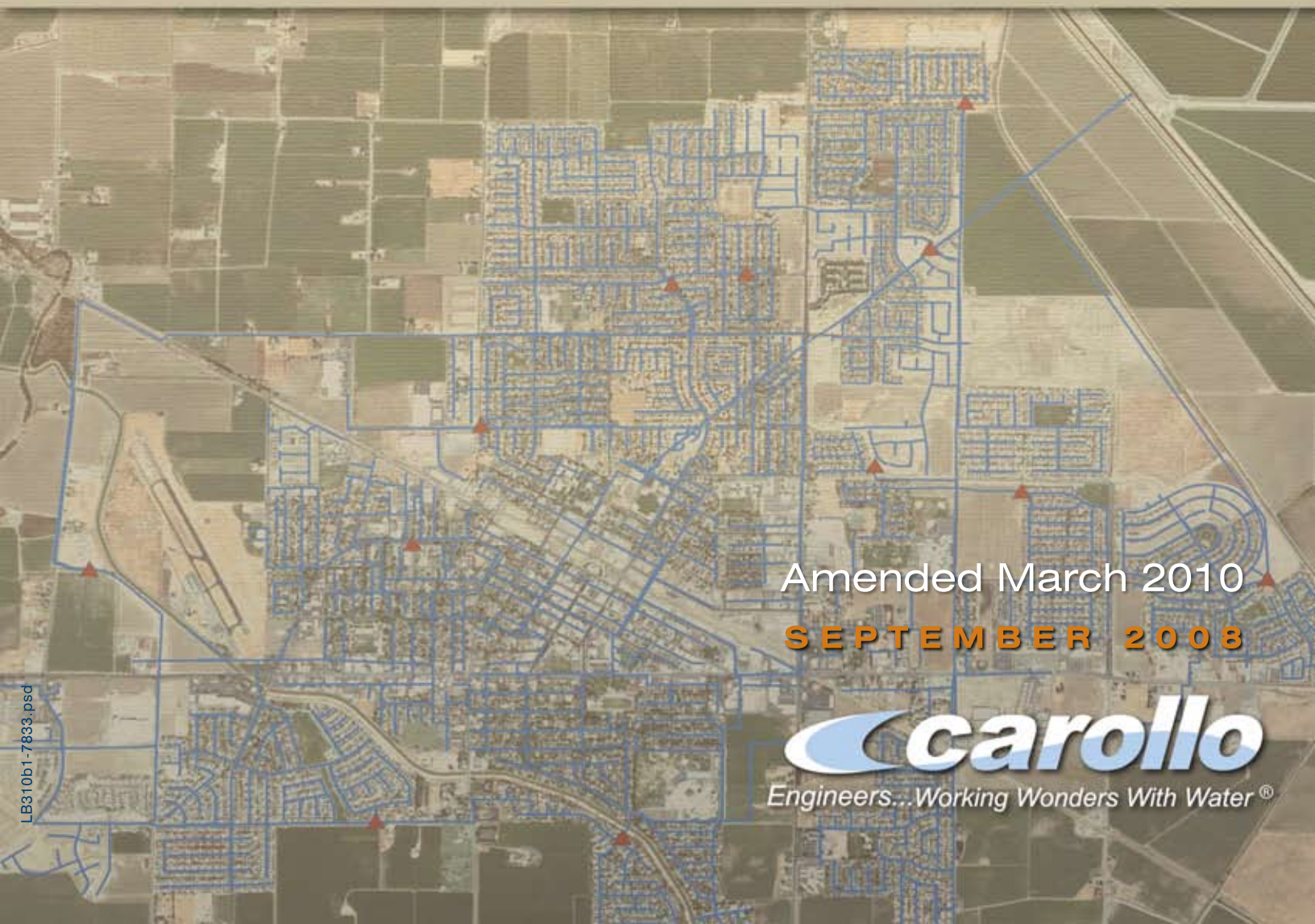
Final Report

MASTER PLAN FOR

City of Los Banos
At the Crossroads of California

Wastewater Collection System



Amended March 2010

SEPTEMBER 2008

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March 31, 2010
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City of Los Banos
411 Madison Avenue
Los Banos, California 93635

Attention: Mr. Mark Fachin, P.E.

Subject: City of Los Banos Final Wastewater Collection System Master Plan
Amended March 2010

Dear Mr. Fachin:

We are pleased to submit 10 copies of the amended final report for the City of Los Banos (City) Wastewater Collection System Master Plan (Master Plan). The Master Plan includes: planning assumptions, the collection system evaluation, and recommended improvements to correct existing deficiencies and to serve future customers. This amended report incorporates the recent changes to land use assumptions and planning boundaries described in the City's 2030 General Plan Update.

Adjustments to the phasing of recommended improvements have also been included to account for the recent slowdown in development and current economic conditions. If economic, development and/or funding conditions change, then the City should revisit the phasing assumptions and consider implementing the recommended improvements at an earlier date, in particular, those that mitigate existing deficiencies.

We would like to extend our thanks to you, Mr. Gary Hutsell, Assistant Public Works Director; and other City staff whose courtesy and cooperation were valuable components in ensuring that this document will assist the City in planning infrastructure improvements to serve its customers.

Sincerely,

CAROLLO ENGINEERS, P.C.

David L. Stringfield, P.E.

Jose L. Gutierrez, P.E.

DLS:JLG:asw

Enclosures: Amended Final Wastewater Collection System Master Plan (10)

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City of Los Banos

WASTEWATER COLLECTION SYSTEM MASTER PLAN

Amended March 2010
September 2008

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City of Los Banos

WASTEWATER COLLECTION SYSTEM
MASTER PLAN

TABLE OF CONTENTS

Page No.

EXECUTIVE SUMMARY

ES.1 INTRODUCTION ES-1
ES.2 STUDY AREA ES-1
ES.3 EXISTING AND FUTURE SERVICE AREA ES-1
ES.4 HISTORICAL AND FUTURE POPULATION ES-3
ES.5 WASTEWATER DESIGN FLOWS ES-3
ES.6 CAPACITY EVALUATION AND PROPOSED IMPROVEMENTS ES-4
ES.6.1 Existing Versus Future Improvement ES-5
ES.6.2 Lift Station Improvements ES-9
ES.6.3 Benefits of Storm Drain Projects to Wastewater System ES-9
ES.6.4 Sewer Main Replacement or Rehabilitation ES-10
ES.6.5 Lift Station Replacement or Rehabilitation ES-10
ES.7 CAPITAL PROJECT PRIORITIZATION ES-10
ES.7.1 Phase 1 Projects (2008-2010) ES-12
ES.7.2 Phase 2 Projects (2011-2015) ES-12
ES.7.3 Phase 3 Projects (2016-2060) ES-13
ES.7.4 Phase 4 and 5 Projects (2021 and beyond) ES-13
ES.7.5 Phase 3 Projects (2021-2025) ES-13
ES.7.6 Phase 4 and 5 Projects (2026 and beyond) ES-14
ES.8 CAPITAL PROJECT COSTS ES-14

CHAPTER 1 – BACKGROUND

1.1 INTRODUCTION 1-1
1.2 BACKGROUND 1-1
1.3 SEWER SERVICE AREA 1-1
1.4 SCOPE AND AUTHORIZATION 1-4
1.5 REPORT ORGANIZATION 1-4
1.6 ACKNOWLEDGMENTS 1-5
1.7 ABBREVIATIONS AND DEFINITIONS 1-5
1.8 REFERENCE MATERIAL 1-6

CHAPTER 2 – STUDY AREA DESCRIPTION

2.1 STUDY AREA 2-1
2.2 PLANNING PERIOD 2-1
2.3 CLIMATE 2-1
2.4 LAND USE 2-3
2.4.1 Sewer Service Area by Land Use 2-3
2.5 HISTORICAL AND FUTURE POPULATION 2-6

CHAPTER 3 – PLANNING CRITERIA

3.1 GRAVITY SEWERS....3-1
3.1.1 Manning Coefficient (n)....3-1
3.1.2 Flow Depth Criteria (d/D)....3-1
3.1.3 Design Velocities and Minimum Slopes....3-2
3.1.4 Changes in Pipe Size....3-2
3.1.5 Wet Well, Lift Stations, and Force Mains....3-3

CHAPTER 4 – SEWER DESIGN FLOWS

4.1 FLOW MONITORING PROGRAM....4-1
4.2 FLOW MONITORING RESULTS....4-1
4.2.1 Average Day Flow Data....4-1
4.2.2 Wet Weather Flow Data....4-3
4.2.3 Rainfall Data....4-4
4.2.4 Design Storm Data....4-4
4.3 WASTEWATER FLOW COMPONENTS....4-5
4.3.1 Base Wastewater Flow....4-7
4.3.2 Groundwater Infiltration....4-7
4.3.3 Average Dry Weather Flow....4-7
4.3.4 Peak Dry Weather Flow....4-7
4.3.5 Maximum Day Wet Weather Flow....4-7
4.3.6 Peak Wet Weather Flow (Design Flow)....4-8
4.3.7 Inflow and Infiltration....4-8
4.4 WASTEWATER TREATMENT PLANT FLOWS....4-9
4.5 WASTEWATER FLOW PROJECTIONS....4-11
4.5.1 Water Conservation Measures....4-11
4.5.2 Largest Industrial Wastewater Dischargers....4-11
4.5.3 Existing Wastewater Flow Coefficients....4-11
4.5.4 Recommended Wastewater Flow Coefficients....4-15
4.5.5 Existing and Future (Build-out) Average Day Flow....4-15
4.5.6 Growth Horizon....4-17
4.6 DESIGN FLOWS....4-18
4.7 INFLOW AND INFILTRATION (I/I) COEFFICIENT....4-19
4.8 PLANNING CRITERIA SUMMARY....4-19

CHAPTER 5 – COLLECTION SYSTEM FACILITIES AND HYDRAULIC MODEL

5.1 WASTEWATER SERVICE AREA OVERVIEW....5-1
5.2 MODELED SEWER SYSTEM....5-3
5.2.1 Interceptors and Major Trunk Sewers....5-3
5.2.2 Lift Stations....5-7
5.3 SEWER SYSTEM HYDRAULIC MODEL....5-7
5.3.1 Quantifying Wastewater Flow....5-9
5.3.2 Sewer Tributary Areas (Existing and Future)....5-9
5.3.3 Wet Weather Flow Modeling....5-10
5.3.4 Model Calibration....5-10
5.3.5 Wet Weather Flow Calibration....5-13

CHAPTER 6 – CAPACITY EVALUATION AND PROPOSED IMPROVEMENTS

6.1 CAPACITY EVALUATION....6-1
6.2 COLLECTION SYSTEM IMPROVEMENTS....6-2
6.2.1 Sewer Main Rehabilitation and Manhole Replacement....6-2
6.2.2 Existing Versus Future Improvement....6-9

6.2.3 Available Capacity in Existing Sewers 6-9
6.2.4 New Trunk Sewers, Interceptors, and Lift Stations 6-10
6.2.5 Existing and Build-out Lift Station Improvements 6-17
6.3 PROJECT PRIORITIZATION 6-17
6.3.1 Phase 1 Projects (2008-2010) 6-18
6.3.2 Phase 2 Projects (2011-2015) 6-18
6.3.3 Phase 3 Projects (2016-2020) 6-18
6.3.4 Phase 4 and 5 Projects (2021 and beyond) 6-19
6.3.5 Phase 3 Projects (2021-2015) 6-19
6.3.6 Phase 4 and 5 Projects (2026 and beyond) 6-20
6.4 ADDITIONAL RECOMMENDATIONS 6-20
6.4.1 Downtown Storm Drain Projects 6-20
6.4.2 Sewer Main Replacement or Rehabilitation 6-22
6.4.3 Lift Station Replacement or Rehabilitation 6-22

CHAPTER 7 – CAPITAL IMPROVEMENTS PROJECTS

7.1 CAPITAL IMPROVEMENT PROJECT COSTS 7-1
7.2 COST ESTIMATING ACCURACY 7-1
7.3 CONSTRUCTION UNIT COSTS 7-1
7.3.1 Pipeline Unit Costs 7-1
7.3.2 Lift Station Unit Costs 7-2
7.3.3 Land Acquisition Costs 7-2
7.4 PROJECT COSTS AND CONTINGENCIES 7-2
7.4.1 Baseline Construction Cost 7-2
7.4.2 Estimated Construction Cost 7-4
7.4.3 Capital Improvement Cost 7-4
7.5 CAPITAL IMPROVEMENT IMPLEMENTATION 7-5
7.6 EXISTING VERSUS FUTURE USER COST SHARE 7-5

APPENDIX A – Land Use Descriptions
APPENDIX B – Design Storm Report
APPENDIX C – Flow Meter Diurnal Curves
APPENDIX D – Average Day Flow Calibration Plots

LIST OF TABLES

Table ES.1 Existing and Projected Year 2030 Population ES-3
Table ES.2 Current and Projected Wastewater Flows ES-4
Table ES.3 Capital Projects (3 pages) ES-15
Table ES.4 Capital Cost Summary ES-18
Table 2.1 Study Area Land Use Designations 2-5
Table 2.2 Historical and Projected Population 2-7
Table 3.1 d/D Ratios for Design Flow Conditions 3-2
Table 3.2 Minimum Slope and Maximum Flow 3-3
Table 4.1 Average Day and Average Peak Dry Weather Flow 4-3
Table 4.2 Rain Gauge Summary 4-4
Table 4.3 Historical Monthly WWTP Influent Flows 4-10
Table 4.4 Industrial Discharger Summary 4-12
Table 4.5 Existing Wastewater Flow Coefficients 4-14
Table 4.6 Recommended Wastewater Flow Coefficients 4-15

Table 4.7 SOI Build-out Flow Projections 4-16
Table 4.8 Average Day Flow Summary 4-17
Table 4.9 Flow Projections 4-18
Table 4.10 Current and Projected Wastewater Flows 4-19
Table 4.11 Planning Criteria Summary 4-20
Table 5.1 Wastewater Collection System Pipeline Summary 5-1
Table 5.2 Modeled Sewer System Pipeline Summary 5-3
Table 5.3 Lift Station and Wet Well Design Data 5-8
Table 5.4 Average Day Flow Calibration Summary 5-15
Table 5.5 Design Storm and Calibration Storm Comparison 5-17
Table 6.1 Proposed Collection System Improvements (3 pages) 6-6
Table 6.2 Lift Station Improvements 6-16
Table 7.1 Pipeline Unit Costs 7-2
Table 7.2 Capital Projects (3 pages) 7-6
Table 7.3 Capital Cost Summary 7-10

LIST OF FIGURES

Figure ES.1 Study Area ES-2
Figure ES.2 Proposed Collection System Improvements (3 Pages) ES-6
Figure ES.3 Storm Drain Cross Connection Removal ES-11
Figure 1.1 Location Map 1-2
Figure 1.2 Current Wastewater Collection Service Area 1-3
Figure 2.1 Study Area 2-2
Figure 2.2 General Plan Land Use 2-4
Figure 2.3 Historical and Projected Population 2-8
Figure 4.1 Flow Meter Locations 4-2
Figure 4.2 10-Year, 24-Hour Design Storm Rainfall Distribution 4-6
Figure 5.1 Existing Wastewater Collection System 5-2
Figure 5.2 Modeled Wastewater Collection System 5-4
Figure 5.3 Existing Sewer System Tributaries 5-11
Figure 5.4 Future System Sewer Tributaries 5-12
Figure 5.5 Flow Meter 4 Diurnal Pattern 5-14
Figure 5.6 Flow Meter 4 Average Day Flow Calibration 5-16
Figure 5.7 February 2005 Wet Weather Calibration 5-19
Figure 6.1 Proposed Collection System Improvements (3 pages) 6-3
Figure 6.2 Storm Drain Cross Connection Removal 6-24
Figure 7.1 Lift Station Cost versus Capacity Curve 7-3

WASTEWATER COLLECTION SYSTEM MASTER PLAN

ES.1 INTRODUCTION

The City of Los Banos (City) is located in western Merced County (County), in the northern portion of the San Joaquin Valley. The City is located near the junction of California State Route (SR)-152 and Interstate 5. Los Banos is the second largest city in the County. The City collects, treats, and disposes wastewater originating from the residential, commercial, institutional, and industrial dischargers within the service area. The City owns, maintains, and operates all wastewater facilities within the service area.

The City's collection system includes sanitary sewer lines that span 4- to 30-inches in diameter, and 13 lift stations. In addition to the collection system, the City also operates a wastewater treatment plant (WWTP) located northeast of the City. As a separate project, the City is currently designing upgrades to the existing WWTP. The improvements to the existing WWTP are not discussed in this report since the focus of this Master Plan was the wastewater collection system.

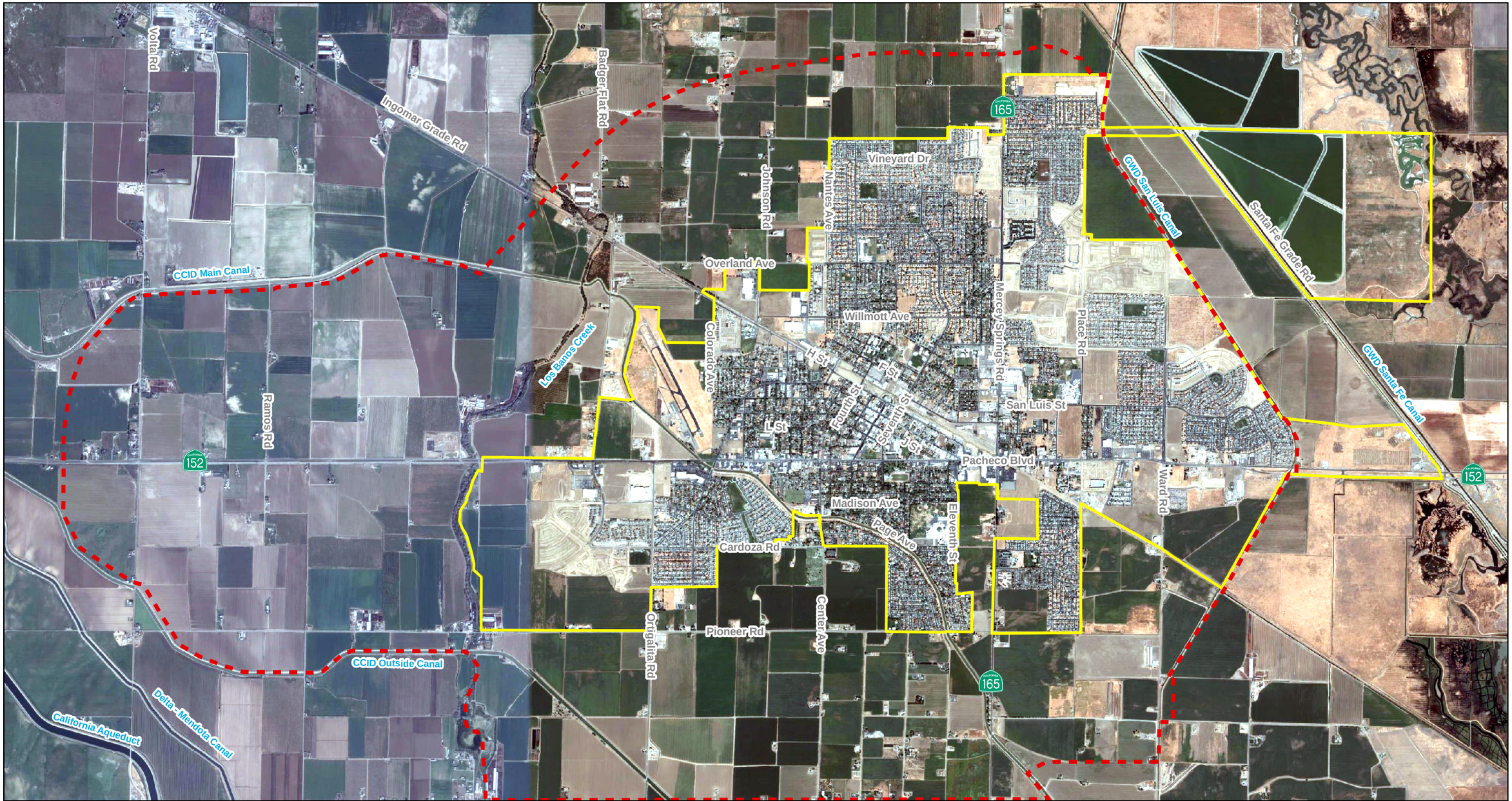
ES.2 STUDY AREA

The City's 2030 General Plan Update (2030 General Plan) sphere of influence (SOI) is the study area boundary for this wastewater collection system master plan (Master Plan). The Master Plan area study boundary and SOI are synonymous and will be used interchangeably throughout this report. The SOI boundary extends far beyond the current wastewater collection service area and is approximately 14,382 acres (22.5 square miles). The Master Plan contains a forecast of sewer improvements in a large study area beyond the City limits. Figure ES.1 shows the study area boundary and the City's limits. Evaluating infrastructure needs beyond the City limits is important because: there are conceptual development plans that are beyond the City limits; recent rapid growth in the San Joaquin Valley indicates that significant development into the study area could occur within a short planning period; and by forecasting the ultimate, orderly expansion of the sewer system, there is a greater utilization of reliable gravity sewers.

ES.3 EXISTING AND FUTURE SERVICE AREA

The land use designations (residential, commercial, etc.) used in this Master Plan are consistent with the City's 2030 General Plan. The type of land use in an area will affect the volume, including daily variation of the wastewater generated.

The City currently provides sewer service to approximately 4,582 acres (includes developed and undeveloped land) or 7.2 square miles. Note that the acreage total does not include



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Sphere of Influence[1]

City Limits

N

Feet

0 2,500 5,000

Figure ES.1
Study Area
Wastewater Collection System Master Plan
City of Los Banos

1. Sphere of Influence from City of Los Banos 2030 General Plan Update, Dyett & Bhatia, July 15, 2009

land occupied by the WWTP because the treatment plant is located outside of the SOI. The largest land use category is residential (low, medium, and high), which accounts for approximately 2,279 acres, or approximately 50 percent of the total acreage. Commercial, office/professional, and industrial make up approximately 925 acres, or 20 percent of the total. Civic/Institutional makes up approximately 181 acres, or 4 percent. Non-wastewater generating land uses like parks, streets, and open space land uses account for 1,197 acres, or 26 percent of the total service area.

At build-out of the SOI boundary, the City will serve approximately 14,382 acres or 22.5 square miles, which is about three times the current service area. Build-out is defined as complete development of all lands. Residential will continue to represent the largest land use category in the City and will make up approximately 38 percent of the total acreage.

ES.4 HISTORICAL AND FUTURE POPULATION

The City's population began to grow quickly after World War II owing to returning veterans and highway construction[1]. A series of irrigation and dam projects in the 1960s brought more people to the City, however, growth slowed from 1970 to 1985. In 1990, the City's population began to grow rapidly and continued through year 2007. From 1990 through the present, the population grew from approximately 14,500 to 35,200. Over the last 20 years, the City has grown at an annual rate of about 5.1 percent.

The 2030 General Plan states that the build-out population will reach approximately 90,400 people. This build-out population reflects an annual growth rate that ranges between 4.1 to 4.6 percent. Table ES.1 summarizes the existing and projected year 2030 population.

Table ES.1 Existing and Projected Year 2030 Population
Wastewater Collection System Master Plan
City of Los Banos

Year	Population
2007	35,200
2030	90,400

Note:
1. Source of historical data: City of Los Banos 2030 General Plan Update, July 2009.

ES.5 WASTEWATER DESIGN FLOWS

The design flow is the maximum hourly flow rate at the WWTP under selected design storm and growth conditions. Design flow is the sum of peak wastewater flows and inflow/infiltration (I/I) resulting from a selected design storm (10-year, 24-hour).

Since the collection system provides service to industrial dischargers, the calculation of the design flows accounted for these dischargers. The maximum industrial discharge was added to the design flow. The maximum industrial discharge was the recorded average hourly flow for the maximum month. By including the maximum month flow for each industry, not only does the design flow account for the 10-year, 24-hour design storm, but it also includes the maximum industrial discharge flow. This approach supports our confidence that we are modeling the maximum flow condition that could occur in the sewer system.

In summary, the design flow consists of three components:

- Average day flow
- Wet weather inflow and infiltration
- Maximum industrial discharge

Table ES.2 presents the current average day and design flow for the service area. Also shown are the forecast average day and design flow at build-out of the City's SOI boundary.

Table ES.2 Current and Projected Wastewater Flows
Wastewater Collection System Master Plan
City of Los Banos

	Average Day Flow[2] (mgd)	**Design Flow (mgd)**	**Peaking Factor**
Current[1]	3.55	6.1[1]	1.7
SOI build-out	11.0	18.7	1.7

Notes:
1. Based on meter data from Sanitary Sewer Flow Monitoring, September 2007.
2. Assumes average industrial flow, not maximum month.

ES.6 CAPACITY EVALUATION AND PROPOSED IMPROVEMENTS

The capacity analysis entailed identifying areas in the collection system where flow restrictions occur or where pipe capacity is insufficient to convey design flows. Sewers that lack sufficient capacity to convey design flows could produce backwater effects in the sewer system and potentially cause sanitary sewer overflows (SSOs).

The hydraulic modeling analysis identified locations of existing and future hydraulic deficiencies resulting from flows exceeding the maximum flow depth (d) to pipe diameter ratio (D) (d/D) criteria and from lift stations lacking the firm capacity to convey design flow.

Most of the existing wastewater collection system has sufficient capacity to convey existing design flows. However, in some locations, such as the City's downtown, existing storm

[1] City of Los Banos 2030 General Plan Administrative Draft, June 2007, Dyett & Bhatia

drain connections cause sudden increases in wastewater flow during a storm event. The storm water inflow could cause a few sewers to surcharge and potentially overflow during a large storm. The City had the option to either upsize the sanitary sewer system to convey storm water runoff, or to construct storm drain pipelines and separate the storm runoff from the wastewater system. City staff made the decision to implement storm drain projects to separate storm runoff from the wastewater collection system. These projects are discussed in Chapter 6 of this Master Plan and in more detail in the Storm Drainage Master Plan. Implementing the storm drain projects achieved multiple benefits including reducing wastewater flow to the WWTP, relieving flooding in the downtown area, and eliminating wastewater capital projects. The projects presented in this Master Plan assume that downtown storm drain projects would also be implemented.

The proposed improvements that will serve future users are sized for build-out conditions. As the City continues to grow beyond its current limits, it is recommended that the pipeline diameters and pump station capacities proposed in this Master Plan be constructed so that the facilities have sufficient capacity for build-out conditions. Building a smaller interim project with the plans of upsizing in the future to account for further growth is not recommended. In this Master Plan, the proposed pipe diameter represents the ultimate diameter for build-out conditions.

Figure ES.2 (three pages) illustrates the proposed improvements necessary to correct the existing deficiencies and to serve future users. Figure ES.2 shows the proposed improvements in different categories (colors). The different colors identify the implementation timeframe of the improvements and differentiate between near-term and long-term improvements.

ES.6.1 Existing Versus Future Improvements

The vast majority of the Master Plan improvements will serve future users, even when an improvement calls for the upgrade of an existing facility. In these cases, an existing sewer or lift station may have sufficient capacity to convey current design flows, but as growth continues and more users are added to the system, the increased flow results in capacity deficiencies. These are labeled future improvements. There are several rehabilitation and replacement projects that are intended to restore existing infrastructure, and these are listed as existing improvements. The future improvements were broken down further based on their funding source. Future improvements will be funded by developers or through development impact fees. All projects fall into one of the three following categories:

- Existing Improvements: Existing improvements correct existing deficiencies or rehabilitate/replace existing facilities that have reached their useful life. These projects are funded through user rates.
- Developer Improvements: Future improvements that serve new users. These improvements will be developer funded and/or may be part of a reimbursement agreement between developers.

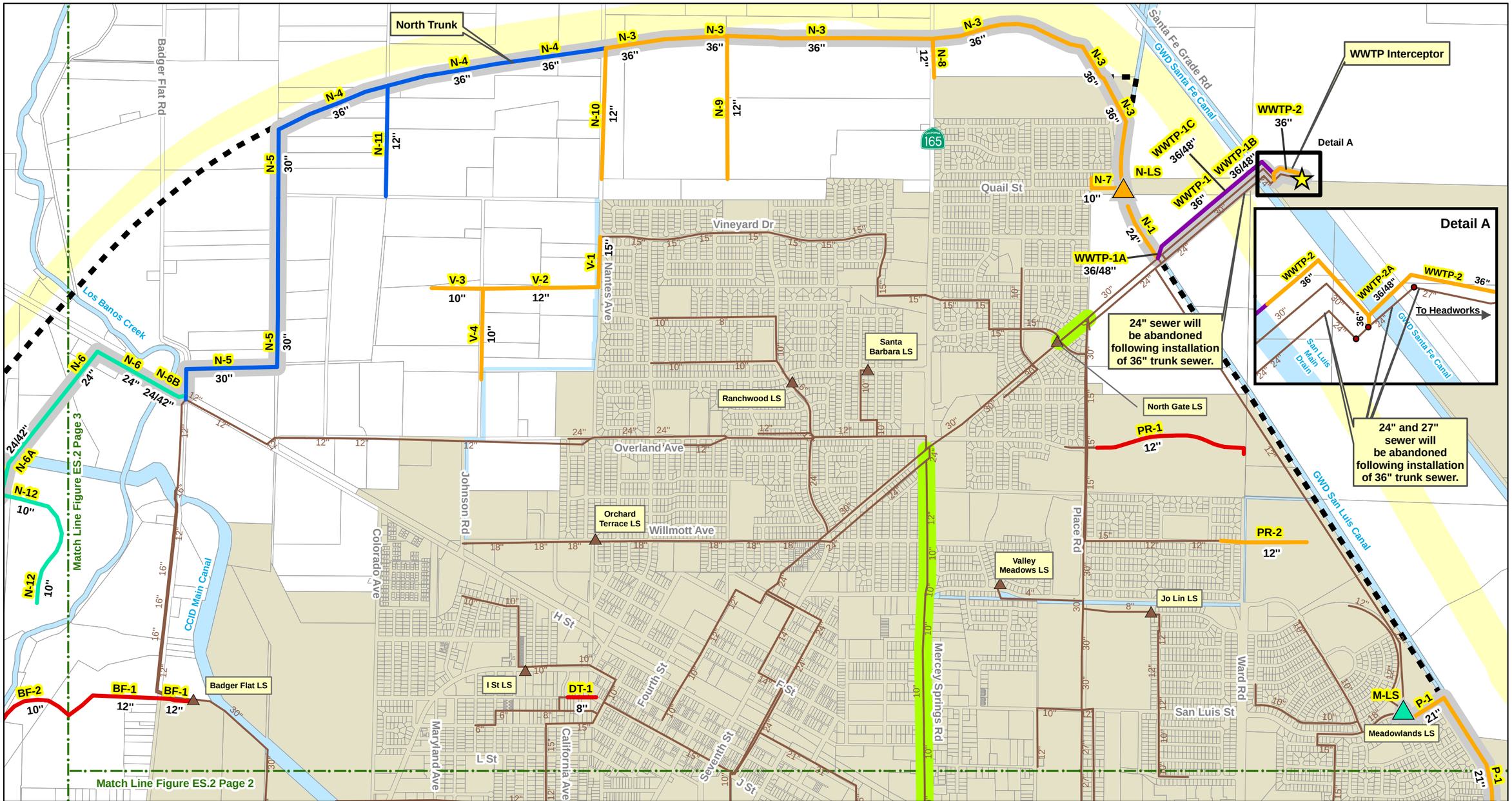
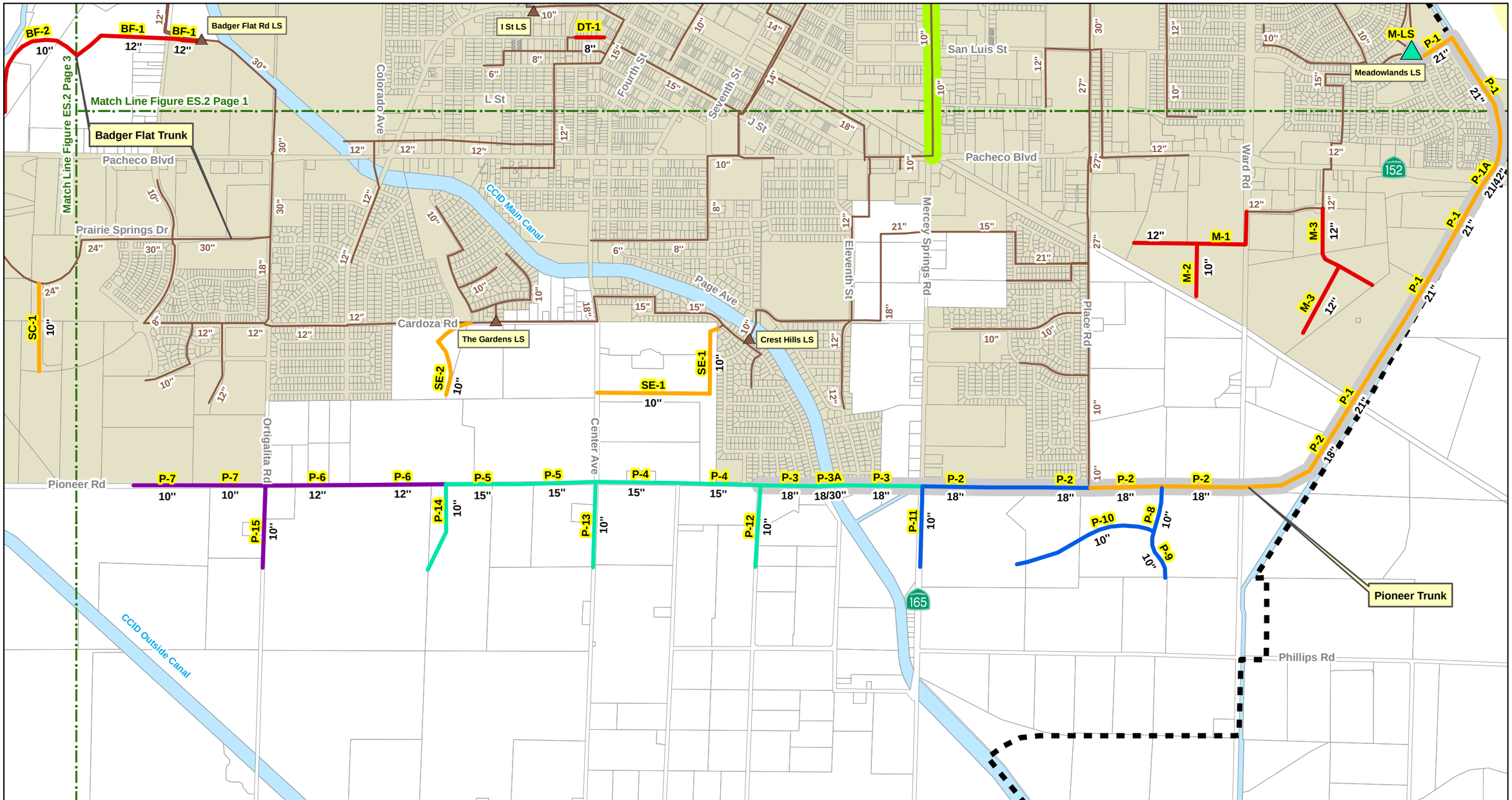


Figure ES.2
Proposed Collection System Improvements (1 of 3)
Wastewater Collection System Master Plan
City of Los Banos



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Modeled Wastewater Collection Facilities

- Lift Station
- Sewer Pipelines

Future Collection Facilities

Lift Stations

- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031+)
- P-5 CIP ID
- 12" CIP Diameter

Sewer Pipelines

- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- 8" Existing Diameter
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031+)
- Rehabilitation Project
- Regional Improvements
- Parcels
- Waterways/Canals
- SR 152 Bypass Corridor
- City Limits
- Sphere of Influence

N

0 1,000 2,000 Feet

Figure ES.2
Proposed Collection System Improvements (2 of 3)
Wastewater Collection System Master Plan
City of Los Banos

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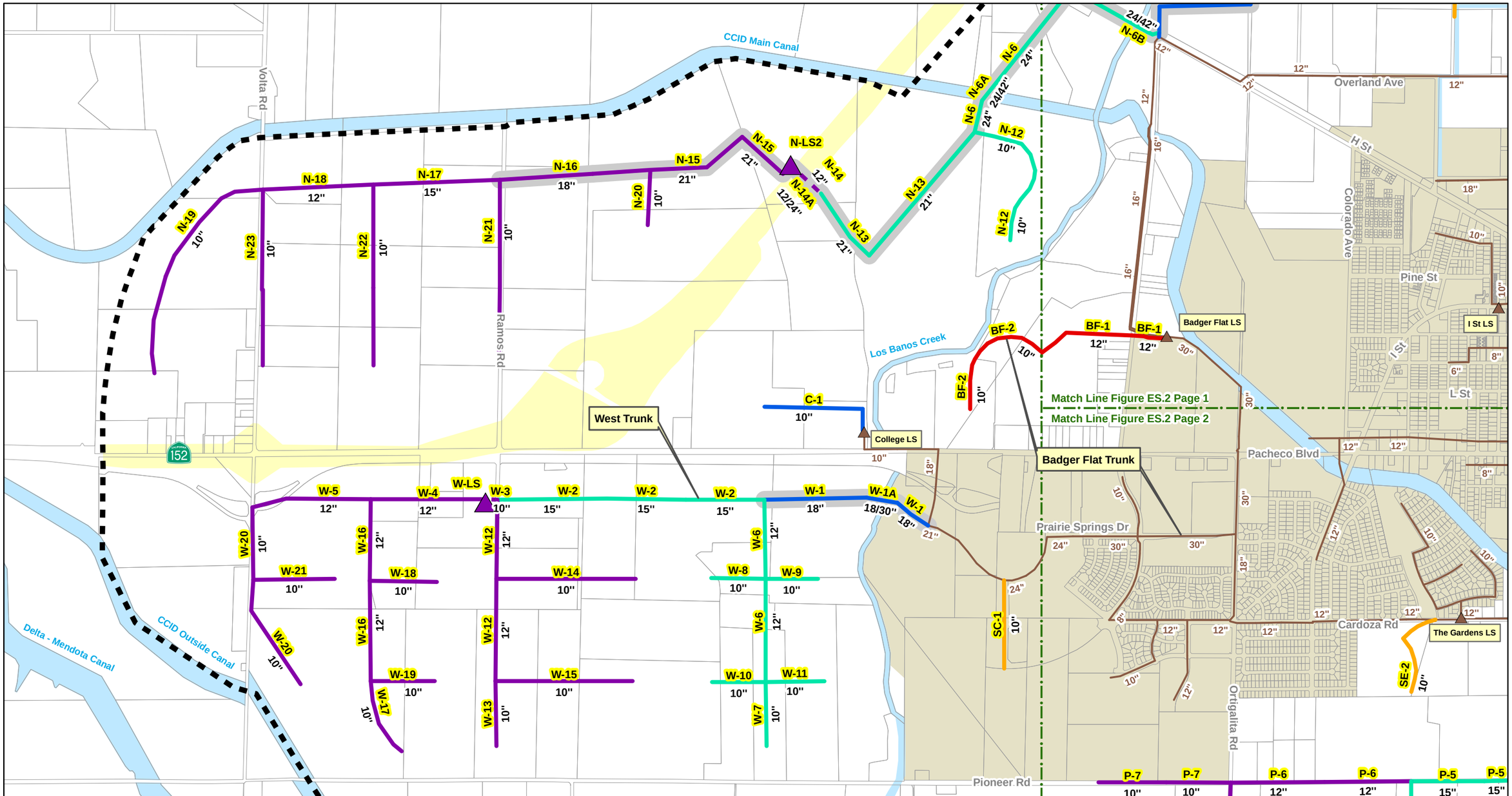


Figure ES.2
Proposed Collection System Improvements (3 of 3)
Wastewater Collection System Master Plan
City of Los Banos

- Regional Improvements: Future improvements that serve new users. These improvements will be funded through wastewater development impact fees collected by the City.

The majority of future improvements are Developer Improvements, but sewers that were 18-inch diameter and larger were designated Regional Improvements. The Regional Improvements are shown in Figure ES.2.

ES.6.2 Lift Station Improvements

The City's Improvement Standards require that all sewage lift stations have two non-clog sewer pumps, each capable of pumping 100 percent of the design flowrate. In other words, each lift station's firm capacity should be sufficient to pump 100 percent of the design flowrate. Each lift station's firm capacity was compared to the existing and build-out design flow conveyed to the lift station. If the design flow was greater than the lift station's firm capacity, then the lift station was considered deficient and required upgrade.

The majority of lift stations contain sufficient firm capacity to convey existing and build-out design flows. However, the Meadowlands lift station will require upgrade to convey build-out design flows.

ES.6.3 Benefits of Storm Drain Projects to Wastewater System

The downtown area of the City experiences sudden increases in flow following large storm events. Previous master plans prepared by the City identified several storm drain connections to the collection system that cause this increase in flow. This Master Plan concluded that if the City implements storm drain projects to separate these inflow connections, then a large downtown wastewater sewer project could be avoided. The City should proceed with the downtown storm drain projects presented in Chapter 6 of the Master Plan and analyzed in more detail in the 2008 Storm Drainage Master Plan.

There are cost savings for the wastewater system associated with implementing the storm drain projects. The City reduces the capital costs required to install large diameter sewers necessary to convey combined sanitary and storm water flows. Our analysis concluded that if storm water runoff continues to flow to the collection system, then 4,200 feet of 24-inch diameter sewer would be constructed to relieve the existing downtown sewers. This 24-inch diameter sewer would jog through several downtown streets, including 3rd, 4th, H, and D Streets. Constructing this sewer would cost approximately $1.6 million and would likely be disruptive to downtown traffic and businesses.

By implementing the storm drain projects, there is also a reduction in peak flows conveyed through the collection system that ultimately reaches the WWTP. Our analysis indicated that peak flows could reduce by as much as 2.0 mgd by removing the storm drain connections. Reducing the peak flows has many benefits, including freeing up capacity in the existing trunk sewers, the Central and WWTP interceptors, and reducing the size

(diameter) of the capital projects. Reduction in peak flows also benefit the WWTP and planned improvements to the headworks. By freeing up capacity, the implementation of the improvements identified in this Master Plan was deferred to the timeframes shown. If storm runoff continued to be conveyed to the wastewater collection system, then implementation of the capital projects would be scheduled at earlier dates. The future capital projects would also be more costly, because the size of pipe required to convey storm runoff and future flows would be greater.

The State Water Resources Control Board (SWRCB) recently adopted (May 2, 2006) the Statewide General Waste Discharge Requirements (WDR) for Sanitary Sewer Systems. The purpose of the WDR is to reduce SSOs. Large increases in sewer flow following a storm could result in SSOs. Identifying and removing the storm connections to the sewer system will reduce the likelihood of SSOs.

The proposed storm drain improvements that separate runoff from the wastewater collection system are shown in Figure ES.3. The capital cost for these projects were included in this Master Plan since they benefit the wastewater collection system.

ES.6.4 Sewer Main Replacement or Rehabilitation

The City identified the 10-inch and 12-inch diameter Mercey Springs trunk sewer as deteriorated. Deteriorated sewers are often corroded and susceptible to collapse. This study did not conduct a condition assessment to evaluate the structural integrity of existing sewers, nor did it evaluate rehabilitation alternatives for existing sewers. However, based on input from City staff, we are including rehabilitation of this and other sewers as capital projects. For the purposes of budgeting, we assumed that the City would implement various rehabilitation projects through the year 2035.

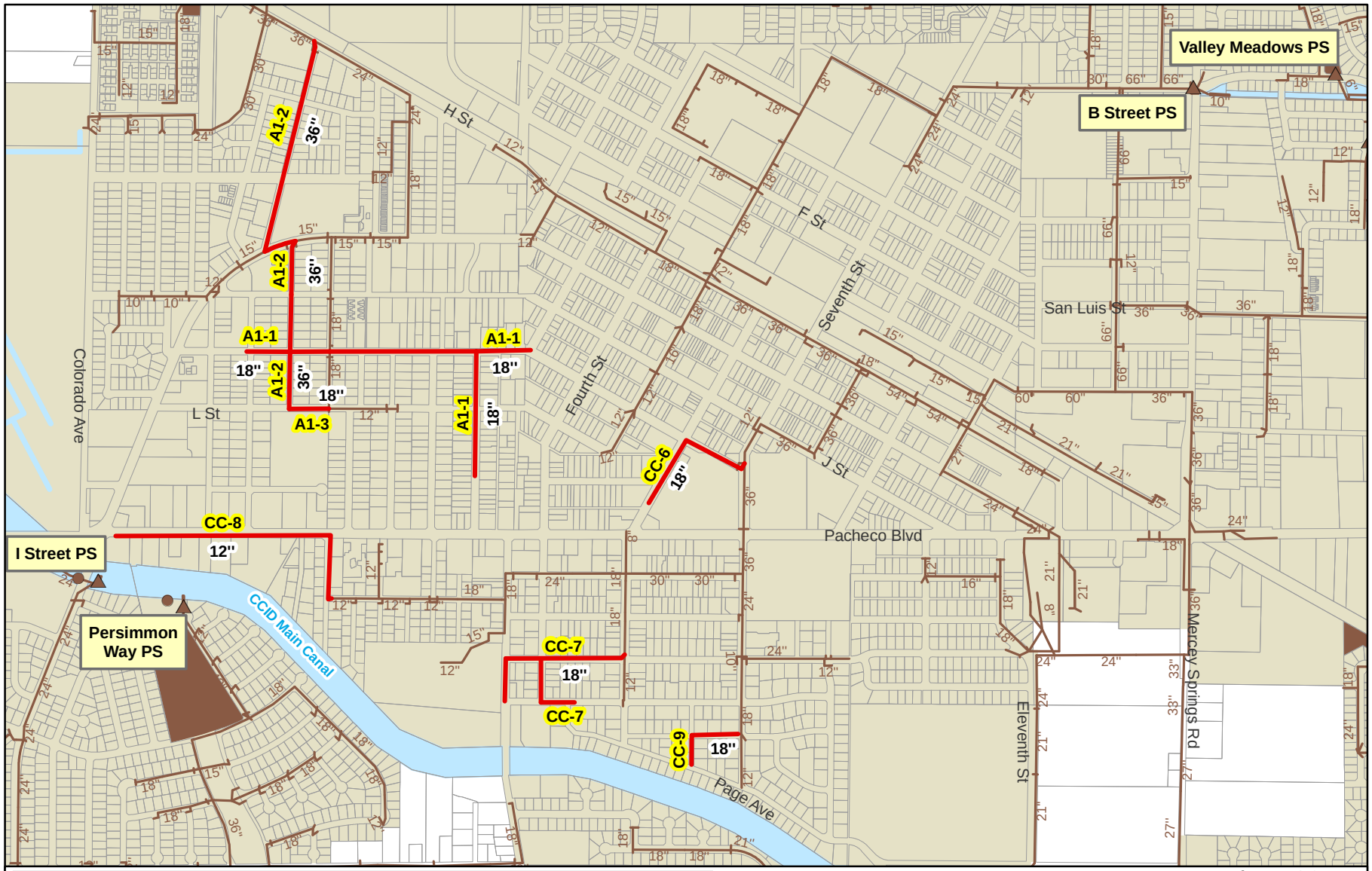
The capital improvements also assumed that the City would replace about 0.25 miles of sewer every year. The weighted average diameter of all sewers in the collection system is 10-inches. Therefore, in order to develop a capital cost, we assumed that about 0.25 miles of 10-inch diameter sewer would be replaced every year through 2035.

ES.6.5 Lift Station Replacement or Rehabilitation

Lift station replacement or rehabilitation will be necessary to maintain proper operation of existing facilities. We assumed that lift stations would be rehabilitated or replaced every five years. For budgeting purposes, we assumed replacement of the older lift stations, which range in capacity from 200 to 3,000 gpm, and average approximately 600 gpm. We also assumed that four lift stations would be rehabilitated or replaced by year 2030.

ES.7 CAPITAL PROJECT PRIORITIZATION

The majority of improvements listed in this Master Plan are driven by future development. Most of the improvements are new sewers and lift stations that serve future growth, but



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Existing Storm Drainage System

- Outfall
- Pump Station
- Storm Drains
- Storm Basins

Storm Drainage System Improvements

- Strom Drain Cross Connection Removal
- CH-2 CIP ID
- 12" CIP Diameter
- 8" Existing Diameter

- Waterways/Canals
- Parcels
- City Limits

N

0 500 1,000 Feet

Figure ES.3
Storm Drain Cross Connection Removal
Wastewater Collection System Master Plan
City of Los Banos

there are some improvements to existing facilities that resulted from future growth. When fully implemented, the capital projects will allow the conveyance of design flows to the WWTP during build-out conditions.

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

- Upgrading existing sewers or lift stations to serve future users
- Eliminating storm runoff into the collection system
- Building the sewers necessary to serve future users

ES.7.1 Existing System Improvement Prioritization

The storm drain projects that reduce storm inflow into the wastewater collection system are high priority projects. These include the Airport No. 1 subbasin storm drain projects (A1-1, 2 and 3) and the Central City subbasin storm drain projects (CC-6 through CC-9).

Due to economic conditions and the slowdown in development, the probability and practicality of constructing all these improvements in the next five years is low. For this reason, the improvements were distributed amongst all phases according to priority and level of benefit provided to the existing system.

Improvements to existing sewers and lift stations will provide sufficient capacity to convey increased flows resulting from new development.

ES.7.2 Future System Improvement Prioritization

Future development will require the construction of sewers to serve new users. The implementation of these improvements will depend on the City's growth and selection of areas to be served with urban infrastructure. The City provided guidance on future development and phasing of infrastructure to serve future users. Based on this input, the projects were grouped into the following timeframes:

- Years 2010 through 2015
- Years 2016 through 2020
- Years 2021 through 2025
- Years 2026 through 2030
- Beyond 2031

Proposed improvements within areas identified for early development were assigned a higher priority. Areas within an approved tentative map tract received the highest priority. The actual implementation of the improvements serving future users depends on growth. The priorities presented below are estimates based on available information provided by

the City. Changes in the City's planning assumptions or growth projections could increase or decrease the priority of each improvement.

ES.7.3 Phase 1 Projects (2010-2015)

The highest priority projects include the first reach of the Pioneer trunk sewer (P-1) and the Provinces trunk sewer (PR-1). The Provinces trunk sewer will serve a new residential development between Place and Ward Road, north of Willmott Road. The Pioneer trunk sewer will serve an industrial redevelopment area south of Highway 152 and east of Ward Road. The design phase of the Pioneer trunk sewer could start in Phase 1, but the construction of the first reach of the sewer will likely span into Phase 2 (2016-2020).

The Phase 1 projects include the following:

- Downtown Sewer Main (DT-1)
- Pioneer Trunk (P-1 and P-1A)
- Meadowlands Trunk (M-1, M-2, and M-3)
- Provinces Trunk (PR-1 and PR-2)
- Badger Flat Trunk (BF-1 and BF-2)
- Stone Creek Trunk (SC-1)

ES.7.4 Phase 2 Projects (2016-2020)

The Phase 2 projects will serve new development in the growth areas targeted by the City. All the Phase 2 projects will likely be implemented between 2016 and 2020. Some of the projects identified within Phase 2 are part of a larger capital project. For example, the first three reaches of the North trunk sewer (N-1, N-2, and N-3) and the lift station are targeted as the first segments of this sewer to be constructed. Several branches of the North trunk (N-7 through N-10) are also identified as Phase 2 projects.

The Phase 2 projects include the following:

- Pioneer trunk (P-1, P-1A, P-2)
- North trunk and lift station (N-1, N-3, and N-LS)
- Vineyard trunk (V-1 through V-4)
- Southeast trunk (SE-1 and SE-2)
- Wastewater Treatment Plant trunk (WWTP-2 and WWTP-2A)
- On going sewer main rehabilitation and replacement, manhole replacement, and lift station rehabilitation or replacement

ES.7.5 Phase 3 Projects (2021-2025)

The Phase 3 projects will serve future development beyond year 2020. These projects are within the ten-year window identified by the City. Many of the projects are continuations of

sewers that were started in Phase 1 and 2. For example, P-2 represents the second phase of the Pioneer trunk sewer. The Phase 3 projects include the following:

- Pioneer trunk (P-2, P-8 through P-11)
- College trunk (C-1)
- West trunk (W-1 and W-1A)
- Meadowlands lift station (M-LS)
- North Trunk (N-4 and N-5)
- On going sewer main rehabilitation and replacement, manhole replacement, and lift station rehabilitation or replacement

ES.7.6 Phase 4 and 5 Projects (2026 and beyond)

For the purposes of prioritization, these are viewed as very long-term, low priority projects, and will be grouped together. The Phase 4 and 5 projects include the following:

- Wastewater Treatment Plant trunk (WWTP-1 through WWTP-1C)
- Pioneer trunk (P-3 through P-7, and P-12 through P-15)
- North trunk (N-6 through N-23, and N-LS2)
- West trunk and lift station (W-2 through W-21, W-LS)
- On going sewer main rehabilitation and replacement, manhole replacement, and lift station rehabilitation or replacement

ES.8 CAPITAL PROJECT COSTS

A summary of the capital project costs is presented in Table ES.3. The table also shows the probable phase in which the project would be implemented. The implementation timeframe was based on the priority of each project to correct existing deficiencies or to serve future users. The future improvements are broken down further into Regional or Developer Improvements. The difference between these two is the funding source. The breakdown in existing and future user cost share by phase is presented in Table ES.4

Table ES.3 Capital Improvement Projects

Wastewater Collection System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-15 ($)	Phase 2 2016-20 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Regional ($)
Wastewater Treament Plant																	
WWTP-1	Pipe	WWTP	WWTP		36	New	2,265	$ 1,351,000					$ 1,351,000	100%	$ -	$ -	$ 1,351,000
WWTP-1A	Casing[1]	WWTP	Casing under San Luis Canal		36/48	New	200	$ 557,000					$ 557,000	100%	$ -	$ -	$ 557,000
WWTP-1C	Casing[1]	WWTP	Casing under future H-152 Bypass		36/48	New	365	$ 1,016,000					$ 1,016,000	100%	$ -	$ -	$ 1,016,000
WWTP-1B	Casing[1]	WWTP	Casing under San Luis Master Drain		36/48	New	200	$ 557,000					$ 557,000	100%	$ -	$ -	$ 557,000
WWTP-2	Pipe	WWTP	WWTP		36	New	475	$ 284,000		$ 284,000				100%	$ -	$ -	$ 284,000
WWTP-2A	Casing[1]	WWTP	Casing under Santa Fe Canal		36/48	New	150	$ 418,000		$ 418,000				100%	$ -	$ -	$ 418,000
Downtown Sewer																	
DT-1	Pipe	J Street	East of Linda Vista		8	New	465	$ 67,000	$ 67,000					0%	$ 67,000	$ -	$ -
Pioneer Trunk																	
P-1	Pipe	Future road	New development		21	New	8,114	$ 2,824,000	$ 1,412,000	$ 1,412,000				100%	$ -	$ -	$ 2,824,000
P-1A	Casing[1]	152	Casing under Highway 152		21/42	New	187	$ 456,000	$ 228,000	$ 228,000				100%	$ -	$ -	$ 456,000
P-2	Pipe	Pioneer	East of 165 along Pioneer and curving northward		18	New	7,135	$ 2,128,000		$ 1,316,000	$ 812,000			100%	$ -	$ -	$ 2,128,000
P-3	Pipe	Pioneer	Plow Camp to 165		18	New	2,623	$ 782,000				$ 782,000		100%	$ -	$ -	$ 782,000
P-3A	Casing[1]	Canal	Casing under Main Canal		18/30	New	200	$ 348,000				$ 348,000		100%	$ -	$ -	$ 348,000
P-4	Pipe	Pioneer	Diana to Plow Camp		15	New	1,348	$ 368,000				$ 368,000		100%	$ -	$ 368,000	$ -
P-5	Pipe	Pioneer	West of Diana		15	New	3,755	$ 1,026,000				$ 1,026,000		100%	$ -	$ 1,026,000	$ -
P-6	Pipe	Pioneer	East of Ortigalita		12	New	2,927	$ 640,000					$ 640,000	100%	$ -	$ 640,000	$ -
P-7	Pipe	Pioneer	West of Origalita		10	New	2,142	$ 390,000					$ 390,000	100%	$ -	$ 390,000	$ -
P-8	Pipe	Future road	New development		12	New	719	$ 158,000			$ 158,000			100%	$ -	$ 158,000	$ -
P-9	Pipe	Future road	New development		10	New	810	$ 148,000			$ 148,000			100%	$ -	$ 148,000	$ -
P-10	Pipe	Phillips	Runs partially along Phillips and to the north of Phillips		10	New	2,400	$ 437,000			$ 437,000			100%	$ -	$ 437,000	$ -
P-11	Pipe	165	South of Pioneer		10	New	1,302	$ 237,000			$ 237,000			100%	$ -	$ 237,000	$ -
P-12	Pipe	Plow Camp	South of Pioneer		10	New	1,323	$ 242,000				$ 242,000		100%	$ -	$ 242,000	$ -
P-13	Pipe	Center	South of Pioneer		10	New	1,384	$ 253,000				$ 253,000		100%	$ -	$ 253,000	$ -
P-14	Pipe	Future road	New development		10	New	1,450	$ 264,000				$ 264,000		100%	$ -	$ 264,000	$ -
P-15	Pipe	Ortigalita	South of Pioneer		10	New	1,330	$ 242,000					$ 242,000	100%	$ -	$ 242,000	$ -
North Trunk																	
N-1	Pipe	152 bypass	Southeast of lift station		24	New	980	$ 390,000		$ 390,000				100%	$ -	$ -	$ 390,000
N-2	Intentionally left blank																
N-3	Pipe	152 bypass	Northwest of lift station, to Nantes		36	New	10,332	$ 6,162,000		$ 6,162,000				100%	$ -	$ -	$ 6,162,000
N-4	Pipe	152 bypass	West of Nantes		36	New	5,501	$ 3,281,000			$ 3,281,000			100%	$ -	$ -	$ 3,281,000
N-5	Pipe	152 bypass	South of 152 bypass		30	New	5,742	$ 2,853,000			$ 2,853,000			100%	$ -	$ -	$ 2,853,000
N-6	Pipe	Ingomar	South of 152 bypass		24	New	4,527	$ 1,800,000				$ 1,800,000		100%	$ -	$ -	$ 1,800,000
N-6A	Casing[1]	Canal	Casing under Main Canal		24/42	New	200	$ 487,000				$ 487,000		100%	$ -	$ -	$ 487,000
N-6B	Casing[1]	River	Casing under Los Banos Creek		24/42	New	200	$ 487,000				$ 487,000		100%	$ -	$ -	$ 487,000
N-7	Pipe	Quail	East of Westminister		10	New	681	$ 125,000		$ 125,000				100%	$ -	$ 125,000	$ -
N-8	Pipe	Mercy Springs	South of 152 bypass		12	New	627	$ 137,000		$ 137,000				100%	$ -	$ 137,000	$ -
N-9	Pipe	Future road	New development		12	New	2,314	$ 505,000		$ 505,000				100%	$ -	$ 505,000	$ -
N-10	Pipe	Nantes	South of 152 bypass		12	New	2,119	$ 463,000		$ 463,000				100%	$ -	$ 463,000	$ -
N-11	Pipe	Johnson	South of 152 bypass		12	New	1,786	$ 390,000			$ 390,000			100%	$ -	$ 390,000	$ -
N-12	Pipe	Future road	New development		10	New	2,513	$ 459,000				$ 459,000		100%	$ -	$ 459,000	$ -
N-13	Pipe	Future road	New development		21	New	3,910	$ 1,360,000				$ 1,360,000		100%	$ -	$ -	$ 1,360,000
N-14	Forcemain	Future road	Force main across future 152 bypass		12	New	700	$ 153,000					$ 153,000	100%	$ -	$ -	$ 153,000

Table ES.3 Capital Improvement Projects

Wastewater Collection System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-15 ($)	Phase 2 2016-20 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Regional ($)
N-14A	Casing[1]	Future road	Casing under future 152 bypass		12/24	New	700	$ 973,000					$ 973,000	100%	$ -	$ -	$ 973,000
N-15	Pipe	Future road	New development		21	New	2,730	$ 950,000					$ 950,000	100%	$ -	$ -	$ 950,000
N-16	Pipe	Future road	New development		18	New	2,450	$ 730,000					$ 730,000	100%	$ -	$ -	$ 730,000
N-17	Pipe	Future road	New development		15	New	2,130	$ 582,000					$ 582,000	100%	$ -	$ 582,000	$ -
N-18	Pipe	Future road	New development		12	New	1,830	$ 401,000					$ 401,000	100%	$ -	$ 401,000	$ -
N-19	Pipe	Future road	New development		10	New	3,570	$ 651,000					$ 651,000	100%	$ -	$ 651,000	$ -
N-20	Pipe	Future road	New development		10	New	890	$ 162,000					$ 162,000	100%	$ -	$ 162,000	$ -
N-21	Pipe	Future road	New development		10	New	3,030	$ 552,000					$ 552,000	100%	$ -	$ 552,000	$ -
N-22	Pipe	Future road	New development		10	New	2,970	$ 541,000					$ 541,000	100%	$ -	$ 541,000	$ -
N-23	Pipe	Future road	New development		10	New	2,920	$ 532,000					$ 532,000	100%	$ -	$ 532,000	$ -
N-LS	Lift Station	Quail	New development		9.2 mgd	New		$ 4,920,000		$ 4,920,000				100%	$ -	$ -	$ 4,920,000
	Land Acquisition				0.25 acres	New		$ 60,000		$ 60,000				100%	$ -	$ -	$ 60,000
N-LS2	Lift Station	Future road	New development		2.7 mgd	New		$ 1,515,000					$ 1,515,000	100%	$ -	$ -	$ 1,515,000
	Land Acquisition				0.25 acres	New		$ 60,000					$ 60,000	100%	$ -	$ -	$ 60,000
Meadowlands																	
Meadowlands-LS	Lift Station	NE Los Banos	NE Los Banos		2.9 mgd	Upsize		$ 1,604,000			$ 1,604,000			100%	$ -	$ -	$ 1,604,000
M-1	Pipe	Ward Road/Future Road	Within Industrial Area Plan		12	New	2,341	$ 512,000	$ 512,000					100%	$ -	$ 512,000	$ -
M-2	Pipe	Future Road	Within Industrial Area Plan		10	New	852	$ 156,000	$ 156,000					100%	$ -	$ 156,000	$ -
M-3	Pipe	Industrial Parkway/Future Road	Within Industrial Area Plan		12	New	2,932	$ 641,000	$ 641,000					100%	$ -	$ 641,000	$ -
Vineyard Trunk																	
V-1	Pipe	Nantes	South of Burgundy		15	New	810	$ 222,000		$ 222,000				100%	$ -	$ 222,000	$ -
V-2	Pipe	Future road	New development		12	New	1,871	$ 409,000		$ 409,000				100%	$ -	$ 409,000	$ -
V-3	Pipe	Future road	New development		10	New	829	$ 151,000		$ 151,000				100%	$ -	$ 151,000	$ -
V-4	Pipe	Johnson	South of Capri		10	New	1,467	$ 267,000		$ 267,000				100%	$ -	$ 267,000	$ -
Provinces Trunk																	
PR-1	Pipe	Overland	New development		12	New	2,200	$ 480,000	$ 480,000					100%	$ -	$ 480,000	$ -
PR-2	Pipe	Palermo	New development		12	New	500	$ 109,000	$ 109,000					100%	$ -	$ 109,000	$ -
Southeast Trunk																	
SE-1	Pipe	Pine	New development		10	New	2,973	$ 541,000		$ 541,000				100%	$ -	$ 541,000	$ -
SE-2	Pipe	Future road	New development		10	New	1,538	$ 281,000		$ 281,000				100%	$ -	$ 281,000	$ -
Badger Flat Trunk																	
BF-1	Pipe	Badger Flat	New development		12	New	2,169	$ 474,000	$ 474,000					100%	$ -	$ 474,000	$ -
BF-2	Pipe	Badger Flat	New development		10	New	2,131	$ 388,000	$ 388,000					100%	$ -	$ 388,000	$ -
College Trunk																	
C-1	Pipe	Future road	New development		10	New	1,974	$ 360,000			$ 360,000			100%	$ -	$ 360,000	$ -
Stone Creek Trunk																	
SC-1	Pipe	Future road	New development		10	New	1,426	$ 261,000	$ 261,000					100%	$ -	$ 261,000	$ -
West Trunk																	
W-1	Pipe	Future road	New development		18	New	2,784	$ 830,000			$ 830,000			100%	$ -	$ -	$ 830,000
W-1A	Casing[1]	Future road	Casing under Los Banos Creek		18/30	New	81	$ 140,000			$ 140,000			100%	$ -	$ -	$ 140,000

Table ES.3 Capital Improvement Projects

Wastewater Collection System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-15 ($)	Phase 2 2016-20 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Regional ($)
W-2	Pipe	Future road	New development		15	New	4,326	$ 1,182,000				$ 1,182,000		100%	$ -	$ 1,182,000	$ -
W-3	Forcemain	Future road	New development		10	New	98	$ 17,000					$ 17,000	100%	$ -	$ 17,000	$ -
W-4	Pipe	Future road	New development		12	New	1,905	$ 417,000					$ 417,000	100%	$ -	$ 417,000	$ -
W-5	Pipe	Future road	New development		12	New	1,941	$ 424,000					$ 424,000	100%	$ -	$ 424,000	$ -
W-6	Pipe	Future road	New development		12	New	2,951	$ 646,000				$ 646,000		100%	$ -	$ 646,000	$ -
W-7	Pipe	Future road	New development		10	New	1,037	$ 189,000				$ 189,000		100%	$ -	$ 189,000	$ -
W-8	Pipe	Future road	New development		10	New	880	$ 161,000				$ 161,000		100%	$ -	$ 161,000	$ -
W-9	Pipe	Future road	New development		10	New	848	$ 154,000				$ 154,000		100%	$ -	$ 154,000	$ -
W-10	Pipe	Future road	New development		10	New	868	$ 158,000				$ 158,000		100%	$ -	$ 158,000	$ -
W-11	Pipe	Future road	New development		10	New	953	$ 173,000				$ 173,000		100%	$ -	$ 173,000	$ -
W-12	Pipe	Breunig	New development		12	New	2,935	$ 641,000					$ 641,000	100%	$ -	$ 641,000	$ -
W-13	Pipe	Breunig	New development		10	New	1,054	$ 192,000					$ 192,000	100%	$ -	$ 192,000	$ -
W-14	Pipe	Future road	New development		10	New	2,257	$ 412,000					$ 412,000	100%	$ -	$ 412,000	$ -
W-15	Pipe	Future road	New development		10	New	2,224	$ 406,000					$ 406,000	100%	$ -	$ 406,000	$ -
W-16	Pipe	Future road	New development		12	New	2,943	$ 644,000					$ 644,000	100%	$ -	$ 644,000	$ -
W-17	Pipe	Future road	New development		10	New	1,290	$ 236,000					$ 236,000	100%	$ -	$ 236,000	$ -
W-18	Pipe	Future road	New development		10	New	1,087	$ 198,000					$ 198,000	100%	$ -	$ 198,000	$ -
W-19	Pipe	Future road	New development		10	New	1,037	$ 189,000					$ 189,000	100%	$ -	$ 189,000	$ -
W-20	Pipe	Volta	New development		10	New	3,106	$ 566,000					$ 566,000	100%	$ -	$ 566,000	$ -
W-21	Pipe	Future road	New development		10	New	1,321	$ 240,000					$ 240,000	100%	$ -	$ 240,000	$ -
W-LS	Lift Station	West of Breunig	New development		1.0 mgd	New		$ 808,000					$ 808,000	100%	$ -	$ 808,000	$ -
	Land Acquisition				0.25 acres	New		$ 60,000					$ 60,000	100%	$ -	$ 60,000	$ -
Existing System Rehabilitation and Replacement																	
	Pipe	Various Locations	Sewer main rehabilitation program			Rehab		$ 700,000		$ 200,000	$ 200,000	$ 200,000	$ 100,000	0%	$ 700,000	$ -	$ -
	Lift Station	Various Locations	Lift station rehabilitation or replacement			Replace/Rehab		$ 2,840,000		$ 710,000	$ 710,000	$ 710,000	$ 710,000	0%	$ 2,840,000	$ -	$ -
	Pipe	Various Locations	Sewer main replacement program. Average size is 10-inch diameter	10	10	Replace	25,000	$ 4,557,000		$ 1,139,000	$ 1,139,000	$ 1,139,000	$ 1,139,000	0%	$ 4,556,000	$ -	$ -
	Manhole	Various Locations	Manhole replacement program			Replace		$ 600,000		$ 200,000	$ 200,000	$ 100,000	$ 100,000	0%	$ 600,000	$ -	$ -
Storm Drain Cross Connection Removal																	
A1-1	Pipe	K Street, California Avenue	California Avenue to Iowa Avenue, and s/o L Street to K Street	-	18	New	2,300	$ 617,000		$ 617,000				0%	$ 617,000	$ -	$ -
A1-2	Pipe	Idaho Ave, I St, Texas Ave	L St to I St, west to Texas Ave, then northeast to H St	15	36	New/Replace	4,050	$ 2,174,000	$ 2,174,000					0%	$ 2,174,000	$ -	$ -
A1-3	Pipe	L Street	Delaware Avenue to Idaho Avenue	-	18	New	300	$ 81,000	$ 81,000					0%	$ 81,000	$ -	$ -
CC-6	Pipe	6th Street, K Street	sw/o M Street to K Street, then 6th Street to 7th Street	-	18	New	1,150	$ 309,000			$ 309,000			0%	$ 309,000	$ -	$ -
CC-7	Pipe	Center Avenue, Jefferson Avenue	Madison Avenue to Jefferson Avenue, then to 6th Street	-	18	New	1,850	$ 497,000				$ 497,000		0%	$ 497,000	$ -	$ -
CC-8	Pipe	Pacheco Blvd, Paradise Lane	I Street to Paradise Lane, then south to Adams Avenue	-	12	New	2,300	$ 453,000					$ 453,000	0%	$ 453,000	$ -	$ -
CC-9	Pipe	Murietta Street	Page Street to Monro Street, then east to 7th Street	-	18	New	600	$ 161,000					$ 161,000	0%	$ 161,000	$ -	$ -
							CIP Total	**$ 75,802,000**	**$ 6,983,000**	**$ 21,157,000**	**$ 13,808,000**	**$ 13,185,000**	**$ 20,668,000**		**$ 13,055,000**	**$ 23,270,000**	**$ 39,476,000**

Notes:

1. Proposed casings size and carrier pipe size.
2. Baseline Construction Cost plus 20% to account for unforeseen events and unknown conditions.
3. Estimated Construction Cost plus 30% to cover other costs including Engineering, Construction Management, and Program Implementation.
5. Land acquisition costs were included for lift stations, but not for pipelines, which will be located within public right of way.
6. Costs are based on the Engingeering News Record Construction Cost Index 20-city average of 8592.

Table ES.4 Capital Cost Summary
Wastewater Collection System Master Plan
City of Los Banos

Reimbursement Category	Implementation Phase					Total
	2010-2015 ($, millions)	2016-2020 ($, millions)	2021-2025 ($, millions)	2026-2030 ($, millions)	2031 + ($, millions)	
Existing Improvement[2]	2.32	2.87	2.56	2.65	2.66	**13.06**
Future Developer Improvement[3]	3.02	3.10	1.73	5.28	10.14	**23.27**
Future Regional Improvement[4]	1.64	15.19	9.52	5.26	7.86	**39.48**
Total	**6.98**	**21.16**	**13.81**	**13.19**	**20.67**	**75.80**

Notes:
1. All costs are in November 2009 dollars. ENR CCI 20 City average = 8592
2. Projects are funded through user rates.
3. Projects are developer funded and/or may be part of a development reimbursement agreement.
4. Projects funded through wastewater development impact fees collected by the City.

Chapter 1

BACKGROUND

1.1 INTRODUCTION

This chapter presents a brief summary of the wastewater collection service area, the need for this wastewater collection system master plan (Master Plan) and the objectives of the study. A list of abbreviations is also provided to assist the reader in understanding the information.

1.2 BACKGROUND

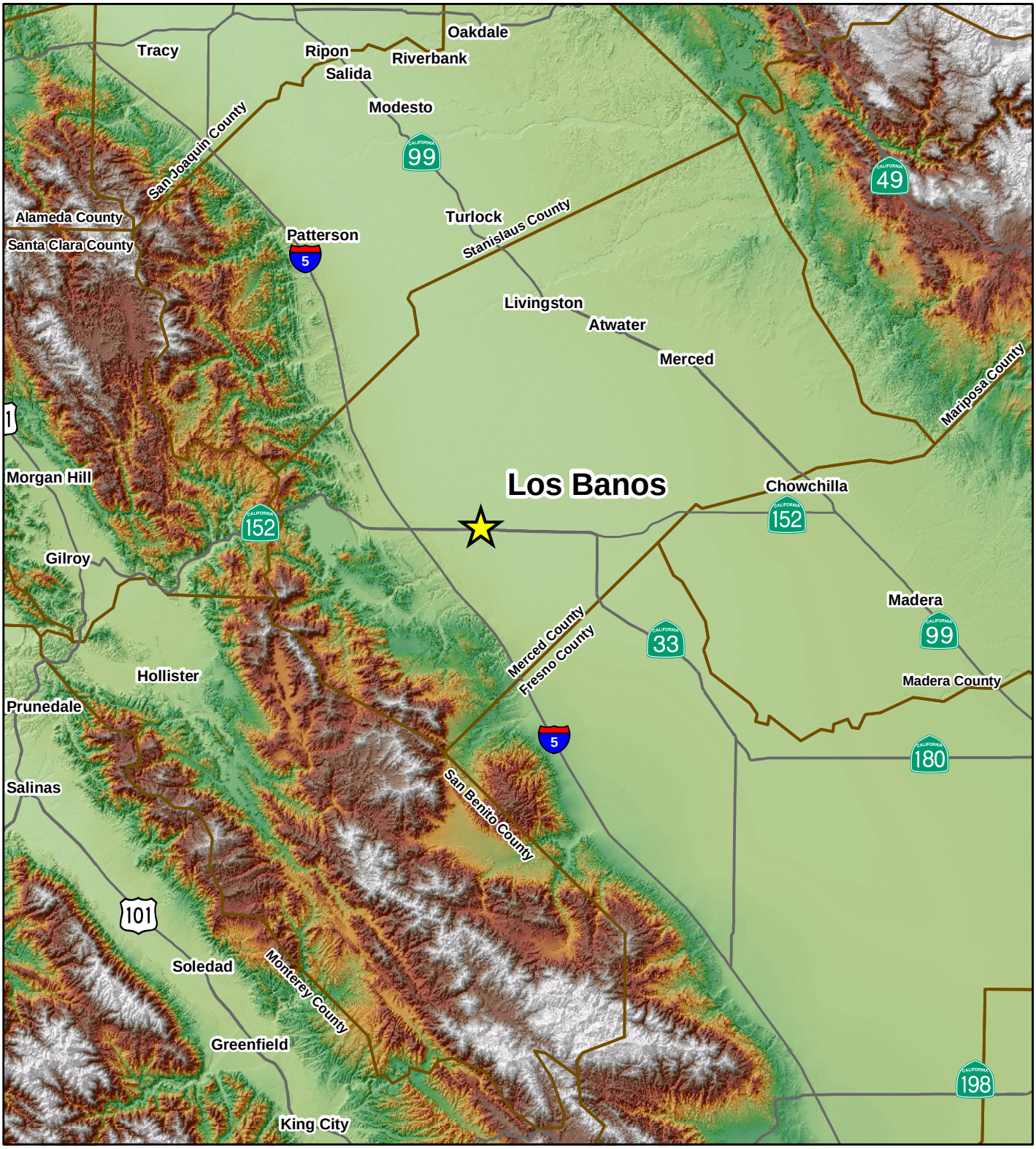
The City of Los Banos (City) is located in western Merced County (County), in the northern portion of the San Joaquin Valley. Figure 1.1 presents a location map of the City. The City is located near the junction of California State Route (SR)-152 and Interstate 5. Los Banos is the second largest city in the County[1]. The City collects, treats, and disposes wastewater originating from the residential, commercial, institutional, and industrial dischargers within the service area. The City owns, maintains, and operates all wastewater facilities within the service area.

1.3 SEWER SERVICE AREA

Figure 1.2 illustrates the City's current wastewater collection service area. The City manages the sewer collection system and maintains sanitary sewer lines, spanning 4- to 30-inches in diameter, and 13 lift stations. In addition to the collection system, the City also operates a wastewater treatment plant (WWTP) located northeast of the City. As a separate project, the City is currently designing upgrades to the existing WWTP. The improvements to the existing WWTP are not discussed in this report since the focus of this Master Plan was the wastewater collection system.

The City's previous wastewater collection system master plan, completed in November 1981 (1981 Master Plan), included a capacity evaluation, recommended improvements to mitigate hydraulic deficiencies, recommended improvements to accommodate growth, and summarized capital costs associated with the improvements. From the time when the 1981 Master Plan was completed, the City's General Plan, land uses, study boundary, infrastructure, and operational conditions changed, creating the need for a new master plan. The land use assumptions in this Master Plan were based on the City's 2030 General Plan Update (2030 General Plan) and projected future developments within the sphere of influence (SOI). Should future planning conditions change from the assumptions stated in this Master Plan (i.e., accelerated growth, more intense developments, etc.), revisions and adjustments to the Master Plan recommendations would be necessary.

[1] City of Los Banos 2030 General Plan Update, approved July 15, 2009



Legend

Elevation

High : 4,500 Feet

Low : Sea Level

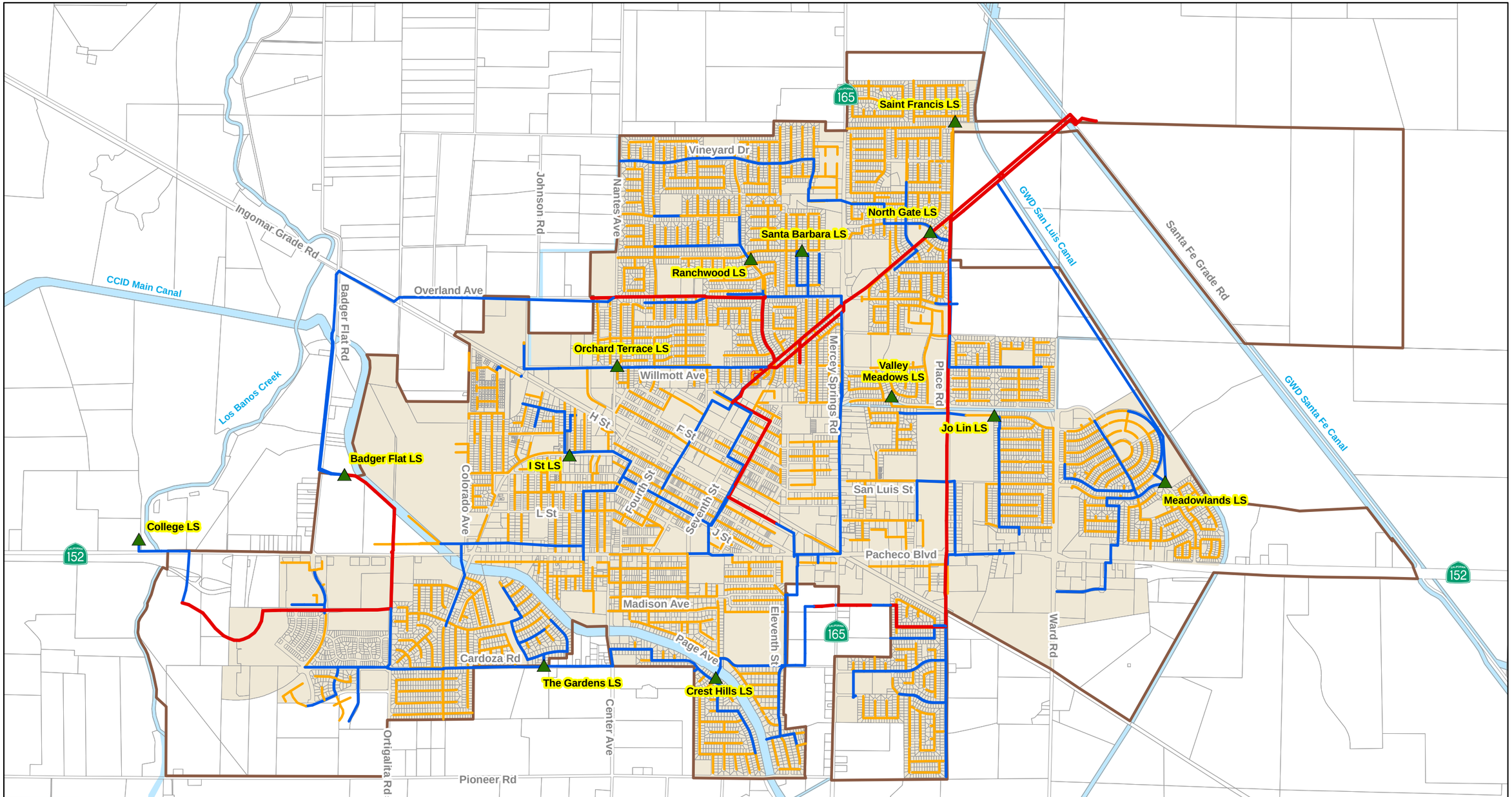
County Boundary

Major Roads

Miles

0 7.5 15

Figure 1.1
Regional Location Map
Wastewater Collection
System Master Plan
City of Los Banos



Legend

Existing Wastewater Collection System

- Lift Station

Sewer Pipeline Diameter

- 8" and Smaller
- 10 - 18"
- 21" and Larger

- Current Wastewater Collection Service Area
- Parcels
- Waterways/Canals
- City Limits

N

0 2,000 4,000 Feet

Figure 1.2
Current Wastewater Collection Service Area
Wastewater Collection System Master Plan
City of Los Banos

1.4 SCOPE AND AUTHORIZATION

The purpose of this 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 October 9, 2007, the City approved a professional service agreement with Carollo Engineers, P.C. (Carollo) to prepare this Master Plan for the wastewater collection system, which included the following main tasks:

- Flow monitoring
- Sewer surveys
- Model development
- Collection system analysis and capital project development
- Master Plan preparation

1.5 REPORT ORGANIZATION

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

Chapter 1 - Background. This chapter presents the need for this Master Plan and the objectives of the study. A list of abbreviations and reference material is also provided to assist the reader in understanding the information presented.

Chapter 2 - Study Area Description. This chapter presents a description of the study area, defines the land use classifications, and summarizes the historical population trends.

Chapter 3 - Planning Criteria. This chapter presents the planning criteria for evaluating the wastewater collection system. The planning criteria address the collection system capacity, gravity sewer slopes, maximum depth of flow within a sewer, average sewer flow coefficients, and sewer peaking factors.

Chapter 4 - Wastewater Design Flows. This chapter summarizes the flow-monitoring program and presents the calculation of the design flows used to model the existing and future sewer system.

Chapter 5 - Wastewater Collection System Facilities and Hydraulic Model. This chapter describes the development and calibration of the City's wastewater collection system hydraulic model.

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

Chapter 7 - Capital Improvement Projects. This chapter presents the capital improvement projects and a summary of the capital costs. This chapter is organized to assist the City in making finance decisions.

1.6 ACKNOWLEDGMENTS

Carollo Engineers wishes to acknowledge and thank Mr. Mark Fachin, Public Works Director/City Engineer; Mr. Gary Hutsell, Assistant Public Works Director; Mr. Royal Lloyd, Wastewater Treatment Plant Supervisor; Mr. Tim Marrison, Assistant Fire Chief; Mr. Stanley Silva; and Ms. Melinda Wall. Their cooperation and courtesy in obtaining a variety of necessary information were valuable components in completing and producing this report.

1.7 ABBREVIATIONS AND DEFINITIONS

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

ADWF	average dry weather flow
ADMMF	average day maximum month flow
BWF	base wastewater flow
CCID	Central California Irrigation District
County	Merced County
DOF	California Department of Finance
ENR CCI	Engineering News Record Construction Cost Index
fps	feet per second
gpd	gallons per day
gpda	gallons per day per acre
gpdc	gallons per day per capita
GWI	groundwater infiltration
I/I	infiltration/inflow

MDWWF	maximum day wet weather flow
mgd	million gallons per day
PDWF	peak dry weather flow
PWWF	peak wet weather flow
SOI	Sphere of Influence
SSO	Sanitary Sewer Overflow
WWTP	Wastewater Treatment Plant

1.8 REFERENCE MATERIAL

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

- City of Los Banos 2030 General Plan Update, Approved July 15, 2009
- City of Los Banos Improvement Standards and Specifications, October 2004
- Sanitary Sewerage Study and Master Plan, George S. Nolte and Associates, November 1981
- City of Los Banos Sewerage and Drainage Survey, Brown and Caldwell, April 1960
- City of Los Banos Wastewater Strategic Plan, ECO:LOGIC Engineering, September 2007

Chapter 2

STUDY AREA DESCRIPTION

This chapter presents a description of the study area, defines the land use classifications, and summarizes the historical population trends.

2.1 STUDY AREA

The 2030 General Plan Update (2030 General Plan) sphere of influence (SOI) is the study area boundary for this wastewater collection system master plan (Master Plan). The Master Plan study boundary and SOI are synonymous and will be used interchangeably throughout this report. The SOI boundary extends far beyond the current wastewater collection service area and is approximately 14,382 acres (22.5 square miles). The Master Plan contains a forecast of sewer improvements in a large study area beyond the City of Los Banos (City) limits. Figure 2.1 shows the study area boundary and the City's limits.

Evaluating infrastructure needs beyond the City limits is important because:

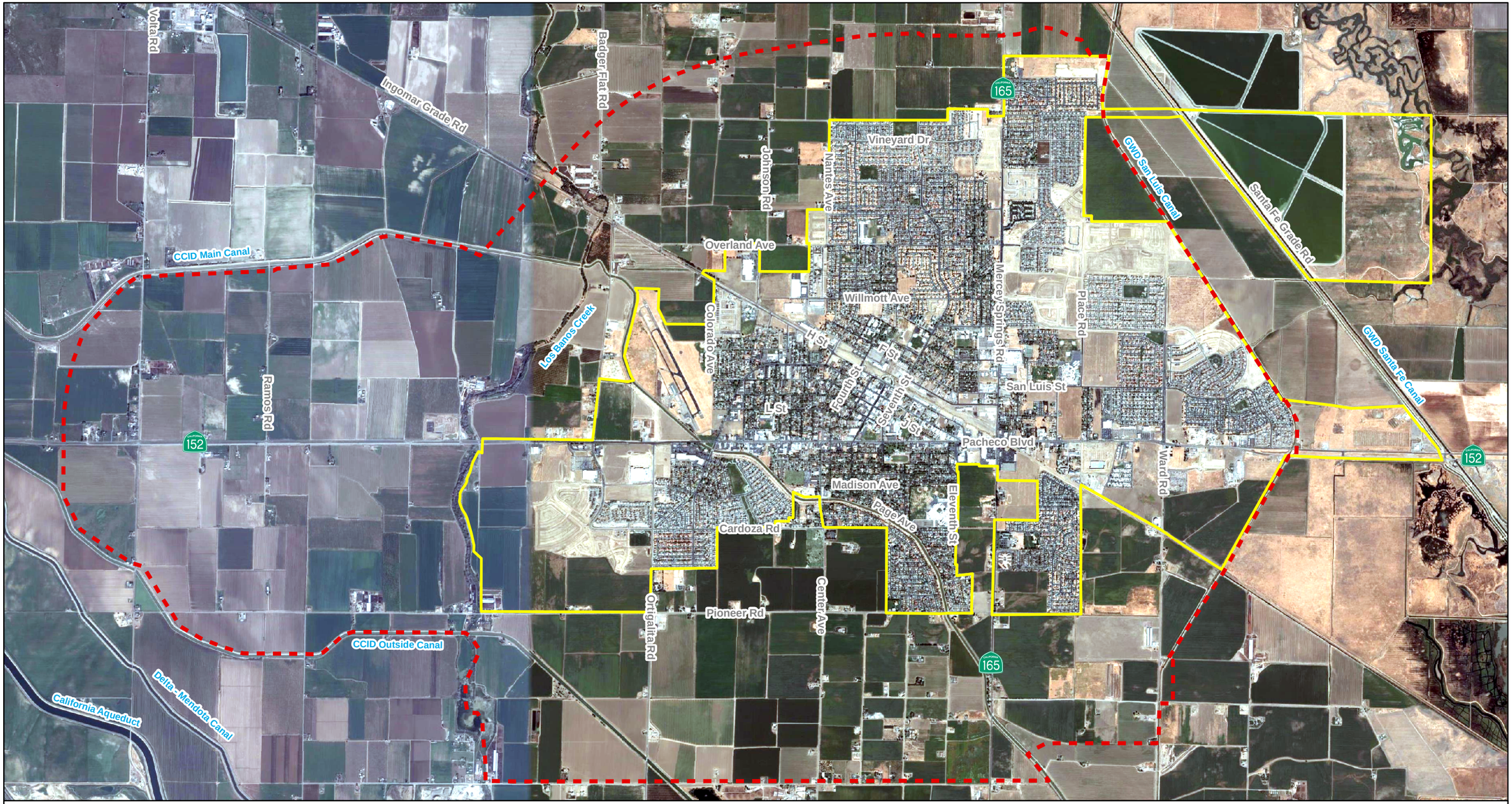
- there are conceptual development plans that are beyond the City limits;
- recent rapid growth in the San Joaquin Valley indicates that significant development into the study area could occur within a short planning period; and
- by forecasting the ultimate, orderly expansion of the sewer system, there is a greater utilization of reliable gravity sewers.

2.2 PLANNING PERIOD

The Master Plan study area is intended to include the existing City limits and development within the SOI that could occur through the year 2030. Existing and projected populations and land uses within the study area are discussed in this chapter.

2.3 CLIMATE

The City is characterized by hot, dry summers and relatively mild winters. Annual rainfall generally totals slightly less than nine inches, with approximately 90 percent of the rainfall occurring between November to April. In the winter months, fog conditions often persist for several days, but the season is generally short.



Legend

Sphere of Influence[1]

City Limits

N

0 2,500 5,000 Feet

Figure 2.1
Study Area
Wastewater Collection System Master Plan
City of Los Banos

1. Sphere of Influence from City of Los Banos 2030 General Plan Update, Dyett & Bhatia, July 2009

2.4 LAND USE

The 2030 General Plan guides development within the SOI and establishes the long-range development policies. The general plan also provides land use and population projections. Land use and population information are integral components in determining the amount of wastewater generated within the City. The type of land use in an area will affect the volume and character of the wastewater generated. Adequately estimating the generation of wastewater from various land use types is important in sizing and maintaining sewer system facilities.

Land use assumptions used in this study are consistent with the 2030 General Plan. Since the land use assumptions forecast the type of growth within the SOI, this association to the Master Plan should ensure that the wastewater projections and facilities required to serve future growth are consistent with the City's guiding document on development. Figure 2.2 illustrates the different land uses found in the 2030 General Plan. The study area's land use designation and respective acreage totals are summarized in Table 2.1. Appendix A provides a description of the different land uses. The descriptions are excerpts from the 2030 General Plan.

2.4.1 Sewer Service Area by Land Use

2.4.1.1 Existing Service Area Land Use

The City provides wastewater collection and treatment service to residents, businesses, and other institutions within its City limits. Table 2.1 provides the acreage totals by land use classification within the SOI. Also included in Table 2.1 are the land use totals for the 2007 sewer service area City limits, and the breakdown between developed land, which generates wastewater, and undeveloped land that will be developed in the future. The City currently provides sewer service to approximately 4,582 acres (includes developed and undeveloped land) or 7.2 square miles. Note that the acreage total does not include land occupied by the wastewater treatment plant (WWTP) because the treatment plant is located outside of the SOI.

The largest land use category is residential (low, medium, and high), which accounts for approximately 2,279 acres, or approximately 50 percent of the total acreage. Commercial, office/professional and industrial make up approximately 925 acres, or 20 percent of the total. Civic/Institutional makes up approximately 181 acres, or 4 percent. Non-wastewater generating land uses like parks, streets, and open space land uses account for 1,197 acres, or 26 percent of the total service area.

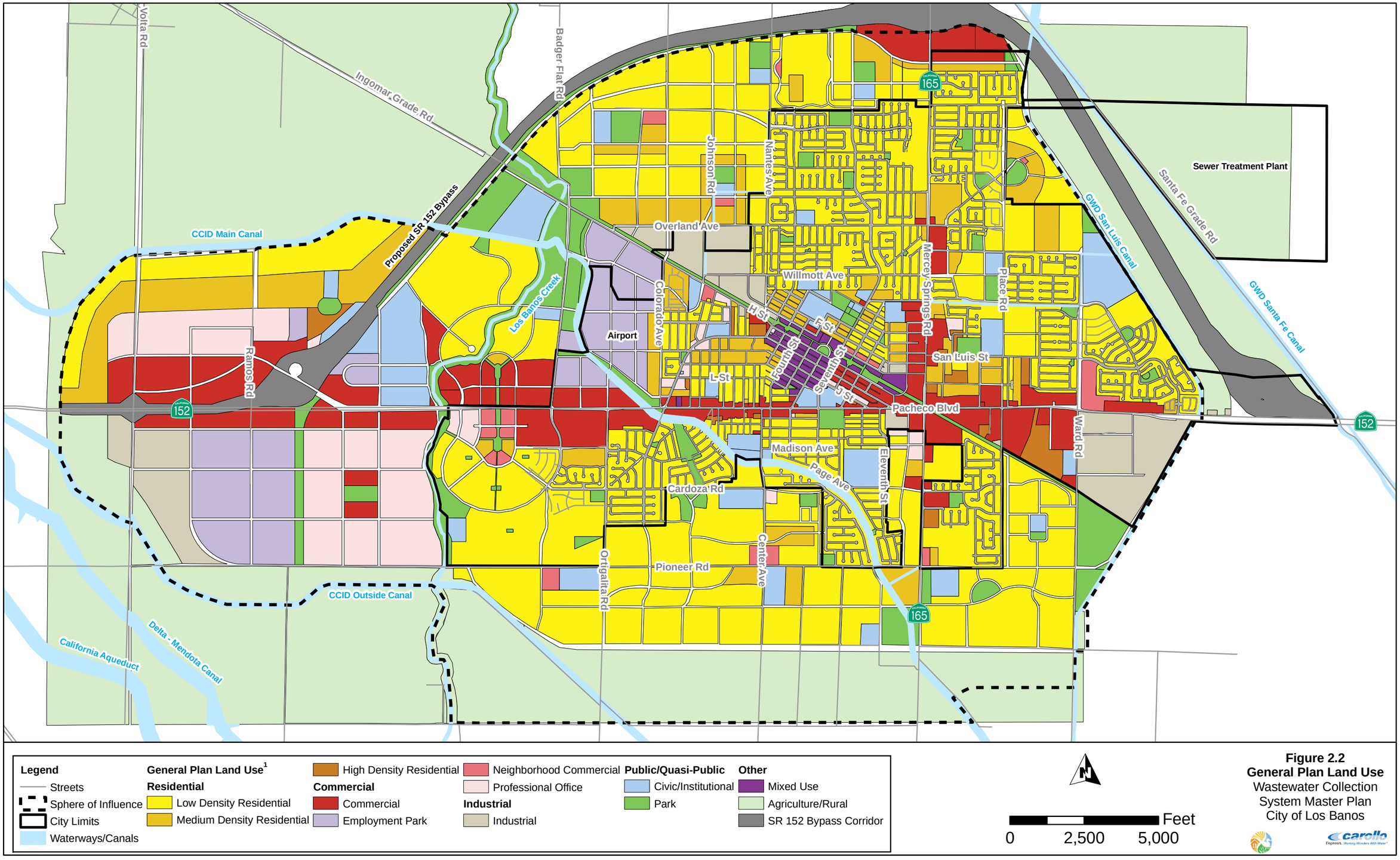


Figure 2.2
General Plan Land Use
Wastewater Collection System Master Plan
City of Los Banos

1. Land use source: City of Los Banos, 2030 General Plan Update, Final, July 15, 2009, Dyett & Bhatia

Table 2.1 Study Area Land Use Designations
Wastewater Collection System Master Plan
City of Los Banos

Land Use Designation	SOI[1] (acres)	2007 City Service Area[2] Total (acres)	Developed (acres)	Undeveloped (acres)
Residential				
Low Density Residential	4,452	1,851	1,605	246
Medium Density Residential	875	372	179	193
High Density Residential	98	56	52	4
Mixed Use				
Mixed Use	73	44	38	6
Neighborhood Commercial	89	68	21	46
Commercial/Office Professional				
Commercial	991	445	255	190
Office/Professional	574	96	55	41
Employment Park	555	149	136	14
Industrial	498	124	88	36
Others				
Agriculture/Rural	1,560	0	0	0
Parks, Trails & Open Space	852	355	323	31
Civic/Institutional	573	181	167	14
SR 152 Bypass Corridor	205	0	0	0
Streets/Roads	2,989	843	805	38
Total	**14,382**	**4,582**	**3,723**	**858**

Notes:
1. Los Banos 2030 General Plan Sphere of Influence is the study area boundary.
2. Total excludes the wastewater treatment plant.

2.4.1.2 Future Service Area Land Use

At build-out of the SOI boundary, the City will serve approximately 14,382 acres. Build-out is defined as complete development of all lands. The breakdown of the different land use categories is provided in Table 2.1.

2.5 HISTORICAL AND FUTURE POPULATION

The City has historically been an agricultural based community and supports food processing facilities and related agricultural services. The City's population began to grow quickly after World War II owing to returning veterans and highway construction[1]. A series of irrigation and dam projects in the 1960s brought more people to the City, however, growth slowed from 1970 to 1985. In 1990, the City's population began to grow rapidly and continued through year 2007. From 1990 through the present, the population grew from approximately 14,500 to 35,200. Over the last 20 years, the City has grown at an annual rate of about 5.1 percent.

The 2030 General Plan states that the build-out population will reach 90,400 people. This build-out population reflects an annual growth rate that ranges between 4.1 to 4.6 percent. Table 2.2 and Figure 2.3 summarize the City's historical and projected population to year 2030.

[1] City of Los Banos 2030 General Plan Update, July 2009

Table 2.2	**Historical and Projected Population Wastewater Collection System Master Plan City of Los Banos**
Year	**Population**
1910	745
1920	1,276
1930	1,745
1940	2,214
1950	3,868
1960	5,272
1970	9,188
1980	10,341
1990	14,519
2000	25,869
2007	35,200
2010	40,300
2020	60,700
2030	90,400

Note:
1. Source of historical data and population projections: City of Los Banos 2030 General Plan Update, Approved July 15, 2009.

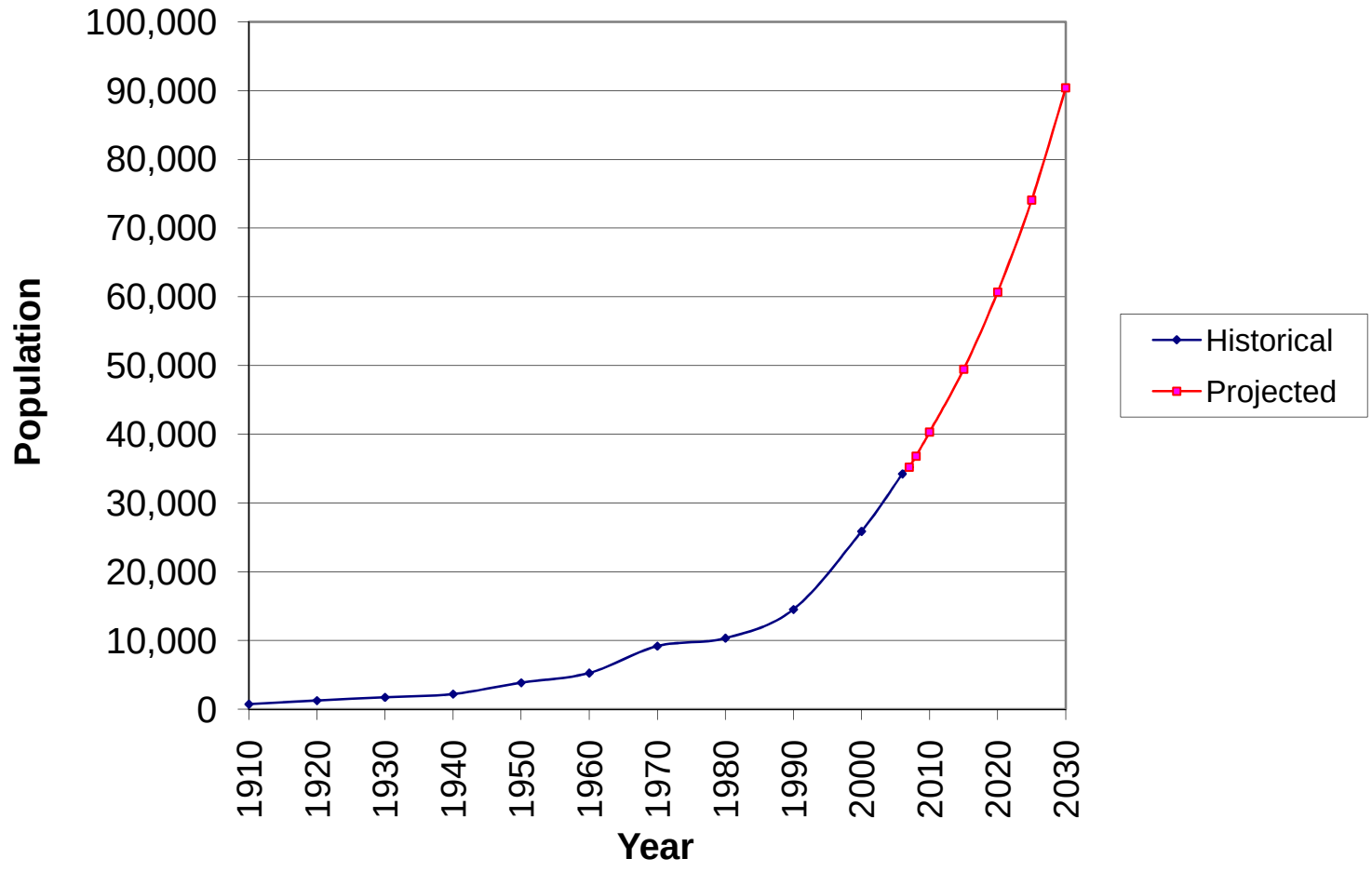


Figure 2.3
Historical and Projected Population
Wastewater Collection System Master Plan
City of Los Banos

carollo
Engineers...Working Wonders With Water™

pw:\Los Banos\7833A00\Disciplines\Population.xls\Sheet1

PLANNING CRITERIA

The capacity of the City of Los Banos' (City) wastewater collection system was evaluated based on the planning criteria defined in this chapter. The criteria include standards from the City's Improvement Standards and Specifications (Improvement Standards). The planning criteria address the collection system capacity, gravity sewer slopes, maximum depth of flow within a sewer, average wastewater flow coefficients, and wastewater peaking factors.

3.1 GRAVITY SEWERS

Capacity analysis of the wastewater collection system was performed in accordance with the criteria established in this chapter. The City's Improvement Standards stipulate general policies of the City and outline sewer design criteria. Some of these criteria are discussed below. If not discussed in this wastewater collection system master plan (Master Plan), the reader should assume that the design criteria conform to the Improvement Standards. Sewer pipe capacities are dependent on many factors, including roughness of the pipe, the maximum allowable depth of flow, minimum velocity, and slope of pipe.

3.1.1 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 and joints, and 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, which is consistent with the City's Improvement Standards.

3.1.2 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 1981 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). The City's Improvement Standards do not define the acceptable d/D values for various pipe diameters. However, the standards do specify the minimum slope and minimum velocity for a sewer flowing full.

3.1.2.1 <u>Flow Depth for Existing Sewers</u>

Using a conservative d/D ratio when evaluating existing sewers may lead to unnecessary replacement of existing pipelines. Therefore, a d/D ratio of 0.92 (pipe flowing at maximum capacity) was used to evaluate the City's existing trunk sewer system for peak dry weather flow (PDWF). During peak wet weather flow (PWWF) (this is typically the maximum hourly flow in the collection system) water levels were allowed to rise to within three feet of the manhole rim. Sewers were allowed to surcharge under these maximum flow conditions. If

the flow depth was greater than the maximum allowed, then the sewer was deemed deficient and a larger sewer was proposed for greater flow capacity.

3.1.2.2 Flow Depth for New Sewers

When designing new sewers, it is common practice to adopt variable flow depth criteria for different pipe sizes. Design d/D ratios typically range from 0.5 to 0.92, with the lower values 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 18-inches in diameter shall be designed to flow at two-thirds depth at peak flow rate. Sewers larger than 18-inches diameter shall be designed to flow at a d/D of 0.75 at peak flow rate. The maximum allowable d/D ratios for design flow conditions are summarized in Table 3.1.

Table 3.1 d/D Ratios for Design Flow Conditions
Wastewater Collection System Master Plan
City of Los Banos

Sewer Diameter	Design Flow Maximum d/D Ratio
Less than 12-inches	0.50
D=12-inches up to D=18-inches	0.67
Greater than 18-inches	0.75

3.1.3 Design Velocities and Minimum Slopes

In order to minimize the settlement of sewage solids, the City's Improvement Standards require that sewer velocity be equal to or greater than 2 feet per second (fps) for all sewers at the design flow and maximum d/D (based on roughness coefficient of 0.013). At this velocity, the sewer flow will typically provide self-cleaning for the pipe. Table 3.2 lists the recommended minimum slopes and their corresponding maximum flows for maintaining self-cleaning velocities (equal to or greater than 2 fps) when the pipe is flowing at its maximum depth.

3.1.4 Changes in Pipe Size

When a smaller sewer joins a large one, the invert of the larger sewer will be lowered sufficiently to maintain the same energy gradient. This can be accomplished by matching the pipe soffits of different size pipes.

Table 3.2 Minimum Slope and Maximum Flow Wastewater Collection System Master Plan City of Los Banos			
Pipe Diameter (inches)	Minimum Slope[1] (feet/feet)	Calculated Flow at Maximum d/D Criteria	
		d/D	Maximum Flow (mgd)
6	0.0049[2]	0.5	0.127
8	0.0034[2]	0.5	0.228
10	0.0025[2]	0.5	0.354
12	0.0019[2]	0.67	0.792
15	0.0014[2]	0.67	1.233
18	0.0011[2]	0.67	1.778
21	0.0009[2]	0.75	3.304
24	0.0008[2]	0.75	4.447
27	0.0006	0.75	5.273
30	0.0005	0.75	6.375

Notes:
1. Recommended minimum slope for maximum pipe flow at various d/D values and velocity greater than or equal to 2 fps.
2. City Improvement Standards for standard minimum slopes of sewer lines. Improvement Standards provided slopes for 6, 8, 10, 12, 15, 18, 21, and 24-inch diameter pipes only. Slopes for sewers 27-inch diameter and greater were calculated based on maximum d/D and minimum velocity criteria.

3.1.5 Wet Well, Lift Stations, and Force Mains

According to City Improvement Standards, wet well capacity shall be adequate to provide a minimum pump cycle time of 10 minutes. At least two non-clog sewer pumps, each capable of pumping 100 percent of the design flow rate, shall be installed at each lift station. Therefore, all sewage lift stations should have sufficient firm capacity (capacity with the largest pump out of service) to pump the design flow.

Force main piping shall be sized to provide a minimum velocity of 2 fps at the design flow rate of the lift station. There are no slope requirements for force mains in the Improvement Standards.

Chapter 4

SEWER DESIGN FLOWS

This chapter summarizes the flow monitoring program and presents the calculation of the design flows used to model the existing and future sewer system.

4.1 FLOW MONITORING PROGRAM

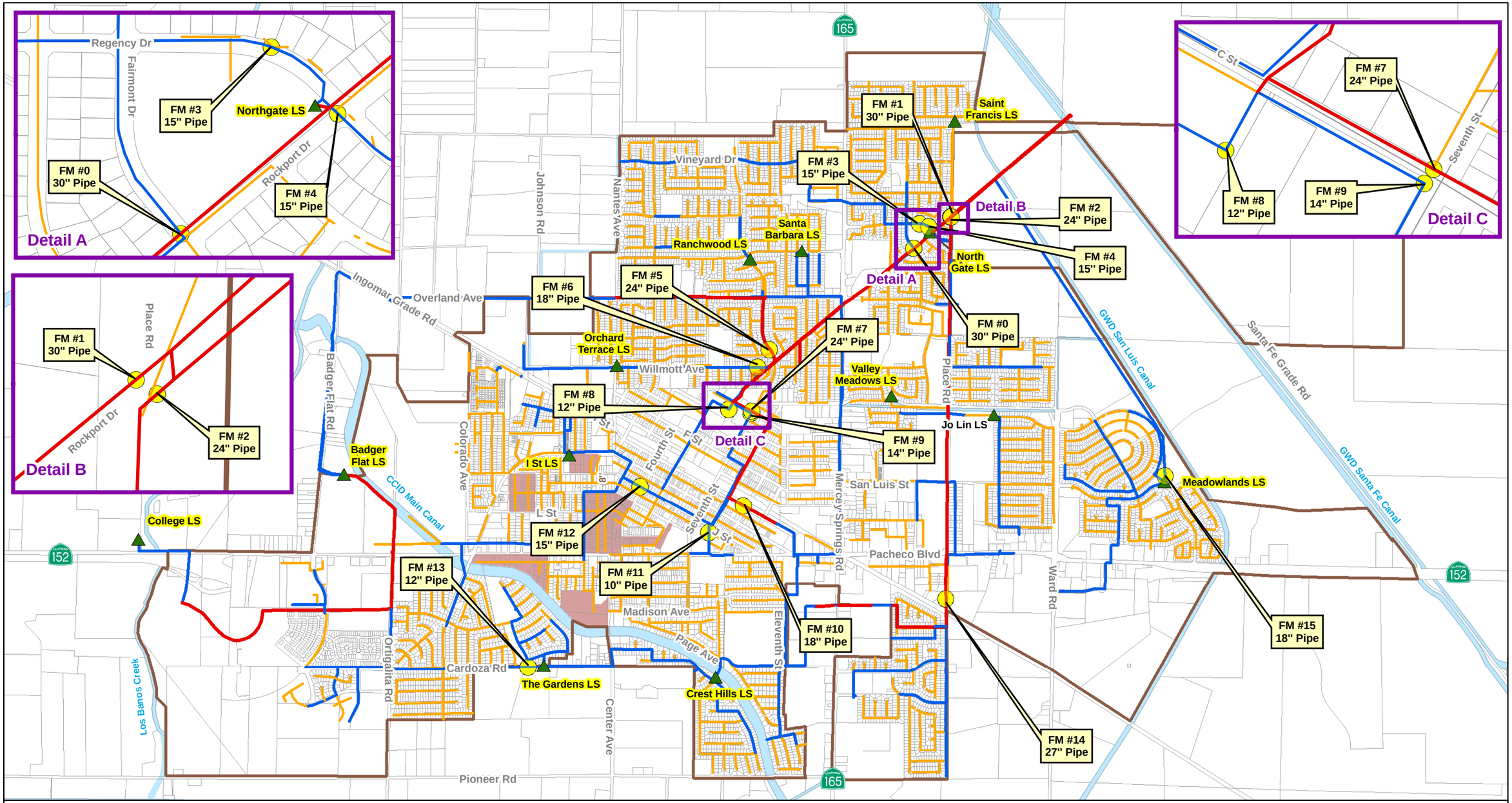
Temporary flow monitoring was conducted to assist in the development of design flow criteria, and to correlate actual sewer system flows to the hydraulic model predicted flows. Flow monitoring data are used to calibrate the wastewater collection system hydraulic model for dry weather flow (DWF). The “Sanitary Sewer Flow Monitoring, September 2007” prepared by V&A Consulting Engineers, Inc. summarizes the flow monitoring program and was submitted to the City as a separate report.

The primary purpose of flow monitoring is to measure flow from different areas of the collection system. The flow monitoring period was conducted for approximately one week from September 7 through the 16, 2007 at 16 monitoring sites, at locations selected by Carollo Engineers, P.C. (Carollo). Figure 4.1 illustrates the flow meter locations. The meter sites were selected to best model the sewer areas and multiple sub-areas within the sewer system.

4.2 FLOW MONITORING RESULTS

4.2.1 Average Day Flow Data

During the flow monitoring period, depth and velocity data were collected at each meter at 5-minute intervals. The 5-minute data was then aggregated to 15-minute and hourly data for the DWF calibration effort. Characteristic dry weather 24-hour diurnal flow patterns for each site were developed based on the hourly data. This hourly flow data was then used to calibrate the hydraulic model for average day flow. A summary of the average day flow for the 16 flow meters is presented in Table 4.1. The flow data indicated that the average weekday flows were generally equal to the average weekend flows, however, the diurnal patterns occasionally differed. For this wastewater collection system master plan (Master Plan), the weekday flow averages and diurnal patterns will be used for calibration and analysis.



Legend

- Flow Meter Location

Existing Wastewater Collection System

- Lift Station

Sewer Pipeline Diameter

- 8" and Smaller
- 10 - 18"
- 21" and Larger

- Storm Runoff that Drains to Sewer
- City Limits
- Waterways/Canals
- Parcels

N

0 2,000 4,000 Feet

Figure 4.1
Flow Meter Locations
Wastewater Collection System Master Plan
City of Los Banos

Table 4.1 Average Day and Average Peak Dry Weather Flow Wastewater Collection System Master Plan City of Los Banos		
Flow Meter	**Average Day Flow[1] (mgd)**	**Average Peak Dry Weather Flow[2] (mgd)**
0	2.71	3.25
1	3.22	4.31
2	1.41	1.78
3	0.29	0.48
4	0.14	0.23
5	0.31	0.51
6	0.16	0.28
7	1.36	1.59
8	0.10	0.17
9	0.14	0.18
10	0.93	1.05
11	0.09	0.13
12	0.36	0.50
13	0.14	0.22
14	0.32	0.45
15	0.12	0.17
Approximate WWTP Flow[3]	4.01	4.90

Source: Sanitary Sewer Flow Monitoring, September 2007

Notes:

1. Average day flow calculated from data, not including weekend flow.
2. Average of the daily peak dry weather flows.
3. The average flow measured at the WWTP from September 7 to 16, 2007. The average peak dry weather flow was calculated based on the peak to average ratio of 1.22 (September average peak to average day [4.83:3.95]).

4.2.2 Wet Weather Flow Data

Wet weather flow (WWF) monitoring data was not collected for this project. However, review of rainfall and wastewater treatment plant (WWTP) influent flow data for 2006 and 2007 indicated that the two-day period of January 1 and 2, 2006 provided the greatest 24-hour storm total and the maximum day flow at the WWTP. The plant flow records for these two days were used for model calibration and analysis.

4.2.3 Rainfall Data

To develop a storm hyetograph and to accomplish the model calibration, rainfall data for January 1-2, 2006 was collected and analyzed. Rainfall data from the California Irrigation Management Information System (CIMIS) Station No. 56 (Los Banos) for these days were available on the California Department of Water Resources web site. This storm was selected because it was one of the largest storms of 2006 and resulted in the maximum flows recorded at the WWTP for any single day in 2006. Rainfall data for the February 2005 storm was also collected for the calibration confirmation step.

The rain gauge recorded a January 2006 monthly total of 2.67-inches, which is greater than average rainfall for this period. For comparison, the historical average rainfall for January is 1.87-inches (1948 to 2007). The historical data was taken from the Western Regional Climate Center (WRCC) at Station 045118 in Los Banos and CIMIS Station No. 56. Rainfall data from the years 1948 through 2007 were used to determine this average. Table 4.2 summarizes the rain data from the CIMS No. 56 rain gauge station for the 2005 and 2006 storms discussed.

Table 4.2 Rain Gauge Summary
Wastewater Collection System Master Plan
City of Los Banos

Total Rainfall (inch)	Greatest Storm Total (inch)	Greatest 24-Hour Total (inch)
2.67(1)	2.21(2)	1.81(3)
2.68(4)	1.6(5)	1.47(6)

Source: California Irrigation Management Information System (CIMIS) Station No. 56 (Los Banos)

Notes:
1. Total rainfall recorded over one month period, January 2006.
2. Total rainfall recorded over a 48-hour period between January 1 and 2, 2006.
3. Total rainfall recorded over a 24-hour period between January 1 and 2, 2006.
4. Total rainfall recorded over one month period, February 2005.
5. Total rainfall recorded over a 48-hour period between February 15 and 16, 2005.
6. Total rainfall recorded over a 24-hour period between February 15 and 16, 2005.

4.2.4 Design Storm Data

Design storms are rainfall events used to analyze the performance of a collection system under peak flows and volumes, and have specific recurrence interval and rainfall duration. Developing a design storm can be accomplished in different ways. If data is not available, a synthetic design storm can be developed. A National Oceanic and Atmospheric Administration (NOAA) Atlas 2 isopluvial (rainfall total contours) map of California was used to approximate the total depth for the 10-year, 24-hour design storm, which is 1.75-inches for this area. The 24-hour storm total that occurred on January 1-2, 2006 was 1.81-inches (slightly larger than, but approximately equal to a 10-year, 24-hour design storm). A

10-year, 24-hour design storm is typically used when modeling WWF in collection systems. This design storm has a ten percent chance (1/10) that 1.75-inches of rain will fall in any 24-hour period in a given year.

The Natural Resources Conservation Service (NRCS), formally known as the Soil Conservation Service (SCS), method is typically used to distribute the rainfall volume and establish a peak intensity over a given storm duration in a very textbook manner. The methodology used to develop the design storms for this study is presented in Appendix B. As described in Appendix B, log-normal probability graphs were constructed from available precipitation data and the Depth-Duration-Frequency (DDF) data was in turn fit to power equations of the form: D = A * t (hours) ^ B, where D is the rainfall depth of accumulation. The results of the NRCS rainfall distribution are shown in Figure 4.2. The NRCS method was used to model the peak wet weather flows (PWWF) in the collection system during a design storm event.

4.3 WASTEWATER FLOW COMPONENTS

Wastewater consists of DWF and WWF. DWF (or base flow) is flow generated by routine water usage in the residential, commercial, business and industrial sectors of the sewer system. The other component of DWF is the contribution of dry weather groundwater infiltration (GWI) into the sewer system. Dry weather GWI will enter the sewer system when the relative depth of the groundwater table is higher than the depth of the pipeline and when the susceptibility of the sanitary sewer pipe allows infiltration through defects such as cracks, misaligned joints and broken pipelines. In the City's sewer service area, dry weather GWI may be considerable because the shallow depth to groundwater in some parts of town.

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

The third element of WWF is GWI, which is not specific to a single rainfall event, but rather to the effects on the sewer system over the entire wet weather season. The depth of the groundwater table rising above the pipe invert elevation causes GWI.

Sewer pipes within close proximity to a body of water can be greatly influenced by groundwater effects. As the groundwater table fluctuates over the wet weather season, this fluctuation is seen as a mounding effect in flow monitoring data. A description of each flow component is detailed in the following sections.

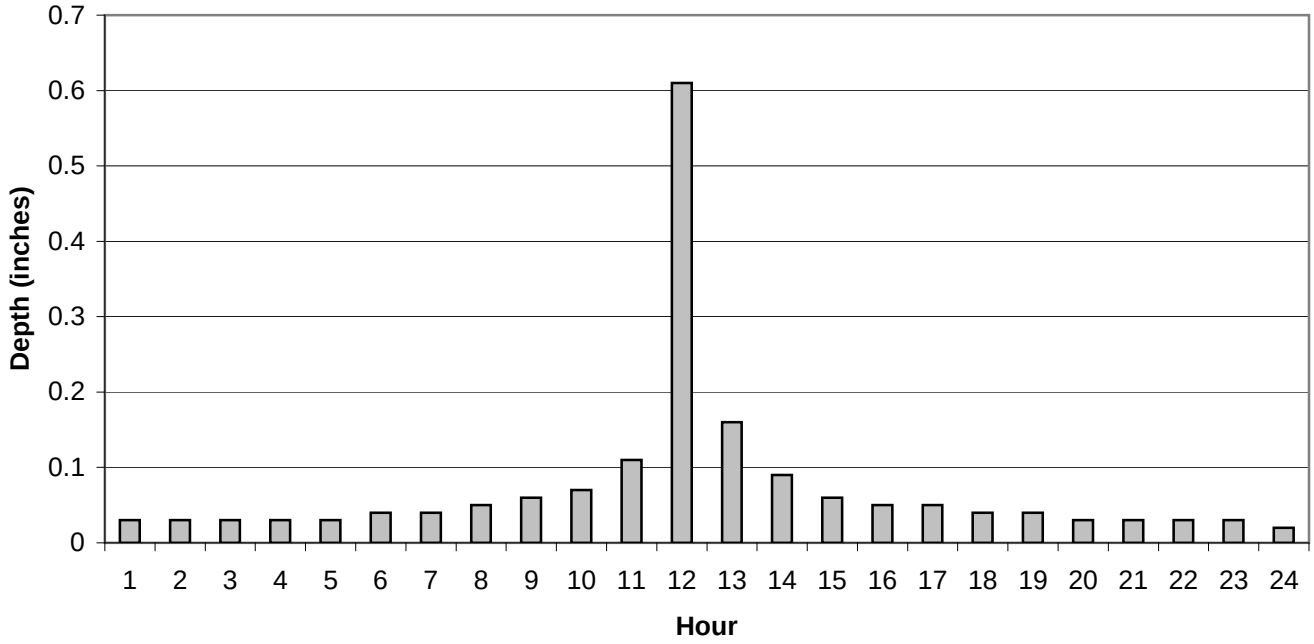


Figure 4.2
10-Year, 24-Hour Design Storm Rainfall Distribution
Wastewater Collection System Master Plan
City of Los Banos

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4.3.1 Base Wastewater Flow

The base wastewater flow (BWF) is the flow generated by the City's residential, commercial, and industrial customers. The flow has a diurnal pattern that varies with land use categories. Typically, a residential diurnal pattern has two peaks with the more pronounced peak following the wake-up hours of the day, and a less pronounced peak occurring in the evening. In Los Banos, the more pronounced peak of the diurnal pattern occurred in the evening. Commercial and industrial patterns, though they vary depending on the type of use, typically have more consistent higher flow patterns during business hours, and lower flows at night. Furthermore, the diurnal flow pattern experienced during a weekend may vary from the diurnal flow experienced during a weekday. For the purpose of this hydraulic analysis, different diurnal curves were developed based on the flow-monitoring data to represent the various uses throughout the City.

4.3.2 Groundwater Infiltration

Ground water infiltration, one of the components of I/I, is associated with extraneous water entering the sewer system through defects in pipes and manholes. GWI is related to the condition of the sewer pipes, manholes, and groundwater levels. GWI may occur throughout the year, although rates are typically higher in the late winter and early spring. Dry weather GWI (or base infiltration) cannot easily be separated from BWF by flow measurement techniques. Therefore, dry weather GWI is typically grouped with BWF.

4.3.3 Average Dry Weather Flow

Average dry weather flow (ADWF) is the average flow that occurs on a daily basis during the dry weather season, defined as June through September for this Master Plan. The ADWF includes the BWF generated by the City's residential, commercial, and industrial users, plus the dry weather GWI component (assumed to be negligible for this Master Plan). See Table 4.3 for a summary of ADWF.

4.3.4 Peak Dry Weather Flow

Peak dry weather flow (PDWF) is the highest observed hourly flow that occurs during the dry weather season. The collection system's ability to convey the PDWF without surcharging is a criterion of this Master Plan. In Los Banos, the month with the highest average flow typically occurs during the dry weather months, as shown in Table 4.3 (see ADMMF column). The PDWF will also occur during this maximum month.

4.3.5 Maximum Day Wet Weather Flow

Maximum day wet weather flow (MDWWF) is the highest daily flow that occurs during the wet weather season (defined as October through May for this Master Plan). The Water Environment Federation (WEF) Manual of Practice FD-6 and the American Society of Civil Engineers (ASCE) Manual and Report on Engineering Practice No. 62 suggest that the

MDWWF to ADWF ratio typically ranges between 2 and 3, even in well constructed systems. Higher values usually indicate a more pronounced I/I problem. Review of daily flows in 2006 indicate that the MDWWF occurred on January 2 and was 4.68 million gallons per day (mgd), which translates to a 2006 MDWWF to ADWF ratio of 1.3 (2006 ADWF of 3.57). The calculated ratio was below typical range, indicating that the City has a well constructed system with low I/I, even though some areas experience I/I following storms.

4.3.6 Peak Wet Weather Flow (Design Flow)

Peak wet weather flow is the highest observed hourly flow that occurs following the design storm event. Wet weather I/I causes flows in the collection system to increase. PWWF is typically used for designing sewers and lift stations. Therefore, PWWF will be referred to as the design flow in this Master Plan. The trunk sewers and lift stations were evaluated based on their capacity to convey the design flow (PWWF). If the sewers violated the flow depth criterion, then they were considered capacity deficient for which improvements were proposed.

The WEF Manual of Practice FD-6 and ASCE Manual No. 62 recommends maintaining design flow to ADWF ratios below 3 to 4, with higher values indicative of pronounced I/I. The WWTP does not measure hourly flow variations, however, based on the modeling results, we were able to derive a peak flow. The model derived peak hourly flow (or model derived design flow) measured at the WWTP was 6.1 mgd for existing conditions. Therefore, the PWWF to ADWF factor was 1.7, which is within the recommended range. Peak to average ratios measured at the treatment plant are generally lower than those measured in the collection system, due to flow attenuation. In the collection system outside the downtown area, the ratio of PWWF to ADWF ranged between 2 and 3. In the downtown area that is influenced by storm drain connections, which result in higher peak flows, the ratio of PWWF to ADWF ranged between 3 and 5. Note that these are model-simulated peak flows and could not be verified because WWF monitoring was not conducted.

4.3.7 Inflow and Infiltration

Infiltration is defined as storm water flows that enter the sewer system by percolating through the soil and then through defects in pipelines, manholes, and joints. Examples of infiltration entry points are cracks in pipelines, misaligned joints, and root penetration. Inflow is defined as storm water that enters the sewer system via a direct connection to the system. Examples of inflow entry points are roof drain and downspout connections, leaky manhole covers, and illegal storm drain connections.

The adverse effects of I/I entering the sewer system is that it increases both the flow volume and peak flows such that the sewer system is operating at or above its capacity. If too much I/I enters the sewer system, sanitary sewer overflows (SSO's) could occur. The modeling results indicate that the City's collection system does not have a considerable infiltration problem. However, the system does have several locations where storm drain

pipelines are directly connected to the sanitary sewer. These direct connections create considerable inflow during storm events.

4.4 WASTEWATER TREATMENT PLANT FLOWS

In addition to the flow-monitoring program, this project reviewed historical WWTP influent flow data since January 2000 to establish wastewater flow criteria. The City also provided daily averages for 2006.

Flow data from January 2000 through December 2007 are summarized in Table 4.3. This Master Plan relied primarily on 2006 plant flow data, because this project was started midway through 2007 and data was not available for the entire year. Table 4.3 lists for each month, the following parameters:

- Population and per capita flow
- Total annual flow
- Average day flow (ADF): Total annual flow divided by the number of days in the year. Average flow entering the plant over the entire year, without consideration of season (dry or wet)
- Average dry weather flow (ADWF): Average WWTP influent flow during the months of June through September
- Average wet weather flow (AWWF): Average WWTP influent flow during the months of January through May, and October through December
- Average day maximum month flow (ADMMF): Average day flow for the maximum month of a given year

As shown in Table 4.3, the ADF in 2006 was 3.55 mgd, the ADWF was 3.57 mgd, and the AWWF was 3.54 mgd. The ADF for the entire year is essentially the same as the ADWF and the AWWF in 2006. For previous years, the ADWF tended to display higher average flows compared to AWWF and average day flow, possibly due to cannery or other seasonal operations discharging to the wastewater collection system. Typically, the wet weather season contributes higher than normal sewer flows due to rainfall dependent I/I following storms. However, from 2000 through 2007 the dry weather averages were slightly greater than the wet weather averages. For this study, since there is little difference between average day, average dry and average WWFs, the average day flow was used in calculations.

For a 2006 average day flow of 3.55 mgd and sewer service area population was 34,220, the calculated gallons per capita per day (gpcd) equal 104. The average per capita flow from 2000 through 2007 is 111 gpcd. In comparison, the City's water use for 2006 averaged approximately 7.2 mgd (~8,200 acre-feet per year [AFY]), and the per capita water use equaled 211 gpcd. The City's wastewater generation represents about 50 percent of the

Table 4.3 Historical Monthly WWTP Influent Flows
Wastewater Collection System Master Plan
City of Los Banos

Year	Population[1]	Per Capita Flow (gpcd)	Total Annual Flow (mg)	Average Day Flow (mgd)	ADWF (mgd)	AWWF (mgd)	ADMMF (mgd)	
2000	25,869	124	1,178	3.22	3.35	3.15	3.44	August
2001	27,503	120	1,200	3.29	3.40	3.23	3.85	October
2002	28,397	109	1,134	3.11	3.16	3.08	3.26	August
2003	29,139	111	1,175	3.22	3.53	3.08	3.97	August
2004	30,626	112	1,261	3.45	3.56	3.39	3.67	July
2005	32,380	106	1,258	3.45	3.58	3.38	3.64	August
2006	34,223	104	1,294	3.55	3.57	3.54	3.80	Feb/March
2007	35,200	99	1,275	3.49	3.66	3.41	3.95	September

Note:
1. Population for 2000 and 2005 from 2030 General Plan. 2007 from City website. Other years interpolated.

City's total water use. Note that two of the large industrial wastewater dischargers operate their own groundwater wells, and water production from these private wells are not reflected in the water demand totals discussed above.

4.5 WASTEWATER FLOW PROJECTIONS

For sewer system master plans, developing relationships between land use and flow is a method typically employed to develop average wastewater flows. The flow planning criteria are typically based on standard practice values, but then refined based on actual flow data. The land use flow coefficients were established to estimate average day flow within the study area.

4.5.1 Water Conservation Measures

The current water conservation measures for the City apply to outdoor use only. There are no required indoor water conservation measures. Therefore, adjustments to account for future water conservation were not made and the future flow projections were based on historical data.

4.5.2 Largest Industrial Wastewater Dischargers

In order to model the largest industrial wastewater dischargers, point loads representing these customers were input into the hydraulic model in place of wastewater flow coefficients. The City provided daily flows from 2003 through 2006 for four industries currently operating and monitored by the City. Table 4.4 summarizes the average day flow and ADMMF measured for each of the four industries from year 2003 to 2006. The average and ADMMF values and the hours of operation were used to simulate each industry's wastewater discharge to the collection system.

4.5.3 Existing Wastewater Flow Coefficients

Average wastewater flow coefficients are rates, usually expressed in gallons per day per acre (gpda), applied to either gross or net acres for calculating average day flow generated from a particular land use. A flow coefficient was developed for each land use classification discussed previously. The flow coefficient provides a means to transform a land use category from acreage into wastewater flow. The resulting flow is then input into the appropriate sewer area in the sewer system model. Wastewater flow coefficients for residential areas can range between 1,000 to 4,000 gpda, and commercial and industrial areas might range from 500 to 2,500 gpda, with typical values averaging approximately 1,000 gpda. Land uses designated as open space and agriculture are assumed to generate negligible amounts of sewage flow.

Table 4.4 Industrial Discharger Summary
Wastewater Collection System Master Plan
City of Los Banos

Industry	Peluso Cheese				Kagome Foods				Los Banos Foods				Los Banos Abattoir			
Year	Total Annual flow (gal)	ADF[1] (gpd)	ADMMF[2] (gpd)	Month	Total Annual Flow (gal)	ADF[1] (gpd)	ADMMF[2] (gpd)	Month	Total Annual Flow (gal)	ADF[1] (gpd)	ADMMF[2] (gpd)	Month	Total Annual Flow (gal)	ADF[1] (gpd)	ADMMF[2] (gpd)	Month
2003	2,600,000	8,300	14,200	April	30,003,000	82,200	123,700	May	214,611,000	588,000	694,000	January	7,655,000	28,500	33,500	September
2004	2,205,000	7,200	11,200	October	20,773,000	56,800	91,800	March	223,384,000	610,300	743,200	June	6,542,000	24,600	28,000	October
2005	2,268,000	7,700	9,800	August	19,301,000	53,400	109,200	November	227,725,000	623,900	687,400	June	6,159,000	23,200	26,600	January
2006	1,403,000	5,100	6,800	April	34,586,000	95,200	149,100	May	216,655,000	593,600	834,100	February	6,640,000	24,400	27,900	June
Average	2,119,000	7,100	10,500		26,166,000	71,900	118,500		220,594,000	604,000	739,700		6,749,000	25,200	29,000	

Notes:
1. Average day flow (ADF): The total annual flow divided by 365 days (leap years divided by 366).
2. Average day maximum month flow (ADMMF): The average day flow for the maximum month of a given year.

The coefficients were estimated by evaluating the flows measured from the flow-monitoring program and analyzing the tributary service area generating flow to each meter. For example, for Flow Meter No. 4, the average day flow during the flow-monitoring period was approximately 0.14 mgd. The tributary service area upstream of this monitoring station is developed with buildings falling into one of the following land use categories (excluding undeveloped land): low density residential, civic/institutional, commercial and other non-wastewater generating lands (e.g. roads and parks). Flow coefficients were multiplied by the acreages for each land use designation until the flows equaled 0.14 mgd. This process was repeated for each flow meter.

The flow coefficients were then adjusted to balance the calculated flows for the entire developed sewer service area to 3.55 mgd, which was the 2006 average day flow. The average day flow is the basis for calibrating the average sewer flow coefficients. Table 4.5 presents the wastewater flow coefficients calculated from the flow monitoring program and the balancing to match 3.55 mgd. In addition, flows for the four industrial dischargers are also included in this table. The flows from the industrial dischargers were taken into account in developing the coefficients.

As with most cities throughout California, residential land use makes up the majority of developed land and wastewater flow. For Los Banos, residential customers make up approximately 66 percent of the current flow.

Table 4.5 Existing Wastewater Flow Coefficients
Wastewater Collection System Master Plan
City of Los Banos

Land Use Designation	2007 City Service Area			
	Developed[(1),(2)] (acres)	Flow Coefficient (gpd/acre)	Average Flow (gpd)	Percent of Total Demand
Residential				
Low Density Residential	1,569	1,225	1,921,000	54%
Medium Density Residential	179	1,725	308,000	9%
High Density Residential	52	2,200	114,000	3%
Mixed Use				
Mixed Use	38	925	35,000	1%
Neighborhood Commercial	21	925	20,000	1%
Commercial/Office Professional				
Commercial	255	925	236,000	7%
Office/Professional	53	925	49,000	1%
Employment Park	7	1,000	7,000	0%
Industrial	59	1,000	59,000	2%
Industrial Discharger[(3)]	29	----	708,000	20%
Others				
Agriculture/Rural	0	0	0	0%
Parks, Trails & Opens Space	323	0	0	0%
Civic/Institutional	105	925	97,000	3%
SR 152 Bypass Corridor	0	0	0	0%
Streets/Roads	805	0	0	0%
Developed Non-Wastewater Generating[(4)]	229	0	0	0%
Total	**3,723**		**3,554,000**	**100%**

Notes:
1. City limit total excludes the wastewater treatment plant.
2. Area totals exclude streets and roads. Streets and roads account for approximately 21 percent of the developed City limits.
3. Industrial dischargers include: Los Banos Foods Inc., Peluso Cheese Company, Kagome Foods Inc., and Los Banos Abattoir Co. Average flow for 2006 used in flow balance and coefficient calculation.
4. Developed Non-Wastewater Generating land uses include areas like school play fields or airport runways.

4.5.4 Recommended Wastewater Flow Coefficients

The recommended sewer flow coefficients are presented in Table 4.6. The recommended sewer coefficients also assume no change in the operation of the large industrial dischargers.

Table 4.6 Recommended Wastewater Flow Coefficients
Wastewater Collection System Master Plan
City of Los Banos

Land Use Designation	Flow Coefficient (gpda)
Residential Land Use	
Low Density	1,225
Medium Density	1,725
High Density	2,200
Mixed Use	
Mixed Use	925
Neighborhood Commercial	925
Commercial/Office Professional	
Commercial	925
Office/Professional	925
Employment Park	1,000
Industrial	1,000
Other	
Civic/Institutional	925

4.5.5 Existing and Future (Build-out) Average Day Flow

Developing an accurate estimate of the quantity of wastewater is an important step in maintaining and sizing sewer system facilities, for both existing conditions and future developments. The future average day flow was generated in a similar manner as the existing average day flow. Future flow projections were developed based on the land use projections as described in the City's 2030 General Plan.

As previously reported, build-out of the SOI boundary will nearly triple the current City limits. The build-out sewer flows were calculated by multiplying each land use area by its corresponding flow coefficient. The resulting flow projections are summarized in Table 4.7. The flows summarized in Table 4.7 assume 100 percent development and occupancy of all land uses within the SOI. This includes the undeveloped areas within the current City limits described in Chapter 2. If we assume that 5 to 10 percent of all residences, commercial

Table 4.7 SOI Build-out Flow Projections
Wastewater Collection System Master Plan
City of Los Banos

Land Use Designation	Projected Build-out of Sphere of Influence			
	Developed[1] (acres)	Flow Coefficient[2] (gpd/acre)	Average Flow (gpd)	Percent of Total Flow
Residential				
Low Density Residential	4,452	1,225	5,454,000	49%
Medium Density Residential	875	1,725	1,509,000	14%
High Density Residential	98	2,200	217,000	2%
Mixed Use				
Mixed Use	73	925	67,000	1%
Neighborhood Commercial	89	925	82,000	1%
Commercial/Office Professional				
Commercial	991	925	916,000	8%
Office/Professional	574	925	531,000	5%
Employment Park	555	1,000	555,000	5%
Industrial	469	1,000	469,000	4%
Industrial Discharger[2]	29	----	708,000	6%
Others				
Agriculture/Rural	1,560	0	0	0%
Parks, Trails & Opens Space	852	0	0	0%
Civic/Institutional	573	925	530,000	5%
SR 152 Bypass Corridor	205	0	0	0%
Streets/Roads[3]	2,989	0	0	0%
Total	**14,382**		**11,038,000**	**100%**

Notes:
1. Total excludes the wastewater treatment plant and about 150 acres outside the SOI, but within the City limits along SR 152.
2. Industrial dischargers include: Los Banos Foods Inc., Peluso Cheese Company, Kagome Foods Inc., and Los Banos Abattoir Co. Average flow for 2006 used in flow balance and coefficient calculation.
3. Adjustments to the acreage totals for the other land uses were made in order to maintain a Streets/Roads total that is approximately 21 percent of the total.

buildings and offices are vacant or not developed at build-out, then the build-out flow could range between 9.4 to 11.0 mgd. For the purposes of modeling and sizing infrastructure, this Master Plan assumed 100 percent development of the SOI.

A summary of the existing and future average day flows is presented in Table 4.8. If the City achieves build-out of the SOI by 2030, then wastewater flow could increase at an annual rate of 4.9 percent between now and build-out of the study area.

For comparison, the sewer flows were projected using the population method. Based on a projected 2030 population of 90,400 and an average per capita flow of 111 gpdc (average from 2000 through 2007), the projected average day flow could approach 10.0 mgd. The population method for calculating wastewater flows results in a slightly lower projection when compared to the land use method. One reason for the lower estimate using the population approach is that employment related lands (e.g. commercial, office, and industrial) will make up a larger percentage of the land use and wastewater flow in the future. The wastewater flow imparted by these employment related lands will increase the future per capita flow, which averaged 111 gpcd over the last seven years. Currently, many local residents commute to areas outside of the City for work.

The 2030 General Plan states that complete build-out of employment related land should be reached around 2055, which is 25 years beyond the planning horizon of this Master Plan. The timing for achieving build-out of the employment related land will effect the phasing of capital projects, but not the build-out demand. Phasing of capital projects is discussed in later chapters of this Master Plan.

Table 4.8 Average Day Flow Summary
Wastewater Collection System Master Plan
City of Los Banos

Planning Year	WWTP Average Day Flow (mgd)
Existing[1]	3.55
SOI Build-out[2]	11.0

Notes:
1. Based on City's WWTP 2006 influent flow data and the meter data from Sanitary Sewer Flow Monitoring, September 2007.
2. Based on land use and acreage from the City's 2030 General Plan and 100 percent Build-out.

4.5.6 Growth Horizon

The discussion up to this point has focused on the flow projections when the SOI is fully built out. The City's 2030 General Plan states, "Although the General Plan applies a 24-year horizon, the Plan is not intended to specify or anticipate when build-out will actually occur." If we assume that the projected population is reached by 2030, then the residential

based land uses will be fully built out. However, a different assumption is provided in the General Plan for the employment based land uses. The 2030 General Plan reports that, based on historical trends, complete build-out of employment-related land should be reached around 2055. Based on this growth rate, it is assumed that half of the employment-related land is developed by year 2030, and the remainder is developed by 2055.

Based on the timing assumptions for build-out of residential and employment-related land uses, the following flow projections in Table 4.9 can be made. The year 2030 projection in Table 4.9 agrees with the 2030 projection from the City's 2007 Wastewater Strategic Plan. The two projections were within five percent of each other.

Table 4.9 Flow Projections
Wastewater Collection System Master Plan
City of Los Banos

Planning Year	WWTP Average Day Flow (mgd)
Existing[1]	3.55
2010	4.16
2015	5.06
2020	6.15
2025	7.49
2030	9.11
2035	9.47
2040	9.84
2045	10.22
2050	10.62
2055	11.0

Note:
1. Based on City's WWTP 2006 influent flow data and the meter data from Sanitary Sewer Flow Monitoring, September 2007.

4.6 DESIGN FLOWS

The design flow is the maximum hourly flow rate under selected design storm and growth conditions. Typically, a design storm is routed through a hydraulic model to estimate the PWWF in a sewer system and to quantify the system's capacity. This Master Plan utilized the 10-year, 24-hour design storm rainfall pattern for generating the design flow in the sewer system ("design flow" is synonymous to peak wet weather flow).

The maximum industrial discharge was added to the design flow. The maximum industrial discharge was the recorded average hourly flow for the maximum month. By including the

maximum month flow for each industry, not only does the design flow account for the 10-year, 24-hour design storm, but it also couples the maximum industrial discharge flow. By doing so, we model a hypothetical maximum flow that could result if all industries are simultaneously discharging at their historical maximums and we experienced a 10-year, 24-hour storm event. This approach supports our confidence that we are modeling the maximum flow condition that could occur in the sewer system.

In summary, the design flow consists of three components:

- Average day flow
- Wet weather inflow and infiltration
- Maximum industrial discharge

Table 4.10 presents the current average day and design flow for the service area. Also shown are the forecast average day and design flow at build-out of the City's SOI boundary.

Table 4.10 Current and Projected Wastewater Flows
Wastewater Collection System Master Plan
City of Los Banos

	Average Day Flow[2] (mgd)	Design Flow (mgd)	Peaking Factor
Current[1]	3.55	6.1	1.7
SOI Build-out	11.0	18.9	1.7

Notes:
1. Based on meter data from Sanitary Sewer Flow Monitoring, September 2007.
2. Assumes average industrial flow, not maximum month.

4.7 INFLOW AND INFILTRATION (I/I) COEFFICIENT

The I/I coefficient is a model-derived value that could not be verified in this Master Plan without WWF monitoring data. The amount of I/I entering the sewer system is dependent on many factors such as cracks in pipelines or storm drain connections. Therefore, we would expect that older areas of the sewer system to display higher WWFs if they were susceptible to I/I and new subdivisions to display lower flows. We would also expect peak flows near the treatment plant to be lower because of flow attenuation that occurs as wastewater runs through miles of pipeline. The City wide calculated peak I/I coefficient is 400 gpda (based on peak flow at the WWTP). Typical I/I coefficients range between 500 and 1,000 gpda for sewer systems. We would expect peak I/I coefficients to fall within this range if a WWF monitoring program were conducted.

4.8 PLANNING CRITERIA SUMMARY

The recommended planning criteria for this Master Plan are summarized in Table 4.11.

Table 4.11 Planning Criteria Summary
Wastewater Collection System Master Plan
City of Los Banos

Minimum Slopes for New Pipes

Pipe Size (inches)	Minimum Slope[1] (ft/ft)	Pipe Capacity d/D	Pipe Capacity Maximum Flow (mgd)
6	0.0049[2]	0.5	0.127
8	0.0034[2]	0.5	0.228
10	0.0025[2]	0.5	0.354
12	0.0019[2]	0.67	0.792
15	0.0014[2]	0.67	1.233
18	0.0011[2]	0.67	1.778
21	0.0009[2]	0.75	3.304
24	0.0008[2]	0.75	4.447
27	0.0006	0.75	5.273
30	0.0005	0.75	6.375

Notes:
1. Recommended minimum slope for maximum pipe flow at various d/D values and velocity greater than or equal to 2 feet/second.
2. City improvement standards provide minimum slopes for these diameters.

Maximum Flow Depth, d/D

The following flow depth criteria was used in the analysis:

Maximum d/D for Existing Sewers

Dry Weather Flows: 0.92

Peak Wet Weather Flow: Pipes will be allowed to surcharge 3 feet below manhole rim

Maximum d/D for Planning New Sewers

Pipe Diameter (inches)	Maximum d/D Ratio (during Peak Flows)
Less than 12	0.50
12 to 18	0.67
Larger than 18	0.75

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 Willam's C = 120

Changes in Pipe Size

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

Average Sewer Flow Coefficients

Land Use Category	Coefficients (gpd/acre)	
Low Density Residential	1,225	
Medium Density Residential	1,725	
High Density Residential	2,200	
Mixed Use	925	
Neighborhood Commercial	925	
Commercial	925	
Office/ Professional	925	
Employment Park	1,000	
Industrial	1,000	(excludes existing large industrial dischargers)
Agriculture/Rural	0	
Parks, Trails & Open Space	0	
Civic/Institutional	925	

COLLECTION SYSTEM FACILITIES AND HYDRAULIC MODEL

This chapter describes the development and calibration of the City of Los Banos (City) wastewater collection system hydraulic model. This model was used to identify the sewer system's capacity deficiencies and to develop improvements to correct those deficiencies.

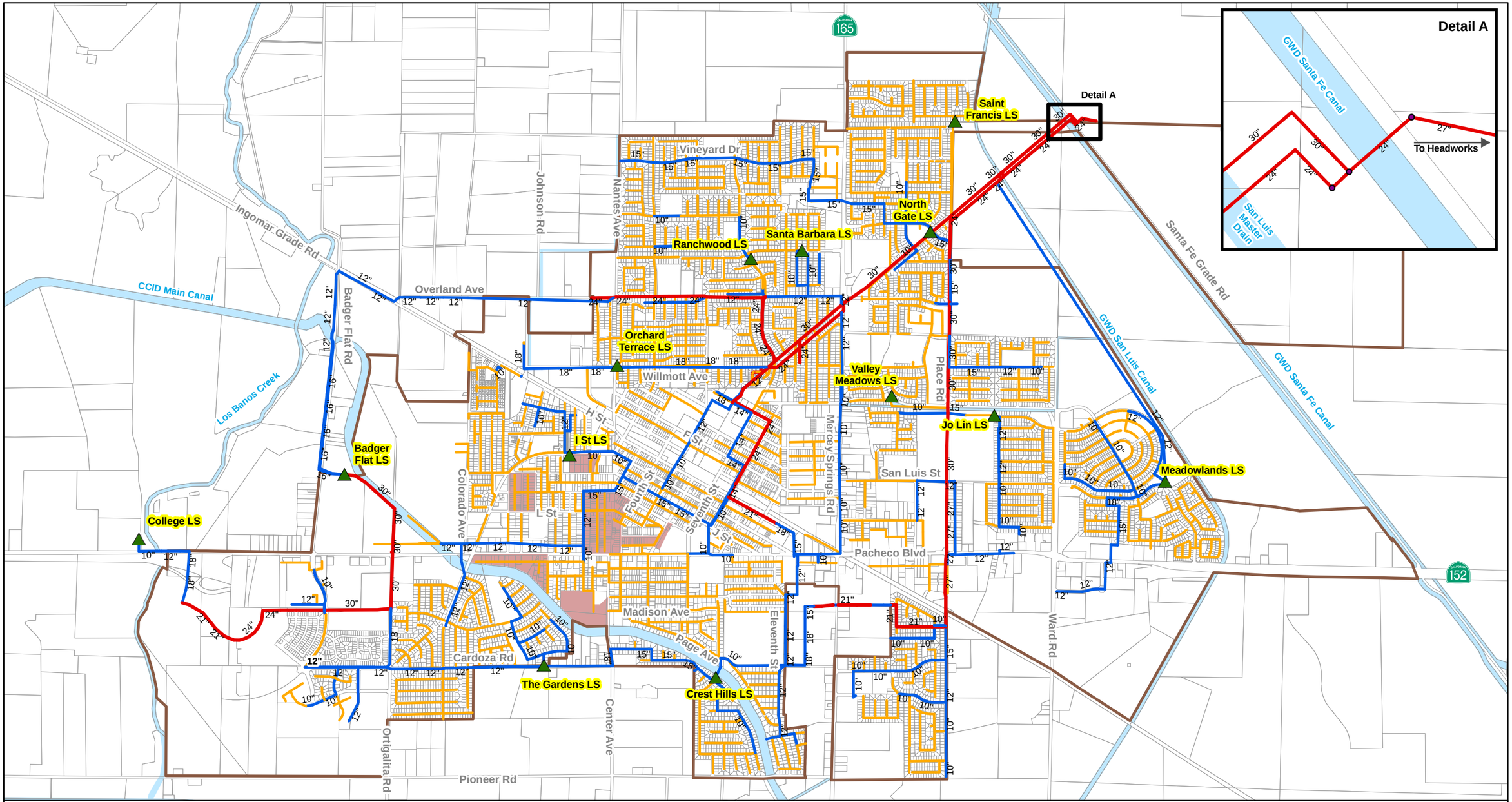
5.1 WASTEWATER SERVICE AREA OVERVIEW

The City's collection system consists of sewer mains and trunk sewers that collect and convey wastewater to the City's wastewater treatment plant (WWTP). There are two parallel interceptors, east of Place Road that convey flow to the WWTP. West of Place Road, the Central interceptor and the Southeast trunk are the two primary sewers that collect flow within the residential and commercial areas of the City. Several other sewers collect wastewater throughout the City and flow tributary to either the Central or the Southeast trunk sewer. Figure 5.1 shows the existing sewer collection system, including sewer diameters and lift station locations. More detail on the City's trunk sewers is provided below. Table 5.1 presents a summary by diameter of the known sewers in the collection system. In total, there is more than 124 miles of sewer mains and trunk sewers in the City's collection system.

Table 5.1 Wastewater Collection System Pipeline Summary
Wastewater Collection System Master Plan
City of Los Banos

Diameter (inch)	Length (feet)	Diameter (inch)	Length (feet)
4	2,192	16	3,973
6	256,406	18	11,694
8	200,090	21	5,932
10	43,894	24	17,887
12	59,655	27	3,541
14	3,198	30	21,959
15	26,914		
		Total	**657,343**

Source: City provided AutoCAD data.



Legend

Existing Wastewater Collection System

- Lift Station

Sewer Pipeline Diameter

- 8" and Smaller
- 10 - 18"
- 21" and Larger

- Storm Runoff that Drains to Sewer
- City Limits
- Waterways/Canals
- Parcels

N

0 2,000 4,000 Feet

Figure 5.1
Existing Wastewater Collection System
Wastewater Collection System Master Plan
City of Los Banos

5.2 MODELED SEWER SYSTEM

The modeled sewer system consists of approximately 39 miles of sanitary sewer lines ranging in diameter from 6-inches to 30-inches, and 13 lift stations. Figure 5.2 presents the City's modeled wastewater collection system. The larger trunk sewers range in diameter from 10-inches to 30-inches. Table 5.2 presents a summary of the modeled sewer system by diameter and length of pipe. Not included in these totals are the smaller sewer mains that were not modeled (typically 8-inch diameter and smaller).

Table 5.2 Modeled Sewer System Pipeline Summary
Wastewater Collection System Master Plan
City of Los Banos

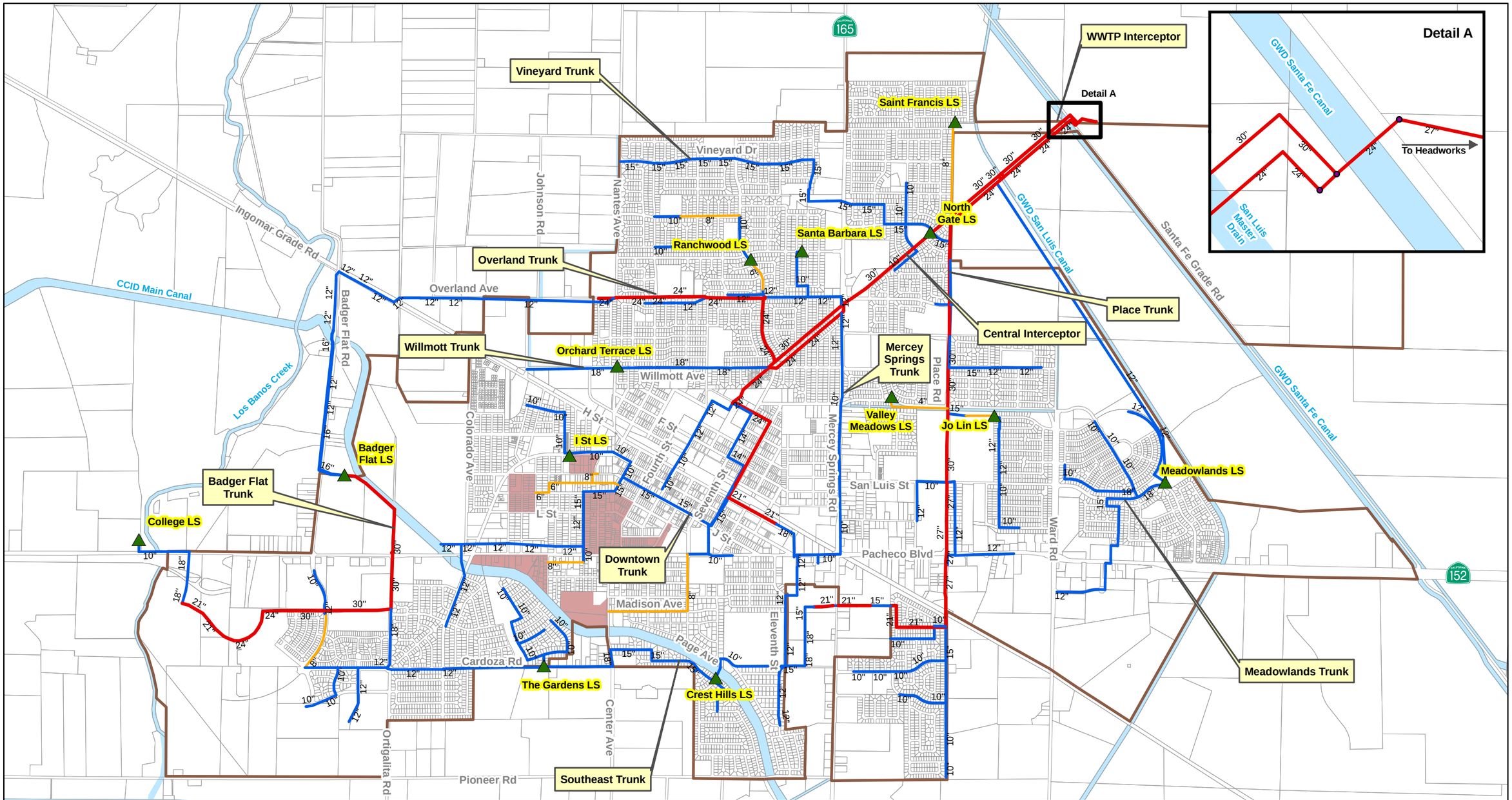
Diameter (inch)	Length (feet)	Diameter (inch)	Length (feet)
6	817	16	3,973
8	6,629	18	11,694
10	43,894	21	5,932
12	59,655	24	17,887
14	3,198	27	3,541
15	26,914	30	21,959
		Total	**206,095**

Source: City provided AutoCAD data.

5.2.1 Interceptors and Major Trunk Sewers

5.2.1.1 WWTP Interceptor

The WWTP interceptors are the principal sewers in the City's collection system. These two parallel interceptors (24-inch and 30-inch diameter) convey all the flow generated within the City to the WWTP. The WWTP interceptors start at Place Road, run parallel to each other and cross under the San Luis Canal and the San Luis Master Drain. In between the San Luis Master Drain and the GWD Santa Fe Canal, the two sewers combine flow at a single manhole. From this point, a single 24-inch diameter trunk sewer crosses the Santa Fe Canal, and increases to a 27-inch diameter trunk sewer on the east side of the canal. The 27-inch diameter sewer conveys flows to the WWTP's headworks and influent pump station. The 24-inch interceptor was constructed in 1927 and the 30-inch was constructed in 1983 and is Perma-Lock plastic pipe. Prior to the construction of the 30-inch sewer, all the City's wastewater flowed through the 24-inch interceptor. The City's two primary trunk sewers (the Central interceptor and the Southeast trunk) flow tributary to the WWTP interceptor.



Legend

Modeled Wastewater Collection System

- Lift Station

Sewer Pipeline Diameter

- 8" and Smaller
- 10 - 18"
- 21" and Larger

- Storm Runoff that Drains to Sewer
- City Limits
- Waterways/Canals
- Parcels

N

0 2,000 4,000 Feet

Figure 5.2
Modeled Wastewater Collection System
Wastewater Collection System Master Plan
City of Los Banos

5.2.1.2 Central Interceptor

The Central interceptor is a major sewer in the City's collection system and currently conveys up to 70 percent of the City's wastewater. The Central interceptor runs from C Street to Place Road, and consists primarily of a 30-inch diameter sewer and a 24-inch diameter parallel sewer. The 24-inch diameter parallel sewer was constructed in 1927, and ends at Mercey Springs Road. The segment between Mercey Springs Road and Place Road was abandoned following the installation of the 30-inch diameter sewer in 1983. East of Mercey Springs Road, only the 30-inch diameter sewer conveys flow to the WWTP interceptors discussed above. The Northgate lift station that pumps into the Central interceptor is located near the intersection of Rockport and Regency Drive.

The 1981 Master Plan concluded that no significant obstructions or infiltration of groundwater was identified in the 24-inch diameter parallel sewer, and as long as the pipe remains undisturbed, it should provide satisfactory service for many years. These conclusions are over 27 years old and the City should consider a condition assessment of the Central interceptor to confirm its current state.

The Central interceptor collects flow from all parts of the City. General summaries of a few trunk sewers that flow tributary to the Central interceptor are provided below.

5.2.1.2.1 *Vineyard Trunk Sewer*

The 15-inch diameter Vineyard trunk sewer conveys flow from the northern part of the City to the Central interceptor. The Vineyard trunk sewer runs primarily west to east in Vineyard Drive before discharging into the Northgate lift station near the intersection of Regency and Rockport Drive.

5.2.1.2.2 *Overland Trunk Sewer*

The 24-inch diameter Overland trunk sewer conveys flow from the north-central part of the City to the Central interceptor. This sewer runs primarily west to east in Overland Road and discharges to the Central interceptor near Stonewood Drive and Willmott Avenue. The Badger Flat trunk sewer (discussed below) also conveys its wastewater to the Overland trunk sewer. Wastewater is pumped from the Badger Flat lift station through a forcemain that discharges to the Overland trunk sewer west of Nantes Avenue.

As more development progresses along Highway 152, west of Ortigalita Road, flows in the Badger Flat trunk sewer will also increase. This will in turn elevate wastewater flows in the Overland trunk sewer. Flows in Overland will ultimately exceed the sewers capacity. At this time, the Badger Flat trunk sewer will begin discharging into a future sewer, and relieve the Overland trunk sewer. This sewer strategy is discussed in more detail in Chapter 6.

5.2.1.2.3 *Willmott Trunk Sewer*

The 18-inch diameter Willmott trunk sewer conveys flow from the central part of the City to the Central interceptor. This sewer runs west to east in Willmott Avenue and terminates near 7th Street.

5.2.1.2.4 *Downtown Trunk Sewers*

Several downtown trunk sewers convey flow from residential, commercial, and industrial users to the Central interceptor. The trunk sewers range in diameter from 10 to 24-inches, and are located throughout the City's downtown, including C, H, I, J, 5th, 8th, and 11th Street. The presence of storm drain connections to the sanitary sewer system around the downtown area increases the amount of wastewater flow during storm events. The increases in flow are generally concentrated and of short duration, but can lead to surcharge conditions and potential overflows.

5.2.1.2.5 *Mercey Springs Trunk Sewer*

The 10/12-inch diameter Mercey Springs trunk sewer conveys flow from the central part of the City to the Central interceptor. This sewer runs south to north in Mercey Springs Road and terminates near Overland Road. City staff has mentioned that this sewer is deteriorated and should be rehabilitated.

5.2.1.2.6 *Place Trunk Sewer*

The Place trunk sewer ranges in diameter from 10 to 15-inches and conveys flow from recently developed residential neighborhoods along the east side of the City to the Central interceptor. This sewer runs primarily south to north in Place Road.

5.2.1.3 Badger Flat Trunk Sewer

The Badger Flat trunk sewer is a relatively new sewer in the collection system, constructed in 2006. At the time of writing this Master Plan, this trunk sewer was built but not operating. This sewer serves the southwest part of the City and commercial areas along Highway 152, west of Ortigalita Road. The College lift station also pumps into the Badger Flat trunk sewer. The trunk sewer's diameter ranges from 12- to 30-inches. The sewer generally runs west to east in a recently developed part of the City, then proceeds north in Ortigalita Road before reaching the Badger Flat lift station. The Badger Flat lift station pumps wastewater north in Badger Flat Road via two forcemains (12 and 16-inch diameter), which combine into a single 12-inch diameter forcemain after crossing under the Central California Irrigation District (CCID) canal. The forcemain continues onto Overland Road and discharges into the Overland trunk sewer.

As development progresses in the southwest part of the City and along Highway 152, wastewater flow will increase in the Badger Flat trunk sewer. At some point, wastewater will need to be pumped to a new trunk sewer north of the City, and cease discharging to the Overland trunk sewer. This strategy is discussed further in Chapter 6.

5.2.1.4 Southeast Trunk Sewer

The Southeast trunk sewer is a major sewer in the City's collection system and currently conveys up to 30 percent of the City's wastewater. This sewer serves primarily the southern part of the City, and some eastern portions. The Southeast trunk sewer starts at the intersection of Cardoza and Ortigalita Road, runs primarily east in Cardoza Road and north in Place Road. The pipeline's diameter ranges from 12 to 30-inches. There are two lift stations on this sewer; the Gardens lift station near Cardoza Road and Mulberry Way and the Crest Hills lift station near the CCID Main Canal. The Crest Hills lift station pumps wastewater east and across the canal.

Several trunk sewers collect and convey wastewater from smaller neighborhoods to the Southeast trunk sewer. These smaller trunk sewers are generally 10-inches and 12-inches in diameter.

5.2.1.5 Meadowlands Trunk Sewer

The Meadowlands trunk sewer collects and conveys wastewater from residential and industrial users along Highway 152, in the eastern most part of the City. Wastewater flows to the Meadowlands lift station, and then is pumped via a 12-inch forcemain to the WWTP interceptor.

5.2.2 Lift Stations

There are 13 lift stations in the collection system, most of which were included in the hydraulic model. The general locations of each lift station are shown on Figure 5.1. Table 5.3 summarizes the lift station and wet well capacity for the 13 lift stations.

5.3 SEWER SYSTEM HYDRAULIC MODEL

A wastewater collection system model is a simplified representation of the real sewer system. Sewer system models can assess the conveyance capacity for a collection system. Also, sewer system models can perform "what if" scenarios to assess the impacts of future developments and land use changes.

The City's hydraulic model combines information on the physical and operational characteristics of the wastewater system, and performs calculations to solve a series of mathematical equations to simulate flows in pipes. The hydraulic model was developed based on data collected from the City's AutoCAD database, developer design drawings, lift station design summaries, and field surveys.

Elements comprising the computer modeling process are: skeletonizing the sewer system, defining pipes and nodes, and identifying the service areas. Skeletonizing is the process by which collection systems are stripped of pipelines not considered essential for the intended analysis purpose. The sewer system model generally includes pipelines with a diameter of 10-inches or greater, all associated manholes, and lift stations. In some instances, 8-inch

Table 5.3 Lift Station and Wet Well Design Data
Wastewater Collection System Master Plan
City of Los Banos

	Pump Design Data						Wet Well Design Data					
Name	**Pump Number**	**Pump Capacity (gpm)**	**Firm Capacity (gpm)**	**Total Capacity (gpm)**	**Total Discharge Head (ft)**	**Horsepower (hp)**	**Bottom El. (feet)**	**Soffit El. (feet)**	**Diameter (feet)**	**Depth (feet)**	**Volume (gallons)**	**Inlet Sewer Invert El. (feet)**
Above Ground Lift Stations												
Crest Hills	1	800	800	1,600	25	10	106.0	128.0	8	22.0	8,267	118.0
	2	800			25	10						
Jo Lin	1	Information not available for Jo Lin Pumps				10	88.0	110.7	8	22.7	8,519	96.3
	2					10						
Orchard Terrace	1	300	300	600	NA	NA	100.5	117.4	4	16.9	1,588	NA
	2	300			NA	NA						
Ranchwood	1	550	550	1,100	35	10	90.6	110.6	8	20.0	7,516	97.7
	2	550			35	10						
Saint Francis	1	120	120	240	15	3	85.5	105.8	8	20.3	7,614	90.3
	2	120			15	3						
Valley Meadows	1	101	101	201	97.5	NA	95.0	112.5	5	17.5	2,569	101.5
	2	101			97.5	NA						
Below Ground Lift Stations												
The Gardens No. 5	1	900	900	1,800	18	NA	107.0	127.8	8	20.9	7,839	116.4
	2	900			18	NA						114.5
Meadowlands	1	700	1,400	2,100	50	20	86.9	107.9	8	21.1	7,918	94.0
	2	700			50	20						
	3	700			50	20						
Northgate	1	1,000	2,000	3,000	28	NA	76.0	106.5	8	30.5	11,462	85.9
	2	1,000			28	NA						
	3	1,000			28	NA						
Santa Barbara	1	350	350	700	15	NA	NA	NA	4	14.8	1,393	NA
	2	350			15	NA						
West I	1	350	350	700	NA	NA	103.2	120.3	6	17.1	3,610	108.2
	2	350			NA	NA						
College	1	900	900	1,800	20	NA	118.4	134.8	8	16.4	6,159	124.4
	2	900			20	NA						
Badger Flat[1]	1	3,150	3,150	6,300	34.5	42	95.0	123	10	28.0	16,441	24
	2	3,150			34.5	42						

Note:
1. Badger Flat lift station pumps will be installed in phases. Interim phase will include 2-800 gpm pumps, Secondary phase will include 2-2,000 gpm pumps, and the Ultimate (build-out) phase will include 2-3,150 gpm pumps. The analysis investigated build-out conditions, therefore the Ultimate pump capacity was included in the model.

diameter pipelines and smaller were included in the model to further define a specific area of interest or to maintain connectivity in the system. Modeling sewers that are 10-inch diameter and greater serves the purpose of minimizing model analysis run time while retaining the hydraulic integrity of the collection system as a whole.

Computer modeling requires gathering information of the sewer system, such as pipe diameters, lengths; invert elevations at the upstream and downstream manholes, pipe slope, manhole rim elevations, and wet well dimensions.

5.3.1 Quantifying Wastewater Flow

Determining the quantity of wastewater flow generated by a City and loaded into a hydraulic model is typically based on land use designations, flow coefficients, and land use area. The land use type will affect the volume and diurnal flow pattern of wastewater being generated from the study area. Adequately estimating this volume of wastewater is an important process in maintaining and sizing sewer system facilities, both for present conditions and future developments.

Land use data provided by the City, wastewater flow coefficients discussed in Chapter 4, and customer billing records were the basis for estimating wastewater loads input into the hydraulic model. The flow coefficients and billing records provided a means to transform a specific land use category into an average day flow. The loads were calculated in the geographic information systems (GIS) software program by multiplying the flow coefficient by the land use acreage. The model's load allocation assigned the calculated average day flow to an appropriate sewershed and corresponding node in the sewer system model.

5.3.2 Sewer Tributary Areas (Existing and Future)

The City's existing and future sewer service area were divided into tributary areas. Each of these tributary areas was further broken down into "sewersheds" to facilitate the assignment of wastewater flow to appropriate sewers. A sewershed is a geographic area within the sewer system where wastewater generated in the area will be injected into a single node in the model. Usually a sewershed will encompass a particular subdivision or grouping of lots.

Figure 5.3 presents the major sewer tributaries for the existing collection system. The tributaries represent the assembly of smaller sewersheds into larger tributaries. As shown in the figure, the Central tributary is the largest of the major tributaries and collects flow from several trunk sewers throughout downtown and the southern parts of the City. Flow generated within this tributary eventually ends up at the Central Interceptor. The other sewer tributaries are named after the major trunk sewer that conveys flow within the tributary. For example, all flow generated within the Vineyard sewer tributary will be conveyed by the Vineyard trunk sewer.

Figure 5.3 is useful because City staff can quickly inspect the figure and determine where a proposed development's flow will discharge. Although Figure 5.3 represents the existing collection system and is useful for infill development within the current City limits, as the City continues to grow through build-out of the sphere of influence (SOI), the tributaries and flow routing scheme will shift. Figure 5.4 illustrates the future sewer tributaries through build-out of the SOI and the anticipated shift in flow routing. As shown in Figure 5.4, some of the future flows were routed to existing sewers like the Southeast trunk. However, a majority of future development was routed to new sewers.

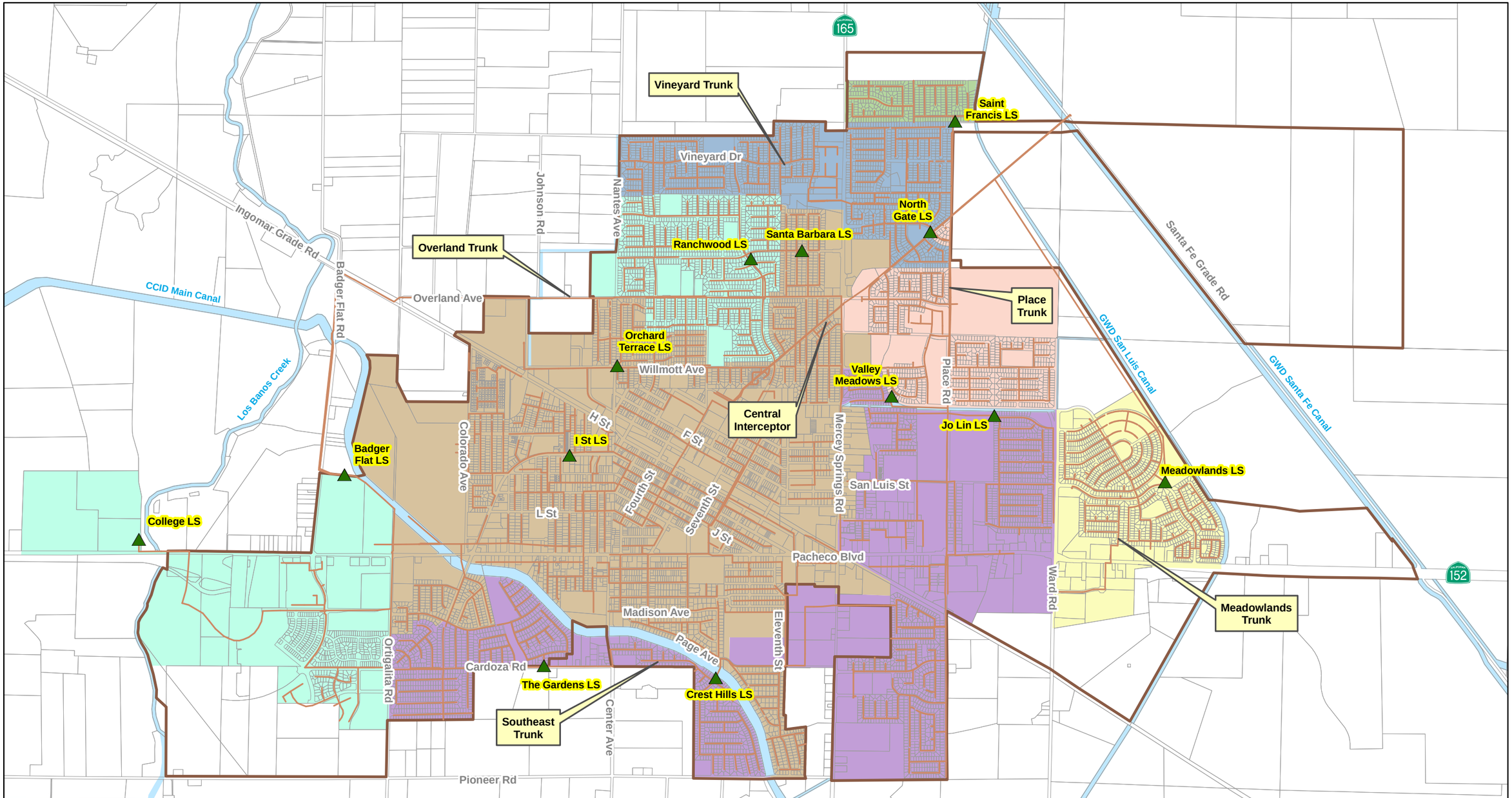
As shown in Figure 5.4, as the City expands beyond the current City limits, several new trunk sewers will convey future flow, including the West, North, and Pioneer trunk sewers. The Pioneer trunk sewer and tributary are located in the southern perimeter of the study area. The southwest part of the City, west of Ortigalita Road currently flows to the Badger Flat Road lift station, which then pumps wastewater to the Overland trunk sewer. At build-out of the SOI, this southwest part of the City will cease pumping to the Overland trunk sewer, and shift to the North trunk sewer tributary. More detailed discussion of future trunk sewers and their tributaries is provided in Chapter 6.

5.3.3 Wet Weather Flow Modeling

Modeling wet weather flow (WWF) consists of estimating the amount of storm runoff entering a sewer system. As mentioned in Chapter 4, older sewers typically allow more infiltration/inflow (I/I) into a sewer system when compared to newer pipelines. The presence of storm drain connections, like those found around the downtown area, increase the quantity of inflow that enters sewers. WWF modeling simulates the amount of inflow and groundwater infiltration (GWI) entering the collection system.

5.3.4 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 ensures the most accurate results possible. The calibration process consists of calibrating to both dry and wet weather conditions. For this project, only dry weather flow (DWF) monitoring was conducted. DWF calibration ensures an accurate depiction of base wastewater flow generated within the study area. The WWF calibration consists of calibrating the hydraulic model to a specific storm event to quantify the peak and volume of I/I into the sewer system. The amount of I/I is essentially the difference between the WWF and DWF components. Even though WWF monitoring was not conducted, we were able to calibrate the model for a wet weather event by matching flow patterns at the WWTP following a storm event.



Legend

Existing Wastewater Collection System

- Lift Stations
- Sewer Pipelines

Sewer Tributary Areas

- Central
- Meadowlands
- Overland
- Place
- Southeast
- St. Francis
- Vineyard
- City Limits
- Waterways/Canals
- Parcels

N

0 2,000 4,000 Feet

Figure 5.3
Existing Sewer System Tributaries
Wastewater Collection System Master Plan
City of Los Banos

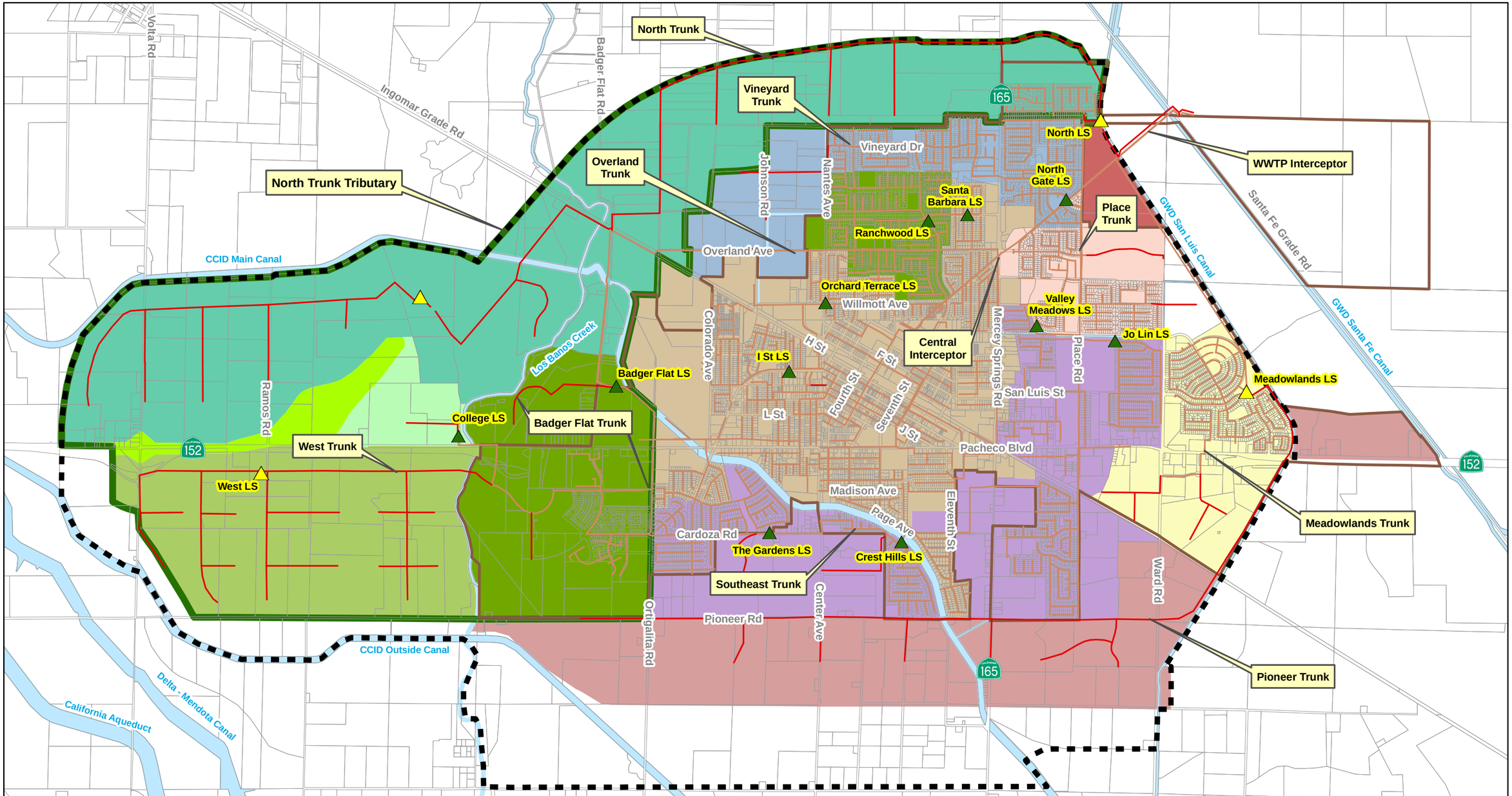


Figure 5.4
Future Sewer System Tributaries
Wastewater Collection System Master Plan
City of Los Banos

5.3.4.1 Average Day Flow Calibration

The average day flow calibration consists of several elements: 1) dividing the sewer system into areas tributary to each of the flow meter stations; 2) defining the flow volumes within each area; and 3) creating diurnal curves to match the temporal distribution of flow. The diurnal curve is the variation of flow throughout the day.

The first step in the calibration process was to divide the City's service area into flow meter tributary areas. Sixteen tributary areas were created, one for each flow meter. The next step was to define the flow volumes within each area, which was accomplished in the flow-loading step discussed above. Diurnal curves based on the flow monitoring data were created for nodes tributary to a specific flow meter. Usually, the peak in a diurnal curve will occur in the morning, between 7 a.m. and 10 a.m. and again in the evening between 5 p.m. and 8 p.m. Figure 5.5 displays the diurnal curve for the area tributary to Flow Meter 4, which measured flows from a residential area in the eastern part of the City. Similar diurnal curves were developed for each of the remaining meters and their tributary areas. These additional curves are available in Appendix C.

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 5.4 summarizes the ADF calibration using minimum, maximum, and average flow results. A sample of the ADF calibration for Flow Meter 4 is presented in Figure 5.6. This figure shows the measured flow at the meter versus the model predicted flows over a 24-hour period. The remaining DWF calibration plots are provided in Appendix D. As shown in Appendix D, the correlation between the modeled and the measured results is good.

5.3.5 Wet Weather Flow Calibration

The WWF calibration enables the hydraulic model to accurately measure I/I entering a sewer system during a large storm. WWF calibration consists of two steps: 1) determining a rainfall event that characterizes the most significant impact on the sewer system facilities, preferably during wet antecedent soil moisture conditions; and 2) creating a database of I/I parameters for this rainfall event. Since WWF monitoring data was not collected, the model derived flows were adjusted by modifying the I/I parameters until they matched the WWTP flow data. The model was considered calibrated when the model derived flows were reasonably close to the measured flows.

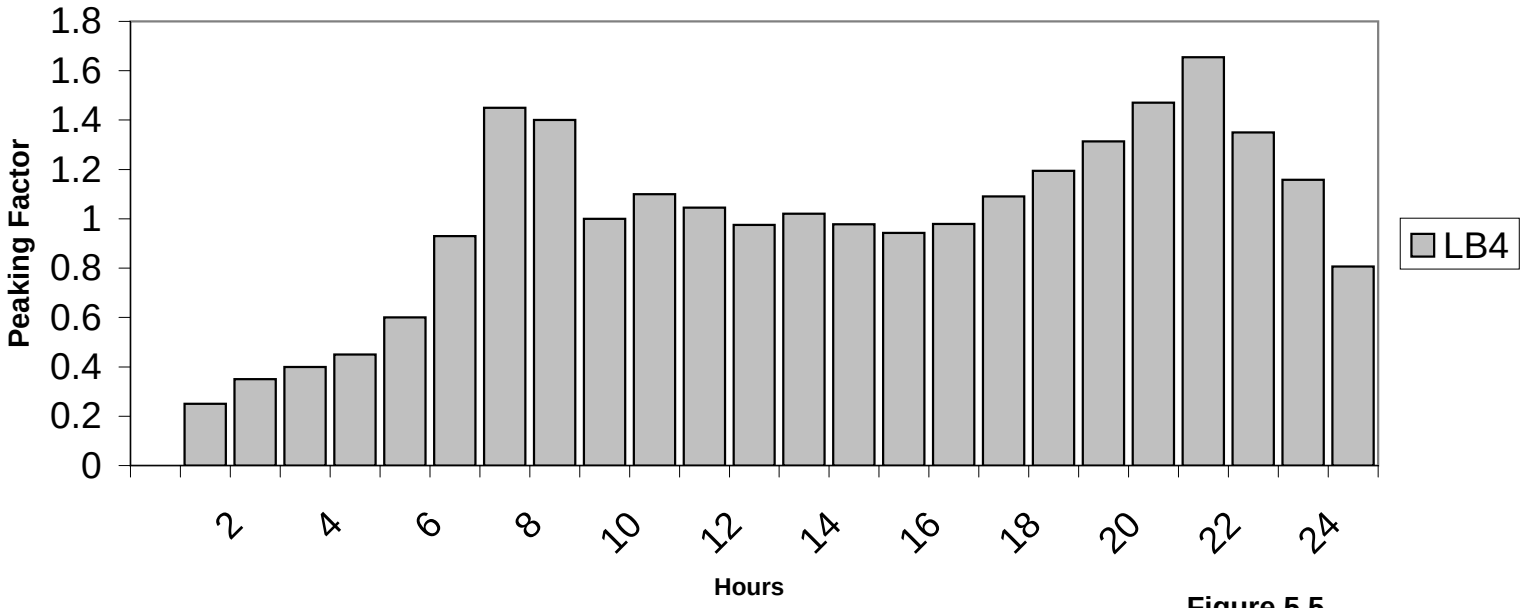


Figure 5.5
Flow Meter 4 Diurnal Pattern
Wastewater Collection System Master Plan

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Table 5.4 Average Day Flow Calibration Summary
Wastewater Collection System Master Plan
City of Los Banos

Meter	Meter Average Day Flow[1]				Model Average Day Flow			Percent Diff.[2]
Site	Average (mgd)	Max. (mgd)	Min. (mgd)		Average (mgd)	Max. (mgd)	Min. (mgd)	
0	2.71	3.24	1.88		2.74	3.24	1.91	1.1
1	3.22	4.24	1.88		3.17	3.91	2.09	1.6
2	1.41	1.77	0.93		1.01	1.24	0.65	39.6[3]
3	0.29	0.47	0.12		0.29	0.46	0.12	0.0
4	0.14	0.23	0.05		0.14	0.23	0.04	0.0
5	0.31	0.50	0.11		0.31	0.47	0.13	0.0
6	0.16	0.25	0.07		0.17	0.25	0.08	5.9
7	1.36	1.56	0.98		1.35	1.51	1.08	0.7
8	0.10	0.16	0.03		0.10	0.15	0.03	0.0
9	0.14	0.18	0.07		0.14	0.18	0.07	0.0
10	0.93	1.02	0.89		0.92	0.99	0.89	1.1
11	0.09	0.13	0.05		0.10	0.13	0.05	10.0
12	0.36	0.50	0.14		0.36	0.49	0.14	0.0
13	0.14	0.22	0.06		0.14	0.21	0.06	0.0
14	0.32	0.44	0.16		0.32	0.45	0.15	0.0
15	0.12	0.15	0.06		0.12	0.15	0.07	0.0

Source: Meter data from Sanitary Sewer Flow Monitoring, September 2007

Notes:

1. Average day flow calculated from flow monitoring data, not including weekend flow. Maximum flow is the maximum hourly flow measured over the monitoring period for dry weather conditions.
2. Percent difference between the average flow for the meter collected data and the modeled derived results.
3. Flow Meter Number 2 was vandalized during the data collection. This could have resulted in corruption of the data.

Ideally, the selected rainfall event used for calibrating the model would have a total volume (or inches of measured rain) very close to the design storm volume. Recall that the 10-year, 24-hour design storm for this area is 1.75-inches. Routing the design storm through the hydraulic model to evaluate the impacts on the collection system is one of the steps in determining necessary capital improvements. GWI can be a large source of inflow if the groundwater table rises above the invert elevation of a pipeline with many cracks or defects. Preferably, the selected rainfall event would have occurred at a time when the

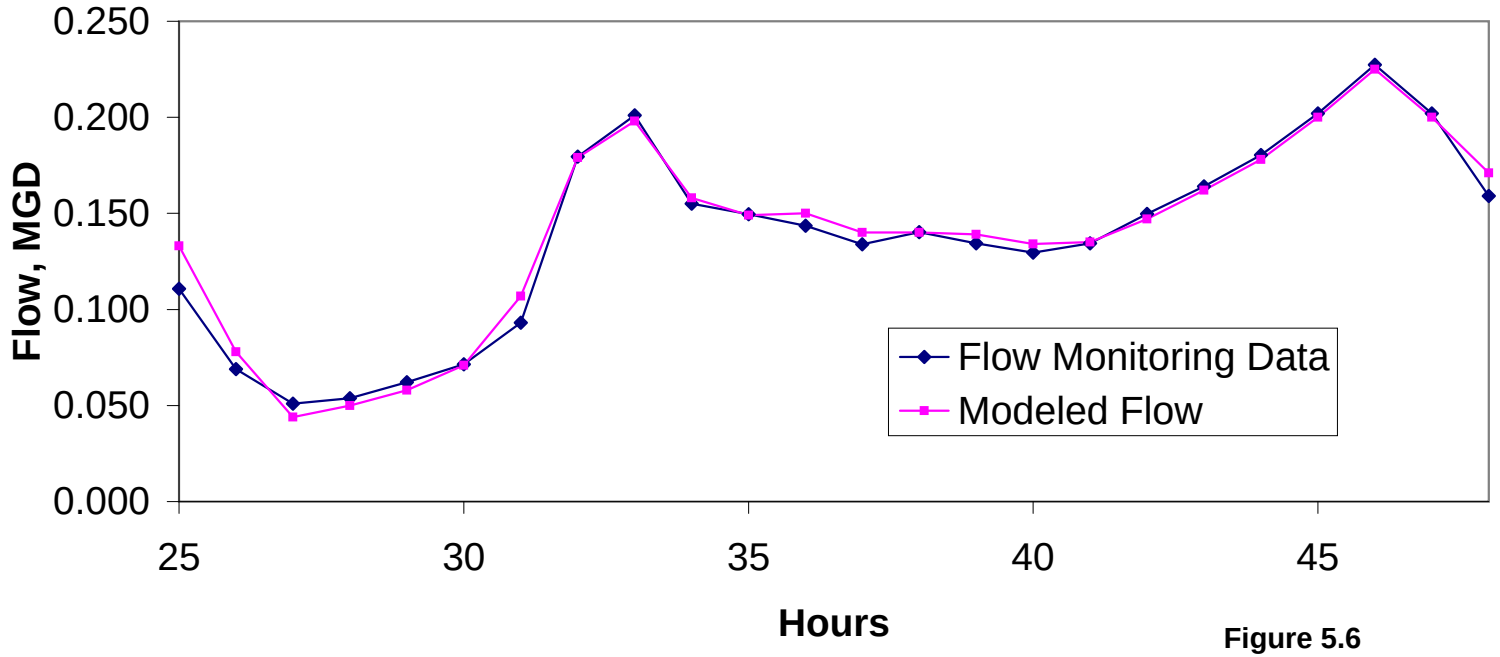

Figure 5.6
Flow Meter 4 Average Day Flow Calibration
Wastewater Collection System Master Plan
City of Los Banos

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groundwater table was at or near its maximum height. This allows the model to be calibrated to the worst-case scenario.

Review of rainfall and WWTP influent flow data for 2006 and 2007 indicated that the two-day period of January 1 and 2, 2006 provided the greatest 24-hour storm total and the maximum day flow at the WWTP. The rainfall and plant flow records for these two days were used for model calibration and analysis. The increase in wastewater flow is indicative of rainfall dependent I/I. The hydraulic model was calibrated to the storm and WWTP flows for these two days to simulate the influence of I/I on the sewer system.

On January 1 and 2, 2006, the total depth at CIMIS Station No. 56 was 1.81-inches, and the peak hour intensity was 0.18-inches. Table 5.5 presents a comparison of the 10-year, 24-hour design storm and the calibration storm. Since the total volume of the calibration storm and the design storm are similar, there is more confidence in the model's results because we were able to compare them to measured sewer flows during a storm of comparable magnitude. For sewer modeling projects, we are often required to calibrate models to a smaller storm event and extrapolate up to a 10-year event.

Table 5.5 Design Storm and Calibration Storm Comparison
Wastewater Collection System Master Plan
City of Los Banos

		Peak Intensity	
Event	**Total Volume (inches)**	**Peak Intensity (in/hr)[1]**	**Peak Percent of Total Volume (percent)**
10-Year 24-Hour Design Storm	1.75	0.61	35
Calibration Storm	1.81	0.18	10

Note:
1. in/hr = inches per hour

The WWF calibration process entails adjusting I/I parameters within the model to match the flow monitoring data measured at various locations throughout the collection system. Since WWF monitoring data was not collected, we matched the flow recorded at the WWTP only. Locations of the City with known I/I problems or with storm drains connected to the sanitary sewer system were modeled to simulate storm runoff entering the wastewater collection system. Unit hydrographs were developed to approximate the amount of runoff entering the collection system and to estimate the variation in runoff intensity over time. Model calibration was achieved by adjusting unit hydrograph parameters in the hydraulic model until the model predicted flows matched the flows measured at the WWTP for these two days.

Model results were compared to the WWTP's chart recorder flow data. In 2006, the WWTP's chart recorder could not read values above 5.0 mgd and flows exceeded this

amount on January 1 and 2, 2006. For this reason, we ran the calibrated model to simulate the collection system's response to the February 15, 2005 storm event. For this storm event, the model output matched the flow at the WWTP using the calibrated model, indicating that we were accurately modeling WWF through the collection system. A sample of the WWF calibration results for the 2005 storm is presented in Figure 5.7.

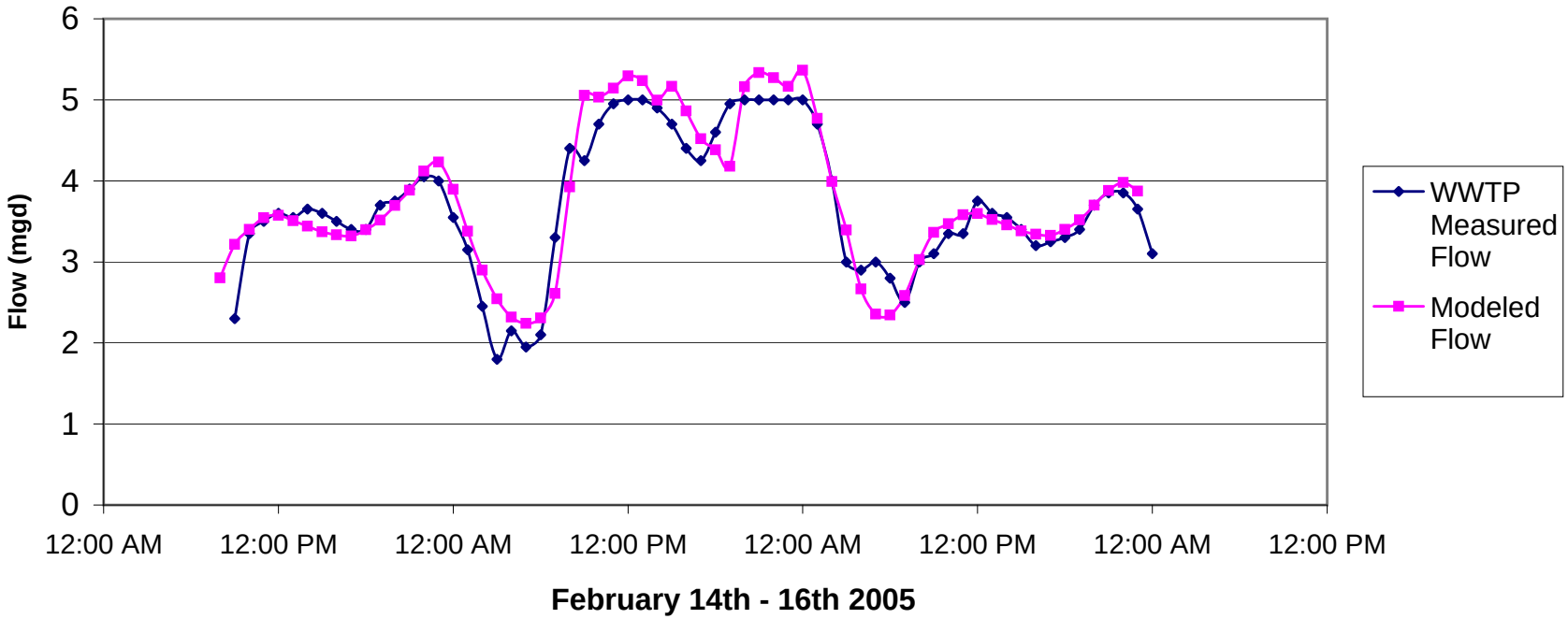

Figure 5.7
February 2005 Wet Weather Calibration
Wastewater Collection System Master Plan
City of Los Banos

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CAPACITY EVALUATION AND PROPOSED IMPROVEMENTS

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

6.1 CAPACITY EVALUATION

Following the dry and wet weather flow calibration, a capacity analysis of the modeled collection system was performed. The capacity analysis entailed identifying areas in the sewer system where flow restrictions occur or where pipe capacity is insufficient to convey design flows. Sewers that lack sufficient capacity to convey design flows could produce backwater effects in the collection system and potentially cause sanitary sewer overflows (SSOs). The sewer system was evaluated based on planning criteria presented in this report.

This chapter discusses the locations of existing and future hydraulic deficiencies resulting from flows exceeding the maximum flow depth (d) to pipe diameter ratio (D) (d/D) criteria and from lift stations lacking the firm capacity to convey design flow. When an increase to capacity is required, existing sewers can be upgraded or a parallel sewer can be constructed. For the purposes of this wastewater collection system master plan (Master Plan), unless otherwise stated, we assumed that a capacity deficient sewer would be upgraded to a larger diameter. The upgraded pipeline generally followed the same slope as the existing pipeline, with the exception where survey data revealed negative or flat slopes in an existing alignment. In essence there are two alternatives for every trunk sewer project, but the decision to upgrade or construct a parallel sewer should be made during the preliminary design phase.

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

In general, the existing wastewater collection system has sufficient capacity to convey existing design flows. In some locations, such as the City of Los Banos' (City) downtown, existing storm drain connections cause sudden increases in wastewater flow during a storm event. The storm water inflow could cause a few sewers to surcharge and potentially overflow during a large storm. The City had the option to either upsize the sanitary sewer system to convey storm water runoff, or to construct storm drain pipelines and separate the storm runoff from the wastewater system. City staff made the decision to implement storm drain projects to separate storm runoff from the wastewater collection system. These projects are discussed in more detail in the Storm Drainage Master Plan. Implementing the storm drain projects achieved multiple benefits including reducing wastewater flow to the

wastewater treatment plant (WWTP), relieving flooding in the downtown area, and eliminating wastewater capital projects. The projects presented in this Master Plan assume that downtown storm drain projects that separate storm runoff from the wastewater collection system would also be implemented.

The proposed improvements that will serve future users are sized for build-out conditions. As the City continues to grow beyond its current limits, it is recommended that the pipeline diameters and pump station capacities proposed in this Master Plan be constructed so that the facilities have sufficient capacity for build-out conditions. Building a smaller interim project with the plans of upsizing in the future to account for further growth is not recommended. In this Master Plan, the proposed pipe diameter represents the ultimate diameter for build-out conditions.

6.2 COLLECTION SYSTEM IMPROVEMENTS

Figure 6.1 illustrates the proposed sewer improvements required to serve future users. The proposed pipeline diameter is also shown on the figures. Since the City plans to implement storm drain projects downtown to relieve existing flooding and to separate storm connections from the wastewater system, there are no improvements required to correct existing capacity deficiencies. The only projects that will benefit existing users are the proposed sewer main rehabilitation and manhole replacement projects discussed below, and a small sewer project near downtown.

Table 6.1 was created to show more detail of each improvement. For future sewers, the proposed diameter is shown along with the length of sewer. This table also shows the figure identification number. Both Figure 6.1 and Table 6.1 should be used together to locate the proposed improvement on the map and to gain details of the improvement (length, diameter, street location, etc.). The improvement identification number links the figure and table. For example, WWTP-1 in Table 6.1 refers to the Wastewater Treatment Plant interceptor, and can be found in Figure 6.1, immediately upstream of the treatment plant.

6.2.1 Sewer Main Rehabilitation and Manhole Replacement

In addition to the pipeline and lift station improvements recommended to mitigate capacity deficiencies, the City will implement a sewer main rehabilitation program. The sewer main rehabilitation program consists of removing older sewers that are susceptible to failure or will line sewers that are exhibiting signs of corrosion but still possess structural integrity. This program will extend the useful life of existing sewers and maintain the operation of the collection system.

The City will also implement a manhole replacement program to remove older manholes in the collection system that are corroded and susceptible to failure. The City will also replace manholes that lack the access for City staff to perform routine maintenance.

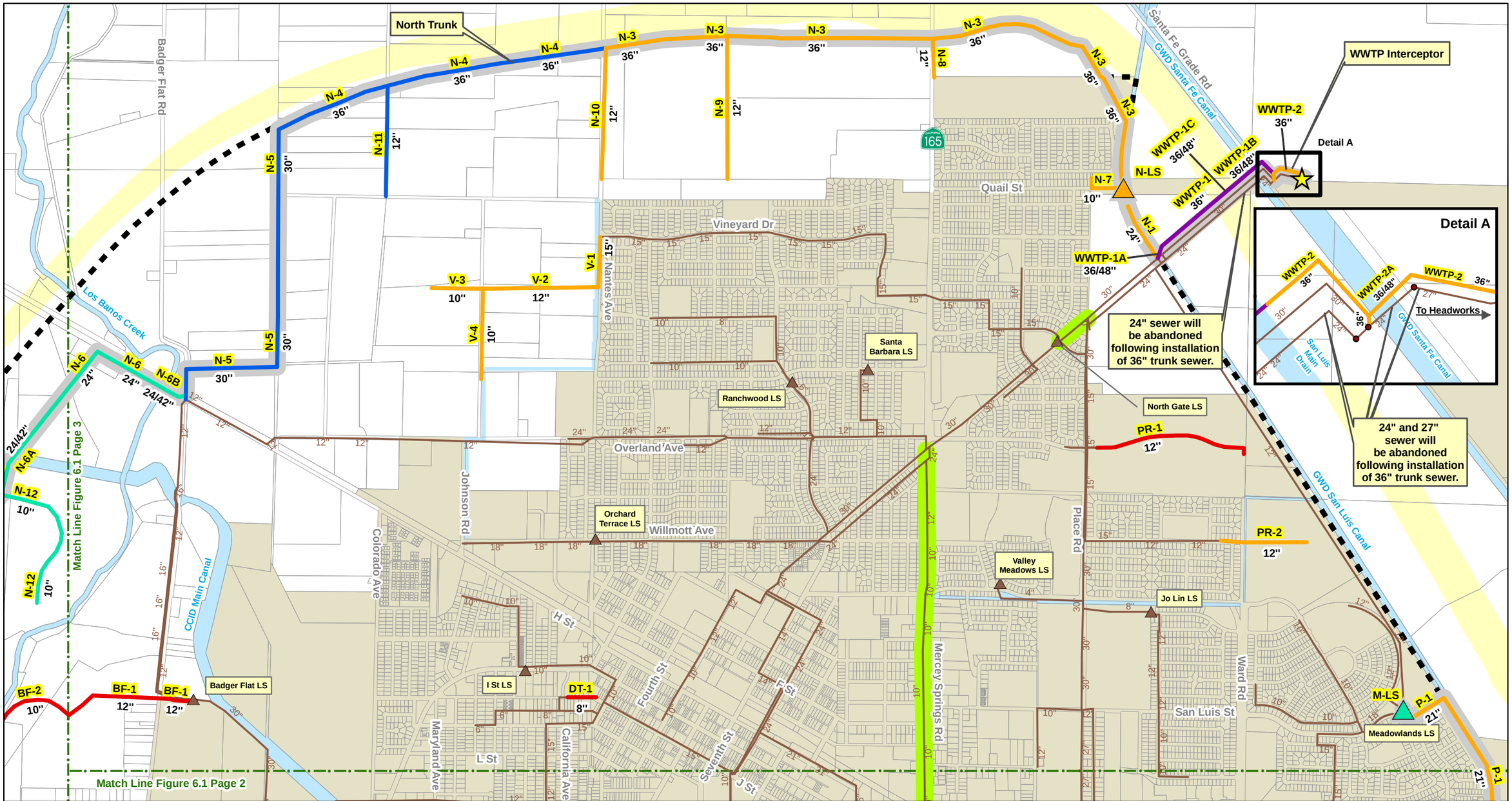


Figure 6.1
Proposed Collection System Improvements (1 of 3)
Wastewater Collection System Master Plan
City of Los Banos

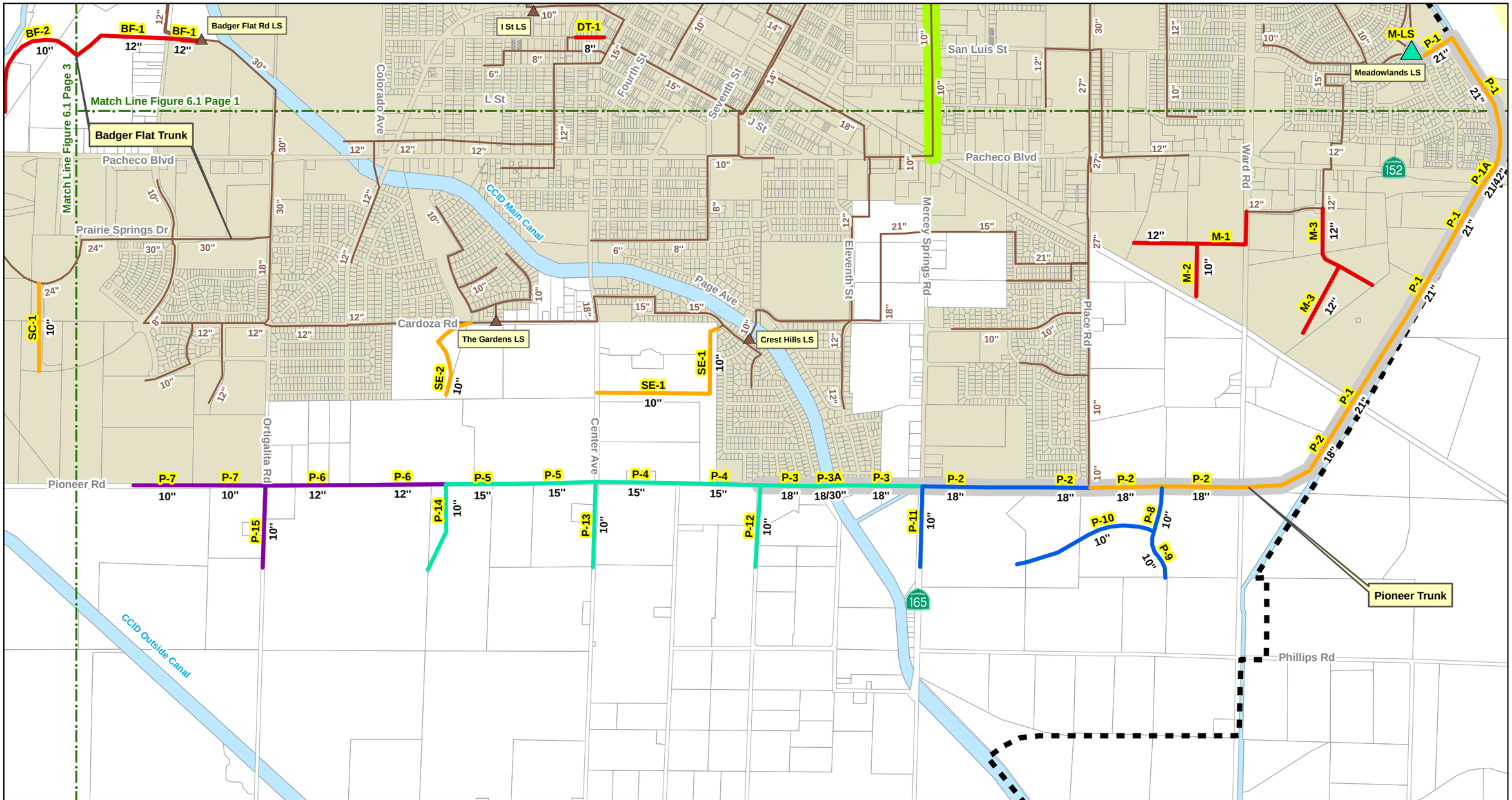
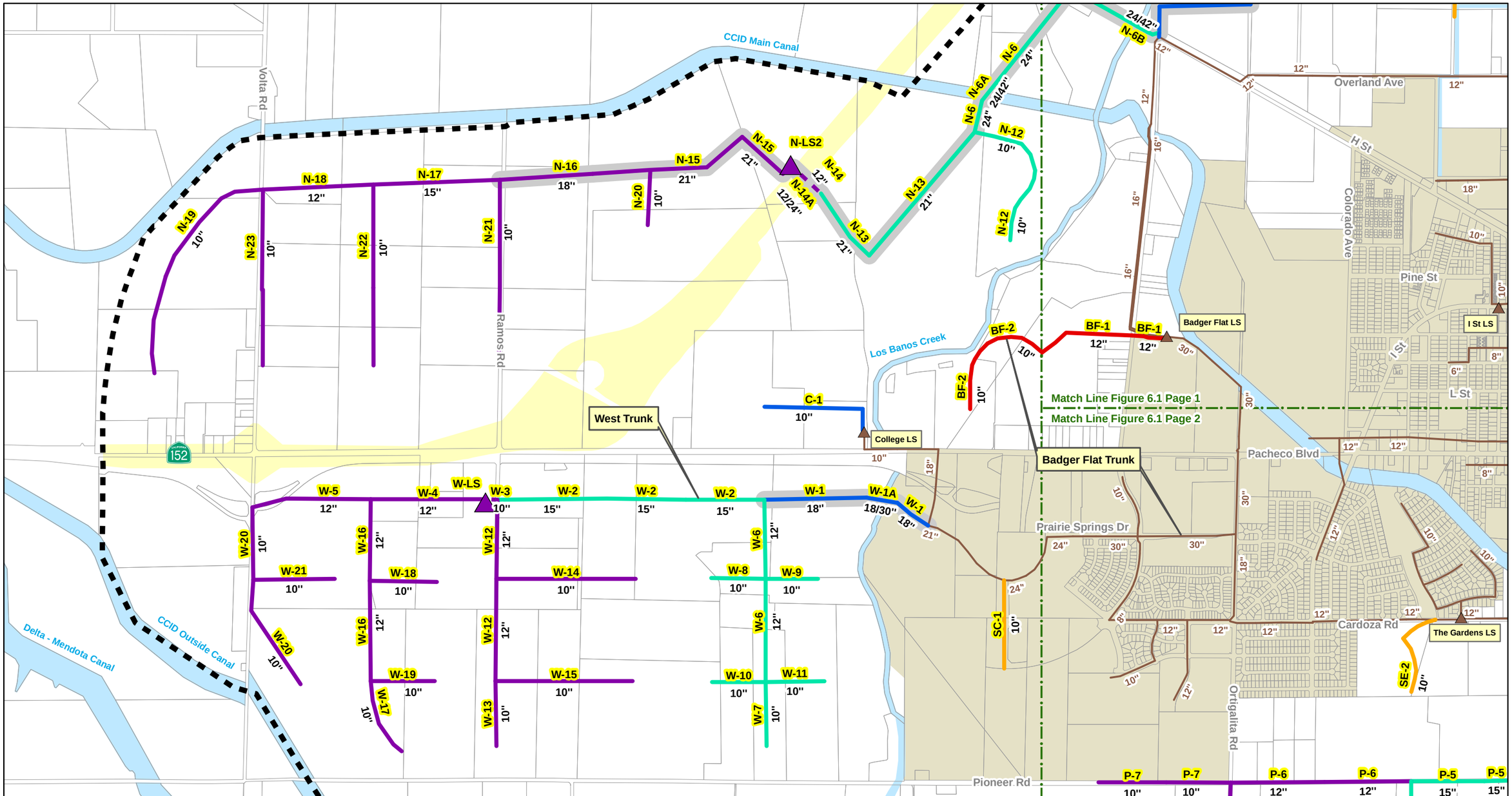


Figure 6.1
Proposed Collection System Improvements (2 of 3)
Wastewater Collection System Master Plan
City of Los Banos



Legend

Modeled Wastewater Collection Facilities

- Lift Station
- Sewer Pipelines

Future Collection Facilities

Lift Stations

- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031+)
- N-5 CIP ID

Sewer Pipelines

- Phase 1 (2010 - 2015)
- Phase 2 (2016 - 2020)
- Phase 3 (2021 - 2025)
- Phase 4 (2026 - 2030)
- Phase 5 (2031+)
- Regional Improvements
- 12" CIP Diameter
- 8" Existing Diameter

- Parcels
- Waterways/Canals
- SR 152 Bypass Corridor
- City Limits
- Sphere of Influence

N

0 1,000 2,000 Feet

Figure 6.1
Proposed Collection System Improvements (3 of 3)
Wastewater Collection System Master Plan
City of Los Banos

Table 6.1 Proposed Collection System Improvements

Wastewater Collection System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Capital Improvement Phasing: Phase 1 2008-10	Phase 2 2011-15	Phase 3 2016-2020	Phase 4 2021-2025	Phase 5 2026+
Wastewater Treament Plant											
WWTP-1	Pipe	WWTP	WWTP		36	New					Phase 5
WWTP-1A	Casing(1)	WWTP	Casing under San Luis Canal		36/48	New					Phase 5
WWTP-1C	Casing(1)	WWTP	Casing under future H-152 Bypass		36/48	New					Phase 5
WWTP-1B	Casing(1)	WWTP	Casing under San Luis Master Drain		36/48	New				Phase 4	Phase 5
WWTP-2	Pipe	WWTP	WWTP		36	New		Phase 2			
WWTP-2A	Casing(1)	WWTP	Casing under Santa Fe Canal		36/48	New		Phase 2			
Downtown Sewer											
DT-1	Pipe	J Street	East of Linda Vista		8	New	Phase 1				
Pioneer Trunk											
P-1	Pipe	Future road	New development		21	New	Phase 1	Phase 2			
P-1A	Casing(1)	152	Casing under Highway 152		21/42	New	Phase 1	Phase 2			
P-2	Pipe	Pioneer	East of 165 along Pioneer and curving northward		18	New		Phase 2	Phase 3		
P-3	Pipe	Pioneer	Plow Camp to 165		18	New		Phase 2		Phase 4	
P-3A	Casing(1)	Canal	Casing under Main Canal		18/30	New				Phase 4	
P-4	Pipe	Pioneer	Diana to Plow Camp		15	New				Phase 4	
P-5	Pipe	Pioneer	West of Diana		15	New				Phase 4	
P-6	Pipe	Pioneer	East of Ortigalita		12	New					Phase 5
P-7	Pipe	Pioneer	West of Origalita		10	New					Phase 5
P-8	Pipe	Future road	New development		12	New			Phase 3		
P-9	Pipe	Future road	New development		10	New			Phase 3		
P-10	Pipe	Phillips	Runs partially along Phillips and to the north of Phillips		10	New			Phase 3		
P-11	Pipe	165	South of Pioneer		10	New			Phase 3		
P-12	Pipe	Plow Camp	South of Pioneer		10	New				Phase 4	
P-13	Pipe	Center	South of Pioneer		10	New				Phase 4	
P-14	Pipe	Future road	New development		10	New				Phase 4	
P-15	Pipe	Ortigalita	South of Pioneer		10	New					Phase 5
North Trunk											
N-1	Pipe	152 bypass	Southeast of lift station		24	New		Phase 2			
N-2	Intentionally left blank										
N-3	Pipe	152 bypass	Northwest of lift station, to Nantes		36	New		Phase 2			
N-4	Pipe	152 bypass	West of Nantes		36	New			Phase 3		
N-5	Pipe	152 bypass	South of 152 bypass		30	New			Phase 3		
N-6	Pipe	Ingomar	South of 152 bypass		24	New				Phase 4	
N-6A	Casing(1)	Canal	Casing under Main Canal		24/42	New				Phase 4	
N-6B	Casing(1)	River	Casing under Los Banos Creek		24/42	New				Phase 4	
N-7	Pipe	Quail	East of Westminister		10	New		Phase 2			
N-8	Pipe	Mercy Springs	South of 152 bypass		12	New		Phase 2			
N-9	Pipe	Future road	New development		12	New		Phase 2			
N-10	Pipe	Nantes	South of 152 bypass		12	New		Phase 2			
N-11	Pipe	Johnson	South of 152 bypass		12	New			Phase 3		
N-12	Pipe	Future road	New development		10	New				Phase 4	

Table 6.1 Proposed Collection System Improvements

Wastewater Collection System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Capital Improvement Phasing: Phase 1 2008-10	Phase 2 2011-15	Phase 3 2016-2020	Phase 4 2021-2025	Phase 5 2026+
N-13	Pipe	Future road	New development		21	New				Phase 4	
N-14	Forcemain	Future road	Force main across future 152 bypass		12	New					Phase 5
N-14A	Casing[1]	Future road	Casing under future 152 bypass		12/24	New					Phase 5
N-15	Pipe	Future road	New development		21	New					Phase 5
N-16	Pipe	Future road	New development		18	New					Phase 5
N-17	Pipe	Future road	New development		15	New					Phase 5
N-18	Pipe	Future road	New development		12	New					Phase 5
N-19	Pipe	Future road	New development		10	New					Phase 5
N-20	Pipe	Future road	New development		10	New					Phase 5
N-21	Pipe	Future road	New development		10	New					Phase 5
N-22	Pipe	Future road	New development		10	New					Phase 5
N-23	Pipe	Future road	New development		10	New					Phase 5
N-LS	Lift Station	Quail	New development		9.2 mgd	New		Phase 2			
	Land Acquisition				0.25 acres	New		Phase 2			
N-LS2	Lift Station	Future road	New development		2.7 mgd	New					Phase 5
	Land Acquisition				0.25 acres	New					Phase 5
Meadowlands											
Meadowlands-LS	Lift Station	NE Los Banos	NE Los Banos		2.9 mgd	Upsize			Phase 3		
M-1	Pipe	Ward Road/Future Road	Within Industrial Area Plan		12	New	Phase 1				
M-2	Pipe	Future Road	Within Industrial Area Plan		10	New	Phase 1				
M-3	Pipe	Industrial Parkway/Future Road	Within Industrial Area Plan		12	New	Phase 1				
Vineyard Trunk											
V-1	Pipe	Nantes	South of Burgundy		15	New		Phase 2			
V-2	Pipe	Future road	New development		12	New		Phase 2			
V-3	Pipe	Future road	New development		10	New		Phase 2			
V-4	Pipe	Johnson	South of Capri		10	New		Phase 2			
Provinces Trunk											
PR-1	Pipe	Overland	New development		12	New	Phase 1				
PR-2	Pipe	Palermo	New development		12	New	Phase 1				
Southeast Trunk											
SE-1	Pipe	Pine	New development		10	New		Phase 2			
SE-2	Pipe	Future road	New development		10	New		Phase 2			
Badger Flat Trunk											
BF-1	Pipe	Badger Flat	New development		12	New	Phase 1				
BF-2	Pipe	Badger Flat	New development		10	New	Phase 1				
College Trunk											
C-1	Pipe	Future road	New development		10	New			Phase 3		
Stone Creek Trunk											

Table 6.1 Proposed Collection System Improvements

Wastewater Collection System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Capital Improvement Phasing: Phase 1 2008-10	Phase 2 2011-15	Phase 3 2016-2020	Phase 4 2021-2025	Phase 5 2026+
SC-1	Pipe	Future road	New development		10	New	Phase 1				
West Trunk											
W-1	Pipe	Future road	New development		18	New			Phase 3		
W-1A	Casing[1]	Future road	Casing under Los Banos Creek		18/30	New			Phase 3		
W-2	Pipe	Future road	New development		15	New			Phase 3	Phase 4	
W-3	Forcemain	Future road	New development		10	New					Phase 5
W-4	Pipe	Future road	New development		12	New					Phase 5
W-5	Pipe	Future road	New development		12	New					Phase 5
W-6	Pipe	Future road	New development		12	New				Phase 4	
W-7	Pipe	Future road	New development		10	New				Phase 4	
W-8	Pipe	Future road	New development		10	New				Phase 4	
W-9	Pipe	Future road	New development		10	New				Phase 4	
W-10	Pipe	Future road	New development		10	New				Phase 4	
W-11	Pipe	Future road	New development		10	New				Phase 4	
W-12	Pipe	Breunig	New development		12	New					Phase 5
W-13	Pipe	Breunig	New development		10	New					Phase 5
W-14	Pipe	Future road	New development		10	New					Phase 5
W-15	Pipe	Future road	New development		10	New					Phase 5
W-16	Pipe	Future road	New development		12	New					Phase 5
W-17	Pipe	Future road	New development		10	New					Phase 5
W-18	Pipe	Future road	New development		10	New					Phase 5
W-19	Pipe	Future road	New development		10	New					Phase 5
W-20	Pipe	Volta	New development		10	New					Phase 5
W-21	Pipe	Future road	New development		10	New					Phase 5
W-LS	Lift Station	West of Breunig	New development		1.0 mgd	New					Phase 5
	Land Acquisition				0.25 acres	New					Phase 5
Existing System Rehabilitation and Replacement											
	Pipe	Various Locations	Sewer main rehabilitation program			Rehab		Phase 2	Phase 3	Phase 4	Phase 5
	Lift Station	Various Locations	Lift station rehabilitation or replacement			Replace/Rehab		Phase 2	Phase 3	Phase 4	Phase 5
	Pipe	Various Locations	Sewer main replacement program. Average size is 10-inch diameter	10	10	Replace		Phase 2	Phase 3	Phase 4	Phase 5
	Manhole	Various Locations	Manhole replacement program			Replace		Phase 2	Phase 3	Phase 4	Phase 5
Storm Drain Cross Connection Removal											
A1-1	Pipe	K Street, California Avenue	California Avenue to Iowa Avenue, and s/o L Street to K Street	-	18	New		Phase 2			
A1-2	Pipe	Idaho Ave, I St, Texas Ave	L St to I St, west to Texas Ave, then northeast to H St	15	36	New/Replace	Phase 1				
A1-3	Pipe	L Street	Delaware Avenue to Idaho Avenue	-	18	New	Phase 1				
CC-6	Pipe	6th Street, K Street	sw/o M Street to K Street, then 6th Street to 7th Street	-	18	New			Phase 3		
CC-7	Pipe	Center Avenue, Jefferson Avenue	Madison Avenue to Jefferson Avenue, then to 6th Street	-	18	New				Phase 4	
CC-8	Pipe	Pacheco Blvd, Paradise Lane	I Street to Paradise Lane, then south to Adams Avenue	-	12	New					Phase 5
CC-9	Pipe	Murietta Street	Page Street to Monro Street, then east to 7th Street	-	18	New					Phase 5

6.2.2 Existing Versus Future Improvement

The vast majority of the Master Plan improvements will serve future users, even when an improvement calls for the upgrade of an existing facility. In these cases, an existing sewer or lift station may have sufficient capacity to convey current design flows, but as growth continues and more users are added to the system, the increased flow results in capacity deficiencies. These are labeled future improvements. The future improvements were broken down further based on their funding source. Future improvements will be funded by developers or through development impact fees. All projects fall into one of the three following categories:

- Existing Improvements: Existing improvements correct existing deficiencies or rehabilitate/replace existing facilities that have reached their useful life. These projects are funded through user rates.
- Developer Improvements: Future improvements that serve new users. These improvements will be developer funded and/or may be part of a reimbursement agreement between developers.
- Regional Improvements: Future improvements that serve new users. These improvements will be funded through wastewater development impact fees collected by the City.

The majority of future improvements are Developer Improvements, but sewers that were 18-inch diameter and larger were designated Regional Improvements. The Regional Improvements are shown in Figure 6.1.

6.2.3 Available Capacity in Existing Sewers

Where applicable, this Master Plan summarizes the available capacity remaining in existing sewers before an improvement is necessary. As previously mentioned, the capacity for existing sewers was increased only to accommodate more flow resulting from future development. To calculate the timing of these improvements or the growth triggers that initiate a capacity expansion, it was necessary to determine the available capacity in an existing sewer or lift station. The available capacity is presented in terms of equivalent single-family dwelling units (EDU) values. In other words, this value defines the number of additional EDUs that can convey wastewater to a sewer before exceeding its capacity.

The City's Improvement Standards and Specifications (Improvement Standards) recommend that 300 gallons per unit per day (gpud) be used to approximate sewage flows for a single family detached residential home. In order to calculate the available capacity in terms of EDUs, the difference between a sewer's maximum capacity (based on size, slope and maximum d/D) and the current design flow was divided by an appropriate peaking factor to derive an average flow. This average flow was then divided by 300 gpud to quantify the EDU. This calculation does not apply to new sewers serving future users, only

to existing sewers that will also serve future users. The number of EDUs that can be served before a capacity expansion is triggered is discussed below. Note that only a few existing facilities need to be improved to serve future users.

The City's Improvement Standards provide a range of peaking factors for residential flow that are based on the average flow. The lower the average flow, the higher the peaking factor. The Improvement Standards' peaking factors ranged between 2 and 3. For the purposes of calculating available capacity, this Master Plan assumed a peaking factor of 2.5.

6.2.4 New Trunk Sewers, Interceptors, and Lift Stations

The following discussion summarizes the new trunk sewers and interceptors that will serve future users. Please note that the locations of the sewers are preliminary and will likely change during the design phase. The locations shown are possible alignments based on available information and are intended to assist in the development of probable construction costs. No investigation into the feasibility of these alignments has been conducted. However an attempt was made to place future pipeline alignments within existing streets, or to follow the Highway 152 Bypass alignment.

The Downtown sewer main (DT-1) on J Street is the only new pipeline intended to serve existing users. The purpose of this sewer is to eliminate a private lateral that serves multiple residents and an apartment complex, and re-route the residential laterals to J Street.

The City's Improvement Standards require that all sewage lift stations have two non-clog sewer pumps, each capable of pumping 100 percent of the design flowrate. In other words, each lift station's firm capacity should be sufficient to pump 100 percent of the design flowrate. Each lift station's firm capacity was compared to the existing and build-out design flow conveyed to the lift station. If the design flow was greater than the lift station's firm capacity, then the lift station was considered deficient and required upgrade.

6.2.4.1 Pioneer Trunk

The proposed Pioneer trunk runs east in Pioneer Avenue and northeast along the San Luis Canal until it reaches the existing Meadowlands lift station. At its most westerly point (P-7), this trunk sewer starts as a 10-inch diameter pipe, and increases to a 21-inch diameter pipe when it reaches the lift station. As shown in Figure 6.1, several trunk sewers are planned to convey wastewater to the Pioneer trunk sewer (see improvements P-8 through P-15 in Figure 6.1). These smaller trunk sewers will convey wastewater generated from future neighborhoods within the Pioneer tributary. Sewer segments P-1 through P-3 are identified as Regional Improvements, all others are Developer Improvements.

All future flow generated south of Pioneer Road and along the San Luis Canal is intended to flow in this trunk sewer. The future tributary area was shown in Figure 5.4. The timing of installation for this sewer will depend on the pace of development within the tributary.

Proposed industrial development south of Highway 152 and east of Ward Road will likely trigger the installation of the first reaches of the Pioneer trunk prior to year 2015. The pace of residential development south of Pioneer Road will drive the installation of the majority of the pipeline. Residential development in this area is not anticipated until after year 2015.

6.2.4.2 Southeast Trunk

As described in Chapter 5, the Southeast trunk sewer is a major sewer in the collection system. No improvements are proposed to the Southeast trunk sewer, but smaller pipelines that will flow tributary to this sewer are proposed (SE-1 and SE-2). Undeveloped land located north of Pioneer Road will flow to the Southeast trunk sewer. Figures 5.3 and 5.4 illustrate the Southeast trunk sewer tributary for existing and future conditions. This trunk sewer should have sufficient capacity to serve this entire tributary without increasing its capacity. However, if the Southeast trunk sewer serves development outside the tributary shown, then its capacity could be exceeded. Analysis is recommended prior to modifying the tributary service area.

6.2.4.3 Stonecreek Trunk

The Stonecreek trunk sewer consists of a single 10-inch diameter sewer (SC-1) that will connect to an existing 24-inch diameter sewer in west Los Banos. The improvement will convey flow south to north, and connect to the existing Badger Flat trunk sewer in the western part of the City.

6.2.4.4 Badger Flat Trunk

The existing Badger Flat trunk sewer was described in Chapter 5. This proposed new sewer is an extension of and flows tributary to the existing Badger Flat sewer. The proposed new 10-inch and 12-inch diameter sewer (BF-1 and BF-2) is located west of Badger Flat Road and north of Highway 152.

6.2.4.5 West Trunk Sewer and Lift Station

The proposed West trunk sewer will serve future users to the west of the 2007 City limits, along Highway 152. This is the area west of Los Banos Creek, shown in Figure 6.1. The West trunk sewer will flow tributary to the existing Badger Flat trunk sewer. The West trunk sewer is comprised of a main trunk that will convey flow from the west to the east for over two miles (W-1 through W-5) and feed into the existing sewer. This reach of the West trunk sewer ranges in diameter from 12 to 18-inches. As shown in Figure 6.1, several other trunk sewers (W-6 through W-21) collect and convey wastewater from the south side of Highway 152 to the main reach of the West trunk. Sewer segments W-1 and W-1A are identified as Regional Improvements, all others are Developer Improvements.

Due to existing grades and elevations at existing sewer connection points, a lift station will be necessary along the west to east alignment. This lift station will be necessary to serve the western most reaches of the study area, west of Breunig and S. Ramos Road. This

area is not anticipated to be developed until after year 2020. Although this does not constitute a design, a possible configuration of this lift station would be three pumps, each with a capacity of 0.35 million gallons per day (mgd) (240 gpm). The firm and total capacity of this lift station would be 0.7 and 1.1 mgd, respectively.

6.2.4.6 Vineyard Trunk

The Vineyard trunk sewer is an existing sewer that currently terminates near the intersection of Vineyard Avenue and Nantes Drive. New residential development west of Nantes Drive can be served by extending the Vineyard trunk sewer west as shown in Figure 6.1 (V-1 through V-4). The Vineyard trunk extension will range in diameter from 10- to 15-inches. This area is anticipated to be developed with residential homes prior to year 2015.

Figures 5.3 and 5.4 illustrate the Vineyard trunk sewer tributary for existing and future conditions. As shown in the figures, this trunk sewer will serve a larger area as development continues to the west. This trunk sewer should have sufficient capacity to serve the entire tributary shown in Figure 5.4 without increasing its capacity. However, if the Vineyard trunk sewer serves development outside the tributary shown, then its capacity could be exceeded. Analysis is recommended prior to modifying the tributary service area.

6.2.4.7 Provinces Trunk

The Provinces improvement will serve new users in a planned future development within 2007 City limits. The improvement consists of a 12-inch diameter sewer (PR-1) that will feed into an existing sewer. At the time of writing this Master Plan, the development for this area was graded, but no utilities were installed. A second 12-inch diameter sewer (PR-2) will extend east from Palermo Drive and serve an undeveloped area east of Ward Road.

6.2.4.8 Meadowlands Lift Station and Trunk Sewers

The Meadowlands lift station currently has a firm and total capacity of 2.0 and 3.0 mgd, respectively. When the Meadowlands tributary is built out and the Pioneer trunk sewer starts conveying flow to this lift station, the Meadowlands lift station capacity will be exceeded. At build-out, the peak flow conveyed to this lift station will be approximately 2.9 mgd. The City will have the option to replace the existing pumps, replace the entire lift station, or increase the size of the existing structure. These options can be evaluated during the preliminary design phase. Capacity expansion of the Meadowlands lift station is identified as a Regional Improvement.

There is sufficient capacity in the Meadowlands lift station to accommodate approximately 2,500 additional EDUs, or about 600 acres of residential development. Since the Meadowlands tributary is scheduled for redevelopment with new industries, the types of businesses attracted to this area could impact the available capacity. But in general, 600 acres is a reasonable target for planning when the Meadowlands lift station will need to

be expanded. Based on the timing of development and implementation of the Pioneer trunk sewer, this lift station should have sufficient capacity through the year 2020.

Recommended sewer improvements to the Meadowlands sewer tributary area are located south of Highway 152 (M-1, M-2, and M-3). The diameters for these proposed sewers are shown on Figure 6.2. These improvements are based on the Los Banos Industrial Area Plan for sanitary sewer and confirmed by this analysis. The size of an improvement ultimately will be covered by a local area of benefit process for this tributary. These sewers collect and convey wastewater to the existing 12-inch diameter sewer in Technology Drive and Industrial Parkway, which ultimately flows to the Meadowlands Lift Station.

6.2.4.9 North Trunk Sewer and Lift Station

The proposed North trunk will serve future users to the north and northwest of the 2007 City limits. This is the single largest trunk sewer improvement proposed in this Master Plan. The North trunk sewer begins as a 24-inch diameter pipeline at the confluence with the WWTP interceptor, near Rockport Drive and Place Road, and proceeds north.

As currently shown in Figure 6.1, the North trunk sewer would run parallel to the proposed Highway 152 Bypass. The bypass alignment shown in the 2030 General Plan was used as a guide for the sewer alignment. The sewer will range in size from a 12-inch diameter near its terminus, up to a 36-inch diameter (N-1 through N-18) at Rockport Drive. As shown in Figure 6.1, the North trunk sewer will convey flow from west of Volta Road to the existing WWTP interceptor. Several smaller trunk sewers will also flow tributary to the North trunk. Figure 5.4 illustrates the entire tributary area that will flow to the North trunk.

Due to shallow sewer invert elevations of the existing WWTP interceptor; a lift station is necessary on the North trunk. The existing sewer elevations near the intersection of Rockport Drive and Place Road make it impossible for the North trunk sewer to flow entirely by gravity. One benefit of the new North trunk lift station is that the existing Saint Francis lift station can be abandoned and its flows conveyed to the new lift station following its construction.

Although this does not constitute a design, a possible configuration of this lift station would be four pumps, each with a capacity of 2.3 mgd (1,600 gpm). The firm and total capacity of this lift station would be 7.0 and 9.2 mgd, respectively. Unfortunately, the lift station would be one of the first facilities constructed on the North trunk, even though the flows would be at their lowest. The City should consider building the lift station structure for its ultimate footprint, but phase the pump installation until flows increase. This approach was used in the construction of the Badger Flat sanitary sewer lift station, and reduces the initial capital cost. This lift station and the first reaches of the North trunk sewer will be necessary prior to year 2015.

An additional lift station will also be necessary to service the area northwest of the planned State Route 152 realignment. A possible configuration of this lift station would be four

pumps with a capacity of 0.7 mgd (470 gpm) each. The firm and total capacity of this lift station would be 2.0 mgd and 2.7 mgd, respectively. Sewer segments N-1 through N-6, N-13 through N-16, and the two North trunk lift stations are identified as Regional Improvements, all others are Developer Improvements.

6.2.4.9.1 *Badger Flat to North Trunk Sewer*

The North trunk sewer not only plays an important role in providing sewer service to the northern parts of the study area, development along Highway 152, west of the current City limits will also benefit. As discussed in Chapter 5, the Badger Flat lift station currently pumps wastewater north in Badger Flat Road via two forcemains (12-inch and 16-inch diameter), which combine into a single 12-inch diameter forcemain after crossing under the Central California Irrigation District (CCID) canal. The forcemain continues onto Overland Road and discharges into the Overland trunk sewer.

As development along Highway 152, west of Ortigalita Road progresses and more flow is conveyed to the Badger Flat trunk sewer, the Overland trunk sewer will eventually run out of capacity. When this happens, the 12-inch diameter forcemain from the Badger Flat lift station will need to be routed over to the North trunk sewer. Diverting flow out of the Overland trunk sewer and into the North trunk sewer will provide the necessary sewer capacity and infrastructure to develop the City west of Ortigalita Road.

There is sufficient capacity in the Overland trunk sewer to accommodate approximately 900 additional EDUs, or about 200 acres of residential development. If the area west of Ortigalita Road develops with more commercial than residential properties, then more development could possibly be accommodated. This depends on the types of commercial or industrial businesses that are proposed, and the wastewater generation. But in general, 200 acres is a reasonable target for planning when the North trunk sewer will need to be in place to serve the area west of Ortigalita Road.

Growth projections indicate that the North trunk sewer (N-4 and N-5) will need to be extended to Badger Flat Road between year 2020 and 2025, at which time flows will be diverted from the Overland sewer to the North trunk sewer. These projections should be adjusted if the pace of development changes. The important concept is that the North trunk is necessary to serve development west of Ortigalita Road and to relieve the Overland sewer.

Figures 5.3 and 5.4 should be reviewed to see the difference in the sewer tributaries for existing and future conditions. For existing conditions, most of the collection system west of Ortigalita Road is collected and conveyed to the Overland trunk sewer. However, for the future system, this area will ultimately flow to the North trunk sewer.

6.2.4.10 College Trunk

The proposed improvement would serve future users upstream of the College lift station. This improvement consists of a 10-inch diameter pipeline (C-1) that will convey flows north of Highway 152.

6.2.4.11 Wastewater Treatment Plant Interceptor

Due to the expected increases in wastewater flow, it will be necessary to construct a third interceptor (WWTP-1) east of Place Road to convey wastewater to the treatment plant. This will be necessary when peak flows to the treatment plant exceed 12 mgd. Based on available capacity in the two existing interceptors (24-inch and 30-inch diameter parallel pipelines), the third 36-inch diameter interceptor will not be necessary until after year 2025. There is sufficient capacity in the existing interceptors to accommodate approximately 10,600 additional EDUs, or about 2,600 acres of residential development. This new interceptor is identified as a Regional Improvement. Following the installation of the new 36-inch diameter interceptor, the 24-inch trunk sewer between the GWD San Luis and Santa Fe Canals will be abandoned. Discussions with the Grasslands Water District indicated that a minimum three feet of separation from the top of the pipe to the bottom of existing canals may be necessary for the new interceptor. Meeting this separation requirement established the slope of the interceptor.

The single 24-inch diameter trunk sewer that crosses the GWD Santa Fe Canal is nearing its capacity. The new 36-inch diameter trunk sewer (WWTP-2) will be constructed to cross under the GWD Santa Fe Canal and terminate at the treatment plant headworks. The size of the 36-inch sewer assumes that it will be installed at a slope of 0.0028 and invert elevation at the headworks is 83 feet. The City plans to abandon the 24-inch diameter sewer and the existing 27-inch diameter sewer within the WWTP property that flows to the headworks. These two sewers will be replaced by the single 36-inch diameter sewer.

It is understood that the City is designing an expansion to the WWTP headworks. Provisions should be made in this design to accommodate a future connection to the 36-inch diameter sewer. If the headworks design revises the invert elevations of the influent pipelines to the headworks, then an analysis should be conducted to verify that the 36-inch diameter sewer remains adequate to convey future flows. This project is identified as a Regional Improvement.

There is sufficient capacity in the existing 24-inch diameter sewer to accommodate approximately 1,700 additional EDUs, or about 400 acres of residential development. However, since the City is in the middle of a headworks design, it may consider installing the 36-inch diameter trunk sewer into the plant in conjunction with the headworks project. This may avoid potential work sequencing, bypass pumping, and coordination issues in the future.

Table 6.2 Lift Station Improvements
Wastewater Collection System Master Plan
City of Los Banos

Name	Pump Number	Pump Capacity (gpm)	Firm Capacity (gpm)	Total Capacity (gpm)	Total Discharge Head (feet)	Pump Firm Capacity versus Build-Out Design Flow: Build-Out Design Flow (mgd)	Build-Out Design Flow (gpm)	Pump Capacity Deficiency (gpm)	Available Firm Capacity (gpm)	Required Improvement	Available Firm Capacity (gpd)	PWWF:ADF Peaking Factor	Available Average Flow (gpd)	Remaining Capacity (EDU)
Above Ground Lift Stations														
Crest Hills	1	800	800	1,600	25	0.971	674	Sufficient Firm Capacity	126	No	181,000	2.50	72,400	241
	2	800			25									
Jo Lin	1	Information not available for Jo Lin Pumps												
	2													
Orchard Terrace	1	300	300	600	NA	0.037	26	Sufficient Firm Capacity	274	No	395,000	2.50	158,000	527
	2	300			NA									
Ranchwood	1	550	550	1,100	35	0.463	322	Sufficient Firm Capacity	228	No	329,000	2.50	131,600	439
	2	550			35									
Saint Francis	1	120	120	240	15	0.177	123	3	0	No	0	2.50	0	0
	2	120			15									
Valley Meadows	1	101	101	201	97.5	0.143	99	Sufficient Firm Capacity	1	No	1,720	2.50	688	2
	2	101			97.5									
Below Ground Lift Stations														
The Gardens No. 5	1	900	900	1,800	18	0.508	353	Sufficient Firm Capacity	547	No	788,000	2.50	315,200	1,051
	2	900			18									
Meadowlands	1	700	1,400	2,100	50	2.892	2,009	609	0	Yes	0	2.50	0	0
	2	700			50									
	3	700			50									
Northgate	1	1,000	2,000	3,000	28	1.729	1,201	Sufficient Firm Capacity	799	No	1,151,000	2.50	460,400	1,535
	2	1,000			28									
	3	1,000			28									
Santa Barbara	1	350	350	700	15	0.078	54	Sufficient Firm Capacity	296	No	426,000	2.50	170,400	568
	2	350			15									
West I	1	350	350	700	NA	0.151	105	Sufficient Firm Capacity	245	No	353,000	2.50	141,200	471
	2	350			NA									
College	1	900	900	1,800	20	0.173	120	Sufficient Firm Capacity	780	No	1,123,000	2.50	449,200	1,497
	2	900			20									
Badger Flat[1]	1	3,150	3,150	6,300	34.5	2.950	2,019	Sufficient Firm Capacity	1.101	No	1,585,440	2.50	634,176	2,114
	2	3,150			34.5									

Note:
1. Badger Flat lift station pumps will be installed in phases. Interim phase will include 2-800 gpm pumps, Secondary phase will include 2-2,000 gpm pumps, and the Ultimate (build-out) phase will include 2-3,150 gpm pumps. The analysis investigated build-out conditions, therefore, the Ultimate pump capacity was included in the model.

6.2.4.12 Downtown Sewer

A new 8-inch diameter sewer is proposed in J Street, near Linda Vista Street. The Downtown sewer main (DT-1) will serve existing users that will need to re-route their sewer laterals to J Street. These existing users currently route their sewer through backyard laterals out to I Street. When the sewer main is in place in J Street, the private lateral that serves multiple residents could then be abandoned. The portion of the lateral that currently serves an apartment complex would remain active.

6.2.5 Existing and Build-out Lift Station Improvements

All the lift stations contain sufficient firm capacity to convey existing design flows. As discussed above, with the exception of Meadowlands, all the lift stations have sufficient capacity to convey build-out design flows also. Table 6.2 summarizes each lift station's current design data. The design data includes the number of pumps, individual pump capacity, firm capacity and total capacity.

Table 6.2 also summarizes the model derived build-out design flows that will be conveyed to each existing lift station. The build-out design flows were compared to each lift station's capacity to determine whether a capacity increase would be necessary. Based on the build-out design flow and existing capacity, the number of EDUs that can be served before an increase in capacity is required was calculated. For example, even after build-out of the study area, the Crest Hills lift station can serve an additional 241 EDUs. This is important to know if the City is considering redevelopment of existing areas that would intensify the number of EDUs within a lift station's tributary. Quick examination of Table 6.2 would provide information on whether a lift station possesses sufficient capacity to serve higher density of housing.

As discussed above and shown in the table, only the Meadowlands lift station lacks the capacity to serve build-out design flows. Note that the Saint Francis lift station will reach its capacity at build-out. The Saint Francis lift station can be taken off line following construction of the new North trunk lift station, so it is unlikely that this lift station will be operating at build-out. The Valley Meadows lift station tributary is built out and according to the modeling results, the lift station is at capacity. This lift station should be monitored to verify that flows are not exceeding its firm capacity.

6.3 PROJECT PRIORITIZATION

The majority of improvements listed in Table 6.1 are driven by future development. Most of the improvements are new sewers and lift stations that serve future growth, but there are some improvements to existing facilities that resulted from future growth. When fully implemented, the capital projects will allow the conveyance of design flows to the WWTP during build-out conditions.

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

- Upgrading existing sewers or lift stations to serve future users
- Eliminating storm runoff into the collection system
- Building the sewers necessary to serve future users

6.3.1 Existing System Improvement Prioritization

The storm drain projects that reduce storm inflow into the wastewater collection system are high priority projects. These include the Airport No. 1 subbasin storm drain projects (A1-1, 2 and 3) and the Central City subbasin storm drain projects (CC-6 through CC-9).

Due to economic conditions and the slowdown n development, the probability and practicality of constructing all these improvements in the next five years is low. For this reason, the improvements were distributed amongst all phase according to priority and level of benefit provided to the existing system.

Improvements to existing sewers and lift stations will provide sufficient capacity to convey increased flows resulting from new development.

6.3.2 Future System Improvement Prioritization

Future development will require the construction of sewers to serve new users. The implementation of these improvements will depend on the City's growth and selection of areas to be served with urban infrastructure. The City provided guidance on future development and phasing of infrastructure to serve future users. Based on this input, the projects were grouped into the following timeframes:

- Years 2010 through 2015
- Years 2016 through 2020
- Years 2021 through 2025
- Years 2026 through 2030
- Beyond 2031

6.3.3 Phase 1 Projects (2010-2015)

The highest priority projects include the first reach of the Pioneer trunk sewer (P-1) and the Provinces trunk sewer (PR-1). The Provinces trunk sewer will serve a new residential development between Place and Ward Road, north of Willmott Road. The Pioneer trunk sewer will serve an industrial redevelopment area south of Highway 152 and east of Ward Road. The design phase of the Pioneer trunk sewer could start in Phase 1, but the

construction of the first reach of the sewer will likely span into Phase 2 (2016-2020). The Phase 1 projects include the following:

- Downtown Sewer Main (DT-1)
- Pioneer Trunk (P-1 and P-1A)
- Meadowlands Trunk (M-1, M-2, and M-3)
- Provinces Trunk (PR-1 and PR-2)
- Badger Flat Trunk (BF-1 and BF-2)
- Stone Creek Trunk (SC-1)

6.3.4 Phase 2 Projects (2016-2020)

The Phase 2 projects will serve new development in the growth areas targeted by the City. As shown in Table 6.1, all the projects with a Phase 2 entry in the 2016-2020 column will likely be implemented within this phase. Some of the projects identified within Phase 2 are part of a larger capital project. For example, the first three reaches of the North trunk sewer (N-1, N-2, and N-3) and the lift station are targeted as the first segments of this sewer to be constructed. Several branches of the North trunk (N-7 through N-10) are also identified as Phase 2 projects.

The Phase 2 projects include the following:

- Pioneer trunk (P-1, P-1A, P-2)
- North trunk and lift station (N-1, N-3, and N-LS)
- Vineyard trunk (V-1 through V-4)
- Southeast trunk (SE-1 and SE-2)
- Wastewater Treatment Plan Trunk (WWTP-2 and WWTP-2A)
- On going sewer main rehabilitation and replacement, manhole replacement, and lift station rehabilitation or replacement.

6.3.5 Phase 3 Projects (2021-2025)

The Phase 3 projects will serve future development beyond year 2020. These projects are within the 10-year window identified by the City. Many of the projects are continuations of sewers that were started in Phase 1 and 2. For example, P-2 represents the second phase of the Pioneer trunk sewer. The Phase 3 projects include the following:

- Pioneer trunk (P-2, P-8 through P-11)
- College trunk (C-1)
- West trunk (W-1 and W-1A)
- Meadowlands lift station (M-LS)

- North Trunk (N-4 and N-5, and N-11)
- On going sewer main rehabilitation and replacement, manhole replacement, and lift station rehabilitation or replacement

6.3.6 Phase 4 and 5 Projects (2026 and beyond)

Table 6.1 breaks the projects into Phase 4 and 5. For the purposes of prioritization, these are viewed as very long-term, low priority projects, and will be grouped together. The Phase 4 and 5 projects include the following:

- Wastewater Treatment Plant trunk (WWTP-1)
- Pioneer trunk (P-3 through P-7, and P-12 through P-15)
- North trunk (N-6 through N-6B, N-12 through N-23, and N-LS2)
- West trunk and lift station (W-2 through W-21, W-LS)
- On going sewer main rehabilitation and replacement, manhole replacement, and lift station rehabilitation or replacement

6.4 ADDITIONAL RECOMMENDATIONS

In addition to the improvements discussed above, the City should consider the following recommendations.

6.4.1 Downtown Storm Drain Projects

The downtown area of the City experiences sudden increases in flow following large storm events. Previous master plans prepared by the City identified several storm drain connections to the collection system that cause this increase in flow. This Master Plan concluded that if the City implements storm drain projects to separate these inflow connections, then a large downtown wastewater sewer project could be avoided. The City should proceed with the downtown storm drain projects outlined in the Storm Drainage Master Plan.

There are cost savings for the wastewater system associated with implementing the storm drain projects. The City reduces the capital costs required to install large diameter sewers necessary to convey combined sanitary and storm water flows. Our analysis concluded that if storm water runoff continues to flow to the collection system, then 4,200 feet of 24-inch diameter sewer would be constructed to relieve the existing downtown sewers. This 24-inch diameter sewer would jog through several downtown streets, including 3rd, 4th, H, and D Streets. Constructing this sewer would cost approximately $1.6 million and would likely be disruptive to downtown traffic and businesses.

By implementing the storm drain projects, there is also a reduction in peak flows conveyed through the collection system that ultimately reaches the WWTP. Our analysis indicated

that peak flows could reduce by as much as 2.0 mgd by removing the storm drain connections. Reducing the peak flows has many benefits, including freeing up capacity in the existing trunk sewers, the Central and WWTP interceptors, and reducing the size (diameter) of the capital projects. Reduction in peak flows also benefit the WWTP and planned improvements to the headworks. By freeing up capacity, the implementation of the improvements identified in this Master Plan was deferred to the timeframes shown. If storm runoff continued to be conveyed to the wastewater collection system, then implementation of the capital projects would be scheduled at earlier dates. The future capital projects would also be more costly, because the size of pipe required to convey storm runoff and future flows would be greater than those shown in Table 6.1.

The State Water Resources Control Board (SWRCB) recently adopted (May 2, 2006) the Statewide General Waste Discharge Requirements (WDR) for Sanitary Sewer Systems. The purpose of the WDR is to reduce SSOs. Large increases in sewer flow following a storm could result in SSOs. Identifying and removing the storm connections to the sewer system will reduce the likelihood of SSOs.

The following storm drainage improvements were analyzed in the Storm Drainage Master Plan but the capital costs are included in this Master Plan because they benefit the sewer system. Please refer to the storm drainage master plan for detailed discussion. The following excerpts from the storm drainage master plan are provided for information on the improvements.

6.4.1.1 Airport No. 1 Subbasin

The Airport No. 1 subbasin currently has storm runoff that drains into the City's wastewater collection system. City staff made the decision to implement storm drain projects to separate storm runoff from the wastewater collection system. As discussed in Chapter 5, these storm drain improvements achieve multiple benefits including reducing wastewater flow to the WWTP, relieving flooding in the downtown area, and eliminating wastewater capital projects. The projects presented in this Master Plan assume that downtown storm drain projects that separate storm runoff from the wastewater collection system would be implemented. Recommended improvements to eliminate inflow into the collection system include the following:

- An 18-inch diameter storm drain in 'K' Street from Iowa Avenue to 3rd Street (A1-1), and in California Avenue from 'K' Street to north of Pacheco Boulevard, and in 'L' Street from Delaware Avenue to Idaho Avenue (A1-3 in Figure 6.2).
- A proposed 36-inch diameter storm drain in Idaho Avenue that runs from L Street to 'I' Street (A1-2) will collect the flow from the proposed projects A1-1 and A1-3, and convey it to a proposed 36-inch diameter storm drain in 'I' Street. The 36-inch diameter storm drain in 'I' Street would replace an existing 15-inch diameter pipeline. The new pipeline would then continue northeast in Texas Avenue to 'H' Street.

Proposed improvement A1-2 is recommended regardless of whether A1-1 and A1-3 are implemented. A1-2 not only conveys runoff of flows that currently enter the sewer collection system, but it also mitigates existing flooding around 'I' and 'J' Streets within the Airport No. 1 subbasin.

6.4.1.2 Central City Subbasin

The Central City subbasin also contains storm runoff that drains into the City's wastewater collection system. Recommended improvements to eliminate inflow into the collection system include the following:

- A 12-inch diameter storm drain from Pacheco Boulevard to Paradise Lane to service the southwest portion of the subbasin (CC-8 in Figure 6.2)
- An 18-inch diameter storm drain in Center Avenue that runs from Madison Street to Jefferson Street, then east to 6th Street (CC-7), and an 18-inch diameter storm drain that runs from Page Avenue to Monroe Street along Murietta Street, then east to 7th Street (CC-9), to eliminate storm flows from the collection system east of Center Avenue.
- An 18-inch diameter storm drain along 6th Street, that runs from an alley north of Pacheco Boulevard to 'K' Street then southeast to 7th Street (CC-6), to eliminate storm flows from the collection system south of 'M' Street.

6.4.2 Sewer Main Replacement or Rehabilitation

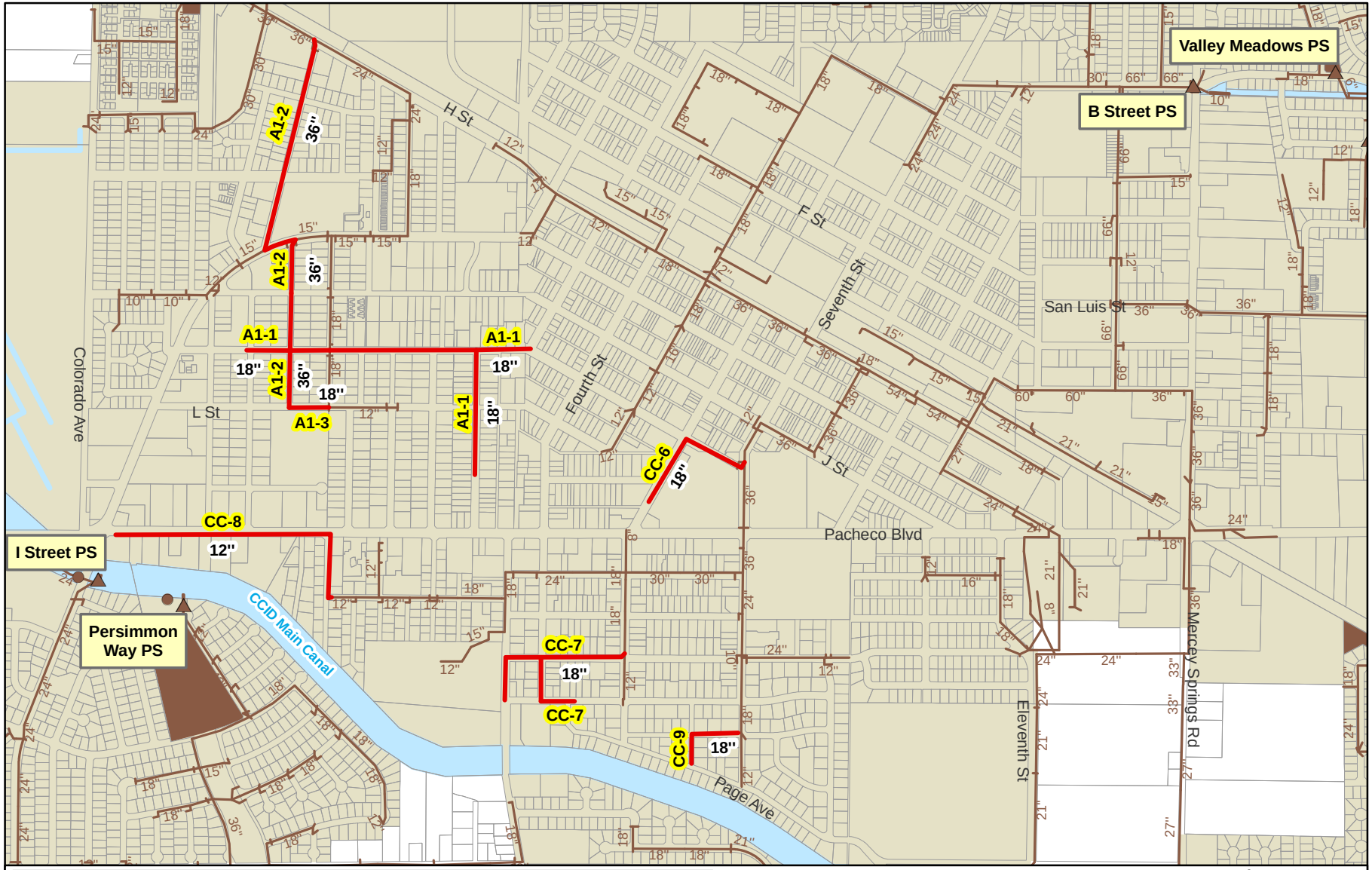
The City identified the 10 and 12-inch diameter Mercey Springs trunk sewer as deteriorated. Deteriorated sewers are often corroded and susceptible to collapse. This study did not conduct a condition assessment to evaluate the structural integrity of existing sewers, nor did it evaluate rehabilitation alternatives for existing sewers. However, based on input from City staff, we are including rehabilitation of this and other sewers as capital projects. For the purposes of budgeting, we assumed that the City would implement various rehabilitation projects through the year 2035. A sewer main rehabilitation allowance was provided for Phases 2 through 5.

The capital improvements also assumed that the City would replace about 0.25 miles of sewer every year. The weighted average diameter of all sewers in the collection system is 10-inches. Therefore, in order to develop a capital cost, we assumed that about 0.25 miles of 10-inch diameter sewer would be replaced every year through 2035.

6.4.3 Lift Station Replacement or Rehabilitation

Lift station replacement or rehabilitation will be necessary to maintain proper operation of existing facilities. We assumed that lift stations would be rehabilitated or replaced every five years, starting in Phase 2. For budgeting purposes, we assumed replacement of the older lift stations, which range in capacity from 200 to 3,000 gpm, and average approximately

600 gpm. We also assumed that four lift stations would be rehabilitated or replaced by year 2035.



Legend

Existing Storm Drainage System

- Outfall
- Pump Station
- Storm Drains
- Storm Basins

Storm Drainage System Improvements

- Strom Drain Cross Connection Removal
- CH-2 CIP ID
- 12" CIP Diameter
- 8" Existing Diameter

- Waterways/Canals
- Parcels
- City Limits

N

0 500 1,000 Feet

Figure 6.2
Storm Drain Cross Connection Removal
Wastewater Collection System Master Plan
City of Los Banos

CAPITAL IMPROVEMENT PROJECTS

This chapter presents the recommended capital improvement projects (CIP) for the City of Los Banos (City) wastewater collection system and a summary of the capital costs. This chapter is organized to assist the City in making finance decisions, and to plan the wastewater collection system improvements through build-out of the 2030 General Plan Update (2030 General Plan). The CIP is based on the evaluation of the City's sewer system, and on the recommended projects described in the previous chapters.

7.1 CAPITAL IMPROVEMENT PROJECT COSTS

The capacity upgrades and new service projects set the foundation for the City's wastewater collection system CIP. The cost estimates presented in this study are opinions developed from bid tabulations, cost curves, information obtained from previous studies, and Carollo Engineers, P.C. (Carollo) experience on other projects. The costs are based on an Engineering News Record Construction Cost Index 20-city average of 8592 (November 2009).

7.2 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 alignment generation, investigation of alternative routings, and detailed utility and topography surveys.

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

7.3 CONSTRUCTION UNIT COSTS

The construction costs are representative of wastewater collection system facilities under normal construction conditions and schedules.

7.3.1 Pipeline Unit Costs

Wastewater collection system improvements range in size from 8- to 36-inches in diameter. Pipeline unit costs are shown on Table 7.1. The construction cost estimates are based upon these unit costs. The unit costs are for "typical" field conditions with construction in stable soil at a depth ranging between 10 to 15 feet.

Table 7.1	Pipeline Unit Costs Wastewater Collection System Master Plan City of Los Banos
Pipe Size (inches)	**Cost Per Linear Foot ($/foot)**
8	93
10	117
12	140
15	175
18	191
21	223
24	255
27	287
30	319
33	350
36	382

Note:
1. ENR CCI 20 City Average (November 2009) = 8592

7.3.2 Lift Station Unit Costs

Lift station improvements include increasing the firm capacity to convey design flows. The lift station cost versus capacity curve shown in Figure 7.1 was developed based on projects of similar size in California. Costs were generated by inputting the appropriate capacity and calculating the corresponding costs.

7.3.3 Land Acquisition Costs

The land acquisition costs for sewer pipelines was assumed to be zero because these will be located within public right of way. However, land acquisition may be required for sanitary sewer lift stations. The land acquisition cost the City assumes for public land purchases is $240,000 per acre based on a land appraisal that the City conducts each year.

7.4 PROJECT COSTS AND CONTINGENCIES

7.4.1 Baseline Construction Cost

This is the total estimated construction cost, in dollars, of the proposed improvement. Pipe and lift station Baseline Construction Costs were developed using the following criteria:

- Pipeline: Calculated by multiplying the estimated length by the unit cost.

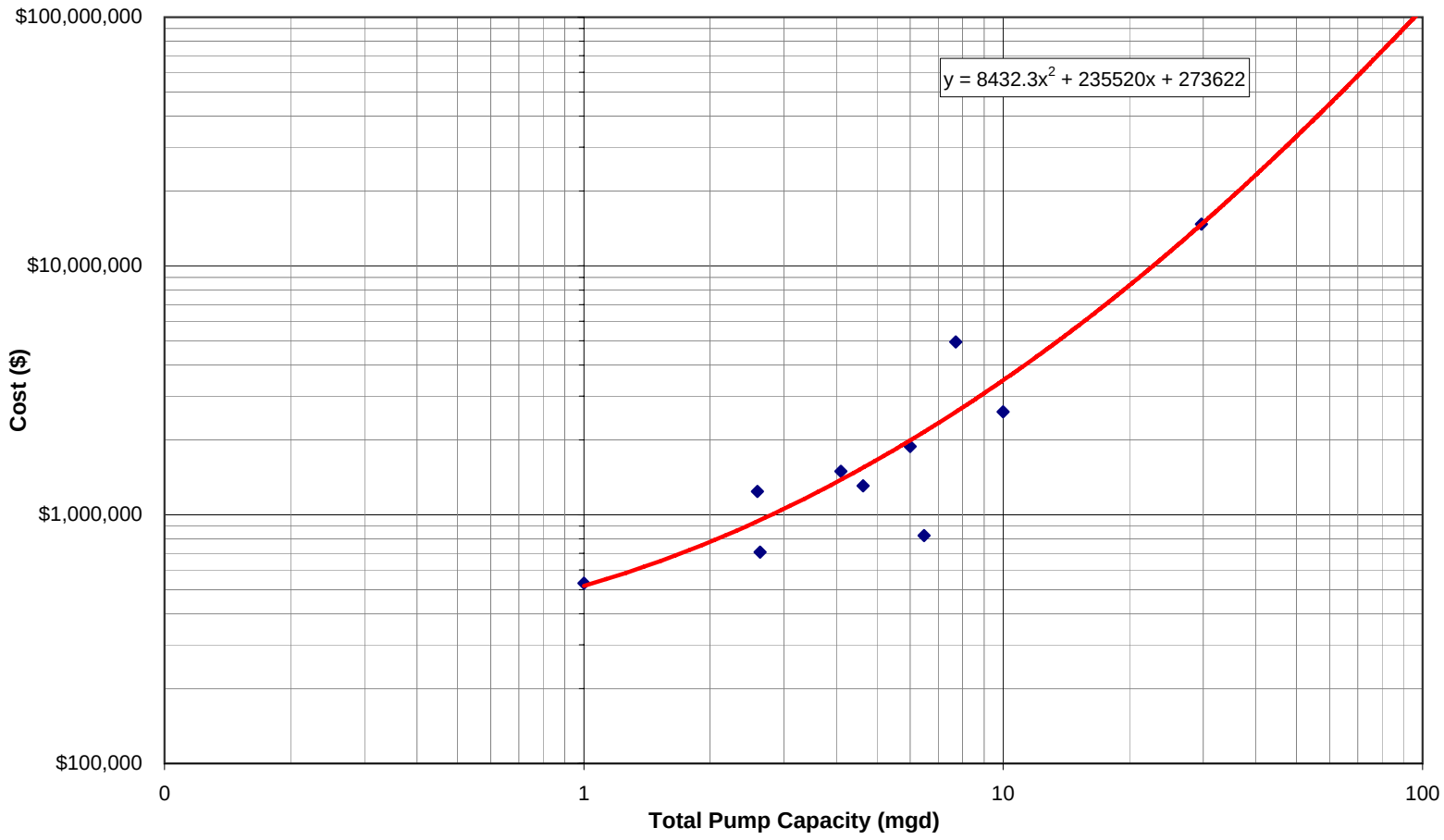


Figure 7.1
Lift Station Cost Versus Capacity Curve
Wastewater Collection System Master Plan
City of Los Banos

carollo
Engineers...Working Wonders With Water™

pw:/Los Banos/7833A00/Cost Estimate/LSCostCurve.xls/LS Cost Curve

- Lift station costs: Calculated by using the required capacity in the cost curve equation.

7.4.2 Estimated Construction Cost

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

Since knowledge about site-specific conditions of each proposed project is limited at the master planning stage, a 20 percent contingency was applied to the Baseline Construction Cost to account for unforeseen events and unknown conditions. The Estimated Construction Cost for the proposed collection system improvement consists of the Baseline Construction Cost plus the 20 percent construction contingency.

7.4.3 Capital Improvement Cost

Other project construction contingency costs are divided into three subcategories, totaling 30 percent: 10 percent engineering, 10 percent construction management, and 10 percent program implementation. Engineering services associated with new facilities include preliminary investigations and reports, right of way (ROW) acquisition, foundation explorations, preparation of drawings and specifications during construction, surveying and staking, sampling of testing material, and start-up services. For this study, engineering costs are assumed to equal 10 percent of the Estimated Construction Cost.

Construction management covers such items as contract management and inspection during construction. The cost of these items can also vary, but for the purpose of this study, it is assumed that construction management charges will equal approximately 10 percent of the Estimated Construction Cost.

Finally, there are program implementation costs, which cover such items as legal fees, environmental/CEQA compliance requirements, financing expenses, administrative costs, and interest during construction. The cost of these items can also vary, but for the purpose of this Master Plan, it is assumed that program implementation costs will equal 10 percent of the Estimated Construction Cost.

The Capital Improvement Cost is the total of the Estimated Construction Cost (including contingency) plus the other costs discussed in the previous paragraphs.

As shown below, the total cost of all project construction contingencies (construction, engineering services, construction management, and program implementation) is approximately 56 percent of the Baseline Construction Cost. Note that contingencies were not applied to land acquisition costs.

Example:

Baseline Construction Cost	$1,000,000
Construction Contingency (20%)	200,000
Estimated Construction Cost	1,200,000
Engineering Cost (10%)	120,000
Construction Management (10%)	120,000
Program Implementation (10%)	120,000
Capital Improvement Cost	$1,560,000

A summary of the capital project costs is presented in Table 7.2. The table also shows the probable phase in which the project would be implemented. The implementation timeframe was based on the priority of each project to correct existing deficiencies or to serve future users. The breakdown in total cost is presented in Table 7.3.

7.5 CAPITAL IMPROVEMENT IMPLEMENTATION

As discussed in Chapter 6, the CIP projects are prioritized based on their urgency to mitigate existing deficiencies and for servicing anticipated growth. It is recommended that improvements to mitigate existing deficiencies be constructed as soon as possible. The deficiencies in the future system have a significant total capital cost that is best distributed based on the order in which the City will develop.

The implementation phases are separated into 5-year increments, except for the first phase, which runs from 2010 through 2015. Each project is itemized by phase in Table 7.2 and a summary by phase is provided in Table 7.3. The need for new pipelines and lift stations was based on the City's projection for extending urban services.

7.6 EXISTING VERSUS FUTURE USER COST SHARE

The improvements proposed in this Master Plan either benefit existing users, or are required to service new development and future users. An opinion of benefit to future users, based on preliminary project information, was included in Table 7.2. It was assumed that projects intended to correct existing deficiencies provide no benefit for future users, and would be required regardless of future development. It was also assumed that future users

Table 7.2 Capital Improvement Projects

Wastewater Collection System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-15 ($)	Phase 2 2016-20 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Regional ($)
Wastewater Treament Plant																	
WWTP-1	Pipe	WWTP	WWTP		36	New	2,265	$ 1,351,000					$ 1,351,000	100%	$ -	$ -	$ 1,351,000
WWTP-1A	Casing[1]	WWTP	Casing under San Luis Canal		36/48	New	200	$ 557,000					$ 557,000	100%	$ -	$ -	$ 557,000
WWTP-1C	Casing[1]	WWTP	Casing under future H-152 Bypass		36/48	New	365	$ 1,016,000					$ 1,016,000	100%	$ -	$ -	$ 1,016,000
WWTP-1B	Casing[1]	WWTP	Casing under San Luis Master Drain		36/48	New	200	$ 557,000					$ 557,000	100%	$ -	$ -	$ 557,000
WWTP-2	Pipe	WWTP	WWTP		36	New	475	$ 284,000		$ 284,000				100%	$ -	$ -	$ 284,000
WWTP-2A	Casing[1]	WWTP	Casing under Santa Fe Canal		36/48	New	150	$ 418,000		$ 418,000				100%	$ -	$ -	$ 418,000
Downtown Sewer																	
DT-1	Pipe	J Street	East of Linda Vista		8	New	465	$ 67,000	$ 67,000					0%	$ 67,000	$ -	$ -
Pioneer Trunk																	
P-1	Pipe	Future road	New development		21	New	8,114	$ 2,824,000	$ 1,412,000	$ 1,412,000				100%	$ -	$ -	$ 2,824,000
P-1A	Casing[1]	152	Casing under Highway 152		21/42	New	187	$ 456,000	$ 228,000	$ 228,000				100%	$ -	$ -	$ 456,000
P-2	Pipe	Pioneer	East of 165 along Pioneer and curving northward		18	New	7,135	$ 2,128,000		$ 1,316,000	$ 812,000			100%	$ -	$ -	$ 2,128,000
P-3	Pipe	Pioneer	Plow Camp to 165		18	New	2,623	$ 782,000				$ 782,000		100%	$ -	$ -	$ 782,000
P-3A	Casing[1]	Canal	Casing under Main Canal		18/30	New	200	$ 348,000				$ 348,000		100%	$ -	$ -	$ 348,000
P-4	Pipe	Pioneer	Diana to Plow Camp		15	New	1,348	$ 368,000				$ 368,000		100%	$ -	$ 368,000	$ -
P-5	Pipe	Pioneer	West of Diana		15	New	3,755	$ 1,026,000				$ 1,026,000		100%	$ -	$ 1,026,000	$ -
P-6	Pipe	Pioneer	East of Ortigalita		12	New	2,927	$ 640,000					$ 640,000	100%	$ -	$ 640,000	$ -
P-7	Pipe	Pioneer	West of Origalita		10	New	2,142	$ 390,000					$ 390,000	100%	$ -	$ 390,000	$ -
P-8	Pipe	Future road	New development		12	New	719	$ 158,000			$ 158,000			100%	$ -	$ 158,000	$ -
P-9	Pipe	Future road	New development		10	New	810	$ 148,000			$ 148,000			100%	$ -	$ 148,000	$ -
P-10	Pipe	Phillips	Runs partially along Phillips and to the north of Phillips		10	New	2,400	$ 437,000			$ 437,000			100%	$ -	$ 437,000	$ -
P-11	Pipe	165	South of Pioneer		10	New	1,302	$ 237,000			$ 237,000			100%	$ -	$ 237,000	$ -
P-12	Pipe	Plow Camp	South of Pioneer		10	New	1,323	$ 242,000				$ 242,000		100%	$ -	$ 242,000	$ -
P-13	Pipe	Center	South of Pioneer		10	New	1,384	$ 253,000				$ 253,000		100%	$ -	$ 253,000	$ -
P-14	Pipe	Future road	New development		10	New	1,450	$ 264,000				$ 264,000		100%	$ -	$ 264,000	$ -
P-15	Pipe	Ortigalita	South of Pioneer		10	New	1,330	$ 242,000					$ 242,000	100%	$ -	$ 242,000	$ -
North Trunk																	
N-1	Pipe	152 bypass	Southeast of lift station		24	New	980	$ 390,000		$ 390,000				100%	$ -	$ -	$ 390,000
N-2	Intentionally left blank																
N-3	Pipe	152 bypass	Northwest of lift station, to Nantes		36	New	10,332	$ 6,162,000		$ 6,162,000				100%	$ -	$ -	$ 6,162,000
N-4	Pipe	152 bypass	West of Nantes		36	New	5,501	$ 3,281,000			$ 3,281,000			100%	$ -	$ -	$ 3,281,000
N-5	Pipe	152 bypass	South of 152 bypass		30	New	5,742	$ 2,853,000			$ 2,853,000			100%	$ -	$ -	$ 2,853,000
N-6	Pipe	Ingomar	South of 152 bypass		24	New	4,527	$ 1,800,000				$ 1,800,000		100%	$ -	$ -	$ 1,800,000
N-6A	Casing[1]	Canal	Casing under Main Canal		24/42	New	200	$ 487,000				$ 487,000		100%	$ -	$ -	$ 487,000
N-6B	Casing[1]	River	Casing under Los Banos Creek		24/42	New	200	$ 487,000				$ 487,000		100%	$ -	$ -	$ 487,000
N-7	Pipe	Quail	East of Westminister		10	New	681	$ 125,000		$ 125,000				100%	$ -	$ 125,000	$ -
N-8	Pipe	Mercy Springs	South of 152 bypass		12	New	627	$ 137,000		$ 137,000				100%	$ -	$ 137,000	$ -
N-9	Pipe	Future road	New development		12	New	2,314	$ 505,000		$ 505,000				100%	$ -	$ 505,000	$ -
N-10	Pipe	Nantes	South of 152 bypass		12	New	2,119	$ 463,000		$ 463,000				100%	$ -	$ 463,000	$ -
N-11	Pipe	Johnson	South of 152 bypass		12	New	1,786	$ 390,000			$ 390,000			100%	$ -	$ 390,000	$ -
N-12	Pipe	Future road	New development		10	New	2,513	$ 459,000				$ 459,000		100%	$ -	$ 459,000	$ -
N-13	Pipe	Future road	New development		21	New	3,910	$ 1,360,000				$ 1,360,000		100%	$ -	$ -	$ 1,360,000
N-14	Forcemain	Future road	Force main across future 152 bypass		12	New	700	$ 153,000					$ 153,000	100%	$ -	$ -	$ 153,000

Table 7.2 Capital Improvement Projects

Wastewater Collection System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-15 ($)	Phase 2 2016-20 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Regional ($)
N-14A	Casing[1]	Future road	Casing under future 152 bypass		12/24	New	700	$ 973,000					$ 973,000	100%	$ -	$ -	$ 973,000
N-15	Pipe	Future road	New development		21	New	2,730	$ 950,000					$ 950,000	100%	$ -	$ -	$ 950,000
N-16	Pipe	Future road	New development		18	New	2,450	$ 730,000					$ 730,000	100%	$ -	$ -	$ 730,000
N-17	Pipe	Future road	New development		15	New	2,130	$ 582,000					$ 582,000	100%	$ -	$ 582,000	$ -
N-18	Pipe	Future road	New development		12	New	1,830	$ 401,000					$ 401,000	100%	$ -	$ 401,000	$ -
N-19	Pipe	Future road	New development		10	New	3,570	$ 651,000					$ 651,000	100%	$ -	$ 651,000	$ -
N-20	Pipe	Future road	New development		10	New	890	$ 162,000					$ 162,000	100%	$ -	$ 162,000	$ -
N-21	Pipe	Future road	New development		10	New	3,030	$ 552,000					$ 552,000	100%	$ -	$ 552,000	$ -
N-22	Pipe	Future road	New development		10	New	2,970	$ 541,000					$ 541,000	100%	$ -	$ 541,000	$ -
N-23	Pipe	Future road	New development		10	New	2,920	$ 532,000					$ 532,000	100%	$ -	$ 532,000	$ -
N-LS	Lift Station	Quail	New development		9.2 mgd	New		$ 4,920,000		$ 4,920,000				100%	$ -	$ -	$ 4,920,000
	Land Acquisition				0.25 acres	New		$ 60,000		$ 60,000				100%	$ -	$ -	$ 60,000
N-LS2	Lift Station	Future road	New development		2.7 mgd	New		$ 1,515,000					$ 1,515,000	100%	$ -	$ -	$ 1,515,000
	Land Acquisition				0.25 acres	New		$ 60,000					$ 60,000	100%	$ -	$ -	$ 60,000
Meadowlands																	
Meadowlands-LS	Lift Station	NE Los Banos	NE Los Banos		2.9 mgd	Upsize		$ 1,604,000			$ 1,604,000			100%	$ -	$ -	$ 1,604,000
M-1	Pipe	Ward Road/Future Road	Within Industrial Area Plan		12	New	2,341	$ 512,000	$ 512,000					100%	$ -	$ 512,000	$ -
M-2	Pipe	Future Road	Within Industrial Area Plan		10	New	852	$ 156,000	$ 156,000					100%	$ -	$ 156,000	$ -
M-3	Pipe	Industrial Parkway/Future Road	Within Industrial Area Plan		12	New	2,932	$ 641,000	$ 641,000					100%	$ -	$ 641,000	$ -
Vineyard Trunk																	
V-1	Pipe	Nantes	South of Burgundy		15	New	810	$ 222,000		$ 222,000				100%	$ -	$ 222,000	$ -
V-2	Pipe	Future road	New development		12	New	1,871	$ 409,000		$ 409,000				100%	$ -	$ 409,000	$ -
V-3	Pipe	Future road	New development		10	New	829	$ 151,000		$ 151,000				100%	$ -	$ 151,000	$ -
V-4	Pipe	Johnson	South of Capri		10	New	1,467	$ 267,000		$ 267,000				100%	$ -	$ 267,000	$ -
Provinces Trunk																	
PR-1	Pipe	Overland	New development		12	New	2,200	$ 480,000	$ 480,000					100%	$ -	$ 480,000	$ -
PR-2	Pipe	Palermo	New development		12	New	500	$ 109,000	$ 109,000					100%	$ -	$ 109,000	$ -
Southeast Trunk																	
SE-1	Pipe	Pine	New development		10	New	2,973	$ 541,000		$ 541,000				100%	$ -	$ 541,000	$ -
SE-2	Pipe	Future road	New development		10	New	1,538	$ 281,000		$ 281,000				100%	$ -	$ 281,000	$ -
Badger Flat Trunk																	
BF-1	Pipe	Badger Flat	New development		12	New	2,169	$ 474,000	$ 474,000					100%	$ -	$ 474,000	$ -
BF-2	Pipe	Badger Flat	New development		10	New	2,131	$ 388,000	$ 388,000					100%	$ -	$ 388,000	$ -
College Trunk																	
C-1	Pipe	Future road	New development		10	New	1,974	$ 360,000			$ 360,000			100%	$ -	$ 360,000	$ -
Stone Creek Trunk																	
SC-1	Pipe	Future road	New development		10	New	1,426	$ 261,000	$ 261,000					100%	$ -	$ 261,000	$ -
West Trunk																	
W-1	Pipe	Future road	New development		18	New	2,784	$ 830,000			$ 830,000			100%	$ -	$ -	$ 830,000
W-1A	Casing[1]	Future road	Casing under Los Banos Creek		18/30	New	81	$ 140,000			$ 140,000			100%	$ -	$ -	$ 140,000

Table 7.2 Capital Improvement Projects

Wastewater Collection System Master Plan

City of Los Banos

Figure No.	Type of Improvement	Description/ Street	Description / Limits	Project Length/Size and Cost: Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Replace/ New	Length (ft)	Capital Improvement Cost[2],[3] ($)	Capital Improvement Phasing: Phase 1 2010-15 ($)	Phase 2 2016-20 ($)	Phase 3 2021-2025 ($)	Phase 4 2026-2030 ($)	Phase 5 2031+ ($)	Future Users Benefit (%)	Improvement Reimbursement Category: Existing Improvements ($)	Future Improvements: Developer ($)	Regional ($)
W-2	Pipe	Future road	New development		15	New	4,326	$ 1,182,000				$ 1,182,000		100%	$ -	$ 1,182,000	$ -
W-3	Forcemain	Future road	New development		10	New	98	$ 17,000					$ 17,000	100%	$ -	$ 17,000	$ -
W-4	Pipe	Future road	New development		12	New	1,905	$ 417,000					$ 417,000	100%	$ -	$ 417,000	$ -
W-5	Pipe	Future road	New development		12	New	1,941	$ 424,000					$ 424,000	100%	$ -	$ 424,000	$ -
W-6	Pipe	Future road	New development		12	New	2,951	$ 646,000				$ 646,000		100%	$ -	$ 646,000	$ -
W-7	Pipe	Future road	New development		10	New	1,037	$ 189,000				$ 189,000		100%	$ -	$ 189,000	$ -
W-8	Pipe	Future road	New development		10	New	880	$ 161,000				$ 161,000		100%	$ -	$ 161,000	$ -
W-9	Pipe	Future road	New development		10	New	848	$ 154,000				$ 154,000		100%	$ -	$ 154,000	$ -
W-10	Pipe	Future road	New development		10	New	868	$ 158,000				$ 158,000		100%	$ -	$ 158,000	$ -
W-11	Pipe	Future road	New development		10	New	953	$ 173,000				$ 173,000		100%	$ -	$ 173,000	$ -
W-12	Pipe	Breunig	New development		12	New	2,935	$ 641,000					$ 641,000	100%	$ -	$ 641,000	$ -
W-13	Pipe	Breunig	New development		10	New	1,054	$ 192,000					$ 192,000	100%	$ -	$ 192,000	$ -
W-14	Pipe	Future road	New development		10	New	2,257	$ 412,000					$ 412,000	100%	$ -	$ 412,000	$ -
W-15	Pipe	Future road	New development		10	New	2,224	$ 406,000					$ 406,000	100%	$ -	$ 406,000	$ -
W-16	Pipe	Future road	New development		12	New	2,943	$ 644,000					$ 644,000	100%	$ -	$ 644,000	$ -
W-17	Pipe	Future road	New development		10	New	1,290	$ 236,000					$ 236,000	100%	$ -	$ 236,000	$ -
W-18	Pipe	Future road	New development		10	New	1,087	$ 198,000					$ 198,000	100%	$ -	$ 198,000	$ -
W-19	Pipe	Future road	New development		10	New	1,037	$ 189,000					$ 189,000	100%	$ -	$ 189,000	$ -
W-20	Pipe	Volta	New development		10	New	3,106	$ 566,000					$ 566,000	100%	$ -	$ 566,000	$ -
W-21	Pipe	Future road	New development		10	New	1,321	$ 240,000					$ 240,000	100%	$ -	$ 240,000	$ -
W-LS	Lift Station	West of Breunig	New development		1.0 mgd	New		$ 808,000					$ 808,000	100%	$ -	$ 808,000	$ -
	Land Acquisition				0.25 acres	New		$ 60,000					$ 60,000	100%	$ -	$ 60,000	$ -
Existing System Rehabilitation and Replacement																	
	Pipe	Various Locations	Sewer main rehabilitation program			Rehab		$ 700,000		$ 200,000	$ 200,000	$ 200,000	$ 100,000	0%	$ 700,000	$ -	$ -
	Lift Station	Various Locations	Lift station rehabilitation or replacement			Replace/Rehab		$ 2,840,000		$ 710,000	$ 710,000	$ 710,000	$ 710,000	0%	$ 2,840,000	$ -	$ -
	Pipe	Various Locations	Sewer main replacement program. Average size is 10-inch diameter	10	10	Replace	25,000	$ 4,557,000		$ 1,139,000	$ 1,139,000	$ 1,139,000	$ 1,139,000	0%	$ 4,556,000	$ -	$ -
	Manhole	Various Locations	Manhole replacement program			Replace		$ 600,000		$ 200,000	$ 200,000	$ 100,000	$ 100,000	0%	$ 600,000	$ -	$ -
Storm Drain Cross Connection Removal																	
A1-1	Pipe	K Street, California Avenue	California Avenue to Iowa Avenue, and s/o L Street to K Street	-	18	New	2,300	$ 617,000		$ 617,000				0%	$ 617,000	$ -	$ -
A1-2	Pipe	Idaho Ave, I St, Texas Ave	L St to I St, west to Texas Ave, then northeast to H St	15	36	New/Replace	4,050	$ 2,174,000	$ 2,174,000					0%	$ 2,174,000	$ -	$ -
A1-3	Pipe	L Street	Delaware Avenue to Idaho Avenue	-	18	New	300	$ 81,000	$ 81,000					0%	$ 81,000	$ -	$ -
CC-6	Pipe	6th Street, K Street	sw/o M Street to K Street, then 6th Street to 7th Street	-	18	New	1,150	$ 309,000			$ 309,000			0%	$ 309,000	$ -	$ -
CC-7	Pipe	Center Avenue, Jefferson Avenue	Madison Avenue to Jefferson Avenue, then to 6th Street	-	18	New	1,850	$ 497,000				$ 497,000		0%	$ 497,000	$ -	$ -
CC-8	Pipe	Pacheco Blvd, Paradise Lane	I Street to Paradise Lane, then south to Adams Avenue	-	12	New	2,300	$ 453,000					$ 453,000	0%	$ 453,000	$ -	$ -
CC-9	Pipe	Murietta Street	Page Street to Monro Street, then east to 7th Street	-	18	New	600	$ 161,000					$ 161,000	0%	$ 161,000	$ -	$ -
							CIP Total	**$ 75,802,000**	**$ 6,983,000**	**$ 21,157,000**	**$ 13,808,000**	**$ 13,185,000**	**$ 20,668,000**		**$ 13,055,000**	**$ 23,270,000**	**$ 39,476,000**

Notes:

1. Proposed casings size and carrier pipe size.
2. Baseline Construction Cost plus 20% to account for unforeseen events and unknown conditions.
3. Estimated Construction Cost plus 30% to cover other costs including Engineering, Construction Management, and Program Implementation.
5. Land acquisition costs were included for lift stations, but not for pipelines, which will be located within public right of way.
6. Costs are based on the Engingeering News Record Construction Cost Index 20-city average of 8592.

would benefit entirely from the construction of facilities necessary to serve future development. The majority of projects proposed in this Master Plan are intended to serve future development and were assigned 100 percent benefit to future users. The future improvements are broken down further into Regional or Developer Improvements. The difference between these two is the funding source, which was described in Chapter 6.

A breakdown in existing and future user cost share of the proposed projects by phase is summarized in Table 7.3.

Table 7.3 Capital Cost Summary
Wastewater Collection System Master Plan
City of Los Banos

Reimbursement Category	Implementation Phase					Total
	2010-2015 ($, millions)	2016-2020 ($, millions)	2021-2025 ($, millions)	2026-2030 ($, millions)	2031 + ($, millions)	
Existing Improvement[2]	2.32	2.87	2.56	2.65	2.66	**13.06**
Future Developer Improvement[3]	3.02	3.10	1.73	5.28	10.14	**25.27**
Future Regional Improvement[4]	1.64	15.19	9.52	5.26	7.86	**39.48**
Total	**6.98**	**21.16**	**13.81**	**13.19**	**20.67**	**75.80**

Notes:
1. All costs are in November 2009 dollars. ENR CCI 20 City average = 8592
2. Projects are funded through user rates.
3. Projects are developer funded and/or may be part of a development reimbursement agreement.
4. Projects funded through wastewater development impact fees collected by the City.

APPENDIX A - LAND USE DESCRIPTIONS

City of Los Banos

2030 General Plan Update

Approved July 15, 2009

The Downtown District is located between the Union Pacific rail corridor and Pacheco Boulevard; it is surrounded by older residential neighborhoods, commercial uses, schools, and parks. The major commercial land uses are located along two State routes. Some industrial land is located in close proximity to the Union Pacific Railroad and Los Banos Municipal Airport. Parks of various sizes are distributed throughout the city, often in close proximity to schools.

3.2 GENERAL PLAN DIAGRAM

The land use framework of the General Plan is illustrated in the General Plan Diagram (Figure 3-2). It designates the proposed general location, distribution, and extent of land uses through buildout. As required by State law, land use classifications—shown as color/graphic patterns, letter designations, or labels on the diagram—specify a range for housing density and building intensity for each type of designated land use. These density/intensity standards allow future street improvements and public facility needs to be determined.

The Diagram is to be used and interpreted only in conjunction with the text and other figures contained in the General Plan. The legend of the General Plan Diagram includes the land use classifications described below. The Diagram is not parcel-specific, and uses on sites less than one acre in size are generally not depicted.

LAND USE FRAMEWORK

The General Plan Diagram illustrates the following ideas:

- Clearly Defined Urban Edges. As depicted on the General Plan Diagram, all development is planned to occur within the Urban Growth Boundary.
- Economic Development and Jobs. A significant amount of land is set aside for job-related land uses. Areas designated "Office and Professional", "Employment Park", and "Industrial" accommodate uses that will provide employment opportunities for existing and future residents.
- Integrated Neighborhoods and Neighborhood Centers. The General Plan Diagram depicts a *network* of neighborhoods; they are all walkable and include community facilities such as parks and schools, and have a central focal point. The diagrams show how these neighborhoods are related to each other and to neighborhood centers and shopping areas.
- A Mix of Housing Types. Three types of residential density ranges are depicted on the Diagram. These will accommodate a full range of housing types and prices to provide housing choice.
- Enhanced Community Character and Aesthetics. The physical character of Los Banos will be enhanced through compact design, pedestrian-oriented circulation, neighborhood-centered activities, and environmental sensitivity. The arrangements of land uses on the General Plan Diagram create a framework within which quality community design is possible.
- Parks. A system of neighborhood and County parks and trails are depicted on the General Plan Diagram. Medium and High Density residential uses are often situated adjacent to these parks, which will provide amenities to nearby residents.

- A Network of Open Space. All of the Parks and Open Space uses are linked by a system of parkways, bikeways, and roadways.
- A Range of Commercial and Retail Opportunities. The General Plan provides for the full range of commercial and retail uses needed for the future population and business community. Regionally-oriented establishments are placed on major roadway corridors; community- and neighborhood-oriented uses are placed within planned communities and neighborhoods.
- Adequate, Flexible School Sites. New school sites are proposed to accommodate future students. The sites depicted on the General Plan Diagram are intended to relate well to adjacent uses, such as neighborhood focal areas and park sites. It should be noted that school site locations can be adjusted if the School District chooses not to locate in those areas and the land will be designated as its surrounding uses.

DENSITY/INTENSITY STANDARDS

The General Plan establishes density/intensity standards for each use classification. Residential density is expressed as housing units per gross acre (including public streets and other rights-of-way). Maximum permitted ratio of gross floor area to site area, called Floor Area Ratio (FAR), is specified for non-residential uses. FAR is a broad measure of building bulk that controls both visual prominence and traffic generation. It can be clearly translated to a limit on building bulk in the Zoning Ordinance and is independent of the type of use occupying the building.

Density (housing units per acre) and intensity (FAR) standards are for gross developable land (that is, including proposed streets and other rights-of-way), but excluding areas subject to physical or environmental constraints, which include ridgelines and steep hillside slopes, creek corridors and floodways, and areas to be dedicated for greenways or habitat protection. The density/intensity standards do not imply that development projects will be approved at the maximum density or intensity specified for each use. Zoning regulations consistent with General Plan policies and/or site conditions may reduce development potential within the stated ranges.

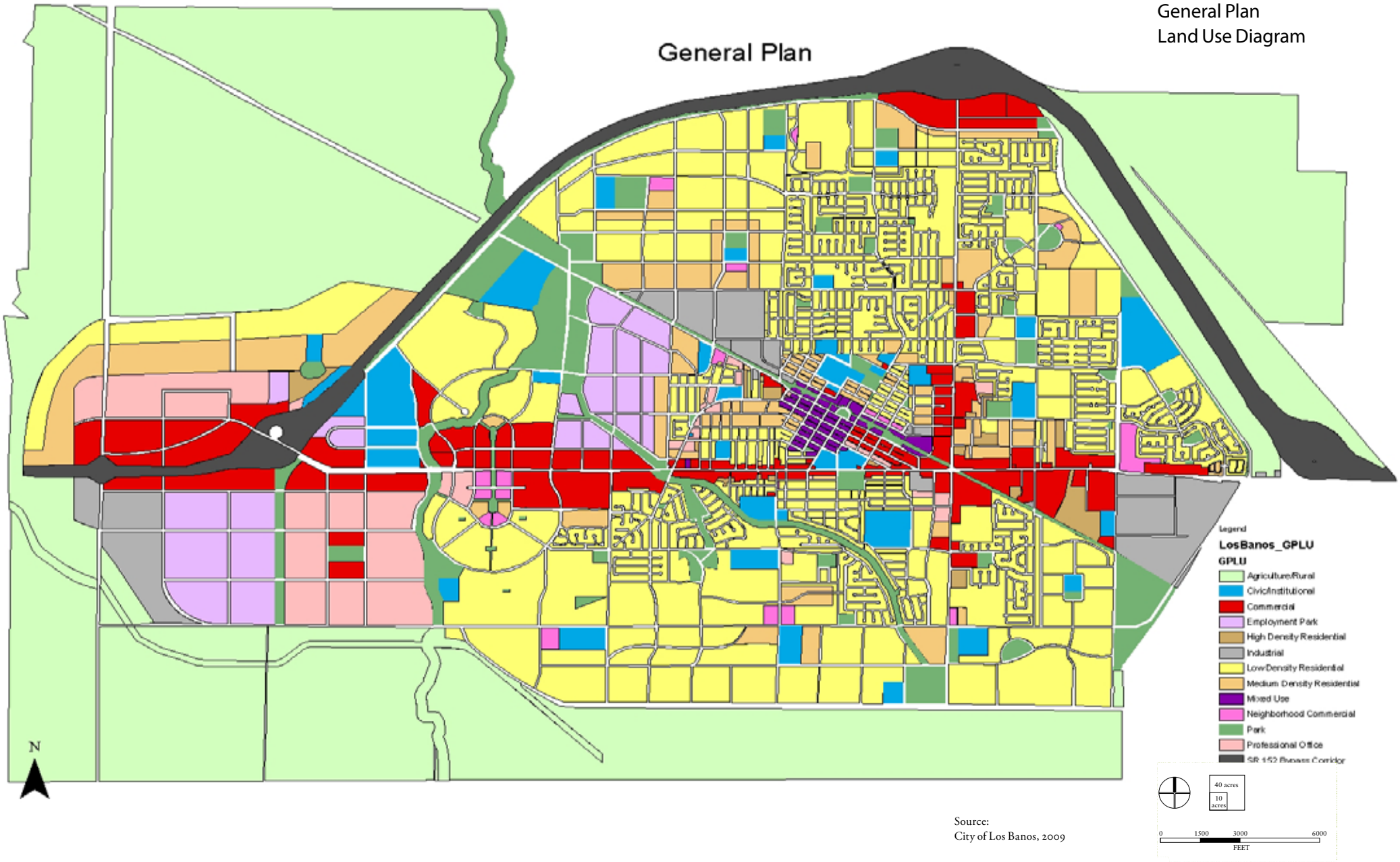
The Zoning Ordinance will provide specific exceptions to the FAR limitations for uses with low employment densities, such as research facilities, or uses with low peak-hour traffic generation, such as a hotel or hospital. Intensity standards for non-residential and mixed-use development are for each entire development site; that is, intensities on individual parcels may exceed the maximum, provided each overall development project does not exceed the stipulated intensity.

LAND USE CLASSIFICATIONS

The following descriptions apply to land uses indicated on the General Plan Land Use Diagram. Land use classifications are organized into the following categories: Residential, Mixed Use, Commercial, Office/Industrial and Public/Open Space. These land use classifications are meant to be broad enough to give the City flexibility in implementing policy, but clear enough to provide sufficient direction to carry out the General Plan. The City's Zoning Ordinance will contain more detailed provisions and standards. More than one zoning district may be consistent with a single General Plan land use classification.

Figure 3-2

General Plan
Land Use Diagram



Source:
City of Los Banos, 2009

Residential

Low Density Residential. This designation is intended for single-family development on lot sizes found in more urban settings. Development intensities range from 2 to 6 units per net acre, and an average density of 4 units per net acre is used for buildout projections.

Medium Density Residential. This designation is intended for small-lot single family low density apartment complexes and multiple-unit homes with typical lot sizes ranging from 2,000 to 5,000 square feet. Allowable residential density is between 7 and 18 units per net acre. The high range of this density is achievable with supportive development regulations and does not necessarily require multi-family development. An average density of 12 units per acre is used for buildout projections.

High Density Residential. This designation is intended for multi-family apartments and condominium development. Residential densities ranging from 12 to 30 units per net acre, with an average density of 20 units per acre used for buildout projections.

Mixed Use

Downtown Mixed Use. This designation is intended for mixed-use development, located downtown, allowing for a mixture of commercial, office, institutional, public/semi public, and residential uses. Maximum FAR for non-residential uses are 0.25 for retail, and 2.0 for office use, with a maximum of 18 dwelling units per acre. For buildout projections, an average density of 12 residential units per net acre and a non-residential FAR of 1.0 are used.

Rail Trail Corridor. This designation is intended for pedistrian oriented mixed use development located on the rail trail corridor allowing for a mixture of commercial, office, instirutional, public/semi-public and residential uses.

Neighborhood Commercial. This designation is intended for a mix of neighborhood-scale commercial use that includes small-scale office space and small retail stores, including grocery stores that serve local neighborhoods. The FAR range for this use is between 0.25 and 0.6, with a typical buildout value of 0.3.

Commercial/Office/Industrial

Commercial. This designation is intended for large-scale commercial developments that serve both residents, visitors, and the surrounding region. Examples of this land use include: shopping centers, large-format retail, auto sales and travel-related services such as hotels, gas stations, and restaurants. These uses typically require excellent access to freeway interchanges. The FAR ranges from 0.25 to 0.60 with a typical value of 0.25 used for buildout estimates.

Office/Professional. This designation is intended for small-scale offices and campus-like office complex development, including professional and medical offices, and research and development (R&D) activities. This designation may also allow small restaurants, support services, and convenience retail activities. The FAR range for Office/Professional use is 0.25 to 0.60, with a typical FAR for build-out estimates of 0.30.

Employment Park. This designation is intended for a mix of light industrial, research and development (R&D)/high technology, office, commercial, and service uses. Typical uses might include office space and R&D/light industrial with limited customer access and support commercial services. Uses in this category are expected to have elements of architectural and landscape design. The FAR ranges from 0.25 to 0.50, with a typical value of 0.35 for buildout estimates.

Industrial. This designation allows primary manufacturing, R&D, wholesale and warehouse distribution, agricultural sales and services, and similar activities including those with outdoor facilities. It also accommodates warehousing and distribution, with support commercial services and ancillary office space. No large-scale retail uses are allowed to minimize land-use conflicts and provide support for commercial areas. The FAR range for Industrial use is 0.25 to 0.35, and the typical FAR for build-out estimates is 0.30.

The density and intensity (FAR) standards used in the General Plan are shown in Table 3-2.

3–2: General Plan Land Use Density Assumptions

	Density (units/net acre)			Floor Area Ratio (FAR)		
Land Use Classification	Min	Typical	Max	Min	Typical	Max
Agricultural/Rural		0.05	0.1[1]	0.01	0.01	0.05
Environmental Conservation						0.01
Special Use Park						0.05
Civic/Institutional						
Low Density Residential	2.0	4.0	6.0			
Medium Density Residential	7.0	12.0	18.0			
High Density Residential	12.0	20.0	30.0			
Downtown Mixed Use	-	12.0	18.0	0.50[2]	1.00	2.00
Neighborhood Commercial				0.25	0.30	0.60
Commercial				0.25	0.25	0.60
Office/Professional				0.25	0.30	0.60
Employment Park				0.25	0.35	0.50
Industrial				0.25	0.30	0.35

[1] 0.4 for cluster rural residential within proposed SOI.

[2] 0.25 for retail

Other

Grasslands Ecological Area. Land within this designation is considered an important resource that needs protection from urban development; it includes the Los Banos Wildlife Area.

Agriculture/Rural. This designation is generally intended for rural and agricultural land uses without municipal services. The typical development allows for large parcels with housing and agricultural related service buildings and uses an average density of 0.1 units per acre for buildout projections. Where applied to land within the SOI adjacent to residential development, clustered, very low density "executive" housing in a rural setting is allowed at an average density of 0.4 units per acre.

Parks. Public and private recreation sites and facilities at intensities of up to 0.05 FAR.

Civic/Institutional. This designation is intended for lands owned by public entities, including schools, administrative offices, corporation yards, and public facilities, including recycling centers, sewage treatment ponds, police and fire stations.

GENERAL PLAN BUILDOUT

Full development under the General Plan is referred to as "buildout". When buildout will actually occur is not specified in or anticipated by the Plan, and designation of a site for a certain use does not necessarily mean that the site will be built/redeveloped with the time horizon of the Plan. Furthermore the airport zoning may prevent full buildout if the airport remains in its current location.

Table 3-3 shows the buildout acreage of the General Plan Diagram. Most areas that are planned for new development are residential in use, totaling about 4,270 acres.

3–3: Development Under the General Plan (Acres)

Land Use	Total Buildout	Percent of Total
Residential	4,270	25
Low Density Residential	3,670	21
Medium Density Residential	590	3
High Density Residential	10	<1
Mixed Use	180	1
Mixed Use	10	<1
Neighborhood Commercial	170	1
Commercial/Office Professional	2,610	15
Commercial	760	4
Office Professional	520	3
Employment Park	820	5
Industrial	510	3
Others	10,370	60
Agriculture/Rural	7,820	45
Parks, Trails & Open Space	1,320	8
Civic/Institutional	490	3
SR-152 Bypass	750	4
Total	17,420	100.0

3.3 PATTERN OF DEVELOPMENT, GROWTH AND EXPANSION

The General Plan Diagram reflects the community's desire to preserve and protect agricultural lands and retain the City's small-town character. The policies presented in this section are intended to help Los Banos achieve growth in a sustainable manner. Specifically, a focused development pattern can be achieved through measures that control growth, manage infrastructure and services, and establish performance standards for different land uses.

GUIDING POLICIES

LU-G-1 Promote a sustainable, balanced land use pattern that satisfies existing needs and safeguards future needs of the City.

LU-G-2 Maintain a well-defined compact urban form, with a defined urban growth boundary and development intensities on land designated for urban uses.

LU-G-3 Ensure that new development provides for infrastructure, schools, parks, neighborhoods shops, and community facilities in close proximity to residents.

IMPLEMENTING ACTIONS

Growth Management

LU-I-1 Delineate an Urban Growth Boundary in the General Plan Land Use Diagram that is an area within which urban development will occur.

APPENDIX B - DESIGN STORM REPORT

October 22, 2007

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Los Banos Design Storm Report

METHODOLOGY

A literature search was made for precipitation records for Los Banos. The best source of potential Depth-Duration-Frequency Data (DDF) was the California Department of Water Resources, (http://www.climate.water.ca.gov/climate_data/). Five stations were used in this analysis. These stations were Los Banos 36 (hourly), Los Banos CDF (hourly), Merced (hourly), Modesto (hourly) and Los Banos (daily). The hourly data for Los Banos 36 and Los Banos CDF were short records, so the long-term hourly data for Merced and Modesto were used as a guide to extrapolation. (See Table 1).

Log-normal probability graphs were constructed from the station data and used to estimate values for recurrence intervals 2-yr, 5-yr, 10-yr, 25-yr, 50-yr and 100-yr. Composite curves of the Depth-Duration-Frequency (DDF) data were fit to power equations of the form: ***Depth (for each recurrence in inches)=a*time(in hours)^b.***

RESULTS

Table 2 shows DDF for Los Banos derived from power equations fit to the log-normal frequency plots. Tables 3A-3G (with figures) show recommended hourly distributions for 24-hour design storms. These distributions are balanced, symmetrical distributions as commonly used nationwide.

Table 1. Precipitation Station Data

Station	Years	Record	Elevation	Latitude	Longitude
Los Banos 36	1989-2005	17	95	37.092	-120.760
Los Banos CDF	1990-2004	15	350	37.053	-121.049
Merced	1940-2004	64	168	37.315	-120.470
Modesto	1942-2004	62	92	37.643	-121.008
Los Banos	1898-2005	98	125	37.050	-120.850

Table 2.
Los Banos DDF Data
Depth (inches) = A * T (hours) ^ B

	A	B	**1-hr**	**2-hr**	**3-hr**	**6-hr**	**12-hr**	**24-hr**	**48-hr**
2-yr	0.33	0.382	*0.33*	*0.43*	*0.50*	*0.65*	*0.85*	*1.11*	*1.45*
5-yr	0.49	0.350	*0.49*	*0.62*	*0.72*	*0.92*	*1.17*	*1.49*	*1.90*
10-yr	0.61	0.332	*0.61*	*0.77*	*0.88*	*1.11*	*1.39*	*1.75*	*2.21*
25-yr	0.77	0.311	*0.77*	*0.96*	*1.08*	*1.34*	*1.67*	*2.07*	*2.57*
50-yr	0.90	0.301	*0.90*	*1.11*	*1.25*	*1.54*	*1.90*	*2.34*	*2.89*
100-yr	1.02	0.294	*1.02*	*1.25*	*1.41*	*1.73*	*2.12*	*2.60*	*3.18*

Table 3A
2-Year Recurrence at Los Banos
D=.33t^.382

Hour	*Depth*	*Incremental*	*Design*
1	0.33	0.33	0.02
2	0.43	0.10	0.02
3	0.50	0.07	0.02
4	0.56	0.06	0.02
5	0.61	0.05	0.02
6	0.65	0.04	0.03
7	0.69	0.04	0.03
8	0.73	0.04	0.03
9	0.76	0.03	0.04
10	0.80	0.03	0.05
11	0.82	0.03	0.07
12	0.85	0.03	0.33
13	0.88	0.03	0.10
14	0.90	0.03	0.06
15	0.93	0.02	0.04
16	0.95	0.02	0.04
17	0.97	0.02	0.03
18	1.00	0.02	0.03
19	1.02	0.02	0.03
20	1.04	0.02	0.02
21	1.06	0.02	0.02
22	1.07	0.02	0.02
23	1.09	0.02	0.02
24	1.11	0.02	0.02

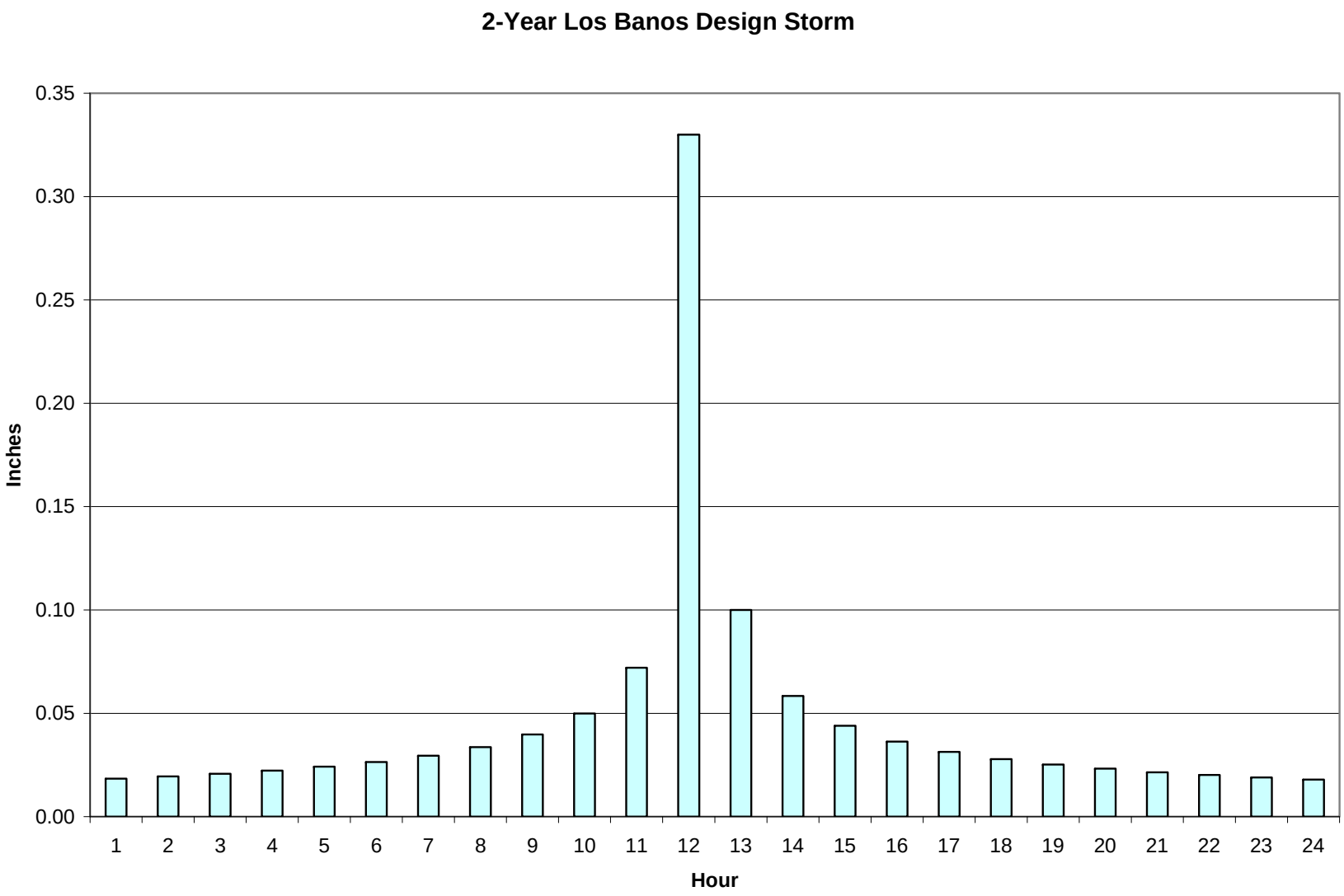

2-Year Los Banos Design Storm
Inches
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour

Table 3B
5-Year Recurrence at Los Banos
D=.49*t^.350

Hour	*Depth*	*Incremental*	*Design*
1	0.49	0.49	0.02
2	0.62	0.13	0.02
3	0.72	0.10	0.03
4	0.80	0.08	0.03
5	0.86	0.06	0.03
6	0.92	0.06	0.03
7	0.97	0.05	0.04
8	1.01	0.05	0.04
9	1.06	0.04	0.05
10	1.10	0.04	0.06
11	1.13	0.04	0.10
12	1.17	0.04	0.49
13	1.20	0.03	0.13
14	1.23	0.03	0.08
15	1.26	0.03	0.06
16	1.29	0.03	0.05
17	1.32	0.03	0.04
18	1.35	0.03	0.04
19	1.37	0.03	0.03
20	1.40	0.02	0.03
21	1.42	0.02	0.03
22	1.45	0.02	0.02
23	1.47	0.02	0.02
24	1.49	0.02	0.02

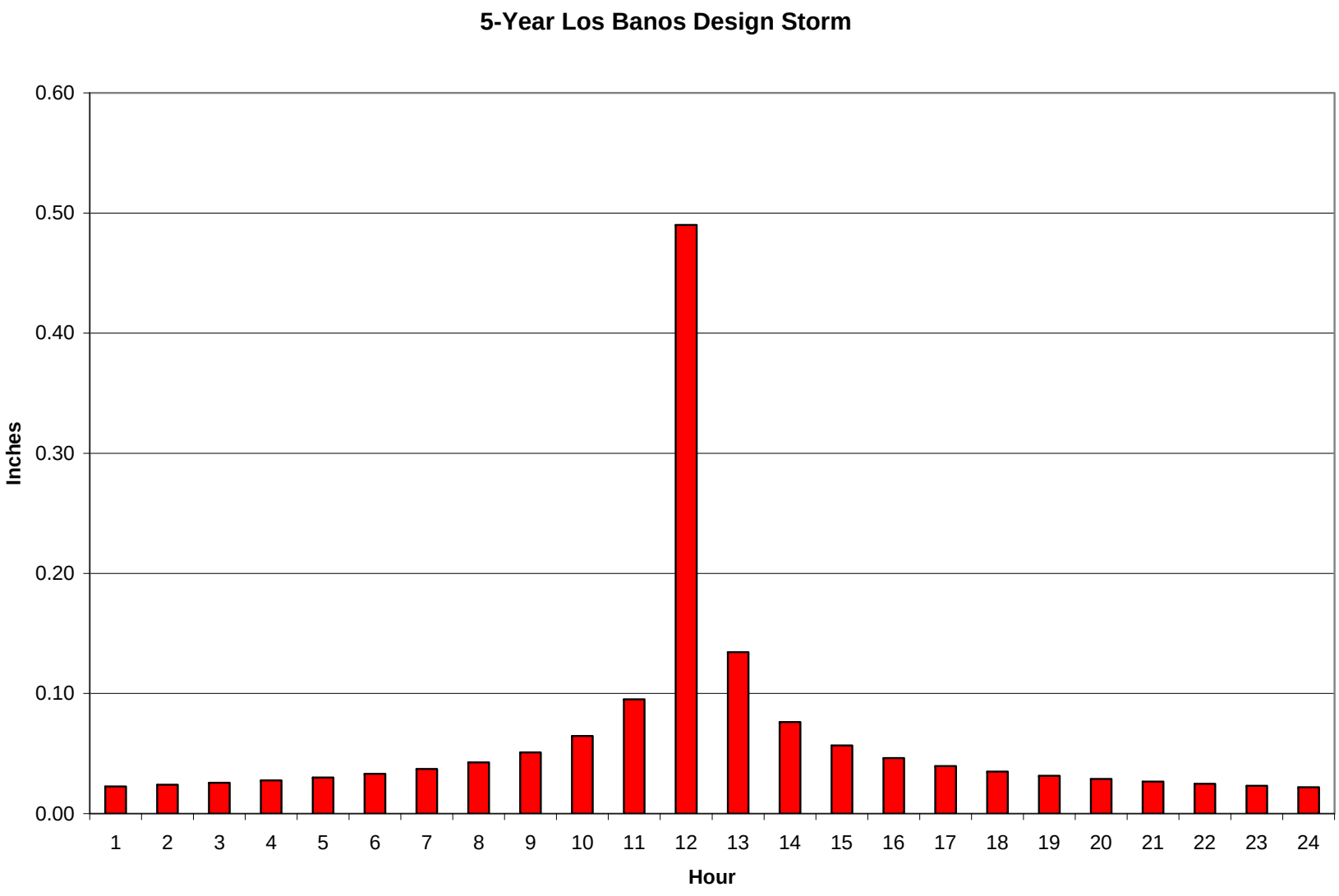

5-Year Los Banos Design Storm
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Inches
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hour

Table 3C
10-Year Recurrence at Los Banos
D=.61*t^.332

Hour	***Depth***	***Incremental***	***Design***
1	0.61	0.61	0.03
2	0.77	0.16	0.03
3	0.88	0.11	0.03
4	0.97	0.09	0.03
5	1.04	0.07	0.03
6	1.11	0.06	0.04
7	1.16	0.06	0.04
8	1.22	0.05	0.05
9	1.27	0.05	0.06
10	1.31	0.05	0.07
11	1.35	0.04	0.11
12	1.39	0.04	0.61
13	1.43	0.04	0.16
14	1.47	0.04	0.09
15	1.50	0.03	0.06
16	1.53	0.03	0.05
17	1.56	0.03	0.05
18	1.59	0.03	0.04
19	1.62	0.03	0.04
20	1.65	0.03	0.03
21	1.68	0.03	0.03
22	1.70	0.03	0.03
23	1.73	0.03	0.03
24	1.75	0.02	0.02

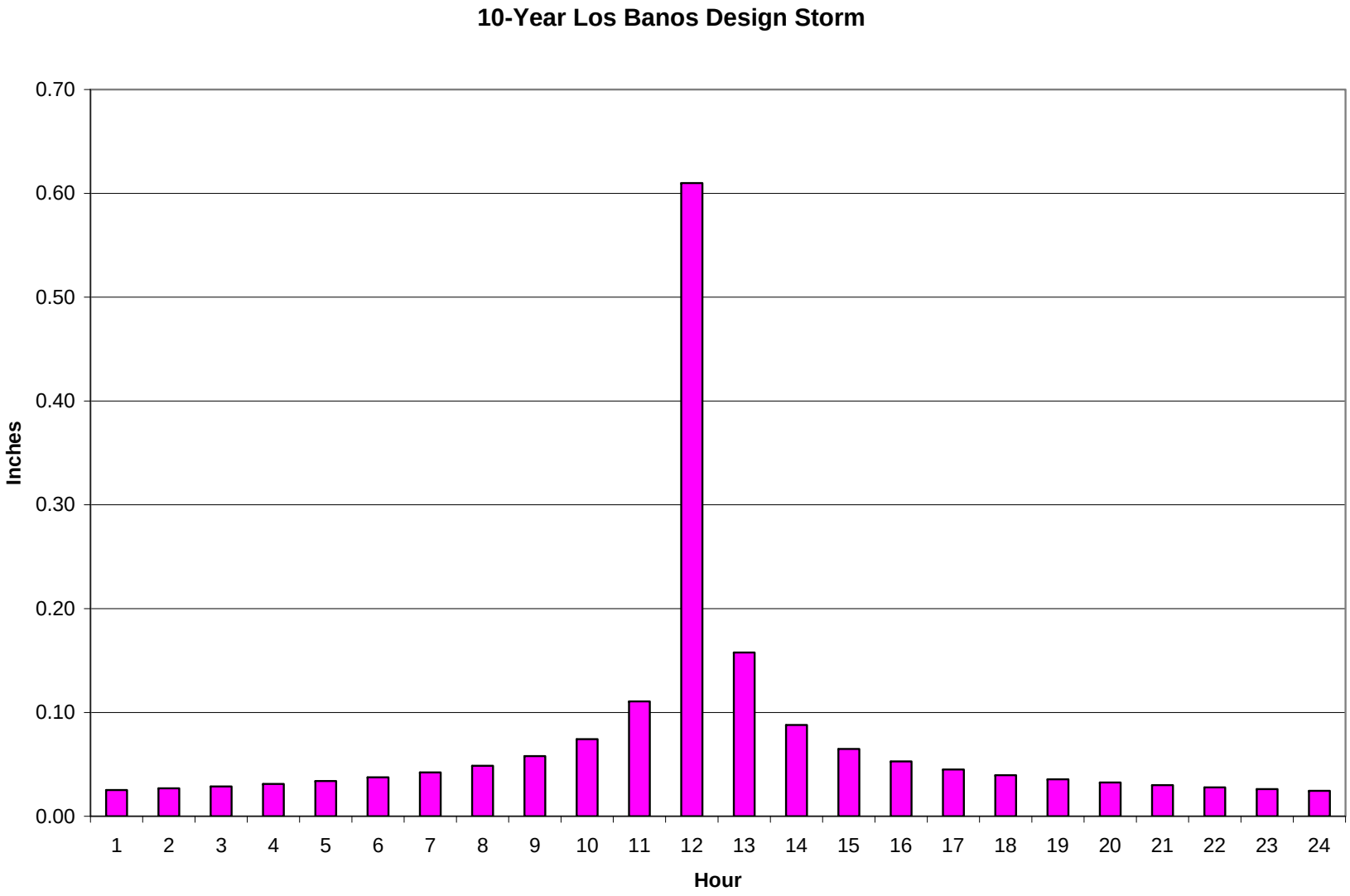

10-Year Los Banos Design Storm
Inches
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour

Table 3D
25-Year Recurrence at Los Banos
D=.77*t^.311

Hour	*Depth*	*Incremental*	*Design*
1	0.77	0.77	0.03
2	0.96	0.19	0.03
3	1.08	0.13	0.03
4	1.19	0.10	0.03
5	1.27	0.09	0.04
6	1.34	0.07	0.04
7	1.41	0.07	0.05
8	1.47	0.06	0.05
9	1.52	0.05	0.07
10	1.58	0.05	0.09
11	1.62	0.05	0.13
12	1.67	0.04	0.77
13	1.71	0.04	0.19
14	1.75	0.04	0.10
15	1.79	0.04	0.07
16	1.82	0.04	0.06
17	1.86	0.03	0.05
18	1.89	0.03	0.04
19	1.92	0.03	0.04
20	1.95	0.03	0.04
21	1.98	0.03	0.03
22	2.01	0.03	0.03
23	2.04	0.03	0.03
24	2.07	0.03	0.03

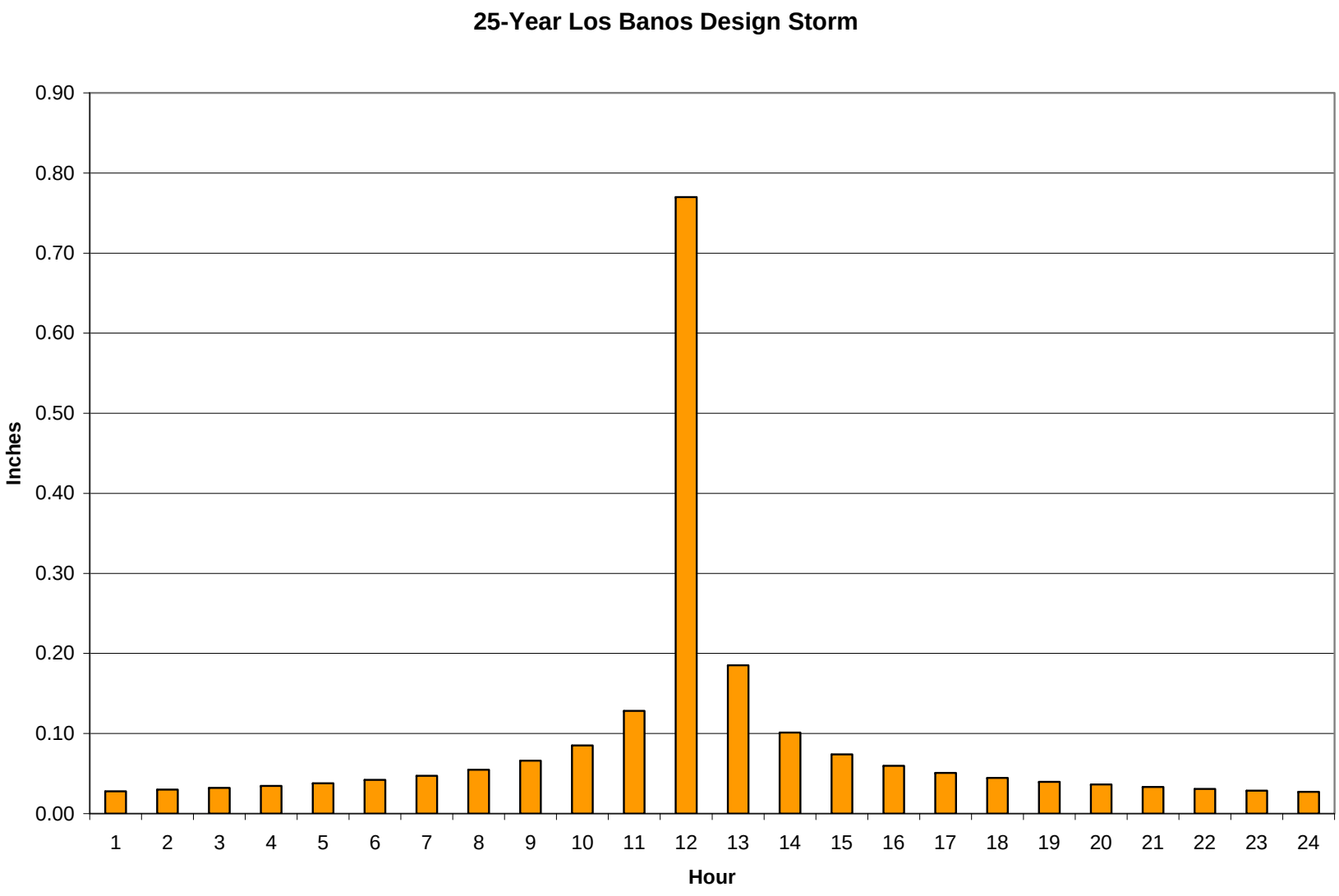

25-Year Los Banos Design Storm
Inches
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour

Table 3E
50-Year Recurrence at Los Banos
D=.90*t^.301

Hour	*Depth*	*Incremental*	*Design*
1	0.90	0.90	0.03
2	1.11	0.21	0.03
3	1.25	0.14	0.04
4	1.37	0.11	0.04
5	1.46	0.09	0.04
6	1.54	0.08	0.05
7	1.62	0.07	0.05
8	1.68	0.07	0.06
9	1.74	0.06	0.07
10	1.80	0.06	0.09
11	1.85	0.05	0.14
12	1.90	0.05	0.90
13	1.95	0.05	0.21
14	1.99	0.04	0.11
15	2.03	0.04	0.08
16	2.07	0.04	0.07
17	2.11	0.04	0.06
18	2.15	0.04	0.05
19	2.18	0.04	0.04
20	2.22	0.03	0.04
21	2.25	0.03	0.04
22	2.28	0.03	0.03
23	2.31	0.03	0.03
24	2.34	0.03	0.03

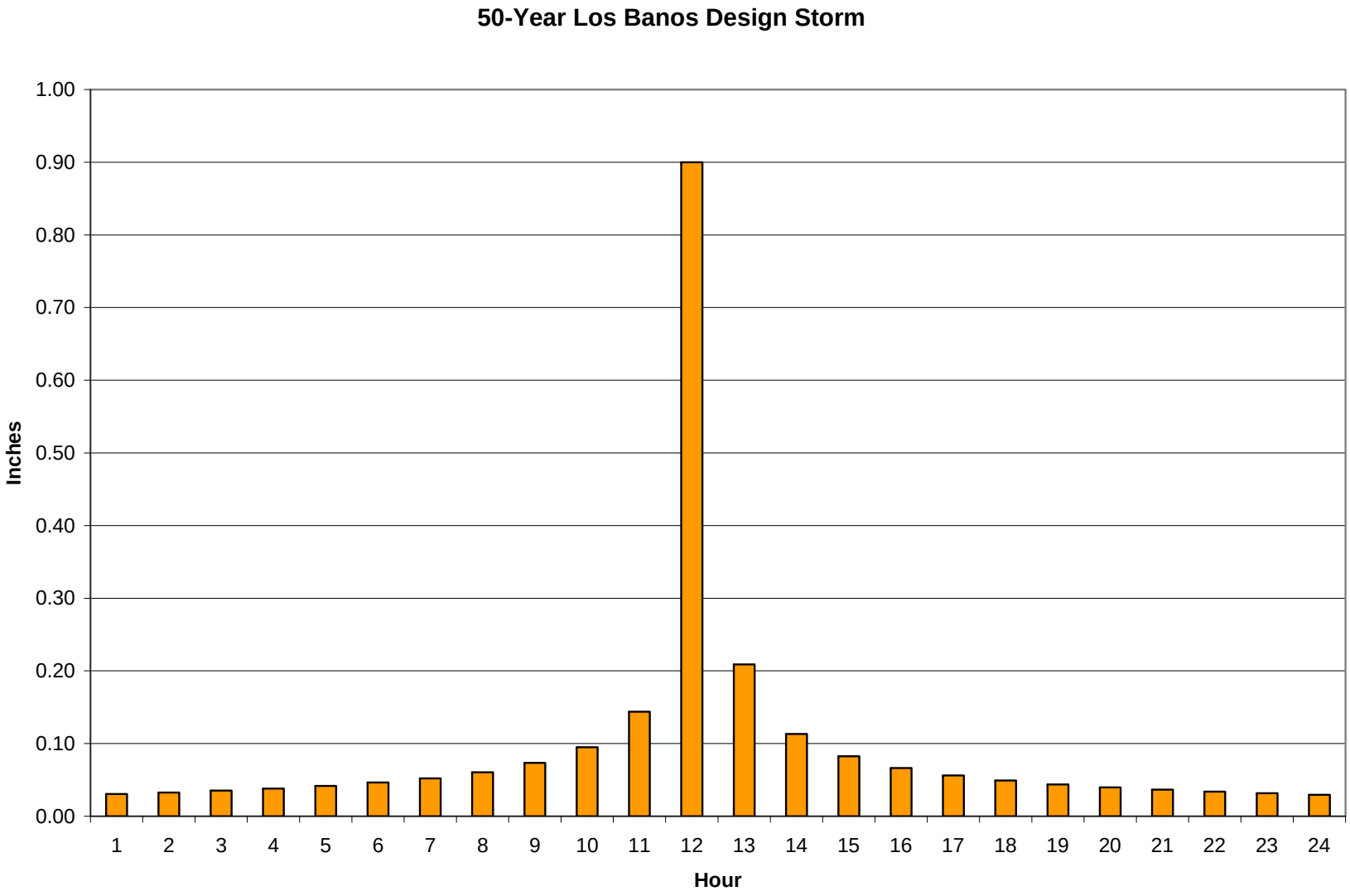
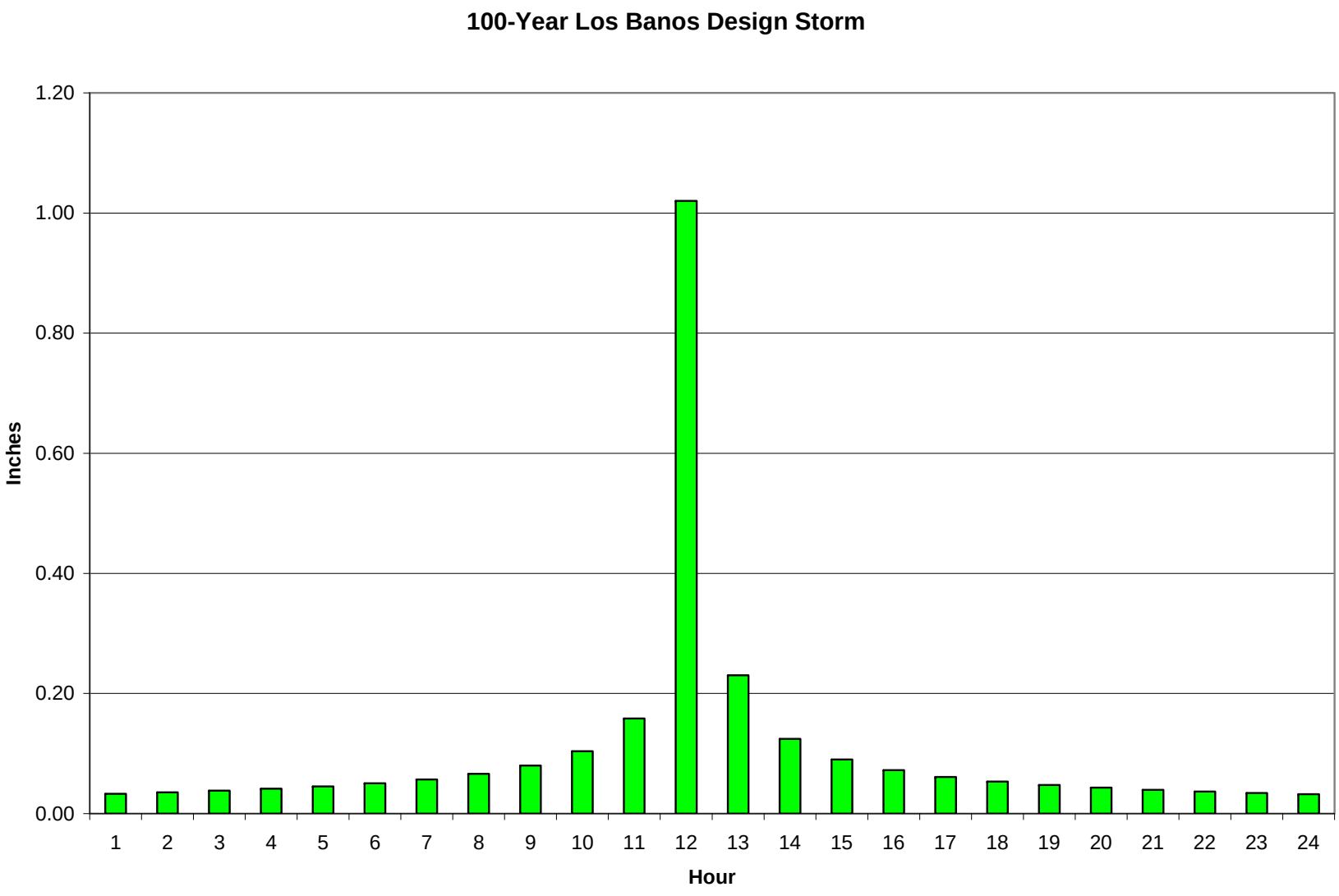

50-Year Los Banos Design Storm
Inches
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Hour

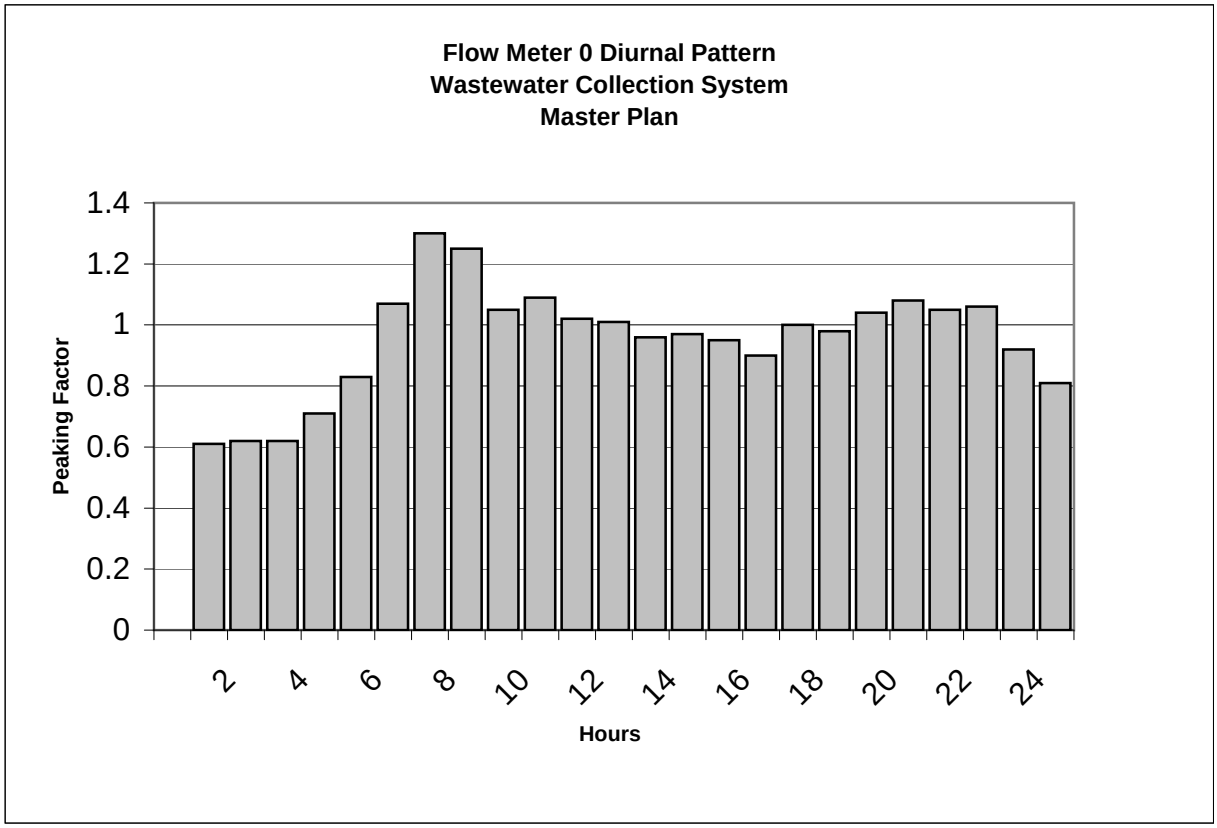
Table 3F
100-Year Recurrence at Los Banos
D=1.02*t^.294

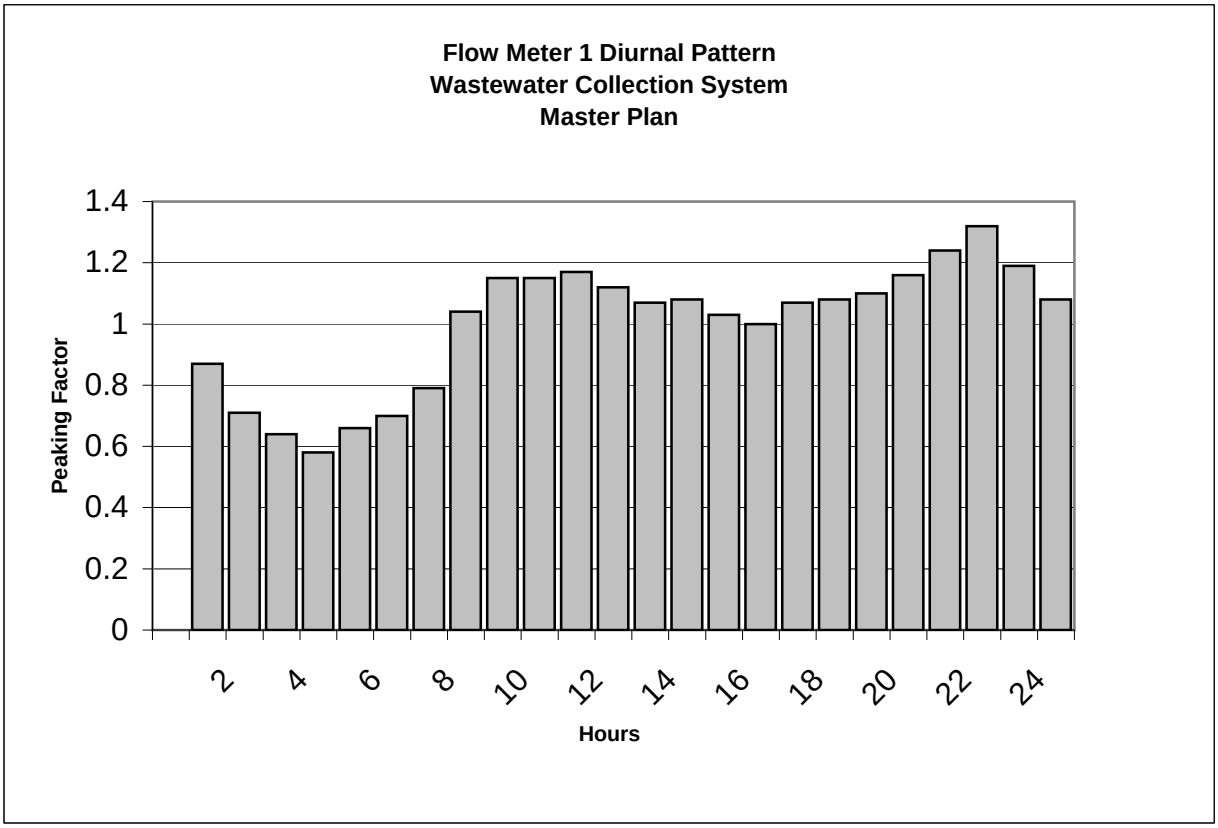
Hour	*Depth*	*Incremental*	*Design*
1	1.02	1.02	0.03
2	1.25	0.23	0.04
3	1.41	0.16	0.04
4	1.53	0.12	0.04
5	1.64	0.10	0.05
6	1.73	0.09	0.05
7	1.81	0.08	0.06
8	1.88	0.07	0.07
9	1.95	0.07	0.08
10	2.01	0.06	0.10
11	2.06	0.06	0.16
12	2.12	0.05	1.02
13	2.17	0.05	0.23
14	2.22	0.05	0.12
15	2.26	0.05	0.09
16	2.30	0.04	0.07
17	2.35	0.04	0.06
18	2.39	0.04	0.05
19	2.42	0.04	0.05
20	2.46	0.04	0.04
21	2.50	0.04	0.04
22	2.53	0.03	0.04
23	2.56	0.03	0.03
24	2.60	0.03	0.03


100-Year Los Banos Design Storm
1.20
1.00
0.80
0.60
0.40
0.20
0.00
Inches
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
Hour

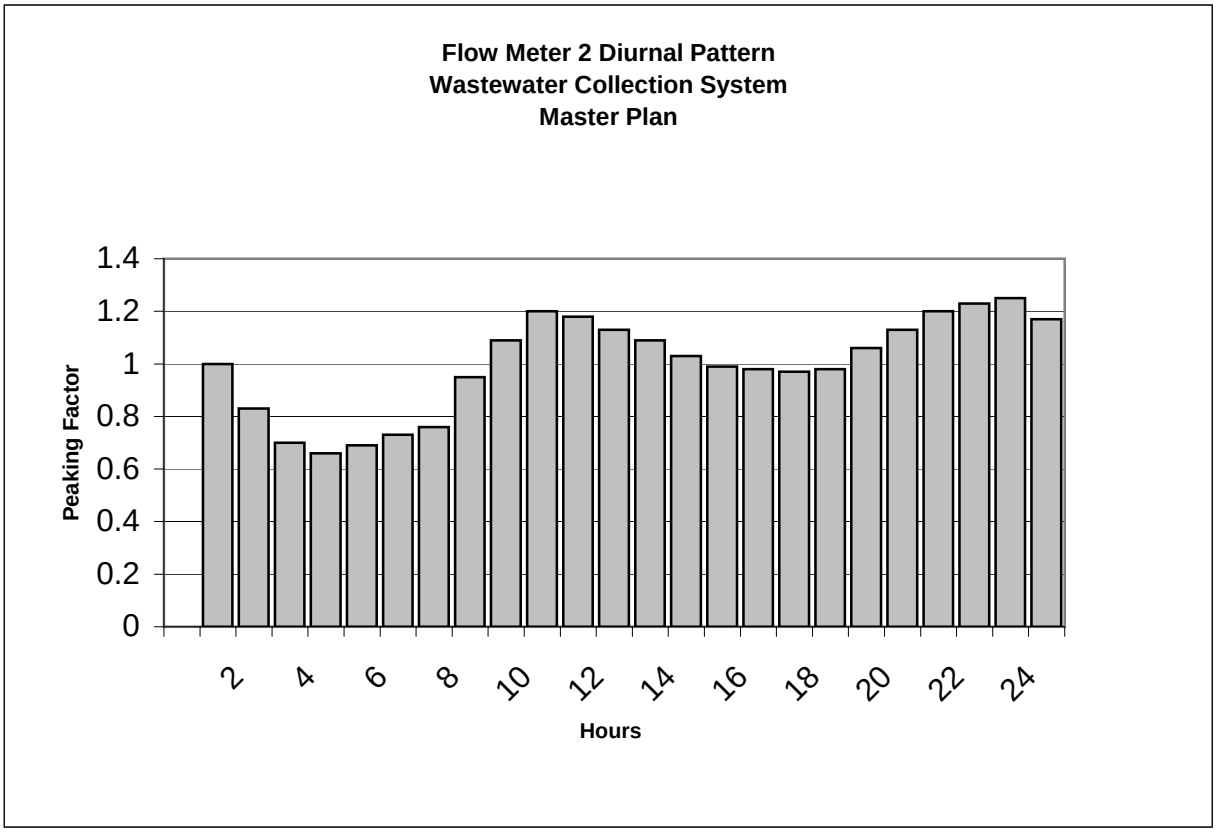
APPENDIX C - FLOW METER DIURNAL CURVES

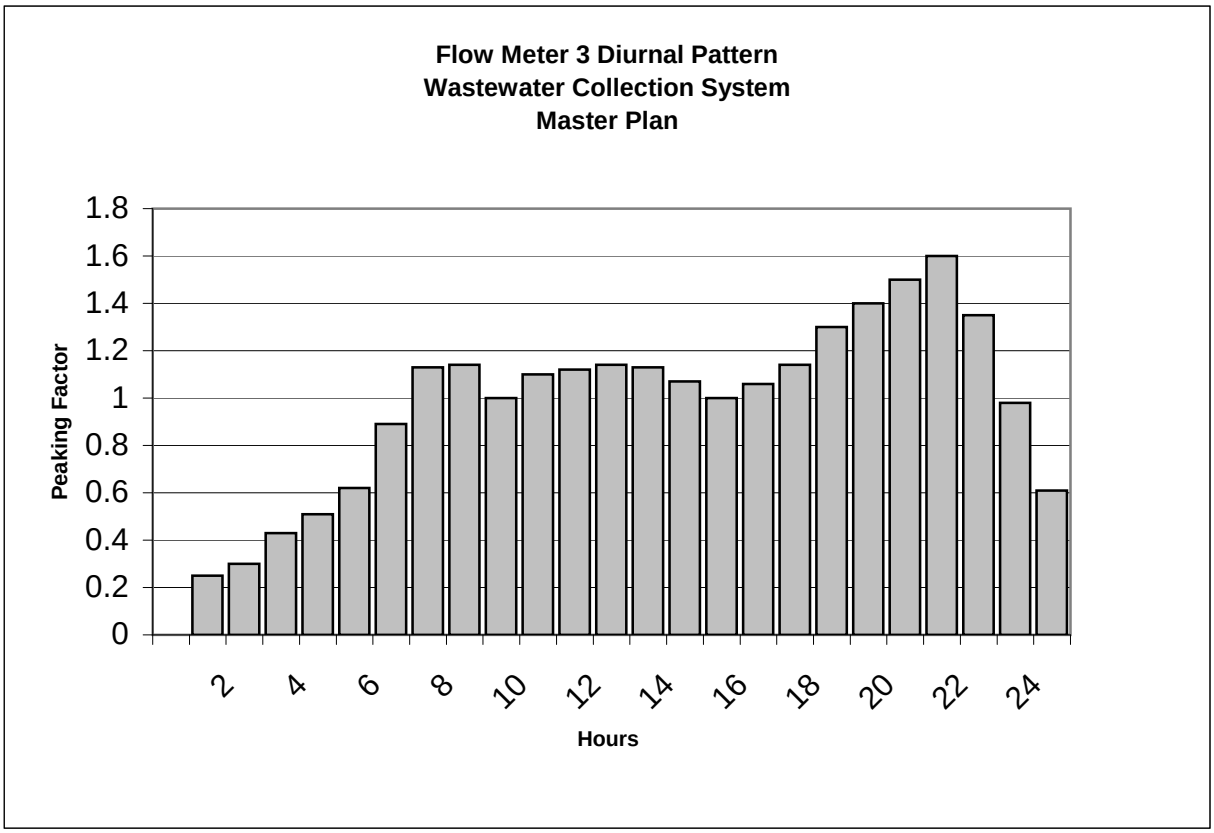
Appendix C: Diurnal Pattern



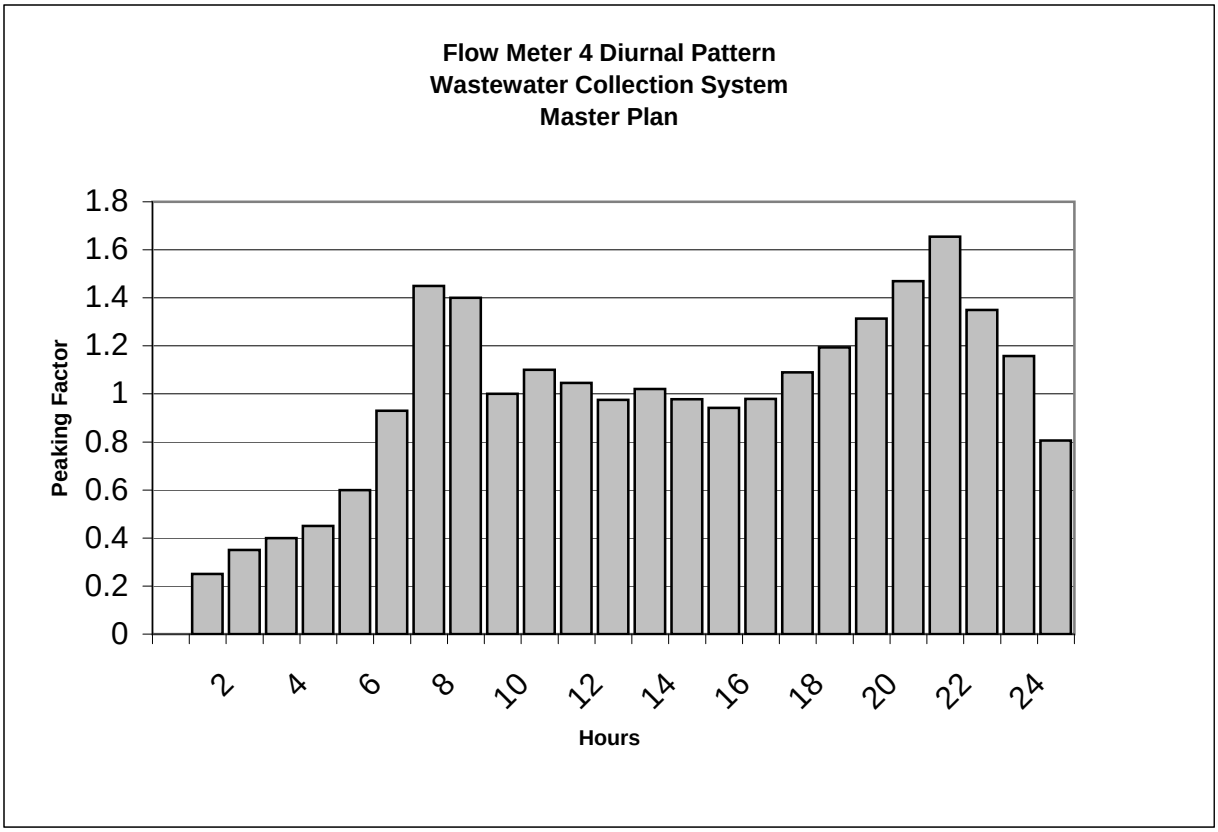


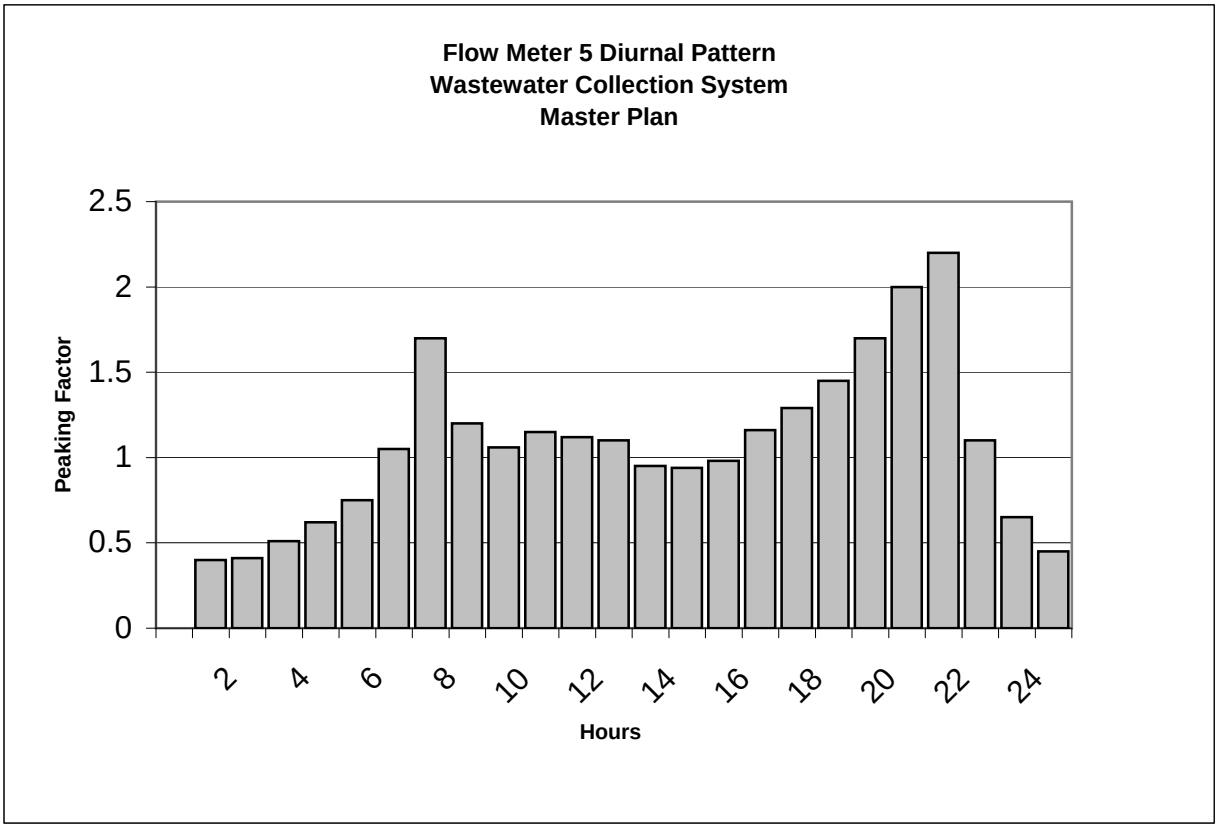
Appendix C: Diurnal Pattern



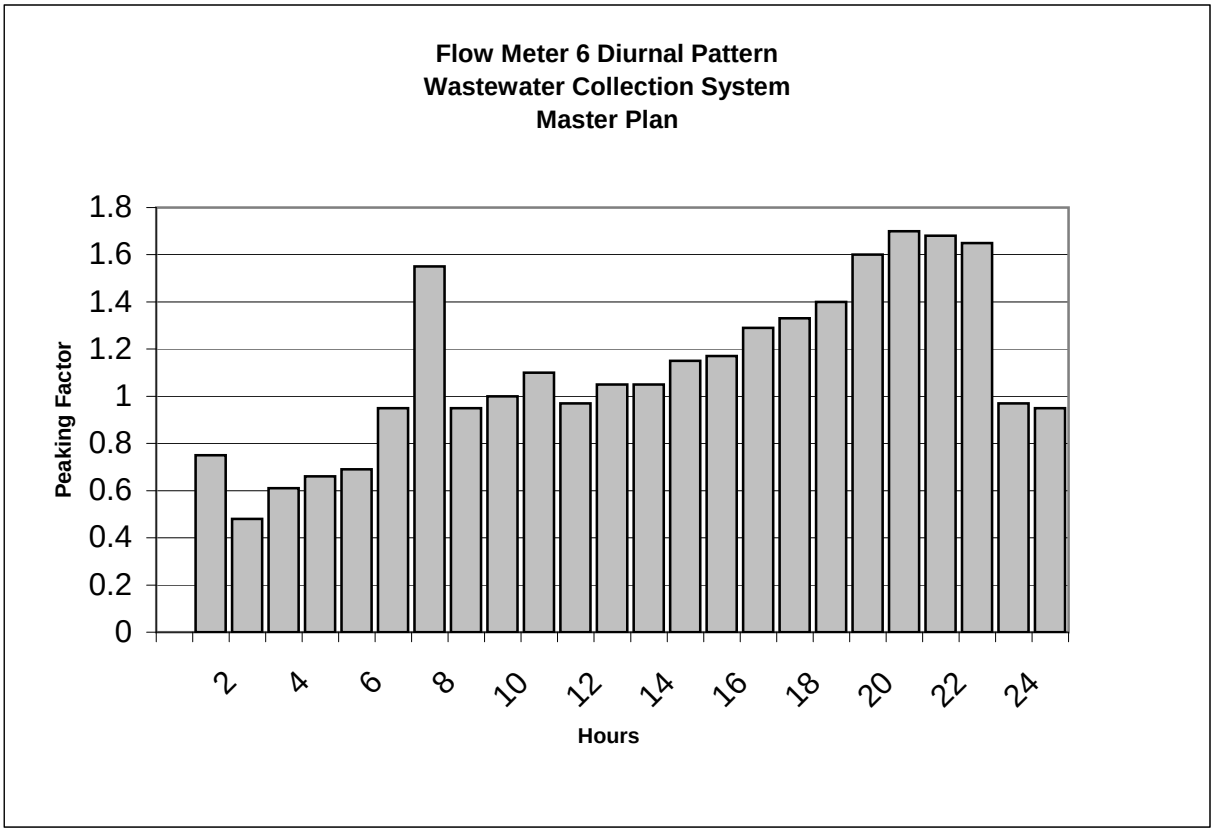


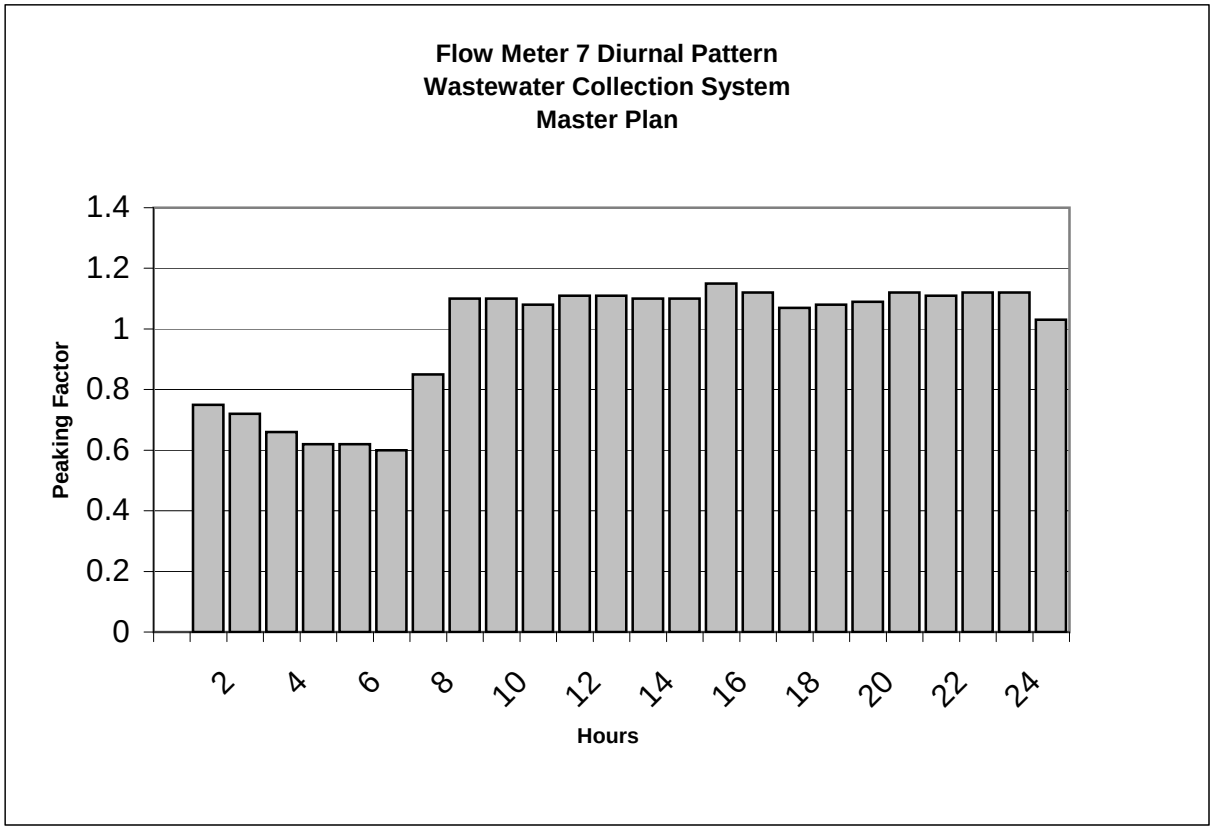
Appendix C: Diurnal Pattern



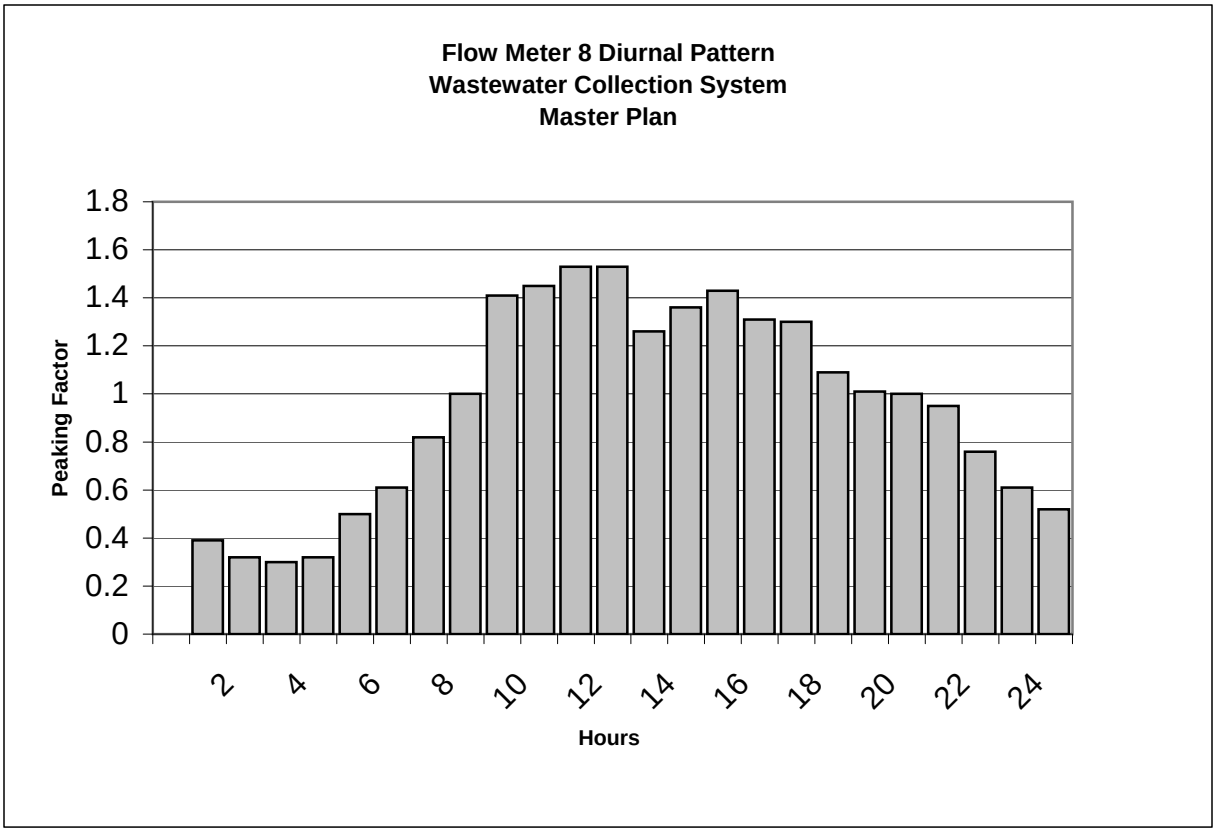


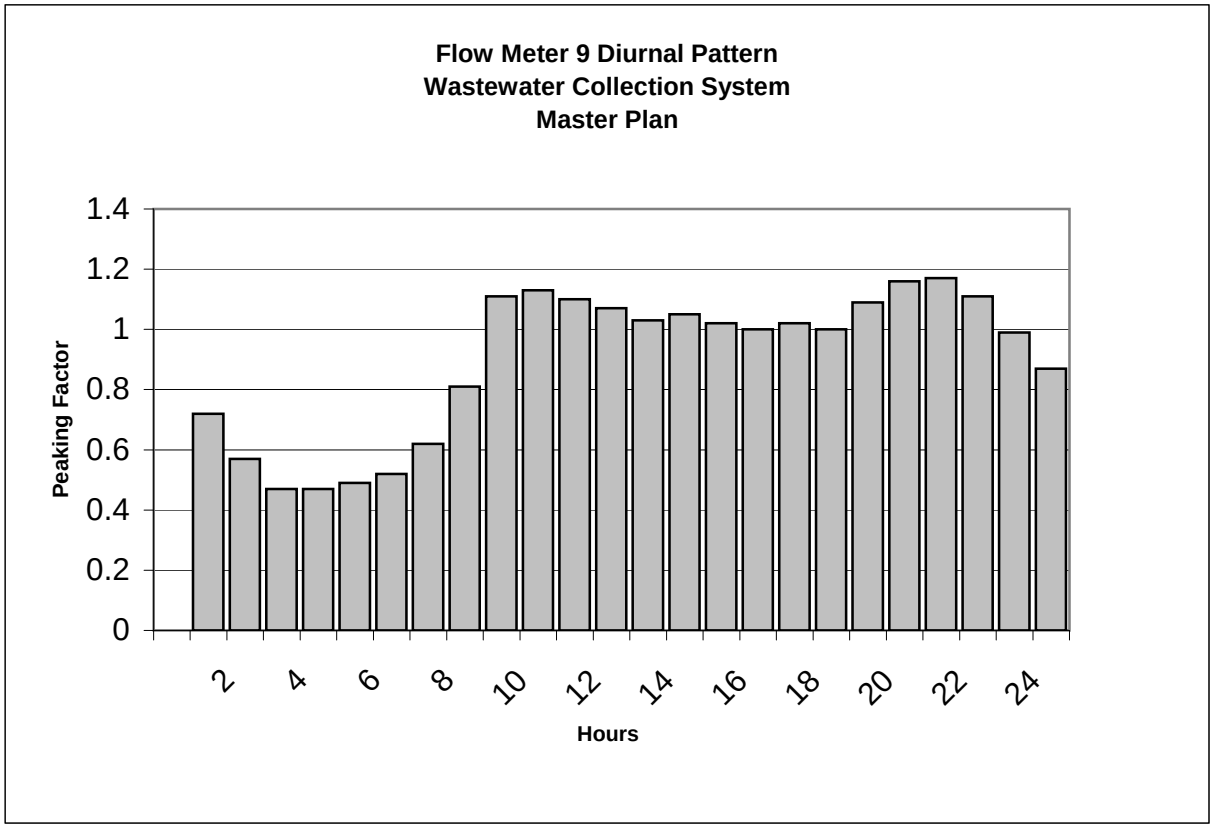
Appendix C: Diurnal Pattern



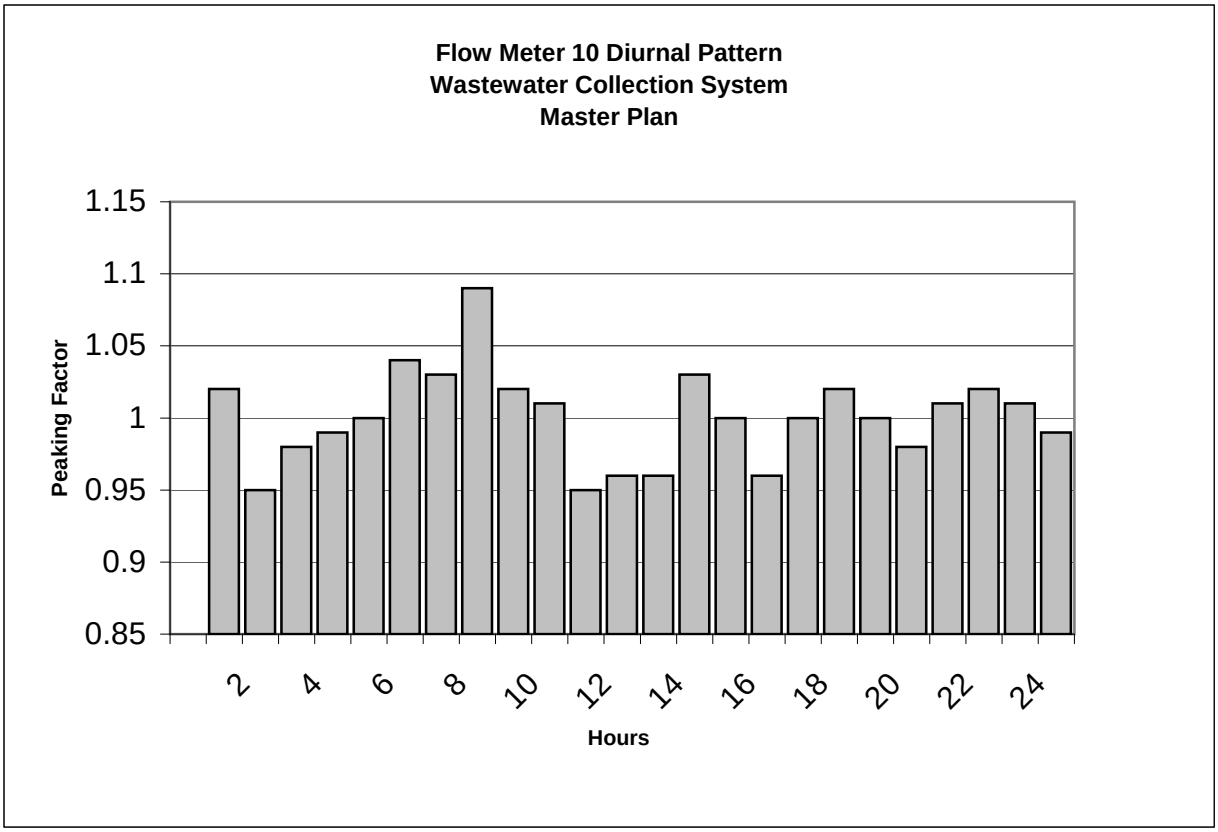


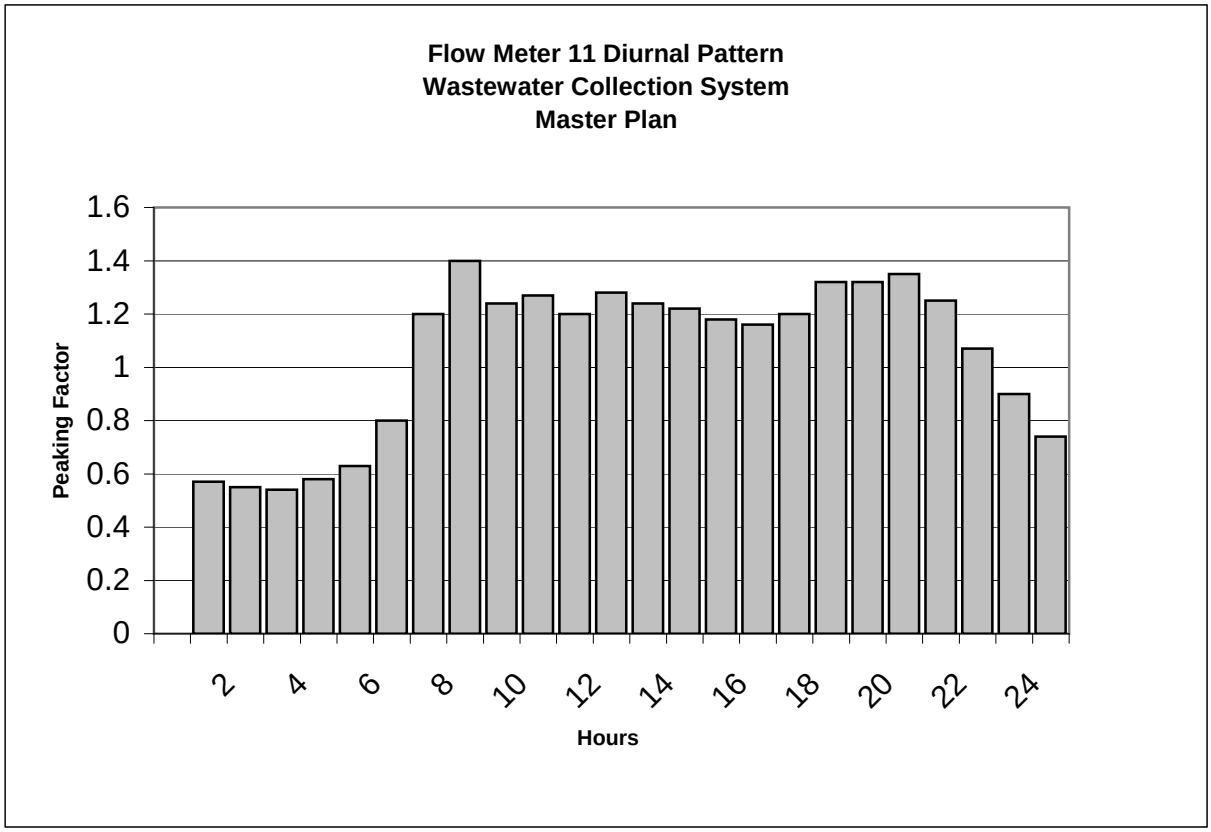
Appendix C: Diurnal Pattern



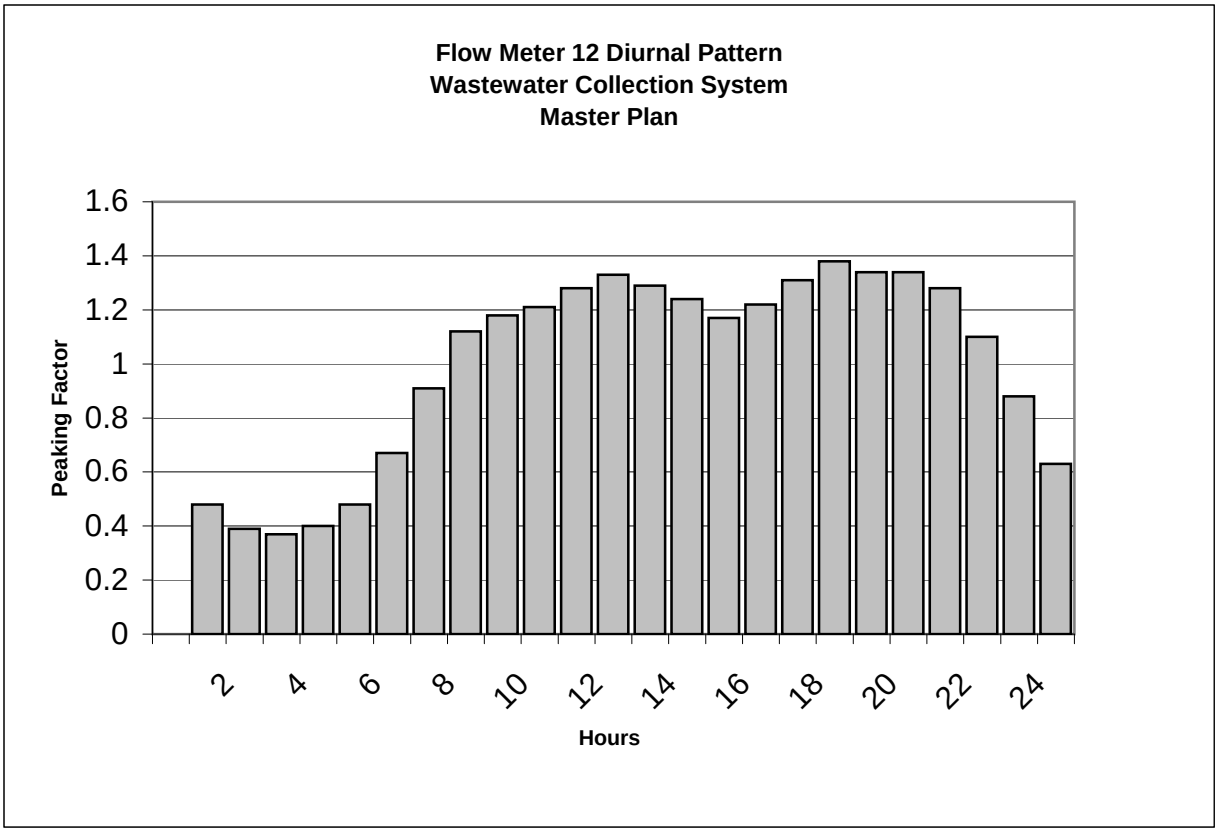


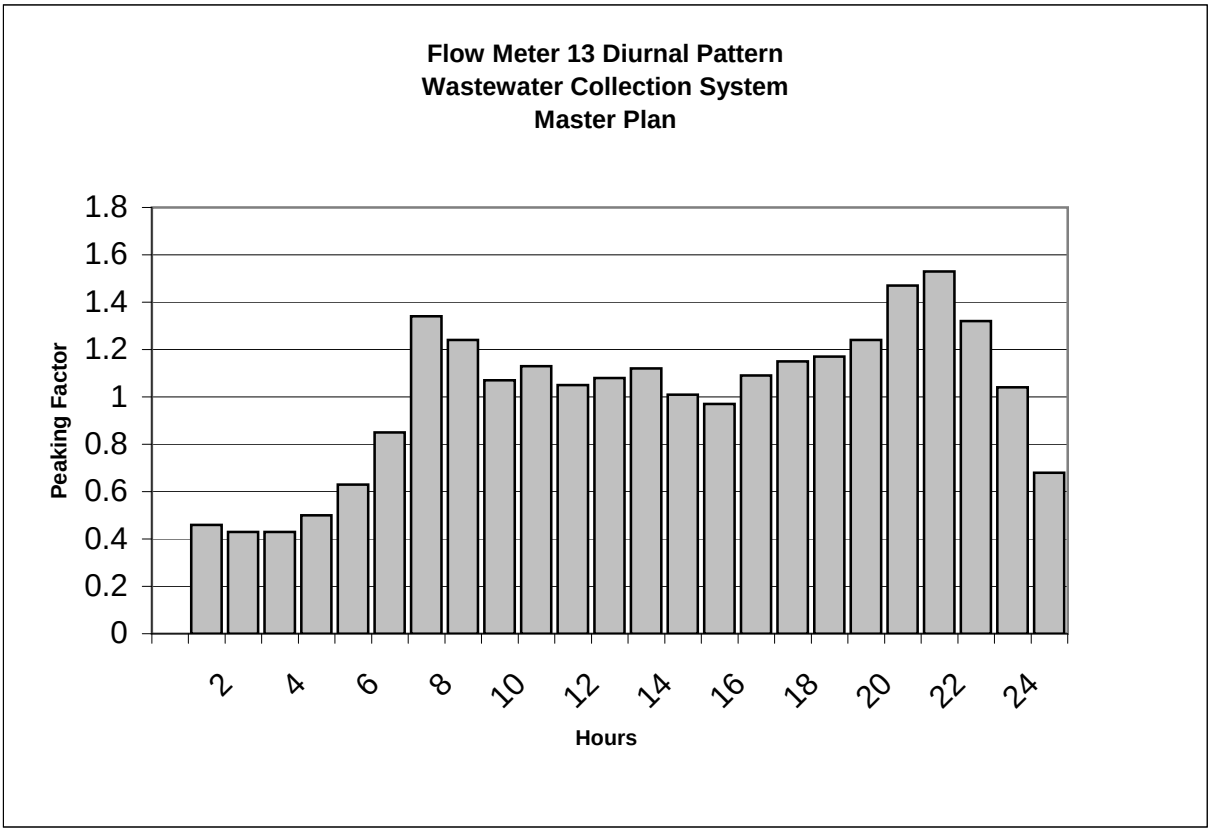
Appendix C: Diurnal Pattern



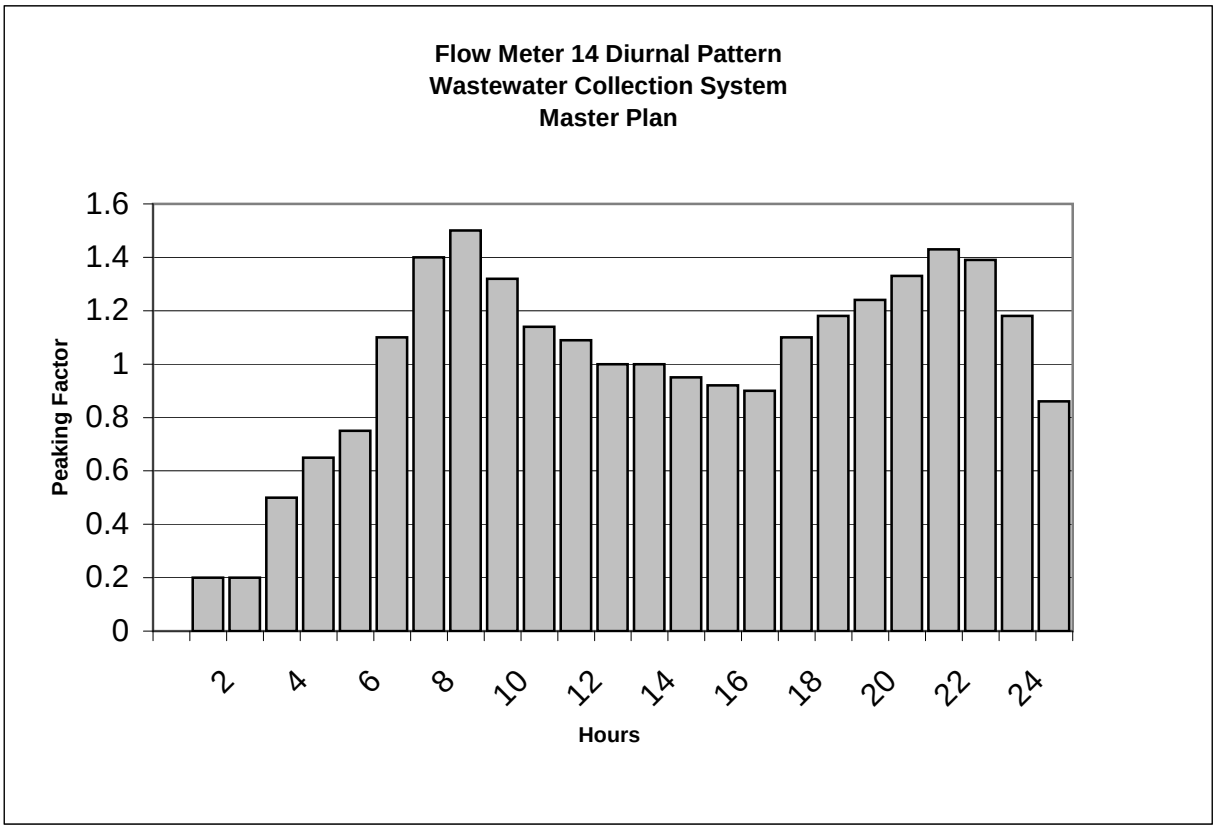


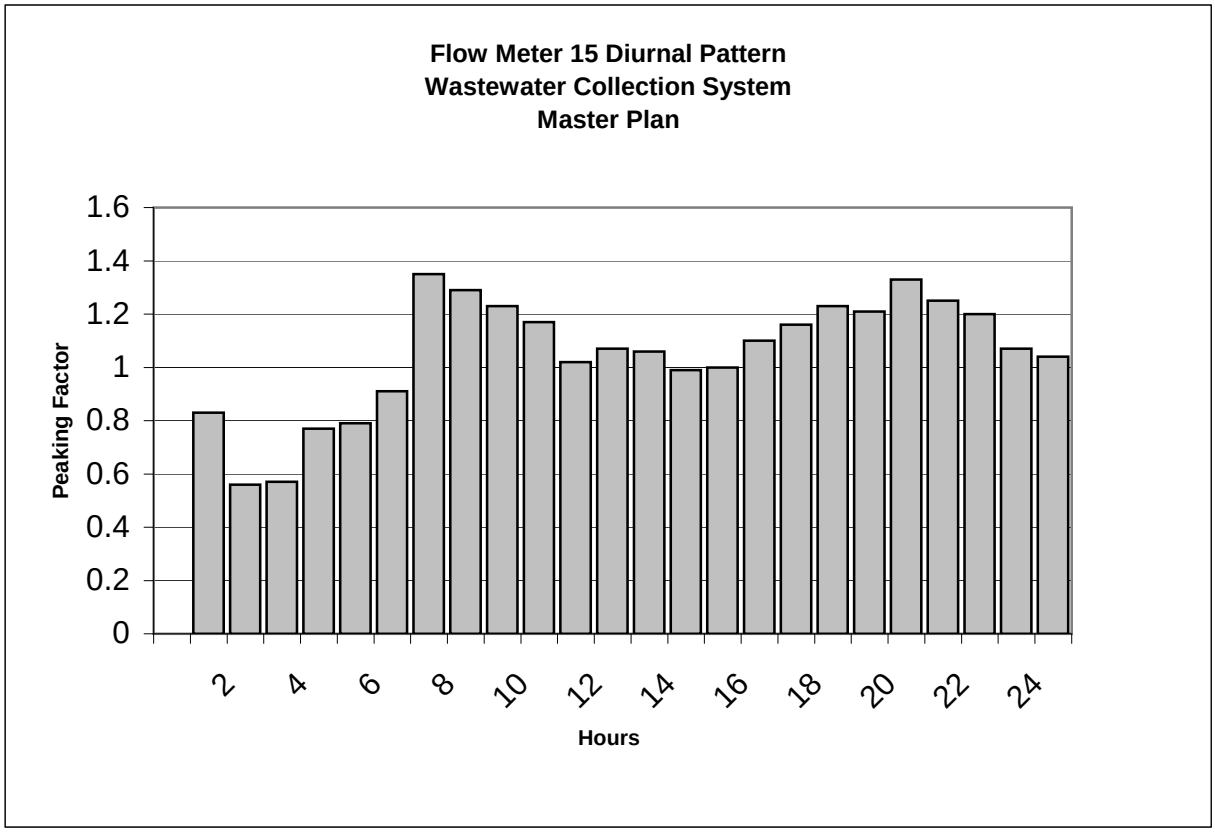
Appendix C: Diurnal Pattern





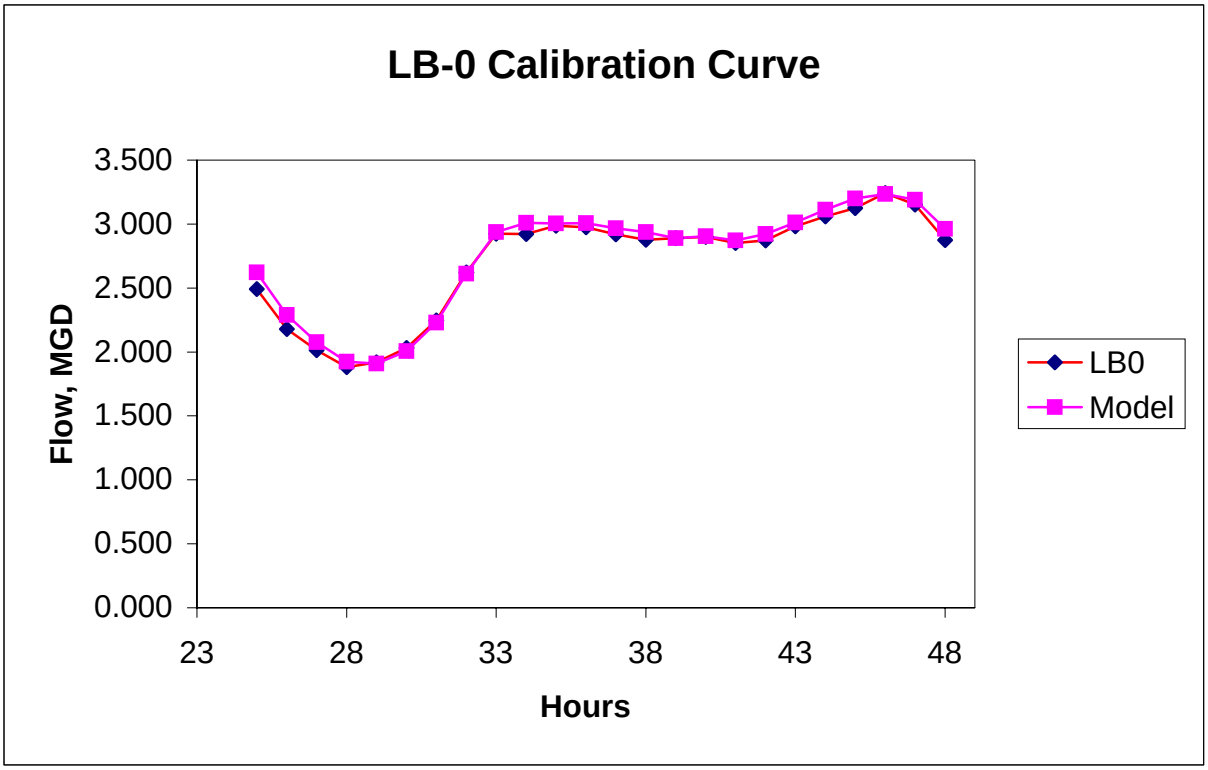
Appendix C: Diurnal Pattern

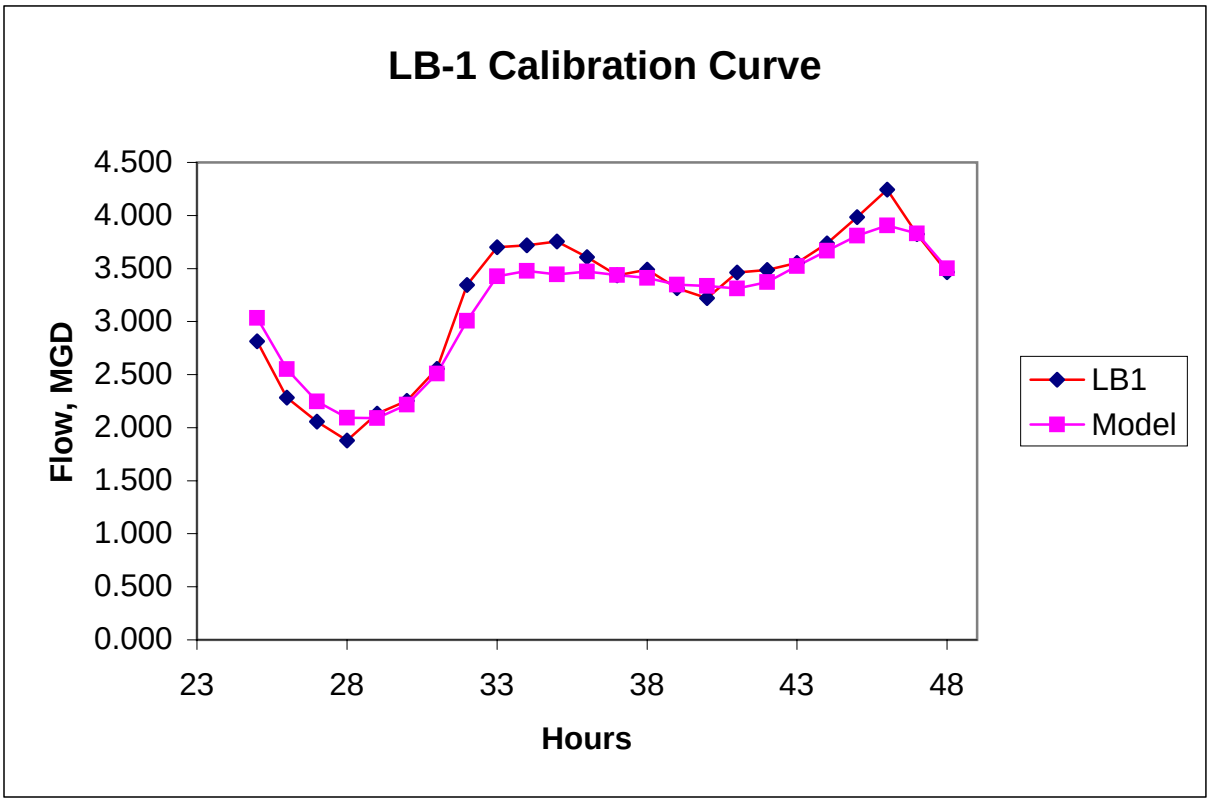




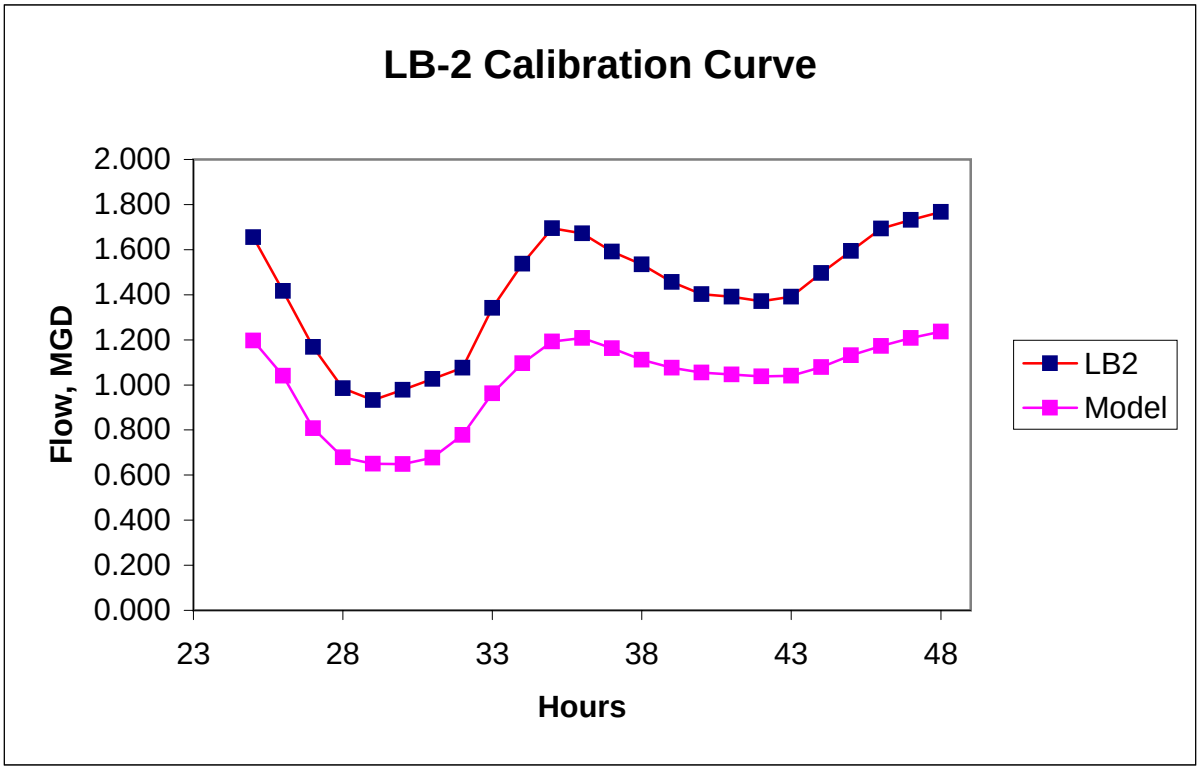
APPENDIX D - AVERAGE DAY FLOW CALIBRATION PLOTS

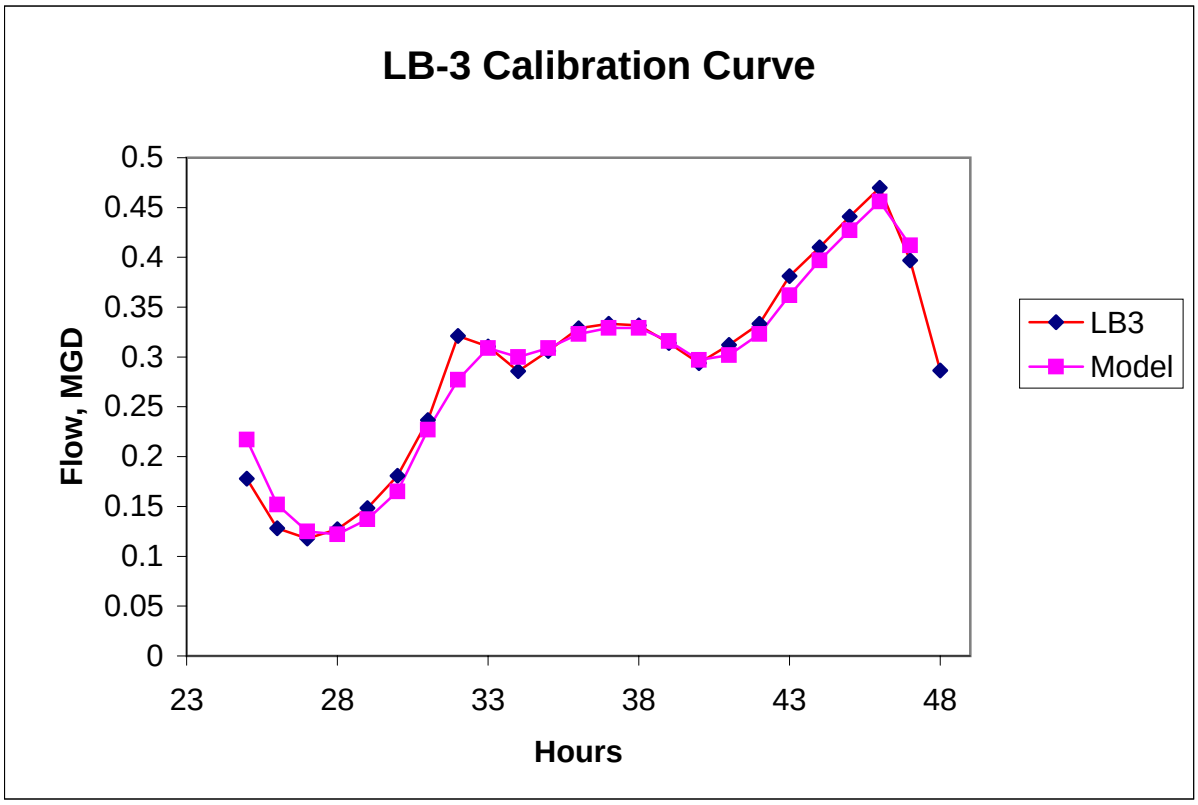
Appendix D: Dry Weather Flow Calibration Plots



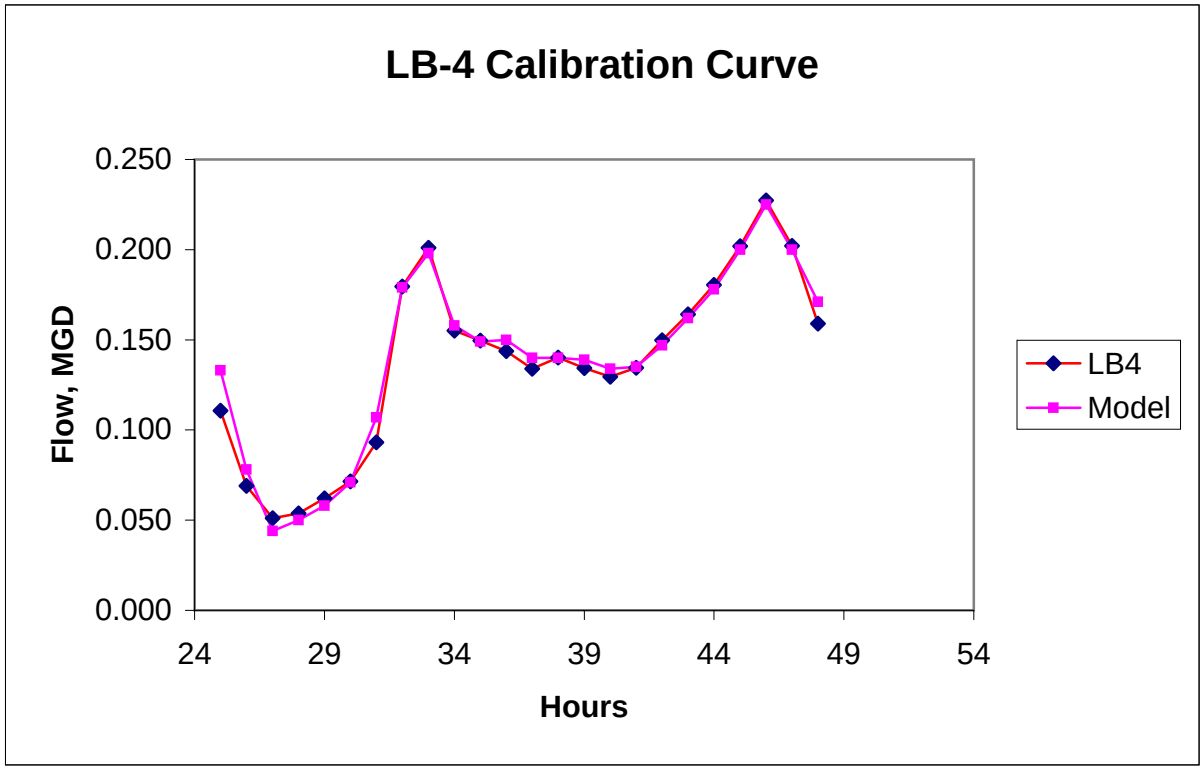


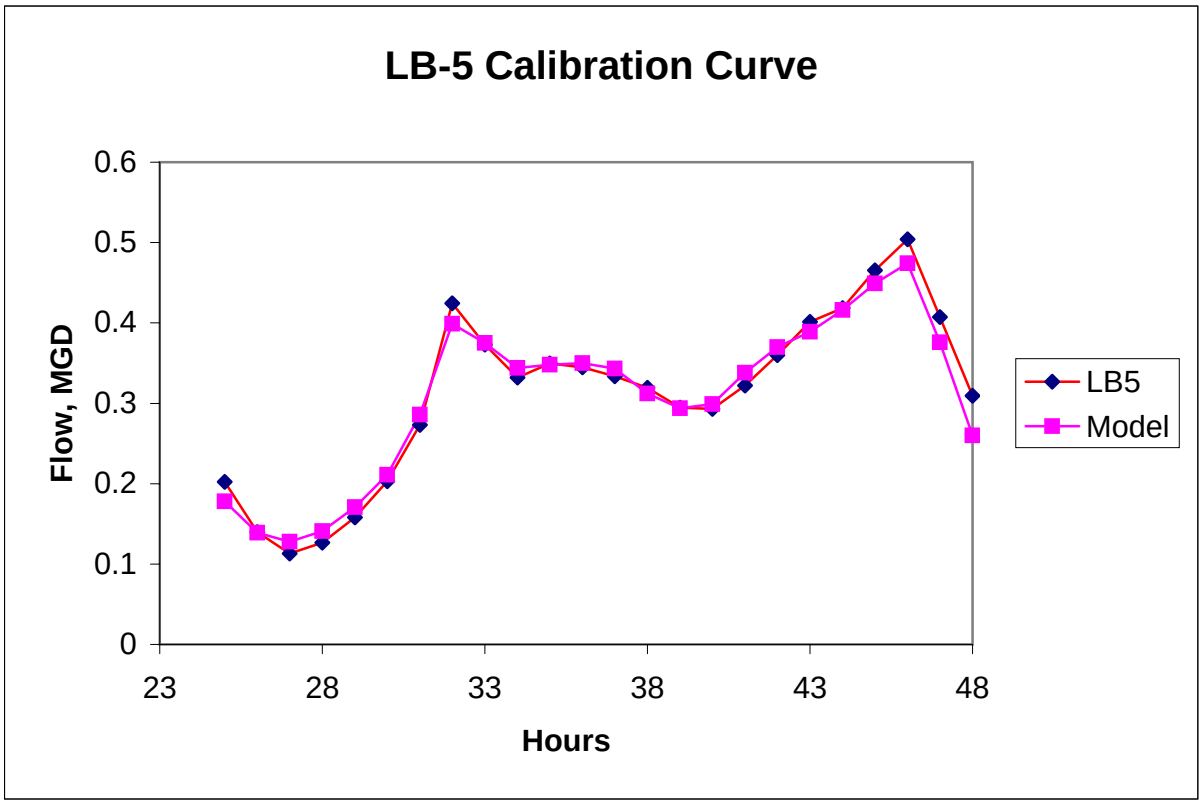
Appendix D: Dry Weather Flow Calibration Plots



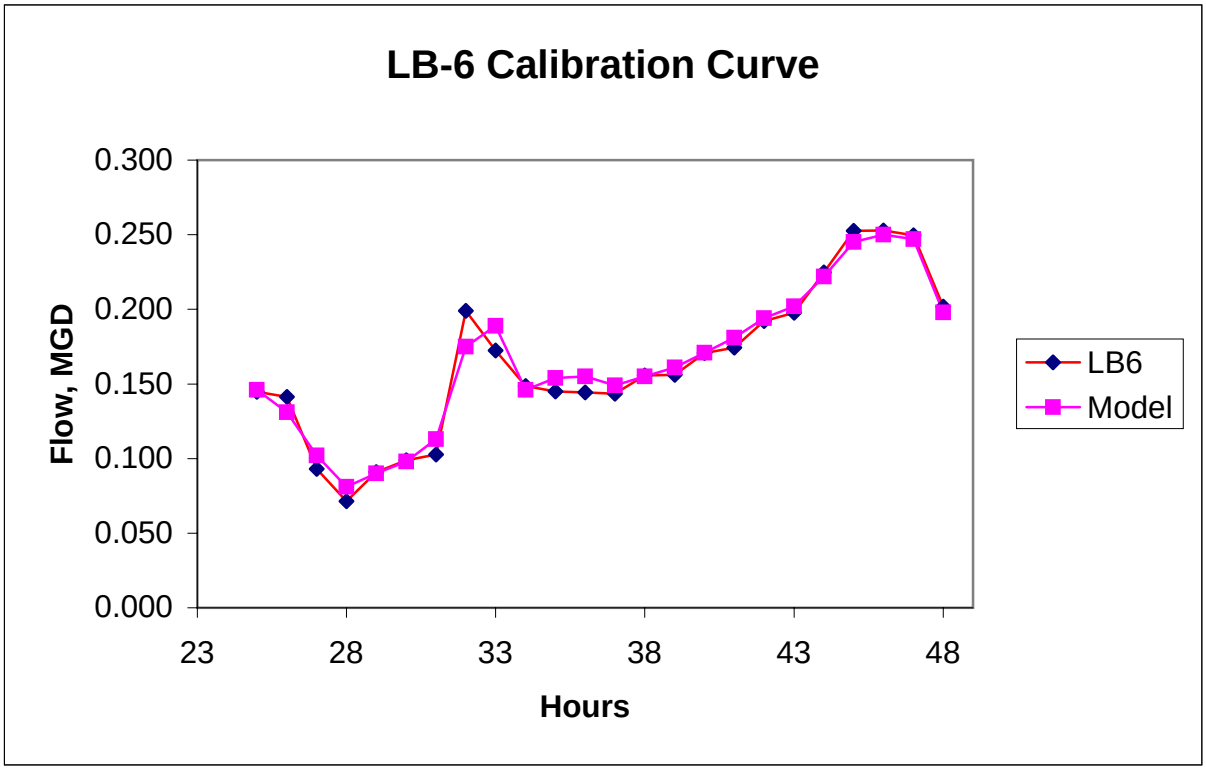


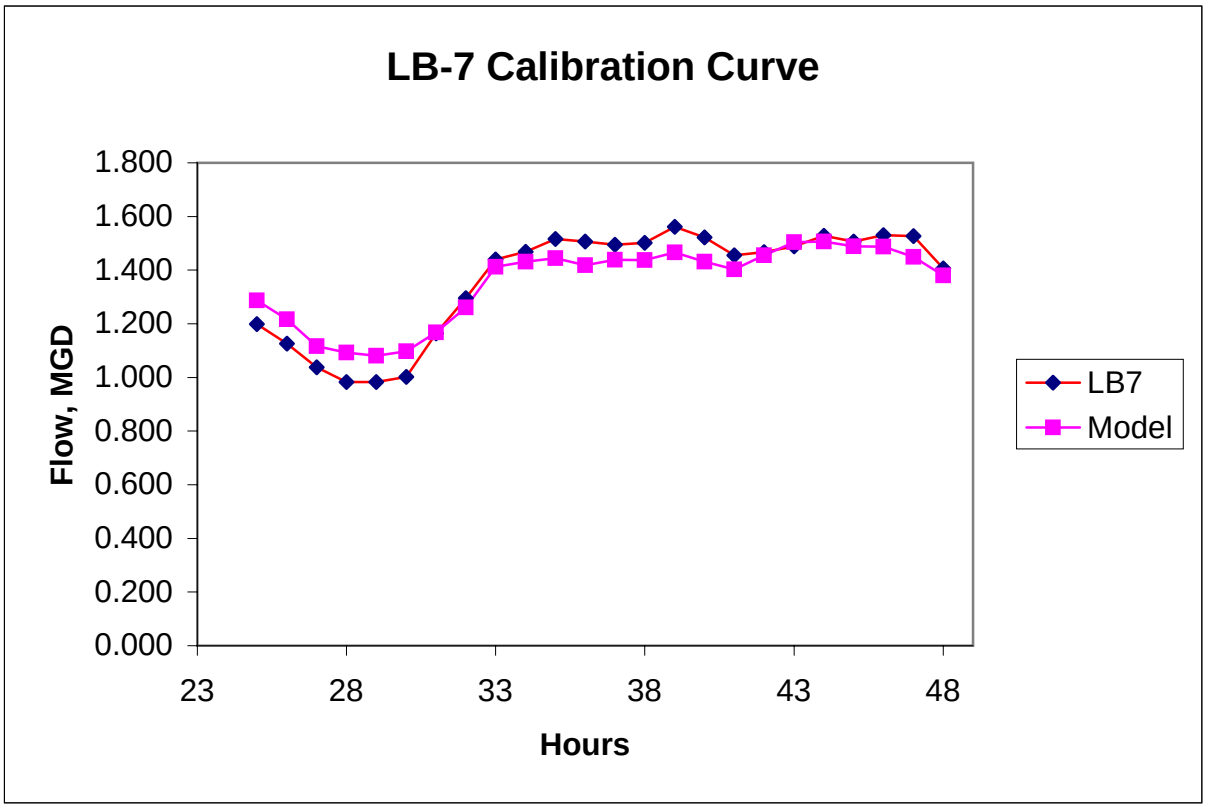
Appendix D: Dry Weather Flow Calibration Plots



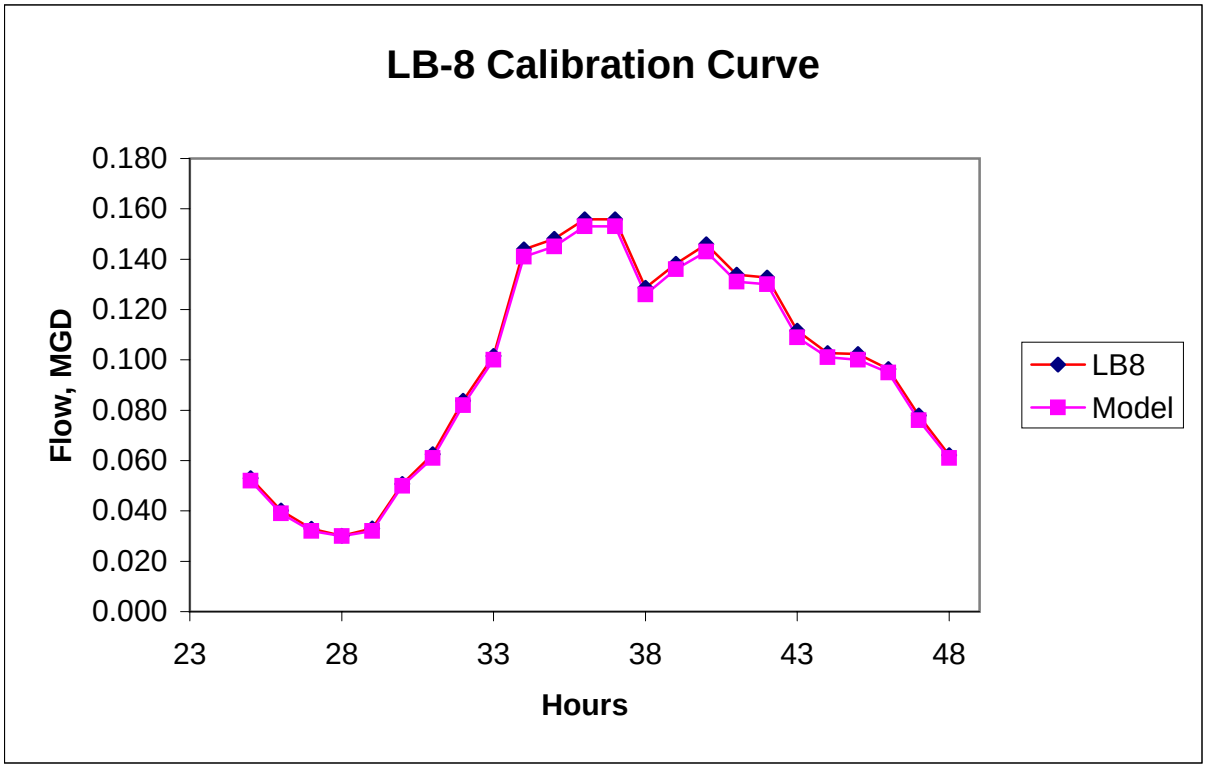


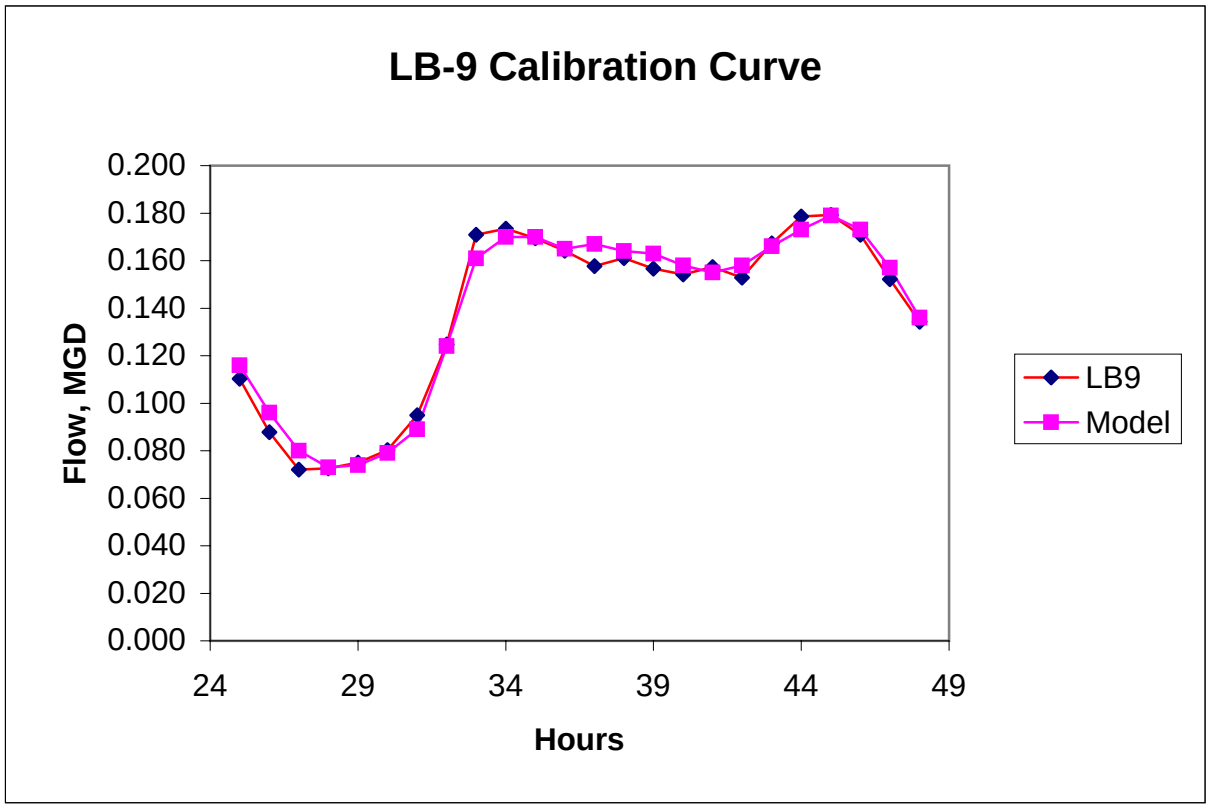
Appendix D: Dry Weather Flow Calibration Plots



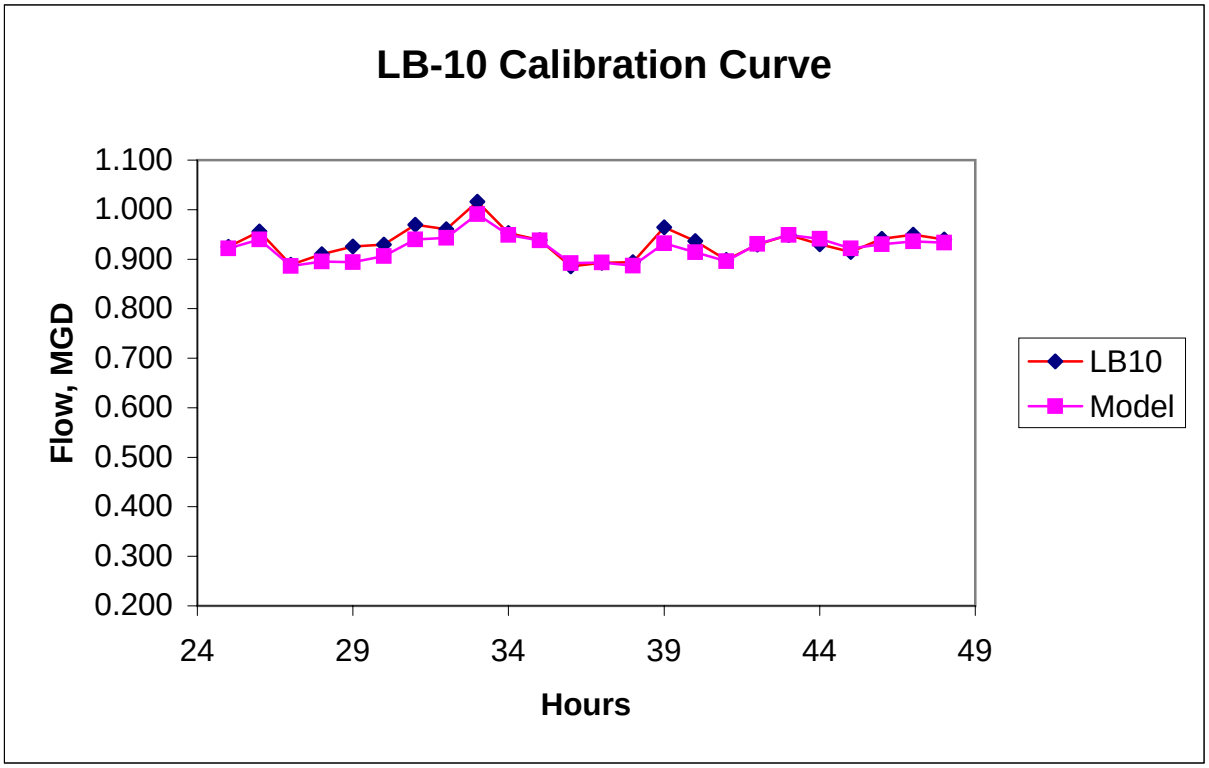


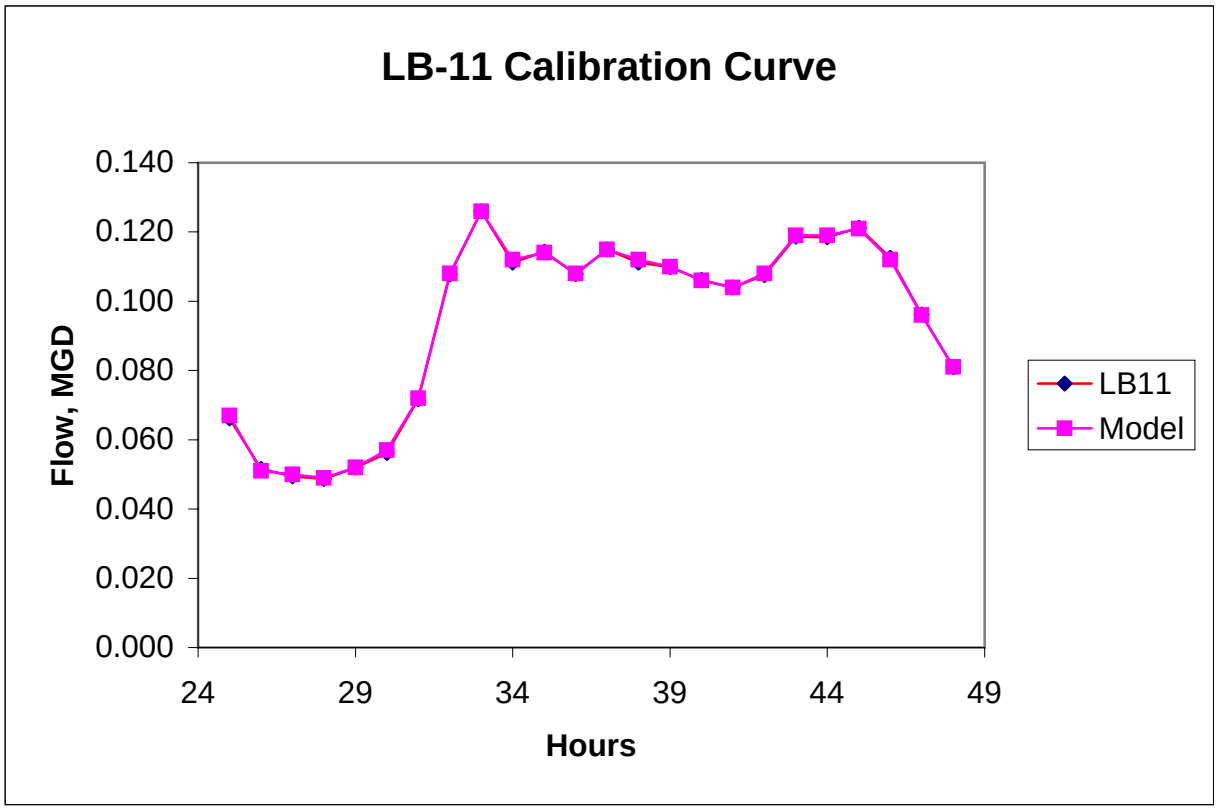
Appendix D: Dry Weather Flow Calibration Plots



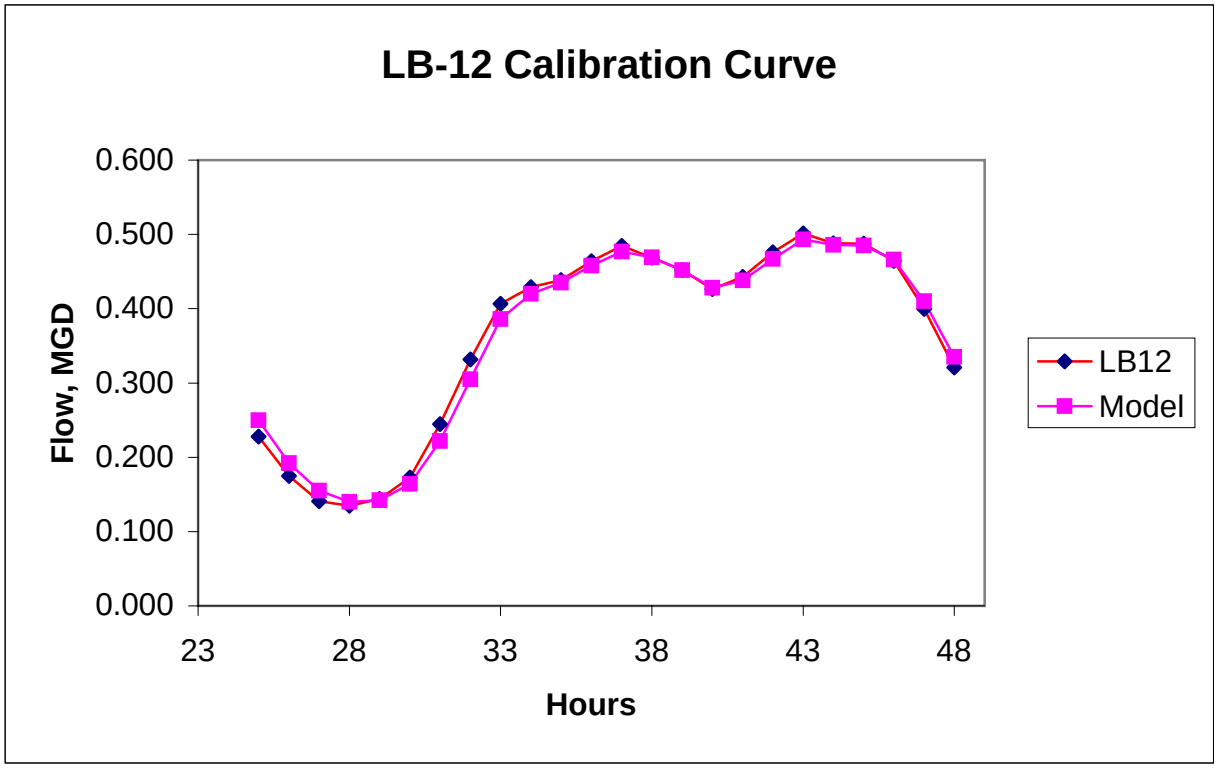


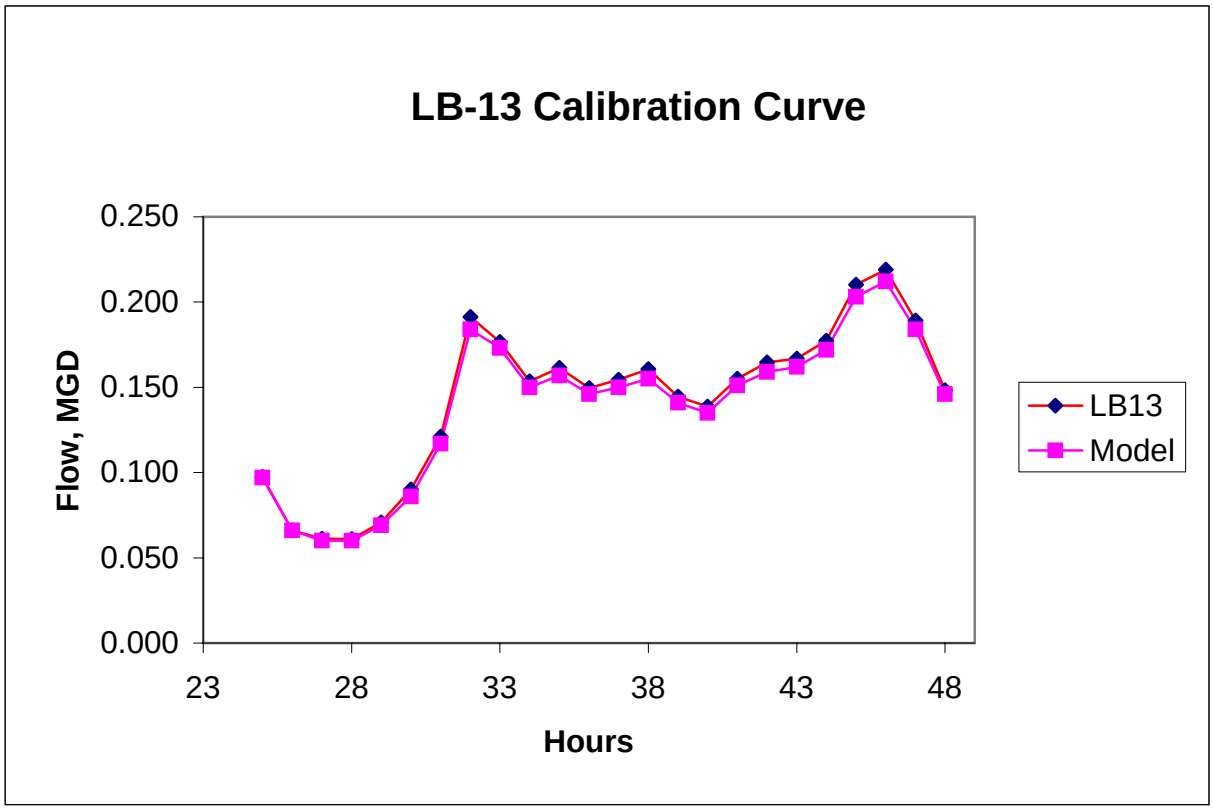
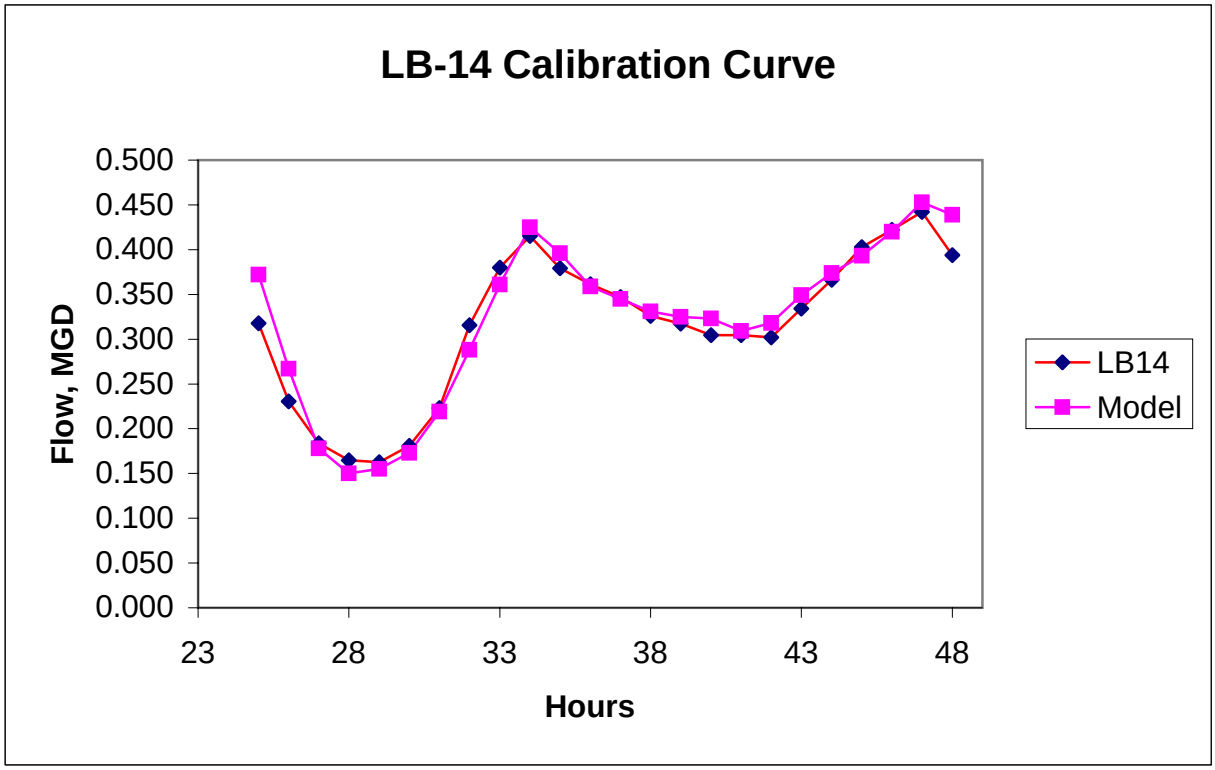
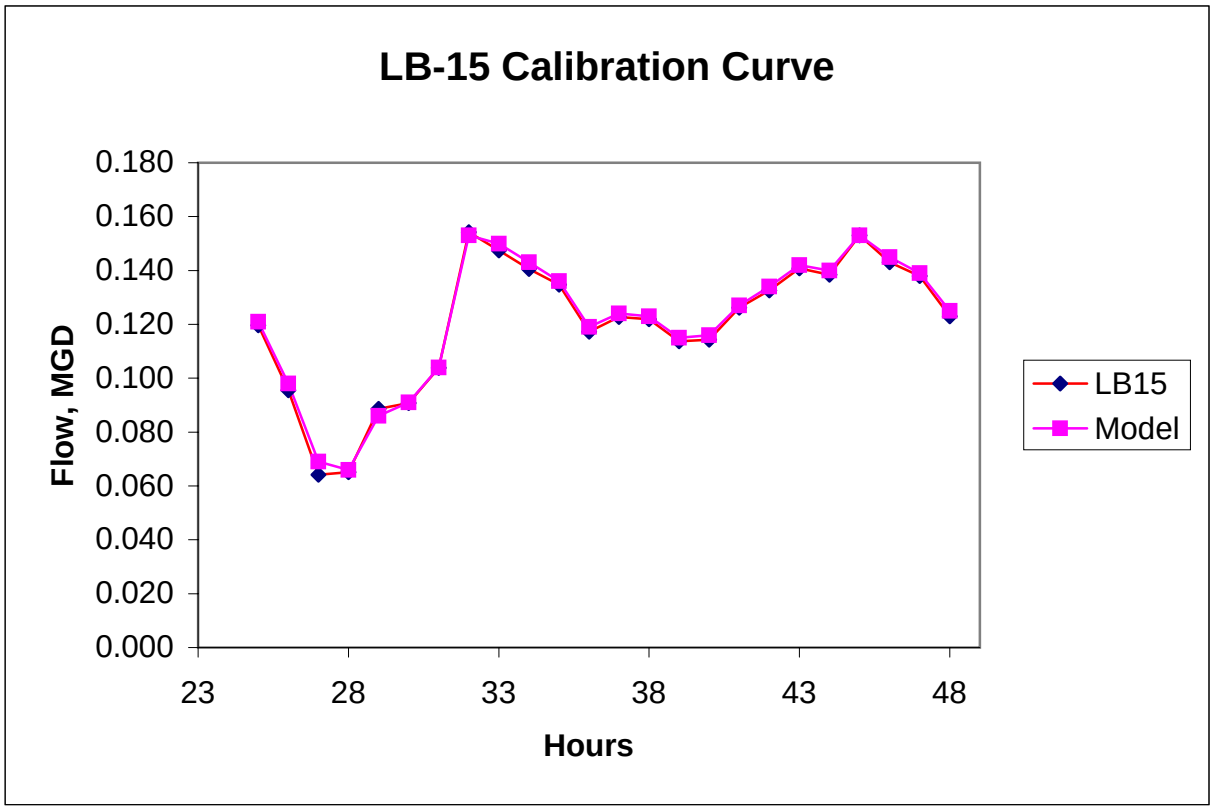
Appendix D: Dry Weather Flow Calibration Plots





Appendix D: Dry Weather Flow Calibration Plots





Appendix D: Dry Weather Flow Calibration Plots