00
5/9/2020	0.09	0.63	0.40	0.00
5/10/2020	0.12	0.63	0.41	0.00
5/11/2020	0.13	0.64	0.41	0.00
5/12/2020	0.11	0.61	0.42	0.00
5/13/2020	0.10	0.60	0.41	0.00
5/14/2020	0.12	0.60	0.41	0.00
5/15/2020	0.10	0.61	0.40	0.00
5/16/2020	0.12	0.62	0.42	0.00
5/17/2020	0.11	0.64	0.43	0.00
5/18/2020	0.11	0.62	0.41	0.00
5/19/2020	0.10	0.61	0.41	0.00
5/20/2020	0.10	0.58	0.40	0.00
5/21/2020	0.10	0.58	0.40	0.00
5/22/2020	0.12	0.61	0.41	0.00
5/23/2020	0.11	0.64	0.42	0.00
5/24/2020	0.12	0.58	0.41	0.00
5/25/2020	0.11	0.65	0.42	0.00
5/26/2020	0.12	0.58	0.41	0.00
5/27/2020	0.11	0.58	0.41	0.00
5/28/2020	0.11	0.60	0.41	0.00
5/29/2020	0.14	0.60	0.42	0.00
5/30/2020	0.13	0.59	0.43	0.00
5/31/2020	0.11	0.62	0.43	0.00
6/1/2020	0.11	0.60	0.41	0.00
6/2/2020	0.12	0.59	0.40	0.00
6/3/2020	0.12	0.59	0.42	0.00
6/4/2020	0.10	0.60	0.42	0.00
6/5/2020	0.09	0.59	0.41	0.00
6/6/2020	0.14	0.62	0.43	0.00
6/7/2020	0.14	0.62	0.44	0.00
6/8/2020	0.16	0.62	0.43	0.00
6/9/2020	0.14	0.60	0.41	0.00
6/10/2020	0.13	0.61	0.42	0.00
6/11/2020	0.14	0.62	0.43	0.00
6/12/2020	0.12	0.61	0.40	0.00
6/13/2020	0.12	0.63	0.41	0.00
6/14/2020	0.15	0.60	0.43	0.00
6/15/2020	0.11	0.61	0.43	0.00
6/16/2020	0.12	0.61	0.41	0.00
6/17/2020	0.12	0.60	0.42	0.00
6/18/2020	0.11	0.60	0.42	0.00
6/19/2020	0.14	0.62	0.41	0.00
6/20/2020	0.09	0.61	0.41	0.00
6/21/2020	0.13	0.60	0.43	0.00
6/22/2020	0.12	0.59	0.42	0.00
6/23/2020	0.11	0.60	0.42	0.00
6/24/2020	0.11	0.61	0.43	0.00
6/25/2020	0.13	0.60	0.41	0.00
6/26/2020	0.13	0.62	0.39	0.05

FLOW METER GJ10

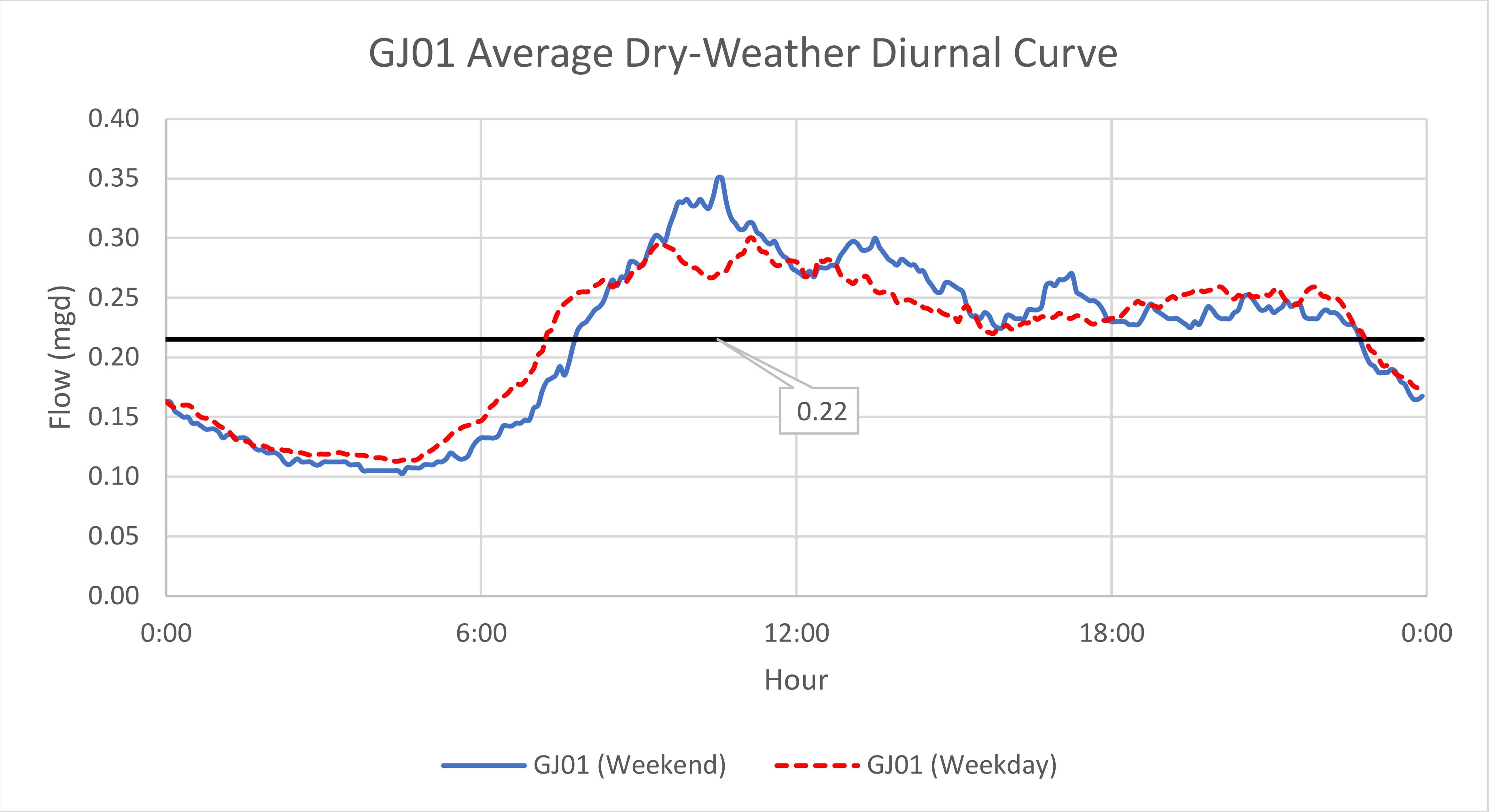
DAILY MIN, MAX, & AVERAGE FLOW, AND TOTAL RAINFALL

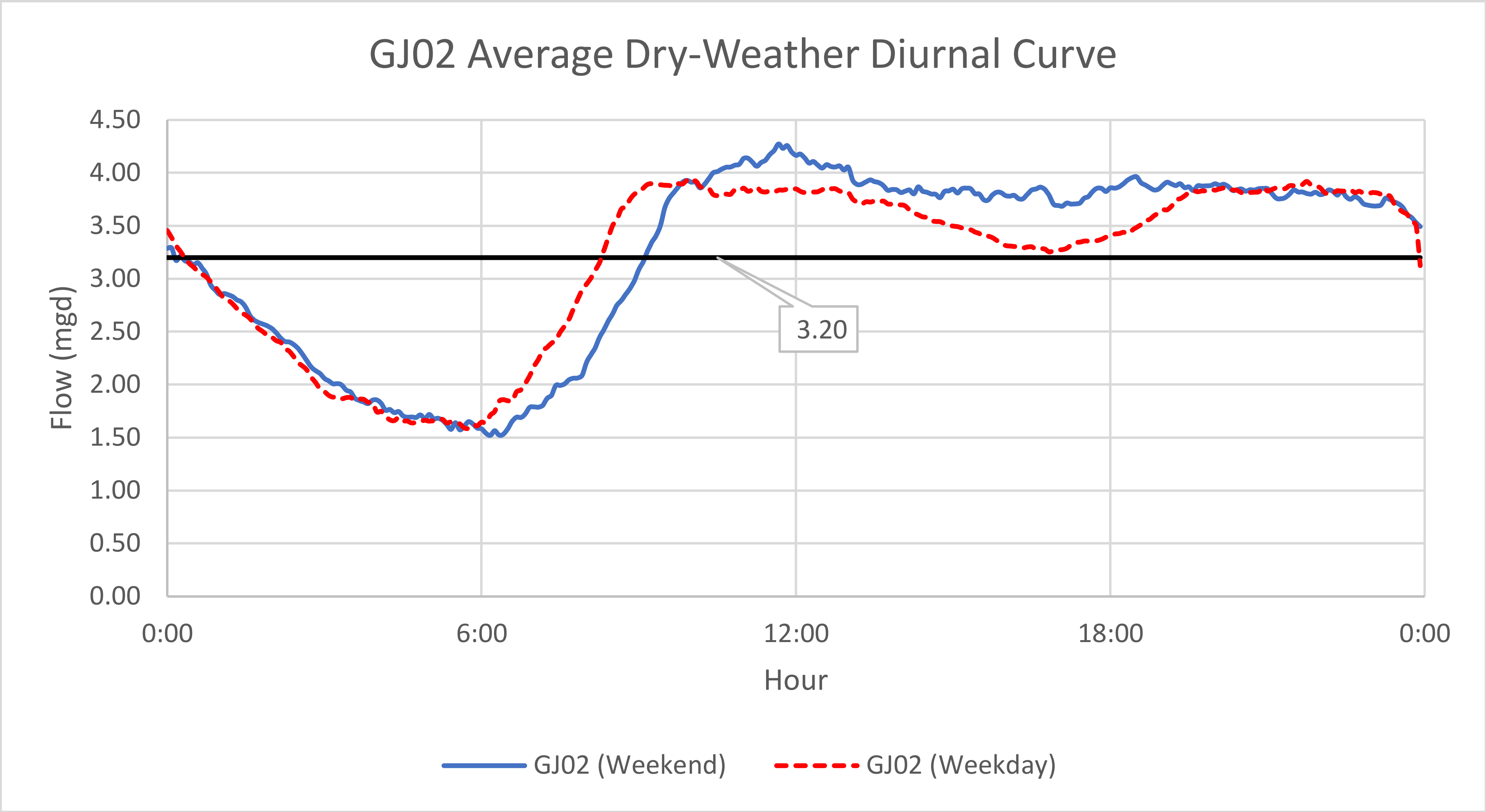
4/27/20 to 6/26/20 *(flow values extracted from 5-minute data)*

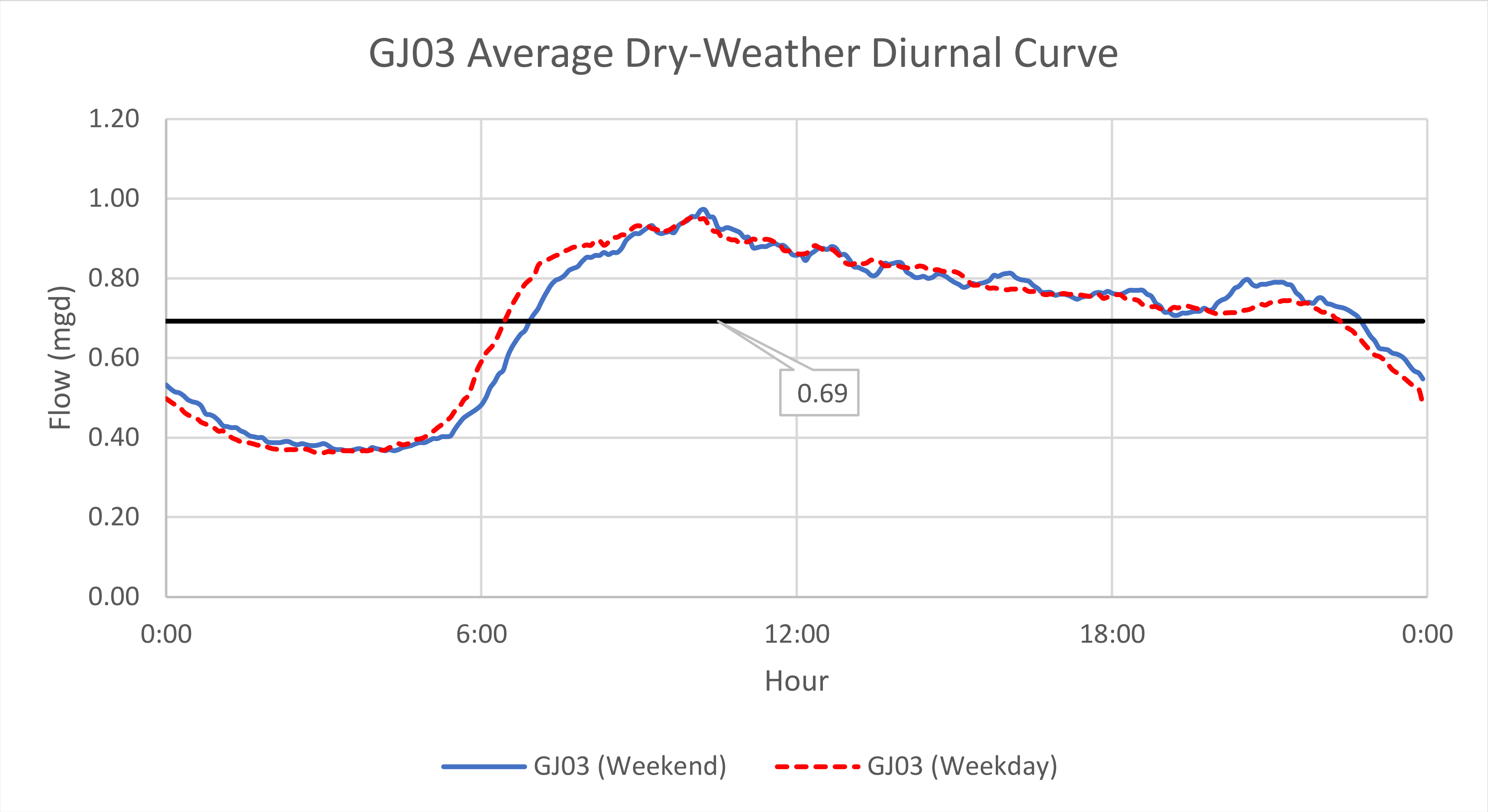
Date	Minimum Flow (MGD)	Maximum Flow (MGD)	Average Flow (MGD)	Total Precipitation RG01 (inches)
4/27/2020	0.07	1.11	0.64	0.00
4/28/2020	0.07	1.25	0.61	0.00
4/29/2020	0.05	1.11	0.61	0.00
4/30/2020	0.06	1.14	0.62	0.00
5/1/2020	0.05	1.00	0.59	0.00
5/2/2020	0.05	0.95	0.56	0.00
5/3/2020	0.08	0.99	0.54	0.00
5/4/2020	0.05	1.04	0.60	0.00
5/5/2020	0.09	1.02	0.62	0.00
5/6/2020	0.12	1.01	0.62	0.00
5/7/2020	0.15	1.00	0.64	0.00
5/8/2020	0.08	0.95	0.64	0.00
5/9/2020	0.11	1.04	0.65	0.00
5/10/2020	0.11	0.98	0.62	0.00
5/11/2020	0.19	0.97	0.64	0.00
5/12/2020	0.09	0.93	0.62	0.00
5/13/2020	0.10	0.90	0.62	0.00
5/14/2020	0.15	1.01	0.67	0.00
5/15/2020	0.15	1.02	0.68	0.00
5/16/2020	0.14	1.00	0.64	0.00
5/17/2020	0.14	1.11	0.67	0.00
5/18/2020	0.12	1.06	0.61	0.00
5/19/2020	0.59	0.98	0.87	0.00
5/20/2020	0.22	0.95	0.74	0.00
5/21/2020	0.12	1.00	0.67	0.00
5/22/2020	0.13	1.03	0.64	0.00
5/23/2020	0.29	0.43	0.39	0.00
5/24/2020				0.00
5/25/2020				0.00
5/26/2020	0.40	0.83	0.65	0.00
5/27/2020	0.13	1.01	0.66	0.00
5/28/2020	0.15	1.07	0.67	0.00
5/29/2020	0.14	1.05	0.68	0.00
5/30/2020	0.17	0.96	0.65	0.00
5/31/2020	0.13	0.98	0.66	0.00
6/1/2020	0.13	1.06	0.70	0.00
6/2/2020	0.15	1.08	0.74	0.00
6/3/2020	0.13	1.30	0.79	0.00
6/4/2020	0.20	1.40	0.80	0.00
6/5/2020	0.16	1.60	0.80	0.00
6/6/2020	0.22	1.20	0.83	0.00
6/7/2020	0.20	1.07	0.72	0.00
6/8/2020	0.17	1.51	0.80	0.00
6/9/2020	0.21	1.40	0.82	0.00
6/10/2020	0.20	1.51	0.80	0.00
6/11/2020	0.23	1.17	0.80	0.00
6/12/2020	0.20	1.94	0.82	0.00
6/13/2020	0.23	1.12	0.74	0.00
6/14/2020	0.22	1.39	0.76	0.00
6/15/2020	0.23	1.30	0.85	0.00
6/16/2020	0.20	1.26	0.86	0.00
6/17/2020	0.29	1.51	0.86	0.00
6/18/2020	0.18	1.27	0.85	0.00
6/19/2020	0.27	1.29	0.86	0.00
6/20/2020	0.23	1.22	0.77	0.00
6/21/2020	0.19	1.18	0.76	0.00
6/22/2020	0.18	1.34	0.86	0.00
6/23/2020	0.14	1.42	0.87	0.00
6/24/2020	0.25	1.29	0.87	0.00
6/25/2020	0.27	1.55	0.90	0.11
6/26/2020	0.21	1.34	0.87	0.00

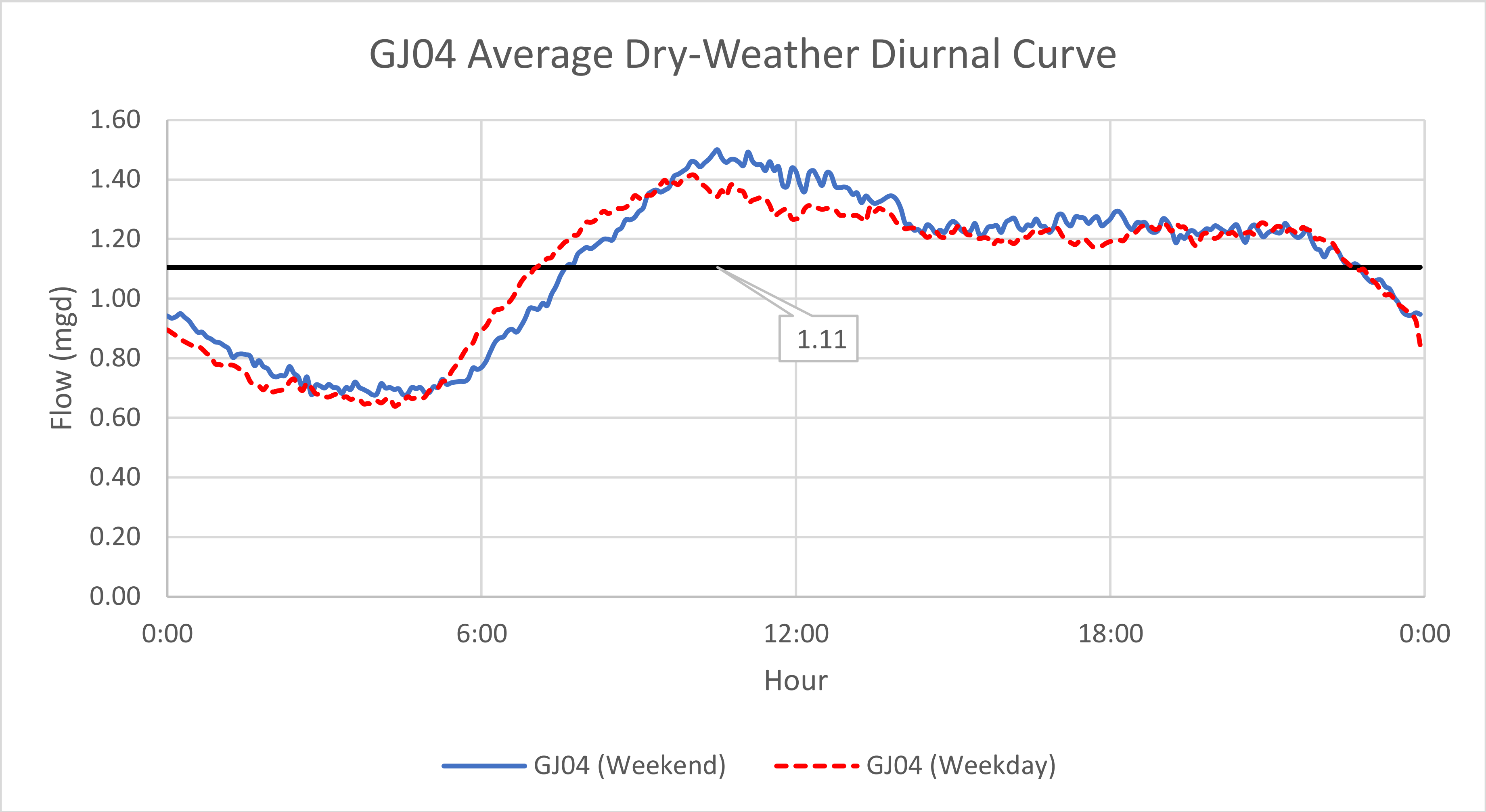
APPENDIX E

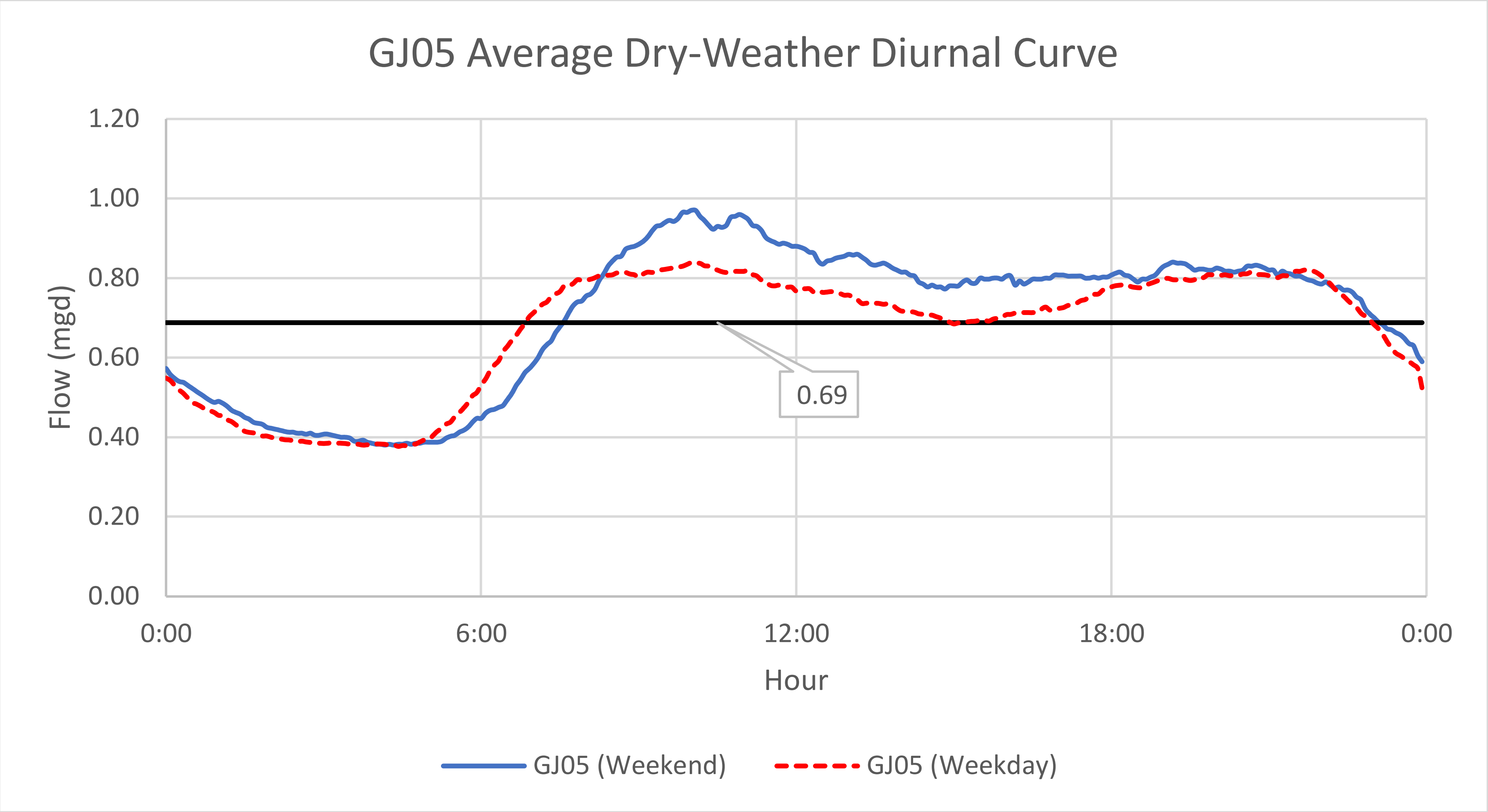
DRY-WEATHER DIURNAL CURVES

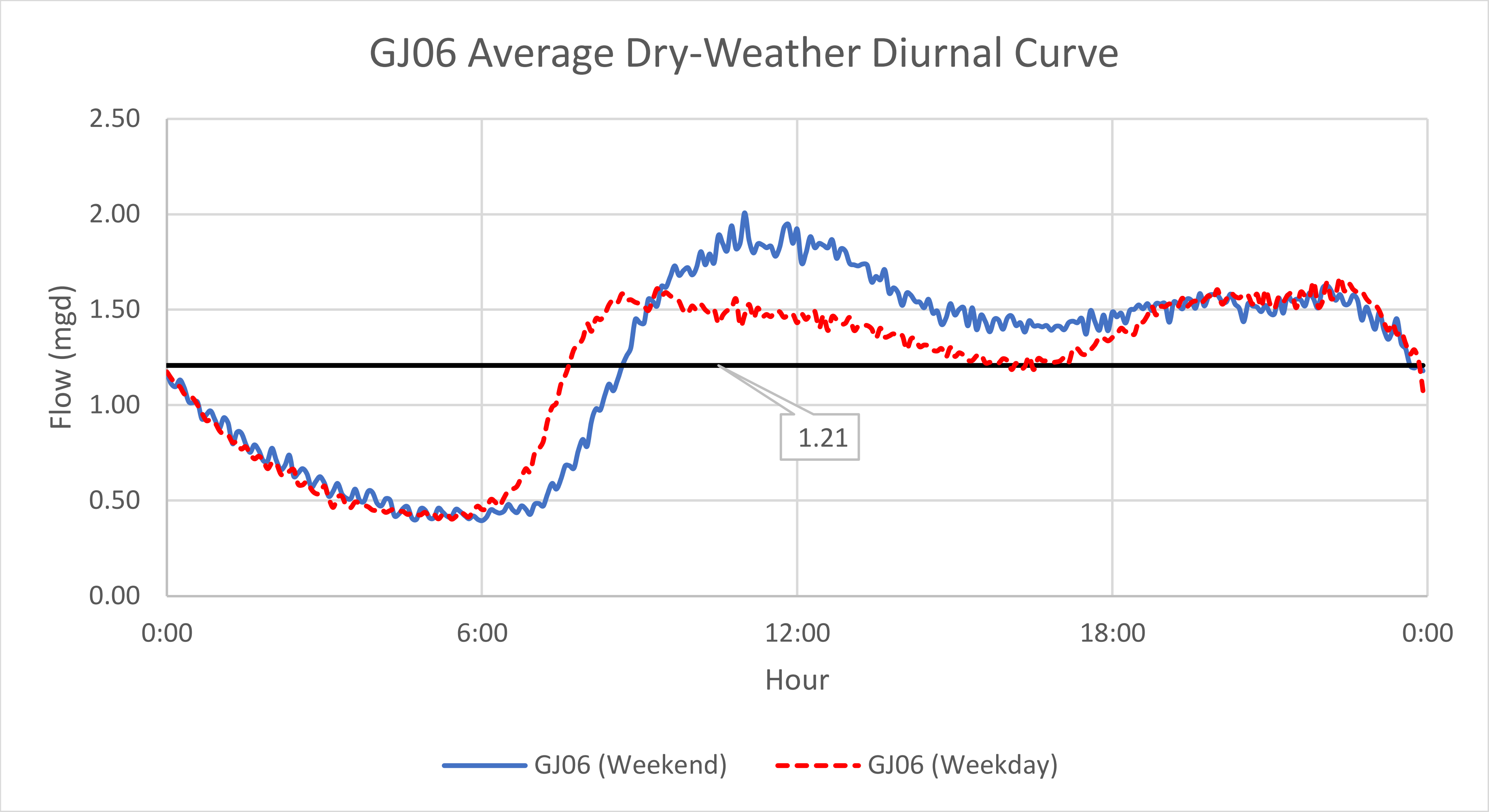

GJ01 Average Dry-Weather Diurnal Curve
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
Flow (mgd)
0:00
6:00
12:00
18:00
0:00
Hour
0.22
GJ01 (Weekend)
GJ01 (Weekday)

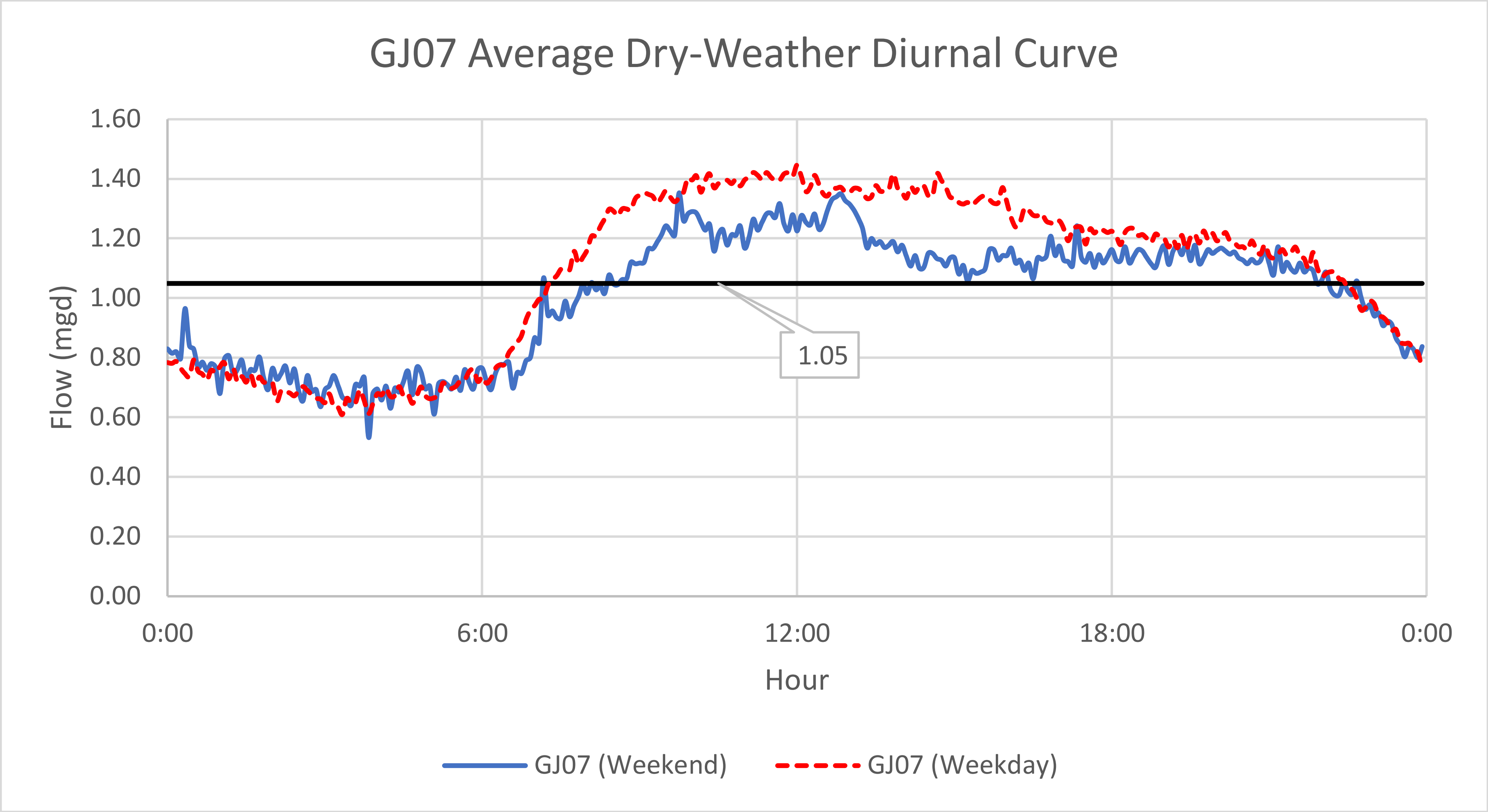

GJ02 Average Dry-Weather Diurnal Curve
Flow (mgd)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0:00
6:00
12:00
18:00
0:00
Hour
3.20
GJ02 (Weekend)
GJ02 (Weekday)

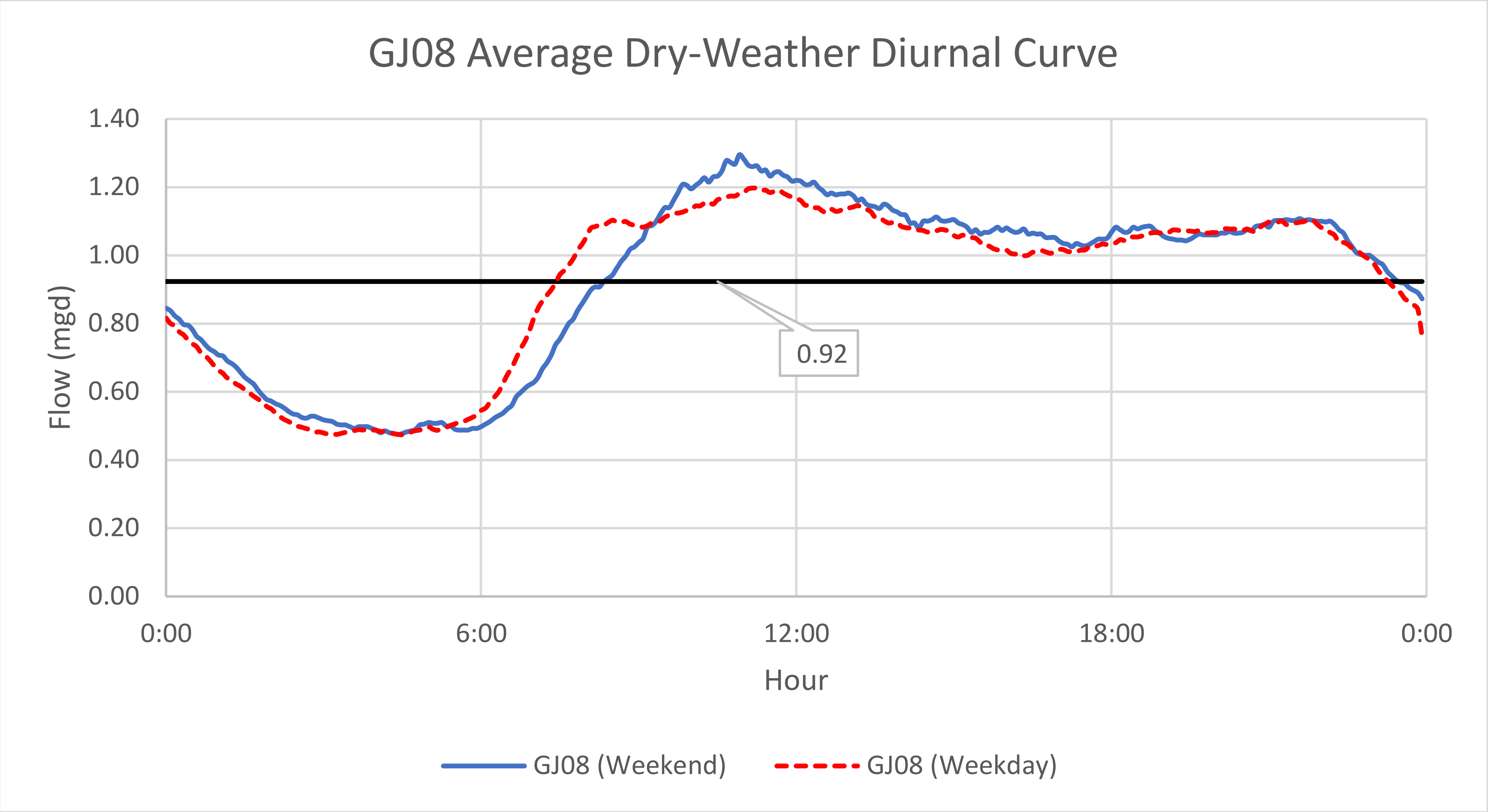

GJ03 Average Dry-Weather Diurnal Curve
Flow (mgd)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0:00
6:00
12:00
18:00
0:00
Hour
0.69
GJ03 (Weekend)
GJ03 (Weekday)

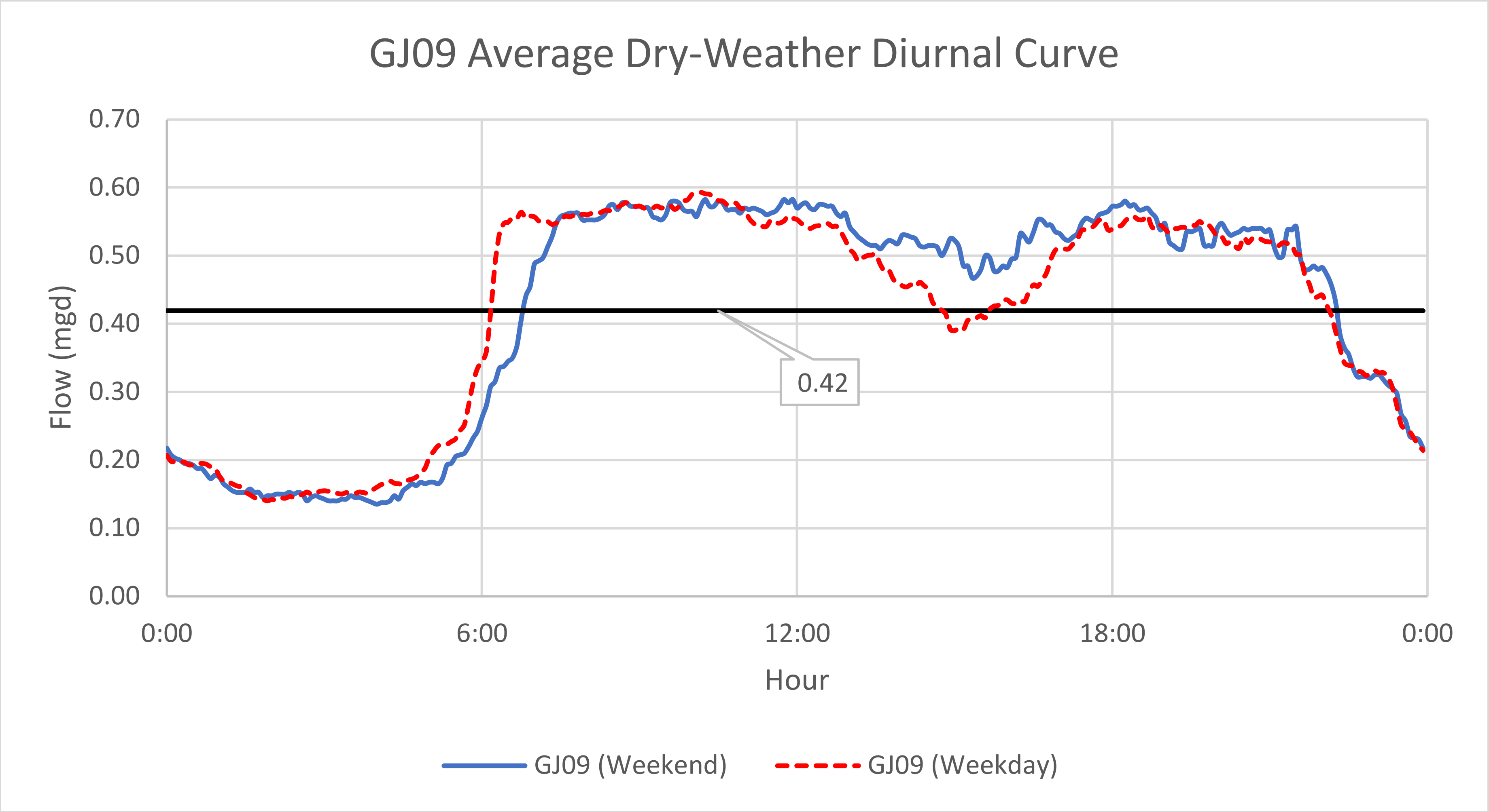

GJ04 Average Dry-Weather Diurnal Curve
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Flow (mgd)
0:00
6:00
12:00
18:00
0:00
Hour
1.11
GJ04 (Weekend)
GJ04 (Weekday)

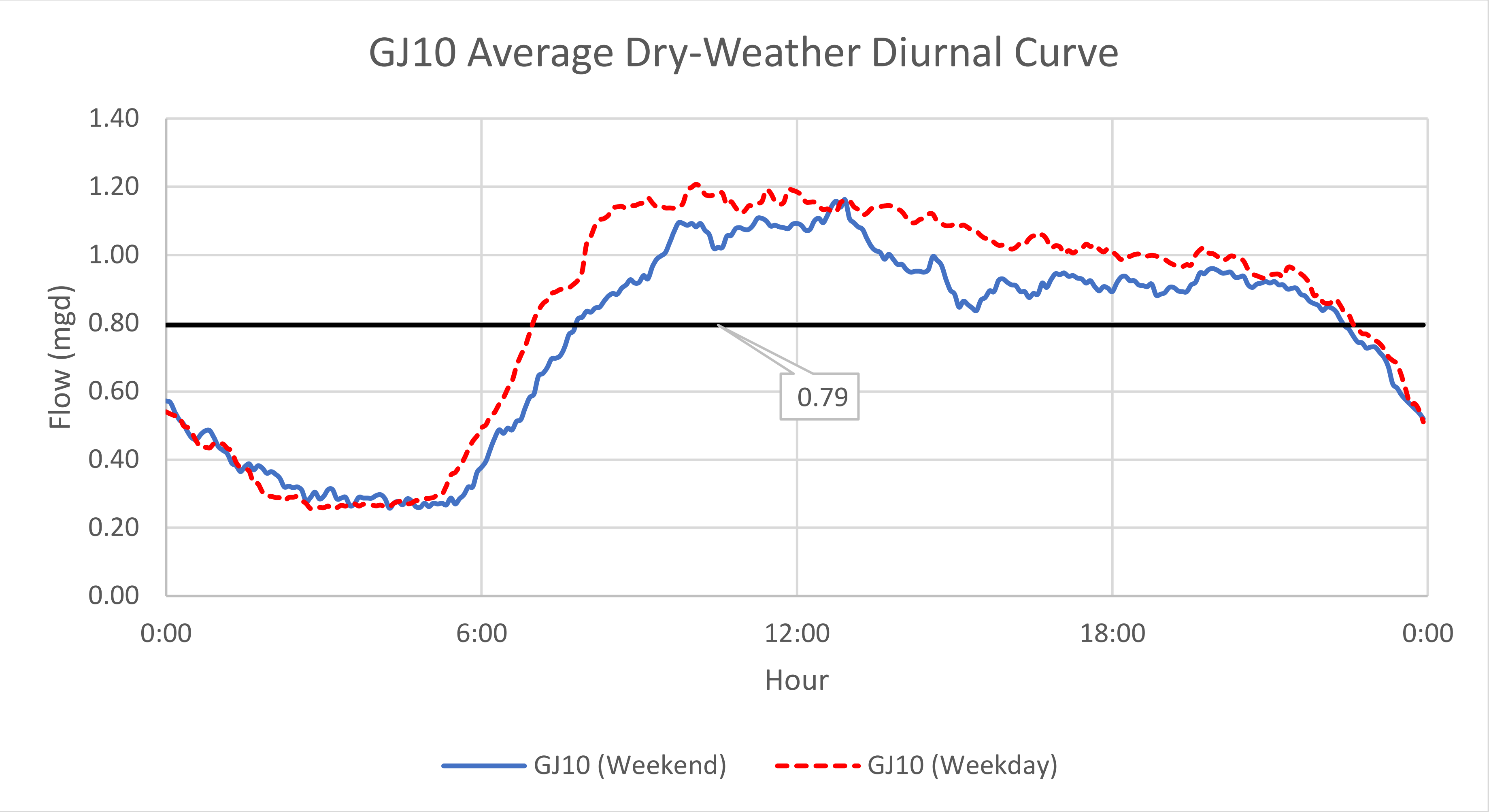

GJ05 Average Dry-Weather Diurnal Curve
Flow (mgd)
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0:00
6:00
12:00
18:00
0:00
Hour
0.69
GJ05 (Weekend)
GJ05 (Weekday)


GJ06 Average Dry-Weather Diurnal Curve
2.50
2.00
1.50
1.00
0.50
0.00
Flow (mgd)
0:00
6:00
12:00
18:00
0:00
Hour
1.21
GJ06 (Weekend)
GJ06 (Weekday)


GJ07 Average Dry-Weather Diurnal Curve
Flow (mgd)
1.60
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0:00
6:00
12:00
18:00
0:00
Hour
1.05
GJ07 (Weekend)
GJ07 (Weekday)


GJ08 Average Dry-Weather Diurnal Curve
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Flow (mgd)
0:00
6:00
12:00
18:00
0:00
Hour
0.92
GJ08 (Weekend)
GJ08 (Weekday)


GJ09 Average Dry-Weather Diurnal Curve
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Flow (mgd)
0:00
6:00
12:00
18:00
0:00
Hour
0.42
GJ09 (Weekend)
GJ09 (Weekday)


GJ10 Average Dry-Weather Diurnal Curve
Flow (mgd)
1.40
1.20
1.00
0.80
0.60
0.40
0.20
0.00
0:00
6:00
12:00
18:00
0:00
Hour
0.79
GJ10 (Weekend)
GJ10 (Weekday)

Appendix B

LIFT STATION INPUT DATA

InfoWorks Lift Station Data

Inputs		El Poso LS		Connected Lakes LS	
Parameter	Unit	InfoWorks Model Input	Comment	InfoWorks Model Input	Comment
Wet Well Invert	ft	4538.00	17.5’ deep	4515.45	
Wet Well Area	ft2	12.57	4’ diameter, estimated	28.27	6' diameter wet well
Top of Wet Well	ft	4555.50		4536.95	
Grd Elevation	ft	4554.98	City GIS	4544.90	Top of LS
Pump 1 On	ft	4541.00		4518.06	
Pump 1 Off	ft	4540.00		4516.95	
Pump 2 On	ft	4541.50		4518.56	
Pump 2 Off	ft	4540.00		4516.95	
Number of Pumps	EA	2		2	
Pump Capacity	mgd	0.21	Fixed Discharge Pump	Pump Curves	Rotodynamic Pump
Pump TDH	ft	11		Pump Curves	
Force Main Size	in	4		6	

Inputs		Ridges 1		Coors	
Parameter	Unit	InfoWorks Model Input	Comment	InfoWorks Model Input	Comment
Wet Well Invert	ft	4618.31	Measured Depth	4526.82	
Wet Well Area	ft2	150.80	3 x 8' diameter wet wells	68.00	8‘ x 8.5‘
Top of Wet Well	ft	4635.56		4545.82	
Grd Elevation	ft	4638.64	Per Online GIS	4545.89	City GIS
Pump 1 On	ft	4622.31		4529.82	High Level Limit Switch
Pump 1 Off	ft	4620.31		4527.82	Low Level Limit Switch
Pump 2 On	ft	4622.81		4530.02	
Pump 2 Off	ft	4620.31		4527.82	
Number of Pumps	EA	2		2	
Pump Capacity	mgd	0.43	Fixed Discharge Pump	0.456509217	Fixed Discharge Pump
Pump TDH	ft	40		15	
Force Main Size	in	10		6	

InfoWorks Lift Station Data

Inputs		Redlands Village		Grand Valley By Products	
Parameter	Unit	InfoWorks Model Input	Comment	InfoWorks Model Input	Comment
Wet Well Invert	ft	4515.82		4561.50	Estimated from Sewer As-Builts.
Wet Well Area	ft2	28.27	6' diameter wet well	28.00	Assumed
Top of Wet Well	ft	4530.39		4570.00	Assumed
Grd Elevation	ft	4530.39		4573.00	Estimated from As-Builts.
Pump 1 On	ft	4520.32		4565.00	Estimated from As-Builts.
Pump 1 Off	ft	4517.82		4563.00	Estimated from As-Builts.
Pump 2 On	ft	4520.82		4565.50	Estimated from As-Builts.
Pump 2 Off	ft	4517.82		4563.00	Estimated from As-Builts.
Number of Pumps	EA	4		2	Estimated from As-Builts.
Pump Capacity	mgd	0.56	Fixed Discharge Pump	0.56	Fixed Discharge Pump
Pump TDH	ft	150		43	
Force Main Size	in	8		6	

Inputs		Rosevale		Tiara Rado	
Parameter	Unit	InfoWorks Model Input	Comment	InfoWorks Model Input	Comment
Wet Well Invert	ft	4536.00		4487.28	H_2O Sewer
Wet Well Area	ft2	28.27	6' diameter wet well	50.27	8' diameter wet well, H_2O Sewer
Top of Wet Well	ft	4551.00		4511.28	H_2O Sewer
Grd Elevation	ft	4560.00	City GIS		
Pump 1 On	ft	4541.00		4492.28	
Pump 1 Off	ft	4538.00		4489.28	
Pump 2 On	ft	4541.50		4492.78	
Pump 2 Off	ft	4538.00		4489.28	
Number of Pumps	EA	2		2	
Pump Capacity	mgd	0.68	Fixed Discharge Pump	3.27	Fixed Discharge Pump
Pump TDH	ft	35		80	
Force Main Size	in	6		12	

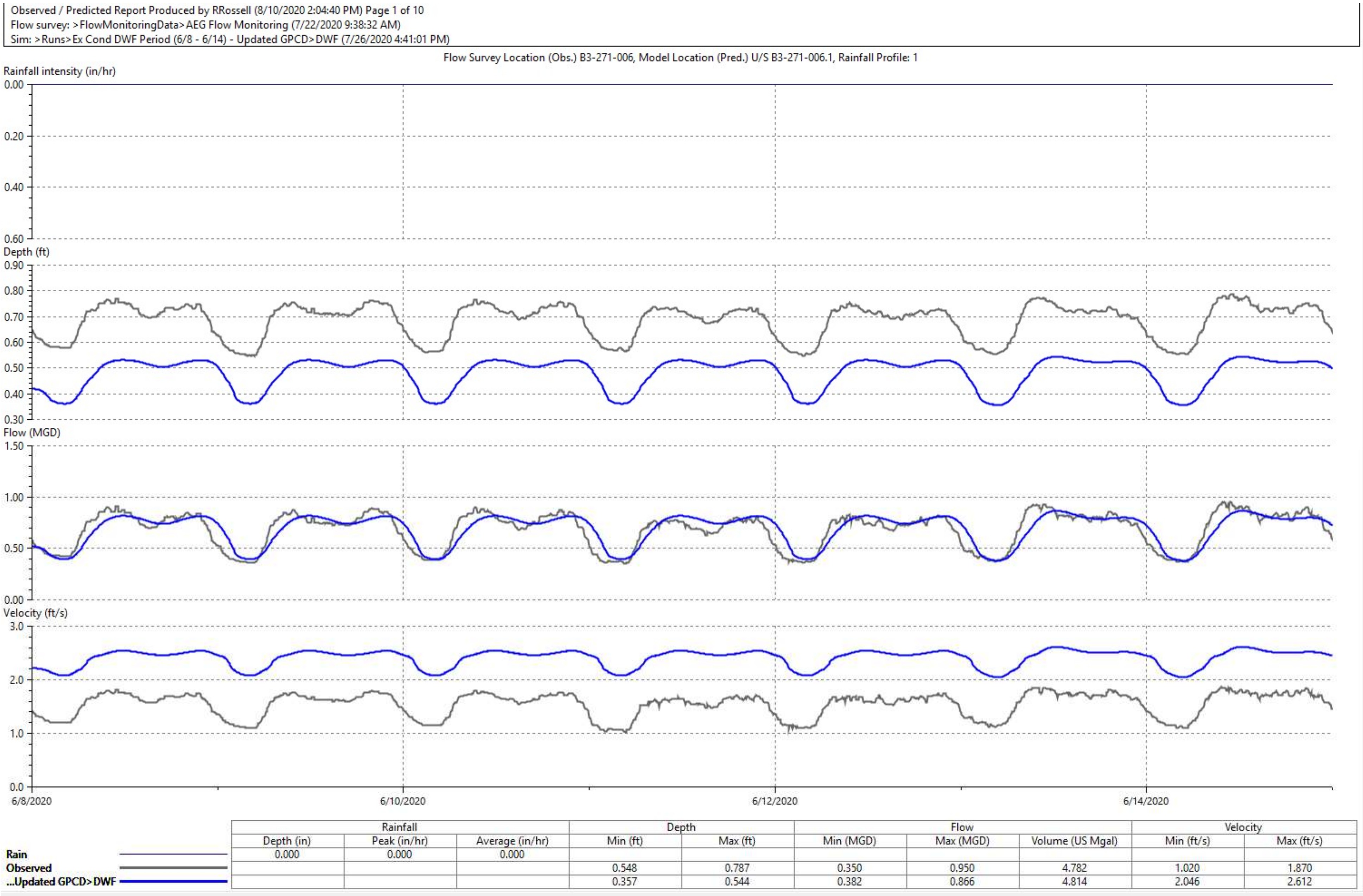
InfoWorks Lift Station Data

Inputs		Railhead	
Parameter	Unit	InfoWorks Model Input	Comment
Wet Well Invert	ft	4502.20	
Wet Well Area	ft2	49.00	7'x7' RCB
Top of Wet Well	ft	4523.90	
Grd Elevation	ft	4529.64	City GIS
Pump 1 On	ft	4507.20	
Pump 1 Off	ft	4504.20	
Pump 2 On	ft	4507.70	
Pump 2 Off	ft	4504.20	
Number of Pumps	EA	2	
Pump Capacity	mgd	Pump Curves	Rotodynamic Pump
Pump TDH	ft	Pump Curves	
Force Main Size	in	6	

Appendix C

DRY WEATHER CALIBRATION SUMMARY

Figure C1 – AEG GJ05: B3-271-006 (Orchard Mesa - East)



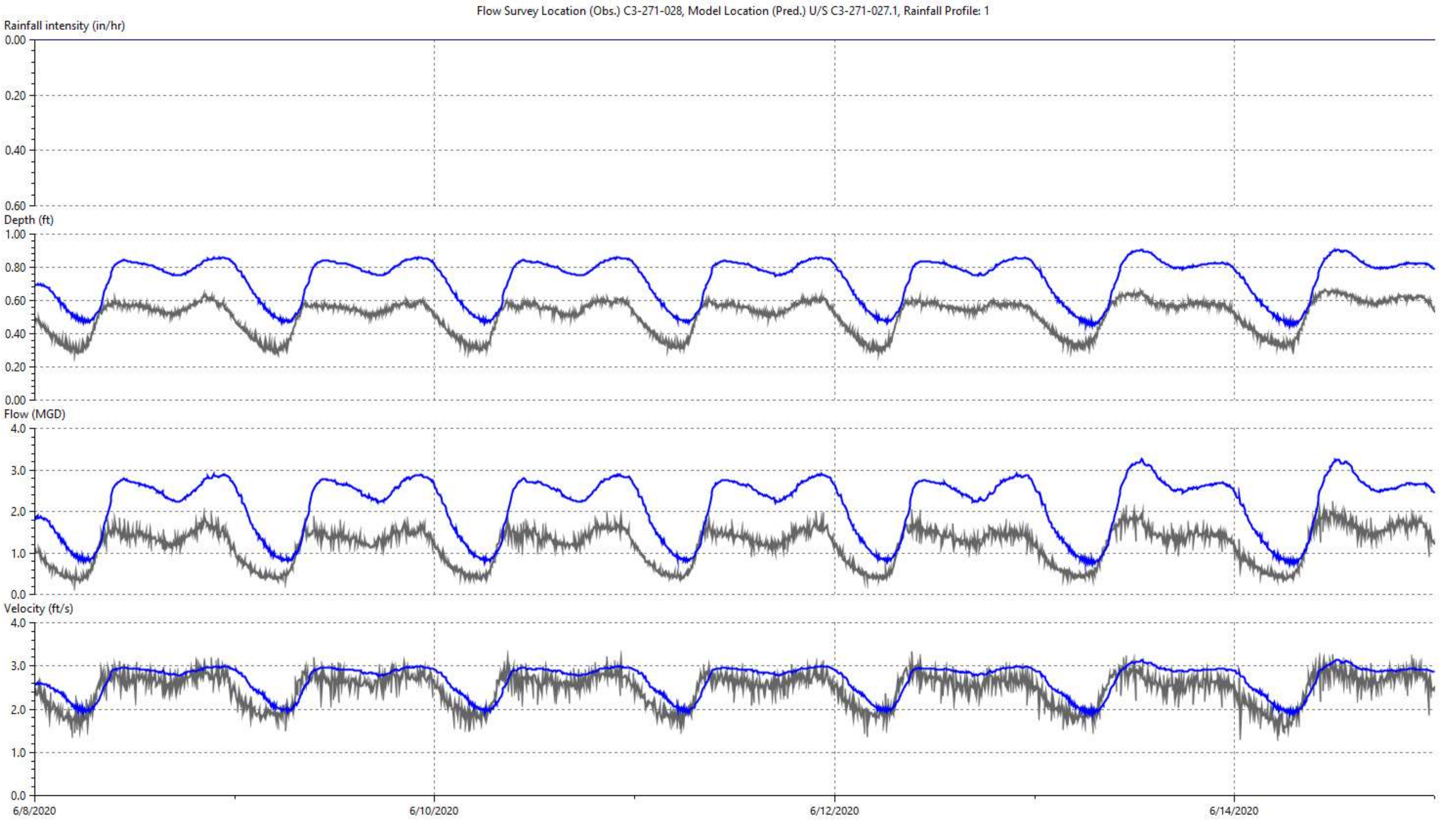
Observed / Predicted Report Produced by RRossell (8/10/2020 2:04:40 PM) Page 1 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

Flow Survey Location (Obs.) B3-271-006, Model Location (Pred.) U/S B3-271-006.1, Rainfall Profile: 1

	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.000	0.000	0.000							
Observed				0.548	0.787	0.350	0.950	4.782	1.020	1.870
...Updated GPCD>DWF				0.357	0.544	0.382	0.866	4.814	2.046	2.612

Figure C2 - AEG GJ06:   C3-271-028 (CGVSD)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:04:40 PM) Page 2 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

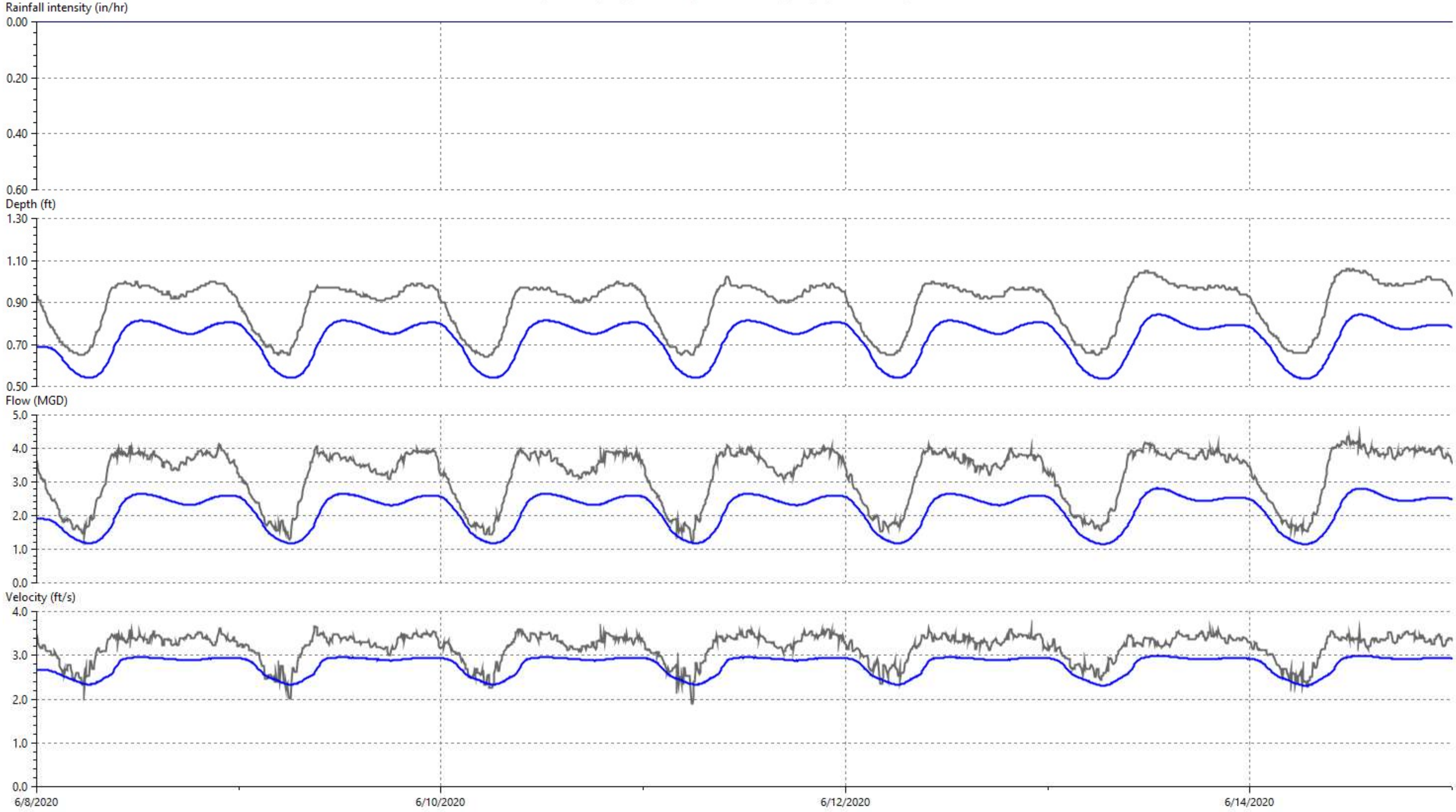


	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.000	0.000	0.000							
Observed				0.278	0.664	0.310	2.020	8.344	1.470	3.130
...Updated GPCD>DWF				0.451	0.907	0.738	3.263	15.050	1.896	3.139

Figure C3 - AEG GJ02: D2-252-002 (Southside, Interceptors)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:04:40 PM) Page 3 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

Flow Survey Location (Obs.) D2-252-002, Model Location (Pred.) U/S D2-252-002.1, Rainfall Profile: 1

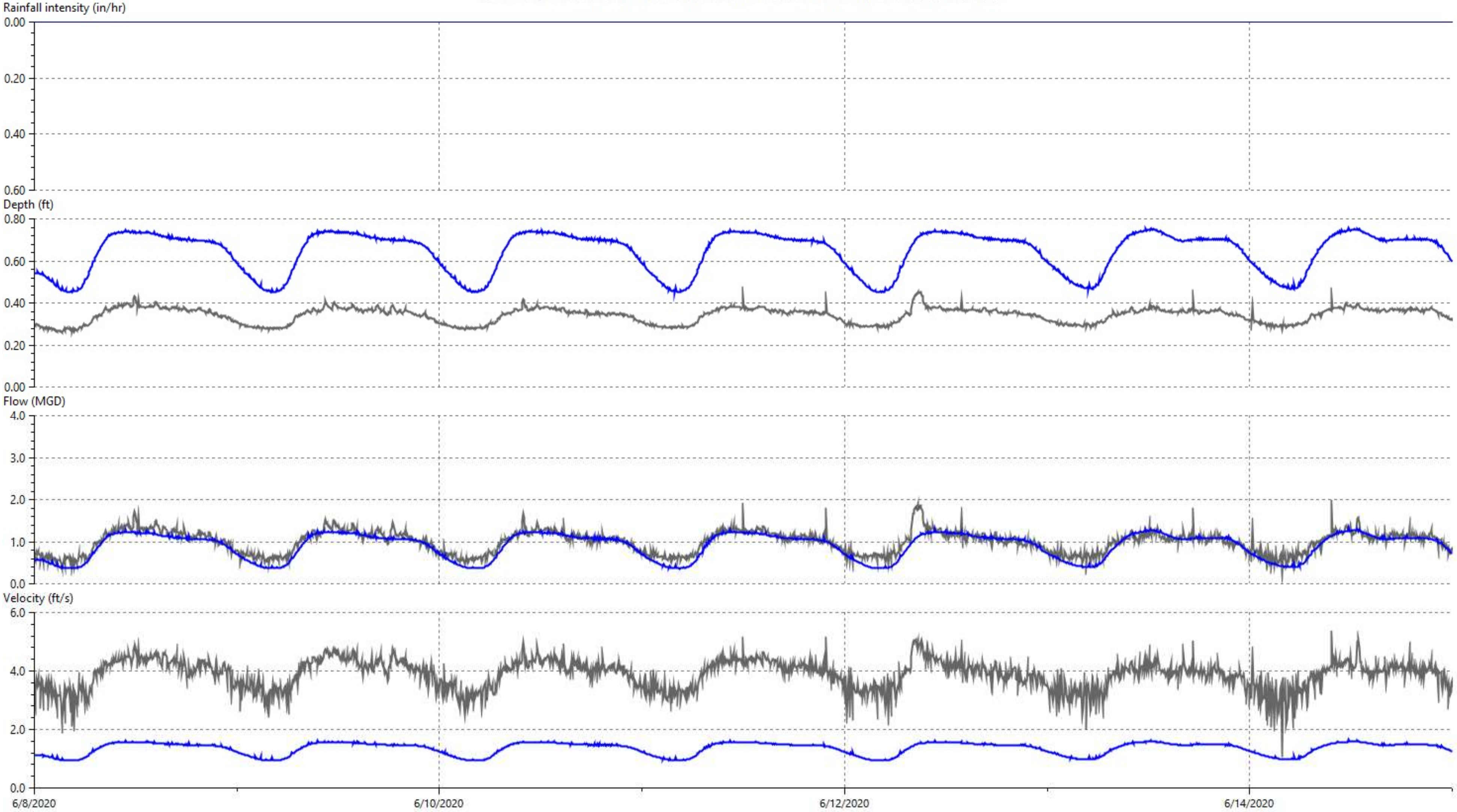


	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.000	0.000	0.000							
Observed				0.640	1.060	1.210	4.370	22.357	1.890	3.650
...Updated GPCD>DWF				0.537	0.842	1.155	2.809	15.040	2.311	2.994

Figure C4 - AEG GJ07:   D2-252-152 (Grand Avenue, Interceptors)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:04:40 PM) Page 4 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

Flow Survey Location (Obs.) D2-252-152, Model Location (Pred.) U/S D2-252-152.1, Rainfall Profile: 1

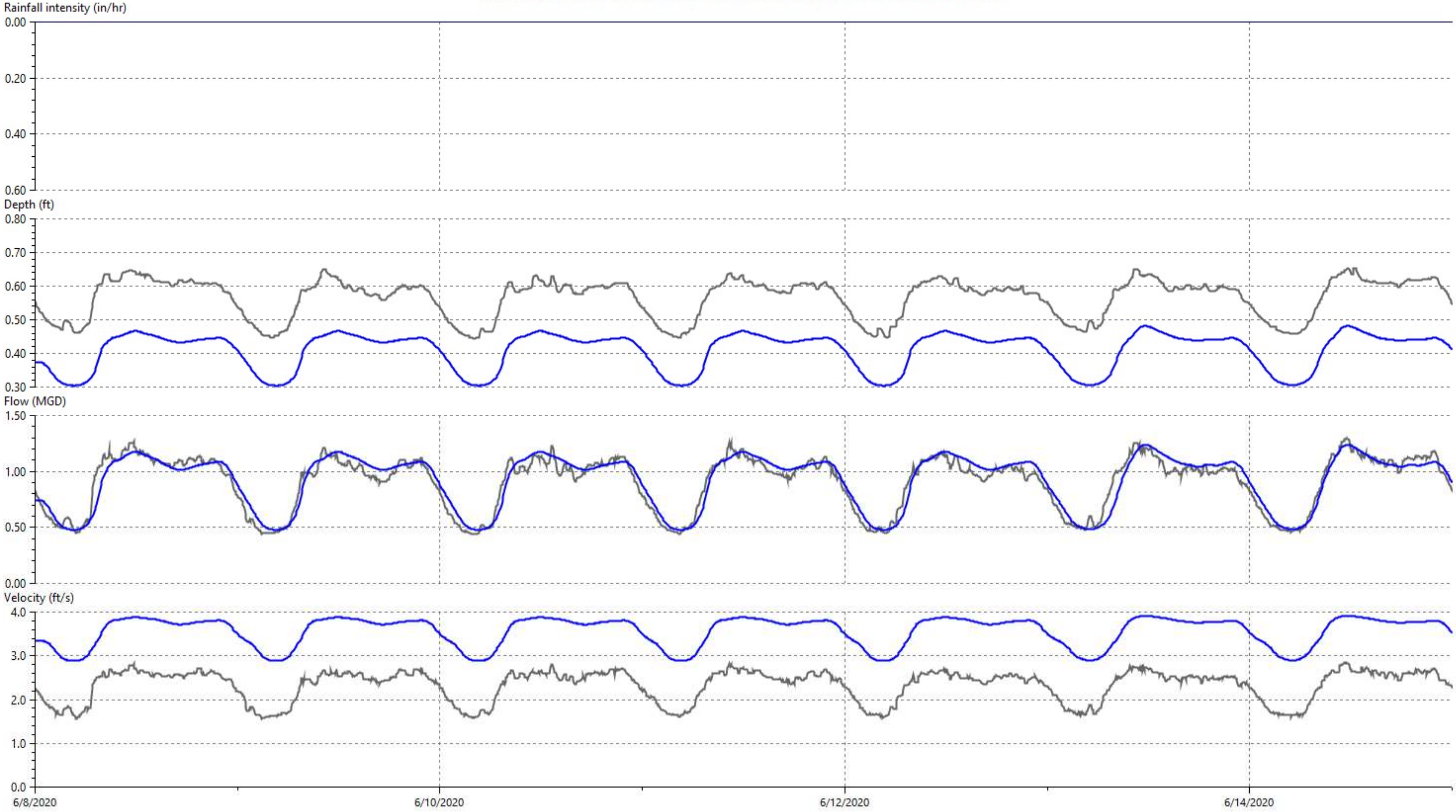


	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.000	0.000	0.000							
Observed				0.259	0.453	0.260	1.880	6.976	1.400	5.080
...Updated GPCD>DWF				0.451	0.757	0.365	1.336	6.367	0.935	1.648

Figure C5 - AEG GJ08: D2-271-043 (Rood, Colorado, Fruivale)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:04:40 PM) Page 5 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

Flow Survey Location (Obs.) D2-271-043, Model Location (Pred.) U/S D2-271-043.1, Rainfall Profile: 1

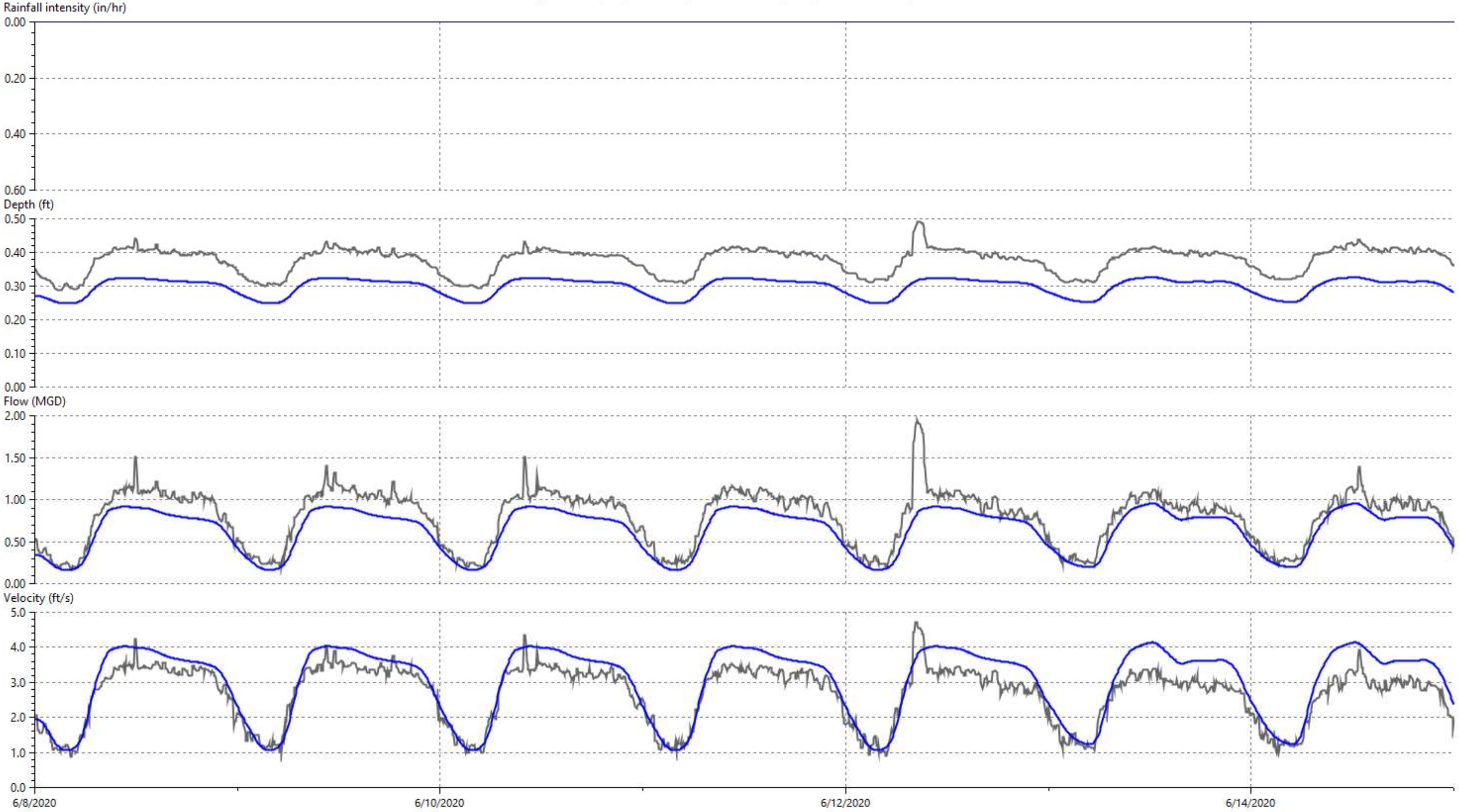


	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.000	0.000	0.000							
Observed				0.445	0.652	0.440	1.300	6.326	1.560	2.850
...Updated GPCD>DWF				0.304	0.481	0.479	1.237	6.426	2.883	3.911

Figure C6 - AEG GJ10:   D3-252-054 (Grand Avenue)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:04:40 PM) Page 6 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

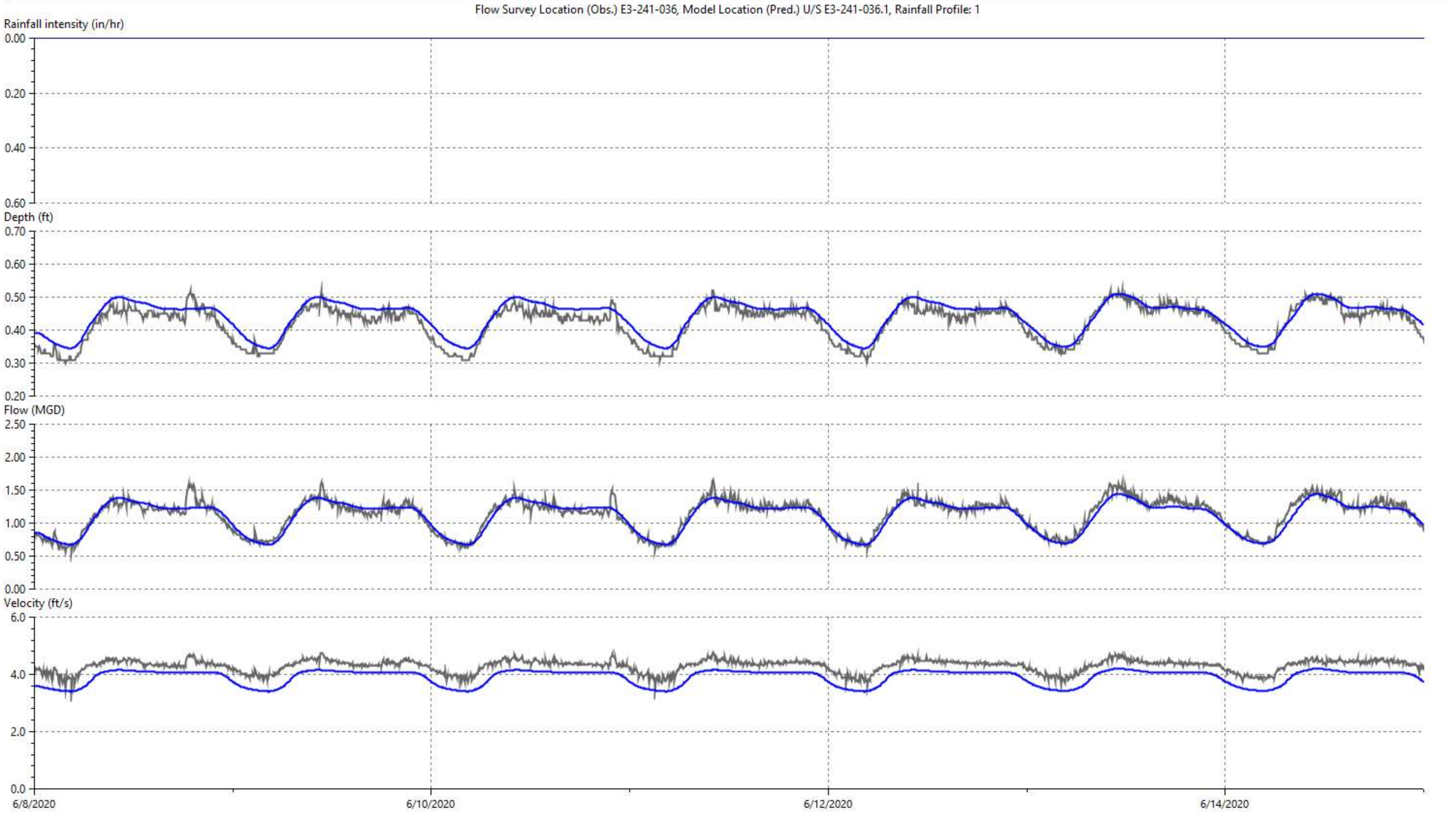
Flow Survey Location (Obs.) D3-252-054, Model Location (Pred.) U/S D3-252-054.1, Rainfall Profile: 1



	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.000	0.000	0.000							
Observed				0.288	0.492	0.170	1.940	5.543	0.870	4.710
...Updated GPCD>DWF				0.249	0.327	0.167	0.955	4.453	1.075	4.143

Figure C7 - AEG GJ04: E3-241-036 (Paradise Hills)

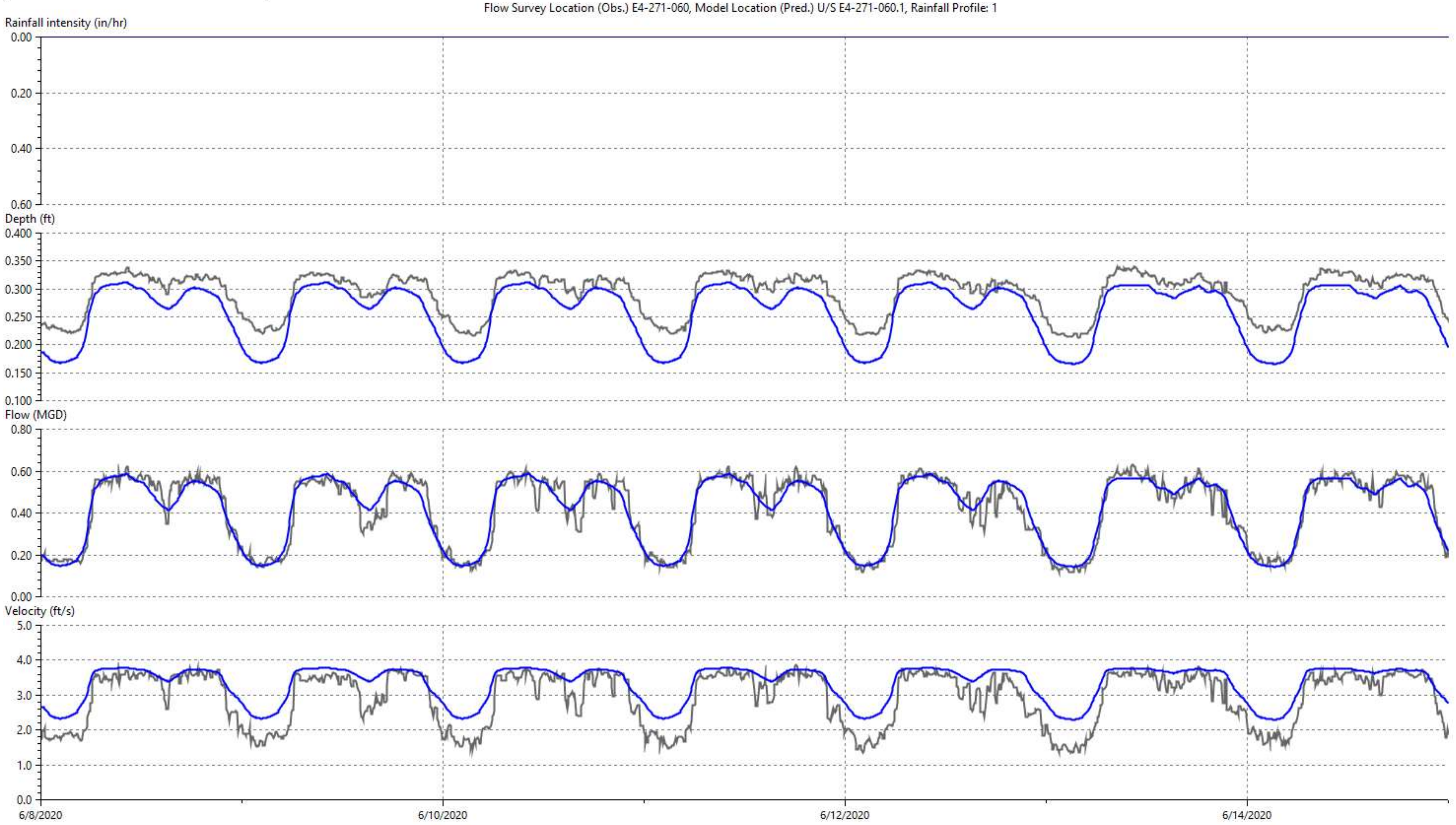
Observed / Predicted Report Produced by RRossell (8/10/2020 2:04:40 PM) Page 7 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)


Flow Survey Location (Obs.) E3-241-036, Model Location (Pred.) U/S E3-241-036.1, Rainfall Profile: 1

	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain —	0.000	0.000	0.000							
Observed —				0.300	0.520	0.560	1.660	7.883	3.400	4.790
...Updated GPCD>DWF —				0.345	0.510	0.676	1.438	7.764	3.406	4.198

Figure C8 - AEG GJ09:   E4-271-060 (15th Street)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:04:40 PM) Page 8 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

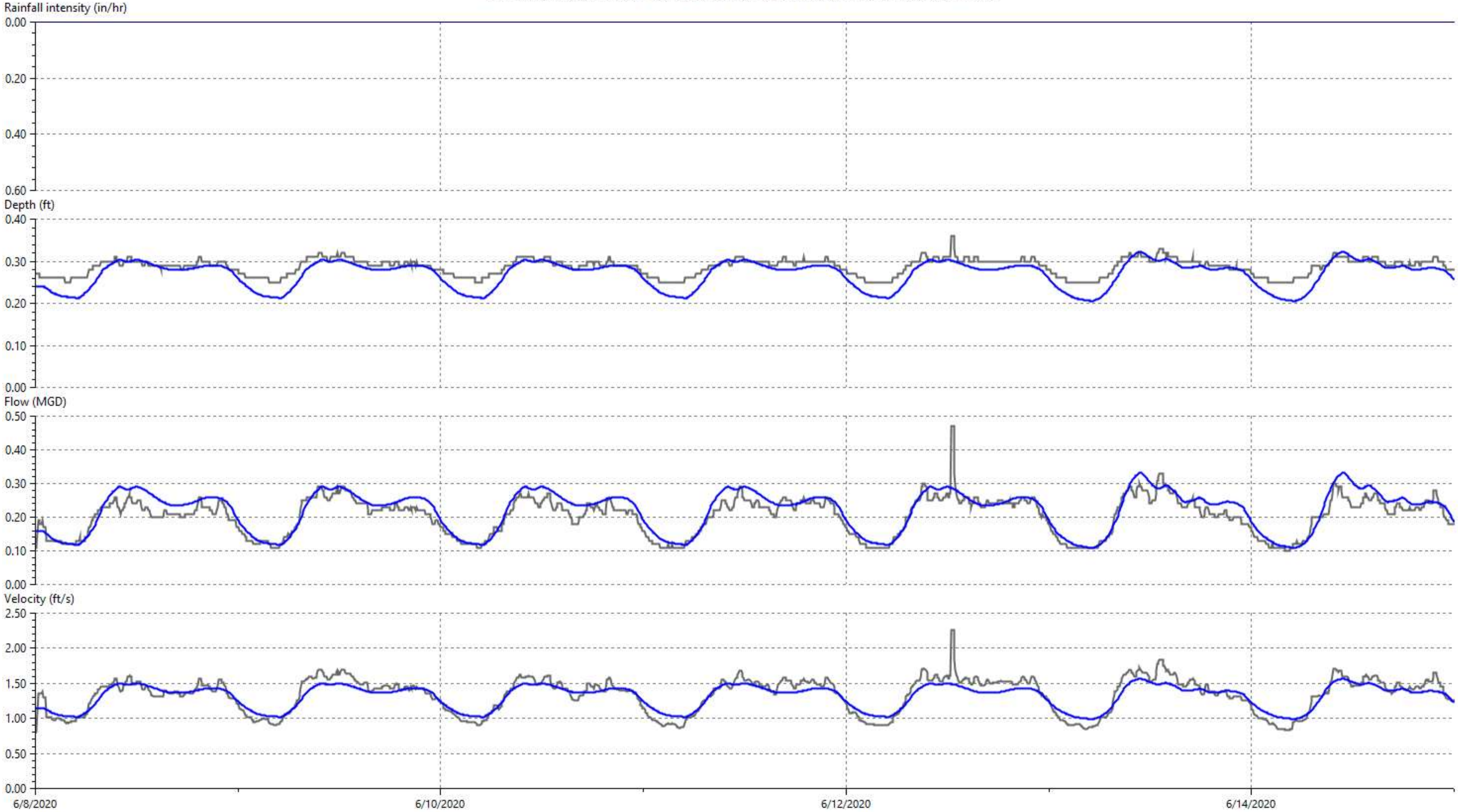

Flow Survey Location (Obs.) E4-271-060, Model Location (Pred.) U/S E4-271-060.1, Rainfall Profile: 1

	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.000	0.000	0.000							
Observed				0.212	0.339	0.120	0.630	2.933	1.350	3.860
...Updated GPCD>DWF				0.166	0.312	0.143	0.587	2.937	2.294	3.786

Figure C9 - AEG GJ01: F1-232-013 (24 Road)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:04:40 PM) Page 9 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

Flow Survey Location (Obs.) F1-232-013, Model Location (Pred.) U/S F1-232-013.1, Rainfall Profile: 1

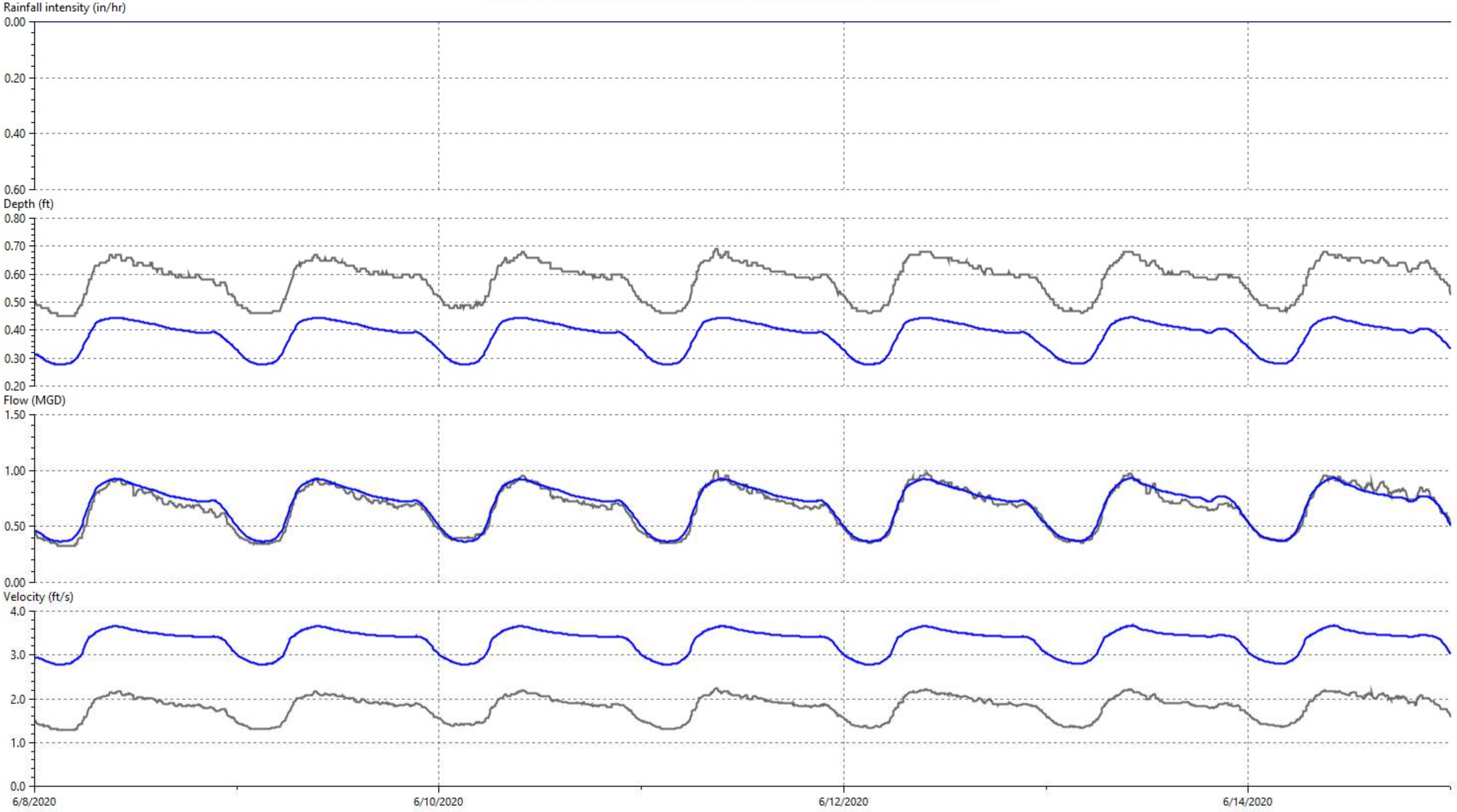


	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain ―	0.000	0.000	0.000							
Observed ━				0.250	0.360	0.100	0.470	1.426	0.820	2.260
...Updated GPCD>DWF ━				0.205	0.323	0.109	0.333	1.540	0.991	1.567

Figure C10 - AEG GJ03:   F1-261-026 (Horizon Drive Upper)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:04:40 PM) Page 10 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

Flow Survey Location (Obs.) F1-261-026, Model Location (Pred.) U/S F1-261-026.1, Rainfall Profile: 1

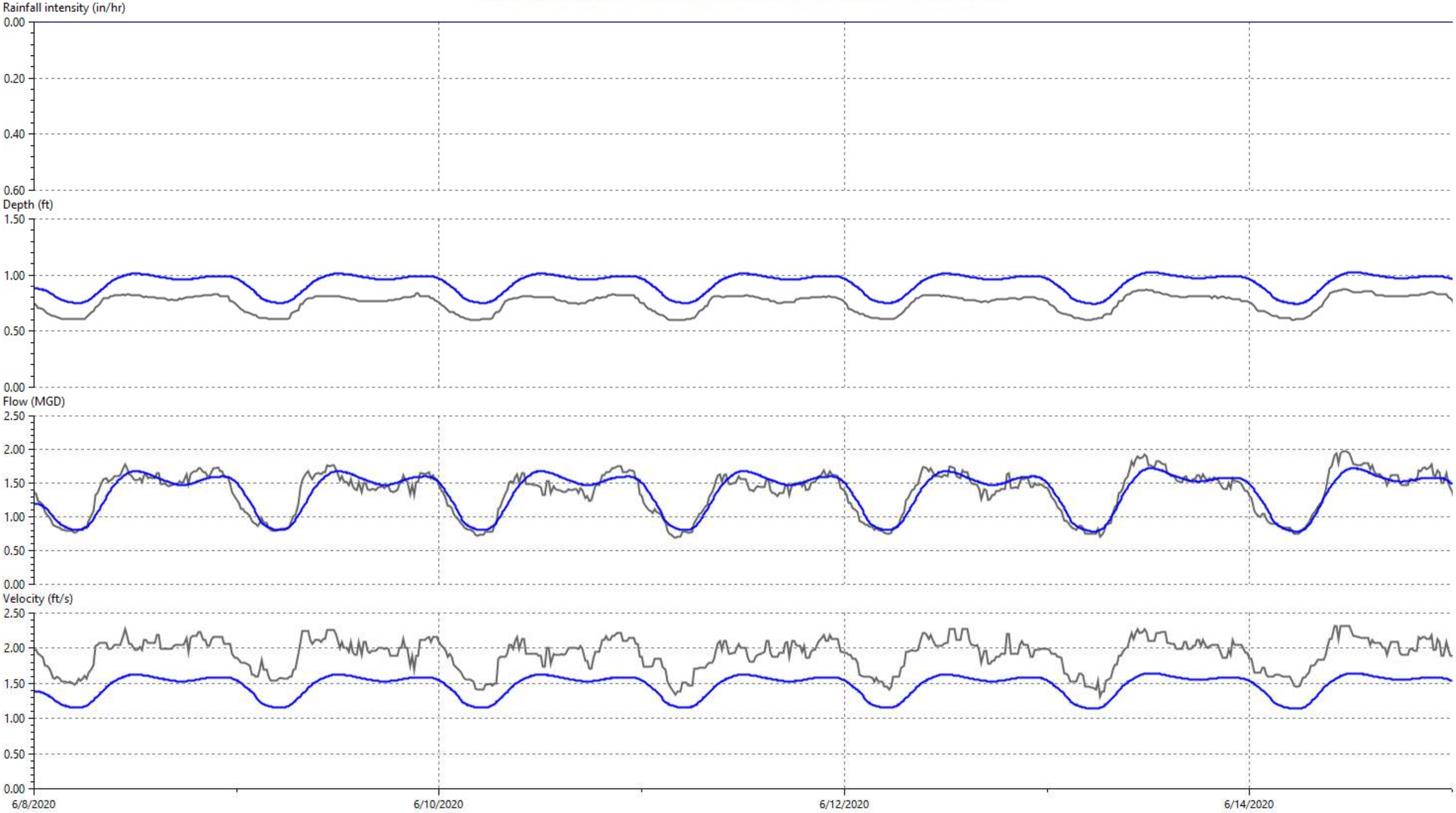


	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.000	0.000	0.000							
Observed				0.450	0.690	0.330	1.000	4.675	1.280	2.240
...Updated GPCD>DWF				0.278	0.446	0.366	0.934	4.832	2.783	3.674

Figure C11 - City Meter : C1-261-097 (Orchard Mesa West)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:26:00 PM) Page 1 of 2
Flow survey: >FlowMonitoringData>CityFlowMonitoring2020 (7/23/2020 4:13:07 PM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

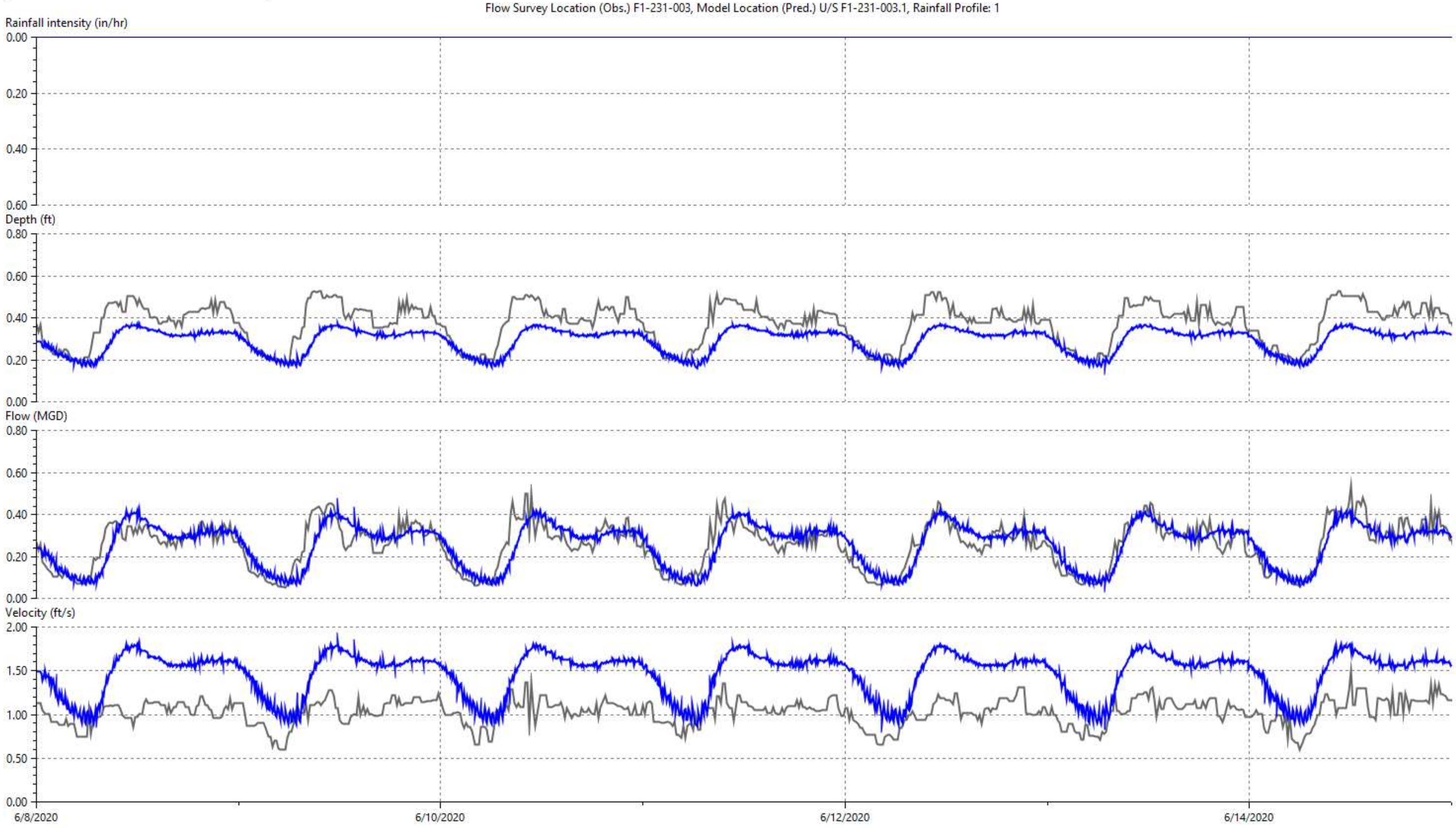
Flow Survey Location (Obs.) C1-261-097, Model Location (Pred.) U/S C1-261-097.1, Rainfall Profile: 1



	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.000	0.000	0.000							
Observed				0.599	0.874	0.688	1.973	9.493	1.312	2.316
...Updated GPCD>DWF				0.745	1.024	0.783	1.720	9.566	1.138	1.645

Figure C12 - City Meter : F1-231-003 (Goat Wash)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:26:00 PM) Page 2 of 2
Flow survey: >FlowMonitoringData>CityFlowMonitoring2020 (7/23/2020 4:13:07 PM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

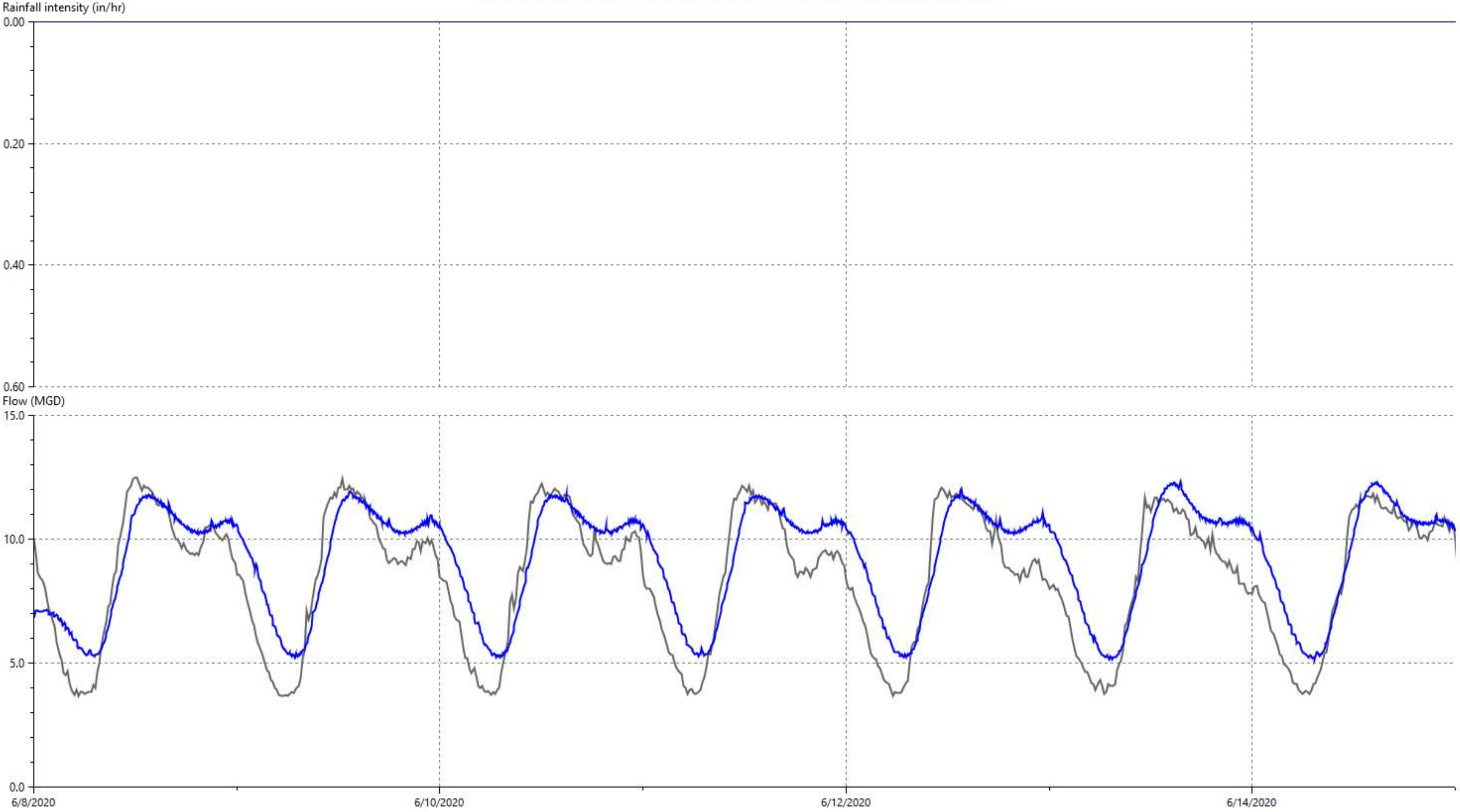

Flow Survey Location (Obs.) F1-231-003, Model Location (Pred.) U/S F1-231-003.1, Rainfall Profile: 1

	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.000	0.000	0.000							
Observed				0.190	0.529	0.054	0.536	1.790	0.595	1.497
...Updated GPCD>DWF				0.162	0.374	0.061	0.432	1.819	0.869	1.826

Figure C13 - Persigo WWTP

Observed / Predicted Report Produced by RRossell (8/10/2020 2:27:08 PM) Page 1 of 1
Flow survey: >FlowMonitoringData>WWTP2020Data (7/23/2020 6:54:25 PM)
Sim: >Runs>Ex Cond DWF Period (6/8 - 6/14) - Updated GPCD>DWF (7/26/2020 4:41:01 PM)

Flow Survey Location (Obs.) G3-211-017, Model Location (Pred.) U/S G3-211-017.1, Rainfall Profile: 1



	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.000	0.000	0.000			
Observed				3.680	12.500	59.293
.../8 - 6/14) - Updated GPCD>DWF				5.160	12.315	64.533

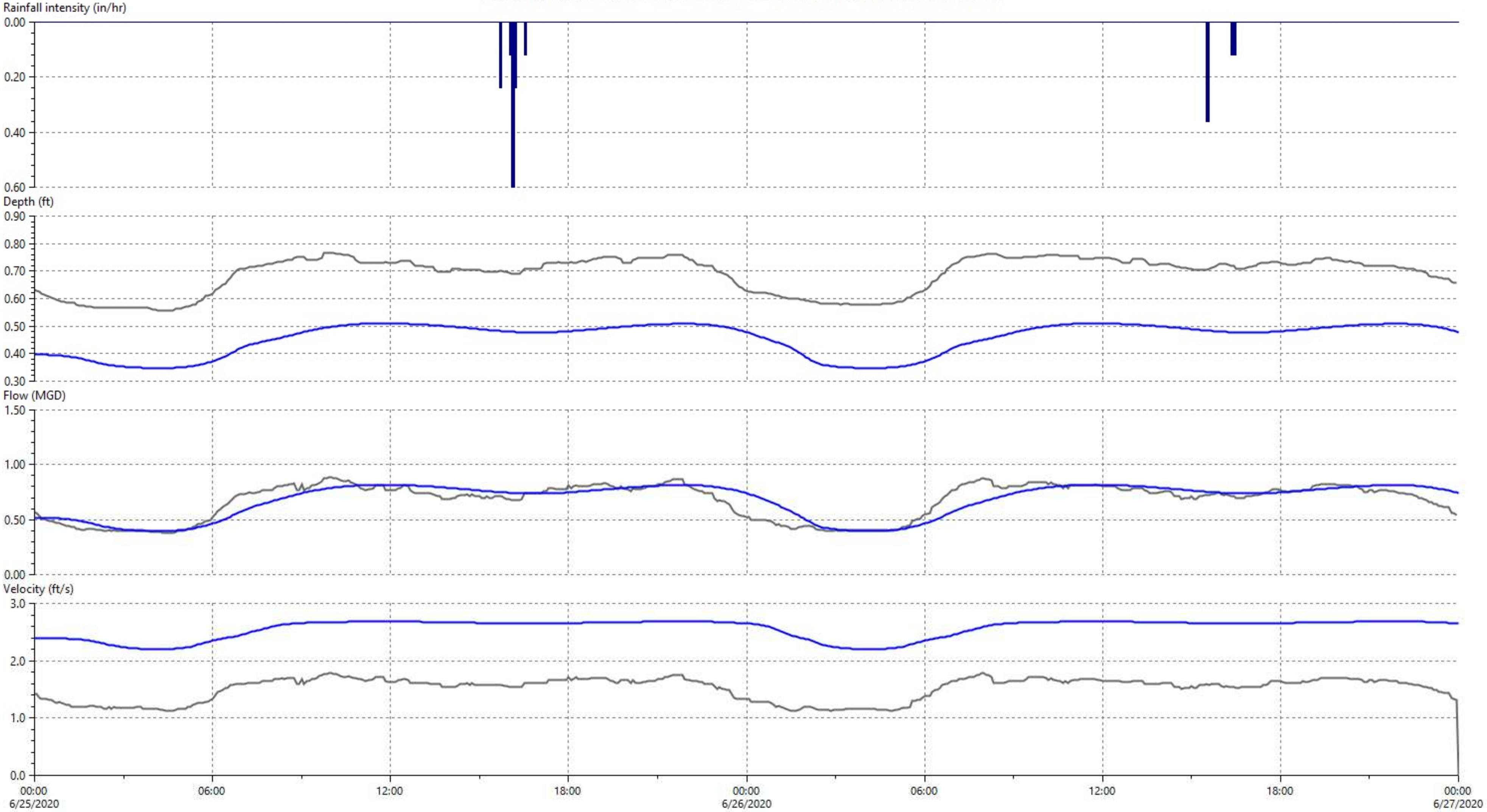
Appendix D

WET WEATHER CALIBRATION SUMMARY

Figure D1 – AEG GJ05:   B3-271-006 (Orchard Mesa - East)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:30:37 PM) Page 1 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)

Flow Survey Location (Obs.) B3-271-006, Model Location (Pred.) D/S B3-271-006.1, Rainfall Profile: 1

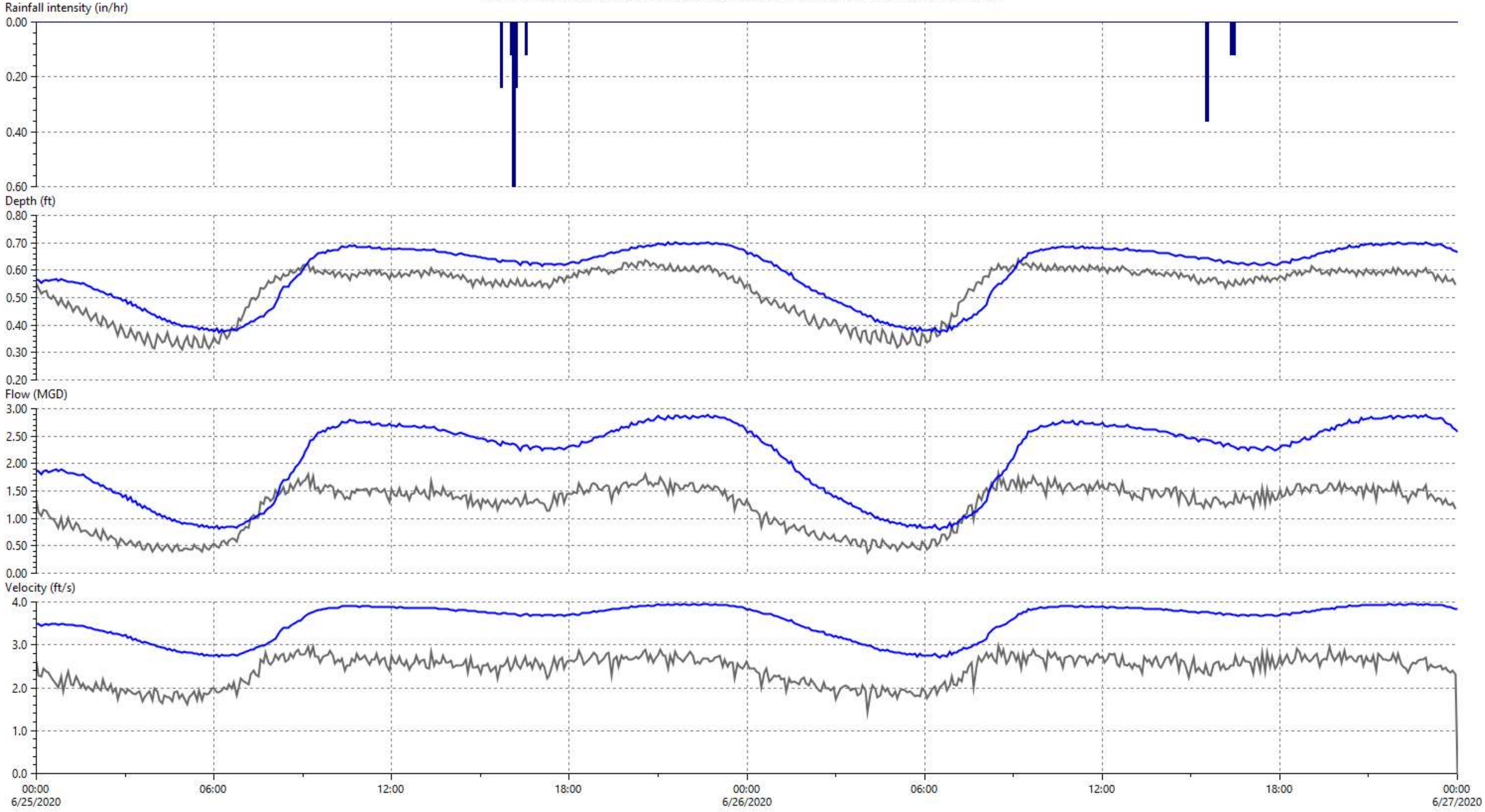


	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.558	0.766	0.380	0.890	1.354	0.000	1.780
...>RG0102 Information				0.347	0.510	0.395	0.817	1.366	2.199	2.690

Figure D2 - AEG GJ06: C3-271-028 (CGVSD)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:30:37 PM) Page 2 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)

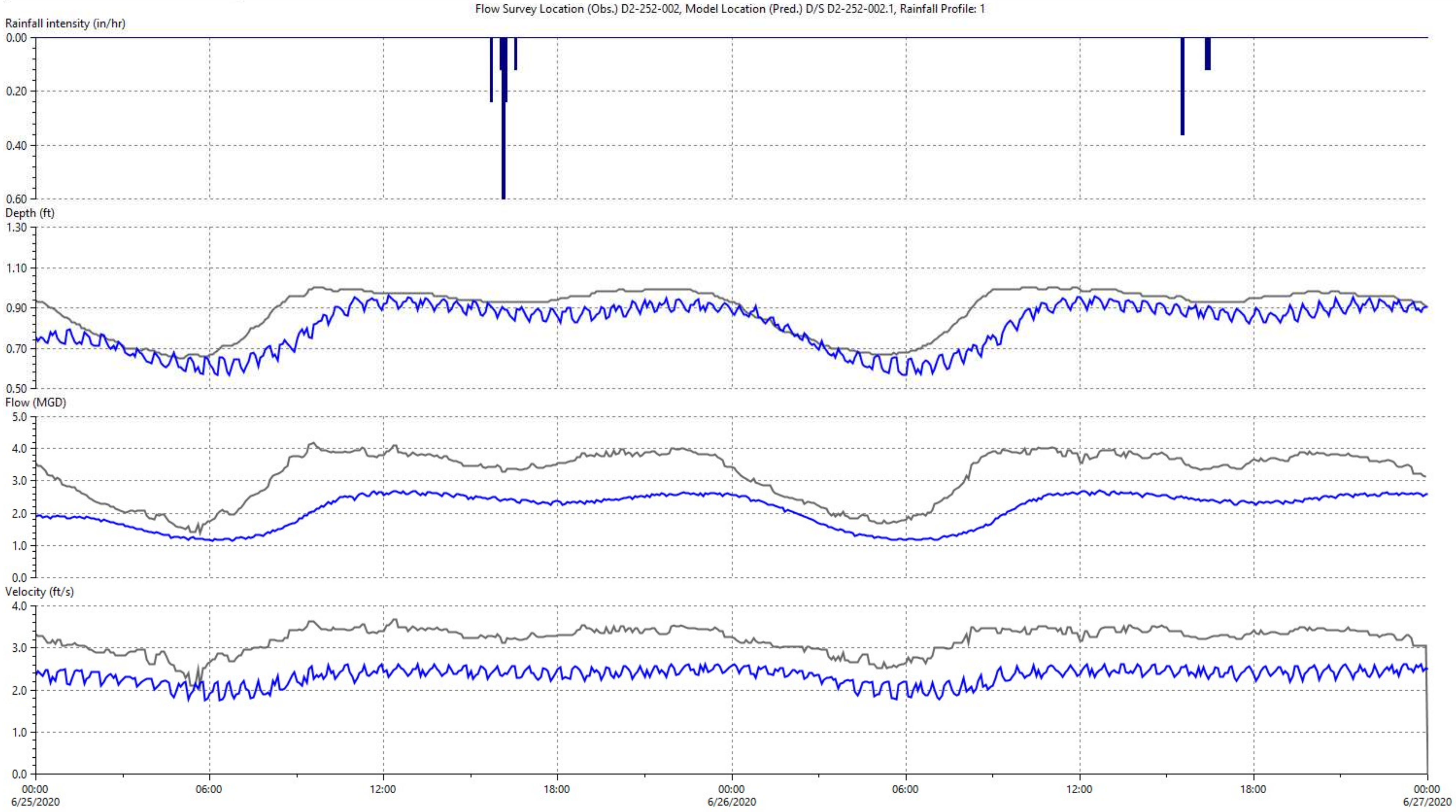
Flow Survey Location (Obs.) C3-271-028, Model Location (Pred.) D/S C3-271-027.1, Rainfall Profile: 1



	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.312	0.639	0.380	1.830	2.451	0.000	2.990
...>RG0102 Information				0.372	0.703	0.798	2.897	4.278	2.709	3.960

Figure D3 - AEG GJ02: D2-252-002 (Southside, Interceptors)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:30:37 PM) Page 3 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)

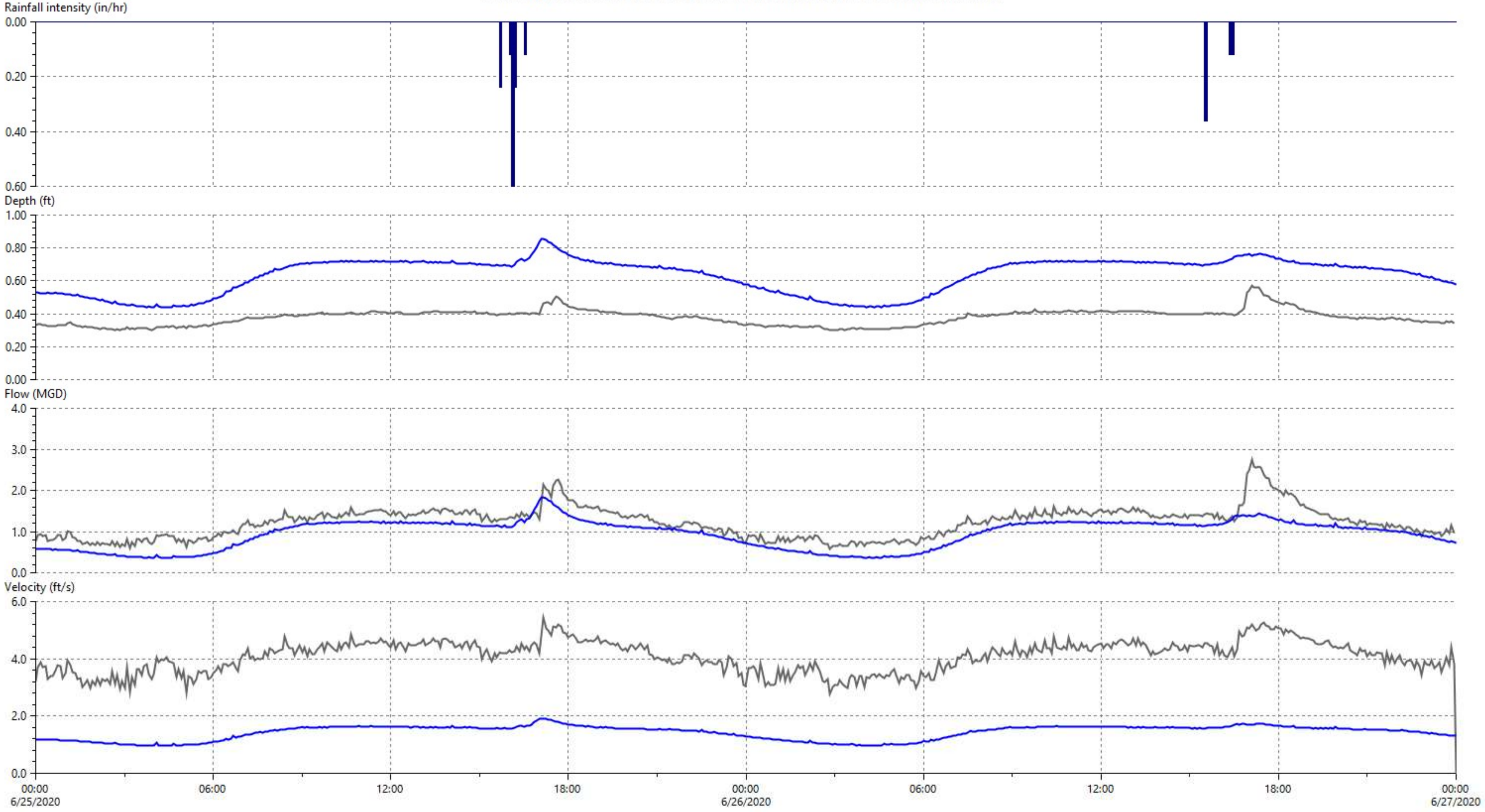


	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.650	1.000	1.380	4.180	6.447	0.000	3.670
...>RG0102 Information				0.566	0.961	1.145	2.696	4.268	1.766	2.621

Figure D4 - AEG GJ07: D2-252-152 (Grand Avenue, Interceptors)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:30:37 PM) Page 4 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)

Flow Survey Location (Obs.) D2-252-152, Model Location (Pred.) D/S D2-252-152.1, Rainfall Profile: 1

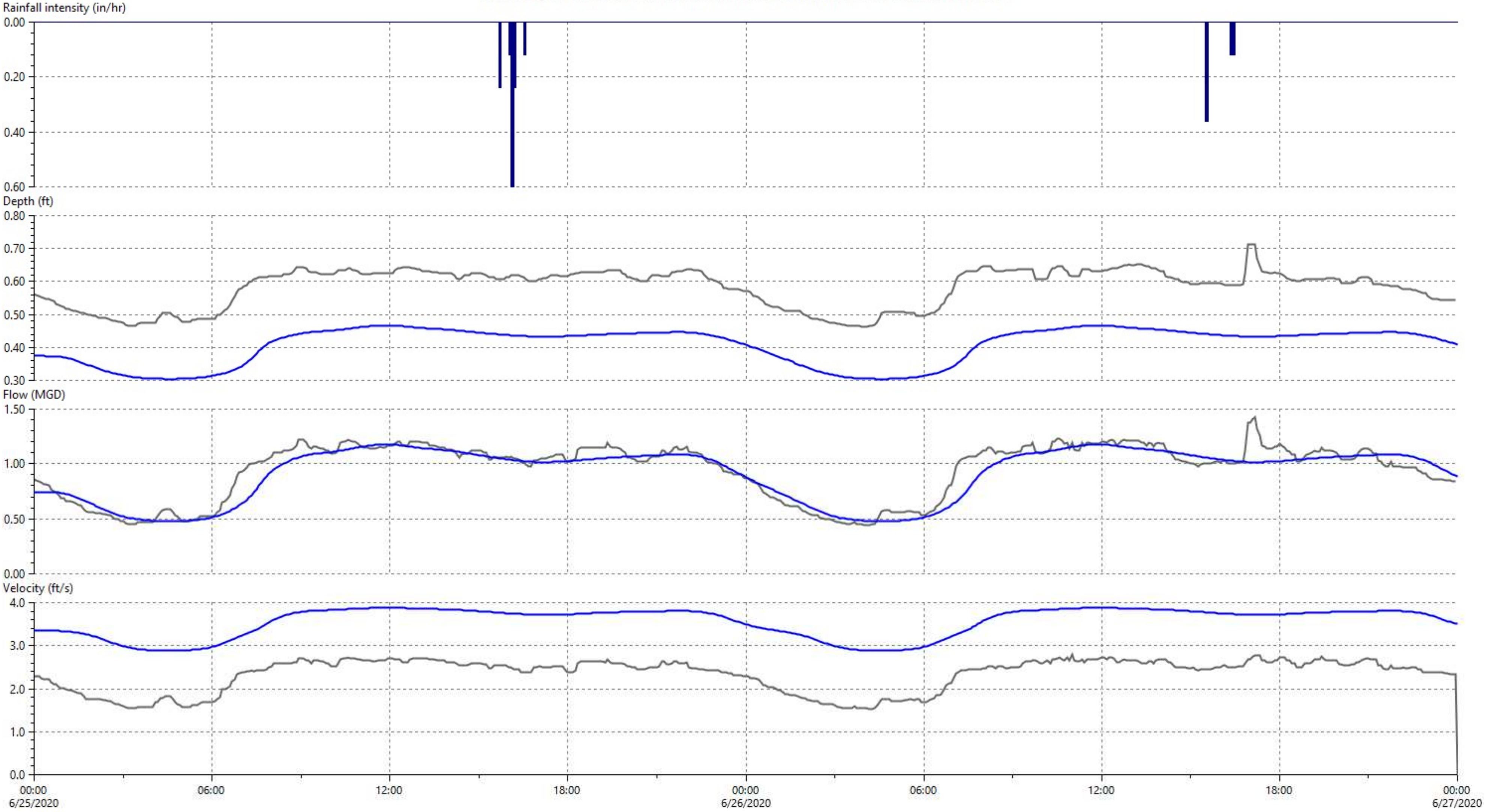


	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.301	0.575	0.570	2.750	2.452	0.000	5.460
...>RG0102 Information				0.439	0.854	0.365	1.841	1.906	0.974	1.925

Figure D5 - AEG GJ08: D2-271-043 (Rood, Colorado, Fruivale)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:30:37 PM) Page 5 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)

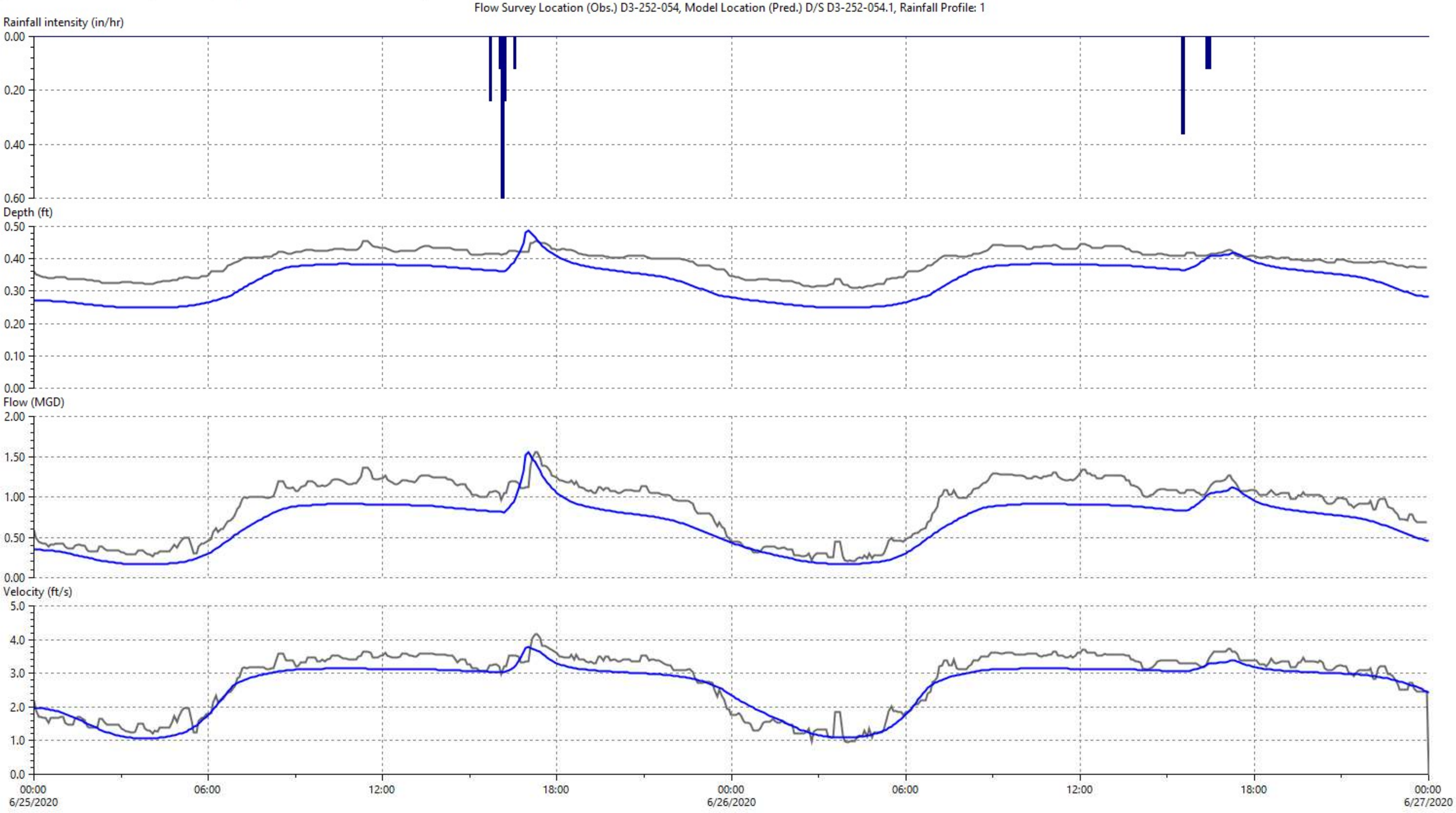
Flow Survey Location (Obs.) D2-271-043, Model Location (Pred.) D/S D2-271-043.1, Rainfall Profile: 1



	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.463	0.713	0.440	1.430	1.888	0.000	2.800
...>RG0102 Information				0.304	0.467	0.479	1.177	1.833	2.883	3.881

Figure D6 - AEG GJ10:   D3-252-054 (Grand Avenue)

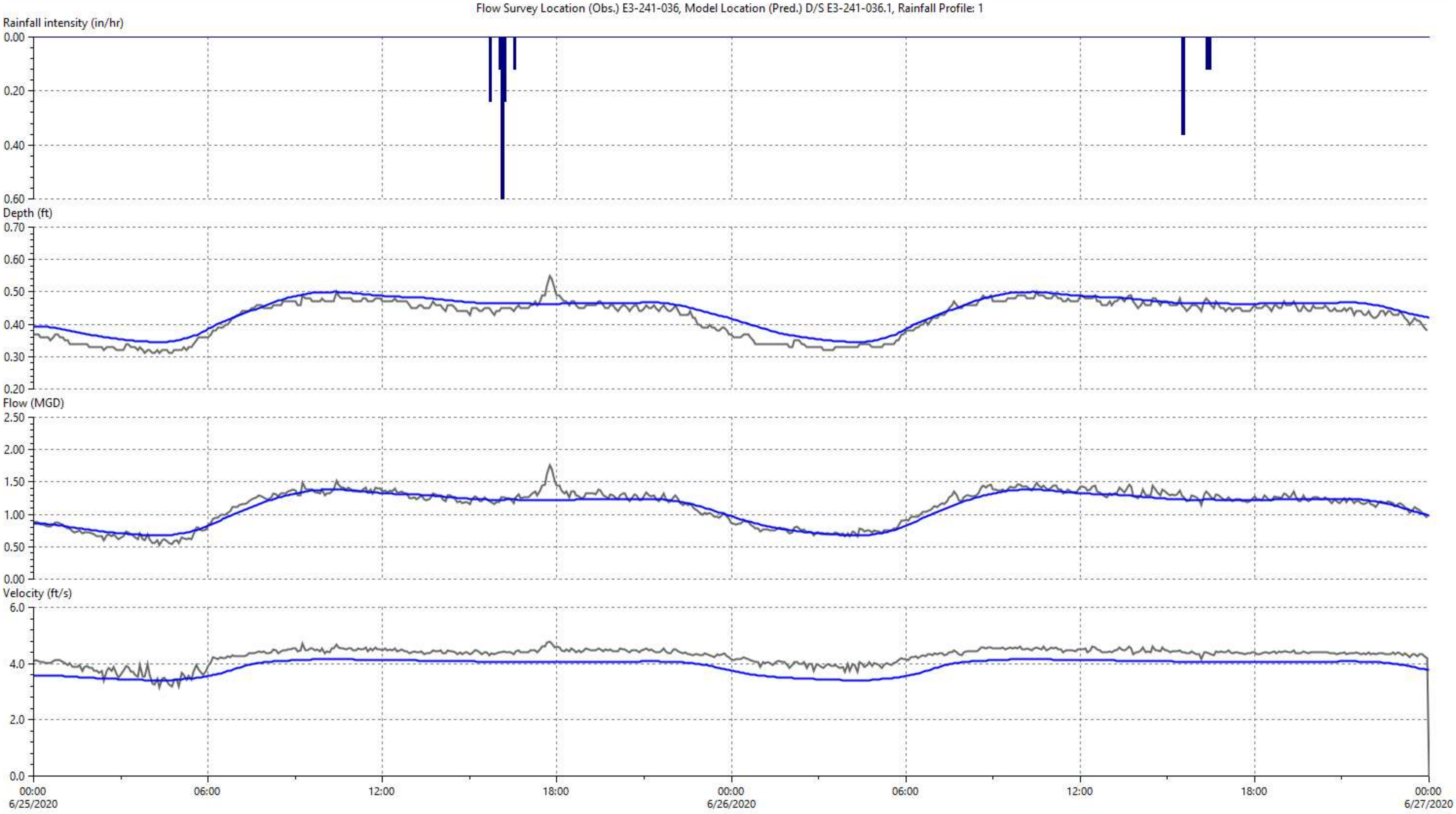
Observed / Predicted Report Produced by RRossell (8/10/2020 2:30:37 PM) Page 6 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)



	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.312	0.455	0.210	1.550	1.772	0.000	4.160
...>RG0102 Information				0.249	0.488	0.167	1.549	1.350	1.075	3.775

Figure D7 - AEG GJ04: E3-241-036 (Paradise Hills)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:30:37 PM) Page 7 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)

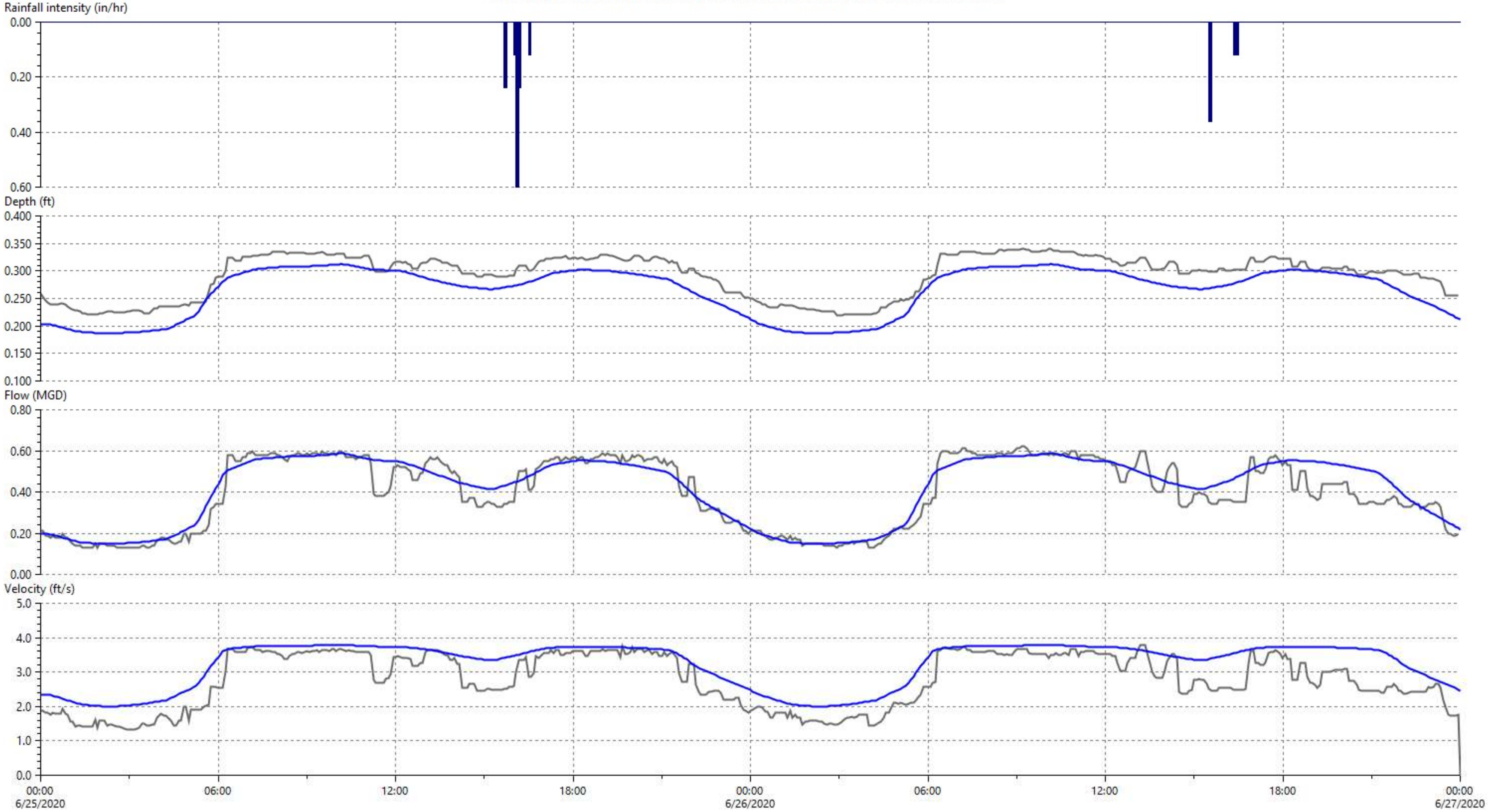


	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.310	0.550	0.530	1.760	2.259	0.000	4.790
...>RG0102 Information				0.345	0.500	0.676	1.384	2.217	3.406	4.156

Figure D8 - AEG GJ09: E4-271-060 (15th Street)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:30:37 PM) Page 8 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)

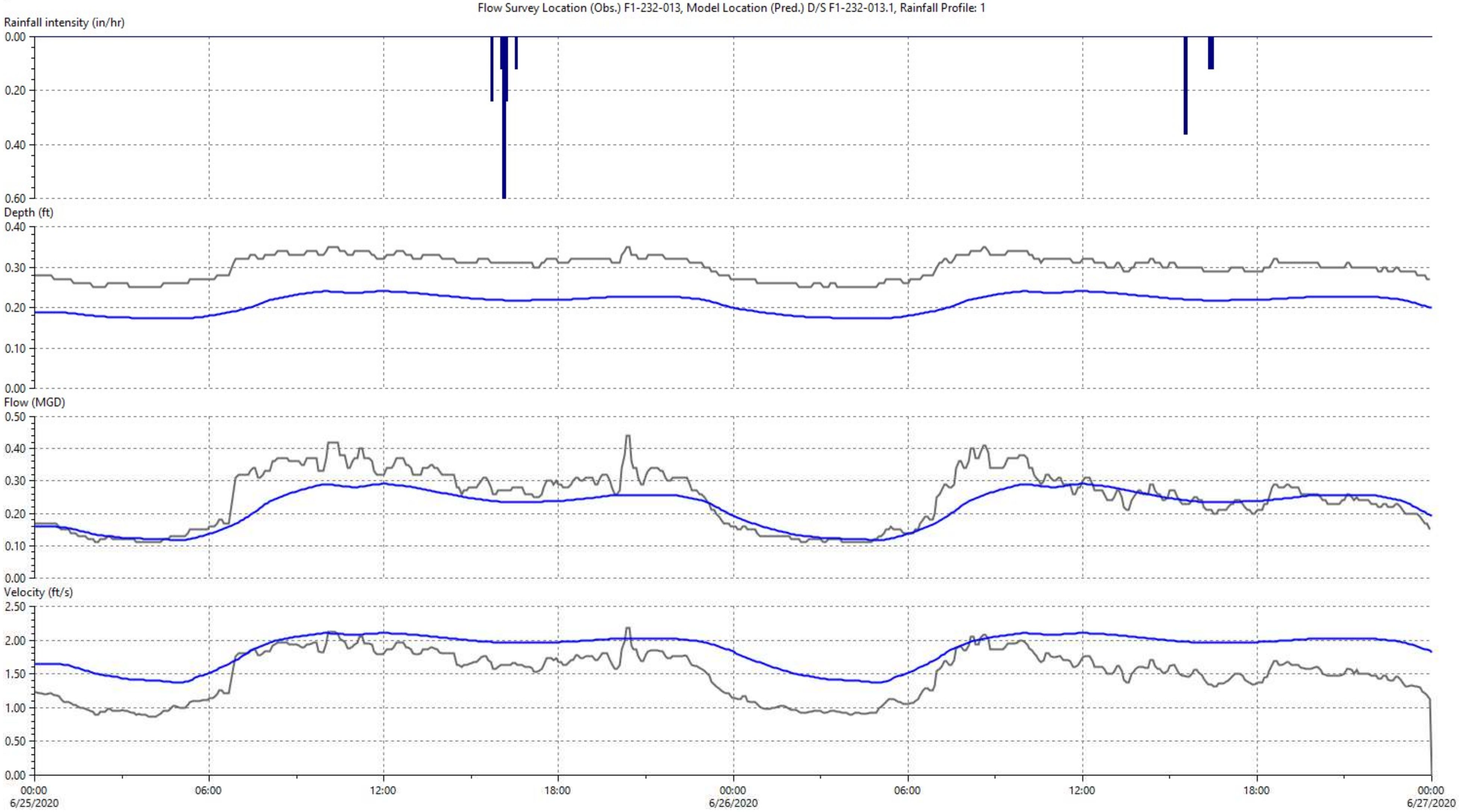
Flow Survey Location (Obs.) E4-271-060, Model Location (Pred.) D/S E4-271-060.1, Rainfall Profile: 1



	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.220	0.340	0.130	0.620	0.804	0.000	3.800
...>RG0102 Information				0.187	0.312	0.148	0.587	0.839	1.996	3.787

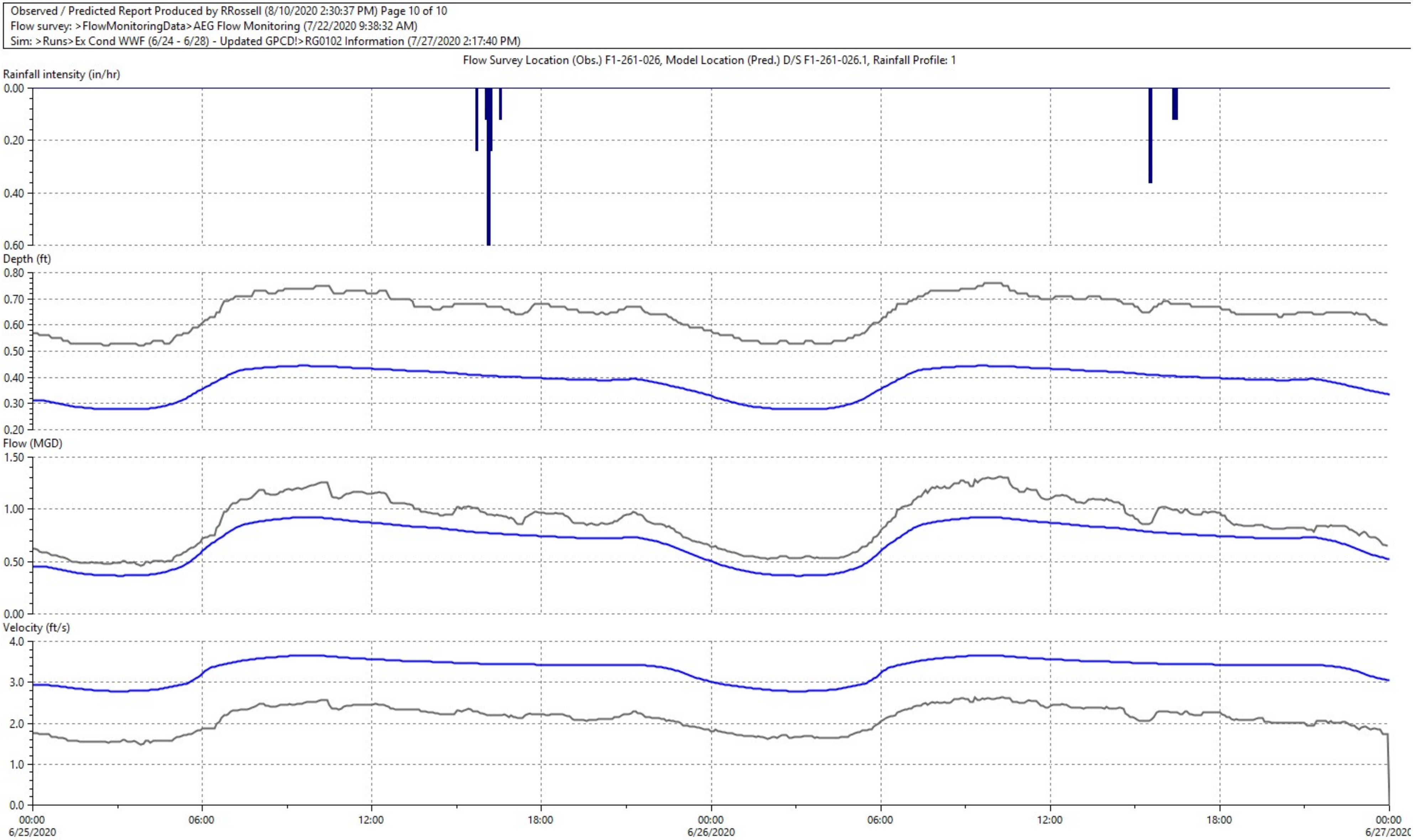
Figure D9 - AEG GJ01:   F1-232-013 (24 Road)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:30:37 PM) Page 9 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)


Flow Survey Location (Obs.) F1-232-013, Model Location (Pred.) D/S F1-232-013.1, Rainfall Profile: 1

	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.250	0.350	0.110	0.440	0.492	0.000	2.180
...>RG0102 Information				0.174	0.240	0.118	0.291	0.439	1.374	2.106

Figure D10 - AEG GJ03: F1-261-026 (Horizon Drive Upper)



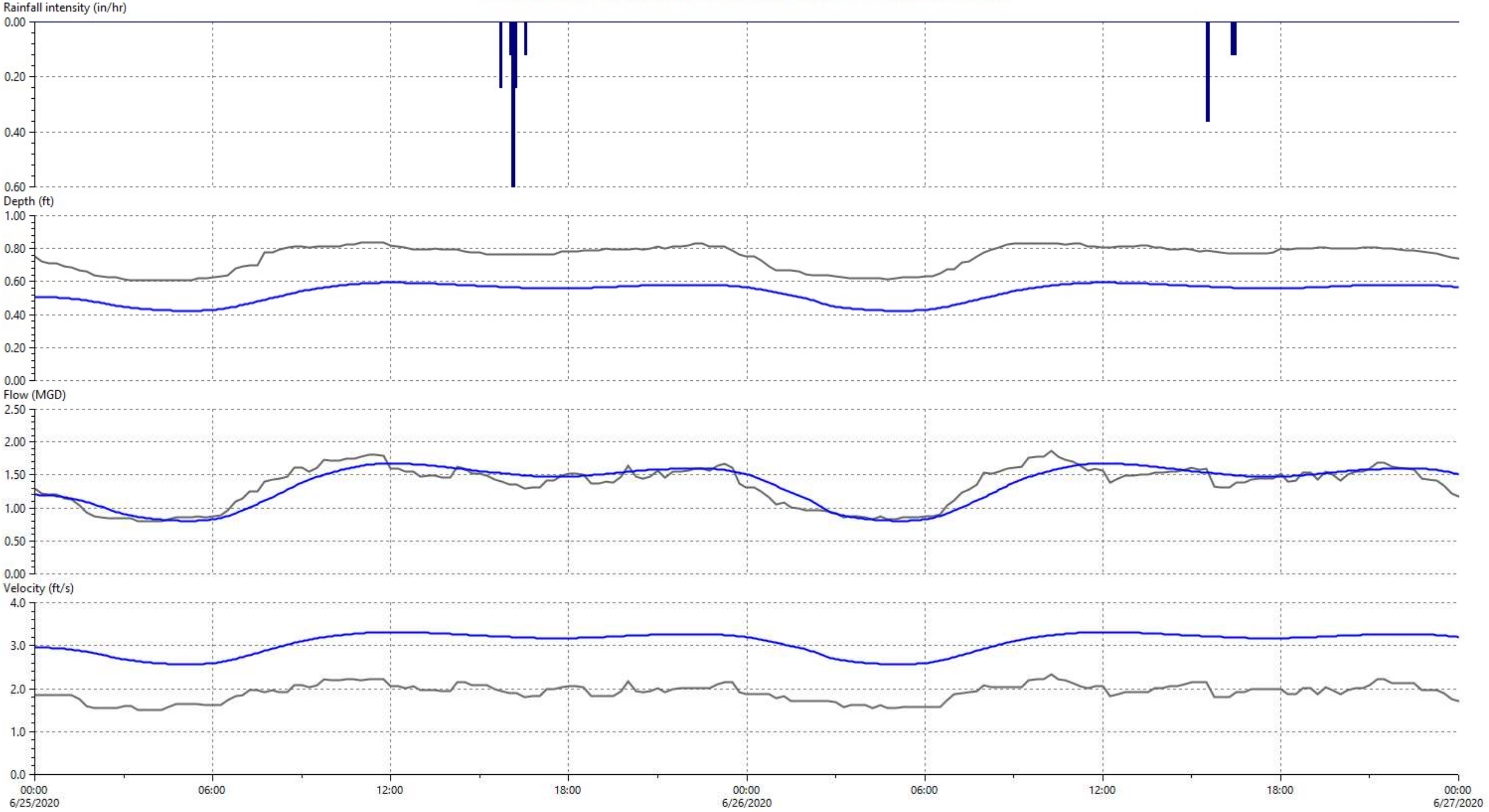
Observed / Predicted Report Produced by RRossell (8/10/2020 2:30:37 PM) Page 10 of 10
Flow survey: >FlowMonitoringData>AEG Flow Monitoring (7/22/2020 9:38:32 AM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)

	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.520	0.760	0.460	1.310	1.762	0.000	2.630
...>RG0102 Information				0.278	0.444	0.366	0.922	1.381	2.783	3.652

Figure D11 - City Meter :   C1-261-097 (Orchard Mesa West)

Observed / Predicted Report Produced by RRossell (8/10/2020 2:43:25 PM) Page 1 of 2
Flow survey: >FlowMonitoringData>CityFlowMonitoring2020 (7/23/2020 4:13:07 PM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)

Flow Survey Location (Obs.) C1-261-097, Model Location (Pred.) D/S C1-261-097.1, Rainfall Profile: 1

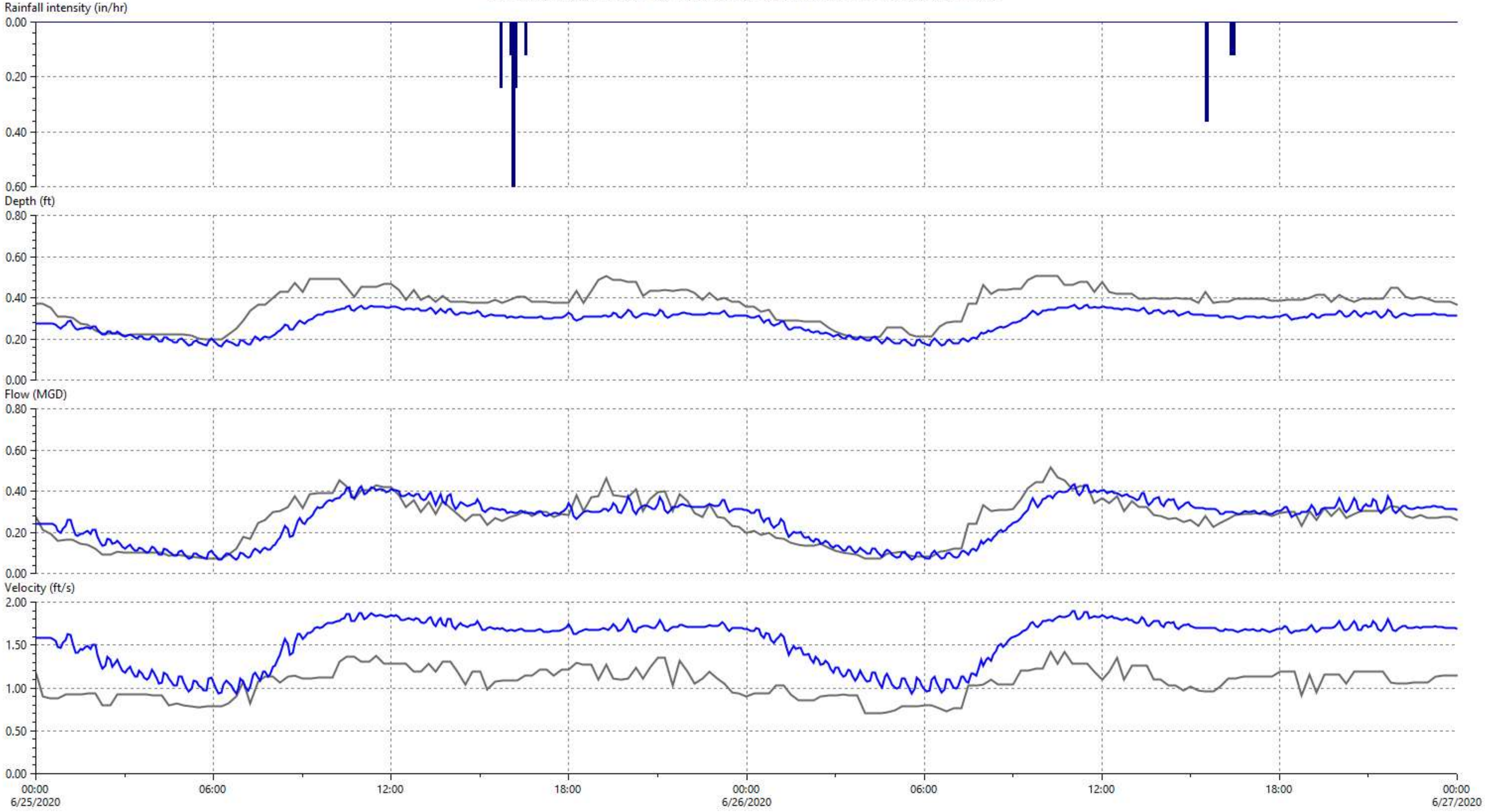


	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.609	0.840	0.792	1.868	2.706	1.508	2.347
...>RG0102 Information				0.423	0.594	0.804	1.677	2.720	2.566	3.316

Figure D12 - City Meter :   F1-231-003 (Goat Wash)

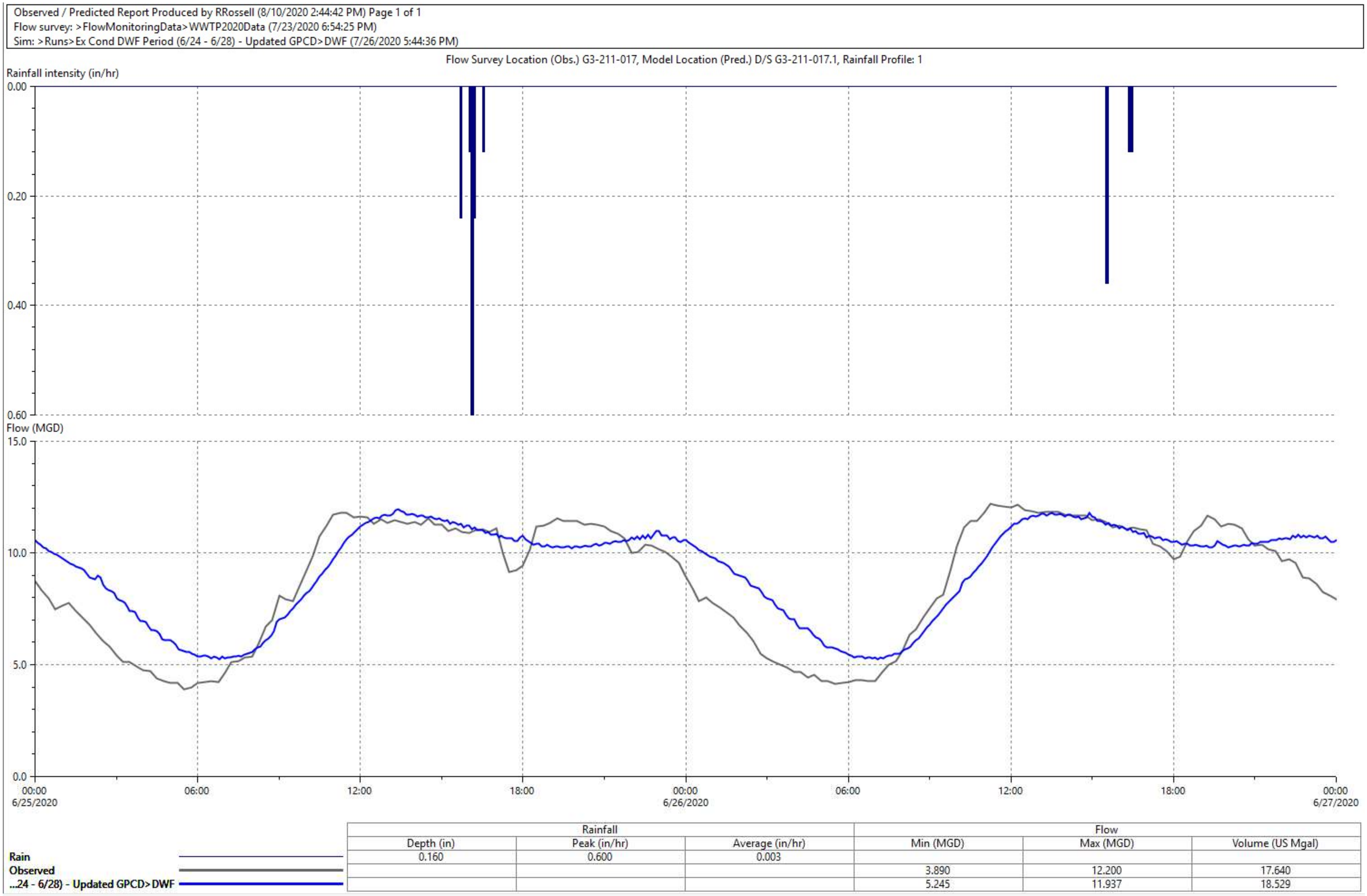
Observed / Predicted Report Produced by RRossell (8/10/2020 2:43:25 PM) Page 2 of 2
Flow survey: >FlowMonitoringData>CityFlowMonitoring2020 (7/23/2020 4:13:07 PM)
Sim: >Runs>Ex Cond WWF (6/24 - 6/28) - Updated GPCD!>RG0102 Information (7/27/2020 2:17:40 PM)

Flow Survey Location (Obs.) F1-231-003, Model Location (Pred.) D/S F1-231-003.1, Rainfall Profile: 1



	Rainfall			Depth		Flow			Velocity	
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (ft)	Max (ft)	Min (MGD)	Max (MGD)	Volume (US Mgal)	Min (ft/s)	Max (ft/s)
Rain	0.160	0.600	0.003							
Observed				0.198	0.508	0.071	0.516	0.520	0.702	1.422
...> RG0102 Information				0.165	0.366	0.068	0.436	0.527	0.931	1.897

Figure D13 - Persigo WWTP



Observed / Predicted Report Produced by RRossell (8/10/2020 2:44:42 PM) Page 1 of 1
Flow survey: >FlowMonitoringData>WWTP2020Data (7/23/2020 6:54:25 PM)
Sim: >Runs>Ex Cond DWF Period (6/24 - 6/28) - Updated GPCD>DWF (7/26/2020 5:44:36 PM)

Flow Survey Location (Obs.) G3-211-017, Model Location (Pred.) D/S G3-211-017.1, Rainfall Profile: 1

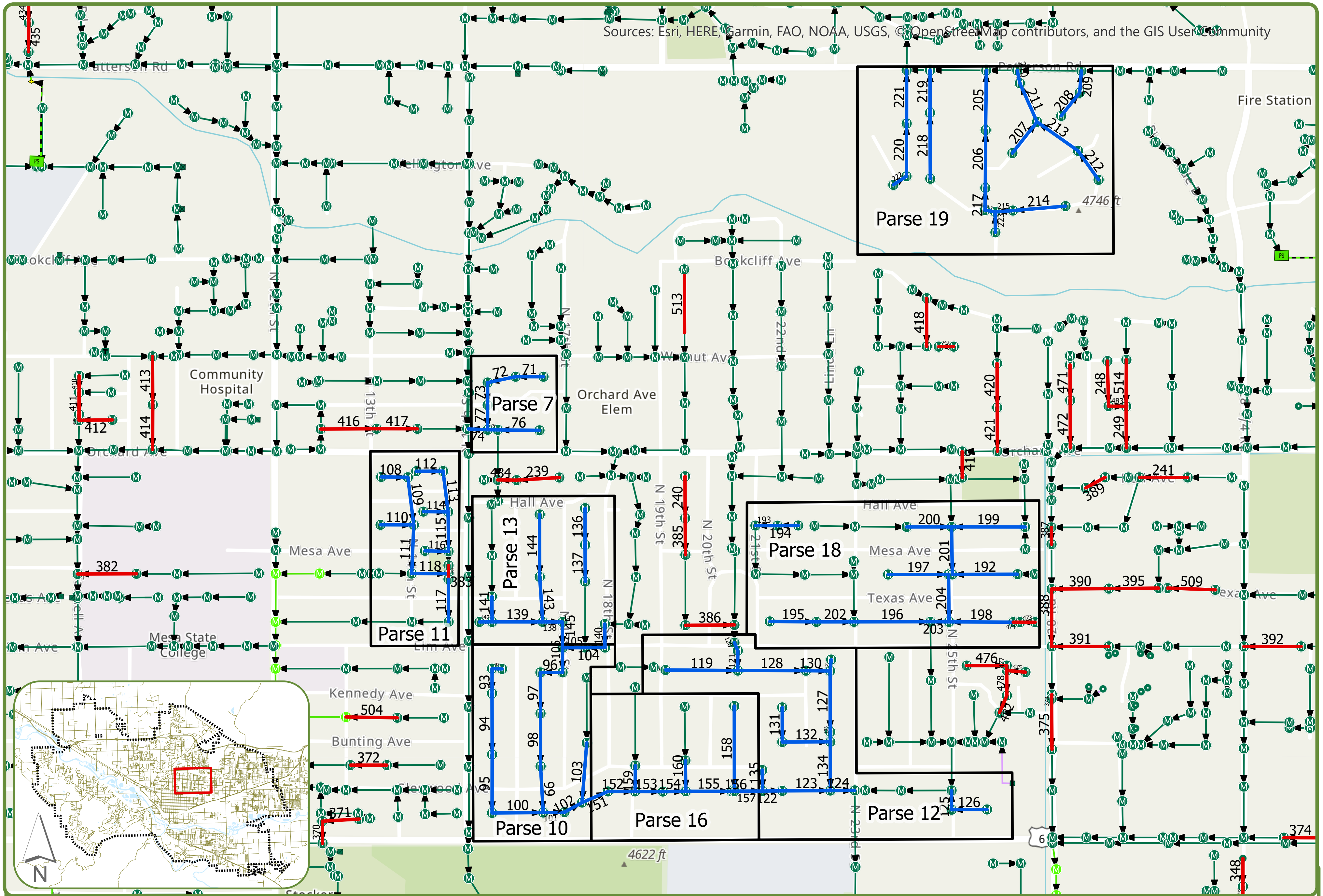
	Rainfall			Flow		
	Depth (in)	Peak (in/hr)	Average (in/hr)	Min (MGD)	Max (MGD)	Volume (US Mgal)
Rain	0.160	0.600	0.003			
Observed				3.890	12.200	17.640
...24 - 6/28) - Updated GPCD>DWF				5.245	11.937	18.529

Appendix E

R&R PROGRAM OVERVIEW

Parse	Parse Description	Additional Justification	*Sum of Cleaning WOs	Max CCTV Total Quick Rating	Access Issues Yards, Fences	Length (ft)	TRUSS (ft)	UNKNOWN (ft)	VCP (ft)	Average Age (yr)	Maximum Age (yr)	Budget R&R
A	1st Street sewer & water prior to state road improvements	Ready for bid - Phase A										$465,800
B	340 Highway cleanout	Ready for bid - Phase A										$150,000
C	Shadow Lake Sewer Line (reslope)	Ready for bid - Phase A										$100,000
1	Clay lines crossing Unaweep	Phase 1 Road Overlay	4	4232	Prior to paving	4,400	0	0	4,400	46.2	47.1	$919,200
2	Pinion & Cedar (Truss & VCP)	Phase 1 Road Overlay	0	4100	Prior to paving	3,100	2,700	0	400	46.1	46.1	$691,800
3	Pine & Holly (Truss & VCP)	Phase 1 Road Overlay	2	5100	Prior to paving	6,300	3,600	0	2,700	46.0	46.1	$1,395,600
4	E & W Parkview Dr (Truss & VCP)	Phase 1 Road Overlay	1	0	Prior to paving	4,200	1,900	0	2,400	45.1	46.1	$933,600
5	Alley (Pitkin & Ute	Alley Project	1	5100	prior to concrete	1,100	0	0	1,100	0.0	0.0	$234,100
6	4th to 5th & Hall	PH2 Priority, Problem Areas Roots	6	4132 ROOTS	Poor Access Yards & Fences	800	0	500	400	69.1	69.1	$171,300
7	15th & Pinyon	PH2 Priority, Problem Areas	17	3600 Roots	Poor Access Yards & Fences	1,200	0	0	1,200	64.1	64.1	$269,800
8	Gunnison St Extension	PH2 Priority, Problem Areas	0	4100 CIRCUM CRACK	Open Ground Prior to paving	2,500	0	0	2,500	54.7	63.1	$552,500
9	North Ave & Sparn	PH2 Priority, Problem Areas	3	4100 ROOTS/SAG	Back Yard Fence Line	900	0	0	900	63.1	63.1	$185,900
10	Bunting to Elm, 15th to 18th St	PH2 Priority, Problem Areas	10	4835 ROOTS	Alley Buniness Lot	4,400	0	100	4,300	72.1	73.1	$974,500
11	Nth 14th to 15th & Hall	PH2 Priority, Problem Areas	10	4500 ROOTS	Yard, Alley & Street	2,700	0	0	2,500	38.6	73.1	$601,200
12	Bunting to Elm, 19th to 23rd	PH2 Priority, Problem Areas	5	5121 GREASE/ROOTS	Alley Buniness Lot	4,000	0	300	3,700	57.3	73.1	$881,000
13	N16th to N18th St, Elm to Hall Ave	PH2 Priority, Problem Areas	7	4100 ROOTS	Alley & Street	2,400	0	0	2,400	73.1	73.1	$518,800
14	Florence	PH2 Priority, Problem Areas	2	5141 ROOTS/HOLE	Street	1,700	0	0	1,500	54.9	62.4	$375,000
16	North Ave to Bunting, 18th to 21rd St	PH2 Priority, Problem Areas	0	3712 Grease/Sag/Grit	Alley Buniness Lot	2,200	0	0	2,000	67.1	73.1	$458,200
17	West Lake	PH2 Priority, Problem Areas	12	5124 ROOTS	Alley & Street	7,000	0	0	7,000	48.7	50.1	$1,398,000
18	Texas to Hall	PH2 Priority, Problem Areas	11	4200	Alley & Street	4,300	0	0	4,300	51.6	72.1	$852,300
19	Mantey Heights	PH2 Priority, Problem Areas	6	4234	Street	4,800	0	0	4,800	46.9	49.1	$959,000
	Subtotal		97	5141		58,000	8,200	900	48,500	51.8	73.1	$13,087,600
XXX	North Avenue, 1st St to 30 Rd	CDOT Overlay 2021				29,040	0	3,990	23,490	61.8 (VCP)	108.2(VCP)	$5,596,500
	Summary					87,040	8,200	4,890	71,990			18,684,100
	Percent						9%	6%	83%			

***Sewer Cleaning Wos are for the last 4 years include all jetting for colapsed sewer, odor complaints, Roots, Sewer backups etc**



Sewer Line Evaluation for Replacement

Map 1

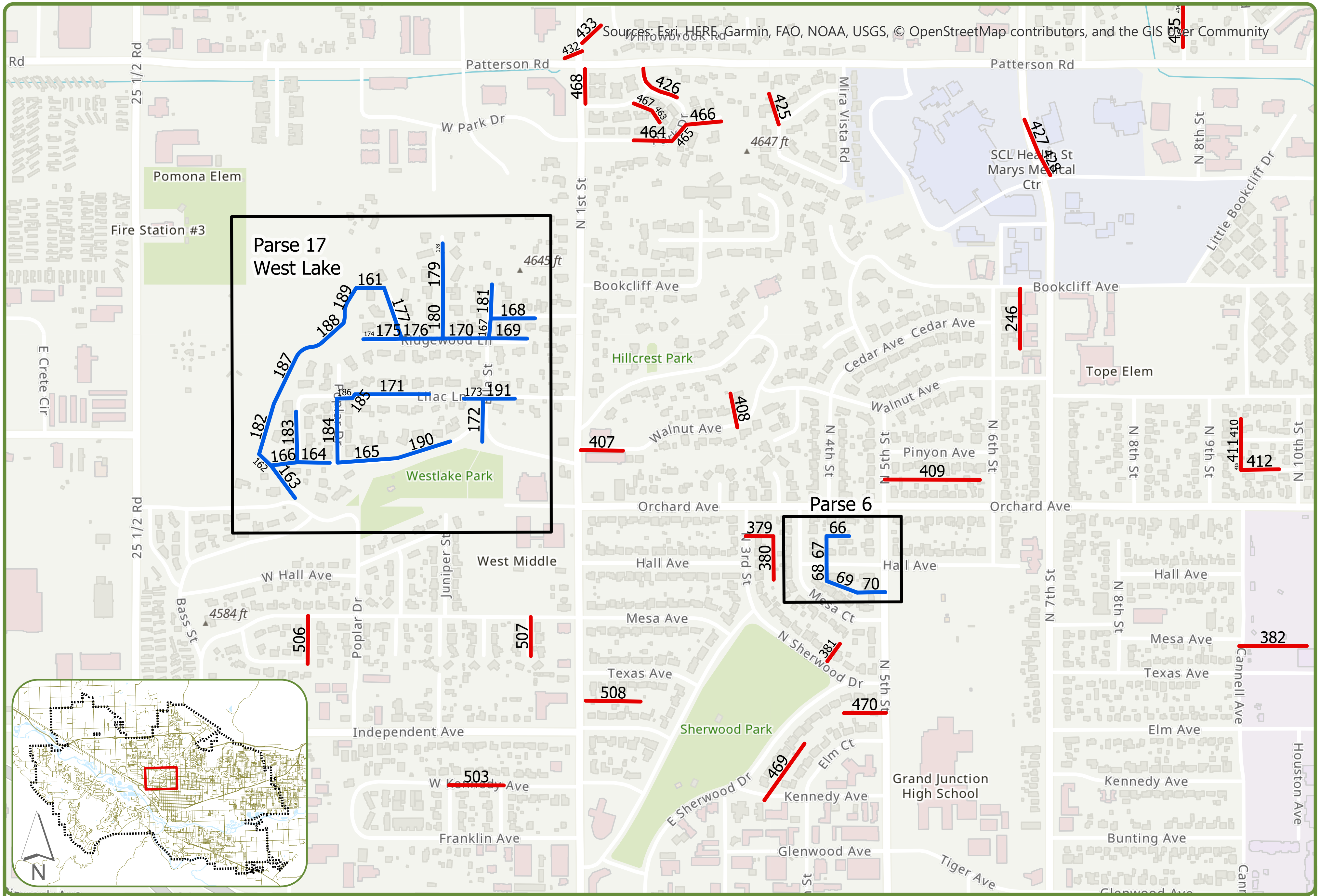
CITY OF Grand Junction COLORADO GEOGRAPHIC INFORMATION SYSTEM

0 305 610 1,220 Feet

- Parse 1-4, Phase 1 Unaweep Road Overlays
- Parse 5, Alley Paving
- Parse 6-19, Proposed Phase 2 Projects
- Parse 20-22, Misc. Trouble Spots
- PS Sewer Pump Stations
- Ⓜ COMBINED SEWER MH
- Ⓜ SANITARY SEWER MH
- ◀ SAN PIPE DISCHARGE
- ● SANITARY SEWER C.O.
- ☒ END SEWER STUB
- T TEE
- ◆ MATERIAL CHANGE
- SANITARY SEWER LINE
- COMBINED SEWER LINE
- FORCE MAIN
- PRIVATE OR SERVICE LINE
- 201 Boundary

DRAWN BY: ScottL DATE: 1/27/2020 H:\SanitarySewer\Doug Dutton\Sanitary Sewer Replacements\Sanitary Sewer Replacements.aprx

Appendix E-2



CITY OF **Grand Junction** COLORADO GEOGRAPHIC INFORMATION SYSTEM

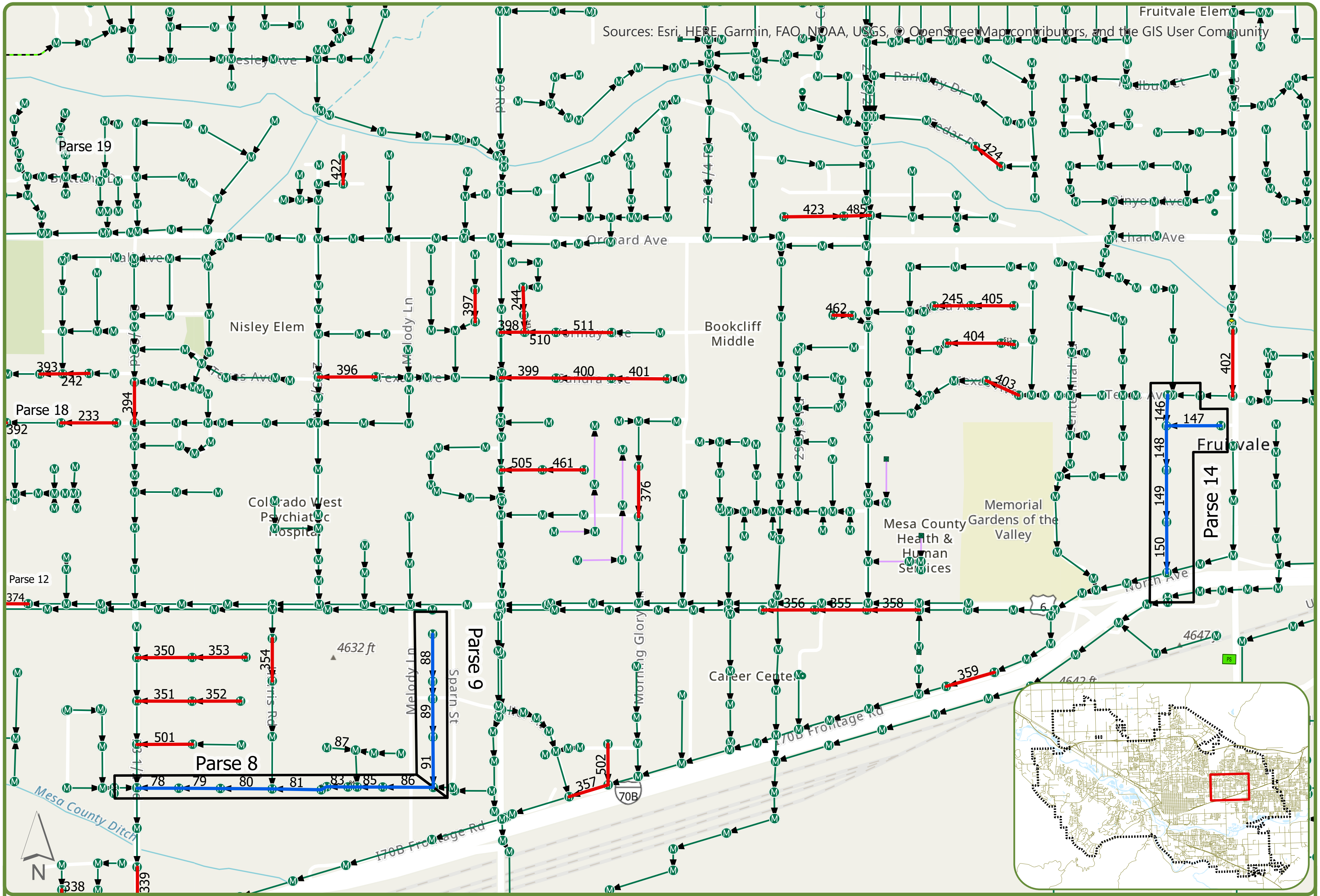
Sewer Line Evaluation for Replacement

Map 2

0 265 530 1,060 Feet

- Parse 1-4, Phase 1 Unaweep Road Overlays
- Parse 5, Alley Paving
- Parse 6-19, Proposed Phase 2 Projects
- Parse 20-22, Misc. Trouble Spots
- PS Sewer Pump Stations
- M COMBINED SEWER MH
- M SANITARY SEWER MH
- SAN PIPE DISCHARGE
- ● SANITARY SEWER C.O.
- ☒ END SEWER STUB
- T TEE
- ◆ MATERIAL CHANGE
- SANITARY SEWER LINE
- COMBINED SEWER LINE
- FORCE MAIN
- PRIVATE OR SERVICE LINE
- 201 Boundary

DRAWN BY: ScottL DATE: 1/27/2020 H:\SanitarySewer\Doug Dutton\Sanitary Sewer Replacements\Sanitary Sewer Replacements.aprx



Grand Junction

CITY OF
COLORADO
GEOGRAPHIC INFORMATION SYSTEM

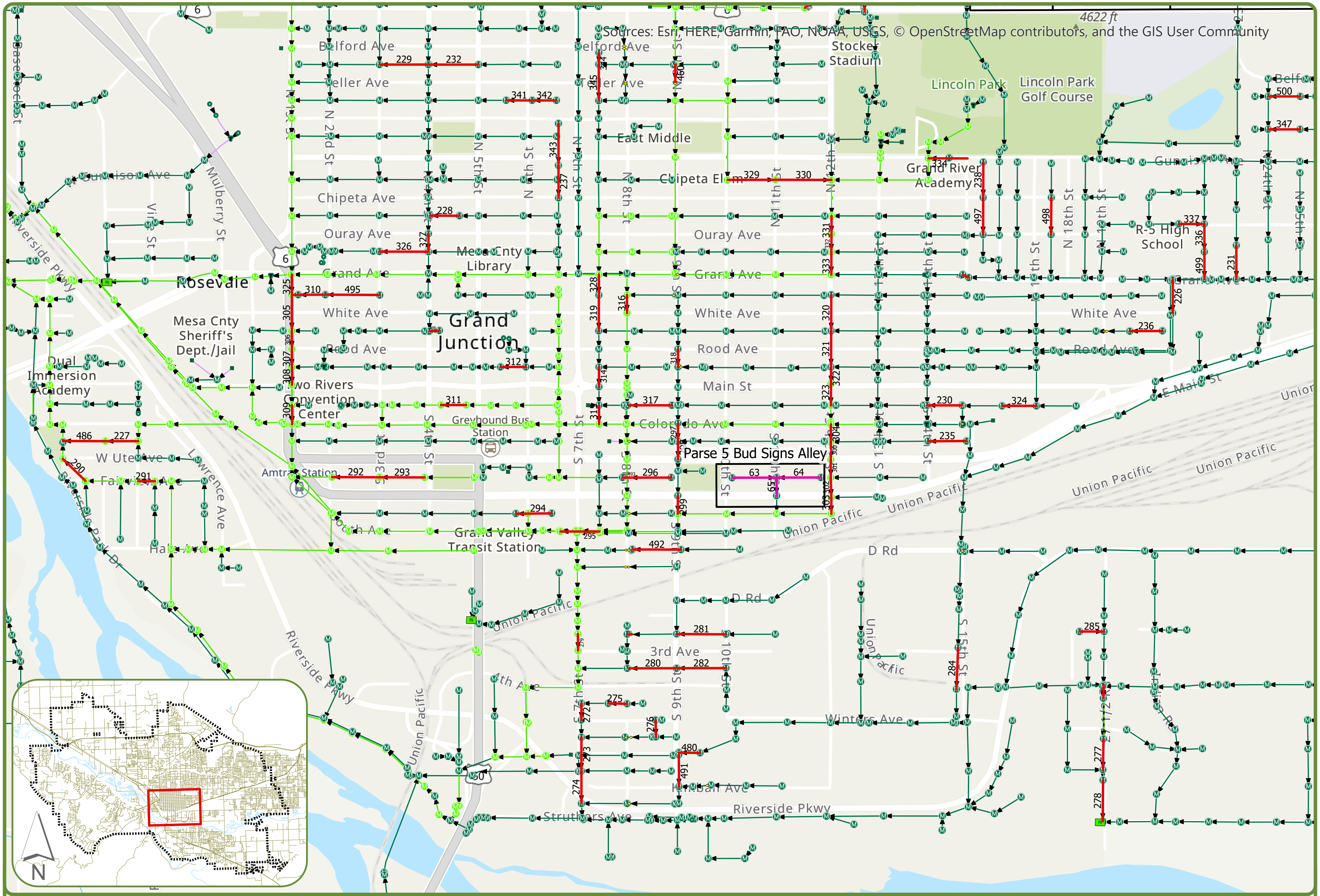
Sewer Line Evaluation for Replacement

Map 3

0 325 650 1,300 Feet

- Parse 1-4, Phase 1 Unaweep Road Overlays
- Parse 5, Alley Paving
- Parse 6-19, Proposed Phase 2 Projects
- Parse 20-22, Misc. Trouble Spots
- PS Sewer Pump Stations
- COMBINED SEWER MH
- SANITARY SEWER MH
- SAN PIPE DISCHARGE
- SANITARY SEWER C.O.
- END SEWER STUB
- TEE
- MATERIAL CHANGE
- SANITARY SEWER LINE
- COMBINED SEWER LINE
- FORCE MAIN
- PRIVATE OR SERVICE LINE
- 201 Boundary

DRAWN BY: ScottL DATE: 1/27/2020 H:\SanitarySewer\Doug Dutton\Sanitary Sewer Replacements\Sanitary Sewer Replacements.aprx



CITY OF Grand Junction COLORADO
GEOGRAPHIC INFORMATION SYSTEM

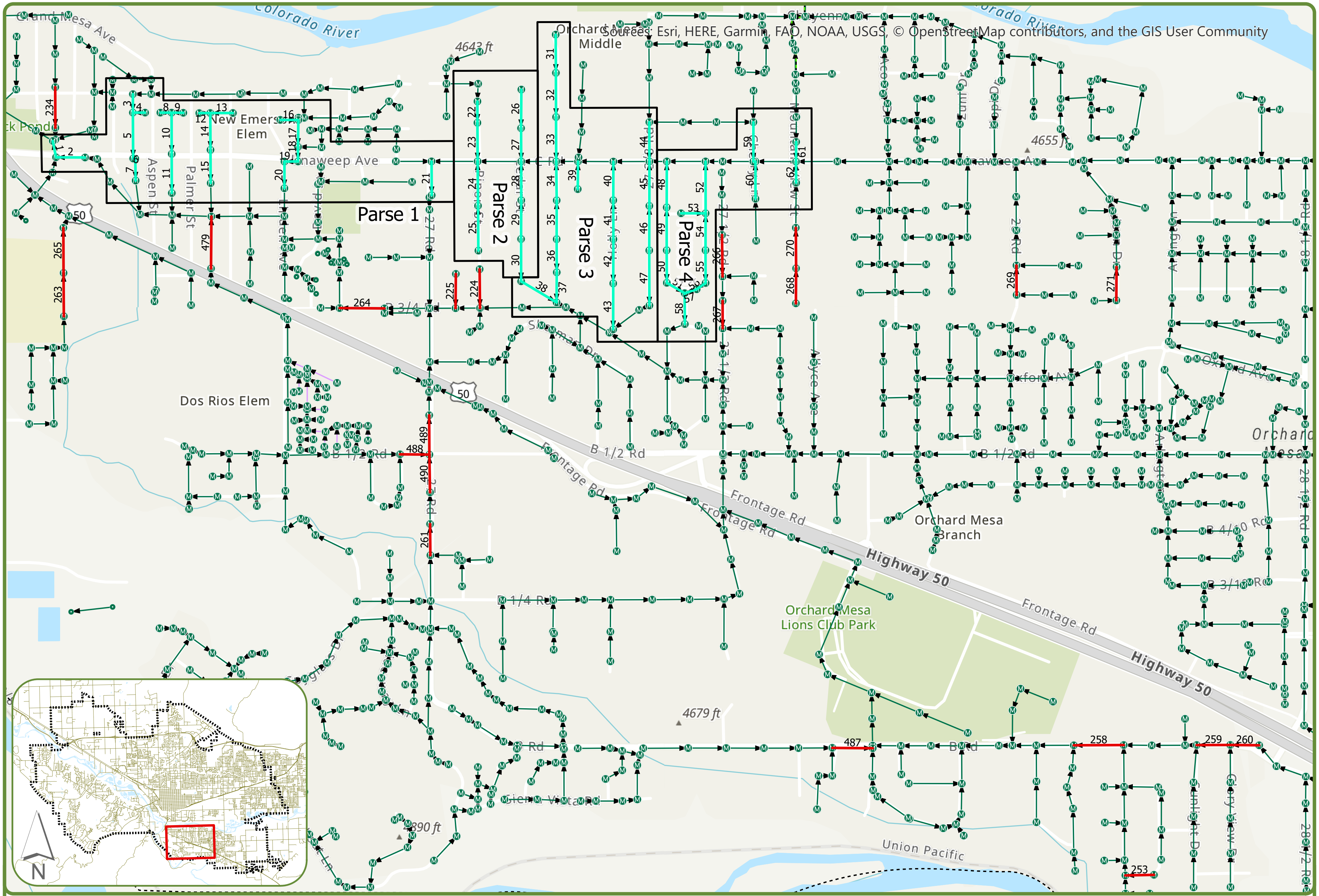
0 437.5 875 1,750
Feet

Sewer Line Evaluation for Replacement

Map 4

- Parse 1-4, Phase 1 Unaweep Road Overlays
- Parse 5, Alley Paving
- Parse 6-19, Proposed Phase 2 Projects
- Parse 20-22, Misc. Trouble Spots
- PS Sewer Pump Stations
- Ⓜ COMBINED SEWER MH
- Ⓜ SANITARY SEWER MH
- SAN PIPE DISCHARGE
- ● SANITARY SEWER C.O.
- ☒ END SEWER STUB
- T TEE
- ◇ MATERIAL CHANGE
- SANITARY SEWER LINE
- COMBINED SEWER LINE
- FORCE MAIN
- PRIVATE OR SERVICE LINE
- 201 Boundary

DRAWN BY: ScottL DATE: 1/27/2020 H:\SanitarySewer\Doug Dutton\Sanitary Sewer Replacements\Sanitary Sewer Replacements.aprx



CITY OF **Grand Junction** COLORADO GEOGRAPHIC INFORMATION SYSTEM

Sewer Line Evaluation for Replacement

Map 5

0 405 810 1,620 Feet

🟩	Parse 1-4, Phase 1 Unaweep Road Overlays
🟪	Parse 5, Alley Paving
🟦	Parse 6-19, Proposed Phase 2 Projects
🟥	Parse 20-22, Misc. Trouble Spots

PS	Sewer Pump Stations
M	COMBINED SEWER MH
M	SANITARY SEWER MH
●	SAN PIPE DISCHARGE
●	SANITARY SEWER C.O.
☒	END SEWER STUB
T	TEE
◆	MATERIAL CHANGE

—	SANITARY SEWER LINE
—	COMBINED SEWER LINE
—	FORCE MAIN
—	PRIVATE OR SERVICE LINE
- -	201 Boundary

DRAWN BY: ScottL DATE: 1/27/2020 H:\SanitarySewer\Doug Dutton\Sanitary Sewer Replacements\Sanitary Sewer Replacements.aprx

Appendix F

DETAILED CIP PROJECT OVERVIEW

Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

Project ID: CGVSD-1

General Location: C 1/2 Road from 27 1/27 Road to 28 Road

Improvements: Gravity

Project Type: Capacity

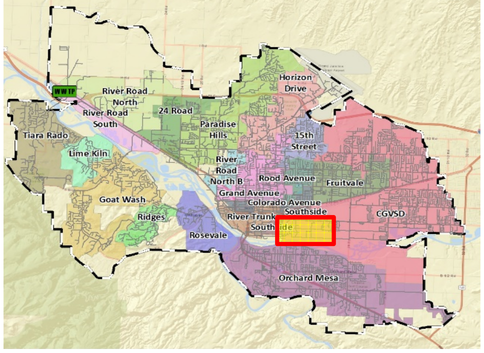
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	**$**	**681,800**
Construction Contingency	$	341,200
Estimated Construction Cost	**$**	**1,023,000**
Engineering Services, Construction Management and Project Administration	$	1,279,000
Total Capital Improvement Cost	**$**	**1,279,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030)	x
Long Term (2030 - 2040)	

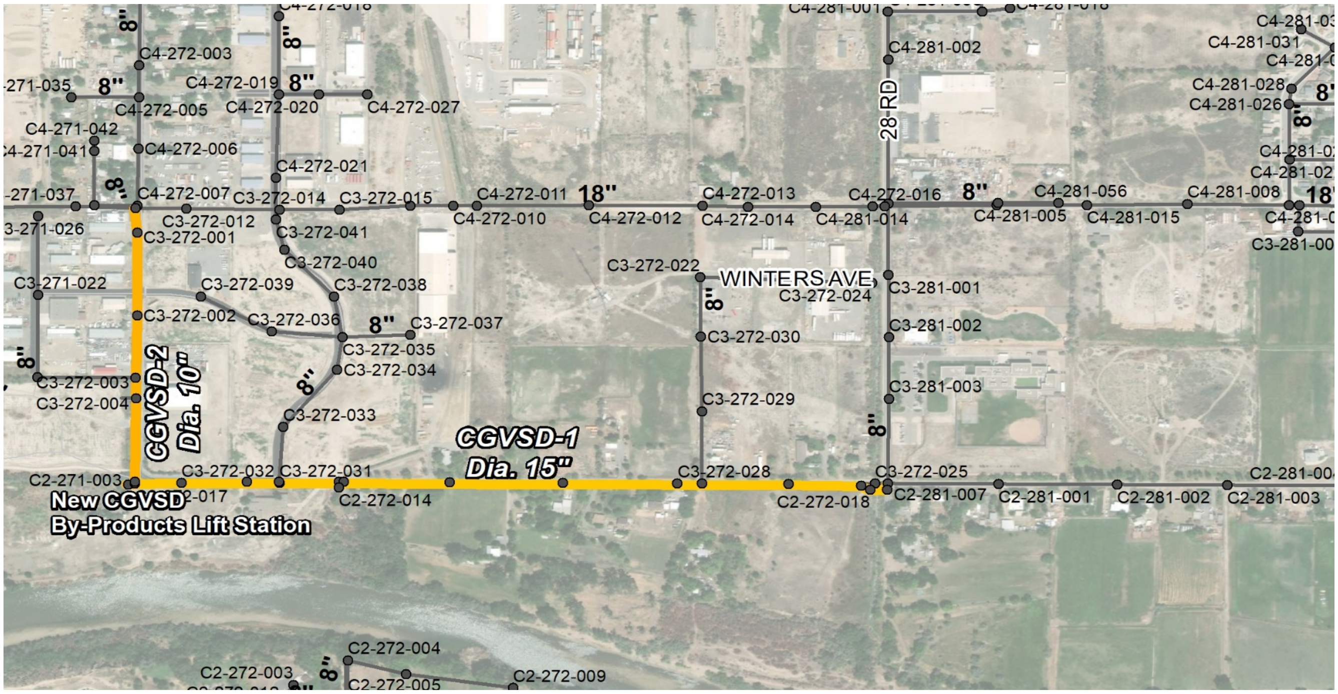
General Description

Upsized gravity sewer upstream of CGVSD By-Products lift station along C 1/2 Rd.

Project Details

A new gravity sewer is required along C 1/2 Road due to convey the future flows. Based on the existing flow capacity evaluation the existing 10-inch sewer is capacity deficient. The flows conveyed to the gravity sewer should be verified with the future land use and industrial users. This project should be constructed/evaluated in conjunction with CGVSD-2. This project was not evaluated as part of the 2008 study (not in model).

Project Detail Map



Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

Project ID: **CGVSD-2**

General Location: 27 1/27 Road from C 1/2 Road to C 3/4 Road.

Improvements: Pump Station and Forcemain

Project Type: Capacity

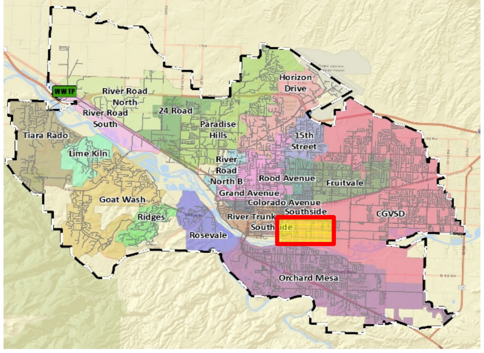
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	**$**	**2,834,200**
Construction Contingency	$	1,416,800
Estimated Construction Cost	**$**	**4,251,000**
Engineering Services, Construction Management and Project Administration	$	5,314,000
Total Capital Improvement Cost	**$**	**5,314,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030) x

Long Term (2030 - 2040) ____

General Description

Upsized CGVSD By-Products lift station. Upsized CGVSD By-Products lift station forcemain.

Project Details

A new lift station and forcemain is required to convey the future flows. The flows conveyed to the lift station should be verified with the future land use and industrial users. This project should be constructed/evaluated in conjunction with CGVSD-2. This project was not evaluated as part of the 2008 study (not in model).

Project Detail Map

Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

Project ID: **FB-1**

General Location: Refer to Detailed Map.

Improvements: Gravity

Project Type: Capacity

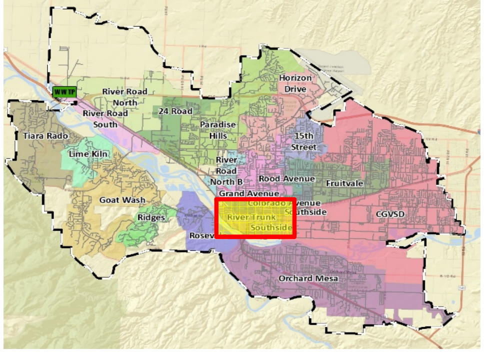
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	**$**	**100,000**
Construction Contingency	$	50,000
Estimated Construction Cost	**$**	**150,000**
Engineering Services, Construction Management and Project Administration	$	188,000
Total Capital Improvement Cost	**$**	**188,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030) x

Long Term (2030 - 2040) ____

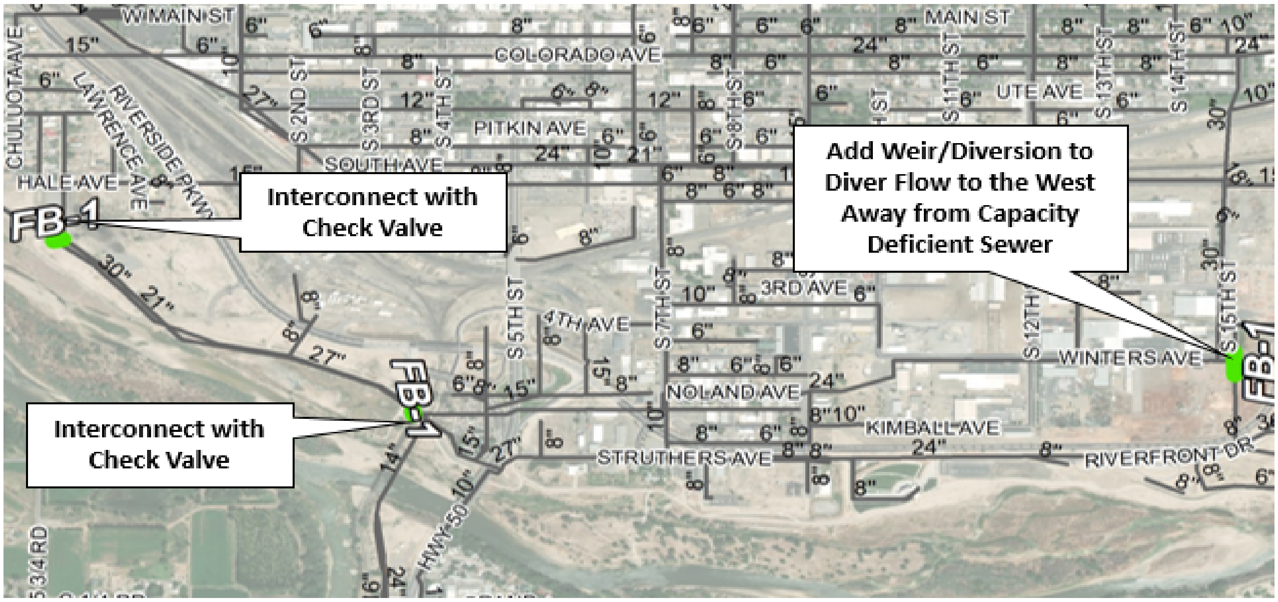
General Description

Flow diversion measures to balance flow along south side interceptors.

Project Details

Flow balancing locations were identifed to shift flow towards the existing 27/30-inch which has available capacity. Two locations located along the interceptors were identifed where interconnects/check valves could be constructed near manholes C3-261-011/C3-261-010 and C4-252-006/C4-252-002. A third location was identified upstream of the interceptors (MH C3-271-028) where flow should be diverted to the west away from the capacity deficient interceptor. The interceptor elevations and the connectivity in the system upstream of the interceptors will need to be verified during design of the improvements. This project was not included in the 2008 study. As part of the 2008 study the existing interceptors were going to be upsized/replaced.

Project Detail Map



Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

Project ID: FV-1

General Location: 28 Road from Hill Avenue to Grand Avenue.

Improvements: Gravity

Project Type: Capacity

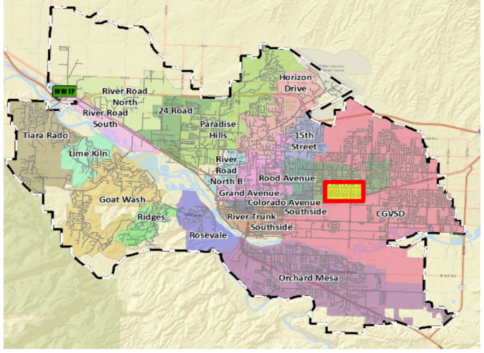
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	**$**	**375,000**
Construction Contingency	$	188,000
Estimated Construction Cost	**$**	**563,000**
Engineering Services, Construction Management and Project Administration	$	704,000
Total Capital Improvement Cost	**$**	**704,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030)	
Long Term (2030 - 2040)	x

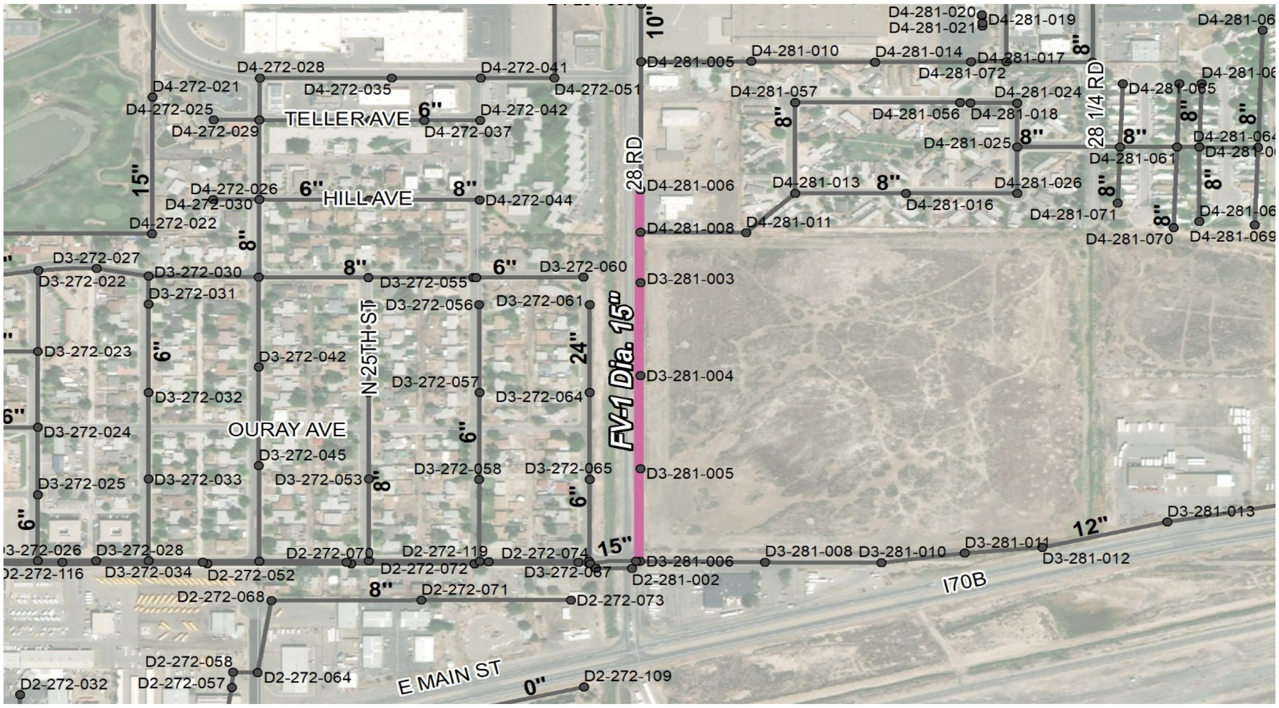
General Description

Upsized sewer along 28 Road.

Project Details

An upsized sewer is required to reduce surcharging along 28 Road. This project was not evaluated as part of the 2008 study (not in model).

Project Detail Map



Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

Project ID: FV-2

General Location: Refer to Detailed Map.

Improvements: Gravity

Project Type: Capacity

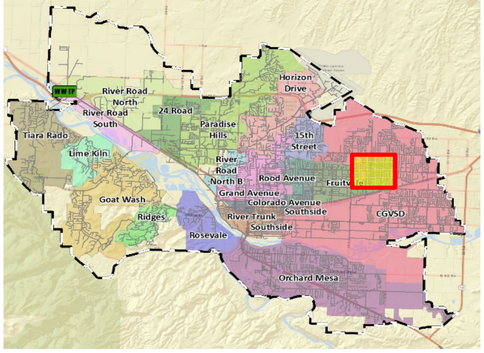
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	**$**	**1,467,700**
Construction Contingency	$	734,300
Estimated Construction Cost	**$**	**2,202,000**
Engineering Services, Construction Management and Project Administration	$	2,752,000
Total Capital Improvement Cost	**$**	**2,752,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030)	
Long Term (2030 - 2040)	x

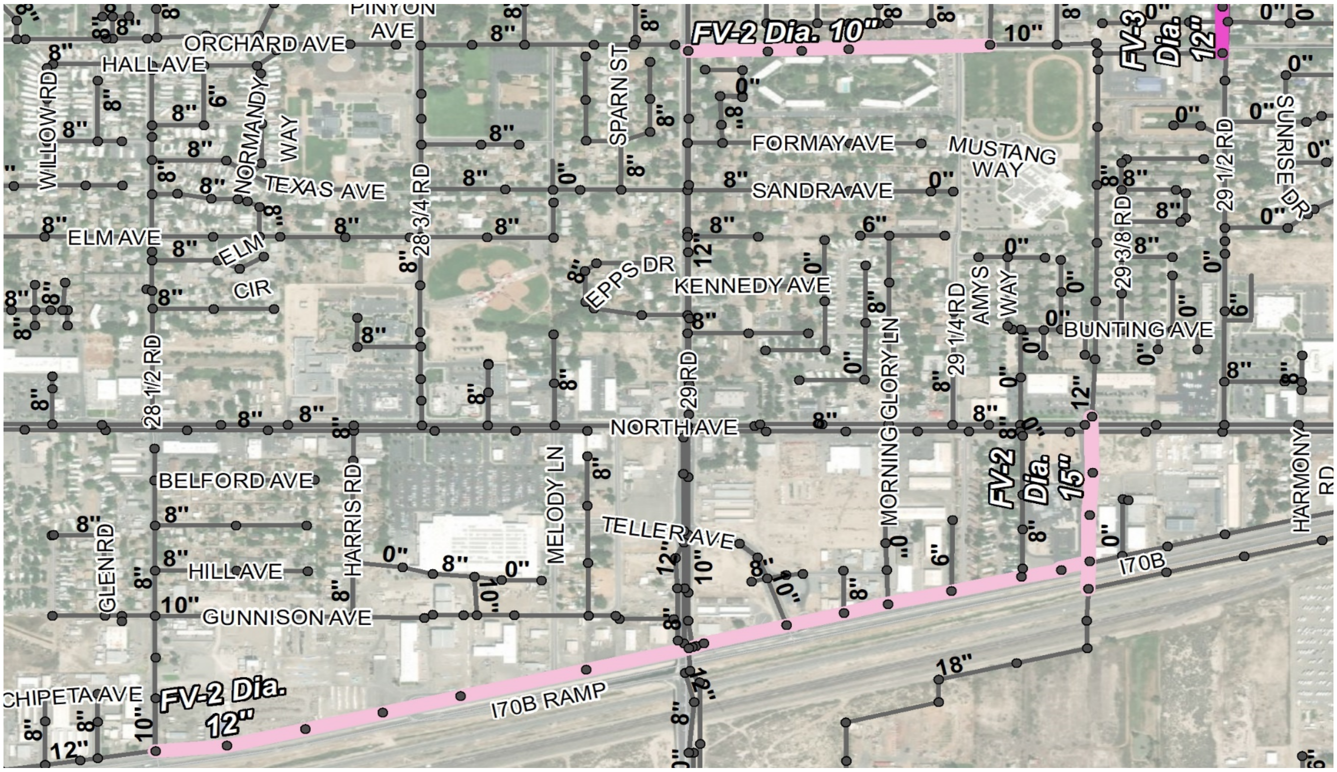
General Description

New sewer along Orchard Avenue to divert flow to the east away from 29 3/8 road sewer. Upsized sewer along Frontage Road. Upsized sewer adjacent to 29 3/8 Road.

Project Details

New and upsized sewer are required to increase LOS of the existing sewers along multiple streets in the Fruitvale area. The inverts and connectivity of the parallel sewers along 29 Road need to be verified as these will affect the project extents. There are also parallel sewers south of I70 that will need to evaluated depending on how flows are diverted/routed as part of this project. This project was not evaluated as part of the 2008 study (not in model).

Project Detail Map



Project ID: **FV-3**

General Location: 29 1/2 Road from N View Drive to Orchard Avenue.

Improvements: Gravity

Project Type: Capacity

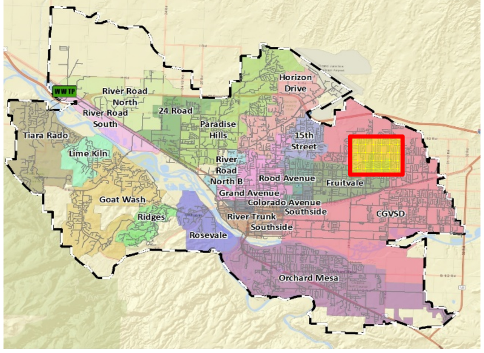
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	**$**	**125,000**
Construction Contingency	$	63,000
Estimated Construction Cost	**$**	**188,000**
Engineering Services, Construction Management and Project Administration	$	235,000
Total Capital Improvement Cost	**$**	**235,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030)	
Long Term (2030 - 2040)	x

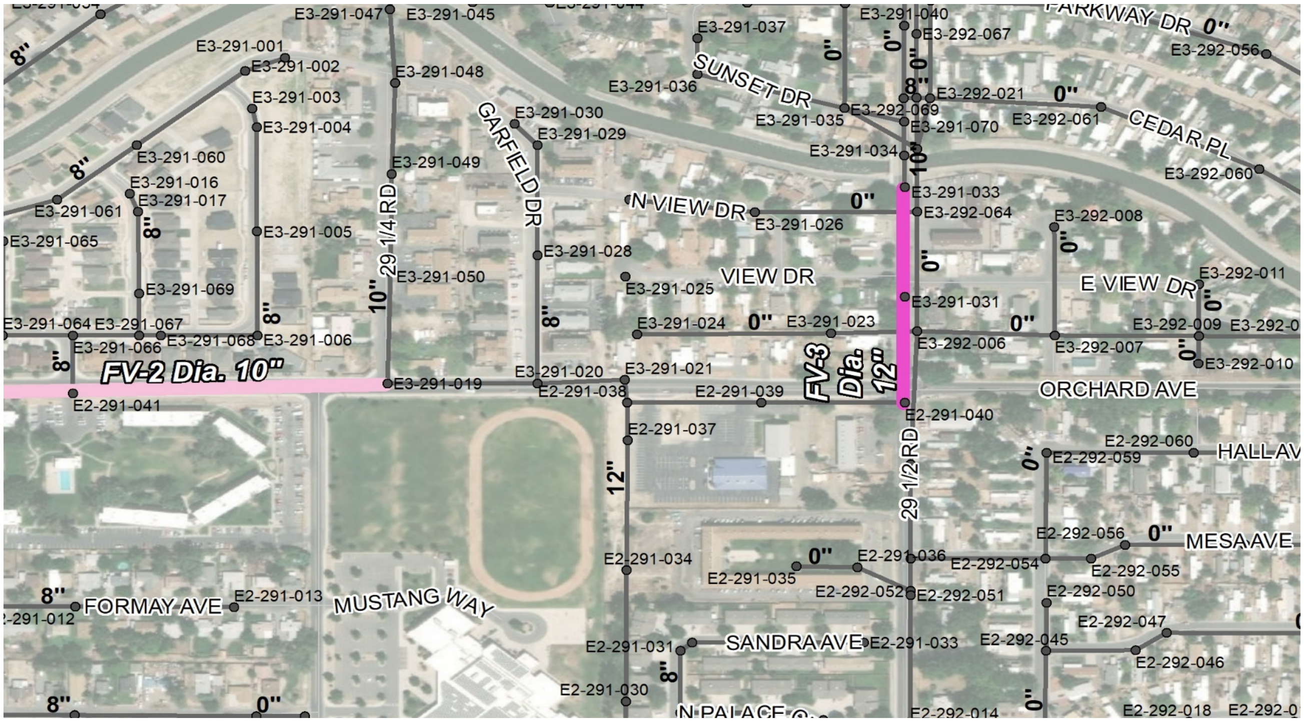
General Description

Upsized sewer along 29 1/2 Road.

Project Details

Upsized sewers are required to reduce the surcharging along 29 1/2 road. There are also parallel sewers near 29 1/2 road that should be evaluated during design of this project. This project was not evaluated as part of the 2008 study (not in model).

Project Detail Map



Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

carollo

Project ID: **GW-1**

General Location: Tiffany Drive from Village Way to Redlands Parkway

Improvements: Gravity

Project Type: Capacity

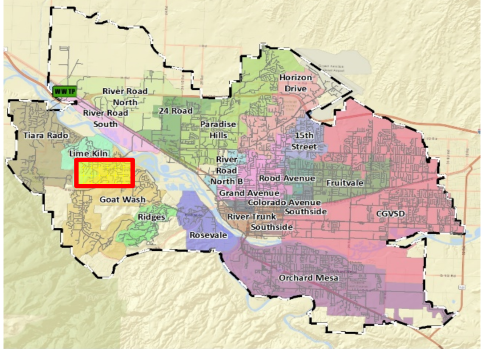
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	**$**	**837,800**
Construction Contingency	$	419,200
Estimated Construction Cost	**$**	**1,257,000**
Engineering Services, Construction Management and Project Administration	$	1,571,000
Total Capital Improvement Cost	**$**	**1,571,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030)	x
Long Term (2030 - 2040)	

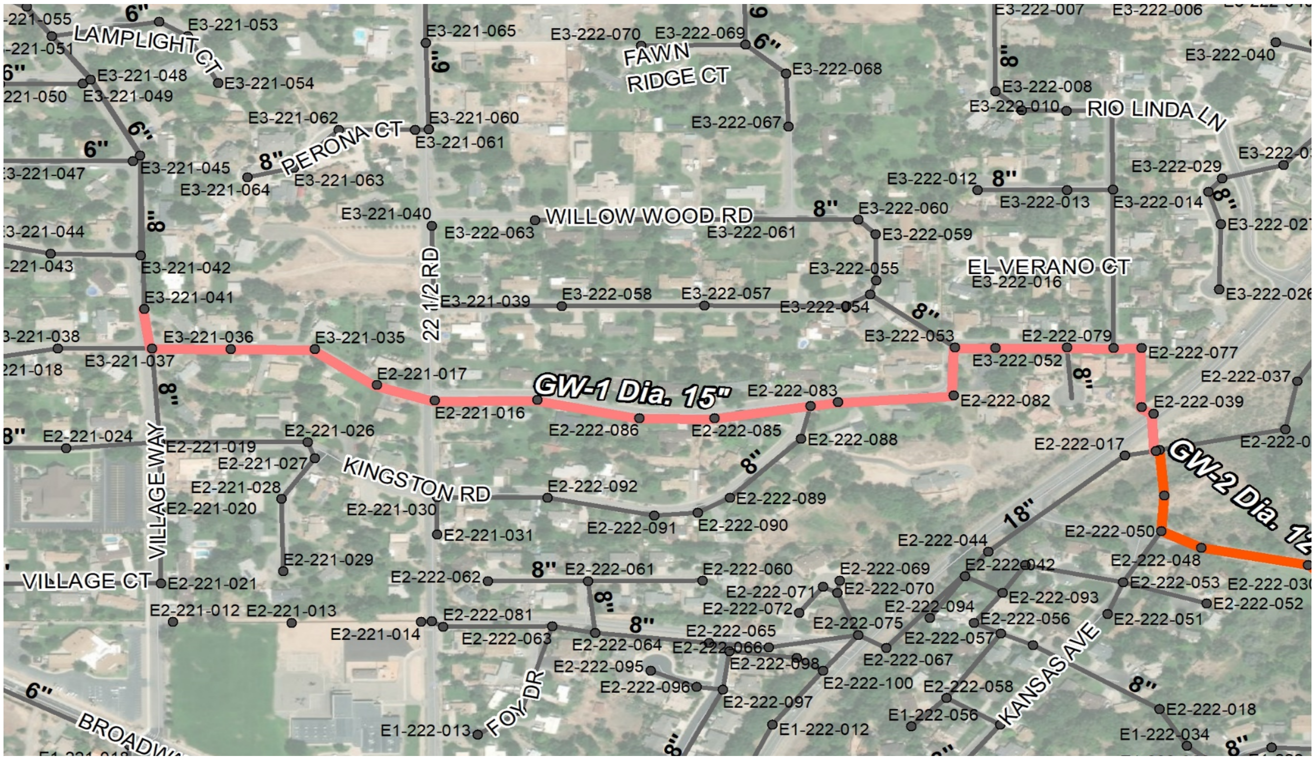
General Description

Upsized sewer along Tiffany Drive/El Rio Drive.

Project Details

Project is needed to increase LOS of the existing sewer along Tiffany Drive. The proposed sewer is located downstream of the Redlands Village Lift Station. The line is surcharged due to the flows conveyed from the lift station. The lift station operations and flows will need to be verified during design of this project. The sewer being replaced as part of this project was included as a 'watch list' pipe as part of the 2008 study.

Project Detail Map



Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

Project ID: GW-2

General Location: Refer to Detailed Map.

Improvements: Gravity, Forcemain, and Lift Station

Project Type: Capacity

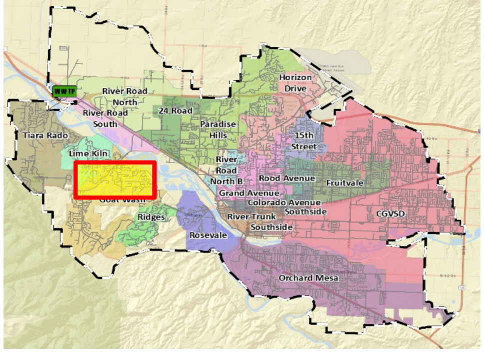
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	**$**	**2,780,300**
Construction Contingency	$	1,390,700
Estimated Construction Cost	**$**	**4,171,000**
Engineering Services, Construction Management and Project Administration	$	5,214,000
Total Capital Improvement Cost	**$**	**5,214,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030)	
Long Term (2030 - 2040)	x

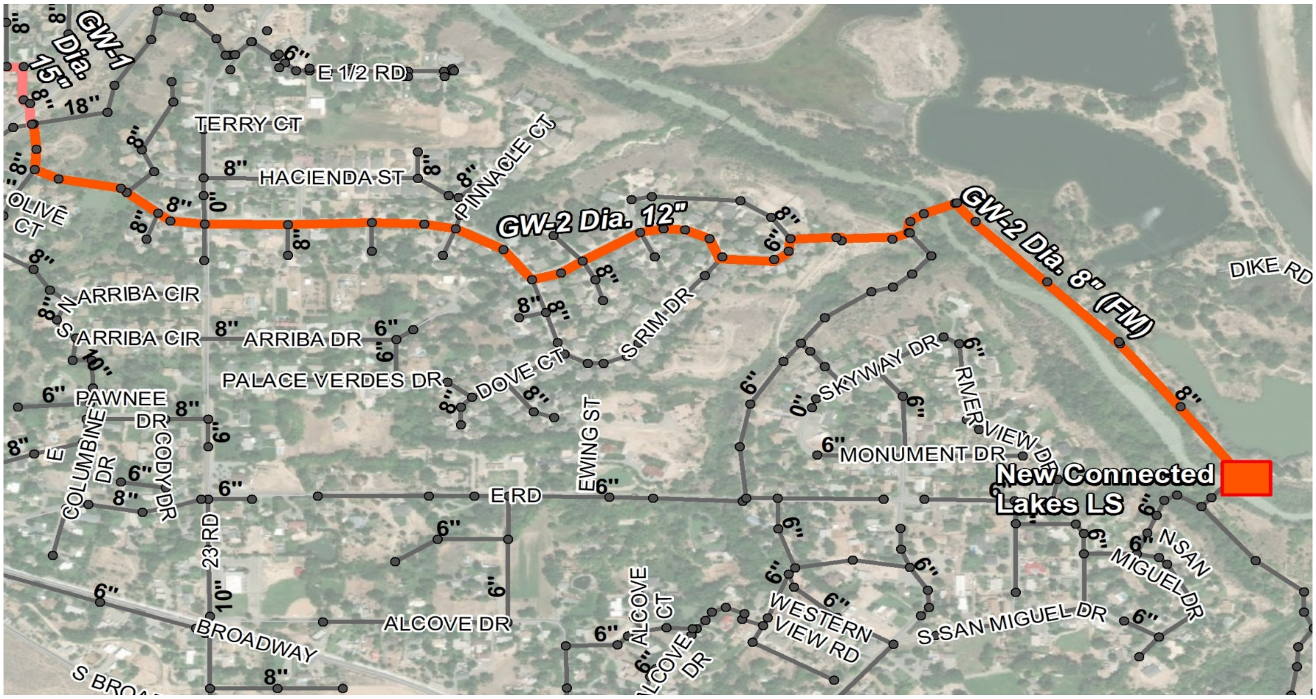
General Description

Upsized sewer along S Rim Drive. Upsized Connected Lakes Lift station Upsized Connected Lakes Lift station forcemain.

Project Details

Projected is needed to constructed a new Connected Lakes lift station/forcemain, and the downstream gravity sewer. The lift station/forcemain are capacity deficient, and the downstream sewer is deficient in the future. The flows to the existing Connected Lakes Lift station should be tracked in the future to verify design flows for the new lift station/forcemain/gravity sewer. This project was included in the 2008 study.

Project Detail Map



Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

Project ID: **OM-1**

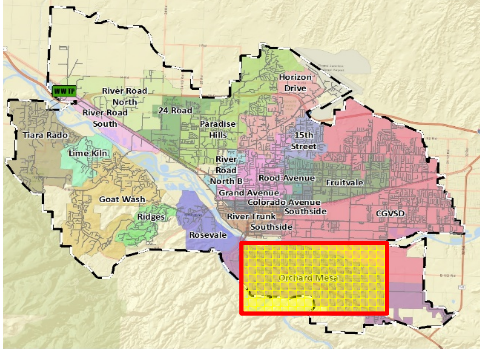
General Location: Downstream of 29 Road through Orchard Mesa.

Improvements: Gravity

Project Type: Capacity

Funding Type: City (Capacity Improvement)

Project Vicinity Map



Capital Improvement Costs

Baseline Construction Cost	**$**	**5,007,600**
Construction Contingency	$	2,504,400
Estimated Construction Cost	**$**	**7,512,000**
Engineering Services, Construction Management and Project Administration	$	9,391,000
Total Capital Improvement Cost	**$**	**9,391,000**

ENR CCI = 11,579 20-City Average, November 2020

Implementation Phase

Near Term (2020 - 2030)	x
Long Term (2030 - 2040)	

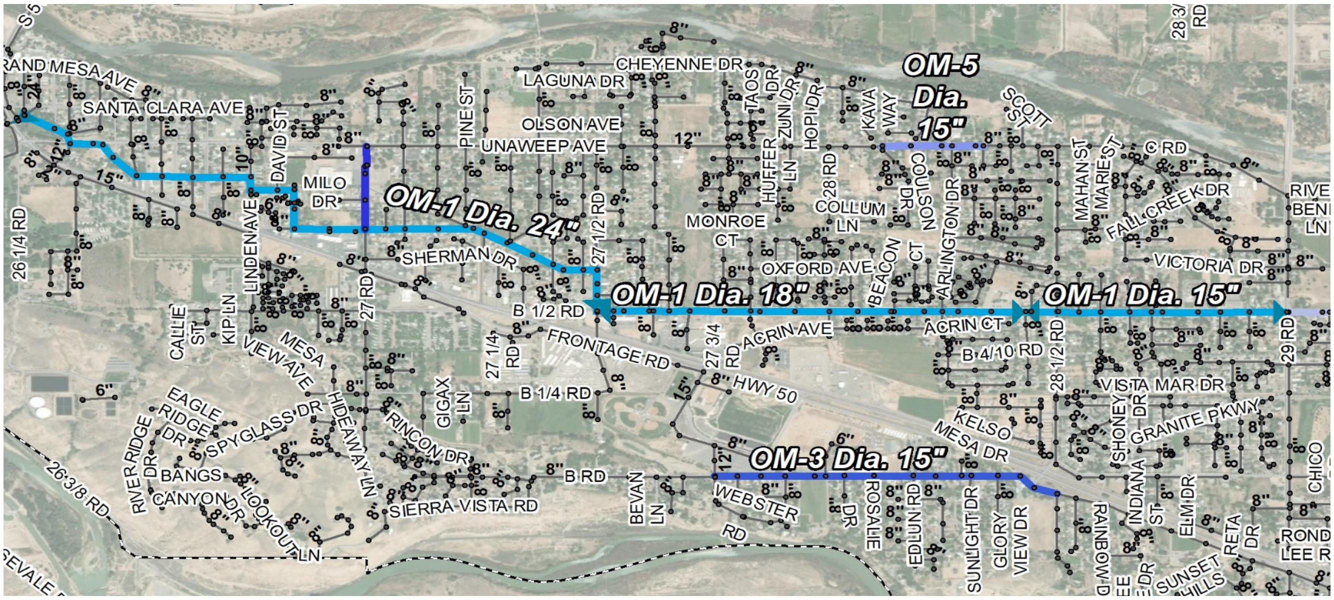
General Description

Upsized sewer along B 1/2 Road.

Project Details

This project includes upsizing the main trunk sewer through Orchard Mesa from 29 Road downstream to Unaweep Avenue. The upsized sewers includes sections of 15, 18, and 24-inch sewers as illustrated in the figure. The sewers are needed to reduce surcharging through the Orchard Mesa sewer basin. The design flows should be verified before the alignment/pipe sizes are finalized. This project was included in the CIP as part of the 2008 plan, and similar to the 2008 study alternative alignments along 29 Road were evaluated as summarized in Chapter 6. This project needs to be correlated with the other design projects in the Orchard Mesa basin.

Project Detail Map



Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

Project ID: OM-2

General Location: B 1/2 Road upstream of 29 Road.

Improvements: Gravity

Project Type: Capacity

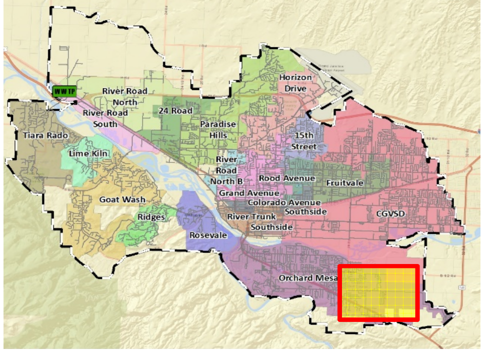
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	**$**	**2,081,000**
Construction Contingency	$	1,041,000
Estimated Construction Cost	**$**	**3,122,000**
Engineering Services, Construction Management and Project Administration	$	3,903,000
Total Capital Improvement Cost	**$**	**3,903,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030) x

Long Term (2030 - 2040) ____

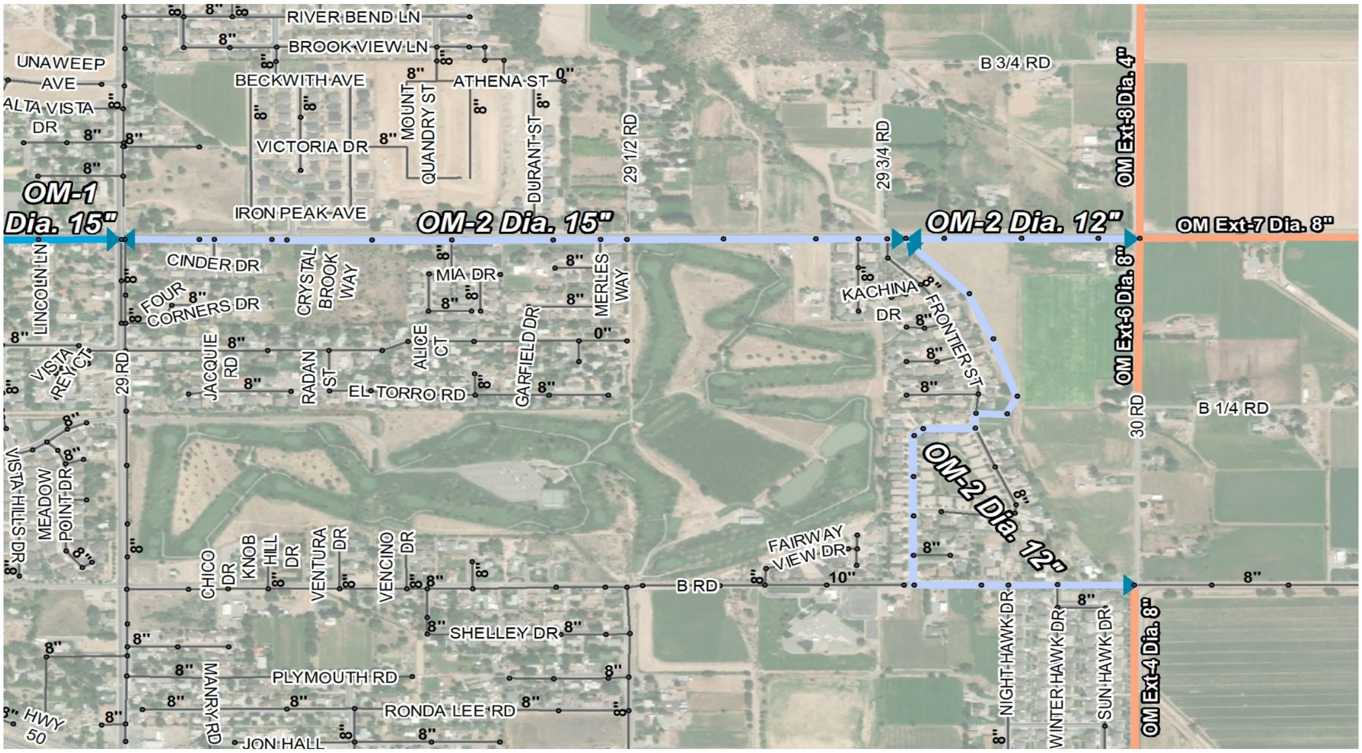
General Description

Upsized sewer along B 1/2 Road. Upsized sewer along Frontier Street.

Project Details

New sewers are required to minimize surcharge in the upper reaches of the Orchard Mesa sewer basin. The inverts of the sewers will need to be verified (model includes assumed inverts in this area). As illustrated in the figure the extension projects will need to be coordinated with this project as well. This project was included in the CIP as part of the 2008 study as a replacement pipe.

Project Detail Map



Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

Project ID: OM-3

General Location: B Road downstream of 28 1/2 Road.

Improvements: Gravity

Project Type: Capacity

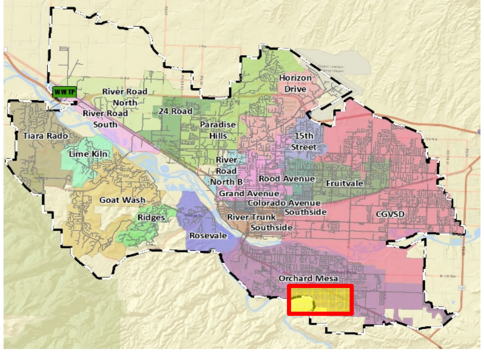
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	$	1,122,300
Construction Contingency	$	560,700
Estimated Construction Cost	$	1,683,000
Engineering Services, Construction Management and Project Administration	$	2,104,000
Total Capital Improvement Cost	**$**	**2,104,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030) x

Long Term (2030 - 2040)

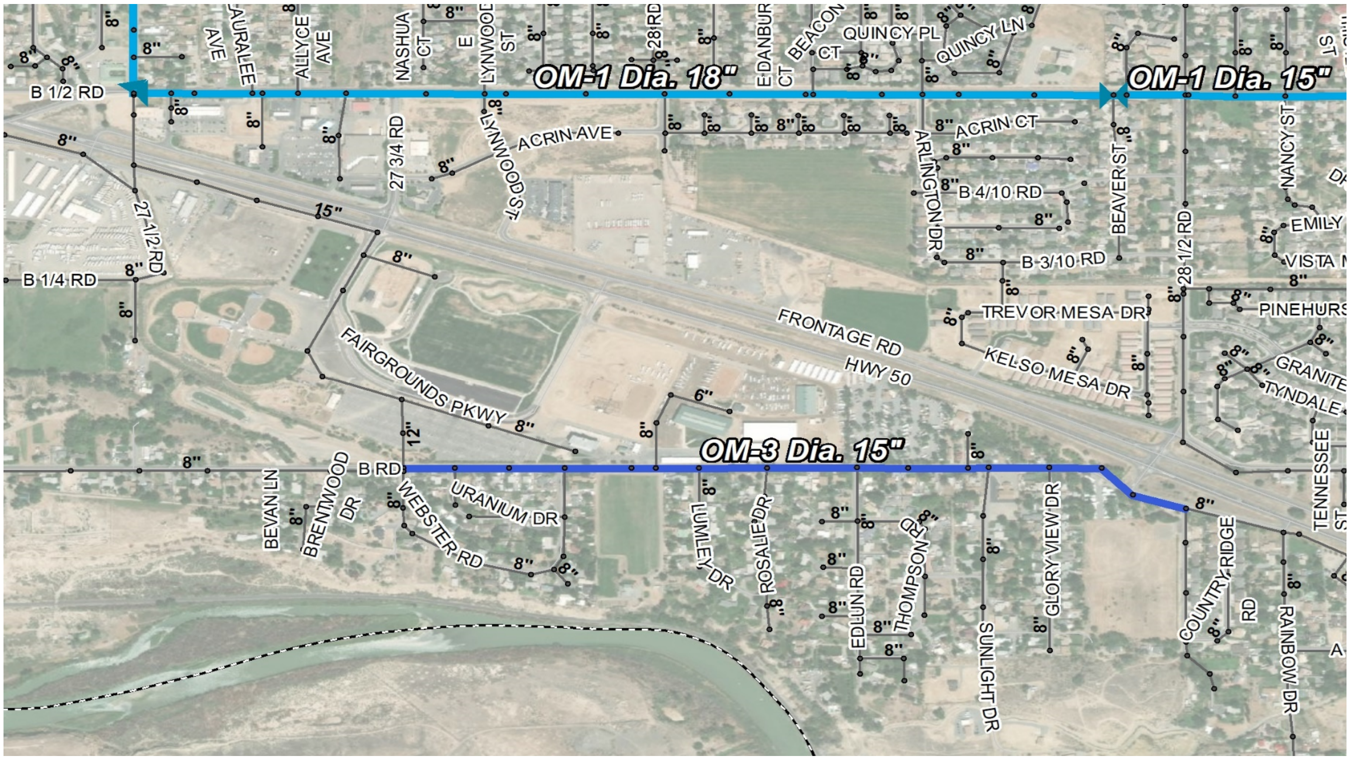
General Description

Upsized sewer along B Road.

Project Details

A new sewer is required to decrease surcharging along B Road. The new sewer size, capacity, and inverts should be coordinated with the downstream infrastructure. There may be some additional 12-inch sewer downstream of B Road that should be replaced. This project was not included in the CIP as part of the 2008 study (not identified as being capacity deficient).

Project Detail Map



Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

Project ID: OM-4

General Location: 27 Road from Unaweep Avenue to B 3/4 Road.

Improvements: Gravity

Project Type: Capacity

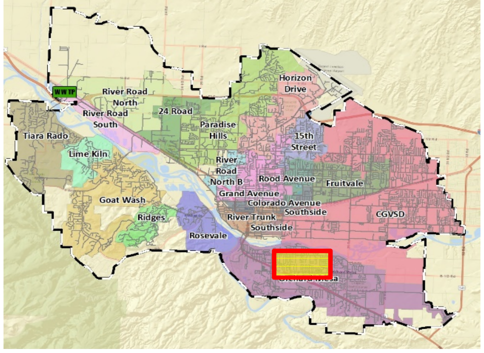
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	$	**333,500**
Construction Contingency	$	166,500
Estimated Construction Cost	**$**	**500,000**
Engineering Services, Construction Management and Project Administration	$	625,000
Total Capital Improvement Cost	**$**	**625,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030)	x
Long Term (2030 - 2040)	

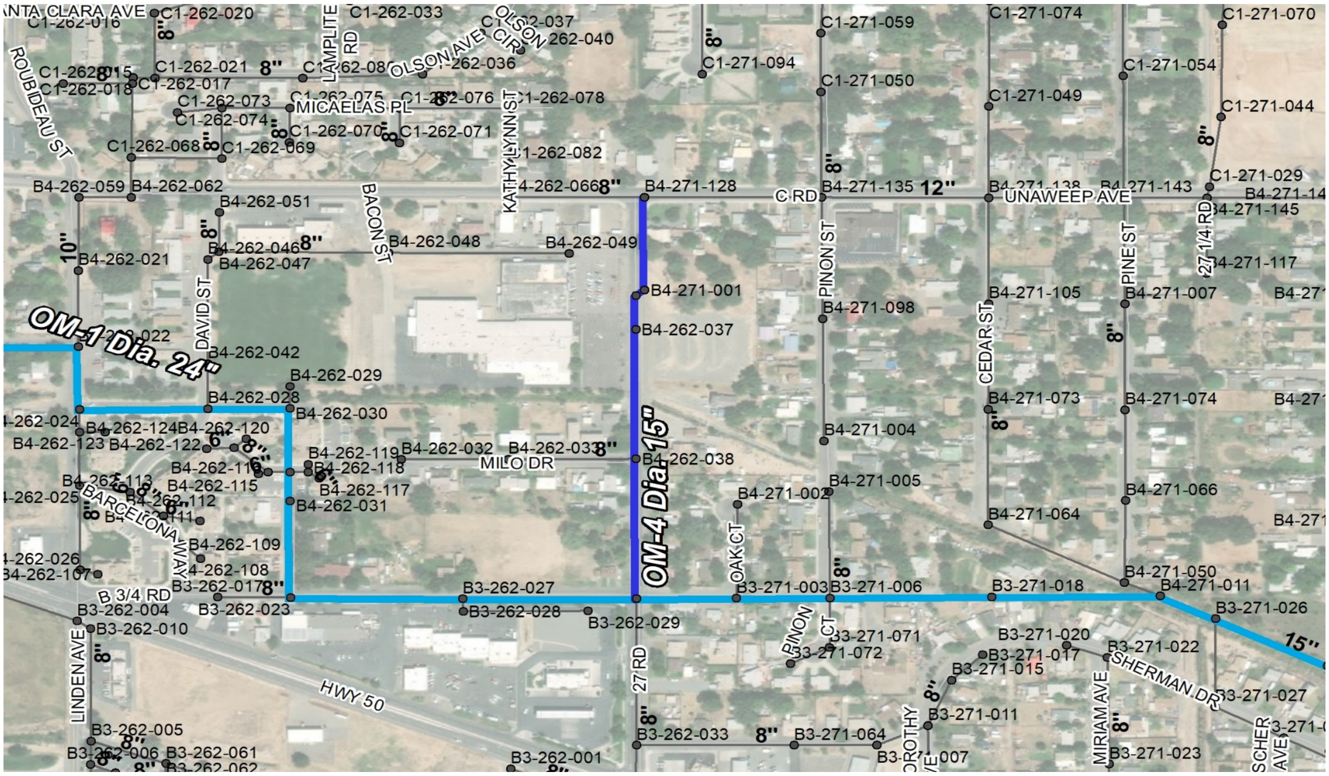
General Description

Upsized sewer along 27 Road.

Project Details

Upsized sewers are required to minimize surcharging along 27 Road. This project will need to be coordinated with OM-1 (downstream) and OM-5 (upstream). This project was included in the CIP as part of the 2008 study as a replacement pipe.

Project Detail Map



Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

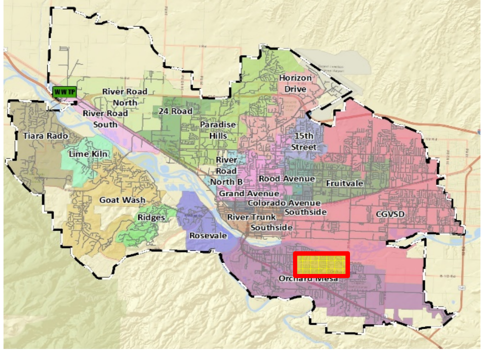
Project ID:	**OM-5**
General Location:	C Road from Boston Lane to Coulson Drive
Improvements:	Gravity
Project Type:	Capacity
Funding Type:	City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	**$**	**289,000**
Construction Contingency	$	145,000
Estimated Construction Cost	**$**	**434,000**
Engineering Services, Construction Management and Project Administration	$	543,000
Total Capital Improvement Cost	**$**	**543,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030)	x
Long Term (2030 - 2040)	

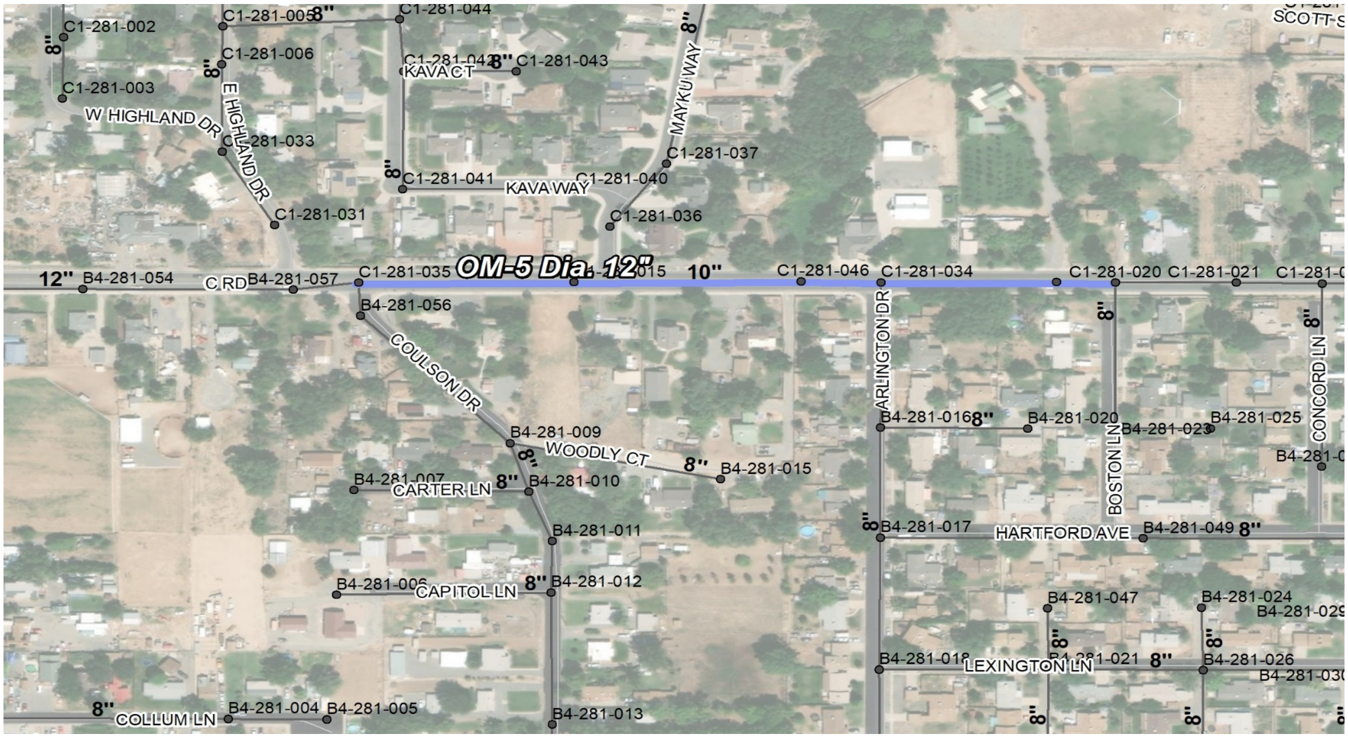
General Description

Upsized sewer along C Road.

Project Details

New sewer is required to reduce surcharging along C Road. This project will need to be coordinated with OM-4. Also, the capacity/inverts of the existing sewers upstream and downstream of this project should be reviewed. As illustrated in the figure the upstream sewer is 8-inches in diameter so it was not included in the master planning model. This project was included in the CIP as part of the 2008 study as a replacement pipe.

Project Detail Map



Detailed CIP Project Overview
2020 Comprehensive Wastewater Basin Study Update
City of Grand Junction

Project ID: **RRN-1**

General Location: 23 Road upstream of 54-inch Interceptor.

Improvements: Gravity

Project Type: Capacity

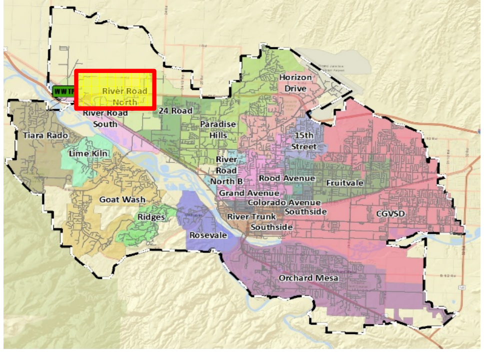
Funding Type: City (Capacity Improvement)

Capital Improvement Costs

Baseline Construction Cost	**$**	**913,800**
Construction Contingency	$	457,200
Estimated Construction Cost	**$**	**1,371,000**
Engineering Services, Construction Management and Project Administration	$	1,714,000
Total Capital Improvement Cost	**$**	**1,714,000**

ENR CCI = 11,579 20-City Average, November 2020

Project Vicinity Map



Implementation Phase

Near Term (2020 - 2030) x

Long Term (2030 - 2040) ______

General Description

Upsized sewer along River Road North.

Project Details

A new sewer is required to minimize surcharging along 23 Road. The new will may have to cross the railroad tracks as illustrated in the figure. The new sewer should be coordinated with the existing sewers in the area. As illustrated in the figure the upstream sewers are 8-inches in diameter, and the City noted there were recent replacement projects performed in the area. This project was included in the CIP as part of the 2008 study as a new extension pipe.

Project Detail Map