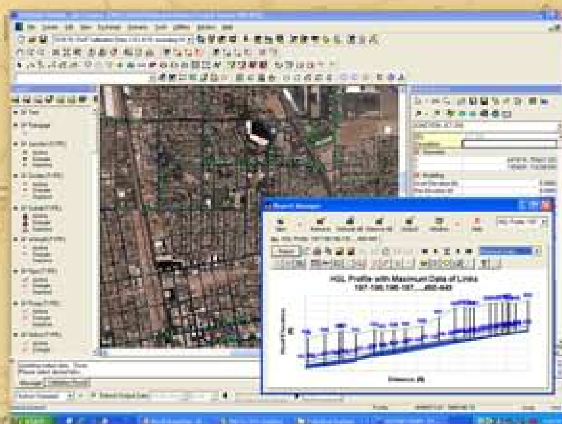
CITY OF TULARE

Sewer System Master Plan



FINAL REPORT

July 2009

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CITY OF TULARE
Sewer System Master Plan
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July 13, 2009
7608A00

City of Tulare
411 East Kern Avenue
Tulare, California 93277

Attention: Kenneth Ramage, P.E.

Subject: City of Tulare Sewer System Master Plan

Dear Mr. Ramage:

We are pleased to submit this final report for the City of Tulare (City) Sewer System Master Plan (Master Plan). Enclosed are ten copies of the Master Plan report. The report presents planning assumptions, the evaluation of the sanitary sewer collection system, recommended facility improvements to correct existing deficiencies and to serve future growth, and a capital improvement program.

We would like to extend our thanks to you, Mr. Darrel Pyle, City Manager; Mr. Lew Nelson, Public Works Director; Mr. Mike Whitlock, Senior Civil Engineer; Mr. Richard Bono, Wastewater Superintendent; and other City Staff whose courtesy and cooperation were valuable components in completing and producing this report.

Sincerely,

CAROLLO ENGINEERS, P.C.

David L. Stringfield, P.E.
Partner

Tim Loper, P.E.
Project Manager

DLS/TJL:asw

Enclosures: Sewer System Master Plan (10)

7580 N. Ingram Avenue, Suite. 112, Fresno, California 93711
P. 559.436.6616 F. 559.436.1191
carollo.com

REGISTERED PROFESSIONAL ENGINEER
DAVID L. STRINGFIELD
No. C25084
Exp. 12/31/09
CIVIL
STATE OF CALIFORNIA

7/13/09

REGISTERED PROFESSIONAL ENGINEER
TIMOTHY JOHN LOPER
No.70847
Exp. 6/30/11
CIVIL
STATE OF CALIFORNIA

7/13/09

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City of Tulare

SEWER SYSTEM MASTER PLAN

FINAL

July 2009

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City of Tulare

SEWER SYSTEM MASTER PLAN

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SEWER SYSTEM MASTER PLAN

This executive summary presents a brief background of the City of Tulare (City) sanitary sewer collection system, the need for this master plan, proposed improvements to mitigate existing system deficiencies, and proposed expansion projects. A summary of capital improvement project costs, through the planning year 2030, is included at the end of this chapter.

ES.1 STUDY OBJECTIVE

On September 21, 2006, the City authorized Carollo Engineers, P.C., (Carollo) to prepare this sewer system master plan study, which included the following tasks:

- Establish sewer system planning criteria.
- Create and calibrate a hydraulic computer model of the collection system.
- Evaluate the capacity of the existing sewer collection system.
- Review existing system deficiencies and propose improvements to enhance system capacity.
- Recommend improvements needed to service anticipated future growth.
- Develop Capital Improvement Program (CIP) with a planning horizon of 2030.

ES.2 STUDY AREA

The City is located along Highway 99 in Tulare County within the Central San Joaquin Valley of California, approximately 45 miles south of Fresno and 60 miles north of Bakersfield.

Tulare was founded in 1872 by the Southern Pacific Railroad, and incorporated in 1888. Agriculture is a major component of the City's economy, due to its highly productive farmland. Tulare is attractive to food processors and distributors because of its central location and abundance of locally grown products.

The City recently updated its General Plan. The City limits and Urban Development Boundary (UDB), as established from the City's Land Use Diagram, are about 19 square miles (12,281 acres) and 37 square miles (23,608 acres), respectively. The current City Limits and UDB are shown on Figure ES.1. The study area boundary for this master plan is the UDB.

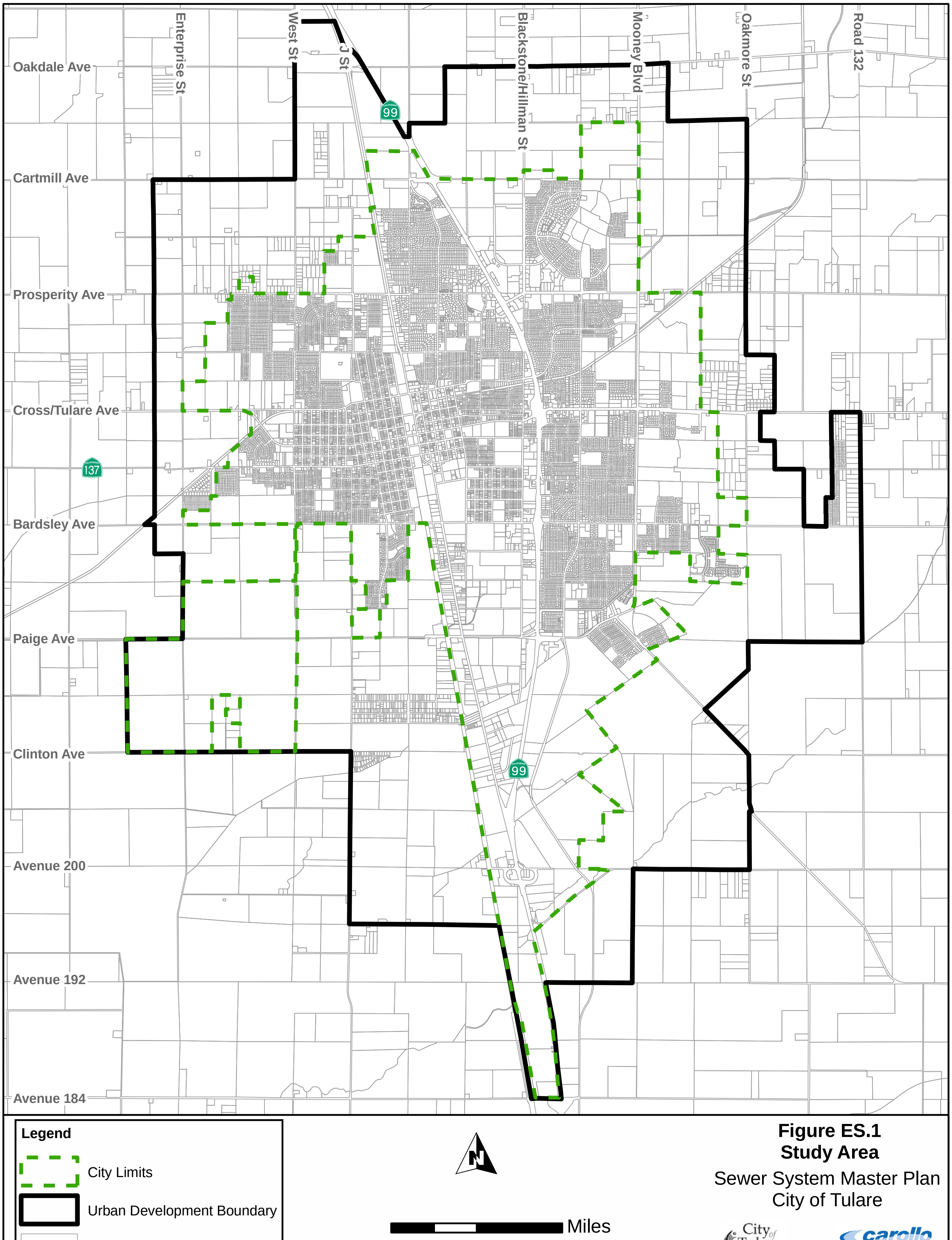


Figure ES.1
Study Area
Sewer System Master Plan
City of Tulare

ES.3 SEWER SYSTEM OVERVIEW

The City's collection system facilities consist of 6-inch diameter through 39-inch diameter gravity sewer pipelines, as well as 16 sewage lift stations and associated force mains (Figure ES.2). The majority of these pipelines convey wastewater generated within the City limits to the City's Domestic Wastewater Treatment Plant (DWWTP). There are also sewers dedicated to conveying wastewater flow from industrial dischargers to the City's Industrial Wastewater Treatment Plant (IWWTP). Figure ES.3 identifies the City's "backbone" sewer system, which was included in the City's hydraulic model.

ES.4 SEWER FLOWS

The City's sewer collection system was analyzed under existing and future (2030) peak flow conditions. The peak flow condition, referred to as the "design flow," represents the peak hourly flow experienced by the collection system and is measured at the DWWTP and IWWTP. Table ES.1 contains a summary of the design flows utilized for this master planning study.

**Table ES.1 Existing and Projected Design Flow
Sewer System Master Plan
City of Tulare**

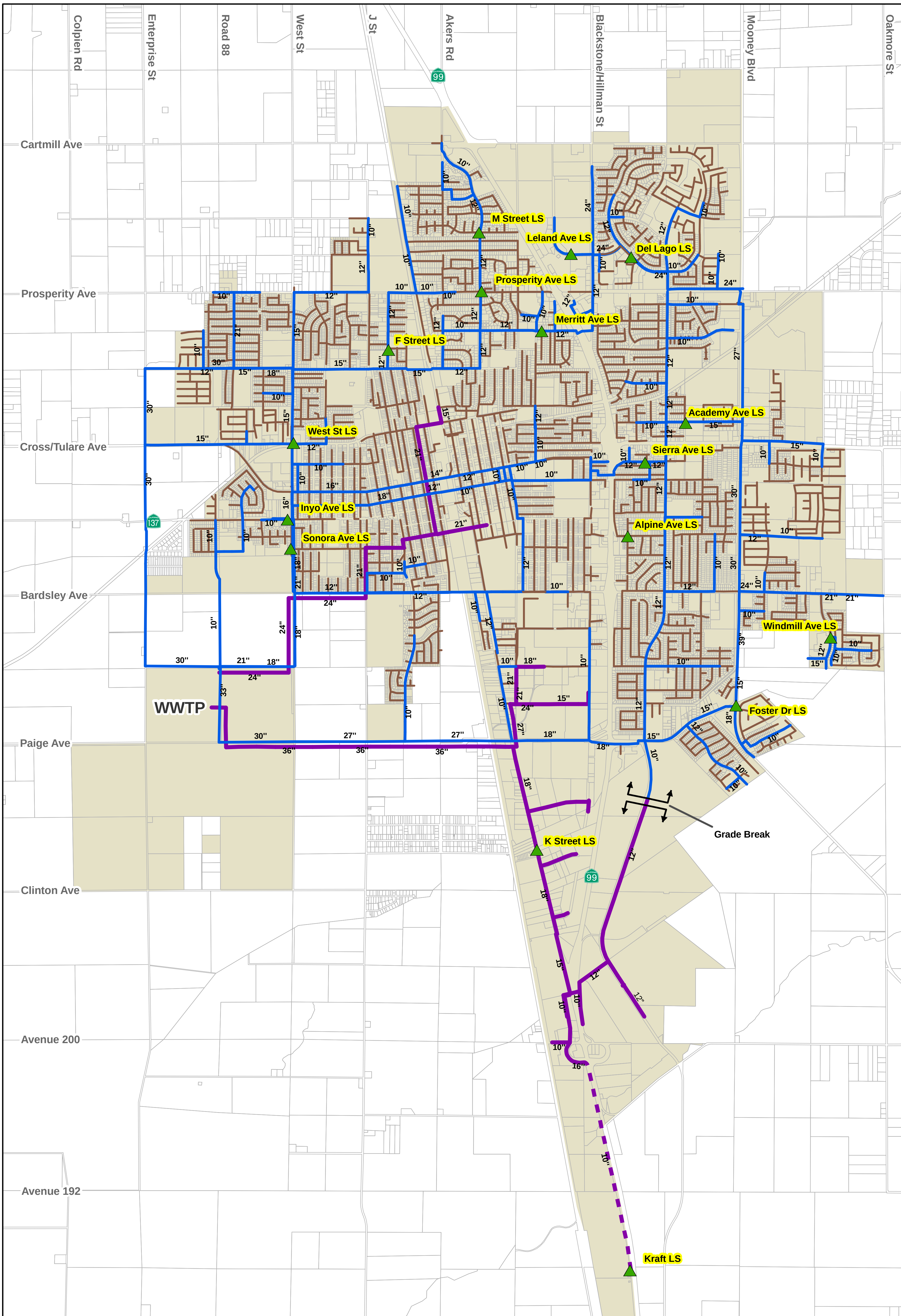
Year	Domestic Collection System			Industrial Collection System		
	ADF (mgd)	Design Flow (mgd)	Peaking Factor	ADF (mgd)	Design Flow (mgd)	Peaking Factor
Existing	4.5	9.5	2.1	6.5	13.0	2.0
2030	12.9	27.9	2.1	13.5	27.4	2.0

Note:
1. ADF and design flow is taken at the DWWTP and IWWTP for this table.

ES.5 EVALUATION AND PROPOSED IMPROVEMENTS

The City's existing and future collection system were evaluated under the design flow conditions presented in Table ES.1 using the planning criteria presented in the body of this report. A hydraulic computer model was assembled and used in the evaluation of the City's existing collection system and the planning of future facilities. The hydraulic model combines information on the physical and operational characteristics of the sewer system, and performs calculations to solve a series of mathematical equations to simulate flows in pipes.

Figure ES.4 identifies existing City facilities that were identified as deficient under existing design flow conditions. The proposed improvements to mitigate existing deficiencies and to



Legend

Existing Wastewater Collection System

Lift Stations

Pipelines

8" and Smaller

10" and Larger

Industrial Gravity Main

Industrial Force Main

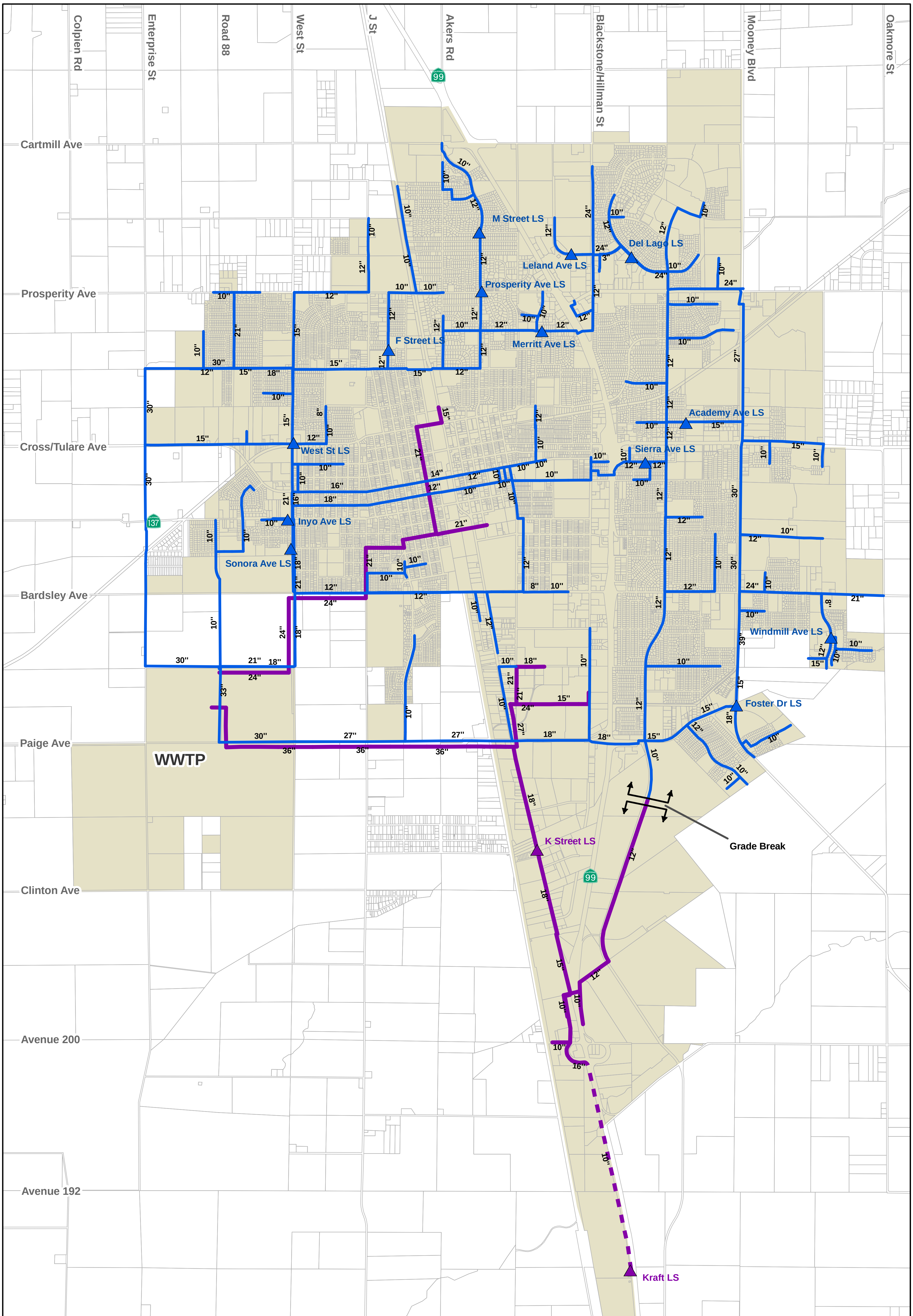
City Limits

Parcels

Miles 0 0.4 0.8

Figure ES.2
Existing Collection System

Sewer System Master Plan
City of Tulare



Legend

Modeled Wastewater Collection System

- Domestic Lift Stations
- Industrial Lift Stations
- Domestic Sewer Pipelines
- Industrial Gravity Main
- Industrial Force Main
- City Limits
- Parcels

Miles: 0, 0.4, 0.8

Figure ES.3
Modeled Collection System

Sewer System Master Plan
City of Tulare

City of Tulare
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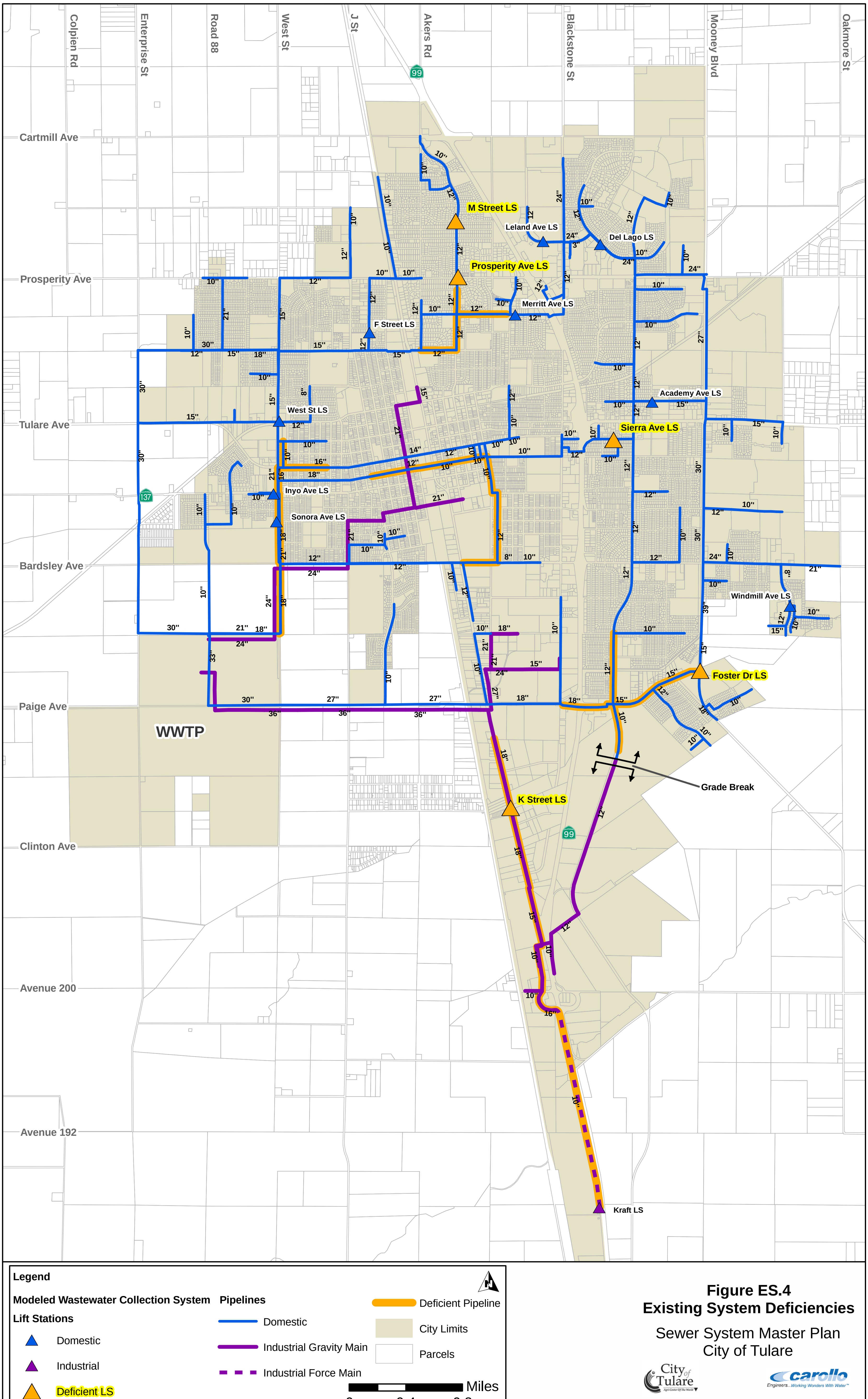


Figure ES.4
Existing System Deficiencies

Sewer System Master Plan
City of Tulare

serve future growth are shown Figure ES.5. Details of each improvement are also provided in Table ES.2.

ES.5.1 Project Prioritization

The master plan CIP provides a breakdown of recommended improvement projects over five phases. Improvement projects to correct existing deficiencies should be implemented by the City as soon as possible. Due to budget and time constraints, however, it may not be feasible for the City to implement all existing system improvement projects within the first or second CIP phase. In order to provide guidance to the City in identifying the most critical improvements, the recommended improvement projects were prioritized based on the severity of the existing or expected deficiency. Projects given highest priority should be implemented as soon as possible, whereas projects given a lower priority can likely be pushed back to later CIP phases.

Improvement projects needed to service future growth will be constructed at the time a specific development comes on line. Therefore, the phasing of future improvements is subject to change dependant upon the rate of growth in the City.

The priorities are described below:

- **Existing Higher Priority -** Surcharging in existing pipelines; existing design flow is nearly equal to the lift stations total capacity.
- **Existing Lower Priority -** Slight surcharging in existing pipelines; existing design flow is slightly above lift station firm capacity.
- **Future Development Related -** Upgrades to lift station or sewer pipeline capacity are needed to serve future growth, or facility is required to extend sanitary sewer service to a new development area.

Table ES.3 provides a summary of the proposed improvement by project prioritization.

Table ES.3 Project Prioritization
Sewer System Master Plan
City of Tulare

Priority	Improvement Number
Existing Higher Priority	B-LS, D-1, ES-1 through ES-7, ES-LS 3, SI-1 through SI-6, SI-10, SI-LS 1, WP2-LS 1, and WP2-LS 2
Existing Lower Priority	D-2, D-LS, WP1-1, WP2-1, and ES-30
Future Development Related	ES-8 through ES-29, ES-31 through ES-41, ES-LS 1, ES-LS 2, ES-LS4, MP-1 through MP-5, WS-1 through WS-5, SI-7 through SI-9, SI-11 through SI-13, SI-LS 2

Table ES.2 Proposed Improvements
Sewer System Master Plan
City of Tulare

Improvement No.	Type of Improv.	Description/ Street	Description / Limits	Existing System Improvement?	Remaining Capacity [4] (EDUs)	Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Parallel/ Replace/ New	Length (ft)
Domestic Collection System									
Bardsley Avenue Sewer Basin									
B-LS	Lift Station	Bardsley Avenue	Proposed Bardsley Ave LS	X	--	--	0.6 mgd	New	--
Downtown Sewer Basin									
D-1	Pipe	Kern Avenue	Blackstone St. to E/F Street Alley	X	0	10/12	15	Replace	6,700
D-1A	Casing [1]	Kern Avenue	UPRR Casing	X	--	--	15/30	New	300
D-2	Pipe	Spruce/Alley n/o Kern Avenue	Sierra St. to Highway 99	X	0	12	12	Replace	1,200
D-LS	Lift Station	Sierra Avenue	Sierra Avenue LS Upgrade	X	0	0.22 mgd	0.5 mgd	Replace	--
Eastside Sewer Basin									
ES-1	Pipe	Levin Avenue	WWTP to West St.	X	--	--	42	New	2,600
ES-2	Pipe	Levin Avenue	West St. to Pratt St.	X	--	--	42	New	2,400
ES-3	Pipe	Levin Avenue	Pratt St. to I St.	X	--	--	42	New	3,900
ES-4	Pipe	I Street	Levin Ave. to Paige Ave.	X	--	--	42	New	2,700
ES-5	Pipe	Paige Avenue	1,700' w/o I St. to Laspina St.	X	--	--	42	New	5,600
ES-5A	Casing [1]	Paige Avenue	Highway 99 Casing	X	--	--	42/72	New	800
ES-5B	Casing [1]	Paige Avenue	UPRR Casing	X	--	--	42/72	New	300
ES-6	Pipe	Foster Drive	Laspina St. to Mooney Blvd	X	--	--	39	New	3,500
ES-7	Pipe	Mooney Boulevard	Foster Dr. to Levin Ave.	X	--	--	39	New	1,400
ES-8	Pipe	Levin Avenue	Mooney Blvd. to 1,250' e/o Mooney Blvd.		--	--	18	New	1,250
ES-9	Pipe	n/o Levin Avenue	1,250 n/o Mooney Blvd. to w/o Morrison St.		--	--	15	New	1,200
ES-10	Pipe	Morrison Street	Levin Ave. to 1,400' s/o Levin Ave.		--	--	12	New	1,400
ES-11	Pipe	Bardsley Avenue	Oakmore St. to Munson		--	--	15	New	3,950
ES-12	Pipe	Oakmore Street	Bardsley Ave. to Ave. 228		--	--	12	New	2,600
ES-13	Pipe	Tulare Avenue	Morrison to 1,000' e/o Morrison		--	--	12	New	1,000
ES-14	Pipe	s/o Highway 137	Mooney Blvd. to Morrison		--	--	10	New	2,850
ES-15	Pipe	Morrison Street	1,200' s/o Prosperity to 2,850' s/o Prosperity		--	--	10	New	1,650
ES-16	Pipe	Prosperity Avenue	Mooney Blvd. to Highway 137		--	--	18	New	2,250
ES-17	Pipe	w/o Morrison Street	Highway 137 to 2,550' s/o Cartmill Ave.		--	--	15	New	2,550
ES-18	Pipe	w/o Morrison Street	2,550' s/o Cartmill Ave. to Cartmill Ave.		--	--	12	New	2,550
ES-19	Pipe	Cartmill Avenue	1,100' e/o Mooney Blvd. to 2,300' e/o Mooney Blvd.		--	--	10	New	1,200
ES-20	Pipe	Hillman Street	Existing 21" Sewer to Cartmill Ave.		--	--	21	New	700
ES-21	Pipe	Cartmill Avenue	Hillman St. to 2,600' e/o Hillman St.		--	--	15	New	2,600
ES-22	Pipe	Cartmill Avenue	2,600' w/o Mooney Blvd. to Mooney Blvd.		--	--	12	New	2,600
ES-23	Pipe	Mooney Boulevard	Cartmill Ave. to Ave. 252		--	--	10	New	2,700
ES-24	Pipe	Cartmill Avenue	Gem St. to Hillman St.		--	--	10	New	2,600
ES-25	Pipe	Gem Street	Cartmill Ave. to Ave. 252		--	--	10	New	2,700
ES-26	Pipe	Hillman Street	Cartmill Ave. to Ave. 252		--	--	10	New	2,600
ES-27	Pipe	2,600' w/o Mooney Blvd.	Cartmill Ave. to Ave. 252		--	--	12	New	2,600
ES-28	Pipe	Turner Avenue	3,800' se/o of Foster Dr. to 2,100' se/o Foster Dr.		--	--	15	New	1,700
ES-29	Pipe	Turner Avenue	5,700' se/o of Foster Dr. to 3,800 se/o Foster Dr.		--	--	10	New	1,900
ES-30	Pipe	Leland Avenue	Abandoned Leland Ave. LS to Hillman St.	X	--	--	12	New	800
ES-31	Pipe	Retherford Street	Corvina Ave. to n/o Corvina Ave.		--	--	10	New	1,300
ES-32	Pipe	Corvina Avenue	Retherford St. to w/o Retherford St.		--	--	8	New	1,300
ES-33	Pipe	se/o Foster Drive	sw/o Road 124 to sw/o Road 124		--	--	12	New	2,600
ES-34	Pipe	sw/o Road 124	Force Main for ES-LS4		--	--	6	New	1,300
ES-35	Pipe	se/o Foster Drive	sw/o Road 124 to sw/o Road 124		--	--	12	New	1,700
ES-36	Pipe	sw/o Road 124	se/o Foster Dr. to se/o Foster Dr.		--	--	10	New	1,300
ES-37	Pipe	sw/o Road 124	se/o Foster Dr. to se/o Foster Dr.		--	--	10	New	1,000
ES-38	Pipe	w/o Elk Bayou	n/o Elk Bayou to n/o Elk Bayou		--	--	10	New	1,700
ES-39	Pipe	w/o Elk Bayou	n/o Elk Bayou to n/o Elk Bayou		--	--	10	New	2,800
ES-40	Pipe	sw/o Road 124	se/o Foster Dr. to se/o Foster Dr.		--	--	12	New	6,200
ES-41	Pipe	sw/o Road 124	se/o Foster Dr. to se/o Foster Dr.		--	--	12	New	3,000
ES-LS 1	Lift Station	Foster Drive	Foster Dr. LS Modifications	X	--	1.0 mgd	1.8 mgd	Modify	--
ES-LS 2	Lift Station	Paseo Del Lago	Del Lago LS Upgrade	X	581	1.0 mgd	3.2 mgd	Replace	--
ES-LS 3	Lift Station	Academy Avenue	Academy Ave LS Upgrade	X	0	0.5 mgd	1.1 mgd	Replace	--
ES-LS 4	Lift Station	sw/o Road 124	Future Commercial LS		--	--	0.5 mgd	New	--
ES-Tank	Tank	sw/o Road 124	300,000 Gallon Wastewater Storage Tank		--	--	0.3 MG	New	--
Milner/Prosperity Sewer Basin									
MP-1	Pipe	Prosperity/West Street	Zumwalt Ave. to Prosperity Ave.		--	--	18	New	2,500
MP-2	Pipe	West Street	Cartmill Ave. to Zumwalt Ave.		--	--	15	New	4,000
MP-3	Pipe	Cartmill Avenue	West St. to w/o J St		--	--	12	New	2,300
MP-4	Pipe	w/o J Street	Cartmill Ave. to n/o Cartmill Ave.		--	--	10	New	2,600
MP-5	Pipe	West Street	Cartmill Ave. to 3,900' n/o Cartmill Ave.		--	--	10	New	3,900
West/Pleasant Sewer Basin									
WP1-1	Pipe	w/o West St/Bardsley Ave	West St. to Laspina LS	X	--	--/10	30	Replace/New	5,100
West/Pleasant 2 Sewer Basin									
WP2-1	Pipe	Pleasant Avenue and M Street	Oaks to Merritt	X	0	12	15	Replace	2,700
WP2-LS 1	Lift Station	M Street	M St. LS Upgrade	X	0	0.16 mgd	0.4 mgd	Replace	--
WP2-LS 2	Lift Station	Prosperity Avenue	Prosperty Ave LS Upgrade	X	0	0.29 mgd	0.6 mgd	Replace	--
Westside Sewer Basin									
WS-1	Pipe	State Highway 137	Enterprise St. to Inyo Ave LS.		--	--	12	New	5,000
WS-2	Pipe	Enterprise Street	Prosperity Ave. to Pleasant Ave.		--	--	15	New	2,700
WS-3	Pipe	Enterprise Street	Zumwalt AVE. to Prosperity Ave.		--	--	12	New	1,300
WS-4	Pipe	Enterprise Street	Elster Ave. to Zumwalt Ave.		--	--	10	New	2,600
WS-5	Pipe	e/o Enterprise Street	Inyo Ave. to n/o Inyo Ave.		--	--	10	New	1,300
Industrial Collection System									
South Industrial Sewer Basin									
SI-1	Pipe	Paige Avenue	2,600' East of Enterprise St. to Pratt Ave.	X	--	--	48	New	6,800
SI-2	Pipe	Pratt Street	Paige Ave. to 2,600' s/o Paige Ave.	X	--	--	42	New	2,600
SI-3	Pipe	Pratt Street	2,600' s/o Paige Ave. to 600' n/o Avenue 204	X	--	--	42	New	4,600
SI-4	Pipe	Pratt Street	600' n/o Avenue 204 to Avenue 196	X	--	--	42	New	5,900
SI-5	Pipe	Avenue 198	Pratt St. to 2,400' e/o Pratt St.	X	--	--	42	New	2,400
SI-6	Pipe	Avenue 198	2,400' e/o Pratt St. to I St.	X	--	--	36	New	4,700
SI-7	Pipe	County Road 112	Ave. 196 to 2,600' s/o Ave 196		--	--	30	New	2,600
SI-8	Pipe	County Road 112	2,600' s/o Ave 196 to 4,500' s/o Ave. 197		--	--	30	New	3,500
SI-8A	Casing [1]	County Road 112	Crossing under Elk Bayou		--	--	30/48	New	200
SI-9	Pipe	Avenue 198	Highway 99 to I St.		--	--	24	New	1,700
SI-10	Pipe	Avenue 196	Crossing Under Highway 99	X	--	--	18	New	300
SI-10A	Casing [1]	Avenue 196	Crossing Under Highway 99	X	--	--	18/30	New	300
SI-11	Pipe	Hosfield Drive	Hwy 99 to Laspina St.		--	--	12	New	2,750
SI-12	Pipe	Laspina Avenue	Ave. 196 to Ave. 192		--	--	12	New	2,400
SI-LS 1	Lift Station	Pratt Street	2,600' s/o Paige Ave.	X	--	--	10.6 mgd	New	--
SI-LS 2	Lift Station	Highway 99 Lift Station	Hosfield and Hwy 99		--	--	0.5 mgd	New	--

Notes:
1. Proposed casing size and carrier pipe size.
2. Proposed Siphon is a triple barrel siphon.
3. Existing lift station capcaity reported as the firm capacity (capacity with the largest pump out of service)
4. EDU=Equivalent Dwelling Unit. See Section 5.2.1 for a discussion of how this calculation was performed.

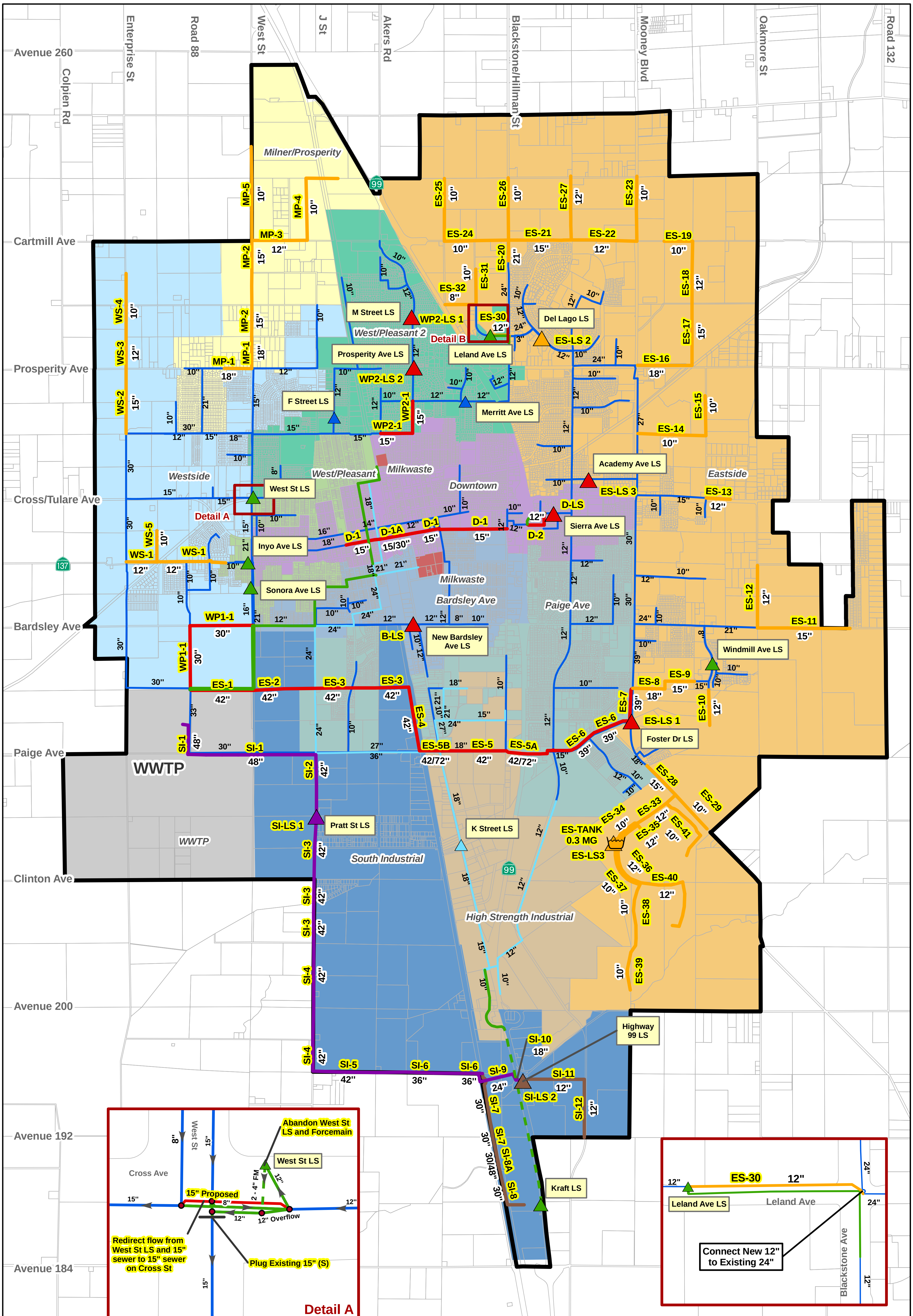
ES.5.1.1 Highest Priority Improvements

Selected improvement projects were identified out of the higher priority improvements as the most critical and are summarized below:

- **South Industrial Trunk (SI-1 through SI-10, SI-LS1)**. Evaluation of the collection system under existing design flows identified a capacity deficiency in the High Strength Industrial Trunk and the K Street LS. This deficiency will be mitigated by redirecting the Kraft facility's wastewater flow from the High Strength Industrial Trunk to the new South Industrial Trunk, which is currently in the design phase. This would be accomplished in the short term by modifying the force main associated with the Kraft LS so that it would discharge into a proposed 30-inch sewer on Avenue 198. In the future, when the Kraft LS approaches capacity, a new trunk would be installed along County Road 112 to convey Kraft's flow through the South Industrial Trunk.
- **Kern Avenue Trunk (Improvement D-1)**. Analysis of the collection system under existing design flows identified surcharge conditions in the Kern Avenue Trunk. City staff has indicated that this creates a maintenance problem for the City because fats, oil, and grease tend to build up in the adjacent tributary sewers, causing backups and sanitary sewer overflows. Implementation of this improvement, therefore, may lead to a reduction in needed maintenance and overflows in the area.
- **Bardsley Avenue LS (Improvement B-LS)**. An adverse slope condition in the Bardsley Trunk east of the UPRR tracks causes constant surcharge conditions in the Bardsley Trunk. Construction of the Bardsley Avenue LS will convey flow past the section of trunk line that flows uphill. Implementation of this improvement will eliminate the surcharging in the Bardsley Trunk.
- **M Street LS (Improvement WP2-LS1)**. The evaluation of the existing system suggests that the peak flow into the M Street LS is well above its firm capacity. In fact, the simulated peak flows into the M Street LS were nearly equal to the total capacity of the lift station.
- **Prosperity Avenue LS (Improvement WP2-LS2)**. The evaluation of the existing system suggests that the peak flow into the Prosperity Avenue LS is also well above its firm capacity and that the simulated peak flows into the lift station were nearly equal to the total capacity of the lift station.

ES.6 CAPITAL IMPROVEMENT PROGRAM

The cost estimates presented in the 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 alignments, alternative routings, and detailed utility and topography surveys.



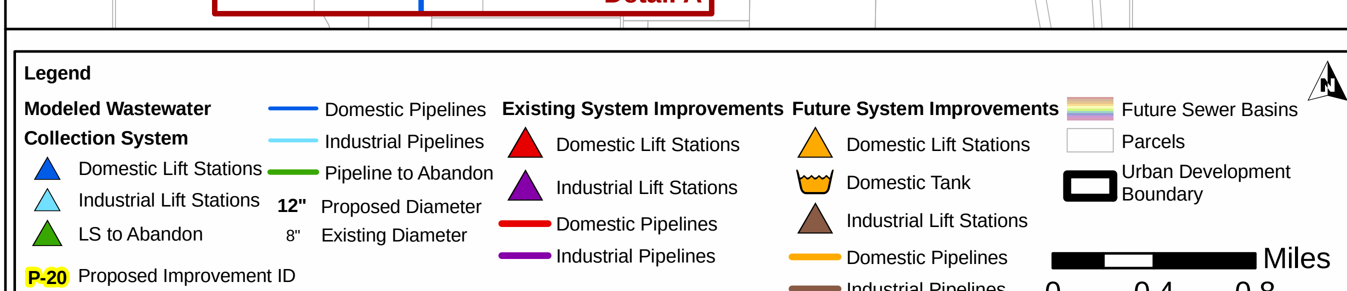


Figure ES.5
Proposed Improvements

Sewer System Master Plan
City of Tulare

Knowledge about site-specific conditions for each proposed project is limited at the master planning stage; therefore the Estimated Construction Costs include a 30 percent contingency to account for unforeseen events and unknown field conditions. The Capital Improvement Costs also include an additional 20 percent (applied to the Estimated Construction costs) for project-related costs, comprised of engineering, administration, construction inspection, and legal costs. Table ES.4 summarizes the master plan CIP.

As shown in Table ES.4, the majority of improvements and capital costs are associated with growth and are therefore allocated to future customers ($52.4 million). The total CIP is estimated to cost approximately $68.5 million, of which 23 percent ($16.1 million) is allocated to existing customers.

It should be noted that the CIP in this master plan is front loaded on the first two improvement phases. This is primarily due to the need for the construction of two major trunk sewers in the earlier phases to address existing deficiencies. These trunks are the South Industrial Trunk (SI-1 through SI-6, SI-9, SI-10, and SI-LS-1) and the Eastside Trunk Sewer Extension (ES-1 through ES-7).

Table ES.4 Capital Improvement Program - Existing and Future Users
Sewer System Master Plan
City of Tulare

	Cost (million dollars)					
Customer Type	**Phase I (2009-2011)**	**Phase II (2012-2015)**	**Phase III (2016-2020)**	**Phase IV (2021-2025)**	**Phase V (2026-2030)**	**Total**
Existing[1]	7.0	9.1	0.0	0.0	0.0	**16.1**
Future	15.7	21.5	7.3	4.4	3.5	**52.4**
Total	**22.7**	**30.6**	**7.3**	**4.4**	**3.5**	**68.5**

Note:
1. Existing User costs have been distributed through two phases based on the project prioritizations presented in Chapter 5.

Table ES.5 provides a breakdown between the Domestic and the Industrial collection system CIP costs. Through 2030 the CIP for the Industrial and Domestic collection systems totals $22.7 and $45.8 million respectively.

Table ES.5	Capital Improvement Schedule - Domestic vs. Industrial Costs Sewer System Master Plan City of Tulare					
	Cost (million dollars)					
Improv. Type	Phase I (2009-2011)	Phase II (2012-2015)	Phase III (2016-2020)	Phase IV (2021-2025)	Phase V (2026-2030)	Total
Industrial	19.5	0	2.0	1.0	0.2	**22.7**
Domestic	3.2	30.6	5.3	3.4	3.3	**45.8**
Total	**22.7**	**30.6**	**7.3**	**4.4**	**3.5**	**68.5**

Table ES.6 provides a breakdown of existing and future users costs for the Industrial and Domestic collection systems.

Table ES.6	Existing and Future User Costs (Domestic and Industrial) Sewer System Master Plan City of Tulare					
	Cost (million dollars)					
Customer Type	Phase I (2009-2010)	Phase II (2012-2015)	Phase III (2016-2020)	Phase IV (2021-2025)	Phase V (2026-2030)	Total
Industrial						
Existing	3.8	0.0	0.0	0.0	0.0	**3.8**
Future	15.7	0.0	2.0	1.0	0.2	**18.9**
Total	**19.5**	**0.0**	**2.0**	**1.0**	**0.2**	**22.7**
Domestic						
Existing	3.2	9.1	0.0	0.0	0.0	**12.3**
Future	0.0	21.5	5.3	3.4	3.3	**33.5**
Total	**3.2**	**30.6**	**5.3**	**3.4**	**3.3**	**45.8**

INTRODUCTION

This chapter presents the need for this Sewer System 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 BACKGROUND

The City of Tulare (City) (Figure 1.1) operates its own sewer collection system and associated infrastructure facilities, and serves customers within the City limits. The previous Sewer System Master Plan was completed in June 1991 (1991 Master Plan) and included a capacity evaluation, recommended improvements to mitigate deficiencies, and provided a summary of capital costs associated with the improvements. The 1991 Master Plan was based on planning assumptions and operational conditions that have since changed.

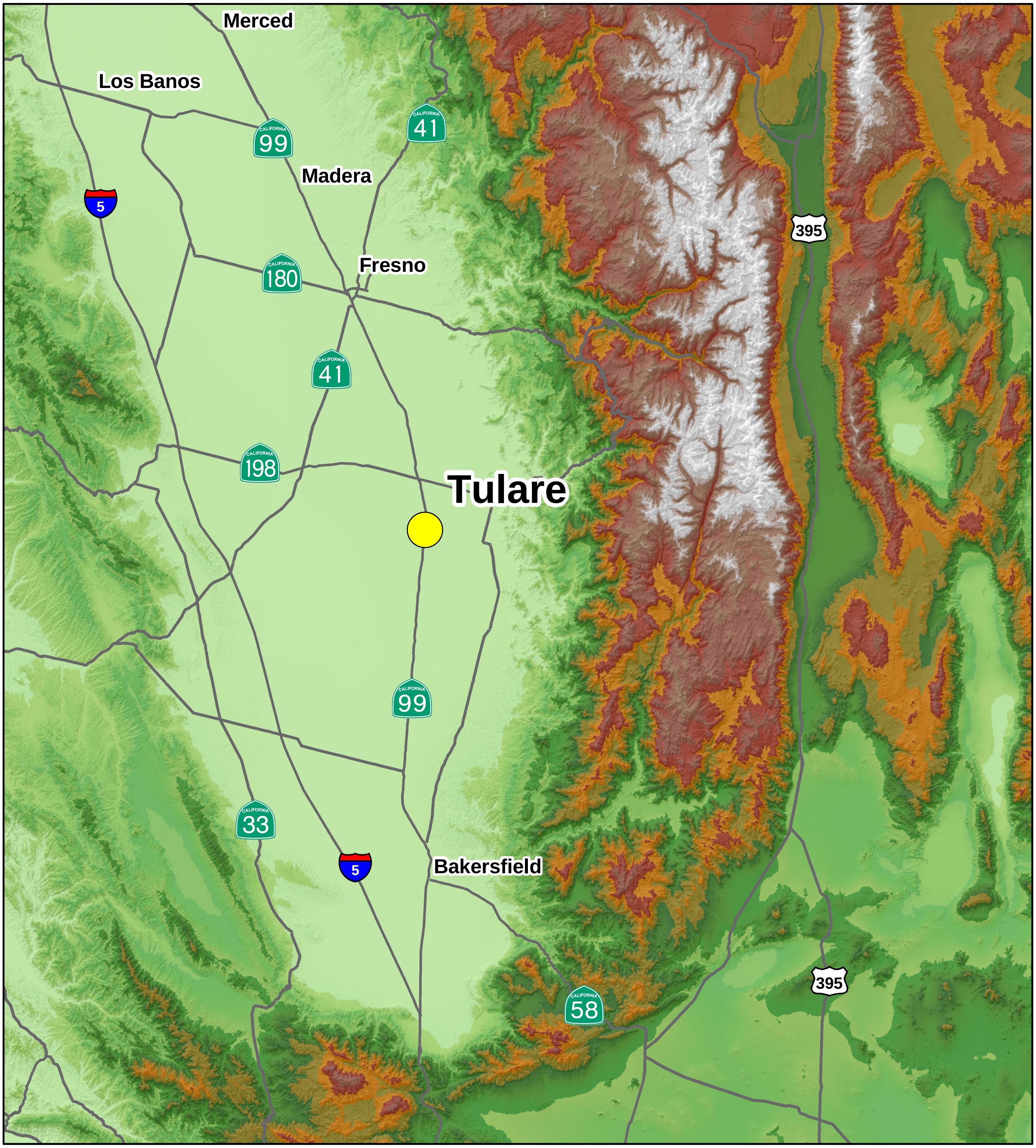
The City recently updated its general plan to the planning horizon of 2030. The land use assumptions and development assumptions used in this master plan are consistent with those provided in the General Plan Update (April 2008). This master plan recommends projects that will serve existing and future customers as development extends to the Urban Development Boundary (UDB) of the General Plan Update.

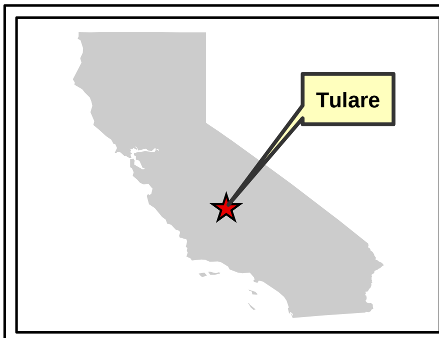
1.2 SCOPE AND AUTHORIZATION

The purpose of this Sewer System Master Plan is to identify capacity deficiencies in the collection system, develop feasible alternatives to correct these deficiencies, and plan the infrastructure that will serve future development.

On September 21, 2006, the City authorized Carollo Engineers, P.C., (Carollo) to prepare this sewer system master plan study, which included the following tasks:

- Establish sewer system planning and evaluation criteria.
- Create and calibrate a hydraulic computer model of the collection system.
- Evaluate the capacity of the existing sewer collection system.
- Review existing system deficiencies and propose improvements to enhance system capacity.
- Recommend improvements needed to service anticipated future growth.
- Develop a capital improvement program (CIP) with a planning horizon of 2030.





Legend

Elevation

High : 12,000 Feet

Low : 0 Feet

Major Roads

Miles

0 15 30

Figure 1.1
Regional Location Map
Sewer System Master Plan
City of Tulare

City of Tulare

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The study includes several planning assumptions that are documented in this report. Should future planning conditions deviate from the assumptions stated in this master plan (i.e., accelerated growth, more developments with higher densities, etc.), revisions and adjustments to the master plan recommendations would be necessary.

1.3 REPORT ORGANIZATION

The sewer system master plan report contains six 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 sewer system master plan and the objectives of the study. A list of abbreviations is also provided to assist the reader in understanding the information presented.

Chapter 2 - Planning Area Characteristics. This chapter presents a discussion of this study's planning area characteristics, defining the land use classifications and summarizing the historical population trends. Population projections, used for forecasting the City's future wastewater flows, are also presented.

Chapter 3 - Planning and Evaluation Criteria. The capacity of the City's sanitary sewer system was evaluated based on the planning criteria defined in this chapter. Historical flows at the City's two wastewater treatment plants were reviewed and analyzed to determine daily, monthly, and seasonal fluctuations experienced by the sewer system. The developed criteria address the sewer system capacity, acceptable gravity pipe slopes, acceptable depths of flow within pipes, average sewer flow coefficients, and daily and hourly peaking factors.

Chapter 4 - Existing System and Hydraulic Model. This chapter presents an overview of the City's sewer collection system. The chapter also describes the development and calibration of the City's Sewer Hydraulic Model. This model was used for identifying existing system deficiencies and for recommending improvements.

Chapter 5- Evaluation and Proposed Improvements. This chapter presents the results of the capacity evaluation of the sewer system. The chapter also presents improvements to mitigate existing system deficiencies and for servicing future growth. These improvements are recommended based on the system's technical requirements, cost effectiveness, and operational reliability.

Chapter 6- Capital Improvement Program. This chapter presents the recommended CIP for the City's sewer system. The program is based on the evaluation of the City's sewer system and on the recommended improvements described in the previous chapters. The CIP has been staged to the planning horizon year of 2030.

1.4 ACKNOWLEDGMENTS

Carollo wishes to acknowledge and thank Mr. Darrel Pyle, City Manager; Mr. Ken Ramage, City Engineer; Mr. Lew Nelson, Public Works Director; Mr. Mike Whitlock, Senior Civil Engineer; and Mr. Richard Bono, Wastewater Superintendent. Their own and their staff's cooperation and courtesy in obtaining a variety of necessary information were valuable components in completing and producing this report.

1.5 ABBREVIATIONS AND DEFINITIONS

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

Abbreviation	Description
$/LF	Dollars per Linear Foot
°F	Degrees Fahrenheit
1991 Master Plan	Sewer System Master Plan, June 1991
AACE	Association for the Advancement of Cost Engineering
ADF	Average Day Flow
C	Hazen Williams Friction Coefficient
Carollo	Carollo Engineers, P.C.
CCTV	Closed Circuit Television
cfs	Cubic Feet per Second
CIP	Capital Improvement Program
City	City of Tulare
d/D	Flow Depth to Pipe Diameter Ratio
DOF	Department of Finance
DWWTP	Domestic Wastewater Treatment Plant
EDU	Equivalent Dwelling Unit
ENR CCI	Engineering News Record Construction Cost Index
FAR	Floor Area Ratio
fps	Feet per Second
ft	Feet
ft/ft	Feet per Feet
gpda	Gallons per Day per Acre
gpdc	Gallons per Day per Capita
gpd/EDU	Gallons per Day per Equivalent Dwelling Unit
gpm	Gallons per Minute
gr. ac.	Gross Acres
I/I	Infiltration and Inflow
in.	Inches
LS	Lift Station
MDF	Maximum Daily Flow
mgd	Million Gallons Per Day
n	Manning's Friction Coefficient
NRCS	Natural Resources Conservation Service
ROW	Right of Way
SIU	Significant Industrial User
sq. ft.	Square Feet
SWMM	Storm Water Management Model

Abbreviation	Description
TDH	Total Dynamic Head
UDB	Urban Development Boundary
USDA	United States Department of Agriculture

1.6 REFERENCES

The following documents were referenced in the preparation of this master plan report.

- City of Tulare Engineering General Design Standards, April 2002.
- City of Tulare Draft Environmental Impact Report for the Tulare Motor Sports Park Complex, May 2008.
- City of Tulare General Plan, April 2008.
- City of Tulare Sanitary Sewer Flow Monitoring, V&A Consulting Engineers, June 2007.
- City of Tulare Sewer System Master Plan, Boyle Engineering Corporation, June 1991.
- City of Tulare Water Pollution Control Facilities Facility Plan, Carollo Engineers, P.C., April 2003.
- Soil Survey of Tulare County, California, Western Part, United States Department of Agriculture Natural Resources Conservation Service, 1999.

PLANNING AREA CHARACTERISTICS

This chapter presents a discussion of this study's planning area characteristics, defining the land use classifications and summarizing the historical population trends. Population projections, used for forecasting Tulare's future sewer flows, are based on the City of Tulare's (City) General Plan Update.

2.1 STUDY AREA

The City is located along Highway 99 in Tulare County within the Central San Joaquin Valley of California, approximately 45 miles south of Fresno and 60 miles north of Bakersfield.

Tulare was founded in 1872 by the Southern Pacific Railroad, and incorporated in 1888. Agriculture is a major component of the City's economy, due to its highly productive farmland. Tulare is attractive to food processors and distributors because of its central location and abundance of locally grown products.

The City recently updated its General Plan. The City limits and Urban Development Boundary (UDB), as established from the City's Land Use Diagram (Updated December 2007), are about 19 square miles (12,281 acres) and 37 square miles (23,608 acres), respectively. The current City limits and UDB are shown on Figure 2.1. The study area boundary for this master plan is the UDB.

2.2 SOIL AND TOPOGRAPHY

According to the Soil Survey for Tulare County, California, Western Part from the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) (http://www.ca.nrcs.usda.gov/), the dominant soil types within City limits include Colpien, Nord, Yettem, Crosscreek, and Flamen soils. Additional soils within City limits include Hanford, Biggriz, and Tagus soils.

The topography of the San Joaquin Valley is generally flat. The City's UDB ground elevations range from approximately 255 feet (ft) to 310 ft above mean sea level.

2.3 CLIMATE

According to the City's website, the average maximum and minimum temperatures in January are 54 degrees Fahrenheit (°F) and 34°F, respectively. In July, the average maximum and minimum temperatures are 96°F and 65°F, respectively. The City's average annual rainfall is 10.15 inches.

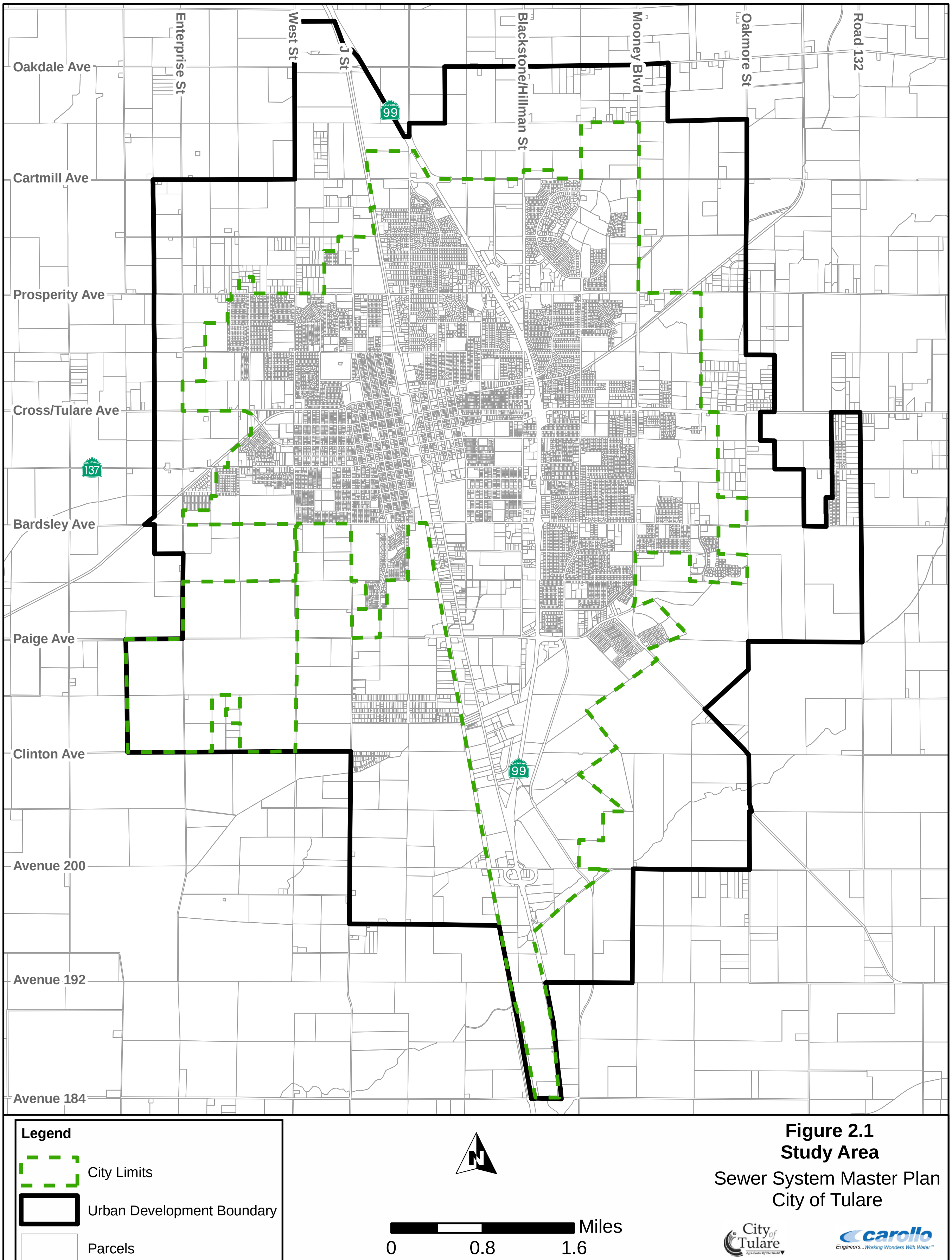

Figure 2.1
Study Area
Sewer System Master Plan
City of Tulare

2.4 LAND USE

The land use classifications used in this master plan are consistent with the Land Use Diagram and Standards described in the City's General Plan Update, as shown on Figure 2.2. Table 2.1 summarizes the land use designations, along with acreages, for the current City limits and UDB. Not all land within the City is developed. Table 2.1 also tabulates the existing developed land within the current City limits.

The current City limits encompass approximately 12,281 acres. The existing land uses include 5,056 acres of residential, 1,598 acres of commercial, 1,781 acres of industrial, 340 acres of Parks and Recreation, and 1,625 acres of Public facilities.

Rural Residential (0-2.0 dwelling units/gross acre). This designation established areas for single-family dwellings and mini-farms or ranchettes where agricultural activity is secondary to the residential land use. Lots within this designation are typically large enough to support independent wastewater disposal (septic) systems. The minimum lot size for this designation is 20,000 square feet (sq. ft.).

Rural Estate (2.1-3.0 dwelling units per gross acre). This designation establishes areas for large lot single-family estate dwellings. Uses typically allowed include detached single - family homes, secondary dwellings, and support uses (i.e., servant quarters and/or pool houses). The minimum lot size for this designation is 12,500 sq. ft.

Low Density Residential (3.1-7.0 dwelling units per gross acre). This designation establishes areas for single-family residences in a suburban configuration. Uses typically allowed include detached single-family homes, secondary dwellings, and residential support uses such as churches, schools, and other necessary public utilities and safety facilities. The minimum lot size for this designation is 6,000 sq. ft.

Medium Density Residential (7.1-14.0 dwelling units per gross acre). This land designation establishes areas for single-family and low density multi-family dwellings located near neighborhood serving uses such as, grocery stores, schools, parks, and other public services. Uses typically allowed include single-family dwellings, second units, town homes, duplexes, triplexes, and mobile park homes. The minimum lot size for this designation is 3,000 sq. ft.

High Density Residential (14.1-29.0 dwelling units per gross acre). This designation establishes areas for multi-family dwellings in urbanized areas with access to public transportation and residential serving uses (i.e., grocers and drug stores). Uses typically allowed include duplexes, triplexes, townhomes, and apartments near schools, parks, and other public services. The minimum lot size for this designation is 1,500 sq. ft.

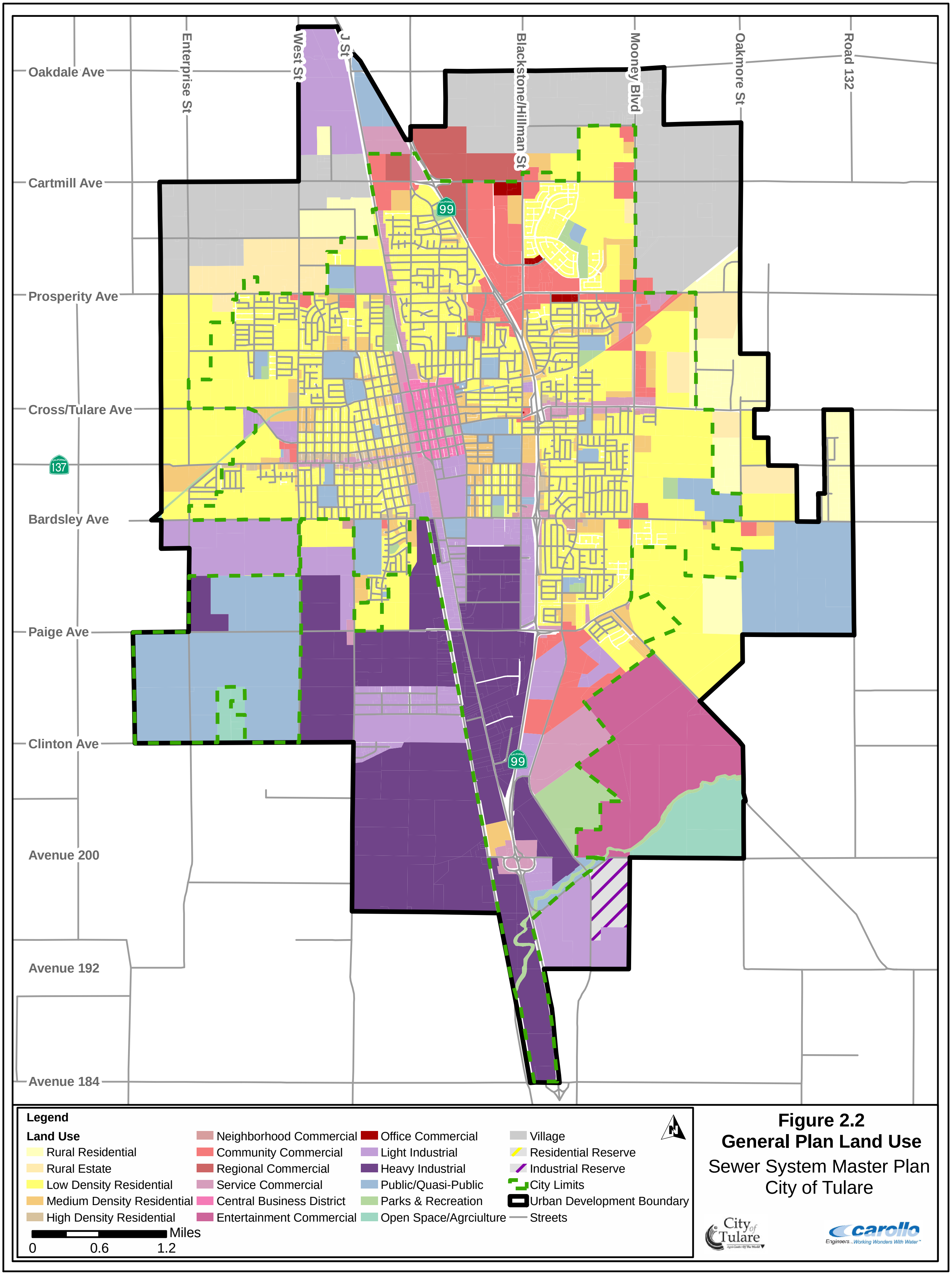

Figure 2.2
General Plan Land Use
Sewer System Master Plan
City of Tulare

Table 2.1 Land Use and Vacant Area
Sewer System Master Plan
City of Tulare

Land Use Designation	Code	City Limits: 2006 Total (gr. Ac.)	City Limits: 2006 Vacant (gr. Ac.)	City Limits: 2006 Developed (gr. Ac.)	City Limits: % Vacant (%)	Urban Development Boundary: 2030 Total (gr. Ac.)
Residential Designations						
Rural Residential	R-RR	30	29	1	0%	813
Rural Estate	R-RE	90	79	11	1%	623
Low Density Residential	R-LDR	4,257	1,739	2,518	14%	5,612
Medium Density Residential	R-MDR	614	206	408	2%	735
High Density Residential	R-HDR	66	19	47	0%	66
Commercial Designations						
Neighborhood Commercial	C-NC	13	6	7	0%	18
Community Commercial	C-CC	856	610	246	5%	894
Regional Commercial	C-RC	76	76	0	1%	280
Service Commercial	C-SC	506	103	403	1%	577
Central Business District	CBD	130	10	120	0%	130
Entertainment Commercial	C-EC	0	0	0	0%	937
Office Commercial	C-OC	16	14	2	0%	35
Industrial Designations						
Light Industrial	I-LI	561	202	359	2%	1,966
Heavy Industrial	I-HI	1,219	501	719	4%	3,106
Other Designations						
Public/Quasi-Public	PUB	1,625	149	1,476	1%	2,306

Table 2.1 Land Use and Vacant Area
Sewer System Master Plan
City of Tulare

Land Use Designation	Code	City Limits				Urban Development Boundary
		2006 Total (gr. Ac.)	2006 Vacant (gr. Ac.)	2006 Developed (gr. Ac.)	% Vacant (%)	2030 Total (gr. Ac.)
Parks and Recreation	PRK	340	47	293	0%	394
Open Space	OS/AG	13	0	13	0%	386
Roadways and Railroads	--	1,864	0	1,864	0%	2,322
Reserve Designations						
Village	NC	5	0	5	0%	2,272
Residential Reserve	UR-R	0	0	0	0%	0
Commercial Reserve	UR-C	0	0	0	0%	0
Industrial	UR-I	0	0	0	0%	136
Total						
Total		**12,281**	**3,788**	**8,492**	**31%**	**23,608**

Source: Draft General Plan Update (Matrix Design Group)

Neighborhood Commercial. This designation establishes areas for daily convenience shopping services adjacent to residential neighborhoods. Uses typically allowed include supermarkets, drug stores, and other residential serving uses that are convenient to vehicular access and highly accessible for pedestrians and bicyclists. These centers typically contain 30,000 to 100,000 square feet of floor area on approximately 2 to 5 acres. Neighborhood centers usually include a grocery store as a leading tenant, and generally require a support population or 3,000 to 40,000 people. The maximum intensity of this designation is 0.60 FAR, and the minimum development size is 2 acres.

Community Commercial. This designation establishes areas for community-oriented uses with a community wide market base. Uses typically allowed include community commercial centers, shopping plazas, and shopping centers that include a junior department store, or a large variety, discount or department store with direct and convenient arterial access and access for pedestrians, bicyclists, and public transit. These centers typically contain 100,000 to 300,000 square feet of floor area on 7 to 20 acres. The maximum intensity of this designation is 0.27 FAR, and the minimum development size is 7 acres.

Regional Commercial. This designation establishes areas for regional retail centers capable of drawing consumers from outside the Planning Area. Uses typically allowed include regional malls and outlet centers that contain department stores, comparison, and specialty retail uses with direct and visual arterial and highway access. Developments in this designation typically contain 500,000 or more square feet of commercial space on approximately 20 to 50 acres. The maximum intensity of this designation is 0.27 FAR, and the minimum development size is 20 acres.

Service Commercial. This designation establishes areas for neighborhood, business, and industrial serving uses. Uses typically allowed include automotive related or heavy equipment sales and services, building maintenance services, construction sales and services, and mini storage. The maximum intensity of this designation is 0.60 FAR, and the minimum development size is 20,000 sq. ft.

Office Commercial. This designation establishes areas for the development of offices and office parks. Uses typically allowed include professional offices (including but not limited to finance, insurance, and real estate), large administrative centers, medical and dental clinics, research and development, and other similar compatible activities. The maximum intensity of this designation is 0.80 FAR, and the minimum development size is 4,000 sq. ft.

Central Business District (0-29.0 dwelling units per gross acre). This designation establishes the Downtown as the predominant urban area of the city to provide a central gathering place for commerce and living. Uses typically allowed include eating and drinking establishments, personal, medical, and professional services, retail sales, medium-high and high density residential dwellings, and mixed-use development. The maximum intensity of this designation is 3.0 FAR.

Entertainment Commercial. This designation establishes areas for regional entertainment centers capable of drawing consumers from outside the Planning Area. Uses typically allowed include fairgrounds, race-tracks, amusement parks, golf courses, and recreation/entertainment facilities with visual arterial and highway access. The maximum intensity of this designation is 0.20 FAR, and the minimum development size is 50 acres.

Light Industrial. This designation establishes areas for a range of non-intensive business park, industrial park, and warehouse uses that do not have detrimental noise or odor impacts on surrounding urban uses. Uses typically allowed include warehousing, welding and fabrication shops, and business support uses such as retail or eating establishments that serve adjacent light industrial uses and employees. The minimum lot size for this designation is 20,000 sq. ft.

Heavy Industrial. This designation establishes areas for the full range of industrial uses, which may cause noise or odor impacts on surrounding urban uses. Uses typically allowed include manufacturing, processing, fabrication, trucking terminals, ethanol plants, warehouses, asphalt batch plants, mills, lumber yards, and aggregate mining operations and support uses such as retail or eating establishments that support adjacent industrial uses and employees. The minimum lot size for this designation is 40,000 sq. ft.

Public. This designation establishes areas for public and institutional uses that serve the local community. Uses typically allowed include government facilities, schools, libraries, municipal corporation yards, sewer and water facilities, police and fire stations, and hospitals located throughout the community to serve neighborhoods and businesses and promote public safety. The maximum intensity of this designation is 0.60 FAR.

Parks and Recreation. This designation establishes areas for outdoor recreation facilities that serve local and regional users. Uses typically allowed in this designation include pocket, neighborhood, community, regional, natural parks, and other outdoor recreation facilities, such as, golf courses, trails, and open space/habitat preserves. Recreation facilities should be connected with accessibility to pedestrians and bicyclists.

Village. This designation establishes areas for planning new residential growth areas within the Planning Area. Key features of a village include a mix of single family and multifamily development, a neighborhood center, and a range of public uses such as schools and parks. The village center is comprised of neighborhood commercial, higher density residential, schools, public and open space uses.

The Village (V) designation is intended to promote a mixed-use village concept, incorporating the principles of smart growth and also recognizing the environmental and physical constraints of each village area. Each of the villages is assigned a particular land use mix, which will set the general parameters of urban development.

The Village designation is considered a “holding” category. The purpose of the Village designation is to promote the development of a detailed specific plan that will provide the details needed to ensure a comprehensive mixed-use area is developed. A specific plan is required to be submitted and approved to ensure a mixed-use concept, and an approved specific plan is required prior to approval of an annexation request.

2.5 POPULATION

According to data collected from the California Department of Finance (DOF), the City's population for the year 2006 was approximately 51,477. This corresponds to an increase in population of approximately 18,000 from 1990 to 2006.

The draft General Plan Update projects a population of 130,975 people by the year 2030. In order for this to happen, the City's population would need to increase by a rate of 4 percent per year. This growth rate corresponds with a projected population of 60,000 in 2010, 89,000 in 2020, and 130,975 in 2030, as shown in Table 2.2. Figure 2.3 shows the historical and projected population trends from 1990 to 2030.

Table 2.2 Historical and Projected Population
Sewer System Master Plan
City of Tulare

Master Plan Projected Years	2010	2015	2020	2025	2030[1]
Projected Population[2]	60,000	73,000	89,000	108,000	**130,975**
Annual Increase over 5-Year Period		4.0%	4.0%	4.0%	4.0%

Notes:
1. Source: General Plan Update (Matrix Design Group).
2. A 4.0% annual growth rate through 2030 was used based on projections provided in the draft General Plan Update.

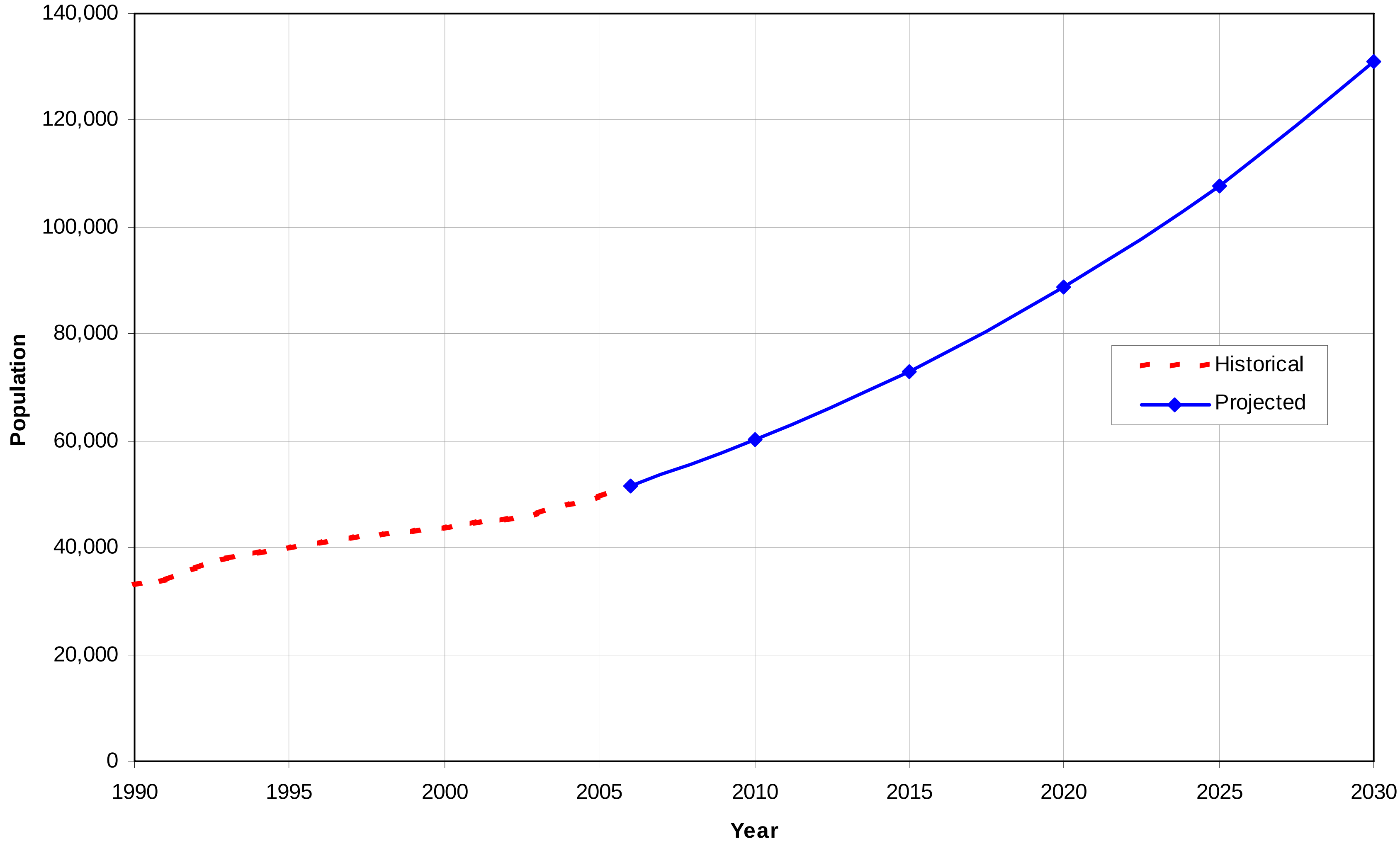

Figure 2.3
Historical and Projected Population
Sewer System Master Plan
City of Tulare

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PLANNING AND EVALUATION CRITERIA

The capacity of the City of Tulare (City) sewer collection system was evaluated based on the planning and evaluation criteria defined in this chapter. Historical flows at the City's Domestic Wastewater Treatment Plant (DWWTP) and Industrial Wastewater Treatment Plant (IWWTP) were reviewed and analyzed to determine daily, monthly, and seasonal fluctuations experienced by the sewer system. The planning criteria address the sewer system capacity, acceptable pipe gravity slopes, acceptable depths of flow within pipes, average sewer flow coefficients, and daily and hourly peaking factors.

3.1 GRAVITY SEWERS

Capacity analysis of the sewer collection system was performed in accordance with the criteria established in this section. The City's improvement standards stipulate general policies of the City and outline sewer design criteria. Some of these criteria are discussed below.

3.1.1 Pipe Capacities

Sewer pipe capacities are dependent on many factors, including roughness of the pipe, the maximum allowable depth of flow, and minimum pipe velocity and slope. The Continuity equation and the Manning equation for steady-state flow are used for gravity sewer hydraulic calculations:

Continuity Equation: $Q = V A$

Where:
- Q = peak flow, cfs
- V = velocity, fps
- A = cross-sectional area of pipe, sq. ft.

Manning Equation:

$$V = \frac{1.486\, R^{2/3} S^{1/2}}{n}$$

Where:
- V = velocity, fps
- n = Manning's coefficient of friction
- R = hydraulic radius (area divided by wetted perimeter), ft
- S = slope of pipe, feet per foot

3.1.2 Manning Coefficient (n)

The Manning coefficient 'n' is a friction coefficient and varies with respect to pipe material, size of pipe, depth of flow, smoothness of pipe end joints and the extent of root intrusion. For sewer pipes, the Manning coefficient typically ranges between 0.011 and 0.017, with 0.013 being a representative value used for sewer system master planning.

3.1.3 Flow Depth Criteria (d/D)

The primary criterion used to identify capacity deficient trunk sewers or to size new improvements is the maximum flow depth to pipe diameter ratio (d/D). This approach is consistent with the 1991 Master Plan. The d/D value is defined as the depth (d) of flow in a pipe during peak flow conditions divided by the pipe's diameter (D).

3.1.3.1 Flow Depth Criteria for Existing Sewers

Utilizing a conservative d/D ratio for evaluating existing sewers may lead to unnecessary replacement of existing pipelines. For this reason, this master plan utilized a maximum d/D ratio of 0.92 (pipe flowing full) for existing sewer pipelines under the design flow condition.

3.1.3.2 Flow Depth Criteria for New Trunk 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 may experience blockages from debris, paper, or rags.

Sewers less than 12-inches in diameter shall be designed to flow half full at peak flow rates (peak flow rates will be discussed later). Sewers 12- to 16-inches in diameter shall be designed to flow at two-thirds depth at peak flow rate. Sewers larger than 16-inches diameter shall be designed to flow at a d/D of 0.75 at peak flow rate. Table 3.1 contains a summary of the d/D ratios used in this master plan for sizing future trunk sewers.

Table 3.1 Maximum Depth to Pipe Diameter Ratio - New Sewer Trunks
Sewer System Master Plan
City of Tulare

Pipe Diameter (in)	Maximum d/D Ratio (during peak flows)
Less than 12-inches	0.50
12-inches to 16-inches	0.67
Greater than 16-inches	0.75

3.1.4 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 2 feet per second (fps) 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 3.2 includes the minimum slopes for planning future improvements. The minimum slopes are consistent with the City's improvement standards and the 1991 Sewer System Master Plan.

Table 3.2 Minimum Slopes for New Circular Pipes
Sewer System Master Plan
City of Tulare

Pipe Diameter (inches)	Minimum Slope[(1),(2)]
8	0.0033
10	0.0025
12	0.0019
15	0.0014
18	0.0011
21	0.0009
24	0.0008
27	0.0007
30	0.0006
36	0.0004
42	0.0004

Notes:
1. Source: 1991 Sewer System Master Plan and the City's Improvement Standards.
2. Approval by the City Engineer is required if designed slopes are flatter than the minimum slopes.

3.1.5 Changes in Pipe Size

When a smaller sewer joins a large one, the invert of the larger sewer is generally lowered sufficiently to maintain the same energy gradient. An approximate method for securing these results is to place the 0.8 depth point (80 percent of pipe diameter) of both sewers at the same elevation. This can be accomplished by matching the pipe soffits of different pipe sizes.

3.2 LIFT STATIONS AND FORCE MAINS

Lift stations were evaluated and sized for peak flow conditions with the largest pump serving as standby. In other words, lift stations were flagged as deficient if the peak hour flow entering into a lift station exceeded its firm capacity (which is the lift station total capacity less the capacity of the largest pump). For the design of force mains, the minimum and maximum recommended velocities are 2.0 and 6.5 fps, respectively. The Hazen-Williams formula is commonly used for the design of force mains. The Velocity Equation is:

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

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

The value of the Hazen-Williams 'C' varies with the type of pipe material and is influenced by the type of construction and age of the pipe. A value of 120 was used for this master plan.

3.3 WASTEWATER TREATMENT FACILITY FLOWS

The initial step in establishing the wastewater flow criteria for the City included a review of historical flow data influent to the DWWTP and IWWTP collected for the years 2004 through 2006, as provided by City Staff. Tables 3.3 and 3.4 contain summaries of the flow data for the DWWTP and IWWTP, respectively, for these years.

These tables list, for each month, the minimum day flow (lowest recorded flow during any single day of the month), the average day flow for each month, and the maximum day flow (highest recorded flow during any single day of the month). Maximum day peaking factors were calculated by dividing the maximum day flows by the average flow for that year.

The tables also summarize the average day flow (ADF); the average wet month flow and the average dry month flow. It can be seen from this data that the ADF, average wet month flow and the average dry month flow are essentially the same for both the DWWTP and the IWWTP. This is important because it signifies that for the DWWTP and the IWWTP, there is no measurable influence from infiltration and inflows (I/I) during wet months. Systems with a significant I/I problem would show increased flows during the wet months of the year, typically between November and March for central California.

Daily flows for 2006 are shown on Figures 3.1 and 3.2 for the DWWTP and IWWTP, respectively. These figures illustrate that no significant trend in higher flows during the wet weather months can be seen.

Table 3.3 Historical Monthly Sewer Inflows at DWWTP
Sewer System Master Plan
City of Tulare

Month-Year	Minimum Day (mgd)	Average Day (mgd)	Maximum Day (mgd)	MaxDay / AvgDay Factor
2004				
January	4.09	4.86	14.22[(2)]	3.05
February	3.99	4.55	4.92	1.06
March	4.16	4.52	4.83	1.04
April	4.25	4.52	4.71	1.01
May	4.20	4.51	4.86	1.04
June	4.22	4.54	4.81	1.03
July	4.23	4.60	4.80	1.03
August	4.24	4.73	4.99	1.07
September	4.26	4.73	5.42	1.16
October	4.35	4.80	5.49	1.18
November	4.45	4.78	5.04	1.08
December	4.32	4.74	5.34	1.15
2005				
January	4.40	4.77	5.70	1.21
February	4.02	4.74	5.33	1.13
March	4.43	4.89	5.29	1.12
April	4.43	4.80	5.17	1.09
May	4.51	4.81	5.15	1.09
June	3.47	4.66	5.02	1.06
July	4.58	4.76	4.91	1.04
August	4.42	4.81	5.07	1.07
September	4.56	4.83	5.21	1.10
October	3.99	4.56	4.90	1.04
November	4.38	4.60	4.81	1.02
December	4.05	4.56	4.97	1.05
2006				
January	3.75	4.53	6.85	1.52
February	4.22	4.49	4.79	1.06

Table 3.3 Historical Monthly Sewer Inflows at DWWTP
Sewer System Master Plan
City of Tulare

Month-Year	Minimum Day (mgd)	Average Day (mgd)	Maximum Day (mgd)	MaxDay / AvgDay Factor
March	4.09	4.49	4.79	1.06
April	4.06	4.63	6.02	1.34
May	4.08	4.52	5.03	1.12
June	4.18	4.48	4.73	1.05
July	3.44	4.50	5.45	1.21
August	2.52	4.49	4.75	1.06
September	3.62	4.40	4.81	1.07
October	4.19	4.52	4.85	1.08
November	4.27	4.48	4.88	1.08
December	4.20	4.47	4.72	1.05

Average Dry and Wet Weather Monthly Summaries(3)

Year	Average Day	Avg. Wet Month	Avg. Dry Month	Avg. Wet Month	Avg. Dry Month Factor
2004	4.66	4.66	4.65	1.00	1.00
2005	4.73	4.73	4.74	1.00	1.00
2006	4.50	4.52	4.49	1.00	1.00

Maximum Dry and Wet Weather Monthly Summaries(3)

Year	Average Day (mgd)	Wet Max Day (mgd)	Dry Max Day (mgd)	Wet Max Day Factor	Dry Max Day Factor
2004	4.66	5.34	5.49	1.15	1.18
2005	4.73	5.70	5.21	1.21	1.10
2006	4.50	6.85	5.45	1.52	1.21

Notes:
1. Source = City of Tulare Wastewater Treatment Plant, Monthly Monitoring Program.
2. Flow data from January 2004 is viewed as erroneous and has been disregarded.
3. Wet Month = November through April, Dry Month = May through October.

Table 3.4 Historical Monthly Sewer Flows at IWWTP
Sewer System Master Plan
City of Tulare

Month-Year	Minimum Day (mgd)	Average Day (mgd)	Maximum Day (mgd)	MaxDay/AvgDay Factor
2004				
January	4.94	5.63	6.28	1.08
February	4.79	5.68	6.51	1.12
March	5.10	5.66	6.39	1.10
April	5.12	5.75	6.26	1.08
May	4.58	5.88	7.17	1.24
June	5.11	5.78	6.50	1.12
July	5.44	5.97	6.49	1.12
August	5.41	5.99	6.76	1.17
September	4.86	5.66	6.02	1.04
October	5.01	5.83	6.59	1.14
November	4.84	5.68	6.25	1.08
December	5.17	6.02	6.60	1.14
2005				
January	5.34	6.31	7.28	1.15
February	3.23	6.14	6.91	1.09
March	5.72	6.28	7.04	1.11
April	0.99(3)	6.10	6.66	1.05
May	5.92	6.31	6.92	1.10
June	5.87	6.41	7.60	1.20
July	4.77	6.25	6.74	1.07
August	5.96	6.60	7.12	1.13
September	5.79	6.26	6.69	1.06
October	5.79	6.40	7.08	1.12
November	5.59	6.29	6.80	1.08
December	5.82	6.46	7.10	1.12

Table 3.4 Historical Monthly Sewer Flows at IWWTP
Sewer System Master Plan
City of Tulare

Month-Year	Minimum Day (mgd)	Average Day (mgd)	Maximum Day (mgd)	MaxDay/AvgDay Factor
2006				
January	5.94	6.89	9.58	1.42
February	6.07	6.68	7.33	1.09
March	6.28	6.93	8.64	1.28
April	5.47	6.87	9.04	1.34
May	6.35	6.85	7.44	1.10
June	5.57	6.75	7.46	1.10
July	6.18	6.71	7.21	1.07
August	6.10	6.89	8.80	1.30
September	6.05	6.62	7.27	1.08
October	3.99	6.72	9.84	1.46
November	5.68	6.49	7.16	1.06
December	5.87	6.66	7.33	1.09

Average Dry and Wet Weather Monthly Summaries(2)

Year	Average Day	Avg. Wet Month	Avg. Dry Month	Avg. Wet Month	Avg. Dry Month
2004	5.79	5.74	5.85	0.99	1.01
2005	6.32	6.26	6.37	0.99	1.01
2006	6.76	6.75	6.76	1.00	1.00

Maximum Dry and Wet Weather Monthly Summaries(2)

Year	Average Day	Avg. Wet Month	Avg. Dry Month	Avg. Wet Month	Avg. Dry Month
2004	5.79	6.60	7.17	1.14	1.24
2005	6.32	7.28	7.60	1.15	1.20
2006	6.76	9.58	9.84	1.42	1.46

Notes:
1. Source - City of Tulare Wastewater Treatment Plant, Monthly Monitoring Program.
2. Wet Month = November through April, Dry Month = May through October.
3. Value presented is viewed as erroneous.

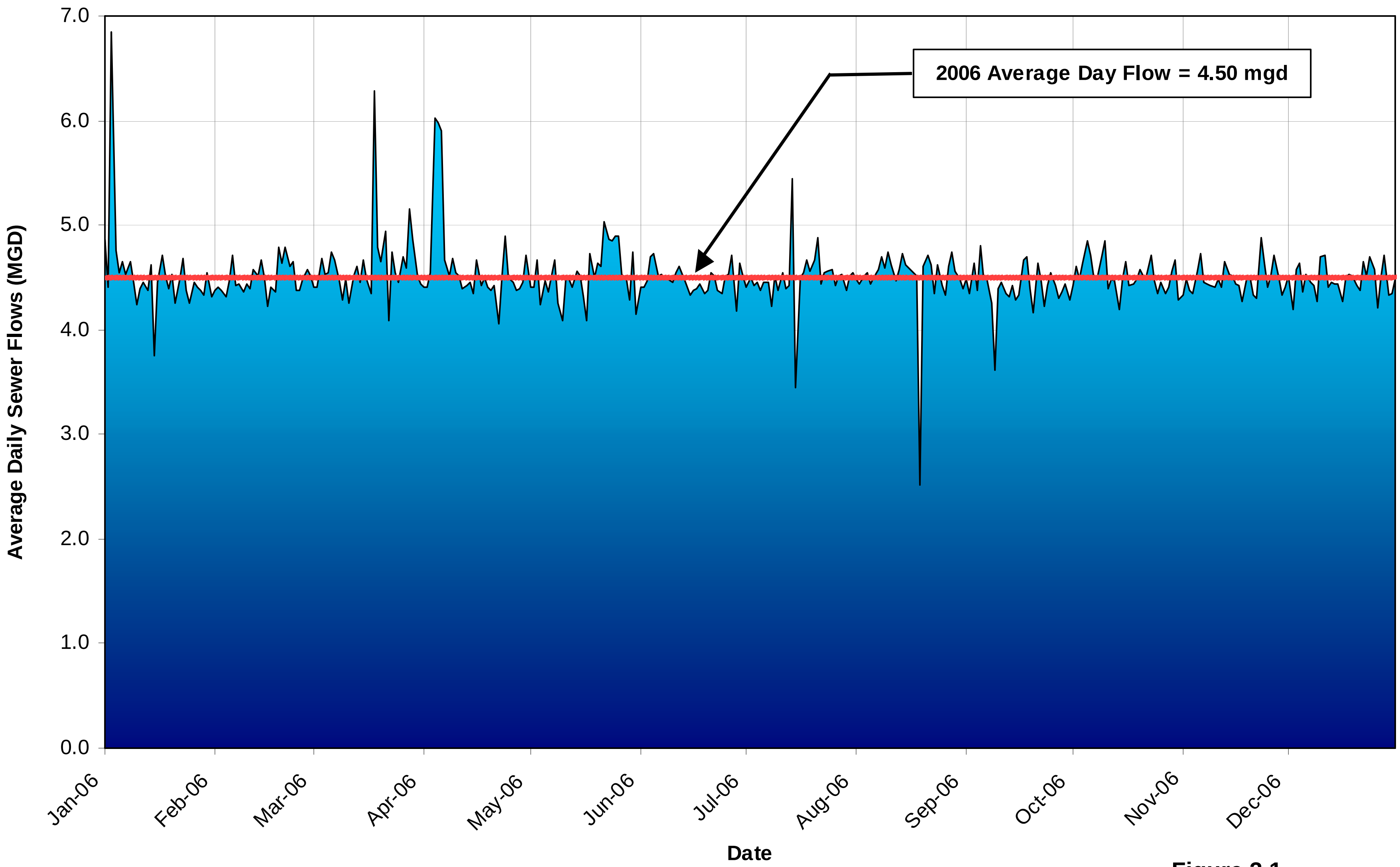

Figure 3.1
2006 Daily Sewer Flows - DWWTP
Sewer System Master Plan
City of Tulare

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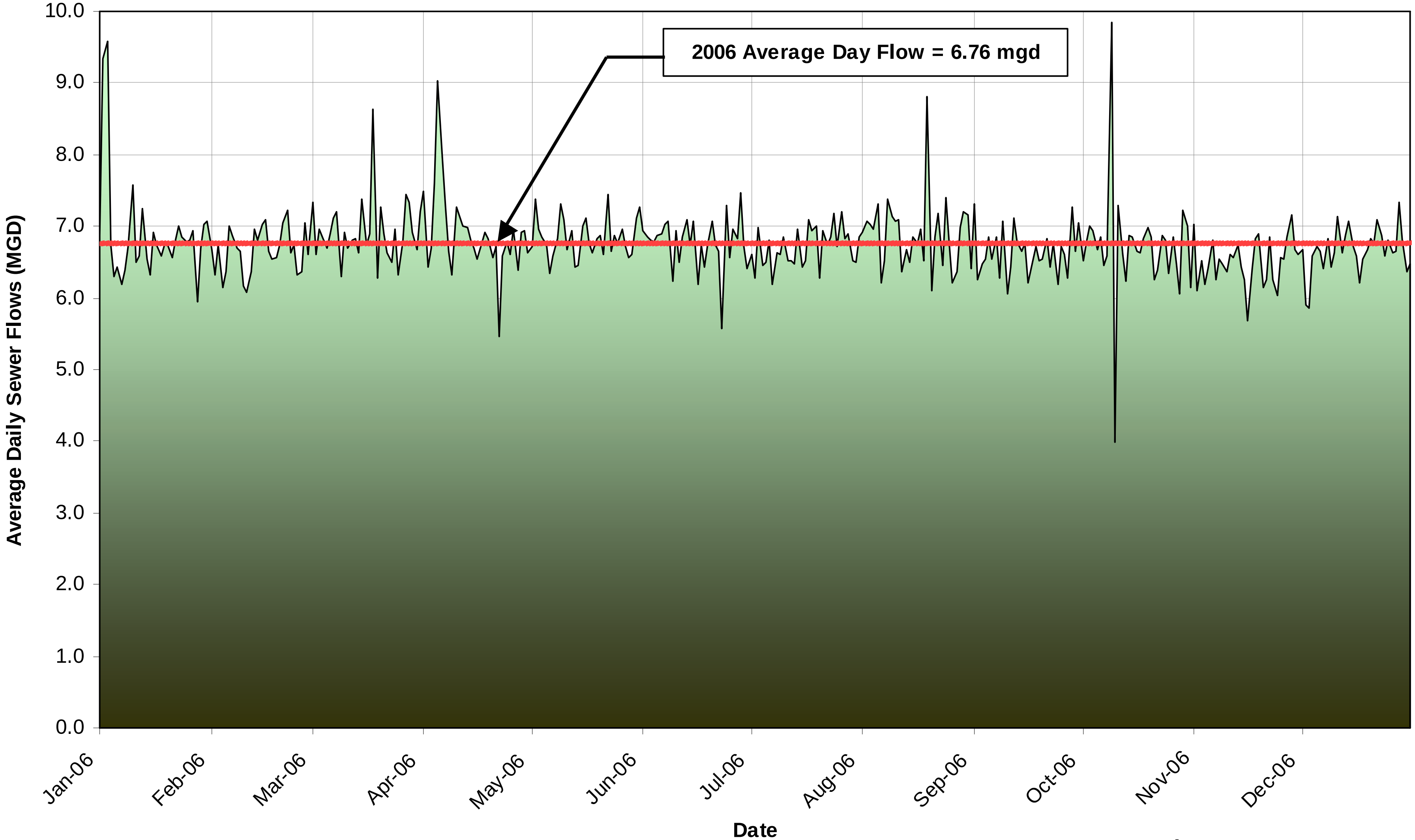

Figure 3.2
2006 Daily Sewer Flows - IWWTP
Sewer System Master Plan
City of Tulare

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3.4 TEMPORARY FLOW MONITORING PROGRAM

A temporary flow monitoring program was conducted to assist in the development of the design flow criteria, and to calibrate the hydraulic collection system model. The purpose of the program was to measure flow and determine relative flow from different areas of the sewer system. The flow monitoring program also helps to determine relative peak to average flow factors for various areas of the collection system. The flows established a benchmark for hydraulic model calibration.

V&A Consulting Engineers conducted the temporary flow monitoring program for a 14-day period from March 22, 2007 through April 4, 2007. Eleven sites were monitored during the flow monitoring program (Figure 3.3). Flow meter sites 2, 4a, and 7 measured flow rates within the City’s industrial collection system. Flow meter sites 1, 3, 4, 5, 6, 8, 9, and 10 measured flows within the City’s domestic collection system.

3.4.1 Flow Monitoring Program Results

The City of Tulare Sanitary Sewer Flow Monitoring Report, dated June 2007, (Appendix A) contains the results of the flow monitoring program. Table 3.5 contains a summary of flow monitoring program data for weekday and weekend flows.

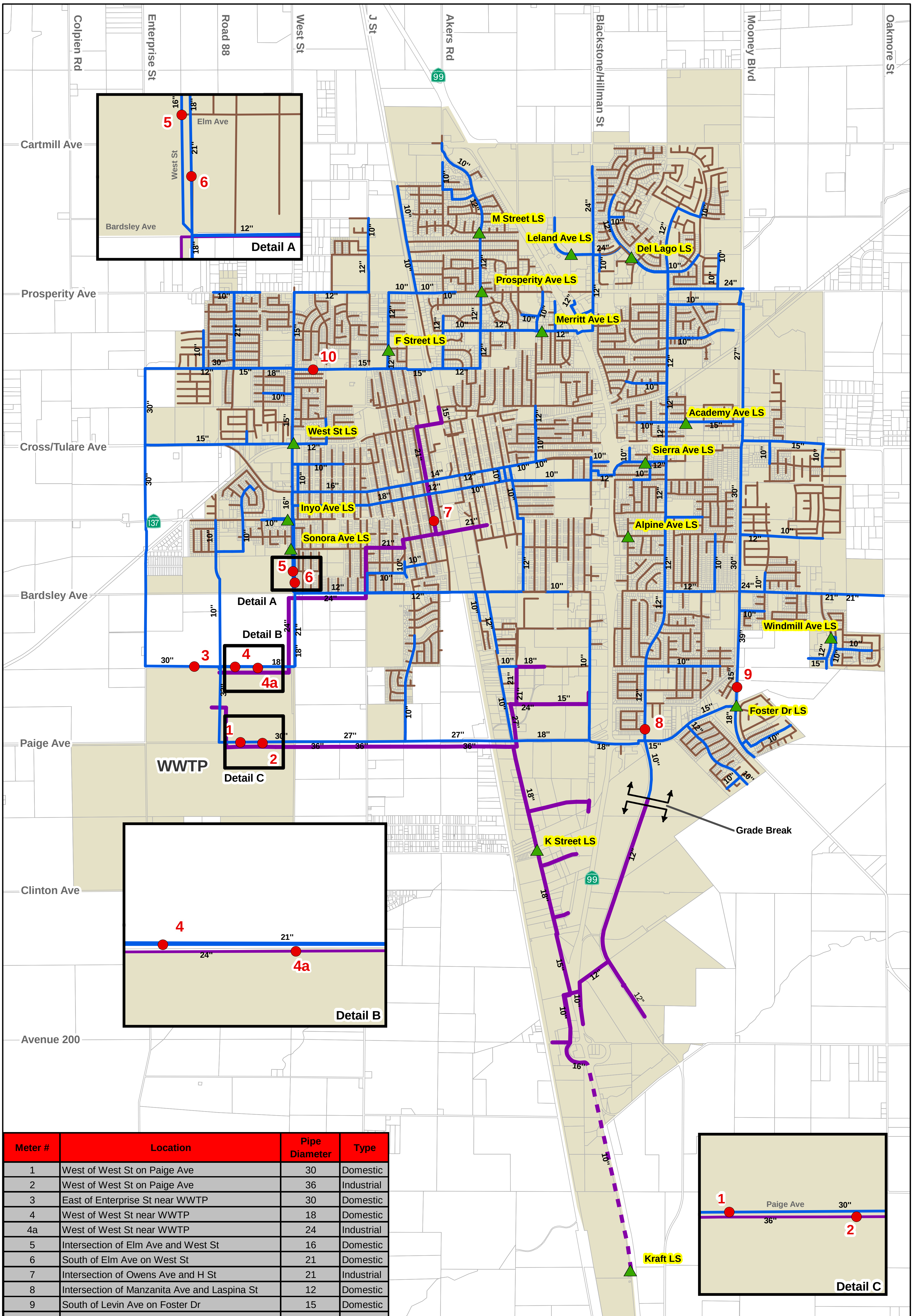
3.5 WASTEWATER FLOW PROJECTIONS

The flow data was used to develop ADF projections for the City through build out of the Urban Development Boundary (UDB) (which is projected to occur by year 2030).

3.5.1 Average Sewer Flow Coefficients

The average sewer flow coefficients are factors, usually expressed in gallons per day per acre (gpda), applied to either gross or net acres for calculating ADF generated from a particular land use designation. Land uses designated as open space, agricultural, and parks, are assumed to generate negligible amounts of sewage flow. Additionally, the City’s wastewater treatment plants are assumed to generate negligible wastewater flow.

The ADF for the DWWTP in 2006 was about 4.5 million gallons per day (mgd). This value was the primary basis for the calibration of the average sewer flow coefficients at the DWWTP. Flows generated by the City’s significant industrial users (SIUs) for the year 2006 were broken down by user based on metered data provided by City Staff, except for Land O Lakes and Morningstar (formerly known as Tulare Cultured Specialists or TCS). Flow data for these users was based on data provided by the flow monitoring program. Figure 3.4 shows the location of the City’s SIUs. Table 3.6 presents the average sewer flow coefficients based on the City’s land use designations.



Meter #	Location	Pipe Diameter	Type
1	West of West St on Paige Ave	30	Domestic
2	West of West St on Paige Ave	36	Industrial
3	East of Enterprise St near WWTP	30	Domestic
4	West of West St near WWTP	18	Domestic
4a	West of West St near WWTP	24	Industrial
5	Intersection of Elm Ave and West St	16	Domestic
6	South of Elm Ave on West St	21	Domestic
7	Intersection of Owens Ave and H St	21	Industrial
8	Intersection of Manzanita Ave and Laspina St	12	Domestic
9	South of Levin Ave on Foster Dr	15	Domestic
10	West of Sacramento St on Pleasant Ave	15	Domestic

Legend

- Flow Meter

Existing Wastewater Collection System

- Lift Stations

Pipelines

- 8" and Smaller
- 10" and Larger
- Industrial Gravity Main
- Industrial Force Main
- City Limits
- Parcels

Miles: 0, 0.4, 0.8

Figure 3.3
Temporary Flow Monitoring Locations

Sewer System Master Plan
City of Tulare

City of Tulare
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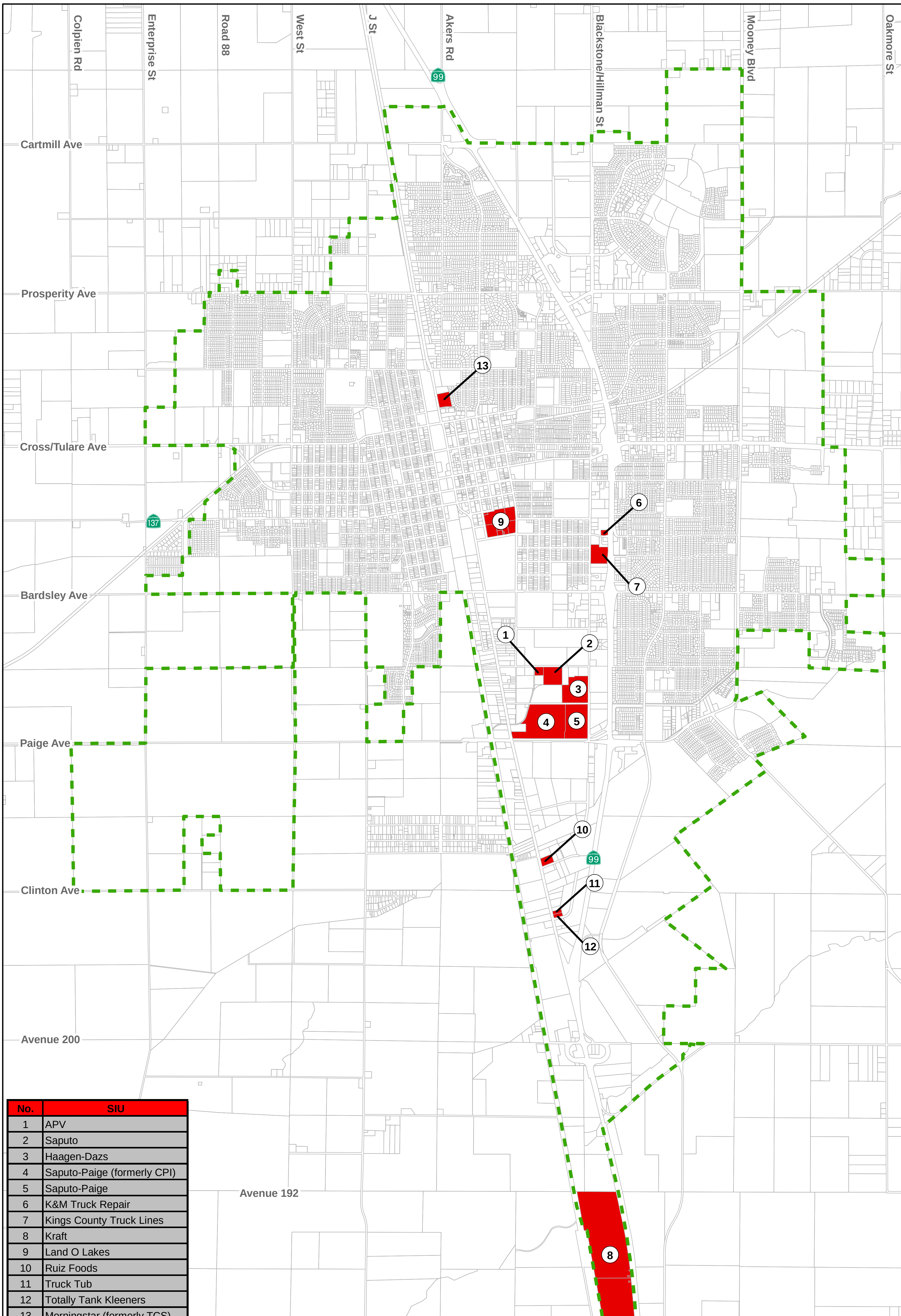
Table 3.5 Temporary Flow Monitoring Program Results
Sewer System Master Plan
City of Tulare

Meter Site	Metered Average Weekday Flow[1] (mgd) Minimum[2]	Average	Peak[2]	Metered Average Weekend Flow[1] (mgd) Minimum[2]	Average	Peak[2]	Domestic/ Industrial
1	0.74	1.91	2.77	0.77	1.99	2.89	Domestic
2	3.56	4.02	4.60	3.35	3.86	4.69	Industrial
3	0.13	0.34	0.49	0.13	0.36	0.54	Domestic
4	0.20	0.50	0.66	0.20	0.51	0.74	Industrial
4a	2.30	2.54	2.90	2.05	2.48	2.83	Domestic
5	0.87	1.53	1.82	0.86	1.59	1.99	Domestic
6	0.21	0.66	0.89	0.20	0.63	0.98	Domestic
7	0.40	0.53	0.66	0.24	0.36	0.54	Domestic
8	0.24	0.54	0.79	0.24	0.58	0.86	Domestic
9	0.41	0.79	1.13	0.40	0.79	1.17	Domestic
10	0.33	0.74	0.98	0.33	0.76	1.05	Domestic

Notes:
1. Source: City of Tulare Sanitary Sewer Flow Monitoring Report, June 2007, by V&A Consulting Engineers (Appendix A).
2. Minimum and peak average day flows were based on hourly averages calculated from the temporary flow monitoring program data (not instantaneous peak).



No.	SIU
1	APV
2	Saputo
3	Haagen-Dazs
4	Saputo-Paige (formerly CPI)
5	Saputo-Paige
6	K&M Truck Repair
7	Kings County Truck Lines
8	Kraft
9	Land O Lakes
10	Ruiz Foods
11	Truck Tub
12	Totally Tank Kleeners
13	Morningstar (formerly TCS)

Legend

- Significant Industrial Users
- City Limits
- Parcels

N

Miles
0 0.4 0.8

Figure 3.4
Significant Industrial Users

Sewer System Master Plan
City of Tulare

City of Tulare

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Table 3.6 Average Sewer Flow Coefficients
Sewer System Master Plan
City of Tulare

Land Use Designation	Land Use Code	Urban Development Boundary [6] (acres)	Existing City Limits Area [6] (acres)	Existing Sewered Service Area [6] (acres)	% of Total Sewered Area (%)	Flow Coefficient (gpd/acre)	2006 ADF Balance (gpd)	% of Total ADF [4] (%)
Tributary to Domestic WWTP [1]								
Residential								
Rural Residential	R-RR	813	30	1	0%	300	300	0%
Rural Estate	R-RE	623	90	11	0%	600	6,600	0%
Low Density Residential	R-LDR	5,545	4,257	2,518	30%	1,300	3,272,900	70%
Medium Density Residential	R-MDR	697	585	379	4%	1,600	607,200	13%
High Density Residential	R-HDR	66	66	47	1%	2,800	131,300	3%
Residential Subtotal		**7,744**	**5,027**	**2,956**	**35%**		**4,018,300**	**86%**
Commercial								
Neighborhood Commercial	C-NC	16	13	7	0%	500	3,400	0%
Community Commericial	C-CC	797	760	245	3%	500	122,400	3%
Regional Commercial	C-RC	280	76	0	0%	500	0	0%
Service Commericial	C-SC	331	275	178	2%	500	89,100	2%
Central Business District	CBD	130	130	120	1%	500	60,100	1%
Entertainment Commercial	C-EC	934	0	0	0%	500	0	0%
Office Commercial	C-OC	35	16	2	0%	500	1,200	0%
Commercial Subtotal		**2,523**	**1,270**	**552**	**7%**		**276,200**	**6%**
Industrial (Tributary to DWWTP)								
Light Industrial	I-LI	1,219	465	318	4%	500	158,800	3%
Heavy Industrial	I-HI	197	193	142	2%	650	92,600	2%
Significant Industrial (Metered) Users							0	
-K&M Truck Repair		1	1	1	0%	--	8,000	0%
-Kings County Truck Lines		9	9	9	0%	--	10,000	0%
Industrial Subtotal		**1,426**	**668**	**470**	**6%**		**269,400**	**6%**
Community Facilities								
Public/Quasi-Public [3]	PUB	1,081	415	266	3%	400	106,400	2%
WWTP [3]	PUB	1,191	1,191	1,191	14%	0	0	0%
Parks and Recreation	PRK	178	130	84	1%	0	0	0%
Open Space	OS/AG	319	13	13	0%	0	0	0%
Roadways and Railroads	--	2,011	1,682	1,682	20%	0	0	0%
Community Facilities Subtotal		**4,780**	**3,431**	**3,235**	**38%**		**106,400**	**2%**
Reserve Designations								
Village	NC	2,272	5	5	0%	617	3,000	0%
Residential Reserve	UR-R	0	0	0	0%	1,361	0	0%
Commercial Reserve	UR-C	0	0	0	0%	650	0	0%
Industrial Reserve	UR-I	136	0	0	0%	600	0	0%
Reserve Designations Subtotal		**2,408**	**5**	**5**	**0%**		**3,000**	**0%**
Domestic WWTP Subtotal								
Domestic WWTP Subtotal		**18,880**	**10,401**	**7,218**	**85%**		**4,673,500**	**100%**
Tributary to Industrial WWTP [2]								
Residential								
Low Density Residential	R-LDR	67	0	0	0%	300	0	0%
Medium Density Residential	R-MDR	38	28	28	0%	1,600	45,500	1%
Residential Subtotal		**105**	**28**	**28**	**0%**		**45,500**	**1%**
Commercial								
Neighborhood Commercial	C-NC	2	0	0	0%		0	0%
Community Commericial	C-CC	96	96	2	0%		0	0%
Service Commericial	C-SC	231	216	210	2%	500	105,100	2%
Entertainment Commercial	C-EC	3	0	0	0%	500	0	0%
Commercial Subtotal		**333**	**313**	**212**	**2%**		**105,100**	**2%**
Industrial (Tributary to IWWTP)								
Light Industrial	I-LI	725	74	20	0%	500	9,800	0%
Heavy Industrial	I-HI	2724	841	391	5%	650	254,300	4%
Significant Industrial (Metered) Users							0	
-APV : North America, Inc.		2	2	2	0%	--	7,000	0%
-Saputo-Paige (formerly CPI)		41	41	41	0%	--	1,381,000	21%
-Haagen Daaz Co./Dreyers		18	18	18	0%	--	214,000	3%
-Kraft - USA		87	87	87	1%	--	869,000	13%
-Land O' Lakes [5]		22	22	22	0%	--	2,010,000	31%
-Ruiz Foods		3	3	3	0%	--	74,000	1%
-Saputo Cheese USA, Inc.		32	32	32	0%	--	990,000	15%
-Totally Tank Kleeners		1	1	1	0%	--	22,000	0%
-Truck Tub, Inc.		1	1	1	0%	--	8,000	0%
-Morningstar (formerly TCS) [5]		5	5	5	0%	--	530,000	8%
Industrial Subtotal		**3,661**	**1,128**	**623**	**7%**		**6,369,100**	**98%**
Community Facilities								
Public/Quasi-Public [3]	PUB	34	19	19	0%	400	7,600	0%
Parks and Recreation	PRK	215	209	209	2%	0	0	0%
Open Space	OS/AG	67	0	0	0%	0	0	0%
Roadways and Railroads	--	311	182	182	2%	0	0	0%
Community Facilities Subtotal		**628**	**411**	**411**	**5%**		**7,600**	**0%**
Reserve Designations								
Industrial Reserve	UR-I	0	0	0	0%	600	0	0%
Reserve Designations Subtotal		**0**	**0**	**0**	**0%**		**0**	**0%**
Industrial WWTP Subtotal								
Industrial WWTP Subtotal		**4,727**	**1,879**	**1,274**	**15%**		**6,527,400**	**100%**
Total City Wide Flow								
Domestic WWTP		**18,880**	**10,401**	**7,218**	**85%**		**4,673,500**	**42%**
Industrial WWTP		**4,727**	**1,879**	**1,274**	**15%**		**6,527,400**	**58%**
Total City Wide Flow		**23,608**	**12,281**	**8,492**	**100%**		**11.2 mgd**	**100%**

Notes:

1. Flow from certain existing industrial land use areas is routed to the DWWTP for treatment (including the Significant Industrial Users K&M Truck Repair and Kings County Truck Lines.
2. Flow to the IWWTP is primarily from the City's Significant Industrial Users. A certain amount of flow, however, is generated from residential, commercial, industrial, and other land use types.
3. The City's WWTPs (which cover a significant portion of the City are assumed to generate no wastewater flow. Therefore, a separate flow coefficient of zero gpd/acre was applied to the WWTP area.
4. Percentage are expressed in terms of percent of total flow at each WWTP (i.e. total % of flow at DWWTP = 100% and total % of flow at IWWTP = 100%).
5. Flow Data for Land O Lakes and Morningstar (formerly TCS) determined from the temporary flow monitoring program (weekday data).
6. Land Use Acreages for the City's Significant Industrial Users were subtracted out for the purposes of sewer coefficient development.

3.5.2 Projected Average Day Sewer Flows

This study considered two methods to determine projected sewer flows within the study area. These methods include projections based on land use and projections based on population projections from the General Plan.

Based on land use, and applying the average sewer flow coefficients developed in Table 3.6, the projected average day flow will approach 12.6 mgd by the year 2030 at the DWWTP assuming 100 percent development and occupancy of all land uses within the UDB (Table 3.7). Figure 3.5 shows the future tributaries that discharge to the DWWTP and IWWTP.

For comparison purposes, the sewer flows were projected using population projections (Table 3.8). A wastewater generation factor of 93 gallons per day per capita (gpdc), which was the average per capita flow for the DWWTP from 2003 through 2006, was used to determine the population based wastewater flow projections for 2030. This value agrees with City's 2003 Wastewater Pollution Control Facilities Facility Plan. By multiplying this factor by the projected population, the City's ADF at the DWWTP will approach 12.2 mgd by 2030. For the purposes of this study, the flow developed using the land use method was used. The land use projections are slightly more conservative and allow the hydraulic model to represent varying land uses throughout the City.

3.6 DESIGN FLOW AND PEAKING FACTORS

The City's sewer collection system was analyzed under existing and future (2030) peak flow conditions. The peak flow condition, which is hereinafter referred to as the "Design Flow," represents the peak hourly flow experienced by the collection system and is measured at the DWWTP and IWWTP. Table 3.9 contains a summary of the design flows utilized for this master planning study. The following subsections contain a more detailed discussion of the determination of the design flow for the domestic and industrial collection systems.

3.6.1 Domestic Collection System

In order to develop a design flow condition, the City's historical DWWTP flow records were reviewed to determine the maximum day wastewater flow (MDF) experienced by the system. The MDF at the DWWTP for the year 2006 was 6.9 mgd. This corresponds to a MDF/ADF ratio of 1.5, and formed the basis of the development of the design flow at the DWWTP for this study.

The initial step in the development of the existing design flow was to scale up the wastewater loads in the City's hydraulic model to match the MDF of 6.9 mgd at the DWWTP. For a MDF of 6.9 mgd, the modeled peak hourly flow at the DWWTP was found to be approximately 9.5 mgd. This is the existing design flow and corresponds to a design flow/ADF peaking factor of 2.1.

Table 3.7 Projected Sewer Flows Based on Land Use
Sewer System Master Plan
City of Tulare

Land Use Designation	Land Use Code	Urban Development Boundary (6) (acres)	% of Total UDB (%)	Adjusted Flow Coefficient (gpd/acre)	2030 ADF Balance (gpd)	% of Total ADF (4) (%)
Tributary to Domestic WWTP (1)						
Residential						
Rural Residential	R-RR	813	3%	300	243,900	2%
Rural Estate	R-RE	623	3%	600	373,800	3%
Low Density Residential	R-LDR	5,545	23%	1,300	7,208,400	56%
Medium Density Residential	R-MDR	697	3%	1,600	1,115,000	9%
High Density Residential	R-HDR	66	0%	2,800	184,300	1%
Residential Subtotal		**7,744**	**33%**		**9,125,400**	**71%**
Commercial						
Neighborhood Commercial	C-NC	16	0%	500	7,900	0%
Community Commericial	C-CC	797	3%	500	398,600	3%
Regional Commercial	C-RC	280	1%	500	139,900	1%
Service Commericial	C-SC	331	1%	500	165,700	1%
Central Business District	CBD	130	1%	500	65,100	1%
Entertainment Commercial	C-EC	223	1%	500	111,300	1%
Office Commercial	C-OC	35	0%	500	17,700	0%
Tulare Motor Sports Park (7)		711	3%	--	230,000	2%
Commercial Subtotal		**2,523**	**8%**		**1,136,100**	**9%**
Industrial (Tributary to DWWTP)						
Light Industrial	I-LI	1,219	5%	500	609,400	5%
Heavy Industrial	I-HI	197	1%	650	128,200	1%
Significant Industrial (Metered) Users					0	
-K&M Truck Repair		1	0%	--	8,000	0%
-Kings County Truck Lines		9	0%	--	10,000	0%
Industrial Subtotal		**1,426**	**6%**		**755,600**	**6%**
Community Facilities						
Public/Quasi-Public (3)	PUB	1,081	5%	400	432,400	3%
WWTP (3)	PUB	1,191	5%	0	0	0%
Parks and Recreation	PRK	178	1%	0	0	0%
Open Space	OS/AG	319	1%	0	0	0%
Roadways and Railroads	--	2,011	9%	0	0	0%
Community Facilities Subtotal		**4,780**	**20%**		**432,400**	**3%**
Reserve Designations						
Village	NC	2,272	10%	617	1,401,200	11%
Residential Reserve	UR-R	0	0%	1,361	100	0%
Commercial Reserve	UR-C	0	0%	650	0	0%
Industrial Reserve	UR-I	136	1%	600	81,300	1%
Reserve Designations Subtotal		**2,408**	**10%**		**1,482,700**	**11%**
Domestic WWTP Subtotal						
Domestic WWTP Subtotal		**18,169**	**80%**		**12,932,200**	**100%**
Tributary to Industrial WWTP (2)						
Residential						
Low Density Residential	R-LDR	67	0%	300	20,000	0%
Medium Density Residential	R-MDR	38	0%	1,600	61,200	0%
Residential Subtotal		**105**	**0%**		**81,200**	**1%**
Commercial						
Neighborhood Commercial	C-NC	2	0%	500	1,200	0%
Community Commericial	C-CC	96	0%	500	48,200	0%
Service Commericial	C-SC	231	1%	500	115,500	1%
Entertainment Commercial	C-EC	3	0%	500	1,700	0%
Commercial Subtotal		**333**	**1%**		**166,600**	**1%**
Industrial (Tributary to IWWTP) (5)						
Light Industrial	I-LI	725	3%	500	362,400	3%
Heavy Industrial	I-HI	2724	12%	650	1,770,700	13%
Significant Industrial (Metered) Users						
-APV : North America, Inc.		2	0%	--	10,000	0%
-Saputo-Paige (formerly CPI)		41	0%	--	1,920,000	14%
-Haagen Daaz Co./Dreyers		18	0%	--	250,000	2%
-Kraft - USA		87	0%	--	2,800,000	21%
-Land O' Lakes		22	0%	--	3,290,000	24%
-Ruiz Foods		3	0%	--	238,700	2%
-Saputo Cheese USA, Inc.		32	0%	--	700,000	5%
-Totally Tank Kleeners		1	0%	--	71,000	1%
-Truck Tub, Inc.		1	0%	--	10,000	0%
-Morningstar (formerly TCS) (5)		5	0%	--	391,000	3%
Future Signficant Industrial Users					0	
- Future Dairy No. 1		--	--	--	1,380,000	10%
Industrial Subtotal		**3,661**	**16%**		**13,193,700**	**98%**
Community Facilities						
Public/Quasi-Public (3)	PUB	34	0%	400	13,700	0%
Parks and Recreation	PRK	215	1%	0	0	0%
Open Space	OS/AG	67	0%	0	0	0%
Roadways and Railroads	--	311	1%	0	0	0%
Community Facilities Subtotal		**628**	**3%**		**13,700**	**0%**
Reserve Designations						
Industrial Reserve	UR-I	0	0%	600	0	0%
Reserve Designations Subtotal		**0**	**0%**		**0**	**0%**
Industrial WWTP Subtotal						
Industrial WWTP Subtotal		**4,727**	**20%**		**13,455,200**	**100%**
Total City Wide Flow						
Domestic WWTP		**18,880**	**80%**		**12,932,200**	**49%**
Industrial WWTP		**4,727**	**20%**		**13,455,200**	**51%**
Total City Wide Flow		**23,608**	**100%**		**26.4 mgd**	**100%**

Notes:

1. Flow from certain existing industrial land use areas is routed to the DWWTP for treatment (including the Significant Industrial Users K&M Truck Repair and Kings County Truck Lines.
2. Flow to the IWWTP is primarily from the City's Significant Industrial Users. A certain amount of flow, however, is generated from residential, commercial, industrial, and other land use types.
3. The City's WWTPs (which cover a significant portion of the City are assumed to generate no wastewater flow. Therefore, a separate flow coefficient of zero gpd/acre was applied to the WWTP area.
4. Percentage are expressed in terms of percent of total flow at each WWTP (i.e. total % of flow at DWWTP = 100% and total % of flow at IWWTP = 100%).
5. Flow projections for the City's SOI are based on Table 3.11 of the City of Tulare WPCF Facility Plan, except for Ruiz Foods and Totally Tank Kleeners, which is based on 2006 ADF with a 5% annual flow increase.
6. Land Use Acreages for the City's Significant Industrial Users were subtracted out for the purposes of flow projections.
7. Based on flow information provided in the Draft EIR for the Tulare Motor Sports Complex.

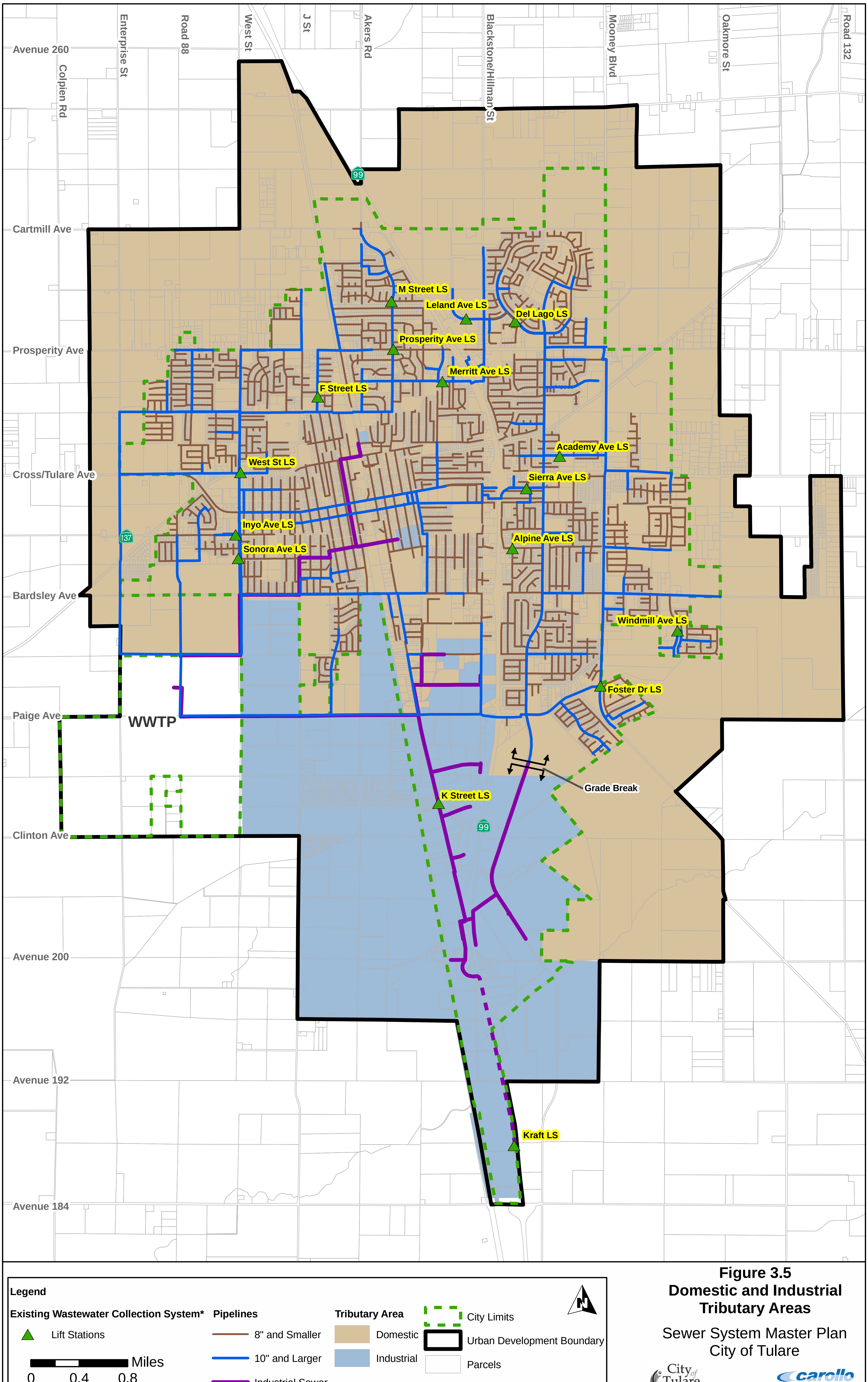

Figure 3.5
Domestic and Industrial Tributary Areas

Sewer System Master Plan
City of Tulare

City of Tulare

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*As of January 2009

Table 3.8 Projected Sewer Flows Based on Population - DWWTP
Sewer System Master Plan
City of Tulare

Year	Population	Projected Sewer Flows[1] Average Day (mgd)
2010	**60,128**	**5.62**
2011	62,509	5.84
2012	64,985	6.07
2013	67,558	6.31
2014	70,233	6.56
2015	**73,015**	**6.82**
2016	75,906	7.09
2017	78,912	7.37
2018	82,037	7.66
2019	85,285	7.97
2020	**88,683**	**8.28**
2021	92,174	8.61
2022	95,824	8.95
2023	99,618	9.31
2024	103,563	9.68
2025	**107,664**	**10.06**
2026	111,928	10.46
2027	116,360	10.87
2028	120,968	11.30
2029	125,759	11.75
2030	**130,975**	**12.24**

Note:
1. Projected Sewer Flows Based on 93 gpdc wastewater generation factor.

Table 3.9 Existing and Projected Design Flow Sewer System Master Plan City of Tulare						
	Domestic Collection System			**Industrial Collection System**		
Year	**ADF (mgd)**	**Design Flow (mgd)**	**Peaking Factor**	**ADF (mgd)**	**Design Flow (mgd)**	**Peaking Factor**
Existing	4.5	9.5	2.1	6.5	13.0	2.0
2030	12.9	27.9	2.1	13.5	27.4	2.0

Note:
1. ADF and Design Flow is taken at the DWWTP and IWWTP for this table.

3.6.2 Industrial Collection System

Based on a review of the historical influent flow records for the IWWTP the maximum daily flow for the past three years was 9.84 mgd, which resulted in a MDF/ADF ratio of 1.46. Using the data collected during the temporary flow monitoring program and City data on metered industrial flows for SIUs, the design flows for the existing industrial collection system peaked at 13.0 mgd. The design flow resulted in a design flow/ADF factor of 2.0 mgd at the IWWTP.

3.7 PLANNING AND EVALUATION CRITERIA SUMMARY

The City's sewer collection system was evaluated based on the planning and evaluation criteria in this chapter. The criteria are summarized in Table 3.10.

Table 3.10 Planning and Evaluation Criteria Summary
Sewer System Master Plan
City of Tulare

Minimum Slopes for New Circular Pipes

Slopes are based on City Improvement Standards and the 1991 Sewer System Master Plan.

Pipe Size (in.)	Minimum Slope [(1)] (ft/ft)
8	0.0033
10	0.0025
12	0.0019
15	0.0014
18	0.0011
21	0.0009
24	0.0008
27	0.0007
30	0.0006
36	0.0004
42	0.0004

Note: 1. Minimum slopes reflect City's minimum slopes when pipe is flowing half-full; based on criteria from 1991 Master Plan.

Flow Depth, d/D

The following flow depth criteria will be used in the analysis:

d/D for evaluating existing sewers: 0.92

d/D for Designing New Sewers:

Pipe Size (in.)	Maximum d/D Ratio (during Peak Flows)
10 and smaller	0.50
12 to 16	0.67
Larger than 16	0.75

Headloss in Existing Pipes

Headloss in existing sewer pipes shall be calculated based on the following:

Gravity Pipes	Manning's n =	0.013
Pressure Pipes	Hazen William's C =	120

Changes in Pipe Size

When a smaller sewer joins a larger one, sewer crowns will be matched.

Average Sewer Flow Coefficients

These flow coefficients are applied to gross land use acreages to yield average day sewer flows.

Land Use Category	Code	Coefficients (gpda)
Rural Residential	R-RR	300
Rural Estate	R-RE	600
Low Density Residential	R-LDR	1,300
Medium Density Residential	R-MDR	1,600
High Density Residential	R-HDR	2,800
Neighborhood Commercial	C-NC	500
Community Commericial	C-CC	500
Regional Commercial	C-RC	500
Service Commericial	C-SC	500
Central Business District	CBD	500
Entertainment Commercial	C-EC	500
Office Commercial	C-OC	500
Light Industrial	I-LI	500
Heavy Industrial	I-HI	650
Public/Quasi-Public	PUB	400
Parks and Recreation	PRK	0
Open Space	OS/AG	0
Roadways and Railroads	--	0
Village	NC	617
Residential Reserve	UR-R	1,361
Commercial Reserve	UR-C	650
Industrial Reserve	UR-I	600

EXISTING SYSTEM AND HYDRAULIC MODEL

This chapter presents an overview of the City of Tulare (City) sewer collection system. The chapter also describes the development and calibration of the City's sewer hydraulic model. This model was used for identifying existing system deficiencies and for recommending enhancements.

4.1 SYSTEM OVERVIEW

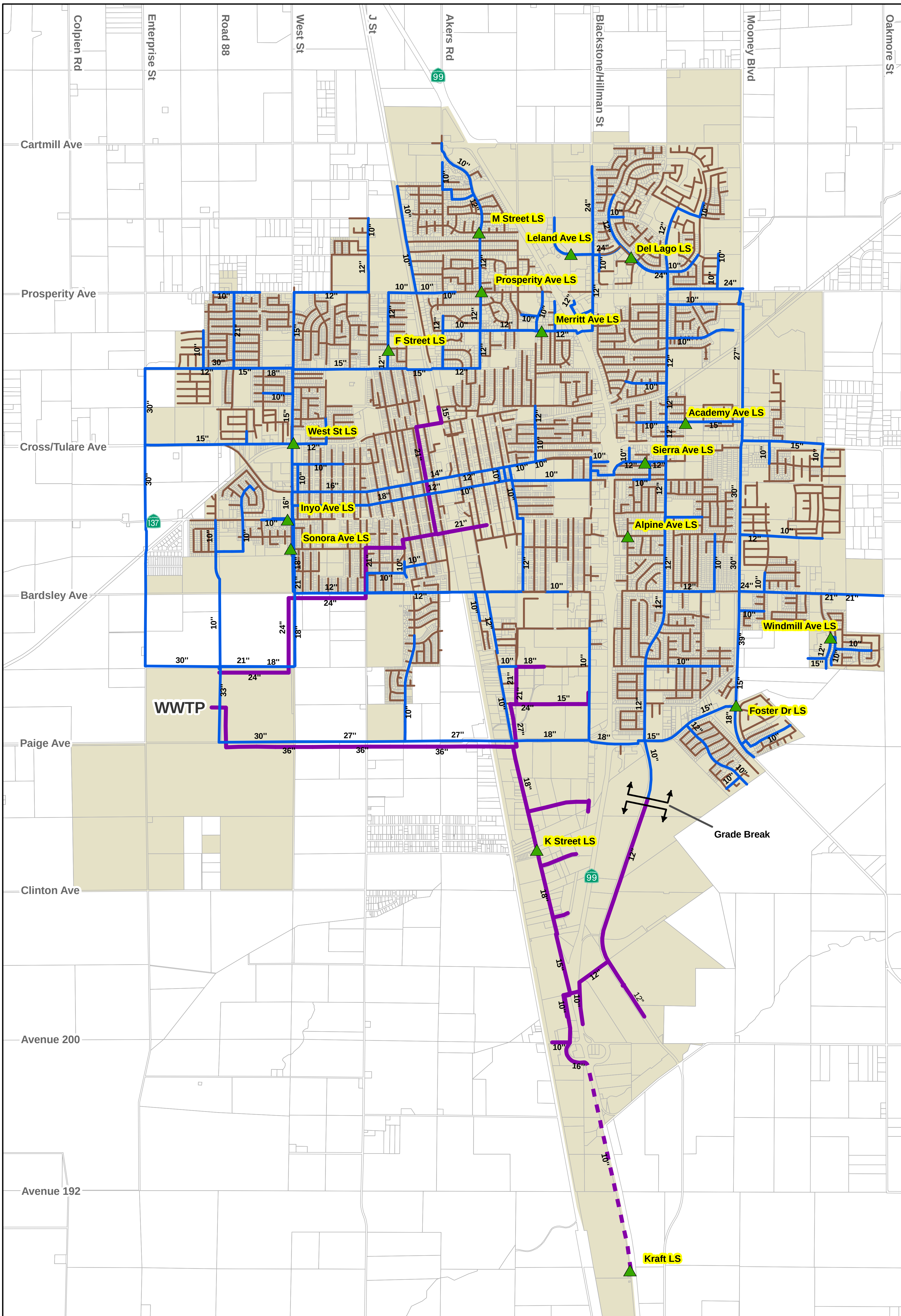
The City's collection system facilities consist of 6-inch through 39-inch diameter gravity sewer pipelines, as well as 16 sewage lift stations and associated force mains (Figure 4.1). The majority of these pipelines convey wastewater generated within the City limits to the City's Domestic Wastewater Treatment Plant (DWWTP). There are also sewers dedicated to conveying wastewater flow from industrial dischargers to the City's Industrial Wastewater Treatment Plant (IWWTP). Figure 4.2 identifies the City's "backbone" sewer system, which was included in the City's hydraulic model.

4.1.1 Domestic Collection System

The City's existing domestic collection system was divided into nine trunk sewers and tributary basins (Figure 4.3). The trunk sewers (which have generally been assigned a name based on the predominant street(s) alignment) and the tributary they serve are described in the following sections, starting at the downstream end and continuing upstream. These sewers convey flow to the DWWTP.

4.1.1.1 West/Pleasant Trunk

The West/Pleasant Trunk conveys flow from the West/Pleasant Sewer Tributary, Tulare Avenue Trunk, and Kern Avenue Trunk to the DWWTP. The trunk begins as a 21-inch diameter pipeline on Avenue 220 near the DWWTP headworks and extends east on Avenue 220 to West Street. The 21-inch diameter trunk then extends north on West Street to Bardsley Avenue, where it splits into parallel 21- and 16-inch diameter pipelines. The 21-inch diameter pipeline, which becomes an 18-inch diameter pipeline at Elm Street, and the 16-inch diameter pipeline extend north on West Street to Tulare Avenue. At Tulare Avenue, the two pipelines converge and become a 15-inch diameter pipeline that extends north on West Street to Pleasant Avenue. The trunk extends as a 15-inch diameter pipeline at the intersection of Pleasant Avenue and West Street east to M Street, becoming a 10-inch diameter pipeline. The trunk then extends north to Merritt Avenue.



Legend

Existing Wastewater Collection System* **Pipelines**

Lift Stations

8" and Smaller

10" and Larger

Industrial Gravity Main

Industrial Force Main

City Limits

Parcels

0 0.4 0.8 Miles

Figure 4.1
Existing Collection System

Sewer System Master Plan
City of Tulare

City of Tulare

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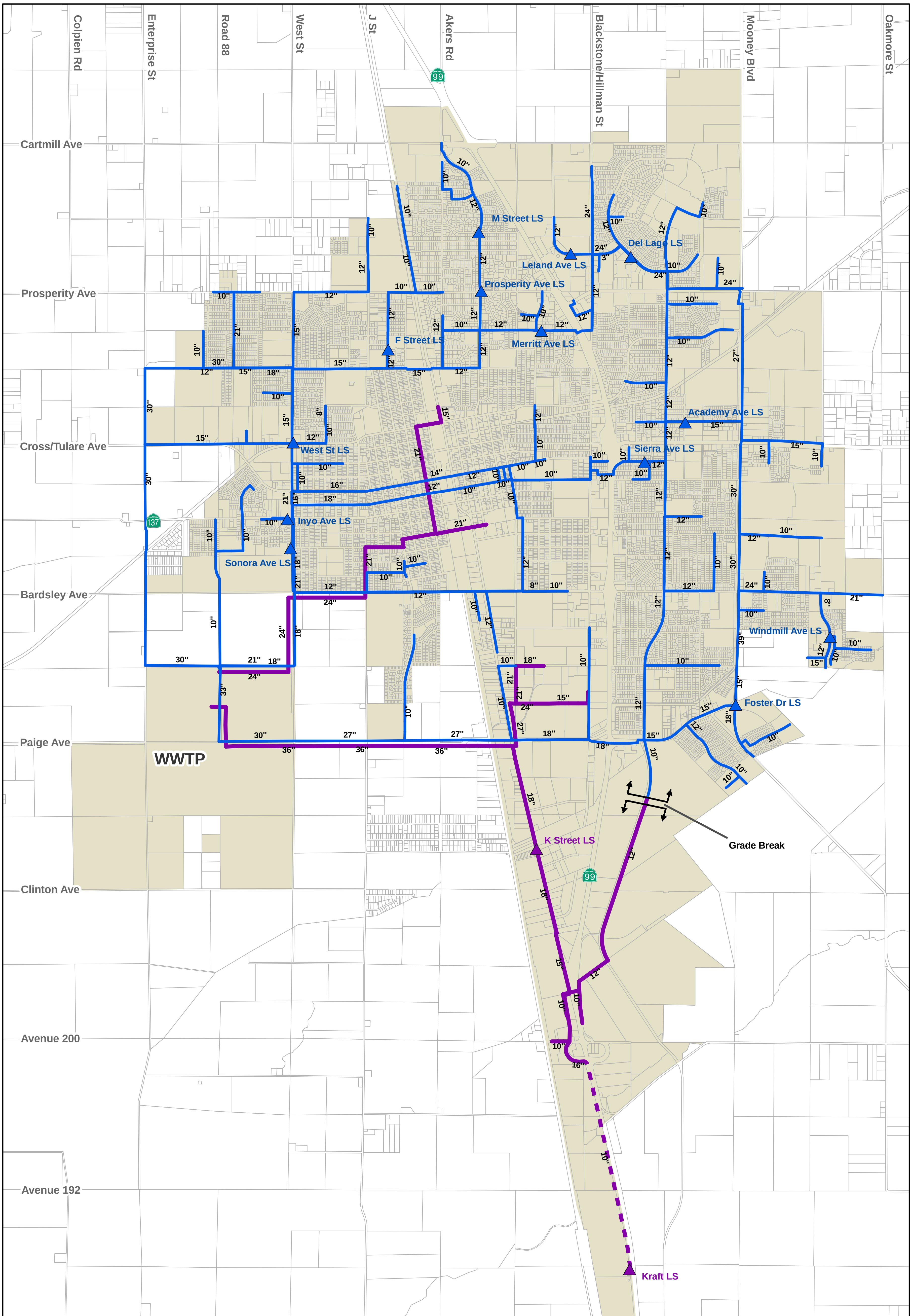
*As of January 2009



Legend

Modeled Wastewater Collection System

Domestic Lift Stations	Domestic Sewer Pipelines	City Limits	
Industrial Lift Stations	Industrial Gravity Main	Parcels	
	Industrial Force Main		

Miles: 0 0.4 0.8

Figure 4.2
Modeled Collection System

Sewer System Master Plan
City of Tulare

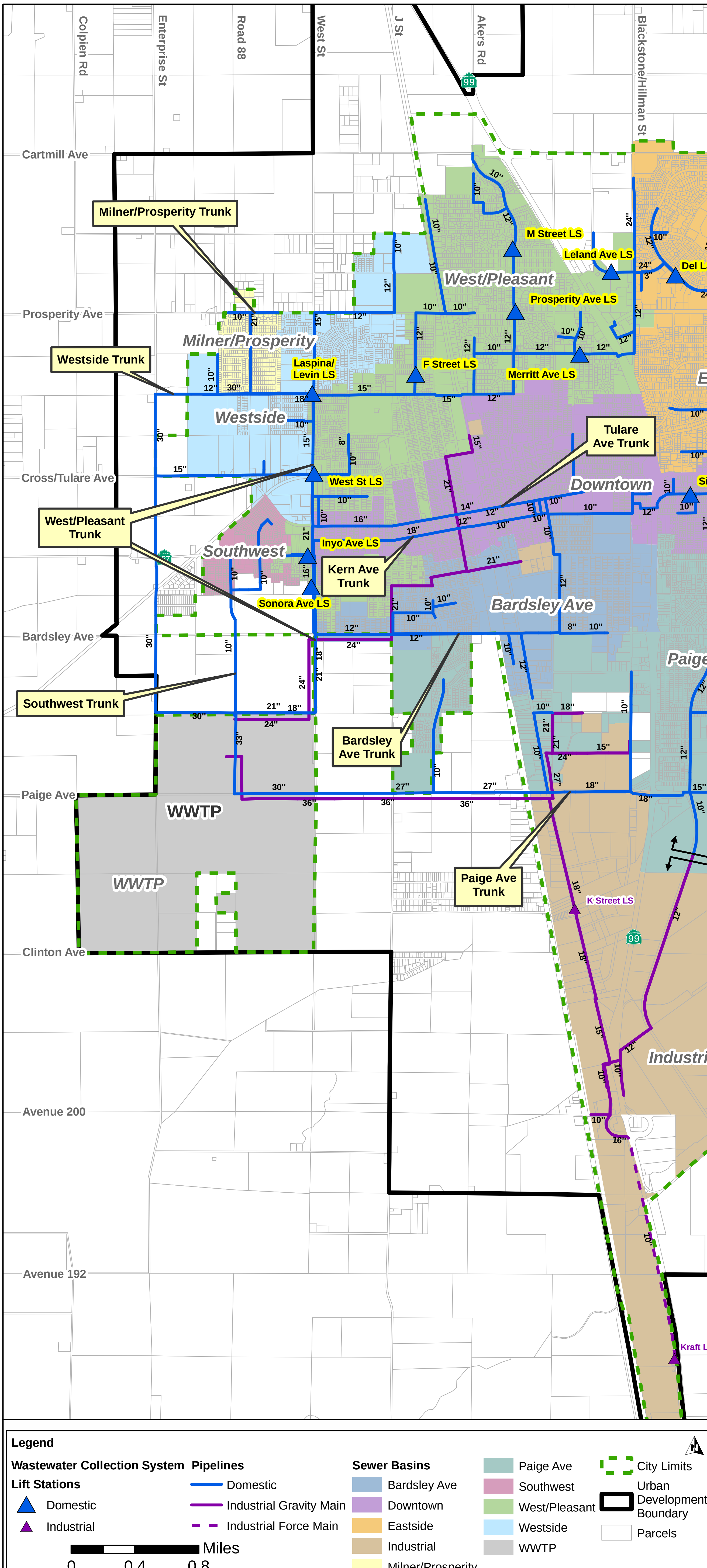


Figure 4.3
Domestic Trunk Sewers

Sewer System Master Plan
City of Tulare

4.1.1.2 Bardsley Avenue Trunk

The Bardsley Avenue Trunk conveys flow from the Bardsley Avenue Sewer Tributary and begins as an 18-inch diameter pipeline on Avenue 220 near the DWWTP headworks. The trunk extends east on Avenue 220 to West Street, where it extends north to Bardsley Avenue. At Bardsley Avenue, the trunk splits into parallel 12-inch diameter pipelines that extend east and come back together again at a manhole located west of J Street. The trunk then extends east as a single 12-inch diameter pipeline to O Street.

4.1.1.3 Westside Trunk

The Westside Trunk conveys flow from the Westside Sewer Tributary and the Milner/Prosperity Trunk. The 30-inch diameter trunk begins at the Laspina/Levin LS (which was not considered as part of the master plan analysis) and extends west on Avenue 220 to Enterprise Street. At Enterprise Street, the trunk extends north to Pleasant Avenue. At Pleasant Ave, the trunk extends east to Milner Avenue, where it becomes an 18-inch diameter pipeline that extends east to West Street.

4.1.1.4 Paige Avenue Trunk

The Paige Avenue Trunk conveys flows from the Paige Avenue Sewer Tributary and the Eastside Trunk to the DWWTP. The trunk begins at the Laspina/Levin LS as a 33-inch diameter pipeline and extends south to Paige Avenue.

The trunk then becomes a 30-inch diameter pipeline that extends east to West Street, where it becomes a 27-inch diameter pipeline. The 27-inch diameter pipeline extends east on Paige Avenue to K Street, where it becomes an 18-inch diameter pipeline. The 18-inch diameter pipeline extends east past Highway 99, where it becomes a 15-inch diameter pipeline that extends east on Paige Avenue and Foster Drive to the Foster Drive LS. From the Foster Drive LS, the 15-inch diameter trunk extends north to Levin Avenue.

4.1.1.5 Southwest Trunk

The Southwest Trunk conveys flow from a relatively small area south of Tulare Avenue and west of West Street. The 10-inch diameter trunk begins at the Laspina/Levin LS and extends north to the intersection of Gemini Street and Sonora Avenue.

4.1.1.6 Kern Avenue Trunk

The Kern Avenue Trunk is tributary to the West/Pleasant Trunk and conveys portions of flow from the Downtown Sewer Tributary. The trunk begins at the intersection of West Street and Kern Avenue as an 18-inch diameter pipeline. The trunk extends east and northeast on Kern Avenue, becoming a 12-inch diameter and then a 10-inch diameter pipeline, to Blackstone Street. At Blackstone Street, the pipeline becomes a 12-inch diameter pipeline that extends north to Sequoia Avenue and then east across Highway 99. The trunk then extends east on Sierra Avenue to Laspina Street.

4.1.1.7 Tulare Avenue Trunk

The Tulare Avenue Trunk is tributary to the West/Pleasant Street Trunk and conveys portions of flow from the Downtown Sewer Tributary. The Trunk begins as a 16-inch diameter pipeline at the intersection of West Street and Tulare Avenue. The trunk extends east and northeast on Tulare Avenue to Cherry Street, becoming a 14-inch diameter, 12-inch diameter, and 10-inch diameter pipeline.

4.1.1.8 Milner/Prosperity Trunk

The Milner/Prosperity Trunk is tributary to the Westside Trunk and conveys flow from the Milner/Prosperity Sewer Tributary. The 21-inch diameter trunk begins at the intersection of Pleasant Avenue and Milner Street and extends north to Prosperity Avenue. The trunk then extends east approximately 1,000 feet.

4.1.1.9 Eastside Trunk

The Eastside Trunk is the major artery for new development on the east side of the City. The Trunk is tributary to the Paige Avenue Trunk and conveys flow from the Eastside Sewer Tributary. The 39-inch diameter trunk begins on Mooney Boulevard at Levin Avenue and extends north on Mooney Boulevard to Prosperity Avenue, becoming a 30-inch diameter and then a 27-inch diameter pipeline. The trunk becomes a 24-inch diameter pipeline on Prosperity Avenue and extends west to Laspina Street where it extends north to Paseo Del Lago, and then northwest to the Del Lago LS. The trunk then becomes a 21-inch diameter pipeline that extends northwest on Paseo Del Lago to Leland Avenue, where it extends west to Hillman Street.

4.1.2 Industrial Collection System

The City’s industrial collection system was divided into two trunk sewers (Figure 4.4). The trunk sewers and the tributary they serve are described in the following sections.

4.1.2.1 High Strength Industrial Trunk

The High Strength Industrial Trunk conveys flow from the High Strength Industrial Sewer Tributary to the IWWTP. The 36-inch diameter trunk begins at the IWWTP and extends south to Paige Avenue, and then east on Paige Avenue to K Street.

4.1.2.2 Dairy Waste Trunk

The Dairy Waste Trunk conveys flow from Land O Lakes and Morningstar (formerly TCS) to the IWWTP. The existing Dairy Waste Trunk begins as a 24-inch diameter pipeline near the IWWTP and extends east on Avenue 220 to West Street, where it extends north to Bardsley Avenue. The trunk then extends east on Bardsley Avenue to Pratt Street. At Pratt Street, the trunk becomes a 21-inch diameter pipeline, which extends north to Sonora Avenue and then east and northeast to H Street.

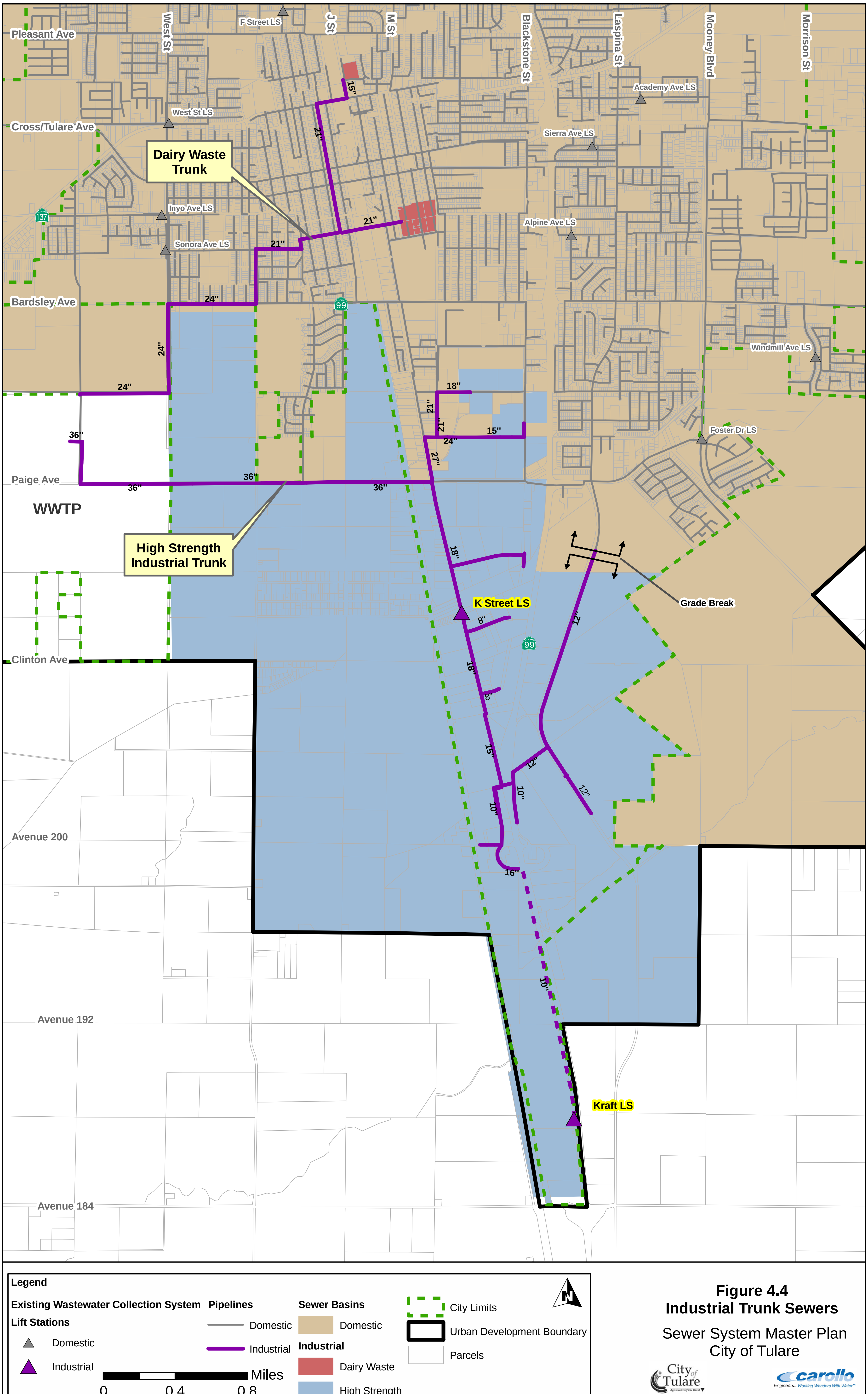


Figure 4.4
Industrial Trunk Sewers

Sewer System Master Plan
City of Tulare

At the intersection of H Street and Sonora Avenue, the trunk splits into a 21-inch diameter pipeline that extends east to Land O Lakes and a 21-inch diameter pipeline that extends northwest along H Street to Morningstar (formerly TCS) becoming a 15-inch diameter pipeline. It should be noted that the City is currently in the process of replacing the existing Dairy Waste Trunk with a new Dairy Waste Trunk. The alignment of the new Dairy Waste Trunk is somewhat different than the existing alignment and will make the new Dairy Waste Trunk tributary to the High Strength Industrial Trunk.

4.2 LIFT STATIONS

The City currently operates 16 sewage lift stations within the existing collection system. Fourteen of these are part of the domestic collection system. The two industrial lift stations (K Street LS and Kraft LS) convey flows from the industrial area south of Paige Avenue to the IWWTP. Table 4.1 is a summary of the City's existing lift stations. The table summarizes each lift stations design capacity and discharge head. Figure 4.5 is a schematic of the collection system and how they convey flow to the treatment plants. It should be noted that the Laspina/Levin Lift Station and the Alpine Lift Station were not evaluated as part of this master plan study. Since the hydraulic model only evaluated the collection system outside the fence line of the DWWTP, the Laspina Lift Station was not included. The Alpine Lift Station is not on a major trunk line (10-inch diameter or larger) therefore it was not included.

4.3 HYDRAULIC MODEL

Hydraulic network analysis is a powerful tool used in sewer collection planning, design, operation, management, and emergency response. The City's hydraulic sewer model is a critical element used in evaluating the capacity of the City's existing sewer system and in planning the City's future facilities.

4.3.1 Selected Hydraulic Model

There is an abundance of sewer analysis software in the marketplace today, with a variety of features and capabilities. The selection of a particular model generally depends on user preferences, software costs, and the complexity of the sewer system. It was agreed that H_2OMAP SWMM Version 7.0, by MWH Soft, would be used by Carollo to assemble the City's hydraulic model.

4.3.2 Elements of the Hydraulic Model

The City's hydraulic model combines information on the physical and operational characteristics of the sewer system, and performs calculations to solve a series of mathematical equations to simulate flows in pipes. Elements comprising the computer modeling process are: skeletonizing the sewer system, defining pipes and nodes, and identifying the service areas.

Table 4.1 Existing Lift Station Summary
Sewer System Master Plan
City of Tulare

Lift Station Name	Location (Intersection)	Record Drawing No.	Lift Station Design Data[1]					
			Pump No.	**hp**	**Pump Capacity (gpm)**	**Firm Capacity[3] (gpm)**	**Total Capacity (gpm)**	**TDH (feet)**
Lift Stations Tributary to Domestic WWTP								
Academy Avenue LS	Academy Avenue and	22-147	1	6.4	375	375	925	25
	Mountain View		2	10	550			25
Alpine Avenue LS[2]	Alpine Avenue and	22-86	1	3	250	250	500	15
	Spruce Street		2	3	250			15
Del Lago LS	Paso Del Lago se/o	17-336 &	1	18	698	698	1,396	35' - 40'
	Leland Avenue	17-348	2	18	698			35' - 40'
F Street LS	F Street n/o	17-72	1	3.9	550	550	1,100	19
	Pleasant Avenue		2	3.9	550			19
Foster Drive LS	Mooney Boulevard and	22-147	1	12	700	700	1,400	20
	Foster Drive		2	12	700			20
Inyo Avenue LS	Inyo Street w/o	22-65	1	3	250	250	500	
	West Street		2	3	250			
Leland Avenue LS	Leland Avenue w/o	17-31	1	5	350	350	700	21
	Hillman Street		2	5	350			21
M Street LS	M Street and	17-63	1	3	110	110	220	15
	Washington Avenue		2	3	110			15
Merritt Avenue LS	Merrit Avenue e/o	22-43	1	5	375	375	925	20
	Cherry Street		2	7.5	550			20
Prosperity Avenue LS	Prosperity Avenue	22-73	1	3	200	200	575	20
	and M Street		2	4.5	375			20
Sierra Avenue LS	Sierra Avenue w/o	29-12	1	5	150	150	300	14
	Redwood Avenue		2	5	150			14
Sonora Avenue LS	Sonora Avenue and	17-105	1	0.5	85	0	85	11
	West Street							
West Street LS	Cross Street and	22-35	1	2	250	250	500	10
	West Street		2	2	250			10
Windmill Avenue LS[4]	Windmill Avenue and	17-406(A)	1	1.5	150	150	150	12
	Morrison Street							
Lift Stations Tributary to Industrial WWTP								
K Street LS	K Street n/o	22-70	1	35	1,500	1,500	3,000	54
	Goodwin Road		2	35	1,500			54
Kraft LS	n/o Avenue 184 and	22-125	1	88	1,800	1,800	3,600	20
	w/o Highway 99		2	88	1,800			20

Notes:
1. Source: Data provided by City Staff.
2. The Alpine Avenue LS was not included in the City's hydraulic model.
3. Firm Capacity is the total lift station capacity with the largest pump out of service.
4. The Windmill Ave LS is a temporary lift station.

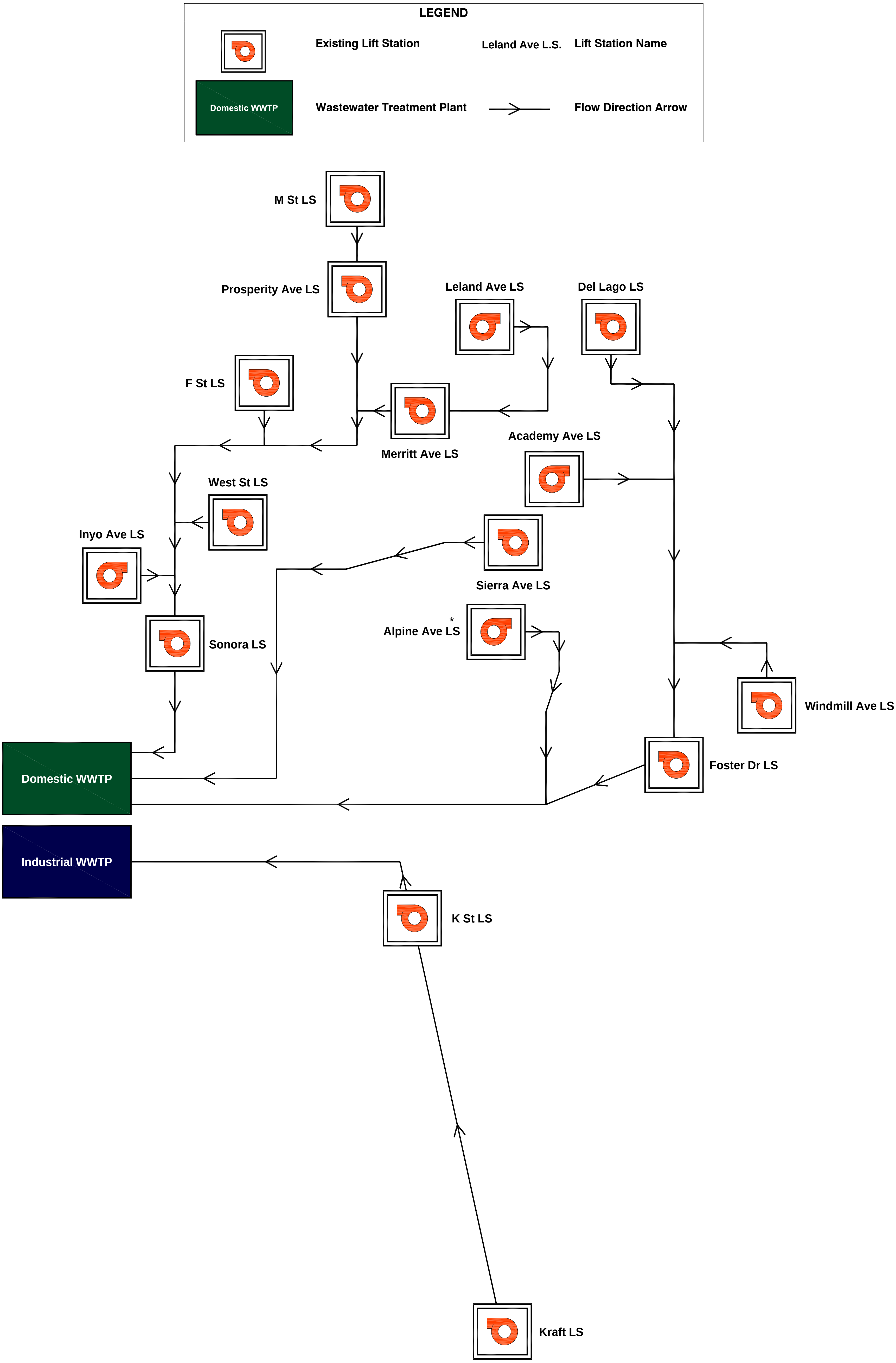


Figure 4.5
Existing Lift Station Schematic
Sewer System Master Plan
City of Tulare

* Note: The Alpine Ave LS was not included in the City's hydraulic model.

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4.3.2.1 Skeletonizing

Skeletonizing is the process by which sewer systems are stripped of pipelines not considered essential for the intended analysis purpose. The purpose of skeletonizing a system is to develop a model that accurately simulates the hydraulics of the pipelines collecting sanitary sewer flows. At the same time, skeletonizing should reduce the complexity of the large model, minimizing the time of analysis, and comply with the limitations imposed by the computer program.

The "backbone" pipelines of the Tulare sewer system were included in the hydraulic model. These pipes are generally 10-inches in diameter and larger and function to convey the wastewater collected in the City's DWWTP and IWWTP. The modeled trunk system was described in detail in a previous section and shown on Figure 4.2.

4.3.2.2 Pipes and Manholes

Computer modeling requires gathering detailed numerical information on the physical characteristics of the modeled sewer system, such as pipe sizes (diameters), pipe lengths, pipe invert elevations at the upstream and downstream manholes, pipe slope, ground elevations at the manholes, and general system geometry.

Pipes and manholes represent the physical elements describing the sewer system. A manhole represents a location in the network where a sewer flow can be applied to the trunk sewer system, while a pipe segment represents an element of the actual collection system. Additionally, pumps and diversions within the skeletonized system are included in the computer model.

4.3.2.3 Sewer Tributary Areas

Allocating sewer flows to appropriate locations throughout the trunk system was accomplished by defining sewer areas tributary to individual manholes, identifying the areas (acres) of land use within each service area, then applying the appropriate average day flow coefficients to each sewer user group in those areas. Sewer flow distribution was performed based on the land use categories generating flows in accordance with the developed average day flow conditions. These coefficients were defined and discussed in Chapter 3.

4.3.3 Hydraulic Model Calibration

Model calibration is a crucial component of the hydraulic modeling effort. Calibrating the model to match data collected during the flow monitoring program provides a reliable representation of conditions in the existing collection system. For this project, only dry weather flow monitoring was conducted. Figure 3.3 shows the location of the 11 dry weather flow monitoring sites, as well as the modeled sewer collection system.

The model calibration consists of several elements: 1) dividing the sewer system into areas tributary to each of the flow meter sites; 2) defining the flow volumes within each area; and 3) creating diurnal curves that can be applied to base flows within the model. The diurnal curves peak the model flow to match the temporal distribution of flow in the collection system pipelines.

The first step in the calibration process was to divide the City's service area into flow meter tributary areas. Eleven tributary areas were created, one for each flow meter. The next step was to define the flow volumes within each area. Diurnal curves were then created based on monitoring data to simulate the daily fluctuations in flow. Figure 4.6 shows a typical diurnal pattern, based on Flow Meter No. 4 data. Appendix B provides plots of all of the diurnal patterns used in this study.

It should be noted that the City's hydraulic model was calibrated to match weekend flows for the Domestic collection system and weekday flows for the industrial collection system. The reason is that in the City's predominantly residential areas (i.e. the Domestic collection system), weekend wastewater flows tend to generate higher flow peaks than weekday wastewater flows. Figure 4.7 presents this flow variation, based on Flow Meter No. 8 data. For the City's industrial collection system, however, weekday flows were higher than weekend flows.

The calibration process compared the meter data with the model output. Comparisons were made for minimum, maximum, and average flows as well as the temporal distribution of flow. Table 4.2 summarizes the calibration results and shows that the modeled and measured flows are very similar. Figure 4.8 presents a sample of the flow calibration for Flow Meter No. 3. This figure shows the measured flow at the meter versus the model predicted flows over a 24-hour period. As shown on the figure, the model predicted flows are nearly identical to the measured flows, which indicated that the model accurately represents the flow in the collection system. The remaining flow calibration plots for each calibration site are provided in Appendix C.

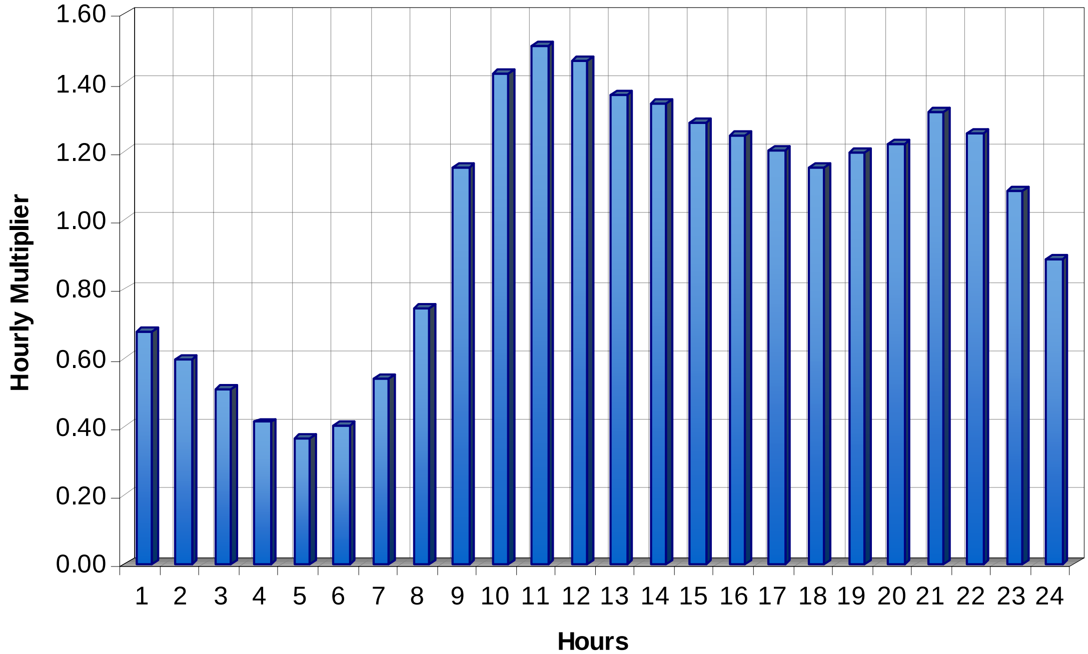

Figure 4.6
Typical Diurnal Pattern
Sewer System Master Plan
City of Tulare

Note: Based on Flow Meter 4 Data

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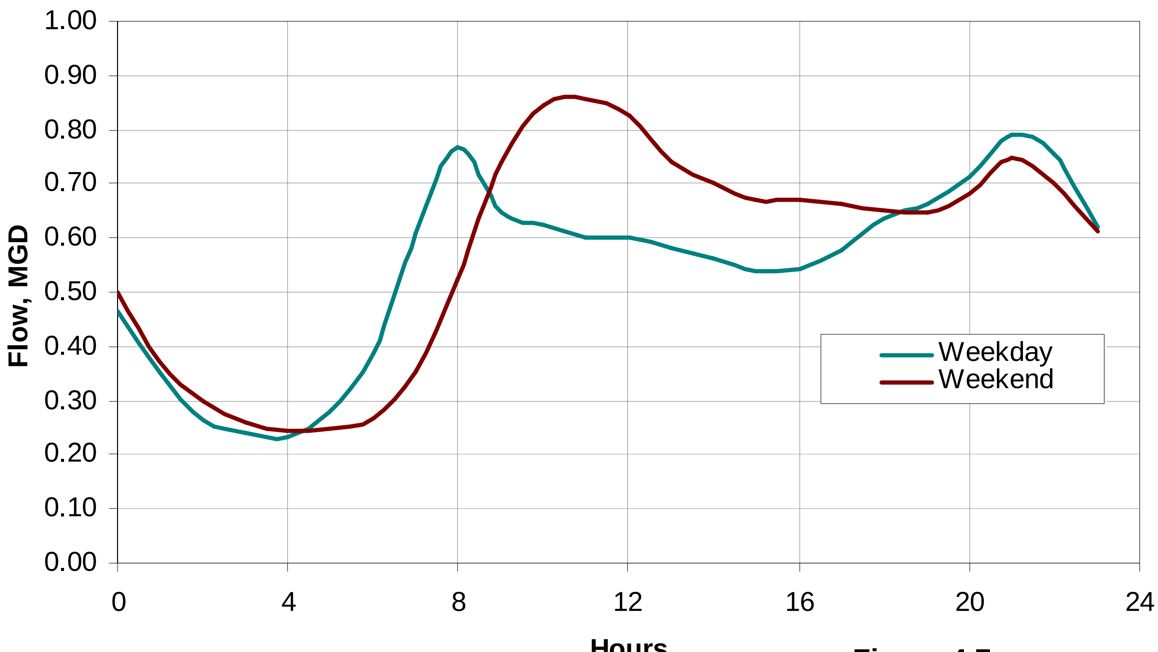

Figure 4.7
Typical Weekend Versus Weekday Flow Variation
Sewer System Master Plan
City of Tulare

Note: Based on Flow Meter 8 Data

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Table 4.2 Model Calibration Results
Sewer System Master Plan
City of Tulare

Meter Site	Metered Average Flow[1]			Modeled Average Flow			Percent Diff.[2] (%)
	Min (mgd)	Average (mgd)	Peak (mgd)	Min (mgd)	Average (mgd)	Peak (mgd)	
1	0.76	2.00	2.93	0.86	1.99	2.76	-0.1
2	3.56	4.02	4.60	3.59	4.00	4.50	-0.6
3	0.13	0.36	0.54	0.12	0.36	0.54	-0.5
4	0.20	0.51	0.75	0.18	0.50	0.72	-2.6
4a	2.30	2.55	2.90	2.32	2.53	2.92	-0.5
5	0.87	1.59	2.00	0.94	1.59	1.90	-0.1
6	0.20	0.63	0.98	0.20	0.63	1.01	0.0
7	0.40	0.53	0.66	0.40	0.53	0.66	0.7
8	0.24	0.57	0.86	0.23	0.57	0.83	-1.0
9	0.41	0.80	1.21	0.44	0.79	1.17	-1.3
10	0.32	0.76	1.05	0.31	0.76	1.02	-0.9

Notes:
1. Source: City of Tulare Sanitary Sewer Flow Monitoring Report, June 2007. The Average flow refers to weekend flow. The minimum and peak flows refer to the average weekend minimum and peak hourly flows.
2. Percent Difference = (Average Modeled - Average Metered)/(Average Metered) x 100.

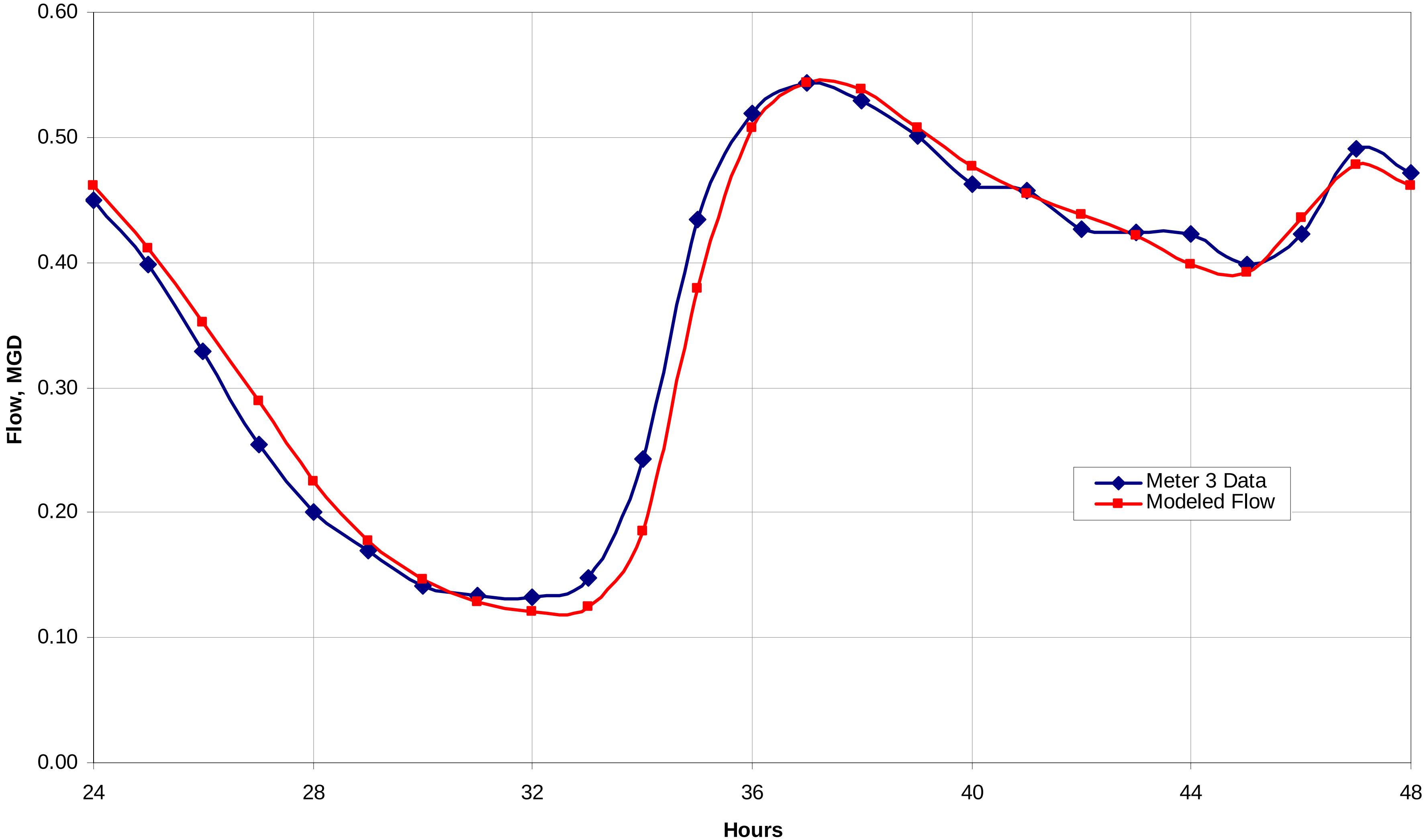

Figure 4.8
Example Flow Calibration Plot
Sewer System Master Plan
City of Tulare

Note: Based on Flow Meter 3 Data.

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EVALUATION AND PROPOSED IMPROVEMENTS

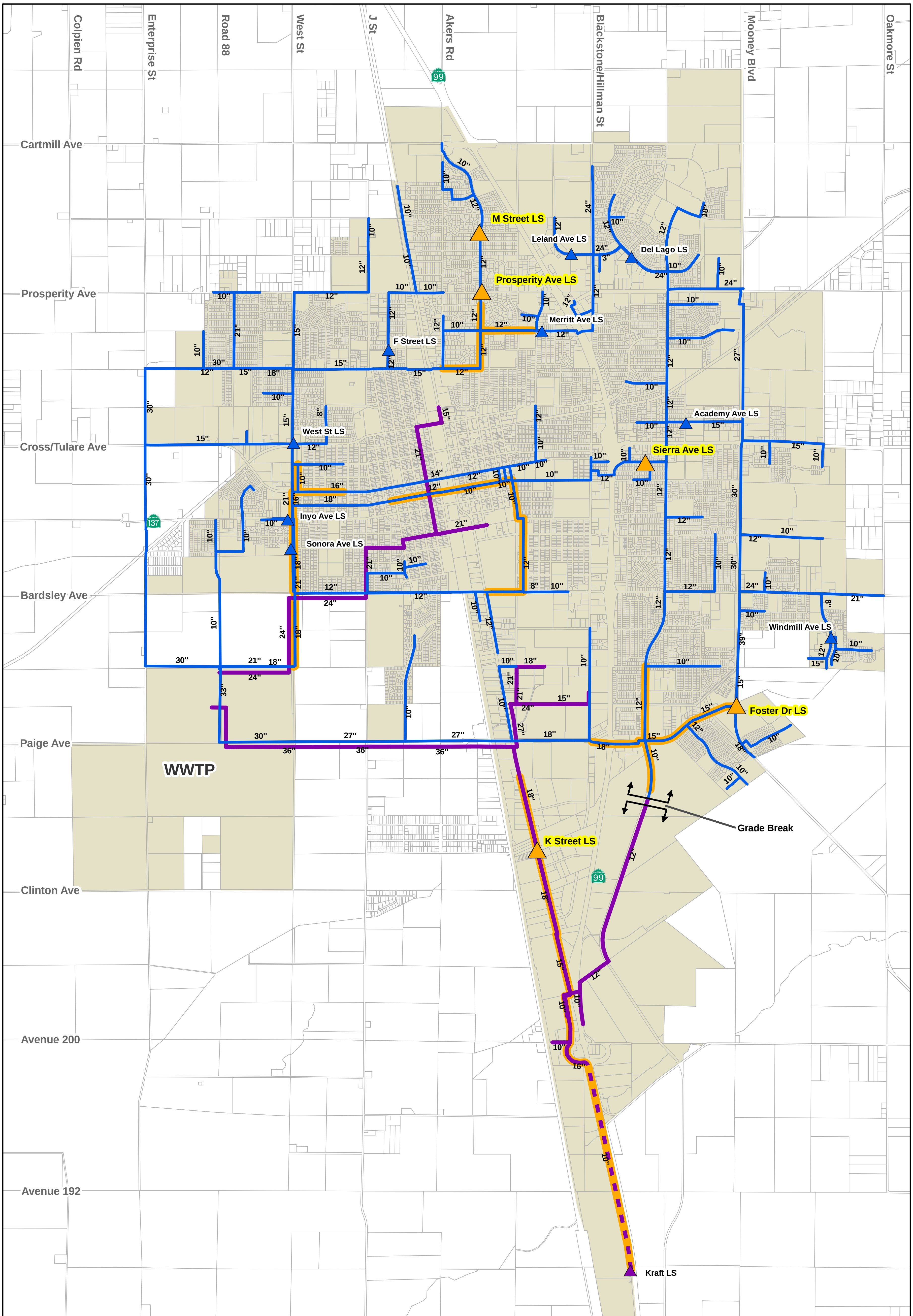
This chapter presents the results of the capacity evaluation of the City of Tulare (City) sewer collection system. The chapter also presents improvements to mitigate existing system deficiencies and to serve future growth. These improvements are recommended based on the system's technical requirements, cost effectiveness, and operational reliability.

5.1 CAPACITY EVALUATION

The City's existing collection system was evaluated on its ability to convey design flows and not exceed the planning criteria presented in Chapter 3. Initially, this evaluation consisted of running the hydraulic computer model under existing design flow conditions. Areas in the City where sewers were found to lack sufficient capacity to convey existing design flows (the maximum flow depth to pipe diameter ratio (d/D) exceeded 0.92) were flagged. Improvement projects to mitigate existing deficiencies were then developed. Figure 5.1 shows the sanitary sewer facilities where existing design flow exceeded the maximum d/D criterion of 0.92.

Following the evaluation of the City's existing collection system, future trunk sewers to service growth within the City Limits and Urban Development Boundary (UDB) were planned and sized. The model was then run under year 2030 design flow conditions and the size of the proposed future trunk sewers were refined to provide sufficient capacity to convey future design flows. The City's existing collection system was then checked to identify areas within the City's existing system that lack the capacity to convey the year 2030 design flows. Improvement projects to mitigate these future capacity deficiencies were then developed.

When a capacity increase is required, existing sewers can either be upgraded (i.e. replaced with a larger diameter sewer) or a parallel sewer can be constructed. Because this study did not include a conditional assessment, it was assumed, unless otherwise specified, that a capacity deficient sewer would be upgraded to a larger diameter. The ultimate decision to upgrade or construct a parallel sewer should be made during the preliminary design phase. During this phase, closed circuit television (CCTV) inspection should be performed to determine its structural integrity. Severely deteriorated sewers should be upgraded, whereas moderately deteriorated sewers could be rehabilitated using pipe lining and a parallel sewer constructed to address the capacity deficiency.



Legend

N

Modeled Wastewater Collection System

Lift Stations

- Domestic
- Industrial
- Deficient LS

Pipelines

- Domestic
- Industrial Gravity Main
- Industrial Force Main

- Deficient Pipeline
- City Limits
- Parcels

0 0.4 0.8 Miles

Figure 5.1
Existing System Deficiencies

Sewer System Master Plan
City of Tulare

5.1.1 Available Capacity in Existing Sewers

This chapter provides summaries of the remaining capacity in the City's lift stations and sewers before an upgrade is necessary. The available capacity is presented in terms of equivalent dwelling units (EDUs). In other words, this value defines the total number of additional EDUs that can be conveyed by a lift station or sewer before it reaches its capacity. This value is useful because, as development occurs, the City can track the remaining EDUs available in a sewer of lift station. Once the available number of EDUs is reached, a capacity enhancement would be required.

Existing sewers and lift stations requiring an improvement to correct an existing deficiency possess no available capacity to accommodate additional EDUs. The maximum d/D ratio is exceeded under existing design flows for these sewers. For this reason, these sewers were shown to have zero available EDU capacity. This calculation does not apply to new sewers or lift stations.

The City's design standards do not currently offer guidance for the average wastewater flow per dwelling. Therefore, this study uses an average wastewater flow per dwelling unit of 310 gallons per day per equivalent dwelling unit (gpd/EDU). This value was calculated by multiplying the average per capita wastewater generation of 93 gallons per day per capita (gpdc) by an average population density of 3.3 people per EDU per the draft General Plan Update. To calculate the available capacity in terms of EDUs, the difference between the sewer or lift stations design capacity (or firm capacity for a lift station) and existing design flow was divided by a peaking factor of 2.5 to derive a total remaining average flow capacity. The peaking factor of 2.5 is the ratio of the design flow to the average flow in the collection system, which is greater than the peaking factor measured at the Domestic wastewater treatment plant (DWWTP) and Industrial wastewater treatment plant (IWWTP). This is typical since flow attenuation tends to reduce peak flows before reaching the treatment plant. The average remaining flow capacity was then divided by 310 gpd/EDU to quantify the remaining available EDUs. An example of this type of calculation is provided below:

Example Calculation:

Given:

Existing Peak Flow = 100,000 gallons per day (gpd)

Existing Design Capacity = 150,000 gpd

Peaking Factor (Design Flow/ADF) = 2.5

Required:

Remaining Available Capacity in terms of EDUs

Solution:

$$\text{Available Capacity} = \frac{(\text{Existing Design Capacity} - \text{Existing Peak Flow})}{\text{Peaking Factor} \times 310\ \text{gpd/EDU}}$$

$$\text{Available Capacity} = \frac{(150{,}000\ \text{gpd} - 100{,}000\ \text{gpd})}{2.5 \times 310\ \text{gpd/EDU}} = \underline{64.5\ \text{EDUs}}$$

5.1.2 Lift Station Evaluation

As discussed in Chapter 3, the City's existing lift stations were evaluated by comparing the existing and 2030 design flow to the firm capacity of the lift station. Lift stations with a design flow above the existing firm capacity were flagged as deficient, and improvement projects were developed. Table 5.1 summarizes the results of the lift station evaluation.

From Table 5.1, seven of the existing 16 lift stations are deficient under existing conditions. The two lift stations with the largest existing capacity deficiencies are the Foster Drive Lift Station and the K Street Lift Station. However, the K Street Lift Station will have sufficient firm capacity once the flows from Kraft are diverted into the proposed South Industrial Trunk Sewer (see Section 5.3).

5.2 PROPOSED IMPROVEMENTS

The recommended improvements discussed in this section are needed to mitigate existing system deficiencies and provide capacity for future development. The improvements are quantified in the Capital Improvement Program (CIP), presented in the following chapter, and are shown on Figure 5.2 and Figure 5.3 and listed in Table 5.2. It should be noted that developers are responsible for paying an equitable cost allocation for the infrastructures needed to extend service from their developments to the master plan facilities.

5.2.1 Domestic Collection System

The proposed improvements to mitigate existing deficiencies and to service future growth within the DWWTP service area are summarized by sewer basin in this section.

- **Bardsley Avenue Sewer Basin**
  - **Improvement No. B-LS**. The evaluation of the City's domestic collection system revealed an existing deficiency in the 12-inch diameter gravity main located on Bardsley Avenue east of the Union Pacific Railroad (UPRR) tracks. An adverse slope condition exists in the area near the UPRR, which causes surcharge conditions in the upstream gravity main. In lieu of replacing entire section of trunk sewer, this plan recommends that a new lift station be constructed to eliminate the surcharge condition. The lift station should be located on the east side of the UPRR tracks, and a force main will discharge to a manhole west of the tracks.

Table 5.1 Existing Lift Station Evaluation
Sewer System Master Plan
City of Tulare

Lift Station Name	Lift Station Design Data[1] Location (Intersection)	No. of Pumps	Firm Capacity[3] (gpm)	Existing Firm Capacity vs. Existing Design Flow: Existing Design Flow (gpm)	Exist. Capacity Deficiency (gpm)	Available Firm Capacity (gpm)	Remaining Capacity (EDU)	Existing Firm Capacity vs. 2030 Design Flow: 2030 Design Flow (gpm)	Future Capacity Deficiency (gpm)	Available Firm Capacity (gpm)	Remaining Capacity (EDU)
Lift Stations Tributary to Domestic WWTP											
Academy Avenue LS	Academy Avenue and Mountain View	2	375	760	385	0	0	760	385	0	0
Alpine Avenue LS[2]	Alpine Avenue and Spruce Street	2	250	Not Modeled							
Del Lago LS	Paso Del Lago se/o Leland Avenue	2	698	386	Sufficient Firm Capacity	312	580	2,110	1,412	0	0
F Street LS	F Street n/o Pleasant Avenue	2	550	165	Sufficient Firm Capacity	385	716	169	Sufficient Firm Capacity	381	708
Foster Drive LS	Mooney Boulevard and Foster Drive	2	700	1,128	428	0	0	1,251	551	0	0
Inyo Avenue LS	Inyo Street w/o West Street	2	250	26	Sufficient Firm Capacity	224	415	29	Sufficient Firm Capacity	221	411
Leland Avenue LS	Leland Avenue w/o Hillman Street	2	350	12	Sufficient Firm Capacity	338	628	131	Sufficient Firm Capacity	219	407
M Street LS	M Street and Washington Avenue	2	110	210	100	0	0	210	100	0	0
Merritt Avenue LS	Merrit Avenue e/o Cherry Street	2	375	280	Sufficient Firm Capacity	95	177	280	Sufficient Firm Capacity	95	177
Prosperity Avenue LS	Prosperity Avenue and M Street	2	200	380	180	0	0	380	180	0	0
Sierra Avenue LS	Sierra Avenue w/o Redwood Avenue	2	150	330	180	0	0	341	191	0	0
Sonora Avenue LS	Sonora Avenue and West Street	1	0	13	13	0	0	123	123	0	0
West Street LS[6]	Cross Street and West Street	2	250	86	Sufficient Firm Capacity	164	305	Abandoned			
Windmill Avenue LS[4]	Windmill Avenue and Morrison Street	1	150	0	Sufficient Firm Capacity	150	279	Abandoned			
Lift Stations Tributary to Industrial WWTP											
K Street LS[5]	K Street n/o Goodwin Road	1	1,500	1,968	468	0	0	1,202	Sufficient Firm Capacity	298	555
Kraft LS	n/o Avenue 184 and w/o Highway 99	1	1,800	1,248	Sufficient Firm Capacity	552	1026	Abandoned			

Notes:
1. Source: Data provided by City Staff.
2. The Alpine Avenue LS was not included in the City's hydraulic model.
3. Firm capacity is the total lift station capacity with the largest pump out of service.
4. The Windmill Ave LS is a temporary lift station.
5. The 2030 Design Flow in the K Street LS is less than the existing design flow because the future Kraft sewage flows will be redirected to the new South Industrial Trunk Sewer.
6. The West Street Lift Station will be abandoned with the completion of West and Cross Street sewer improvements, currently under construction.

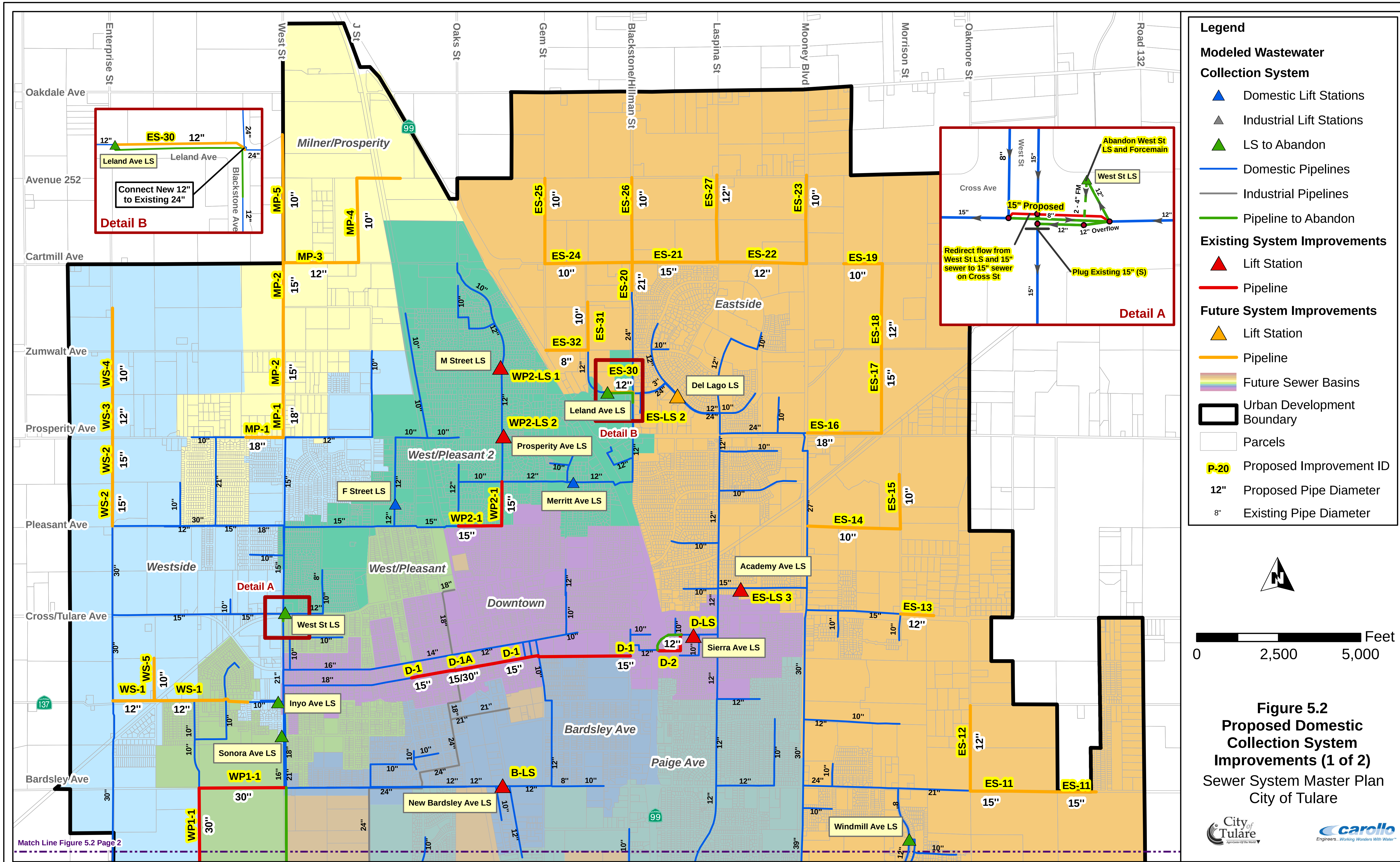


Figure 5.2
Proposed Domestic Collection System Improvements (1 of 2)
Sewer System Master Plan
City of Tulare

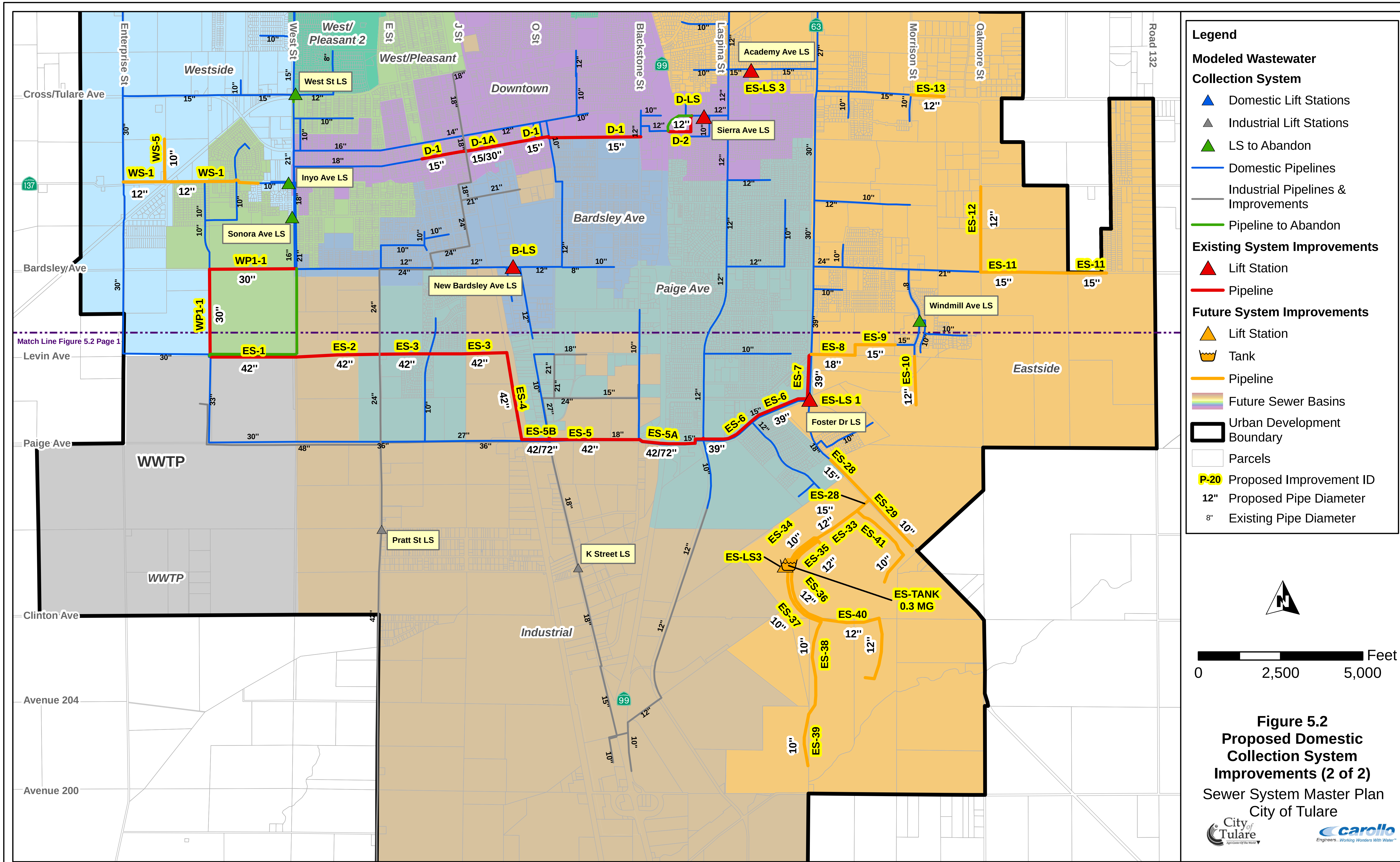


Figure 5.2
Proposed Domestic Collection System Improvements (2 of 2)

Sewer System Master Plan
City of Tulare

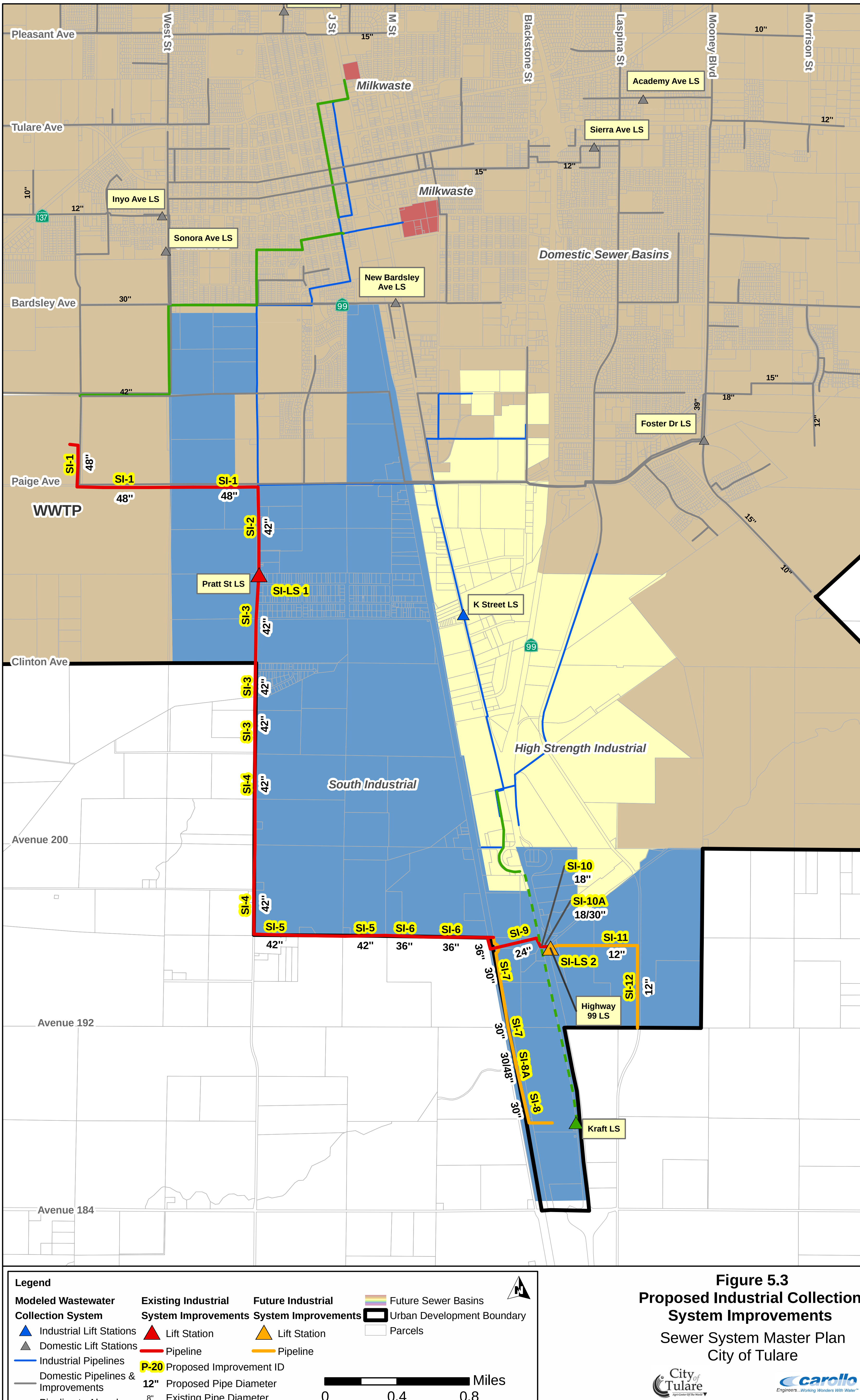


Figure 5.3
Proposed Industrial Collection System Improvements

Sewer System Master Plan
City of Tulare

Table ES.2 Proposed Improvements
Sewer System Master Plan
City of Tulare

Improvement No.	Type of Improv.	Description/ Street	Description / Limits	Existing System Improvement?	Remaining Capacity (4) (EDUs)	Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Parallel/ Replace/ New	Length (ft)
Domestic Collection System									
Bardsley Avenue Sewer Basin									
B-LS	Lift Station	Bardsley Avenue	Proposed Bardsley Ave LS	X	--	--	0.6 mgd	New	--
Downtown Sewer Basin									
D-1	Pipe	Kern Avenue	Blackstone St. to E/F Street Alley	X	0	10/12	15	Replace	6,700
D-1A	Casing (1)	Kern Avenue	UPRR Casing	X	--	--	15/30	New	300
D-2	Pipe	Spruce/Alley n/o Kern Avenue	Sierra St. to Highway 99	X	0	12	12	Replace	1,200
D-LS	Lift Station	Sierra Avenue	Sierra Avenue LS Upgrade	X	0	0.22 mgd	0.5 mgd	Replace	--
Eastside Sewer Basin									
ES-1	Pipe	Levin Avenue	WWTP to West St.	X	--	--	42	New	2,600
ES-2	Pipe	Levin Avenue	West St. to Pratt St.	X	--	--	42	New	2,400
ES-3	Pipe	Levin Avenue	Pratt St. to I St.	X	--	--	42	New	3,900
ES-4	Pipe	I Street	Levin Ave. to Paige Ave.	X	--	--	42	New	2,700
ES-5	Pipe	Paige Avenue	1,700' w/o I St. to Laspina St.	X	--	--	42	New	5,600
ES-5A	Casing (1)	Paige Avenue	Highway 99 Casing	X	--	--	42/72	New	800
ES-5B	Casing (1)	Paige Avenue	UPRR Casing	X	--	--	42/72	New	300
ES-6	Pipe	Foster Drive	Laspina St. to Mooney Blvd	X	--	--	39	New	3,500
ES-7	Pipe	Mooney Boulevard	Foster Dr. to Levin Ave.	X	--	--	39	New	1,400
ES-8	Pipe	Levin Avenue	Mooney Blvd. to 1,250' e/o Mooney Blvd.		--	--	18	New	1,250
ES-9	Pipe	n/o Levin Avenue	1,250 n/o Mooney Blvd. to w/o Morrison St.		--	--	15	New	1,200
ES-10	Pipe	Morrison Street	Levin Ave. to 1,400' s/o Levin Ave.		--	--	12	New	1,400
ES-11	Pipe	Bardsley Avenue	Oakmore St. to Munson		--	--	15	New	3,950
ES-12	Pipe	Oakmore Street	Bardsley Ave. to Ave. 228		--	--	12	New	2,600
ES-13	Pipe	Tulare Avenue	Morrison to 1,000' e/o Morrison		--	--	12	New	1,000
ES-14	Pipe	s/o Highway 137	Mooney Blvd. to Morrison		--	--	10	New	2,850
ES-15	Pipe	Morrison Street	1,200' s/o Prosperity to 2,850' s/o Prosperity		--	--	10	New	1,650
ES-16	Pipe	Prosperity Avenue	Mooney Blvd. to Highway 137		--	--	18	New	2,250
ES-17	Pipe	w/o Morrison Street	Highway 137 to 2,550' s/o Cartmill Ave.		--	--	15	New	2,550
ES-18	Pipe	w/o Morrison Street	2,550' s/o Cartmill Ave. to Cartmill Ave.		--	--	12	New	2,550
ES-19	Pipe	Cartmill Avenue	1,100' e/o Mooney Blvd. to 2,300' e/o Mooney Blvd.		--	--	10	New	1,200
ES-20	Pipe	Hillman Street	Existing 21" Sewer to Cartmill Ave.		--	--	21	New	700
ES-21	Pipe	Cartmill Avenue	Hillman St. to 2,600' e/o Hillman St.		--	--	15	New	2,600
ES-22	Pipe	Cartmill Avenue	2,600' w/o Mooney Blvd. to Mooney Blvd.		--	--	12	New	2,600
ES-23	Pipe	Mooney Boulevard	Cartmill Ave. to Ave. 252		--	--	10	New	2,700
ES-24	Pipe	Cartmill Avenue	Gem St. to Hillman St.		--	--	10	New	2,600
ES-25	Pipe	Gem Street	Cartmill Ave. to Ave. 252		--	--	10	New	2,700
ES-26	Pipe	Hillman Street	Cartmill Ave. to Ave. 252		--	--	10	New	2,600
ES-27	Pipe	2,600' w/o Mooney Blvd.	Cartmill Ave. to Ave. 252		--	--	12	New	2,600
ES-28	Pipe	Turner Avenue	3,800' se/o of Foster Dr. to 2,100' se/o Foster Dr.		--	--	15	New	1,700
ES-29	Pipe	Turner Avenue	5,700' se/o of Foster Dr. to 3,800 se/o Foster Dr.		--	--	10	New	1,900
ES-30	Pipe	Leland Avenue	Abandoned Leland Ave. LS to Hillman St.	X	--	--	12	New	800
ES-31	Pipe	Retherford Street	Corvina Ave. to n/o Corvina Ave.		--	--	10	New	1,300
ES-32	Pipe	Corvina Avenue	Retherford St. to w/o Retherford St.		--	--	8	New	1,300
ES-33	Pipe	se/o Foster Drive	sw/o Road 124 to sw/o Road 124		--	--	12	New	2,600
ES-34	Pipe	sw/o Road 124	Force Main for ES-LS4		--	--	6	New	1,300
ES-35	Pipe	se/o Foster Drive	sw/o Road 124 to sw/o Road 124		--	--	12	New	1,700
ES-36	Pipe	sw/o Road 124	se/o Foster Dr. to se/o Foster Dr.		--	--	10	New	1,300
ES-37	Pipe	sw/o Road 124	se/o Foster Dr. to se/o Foster Dr.		--	--	10	New	1,000
ES-38	Pipe	w/o Elk Bayou	n/o Elk Bayou to n/o Elk Bayou		--	--	10	New	1,700
ES-39	Pipe	w/o Elk Bayou	n/o Elk Bayou to n/o Elk Bayou		--	--	10	New	2,800
ES-40	Pipe	sw/o Road 124	se/o Foster Dr. to se/o Foster Dr.		--	--	12	New	6,200
ES-41	Pipe	sw/o Road 124	se/o Foster Dr. to se/o Foster Dr.		--	--	12	New	3,000
ES-LS 1	Lift Station	Foster Drive	Foster Dr. LS Modifications	X	--	1.0 mgd	1.8 mgd	Modify	--
ES-LS 2	Lift Station	Paseo Del Lago	Del Lago LS Upgrade	X	581	1.0 mgd	3.2 mgd	Replace	--
ES-LS 3	Lift Station	Academy Avenue	Academy Ave LS Upgrade	X	0	0.5 mgd	1.1 mgd	Replace	--
ES-LS 4	Lift Station	sw/o Road 124	Future Commercial LS		--	--	0.5 mgd	New	--
ES-Tank	Tank	sw/o Road 124	300,000 Gallon Wastewater Storage Tank		--	--	0.3 MG	New	--
Milner/Prosperity Sewer Basin									
MP-1	Pipe	Prosperity/West Street	Zumwalt Ave. to Prosperity Ave.		--	--	18	New	2,500
MP-2	Pipe	West Street	Cartmill Ave. to Zumwalt Ave.		--	--	15	New	4,000
MP-3	Pipe	Cartmill Avenue	West St. to w/o J St		--	--	12	New	2,300
MP-4	Pipe	w/o J Street	Cartmill Ave. to n/o Cartmill Ave.		--	--	10	New	2,600
MP-5	Pipe	West Street	Cartmill Ave. to 3,900' n/o Cartmill Ave.		--	--	10	New	3,900
West/Pleasant Sewer Basin									
WP1-1	Pipe	w/o West St/Bardsley Ave	West St. to Laspina LS	X	--	--/10	30	Replace/New	5,100
West/Pleasant 2 Sewer Basin									
WP2-1	Pipe	Pleasant Avenue and M Street	Oaks to Merritt	X	0	12	15	Replace	2,700
WP2-LS 1	Lift Station	M Street	M St. LS Upgrade	X	0	0.16 mgd	0.4 mgd	Replace	--
WP2-LS 2	Lift Station	Prosperity Avenue	Prosperty Ave LS Upgrade	X	0	0.29 mgd	0.6 mgd	Replace	--
Westside Sewer Basin									
WS-1	Pipe	State Highway 137	Enterprise St. to Inyo Ave LS.		--	--	12	New	5,000
WS-2	Pipe	Enterprise Street	Prosperity Ave. to Pleasant Ave.		--	--	15	New	2,700
WS-3	Pipe	Enterprise Street	Zumwalt AVE. to Prosperity Ave.		--	--	12	New	1,300
WS-4	Pipe	Enterprise Street	Elster Ave. to Zumwalt Ave.		--	--	10	New	2,600
WS-5	Pipe	e/o Enterprise Street	Inyo Ave. to n/o Inyo Ave.		--	--	10	New	1,300
Industrial Collection System									
South Industrial Sewer Basin									
SI-1	Pipe	Paige Avenue	2,600' East of Enterprise St. to Pratt Ave.	X	--	--	48	New	6,800
SI-2	Pipe	Pratt Street	Paige Ave. to 2,600' s/o Paige Ave.	X	--	--	42	New	2,600
SI-3	Pipe	Pratt Street	2,600' s/o Paige Ave. to 600' n/o Avenue 204	X	--	--	42	New	4,600
SI-4	Pipe	Pratt Street	600' n/o Avenue 204 to Avenue 196	X	--	--	42	New	5,900
SI-5	Pipe	Avenue 198	Pratt St. to 2,400' e/o Pratt St.	X	--	--	42	New	2,400
SI-6	Pipe	Avenue 198	2,400' e/o Pratt St. to I St.	X	--	--	36	New	4,700
SI-7	Pipe	County Road 112	Ave. 196 to 2,600' s/o Ave 196		--	--	30	New	2,600
SI-8	Pipe	County Road 112	2,600' s/o Ave 196 to 4,500' s/o Ave. 197		--	--	30	New	3,500
SI-8A	Casing (1)	County Road 112	Crossing under Elk Bayou		--	--	30/48	New	200
SI-9	Pipe	Avenue 198	Highway 99 to I St.		--	--	24	New	1,700
SI-10	Pipe	Avenue 196	Crossing Under Highway 99	X	--	--	18	New	300
SI-10A	Casing (1)	Avenue 196	Crossing Under Highway 99	X	--	--	18/30	New	300
SI-11	Pipe	Hosfield Drive	Hwy 99 to Laspina St.		--	--	12	New	2,750
SI-12	Pipe	Laspina Avenue	Ave. 196 to Ave. 192		--	--	12	New	2,400
SI-LS 1	Lift Station	Pratt Street	2,600' s/o Paige Ave.	X	--	--	10.6 mgd	New	--
SI-LS 2	Lift Station	Highway 99 Lift Station	Hosfield and Hwy 99		--	--	0.5 mgd	New	--

Notes:
1. Proposed casing size and carrier pipe size.
2. Proposed Siphon is a triple barrel siphon.
3. Existing lift station capcaity reported as the firm capacity (capacity with the largest pump out of service)
4. EDU=Equivalent Dwelling Unit. See Section 5.2.1 for a discussion of how this calculation was performed.

- **Downtown Sewer Basin**
  - **Improvement No. D-1**. Replace the existing 10-inch diameter and 12-inch diameter sewers on Kern Avenue from the E/F Street alley to Blackstone Street with a 15-inch diameter sewer. This includes 300 linear feet of casing under the UPRR tracks.
  - **Improvement No. D-2**. Install a new 12-inch diameter sewer on Spruce Street and the alley north of Kern Street from Sierra Street to Highway 99 and abandon the existing 12-inch diameter sewer between Spruce Street and Highway 99.
  - **Improvement No. D-LS**. Upgrade the existing Sierra Avenue Lift Station to a firm capacity of 0.5 mgd (340 gpm). This improvement will increase the current firm capacity of 0.2 mgd.
- **Eastside Sewer Basin**
  - **Eastside Trunk Sewer Extension (Improvement No. ES-1 through ES-7)**. Construct new 39-inch and 42-inch diameter trunk sewers from the WWTP in a general easterly direction to the existing 39-inch diameter trunk sewer located at the intersection of Mooney Boulevard and Levin Street. This improvement is required primarily to service future growth, but is also required to correct an existing capacity deficiency in the 15-inch diameter gravity sewer downstream of the Foster Drive LS.
  - **Improvement No. ES-8 through ES-10**. Construct a series of 12-inch diameter through 18-inch diameter gravity sewers to connect the existing Windmill Park development and future development south of Windmill Park to the proposed Eastside Trunk Sewer Extension (Improvement No. ES-1 through ES-7). It should be noted that the existing Windmill Avenue LS can be abandoned upon the construction of Improvement Nos. ES-8 and ES-9.
  - **Improvement No. ES-11 and ES-12**. Construct a 15-inch diameter gravity sewer on Bardsley Avenue from Oakmore Street east to the future College of the Sequoias Campus, as well as a 12-inch diameter gravity sewer on Oakmore Street to service the area north of Bardlsey Avenue.
  - **Improvement No. ES-13**. Construct a 12-inch diameter gravity sewer on Tulare Avenue east of Morrison Street.
  - **Improvement No. ES-14 and ES-15**. Construct a 10-inch diameter gravity sewer south of Highway 137 from Mooney Boulevard east to Morrison, and then north.
  - **Improvement No. ES-16 through ES-19**. Construct a series of 10-inch diameter to 18-inch diameter gravity sewers to service the area north of Prosperity Avenue and east of Mooney Boulevard.

- **Improvement No. ES-20 through ES-27**. Construct a network of 10-inch through 21-inch diameter gravity sewers that would service the area bounded by Mooney Boulevard to the east, Highway 99 to the west, Cartmill Avenue to the south, and the UDB to the north.
- **Improvement No. ES-28 and ES-29**. Construct a 10-inch diameter and 15-inch diameter gravity sewer to service the proposed Motor Sports Park and the area southeast of the Motor Sports Park.
- **Improvement No. ES-30 through ES-32.** Abandon Leland Avenue LS and construct a new, 12-inch diameter gravity sewer from the Leland Avenue LS to the 21-inch sewer at Hillman Street. In addition, extend the 12-inch sewer on Rutherford Street to service future growth near the outlet center.
- **Improvement No. ES-33 through ES-41, ES-LS4, ES-Tank.** Construct a network of 10-inch through 12-inch gravity sewers to serve a commercial area east of the airport. Also required will be a 300,000 gallon wastewater storage tank to store peak flows from the area, as well as a 0.5 mgd lift station.
- **Improvement No. ES-LS 1**. Modify discharge of the Foster Drive Lift Station to convey all flow to the proposed 39-inch diameter trunk line (ES-6 and ES-7) near the intersection of Foster Drive and Mooney Boulevard.
- **Improvement No. ES-LS 2**. Upgrade Paseo Del Lago Lift Station from a firm capacity of 1.0 mgd to a firm capacity of 3.2 mgd to convey projected design flows.
- **Improvement No. ES-LS 3**. Upgrade the Academy Avenue Lift Station from a firm capacity of 0.5 mgd to a firm capacity of 1.1 mgd.

- **Milner/Prosperity Sewer Basin**
  - **Improvement No. MP-1 through MP-5**. Construct a series of 10-inch diameter to 18-inch diameter gravity sewers to service the area north of Prosperity Avenue and West of J Street to serve future growth.

- **West/Pleasant Sewer Basin**
  - **Improvement No. WP1-1**. The capacity evaluation indicated existing capacity deficiencies in the trunk sewers on West Street south of Kern Avenue. The City recently abandoned the West Street LS and redirected over 1.0 mgd of wastewater flow from the trunk sewers on West Street to the Westside trunk. The hydraulic analysis indicated that this project should have alleviated this deficiency. However, City staff still reports surcharged conditions in the West Street trunk sewers. For this reason, an improvement project to abandon the parallel trunks from Bradley Avenue to the Laspina LS is presented in this master plan. A new 30-inch pipeline is recommended going west from West Street to an existing 10-inch sewer west of West Street, which will be replaced with a 30-inch sewer extending to the Laspina LS. Prior to the construction of this project, however, it is recommended that the city clean and CCTV the

surcharged pipelines on West Street to check for sagging pipes or blockages, which may be the cause of the surcharged conditions.

- **West/Pleasant-2 Sewer Basin**
  - **Improvement No. WP2-1**. Replace the existing 12-inch diameter on Pleasant Avenue and north of Pleasant on M Street with a new 15-inch diameter gravity trunk.
  - **Improvement No. WP2-LS 1**. Upgrade the M Street Lift Station from an existing firm capacity of 0.16 mgd to a proposed firm capacity of 0.4 mgd.
  - **Improvement No. WP2-LS 2**. Upgrade the Prosperity Avenue Lift Station from and existing firm capacity of 0.29 mgd to a proposed firm capacity of 0.6 mgd.
- **Westside Sewer Basin**
  - **Improvement No. WS-1 and WS-5**. Construct a 12-inch diameter gravity sewer from the Inyo LS (to be abandoned) to the Westside trunk, and a 10-inch sewer to serve the area northwest of State Highway 137.
  - **Improvement No. WS-2 through WS-4**. Construct a series of 10-inch to 15-inch diameter gravity sewers to service the area near Enterprise Street north of Prosperity Avenue and south of Cartmill Avenue.

5.2.2 Industrial Collection System

The proposed improvements to mitigate existing deficiencies and to service future growth within the IWWTP service area are summarized by sewer basin in this section.

- **Dairy Waste Sewer**
  - Wastewater flow projections for the City's significant industrial users (SIUs) were developed based on projections provided in the City of Tulare Water Pollution Control Facilities Facility Plan, dated April 2003. According to these projections, the ADF associated with Land O Lakes is projected to increase to 3.29 mgd. Based on these flow projections, the existing 21-inch diameter sewer that services Land O Lakes and the new 24-inch diameter Dairy Waste Trunk Sewer from Sonora Avenue to Paige Avenue would not be sufficient to convey the projected design flows. Per direction from City Staff, no improvement projects were identified to service the projected Land O Lakes flow increases. Should Land O Lakes seek to expand their facility in the future, improvements to the 21-inch diameter sewer that services Lank O Lakes would be necessary, as well as improvements to the new Dairy Waste Trunk from Sonora Avenue to Paige Avenue.
- **South Industrial Sewer Basin**
  - **Improvement No. SI-1 through SI-2**. Construct a 48-inch and 42-inch diameter trunk sewer from the IWWTP to Pratt Street and then south of Pratt Street.
  - **Improvement No. SI-LS 1**. Construct a 13.5 mgd Lift Station.

- **Improvement No. SI-3 through SI-6**. Construct a 42-inch and 36-inch diameter trunk sewer from the IWWTP south on Pratt Street and east on Avenue 196 to I Street.
- **Improvement No. SI-7 and SI-8**. Construct a 30-inch diameter gravity sewer that will service Kraft.
- **Improvement No. SI-9**. Construct a 24-inch diameter gravity sewer on Avenue 196 from Highway 99 to County Road 112. It is important to note that the existing Kraft force main will be temporarily connected to this pipeline until improvement projects SI-7 through SI-9 are constructed.
- **Improvement No. SI-10 through SI-13 and SI-LS 2**. Construct a 12-inch diameter gravity sewer north in Laspina Avenue, then west to Highway 99. At Highway 99 a new 0.5 mgd pump station will convey flows to an 18-inch gravity main under Highway 99.

5.3 PROJECT PRIORITIZATION

The master plan CIP provides a breakdown of recommended improvement projects by phase. The CIP phases are:

- Phase I: 2009-2011;
- Phase II: 2012-2015;
- Phase III: 2016-2020;
- Phase IV: 2021-2025;
- Phase V: 2026-2030.

Improvement projects to correct existing deficiencies should be implemented by the City as soon as possible. Due to budget and time constraints, however, it may not be feasible for the City to implement all existing system improvement projects within the first or second CIP phase. In order to provide guidance to the City in identifying the most critical improvements, the recommended improvement projects were prioritized based on the severity of the existing or expected deficiency. Projects given highest priority should be implemented as soon as possible, whereas projects given a lower priority can likely be pushed back to later CIP phases.

Improvement projects needed to service future growth will be constructed at the time a specific development comes on line. Therefore, the phasing of future improvements is subject to change dependant upon the rate of growth in the City.

The priorities are described below:

- **Existing Higher Priority -** Surcharging in existing pipelines; existing design flow is nearly equal to the lift station's total capacity.

- **Existing Lower Priority -** Slight surcharging in existing pipelines; existing design flow is slightly above lift station firm capacity.
- **Future Development Related -** Upgrades to lift station or sewer pipeline capacity are needed to serve future growth, or facility is required to extend sanitary sewer service to a new development area.

Table 5.3 provides a summary of the proposed improvement by project prioritization.

Table 5.3 Project Prioritization
Sewer System Master Plan
City of Tulare

Priority	Improvement Number
Existing Higher Priority	B-LS, D-1, ES-1 through ES-7, ES-LS 3, SI-1 through SI-6, SI-10, SI-LS 1, WP2-LS 1, and WP2-LS 2
Existing Lower Priority	D-2, D-LS, WP1-1, WP2-1, and ES-30
Future Development Related	ES-8 through ES-29, ES-31 through ES-41, ES-LS 1, ES-LS 2, ES-LS 4, MP-1 through MP-5, WS-1 through WS-5, SI-7 through SI-9, SI-11 through SI-13, SI-LS 2

5.3.1 Highest Priority Improvements

Selected improvement projects were identified out of the higher priority improvements as the most critical and are summarized below:

- **South Industrial Trunk (SI-1 through SI-10, SI-LS1)**. Evaluation of the collection system under existing design flows identified a capacity deficiency in the High Strength Industrial Trunk and the K Street LS. This deficiency will be mitigated by redirecting the Kraft facility's wastewater flow from the High Strength Industrial Trunk to the new South Industrial Trunk, which is currently in the design phase. This would be accomplished in the short term by modifying the force main associated with the Kraft LS so that it would discharge into a proposed 30-inch sewer on Avenue 198. In the future, when the Kraft LS approaches capacity, a new trunk would be installed along County Road 112 to convey Kraft's flow through the South Industrial Trunk.
- **Kern Avenue Trunk (Improvement D-1)**. Analysis of the collection system under existing design flows identified surcharge conditions in the Kern Avenue Trunk. City staff have indicated that this poses a maintenance problem for the City, because fats, oil, and grease tend to build up in the adjacent tributary sewers, causing backups and sanitary sewer overflows. Implementation of this improvement, therefore, may lead to a reduction in needed maintenance and overflows in the area.
- **Bardsley Avenue LS (Improvement B-LS)**. An adverse slope condition in the Bardsley Trunk east of the UPRR tracks causes constant surcharge conditions in the

Bardsley Trunk. Construction of the Bardsley Avenue LS will convey flow past the section of trunk line that flows uphill. Implementation of this improvement will eliminate the surcharging.

- **M Street LS (Improvement WP2-LS1)**. The evaluation of the existing system suggests that the peak flow into the M Street LS is well above its firm capacity. In fact, the simulated peak flows into the M Street LS were nearly equal to the total capacity of the lift station.
- **Prosperity Avenue LS (Improvement WP2-LS2)**. The evaluation of the existing system suggests that the peak flow into the Prosperity Avenue LS is also well above its firm capacity and that the simulated peak flows into the lift station were nearly equal to the total capacity of the lift station.

CAPITAL IMPROVEMENT PROGRAM

This chapter presents the proposed Capital Improvement Program (CIP) for the City of Tulare (City) sewer system. The projects are based on the evaluation of the City's sewer system, and on the recommended projects described in the previous chapters. The CIP has been prepared to assist the City in planning and constructing the sewer system improvements through the planning horizon year of 2030.

6.1 COST ESTIMATING ACCURACY

The cost estimates presented in the 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 alignments investigation of alternative routings, and detailed utility and topography surveys.

The Association for the Advancement of Cost Engineering (AACE) defines three types of cost estimates:

- **An Order of Magnitude Estimate for Master Plan Studies.** This is an approximate estimate made without detailed engineering data. It is normally expected that an estimate of this type would be accurate within +50 percent to -30 percent.
- **A Budget Estimate for Predesign Study.** A budget estimate is prepared with the use of flow sheets, layouts, and equipment details. It is normally expected that an estimate of this type would be accurate within +30 percent to -15 percent.
- **A Definite Estimate (Engineer's Estimate) for Time of Contract Bidding.** This estimate is prepared from very defined engineering data. The data includes fairly complete plot plans and elevations, soil data, and a complete set of specs. It is expected that a definite estimate would be accurate within +15 to -5 percent.

Costs developed for this study should be considered "order of magnitude" and have an expected accuracy range of +50 percent to -30 percent. The purpose of this chapter is to present the assumptions used in developing order of magnitude cost estimates for facilities recommended with this master plan. Recommended facility improvements, which will address current deficiencies and facilities required to meet future City needs, are presented within the body of the report.

6.2 COST ESTIMATING CRITERIA

The cost estimates presented in this study are developed from bid tabulations, cost curves, information obtained from previous studies, and Carollo Engineers, P.C. (Carollo) experience on other projects. The costs estimated for each recommended facility are included in the CIP tables developed with this study. The tables are intended to be used to facilitate revisions to the City's CIP and ultimately to support determination of the user rates and connection impact fees.

6.2.1 Pipeline Unit Costs

Pipeline improvements to the City range in size from approximately 10-inches to 48-inches in diameter. Unit costs are given in Table 6.1. Construction of pipelines in undeveloped areas will likely cost less than those constructed in developed areas, such as downtown. To account for this, two separate unit cost schedules were developed. Schedule A is applied to pipeline projects in developed areas, whereas Schedule B is applied to currently undeveloped areas. Schedule B unit costs have been assumed to be equal to half of the Schedule A costs, based on data provided by City staff.

Table 6.1 Pipeline Costs
Sewer System Master Plan
City of Tulare

	Unit Cost[1] ($/Linear Foot)	
Pipe Size (inches)	**Schedule A (Developed)**	**Schedule B (Undeveloped)**
10	114	57
12	136	68
15	171	85
18	186	93
21	217	109
24	248	124
27	279	140
30	310	155
33	341	171
36	372	186
42	434	217
48	496	248

Note:
1. ENR CCI = 8,362 (20-City Average, August 2008)

6.2.2 Lift Station Unit Cost

Lift station improvements include increasing firm capacity to convey design flows. The lift station cost versus capacity curve shown in Figure 6.1 was developed based on projects of similar size in California. Costs were generated by inputting the appropriate capacity and calculating the corresponding costs.

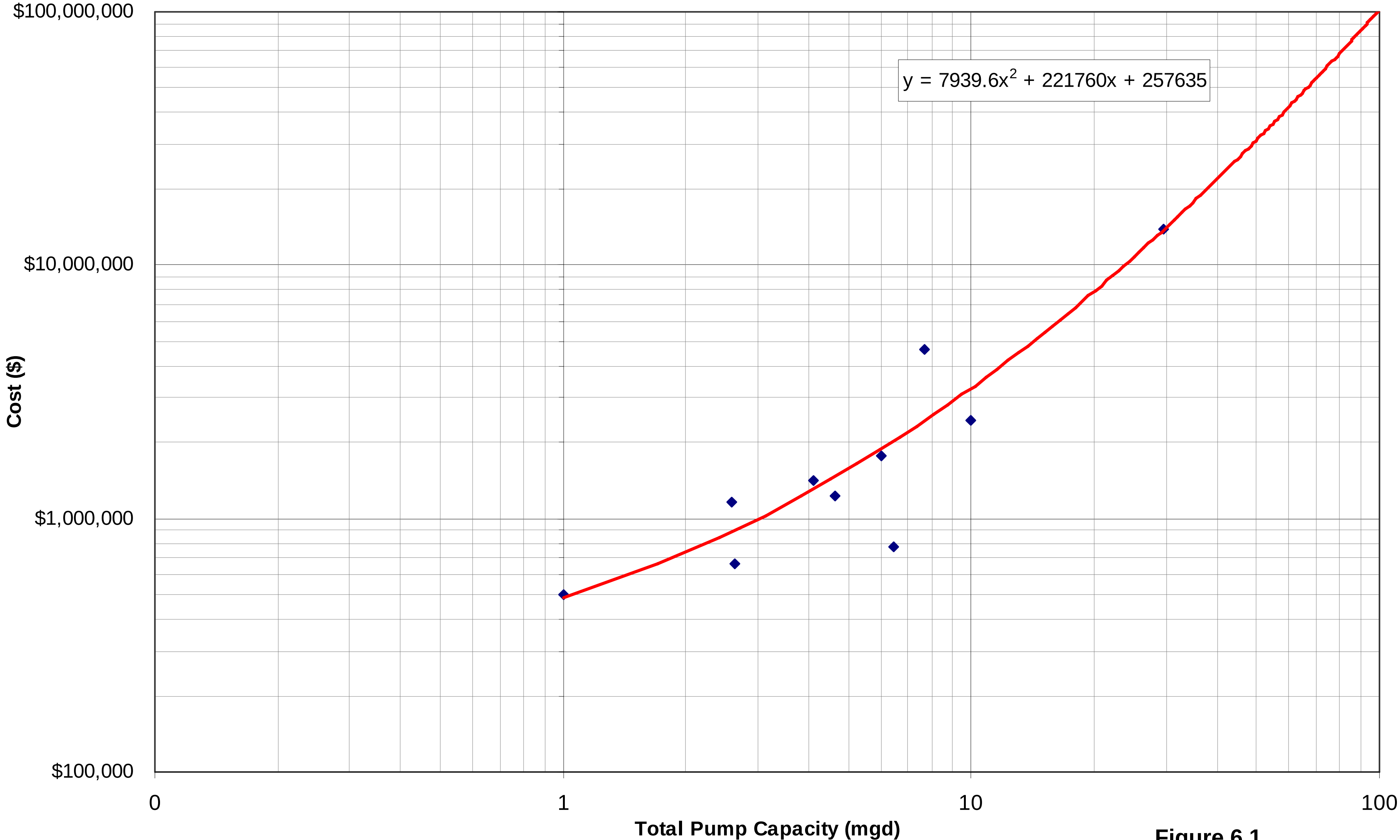


Figure 6.1
Lift Station Cost Versus Capacity Curve
Sewer System Master Plan
City of Tulare

Note: LS Costs are based on an ENR CCI of 8,362 (20-City Average, August 2008)

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6.2.3 Land Acquisition

Acquisition of property, easements, and right-of-way (ROW) will be required for some new lift stations, but not pipelines because it was assumed that public ROW will be utilized wherever possible. Land costs in Tulare County are not easily determined, particularly in the master-planning phase, and variables affecting properties can result in widely varying land prices. Since land acquisition costs are not included in this master plan, the final capital costs may vary from the estimates presented herein.

6.2.4 Construction Cost Adjustments

Costs estimated for this study were adjusted utilizing the Engineering News Record (ENR) Cost Construction Index (CCI). The ENR CCI is the primary index utilized by the planning and engineering community to adjust cost estimates developed in different years. The costs estimated in this chapter are in year 2008 dollars, based on an ENR CCI of 8,362 (August 2008, 20-City Average).

6.3 CAPITAL IMPROVEMENT PROGRAM

The CIP for this master plan are presented in Table 6.2. Cost related contingencies are provided below.

6.3.1 Baseline Construction Cost

This is the total estimated construction cost, in dollars, of the proposed improvements. Baseline Construction Costs were calculated according to the following:

- **Pipe Unit Cost**: Estimated unit cost of pipeline is based on the pipe's present day cost. The cost is expressed in dollars per linear foot ($/LF) of pipe length.
- **Pipe Cost**: Estimated cost of the pipeline, calculated by multiplying the estimated length by the unit cost.
- **Other Infrastructure Facilities Costs**: Estimated lump sum costs. Used for lift stations and other similar facilities.

6.3.2 Estimated Construction Cost

Since knowledge about site-specific conditions of each proposed project is limited at the master planning stage, a 30 percent contingency was applied to the Baseline Construction Cost to account for unforeseen events and unknown conditions.

The Estimated Construction Cost for the proposed improvement consists of the Baseline Construction Cost plus the construction contingency.

Table 6.2 Capital Improvement Program
Sewer System Master Plan
City of Tulare

Improvement No.	Type of Improv.	Description/ Street	Description / Limits	Existing System Improvement?	Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Parallel/ Replace/ New	Length (ft)	Capital Improv. Cost [4] ($)	Capital Improvement Program: Phase I 2008-10 ($)	Phase II 2011-15 ($)	Phase III 2016-20 ($)	Phase IV 2021-25 ($)	Phase V 2026-2030 ($)	Financing: Future Users Benefit (%)	Total Capital Cost ($)	Future Users Cost ($)	Existing Users Cost ($)
Domestic Collection System																		
Bardsley Avenue Sewer Basin																		
B-LS	Lift Station	Bardsley Avenue	Proposed Bardsley Ave LS	X	--	0.6 mgd	New	--	835,000	835,000					0%	835,000	0	835,000
Downtown Sewer Basin																		
D-1	Pipe	Kern Avenue	Blackstone St. to E/F Street Alley	X	10/12	15	Replace	6,700	1,783,000	1,783,000					0%	1,783,000	0	1,783,000
D-1A	Casing [1]	Kern Avenue	UPRR Casing	X	--	15/30	New	300	145,000	145,000					0%	145,000	0	145,000
D-2	Pipe	Spruce/Alley n/o Kern Avenue	Sierra St. to Highway 99	X	12	12	Replace	1,200	255,000		255,000				0%	255,000	0	255,000
D-LS	Lift Station	Sierra Avenue	Sierra Avenue LS Upgrade	X	0.22 mgd	0.5 mgd	Replace	--	668,000		668,000				0%	668,000	0	668,000
Eastside Sewer Basin																		
ES-1	Pipe	Levin Avenue	WWTP to West St.	X	--	42	New	2,600	1,761,000		1,761,000				87%	1,761,000	1,532,000	229,000
ES-2	Pipe	Levin Avenue	West St. to Pratt St.	X	--	42	New	2,400	1,625,000		1,625,000				87%	1,625,000	1,414,000	211,000
ES-3	Pipe	Levin Avenue	Pratt St. to I St.	X	--	42	New	3,900	2,641,000		2,641,000				87%	2,641,000	2,298,000	343,000
ES-4	Pipe	I Street	Levin Ave. to Paige Ave.	X	--	42	New	2,700	1,829,000		1,829,000				87%	1,829,000	1,591,000	238,000
ES-5	Pipe	Paige Avenue	1,700' w/o I St. to Laspina St.	X	--	42	New	5,600	3,792,000		3,792,000				87%	3,792,000	3,299,000	493,000
ES-5A	Casing [1]	Paige Avenue	Highway 99 Casing	X	--	42/72	New	800	929,000		929,000				87%	929,000	808,000	121,000
ES-5B	Casing [1]	Paige Avenue	UPRR Casing	X	--	42/72	New	300	348,000		348,000				87%	348,000	303,000	45,000
ES-6	Pipe	Foster Drive	Laspina St. to Mooney Blvd	X	--	39	New	3,500	2,201,000		2,201,000				87%	2,201,000	1,915,000	286,000
ES-7	Pipe	Mooney Boulevard	Foster Dr. to Levin Ave.	X	--	39	New	1,400	880,000		880,000				86%	880,000	757,000	123,000
ES-8	Pipe	Levin Avenue	Mooney Blvd. to 1,250' e/o Mooney Blvd.		--	18	New	1,250	363,000		363,000				100%	363,000	363,000	0
ES-9	Pipe	n/o Levin Avenue	1,250 n/o Mooney Blvd. to w/o Morrison St.		--	15	New	1,200	319,000		319,000				100%	319,000	319,000	0
ES-10	Pipe	Morrison Street	Levin Ave. to 1,400' s/o Levin Ave.		--	12	New	1,400	298,000				298,000		100%	298,000	298,000	0
ES-11	Pipe	Bardsley Avenue	Oakmore St. to Munson		--	15	New	3,950	1,051,000			1,051,000			100%	1,051,000	1,051,000	0
ES-12	Pipe	Oakmore Street	Bardsley Ave. to Ave. 228		--	12	New	2,600	553,000					553,000	100%	553,000	553,000	0
ES-13	Pipe	Tulare Avenue	Morrison to 1,000' e/o Morrison		--	12	New	1,000	213,000					213,000	100%	213,000	213,000	0
ES-14	Pipe	s/o Highway 137	Mooney Blvd. to Morrison		--	10	New	2,850	506,000				506,000		100%	506,000	506,000	0
ES-15	Pipe	Morrison Street	1,200' s/o Prosperity to 2,850' s/o Prosperity		--	10	New	1,650	293,000				293,000		100%	293,000	293,000	0
ES-16	Pipe	Prosperity Avenue	Mooney Blvd. to Highway 137		--	18	New	2,250	653,000				653,000		100%	653,000	653,000	0
ES-17	Pipe	w/o Morrison Street	Highway 137 to 2,550' s/o Cartmill Ave.		--	15	New	2,550	678,000				678,000		100%	678,000	678,000	0
ES-18	Pipe	w/o Morrison Street	2,550' s/o Cartmill Ave. to Cartmill Ave.		--	12	New	2,550	543,000				543,000		100%	543,000	543,000	0
ES-19	Pipe	Cartmill Avenue	1,100' e/o Mooney Blvd. to 2,300' e/o Mooney Blvd.		--	10	New	1,200	213,000				213,000		100%	213,000	213,000	0
ES-20	Pipe	Blackstone Street	Existing 21" Sewer to Cartmill Ave.		--	21	New	700	237,000			237,000			100%	237,000	237,000	0
ES-21	Pipe	Cartmill Avenue	Blackstone St. to 2,600' e/o Blackstone St.		--	15	New	2,600	692,000			692,000			100%	692,000	692,000	0
ES-22	Pipe	Cartmill Avenue	2,600' w/o Mooney Blvd. to Mooney Blvd.		--	12	New	2,600	553,000			553,000			100%	553,000	553,000	0
ES-23	Pipe	Mooney Boulevard	Cartmill Ave. to Ave. 252		--	10	New	2,700	479,000			479,000			100%	479,000	479,000	0
ES-24	Pipe	Cartmill Avenue	Gem St. to Blackstone St.		--	10	New	2,600	461,000					461,000	100%	461,000	461,000	0
ES-25	Pipe	Gem Street	Cartmill Ave. to Ave. 252		--	10	New	2,700	479,000					479,000	100%	479,000	479,000	0
ES-26	Pipe	Blackstone Street	Cartmill Ave. to Ave. 252		--	10	New	2,600	461,000				461,000		100%	461,000	461,000	0
ES-27	Pipe	2,600' w/o Mooney Blvd.	Cartmill Ave. to Ave. 252		--	12	New	2,600	553,000				553,000		100%	553,000	553,000	0
ES-28	Pipe	Turner Avenue	3,800' se/o of Foster Dr. to 2,100' se/o Foster Dr.		--	15	New	1,700	452,000		452,000				100%	452,000	452,000	0
ES-29	Pipe	Turner Avenue	5,700' se/o of Foster Dr. to 3,800 se/o Foster Dr.		--	10	New	1,900	337,000					337,000	100%	337,000	337,000	0
ES-LS 1	Lift Station	Foster Drive	Foster Dr. LS Modifications	X	1.0 mgd	1.8 mgd	Modify	--	1,808,000		1,808,000				100%	1,808,000	1,808,000	0
ES-LS 2	Lift Station	Paseo Del Lago	Del Lago LS Upgrade	X	1.0 mgd	3.0 mgd	Replace	--	2,923,000			2,923,000			100%	2,923,000	2,923,000	0
ES-LS 3	Lift Station	Academy Avenue	Academy Ave LS Upgrade	X	0.5 mgd	1.1 mgd	Replace	--	1,223,000		1,223,000				0%	1,223,000	0	1,223,000
Milner/Prosperity Sewer Basin																		
MP-1	Pipe	Prosperity/West Street	Zumwalt Ave. to Prosperity Ave.		--	18	New	2,500	726,000				726,000		100%	726,000	726,000	0
MP-2	Pipe	West Street	Cartmill Ave. to Zumwalt Ave.		--	15	New	4,000	1,064,000					1,064,000	100%	1,064,000	1,064,000	0
MP-3	Pipe	Cartmill Avenue	West St. to Sacramento Ave.		--	12	New	1,600	341,000					341,000	100%	341,000	341,000	0
MP-4	Pipe	Cartmill Avenue	Sacramento Ave. to J St.		--	10	New	1,600	284,000					284,000	100%	284,000	284,000	0
MP-5	Pipe	West Street	Cartmill Ave. to 3,900' n/o Cartmill Ave.		--	10	New	3,900	692,000					692,000	100%	692,000	692,000	0
Southwest Sewer Basin																		
SW-1	Pipe	2,600' e/o Enterprise Street	Bardsley St. to 2,600' s/o Bardsley		10	15	Replace	2,600	692,000					692,000	100%	692,000	692,000	0

Table 6.2 Capital Improvement Program
Sewer System Master Plan
City of Tulare

Improvement No.	Type of Improv.	Description/ Street	Description / Limits	Existing System Improvement?	Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Parallel/ Replace/ New	Length (ft)	Capital Improv. Cost [4] ($)	Capital Improvement Program: Phase I 2008-10 ($)	Phase II 2011-15 ($)	Phase III 2016-20 ($)	Phase IV 2021-25 ($)	Phase V 2026-2030 ($)	Financing: Future Users Benefit (%)	Total Capital Cost ($)	Future Users Cost ($)	Existing Users Cost ($)
West/Pleasant Sewer Basin																		
WP-1	Pipe	Pleasant Avenue and M Street	Oaks to Merritt	X	12	15	Replace	2,700	718,000		718,000				0%	718,000	0	718,000
WP-LS 1	Lift Station	M Street	M St. LS Upgrade	X	0.16 mgd	0.3 mgd	Replace	--	614,000		614,000				0%	614,000	0	614,000
WP-LS 2	Lift Station	Prosperity Avenue	Prosperty Ave LS Upgrade	X	0.29 mgd	0.55 mgd	Replace	--	797,000		797,000				0%	797,000	0	797,000
Westside Sewer Basin																		
WS-1	Pipe	State Highway 137	Enterprise St. to 1,400' East of Enterprise St.		--	10	New	2,500	443,000			443,000			100%	443,000	443,000	0
WS-2	Pipe	Enterprise Street	Prosperity Ave. to Pleasant Ave.		--	15	New	2,700	718,000				718,000		100%	718,000	718,000	0
WS-3	Pipe	Enterprise Street	Zumwalt AVE. to Prosperity Ave.		--	12	New	1,300	277,000					277,000	100%	277,000	277,000	0
WS-4	Pipe	Enterprise Street	Elster Ave. to Zumwalt Ave.		--	10	New	2,600	461,000					461,000	100%	461,000	461,000	0
Domestic Collection System Subtotal																		
								Domestic Collection System Subtotal	**43,860,000**	**2,763,000**	**23,223,000**	**6,378,000**	**5,642,000**	**5,854,000**		**43,860,000**	**34,733,000**	**9,127,000**
Industrial Collection System																		
South Industrial Sewer Basin																		
SI-1	Pipe	Paige Avenue	2,600' East of Enterprise St. to Pratt Ave.	X	--	48	New	6,800	5,263,000	5,263,000					85%	5,263,000	4,474,000	789,000
SI-2	Pipe	Pratt Street	Paige to Clinton Ave.	X	--	42	New	5,200	3,522,000	3,522,000					84%	3,522,000	2,958,000	564,000
SI-3	Pipe	Pratt Street	Clinton Ave. to Lopes Ave.	X	--	42	New	2,650	1,795,000	1,795,000					83%	1,795,000	1,490,000	305,000
SI-4	Pipe	Pratt Street	Lopes Ave. to Avenue 196	X	--	42	New	5,100	3,454,000	3,454,000					83%	3,454,000	2,867,000	587,000
SI-5	Pipe	Avenue 198	Pratt St. to 3,200' w/o I St.	X	--	36	New	3,700	2,148,000	2,148,000					74%	2,148,000	1,590,000	558,000
SI-6	Pipe	Avenue 198	3,200' w/o I St. to I St.	X	--	36	New	3,200	1,858,000	1,858,000					72%	1,858,000	1,338,000	520,000
SI-7	Pipe	County Road 112	Ave. 196 to 3,500' s/o Ave 196		--	30	New	2,300	1,113,000			1,113,000			100%	1,113,000	1,113,000	0
SI-8A	Siphon [2]	County Road 112	3,500' South of Ave. 196 to 3,900' s/o Ave. 196		--	15	New	2,250	599,000			599,000			100%	599,000	599,000	0
SI-8B	Siphon [2]	County Road 112	3,500' South of Ave. 196 to 3,900' s/o Ave. 196		--	15	New	2,250	599,000			599,000			100%	599,000	599,000	0
SI-8C	Siphon [2]	County Road 112	3,500' South of Ave. 196 to 3,900' s/o Ave. 196		--	15	New	2,250	599,000			599,000			100%	599,000	599,000	0
SI-9	Pipe	County Road 112	3,900' South of Ave. 196 to 4,500' s/o Ave. 197		--	30	New	2,750	1,330,000			1,330,000			100%	1,330,000	1,330,000	0
SI-10	Pipe	Avenue 196	Hwy 99 to County Rd 112	X	--	30	New	1,200	580,000	580,000					56%	580,000	325,000	255,000
SI-10A	Casing [1]	Avenue 196	UPRR Casing	X	--	30/48	New	300	232,000	232,000					56%	232,000	130,000	102,000
SI-11	Force Main	Avenue 196	Hwy 99 Lift Station Force Main		--	8	New	400	52,000				52,000		100%	52,000	52,000	0
SI-11A	Casing [1]	Avenue 196	Hwy 99 Force Main Casing		--	8/15	New	800	182,000				182,000		100%	182,000	182,000	0
SI-12	Pipe	Hosfield Drive	Hwy 99 to Laspina St.		--	12	New	2,750	585,000				585,000		100%	585,000	585,000	0
SI-13	Pipe	Laspina Avenue	Ave. 196 to Ave. 192		--	12	New	2,400	511,000					511,000	100%	511,000	511,000	0
SI-LS 1	Lift Station	Pratt Street	Lopes Ave. To 400' s/o Lopes Ave.	X	--	10.6 mgd	New	--	9,034,000	9,034,000					83%	9,034,000	7,498,000	1,536,000
SI-LS 2	Lift Station	Highway 99 Lift Station	Hosfield and Hwy 99		--	0.5 mgd	New	--	760,000				760,000		100%	760,000	760,000	0
Industrial Collection System Subtotal																		
								Industrial Collection System Subtotal	**34,216,000**	**27,886,000**	**0**	**4,240,000**	**1,579,000**	**511,000**		**34,216,000**	**29,000,000**	**5,216,000**
Total City of Tulare CIP																		
								Total City of Tulare CIP	**78,076,000**	**30,649,000**	**23,223,000**	**10,618,000**	**7,221,000**	**6,365,000**		**78,076,000**	**63,733,000**	**14,343,000**

Notes:
1. Proposed casings size and carrier pipe size.
2. Proposed Siphon is a triple barrel siphon.
3. Estimated Construction Cost is Baseline Construction Cost plus 30% to account for unforeseen events and unknown conditions.
4. Capital Improvement Cost is Estimated Construction Cost plus 20% to cover other costs including Engineering, Administation, Construction Inspection, and Legal Costs.

6.3.3 Capital Improvement Cost

Other project-related costs have been identified and estimated at 20 percent of the Estimated Construction Costs. These costs include engineering, administration, construction inspection, and legal costs.

The Capital Improvement Cost for each proposed improvement is the total of the Estimated Construction Cost (including contingency) plus the other costs discussed in the previous paragraph.

An example calculation to determine the Capital Improvement Cost is provided as follows:

Example Calculation:

Given:

Baseline Construction Cost = $1,000,000

Required:

Capital Improvement Cost

Solution:

Estimated Construction Cost = (Baseline Construction Cost) x (1 + 0.30)

Estimated Construction Cost = ($1,000,000) x (1 + 0.30)

Estimated Construction Cost = $1,300,000

Capital Improvement Cost = (Estimated Construction Cost) x (1 + 0.20)

Capital Improvement Cost = ($1,300,000) x (1+ 0.20)

Capital Improvement Cost = $1,560,000

6.3.4 Capital Improvement Schedule

The CIP costs were prioritized based on their urgency to meet existing deficiencies and for servicing anticipated growth. It is recommended that improvements to mitigate existing deficiencies be constructed as soon as possible. In some cases, the recommended improvements to mitigate existing deficiencies are currently in the design phase. The recommended improvements to serve future growth have a significant total capital cost that is best distributed based on the order in which the City will develop. The master plan CIP utilizes the following phases:

- **Phase I**. This short-term phase includes improvements that are allocated between 2009 and 2011.
- **Phase II**. This intermediate phase includes improvements that are allocated between 2012 and 2015.
- **Phase III**. This intermediate phase includes improvements that are allocated 2016 and 2020.

- **Phase IV**. This long-term phase includes improvements that are 2021 and 2025.
- **Phase V**. This long-term phase includes improvements that are allocated 2026 and 2030.

Table 6.3 summarizes the master plan capital improvement costs by phase and improvement type. It should be noted that the CIP in this master plan is front loaded on the first two improvement phases. This is primarily due to the need for the construction of two major trunk sewers in the earlier phases to address existing deficiencies and serve new industrial customers. These trunks are the South Industrial Trunk (SI-1 through SI-6 and SI-LS-1) and the Eastside Trunk Sewer Extension (ES-1 through ES-7).

Table 6.3 Capital Improvement Schedule - Pipeline vs. Lift Station
Sewer System Master Plan
City of Tulare

	Cost (million dollars)					
Improv. Type	**Phase I (2009-2011)**	**Phase II (2012-2015)**	**Phase III (2016-2020)**	**Phase IV (2021-2025)**	**Phase V (2026-2030)**	**Total**
Pipelines(1)	12.8	24.0	4.2	3.7	3.5	**48.2**
Lift Stations/ Tank	9.9	6.6	3.1	0.7	0.0	**20.3**
Total	**22.7**	**30.6**	**7.3**	**4.4**	**3.5**	**68.5**

Note:
1. Includes gravity sewers, force mains, siphons and pipeline casings.

Table 6.4 provides a breakdown between the Domestic and the Industrial collection system CIP costs. Through 2030 the CIP for the Industrial and Domestic collection systems totals $22.7 and $45.8 million respectively.

Table 6.4 Capital Improvement Schedule - Domestic vs. Industrial Costs
Sewer System Master Plan
City of Tulare

	Cost (million dollars)					
Improv. Type	**Phase I (2009-2011)**	**Phase II (2012-2015)**	**Phase III (2016-2020)**	**Phase IV (2021-2025)**	**Phase V (2026-2030)**	**Total**
Industrial	19.5	0	2.0	1.0	0.2	**22.7**
Domestic	3.2	30.6	5.3	3.4	3.3	**45.8**
Total	**22.7**	**30.6**	**7.3**	**4.4**	**3.5**	**68.5**

6.4 USER BENEFIT AND COST ALLOCATION

The improvements in this master plan have been classified into two categories:

- Services benefiting existing users.
- Services necessitated by or benefiting new development.

An opinion of benefit to existing and future users, based on preliminary project information, was included in this master plan. Once estimates for specific projects are completed, a more precise allocation may be performed if required by the provisions of the California Government Code Section 66000 and AB1600.

Table 6.5 summarizes the master plan capital improvement costs by phase and user type.

Table 6.5 Capital Improvement Program – Existing and Future Users
Sewer System Master Plan
City of Tulare

Customer Type	**Cost (million dollars)**					
	Phase I (2009-2011)	**Phase II (2012-2015)**	**Phase III (2016-2020)**	**Phase IV (2021-2025)**	**Phase V (2026-2030)**	**Total**
Existing[(1)]	7.0	9.1	0.0	0.0	0.0	**16.1**
Future	15.7	21.5	7.3	4.4	3.5	**52.4**
Total	**22.7**	**30.6**	**7.3**	**4.4**	**3.5**	**68.5**

Note:
1. Existing user costs have been distributed through the first two phases based on the project prioritizations presented in Chapter 5.

Table 6.6 provides a break down of the existing and future user cost for both the Industrial and Domestic collection systems.

Table 6.6 Existing and Future User Costs (Domestic and Industrial)
Sewer System Master Plan
City of Tulare

Customer Type	**Phase I (2009-2011)**	**Phase II (2012-2015)**	**Phase III (2016-2020)**	**Phase IV (2021-2025)**	**Phase V (2026-2030)**	**Total**
Industrial						
Existing	3.8	0.0	0.0	0.0	0.0	**3.8**
Future	15.7	0.0	2.0	1.0	0.2	**18.9**
Total	**19.5**	**0.0**	**2.0**	**1.0**	**0.2**	**22.7**
Domestic						
Existing	3.2	9.1	0.0	0.0	0.0	**12.3**
Future	0.0	21.5	5.3	3.4	3.3	**33.5**
Total	**3.2**	**30.6**	**5.3**	**3.4**	**3.3**	**45.8**

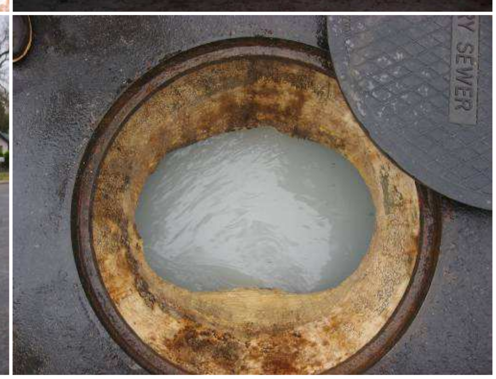
APPENDIX A - SANITARY SEWER FLOW MONITORING STUDY (JUNE 2007)

City of Tulare

Sanitary Sewer Flow Monitoring





June 2007

V&A

SANITARY SEWER
FLOW MONITORING

CITY OF TULARE

Prepared for:

CAROLLO ENGINEERS
7580 North Ingram Avenue, Suite 112
Fresno, CA 93711

Prepared by:

V&A CONSULTING ENGINEERS
Lake Merritt Plaza
1999 Harrison Street, Suite 975
Oakland, CA 94612

June 2007

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TABLES

FIGURES

EXECUTIVE SUMMARY

V&A Consulting Engineers (V&A) has completed sanitary sewer flow monitoring at 10 locations within the City of Tulare. Flow monitoring was conducted over a 2-week period from from March 22, 2007 through April 4, 2007 at the 10 flow monitoring sites chosen by Carollo Engineers. The 10 flow monitoring sites are shown in Figure 1 on Page 2 of this report.

Table 1 summarizes the flow monitoring results for each flow monitoring site.

Table 1. Summary of Flow Monitoring Results

Location	Diameter (in)	Type of Waste	Average Dry Weather Flow (MGD)		Weekend/ Weekday Ratio	Peak Level (in)	d/D Ratio
			Weekday	Weekend			
Site 1	30	Residential	1.91	1.99	1.05	16.06	0.54
Site 2	36	Industrial	4.02	3.86	0.96	19.24	0.53
Site 3	30	Residential	0.34	0.36	1.05	6.04	0.20
Site 4	15	Residential	0.50	0.51	1.02	9.13	0.61
Site 5	16	Residential	1.53	1.59	1.04	11.99	0.75
Site 6	21	Residential	0.66	0.63	0.96	10.18	0.48
Site 7	21	Industrial	0.53	0.36	0.67	35.38	**1.68**
Site 8	12	Residential	0.54	0.58	1.06	7.56	0.63
Site 9	15	Residential	0.79	0.79	1.00	10.28	0.69
Site 10	15	Residential	0.74	0.76	1.02	18.43	**1.23**

The following analysis items are noted:

- **Groundwater Infiltration:** There appears to be slightly higher-than-normal groundwater infiltration occurring in the basins upstream from Site 5 during periods of dry weather flow.
- **d/D Ratio:** Sites 7 and 10 exceeded the threshold d/D ratio 0.75 and also experienced surcharged conditions. The City may wish to conduct further investigations regarding the hydraulic conditions of the localized collection systems near these sites to determine the cause of insufficient capacity at these sites.

INTRODUCTION

V&A Consulting Engineers (V&A) was retained by Carollo Engineers to conduct sanitary sewer flow monitoring at 10 locations within the City of Tulare, California. The purpose of this study was to record and report the existing flow volumes through the sanitary sewer pipes. Flow monitoring was recorded at 15-minute intervals and conducted over a 14-day period from March 22, 2007 through April 4, 2007.

The flows through Sites 2 and 7 convey industrial waste. The flows through Sites 1, 3, 4, 5, 6, 8, 9 and 10 convey residential sanitary wastewater.

Figure 1 illustrates the locations of the manholes where the flow meters were installed.

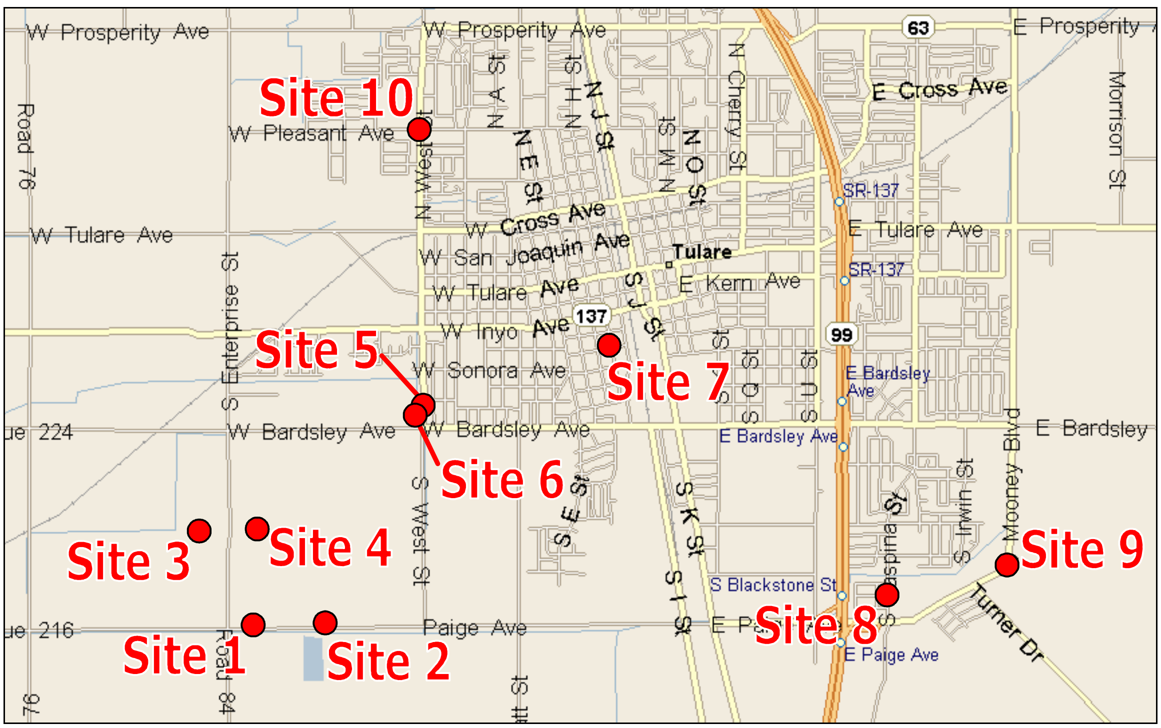


Figure 1. Map of Flow Monitoring Sites

FLOW MONITORING METHODS AND PROCEDURES

Meter Installation

Ten Isco 2150 area-velocity flow meters were installed by V&A in the sewer manholes shown in Figure 1. Sigma meters use a pressure transducer to collect depth readings, and ultrasonic Doppler sensors on the probe determine the average fluid velocity. Figure 2 shows a diagram of a typical flow meter installation.

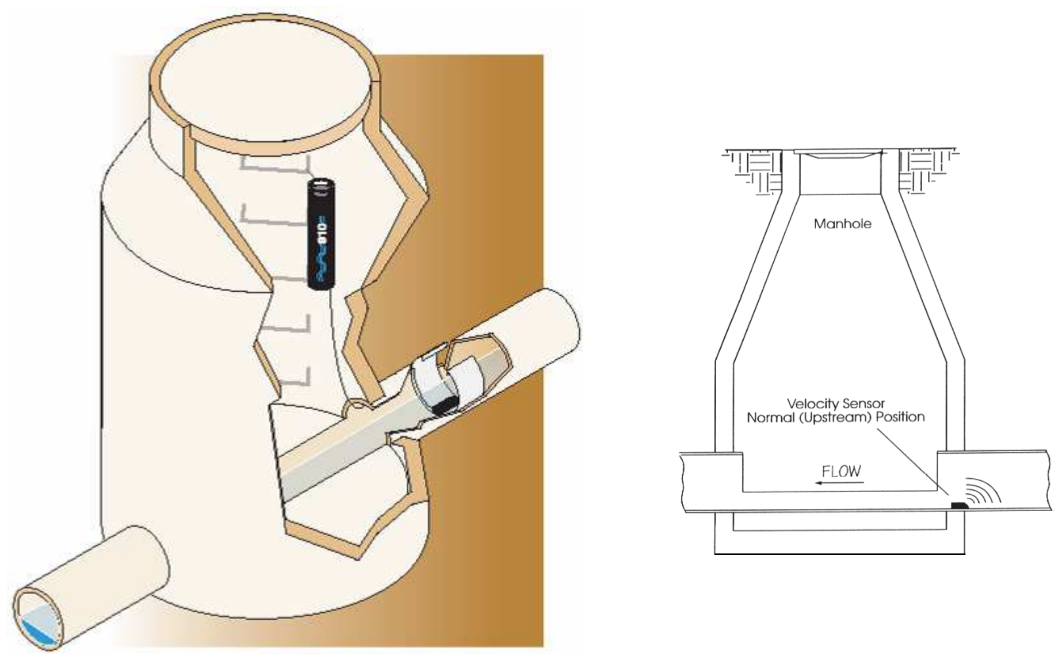


Figure 2. Flow Meter Installation Diagram

Manual level and velocity measurements were taken in the field during the flow meter installation and again when the meters were removed. These manual measurements are compared to the instantaneous level and velocity readings of the flow meter to ensure proper calibration and accuracy. The continuous depth and velocity readings were recorded by the flow meters in 15-minute increments and downloaded into a computer spreadsheet program where the data could be analyzed and made report-ready.

Explanation of Report Graphs and Definition of Terms

Flow versus time graphs are created by plotting the data recorded by the flow meter in 15-minute intervals. The graphs represent the diurnal flow curve recorded over a given monitoring period and represent the data in its rawest form. Figure 3 shows a typical diurnal flow curve and identified on this graph are the hypothetical peak, low, and average flows recorded over an example monitoring period. These graphs are useful in identifying the extreme limits of the flows being monitored, and identifying any trends that might be occurring at a particular site. The graphs for flow, level, and velocity versus time for this project are provided in *Appendix A* of this report.

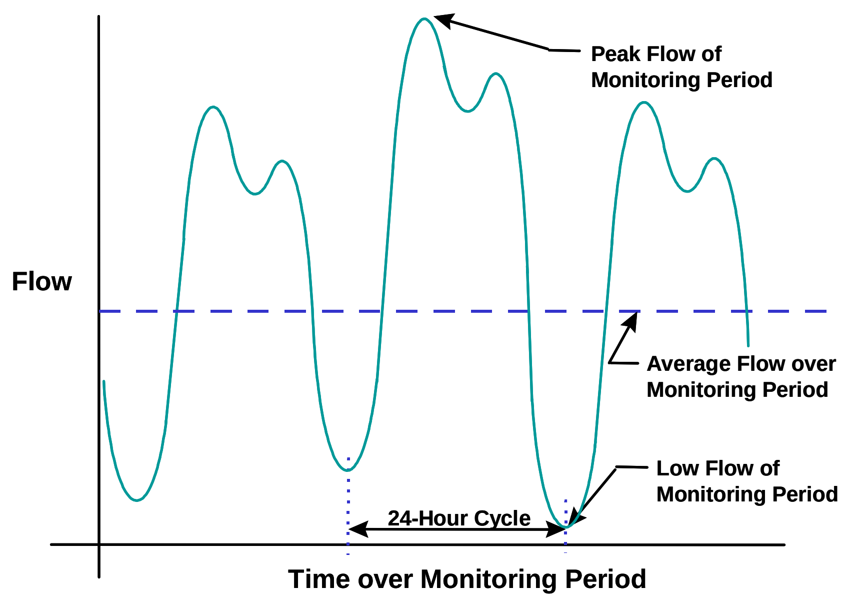


Figure 3. Diagram of Hypothetical Diurnal Flow over Monitoring Period

Dry weather flow is the flow that is caused by actual waste drainage from buildings in the area. Wet weather flow includes rain-dependent infiltration and inflow which may increase the flow through the sewer pipes. The flows recorded during this study were considered to be dry weather flows.

FINDINGS

Flow Monitoring Results

For the flow monitoring sites conveying residential wastewater (Sites 1, 3, 4, 5, 6, 8, 9 and 10), the recorded flows showed a diurnal curve with peaks in the early morning and evening hours. Figure 4 plots the average daily weekday and weekend flows for Site 1. Similar plots for all sites are shown in *Appendix A*.

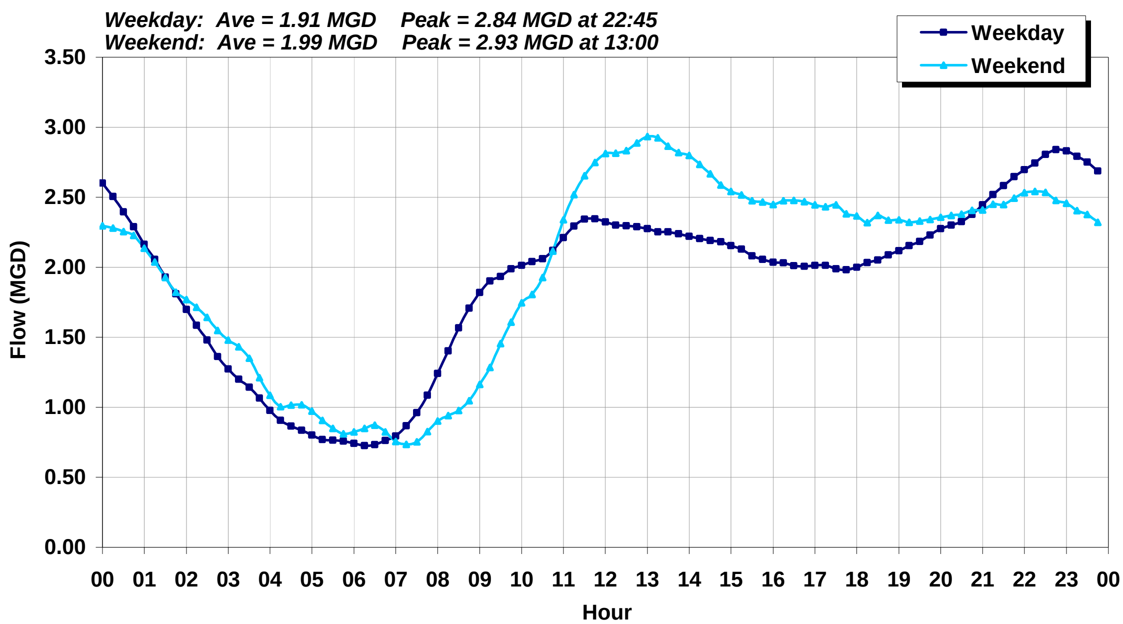


Figure 4. Average Daily Flow Graph (Site 1)

Table 2 on the following page summarizes the measured average dry weather flow and the peak measured flow at the monitoring sites during the monitoring period.

Table 2. Flow Monitoring Results

Location	Type of Waste	Average Dry Weather Flow (MGD)		Weekend/ Weekday Ratio	Average Peak Dry Weather Flow (MGD)		PDWF/ADWF Ratio	
		Weekday	Weekend		Weekday	Weekend	Weekday	Weekend
Site 1	Residential	1.91	1.99	1.05	2.84	2.93	1.49	1.47
Site 2	Industrial	4.02	3.86	0.96	4.63	4.77	1.15	1.23
Site 3	Residential	0.34	0.36	1.05	0.50	0.55	1.46	1.53
Site 4	Residential	0.50	0.51	1.02	0.66	0.75	1.33	1.48
Site 5	Residential	1.53	1.59	1.04	1.84	2.00	1.20	1.26
Site 6	Residential	0.66	0.63	0.96	0.91	0.98	1.38	1.55
Site 7	Industrial	0.53	0.36	0.67	0.68	0.56	1.28	1.58
Site 8	Residential	0.54	0.58	1.06	0.79	0.87	1.46	1.50
Site 9	Residential	0.79	0.79	1.00	1.14	1.22	1.43	1.54
Site 10	Residential	0.74	0.76	1.02	0.98	1.06	1.32	1.39

Plots and tables summarizing the flows at each of the monitoring sites are shown in *Appendix A*.

Dry Weather Ground Water Infiltration Analysis

Dry weather (baseline) flow can be expected to have a predictable diurnal flow pattern. While each site is unique, experience has shown that, given a reasonable volume of flow and typical loading conditions, the daily peaks and lows fall into a predictable range when compared to the daily average flow. If a site has a large percentage of ground water infiltration occurring during the periods of dry weather flow measurement, the amplitudes of the peak and low flows will be dampened[1]. Figure 5 shows a sample of two flow monitoring sites, both with nearly the same average daily flow, but with considerably different peak and low flows. In this *sample* case, Site B1 may have a considerable volume of ground water infiltration.

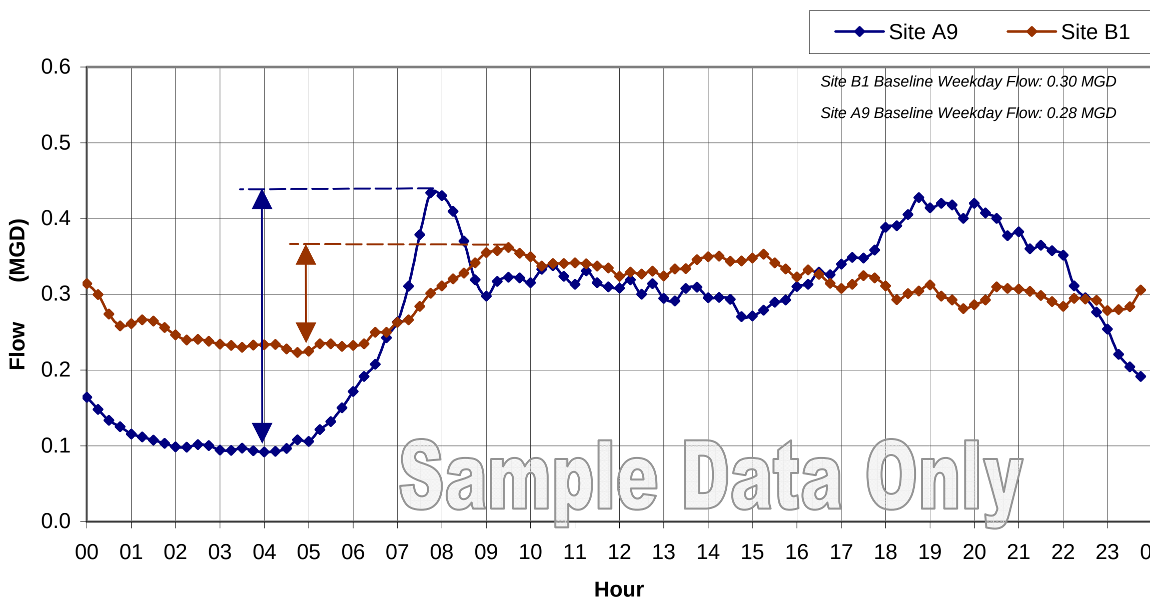


Figure 5. Ground Water Infiltration Sample Figure

It can be useful to compare the peak-to-baseline and low-to-baseline flow ratios for all flow metering sites. A site with abnormal ratios, and with no other reasons to suspect abnormal flow patterns (such as proximity to pump station, treatment facilities, etc.), has a distinct possibility of higher levels of ground water infiltration in comparison to the rest of the collection system. Figure 6 plots the peak-to-baseline and min-to-baseline flow ratios against the baseline flows for all sites monitored during this study. The dotted line shows "typical" min-to-baseline flow ratios per the Water Pollution Control Federation[2]. There are no established peak-to-baseline ratios,

[1] Theoretically imagining an extreme case, if there were 0.2 MGD of baseline flow and 2.0 MGD of groundwater infiltration, the peaks and lows would be barely recognizable; the baseline flow would be nearly a straight line.

[2] WPCF Manual of Practice No. 9 "Design and Construction of Sanitary and Storm Sewers"

but a system trendline has been drawn to better distinguish sites that fall outside the system trends. The min-to-baseline ratio should be taken with more weight as low flows during early morning hours are generally more predictable than peak flows.

Please note: this analysis is only valid for residential flows. Industrial flow patterns vary considerably by location and are not predictable. Sites 2 and 7 servicing industrial waste are not shown in the figure below.

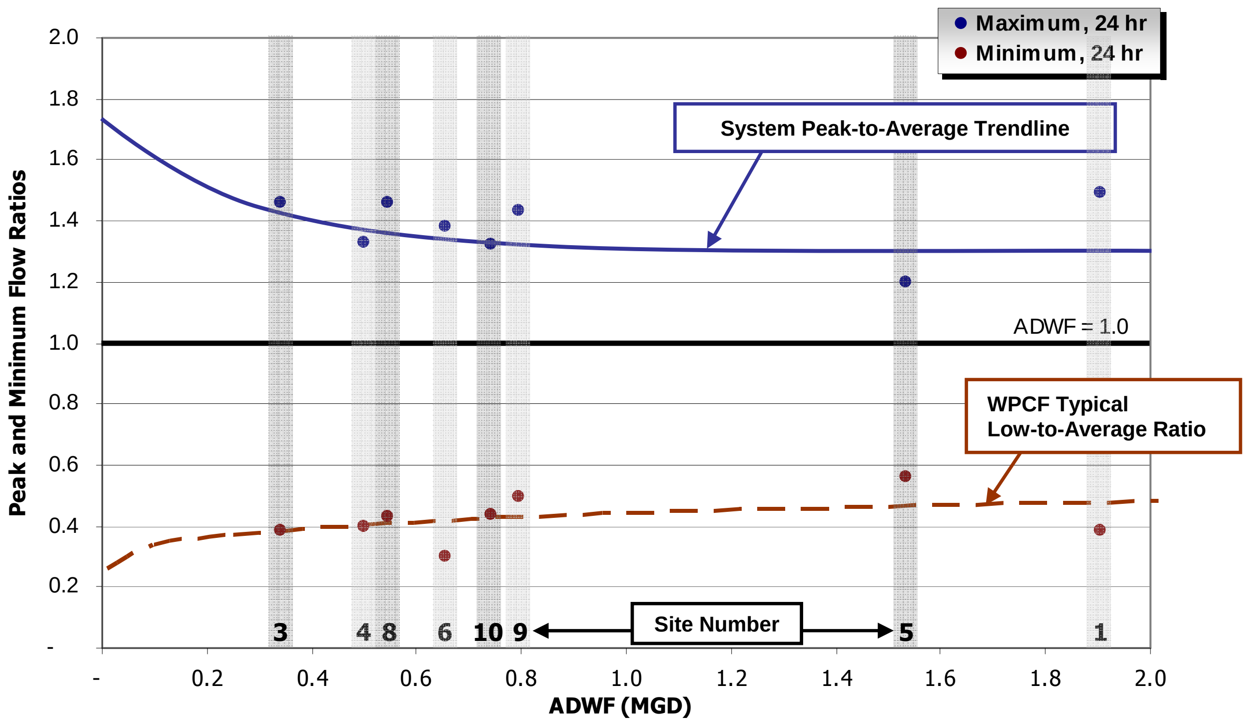


Figure 6. Peak and Minimum Flow Ratios vs. ADWF[3]

Site 5 had min-to-baseline ratios that fell slightly outside of the typical min-to-baseline ratios as defined by WPCF. There may be slightly higher-than-normal groundwater infiltration occurring in the basin upstream from Site 5 during periods of dry weather flow.

3 Due to attenuation, it should be expected that sites with larger flow volumes should not have quite the peak-to-average and low-to-average flow ratios as sites with lesser flow volumes, which is why the typical and system trend lines slope closer to 1.0 as the ADWF increases, as shown in the figure.

Pipeline Capacity Analysis

The d/D ratio is the peak measured depth of flow divided by the pipe diameter. A d/D ratio less than 0.75 is a common threshold value used for pipe design. Table 3 summarizes the peak recorded d/D ratios per site during the flow monitoring period.

Table 3. d/D Ratio per Site

Monitoring Site	Diameter (in)	Peak Level (in)	d/D Ratio	Comments
Site 1	30	16.06	0.54	Did not exceed threshold of 0.75.
Site 2	36	19.24	0.53	Did not exceed threshold of 0.75.
Site 3	30	6.04	0.20	Did not exceed threshold of 0.75.
Site 4	15	9.13	0.61	Did not exceed threshold of 0.75.
Site 5	16	11.99	0.75	Right at threshold of 0.75.
Site 6	21	10.18	0.48	Did not exceed threshold of 0.75.
Site 7	21	35.38	**1.68**	Exceeded threshold of 0.75. Surcharged condition 14.4 inches above pipe crown.
Site 8	12	7.56	0.63	Did not exceed threshold of 0.75.
Site 9	15	10.28	0.69	Did not exceed threshold of 0.75.
Site 10	15	18.43	**1.23**	Exceeded threshold of 0.75. Surcharged condition 3.4 inches above pipe crown.

Sites 7 and 10 exceeded the threshold d/D ratio 0.75 and also experienced surcharged conditions. The City may wish to conduct further investigations regarding the hydraulic conditions of the localized collection systems near these sites to determine the cause of insufficient capacity at these sites.

APPENDIX A

FLOW MONITORING SITES: GRAPHS, FIGURES & TABLES

City of Tulare
CALIFORNIA

Temporary Flow Monitoring Study

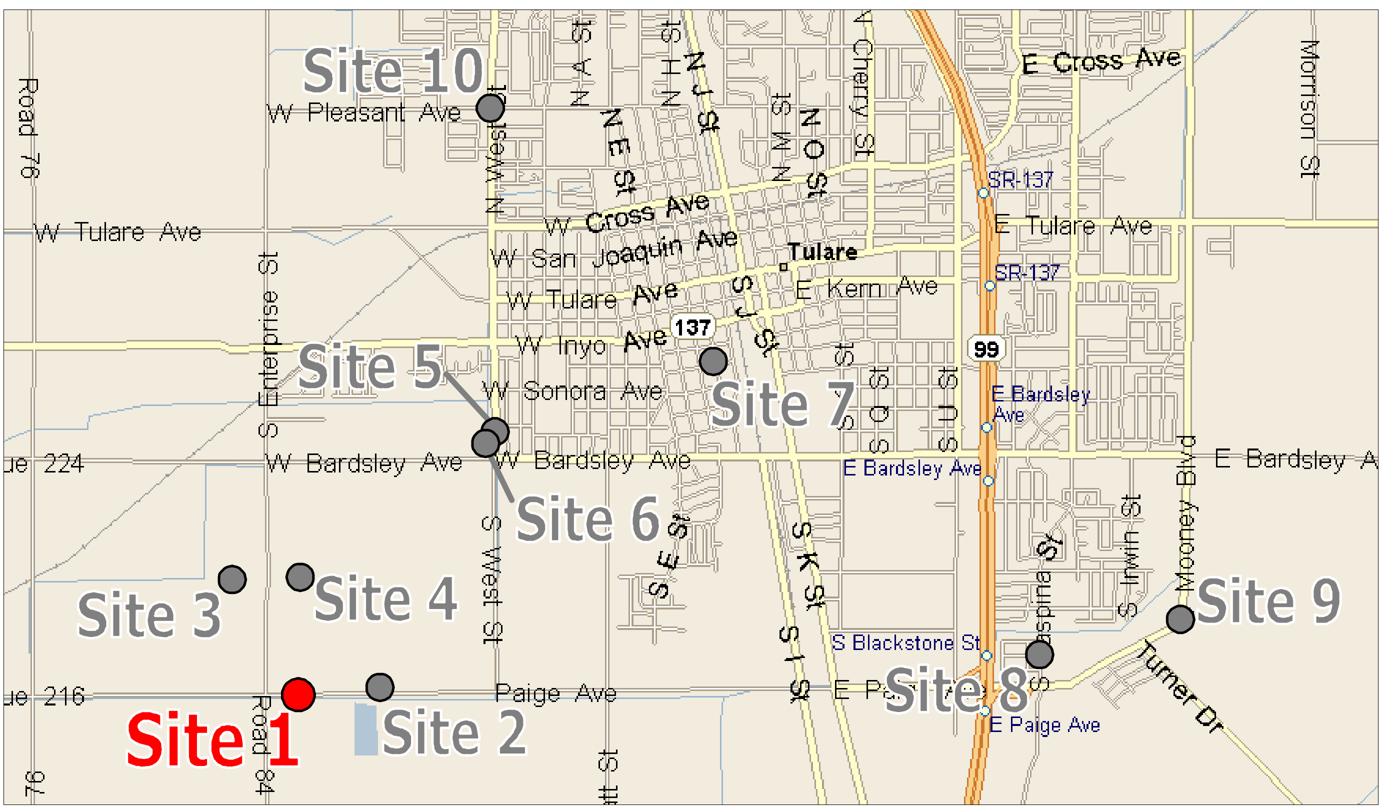
Sanitary Sewer Collection System

Monitoring Site: Site 1

Manhole Address: Avenue 216, east of Road 84

Size/Type of Line: 30-inch Sanitary Sewer Pipe

Data Summary Report



V&A

City of Tulare CALIFORNIA

Site Information Report

Monitoring Site:
Site 1

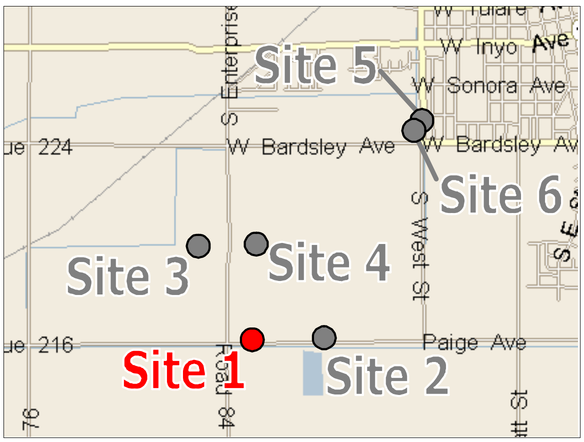
Location: Avenue 216, east of Road 84

Diameter: 30 inches

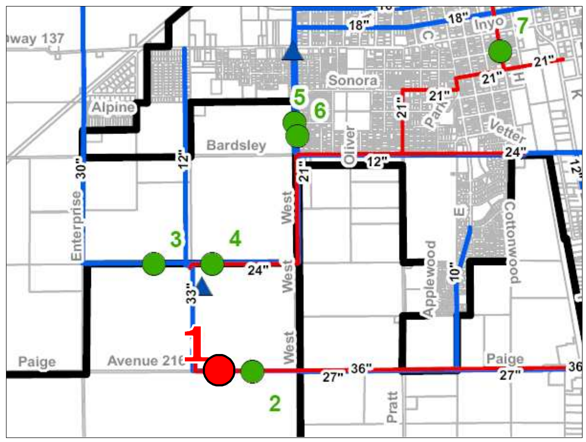
Average Dry Weather Flow: 1.930 *MGD*

Peak Measured Flow: 3.532 *MGD*

Street map:



Sanitary sewer map:

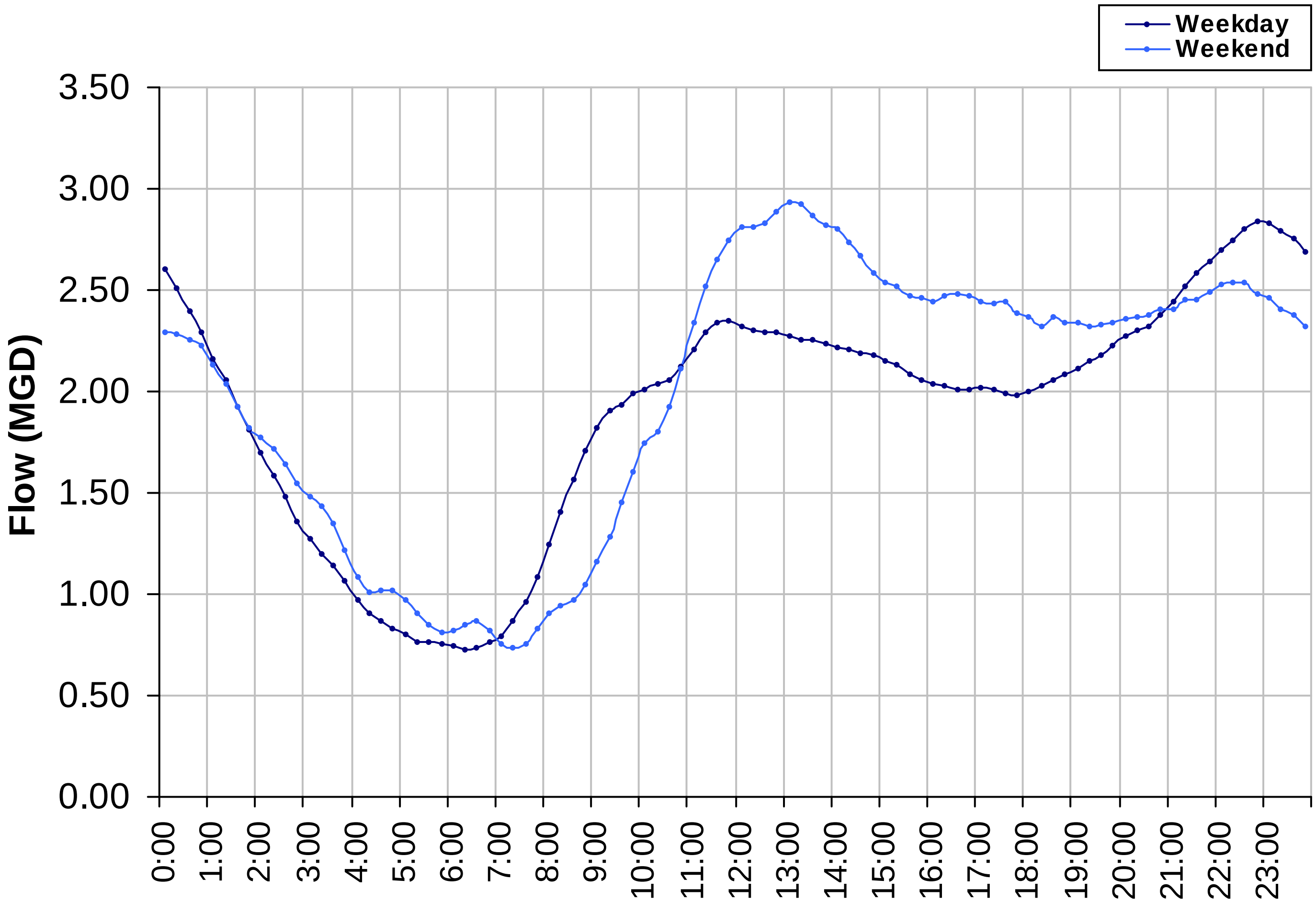


Street-level photo:

Plan view photo:

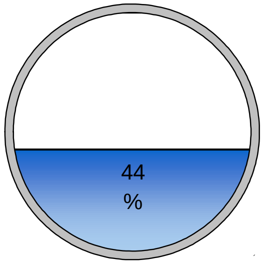
V&A

	Average Dry Weather Flow	**Monitoring Site:** Site 1



Average Dry Weather Flow:

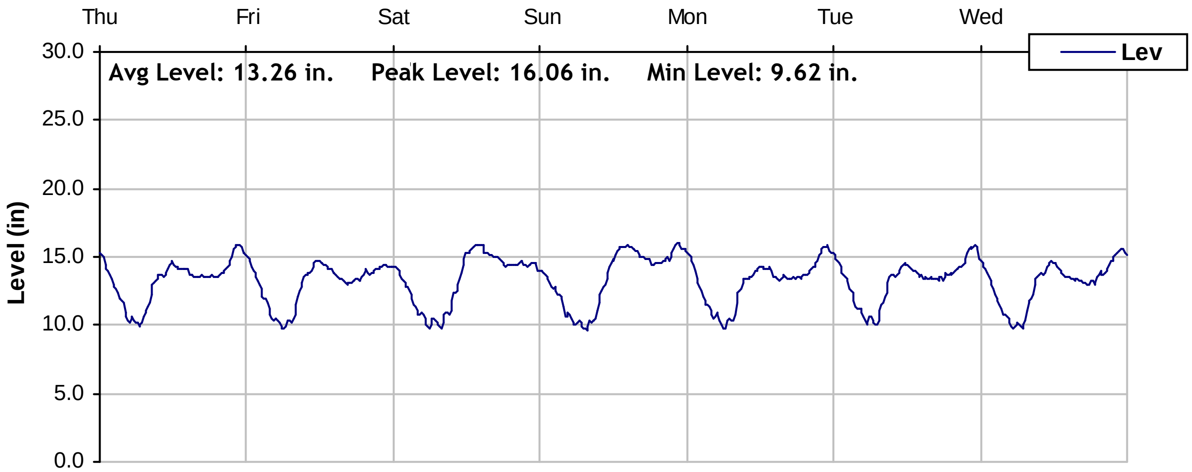
1.93 *MGD*

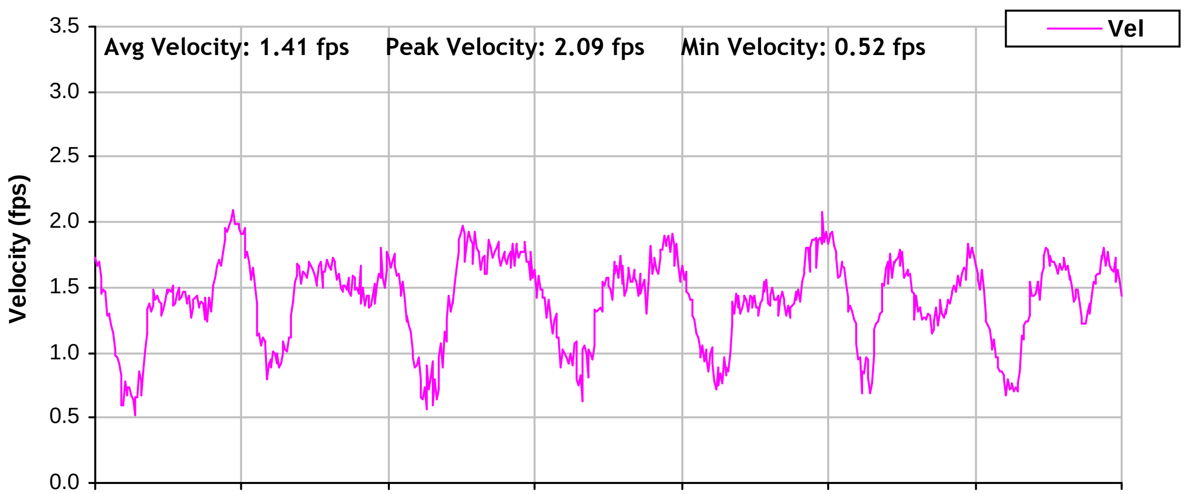


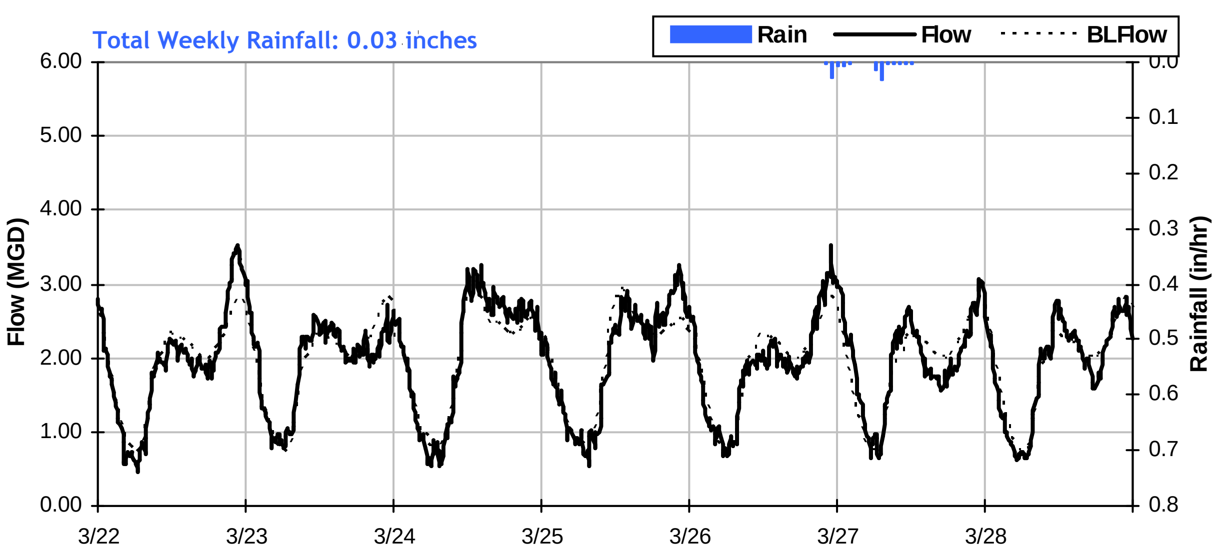
City of Tulare
CALIFORNIA

Level, Velocity and Flow
From 3/22/2007 to 3/29/2007

Monitoring Site:
Site 1



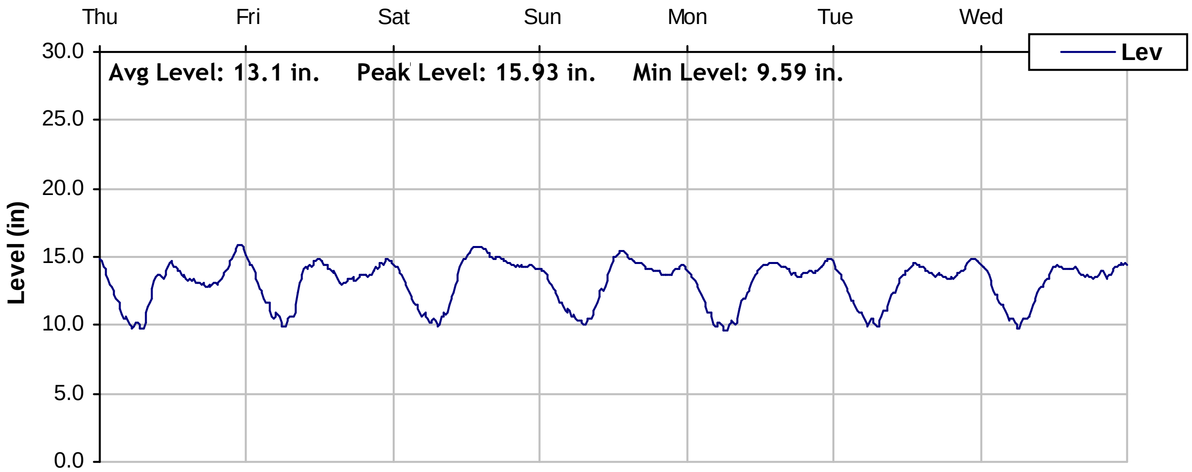


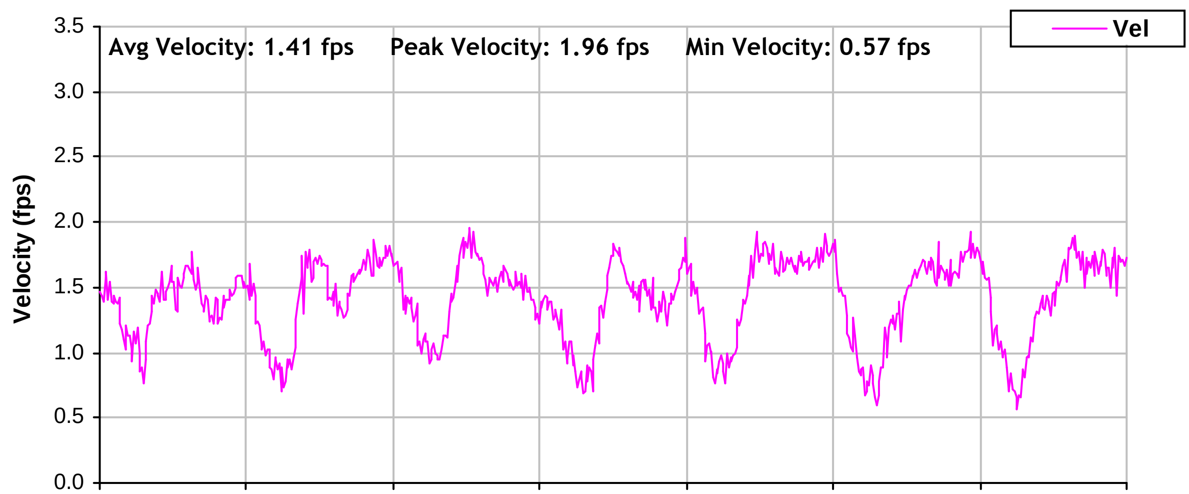


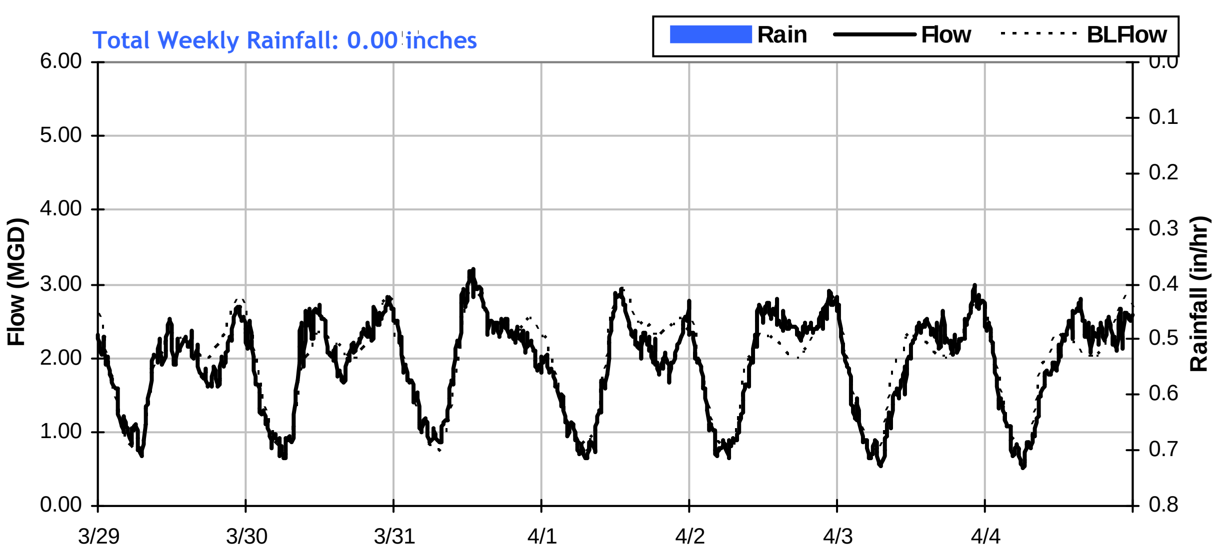
Avg Flow: 1.95 MGD **Peak Flow: 3.53 MGD** **Min Flow: 0.47 MGD**

V&A

City of Tulare CALIFORNIA	**Level, Velocity and Flow** From 3/29/2007 to 4/5/2007	**Monitoring Site:** Site 1







Avg Flow: 1.92 MGD **Peak Flow: 3.21 MGD** **Min Flow: 0.5 MGD**

V&A

Temporary Flow Monitoring Study

Sanitary Sewer Collection System

Monitoring Site: Site 2

Manhole Address: Avenue 216, east of Road 84

Size/Type of Line: 36-inch Sanitary Sewer Pipe

Data Summary Report

City of Tulare
CALIFORNIA

Site Information Report

Monitoring Site:
Site 2

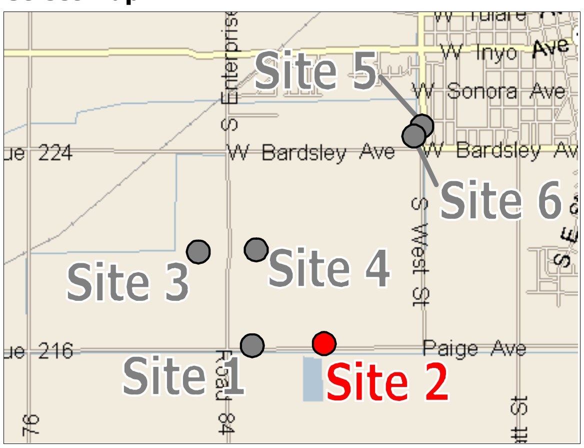
Location: Avenue 216, east of Road 84

Diameter: 36 inches

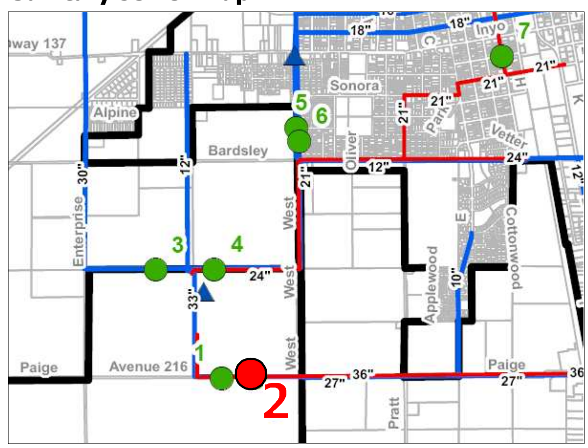
Average Dry Weather Flow: 3.976 *MGD*

Peak Measured Flow: 5.764 *MGD*

Street map:

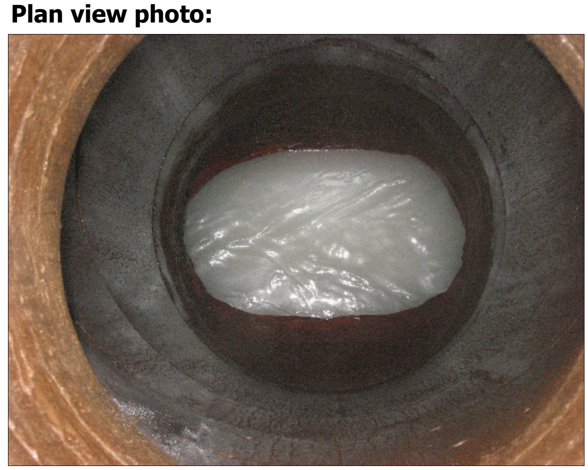


Sanitary sewer map:



Street-level photo:

Plan view photo:

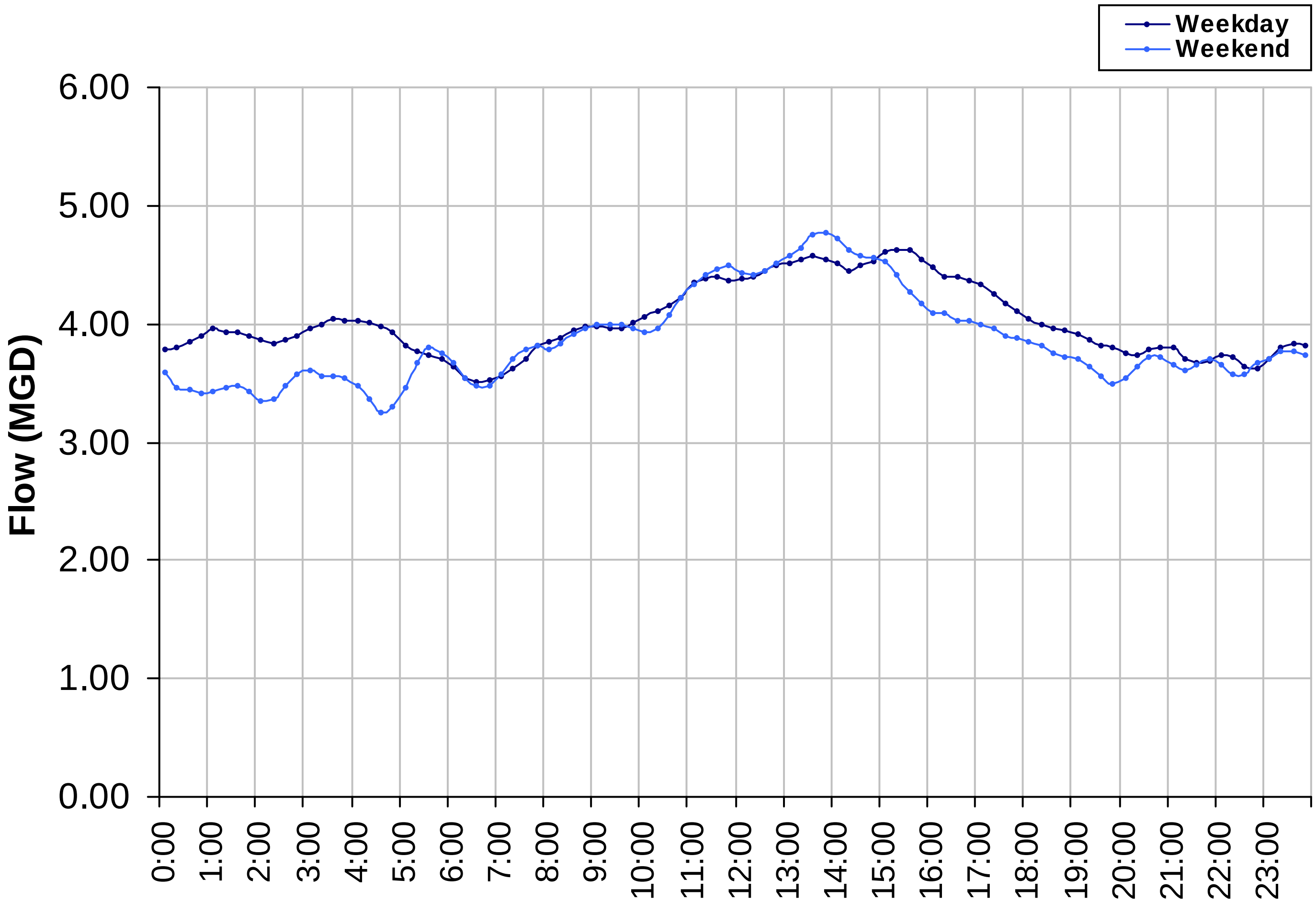


V&A

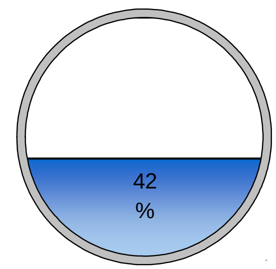
City of Tulare CALIFORNIA

Average Dry Weather Flow

Monitoring Site:
Site 2

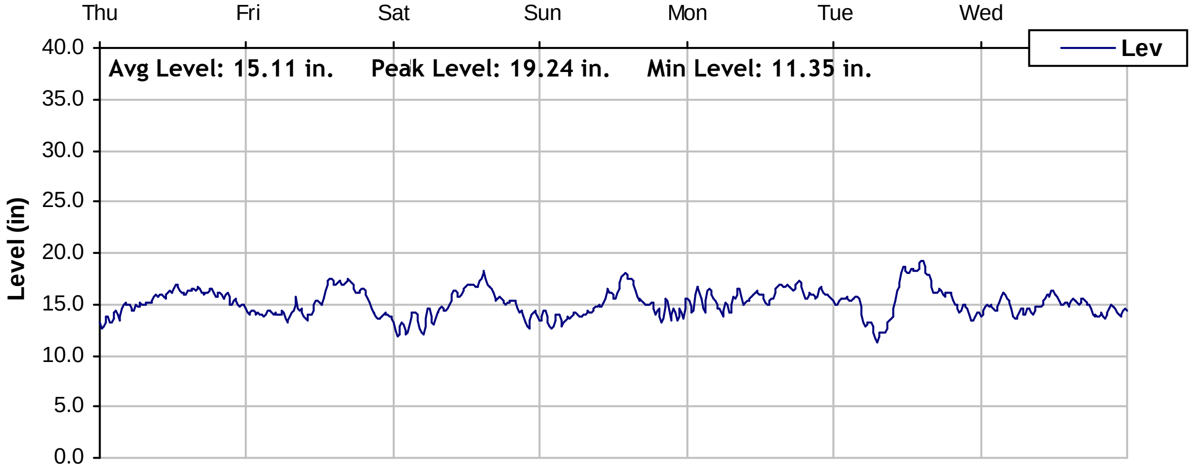


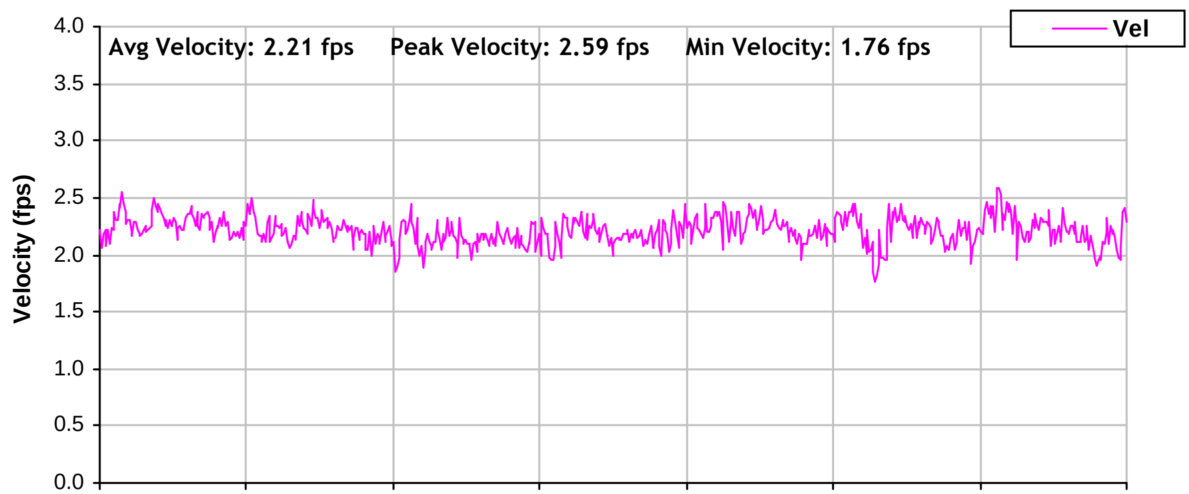
Average Dry Weather Flow:
3.98 *MGD*

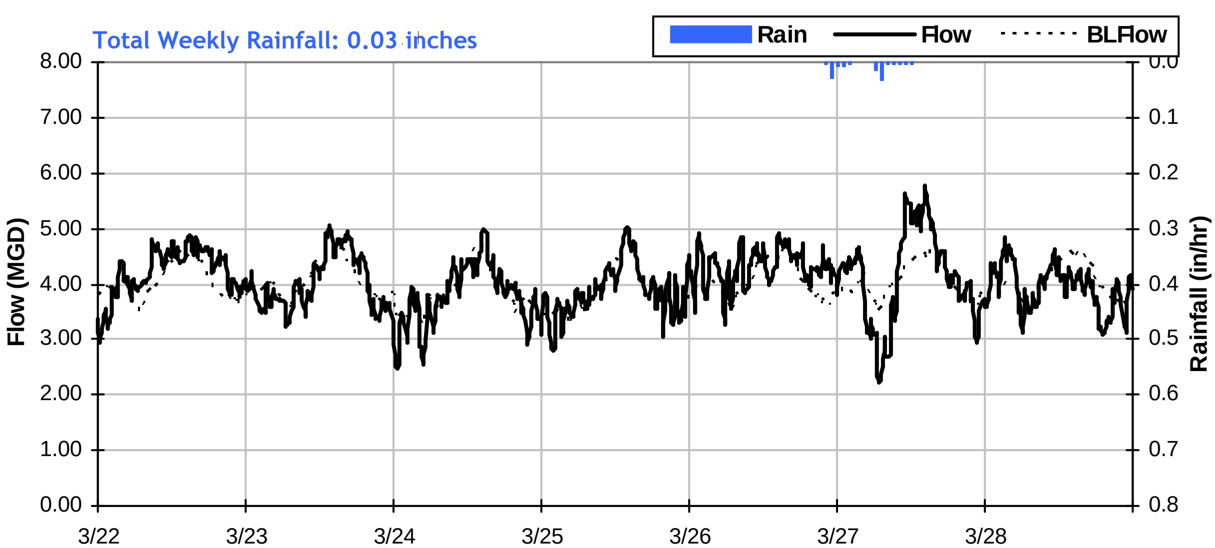


V&A

City of Tulare CALIFORNIA	**Level, Velocity and Flow** From 3/22/2007 to 3/29/2007	**Monitoring Site:** Site 2



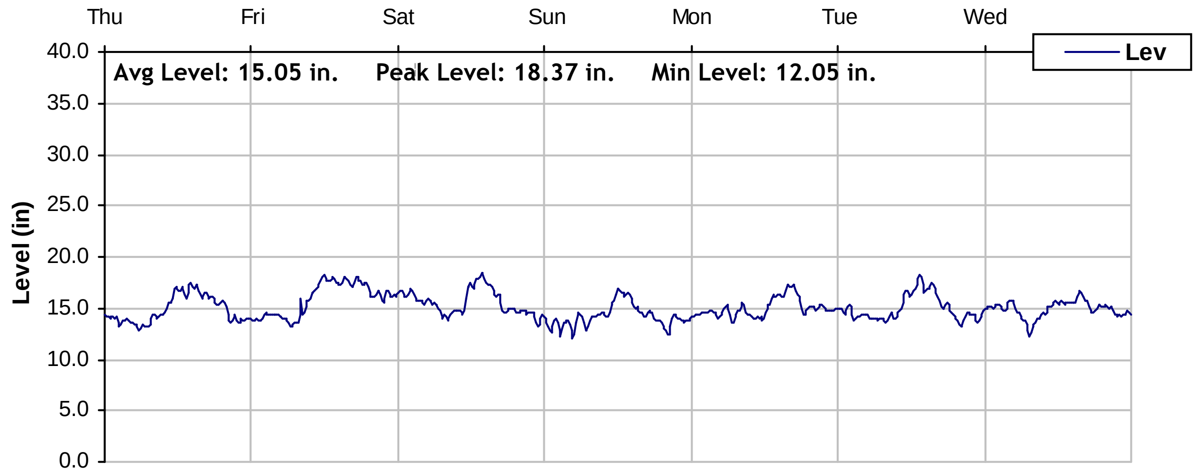


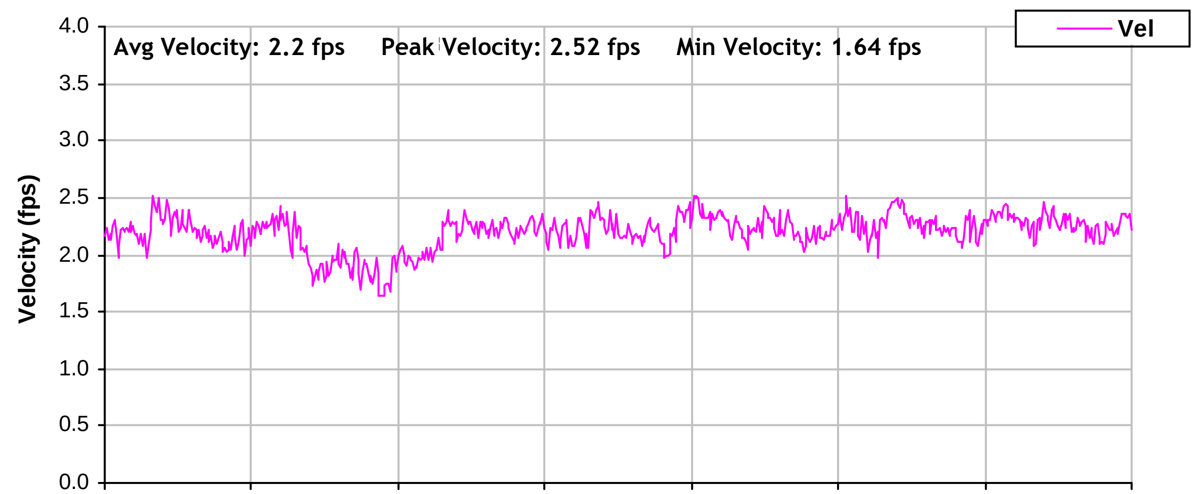


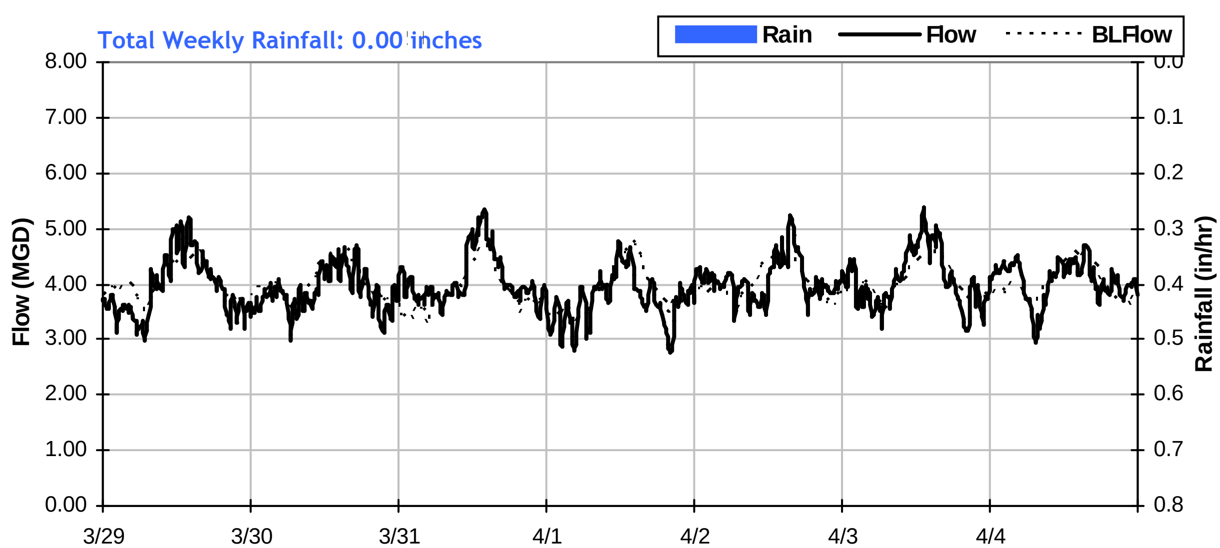
Avg Flow: 4.04 MGD **Peak Flow: 5.76 MGD** **Min Flow: 2.24 MGD**

V&A

City of Tulare CALIFORNIA	**Level, Velocity and Flow** From 3/29/2007 to 4/5/2007	**Monitoring Site:** Site 2







Avg Flow: 3.97 MGD **Peak Flow: 5.38 MGD** **Min Flow: 2.77 MGD**

V&A

Temporary Flow Monitoring Study

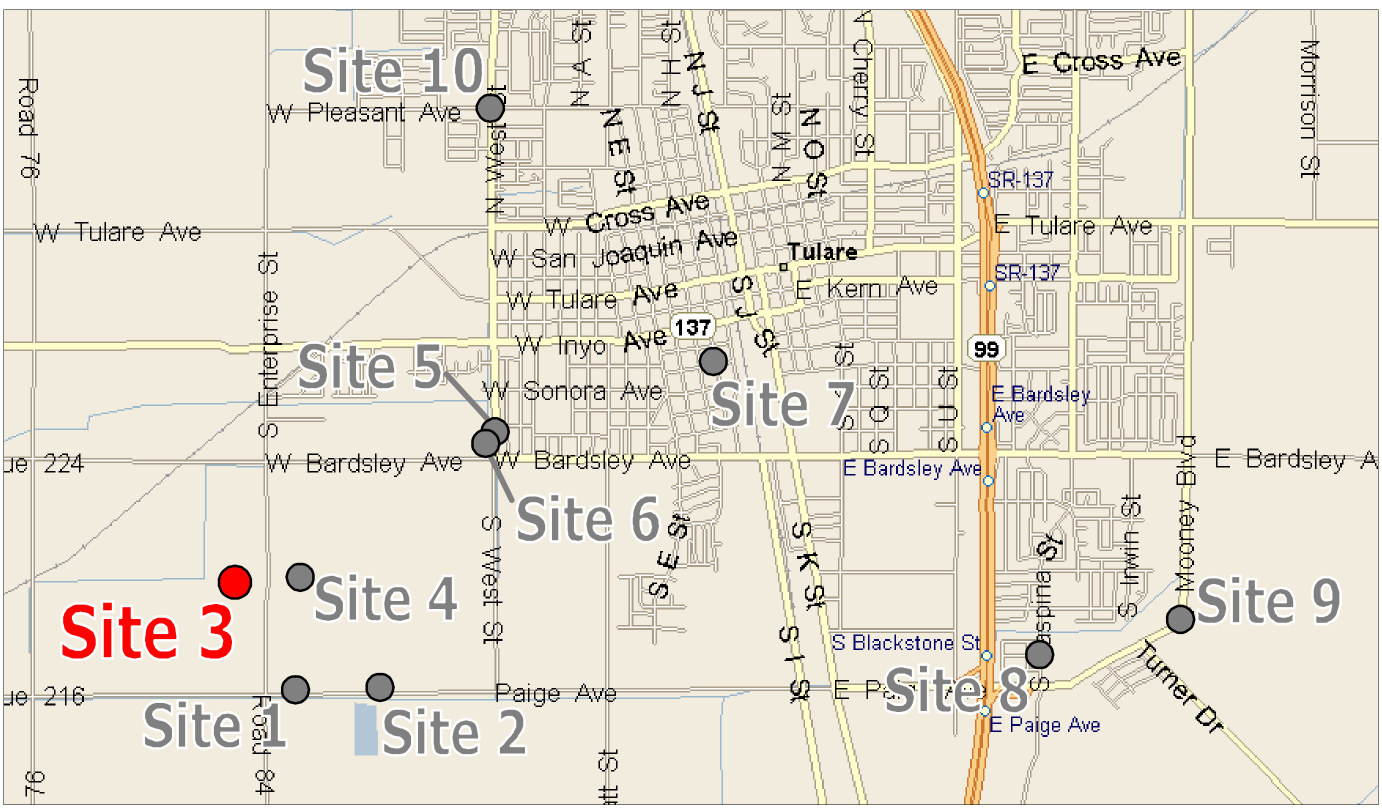
Sanitary Sewer Collection System

Monitoring Site: Site 3

Manhole Address: Service Road, east of South Enterprise Street

Size/Type of Line: 30-inch Sanitary Sewer Pipe

Data Summary Report



City of Tulare CALIFORNIA	**Site Information Report**	**Monitoring Site:** Site 3

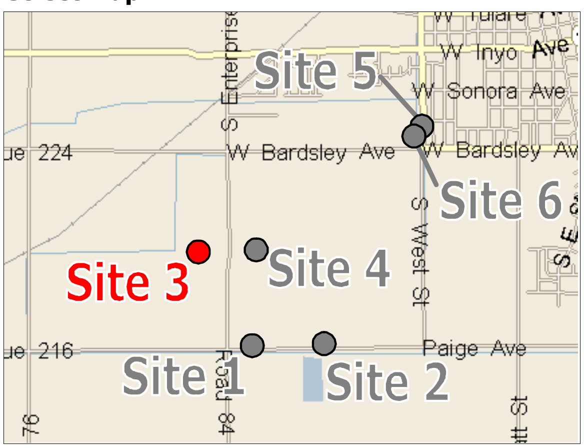
Location: Service Road, east of South Enterprise Street

Diameter: 30 inches

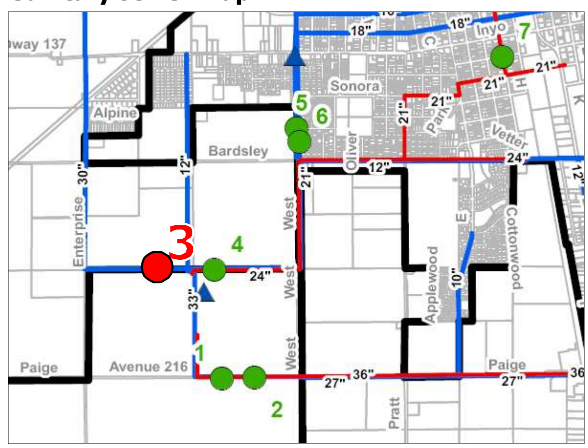
Average Dry Weather Flow: 0.347 *MGD*

Peak Measured Flow: 0.722 *MGD*

Street map:



Sanitary sewer map:

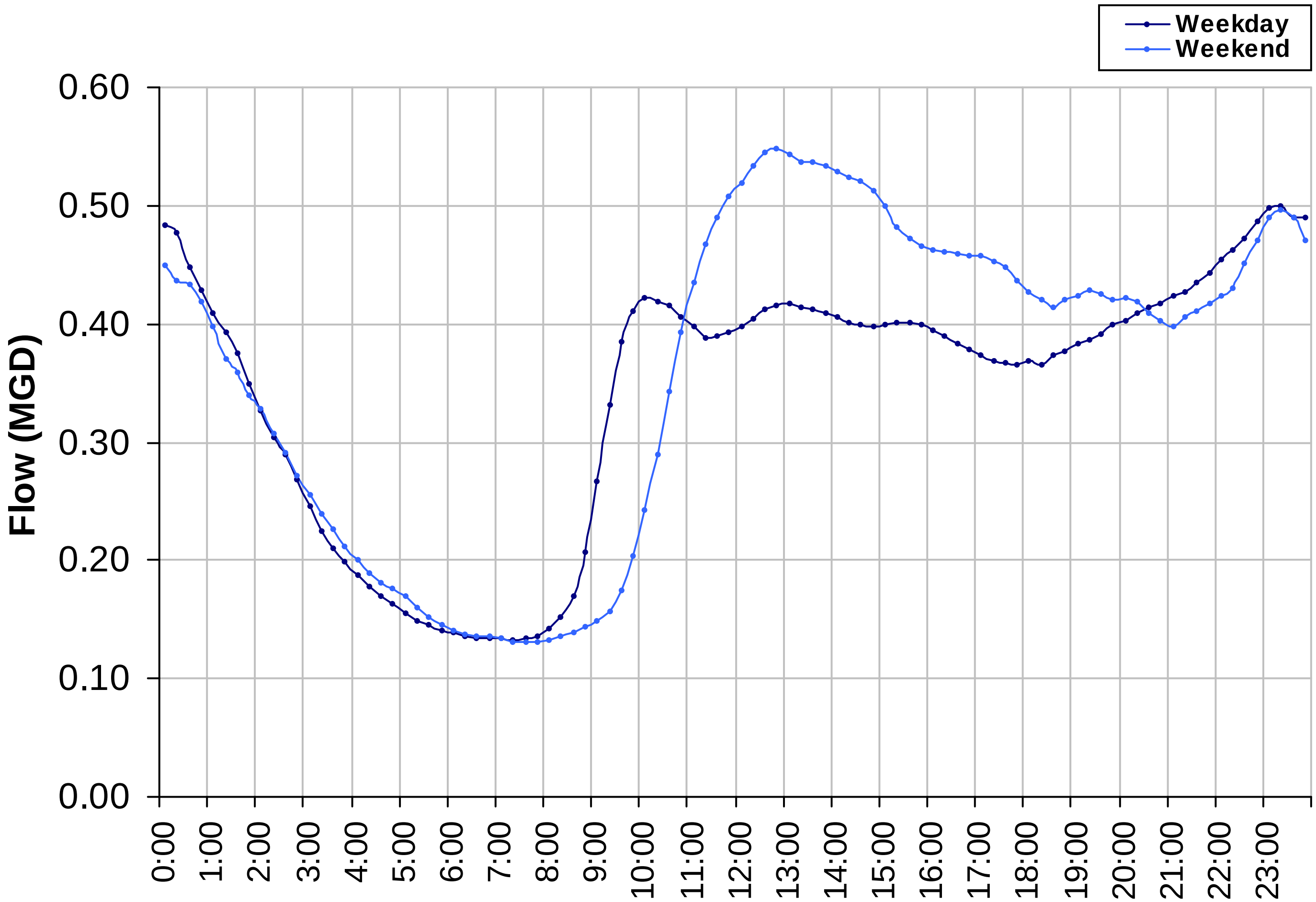


Street-level photo:

Plan view photo:

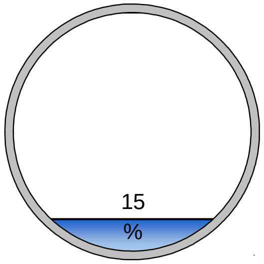
V&A

City of Tulare California	Average Dry Weather Flow	Monitoring Site: Site 3



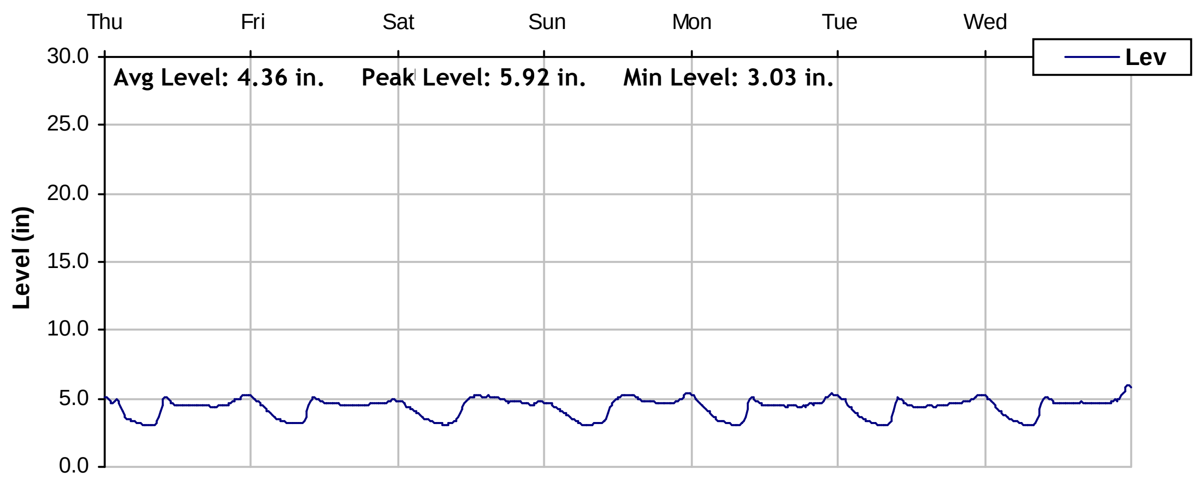
Average Dry Weather Flow:

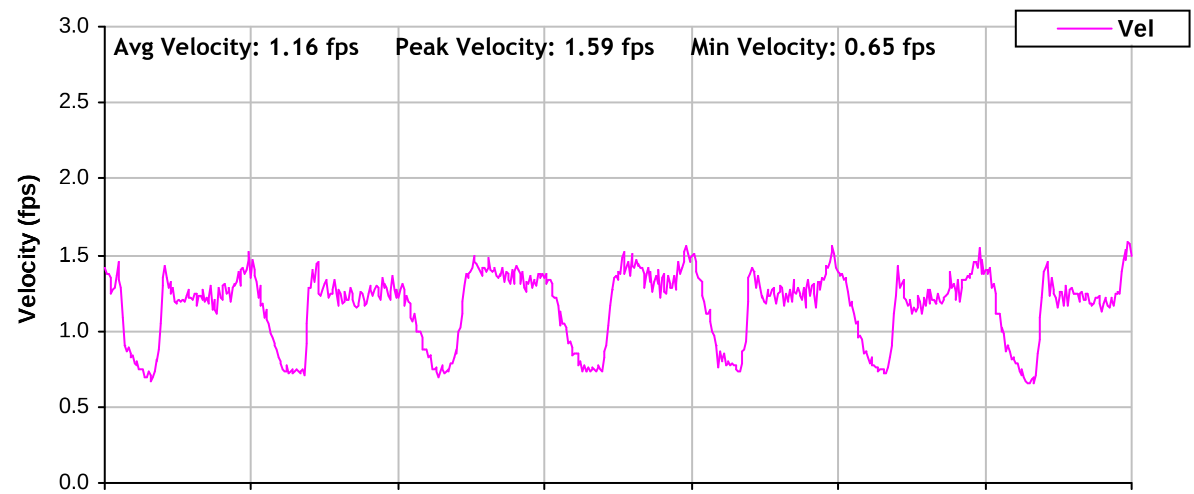
0.35 *MGD*

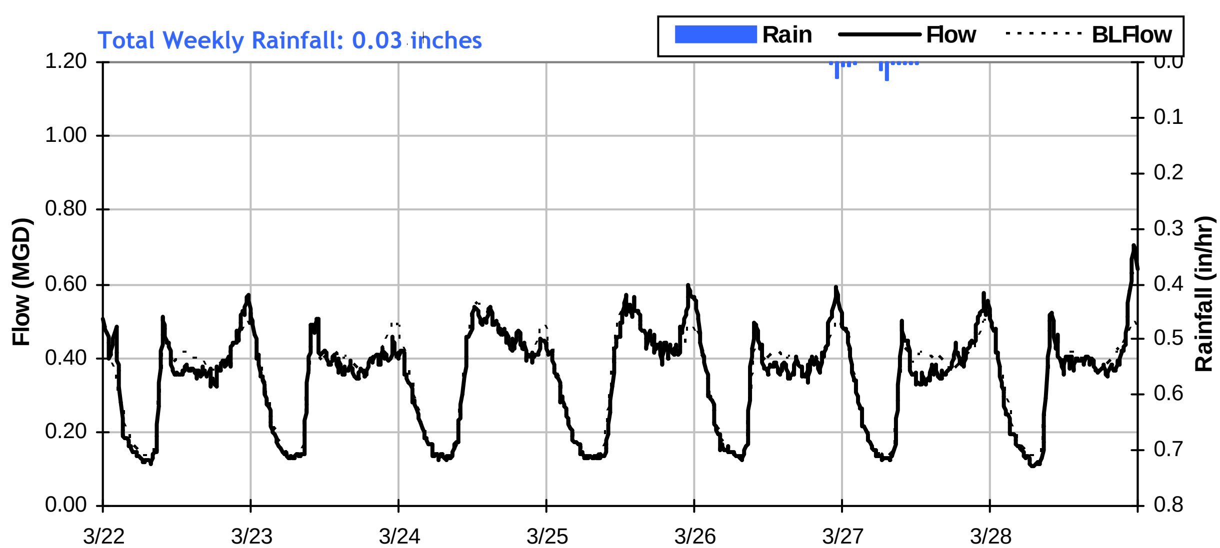


V&A

City of Tulare CALIFORNIA	**Level, Velocity and Flow** From 3/22/2007 to 3/29/2007	**Monitoring Site:** Site 3



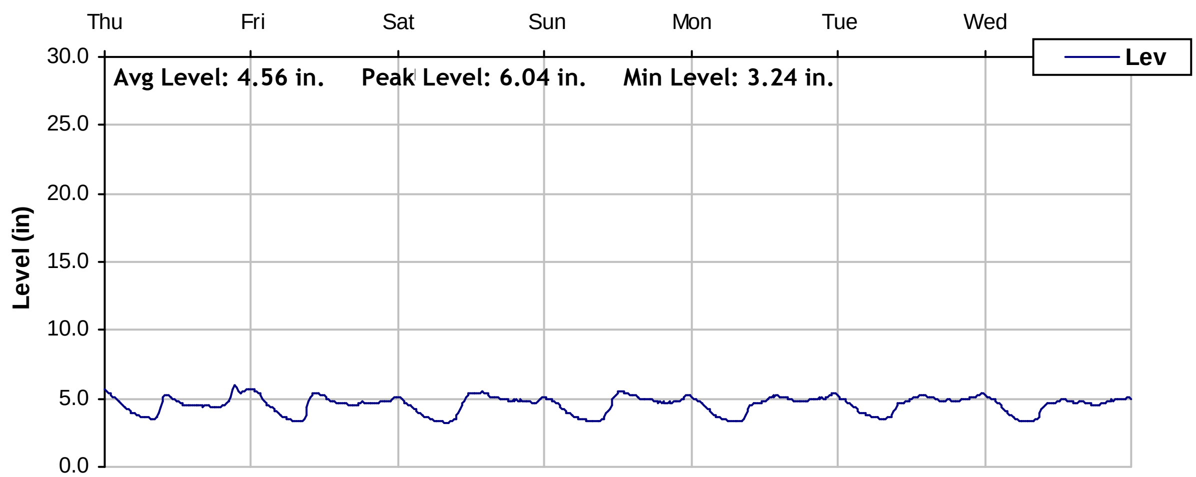


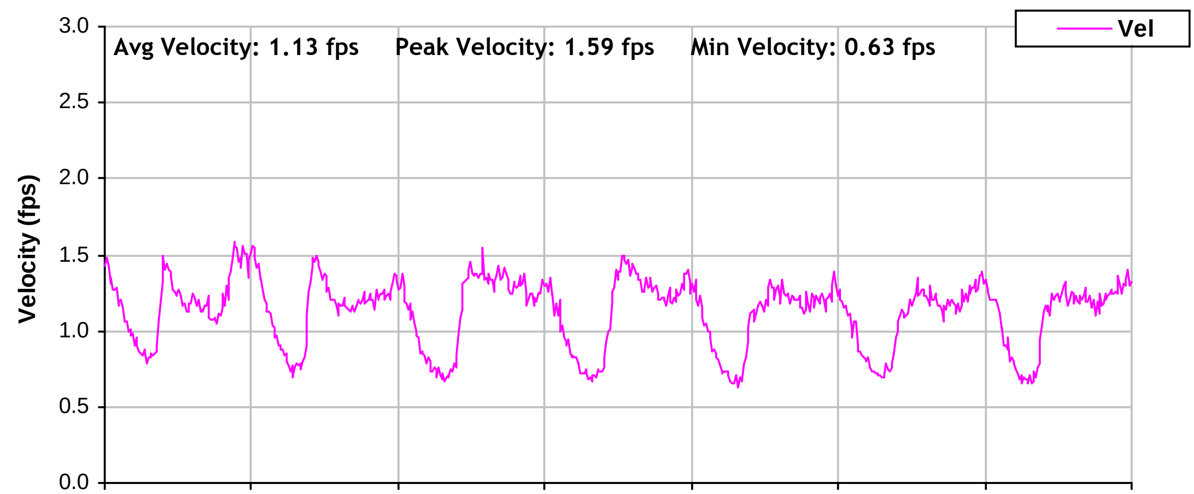


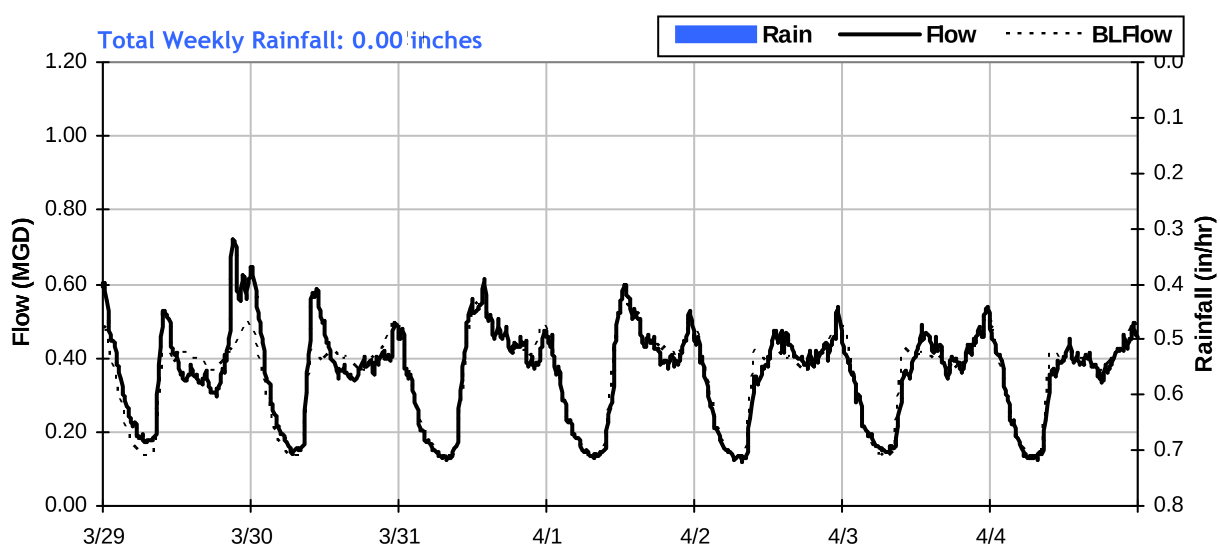
Avg Flow: 0.35 MGD Peak Flow: 0.71 MGD Min Flow: 0.11 MGD

V&A

City of Tulare CALIFORNIA	**Level, Velocity and Flow** From 3/29/2007 to 4/5/2007	**Monitoring Site:** Site 3







Avg Flow: 0.36 MGD Peak Flow: 0.72 MGD Min Flow: 0.12 MGD

V&A

Temporary Flow Monitoring Study

Sanitary Sewer Collection System

Monitoring Site: Site 4

Manhole Address: Service Road, east of South Enterprise Street

Size/Type of Line: 15-inch Sanitary Sewer Pipe

Data Summary Report

City of Tulare CALIFORNIA	**Site Information Report**	**Monitoring Site:** Site 4

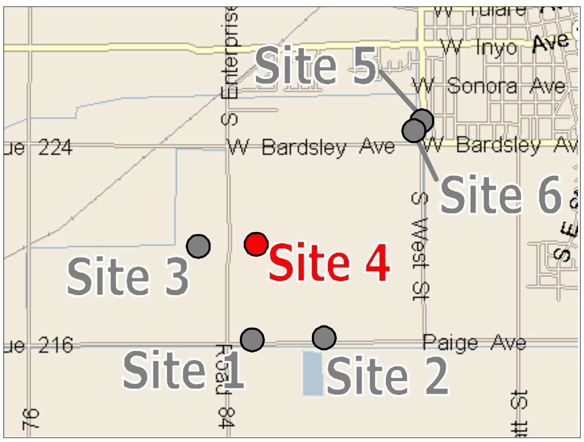
Location: Service Road, east of South Enterprise Street

Diameter: 15 inches

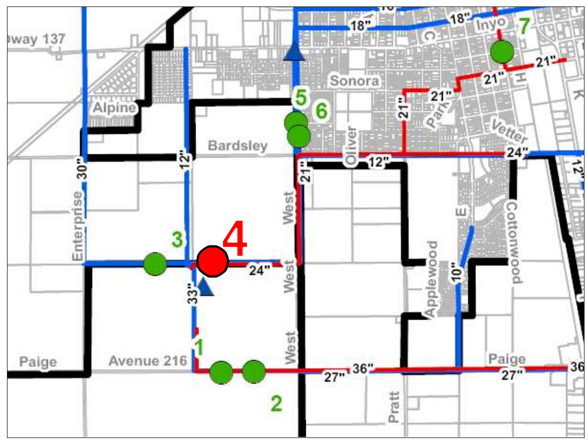
Average Dry Weather Flow: 0.502 *MGD*

Peak Measured Flow: 0.794 *MGD*

Street map:



Sanitary sewer map:



Street-level photo:

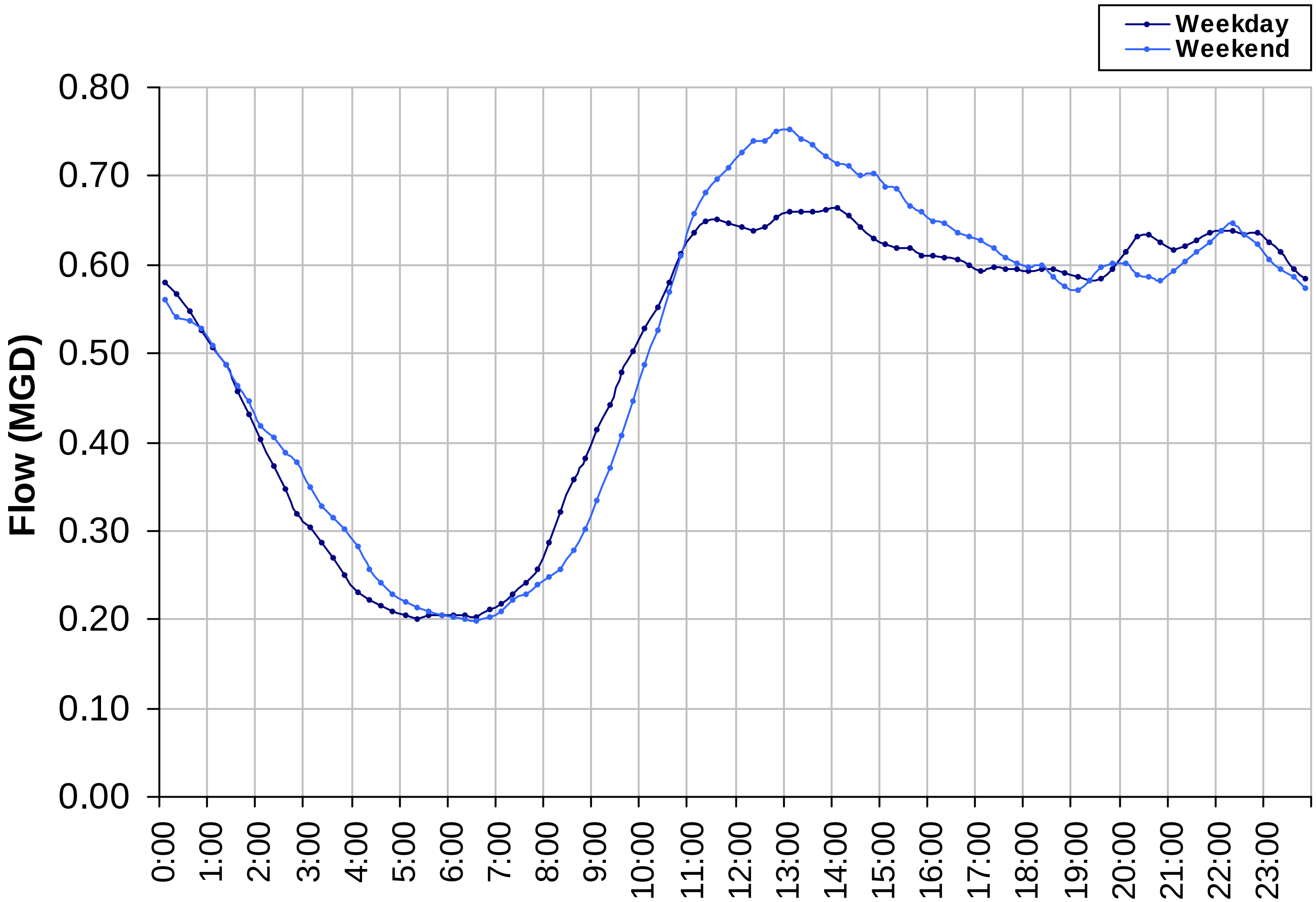
Plan view photo:

V&A

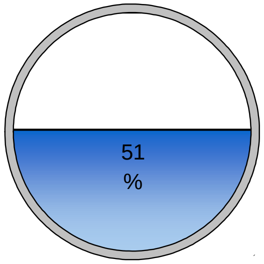
City of Tulare CALIFORNIA

Average Dry Weather Flow

Monitoring Site:
Site 4

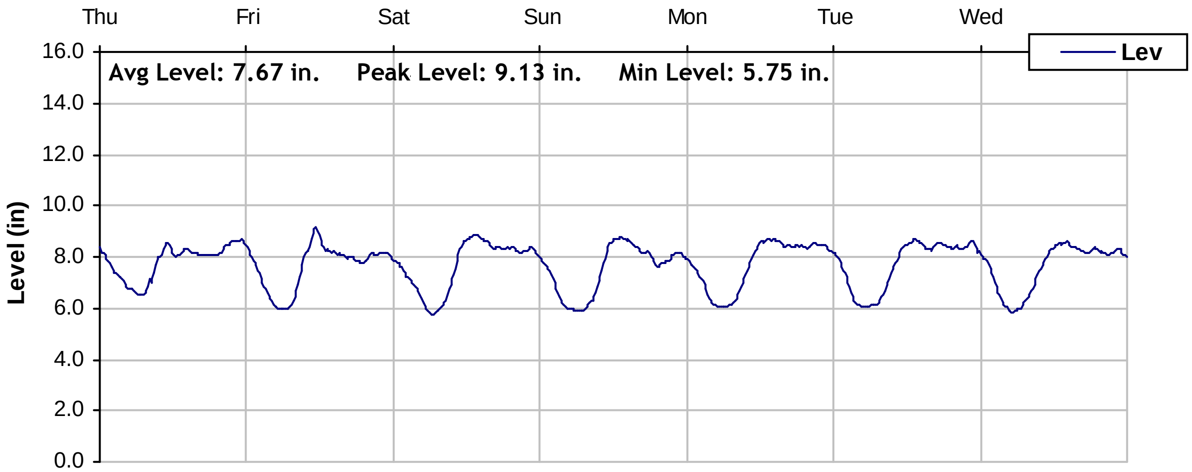


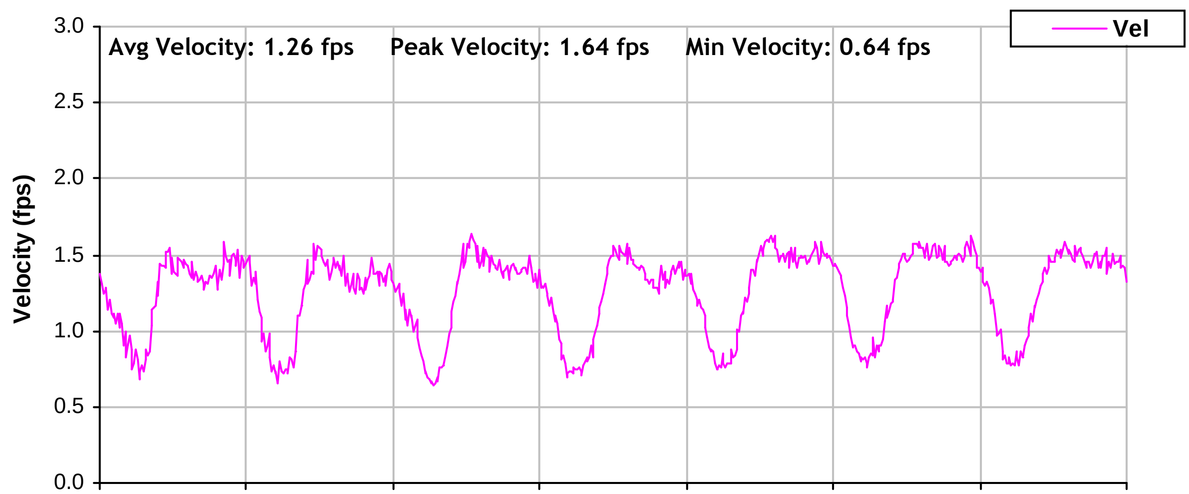
Average Dry Weather Flow:
0.50 *MGD*

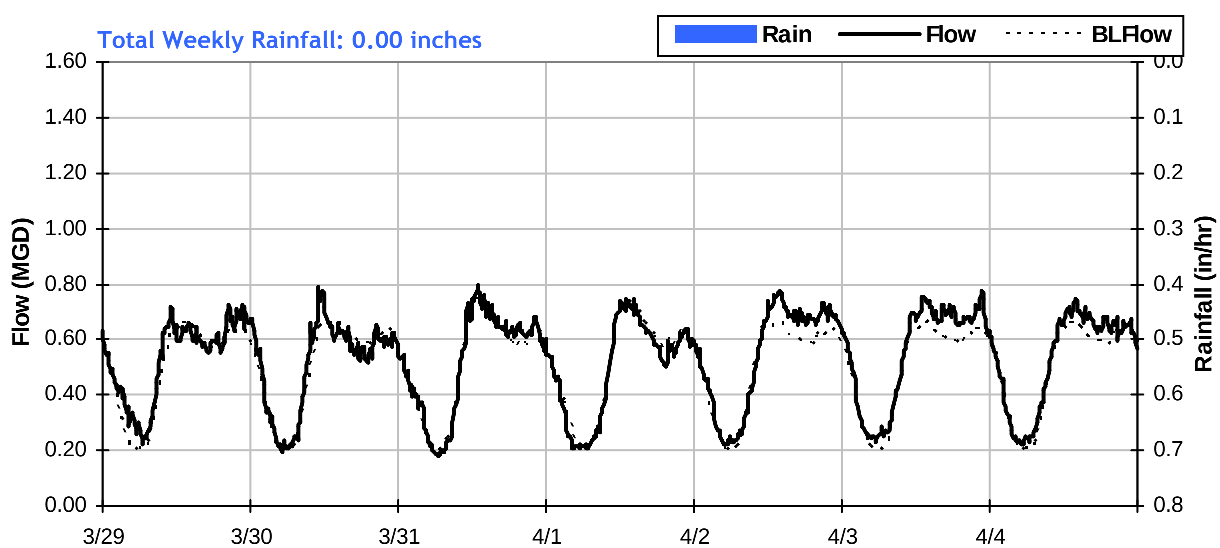


V&A

City of Tulare California	**Level, Velocity and Flow** From 3/29/2007 to 4/5/2007	**Monitoring Site:** Site 4







Avg Flow: 0.53 MGD **Peak Flow: 0.79 MGD** **Min Flow: 0.18 MGD**

V&A

Temporary Flow Monitoring Study

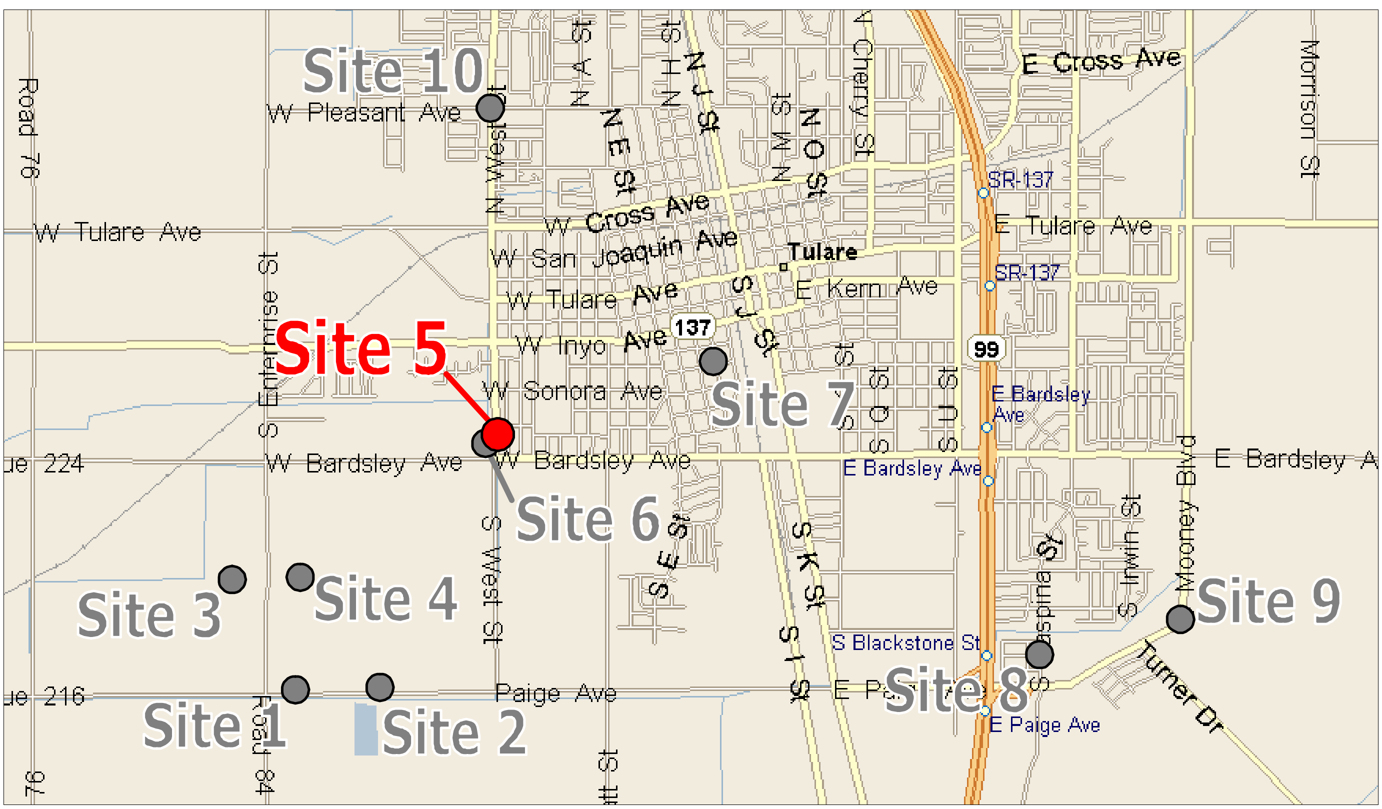
Sanitary Sewer Collection System

Monitoring Site: Site 5

Manhole Address: West of South West Road, north of Bardsley Avenue

Size/Type of Line: 16-inch Sanitary Sewer Pipe

Data Summary Report



City of Tulare CALIFORNIA	**Site Information Report**	**Monitoring Site:** Site 5

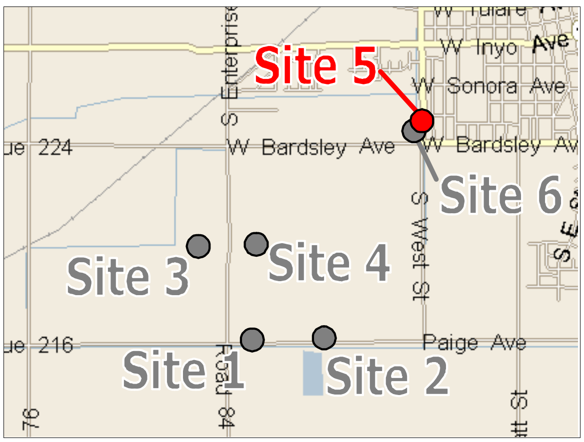
Location: West of South West Road, north of Bardsley Avenue

Diameter: 16 inches

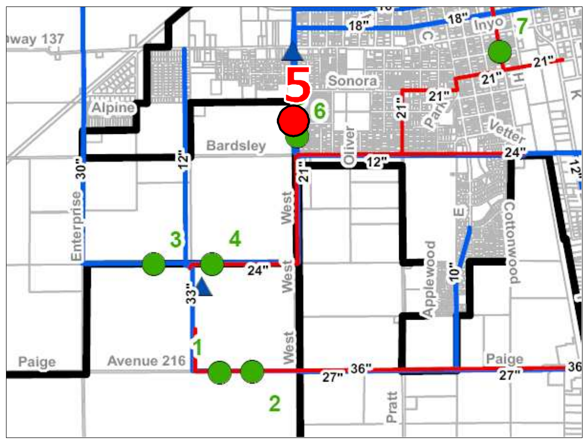
Average Dry Weather Flow: 1.551 *MGD*

Peak Measured Flow: 2.049 *MGD*

Street map:



Sanitary sewer map:



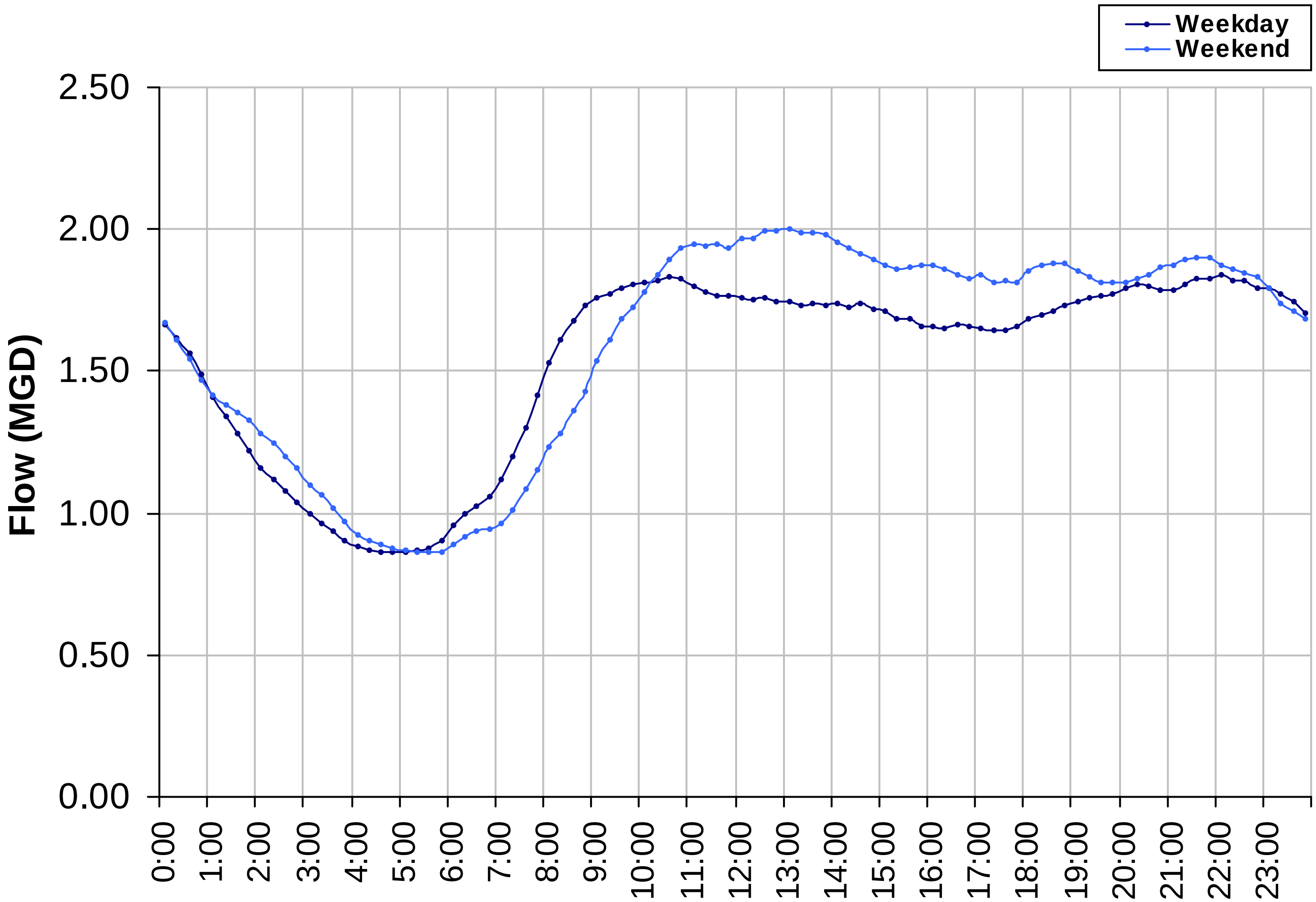
Street-level photo:

Plan view photo:

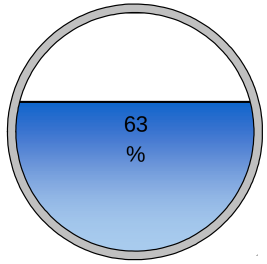
City of Tulare CALIFORNIA

Average Dry Weather Flow

Monitoring Site:
Site 5

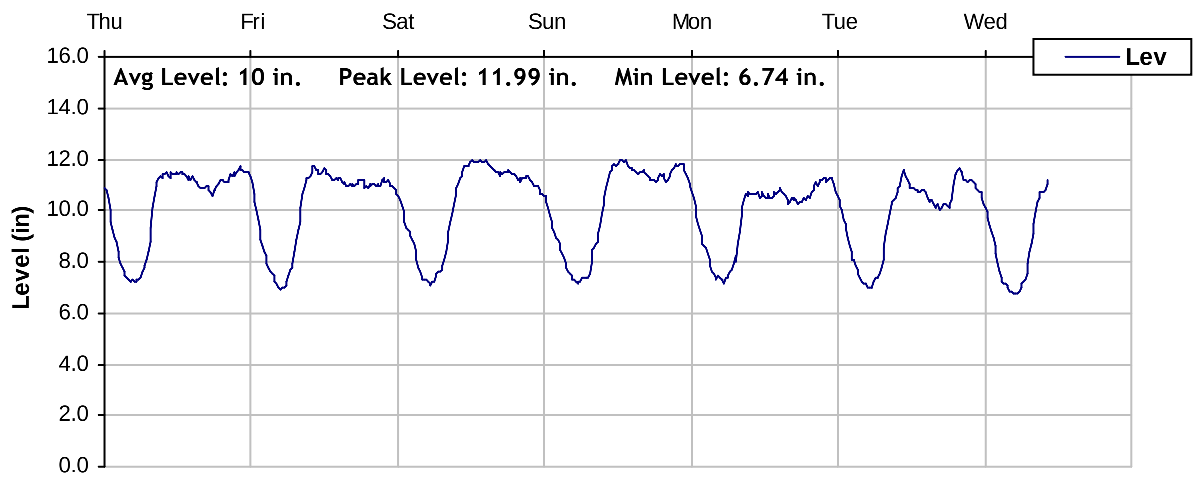


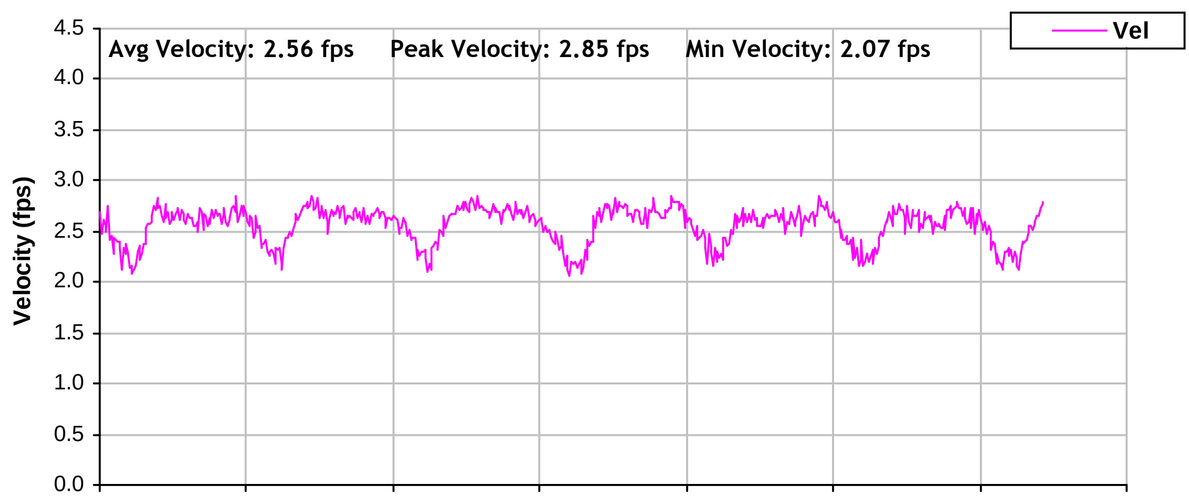
Average Dry Weather Flow:
1.55 *MGD*

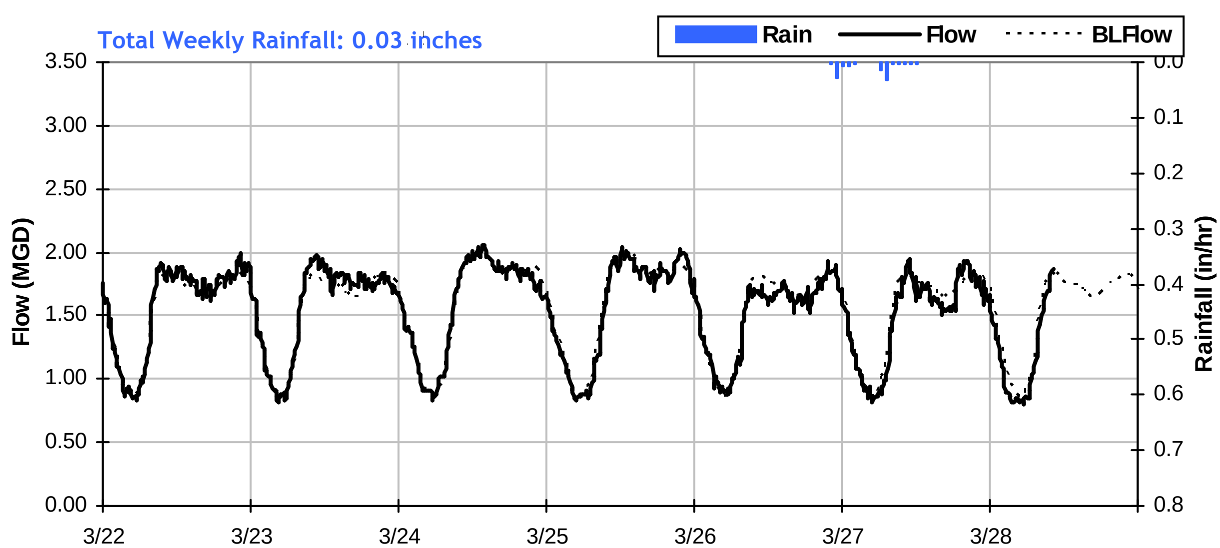


V&A

	Level, Velocity and Flow From 3/22/2007 to 3/29/2007	Monitoring Site: Site 5







Avg Flow: 1.53 MGD **Peak Flow: 2.05 MGD** **Min Flow: 0.8 MGD**

Temporary Flow Monitoring Study

Sanitary Sewer Collection System

Monitoring Site: Site 6

Manhole Address: South West Road, north of Bardsley Avenue

Size/Type of Line: 21-inch Sanitary Sewer Pipe

Data Summary Report

City of Tulare CALIFORNIA

Site Information Report

Monitoring Site: Site 6

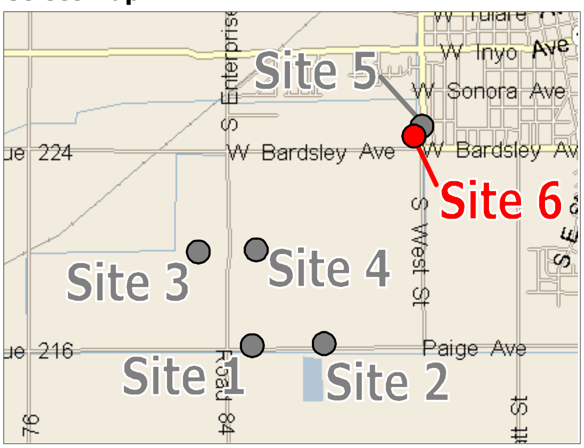
Location: South West Road, north of Bardsley Avenue

Diameter: 21 inches

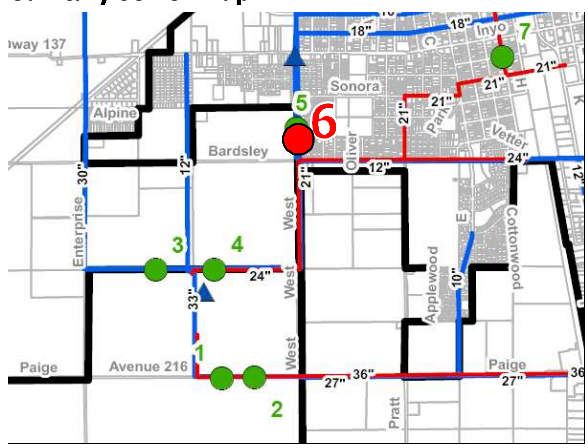
Average Dry Weather Flow: 0.651 *MGD*

Peak Measured Flow: 1.266 *MGD*

Street map:



Sanitary sewer map:



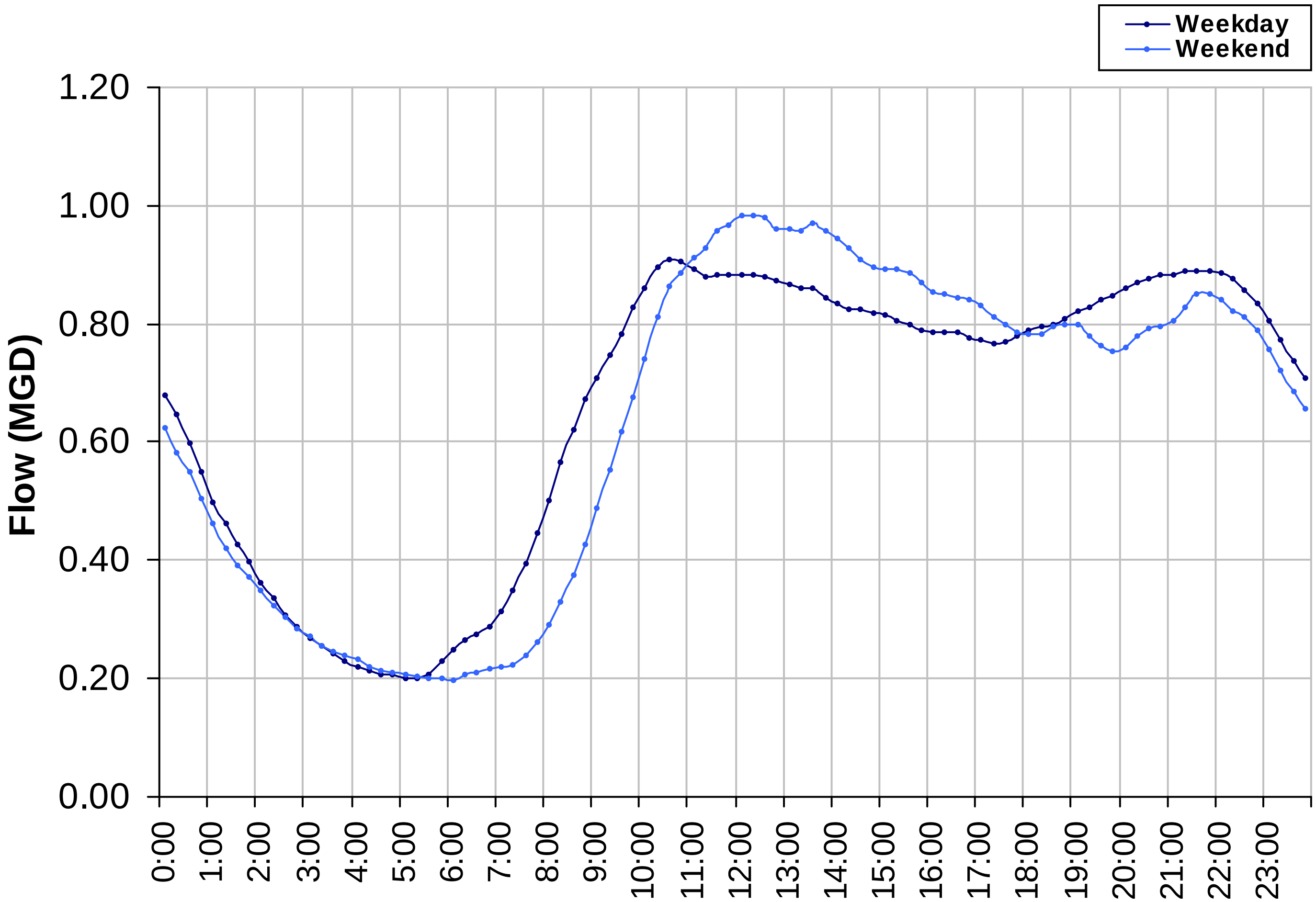
Street-level photo:

Plan view photo:

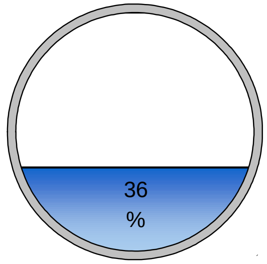
V&A

Average Dry Weather Flow

Monitoring Site:
Site 6



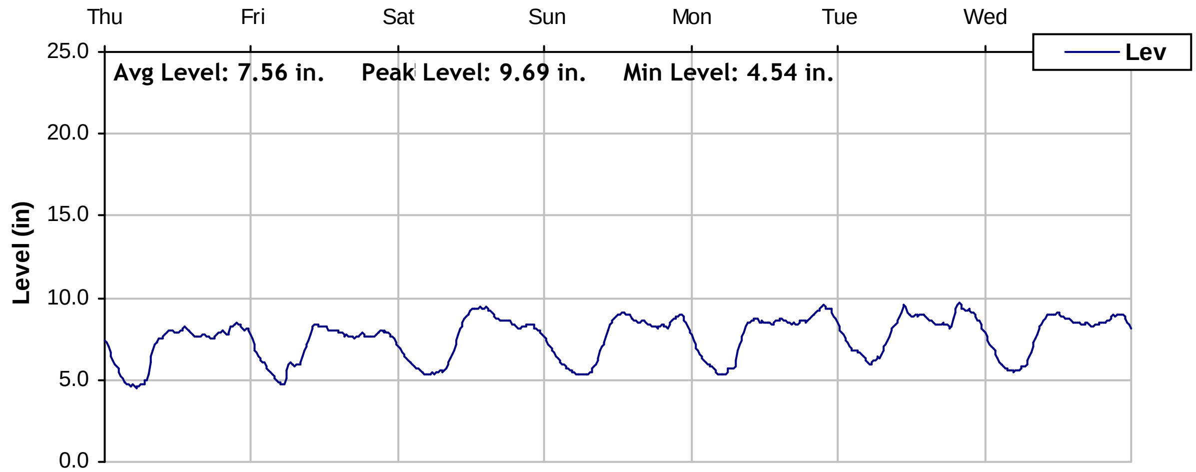
Average Dry Weather Flow:
0.65 *MGD*

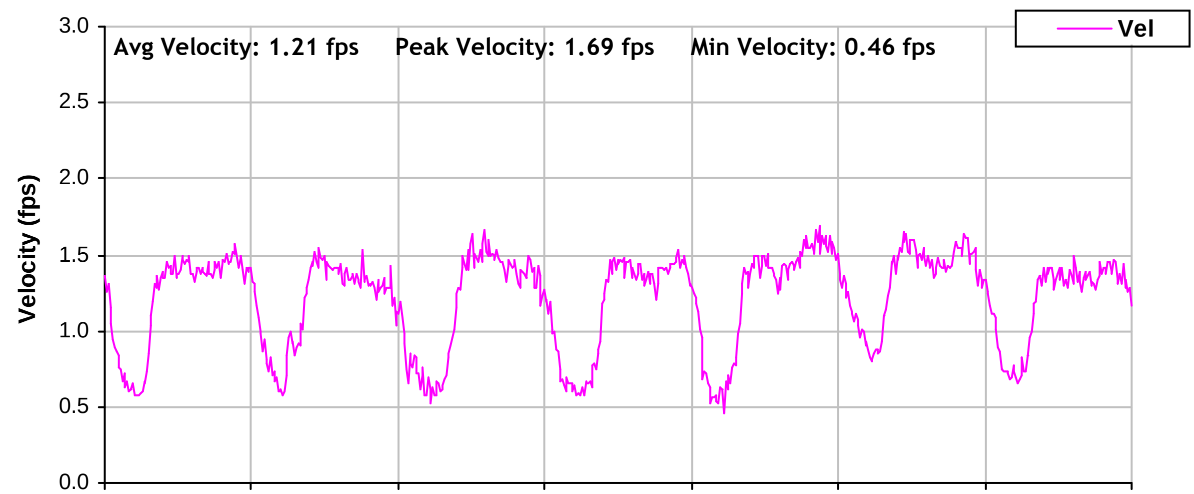


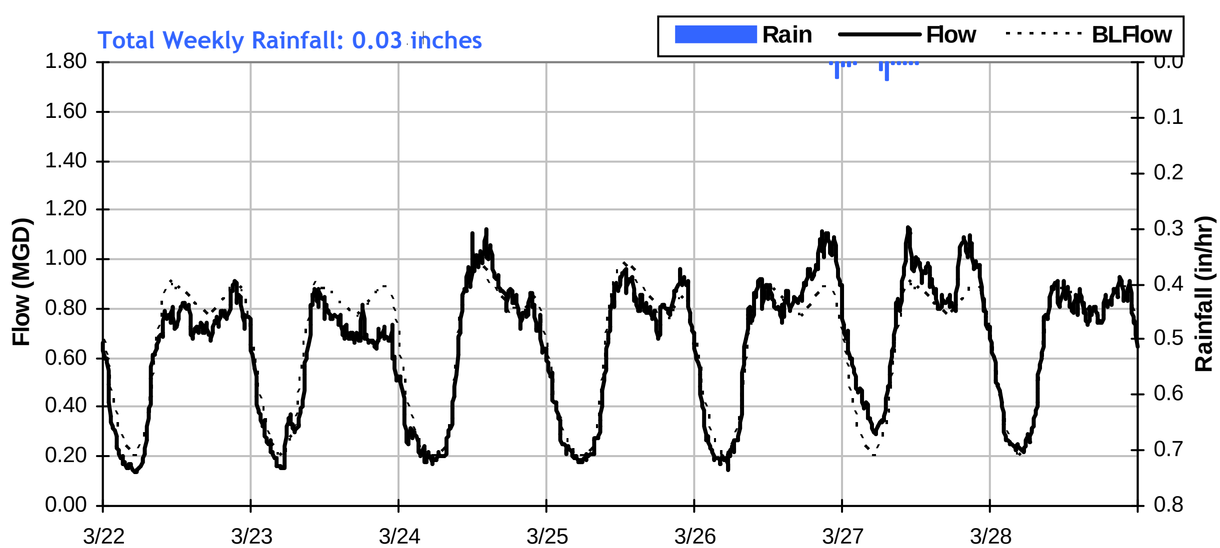
City of Tulare CALIFORNIA

Level, Velocity and Flow
From 3/22/2007 to 3/29/2007

Monitoring Site:
Site 6





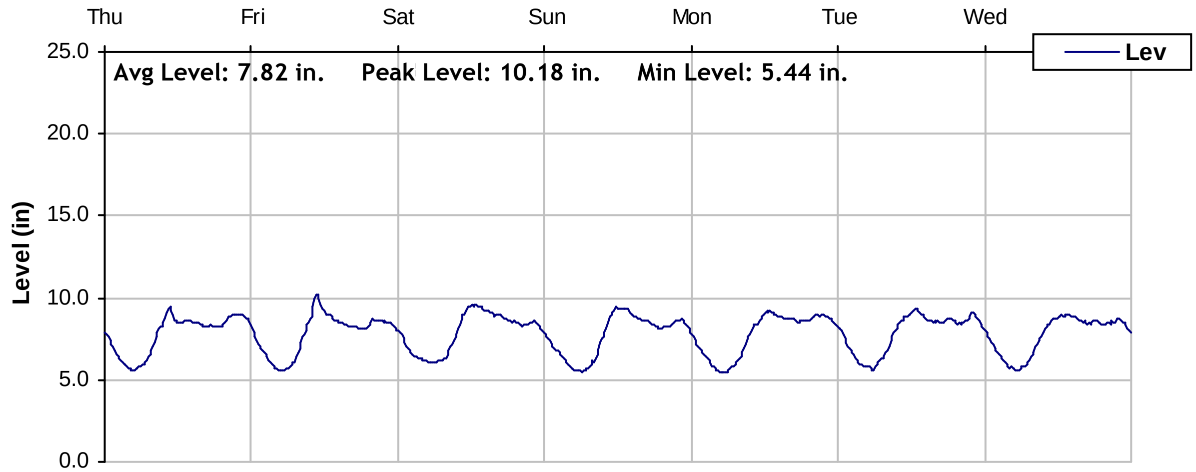


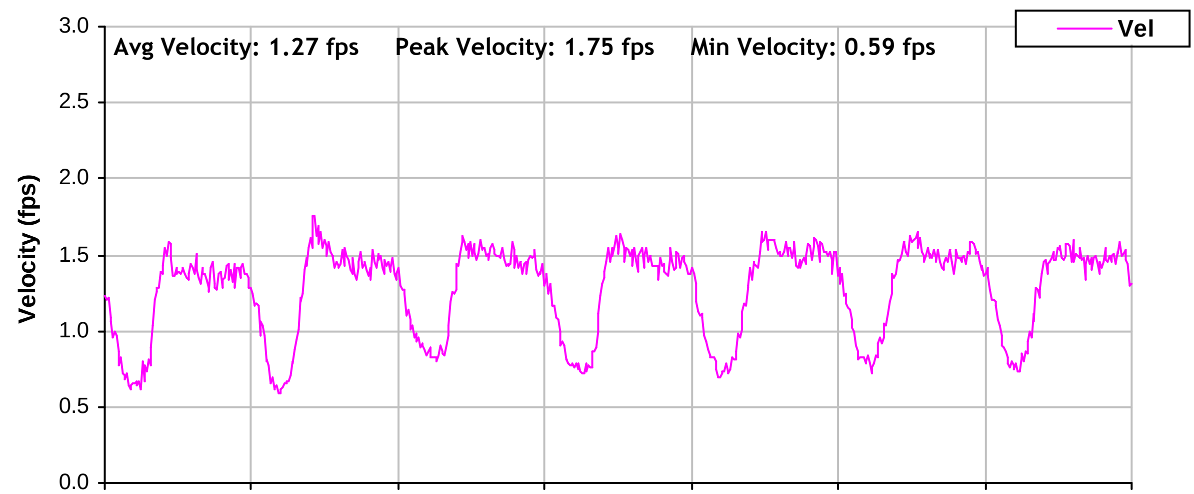
Avg Flow: 0.65 MGD **Peak Flow: 1.13 MGD** **Min Flow: 0.14 MGD**

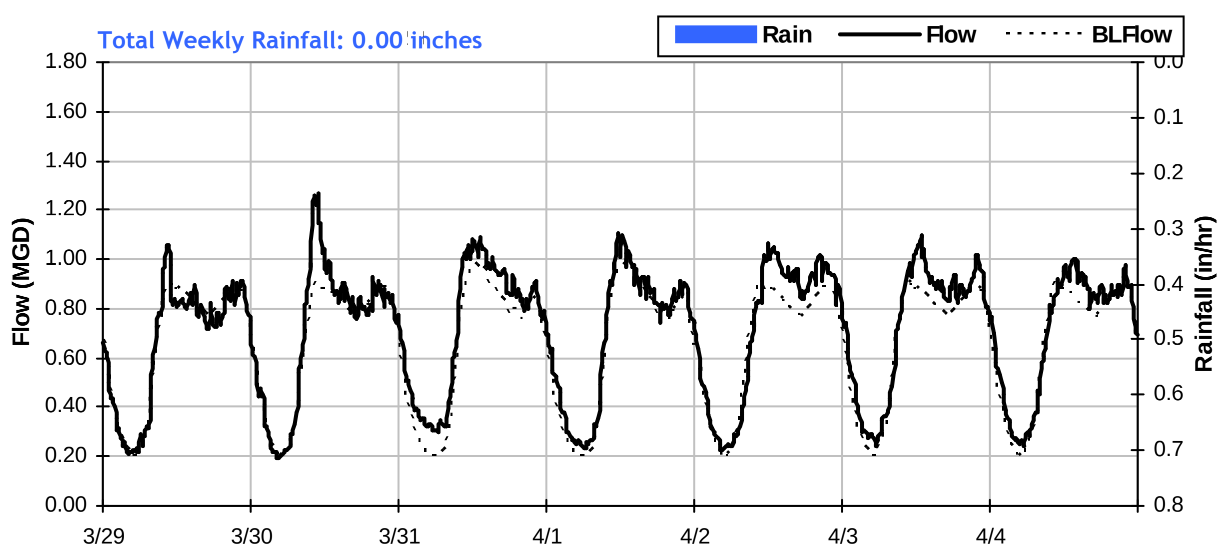
V&A

Level, Velocity and Flow
From 3/29/2007 to 4/5/2007

Monitoring Site:
Site 6







Avg Flow: 0.7 MGD Peak Flow: 1.27 MGD Min Flow: 0.19 MGD

Temporary Flow Monitoring Study

Sanitary Sewer Collection System

Monitoring Site: Site 7

Manhole Address: Intersection of South H Street and West Sonora Avenue

Size/Type of Line: 21-inch Sanitary Sewer Pipe

Data Summary Report

City of Tulare CALIFORNIA

Site Information Report

Monitoring Site: Site 7

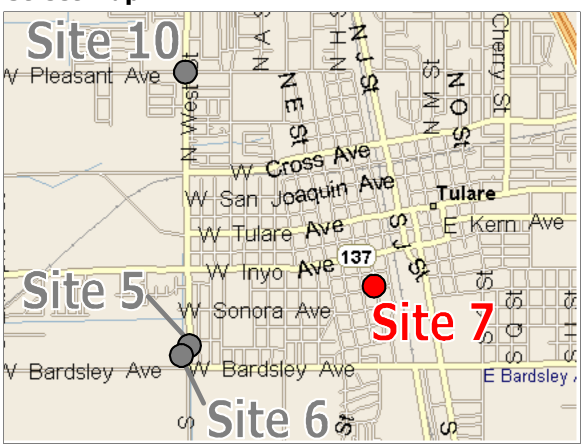
Location: Intersection of South H Street and West Sonora Avenue

Diameter: 21 inches

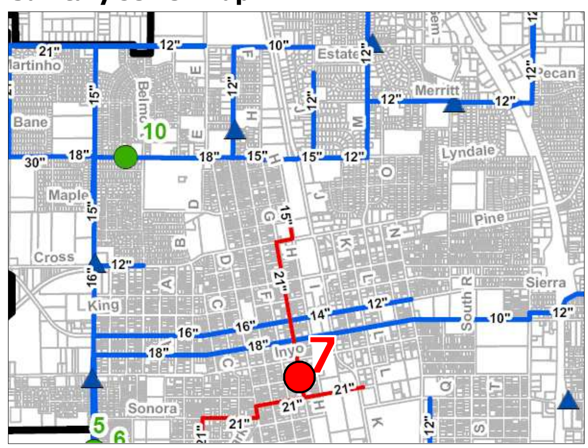
Average Dry Weather Flow: 0.479 *MGD*

Peak Measured Flow: 1.202 *MGD*

Street map:



Sanitary sewer map:

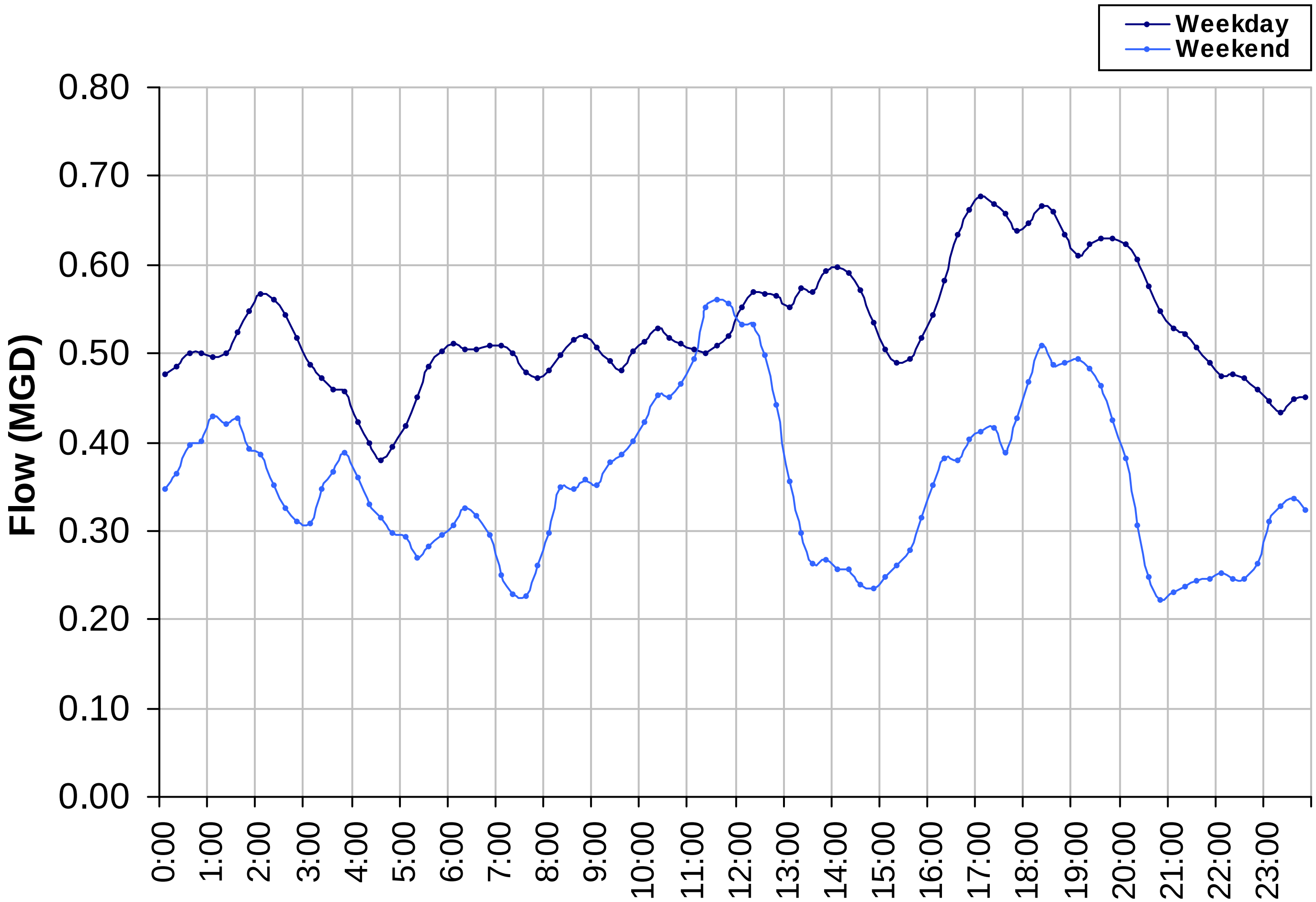


Street-level photo:

Plan view photo:

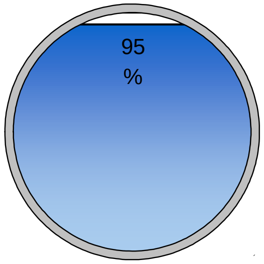
V&A

City of Tulare CALIFORNIA	**Average Dry Weather Flow**	**Monitoring Site:** Site 7



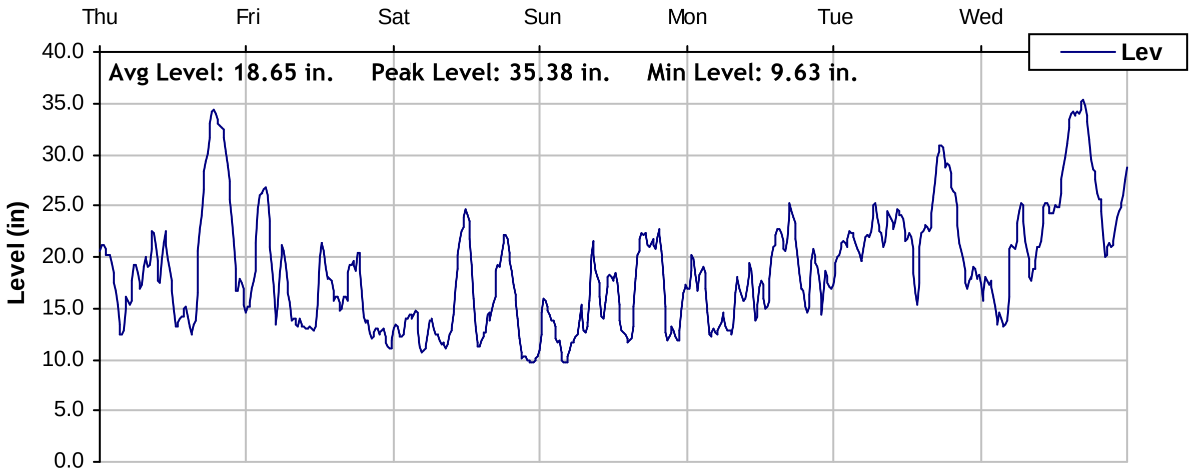
Average Dry Weather Flow:

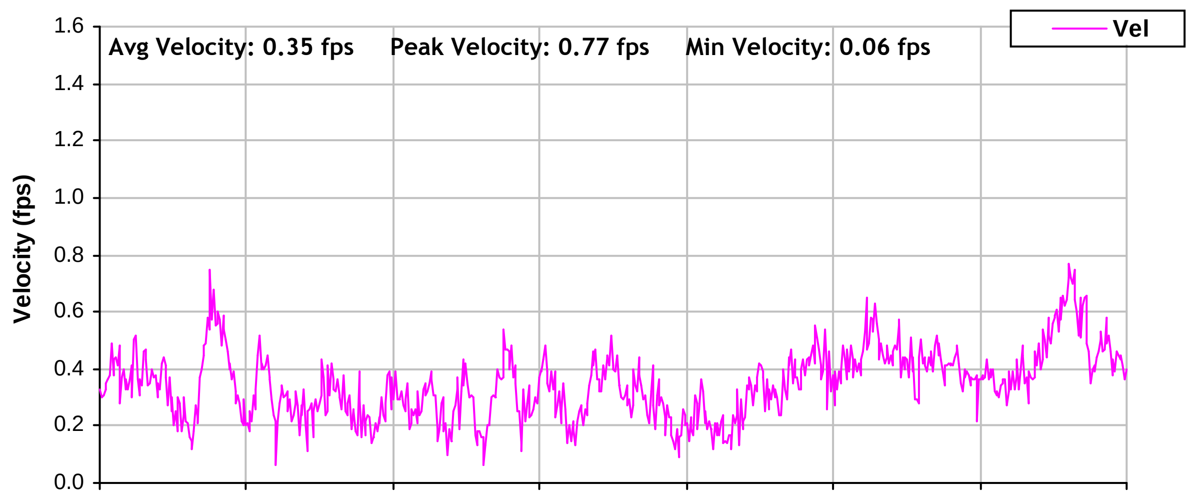
0.48 *MGD*

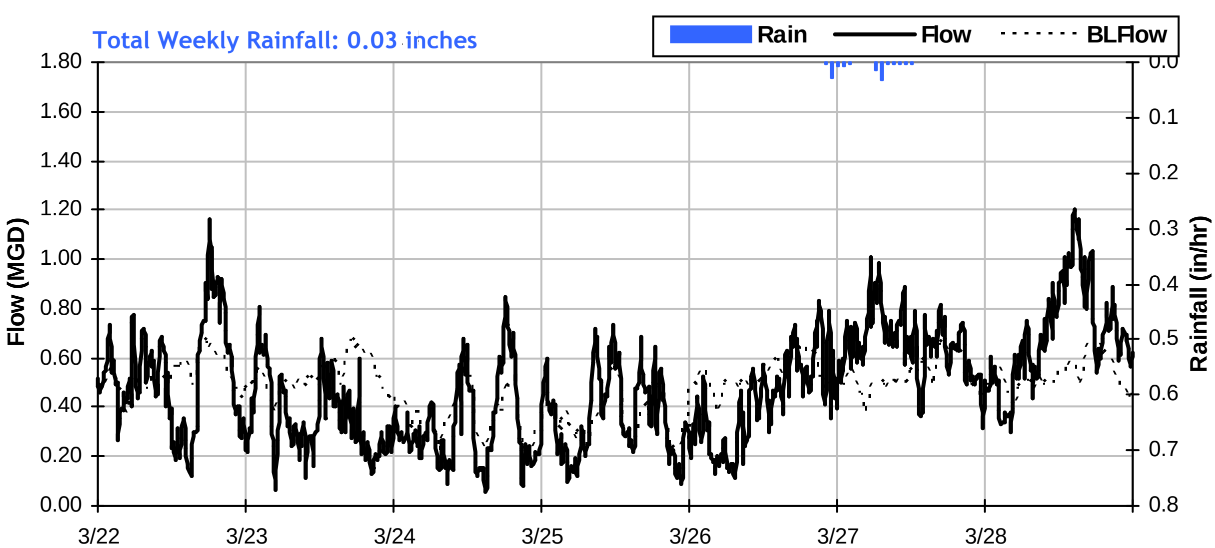


V&A

City of Tulare CALIFORNIA	**Level, Velocity and Flow** From 3/22/2007 to 3/29/2007	**Monitoring Site:** Site 7



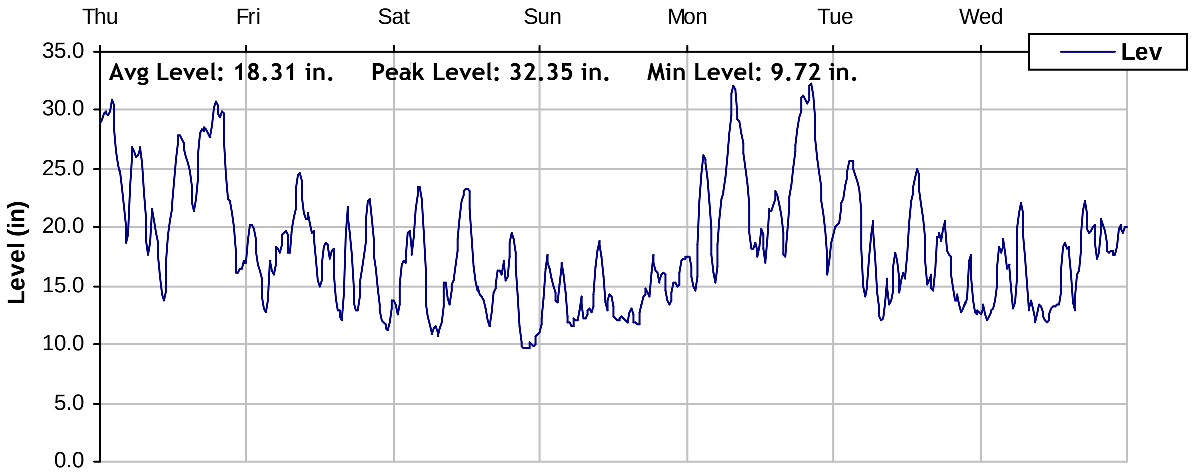


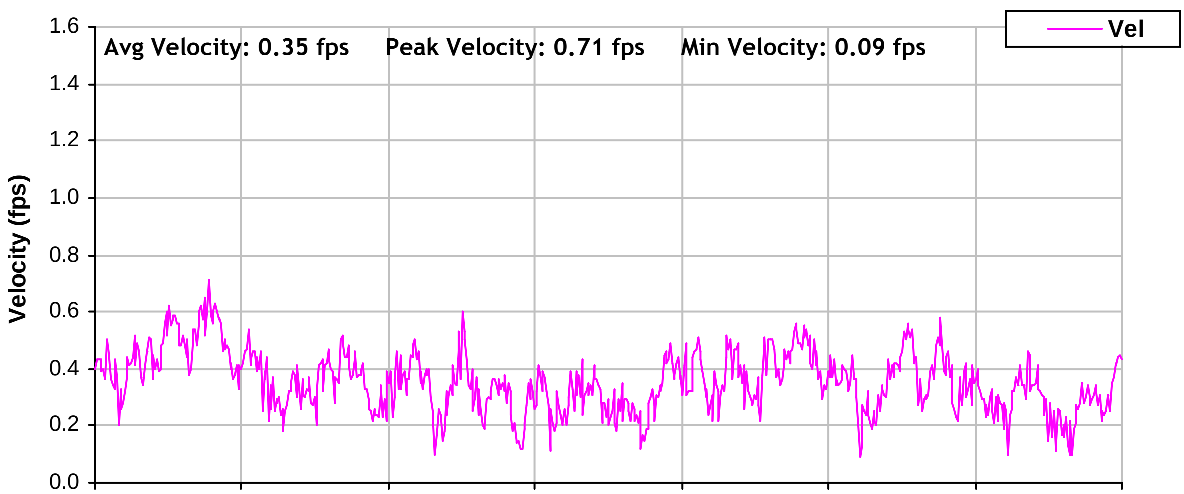


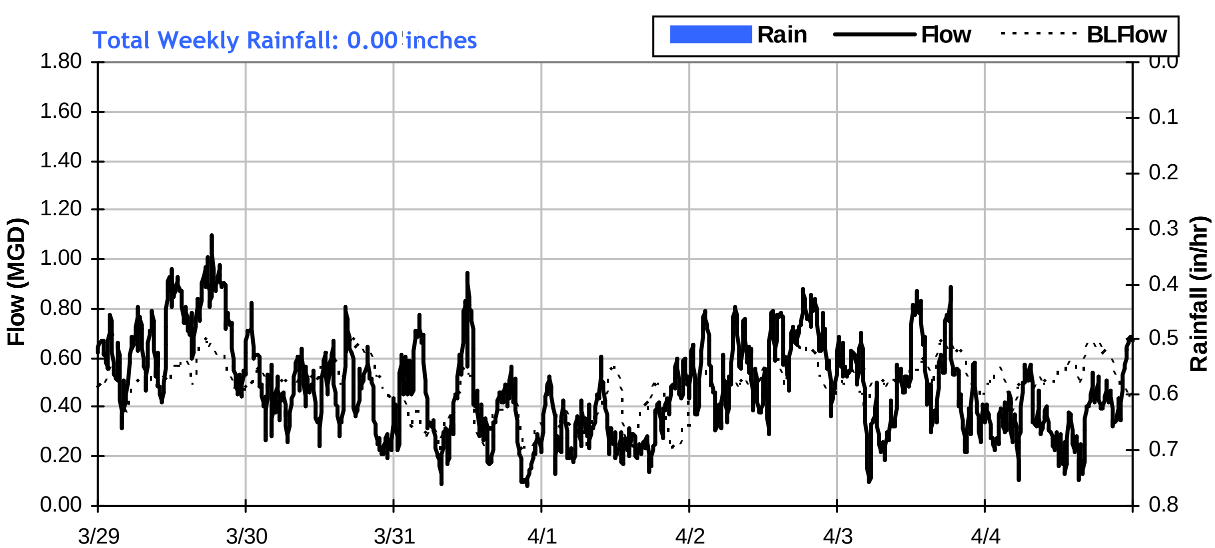
Avg Flow: 0.48 MGD **Peak Flow: 1.2 MGD** **Min Flow: 0.05 MGD**

V&A

City of Tulare CALIFORNIA	**Level, Velocity and Flow** From 3/29/2007 to 4/5/2007	**Monitoring Site:** Site 7







Avg Flow: 0.48 MGD **Peak Flow: 1.1 MGD** **Min Flow: 0.08 MGD**

V&A

Temporary Flow Monitoring Study

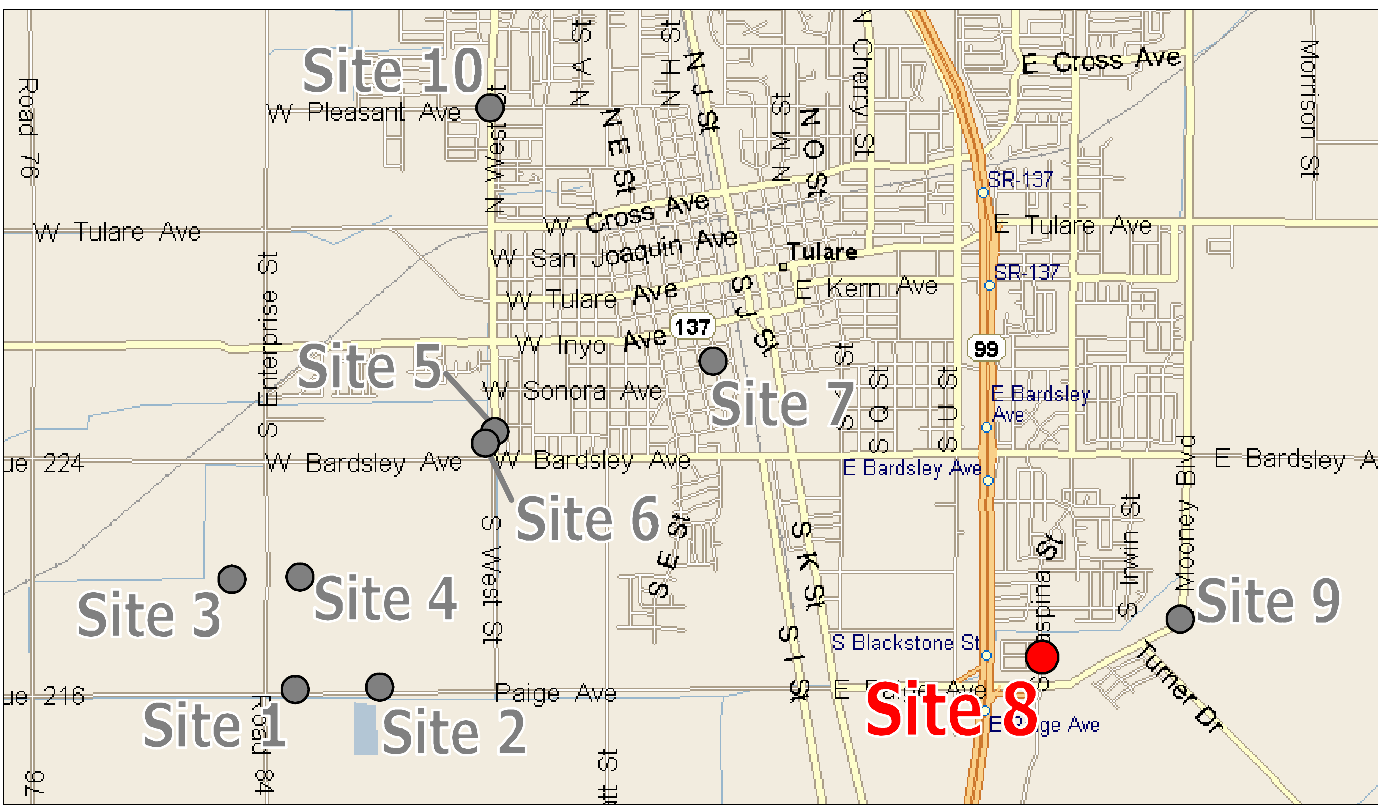
Sanitary Sewer Collection System

Monitoring Site: Site 8

Manhole Address: South Laspina Street, north of Manzanita Avenue

Size/Type of Line: 12-inch Sanitary Sewer Pipe

Data Summary Report



City of Tulare CALIFORNIA	**Site Information Report**	**Monitoring Site:** Site 8

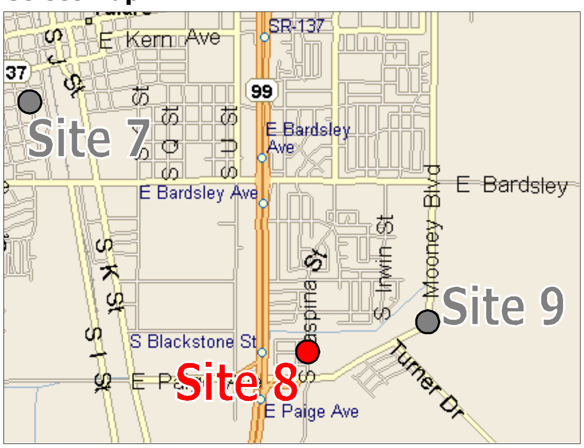
Location: South Laspina Street, north of Manzanita Avenue

Diameter: 12 inches

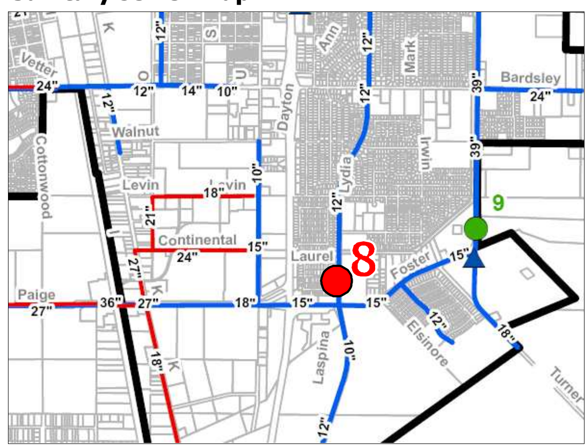
Average Dry Weather Flow: 0.553 *MGD*

Peak Measured Flow: 0.934 *MGD*

Street map:



Sanitary sewer map:



Street-level photo:

Plan view photo:

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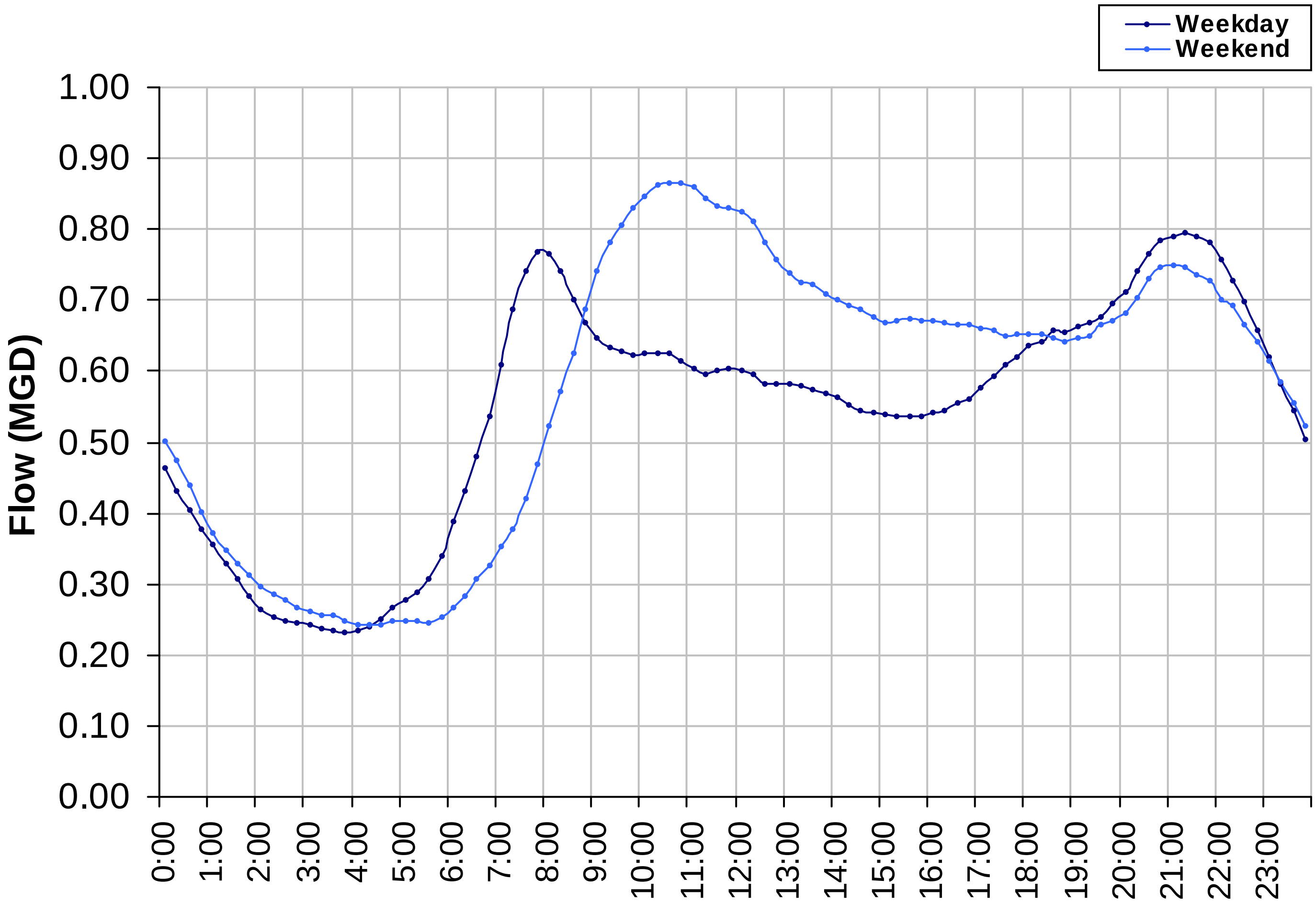
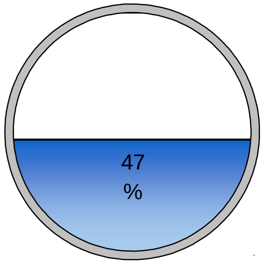
	Average Dry Weather Flow	**Monitoring Site:** Site 8

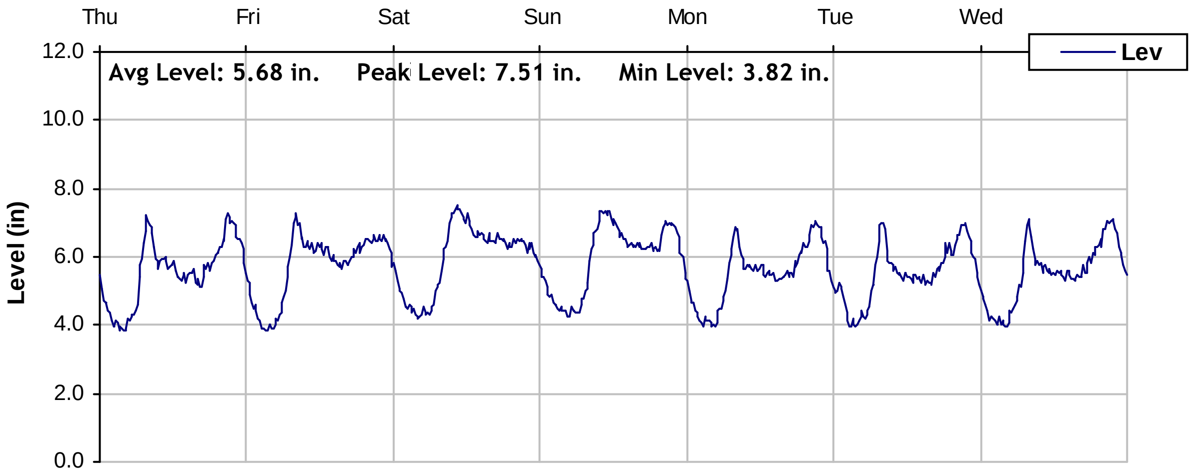


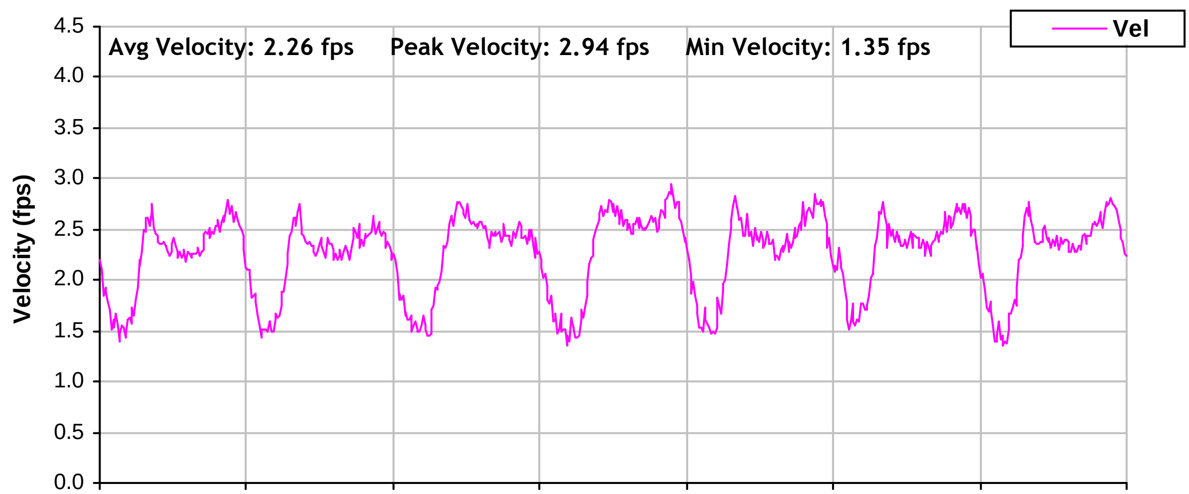
Average Dry Weather Flow:

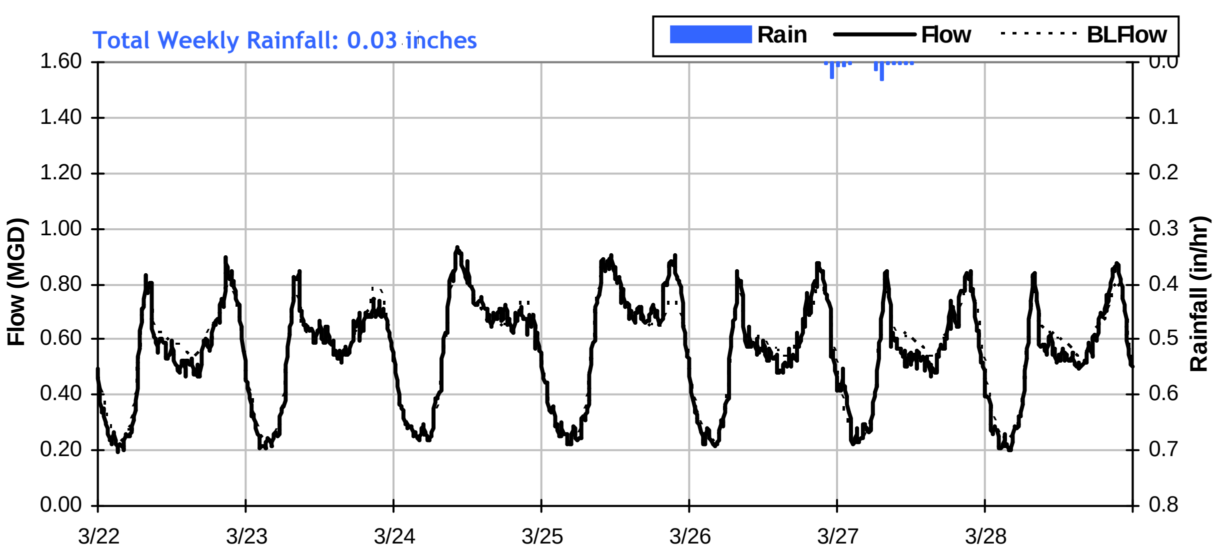
0.55 *MGD*



	Level, Velocity and Flow From 3/22/2007 to 3/29/2007	Monitoring Site: Site 8





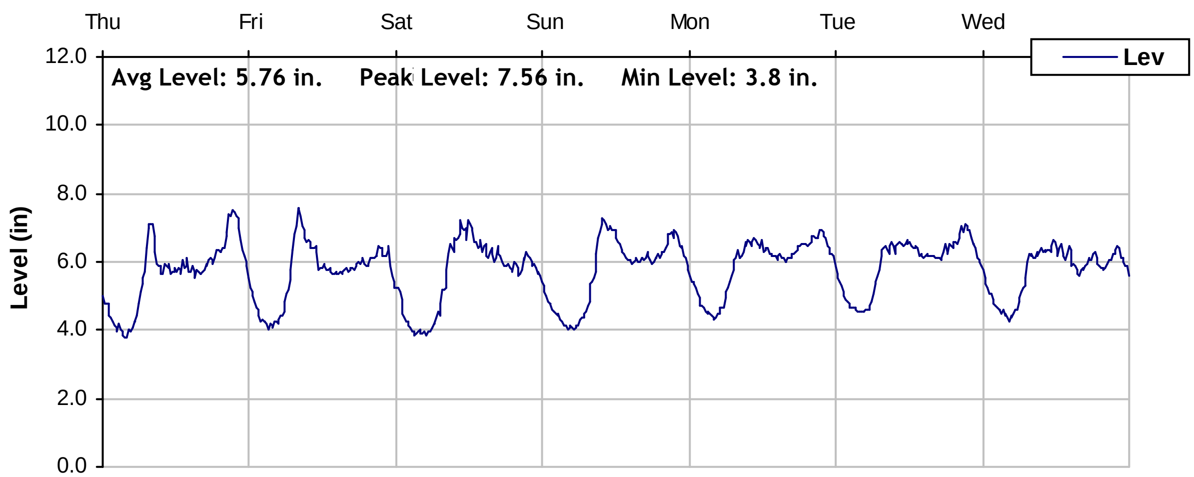


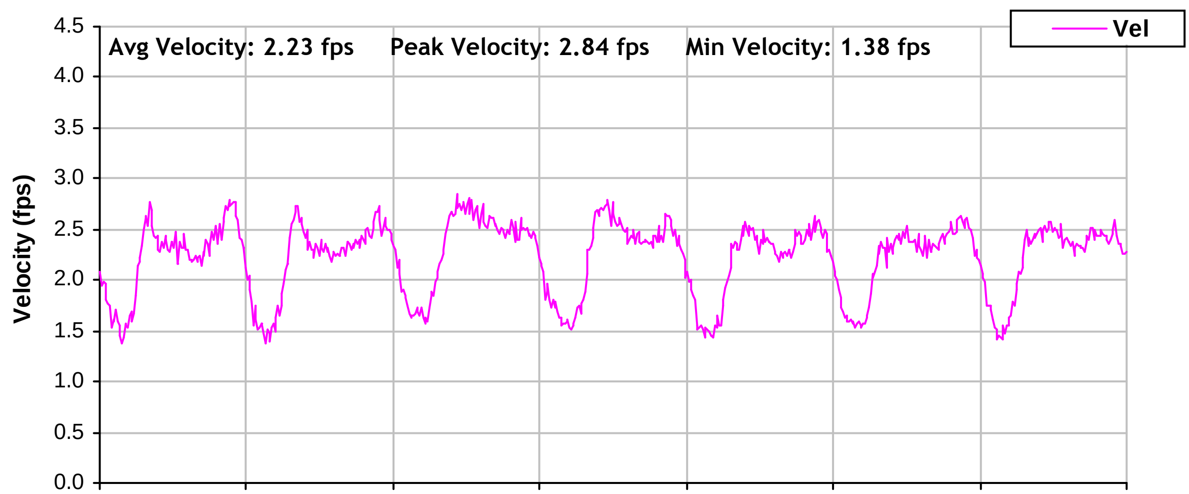
Avg Flow: 0.55 MGD Peak Flow: 0.93 MGD Min Flow: 0.19 MGD

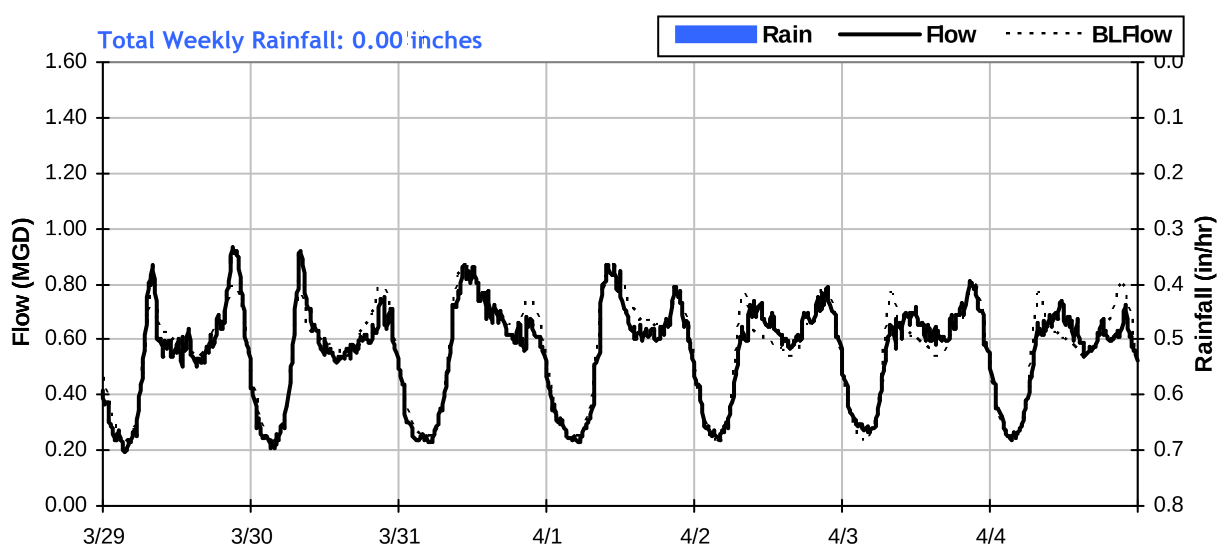
City of Tulare CALIFORNIA

Level, Velocity and Flow
From 3/29/2007 to 4/5/2007

Monitoring Site:
Site 8







Avg Flow: 0.55 MGD Peak Flow: 0.93 MGD Min Flow: 0.19 MGD

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Temporary Flow Monitoring Study

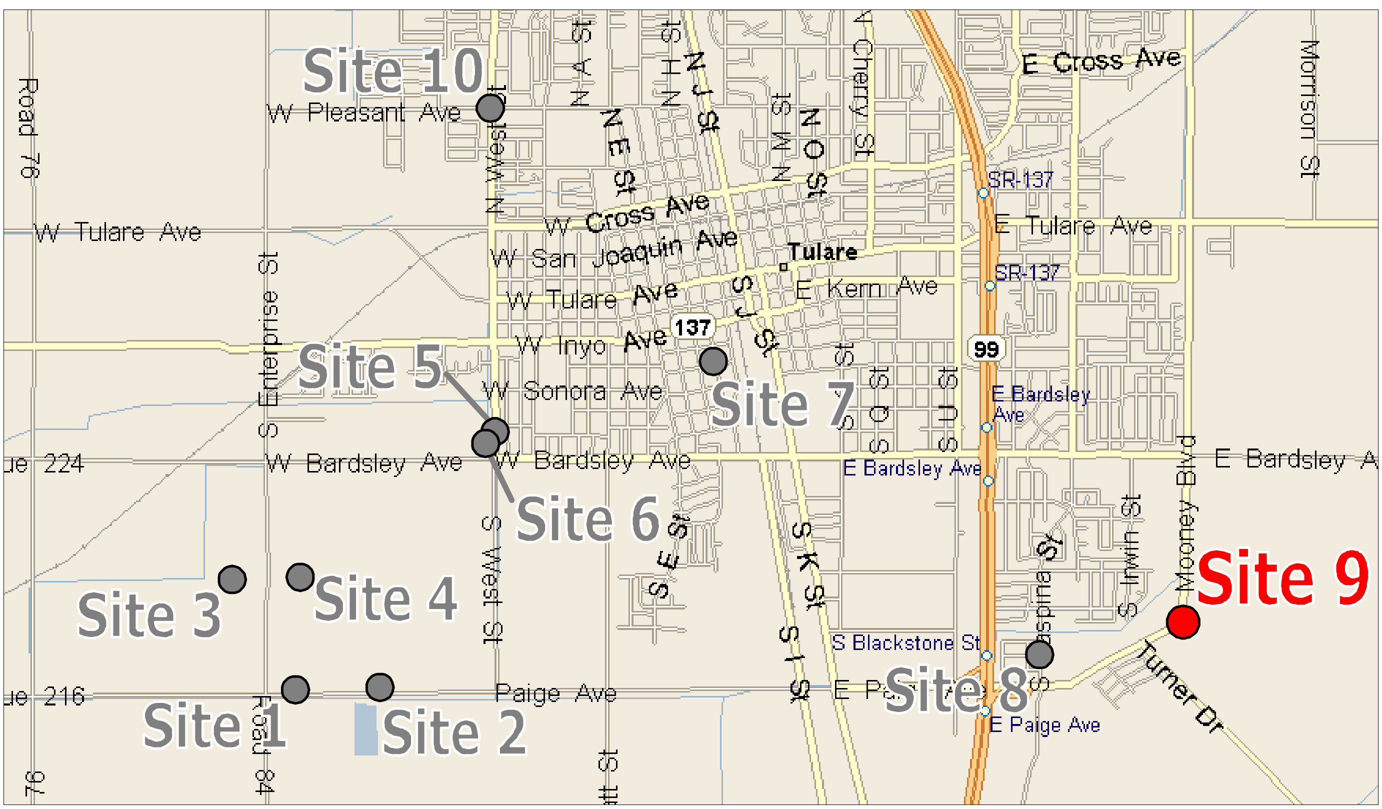
Sanitary Sewer Collection System

Monitoring Site: Site 9

Manhole Address: South Mooney Boulevard, north of Foster Drive

Size/Type of Line: 15-inch Sanitary Sewer Pipe

Data Summary Report



City of Tulare California	**Site Information Report**	**Monitoring Site:** Site 9

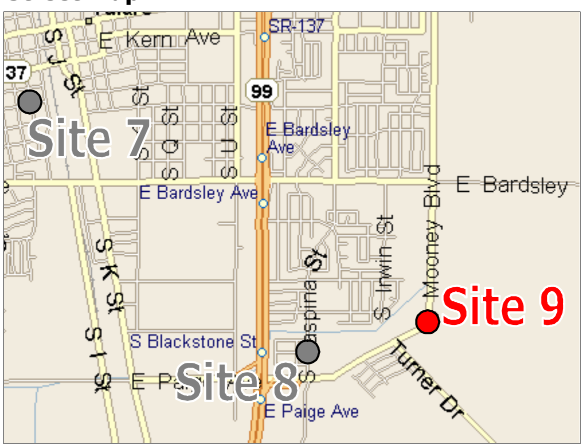
Location: South Mooney Boulevard, north of Foster Drive

Diameter: 15 inches

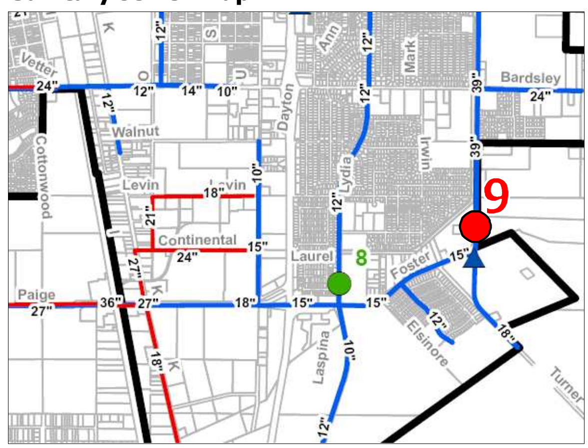
Average Dry Weather Flow: 0.794 *MGD*

Peak Measured Flow: 1.481 *MGD*

Street map:



Sanitary sewer map:



Street-level photo:

Plan view photo:

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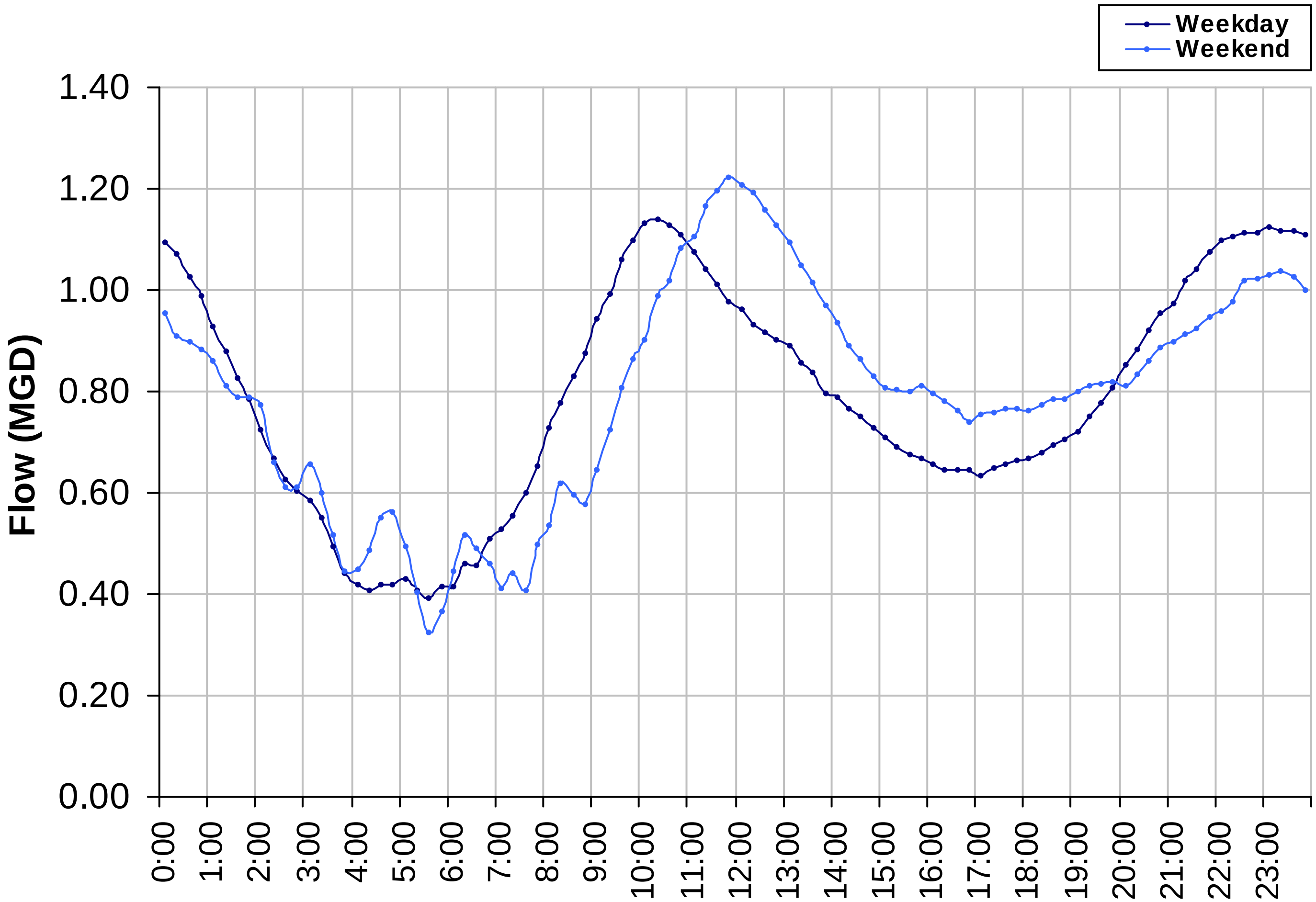
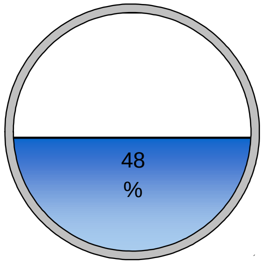
City of Tulare CALIFORNIA	**Average Dry Weather Flow**	**Monitoring Site:** Site 9



Average Dry Weather Flow:

0.79 *MGD*



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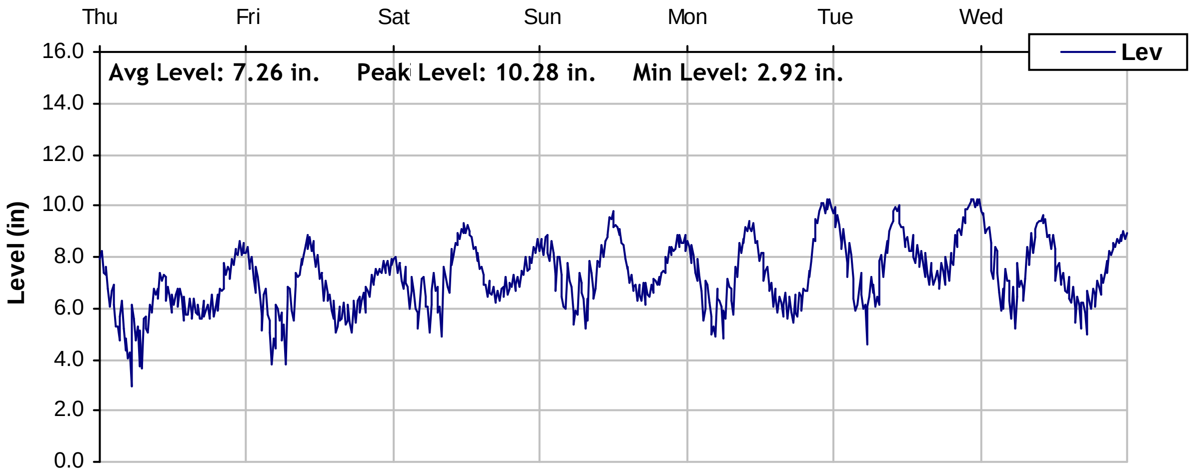
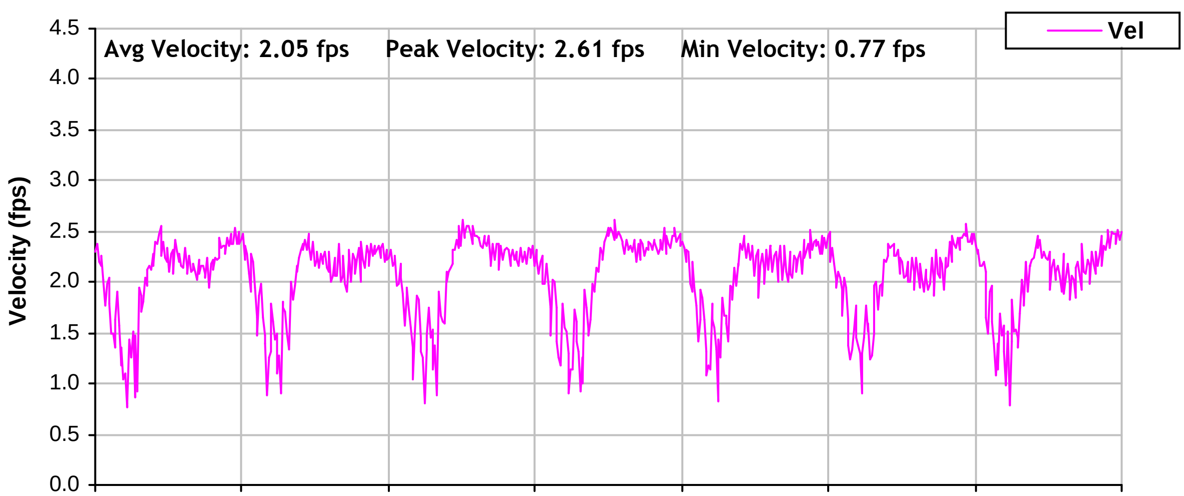
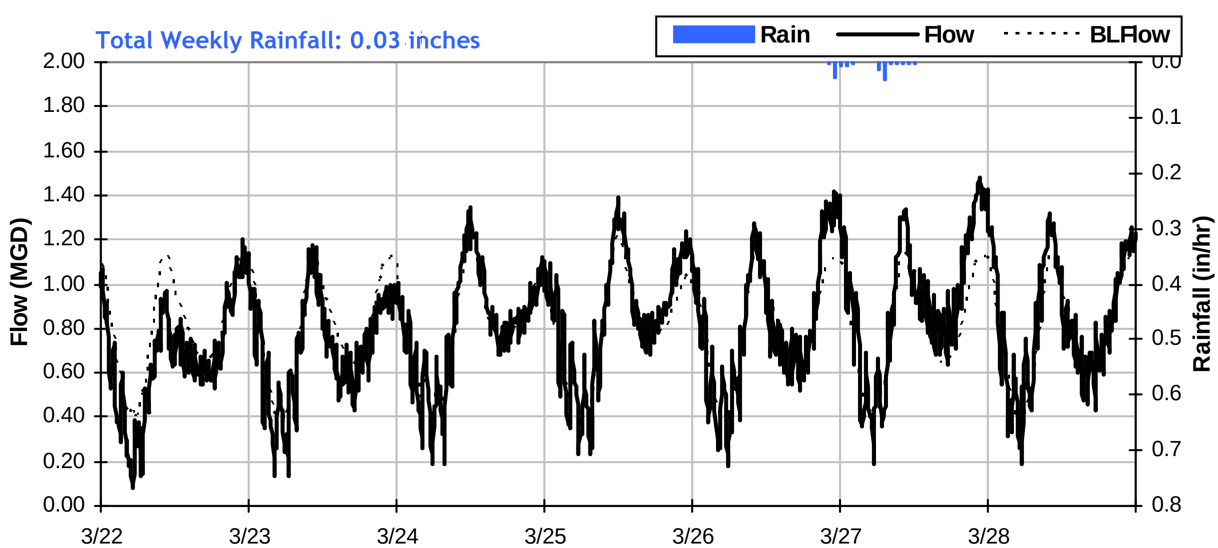
City of Tulare CALIFORNIA	**Level, Velocity and Flow** From 3/22/2007 to 3/29/2007	**Monitoring Site:** Site 9







Avg Flow: 0.8 MGD **Peak Flow: 1.48 MGD** **Min Flow: 0.08 MGD**

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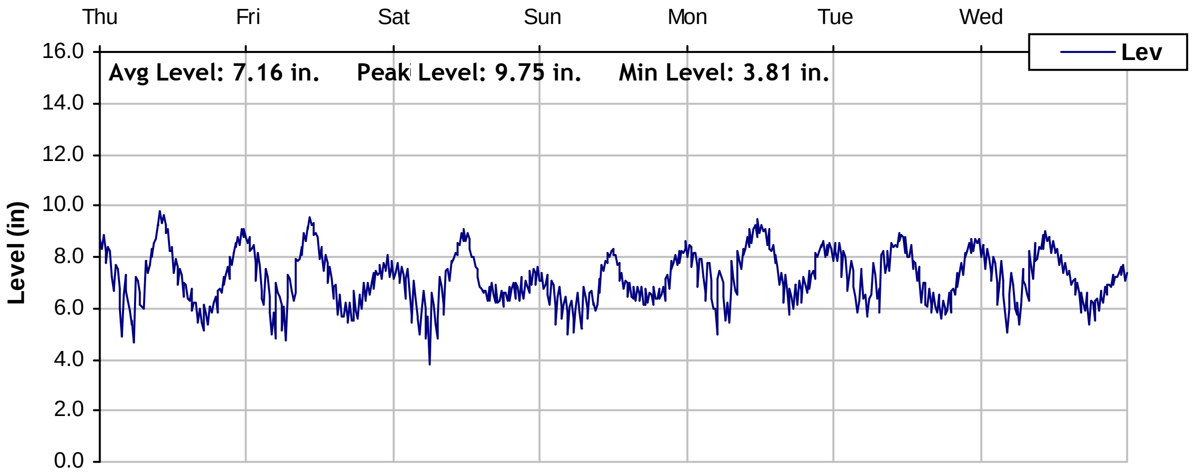
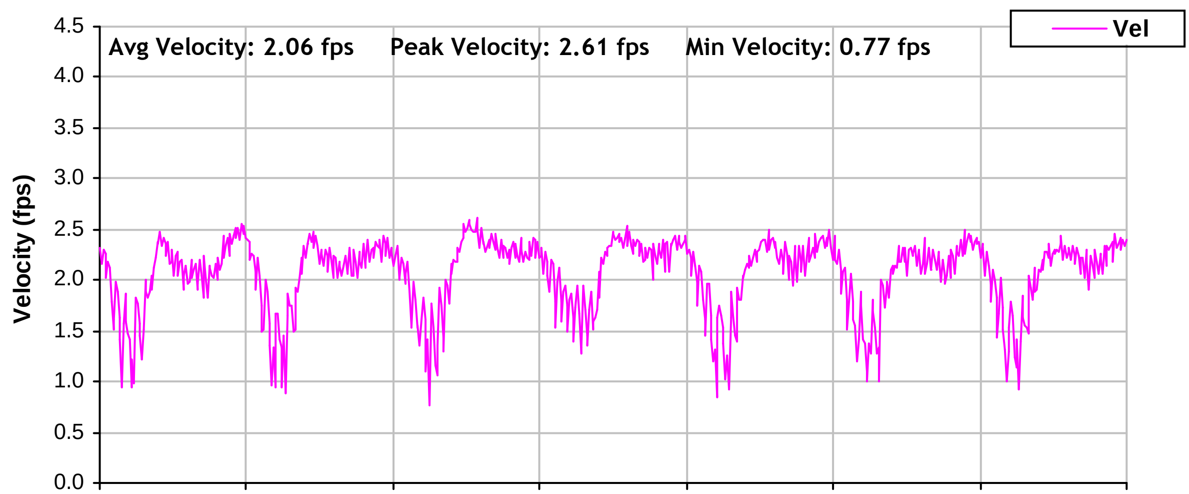
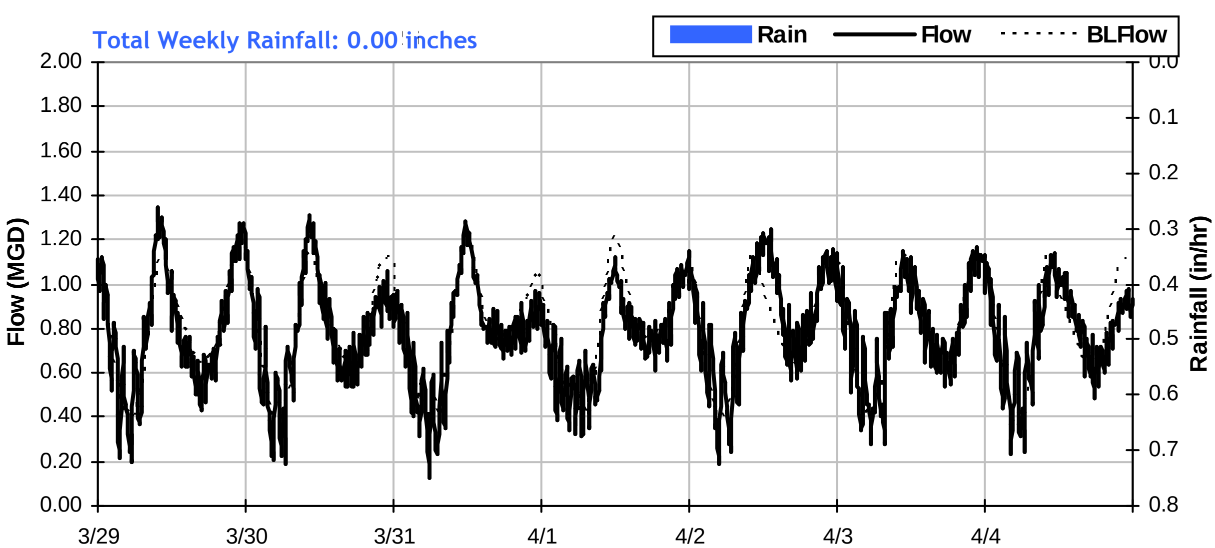
City of Tulare CALIFORNIA

Level, Velocity and Flow
From 3/29/2007 to 4/5/2007

Monitoring Site:
Site 9







Avg Flow: 0.79 MGD Peak Flow: 1.35 MGD Min Flow: 0.12 MGD

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Temporary Flow Monitoring Study

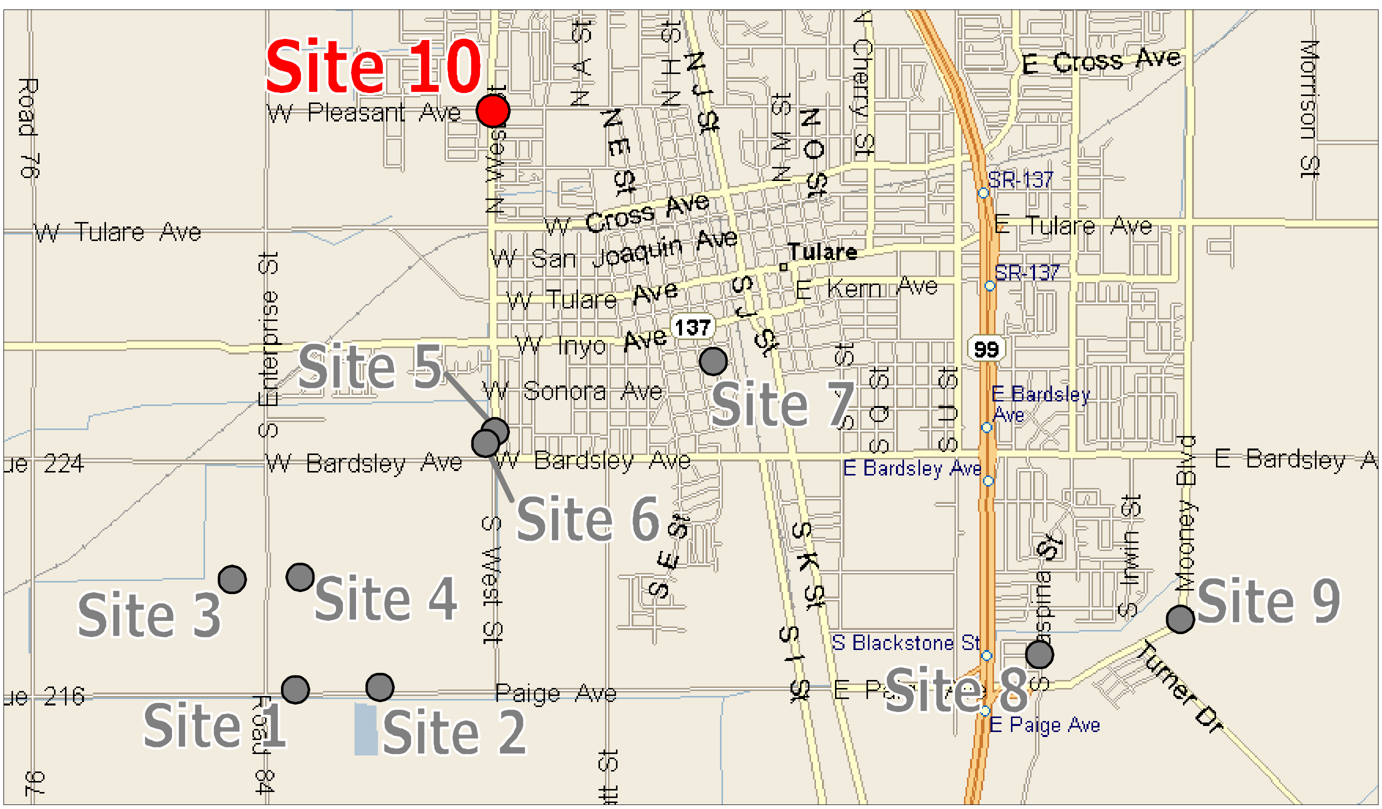
Sanitary Sewer Collection System

Monitoring Site: Site 10

Manhole Address: Pleasant Avenue, east of West Street

Size/Type of Line: 15-inch Sanitary Sewer Pipe

Data Summary Report



	Site Information Report	Monitoring Site: Site 10

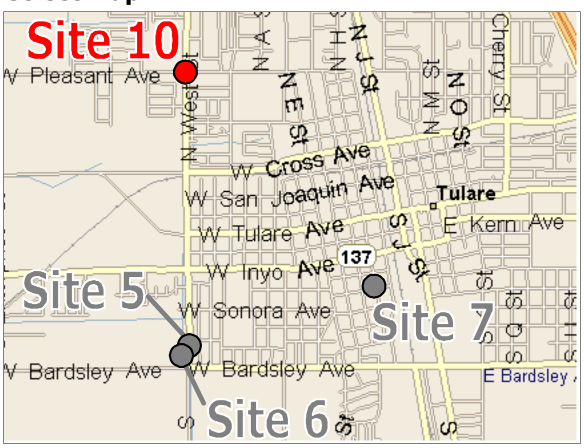
Location: Pleasant Avenue, east of West Street

Diameter: 15 inches

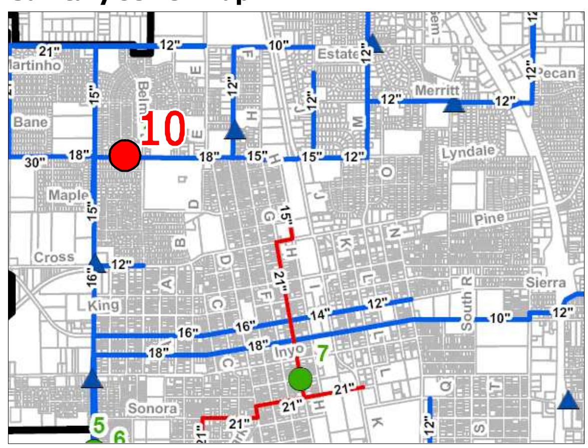
Average Dry Weather Flow: 0.749 *MGD*

Peak Measured Flow: 1.449 *MGD*

Street map:



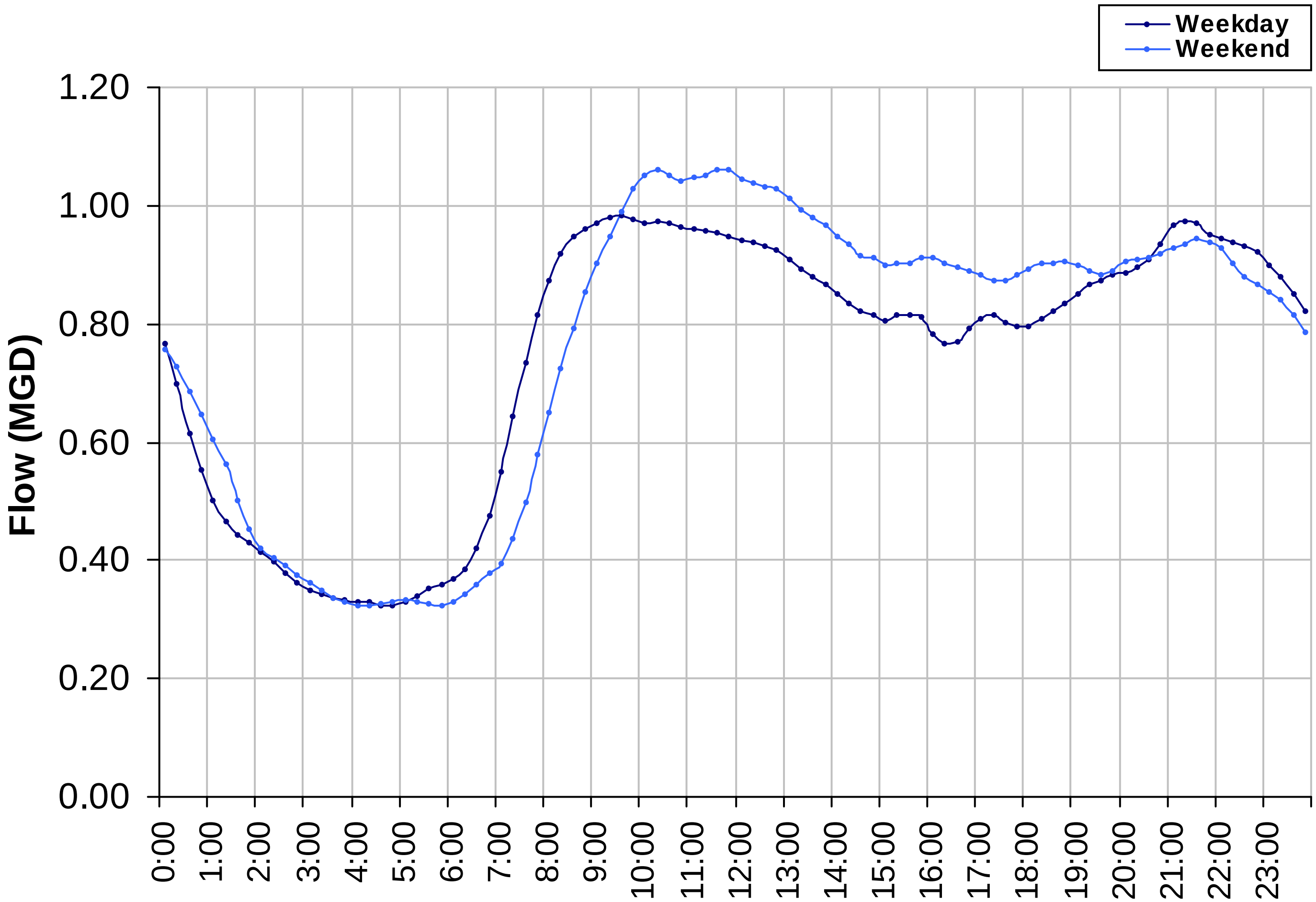
Sanitary sewer map:



Street-level photo:

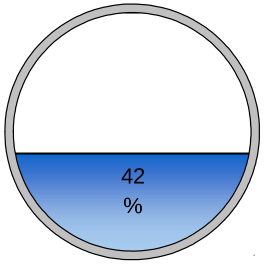
Plan view photo:

City of Tulare CALIFORNIA	**Average Dry Weather Flow**	**Monitoring Site:** Site 10



Average Dry Weather Flow:

0.75 *MGD*



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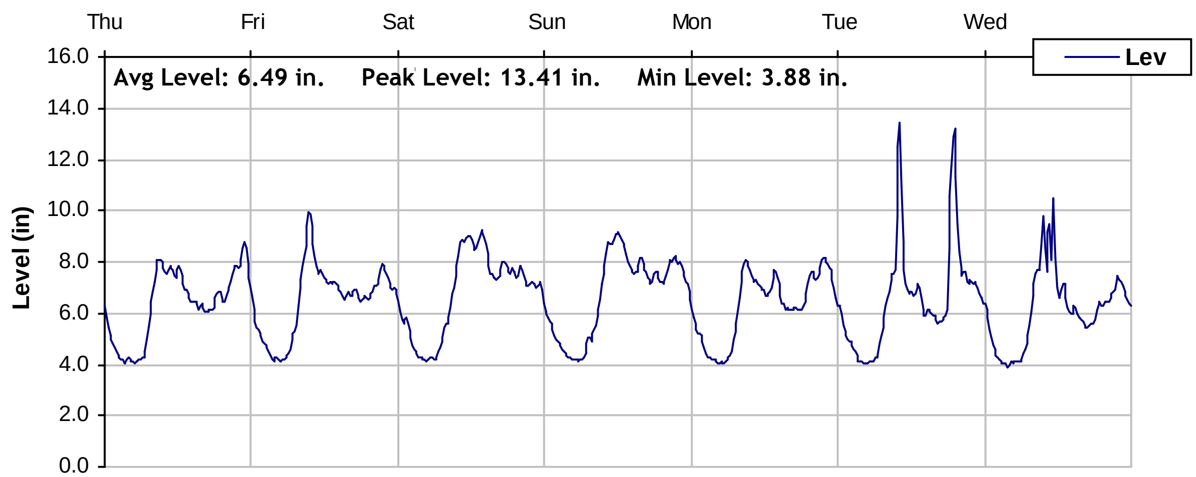
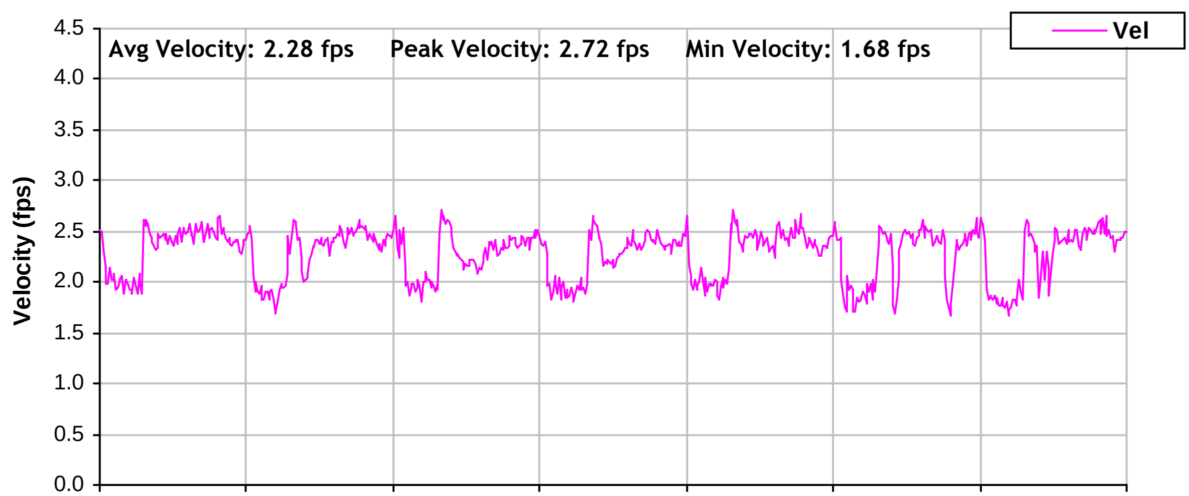
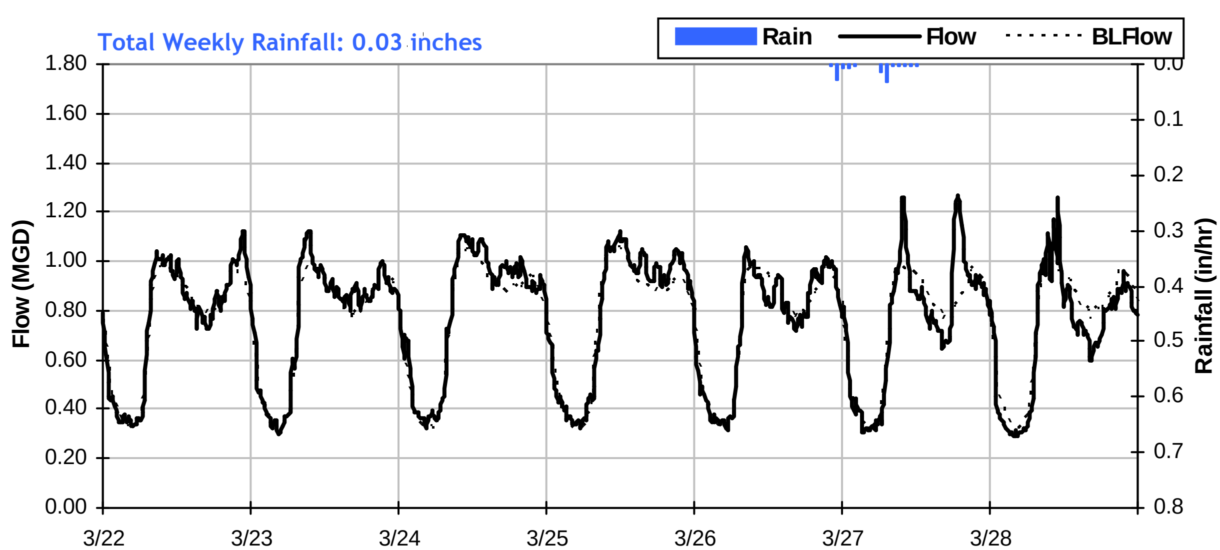
City of Tulare CALIFORNIA	**Level, Velocity and Flow** From 3/22/2007 to 3/29/2007	**Monitoring Site:** Site 10





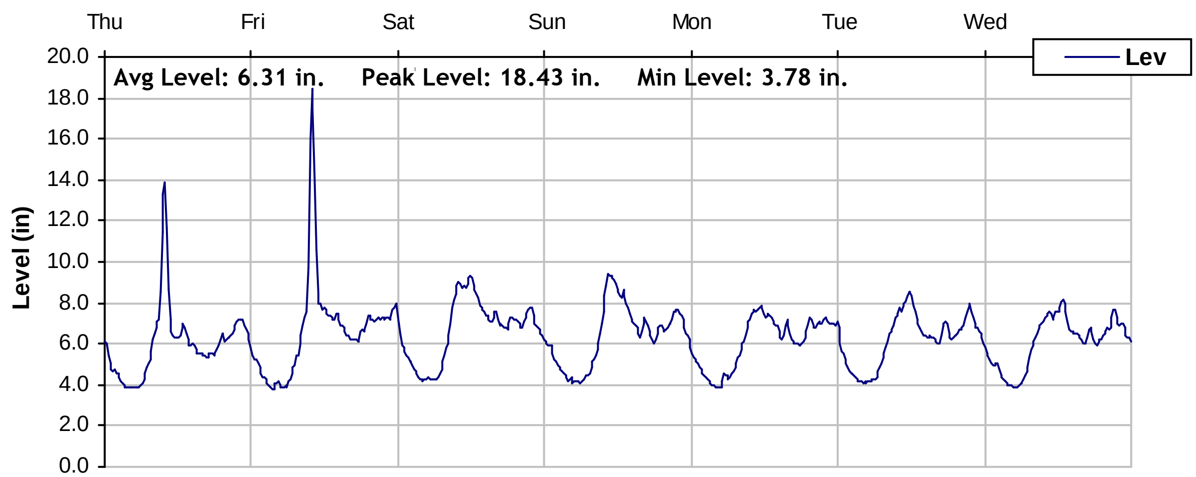


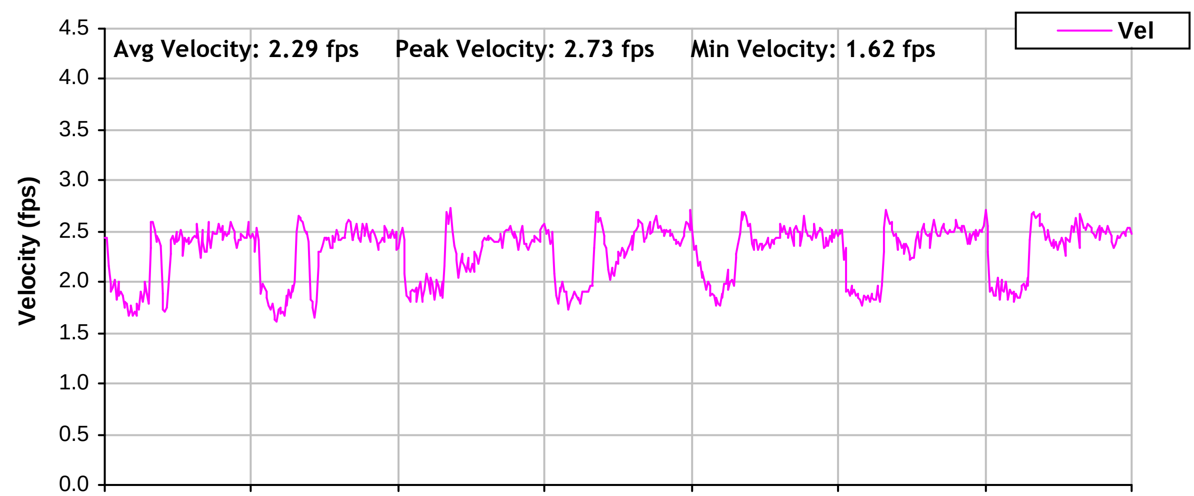
Avg Flow: 0.76 MGD   Peak Flow: 1.27 MGD   Min Flow: 0.29 MGD

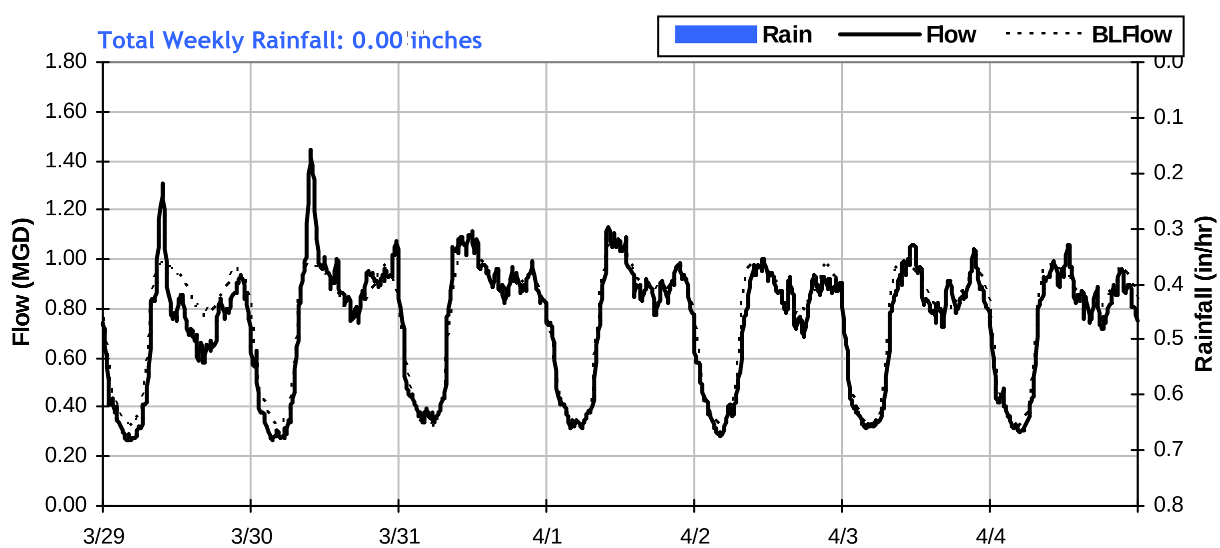
V&A

Level, Velocity and Flow
From 3/29/2007 to 4/5/2007

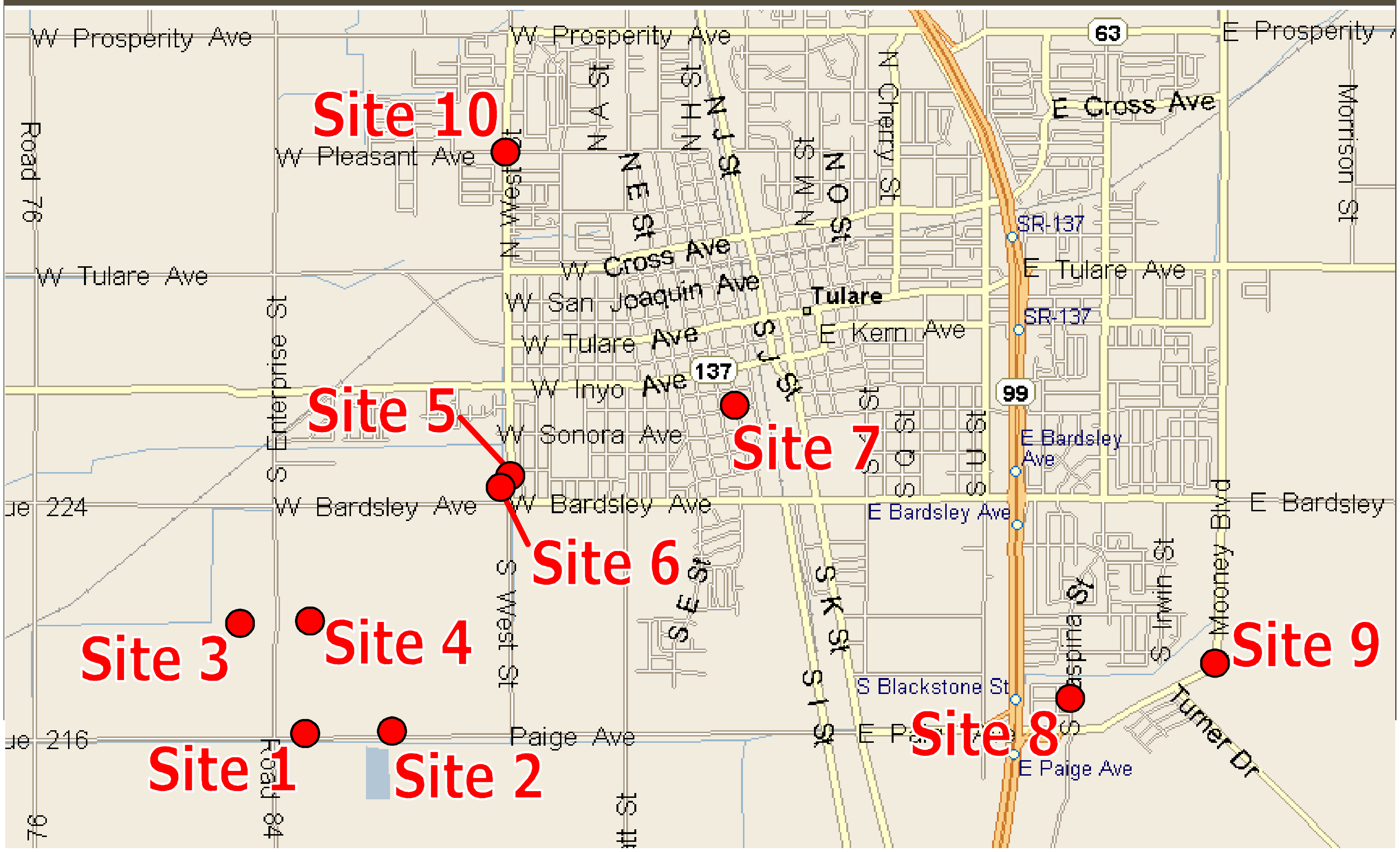
Monitoring Site:
Site 10





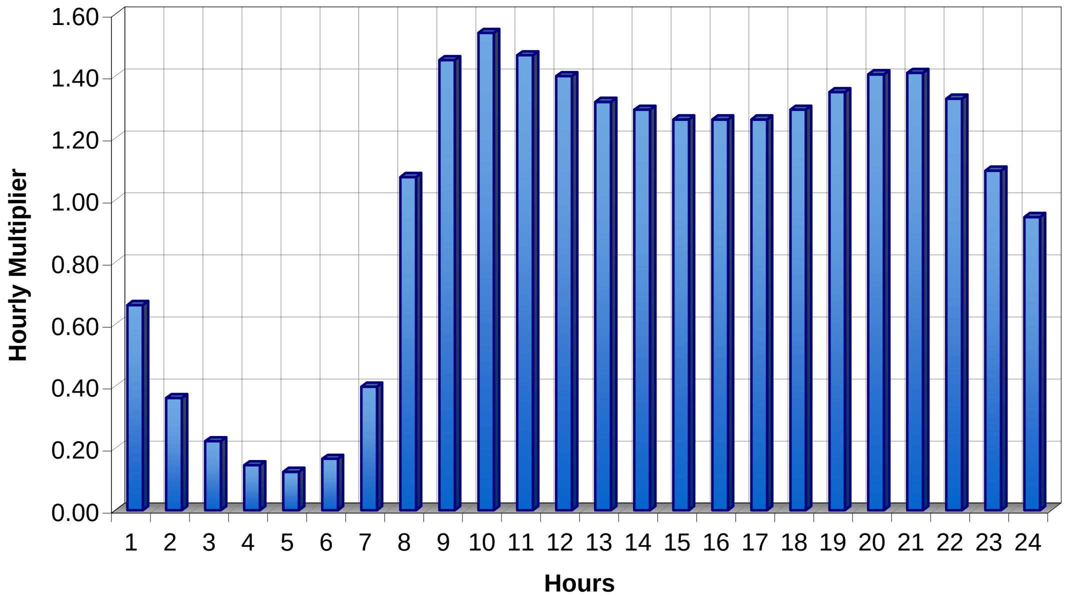


Avg Flow: 0.74 MGD   Peak Flow: 1.45 MGD   Min Flow: 0.26 MGD



Oakland 1999 Harrison St., Suite 975, Oakland, CA 94612 **Tel** 510.903.6600 **Fax** 510.903.6601
San Diego 8291 Aero Place, Suite 110, San Diego, CA 92123 **Tel** 858.576.0226 **Fax** 858.576.0004
Houston One Riverway, Suite 1700, Houston, TX 77056 **Tel** 713.840.6490 **Fax** 713.840.6491
www.vaengineering.com

APPENDIX B - DIURNAL PATTERNS FOR CALIBRATION OF HYDRAULIC MODEL



SITE 1 FLOW MONITOR
DIURNAL CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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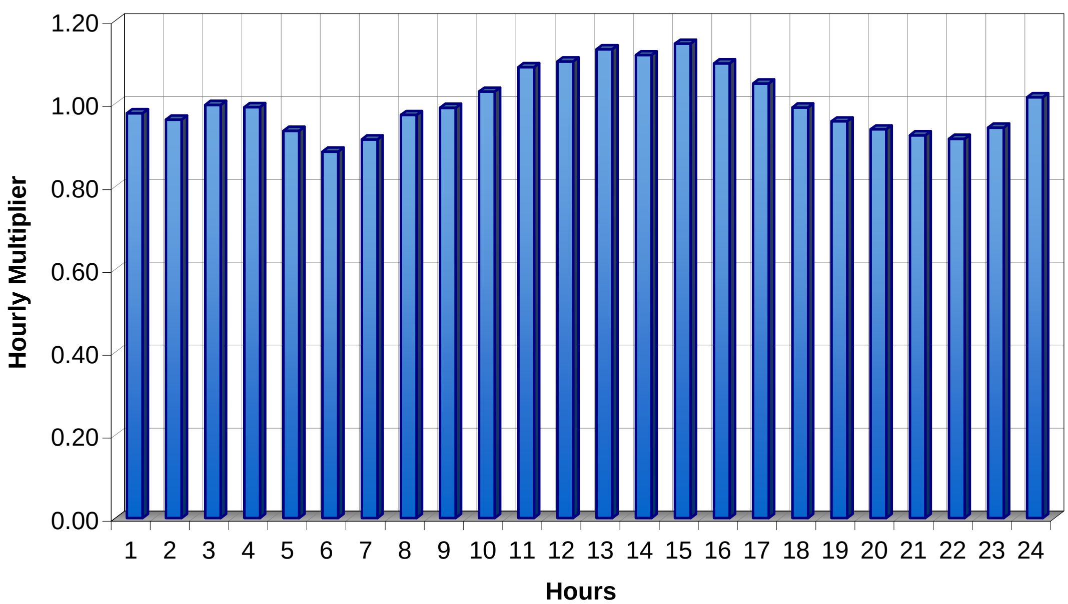

SITE 2 FLOW MONITOR
DIURNAL CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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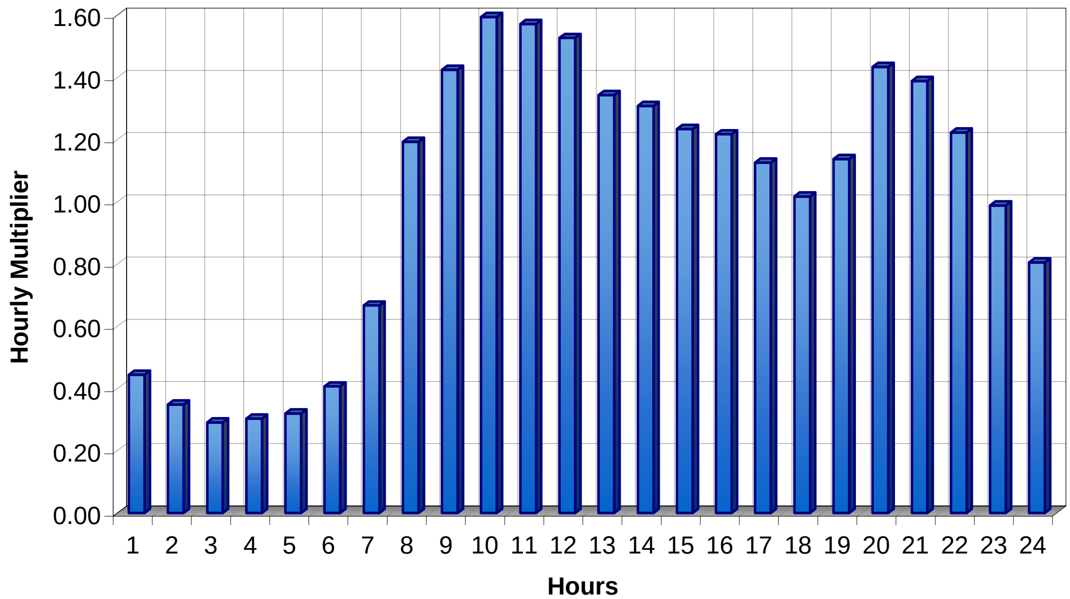

SITE 3 FLOW MONITOR
DIURNAL CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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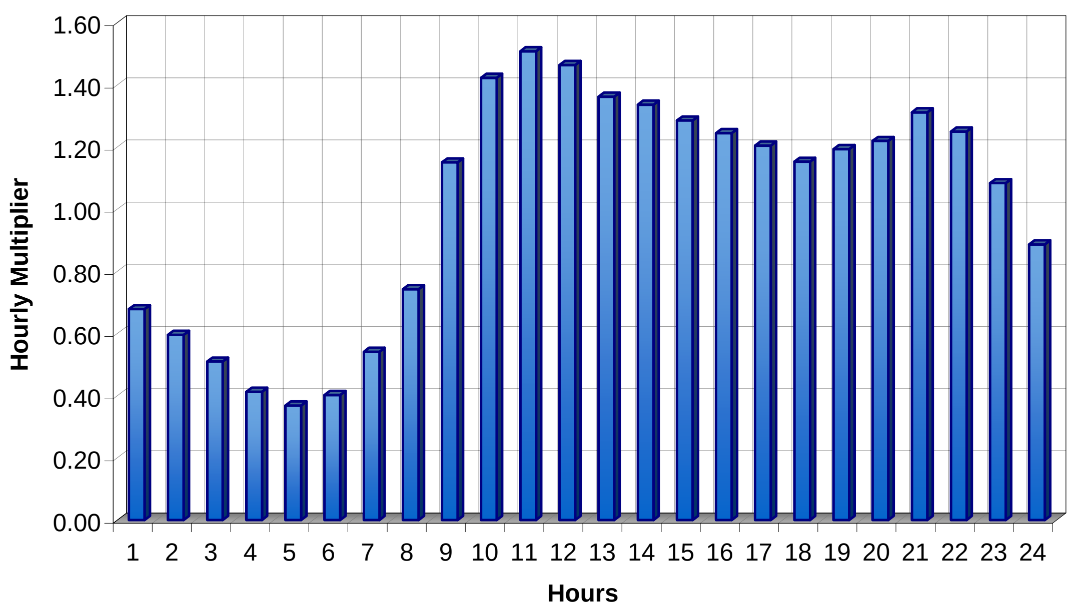

SITE 4 FLOW MONITOR
DIURNAL CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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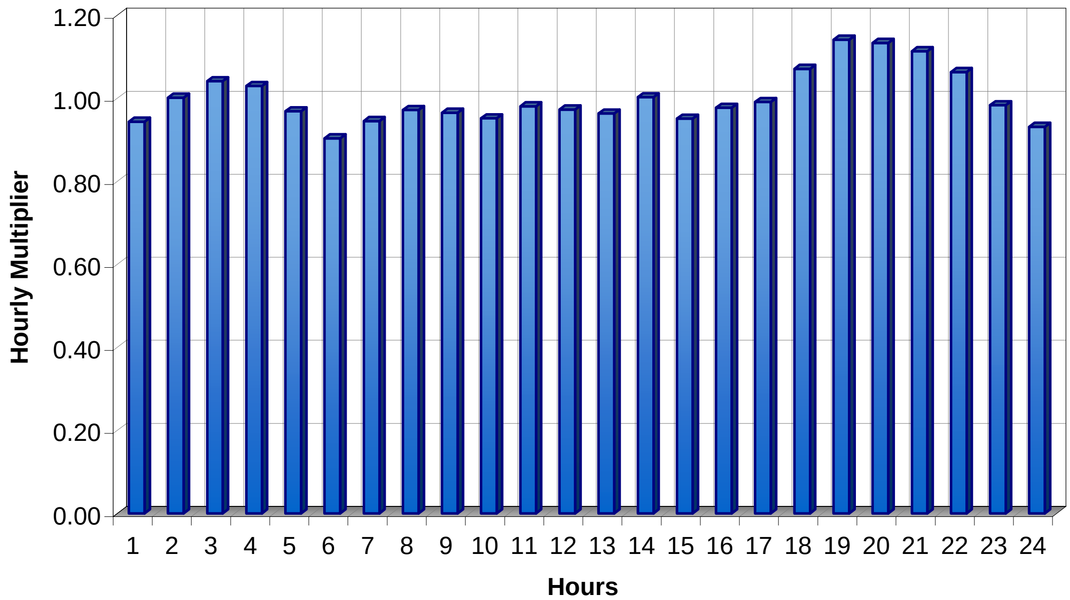

SITE 4a FLOW MONITOR
DIURNAL CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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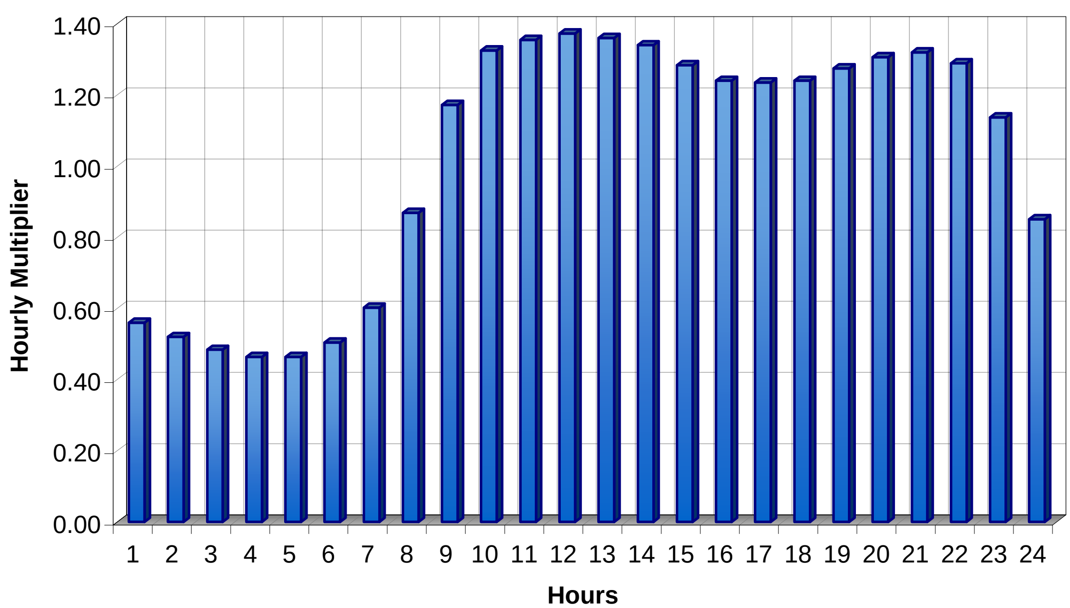

SITE 5 FLOW MONITOR
DIURNAL CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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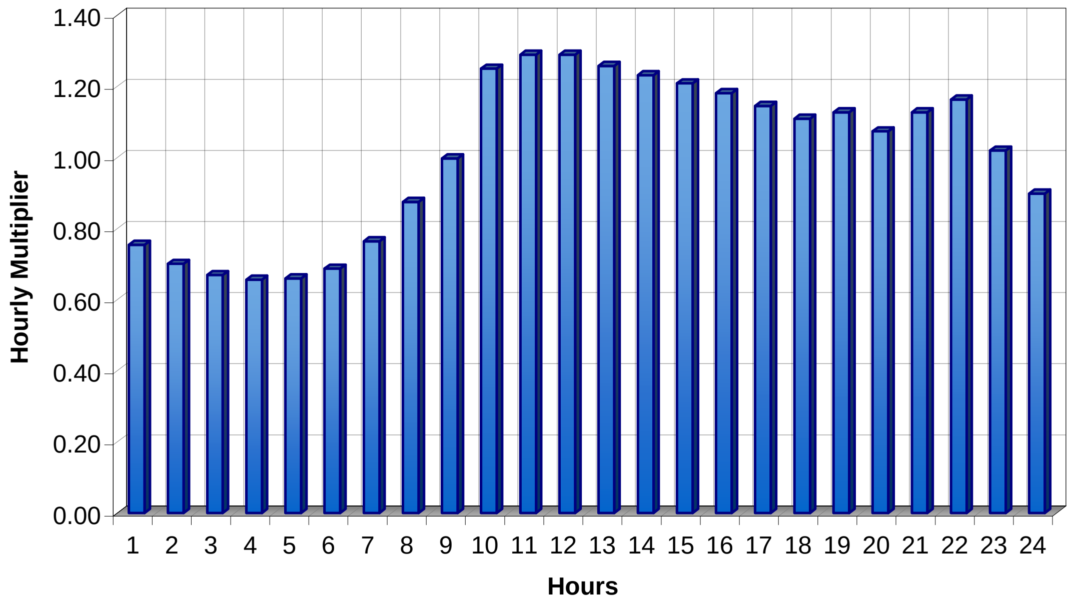

SITE 6 FLOW MONITOR
DIURNAL CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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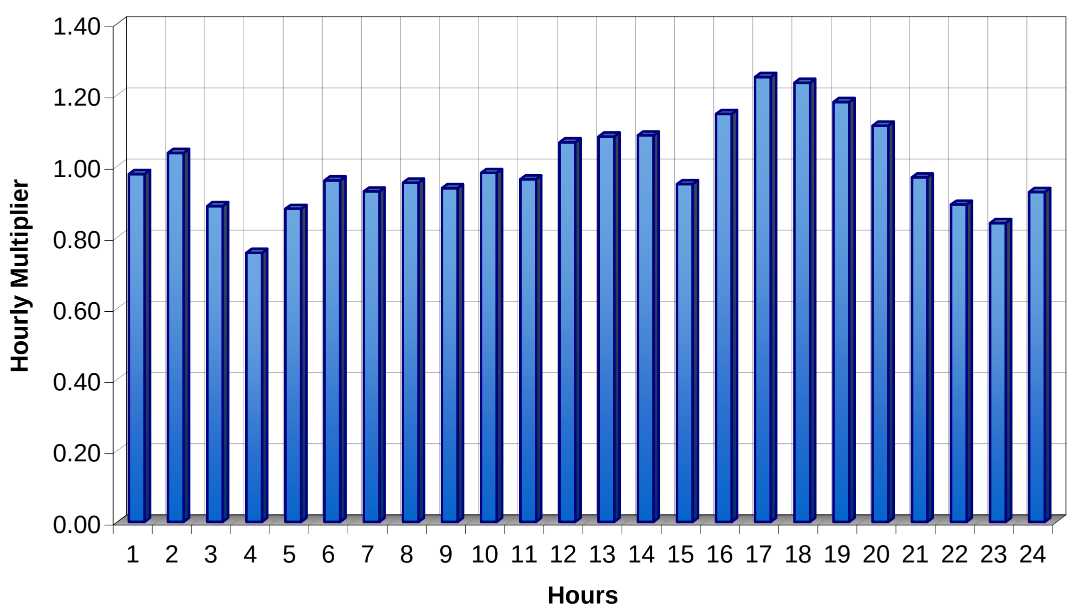

SITE 7 FLOW MONITOR
DIURNAL CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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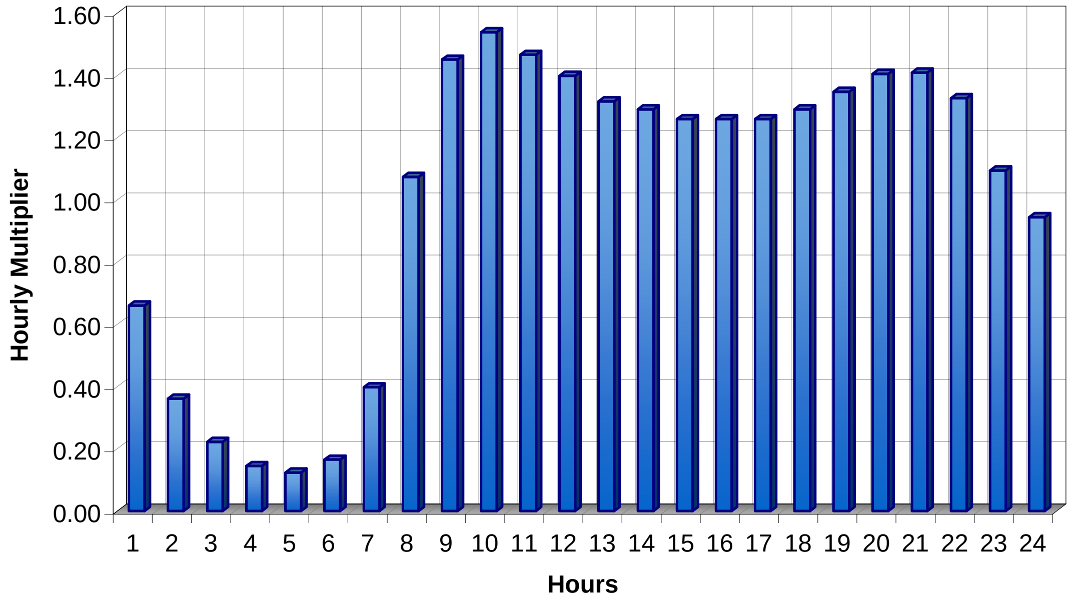
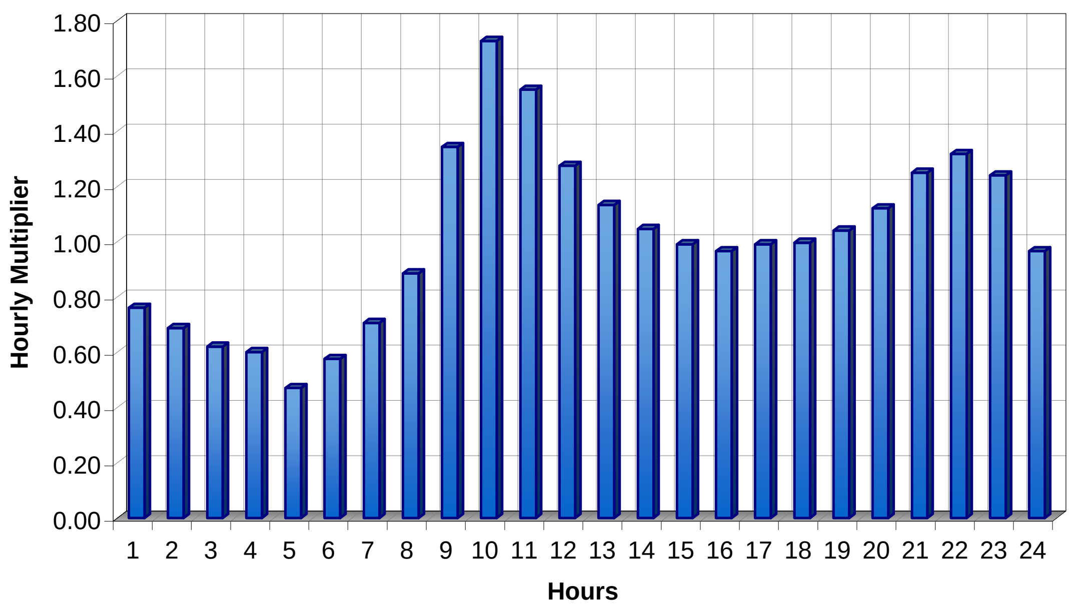
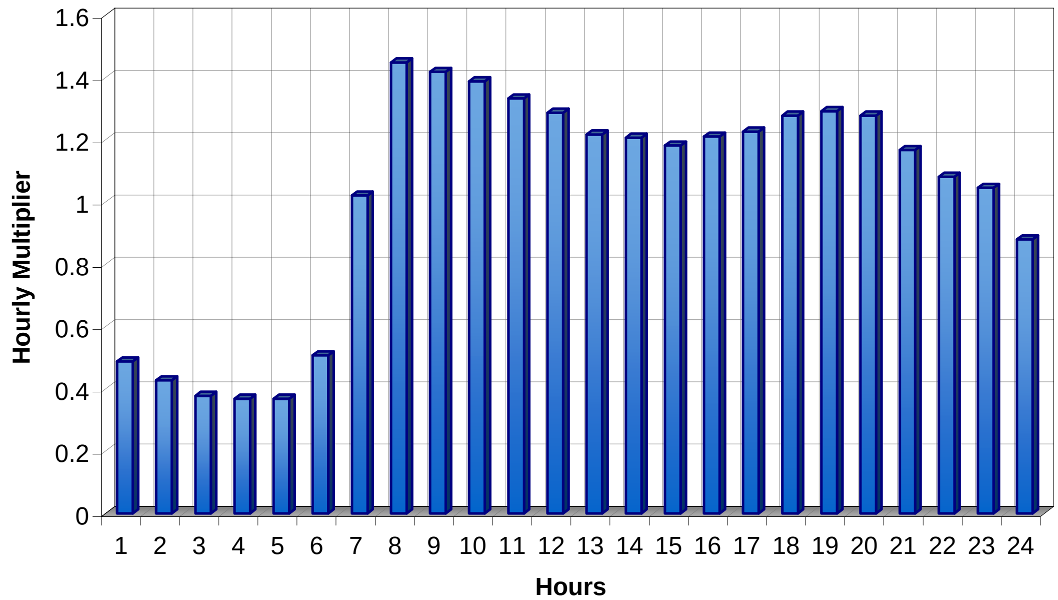


SITE 8 FLOW MONITOR
DIURNAL CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE



SITE 9 FLOW MONITOR
DIURNAL CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE



SITE 10 FLOW MONITOR
DIURNAL CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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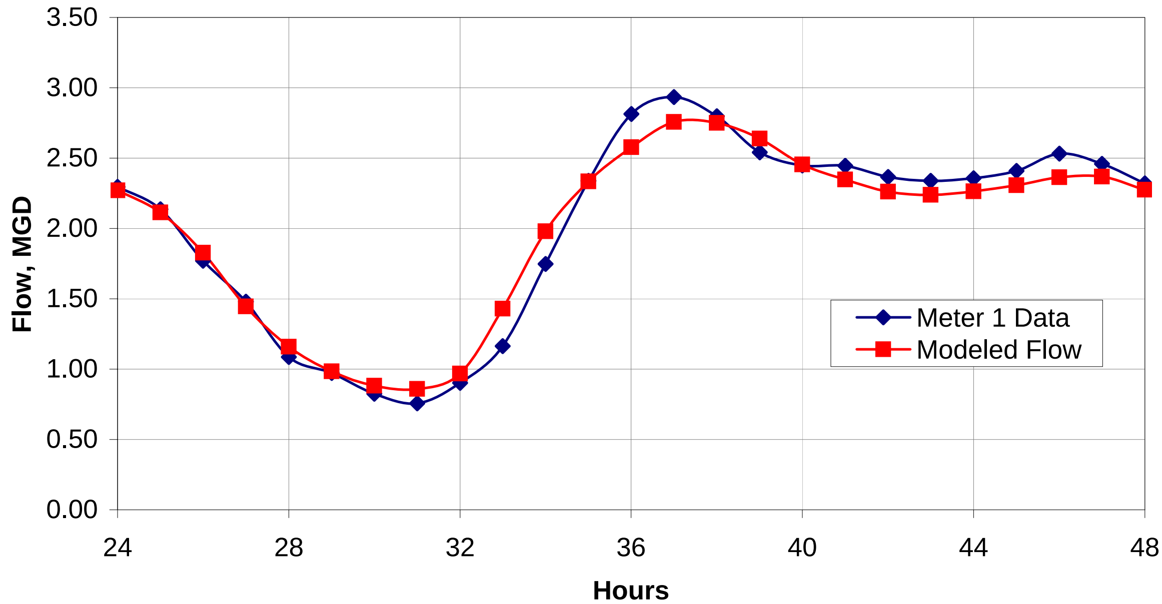
APPENDIX C - HYDRAULIC MODEL FLOW CALIBRATION PLOTS



SITE 1 FLOW MONITOR
CALIBRATION CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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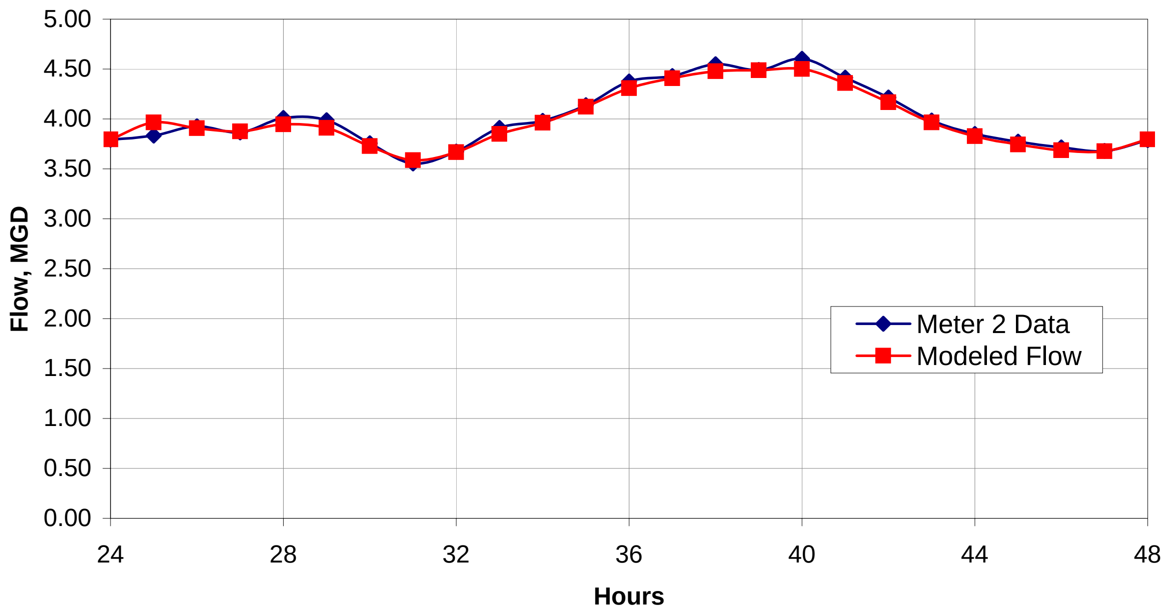

SITE 2 FLOW MONITOR
CALIBRATION CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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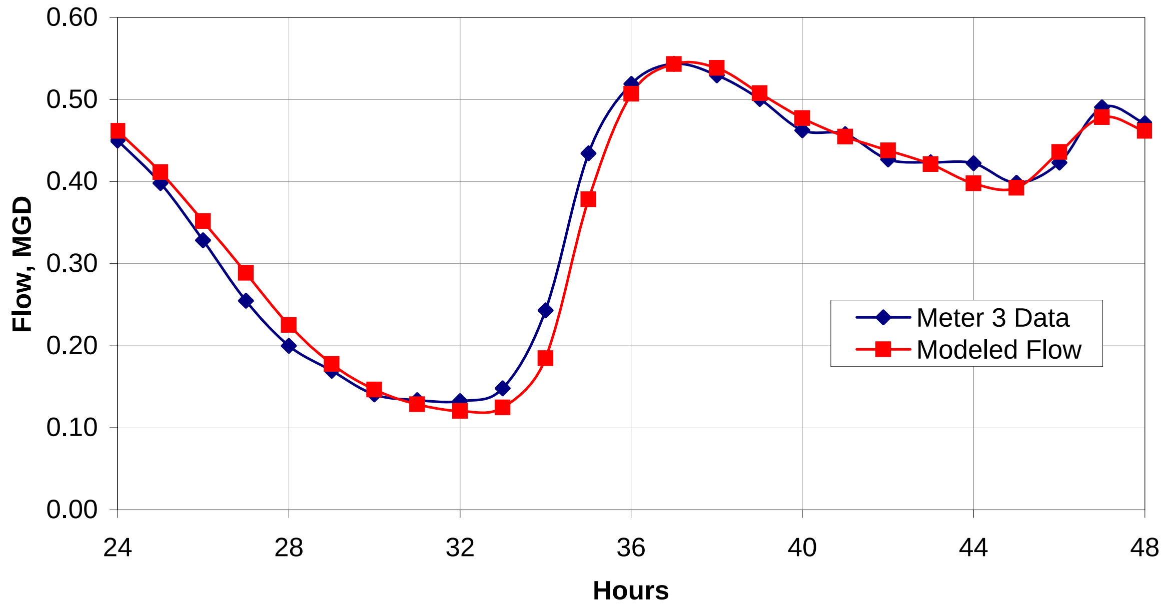

SITE 3 FLOW MONITOR
CALIBRATION CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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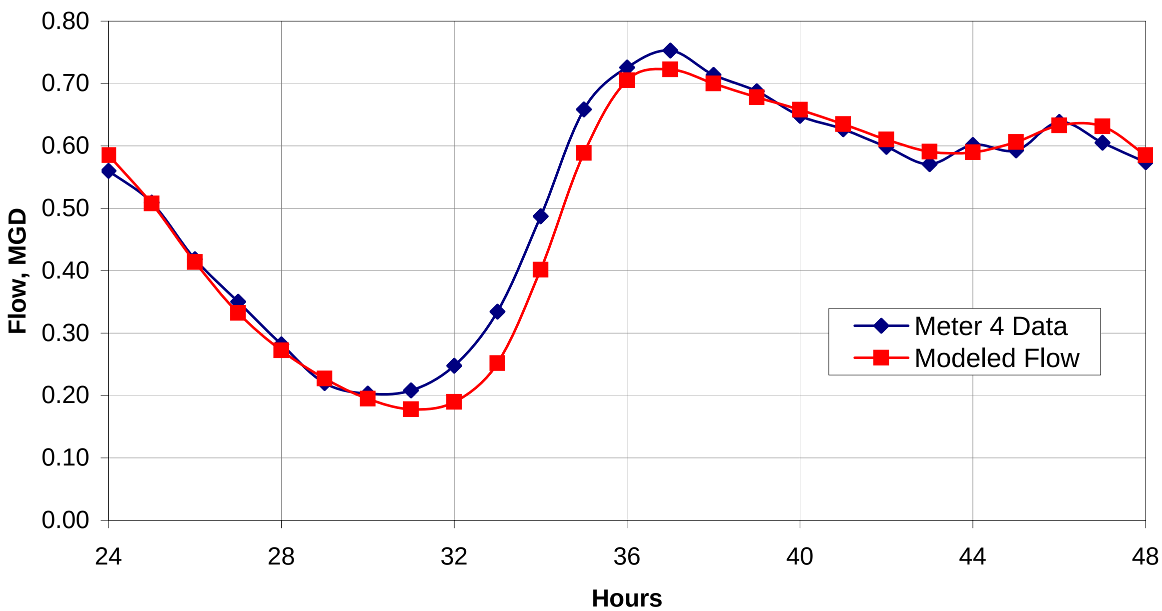

SITE 4 FLOW MONITOR
CALIBRATION CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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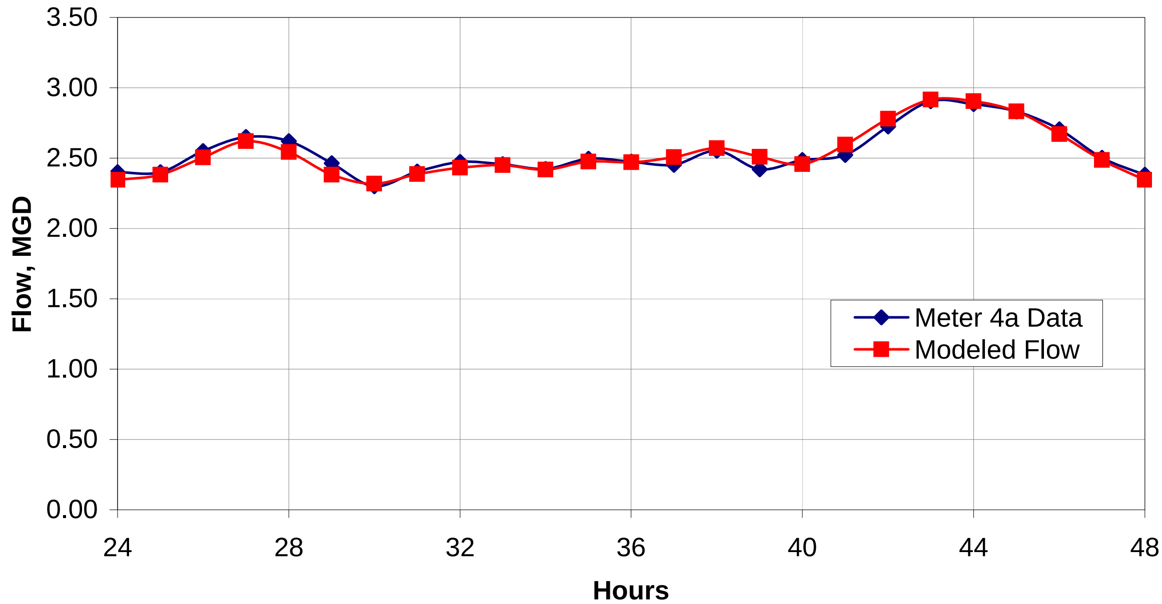

SITE 4a FLOW MONITOR
CALIBRATION CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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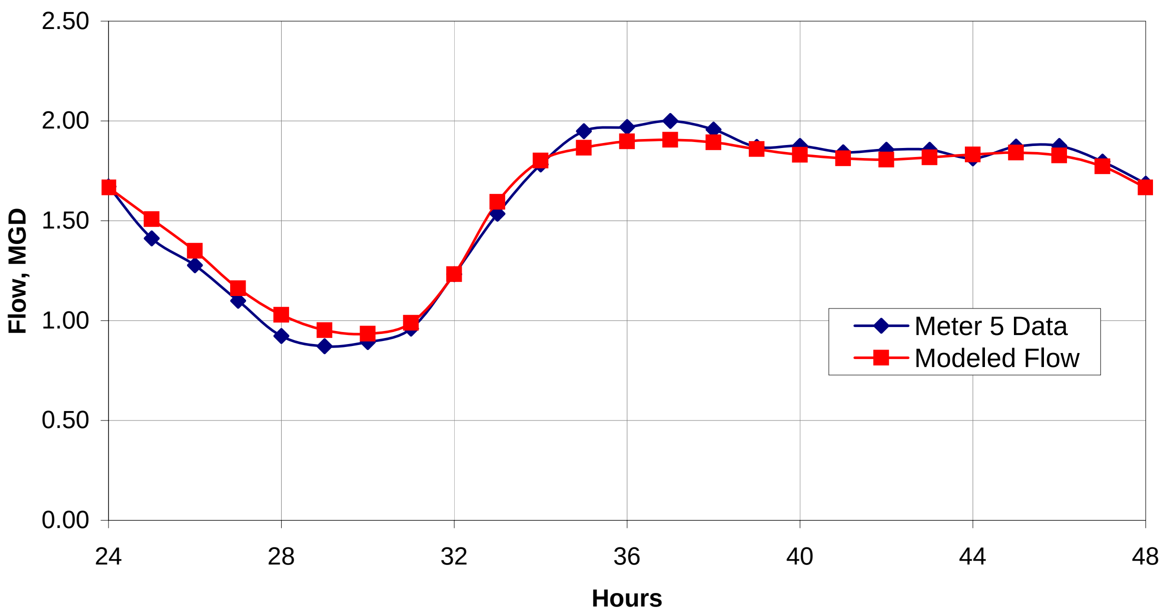

SITE 5 FLOW MONITOR
CALIBRATION CURVE
SEWER SYSTEM MASTER PLAN
CITY OF TULARE

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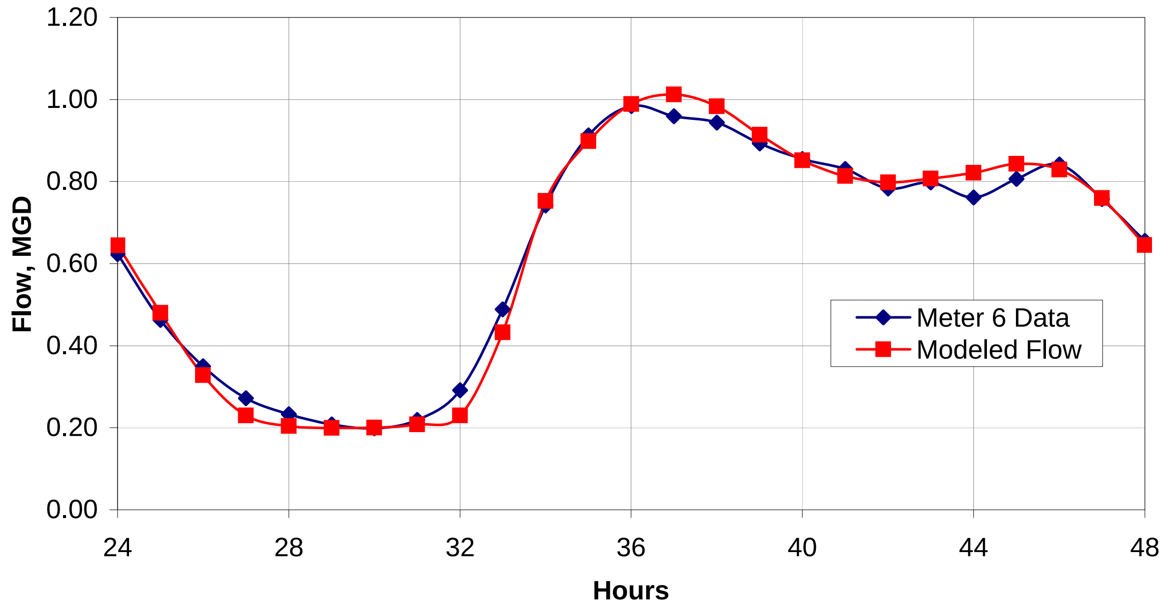

SITE 6 FLOW MONITOR
CALIBRATION CURVE
SEWER SYSTEM MASTER PLAN
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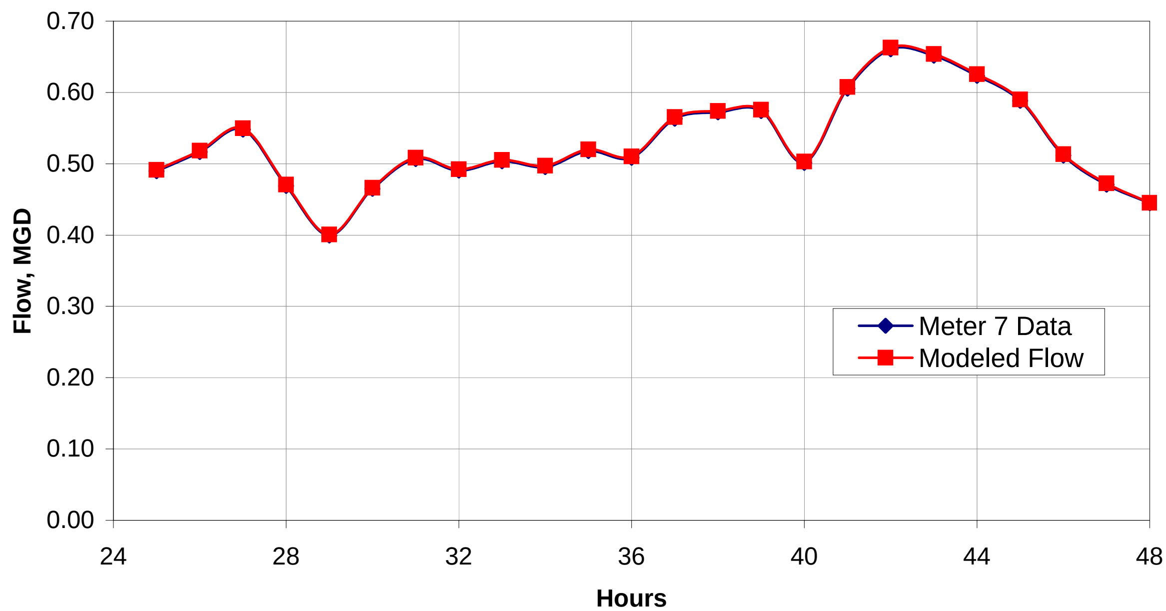

SITE 7 FLOW MONITOR
CALIBRATION CURVE
SEWER SYSTEM MASTER PLAN
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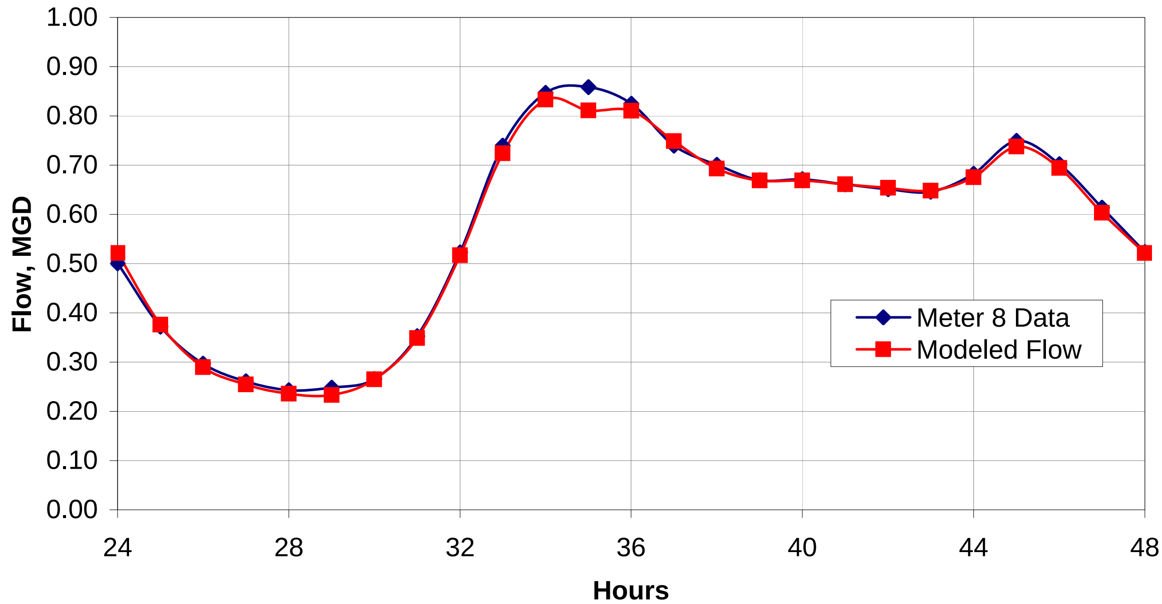

SITE 8 FLOW MONITOR
CALIBRATION CURVE
SEWER SYSTEM MASTER PLAN
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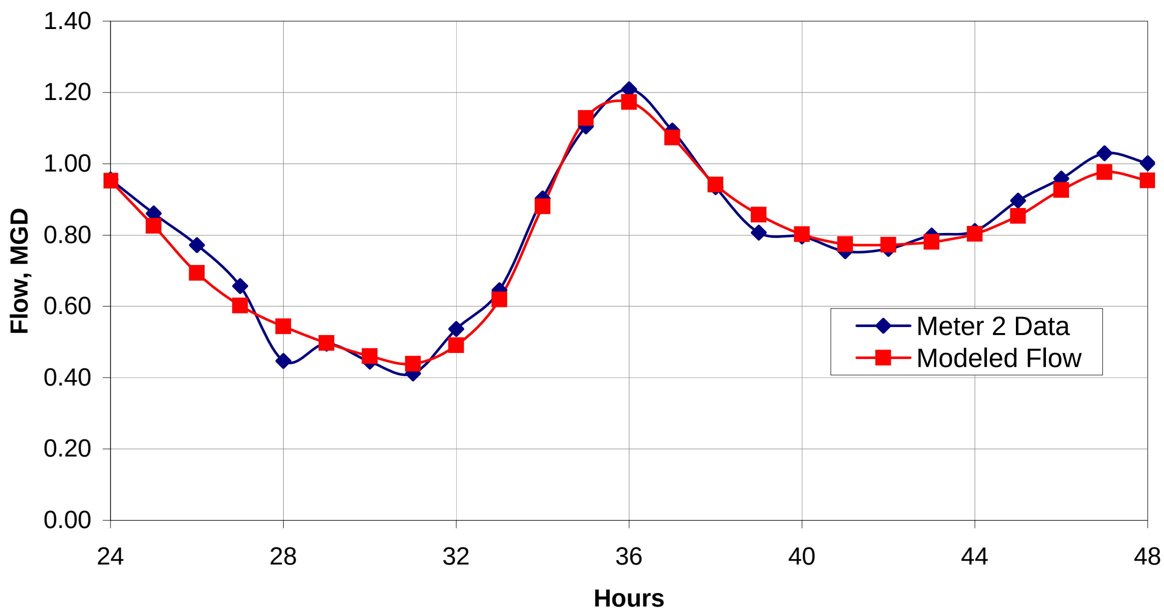

SITE 9 FLOW MONITOR
CALIBRATION CURVE
SEWER SYSTEM MASTER PLAN
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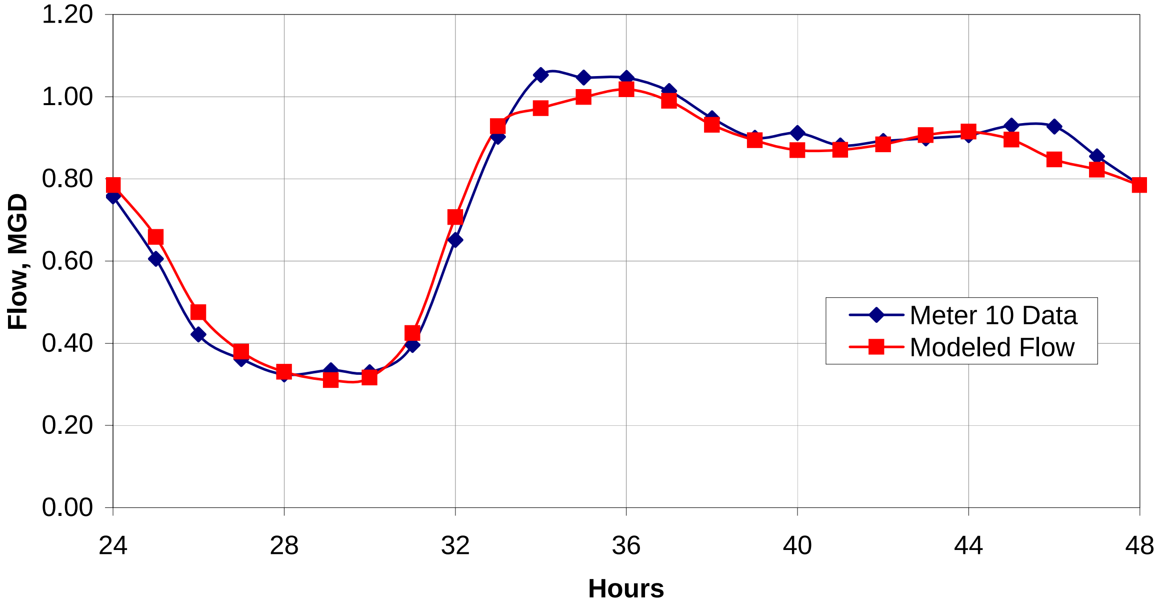

SITE 10 FLOW MONITOR
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