City of FRESNO
DEPARTMENT OF PUBLIC UTILITIES
WATER & CONSERVATION • WASTEWATER & RECLAMATION • SOLID WASTE & RECYCLING
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WASTEWATER COLLECTION SYSTEM
MASTER PLAN UPDATE

Final • September 2015

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DEPARTMENT OF PUBLIC UTILITIES

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City of Fresno

September 2015

FINAL

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY J. LOPER
No. 70847
CIVIL
STATE OF CALIFORNIA

September 18, 2015

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

September 18, 2015

carollo

710 W. PINEDALE AVENUE • FRESNO, CALIFORNIA 93711 • P. 559.436.6616 • F. 559.436.1191
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WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

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WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

This executive summary presents a brief background of the City of Fresno (City) wastewater collection system, the need for this master plan update, proposed improvements to mitigate existing system deficiencies, and proposed expansion projects. A summary of capital improvement project costs is included at the end of this chapter.

ES.1 INTRODUCTION

The City was founded in 1872 by the Central Pacific Railroad Company and incorporated in 1885. The City has since grown to over 112 square miles with a population of just under a half million people in the incorporated area. Today, Fresno is the fifth largest city in the state of California. Centrally located, Fresno is the financial, industrial, trade, and commercial capital in the Central San Joaquin Valley. Figure ES.1 presents a location map of the City. The City is the hub of a region rich in heritage, resources, and people.

The City owns and operates the Fresno/Clovis Regional Wastewater Reclamation Facility (RWRF), as well as the smaller North Fresno Wastewater Reclamation Facility (NFWRF). The City owns and maintains a wastewater collection system that serves the City and the other participating agencies: the County of Fresno, the majority of the City of Clovis, the Pinedale Public Utility District, and the Pinedale County Water District.

ES.2 STUDY AREA

The area served by the City is characterized by residential, commercial, and industrial uses within the City limits. While the City has a diverse economy, Fresno County is the nations' top-ranked agriculture-producing county. There are some agricultural lands within the metropolitan area that are interspersed on larger parcels along the fringe of urbanized area and in between parcels.

There are many open space areas within the City, including Woodward Park and Roeding Park which is home of the Fresno Chaffee Zoo. The main water bodies near the City are located on the outskirts of town. The San Joaquin River runs east and west just to the North of the City limits. The Kings River is about 12 miles east of the City limits and the City diverts water from the river for part of their water supply. The Sierra Nevada Mountains are located about 25 miles east of the City.

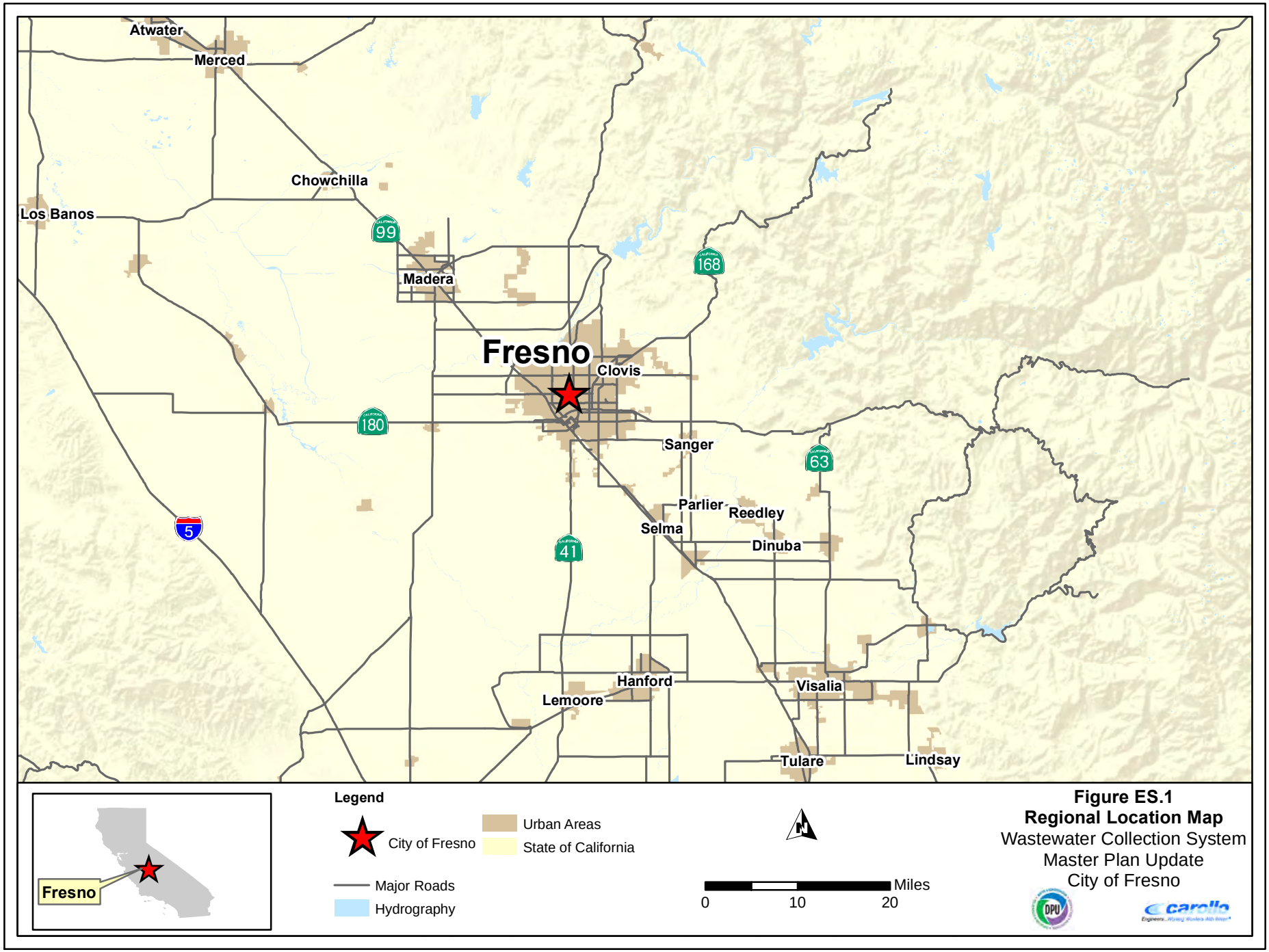

Figure ES.1
Regional Location Map
Wastewater Collection System
Master Plan Update
City of Fresno

There are four major highways that run through the City which include State Route 99, State Route 168, State Route 41, and State Route 180. State Route 99 connects the major cities in the central valley and runs north and south. State Route 168 heads east out of the City through Clovis and heads to the Sierras to the east. State Route 41 runs north and south which connects to Atascadero in the South and to Yosemite to the north. State Route 180 runs east and west which connects to Mendota to the west and to Kings Canyon National Park to the east.

The City's proposed Sphere of Influence (SOI), as defined in Fresno General Plan (General Plan) is the study area boundary for this Wastewater Collection System Master Plan Update (Master Plan). The Master Plan study area boundary and the SOI are synonymous and will be used interchangeably throughout this report. The Master Plan study area is intended to include the existing City limits and development that could occur through build out of the City's General Plan. The General Plan Buildout (Buildout) is defined as all developable sites will be fully occupied according to the General Plan.

ES.3 SEWER SERVICE AREA

Figure ES.2 illustrates the City's current wastewater service area. The City manages and maintains more than 1,500 miles of gravity sewer lines up to 84-inches in diameter, 15 active lift stations, and associated force mains. Nearly all of the wastewater generated within the sewer service area is conveyed to the City's RWRF for treatment, with the exception of a small amount of flow that is treated at the City's NFWRF. In addition, the City of Clovis recently constructed its own wastewater treatment facility on the eastern edge of the Clovis City limits (near the intersection of Ashlan Avenue and McCall Avenue), which provides wastewater service for a portion of the City of Clovis. However, most of the flow generated within the City of Clovis is treated at the RWRF.

The land use assumptions in this Master Plan were based on the Fresno General Plan and projected future developments within the City's proposed growth boundary. Should future planning conditions change from the assumptions stated in this Master Plan (i.e., accelerated growth, more intense developments, etc.), revisions and adjustments to the Master Plan recommendations would be necessary.

ES.4 WASTEWATER FLOWS

In general, wastewater consists of base wastewater flow (BWF) and wet weather flow (WWF). BWF is flow generated by routine water usage in the residential, commercial, business and industrial sectors of the collection system. WWF includes storm water inflow, trench infiltration, and wet weather ground water infiltration.

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave

Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave

NFWRF
LS05
LS06
LS10
LS04
LS16
LS14
LS12
LS03
LS15
LS13
LS18
LS02
LS01
LS20
RWRF

99
41
168
180

Legend

Existing Wastewater Collection System

- Lift Stations
- Special Structures

Pipelines

- 8" and Smaller
- 10" - 18"
- 20" - 36"
- Greater than 36"
- Streets
- Existing Sewer Service Area
- City Limits

N

0 10,000 20,000 Feet

Figure ES.2
Wastewater Service Area
Wastewater Collection System
Master Plan Update
City of Fresno

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Peak wet weather flow (PWWF) is the highest observed hourly flow that occurs following the design storm event. The City's sewers and lift stations were evaluated based on their capacity to convey the "design flow ("design flow" is synonymous to PWWF in this study).

A summary of the existing and build-out BWF and the PWWF is presented in Table ES.1. The City's BWF is projected to roughly double from 64.1 million gallons per day (mgd) to 129.9 mgd by build out, whereas the PWWF is projected to increase from 123.9 mgd to about 202.4 mgd by build out (an increase of approximately 63-percent). Therefore, the City's PWWF to BWF peaking factor is projected to decrease from roughly 1.93 to 1.56, which is relatively low for sanitary sewer collection systems.

Table ES.1 Current and Projected Wastewater Flows
Wastewater Collection System Master Plan Update
City of Fresno

Year	BWF[(1)] (mgd)	PDWF[(2)] (mgd)	PDWF Peaking Factor	PWWF[(3)] (mgd)	PWWF Peaking Factor
Existing	64.1	88.5	1.38	123.9	1.93
Build Out	129.9	164.7	1.27	202.4	1.56

Notes:
(1) BWF = Base Wastewater Flow.
(2) PDWF = Peak Dry Weather Flow.
(3) PWWF = Peak Wet Weather Flow.

ES.5 CAPACITY EVALUATION AND PROPOSED IMPROVEMENTS

The capacity analysis identified areas in the sewer system where flow restrictions occur or where pipe capacity is insufficient to convey design flows. Sewers that lack sufficient capacity to convey design flows create bottlenecks in the collection system that can potentially cause sanitary sewer overflows (SSOs).

For the existing sewer collection system, the Peak Dry Weather Flow (PDWF) and PWWF were routed through the hydraulic model. In accordance with the established flow depth criteria for sewers during PDWF, pipelines where the maximum depth to full flow depth (d/D) ratio that exceeded 1.0 were flagged. Each pipeline with a maximum d/D in excess of 1.0 was reviewed on a case-by-case basis to determine if a capacity improvement project was warranted. Similarly, in accordance with the established flow depth criteria for sewers during PWWF, manholes where the maximum flow to full flow (q/Q) ratio that exceeded 1.15 were flagged. Each pipeline with a maximum q/Q in excess of 1.15 was reviewed on a case-by-case basis to determine if a capacity improvement project was warranted.

In general, the City's collection system has sufficient capacity to convey current PWWFs without exceeding the established flow depth criterion. However, there are a few areas

where capacity restrictions lead to flow depths that exceed allowable levels. Following the completion of the existing system analysis, improvement projects and alternatives were identified in order to mitigate existing system pipeline capacity deficiencies.

The build out system analysis was performed in a manner similar to the existing system analysis. The purpose of the build out system evaluation is to verify that the existing system improvements were appropriately sized to convey build out PWWFs, and to identify the locations of sewers that are adequately sized to convey existing PWWFs, but cannot convey build out PWWFs. Additionally, new trunk sewers were added to the hydraulic model and sized to service major growth areas beyond the current City sewer service area.

Figure ES.3 illustrates the improvements recommended to mitigate capacity deficiencies in the existing and future sewer collection system and improvements to accommodate future growth as identified by the hydraulic analysis. Details of each improvement are also provided in Table ES.2.

ES.5.1 Project Prioritization

The majority of improvements listed in Table ES.2 are driven by future development, which consist of new sewers that serve future growth or improvements to existing facilities that are needed to serve future growth. When fully implemented, the capital projects will allow the conveyance of PWWFs to the RWRF during build out conditions.

Prioritizing the required capital improvements for the City's sewer system is an important aspect of this study. The improvement projects were prioritized based on the following factors:

- Upgrading existing facilities to mitigate current capacity deficiencies and to serve future users
- Building the new trunks necessary to serve future users

Improvements to existing facilities will provide sufficient capacity to mitigate existing issues and to convey increased flows resulting from future growth. Future development will require the construction of sewers to serve new users. The projects were grouped into the following phases:

- Phase 1: Years 2014 through 2015
- Phase 2: Years 2016 through 2020
- Phase 3: Years 2021 through 2025
- Phase 4: Years 2026 through 2030

Dickenson Ave
West Lawn Ave
Chateau Fresno Ave
Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave
Del Rey Ave
Bethel Ave
Academy Ave
Madsen Ave

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave
Central Ave
American Ave

NFWRF
RWRF
LS01
LS02
LS03
LS04
LS05
LS06
LS10
LS12
LS13
LS14
LS15
LS16
LS18
LS20
GALLO
Direct Storm Drain Connections to be Removed

Legend

Existing Wastewater Collection System

- Lift Stations

Pipelines

- 8" and Smaller
- 10" and Larger

Proposed Improvements

- Existing System
- Future System
- Development
- Gallo Winery I/I Reduction Program
- Streets
- Sphere of Influence
- City Limits
- Existing Sewer Service Area

N

0 12,500 25,000 Feet

Figure ES.3
Proposed Collection System Capacity Improvements
Wastewater Collection System Master Plan Update
City of Fresno

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Table ES.2 Capital Improvement Projects
Wastewater Collection System Master Plan
City of Fresno

Job No.	Project Type	Description / Limits	Existing Diameter (in)	New Diameter (in)	Rehab, Replace, or New	Length (ft)	Improvement Cost ($)	Capital Improvement Phasing				Future User Benefit (%)	Reimbursement Category	
								Phase 1 2015-2020 ($)	Phase 2 2021-2025 ($)	Phase 3 2026-2030 ($)	Phase 4 2031-2035 ($)		Existing Improvements	Future Improvements
Existing Improvements														
C1	ravit	a o ve e et ee lacito e ve. a St.	20	**24**	Replace	30	4120000	4120000				7	383160	28840
C1	ravit	Street ro a o ve. to a Salle ve.	20	**24**	Replace	1822	868000	868000				7	807240	60760
C2	ravit	le ve e ro re er ve. to o a ve.	24	**27**	Replace	31	430000	430000				7	399200	30100
C2	ravit	le ve e ro 180 to oor a ve.	24	**27**	Replace	2580	1580000		1580000			14	1358800	221200
C3	ravit	le ve e Street ro oor a ve. to ol e St.	27	**30**	Replace	1530	1148000			1148000		1	2288880	218120
C4	ravit	Mo tere Street ro lto Street to Street	6	**10**	Replace	1812	683000			683000		0	683000	
C5	ravit	itt Street ro e t ra St. to oo ar ve.	36	**42**	Replace	4717	3825000			3825000		17	3174750	650250
C5	ravit	oo ar ve e ro itt St. to Ora e ve.	36	**42**	Replace	62	733000			733000		17	608390	124610
C5C	ravit	Ora e ve e ro oo ar ve. to Cali or ia ve.	36	**42**	Replace	693	778000			778000		17	645740	132260
C6	ravit	Sa or ve e ro Pro cer air to Street	6	**8**	Replace	30	32000		32000			0	32000	
							Existing Improvement Totals	**$ 1,710,000**	**$ 1,909,000**	**$ 7,167,000**	**$ -**		**$ 9,319,860**	**$ 1,466,140**
Build-Out Improvements														
C7	ravit	ol e Street a e ve e ro Street to Merce St.	27	**30**	Replace	1567	1228000				1228000	100		1228000
C8	ravit	ort ve e ro Pol ve. li e t to ir it ve.		**60**	e	20857	1615000				1615000	100		1615000
C	ravit	ort ve e ro ir it ve. to Ora e ve.	60	**60**	Rea	1514	1376000				1376000	100		1376000
1	ravit	e era ce ve e ro ort ve. to e e ve.		**48**	e	5875	4805000				4805000	100		4805000
2	ravit	e era ce ve e ro e e e ve. to lare St.		**42**	e	1352	1224000				1224000	100		1224000
3	ravit	e era ce ve e ro lare St. to Olive ve.		**36**	e	487	508000				508000	100		508000
4	ravit	e era ce Mc i le e ol ro Olive ve. to Siel ve.		**30**	e	1300	770000				770000	100		770000
5	ravit	Siel ve. eo ar ve. ro e ol ve. to a ota ve.		**27**	e	4575	2837000				2837000	100		2837000
6	ravit	e e e ve e ro e era ce ve. to e ol ve.		**15**	e	5228	2053000				2053000	100		2053000
6	ravit	e e e ve e ro e ol ve. to eo ar ve.		**12**	e	2732	643000				643000	100		643000
7	ravit	C rc ve e ro e era ce ve. to oca ve.		**15**	e	2552	1016000				1016000	100		1016000
7	ravit	C rc ve e ro oca ve. to e ol ve.		**12**	e	2772	630000				630000	100		630000
7C	ravit	C rc ve e ro e ol ve. to eo ar ve.		**8**	e	2673	82000				82000	100		82000
8	ravit	Cali or ia ve e ro e era ce ve to oca ve.		**18**	e	2676	1137000				1137000	100		1137000
8	ravit	Cali or ia ve e ro oca ve. to e ol ve.		**15**	e	2670	1058000				1058000	100		1058000
8C	ravit	Cali or ia ve e ro e ol ve. to eo ar ve.		**10**	e	2617	870000				870000	100		870000
	ravit	tler ve e ro e e era ce ve to oca ve.		**18**	e	2617	1115000				1115000	100		1115000
	ravit	tler ve e ro oca ve. to e ol ve.		**15**	e	2611	1037000				1037000	100		1037000
C	ravit	tler ve e ro e ol ve. to eo ar ve.		**8**	e	2778	862000				862000	100		862000
10	ravit	lare Street ro e e era ce ve. to oca ve.		**21**	e	2730	1237000				1237000	100		1237000
10	ravit	lare Street e ol ve e ro oca ve. to a rel ve. li e t		**15**	e	4035	1586000				1586000	100		1586000
10C	ravit	a rel ve e e li e t ro e ol ve. to eo ar ve.		**8**	e	2772	845000				845000	100		845000
10	ravit	oca ve e el o t ve. ro lare St. to e ol ve.		**12**	e	4026	1738000				1738000	100		1738000
10	ravit	el o t ve e ro e ol ve. to eo ar ve.		**10**	e	2554	851000				851000	100		851000
11	ravit	Olive ve e ro e e era ce ve. to oca ve.		**15**	e	2671	1058000				1058000	100		1058000
11	ravit	Olive ve e ro oca ve. to e ol ve.		**12**	e	2613	266000				266000	100		266000
11C	ravit	Olive ve e ro e ol ve. to eo ar ve.		**8**	e	2617	813000				813000	100		813000
12	ravit	Mc i le ve e ro e ol ve. to eo ar ve.		**21**	e	2772	1237000				1237000	100		1237000
12	ravit	Mc i le ve e ro eo ar ve. to o o ve.		**18**	e	5103	2157000				2157000	100		2157000
12C	ravit	o o ve e ro Mc i le ve. to Cli to ve.		**15**	e	2730	1807000				1807000	100		1807000
13	ravit	Cli to ve e ro e ol ve. to eo ar ve.		**10**	e	2842	832000				832000	100		832000
14	ravit	ort ve e ro Peac ve. to e era ce ve.		**36**	e	15787	11051000				11051000	100		11051000

Table ES.2 Capital Improvement Projects
Wastewater Collection System Master Plan
City of Fresno

Job No.	Project Type	Description / Limits		Existing Diameter (in)	New Diameter (in)	Rehab, Replace, or New	Length (ft)	Improvement Cost ($)	Capital Improvement Phasing				Future User Benefit (%)	Reimbursement Category	
									Phase 1 2015-2020 ($)	Phase 2 2021-2025 ($)	Phase 3 2026-2030 ($)	Phase 4 2031-2035 ($)		Existing Improvements	Future Improvements
??15	?ravit?	Mi??e? a? a ?ve??e	?ro? ?ort? ?ve. to ???a?ale ?ve.	?	12	?e?	2?730	? ?64?000				? ?64?000	100?	? ?	? ?64?000
??16	?ravit?	S?????e ?ve??e	?ro? ?ort? ?ve. to ???a?ale ?ve.	?	15	?e?	2?611	? 10?037?000				? 10?037?000	100?	? ?	? 10?037?000
??17	?ravit?	?o? ler ?ve??e	?ro? ?ort? ?ve. to ???a?ale ?ve.	?	10	?e?	2?78?	? ??22?000				? ??22?000	100?	? ?	? ??22?000
??18	?ravit?	?r? ?tro?? ?ve??e	?ro? ?ort? ?ve. to ???a?ale ?ve.	?	8	?e?	2?671	? 828?000				? 828?000	100?	? ?	? 828?000
??1??	?ravit?	?ale?ti?e ?ve??e	?ro? C??rc? ?ve. to ?ear?e? ?ro?ta?e	?	12	?e?	3??45	? 1?38?000				? 1?38?000	100?	? ?	? 1?38?000
??1??	?ravit?	?ale?ti?e ?ve??e	?ro? ?ear?e? ?ro?ta?e to Ma?i?o? ?ve.	?	10	?e?	1?312	? 444?000				? 444?000	100?	? ?	? 444?000
??20	?ravit?	?ra? le? ?ve??e	?ro? C??rc? ?ve. to Ma?i?o? ?ve.	?	8	?e?	5?303	? 1?630?000				? 1?630?000	100?	? ?	? 1?630?000
??21?	?ravit?	? ?ite??ri??e ?ve??e	?ro? Pol??ve. to ?l?t?e ?ve.	?	12	?e?	5?271	? 1?851?000				? 1?851?000	100?	? ?	? 1?851?000
??21?	?ravit?	? ?ite??ri??e??ra? le??ve??e	?ro? ?l?t?e ?ve. to ?iel?e? ?ve.	?	10	?e?	5?3?2	? 1?773?000				? 1?773?000	100?	? ?	? 1?773?000
??22?	?ravit?	?el? o?t ?ve??e	?ro? Pol??ve. to Cor?elia ?ve.	?	12	?e?	2?716	? ?5?000				? ?5?000	100?	? ?	? ?5?000
??22?	?ravit?	?el? o?t ?ve??e	?ro? Cor?elia ?ve. to ?l?t?e ?ve.	?	10	?e?	2?675	? 887?000				? 887?000	100?	? ?	? 887?000
??22C	?ravit?	?el? o?t ?ve??e	?ro? ?l?t?e ?ve. to ?ra? le??ve.	?	8	?e?	2?640	? 81?000				? 81?000	100?	? ?	? 81?000
??23?	?ravit?	Olive ?ve??e	?ro? Pol??ve. to ?l?t?e ?ve.	?	12	?e?	5?260	? 1?847?000				? 1?847?000	100?	? ?	? 1?847?000
??23?	?ravit?	Olive ?ve??e	?ro? ?l?t?e ?ve. to ?ra? le??ve.	?	8	?e?	2?675	? 82?000				? 82?000	100?	? ?	? 82?000
??24?	?ravit?	Olive ?ve??e	?ro? ?ra?tla?? ?ve. to ?r?a? ?ve.	?	12	?e?	2?64?	? ?37?000				? ?37?000	100?	? ?	? ?37?000
??24?	?ravit?	Olive ?ve??e	?ro? ?r?a? ?ve. to ?a?e??ve.	?	10	?e?	1?73	? 65?000				? 65?000	100?	? ?	? 65?000
??25	?ravit?	Mc?i?le? ?ve??e	?ro? ?ra?tla?? ?ve. to Ri??ve.	?	10	?e?	3?603	? 1?1??000				? 1?1??000	100?	? ?	? 1?1??000
??26?	?ravit?	Cli?to? ?ve??e	?ro? ?ra?tla?? ?ve. to ?r?a? ?ve.	?	12	?e?	2?645	? ?36?000				? ?36?000	100?	? ?	? ?36?000
??26?	?ravit?	Cli?to? ?ve??e	?ro? ?r?a? ?ve. to ?a?e??ve.	?	10	?e?	2?5?2	? 862?000				? 862?000	100?	? ?	? 862?000
??27?	?ravit?	S?iel???ve??e	?ro? ?ra?tla?? ?ve. to ?r?a? ?ve.	?	15	?e?	2?627	? 1?042?000				? 1?042?000	100?	? ?	? 1?042?000
??27?	?ravit?	S?iel???ve??e	?ro? ?r?a? ?ve. to ?a?e??ve.	?	12	?e?	2?5?2	? ?1?000				? ?1?000	100?	? ?	? ?1?000
							Build-Out Improvement Totals	**$ 125,170,000**	**$ -**	**$ -**	**$ -**	**$ 125,170,000**		**$ -**	**$ 125,170,000**
New Facilities															
?C?? R??1	?reat? e?t	Ce?ar??a?ota?Scal?i?? Pla?t at ?aca?t ?iel? ?e?i?? ?ra?ite Par?	?	?	**6 mgd**	?e?	?	? 51?106?000		? 51?106?000			0?	? 51?106?000	? ?
?C?? R??2	?ravit?	?a?ota??ro? ?reat? e?t ?acilit? to Mill?roo? ?ve.	?	?	**36**	?e?	4?042	? 2?833?000		? 2?833?000			0?	? 2?833?000	? ?
S???	?reat? e?t	?e? ?era?ce?Scal?i?? Pla?t O? Cor?er o??e? ?era?ce a?? ?ort? ?ve.	?	?	**15 mgd**	?e?	?	? 77?760?000				? 77?760?000	100?	? ?	? 77?760?000
							New Facilities Totals	**$ 131,699,000**	**$ -**	**$ 53,939,000**	**$ -**	**$ 77,760,000**		**$ 53,939,000**	**$ 77,760,000**
Lift Stations															
?SF1	?i?t Statio?	? e?t o??e?e?e? a?? ? al??t ?ve??e?	?	?	?	?	?	? 15?000	? 15?000					? 15?000	? ?
?SF2	?i?t Statio?	?ear?e? ?o?levar? a?? Mar???ve??e	?	?	?	?	?	? 3??000	? 3??000					? 3??000	? ?
?SF3	?i?t Statio?	?ort? o?S?iel? a?? ? il?o? ?ve??e?	?	?	?	?	?	? 15?000	? 15?000					? 15?000	? ?
?SF4	?i?t Statio?	Rivervie? ?rive a?? ?l????ve??e	?	?	?	?	?	? 200?000	? 200?000					? 200?000	? ?
?SF5	?i?t Statio?	?ort ? a??i??to? Roa? a?? C?a? ?lai? ?rive	?	?	?	?	?	? ?6?000	? ?6?000					? ?6?000	? ?
?SF6	?i?t Statio?	So??ea?t o?Perri? ?ve??e a?? C?a? ?lai? ?rive	?	?	?	?	?	? 114?000	? 114?000					? 114?000	? ?
?SF10	?i?t Statio?	Strat?or? a?? ? oo?la? ? ?rive?	?	?	?	?	?	? 4??000	? 4??000					? 4??000	? ?
?SF11	?i?t Statio?	?a?t o?Ce?ar a?? Co??er ?ve??e?	?	?	?	?	?	? 160?000	? 160?000					? 160?000	? ?
?SF12	?i?t Statio?	Car?e?ie a?? ??llar? ?ve??e?	?	?	?	?	?	? ?	? ?					? ?	? ?
?SF13	?i?t Statio?	?ort? o??ac??o? a?? ??iver?it? ?ve??e?	?	?	?	?	?	? 5??000	? 5??000					? 5??000	? ?
?SF14	?i?t Statio?	?a?t o?Car?e?ie a?? ?ll?vial ?ve??e?	?	?	?	?	?	? 70?000	? 70?000					? 70?000	? ?
?SF15	?i?t Statio?	?ort? o??? a?to? ?ve??e a?? ?o??tai? ? a?	?	?	?	?	?	? 128?000	? 128?000					? 128?000	? ?
?SF16	?i?t Statio?	?ort?? e?t o?Sa?ta ?e a?? ?l Pa?o ?ve??e?	?	?	?	?	?	? 72?000	? 72?000					? 72?000	? ?
?SF18	?i?t Statio?	So?t? o?? iel?e? a?? ????e??ve??e?	?	?	?	?	?	? 82?000	? 82?000					? 82?000	? ?
?SF20	?i?t Statio?	?ort? o?C?err? a?? M???cat ?ve??e?	?	?	?	?	?	? 15?000	? 15?000					? 15?000	? ?
							Lift Station Totals	**$ 1,114,000**	**$ 1,114,000**	**$ -**	**$ -**	**$ -**		**$ 1,114,000**	**$ -**
Point Repairs															
?PPR?1	Poi?t Re?air	250 Priorit? Poi?t Re?air?a??eter? i?e? ??? Cit? o???re??o ?er?o??el	?arie?	?arie?		Re?lace	?arie?	? 5?800?000	? 5?800?000					? 5?800?000	? ?

Table ES.2 Capital Improvement Projects
Wastewater Collection System Master Plan
City of Fresno

Job No.	Project Type	Description / Limits	Existing Diameter (in)	New Diameter (in)	Rehab, Replace, or New	Length (ft)	Improvement Cost ($)	Capital Improvement Phasing: Phase 1 2015-2020 ($)	Phase 2 2021-2025 ($)	Phase 3 2026-2030 ($)	Phase 4 2031-2035 ($)	Future User Benefit (%)	Reimbursement Category: Existing Improvements	Future Improvements
PPR2	Point Repair	250 Priority Point Repair at Peter Pipe Cut off Repair Pipe Pipe	Varies	Varies	Replace	Varies	5,800,000	5,800,000					5,800,000	
PPR3	Point Repair	250 Priority Point Repair at Peter Pipe Cut off Repair Pipe Pipe	Varies	Varies	Replace	Varies	5,800,000	5,800,000					5,800,000	
PPR4	Point Repair	250 Priority Point Repair at Peter Pipe Cut off Repair Pipe Pipe	Varies	Varies	Replace	Varies	5,800,000	5,800,000					5,800,000	
PPR5	Point Repair	24 Priority Point Repair at Peter Pipe Cut off Repair Pipe Pipe	Varies	Varies	Replace	Varies	5,777,000	5,777,000					5,777,000	
						Point Repair Totals	**$ 28,977,000**	**$ 28,977,000**	**$ -**	**$ -**	**$ -**		**$ 28,977,000**	**$ -**
Pipe Rehabilitation														
R1	Rehabilitation	16 in MOSR Pipe Pipe	Varies	Varies	Repair	Varies	2,488,000	2,488,000					2,488,000	
R1	Rehabilitation	18 in MOSR Pipe Pipe	Varies	Varies	Repair	Varies	2,571,000	2,571,000					2,571,000	
R1C	Rehabilitation	23 in MOSR Pipe Pipe	Varies	Varies	Repair	Varies	2,631,000	2,631,000					2,631,000	
R2	Rehabilitation	2006 Master Plan Project RS03	24	24	Repair	3,118	1,126,000	1,126,000					1,126,000	
R3	Rehabilitation	2006 Master Plan Project RS06	15	15	Repair	300	2,000	2,000					2,000	
R4	Rehabilitation	2006 Master Plan Project R02	48	48	Repair	2,644	2,101,000	2,101,000					2,101,000	
R5	Rehabilitation	2006 Master Plan Project R11	54	54	Repair	3,[illegible]2	3,561,000	3,561,000					3,561,000	
						Pipe Rehabilitation Totals	**$ 14,570,000**	**$ 14,570,000**	**$ -**	**$ -**	**$ -**		**$ 14,570,000**	**$ -**
						Capitol Improvement Projects Totals	**$ 312,316,000**	**$ 46,371,000**	**$ 55,848,000**	**$ 7,167,000**	**$ 202,930,000**		**$ 107,919,860**	**$ 204,396,140**

The projects were phased based on the best available information for how the City will develop moving forward. The actual implementation of the improvements serving future users ultimately depends on growth. The priorities presented below are estimates, and changes in the City's planning assumptions or growth projections could increase or decrease the priority of each improvement.

ES.6 REHABILITATION AND REPAIR PLAN

The purpose of the rehabilitation and repair (R&R) plan is to identify sewer infrastructure conditions that pose a current or future threat to regular sewer operations and restore the affected facilities to an acceptable state. Sewer system conditions change over time and require periodic examination to monitor deterioration and determine when rehabilitation efforts are warranted. When sewer condition assessment activities yield signs of significant deterioration, rehabilitation is recommended to prevent operational system failures.

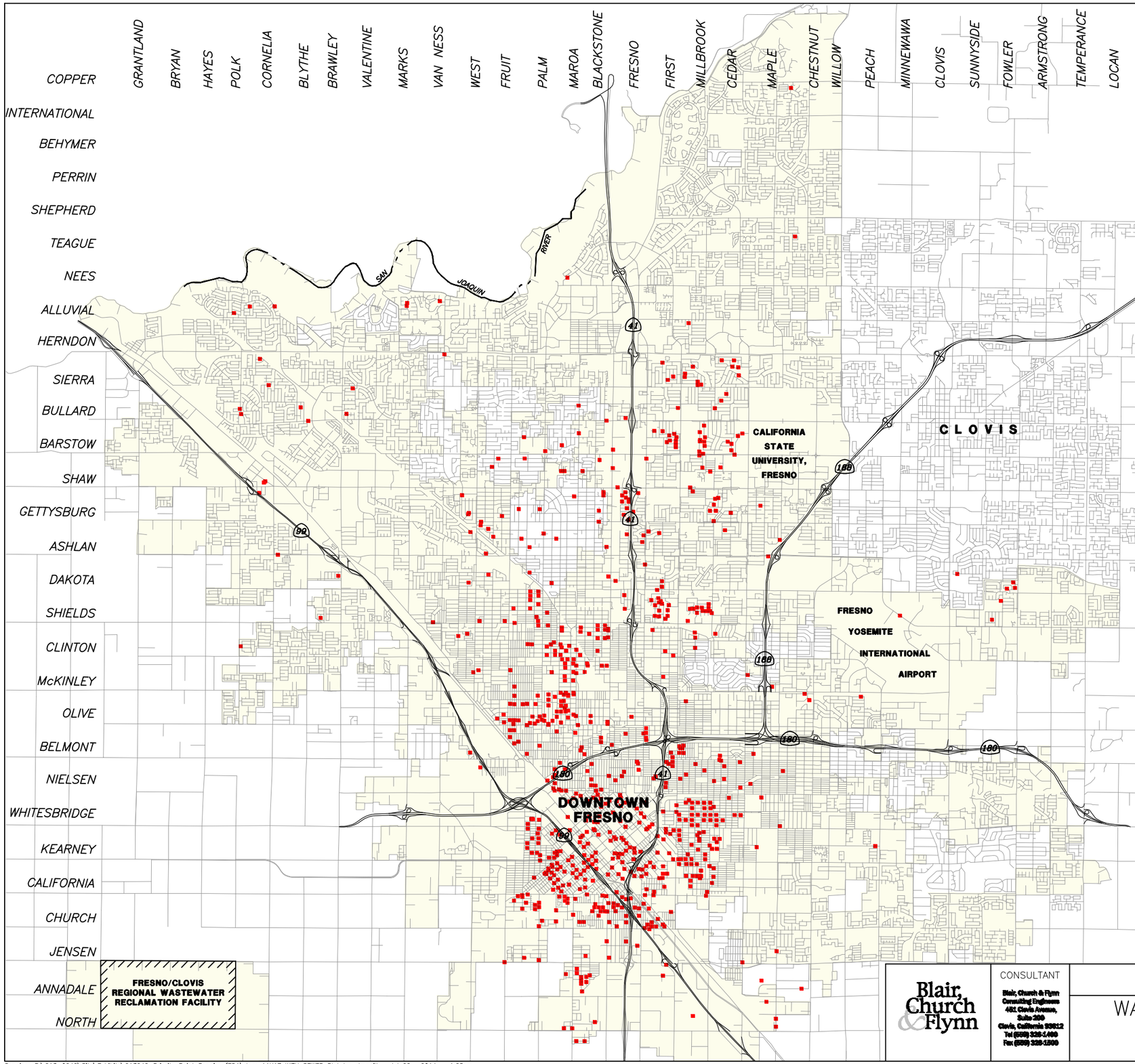
The City has developed and actively maintains a Geographic Information System (GIS) database of their sewer system. This GIS database includes detailed information that was used in the development of this R&R plan. City owned and operated truck mounted closed circuit television (CCTV) units have been used to collect video and condition assessment data for approximately 43 percent (690.5 miles) of the City's gravity sewer system. The City uses the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP©) evaluation protocols to rate the condition of each CCTV inspected sewer main.

Rehabilitation recommendations have been provided for previously recommended rehabilitation projects, high priority point repairs, high Modified Overall Structural Rating (MDRS) sewers, and sewer lift stations. Figures ES.4 through ES.6 represent the recommended rehabilitation improvements.

ES.7 CAPITAL IMPROVEMENT PLAN

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

The capital improvement project costs are based on City bid results for wastewater projects, previous cost studies, interviews with local contractors and our project experience with similar wastewater infrastructure projects throughout the Central Valley. The costs have been adjusted to the Engineering News Record Construction Cost Index (ENRCCI) 20 City Average of 9,800 for June 2014.



LEGEND

- PRIORITY POINT REPAIRS
- STREETS
- CITY LIMITS

Priority Point Repairs
Wastewater Master Plan Update
City of Fresno

Priority Code	Code Description	Occurrences
B	Broken	616
BSV	Broken Soil Visible	136
BVV	Broken Void Visible	139
CH3	Hinge Crack	3
CH4	Hinge Crack	2
D	Deformed	33
FH3	Hinge Fracture	2
FH4	Hinge Fracture	1
H	Hole	195
HSV	Hole Soil Visible	31
HVV	Hole Void Visible	28
SMW	Missing Wall	4
SMWZ	Missing Wall, Surface Damage Not Evident	6
SRC	Reinforcement Corroded	35
SRCZ	Reinforcement Corroded, Surface Damage Not Evident	1
SRV	Reinforcement Visible	6
SRVC	Reinforcement Visible, Surface Damage Chemical	1
XP	Pipe Collapse	10
	Priority Point Repair Total:	**1249**

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church & Flynn

CONSULTANT
Blair, Church & Flynn
Consulting Engineers
451 Clovis Avenue,
Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

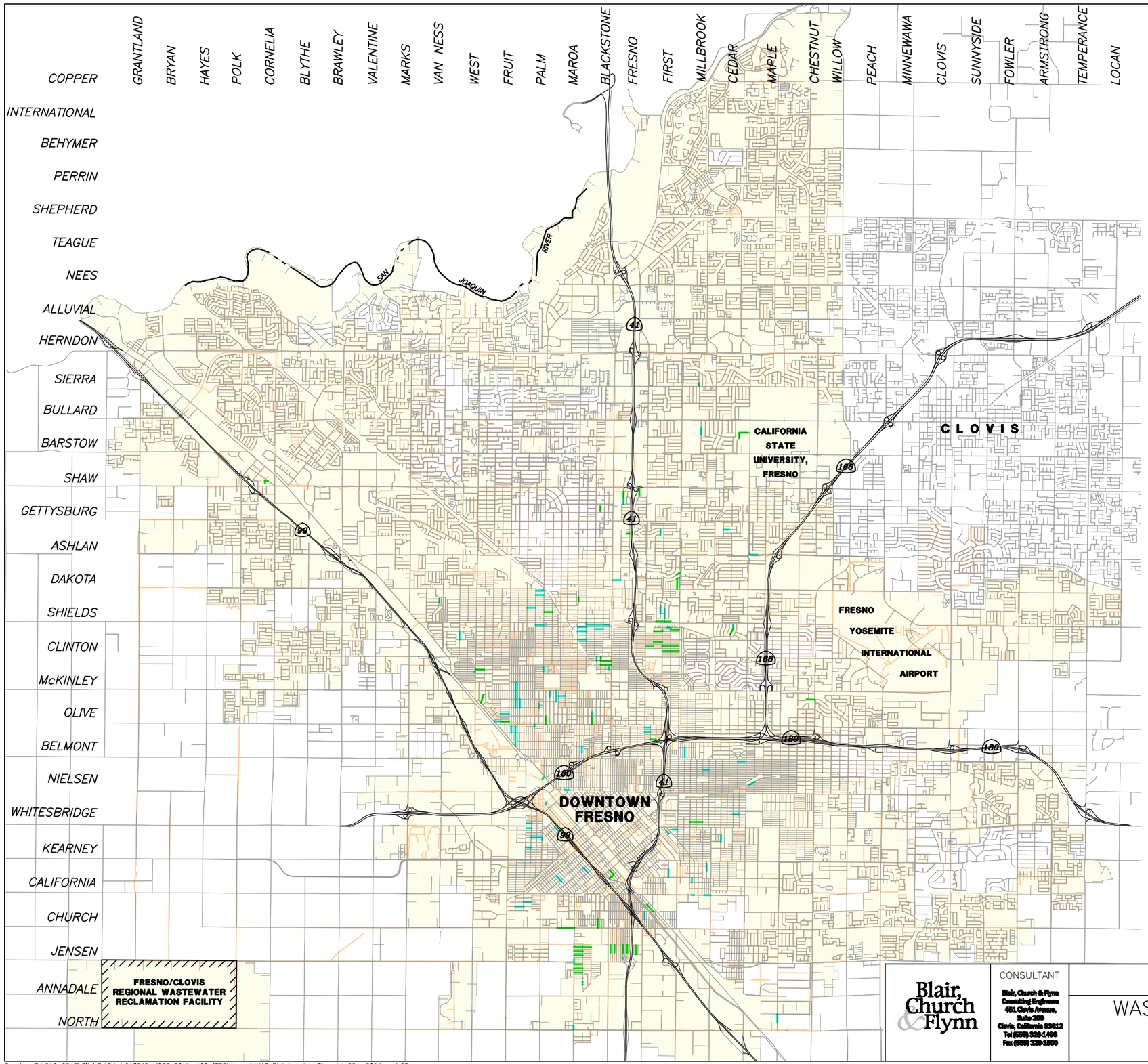
CITY OF FRESNO

WASTEWATER MASTER PLAN
PRIORITY POINT REPAIRS
FIGURE ES.4

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1 OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_Priority Point Repairs (ES4).dwg; 11X17 WITH SEWER Plot by: dmagill Jul 22, 2014 - 1:25pm



LEGEND

- SEVERE & CRITICAL MOSR SEWERS (MOSR ≥ 100)
- POOR MOSR SEWERS (50 ≤ MOSR < 100)
- OTHER EXISTING SEWERS
- STREETS
- CITY LIMITS

MOSR Overview
Wastewater Collection System Master Plan Update
City of Fresno

Sewer Condition	Range	Condition Occurrence	Percent of Inspected System
Severe	MOSR ≥ 200	53	0.43
Critical	100 ≤ MOSR < 200	33	0.27
Poor	50 ≤ MOSR < 100	84	0.68

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church & Flynn

CONSULTANT
Blair, Church & Flynn Consulting Engineers
481 Clovis Avenue, Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

CITY OF FRESNO

WASTEWATER MASTER PLAN
HIGH MOSR SEWERS
FIGURE ES.5

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR 50 to 100 (ES5).dwg; 11X17 Plot by: dmagill Jul 22, 2014 - 1:28pm

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDGE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNADALE
NORTH

GRANTLAND
BRYAN
HAYES
POLK
CORNELIA
BLYTHE
BRAWLEY
VALENTINE
MARKS
VAN NESS
WEST
FRUIT
PALM
MAROA
BLACKSTONE
FRESNO
FIRST
MILLBROOK
CEDAR
MAPLE
CHESTNUT
WILLOW
PEACH
MINNEWAWA
CLOVIS
SUNNYSIDE
FOWLER
ARMSTRONG
TEMPERANCE
LOCAN

SAN JOAQUIN RIVER

CALIFORNIA STATE UNIVERSITY, FRESNO

CLOVIS

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

FRESNO/CLOVIS REGIONAL WASTEWATER RECLAMATION FACILITY

99 41 168 180

LEGEND

REHABILITATION PROJECTS

STREETS

CITY LIMITS

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Drawing: P:\213-0242\Site\Exhibits\213242_Improvement status (ES6).dwg; 11X17 Plot by: dmagill Jul 22, 2014 - 1:31pm

Blair, Church & Flynn

CONSULTANT
Blair, Church & Flynn
Consulting Engineers
481 Clovis Avenue,
Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

CITY OF FRESNO

WASTEWATER MASTER PLAN
PREVIOUS REHABILITATION PROJECTS NOT COMPLETED
FIGURE ES.6

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Cost estimates have been developed to help the City prepare budgeting and scheduling for these projects. The cost estimates included in this master plan are Class 5 estimates as defined by the Association for the Advancement of Cost Engineering (AACE) International publication entitled *Recommend Practice No. 56R-08*. Class 5 estimates are generally prepared on limited design information and subsequently have wide accuracy ranges. A typical Class 5 estimate for a civil engineering project may have an accuracy range as broad as -30 percent to +50 percent, or as narrow as -20 to +30 percent. Class 5 estimates are typically used for evaluation of resource needs, budgeting and capital planning.

The CIP scheduling assigns a fiscal year for each project as a target date for construction. The CIP scheduling was developed with consideration given to the following:

- Project Prioritization
- Anticipated City Growth Rates and Patterns
- Cost Distribution and Budgeting
- City of Fresno Direction

Short term projects are phased by year through the year 2020 and long-term projects are phased in five year increments beginning in 2020 through 2035.

Rehabilitation projects and capacity projects are given the highest priority needs are and are all scheduled as short term projects to be completed between 2015 and 2020. Each project is itemized by phase in Table ES.3.

The improvements proposed in this study either benefit existing users, or are required to service new development and future users. A summary of the existing and future user cost share for the proposed projects by phase is summarized in Table ES.3.

Table ES.3 Summary of Capital Improvement Costs
Wastewater Collection System Master Plan Update
City of Fresno

	Implementation Phase				
Reimbursement Category	**2015-20 ($, mill.)**	**2021-25 ($, mill.)**	**2026-30 ($, mill.)**	**2031-35 ($, mill.)**	**Total ($, mill.)**
Existing User	46.3	55.6	6.1	0	108.0
Future User	0.1	0.2	1.1	202.9	204.3
Total	**46.4**	**55.8**	**7.2**	**202.9**	**312.3**

Notes:
(1) Costs are based on ENR CCI 20-City Average of 9,800 (June 2014).

BACKGROUND

This chapter presents a brief summary of the sanitary sewer system service area, the need for this Wastewater Collection System Master Plan Update (Master Plan) and the objectives of the study. A list of abbreviations is also provided to assist the reader in understanding the information presented.

1.1 INTRODUCTION

The City of Fresno (City) was founded in 1872 by the Central Pacific Railroad Company and incorporated in 1885. The City has since grown to over 112 square miles with a population of just under a half million people in the incorporated area. Today, Fresno is the fifth largest city in the state of California. Centrally located, Fresno is the financial, industrial, trade, and commercial capital in the Central San Joaquin Valley. Figure 1.1 presents a location map of the City. The City is the hub of a region rich in heritage, resources, and people.

The City is the Regional Sewer Agency for the Fresno-Clovis Metropolitan Area (FCMA). The City owns and maintains a wastewater collection system that serves the City and the other participating agencies: the County of Fresno, the majority of the City of Clovis, the Pinedale Public Utility District, and the Pinedale County Water District. The City also owns and operates the Fresno/Clovis Regional Wastewater Reclamation Facility (RWRF), as well as the smaller North Fresno Wastewater Reclamation Facility (NFWRF) scalping plant.

1.2 SEWER SERVICE AREA

Figure 1.2 illustrates the City's current wastewater service area. The City manages and maintains more than 1,500 miles of gravity sewer lines up to 84-inches in diameter, 15 active lift stations, and associated force mains. Nearly all of the wastewater generated within the sewer service area is conveyed to the City's RWRF for treatment, with the exception of a small amount of flow that is treated at the City's NFWRF. In addition, the City of Clovis recently constructed its own wastewater treatment facility on the eastern edge of the Clovis City limits (near the intersection of Ashlan Avenue and McCall Avenue), which provides wastewater service for a portion of the City of Clovis. However, most of the flow generated within the City of Clovis is treated at the RWRF.

The land use assumptions in this Master Plan were based on the Fresno General Plan (General Plan) and projected future developments within the City's proposed growth boundary. Should future planning conditions change from the assumptions stated in this Master Plan (i.e., accelerated growth, more intense developments, etc.), revisions and adjustments to the Master Plan recommendations would be necessary.

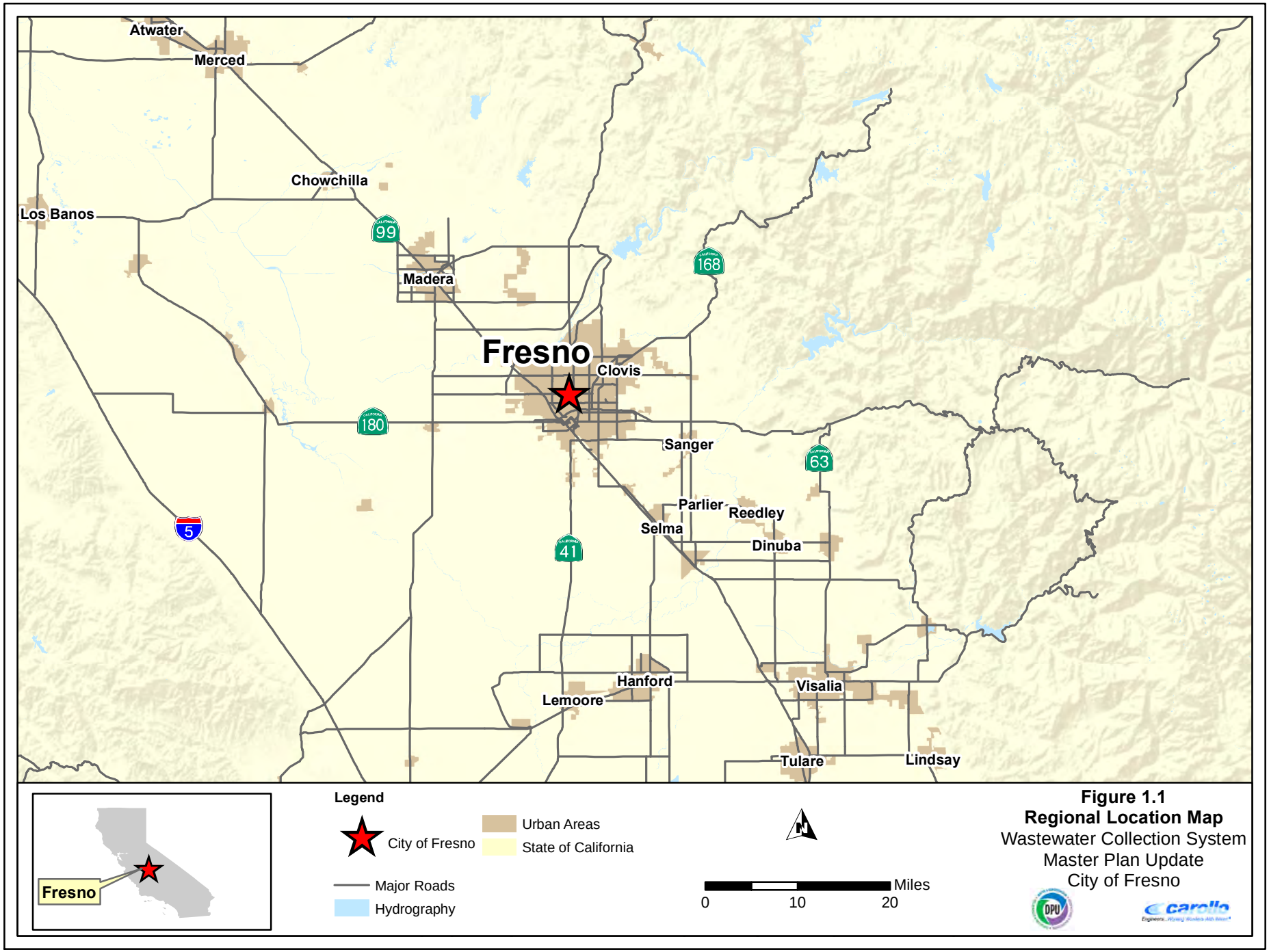


Figure 1.1
Regional Location Map
Wastewater Collection System
Master Plan Update
City of Fresno

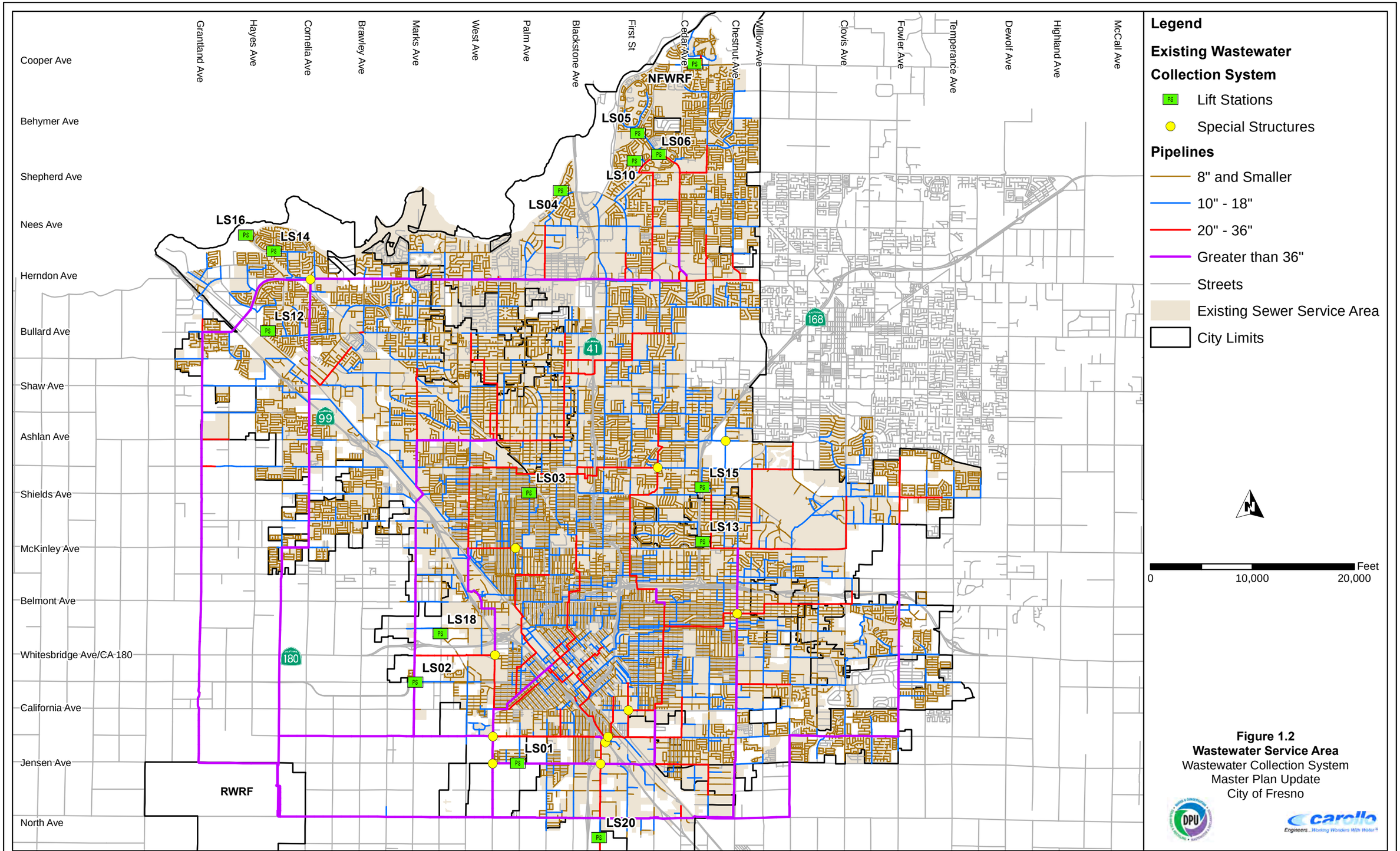


Figure 1.2
Wastewater Service Area
Wastewater Collection System
Master Plan Update
City of Fresno

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1.3 PREVIOUS MASTER PLAN

The City's previous Wastewater Collection System Master Plan was completed in 2004 by Brown and Caldwell with the assistance of Blair, Church, and Flynn Consulting Engineers (BC&F). The objective of the 2004 Master Plan was to develop a long-range planning document that would assist the City's staff with managing the collection system capital improvement program and update the impact and connection fees.

One component in this project was the development of a hydraulic model of the collection system and performing a hydraulic assessment for current and future conditions. The model allowed for identification of hydraulic deficiencies in the current collection system and new pipelines to serve new developments as well as development of a capital improvement program that included collection system projects identified during the hydraulic analysis and other projects already identified by the city.

1.4 SCOPE AND AUTHORIZATION

The purpose of this Master Plan is to update the 2004 Master Plan and to identify capacity deficiencies in the sanitary sewer system, develop feasible alternatives to correct these deficiencies, plan the infrastructure that will serve future development projected by the Fresno General Plan, and to develop a rehabilitation and repair plan for the City's wastewater collection system.

In July 2013, the City approved a professional service agreement with Carollo Engineers, Inc. (Carollo), to prepare this Master Plan Update for the wastewater collection system. The professional services agreement included the following main tasks:

- Task 1 – Project Management and Meetings
- Task 2 – Data Collection and Review
- Task 3 – Wastewater Flow Projections
- Task 4 – Model Review, Evaluation, and Calibration
- Task 5 – Planning Criteria Development
- Task 6 – Rehabilitation/Repair Plan
- Task 7 – System Evaluation and Capital Improvement Plan
- Task 8 – Master Plan Report Preparation

Carollo entered into a Subconsultant Agreement with BC&F to assist with the development of certain aspects of this Master Plan, including field reconnaissance, development of the rehabilitation and repair plan, and development of capital cost estimates.

1.5 REPORT ORGANIZATION

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

Chapter 1 - Introduction. This chapter presents the need for this Master Plan and the objectives of the study. Lists of abbreviations and reference materials are also provided to assist the reader in understanding the information presented.

Chapter 2 - Study Area Description. This chapter presents a description of the study area, defines the planning horizon for this study, and summarizes the land use classifications.

Chapter 3 - Flow Monitoring Program. This chapter defines the typical components of wastewater in a collection system as they pertain to this Master Plan. The flow monitoring data and results from the flow monitoring program are summarized and discussed.

Chapter 4 - Collection System Facilities and Hydraulic Model. This chapter describes the update and calibration of the City's collection system hydraulic model. A description of the City's wastewater collection system, the existing hydraulic model, and an outline of the steps used to update the model are provided. A detailed summary of the hydraulic model calibration steps, standards, and results for both base wastewater flow (BWF) and wet weather flow (WWF) conditions is also provided.

Chapter 5 - Planning Criteria and Design Flows. The capacity of the City's wastewater collection system was evaluated based on the planning criteria defined in this chapter. The planning criteria address the collection system capacity, gravity sewer pipe slopes, and maximum allowable depth of flow within a sewer. This chapter also summarizes the existing and build out design flows.

Chapter 6 - Capacity Evaluation and Proposed Improvements. This chapter discusses the hydraulic evaluation of the sewer collection system and the proposed projects that correct capacity deficiencies and serve future users.

Chapter 7 – Rehabilitation and Replacement Plan. This Chapter describes the proposed rehabilitation and repair (R&R) plan for the City's wastewater collection system, and includes the objectives of the plan, the data used to develop the plan, and the evaluation of the City's collection system assets.

Chapter 8 - Capital Improvement Plan. This chapter presents the capital improvement projects, a summary of the capital costs, and a basic assessment of the possible financial impacts on the City. This chapter presents the recommended capital improvement plan (CIP) for the City collection system and a summary of the capital costs.

1.6 ACKNOWLEDGMENTS

Carollo and BC&F wish to acknowledge and thank Mr. Steve Hogg, Assistant Director, Department of Public Utilities; Mr. Kevin Norgaard, Supervising Professional Engineer, Department of Public Utilities; and Mr. Orlando Gonzalez, Engineer, Department of Public Utilities. Their cooperation and courtesy in obtaining a variety of necessary information were valuable components in completing and producing this report.

1.7 ABBREVIATIONS AND DEFINITIONS

To conserve space and to improve readability, the following abbreviations are used in this report.

°F	Degrees Fahrenheit
General Plan	Fresno General Plan
AACE	Association for the Advancement of Cost Engineering
AAF	Average Annual Flow
ADWF	Average Dry Weather Flow
ADS	ADS Environmental Services
BCC	Baseline Construction Cost
BC&F	Flair, Church, and Flynn Consulting Engineers
BRT	Bus Rapid Transit
BWF	Base Wastewater Flow
Buildout	General Plan Buildout
Carollo	Carollo Engineers, Inc.
CCTV	Closed-Circuit Television
CIP	Capital Improvement Plan
CIPP	Cured-in-Place Pipe
City	City of Fresno
CSUF	California State University, Fresno
d/D	Flow Depth to Pipe Diameter Ratio

DWF	Dry Weather Flow
ENRCCI	Engineering News Record Construction Cost Index
EPS	Extended Period Simulation
FCMA	Fresno-Clovis Metropolitan Area
ft/s	Feet Per Second
ft^2	Square Feet
GIS	Geographic Information System
gpd	Gallons Per Day
gpd/ac	Gallons Per Day Per Acre
gpm	Gallons Per Minute
GWI	Groundwater Infiltration
HDPE	High-Density Polyethylene
HGL	Hydraulic Grade Line
I/I	Infiltration and Inflow
JPA	Fresno-Clovis Regional Sewerage System Joint Powers Agreement
Master Plan	Wastewater Collection System Master Plan Update
mgd	Million Gallons Per Day
MGP	Master Group Polygons
MOSR	Modified Overall Structural Rating
MPG	Master Group Polygons
MSL	Mean Sea Level
n	Manning Friction Coefficient
NASSCO	National Association of Sewer Service Companies
NCFWRF	North Central Fresno Wastewater Reclamation Facility
NFWRF	North Fresno Wastewater Reclamation Facility
NOAA	National Oceanic and Atmospheric Administration

NRCS	Natural Resources Conservation Service
OSR	Overall Structural Rating
PACP©	Pipeline Assessment and Certification Program
PDWF	Peak Dry Weather Flow
PVC	Polyvinyl Chloride
PWWF	Peak Wet Weather Flow
q/Q	Peak Flow to Pipe Capacity Ratio
R&R	Rehabilitation and Repair
RDII	Rainfall Derived Infiltration and Inflow
ROW	Right Of Way
RWRF	Regional Water Reclamation Facility
SCADA	Supervisory Control and Data Acquisition
SEDA	Southeast Development Area
SIU	Significant Industrial Users
SOI	Sphere of Influence
SSO	Sanitary Sewer Overflow
SWMM	Stormwater Management Model
VCP	Vitrified Clay Pipe
WaPUG	Wastewater Planning Users Group
WWF	Wet Weather Flow

1.8 REFERENCE MATERIAL

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

- *City of Fresno General Plan Update*, December 2014.
- *City of Fresno CCTV Inspection and Evaluation for Mid-Sized Concrete Sewers*, Final, Blair, Church & Flynn, July 2010.
- *City of Fresno Evaluation of Large Diameter Wastewater Collection System*, Final, Blair, Church & Flynn, 1992-1996.

- *City of Fresno Inspection and Evaluation of Concrete Sewers 12 Inches to 27 Inches in Diameter*, Final, Blair, Church & Flynn, July 2001.
- *City of Fresno Large Diameter Sewer Evaluation Update*, Final, Blair, Church & Flynn, January 2012.
- *City of Fresno North Avenue Trunk Sewer Evaluation*, Final, Blair, Church, and Flynn, 1990.
- *City of Fresno Permanent Flow Monitoring Data*, ADS, 2010-2012
- *City of Fresno Wastewater Collection System Master Plan,* Final, Brown and Caldwell, May 2006.

Chapter 2

STUDY AREA DESCRIPTION

This chapter presents a description of the study area, defines the planning horizon for the study, and summarizes the land use classifications.

2.1 STUDY AREA

The area serviced by the City of Fresno (City) is characterized by residential, commercial, and industrial uses within the City limits. While the City has a diverse economy, Fresno County is the nations' top-ranked agriculture-producing county. There are some agricultural lands within the metropolitan area that are interspersed on larger parcels along the fringe of urbanized area and in between parcels.

There are many open space areas within the City, including Woodward Park and Roeding Park which is home of the Fresno Chaffee Zoo. The main water bodies near the City are located on the outskirts of town. The San Joaquin River runs east and west just to the North of the City limits. The Kings River is about 12 miles east of the City limits and the City diverts water from the river for part of their water supply. The Sierra Nevada Mountains are located about 25 miles east of the City.

There are four major highways that run through the City which include State Route 99, State Route 168, State Route 41, and State Route 180. State Route 99 connects the major cities in the central valley and runs north and south. State Route 168 heads east out of the City through Clovis and heads to the Sierras to the east. State Route 41 runs north and south which connects to Atascadero in the South and to Yosemite to the north. State Route 180 runs east and west which connects to Mendota to the west and to Kings Canyon National Park to the east.

The City's proposed Sphere of Influence (SOI), as defined in Fresno General Plan (General Plan) is the study area boundary for this Wastewater Collection System Master Plan Update (Master Plan). The Master Plan study area boundary and the SOI are synonymous and will be used interchangeably throughout this report. The SOI extends beyond the current sewer service area and is approximately 100,240 acres (156.6 square miles). This Master Plan is intended as the guiding document to plan and implement sewer system improvements to accommodate future growth to build out of the General Plan. Figure 2.1 shows the study area boundary and the current City limits.

2.2 PLANNING PERIOD

The Master Plan study area is intended to include the existing City limits and development that could occur through build out of the City's General Plan. Existing and build out land uses within the study area are discussed in this chapter.

Dickenson Ave
West Lawn Ave
Chateau Fresno Ave
Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave
Del Rey Ave
Bethel Ave
Academy Ave
Madsen Ave

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave
Central Ave
American Ave

99
41
168
180

RWRF

Legend

- Sphere of Influence
- City Limits

N

0 12,500 25,000 Feet

Figure 2.1
Study Area
Wastewater Collection System
Master Plan Update
City of Fresno

DPU

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2.3 CLIMATE

The City's study area is characterized by a semi-arid climate with mild, moderately wet winters and hot, dry summers. Table 2.1 summarizes the maximum and minimum monthly temperatures as well as the average monthly precipitation. January is the City's coldest and wettest month, with an average high temperature of 55.3 degrees Fahrenheit (°F), an average low temperature of 39.3°F, and 2.19 inches of precipitation. July is the City's hottest month, with an average high temperature of 98.7°F and an average low temperature of 68.1°F. Approximately 87 percent of the annual rainfall occurs between November and May, with an average annual rainfall of 10.73 inches.

Table 2.1 Study Area Climate
Wastewater Collection System Master Plan Update
City of Fresno

Month	Average Maximum Temperature (ºF)	Average Minimum Temperature (ºF)	Average Monthly Rainfall (inches)
January	55.3	39.3	2.19
February	61.0	41.7	2.08
March	68.3	45.8	1.40
April	73.4	49.0	1.05
May	84.4	56.5	0.42
June	92.1	62.4	0.23
July	98.7	68.1	0.01
August	97.2	66.0	0.08
September	90.8	61.3	0.07
October	78.7	52.6	0.62
November	65.0	44.8	0.98
December	55.7	38.4	1.62
Annual	**76.7**	**52.2**	**10.73**

Notes:
(1) Source: Western Regional Climate Center, Fresno Yosemite International Airport, www.wrcc.dri.edu.

2.4 TOPOGRAPHY

The City is located in the center of San Joaquin Valley near the eastern fringe of the Sierra Nevada mountain range. The terrain is flat except for the bluffs near the San Joaquin River.

The majority of the City is relatively flat with an average elevation of approximately 335 feet above mean sea level (MSL). Figure 2.2 shows the general topography of the study area.

2.5 LAND USE

Land use information is an integral component in determining the amount of wastewater generated within the City. The type of land use in an area will affect the volume and characteristics of the wastewater generation. Therefore, adequately estimating the generation of wastewater from various land use types is important in sizing and maintaining effective sanitary sewer system facilities. Existing land use was utilized to develop the initial estimate of wastewater flows for current conditions. For future flow conditions, the City's General Plan land use was used.

An important tool for determining land use projections is the City's General Plan, which guides development within the study area and establishes long-range development policies. Land use assumptions used in this study area consistent with those for existing and proposed development as published in the General Plan.

2.5.1 Existing Wastewater Collection System Service Area Land Use

The City provides wastewater collection service to residents, businesses, and other institutions within its service area, which currently encompasses and area of approximately 61,200 acres or 95.7 square miles. It should be noted that the 95.7 square miles excludes areas within the City limits that are developed but are unsewered (e.g., areas served by septic tanks), land area within the City of Clovis, and undeveloped land outside of the current service area. It does however include some County islands that area not technically within the City limits (e.g., Pinedale). Figure 2.3 shows the City's existing land use within the current sewer service area. Table 2.2 summarizes the existing sewer service land area by existing land use designation.

The largest land use category is residential, which accounts for approximately 44 percent of the total current service area acreage. Commercial land uses make up approximately 6 percent of the total. Industrial designations comprise 7 percent of the service area. Public land uses account for approximately 8 percent of the service area. Other land uses, such as open space, roads, and vacant land account for the remaining 35 percent of the total service area.

2.5.2 Build Out Wastewater Service Area Land Use

At build out of the General Plan, the City will encompass approximately 100,240 acres (156.6 square miles). Build out is defined as complete development of the General Plan Boundary. Appendix A provides a description of the different land uses associated with the General Plan. The descriptions are excerpts from the General Plan. Figure 2.4 and Table 2.3 show the General Plan land uses.

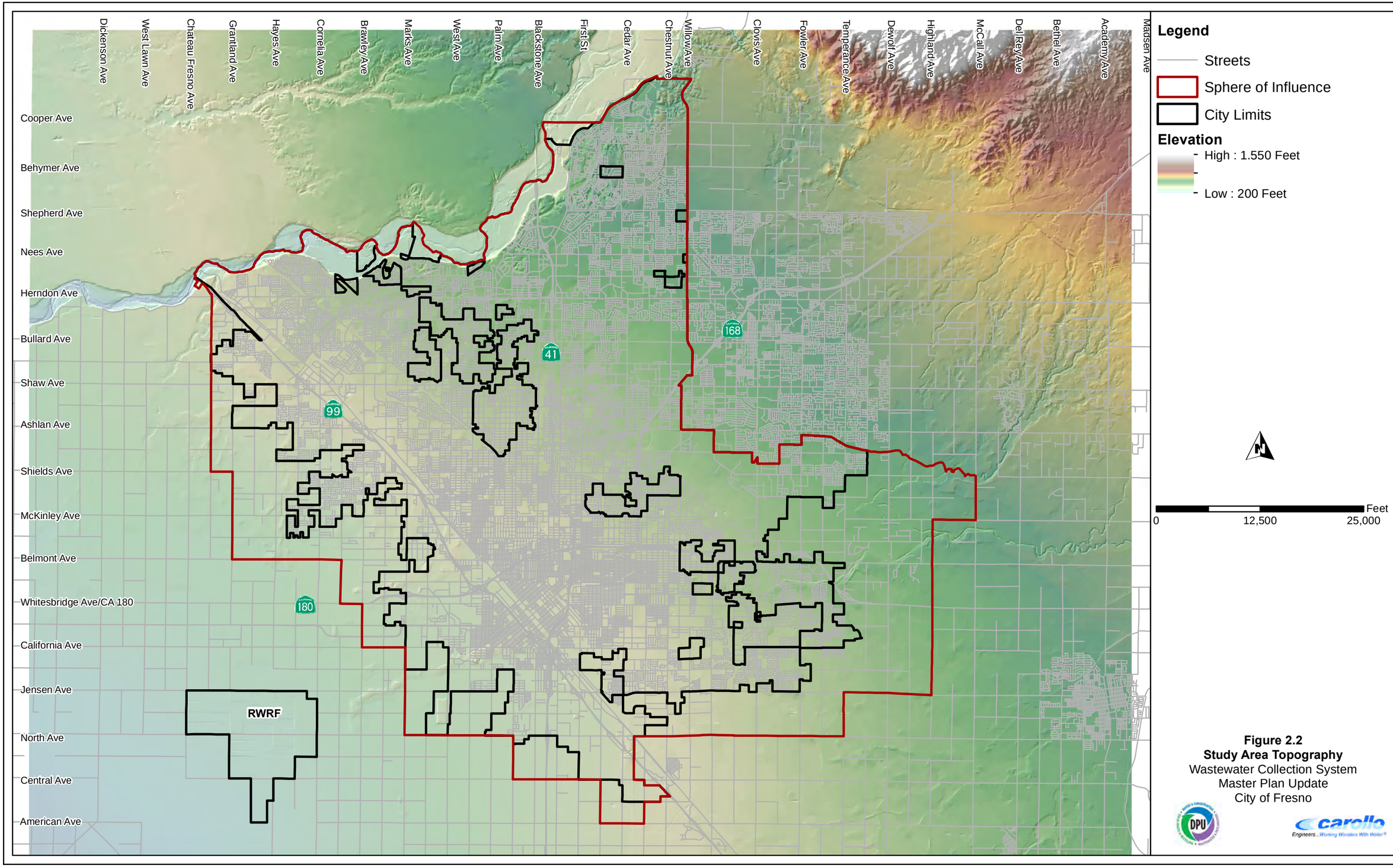

Figure 2.2
Study Area Topography
Wastewater Collection System
Master Plan Update
City of Fresno

DPU

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Dickenson Ave
West Lawn Ave
Chateau Fresno Ave
Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave
Del Rey Ave
Bethel Ave
Academy Ave
Madsen Ave

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave
Central Ave
American Ave

99
41
168
180

RWRF

Legend

- Sphere of Influence
- City Limits
- Major Streets

Existing Land Use

- Residential Rural
- Residential Low Density
- Residential Medium Low Density
- Residential Medium Density
- Residential Medium High Density
- Residential High Density
- Residential Mobile Home
- Commercial
- Industrial
- Public Facilities
- Open Space
- Vacant

N

0 12,500 25,000 Feet

Figure 2.3
Existing Land Use
Wastewater Collection System
Master Plan Update
City of Fresno

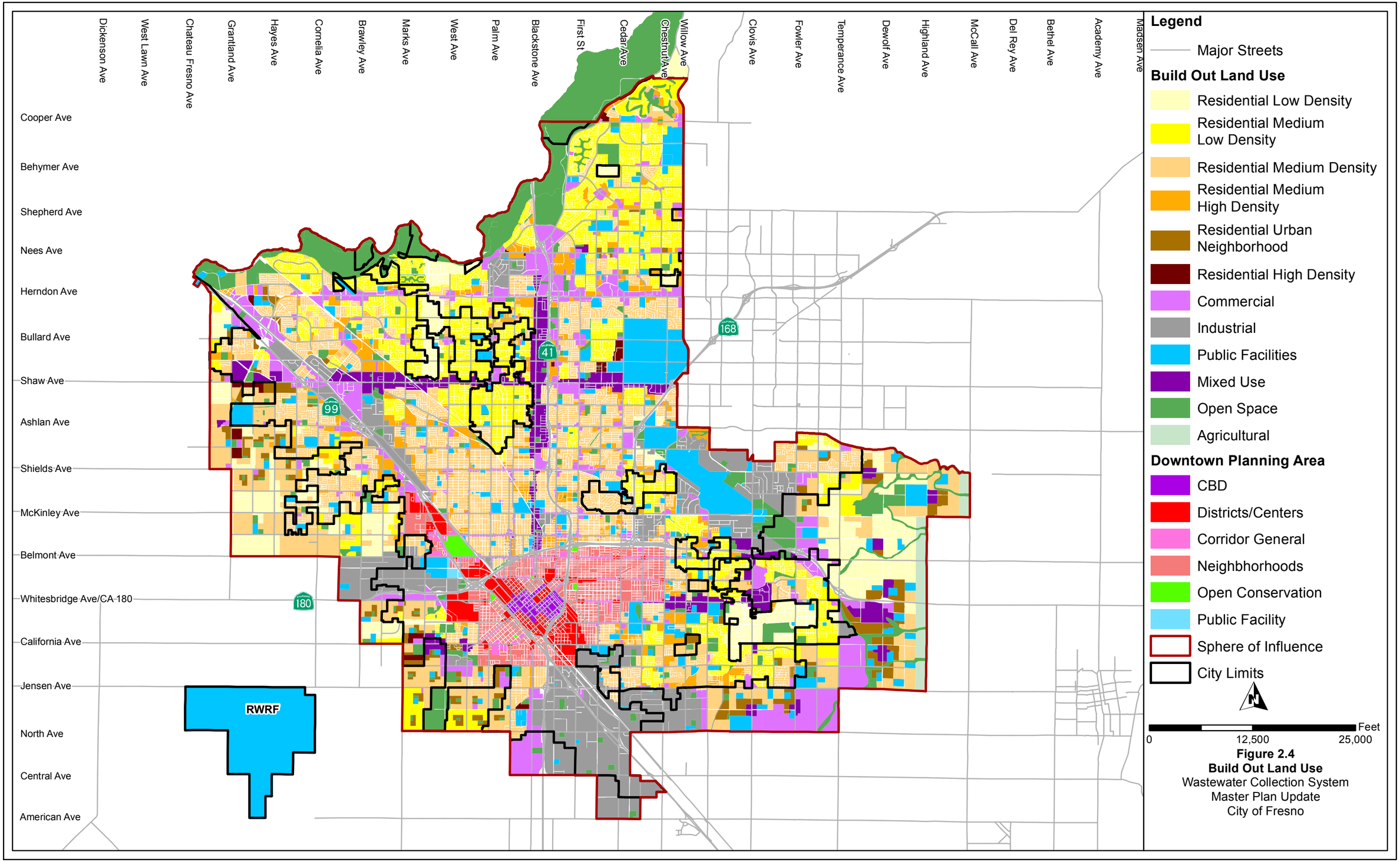

Figure 2.4
Build Out Land Use
Wastewater Collection System
Master Plan Update
City of Fresno

Table 2.2 Existing Land Use
Wastewater Collection System Master Plan Update
City of Fresno

Land Use Classification	Current Sewer Service Area Land Use	
	Land Use Area (acre)	Percent of Total (%)
Residential		
Rural Density	1,216	2.0%
Low Density (1-3 DU/acre)	1,138	1.9%
Medium Low Density (3.5 -6 DU/acre)	10,361	16.9%
Medium Density (5-12 DU/acre)	11,143	18.2%
Medium High Density (12-16 DU/acre)	2,039	3.3%
High Density (30-45 DU/acre)	1,316	2.1%
Subtotal	**27,212**	**44.4%**
Commercial		
Community	604	1.0%
General Heavy	1,054	1.7%
Neighborhood	569	0.9%
Neighborhood Limited	3	0.0%
Office	1,057	1.7%
Professional Services Office	100	0.2%
Regional	218	0.4%
Recreational	119	0.2%
Storage Limited	44	0.1%
Subtotal	**3,768**	**6.2%**
Public Facilities		
Airport	1,065	1.7%
College	151	0.2%
High school	475	0.8%
Elementary School and High School	141	0.2%
Middle School	233	0.4%
Elementary School and Middle School	188	0.3%
Elementary School	735	1.2%
Special School	42	0.1%
Cemetery	165	0.3%
Church	545	0.9%
Community Activity Center	8	0.0%
Neighborhood Center	5	0.0%
Convention Center	17	0.0%
Fairgounds	90	0.1%
Fire Station	14	0.0%
Government Offices	141	0.2%
County Court House Central Area	14	0.0%
Hospital	137	0.2%
Medical Center	10	0.0%
Convalescent Hospital	64	0.1%
Military	60	0.1%
Mobile Home Park	388	0.6%
Municipal Service Center	37	0.1%
Post Office	23	0.0%
Public Facility	21	0.0%
Public/Quasi-Public Facility	43	0.1%
Pump Station	44	0.1%
Subtotal	**4,854**	**7.9%**
Open Space		
Open Space	60	0.1%
Recreational Use/Clear Zone	16	0.0%
Ag	233	0.4%
Canal	38	0.1%
Community Park	28	0.0%
Golf Course	597	1.0%
Lake or Pond	54	0.1%
Multi-Use	101	0.2%
Neighborhood Park	212	0.3%
Recreational Park	59	0.1%
Recreational Use	12	0.0%
Regional Park	154	0.3%
Parking	78	0.1%
Pg&e Substation	117	0.2%
Ponding Basin	407	0.7%
Ponding Basin/Park	108	0.2%
Subtotal	**2,281**	**3.7%**
Other		
Roads/ Canals/ Highways	16,545	27.0%
Vacant	2,303	3.8%
Subtotal	**18,848**	**30.8%**
Industrial/Clovis		
Light Industrial	2,979	4.9%
Heavy Industrial	1,291	2.1%
Subtotal	**4,270**	**7.0%**
Total		
Total	**61,234**	**100.0%**

Table 2.3 Build Out Land Use
Wastewater Collection System Master Plan Update
City of Fresno

Land Use Type	Build Out Sewer Service Area Land Use	
	Land Use Area (acre)	Percent of Total (%)
Residential		
Low Density (1-3 DU/acre)	6,436	6.4%
Medium Low Density (3.5 -6 DU/acre)	12,558	12.5%
Medium Density (5-12 DU/acre)	17,977	17.9%
Medium High Density (12-16 DU/acre)	3,743	3.7%
Urban Neighborhood (16-30 DU/acre)	2,184	2.2%
High Density (30-45 DU/acre)	371	0.4%
Subtotal	**43,269**	**43.2%**
Commercial		
Main Street	72	0.1%
Community	1,363	1.4%
Recreation	111	0.1%
General Heavy	437	0.4%
Highway & Auto	253	0.3%
Regional	553	0.6%
Neighborhood	0	0.0%
Subtotal	**2,790**	**2.8%**
Employment		
Office	1,426	1.4%
Professional Services Office	1	0.0%
Business Park	842	0.8%
Regional Business Park	1,817	1.8%
Light Industrial	4,847	4.8%
Heavy Industrial	3,960	4.0%
Subtotal	**12,893**	**12.9%**
Mixed Use		
Corridor/Center Mixed Use	2,046	2.0%
Regional Mixed Use	956	1.0%
Neighborhood Mixed Use	131	0.1%
Subtotal	**3,133**	**3.1%**
Open Space		
Recreational Use/Clear Zone	8	0.0%
Recreational Use	339	0.3%
Commercial-Recreational	18	0.0%
Community Park	105	0.1%
Golf Course	985	1.0%
Lake, Pond	86	0.1%
Multi-Use	2,221	2.2%
Neighborhood Park	228	0.2%
Open Space	1,552	1.5%
Recreational Park	222	0.2%
Ponding Basin	1,244	1.2%
Ponding Basin (Park Use)	102	0.1%
Regional Park	561	0.6%
Subtotal	**7,670**	**7.7%**
Public Facilities		
Public/Quasi-Public Facility	596	0.6%
Public Facility	321	0.3%
Special School	635	0.6%
Elementary School	1,071	1.1%
Elementary & Middle School	62	0.1%
Elementary, Middle, & High School	40	0.0%
Middle School	290	0.3%
Junior High School	34	0.0%
High School	383	0.4%
College	282	0.3%
Cal State University	1,258	1.3%
Airport	928	0.9%
Cemetary	75	0.1%
Church	149	0.1%
Community Activity Center	9	0.0%
Convalescent Hospital	7	0.0%
Fairgrounds	116	0.1%
Fire Station	20	0.0%
Hospital	58	0.1%
Neighborhood Center	5	0.0%
PG&E Substation	141	0.1%
Police Dressing Station	1	0.0%
Water Recharge Basin	288	0.3%
Subtotal	**6,770**	**6.8%**
Buffer		
Buffer (Ag)	736	0.7%
Subtotal	**736**	**0.7%**
Downtown		
Central Business District	267	0.3%
Civic Center	37	0.0%
Town Center	55	0.1%
Neighborhood Center	84	0.1%
Chinatown District	29	0.0%
Cultural Arts District	69	0.1%
Corridor General	466	0.5%
Neighborhoods	2,584	2.6%
Special Districts	1,000	1.0%
Public Facility	150	0.1%
Open Conservation	178	0.2%
South Stadium District	120	0.1%
Subtotal	**5,039**	**5.0%**
Other		
Street, Rail, Canal, Etc.	17,941	17.9%
Subtotal	**17,941**	**17.9%**
Total		
Total	**100,240**	**100.0%**

At build out, the largest land use category is residential, which accounts for approximately 43 percent of the total service area acreage. Commercial land uses make up approximately 3 percent of the total. Employment land uses make up approximately 13 percent, and mixed use areas account for roughly 3 percent of the service area. Public land uses account for approximately 7 percent of the service area. The downtown area, which consists of a mixture of land uses, accounts for 5 percent of the service area. Other land uses, such as open space, roads, and vacant land account for the remaining 26 percent of the total service area.

In general terms, the study area can be grouped into two mains categories in regards to future development/land use. These are “Areas of Stability” and “Areas of Change,” as summarized below:

- **Areas of Change:** For the purposes of this Master Plan, areas of change are defined as an area within the study area that will contribute to a net increase in wastewater flows into the collection system. These areas are further broken down subcategories, as described below:
  - Downtown: A major component of the General Plan is Downtown. The General Plan envisions a new focus on land use and design along major streets and in neighborhoods that support Downtown. This new focus includes proposals for increased density in Downtown itself and vibrant mixed-use centers that will emanate from Downtown (mixed use corridors are described below), extending the reach of and connections with Downtown in all directions.
  - Bus Rapid Transit (BRT) Corridors: The City believes that the BRT corridors proposed in the General Plan offer great opportunities for future growth in form of mixed-use development on sites that are now underutilized or vacant. These areas are assigned a mixed use land use designation, and are targeted for densification in the General Plan. The City provided Carollo with a Geographic Information System (GIS) shape file indicating which areas are targeted for redevelopment in the BRT corridors, as well as the Downtown area.
  - Infill: For the purposes of this Master Plan, infill is defined as development of existing vacant parcels that lie within the existing wastewater service area. Development of these vacant areas will increase wastewater flows within the existing collection system, and are therefore targeted as areas of change.
  - New Growth Areas: There are several planned growths areas within the study area. These areas primarily consist of the Southeast Development Area (SEDA), the West Growth Area, and the Southwest Growth Area. In addition, this Master Plan includes other areas that are within the current City limits, but are not currently developed or otherwise connected to the wastewater collection system (i.e., areas on septic systems), as these areas will also contribute to an expansion of the service area and increased wastewater flows.

- **Areas of Stability:** The remaining land use areas within the current sewer service area (not designated as areas of change) are defined as areas of stability for the purposes of this Master Plan. Wastewater flows associated with areas of stability are assumed to remain unchanged at build out of the General Plan.

Figure 2.5 identifies the “Areas of Stability” and “Areas of Change” within the City’s General Plan Boundary.

Dickenson Ave
West Lawn Ave
Chateau Fresno Ave
Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave
Del Rey Ave
Bethel Ave
Academy Ave
Madsen Ave

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave
Central Ave
American Ave

99
41
168
180

RWRF

Legend

- Streets
- Areas of Change
- Existing Sewer Service Area
- Sphere of Influence
- City Limits

N

0 12,500 25,000 Feet

Figure 2.5
Areas of Stability and Areas of Change
Wastewater Collection System
Master Plan Update
City of Fresno

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Chapter 3

FLOW MONITORING PROGRAM

This chapter defines the typical components of wastewater in a collection system as they pertain to this Wastewater Collection System Master Plan Update (Master Plan). The flow monitoring data and results from the flow monitoring program are summarized and discussed.

3.1 PERMANENT FLOW MONITORING SITES AND TRIBUTARY AREAS

The City of Fresno (City) has an ongoing contract with ADS Environmental Services (ADS) to perform quarterly quality control on the City's permanent flow meters. The purpose of the City's permanent flow monitoring program monitors flows at specific locations in the collection system over an extended period of time. In general, the permanent flow monitors were located to capture flows from various sewer basins within the collection system, and to capture flows from the City of Clovis and a portion of the flow discharged from California State University, Fresno (CSUF). This section defines the typical components of wastewater in a collection system, and summarizes and discusses the flow monitoring data used as part of this study.

A total of 21 open channel flow meters are currently installed in the City's wastewater collection system at strategic locations. The meter sites were selected by the City to isolate flows in specific areas and subareas in the collection system, and to capture flows from the City of Clovis and Fresno State. The 21 flow monitoring locations, as well as the area tributary to each site, are shown on Figure 3.1. Table 3.1 lists the flow monitoring locations and the diameters for the sewers where the meters were installed. Figure 3.2 provides a schematic illustration of the flow monitoring locations.

3.2 WASTEWATER FLOW COMPONENTS

As a way to help the reader understand the wastewater flow components, this section describes and provides definitions of commonly used terminology in the wastewater collection system analysis and evaluations conducted as part of this project. In general, wastewater consists of base wastewater flow (BWF) and wet weather flow (WWF). BWF is flow generated by routine water usage in the residential, commercial, business and industrial sectors of the collection system.

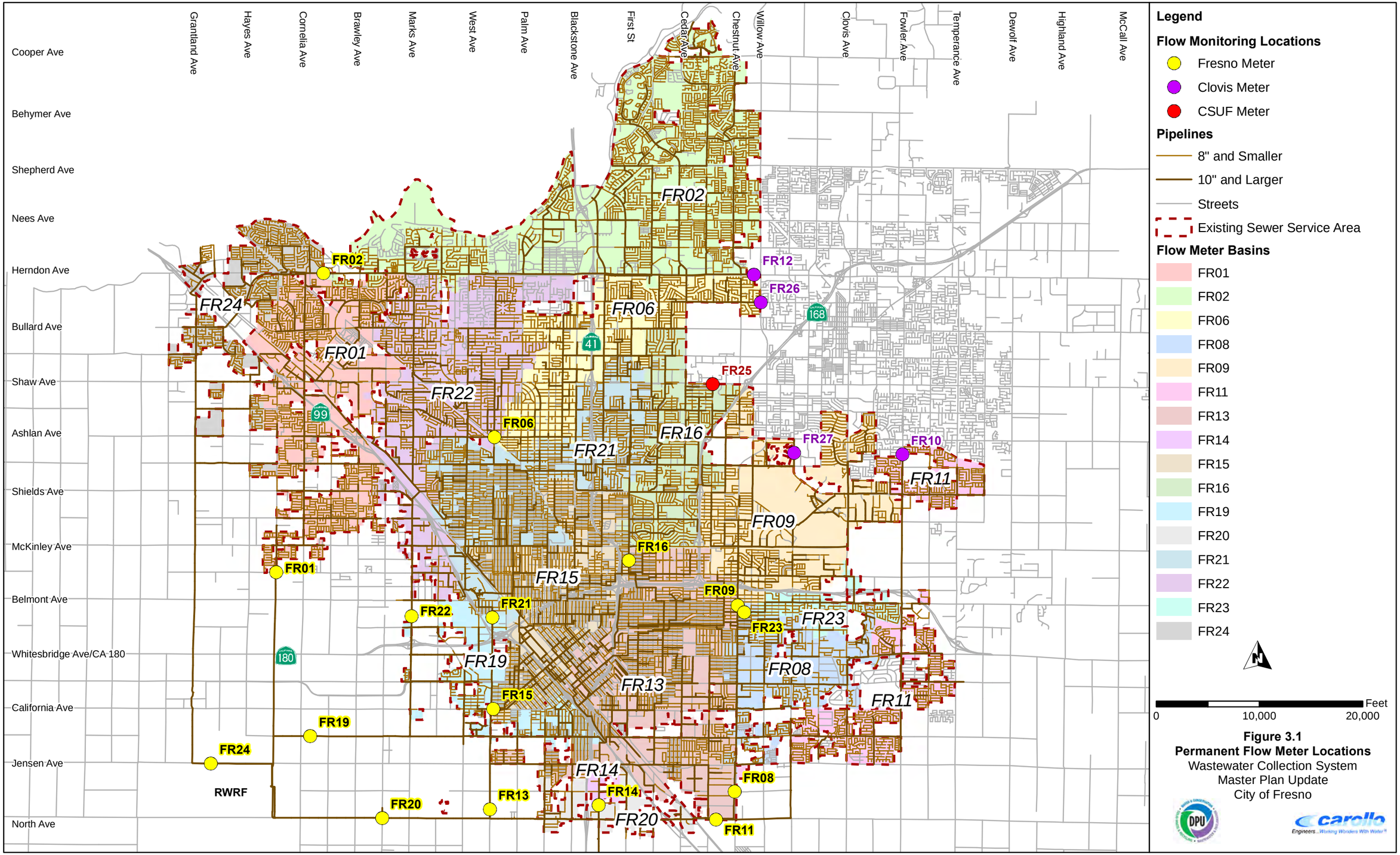
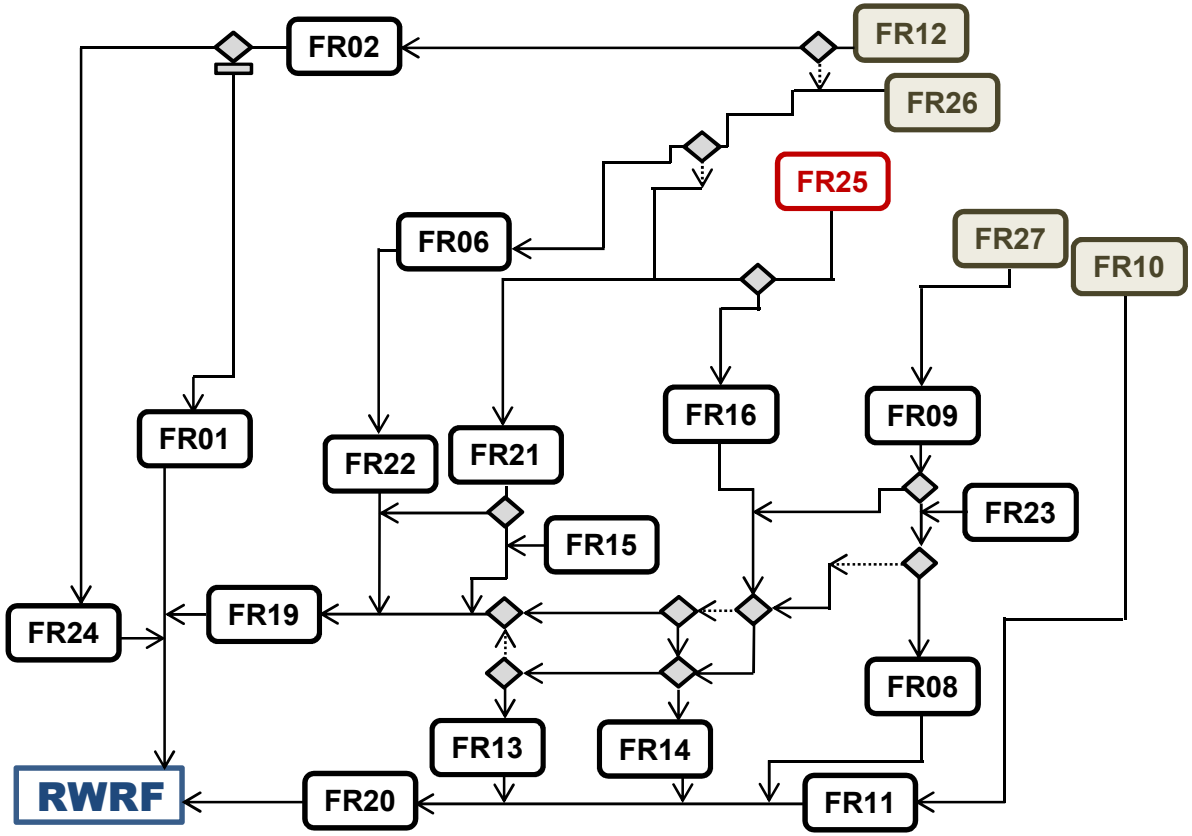


Figure 3.1
Permanent Flow Meter Locations
Wastewater Collection System
Master Plan Update
City of Fresno



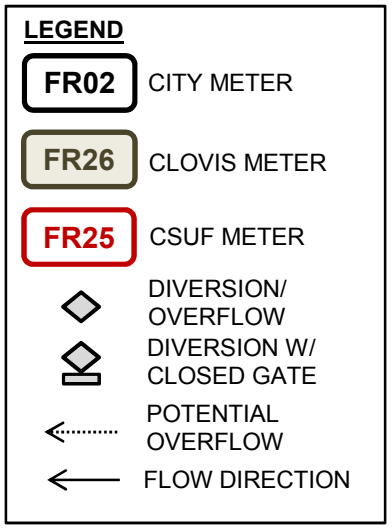


Figure 3.2
Flow Monitoring Locations Schematic
Wastewater Collection System Master Plan Update
City of Fresno

Table 3.1 Flow Monitoring Locations
Wastewater Collection System Master Plan Update
City of Fresno

Meter Site	Manhole ID	Pipe Diameter (in.)	Location	Notes
FR01	2345-01	45	Polk Ave. & Olive Ave.	
FR02	1346-24	45	Herndon Ave. & Blythe Ave.	
FR06	1953-02	36	Ashlan Ave. & Fruit Ave.	
FR08	3261-05	48	Chestnut Ave. & Annadale Ave.	
FR09	2561-09	39	Chestnut Ave. & Madison Ave.	
FR10	1967-46	36	Fowler Ave. near Sussex Way	Clovis
FR11	3361-01	66	North Ave. & Maple Ave.	
FR12	1362-02	33	Herndon Ave. & Willow Ave.	Clovis
FR13	3253-06	51	Fruit Ave. & North Ave.	
FR14	3256-11	36	Cherry Ave. & Edgar Ave.	
FR15	2853-86	48	California Ave. & Fruit Ave.	
FR16	2357-34	30	First St. & Floradora Ave.	
FR19	2946-02	66	Church Ave. & Cornelia Ave.	
FR20	3249-01	66	North Ave. & Prospect Ave.	
FR21	2552-36	42	Fruit Ave. & Nielsen Ave.	
FR22	2550-07	45	Marks Ave. & Nielsen Ave.	
FR23	2562-21	27	Washington Ave. & Garden Ave.	
FR24	3042-07	72	Jensen Ave. & Grantland Ave.	
FR25	1760-56	15	Shaw Ave. & Maple Ave.	Fresno State, Maple
FR26	1362-45	12	Sierra Ave. & Willow Ave.	Clovis
FR27	1963-09	27	Peach Ave. & Pontiac Way	Clovis

The other component of BWF is the contribution of dry weather groundwater infiltration (GWI) into the collection system. Dry weather GWI will enter the sewer system when the relative depth of the groundwater table is higher than the depth of the pipeline and when the susceptibility of the sanitary sewer pipe allows infiltration through defects such as cracks, misaligned joints, and broken pipelines. In the City specifically, the depth to the groundwater table is quite deep, and therefore there is little to no influence associated with dry weather GWI into the collection system.

WWF includes storm water inflow, trench infiltration, and wet weather GWI. The storm water inflow and trench infiltration comprise the WWF component termed infiltration and inflow (I/I). The response in the sewer system to rainfall is seen immediately (as with inflow) or within hours after the storm (as with infiltration).

The third element of WWF is GWI, which is not specific to a single rainfall event, but rather to the effects on the sewer system over the entire wet weather season. The depth of the groundwater table rising above the pipe invert elevation causes GWI. Sewer pipes within close proximity to a body of water can be greatly influenced by groundwater effects. As the groundwater table fluctuates over the wet weather season, this fluctuation is seen as a mounding effect in flow monitoring data. As previously mentioned, the depth to groundwater in Fresno is very deep, and so the effect of wet weather GWI is negligible. In fact, wastewater flows, on average, are lowest during the wet weather months in the City. Figure 3.3 illustrates the various flow components of wastewater in general, which are described in detail in the following sections.

3.2.1 Base Wastewater Flow

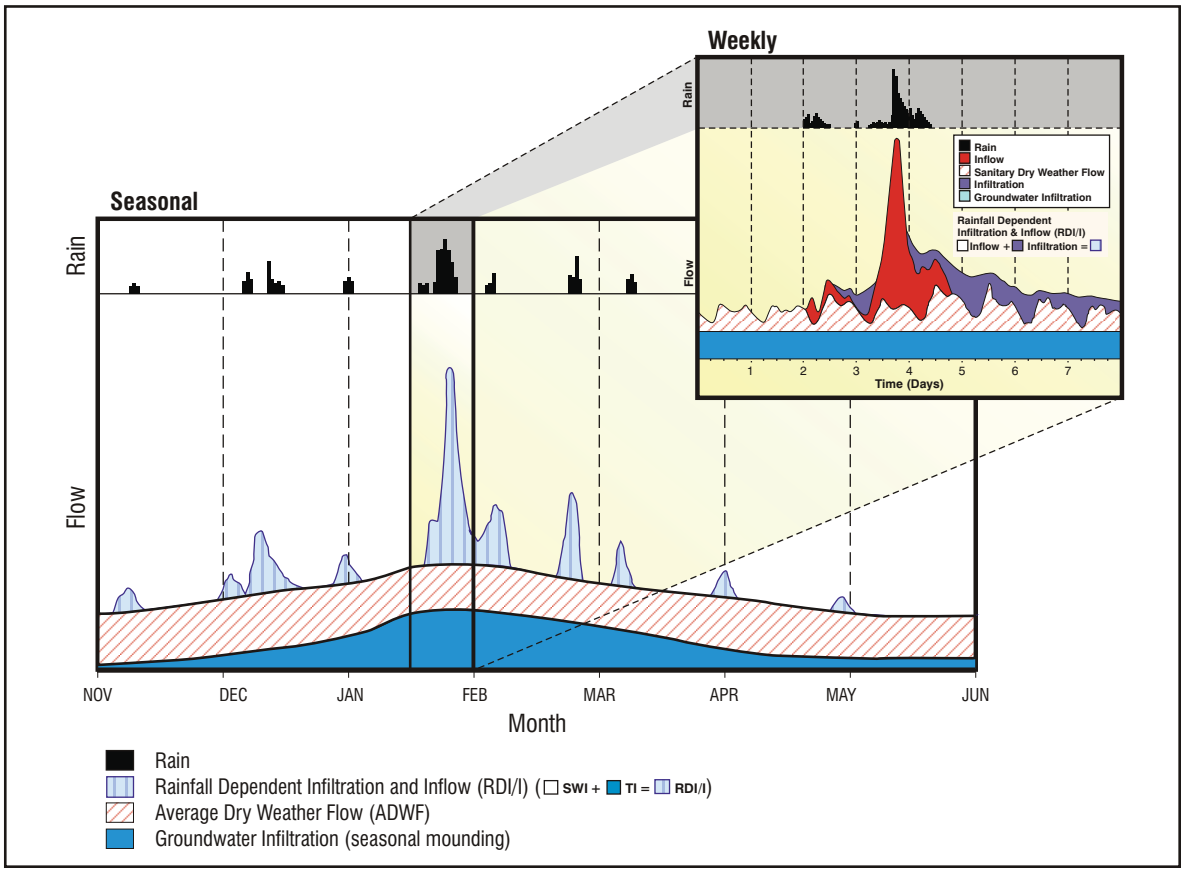
The BWF is the flow generated by the City's customers. The flow has a diurnal pattern that varies depending on the type of use. Commercial and industrial patterns, though they vary depending on the type of use, typically have more consistent higher flows during business hours and lower flows at night. Furthermore, the diurnal flow pattern experienced during a weekend may vary from the diurnal flow experienced during a weekday.

3.2.2 Average Annual Flow

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

3.2.3 Average Dry Weather Flow

The Average Dry Weather Flow (ADWF) is the average flow that occurs on a daily basis during the dry weather season. The ADWF includes the BWF generated by the City's residential, commercial, and industrial users, plus the dry weather GWI component. For the City, the ADWF and the BWF are synonymous, because dry weather GWI is not a contributor to the City's collection system. Therefore, throughout the remainder of this Master Plan, the term BWF will be used in place of the term ADWF.



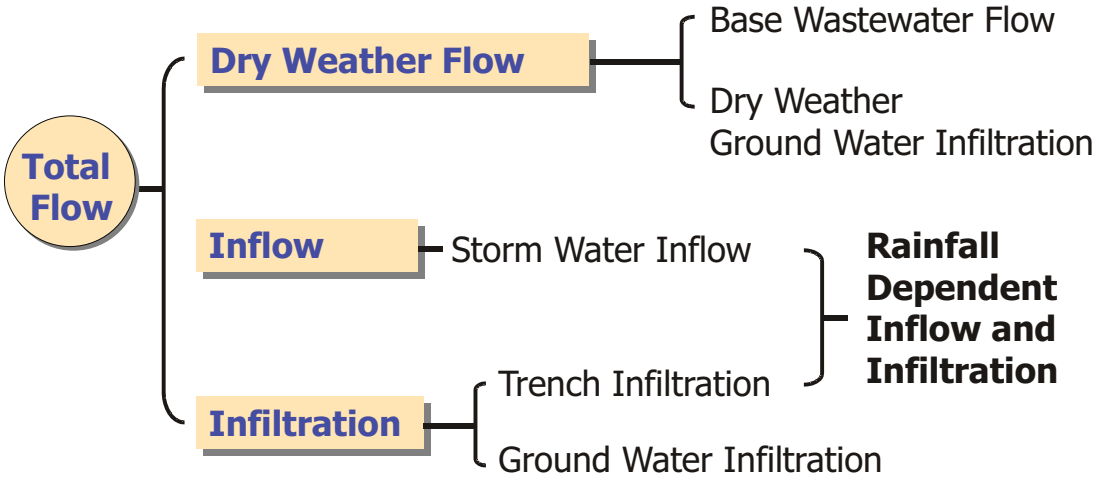


Figure 3.3
Typical Wastewater Flow Components
Wastewater Collection System Master Plan Update
City of Fresno

Note: This figure is not based on flow data specific to the City or this Master Plan

3.2.4 Infiltration and Inflow

All wastewater collection systems have some I/I, although the characteristics and severity vary by region and individual collection system. Some of the most common sources of I/I are shown on Figure 3.4. Infiltration is defined as storm water flows that enter the sewer system by percolating through the soil and then through defects in pipelines, manholes, and joints.

Examples of infiltration entry points are cracks in pipelines, misaligned joints, and root penetration. Inflow is defined as storm water that enters the sewer system via a storm drain cross connections, leaky manhole covers, or cleanouts. Examples of inflow entry points are roof drain and downspout connections, leaky manhole covers, and illegal storm drain connections.

The adverse effects of I/I entering the sewer system is that it increases both the flow volume and peak flows, as illustrated on Figure 3.5. If too much I/I enters the sewer system such that the sewer system is operating at or above its capacity, sanitary sewer overflows (SSOs) could occur. The City's wastewater collection system exhibits relatively low I/I contribution as a whole, although there are certain areas with relatively high rates of I/I.

3.2.5 Peak Dry Weather Flow

Peak dry weather flow (PDWF) is the highest observed hourly flow in the collection system during the dry weather season. In the case of the City, industrial flows increase significantly during the late summer months. The highest monthly flow rates at the RWRF are typically experienced in the months of August, September, and October. PDWF is used to evaluate the capacity of the collection system.

3.2.6 Peak Wet Weather Flow (Design Flow)

Peak wet weather flow (PWWF) is the highest observed flow that occurs following a design storm event. Wet weather I/I cause flows in the collection system to increase. PWWF is typically used for designing sewers and lift stations. Therefore, the PWWF and the "Design Flow" are synonymous and will be used interchangeably. As with PDWF, PWWF is also used to evaluate the capacity of the collection system.

3.3 FLOW MONITORING DATA SUMMARY

This section summarizes the data obtained and analyzed from the City's permanent flow monitoring program, including BWF data and wet weather flow data. Data collected from Meter FR06 is presented throughout this and other chapters as an example of the type of data collected from the flow monitoring program. Refer to Appendix B and Appendix C for additional data summaries and other information associated with the remaining meter sites.

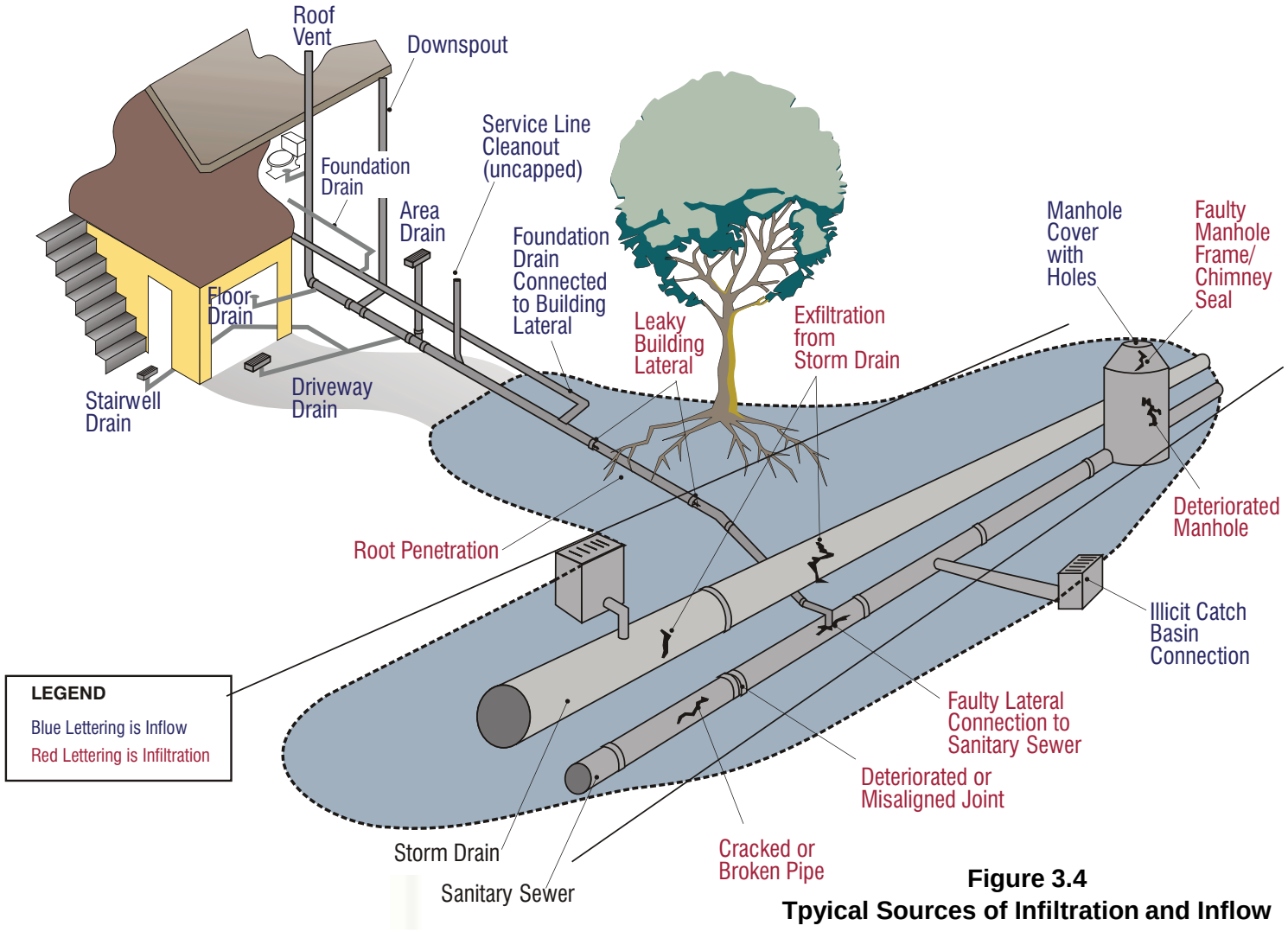


Figure 3.4
Tpyical Sources of Infiltration and Inflow
Wastewater Collection System Master Plan Update
City of Fresno

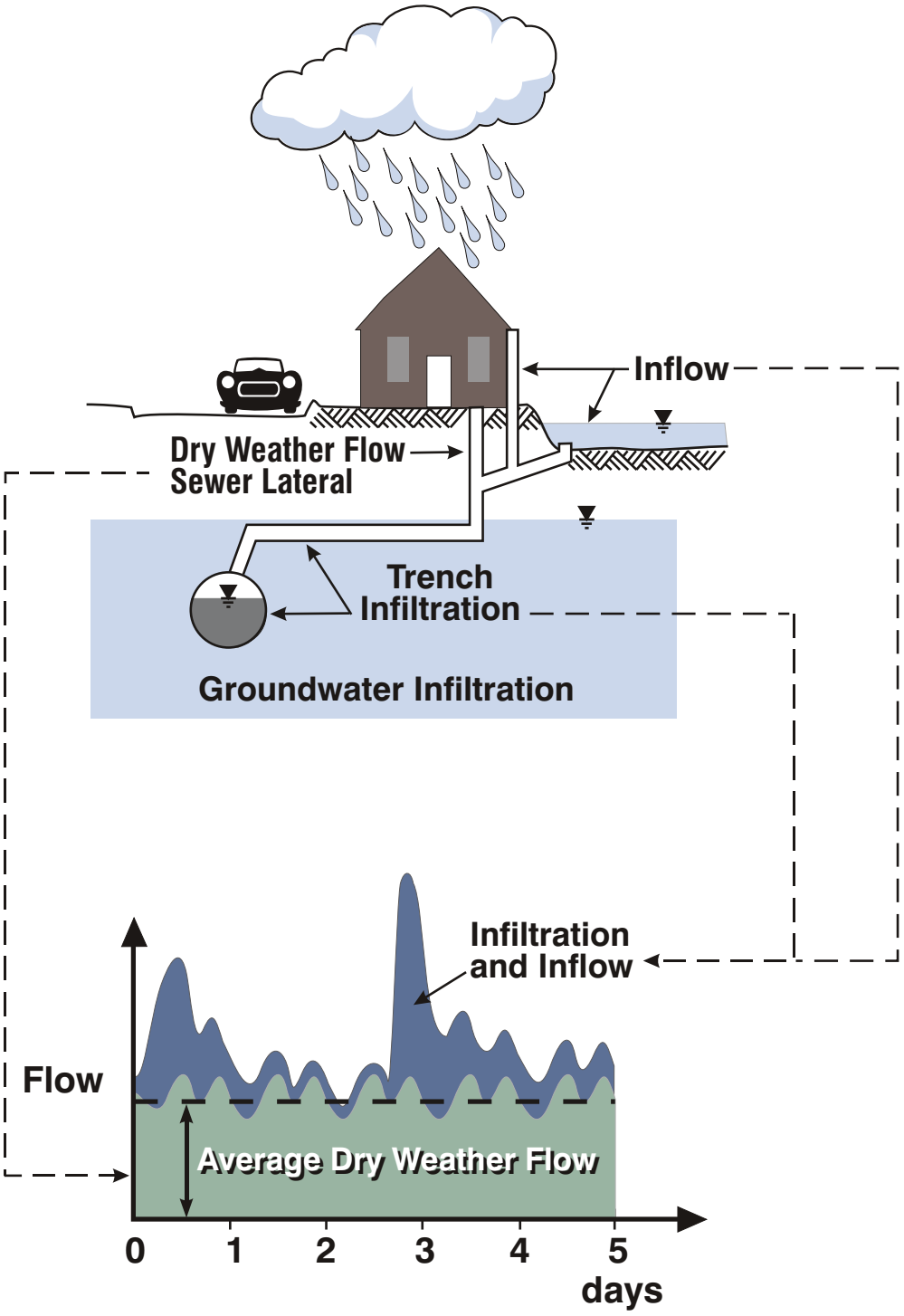


Figure 3.5
Typical Effects of Infiltration and Inflow
Wastewater Collection System Master Plan Update
City of Fresno

3.3.1 Base Wastewater Flow Data

The City's permanent flow meters collect depth and velocity data at 5-minute intervals. Characteristic dry weather 24 hour diurnal flow patterns for each site were developed for each meter based on data available during base flow periods (i.e., in the winter when there is no rainfall). This hourly flow data was then used to calibrate the hydraulic model for the observed dry weather flows during the flow monitoring period.

For Fresno, it was determined, based on a review of the available flow monitoring data and the monthly flows at the RWRF, that the month of January 2013 was the most appropriate time period to select for the determination of BWF at each flow meter. At a few sites, flow monitoring data were not available in January 2013. In these cases, January 2012 was used.

Hourly patterns for weekday and weekend flows vary and are separated to better understand dry weather flow. Carollo used the data from days in January 2013 that were least affected by rainfall to estimate the weekday and weekend dry weather flows. In addition, Carollo prepared estimates for the average weekday and weekend levels and velocities at each site, which are used in BWF calibration. Figure 3.6 illustrates a typical variation of weekday and weekend flow in the City, which is based on the data collection from Meter FR06. Similar graphics associated with the remaining sites are included in Appendix B. Table 3.2 summarizes the BWF at each meter.

3.3.2 Industrial Flow Data

The City has several large significant industrial users (SIUs). Some users have dedicated flow meters, and flow records were available on a monthly basis. For other SIUs, the City provided average flow estimates. A summary of the average flows associated with each SIU is provided in Appendix D.

3.3.3 Rainfall Data

Available rainfall data for the Fresno area were reviewed to identify significant rainfall events that have occurred in recent years. Based on a review of this data, as well as the available flow monitoring data, it was determined that the most significant rainfall events that have occurred in recent years occurred from March 20-21, 2011, and April 11-13, 2012.

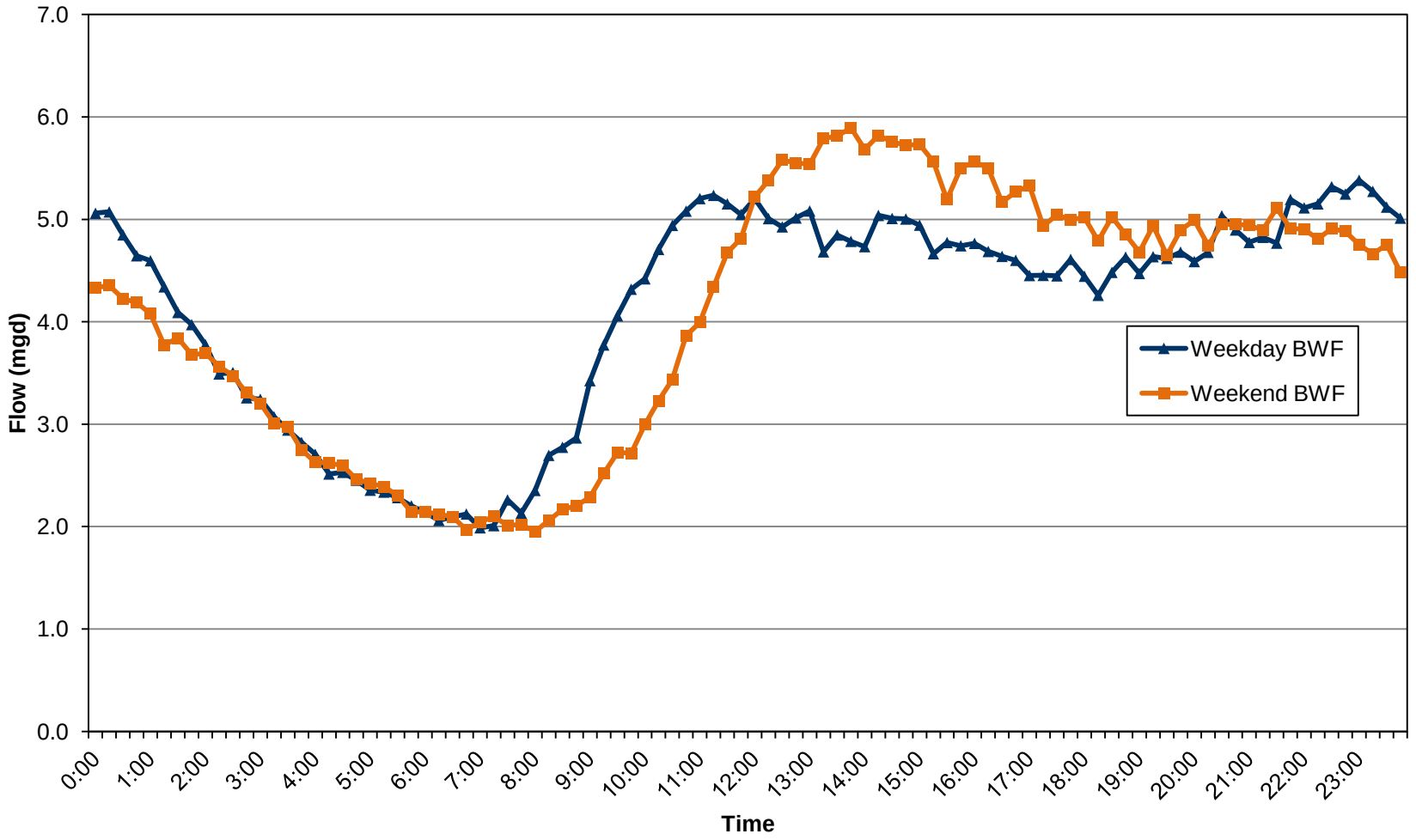


Figure 3.6

Example Weekday vs. Weekend Flow Variation (Meter FR06)

Wastewater Collection System Master Plan Update

Table 3.2 Base Wastewater Flow Summary
Wastewater Collection System Master Plan Update
City of Fresno

Meter Site	Weekday BWF (mgd)	Weekend BWF (mgd)	Overall BWF (mgd)	Weekend/ Weekday Ratio
FR01	3.70	3.70	3.76	1.05
FR02	8.05	7.73	8.07	1.01
FR06	4.13	4.13	4.12	0.99
FR08	7.66	7.67	7.51	0.93
FR09	5.03	4.86	4.92	0.93
FR10	1.49	1.46	1.49	1.00
FR11	3.58	3.61	3.55	0.97
FR12	1.58	1.58	1.58	1.01
FR13	8.53	8.33	8.36	0.93
FR14	4.06	4.02	4.05	0.99
FR15	6.19	6.07	6.12	0.96
FR16	3.72	3.70	3.72	1.00
FR19	23.15	23.07	22.51	0.90
FR20	29.85	26.96	28.94	0.89
FR21	4.40	4.45	4.42	1.01
FR22	7.46	7.47	7.51	1.02
FR23	1.25	1.26	1.11	0.61
FR24	8.12	8.99	8.15	1.01
FR25	0.08	0.08	0.08	0.96
FR26	0.19	0.19	0.19	1.03
FR27	1.90	1.90	1.91	1.02

3.3.4 Wet Weather Flow Data

The flow monitoring data was also evaluated to determine how the collection system responds to wet weather events. As mentioned above, the most significant rainfall events in recent years occurred in March 2011 and April 2012. There was limited flow monitoring data available for March 2011, but most of the City's flow meters had valid data for the April 2012. For this reason, the April 2012 storm was used for model calibration, and the March 2011 storm was used to validate the I/I parameters developed as part of the April 2012 WWF calibration.

Figure 3.7 shows an example of the wet weather response at Meter FR06 during the April 2012 storm. Figure 3.7 illustrates the volume of I/I that entered the system from the collection system upstream of Site FR06. The light blue area is the base sanitary flow while the gray area is the measured flow from the flow monitoring period. As can be seen in the figure, discernible amounts of I/I do enter the system during wet weather events.

The metric typically used to quantify the severity of the system's I/I is the R-value. The R-value is defined as the percentage of rainfall volume that makes it into the collection system as I/I. Table 3.3 summarizes the calibrated R-values for each flow monitoring basin. As shown in Table 3.3, the R-Values vary from 0.2-percent in basin FR02 to 1.45 percent in Basin 20. In general, an R-Value of 5 percent or more is usually considered indicative of a significant I/I response. It should be noted that Basin 23 exhibited an R-Value in excess of 5 percent. Based on a review of available data, it appears that the majority of I/I contributions in this basin are associated with the Gallo property (see Section 1.5.4 for more information).

The R-Value for each basin is determined by isolating I/I associated with individual flow monitoring basins (i.e., excluding flow rates from upstream flow monitors) and calculating the ratio of the volume of water that enters the system as I/I versus the volume of rainfall that fell over the flow monitoring basin tributary area.

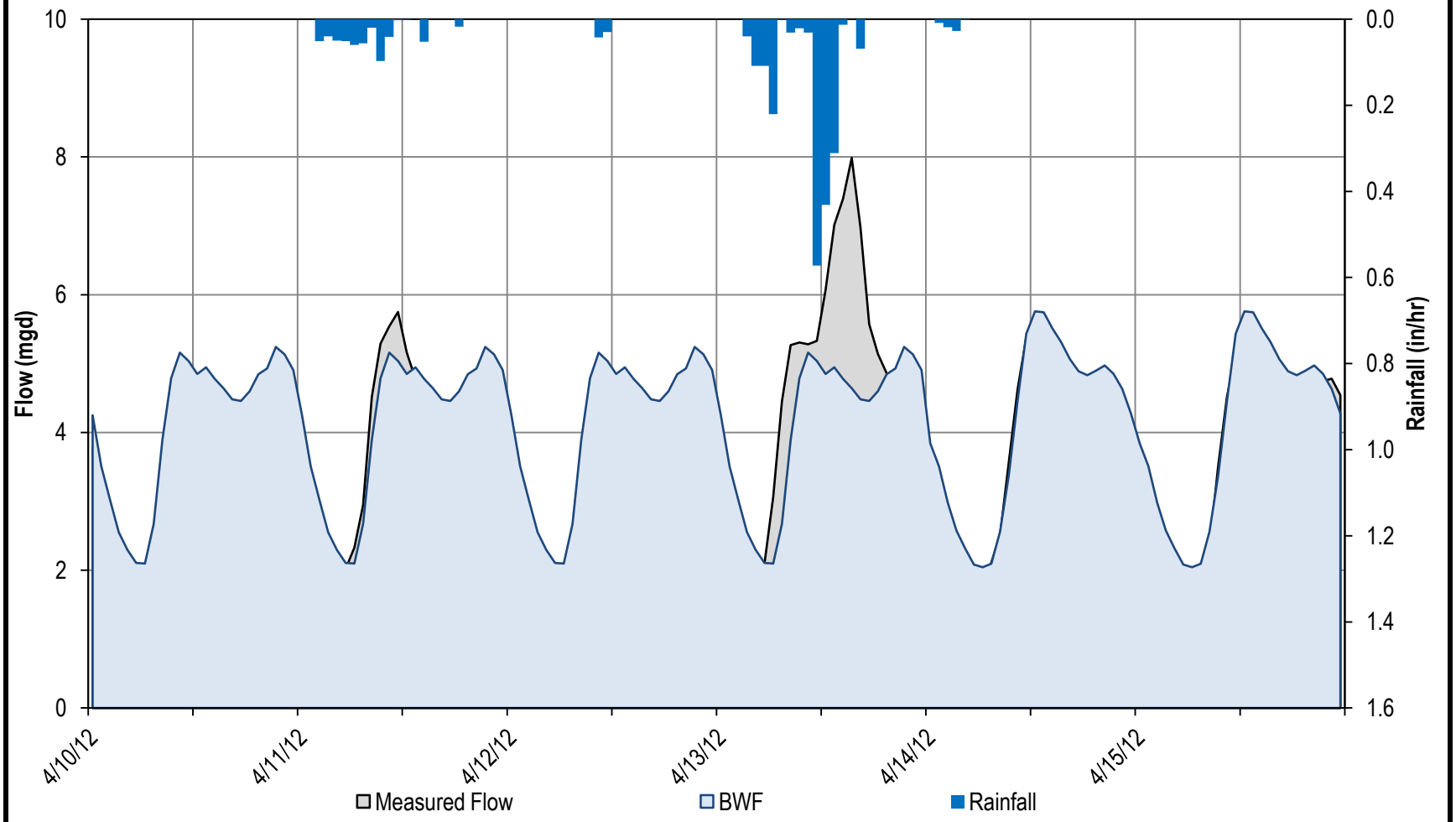


Figure 3.7

Example WWF Response (Meter FR06)

Wastewater Collection System Master Plan Update

City of Fresno

Table 3.3 R-Value Summary
Wastewater Collection System Master Plan Update
City of Fresno

Meter Basin	R-Value (%)
FR01	0.40
FR02	0.20
FR06	0.41
FR08	1.30
FR09	1.20
FR10	Note(1)
FR11	1.00
FR12	Note(1)
FR13	1.30
FR14	1.30
FR15	1.20
FR16	0.88
FR19	0.25
FR20	1.45
FR21	0.80
FR22	0.65
FR23(1)	0.75
Gallo Property, Basin 23	75
FR24	0.80
FR25	0.75
FR26	Note(1)
FR27	Note(1)

Notes:

(1) Tributary areas associated with the City of Clovis are not known. Therefore, R-values are not presented in this document.

(2) R-value presented excludes the Gallo Property, which is estimated to have an R-value of roughly 75 percent.

COLLECTION SYSTEM FACILITIES AND HYDRAULIC MODEL

This Chapter describes the update and calibration of the City of Fresno's (City's) collection system hydraulic model. A description of the City's wastewater collection system, the existing hydraulic model, and an outline of the steps used to update the model are provided. A detailed summary of the hydraulic model calibration steps, standards, and results for both base wastewater flow (BWF) and wet weather flow (WWF) conditions is also provided.

4.1 COLLECTION SYSTEM FACILITIES

The City's collection system consists of gravity sewers, lift stations, associated force mains, and several special structures/flow diversions that collect and convey wastewater to the Fresno/Clovis Regional Wastewater Reclamation Facility (RWRF), which is located on Jenson Avenue just west of Cornelia Avenue. In addition, the City operates the North Fresno Wastewater Reclamation Facilities (NFWRF) satellite plant, which serves the Copper River Ranch development, and provides recycled water via irrigation to the Copper River Country Club golf course.

Figure 4.1 presents the City's collection system, and the current wastewater service area. The collection system conveys wastewater primarily by gravity flow, generally from the northeast to the southwest, and ultimately to the RWRF. In addition to customers within City limits, the RWRF also serves a majority of flow generated within the City of Clovis, as well as unincorporated County islands within the City. The City of Clovis has four connections to the City collection system. The maximum discharge at each connection is defined by the Fresno-Clovis Regional Sewerage System Joint Powers Agreement (JPA), dated March 3, 1977.

The City's wastewater collection system has roughly 23,000 manholes, 15 lift stations, 1.7 miles of force mains, and 1,500 miles of gravity sewer pipes (excluding abandoned/out of service and private facilities).

4.1.1 Gravity Collection System

The City's existing sanitary sewer collection system is comprised of over 1,500 miles of gravity collection system pipe up to 84-inches in diameter, and over 23,000 manholes. Table 4.1 presents a summary by diameter of the known sewers in the collection system. This table excludes abandoned and private sewers, as well as sewers associated with the City of Clovis collection system.

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave

Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave

NFWRF
RWRF
LS01
LS02
LS03
LS04
LS05
LS06
LS10
LS12
LS13
LS14
LS15
LS16
LS18
LS20
1346-25
1961-01
2058-06
2253-15
2561-21
2652-03
2858-101
2952-49
2957-22
3057-07
3153-01
3056-03

99
180
41
168

Legend

Existing Wastewater Collection System

- Lift Stations
- Special Structures

Pipelines

- 8" and Smaller
- 10" - 18"
- 20" - 36"
- Greater than 36"
- Streets
- Existing Sewer Service Area
- City Limits

Feet
0 10,000 20,000

Figure 4.1
Existing Wastewater Collection System
Wastewater Collection System
Master Plan Update
City of Fresno

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As shown in Table 4.1, approximately 72-percent of the system is 8-inches in diameter and smaller, with the majority (46.6-percent) being 8-inches in diameter.

Table 4.1 Collection System Gravity Pipeline Summary
Wastewater Collection System Master Plan Update
City of Fresno

Diameter (inches)	Length[(1),(2)] (miles)	Percent of System (by length)	Diameter (inches)	Length[(1),(2)] (miles)	Percent of System (by length)
4	0.02	0.0	33	5.1	0.3
6	386.7	25.7	36	9.4	0.6
8	702.1	46.6	39	8.2	0.5
10	104.2	6.9	40	0.7	0.0
12	71.1	4.7	42	7.3	0.5
14	2.3	0.2	45	13.7	0.9
15	41.9	2.8	46	0.0	0.0
16	2.8	0.2	48	10.2	0.7
18	39.5	2.6	51	3.5	0.2
20	2.6	0.2	54	2.9	0.2
21	16.0	1.1	57	1.1	0.1
22	1.1	0.1	60	9.1	0.6
24	21.0	1.4	66	11.2	0.7
27	11.0	0.7	72	6.6	0.4
30	13.5	0.9	84	1.4	0.1
			Total (miles)	**1,506**	**100**

Notes:
(1) Source: City of Fresno GIS database
(2) Totals exclude abandoned and private facilities

Table 4.2 summarizes the gravity collection system by pipe material. As shown in Table 4.2, the majority of the collection system (56-percent) consists of vitrified clay pipe (VCP), and roughly one-third of the collection system (30.8-percent) consists of polyvinyl chloride (PVC) pipe.

Table 4.2 Collection System Gravity Pipeline Material Summary
Wastewater Collection System Master Plan Update
City of Fresno

Material	Abbreviation	Length[(1),(2)] (miles)	Percent of System (by length)
Asbestos Cement Pipe	ACP	6.2	0.4
Armco Plastic Truss	APT	5.7	0.4
Closed Profile PVC	CCP	1.1	0.1
Cast Iron Pipe	CIP	6.3	0.4
Ductile Iron Pipe	DIP	4.6	0.3
Fiberglass Reinforced Plastic	FRP	0.01	0.0
Polyvinyl Chloride Pipe	PVC	464.5	30.8
Reinforced Concrete Lined Pipe	RCL	20.2	1.3
Reinforced Concrete Pipe	RCP	95.0	6.3
Standard Concrete Pipe	SCP	56.0	3.7
Truss Pipe	TRS	0.2	0.0
Vitrified Clay Pipe	VCP	846.2	56.2
Total	**--**	**1,506.2**	**100.0**

Notes:
(1) Source: City of Fresno GIS database
(2) Totals exclude abandoned and private facilities
(3) Approximately 68.9 miles of pipe have been rehabilitated using a CIPP liner, or 4.6 percent of the system.

Table 4.3 summarizes the gravity collection system by installation year. As shown on Table 4.3, approximately 16-percent of the collection system was originally installed before 1950. Roughly 48-percent of the system was installed between 1950 and 1980 (26-percent of the system was installed in the 1970's), and the remaining 36-percent of the system was installed since 1980.

Table 4.3 Collection System Gravity Pipeline Installation Year Summary
Wastewater Collection System Master Plan Update
City of Fresno

Years	Length[(1),(2)] (miles)	Percent of System (by length)
Unknown	0.1	0.0
Pre 1900	8.8	0.6
1900-1910	7.4	0.5
1911-1920	55.9	3.7
1921-1930	29.0	1.9
1931-1940	25.8	1.7
1941-1950	106.5	7.1
1951-1960	163.1	10.8
1961-1970	179.6	11.9
1971-1980	385.7	25.6
1981-1990	153.0	10.2
1991-2000	196.7	13.1
2001-2010	185.2	12.3
2011-2013	9.4	0.6
Total	**1,506.2**	**100.0**

Notes:
(1) Source: City of Fresno GIS database
(2) Totals exclude abandoned and private facilities

4.1.2 Lift Stations

The City operates and maintains 15 active wastewater lift stations throughout the City (excluding private and abandoned lift stations). Figure 4.1 shows the location of each lift station. Table 4.4 summarizes the available design data for each f the City's active lift stations.

4.1.3 Special Structures/Field Reconnaissance

The City's collection system includes several important flow diversions, which split average and peak wastewater flows between sewer basins. The City's previous Collection System Master Plan provided a description of many of the flow diversions. In most cases, these descriptions were deemed sufficient for the purposes of this Master Plan. Supplemental field reconnaissance was also performed by Blair, Church, and Flynn (BC&F) and City staff at seven sites selected by Carollo (Figure 4.2). The sites selected for field reconnaissance

were determined to be complex or otherwise important enough to warrant further investigation. As part of the field reconnaissance, BC&F provided rim elevations, invert elevations, rough estimates for flow splits between outlet pipes, general observations, and photographs for each site (with the exception of the Dakota and Millbrook Structure, which was visually inspected by Carollo Engineers (Carollo)/City staff only).

Table 4.4 Wastewater Lift Station Summary
Wastewater Collection System Master Plan Update
City of Fresno

Name	Location	No. of Pumps	Capacity (per pump)		Firm Capacity (mgd)
			(gpm)	(mgd)	
LS01	Jensen and Walnut Avenues	2	750	1.080	1.080
LS02	Marks Avenue and Kearney Boulevard	2	450	0.648	0.648
LS03	Wilson Avenue north of Shields Avenue	2	250	0.360	0.360
LS04	Riverview Drive and Del Mar Avenue	2	186	0.272	0.272
LS05	Fort Washington Road and Champlain Drive	2	515	0.742	0.742
LS06	Champlain Drive and Perrin Avenue	2	1545	2.220	2.220
LS10	Stratford Drive and Woodlawn Drive	2	260	0.374	0.374
LS12	Bullard and Carnegie Avenues	2	200	0.288	0.288
LS13	Jackson and University Avenues	2	190	0.272	0.272
LS14	Alluvial and Carnegie Avenues	2	400	0.576	0.576
LS15	Hayston Avenue and Fountain Way	2	400	0.576	0.576
LS16	Santa Fe and Bluff Avenues	2	175	0.252	0.252
LS18	Hughes and Nielson Avenues	2	670	0.959	0.959
LS20	Cherry Avenue south of North Avenue	2	670	0.959	0.959
NFWRF	North Fresno WRF	2	440	0.639	0.639

Notes:
(1) Source: Data provided by City Staff.

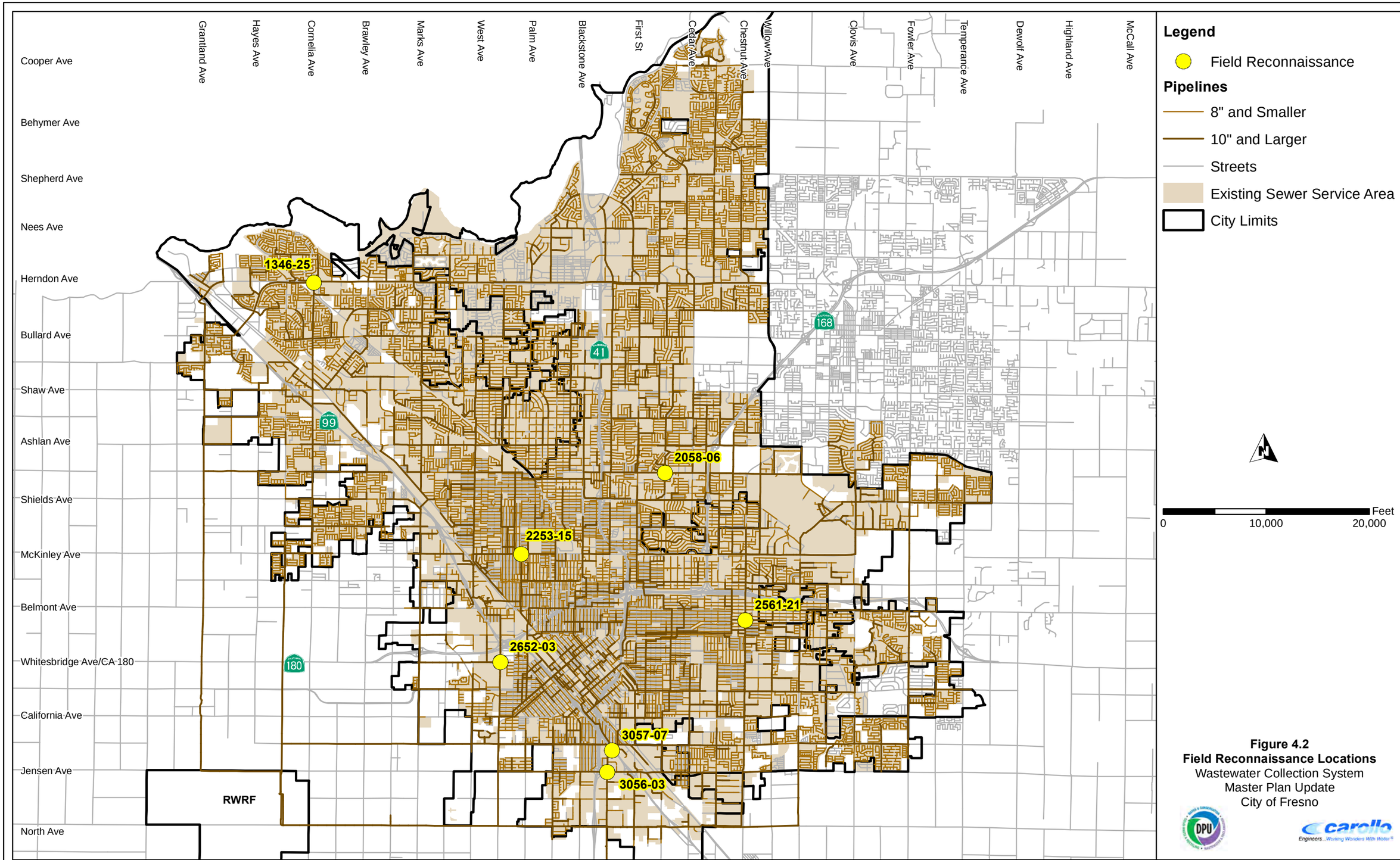

Figure 4.2
Field Reconnaissance Locations
Wastewater Collection System
Master Plan Update
City of Fresno

Table 4.5 provides a summary of the major diversions within the collection system, and identifies which of the structures were investigated as part of this Master Plan Update. Appendix E provides detailed survey data, sketches, and photographs from the site reconnaissance performed by BC&F.

During the base wastewater flow calibration process (see Section 3.4), it was discovered that there was a flow discrepancy in the model for Flow Meters FM16 and FM21. Further investigation revealed that the most likely source of the flow discrepancy was the junction structure located at the intersection of Dakota Avenue and Millbrook Avenue. For this reason, Carollo and City staff performed a site visit at one additional manhole to supplement the field reconnaissance activities performed by BC&F, as described below:

- **MH 2058-06, Dakota and Millbrook:** During the base wastewater flow calibration process (see Section 4.3.3), it was discovered that there was a flow discrepancy in the model for Flow Meters FM16 and FM21. Further investigation revealed that the most likely source of the flow discrepancy was the junction structure located at the intersection of Dakota Avenue and Millbrook Avenue. The previous Collection System Master Plan indicated that flows into this structure are split roughly 50/50 between a 21-inch diameter sewer that flows south into Basin 16 and a 21-inch sewer that flows west into Basin 21. However, Carollo determined that during base flow conditions, the majority of flow in this structure is routed to the 21-inch pipeline flowing south to Meter FM16. In order to confirm this, Carollo arranged with City staff to perform an additional site investigation of this structure. At the site investigation, it was discovered that a concrete wall has been installed on the 21-inch pipeline flowing to the west, approximately to the halfway depth of the pipe. Therefore, at this structure, low flows are conveyed south. Once flows reach a flow depth to pipe diameter ratio (d/D) of roughly 0.5, flows are split between both pipelines. At the time of the site visit (about 9:30 AM), it was estimated that approximately 10 to 20-percent of the flow into the structure was observed to be diverted west into Basin 21. The majority of the remaining flow continued south to Meter FM16, which was consistent with the flow monitoring data.

  A custom flow inflow/outflow diversion curve of this structure was developed using H_2OMAP SWMM and input into H_2OMAP Sewer. Because H_2OMAP SWMM features a more accurate routing engine than H_2OMAP Sewer, it was determined that a curve generated from H_2OMAP SWMM would be the most appropriate method of simulating this structure. Figure 4.3 shows the custom diversion curve that was developed for this structure. Furthermore, the pipelines downstream of this structure are known capacity issues, and therefore it is critical to simulate the flow splits at this location as accurately as possible.

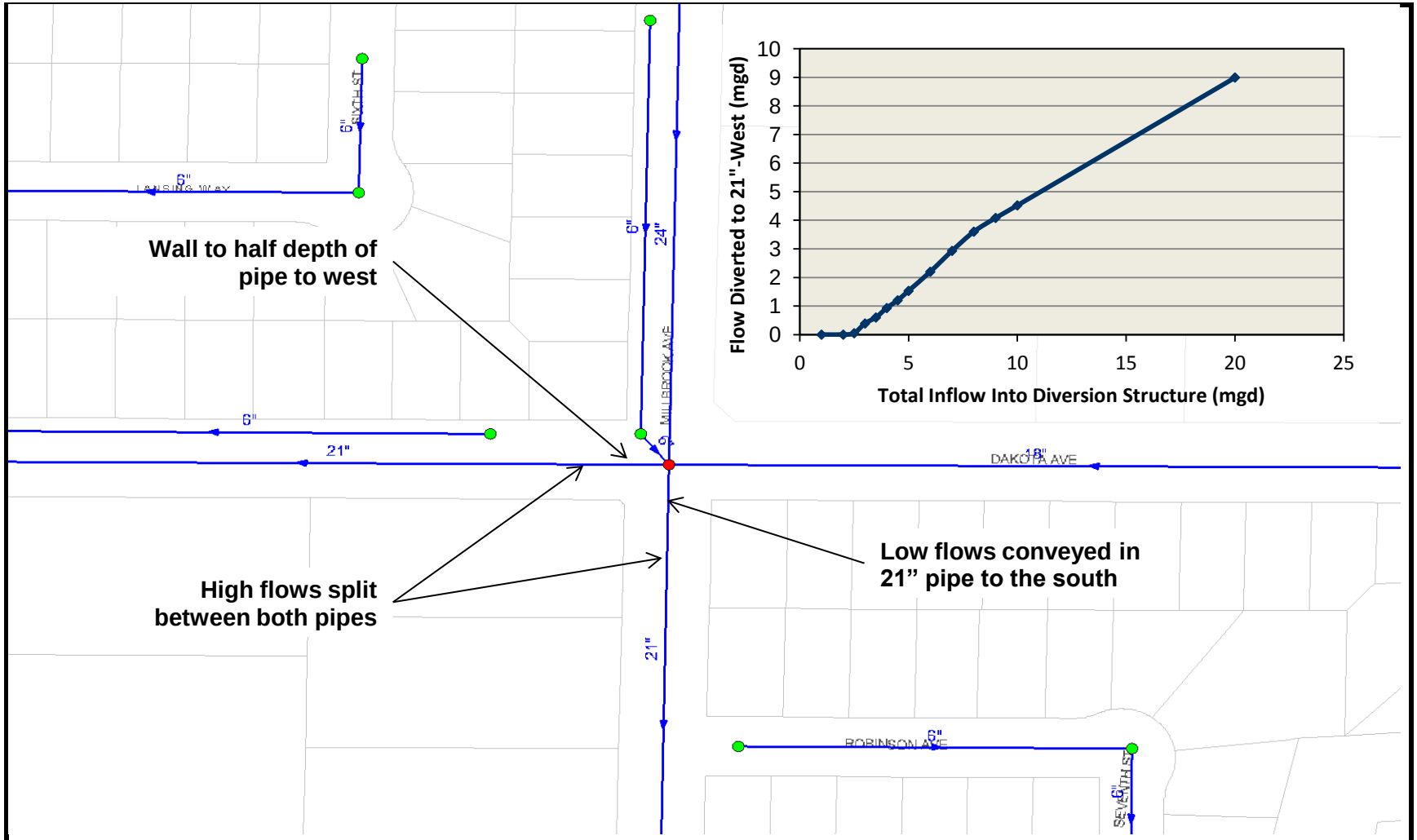

Figure 4.3
Dakota/Millbrook Diversion Curve
Wastewater Collection System Master Plan Update
City of Fresno

Table 4.5 Special Structures
Wastewater Collection System Master Plan
City of Fresno

Manhole ID	Location	Model ID	Structure Type	Flow Description	Reconn. Performed
2858-101	California Ave. and East Ave.	37421	This structure consists of a 60-inch standard manhole design with frame and cover, and channelized base.	Under average day conditions, all flow diverts east to the 30-inch pipe with an upstream invert elevation of 275.7 feet However, once the hydraulic grade line reaches 276.5 feet flow will split south to the 21-inch pipe.	
2952-49	Church Ave. and Fruit Ave.	39583	This structure is a cast-in-place, reinforced concrete structure with a channelized bottom, and the manhole risers are made of brick with cast iron covers.	Flow enters the structure from the east via two new 30-inch pipes. Currently, flow also enters from a 48-inch pipe from the south. Flow exits the structure through an existing 48-inch pipe to the west. The structure had options for installing 2"x12"x4'-4" redwood board gates on the 48- inch pipe exiting the structure; however, due to a blow-out in 2002 flow is no longer prohibited from exiting the structure and continuing westerly in Church Avenue. The structure was repaired in 2003, but the gate was not reinstated. A new gate will need to be constructed such that the flow can be diverted to the south in the 48-inch Fruit Avenue pipeline to North Avenue as originally conceived.	
3153-01	Jenson Ave. and Fruit Ave.	40580	This structure was constructed with reinforced, cast-in-place concrete. The structure has one 24"x 60" access manhole.	Currently, wastewater entering the structure from the north and east flows south in Fruit Avenue. The north and east are 48-inch pipelines and south is a 51-inch pipeline. There are channels provided to install a gate in this junction structure to block flow from going south to North Avenue, thus forcing flows north to West Church Avenue; however, gates are not currently installed. Therefore, no gates were modeled.	
3153-09	Jenson Ave. and Fruit Ave.		The structure has a standard manhole design with frame and cover for access.	Flow enters the structure from the easterly 48-inch pipeline and currently is diverted south to a 51-inch pipeline in South Fruit Avenue. Having since been plugged and abandoned, this structure was originally constructed with a 48-inch pipeline and radius bend to the north directing flow from West Jensen Avenue north in South Fruit Avenue to West Church Avenue. A 48-inch pipeline was also constructed with a radius bend to the south that allows flow from East Jensen Avenue to travel south in South Fruit Avenue when the gate described above for the structure at manhole 3153-01 is not in place. As mentioned above, this gate is currently not installed and flow is directed south in South Fruit Avenue to West North Avenue.	
3506-03	Jenson Ave. and Cherry Ave.	39753	This structure was constructed with reinforced, cast-inplace concrete. The structure has two 24"x 50" access manholes.	Flow entering the structure from the north and east is split to the south and west, respectively. The north and south pipelines are 48-inch pipes and the pipelines in the east and west directions are both 36-inch pipes. An existing manhole is located just outside the junction on the east and the 48-inch pipe passes through this manhole before entering the junction structure. There are notches provided to install gates in this junction structure for the east 48-inch pipe and the south 36-inch pipe; however, gates are not installed. Under average day conditions, approximately two-thirds of the wastewater flows west and the remaining one-third flows south.	X
3057-07	Highway 99 and South of Church Ave.	39851	This structure was constructed with reinforced, cast-in-place concrete. The structure has two 24"x 50" access manholes.	Flow enters the junction structure through a 6'x 3' single box sewer from the east. Currently, flow exits the structure to northwest and west by a 34" x 54" elliptical sewer and a 36-inch pipe, respectively. Under average day conditions, flow splits approximately in half between the two exiting pipes. There are notches provided to install gates in this junction structure for the northwest elliptical pipe and the west 36-inch pipe. However, gates are not currently in place.	X
2652-03	Whitesbridge Rd. at Fruit Ave.	33197	This structure was constructed with reinforced, cast-in-place concrete.	Flow enters the structure through a 42-inch pipe from the north and is split approximately in half between to the south and southwest into a 42-inch pipe and a 33-inch pipe respectively.	X
2957-22	Taylor Ave. and Church Ave.	39841	The structure was constructed with reinforced, cast-in-place concrete.	Flow enters the structure from the east via existing 27-inch and 30-inch pipes. Currently, flow exits the structure to the west through a 34" x 53" elliptical sewer pipe. The elliptical sewer pipe curves at a radius of 30 feet to the south into an existing manhole where a 6-inch pipe from the northwest connects. Flow is not split at this structure; the elliptical pipe and radius of this pipe are a unique feature of this collection system and is considered a special structure.	
1346-25	Herndon Ave. and Milburn Ave.	7780	The structure was constructed with reinforced, cast-in-place concrete. The interior concrete surfaces, except the floor of the structure, are lined with PVC.	Flow enters the junction structure from the north via an existing 45-inch pipe. The flow can be split to the southwest and south to 45-inch pipes. Flow is controlled using two 45" x 45" fabricated, stainless steel slide gates. A 24-inch PVC air jumper connects the junction structure with a manhole located to the west of the structure. Currently, the south slide gate is closed forcing all flow to the southwest into the Grantland Trunk.	X
1961-01	Ashlan Ave. and Sierra Vista Ave.	18338	Unknown	Currently, flow enters the structure from the north via a 12-inch pipe and splits approximately in half to the west and south into a 12-inch and a 15-inch pipe, respectively.	
2253-15	McKinley Ave. and Harrison Ave.	25677	This structure consists of a standard manhole design with frame and cover, and channelized base.	Under average day conditions, all the flow diverts west to the 21-inch pipe with an upstream invert elevation of 282.8 feet However, once the hydraulic grade line reaches 283.7 feet (0.8 ft depth) flow will split south to the 12-inch pipe.	X
2058-06	Dakota Ave. and Milbrook Ave.	19985	This structure is a cast-in-place, reinforced concrete structure with a a 42" diameter manhole cover.	Flow enters the structure from the north and east via a 24-inch and 18-inch pipe, respectively. Currently, flow is split approximately in half to the south and west through two 21-inch pipes.	X
2561-21	Chestnut Ave. and Washington Ave.	32321	The structure was constructed with reinforced, cast-in-place concrete.	Flow enters the structure from the north via a 42-inch pipe and can exit south and west into a 42-inch and 21-inch pipe, respectively. The majority of flow exits south in the 42-inch. Roughly a thrid of the flow is estimated to be conveyed in the 21-inch sewer.	X

4.2 HYDRAULIC MODEL UPDATE

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

As part of this Wastewater Collection System Master Plan Update (Master Plan Update) project, Carollo reviewed the existing hydraulic model, and updated/expanded upon certain aspects of the model. This section summarizes the hydraulic model review and update process.

4.2.1 Existing Hydraulic Model

The City's existing hydraulic model was built in-house using the City's current geographic information system (GIS) database. The hydraulic model was built using the H_2OMAP Sewer hydraulic modeling software package, developed by Innovyze (formerly MWH Soft). H_2OMAP Sewer tracks the movement of wastewater flowing through the network over an extended period of time under varying wastewater loading and operating conditions. The extended period simulation (EPS) model implemented in H_2OMAP Sewer is a quasi-dynamic model and is predicated on solving a simplified form of the full 1D Saint-Venant equations neglecting local acceleration. It provides seamless database and GIS interfacing and outputs features for presentations and reports.

The City's existing H_2OMAP Sewer model is an "all-pipe" model. In other words, the model includes all of the City's active wastewater collection system sewer mains, trunks, interceptors, and lift stations. Not included in the City's wastewater collection system hydraulic model are the City of Clovis collection system facilities, as well as other private collection system facilities (usually within County islands or other large facilities, such as the California State University Fresno (CSUF) campus or Pinedale).

The existing hydraulic model does include base wastewater loads (flows). However, these loads were reallocated and revised as part of the model update process.

4.2.2 Elements of the Hydraulic Model

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

- **Loading Manholes**: Sewer manholes, cleanouts, as well as other locations where pipe sizes change or where pipelines intersect are represented by loading manholes in the hydraulic model. Required inputs for loading manholes include diameter, rim elevation, and wastewater loads (dry and wet weather). Loading manholes are also

used to represent locations where flows are split or diverted between two or more downstream links.

- **Chamber Manholes**: Chamber manholes connects pumps and force mains in the hydraulic model. The only required input parameter for a chamber manhole is elevation.
- **Gravity Mains**: Gravity sewers are represented as gravity mains in the hydraulic model. Input parameters for pipes include length, friction factor (i.e., Manning's n for gravity mains, Hazen Williams C for force mains), invert elevations, diameter, and a flow split type and percentage/curve (if the pipeline is directly downstream of an overflow/flow diversion).
- **Force Mains**: Force mains represent pressure sewers in the model. Required input parameters are diameter, invert elevations, length, and friction factor (i.e., Hazen Williams C).
- **Wet Wells**: Required input parameters for wet wells include invert elevation, wet well depth, cross section type (e.g., circular or variable area) and wet well cross section (e.g., diameter).
- **Pumps**: Pumps are included in the hydraulic model as links. Input parameters for pumps include type (fixed capacity, design point, or exponential 3 point curve), pump capacity/head information, and operational controls (on/off set points).
- **Outlets**: Outlets represent areas where flow leaves the system. For sewer system modeling, an outfall typically represents the connection to the influent pump station at a wastewater treatment plant.
- **Curves**: Curves represent a number of items in the hydraulic model, including rainfall hyetographs, flow split curves, and other miscellaneous items.
- **Inflows**: The following are the two types of wastewater flow sources that can be injected into individual model junctions:
  - Loads. Loads simulate base sanitary wastewater flows and represent the average flow. The base flows are multiplied by a pattern that varies the flow temporally. The base flow diurnal patterns are adjusted during the dry weather calibration process.
  - Stormwater Flows. Rainfall Derived Infiltration and Inflows (RDII) are applied in the model by assigning a unit hydrograph and a corresponding tributary area to a given loading manhole. The unit hydrographs consists of several parameters that are used to adjust the volume of RDII that enters the system at a given location. These parameters are adjusted during the wet weather calibration process.

4.2.3 General Model Review

In the early stages of the Master Plan Update project, Carollo worked closely with City Staff to gain an understanding of how the model was created. The model was then reviewed

against industry standards, to identify discrepancies, and to determine which aspects of the model could be improved upon.

The model review process consisted of several steps, as described below:

- **Step 1**: The first step involved in the model review process was to verify that the model data (i.e., inverts, diameters, etc.) were input correctly and that the flow direction, size, and layout of the modeled pipelines were logical. Additionally, the modeled lift stations were also checked to verify that they operated correctly.
- **Step 2**: Review which model nodes were associated with each significant industrial user (SIU) to verify that the flows associated each SIU are injected at the appropriate location in the model. For certain larger SIUs (e.g., Foster Farms, Beef Packers, Gallo), the industrial customer was contacted directly, as necessary, to verify their discharge point into the collection system and to obtain supplemental data.
- **Step 3**: Review pipeline connectivity to determine, in a general sense, how flows are routed through collection system basins, and to identify the locations of potential overflows.
- **Step 4**: Review the model/GIS facilities database to determine which portions of the existing City limits are currently served and which are not currently connected to the wastewater collection system.
- **Step 5**: Review the City's existing "master group polygons" (MGPs), which are used by the hydraulic model to allocate flows from specific parcels within the system to specific model nodes.
- **Step 6**: Review existing baseline wastewater flows in the existing hydraulic model to determine the need to develop new wastewater flow factors and reallocate the model.
- **Step 7**: Review other miscellaneous model parameters.

In general, the City's hydraulic model was constructed well and there were very few discrepancies with the physical configuration and invert elevations of the collection system facilities. However, there were some enhancements that were performed to the hydraulic model, which are summarized in the following sections.

4.2.4 Model Wastewater Loads

Determining the quantity of base wastewater flows generated by a municipality and how they are distributed throughout the collection system is a critical component of the hydraulic modeling process. Based on a review of the City's historical flow monitoring data (see Chapter 3) over the last few years, it was determined that the City's existing hydraulic model tended to overestimate wastewater flows into the collection system, in some cases by a significant amount. For this reason, it was determined that the model should be reallocated using revised wastewater flow factors.

Various techniques can be used to assign wastewater flows to individual model junctions, depending on the type of data that is available. Adequate estimates of the volume of

wastewater are important in maintaining and sizing sewer system facilities, both for present and future conditions. Baseline wastewater loads were allocated (assigned to specific nodes) in the hydraulic model based on land use data provided by the City and revised wastewater flow factors developed for each land use type (these are described in detail in Chapter 3). The flow coefficients and land use data provides a means to transform a specific land use category into a BWF, as described below:

- **Step 1**: The City's service area was broken up into individual loading polygons. The City's MGPs were used as the City's loading polygons. Each loading polygon represents the geographic area that contributes flows into a single model node (i.e., trunk system manhole). In an all pipe model, a loading polygon could be as small as a few parcels, or could encompass a particular subdivision or grouping of lots.

  In the case of the City, the MGPs were developed to allocate BWFs to "large diameter" pipes only (i.e., 10" and larger), and updating the MGPs to reassign individual loading polygons to small diameter pipes was beyond the scope of this Master Plan. For this reason, although the City's model is an "all pipe" model, there are only loads allocated to large diameter pipes. The City has indicated that it plans to revise the MGPs in house, at which point the model should be updated and reallocated, either in-house, or with the assistance or guidance of an outside consultant.

- **Step 2**: The loads were calculated for each loading polygon using the hydraulic model's "load allocator" tool by multiplying the appropriate flow coefficient by the land use acreage. Load = Land Use Area (ac) x Wastewater Flow Factor (gpd/ac) x conversion factor (mgd/gpd).

- **Step 3**: Once the load allocator tool assigns BWFs into the hydraulic model, the total flows were reviewed by type (i.e., residential vs. non-residential) to confirm that the load allocator functioned correctly.

- **Step 4**: The allocated loads were adjusted as necessary during the BWF calibration process (see Section 4.3.3) to closely match the actual BWFs recorded from the City's permanent flow monitoring data.

4.2.5 Model Scenarios

The City's existing hydraulic model contained only one scenario (the "BASE" scenario). As part of any master planning project, multiple scenarios are used to simulate different flow conditions, for both current flow conditions and future flow conditions. As part of the model update process, additional model scenarios were added. There are three model calibration scenarios, which usually are not modified by the end user after model calibration is complete. In addition, there are two "evaluation" scenarios for both existing and build out flow conditions. These are the peak dry weather flow (PDWF) condition, and the peak wet weather flow (PWWF) condition. These scenarios are used to identify system deficiencies and to develop capacity improvement projects, and can be used by the City in the future to

run several “what if” scenarios, such as the impact of new developments or land use changes.

4.2.6 Miscellaneous Model Updates

Several other additions/modifications were made to the hydraulic model as part of the model update process, including:

- Information fields were created in the model to identify which flow monitor a group of collection system facilities are associated with (e.g., FR01, FR02, etc.), and database queries/query sets were created for each flow monitoring basin.
- Custom diurnal patterns for each flow monitoring basin were created based on the flow data collected from the City’s permanent flow monitoring data. The custom diurnal patterns include both weekday and weekend flow conditions.
- Diurnal patterns for the City’s significant industrial users (SIU)s were updated based on available data to include both weekday and weekend flow conditions. For the build out scenario, SIU’s were modeled at their maximum permit capacity.
- Diurnal patterns for certain other large facilities (e.g., hospitals) were developed and applied based on typical hourly use patterns.
- Due to the limitations of the H_2OMAP Sewer hydraulic modeling package, the hydraulic grade line (HGL) calculations for flow diversions where an overflow pipe is significantly higher than the rim of the main downstream pipeline are inaccurate. An example of this condition is shown on Figure 4.4. Therefore, where an overflow pipeline was significantly higher than the rim of the main pipeline, and it was apparent that no flow would be diverted to the overflow pipeline, the overflow pipeline was deactivated in the model, similar to how loops have been deactivated in the existing hydraulic model. A selection set “Deactivated Overflows” was created to keep track of these the deactivated diversions. No pipelines were deactivated in the model that were deemed to be hydraulically significant. Should the City wish to include the inactivated pipelines, as well as the loops that had been previously deactivated, the City should consider converting to the H_2OMAP SWMM or InfoSWMM hydraulic modeling software platform.

4.3 MODEL CALIBRATION

Hydraulic models are built off the best available information regarding the physical attributes and operational conditions of the collection system, most of which are known to a reasonable level of confidence. Even so, there are a number of parameters that are not directly known and cannot be directly measured. For this reason, these parameters must be assumed initially based on typical values and engineering judgment. Every collection system is unique. For this reason, industry standard of care dictates that a model be validated to ensure that the assumptions built into the model are accurate. This validation process is commonly referred to as calibration.

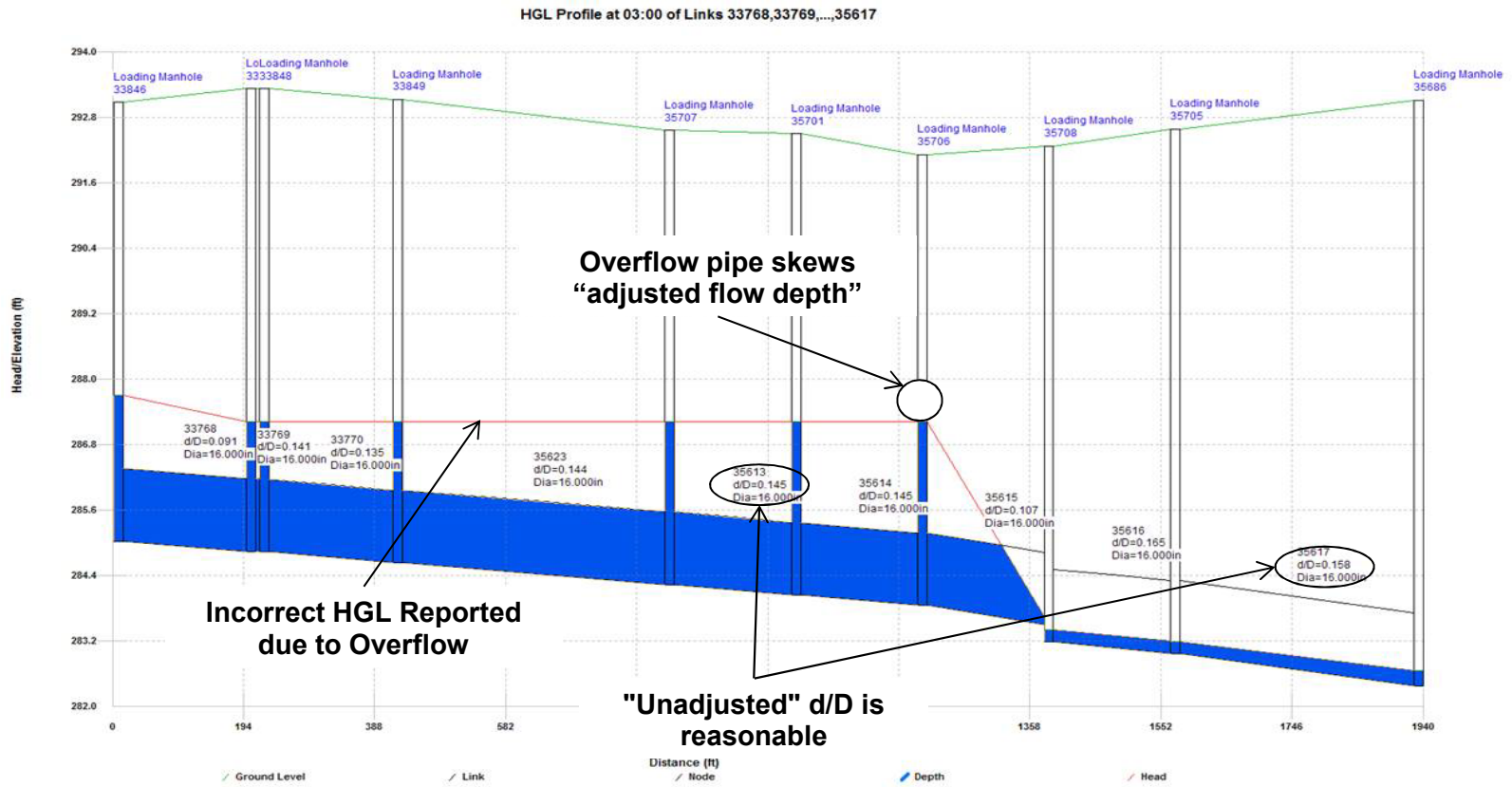

Figure 4.4
Example HGL Limitations for Overflow Pipelines in H_2OMAP Sewer
Wastewater Collection System Master Plan Update

The calibration process must be undertaken in any modeling effort. Having an appropriately calibrated model is necessary to provide confidence in all project team members and stakeholders that the results produced by the model are as accurate as possible and defensible.

A model cannot be considered calibrated unless it accurately represents flow conditions that have actually occurred, preferably in the very recent past. This dictates that the model include an "existing" model scenario, which represents the configuration and flow conditions that are currently experienced. Only after the model has been shown to accurately simulate these flow conditions can it be used to simulate hypothetical conditions, such as a design storm event or a build out flow condition.

The intended purpose of the model will dictate how the model is constructed and should be calibrated. For Fresno, flow conditions observed in the flow monitoring data and at the RWRF have demonstrated that it is necessary to calibrate to both dry weather and wet weather flow conditions. Model calibration of the City's collection system hydraulic model consisted of three main parts, a macro calibration, a base flow calibration, and wet weather flow calibration.

4.3.1 Calibration Standards

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

- **Base Wastewater Flow Calibration Standards**: Base flow calibration should be carried out for two base flow days and the modeled flows and depths should be compared to the field measured flows and depths. Both the modeled and field measured flow hydrographs should closely follow each other in both shape and magnitude.

  In addition to the shape, the flow hydrographs should also meet the following criteria as a general guide:

  – The timing of flow peaks and troughs should be within one hour.

  – The peak flow rate should be within the range of ±10 percent

  – The volume of flow (or the average rate of flow) should be within the range of ±10 percent. If applicable, care should be taken to exclude periods of missing or inaccurate data.

- **Wet Weather Calibration Standards**: The model simulated flows and depths should be compared to the field measured flows and depths. The flow hydrographs should

closely follow each other in both shape and magnitude, until the flow has substantially returned to dry weather flow rates.

In addition to the shape, the flow hydrographs should also meet the following criteria as a general guide:

– The timing of the peaks and troughs should be similar with regard to the duration of the events.

– The peak flow rates at significant peaks should be in the range of +25 percent to 15 percent and should be generally similar throughout.

– The volume of flow (or the average flow rate) should be within the range of +20 percent to -10 percent.

4.3.2 Macro Calibration

The initial calibration process consisted of a macro calibration. Initially, Carollo ran the model under existing BWF conditions and necessary adjustments were made to produce reasonable system flows. Such adjustments include modifications of pipeline connectivity, inverts, facility characteristics, and lift station characteristics.

4.3.3 Base Wastewater Flow Calibration

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

- **Divide the system into areas tributary to each flow meter**. The first step in the calibration process was to divide the City into flow meter tributary areas. Twenty-one tributary areas were created, one for each flow meter from the permanant flow monitoring program. A map showing the locations of each flow monitoring site and their associated tributary area are provided in Chapter 3 along with a schematic of the flow meters.
- **Define flow volumes within each area**. The next step was to define the flow volumes within each area, which was accomplished in the flow allocation step.
- **Create diurnal patterns to match the temporal distribution of flow**. A diurnal curve is a pattern of hourly multipliers that are applied to the base flow to simulate the variation in flow that occurs throughout the day. In order to match the flows throughout the week, a seven day diurnal pattern was established for each flow meter. The diurnal patterns were initially developed based on the flow monitoring data and adjusted as part of the calibration process until the model simulated flows closely matched the field measured flows. Figure 4.5 shows the calibrated weekday and weekend diurnal patterns for the area tributary to Site FR06. Similar diurnal curves were developed for each of the meters and its tributary area. These additional curves are available in Appendix B.

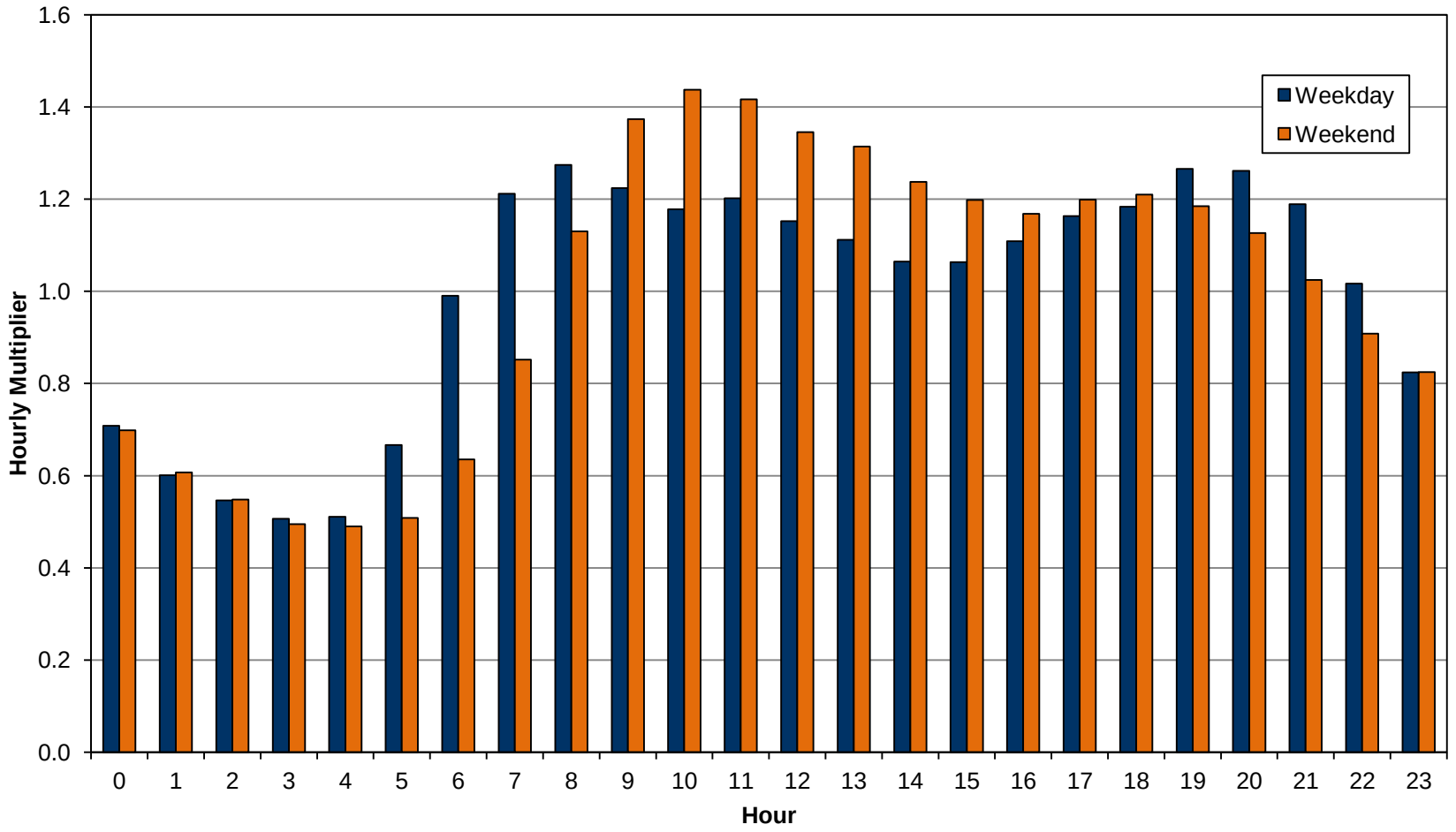

Figure 4.5

Example Diurnal Patterns (Meter FR06)
Wastewater Collection System Master Plan Update
City of Fresno

- **Adjust model variables to match field measured velocity and flow depths**. Once the model simulated flows acceptably matched the field measured flows, the model simulated velocity and flow depth were compared to the field measured velocity and flow depth. Adjustments were made to various model parameters until the modeled and measured velocity and depth closely matched one another. The primary varied parameters for this process are pipeline roughness (Manning's n) and sediment build up in the pipe, although other parameters can also be adjusted as calibration results are generated.

  Manning's roughness coefficients, or n values, have industry accepted ranges based on a number of variables. Roughness coefficients increase over time depending on the construction methods, installation quality, system maintenance, and other environmental factors. There can be certain factors within the City's collection system that can result in roughness coefficients which differ from the typical range. For example, pipeline bellies, joint misalignment, cracks, and debris (e.g., root intrusion, etc.) lead to increased turbulence in a pipe, as well as the apparent Manning's n factor.

  If the model is unable to reasonably match the field measured flow depth and velocity without leaving the acceptable range of Manning's roughness coefficients, further investigation is conducted to help determine the cause of the discrepancy. Some issues that could cause such a discrepancy can include errors in the slope or diameter of a pipeline, downstream blockages, pipeline sags, and, in some cases, influences from downstream lift station operations. This method was not needed on any of the City's current flow metering points to match flows.

Table 4.6 provides a summary of the BWF calibration using the average and daily peak flow results for both weekday and weekend conditions. As shown in Table 4.6, with the exception of Meter FR24 (which was only very slightly above 10-percent), the model simulated average and peak flows for both weekday and weekend BWF were all within 10-percent. The flow monitoring data associated with meter FR24 was limited and somewhat questionable, so a percent error of only slightly greater than 10-percent was deemed acceptable for this meter.

Appendix B contains a detailed BWF calibration summary sheet for each of the 21 meter sites. Each calibration sheet provides plots that compare the model simulated and field measured flow, velocity, and level data for both weekday and weekend conditions. An example of the dry weather calibration for Site FR06 is shown on Figure 4.6. As shown on Figure 4.6 and in Appendix B, there is excellent overall correlation of the field measured data to the model output results.

4.3.4 Wet Weather Flow Calibration

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

Table 4.6 BWF Calibration Summary
Wastewater Collection System Master Plan Update
City of Fresno

		Weekday Base Wastewater Flow												Weekend Base Wastewater Flow										Base Wastewater Flow[4]		
		Measured Data[1]				Modeled Data[2]				Percent Error[3]				Measured Data[1]				Modeled Data[2]				Percent Error[3]						
Meter Number	Pipe Diameter (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Peak Flow (%)	Avg. Velocity (%)	Avg. Level (%)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Peak Flow (%)	Avg. Velocity (%)	Avg. Level (%)	Measured BWF (mgd)	Modeled BWF (mgd)	Percent Difference (%)
FR01	45	3.701	5.507	3.36	9.3	3.704	5.212	3.06	10.0	0.1%	-5.4%	-8.9%	7.1%	3.904	5.939	3.39	9.5	3.927	5.766	3.09	10.2	0.6%	-2.9%	-8.7%	7.3%	3.759	3.768	0.2%
FR02	45	8.049	10.996	3.52	15.9	7.726	10.331	3.59	15.1	-4.0%	-6.0%	2.0%	-4.5%	8.135	12.465	3.51	15.9	7.777	11.659	3.57	15.1	-4.4%	-6.5%	1.7%	-4.9%	8.074	7.741	-4.1%
FR06	36	4.132	5.207	2.59	14.2	4.131	5.050	2.57	13.6	0.0%	-3.0%	-0.7%	-4.0%	4.089	5.758	2.54	14.2	4.118	5.630	2.56	13.5	0.7%	-2.2%	1.1%	-4.7%	4.120	4.128	0.2%
FR08	48	7.661	9.894	4.59	12.3	7.672	10.070	4.24	13.0	0.2%	1.8%	-7.7%	5.9%	7.131	9.883	4.52	11.7	7.336	10.727	4.16	12.6	2.9%	8.5%	-7.8%	8.1%	7.509	7.576	0.9%
FR09	39	5.025	6.285	3.41	12.8	4.860	6.020	3.23	12.4	-3.3%	-4.2%	-5.4%	-2.8%	4.673	6.466	3.31	12.3	4.556	6.325	3.16	12.0	-2.5%	-2.2%	-4.5%	-2.8%	4.925	4.773	-3.1%
FR10	0	1.491	2.750	1.16	10.4	1.464	2.697	1.19	10.3	-1.8%	-1.9%	2.3%	-1.4%	1.496	3.201	1.11	10.0	1.469	3.103	1.15	10.0	-1.8%	-3.1%	3.4%	-0.7%	1.492	1.465	-1.8%
FR11	66	3.582	5.199	2.23	10.3	3.609	4.851	2.16	10.8	0.8%	-6.7%	-3.3%	4.3%	3.483	5.471	2.24	10.0	3.665	5.539	2.16	10.7	5.2%	1.2%	-3.7%	7.0%	3.554	3.625	2.0%
FR12	33	1.578	2.513	1.89	8.6	1.579	2.502	1.93	8.5	0.0%	-0.4%	1.9%	-1.6%	1.590	2.673	1.84	8.7	1.592	2.671	1.91	8.4	0.1%	-0.1%	3.9%	-2.9%	1.582	1.582	0.0%
FR13	51	8.526	10.118	3.29	15.8	8.329	9.611	3.31	16.2	-2.3%	-5.0%	0.6%	2.3%	7.951	10.072	3.24	15.2	7.902	9.556	3.26	15.7	-0.6%	-5.1%	0.6%	3.6%	8.362	8.207	-1.9%
FR14	36	4.058	4.998	2.40	14.4	4.022	4.819	2.25	14.8	-0.9%	-3.6%	-6.1%	2.9%	4.017	5.367	2.39	14.3	3.762	4.806	2.21	14.2	-6.3%	-10.4%	-7.8%	-0.1%	4.046	3.948	-2.4%
FR15	48	6.194	7.184	2.19	18.2	6.071	6.949	2.25	17.5	-2.0%	-3.3%	2.7%	-3.5%	5.939	7.337	2.17	17.7	5.850	7.075	2.22	17.2	-1.5%	-3.6%	2.5%	-3.1%	6.121	6.008	-1.9%
FR16	30	3.724	4.692	3.34	11.5	3.702	4.463	3.26	11.5	-0.6%	-4.9%	-2.5%	0.3%	3.708	5.104	3.32	11.5	3.667	4.664	3.24	11.4	-1.1%	-8.6%	-2.3%	-0.5%	3.720	3.692	-0.7%
FR19	66	23.147	27.598	4.52	24.1	23.071	27.048	4.89	22.7	-0.3%	-2.0%	8.2%	-5.8%	20.907	26.800	4.35	22.8	22.057	28.163	4.81	22.1	5.5%	5.1%	10.6%	-3.2%	22.507	22.781	1.2%
FR20	66	29.854	34.806	4.60	28.6	26.961	31.643	4.71	26.2	-9.7%	-9.1%	2.3%	-8.3%	26.650	34.503	4.48	26.6	25.500	31.954	4.62	25.4	-4.3%	-7.4%	3.1%	-4.6%	28.939	26.544	-8.3%
FR21	42	4.403	5.596	2.11	15.3	4.451	5.716	2.11	15.4	1.1%	2.1%	0.0%	0.9%	4.454	6.167	2.10	15.4	4.541	6.199	2.11	15.6	1.9%	0.5%	0.7%	0.7%	4.418	4.477	1.3%
FR22	45	7.461	9.611	2.90	17.5	7.471	9.230	2.88	17.5	0.1%	-4.0%	-0.8%	0.0%	7.615	10.754	2.90	17.6	7.650	10.427	2.88	17.6	0.5%	-3.0%	-0.5%	0.1%	7.505	7.522	0.2%
FR23	27	1.251	1.638	2.08	7.5	1.262	1.521	2.20	7.4	0.9%	-7.2%	5.5%	-1.5%	0.762	1.032	1.94	5.5	0.827	1.469	1.93	5.9	8.5%	42.4%	-0.6%	7.6%	1.111	1.138	2.4%
FR24	72	8.120	10.599	2.60	16.1	8.987	11.826	2.63	17.3	10.7%	11.6%	0.9%	7.5%	8.216	11.913	2.61	16.1	9.103	13.093	2.63	17.3	10.8%	9.9%	0.8%	7.5%	8.147	9.021	10.7%
FR25	15	0.082	0.121	1.11	2.1	0.082	0.121	1.12	2.1	0.1%	0.1%	1.1%	1.0%	0.079	0.134	1.12	2.0	0.079	0.134	1.10	2.1	0.2%	-0.1%	-2.0%	3.0%	0.081	0.081	0.1%
FR26	0	0.190	0.311	0.92	4.9	0.192	0.308	0.91	5.1	1.4%	-1.0%	-1.1%	2.6%	0.195	0.321	0.93	5.0	0.198	0.322	0.91	5.1	1.3%	0.4%	-1.9%	3.3%	0.191	0.194	1.3%
FR27	27	1.900	2.558	1.82	12.1	1.900	2.546	1.86	11.1	0.0%	-0.5%	2.6%	-8.4%	1.935	2.786	1.86	12.1	1.935	2.783	1.86	11.2	0.0%	-0.1%	0.1%	-7.4%	1.910	1.910	0.0%

Notes:

1. Source: City of Fresno Permanent Flow Monitoring Data
2. Average flow, level, and velocity are calculated from weekday/weekend dry weather flow monitoring data. Maximum flow values are hourly peaks corresponding to either weekend or weekday confitions, as appropriate.
3. Percent Difference = (Modeled - Measured)/Measured*100.
4. Base Wastewater Flow = (5*Weekday Base Wastewater Flow + 2*Weekend Base Wastewater Flow)/7

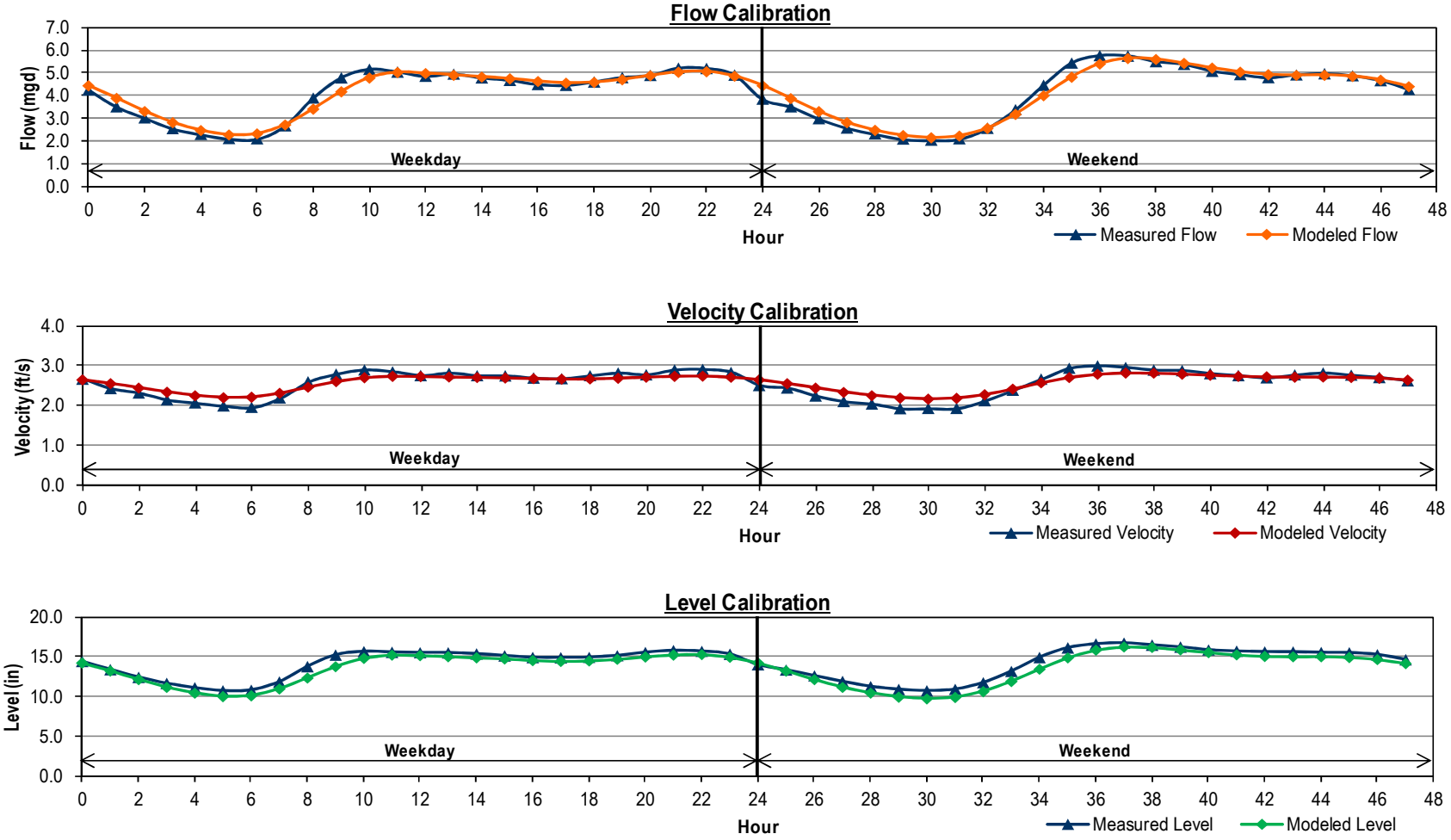

Figure 4.6

Example BWF Calibration (Meter FR06)
Wastewater Collection System Master Plan Update
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- **Identify calibration rainfall events**. The WWF calibration process consists of running model simulations of historic rainfall events based on data from the City's permanent flow monitoring program. The goal of any wet weather flow monitoring program is to capture and characterize a system's response to a significant rainfall event, preferably during wet antecedent moisture conditions. In the case of the City, although there is permanent flow monitoring data available, there were significant data gaps in recent years, and so selection of a calibration rainfall event was limited to periods of time in which sufficient data were available.

  The selection of a particular calibration storm or group of storms is based on a review of the flow and rainfall data. In the case of the City, the most significant event in recent years with sufficient data availability to perform an adequate WWF calibration occurred in April 2012, and therefore this storm was used as the basis for WWF calibration. As a validation of the April 2012 WWF calibration, the model was validated to a series of rainfall events that occurred in March 2011 for sites where data was available, and to the hourly influent flow data at the RWRF.

  In order to run a model simulation for the both of these rainfall events, the hourly rainfall data were input into the model for these events. Each flow monitoring tributary area, or basin, was assigned a specific rainfall hyetograph, which was calculated for each basin based on available historic rainfall data.

- **Define RDII tributary areas**. For the WWF calibration, RDII flows are superimposed on top of the BWF. RDII inflows consist of both a unit hydrograph and the total area that is tributary to the model node. The RDII tributary areas were calculated in GIS using the City's loading polygons (MGPs), excluding any large vacant, open space, or other areas in the system which are not expected to contribute to I/I into the collection system. The tributary area provides a means to transform hourly rainfall depth from the rainfall hyetographs into a rainfall volume. The rainfall volume is transformed into actual RDII flows using the unit hydrograph, as described in the next step.

- **Create I/I parameter database and modify to match field measured flows**. The main step in the WWF calibration process involves creating custom unit hydrographs for each flow monitoring tributary area using the "RTK Method," which is widely used in collection system master planning. Using the RTK Method, the RDII unit hydrograph is the summation of three separate triangular hydrographs (short term, medium term, and long term), which are each defined by three parameters: R, T, and K. R represents the fraction of rainfall over the sewer shed that enters the collection system; T represents the time to peak of the hydrograph; and K represents the ratio of time to recession to the time to peak. Therefore, there are a total of nine separate variables associated with each unit hydrograph. Figure 4.7 shows the shape of an example unit hydrograph.

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

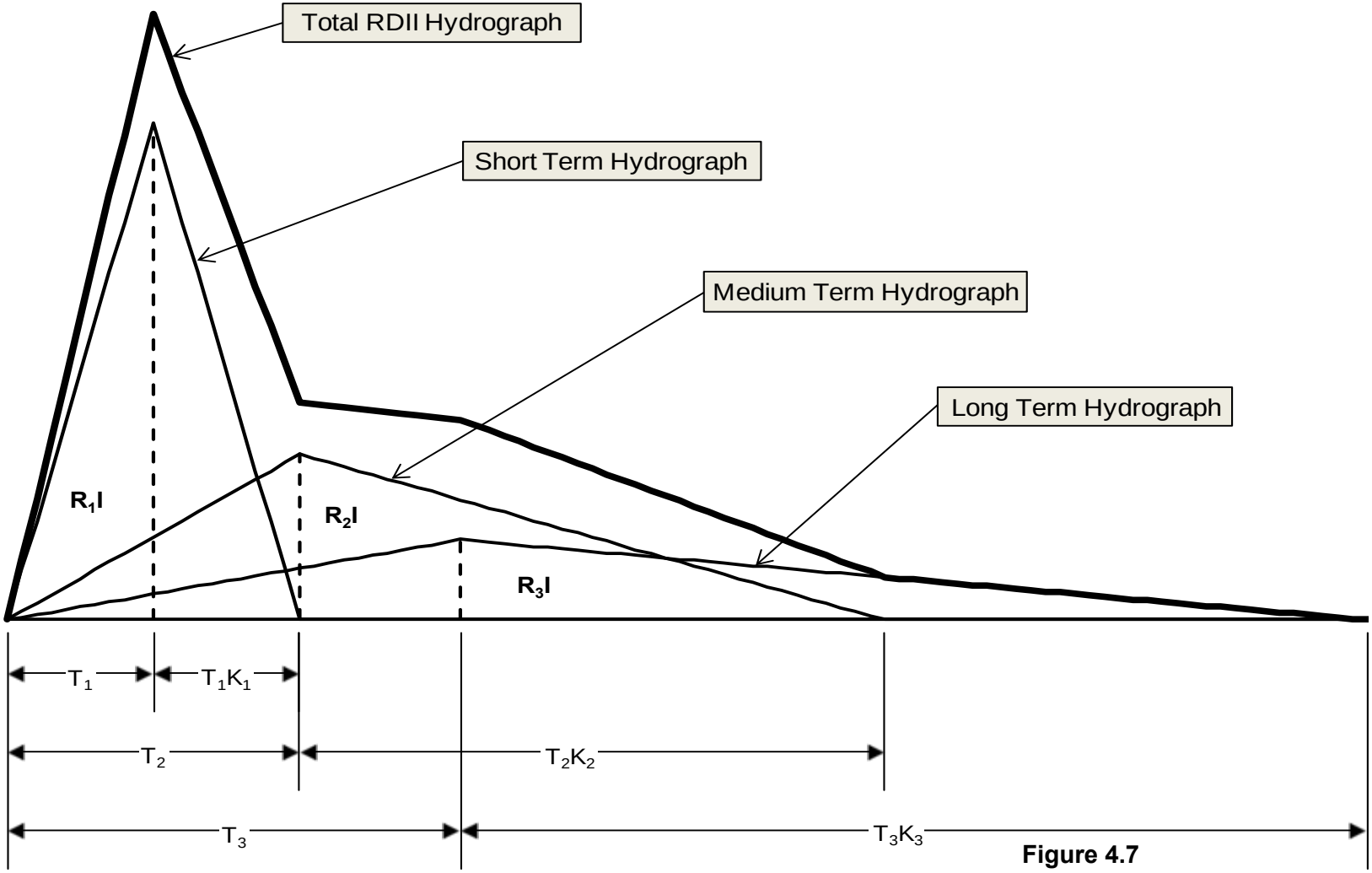

Figure 4.7

Example RDII Unit Hydrograph
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As with the dry weather calibration, the wet weather calibration process compared the meter data with the model output. Comparisons were made for average and peak flows as well as the temporal distribution of flow until flows returned to their baseline levels. According to the WaPUG, a hydraulic model is generally considered to be satisfactorily calibrated to WWF conditions if the modeled peak flows are within +25 percent to -15 percent of the field measured data, and if the average modeled flows are within +20 percent to -10 percent of the field measured data.

- **Refine model variables to match field measured velocity and flow depths**. After the model was considered to be satisfactorily calibrated for wet weather flows, the model simulated velocities and flow depths were checked against the field measured velocities and flow depths during the calibration storms. Refinements were made to the various model parameters so that the modeled and measured velocity and depth closely matched one another. If any adjustments were made to Manning's n-values or other parameters, the BWF calibration was rechecked as well to make sure that the flow depth and velocities still matched well under BWF conditions.

Appendix C contains a detailed wet weather flow calibration summary sheet for each of the 21 meter sites. Each calibration sheet provides plots that compare the model simulated and field measured flow, velocity, and level data for the calibration storms. An example of the wet weather calibration for Site FR06 is shown on Figure 4.8. Table 4.7 provides a summary of the wet weather flow calibration using the average and peak flow results. Additionally, Figure 4.9 and Figure 4.10 show a comparison of the modeled and measured flows at the RWRF influent pump station for the April 2012 and March 2011 storms, respectively.

It should be noted that there is a considerable amount of I/I contributed into the collection system in Basin 23 (see Figure 4.11). This basin is relatively small and receives a significant amount of flow from Gallo, an SIU.

For this reason, flow data from Gallo was obtained for the April 2012 storm event. Based on a review of this data, it was confirmed that the majority of the observed I/I flow from Basin 23 appears to be associated with the Gallo property (see Appendix C). Furthermore, the amount of flow observed in Basin 23 during the April 2012 storm event would suggest that under PWWF conditions, there will be significant capacity deficiencies cause immediately downstream of Gallo. For this reason, it is recommended that the City investigate the cause of the excessive rates of I/I associated with the Gallo property, and work with Gallo to identify possible solutions to address the issue.

As shown on Table 4.7, the model simulated average and peak flows at all meter sites were within the acceptable tolerances for at least two of the three calibration storms, and therefore the model was considered calibrated and ready to use for capacity analysis purposes.

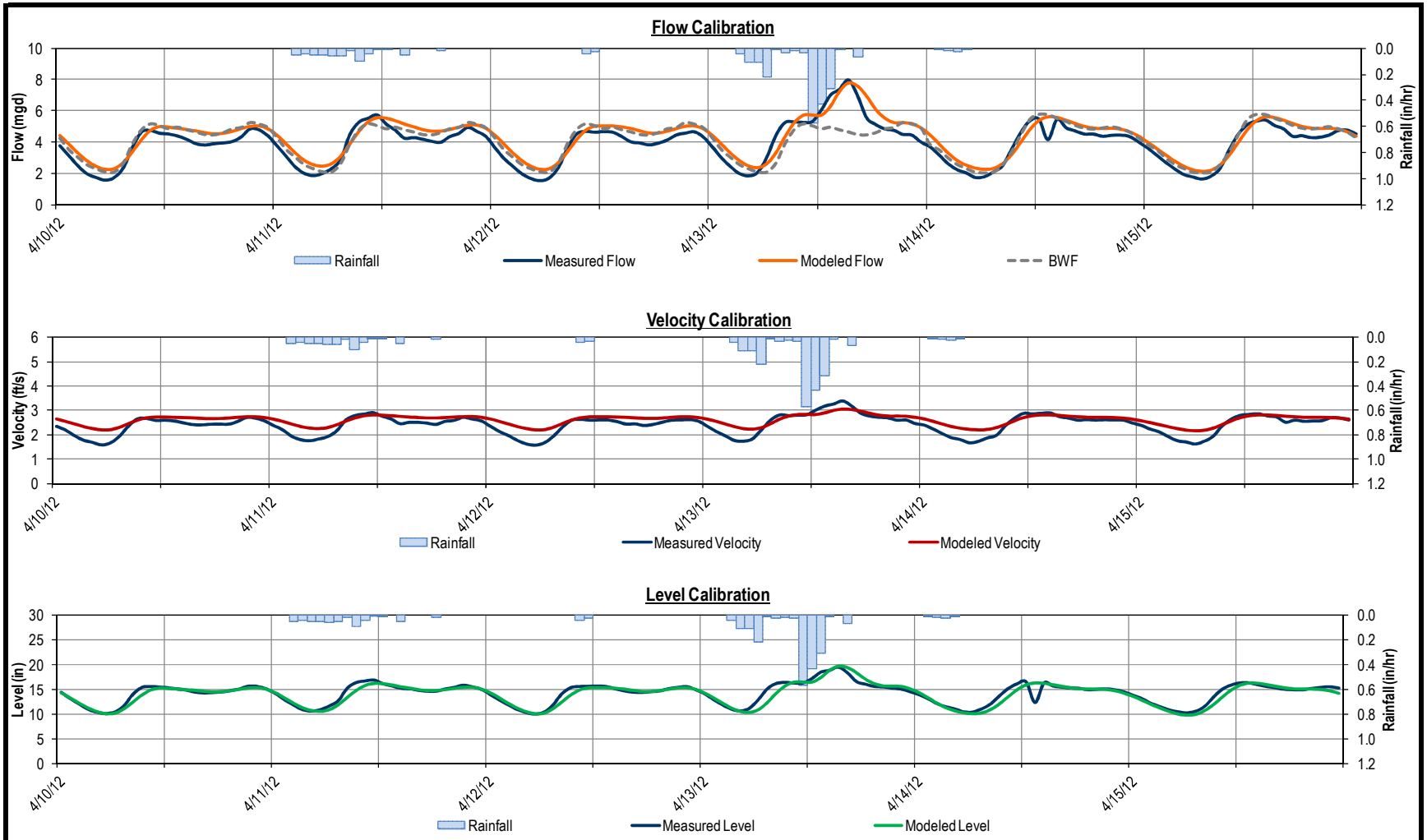

Figure 4.8
Example WWF Calibration (Meter FR06)
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Table 4.7 WWF Calibration Sumnmary
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		April 13-14, 2012 Storm Event												March 20-21, 2011 Storm Event											
		Measured Data[1]				Modeled Data[2]				Percent Error[3]				Measured Data[1]				Modeled Data[2]				Percent Error[3]			
Meter Number	Pipe Diameter (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Peak Flow (%)	Avg. Velocity (%)	Avg. Level (%)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Peak Flow (%)	Avg. Velocity (%)	Avg. Level (%)
FR01	45	3.60	5.50	3.40	9.07	4.08	5.81	3.14	10.46	13.2%	5.5%	-7.6%	15.4%	4.14	6.64	3.52	9.69	4.28	6.44	3.19	10.72	3.4%	-3.0%	-9.6%	10.7%
FR02	45	8.86	12.72	3.58	16.78	8.64	13.32	3.67	15.98	-2.5%	4.8%	2.6%	-4.7%	8.02	13.11	3.22	16.67	8.51	13.68	3.67	15.89	6.1%	4.4%	13.8%	-4.7%
FR06	36	4.24	7.99	2.52	14.58	4.57	7.80	2.63	14.33	7.8%	-2.3%	4.5%	-1.7%	--	--	--	--	--	--	--	--	--	--	--	--
FR08	48	Note 4	Note 4	Note 4	Note 4	9.47	15.58	4.46	14.35	Note 4	Note 4	Note 4	Note 4	--	--	--	--	--	--	--	--	--	--	--	--
FR09	39	--	--	--	--	5.73	9.77	3.36	13.48	n/a	n/a	n/a	n/a	--	--	--	--	--	--	--	--	--	--	--	--
FR10	0	1.33	2.98	1.19	8.22	1.68	3.26	1.23	10.99	26.1%	9.1%	2.9%	33.7%	--	--	--	--	--	--	--	--	--	--	--	--
FR11	66	--	--	--	--	4.16	6.22	2.24	11.45	n/a	n/a	n/a	n/a	--	--	--	--	--	--	--	--	--	--	--	--
FR12	33	1.79	4.58	1.89	9.28	2.07	4.65	2.06	9.64	15.6%	1.5%	8.7%	3.8%	2.11	3.82	1.95	10.32	2.09	3.85	2.08	9.75	-0.9%	0.6%	6.6%	-5.5%
FR13	51	--	--	--	--	9.28	14.37	3.40	17.04	n/a	n/a	n/a	n/a	10.26	14.43	3.54	17.09	9.62	12.90	3.44	17.40	-6.3%	-10.6%	-2.7%	1.8%
FR14	36	4.36	6.79	2.11	16.88	4.64	7.90	2.32	15.98	6.4%	16.3%	9.7%	-5.3%	--	--	--	--	--	--	--	--	--	--	--	--
FR15	48	6.33	8.27	2.14	18.79	6.57	9.51	2.29	18.25	3.7%	14.9%	6.8%	-2.9%	7.57	11.22	2.36	19.89	7.03	9.87	2.33	18.94	-7.2%	-12.0%	-1.4%	-4.8%
FR16	30	4.13	6.43	3.29	12.56	4.17	7.46	3.35	12.23	0.8%	16.0%	1.9%	-2.7%	3.91	6.18	3.18	12.24	4.24	5.87	3.37	12.37	8.3%	-4.9%	6.0%	1.1%
FR19	66	22.98	34.12	5.46	20.79	25.38	37.23	4.99	23.80	10.4%	9.1%	-8.6%	14.5%	--	--	--	--	--	--	--	--	--	--	--	--
FR20	66	Note 4	Note 4	Note 4	Note 4	31.07	47.74	4.86	28.24	Note 4	Note 4	Note 4	Note 4	--	--	--	--	--	--	--	--	--	--	--	--
FR21	42	5.49	9.33	2.13	17.91	5.24	9.03	2.18	16.76	-4.5%	-3.3%	2.5%	-6.4%	--	--	--	--	--	--	--	--	--	--	--	--
FR22	45	8.46	12.88	3.02	18.56	8.55	13.45	2.96	18.74	1.1%	4.5%	-1.7%	0.9%	--	--	--	--	--	--	--	--	--	--	--	--
FR23	27	1.46	5.03	2.01	8.22	1.73	4.52	2.29	8.37	18.6%	-10.0%	14.0%	1.8%	--	--	--	--	--	--	--	--	--	--	--	--
FR24	72	Note 4	Note 4	Note 4	Note 4	10.32	15.57	2.72	18.42	Note 4	Note 4	Note 4	Note 4	--	--	--	--	--	--	--	--	--	--	--	--
FR25	15	0.12	0.32	1.26	2.48	0.11	0.33	1.22	2.48	-3.4%	3.5%	-3.1%	-0.1%	--	--	--	--	--	--	--	--	--	--	--	--
FR26	0	0.22	0.67	0.93	5.28	0.25	0.66	0.95	5.91	14.8%	-1.5%	2.0%	11.9%	--	--	--	--	--	--	--	--	--	--	--	--
FR27	27	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Notes:
1. Source: City of Fresno Permanent Flow Monitoring Data
2. Average flow, level, and velocity are calculated from weekday/weekend dry weather flow monitoring data.
3. Base Wastewater Flow = (5*Weekday Base Wastewater Flow + 2*Weekend Base Wastewater Flow)/7
4. "--" indicates that data were not available. "Note 4" indicates that data were available, but with data gaps.

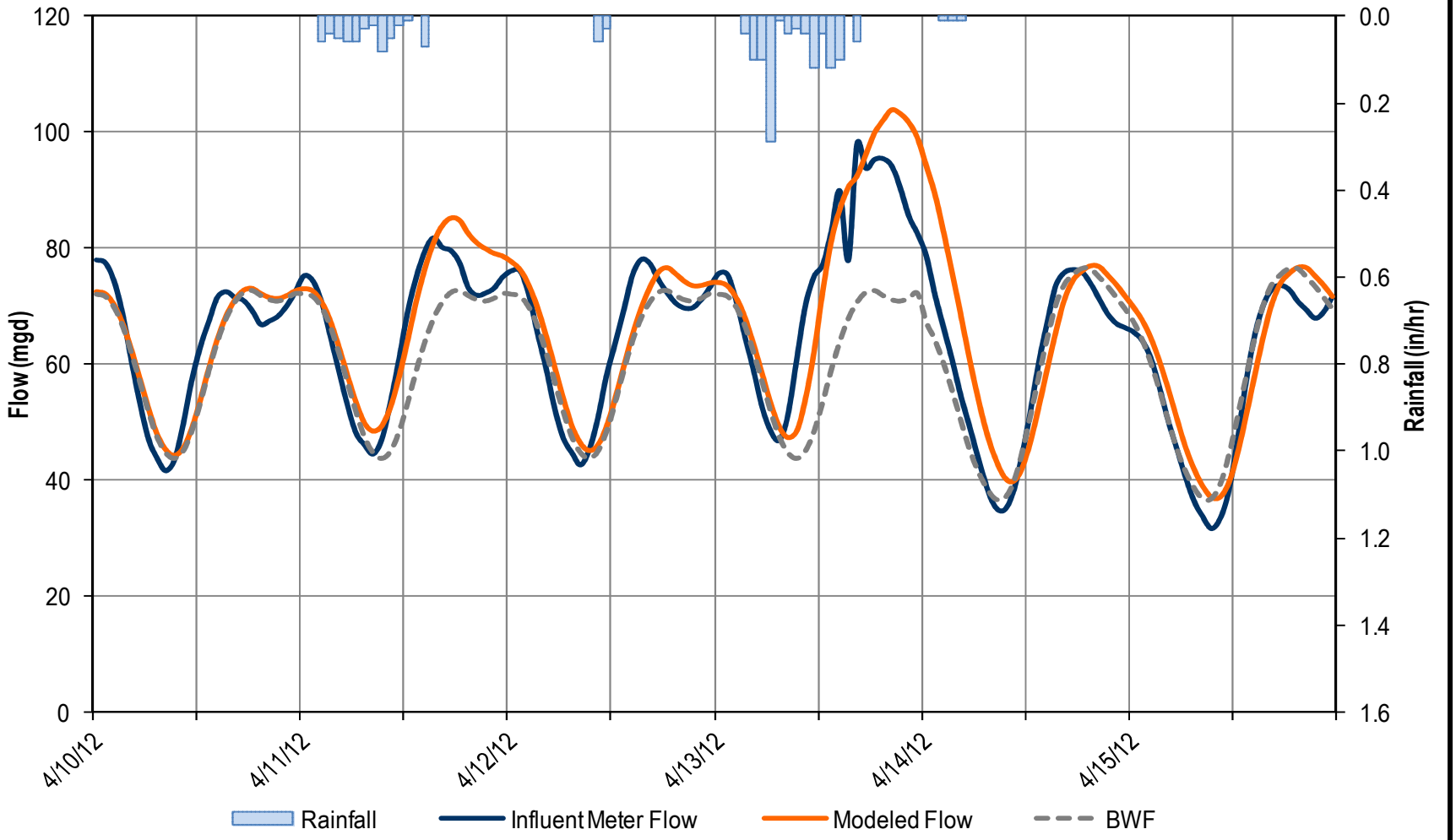

Figure 4.9
RWRF WWF Calibration (April 2012)
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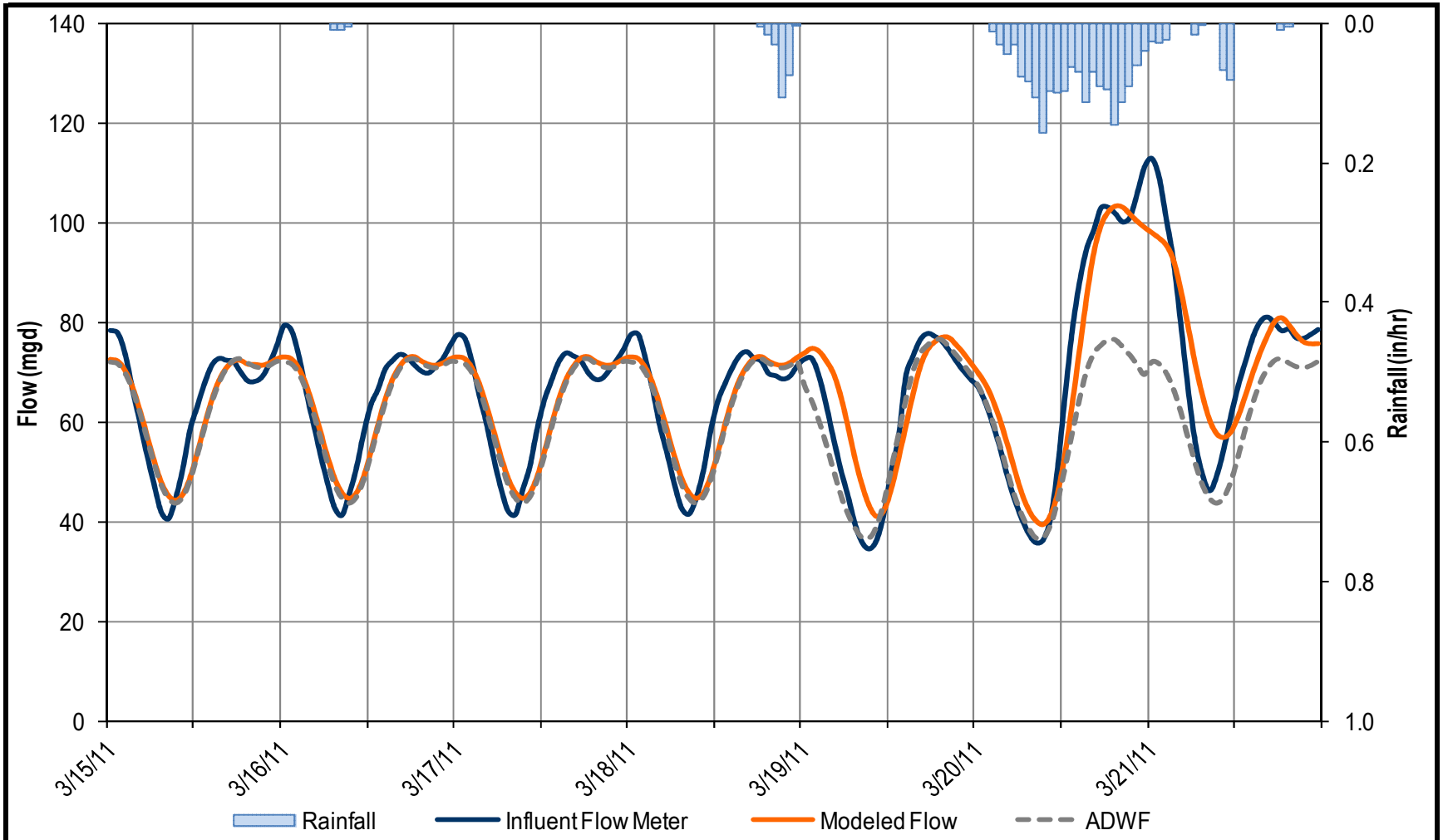

Figure 4.10

RWRF WWF Calibration (March 2011)
Wastewater Collection System Master Plan Update
City of Fresno

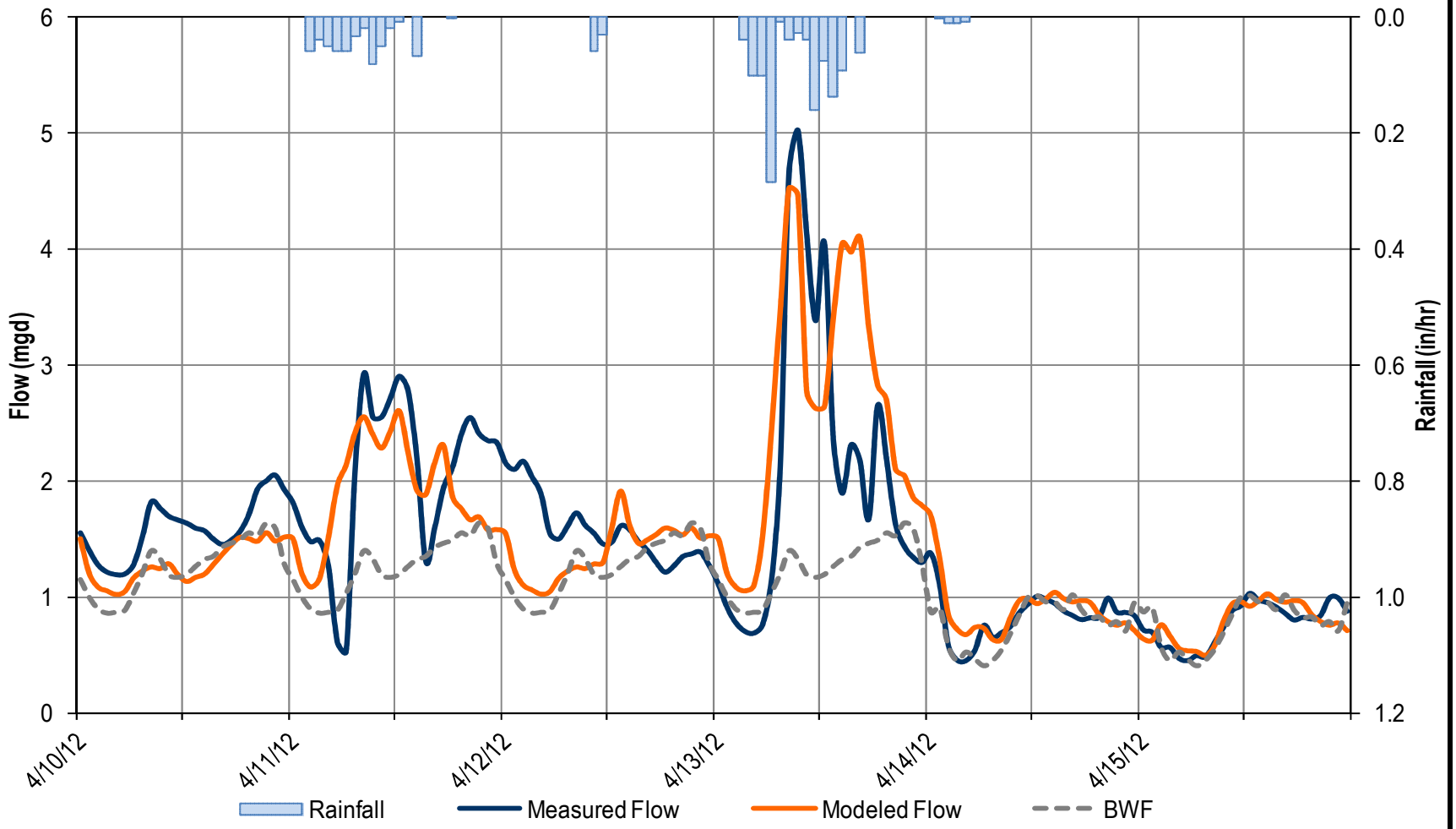

Figure 4.11
WWF Calibration for Meter 23
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4.3.5 Model Calibration Summary

As documented in this section, there is excellent agreement between the field measured and hydraulic model simulated flows, depths, and velocities under both BWF and WWF conditions, and meets the generally accepted standards used to determine the adequacy of model calibration, according to the WaPUG. For this reason, the model is considered calibrated.

Chapter 5

PLANNING CRITERIA AND DESIGN FLOWS

The capacity of the City of Fresno's (City's) wastewater collection system was evaluated based on the planning criteria defined in this chapter. The planning criteria address the collection system capacity, gravity sewer pipe slopes, and maximum allowable depth of flow within a sewer. This chapter also summarizes the existing and build out design flows.

5.1 GRAVITY SEWERS

Gravity sewer pipe capacities are dependent on many factors. The factors include roughness of the pipe, the chosen maximum allowable depth of flow downstream, and limiting velocity and slope. The following sections describe the factors that account for the determination of existing and future pipeline capacities in the City's collection system.

5.1.1 Manning Coefficient (n)

The manning coefficient 'n' is a friction coefficient that varies with respect to pipe material, size of pipe, depth of flow, smoothness of joints, root intrusion, and other factors. For sewer pipes, the manning coefficient typically ranges between 0.011 and 0.017, with 0.013 being a representative value used for system planning purposes. For this study, the existing manning's coefficients provided in the hydraulic model were used, and then refined as necessary during model calibration to accurately simulated field measured levels and velocities.

5.1.2 Peak Flow Criteria

The primary criteria used to identify capacity deficient sewers or to size new sewer improvements are the maximum flow depth to pipe diameter ratio (d/D), as well as the peak flow to pipe capacity ratio (q/Q). The d/D value is defined as the depth of flow (d) in a pipe during peak (design) flow conditions divided by the pipe's diameter (D). The q/Q is defined as the maximum flow rate in a pipe (q) divided by the maximum flow capacity of the pipe (Q). Based on Carollo Engineers, Inc's (Carollo's) experience, City staff input, and industry standards, the following criteria were used:

- **Flow Depth for Existing Sewers.** Peak flow criteria for existing sanitary sewers are established based on a number of factors, including the acceptable risk tolerance of the utility, local standards and codes, and other factors. Using a conservative criterion for evaluating existing sewers may lead to unnecessary replacement of existing pipelines. Conversely, lenient criteria could increase the risk of sanitary sewer overflows (SSOs). Ultimately, the maximum allowable peak flow criteria should be established to be as cost effective as possible while at the same time reducing the risk of SSOs to the greatest extent possible.

For Fresno, it was decided that a maximum q/Q ratio of 1.15 would be used to identify capacity deficient sewers. In other words, a pipeline was considered capacity deficient if the peak flow is 15-percent over capacity.

- **Flow Depth for New Sewers.** When designing sewer pipelines, it is common practice to adopt variable flow depth criteria for various pipe sizes. Design d/D ratios typically range from 0.5 to 0.92, with the lower values typically used for smaller pipes, which may experience flow peaks greater than design flow or blockages from debris, paper, or rags. Table 5.1 summarizes the criteria for the evaluation of existing sewers and for sizing new trunk lines. For pipelines less than 12-inches in diameter the max d/D value is 0.5 or 50 percent of the pipeline depth. Pipelines 12- to 18-inches in diameter, the max d/D is 0.67, and for pipelines larger than 18-inches in diameter the maximum d/D value is 0.75.

Table 5.1 Maximum Flow Depth Criteria
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Maximum Flow Depth for Existing Sewers	
Peak Wet Weather Flow:	Maximum q/Q = 1.15
Maximum d/D for New Sewers	
Pipe Diameter (inches)	Maximum d/D Ratio (during Peak Flows)
Less than 12	0.50
12 to 18	0.67
Larger than 18	0.75

5.1.3 Design Velocities and Minimum Slopes

In order to minimize the settlement of sewage solids, it is standard practice in the design of gravity sewers to specify that a minimum velocity of two feet per second (ft/s) be maintained when the pipeline is half-full. At this velocity, the sewer flow will typically provide self cleaning for the pipe. Due to hydraulics of a circular conduit, velocity of half-full flow in pipes approaches the velocity of nearly full flow in pipes.

Table 5.2 lists the recommended minimum slopes and their corresponding maximum flows for maintaining self-cleaning velocities (equal to or greater than two ft/s) when the pipe is flowing at its maximum depth (d/D ratio).

Table 5.2 Minimum Slope for New Pipes Wastewater Collection System Master Plan Update City of Fresno			
Pipe Diameter (inches)	Minimum Slope[1][2] (feet/feet)	Calculated Flow at Maximum d/D[2][3]	
		d/D	Maximum Flow (mgd)
6	0.0050	0.50	0.127
8	0.0033	0.50	0.226
10	0.0025	0.50	0.353
12	0.0019	0.67	0.796
15	0.0014	0.67	1.24
18	0.0011	0.67	1.79
21	0.0009	0.75	2.84
24	0.0008	0.75	3.70
27	0.0007	0.75	4.68
30	0.0006	0.75	5.79
36	0.0006	0.75	9.65
42	0.0006	0.75	14.56

Notes:
(1) Recommended minimum slope for flows at a velocity greater than or equal to 2 ft/s.
(2) Manning's n = 0.013
(3) Calculated flow is determined using the minimum slope and maximum allowable d/D from Table 3.1.

5.1.4 Changes in Pipe Size

When a smaller sewer joins a large one, the invert of the larger sewer should be lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation. For planning purposes and designing new pipes, and in the absence of field data, sewer crowns are typically matched at the manholes.

5.2 LIFT STATIONS AND FORCE MAINS

Industry standard practice is to require that sewage lift stations have sufficient capacity to pump the Peak Dry Weather Flow (PDWF) and Peak Wet Weather Flow (PWWF) (whichever is greater) with the largest pump out of service (firm capacity).

Force main piping should be sized to provide a minimum velocity of 3 ft/s at the design flow rate of the lift station and no more than 8 ft/s. For the determination of head loss, the Hazen

Williams Equation is used with a C-factor of 110. These factors are typical for sewer system master planning purposes.

5.3 DESIGN FLOWS

This section summarizes the historic flows measured at the Fresno-Clovis Regional Wastewater Reclamation Facility (RWRF) and presents the calculation of the design flows used to model the existing and future sewer collection system.

5.3.1 Historic RWRF Flows

In addition to the flow monitoring data (summarized in Chapter 3), this project reviewed historical influent flow data at the RWRF from 2008 to 2012 to help establish wastewater flow criteria.

Flow data from January 2008 through December 2012 are summarized in Table 5.3. Table 5.3 lists the average flow at the RWRF for each month from 2007 through 2012. In addition, Table 5.3 summarizes the annual average flow (i.e., the average day flow) and the base wastewater flow (BWF) for each of those years. Flows at the plant have declined since 2008, due to economic conditions, and possibly increased water conservation. Therefore, based on a review of the historical flow data at the RWRF, the years 2010 through 2012 were determined to be the most appropriate time period to define the "existing" flow condition. As shown in Table 5.3, the annual average flow ranged from 63.2 million gallons per day (mgd) in 2012 to 68.8 mgd in 2008, with a three-year average of 64.7 mgd. The BWF (defined as the average flow during the months of November through July) ranged from 62.6 mgd in 2012 to 68.1 mgd in 2008, with a three year average of 64.1 mgd. For this study, the existing BWF was defined as the three year BWF, which is equal to 64.1 mgd.

5.3.2 Wastewater Unit Flow Factors

In order to develop wastewater flow projections and allocate future flows to the collection system, relationships between land use and wastewater generation were developed. These relationships, called wastewater flow factors are established based on the average wastewater flow generated for each existing land use type. The land use flow coefficients were established to project the estimated BWF through build out of the City's general plan boundary.

Unit flow factors provide a means to estimate flow per acre for each land use category. Wastewater unit flow factors are expressed in gallons per day per acre (gpd/ac), applied to land use acreage for calculating average day flow generated from a particular land use. A unit flow factor was developed for each of the City's existing land use classifications. The resulting flow was entered in the sewer system hydraulic model.

Table 5.3 Historical RWRF Flows
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Month	RWRF Influent Flow[(1)] (mgd)					5-Year Average (2008-2012)	3-Year Average (2010-2012)
	2008	2009	2010	2011	2012		
January	70.0	66.2	62.9	65.9	62.4	65.5	63.7
February	67.4	66.8	64.8	65.1	64.1	65.6	64.7
March	66.0	65.3	64.7	64.2	62.1	64.5	63.7
April	66.8	65.1	66.1	63.1	62.0	64.6	63.7
May	67.5	65.5	64.8	63.3	62.2	64.7	63.4
June	68.7	66.5	65.3	64.3	63.1	65.6	64.2
July	69.7	65.6	65.7	63.5	62.8	65.5	64.0
August	70.7	66.0	67.5	65.3	65.3	67.0	66.0
September	71.6	66.9	68.9	66.5	64.6	67.7	66.6
October	70.9	67.3	68.7	65.9	64.9	67.5	66.5
November	68.7	64.2	67.8	64.8	62.5	65.6	65.0
December	67.6	64.0	68.7	62.8	61.8	65.0	64.4
Average Annual Flow	**68.8**	**65.8**	**66.3**	**64.6**	**63.2**	**65.7**	**64.7**
BWF (Nov.-July)	**68.1**	**65.5**	**65.6**	**64.1**	**62.6**	**65.2**	**64.1**
Minimum Month Flow	**66.0**	**64.0**	**62.9**	**62.8**	**61.8**	**63.5**	**62.5**
Maximum Month Flow	**71.6**	**67.3**	**68.9**	**66.5**	**65.3**	**67.9**	**66.9**

Notes:
(1) Source: City influent metering records.

Flow factors for residential areas typically range between 250 to 4,000 gallons per day per acre (gpd/ac), and commercial and industrial areas may range from 600 to 3,000 gpd/ac or higher. Open space land uses were assumed to generate negligible amounts of sewage flow. The factors were developed using the following procedure:

- Average flows for each flow metering tributary area were derived from the flow monitoring data (see Chapter 3).
- Flows associated with each of the City's existing significant industrial users (SIU)s were identified based on meter data provided by the City. A summary of the average flows associated with each SIU is provided in Appendix D. Each SIU was assigned to the appropriate flow metering tributary area and its average flows were subtracted

from the average flows measured during the flow monitoring period. Flows associated with the SIUs were input into the model as “point loads”.

- Using Geographic Information Systems (GIS), the acres for each existing land use type contained in each flow monitoring tributary area were calculated, excluding the SIU areas and vacant areas. According to City staff, the City’s vacant land shape file was is out of date. For this reason, Carollo examined and revised the City’s vacant land use database by comparing the vacant land shape file against a recent aerial photograph.
- Preliminary flow factors for each land use type are estimated based on the approximate number of dwelling units per acre, the assumed per capita wastewater generation rates, and the typical number of people per dwelling unit for each land use type.
- The flow factors for each flow metering tributary were then adjusted up or down (balanced) so that the calculated average flows from each tributary match what was measured from the flow monitoring data.
- Once the flow factors for each of the flowmeter tributary areas were balanced, the weighted average of the coefficients for each existing land use type was calculated based on the acreage contribution from each metering tributary area.

The calibrated wastewater flow factors developed for existing land uses are summarized in Table 5.4. A wastewater flow balance was performed to test the accuracy of the flow factor estimates. As with most cities throughout California, residential land use makes up the majority of developed land and wastewater flow. For Fresno, residential customers within the City proper (excluding Clovis) make up approximately 63 percent of the current flow (40.2 million gallons per day [mgd]). Additionally, Fresno’s industrial sector also makes up a significant portion of the City’s current flow. Industrial customers account for 17 percent of the current BWF (11.3 mgd) and a greater percentage in the summer months when industrial flows increase. The City of Clovis flows currently account for 8 percent of the existing flow (5.1 mgd), although the City of Clovis is entitled to discharge up to roughly 8.9 mgd. Commercial customers account for roughly 6 percent of the current flow (3.8 mgd), and other land uses, such as public land use areas, account for the remaining 5 percent of current flow (3.4 mgd).

Table 5.4 Wastewater Flow Balance
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Land Use Classification	Current Sewer Service Area and Existing Land Use		
	Wastewater Flow Factor (gpd/ac)	Land Use Area (acre)	Base Wastewater Flow (gpd)
Residential			
Rural Density	250	1,216	0.30
Low Density (1-3 DU/acre)	600	1,138	0.68
Medium Low Density (3.5 -6 DU/acre)	900	10,361	9.33
Medium Density (5-12 DU/acre)	1,700	11,143	18.94
Medium High Density (12-16 DU/acre)	2,800	2,039	5.71
High Density (30-45 DU/acre)	4,000	1,316	5.26
Subtotal		**27,212**	**40.2**
Commercial			
Community	800	604	0.48
General Heavy	950	1,054	1.00
Neighborhood	1,660	569	1.06
Neighborhood Limited	1,410	3	0.94
Office	1,000	1,057	0.00
Professional Services Office	800	100	0.08
Regional	800	218	0.17
Recreational	600	119	0.07
Storage Limited	0	44	0.00
Subtotal		**3,768**	**3.8**
Public Facilities			
Airport	300	1,065	0.32
College	0	151	0.00
High school	700	475	0.33
Elementary School and High School	700	141	0.10
Middle School	700	233	0.16
Elementary School and Middle School	700	188	0.13
Elementary School	700	735	0.51
Special School	700	42	0.03
Cemetery	0	165	0.00
Church	500	545	0.27
Community Activity Center	850	8	0.01
Neighborhood Center	1,000	5	0.00
Convention Center	850	17	0.01
Fairgounds	500	90	0.04
Fire Station	850	14	0.01
Government Offices	1,000	141	0.14
County Court House Central Area	1,500	14	0.02
Hospital	4,000	137	0.55
Medical Center	3,000	10	0.03
Convalescent Hospital	3,000	64	0.19
Military	850	60	0.05
Mobile Home Park	500	388	0.19
Municipal Service Center	1,300	37	0.05
Post Office	1,200	23	0.03
Public Facility	1,200	21	0.03
Public/Quasi-Public Facility	850	43	0.04
Pump Station	0	44	0.00
Subtotal		**4,854**	**3.3**
Open Space			
Open Space	0	60	0.00
Recreational Use/Clear Zone	0	16	0.00
Ag	0	233	0.00
Canal	0	38	0.00
Community Park	0	28	0.00
Golf Course	150	597	0.09
Lake or Pond	0	54	0.00
Multi-Use	0	101	0.00
Neighborhood Park	0	212	0.00
Recreational Park	0	59	0.00
Recreational Use	0	12	0.00
Regional Park	0	154	0.00
Parking	0	78	0.00
Pg&e Substation	500	117	0.06
Ponding Basin	0	407	0.00
Ponding Basin/Park	0	108	0.00
Subtotal		**2,281**	**0.1**
Other			
Roads/ Canals/ Highways		16,545	0.00
Vacant	0	2,303	0.00
Subtotal		**18,848**	**0.0**
Industrial/Clovis			
Light Industrial	620	2,979	1.85
Heavy Industrial	1,160	1,291	1.50
Metered Industrial Users	-	-	7.95
City of Clovis	-	-	5.12
Subtotal		**4,270**	**16.4**
Total			
Total	**--**	**61,234**	**63.9**

5.3.3 Existing and Projected Base Wastewater Flow

Developing an accurate estimate of the future quantity of wastewater generated at build out of the collections system is an important step in maintaining and sizing sewer system facilities, for both existing conditions and future developments. In general, the future BWF for build out of the study area was determined by multiplying the wastewater flow factors by the projected land use acreage.

As noted in Chapter 2, the City's General Plan land use can be broken down into "Areas of Change" and "Areas of Stability." Areas of Change are generally defined as areas that contribute to a net increase in wastewater flow in the future, and include densification areas (i.e., Downtown, and densification corridors), infill areas (i.e., development of vacant parcels), and new growth areas (i.e., expansion of the wastewater service area). Wastewater flows associated with the "Areas of Change" were estimated to be 71.8 mgd, which was estimated by multiplying the appropriate wastewater unit flow factor by the land use acreage identified in Table 5.5.

Areas of Stability include the remaining land use areas within the existing sewer service area. The existing BWF associated with these "Areas of Stability" is estimated to be approximately 46.6 mgd, which includes 8.2 mgd of flow from the existing metered industrial customers, but not including the City of Clovis. City of Clovis flows at build out were assumed to be equal to their maximum permit capacity, as well as 3 mgd of additional flow associated with the future Leonard Trunk. In total, the City of Clovis wastewater flows are assumed to be 11.9 mgd at build out.

As shown in Table 5.5, the build out BWF is projected to be approximately 129.9 mgd.

5.3.4 Existing and Project PDWF

The PDWF is the highest hourly flow that occurs during dry weather conditions. In Fresno, the PDWF condition occurs in the late summer when industry is discharging at its maximum rate. Based on a review of the historical RWRF flow data (see Table 5.3), the highest monthly flow rate at the RWRF between 2010 and 2012 was 68.9 mgd (September 2010). The existing PDWF was derived throughout the system based on the hydraulic modeling results. For the PDWF model run, model flows were increased for each SIU based on the maximum monthly flow for each user (see Appendix C), and the remaining flows were scaled up to match 68.9 mgd (daily average flow). In addition, for the PDWF scenario, the City of Clovis flows were set to their maximum permitted discharge rates. From the modeling results, the existing PDWF is estimated to be 88.5 mgd. The build out PDWF was generated using this approach. At build out, the PDWF is estimated to increase to 164.7 mgd.

Table 5.5 Future BWF Projections
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Land Use Type	Wastewater Flow Coefficient (gpd/ac)	Land Use Area Totals				BWF by Land Use Type			
		Current Service Area		New Growth Areas (acres)	Total (acres)	Current Service Area		New Growth Areas (mgd)	Total (mgd)
		Infill (acres)	Redevelopment (acres)			Infill (mgd)	Redevelopment (mgd)		
Residential									
Low Density (1-3 DU/acre)	600	75	0	5,089	5,164	0.0	0.0	3.1	**3.1**
Medium Low Density (3.5 -6 DU/acre)	900	191	4	2,226	2,421	0.2	0.0	2.0	**2.2**
Medium Density (5-12 DU/acre)	1,700	264	29	6,990	7,282	0.4	0.0	11.9	**12.4**
Medium High Density (12-16 DU/acre)	2,800	89	16	531	636	0.2	0.0	1.5	**1.8**
Urban Neighborhood (16-30 DU/acre)	3,500	63	121	2,001	2,184	0.2	0.4	7.0	**7.6**
High Density (30-45 DU/acre)	4,000	9	20	252	281	0.0	0.1	1.0	**1.1**
Commercial									
Main Street	800	4	67	0	72	0.0	0.1	0.0	**0.1**
Community	800	106	507	436	1,050	0.1	0.4	0.3	**0.8**
Recreation	500	0	0	8	8	0.0	0.0	0.0	**0.0**
General	950	73	0	75	147	0.1	0.0	0.1	**0.1**
Highway and Auto	950	31	50	169	250	0.0	0.0	0.2	**0.2**
Regional	800	8	136	186	331	0.0	0.1	0.1	**0.3**
Employment									
Office	1,000	217	5	226	448	0.2	0.0	0.2	**0.4**
Business Park	800	12	63	743	817	0.0	0.1	0.6	**0.7**
Regional Business Park	800	28	126	1,662	1,817	0.0	0.1	1.3	**1.5**
Light Industrial	620	362	2	1,781	2,145	0.2	0.0	1.1	**1.3**
Heavy Industrial	5,000	148	7	2,368	2,522	0.7	0.0	11.8	**12.6**
Mixed Use									
Corridor/Center Mixed Use	2,800	78	1,139	829	2,046	0.2	3.2	2.3	**5.7**
Regional Mixed Use	3,300	19	613	321	952	0.1	2.0	1.1	**3.1**
Neighborhood Mixed Use	2,300	3	112	15	131	0.0	0.3	0.0	**0.3**
Open Space									
Clear Zone	0	2	0	4	7	0.0	0.0	0.0	**0.0**
Commercial-Recreational	0	1	0	0	1	0.0	0.0	0.0	**0.0**
Community Park	0	0	0	40	41	0.0	0.0	0.0	**0.0**
Flood Control Project	0	0	0	0	0	0.0	0.0	0.0	**0.0**
Golf Course	150	8	0	418	426	0.0	0.0	0.1	**0.1**
Lake, Pond	0	0	0	32	32	0.0	0.0	0.0	**0.0**
Multi-Use	0	46	0	2,053	2,098	0.0	0.0	0.0	**0.0**
Neighborhood Park	0	17	0	61	79	0.0	0.0	0.0	**0.0**
Outdoor Environmental Education Area	0	0	0	0	0	0.0	0.0	0.0	**0.0**
Open Space	0	0	0	339	339	0.0	0.0	0.0	**0.0**
Park	0	11	12	1,441	1,464	0.0	0.0	0.0	**0.0**
Ponding Basin	0	0	0	894	894	0.0	0.0	0.0	**0.0**
Ponding Basin (Park Use)	0	0	15	0	15	0.0	0.0	0.0	**0.0**
Regional Park	0	44	43	642	729	0.0	0.0	0.0	**0.0**
Public Facilities									
Public/Quasi-Public Facility	850	47	88	535	670	0.0	0.1	0.5	**0.6**
Special School	700	0	0	0	0	0.0	0.0	0.0	**0.0**
Elementary School	700	4	12	236	252	0.0	0.0	0.2	**0.2**
Elementary & Middle School	700	0	0	0	0	0.0	0.0	0.0	**0.0**
Elementary, Middle, & High School	700	0	0	0	0	0.0	0.0	0.0	**0.0**
Middle School	700	0	17	115	132	0.0	0.0	0.1	**0.1**
High School	700	0	0	0	0	0.0	0.0	0.0	**0.0**
College	700	8	0	0	8	0.0	0.0	0.0	**0.0**
School with Park	700	0	0	596	596	0.0	0.0	0.4	**0.4**
Airport	300	0	0	86	86	0.0	0.0	0.0	**0.0**
Cemetary	0	0	0	61	61	0.0	0.0	0.0	**0.0**
Church	500	12	24	22	58	0.0	0.0	0.0	**0.0**
Community Activity Center	850	0	0	0	0	0.0	0.0	0.0	**0.0**
Convalescent Hospital	3,000	0	0	0	0	0.0	0.0	0.0	**0.0**
Fairgrounds	500	0	0	0	0	0.0	0.0	0.0	**0.0**
Fire Station	850	0	0	0	0	0.0	0.0	0.0	**0.0**
Government Offices	1,000	0	0	0	0	0.0	0.0	0.0	**0.0**
Hospital	4,000	0	0	0	0	0.0	0.0	0.0	**0.0**
Medical Center	3,000	0	0	0	0	0.0	0.0	0.0	**0.0**
Neighborhood Center	1,000	0	0	0	0	0.0	0.0	0.0	**0.0**
PG&E Substation	500	0	0	34	34	0.0	0.0	0.0	**0.0**
Police Dressing Station	1,200	0	0	0	0	0.0	0.0	0.0	**0.0**
Water Recharge Basin	0	0	0	288	288	0.0	0.0	0.0	**0.0**
Wastewater Treatment Facility	0	0	0	0	0	0.0	0.0	0.0	**0.0**
Buffer									
Buffer (Ag)	50	0	0	736	736	0.0	0.0	0.0	**0.0**
Downtown									
Central Business District	7,900	23	244	0	267	0.2	1.9	0.0	**2.1**
Civic Center	4,000	0	37	0	37	0.0	0.1	0.0	**0.1**
Town Center	5,200	1	54	0	55	0.0	0.3	0.0	**0.3**
Neighborhood Center	3,200	11	72	0	84	0.0	0.2	0.0	**0.3**
Chinatown District	4,800	5	24	0	29	0.0	0.1	0.0	**0.1**
Cultural Arts District	1,000	13	56	0	69	0.0	0.1	0.0	**0.1**
Corridor General	3,400	24	442	0	466	0.1	1.5	0.0	**1.6**
Downtown Neighborhoods	2,800	101	2,482	0	2,584	0.3	7.0	0.0	**7.2**
Special Districts	2,000	82	815	0	897	0.2	1.6	0.0	**1.8**
Public Facility	1,200	0	150	0	150	0.0	0.2	0.0	**0.2**
Open Conservation	0	0	178	0	178	0.0	0.0	0.0	**0.0**
South Stadium District	6,900	16	99	0	115	0.1	0.7	0.0	**0.8**
Other									
Street, Rail, Canal, Etc.	0	41	2,035	3,070	5,146	0.0	0.0	0.0	**0.0**
Total Infill, Redevelopment Areas, and Growth Areas									
Total	--	2,299	9,919	37,614	49,832	3.8	20.7	47.0	**71.5**

Grand Total BWF at Build Out	
Existing BWF from SIUs, mgd:	8.2
City of Clovis (Max Permit + 3 mgd in Leonard Trunk), mgd:	11.9
BWF from Existing "Areas of Stability", mgd:	38.4
BWF from Infill, Redevelopment, and Growth Areas, mgd:	71.5
Grand Total BWF at Build Out:	**129.9**

5.3.5 Design Storm

Design storms are rainfall events used to analyze the performance of a collection system under extreme wet weather events. The first step in the development of the design storm is to define its recurrence interval and rainfall duration. The recurrence interval is based on the probability that a given rainfall event will occur or be exceeded in any given year. For example, a “100-year storm” means there is a 1 in 100 chance that a storm as large or larger than this event will occur at a specific location in any year.

Duration is the length of time in which the rainfall occurs. It is an industry standard in California to use the 10-year, 24-hour design storm for analyzing wastewater collection system performance during PWWF conditions. For this reason, this study defines the design storm as a 10-year, 24-hour rainfall event. The 10-year, 24-hour design storm volume is available from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, which revealed that a 10-year storm would have a total volume of 2.06-inches.

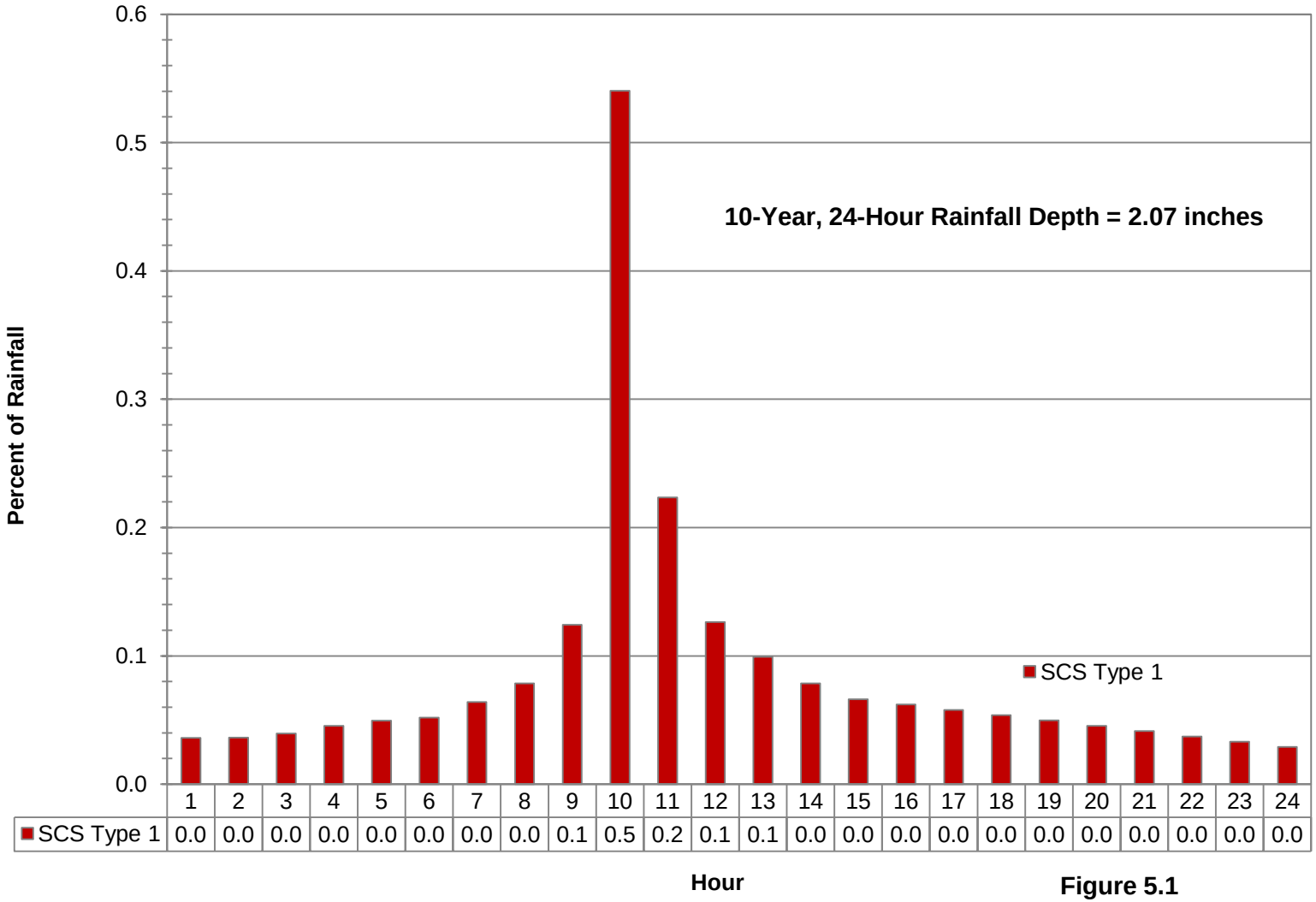
Once the design storm recurrence interval, duration, and associated rainfall volume have been determined, the next step in defining the design storm is to distribute the total rainfall over duration of the storm. To accomplish this, an industry standard synthetic rainfall distribution (SCS Type 1, developed by the Natural Resource Conservation Service [NRCS]) was used. Figure 5.1 shows the 10-year, 24-hour design storm.

5.3.6 Existing and Projected Peak Wet Weather Flow

The PWWF is the highest observed hourly flow that occurs following the design storm event. Wet weather infiltration and inflow (I/I), which occurs during and after rainfall events, increases flows in the collection system. PWWF is typically used for designing sewers and lift stations. The City’s sewers and lift stations were evaluated based on their capacity to convey the PWWF.

The existing PWWF was derived throughout the system based on the hydraulic modeling results. This was accomplished by routing the 10-year, 24-hour design storm through the hydraulic model, which was calibrated to both dry weather and wet weather conditions. Detailed information regarding the calibration of the City’s hydraulic model is provided in Chapter 4.

Similar to the existing PWWF, the build out PWWF was derived by routing a 10-year, 24 hour design storm through the hydraulic model. Peak I/I rates for future growth areas (e.g., vacant areas within the existing service area, growth areas outside of the current service area, etc.) were developed based on a peak I/I rate of 370 gpd/ac, based on the peak I/I rates experienced in Basin 2, which is considered the most representative area for new growth within the City.



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
SCS Type 1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.5	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Figure 5.1
10-Year, 24-Hour Design Storm
Wastewater Collection System Master Plan Update
City of Fresno

Table 5.6 presents a summary of the existing and build out BWF. In addition to the build out BWF, Table 5.6 includes the existing and build out peak dry weather flow (PDWF) and peak wet weather flow (PWWF). As shown in Table 5.6, the City's BWF is projected to roughly double from 64.1 mgd to 129.9 mgd by build out. The PDWF is projected to increase from 88.5 mgd to about 164.7 mgd (an increase of approximately 86-percent), and the PWWF is projected to increase from 123.9 mgd to about 202.4 mgd by build out (an increase of approximately 63 percent). Overall, the City's PWWF to ADWF peaking factor is projected to decrease from roughly 1.93 to 1.56, which is typical for sanitary sewer collection systems. Newer sewers tend to have less I/I response than older areas of the system, primarily due to better construction methods. Furthermore, flow attenuation also tends to dampen out flow peaks as collection systems expand. In addition, a significant portion of the future increase in wastewater flows at the City is associated with densification, which would not include a corresponding increase in I/I.

Table 5.6 Current and Projected Wastewater Flows
Wastewater Collection System Master Plan Update
City of Fresno

Year	BWF(1) (mgd)	PDWF(2) (mgd)	PDWF Peaking Factor	PWWF(3) (mgd)	PWWF Peaking Factor
Existing	64.1	88.5	1.38	123.9	1.93
Build Out	129.9	164.7	1.27	202.4	1.56

Notes:
(1) BWF = Base Wastewater Flow.
(2) PDWF = Peak Dry Weather Flow
(3) PWWF = Peak Wet Weather Flow.

CAPACITY EVALUATION AND PROPOSED IMPROVEMENTS

This chapter discusses the hydraulic evaluation of the sewer collection system and the proposed projects that correct capacity deficiencies and serve future users.

6.1 CAPACITY EVALUATION

This section summarizes the results of the capacity evaluation of the City of Fresno's (City's) wastewater collection system, which includes a gravity pipeline capacity evaluation, as well as a lift station capacity evaluation. The evaluation considers both current and projected peak dry weather flow (PDWF) and peak wet weather flow (PWWF) conditions.

6.1.1 Gravity Collection System Evaluation

Following the dry and wet weather flow calibration, which is summarized in detail in Chapter 4, a capacity analysis of the existing and future collection system was performed. The capacity analysis entailed identifying areas in the sewer system where flow restrictions occur or where pipe capacity is insufficient to convey PDWFs or PWWFs. Sewers that lack sufficient capacity to convey these flows create bottlenecks in the collection system that can potentially cause sanitary sewer overflows (SSOs). The sewer system was evaluated based on planning criteria presented in Chapter 5.

Per staff's request, it is recommended that each identified project be further investigated using temporary flow monitoring during the preliminary design phase of the project. This will not only further define the extent of the determined deficiency, but also allows the designer to have a better understanding of potential bypass flows which will help mitigate problems during the construction phase.

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

- PDWF Analysis:
  - Existing System. For the existing sewer collection system, the PDWF was routed through the hydraulic model. In accordance with the established flow depth criteria for existing sewers, pipelines where the maximum depth to full flow depth (d/D) ratio that exceeded 1.0 were flagged. Each pipeline with a maximum d/D in excess of 1.0 was reviewed on a case-by-case basis to determine if a capacity improvement project was warranted. Some pipelines with very shallow or flats slopes may exceed the 1.0 d/D threshold but only cause minor surcharging. Each of these cases was evaluated to determine the risk of SSO, and some pipeline reaches with slight surcharging were allowed. The locations of the capacity deficient pipelines for current PDWF conditions are shown on Figure 6.1 in red.

Dickenson Ave
West Lawn Ave
Chateau Fresno Ave
Grantland Ave
Hayes Ave
Cornelia Ave
Brawley Ave
Marks Ave
West Ave
Palm Ave
Blackstone Ave
First St
Cedar Ave
Chestnut Ave
Willow Ave
Clovis Ave
Fowler Ave
Temperance Ave
Dewolf Ave
Highland Ave
McCall Ave
Del Rey Ave
Bethel Ave
Academy Ave
Madsen Ave

Cooper Ave
Behymer Ave
Shepherd Ave
Nees Ave
Herndon Ave
Bullard Ave
Shaw Ave
Ashlan Ave
Shields Ave
McKinley Ave
Belmont Ave
Whitesbridge Ave/CA 180
California Ave
Jensen Ave
North Ave
Central Ave
American Ave

NFWRF
LS05
LS06
LS04
LS10
LS16
LS14
LS12
LS03
LS15
LS13
LS18
LS02
LS01
LS20
RWRF
99
41
168
180
Direct Storm Drain Connections to be Removed
GALLO

Legend

Existing Wastewater Collection System

- Lift Stations

Pipelines

- 8" and Smaller
- 10" and Larger

Proposed Improvements

- Existing System
- Future System
- Development
- Gallo Winery I/I Reduction Program
- Streets
- Sphere of Influence
- City Limits
- Existing Sewer Service Area

N

0 12,500 25,000 Feet

Figure 6.1
Proposed Collection System Capacity Improvements
Wastewater Collection System Master Plan Update
City of Fresno

DPU

carollo
Engineers...Working Wonders With Water®

- Build Out System. The build out system analysis was performed in a manner similar to the existing system analysis. The purpose of the build out system evaluation is to verify that the existing system improvements were appropriately sized to convey build out PDWFs, and to identify the locations of sewers that are adequately sized to convey existing PDWFs, but cannot convey build out PWWFs. At the time of this Master Plan, there are no known planned future industrial users that will add significant PDWFs to the collection system causing system deficiencies. Should new industrial loads increase in the future, a project-by-project analysis is recommended to assure the collection system has adequate capacity.

- **PWWF Analysis:**
  - Existing System. For the existing sewer collection system, the PWWF was routed through the hydraulic model. In accordance with the established flow depth criteria for existing sewers, manholes where the maximum flow to full flow (q/Q) ratio that exceeded 1.15 were flagged. Each pipeline with a maximum q/Q in excess of 1.15 was reviewed on a case-by-case basis to determine if a capacity improvement project was warranted. As with the PDWF analysis, some pipelines with very shallow or flats slopes may exceed the 1.15 q/Q threshold but only cause minor surcharging. In these cases, these pipelines were removed from the list of deficiencies.

    In general, the City's collection system has sufficient capacity to convey current PWWFs without exceeding the established q/Q ratio. However, there are a few areas where wet weather capacity restrictions are present and required mitigation. The location of these capacity deficient pipelines for current PWWF conditions are shown on Figure 6.1 in red.

    Following the completion of the existing system analysis, improvement projects and alternatives were identified in order to mitigate existing system pipeline capacity deficiencies. The recommended improvement projects are discussed in greater detail in Section 6.2 and project specific detail sheets will be provided in Appendix F. In accordance with the established planning criteria, new sewer pipelines were sized such that the maximum flow depth to pipe diameter ratio (d/D) did not exceed the values summarized in Chapter 5. In other words, flows in recommended improvements were not allowed to surcharge during PWWF conditions.
  - Build Out System. The build out system analysis was performed in a manner similar to the existing system analysis. The purpose of the build out system evaluation is to verify that the existing system improvements were appropriately sized to convey build out PWWFs, and to identify the locations of sewers that are adequately sized to convey existing PWWFs, but cannot convey build out PWWFs. Additionally, new trunk sewers were added to the hydraulic model and sized to service major growth areas beyond the current City sewer service area.

At build out, the City's wastewater flows are expected to increase substantially. As such, there are some areas of the existing collection system that cannot convey the build out PWWF within the established q/Q ratio. These pipelines are shown on Figure 6.1 in orange. The locations of new trunk sewers to service future growth are also shown in green.

6.1.2 Lift Station Evaluation

The City's hydraulic model includes 15 lift stations that service the major trunk system (typically pipes 10-inches and larger sewers) and smaller developments (less than 10-inch diameter). The hydraulic model does not have flows routed to a majority of these lift stations. However, the lift stations that do have flows allocated to them were determined to have sufficient capacity to convey the existing and future PWWF.

It is recommended that the capacity evaluation be updated when flows allocations within the hydraulic modeling software have been modified such that the capacity of the additional lift station can be evaluated. In addition, the City does not currently collect supervisory control and data acquisition (SCADA) data for their lift stations. Were feasible, it is recommended that upgrades be performed to allow for proper flow monitoring data acquisition, which will help confirm lift station capacity and monitor lift station performance.

6.2 COLLECTION SYSTEM IMPROVEMENTS

Figure 6.1 illustrates the proposed sewer improvements required to correct existing deficiencies and to serve future users. Detail maps for each of the proposed improvements are provided in Chapter 8 for clarity. Table 6.1 provides more detail of each improvement. Both Figure 6.1 and Table 6.1 should be used together to locate the proposed improvement and to gain details of the improvement (length, diameter, street location, etc.). The improvement identification number links the figure and table. The improvements summarized in Table 6.1 use a cross-referenced number system. The columns used in Table 6.1 refer to the following:

- **Improvement ID**: Assigned unique identifier associated with each improvement project. This is an alphanumeric number that starts with one letter indicating the type of improvement C = Capacity, D = Development, NCFWRF = North Central Fresno Wastewater Reclamation Facility, SEDA = Southeast Development Area Treatment Facility, and each continues with a number indicating different projects.
- **Type of improvement**: Pipelines, lift stations, force mains, and jacked steel casings.
- **Street Description**: Street in which the improvement is proposed.
- **Limits**: Description of the beginning and end of a proposed pipeline project.
- **Existing Size**: This is the size of the existing pipeline/facility. It represents the diameter of the existing pipelines (inches), and the total capacity of lift stations (million gallons per day [mgd]).

- **Proposed Size**: This is the size of the proposed improvement. It represents the diameter of the proposed pipelines (inches), and the total capacity of lift stations or plants (mgd). Additionally, for jacked steel casings, the size of the casing as well as the carrier pipe are indicated (inches).
- **Replace/New**: Indicates whether the proposed improvement is a replacement pipeline, parallel pipeline, or a new facility.
- **Length**: Estimated length of the proposed improvement (in feet). It should be noted that the length estimates do not account for re-routing the alignment to avoid unknown conditions.

When an increase to capacity is required, existing sewers can be upgraded or a parallel relief sewer can be constructed. For the purposes of this study, unless otherwise stated, we assumed that a capacity deficient sewer would be upgraded to a larger diameter. The upgraded pipeline generally followed the same slope as the existing pipeline, with the exception where survey data revealed negative or flat slopes in an existing alignment.

In essence, there are two alternatives for every trunk sewer project, but the decision to replace or construct a parallel sewer should be made during the preliminary design phase.

During the preliminary design phase, the existing sewer should be inspected by closed circuit television (CCTV) to determine its structural condition. If severely deteriorated, the existing sewer should be upgraded using a replacement pipe. If moderately deteriorated, slip lining or cured-in-place pipe lining can rehabilitate the existing sewer.

The proposed improvements that will serve future users are sized for build-out conditions. As the City continues to grow, it is recommended that the proposed pipeline diameters be constructed so that the facilities have sufficient capacity for build out conditions. Building a smaller interim project with the plans of upsizing in the future to account for further growth is not recommended due to the extended useful life of the improvements proposed herein. The proposed pipe diameter represents the ultimate diameter for build out conditions.

6.2.1 Existing versus Future Improvement

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

Table 6.1 Proposed Collection System Improvements
Collection System Master Plan
City of Fresno

Project Description					Project Size				Project Phasing			
Improv. ID	Type of Improv.	Description/Street	Description/Limits	Detail Sheet No. (Appendix xx)	Existing Size (in.)	Proposed Size (in)	Replace/ New	Length (ft)	Phase 1 (2014-2020)	Phase 2 (2020-2025)	Phase 3 (2025-2030)	Phase 4 (2030-2035)
Existing Improvements												
C-1A	Gravity	Hammond Avenue	Between Blackstone Ave. and Abby St.	1	20	**24**	Replace	390	x			
C-1B	Gravity	Abby Street	From Hammond Ave. to La Salle Ave.	2	20	**24**	Replace	1,619	x			
C-2A	Gravity	Glenn Avenue	From Brewer Ave. to Thomas Ave.	3	24	**27**	Replace	390	x			
C-2B	Gravity	Glenn Avenue	From HWY 180 to Voorman Ave.	4	24	**27**	Replace	2,594		x		
C-3	Gravity	Glenn Avenue / N Street	From Voorman Ave. to Tuolumne St.	5	27	**30**	Replace	1,343			x	
C-4	Gravity	Monterey Avenue	From Fulton Street to N Street	6	6	**10**	Replace	1,820			x	
C-5A	Gravity	Eighth Street	From Ventura Ave. to Woodward Ave.	7	36	**42**	Replace	4,752			x	
C-5B	Gravity	Woodward Avenue	From Eigth St. to Orange Ave.	8	36	**42**	Replace	597			x	
C-5C	Gravity	Orange Avenue	From Woodward Ave. to California Ave.	9	36	**42**	Replace	707			x	
C-6	Gravity	Safford Avenue	From Producers Dairy to H Street	10	6	**8**	Replace	930		x		
Build-Out Improvements												
C-7	Gravity	Tuolumne Street/ Van Ness Avenue	From N Street to Merced Ave.	11	27	**30**	Replace	1,680				x
C-8	Gravity	North Avenue	From Polk Ave. to Fruit Ave.	12	-	**60**	New	20,855				x
C-9	Gravity	North Avenue	From Fruit Ave. to HWY 99	13	60	**60**	Rehab	15,533				x
D-1	Gravity	Temperance Avenue	From North Ave. to Jensen Ave.	-	-	**48**	New	5,873				x
D-2	Gravity	Temperance Avenue	From Jensen Ave. to Tulare St.	-	-	**42**	New	13,350				x
D-3	Gravity	Temperance Avenue	From Tulare St. to Olive Ave.	-	-	**36**	New	4,987				x
D-4	Gravity	Temperance/McKinley/DeWolf	From Olive Ave. to Shields	-	-	**30**	New	13,299				x
D-5	Gravity	Shields Ave./Leonard Ave.	From DeWolf Ave. to Leonard Ave.	-	-	**27**	New	4,575				x
D-6A	Gravity	Jensen Avenue	From Temperance Ave. to DeWolf	-	-	**15**	New	5,227				x
D-6B	Gravity	Jensen Avenue	From DeWolf Ave. to Leonard Ave.	-	-	**12**	New	2,732				x
D-7A	Gravity	Church Avenue	From Temperance Ave. to Locan Ave.	-	-	**15**	New	2,552				x
D-7B	Gravity	Church Avenue	From Locan Ave. to DeWolf Ave.	-	-	**12**	New	2,729				x
D-7C	Gravity	Church Avenue	From DeWolf Ave. to Leonard Ave.	-	-	**8**	New	2,673				x
D-8A	Gravity	Locans Avenue	From Temperance Ave to Locan Ave.	-	-	**18**	New	2,676				x
D-8B	Gravity	Locans Avenue	From Locan Ave. to DeWolf Ave.	-	-	**15**	New	2,670				x
D-8C	Gravity	Locans Avenue	From DeWolf Ave. to Leonard Ave.	-	-	**10**	New	2,492				x
D-9A	Gravity	Butler Avenue	From Temperance Ave to Locan Ave.	-	-	**18**	New	2,617				x
D-9B	Gravity	Butler Avenue	From Locan Ave. to DeWolf Ave.	-	-	**15**	New	2,611				x
D-9C	Gravity	Butler Avenue	From DeWolf Ave. to Leonard Ave.	-	-	**8**	New	2,849				x
D-10A	Gravity	Tulare Street	From Temperance Ave. to Locan Ave.	-	-	**21**	New	2,730				x
D-10B	Gravity	Tulare Street/DeWolf Avenue	From Locan Ave. to DeWolf Ave.	-	-	**15**	New	4,034				x
D-10C	Gravity	Laurel Avenue	From DeWolf Ave. to Leonard Ave.	-	-	**8**	New	2,729				x
D-10D	Gravity	Locan Ave/ Belmont Ave.	From Tulare St. to DeWolf Ave.	-	-	**12**	New	4,926				x
D-10E	Gravity	Belmont Avenue	From DeWolf Ave. to Leonard Ave.	-	-	**10**	New	2,554				x
D-11A	Gravity	Olive Avenue	From Temperance Ave. to Locan Ave.	-	-	**15**	New	2,671				x
D-11B	Gravity	Olive Avenue	From Locan Ave. to DeWolf Ave.	-	-	**12**	New	2,613				x
D-11C	Gravity	Olive Avenue	From DeWolf Ave. to Leonard Ave.	-	-	**8**	New	2,617				x
D-12A	Gravity	McKinley Avenue	From DeWolf Ave. to Leonard Ave.	-	-	**21**	New	2,729				x
D-12B	Gravity	McKinley Avenue	From Leonard Ave. to Thompson Ave.	-	-	**18**	New	5,103				x
D-12C	Gravity	Thompson Avenue	From McKinley Ave. to Clinton Ave.	-	-	**15**	New	2,730				x
D-13	Gravity	Clinton Avenue	From DeWolf Ave. to Leonard Ave.	-	-	**10**	New	2,492				x

Table 6.1 Proposed Collection System Improvements
Collection System Master Plan
City of Fresno

Project Description					Project Size				Project Phasing			
Improv. ID	Type of Improv.	Description/Street	Description/Limits	Detail Sheet No. (Appendix xx)	Existing Size (in.)	Proposed Size (in)	Replace/ New	Length (ft)	Phase 1 (2014-2020)	Phase 2 (2020-2025)	Phase 3 (2025-2030)	Phase 4 (2030-2035)
D-14	Gravity	North Avenue	From Peach Ave. to Temperance Ave.	-	-	**36**	New	15,787				x
D-15	Gravity	Minnewawa	From North Ave. to Annadale Ave.	-	-	**12**	New	2,729				x
D-16	Gravity	Sunnyside Avenue	From North Ave. to Annadale Ave.	-	-	**15**	New	2,610				x
D-17	Gravity	Fowler Avenue	From North Ave. to Annadale Ave.	-	-	**10**	New	2,789				x
D-18	Gravity	Armstrong Avenue	From North Ave. to Annadale Ave.	-	-	**8**	New	2,671				x
D-19A	Gravity	Valentine Avenue	From Church Ave. to Kearney Frontage	-	-	**12**	New	3,976				x
D-19B	Gravity	Valentine Avenue	From Kearney Frontage to Madison Ave.	-	-	**10**	New	1,312				x
D-20	Gravity	Brawley Avenue	From Church Ave. to Madison Ave.	-	-	**8**	New	5,415				x
D-21A	Gravity	Whitesbridge Avenue	From Polk Ave. to Blythe Ave.	-	-	**12**	New	5,336				x
D-21B	Gravity	Whitesbridge/Brawley Avenue	From Blythe Ave. to Nelsen Ave.	-	-	**10**	New	5,392				x
D-22A	Gravity	Belmont Avenue	From Polk Ave. to Cornelia Ave.	-	-	**12**	New	2,734				x
D-22B	Gravity	Belmont Avenue	From Cornelia Ave. to Blythe Ave.	-	-	**10**	New	2,675				x
D-22C	Gravity	Belmont Avenue	From Blythe Ave. to Brawley Ave.	-	-	**8**	New	2,640				x
D-23A	Gravity	Olive Avenue	From Polk Ave. to Blythe Ave.	-	-	**12**	New	5,343				x
D-23B	Gravity	Olive Avenue	From Blythe Ave. to Brawley Ave.	-	-	**8**	New	2,675				x
D-24A	Gravity	Olive Avenue	From Grantland Ave. to Bryan Ave.	-	-	**12**	New	2,769				x
D-24B	Gravity	Olive Avenue	From Bryan Ave. to Hayes Ave.	-	-	**10**	New	1,973				x
D-25	Gravity	McKinley Avenue	From Grantland Ave. to Ring Ave.	-	-	**10**	New	3,748				x
D-26A	Gravity	Clinton Avenue	From Grantland Ave. to Bryan Ave.	-	-	**12**	New	2,621				x
D-26B	Gravity	Clinton Avenue	From Bryan Ave. to Hayes Ave.	-	-	**10**	New	2,592				x
D-27A	Gravity	Shields Avenue	From Grantland Ave. to Bryan Ave.	-	-	**15**	New	2,775				x
D-27B	Gravity	Shields Avenue	From Bryan Ave. to Hayes Ave.	-	-	**12**	New	2,592				x
New Facilities												
NCFWRF-1	Treatment	Cedar/Dakota	Reclamation Facility at Vacant Field Behind Granite Park	-	-	**3 mgd**	New	-	x			
NCFWRF-2	Gravity	Dakota	From Treatment Facility to Millbrook Ave.	-	-	**36**	New	4,042	x			
SEGA	Treatment	Temperance	Reclamation Facility on Corner of Temperance and North Ave.	-	-	**12 mgd**	New	-				x

Many of the Master Plan improvements will serve future users, even when an improvement calls for the upgrade of an existing facility. In these cases, an existing sewer or lift station may have sufficient capacity to convey current PWWFs, but as growth continues and more users are added to the system, the increased flow results in capacity deficiencies. These projects, as well as new trunk sewers to extend wastewater collection system service to future growth areas, are future improvements. Future users were assigned 100 percent of the future project's benefit and 100 percent of the costs.

In some cases, a project is needed to correct an existing capacity deficiency, but is sized to accommodate additional flows from future development. In these cases, the hydraulic modeling results were used to determine the cost breakdown between existing and future users based on the ratio of existing and build out average dry weather flows. More information on the breakdown in cost split between existing and future users and whether a proposed improvement is intended to correct an existing deficiency, to serve a future user, or both, is provided in Chapter 8.

6.2.2 Existing System Improvements

For the majority of the City, the existing wastewater collection system contains sufficient capacity to convey the PDWF and PWWF without exceeding the capacity criteria discussed Chapter 5. There are a few exceptions where existing sewers will need to be replaced by larger diameter sewers, or parallel sewers will need to be constructed to bypass flow around hydraulically deficient sewers. These projects are discussed in this section and details for each are provided in Chapter 8. Detail sheets for individual projects are provided in Appendix F.

- **Project 1 – Hammond Avenue and Abby Street Sewers (C-1A and C-1B)**. This project consists of replacing approximately 2,000 feet of existing 20-inch diameter sewer on Hammond Avenue and Abby Street from Blackstone Avenue to La Salle Avenue with a new 24-inch diameter sewer. This project is required to mitigate surcharged conditions for existing PWWFs. It is recommended that the City perform a flow-monitoring program to confirm the capacity deficiency in this pipeline prior to construction. If the flow-monitoring program determines that the I/I for this pipeline is significantly lower, then this project could possibly be avoided. However, due to the age of this pipeline (over 100 years old) it is recommended that the City develop a program for flow monitoring and inspection in the near future.
- **Project 2 – Glenn Avenue Sewers (C-2A and C-2B)**. This project consists of replacing the existing 24-inch diameter sewer on Glenn Avenue, from Brewer Avenue to Voorman Avenue with a new 27-inch diameter sewer. This project is required to mitigate surcharged conditions on the Glenn Avenue sewer for existing PWWFs. It is recommended that the City perform a flow-monitoring program to confirm the capacity deficiency in this pipeline prior to construction. If the flow-monitoring program determines that the I/I for this pipeline is significantly lower, then this project could

possibly be avoided. However, due to the age of this pipeline (over 100 years old) it is recommended that the City develop a program for flow monitoring and inspection in the near future.

- **Project 3 – Glenn Avenue Sewer (C-3)**. This project is required to mitigate existing capacity deficiencies due to PWWF in the 27-inch diameter gravity sewer immediately downstream of Project C-2. The replacement 30-inch sewer extends from Voorman Avenue to Tuolumne Street. It is recommended that the City perform a flow-monitoring program to confirm the capacity deficiency in this pipeline prior to construction. If the flow-monitoring program determines that the I/I for this pipeline is significantly lower, then this project could possibly be avoided. However, due to the age of this pipeline (over 100 years old) it is recommended that the City develop a program for flow monitoring and inspection in the near future.
- **Project 4 – Monterey Avenue Sewer (C-4)**. This project mitigates existing capacity deficiencies in the sewer immediately downstream of two medium sized industrial users. The existing 6-inch sewer is capacity deficient during PDWF caused by the two large industrial users directly upstream. This project consists of replacing approximately 1,800 feet of 6-inch diameter pipeline with a new 10-inch diameter sewer on Monterey Avenue from Fulton Street to N Street.
- **Project 5 – Orange Avenue Trunk Sewers (C-5A, C-5B, and C-5C)**. The Orange Avenue trunk is a main sewer artery that conveys flows from the City of Clovis, California State University Fresno (CSUF), and a large area of the central section of the City. This project mitigates existing capacity deficiencies during PWWF. This project consists of replacing approximately 6,050 feet of 36-inch diameter pipeline with a new 42-inch diameter sewer on Eighth Street, Woodward Avenue, and Orange Avenue from Ventura Street to California Avenue.
- **Project 6 – Safford Avenue Sewer (C-6)**. The Safford Avenue project consists of replacing approximately 930 feet of existing 6-inch diameter sewer from Producers Dairy to H Street with a new 8-inch diameter sewer. This project is required to mitigate surcharged conditions for existing PDWFs due to the flows from Producers Dairy.

6.2.3 Build Out System Improvements

The following discussion summarizes the new trunk sewers that will serve future users, as well as the locations of existing pipelines that would need to be replaced in order to accommodate build out PWWFs. The locations of the new trunk sewers are conceptual and are likely to change during the design phase. The locations shown are possible alignments based on available information and are intended to assist in the development of probable construction costs. No investigation into the feasibility of these alignments has been conducted. However, an attempt was made to place new trunk sewer alignments within existing streets or other feasible pipeline alignments.

- **Project 7 – Tuolumne Street and Van Ness Avenue Sewers (C-7).** . Under current PWWF conditions, the existing 27-inch diameter sewers on Tuolumne Street and Van Ness Avenue from N Street to Merced Avenue experience surcharging. However, the surcharged conditions did not exceed the allowable flow depth criteria and therefore no improvement is required for current PWWFs.

  At build out, however, there is a capacity increase seen in this sewer due to redevelopment areas and requires the existing 27-inch sewer to be replaced with a 30-inch sewer.

- **Project 8 – North Avenue Trunk (C-8 and C-9)**. As determined in the previous 2006 Master Plan, the North Avenue trunk is capacity deficient under current PWWF conditions and the existing 66-inch diameter sewers on North Avenue experience surcharging. However, the surcharged conditions did not exceed the allowable flow depth criteria and therefore no improvement is required for existing PWWFs.

  However, at build out, a significant increase in flow from new industrial land uses as well as redevelopment causes significant surcharging throughout the North Avenue trunk. The flows exceed the flow depth criteria and create a condition that requires an improvement project.

  This proposed improvement project is broken up into two portions. The fist project (C-8) entails constructing a new 60-inch diameter sewer parallel to the existing 66-inch diameter sewer on North Avenue that will tie into the existing 60-inch diameter at Polk Avenue and extend to a new flow diversion structure at Fruit Avenue. The second project (C-9) will require the rehabilitation of the existing abandoned 60-inch diameter sewer on North Avenue from Fruit Avenue to Highway 99.

- **Project 10 – SEDA North Trunk Sewers (D-1 through D-13)**. In order to serve the planned growth areas in the Southeast Development Area (SEDA), it is recommended that a new sewer be constructed from 8-inch diameter up to 48-inch diameter. The main 48-inch diameter trunk sewer will extend up Temperance Avenue from the proposed SEDA scalping facility near the intersection of North Avenue and Temperance Avenue. The trunk sewer will extend from the scalping facility sequentially reducing in diameter to the 27-inch diameter sewer at the upstream City of Clovis connection near Leonard Avenue and Shields Avenue. Laterals from the main Temperance trunk are sized from 8-inch, 10-inch, 12-inch, and 15-inch diameter to serve new developments.

- **Project 11 – SEDA South Sewers (D-14 through D-18)**. Similar to project 10, this project involves development improvements stemming from the SEDA. It is recommended that a 24-inch diameter trunk sewer be constructed in North Avenue from Peach Avenue to Armstrong Avenue. This pipeline is sized to convey the PWWF and solids from the SEDA facility and to serve the new developments planned for this area. Arterial laterals from the North Avenue trunk main sized from 8-inch, 10-inch,

12-inch, and 15-inch diameter sewers will be connected to serve planned developments.

- **Project 12 – West Fresno Development Sewers (D-19 through D-27)**. There are a number of planned developments in west Fresno within the existing sphere of influence. This project provides new 8-inch to 15-inch diameter sewers to serve these new planned development areas.
- **Project 13 – North Central Fresno Wastewater Reclamation Facility (NCFWRF-1 and NCFWRF -2)**. The 2010 Fresno Recycled Water Master Plan has identified an alternative to provide recycled water to potential users in the central portion of the City. In this alternative, a satellite treatment facility would be constructed at the CSUF campus (as a demonstration reuse project) or on a parcel of land currently owned by the City at the intersection of Cedar Avenue and Dakota Avenue(Granite Park). The proposed treatment facility would treat 2-4 mgd average daily flow and alleviate a number of deficient pipelines downstream of the diversion. However, if the treatment facility is not constructed to intercept wastewater flows, further investigations is needed to investigate the capacity deficiencies in the Orange Avenue Trunk system.
- **Project 14 – Southeast Development Area Reclamation Facility (SEDA)**. Staff has planned for a satellite treatment facility in the southeast portion of the City near North Avenue and Temperance Avenue. This treatment plant would treat all the flow from the new development pipelines in Project 10 and treat between 12-15 mgd average daily flows. If the treatment facility is not constructed and development projects begin to be built, further analysis on the existing downstream pipelines in North Avenue is needed to determine if wastewater capacity is available.
- **Project 15 – Gallo Direct Storm Drain**. During the PWWF analysis, it was determined that a number of pipelines downstream of the Gallo winery facility are experiencing very high peak flows during storm events. After discussion with staff, it was confirmed that Gallo has a direct storm drain connection to the sewer system. It is recommended that this direct connection be removed to eliminate the PWWF surcharging currently present in the downstream pipelines. If the storm drain connection cannot be performed, further analysis shall be performed to determine the required additional capacity for downstream pipelines.

6.2.4 Project Prioritization

The majority of the improvements listed in Table 6.1 are driven by future development, which consist of new sewers that serve future growth or improvements to existing facilities that are needed to serve future growth. When fully implemented, the capital projects will allow the conveyance of PWWFs to the RWRF and satellite plants during build out conditions.

Prioritizing the required capital improvements for the City's sewer system is an important aspect of this study. The improvement projects were prioritized based on the following factors:

- Upgrading existing facilities to mitigate current capacity deficiencies and to serve future users
- Building the new trunks necessary to serve future users

Improvements to existing facilities will provide sufficient capacity to mitigate existing issues and to convey increased flows resulting from future growth. Future development will require the construction of sewers to serve new users. The projects were grouped into the following phases:

- Phase 1: Years 2014 through 2015
- Phase 2: Years 2016 through 2020
- Phase 3: Years 2021 through 2025
- Phase 4: Years 2026 through 2030

The projects were phased based on the best available information for how the City will develop moving forward. The actual implementation of the improvements serving future users ultimately depends on growth. The priorities presented in Table 6.1 are estimates, and changes in the City's planning assumptions or growth projections could increase or decrease the priority of each improvement.

REHABILITATION AND REPAIR PLAN

This Chapter describes the proposed rehabilitation and repair (R&R) plan for the City of Fresno (City) wastewater collection system. This chapter also includes the objectives of the plan, the data used to develop the plan, and the evaluation of the City's collection system assets.

7.1 BACKGROUND AND OBJECTIVES

The purpose of the R&R plan is to identify sewer infrastructure conditions that pose a current or future threat to regular sewer operations and restore the affected facilities to an acceptable state. Sewer system conditions change over time and require periodic examination to monitor deterioration and determine when rehabilitation efforts are warranted. When sewer condition assessment activities yield signs of significant deterioration, rehabilitation is recommended to prevent operational system failures. Rehabilitation may include removing and replacing the existing infrastructure, installing a new liner in deteriorated sewer mains, or individual point repairs. Sewer systems also experience blockages for various reasons and require routine maintenance for problem areas. The routine maintenance of sewer systems is crucial and includes cleaning, root removal, obstruction elimination, and other efforts as needed. This rehabilitation and repair plan provides tools for the orderly and timely implementation of rehabilitation projects that will extend the useful life and strengthen the condition of the City's current wastewater collection system.

7.2 COLLECTION SYSTEM ASSET DATA

7.2.1 Collection System GIS Data

The City has developed and actively maintains a Geographic Information System (GIS) database of their sewer system. This GIS database includes detailed information that was used in the development of this R&R plan. For gravity sewers, key facility attributes available in the GIS data include pipe size, pipe material, installation year, upstream and downstream manhole ID's, pipe slope, pipeline alignment, and past rehabilitation information.

7.2.2 CCTV Inspection Data

City owned and operated truck mounted closed circuit television (CCTV) units have been used to collect video and condition assessment data for approximately 43 percent (690.5 miles) of the City's gravity sewer system. The City uses the National Association of Sewer Service Companies (NASSCO) Pipeline Assessment Certification Program (PACP) evaluation protocols to rate the condition of each CCTV inspected sewer main. Figure 7.1 shows inspected and non-inspected sewers as of December 2012.

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDGE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNADALE
NORTH

GRANTLAND
BRYAN
HAYES
POLK
CORNELIA
BLYTHE
BRAWLEY
VALENTINE
MARKS
VAN NESS
WEST
FRUIT
PALM
MAROA
BLACKSTONE
FRESNO
FIRST
MILLBROOK
CEDAR
MAPLE
CHESTNUT
WILLOW
PEACH
MINNEWAWA
CLOVIS
SUNNYSIDE
FOWLER
ARMSTRONG
TEMPERANCE
LOGAN

RIVER

CALIFORNIA STATE UNIVERSITY, FRESNO

CLOVIS

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

99
41
180
90

FRESNO/CLOVIS REGIONAL WASTEWATER RECLAMATION FACILITY

LEGEND

- SEWER EVALUATED WITH CCTV
- SEWER NOT EVALUATED WITH CCTV
- CITY LIMITS

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church & Flynn
CONSULTING ENGINEERS

CONSULTANT
Blair, Church & Flynn Consulting Engineers
481 Clovis Avenue, Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

CITY OF FRESNO

WASTEWATER MASTER PLAN
EVALUATED VS UNEVALUATED SEWER SEGMENTS
FIGURE 7.1

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_Sewers Evaluated.dwg; 11X17 Plot by: mgraham Jul 11, 2014 - 4:51pm

Approximately 57 percent (916 miles) of the City's gravity sewers have not received an initial CCTV inspection. Table 7.1 summarizes the total length of sewer, by pipe diameter, that has been inspected to date by the City. As shown in Table 7.1, sewers that are 6-inch and 8-inch have the highest percent of completed CCTV inspection. Small sewers have relatively low wastewater flows, which is accommodating to the CCTV inspection process. For sewers larger than 30-inches there is little or no CCTV inspection completed, likely due to the challenges in bypassing the high wastewater flows typical for these large diameter sewer mains.

Table 7.1 CCTV Inspection Summary by Pipe Diameter
Wastewater Collection System Master Plan Update
City of Fresno

Pipe Diameter (in)	Inspected Length (miles)	Total Pipeline Length (miles)	Percent Inspected to Date (%)
3	-	0.0	0.0
4	-	0.9	0.0
6	209.9	409.1	51.3
8	371.6	742.4	50.1
10	43.1	110.2	39.1
12	26.8	79.6	33.7
14	0.9	7.9	11.9
15	17.1	43.3	39.5
16	0.9	3.2	27.4
18	7.9	40.0	19.7
20	0.8	2.9	28.8
21	1.4	16.5	8.4
22	0.6	1.3	48.0
24	1.7	21.2	8.1
27	3.4	11.2	30.2
30	2.7	14.5	18.5
33	0.1	6.0	1.8
36	0.1	11.1	0.6
39	0.6	8.2	7.4

Table 7.1 CCTV Inspection Summary by Pipe Diameter
Wastewater Collection System Master Plan Update
City of Fresno

Pipe Diameter (in)	Inspected Length (miles)	Total Pipeline Length (miles)	Percent Inspected to Date (%)
40	-	0.7	0.0
42	-	7.6	0.0
45	0.2	13.7	1.4
46	-	0.3	0.0
48	0.6	10.2	6.2
51	-	3.5	0.0
54	-	5.5	0.0
57	-	1.1	0.0
60	-	15.4	0.0
66	-	11.1	0.0
72	-	6.6	0.0
84	-	1.4	0.0
Total	**690.5**	**1,606.5**	**43.0**

Table 7.2 summarizes the total length of sewers, by material type, within the City that have been inspected. As shown in Table 7.2, cast iron, polyvinyl chloride (PVC), vitrified clay and asbestos cement sewers have the greatest percent of completed CCTV inspections. These pipe materials are generally used for small diameter sewers, which are easier to CCTV than the mid-sized and large diameter sewers.

The PACP standards enable an objective evaluation of the condition of gravity sewers based on a standard and consistent coding system. The Pipeline Assessment and Certification Program (PACP©) coding system allows the user to code structural defects, operational and maintenance (O&M) defects, and construction features/defects. Structural defects are assigned a structural grade that ranges from 1 (minor defect) to 5 (most significant defect). O&M and construction defects are also assigned a grade that ranges from 1 (minor defect) to 5 (most significant defect).

Table 7.2 CCTV Inspection Summary by Pipe Material Wastewater Collection System Master Plan Update City of Fresno			
Pipe Material	**Inspected Pipeline Length (miles)**	**Total Pipeline Length (miles)**	**Percent Inspected to Date (%)**
Asbestos Cement	2.6	6.3	41.6
Cast Iron	4.1	6.4	64.1
Concrete	19.1	64.4	29.7
Concrete Cylinder		1.1	0.0
Ductile Iron	1.3	4.7	28.2
Fiberglass		9.6	0.0
PVC	314.8	503.4	62.5
Reinforced Concrete	8.7	123.7	7.1
Truss	0.2	6.2	3.2
Vitrified Clay	334.1	880.8	37.9
Not Identified	5.5	0.0	N/A
Total	**690.5**	**1,606.5**	**43.0**

The PACP condition grading system uses more than one method to rate the condition of each pipe segment, including a rating that considers the total number of defects within a pipe segment (Overall Rating) and a rating that only considers the most severe defects within a pipe segment (Quick Rating). Appendix G provides a short guidance document that summarizes the PACP rating system.

7.2.3 Previous Reports

Previous evaluations of the City's system have been conducted and described in the following documents:

- *North Avenue Trunk Sewer Evaluation;* Final, Blair, Church, & Flynn, 1990.
- *Evaluation of Large Diameter Wastewater Collection System;* Final, Blair, Church, & Flynn, 1992-1996.
- *Inspection and Evaluation of Concrete Sewers 12-inches to 27-inches in Diameter;* Final, Blair, Church, & Flynn, July 2001.
- *Wastewater Collection System Master Plan*, Final; Brown and Caldwell, May 2006.
- *CCTV Inspection and Evaluation for Mid-Sized Concrete Sewers;* Final, Blair, Church, & Flynn, July 2010.

- *Large Diameter Sewer Evaluation Update;* Final, Blair, Church, & Flynn, January 2012.

These reports identified substantial rehabilitation work for mid-sized and large diameter concrete sewers. Most of the rehabilitation work identified in the previous reports has been completed or is in some stage of design or construction Recommended rehabilitation and repair projects that have not been completed are described in Section 7.3.2.3.

7.2.4 Lift Station Visual Inspection

The sewer system includes 15 submersible-type sewer lift stations, which are owned, operated, and maintained by the City. Figure 4.1 includes the location of each lift station and Table 4.4 identifies their pumping capacities. The lift stations are generally situated on relatively small sites and consist of either duplex or triplex submersible pumps housed in circular wet wells. A limited on-site review of each lift station site was conducted on October 10, 2013 by Blair, Church, & Flynn Consulting Engineers (BC&F) Staff to help identify lift station infrastructure in need of repair or rehabilitation. Wet well, valve vault, and discharge manhole inspections consisted of an above-grade visual observation aided by illumination tools. Available City staff was interviewed on site regarding lift station operation and maintenance.

7.3 COLLECTION SYSTEM ASSET EVALUATION

This section summarizes the criteria used to identify pipelines in need of R&R and the results of the asset evaluation.

7.3.1 Rehabilitation Project Selection Criteria

The priorities for project selection for the R&R Plan begin with sewer segments that are in the most severe state followed by successively less severe sewer mains.

7.3.1.1 High Priority Point Repair Criteria

There are locations within the City's sewer system where significant structural defects in sewer mains exist. The City has selected the PACP structural defect codes that should be considered for high priority repairs, and are shown in Table 7.3. Sewer mains that were coded with a high priority structural defect code are designated in this report for high priority repair projects.

Table 7.3 High Priority PACP Structural Defects Codes
Wastewater Collection System Master Plan Update
City of Fresno

Group	Descriptor	Modifier	Code	Structural Grade
Crack (C)	Hinge (CH3)	-	CH3	5
Crack (C)	Hinge (CH4)	-	CH3	5
Fracture (F)	Hinge (H3)	-	FH3	5
Fracture (F)	Hinge (H4)	-	FH3	5
Pipe Failures (Silent)	Broken (B)	-	B	3,4,5
Pipe Failures (Silent)	Broken (B)	Soil Visible (SV)	BSV	5
Pipe Failures (Silent)	Broken (B)	Void Visible (VV)	BVV	5
Pipe Failures (Silent)	Hole (H)	-	H	3,4,5
Pipe Failures (Silent)	Hole (H)	Soil Visible (SV)	HSV	5
Pipe Failures (Silent)	Hole (H)	Void Visible (VV)	HVV	5
Collapse (X)	Pipe (P)	-	XP	5
Deformed	(Pipe)	-	D	4,5
Surface Damage Chemical (S)	Reinforcement Visible (RV)	C	SRVC	5
Surface Damage Chemical (S)	Reinforcement Corroded (RC)	C	SRCC	5
Surface Damage Chemical (S)	Missing Wall (MW)	C	SMWC	5
Surface Damage Mechanical (M)	Reinforcement Visible (RV)	M	SRVM	5
Surface Damage Mechanical (M)	Reinforcement Corroded (RC)	M	SRCM	5
Surface Damage Mechanical (M)	Missing Wall (MW)	M	SMWM	5
Surface Damage Not Evident (Z)	Reinforcement Visible (RV)	Z	SRVZ	5
Surface Damage Not Evident (Z)	Reinforcement Corroded (RC)	Z	SRCZ	5
Surface Damage Not Evident (Z)	Missing Wall (MW)	Z	SMWZ	5

7.3.1.2 Modified Overall Structural Rating

The PACP coding system includes an overall structural rating (OSR) that represents a weighted total of all defects coded for each sewer segment. The number of occurrences of

each pipe code is multiplied by the pipe defect grade (1 though 5) to calculate the overall structural rating of the pipe segment.

Per City staff direction, the OSR was modified to eliminate contributions from defect Grades 1 and 2 (minor and minor-moderate defects), resulting in a Modified Overall Structural Rating (MOSR) that was used for the purpose of this Master Plan. Minor and minor to moderate grades were omitted from the overall scores to prevent artificially high scores being created by less significant defects.

The MOSR information in Table 7.4 was developed to provide tools for the categorization of each sewer segment by priority and sorting based on sewer conditions. Analysis of the current City of Fresno sewer system showed MOSR scores varying from 0 to 630. The MOSR range criterion was determined from review of CCTV data that was made available for each inspected sewer segment. General review of the CCTV videos provided insight about the actual sewer conditions of the MOSR sewers and an appropriate range was developed for each condition. The critical and severe conditions were chosen to be rehabilitated as part of the recommended projects within this master plan. Further rehabilitation projects may continue with sewer segments that received a poor rating after the severe and critical sewers are rehabilitated.

Table 7.4 MOSR Overview
Wastewater Collection System Master Plan Update
City of Fresno

Sewer Condition	Range
Severe	MOSR ≥ 200
Critical	100 ≤ MOSR < 200
Poor	50 ≤ MOSR < 100
Moderate	25 ≤ MOSR < 50
Average	0 ≤ MOSR < 25

7.3.1.3 Previously Recommended Rehabilitation Projects

Rehabilitation projects recommended in previous reports that have yet to be completed are included as rehabilitation projects in this Master Plan. Section 7.3.2.3 includes a detailed description of these projects.

7.3.2 Evaluation Results

A summary of the evaluation results is presented within this section.

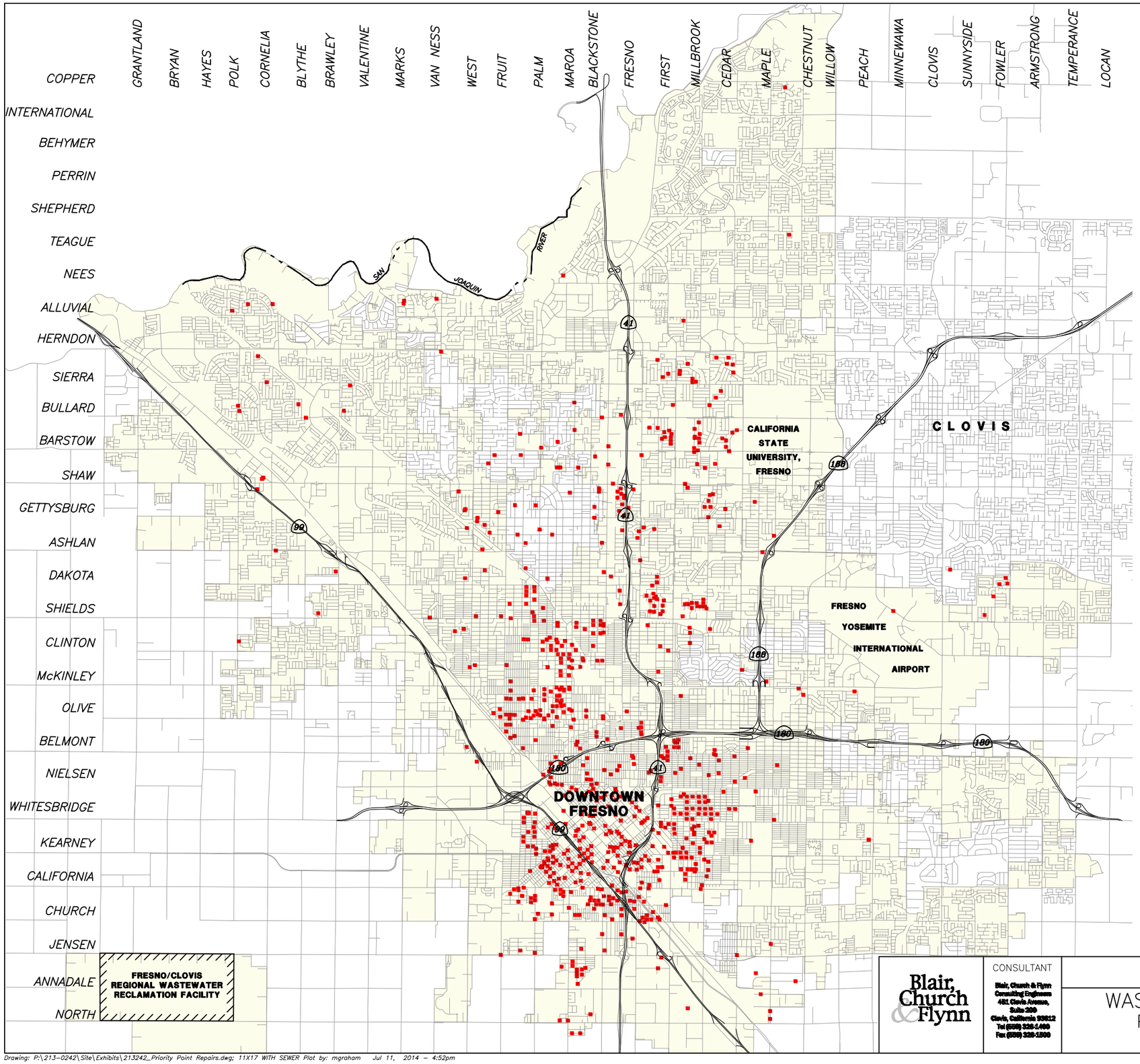
7.3.2.1 High Priority Point Repairs

Sewer main defects requiring high priority point repairs exist at 1,249 locations. Table 7.5 includes the priority codes together with the number of occurrence per code.

Table 7.5 Point Repairs
Wastewater Collection System Master Plan Update
City of Fresno

Priority Code	Code Description	Occurrences
B	Broken	616
BSV	Broken Soil Visible	136
BVV	Broken Void Visible	139
CH3	Hinge Crack	3
CH4	Hinge Crack	2
D	Deformed	33
FH3	Hinge Fracture	2
FH4	Hinge Fracture	1
H	Hole	195
HSV	Hole Soil Visible	31
HVV	Hole Void Visible	28
SMW	Missing Wall	4
SMWZ	Missing Wall, Surface Damage Not Evident	6
SRC	Reinforcement Corroded	35
SRCZ	Reinforcement Corroded, Surface Damage Not Evident	1
SRV	Reinforcement Visible	6
SRVC	Reinforcement Visible, Surface Damage Chemical	1
XP	Pipe Collapse	10
	Point Repair Total:	**1,249**

Figure 7.2 shows high priority repair locations. Appendix H provides a summary list of the significant sewer main defects described above and includes information on the type of pipe defect, pipe size, pipe material, upstream and downstream manhole identification numbers, street name and sewer plat area. An initial order of work for the point repairs is also included in Appendix H. The City should review available data and new data as it becomes available and adjust the order of work as necessary.



LEGEND

- PRIORITY POINT REPAIRS
- STREETS
- CITY LIMITS

Priority Point Repairs
Wastewater Master Plan Update
City of Fresno

Priority Code	Code Description	Occurrences
	ro e	616
S	ro e Soil i le	136
	ro e oi i le	13
C 3	i e Crac	3
C 4	i e Crac	2
	e or e	33
3	i e ract re	2
4	i e ract re	1
	ole	1 5
S	ole Soil i le	31
	ole oi i le	28
SM	Mi all	4
SM	Mi all S ace a a e ot vi e t	6
SRC	Rei orce e t Corro e	35
SRC	Rei orce e t Corro e S ace a a e ot vi e t	1
SR	Rei orce e t i le	6
SR C	Rei orce e t i le S ace a a e C e ical	1
P	Pi e Colla e	10
	Priority Point Repair Total:	**1249**

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church & Flynn

CONSULTANT
Blair, Church & Flynn
Consulting Engineers
451 Clovis Avenue,
Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

CITY OF FRESNO

WASTEWATER MASTER PLAN
PRIORITY POINT REPAIRS
FIGURE 7.2

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1 OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_Priority Point Repairs.dwg; 11X17 WITH SEWER Plot by: mgraham Jul 11, 2014 - 4:52pm

7.3.2.2 Modified Overall Structural Rating

Sewer mains with a MOSR greater than or equal to 100 meet the criteria developed for rehabilitation. Rehabilitation is expected to be a cured-in-place pipe (CIPP) liner as described in Section 7.4.1.2. A total of 86 pipe segments were identified as having a MOSR greater than 100.

Figure 7.3 shows pipe segments with a high MOSR that are recommended for rehabilitation. Appendix BCF-3 includes each sewer segment MOSR, pipe size, pipe material, upstream and downstream manhole identification numbers, street name and sewer plat area for proposed rehabilitation projects.

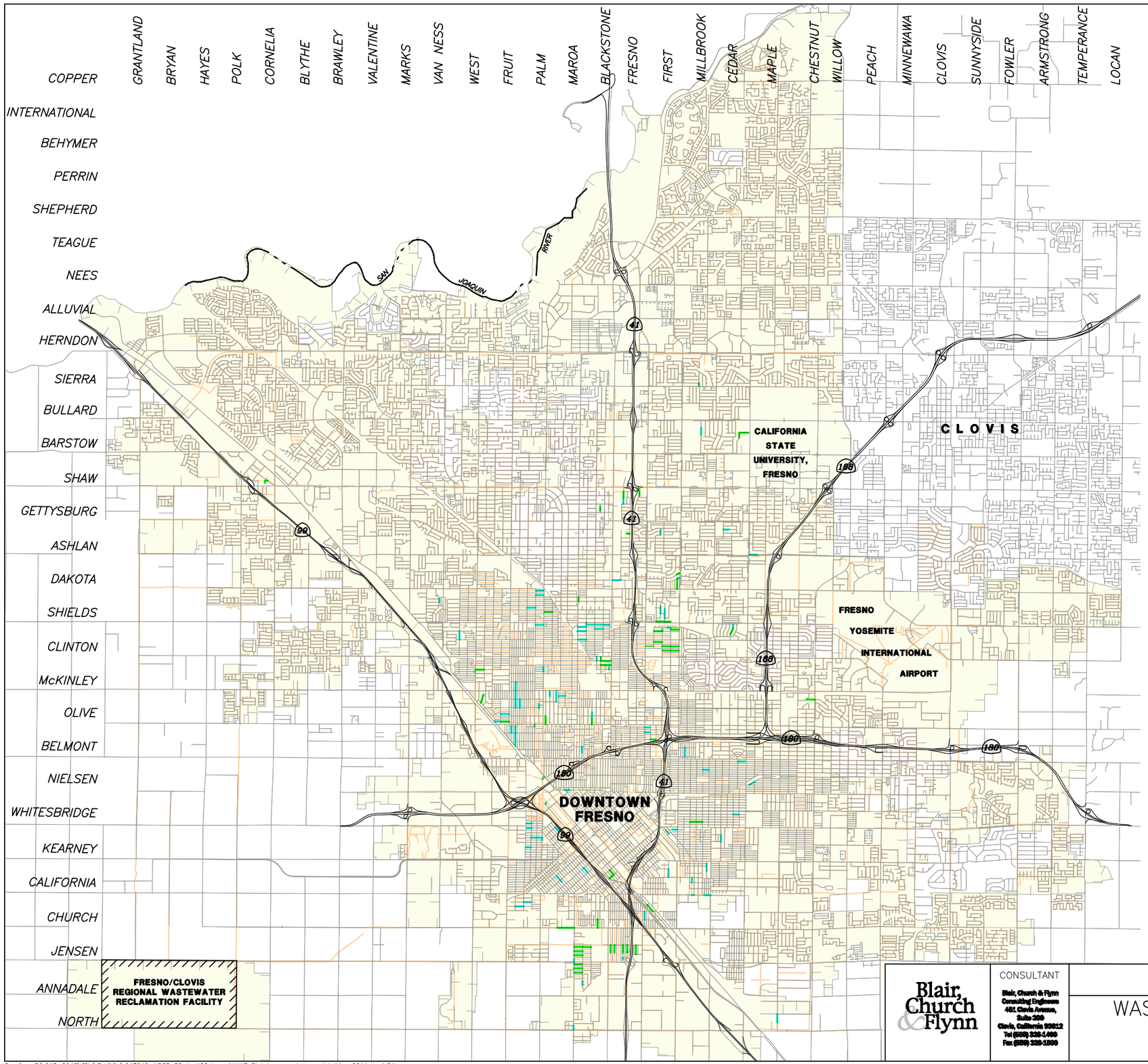
As shown in Table 7.6, only 0.7 percent of the sewers that have been inspected received a MOSR in the severe to critical range, and 2.5 percent of the system received a MOSR in the poor to moderate range. The vast majority (96.9 percent) received an average MOSR rating. It should be noted that as older portions of the city are inspected, the percent of the system with a MOSR greater than 25 will likely increase.

Table 7.6 MOSR Overview
Wastewater Collection System Master Plan Update
City of Fresno

Sewer Condition	Range	Condition Occurrence	Percent of Inspected System
Severe	MOSR ≥ 200	53	0.43
Critical	100 ≤ MOSR < 200	33	0.27
Poor	50 ≤ MOSR < 100	84	0.68
Moderate	25 ≤ MOSR < 50	219	1.77
Average	0 ≤ MOSR < 25	12,010	96.85

7.3.2.3 Previously Recommend Rehabilitation Projects

Five rehabilitation projects identified in the 2006 Wastewater Master Plan remain uncompleted. The rehabilitation projects are identified in the 2006 Wastewater Master Plan as Projects RL11, RS06B, RL02, RS03A and RS04A are summarized in Table 7.7. The project locations can be seen on Figure 7.4.



LEGEND

- SEVERE & CRITICAL MOSR SEWERS (MOSR ≥ 100)
- POOR MOSR SEWERS (50 ≤ MOSR < 100)
- OTHER EXISTING SEWERS
- STREETS
- CITY LIMITS

MOSR Overview
Wastewater Collection System Master Plan Update
City of Fresno

Sewer Condition	Range	Condition Occurrence	Percent of Inspected System
Severe	MOSR ≥ 200	53	0.43
Critical	100 ≤ MOSR < 200	33	0.27
Poor	50 ≤ MOSR < 100	84	0.68

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church & Flynn

CONSULTANT
Blair, Church & Flynn Consulting Engineers
401 Clovis Avenue, Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

CITY OF FRESNO

WASTEWATER MASTER PLAN
HIGH MOSR SEWERS
FIGURE 7.3

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR 50 to 100.dwg; 11X17 Plot by: mgraham Jul 11, 2014 - 4:54pm

GRANTLAND
BRYAN
HAYES
POLK
CORNELIA
BLYTHE
BRAWLEY
VALENTINE
MARKS
VAN NESS
WEST
FRUIT
PALM
MAROA
BLACKSTONE
FRESNO
FIRST
MILLBROOK
CEDAR
MAPLE
CHESTNUT
WILLOW
PEACH
MINNEWAWA
CLOVIS
SUNNYSIDE
FOWLER
ARMSTRONG
TEMPERANCE
LOCAN

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDGE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNADALE
NORTH

SAN JOAQUIN RIVER

CALIFORNIA STATE UNIVERSITY, FRESNO

C L O V I S

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

FRESNO/CLOVIS REGIONAL WASTEWATER RECLAMATION FACILITY

LEGEND

- REHABILITATION PROJECTS
- CAPACITY PROJECTS
- ACTION RECOMMENDED PER THE 2010 MID-SIZED CONCRETE SEWER REPORT
- STREETS
- CITY LIMITS

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church & Flynn

CONSULTANT
Blair, Church & Flynn
Consulting Engineers
481 Clovis Avenue,
Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

CITY OF FRESNO

WASTEWATER MASTER PLAN
PROJECTS FROM PREVIOUS REPORTS
FIGURE 7.4

DR. BY JRS
CH. BY LMG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_Improvement status.dwg; 11X17 Plot by: mgraham Jul 11, 2014 - 4:55pm

Table 7.7 Previously Recommend Rehabilitation Projects Wastewater Collection System Master Plan Update City of Fresno			
2006 Master Plan Project Designation	**Pipe Size (inches)**	**Rehabilitation Length (feet)**	**Type of Rehabilitation**
RS03A	24	3,118	CIPP Liner
RS04A	18-21	4,341	CIPP Liner
RS06B	15	300	CIPP Liner
RL02	48	2,644	CIPP Liner
RL11	48-54	3,992	CIPP Liner

7.3.2.4 Sewer Lift Station Survey Results

The City's lift stations were inspected to document existing conditions and make recommendations for rehabilitation. The findings from the inspection are summarized in Table 7.8 for all surveyed locations. Existing liners or coatings were observed to be in some level of distress at all but four of the lift stations inspected and will require liner/coating repair or removal and replacement. Complications with failing liners getting caught in the wet well pumps has been a maintenance issue and can potentially cause damage to the current infrastructure. Lack of liner/coating integrity can allow corrosion and deterioration of substrate materials. During the rehabilitation process, quick connect locations for bypass pumping will be available for some locations on the upstream and downstream side of the wet wells as seen in the available data.

7.4 RECOMMENDED REHABILITATION/REPAIR PLAN

This section summarizes the proposed R&R plan for the City, including a description of the highest priority projects in the "Primary Recommendations" section, and the lower priority projects in the "Secondary Recommendations" section.

All of the proposed projects included in the recommended R&R plan were developed for general master planning purposes based on the best available information provided by the City. For all proposed sewer system rehabilitation and repair projects, the City or its design consultant should conduct a careful review of available or new CCTV video inspection data to verify that there is a defect requiring mitigation and to establish a detailed scope of the remedial work prior to construction.

Table 7.8 Lift Station Condition Survey Results
Wastewater Collection System Master Plan Update
City of Fresno

Lift Station	Existing Liner	New Liner or Rehabilitate Existing Liner Required	Dedicated Upstream Bypass Quick Connection	Dedicated Downstream Bypass Quick Connection	Adequate Site Lighting	History of Odor Control Complaints	Approximate Wet Well Area (ft^2)
LS-01	Y	N	N	N	Y	N	428
LS-02	Y	N	N	N	Y	N	226
LS-03	Y	N	Y	N	N	N	214
LS-04	N	Y	Y	N	Y	N	754
LS-05	N	Y	N	N	Y	N	892
LS-06	Y	Y	Y	Y	Y	N	892
LS-10	N	Y	N	N	Y	N	339
LS-11	Y	Y	N	N	N	N	352
LS-12	Y	N	Y	N	Y	N	434
LS-13	Y	Y	N	N	N	N	310
LS-14	Y	Y	N	N	Y	N	434
LS-15	Y	Y	Y	N	N	N	343
LS-16	Y	Y	N	Y	Y	N	452
LS-18	Y	Y	N	Y	Y	N	561
LS-20	Y	Y	N	N	N	N	855

Notes:
Y = Yes; N = No

7.4.1 Primary Recommendations

7.4.1.1 High Priority Point Repairs

Sewer system defects requiring high priority point repairs, as described in Sections 7.3.1.1 and 7.3.2.1, pose a threat to the sewer system operations and should be the first projects undertaken by the City. The high priority repairs are generally expected to consist of excavation via conventional open cut methods to gain access to the area of defective pipe, removal and replacement of a small section of pipe, followed by trench backfill and resurfacing. For pipe segments that have several significant point defects in proximity to each other, it may be prudent to install a CIPP liner in lieu of removal and replacement of multiple sections of pipe.

High priority repairs described in Sections 7.3.2 and 7.3.3 should be repaired as outlined in Chapter 8.

7.4.1.2 Sewer Rehabilitation - High MOSR

Sewer mains with a MOSR greater than or equal to 100 should be rehabilitated in order of severity. It is anticipated that the pipe segment rehabilitation would be accomplished with a CIPP liner, but other options such as a slip liner or a high-density polyethylene (HDPE) solid wall pipe liner may be considered.

Sewer rehabilitation using a CIPP liner consists of installing a fabric tube that is impregnated with a thermosetting resin, either by hydrostatic inversion methods or by pulling it into the host pipe and expanding it under hydrostatic head, followed by thermal curing. For pipe diameters less than 12-inches, an air inversion process may be used in lieu of a hydrostatic inversion. The air inversion process is faster and more cost effective. No insertion pit excavation is required under most circumstances, and service connection reinstatement may be done by remote internal methods.

CIPP liner installation is usually a completely trenchless process, requiring no excavation. However, open cut excavation is sometimes required in localized areas for placement of temporary wastewater bypass pipelines, for manhole construction if the project includes it, or for repair of localized sewer defects.

Sewer mains with a high MOSR as described in Sections 7.3.1.2 and 7.3.2.2 should be rehabilitated as outlined in Chapter 8.

7.4.1.3 Previously Identified Rehabilitation Projects

Sewers previously identified as requiring rehabilitation as described in Section 7.3.2.3 should be rehabilitated.

7.4.2 Secondary Recommendations

7.4.2.1 Sewer Lift Station Rehabilitation

For all lift stations other than Lift Stations Nos. 1, 2, 3 and 12, lift station facilities should be rehabilitated by repair or removal and replacement of distressed liners and coatings. Where necessary, as indicated in Table 7.9, lift station rehabilitation should include lighting improvements to provide adequate lift station lighting. Lift Station No. 11 is in failing condition and requires replacement of the entire lift station.

Table 7.9 Proposed Lift Station Improvements Wastewater Collection System Master Plan City of Fresno

Lift Station	Existing Wet Well Coating	Failure of Existing Coating	Apply New Wet Well Coating	Install Site Lighting
LS-01	Y	N	N	Y
LS-02	Y	N	Y	Y
LS-03	Y	N	N	N
LS-04	N	N/A	Y	Y
LS-05	N	N/A	Y	Y
LS-06	Y	Y	Y	Y
LS-10	N	N/A	Y	Y
LS-11	Y	Y	N/A	N
LS-12	Y	N/A	N	Y
LS-13	Y	Y	Y	N
LS-14	Y	Y	Y	Y
LS-15	Y	Y	Y	N
LS-16	Y	Y	Y	Y
LS-18	Y	Y	Y	Y
LS-20	Y	N	N	N

Notes:
Y = Yes; N = No; N/A = Not Applicable

7.4.2.2 Unlined Sewer Pipe

Certain pipe materials once commonly used in sanitary sewer systems, such as asbestos cement pipe (ACP), reinforced concrete pipe (RCP), standard (non-reinforced) concrete pipe (SCP), and cast iron pipe (CIP), are susceptible to sulfide-related corrosion, often referred to as microbially-induced corrosion (MIC), if they are not otherwise protected against MIC. MIC can ultimately result in complete pipe wall penetration and sewer collapse, particularly in partly full pipes where wastewater chemistry is conducive to MIC

processes. The rate at which MIC occurs can be highly variable, ranging from none at all where the sewer environment is not conducive to MIC processes, to very rapid in an aggressive sewer environment.

Existing sewers where MIC has resulted in a MOSR greater than 100 are included under the corresponding recommendations of this report. Wherever other sewers exist that are susceptible to MIC, the sewer condition should be carefully evaluated during regular or special sewer inspection efforts to determine the extent to which MIC processes are affecting sewer conditions, and the extent to which sewer rehabilitation may be required to halt MIC processes and preserve sewer main integrity. In general, whenever MIC results in an MOSR greater than 100, the affected sewer should be rehabilitated or replaced.

7.4.2.3 Low MOSR

Low MOSR sewers shall be evaluated on a case by case basis by City personnel to determine the correct action necessary. Sewers that have a “poor” rating in Table 7.4 should be evaluated for rehabilitation following the completion of all primary recommendations.

7.4.3 Prioritization and Scheduling

The sewer system rehabilitation work should generally be prioritized such that the most critical defective areas can be addressed first. The scheduling recommendations were derived from the available PACP records provided by the City, on-site inspections and previous reports. Scheduling for the priority repairs and rehabilitation can be seen in Table 7.10 by the appropriate fiscal years. Projects are further divided into phases which are detailed in Chapter 8.

Table 7.10 Rehabilitation Project Prioritization
Wastewater Collection System Master Plan
City of Fresno

Priority	Project	Fiscal Year
1	High Priority Point Repairs	2015-2020
2	Rehabilitation of Sewer with High MOSR	2015-2020
3	Previously Recommend Rehab Projects	2015-2020
4	Sewer Lift Station Rehabilitation	2015-2020

7.4.4 Recommended Sewer Inspection Plan

7.4.4.1 Background

Approximately 57 percent (916.0 miles) of the City’s sewers have not been inspected via CCTV and evaluated using the PACP coding system. These areas are shown on Figure 7.1. To properly assess a sewer system, an initial baseline inspection is required. The baseline inspection together with subsequent inspections enables users to monitor the

changing conditions of each sewer segment. Areas of the sewer systems that have not been inspected should be a high priority and scheduled for video inspection.

The City currently owns three CCTV trucks which are dedicated to sewer system inspections. The current target productivity rate for all three trucks is 60,300 feet per month which is roughly 0.71 percent of the entire system. At this rate, it would take approximately 11 years to survey the entire system. This target requires that all three trucks be in working order and the appropriate staff be available to operate the equipment. The City also has secured funds to purchase an additional CCTV truck that will be dedicated to sewer system inspections. The purchase of this new CCTV truck is imminent. Once the additional truck is secured the City's productivity rate for four trucks would be 80,400 feet per month, which is roughly 0.95 percent of the entire system.

Prior to CCTV inspection, sewer pipelines should be cleaned of debris to provide a relatively clear path for the tractor mounted camera and potentially uncover any underlying defects. Two cleaning trucks specifically dedicated to aid sewer man inspections are dispatched with the CCTV trucks.

Sewer main inspections can be used to estimate the amount of time needed before pipeline rehabilitation or replacement is required. This can only be accomplished by observing and monitoring the changes between successive inspections. The majority of uninspected pipelines are near the end of their design life or currently exceeding that period. Some of these pipes are probably already in a deteriorated condition and may require immediate maintenance, rehabilitation, repair or replacement.

7.4.4.2 Sewer Inspection: Phase 1 Scheduling

Scheduling for the inspection of sewers is divided into two phases. Phase 1 includes scheduling of work to inspect all sewers that have not had an initial PACP coding system inspection. Once Phase 1 inspections are completed, sewer inspection work should be in accordance with the Phase 2 scheduling. Figure 7.5 includes the limits of uninspected sewers and distinguishes sewers that are susceptible to corrosion from sewers that are not susceptible to corrosion.

For Phase 1 inspections, sewers that are susceptible to corrosions should be inspected first. Sewers that are not susceptible to corrosion should be given second priority in the schedule. Table 7.11 summarizes the length of sewers that have not been inspected. Based on the City's expected productivity rate of 80,400 feet per month, the time to complete an initial inspection of sewers that are susceptible to corrosion and not susceptible to corrosion is 0.54 and 4.47 years, respectively.

GRANTLAND
BRYAN
HAYES
POLK
CORNELIA
BLYTHE
BRAWLEY
VALENTINE
MARKS
VAN NESS
WEST
FRUIT
PALM
MAROA
BLACKSTONE
FRESNO
FIRST
MILLBROOK
CEDAR
MAPLE
CHESTNUT
WILLOW
PEACH
MINNEWAWA
CLOVIS
SUNNYSIDE
FOWLER
ARMSTRONG
TEMPERANCE
LOGAN

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDGE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNANDALE
NORTH

CALIFORNIA STATE UNIVERSITY, FRESNO

CLOVIS

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

FRESNO/CLOVIS REGIONAL WASTEWATER RECLAMATION FACILITY

41
99
180
168
190

LEGEND

- UNINSPECTED SEWER PIPE SUSCEPTIBLE TO CORROSION
- UNINSPECTED SEWER PIPES NOT SUSCEPTIBLE TO CORROSION
- STREETS
- CITY LIMITS

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church Flynn
CONSULTING ENGINEERS

CONSULTANT
Blair, Church & Flynn Consulting Engineers
400 Clovis Avenue, Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

CITY OF FRESNO

WASTEWATER MASTER PLAN
UNINSPECTED CORROSION POTENTIAL
FIGURE 7.5

DR. BY JRS
CH. BY MDG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_UninspectedCorrosionSusceptible.DWG; 11x17 Plot by: mgraham Jul 11, 2014 - 4:56pm

Table 7.11 Phase 1 Sewer Inspection Schedule Wastewater Collection System Master Plan City of Fresno		
Sewer Description	**Length (miles)**	**Time to Complete[1] (Years)**
Susceptible to Corrosion, Not Inspected	98.9	0.54
Not Susceptible to Corrosion, Not Inspected	817.1	4.47
Total	**916.0**	**5.01**

Notes:
(1) Based on an inspection rate of 80,400 feet per month.

7.4.4.3 Sewer Inspection: Phase 2 Scheduling

The second phase includes scheduling to provide subsequent inspection of all sewers and should be in accordance with Table 7.12.

Sewer systems shall also be inspected based upon their MOSR as show in Table 7.12. Elevated MOSR sections shall be monitored to observe existing problems and changing conditions. If a CCTV inspection reveals a section of pipe that has an MOSR greater than 100, the section of pipe should be rehabilitated. Figure 7.6 represents the recommended sewer inspection phasing.

Table 7.12 Inspection Frequency Wastewater Collection System Master Plan City of Fresno	
Sewer Description	**Maximum Inspection Frequency Interval (Years)**
Pipe Materials Susceptible to Corrosion	5
Sewers with a MOSR between 50 and 100	5
Pipe Materials Not Susceptible to Corrosion	10

GRANTLAND
BRYAN
HAYES
POLK
CORNELIA
BLYTHE
BRAWLEY
VALENTINE
MARKS
VAN NESS
WEST
FRUIT
PALM
MAROA
BLACKSTONE
FRESNO
FIRST
MILLBROOK
CEDAR
MAPLE
CHESTNUT
WILLOW
PEACH
MINNEWAWA
CLOVIS
SUNNYSIDE
FOWLER
ARMSTRONG
TEMPERANCE
LOCAN

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNADALE
NORTH

CALIFORNIA STATE UNIVERSITY, FRESNO

C L O V I S

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

WASTEWATER TREATMENT PLANT

41 99 168 180

LEGEND

- PIPES SUSCEPTIBLE TO CORROSION
- PIPES NOT SUSCEPTIBLE TO CORROSION
- POOR MOSR SEWERS (50 ≤ MOSR < 100)
- STREETS
- CITY LIMITS

SCALE: N 1"=8000'

0 4000 8000 16000
SCALE IN FEET

Blair, Church & Flynn

CONSULTANT
Blair, Church & Flynn
Consulting Engineers
481 Clovis Avenue, Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

CITY OF FRESNO

WASTEWATER MASTER PLAN
INSPECTION FREQUENCY
FIGURE 7.6

DR. BY JRS
CH. BY MDG
DATE 7-3-14
SCALE: AS NOTED

SHEET NO. 1
OF 1 SHEETS

Drawing: P:\213-0242\Site\Exhibits\213242_PipeCorrosion.dwg; 11x17 Plot by: mgraham Jul 22, 2014 - 10:07am

CAPITAL IMPROVEMENT PLAN

This chapter describes the development of the Capital Improvement Plan (CIP). This CIP is a comprehensive plan that incorporates recommended improvements identified in Chapters 6 and 7 of this report.

8.1 CAPITAL IMPROVEMENT PROJECT COSTS

The capital improvement project costs are based on City of Fresno (City) bid results for wastewater projects, previous cost studies, interviews with local contractors and our project experience with similar wastewater infrastructure projects throughout the Central Valley. The costs have been adjusted to the Engineering News Record Construction Cost Index 20 City Average of 9,800 for June 2014.

8.2 COST ESTIMATING ACCURACY

Cost estimates have been developed to help the City prepare budgeting and scheduling for these projects. The cost estimates included in this master plan are Class 5 estimates as defined by the Association for the Advancement of Cost Engineering (AACE) International publication entitled *Recommend Practice No. 56R-08*. Class 5 estimates are generally prepared on limited design information and subsequently have wide accuracy ranges. A typical Class 5 estimate for a civil engineering project may have an accuracy range as broad as -30 percent to +50 percent, or as narrow as -20 percent to +30 percent. Class 5 estimates are typically used for evaluation of resource needs, budgeting and capital planning.

8.3 CONSTRUCTION UNIT COSTS

The construction unit costs for sewer infrastructure projects are based on a normal bidding environment and normal construction schedules. Costs for new projects and rehabilitation projects are included.

8.3.1 Rehabilitation Unit Costs

One goal in developing unit costs for pipe rehabilitation was to develop “loaded” unit costs which, when applied to the key elements of the capital improvement projects, would result in an estimated project cost inclusive of all necessary associated incidental and ancillary work. Recent City bid tabulations for sewer rehabilitation projects were primarily used to develop rehabilitation unit costs.

8.3.1.1 Point Repairs

Point repairs costs include temporary wastewater handling, traffic control, excavation, removal and replacement of up to 15 feet of sewer pipe, backfill, video inspection of repaired line, and surface restoration. Nearly all defects requiring point repairs occur on sewer mains ranging in size from 6 to 15 inches. Between August 2013 and March 2014, the City completed 4 point repair projects for pipe sizes ranging from 4-to 12-inches. The cost for the point repair projects ranged from $15,250 to $16,650 with an average cost of approximately $16,000. Based on these results it appears that the pipe size has little effect on the cost of point repairs for small to medium sized sewer mains. As a result, a cost of $16,000 per point repair is used for point repairs on pipe sizes ranging from 6 to 15 inches.

8.3.1.2 Sewer Main Rehabilitation

For sewer mains with moderate defects throughout, rehabilitation of the entire sewer main is necessary. Sewer main rehabilitation is commonly accomplished via the installation of an internal liner. Sewer main rehabilitation costs are based on cured-in-place pipe (CIPP) liner methods, which is the most common type of liner used for City projects. Bid summaries for 17 recent City CIPP sewer rehabilitation projects, for sewers ranging in size from 6- to 45-inches in diameter, were used to help develop unit costs. See Table 8.1 for estimated sewer main rehabilitation unit costs.

Table 8.1 Cured-in-Place Pipe Rehabilitation Unit Costs
Wastewater Collection System Master Plan Update
City of Fresno

Item No.	Item Description	Cost Per Foot ($)
1	6" CIPP Sewer Rehabilitation	100
2	8" CIPP Sewer Rehabilitation	113
3	10" CIPP Sewer Rehabilitation	126
5	12" CIPP Sewer Rehabilitation	140
6	15" CIPP Sewer Rehabilitation	160
7	18" CIPP Sewer Rehabilitation	180
8	21" CIPP Sewer Rehabilitation	200
9	24" CIPP Sewer Rehabilitation	220
10	27" CIPP Sewer Rehabilitation	240
11	30" CIPP Sewer Rehabilitation	260
12	36" CIPP Sewer Rehabilitation	300
13	42" CIPP Sewer Rehabilitation	400
14	45" CIPP Sewer Rehabilitation	470

8.3.1.3 Lift Station Rehabilitation

Lift Station rehabilitation includes removal and replacement of failed existing wet well coatings or application of wet well coatings to uncoated wet wells. Recent construction cost data for wet well rehabilitation is not available but interviews with two coating contractors were conducted to help determine construction costs. Wet well rehabilitation costs include bypass pumping, interior wet well surface preparation, coating application, and non destructive testing. Estimated wet well rehabilitation unit costs are summarized in Table 8.2.

Table 8.2 Lift Station Rehabilitation Unit Costs
Wastewater Collection System Master Plan Update
City of Fresno

Item No.	Item Description	Cost per square foot ($)
1	Removal of Existing Liner	25
2	Install New Liner	40
3	Bypass Pumping	Site Specific

8.3.2 New or Replacement Unit Costs

Unit costs for new or replacement infrastructure are “loaded” unit costs which, when applied to the key elements of the capital improvement projects, would result in an estimated project cost inclusive of all necessary associated incidental and ancillary work. Recent City bid tabulations for new sewer construction projects were primarily used to develop unit costs.

8.3.2.1 New or Replacement Sewer Mains

New or replacement sewer mains range in size from 8- to 60-inches. Bid summaries for 7 recent City new or replacement sewer main projects for sewers ranging in size from 8- to 72-inches in diameter were used to help develop unit costs. See Table 8.3 for estimated sewer main installation unit costs.

Table 8.3 Pipe Construction Unit Costs
Wastewater Collection System Master Plan Update
City of Fresno

Item No.	Item Description	Cost per Foot ($)
1	6" PVC Sewer Pipe	185
2	8" PVC Sewer Pipe	195
3	10" PVC Sewer Pipe	210
5	12" PVC Sewer Pipe	225

Table 8.3 Pipe Construction Unit Costs Wastewater Collection System Master Plan Update City of Fresno		
Item No.	**Item Description**	**Cost per Foot ($)**
6	15" PVC Sewer Pipe	245
7	18" PVC Sewer Pipe	265
8	21" PVC Sewer Pipe	285
9	24" PVC Sewer Pipe	305
10	27" PVC Sewer Pipe	335
11	30" PVC Sewer Pipe	370
12	36" PVC Sewer Pipe	440
13	42" PVC Lined RCP Sewer Pipe	485
14	48" PVC Lined RCP Sewer Pipe	530
15	54" PVC Lined RCP Sewer Pipe	570
16	60" PVC Lined RCP Sewer Pipe	615
17	66" PVC Lined RCP Sewer Pipe	655

8.3.2.2 Lift Station Replacement

As described in Chapter 7, Lift Station No. 11 is slated for a complete removal and replacement. A unit cost of $110,000 was used for the lift station based on a recently constructed lift station of comparable size and complexity.

8.4 PROJECT COSTS AND CONTINGENCIES

8.4.1 Baseline Construction Costs

Baseline construction costs were developed for all rehabilitation and replacement/new projects. The baseline construction costs for each type of project were developed according to the methods described below.

Rehabilitation Projects:

1. Point Repairs: Determined by multiplying the unit cost by the number of point repairs.
2. Sewer Main Rehabilitation: Determined by multiplying the pipeline length by the CIPP liner unit costs.
3. Pump Station Wet Well Coating (Remove and Replace): Determined by multiplying the wet well interior area by the unit cost for coating removal and replacement together with the unit costs for bypass pumping.

4. Pump Station Wet Well Coating (Bare Concrete): Determined by multiplying the wet well interior area by the unit cost for wet well coating together with the unit costs for bypass pumping.

New or Replacement Projects:

1. New or Replacement Pipeline: Determined by multiplying the pipeline length by the unit costs for new or replacement pipe.
2. Replacement Lift Station: Determined by using the unit cost described in Section 8.3.2.2.

8.4.2 Construction Costs Contingency

Development of the recommended wastewater construction projects is limited to a master planning level of detail. As such, a 25 percent contingency has been added to all construction project costs to help account for unknown conditions, fluctuations in material prices, changes in the bidding climate and unexpected changes to the scope of the projects.

8.5 CAPITAL IMPROVEMENT COSTS

8.5.1 Capital Improvement Cost Summary

The Capital Improvement Cost is the total estimated cost for each project and includes the baseline construction costs (BCC), contingency, engineering, and management costs. The composition of the baseline construction cost is detailed in Section 8.4.1 of this report. Contingencies are calculated as 25 percent of the baseline construction cost to help account for unknown or changed conditions. The engineering portion of the estimate is 10 percent of the BCC and includes all services normally required to produce construction documents and provide engineering support during bidding and construction phases. This includes the production of plans, specifications, and construction support for each project. Management is the final portion of the Capital Improvement Cost and is calculated at 10 percent of the BCC. Management costs encompass all administrative expenditures, legal fees, financing, and environmental documents required for construction. The summation of all these components covers the total cost for each project.

8.5.2 Capital Improvement Implementation

The CIP Scheduling assigns a fiscal year for each project as a target date for construction. The CIP scheduling was developed with consideration given to the following:

- Project Prioritization
- Anticipated City Growth Rates and Patterns
- Cost Distribution and Budgeting

- City Direction

Short term projects are phased by year through the year 2020 and long-term projects are phased in five year increments beginning in 2020 through 2035.

Rehabilitation projects and capacity projects are given the highest priority needs are and are all scheduled as short term projects to be completed between 2015 and 2020. Each project is itemized by phase in Table 8.5. Appendix J includes a large format figure showing all CIP projects. Appendix F includes detailed project summary sheets for CIP projects scheduled to be completed between 2015 and 2020.

8.6 EXISTING VERSUS FUTURE USER COST SHARE

The CIP includes projects that will benefit existing users and future users. An initial estimate of the project benefit for existing and future users is included in Table 8.4.

Table 8.4 Summary of Capital Improvement Costs
Wastewater Collection System Master Plan Update
City of Fresno

	Implementation Phase				
Reimbursement Category	**2015-20 ($, mill.)**	**2021-25 ($, mill.)**	**2026-30 ($, mill.)**	**2031-35 ($, mill.)**	**Total ($, mill.)**
Existing User	46.3	55.6	6.1	0	108.0
Future User	0.1	0.2	1.1	202.9	204.3
Total	**46.4**	**55.8**	**7.2**	**202.9**	**312.3**

Notes:
(1) Costs are based on ENR CCI 20-City Average of 9,800 (June 2014).

Table 8.5 Capital Improvement Projects
Wastewater Collection System Master Plan
City of Fresno

Job No.	Project Type	Description / Limits		Existing Diameter (in)	New Diameter (in)	Rehab, Replace, or New	Length (ft)	Improvement Cost ($)	Capital Improvement Phasing				Future User Benefit (%)	Reimbursement Category	
									Phase 1 2015-2020 ($)	Phase 2 2021-2025 ($)	Phase 3 2026-2030 ($)	Phase 4 2031-2035 ($)		Existing Improvements	Future Improvements
Existing Improvements															
C-1A	Gravity	Hammond Avenue	Between Blackstone Ave. and Abby St.	20	**24**	Replace	390	$ 412,000	$ 412,000				7%	$ 383,160	$ 28,840
C-1B	Gravity	Abby Street	From Hammond Ave. to La Salle Ave.	20	**24**	Replace	1,322	$ 868,000	$ 868,000				7%	$ 807,240	$ 60,760
C-2A	Gravity	Glenn Avenue	From Bremer Ave. to Thomas Ave.	24	**27**	Replace	391	$ 430,000	$ 430,000				7%	$ 399,900	$ 30,100
C-2B	Gravity	Glenn Avenue	From HWY 180 to Voorman Ave.	24	**27**	Replace	2,580	$ 1,580,000		$ 1,580,000			14%	$ 1,358,800	$ 221,200
C-3	Gravity	Glenn Avenue / N Street	From Voorman Ave. to Tuolumne St.	27	**30**	Replace	1,530	$ 1,148,000			$ 1,148,000		19%	$ 929,880	$ 218,120
C-4	Gravity	Monterey Street	From Fulton Street to N Street	6	**10**	Replace	1,812	$ 683,000			$ 683,000		0%	$ 683,000	$ -
C-5A	Gravity	Eighth Street	From Ventura St. to Woodward Ave.	36	**42**	Replace	4,717	$ 3,825,000			$ 3,825,000		17%	$ 3,174,750	$ 650,250
C-5B	Gravity	Woodward Avenue	From Eighth St. to Orange Ave.	36	**42**	Replace	629	$ 733,000			$ 733,000		17%	$ 608,390	$ 124,610
C-5C	Gravity	Orange Avenue	From Woodward Ave. to California Ave.	36	**42**	Replace	693	$ 778,000			$ 778,000		17%	$ 645,740	$ 132,260
C-6	Gravity	Safford Avenue	From Producers Dairy to H Street	6	**8**	Replace	930	$ 329,000		$ 329,000			0%	$ 329,000	$ -
							Existing Improvement Totals	**$ 10,786,000**	**$ 1,710,000**	**$ 1,909,000**	**$ 7,167,000**	**$ -**		**$ 9,319,860**	**$ 1,466,140**
Build-Out Improvements															
C-7	Gravity	Tuolumne Street/ Van Ness Avenue	From N Street to Merced St.	27	**30**	Replace	1,679	$ 1,228,000				$ 1,228,000	100%	$ -	$ 1,228,000
C-8	Gravity	North Avenue	From Polk Ave. Alignment to Fruit Ave.	-	**60**	New	20,857	$ 19,615,000				$ 19,615,000	100%	$ -	$ 19,615,000
C-9	Gravity	North Avenue	From Fruit Ave. to Orange Ave.	60	**60**	Rehab	15,514	$ 15,376,000				$ 15,376,000	100%	$ -	$ 15,376,000
D-1	Gravity	Temperance Avenue	From North Ave. to Jensen Ave.	-	**48**	New	5,875	$ 4,805,000				$ 4,805,000	100%	$ -	$ 4,805,000
D-2	Gravity	Temperance Avenue	From Jensen Ave. to Tulare St.	-	**42**	New	13,352	$ 10,224,000				$ 10,224,000	100%	$ -	$ 10,224,000
D-3	Gravity	Temperance Avenue	From Tulare St. to Olive Ave.	-	**36**	New	4,987	$ 3,508,000				$ 3,508,000	100%	$ -	$ 3,508,000
D-4	Gravity	Temperance/McKinley/DeWolf	From Olive Ave. to Shields Ave.	-	**30**	New	13,300	$ 7,970,000				$ 7,970,000	100%	$ -	$ 7,970,000
D-5	Gravity	Shields Ave./Leonard Ave.	From DeWolf Ave. to Dakota Ave.	-	**27**	New	4,575	$ 2,397,000				$ 2,397,000	100%	$ -	$ 2,397,000
D-6A	Gravity	Jensen Avenue	From Temperance Ave. to DeWolf Ave.	-	**15**	New	5,228	$ 2,053,000				$ 2,053,000	100%	$ -	$ 2,053,000
D-6B	Gravity	Jensen Avenue	From DeWolf Ave. to Leonard Ave.	-	**12**	New	2,732	$ 964,000				$ 964,000	100%	$ -	$ 964,000
D-7A	Gravity	Church Avenue	From Temperance Ave. to Locan Ave.	-	**15**	New	2,552	$ 1,016,000				$ 1,016,000	100%	$ -	$ 1,016,000
D-7B	Gravity	Church Avenue	From Locan Ave. to DeWolf Ave.	-	**12**	New	2,729	$ 963,000				$ 963,000	100%	$ -	$ 963,000
D-7C	Gravity	Church Avenue	From DeWolf Ave. to Leonard Ave.	-	**8**	New	2,673	$ 829,000				$ 829,000	100%	$ -	$ 829,000
D-8A	Gravity	California Avenue	From Temperance Ave to Locan Ave.	-	**18**	New	2,676	$ 1,137,000				$ 1,137,000	100%	$ -	$ 1,137,000
D-8B	Gravity	California Avenue	From Locan Ave. to DeWolf Ave.	-	**15**	New	2,670	$ 1,058,000				$ 1,058,000	100%	$ -	$ 1,058,000
D-8C	Gravity	California Avenue	From DeWolf Ave. to Leonard Ave.	-	**10**	New	2,617	$ 870,000				$ 870,000	100%	$ -	$ 870,000
D-9A	Gravity	Butler Avenue	From Temperance Ave to Locan Ave.	-	**18**	New	2,617	$ 1,115,000				$ 1,115,000	100%	$ -	$ 1,115,000
D-9B	Gravity	Butler Avenue	From Locan Ave. to DeWolf Ave.	-	**15**	New	2,611	$ 1,037,000				$ 1,037,000	100%	$ -	$ 1,037,000
D-9C	Gravity	Butler Avenue	From DeWolf Ave. to Leonard Ave.	-	**8**	New	2,789	$ 862,000				$ 862,000	100%	$ -	$ 862,000
D-10A	Gravity	Tulare Street	From Temperance Ave. to Locan Ave.	-	**21**	New	2,730	$ 1,237,000				$ 1,237,000	100%	$ -	$ 1,237,000
D-10B	Gravity	Tulare Street/DeWolf Avenue	From Locan Ave. to Laurel Ave. Alignment	-	**15**	New	4,035	$ 1,586,000				$ 1,586,000	100%	$ -	$ 1,586,000
D-10C	Gravity	Laurel Avenue Alignment	From DeWolf Ave. to Leonard Ave.	-	**8**	New	2,729	$ 845,000				$ 845,000	100%	$ -	$ 845,000
D-10D	Gravity	Locan Ave/ Belmont Ave.	From Tulare St. to DeWolf Ave.	-	**12**	New	4,926	$ 1,738,000				$ 1,738,000	100%	$ -	$ 1,738,000
D-10E	Gravity	Belmont Avenue	From DeWolf Ave. to Leonard Ave.	-	**10**	New	2,554	$ 851,000				$ 851,000	100%	$ -	$ 851,000
D-11A	Gravity	Olive Avenue	From Temperance Ave. to Locan Ave.	-	**15**	New	2,671	$ 1,058,000				$ 1,058,000	100%	$ -	$ 1,058,000
D-11B	Gravity	Olive Avenue	From Locan Ave. to DeWolf Ave.	-	**12**	New	2,613	$ 926,000				$ 926,000	100%	$ -	$ 926,000
D-11C	Gravity	Olive Avenue	From DeWolf Ave. to Leonard Ave.	-	**8**	New	2,617	$ 813,000				$ 813,000	100%	$ -	$ 813,000
D-12A	Gravity	McKinley Avenue	From DeWolf Ave. to Leonard Ave.	-	**21**	New	2,729	$ 1,237,000				$ 1,237,000	100%	$ -	$ 1,237,000
D-12B	Gravity	McKinley Avenue	From Leonard Ave. to Thompson Ave.	-	**18**	New	5,103	$ 2,157,000				$ 2,157,000	100%	$ -	$ 2,157,000
D-12C	Gravity	Thompson Avenue	From McKinley Ave. to Clinton Ave.	-	**15**	New	2,730	$ 1,079,000				$ 1,079,000	100%	$ -	$ 1,079,000
D-13	Gravity	Clinton Avenue	From DeWolf Ave. to Leonard Ave.	-	**10**	New	2,492	$ 832,000				$ 832,000	100%	$ -	$ 832,000
D-14	Gravity	North Avenue	From Peach Ave. to Temperance Ave.	-	**36**	New	15,787	$ 11,051,000				$ 11,051,000	100%	$ -	$ 11,051,000

Table 8.5 Capital Improvement Projects
Wastewater Collection System Master Plan
City of Fresno

Job No.	Project Type	Description / Limits		Existing Diameter (in)	New Diameter (in)	Rehab, Replace, or New	Length (ft)	Improvement Cost ($)	Capital Improvement Phasing: Phase 1 2015-2020 ($)	Phase 2 2021-2025 ($)	Phase 3 2026-2030 ($)	Phase 4 2031-2035 ($)	Future User Benefit (%)	Reimbursement Category: Existing Improvements	Reimbursement Category: Future Improvements
D-15	Gravity	Minnewawa Avenue	From North Ave. to Annadale Ave.	-	**12**	New	2,730	$ 964,000				$ 964,000	100%	$ -	$ 964,000
D-16	Gravity	Sunnyside Avenue	From North Ave. to Annadale Ave.	-	**15**	New	2,611	$ 1,037,000				$ 1,037,000	100%	$ -	$ 1,037,000
D-17	Gravity	Fowler Avenue	From North Ave. to Annadale Ave.	-	**10**	New	2,789	$ 922,000				$ 922,000	100%	$ -	$ 922,000
D-18	Gravity	Armstrong Avenue	From North Ave. to Annadale Ave.	-	**8**	New	2,671	$ 828,000				$ 828,000	100%	$ -	$ 828,000
D-19A	Gravity	Valentine Avenue	From Church Ave. to Kearney Frontage	-	**12**	New	3,945	$ 1,389,000				$ 1,389,000	100%	$ -	$ 1,389,000
D-19B	Gravity	Valentine Avenue	From Kearney Frontage to Madison Ave.	-	**10**	New	1,312	$ 444,000				$ 444,000	100%	$ -	$ 444,000
D-20	Gravity	Brawley Avenue	From Church Ave. to Madison Ave.	-	**8**	New	5,303	$ 1,630,000				$ 1,630,000	100%	$ -	$ 1,630,000
D-21A	Gravity	Whitesbridge Avenue	From Polk Ave. to Blythe Ave.	-	**12**	New	5,271	$ 1,851,000				$ 1,851,000	100%	$ -	$ 1,851,000
D-21B	Gravity	Whitesbridge/Brawley Avenue	From Blythe Ave. to Nielsen Ave.	-	**10**	New	5,392	$ 1,773,000				$ 1,773,000	100%	$ -	$ 1,773,000
D-22A	Gravity	Belmont Avenue	From Polk Ave. to Cornelia Ave.	-	**12**	New	2,716	$ 959,000				$ 959,000	100%	$ -	$ 959,000
D-22B	Gravity	Belmont Avenue	From Cornelia Ave. to Blythe Ave.	-	**10**	New	2,675	$ 887,000				$ 887,000	100%	$ -	$ 887,000
D-22C	Gravity	Belmont Avenue	From Blythe Ave. to Brawley Ave.	-	**8**	New	2,640	$ 819,000				$ 819,000	100%	$ -	$ 819,000
D-23A	Gravity	Olive Avenue	From Polk Ave. to Blythe Ave.	-	**12**	New	5,260	$ 1,847,000				$ 1,847,000	100%	$ -	$ 1,847,000
D-23B	Gravity	Olive Avenue	From Blythe Ave. to Brawley Ave.	-	**8**	New	2,675	$ 829,000				$ 829,000	100%	$ -	$ 829,000
D-24A	Gravity	Olive Avenue	From Grantland Ave. to Bryan Ave.	-	**12**	New	2,649	$ 937,000				$ 937,000	100%	$ -	$ 937,000
D-24B	Gravity	Olive Avenue	From Bryan Ave. to Hayes Ave.	-	**10**	New	1973	$ 659,000				$ 659,000	100%	$ -	$ 659,000
D-25	Gravity	McKinley Avenue	From Grantland Ave. to Ring Ave.	-	**10**	New	3,603	$ 1,199,000				$ 1,199,000	100%	$ -	$ 1,199,000
D-26A	Gravity	Clinton Avenue	From Grantland Ave. to Bryan Ave.	-	**12**	New	2,645	$ 936,000				$ 936,000	100%	$ -	$ 936,000
D-26B	Gravity	Clinton Avenue	From Bryan Ave. to Hayes Ave.	-	**10**	New	2,592	$ 862,000				$ 862,000	100%	$ -	$ 862,000
D-27A	Gravity	Shields Avenue	From Grantland Ave. to Bryan Ave.	-	**15**	New	2,627	$ 1,042,000				$ 1,042,000	100%	$ -	$ 1,042,000
D-27B	Gravity	Shields Avenue	From Bryan Ave. to Hayes Ave.	-	**12**	New	2,592	$ 919,000				$ 919,000	100%	$ -	$ 919,000
							Build-Out Improvement Totals	**$ 125,170,000**	**$ -**	**$ -**	**$ -**	**$ 125,170,000**		**$ -**	**$ 125,170,000**
New Facilities															
NCFWRF-1	Treatment	Cedar/Dakota, Scalping Plant at Vacant Field Behind Granite Park		-	**6 mgd**	New	-	$ 51,106,000		$ 51,106,000			0%	$ 51,106,000	$ -
NCFWRF-2	Gravity	Dakota, From Treatment Facility to Millbrook Ave.		-	**36**	New	4,042	$ 2,833,000		$ 2,833,000			0%	$ 2,833,000	$ -
SEGA	Treatment	Temperance, Scalping Plant On Corner of Temperance and North Ave.		-	**15 mgd**	New	-	$ 77,760,000				$ 77,760,000	100%	$ -	$ 77,760,000
							New Facilities Totals	**$ 131,699,000**	**$ -**	**$ 53,939,000**	**$ -**	**$ 77,760,000**		**$ 53,939,000**	**$ 77,760,000**
Lift Stations															
LS-1	Lift Station	West of Jensen and Walnut Avenues		-	-	-	-	$ 15,000	$ 15,000					$ 15,000	$ -
LS-2	Lift Station	Kearney Boulevard and Marks Avenue		-	-	-	-	$ 39,000	$ 39,000					$ 39,000	$ -
LS-3	Lift Station	North of Shield and Wilson Avenues		-	-	-	-	$ 15,000	$ 15,000					$ 15,000	$ -
LS-4	Lift Station	Riverview Drive and Bluff Avenue		-	-	-	-	$ 200,000	$ 200,000					$ 200,000	$ -
LS-5	Lift Station	Fort Washington Road and Champlain Drive		-	-	-	-	$ 96,000	$ 96,000					$ 96,000	$ -
LS-6	Lift Station	Southeast of Perrin Avenue and Champlain Drive		-	-	-	-	$ 114,000	$ 114,000					$ 114,000	$ -
LS-10	Lift Station	Stratford and Woodlawn Drives		-	-	-	-	$ 49,000	$ 49,000					$ 49,000	$ -
LS-11	Lift Station	East of Cedar and Copper Avenues		-	-	-	-	$ 160,000	$ 160,000					$ 160,000	$ -
LS-12	Lift Station	Carnegie and Bullard Avenues		-	-	-	-	$ -	$ -					$ -	$ -
LS-13	Lift Station	North of Jackson and University Avenues		-	-	-	-	$ 59,000	$ 59,000					$ 59,000	$ -
LS-14	Lift Station	East of Carnegie and Alluvial Avenues		-	-	-	-	$ 70,000	$ 70,000					$ 70,000	$ -
LS-15	Lift Station	North of Haston Avenue and Fountain Way		-	-	-	-	$ 128,000	$ 128,000					$ 128,000	$ -
LS-16	Lift Station	Northwest of Santa Fe and El Paso Avenues		-	-	-	-	$ 72,000	$ 72,000					$ 72,000	$ -
LS-18	Lift Station	South of Nielsen and Hughes Avenues		-	-	-	-	$ 82,000	$ 82,000					$ 82,000	$ -
LS-20	Lift Station	North of Cherry and Muscat Avenues		-	-	-	-	$ 15,000	$ 15,000					$ 15,000	$ -
							Lift Station Totals	**$ 1,114,000**	**$ 1,114,000**	**$ -**	**$ -**	**$ -**		**$ 1,114,000**	**$ -**
Point Repairs															
HPPR-1	Point Repair	250 Priority Point Repairs as determined by City of Fresno personnel		Varies	Varies	Replace	Varies	$ 5,800,000	$ 5,800,000					$ 5,800,000	$ -

Table 8.5 Capital Improvement Projects
Wastewater Collection System Master Plan
City of Fresno

Job No.	Project Type	Description / Limits	Existing Diameter (in)	New Diameter (in)	Rehab, Replace, or New	Length (ft)	Improvement Cost ($)	Capital Improvement Phasing				Future User Benefit (%)	Reimbursement Category	
								Phase 1 2015-2020 ($)	Phase 2 2021-2025 ($)	Phase 3 2026-2030 ($)	Phase 4 2031-2035 ($)		Existing Improvements	Future Improvements
HPPR-2	Point Repair	250 Priority Point Repairs as determined by City of Fresno personnel	Varies	Varies	Replace	Varies	$ 5,800,000	$ 5,800,000					$ 5,800,000	$ -
HPPR-3	Point Repair	250 Priority Point Repairs as determined by City of Fresno personnel	Varies	Varies	Replace	Varies	$ 5,800,000	$ 5,800,000					$ 5,800,000	$ -
HPPR-4	Point Repair	250 Priority Point Repairs as determined by City of Fresno personnel	Varies	Varies	Replace	Varies	$ 5,800,000	$ 5,800,000					$ 5,800,000	$ -
HPPR-5	Point Repair	249 Priority Point Repairs as determined by City of Fresno personnel	Varies	Varies	Replace	Varies	$ 5,777,000	$ 5,777,000					$ 5,777,000	$ -
						Point Repair Totals	**$ 28,977,000**	**$ 28,977,000**	**$ -**	**$ -**	**$ -**		**$ 28,977,000**	**$ -**
Pipe Rehabilitation														
R-1A	Rehabilitation	16 high MOSR segments	Varies	Varies	Rehab	Varies	$ 2,488,000	$ 2,488,000					$ 2,488,000	$ -
R-1B	Rehabilitation	18 high MOSR segments	Varies	Varies	Rehab	Varies	$ 2,571,000	$ 2,571,000					$ 2,571,000	$ -
R-1C	Rehabilitation	23 high MOSR segments	Varies	Varies	Rehab	Varies	$ 2,631,000	$ 2,631,000					$ 2,631,000	$ -
R-2	Rehabilitation	2006 Master Plan Project RS03A	24	24	Rehab	3,118	$ 1,126,000	$ 1,126,000					$ 1,126,000	$ -
R-3	Rehabilitation	2006 Master Plan Project RS06B	15	15	Rehab	300	$ 92,000	$ 92,000					$ 92,000	$ -
R-4	Rehabilitation	2006 Master Plan Project RL02	48	48	Rehab	2,644	$ 2,101,000	$ 2,101,000					$ 2,101,000	$ -
R-5	Rehabilitation	2006 Master Plan Project RL11	54	54	Rehab	3,992	$ 3,561,000	$ 3,561,000					$ 3,561,000	$ -
						Pipe Rehabilitation Totals	**$ 14,570,000**	**$ 14,570,000**	**$ -**	**$ -**	**$ -**		**$ 14,570,000**	**$ -**
						Capitol Improvement Projects Totals	**$ 312,316,000**	**$ 46,371,000**	**$ 55,848,000**	**$ 7,167,000**	**$ 202,930,000**		**$ 107,919,860**	**$ 204,396,140**

APPENDIX A – GENERAL PLAN LAND USE DESCRIPTIONS

- *Walls and fences that separate related uses or isolate neighborhoods;*
- *Over reliance on cul-de-sacs and dead end streets that cut off access within neighborhoods;*
- *Disconnected bike and pedestrian paths;*
- *Wide streets that lack pedestrian support, such as sidewalks, median strips, and a landscaped strip that separates pedestrians from the street;*
- *Street front parking lots that separate pedestrian from commercial operations;*
- *Retail centers that are exclusively auto-oriented;*
- *Transit stops that are not easily accessible from an individual's starting point and destination; and*
- *Long blocks that discourage walking.*

UF-14-b **Local Street Connectivity.** Design local roadways to connect throughout neighborhoods and large private developments with adjacent major roadways and pathways of existing adjacent development. Create access for pedestrians and bicycles where a local street must dead end or be designed as a cul-de-sac to adjoining uses that provide services, shopping, and connecting pathways for access to the greater community area.

UF-14-c **Block Length.** Create development standards that provide desired and maximum block lengths in residential, retail, and mixed-use districts in order to enhance walkability.

Commentary: *When preparing such standards the City should assess the desirability of varying maximum block length requirements between single family residential, multi-family residential, mixed use, and commercial districts.*

3.5 LAND USE

The following sections provide the General Plan's required land use information with use classifications, maximum densities and intensities on Figure LU-1: Fresno General Plan Land Use Diagram.

The City has reviewed those areas covered by the General Plan that are subject to flooding identified by flood plain mapping prepared by the Federal Emergency Management Agency (FEMA), which can be found at Figure NS-7: Floodplains. The City

will annually review those areas covered by the Plan as set out in the Implementation Element.

Land Use Diagram

The Land Use Diagram is the City's master designation of land uses for Fresno including the City's SOI. The Land Use Diagram includes the Downtown Planning Area, shown in an inset, and its designations are anticipated to be further refined and implemented through specific and community plans, such as the proposed FCSP and the DNCP. Land use designations for the Downtown Planning Area are generalized to facilitate implementation by providing some flexibility for the detailed plans.

Dual Designations

All new parks, open space, and public facilities (such as school sites) carry dual land use designations, so that if that facility is not needed, private and public development consistent with zoning and development standards may be approved. These dual land use designations are shown in Figure LU-2: Dual Designation.

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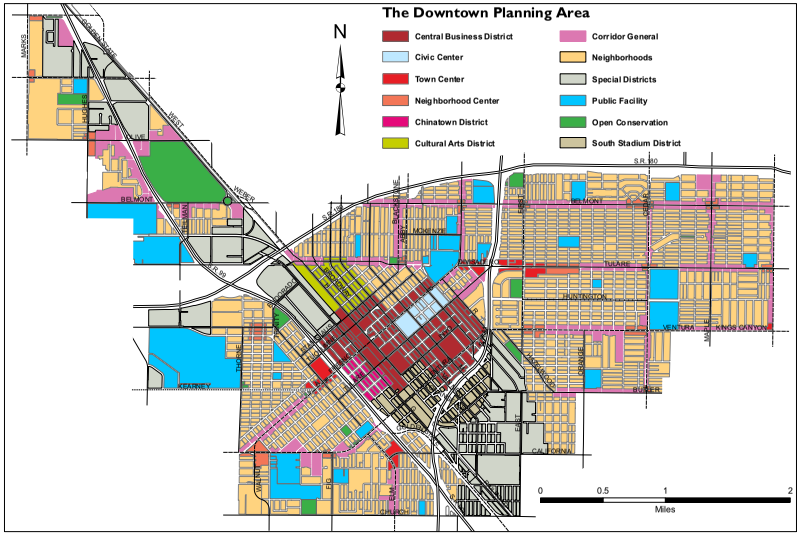
City of Fresno General Plan Land Use and Circulation Map

PLAN ADOPTION	
Resolution Number	Date
2014 - 226	18-Dec-14
2014 - 227	18-Dec-14
PLAN AMMENDMENTS	
Resolution Number	Date
2015 - 133	16-Jul-15
2016 - 21	4-Feb-16
2016 - 23	4-Feb-16



(Proposed downtown land use and circulation classifications are anticipated to be further refined through specific and community plans such as the proposed Fulton Corridor Specific Plan and the Downtown Neighbohoods Community Plan.)

LEGEND

RESIDENTIAL
- Low Density (1-3.5 D.U./acre)
- Medium Low Density (3.5-6 D.U./acre)
- Medium Density (5.0-12 D.U./acre)
- Medium High Density (12-16 D.U./acre)
- Urban Neighborhood (16-30 D.U./acre)
- High Density (30-45 D.U./acre)

COMMERCIAL
- Main Street
- Community
- Recreation
- General
- Highway & Auto
- Regional

EMPLOYMENT
- Office
- Business Park
- Regional Business Park
- Light Industrial
- Heavy Industrial

MIXED USE
- Corridor/Center Mixed Use
- Regional Mixed Use
- Neighborhood Mixed Use

OPEN SPACE
- Clear Zone
- Commercial-Recreational
- Community Park
- Flood Control Project
- Golf Course
- Lake, Pond
- Multi-Use
- Neighborhood Park
- Outdoor Environmental Education Area
- Open Space
- Park
- Ponding Basin
- Ponding Basin (Park use)
- Regional Park

PUBLIC FACILITIES
- Public/Quasi-public Facility
- Special School
- Elementary School
- Elementary & Middle School
- Elementary, Middle & High School
- Middle School
- High School
- College
- School with Park
- Airport
- Cemetery
- Church
- Community Activity Center
- Convalescent Hospital
- Fairgrounds
- Fire Station
- Government Offices
- Hospital
- Medical Center
- Neighborhood Center
- PG & E Substation
- Police Dressing Station
- Water Recharge Basin
- Waste Water Treatment Facility

BUFFER
- Buffer

BOUNDARIES
- Existing Fresno Sphere of Influence
- Fresno Planning Boundary
- Downtown Neighborhoods
- Southeast Development Area (SEDA)

Date: 2/29/2016

Circulation Legend

Freeway	Super Arterial	Scenic Drive
Expressway	Arterial	Collector
Scenic Expressway	Scenic Arterial	Scenic Collector

0 0.5 1 2 3 4 5 Miles

Dual land use designations for public facilities and open space are shown on a supplemental map.

This map is believed to be an accurate representation of the City of Fresno GIS data. However, we make no warranties either expressed or implied for the correctness of this data.

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City of Fresno
Development and Resource Management
Planning Division

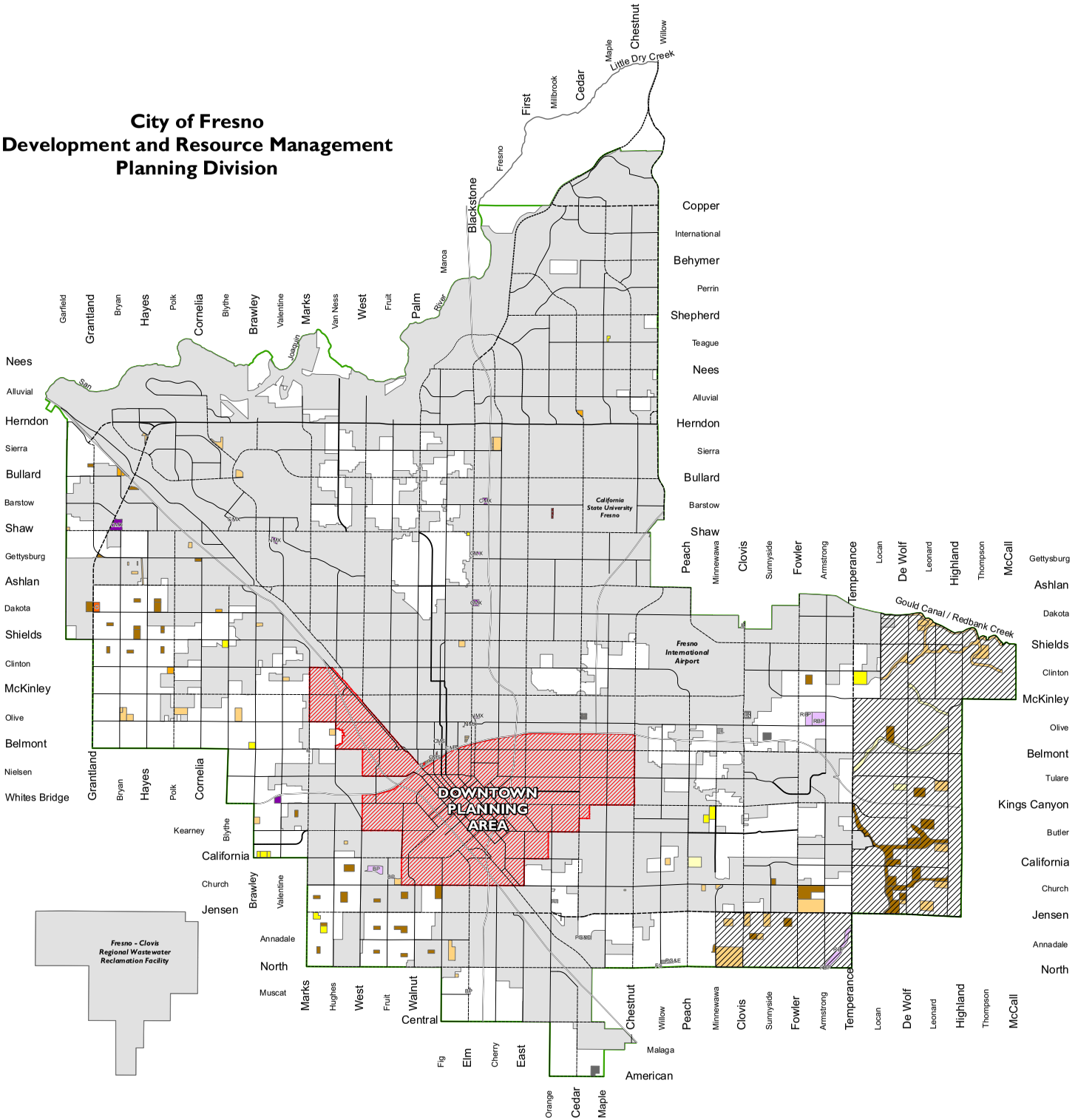

Figure LU - 2:
Dual Designation Diagram

Residential
- Low Desnisty (1-3.5 D. U./Acre)
- Medium Low Desnisty (3.5-6 D. U./Acre)
- Medium Desnisty (5-12 D. U./Acre)
- Medium High Desnisty (12-16 D. U./Acre)
- Urban Neighborhood (16-30 D. U./Acre)
- High Density (30-45 D. U./Acre)

Commercial
- C Community
- M Main Street
- G General

Employment
- Office
- BP Business Park
- RBP Regional Business Park
- Light Industrial
- Heavy Industrial

Mixed Use
- CMX Corridor/Center Mixed Use
- RMX Regional Mixed Use
- NMX Neighborhood Mixed Use

Boundaries
- Fresno Planning Boundary
- Existing Sphere of Influence
- City Limit
- Downtown Neighborhoods
- Southeast Development Area (SEDA)

Date: 1/4/2016

Circulation Legend

Freeway	Super Arterial	Scenic Drive
Expressway	Arterial	Collector
Scenic Expressway	Scenic Arterial	Scenic Collector
Ramp		

0 1 2 4 6 Miles

N

Note: All planned land uses for future parks, open space, ponding basins, schools (e.g. special, elementary, middle, high, and colleges) and schools with parks carry dual planned land use designations so that if that facility is not needed private and public development consistent with zoning and development standards may be approved. This map shows the additional land use designations.

Source: City of Fresno, DARM Dept., Planned Land Use, 2015.

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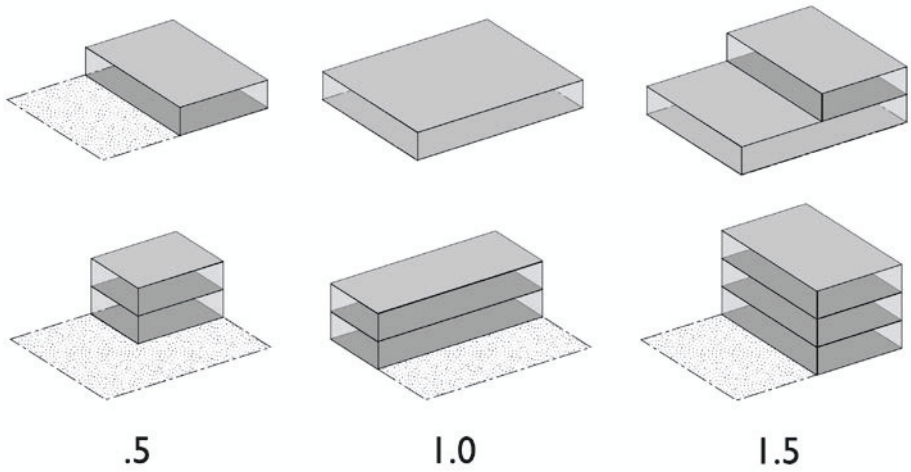
Density and Intensity

The General Plan calculates density on net acreage, defined as the land area of a lot remaining after dedication of all areas for major streets, schools, regional trails, certified wetlands or floodplains, and land underneath electric transmission lines. For residential uses, the density and intensity standards are expressed as the number of housing units per net acre. For non-residential uses, a measure known as Floor Area Ratio (FAR) is specified. FAR is defined as the permitted ratio of gross floor area to site area. It is a measure of building bulk that controls both visual prominence and traffic generation, as shown in the diagram below.



The citywide density and intensity standards, established in Table 3-1, are intended to establish minimum and maximum densities per net acre allowed in each General Plan land use category, exclusive of the Downtown Planning Area. Minimum and maximum densities, intensities, and required land use mixes will be more precisely defined within the Development Code for purposes of determining the consistency of a proposed zone district and a property development entitlement with an applicable land use designation.

Minimum lot/parcel sizes (and corresponding lot frontage minimums and other lot design requirements) will be defined in the Development Code for each zone district. The Development Code will also provide procedures and criteria for preparing and implementing "planned development" for a given area to allow for limited reconfiguration of the planned land uses for that area and variations from base zoning district development standard, while maintaining the equivalent densities, intensities and mix of uses. Finally, the General Plan land use designation may provide overlap in the defined densities, intensities and land uses described for various land uses.

TABLE 3-1: CITYWIDE STANDARDS FOR DENSITY AND DEVELOPMENT INTENSITY

Land Use	Minimum to Maximum Residential Density (du/net acre)[1,2,3]	Maximum Floor Area Ratio
Buffer	Max = 0.05 (1 unit per 20 net acres)	-
Residential		
Low Density	Min = 1 unit per 5 acres Max = 3.5 units per acre	-
Medium Low Density	Min = 3.5 units per acre Max = 6 units per acre	-
Medium Density	Min = 5 units per acre Max = 12 units per acre	-
Medium High Density	Min = 12 units per acre Max = 16 units per acre	-
Urban Neighborhood Density	Min = 16 units per acre Max = 30 units per acre	-
High Density	Min = 30 units per acre Max = 45 units per acre	-
Commercial		
Main Street		1.0
Community		1.0
Recreation		0.5
General		2.0
Highway & Auto		0.75
Regional		1.0
Mixed-Use		
Neighborhood Mixed-Use	Min = 12 units per acre Max = 16 units per acre	1.5
Corridor/Center Mixed-Use	Min = 16 units per acre Max = 30 units per acre	1.5
Regional Mixed-Use	Min = 30 units per acre Max = 45 units per acre	2.0
Employment		
Office	-	2.0
Business Park	-	1.0
Regional Business Park	-	1.0
Light Industrial	-	1.5
Heavy Industrial	-	1.5

1. Based on Net Acreage.
2. Residential density refers to the ratio of residential dwelling units per acre (43,560 square feet) of land which is calculated by dividing the number of existing or proposed residential dwelling units by the land area of the property designated for, or proposed for development with, a residential use. The residential land area includes property upon which the residential and ancillary structures are located, together with yards and other private or common open spaces, and includes vehicle access drives and parking areas together with public and private roadways. The residential land area does not include major streets or State Routes designated by Figure MT-1: General Plan Circulation Diagram, and does not include schools or regional trails.
3. Additional density may be allowed for affordable housing or provision of community benefits (pursuant to California Government Code Sections 65915 – 65918, as may be amended).

Table 3-2 provides density and intensity standards specific to the Downtown Planning Area.

TABLE 3-2: DOWNTOWN PLANNING AREA STANDARDS FOR DENSITY AND DEVELOPMENT INTENSITY		
Land Use	Maximum Residential Density (du/net acre)[1,2]	Maximum Floor Area Ratio
Central Business District (CBD)	60 units per acre[3]	7.5
Civic Center	-	5.0
Town Center	45 units per acre	4.0
Neighborhood Center	30 units per acre	2.0
Chinatown District	45 units per acre	3.0
Cultural Arts District		
Corridor General	30 units per acre	2.5
Neighborhoods	16 units per acre	-
Special Districts[4]	-	2.5
Public Facility	-	-
Open Conservation	-	-
South Stadium District	60 units per acre	5.0

1. Based on Net Acreage.
2. Additional density may be allowed for affordable housing or provision of community benefits (pursuant to California Government Code Sections 65915 – 65918, as may be amended).
3. Maximum density in CBD provided for capacity analysis and is considered an average for the district. Industrial projects may be allowed to exceed this density.
4. Additional FAR may be granted for hospitals and related uses, up to 5.0.

Land Use Classifications

These land use classifications cover the entire Planning Area, with the exception of the Downtown Planning Area. The land use classifications for the Downtown Planning Area are described later in this element.

Residential

Residential land uses provide for a wide range of neighborhoods and housing types.

LOW DENSITY

This designation is intended to provide for large lot residential development. Low Density residential allows one to 3.5 housing units per acre. The resulting land use pattern is large lot residential in nature, such as rural residential, ranchettes, or estate homes.

MEDIUM LOW DENSITY

The Medium Low Density designation is intended to provide for single family detached housing with densities of 3.5 to 6 units per acre.

MEDIUM DENSITY

Medium Density residential covers developments of 5 to 12 units per acre and is intended for areas with predominantly single-family residential development, but can

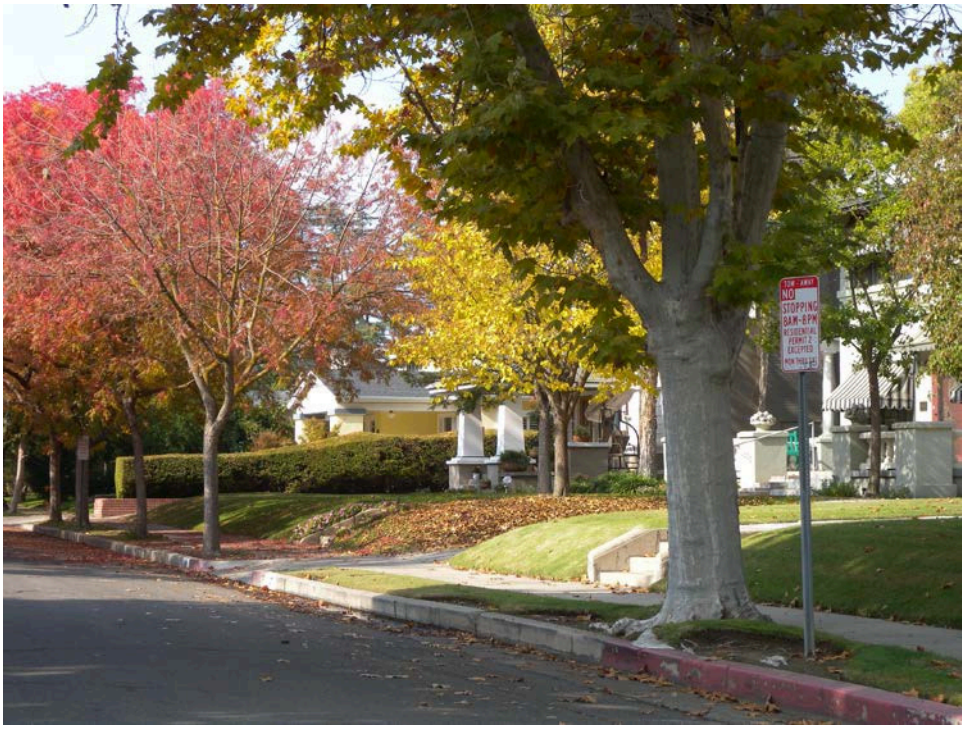
also accommodate a mix of housing types, including small-lot starter homes, zero-lot-line developments, duplexes, and townhouses. Much of the City's established neighborhoods fall within this designation.

MEDIUM HIGH

Medium High Density residential is intended for neighborhoods with a mix of single-family residences, townhomes, garden apartments, and multi-family units intended to support a fine-grain, pedestrian scale. This land use accommodates densities from 12 to 16 units per acre overall.

URBAN NEIGHBORHOOD

Urban Neighborhood residential covers densities from 16 to 30 units per acre, which will require multi-family dwellings but still allows for a mix of housing types including single-family houses. This land use is intended to provide for a compact community that includes community facilities and walkable access to parkland and commercial services; it also supports efficient, frequent transit service. Urban Neighborhood is designated for targeted areas with complementary land uses adjacently located.



An example of Fresno's established residential neighborhoods, with wide streets, sidewalks, and large trees.

HIGH DENSITY

High Density residential is intended to accommodate attached homes, two- to four-plexes, and apartment buildings, and it will be supported by walkable access to frequent transit, retail and services, and community facilities such as parks and schools. High Density allows for 30 to 45 units per acre.

Commercial

Commercial land use designations allow a wide range of retail and service establishments intended to serve local and regional needs.

MAIN STREET

Main Street Commercial encourages a traditional Main Street character with active storefronts, outdoor seating and pedestrian-oriented design. This designation promotes primarily one to two story retail uses. It also preserves small-scale, fine-grain character in neighborhoods where single-family residential and townhomes are predominant. The maximum FAR is 1.0.

COMMUNITY

Community Commercial is intended for commercial development that primarily serves local needs such as convenience shopping and small offices. Many of the city's current commercial districts fall into this designation. Specific uses allowed include medium-scale retail, office, civic and entertainment uses, supermarkets, drug stores and supporting uses. The maximum FAR is 1.0.

RECREATION

The Recreation designation is intended for areas of private commercial recreation uses, such as bowling alleys and golf driving ranges. The maximum FAR is 0.5.

GENERAL

The General Commercial designation is intended for a range of retail and service uses that are not appropriate in other areas because of higher volumes of vehicle traffic and potential adverse impacts on other uses. Development such as strip malls fall into this designation. Examples of allowable uses include: building materials, storage facilities with active storefronts, equipment rental, wholesale businesses, and specialized retail not normally found in shopping centers. The maximum FAR is 2.0.

HIGHWAY & AUTO

The Highway & Auto designation is intended for limited areas near State Route 99 to accommodate uses that depend on or are supported by freeway access but do not generate a large volume of traffic. Hotels, restaurants, and auto malls are typical land uses. The maximum FAR is 0.75.

REGIONAL

The Regional Commercial designation is intended to meet local and regional retail demand, such as large-scale retail, office, civic and entertainment uses; shopping malls, with large format or "big-box" retail allowed; and supporting uses such as gas stations, and hotels. Buildings typically have relatively large footprints. Development and design standards will create a pedestrian orientation within centers and along major corridors. The maximum FAR is 1.0.

Employment

OFFICE

The Office designation is intended for administrative, financial, business, professional, medical, and public offices. This designation is mainly intended to apply to existing office uses on smaller lots, generally located on arterial roadways. This designation is also considered compatible with existing residential neighborhoods given the smaller level of noise and traffic generated compared to commercial uses. Retail uses would be limited to business services, food services, and convenience goods for those who work in the area. The maximum FAR is 2.0.

BUSINESS PARK

The Business Park designation provides for office/business parks in campus-like settings that are well suited for large offices or multi-tenant buildings. This designation is intended to accommodate and allow for the expansion of small businesses. Given its proximity to residential uses, only limited outdoor storage will be permitted, while adequate landscaping is imperative to minimize the visual impacts. Typical land uses include research and development, laboratories, administrative and general offices, medical offices and clinics, professional offices, prototype manufacturing, testing, repairing, packaging, and printing. No free-standing retail is permitted, except for small uses serving businesses and employees. The maximum FAR is 1.0.

REGIONAL BUSINESS PARK

The Regional Business Park designation is intended for large or campus-like office and technology development that includes office, research and development, manufacturing, and other large-scale, professional uses, with limited and properly screened outdoor storage. Permitted uses include incubator-research facilities, prototype manufacturing,

testing, repairing, packaging, and printing, as well as offices and research facilities. Small-scale retail and service uses serving local employees and visitors are permitted as secondary uses. The maximum FAR is 1.0.

LIGHT INDUSTRIAL

The Light Industrial designation accommodates a diverse range of light industrial uses, including limited manufacturing and processing, research and development, fabrication, utility equipment and service yards, wholesaling, warehousing, and distribution activities. Small-scale retail and ancillary office uses are also permitted. Light Industrial areas may serve as buffers between Heavy Industrial and other land uses and otherwise are generally located in areas with good transportation access, such as along railroads and State Routes. The maximum FAR is 1.5.

HEAVY INDUSTRIAL

The Heavy Industrial designation accommodates the broadest range of industrial uses including manufacturing, assembly, wholesaling, distribution, and storage activities that are essential to the development of a balanced economic base. Small-scale commercial services and ancillary office uses are also permitted. The maximum FAR is 1.5.

Mixed-Use[5]

Mixed-use designations are based on commercial uses and also require a residential or upper-floor office component.

NEIGHBORHOOD MIXED-USE

This designation allows a minimum of 50 percent residential uses and provides for mixed-use districts of local-serving, pedestrian-oriented commercial development, such as convenience shopping and professional offices in two- to three-story buildings. Development is expected to include ground-floor neighborhood retails uses and upper-level housing or offices, with a mix of small lot single family houses, townhomes, and multi-family dwelling units on side streets, in a horizontal or vertical mixed-use orientation. The built form will have a scale and character that is consistent with pedestrian-orientation, to attract and promote a walk-in clientele, with small lots and frequent roadway and pedestrian connections permitting convenient access from residences to commercial space. Automobile-oriented uses are not permitted.

[5] The General Plan is long-term in nature, and recognizes the importance of providing for an orderly evolution of existing, legal non-conforming uses during the planning period in a manner that acknowledges their current economic contributions while providing for a transition into conforming uses consistent with applicable land use designations.

Residential densities range between 12 and 16 units per acre and the maximum FAR is 1.5.

CORRIDOR/CENTER MIXED-USE

The Corridor/Center Mixed-Use designation is higher intensity than Neighborhood Mixed-Use, and is intended to allow for horizontal and vertical mixed-use development in multiple story buildings along key circulation corridors where height and density can be easily accommodated. Ground-floor retail and upper-floor residential or offices are the primary uses, with personal and business services and public and institutional space as supportive uses. Development will facilitate the transformation of existing transportation corridors into vibrant, highly walkable areas with broad, pedestrian-friendly sidewalks, trees, landscaping, and local-serving uses with new buildings that step down in relationship to the scale and character of adjacent neighborhoods. This designation will largely apply along major roadways, at targeted locations between regional Activity Centers. Residential densities range between 16 and 30 units per acre with a minimum 40 percent residential uses, and the maximum FAR is 1.5.

REGIONAL MIXED-USE

The Regional Mixed-Use land use designation is intended to accommodate mixed-use development in urban-scale buildings and retail establishments that serve residents and businesses of the region at large. Medium-scale retail, residential, office, civic and entertainment uses, and shopping malls (with large format or "big-box" retail) are allowed, as are supporting uses such as gas stations and hotels in mixed-use or single use buildings. Design standards will support a pedestrian orientation within centers and along major corridors, with parking on the side or rear in general, but automobile-oriented uses also will be accommodated on identified streets and frontages. Residential densities range between 30 and 45 units per acre with a minimum 30 percent residential uses, and the maximum FAR is 2.0.

Open Space

The Open Space designations (Parks and Recreational Facilities; Other Public Open Space) apply to open space areas that are not parks or trails, such as riparian corridors, the clear zone around Fresno-Yosemite International Airport, and the San Joaquin River bottom, which is primarily designated as open space even though it includes a limited number of existing homes.

Public Facilities

This designation applies to public facilities, such as City Hall, county buildings, schools, colleges, the municipal airports, and hospitals. It also includes public facilities, such as fire and police stations, City-operated recycling centers, sewage treatment plants, neighborhood, community and regional parks, recreational centers, and golf courses.

Finally, it applies to multi-purpose trails that serve both regional and neighborhood needs.

Buffer

This designation is intended to separate urban uses from long-term agricultural uses in order to preserve long-term viable agricultural areas and intensive farming operations adjoining but outside the Planning Area. The Buffer designation will serve to prevent urban residential and related uses from developing near agricultural operations and infringing on full operation of important farmland. A variety of uses are compatible with the purpose of the Buffer, which will be defined in detail in the Development Code. General categories include environmental habitats; water conveyance, retention and recharge; preservation and preparation of gravel resources for beneficial uses related to permanent water resource facilities; limited agriculture and necessary supportive uses, such as agricultural processing, excluding animal processing or uses that have the potential to create nuisances; and residential uses with 20 acres of land required per residence.

Downtown Land Use Classifications

These land use classifications are specific only to the Downtown Planning Area portion of the Planning Area, as depicted in the inset to Figure LU-1: General Plan Land Use Diagram. It is anticipated the land use classifications may be further refined in community or Specific Plans, such as the proposed DNCP and FCSP. The following are general descriptions of the Land Use classifications within the Downtown Planning Area.

Central Business District

The Central Business District (CBD) is the cultural, civic, shopping, and transit center of Fresno and the region. This designation is applied to areas of the Downtown Planning Area bounded by Stanislaus Street, the Union Pacific tracks, Inyo Street, and the alley between Van Ness Avenue and L Street. New buildings will be at least 2 to 15 stories in height and located at or near the sidewalk. Buildings will be occupied with ground floor commercial, retail, multi-family housing, and office activity to support active streetscapes and walking. Upper floors and the floor area behind storefronts will accommodate a wide variety of office, civic, lodging, housing, or additional commercial uses.

Civic Center

The Civic Center is intended for civic and office uses, including numerous public buildings containing City, County, State, and federal uses. This land use designation is applied to properties currently fronting Mariposa Street, the south side of Fresno Street, and the north side of Tulare Street between Van Ness Avenue and Q Street.

New buildings will be block-scale, up to 10 stories in height, and set back from the sidewalk along a continuous build-to line to maintain a formal alignment and arrangement of building frontages. Upper stories will be expressed in volumes that enhance and support the civic presence of buildings along these streets. A full range of civic and office uses, including ground floor retail, are envisioned to support active streetscapes and walking. Upper floors will have office and civic uses.

Chinatown District

The Chinatown District designation is applied to the areas bounded by the Union Pacific Railroad tracks, State Route 99, Stanislaus Street, and Inyo Street. Chinatown's close proximity to State Route 99 and Downtown Core create the unique opportunity to introduce buildings and uses that serve both the region and the surrounding neighborhoods. F Street is preserved and developed as Chinatown's "Main Street." New buildings will be block-scale, up to three stories in height and located at the sidewalk to activate the street with pedestrian-oriented commercial activity. Most upper stories will be expressed in single volumes to enhance the small scale of this urban neighborhood and historic main street. Ground floor uses will include commercial, retail, civic, or office uses to support active streetscapes and walking. Upper floors and the space behind storefronts will have offices, housing, or additional commercial uses.

Cultural Arts District

This designation is applied to the area immediately north of the CBD bounded by Divisadero Street to the north, Van Ness Avenue to the east, Stanislaus Street to the south and Union Pacific railroad tracks to the west. This designation is intended to spur the area's transformation by encouraging mixed-use buildings comprised primarily of small-scale retail, office, industrial, and multi-family residential uses. New buildings will be block scale, up to five stories tall, and located at or near the sidewalk to generate an active public realm and support walking. Buildings will have ground floor retail, live-work, and uses such as art galleries on key streets.

South Stadium / South Van Ness

This designation is applied to the areas immediately to south of the Central Business District, including the Monterey and Los Angeles Street areas. It is intended for small-scale retail, office, and industrial uses. New buildings will be block-scale, with non-industrial buildings up to five stories in height, and located at or near the sidewalk to generate an active public realm. Secondary streets and upper floors will have residential and office uses. Industrial buildings may have larger footprints and may be up to two stories tall.

Town Center

The Town Center designation is applied to nodes at major intersections along major roadway corridors. It is intended for medium-scale retail, housing, office, civic, and entertainment uses that serve several neighborhoods. New buildings will be block-scale, up to five stories in height and located at or near the sidewalk to generate focused and active, commercial activity along corridors. Most upper stories will be expressed in single volumes along the corridor and in multiple volumes with significant setbacks when adjacent to neighborhoods. Ground floor uses will include commercial, retail, and office uses to support active streetscapes and walking. Upper floors and the floor area behind storefronts will have office, civic, residential, or additional commercial uses.

Neighborhood Center

The Neighborhood Center designation is applied to nodes at secondary intersections and along corridors and is comprised of primarily small-scale neighborhood uses such as retail, office, civic, entertainment, and housing. New buildings will be block and house-scale, up to three stories in height, completely compatible in scale with adjacent single-family houses, and located at or near the sidewalk to generate pedestrian activity. Upper stories will be expressed in volumes compatible with adjacent houses. Buildings will have ground floor commercial, retail, and office uses to support active streetscapes and walking. Upper floors and the floor area behind shop fronts will have office, civic, residential or additional commercial uses.

Neighborhood Centers support surrounding neighborhoods with a mix of uses, including retail, office, civic, housing, and entertainment.

Corridor General

This designation is applied to areas fronting on corridors including Belmont Avenue, Kings Canyon Road, Blackstone Avenue, Abby Street, and North Fresno Street. It is intended for moderate intensity housing and neighborhood services, while also accommodating automobile-oriented commercial uses. New buildings will be block-scale and house-scale, up to three stories in height, and located at or near the sidewalk to generate more pedestrian activity. Buildings will vary in size and type, but be compatible in massing and scale with adjacent buildings. Most upper stories will be expressed in single volumes along the corridor and in multiple volumes with significant setbacks when adjacent to neighborhoods. Living rooms, dining rooms, and other formal rooms will face the street. Ground floor uses will include housing, as well as commercial, retail and office uses. Upper floors will be for housing, office, or additional commercial uses.

Neighborhood (General, General Preservation, General Revitalization, Edge)

The Neighborhood designations are applied to areas outside of the Downtown CBD. These areas include the Lowell neighborhood; much of the southwest and southeast neighborhoods; the L Street area and the Huntington Boulevard area east of Downtown Core; the Jefferson Neighborhood; areas south of Elm and B Streets in southwest; several southeast neighborhoods adjacent to State Route 180; and areas west of State Route 99, including the Jane Addams area. New buildings will be house-scale, up to two stories in height, and some buildings may be up to two and one-half stories. All buildings will set back from the sidewalk to provide a buffer between the sidewalk and the dwellings. Living rooms, dining rooms, and other formal rooms will face and activate the street. Other house-scale buildings are compatible in these neighborhoods when scaled and massed in relation to the predominant single-family houses. Buildings will be occupied with residential uses, limited live/work uses, and home occupation activity.

Special Districts

The Special Districts designation is applied to areas that are best suited for a variety of moderate to intense industrial and manufacturing activity. These areas are comprised primarily of large and varied building sizes with substantial activity from large cargo vehicles. New buildings will be block-scale, up to eighteen stories in height (hospitals), and located with a portion, or all, of their frontage at or near the sidewalk. Ground floor activity will range from industrial and manufacturing uses and outdoor assembly to offices. Included in the Special Districts designation are General Industrial (1 & 2); Fresno Chandler Executive Airport between Kearney Boulevard, and Thorne Avenue and Whitesbridge Road; and Downtown Hospital that includes the hospital campus and

surrounding streets with Diana Street / railroad tracks on the west and south, McKenzie Avenue on the north and Fresno Street on the east and south.

Open Conservation

This designation is intended to provide for permanent open spaces, and does not include neighborhood and community parks and recreational center. This applies only to parcels zoned Open Conservation (FMC 12-204) prior to the adoption of the DNCP.

General Plan and Zoning Consistency

Table 3-3 summarizes the proposed zoning districts that will contain detailed development guidelines and regulations for the land uses in the General Plan.

TABLE 3-3: GENERAL PLAN LAND USE DESIGNATIONS AND ZONING DISTRICTS CONSISTENCY

General Plan Land Use Designation	Development Code Zoning District	
Buffer	B	Buffer
Residential		
Low Density	RE	Residential Estate
	RS-1	Residential Single Family, Extremely Low Density
	RS-2	Residential Single Family, Very Low Density
	RS-3	Residential Single Family, Low Density
Medium Low Density	RS-4	Residential Single Family, Medium Low Density
Medium Density	RS-5	Residential Single Family, Medium Density
Medium High Density	RM-MH	Mobile Home Park
	RM-1	Residential Multi-Family, Medium High Density
Urban Neighborhood	RM-2	Residential Multi-Family, Urban Neighborhood
High Density	RM-3	Residential Multi-Family, High Density
Mixed-Use		
Neighborhood	NMX	Neighborhood Mixed Use
Corridor/Center	CMX	Corridor/Center Mixed Use
Regional	RMX	Regional Mixed Use
Commercial		
Main Street	CMS	Commercial - Main Street
Community	CC	Commercial - Community
Regional	CR	Commercial - Regional
General	CG	Commercial - General
Highway and Auto	CH	Commercial - Highway and Auto
Recreation	CRC	Commercial - Recreation

Employment		
Office	O	Office
Business Park	BP	Business Park
Regional Business Park	RBP	Regional Business Park
Light Industrial	IL	Light Industrial
Heavy Industrial	IH	Heavy Industrial
Other		
Open Space	OS	Open Space
	PR	Parks and Recreation
Public Facilities	PI	Public and Institutional
Downtown Planning Area Anticipated Zoning Districts		
Central Business District	DTC	Downtown Core
	DTG	Downtown General
Civic Center	DTG	Downtown General
Town Center	DTN	Downtown Neighborhood
Chinatown		
Cultural Arts		
South Stadium		
Neighborhood Center	NMX	Neighborhood Mixed Use
Corridor General		
Neighborhoods	RS-5	Residential Single Family, Medium Density
	RS-4	Residential Single Family, Medium Low Density
Special Districts	IL	Light Industrial
Public Facility	PI	Public and Institutional
Open Conservation	OS	Open Space
	PR	Parks and Recreation

Local Plans

The City has adopted a number of plans that apply to defined areas throughout Fresno. Under the City's Local Planning and Procedures Ordinance (LPPO), Specific and Community Plans prevail when inconsistent with the General Plan. As a practical matter, this means full implementation of the General Plan may require certain Specific or Community plans to be either repealed or amended to allow consistency. As part of this process, policies and portions from certain plans have been considered in developing the General Plan, essentially resulting in a consolidation and update of planning documents through this repeal and amendment of plans. See Implementing Policy D-7-a for the list of plans being amended or repealed.

Annexation

As specified by Policy LU-1-g, this General Plan promotes the principle that the SOI not be expanded. The one exception to SOI expansion is to allow for the siting of a

maintenance yard proximate to and south of the SOI boundary associated with the California High Speed Train project.

Regional Cooperation

Fresno is part of an eight-county region, each with its own Metropolitan Planning Organization. Collectively, they have approved the San Joaquin Valley Blueprint along with the Smart Growth principles listed below, which have been integrated into the General Plan. The adopted San Joaquin Valley Blueprint 12 Smart Growth principles:

1. Create a range of housing opportunities and choices;
2. Create walkable neighborhoods;
3. Encourage community and stakeholder collaboration;
4. Foster distinctive, attractive communities with a strong sense of place;
5. Make development decisions predictable, fair, and cost-effective;
6. Mix land uses;
7. Preserve open space, farmland, natural beauty, and critical environmental areas;
8. Provide a variety of transportation choices;
9. Strengthen and direct development towards existing communities;
10. Take advantage of compact building design;
11. Enhance the economic vitality of the region; and
12. Support actions that encourage environmental resource management.

The City of Fresno is also partnering with 13 of the other 15 federally defined Urbanized Areas in the San Joaquin Valley as part of the Smart Valley Places network, to plan and implement smart growth, livability, and sustainability through revised land use and transportation systems in the respective cities within all the Urbanized Areas in the eight-county Valley region. The City of Fresno also seeks to develop a regional cooperative planning and development strategy with all the city, county, and special district jurisdictions in Fresno, Madera, Tulare, and Kings counties in order to better achieve increased air quality, lower greenhouse gas emissions, farmland preservation, water and energy conservation, increased regional transportation infrastructure and economic development, and sustainable fiscal resource and mutual quality-of-life goals in the region.

APPENDIX B – BASE WASTEWATER FLOW CALIBRATION

Table 1 Base Wastewater Flow Calibration Results
Wastewater Collection System Master Plan Update
City of Fresno

		Weekday Base Wastewater Flow												Weekend Base Wastewater Flow										Base Wastewater Flow[4]		
		Measured Data[1]				Modeled Data[2]				Percent Error[3]				Measured Data[1]				Modeled Data[2]				Percent Error[3]						
Meter Number	Pipe Diameter (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Peak Flow (%)	Avg. Velocity (%)	Avg. Level (%)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Peak Flow (%)	Avg. Velocity (%)	Avg. Level (%)	Measured BWF (mgd)	Modeled BWF (mgd)	Percent Difference (%)
FR01	45	3.701	5.507	3.36	9.3	3.704	5.212	3.06	10.0	0.1%	-5.4%	-8.9%	7.1%	3.904	5.939	3.39	9.5	3.927	5.766	3.09	10.2	0.6%	-2.9%	-8.7%	7.3%	3.759	3.768	0.2%
FR02	45	8.049	10.996	3.52	15.9	7.726	10.331	3.59	15.1	-4.0%	-6.0%	2.0%	-4.5%	8.135	12.465	3.51	15.9	7.777	11.659	3.57	15.1	-4.4%	-6.5%	1.7%	-4.9%	8.074	7.741	-4.1%
FR06	36	4.132	5.207	2.59	14.2	4.131	5.050	2.57	13.6	0.0%	-3.0%	-0.7%	-4.0%	4.089	5.758	2.54	14.2	4.118	5.630	2.56	13.5	0.7%	-2.2%	1.1%	-4.7%	4.120	4.128	0.2%
FR08	48	7.661	9.894	4.59	12.3	7.672	10.070	4.24	13.0	0.2%	1.8%	-7.7%	5.9%	7.131	9.883	4.52	11.7	7.336	10.727	4.16	12.6	2.9%	8.5%	-7.8%	8.1%	7.509	7.576	0.9%
FR09	39	5.025	6.285	3.41	12.8	4.860	6.020	3.23	12.4	-3.3%	-4.2%	-5.4%	-2.8%	4.673	6.466	3.31	12.3	4.556	6.325	3.16	12.0	-2.5%	-2.2%	-4.5%	-2.8%	4.925	4.773	-3.1%
FR10	0	1.491	2.750	1.16	10.4	1.464	2.697	1.19	10.3	-1.8%	-1.9%	2.3%	-1.4%	1.496	3.201	1.11	10.0	1.469	3.103	1.15	10.0	-1.8%	-3.1%	3.4%	-0.7%	1.492	1.465	-1.8%
FR11	66	3.582	5.199	2.23	10.3	3.609	4.851	2.16	10.8	0.8%	-6.7%	-3.3%	4.3%	3.483	5.471	2.24	10.0	3.665	5.539	2.16	10.7	5.2%	1.2%	-3.7%	7.0%	3.554	3.625	2.0%
FR12	33	1.578	2.513	1.89	8.6	1.579	2.502	1.93	8.5	0.0%	-0.4%	1.9%	-1.6%	1.590	2.673	1.84	8.7	1.592	2.671	1.91	8.4	0.1%	-0.1%	3.9%	-2.9%	1.582	1.582	0.0%
FR13	51	8.526	10.118	3.29	15.8	8.329	9.611	3.31	16.2	-2.3%	-5.0%	0.6%	2.3%	7.951	10.072	3.24	15.2	7.902	9.556	3.26	15.7	-0.6%	-5.1%	0.6%	3.6%	8.362	8.207	-1.9%
FR14	36	4.058	4.998	2.40	14.4	4.022	4.819	2.25	14.8	-0.9%	-3.6%	-6.1%	2.9%	4.017	5.367	2.39	14.3	3.762	4.806	2.21	14.2	-6.3%	-10.4%	-7.8%	-0.1%	4.046	3.948	-2.4%
FR15	48	6.194	7.184	2.19	18.2	6.071	6.949	2.25	17.5	-2.0%	-3.3%	2.7%	-3.5%	5.939	7.337	2.17	17.7	5.850	7.075	2.22	17.2	-1.5%	-3.6%	2.5%	-3.1%	6.121	6.008	-1.9%
FR16	30	3.724	4.692	3.34	11.5	3.702	4.463	3.26	11.5	-0.6%	-4.9%	-2.5%	0.3%	3.708	5.104	3.32	11.5	3.667	4.664	3.24	11.4	-1.1%	-8.6%	-2.3%	-0.5%	3.720	3.692	-0.7%
FR19	66	23.147	27.598	4.52	24.1	23.071	27.048	4.89	22.7	-0.3%	-2.0%	8.2%	-5.8%	20.907	26.800	4.35	22.8	22.057	28.163	4.81	22.1	5.5%	5.1%	10.6%	-3.2%	22.507	22.781	1.2%
FR20	66	29.854	34.806	4.60	28.6	26.961	31.643	4.71	26.2	-9.7%	-9.1%	2.3%	-8.3%	26.650	34.503	4.48	26.6	25.500	31.954	4.62	25.4	-4.3%	-7.4%	3.1%	-4.6%	28.939	26.544	-8.3%
FR21	42	4.403	5.596	2.11	15.3	4.451	5.716	2.11	15.4	1.1%	2.1%	0.0%	0.9%	4.454	6.167	2.10	15.4	4.541	6.199	2.11	15.6	1.9%	0.5%	0.7%	0.7%	4.418	4.477	1.3%
FR22	45	7.461	9.611	2.90	17.5	7.471	9.230	2.88	17.5	0.1%	-4.0%	-0.8%	0.0%	7.615	10.754	2.90	17.6	7.650	10.427	2.88	17.6	0.5%	-3.0%	-0.5%	0.1%	7.505	7.522	0.2%
FR23	27	1.251	1.638	2.08	7.5	1.262	1.521	2.20	7.4	0.9%	-7.2%	5.5%	-1.5%	0.762	1.032	1.94	5.5	0.827	1.469	1.93	5.9	8.5%	42.4%	-0.6%	7.6%	1.111	1.138	2.4%
FR24	72	8.120	10.599	2.60	16.1	8.987	11.826	2.63	17.3	10.7%	11.6%	0.9%	7.5%	8.216	11.913	2.61	16.1	9.103	13.093	2.63	17.3	10.8%	9.9%	0.8%	7.5%	8.147	9.021	10.7%
FR25	15	0.082	0.121	1.11	2.1	0.082	0.121	1.12	2.1	0.1%	0.1%	1.1%	1.0%	0.079	0.134	1.12	2.0	0.079	0.134	1.10	2.1	0.2%	-0.1%	-2.0%	3.0%	0.081	0.081	0.1%
FR26	0	0.190	0.311	0.92	4.9	0.192	0.308	0.91	5.1	1.4%	-1.0%	-1.1%	2.6%	0.195	0.321	0.93	5.0	0.198	0.322	0.91	5.1	1.3%	0.4%	-1.9%	3.3%	0.191	0.194	1.3%
FR27	27	1.900	2.558	1.82	12.1	1.900	2.546	1.86	11.1	0.0%	-0.5%	2.6%	-8.4%	1.935	2.786	1.86	12.1	1.935	2.783	1.86	11.2	0.0%	-0.1%	0.1%	-7.4%	1.910	1.910	0.0%

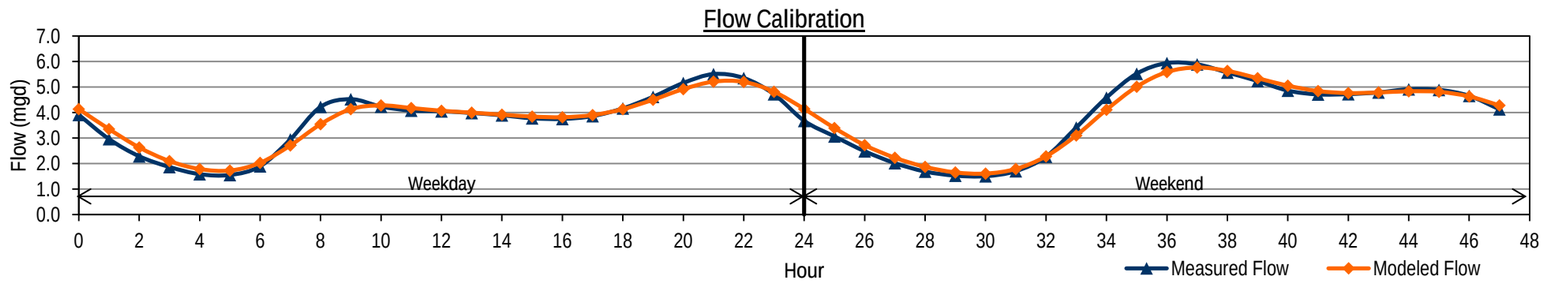
Notes:
1. Source: City of Fresno Permanent Flow Monitoring Data
2. Average flow, level, and velocity are calculated from weekday/weekend dry weather flow monitoring data. Maximum flow values are hourly peaks corresponding to either weekend or weekday confitions, as appropriate.
3. Percent Difference = (Modeled - Measured)/Measured*100.
4. Base Wastewater Flow = (5*Weekday Base Wastewater Flow + 2*Weekend Base Wastewater Flow)/7

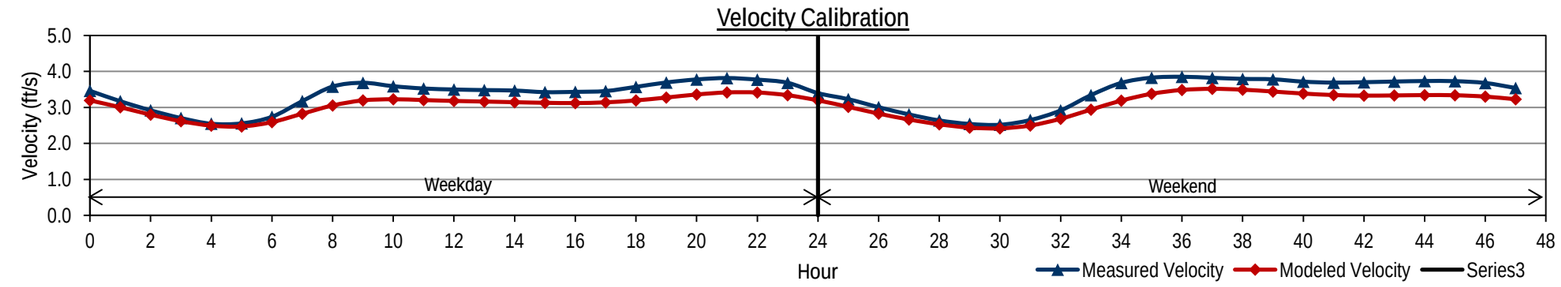
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR01 BASE WASTEWATER FLOW CALIBRATION

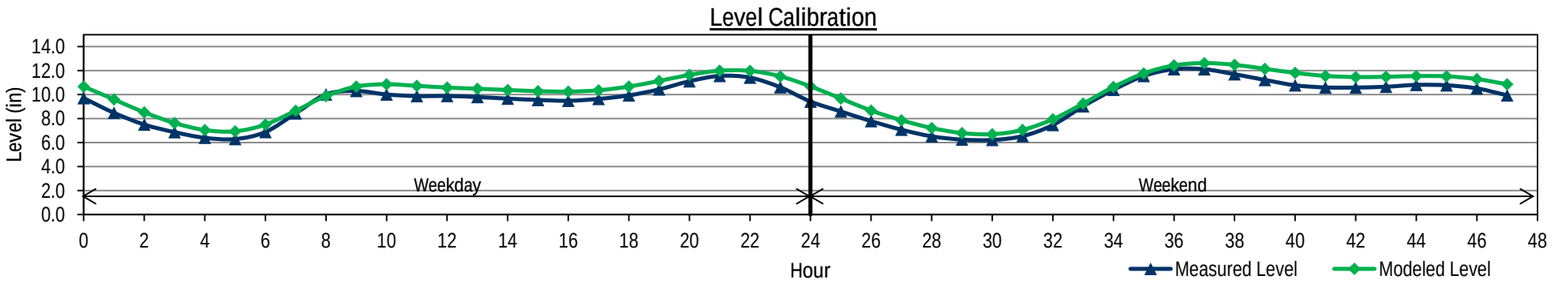
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Calibrated Diurnal
Weekday	0	3.908	9.7	3.46	4.134	10.7	3.19	0.61
	1	2.958	8.5	3.17	3.350	9.6	3.00	0.49
	2	2.282	7.5	2.92	2.629	8.5	2.80	0.42
	3	1.863	6.9	2.71	2.096	7.6	2.62	0.41
	4	1.581	6.4	2.55	1.783	7.0	2.49	0.50
	5	1.549	6.3	2.56	1.724	6.9	2.47	0.78
	6	1.892	6.9	2.74	2.027	7.5	2.59	1.12
	7	2.945	8.4	3.18	2.710	8.7	2.82	1.20
	8	4.222	10.0	3.58	3.543	9.9	3.05	1.13
	9	4.522	10.3	3.68	4.134	10.7	3.19	1.08
	10	4.230	10.0	3.59	4.280	10.9	3.23	1.08
	11	4.075	9.9	3.53	4.177	10.7	3.20	1.06
	12	4.047	9.9	3.50	4.069	10.6	3.18	1.03
	13	3.981	9.8	3.48	3.995	10.5	3.16	1.00
	14	3.890	9.7	3.47	3.916	10.4	3.14	1.00
	15	3.773	9.6	3.42	3.841	10.3	3.13	1.03
	16	3.747	9.5	3.43	3.815	10.2	3.12	1.11
	17	3.860	9.6	3.45	3.900	10.4	3.14	1.23
	18	4.161	9.9	3.57	4.132	10.7	3.19	1.37
	19	4.616	10.4	3.69	4.502	11.1	3.27	1.47
	20	5.158	11.1	3.78	4.918	11.6	3.36	1.42
	21	5.507	11.6	3.81	5.212	12.0	3.41	1.26
	22	5.351	11.4	3.77	5.202	12.0	3.41	1.04
	23	4.718	10.6	3.68	4.815	11.5	3.34	0.79
Weekend	24	3.672	9.4	3.40	4.141	10.7	3.19	0.66
	25	3.063	8.6	3.23	3.393	9.7	3.01	0.54
	26	2.480	7.8	3.01	2.722	8.7	2.83	0.45
	27	2.014	7.1	2.81	2.227	7.9	2.66	0.40
	28	1.684	6.5	2.64	1.869	7.2	2.53	0.40
	29	1.524	6.3	2.54	1.651	6.8	2.44	0.45
	30	1.502	6.2	2.52	1.605	6.7	2.42	0.60
	31	1.700	6.6	2.65	1.786	7.1	2.50	0.91
	32	2.267	7.5	2.92	2.281	7.9	2.68	1.22
	33	3.409	9.0	3.34	3.102	9.3	2.94	1.47
	34	4.582	10.4	3.68	4.109	10.6	3.19	1.58
	35	5.522	11.6	3.82	5.013	11.8	3.38	1.57
	36	5.939	12.1	3.85	5.589	12.4	3.48	1.48
	37	5.889	12.1	3.82	5.766	12.6	3.51	1.39
	38	5.568	11.7	3.79	5.634	12.5	3.49	1.29
	39	5.235	11.2	3.78	5.347	12.1	3.44	1.25
	40	4.858	10.8	3.72	5.053	11.8	3.38	1.26
	41	4.709	10.6	3.69	4.842	11.6	3.34	1.27
	42	4.721	10.6	3.70	4.763	11.5	3.33	1.31
	43	4.788	10.7	3.72	4.787	11.5	3.33	1.30
	44	4.911	10.8	3.73	4.834	11.5	3.34	1.24
	45	4.887	10.8	3.73	4.813	11.5	3.34	1.10
	46	4.654	10.5	3.68	4.632	11.3	3.30	0.98
	47	4.126	9.9	3.54	4.281	10.9	3.23	0.82
Average								
	Weekday	3.701	9.3	3.36	3.704	10.0	3.06	0.98
	Weekend	3.904	9.5	3.39	3.927	10.2	3.09	1.04
	BWF[1]	3.759	9.4	3.37	3.768	10.1	3.07	1.00
% Error								
	Weekday				0.1%	7.1%	-8.9%	
	Weekend				0.6%	7.3%	-8.7%	

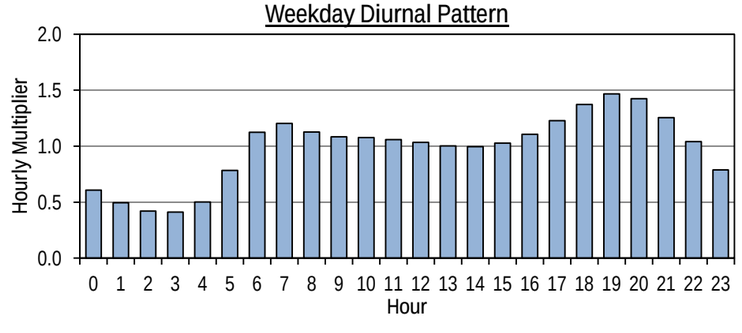
Note:

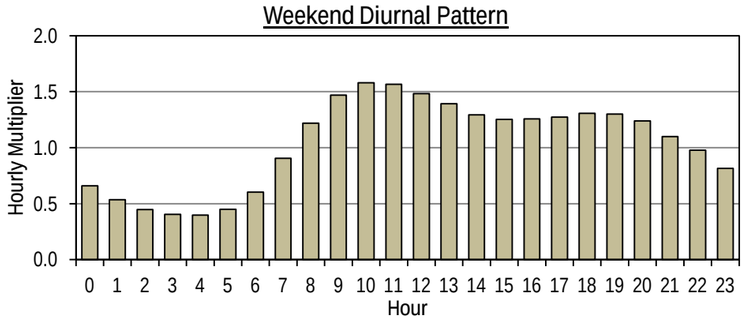
1. BWF = (5xWeekday Average + 2xWeekend Average)/7









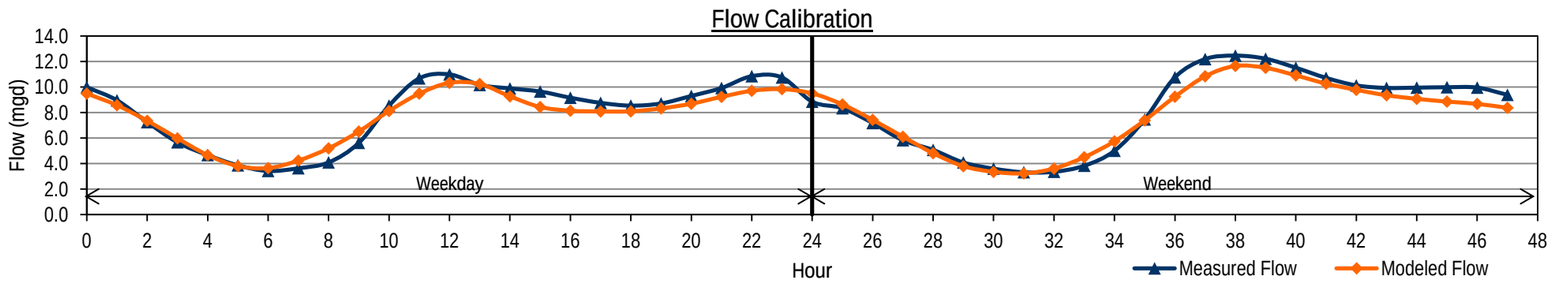


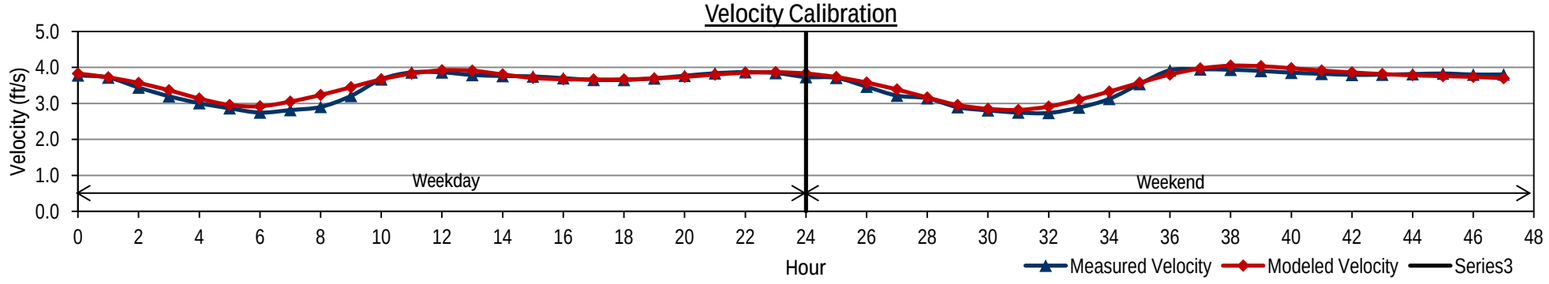
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR02 BASE WASTEWATER FLOW CALIBRATION

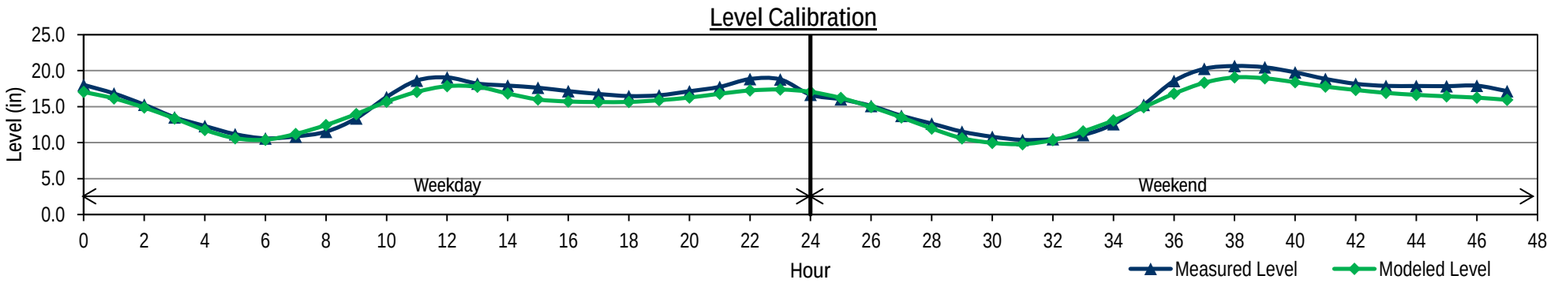
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	9.994	18.0	3.78	9.489	17.0	3.83	0.34
	1	8.962	16.8	3.72	8.573	16.1	3.73	0.33
	2	7.253	15.3	3.44	7.353	14.9	3.57	0.32
	3	5.672	13.5	3.20	5.977	13.4	3.37	0.36
	4	4.670	12.3	3.01	4.657	11.8	3.14	0.48
	5	3.865	11.2	2.87	3.800	10.6	2.96	0.92
	6	3.425	10.6	2.75	3.642	10.4	2.92	1.79
	7	3.639	10.8	2.82	4.231	11.2	3.05	1.89
	8	4.097	11.5	2.90	5.191	12.4	3.24	1.46
	9	5.629	13.4	3.21	6.512	14.0	3.45	1.13
	10	8.545	16.3	3.67	8.123	15.7	3.67	1.04
	11	10.685	18.6	3.86	9.487	17.0	3.83	1.05
	12	10.996	19.1	3.86	10.331	17.8	3.92	1.02
	13	10.170	18.2	3.79	10.241	17.8	3.91	0.99
	14	9.894	17.9	3.76	9.272	16.8	3.81	0.98
	15	9.652	17.6	3.75	8.434	16.0	3.71	1.03
	16	9.166	17.1	3.70	8.145	15.7	3.67	1.12
	17	8.763	16.8	3.65	8.085	15.6	3.67	1.33
	18	8.547	16.5	3.65	8.095	15.6	3.67	1.50
	19	8.718	16.6	3.70	8.325	15.9	3.70	1.55
	20	9.305	17.1	3.77	8.692	16.3	3.74	1.31
	21	9.930	17.7	3.84	9.233	16.8	3.80	1.01
	22	10.856	18.8	3.87	9.706	17.2	3.85	0.73
	23	10.753	18.8	3.84	9.837	17.4	3.87	0.52
Weekend	24	8.855	16.6	3.73	9.500	17.1	3.83	0.46
	25	8.345	16.0	3.71	8.637	16.2	3.73	0.34
	26	7.183	15.1	3.47	7.428	15.0	3.58	0.33
	27	5.834	13.7	3.22	6.103	13.5	3.39	0.33
	28	5.075	12.6	3.15	4.809	12.0	3.17	0.34
	29	4.089	11.5	2.90	3.792	10.6	2.96	0.44
	30	3.607	10.8	2.81	3.345	10.0	2.85	0.69
	31	3.324	10.4	2.75	3.227	9.8	2.82	1.17
	32	3.361	10.5	2.74	3.606	10.3	2.91	1.86
	33	3.834	11.1	2.89	4.497	11.6	3.10	1.91
	34	5.008	12.6	3.13	5.741	13.1	3.33	1.71
	35	7.467	15.2	3.54	7.388	14.9	3.58	1.46
	36	10.763	18.6	3.92	9.242	16.8	3.80	1.31
	37	12.197	20.3	3.95	10.846	18.3	3.97	1.20
	38	12.465	20.6	3.93	11.659	19.1	4.05	1.12
	39	12.224	20.5	3.90	11.510	18.9	4.04	1.12
	40	11.518	19.8	3.85	10.919	18.4	3.98	1.16
	41	10.722	18.8	3.82	10.270	17.8	3.91	1.20
	42	10.133	18.2	3.79	9.781	17.3	3.86	1.21
	43	9.934	17.9	3.80	9.357	16.9	3.82	1.12
	44	9.956	17.9	3.81	9.075	16.6	3.78	0.99
	45	9.989	17.8	3.83	8.860	16.4	3.76	0.88
	46	9.960	17.9	3.80	8.680	16.2	3.74	0.68
	47	9.393	17.1	3.80	8.372	15.9	3.70	0.51
Average								
Weekday		8.049	15.9	3.52	7.726	15.1	3.59	1.01
Weekend		8.135	15.9	3.51	7.777	15.1	3.57	0.98
ADWF[1]		8.074	15.9	3.51	7.741	15.1	3.58	1.00
% Error								
Weekday					-4.0%	-4.5%	2.0%	
Weekend					-4.4%	-4.9%	1.7%	

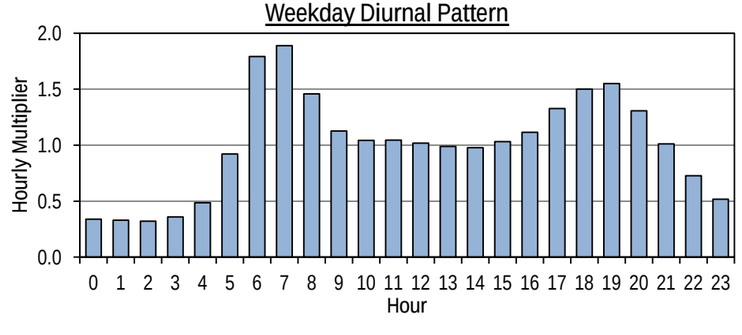
Note:

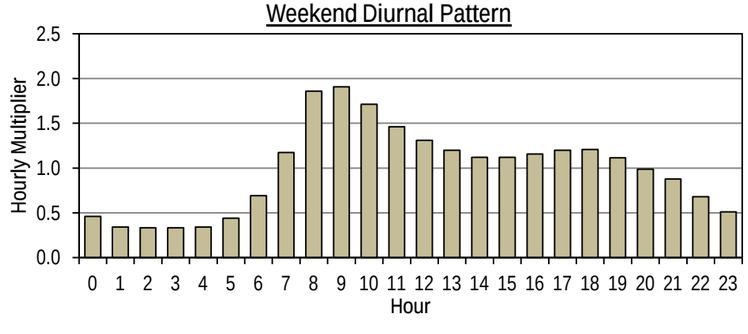
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







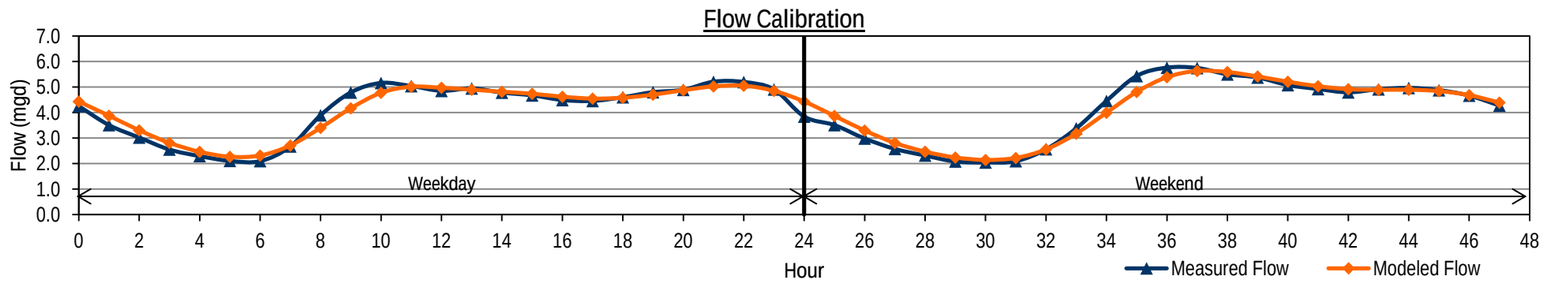


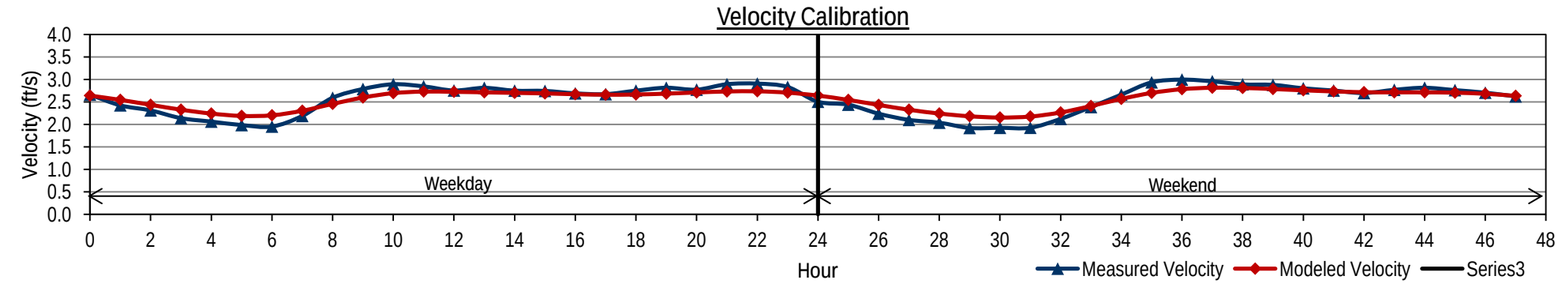


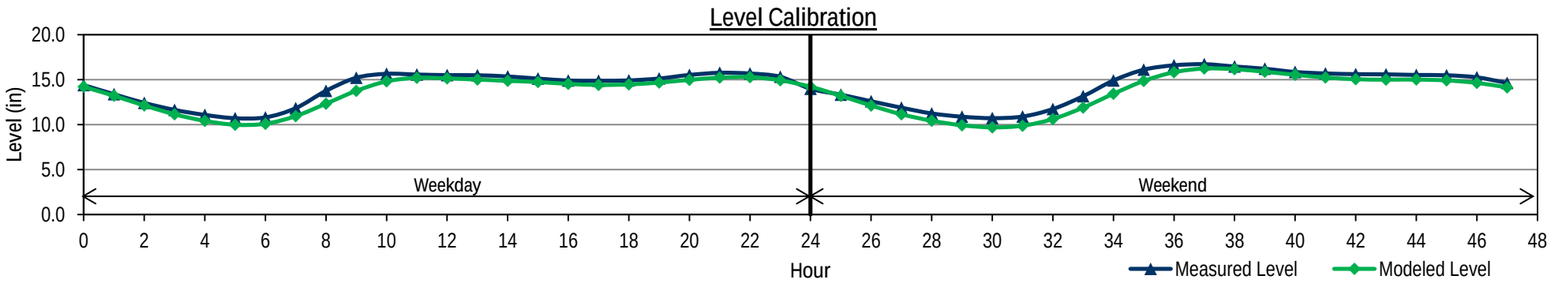
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR06 BASE WASTEWATER FLOW CALIBRATION

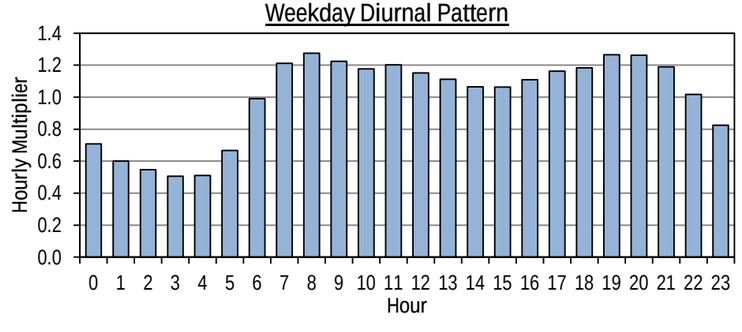
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	4.250	14.4	2.66	4.429	14.2	2.64	0.71
	1	3.507	13.4	2.42	3.873	13.2	2.55	0.60
	2	3.020	12.4	2.31	3.300	12.1	2.44	0.55
	3	2.551	11.6	2.14	2.807	11.1	2.33	0.51
	4	2.294	11.1	2.06	2.458	10.4	2.24	0.51
	5	2.105	10.7	1.99	2.264	10.0	2.19	0.67
	6	2.097	10.8	1.95	2.312	10.1	2.20	0.99
	7	2.672	11.8	2.19	2.705	10.9	2.31	1.21
	8	3.894	13.8	2.59	3.399	12.3	2.46	1.27
	9	4.787	15.2	2.79	4.167	13.8	2.60	1.22
	10	5.159	15.7	2.89	4.774	14.8	2.70	1.18
	11	5.038	15.6	2.85	5.012	15.2	2.73	1.20
	12	4.849	15.5	2.75	4.971	15.1	2.73	1.15
	13	4.946	15.5	2.81	4.896	15.0	2.71	1.11
	14	4.781	15.4	2.75	4.813	14.9	2.70	1.06
	15	4.673	15.1	2.75	4.736	14.7	2.69	1.06
	16	4.490	14.9	2.69	4.618	14.5	2.67	1.11
	17	4.454	14.9	2.67	4.546	14.4	2.66	1.16
	18	4.601	14.9	2.75	4.578	14.5	2.67	1.18
	19	4.799	15.1	2.82	4.699	14.7	2.69	1.27
	20	4.890	15.5	2.77	4.874	15.0	2.71	1.26
	21	5.207	15.8	2.89	5.024	15.2	2.73	1.19
	22	5.197	15.7	2.91	5.050	15.3	2.74	1.02
	23	4.906	15.3	2.83	4.849	14.9	2.71	0.82
Weekend	24	3.842	14.0	2.50	4.428	14.2	2.64	0.70
	25	3.508	13.3	2.44	3.867	13.2	2.55	0.61
	26	2.983	12.6	2.24	3.292	12.1	2.44	0.55
	27	2.576	11.9	2.10	2.804	11.1	2.33	0.49
	28	2.316	11.2	2.04	2.463	10.4	2.24	0.49
	29	2.083	10.9	1.92	2.235	9.9	2.18	0.51
	30	2.044	10.7	1.93	2.138	9.7	2.16	0.64
	31	2.095	10.9	1.93	2.216	9.9	2.18	0.85
	32	2.562	11.7	2.12	2.552	10.6	2.27	1.13
	33	3.380	13.2	2.39	3.171	11.9	2.41	1.37
	34	4.454	14.9	2.66	3.991	13.4	2.57	1.44
	35	5.432	16.1	2.94	4.806	14.9	2.70	1.42
	36	5.758	16.6	3.00	5.386	15.8	2.78	1.35
	37	5.745	16.7	2.96	5.630	16.2	2.82	1.31
	38	5.496	16.5	2.89	5.588	16.2	2.81	1.24
	39	5.374	16.2	2.88	5.414	15.9	2.79	1.20
	40	5.077	15.9	2.80	5.207	15.5	2.76	1.17
	41	4.921	15.7	2.75	5.032	15.2	2.73	1.20
	42	4.791	15.6	2.70	4.914	15.0	2.72	1.21
	43	4.911	15.6	2.77	4.889	15.0	2.71	1.18
	44	4.965	15.5	2.82	4.894	15.0	2.71	1.13
	45	4.876	15.5	2.76	4.840	14.9	2.71	1.02
	46	4.664	15.3	2.71	4.680	14.6	2.68	0.91
	47	4.274	14.6	2.62	4.390	14.1	2.64	0.82
Average								
Weekday		4.132	14.2	2.59	4.131	13.6	2.57	1.00
Weekend		4.089	14.2	2.54	4.118	13.5	2.56	1.00
ADWF[1]		4.120	14.2	2.58	4.128	13.6	2.57	1.00
% Error								
Weekday					0.0%	-4.0%	-0.7%	
Weekend					0.7%	-4.7%	1.1%	

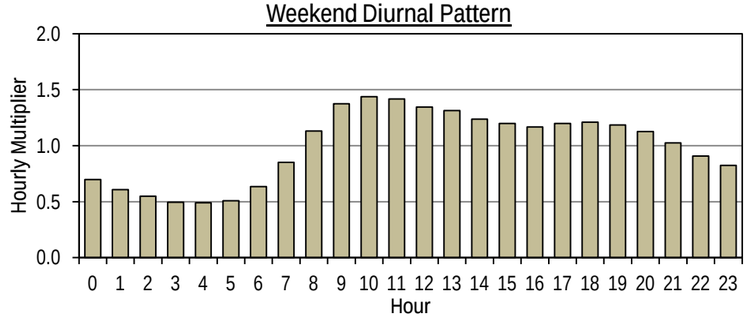
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7









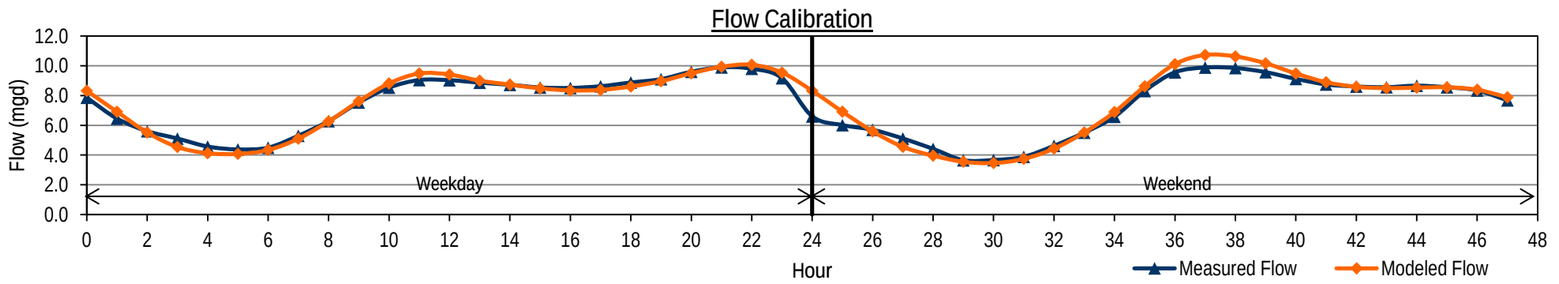


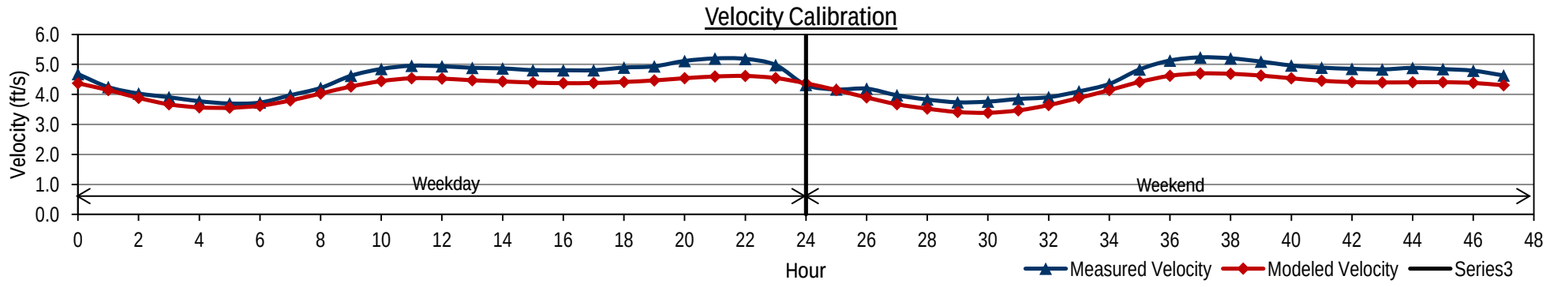
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR08 BASE WASTEWATER FLOW CALIBRATION

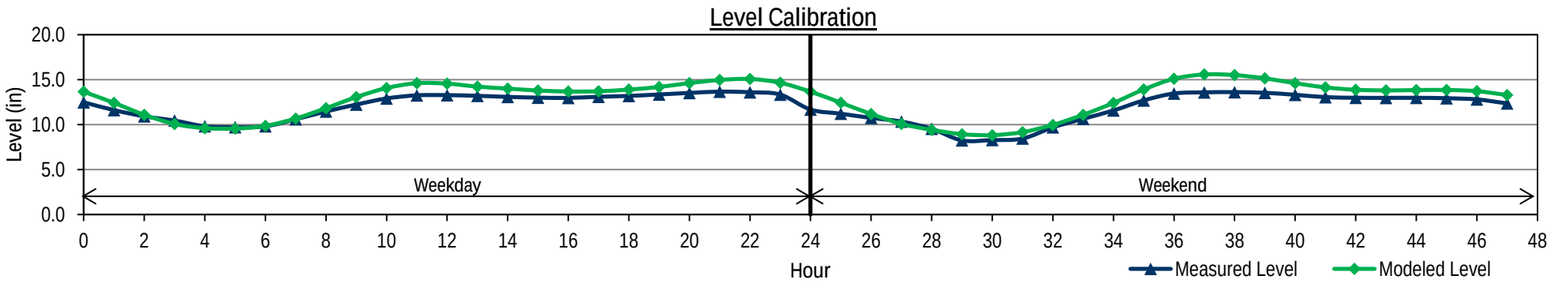
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Calibrated Diurnal
Weekday	0	7.854	12.5	4.68	8.322	13.7	4.37	0.23
	1	6.447	11.6	4.25	6.911	12.4	4.15	0.15
	2	5.604	10.9	4.03	5.519	11.1	3.88	0.27
	3	5.106	10.5	3.91	4.546	10.1	3.67	0.37
	4	4.567	9.8	3.78	4.130	9.6	3.57	0.48
	5	4.376	9.7	3.70	4.085	9.6	3.56	0.63
	6	4.494	9.8	3.73	4.347	9.9	3.62	0.97
	7	5.296	10.6	3.97	5.108	10.7	3.80	1.25
	8	6.277	11.5	4.22	6.265	11.8	4.03	1.50
	9	7.532	12.2	4.62	7.620	13.1	4.26	1.56
	10	8.531	12.9	4.85	8.817	14.1	4.44	1.39
	11	9.041	13.2	4.95	9.485	14.6	4.54	1.19
	12	9.030	13.3	4.94	9.414	14.6	4.53	1.13
	13	8.864	13.2	4.89	9.000	14.2	4.47	1.04
	14	8.720	13.1	4.87	8.736	14.0	4.43	0.94
	15	8.540	13.0	4.81	8.484	13.8	4.40	0.94
	16	8.510	13.0	4.81	8.344	13.7	4.38	1.01
	17	8.624	13.1	4.81	8.381	13.7	4.38	1.16
	18	8.875	13.2	4.89	8.608	13.9	4.42	1.27
	19	9.101	13.3	4.94	8.967	14.2	4.47	1.44
	20	9.598	13.5	5.11	9.497	14.6	4.54	1.54
	21	9.894	13.7	5.20	9.934	15.0	4.60	1.41
	22	9.801	13.6	5.18	10.070	15.1	4.62	1.11
	23	9.168	13.3	4.98	9.543	14.7	4.55	0.55
Weekend	24	6.597	11.7	4.32	8.322	13.7	4.37	0.23
	25	6.011	11.2	4.17	6.917	12.4	4.15	0.20
	26	5.697	10.7	4.19	5.596	11.2	3.90	0.32
	27	5.109	10.3	3.97	4.556	10.1	3.67	0.43
	28	4.411	9.5	3.83	3.965	9.4	3.53	0.33
	29	3.651	8.3	3.74	3.556	8.9	3.42	0.47
	30	3.663	8.3	3.76	3.469	8.8	3.39	0.64
	31	3.881	8.5	3.85	3.749	9.2	3.47	1.02
	32	4.620	9.7	3.91	4.440	10.0	3.65	1.36
	33	5.502	10.7	4.10	5.518	11.1	3.88	1.60
	34	6.573	11.6	4.35	6.894	12.4	4.14	1.97
	35	8.307	12.7	4.83	8.620	13.9	4.42	2.07
	36	9.560	13.5	5.13	10.111	15.1	4.62	1.85
	37	9.883	13.6	5.23	10.727	15.6	4.70	1.61
	38	9.850	13.6	5.20	10.629	15.5	4.69	1.38
	39	9.572	13.5	5.09	10.165	15.1	4.63	1.20
	40	9.119	13.3	4.96	9.482	14.6	4.54	1.12
	41	8.746	13.0	4.89	8.898	14.1	4.46	1.12
	42	8.605	13.0	4.85	8.588	13.9	4.41	1.14
	43	8.558	13.0	4.83	8.500	13.8	4.40	1.25
	44	8.662	13.0	4.88	8.536	13.8	4.40	1.23
	45	8.555	12.9	4.84	8.555	13.8	4.41	1.19
	46	8.343	12.8	4.79	8.393	13.7	4.38	0.94
	47	7.678	12.4	4.63	7.884	13.3	4.31	0.52
Average								
	Weekday	7.661	12.3	4.59	7.672	13.0	4.24	0.98
	Weekend	7.131	11.7	4.52	7.336	12.6	4.16	1.05
	ADWF[1]	7.509	12.1	4.57	7.576	12.9	4.22	1.00
% Error								
	Weekday				0.2%	5.9%	-7.7%	
	Weekend				2.9%	8.1%	-7.8%	

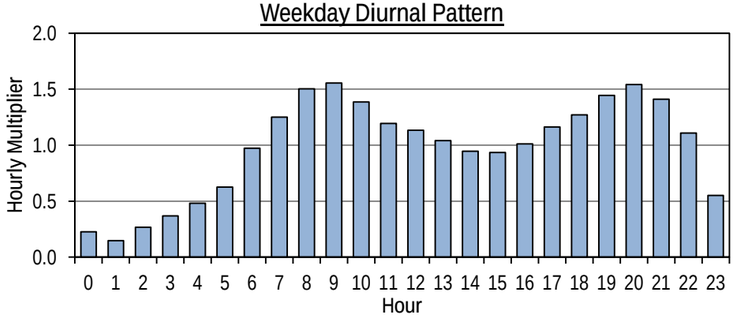
Note:

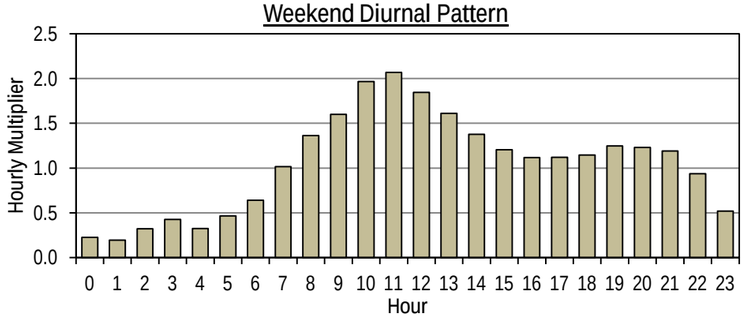
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7









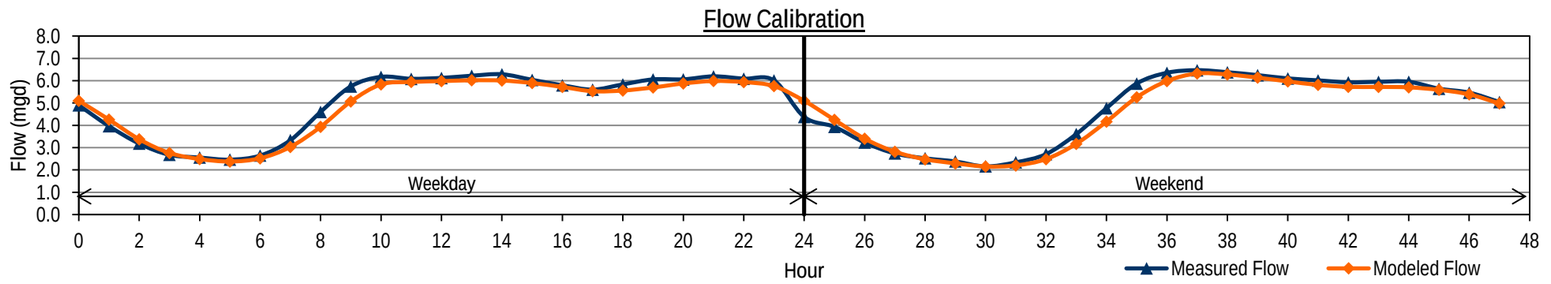


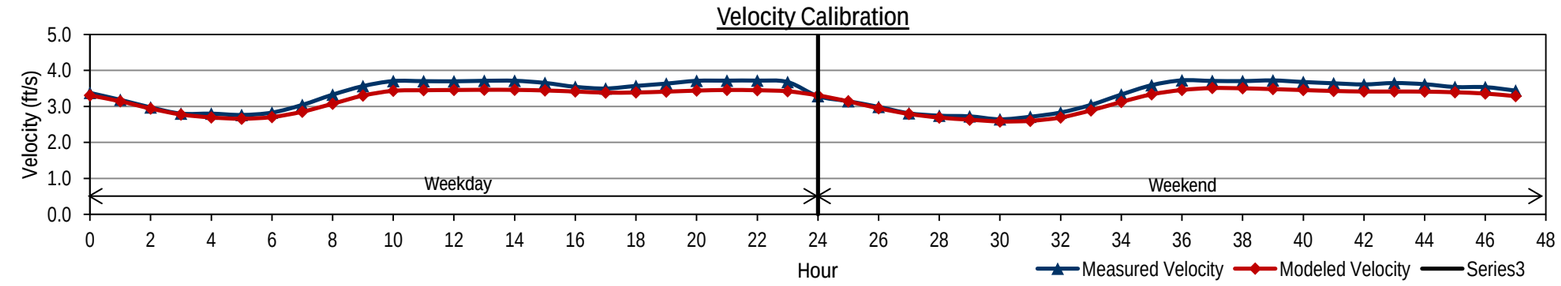
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR09 BASE WASTEWATER FLOW CALIBRATION

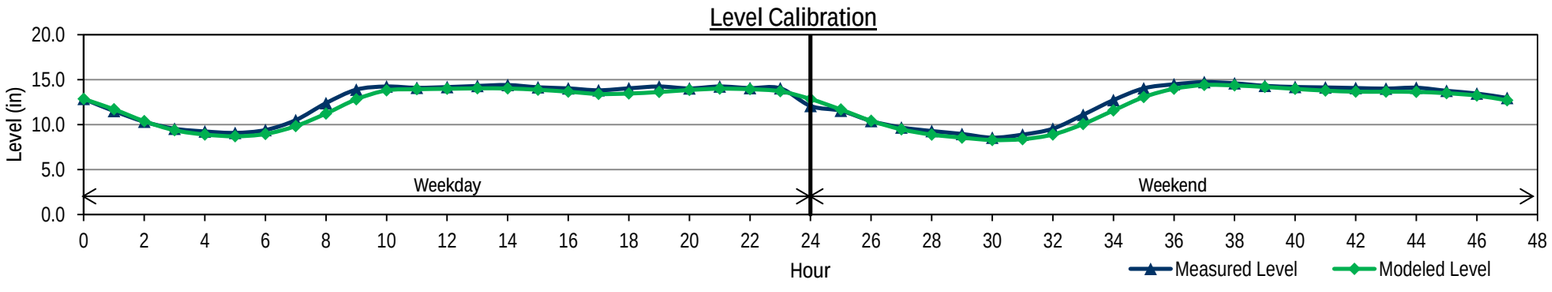
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Calibrated Diurnal
Weekday	0	4.899	12.9	3.38	5.098	12.9	3.31	0.66
	1	3.962	11.5	3.19	4.255	11.7	3.14	0.52
	2	3.182	10.3	2.97	3.371	10.4	2.94	0.46
	3	2.679	9.5	2.80	2.757	9.4	2.78	0.48
	4	2.559	9.2	2.80	2.485	8.9	2.69	0.49
	5	2.465	9.1	2.76	2.374	8.7	2.66	0.56
	6	2.647	9.4	2.83	2.518	9.0	2.70	0.77
	7	3.335	10.5	3.04	3.028	9.8	2.85	1.12
	8	4.599	12.4	3.33	3.930	11.2	3.07	1.33
	9	5.742	13.9	3.57	5.068	12.8	3.30	1.32
	10	6.168	14.2	3.71	5.834	13.8	3.43	1.26
	11	6.082	14.1	3.70	5.944	13.9	3.45	1.25
	12	6.121	14.2	3.70	5.981	14.0	3.46	1.26
	13	6.220	14.3	3.71	6.020	14.0	3.46	1.30
	14	6.285	14.4	3.71	6.008	14.0	3.46	1.22
	15	6.035	14.2	3.65	5.896	13.9	3.44	1.15
	16	5.792	14.0	3.55	5.720	13.7	3.42	1.12
	17	5.599	13.8	3.50	5.528	13.4	3.38	1.22
	18	5.832	14.0	3.57	5.559	13.5	3.39	1.29
	19	6.055	14.2	3.64	5.697	13.6	3.41	1.25
	20	6.057	14.0	3.71	5.876	13.9	3.44	1.26
	21	6.191	14.2	3.72	5.987	14.0	3.46	1.22
	22	6.087	14.1	3.72	5.937	13.9	3.45	1.20
	23	6.010	14.0	3.68	5.759	13.7	3.42	0.88
Weekend	24	4.375	12.1	3.29	5.094	12.9	3.31	0.65
	25	3.933	11.5	3.15	4.245	11.7	3.14	0.53
	26	3.230	10.4	2.99	3.398	10.4	2.95	0.46
	27	2.742	9.7	2.81	2.812	9.5	2.79	0.47
	28	2.524	9.3	2.74	2.473	8.9	2.69	0.47
	29	2.383	9.0	2.73	2.291	8.6	2.63	0.43
	30	2.162	8.6	2.64	2.150	8.3	2.58	0.52
	31	2.344	8.9	2.71	2.198	8.4	2.60	0.64
	32	2.711	9.6	2.83	2.481	8.9	2.69	0.89
	33	3.606	11.1	3.04	3.167	10.1	2.89	1.17
	34	4.767	12.7	3.33	4.164	11.6	3.12	1.36
	35	5.870	14.0	3.59	5.254	13.1	3.34	1.37
	36	6.349	14.5	3.73	5.983	14.0	3.46	1.30
	37	6.466	14.7	3.71	6.325	14.4	3.51	1.24
	38	6.377	14.6	3.71	6.281	14.4	3.50	1.19
	39	6.246	14.3	3.72	6.139	14.2	3.48	1.17
	40	6.099	14.2	3.68	5.969	14.0	3.46	1.19
	41	6.012	14.1	3.64	5.812	13.8	3.43	1.20
	42	5.925	14.1	3.61	5.724	13.7	3.42	1.22
	43	5.947	14.0	3.65	5.721	13.7	3.42	1.23
	44	5.950	14.1	3.62	5.702	13.6	3.41	1.11
	45	5.639	13.8	3.54	5.590	13.5	3.39	1.06
	46	5.463	13.5	3.54	5.387	13.2	3.36	0.95
	47	5.044	13.0	3.44	4.982	12.7	3.29	0.69
Average								
Weekday		5.025	12.8	3.41	4.860	12.4	3.23	1.02
Weekend		4.673	12.3	3.31	4.556	12.0	3.16	0.94
ADWF[1]		4.925	12.6	3.38	4.773	12.3	3.21	1.00
% Error								
Weekday					-3.3%	-2.8%	-5.4%	
Weekend					-2.5%	-2.8%	-4.5%	

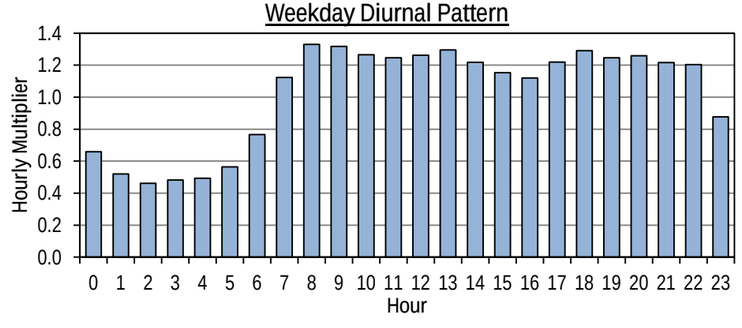
Note:

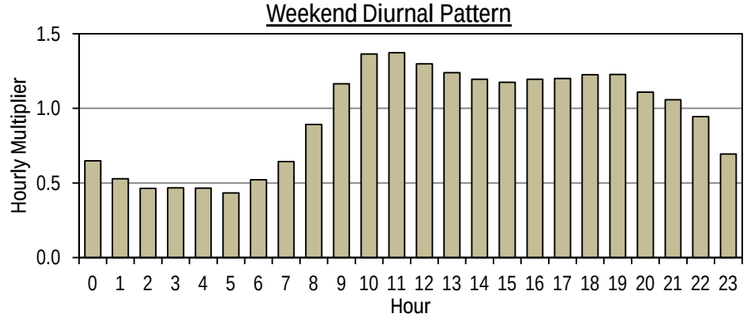
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7









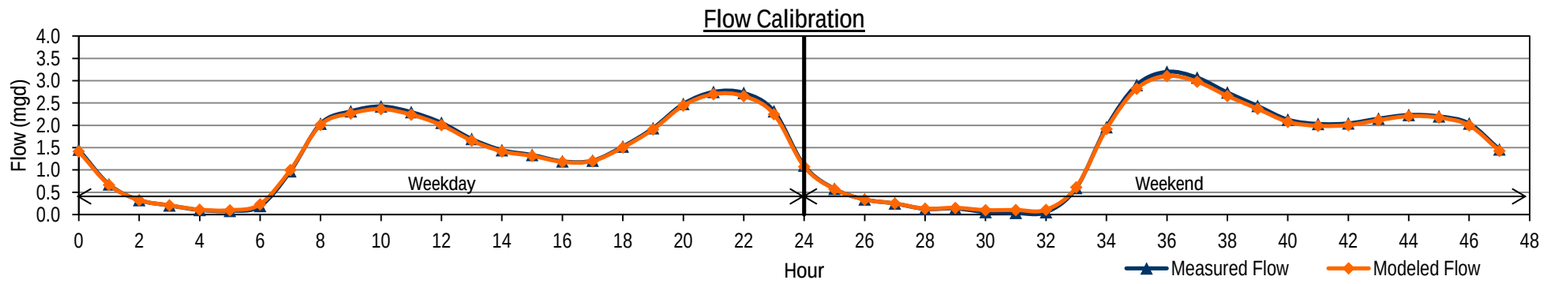


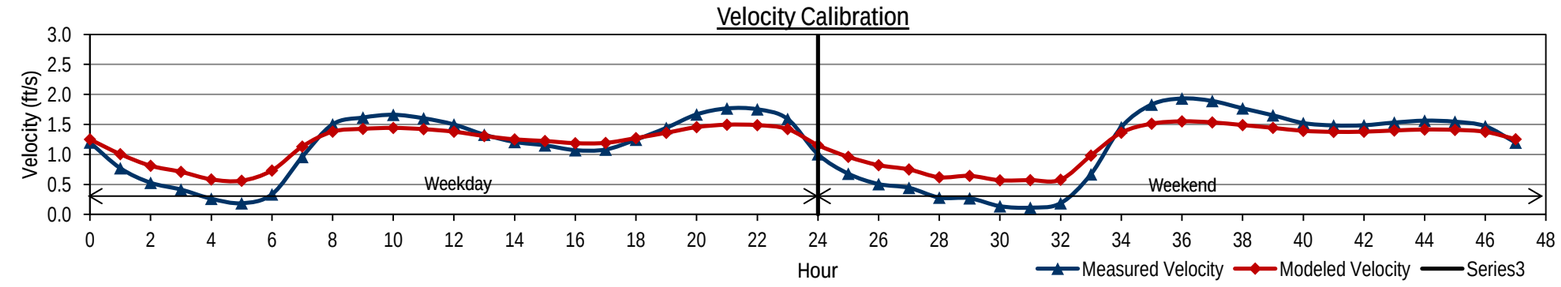
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR10 BASE WASTEWATER FLOW CALIBRATION

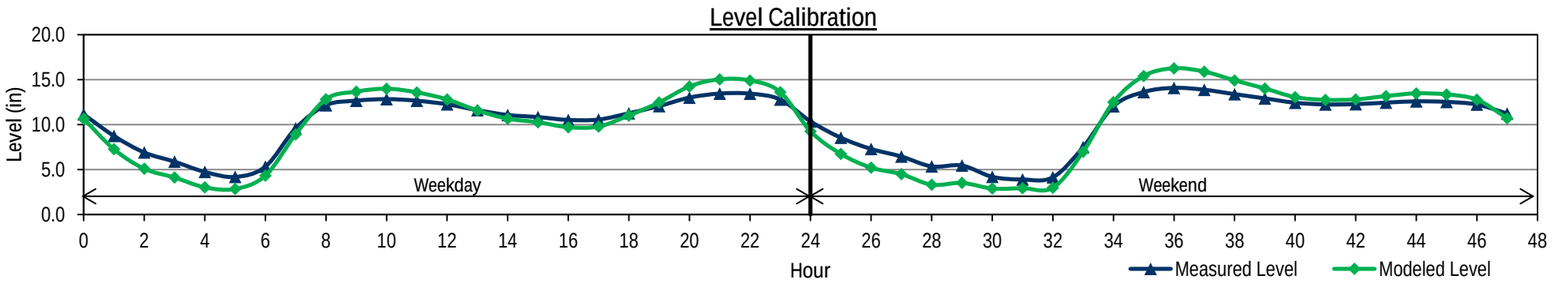
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Calibrated Diurnal
Weekday	0	1.456	11.1	1.20	1.415	10.7	1.25	0.98
	1	0.678	8.8	0.77	0.663	7.3	1.00	0.45
	2	0.326	6.9	0.53	0.321	5.1	0.81	0.22
	3	0.206	5.9	0.41	0.205	4.1	0.71	0.14
	4	0.105	4.8	0.26	0.108	3.0	0.58	0.07
	5	0.084	4.2	0.19	0.095	2.9	0.56	0.06
	6	0.193	5.3	0.33	0.228	4.3	0.73	0.13
	7	0.972	9.6	0.96	0.997	8.9	1.13	0.65
	8	2.038	12.2	1.50	2.010	12.8	1.38	1.37
	9	2.317	12.7	1.61	2.264	13.7	1.43	1.55
	10	2.425	12.8	1.66	2.364	14.0	1.44	1.63
	11	2.298	12.7	1.60	2.238	13.6	1.42	1.54
	12	2.058	12.3	1.50	2.004	12.8	1.38	1.38
	13	1.696	11.6	1.33	1.656	11.6	1.31	1.14
	14	1.444	11.1	1.21	1.415	10.7	1.25	0.97
	15	1.337	10.8	1.15	1.313	10.3	1.22	0.90
	16	1.194	10.5	1.07	1.178	9.7	1.19	0.80
	17	1.210	10.6	1.08	1.197	9.8	1.19	0.81
	18	1.526	11.3	1.25	1.503	11.0	1.27	1.02
	19	1.937	12.1	1.44	1.908	12.5	1.36	1.30
	20	2.481	13.0	1.67	2.442	14.2	1.45	1.66
	21	2.750	13.4	1.77	2.697	15.0	1.49	1.84
	22	2.728	13.4	1.75	2.655	14.9	1.49	1.83
	23	2.317	12.8	1.59	2.248	13.6	1.42	1.55
Weekend	24	1.100	10.4	1.00	1.072	9.3	1.15	0.74
	25	0.578	8.5	0.68	0.568	6.7	0.96	0.39
	26	0.341	7.3	0.51	0.335	5.2	0.82	0.23
	27	0.250	6.5	0.44	0.247	4.5	0.75	0.17
	28	0.129	5.4	0.28	0.131	3.3	0.62	0.09
	29	0.139	5.5	0.27	0.148	3.5	0.64	0.09
	30	0.058	4.2	0.14	0.098	2.9	0.57	0.04
	31	0.039	3.9	0.11	0.101	2.9	0.57	0.03
	32	0.055	4.2	0.19	0.105	3.0	0.58	0.04
	33	0.596	7.5	0.67	0.611	7.0	0.98	0.40
	34	1.960	12.0	1.45	1.918	12.5	1.36	1.31
	35	2.904	13.6	1.83	2.820	15.4	1.51	1.95
	36	3.201	14.1	1.93	3.103	16.2	1.55	2.15
	37	3.070	13.9	1.89	2.977	15.9	1.53	2.06
	38	2.737	13.4	1.77	2.658	14.9	1.49	1.83
	39	2.437	12.9	1.65	2.370	14.0	1.44	1.63
	40	2.129	12.4	1.52	2.077	13.0	1.39	1.43
	41	2.033	12.2	1.48	1.988	12.7	1.38	1.36
	42	2.045	12.3	1.49	2.004	12.8	1.38	1.37
	43	2.152	12.4	1.53	2.114	13.2	1.40	1.44
	44	2.233	12.6	1.56	2.204	13.5	1.41	1.50
	45	2.202	12.5	1.55	2.171	13.3	1.41	1.48
	46	2.042	12.2	1.47	1.997	12.8	1.38	1.37
	47	1.462	11.2	1.20	1.427	10.7	1.25	0.98
Average								
Weekday		1.491	10.4	1.16	1.464	10.3	1.19	1.00
Weekend		1.496	10.0	1.11	1.469	10.0	1.15	1.00
ADWF[1]		1.492	10.3	1.15	1.465	10.2	1.17	1.00
% Error								
Weekday					-1.8%	-1.4%	2.3%	
Weekend					-1.8%	-0.7%	3.4%	

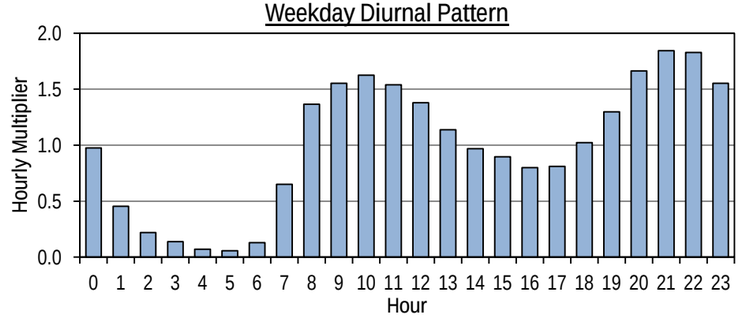
Note:

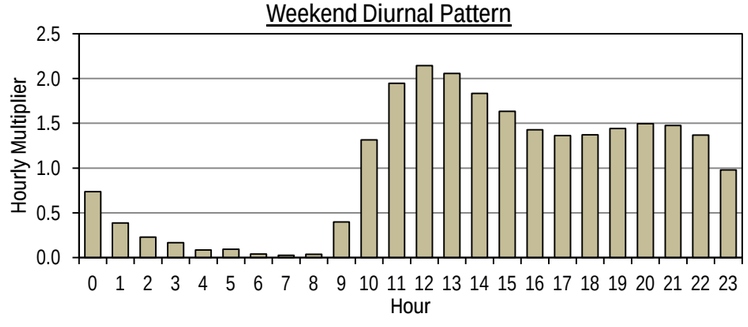
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







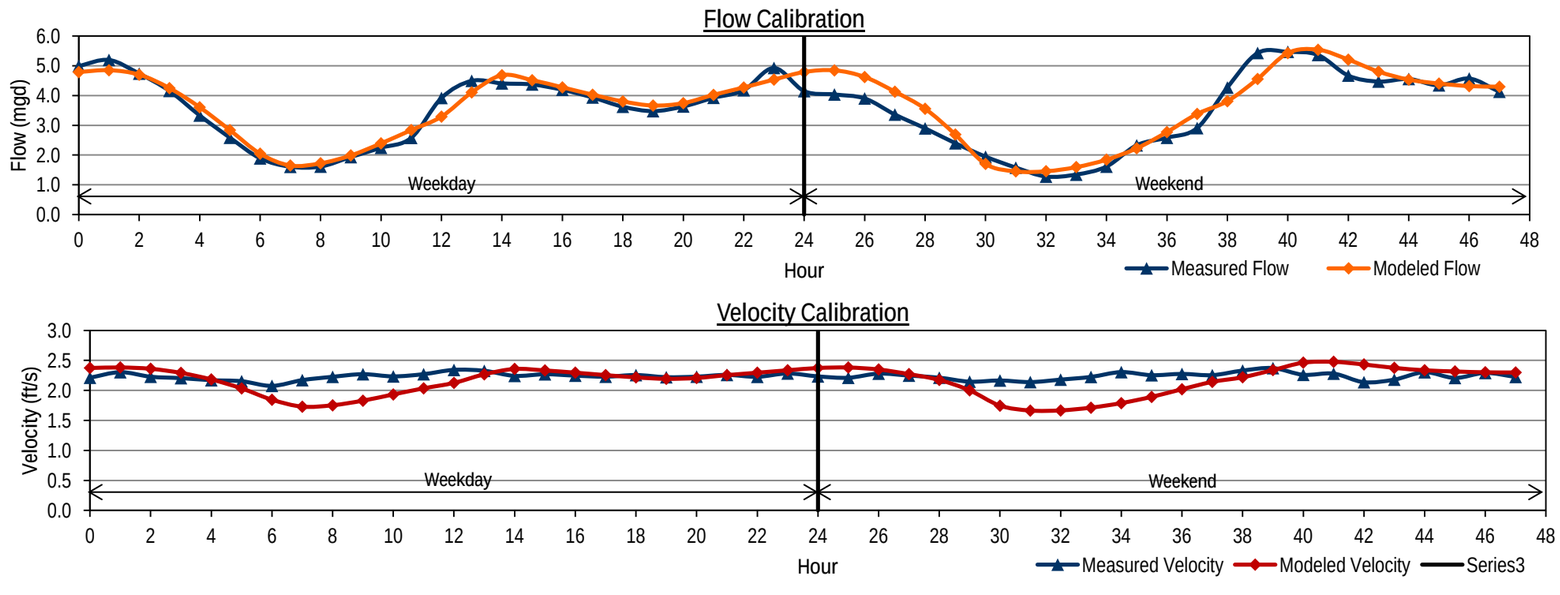


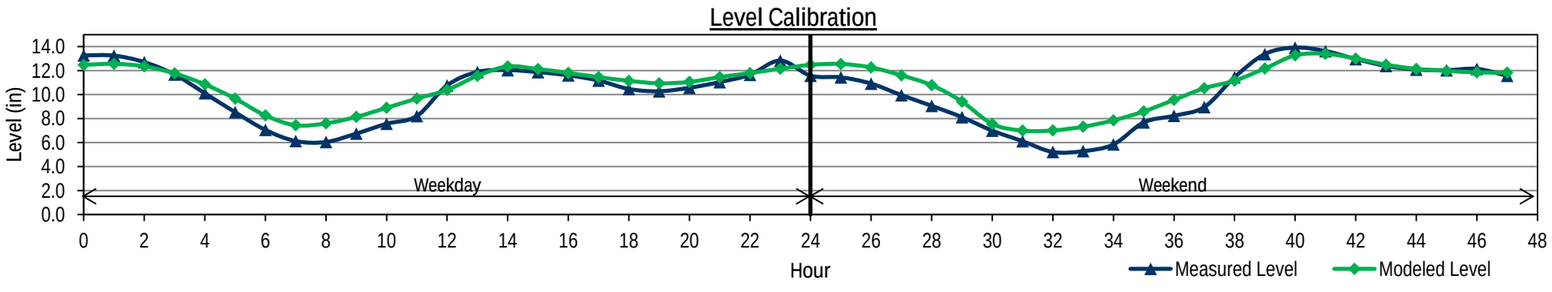


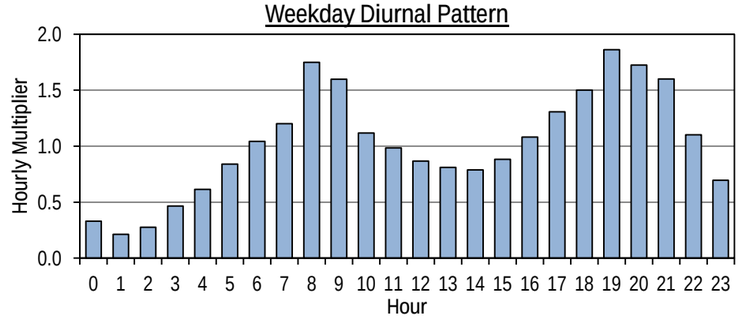
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR11 BASE WASTEWATER FLOW CALIBRATION

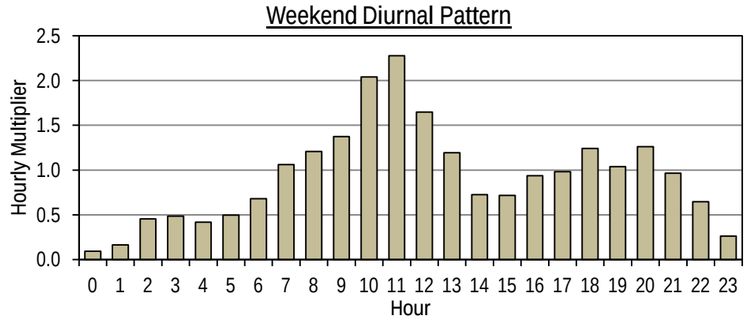
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Calibrated Diurnal
Weekday	0	4.997	13.3	2.21	4.790	12.5	2.37	0.33
	1	5.199	13.2	2.30	4.851	12.6	2.38	0.21
	2	4.738	12.7	2.23	4.700	12.4	2.36	0.28
	3	4.157	11.7	2.20	4.249	11.8	2.29	0.47
	4	3.330	10.1	2.17	3.607	10.9	2.18	0.61
	5	2.583	8.5	2.15	2.839	9.7	2.03	0.84
	6	1.889	7.1	2.08	2.047	8.3	1.84	1.04
	7	1.605	6.1	2.17	1.650	7.5	1.73	1.20
	8	1.612	6.1	2.23	1.725	7.6	1.75	1.75
	9	1.932	6.8	2.27	1.989	8.1	1.83	1.60
	10	2.244	7.6	2.23	2.394	8.9	1.93	1.12
	11	2.578	8.2	2.27	2.841	9.7	2.03	0.98
	12	3.920	10.8	2.34	3.292	10.4	2.13	0.87
	13	4.496	11.9	2.33	4.106	11.6	2.27	0.81
	14	4.410	12.0	2.24	4.683	12.3	2.36	0.79
	15	4.374	11.9	2.27	4.516	12.1	2.33	0.88
	16	4.195	11.6	2.25	4.275	11.8	2.30	1.08
	17	3.937	11.2	2.23	4.028	11.5	2.26	1.31
	18	3.625	10.5	2.26	3.802	11.1	2.22	1.50
	19	3.477	10.3	2.22	3.664	10.9	2.19	1.86
	20	3.634	10.6	2.23	3.744	11.1	2.21	1.72
	21	3.926	11.0	2.26	4.023	11.5	2.26	1.60
	22	4.181	11.7	2.23	4.271	11.8	2.30	1.10
	23	4.929	12.8	2.28	4.536	12.2	2.34	0.70
Weekend	24	4.149	11.6	2.23	4.790	12.5	2.37	0.09
	25	4.037	11.4	2.21	4.846	12.6	2.38	0.16
	26	3.904	10.9	2.28	4.623	12.3	2.35	0.46
	27	3.362	10.0	2.25	4.129	11.6	2.27	0.49
	28	2.897	9.1	2.21	3.556	10.8	2.17	0.42
	29	2.396	8.1	2.15	2.691	9.4	2.00	0.50
	30	1.944	7.0	2.17	1.703	7.6	1.75	0.68
	31	1.576	6.1	2.14	1.453	7.0	1.66	1.06
	32	1.275	5.2	2.18	1.457	7.0	1.67	1.21
	33	1.341	5.3	2.22	1.596	7.3	1.71	1.37
	34	1.611	5.9	2.30	1.846	7.9	1.79	2.04
	35	2.327	7.7	2.25	2.228	8.6	1.89	2.28
	36	2.581	8.2	2.27	2.773	9.6	2.02	1.65
	37	2.907	9.0	2.25	3.383	10.5	2.14	1.19
	38	4.270	11.4	2.33	3.810	11.2	2.22	0.73
	39	5.432	13.4	2.37	4.557	12.2	2.34	0.72
	40	5.471	13.9	2.26	5.428	13.3	2.46	0.94
	41	5.366	13.6	2.28	5.539	13.4	2.48	0.98
	42	4.673	13.0	2.14	5.207	13.0	2.43	1.24
	43	4.472	12.4	2.18	4.803	12.5	2.38	1.04
	44	4.558	12.1	2.30	4.534	12.1	2.34	1.26
	45	4.345	12.0	2.21	4.403	12.0	2.32	0.97
	46	4.574	12.1	2.29	4.317	11.9	2.30	0.65
	47	4.129	11.6	2.22	4.297	11.8	2.30	0.26
Average								
	Weekday	3.582	10.3	2.23	3.609	10.8	2.16	1.03
	Weekend	3.483	10.0	2.24	3.665	10.7	2.16	0.93
	ADWF[1]	3.554	10.2	2.24	3.625	10.8	2.16	1.00
% Error								
	Weekday				0.8%	4.3%	-3.3%	
	Weekend				5.2%	7.0%	-3.7%	

Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7





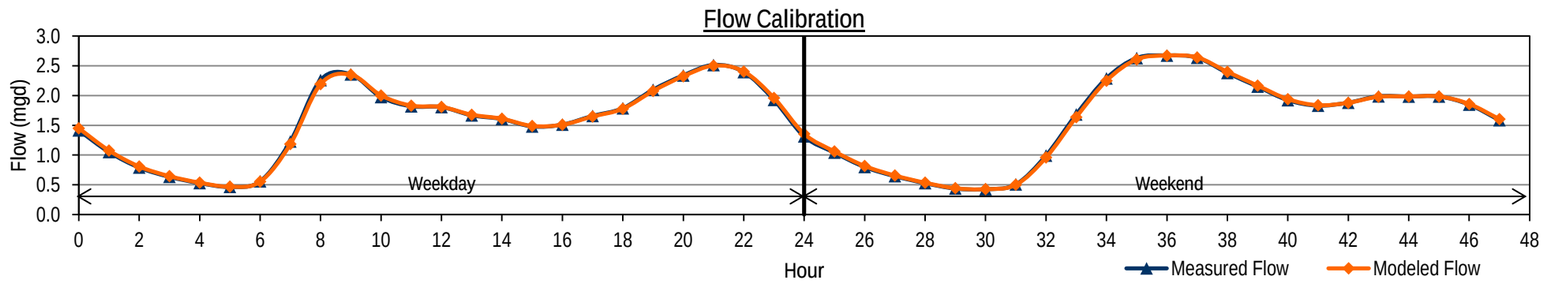


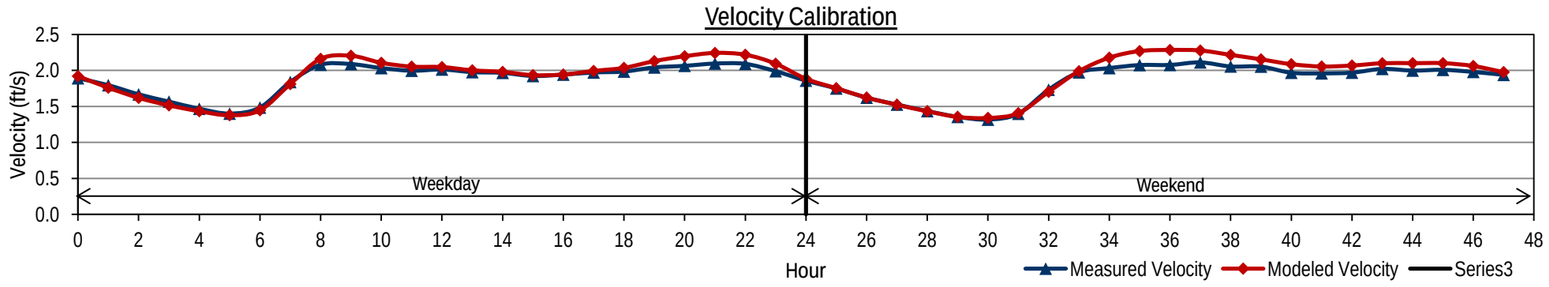


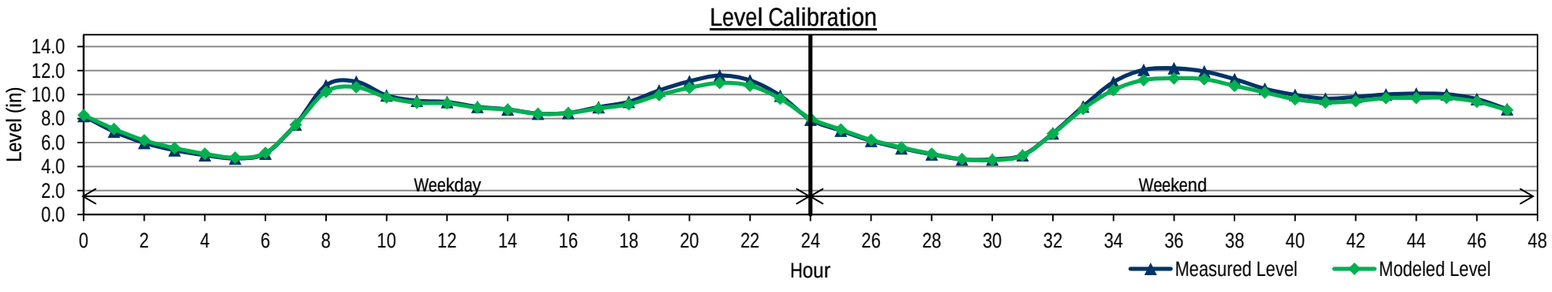
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR12 BASE WASTEWATER FLOW CALIBRATION

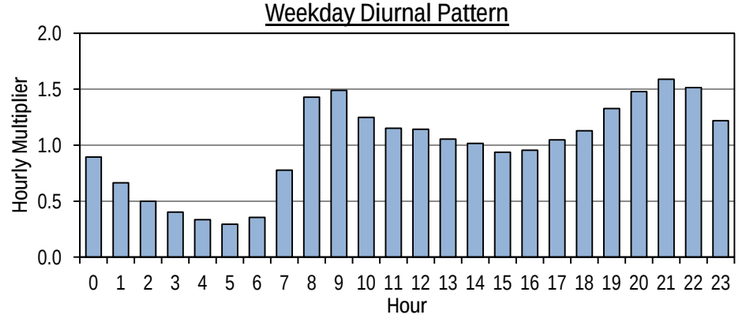
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Calibrated Diurnal
Weekday	0	1.415	8.2	1.89	1.450	8.3	1.92	0.89
	1	1.051	6.9	1.80	1.076	7.1	1.76	0.66
	2	0.791	6.0	1.67	0.808	6.2	1.62	0.50
	3	0.635	5.4	1.57	0.646	5.6	1.52	0.40
	4	0.530	5.0	1.47	0.537	5.1	1.43	0.33
	5	0.466	4.7	1.40	0.469	4.8	1.38	0.29
	6	0.559	5.1	1.48	0.554	5.1	1.45	0.35
	7	1.229	7.5	1.84	1.185	7.5	1.81	0.78
	8	2.260	10.8	2.08	2.192	10.2	2.16	1.43
	9	2.356	11.1	2.09	2.351	10.6	2.20	1.49
	10	1.975	9.9	2.03	2.001	9.8	2.11	1.25
	11	1.819	9.5	2.00	1.830	9.3	2.05	1.15
	12	1.807	9.4	2.01	1.809	9.3	2.05	1.14
	13	1.667	9.0	1.98	1.677	8.9	2.00	1.05
	14	1.606	8.8	1.97	1.611	8.7	1.98	1.02
	15	1.481	8.4	1.92	1.489	8.4	1.93	0.94
	16	1.512	8.5	1.94	1.510	8.5	1.94	0.96
	17	1.658	9.0	1.97	1.648	8.8	1.99	1.05
	18	1.786	9.4	1.98	1.778	9.2	2.04	1.13
	19	2.098	10.3	2.04	2.077	10.0	2.13	1.33
	20	2.338	11.1	2.06	2.324	10.6	2.20	1.48
	21	2.513	11.6	2.10	2.502	11.0	2.24	1.59
	22	2.395	11.2	2.09	2.403	10.7	2.22	1.51
	23	1.928	9.9	1.99	1.960	9.7	2.09	1.22
Weekend	24	1.315	7.9	1.86	1.356	8.0	1.88	0.83
	25	1.042	7.0	1.75	1.061	7.1	1.75	0.66
	26	0.800	6.1	1.62	0.817	6.2	1.62	0.51
	27	0.646	5.5	1.53	0.657	5.6	1.52	0.41
	28	0.529	5.0	1.44	0.536	5.1	1.43	0.33
	29	0.438	4.6	1.35	0.444	4.6	1.36	0.28
	30	0.427	4.6	1.32	0.428	4.5	1.34	0.27
	31	0.507	5.0	1.40	0.502	4.9	1.41	0.32
	32	0.992	6.8	1.73	0.960	6.7	1.70	0.63
	33	1.683	9.0	1.97	1.637	8.8	1.99	1.06
	34	2.289	11.0	2.03	2.249	10.4	2.18	1.45
	35	2.630	12.1	2.07	2.608	11.2	2.27	1.66
	36	2.673	12.2	2.08	2.671	11.4	2.28	1.69
	37	2.636	11.9	2.11	2.640	11.3	2.28	1.67
	38	2.380	11.3	2.06	2.398	10.7	2.22	1.50
	39	2.152	10.5	2.05	2.167	10.2	2.15	1.36
	40	1.923	10.0	1.97	1.939	9.6	2.09	1.22
	41	1.830	9.7	1.96	1.837	9.3	2.05	1.16
	42	1.880	9.8	1.97	1.878	9.5	2.07	1.19
	43	1.987	10.0	2.02	1.980	9.7	2.10	1.26
	44	1.984	10.1	2.00	1.984	9.7	2.10	1.25
	45	1.985	10.0	2.01	1.985	9.7	2.10	1.25
	46	1.848	9.6	1.98	1.858	9.4	2.06	1.17
	47	1.587	8.8	1.94	1.604	8.7	1.98	1.00
Average								
	Weekday	1.578	8.6	1.89	1.579	8.5	1.93	1.00
	Weekend	1.590	8.7	1.84	1.592	8.4	1.91	1.01
	ADWF[1]	1.582	8.6	1.88	1.582	8.5	1.92	1.00
% Error								
	Weekday				0.0%	-1.6%	1.9%	
	Weekend				0.1%	-2.9%	3.9%	

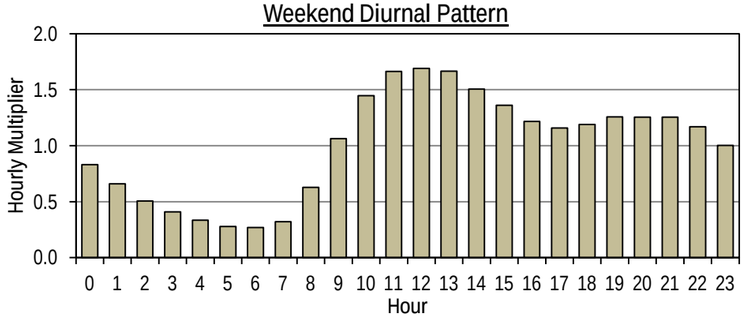
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







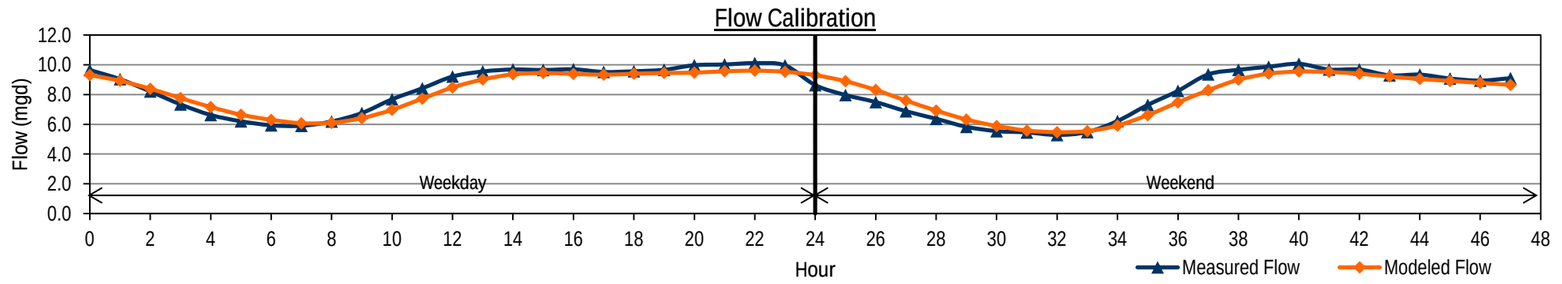


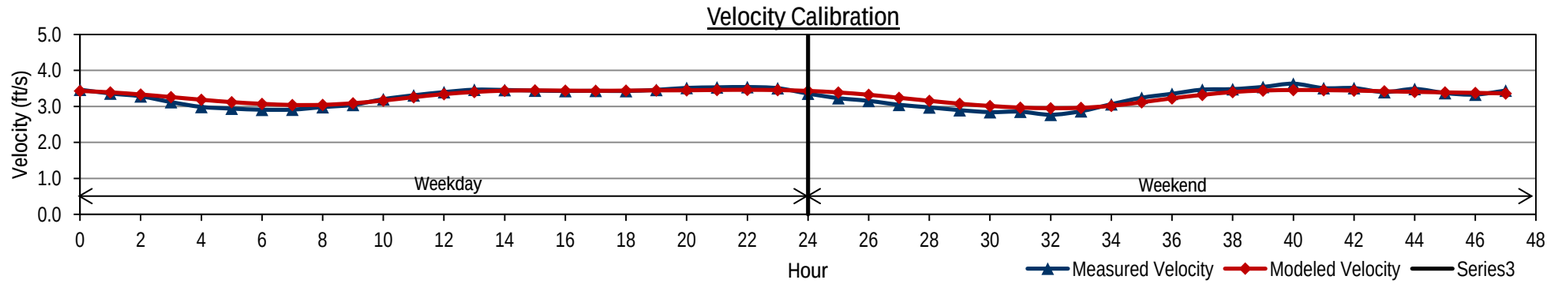


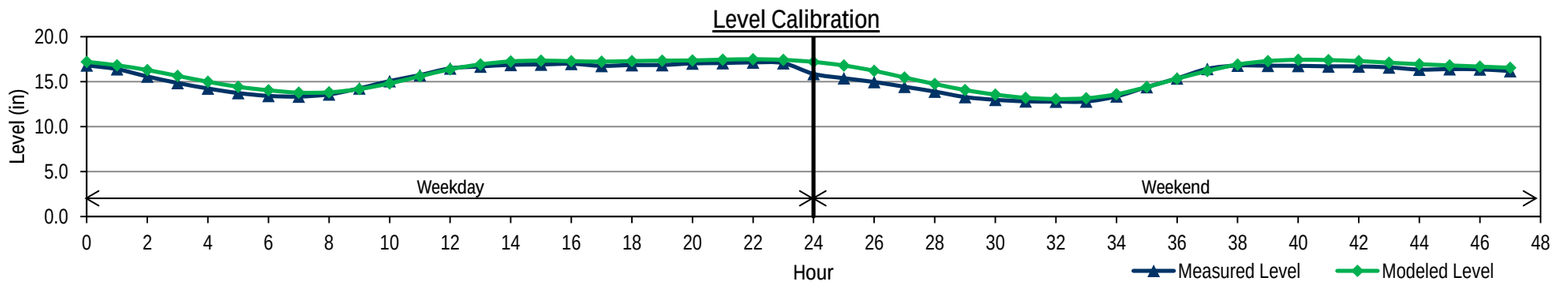
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR13 BASE WASTEWATER FLOW CALIBRATION

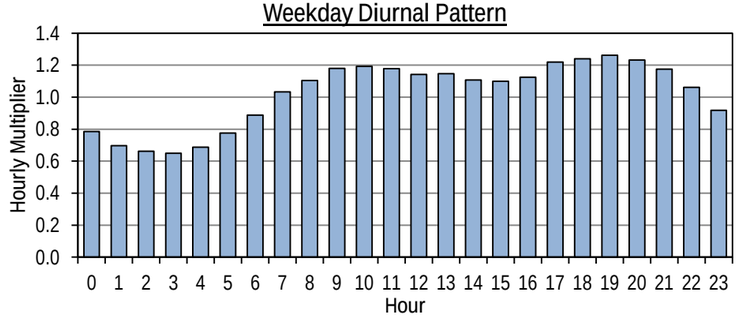
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	9.655	16.8	3.46	9.313	17.2	3.43	0.79
	1	9.037	16.4	3.36	8.931	16.8	3.39	0.70
	2	8.211	15.6	3.28	8.392	16.3	3.33	0.66
	3	7.339	14.8	3.12	7.765	15.6	3.26	0.65
	4	6.626	14.2	2.98	7.159	15.0	3.18	0.69
	5	6.203	13.7	2.94	6.644	14.4	3.12	0.78
	6	5.934	13.4	2.91	6.297	14.0	3.07	0.89
	7	5.898	13.3	2.91	6.071	13.8	3.04	1.03
	8	6.191	13.6	2.98	6.101	13.8	3.04	1.10
	9	6.758	14.2	3.04	6.411	14.2	3.09	1.18
	10	7.684	15.1	3.20	6.976	14.8	3.16	1.19
	11	8.423	15.7	3.31	7.727	15.6	3.25	1.18
	12	9.214	16.5	3.40	8.480	16.4	3.34	1.14
	13	9.555	16.7	3.46	9.020	16.9	3.40	1.15
	14	9.691	16.9	3.46	9.367	17.2	3.43	1.11
	15	9.656	16.9	3.44	9.454	17.3	3.44	1.10
	16	9.704	17.0	3.43	9.392	17.3	3.44	1.13
	17	9.524	16.7	3.43	9.339	17.2	3.43	1.22
	18	9.572	16.8	3.43	9.405	17.3	3.44	1.24
	19	9.671	16.8	3.46	9.456	17.3	3.44	1.26
	20	9.977	17.0	3.51	9.479	17.4	3.45	1.23
	21	10.028	17.1	3.53	9.572	17.4	3.45	1.18
	22	10.118	17.1	3.54	9.611	17.5	3.46	1.06
	23	9.964	17.0	3.51	9.537	17.4	3.45	0.92
Weekend	24	8.636	15.8	3.35	9.309	17.2	3.43	0.69
	25	7.971	15.4	3.23	8.901	16.8	3.39	0.64
	26	7.494	15.0	3.15	8.313	16.2	3.32	0.60
	27	6.880	14.4	3.04	7.596	15.5	3.24	0.60
	28	6.369	13.9	2.97	6.921	14.7	3.15	0.64
	29	5.830	13.3	2.89	6.319	14.1	3.07	0.64
	30	5.540	13.0	2.84	5.882	13.6	3.01	0.70
	31	5.452	12.8	2.85	5.576	13.2	2.96	0.84
	32	5.281	12.8	2.77	5.468	13.1	2.95	1.01
	33	5.478	12.8	2.87	5.538	13.2	2.96	1.12
	34	6.219	13.4	3.06	5.915	13.6	3.01	1.27
	35	7.302	14.4	3.24	6.617	14.4	3.11	1.24
	36	8.251	15.4	3.35	7.475	15.3	3.22	1.22
	37	9.359	16.4	3.46	8.291	16.2	3.32	1.22
	38	9.667	16.8	3.48	9.004	16.9	3.40	1.13
	39	9.874	16.8	3.54	9.409	17.3	3.44	1.13
	40	10.072	16.7	3.63	9.556	17.4	3.45	1.07
	41	9.687	16.7	3.51	9.521	17.4	3.45	1.10
	42	9.691	16.7	3.51	9.404	17.3	3.44	1.06
	43	9.295	16.6	3.40	9.216	17.1	3.42	1.04
	44	9.345	16.3	3.48	9.052	16.9	3.40	1.09
	45	9.083	16.4	3.37	8.919	16.8	3.39	0.96
	46	8.943	16.4	3.33	8.787	16.7	3.37	0.83
	47	9.107	16.2	3.44	8.652	16.5	3.36	0.77
Average								
	Weekday	8.526	15.8	3.29	8.329	16.2	3.31	1.02
	Weekend	7.951	15.2	3.24	7.902	15.7	3.26	0.94
	ADWF[1]	8.362	15.6	3.28	8.207	16.0	3.30	1.00
% Error								
	Weekday				-2.3%	2.3%	0.6%	
	Weekend				-0.6%	3.6%	0.6%	

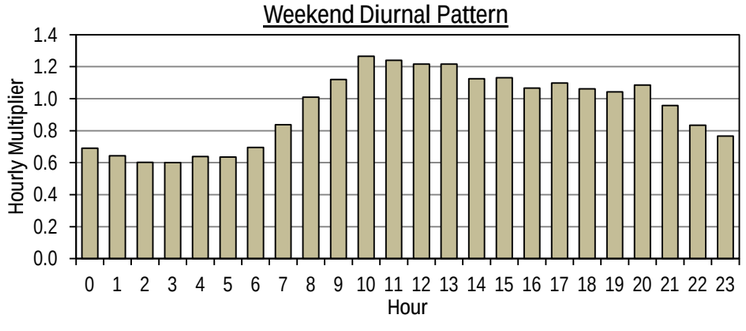
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







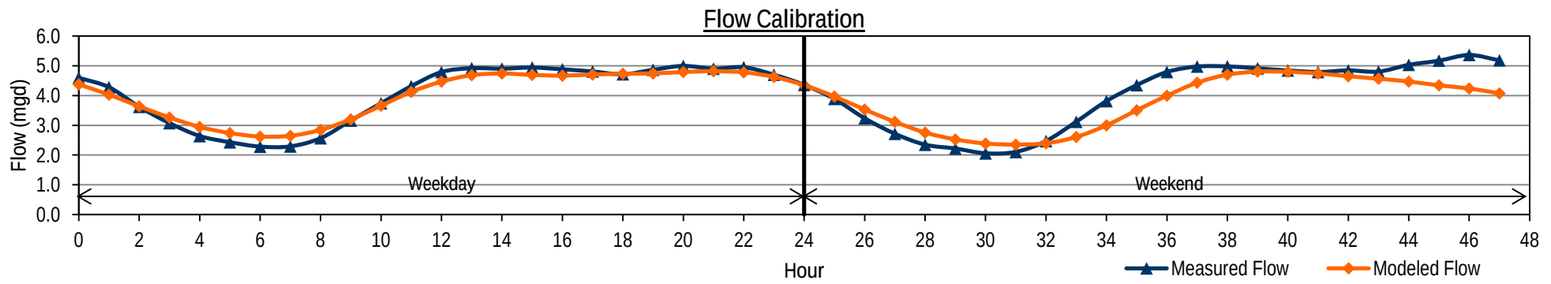


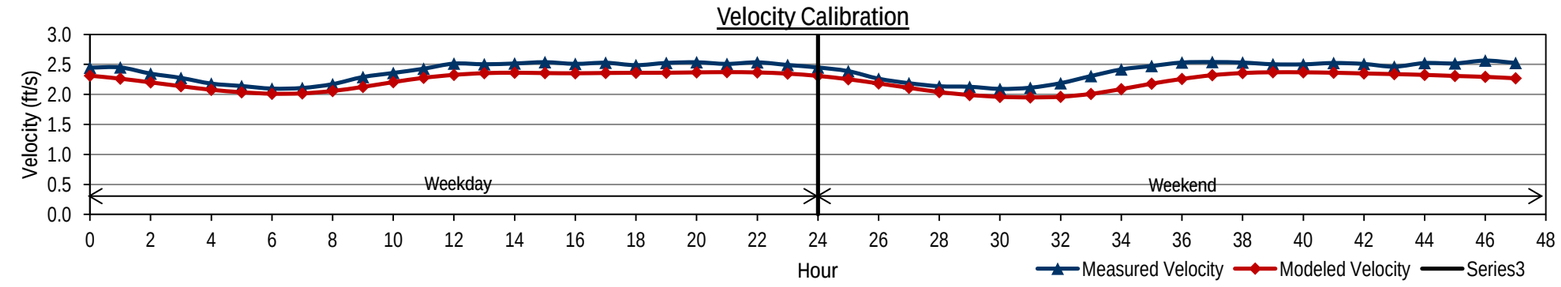


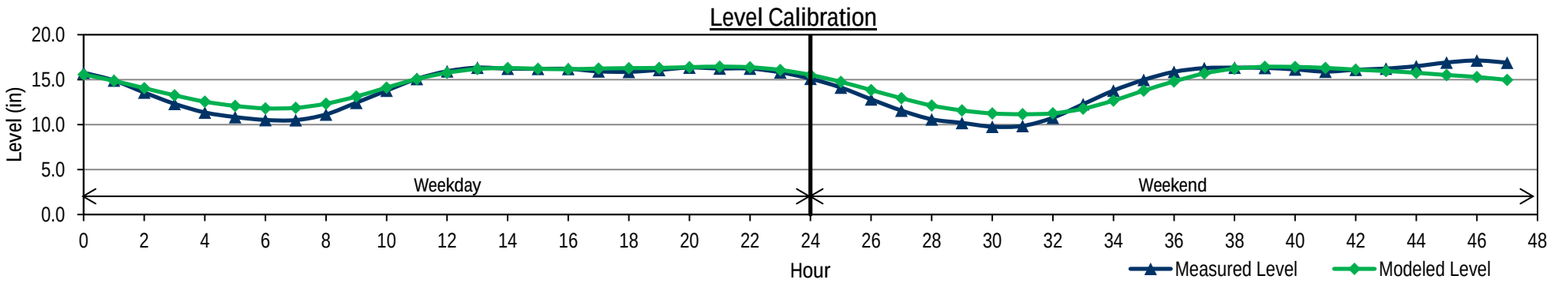
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR14 BASE WASTEWATER FLOW CALIBRATION

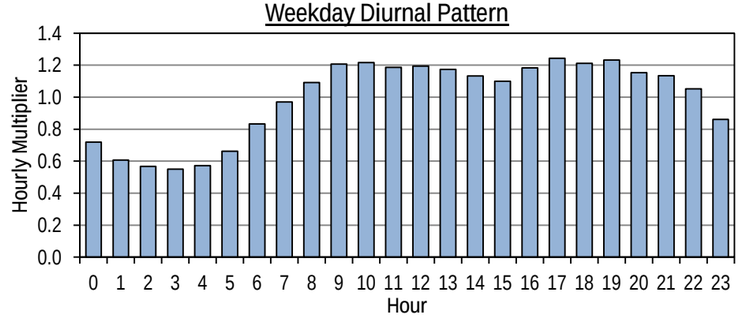
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Calibrated Diurnal
Weekday	0	4.599	15.8	2.45	4.376	15.6	2.31	0.72
	1	4.281	14.9	2.45	4.029	14.9	2.26	0.61
	2	3.620	13.6	2.35	3.635	14.1	2.20	0.57
	3	3.074	12.3	2.28	3.261	13.3	2.14	0.55
	4	2.639	11.3	2.18	2.943	12.6	2.08	0.57
	5	2.429	10.8	2.14	2.738	12.1	2.04	0.66
	6	2.282	10.5	2.10	2.620	11.8	2.01	0.83
	7	2.290	10.5	2.11	2.646	11.9	2.02	0.97
	8	2.566	11.1	2.17	2.844	12.3	2.06	1.09
	9	3.159	12.4	2.29	3.197	13.1	2.12	1.21
	10	3.743	13.8	2.36	3.658	14.1	2.20	1.22
	11	4.316	15.1	2.43	4.122	15.1	2.28	1.19
	12	4.793	15.9	2.51	4.468	15.8	2.33	1.20
	13	4.921	16.3	2.50	4.686	16.2	2.35	1.17
	14	4.906	16.2	2.52	4.741	16.3	2.36	1.13
	15	4.943	16.2	2.54	4.694	16.2	2.36	1.10
	16	4.884	16.2	2.51	4.669	16.2	2.35	1.18
	17	4.812	15.9	2.53	4.707	16.2	2.36	1.24
	18	4.717	15.9	2.49	4.732	16.3	2.36	1.21
	19	4.868	16.1	2.53	4.744	16.3	2.36	1.23
	20	4.998	16.3	2.54	4.790	16.4	2.37	1.15
	21	4.905	16.2	2.51	4.819	16.4	2.37	1.14
	22	4.953	16.2	2.54	4.780	16.4	2.37	1.05
	23	4.701	15.8	2.49	4.626	16.1	2.35	0.86
Weekend	24	4.359	15.1	2.45	4.348	15.5	2.31	0.59
	25	3.889	14.1	2.39	3.967	14.7	2.25	0.52
	26	3.235	12.8	2.26	3.529	13.8	2.18	0.52
	27	2.716	11.6	2.19	3.114	12.9	2.11	0.50
	28	2.347	10.6	2.14	2.754	12.1	2.04	0.55
	29	2.218	10.2	2.13	2.524	11.6	1.99	0.69
	30	2.056	9.8	2.09	2.386	11.2	1.96	0.91
	31	2.103	9.8	2.11	2.350	11.2	1.95	1.12
	32	2.470	10.8	2.19	2.393	11.3	1.96	1.23
	33	3.119	12.3	2.31	2.607	11.8	2.01	1.31
	34	3.815	13.8	2.42	2.997	12.7	2.09	1.30
	35	4.351	15.0	2.47	3.503	13.8	2.18	1.24
	36	4.795	15.9	2.53	3.995	14.8	2.26	1.18
	37	4.977	16.3	2.54	4.433	15.7	2.32	1.14
	38	4.983	16.3	2.53	4.701	16.2	2.36	1.13
	39	4.915	16.3	2.50	4.806	16.4	2.37	1.17
	40	4.845	16.1	2.50	4.798	16.4	2.37	1.17
	41	4.794	15.9	2.52	4.743	16.3	2.36	1.28
	42	4.847	16.1	2.51	4.648	16.1	2.35	1.34
	43	4.808	16.2	2.46	4.566	15.9	2.34	1.42
	44	5.034	16.5	2.52	4.471	15.8	2.33	1.36
	45	5.175	16.9	2.52	4.343	15.5	2.31	1.05
	46	5.367	17.1	2.57	4.237	15.3	2.29	0.91
	47	5.186	16.9	2.53	4.073	15.0	2.27	0.72
Average								
Weekday		4.058	14.4	2.40	4.022	14.8	2.25	0.99
Weekend		4.017	14.3	2.39	3.762	14.2	2.21	1.01
ADWF[1]		4.046	14.4	2.39	3.948	14.6	2.24	1.00
% Error								
Weekday					-0.9%	2.9%	-6.1%	
Weekend					-6.3%	-0.1%	-7.8%	

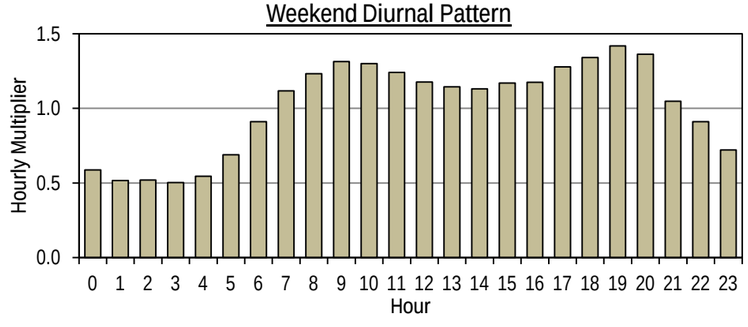
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







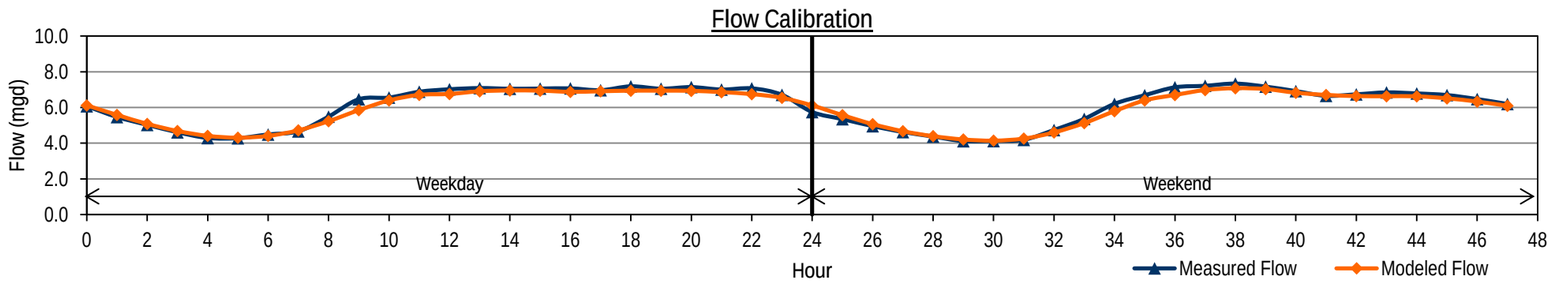


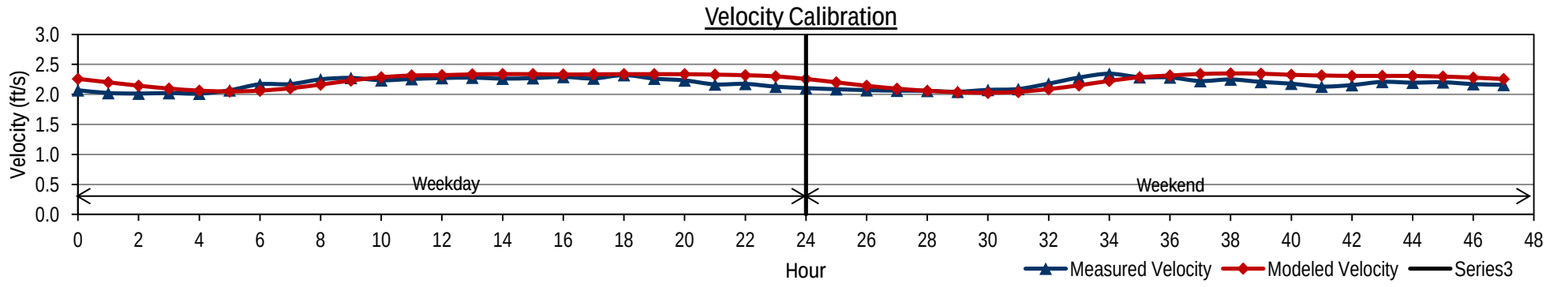


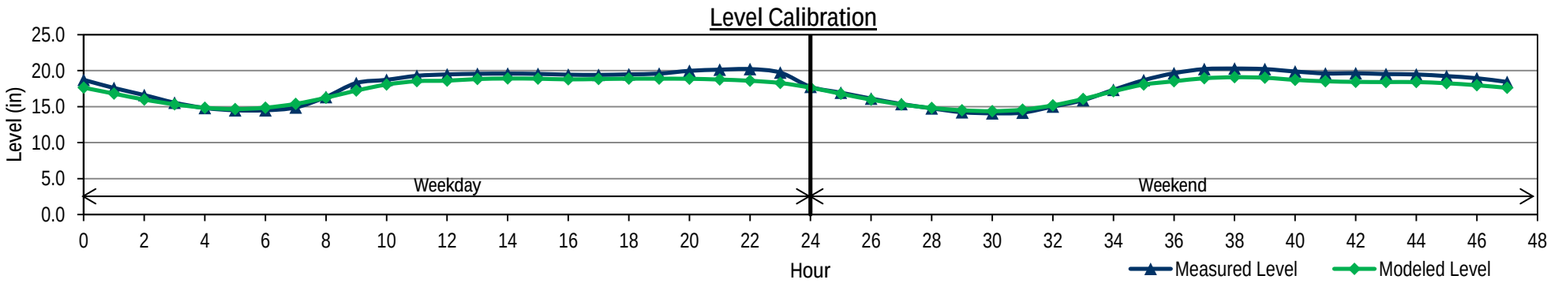
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR15 BASE WASTEWATER FLOW CALIBRATION

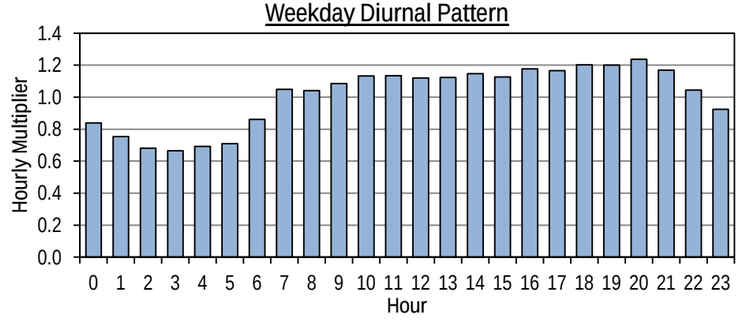
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	6.069	18.7	2.07	6.112	17.6	2.26	0.84
	1	5.461	17.6	2.02	5.580	16.8	2.20	0.75
	2	5.022	16.6	2.01	5.077	16.0	2.14	0.68
	3	4.608	15.5	2.02	4.679	15.3	2.10	0.67
	4	4.286	14.8	2.01	4.407	14.8	2.06	0.69
	5	4.275	14.5	2.07	4.304	14.7	2.05	0.71
	6	4.484	14.5	2.17	4.409	14.9	2.06	0.86
	7	4.660	14.9	2.17	4.716	15.4	2.10	1.05
	8	5.485	16.3	2.25	5.228	16.2	2.16	1.04
	9	6.460	18.3	2.28	5.847	17.2	2.23	1.09
	10	6.555	18.7	2.24	6.392	18.1	2.29	1.13
	11	6.882	19.3	2.26	6.701	18.5	2.32	1.13
	12	7.020	19.5	2.27	6.752	18.6	2.32	1.12
	13	7.087	19.6	2.28	6.902	18.8	2.33	1.12
	14	7.048	19.6	2.26	6.949	18.9	2.34	1.15
	15	7.059	19.6	2.27	6.937	18.9	2.34	1.13
	16	7.070	19.4	2.29	6.871	18.8	2.33	1.18
	17	6.968	19.4	2.27	6.904	18.8	2.33	1.17
	18	7.184	19.5	2.32	6.937	18.9	2.34	1.20
	19	7.051	19.6	2.26	6.935	18.9	2.34	1.20
	20	7.141	20.0	2.23	6.928	18.9	2.34	1.24
	21	7.004	20.1	2.17	6.853	18.8	2.33	1.17
	22	7.070	20.2	2.18	6.744	18.6	2.32	1.04
	23	6.707	19.7	2.13	6.538	18.3	2.30	0.92
Weekend	24	5.742	17.8	2.10	6.108	17.6	2.26	0.82
	25	5.344	16.9	2.09	5.568	16.8	2.20	0.75
	26	4.951	16.1	2.07	5.063	16.0	2.14	0.69
	27	4.621	15.4	2.06	4.668	15.3	2.09	0.62
	28	4.365	14.8	2.06	4.390	14.8	2.06	0.61
	29	4.111	14.2	2.04	4.205	14.5	2.03	0.61
	30	4.117	14.1	2.08	4.139	14.4	2.03	0.70
	31	4.184	14.2	2.09	4.255	14.6	2.04	0.82
	32	4.735	15.0	2.18	4.599	15.2	2.09	0.98
	33	5.358	15.9	2.28	5.122	16.1	2.15	1.07
	34	6.201	17.3	2.34	5.788	17.1	2.22	1.19
	35	6.685	18.7	2.29	6.393	18.1	2.29	1.20
	36	7.129	19.6	2.28	6.695	18.5	2.31	1.23
	37	7.214	20.2	2.22	6.973	18.9	2.34	1.19
	38	7.337	20.3	2.25	7.075	19.1	2.35	1.15
	39	7.168	20.2	2.21	7.027	19.0	2.35	1.09
	40	6.916	19.9	2.18	6.822	18.7	2.33	1.11
	41	6.651	19.6	2.13	6.698	18.5	2.32	1.14
	42	6.734	19.6	2.16	6.634	18.4	2.31	1.14
	43	6.844	19.5	2.21	6.625	18.4	2.31	1.14
	44	6.785	19.5	2.20	6.622	18.4	2.31	1.11
	45	6.694	19.2	2.20	6.507	18.3	2.30	1.06
	46	6.468	18.9	2.17	6.327	18.0	2.28	0.97
	47	6.194	18.4	2.16	6.091	17.6	2.26	0.90
Average								
Weekday		6.194	18.2	2.19	6.071	17.5	2.25	1.01
Weekend		5.939	17.7	2.17	5.850	17.2	2.22	0.97
ADWF[1]		6.121	18.0	2.18	6.008	17.4	2.24	1.00
% Error								
Weekday					-2.0%	-3.5%	2.7%	
Weekend					-1.5%	-3.1%	2.5%	

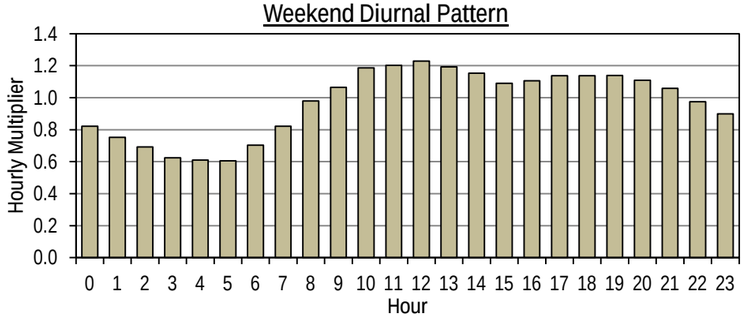
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







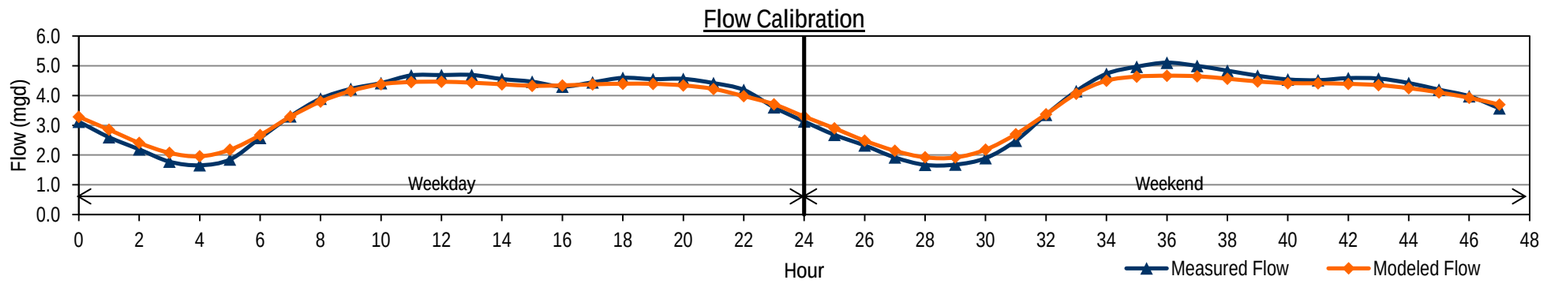


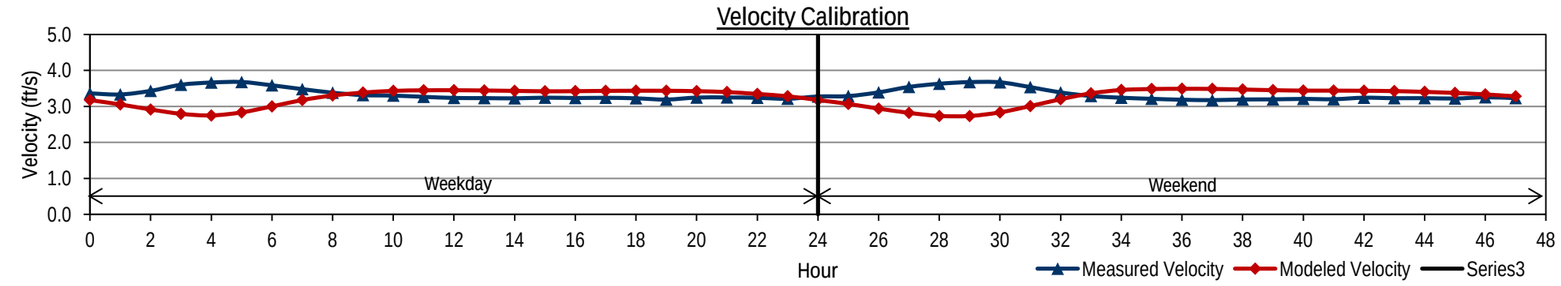


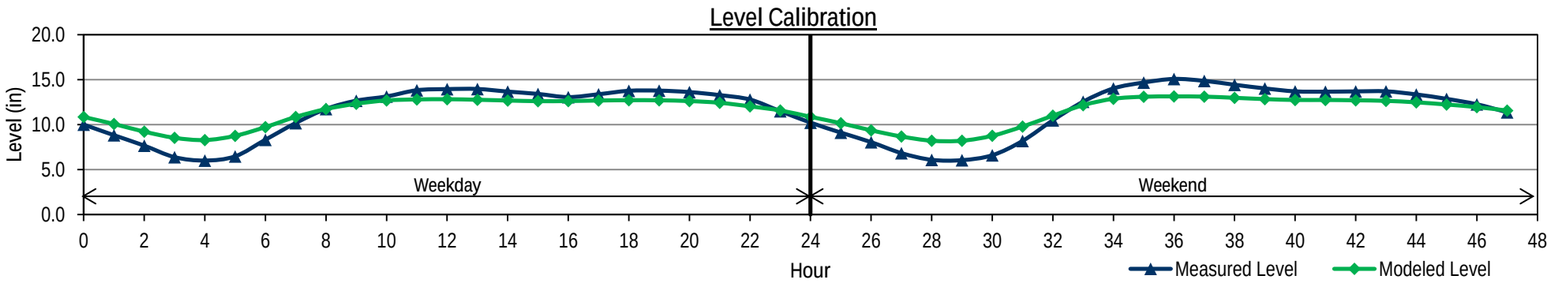
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR16 BASE WASTEWATER FLOW CALIBRATION

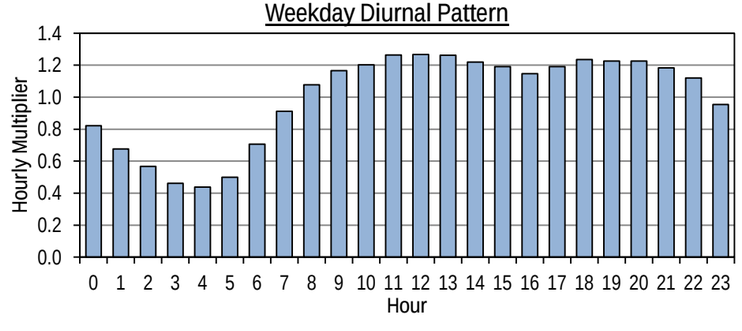
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	3.122	10.0	3.37	3.284	10.8	3.18	0.82
	1	2.601	8.8	3.33	2.853	10.1	3.06	0.68
	2	2.193	7.7	3.43	2.410	9.2	2.91	0.57
	3	1.781	6.4	3.60	2.076	8.5	2.79	0.46
	4	1.660	6.0	3.67	1.960	8.3	2.75	0.44
	5	1.853	6.5	3.68	2.181	8.7	2.83	0.50
	6	2.577	8.3	3.59	2.673	9.7	3.00	0.71
	7	3.304	10.2	3.48	3.288	10.8	3.18	0.91
	8	3.897	11.7	3.38	3.797	11.7	3.31	1.08
	9	4.225	12.6	3.32	4.153	12.3	3.39	1.17
	10	4.420	13.1	3.30	4.379	12.7	3.43	1.20
	11	4.677	13.8	3.27	4.452	12.8	3.45	1.26
	12	4.688	13.9	3.24	4.463	12.8	3.45	1.27
	13	4.692	14.0	3.23	4.430	12.8	3.45	1.26
	14	4.555	13.7	3.23	4.376	12.7	3.43	1.22
	15	4.466	13.4	3.25	4.326	12.6	3.42	1.19
	16	4.301	13.0	3.24	4.339	12.6	3.43	1.15
	17	4.445	13.4	3.24	4.374	12.7	3.43	1.19
	18	4.595	13.7	3.23	4.396	12.7	3.44	1.24
	19	4.551	13.8	3.19	4.391	12.7	3.44	1.23
	20	4.560	13.6	3.25	4.339	12.6	3.43	1.23
	21	4.419	13.3	3.25	4.220	12.4	3.40	1.18
	22	4.191	12.8	3.24	3.980	12.0	3.35	1.12
	23	3.607	11.5	3.22	3.707	11.6	3.28	0.95
Weekend	24	3.131	10.2	3.28	3.294	10.9	3.18	0.82
	25	2.682	9.1	3.29	2.900	10.2	3.07	0.70
	26	2.325	8.0	3.39	2.486	9.4	2.94	0.60
	27	1.923	6.8	3.54	2.146	8.7	2.82	0.50
	28	1.674	6.1	3.63	1.926	8.2	2.73	0.44
	29	1.682	6.0	3.68	1.922	8.2	2.73	0.45
	30	1.898	6.6	3.67	2.183	8.8	2.83	0.51
	31	2.482	8.2	3.54	2.702	9.8	3.01	0.68
	32	3.354	10.5	3.39	3.372	11.0	3.20	0.93
	33	4.148	12.5	3.29	4.059	12.2	3.37	1.15
	34	4.731	14.0	3.24	4.497	12.9	3.46	1.31
	35	4.968	14.7	3.21	4.634	13.1	3.49	1.37
	36	5.104	15.1	3.19	4.664	13.1	3.49	1.40
	37	4.997	14.9	3.18	4.646	13.1	3.49	1.36
	38	4.836	14.4	3.20	4.564	13.0	3.47	1.30
	39	4.668	14.0	3.20	4.471	12.8	3.45	1.25
	40	4.542	13.7	3.21	4.414	12.7	3.44	1.22
	41	4.517	13.7	3.20	4.411	12.7	3.44	1.21
	42	4.586	13.7	3.24	4.391	12.7	3.44	1.23
	43	4.572	13.7	3.23	4.349	12.6	3.43	1.23
	44	4.422	13.3	3.23	4.247	12.5	3.41	1.18
	45	4.198	12.9	3.22	4.104	12.2	3.38	1.12
	46	3.978	12.3	3.26	3.924	11.9	3.34	1.05
	47	3.572	11.4	3.23	3.697	11.6	3.28	0.94
Average								
Weekday		3.724	11.5	3.34	3.702	11.5	3.26	1.00
Weekend		3.708	11.5	3.32	3.667	11.4	3.24	1.00
ADWF[1]		3.720	11.5	3.34	3.692	11.5	3.26	1.00
% Error								
Weekday					-0.6%	0.3%	-2.5%	
Weekend					-1.1%	-0.5%	-2.3%	

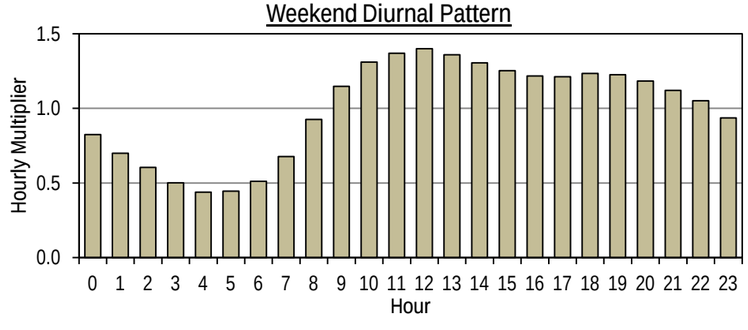
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







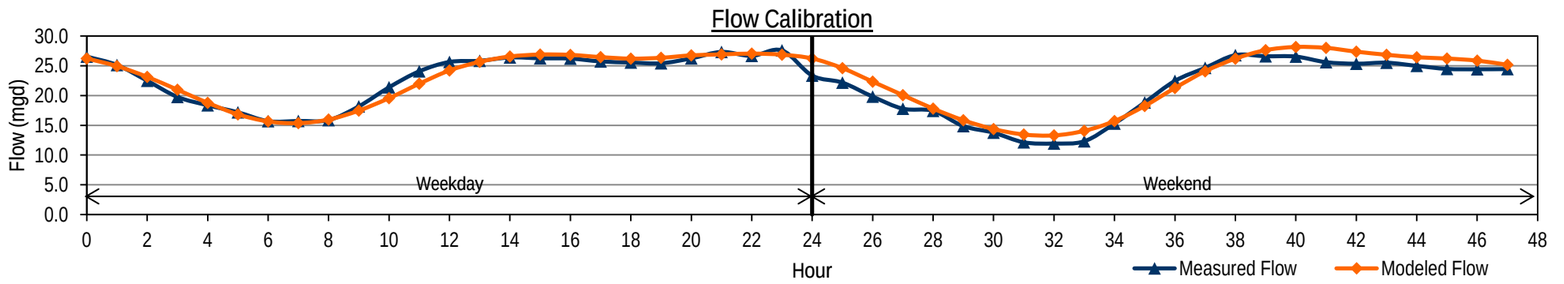


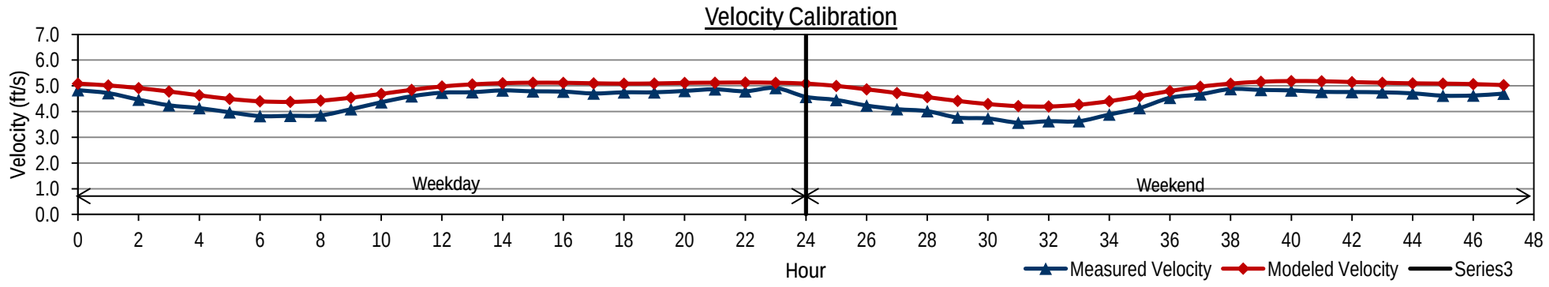


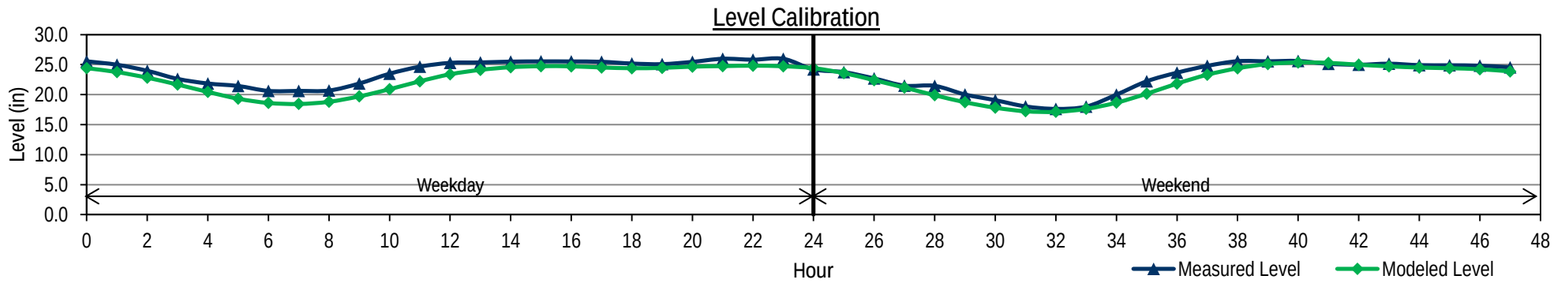
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR19 BASE WASTEWATER FLOW CALIBRATION

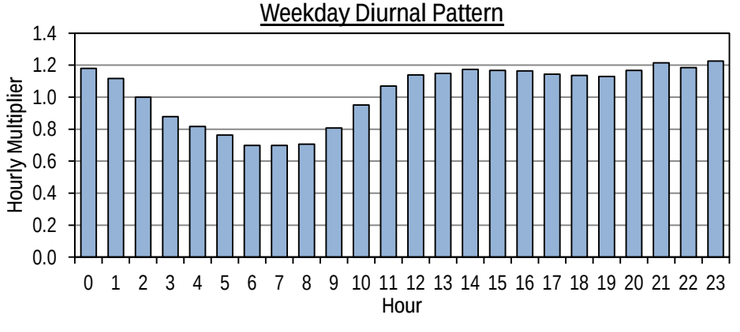
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	26.554	25.6	4.83	26.229	24.4	5.08	1.18
	1	25.140	25.0	4.72	24.946	23.8	5.01	1.12
	2	22.494	24.0	4.46	23.137	22.8	4.91	1.00
	3	19.773	22.6	4.25	20.978	21.7	4.78	0.88
	4	18.374	21.9	4.14	18.777	20.5	4.63	0.82
	5	17.191	21.4	3.97	16.837	19.3	4.49	0.76
	6	15.704	20.6	3.83	15.652	18.6	4.40	0.70
	7	15.738	20.6	3.84	15.371	18.5	4.38	0.70
	8	15.882	20.7	3.85	15.968	18.8	4.42	0.71
	9	18.189	21.9	4.09	17.474	19.7	4.54	0.81
	10	21.393	23.5	4.36	19.565	20.9	4.69	0.95
	11	24.081	24.7	4.59	21.992	22.2	4.84	1.07
	12	25.653	25.3	4.73	24.218	23.4	4.97	1.14
	13	25.849	25.4	4.75	25.671	24.1	5.05	1.15
	14	26.413	25.5	4.82	26.561	24.6	5.10	1.17
	15	26.271	25.5	4.79	26.894	24.7	5.12	1.17
	16	26.219	25.5	4.78	26.834	24.7	5.12	1.16
	17	25.742	25.5	4.70	26.462	24.5	5.10	1.14
	18	25.563	25.2	4.75	26.205	24.4	5.08	1.14
	19	25.434	25.1	4.75	26.348	24.5	5.09	1.13
	20	26.261	25.5	4.80	26.757	24.7	5.11	1.17
	21	27.339	26.0	4.87	26.915	24.7	5.12	1.21
	22	26.677	25.8	4.79	27.048	24.8	5.13	1.19
	23	27.598	26.0	4.92	26.869	24.7	5.12	1.23
Weekend	24	23.356	24.2	4.57	26.229	24.4	5.08	1.04
	25	22.179	23.8	4.45	24.606	23.6	4.99	0.99
	26	19.829	22.7	4.23	22.338	22.4	4.86	0.88
	27	17.797	21.5	4.09	20.068	21.2	4.72	0.79
	28	17.435	21.5	4.02	17.807	19.9	4.56	0.77
	29	14.872	20.0	3.77	15.855	18.7	4.41	0.66
	30	13.771	19.1	3.73	14.370	17.8	4.29	0.61
	31	12.152	18.0	3.57	13.455	17.2	4.21	0.54
	32	11.944	17.6	3.63	13.305	17.1	4.20	0.53
	33	12.324	18.0	3.63	14.069	17.6	4.27	0.55
	34	15.301	20.0	3.89	15.716	18.7	4.40	0.68
	35	18.845	22.2	4.14	18.247	20.2	4.59	0.84
	36	22.468	23.7	4.53	21.273	21.8	4.80	1.00
	37	24.664	24.8	4.67	24.077	23.3	4.97	1.10
	38	26.800	25.6	4.88	26.202	24.4	5.08	1.19
	39	26.613	25.6	4.84	27.629	25.1	5.16	1.18
	40	26.558	25.6	4.82	28.163	25.4	5.18	1.18
	41	25.614	25.1	4.77	28.015	25.3	5.18	1.14
	42	25.359	25.0	4.76	27.377	25.0	5.14	1.13
	43	25.528	25.2	4.75	26.854	24.7	5.12	1.13
	44	24.999	24.9	4.71	26.438	24.5	5.09	1.11
	45	24.482	24.9	4.62	26.224	24.4	5.08	1.09
	46	24.425	24.8	4.62	25.873	24.2	5.06	1.09
	47	24.459	24.6	4.70	25.173	23.9	5.03	1.09
Average								
Weekday		23.147	24.1	4.52	23.071	22.7	4.89	1.03
Weekend		20.907	22.8	4.35	22.057	22.1	4.81	0.93
ADWF[1]		22.507	23.8	4.47	22.781	22.5	4.86	1.00
% Error								
Weekday					-0.3%	-5.8%	8.2%	
Weekend					5.5%	-3.2%	10.6%	

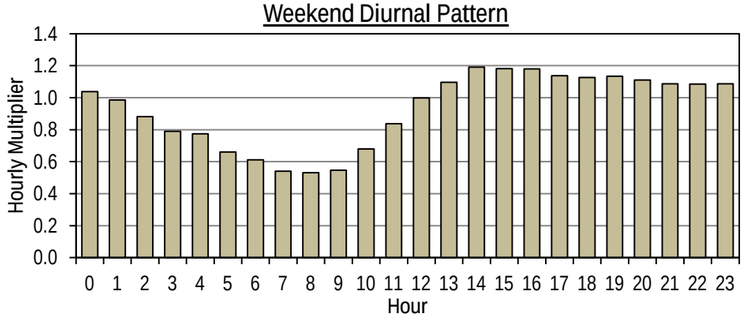
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







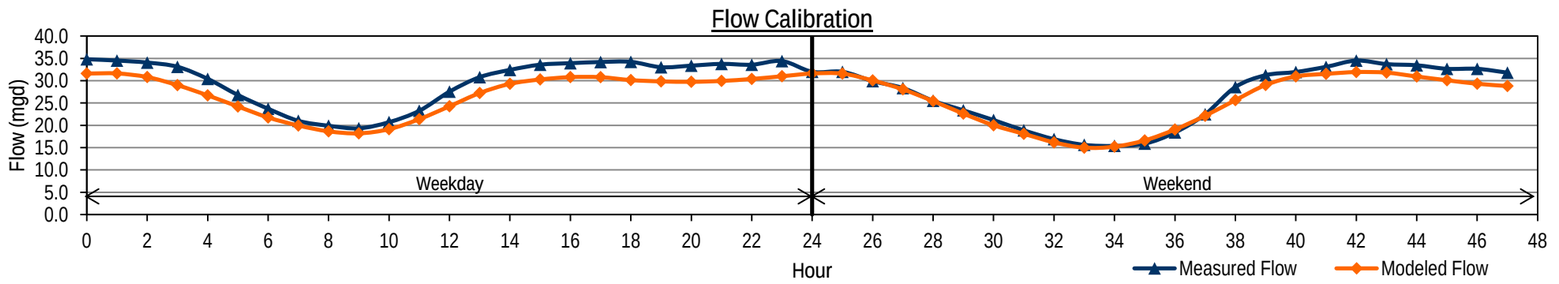


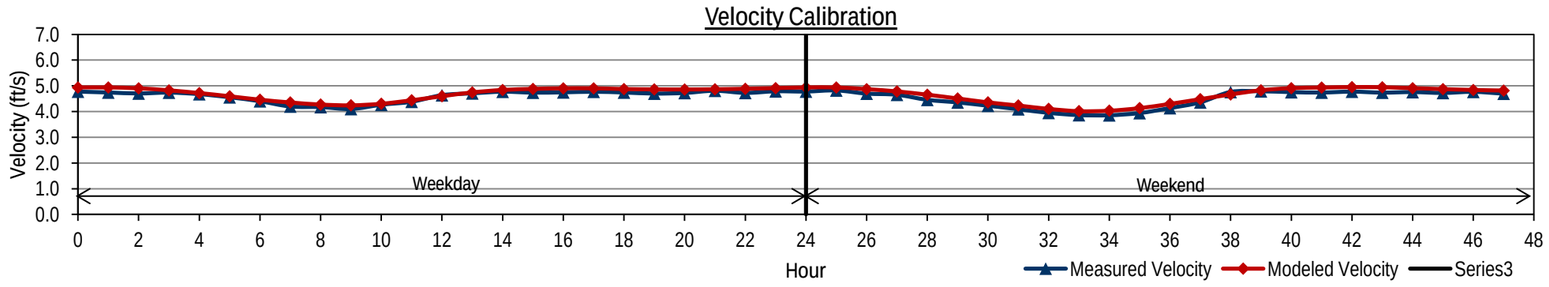


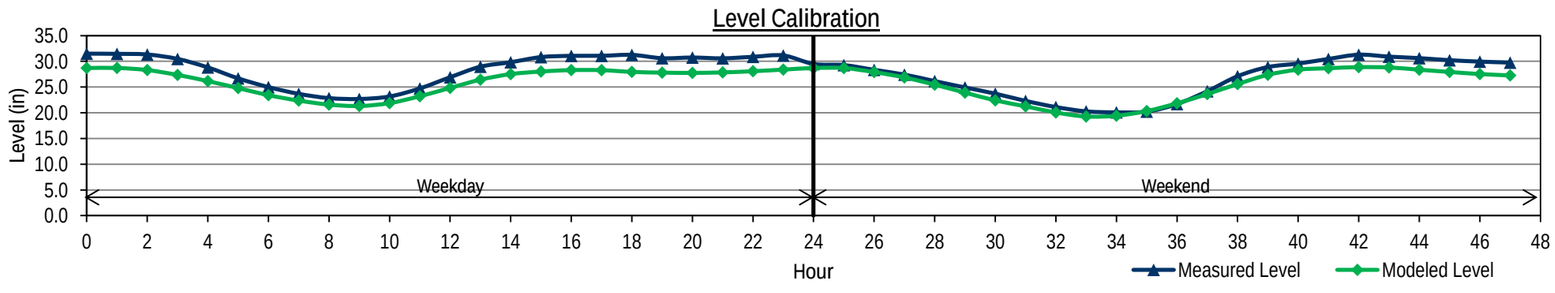
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR20 BASE WASTEWATER FLOW CALIBRATION

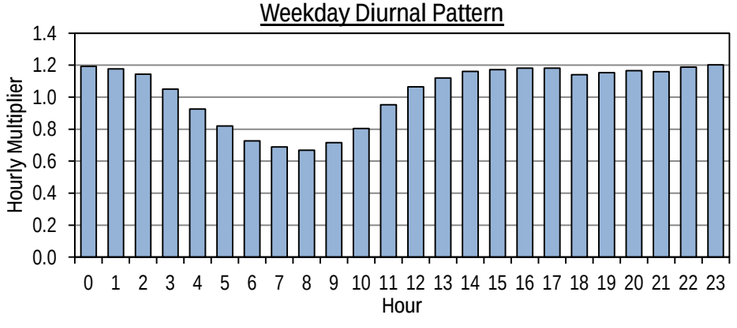
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	34.806	31.5	4.77	31.625	28.7	4.93	1.19
	1	34.508	31.5	4.74	31.643	28.7	4.94	1.18
	2	34.059	31.3	4.70	30.832	28.3	4.90	1.14
	3	33.114	30.5	4.73	29.012	27.4	4.82	1.05
	4	30.411	28.8	4.67	26.722	26.2	4.72	0.93
	5	26.794	26.7	4.55	24.224	24.8	4.59	0.82
	6	23.721	25.0	4.40	21.763	23.4	4.46	0.73
	7	21.021	23.7	4.19	19.963	22.4	4.35	0.69
	8	19.923	22.8	4.17	18.658	21.6	4.27	0.67
	9	19.350	22.7	4.10	18.205	21.3	4.24	0.72
	10	20.724	23.2	4.26	19.138	21.9	4.30	0.80
	11	23.265	24.7	4.38	21.390	23.2	4.44	0.95
	12	27.552	26.9	4.63	24.274	24.8	4.60	1.06
	13	30.797	29.0	4.71	27.249	26.4	4.74	1.12
	14	32.418	29.8	4.77	29.310	27.5	4.84	1.16
	15	33.584	30.8	4.73	30.287	28.0	4.88	1.17
	16	33.924	31.1	4.74	30.816	28.3	4.90	1.18
	17	34.184	31.1	4.77	30.803	28.3	4.90	1.18
	18	34.222	31.2	4.74	30.151	27.9	4.87	1.14
	19	33.023	30.6	4.70	29.859	27.8	4.86	1.15
	20	33.372	30.7	4.72	29.765	27.8	4.86	1.17
	21	33.764	30.6	4.81	29.963	27.9	4.86	1.16
	22	33.580	30.9	4.72	30.402	28.1	4.88	1.19
	23	34.393	31.1	4.78	31.015	28.4	4.91	1.20
Weekend	24	31.997	29.5	4.78	31.625	28.7	4.93	1.11
	25	31.994	29.3	4.82	31.603	28.7	4.93	1.03
	26	29.908	28.3	4.70	30.071	27.9	4.87	0.98
	27	28.352	27.4	4.65	28.073	26.9	4.78	0.88
	28	25.504	26.2	4.45	25.440	25.5	4.65	0.81
	29	23.368	24.9	4.35	22.630	23.9	4.51	0.73
	30	21.197	23.7	4.22	20.016	22.4	4.36	0.65
	31	18.890	22.3	4.09	18.098	21.3	4.24	0.58
	32	16.918	21.1	3.95	16.189	20.1	4.11	0.54
	33	15.644	20.3	3.86	14.991	19.3	4.02	0.53
	34	15.409	20.1	3.85	15.231	19.4	4.04	0.55
	35	15.909	20.2	3.94	16.616	20.3	4.14	0.64
	36	18.412	21.7	4.13	19.062	21.8	4.30	0.78
	37	22.476	24.2	4.36	22.141	23.6	4.48	0.99
	38	28.577	27.1	4.76	25.657	25.6	4.67	1.08
	39	31.231	28.9	4.79	29.048	27.4	4.82	1.10
	40	31.945	29.6	4.75	30.978	28.4	4.91	1.14
	41	33.095	30.5	4.74	31.547	28.7	4.93	1.19
	42	34.503	31.3	4.77	31.954	28.9	4.95	1.16
	43	33.711	30.9	4.73	31.826	28.8	4.94	1.16
	44	33.451	30.6	4.75	30.956	28.4	4.91	1.13
	45	32.656	30.2	4.72	30.112	27.9	4.87	1.13
	46	32.661	29.9	4.76	29.330	27.5	4.84	1.10
	47	31.803	29.7	4.69	28.816	27.3	4.81	1.11
Average								
Weekday		29.854	28.6	4.60	26.961	26.2	4.71	1.03
Weekend		26.650	26.6	4.48	25.500	25.4	4.62	0.92
ADWF[1]		28.939	28.0	4.57	26.544	26.0	4.69	1.00
% Error								
Weekday					-9.7%	-8.3%	2.3%	
Weekend					-4.3%	-4.6%	3.1%	

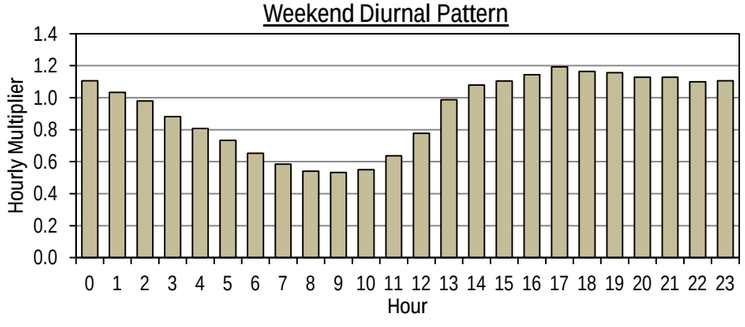
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7









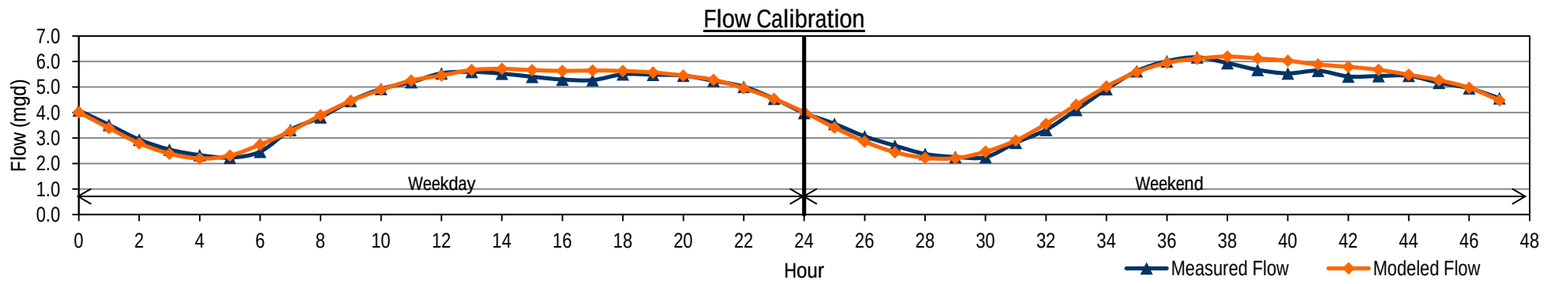


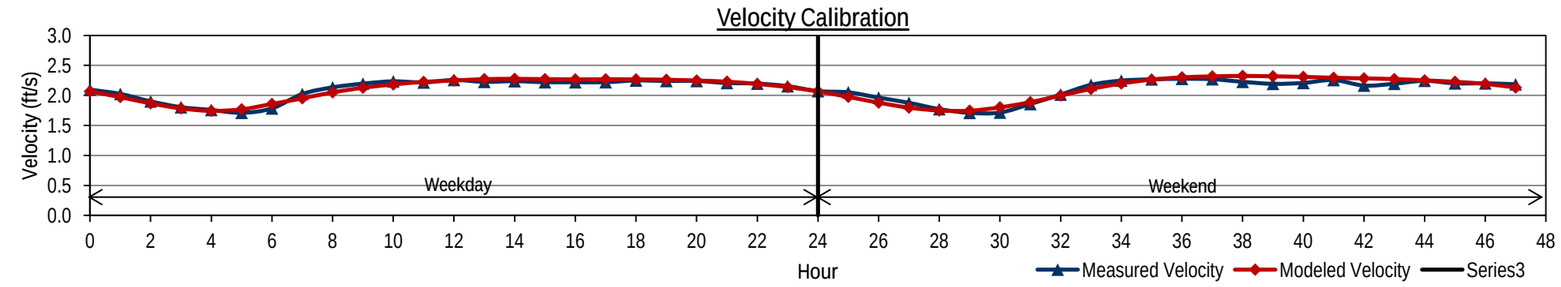
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR21 BASE WASTEWATER FLOW CALIBRATION

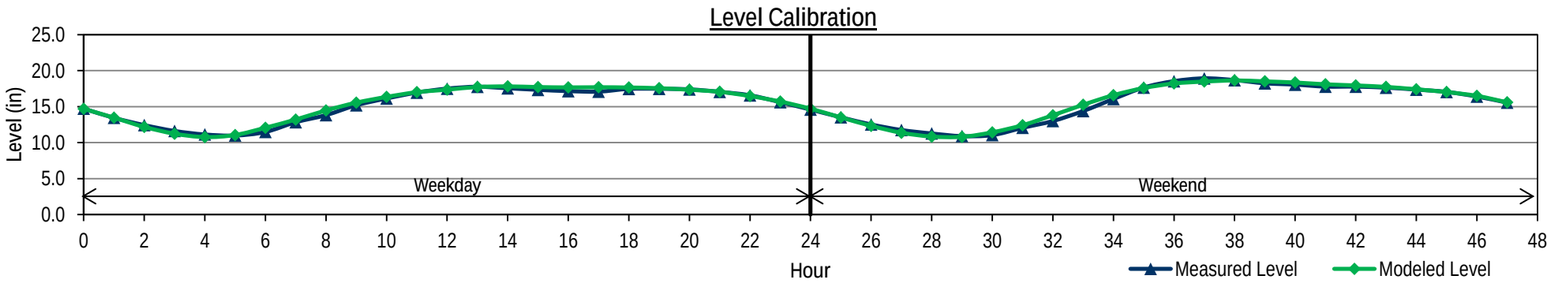
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Calibrated Diurnal
Weekday	0	4.083	14.7	2.10	4.012	14.7	2.07	0.53
	1	3.514	13.5	2.02	3.392	13.5	1.97	0.48
	2	2.936	12.4	1.90	2.794	12.2	1.87	0.46
	3	2.545	11.6	1.80	2.387	11.2	1.79	0.53
	4	2.330	11.1	1.76	2.196	10.8	1.74	0.76
	5	2.229	11.0	1.71	2.312	11.1	1.77	0.88
	6	2.463	11.5	1.78	2.743	12.1	1.86	1.04
	7	3.317	12.8	2.02	3.266	13.2	1.95	1.15
	8	3.815	13.8	2.13	3.895	14.5	2.05	1.22
	9	4.455	15.2	2.20	4.458	15.6	2.13	1.30
	10	4.926	16.1	2.23	4.893	16.4	2.18	1.29
	11	5.194	16.9	2.22	5.257	17.0	2.23	1.27
	12	5.539	17.5	2.26	5.456	17.4	2.25	1.24
	13	5.596	17.8	2.23	5.672	17.7	2.27	1.20
	14	5.526	17.5	2.24	5.716	17.8	2.28	1.19
	15	5.402	17.3	2.22	5.665	17.7	2.27	1.25
	16	5.294	17.1	2.22	5.632	17.7	2.27	1.25
	17	5.272	17.1	2.22	5.649	17.7	2.27	1.24
	18	5.500	17.5	2.25	5.631	17.7	2.27	1.18
	19	5.484	17.5	2.24	5.573	17.6	2.26	1.12
	20	5.448	17.4	2.24	5.452	17.4	2.25	1.00
	21	5.246	17.0	2.21	5.284	17.1	2.23	0.89
	22	5.012	16.6	2.20	4.957	16.5	2.19	0.76
	23	4.544	15.6	2.15	4.537	15.7	2.14	0.62
Weekend	24	3.984	14.6	2.07	4.014	14.7	2.07	0.57
	25	3.557	13.5	2.05	3.411	13.5	1.98	0.49
	26	3.066	12.5	1.96	2.860	12.3	1.88	0.47
	27	2.700	11.8	1.88	2.443	11.4	1.80	0.48
	28	2.374	11.3	1.77	2.224	10.8	1.75	0.64
	29	2.256	10.9	1.71	2.208	10.8	1.75	0.77
	30	2.250	11.1	1.71	2.466	11.4	1.80	0.96
	31	2.816	12.1	1.86	2.902	12.4	1.89	1.16
	32	3.319	13.0	2.01	3.554	13.8	2.00	1.34
	33	4.105	14.4	2.18	4.303	15.3	2.11	1.42
	34	4.919	16.1	2.25	5.022	16.6	2.20	1.46
	35	5.624	17.6	2.27	5.589	17.6	2.26	1.39
	36	6.011	18.5	2.28	5.953	18.2	2.30	1.31
	37	6.167	18.9	2.27	6.112	18.5	2.32	1.27
	38	5.940	18.7	2.23	6.199	18.6	2.33	1.30
	39	5.675	18.2	2.19	6.123	18.5	2.32	1.24
	40	5.534	18.0	2.21	6.033	18.4	2.31	1.24
	41	5.641	17.8	2.26	5.883	18.1	2.29	1.24
	42	5.414	17.8	2.16	5.794	18.0	2.28	1.17
	43	5.431	17.6	2.19	5.677	17.7	2.27	1.11
	44	5.442	17.4	2.24	5.484	17.4	2.25	1.02
	45	5.169	17.0	2.20	5.269	17.0	2.23	0.87
	46	4.952	16.4	2.20	4.971	16.5	2.19	0.77
	47	4.563	15.6	2.19	4.483	15.6	2.13	0.65
Average								
	Weekday	4.403	15.3	2.11	4.451	15.4	2.11	0.99
	Weekend	4.454	15.4	2.10	4.541	15.6	2.11	1.01
	ADWF[1]	4.418	15.3	2.10	4.477	15.5	2.11	1.00
% Error								
	Weekday				1.1%	0.9%	0.0%	
	Weekend				1.9%	0.7%	0.7%	

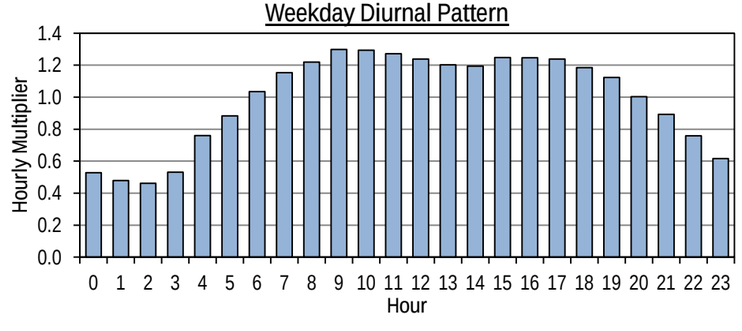
Note:

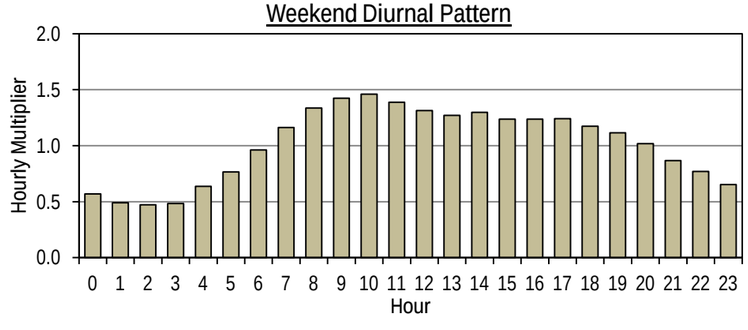
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







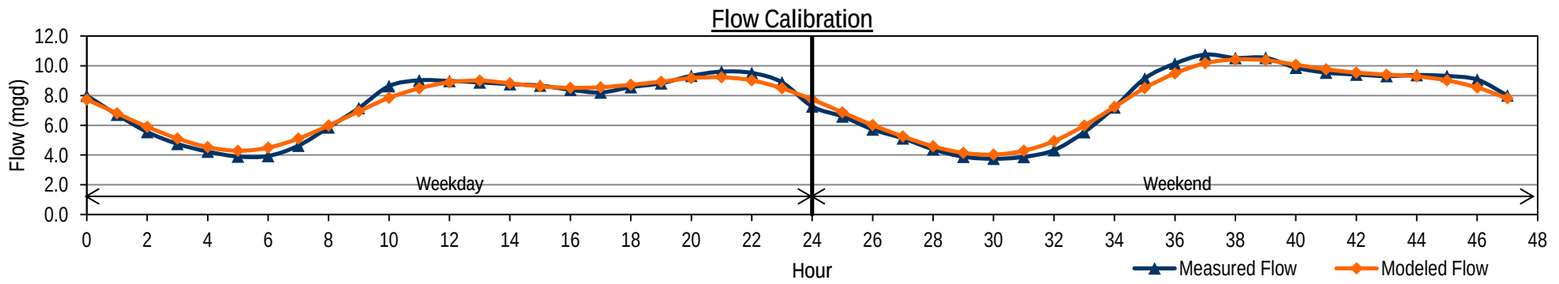


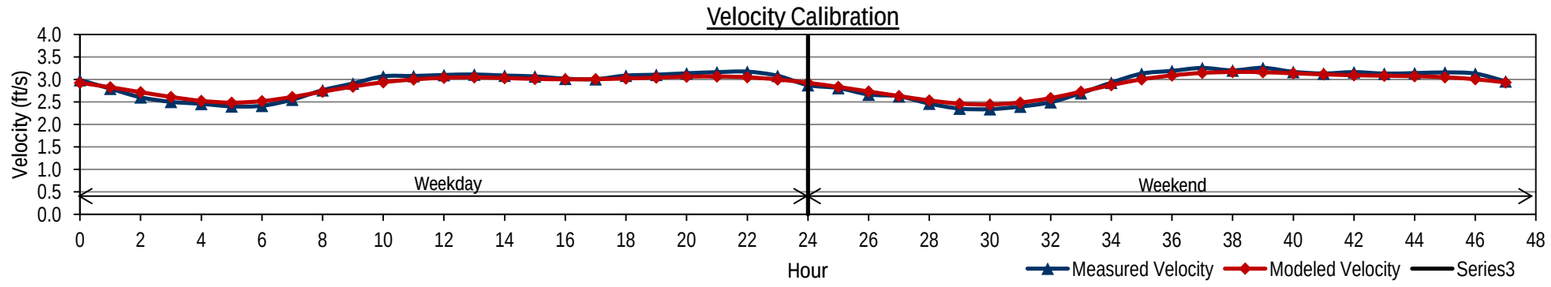


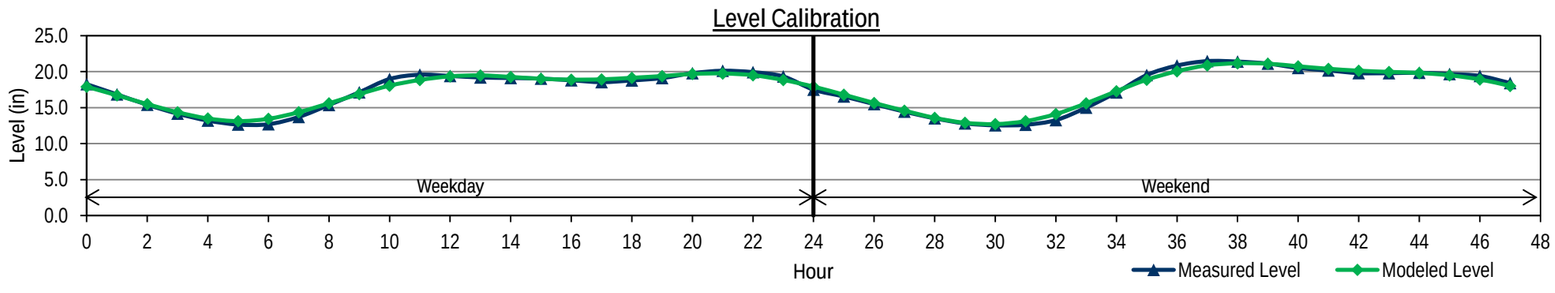
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR22 BASE WASTEWATER FLOW CALIBRATION

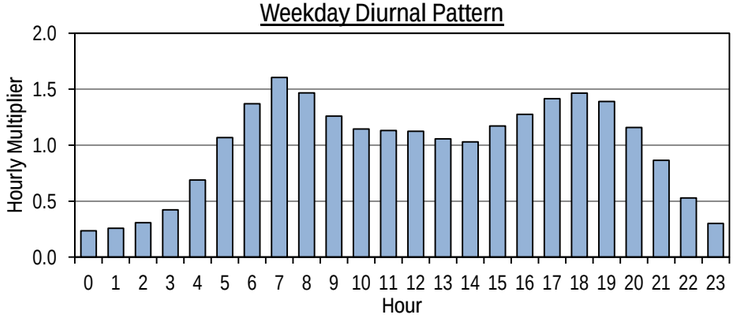
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	7.998	18.3	2.98	7.734	17.9	2.92	0.24
	1	6.717	16.8	2.79	6.812	16.7	2.83	0.26
	2	5.552	15.4	2.60	5.903	15.5	2.72	0.31
	3	4.752	14.2	2.50	5.115	14.4	2.61	0.42
	4	4.235	13.2	2.46	4.540	13.5	2.52	0.69
	5	3.902	12.7	2.40	4.293	13.1	2.48	1.07
	6	3.939	12.7	2.41	4.503	13.4	2.52	1.37
	7	4.632	13.7	2.55	5.112	14.4	2.61	1.60
	8	5.863	15.4	2.76	5.987	15.6	2.73	1.47
	9	7.159	17.1	2.91	6.941	16.9	2.84	1.26
	10	8.638	19.0	3.07	7.851	18.0	2.94	1.15
	11	9.026	19.6	3.07	8.489	18.8	3.00	1.13
	12	8.983	19.4	3.10	8.895	19.3	3.04	1.12
	13	8.886	19.2	3.11	9.010	19.5	3.05	1.06
	14	8.770	19.1	3.08	8.826	19.2	3.03	1.03
	15	8.671	19.0	3.07	8.621	19.0	3.01	1.17
	16	8.391	18.8	3.01	8.525	18.9	3.00	1.28
	17	8.209	18.5	3.00	8.558	18.9	3.00	1.41
	18	8.568	18.8	3.08	8.728	19.1	3.02	1.46
	19	8.825	19.1	3.10	8.932	19.4	3.04	1.39
	20	9.330	19.8	3.13	9.175	19.7	3.06	1.16
	21	9.611	20.1	3.16	9.230	19.7	3.07	0.86
	22	9.521	19.9	3.17	9.024	19.5	3.05	0.53
	23	8.892	19.3	3.08	8.491	18.8	3.00	0.30
Weekend	24	7.268	17.5	2.87	7.740	17.9	2.92	0.35
	25	6.599	16.6	2.81	6.877	16.8	2.83	0.31
	26	5.723	15.5	2.66	6.017	15.6	2.73	0.30
	27	5.125	14.5	2.62	5.258	14.6	2.63	0.36
	28	4.388	13.5	2.46	4.593	13.6	2.53	0.46
	29	3.886	12.8	2.35	4.154	12.9	2.46	0.64
	30	3.755	12.6	2.34	4.038	12.7	2.44	1.00
	31	3.876	12.6	2.40	4.299	13.1	2.48	1.42
	32	4.333	13.3	2.49	4.939	14.1	2.58	1.83
	33	5.546	15.0	2.69	5.984	15.6	2.73	1.88
	34	7.207	17.1	2.93	7.240	17.3	2.87	1.80
	35	9.146	19.5	3.13	8.509	18.9	3.00	1.54
	36	10.149	20.8	3.19	9.490	20.0	3.09	1.46
	37	10.754	21.5	3.25	10.178	20.9	3.14	1.27
	38	10.529	21.4	3.20	10.427	21.1	3.16	1.22
	39	10.540	21.1	3.25	10.379	21.1	3.16	1.24
	40	9.876	20.5	3.17	10.070	20.7	3.14	1.27
	41	9.545	20.2	3.13	9.767	20.4	3.11	1.32
	42	9.413	19.8	3.16	9.545	20.1	3.09	1.32
	43	9.313	19.8	3.13	9.406	19.9	3.08	1.24
	44	9.381	19.8	3.14	9.291	19.8	3.07	0.93
	45	9.319	19.7	3.15	9.022	19.5	3.05	0.64
	46	9.074	19.4	3.13	8.544	18.9	3.00	0.49
	47	8.010	18.4	2.96	7.821	18.0	2.93	0.35
Average								
Weekday		7.461	17.5	2.90	7.471	17.5	2.88	0.99
Weekend		7.615	17.6	2.90	7.650	17.6	2.88	1.03
ADWF[1]		7.505	17.5	2.90	7.522	17.5	2.88	1.00
% Error								
Weekday					0.1%	0.0%	-0.8%	
Weekend					0.5%	0.1%	-0.5%	

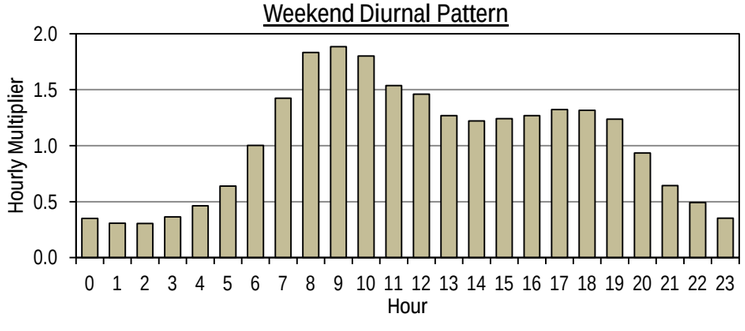
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







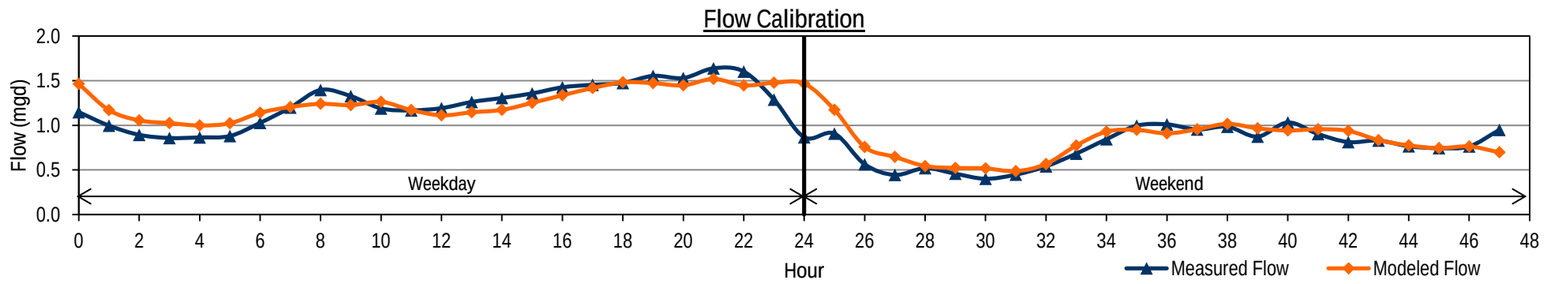


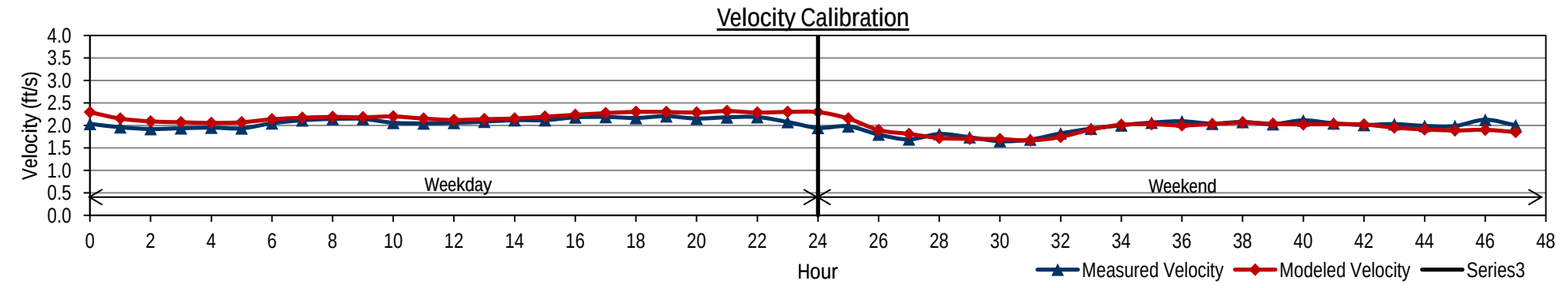


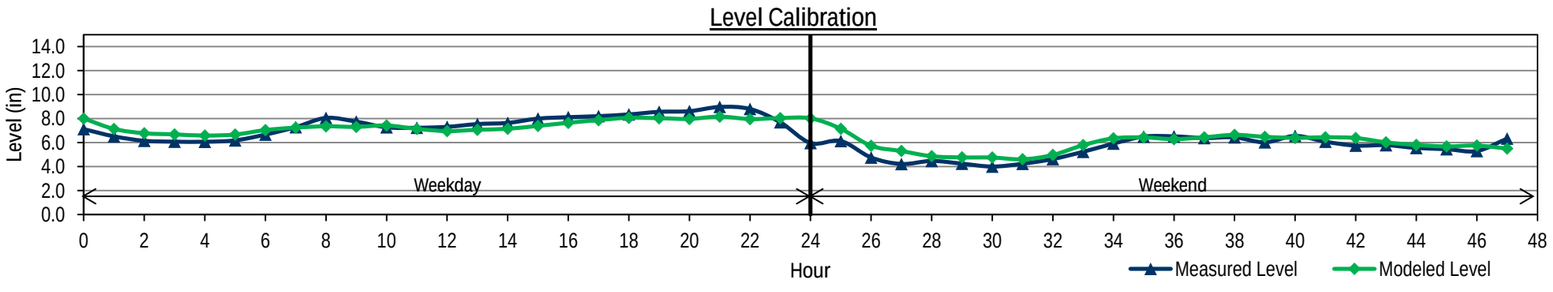
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR23 BASE WASTEWATER FLOW CALIBRATION

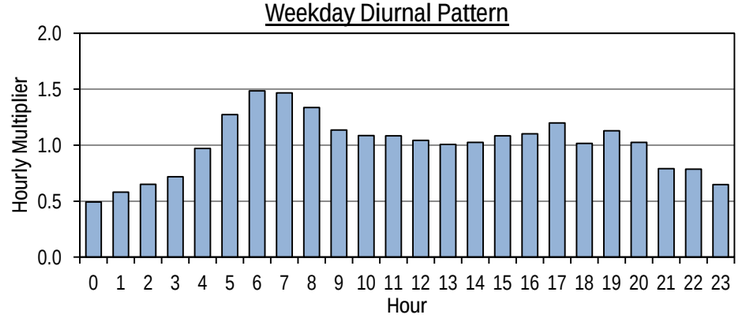
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	1.148	7.1	2.03	1.465	8.0	2.30	0.49
	1	0.996	6.5	1.96	1.171	7.1	2.15	0.58
	2	0.893	6.2	1.92	1.056	6.8	2.09	0.65
	3	0.858	6.1	1.94	1.026	6.7	2.07	0.72
	4	0.864	6.1	1.95	0.999	6.6	2.06	0.97
	5	0.880	6.2	1.93	1.024	6.7	2.07	1.27
	6	1.028	6.7	2.05	1.142	7.0	2.14	1.48
	7	1.199	7.3	2.11	1.206	7.2	2.17	1.47
	8	1.396	8.1	2.14	1.242	7.4	2.19	1.34
	9	1.327	7.8	2.14	1.227	7.3	2.18	1.14
	10	1.189	7.3	2.06	1.264	7.4	2.20	1.09
	11	1.167	7.2	2.04	1.172	7.1	2.15	1.08
	12	1.192	7.3	2.06	1.113	7.0	2.12	1.04
	13	1.262	7.6	2.08	1.147	7.1	2.14	1.01
	14	1.306	7.6	2.12	1.174	7.2	2.16	1.03
	15	1.357	8.0	2.12	1.253	7.4	2.20	1.08
	16	1.426	8.1	2.18	1.338	7.6	2.24	1.10
	17	1.454	8.2	2.19	1.419	7.9	2.28	1.20
	18	1.474	8.4	2.16	1.483	8.1	2.30	1.02
	19	1.553	8.6	2.20	1.474	8.0	2.30	1.13
	20	1.529	8.6	2.15	1.449	8.0	2.29	1.03
	21	1.638	9.0	2.18	1.521	8.2	2.32	0.79
	22	1.602	8.8	2.18	1.448	8.0	2.29	0.79
	23	1.288	7.7	2.08	1.478	8.0	2.30	0.65
Weekend	24	0.866	6.0	1.95	1.469	8.0	2.30	0.57
	25	0.907	6.1	1.98	1.175	7.2	2.16	0.72
	26	0.564	4.8	1.80	0.758	5.7	1.90	0.56
	27	0.445	4.2	1.69	0.647	5.3	1.81	0.55
	28	0.520	4.5	1.81	0.544	4.9	1.72	0.61
	29	0.458	4.2	1.74	0.523	4.8	1.70	0.59
	30	0.401	4.0	1.65	0.518	4.8	1.70	0.57
	31	0.448	4.2	1.69	0.487	4.6	1.67	0.91
	32	0.541	4.6	1.82	0.567	5.0	1.74	1.33
	33	0.683	5.2	1.93	0.774	5.8	1.91	1.50
	34	0.844	5.9	2.00	0.930	6.4	2.02	1.36
	35	0.996	6.5	2.06	0.950	6.4	2.03	1.26
	36	1.011	6.5	2.09	0.910	6.3	2.00	1.46
	37	0.953	6.4	2.04	0.956	6.4	2.03	1.40
	38	0.984	6.4	2.08	1.017	6.6	2.07	1.30
	39	0.873	6.0	2.03	0.967	6.5	2.04	1.24
	40	1.032	6.6	2.11	0.943	6.4	2.02	1.36
	41	0.903	6.1	2.05	0.957	6.4	2.03	1.08
	42	0.812	5.8	2.01	0.939	6.4	2.02	1.08
	43	0.829	5.8	2.03	0.835	6.0	1.95	0.87
	44	0.765	5.6	1.99	0.776	5.8	1.91	1.04
	45	0.744	5.5	1.99	0.745	5.7	1.89	1.02
	46	0.764	5.3	2.12	0.764	5.8	1.90	0.88
	47	0.949	6.3	2.00	0.698	5.5	1.85	0.40
Average								
Weekday		1.251	7.5	2.08	1.262	7.4	2.20	1.01
Weekend		0.762	5.5	1.94	0.827	5.9	1.93	0.99
ADWF[1]		1.111	6.9	2.04	1.138	7.0	2.12	1.00
% Error								
Weekday					0.9%	-1.5%	5.5%	
Weekend					8.5%	7.6%	-0.6%	

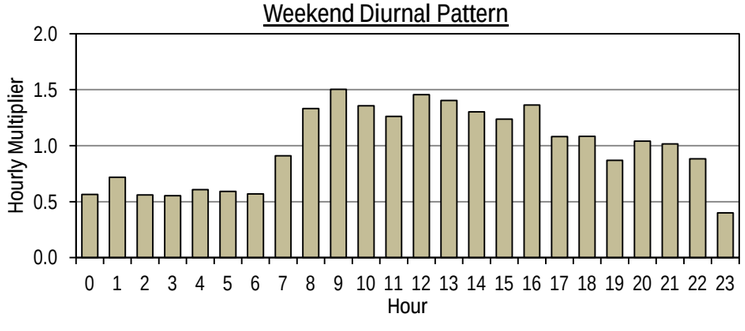
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







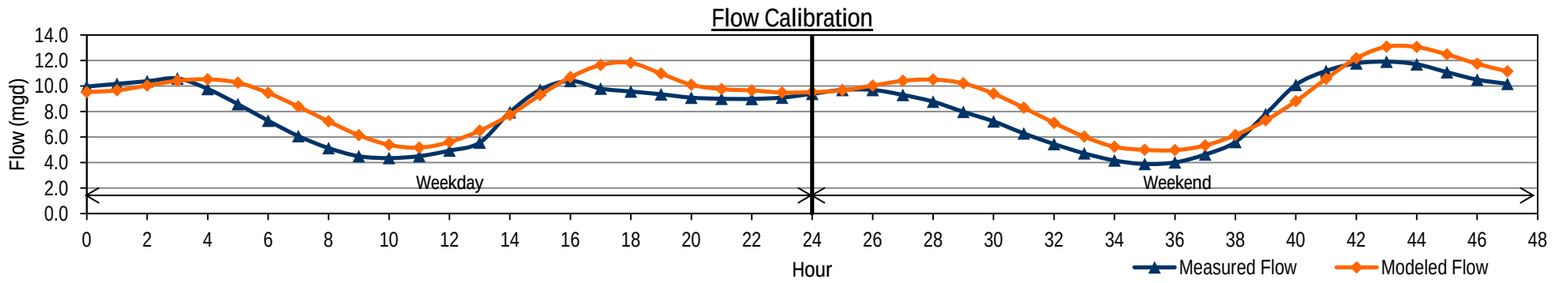


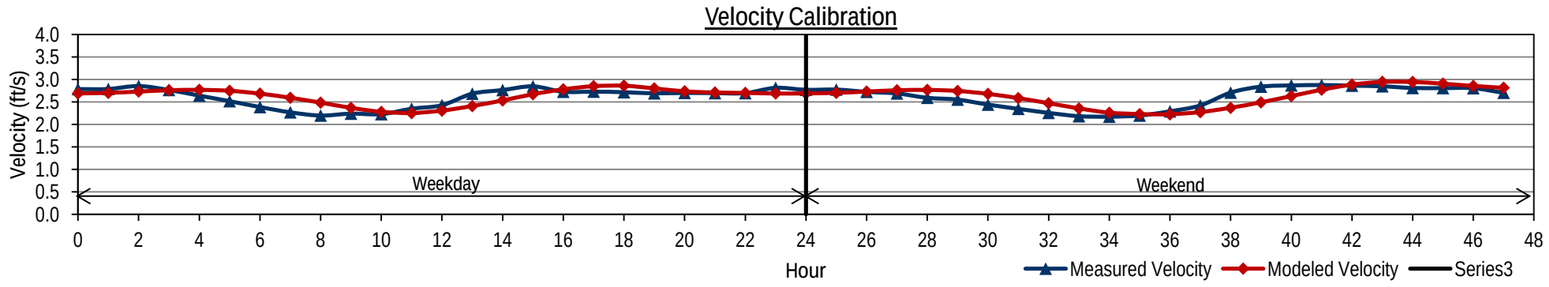


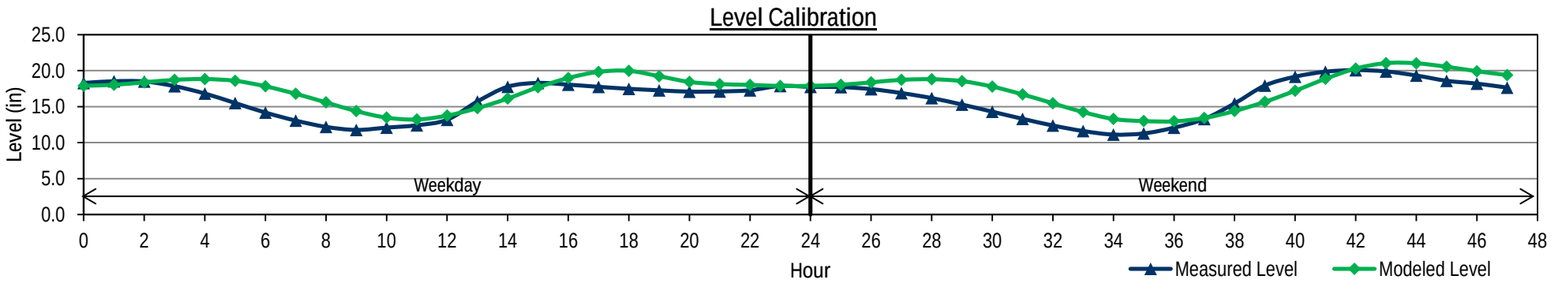
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR24 BASE WASTEWATER FLOW CALIBRATION

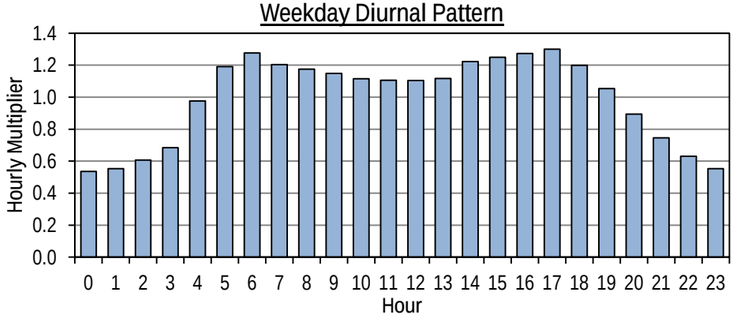
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	9.962	18.3	2.79	9.529	17.9	2.69	0.54
	1	10.176	18.5	2.79	9.673	18.0	2.70	0.55
	2	10.381	18.5	2.85	10.041	18.4	2.73	0.61
	3	10.599	17.8	2.77	10.424	18.7	2.76	0.68
	4	9.775	16.8	2.64	10.537	18.8	2.77	0.98
	5	8.583	15.5	2.52	10.273	18.6	2.75	1.19
	6	7.285	14.2	2.39	9.469	17.8	2.68	1.28
	7	6.080	13.1	2.27	8.397	16.8	2.59	1.20
	8	5.139	12.2	2.20	7.237	15.6	2.48	1.18
	9	4.504	11.8	2.24	6.154	14.4	2.37	1.15
	10	4.360	12.1	2.23	5.399	13.5	2.28	1.12
	11	4.511	12.4	2.35	5.181	13.2	2.25	1.11
	12	4.945	13.2	2.43	5.619	13.8	2.31	1.10
	13	5.571	15.7	2.68	6.512	14.8	2.41	1.12
	14	7.958	17.8	2.76	7.740	16.1	2.53	1.22
	15	9.709	18.3	2.85	9.306	17.7	2.67	1.25
	16	10.407	18.0	2.73	10.700	19.0	2.78	1.27
	17	9.803	17.7	2.73	11.660	19.8	2.85	1.30
	18	9.576	17.5	2.72	11.826	20.0	2.86	1.20
	19	9.356	17.3	2.69	10.982	19.2	2.80	1.05
	20	9.093	17.1	2.70	10.107	18.4	2.74	0.89
	21	9.006	17.1	2.70	9.769	18.1	2.71	0.75
	22	8.995	17.3	2.70	9.661	18.0	2.70	0.63
	23	9.098	17.9	2.81	9.501	17.9	2.69	0.55
Weekend	24	9.394	17.7	2.77	9.529	17.9	2.69	0.51
	25	9.700	17.7	2.78	9.673	18.0	2.70	0.48
	26	9.699	17.4	2.72	10.041	18.4	2.73	0.49
	27	9.309	16.9	2.69	10.419	18.7	2.76	0.57
	28	8.780	16.2	2.59	10.516	18.8	2.77	0.69
	29	7.983	15.3	2.55	10.220	18.5	2.74	0.96
	30	7.232	14.3	2.44	9.412	17.8	2.68	1.24
	31	6.290	13.3	2.35	8.308	16.7	2.58	1.37
	32	5.458	12.4	2.26	7.121	15.5	2.47	1.45
	33	4.729	11.6	2.18	6.038	14.3	2.35	1.46
	34	4.171	11.1	2.17	5.245	13.3	2.26	1.44
	35	3.896	11.3	2.20	5.007	13.0	2.23	1.36
	36	4.021	12.1	2.29	4.980	13.0	2.22	1.29
	37	4.637	13.3	2.42	5.348	13.4	2.27	1.25
	38	5.618	15.4	2.71	6.163	14.4	2.37	1.15
	39	7.805	17.9	2.84	7.314	15.7	2.49	1.19
	40	10.093	19.1	2.87	8.820	17.2	2.63	1.19
	41	11.185	19.8	2.88	10.574	18.9	2.77	1.14
	42	11.784	20.1	2.86	12.187	20.3	2.89	1.08
	43	11.913	19.9	2.85	13.093	21.0	2.95	0.98
	44	11.711	19.3	2.81	13.069	21.0	2.94	0.89
	45	11.090	18.6	2.81	12.490	20.5	2.91	0.77
	46	10.506	18.2	2.81	11.755	19.9	2.86	0.67
	47	10.177	17.6	2.70	11.158	19.4	2.81	0.58
Average								
Weekday		8.120	16.1	2.60	8.987	17.3	2.63	1.00
Weekend		8.216	16.1	2.61	9.103	17.3	2.63	1.01
ADWF[1]		8.147	16.1	2.61	9.021	17.3	2.63	1.00
% Error								
Weekday					10.7%	7.5%	0.9%	
Weekend					10.8%	7.5%	0.8%	

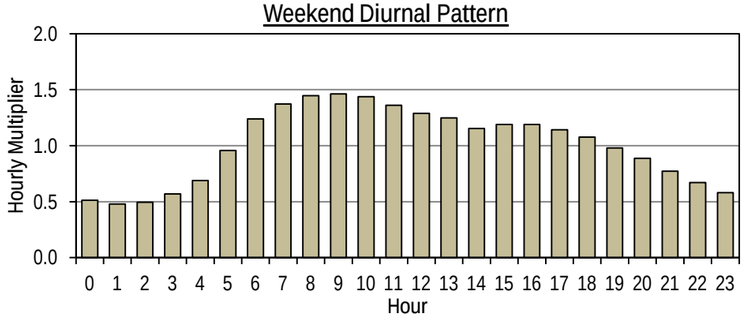
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







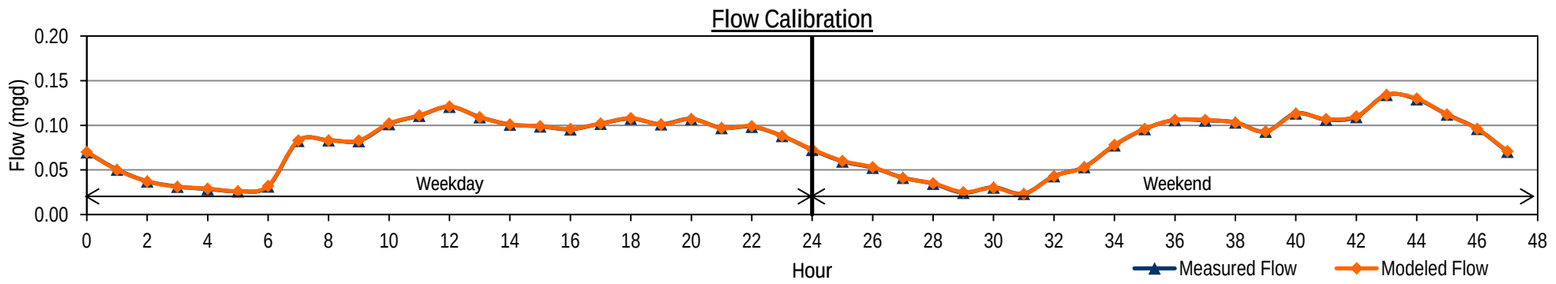


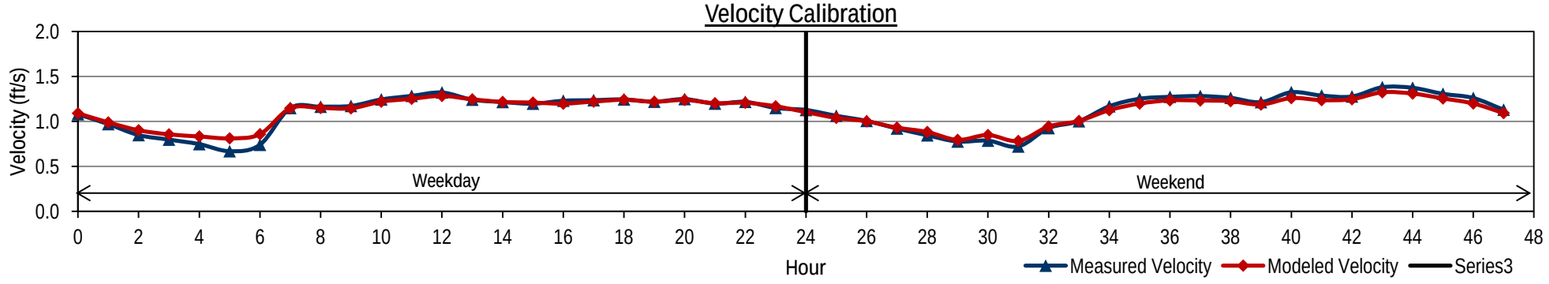


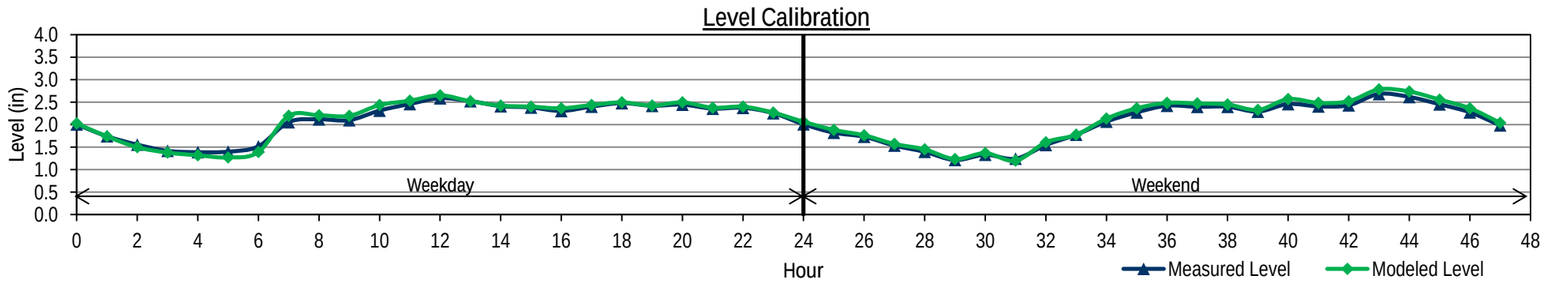
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR25 BASE WASTEWATER FLOW CALIBRATION

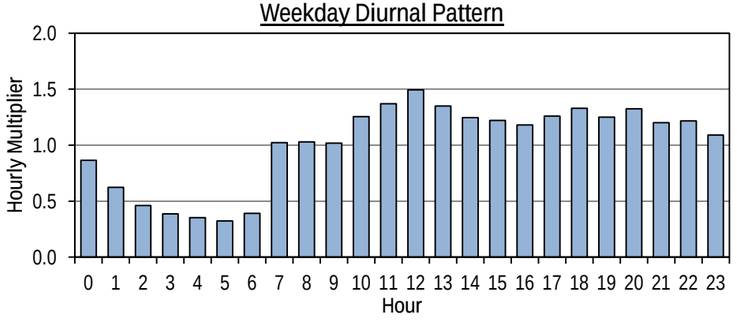
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	0.070	2.0	1.08	0.070	2.0	1.09	0.86
	1	0.050	1.7	0.97	0.050	1.7	0.99	0.62
	2	0.037	1.6	0.85	0.037	1.5	0.90	0.46
	3	0.031	1.4	0.80	0.031	1.4	0.86	0.39
	4	0.029	1.4	0.75	0.029	1.3	0.83	0.35
	5	0.026	1.4	0.67	0.026	1.3	0.81	0.32
	6	0.032	1.5	0.74	0.032	1.4	0.86	0.39
	7	0.083	2.1	1.15	0.083	2.2	1.15	1.02
	8	0.083	2.1	1.16	0.083	2.2	1.15	1.03
	9	0.082	2.1	1.17	0.083	2.2	1.15	1.02
	10	0.102	2.3	1.25	0.102	2.4	1.22	1.25
	11	0.111	2.5	1.28	0.111	2.5	1.25	1.37
	12	0.121	2.6	1.32	0.121	2.7	1.28	1.49
	13	0.109	2.5	1.24	0.109	2.5	1.25	1.35
	14	0.101	2.4	1.22	0.101	2.4	1.22	1.25
	15	0.099	2.4	1.20	0.099	2.4	1.21	1.22
	16	0.096	2.3	1.23	0.096	2.4	1.20	1.18
	17	0.102	2.4	1.24	0.102	2.4	1.22	1.26
	18	0.108	2.5	1.25	0.108	2.5	1.24	1.33
	19	0.101	2.4	1.22	0.101	2.4	1.22	1.25
	20	0.107	2.4	1.25	0.107	2.5	1.24	1.33
	21	0.097	2.4	1.20	0.097	2.4	1.20	1.20
	22	0.098	2.4	1.22	0.099	2.4	1.21	1.22
	23	0.088	2.3	1.15	0.088	2.3	1.17	1.09
Weekend	24	0.073	2.0	1.13	0.073	2.1	1.10	0.90
	25	0.060	1.8	1.06	0.060	1.9	1.04	0.74
	26	0.053	1.7	1.01	0.053	1.8	1.00	0.65
	27	0.041	1.5	0.92	0.041	1.6	0.93	0.51
	28	0.035	1.4	0.85	0.035	1.5	0.88	0.43
	29	0.025	1.2	0.78	0.025	1.2	0.80	0.30
	30	0.030	1.3	0.79	0.030	1.4	0.85	0.38
	31	0.023	1.2	0.72	0.023	1.2	0.78	0.29
	32	0.043	1.5	0.93	0.043	1.6	0.94	0.53
	33	0.053	1.8	1.00	0.053	1.8	1.01	0.66
	34	0.078	2.1	1.17	0.078	2.1	1.13	0.96
	35	0.096	2.3	1.25	0.096	2.4	1.20	1.19
	36	0.106	2.4	1.27	0.106	2.5	1.23	1.31
	37	0.106	2.4	1.28	0.106	2.5	1.23	1.30
	38	0.103	2.4	1.26	0.103	2.4	1.23	1.28
	39	0.093	2.3	1.22	0.093	2.3	1.19	1.15
	40	0.113	2.5	1.33	0.113	2.6	1.26	1.40
	41	0.106	2.4	1.29	0.107	2.5	1.24	1.32
	42	0.109	2.4	1.28	0.110	2.5	1.25	1.35
	43	0.134	2.7	1.38	0.134	2.8	1.32	1.66
	44	0.129	2.6	1.37	0.130	2.7	1.31	1.60
	45	0.112	2.5	1.31	0.112	2.6	1.26	1.39
	46	0.096	2.3	1.26	0.096	2.4	1.20	1.19
	47	0.071	2.0	1.13	0.071	2.0	1.09	0.87
Average								
Weekday		0.082	2.1	1.11	0.082	2.1	1.12	1.01
Weekend		0.079	2.0	1.12	0.079	2.1	1.10	0.97
ADWF[1]		0.081	2.1	1.11	0.081	2.1	1.12	1.00
% Error								
Weekday					0.1%	1.0%	1.1%	
Weekend					0.2%	3.0%	-2.0%	

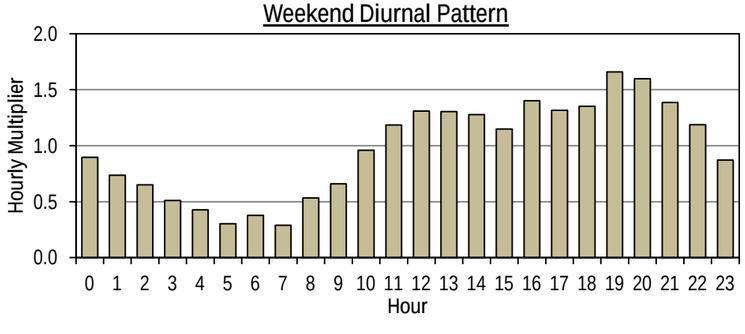
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7







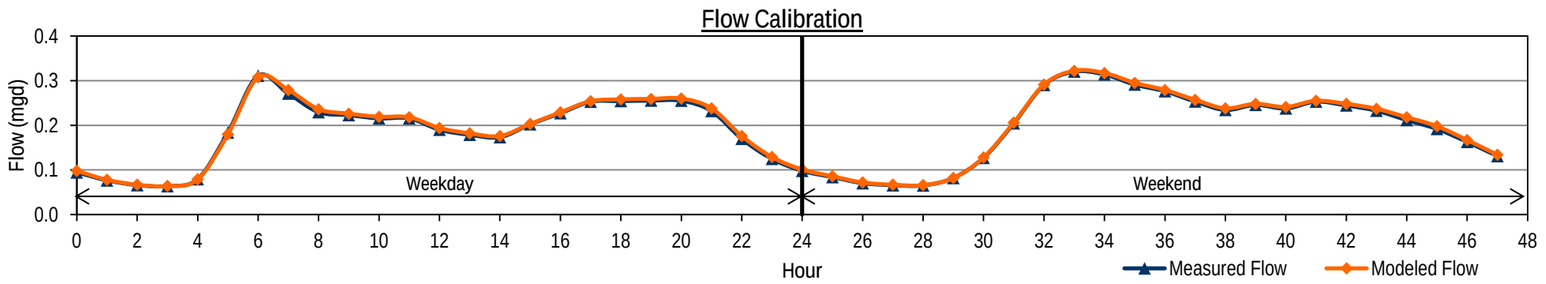


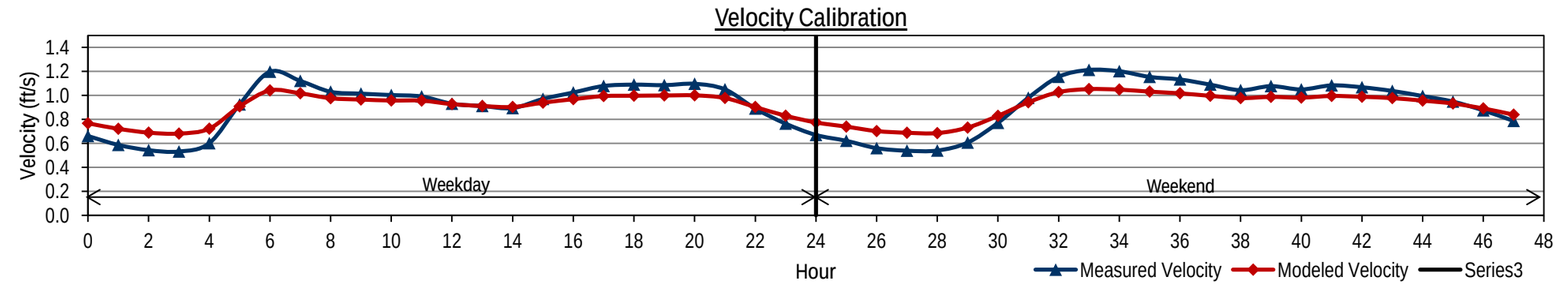


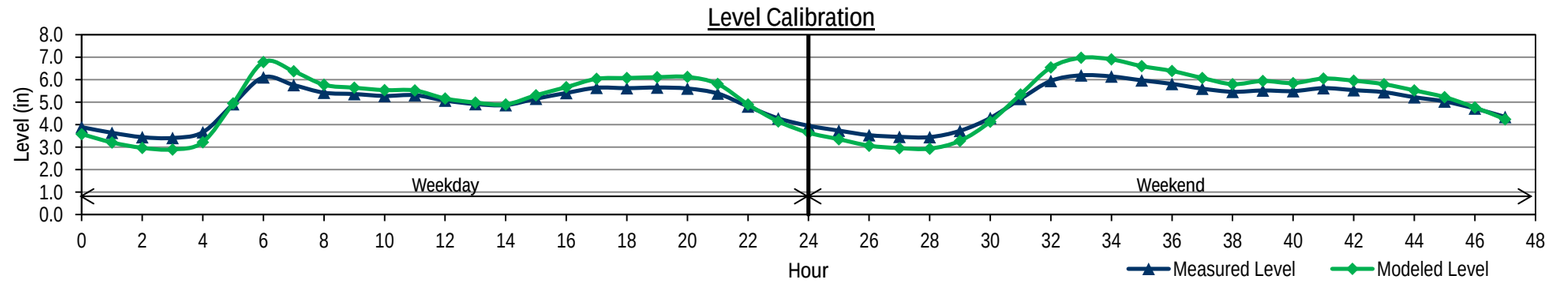
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR26 BASE WASTEWATER FLOW CALIBRATION

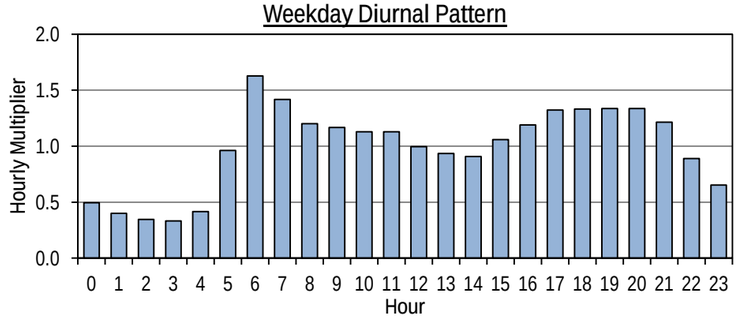
	Hour	Measured Data Flow (mgd)	Measured Data Level (in)	Measured Data Velocity (ft/s)	Modeled Data Flow (mgd)	Modeled Data Level (in)	Modeled Data Velocity (ft/s)	Diurnal Calibrated Diurnal
Weekday	0	0.095	3.9	0.66	0.098	3.6	0.77	0.49
	1	0.077	3.6	0.59	0.078	3.2	0.72	0.40
	2	0.066	3.4	0.54	0.067	3.0	0.69	0.34
	3	0.064	3.4	0.53	0.064	2.9	0.68	0.33
	4	0.079	3.7	0.60	0.079	3.2	0.72	0.42
	5	0.184	4.9	0.93	0.180	4.9	0.91	0.96
	6	0.311	6.1	1.20	0.308	6.8	1.04	1.63
	7	0.271	5.8	1.12	0.279	6.4	1.02	1.42
	8	0.230	5.4	1.03	0.236	5.8	0.98	1.20
	9	0.223	5.4	1.02	0.226	5.6	0.97	1.17
	10	0.216	5.3	1.00	0.219	5.5	0.96	1.13
	11	0.216	5.3	0.99	0.218	5.5	0.96	1.13
	12	0.190	5.1	0.93	0.194	5.2	0.93	0.99
	13	0.179	4.9	0.91	0.182	5.0	0.91	0.94
	14	0.174	4.9	0.90	0.176	4.9	0.90	0.91
	15	0.203	5.2	0.97	0.203	5.3	0.94	1.06
	16	0.227	5.4	1.03	0.229	5.7	0.97	1.19
	17	0.253	5.6	1.08	0.254	6.0	1.00	1.32
	18	0.255	5.6	1.09	0.258	6.1	1.00	1.33
	19	0.256	5.6	1.09	0.259	6.1	1.00	1.34
	20	0.255	5.6	1.10	0.260	6.1	1.00	1.34
	21	0.232	5.4	1.05	0.238	5.8	0.98	1.21
	22	0.170	4.8	0.89	0.176	4.9	0.90	0.89
	23	0.125	4.3	0.77	0.129	4.1	0.83	0.65
Weekend	24	0.098	4.0	0.67	0.101	3.6	0.78	0.51
	25	0.084	3.7	0.62	0.086	3.3	0.74	0.44
	26	0.070	3.5	0.56	0.072	3.1	0.70	0.37
	27	0.066	3.5	0.54	0.067	3.0	0.69	0.34
	28	0.065	3.4	0.54	0.066	2.9	0.69	0.34
	29	0.082	3.7	0.61	0.082	3.3	0.73	0.43
	30	0.127	4.3	0.77	0.128	4.1	0.83	0.66
	31	0.205	5.1	0.98	0.206	5.3	0.94	1.07
	32	0.291	5.9	1.16	0.291	6.5	1.03	1.52
	33	0.321	6.2	1.21	0.322	7.0	1.05	1.68
	34	0.314	6.1	1.20	0.317	6.9	1.05	1.64
	35	0.292	6.0	1.16	0.295	6.6	1.03	1.52
	36	0.277	5.8	1.13	0.279	6.4	1.02	1.45
	37	0.254	5.6	1.09	0.257	6.1	1.00	1.33
	38	0.235	5.5	1.04	0.238	5.8	0.98	1.23
	39	0.246	5.5	1.08	0.248	5.9	0.99	1.29
	40	0.238	5.5	1.05	0.241	5.8	0.98	1.24
	41	0.253	5.6	1.08	0.255	6.0	1.00	1.32
	42	0.245	5.5	1.07	0.248	6.0	0.99	1.28
	43	0.233	5.4	1.04	0.237	5.8	0.98	1.22
	44	0.212	5.2	1.00	0.218	5.5	0.96	1.11
	45	0.192	5.0	0.95	0.198	5.2	0.93	1.00
	46	0.163	4.7	0.88	0.167	4.8	0.89	0.85
	47	0.131	4.3	0.79	0.134	4.2	0.84	0.69
Average								
	Weekday	0.190	4.9	0.92	0.192	5.1	0.91	0.99
	Weekend	0.195	5.0	0.93	0.198	5.1	0.91	1.02
	ADWF[1]	0.191	4.9	0.92	0.194	5.1	0.91	1.00
% Error								
	Weekday				1.4%	2.6%	-1.1%	
	Weekend				1.3%	3.3%	-1.9%	

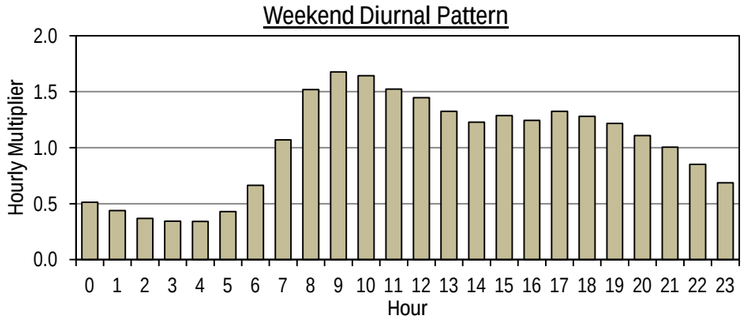
Note:
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7









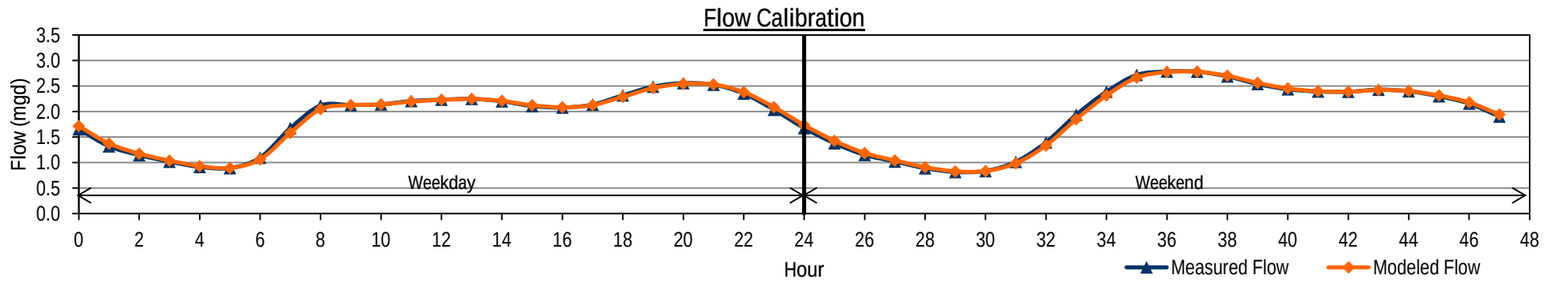


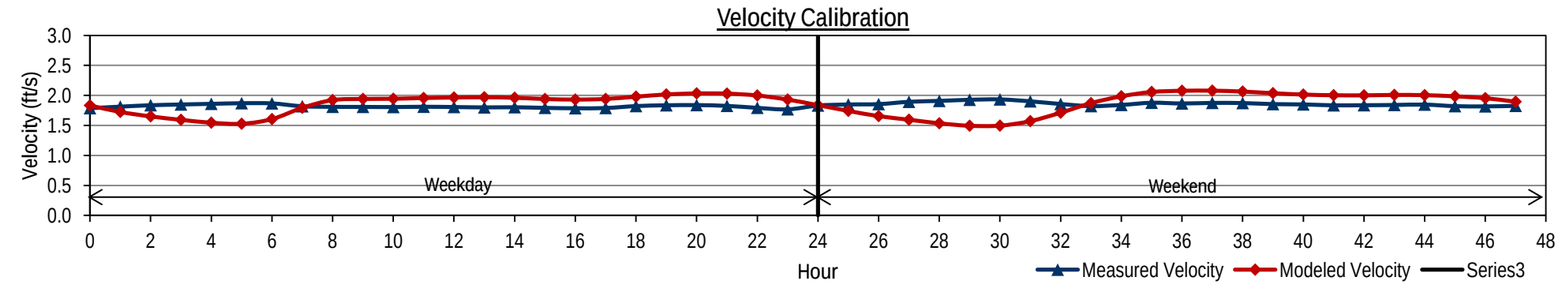
CITY OF FRESNO
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE
FLOW MONITORING SITE FR27 BASE WASTEWATER FLOW CALIBRATION

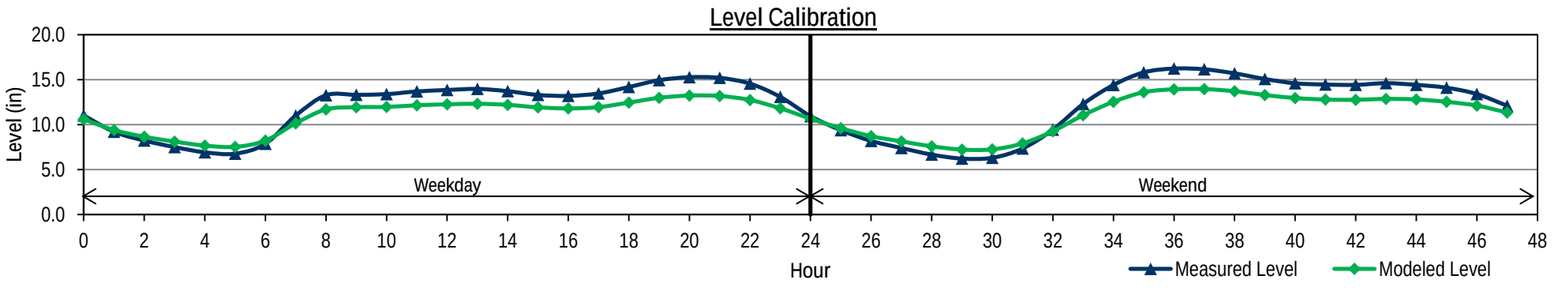
		Measured Data			Modeled Data			Diurnal
	Hour	Flow (mgd)	Level (in)	Velocity (ft/s)	Flow (mgd)	Level (in)	Velocity (ft/s)	Calibrated Diurnal
Weekday	0	1.653	11.0	1.79	1.715	10.6	1.83	0.87
	1	1.319	9.2	1.81	1.373	9.4	1.73	0.69
	2	1.146	8.2	1.84	1.174	8.7	1.65	0.60
	3	1.017	7.5	1.85	1.037	8.1	1.59	0.53
	4	0.914	6.9	1.86	0.929	7.7	1.55	0.48
	5	0.891	6.8	1.87	0.894	7.5	1.53	0.47
	6	1.096	7.9	1.87	1.063	8.2	1.61	0.57
	7	1.675	11.0	1.82	1.582	10.1	1.79	0.88
	8	2.119	13.3	1.81	2.049	11.7	1.92	1.11
	9	2.128	13.3	1.81	2.127	11.9	1.94	1.11
	10	2.142	13.4	1.81	2.139	12.0	1.95	1.12
	11	2.207	13.7	1.81	2.196	12.1	1.96	1.16
	12	2.234	13.9	1.81	2.230	12.3	1.97	1.17
	13	2.249	14.0	1.80	2.248	12.3	1.97	1.18
	14	2.202	13.7	1.80	2.210	12.2	1.96	1.15
	15	2.108	13.3	1.79	2.124	11.9	1.94	1.10
	16	2.079	13.2	1.79	2.085	11.8	1.93	1.09
	17	2.138	13.5	1.79	2.128	11.9	1.94	1.12
	18	2.319	14.2	1.82	2.290	12.4	1.98	1.21
	19	2.490	14.9	1.84	2.462	13.0	2.02	1.30
	20	2.558	15.3	1.84	2.546	13.2	2.03	1.34
	21	2.527	15.2	1.83	2.532	13.2	2.03	1.32
	22	2.354	14.6	1.79	2.383	12.7	2.00	1.23
	23	2.036	13.1	1.77	2.087	11.8	1.93	1.07
Weekend	24	1.676	11.0	1.83	1.734	10.7	1.84	0.88
	25	1.379	9.4	1.85	1.427	9.6	1.74	0.72
	26	1.150	8.2	1.86	1.186	8.7	1.66	0.60
	27	1.020	7.4	1.89	1.041	8.1	1.60	0.53
	28	0.889	6.7	1.91	0.909	7.6	1.54	0.47
	29	0.815	6.2	1.93	0.827	7.2	1.50	0.43
	30	0.834	6.3	1.93	0.832	7.2	1.50	0.44
	31	1.014	7.4	1.90	0.985	7.9	1.57	0.53
	32	1.397	9.5	1.86	1.335	9.3	1.71	0.73
	33	1.938	12.3	1.82	1.850	11.0	1.87	1.01
	34	2.389	14.4	1.84	2.317	12.5	1.99	1.25
	35	2.719	15.8	1.88	2.667	13.6	2.06	1.42
	36	2.786	16.2	1.87	2.776	13.9	2.08	1.46
	37	2.784	16.2	1.88	2.783	13.9	2.08	1.46
	38	2.690	15.7	1.87	2.704	13.7	2.07	1.41
	39	2.541	15.1	1.86	2.564	13.3	2.04	1.33
	40	2.438	14.6	1.85	2.454	12.9	2.02	1.28
	41	2.394	14.5	1.84	2.400	12.8	2.00	1.25
	42	2.389	14.4	1.84	2.390	12.8	2.00	1.25
	43	2.430	14.6	1.84	2.423	12.9	2.01	1.27
	44	2.399	14.4	1.85	2.404	12.8	2.01	1.26
	45	2.301	14.1	1.82	2.317	12.5	1.99	1.20
	46	2.158	13.4	1.82	2.181	12.1	1.96	1.13
	47	1.903	12.1	1.83	1.943	11.3	1.90	1.00
Average								
	Weekday	1.900	12.1	1.82	1.900	11.1	1.86	0.99
	Weekend	1.935	12.1	1.86	1.935	11.2	1.86	1.01
	ADWF[1]	1.910	12.1	1.83	1.910	11.1	1.86	1.00
% Error								
	Weekday				0.0%	-8.4%	2.6%	
	Weekend				0.0%	-7.4%	0.1%	

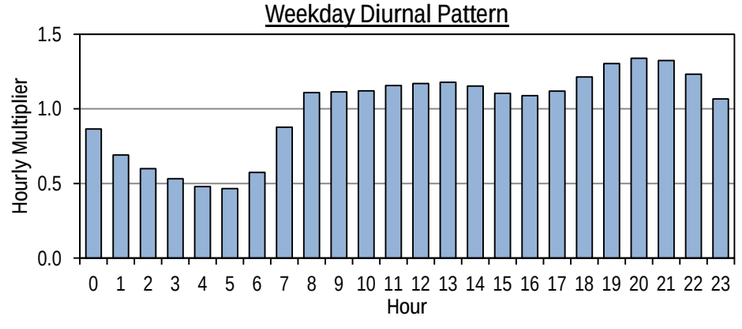
Note:

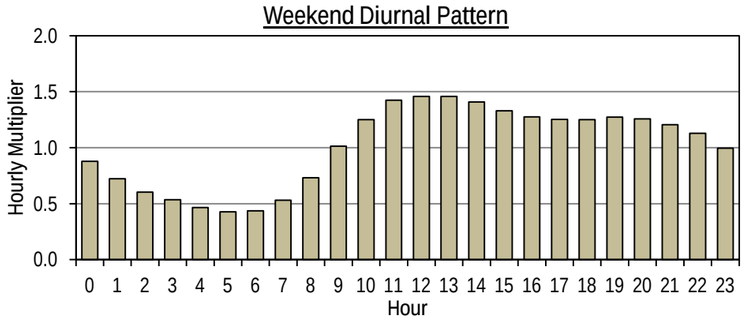
1. ADWF = (5xWeekday Average + 2xWeekend Average)/7











APPENDIX C – WET WEATHER FLOW CALIBRATION

Table 2 Wet Weather Calibration Summary - April 2012 Storm Event
Wastewater Collection System Master Plan Update
City of Fresno

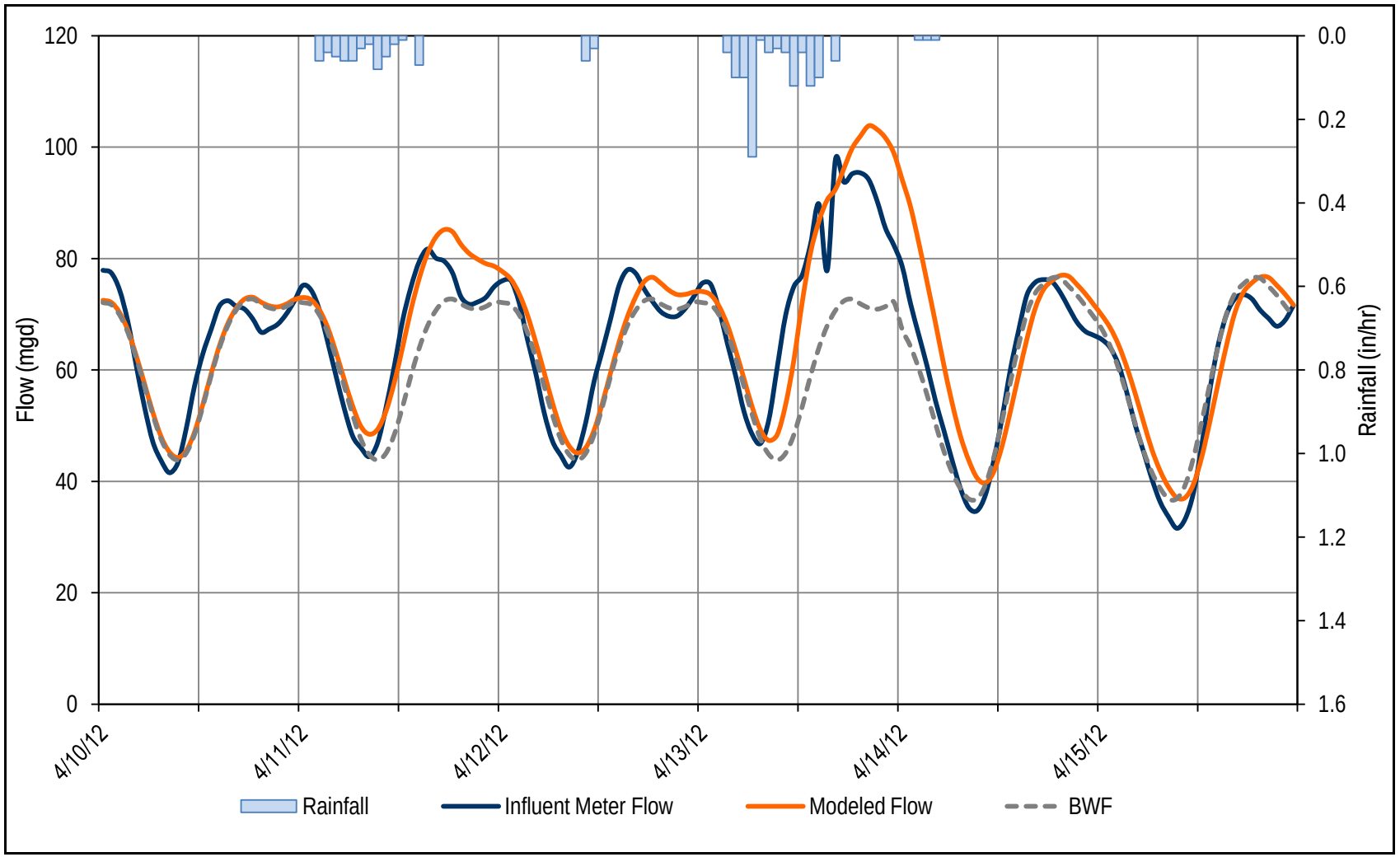
Meter Number	April 13-14, 2012 Storm Event											
	Measured Data[1]				Modeled Data[2]				Percent Error[3]			
	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Peak Flow (%)	Avg. Velocity (%)	Avg. Level (%)
FR01	3.603	5.501	3.40	9.1	4.080	5.806	3.14	10.5	13.2%	5.5%	-7.6%	15.4%
FR02	8.864	12.715	3.58	16.8	8.642	13.321	3.67	16.0	-2.5%	4.8%	2.6%	-4.7%
FR06	4.241	7.986	2.52	14.6	4.572	7.804	2.63	14.3	7.8%	-2.3%	4.5%	-1.7%
FR08	Note 4	Note 4	Note 4	Note 4	9.466	15.576	4.46	14.4	Note 4	Note 4	Note 4	Note 4
FR10	1.332	2.985	1.19	8.2	1.680	3.255	1.23	11.0	*26.1%*	9.1%	2.9%	*33.7%*
FR12	1.790	4.581	1.89	9.3	2.070	4.647	2.06	9.6	15.6%	1.5%	8.7%	3.8%
FR14	4.363	6.793	2.11	16.9	4.641	7.900	2.32	16.0	6.4%	16.3%	9.7%	-5.3%
FR15	6.330	8.273	2.14	18.8	6.565	9.505	2.29	18.2	3.7%	14.9%	6.8%	-2.9%
FR16	4.135	6.434	3.29	12.6	4.168	7.464	3.35	12.2	0.8%	16.0%	1.9%	-2.7%
FR19	22.983	34.118	5.46	20.8	25.384	37.234	4.99	23.8	10.4%	9.1%	-8.6%	14.5%
FR20	Note 4	Note 4	Note 4	Note 4	31.073	47.739	4.86	28.2	Note 4	Note 4	Note 4	Note 4
FR21	5.485	9.333	2.13	17.9	5.241	9.025	2.18	16.8	-4.5%	-3.3%	2.5%	-6.4%
FR22	8.456	12.878	3.02	18.6	8.547	13.454	2.96	18.7	1.1%	4.5%	-1.7%	0.9%
FR23	1.455	5.026	2.01	8.2	1.726	4.522	2.29	8.4	18.6%	-10.0%	14.0%	1.8%
FR24	Note 4	Note 4	Note 4	Note 4	10.316	15.570	2.72	18.4	Note 4	Note 4	Note 4	Note 4
FR25	0.117	0.318	1.26	2.5	0.113	0.329	1.22	2.5	-3.4%	3.5%	-3.1%	-0.1%
FR26	0.216	0.669	0.93	5.3	0.248	0.659	0.95	5.9	14.8%	-1.5%	2.0%	11.9%

Notes:
1. Source: City of Fresno Permanent Flow Monitoring Data
2. Average flows are calculated from flow monitoring data. Maximum flow values are hourly peaks.
3. Percent Difference = (Modeled - Measured)/Measured*100.
4. Meters FR08, FR20, and FR24 have data gaps or questionable data quality, and therefore percent error comparisons are not appropriate for these meters.

CITY OF FRESNO

WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

RWRF WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

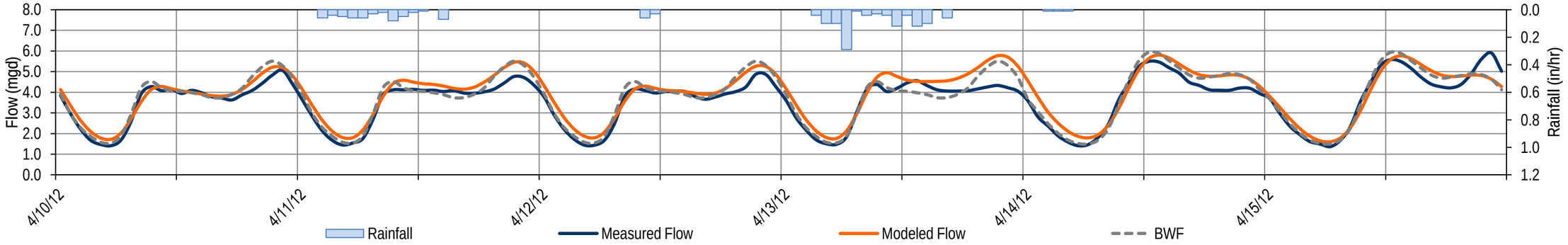


CITY OF FRESNO

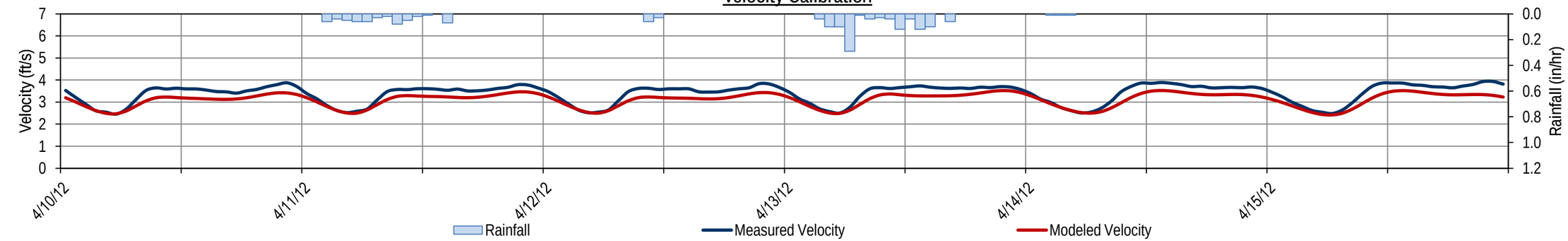
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR01 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

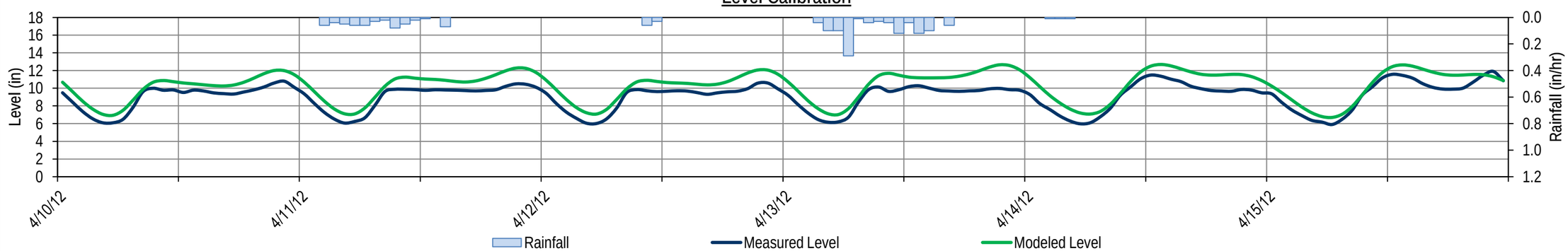
Flow Calibration



Velocity Calibration



Level Calibration

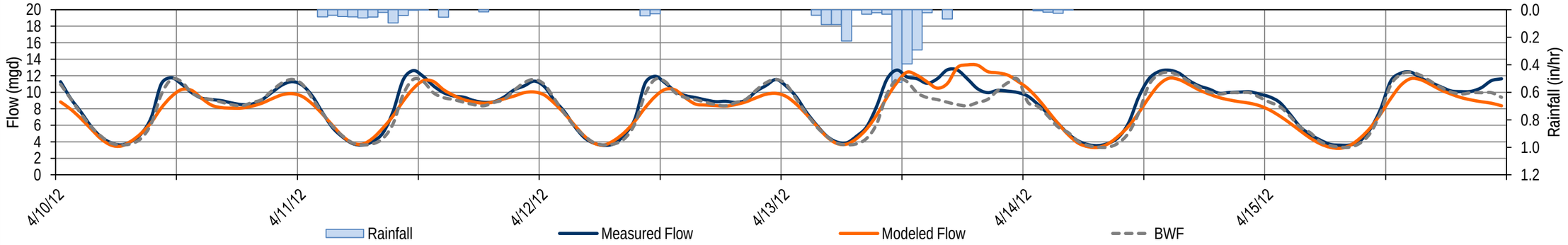


CITY OF FRESNO

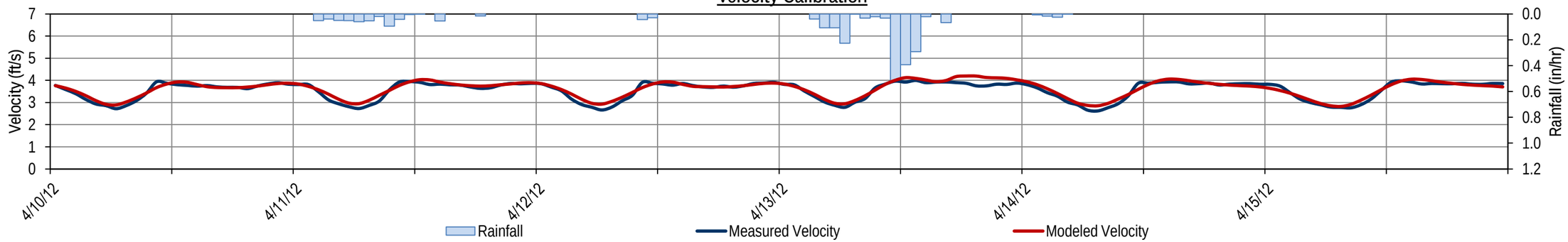
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR02 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

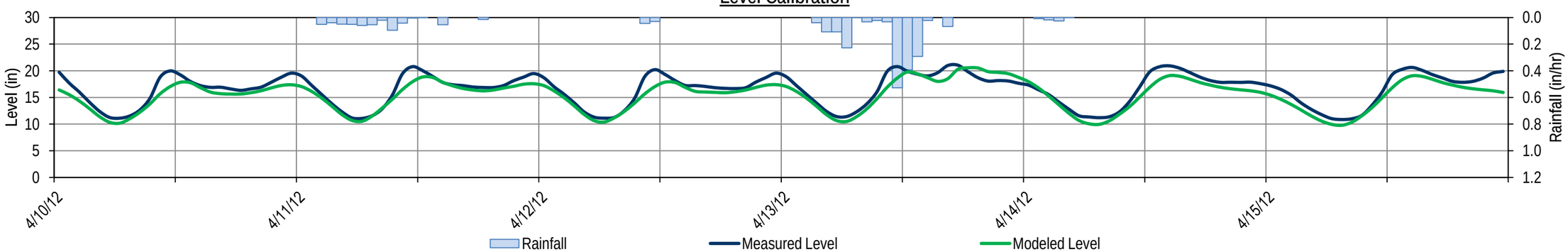
Flow Calibration



Velocity Calibration



Level Calibration

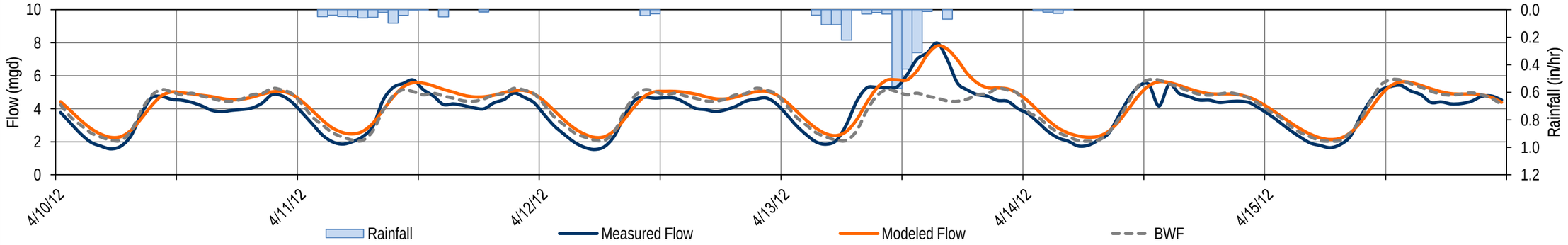


CITY OF FRESNO

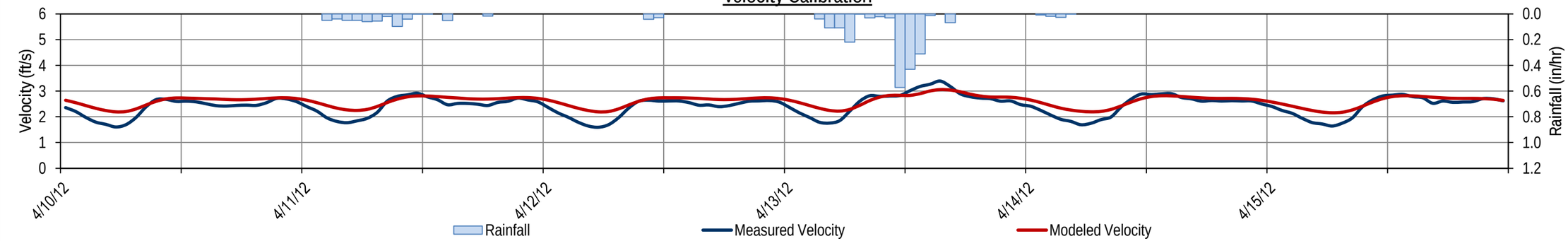
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR06 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

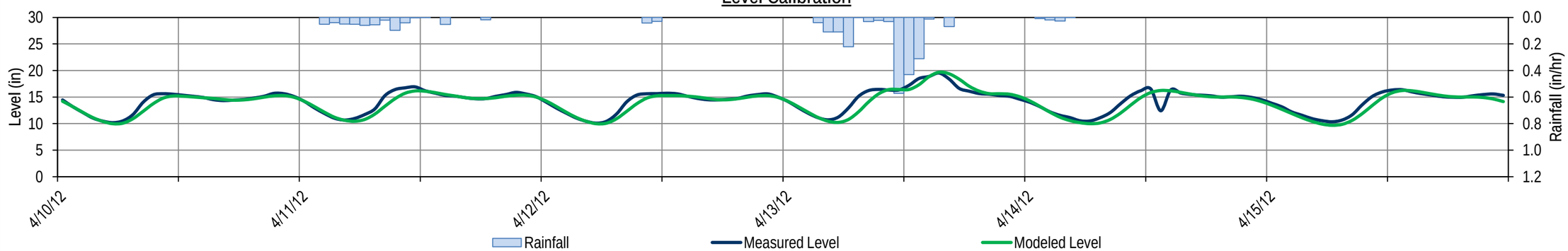
Flow Calibration



Velocity Calibration



Level Calibration

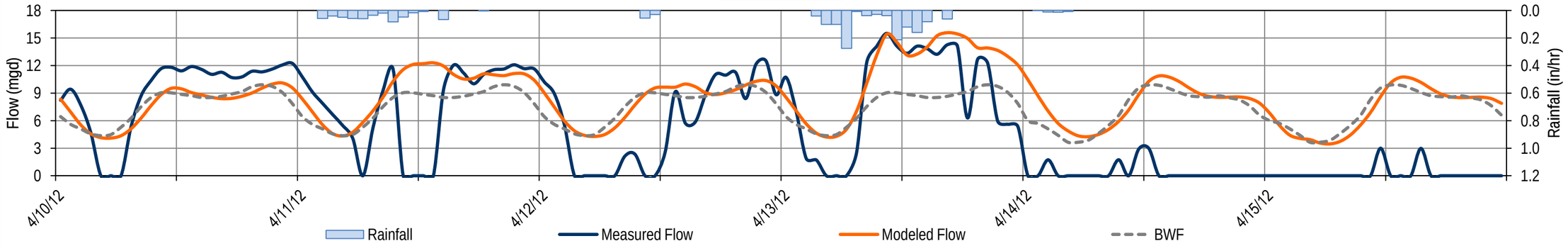


CITY OF FRESNO

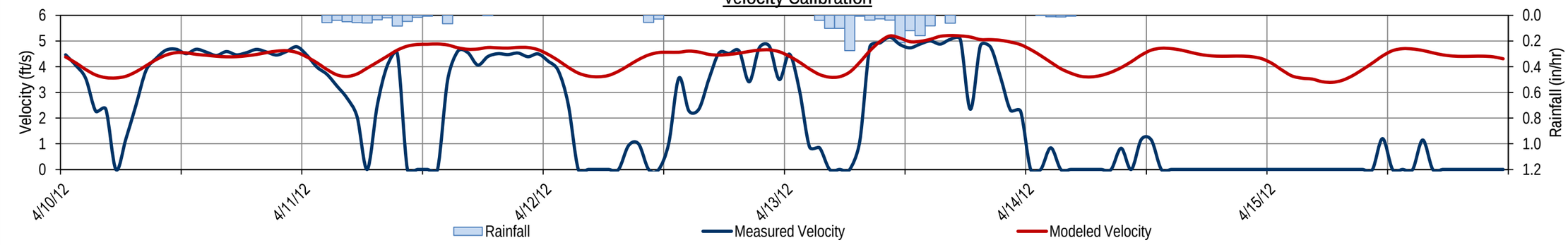
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR08 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

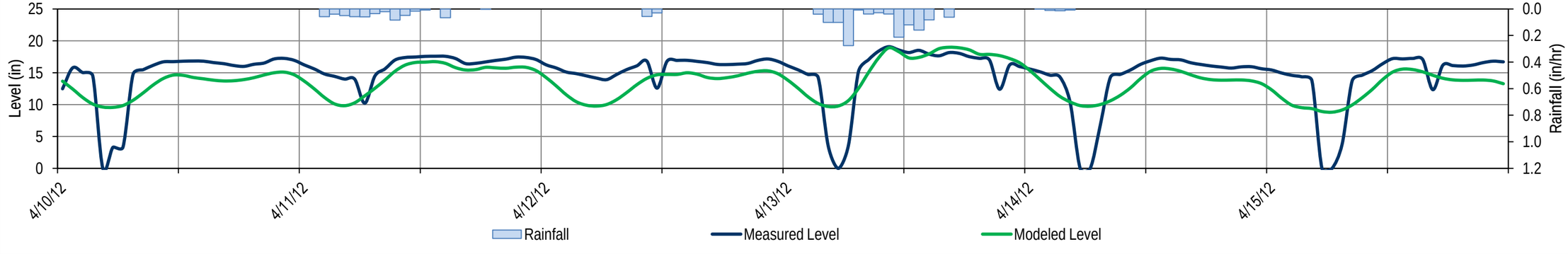
Flow Calibration



Velocity Calibration



Level Calibration

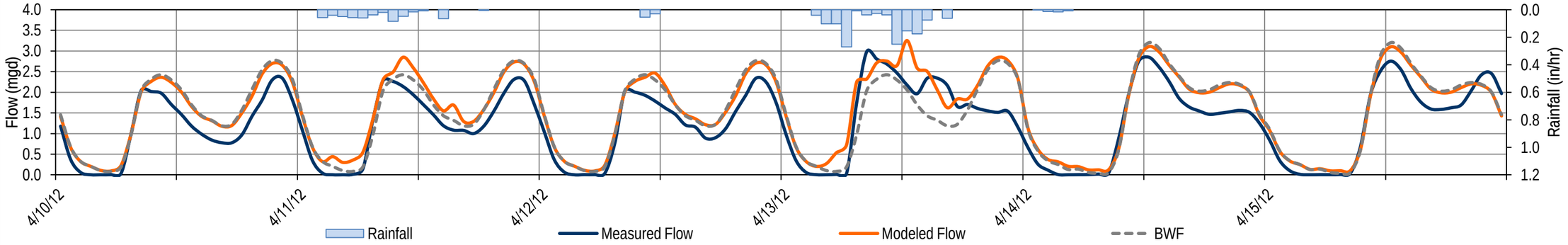


CITY OF FRESNO

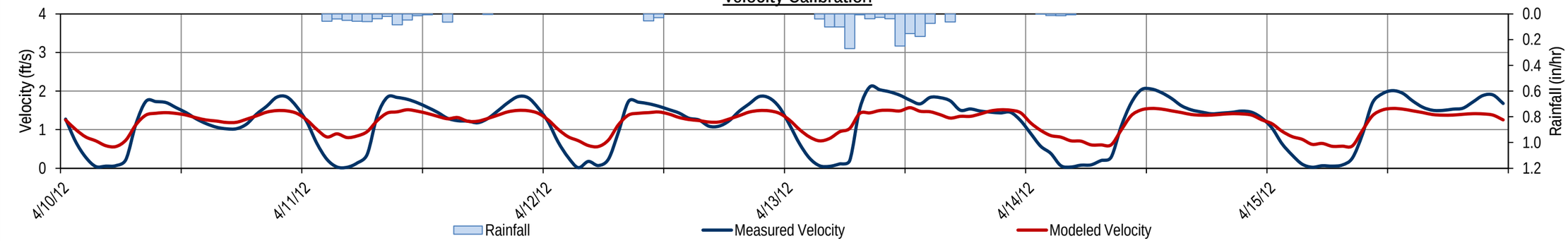
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR10 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

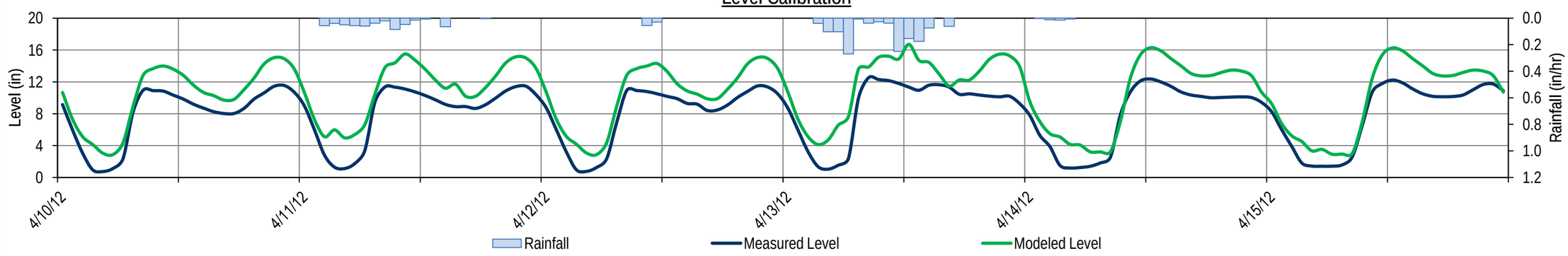
Flow Calibration



Velocity Calibration



Level Calibration

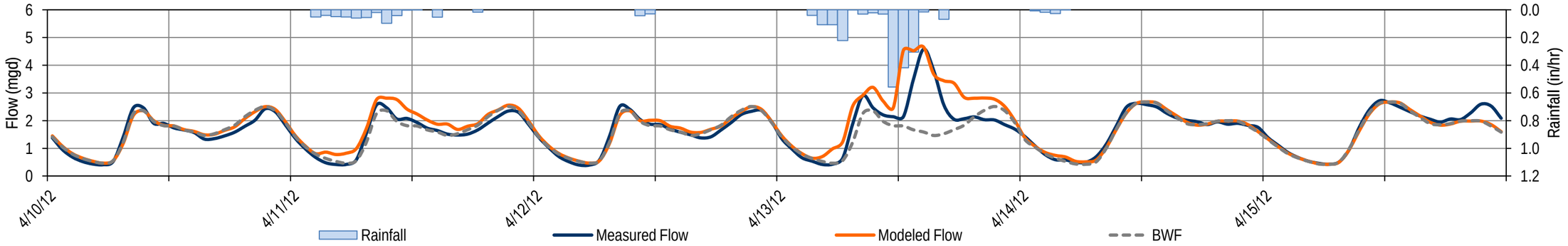


CITY OF FRESNO

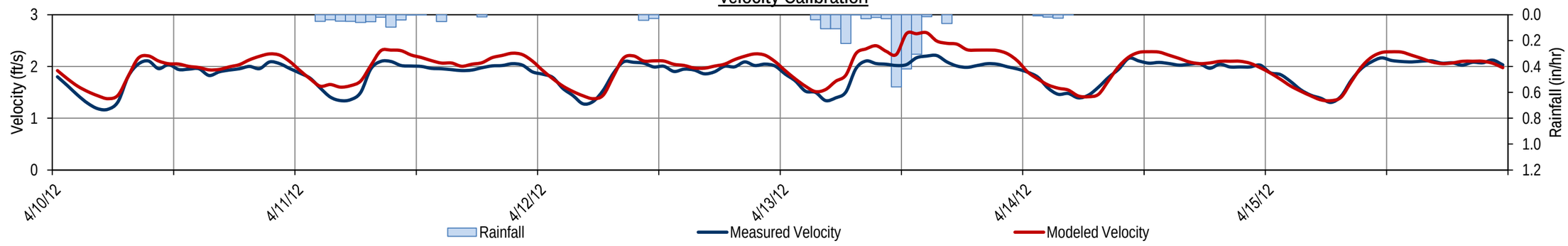
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR12 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

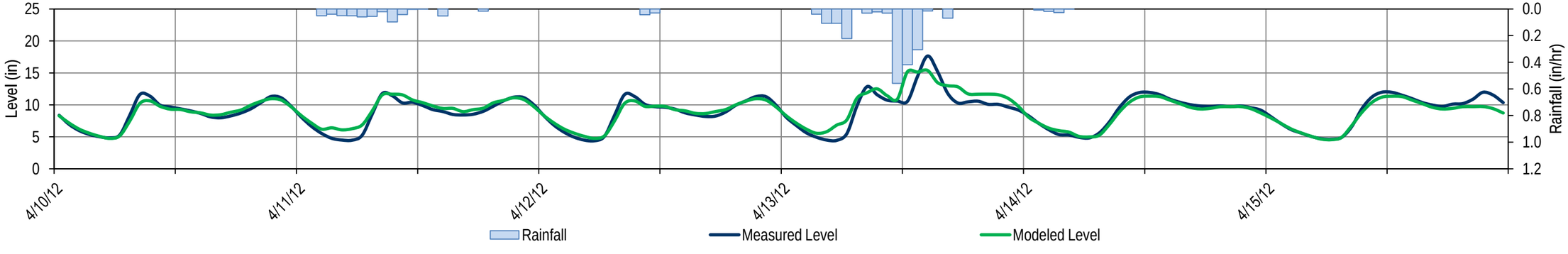
Flow Calibration



Velocity Calibration



Level Calibration

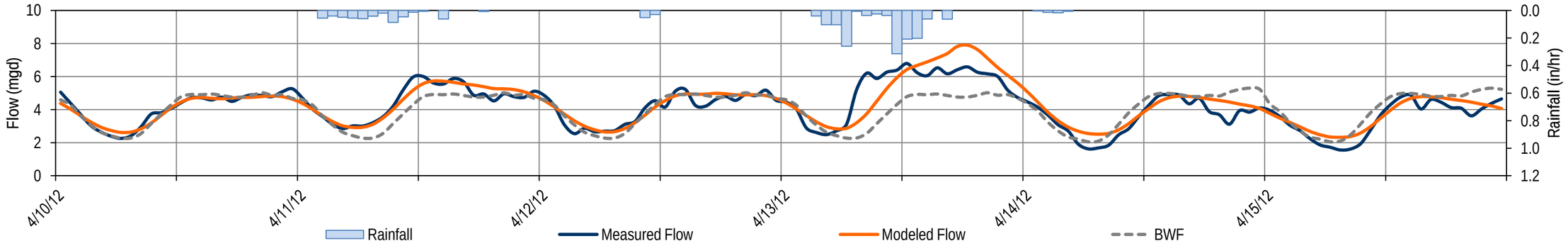


CITY OF FRESNO

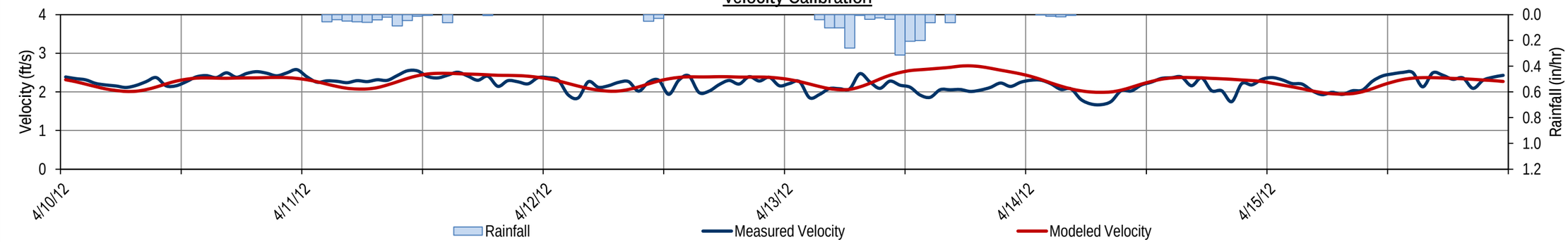
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR14 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

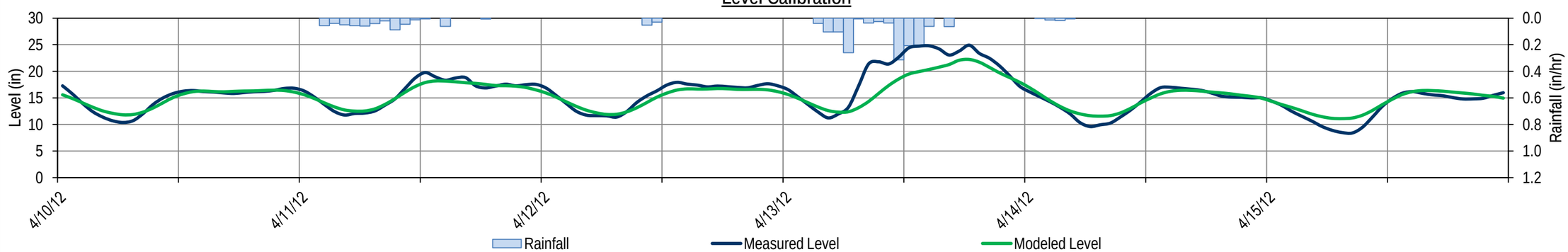
Flow Calibration



Velocity Calibration



Level Calibration

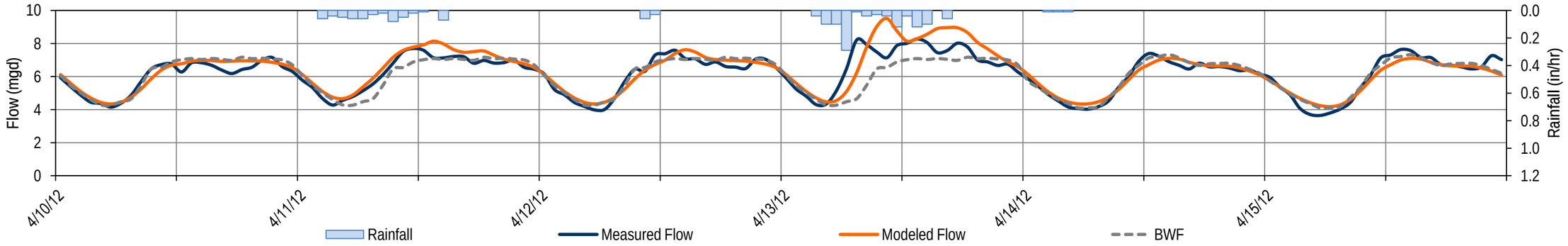


CITY OF FRESNO

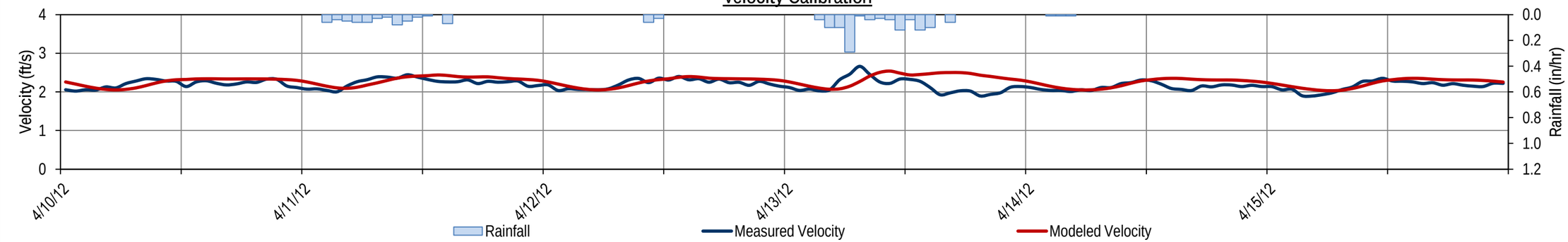
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR15 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

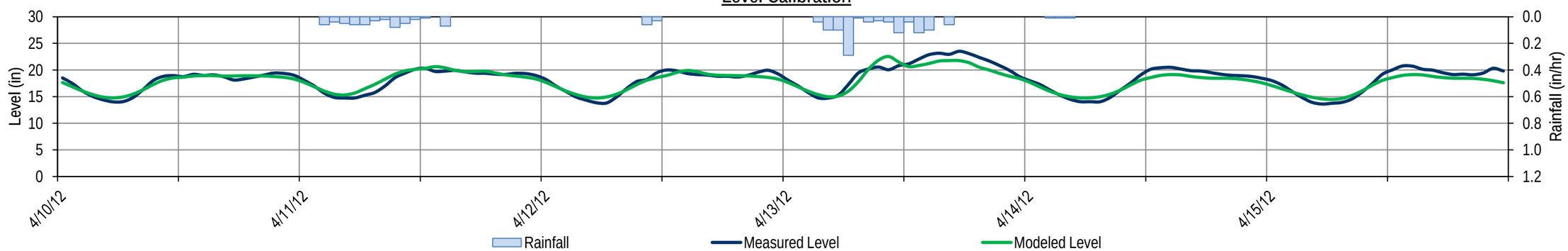
Flow Calibration



Velocity Calibration



Level Calibration

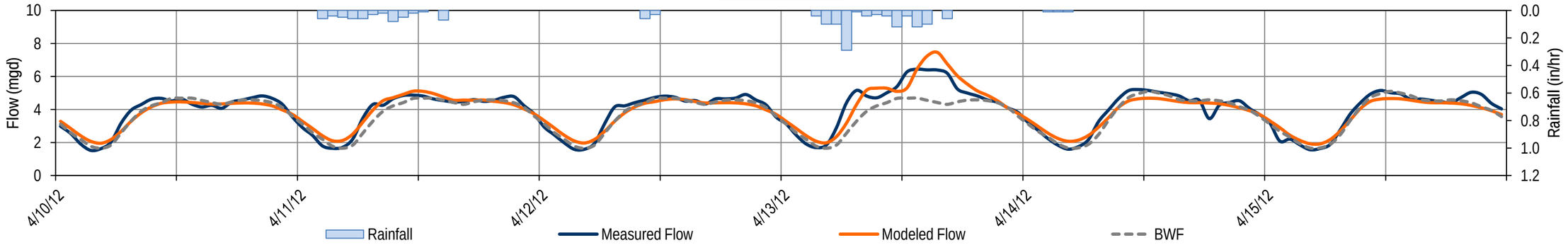


CITY OF FRESNO

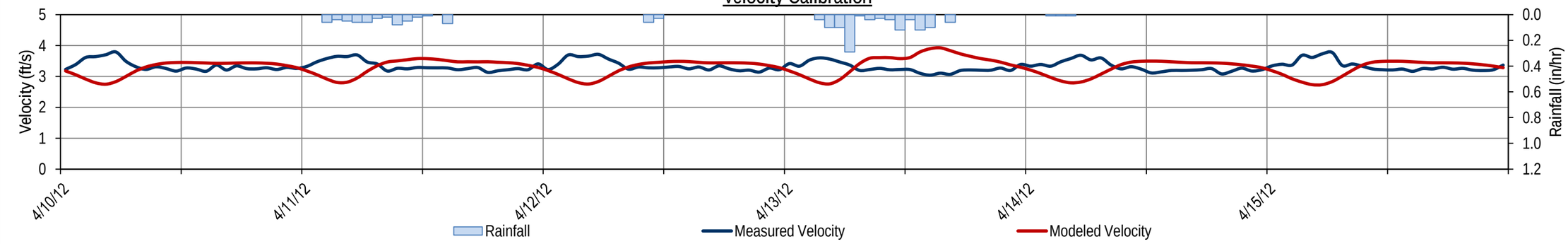
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR16 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

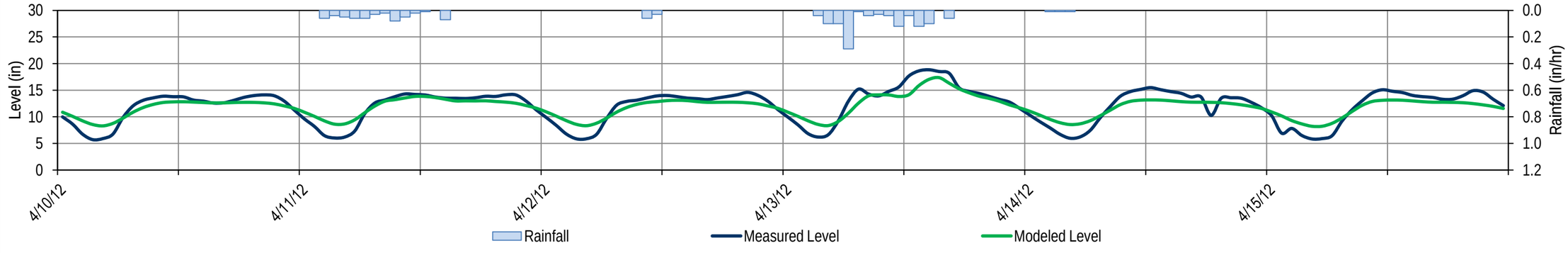
Flow Calibration



Velocity Calibration



Level Calibration

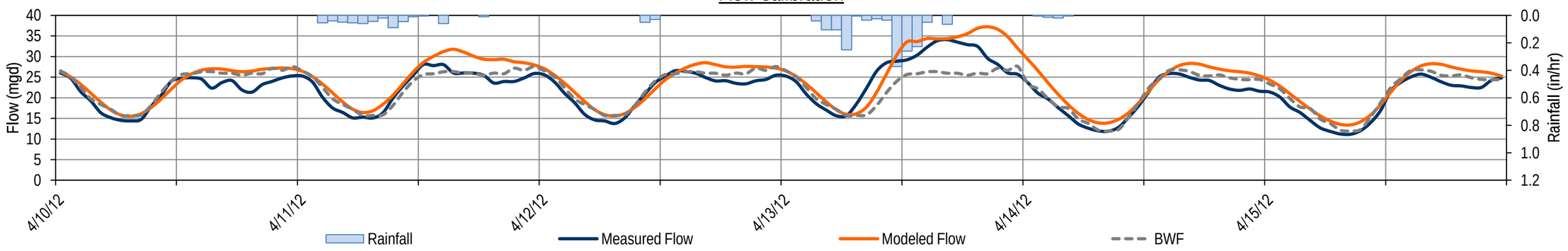


CITY OF FRESNO

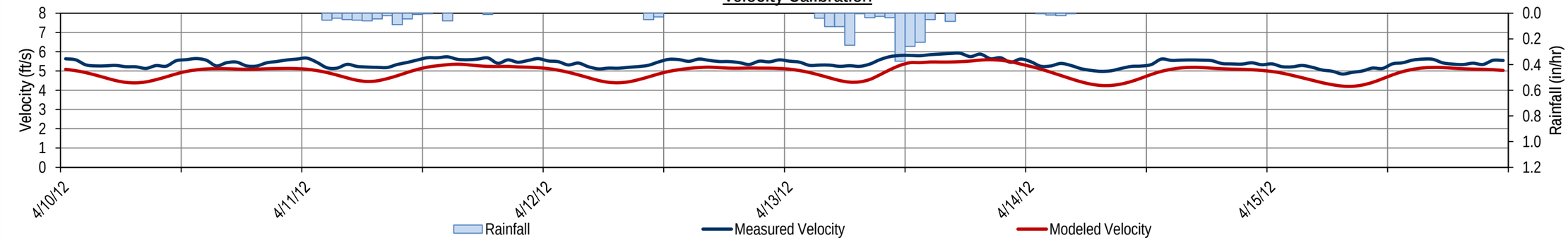
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR19 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

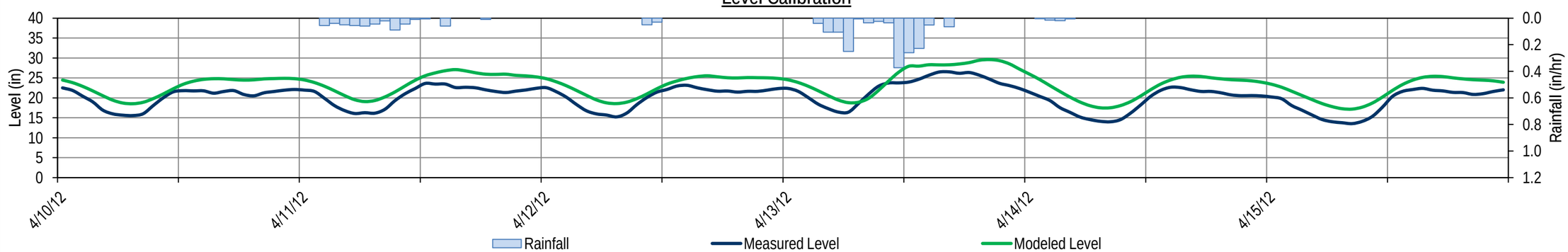
Flow Calibration



Velocity Calibration



Level Calibration

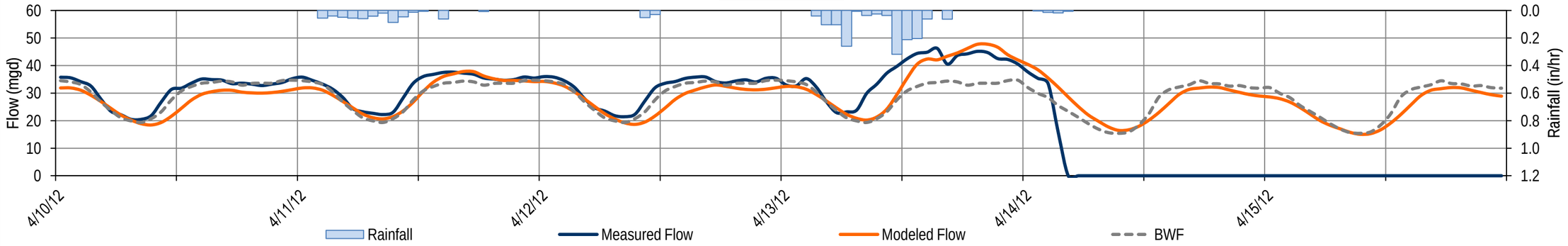


CITY OF FRESNO

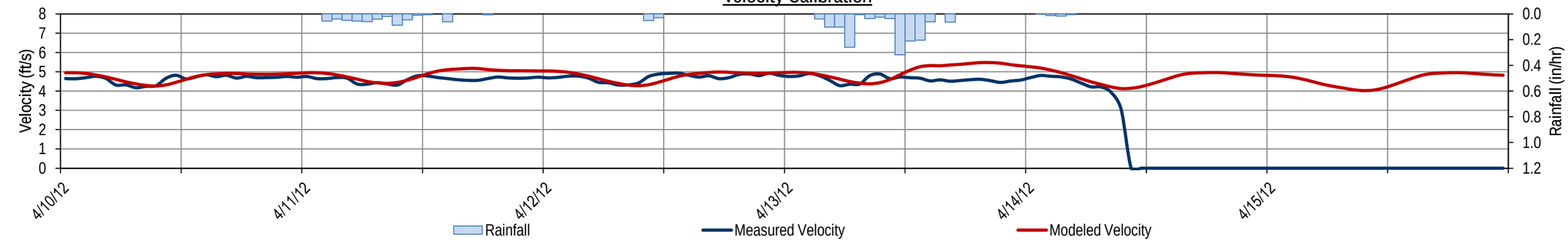
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR20 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

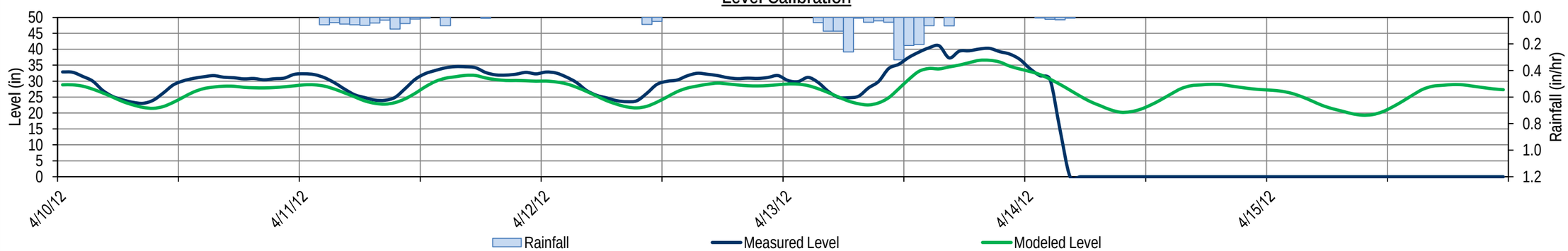
Flow Calibration



Velocity Calibration



Level Calibration

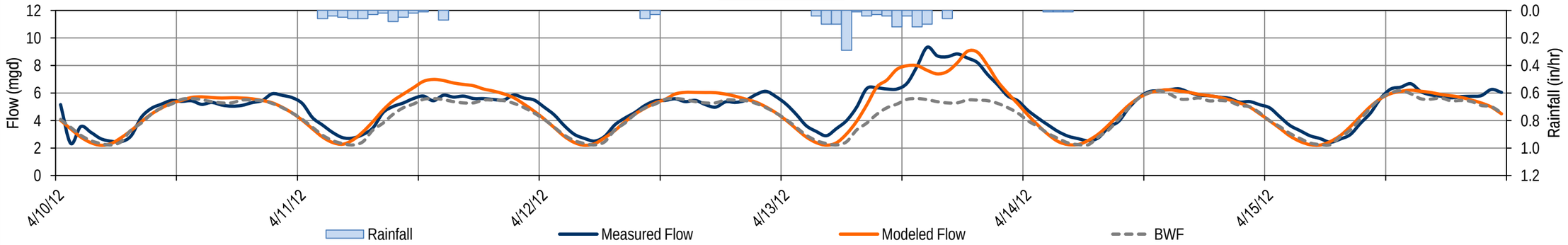


CITY OF FRESNO

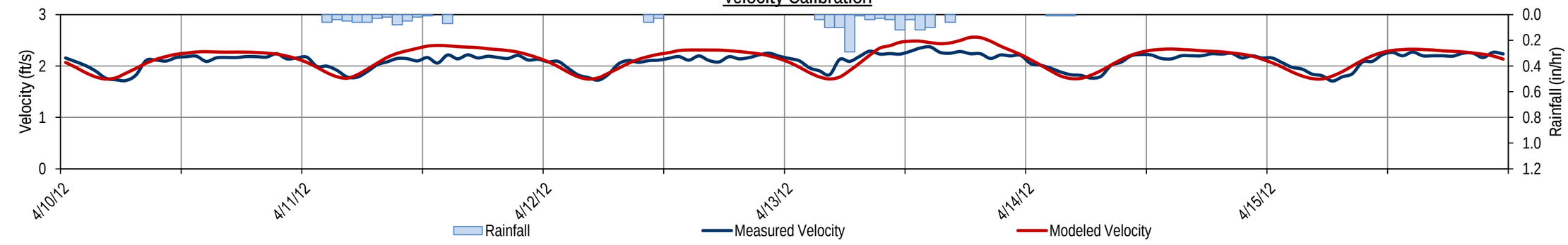
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR21 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

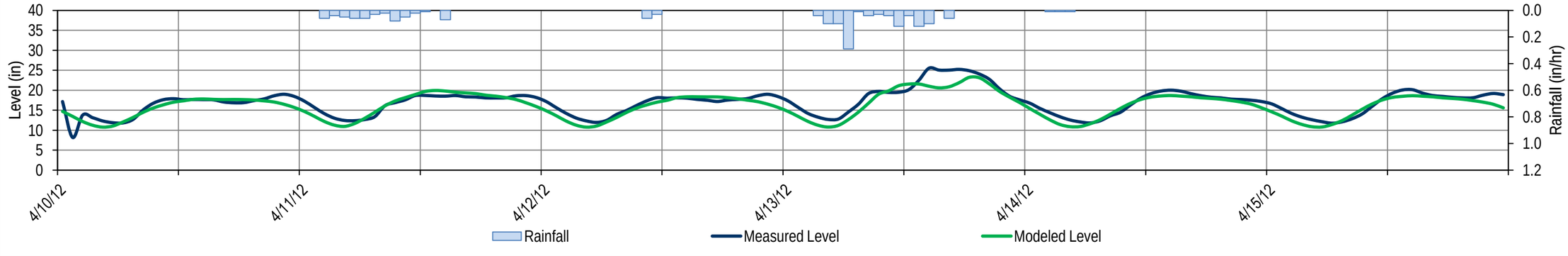
Flow Calibration



Velocity Calibration



Level Calibration

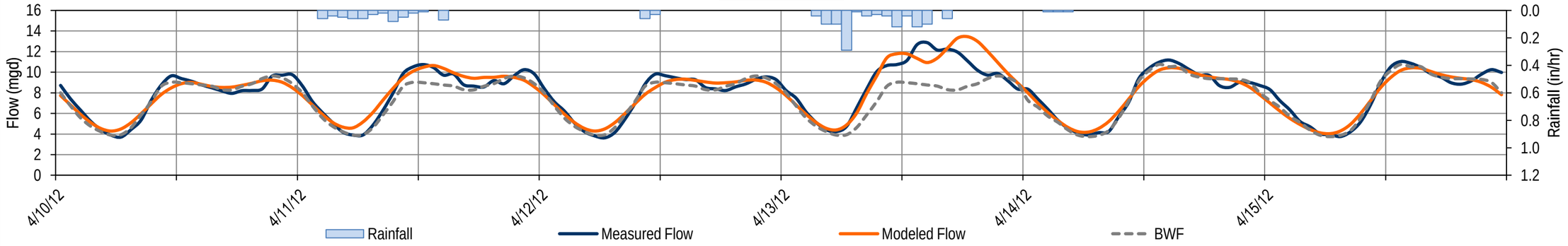


CITY OF FRESNO

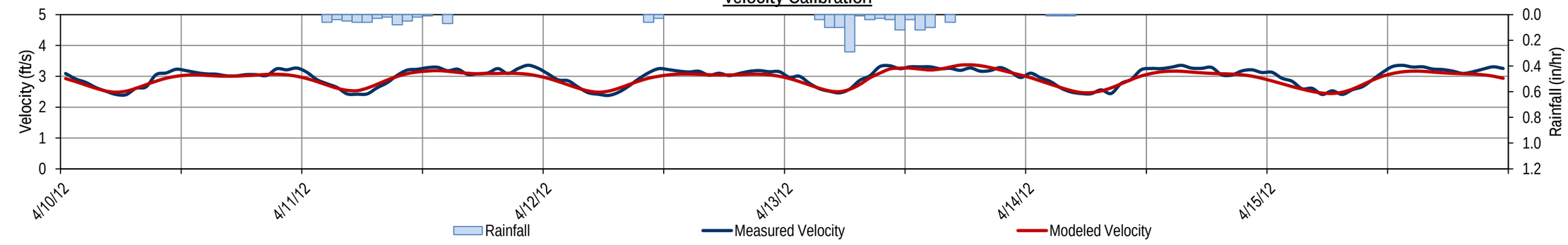
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR22 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

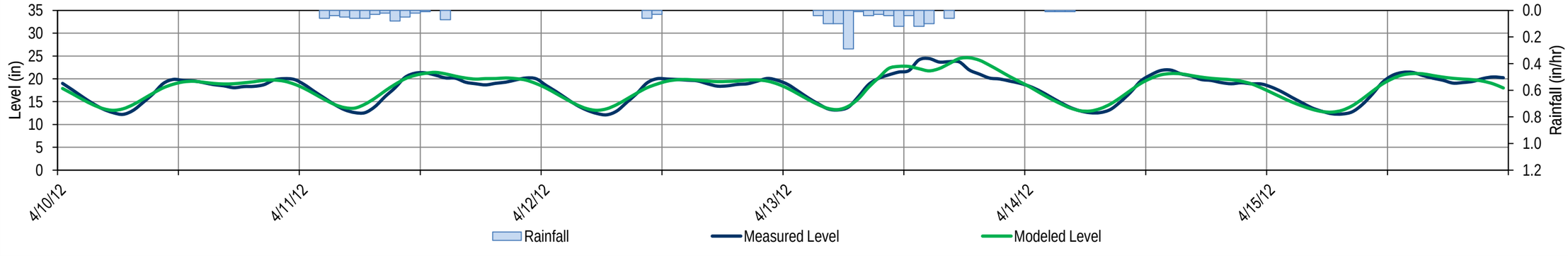
Flow Calibration



Velocity Calibration



Level Calibration

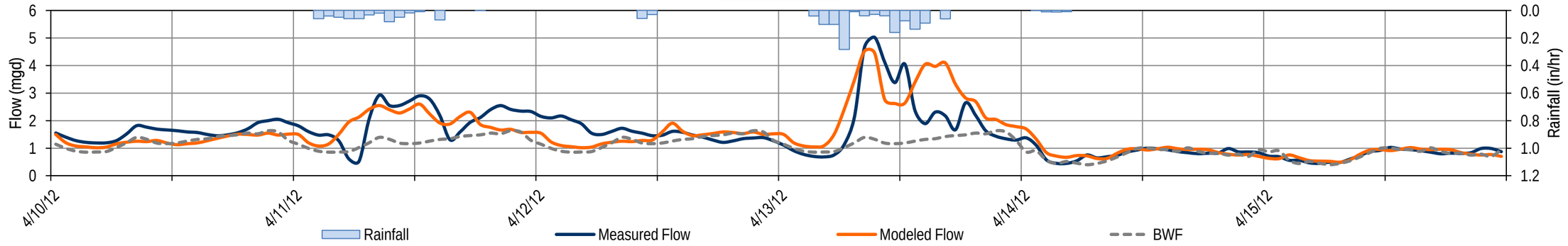


CITY OF FRESNO

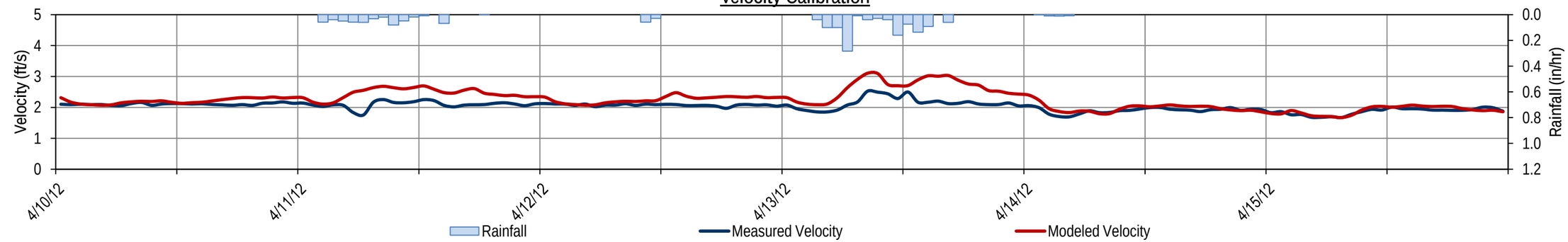
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR23 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

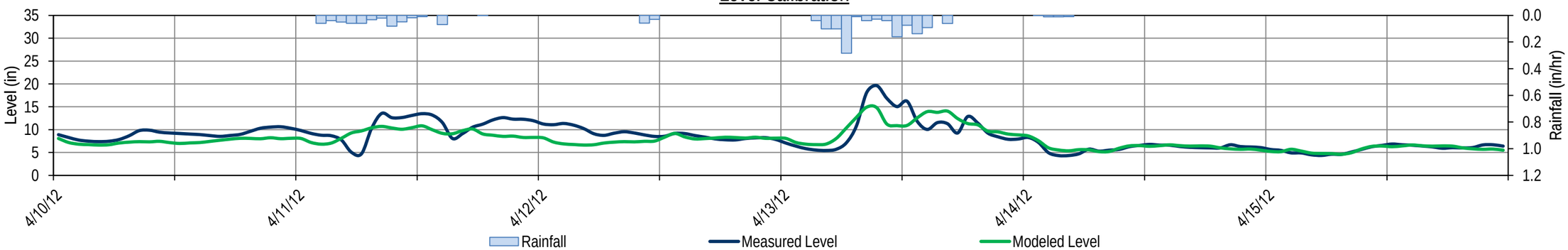
Flow Calibration



Velocity Calibration



Level Calibration

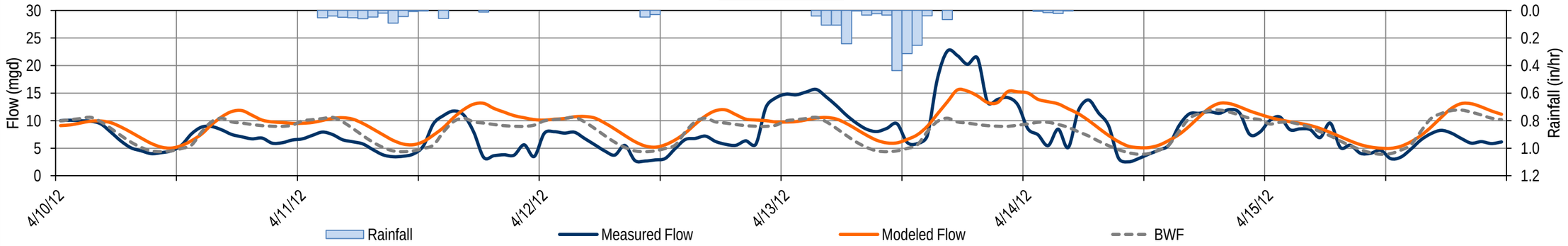


CITY OF FRESNO

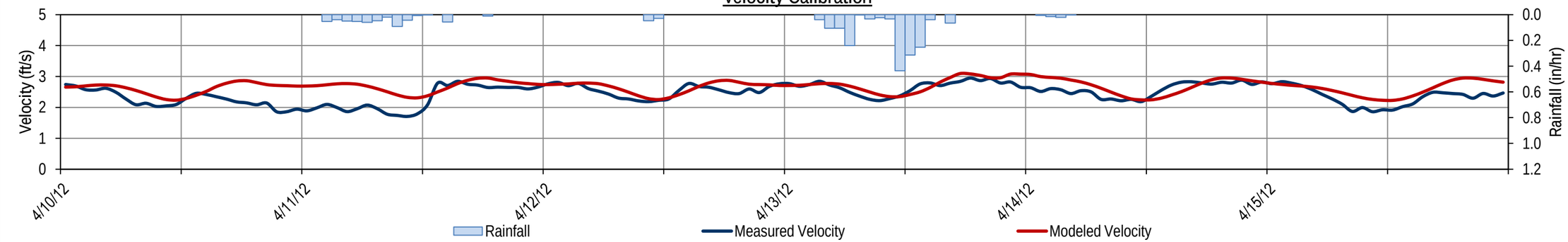
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR24 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

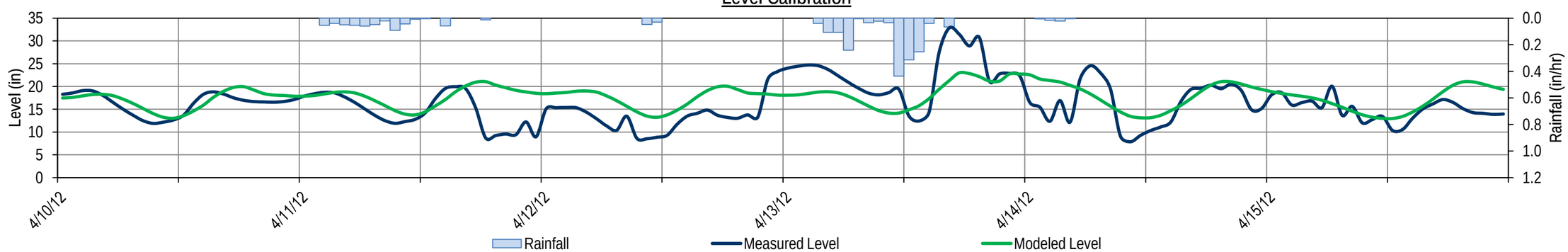
Flow Calibration



Velocity Calibration



Level Calibration

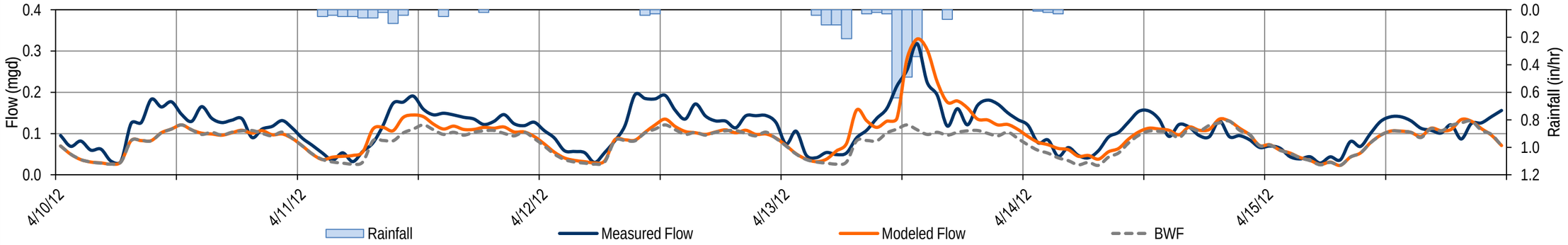


CITY OF FRESNO

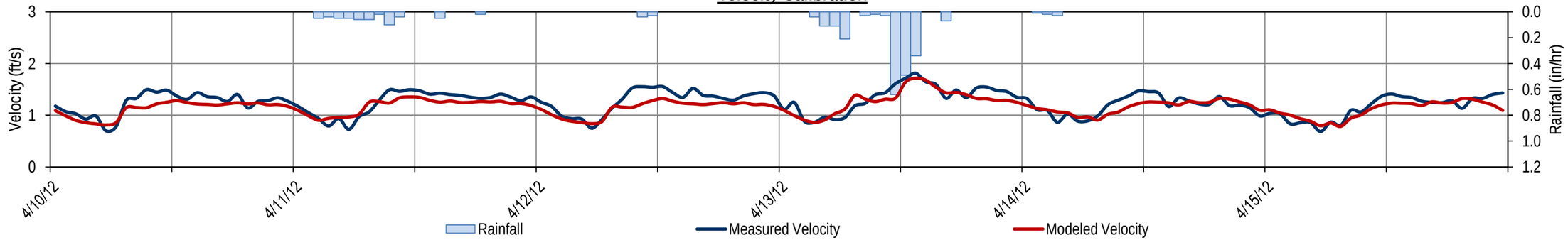
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR25 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

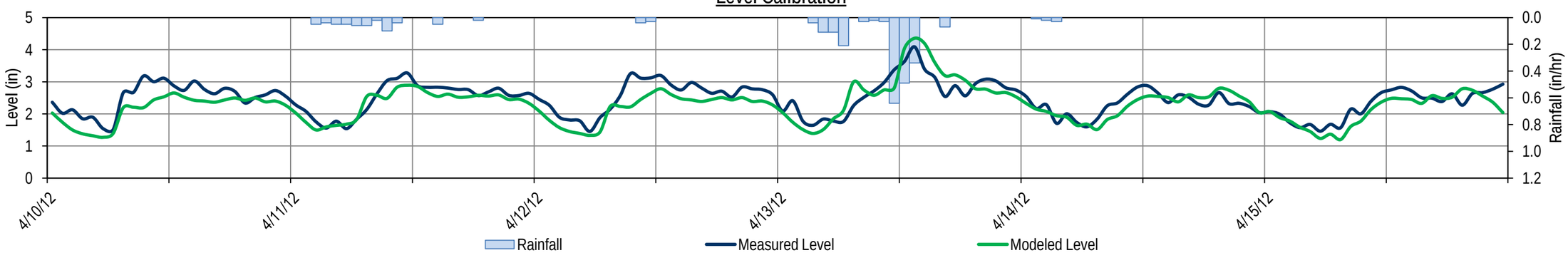
Flow Calibration



Velocity Calibration



Level Calibration

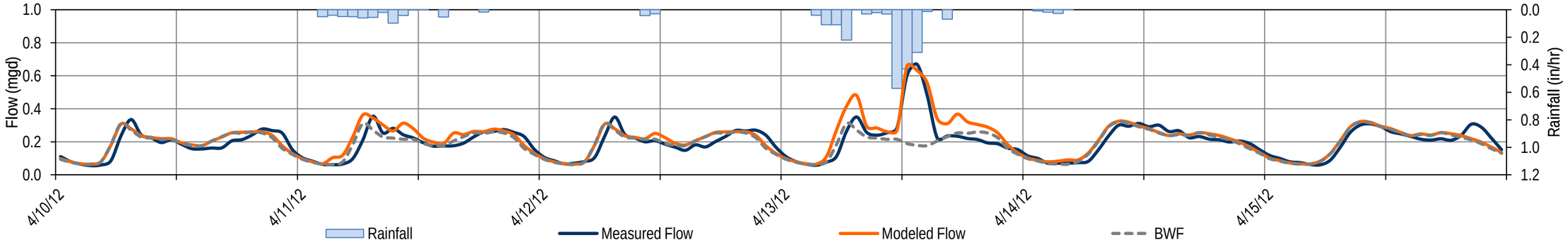


CITY OF FRESNO

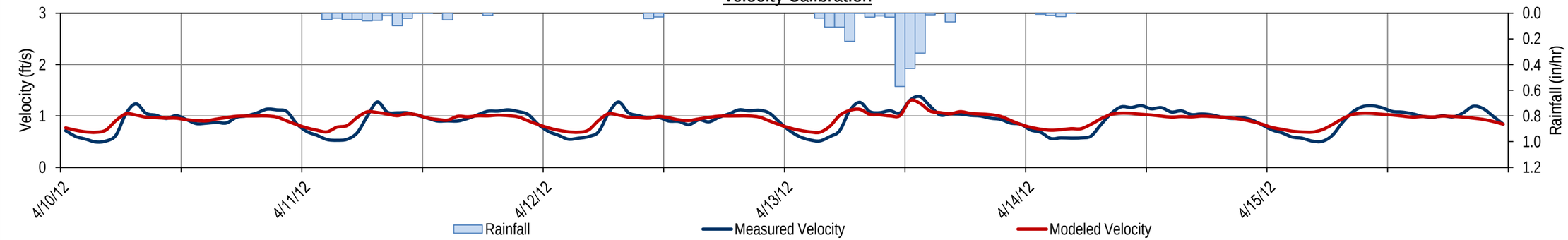
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR26 WET WEATHER FLOW CALIBRATION (4/10/2012-4/15/2012)

Flow Calibration



Velocity Calibration



Level Calibration

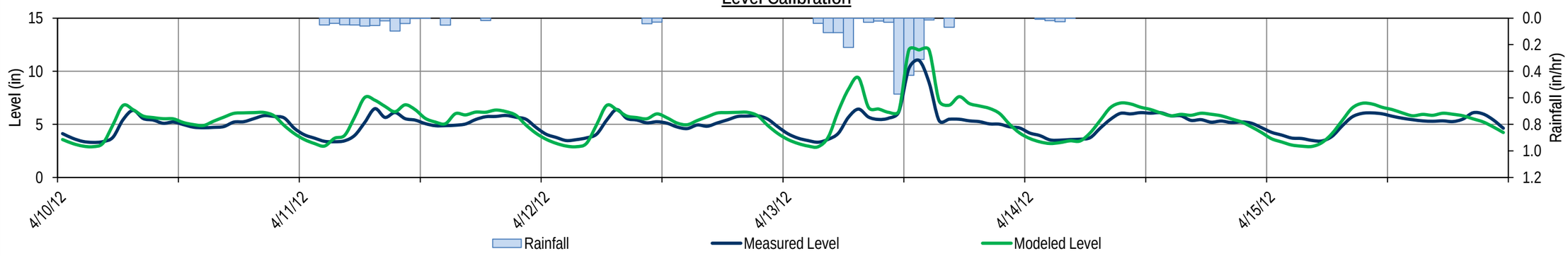


Table 1 Wet Weather Calibration Summary - March 2011 Storm Event
Wastewater Collection System Master Plan Update
City of Fresno

Meter Number	March 20-21, 2011 Storm Event											
	Measured Data[1]				Modeled Data[2]				Percent Error[3]			
	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (mgd)	Peak Flow (mgd)	Avg. Velocity (ft/s)	Avg. Level (in)	Avg. Flow (%)	Peak Flow (%)	Avg. Velocity (%)	Avg. Level (%)
FR01	4.142	6.641	3.52	9.7	4.282	6.444	3.19	10.7	3.4%	-3.0%	-9.6%	10.7%
FR02	8.019	13.113	3.22	16.7	8.512	13.684	3.67	15.9	6.1%	4.4%	13.8%	-4.7%
FR12	2.106	3.823	1.95	10.3	2.088	3.845	2.08	9.7	-0.9%	0.6%	6.6%	-5.5%
FR13	10.263	14.428	3.54	17.1	9.615	12.896	3.44	17.4	-6.3%	-10.6%	-2.7%	1.8%
FR15	7.574	11.218	2.36	19.9	7.030	9.866	2.33	18.9	-7.2%	-12.0%	-1.4%	-4.8%
FR16	3.910	6.178	3.18	12.2	4.236	5.873	3.37	12.4	8.3%	-4.9%	6.0%	1.1%

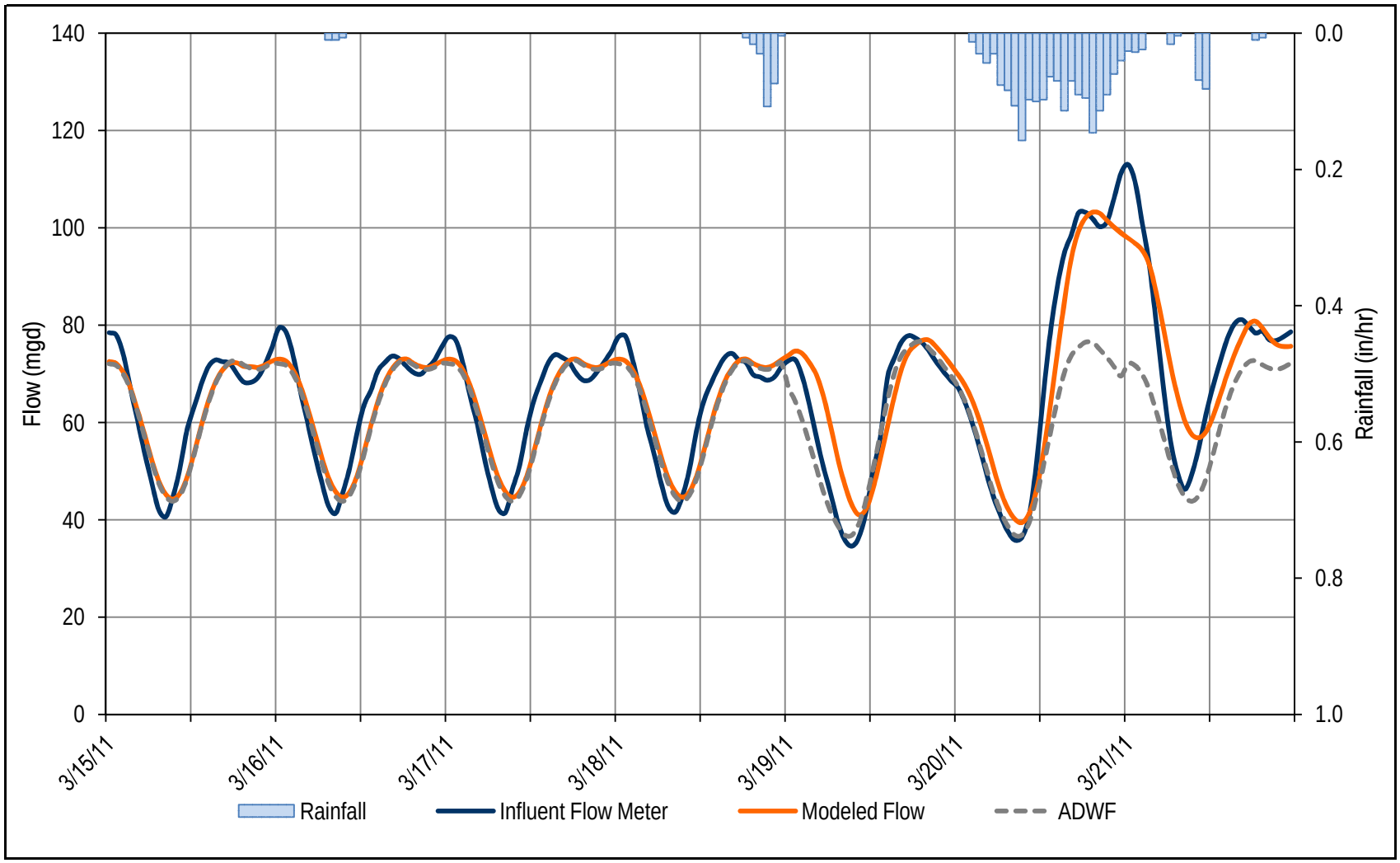
Notes:

1. Source: City of Fresno Permanent Flow Monitoring Data
2. Average flows are calculated from flow monitoring data. Maximum flow values are hourly peaks.
3. Percent Difference = (Modeled - Measured)/Measured*100.

CITY OF FRESNO

WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

RWRF WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

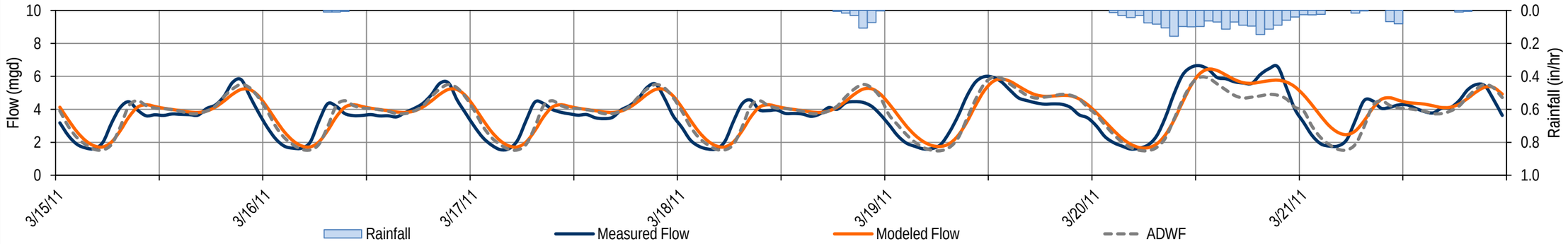


CITY OF FRESNO

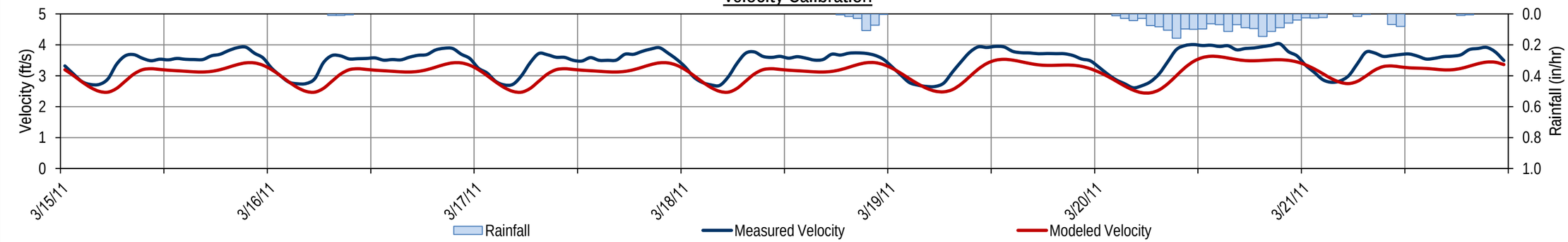
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR01 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

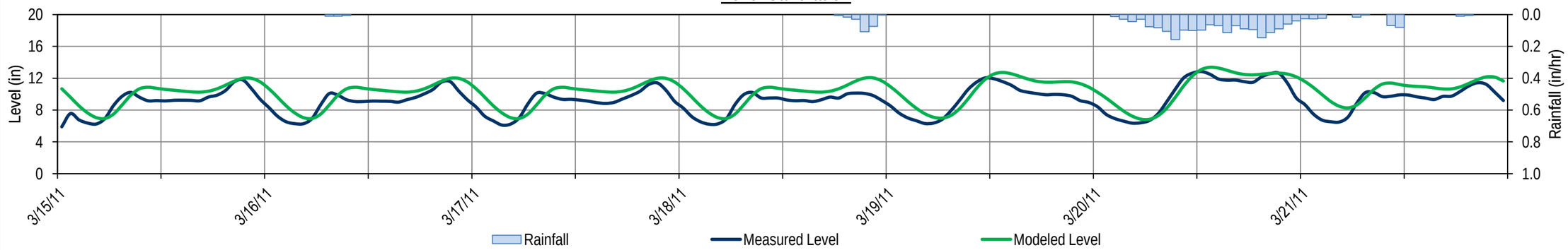
Flow Calibration



Velocity Calibration



Level Calibration

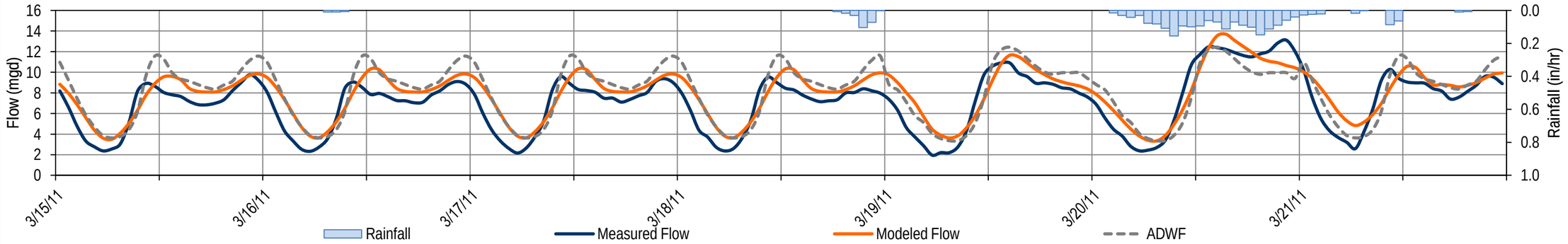


CITY OF FRESNO

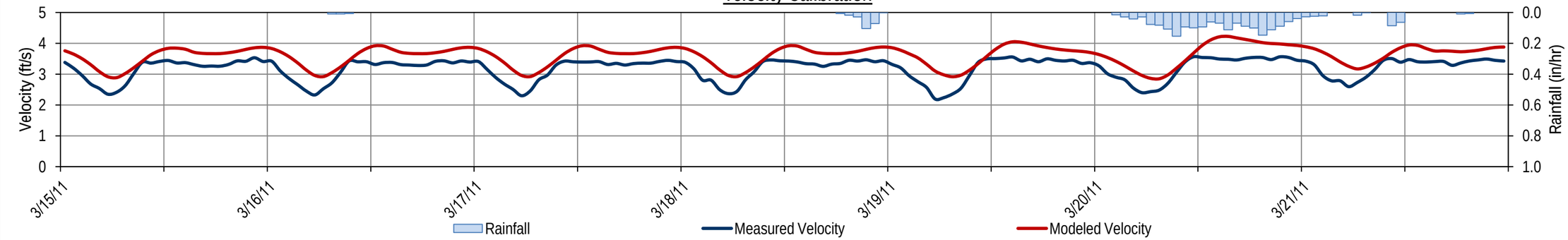
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR02 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

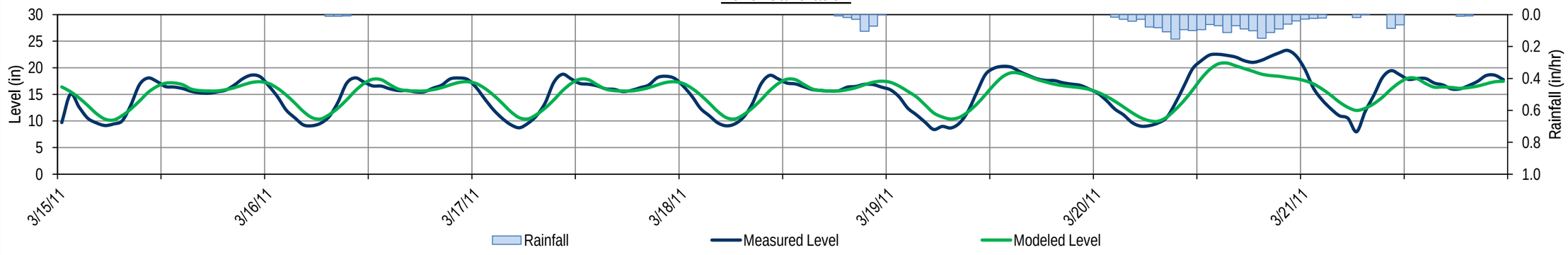
Flow Calibration



Velocity Calibration



Level Calibration

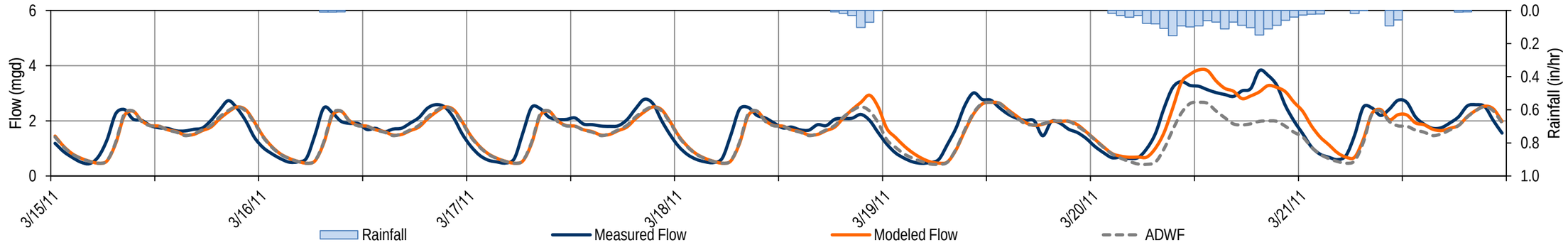


CITY OF FRESNO

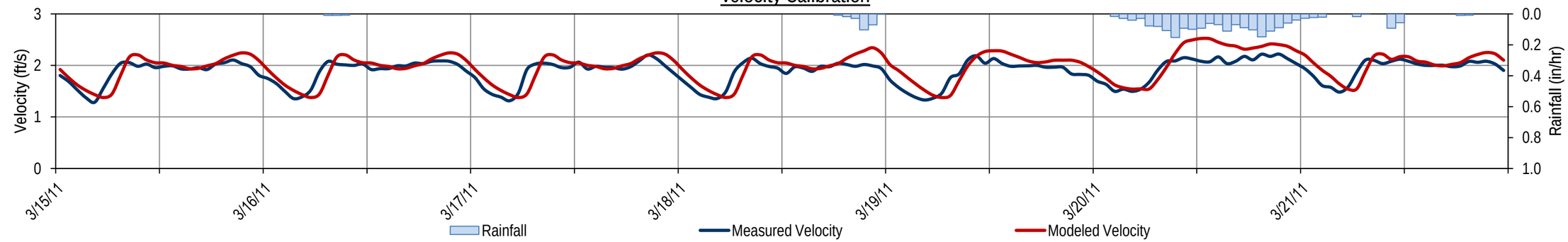
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR12 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

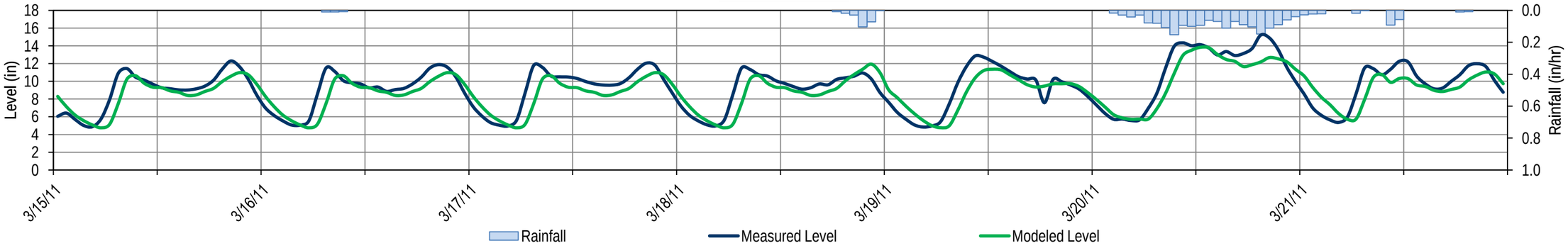
Flow Calibration



Velocity Calibration



Level Calibration

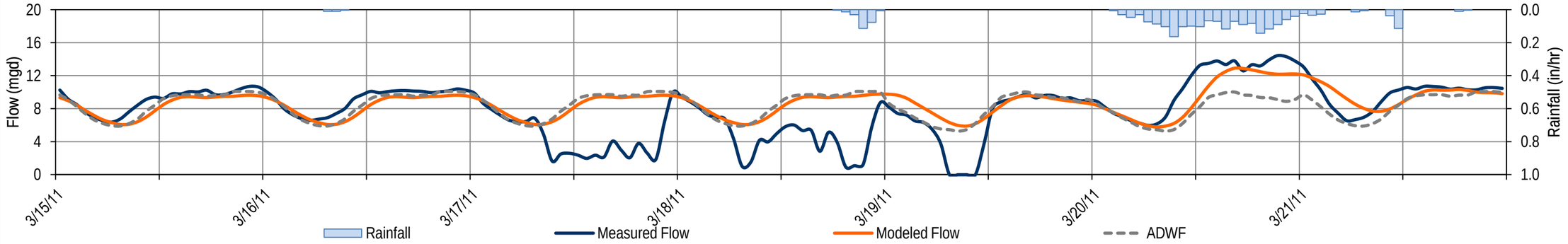


CITY OF FRESNO

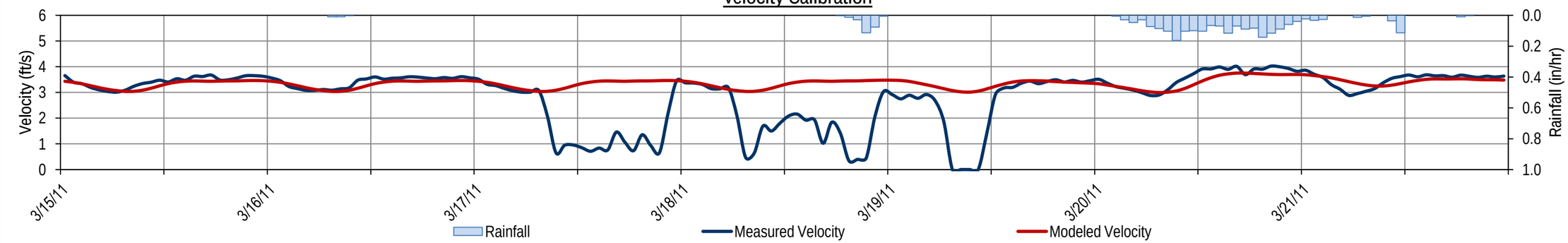
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR13 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

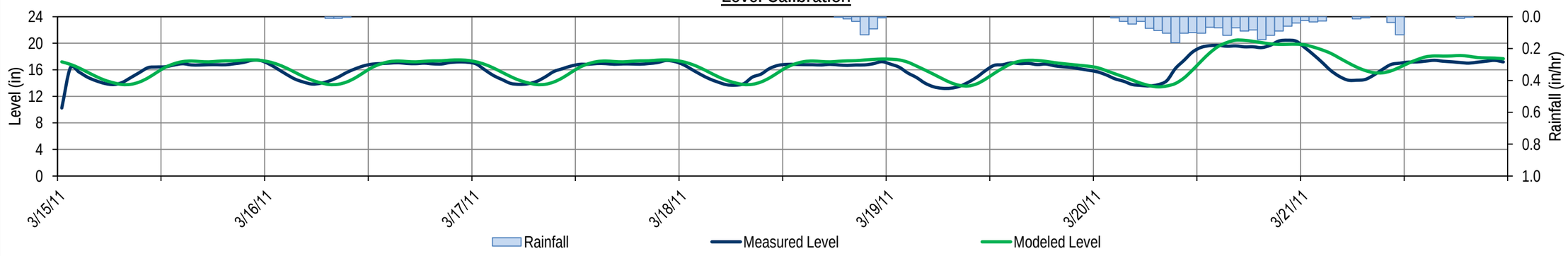
Flow Calibration



Velocity Calibration



Level Calibration

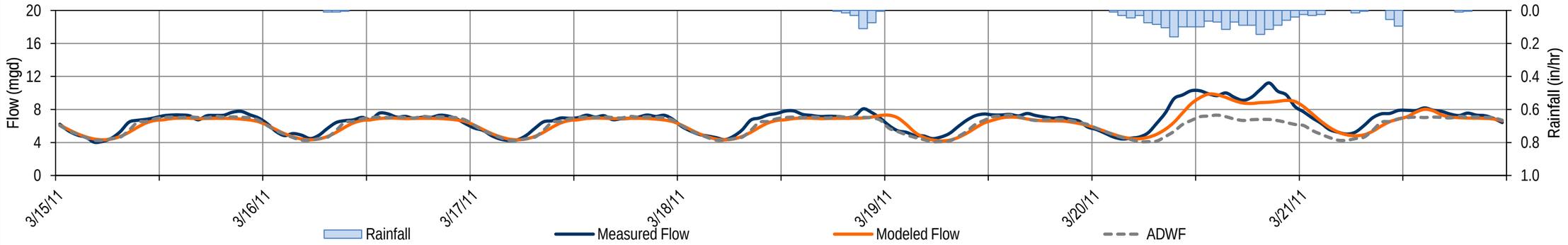


CITY OF FRESNO

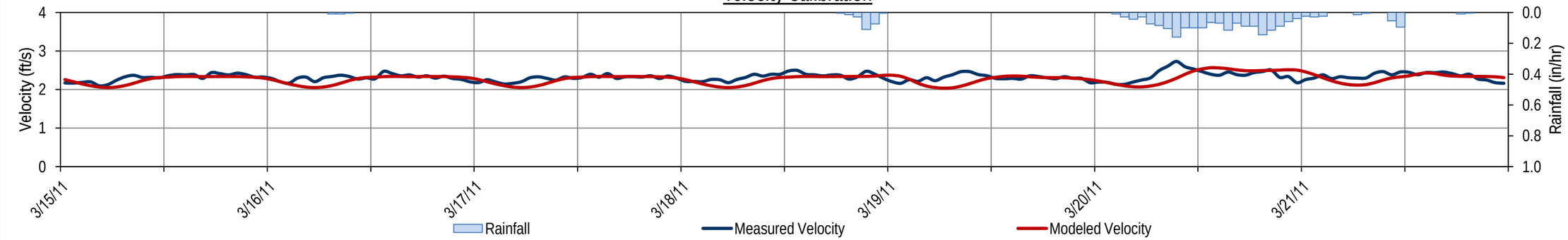
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR15 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

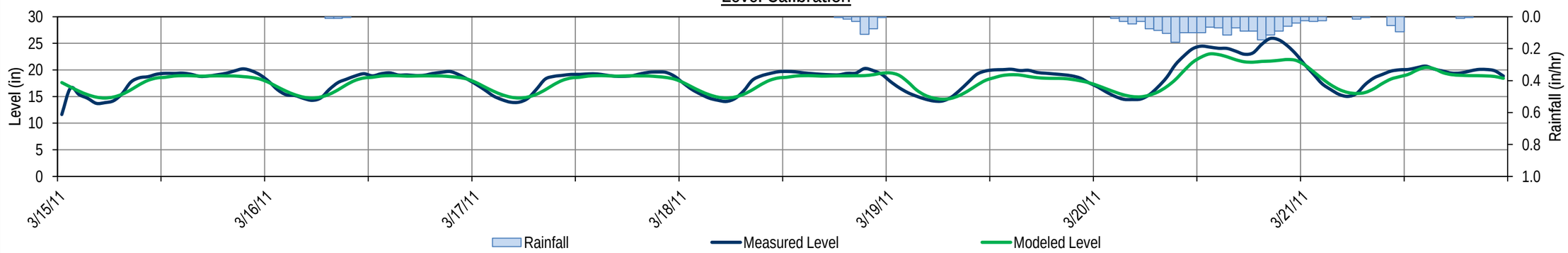
Flow Calibration



Velocity Calibration



Level Calibration

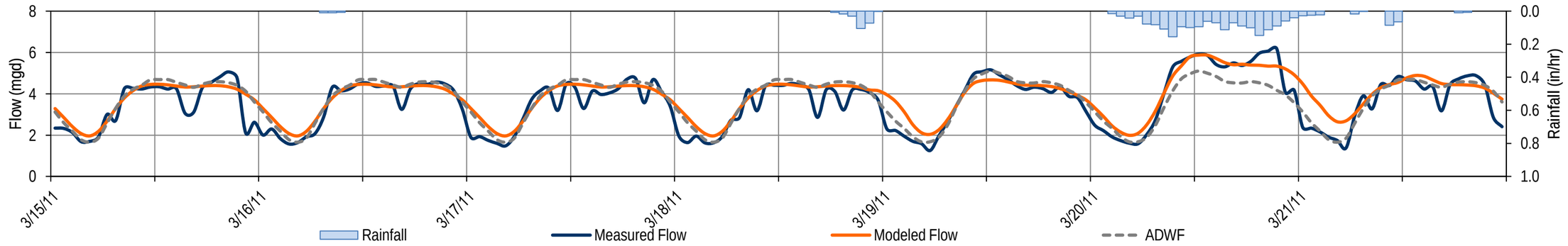


CITY OF FRESNO

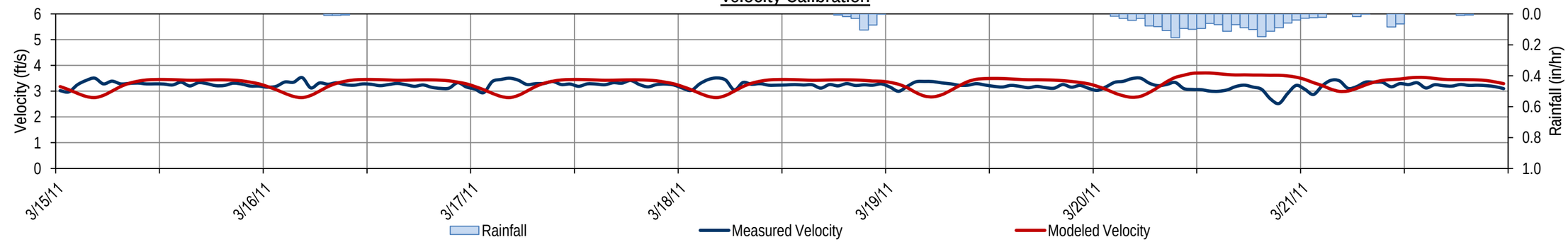
WASTEWATER COLLECTION SYSTEM MASTER PLAN UPDATE

FLOW MONITORING SITE FR16 WET WEATHER FLOW CALIBRATION (3/15/2011-3/21/2011)

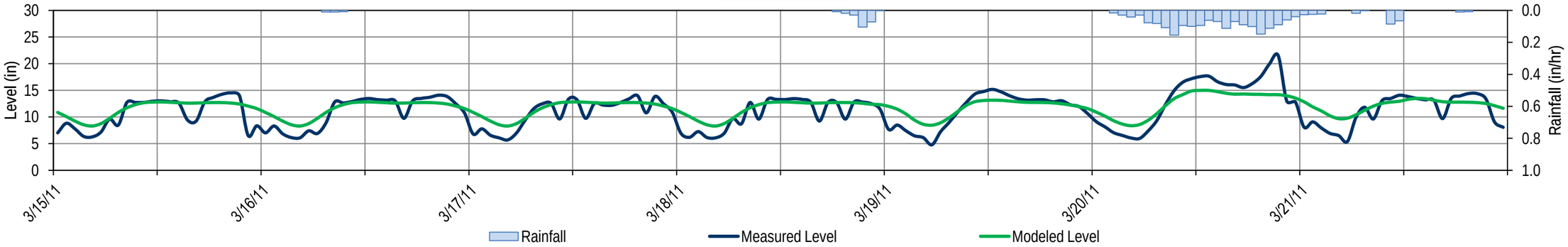
Flow Calibration



Velocity Calibration



Level Calibration



APPENDIX D – SIGNIFICANT INDUSTRIAL USER FLOW DATA

Available Monthly SIU Discharge Data
Wastewater Collection System Master Plan Update
City of Fresno

		Assumed Model Flows		Actual Monthly Flow, where Available (gpd)																												
		Model Flow	Model Flow	2011												2012												2013					
Name	Address	BWF (mgd)	PDWF (mgd)	Jan-11	Feb-11	Mar-11	Apr-11	May-11	Jun-11	Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13
Ameripride	1050 W Whitesbridge	0.086	0.114	81,731	82,704	91,630	110,430	87,591	81,183	95,420	88,488	68,816	77,617	94,423	113,123	107,887	65,026	65,699	67,445	29,471	72,556	91,854	75,199	86,494	100,830	113,846	110,679	85,596	68,442	52,659	67,021	51,562	43,608		
Angelica	422 S Fruit	0.091	0.116	116,139	72,506	54,928	61,286	57,172	66,348	79,413	81,906	69,365	80,211	67,869	75,598	88,364	67,096	61,112	62,907	64,627	68,841	94,348	77,144	104,944	84,424	116,065	73,379	91,106	73,354	66,447	98,911	73,279	74,975		
Aramark	3333 N Sabre Dr	0.110	0.160	117,985	113,945	112,225	131,897	111,776	122,497	159,922	155,035	130,825	125,839	145,935	150,223	154,487	135,488	131,847	129,828	121,001	123,096	145,561	112,001	155,808	121,425	147,855	116,663	110,230	114,220	119,680	142,319	116,887	111,976		
Beef Packers	3115 S Fig	0.659	1.009	1,009,476	777,033	753,161	803,925	682,475	873,066	802,031	896,303	699,006	768,096	740,196	853,543	865,137	673,175	708,431	691,302	731,369	888,026	663,700	815,270	765,603	714,440	881,842	683,772	658,589	638,867	868,603	630,838	678,660	851,773		
Breckenridge, Durbin	1828 E Hedges Ave	0.020	0.020																																
Cal Dairies 15"	755 F St	0.787	1.216	896,653	700,745	757,494	890,644	742,515	895,206	815,320	906,052	671,056	733,589	736,531	960,208	1,101,629	882,640	914,355	910,939	1,182,613	1,215,650	1,006,160	918,444	647,967	573,317	780,114	654,575	787,469	823,997	1,087,692	865,212	901,490	1,382,030	946,370	
Cellulo	81 M St	0.076	0.152	95,306	67,198	98,676	72,648	144,721	100,058	54,029	82,430	130,250	73,229	59,937	88,439	72,076	87,993	107,297	115,712	85,716	100,801	117,922	95,882	93,536	125,938	152,255	92,702	75,827	106,222	115,317	106,359	116,278			
Clovis Connection	Ashlan and Peach	1.910	1.910																																
Clovis Connection	Fowler and Sussex	1.434	1.434																																
Clovis Connection	Herndon and Willow	1.582	1.582																																
Clovis Connection	Sierra and Willow	0.191	0.191																																
Community Hospital	202 N Valeria St	0.226	0.226																																
ConAgra	5626 E Shields	0.017	0.017																																
Costco Wholesale	4500 W Shaw Ave	0.011	0.011																																
Costco Wholesale #657	7100 N Abby St	0.014	0.014																																
CSUF Cedar	5241 N Maple Ave	0.150	0.150																																
CSUF Maple	5241 N Maple Ave	0.081	0.140																																
Darling	995 W Belgravia	0.068	0.086	86,269	79,193	77,119	76,570	61,012	75,448	64,677	75,623	57,970	67,170	67,220	80,211	85,172	66,447	65,026	69,888	63,381	79,288	60,638	68,143	62,209	62,882	77,792	67,569	67,968	62,682	91,081	73,678	69,439	84,000		
E&J Gallo Winery (A)	5610 E Olive	0.145	0.328	205,326	133,610	327,799	147,830	62,059	195,477	129,903	106,191	60,463	98,886	6,308	42,112	159,773	73,030	166,405	151,719	199,093	233,925	122,173	128,531	76,121	169,472	192,660	96,517	144,813	104,047	55,950	100,905	31,989	78,540		
E&J Gallo Winery (FATS)	5610 E Olive	0.154	1.348	375,097	749,478	384,622	848,407	446,855	641,086	515,048	645,491	1,002,470	1,334,233	1,347,672	820,357	318,872	570,874	398,534	341,562	909,468	461,666	440,896	720,698	955,221	1,152,344	1,102,178	671,978	154,836	409,256	846,088	330,067	499,465	494,403		
Foster Farms (Front)	900 W Belgravia	0.022	0.056	40,916	40,467	38,796	38,746	38,173	32,264	48,022	38,572	34,009	33,111	35,630	46,376	25,781	21,966	24,360	32,812	29,471	41,040	50,590	38,622	56,399	36,727	56,349	48,520	22,191	21,019	21,094	30,294	32,388	22,490		
Foster Farms (Pretreat)	900 W Belgravia	1.326	1.861	1,343,857	1,249,035	1,332,562	1,422,497	1,251,254	1,331,839	1,860,825	1,632,759	1,404,395	1,322,167	1,236,045	1,599,623	1,641,810	1,357,819	1,315,931	1,458,575	1,399,234	1,392,776	1,832,650	1,411,102	1,731,869	1,341,812	1,686,466	1,278,606	1,326,304	1,398,660	1,318,175	1,661,258	1,323,860	1,318,300		
Foster Farms Poultry	2960 S Cherry	1.492	1.951	1,712,995	969,558	1,293,167	1,290,325	1,246,791	1,364,078	1,691,677	1,735,036	1,550,429	1,299,675	1,525,970	1,741,469	1,749,173	1,568,132	1,618,921	1,639,092	1,446,831	1,327,401	1,726,758	1,368,242	1,682,776	1,511,110	1,951,058	1,433,866	1,492,410	1,386,094	1,263,372	1,637,322	1,328,697	1,251,703		
Fresno Bee	1626 E St	0.044	0.052	16,281	11,100	29,347	17,503	24,360	8,303	7,954	9,624	7,879	11,270	16,905	39,220	52,235	24,185	17,902	19,099	16,556	12,492	7,879	9,574	8,901	10,472	22,490	33,311	44,057	32,713	60,937	24,809	28,823	11,494		
Fruit Fillings	2531 E Edgar	0.016	0.023	15,209	14,486	14,885	18,501	13,364	13,838	18,949	20,071	17,054	16,207	19,623	19,573	18,426	16,207	16,032	15,234	16,356	15,583	13,663	15,359	21,218	14,312	23,288	16,456	16,207	17,628	15,808	20,021	15,509	19,822		
Kaiser Permanente Inc	7300 N Fresno St	0.066	0.066																																
Kraft-Capri Sun	2494 S Orange	0.079	0.137	126,836	104,577	111,427	118,533	112,724	136,660	126,985	136,136	104,321	120,902	117,361	103,423	111,552	91,032	126,337	90,259	97,988	121,326	89,087	133,717	99,010	93,600	105,368	52,161	78,615	93,375	143,766	95,769	109,632	131,473	86,195	108,011
Kraft-Cornnuts	4343 E Florence	0.186	0.312	124,318	100,793	187,125	209,664	137,881	166,430	199,517	163,488	197,372	124,118	120,403	148,578	193,632	166,505	219,239	186,651	232,254	236,941	312,415	195,303	226,644	129,254	170,818	182,886	185,654	143,766	175,506	155,409	122,223	146,508	214,526	
La Tapatia	104 E Belmont	0.017	0.027	14,935	11,619	20,246		17,503	16,057	19,672	18,650	24,135	18,326	19,523	19,947	21,094	15,035	13,663	11,395	18,999	20,296	27,452	20,171	26,778	25,831	25,407	24,285	17,578	18,875	18,226	30,942				
La Tapatia B	94 E Belmont	0.034	0.050	15,907	12,417	9,151	7,281	2,743	28,349	27,925	43,833	30,942	26,112	16,655	49,817	44,481	42,087	30,818	26,055	29,770	35,206	45,952	34,009	28,798	30,618	30,992	41,190	34,458	31,067	21,193	23,163				
LiDestri	568 S Temperance	0.205	0.326	236,617	240,688	227,217	178,523	219,737	249,707	217,319	303,663	195,926	183,484	282,345	277,807	205,176	201,935	216,571	168,649	247,239	326,452	202,533	323,510	267,634	257,836	283,642	224,500								
Louie, Jay	471 S Teilman Ave	0.016	0.016																																
Lyons PLT 1	1634 S Second St	0.109	0.204	89,361	126,136	217,618	282,569	347,122	391,927	358,292	556,063	276,411	191,064	187,923	223,178	177,027	211,659	229,486	270,901	378,588	436,583	392,501	610,767	317,775	194,330	255,791	188,147	114,120							
Lyons PLT 1	1635 S Second St	0.109	0.204																																
Lyons PLT 1	1636 S Second St	0.109	0.204																																
Mission Linen	2555 S Orange	0.020	0.055	20,296	21,717	22,664	26,729	33,386	45,927	49,418	47,573	55,452	42,960	41,115	41,140	44,606	30,319	21,742	16,855	18,127	35,630	52,061	36,901	44,182	35,879	35,954	35,680	20,445	13,913	10,946	6,183	34,533	28,025	36,577	29,247
New World Pasta	2704 S Maple	0.015	0.027	20,021	9,700	22,567	16,381	26,679	2,194	27,452	4,114	6,009	5,061	3,715	3,316	3,590	4,712	7,081	7,729	5,560	8,427	16,456	13,838	25,058	17,005	21,667	18,575	15,409	11,370	11,395	21,044	22,964	18,775	20,545	13,813
Pacific Choice	4667 E Date	0.096	0.230	112,375	54,978	166,555	154,936	119,630	167,826	229,611	202,957	203,431	187,000	193,782	147,705	121,849	64,054	91,555	75,199	105,717	119,481	166,181	111,477	211,160	177,575	158,003	108,734	95,644	57,421	91,206	97,065				
PepsiCo	1150 E North	0.126	0.277	123,993	131,847	163,014	173,312	208,343	196,674	250,231	201,536	181,789	152,991	149,824	180,717	157,404	138,679	144,937	150,797	162,815	204,852	277,458	226,370	203,082	171,417	171,716	115,741	126,487	139,053	181,839					
Producers Dairy	144 E Belmont	0.244	0.256	220,560	220,111	227,442	240,208	212,158	199,118	227,716	199,093	245,893	207,321	209,739	245,219	244,870	198,569	202,932	177,974	253,348	210,562	255,666													
Producers Dairy	144 E Belmont	0.220	0.220																																
Prudential	1260 E North	0.017	0.028	27,676	24,709	24,509	17,204	13,564	23,188	15,658	17,304	13,439	13,963	14,860	16,730	17,603	15,683	12,591	13,763	15,085	14,212	16,207	12,342	17,329	21,368	25,083									
Rich Products	320 O St	0.022	0.039	32,048	38,746	22,864	18,476	15,858	37,575	30,020	35,879	28,428	22,964	8,502	4,438	21,542	15,159	13,813	13,713	27,402	26,554	25,307	27,402	22,615	19,398										
San Joaquin Fig	3564 N Hazel	0.012	0.012																																
SJV Concentrate	5631 E Olive	0.013	0.013																																
St Agnes Hospital	1303 E Herndon Ave	0.274	0.274																																
VA Medical Ctr 134	2615 E Clinton Ave	0.090	0.090																																
Valley Fig	2028 S Third	0.045	0.201	91,406	45,867	53,158	59,865	49,567	56,200	76,795	127,359	86,544	71,235	62,358	127,260	105,742	200,564	46,925	71,459	95,195	99,334	70,312	60,339	46,376	74,975	114,643	55,826	44,855	58,494						
Wawona Fresno	2202 S Cedar	0.076	0.280	0	0	0	0	0	103,000	103,000	228,414	234,473	183,310	75,149							51,138	57,421	280,126	188,720										
Westlake		0.000	0.000																																
Yosemite	3330 E Church	0.019	0.049	19,523	27,393	35,380	44,157	27,851	22,989	25,806	31,217	18,351	22,141	28,948	27,402	34,433	26,030	30,344	26,579	38,123	48,795	46,251	46,900	30,244	28,623	38,572	20,620	18,974	21,019	34,583	28,723	30,967	30,194	31,815	
Zacky Packing	2950 E California	0.113	0.210	125,067	102,326	103,573	116,788	107,911	138,330	123,021	138,131	120,927	127,933	117,635	115,042	135,263	182,736	113,621	114,344	131,922	205,201	149,176	209,590	158,925	157,304	184,931	139,178	112,998	67,968	155,360					
Zacky Turkey	2222 S East	0.396	0.816	355,200	287,933	290,099	441,071	444,312	527,365	475,504	517,092	362,306	448,725	623,832	423,343	375,197	411,101	566,336	455,707	601,168	659,088	574,863	689,531	629,492	684,595	815,844	440,871	396,265	396,639	555,639	378,338				

APPENDIX E – FIELD RECONNAISSANCE DATA

Structure Information

Location	Manhole ID	Model ID	Time of Survey
Herndon Ave and Milburn Ave	1346-25	7780	11:30 AM

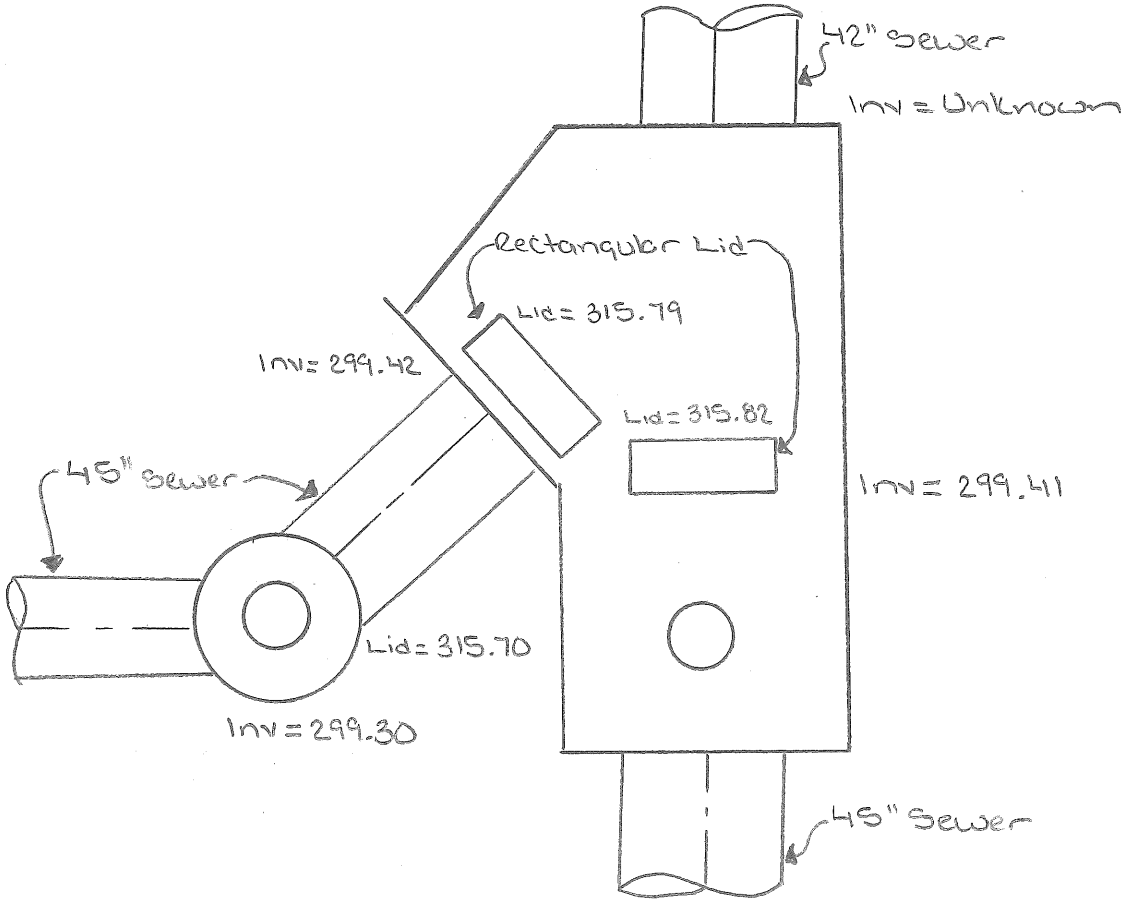
Rim and Invert Data	Elevation
North Rectangular Lid (avg 4 corners)	315.79
Southwest FL	299.42
East Rectangular Lid (avg 4 corners)	315.82
South FL	299.41
North FL	Unknown
West MH Rim	315.70
Northeast and West FL	299.30

Depth of Flow (estimated)	
West	50%
South	No flow to south, slide gate closed
Inlet Pipe	Could not be determined

Flow to Each Outlet Pipe (estimated)	
West	100%
South	0%

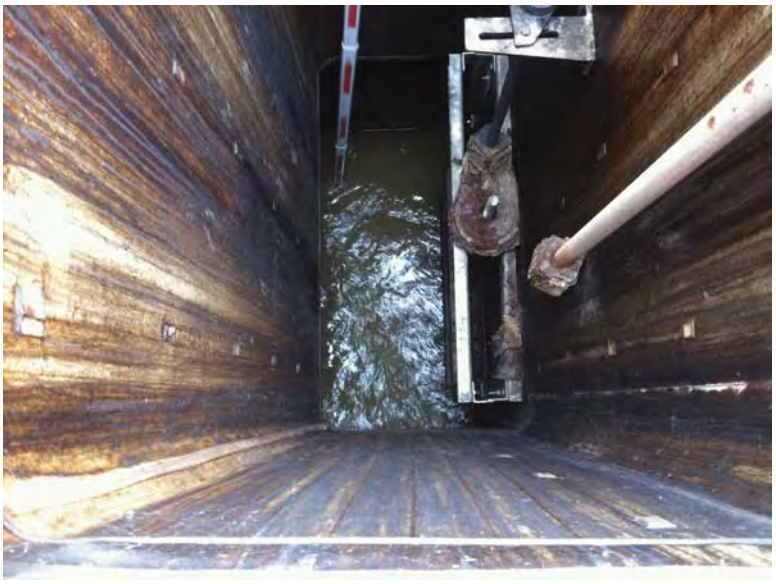
General Observations

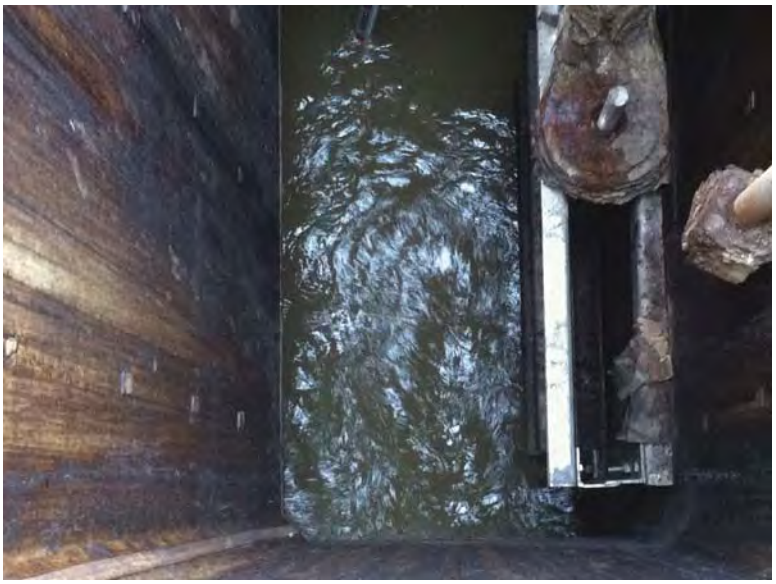
Wastewater was swirling around inside junction structure, all flow goes to west as the slide gate to the south is closed. Invert for the inlet pipe could not be determined due to the location of the structure lids.



MH 1346-25 Herndon and Milburn

MH 1346-25 Herndon and Milburn





MH 1346-25 Herndon and Milburn

MH 1346-25 Herndon and Milburn

MH 1346-25 Herndon and Milburn

MH 1346-25 Herndon and Milburn

Structure Information

Location	Manhole ID	Model ID	Time of Survey
McKinley Ave and Harrison Ave	2253-15	25677	11:00 AM

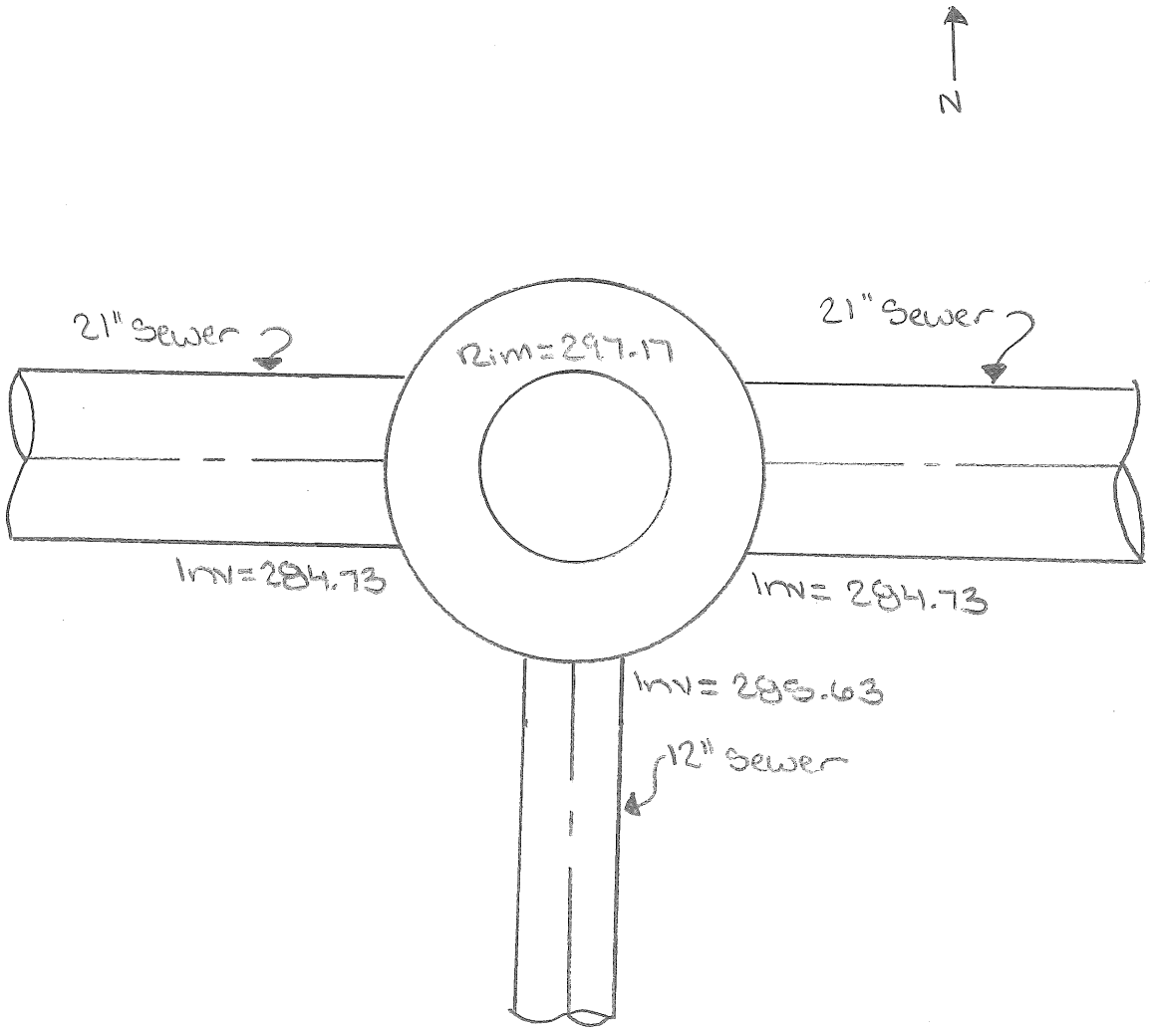
Rim and Invert Data	Elevation
Rim	297.17
East and West FL	284.73
South FL	285.63

Depth of Flow (estimated)	
East and West	30% to 50%

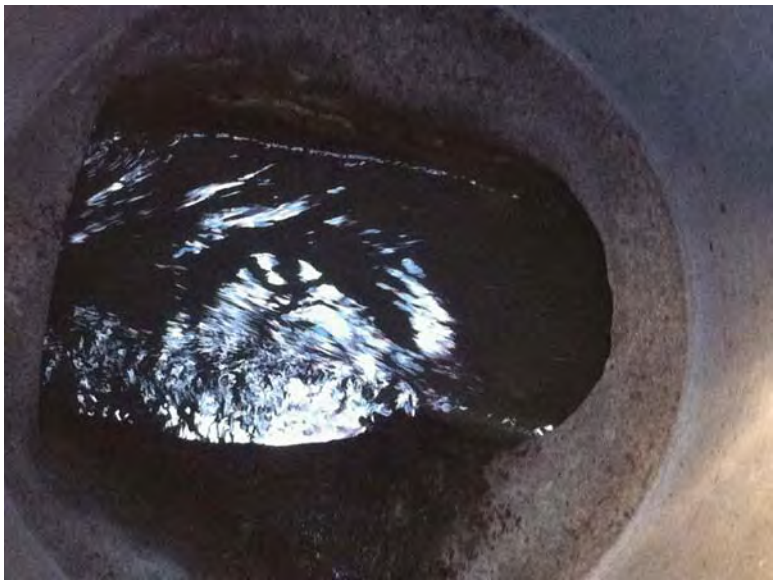
Flow to Each Outlet Pipe (estimated)	
West (only outlet)	100%

General Observations

No flow entering from southerly pipe into manhole, all flow to west. Obstruction in pipe included a storm drain valve which the City removed while we were on-site.



MH 2253-15 McKinley and Harrison



MH 2253-15 McKinley and Harrison

Structure Information

Location	Manhole ID	Model ID	Time of Survey
Chestnut Ave and Washington Ave	2561-21	32321	8:45 AM

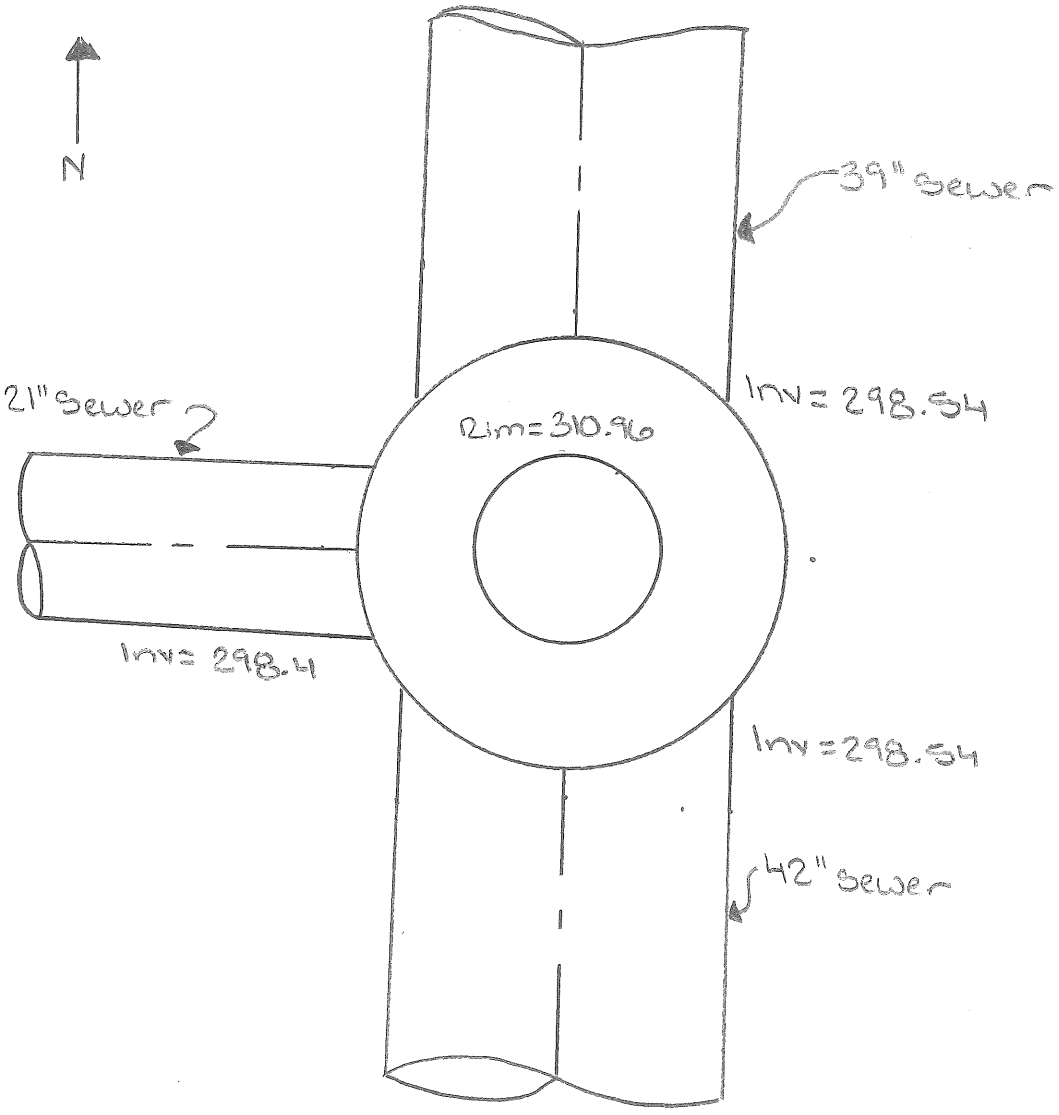
Rim and Invert Data	Elevation
Rim	310.96
North and South FL	298.54
West FL	298.41

Depth of Flow (estimated)	
South and West	50%

Flow to Each Outlet Pipe (estimated)	
South	70%
West	30%

General Observations

Flow through manhole was moving swiftly through pipe.



MH 2561-21 Chestnut and Washington

MH 2561-21 Chestnut and Washington

Structure Information

Location	Manhole ID	Model ID	Time of Survey
Chestnut Ave and Washington Ave	2562-59	N/A	8:45 AM

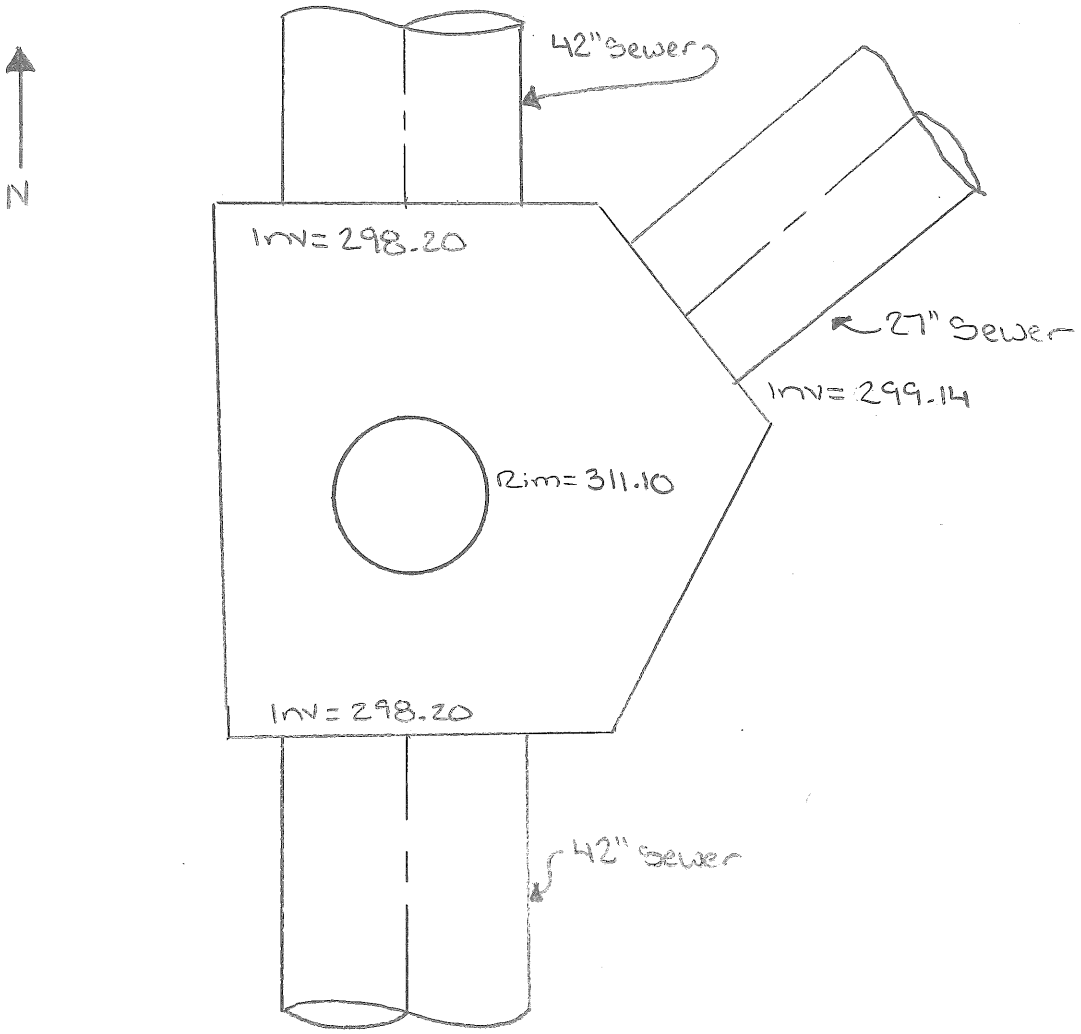
Rim and Invert Data	Elevation
Rim	311.10
North and South FL	298.20
East FL	299.14

Depth of Flow (estimated)	
North, South and Northeast	50%

Flow to Each Outlet Pipe (estimated)	
South (only outlet)	100%

General Observations

Flow through manhole was moving swiftly through pipe.



MH 2562-59 Chestnut and Washington

MH 2562-59 Chestnut and Washington

Structure Information

Location	Manhole ID	Model ID	Time of Survey
Whitesbridge Ave and Fruit Ave	2652-03	33197	8:00 AM

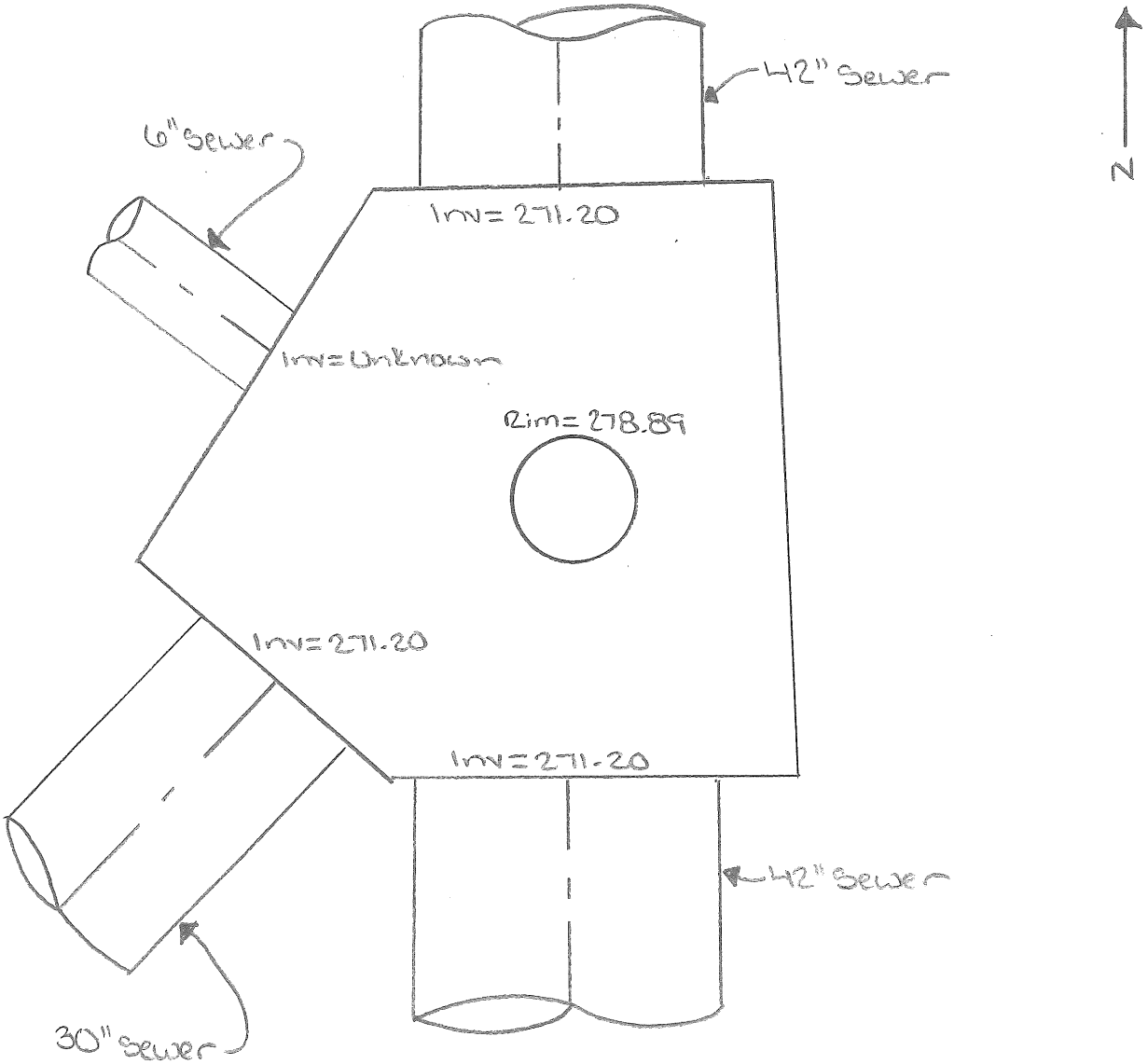
Rim and Invert Data	Elevation
Rim	278.89
North, South and Southwest FL	271.20
Northwest FL	Unknown

Depth of Flow (estimated)	
North and South	30%

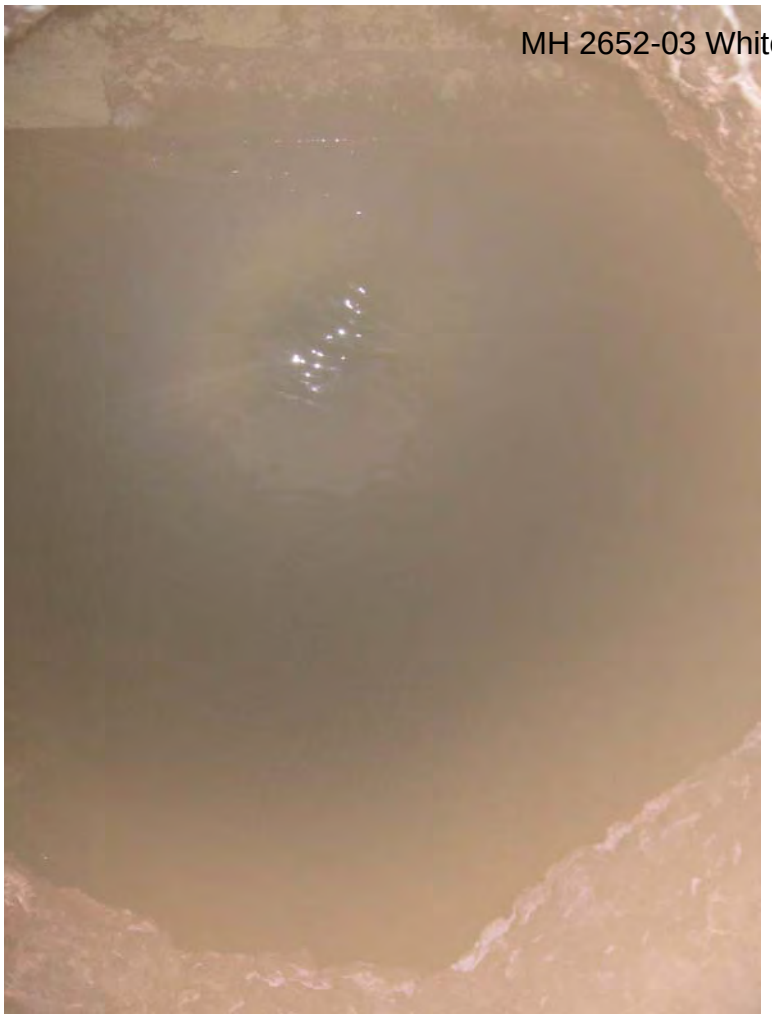
Flow to Each Outlet Pipe (estimated)	
South	50%
Southwest	50%

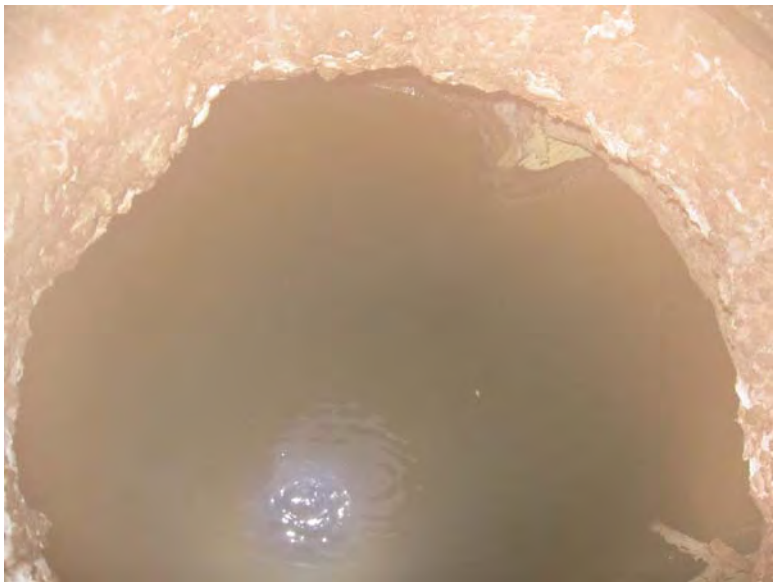
General Observations

Could not observe inlet pipe from northwest although View Fresno indicates there is a pipe from the northwest.



MH 2652-03 Whitesbridge and Fruit





Structure Information

Location	Manhole ID	Model ID	Time of Survey
Jensen Ave and Cherry Ave	3056-03	39753	9:45 AM

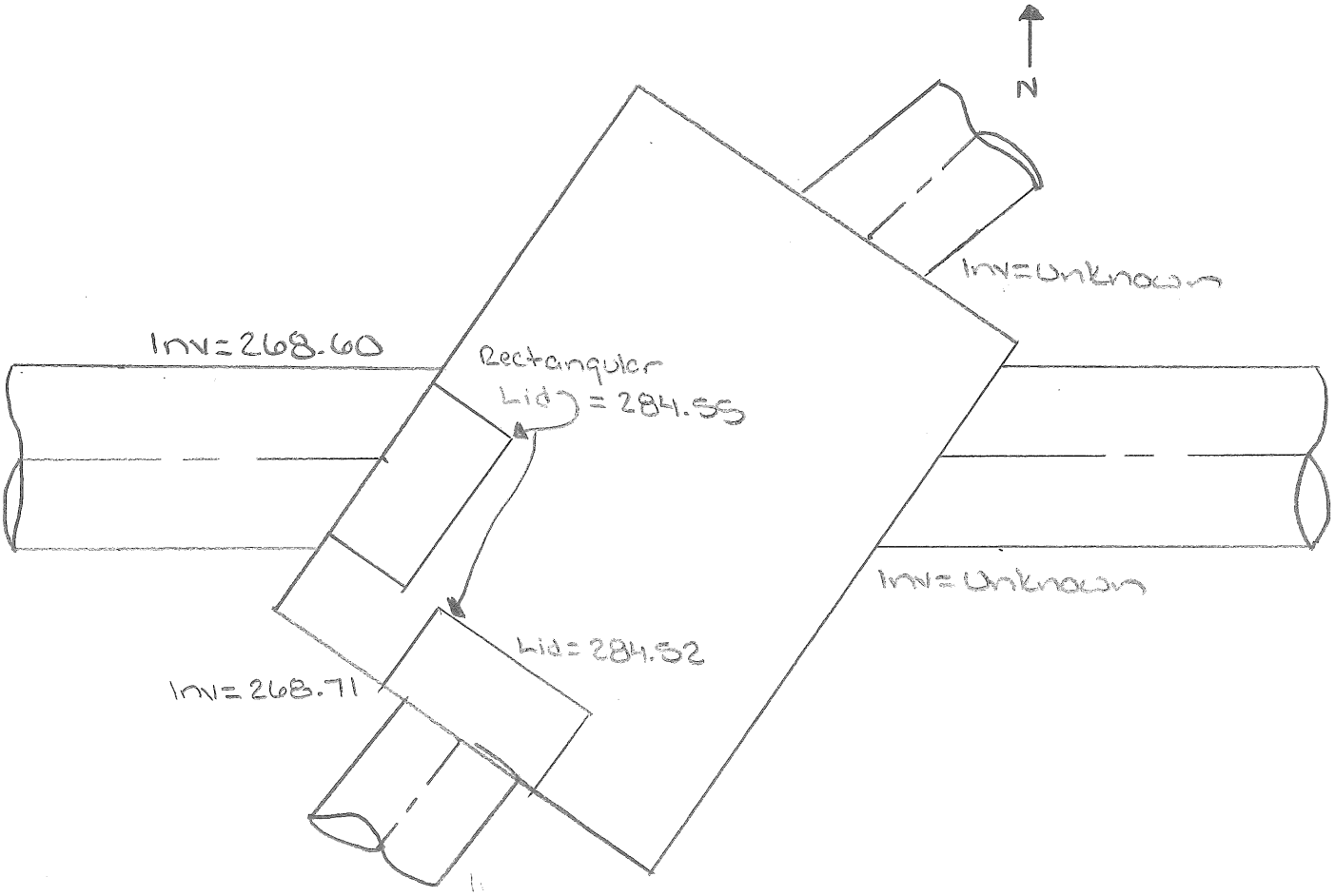
Rim and Invert Data	Elevation
North Rectangular Lid (avg 4 corners)	284.55
South Rectangular Lid (avg 4 corners)	284.52
West FL	268.60
South FL	268.71
Northeast FL	Unknown
East FL	Unknown

Depth of Flow (estimated)	
West	50%
South	50%
Inlet Pipes	Could not be determined

Flow to Each Outlet Pipe (estimated)	
West	50%
South	50%

General Observations

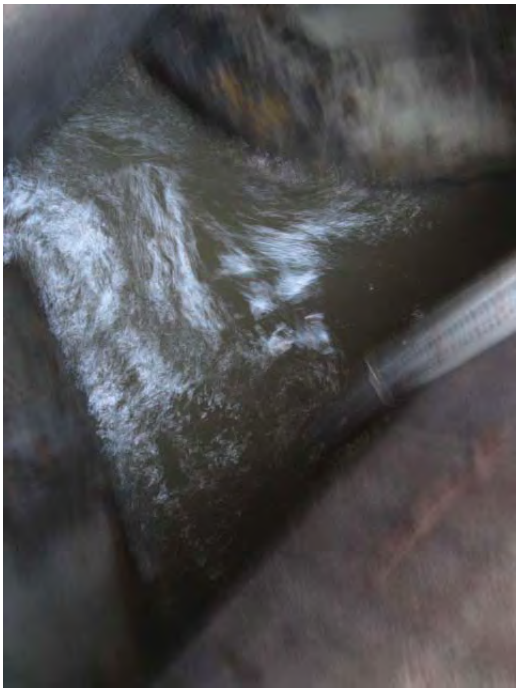
Inlet flowlines could not be determined due to location of junction structure steel lids. Debris in the structure included an abandoned air line for confined entry.



MH 3056-03 Jensen and Cherry

MH 3056-03 Jensen and Cherry

MH 3056-03 Jensen and Cherry



MH 3056-03 Jensen and Cherry

Structure Information

Location	Manhole ID	Model ID	Time of Survey
Cherry Ave s/o Church Ave	3057-07	39851	7:00 AM

Rim and Invert Data	Elevation
North Rectangular Lid (avg 4 corners)	282.97
South Rectangular Lid (avg 4 corners)	283.07
Northwest FL	270.74
West FL	270.69
East FL	Unknown

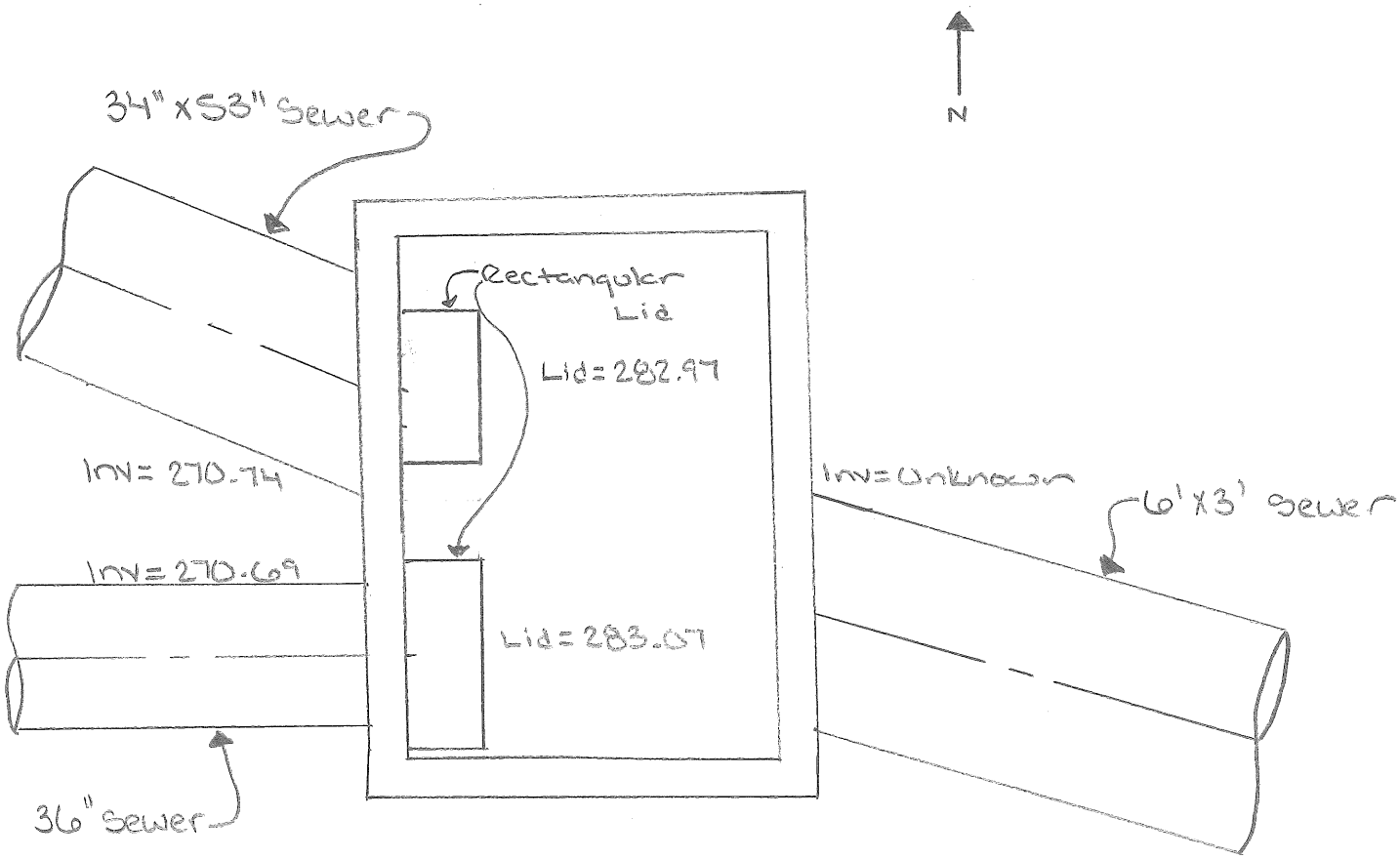
Depth of Flow (estimated)

Could not be determined due to buildup of debris and grease within outlet pipes

Flow to Each Outlet Pipe (estimated)	
Northwest	60%
West	40%

General Observations

A lot of debris and grease buildup within outlet pipes near westerly face of junction structure. Slots for redwood boards are present but no boards were in place. Flowline and photos of inlet pipe could not be observed due to location of lids to structure and angle to inlet pipe.



MH 3057-07 Cherry Near Church

MH 3057-07 Cherry Near Church

MH 3057-07 Cherry Near Church

MH 3057-07 Cherry Near Church

MH 3057-07 Cherry Near Church

APPENDIX F – BCF-PROJECT DATA SHEETS

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

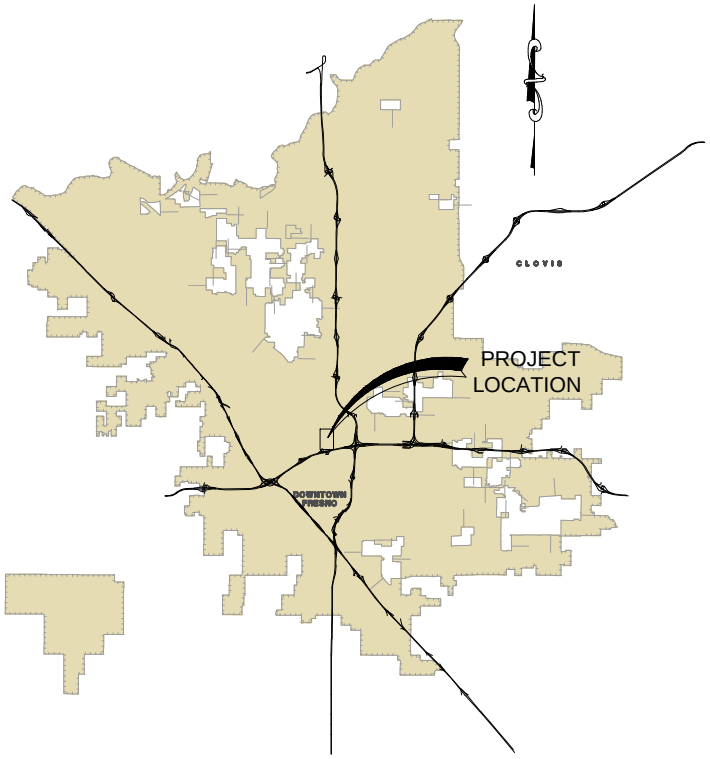
Project: C-1A

Sewer Plat No. 2356, 2456

Implementation Phase Phase 1 (2015-2020)

Project Purpose: Replacement of Existing Sewer Facilities

Project Location: Hammond Avenue between Blackstone Avenue and Abby Street



Project Vicinity Map
Not to Scale

Approximate Project Quantities:
Proposed Diameter: 24"

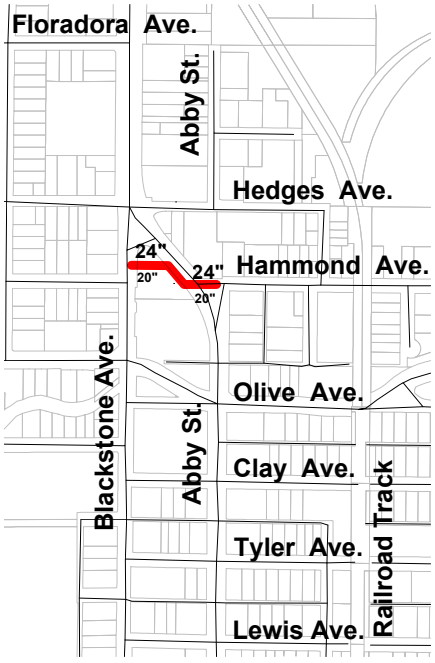
Project Conditions:
2-Lane Streets
Commercial Setting

Project Benefit:
Existing Customers: 93%
Future Development: 7%

Estimated Project Costs:

Estimated Construction Cost:	$284,000.00
Estimated Contingencies Cost:	$71,000.00
Estimated Management and Engineering Cost:	$57,000.00
Total Estimated Project Cost:	$412,000.00

ENR CCI = 9,835 (20 City Average, July 2014)



Project Location Map
1" = 800'

Legend:

- Project Sewer
- Street
- 24" Proposed Pipe Diameter
- 20" Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-1A)ECA-1-REP
Plot by: dmagill Jul 11, 2014 - 3:51pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

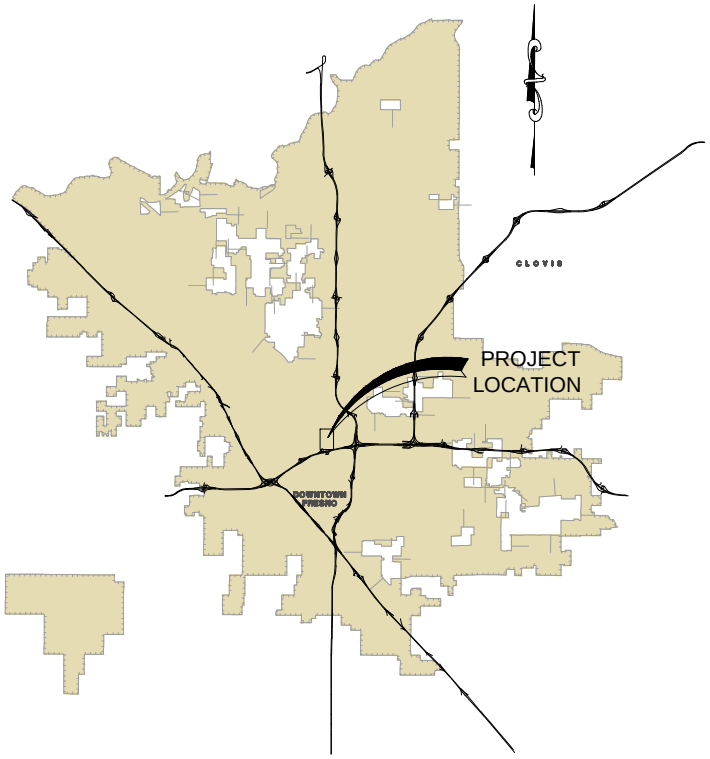
Project: C-1B

Sewer Plat No. 2356, 2456

Implementation Phase Phase 1 (2015-2020)

Project Purpose: Replacement of Existing Sewer Facilities

Project Location: Abby Street between Hammond Avenue and La Salle Avenue Alignment



Project Vicinity Map
Not to Scale

Approximate Project Quantities:
Proposed Diameter: 24"

Project Conditions:
2-Lane Streets
Commercial Setting

Project Benefit:
Existing Customers: 93%
Future Development: 7%

Estimated Project Costs:

Estimated Construction Cost:	$598,000.00
Estimated Contingencies Cost:	$150,000.00
Estimated Management and Engineering Cost:	$120,000.00
Total Estimated Project Cost:	$868,000.00

ENR CCI = 9,835x (20 City Average, July 2014)

Project Location Map
1" = 800'

Legend:

- Project Sewer
- Street
- 24" Proposed Pipe Diameter
- 20" Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-1B)ECA-1-REP
Plot by: dmagill Jul 11, 2014 - 3:52pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

Project:	**C-2A**
Sewer Plat No.	**2455, 2555**
Implementation Phase	**Phase 1 (2015-2020)**
Project Purpose:	Replacement of Existing Sewer Facilities
Project Location:	Glenn Avenue between Bremer and Thomas Avenues

Approximate Project Quantities:
Proposed Diameter: 27"

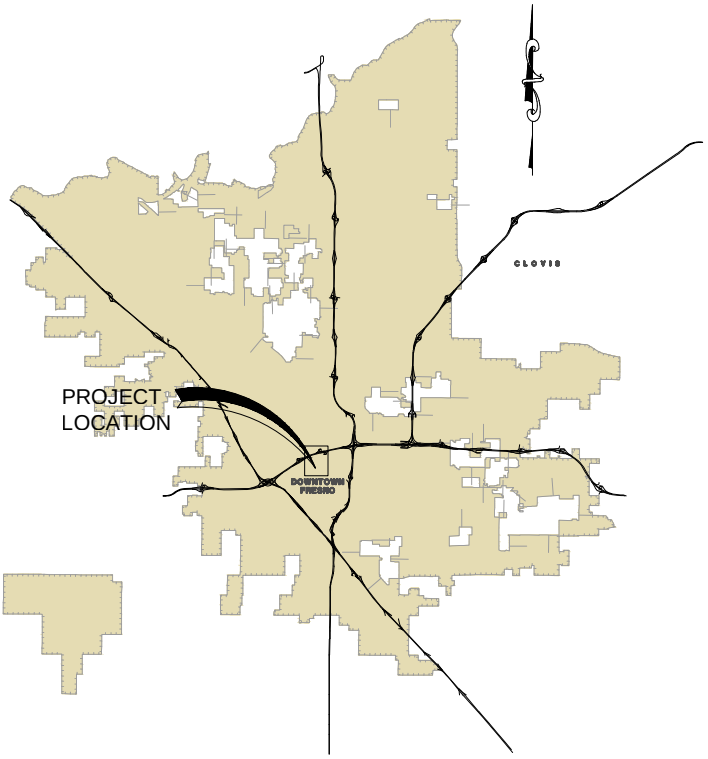
Project Conditions:
2-Lane Streets
Residential Setting

Project Benefit:
Existing Customers: 93%
Future Development: 7%

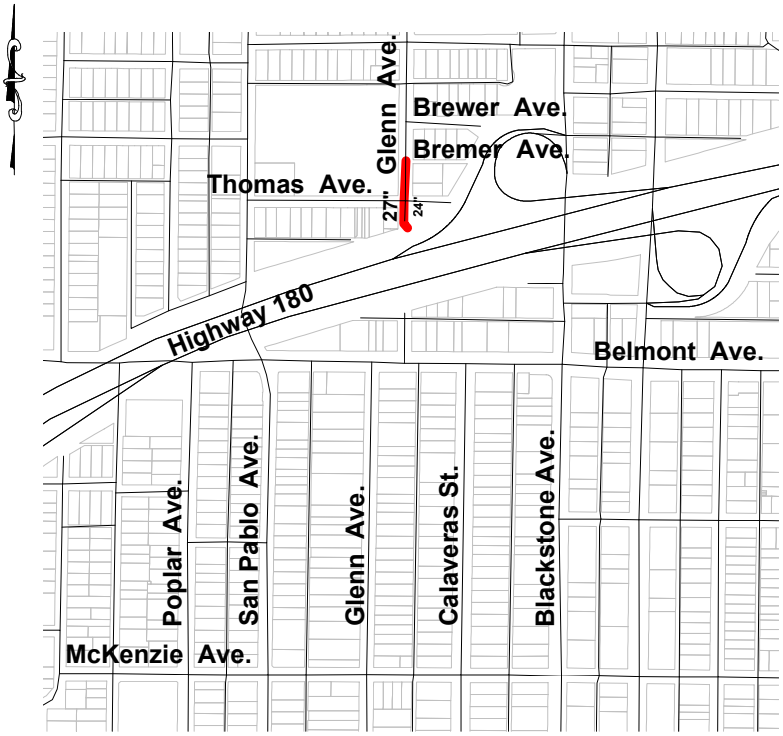
Estimated Project Costs:

Estimated Construction Cost:	$297,000.00
Estimated Contingencies Cost:	$74,000.00
Estimated Management and Engineering Cost:	$59,000.00
Total Estimated Project Cost:	$430,000.00

ENR CCI = 9,835 (20 City Average, July 2014)



Project Vicinity Map
Not to Scale



Project Location Map
1" = 800'

Legend:

	Project Sewer
	Street
27"	**Proposed Pipe Diameter**
24"	**Existing Pipe Diameter**

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-2A)ECA-2-REP
Plot by: dmagill Jul 11, 2014 - 3:54pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

carollo

Blair, Church & Flynn

Project: C-2B

Sewer Plat No. 2455, 2555

Implementation Phase Phase 1 (2015-2020)

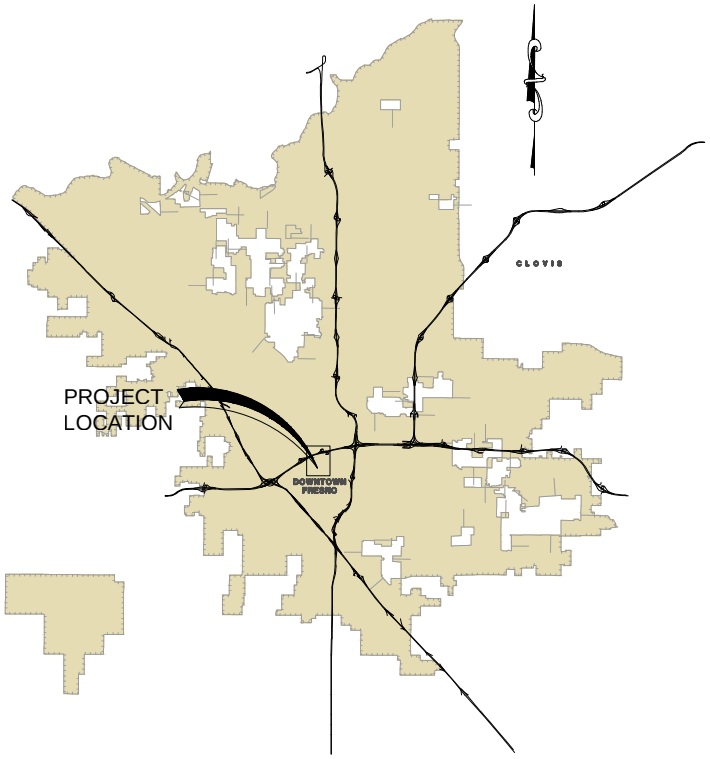
Project Purpose: Replacement of Existing Sewer Facilities

Project Location: Glenn Avenue from Highway 180 to Voorman Avenue

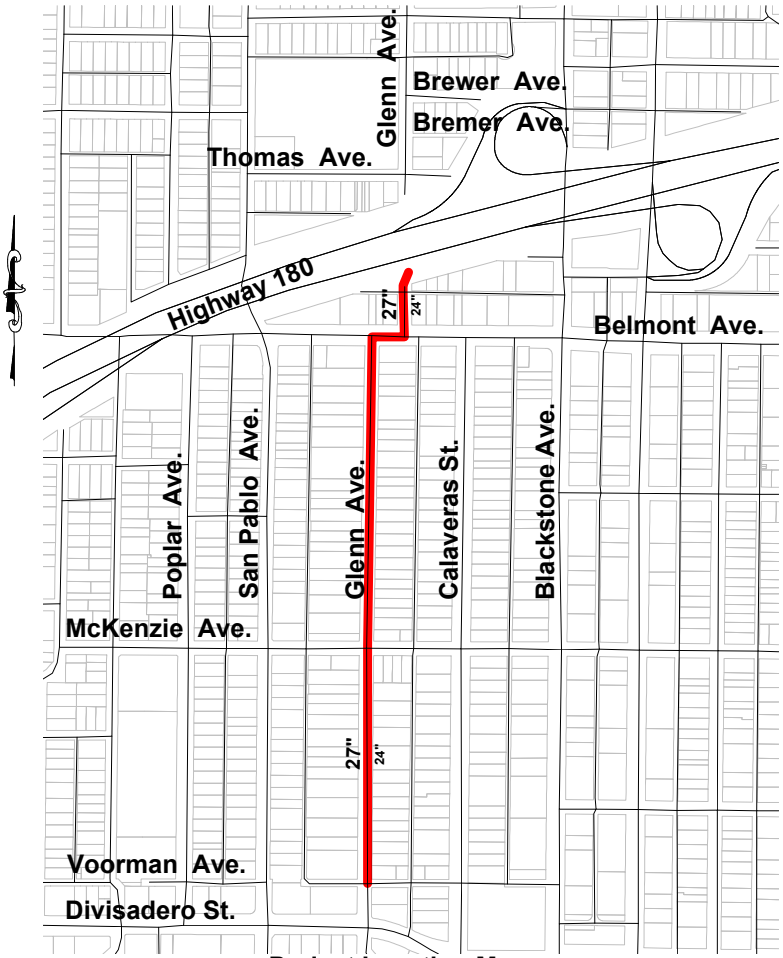
Approximate Project Quantities:
Proposed Diameter: 27"

Project Conditions:
2-Lane Streets
Residential Setting

Project Benefit:
Existing Customers: 86%
Future Development: 14%



Project Vicinity Map
Not to Scale



Project Location Map
1" = 800'

Estimated Project Costs:

Estimated Construction Cost:	$1,090,000.00
Estimated Contingencies Cost:	$272,000.00
Estimated Management and Engineering Cost:	$218,000.00
Total Estimated Project Cost:	$1,580,000.00

ENR CCI = 9,835 (20 City Average, July 2014)

Legend:

- **Project Sewer**
- **Street**
- 27" **Proposed Pipe Diameter**
- 24" **Existing Pipe Diameter**

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-2B)ECA-2-REP
Plot by: dmagill Jul 11, 2014 - 3:55pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

Project: C-3

Sewer Plat No. 2555, 2655

Implementation Phase Phase 2 (2021-2025)

Project Purpose: Replacement of Existing Sewer Facilities

Project Location: Glenn Avenue and N Street between Voorman Avenue and Tuolumne Street

Approximate Project Quantities:
Proposed Diameter: 30"

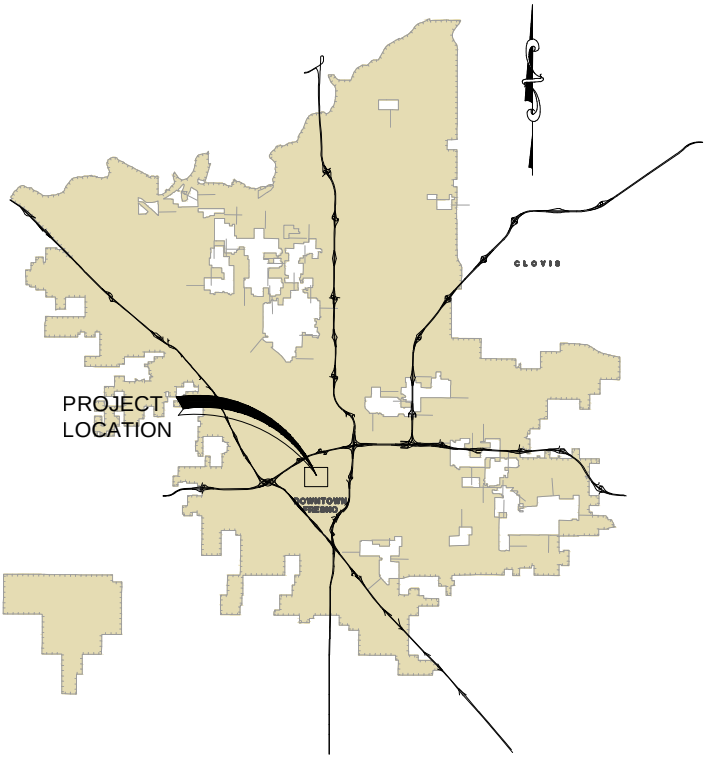
Project Conditions:
2-Lane Streets
Residential Setting

Project Benefit:
Existing Customers: 81%
Future Development: 19%

Estimated Project Costs:

Estimated Construction Cost:	$792,000.00
Estimated Contingencies Cost:	$198,000.00
Estimated Management and Engineering Cost:	$158,000.00
Total Estimated Project Cost:	$1,148,000.00

ENR CCI = 9,835 (20 City Average, July 2014)



Project Vicinity Map
Not to Scale

Project Location Map
1" = 800'

Legend:

- Project Sewer
- Street
- 30" Proposed Pipe Diameter
- 27" Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-3)ECA-3-REP.d
Plot by: dmagill Jul 11, 2014 - 3:55pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

Project: C-4

Sewer Plat No. 2757, 2856, 2857

Implementation Phase Phase 3 (2026-2030)

Project Purpose: Replacement of Existing Sewer Facilities

Project Location: Monterey Street between N Street Fulton Streets

Approximate Project Quantities:
Proposed Diameter: 10"

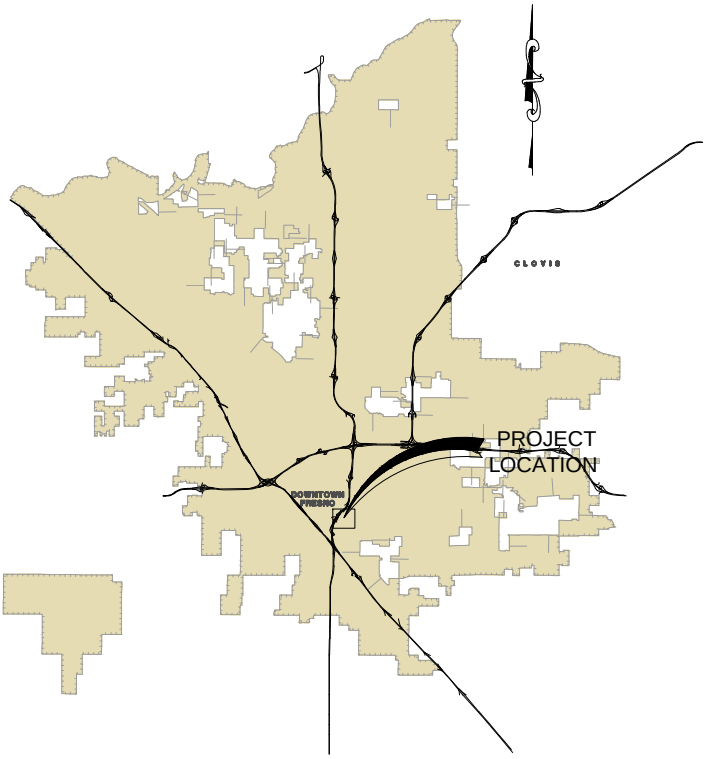
Project Conditions:
2-Lane Streets
Residential Setting

Project Benefit:
Existing Customers: 100%
Future Development: 0%

Estimated Project Costs:

Estimated Construction Cost:	$471,000.00
Estimated Contingencies Cost:	$118,000.00
Estimated Management and Engineering Cost:	$94,000.00
Total Estimated Project Cost:	$683,000.00

ENR CCI = 9,835 (20 City Average, July 2014)



Project Vicinity Map
Not to Scale

Project Location Map
1" = 800'

Legend:

- Project Sewer
- Street
- 10" Proposed Pipe Diameter
- 8" Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-4)ECA-5-REP.d
Plot by: dmagill Jul 11, 2014 - 3:56pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

carollo

Blair, Church & Flynn

Project: C-5A

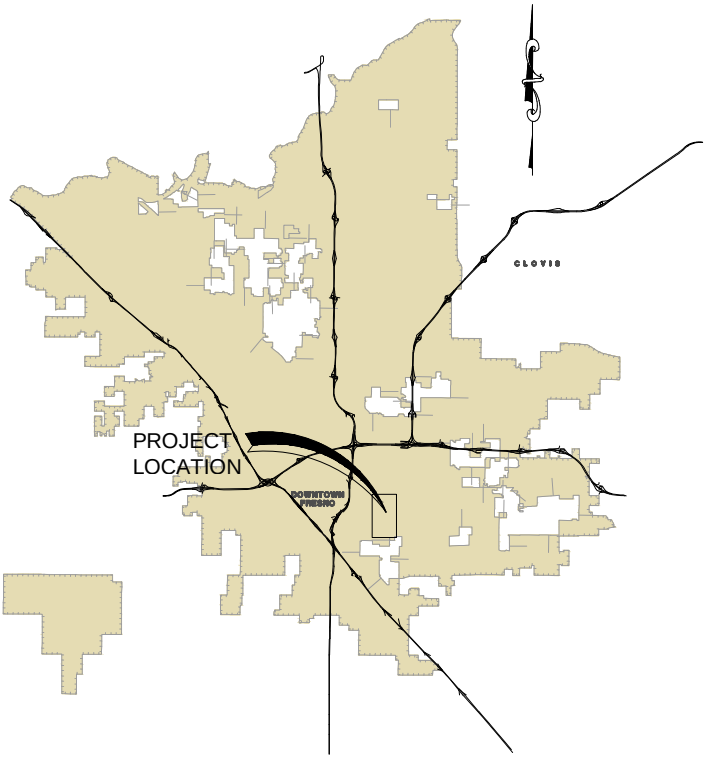
Sewer Plat No. 2759, 2859

Implementation Phase Phase 4 (2031-2035)

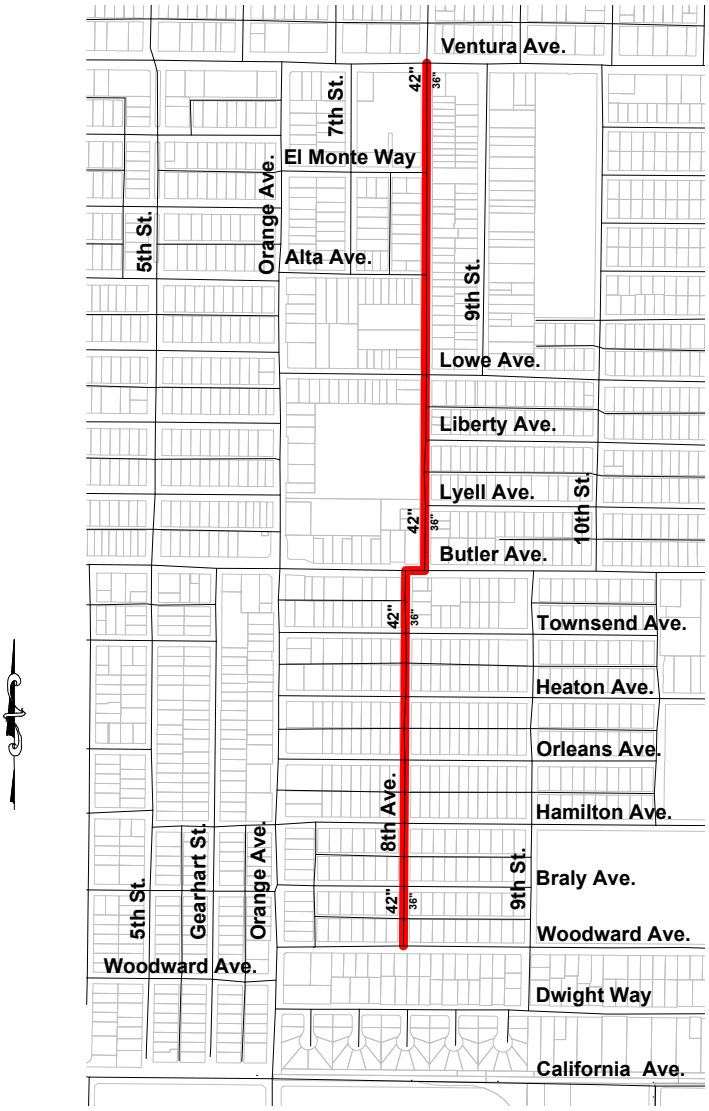
Project Purpose: Replacement of Existing Sewer Facilities

Project Location: Eighth Street between Ventura Street and Woodward Avenue

Approximate Project Quantities:
Proposed Diameter: 42"



Project Vicinity Map
Not to Scale



Project Location Map
1" = 1,000'

Project Conditions:
2-Lane Streets
Residential Setting

Project Benefit:
Existing Customers: 83%
Future Development: 17%

Estimated Project Costs:

Estimated Construction Cost:	$2,638,000.00
Estimated Contingencies Cost:	$659,000.00
Estimated Management and Engineering Cost:	$528,000.00
Total Estimated Project Cost:	$3,825,000.00

ENR CCI = 9,835 (20 City Average, July 2014)

Legend:

- **Project Sewer**
- **Street**
- 42" **Proposed Pipe Diameter**
- 36" **Existing Pipe Diameter**

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-5A)ECA-4-REP
Plot by: dmagill Jul 11, 2014 - 3:57pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

carollo

Blair, Church & Flynn

Project: C-5B

Sewer Plat No. 2759, 2859

Implementation Phase Phase 4 (2031-2035)

Project Purpose: Replacement of Existing Sewer Facilities

Project Location: Woodward Avenue between Eighth and Orange Avenues

Approximate Project Quantities:
Proposed Diameter: 42"

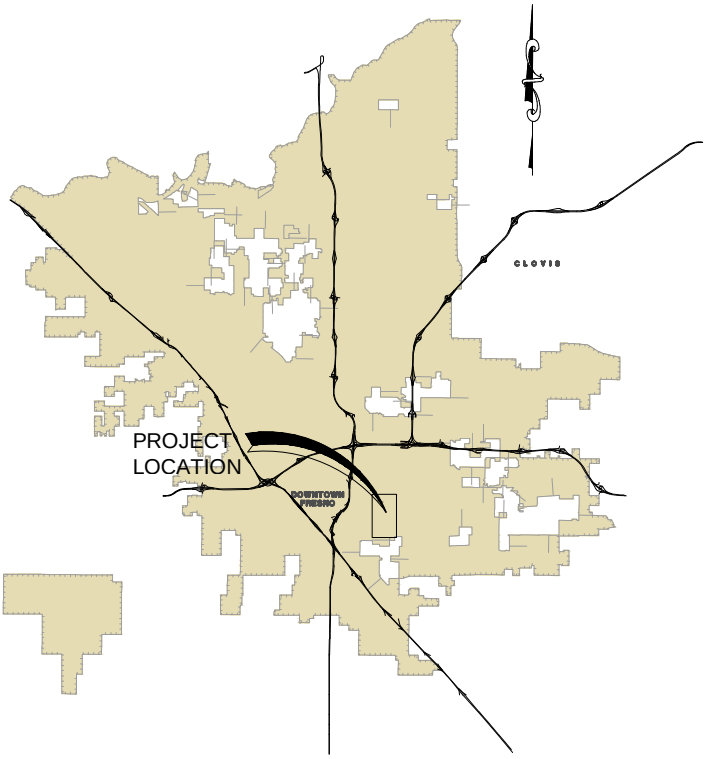
Project Conditions:
2-Lane Streets
Residential Setting

Project Benefit:
Existing Customers: 83%
Future Development: 17%

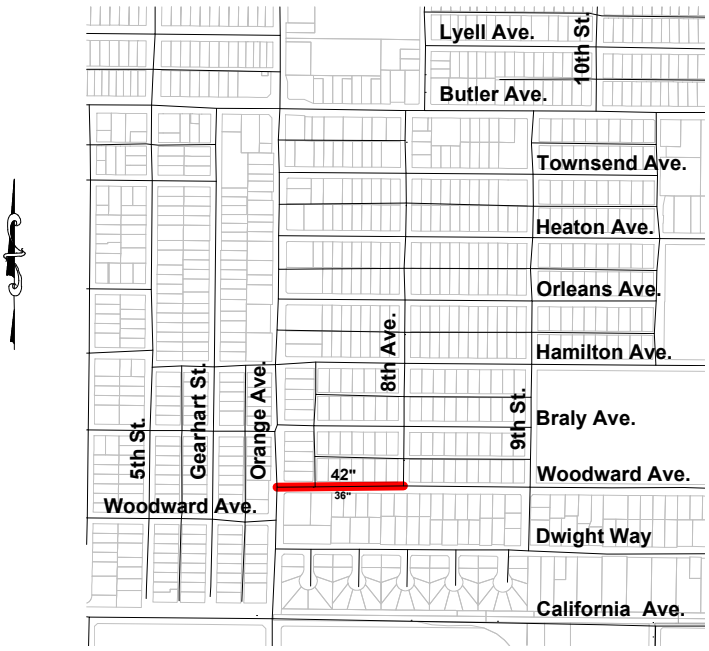
Estimated Project Costs:

Estimated Construction Cost:	$506,000.00
Estimated Contingencies Cost:	$126,000.00
Estimated Management and Engineering Cost:	$101,000.00
Total Estimated Project Cost:	$733,000.00

ENR CCI = 9,835 (20 City Average, July 2014)



Project Vicinity Map
Not to Scale



Project Location Map
1" = 1,000'

Legend:

	Project Sewer
	Street
42"	Proposed Pipe Diameter
36"	Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-5B)ECA-4-REP
Plot by: dmagill Jul 11, 2014 - 3:58pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

Project: C-5C

Sewer Plat No. 2759, 2859

Implementation Phase Phase 4 (2031-2035)

Project Purpose: Replacement of Existing Sewer Facilities

Project Location: Orange Avenue between Woodward and California Avenues

Approximate Project Quantities:
Proposed Diameter: 42"

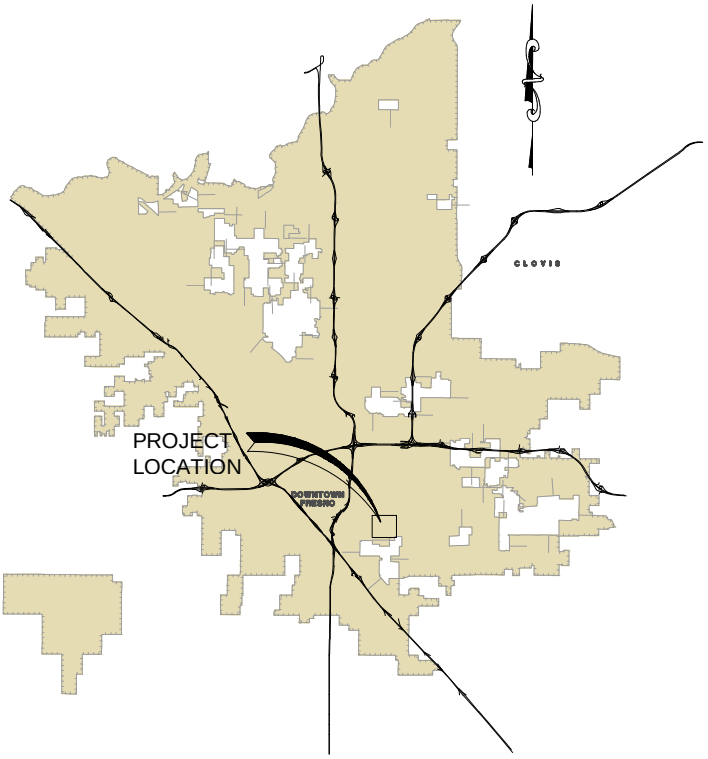
Project Conditions:
2-Lane Streets
Residential Setting

Project Benefit:
Existing Customers: 83%
Future Development: 17%

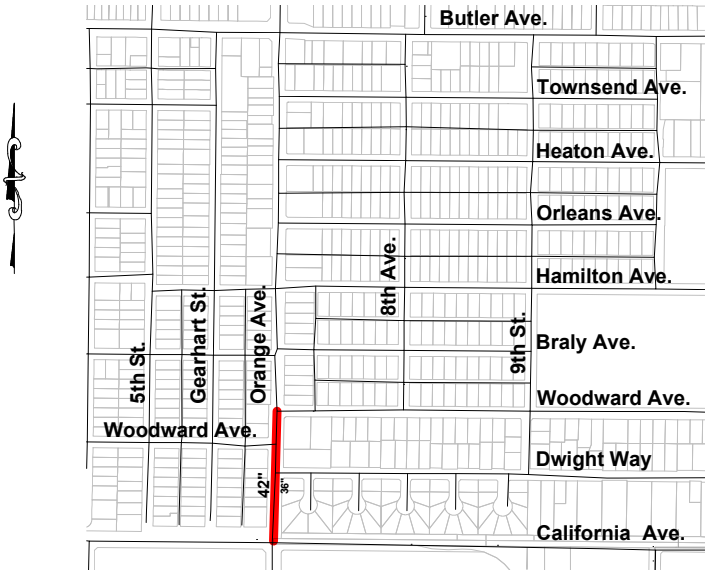
Estimated Project Costs:

Estimated Construction Cost:	$537,000.00
Estimated Contingencies Cost:	$134,000.00
Estimated Management and Engineering Cost:	$107,000.00
Total Estimated Project Cost:	$778,000.00

ENR CCI = 9,835 (20 City Average, July 2014)



Project Vicinity Map
Not to Scale



Project Location Map
1" = 1,000'

Legend:

	Project Sewer
	Street
42"	Proposed Pipe Diameter
36"	Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-5C)ECA-4-REP
Plot by: dmagill Jul 11, 2014 - 3:59pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

Project: C-6

Sewer Plat No. 2553

Implementation Phase Phase 4 (2031-2035)

Project Purpose: Replacement of Existing Sewer Facilities

Project Location: Alley between Producers Dairy and H Street

Approximate Project Quantities:
Proposed Diameter: 8"

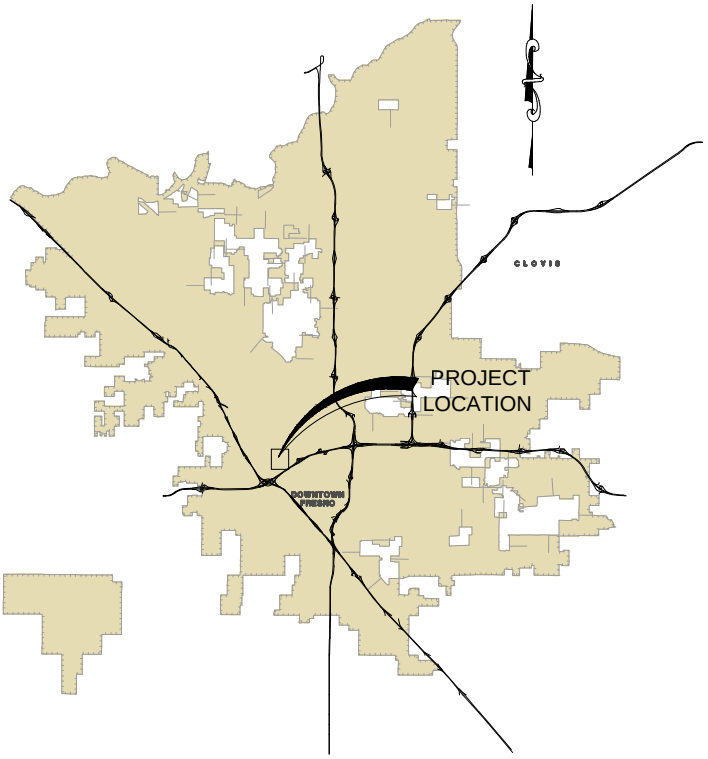
Project Conditions:
2-Lane Streets
Commercial Setting

Project Benefit:
Existing Customers: 100%
Future Development: 0%

Estimated Project Costs:

Estimated Construction Cost:	$227,000.00
Estimated Contingencies Cost:	$57,000.00
Estimated Management and Engineering Cost:	$45,000.00
Total Estimated Project Cost:	$329,000.00

ENR CCI = 9,835 (20 City Average, July 2014)



Project Vicinity Map
Not to Scale

Project Location Map
1" = 800'

Legend:

	Project Sewer
	Street
8"	Proposed Pipe Diameter
6"	Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-6)ECA-6-REP.d
Plot by: dmagill Jul 11, 2014 - 4:00pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

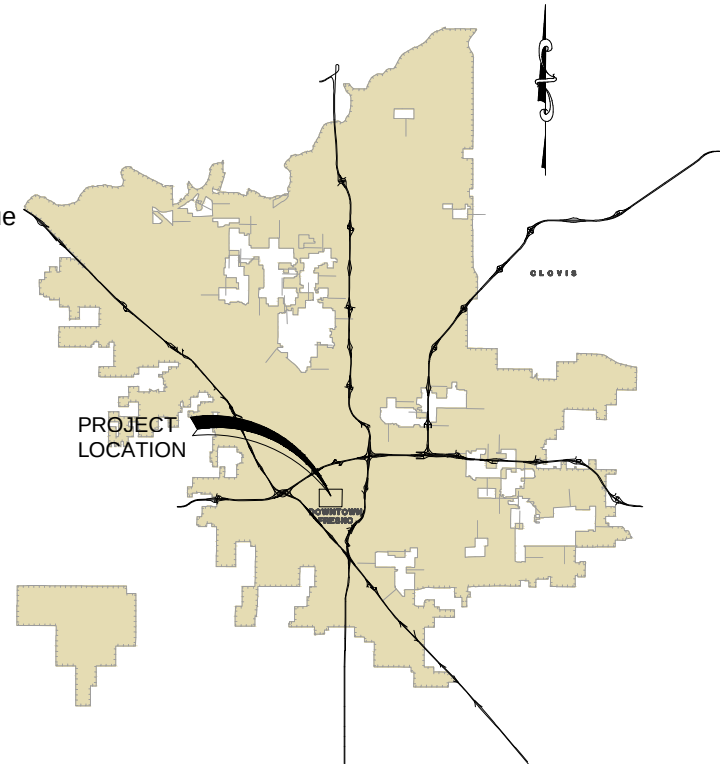
Project: C-7

Sewer Plat No. 2655

Implementation Phase Phase 4 (2031-2035)

Project Purpose: Replacement of Existing Sewer Facilities

Project Location: Tuolumne Street and Van Ness Avenue between N and Merced Streets



Project Vicinity Map
Not to Scale

Approximate Project Quantities:
Proposed Diameter: 30"

Project Conditions:
2-Lane Streets
Commercial Setting

Project Benefit:
Existing Customers: 0%
Future Development: 100%

Estimated Project Costs:

Estimated Construction Cost:	$847,000.00
Estimated Contingencies Cost:	$212,000.00
Estimated Management and Engineering Cost:	$169,000.00
Total Estimated Project Cost:	$1,228,000.00

ENR CCI = 9,835 (20 City Average, July 2014)

Project Location Map
1" = 800'

Legend:

	Project Sewer
	Street
30"	Proposed Pipe Diameter
27"	Existing Pipe Diameter

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-7)FCA-1-REP.d
Plot by: dmagill Jul 11, 2014 - 4:01pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

Project: C-8

Sewer Plat No. 3245, 3246, 3247, 3248, 3249, 3250, 3251, 3252

Implementation Phase Phase 4 (2031-2035)

Project Purpose: Relief Line for Existing Sewer Facilities

Project Location: North Avenue between Polk Avenue Alignment and Fruit Avenue

Approximate Project Quantities:
Proposed Diameter: 60"

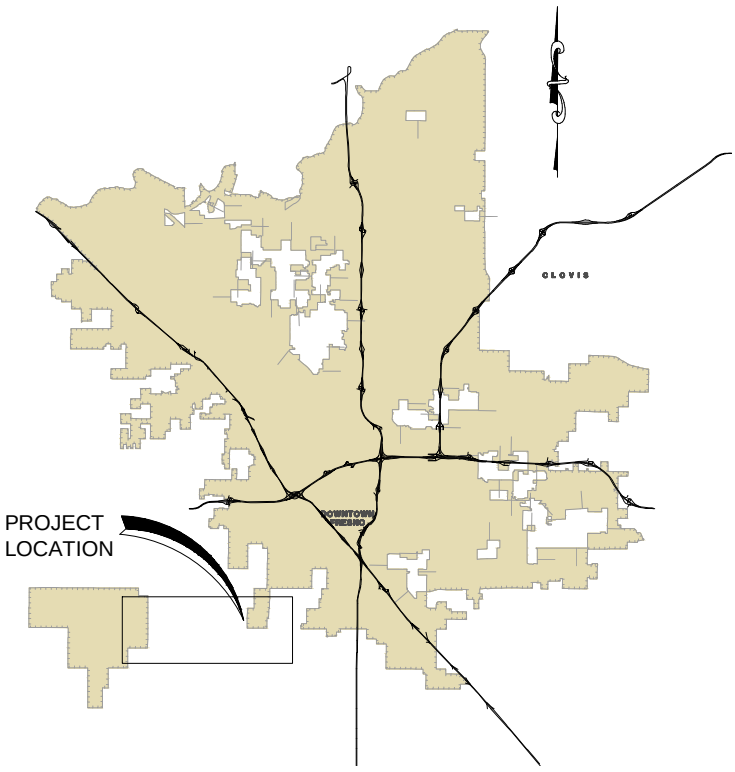
Project Conditions:
2-Lane Streets
Rural Setting

Project Benefit:
Existing Customers: 0%
Future Development: 100%

Estimated Project Costs:

Estimated Construction Cost:	$13,527,000.00
Estimated Contingencies Cost:	$3,382,000.00
Estimated Management and Engineering Cost:	$,2706,000.00
Total Estimated Project Cost:	$19,615,000.00

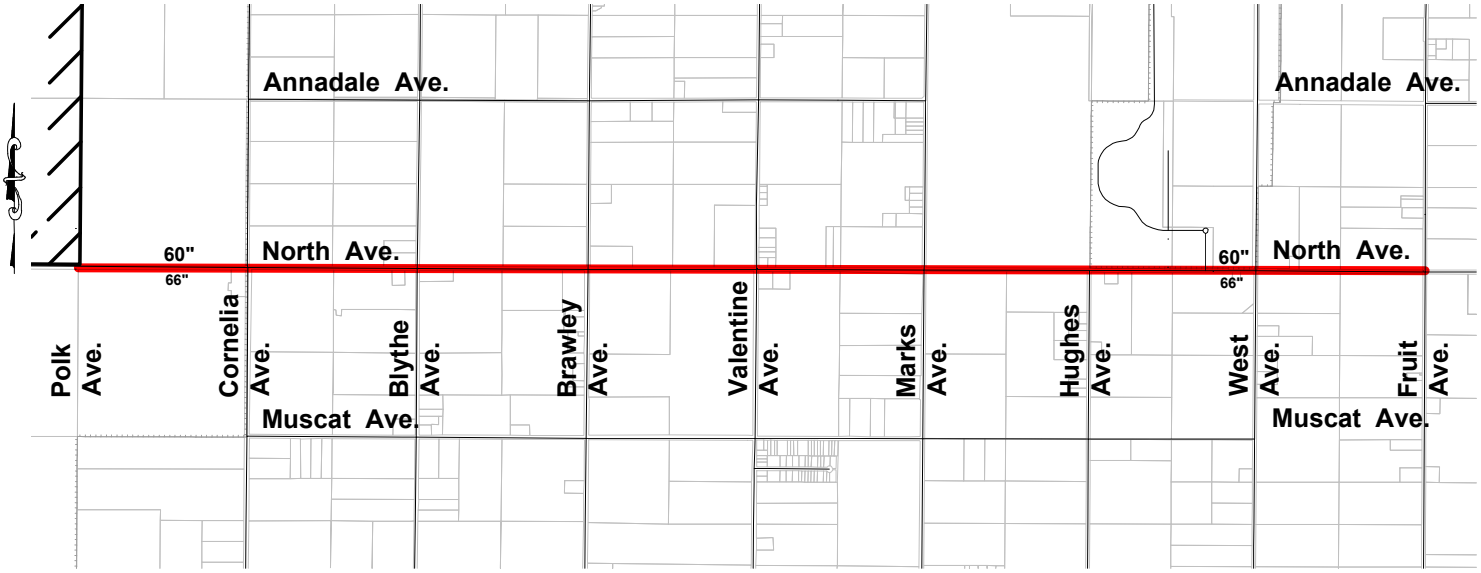
ENR CCI = 9,835 (20 City Average, July 2014)



Project Vicinity Map
Not to Scale

Legend:

- **Project Sewer**
- **Street**
- 60" **Proposed Pipe Diameter**
- 66" **Existing Pipe Diameter**



Project Location Map
1" = 3,000'

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-8)FCA-2-REL
Plot by: dmagill Jul 11, 2014 - 4:01pm

City of Fresno
Wastewater Collection System Master Plan Update
CAPITAL IMPROVEMENT PLAN
PROJECT SHEET

Project: C-9

Sewer Plat No. 3253, 3254, 3255, 3256 3257, 3258

Implementation Phase Phase 4 (2031-2035)

Project Purpose: Rehabilitate Line for Existing Sewer Facilities

Project Location: North Avenue between Fruit and Orange Avenues

Approximate Project Quantities:
Proposed Diameter: 60"

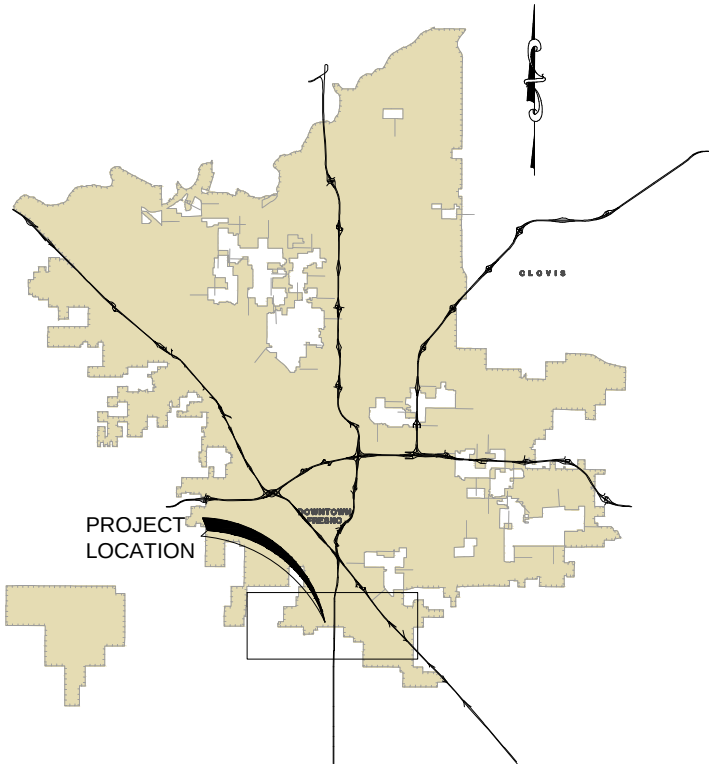
Project Conditions:
2-Lane Streets
Rural Setting

Project Benefit:
Existing Customers: 0%
Future Development: 100%

Estimated Project Costs:

Estimated Construction Cost:	$10,604,000.00
Estimated Contingencies Cost:	$2,651,000.00
Estimated Management and Engineering Cost:	$2,121,000.00
Total Estimated Project Cost:	$15,376,000.00

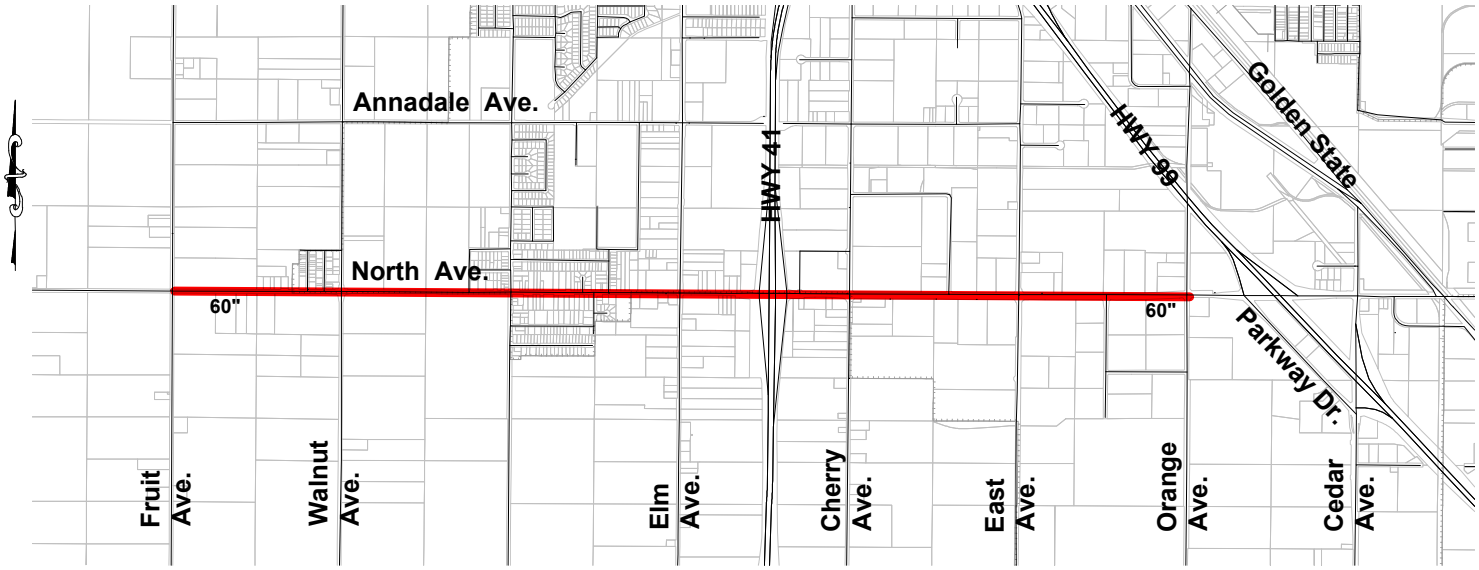
ENR CCI = 9,835 (20 City Average, July 2014)



Project Vicinity Map
Not to Scale

Legend:

Project Sewer
Street
60" **Proposed Pipe Diameter**



Project Location Map
1" = 3,000'

Drawing: P:\213-0242\Site\Exhibits\Project Jobs\213242_(C-9)FCA-3-REH
Plot by: dmagill Jul 11, 2014 - 4:02pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: B

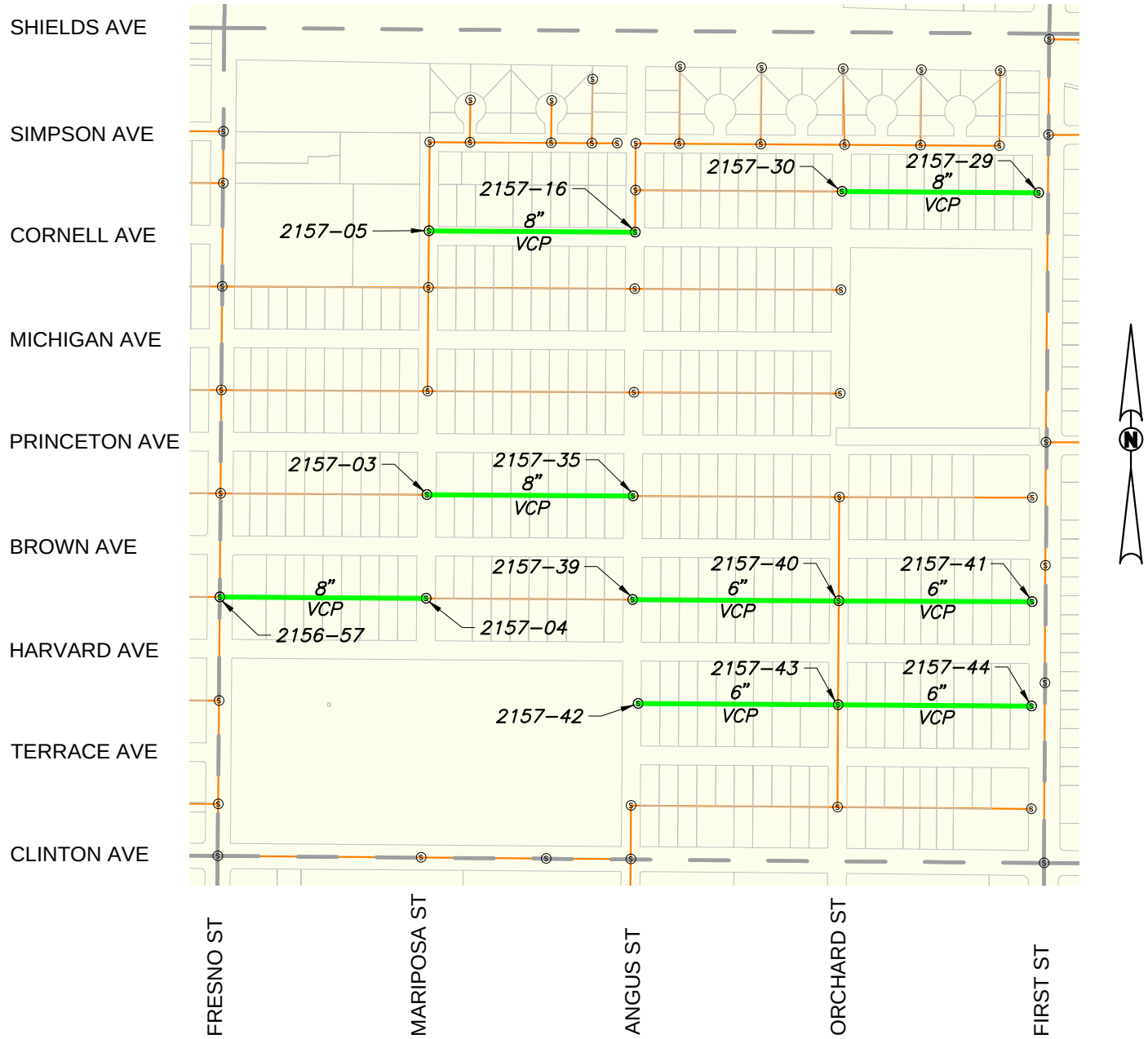
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2157

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

8"	2,603 LF
6"	2,530 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358–23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2157 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:39pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

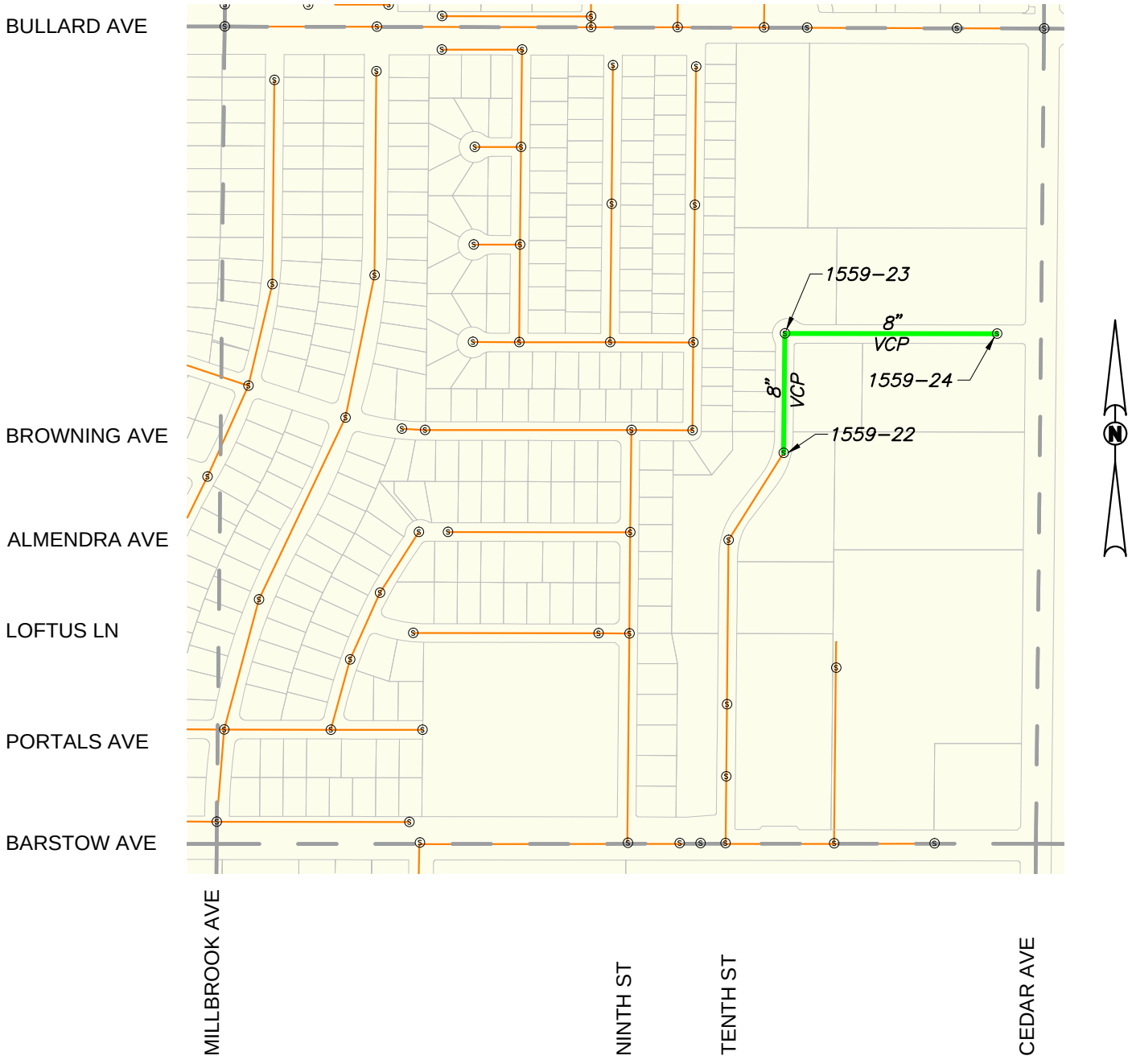
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 1559

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

8"	1,074 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358–23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1559 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:39pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 1358

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:
6" 200 LF

Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358–23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1358 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:39pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

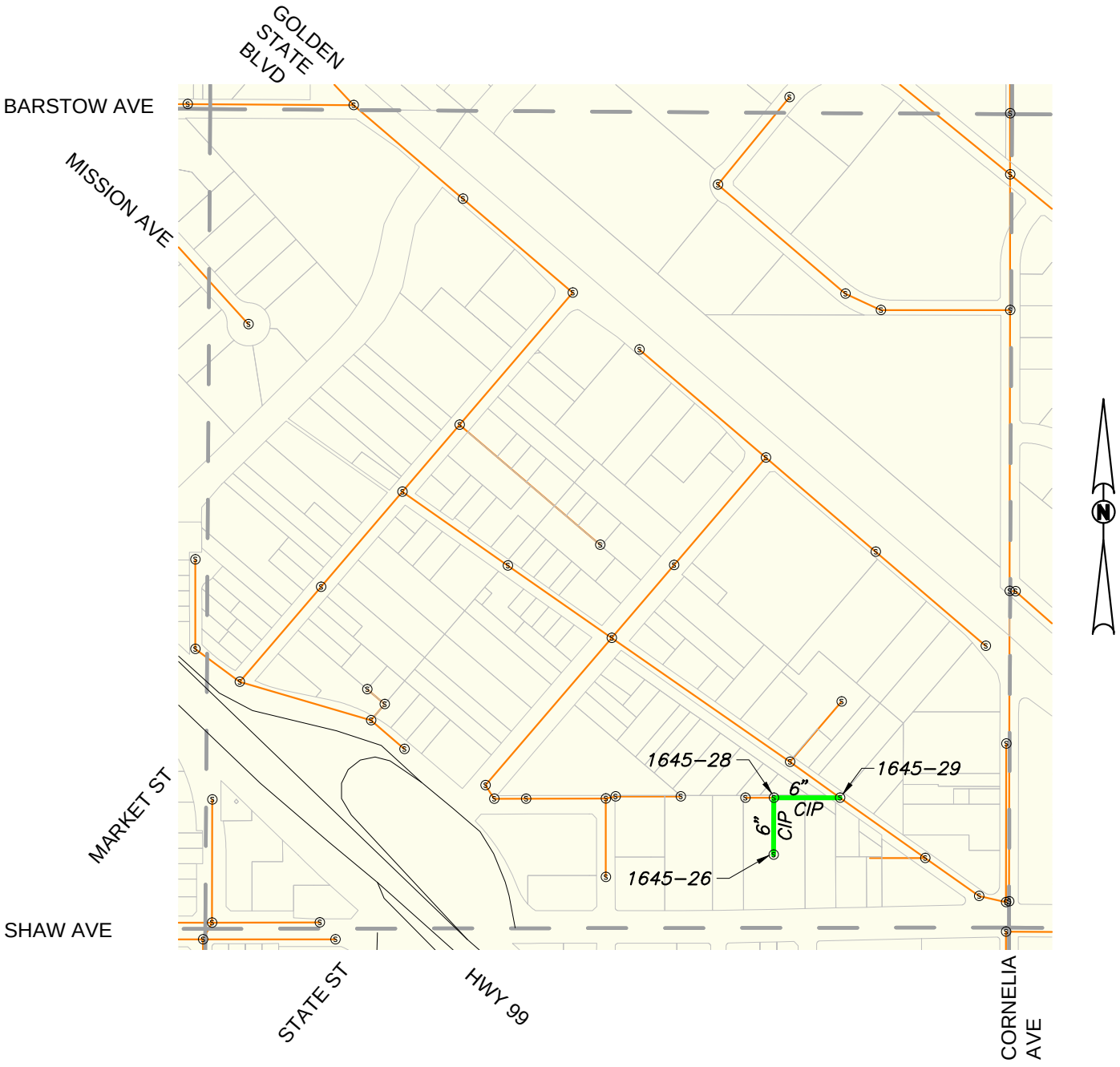
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 1645

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

6"	100 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
CIP — Cast In Place	1358-23 — Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1645 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:39pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: B

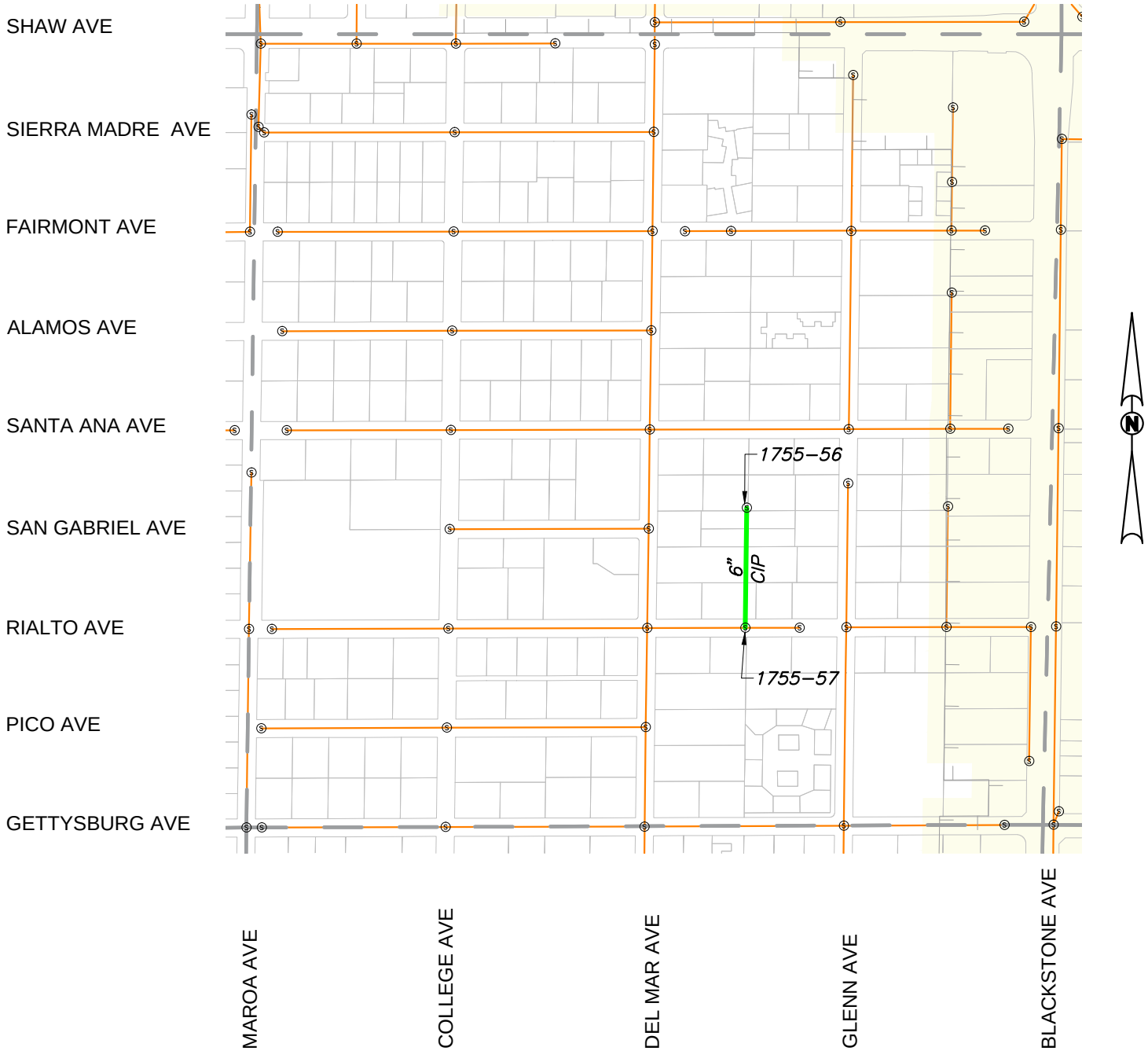
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 1755

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

6"	398 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
CIP — Cast In Place	1358–23 — Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1755 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:40pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: B

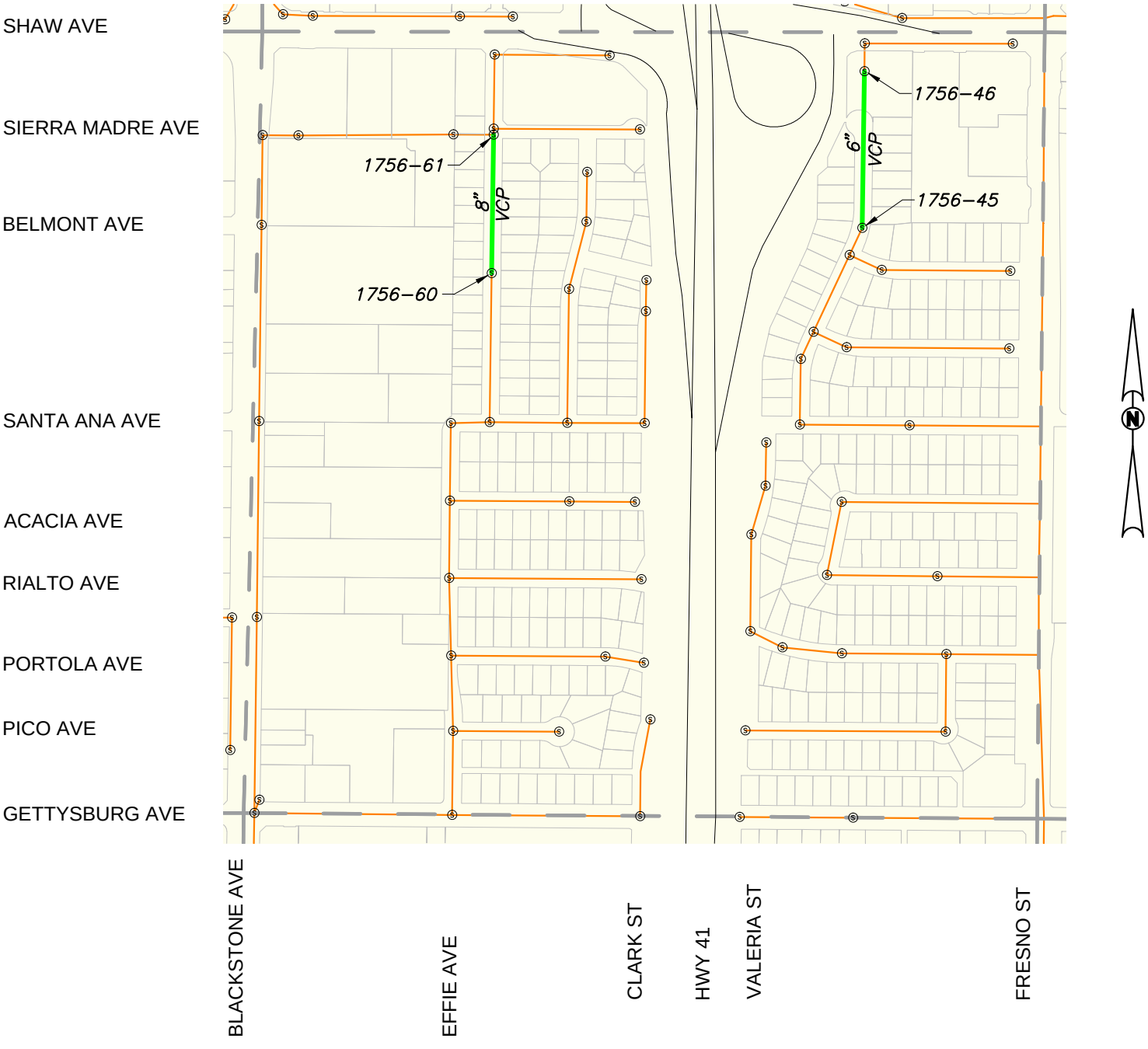
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 1756

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

8"	464 LF
6"	525 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358-23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1756 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:40pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

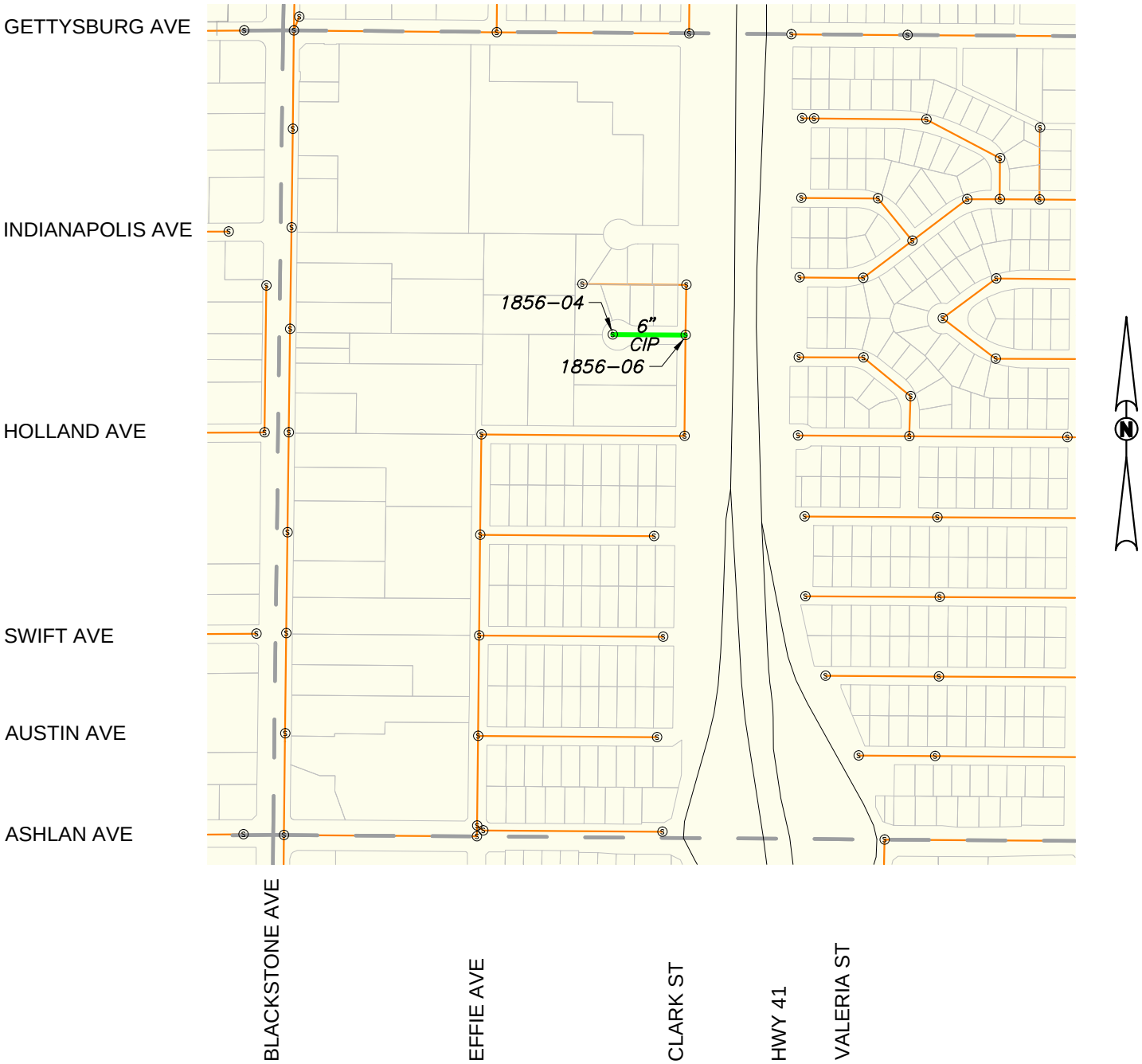
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 1856

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

6"	239 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
CIP — Cast In Place	1358-23 — Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1856 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:40pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: A

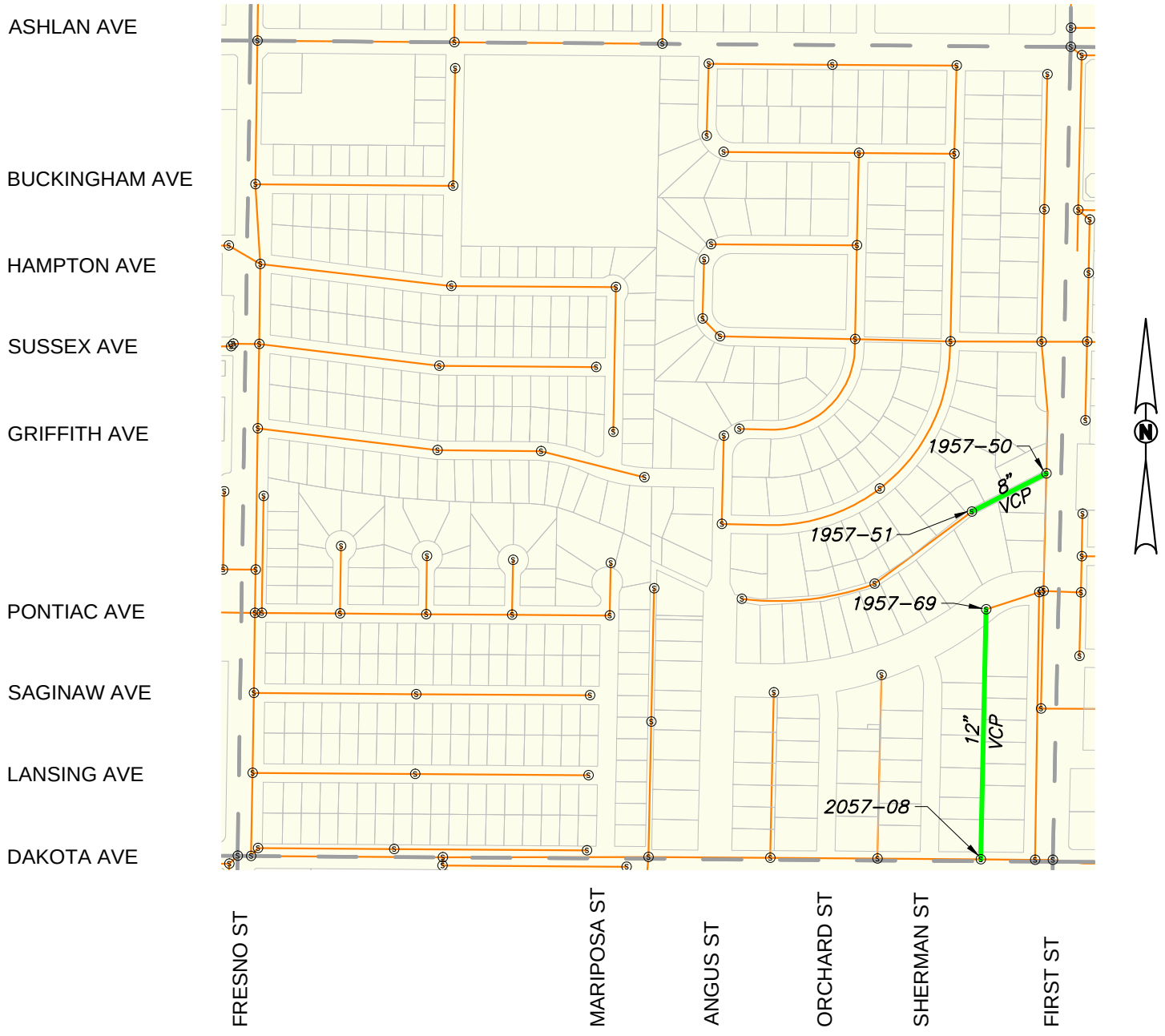
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 1957

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

12"	813 LF
8"	272 LF



Legend

	Rehabilitation Required		Plat Boundary
	Other Sewers		City Limits
	Parcel Boundary	Ⓢ	Sewer Manhole
VCP	Vitrified Clay Pipe	1358–23	Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 1957 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:40pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

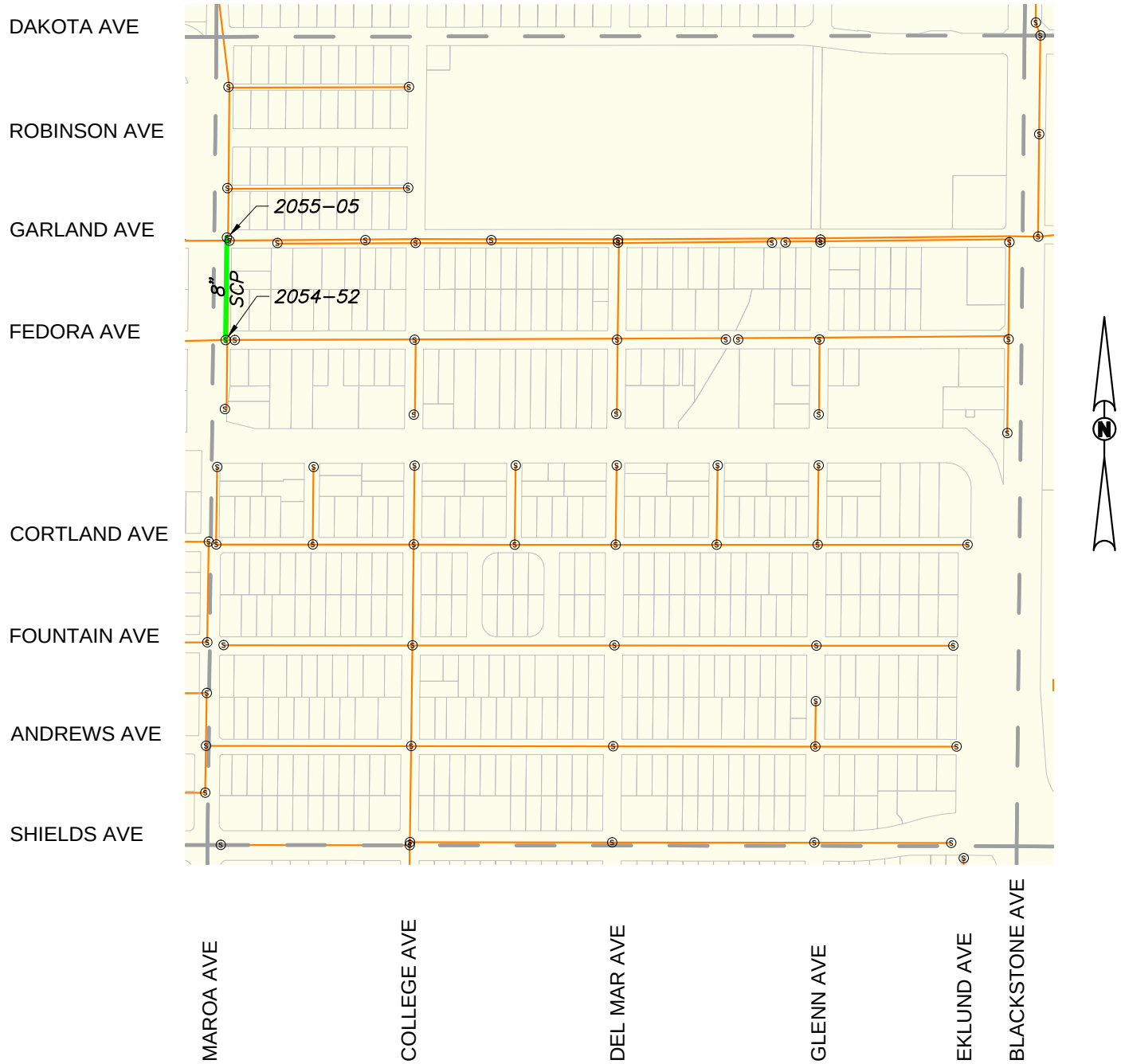
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2055

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

8"	335 LF



Legend

Rehabilitation Required		Plat Boundary	
Other Sewers		City Limits	
Parcel Boundary	Ⓢ	Sewer Manhole	
SCP	Standard Concrete Pipe	1358-23	Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2055 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:40pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

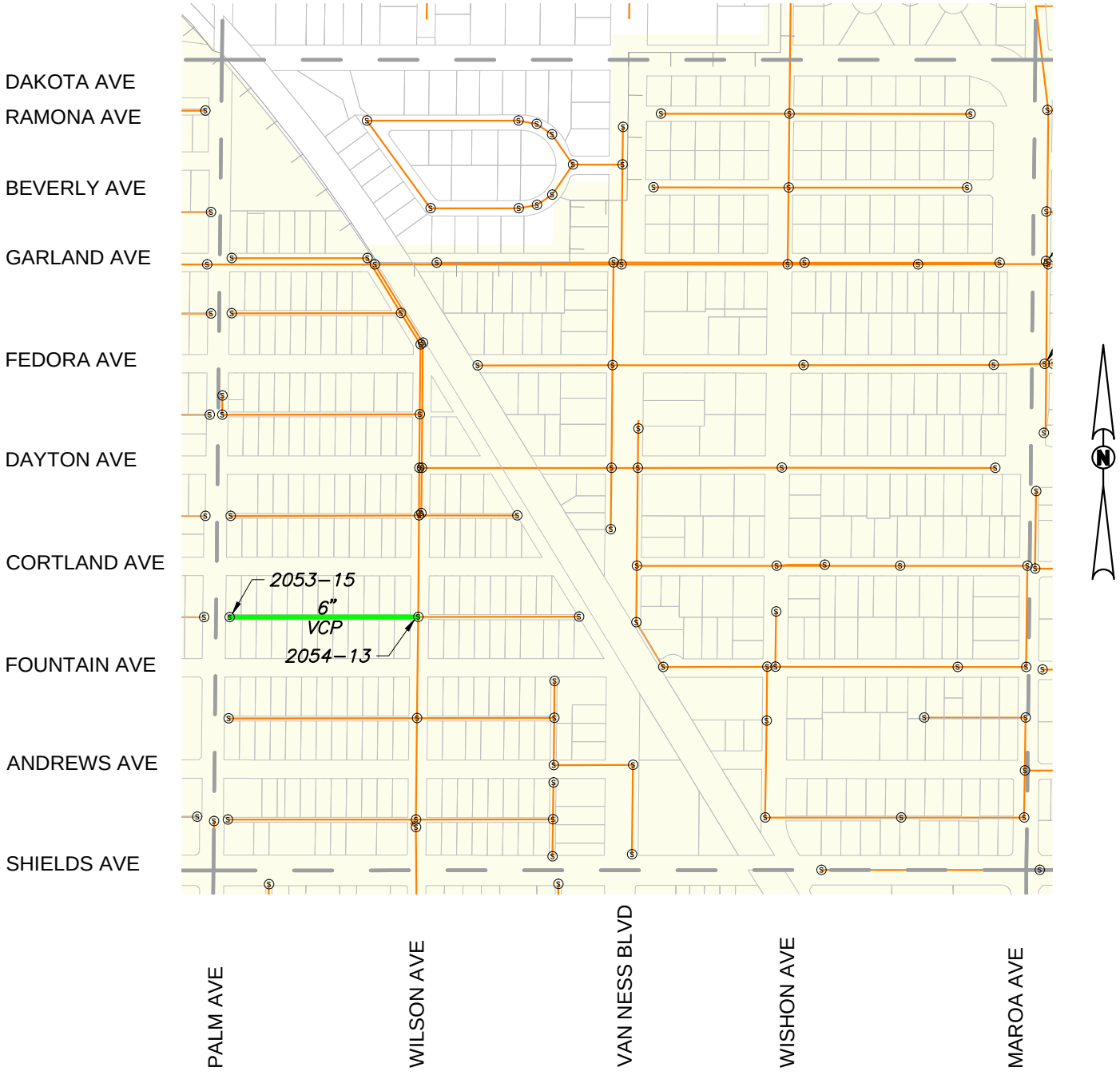
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2054

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

6"	615 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358–23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2054 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:40pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

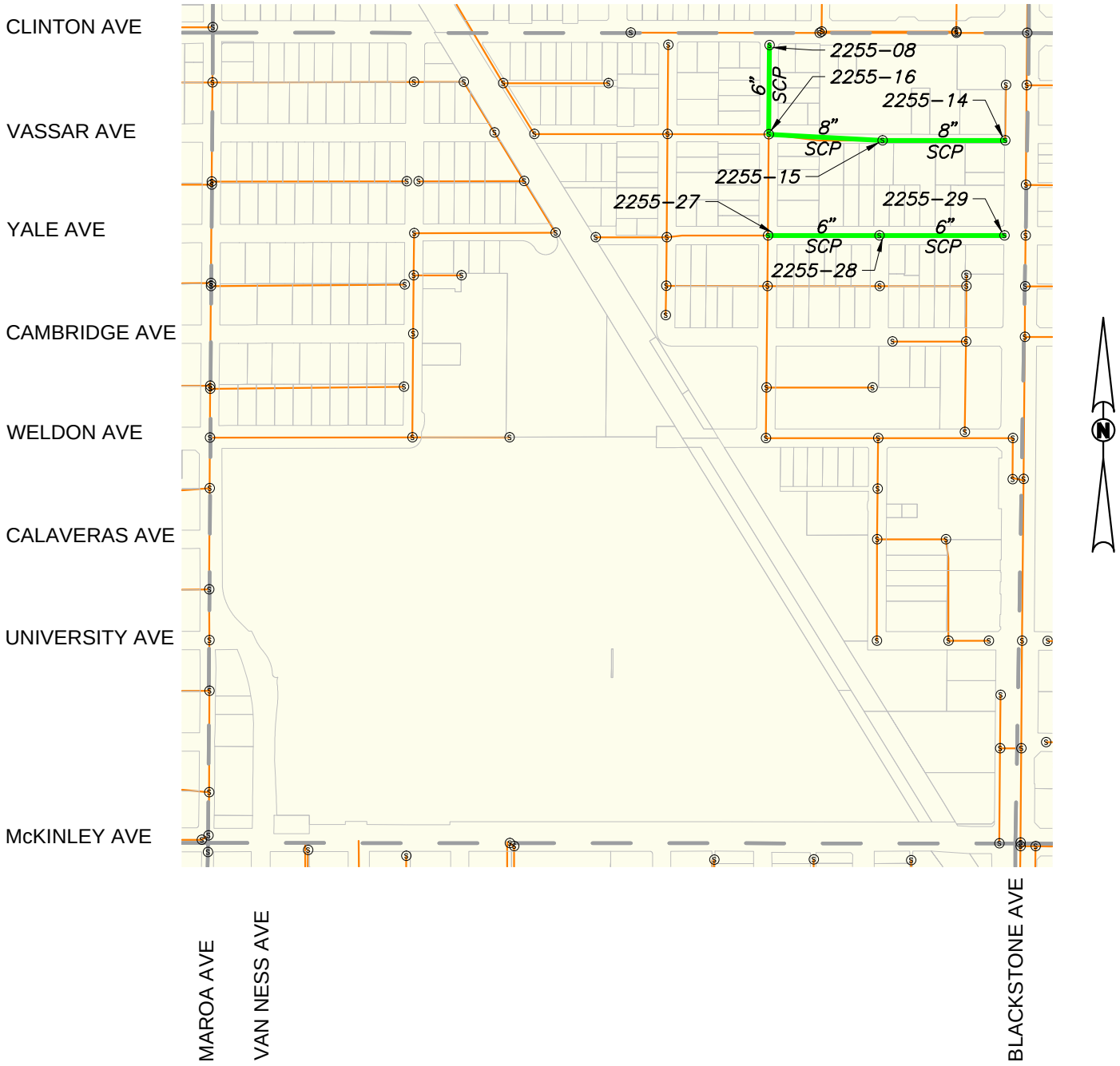
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2255

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

8"	771 LF
6"	1,061 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358–23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2255 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:41pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: A

Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2057

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

12"	953 LF

Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358–23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2057 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:41pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

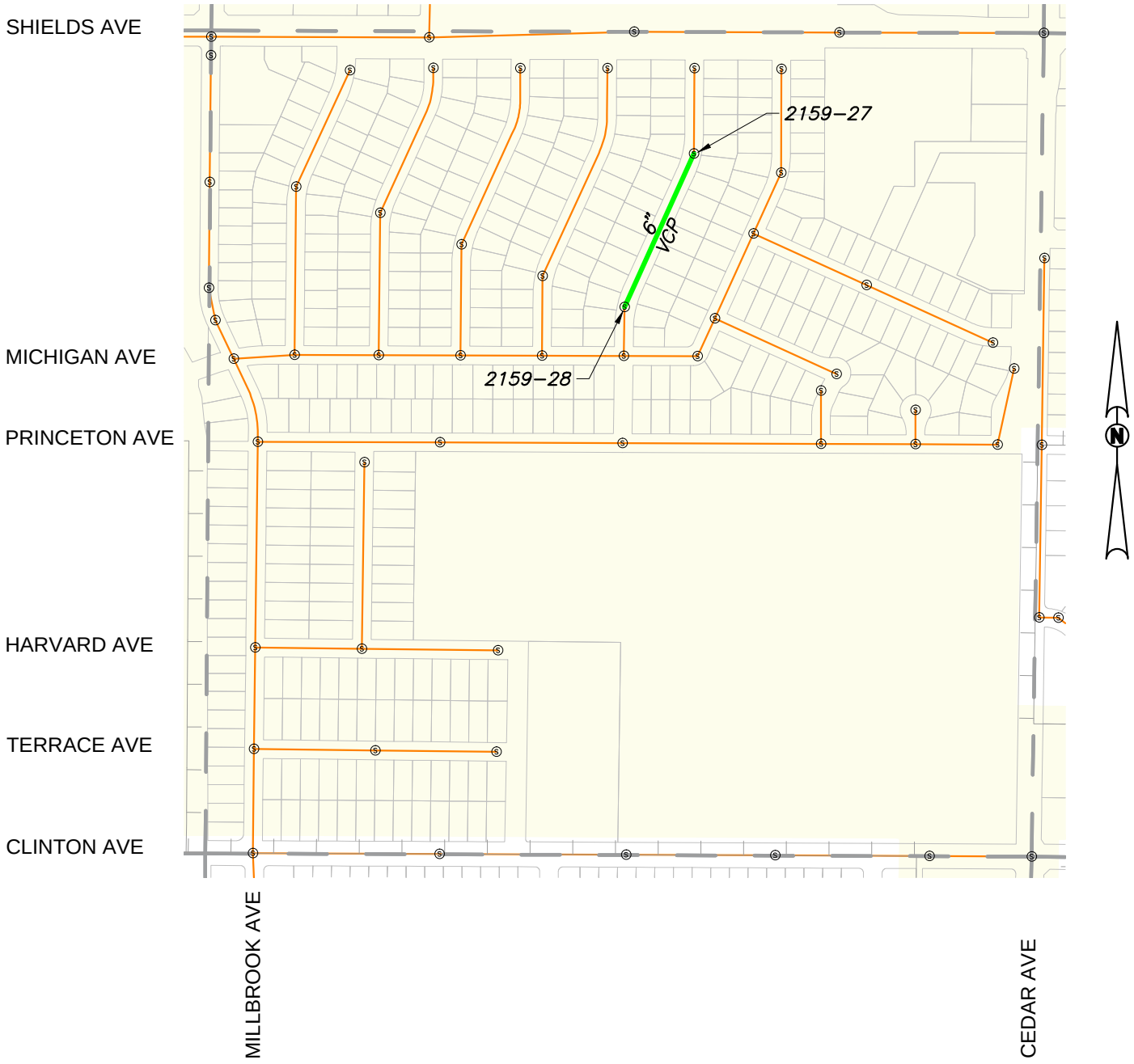
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2159

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

6"	543 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358–23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2159 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:41pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

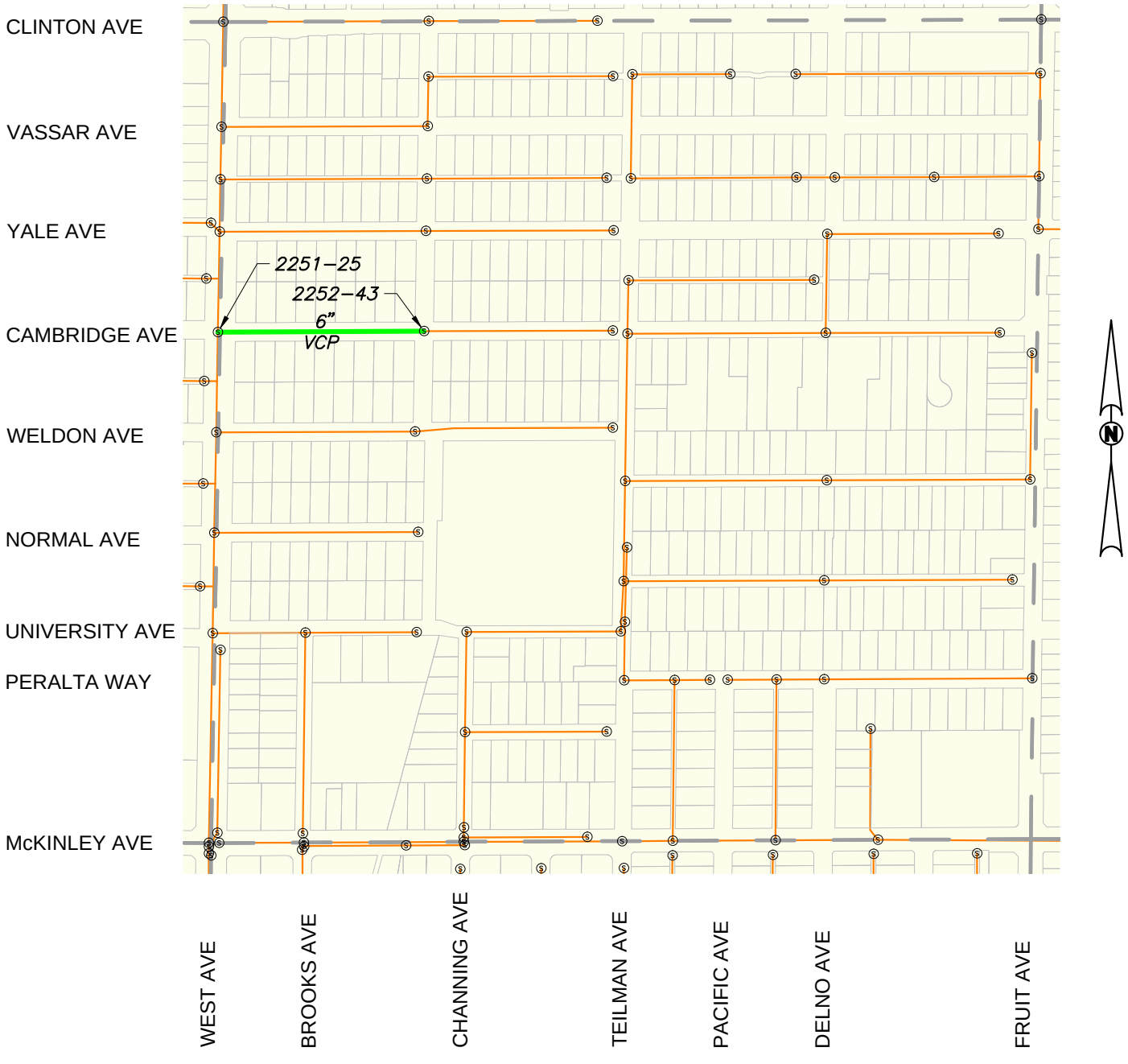
Project Phase: C

Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2252

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:
6" 668 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358–23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2252 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:41pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: B

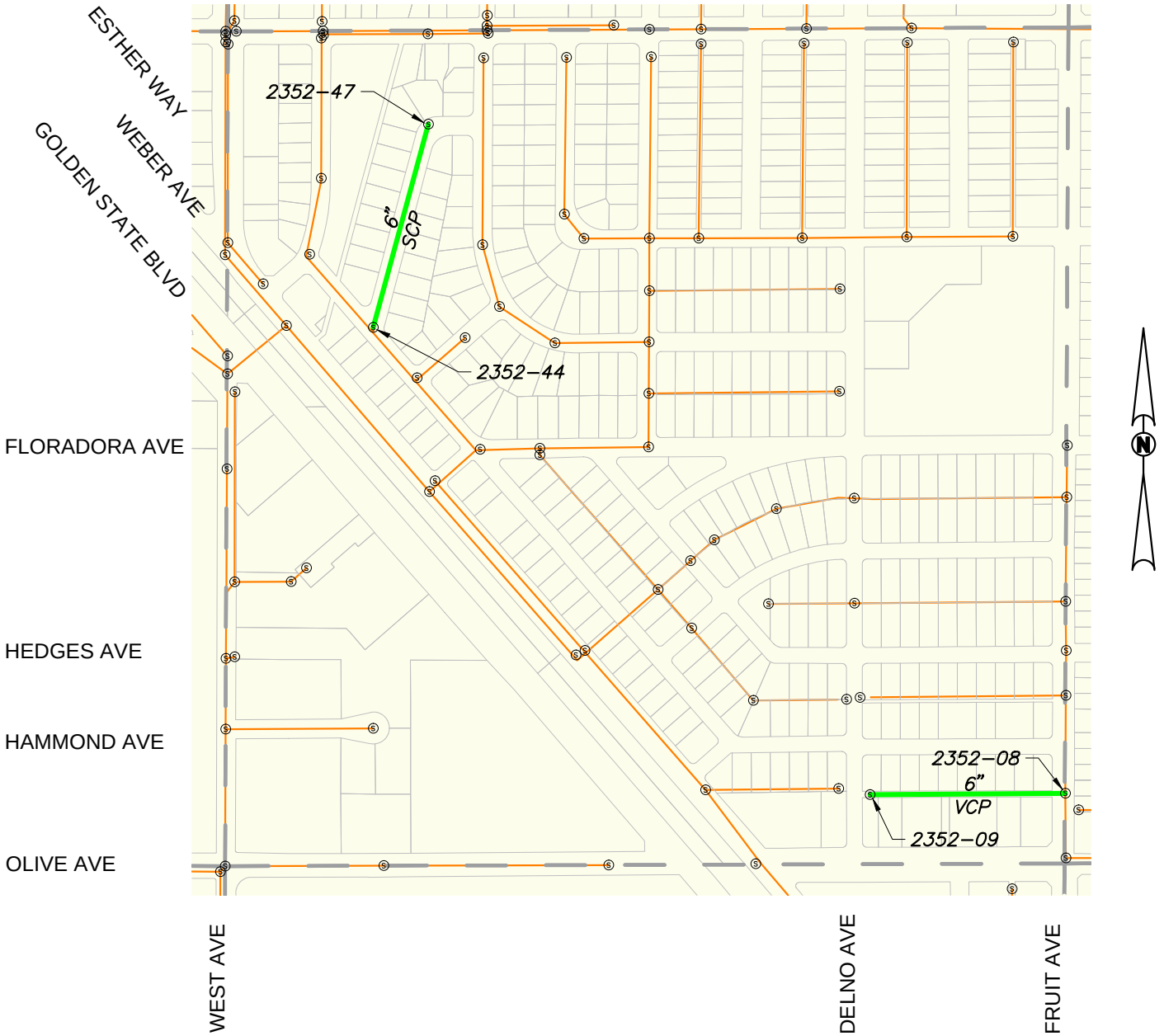
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2352

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

6"	1,281 LF



Legend

	Rehabilitation Required		Plat Boundary
	Other Sewers		City Limits
	Parcel Boundary	Ⓢ	Sewer Manhole
SCP	Standard Concrete Pipe	1358–23	Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2352 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:41pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

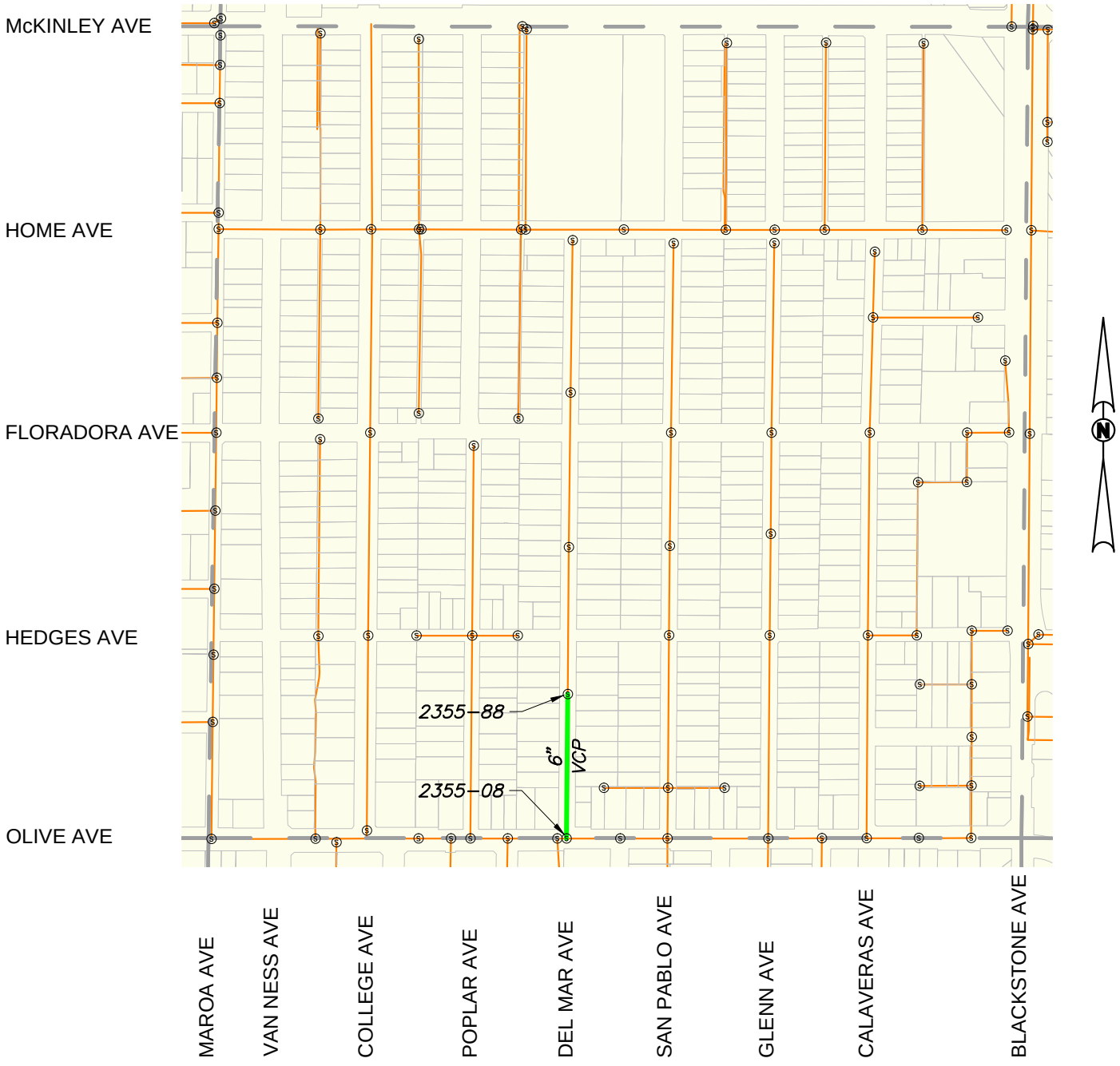
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2355

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

6"	471 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP — Vitrified Clay Pipe	1358-23 — Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2355 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:41pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

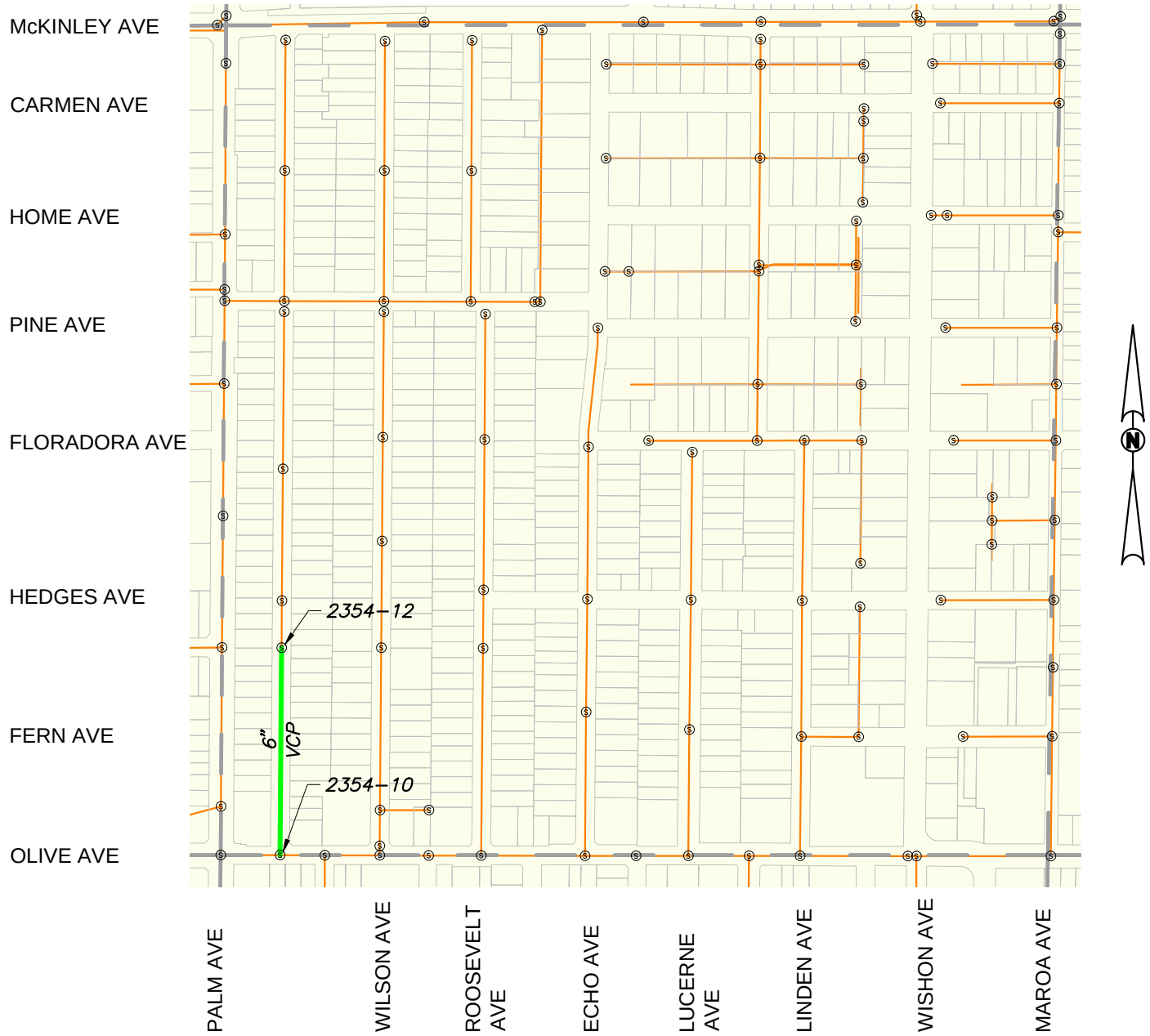
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2354

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

6"	661 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358-23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2354 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: A

Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2361

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

8"	637 LF

Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
CIP — Cast In Place	1358–23 — Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2361 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: A

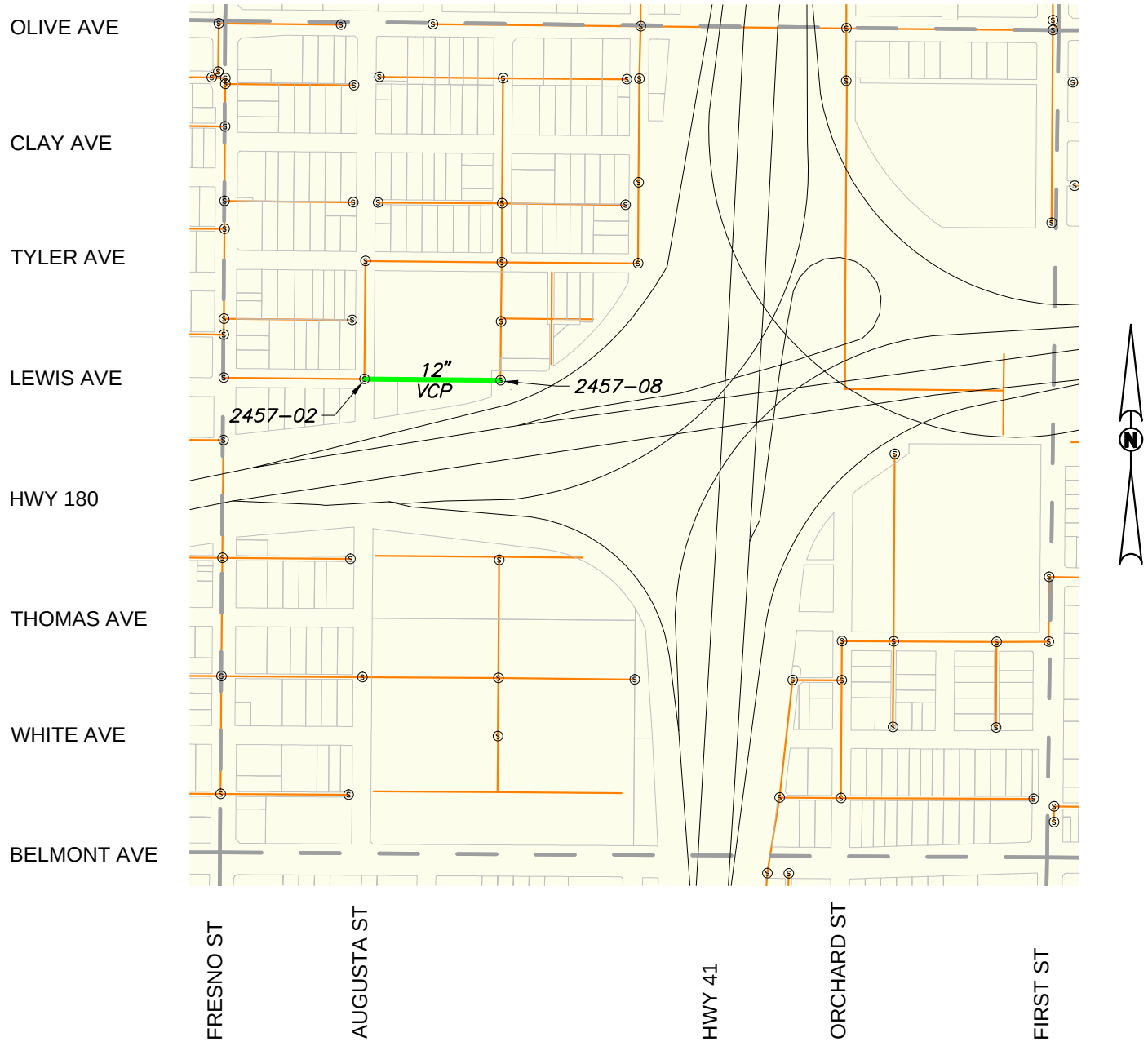
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2457

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

12"	435 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358-23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2457 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: A

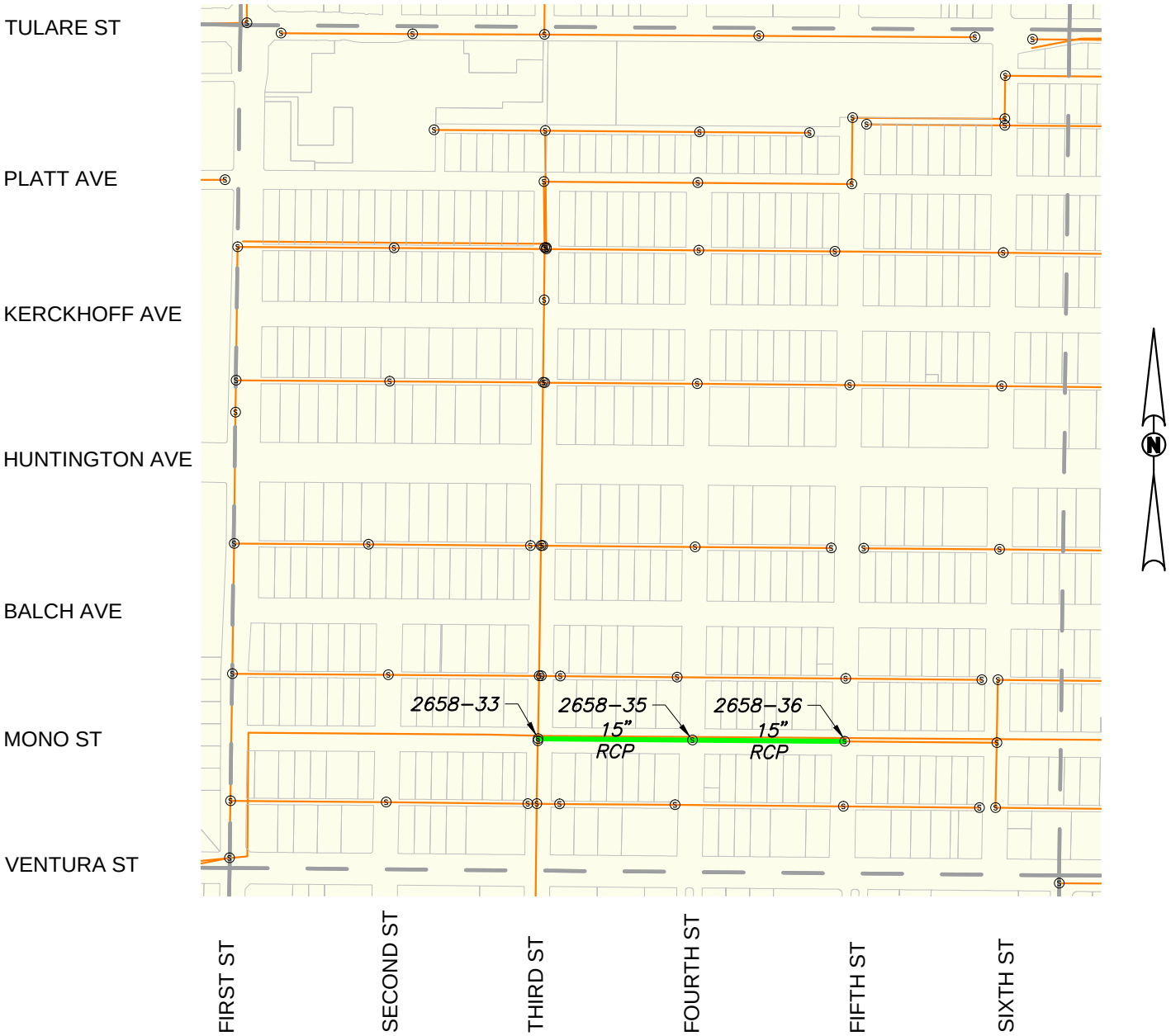
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2658

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

15"	967 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
RCP — Reinforced Concrete Pipe	1358-23 — Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2658 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: A

Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2856

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

18"	925 LF

Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358–23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2856 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:42pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: A

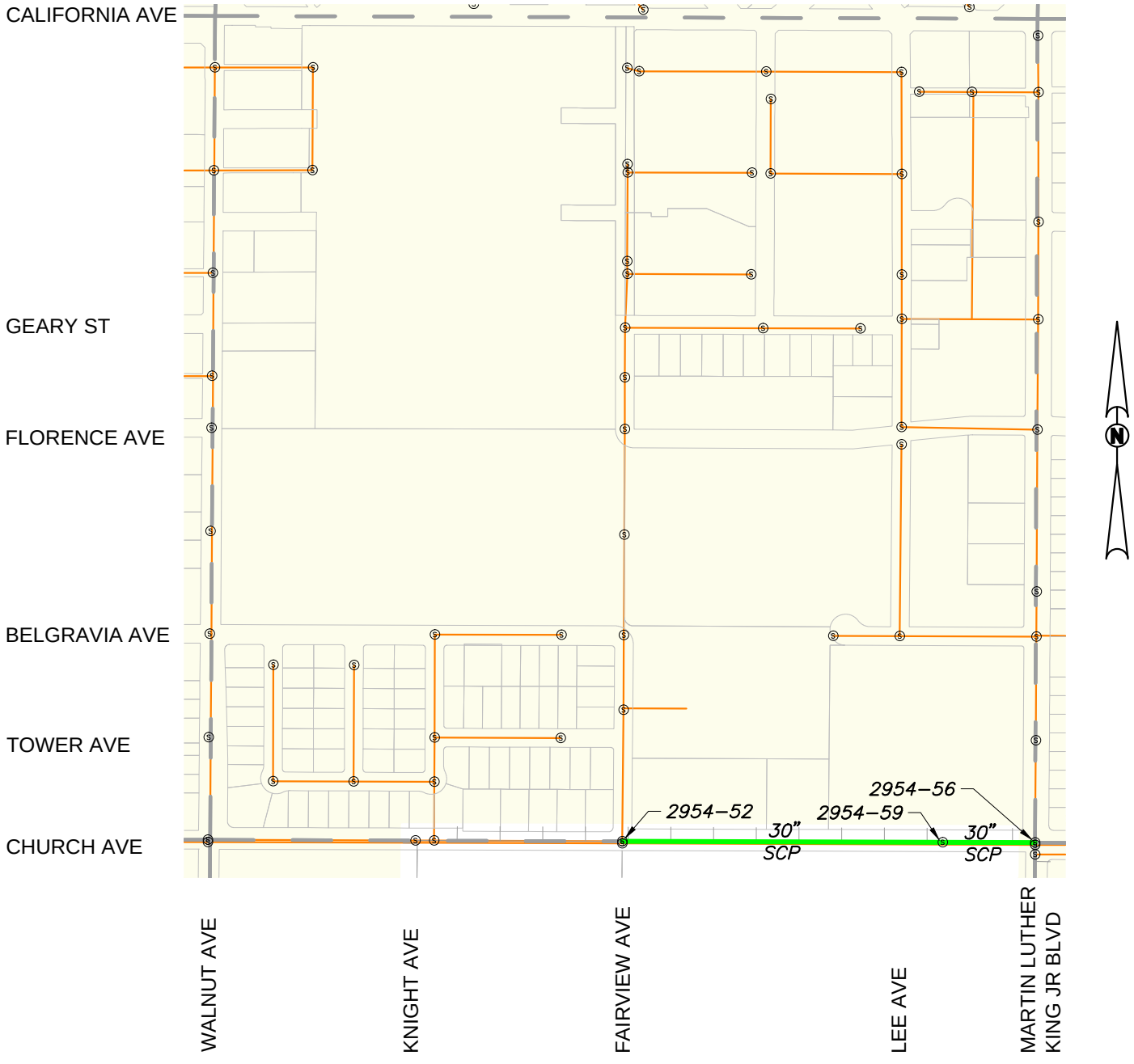
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2954

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

30"	1,329 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
SCP Standard Concrete Pipe	1358-23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2954 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

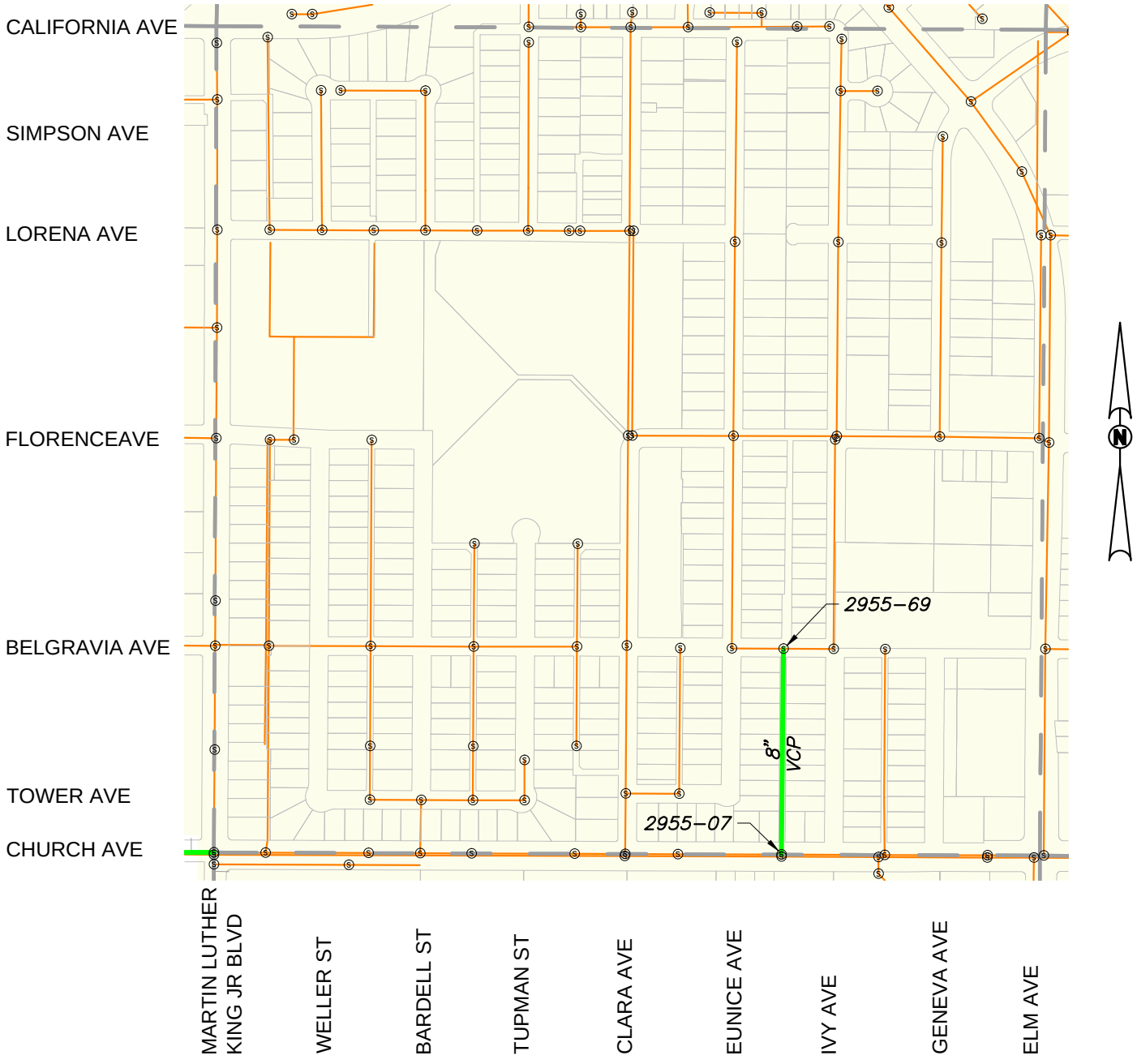
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2955

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

8"	661 LF



Legend

	Rehabilitation Required		Plat Boundary
	Other Sewers		City Limits
	Parcel Boundary	Ⓢ	Sewer Manhole
VCP	Vitrified Clay Pipe	1358-23	Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2955 - BCF.ctb
Plot by: dmagill Jul 11, 2014 - 4:42pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: B

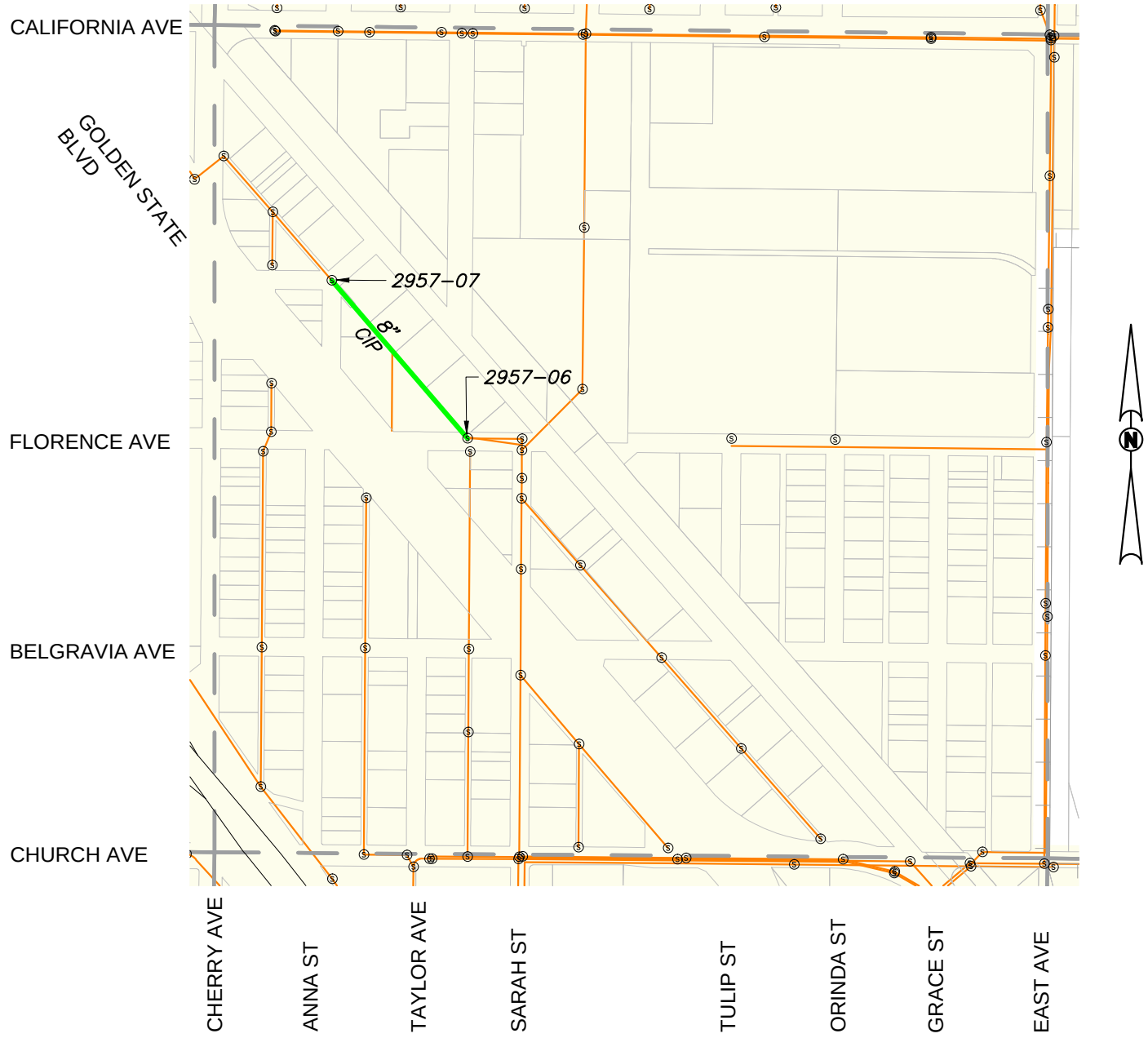
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 2957

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

8"	665 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
CIP — Cast In Place	1358–23 — Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 2957 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:43pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: B

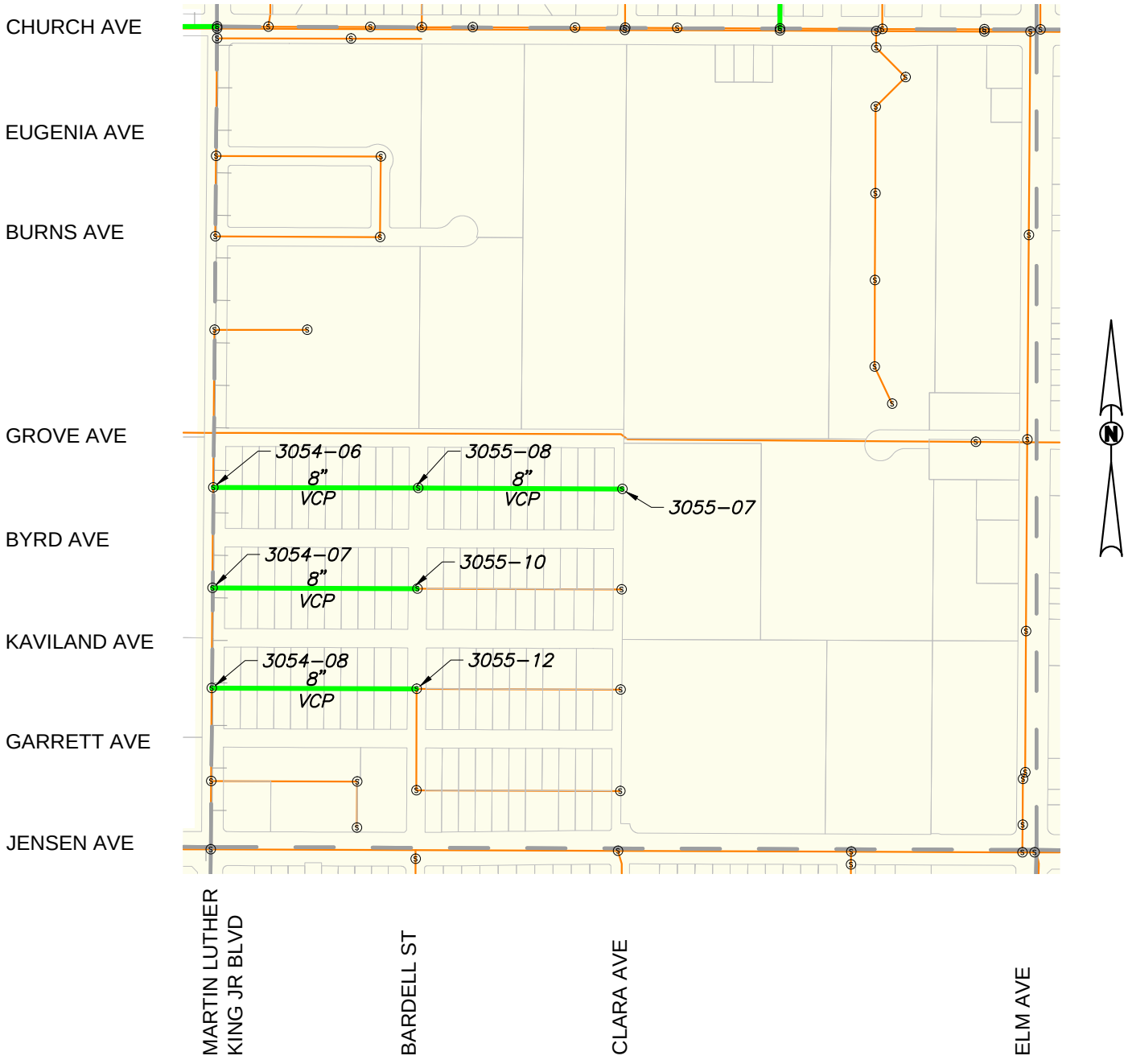
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 3055

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

8"	1,991 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP — Vitrified Clay Pipe	1358–23 — Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 3055 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:43pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: C

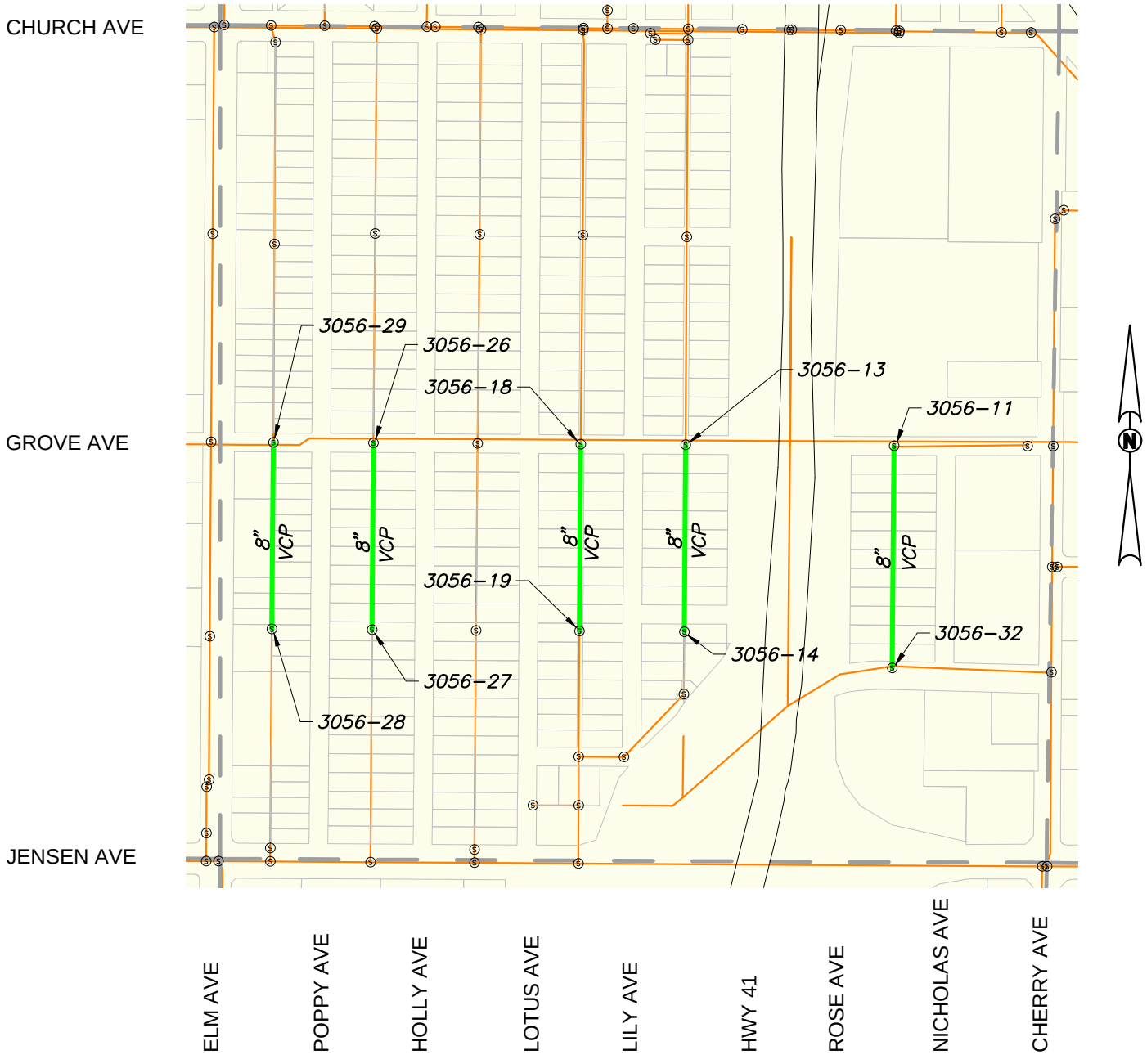
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 3056

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

8"	3,087 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358–23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 3056 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:43pm

City of Fresno
Wastewater Collection System Master Plan
CAPITAL IMPROVEMENT PLAN
HIGH MOSR SEWER REPAIRS

Project Phase: A

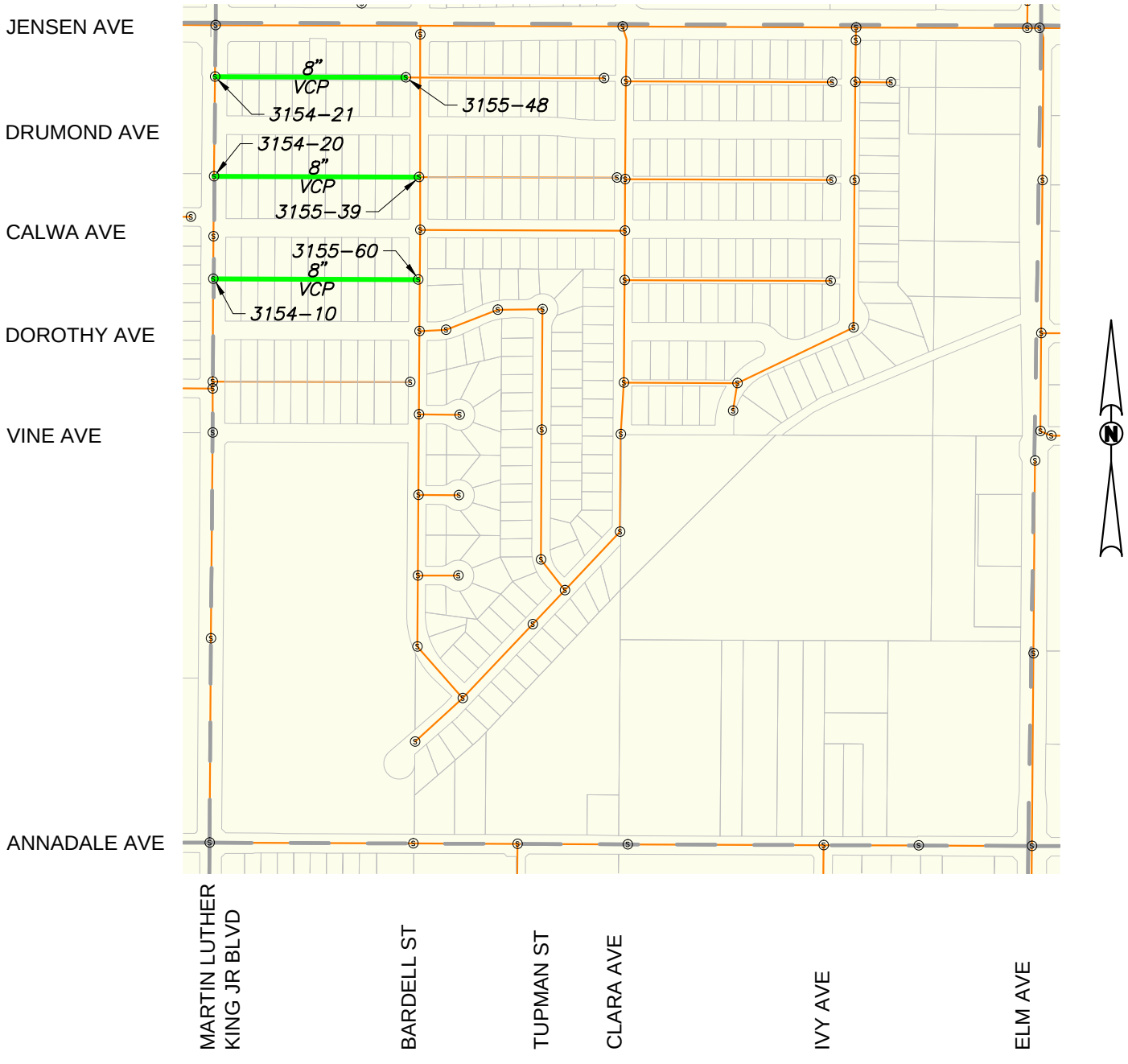
Project Purpose: Rehabilitation of Existing Sewer Facilities

Plat Area: 3155

Reccomendation: Install Cured-In-Place (CIPP) Liner

Pipe Diameter Quantities:

8"	1,945 LF



Legend

Rehabilitation Required	Plat Boundary
Other Sewers	City Limits
Parcel Boundary	Sewer Manhole
VCP Vitrified Clay Pipe	1358–23 Sewer Manhole Number

0 100 250 500 1000
SCALE IN FEET

PRELIMINARY

Drawing: P:\213-0242\Site\Exhibits\213242_MOSR Pipe Rehab CIPP Plats.dwg; Plat 3155 – BCF.ctb
Plot by: dmagill Jul 11, 2014 – 4:43pm

APPENDIX G –BCF-PACP RATING SYSTEM

PACP© Condition Grading System

The Pipeline Assessment and Certification Program (PACP) developed by NASSCO provides a mechanism for creating reliable descriptions of pipe conditions. NASSCO has also developed a system based on the PACP codes to assign a condition rating to pipelines. Requirements of the grading system were as follows:

1. Like the PACP, the grading system should be direct and objective.
2. Provide the ability to qualitatively identify differences in pipe condition between one inspection and subsequent inspections, and to prioritize based on the significance of the defects different pipe segments.

Many other approaches to sewer pipe grading have been used in the United States as well as in other parts of the World. These approaches generally use some type of defect grading that is then used to calculate an overall pipe rating.

It is problematic to develop a single pipe segment rating that fully describes all of the important aspects of a pipe. Therefore the PACP Condition Grading System uses more than one method of rating pipe segment condition including a rating that considers the number of total defects within the pipe segment and a rating that considers the most severe defects within the pipe segment.

The PACP Condition Grading System only considers internal pipe conditions obtained from TV inspection. While other factors such as pipe material, depth, soils, and surface conditions also affect pipe survivability, those factors have not been included in the PACP Condition Grading System. The PACP Condition Grading System should be used only as a tool for screening pipe segment inspections, allowing the User to quickly determine which pipe segments have significant defects. It is expected that as the PACP further develops the PACP Condition Grading System will expand to include other factors.

The PACP Condition Grading System provides condition ratings for Structural Defects and Operation and Maintenance Defects.

Approach

Using the PACP Code Matrix, Each PACP defect code is assigned a condition grade of from 1 to 5. Grades are assigned based on the significance of the defect, extent of

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damage, percentage of flow capacity restriction, or the amount of wall loss due to deterioration.

The PACP Condition Grading System alone is inadequate for determining if a pipe segment should be rehabilitated or replaced. Many other factors in addition to the internal condition of the segment should be considered. The fact that a segment has significant Grade 4 or Grade 5 defects does not necessarily mean the pipe segment should be immediately rehabilitated. Recent experience by PACP Users has shown that pipe segments with serious defects such as hinge failures may remain largely unchanged for many decades if no deterioration factors such as surcharging, roots, or groundwater are present.

What is needed is improved estimates of remaining life or mean time before failure that are based on close monitoring of pipe segments over time. Once we know how much change occurs in pipe segments we can better understand the relationship between defects, deterioration factors, and pipe segment life expectancy. PACP continues to be an excellent tool for benchmarking pipe condition between one inspection and subsequent inspections of the same pipe.

Grades are assigned for two categories, Structural, and O&M defects.
Grades are as follows;
5 - Most significant defect grade
4 – Significant
3 – Moderate defect grade
2 – Minor to Moderate
1 –Minor defect grade

The PACP Condition Grading System results are entirely dependent on the quality of the PACP defect coding. Errors in the coding will directly result in errors in the Grading. All utilities, engineers, and contractors should make sure the data they are using was coded by experienced technicians who have successfully demonstrated their competence through a formal or informal apprenticeship program. PACP data from inexperienced technicians should be checked and corrected as needed. Errors found in coding should be corrected and the errors brought to the attention of the technician.

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Grading of Continuous Defects

The PACP continuous defect feature is used to denote where long portions of a sewer pipe are affected by the same defect, without the User having to repetitively enter point defects. However to develop a grade for the pipe segment, a mechanism is needed to translate a continuous defect into an equivalent number of point defects.

The equivalent number (quantity) of "uninterrupted" and "joint repeating" continuous defects is calculated by dividing the length of the continuous defect by 5. Example, a 6-meter long continuous defect, grade 3, should equate to four Grade 3 defects. Fractions are rounded to the nearest whole number.

Pipe Ratings

The pipe rating is based on the number of occurrences for each condition grade. Ratings are calculated separately for **Structural Defects** and **O&M Defects**. Several ways of expressing pipe segment condition are used by the PACP Condition Grading System as follows.

Segment Grade Scores - Each pipe segment will have a Segment Grade Score for each of the five grades. The number of occurrences of each pipe grade is multiplied by the pipe grade to calculate the segment grade score. Example, six Grade 5 defects would be 6 times 5 and equates to a Segment Grade 5 Score of 30. If a pipe segment had no defects of a particular grade, then the Segment Grade Score for that grade would be 0.

Overall Pipe Rating –The five Segment Grade Scores are added together to calculate the **Overall Pipe Rating. Structural Pipe Ratings** are calculated using only Structural Defect grades, while **O&M Pipe Ratings** are calculated using only O&M Defect grades.

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PACP Quick Rating – The PACP Quick Rating is a shorthand way of expressing the number of occurrences for the two highest severity grades. The PACP Quick Rating is a four character score as follows:

1. The first character is the highest severity grade occurring along the pipe length.
2. The second character is the total number of occurrences of the highest severity grade. If the total number exceeds 9, then alphabetic characters are used as follows- 10 to 14 – A; 15 to 19 – B; 20 to 24 – C; etc.
3. The third character is the next highest severity grade occurring along the pipe length.
4. The fourth character is the total number of the second highest severity grade occurrences, derived as in item 2 above.

For Example

4B27

This immediately shows that no grade 5 defects or grade 3 defects, however 15 to 19 grade 4 defects and seven grade 2 defects were found.

Another Example

3224

Two grade 3 defects and four grade 2 defects, however no grade 5 or grade 4 defects were found.

If a pipe segment only has defects of one grade, the first two characters are the grade and the quantity of defects, and the last two characters are 00 (denoting no other defect grades). A pipe segment with no defects would have a Quick Score of 0000 (all zeros).

The PACP Quick Rating provides the ability to summarize the number and severity of defects found within a pipe segment. As with the Pipe Rating, Quick Structural Ratings

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are calculated using only Structural Defect Grades, and Quick O&M Ratings are calculated using only O&M Defect Grades.

The Quick Rating is an excellent screening tool to determine which pipe segments require closer scrutiny. If a pipe has not defects greater than Grade 1 or 2, then the pipe segment probably does not need any further investigation.

Pipe Ratings Index – This is an indicator of the distribution of defect severity. The Pipe Ratings Index is calculated by dividing the Pipe Rating by the number of defects. For example, the Structural Pipe Ratings Index would be the Structural Pipe Rating divided by the number of structural defects. Pipe Ratings Indexes are calculated for Structural, O&M, and Overall. A pipe segment with a Pipe Rating of zero (0) would have a Pipe Rating Index of zero (0).

Summary

The following procedures are used to calculate pipe segment ratings using the PACP Condition Grading System:

1. Determine the number of occurrences for each condition grade within the pipe segment. Calculate separately for Structural Defect Grades and O&M Defect Grades.
2. Calculate the Segment Grade Score by multiplying the number of occurrences by the respective grade 1 through 5. Calculate the Structural Segment Grade Score and the O&M Segment Grade Score separately, and then add together for the Overall Segment Grade Score.
3. Calculate the Pipe Rating for the pipe segment by adding the Segment Grade Scores. Add all five Structural Segment Grade Scores for the Structural Pipe Rating, and add all five O&M Segment Grade Scores for the O&M Pipe Rating. Add all five Overall Segment Grade Scores for the Overall Pipe Rating.
4. Determine the PACP Quick Rating by calculating the number of occurrences of the two highest severity grades.

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5. Calculate the Pipe Ratings Index by dividing the Pipe Rating by the number of defects. If the pipe has no defects, the Pipe Ratings Index is zero.
6. Verify the PACP defect data used in accurate. The grading is a direct calculation from the defect data, and coding errors will be reflected in grading errors.

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Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
Structural	Crack (C)	Circumferential (C)		CC	1	
		Longitudinal (L)		CL	2	
		Multiple (M)		CM	3	
		Hinge (CH2)		CH2	4	
		Hinge (CH3)		CH3	5	
		Hinge (CH4)		CH4	5	
		Spiral (S)		CS	2	
Structural	Fracture (F)	Circumferential (C)		FC	2	
		Longitudinal (L)		FL	3	
		Multiple (M)		FM	4	
		Hinge (H2)		FH2	4	
		Hinge (H3)		FH3	5	
		Hinge (H4)		FH4	5	
		Spiral (S)		FS	3	
Structural	Pipe Failures (Silent)	Broken (B)		B	1 clock pos - 3, 2 clock pos - 4, >=3 clock pos - 5	
		Broken (B)	Soil Visible (SV)	BSV	5	
		Broken (B)	Void Visible (V V)	BVV	5	
		Hole (H)		H	1 clock pos - 3, 2 clock pos - 4, >= 3 clock pos - 5	
		Hole (H)	Soil Visible (SV)	HSV	5	
		Hole (H)	Void Visible (V V)	HVV	5	
Structural	Collapse (X)	Pipe (P)		XP	5	
		Brick (B)		XB	5	
Structural	Deformed (D)	(Pipe)		D	<=10% - 4,>10% - 5	
		(Brick)	Horizontally (H)	DH	5	
		(Brick)	Vertically (V)	DV	5	
Structural	Joint (J)	Offset (displaced) (O)	Med (M)	JOM	1	
			Large (L)	JOL	2	
		Separated (open) (S)	Med (M)	JSM	1	
			Large (L)	JSL	2	
		Angular (A)	Med (M)	JAM	1	
			Large (L)	JAL	2	
Structural	Surface Damage Chemical (S)	Roughness Increased (RI)	C	SRIC	1	
		Surface Spalling (SS)	C	SSSC	2	
		Aggregate Visible (AV)	C	SAVC	3	
		Aggregate Projecting (AP)	C	SAPC	3	
		Aggregate Missing (AM)	C	SAMC	4	

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NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
		Reinforcement Visible (RV)	C	SRVC	5	
		Reinforcement Projecting (RP)	C	SRPC	3	
		Reinforcement Corroded (RC)	C	SRCC	5	
		Missing Wall (MW)	C	SMWC	5	
		Other (Z)	C	SZC		
Structural	Surface Damage Mechanical (M)	Roughness Increased (RI)	M	SRIM	1	
		Surface Spalling (SS)	M	SSSM	2	
		Aggregate Visible (AV)	M	SAVM	3	
		Aggregate Projecting (AP)	M	SAPM	3	
		Aggregate Missing (AM)	M	SAMM	4	
		Reinforcement Visible (RV)	M	SRVM	5	
		Reinforcement Projecting (RP)	M	SRPM	3	
		Reinforcement Corroded (RC)	M	SRCM	5	
		Missing Wall (MW)	M	SMWM	5	
		Other (Z)	M	SZM	N/A	
Structural	Surface Damage Not Evident (Z)	Roughness Increased (RI)	Z	SRIZ	1	
		Surface Spalling (SS)	Z	SSSZ	2	
		Aggregate Visible (AV)	Z	SAVZ	3	
		Aggregate Projecting (AP)	Z	SAPZ	3	
		Aggregate Missing (AM)	Z	SAMZ	4	
		Reinforcement Visible (RV)	Z	SRVZ	5	
		Reinforcement Projecting (RP)	Z	SRPZ	3	
		Reinforcement Corroded (RC)	Z	SRCZ	5	
		Missing Wall (MW)	Z	SMWZ	5	
		Other (Z)	Z	SZZ	N/A	
Structural	Surface Damage (Metal Pipes)	Corrosion (CP)		SCP	3	
Structural	Lining Features (LF)	Detached (D)		LFD	3	
		Defective End (DE)		LFDE	3	
		Blistered (B)		LFB	3	
		Service Cut Shifted (CS)		LFCS	3	
		Abandoned Connection (AC)		LFAC		
		Overcut Service (OC)		LFOC	3	
		Undercut Service (UC)		LFUC	3	
		Buckled (BK)		LFBK	3	
		Annular Space (AS)		LFAS	3	
		Bulges (BU)		LFBU	3	
		Discoloration (DC)		LFDC	3	
		Delamination (DL)		LFDL	3	
		Pinholes (PH)		LFPH	3	
		Resin Slug (RS)		LFRS	3	
		Wrinkled (W)		LFW	3	
		Other (Z)		LFZ	N/A	
Structural	Weld Failure (WF)	Circumfrential (C)		WFC	2	
		Longitudinal (L)		WFL	2	

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NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
		Multiple (M)		WFM	3	
		Spiral (S)		WFS	2	
Structural	Point Repair (RP)	Localized Pipeliner (L)		RPL		
		Localized Pipeliner (L)	Defective (D)	RPLD	4	
		Patch Repair (P)		RPP		
		Patch Repair (P)	Defective (D)	RPPD	4	
		Pipe Replaced (R)		RPR		
		Pipe Replaced (R)	Defective (D)	RPRD	4	
		Other (Z)		RPZ		
		Other (Z)	Defective (D)	RPZD		
Structural	Brickwork (Silent)	Displaced (DB)		DB	3	
		Missing (MB)		MB	4	
		Dropped Invert (DI)		DI	5	
		Missing Mortar	Small	MMS	2	
			Medium	MMM	3	
			Large	MML	3	
O&M	Deposits (D)	Deposits Attached (DA)	Encrustation (E)	DAE		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Grease (G)	DAGS		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Ragging (R)	DAR		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Other (Z)	DAZ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Deposits Settled (DS)	Hard/Compacted (C)	DSC		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Fine silt/sand (F)	DSF		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Gravel (G)	DSGV		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Other (Z)	DSZ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Deposits Ingress (DN)	Fine silt/sand (F)	DNF		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Gravel (GV)	DNGV		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5

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NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
			Other (Z)	DNZ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
O&M	Roots (R)	Fine (F)	Barrel (B)	RFB		2
			Lateral (L)	RFL		1
			Connecfion (C)	RFC		1
	Roots (R) at a Joint		N/A	RFJ	in software with a J	1
		Tap (T)	Barrel (B)	RTB		3
			Lateral (L)	RTL		2
			Connecfion (C)	RTC		2
	Roots (R) at a Joint		N/A	RTJ		2
		Medium (M)	Barrel (B)	RMB		4
			Lateral (L)	RML		3
			Connecfion (C)	RMC		3
	Roots (R) at a Joint		N/A	RMJ		3
		Ball (B)	Barrel (B)	RBB		5
			Lateral (L)	RBL		4
			Connecfion (C)	RBC		4
	Roots (R) at a Joint		N/A	RBJ		4
O&M	Infiltration (I)	Weeper (W)		IW		2
		Dripper (D)		ID		3
		Runner (R)		IR		4
		Gusher (G)		IG		5
		Stain (S)		IS		
O&M	Obstacles/Obstructions (OB)	Brick or Masonry (B)		OBB		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Pipe Material in Invert (M)		OBM		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Object Intruding Thru Wall (I)		OBI		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Object Wedged in Joint (J)		OBJ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Object Thru Connection (C)		OBC		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		External Pipe or Cable In Sewer (P)		OBP		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Built Into Structure (S)		OBS		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5

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NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
		Construction Debris (N)		OBN		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Rocks (R)		OBR		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Other Objects (Z)		OBZ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
O&M	Vermin (V)	Rat (R)		VR		2
		Cockroach (C)		VC		1
		Other (Z)		VZ		1
O&M	Grout Test and Seal (G)	Grout Test Pass (GTP)				
			Joint (J)	GTPJ		
			Lateral (L)	GTPL		
		Grout Test Fail (GTF)				
			Joint (J)	GTFJ		
			Lateral (L)	GTFL		
		Grout Test Unable to Test (GTU)				
			Joint (J)	GTUJ		
			Lateral (L)	GTUL		
		Grout at a Location (not a joint) (GRT)		GRT		
Construction Features	Tap (T)	Factory Made (F)		TF		
			Capped (C)	TFC		
			Abandoned (B)	TFB		
			Defective (D)	TFD		2
			Intruding (I)	TFI		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Activity (A)	TFA		
		Break-In/Hammer (B)		TB		
			Capped (C)	TBC		2
			Abandoned (B)	TBB		
			Defective (D)	TBD		3
			Intruding (I)	TBI		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Activity (A)	TBA		
		Saddle (S)		TS		
			Capped (C)	TSC		
			Abandoned (B)	TSB		

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NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
			Defective (D)	TSD		2
			Intruding (I)	TSI		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Activity (A)	TSA		
		Rehabilitated (R)		TR		
			Defective (D)	TRD		2
			Intruding (I)	TRI		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
Construction Features	Intruding Seal Material (IS)			IS		
		Sealing Ring (SR)		ISSR		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Hanging (H)	ISSRH		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
			Broken (B)	ISSRB		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Loose, Poorly Fitting (SRL)		ISSRL		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Grout (GT)		ISGT		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
		Other (Z)		ISZ		<=10% - 2, <=20% - 3, <=30% - 4, >30% - 5
Construction Features	Line (L)	Left (L)		LL		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Left/Up (LU)		LLU		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Left/Down (LD)		LLD		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Right (R)		LR		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4

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NASSCO PACP Condition Grading System
Code Matrix

Family	Group	Descriptor	Modifier	Code	Structural Grade	O&M Grade
		Right/Up (RU)		LRU		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Right/Down (RD)		LRD		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Up (U)		LU		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
		Down (D)		LD		<=10 Deg - 1, <=20 Deg 2, >20 Deg - 4
Construction	Access Points (A)					
		Cleanout (CO)		ACO		
			Mainline (M)	ACOM		
			Property (P)	ACOP		
			House (H)	ACOH		
		Discharge Point (DP)		ADP		
		Junction Box (JB)		AJB		
		Meter (M)		AM		
		Manhole (MH)		AMH		
		Other Special Chamber (OC)		AOC		
		Tee Connection (TC)		ATC		
		WW Access Device (WA)		AWA		
		Wet Well (WW)		AWW		
		Catch Basin (CB)		ACB		
		End of Pipe (EP)		AEP		
Other	Miscellaneous (M)	Camera Underwater (CU)		MCU		4
		Dimension/Diam/Shape Change (SC)		MSC		
		General Observation (GO)		MGO		
		General Photograph (GP)		MGP		
		Material Change (MC)		MMC		
		Lining Change (LC)		MLC		
		Pipe Joint Length Change (JL)		MJL		
		Survey Abandoned (SA)		MSA		
		Water Level (WL)		MWL		
			Sag (S)	MWLS	<=30% - 2, <=50% - 3, >50% - 4	
		Water Mark (WM)		MWM		>=50% 4, >=75% 5
		Dye Test (Y)		MY		
			Visible (V)	MYV		5
			Not Visible (N)	MYN		3

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APPENDIX H – BCF-POINT REPAIRS

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

DRAFT

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
1	533 W AUDUBON	1054-02	1054-01	8	Polyvinyl Chloride	605	5	HVV
2	5622 W ATHENS AVE	1145-12	1145-09	8	Polyvinyl Chloride	247	4	D
3	7653 N ELLENDALE AVE	1145-43	1145-42	6	Polyvinyl Chloride	339	13	D
4	7653 N ELLENDALE AVE	1145-43	1145-42	6	Polyvinyl Chloride	339	13	D
5	7653 N ELLENDALE AVE	1145-43	1145-42	6	Polyvinyl Chloride	339	13	D
6	4897 W BLUFF AVE	1146-13	1146-12	8	Polyvinyl Chloride	194	4	D
7	2865 W DECATUR AVE	1150-25	1150-24	8	Asbestos Cement Pipe	141	9	H
8	2865 W DECATUR AVE	1150-25	1150-24	8	Asbestos Cement Pipe	141	9	H
9	2865 W DECATUR AVE	1150-25	1150-24	8	Asbestos Cement Pipe	141	9	H
10	7581 N MONTE AVE	1150-33	1150-25	8	Asbestos Cement Pipe	315	8	HSV
11	2483 W BLUFF AVE	1151-06	1151-07	8	Vitrified Clay Pipe	280	5	B
12	7341 N BOND ST	1258-23	1258-24	6	Vitrified Clay Pipe	374	5	B
13	6716 N DANTE AVE	1345-60	1345-61	6	Polyvinyl Chloride	153	8	D
14	6716 N DANTE AVE	1345-60	1345-61	6	Polyvinyl Chloride	153	8	D
15	6776 N VAN NESS BLVD	1350-03	1350-02	8	Vitrified Clay Pipe	272	5	BVV
16	570 E MAGILL AVE	1357-15	1357-16	8	Vitrified Clay Pipe	140	5	BVV
17	705 E PAUL AVE	1357-39	1357-44	8	Vitrified Clay Pipe	528	18	B
18	705 E PAUL AVE	1357-39	1357-44	8	Vitrified Clay Pipe	528	18	B
19	705 E PAUL AVE	1357-39	1357-44	8	Vitrified Clay Pipe	528	18	D
20	637 E PAUL VE	1357-42	1357-43	8	Vitrified Clay Pipe	282	13	B
21	637 E PAUL VE	1357-42	1357-43	8	Vitrified Clay Pipe	282	13	D
22	1155 E FREMONT AVE	1358-12	1358-13	8	Vitrified Clay Pipe	50	5	B
23	6510 N FOURTH ST	1358-21	1358-22	6	Vitrified Clay Pipe	337	5	B
24	6414 N FOURTH ST	1358-23	1358-22	6	Vitrified Clay Pipe	200	104	B
25	6414 N FOURTH ST	1358-23	1358-22	6	Vitrified Clay Pipe	200	104	H
26	1023 E WATHEN AVE	1358-30	1357-54	8	Vitrified Clay Pipe	400	5	BVV
27	1019 E LOS ALTOS AVE	1358-32	1357-56	8	Vitrified Clay Pipe	450	8	B
28	6410 N FLORA AVE	1358-37	1358-47	8	Vitrified Clay Pipe	405	16	B
29	6410 N FLORA AVE	1358-37	1358-47	8	Vitrified Clay Pipe	405	16	B
30	1674 E MAGILL AVE	1359-06	1359-08	8	Vitrified Clay Pipe	500	17	B
31	1580 E MAGILL AVE	1359-09	1359-11	8	Vitrified Clay Pipe	631	8	XP
32	1612 E PALO ALTO AVE	1359-17	1359-19	8	Vitrified Clay Pipe	289	5	B
33	1660 E PALO ALTO AVE	1359-22	1359-23	8	Vitrified Clay Pipe	142	5	B
34	1663 E LOS ALTOS AVE	1359-52	1359-72	8	Vitrified Clay Pipe	630	5	B
35	6057 N POLK AVE	1444-03	1444-02	8	Polyvinyl Chloride	156	5	B
36	5509 W STUART AVE	1444-08	1444-10	6	Polyvinyl Chloride	75	4	D
37	6399 N CLEO AVE	1445-13	1445-14	6	Polyvinyl Chloride	413	5	D

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
38	6178 N MITRE AVE	1446-02	1446-03	6	Polyvinyl Chloride	520	5	B
39	6068 N GENTRY AVE	1448-04	1448-02	8	Vitrified Clay Pipe	134	4	D
40	3645 W ATWATER AVE	1448-56	1448-90	6	Polyvinyl Chloride	400	5	H
41	122 E BULLARD AVE	1456-01	1456-02	6	Cast Iron	450	5	SRC
42	781 E STUART AVE	1457-64	1457-63	8	Vitrified Clay Pipe	450	10	B
43	781 E STUART AVE	1457-64	1457-63	8	Vitrified Clay Pipe	450	10	BVV
44	1411 E ESCALON AVE	1458-24	1458-36	12	Vitrified Clay Pipe	663	5	BVV
45	6307 N EIGHTH ST	1459-04	1459-05	6	Vitrified Clay Pipe	142	10	B
46	6307 N EIGHTH ST	1459-04	1459-05	6	Vitrified Clay Pipe	142	10	B
47	1449 E SAMPLE AVE	1459-10	1459-11	6	Vitrified Clay Pipe	475	5	B
48	4433 W BULLARD AVE	1547-25	1546-13	12	Polyvinyl Chloride	604	5	BSV
49	5610 N ARTHUR AVE	1553-16	1553-17	8	Vitrified Clay Pipe	318	5	BSV
50	5424 N PALM AVE	1553-21	1553-01	8	Vitrified Clay Pipe	489	5	BVV
51	590 W ROBINWOOD LN	1554-31	1554-11	6	Vitrified Clay Pipe	368	5	B
52	5680 N MAROA AVE	1554-44	1554-21	10	Vitrified Clay Pipe	656	15	B
53	5680 N MAROA AVE	1554-44	1554-21	10	Vitrified Clay Pipe	656	15	B
54	5680 N MAROA AVE	1554-44	1554-21	10	Vitrified Clay Pipe	656	15	BSV
55	5422 N BLACKSTONE AVE	1555-28	1555-01	10	Vitrified Clay Pipe	610	5	B
56	50 W BULLARD AVE	1555-41	1555-42	12	Vitrified Clay Pipe	327	5	BVV
57	715 E ROBINWOOD LN	1557-12	1557-13	6	Vitrified Clay Pipe	469	23	B
58	715 E ROBINWOOD LN	1557-12	1557-13	6	Vitrified Clay Pipe	469	23	B
59	715 E ROBINWOOD LN	1557-12	1557-13	6	Vitrified Clay Pipe	469	23	B
60	715 E ROBINWOOD LN	1557-12	1557-13	6	Vitrified Clay Pipe	469	23	B
61	19 E WRENWOOD LN	1557-18	1557-17	6	Vitrified Clay Pipe	469	12	B
62	5563 N FIRST ST	1557-19	1557-20	6	Vitrified Clay Pipe	469	11	B
63	653 E DOVEWOOD LN	1557-20	1557-21	8	Vitrified Clay Pipe	469	5	B
64	5521 N CALLISCH ST	1557-21	1557-16	8	Vitrified Clay Pipe	260	5	H
65	739 E BROWING AVE	1557-31	1557-30	6	Vitrified Clay Pipe	376	10	B
66	739 E BROWING AVE	1557-31	1557-30	6	Vitrified Clay Pipe	376	10	B
67	713 E ROBERTS AVE	1557-33	1557-35	8	Vitrified Clay Pipe	269	10	BVV
68	713 E ROBERTS AVE	1557-33	1557-35	8	Vitrified Clay Pipe	269	10	BVV
69	677 E ROBERTS AVE	1557-36	1557-29	10	Vitrified Clay Pipe	260	5	B
70	585 E ROBERTS AVE	1557-43	1557-38	8	Vitrified Clay Pipe	490	5	B
71	5671 N AUGUSTA ST	1557-57	1557-56	6	Vitrified Clay Pipe	260	5	BSV
72	1236 E BARSTOW AVE	1558-12	1558-13	6	Vitrified Clay Pipe	443	8	B
73	1295 E LOFTUS LN	1558-20	1558-19	8	Vitrified Clay Pipe	210	5	B
74	1255 E ALMENDRA DR	1558-27	1558-28	8	Vitrified Clay Pipe	316	15	BVV

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
75	5543 N BOND ST	1558-29	1558-30	12	Vitrified Clay Pipe	135	8	BVV
76	5411 N BOND ST	1558-31	1558-06	12	Vitrified Clay Pipe	500	8	B
77	5581 N BOND ST	1558-32	1558-29	12	Vitrified Clay Pipe	130	5	B
78	1267 E BULLARD AVE	1558-36	1558-37	6	Vitrified Clay Pipe	511	27	B
79	1267 E BULLARD AVE	1558-36	1558-37	6	Vitrified Clay Pipe	511	27	B
80	1267 E BULLARD AVE	1558-36	1558-37	6	Vitrified Clay Pipe	511	27	B
81	1267 E BULLARD AVE	1558-36	1558-37	6	Vitrified Clay Pipe	511	27	B
82	5616 N FOURTH ST	1558-39	1558-38	8	Vitrified Clay Pipe	165	9	BVV
83	5627 N BOND ST	1558-60	1558-34	8	Vitrified Clay Pipe	528	55	B
84	5627 N BOND ST	1558-60	1558-34	8	Vitrified Clay Pipe	528	55	CH3
85	5627 N BOND ST	1558-60	1558-34	8	Vitrified Clay Pipe	528	55	FH3
86	5420 N NINTH ST	1559-03	1559-44	10	Vitrified Clay Pipe	150	8	B
87	5494 N NINTH ST	1559-14	1559-04	10	Vitrified Clay Pipe	683	5	H
88	1535 E ALMENDRA DR	1559-15	1559-16	6	Vitrified Clay Pipe	590	5	B
89	1568 E LOFTUS LN	1559-16	1559-14	10	Vitrified Clay Pipe	590	15	B
90	1568 E LOFTUS LN	1559-16	1559-14	10	Vitrified Clay Pipe	590	15	B
91	1568 E LOFTUS LN	1559-16	1559-14	10	Vitrified Clay Pipe	590	15	B
92	6537 N TENTH ST	1559-23	1559-22	8	Vitrified Clay Pipe	387	103	CH3
93	5645 N TENTH ST	1559-24	1559-23	8	Vitrified Clay Pipe	687	135	B
94	5645 N TENTH ST	1559-24	1559-23	8	Vitrified Clay Pipe	687	135	B
95	5645 N TENTH ST	1559-24	1559-23	8	Vitrified Clay Pipe	687	135	CH3
96	5106 W SHAW AVE	1645-26	1645-28	6	Cast Iron	185	165	SRC
97	5106 W SHAW AVE	1645-26	1645-28	6	Cast Iron	185	165	SRC
98	5106 W SHAW AVE	1645-26	1645-28	6	Cast Iron	185	165	SRC
99	5123 W MISSION AVE	1645-28	1645-29	6	Cast Iron	212	165	SRC
100	5123 W MISSION AVE	1645-28	1645-29	6	Cast Iron	212	165	SRC
101	1529 W SAN MADELE AVE	1652-05	1652-06	8	Vitrified Clay Pipe	657	8	B
102	1621 W SAN BRUNO AVE	1652-16	1652-17	8	Vitrified Clay Pipe	319	5	B
103	W SAN MADELE AVE	1653-08	1653-09	8	Vitrified Clay Pipe	490	5	B
104	594 W SAN JOSE AVE	1654-14	1654-48	8	Vitrified Clay Pipe	312	5	BSV
105	5212 N MAROA AVE	1654-17	1655-16	12	Vitrified Clay Pipe	659	5	B
106	594 W SAN JOSE AVE	1654-48	1654-15	8	Vitrified Clay Pipe	207	5	B
107	5365 N SAN PABLO AVE	1655-33	1655-53	8	Vitrified Clay Pipe	327	5	B
108	5262 N BLACKSTONE AVE	1655-51	1655-41	6	Vitrified Clay Pipe	470	13	B
109	5262 N BLACKSTONE AVE	1655-51	1655-41	6	Vitrified Clay Pipe	470	13	BSV
110	5321 N FRESNO ST	1656-09	1556-03	10	Vitrified Clay Pipe	656	5	BSV
111	50 E SHAW AVE	1656-16	1656-17	8	Vitrified Clay Pipe	493	29	HVV

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
112	1255 E BARSTOW AVE	1658-15	1658-14	8	Vitrified Clay Pipe	494	20	BSV
113	1257 E BRUNO AVE	1658-18	1658-22	8	Vitrified Clay Pipe	280	17	B
114	1365 E BULLDOG LN	1658-29	1658-30	8	Vitrified Clay Pipe	705	32	B
115	5240 N SIXTH ST	1659-03	1659-04	8	Vitrified Clay Pipe	332	5	B
116	4915 N DALE AVE	1745-21	1745-23	8	Cast Iron	484	5	SRC
117	4915 N DALE AVE	1745-21	1745-23	8	Cast Iron	484	5	SRC
118	4915 N CRYSTAL AVE	1751-28	1751-29	8	Cast Iron	195	0	SRC
119	4707 N WARREN AVE	1751-43	1751-46	10	Vitrified Clay Pipe	190	5	B
120	4717 N WARREN AVE	1751-45	1751-46	8	Vitrified Clay Pipe	52	8	BSV
121	1221 W GETTYSBURG AVE	1752-26	1751-50	8	Vitrified Clay Pipe	623	14	BSV
122	4660 N DELNO AVE	1752-52	1752-54	6	Vitrified Clay Pipe	241	5	B
123	235 SANTA ANA AVE	1753-06	1753-07	8	Vitrified Clay Pipe	658	5	B
124	4710 N SAFFORD AVE	1753-35	1753-36	8	Vitrified Clay Pipe	654	8	B
125	4919 N MAROA AVE	1754-42	1754-43	8	Vitrified Clay Pipe	578	3	H
126	4589 N GLENN AVE	1755-28	1755-27	12	Vitrified Clay Pipe	655	5	BSV
127	4911 N GLENN AVE	1755-38	SN17550001	8	Vitrified Clay Pipe	368	10	B
128	4911 N GLENN AVE	1755-38	SN17550001	8	Vitrified Clay Pipe	368	10	B
129	4911 N GLENN AVE	1755-38	1755-43	8	Vitrified Clay Pipe	518	13	BSV
130	4911 N GLENN AVE	1755-38	1755-43	8	Vitrified Clay Pipe	518	13	CH4
131	4748 N SAN PABLO AVE	1755-56	1755-57	6	Cast Iron	398	380	SRC
132	4748 N SAN PABLO AVE	1755-56	1755-57	6	Cast Iron	398	380	SRC
133	2004 E PORTOLA AVE	1756-10	1756-08	6	Vitrified Clay Pipe	516	25	B
134	2004 E PORTOLA AVE	1756-10	1756-08	6	Vitrified Clay Pipe	516	25	BSV
135	4609 N CLARK ST	1756-11	1756-04	6	Vitrified Clay Pipe	327	9	B
136	4710 N VALERIA ST	1756-19	1756-18	8	Vitrified Clay Pipe	3297	5	BSV
137	2044 E ACACIA AVE	1756-38	1756-70	6	Vitrified Clay Pipe	220	10	B
138	2044 E ACACIA AVE	1756-38	1756-70	6	Vitrified Clay Pipe	220	10	B
139	4947 N THESTA ST	1756-46	1756-45	6	Vitrified Clay Pipe	525	116	B
140	4947 N THESTA ST	1756-46	1756-45	6	Vitrified Clay Pipe	525	116	BVV
141	4944 N DIANA ST	1756-54	1756-63	6	Vitrified Clay Pipe	490	21	B
142	4944 N DIANA ST	1756-54	1756-63	6	Vitrified Clay Pipe	490	21	B
143	4865 N DIANA ST	1756-56	1756-57	6	Vitrified Clay Pipe	232	14	B
144	4863 N DOON WAY	1756-58	1756-59	6	Vitrified Clay Pipe	105	5	BSV
145	4863 N DOON WAY	1756-58	1756-33	6	Vitrified Clay Pipe	480	17	B
146	1914 E SANTA ANA AVE	1756-60	1756-35	8	Vitrified Clay Pipe	500	96	B
147	1914 E SANTA ANA AVE	1756-60	1756-35	8	Vitrified Clay Pipe	500	96	B
148	1914 E SANTA ANA AVE	1756-60	1756-35	8	Vitrified Clay Pipe	500	96	BSV

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
149	4946 N EFFIE ST	1756-61	1756-60	8	Vitrified Clay Pipe	464	156	B
150	4946 N EFFIE ST	1756-61	1756-60	8	Vitrified Clay Pipe	464	156	B
151	4605 N MILLBROOK AVE	1758-04	1758-01	18	Reinforced Concrete Pipe	67	5	HSV
152	3602 E RIALTO AVE	1758-43	1758-44	6	Vitrified Clay Pipe	459	11	B
153	4715 N FIFTH ST	1758-44	1758-42	6	Vitrified Clay Pipe	450	5	B
154	4847 N SIXTH ST	1758-48	1758-46	8	Vitrified Clay Pipe	385	8	B
155	3305 E SIERRA MADRE AVE	1758-61	1758-60	8	Vitrified Clay Pipe	659	16	B
156	1110 E SHAW AVE	1758-67	1758-68	8	Cast Iron	393	5	SRC
157	1110 E SHAW AVE	1758-67	1758-68	8	Cast Iron	393	5	SRC
158	3889 E RIALTO AVE	1759-27	1759-28	8	Vitrified Clay Pipe	280	5	B
159	3633 E FAIRMONT AVE	1759-41	1759-42	6	Vitrified Clay Pipe	130	8	B
160	3542 E FAIRMONT AVE	1759-42	1758-53	8	Vitrified Clay Pipe	489	27	B
161	4450 E SANTA ANNA AVE	1760-32	1760-59	15	Vitrified Clay Pipe	655	5	B
162	2720 TULARE ST	2656-62	2657-35	6	Vitrified Clay Pipe	521	23	B
163	2720 TULARE ST	2656-62	2657-35	6	Vitrified Clay Pipe	521	23	B
164	2720 TULARE ST	2656-62	2657-35	6	Vitrified Clay Pipe	521	23	H
165	2720 TULARE ST	2656-62	2657-35	6	Vitrified Clay Pipe	521	23	H
166	4790 W ASHLAN AVE	1846-06	1846-07	12	Polyvinyl Chloride	660	5	HSV
167	4475 W ILA AVE	1851-57	1851-58	6	Vitrified Clay Pipe	83	3	H
168	1019 W SWIFT AVE	1852-11	1852-12	6	Vitrified Clay Pipe	360	5	B
169	4410 N TEILMAN AVE	1852-40	1852-28	6	Vitrified Clay Pipe	655	5	B
170	4546 N WEST AVE	1852-51	1851-67	6	Vitrified Clay Pipe	561	5	B
171	1046 W INDIANAPOLIS AVE	1852-52	1852-35	6	Vitrified Clay Pipe	498	5	HSV
172	131 W HOLLAND AVE	1853-11	1853-10	6	Vitrified Clay Pipe	480	5	B
173	12 E SWIFT AVE	1853-22	1853-18	6	Vitrified Clay Pipe	453	5	B
174	HOLLAND & PALM INTERSECTION	1853-29	1853-28	6	Vitrified Clay Pipe	510	5	BVV
175	530 E HOLLAND AVE	1854-11	1854-12	8	Vitrified Clay Pipe	666	5	B
176	4285 N BLACKSTONE AVE	1855-32	1855-31	8	Vitrified Clay Pipe	597	5	H
177	2033 E ASHCROFT AVE	1856-04	1856-06	6	Cast Iron	233	200	SRC
178	2033 E ASHCROFT AVE	1856-04	1856-06	6	Cast Iron	233	200	SRC
179	4429 N FRESNO ST	1856-40	1856-42	6	Vitrified Clay Pipe	341	5	B
180	2432 E RICHERT AVE	1856-45	1856-44	6	Vitrified Clay Pipe	527	28	B
181	470 N FRESNO ST	1857-11	1856-36	6	Vitrified Clay Pipe	364	29	B
182	470 N FRESNO ST	1857-11	1856-36	6	Vitrified Clay Pipe	364	29	CH4
183	4455 N AUGUSTA ST	1857-17	1857-26	6	Vitrified Clay Pipe	400	79	B
184	4455 N AUGUSTA ST	1857-17	1857-26	6	Vitrified Clay Pipe	400	79	B
185	3823 E DONNER AVE	1859-05	1859-04	6	Vitrified Clay Pipe	450	96	H

BCF-2 POINT REPAIRS
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HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
186	3823 E DONNER AVE	1859-05	1859-04	6	Vitrified Clay Pipe	450	96	HSV
187	3823 E DONNER AVE	1859-05	1859-04	6	Vitrified Clay Pipe	450	96	HSV
188	3823 E DONNER AVE	1859-05	1859-04	6	Vitrified Clay Pipe	450	96	HVV
189	3823 E DONNER AVE	1859-05	1859-04	6	Vitrified Clay Pipe	450	96	HVV
190	4410 N MERIDIAN AVE	1860-43	1860-51	8	Vitrified Clay Pipe	221	5	BSV
191	4133 W SAGINAW WAY	1947-04	1947-05	6	Polyvinyl Chloride	470	11	D
192	3884 N MANOR AVE	1951-49	1951-51	6	Vitrified Clay Pipe	500	43	B
193	3884 N MANOR AVE	1951-49	1951-51	6	Vitrified Clay Pipe	500	43	B
194	3884 N MANOR AVE	1951-49	1951-51	6	Vitrified Clay Pipe	500	43	B
195	3884 N MANOR AVE	1951-49	1951-51	6	Vitrified Clay Pipe	500	43	B
196	3884 N MANOR AVE	1951-49	1951-51	6	Vitrified Clay Pipe	500	43	B
197	934 W PONTIAC WAY	1952-11	1952-09	6	Vitrified Clay Pipe	633	17	H
198	934 W PONTIAC WAY	1952-11	1952-09	6	Vitrified Clay Pipe	633	17	H
199	934 W PONTIAC WAY	1952-11	1952-09	6	Vitrified Clay Pipe	633	17	H
200	934 W PONTIAC WAY	1952-11	1952-09	6	Vitrified Clay Pipe	633	17	H
201	934 W PONTIAC WAY	1952-11	1952-09	6	Vitrified Clay Pipe	633	17	HSV
202	36 E GRIFFITH WAY	1953-18	1953-17	8	Vitrified Clay Pipe	486	5	B
203	3862 N WILSON AVE	1954-50	1954-54	8	Vitrified Clay Pipe	330	15	B
204	3862 N WILSON AVE	1954-50	1954-54	8	Vitrified Clay Pipe	330	15	BVV
205	3862 N WILSON AVE	1954-50	1954-54	8	Vitrified Clay Pipe	330	15	BVV
206	3927 N BLACKSTONE AVE	1955-31	1955-38	8	Cast Iron	662	0	SRC
207	2516 E HAMPTON WAY	1956-41	1956-08	6	Vitrified Clay Pipe	119	5	B
208	1837 E SAGINAW WAY	1956-43	1956-42	6	Vitrified Clay Pipe	599	51	B
209	1837 E SAGINAW WAY	1956-43	1956-42	6	Vitrified Clay Pipe	599	51	B
210	1837 E SAGINAW WAY	1956-43	1956-42	6	Vitrified Clay Pipe	599	51	B
211	1837 E SAGINAW WAY	1956-43	1956-42	6	Vitrified Clay Pipe	599	51	BSV
212	3902 N MARIPOSA ST	1957-54	1957-66	8	Vitrified Clay Pipe	433	41	B
213	3822 N MARIPOSA ST	1957-66	2057-05	8	Vitrified Clay Pipe	440	16	B
214	4530 E ASHLAN AVE	1960-03	1960-02	15	Polyvinyl Chloride	640	5	B
215	3445 CLOVIS AVE	1966-61	1966-29	6	Vitrified Clay Pipe	250	5	HVV
216	3845 N SHIRLEY AVE	1967-04	1967-05	8	Vitrified Clay Pipe	281	10	B
217	3845 N SHIRLEY AVE	1967-04	1967-05	8	Vitrified Clay Pipe	281	10	BSV
218	5936 E LANSING WAY	1967-12	1967-13	8	Vitrified Clay Pipe	192	5	BSV
219	5971 E PONTIAC WAY	1967-43	1967-44	8	Vitrified Clay Pipe	151	5	B
220	4245 W. ANDREWS AVE	2047-40	2047-41	6	Polyvinyl Chloride	405	10	D
221	4245 W ANDREWS AVE	2047-40	2047-41	6	Polyvinyl Chloride	405	10	D
222	2244 W SHIELDS AVE	2050-38	2050-30	6	Vitrified Clay Pipe	260	5	B

BCF-2 POINT REPAIRS
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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
223	3216 N WEST AVE	2052-01	2051-15	6	Vitrified Clay Pipe	682	5	XP
224	536 W SHIELDS AVE	2052-05	2052-06	8	Vitrified Clay Pipe	643	16	BSV
225	536 W SHIELDS AVE	2052-05	2052-06	8	Vitrified Clay Pipe	643	16	BSV
226	54 E DAKOTA AVE	2053-04	2053-03	8	Concrete Pipe	654	12	BVV
227	3758 N PALM AVE	2053-05	2053-04	6	Vitrified Clay Pipe	598	53	B
228	3758 N PALM AVE	2053-05	2053-04	6	Vitrified Clay Pipe	598	53	B
229	3758 N PALM AVE	2053-05	2053-04	6	Vitrified Clay Pipe	598	53	B
230	3758 N PALM AVE	2053-05	2053-04	6	Vitrified Clay Pipe	598	53	BSV
231	3717 N PALM AVE	2053-06	2053-28	6	Vitrified Clay Pipe	628	77	H
232	3621 N PALM AVE	2053-10	2053-36	8	Concrete Pipe	627	11	B
233	307 E FOUNTAIN	2053-15	2054-13	6	Vitrified Clay Pipe	612	134	B
234	307 E FOUNTAIN	2053-15	2054-13	6	Vitrified Clay Pipe	612	134	B
235	307 E FOUNTAIN	2053-15	2054-13	6	Vitrified Clay Pipe	612	134	B
236	307 E FOUNTAIN	2053-15	2054-13	6	Vitrified Clay Pipe	612	134	H
237	307 E FOUNTAIN	2053-15	2054-13	6	Vitrified Clay Pipe	612	134	H
238	307 E FOUNTAIN	2053-15	2054-13	6	Vitrified Clay Pipe	612	134	H
239	307 E FOUNTAIN	2053-15	2054-13	6	Vitrified Clay Pipe	612	134	H
240	3219 N PALM AVE	2053-17	2053-51	6	Vitrified Clay Pipe	602	31	B
241	350 W SHIELDS AVE	2053-22	2053-23	6	Vitrified Clay Pipe	232	23	B
242	350 W SHIELDS AVE	2053-22	2053-23	6	Vitrified Clay Pipe	232	23	B
243	95 E GARLAND AVE	2053-28	2053-26	6	Vitrified Clay Pipe	675	34	H
244	93 E FEDORA AVE	2053-30	2053-31	6	Vitrified Clay Pipe	655	31	B
245	93 E FEDORA AVE	2053-30	2053-31	6	Vitrified Clay Pipe	655	31	BVV
246	305 W DAYTON AVE	2053-37	2053-38	8	Concrete Pipe	621	16	H
247	305 W DAYTON AVE	2053-37	2053-38	8	Concrete Pipe	621	16	H
248	43 E CORTLAND AVE	2053-41	2053-40	6	Vitrified Clay Pipe	655	51	B
249	135 E ANDREWS AVE	2053-45	2053-46	6	Vitrified Clay Pipe	454	22	H
250	3797 N EFFIE ST	2056-01	2056-58	6	Vitrified Clay Pipe	715	43	B
251	3797 N EFFIE ST	2056-01	2056-58	6	Vitrified Clay Pipe	715	43	B
252	3797 N EFFIE ST	2056-01	2056-58	6	Vitrified Clay Pipe	715	43	BVV
253	3605 N EFFIE ST	2056-47	2056-45	8	Vitrified Clay Pipe	90	8	XP
254	2704 E DAKOTA AVE	2057-04	2057-02	6	Vitrified Clay Pipe	598	20	XP
255	3686 N AGUSTA ST	2057-39	2057-38	6	Vitrified Clay Pipe	281	17	B
256	2840 E GARLAND	2057-44	2057-43	6	Vitrified Clay Pipe	496	8	B
257	3554 N MARIPOSA ST	2057-46	2057-47	6	Vitrified Clay Pipe	265	27	H
258	3334 N MARIPOSA ST	2057-48	2057-49	6	Vitrified Clay Pipe	437	24	B
259	3320 N ANGUS ST	2057-51	2057-50	6	Vitrified Clay Pipe	356	36	B

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
260	3536 N ANGUS ST	2057-52	2057-51	6	Vitrified Clay Pipe	561	53	B
261	2818 E FEDORA AVE	2057-55	2057-54	6	Vitrified Clay Pipe	148	15	B
262	2818 E FEDORA AVE	2057-55	2057-54	6	Vitrified Clay Pipe	148	15	B
263	2818 E FEDORA AVE	2057-55	2057-54	6	Vitrified Clay Pipe	148	15	B
264	2904 E FEDORA AVE	2057-56	2057-55	6	Vitrified Clay Pipe	353	8	B
265	3267 N ORCHARD ST	2057-58	2057-60	6	Vitrified Clay Pipe	383	17	B
266	3553 N ORCHARD ST	2057-60	2057-61	6	Vitrified Clay Pipe	455	41	B
267	3553 N ORCHARD ST	2057-60	2057-61	6	Vitrified Clay Pipe	455	41	B
268	3407 N ORCHARD ST	2057-61	2057-62	6	Vitrified Clay Pipe	443	45	B
269	3403 N ORCHARD ST	2057-62	2057-63	6	Vitrified Clay Pipe	329	33	B
270	3662 N ANGUS ST	2057-70	2057-55	6	Vitrified Clay Pipe	286	10	B
271	3662 N ANGUS ST	2057-70	2057-55	6	Vitrified Clay Pipe	286	10	B
272	3443 N MILLBROOK AVE	2058-16	2058-15	6	Vitrified Clay Pipe	308	11	B
273	3452 N THIRD ST	2058-26	2058-29	6	Vitrified Clay Pipe	357	5	B
274	3201 E SHIELDS AVE	2058-31	2058-23	8	Vitrified Clay Pipe	481	12	B
275	3614 N VIRGINIA AVE	2058-34	2058-35	6	Vitrified Clay Pipe	378	8	B
276	3427 E CORTLAND AVE	2058-43	2058-44	6	Vitrified Clay Pipe	552	5	BSV
277	3445 N BOND ST	2058-45	2058-44	6	Vitrified Clay Pipe	275	22	B
278	3445 N BOND ST	2058-45	2058-44	6	Vitrified Clay Pipe	275	22	B
279	3445 N BOND ST	2058-45	2058-44	6	Vitrified Clay Pipe	275	22	B
280	3442 N FOURTH ST	2058-51	2058-52	6	Vitrified Clay Pipe	292	11	B
281	3446 N FIFTH ST	2058-52	2058-54	6	Vitrified Clay Pipe	292	13	B
282	3446 N FIFTH ST	2058-52	2058-54	6	Vitrified Clay Pipe	292	13	B
283	3111 N SIXTH ST	2058-54	2058-15	6	Vitrified Clay Pipe	275	5	B
284	3442 E DAYTON AVE	2058-56	2058-57	6	Vitrified Clay Pipe	558	26	H
285	3524 E DAYTON AVE	2058-57	2058-14	6	Vitrified Clay Pipe	492	13	B
286	3524 E DAYTON AVE	2058-57	2058-14	6	Vitrified Clay Pipe	492	13	B
287	3542 E REDLANDS AVE	2058-59	2058-12	6	Vitrified Clay Pipe	492	18	B
288	3542 E REDLANDS AVE	2058-59	2058-12	6	Vitrified Clay Pipe	492	18	BVV
289	5348 E AIRWAYS BLVD	2064-05	2064-06	8	Polyvinyl Chloride	660	5	H
290	5884 E RAMONA WAY	2067-16	2067-64	8	Cast Iron	307	0	SRC
291	5849 E ANDREWS AVE	2067-44	2067-45	6	Vitrified Clay Pipe	473	5	H
292	2625 N ELLENDALE AVE	2145-05	2145-03	8	Polyvinyl Chloride	205	5	XP
293	2850 N CRYSTAL AVE	2151-16	2151-17	8	Vitrified Clay Pipe	663	70	B
294	1538 W MICHIGAN AVE	2151-34	2151-33	6	Vitrified Clay Pipe	575	49	B
295	3110 N HARRISON AVE	2153-02	2153-14	8	Vitrified Clay Pipe	656	57	B
296	2743 N FARRIS AVE	2153-44	2153-29	6	Vitrified Clay Pipe	600	20	B

BCF-2 POINT REPAIRS
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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
297	2743 N FARRIS AVE	2153-44	2153-29	6	Vitrified Clay Pipe	600	20	H
298	2731 N HARRISON AVE	2153-46	2153-30	6	Vitrified Clay Pipe	646	5	B
299	305 E CLINTON AVE	2153-57	2154-83	6	Vitrified Clay Pipe	617	19	B
300	305 E CLINTON AVE	2153-57	2154-83	6	Vitrified Clay Pipe	617	19	D
301	304 E BROWN AVE	2153-62	2154-59	6	Vitrified Clay Pipe	635	11	BSV
302	3117 N WILSON AVE	2154-02	2154-03	6	Vitrified Clay Pipe	484	18	B
303	628 E SIMPSON AVE	2154-08	2154-17	6	Vitrified Clay Pipe	90	5	B
304	1036 E SIMPSON AVE	2154-104	2155-01	8	Vitrified Clay Pipe	638	56	B
305	1036 E SIMPSON AVE	2154-104	2155-01	8	Vitrified Clay Pipe	638	56	B
306	529 E TERRACE AVE	2154-107	2154-71	6	Vitrified Clay Pipe	661	46	BSV
307	2426 N VAN NESS BLVD	2154-108	2154-83	6	Vitrified Clay Pipe	663	14	BVV
308	629 E CORNELL AVE	2154-18	2154-24	6	Vitrified Clay Pipe	165	11	B
309	505 E BROWN AVE	2154-44	2154-59	10	Vitrified Clay Pipe	326	20	B
310	505 E BROWN AVE	2154-44	2154-59	10	Vitrified Clay Pipe	326	20	BSV
311	527 E BROWN AVE	2154-46	2154-44	6	Vitrified Clay Pipe	479	9	B
312	527 E BROWN AVE	2154-46	2154-44	6	Vitrified Clay Pipe	479	9	B
313	2640 N VAN NESS AVE	2154-50	2154-48	6	Vitrified Clay Pipe	177	5	B
314	625 E HARVARD AVE	2154-63	2154-62	6	Vitrified Clay Pipe	121	5	HSV
315	2611 N WISHON AVE	2154-64	2154-65	6	Vitrified Clay Pipe	121	19	BSV
316	2611 N WISHON AVE	2154-64	2154-65	6	Vitrified Clay Pipe	121	19	HVV
317	2611 N WISHON AVE	2154-64	2154-65	6	Vitrified Clay Pipe	121	19	XP
318	2644 N MAROA AVE	2154-69	2154-90	8	Vitrified Clay Pipe	166	16	B
319	745 E TERRACE AVE	2154-75	2154-73	6	Vitrified Clay Pipe	678	5	B
320	2426 N VAN NESS BLVD	2154-85	2154-108	6	Vitrified Clay Pipe	193	15	HSV
321	1044 E CORNELL AVE	2154-94	2155-14	8	Vitrified Clay Pipe	682	72	B
322	1044 E CORNELL AVE	2154-94	2155-14	8	Vitrified Clay Pipe	682	72	H
323	1044 E CORNELL AVE	2154-94	2155-14	8	Vitrified Clay Pipe	682	72	H
324	1323 E SIMPSON AVE	2155-04	2155-03	6	Vitrified Clay Pipe	661	76	BVV
325	1323 E SIMPSON AVE	2155-04	2155-03	6	Vitrified Clay Pipe	661	76	H
326	1545 E SIMPSON AVE	2155-05	2155-04	6	Vitrified Clay Pipe	489	79	B
327	1545 E SIMPSON AVE	2155-05	2155-04	6	Vitrified Clay Pipe	489	79	B
328	1405 E CORNELL AVE	2155-10	2155-09	6	Vitrified Clay Pipe	661	54	H
329	1405 E CORNELL AVE	2155-10	2155-09	6	Vitrified Clay Pipe	661	54	H
330	3006 N GLENN AVE	2155-11	2155-10	6	Vitrified Clay Pipe	488	33	B
331	3006 N GLENN AVE	2155-11	2155-10	6	Vitrified Clay Pipe	488	33	BSV
332	1624 E SIMPSON AVE	2155-12	2155-11	6	Vitrified Clay Pipe	125	12	BSV
333	3003 N BLACKSTONE AVE	2155-13	2155-11	6	Vitrified Clay Pipe	125	9	B

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
334	1243 E MICHIGAN AVE	2155-16	2155-15	8	Vitrified Clay Pipe	661	47	B
335	1337 E PRINCTON AVE	2155-24	2155-23	6	Vitrified Clay Pipe	661	44	B
336	2809 N BLACKSTONE AVE	2155-25	2155-24	8	Vitrified Clay Pipe	488	45	B
337	1620 N MICHIGAN AVE	2155-26	2155-25	6	Vitrified Clay Pipe	125	24	B
338	1145 E TERRACE AVE	2155-45	2155-46	6	Concrete Pipe	661	7	H
339	910 E TERRACE AVE	2155-50	2154-92	6	Vitrified Clay Pipe	588	16	BVV
340	3004 N MARIPOSA ST	2157-06	2157-05	8	Vitrified Clay Pipe	284	33	BVV
341	2514 N ANGUS ST	2157-42	2157-43	6	Concrete Pipe	638	170	H
342	2415 N FIRST ST	2157-47	2157-46	6	Concrete Pipe	617	20	H
343	3426 E SIMPSON AVE	2158-03	2158-04	6	Vitrified Clay Pipe	690	21	B
344	3426 E SIMPSON AVE	2158-03	2158-04	6	Vitrified Clay Pipe	690	21	B
345	3426 E SIMPSON AVE	2158-03	2158-04	6	Vitrified Clay Pipe	690	21	B
346	2836 N BOND AVE	2158-11	2158-10	6	Vitrified Clay Pipe	217	5	B
347	3401 E HARVARD AVE	2158-31	2158-38	8	Vitrified Clay Pipe	280	11	BVV
348	3012 N SEVENTH ST	2159-16	2159-01	6	Vitrified Clay Pipe	541	40	B
349	3012 N SEVENTH ST	2159-16	2159-01	6	Vitrified Clay Pipe	541	40	BVV
350	2030 N WEST AVE	2252-43	2251-25	6	Vitrified Clay Pipe	668	218	BVV
351	438 W WELDON AVE	2253-41	2253-51	8	Vitrified Clay Pipe	647	18	B
352	1749 N ARTHUR AVE	2253-81	2253-78	6	Vitrified Clay Pipe	632	78	B
353	1749 N ARTHUR AVE	2253-81	2253-78	6	Vitrified Clay Pipe	632	78	B
354	622 E CLINTON AVE	2254-06	2254-05	6	Vitrified Clay Pipe	441	12	BSV
355	740 E CLINTON AVE	2254-07	2254-06	6	Vitrified Clay Pipe	400	15	HVV
356	2325 N MAROA AVE	2254-08	2254-11	6	Vitrified Clay Pipe	409	24	HSV
357	2325 N MAROA AVE	2254-08	2254-11	6	Vitrified Clay Pipe	409	24	HVV
358	2325 N MAROA AVE	2254-08	2254-11	6	Vitrified Clay Pipe	409	24	HVV
359	904 E YALE AVE	2254-13	2254-23	8	Vitrified Clay Pipe	320	14	B
360	805 E YALE AVE	2254-14	2254-13	6	Vitrified Clay Pipe	455	36	B
361	805 E YALE AVE	2254-14	2254-13	6	Vitrified Clay Pipe	455	36	B
362	805 E YALE AVE	2254-14	2254-13	6	Vitrified Clay Pipe	455	36	B
363	2220 N VAN NESS BLVD	2254-15	2254-14	6	Vitrified Clay Pipe	815	35	B
364	2220 N VAN NESS BLVD	2254-15	2254-14	6	Vitrified Clay Pipe	815	35	B
365	2220 N VAN NESS BLVD	2254-15	2254-14	6	Vitrified Clay Pipe	815	35	B
366	2220 N VAN NESS BLVD	2254-15	2254-14	6	Vitrified Clay Pipe	815	35	HVV
367	2124 N VAN NESS BLVD	2254-21	2254-22	6	Vitrified Clay Pipe	838	40	B
368	901 E WELDON AVE	2254-26	2255-01	8	Vitrified Clay Pipe	158	11	BSV
369	850 E CAMBRIDGE AVE	2254-27	2254-25	6	Vitrified Clay Pipe	434	5	B
370	2019 N WILSON AVE	2254-33	2254-34	6	Vitrified Clay Pipe	165	12	H

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
371	2019 N WILSON AVE	2254-33	2254-34	6	Vitrified Clay Pipe	165	12	H
372	1922 N ECHO AVE	2254-38	2254-39	6	Vitrified Clay Pipe	859	24	B
373	N WISHON AVE	2254-42	2254-41	6	Vitrified Clay Pipe	454	5	H
374	1808 N WISHON AVE	2254-42	2254-41	6	Vitrified Clay Pipe	454	5	HVV
375	1814 N ECHO AVE	2254-44	2254-42	6	Vitrified Clay Pipe	851	33	B
376	1814 N ECHO AVE	2254-44	2254-42	6	Vitrified Clay Pipe	851	33	B
377	1814 N ECHO AVE	2254-44	2254-42	6	Vitrified Clay Pipe	851	33	HSV
378	1138 E VASSAR AVE	2255-21	2255-22	6	Vitrified Clay Pipe	344	9	D
379	1138 E YALE AVE	2255-25	2255-23	6	Vitrified Clay Pipe	465	5	BVV
380	1522 E YALE AVE	2255-28	2255-27	6	Concrete Pipe	364	215	B
381	1610 E YALE AVE	2255-29	2255-28	6	Concrete Pipe	417	320	HVV
382	2104 N COLLEGE AVE	2255-41	2255-59	6	Vitrified Clay Pipe	333	20	B
383	2104 N COLLEGE AVE	2255-41	2255-59	6	Vitrified Clay Pipe	333	20	B
384	2104 N COLLEGE AVE	2255-41	2255-59	6	Vitrified Clay Pipe	333	20	B
385	2104 N COLLEGE AVE	2255-41	2255-59	6	Vitrified Clay Pipe	333	20	B
386	2929 E NORMAL AVE	2257-27	2257-28	8	Cast Iron	395	5	SRC
387	4556 E UNIVERSITY AVE	2260-09	2260-25	6	Cast Iron	350	10	BSV
388	4556 E UNIVERSITY AVE	2260-09	2260-25	6	Cast Iron	350	10	BVV
389	4556 E UNIVERSITY AVE	2260-09	2260-25	6	Cast Iron	350	10	SRC
390	4207 E WELDON	2260-38	2259-32	8	Vitrified Clay Pipe	296	10	H
391	4207 E WELDON	2260-38	2259-32	8	Vitrified Clay Pipe	296	10	H
392	537 W HAMMOND AVE	2352-09	2352-08	6	Vitrified Clay Pipe	617	104	B
393	537 W HAMMOND AVE	2352-09	2352-08	6	Vitrified Clay Pipe	617	104	B
394	734 W HAMMOND AVE	2352-14	2352-71	8	Polyvinyl Chloride	266	19	B
395	734 W HAMMOND AVE	2352-14	2352-71	8	Polyvinyl Chloride	266	19	H
396	1225 N VAGEDES AVE	2352-17	2352-07	6	Vitrified Clay Pipe	460	9	HSV
397	1315 N FRUIT AVE	2352-20	2352-19	6	Vitrified Clay Pipe	667	58	B
398	1315 N FRUIT AVE	2352-20	2352-19	6	Vitrified Clay Pipe	667	58	BVV
399	1315 N FRUIT AVE	2352-20	2352-19	6	Vitrified Clay Pipe	667	58	D
400	1315 N FRUIT AVE	2352-20	2352-19	6	Vitrified Clay Pipe	667	58	D
401	43 W OLIVE AVE	2353-05	2353-04	8	Vitrified Clay Pipe	331	8	B
402	1228 N VAGEDES AVE	2353-09	2353-07	6	Vitrified Clay Pipe	120	5	BSV
403	1224 N FARRIS AVE	2353-23	2353-22	6	Vitrified Clay Pipe	137	15	BVV
404	1208 N HARRISON AVE	2353-26	2353-24	6	Vitrified Clay Pipe	230	5	B
405	244 E HEDGES AVE	2353-30	2353-28	14	Vitrified Clay Pipe	506	20	HSV
406	1284 N SAFFORD AVE	2353-31	2353-30	6	Vitrified Clay Pipe	331	8	BVV
407	1219 N SAFFORD AVE	2353-32	2353-02	6	Vitrified Clay Pipe	615	36	H

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
408	1295 N HARRISON AVE	2353-36	2353-34	6	Vitrified Clay Pipe	174	5	H
409	222 W OLIVE AVE	2353-41	2353-15	6	Vitrified Clay Pipe	501	32	B
410	222 W OLIVE AVE	2353-41	2353-15	6	Vitrified Clay Pipe	501	32	B
411	222 W OLIVE AVE	2353-41	2353-15	6	Vitrified Clay Pipe	501	32	B
412	222 W OLIVE AVE	2353-41	2353-15	6	Vitrified Clay Pipe	501	32	D
413	316 W OLIVE AVE	2353-42	2353-12	6	Vitrified Clay Pipe	460	8	B
414	144 E HOME AVE	2353-61	2353-49	6	Vitrified Clay Pipe	641	9	HVV
415	1407 N FARRIS AVE	2353-65	2353-52	6	Vitrified Clay Pipe	570	44	H
416	1407 N THORNE AVE	2353-67	2353-46	6	Vitrified Clay Pipe	704	28	B
417	1407 N THORNE AVE	2353-67	2353-46	6	Vitrified Clay Pipe	704	28	B
418	1405 N ARTHUR AVE	2353-69	2353-44	6	Vitrified Clay Pipe	704	65	B
419	1405 N VAGEDES AVE	2353-70	2353-43	6	Vitrified Clay Pipe	570	5	HVV
420	1507 N ARTHUR AVE	2353-73	2353-69	6	Vitrified Clay Pipe	604	70	B
421	1532 N SAFFORD AVE	2353-76	2353-60	6	Vitrified Clay Pipe	621	8	B
422	405 E OLIVE AVE	2354-11	2354-91	6	Vitrified Clay Pipe	115	13	B
423	405 E OLIVE AVE	2354-11	2354-91	6	Vitrified Clay Pipe	115	13	XP
424	1218 N FERGER AVE	2354-12	2354-10	6	Vitrified Clay Pipe	662	144	H
425	437 E OLIVE AVE	2354-14	2354-07	6	Vitrified Clay Pipe	395	14	BSV
426	645 E OLIVE AVE	2354-16	2354-04	6	Vitrified Clay Pipe	405	22	B
427	645 E OLIVE AVE	2354-16	2354-04	6	Vitrified Clay Pipe	405	22	B
428	858 E HEDGES AVE	2354-21	2354-96	12	Vitrified Clay Pipe	215	8	B
429	1320 N WISHON AVE	2354-22	2354-21	6	Vitrified Clay Pipe	360	31	B
430	1320 N WISHON AVE	2354-22	2354-21	6	Vitrified Clay Pipe	360	31	H
431	733 E FERN AVE	2354-23	2354-18	6	Vitrified Clay Pipe	414	26	H
432	1320 N ECHO AVE	2354-26	2354-15	6	Vitrified Clay Pipe	355	20	H
433	1319 N FERGER AVE	2354-29	2354-12	6	Vitrified Clay Pipe	150	14	BSV
434	1350 N ECHO AVE	2354-33	2354-26	6	Vitrified Clay Pipe	490	29	B
435	645 W HEDGES AVE	2354-35	2354-25	6	Vitrified Clay Pipe	475	23	BSV
436	1360 N LINDEN AVE	2354-36	2354-39	6	Vitrified Clay Pipe	390	33	B
437	1360 N LINDEN AVE	2354-36	2354-39	6	Vitrified Clay Pipe	390	33	H
438	1360 N LINDEN AVE	2354-36	2354-39	6	Vitrified Clay Pipe	390	33	H
439	1394 N LINDEN AVE	2354-37	2354-38	6	Vitrified Clay Pipe	150	16	B
440	1394 N LINDEN AVE	2354-37	2354-38	6	Vitrified Clay Pipe	150	16	B
441	1394 N LINDEN AVE	2354-38	2354-24	8	Vitrified Clay Pipe	509	15	B
442	748 E PINE AVE	2354-46	2354-47	6	Vitrified Clay Pipe	329	8	BSV
443	1460 N WILSON AVE	2354-53	2354-31	6	Vitrified Clay Pipe	400	17	B
444	655 E PINE AVE	2354-58	2354-60	6	Vitrified Clay Pipe	414	40	B

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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
445	655 E PINE AVE	2354-58	2354-60	6	Vitrified Clay Pipe	414	40	H
446	655 E PINE AVE	2354-58	2354-60	6	Vitrified Clay Pipe	414	40	H
447	655 E PINE AVE	2354-58	2354-60	6	Vitrified Clay Pipe	414	40	H
448	655 E PINE AVE	2354-58	2354-60	6	Vitrified Clay Pipe	414	40	H
449	655 E PINE AVE	2354-58	2354-60	6	Vitrified Clay Pipe	414	40	H
450	701 E PINE AVE	2354-59	2354-60	8	Vitrified Clay Pipe	20	8	BSV
451	742 E CARMEN AVE	2354-71	2354-70	6	Vitrified Clay Pipe	120	9	H
452	742 E CARMEN AVE	2354-72	2354-71	6	Vitrified Clay Pipe	40	15	H
453	1460 N WILSON AVE	2354-76	2354-52	6	Vitrified Clay Pipe	415	11	BSV
454	1550 N WILSON AVE	2354-79	2354-76	6	Vitrified Clay Pipe	415	51	H
455	1549 N ECHO AVE	2354-81	2354-92	6	Vitrified Clay Pipe	864	57	B
456	1549 N ECHO AVE	2354-81	2354-92	6	Vitrified Clay Pipe	864	57	B
457	1549 N ECHO AVE	2354-81	2354-92	6	Vitrified Clay Pipe	864	57	B
458	1549 N ECHO AVE	2354-81	2354-92	6	Vitrified Clay Pipe	864	57	H
459	641 E CARMEN AVE	2354-82	2354-84	6	Vitrified Clay Pipe	489	8	HVV
460	708 E CARMEN AVE	2354-84	2354-73	8	Vitrified Clay Pipe	300	13	B
461	708 E CARMEN AVE	2354-84	2354-73	8	Vitrified Clay Pipe	300	13	BSV
462	743 E CARMEN AVE	2354-85	2354-84	6	Vitrified Clay Pipe	328	5	H
463	855 E CARMEN AVE	2354-86	2354-88	6	Vitrified Clay Pipe	403	8	BVV
464	822 E CARMEN AVE	2354-90	2354-89	6	Vitrified Clay Pipe	378	24	B
465	405 E OLIVE AVE	2354-91	2354-09	6	Vitrified Clay Pipe	30	17	B
466	405 E OLIVE AVE	2354-91	2354-09	6	Vitrified Clay Pipe	30	17	XP
467	1002 E OLIVE AVE	2355-15	2354-01	12	Vitrified Clay Pipe	338	38	B
468	1229 N BLACKSTONE AVE	2355-24	2355-25	8	Cast Iron	166	5	SRC
469	1229 N BLACKSTONE AVE	2355-24	2355-25	8	Cast Iron	166	5	SRC
470	1649 E OLIVE AVE	2355-25	2355-01	8	Cast Iron	186	35	SRC
471	1649 E OLIVE AVE	2355-25	2355-01	8	Cast Iron	186	35	SRC
472	1302 N DEL MAR AVE	2355-67	2355-88	6	Vitrified Clay Pipe	479	62	B
473	1302 N DEL MAR AVE	2355-67	2355-88	6	Vitrified Clay Pipe	479	62	B
474	1302 N DEL MAR AVE	2355-67	2355-88	6	Vitrified Clay Pipe	479	62	B
475	1305 E OLIVE AVE	2355-88	2355-08	6	Vitrified Clay Pipe	471	155	B
476	1305 E OLIVE AVE	2355-88	2355-08	6	Vitrified Clay Pipe	471	155	B
477	1305 E OLIVE AVE	2355-88	2355-08	6	Vitrified Clay Pipe	471	155	HVV
478	1295 N THESTA ST	2356-20	2356-24	6	Vitrified Clay Pipe	570	9	B
479	3237 E PINE AVE	2358-62	2358-39	6	Vitrified Clay Pipe	199	9	BVV
480	1501 N CHESTNUT AVE	2361-29	2362-76	8	Cast Iron	635	510	SRC
481	1501 N CHESTNUT AVE	2361-29	2362-76	8	Cast Iron	635	510	SRC

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
482	4734 E CARMEN AVE	2361-33	2361-32	8	Vitrified Clay Pipe	427	8	B
483	5096 E CARMEN AVE	2363-76	2363-77	8	Vitrified Clay Pipe	440	28	BSV
484	1444 W WHITE AVE	2451-23	2451-24	8	Vitrified Clay Pipe	220	10	HSV
485	1444 W WHITE AVE	2451-23	2451-24	8	Vitrified Clay Pipe	220	10	HSV
486	1005 N VAGEDES AVE	2452-16	2452-17	6	Vitrified Clay Pipe	505	50	B
487	1005 N VAGEDES AVE	2452-16	2452-17	6	Vitrified Clay Pipe	505	50	BVV
488	915 N VAGEDES AVE	2452-17	2453-56	6	Vitrified Clay Pipe	551	44	B
489	915 N VAGEDES AVE	2452-17	2453-56	6	Vitrified Clay Pipe	551	44	H
490	915 N VAGEDES AVE	2452-17	2453-56	6	Vitrified Clay Pipe	551	44	H
491	1105 N ARTHUR AVE	2453-01	2453-02	6	Vitrified Clay Pipe	505	53	B
492	1105 N ARTHUR AVE	2453-01	2453-02	6	Vitrified Clay Pipe	505	53	BVV
493	1105 N ARTHUR AVE	2453-01	2453-02	6	Vitrified Clay Pipe	505	53	BVV
494	1105 N ARTHUR AVE	2453-01	2453-02	6	Vitrified Clay Pipe	505	53	BVV
495	715 N WEBER AVE	2453-03	2453-04	6	Vitrified Clay Pipe	514	86	B
496	715 N WEBER AVE	2453-03	2453-04	6	Vitrified Clay Pipe	514	86	B
497	715 N WEBER AVE	2453-03	2453-04	6	Vitrified Clay Pipe	514	86	B
498	715 N WEBER AVE	2453-03	2453-04	6	Vitrified Clay Pipe	514	86	HVV
499	905 N ADOLINE AVE	2453-08	2453-07	6	Vitrified Clay Pipe	455	10	B
500	905 N ADOLINE AVE	2453-08	2453-07	6	Vitrified Clay Pipe	455	10	BVV
501	217 E THOMAS AVE	2453-43	2453-44	6	Vitrified Clay Pipe	585	48	BSV
502	217 E THOMAS AVE	2453-43	2453-44	6	Vitrified Clay Pipe	585	48	BVV
503	217 E THOMAS AVE	2453-43	2453-44	6	Vitrified Clay Pipe	585	48	BVV
504	517 N FARRIS AVE	2453-49	2453-50	6	Vitrified Clay Pipe	466	19	H
505	1003 N ECHO AVE	2454-11	2454-12	6	Vitrified Clay Pipe	320	28	B
506	1030 N FULTON	2455-02	2455-03	6	Cast Iron	474	0	SRC
507	733 N COLLEGE AVE	2455-09	2455-08	8	Vitrified Clay Pipe	437	52	B
508	733 N COLLEGE AVE	2455-09	2455-08	8	Vitrified Clay Pipe	437	52	H
509	545 PARK AVE	2455-20	2555-82	6	Cast Iron	732	32	H
510	545 PARK AVE	2455-20	2555-82	6	Cast Iron	732	32	H
511	545 PARK AVE	2455-20	2555-82	6	Cast Iron	732	32	H
512	545 PARK AVE	2455-20	2555-82	6	Cast Iron	732	32	H
513	545 PARK AVE	2455-20	2555-82	6	Cast Iron	732	32	H
514	545 PARK AVE	2455-20	2555-82	6	Cast Iron	732	32	H
515	914 N GLENN AVE	2455-53	2455-45	8	Vitrified Clay Pipe	336	23	B
516	1506 E LA SALLE AVE	2455-61	2455-53	8	Vitrified Clay Pipe	329	14	B
517	733 N COLLEGE	2455-89	2455-09	6	Vitrified Clay Pipe	156	5	HSV
518	2011 E TYLER AVE	2456-60	2456-59	6	Vitrified Clay Pipe	476	37	B

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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
519	2011 E TYLER AVE	2456-60	2456-59	6	Vitrified Clay Pipe	476	37	BSV
520	1004 N FRESNO ST	2456-65	2456-56	10	Concrete Pipe	92	15	B
521	1721 E HARVEY AVE	2456-70	2456-26	6	Vitrified Clay Pipe	210	13	BVV
522	1721 E HARVEY AVE	2456-70	2456-26	6	Vitrified Clay Pipe	210	13	HSV
523	2558 E LEWIS AVE	2457-02	2456-55	12	Concrete Pipe	449	290	B
524	2558 E LEWIS AVE	2457-02	2456-55	12	Concrete Pipe	449	290	B
525	3027 E WHITE AVE	2457-25	2457-19	6	Vitrified Clay Pipe	272	5	H
526	1100 N FRESNO ST	2457-35	2457-01	6	Vitrified Clay Pipe	409	62	BSV
527	1100 N FRESNO ST	2457-35	2457-01	6	Vitrified Clay Pipe	409	62	BSV
528	1011 N AUGUSTA ST	2457-36	2456-65	6	Vitrified Clay Pipe	409	55	B
529	1011 N AUGUSTA ST	2457-36	2456-65	6	Vitrified Clay Pipe	409	55	BSV
530	1011 N AUGUSTA ST	2457-36	2456-65	6	Vitrified Clay Pipe	409	55	BSV
531	918 N FRESNO ST	2457-38	2456-53	6	Vitrified Clay Pipe	409	13	B
532	3099 E BELMONT AVE	2457-48	2457-23	6	Vitrified Clay Pipe	618	5	BSV
533	3236 E HARVEY AVE	2458-52	2458-54	6	Vitrified Clay Pipe	425	24	BVV
534	3236 E HARVEY AVE	2458-52	2458-54	6	Vitrified Clay Pipe	425	24	H
535	3209 E THOMAS AVE	2458-54	2458-60	8	Vitrified Clay Pipe	180	21	B
536	3167 E BELMONT AVE	2458-56	2458-54	8	Vitrified Clay Pipe	730	66	B
537	3167 E BELMONT AVE	2458-56	2458-54	8	Vitrified Clay Pipe	730	66	BSV
538	3167 E BELMONT AVE	2458-56	2458-54	8	Vitrified Clay Pipe	730	66	BVV
539	3167 E BELMONT AVE	2458-56	2458-54	8	Vitrified Clay Pipe	730	66	BVV
540	667 N SECOND ST	2458-60	2458-59	8	Vitrified Clay Pipe	150	32	BVV
541	3123 E BELMONT AVE	2458-65	2458-59	6	Vitrified Clay Pipe	730	41	B
542	3117 E THOMAS AVE	2458-76	2458-59	6	Vitrified Clay Pipe	425	27	BVV
543	3778 E WHITE AVE	2459-60	2459-61	8	Vitrified Clay Pipe	400	5	B
544	4345 E WHITE AVE	2460-25	2460-27	8	Vitrified Clay Pipe	330	5	B
545	1144 W FRANKLIN AVE	2552-05	2552-04	8	Vitrified Clay Pipe	308	16	BSV
546	1144 W FRANKLIN AVE	2552-05	2552-04	8	Vitrified Clay Pipe	308	16	BSV
547	620 E BELMONT AVE	2554-25	2554-05	6	Vitrified Clay Pipe	626	13	B
548	512 E FRANKLIN AVE	2554-36	2554-27	8	Vitrified Clay Pipe	406	16	B
549	512 E FRANKLIN AVE	2554-36	2554-27	8	Vitrified Clay Pipe	406	16	B
550	202 N H ST	2554-41	2554-40	6	Vitrified Clay Pipe	24	13	B
551	202 N H ST	2554-41	2554-40	6	Vitrified Clay Pipe	24	13	BSV
552	279 N ECHO AVE	2554-43	2554-92	6	Vitrified Clay Pipe	140	20	H
553	164 N ROOSEVELT AVE	2554-45	2554-46	6	Vitrified Clay Pipe	211	8	B
554	108 N H ST	2554-49	2554-47	6	Polyvinyl Chloride	233	34	B
555	108 N H ST	2554-49	2554-47	6	Polyvinyl Chloride	233	34	BSV

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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
556	108 N H ST	2554-49	2554-47	6	Polyvinyl Chloride	233	34	HSV
557	730 E FRANKLIN AVE	2554-53	2554-55	6	Vitrified Clay Pipe	223	31	B
558	730 E FRANKLIN AVE	2554-53	2554-55	6	Vitrified Clay Pipe	223	31	B
559	730 E FRANKLIN AVE	2554-53	2554-55	6	Vitrified Clay Pipe	223	31	BSV
560	730 E FRANKLIN AVE	2554-53	2554-55	6	Vitrified Clay Pipe	223	31	BVV
561	2121 H ST	2554-74	2554-73	10	Vitrified Clay Pipe	315	17	B
562	2121 H ST	2554-74	2554-73	10	Vitrified Clay Pipe	315	17	B
563	607 E DIVISADERO ST	2554-78	2554-75	6	Vitrified Clay Pipe	340	46	BSV
564	607 E DIVISADERO ST	2554-78	2554-75	6	Vitrified Clay Pipe	340	46	BVV
565	742 E VOORMAN AVE	2554-79	2554-78	6	Vitrified Clay Pipe	405	59	B
566	742 E VOORMAN AVE	2554-79	2554-78	6	Vitrified Clay Pipe	405	59	B
567	742 E VOORMAN AVE	2554-79	2554-78	6	Vitrified Clay Pipe	405	59	BVV
568	607 E DIVISADERO ST	2554-88	2554-75	12	Vitrified Clay Pipe	178	9	BSV
569	205 N H ST	2554-90	2553-49	8	Vitrified Clay Pipe	671	18	BSV
570	1330 E BELMONT AVE	2555-11	2555-28	6	Vitrified Clay Pipe	635	5	B
571	1224 E FRANKLIN AVE	2555-21	2555-26	8	Cast Iron	750	0	SRC
572	252 N POPLAR AVE	2555-37	2555-48	6	Vitrified Clay Pipe	435	29	H
573	158 N POPLAR AVE	2555-48	2555-54	6	Vitrified Clay Pipe	490	12	H
574	214 N SAN PABLO	2555-57	2555-56	6	Vitrified Clay Pipe	435	19	B
575	214 N SAN PABLO	2555-57	2555-56	6	Vitrified Clay Pipe	435	19	B
576	214 N SAN PABLO	2555-57	2555-56	6	Vitrified Clay Pipe	435	19	BVV
577	1537 E VOORMAN AVE	2555-66	2555-59	6	Vitrified Clay Pipe	180	14	B
578	16 N SAN PABLO AVE	2555-70	2555-67	8	Vitrified Clay Pipe	424	18	B
579	297 N BLACKSTONE AVE	2556-01	2555-40	15	Vitrified Clay Pipe	375	5	B
580	215 N EFFIE ST	2556-11	2556-09	8	Vitrified Clay Pipe	630	8	B
581	385 N CLARK ST	2556-19	2556-20	8	Vitrified Clay Pipe	653	8	XP
582	275 N DIANA ST	2556-20	2556-15	15	Vitrified Clay Pipe	330	10	B
583	2329 E GRANT AVE	2556-45	2556-46	6	Vitrified Clay Pipe	266	41	B
584	2329 E GRANT AVE	2556-45	2556-46	6	Vitrified Clay Pipe	266	41	BSV
585	2329 E GRANT AVE	2556-45	2556-46	6	Vitrified Clay Pipe	266	41	BSV
586	2329 E GRANT AVE	2556-45	2556-46	6	Vitrified Clay Pipe	266	41	HSV
587	2329 E GRANT AVE	2556-45	2556-46	6	Vitrified Clay Pipe	266	41	HSV
588	451 N HOWARD ST	2556-46	2556-47	6	Vitrified Clay Pipe	156	30	BVV
589	384 N THESTA ST	2556-99	2556-44	8	Vitrified Clay Pipe	630	15	B
590	384 N THESTA ST	2556-99	2556-44	8	Vitrified Clay Pipe	630	15	B
591	384 N THESTA ST	2556-99	2556-44	8	Vitrified Clay Pipe	630	15	B
592	2734 N MCKENZIE AVE	2557-16	2557-15	10	Vitrified Clay Pipe	331	5	B

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CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
593	270 N MARIPOSA ST	2557-20	2557-15	8	Vitrified Clay Pipe	320	19	B
594	270 N MARIPOSA ST	2557-20	2557-15	8	Vitrified Clay Pipe	320	19	BSV
595	2988 E BELMONT AVE	2557-26	2557-27	6	Vitrified Clay Pipe	273	33	B
596	2988 E BELMONT AVE	2557-26	2557-27	6	Vitrified Clay Pipe	273	33	B
597	2988 E BELMONT AVE	2557-26	2557-27	6	Vitrified Clay Pipe	273	33	H
598	450 N ORCHARD ST	2557-30	2557-31	8	Vitrified Clay Pipe	330	5	B
599	3017 E MADISON AVE	2557-33	2557-30	6	Vitrified Clay Pipe	615	26	B
600	3017 E MADISON AVE	2557-33	2557-30	6	Vitrified Clay Pipe	615	26	B
601	3017 E MADISON AVE	2557-33	2557-30	6	Vitrified Clay Pipe	615	26	B
602	3017 E MADISON AVE	2557-33	2557-30	6	Vitrified Clay Pipe	615	26	H
603	3037 E GRANT AVE	2557-34	2557-31	6	Vitrified Clay Pipe	614	40	B
604	3037 E GRANT AVE	2557-34	2557-31	6	Vitrified Clay Pipe	614	40	B
605	3037 E GRANT AVE	2557-34	2557-31	6	Vitrified Clay Pipe	614	40	B
606	3037 E GRANT AVE	2557-34	2557-31	6	Vitrified Clay Pipe	614	40	B
607	3037 E GRANT AVE	2557-34	2557-31	6	Vitrified Clay Pipe	614	40	BSV
608	221 N ORCHARD ST	2557-49	2557-50	6	Vitrified Clay Pipe	302	13	B
609	221 N ORCHARD ST	2557-49	2557-50	6	Vitrified Clay Pipe	302	13	B
610	137 N ORCHARD ST	2557-52	2557-51	6	Vitrified Clay Pipe	368	43	H
611	137 N ORCHARD ST	2557-52	2557-51	6	Vitrified Clay Pipe	368	43	H
612	137 N ORCHARD ST	2557-52	2557-51	6	Vitrified Clay Pipe	368	43	H
613	137 N ORCHARD ST	2557-52	2557-51	6	Vitrified Clay Pipe	368	43	H
614	137 N ORCHARD ST	2557-52	2557-51	6	Vitrified Clay Pipe	368	43	H
615	137 N ORCHARD ST	2557-52	2557-51	6	Vitrified Clay Pipe	368	43	H
616	137 N ORCHARD ST	2557-52	2557-51	6	Vitrified Clay Pipe	368	43	H
617	137 N ORCHARD ST	2557-52	2557-51	6	Vitrified Clay Pipe	368	43	H
618	3402 E MADISON AVE	2558-10	2558-16	8	Vitrified Clay Pipe	329	5	H
619	364 N FIFTH ST	2558-24	2558-23	6	Vitrified Clay Pipe	441	87	BSV
620	364 N FIFTH ST	2558-24	2558-23	6	Vitrified Clay Pipe	441	87	BVV
621	364 N FIFTH ST	2558-24	2558-23	6	Vitrified Clay Pipe	441	87	H
622	364 N FIFTH ST	2558-24	2558-23	6	Vitrified Clay Pipe	441	87	H
623	310 N SECOND ST	2558-26	2558-27	6	Vitrified Clay Pipe	479	5	HSV
624	258 N FIRST ST	2558-31	2558-32	6	Vitrified Clay Pipe	417	18	H
625	258 N FIRST ST	2558-31	2558-32	6	Vitrified Clay Pipe	417	18	HSV
626	258 N FIRST ST	2558-31	2558-32	6	Vitrified Clay Pipe	417	18	HSV
627	258 N FIRST ST	2558-31	2558-32	6	Vitrified Clay Pipe	417	18	HSV
628	3666 E NEVADA AVE	2559-14	2559-18	8	Vitrified Clay Pipe	330	20	B
629	3666 E NEVADA AVE	2559-14	2559-18	8	Vitrified Clay Pipe	330	20	BVV

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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
630	5965 E SHIELDS AVE	2559-15	2559-16	6	Vitrified Clay Pipe	590	8	B
631	3746 E BELMONT AVE	2559-52	2559-54	30	Concrete Pipe	322	152	SRV
632	3746 E BELMONT AVE	2559-52	2559-54	30	Concrete Pipe	322	152	SRV
633	3770 E BELMONT AVE	2559-54	2559-90	30	Concrete Pipe	127	184	SRV
634	3770 E BELMONT AVE	2559-54	2559-90	30	Concrete Pipe	127	184	SRV
635	3770 E BELMONT AVE	2559-54	2559-90	30	Concrete Pipe	127	184	SRV
636	4128 E BELMONT AVE	2559-62	2559-64	8	Vitrified Clay Pipe	560	52	B
637	4128 E BELMONT AVE	2559-62	2559-64	8	Vitrified Clay Pipe	560	52	HVV
638	411 N NINTH ST	2559-67	2559-05	6	Vitrified Clay Pipe	491	20	BSV
639	160 N ELEVENTH ST	2559-85	2559-86	12	Vitrified Clay Pipe	664	21	B
640	4321 E ILLINOIS AVE	2560-39	2560-40	6	Vitrified Clay Pipe	497	90	B
641	4321 E ILLINOIS AVE	2560-39	2560-40	6	Vitrified Clay Pipe	497	90	B
642	4321 E ILLINOIS AVE	2560-39	2560-40	6	Vitrified Clay Pipe	497	90	B
643	4321 E ILLINOIS AVE	2560-39	2560-40	6	Vitrified Clay Pipe	497	90	B
644	370 N MAPLE AVE	2561-25	2560-17	6	Vitrified Clay Pipe	660	13	H
645	370 N MAPLE AVE	2561-25	2560-17	6	Vitrified Clay Pipe	660	13	HSV
646	370 N MAPLE AVE	2561-25	2560-17	6	Vitrified Clay Pipe	660	13	HVV
647	530 S TRINITY ST	2653-111	2653-87	6	Vitrified Clay Pipe	91	14	B
648	530 S TRINITY ST	2653-111	2653-87	6	Vitrified Clay Pipe	91	14	H
649	624 S PLUMAS ST	2653-73	2653-90	6	Vitrified Clay Pipe	391	52	B
650	624 S PLUMAS ST	2653-73	2653-90	6	Vitrified Clay Pipe	391	52	BSV
651	127 E ONEIL AVE	2653-94	2653-95	6	Vitrified Clay Pipe	110	5	BSV
652	127 E ONEIL AVE	2653-95	2653-74	6	Vitrified Clay Pipe	159	8	B
653	127 E ONEIL AVE	2653-96	SN26530004	6	Vitrified Clay Pipe	90	5	BVV
654	1762 G ST	2654-30	2654-29	10	Vitrified Clay Pipe	580	5	B
655	1332 N ST	2655-02	2655-01	6	Vitrified Clay Pipe	440	24	BSV
656	1630 VAN NESS AVE	2655-10	2655-16	6	Vitrified Clay Pipe	479	32	B
657	1630 VAN NESS AVE	2655-10	2655-16	6	Vitrified Clay Pipe	479	32	BVV
658	1630 VAN NESS AVE	2655-10	2655-16	6	Vitrified Clay Pipe	479	32	H
659	1630 VAN NESS AVE	2655-10	2655-16	6	Vitrified Clay Pipe	479	32	SRCZ
660	1650 L ST	2655-11	2655-15	6	Vitrified Clay Pipe	388	9	HVV
661	1402 BROADWAY	2655-40	2655-21	6	Vitrified Clay Pipe	375	18	B
662	1402 BROADWAY	2655-40	2655-21	6	Vitrified Clay Pipe	375	18	B
663	1402 BROADWAY	2655-40	2655-21	6	Vitrified Clay Pipe	375	18	BSV
664	1315 VAN NESS AVE	2655-41	2655-57	27	Concrete Pipe	481	5	H
665	2305 STANISLAUS ST	2655-49	2655-13	6	Vitrified Clay Pipe	429	40	HVV
666	2310 STANISLAUS ST	2655-50	2655-72	6	Vitrified Clay Pipe	423	24	B

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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
667	2310 STANISLAUS ST	2655-50	2655-72	6	Vitrified Clay Pipe	423	24	BVV
668	2222 STANISLAUS ST	2655-51	2655-27	6	Vitrified Clay Pipe	425	9	B
669	1428 H ST	2655-56	2655-71	8	Vitrified Clay Pipe	433	23	H
670	1428 H ST	2655-56	2655-71	8	Vitrified Clay Pipe	433	23	H
671	1428 H ST	2655-56	2655-71	8	Vitrified Clay Pipe	433	23	H
672	1428 H ST	2655-56	2655-71	8	Vitrified Clay Pipe	433	23	H
673	1911 MERCED ST	2655-64	2655-63	8	Vitrified Clay Pipe	411	19	B
674	1432 E DIVISADERO ST	2655-66	2655-13	6	Vitrified Clay Pipe	385	37	BSV
675	1432 E DIVISADERO ST	2655-66	2655-13	6	Vitrified Clay Pipe	385	37	HVV
676	946 E DIVISADERO ST	2655-73	2554-81	6	Vitrified Clay Pipe	153	5	B
677	2619 MERCED ST	2656-06	2656-04	6	Vitrified Clay Pipe	430	12	BSV
678	2505 MERCED ST	2656-07	2656-03	6	Vitrified Clay Pipe	432	39	B
679	2505 MERCED ST	2656-07	2656-03	6	Vitrified Clay Pipe	432	39	B
680	2505 MERCED ST	2656-07	2656-03	6	Vitrified Clay Pipe	432	39	BVV
681	2520 MERCED ST	2656-08	2656-09	6	Vitrified Clay Pipe	421	12	BVV
682	1230 M ST	2656-14	2656-63	6	Vitrified Clay Pipe	409	5	H
683	2314 MARIPOSA MALL	2656-18	2656-17	6	Vitrified Clay Pipe	200	5	H
684	908 M ST	2656-19	2756-47	6	Vitrified Clay Pipe	524	9	B
685	908 M ST	2656-19	2756-47	6	Vitrified Clay Pipe	524	10	B
686	908 M ST	2656-19	2756-47	6	Vitrified Clay Pipe	524	10	B
687	2606 KERN ST	2656-41	2656-40	6	Vitrified Clay Pipe	376	44	BVV
688	2950 MARIPOSA ST	2656-47	2657-06	6	Vitrified Clay Pipe	438	12	H
689	2727 TULARE ST	2656-49	2656-62	6	Vitrified Clay Pipe	485	9	D
690	2727 TULARE ST	2656-49	2656-62	6	Vitrified Clay Pipe	485	9	H
691	2621 FRESNO ST	2656-54	2656-55	6	Vitrified Clay Pipe	424	16	H
692	2621 FRESNO ST	2656-54	2656-55	6	Vitrified Clay Pipe	424	16	H
693	2006 E DIVISADERO	2656-57	2656-04	8	Vitrified Clay Pipe	232	10	H
694	2006 E DIVISADERO	2656-57	2656-04	8	Vitrified Clay Pipe	232	10	HVV
695	2448 STANISLAUS ST	2656-64	2656-01	6	Vitrified Clay Pipe	428	18	B
696	2448 STANISLAUS ST	2656-64	2656-01	6	Vitrified Clay Pipe	428	18	B
697	2448 STANISLAUS ST	2656-64	2656-01	6	Vitrified Clay Pipe	428	18	B
698	2920 E HUNTINGTON BLVD	2657-20	2657-67	12	Vitrified Clay Pipe	325	11	H
699	3103 KERCKHOFF AVE	2657-31	2657-32	14	Vitrified Clay Pipe	420	10	D
700	430 S FIRST ST	2657-33	2657-34	14	Vitrified Clay Pipe	414	5	B
701	2730 TULARE ST	2657-64	2657-35	6	Vitrified Clay Pipe	250	8	B
702	900 SANTA FE AVE	2657-65	2757-01	8	Vitrified Clay Pipe	384	30	BVV
703	900 SANTA FE AVE	2657-65	2757-01	8	Vitrified Clay Pipe	384	30	BVV

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
704	900 SANTA FE AVE	2657-65	2757-01	8	Vitrified Clay Pipe	384	30	H
705	900 SANTA FE AVE	2657-65	2757-01	8	Vitrified Clay Pipe	384	30	H
706	710 R ST	2657-68	2657-65	8	Vitrified Clay Pipe	191	5	B
707	3303 E PLATT AVE	2658-02	2658-12	12	Vitrified Clay Pipe	368	28	H
708	3025 E KERCKHOFF AVE	2658-13	2658-50	6	Vitrified Clay Pipe	479	18	B
709	3025 E KERCKHOFF AVE	2658-13	2658-50	6	Vitrified Clay Pipe	479	18	D
710	3327 KERCKHOFF AVE	2658-14	2658-13	6	Vitrified Clay Pipe	479	32	B
711	3403 E KERCKHOFF AVE	2658-15	2658-14	6	Vitrified Clay Pipe	428	13	B
712	3561 E KERCKHOFF AVE	2658-16	2658-15	6	Vitrified Clay Pipe	530	5	BSV
713	3362 E KERCKHOFF AVE	2658-19	2658-53	10	Vitrified Clay Pipe	479	28	B
714	3555 E HUNTINGTON BLVD	2658-21	2658-20	10	Vitrified Clay Pipe	479	30	H
715	3363 E BALCH AVE	2658-24	2658-23	6	Vitrified Clay Pipe	479	11	D
716	3463 E BALCH AVE	2658-25	2658-24	6	Vitrified Clay Pipe	428	20	B
717	3463 E BALCH AVE	2658-25	2658-24	6	Vitrified Clay Pipe	428	20	B
718	3561 E BALCH AVE	2658-26	2658-70	6	Vitrified Clay Pipe	428	22	B
719	3561 E BALCH AVE	2658-26	2658-70	6	Vitrified Clay Pipe	428	22	BSV
720	3561 E BALCH AVE	2658-26	2658-70	6	Vitrified Clay Pipe	428	22	H
721	528 S FIFTH ST	2658-27	2658-29	6	Vitrified Clay Pipe	428	8	H
722	3302 BALCH AVE	2658-30	2658-31	6	Vitrified Clay Pipe	368	28	B
723	3302 BALCH AVE	2658-30	2658-31	6	Vitrified Clay Pipe	368	28	BVV
724	532 S SECOND ST	2658-32	2658-73	6	Vitrified Clay Pipe	474	14	B
725	623 S FOURTH ST	2658-40	2658-41	6	Vitrified Clay Pipe	530	24	B
726	623 S FOURTH ST	2658-40	2658-41	6	Vitrified Clay Pipe	530	24	B
727	3360 E MONO ST	2658-41	2658-42	6	Vitrified Clay Pipe	363	46	BVV
728	3360 E MONO ST	2658-41	2658-42	6	Vitrified Clay Pipe	363	46	BVV
729	3130 E HUNTINGTON BLVD	2658-51	2657-34	6	Vitrified Clay Pipe	420	43	B
730	3130 E HUNTINGTON BLVD	2658-51	2657-34	6	Vitrified Clay Pipe	420	43	B
731	3653 E BALCH AVE	2658-70	2659-22	6	Vitrified Clay Pipe	479	5	B
732	543 S FIRST ST	2658-73	2657-36	6	Vitrified Clay Pipe	489	41	D
733	3911 E PLATT AVE	2659-06	2659-05	6	Vitrified Clay Pipe	459	5	HSV
734	3669 E KERCKHOFF AVE	2659-09	2658-16	6	Vitrified Clay Pipe	428	13	B
735	3669 E KERCKHOFF AVE	2659-09	2658-16	6	Vitrified Clay Pipe	428	13	BSV
736	3655 E HUNTINGTON BLVD	2659-15	2658-21	10	Vitrified Clay Pipe	479	25	B
737	3655 E HUNTINGTON BLVD	2659-15	2658-21	10	Vitrified Clay Pipe	479	25	B
738	3655 E HUNTINGTON BLVD	2659-15	2658-21	10	Vitrified Clay Pipe	479	25	H
739	3753 E BALCH AVE	2659-23	2659-22	6	Vitrified Clay Pipe	430	5	B
740	4055 E BALCH AVE	2659-26	2659-25	6	Vitrified Clay Pipe	459	54	B

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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
741	4055 E BALCH AVE	2659-26	2659-25	6	Vitrified Clay Pipe	459	54	BSV
742	4167 BALCH AVE	2659-27	2659-26	6	Vitrified Clay Pipe	479	41	B
743	4167 BALCH AVE	2659-27	2659-26	6	Vitrified Clay Pipe	479	41	B
744	4167 BALCH AVE	2659-27	2659-26	6	Vitrified Clay Pipe	479	41	BSV
745	3659 E MONO ST	2659-33	2658-28	8	Vitrified Clay Pipe	480	28	B
746	522 EIGHTH ST	2659-34	2659-33	8	Vitrified Clay Pipe	480	27	H
747	521 EIGHTH ST	2659-35	2659-34	8	Vitrified Clay Pipe	480	21	H
748	3751 E VENTURA ST	2659-43	2659-45	8	Vitrified Clay Pipe	480	35	B
749	3751 E VENTURA ST	2659-43	2659-45	8	Vitrified Clay Pipe	480	35	BVV
750	3751 E VENTURA ST	2659-43	2659-45	8	Vitrified Clay Pipe	480	35	BVV
751	3751 E VENTURA ST	2659-43	2659-45	8	Vitrified Clay Pipe	480	35	BVV
752	3660 E KERCKHOFF AVE	2659-83	2659-15	8	Vitrified Clay Pipe	210	8	H
753	205 S BARTON AVE	2660-01	2560-58	6	Vitrified Clay Pipe	485	29	B
754	205 S BARTON AVE	2660-01	2560-58	6	Vitrified Clay Pipe	485	29	BVV
755	4608 E MONO ST	2661-28	2660-24	6	Vitrified Clay Pipe	279	5	B
756	47 E AMADOR ST	2753-11	2753-12	6	Vitrified Clay Pipe	380	55	BSV
757	47 E AMADOR ST	2753-11	2753-12	6	Vitrified Clay Pipe	380	55	BSV
758	217 E AMADOR ST	2753-14	2753-15	6	Vitrified Clay Pipe	380	28	BVV
759	823 S MODOC ST	2753-16	2753-55	6	Vitrified Clay Pipe	430	5	B
760	129 E SAN JOAQUIN ST	2753-21	2753-20	6	Vitrified Clay Pipe	380	73	B
761	129 E SAN JOAQUIN ST	2753-21	2753-20	6	Vitrified Clay Pipe	380	73	BSV
762	129 E SAN JOAQUIN ST	2753-21	2753-20	6	Vitrified Clay Pipe	380	73	BSV
763	129 E SAN JOAQUIN ST	2753-21	2753-20	6	Vitrified Clay Pipe	380	73	BVV
764	223 E SAN JOAQUIN ST	2753-22	2753-23	6	Vitrified Clay Pipe	375	56	B
765	53 E STANISLAUS ST	2753-27	2753-28	6	Vitrified Clay Pipe	380	21	FH3
766	219 E STANISLAUS ST	2753-30	2753-32	6	Vitrified Clay Pipe	368	14	BSV
767	219 E STANISLAUS ST	2753-30	2753-32	6	Vitrified Clay Pipe	368	14	BVV
768	51 E TUOLUMNE ST	2753-38	2753-37	6	Vitrified Clay Pipe	380	74	B
769	51 E TUOLUMNE ST	2753-38	2753-37	6	Vitrified Clay Pipe	380	74	B
770	51 E TUOLUMNE ST	2753-38	2753-37	6	Vitrified Clay Pipe	380	74	BSV
771	51 E TUOLUMNE ST	2753-38	2753-37	6	Vitrified Clay Pipe	380	74	BSV
772	51 E TUOLUMNE ST	2753-38	2753-37	6	Vitrified Clay Pipe	380	74	BSV
773	101 E OLEANDER AVE	2753-41	2753-40	6	Vitrified Clay Pipe	380	47	BSV
774	231 E OLEANDER AVE	2753-42	2753-41	6	Vitrified Clay Pipe	430	49	BSV
775	231 E OLEANDER AVE	2753-42	2753-41	6	Vitrified Clay Pipe	430	49	BSV
776	1244 S TRINITY ST	2753-43	2753-44	16	Vitrified Clay Pipe	379	11	HSV
777	304 E KEARNEY BLVD	2753-44	2853-78	16	Vitrified Clay Pipe	443	5	B

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
778	1622 C ST	2754-02	2754-09	6	Vitrified Clay Pipe	484	56	B
779	1622 C ST	2754-02	2754-09	6	Vitrified Clay Pipe	484	56	BSV
780	1622 C ST	2754-02	2754-09	6	Vitrified Clay Pipe	484	56	BVV
781	1107 CALAVERAS ST	2754-04	2754-08	6	Vitrified Clay Pipe	484	22	FH4
782	1211 STANISLAUS ST	2754-10	2754-09	6	Vitrified Clay Pipe	428	46	B
783	1211 STANISLAUS ST	2754-10	2754-09	6	Vitrified Clay Pipe	428	46	BSV
784	1211 STANISLAUS ST	2754-10	2754-09	6	Vitrified Clay Pipe	428	46	BVV
785	1444 STANISLAUS ST	2754-26	2754-20	10	Vitrified Clay Pipe	434	11	BVV
786	1018 TUOLUMNE ST	2754-49	2754-50	6	Vitrified Clay Pipe	423	31	B
787	1018 TUOLUMNE ST	2754-49	2754-50	6	Vitrified Clay Pipe	423	31	B
788	1215 S SNOW AVE	2754-52	2754-55	6	Vitrified Clay Pipe	375	36	B
789	1215 S SNOW AVE	2754-52	2754-55	6	Vitrified Clay Pipe	375	36	B
790	1215 S SNOW AVE	2754-52	2754-55	6	Vitrified Clay Pipe	375	36	B
791	1215 S SNOW AVE	2754-52	2754-55	6	Vitrified Clay Pipe	375	36	BSV
792	457 E KEARNEY BLVD	2754-53	2754-54	6	Vitrified Clay Pipe	380	11	B
793	505 E KEARNEY BLVD	2754-54	2754-55	6	Vitrified Clay Pipe	425	14	B
794	1116 B ST	2754-65	2754-64	6	Vitrified Clay Pipe	440	17	BVV
795	552 E TUOLUMNE ST	2754-72	2754-71	12	Vitrified Clay Pipe	724	5	H
796	543 E OLEANDER AVE	2754-75	2754-52	6	Vitrified Clay Pipe	380	29	B
797	543 E OLEANDER AVE	2754-75	2754-52	6	Vitrified Clay Pipe	380	29	BSV
798	543 E OLEANDER AVE	2754-75	2754-52	6	Vitrified Clay Pipe	380	29	BVV
799	1344 TULARE ST	2755-09	2755-11	6	Vitrified Clay Pipe	528	16	B
800	1344 TULARE ST	2755-09	2755-11	6	Vitrified Clay Pipe	528	16	BVV
801	1023 E ST	2755-12	2755-11	6	Vitrified Clay Pipe	454	33	B
802	1023 E ST	2755-12	2755-11	6	Vitrified Clay Pipe	454	33	B
803	1023 E ST	2755-12	2755-11	6	Vitrified Clay Pipe	454	33	HSV
804	1417 KERN ST	2755-20	2755-21	12	Vitrified Clay Pipe	480	8	H
805	1420 FRESNO ST	2755-23	2755-24	6	Vitrified Clay Pipe	388	16	B
806	1420 FRESNO ST	2755-23	2755-24	6	Vitrified Clay Pipe	388	16	BSV
807	1441 FRESNO ST	2755-25	2755-02	6	Vitrified Clay Pipe	496	5	HVV
808	1445 FRESNO ST	2755-30	2755-27	18	Vitrified Clay Pipe	200	10	SMWZ
809	1445 FRESNO ST	2755-30	2755-27	18	Vitrified Clay Pipe	200	10	SMWZ
810	1136 F ST	2755-33	2755-32	8	Vitrified Clay Pipe	477	23	B
811	1136 F ST	2755-33	2755-32	8	Vitrified Clay Pipe	477	23	B
812	1136 F ST	2755-33	2755-32	8	Vitrified Clay Pipe	477	23	B
813	1136 F ST	2755-33	2755-32	8	Vitrified Clay Pipe	477	23	BVV
814	1136 F ST	2755-33	2755-32	8	Vitrified Clay Pipe	477	12	B

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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
815	1136 F ST	2755-33	2755-32	8	Vitrified Clay Pipe	477	12	D
816	921 CHINA ALLEY	2755-38	2755-36	8	Vitrified Clay Pipe	430	9	BVV
817	1257 G ST	2755-47	2755-30	18	Vitrified Clay Pipe	190	15	SMWZ
818	1257 G ST	2755-47	2755-30	18	Vitrified Clay Pipe	190	15	SMWZ
819	1257 G ST	2755-47	2755-30	18	Vitrified Clay Pipe	190	15	SMWZ
820	1266 G ST	2755-68	2755-47	18	Vitrified Clay Pipe	690	21	SMW
821	1266 G ST	2755-68	2755-47	18	Vitrified Clay Pipe	690	21	SMW
822	1266 G ST	2755-68	2755-47	18	Vitrified Clay Pipe	690	21	SMW
823	1920 TULARE ST	2755-73	2756-05	10	Vitrified Clay Pipe	425	5	H
824	1821 FRESNO ST	2755-79	2755-80	6	Vitrified Clay Pipe	241	5	B
825	1821 FRESNO ST	2755-80	2755-67	8	Vitrified Clay Pipe	10	5	BSV
826	1901 MARIPOSA ST	2755-81	2755-59	6	Vitrified Clay Pipe	430	34	B
827	1901 MARIPOSA ST	2755-81	2755-59	6	Vitrified Clay Pipe	430	34	BSV
828	1901 MARIPOSA ST	2755-81	2755-59	6	Vitrified Clay Pipe	430	34	BVV
829	1901 MARIPOSA ST	2755-81	2755-59	6	Vitrified Clay Pipe	430	34	BVV
830	1010 FULTON MALL	2756-01	2755-74	10	Vitrified Clay Pipe	414	16	B
831	740 H ST	2756-08	2756-13	6	Vitrified Clay Pipe	439	23	BSV
832	740 H ST	2756-08	2756-13	6	Vitrified Clay Pipe	439	23	H
833	740 H ST	2756-08	2756-13	6	Vitrified Clay Pipe	439	23	H
834	648 N BROADWAY	2756-12	2756-13	12	Polyvinyl Chloride	400	15	H
835	735 H ST	2756-14	2756-84	10	Vitrified Clay Pipe	371	9	BSV
836	635 BROADWAY	2756-15	2756-13	6	Vitrified Clay Pipe	432	8	B
837	626 N BROADWAY	2756-16	2756-12	6	Vitrified Clay Pipe	429	5	BSV
838	458 FULTON ST	2756-19	2756-20	6	Vitrified Clay Pipe	277	8	BVV
839	2033 VENTURA ST	2756-22	2756-11	8	Vitrified Clay Pipe	429	10	H
840	2033 VENTURA ST	2756-22	2756-11	8	Vitrified Clay Pipe	429	10	H
841	2126 VENTURA ST	2756-27	2756-26	6	Vitrified Clay Pipe	399	5	H
842	2126 VENTURA ST	2756-27	2756-26	6	Vitrified Clay Pipe	399	8	H
843	2126 INYO ST	2756-29	2756-28	6	Vitrified Clay Pipe	427	39	B
844	2126 INYO ST	2756-29	2756-28	6	Vitrified Clay Pipe	427	39	H
845	2126 INYO ST	2756-29	2756-28	6	Vitrified Clay Pipe	427	39	H
846	2126 INYO ST	2756-29	2756-28	6	Vitrified Clay Pipe	427	39	H
847	2126 INYO ST	2756-29	2756-28	6	Vitrified Clay Pipe	427	39	H
848	2134 KERN ST	2756-30	2756-98	6	Vitrified Clay Pipe	50	19	B
849	2134 KERN ST	2756-30	2756-98	6	Vitrified Clay Pipe	50	19	B
850	2228 SANTA CLARA ST	2756-38	2756-39	6	Vitrified Clay Pipe	110	5	B
851	2130 VENTURA ST	2756-41	2756-73	16	Vitrified Clay Pipe	382	5	B

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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
852	654 VAN NESS AVE	2756-48	2756-28	6	Vitrified Clay Pipe	430	23	BSV
853	654 VAN NESS AVE	2756-48	2756-28	6	Vitrified Clay Pipe	430	23	H
854	2027 KERN ST	2756-71	2756-03	8	Vitrified Clay Pipe	110	32	B
855	2027 KERN ST	2756-71	2756-02	8	Vitrified Clay Pipe	110	8	B
856	2134 KERN ST	2756-98	2756-31	6	Vitrified Clay Pipe	371	5	BSV
857	900 SANTA FE AVE	2757-01	2757-02	8	Vitrified Clay Pipe	20	11	BSV
858	900 SANTA FE AVE	2757-02	2757-97	8	Vitrified Clay Pipe	201	34	B
859	900 SANTA FE AVE	2757-02	2757-97	8	Vitrified Clay Pipe	201	34	B
860	900 SANTA FE AVE	2757-02	2757-97	8	Vitrified Clay Pipe	201	34	BVV
861	900 SANTA FE AVE	2757-02	2757-97	8	Vitrified Clay Pipe	201	34	BVV
862	900 SANTA FE AVE	2757-02	2757-97	8	Vitrified Clay Pipe	201	34	H
863	825 S TOPEKA AVE	2757-04	2757-10	8	Vitrified Clay Pipe	375	26	BSV
864	825 S TOPEKA AVE	2757-04	2757-10	8	Vitrified Clay Pipe	375	26	H
865	305 O ST	2757-21	2757-31	8	Vitrified Clay Pipe	311	10	H
866	305 O ST	2757-21	2757-31	8	Vitrified Clay Pipe	311	10	H
867	235 SANTE FE AVE	2757-44	2757-45	10	Vitrified Clay Pipe	266	10	B
868	235 SANTE FE AVE	2757-44	2757-45	10	Vitrified Clay Pipe	266	10	BVV
869	3095 E BUTLER	2757-47	2757-48	10	Vitrified Clay Pipe	350	19	BVV
870	3095 E BUTLER	2757-47	2757-48	10	Vitrified Clay Pipe	350	19	BVV
871	3095 E BUTLER	2757-47	2757-48	10	Vitrified Clay Pipe	350	19	BVV
872	3259 E BUTLER AVE	2757-52	2758-11	6	Vitrified Clay Pipe	431	36	B
873	3259 E BUTLER AVE	2757-52	2758-11	6	Vitrified Clay Pipe	431	36	B
874	3259 E BUTLER AVE	2757-52	2758-11	6	Vitrified Clay Pipe	431	36	BVV
875	3203 E BUTLER AVE	2757-54	2757-52	6	Vitrified Clay Pipe	305	40	B
876	3203 E BUTLER AVE	2757-54	2757-52	6	Vitrified Clay Pipe	305	40	BVV
877	1236 S PARALLEL AVE	2757-55	2757-51	12	Concrete Pipe	341	8	BSV
878	3114 E VENTURA ST	2757-70	2757-71	6	Vitrified Clay Pipe	492	37	H
879	724 S ORANGE AVE	2757-71	2757-72	6	Vitrified Clay Pipe	355	61	B
880	2970 E VENTURA ST	2757-73	2757-63	10	Vitrified Clay Pipe	242	17	B
881	778 S HAZELWOOD BLVD	2757-75	2757-74	8	Vitrified Clay Pipe	158	8	H
882	3135 E MONTECITO AVE	2757-78	2757-77	6	Vitrified Clay Pipe	492	15	BVV
883	925 S FIRST ST	2757-80	2757-79	6	Vitrified Clay Pipe	430	11	B
884	935 TOPEKA AVE	2757-92	2757-90	8	Vitrified Clay Pipe	326	24	B
885	728 S HAZELWOOD BLVD	2757-95	2757-103	6	Vitrified Clay Pipe	326	50	B
886	728 S HAZELWOOD BLVD	2757-95	2757-103	6	Vitrified Clay Pipe	326	50	B
887	728 S HAZELWOOD BLVD	2757-95	2757-103	6	Vitrified Clay Pipe	326	50	H
888	728 S HAZELWOOD BLVD	2757-95	2757-103	6	Vitrified Clay Pipe	326	50	H

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
889	728 S HAZELWOOD BLVD	2757-95	2757-103	6	Vitrified Clay Pipe	326	50	HSV
890	728 S HAZELWOOD BLVD	2757-95	2757-103	6	Vitrified Clay Pipe	326	50	HVV
891	728 S HAZELWOOD BLVD	2757-95	2757-103	6	Vitrified Clay Pipe	326	50	HVV
892	728 S HAZELWOOD BLVD	2757-95	2757-103	6	Vitrified Clay Pipe	326	50	SMWZ
893	1259 S HAZELWOOD BLVD	2758-09	2758-10	6	Vitrified Clay Pipe	105	5	BVV
894	1309 S THIRD ST	2758-14	2758-11	6	Vitrified Clay Pipe	486	18	B
895	1034 S FOURTH ST	2758-17	2758-06	6	Vitrified Clay Pipe	485	30	B
896	1034 S FOURTH ST	2758-17	2758-06	6	Vitrified Clay Pipe	485	30	B
897	1034 S FOURTH ST	2758-17	2758-06	6	Vitrified Clay Pipe	485	30	B
898	1034 S FOURTH ST	2758-17	2758-06	6	Vitrified Clay Pipe	485	30	BVV
899	833 S FOURTH ST	2758-23	2758-31	6	Vitrified Clay Pipe	297	22	B
900	833 S FOURTH ST	2758-23	2758-31	6	Vitrified Clay Pipe	297	22	B
901	833 S FOURTH ST	2758-23	2758-31	6	Vitrified Clay Pipe	297	22	BSV
902	833 S FOURTH ST	2758-23	2758-31	6	Vitrified Clay Pipe	297	22	D
903	3445 E EL MONTE WAY	2758-29	2758-31	6	Vitrified Clay Pipe	373	5	B
904	3438 E MONTECITO AVE	2758-33	2758-32	6	Vitrified Clay Pipe	187	10	B
905	3438 E MONTECITO AVE	2758-33	2758-32	6	Vitrified Clay Pipe	187	10	B
906	3445 E ALTA AVE	2758-34	2758-33	6	Vitrified Clay Pipe	100	5	BSV
907	3522 E EL MONTE WAY	2758-41	2758-40	6	Vitrified Clay Pipe	242	28	BVV
908	1134 S FIFTH ST	2758-51	2758-16	6	Vitrified Clay Pipe	519	9	H
909	3588 E ALTA AVE	2758-53	2758-47	6	Vitrified Clay Pipe	522	33	B
910	3588 E ALTA AVE	2758-53	2758-47	6	Vitrified Clay Pipe	522	33	B
911	3585 E LYELL AVE	2758-55	2758-56	6	Vitrified Clay Pipe	606	43	H
912	3585 E LYELL AVE	2758-55	2758-56	6	Vitrified Clay Pipe	606	43	H
913	1354 S ORANGE AVE	2758-60	2758-62	6	Vitrified Clay Pipe	604	20	B
914	3701 E ALTA AVE	2759-02	2759-03	6	Vitrified Clay Pipe	531	34	B
915	3701 E ALTA AVE	2759-02	2759-03	6	Vitrified Clay Pipe	531	34	B
916	3701 E ALTA AVE	2759-02	2759-03	6	Vitrified Clay Pipe	531	34	H
917	3750 E EL MONTE WAY	2759-10	2759-12	6	Vitrified Clay Pipe	531	97	B
918	3750 E EL MONTE WAY	2759-10	2759-12	6	Vitrified Clay Pipe	531	97	B
919	3750 E EL MONTE WAY	2759-10	2759-12	6	Vitrified Clay Pipe	531	97	B
920	3750 E EL MONTE WAY	2759-10	2759-12	6	Vitrified Clay Pipe	531	97	B
921	3750 E EL MONTE WAY	2759-10	2759-12	6	Vitrified Clay Pipe	531	97	BSV
922	3750 E EL MONTE WAY	2759-10	2759-12	6	Vitrified Clay Pipe	531	97	BVV
923	3733 E ALTA AVE	2759-11	2759-03	6	Vitrified Clay Pipe	380	21	BSV
924	1104 S EIGHTH ST	2759-15	2759-16	6	Vitrified Clay Pipe	377	18	B
925	1104 S EIGHTH ST	2759-15	2759-16	6	Vitrified Clay Pipe	377	18	B

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
926	1104 S EIGHTH ST	2759-15	2759-16	6	Vitrified Clay Pipe	377	18	BVV
927	1133 S ORANGE AVE	2759-16	2758-53	6	Vitrified Clay Pipe	378	21	D
928	1040 S CHANCE AVE	2760-13	2760-14	12	Vitrified Clay Pipe	244	5	XP
929	1034 S PEACH AVE	2763-14	2763-20	8	Vitrified Clay Pipe	679	36	BSV
930	1034 S PEACH AVE	2763-14	2763-20	8	Vitrified Clay Pipe	679	36	BVV
931	154 E EDEN AVE	2853-33	2853-35	30	Concrete Pipe	24	5	B
932	661 E CALIFORNIA AVE	2854-02	2854-18	6	Vitrified Clay Pipe	388	18	B
933	661 E CALIFORNIA AVE	2854-02	2854-18	6	Vitrified Clay Pipe	388	18	B
934	941 KLETTE AVE	2854-07	2854-08	6	Vitrified Clay Pipe	425	17	B
935	941 KLETTE AVE	2854-07	2854-08	6	Vitrified Clay Pipe	425	17	BVV
936	527 FRESNO ST	2854-13	2854-14	6	Vitrified Clay Pipe	202	17	B
937	527 FRESNO ST	2854-13	2854-14	6	Vitrified Clay Pipe	202	17	BVV
938	1138 KLETTE AVE	2854-16	2854-15	6	Vitrified Clay Pipe	350	30	BSV
939	1052 KLETTE AVE	2854-17	2854-16	6	Vitrified Clay Pipe	600	36	B
940	1052 KLETTE AVE	2854-17	2854-16	6	Vitrified Clay Pipe	600	36	B
941	928 KLETTE AVE	2854-18	2854-17	6	Vitrified Clay Pipe	354	13	B
942	617 KERN ST	2854-19	2854-20	6	Vitrified Clay Pipe	609	8	BSV
943	1060 WATERMAN AVE	2854-20	2854-21	6	Vitrified Clay Pipe	578	60	B
944	1060 WATERMAN AVE	2854-20	2854-21	6	Vitrified Clay Pipe	578	60	B
945	1060 WATERMAN AVE	2854-20	2854-21	6	Vitrified Clay Pipe	578	60	B
946	1060 WATERMAN AVE	2854-20	2854-21	6	Vitrified Clay Pipe	578	60	B
947	1060 WATERMAN AVE	2854-20	2854-21	6	Vitrified Clay Pipe	578	60	B
948	1060 WATERMAN AVE	2854-20	2854-21	6	Vitrified Clay Pipe	578	60	B
949	1140 WATERMAN AVE	2854-21	2854-22	6	Vitrified Clay Pipe	350	42	BSV
950	1140 WATERMAN AVE	2854-22	2854-23	6	Vitrified Clay Pipe	188	20	B
951	1240 WATERMAN AVE	2854-25	2854-24	6	Vitrified Clay Pipe	250	20	B
952	1240 WATERMAN AVE	2854-25	2854-24	6	Vitrified Clay Pipe	250	20	H
953	1234 POTTLE AVE	2854-30	2854-29	6	Vitrified Clay Pipe	295	17	B
954	1234 POTTLE AVE	2854-30	2854-29	6	Vitrified Clay Pipe	295	17	H
955	800 POTTLE AVE	2854-36	2854-35	6	Vitrified Clay Pipe	480	5	BVV
956	1053 MAYOR AVE	2854-40	2854-41	6	Vitrified Clay Pipe	535	21	BVV
957	1138 COLLINS AVE	2854-41	2854-42	6	Vitrified Clay Pipe	428	16	B
958	1210 COLLINS AVE	2854-43	2854-42	6	Vitrified Clay Pipe	347	11	B
959	917 A ST	2854-48	2854-47	10	Vitrified Clay Pipe	480	5	B
960	1032 TULARE ST	2854-54	2854-49	6	Vitrified Clay Pipe	435	23	B
961	1032 TULARE ST	2854-54	2854-49	6	Vitrified Clay Pipe	435	23	B
962	1032 TULARE ST	2854-54	2854-49	6	Vitrified Clay Pipe	435	23	B

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
963	1032 TULARE ST	2854-54	2854-49	6	Vitrified Clay Pipe	435	23	BVV
964	1136 A ST	2854-55	2754-67	6	Vitrified Clay Pipe	440	5	B
965	371 B ST	2855-02	2955-52	8	Vitrified Clay Pipe	402	9	BVV
966	320 B ST	2855-03	2955-52	8	Vitrified Clay Pipe	392	5	BSV
967	2103 S TUPMAN ST	2855-07	2855-86	10	Vitrified Clay Pipe	166	5	B
968	664 MAYOR AVE	2855-36	2855-30	8	Vitrified Clay Pipe	429	37	H
969	915 INYO ST	2855-39	2854-48	6	Vitrified Clay Pipe	430	35	B
970	915 INYO ST	2855-39	2854-48	6	Vitrified Clay Pipe	430	35	BVV
971	764 A ST	2855-40	2855-41	6	Vitrified Clay Pipe	483	9	B
972	554 B ST	2855-42	2855-28	6	Vitrified Clay Pipe	431	17	B
973	1124 KERN ST	2855-45	2855-90	6	Vitrified Clay Pipe	433	62	B
974	1124 KERN ST	2855-45	2855-90	6	Vitrified Clay Pipe	433	62	B
975	1124 KERN ST	2855-45	2855-90	6	Vitrified Clay Pipe	433	62	BVV
976	1124 KERN ST	2855-45	2855-90	6	Vitrified Clay Pipe	433	62	BVV
977	1124 KERN ST	2855-45	2855-90	6	Vitrified Clay Pipe	433	62	BVV
978	912 B ST	2855-45	2855-90	6	Vitrified Clay Pipe	480	15	B
979	811 B ST	2855-46	2855-47	6	Vitrified Clay Pipe	434	12	B
980	920 A ST	2855-47	2854-49	6	Vitrified Clay Pipe	479	18	BSV
981	1257 KERN ST	2855-50	2755-08	6	Vitrified Clay Pipe	420	9	B
982	1224 KERN ST	2855-51	2855-50	6	Vitrified Clay Pipe	487	5	B
983	1320 KERN ST	2855-56	2755-09	6	Vitrified Clay Pipe	380	8	B
984	761 E ST	2855-57	2855-58	6	Vitrified Clay Pipe	375	11	B
985	506 E ST	2855-64	2855-63	8	Vitrified Clay Pipe	538	5	B
986	1424 KERN ST	2855-67	2755-19	6	Vitrified Clay Pipe	423	19	B
987	1424 KERN ST	2855-67	2755-19	6	Vitrified Clay Pipe	423	19	BSV
988	750 MONO ST	2855-82	2855-33	6	Vitrified Clay Pipe	450	5	B
989	1424 KERN ST	2855-84	2855-85	10	Vitrified Clay Pipe	430	5	B
990	2539 E WOODWARD AVE	2856-04	2857-16	14	Vitrified Clay Pipe	407	9	H
991	1320 MONTEREY ST	2856-08	2856-62	6	Vitrified Clay Pipe	391	44	H
992	1320 MONTEREY ST	2856-08	2856-62	6	Vitrified Clay Pipe	391	44	H
993	1320 MONTEREY ST	2856-08	2856-62	6	Vitrified Clay Pipe	391	44	H
994	1320 MONTEREY ST	2856-08	2856-62	6	Vitrified Clay Pipe	391	44	H
995	1320 MONTEREY ST	2856-08	2856-62	6	Vitrified Clay Pipe	391	44	H
996	1320 MONTEREY ST	2856-08	2856-62	6	Vitrified Clay Pipe	391	44	H
997	1320 MONTEREY ST	2856-08	2856-62	6	Vitrified Clay Pipe	391	44	H
998	1320 MONTEREY ST	2856-08	2856-62	6	Vitrified Clay Pipe	391	44	H
999	214 BROADWAY	2856-19	2856-20	6	Vitrified Clay Pipe	325	22	BVV

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
1000	214 BROADWAY	2856-19	2856-20	6	Vitrified Clay Pipe	325	22	H
1001	1820 MONTERY ST	2856-21	2856-71	6	Vitrified Clay Pipe	372	13	B
1002	253 FULTON ST	2856-28	2856-25	8	Vitrified Clay Pipe	401	33	B
1003	1820 SAN BENITO ST	2856-39	2856-23	6	Vitrified Clay Pipe	402	11	BSV
1004	564 F ST	2856-50	2855-69	18	Vitrified Clay Pipe	392	5	BVV
1005	401 H ST	2856-53	2856-42	10	Vitrified Clay Pipe	478	5	BSV
1006	1804 VENTURA ST	2856-55	2756-15	6	Vitrified Clay Pipe	536	39	B
1007	1804 VENTURA ST	2856-55	2756-15	6	Vitrified Clay Pipe	536	39	BSV
1008	1804 VENTURA ST	2856-55	2756-15	6	Vitrified Clay Pipe	536	39	BSV
1009	1804 VENTURA ST	2856-55	2756-15	6	Vitrified Clay Pipe	536	39	HSV
1010	241 H ST	2856-79	2856-80	10	Vitrified Clay Pipe	481	10	BVV
1011	241 H ST	2856-79	2856-80	10	Vitrified Clay Pipe	481	10	BVV
1012	310 G ST	2856-80	2856-67	10	Vitrified Clay Pipe	476	19	B
1013	310 G ST	2856-80	2856-67	10	Vitrified Clay Pipe	476	19	BSV
1014	2105 S VAN NESS AVE	2857-03	2857-05	8	Vitrified Clay Pipe	460	23	B
1015	1923 S MARY ST	2857-20	2857-11	6	Vitrified Clay Pipe	439	14	B
1016	2933 E HAMILTON	2857-27	2857-28	8	Vitrified Clay Pipe	75	21	H
1017	2748 E HAMILTON	2857-28	2857-30	8	Vitrified Clay Pipe	400	38	B
1018	2748 E HAMILTON	2857-28	2857-30	8	Vitrified Clay Pipe	400	38	B
1019	2748 E HAMILTON	2857-28	2857-30	8	Vitrified Clay Pipe	400	38	B
1020	2748 E HAMILTON	2857-28	2857-30	8	Vitrified Clay Pipe	400	38	B
1021	2748 E HAMILTON	2857-28	2857-30	8	Vitrified Clay Pipe	400	38	B
1022	2748 E HAMILTON	2857-28	2857-30	8	Vitrified Clay Pipe	400	38	HSV
1023	120 FULTON ST	2857-37	2857-48	6	Vitrified Clay Pipe	418	13	H
1024	2250 LOS ANGELES ST	2857-38	2857-40	6	Vitrified Clay Pipe	469	10	B
1025	2250 LOS ANGELES ST	2857-38	2857-40	6	Vitrified Clay Pipe	469	10	H
1026	210 VAN NESS AVE	2857-39	2856-31	6	Vitrified Clay Pipe	418	5	H
1027	2202 MONTEREY ST	2857-40	2757-26	6	Vitrified Clay Pipe	418	5	H
1028	2910 E HEATON AVE	2857-41	2857-27	8	Vitrified Clay Pipe	640	33	B
1029	100 M ST	2857-42	2857-41	8	Vitrified Clay Pipe	487	21	B
1030	100 M ST	2857-42	2857-41	8	Vitrified Clay Pipe	487	21	B
1031	100 M ST	2857-42	2857-41	8	Vitrified Clay Pipe	487	21	B
1032	1780 S PEARL ST	2857-43	2857-24	6	Vitrified Clay Pipe	197	60	B
1033	1780 S PEARL ST	2857-43	2857-24	6	Vitrified Clay Pipe	197	60	H
1034	1780 S PEARL ST	2857-43	2857-24	6	Vitrified Clay Pipe	197	60	H
1035	1780 S PEARL ST	2857-43	2857-24	6	Vitrified Clay Pipe	197	60	H
1036	1780 S PEARL ST	2857-43	2857-24	6	Vitrified Clay Pipe	197	60	H

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
1037	1780 S PEARL ST	2857-43	2857-24	6	Vitrified Clay Pipe	197	60	H
1038	1780 S PEARL ST	2857-43	2857-24	6	Vitrified Clay Pipe	197	60	H
1039	1780 S PEARL ST	2857-43	2857-24	6	Vitrified Clay Pipe	197	60	H
1040	1780 S PEARL ST	2857-43	2857-24	6	Vitrified Clay Pipe	197	60	H
1041	2730 E WOODWARD AVE	2857-46	2857-14	8	Vitrified Clay Pipe	380	5	B
1042	202 FULTON ST	2857-48	2856-29	6	Vitrified Clay Pipe	483	15	B
1043	202 FULTON ST	2857-48	2856-29	6	Vitrified Clay Pipe	483	15	B
1044	202 FULTON ST	2857-48	2856-29	6	Vitrified Clay Pipe	483	15	H
1045	2060 S GEARHART ST	2858-02	2858-04	8	Vitrified Clay Pipe	496	58	B
1046	2008 ORANGE AVE	2858-03	2858-19	8	Vitrified Clay Pipe	420	8	B
1047	1919 S THIRD ST	2858-26	2858-14	6	Cast Iron	433	0	SRC
1048	3321 E BRALY AVE	2858-31	2858-27	6	Cast Iron	355	90	SRC
1049	3321 E BRALY AVE	2858-31	2858-27	6	Cast Iron	355	90	SRC
1050	1808 S FIFTH ST	2858-37	2858-34	8	Vitrified Clay Pipe	146	17	B
1051	3230 E ORLEANS AVE	2858-49	2858-43	6	Cast Iron	335	5	SRC
1052	3230 E ORLEANS AVE	2858-49	2858-43	6	Cast Iron	335	5	SRC
1053	1736 S HAZELWOOD BLVD	2858-52	2858-39	6	Vitrified Clay Pipe	335	26	B
1054	1728 S FOURTH ST	2858-53	2858-38	6	Vitrified Clay Pipe	335	8	BSV
1055	1742 S FIFTH ST	2858-54	2858-37	6	Vitrified Clay Pipe	335	21	D
1056	1725 S FIFTH ST	2858-55	2858-36	6	Vitrified Clay Pipe	363	21	B
1057	1429 S ORANGE AVE	2858-59	2858-58	6	Vitrified Clay Pipe	329	16	BVV
1058	1627 S FIFTH ST	2858-62	2858-55	6	Vitrified Clay Pipe	521	48	B
1059	1627 S FIFTH ST	2858-62	2858-55	6	Vitrified Clay Pipe	521	48	B
1060	1627 S FIFTH ST	2858-62	2858-55	6	Vitrified Clay Pipe	521	48	BVV
1061	1627 S FIFTH ST	2858-62	2858-55	6	Vitrified Clay Pipe	521	48	H
1062	1640 S FIFTH ST	2858-63	2858-54	6	Vitrified Clay Pipe	520	5	B
1063	1435 S FOURTH ST	2858-65	2858-68	6	Vitrified Clay Pipe	387	12	H
1064	3356 E BUTLER AVE	2858-68	2858-72	6	Vitrified Clay Pipe	465	12	B
1065	3241 E TOWNSEND AVE	2858-74	2858-72	6	Vitrified Clay Pipe	320	29	B
1066	3241 E TOWNSEND AVE	2858-74	2858-72	6	Vitrified Clay Pipe	320	29	BVV
1067	3125 E TOWNSEND AVE	2858-83	2858-80	6	Vitrified Clay Pipe	280	37	B
1068	3125 E TOWNSEND AVE	2858-83	2858-80	6	Vitrified Clay Pipe	280	37	B
1069	3125 E TOWNSEND AVE	2858-83	2858-80	6	Vitrified Clay Pipe	280	37	BVV
1070	3633 E BRALY AVE	2859-27	2859-17	8	Vitrified Clay Pipe	324	8	B
1071	1727 S ORANGE AVE	2859-30	2858-87	6	Vitrified Clay Pipe	615	17	BVV
1072	3747 E HEATON AVE	2859-40	2858-58	6	Vitrified Clay Pipe	640	16	B
1073	3747 E HEATON AVE	2859-40	2858-58	6	Vitrified Clay Pipe	640	16	B

BCF-2 POINT REPAIRS
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No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
1074	54 E CALIFORNIA AVE	2953-12	2953-11	6	Vitrified Clay Pipe	362	30	B
1075	54 E CALIFORNIA AVE	2953-12	2953-11	6	Vitrified Clay Pipe	362	30	B
1076	54 E CALIFORNIA AVE	2953-12	2953-11	6	Vitrified Clay Pipe	362	30	BSV
1077	216 W ATCHISON ST	2953-13	2953-14	8	Vitrified Clay Pipe	628	34	BSV
1078	216 W ATCHISON ST	2953-13	2953-14	8	Vitrified Clay Pipe	628	34	BVV
1079	9 W ATCHISON ST	2953-14	2953-15	8	Vitrified Clay Pipe	97	8	B
1080	9 W ATCHISON ST	2953-20	2953-15	8	Concrete Pipe	257	8	B
1081	241 W ATCHISON ST	2953-23	2953-18	8	Vitrified Clay Pipe	330	5	B
1082	56 E LORENA ST	2953-26	2953-25	6	Vitrified Clay Pipe	582	51	B
1083	56 E LORENA ST	2953-26	2953-25	6	Vitrified Clay Pipe	582	51	B
1084	2220 S WALNUT AVE	2953-28	2953-30	8	Vitrified Clay Pipe	330	8	BVV
1085	2220 S WALNUT AVE	2953-29	2953-30	6	Vitrified Clay Pipe	658	8	BVV
1086	2220 S WALNUT AVE	2953-30	2953-42	8	Vitrified Clay Pipe	332	11	B
1087	2887 S THORNE AVE	2953-39	2953-33	8	Vitrified Clay Pipe	256	19	B
1088	2887 S THORNE AVE	2953-39	2953-33	8	Vitrified Clay Pipe	256	19	B
1089	2280 S WALNUT AVE	2953-41	2953-42	6	Vitrified Clay Pipe	659	18	B
1090	2280 S WALNUT AVE	2953-41	2953-42	6	Vitrified Clay Pipe	659	18	B
1091	2280 S WALNUT AVE	2953-41	2953-42	6	Vitrified Clay Pipe	659	18	BVV
1092	2131 S FAIVIEW AVE	2954-04	2954-05	6	Vitrified Clay Pipe	410	11	B
1093	2166 S LEE AVE	2954-05	2954-06	6	Vitrified Clay Pipe	437	18	BVV
1094	2139 S LEE AVE	2954-06	2954-14	8	Vitrified Clay Pipe	329	13	B
1095	2139 S LEE AVE	2954-06	2954-14	8	Vitrified Clay Pipe	329	13	B
1096	855 E LORENA AVE	2954-14	2954-24	8	Vitrified Clay Pipe	327	9	B
1097	2163 S MAUD AVE	2954-16	2954-14	6	Vitrified Clay Pipe	423	24	B
1098	608 E GEARY ST	2954-32	2954-33	6	Vitrified Clay Pipe	166	10	B
1099	608 E GEARY ST	2954-32	2954-33	6	Vitrified Clay Pipe	166	10	SMW
1100	2218 S MARTIN LUTHER	2954-36	2954-38	10	Vitrified Clay Pipe	521	25	B
1101	2385 S FAIRVIEW AVE	2954-61	2954-45	8	Vitrified Clay Pipe	241	16	BVV
1102	2390 S WALNUT AVE	2954-63	2953-09	10	Vitrified Clay Pipe	330	5	B
1103	2338 S WALNUT AVE	2954-64	2954-47	10	Vitrified Clay Pipe	331	14	BSV
1104	2374 S BARDELL ST	2955-18	2955-19	6	Vitrified Clay Pipe	320	8	B
1105	2372 S TUPMAN ST	2955-25	2955-26	8	Concrete Pipe	320	11	B
1106	2105 S MARTIN LUTHER	2955-28	2955-29	6	Vitrified Clay Pipe	619	37	B
1107	2105 S MARTIN LUTHER	2955-28	2955-29	6	Vitrified Clay Pipe	619	37	B
1108	1311 E FLORENCE AVE	2955-44	2955-47	10	Vitrified Clay Pipe	325	21	B
1109	1311 E FLORENCE AVE	2955-44	2955-47	10	Vitrified Clay Pipe	325	21	B
1110	2225 S EUNICE AVE	2955-46	2955-47	6	Vitrified Clay Pipe	523	38	B

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
1111	2225 S EUNICE AVE	2955-46	2955-47	6	Vitrified Clay Pipe	523	38	H
1112	2206 S IVY AVE	2955-49	2955-50	6	Vitrified Clay Pipe	622	21	B
1113	1551 E FLORENCE AVE	2955-50	2955-55	10	Vitrified Clay Pipe	331	14	BVV
1114	2324 S IVY AVE	2955-51	2955-70	6	Vitrified Clay Pipe	681	33	B
1115	2292 S GENEVA AVE	2955-54	2955-55	6	Vitrified Clay Pipe	621	45	BSV
1116	2292 S GENEVA AVE	2955-54	2955-55	6	Vitrified Clay Pipe	621	45	H
1117	1636 E FLORENCE AVE	2955-55	2955-56	10	Vitrified Clay Pipe	307	27	B
1118	1636 E FLORENCE AVE	2955-55	2955-56	10	Vitrified Clay Pipe	307	27	B
1119	1636 E FLORENCE AVE	2955-55	2955-56	10	Vitrified Clay Pipe	307	27	H
1120	2290 S ELM AVE	2955-56	2955-57	10	Vitrified Clay Pipe	30	5	B
1121	1329 E FLORENCE AVE	2955-75	2955-44	8	Vitrified Clay Pipe	657	13	B
1122	2370 S KIRK ST	2956-21	2956-22	6	Vitrified Clay Pipe	305	8	B
1123	2385 S HOLLY AVE	2956-27	2956-28	6	Vitrified Clay Pipe	132	10	B
1124	2385 S HOLLY AVE	2956-27	2956-28	6	Vitrified Clay Pipe	132	10	B
1125	235 S ELM AVE	2956-32	2956-72	6	Vitrified Clay Pipe	165	13	B
1126	235 S ELM AVE	2956-32	2956-72	6	Vitrified Clay Pipe	165	13	BSV
1127	2365 S ELM AVE	2956-33	2956-32	6	Vitrified Clay Pipe	318	16	H
1128	1824 E CALIFORNIA AVE	2956-35	2956-46	6	Vitrified Clay Pipe	586	29	B
1129	1824 E CALIFORNIA AVE	2956-35	2956-46	6	Vitrified Clay Pipe	586	29	B
1130	2195 S ELM AVE	2956-36	2955-58	8	Vitrified Clay Pipe	168	9	B
1131	2233 S HOLLY AVE	2956-43	2956-40	6	Vitrified Clay Pipe	320	20	B
1132	2229 S POPPY AVE	2956-46	2956-37	6	Vitrified Clay Pipe	627	16	B
1133	2285 S HOLLY AVE	2956-47	2956-46	6	Vitrified Clay Pipe	305	32	BSV
1134	2285 S HOLLY AVE	2956-47	2956-46	6	Vitrified Clay Pipe	305	32	HVV
1135	2316 S KIRK ST	2956-54	2956-21	6	Vitrified Clay Pipe	664	33	B
1136	2316 S KIRK ST	2956-54	2956-21	6	Vitrified Clay Pipe	664	33	H
1137	2250 E CALIFORNIA AVE	2956-56	2956-57	6	Vitrified Clay Pipe	167	5	BVV
1138	2590 E CHURCH AVE	2956-62	2957-01	36	Reinforced Concrete Pipe	374	10	B
1139	2590 E CHURCH AVE	2956-62	2957-01	36	Reinforced Concrete Pipe	374	10	SRV
1140	2301 E FLORENCE AVE	2956-64	2956-63	6	Vitrified Clay Pipe	663	8	B
1141	2224 S CHERRY AVE	2956-66	2956-67	6	Vitrified Clay Pipe	545	28	B
1142	2224 S CHERRY AVE	2956-66	2956-67	6	Vitrified Clay Pipe	545	28	H
1143	2328 S CHERRY AVE	2956-67	2956-61	6	Vitrified Clay Pipe	615	21	H
1144	2167 S G ST	2956-79	2956-78	6	Vitrified Clay Pipe	165	9	B
1145	2167 S G ST	2956-79	2956-78	6	Vitrified Clay Pipe	165	9	H
1146	2111 S LOTUS AVE	2956-80	2956-82	6	Vitrified Clay Pipe	325	24	BVV
1147	2111 S LOTUS AVE	2956-80	2956-82	6	Vitrified Clay Pipe	325	24	H

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
1148	2161 S LILY AVE	2956-81	2956-84	6	Vitrified Clay Pipe	600	20	B
1149	2256 S RAILROAD	2957-07	2957-06	8	Cast Iron	658	384	B
1150	2256 S RAILROAD	2957-07	2957-06	8	Cast Iron	658	384	B
1151	2384 SARAH ST	2957-12	2957-53	8	Vitrified Clay Pipe	265	16	B
1152	2384 SARAH ST	2957-12	2957-53	8	Vitrified Clay Pipe	265	16	H
1153	2336 S RAILROAD AVE	2957-15	2957-14	6	Vitrified Clay Pipe	393	27	B
1154	2336 S RAILROAD AVE	2957-15	2957-14	6	Vitrified Clay Pipe	393	27	BVV
1155	2336 S RAILROAD AVE	2957-15	2957-14	6	Vitrified Clay Pipe	393	27	BVV
1156	2356 S RAILROAD AVE	2957-16	2957-15	6	Vitrified Clay Pipe	771	22	H
1157	2356 S RAILROAD AVE	2957-16	2957-102	6	Vitrified Clay Pipe	383	15	B
1158	2356 S RAILROAD AVE	2957-16	2957-102	6	Vitrified Clay Pipe	383	15	B
1159	2356 S RAILROAD AVE	2957-16	2957-102	6	Vitrified Clay Pipe	383	15	H
1160	2643 E CHURCH AVE	2957-18	2957-19	6	Vitrified Clay Pipe	660	21	B
1161	2643 E CHURCH AVE	2957-18	2957-19	6	Vitrified Clay Pipe	660	21	B
1162	2643 E CHURCH AVE	2957-20	2957-21	8	Vitrified Clay Pipe	53	5	BSV
1163	2811 E CHURCH AVE	2957-28	2957-27	6	Vitrified Clay Pipe	329	29	BSV
1164	2811 E CHURCH AVE	2957-28	2957-27	6	Vitrified Clay Pipe	329	29	BVV
1165	2811 E CHURCH AVE	2957-28	2957-27	6	Vitrified Clay Pipe	329	29	BVV
1166	2303 S ORINDA ST	2957-38	2957-36	10	Vitrified Clay Pipe	672	34	B
1167	2500 E CALIFORNIA AVE	2957-40	2957-41	8	Vitrified Clay Pipe	250	36	B
1168	2500 E CALIFORNIA AVE	2957-40	2957-41	8	Vitrified Clay Pipe	250	36	B
1169	2384 SARAH ST	2957-53	2957-23	6	Vitrified Clay Pipe	397	16	BSV
1170	2384 SARAH ST	2957-53	2957-23	6	Vitrified Clay Pipe	397	16	H
1171	89 E GARRETT AVE	3053-19	3053-18	6	Vitrified Clay Pipe	388	5	B
1172	2581 S WALNUT AVE	3053-28	3153-05	12	Vitrified Clay Pipe	360	8	B
1173	1222 E KAVILAND AVE	3055-11	3055-12	8	Concrete Pipe	551	5	B
1174	2498 S ELM AVE	3055-18	3055-17	8	Vitrified Clay Pipe	660	5	B
1175	2424 E GROVE AVE	3056-10	3056-11	6	Vitrified Clay Pipe	444	21	B
1176	2424 E GROVE AVE	3056-10	3056-11	6	Vitrified Clay Pipe	444	21	B
1177	2424 E GROVE AVE	3056-10	3056-11	6	Vitrified Clay Pipe	444	21	B
1178	2495 S LILY AVE	3056-13	3056-12	8	Vitrified Clay Pipe	663	9	B
1179	2953 S ELM AVE	3056-28	3056-01	8	Concrete Pipe	676	13	BVV
1180	2953 S ELM AVE	3056-28	3056-01	8	Concrete Pipe	676	13	BVV
1181	2592 S CEDAR AVE	3059-10	3159-24	8	Vitrified Clay Pipe	207	5	B
1182	2536 S MAPLE AVE	3061-10	3061-11	6	Polyvinyl Chloride	388	4	D
1183	2594 S HABITAT AVE	3153-01	3153-08	48	Concrete Pipe	87	8	SRC
1184	2658 S LEE AVE	3154-07	3154-06	8	Vitrified Clay Pipe	555	10	B

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
1185	2658 S LEE AVE	3154-07	3154-06	8	Vitrified Clay Pipe	555	10	B
1186	2750 S BARDELL ST	3155-12	3155-13	8	Vitrified Clay Pipe	209	5	B
1187	2734 S TUPMAN ST	3155-17	3155-30	8	Vitrified Clay Pipe	420	38	B
1188	2734 S TUPMAN ST	3155-17	3155-30	8	Vitrified Clay Pipe	420	38	B
1189	2734 S TUPMAN ST	3155-17	3155-30	8	Vitrified Clay Pipe	420	38	B
1190	2734 S TUPMAN ST	3155-17	3155-30	8	Vitrified Clay Pipe	420	38	BSV
1191	2727 S BARDELL ST	3155-19	3155-21	8	Vitrified Clay Pipe	260	56	B
1192	2727 S BARDELL ST	3155-19	3155-21	8	Vitrified Clay Pipe	260	56	B
1193	2727 S BARDELL ST	3155-19	3155-21	8	Vitrified Clay Pipe	260	56	B
1194	2727 S BARDELL ST	3155-19	3155-21	8	Vitrified Clay Pipe	260	56	B
1195	2697 S BARDELL ST	3155-21	3155-23	8	Vitrified Clay Pipe	260	19	B
1196	2677 S BARDELL ST	3155-23	3155-26	8	Vitrified Clay Pipe	270	22	B
1197	2677 S BARDELL ST	3155-23	3155-26	8	Vitrified Clay Pipe	270	22	B
1198	2677 S BARDELL ST	3155-23	3155-26	8	Vitrified Clay Pipe	270	22	B
1199	2672 S TUPMAN ST	3155-30	3155-29	8	Vitrified Clay Pipe	390	39	B
1200	2672 S TUPMAN ST	3155-30	3155-29	8	Vitrified Clay Pipe	390	39	B
1201	2672 S TUPMAN ST	3155-30	3155-29	8	Vitrified Clay Pipe	390	39	B
1202	2672 S TUPMAN ST	3155-30	3155-29	8	Vitrified Clay Pipe	390	39	BVV
1203	1307 E DOROTHY AVE	3155-32	3155-36	8	Vitrified Clay Pipe	165	16	BVV
1204	1004 E DRUMMOND AVE	3155-39	3154-20	8	Vitrified Clay Pipe	664	371	HVV
1205	1046 E CALWA AVE	3155-60	3154-10	8	Vitrified Clay Pipe	664	326	B
1206	2627 S EAST AVE	3157-08	3157-09	10	Vitrified Clay Pipe	222	5	BVV
1207	2734 S TUPMAN ST	3157-17	3157-23	8	Vitrified Clay Pipe	420	20	B
1208	2734 S TUPMAN ST	3157-17	3157-23	8	Vitrified Clay Pipe	420	20	B
1209	2696 S MAPLE AVE	3160-17	3160-10	12	Vitrified Clay Pipe	350	5	BSV
1210	4771 E DATE AVE	3161-01	3161-08	8	Vitrified Clay Pipe	535	5	B
1211	2991 LEE AVE	3254-09	3254-12	6	Vitrified Clay Pipe	316	5	B
1212	3052 S MARTIN LUTHER	3254-11	3254-13	15	Reinforced Concrete Pipe	331	75	BSV
1213	3052 S MARTIN LUTHER	3254-11	3254-13	15	Reinforced Concrete Pipe	331	75	BVV
1214	3052 S MARTIN LUTHER	3254-11	3254-13	15	Reinforced Concrete Pipe	331	75	SRVC
1215	1664 E CHESTER AVE	3255-15	3255-14	8	Vitrified Clay Pipe	458	5	BSV
1216	3187 E COMMERCE AVE	3258-03	3258-08	8	Vitrified Clay Pipe	625	5	H
1217	2907 S MAPLE AVE	3260-04	3260-14	10	Vitrified Clay Pipe	570	35	B
1218	2907 S MAPLE AVE	3260-04	3260-14	10	Vitrified Clay Pipe	570	35	B
1219	2907 S MAPLE AVE	3260-04	3260-14	10	Vitrified Clay Pipe	570	35	BSV
1220	4525 E COMMERCE AVE	3260-09	3260-10	8	Vitrified Clay Pipe	500	8	B
1221	2907 S MAPLE AVE	3260-14	3260-13	10	Vitrified Clay Pipe	660	54	B

BCF-2 POINT REPAIRS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH PRIORITY POINT REPAIRS

No.	Street	Upstream MH	Downstream MH	Diameter (in)	Material	Total Length (ft)	MOSR	Priority Code
1222	2907 S MAPLE AVE	3260-14	3260-13	10	Vitrified Clay Pipe	660	54	B
1223	2907 S MAPLE AVE	3260-14	3260-13	10	Vitrified Clay Pipe	660	54	B
1224	2907 S MAPLE AVE	3260-14	3260-13	10	Vitrified Clay Pipe	660	54	B
1225	2907 S MAPLE AVE	3260-14	3260-13	10	Vitrified Clay Pipe	660	54	B
1226	313 W ROY AVE	3355-08	3355-02	8	Vitrified Clay Pipe	640	5	B
1227	207 W ROY AVE	3355-10	3355-08	8	Vitrified Clay Pipe	660	5	BSV
1228	10882 N. WOODROW AVE	561-44	561-43	8	Polyvinyl Chloride	184	5	D
1229	2303 E. WARICK	961-26	961-27	6	Polyvinyl Chloride	413	4	D
1230	419 W ESCALON AVE	SN14540003	1454-11	8	Vitrified Clay Pipe	75	5	B
1231	4909 N GLENN AVE	SN17550001	1755-43	8	Vitrified Clay Pipe	200	5	BSV
1232	1303 W CAMBRIDGE AVE	SN22510002	2251-26	8	Cast Iron	71	65	SRC
1233	1303 W CAMBRIDGE AVE	SN22510002	2251-26	8	Cast Iron	71	65	SRC
1234	1426 N ECHO AVE	SN23540004	2354-47	6	Vitrified Clay Pipe	400	13	BVV
1235	1426 N ECHO AVE	SN23540004	2354-47	6	Vitrified Clay Pipe	400	13	H
1236	1840 BROADWAY	SN26540003	2654-32	6	Vitrified Clay Pipe	428	22	H
1237	1840 BROADWAY	SN26540003	2654-32	6	Vitrified Clay Pipe	428	22	H
1238	1840 BROADWAY	SN26540003	2654-32	6	Vitrified Clay Pipe	428	22	H
1239	1840 BROADWAY	SN26540003	2654-32	6	Vitrified Clay Pipe	428	22	H
1240	1861 AMADOR ST	SN26540004	2654-11	6	Vitrified Clay Pipe	428	26	B
1241	1861 AMADOR ST	SN26540004	2654-11	6	Vitrified Clay Pipe	428	26	D
1242	1254 FULTON MALL	SN26550002	SN26550003	30	Vitrified Clay Pipe	400	5	B
1243	517 FRESNO ST	SN28540006	2854-13	6	Vitrified Clay Pipe	150	10	B
1244	517 FRESNO ST	SN28540006	2854-13	6	Vitrified Clay Pipe	150	10	BVV
1245	517 FRESNO ST	SN28540007	2854-13	6	Vitrified Clay Pipe	150	5	BVV
1246	1232 WATERMAN AVE	SN28540010	2854-24	6	Vitrified Clay Pipe	150	5	B
1247	1226 POTTLE AVE	SN28540012	2854-30	6	Vitrified Clay Pipe	150	5	H
1248	1137 COLLINS AVE	SN28540014	2854-32	6	Vitrified Clay Pipe	150	10	BSV
1249	1137 COLLINS AVE	SN28540014	2854-32	6	Vitrified Clay Pipe	150	10	BSV

APPENDIX I – BCF-MOSR SEWER SEGMENTS

BCF-3 MOSR SEWER SEGMENTS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH MOSR REHABILITATION SECTIONS

DRAFT

CIPP Liner Rehabilitation Phase A										
No.	Street	Plat Number	Upstream MH	Downstream MH	Pipe Diameter (in)	Material	Total Length (ft)	MOSR	$/ft	Price
1	810 E BELGRAVIA AVE	2954	2954-59	2954-52	30	Concrete Segments	1038	600	260	$431,000
2	871 E CHURCH AVE	2954	2954-56	2954-59	30	Concrete Segments	294	138	260	$143,000
3	505 F ST	2856	2855-70	2856-64	18	Vitrified Clay Pipe	475	288	180	$155,000
4	506 E ST	2856	2855-63	2855-62	18	Vitrified Clay Pipe	230	129	180	$ 94,000
5	1430 SANTA CLARA ST	2856	2856-64	2855-63	18	Vitrified Clay Pipe	218	123	180	$ 91,000
6	3370 E MONO ST	2658	2658-35	2658-33	15	Reinforced Concrete Pipe	479	376	160	$143,000
7	3408 E MONO ST	2658	2658-36	2658-35	15	Reinforced Concrete Pipe	479	116	160	$143,000
8	860 N AUGUSTA AVE	2457	2457-08	2457-02	12	Standard Concrete Pipe	435	352	140	$121,000
9	2841 E SHIELDS AVE	2057	2057-26	2057-27	12	Vitrified Clay Pipe	473	272	140	$128,000
10	2997 E SHIELDS AVE	2057	2057-24	2057-25	12	Standard Concrete Pipe	473	267	140	$128,000
11	3074 E SAGINAW WAY	1957	1957-69	2057-08	12	Vitrified Clay Pipe	812	477	140	$212,000
12	3995 N FIRST ST	1957	1957-51	1957-50	8	Vitrified Clay Pipe	272	141	113	$ 79,000
13	1501 N CHESTNUT AVE	2361	2361-29	2362-76	8	Cast Iron	635	510	113	$153,000
14	1004 E DRUMMOND AVE	3155	3155-39	3154-20	8	Vitrified Clay Pipe	664	371	113	$158,000
15	1002 E JENSEN AVE	3155	3155-48	3154-21	8	Standard Concrete Pipe	619	348	113	$151,000
16	1046 E CALWA AVE	3155	3155-60	3154-10	8	Vitrified Clay Pipe	664	326	113	$158,000

Phase A Total = $ 2,488,000

BCF-3 MOSR SEWER SEGMENTS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH MOSR REHABILITATION SECTIONS

DRAFT

CIPP Liner Rehabilitation Phase B										
No.	Street	Plat Number	Upstream MH	Downstream MH	Pipe Diameter (in)	Material	Total Length (ft)	MOSR	$/ft	Price
17	1206 E GROVE AVE	3055	3055-07	3055-08	8	Standard Concrete Pipe	660	351	113	$157,000
18	945 E KAVILAND AVE	3055	3055-10	3054-07	8	Standard Concrete Pipe	664	333	113	$158,000
19	1047 E BYRD AVE	3055	3055-08	3054-06	8	Concrete Segments	664	259	113	$158,000
20	952 E KAVILAND AVE	3055	3055-12	3054-08	8	Standard Concrete Pipe	664	144	113	$158,000
21	2256 S RAILROAD	2957	2957-07	2957-06	8	Cast Iron	658	384	113	$157,000
22	2943 N MARIPOSA ST	2157	2157-16	2157-05	8	Concrete Segments	659	380	113	$157,000
23	2602 N FRESNO ST	2157	2157-04	2156-57	8	Standard Concrete Pipe	659	363	113	$157,000
24	3013 E CORNELL AVE	2157	2157-29	2157-30	8	Standard Concrete Pipe	628	222	113	$152,000
25	2707 E BROWN AVE	2157	2157-35	2157-03	8	Standard Concrete Pipe	658	126	113	$157,000
26	4946 N EFFIE ST	1756	1756-61	1756-60	8	Vitrified Clay Pipe	464	156	113	$109,000
27	2515 N FIRST ST	2157	2157-44	2157-43	6	Standard Concrete Pipe	620	366	100	$140,000
28	2619 N FIRST ST	2157	2157-41	2157-40	6	Standard Concrete Pipe	617	337	100	$139,000
29	2907 E HARVARD AVE	2157	2157-39	2157-40	6	Vitrified Clay Pipe	659	318	100	$145,000
30	2514 N ANGUS ST	2157	2157-42	2157-43	6	Standard Concrete Pipe	638	170	100	$142,000
31	1540 N GERALDINE WAY	2352	2352-47	2352-44	6	Concrete Segments	665	436	100	$146,000
32	537 W HAMMOND AVE	2352	2352-09	2352-08	6	Vitrified Clay Pipe	617	104	100	$139,000
33	4947 N THESTA ST	1756	1756-46	1756-45	6	Vitrified Clay Pipe	525	116	100	$109,000
34	4748 N SAN PABLO AVE	1755	1755-56	1755-57	6	Cast Iron	398	380	100	$ 91,000

Phase B Total = $ 2,571,000

BCF-3 MOSR SEWER SEGMENTS
CITY OF FRESNO WASTEWATER MASTER PLAN
HIGH MOSR REHABILITATION SECTIONS

DRAFT

CIPP Liner Rehabilitation Phase C										
No.	Street	Plat Number	Upstream MH	Downstream MH	Pipe Diameter (in)	Material	Total Length (ft)	MOSR	$/ft	Price
35	1782 E GROVE AVE	3056	3056-29	3056-28	8	Standard Concrete Pipe	659	346	113	$157,000
36	2504 S KIRK ST	3056	3056-13	3056-14	8	Standard Concrete Pipe	624	315	113	$152,000
37	2504 S HOLLY AVE	3056	3056-26	3056-27	8	Standard Concrete Pipe	630	261	113	$153,000
38	2504 S NICHOLAS AVE	3056	3056-11	3056-32	8	Concrete Segments	678	201	113	$160,000
39	2582 S LILY AVE	3056	3056-18	3056-19	8	Vitrified Clay Pipe	630	114	113	$153,000
40	1421 E CHURCH AVE	2955	2955-69	2955-07	8	Concrete Segments	664	162	113	$158,000
41	1503 E VASSAR AVE	2255	2255-14	2255-15	8	Standard Concrete Pipe	402	231	113	$ 99,000
42	2242 N GLENN AVE	2255	2255-15	2255-16	8	Standard Concrete Pipe	372	225	113	$ 94,000
43	3672 N MAROA AVE	2055	2055-05	2054-52	8	Concrete Segments	336	189	113	$ 89,000
44	6537 N TENTH ST	1559	1559-23	1559-22	8	Vitrified Clay Pipe	387	103	113	$ 97,000
45	5645 N TENTH ST	1559	1559-24	1559-23	8	Vitrified Clay Pipe	687	135	113	$162,000
46	1305 E OLIVE AVE	2355	2355-88	2355-08	6	Vitrified Clay Pipe	471	155	100	$101,000
47	1218 N FERGER AVE	2354	2354-12	2354-10	6	Vitrified Clay Pipe	662	144	100	$146,000
48	1610 E YALE AVE	2255	2255-29	2255-28	6	Standard Concrete Pipe	417	320	100	$ 94,000
49	1522 E YALE AVE	2255	2255-28	2255-27	6	Standard Concrete Pipe	364	215	100	$ 86,000
50	1508 E CLINTON AVE	2255	2255-08	2255-16	6	Standard Concrete Pipe	290	176	100	$ 76,000
51	2030 N WEST AVE	2252	2252-43	2251-25	6	Vitrified Clay Pipe	668	218	100	$147,000
52	3104 N NINTH ST	2159	2159-27	2159-28	6	Vitrified Clay Pipe	542	203	100	$111,000
53	307 E FOUNTAIN	2054	2053-15	2054-13	6	Vitrified Clay Pipe	612	134	100	$139,000
54	2033 E ASHCROFT AVE	1856	1856-04	1856-06	6	Cast Iron	233	200	100	$ 68,000
55	5123 W MISSION AVE	1645	1645-28	1645-29	6	Cast Iron	212	165	100	$ 65,000
56	5106 W SHAW AVE	1645	1645-26	1645-28	6	Cast Iron	185	165	100	$ 61,000
57	6414 N FOURTH ST	1358	1358-23	1358-22	6	Vitrified Clay Pipe	200	104	100	$ 63,000

Phase C Total = $ 2,631,000

APPENDIX J – BCF-CIP PROJECT MAP

COPPER
INTERNATIONAL
BEHYMER
PERRIN
SHEPHERD
TEAGUE
NEES
ALLUVIAL
HERNDON
SIERRA
BULLARD
BARSTOW
SHAW
GETTYSBURG
ASHLAN
DAKOTA
SHIELDS
CLINTON
McKINLEY
OLIVE
BELMONT
NIELSEN
WHITESBRIDGE
KEARNEY
CALIFORNIA
CHURCH
JENSEN
ANNANDALE
NORTH
MUSCAT
CENTRAL

GARFIELD GRANTLAND BRYAN HAYES POLK CORNELIA BLYTHE BRAWLEY VALENTINE MARKS VAN NESS WEST FRUIT PALM MAROA BLACKSTONE FRESNO FIRST MILLBROOK CEDAR MAPLE CHESTNUT WILLOW PEACH MINNEWAWA CLOVIS SUNNYSIDE FOWLER ARMSTRONG TEMPERANCE LOGAN DEWOLF LEONARD HIGHLAND THOMPSON McCALL

SAN JOAQUIN RIVER

LS-4 LS-5 LS-6 LS-10 LS-16 LS-14 LS-12 LS-18 LS-2 LS-11 LS-1 LS-3 LS-15 LS-13 LS-20

R-01A R-01B R-01C

C-1A C-1B C-2A C-2B C-3 C-4 C-5A C-5B C-5C C-6 C-7 C-8 C-9

D-1 D-2 D-3 D-4 D-5 D-6A D-6B D-7A D-7B D-7C D-8A D-8B D-8C D-9A D-9B D-9C D-10A D-10B D-10C D-10D D-10E D-11A D-11B D-11C D-12A D-12B D-12C D-13 D-14A D-14B D-14C D-14D D-15 D-16 D-17 D-18 D-19A D-19B D-20 D-21A D-21B D-22A D-22B D-22C D-23A D-23B D-24A D-24B D-25 D-26A D-26B D-27A D-27B

GPSP GPSP-PIPE SEGA

CALIFORNIA STATE UNIVERSITY, FRESNO

FRESNO YOSEMITE INTERNATIONAL AIRPORT

DOWNTOWN FRESNO

FRESNO/CLOVIS REGIONAL WASTEWATER RECLAMATION FACILITY

99 41 180

HERNDON MARKS CORNELIA GRANTLAND ORANGE CHESTNUT FOWLER LEONARD NORTH AVENUE

LEGEND

- REHABILITATION/REPAIR PROJECTS (R-X)
- DEVELOPMENT/GROWTH PROJECTS (D-X)
- CAPACITY PROJECTS (C-X)
- OTHER EXISTING SEWER ≥ 27"
- OTHER EXISTING SEWER
- SEWER SERVICE AREA BOUNDARIES
- CITY LIMITS
- LIFT STATION REHABILITATION PROJECT (LS-X)
- PROPOSED TREATMENT FACILITY

NOTE: PRIORITY POINT REPAIR LOCATIONS NOT SHOWN, SEE CHAPTER 7 FOR LOCATIONS

N

0 1500 3000 6000
SCALE IN FEET

PRELIMINARY

Blair, Church & Flynn CONSULTING ENGINEERS

CONSULTANT
Blair, Church & Flynn Consulting Engineers
401 Clovis Avenue, Suite 200
Clovis, California 93612
Tel (559) 326-1400
Fax (559) 326-1500

REF. & REV.

CITY OF FRESNO

WASTEWATER COLLECTION SYSTEM MASTER PLAN
FIGURE 1
CAPITAL IMPROVEMENT PROJECTS

DR. BY: DGM
CH. BY: LMG
DATE: 7-11-2014
SCALE AS NOTED

SHEET NO. 1 OF 1 SHEETS

Drawing: P:\277-50\CAD\Civil\Fig1_Master_Plan.dwg, 30x42 - BCF.ctb