FINAL

City of Livingston

Wastewater Collection System Master Plan

July 2007

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August 21, 2007
6267B00

City of Livingston
1416 'C' Street
Livingston, California 95334

Attention: Ms. Donna Kenney, Community Development Director

Subject: Wastewater Collection System Master Plan - Final

Dear Ms. Kenney:

We are pleased to submit the final report for the City of Livingston (City) Wastewater Collection System Master Plan. The report presents planning assumptions, the wastewater collection system evaluation, recommended facility improvements to correct existing deficiencies and to serve future customers, and a capital improvement program.

This final report completes Carollo Engineers, P.C. work on the Wastewater Collection System Master Plan. We would like to extend our thanks to you, Mr. Warne, City Manager; Mr. Creighton, Public Works Director; Mr. Gottiparthy, City Engineer; and other City staff whose courtesy and cooperation were valuable components in ensuring that this document will assist the City achieve its mission.

We look forward to our continued efforts in providing the City with engineering services.

Sincerely,

CAROLLO ENGINEERS, P.C.

David L. Stringfield, P.E.
Partner

Jose L. Gutierrez, P.E.
Project Manager

DLS/JLG:dlo

Enclosures: Final Report (15)

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

REGISTERED PROFESSIONAL ENGINEER
DAVID L. STRINGFIELD
No. C25084
Exp. 12/31/07
CIVIL
STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER
JOSE L. GUTIERREZ
NO. C 057305
EXP. 12/31/07
CIVIL
STATE OF CALIFORNIA

08/22/07

City of Livingston

WASTEWATER COLLECTION SYSTEM MASTER PLAN

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7580 NORTH INGRAM AVENUE, SUITE 112 • FRESNO, CALIFORNIA 93711 • (559) 436-6616 • FAX (559) 436-1191

City of Livingston

WASTEWATER COLLECTION SYSTEM
MASTER PLAN

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WASTEWATER COLLECTION SYSTEM MASTER PLAN

This executive summary presents a brief background of the City of Livingston's (City) wastewater collection system, the need for this wastewater collection system master plan, proposed improvements to mitigate existing capacity deficiencies, and proposed improvements to serve future growth. A summary of the capital improvement program costs through buildout of the City's General Plan is also presented.

ES.1 STUDY OBJECTIVE

Recognizing the importance of planning, developing, and financing sewer system facilities to provide reliable and enhanced service for existing customers and to serve anticipated growth, the City initiated the preparation of this wastewater collection system master planning study. The Wastewater Collection System Master Plan study has been coordinated with the preparation of the Water System Master Plan, which were concurrently completed by Carollo Engineers, P.C. (Carollo).

The objective of the study included the following tasks:

- Establish wastewater collection system design and planning criteria.
- Review temporary flow monitoring program and data performed by another consultant.
- Evaluate the capacity of the existing wastewater collection system using computer hydraulic modeling.
- Review existing system and propose improvements to enhance system reliability.
- Recommend improvements needed to service anticipated future growth.
- Develop a Capital Improvement Program for buildout conditions that will be used by the City in the Determination of Development Impact Fees.

ES.2 STUDY AREA

The City adopted the Urban Area General Plan (General Plan) in December 1999, but is currently updating this General Plan to reflect expended planning boundaries, and revised land uses. The General Plan delineates potential growth areas and identifies policies directing growth within its sphere of influence (SOI) and future growth boundaries. The 2007 City limits and the SOI encompass approximately 3.2 square miles (2,044 acres) and

4.7[1] square miles (2,044 acres), respectively. The Master Plan Study Boundary Area[2] encompasses approximately 12.6 square miles (8,051 acres). The SOI, the current City limits, and the Master Plan Study Boundary are shown on Figure ES.1.

In 2007, the City's planning consultant, Pacific Municipal Consultants (PMC), updated the City's growth plan and land use assumptions for areas outside the current City limits. Development assumptions were presented for eight distinct areas around the City, as shown in Figure ES.2 (figure recreated based on information provided by PMC).

For areas defined Urban Reserve (land within the Master Plan Study Boundary but outside Areas 1 through 8) the City assumed these lands would build out similar to existing City land uses. This assumption was used to quantify the wastewater generation coefficient for the Urban Reserve.

This master plan assumes that Areas 1 through 8 and the Urban Reserve represent the future wastewater collection system. The land use classifications used in this master plan are consistent with the City's General Plan (land use map updated April 2007) and the development assumptions for Areas 1 through 8 provided by PMC (Figure ES.3).

The City's 2005 population was approximately 15,400. The most recent available population projections were developed by the City's Planning Department consultant (PMC). The City forecasts that Livingston's population could reach approximately 39,700 in year 2012 and 72,800 in 2024 as shown on Figure ES.4.

ES.3 COLLECTION SYSTEM OVERVIEW

The City's wastewater collection system consists of approximately 29 miles of 6-inch through 27-inch diameter sewers. Approximately half of this total consists of 8-inch sewer mains. A new 42-inch diameter trunk sewer was constructed west of the City's limits and will serve future development, but is not currently used. The "backbone" of the system consists of the trunk sewers, generally 10-inches in diameter and larger, that convey the flows to the Wastewater Treatment Plant (WWTP), where it is treated (Figure ES.5).

The City's first WWTP was constructed in 1963. It consisted of screening, grit removal, primary clarification, anaerobic digestion, solar sludge drying, and six treatment/percolation ponds. In 2004, the City upgraded the facility to include a new oxidation ditch, two new secondary clarifiers, four new influent pumps, and a mechanical bar screen.

[1] Area calculations exclude Highway 99 and Caltrans on/off ramps. Common to land use area calculations in this report.

[2] Boundaries based on City's Annexation and Development Scenarios developed by Pacific Municipal Consultants, April 2007 (Appendix A).

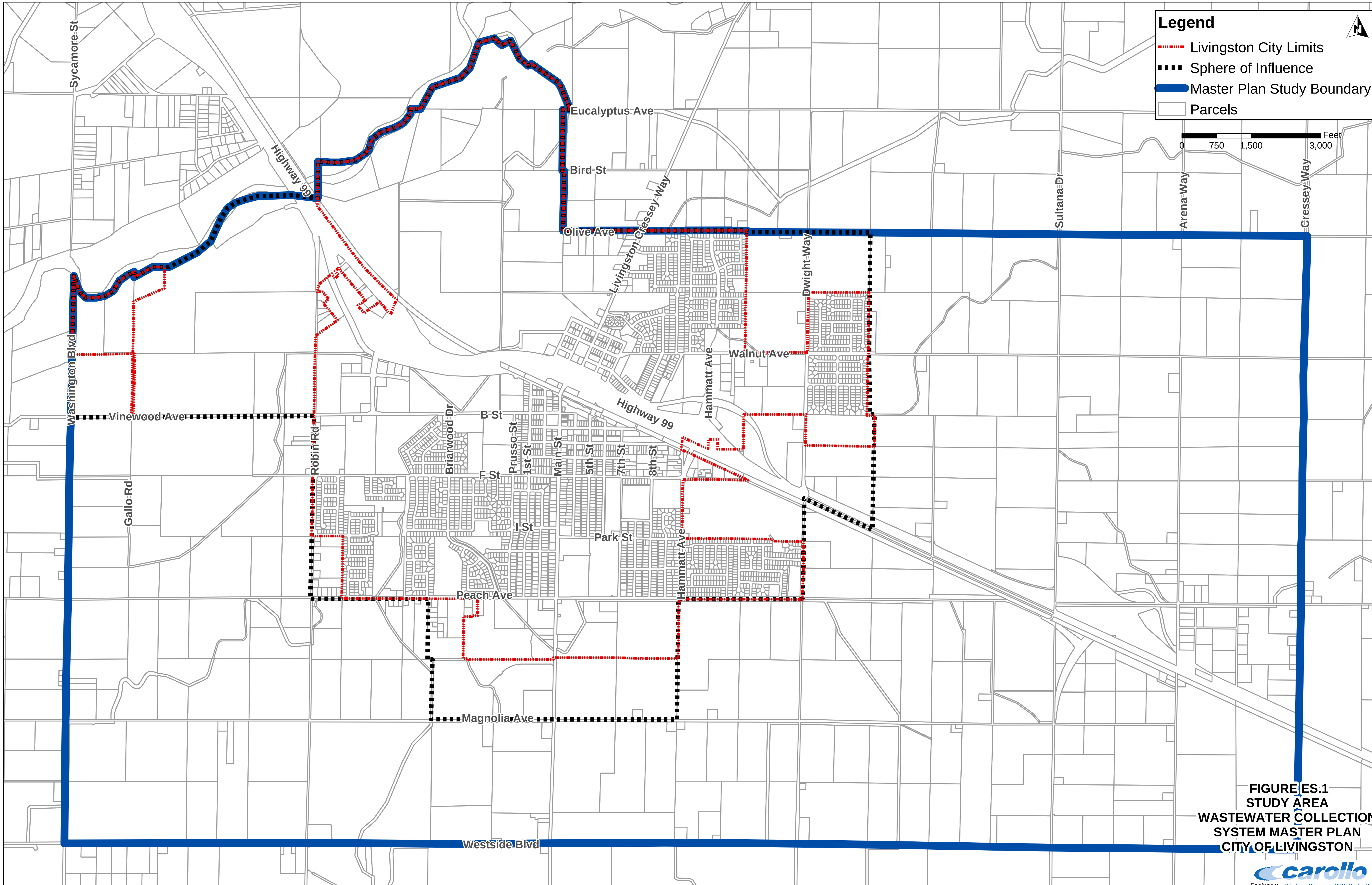

FIGURE ES.1
STUDY AREA
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

Information Source: City of Livingston Planning Department. Annexation and Development Scenarios figure prepared by Pacific Municipal Consultants (Update April 2007).

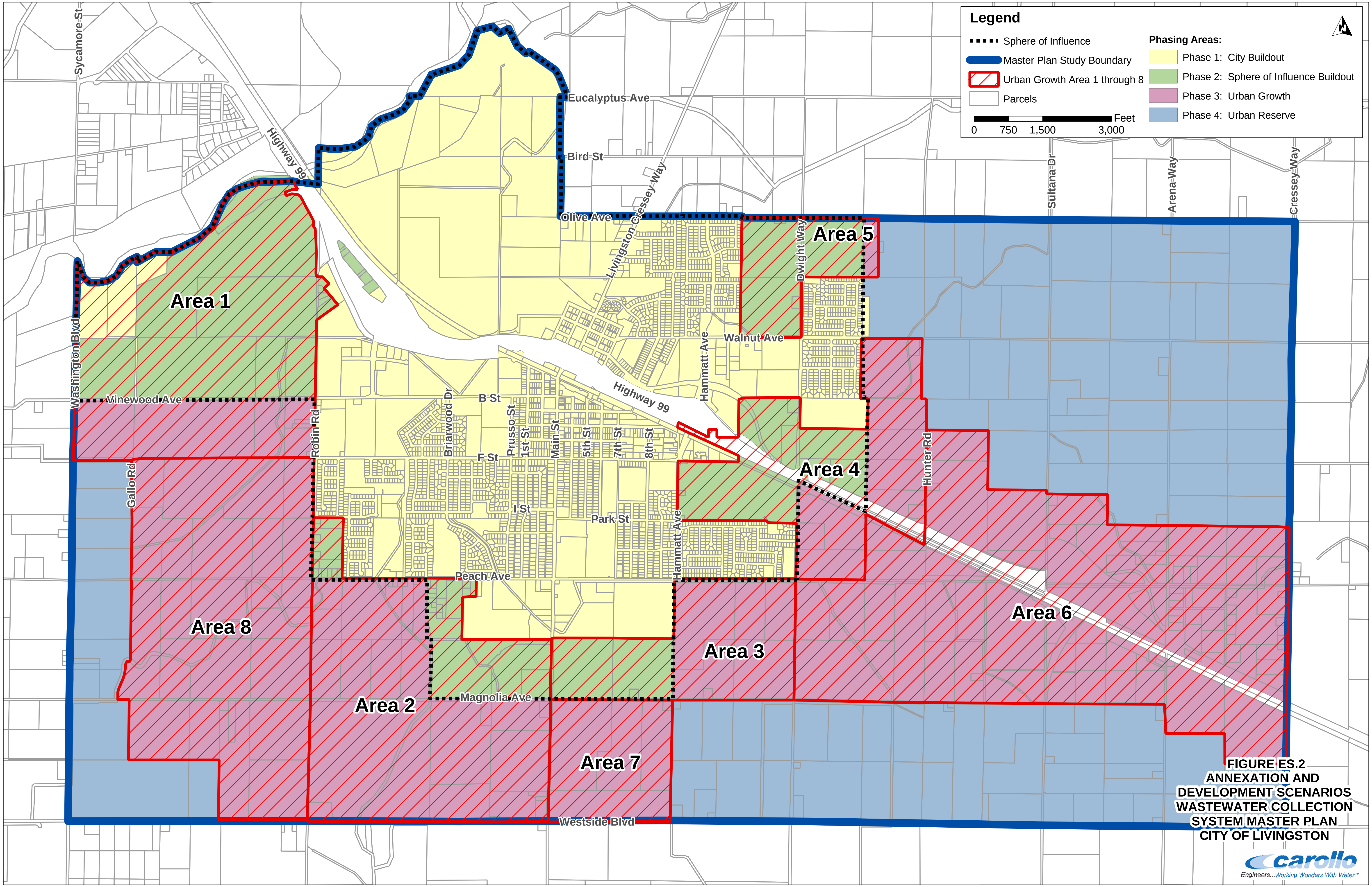

FIGURE ES.2
ANNEXATION AND DEVELOPMENT SCENARIOS
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

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Information Source: City of Livingston Planning Department. Annexation and Development Scenarios figure prepared by Pacific Municipal Consultants (Update April 2007).

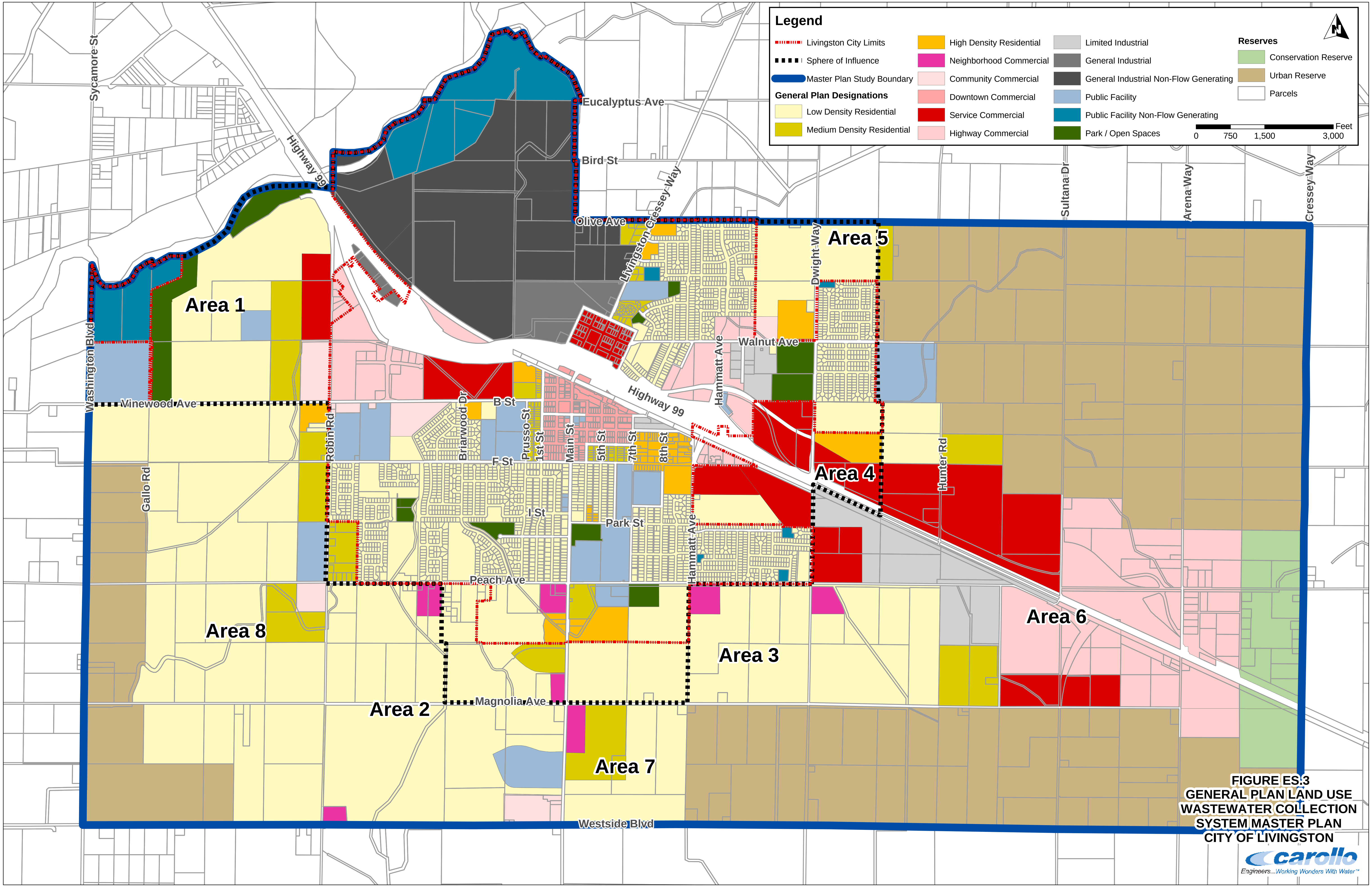

FIGURE ES.3
GENERAL PLAN LAND USE
WASTEWATER COLLECTION
SYSTEM MASTER PLAN
CITY OF LIVINGSTON

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Information Source: City of Livingston Planning Department. Annexation and Development Scenarios figure prepared by Pacific Municipal Consultants (Update April 2007).

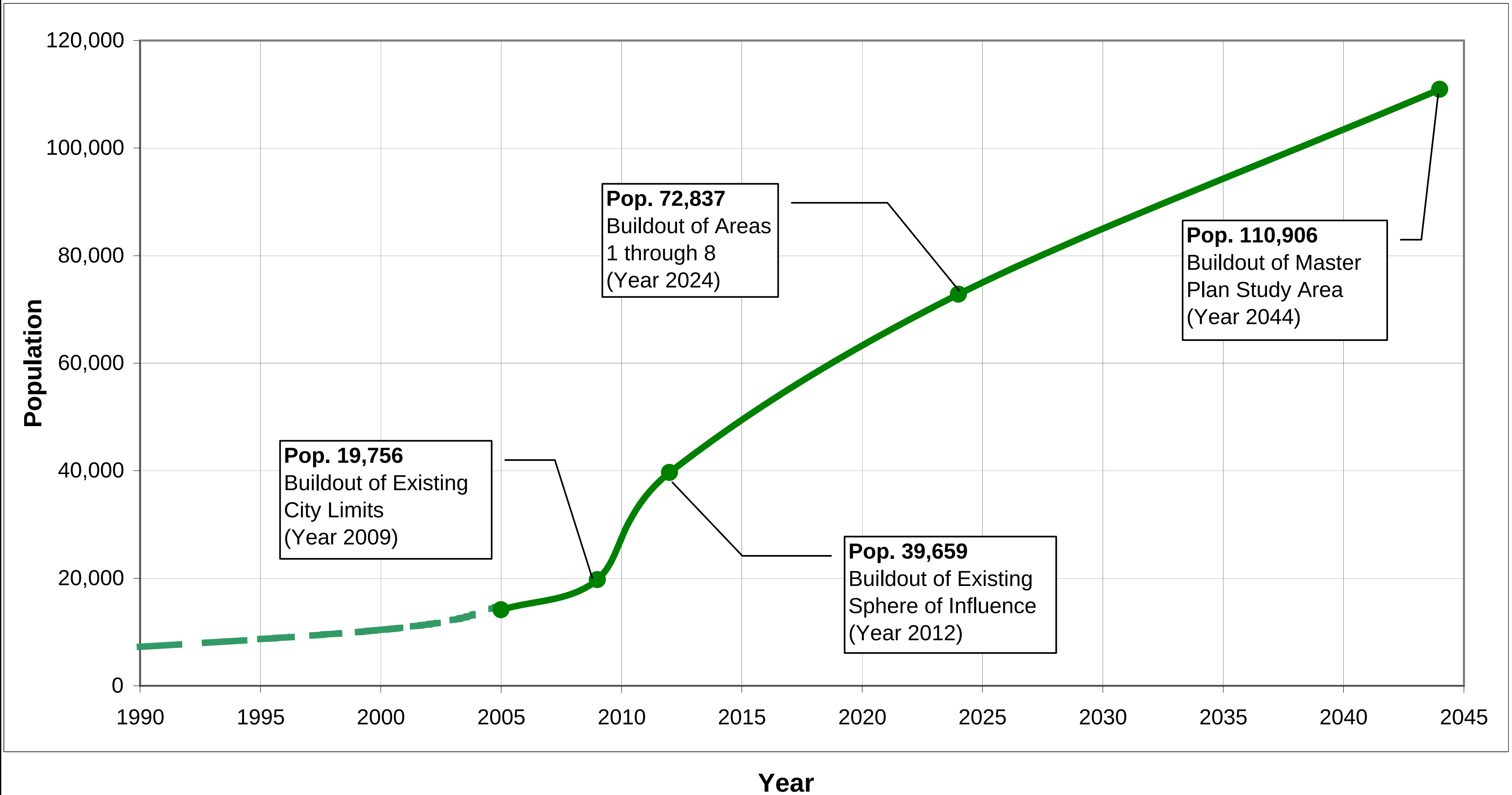

FIGURE ES.4
HISTORICAL AND PROJECTED POPULATION
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

Data Source: Population projections provided by Pacific Municipal Consultants, Land Use Assumptions, revised April 2007 (Appendix A).

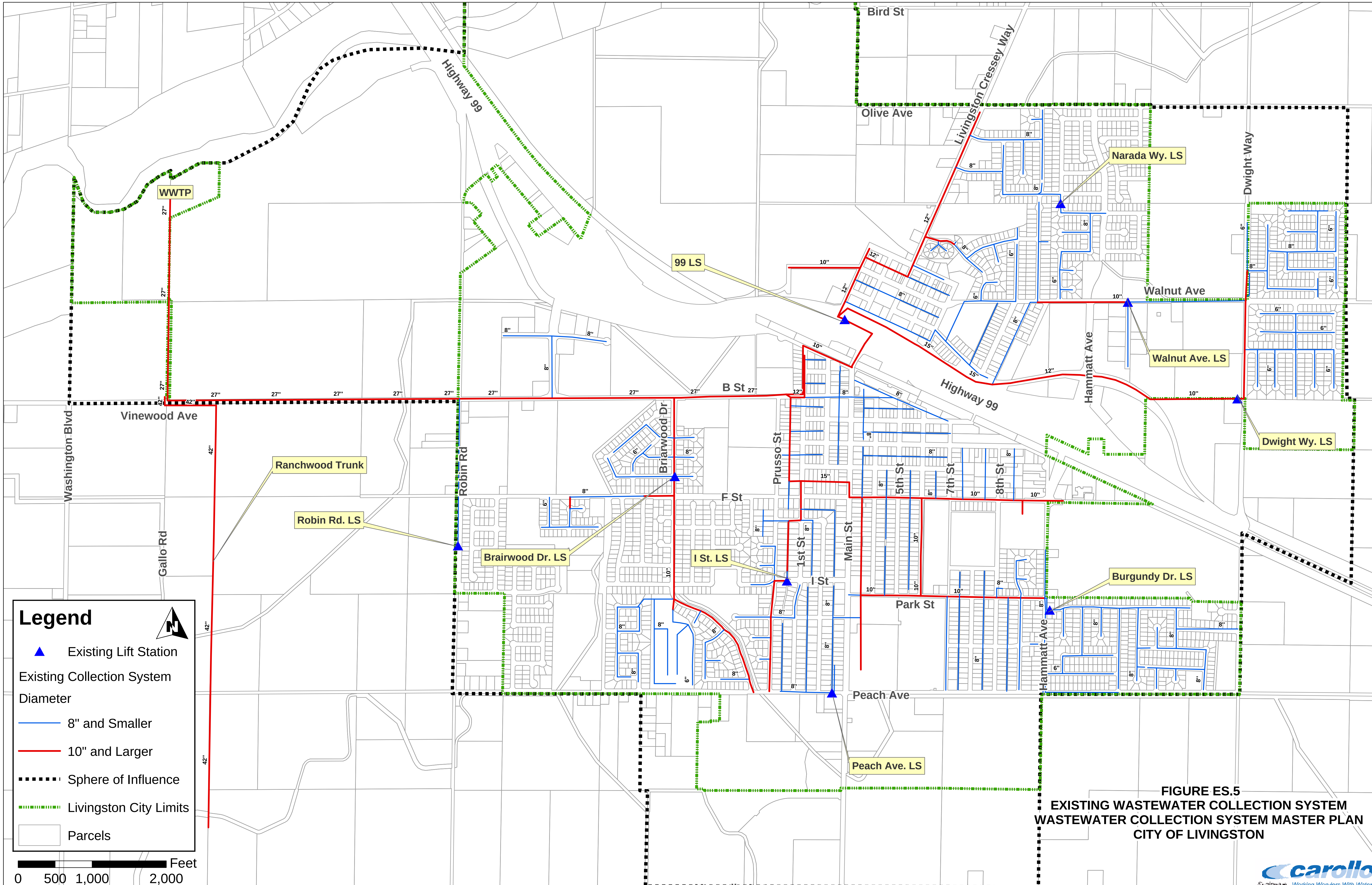

FIGURE ES.5
EXISTING WASTEWATER COLLECTION SYSTEM
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

In accordance with the June 2001 Engineering Report on the WWTP, the current treatment plant flow capacity is 2.0 mgd (Average Day Max Monthly Flow [ADMMF]).

As a separate project, Carollo completed a WWTP Capacity Analysis in December 2005 (Appendix D). The WWTP Capacity Analysis reports that the ability of the existing oxidation ditch to treat wastewater will be reached when the City's population exceeds 24,000 people. Updated City population projections indicate that 2009/2010 is the year when the oxidation ditch's capacity will be reached. The existing WWTP site possesses sufficient land to expand the treatment capacity to 4.0 mgd. The City is currently designing an expansion to the WWTP to increase the treatment capacity to 4.0 mgd. To treat wastewater flows greater than 4.0 mgd, additional land for percolation of treated effluent should be purchased. As the City continues to grow and experience increases in wastewater flow, land is available near the existing WWTP to expand its capacity. Note that the costs for WWTP improvements are not included in this collection system capital improvement program.

ES.4 WASTEWATER FLOWS

Historical flows at the WWTP were reviewed and analyzed to determine daily, monthly, and seasonal fluctuations experienced by the sewer system. Design flow criteria were developed to estimate the City's future sewer requirements and to evaluate the capacity of the collection system. The dry weather flows were estimated by applying land use coefficient factors. A 10-year 24-hour storm event was used to simulate the wet weather flows.

ES.4.1 Dry Weather Conditions

The 2006 average dry weather flow (ADWF) for Livingston was 1.12 mgd. At buildout of Areas 1 through 8, the average dry weather flow is anticipated to approach 7.0 mgd. At buildout of the Master Plan Study Area, the City's ADWF could approach 10.1 mgd. The City anticipates the study area being developed by year 2044.

ES.4.2 Wet Weather Conditions

Wet weather flows are based on infiltration and inflow (I/I) entering the sewer system. A 10-year, 24-hour storm was routed through the collection system to simulate peak flow conditions. For existing conditions, the model was calibrated to match the maximum day wet weather flow measured at the WWTP.

Should the design storm occur, the hydraulic model predicts existing maximum day wet weather and peak wet weather flows (PWWF) of 2.0 mgd and 2.7 mgd, respectively. Applying the same storm event to buildout of Areas 1 through 8 results in maximum day wet weather and PWWF of 10.98 mgd and 13.25 mgd, respectively. Applying the same storm event to buildout of the Master Plan Study Area results in a maximum day wet weather and

PWWF of 16.61 mgd and 19.29 mgd, respectively. These projected wet weather flows assume that the City implements a storm drain project upstream of the 99 Lift Station to reduce storm inflow into the collection system.

ES.5 COLLECTION SYSTEM EVALUATION

The City's collection system was evaluated based on the analysis and design criteria defined in this study and summarized in Table ES.1. A hydraulic sewer model was assembled and used in evaluating the adequacy of the City's collection system. The hydraulic model combines information on the physical characteristics of the sewer system (pipe sizes, pipe slopes, etc.), and performs calculations to solve a series of mathematical equations to simulate flows in pipes.

ES.6 CONCLUSIONS

The analysis of the City's existing wastewater collection system indicates that the collection system meets the needs for the majority of existing customers, provided the City implements the projects recommended in the storm water master plan. Some improvements are necessary along Stefani Avenue and the downtown area around Prusso and Main Street. However, in anticipation of future growth, the City will need to implement a capital improvement program that includes upsizing existing pipelines, upgrading existing lift stations, constructing new trunk sewers and lift stations to serve future growth areas.

Each new development project will include site-specific or project level engineering analysis and proposed solutions, to be consistent with the overall infrastructure approach in this Master Plan. Some degree of flexibility in developing proposed solutions may be considered appropriate by the City in order to ensure the best possible alternative for the City.

The City is completing a storm water master plan project. Preliminary results from the storm water master plan indicate that there is a financial benefit to intercepting storm runoff from the City's sanitary sewer system. Implementing a storm drain project to divert storm runoff from the collection system is beneficial from a financial perspective because the avoided costs for improving the sewer collection system are greater than the storm drain project costs. This master plan recommends implementing the storm drain project as an effective approach for providing relief to the Stefani Avenue trunk sewer and the 99 Lift Station.

Table ES.1 Planning and Design Criteria Summary
Wastewater Collection System Master Plan
City of Livingston

Recommended Minimum Slopes for New Pipes

Pipe Dia. (in)	Flow Depth to Diameter (d/D) = 0.70 Slope [1] (ft/ft)	(cfs)	(mgd)
6	0.0040	0.30	0.19
8	0.0030	0.55	0.36
10	0.0025	0.92	0.59
12	0.0020	1.33	0.86
15	0.0012	1.87	1.21
18	0.0010	2.78	1.80
21	0.0008	3.75	2.42
24	0.0007	5.01	3.24
27	0.0006	6.35	4.10
30	0.0005	7.68	4.96
33	0.0005	9.90	6.40
36	0.0004	11.17	7.22
42	0.0003	14.59	9.43

Note:
1. Design flow for new pipes at a d/D of 0.7 and velocity greater than or equal to 2 ft/sec.

Flow Depth, d/D

The following flow depth criteria will be used in the analysis

	Peak Dry Flow	Peak Wet Flow
Max d/D for Evaluating Existing Pipes =	0.92	0.92
Max d/D for Evaluating New Pipes =	0.70	0.92

Headloss in Existing Pipes

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

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

Changes in Pipe Size

When a smaller pipe joins a larger one, pipe soffits will be matched.

Average Wastewater Flow Coefficients based on Land Use

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

Land Use Designation	Wastewater Generation Coefficient (gpd/gr. Ac.)
Low Density/Estate	1,500
Medium Density	2,300
High Density	2,800
Downtown Commercial	1,000
Neighborhood Commercial	1,000
Highway Commercial	1,000
Community Commercial	1,000
Service Commercial	1,000
Limited Industrial	1,000
General Industrial	see note 1
Public Facility Wastewater Generating	1,000
Public Facility Non-Wastewater Generating	0
General Industrial Non-Wastewater Generating	0
Park/Open Space	0
Industrial Reserve Non-Wastewater Generating	0

Note:
1. Foster Farms municipal wastewater flow only. Based on 1,500 employees during the day and an average flow per employee of 15 gpd (average flow based on typical flow per office employee, Metcalf Eddy, Wastewater Engineering).

ES.7 RECOMMENDATIONS

The proposed projects consist of new or increased capacity pipelines that are needed to correct existing deficiencies and to extend service to currently undeveloped areas. These proposed improvements, which are discussed in detail in the report, and shown on Figure ES.6, are phased to provide capacity enhancements to the collection system when they are needed to serve existing customers and future anticipated developments.

ES.8 CAPITAL IMPROVEMENT PROGRAM

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

Knowledge about site-specific conditions for each proposed project is limited at the master planning stage; therefore, the Estimated Construction Costs include a 20 percent contingency to account for unforeseen events and unknown field conditions. The Capital Improvement Costs also include an additional 50 percent (applied to the Estimated Construction Costs) for project-related costs, comprised of engineering, administration, construction inspection, and legal costs. Table ES.2 summarizes the CIP for Livingston.

Table ES.2 Capital Improvement Program Summary
Wastewater Collection System Master Plan
City of Livingston

Planning Period	Years	Capital Cost	Existing Users	Future Users
Phase I	2006-2010	$20,039,000	$506,500	$19,532,500
Phase II	2010-2015	27,224,500	$0	$27,224,500
Phase III	2015-2024	$8,675,500	$0	$8,675,500
Phase IV	2024-2044	$6,894,000		$6,894,000
Total		**$62,833,000**	**$506,500**	**$62,326,500**

Note: Does not include Wastewater Treatment Plant improvement cost from Appendix D.

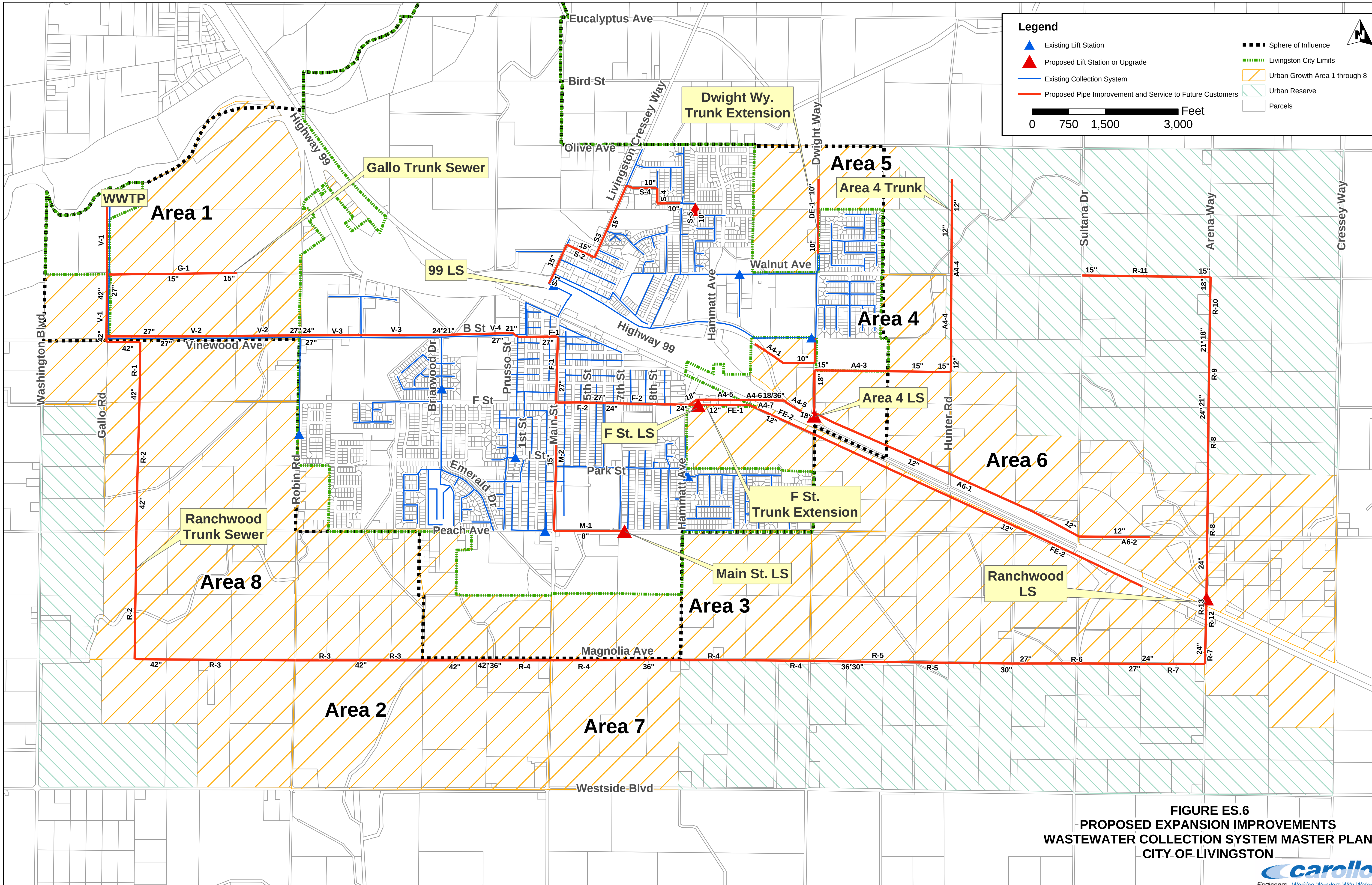

FIGURE ES.6
PROPOSED EXPANSION IMPROVEMENTS
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

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INTRODUCTION

This chapter presents the need for this wastewater collection system master plan and the objectives of the study. A list of abbreviations is also provided to assist the reader in understanding the information presented.

1.1 BACKGROUND

The City of Livingston (City) (Figure 1.1) operates its own wastewater collection system and associated facilities to serve customers within the City limits. The previous sewer collection system master plan, completed in September 1992 (1992 Plan) (updated November 1996), included a capacity evaluation, recommended improvements to mitigate deficiencies, recommended improvements to accommodate growth, and a summary of capital costs associated with the improvements. The 1992 Plan was based on planning assumptions and operational conditions that have since changed.

In December 1999, the City certified the latest General Plan. The City is now in the process of updating the General Plan, the Sphere of Influence (SOI) and the future growth boundaries. In 2007, the City's planning consultant, Pacific Municipal Consultants (PMC), updated the City's growth plan and land use assumptions for areas outside the current City limits, which identify lands intended for future development within the study area[1]. Land use assumptions used in this study are consistent with the General Plan update provided by PMC.

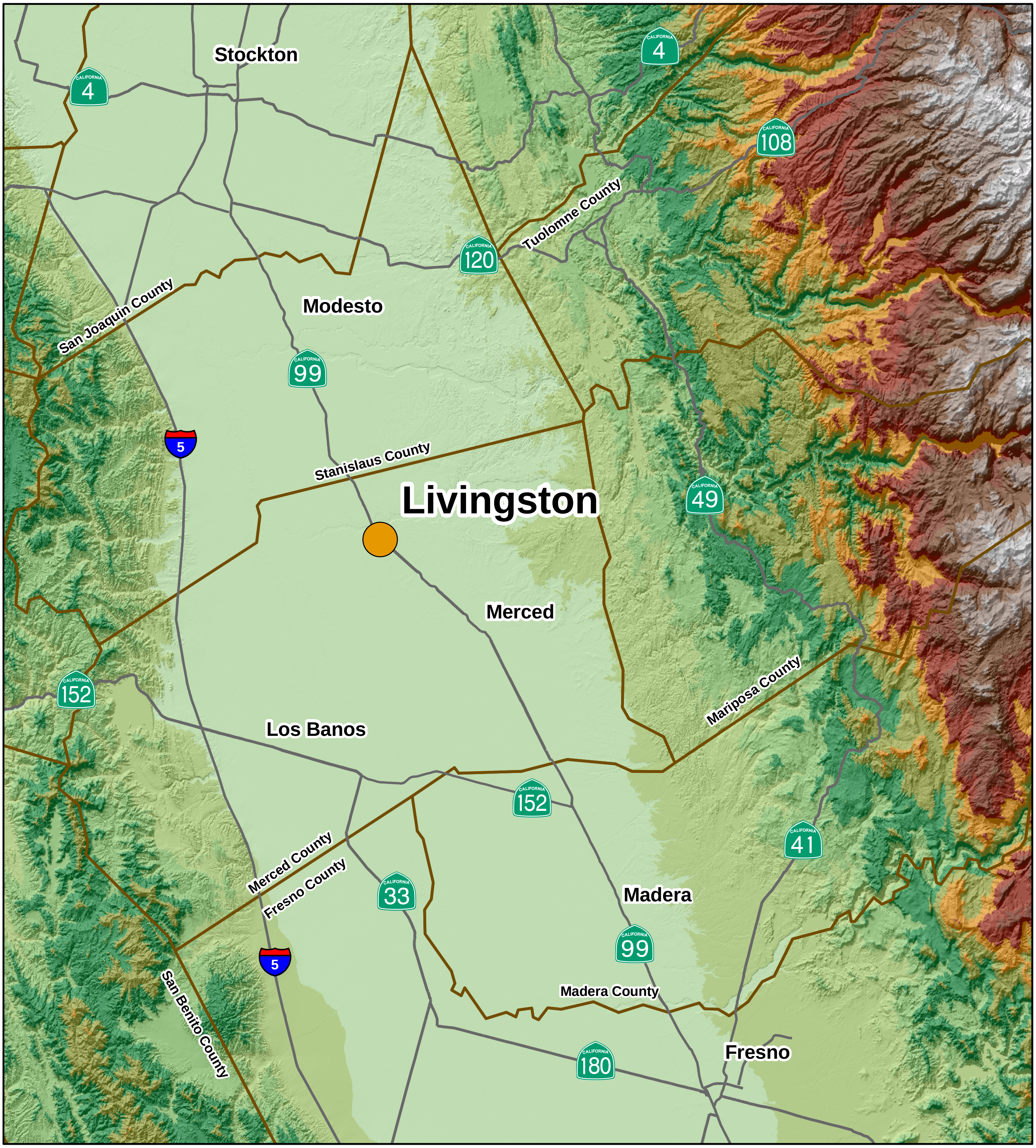
1.2 SCOPE AND AUTHORIZATION

Recognizing the importance of planning, developing, and financing sewer system facilities to provide reliable and enhanced service for existing customers and to serve anticipated growth, the City initiated the preparation of this wastewater collection system master planning study.

On April 7, 2004, the City authorized Carollo Engineers, P.C. (Carollo) to prepare this wastewater collection system master plan study, which included the following tasks:

- Collect and review data
- Attend workshop with developers
- Define sewer sub-basins and service areas

[1] Urban Area Development boundaries based on General Plan layout of Pacific Municipal Consultants, Updated April 2007, the Annexation and Development Scenarios and the Land use Assumptions (April 2007) provided by PMC.



Legend

Elevation

High :13,000 Feet

Low : 0 Feet

County Boundary

Major Roads

Miles

0 5 10 20

FIGURE 1.1
REGIONAL LOCATION MAP
WASTEWATER COLLECTION SYSTEM MASTER PLAN CITY OF LIVINGSTON

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- Perform electronic mapping
- Conduct temporary flow-monitoring program
- Develop and calibrate hydraulic model
- Evaluate the capacity of the existing sewer collection system using computer hydraulic modeling
- Review existing system and propose improvements to enhance system reliability
- Recommend improvements needed to service anticipated future growth
- Develop a Capital Improvement Program for residential buildout conditions that will be used by the City in the determination of Development Impact Fees.

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

1.3 REPORT ORGANIZATION

The wastewater collection system master plan report contains six chapters, followed by appendices that provide supporting documentation for the information presented in the report. The chapters are briefly described below:

Chapter 1 - Introduction. This chapter presents the need for this wastewater collection system master plan and the objectives of the study. A list of abbreviations is also provided to assist the reader in understanding the information presented.

Chapter 2 - Planning Area Characteristics. This chapter presents a discussion of this study's planning area characteristics, defines the land use classifications and summarizes the historical population trends. Population projections used for forecasting the City's future water requirements and sewer flows are based on the City's 2007 population projections.

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

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

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

Chapter 6 - Capital Improvement Program. This chapter presents the recommended Capital Improvement Program (CIP) for the City's wastewater collection system. The program is based on the evaluation of the City's sewer system and on the recommended projects described in the previous chapters. The CIP has been prepared to assist the City in planning and constructing the sewer system improvements through the residential buildout of the Master Plan Study Boundary Area in year 2044.

1.4 ACKNOWLEDGMENTS

Carollo Engineers wishes to acknowledge and thank Mr. Richard Warne, City Manager; Mr. Nanda Gottiparthy, City Engineer; Ms. Donna Kenney, Community Development Director; and Paul Creighton, Public Works Director. Their own and their staff's cooperation and courtesy in obtaining a variety of necessary information were valuable components in completing and producing this report.

1.5 ABBREVIATIONS AND DEFINITIONS

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

ADWF	average dry weather flow
ASCE	American Society of Civil Engineers
BWF	base wastewater flow
CIMIS	California Irrigation Management Information System
CIP	capital improvement program
City	City of Livingston
cfs	cubic feet per second
County	County of Merced

DOF	California Department of Finance
ENR CCI	Engineering News Record Construction Cost Index
fps	feet per second
gpad	gallons per acre per day
gpcd	gallons per capita per day
GWI	groundwater infiltration
I/I	infiltration/inflow
LF	linear feet
LAFCo	Local Agency Formation Commission
LUE	Land Use Element
MDWWF	maximum day wet weather flow
mgd	million gallons per day
PDWF	peak dry weather flow
PMC	Pacific Municipal Consultants
PWWF	peak wet weather flow
RDI/I	rainfall dependent infiltration & inflow
ROW	right-of-way
SOI	Sphere of Influence
sq ft	square feet
VCP	Vitrified Clay Pipe
WEF	Water Environment Federation
WWTP	Wastewater Treatment Plant

PLANNING AREA CHARACTERISTICS

This chapter presents a description of the study area, defines the land use classifications and summarizes the historical population trends. Land use classifications are based on the City of Livingston's (City) 1999 General Plan and updated land use maps provided by the City. Population projections are based on the City's planning consultant's 2007 population projections.

2.1 STUDY AREA

The City is located along State Highway 99 in north central Merced County (County) within the Central Valley of California, approximately 115 miles southeast of San Francisco and 290 miles northwest of Los Angeles. Incorporated as a General City in 1922, Livingston is centrally located between Stockton and Fresno along the Highway 99 corridor. The Union Pacific Railroad passes through the City along the general alignment of State Highway 99.

The City is the governing agency and provides wastewater collection and treatment services within the City limits. The City adopted the Urban Area General Plan (General Plan) in December 1999, but is currently updating this plan. The General Plan delineates potential growth areas and identifies policies directing growth within its sphere of influence (SOI) and future growth boundaries. The Merced County Local Agency Formation Commission (LAFCo) reviews changes to the SOI and specific urban development plan boundaries, and annexations to cities.

The 2007 City limits and the SOI encompassed approximately 3.2 square miles (2,044 acres) and 4.7[1] square miles (3,002 acres), respectively. The Master Plan Study Boundary Area[2] encompasses approximately 12.6 square miles (8,051 acres). The SOI, the City limits, and the Master Plan Study Boundary are shown on Figure 2.1.

In 2007, the City's planning consultant, PMC, updated the City's growth plan and land use assumptions for areas outside the current City limits. PMC provided land use scenarios and development assumptions for future growth. The information provided by PMC addressed location, type and intensity for development in and around the City boundary and is presented in Appendix A.

The City's water distribution and wastewater collection master plans were prepared concurrently and identified the infrastructure necessary to service lands within the future growth area. Development assumptions were presented for eight distinct areas around the City, as shown in Figure 2.2 (figure recreated based on information provided by PMC).

[1] Area calculations exclude Highway 99 and Caltrans on/off ramps. This exclusion is common to land use area calculations in this report.

[2] Boundaries based on City's Annexation and Development Scenarios developed by Pacific Municipal Consultants, April 2007 (Appendix A).

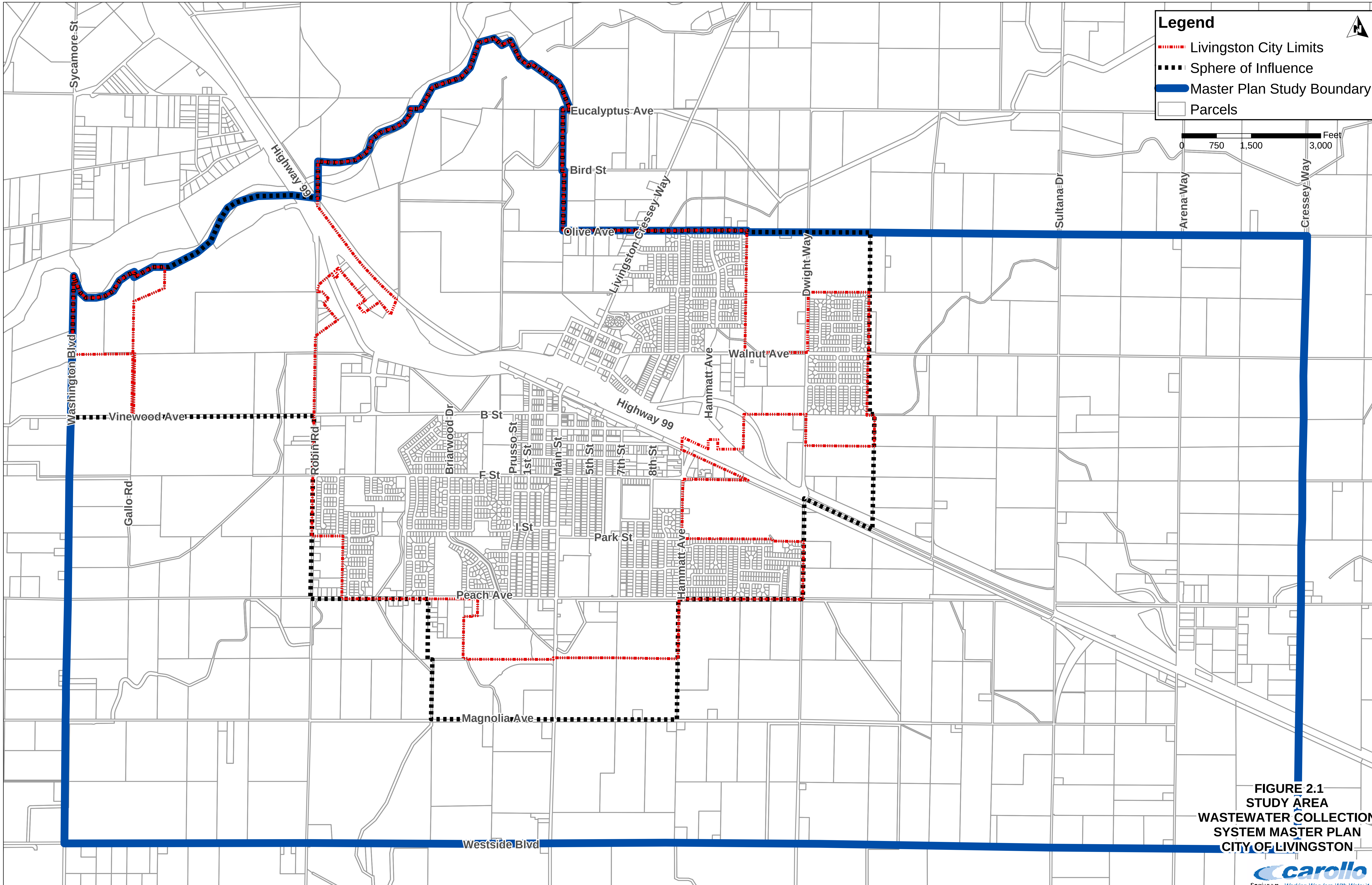

FIGURE 2.1
STUDY AREA
WASTEWATER COLLECTION
SYSTEM MASTER PLAN
CITY OF LIVINGSTON

Information Source: City of Livingston Planning Department. Annexation and Development Scenarios figure prepared by Pacific Municipal Consultants (Update April 2007).

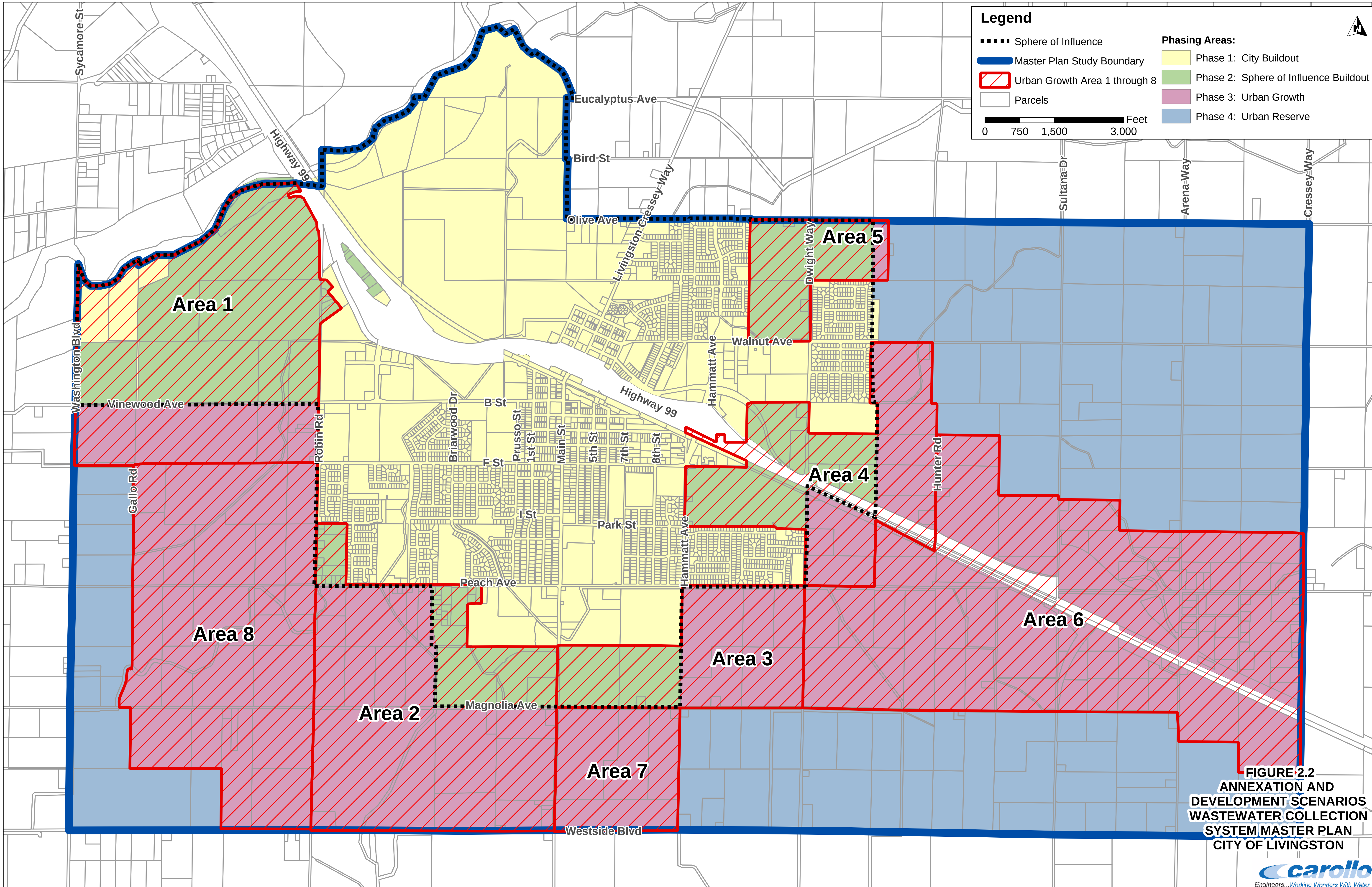

FIGURE 2.2
ANNEXATION AND
DEVELOPMENT SCENARIOS
WASTEWATER COLLECTION
SYSTEM MASTER PLAN
CITY OF LIVINGSTON

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Information Source: City of Livingston Planning Department. Annexation and Development Scenarios figure prepared by Pacific Municipal Consultants (Update April 2007).

The land beyond the City's limits and Areas 1 through 8 is generally described as Urban Reserve by the City. It was assumed that the Urban Reserve would develop similar to existing City land uses. These land use designations are also included in Appendix A.

This report assumes that Areas 1 through 8 and the Urban Reserve represent the future wastewater collection system. The land use classifications used in this master plan are consistent with the City's General Plan (land use map updated April 2007) and the development assumptions for Areas 1 through 8 provided by PMC (Figure 2.3).

2.2 CLIMATE[3]

The City is located within the north-central portion of Merced County. Merced County is characterized by an "inland Mediterranean" type climate; the winters are cool and moist and the summers are dry and warm. Approximately 85 percent of the precipitation occurs during November to April. Temperatures average in the low 90s in the summer. Average high temperatures in the winter are in the 50s, but highs in the 30s and 40s can occur on days with persistent fog and low cloudiness. The average winter daily low is 45 degrees. Rainfall averages 10.29 inches per year.

2.3 LAND USE

The land use classifications used in this master plan are consistent with the following documents:

- The current Land Use Element (LUE) of the City's General Plan (land use map updated April 2007) as shown on Figure 2.3, and
- The development assumptions for Areas 1 through 8 and the Urban Reserve provided by PMC, as shown in Appendix A.

Table 2.1 summarizes the land use designations, along with the gross acreages (includes public right-of-way), for the City limits. Also provided in Table 2.1 are the land use designations and acreages for the eight expansion areas outside the City limits. The information for the eight areas was reproduced from tables provided by PMC.

[3] Excerpt from the 1999 General Plan

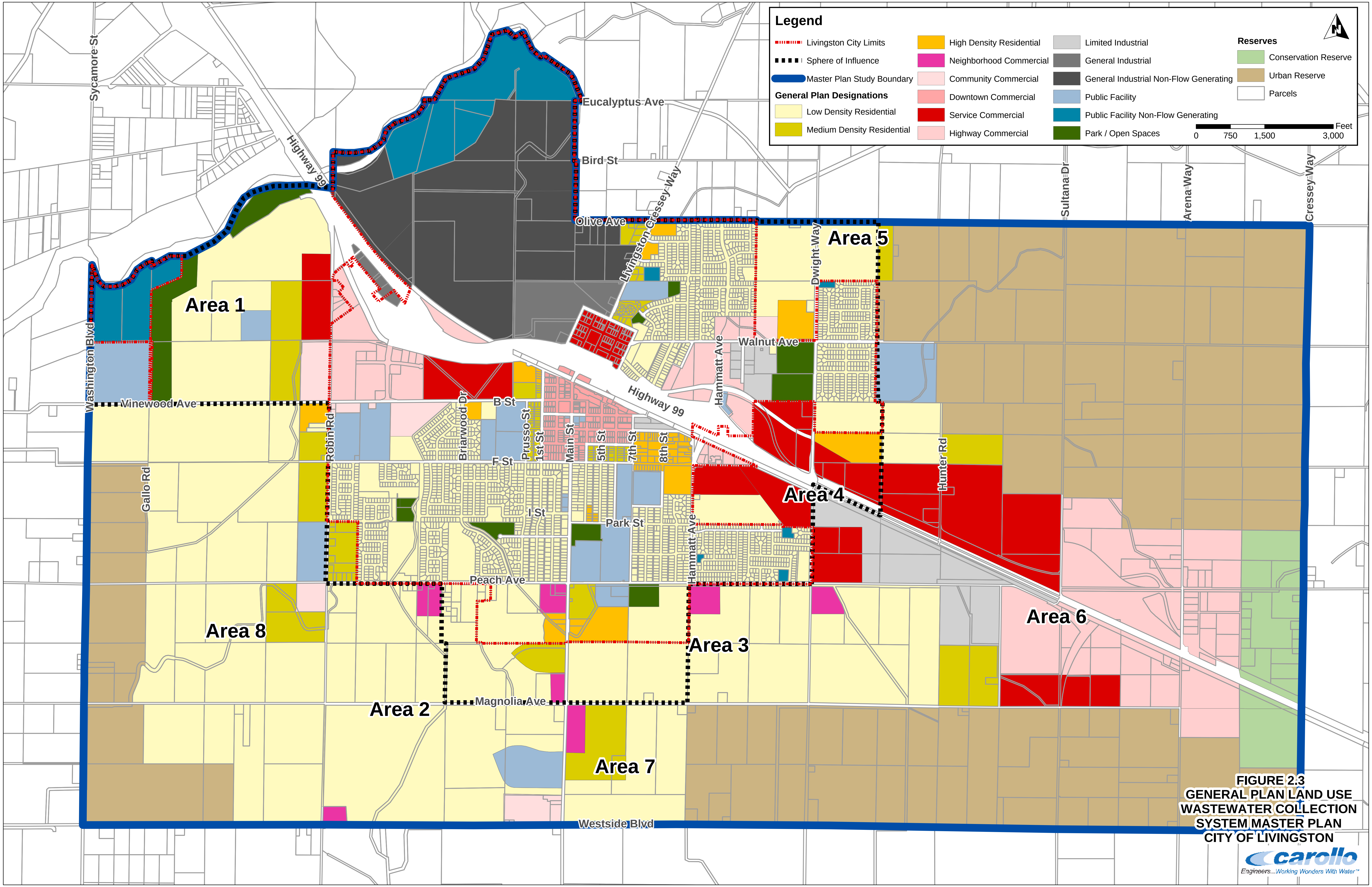

FIGURE 2.3
GENERAL PLAN LAND USE
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

Information Source: City of Livingston Planning Department. Annexation and Development Scenarios figure prepared by Pacific Municipal Consultants (Update April 2007).

Table 2.1 Land Use and Developed Service Area
Wastewater Collection System Master Plan
City of Livingston

	City Sewer Service Area			Expansion Areas Outside Current City Limits									
Land Use Designation	**2006 (developed) Sewer Service Area[5] (gr. Ac.)**	**Current City Limits[1,2] (gr. Ac.)**	**% of Total Service Area (%)**	**Area 1[3,4] (gr. Ac.)**	**Area 2[3,4] (gr. Ac.)**	**Area 3[3,4] (gr. Ac.)**	**Area 4[3,4] (gr. Ac.)**	**Area 5[3,4] (gr. Ac.)**	**Area 6[3,4] (gr. Ac.)**	**Area 7[3,4] (gr. Ac.)**	**Area 8[3,4] (gr. Ac.)**	**Urban Reserve (gr. Ac.)**	**Total Master Plan Study Area (gr. Ac.)**
Residential													
Low Density/Estate	483	776	45%	332	491	256	89	95	166	107	574	0	2,886
Medium Density	49	45	5%	49	33	0	0	10	74	40	48	0	300
High Density	50	74	5%	7	0	0	18	15	0	0	0	0	115
Commercial													
Downtown	62	59	6%	0	0	0	0	0	0	0	0	0	59
Neighborhood	1	9	0%	0	18	10	0	0	8	10	0	0	55
Community	4	19	0%	19	19	0	0	6	0	0	9	0	73
Service	29	59	3%	28	0	0	171	0	156	0	0	0	413
Highway	13	134	1%	5	0	0	0	0	382	0	0	0	522
Office	0	0	0%	0	0	0	0	0	0	0	0	0	0
Industrial													
Light	23	26	2%	0	0	0	29	0	92	0	0	0	147
General	46	55	4%	7	0	0	0	0	0	0	0	0	62
Other													
Public Facility Wastewater Generating	132	132	12%	10	27	0	40	0	0	0	19	0	228
Public Facility Non-Wastewater Generating	97	177	9%	90	0	0	0	0	0	0	0	0	267
General Industrial Non-Wastewater Generating	34	426	3%	0	0	0	0	0	0	0	0	0	426
Park/Open Space	42	52	4%	53	0	7	0	0	0	0	0	0	112
Urban Reserve	0	0	0%	0	0	0	0	1	0	0	1	2,227	2,230
Commercial Reserve	0	0	0%	0	0	0	0	0	155	0	0	0	155
Totals	**1,065**	**2,044**	**100%**	**601**	**587**	**274**	**346**	**127**	**1,035**	**157**	**652**	**2,227**	**8,050**

Notes:
1. Current City Limits, Sphere of Influence (SOI) and future growth areas based on City's General Plan Map prepared by Pacific Municipal Consultants (updated April 2007).
2. Acreages obtained from City's General Plan land use figure prepared by the Merced County Association of Governments.
3. Area layout provided by Pacific Municipal Consultants, figure titled Annexation and Development Scenarios (Appendix A).
4. Breakdown in land use and total acreage provided in Appendix A, Updated Land Use Area Calculations prepared by Pacific Municipal Consultants, April 2007 (Appendix A).
5. Includes all developed lands within the City Boundary in June 2006.

Table 2.1 also tabulates the 2006 developed land within the City limits. The totals for developed land were used in calculating wastewater generation coefficients discussed in this report.

The current City limits encompass approximately 2,044-acres. The existing land uses include 896-acres of residential, 279-acres of commercial, 507-acres of industrial, 52 acres of parks and 310-acres of public facilities. As with most cities in California, the detached single-family home is the predominant residential unit in Livingston. Currently, about 87 percent of the housing units are in the low-density category, while the medium and high densities make up 5 and 8 percent each, respectively.

Low/Estate Density Residential. **(0-6 dwelling units/gross acre)**. The low density residential category provides for a land use pattern of predominantly single-family development as permitted in the R-1 district. Lot sizes generally range from 6,000-8000 square feet. The estate sub-category is characterized by single-family residential development with large lot sizes. Lot sizes generally range between 8,500-12,000 square feet.

Medium Density Residential. **(6.1-11.9 dwelling units/gross acre)**. This land use category provides for a land use pattern characterized predominantly by small-scale multiple-family residential developments. The typical residential pattern includes duplexes and large scale, high-amenity apartments.

High Density Residential. **(12-29 dwelling units/gross acre)**. The high-density residential land use category provides for the highest residential densities permitted in the City.

Downtown Commercial. This designation provides the City with a mixed-use activity in the downtown area. It is intended to provide for a wide range of uses and to promote feasibility and vitality of downtown.

Neighborhood Commercial. This designation provides for a maximum of 10-acre grouping of commercial establishments serving the everyday convenience goods and personal service needs of a defined neighborhood.

Community Commercial. This designation provides for no less than a 10-acre or larger grouping of commercial establishments serving needs similar to the neighborhood commercial centers, but serves a market area within ten miles.

Service Commercial. This designates land for commercial activities in which the function performed is of equal or greater importance than the produce traded.

Highway Commercial. Allows Service Commercial uses which, due to space requirements, the proximity to the highway, or the distinctive nature of their operation, are not compatible with or not usually located in other commercial designations.

Light Industrial. This designation establishes light industrial areas where uses such as fabricating, assembly, research and development, electronics, low intensity warehousing and other such similar industrial uses are appropriate.

General Industrial. This designation allows for heavy industrial and a range of activities including manufacturing, wholesale distribution, large storage areas and other non-hazardous industrial uses. The industrial designated property located on the Merced River east of Highway 99 is limited to the existing wastewater treatment plant. No other industrial uses are permitted. The **Industrial Reserve** is within the Master Plan Study Boundary, but possesses urban service constraints.

Public Facility. This designation indicates areas owned and maintained by public or institutional agencies such as the city, schools, hospitals, or other special districts.

Parks and Open Space. This designation determines areas of permanent open spaces, parks and/or areas precluded from major development.

2.4 HISTORICAL AND FUTURE GROWTH

The City was incorporated in 1922 in a highly productive agricultural region. The City has continued to thrive as a farming and poultry processing community. According to the General Plan, Livingston is expected to be one of the fastest growing communities in the County in the next ten to fifteen years. After 2009 the City forecasts that its population will more than triple in size by year 2024.

Livingston, along with a number of the other communities in the region, has experienced population growth from commuters working in job centers outside the County. For the most part, this is a result of the eastward expansion of growth from the San Francisco Bay Area, which has raised housing prices in San Joaquin and Stanislaus County and created a need for some families to look for affordable housing. Additionally, the proposed University of California Merced will contribute to the accelerated growth.

The City's 2004 population was approximately 13,000. The most recent available population projections were developed by the City's Planning Department consultant PMC (Appendix A). The City forecasts that Livingston's population could reach approximately 19,800 in year 2009 and 72,800 in 2024 as illustrated in Figure 2.4.

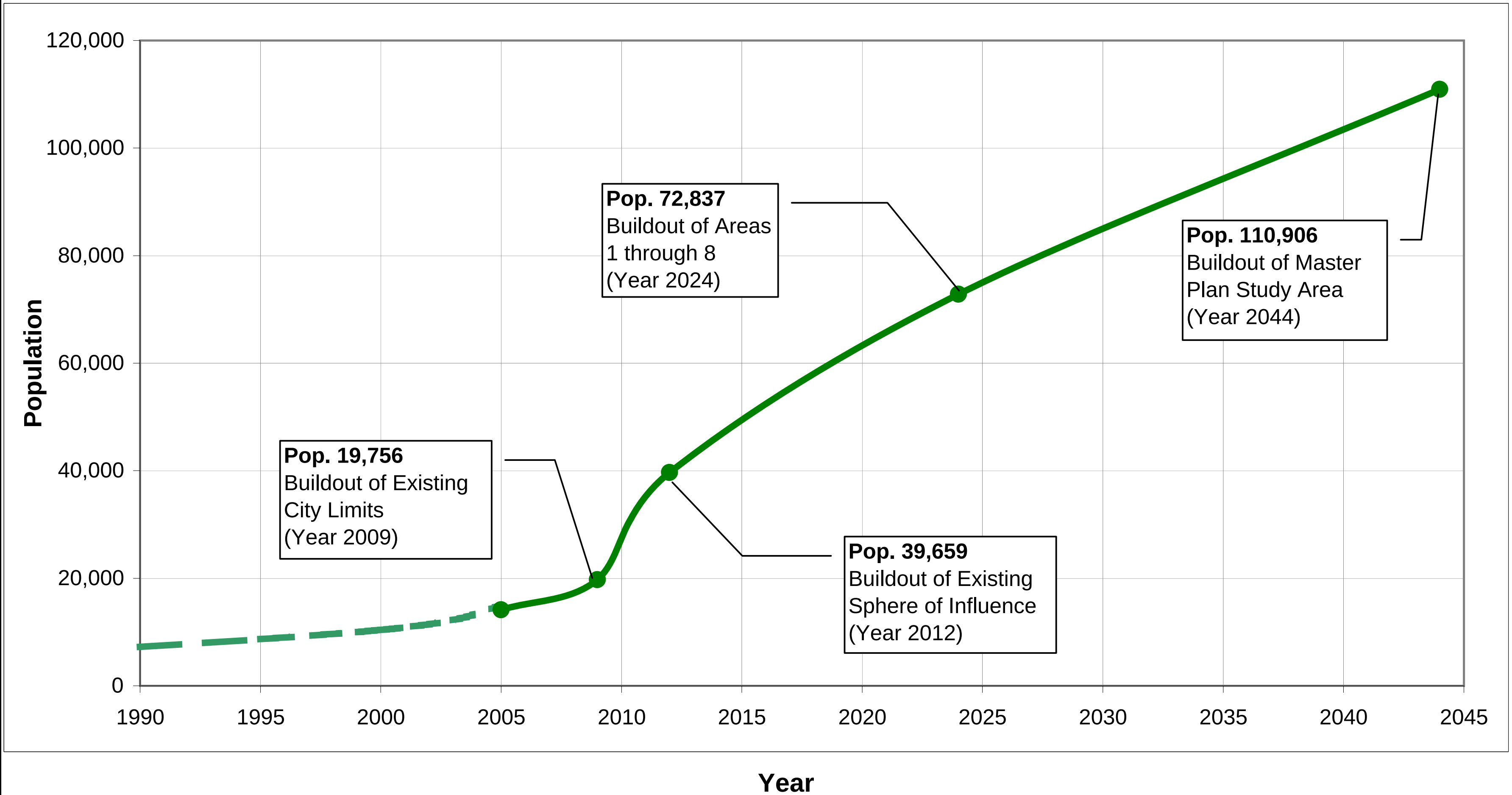

FIGURE 2.4
HISTORICAL AND PROJECTED POPULATION
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

Data Source: Population projections provided by Pacific Municipal Consultants, Land Use Assumptions, revised April 2007 (Appendix A).

H:\Client\Livingston_FNO\6267B00\Reports\Sewer\Figure 2.4- Population

PLANNING AND DESIGN CRITERIA

The capacity of the City of Livingston's (City) wastewater collection system was evaluated based on the planning and design criteria defined in this chapter. Historical flows at the wastewater treatment plant (WWTP) were reviewed and analyzed to determine daily, monthly, and seasonal fluctuations experienced by the sewer system. The developed criteria address the wastewater collection system capacity, gravity sewer slopes, maximum depth of flow within a sewer, average sewer flow coefficients, and sewer peaking factors.

3.1 GRAVITY SEWERS

Capacity analysis of the gravity sewers was performed in accordance with the criteria established in this section.

3.1.1 Pipe Capacities

Sewer pipe capacities are dependent on many factors, including roughness of the pipe, the maximum allowable depth of flow, minimum velocity and slope.

3.1.2 Manning Coefficient (n)

The Manning coefficient 'n' is a friction coefficient and varies with respect to pipe material, size of pipe, depth of flow, smoothness of joints, root intrusion, and other factors. For sewer pipes, the Manning coefficient typically ranges between 0.011 and 0.017, with 0.013 being a representative value used for system master planning purposes. The City is considering adopting a range of 'n' values for the design of different types of pipe (e.g. PVC and VCP).

3.1.3 Flow Depth Criteria (d/D)

When designing sewer pipelines, it is common practice to adopt variable flow depth criteria for various pipe sizes. This criteria is expressed as a maximum depth of flow to pipe diameter ratio (d/D). Design d/D ratios typically range from 0.5 to 0.92, with the lower values typically used for smaller pipes - which may experience flow peaks greater than design flow or may experience blockages from debris, paper, or rags.

For peak dry weather flow (PDWF), it is recommended that all new sewer trunks and mains be designed to carry the flow at a maximum d/D of 0.7. New trunks and mains should also be designed to convey peak wet weather flow (PWWF) at a maximum d/D of 0.92. Whichever criteria results in the larger pipe diameter size will dictate the design.

Utilizing a d/D ratio of 0.70 for analyzing existing sewer lines may lead to unnecessary replacement of existing pipelines. Therefore, a d/D ratio of 0.92 (pipe flowing full) was utilized to evaluate Livingston's existing trunk system for peak dry and PWWF conditions. The recommended d/D ratios for peak dry weather and peak wet weather design flows are summarized in Table 3.1.

Table 3.1 Recommended d/D Ratios for Design Flow Conditions Wastewater Collection System Master Plan City of Livingston		
Sewer	**Peak Dry Weather Flow Maximum d/D Ratio**	**Peak Wet Weather Flow Maximum d/D Ratio**
Existing	0.92	0.92
Future/Proposed	0.70	0.92

3.1.4 Design Velocities and Minimum Slopes

In order to minimize the settlement of sewage solids, it is standard practice in the design of gravity sewers to specify that a minimum velocity of 2 feet per second (fps) be maintained when the pipeline is half-full. At this velocity, the sewer flow will typically provide self-cleaning for the pipe. Due to hydraulics of a circular conduit, velocity of half-full flow in pipes approaches the velocity of nearly full flow in pipes.

The City's design standards specify the minimum slopes presented in Table 3.2 for pipe sizes 12-inches and smaller. Table 3.2 also lists the recommended minimum slopes for planning future improvements and for maintaining self-cleaning velocities when the pipe is flowing at a d/D ratio of 0.7. Because the general topography in Livingston is flat, future improvements based on recommended slopes may require the use of lift stations, which require frequent maintenance.

3.1.5 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. An approximate method for securing these results is to place the 0.8 depth point of both sewers at the same elevation. For master planning purposes, and in the absence of field data, sewer crowns will be matched at the manholes.

3.1.6 Manholes

Manholes will be constructed at all changes in vertical and horizontal alignment and at all pipe intersections. The maximum distance between manholes is 400 feet. A terminal manhole or cleanout will be constructed at all dead ends.

3.1.7 Lift Stations and Force Mains

Lift stations were evaluated based on their ability to convey peak flow with the largest pump out of service. This is defined as a lift station's firm capacity. For the design of force mains, the minimum and maximum recommended velocities are 2.0 and 6.5 fps, respectively. The roughness coefficient, or 'C' value, of 120 will be used for this master plan.

Table 3.2 Minimum Slopes for New Sewers
Wastewater Collection System Master Plan
City of Livingston

Pipe Diameter (in)	Recommended Minimum Slope [1] (ft/ft)	Calculated Flow at d/D=0.92		Calculated Flow at d/D=0.7 [3]	
		(cfs)	(mgd)	(cfs)	(mgd)
6	0.004 [2]	0.38	0.25	0.30	0.19
8	0.003 [2]	0.71	0.46	0.55	0.36
10	0.0025 [2]	1.18	0.76	0.92	0.59
12	0.002 [2]	1.71	1.11	1.33	0.86
15	0.0012	2.41	1.56	1.87	1.21
18	0.0010	3.57	2.31	2.78	1.80
21	0.0008	4.82	3.11	3.75	2.42
24	0.0007	6.44	4.16	5.01	3.24
27	0.0006	8.16	5.27	6.35	4.10
30	0.0005	9.86	6.37	7.68	4.96
33	0.0005	12.72	8.22	9.90	6.40
36	0.0004	14.34	9.27	11.17	7.22
42	0.0003	18.74	12.11	14.59	9.43

Notes:
1. Recommended minimum slope for maximum pipe flow at a d/D=0.92 and velocity greater than or equal to 2 ft/sec.
2. City design standards for minimum slopes of sewer lines. Slopes provided only for 6-, 8-, 10- and 12-inch pipes
3. Design flow for new pipes at a d/D of 0.7 and velocity greater than or equal to 2 ft/sec.

3.2 WASTEWATER DESIGN FLOWS

Historical flows at the WWTP were reviewed and analyzed to determine daily, monthly, and seasonal fluctuations in sewer flow. A flow-monitoring program, completed by V&A Consulting Engineers, was also used to calculate the dry weather flow components. The average dry weather flow (ADWF) coefficients were developed for each land use category based on this data.

3.2.1 Wastewater Treatment Plant Flows

The initial step in establishing the wastewater flow criteria for the City included a review of historical flow data influent to the WWTP. Typically, data collected for the past five years would be used, however, since new influent flow meters were installed at the WWTP in September 2003, only data collected from October 2003 through December 2006 was evaluated to determine design flows. Monthly historical flows at the WWTP influent line were obtained from monthly records. Table 3.3 summarizes flow data from October 2003 through December 2006. The table lists the average day flow for each month. For 2003 and 2004 only, data included the total flow, the average day flow, the minimum day flow (lowest flow recorded during any single day of the month), and the maximum day flow (highest flow recorded during any single day of the month).

3.2.2 Wastewater Flow Components

The City’s wastewater flows consist of many components including the base wastewater flow (BWF) plus extraneous groundwater and storm water, termed infiltration/inflow (I/I), that may enter the sewers through pipe and manhole defects or direct drainage connections. I/I flows are dependent upon groundwater levels and rainfall patterns. Peak I/I flows occur during major rainstorms and are related to the intensity and duration of rainfall.

3.2.3 Base Wastewater Flow

The BWF is the flow generated by the City's residential, commercial, and industrial customers. The flow has a diurnal pattern that varies by type of use (e.g. residential versus industrial). Typically, a residential diurnal pattern has two peaks, with the more pronounced peak following the early morning hours of the day, and a less pronounced peak occurring in the evening. Commercial and industrial patterns, though they vary depending on the type of use, typically have 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.

Table 3.3 WWTP Historical Wastewater Flows
Wastewater Collection System Master Plan
City of Livingston

Month-Year	Total Month (mg)	Average Day (mgd)	Minimum Day (mgd)	Maximum Day (mgd)
2003				
October	36.27	1.17	1.02	1.70
November	32.36	1.08	0.81	1.40
December	36.09	1.16	0.79	3.03
Total	**274.95**	**1.14**	**0.79**	**3.03**
Notes: New plant influent meter installed September 03				
2004				
January	31.74	1.02	0.79	1.20
February	31.73	1.09	0.91	1.71
March	32.78	1.06	0.87	1.18
April	31.77	1.06	0.86	1.31
May	32.21	1.04	0.55	1.19
June	31.00	1.03	0.86	1.29
July	32.28	1.04	0.92	1.14
August	33.21	1.07	0.97	1.16
September	32.22	1.07	0.94	1.17
October	34.85	1.12	1.04	1.28
November	33.10	1.10	1.01	1.40
December	N/A	1.10	N/A	N/A
Total	**356.89**	**1.07**	**0.55**	**1.71**
2005				
January	N/A	1.07	N/A	N/A
February	N/A	1.14	N/A	N/A
March	N/A	1.10	N/A	N/A
April	N/A	1.06	N/A	N/A
May	N/A	1.14	N/A	N/A
June	N/A	1.14	N/A	N/A
July	N/A	1.09	N/A	N/A
August	N/A	1.14	N/A	N/A
September	N/A	1.12	N/A	N/A
October	N/A	1.12	N/A	N/A
November	N/A	1.11	N/A	N/A
December	N/A	1.09	N/A	N/A
Total	**N/A**	**1.11**	**N/A**	**N/A**
2006				
January	N/A	1.13	N/A	N/A
February	N/A	1.13	N/A	N/A
March	N/A	1.15	N/A	N/A
April	N/A	1.11	N/A	N/A
May	N/A	1.12	N/A	N/A
June	N/A	1.10	N/A	N/A
July	N/A	1.11	N/A	N/A
August	N/A	1.12	N/A	N/A
September	N/A	1.13	N/A	N/A
October	N/A	1.17	N/A	N/A
November	N/A	1.12	N/A	N/A
December	N/A	1.07	N/A	N/A
Total	**N/A**	**1.12**	**N/A**	**N/A**

Average Dry and Wet Weather Flow Summaries

Year	Average Day	Avg Wet Weather [1]	Avg Dry Weather [2]	Avg Wet/Avg Day Ratio	Avg Dry/Avg Day Ratio
2003	1.14	1.14	1.40	1.0	1.2
2004	1.07	1.07	1.06	1.0	1.0
2005	1.11	1.10	1.12	1.0	1.0
2006	1.12	1.13	1.12	1.0	1.0

Maximum Dry and Wet Weather Flow Summaries (03 and 04)

Year	Avg Dry Weather (mgd)	Max Wet Day [3] (mgd)	Max Dry Day [4] (mgd)	Max Wet Day Factor	Max Dry Day Factor
2003	1.40	3.03	4.81	2.2	3.4
2004	1.06	1.71	1.29	1.6	1.2
10/03 thru 12/04	1.06	3.03	1.29	2.9	1.2

Notes:
1. Average Wet Month is the average flow for the months of Jan.-May and Oct.-Dec. (review of CIMIS Station 148 data)
2. Average Dry Month is the average flow for the months of Jun.-Sep. (review of CIMIS Station 71 data)
3. Max Wet Day is the maximum daily flow recorded during Jan.-May and Oct.-Dec.
4. Max Dry Day is the maximum daily flow recorded during June-Sep.

Data Source: City of Livingston Wastewater Treatment Plant

3.2.4 Groundwater Infiltration

Groundwater infiltration (GWI), one of the components of I/I, is associated with extraneous water entering the sewer system through defects in pipes and manholes. This component is related to the condition of the sewer pipes, manholes, and groundwater levels. GWI may occur throughout the year, although GWI 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.

3.2.5 Average Dry Weather Flow

The ADWF is the average flow that occurs on a daily basis during the dry weather season, with no evident reaction to rainfall. Review of the California Irrigation Management Information System (CIMIS) Station 148 precipitation data indicated that the months of June through September were the typical dry weather months. The ADWF includes the BWF generated by the City's residential, commercial, and industrial users, plus the dry weather GWI component. The importance of this component lies in its use as a basis for expressing other flow components by applying multipliers to the ADWF. The ADWF for 2006 was approximately 1.12 mgd.

3.2.6 Maximum Day Wet Weather Flow

The 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. The MDWWF measured at the WWTP was approximately 3.03 mgd in 2004, or 2.9 times the ADWF for that year.

3.2.7 Peak Wet Weather Flow

The peak wet weather flow (PWWF or design flow) is the peak flow, including I/I, that would be expected during a major storm event. The peak wet weather flow component is typically used for designing the capacity of a sewer system. For this master plan, surcharging during PWWF will be interpreted as a pipeline capacity deficiency for which improvements will be proposed.

The WEF Manual of Practice FD-6 and ASCE Manual No. 62 suggest typical PWWF to ADWF ratios range between 3 and 4, with higher values indicative of pronounced infiltration and inflows. The flow-monitoring program conducted for this study did not collect flows during a major storm event; therefore, typical peaking factors were used to calculate the PWWF.

3.2.8 Inflow and Infiltration

Inflow is a sharp rise in flow in direct response to a rainfall event. Infiltration is a slower response to the rainfall event, which builds up with time and continues even after rainfall has stopped. I/I are typically estimated by reviewing and examining flow components, and by conducting temporary or long-term flow-monitoring programs.

3.2.8.1 Inflow and Infiltration Allowance

When designing sewers, allowance must be made for unavoidable I/I. If flow data is unavailable, peak infiltration allowances may be used. Peak infiltration allowances for sewer design are often related to the size of the area served. Metcalf & Eddy's Wastewater Engineering: Collection and Pumping of Wastewater provides estimates for peak infiltration allowances for old and new sewers. For a city the size of Livingston, the peak infiltration allowance ranged between 650 to 1,700 gallons per acre-day (gpad) depending on age, material, method of installation and pipe condition. For modeling PWWF in this project, a 10-year, 24-hour design storm was routed through the model to simulate I/I.

3.2.8.2 Storm Inflow Connections

An area in the City east of Highway 99 has storm sewer connections to the sanitary sewer system. It is estimated that runoff from an area of approximately 60 acres currently drains to the sanitary sewer trunk lines in Stefani Avenue. The general area is described as being bound by Stefani Avenue on the west, Swan Street to the north, Franci Street to the east and Campbell Boulevard on the south. In order to evaluate the capacity of the combined sewer system during wet weather events, a 10-year, 24-hour design storm was routed through the model to simulate storm inflow. The total depth of rain for this storm event is 1.8 inches (NOAA Atlas 2 values for Livingston).

3.2.9 Temporary Flow Monitoring Program

A temporary flow-monitoring program was conducted to assist in the development of the design flow criteria and sewer flow coefficients. The primary purpose of the program was to determine existing dry weather flows and to determine the relative flow from different areas of the wastewater system. These flows established a benchmark for hydraulic model calibration.

The temporary program, which occurred in July 2004, consisted of installing six flow meters for a period of one week at locations selected by Carollo. The flow-monitoring program results are summarized in detail in a report titled Sanitary Sewer Flow Monitoring Study (July 2004), prepared by V&A Consulting Engineers (Appendix B).

Typically, a flow-monitoring program is utilized to determine the magnitude of I/I into the City's sanitary sewer system. However, due to the project schedule, the monitoring could not take place during the wet weather season.

3.2.10 Average Wastewater Flow Coefficients

For sewer system master planning, design flows are developed by applying design flow criteria to land use and population data in order to quantify average and peak flows. The design flow criteria are typically based on standard practice values, but are refined based on actual flow data. The flow coefficients are established to estimate average wastewater flow, while the peaking factors are used to estimate PDWF and PWWF.

The design flow criteria include average wastewater flow coefficients, usually expressed in gallons per acre per day (gpad), and applied to either gross or net acres for calculating ADWF generated from a particular land use designation. For this master plan, the average sewer flow coefficients were applied to gross acres.

Average wastewater flow coefficients for commercial and industrial areas may range from 500 to 2,500 gpad, with typical values averaging approximately 1,000 gpad. Land uses designated as open space or agricultural are assumed to generate negligible amounts of sewage flow.

Table 3.4 presents wastewater flow coefficients for each land use designation. The flow coefficients by land use were calculated by dividing the ADWF measured during the flow-monitoring program by the acreage of the area tributary to a given flow meter. For example, flow-monitoring station Number 4 measured an ADWF of 0.03 mgd, and the upstream 37 acre tributary area consisted primarily of downtown commercial and limited industrial land uses. The calculated wastewater flow coefficient was approximately 800 gpad for downtown commercial and limited industrial. The coefficients were then adjusted to balance the calculated flow with the total flow measured at the WWTP. The coefficients in Table 3.4 represent City averages for existing developed lands.

Similar calculations were conducted for each of the flow-monitoring stations and the respective tributary area. Adjustments to each land use wastewater coefficient were made to balance the flows to those measured during the flow-monitoring program. Further adjustments were made to balance the flow coefficients with the ADWF of 1.12 mgd (Table 3.4). As shown in the table, the largest wastewater generation is assigned to the residential land use categories. Low density residential makes up the single largest wastewater producer on a gallons per day (gpd) basis.

3.2.11 Wastewater Peaking Factors

Peaking factors represent the increase in sewer flows experienced above the ADWF. Peaking factors are calculated based on historical data and, at times, tempered by engineering judgment.

Table 3.4 Existing Average Wastewater Flow Coefficients
Wastewater Collection System Master Plan
City of Livingston

Land Use Designation	2006 (developed) Sewer Service Area[1] (gr. Ac.)	% of Total Service Area (%)	Wastewater Generation Coefficient (gpd/gr. Ac.)	2006 ADWF (gpd)	% of Total Generation (%)
Residential					
Low Density/Estate	483	45%	1,250	603,800	54%
Medium Density	49	5%	2,300	112,600	10%
High Density	50	5%	2,600	130,100	12%
					76%
Commercial					
Downtown	62	6%	950	58,800	5%
Neighborhood	1	0%	950	1,300	0%
Community	4	0%	950	3,900	0%
Service	29	3%	950	27,900	2%
Highway	13	1%	950	12,200	1%
Office	0	0%	950	0	0%
					9%
Industrial					
Light	23	2%	950	21,700	2%
General	46	4%	see note 1	22,500	2%
					4%
Other					
Public Facility Wastewater Generating	132	12%	950	125,400	11%
Public Facility Non-Wastewater Generating	97	9%	0	0	0%
General Industrial Non-Wastewater Generating	34	3%	0	0	0%
Park/Open Space	42	4%	0	0	0%
Urban Reserve	0	0%	0	0	0%
Commercial Reserve	0	0%	0	0	0%
					11%
Totals	**1,065**	**100%**		**1,120,200**	**100%**

Notes:

1. Includes all developed lands within the City Boundary in 2006.
2. Foster Farms municipal wastewater flow only. Based on 1,500 employees during the day and an average flow per employee of 15 gpd (average flow based on typical flow per office employee, Metcalf Eddy, Wastewater Engineering).

The peak flows significant to hydraulic analysis include the PDWF and the PWWF. A method for calculating PWWF includes developing I/I rates. A 10-year, 24-hour storm was routed through the collection system to simulate PWWF. During significant storm events, some sewer systems experience wet weather peaking factors that are 5 to 10 times greater than the ADWF. Typically, peaking factors of 2.0 are used to estimate peak flows at the treatment plant and peaking factors ranging between 2.5 and 4.0 are used to estimate peak flows in the collection system.

For existing conditions, the wet weather hydrographs in the model were adjusted so that model simulations would match recorded flows at the WWTP. The peak dry and PWWF from these scenarios were then divided by the ADWF. The resulting peaking factors for the PDWF and the PWWF scenarios were 1.5 and 4.5, respectively (flows measured upstream of the WWTP).

The peaking factor for PWWF was influenced by the storm sewer connections that convey runoff to the 99 Lift Station. If storm runoff was routed away from the sanitary sewer system, then the PWWF peaking factor measured at the WWTP reduces to 2.5. A more detailed discussion on impacts to the sanitary sewer system caused by storm sewer inflow is presented in Chapter 5.

3.3 FUTURE SEWER FLOWS

This study applied two methods to determine future sewer flows. These methods include projections based on land use and projections based on future population.

In order to develop sewer flow projections based on land use, the coefficients presented in Table 3.4 were adjusted to reflect future conditions. Design flow coefficients from surrounding communities and future water consumption estimates for Livingston were used to develop future sewer flows.

Metcalf & Eddy's Wastewater Engineering: Treatment Disposal Reuse reports that about 60 to 85 percent of the per capita consumption of water becomes wastewater. Analysis of Livingston's municipal use indicates that approximately 50 to 60 percent of residential water use becomes wastewater (excludes water loss in the distribution system). Compared to the year 2006 wastewater generation coefficients in Table 3.4, the future coefficients increased for the three residential land use categories. When compared to surrounding communities, the residential wastewater generation coefficients for Livingston are within a typical range. The wastewater generation coefficients for commercial and industrial land uses was increased to 1,000 gpad.

Applying the average sewer flow coefficients in Table 3.5 to the gross acreage of Areas 1 through 8, the projected average dry weather flows will approach 7.0 mgd by the year 2024, following buildout of Areas 1 through 8.

Table 3.5 Wastewater Flow at Buildout
Wastewater Collection System Master Plan
City of Livingston

Land Use Designation	Wastewater Generation Coefficient (gpd/gr. Ac.)	Existing City Limits (gr. Ac.)	Buildout of Existing City Limits Year 2009 ADWF (gpd)	City Limits plus Areas 1 through 8 [1,2] (gr. Ac.)	Buildout of Area 1-8 Year 2024 ADWF (gpd)	Master Plan Study Boundary (gr. Ac.)	Buildout of Urban Reserve Year 2044 ADWF (gpd)
Residential							
Low Density/Estate	1,500	776	1,164,500	2,886	4,329,200	2,886	4,329,200
Medium Density	2,300	45	104,500	300	689,700	300	689,700
High Density	2,800	74	208,300	115	321,300	115	321,300
Commercial							
Downtown	1,000	59	58,700	59	58,700	59	58,700
Neighborhood	1,000	9	8,500	55	54,700	55	54,700
Community	1,000	19	19,000	73	72,600	73	72,600
Service	1,000	59	58,600	413	413,300	413	413,300
Highway	1,000	134	134,200	522	521,500	522	521,500
Office	1,000	0	0	0	0	0	0
Industrial							
Limited	1,000	26	25,700	147	146,900	147	146,900
General	see note 3	55	22,500	62	22,500	62	22,500
Other							
Public Facility Wastewater Generating	1,000	132	132,500	228	228,300	228	228,300
Public Facility Non-Wastewater Generating	0	177	0	267	0	267	0
General Industrial Non-Wastewater Generating	0	426	0	426	0	426	0
Park/Open Space	0	52	0	112	0	112	0
Urban Reserve	1,400	0	0	3	3,570	2,230	3,121,500
Commercial Reserve	1,000	0	0	155	155,200	155	155,200
Totals		**2,044**	**1,937,000**	**5,823**	**7,017,000**	**8,050**	**10,135,000**

Notes:
1. Area total based on the 2006 City Limit plus Areas 1 through 8 identified by Pacific Municipal Consultants for future development (Annexation and Development Scenarios dated April 2007)
2. Acreages obtained from City's General Plan land use figure prepared by the Merced County Association of Governments.
3. Foster Farms municipal wastewater flow only. Based on 1,500 employees during the day and an average flow per employee of 15 gpd (average flow based on typical flow per office employee, Metcalf Eddy, Wastewater Engineering).

For comparison purposes, the sewer flows were projected using the population method. Based on Carollo's December 2005 WWTP Capacity Analysis, the per capita flows were 90 gpcd (gallons per capita per day). By multiplying the per capita flow of 90 gpcd by the projected population of 72,837, the City's average dry weather flows could approach 6.6 mgd by the year 2024. The population method for calculating wastewater flows results in a slightly lower projection as the land use method in Table 3.5. For this anlaysis, we used the land use method for calculating flows.

As discussed in Chapter 2, it was assumed that the Urban Reserve would develop in a similar pattern to existing land uses. The land use breakdown and percent of total area made up by each designation within the Urban Reserve are summarized in Table 3.6. Multiplying each designation's percent total by its flow coefficient resulted in an aggregate flow coefficient of 1,400 gpad for the Urban Reserve. At buildout of the Urban Reserve, the City's ADWF could approach 10.1 mgd. The City anticipates the entire Master Plan Study Area being developed by year 2044.

Table 3.6 Urban Reserve Land Use
Wastewater Collection System Master Plan
City of Livingston

Land Use	Percent
Low-Density Residential	41.1%
Medium-Density Residential	17.0%
High-Density Residential	2.8%
Mixed Use/Office	0.1%
Neighborhood Commercial	3.8%
Service Commercial	9.3%
Highway Commercial	9.6%
Light Industrial	6.7%
Parks/Open Space	6.1%
Public Facilities	3.5%
Total	**100.0%**

EXISTING SYSTEM AND HYDRAULIC MODEL

This chapter presents an overview of the City of Livingson's (City) wastewater collection system. The chapter also describes the development and calibration of the City's collection system hydraulic model. This model was used to identify existing system deficiencies and to develop improvements to correct those deficiencies.

4.1 SYSTEM OVERVIEW

The City's wastewater collection system consists of approximately 29 miles of 6-inch through 27-inch diameter sewers. Approximately half of this total consists of 8-inch sewer mains. The "backbone" of the system consists of the trunk sewers, generally 10-inches in diameter and larger, that convey the collected wastewater to the wastewater treatment plant (WWTP). The WWTP treats the collected wastewater from the City.

4.1.1 Trunk Sewers

The City's existing wastewater collection system is shown on Figure 4.1. For clarity, the major components of the City's trunk system that were modeled are shown on Figure 4.2. Each major trunk sewer has been assigned a name that identifies it with the predominant street(s) alignment and their major alignments described below starting at the downstream end and continuing upstream.

4.1.1.1 Vinewood Avenue Trunk

The Vinewood Avenue Trunk starts at the WWTP in Gallo Road with a 27-inch diameter pipeline and continues southward towards Vinewood Avenue. At Vinewood, the trunk continues east into the City where it terminates near the intersection of B Street and Prusso Street. Please note that Vinewood Avenue changes name to B Street east of Robin Avenue.

4.1.1.2 99 Lift Station Force Main

The force main discharges into the Vinewood Avenue Trunk in B Street near Prusso Street. The 10-inch diameter force main continues east in B Street to the intersection with 1st Street where it turns north on 1st Street until reaching Front Street. The force main then turns east towards 3rd Street. At 3rd Street, it turns north and crosses Highway 99. At the intersection of Campbell Boulevard and Cressey Way, the force main turns west where it terminates at the 99 Lift Station.

4.1.1.3 Stefani Avenue Trunk

The Stefani Avenue Trunk is tributary to the 99 Lift Station. The Stefani Avenue Trunk begins at the 99 Lift Station, near the intersection of Campbell Boulevard and Stefani Avenue, and runs northeast in Stefani until reaching an alley near Swan Street. The

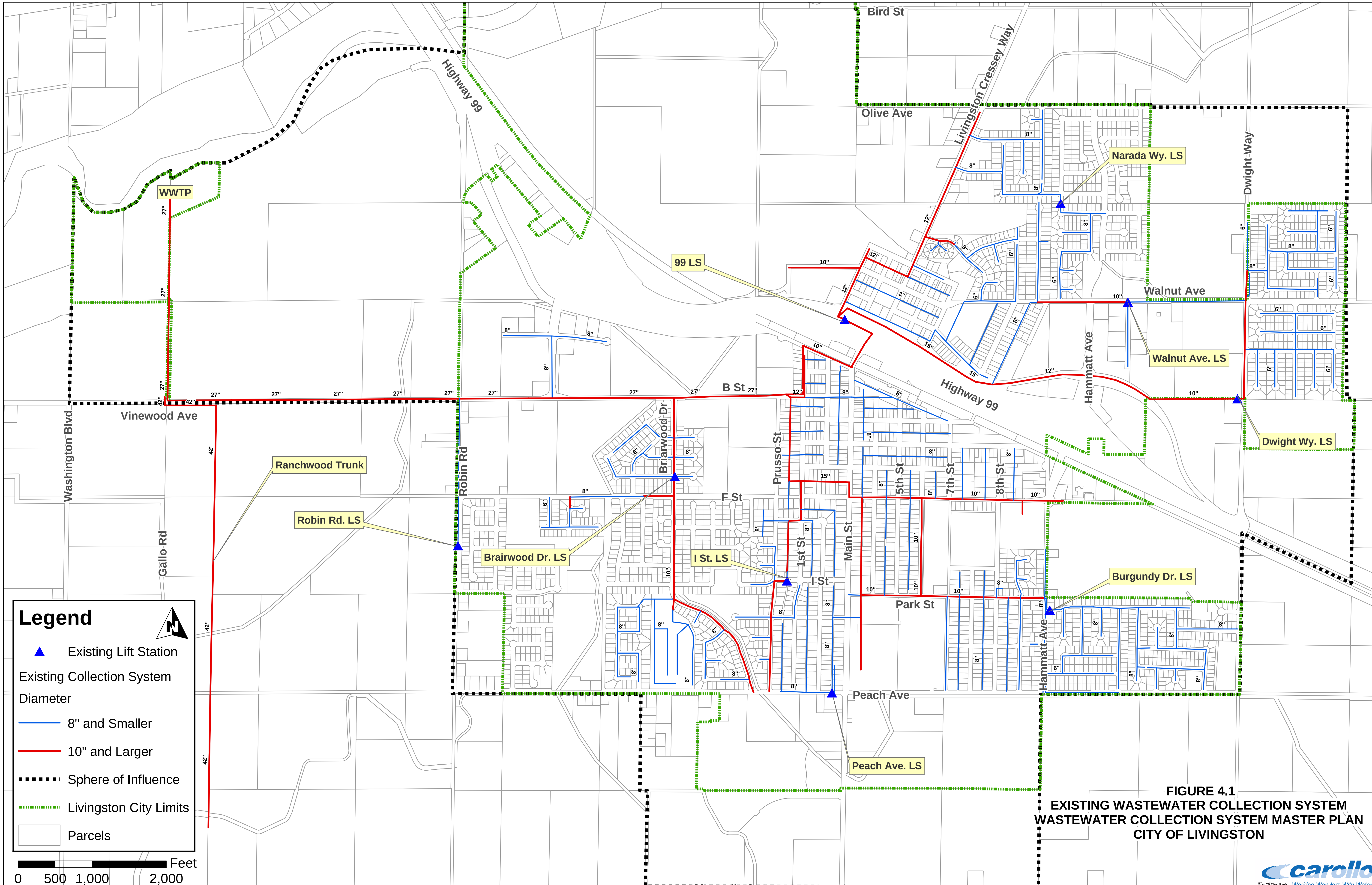

FIGURE 4.1
EXISTING WASTEWATER COLLECTION SYSTEM
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

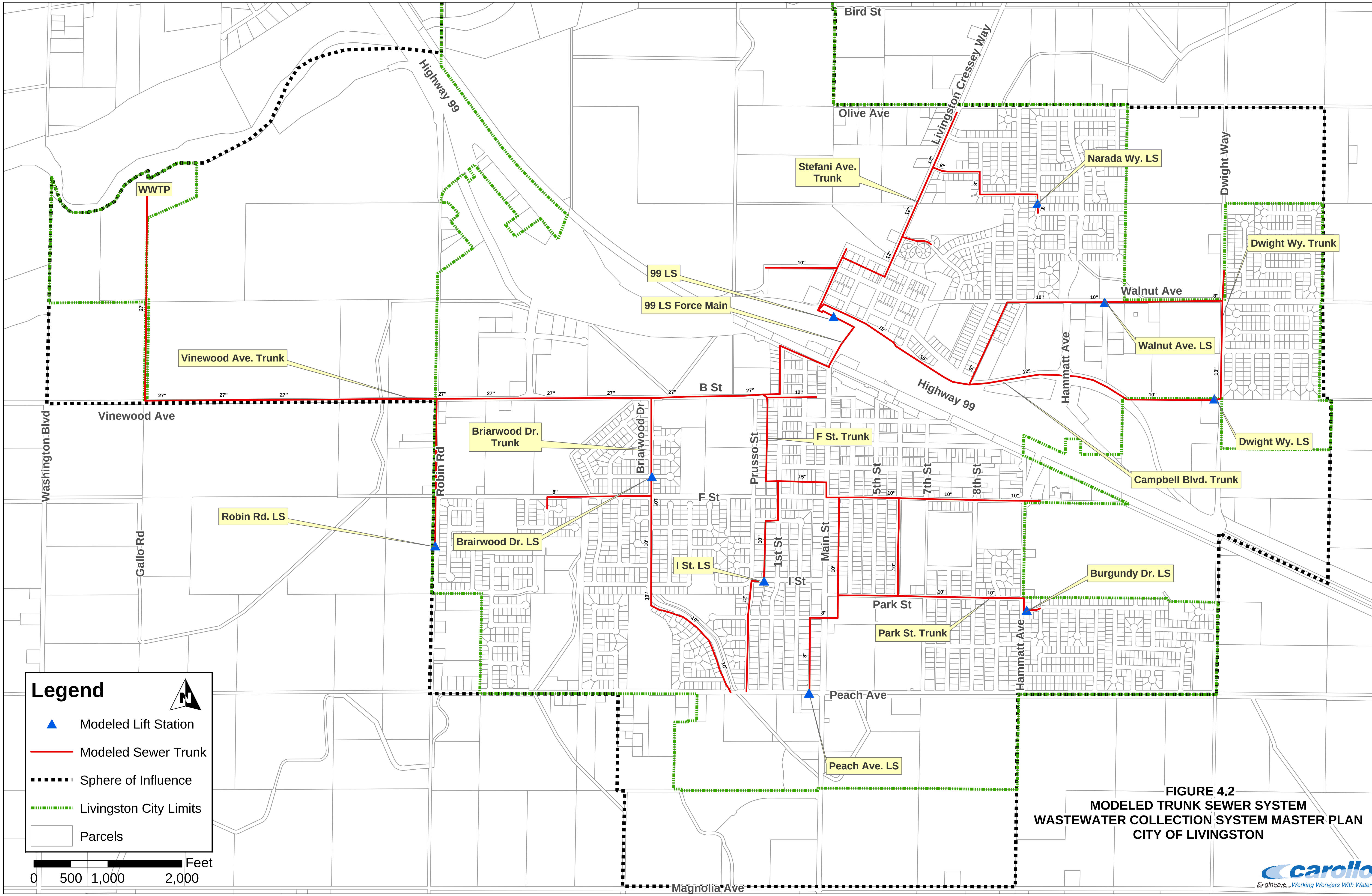

FIGURE 4.2
MODELED TRUNK SEWER SYSTEM
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

12-inch diameter trunk then turns east until reaching Livingston/Cressey Way, where it turns northeast and continues northward in Livingston/Cressey Way. The Stefani Avenue Trunk terminates north of Harvest Avenue, near Olive Avenue.

4.1.1.4 Campbell Boulevard Trunk and Force Main

The Campbell Boulevard Trunk is tributary to the 99 Lift Station. The Campbell Boulevard Trunk begins at the 99 Lift Station near the intersection of Stefani Avenue and Campbell Boulevard. The 15-inch diameter trunk sewer runs east in Campbell Boulevard. Near the intersection of Campbell Boulevard and East Avenue, the pipe diameter size reduces to 12-inches. The trunk sewer continues east until reaching Hammatt Avenue where the gravity line ends and the 10-inch diameter force main begins. The force main continues east in Campbell Boulevard until it reaches Industrial Drive where it proceeds in an unpaved dirt avenue. The force main terminates at the Dwight Way lift station.

4.1.1.5 Dwight Way Trunk

The Dwight Way Trunk is tributary to the Dwight Way lift station and the Campbell Boulevard Trunk. A short 12-inch diameter section runs from the lift station to Dwight Way. The trunk sewer reduces in size to a 10-inch diameter pipe and runs north in Dwight Way until terminating near the intersection with Oak Street.

4.1.1.6 Briarwood Drive Trunk

The Briarwood Drive Trunk is tributary to the Vinewood Avenue Trunk sewer. The Briarwood Drive Trunk begins near the intersection of Briarwood Drive and B Street. The sewer continues south as a 12-inch diameter pipe. The Briarwood Drive lift station, located at the intersection of Briarwood Drive and Elmwood Way, is located on this alignment. Upstream of the lift station, the trunk sewer continues south until reaching Flint Avenue, where the pipe size reduces to a 10-inch diameter trunk. The trunk continues southward through what is currently an open field, until reaching Emerald Drive, where it runs southeast before terminating at Peach Avenue.

4.1.1.7 F Street Trunk

The 15-inch diameter F Street Trunk sewer is tributary to the Vinewood Avenue Trunk. The sewer begins in an alley, near the intersection of Prusso Street and B Street. It runs south in the alley until turning east before reaching F Street. The sewer crosses 1st Street and continues east within a second alley until reaching 3rd Street. At 3rd Street, the pipe diameter reduces in size to 10-inches and runs a short distance south to F Street before turning east. The pipe continues in F Street and terminates at Hammatt Avenue.

4.1.1.8 Park Street Trunk

The 10-inch diameter Park Street Trunk is tributary to the F Street Trunk. The Park Street Trunk begins in an alley near the intersection of F Street and 3rd Street. The sewer runs south in the alley before reaching Park Street where it turns east and runs to its termination point at Hammatt Avenue.

4.1.2 Lift Stations

There are ten lift stations in the collection system, the largest of which is the 99 Lift Station. The 99 Lift Station pumps wastewater collected from the east side of Highway 99, and discharges on the west side of the highway, into the Vinewood Trunk sewer. All lift stations were modeled except for the I Street, Peach Avenue, and Robin Road stations because no design information was available for these pumps. Pump capacities for each of the lift stations are summarized in Table 4.1 and locations of each lift station are shown in Figure 4.2.

Table 4.1 presents the firm and total capacity for each lift station (in gallons per minute [gpm] and million gallons per day [mgd]). The majority of lift stations in the City contain two pumps, with the exception of the 99 Lift Station. In 2004, the 99 Lift Station was upgraded and now has four operating pumps.

4.2 WASTEWATER TREATMENT PLANT

The first treatment plant was constructed in 1963. It consisted of screening, grit removal, primary clarification, anaerobic digestion, solar sludge drying, and six treatment/percolation ponds. In 2004, the City upgraded the facility to include a new oxidation ditch, two new secondary clarifiers, four new influent pumps, and a mechanical bar screen. In accordance with the June 2001 Engineering Report on the WWTP, the current plant's treatment capacity is 2.0 mgd (Average Day Max Monthly Flow [ADMMF]). The City is currenlty desiging an expansion of the treatment plant that will double the treatment capacity to 4.0 mgd ADMMF.

4.3 HYDRAULIC MODEL

Hydraulic network analysis is a tool used in sewer collection planning, design, operation, management, and emergency response. The City's hydraulic sewer model is a critical element that was used in evaluating the capacity of the City's existing sewer system and in planning the City's future facilities. MWH Soft, Inc. H_2OMap Sewer was the computer software program used in the hydraulic analysis of the existing and proposed collection system.

Table 4.1 Existing Lift Station Design Capacity
Wastewater Collection System Master Plan
City of Livingston

Lift Station	Number of Pumps	Capacity per pump (gpm)	Firm Capacity [1] (gpm)	Firm Capacity [1] (mgd)	Total Capacity (gpm)	Total Capacity (mgd)	TDH (ft)
Walnut Avenue	2	300	300	0.43	600	0.86	16
Narada Way	2	150	150	0.22	300	0.43	16
Briarwood Drive	2	745	745	1.07	1,490	2.15	20
Burgundy Drive	2	335	335	0.48	670	0.96	22
Dwight Way	2	595	595	0.86	1,190	1.71	37
99 Lift Station	4	580	1,740	2.51	2,320	3.34	69
I Street [2]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Peach Avenue [2]	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Robin Road [2]	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Notes:
1. Firm capacity of lift station with the largest pump out of service.
2. Information not available for the I Street, Peach Avenue, and Robin Road Lift Stations

4.3.1 Elements of the Hydraulic Model

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

4.3.2 Elements of the Hydraulic Model

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

4.3.2.1 Skeletonizing

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

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

4.3.2.2 Pipes and Manholes

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

Pipes and manholes represent the physical elements describing the sewer system. A manhole represents a location in the network where a sewer flow can be applied to the trunk sewer system, while a pipe segment represents an element of the actual collection system.

4.3.2.3 Sewer Basins

Allocating sewer flows to appropriate locations throughout the trunk system was accomplished by defining tributary sub-basins to selected manholes, identifying the land use designations and sizes within each bus-basin, then applying the appropriate flow coefficients to each land use in those basins. The seven sewer basins, that the collection system was divided into, are illustrated in Figure 4.3. Each of these seven basins was further broken down into smaller sewer sub-basins to manholes.

4.3.3 Hydraulic Model Calibration

The City's hydraulic model was calibrated to establish a level of confidence in the flows that it simulates. The calibrated model serves as an established benchmark for further analysis and evaluation. Future analysis consisted of modifications to the calibrated model to simulate other sewer flow patterns or additional facilities.

Calibration is complicated by the fact that some data are known and unchanging; some are variable over time, while others are estimated. Pipe and manhole information such as diameter, lengths, slopes, and location are known. Flow data obtained from the WWTP records and from the flow-monitoring program vary with time of day, season, and total number of customers. The City's model was calibrated for the flows recorded during the temporary flow-monitoring program in July 2004. The flow-monitoring program results are included in Appendix B.

The calibrated model was then used to simulate existing and buildout peak flow conditions. Capacity evaluation is discussed in Chapter 5 of this report.

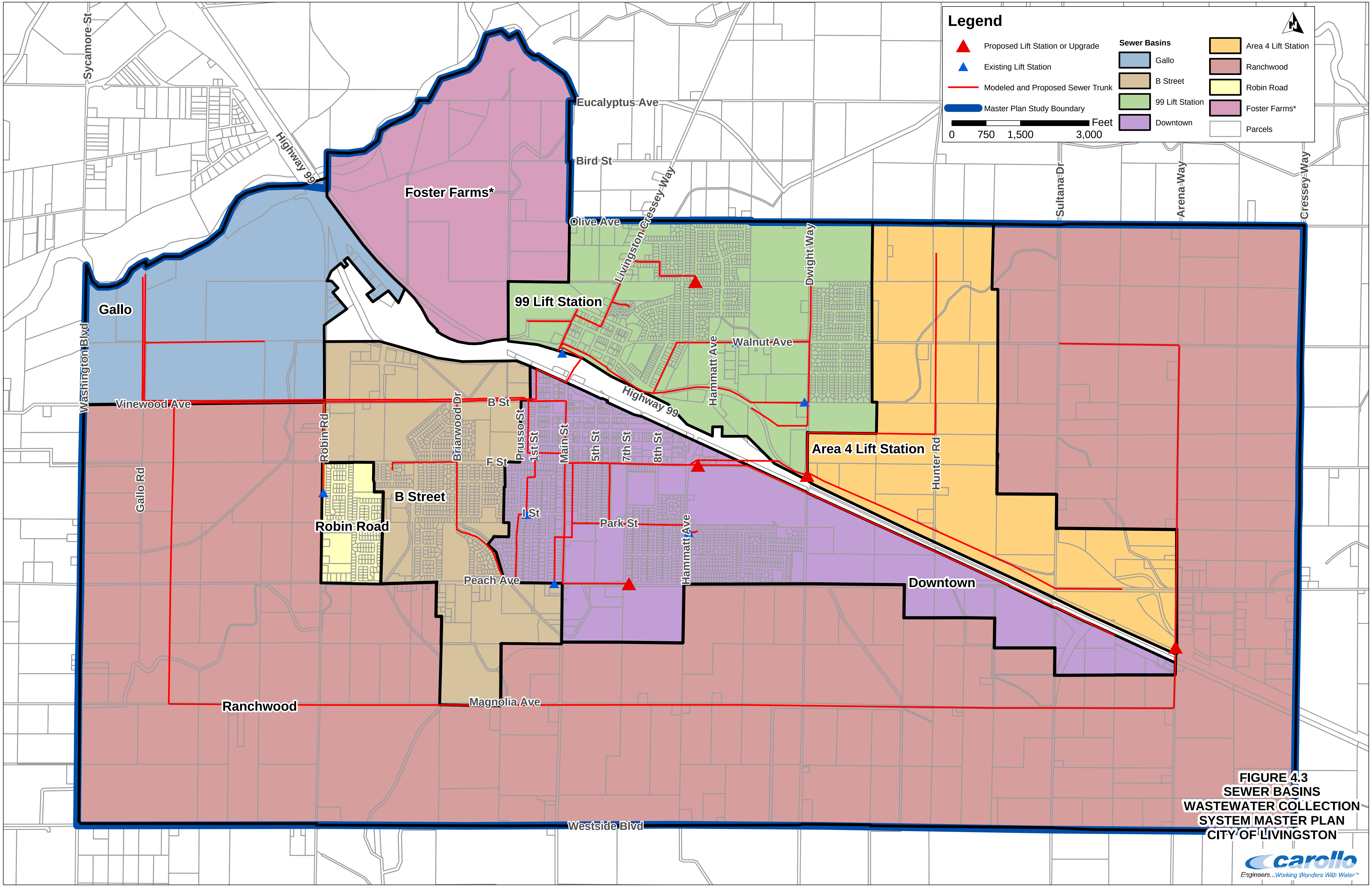

FIGURE 4.3
SEWER BASINS
WASTEWATER COLLECTION
SYSTEM MASTER PLAN
CITY OF LIVINGSTON

*Foster Farms basin tributary to Industral Treatment Plant.

Updated: June 18 , 2007

EVALUATION AND PROPOSED IMPROVEMENTS

This chapter presents the investigation performed and the results for the capacity evaluation of the wastewater collection system. The chapter also presents improvements to mitigate existing system deficiencies and for servicing future growth. These improvements are recommended based on the system's technical requirements, cost effectiveness, and operational reliability.

The existing collection system was evaluated for adequate capacity to convey peak dry weather and peak wet weather flows (design flows) at full pipe depth without surcharging. The capacity of the system was evaluated based on the planning and design criteria defined in Chapter 3. For planning purposes, all improvements for existing deficiencies were assumed to be constructed as replacements, rather than constructed parallel to the existing sewer.

Pumping stations were evaluated for sufficient firm capacity to convey the peak flow rate. The firm capacity is the rated capacity of the pumps with the largest unit out of service.

5.1 DESIGN FLOWS

Based on the evaluation criteria discussed in a previous chapter, design flows were simulated in the model to evaluate the capacity of the existing collection system. Future design flows were also simulated to evaluate the improvements necessary to serve future customers. As discussed in Chapter 3, the projected design flows consist of buildout of the General Plan SOI, buildout of Areas 1 through 8 and buildout of the Master Plan Study Area. The projected design flows (Table 5.1) include dry weather and wet weather conditions.

5.1.1. Dry Weather Conditions

In 2006, the average dry weather and the PDWF for Livingston were 1.12 and 1.64 mgd, respectively. At buildout of the SOI and Areas 1 through 8, the ADWF and PDWF are anticipated to approach 7.02 and 10.61 mgd, respectively. At buildout of the Master Plan Study Area, the City's ADWF could approach 10.14 mgd. The City anticipates the Study Area being developed by year 2044.

5.1.2. Wet Weather Conditions

A 10-year, 24-hour storm was routed through the collection system to simulate PWWF conditions. For existing conditions, the model was calibrated to match the maximum day flow measured at the WWTP. For buildout conditions, a peaking factor of 2.0 was the target ratio between the PWWF to the ADWF.

Table 5.1 Design Flows Wastewater Collection System Master Plan City of Livingston			
Design Flow Condition	**2006 (mgd)**	**Buildout of SOI and Areas 1-8 2024 (mgd)**	**Buildout of Master Plan Study Area 2044 (mgd)**
Average Dry Weather Flow	1.12	7.02	10.14
Peak Dry Weather Flow[1]	1.64	10.61	16.02
Maximum Day Wet Weather Flow with Reduction in I/I[2]	2.0	10.98	16.61
Peak Wet Weather Flow with Reduction in I/I[1]	2.71	13.25	19.29

Notes:
1. Peak Hour Flow based on model result of maximum flow in pipeline upstream of the WWTP.
2. Inflow/Infiltration (I/I) refers to the storm drain connections to the collection system upstream of the 99 Lift Station.

Should the design storm occur, the hydraulic model predicts existing maximum day wet weather and PWWF of 2.0 mgd and 2.71 mgd, respectively. Note that this assumes the storm sewer connections upstream of the 99 Lift Station are removed from the wastewater collection system. If the design storm occurs and storm runoff is conveyed to the sanitary sewers, then the maximum day wet weather and PWWF would be 3.03 and 5.10 mgd, respectively. Applying the same storm event to buildout of the SOI and Areas 1 through 8 results in maximum day wet weather and PWWF of 10.98 mgd and 13.25 mgd, respectively. These projected wet weather flows assume mitigation to the current storm water inflow around Stefani Avenue. At buildout of the Master Plan Study Area, the maximum day wet weather flow and PWWF could reach 16.61 mgd and 19.29 mgd, respectively.

5.2 EXISTING TRUNK SEWER EVALUATION AND PROPOSED IMPROVEMENTS

The existing collection system was evaluated for adequate capacity to convey current and buildout peak dry weather and PWWF at full pipe depth without surcharging. For PDWF conditions, some sections of pipe along Stefani Avenue and B Street surcharged. For PWWF conditions, the model predicted that several sewer lines surcharged. Pipe replacements and capacity increases would be necessary to convey current peak flows.

Engineering judgment was exercised when trunk sewers experienced minimal surcharge (less than 1 foot) and the trunk sewers were approximately 10 feet deep or more. In these circumstances, it was determined that the trunk sewers contained sufficient capacity to convey PWWF and would not likely overflow. This approach for identifying deficient pipes was employed so as not to propose unnecessary replacement of existing pipes.

Continued development in Livingston will increase the peak flow conveyed through the existing collection system. Those segments of the existing collection system that will need to be replaced in order to correct existing deficiencies and to accommodate growth are discussed below. The costs for the recommended improvements are quantified in the Capital Improvement Program (CIP) presented in the following chapter.

Each development project will include site-specific or project level engineering analysis and proposed solutions, to be consistent with the overall infrastructure approach in this Master Plan. Some degree of flexibility in developing proposed solutions may be considered appropriate by the City in order to ensure the best possible alternative for the City.

Though some 8-inch sewer mains were included in this study, it is impractical to include new small sewer mains (8-inches and smaller) in a master planning effort. It should be noted that developers are still responsible for paying an equitable cost allocation for the infrastructures needed to extend service from their developments to the master plan facilities.

Since this study did not include a condition assessment, it assumes replacement of deficient sewers. The City should consider conducting a condition assessment of existing pipelines to determine whether the trunk sewers should be rehabilitated or replaced. Condition assessments can be conducted through television inspection or photographing the interior wall of a pipe from manholes. Depending on the condition of existing trunk sewers, during the preliminary design phase of proposed improvements, City staff may decide to parallel the existing pipes rather than replace them.

5.2.1. Stefani Avenue Trunk Sewer

5.2.1.1 Existing and Buildout Capacity Analysis

The existing 12-inch Stefani Avenue trunk sewer surcharges under current PWWF conditions between the 99 Lift Station and Livingston/Cressey Way. The trunk sewer in Stefani Avenue is relatively flat, but the capacity deficiency problem is exacerbated by storm drain connections to the 8-inch sewer mains. The sewer mains with storm connections are generally located within an area east of Highway 99, bounded by Stefani Avenue on the west, Swan Street to the north, Franci Street to the east and Campbell Boulevard on the south. A comprehensive storm drain inventory was not conducted as part of this study and there may be additional connections beyond the area described above.

Two hydraulic scenarios were analyzed to quantify the impact of storm runoff on the existing sanitary sewer system; 1) reduction in storm inflow to the collection system, and 2) current conditions with storm inflow entering the collection system around Stefani Avenue.

Discussions with City staff and preliminary results from the City's storm drain master plan study indicate that improvements are proposed to divert storm runoff away from the sanitary sewer system. If the proposed storm drain improvements are implemented, then the number of sanitary sewer improvements will be reduced. If the storm drain connections are removed from the sanitary sewer system, then only a few relatively flat segments of the 12-inch trunk sewer along Stefani Avenue and in the alley parallel to Swan Street would need to be upsized.

If storm runoff continues to collect and discharge to the wastewater system, then several thousand feet of pipe will need to be upsized in order to create sufficient capacity to convey sewer and storm flow. Also, an additional lift station and force main will be required to pump flow west across Highway 99. Figure 5.1 presents the pipe segments requiring replacement to mitigate existing capacity deficiencies if storm runoff continues to be routed through the sanitary sewer system. As illustrated, more sewers and pumps require upgrade if storm runoff continues to be routed through the sewer system.

Continued residential development east of Olds Avenue will increase flow in the Stefani Avenue trunk sewer, resulting in higher peak dry and PWWF. Increased wastewater flow from future development resulted in surcharging of the entire Stefani Avenue trunk sewer. Also, the 8-inch sewer main in Nut Tree Road, between the Narada Way Lift Station and Livingston/Cressey Way also surcharged during peak flows.

5.2.1.2 Proposed CIP

Relatively flat slopes in existing pipes resulted in capacity deficiencies in the Stefani Avenue trunk sewer. Continued growth east of Olds Avenue in the north-eastern part of the City (Kishi and Liberty Square subdivisions) will also result in capacity deficiencies in this trunk sewer and trigger the need to upgrade the capacity of the Narada Way Lift Station. Please note that City staff and the developer of the Kishi subdivision completed the upgrade to the Narada Way lift station during the preparation of this master plan. Nonetheless, this upgrade will remain in the master plan as a proposed project. To accommodate future growth, the entire Stefani Avenue trunk sewer should be replaced and upsized.

This can be accomplished by replacing approximately 3,200 feet of the existing 12-inch pipeline from Stefani Avenue to Nut Tree Road, with the proposed 15-inch pipeline shown in Figure 5.2. The 1,600-foot, 8-inch sewer main in Nut Tree Road and Grapevine Drive should also be upsized and replaced by a 10-inch trunk sewer. Please note that diameters depicted for the Stefani Avenue trunk sewer assume that the City will implement a storm drain project and divert storm runoff away from the sewer collection system.

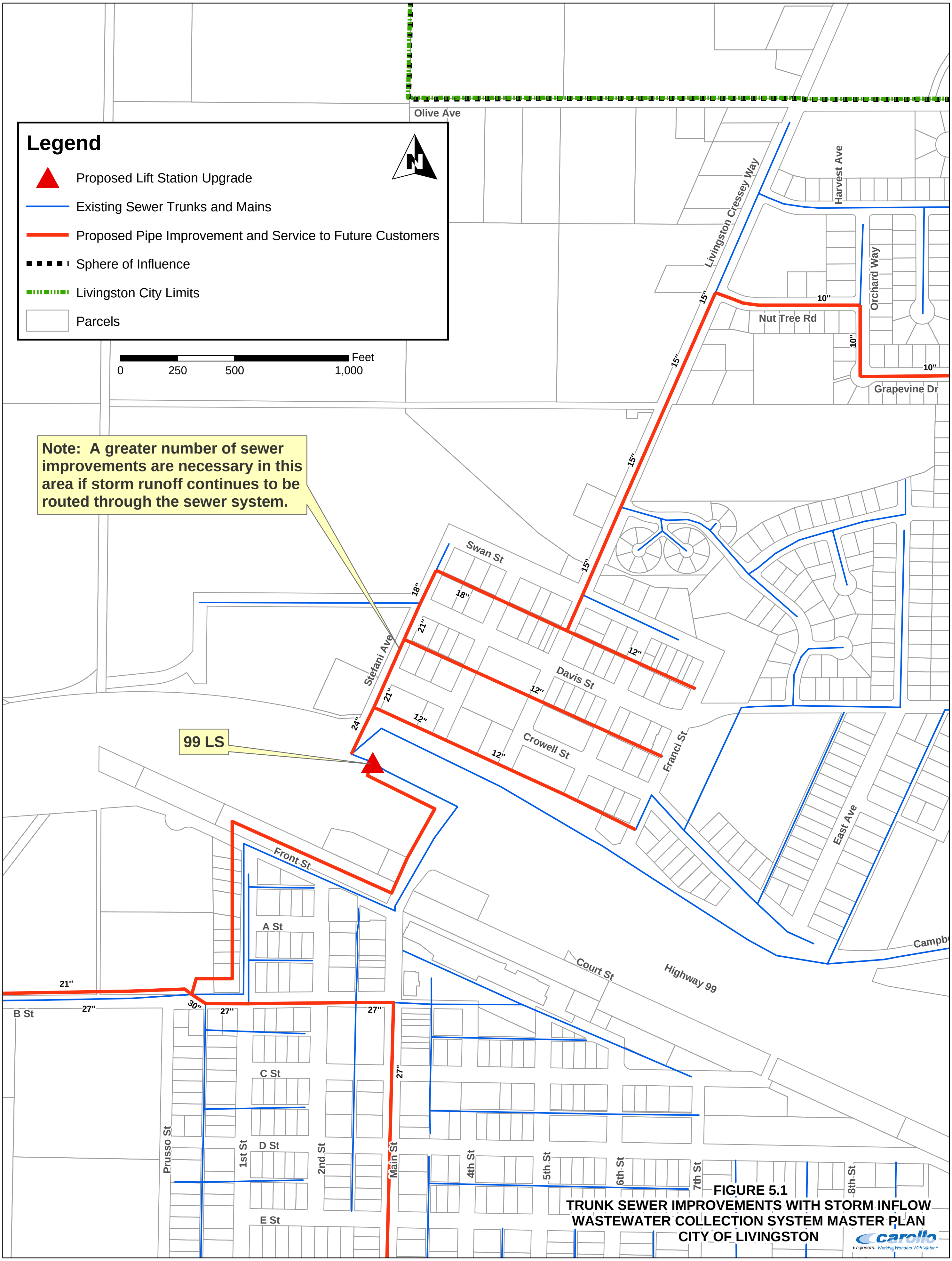

FIGURE 5.1
TRUNK SEWER IMPROVEMENTS WITH STORM INFLOW
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

carollo

FIGURE 5.2
TRUNK SEWER IMPROVEMENTS
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

5.2.2. Vinewood Avenue Trunk

5.2.2.1 Existing and Buildout Capacity Analysis

The segment of the 27-inch Vinewood Avenue trunk sewer immediately downstream of the 99 Lift Station force main discharge point is relatively flat and surcharges during existing PWWF conditions. If storm runoff is diverted away from the sanitary sewer system, then the impacts decrease.

At buildout, a majority of the Vinewood Avenue trunk sewer will surcharge. If storm flows upstream of the 99 Lift Station continue to discharge into the sanitary sewer system, then larger replacement pipelines would be necessary to prevent sewer overflows. The capacity deficiency starts at the WWTP and continues upstream. A few short sections of this trunk sewer between Robin Avenue and Gallo Road have steep slopes and therefore can convey larger peak flows without surcharging. Between Robin Avenue and Prusso Street, the pipe surcharges during PWWF and should be replaced.

A 12-inch trunk sewer in B Street, between 1st Street and Prusso Street currently slopes in the reverse direction to flow. This segment surcharges under existing peak flow conditions and a new pipe should be constructed parallel to it.

5.2.2.2 Proposed CIP

Improvements to the Vinewood Avenue trunk depend on the City's implementation of upstream storm drain projects. If the City constructs a storm drain project to divert runoff away from the sewer collection system, then the proposed parallel relief trunk can be a smaller diameter. If storm runoff is not diverted upstream of the 99 Lift Station, then a larger diameter relief trunk is necessary to convey future peak flows. The proposed improvements for the Vinewood Avenue trunk sewer assume that the City will construct a storm drain project to divert runoff away from the sewer collection system.

Figure 5.3 shows the Vinewood Avenue trunk sewer, from the WWTP to Prusso Street, and the proposed parallel relief trunk necessary to correct deficiencies created by future design flows. A 42-inch diameter trunk sewer, starting at the WWTP, should be constructed parallel to the existing sewer. The reason for the large size is that this reach will also convey flows from future development in Areas 1, 2, 3, 6, 7, 8, and the Urban Reserve.

Between Gallo Road and Robin Road, the diameter of the proposed parallel trunk reduces to 27-inch. Between Robin Road and Briarwood Drive, the parallel trunk reduces to 24-inch diameter, and between Briarwood Drive and Prusso Street, the diameter reduces to 21-inch. In total, approximately 11,750 feet of parallel relief trunk for the Vinewood Avenue trunk is proposed.

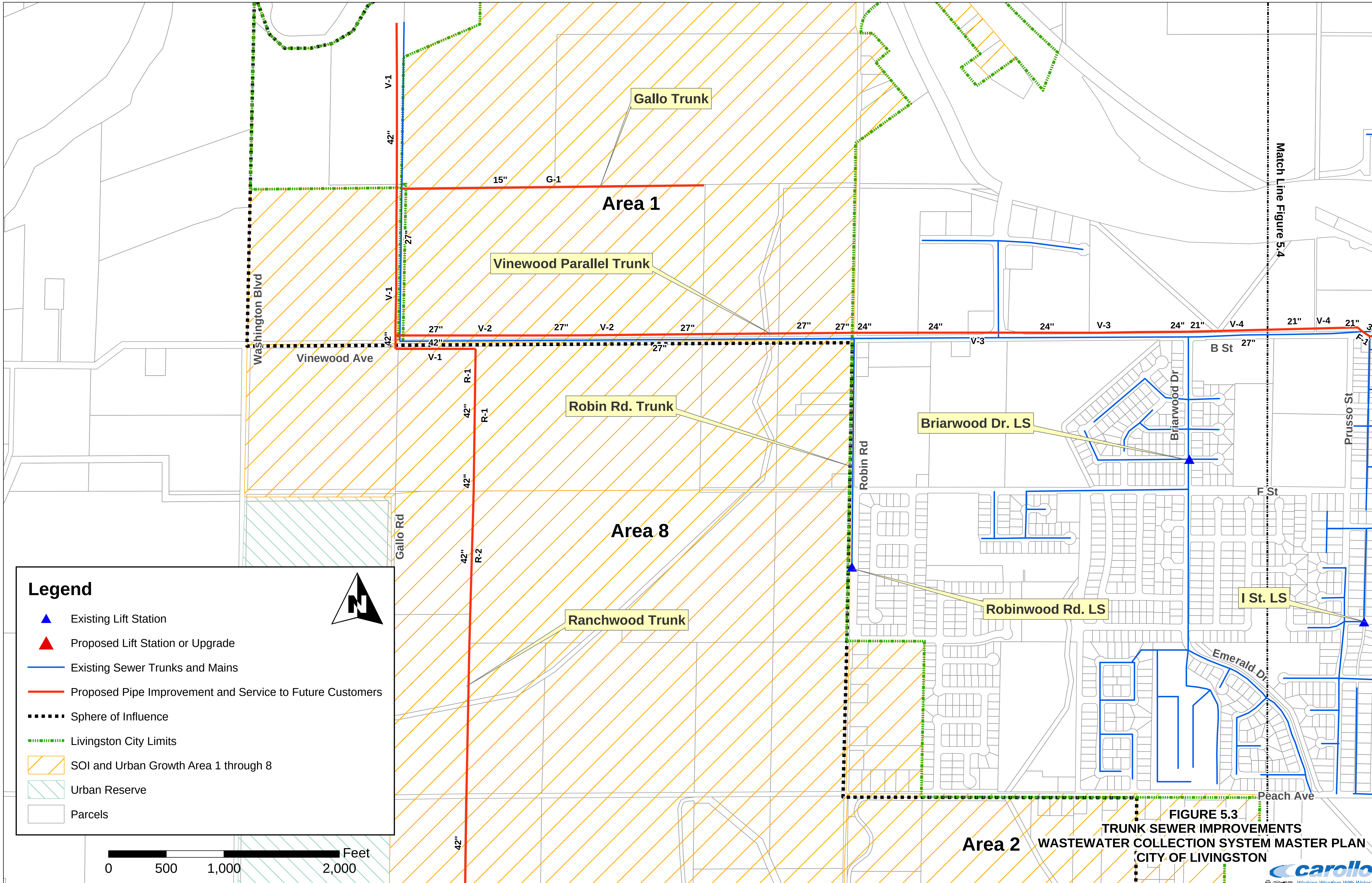

FIGURE 5.3
TRUNK SEWER IMPROVEMENTS
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

Currently, the existing 27-inch diameter sewer is at 50 percent of its capacity (assuming storm connections are removed). As the City continues to grow, the proposed improvements will need to be implemented to provide sufficient conveyance capacity. The parallel sewer should be in place when an additional 700 acres of land is developed. The 2004 developed acreage total was 914 acres; therefore, the parallel sewer should be in place when the City's total developed acreage equals 1,600 acres. Based on City population projections, this could occur between year 2010 and 2015. If storm connections are not removed, then installation of the parallel sewer should occur prior to further customers being added to the collection system.

5.2.3. F Street Trunk

5.2.3.1 Existing and Buildout Capacity Analysis

The existing 15- and 10-inch F Street trunk sewer surcharges during existing PWWF from B Street to 6th Street. The deficiency begins at B Street, where the F Street and Vinewood Avenue trunk sewers meet. Surcharge conditions continue upstream where the pipe diameter reduces from 15- to 10-inch.

Future development of Areas 4, 6 and the Urban Reserve east of Highway 99 will increase peak flows into the F Street trunk sewer. The model predicts that under future conditions, the entire F Street trunk will surcharge resulting in larger pipe diameters being required to correct the deficiency.

5.2.3.1.1Proposed CIP

Eliminating pipe surcharge for existing and future peak flows can be accomplished by constructing a new 27-inch diameter trunk sewer in Main Street to divert flow from the F Street trunk sewer. As shown in Figure 5.4, this 27-inch trunk sewer would begin at the Vinewood trunk near Prusso Street and continue east in B Street until reaching Main Street. At Main Street, the 27-inch diameter trunk would continue south in Main Street until reaching F Street where it would continue east to 6th street. In anticipation of future growth, a 24-inch diameter trunk would continue east in F Street to Hammatt Avenue. This proposed 5,100 foot relief trunk and replacement project would correct existing deficiencies and serve future customers in Areas 4, 6 and the Urban Reserve east of Highway 99. This project should be implemented in conjunction with the development of Areas 4 and 6, east of Highway 99.

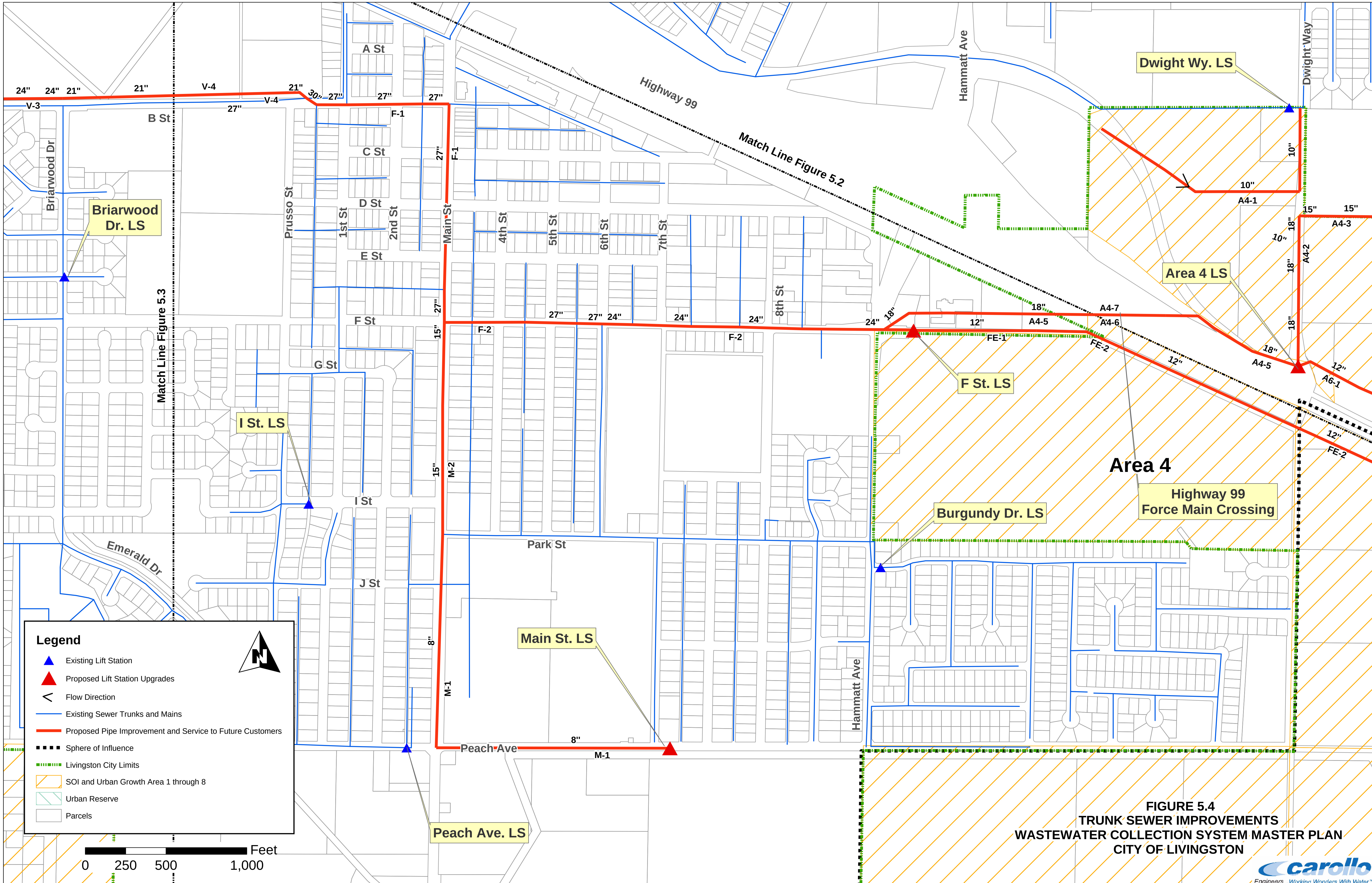

FIGURE 5.4
TRUNK SEWER IMPROVEMENTS
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

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5.3 EXISTING LIFT STATION IMPROVEMENTS

5.3.1. Capacity Analysis

The lift stations were evaluated on their ability to convey peak flow for existing and buildout conditions. Design information is not available for the I Street, Peach Avenue and Robin Road lift stations, therefore analysis of their capacity was not conducted. The conclusions discussed in this section are based on a lift station's firm capacity compared to the PWWF conveyed to the lift station. Table 5.2 summarizes each lift station's firm and total capacity, model predicted peak flows conveyed to each lift station, and the increase in firm capacity necessary to convey future peak flows. A lift station's capacity deficiency was determined by subtracting the firm capacity from the peak flow.

Each lift station has sufficient firm capacity to convey existing PWWFs, except for the Narada Way lift station. As mentioned, the Narada Way lift station has been upgraded.

5.3.1.1 99 Lift Station

The 99 Lift Station was recently upgraded to a firm and total capacity of 1,740 and 2,320 gpm, respectively. This lift station was analyzed with and without storm inflow conveyed to the Stefani Trunk sewer. If storm runoff continues to enter the sanitary sewer system, then the capacity of the 99 Lift Station will need to be increased by approximately 1,200 gpm at buildout. If storm runoff is diverted away from the sanitary system, then no improvement to the 99 Lift Station is necessary.

Table 5.2 Lift Station Capacity Improvement
Wastewater Collection System Master Plan
City of Livingston

Lift Station	Number of Pumps	Capacity per pump (gpm)	Firm Capacity [1] (gpm)	Total Capacity (gpm)	TDH (ft)	Existing PWWF (gpm)	Existing Capacity Improvement (gpm)	Buildout PWWF (gpm)	Buildout Capacity Improvement (gpm)
Walnut Avenue	2	300	300	600	16	108	none	198	none
Narada Way	2	150	150	300	16	109	none	383	**233**
Briarwood Drive	2	745	745	1,490	20	135	none	603	none
Burgundy Drive	2	335	335	670	22	181	none	285	none
Dwight Way	2	595	595	1,190	37	293	none	617	none
I Street [2]	n/a	n/a	n/a	n/a	n/a	56	n/a	66	n/a
Peach Avenue [2]	n/a	n/a	n/a	n/a	n/a	56	n/a	56	n/a
Robin Road [2]	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Notes:
1. Firm capacity of lift station with the largest pump out of service.
2. Information not available for the I Street and the Peach Avenue Lift Stations

Table 5.3 summarizes the 99 Lift Station's firm and total capacity, the PWWF and the firm capacity improvement required to convey peak flows. Two sets of numbers are provided, one assuming that runoff is directed out of the collection system, and the second set assuming that storm runoff continues to flow directly into the sanitary sewer system.

5.3.2. Proposed Lift Station CIP

5.3.2.1 99 Lift Station

If the City implements improvements proposed in the storm water master plan and diverts runoff away from the sanitary sewer collection system, then not only will the 99 Lift Station have sufficient firm capacity to convey existing peak flows, it will have sufficient supplemental capacity to accommodate approved and pending subdivisions east of Highway 99, including Country Villas Unit 4. This assumes that Areas 4, 6, and the Urban Reserve will be conveyed to a new proposed lift station south of the Dwight Way lift station. This proposed lift station is discussed later in this chapter. Note that even though Country Villas Unit 4 is within Area 4, flows from this development will flow to the Highway 99 lift station.

If storm flows continue to combine with sanitary sewer in the Stefani Avenue trunk line, then the model predicts that current and future peak flows will exceed the 99 Lift Station's firm capacity. A new lift station containing three pumps, 700 gpm each would be necessary to convey the model predicted peak flow.

5.3.2.2 Narada Way Lift Station

The Narada Way Lift Station's firm capacity was upgraded by City staff and the Kishi subdivision developer during preparation of this master plan.

5.4 FUTURE DEVELOPMENT IMPROVEMENTS

Future developments will be served by upsizing existing facilities and by constructing new sewers. Since flows from future developments are often routed through existing trunk sewers, it sometimes results in capacity deficiencies that require sewer replacement. Deficiencies to existing trunk sewers resulting from future development and the corresponding improvements were discussed previously. While this section provides a general description of the proposed expansion improvements, and Figure 5.5 provides a graphical representation of the improvements, more detailed pipe information (e.g. length and street location) is provided in the CIP table in Chapter 6.

Table 5.3 99 Lift Station Capacity Improvement
Wastewater Collection System Master Plan
City of Livingston

Lift Station	Number of Pumps	Capacity per pump (gpm)	Firm Capacity [1] (gpm)	Total Capacity (gpm)	TDH (ft)	Storm Runoff Diverted from Sanitary Sewer: Existing PWWF (gpm)	Storm Runoff Diverted from Sanitary Sewer: Buildout PWWF (gpm)	Storm Runoff Diverted from Sanitary Sewer: Existing Capacity Improvement (gpm)	Storm Runoff Diverted from Sanitary Sewer: Buildout Capacity Improvement (gpm)
99 Lift Station	4	580	1,740	2,320	69	968	1,712	none	none
						Direct Storm Inflow to the Sanitary Sewer			
						Existing PWWF (gpm)	**Buildout PWWF (gpm)**	**Existing Capacity Improvement (gpm)**	**Buildout Capacity Improvement (gpm)**
						2,966	3,864	**1,226**	**2,124**

Notes:
1. Firm capacity of lift station with the largest pump out of service.

The total flows, trunk sewer alignments, and pipeline diameters for proposed expansion areas should be used as a guideline for planning. The final sizing and alignment of proposed trunk sewers should be confirmed as part of the final sewer design.

5.4.1. Gallo Trunk Sewer

As growth begins in the City's northwest expansion area (Area 1 north of Vinewood Avenue), a new 15-inch diameter trunk sewer should provide sufficient capacity to convey wastewater to the new 42-inch diameter trunk sewer in Gallo Road, upstream of the WWTP. Figure 5.5 shows a conceptual alignment for the 15-inch trunk sewer. Conveying flow from Area 1 to the trunk sewer in Gallo Road is preferred over conveying flow south to Vinewood because the latter would require further upsizing of the Vinewood Avenue trunk sewer. The new 42-inch diameter trunk sewer is being designed as part of the WWTP expansion project, and should be operating by year 2010.

5.4.2. Ranchwood Trunk Sewer

Growth of Areas 2, 3, 6, 7, 8, the southern third of Area 1 and the Urban Reserve would trigger the construction of the largest trunk sewer to serve future customers. As shown in Figure 5.5, the Ranchwood trunk sewer would begin as a 42-inch diameter pipe east of the intersection of Vinewood Avenue and Gallo Road. The pipeline would start south until reaching Magnolia Avenue. At Magnolia Avenue, the alignment continues east. West of Main Street, the trunk diameter reduces to 36-inch and continues east towards Dwight Way. Between Dwight Way and Highway 99, the diameter ranges from 30-inch down to 24-inch.

Ranchwood Homes constructed approximately 6,000 feet of this sewer, from Vinewood Avenue to north of Magnolia Avenue. Currently no flow is conveyed in this 42-inch diameter reach.

A large area north of Highway 99 will also flow tributary to the Ranchwood trunk sewer. This area is primarily Urban Reserve, and will likely not be developed until after Areas 1 through 8 are developed. A list station is proposed to pump wastewater across Highway 99. Upstream of the lift station, the trunk sewer diameter ranges from 24-inch down to 15-inch.

The Ranchwood lift station should have sufficient capacity to pump approximately 3.5 mgd across Highway 99. A possible configuration is the installation of four pumps (three firm and one standby), each with a capacity of 800 gpm.

The entire length of the Ranchwood trunk sewer is approximately 7.7 miles. The Ranchwood trunk sewer would have sufficient capacity to convey future PWWFs not only from future development within Areas 1, 2, 3, 6, 7, and 8, but also from buildout of the Urban Reserve.

Review of available ground elevations indicates that this alignment and the proposed pipeline diameters will preclude the need for a lift station except to pump across

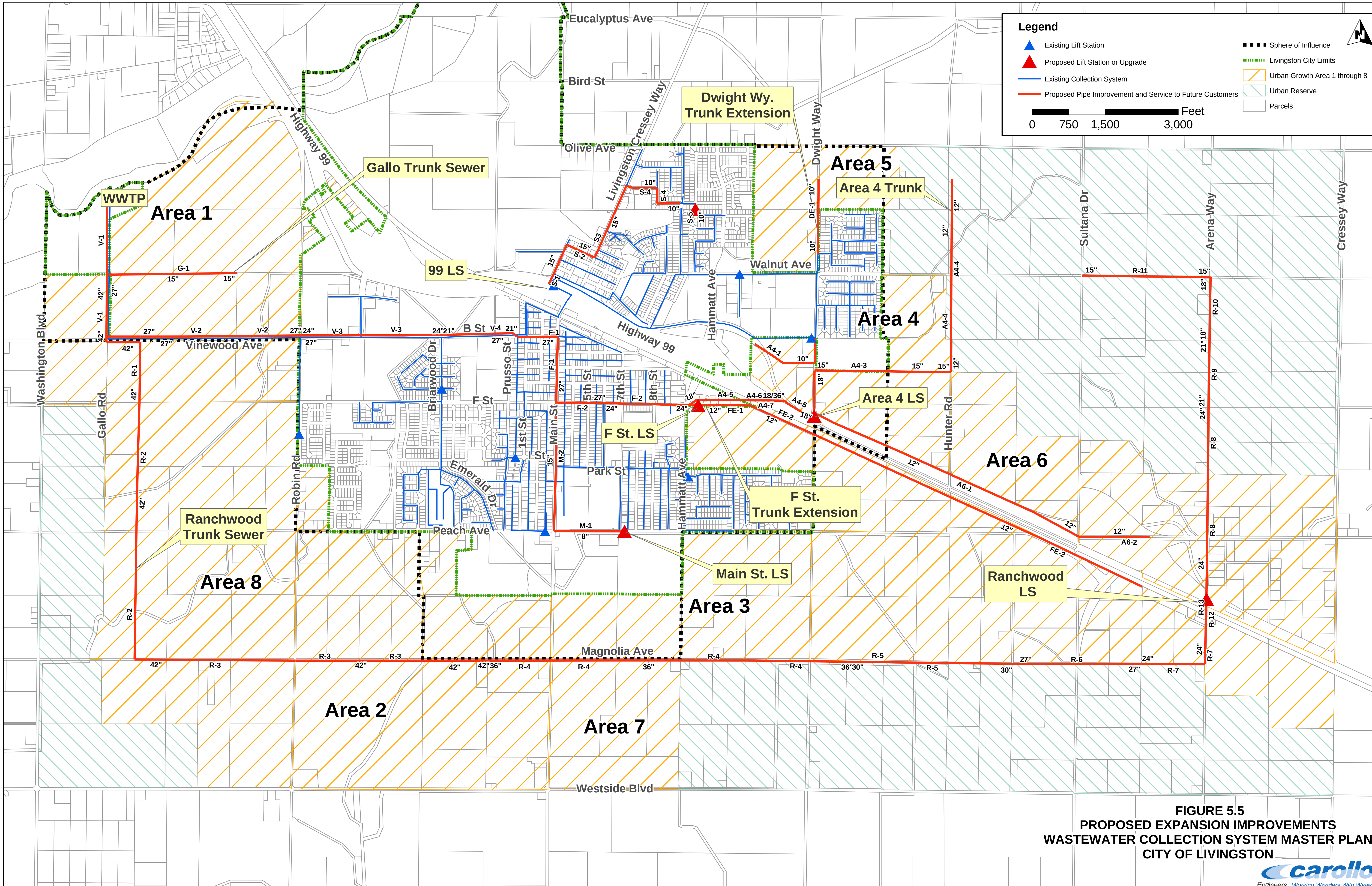

FIGURE 5.5
PROPOSED EXPANSION IMPROVEMENTS
WASTEWATER COLLECTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

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Highway 99. Modifying the alignment and reducing pipe diameters could trigger the need for a lift station because smaller diameter pipes would be installed at steeper slopes.

5.4.3. F Street Trunk Sewer Extension

The existing 10-inch F Street trunk sewer terminates near Hammatt Avenue, which is also the termination point of the 24-inch replacement sewer in F Street. Area 4 is currently divided by Highway 99 into two sections. In order to serve future development within the south-west section of Area 4 and parts of Area 6 along Highway 99, a 12-inch trunk should be extended east from Hammatt Avenue and along Highway 99 as shown in Figure 5.5. The purpose of extending the sewer south-east along Highway 99 is to support commercial and industrial development along the highway.

A lift station will be necessary to convey flow collected from development south of F Street and along Highway 99. The proposed lift station should be sized to convey a buildout PWWF of 500 gpm. A possible configuration is the installation of three new pumps (two firm and one standby), each with a capacity of 250 gpm.

5.4.4. Area 4 and 6 Trunk Sewer

Providing sewer service to the north-east portions of Areas 4, 6, and the Urban Reserve that is north-east of Highway 99 will require the construction of trunk sewers and a lift station east of Highway 99. The lift station would pump wastewater through a force main under Highway 99 to the proposed 24-inch replacement sewer in F Street. The lift station could be constructed near the future extension of Campbell Boulevard and Dwight Way, as shown in Figure 5.5.

The trunk sewers serving Area 4 and the Urban Reserve range in size from 10- to 12-inch diameter. The proposed lift station should have sufficient firm capacity to convey a buildout PWWF of 2.07 mgd. While not constituting a design, a possible configuration for this lift station includes the installation of four pumps (three firm and one standby) with a capacity of 500 gpm each. This would provide a firm and total capacity of approximately 2.2 and 2.9 mgd, respectively.

The trunk sewer serving Area 6 north of Highway 99 is a 12-inch diameter. This sewer runs from the lift station to Sultana Drive and will serve the commercial development planned along Highway 99.

5.4.5. Dwight Way Trunk Sewer Extension

The existing 10-inch Dwight Way trunk sewer terminates near Oak Street in the north. Development of Area 5 will require the extension of this sewer to the north as shown in Figure 5.5.

5.4.6. Main Street Forcemain and Lift Station

As shown in Figure 5.5, a new forcemain and lift station are recommended to convey wastewater generated from an 80-acre development located southeast of Peach Avenue and Lincoln Boulevard. Developments that would be served by this lift station and forcemain include Yagi and Kounalakis. The proposed lift station should have sufficient firm capacity to convey a buildout PWWF of 150 gpm. While not constituting a design, a possible configuration for this lift station includes the installation of two pumps with a capacity of 150 gpm each. This would provide a firm and total capacity of approximately 0.22 and 0.44 mgd, respectively. A 1,300 foot, 8-inch diameter forcemain would convey flows from the lift station to a gravity sewer at Park and Main Street. A new 15-inch diameter sewer would convey flows from Park Street to the proposed 27-inch diameter sewer at the intersection of F and Main Street.

5.5 WASTEWATER TREATMENT PLANT IMPROVEMENTS

As a separate project, Carollo completed the Wastewater Treatment Plant Capacity Analysis in December 2005 (Appendix D). The WWTP Capacity Analysis reports that the ability of the existing oxidation ditch to treat wastewater will be reached when the City's population exceeds 24,000 people. Updated City population projections indicate that 2009/2010 is the year when the oxidation ditch's capacity will be reached. The existing WWTP site possesses sufficient land to expand the treatment capacity to 4.0 mgd. To treat wastewater flows greater than 4.0 mgd, additional land for percolation of treated effluent should be purchased. As the City continues to grow and experience increases in wastewater flow, land is available near the existing WWTP to expand its capacity. The City is currently designing an expansion to the WWTP, which will increase its treatment capacity to 4.0 mgd. Additional WWTP expansion requirements are presented in Appendix D. Note that the costs for WWTP improvements are not included in this collection system's capital improvement program. Also note that the WWTP Capacity Analysis was based on earlier population projection, different than the one shown in Appendix A.

CAPITAL IMPROVEMENT PROGRAM

This chapter presents the recommended Capital Improvement Program (CIP) for the City's wastewater collection system. The program is based on evaluation of the City's sewer system and on the recommended projects described in the previous chapters. The CIP has been prepared to assist the City in planning and constructing the sewer system improvements through the residential buildout of the current City limits, Areas 1 through 8 of the City's annexation and development scenarios, and the Urban Reserve.

6.1 COST ESTIMATING CRITERIA

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

6.1.1 Cost Estimating Accuracy

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

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

- An Order of Magnitude Estimate for Master Plan Studies. This is an approximate estimate made without detailed engineering data. It is normally expected that an estimate of this type would be accurate within +50 percent to -30 percent.

- A Budget Estimate for Predesign Study. A budget estimate is prepared with the use of flow sheets, layouts, and equipment details. It is normally expected that an estimate of this type would be accurate within +30 percent to -15 percent.

- A Definite Estimate (Engineer's Estimate) for Time of Contract Bidding. This estimate is prepared from very defined engineering data. The data includes fairly complete plot plans and elevations, soil data, and a complete set of specs. It is expected that a definite estimate would be accurate within +15 to -5 percent.

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

6.1.2 Pipelines

Pipeline improvements range in size from approximately 8- to 42-inches in diameter. Pipeline unit costs for this size range are shown on Table 6.1. Pipeline costs reflect June 2007 dollars.

Table 6.1 Pipeline Costs
Wastewater Collection System Master Plan
City of Livingston

Pipe Size (inches)	$/Linear Foot
8	148
10	185
12	190
15	200
18	215
21	234
24	242
27	280
30	329
33	362
36	409
39	485
42	606

Notes:
1. Pipeline costs include utilities, construction staging, traffic control, lighting, and signing.
2. ENR CCI 20 City Average June 2007 = 7939

6.1.3 Land Acquisition

Acquisition of property, easements, and right-of-way (ROW) may be required for some of the recommended projects. Additionally, the capital costs do not include pipeline corridor purchases or easement costs because it was assumed that public ROW will be utilized wherever possible. Land costs in Merced County are not easily determined, particularly in the master-planning phase, and variables affecting properties can result in widely varying land prices. Since land acquisition costs are not included in this master plan, the final capital costs may vary from the estimates presented herein.

6.2 CAPITAL IMPROVEMENT PROGRAM

The CIP for the improvements identified by this master plan are presented in Table 6.2. This table is organized into two groups, existing facility improvements and service to future development improvements. Each group is further broken down by trunk sewer name and pipe segment. For each pipe segment, the street location, limits, existing diameter, proposed improvement and pipe length are provided. Table 6.2 does not include the WWTP improvement costs presented in Appendix D.

The table also shows the calculated capital improvement cost, and for financing purposes, the breakdown in cost sharing between existing and future users. Discussions on the methods for calculating the capital improvement costs and user benefits are provided below.

6.2.1 Baseline Construction Cost

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

- Pipe Unit Cost: Estimated unit cost of pipeline is based on the pipe's present day cost and is expressed in dollars per linear foot ($/LF) of pipe length.
- Pipe Cost: Estimated cost of the pipeline, calculated by multiplying the estimated length by the unit cost, in dollars.

6.2.2 Estimated Construction 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, in dollars, for the proposed improvement consists of the Baseline Construction Cost plus the construction contingency.

6.2.3 Capital Improvement Cost

Other project-related costs have been identified and estimated at 50 percent of the Estimated Construction Costs. These costs include engineering, administration, construction inspection, and legal costs.

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

6.2.4 Capital Improvement Program

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 improvements to serve the future customers are best distributed based on the order in which the City will develop.

It is assumed that any replacement pipes will be in the same alignment and at the same slope as the existing pipe. However, this study recommends an investigation of the alignment during the pre-design stage of each project.

6.2.4.1 Effect of Storm Drain Improvements on Wastewater CIP

As previously discussed in this report, the City is completing a storm water master plan project. Preliminary results from the storm water master plan indicate that there is a financial benefit to intercepting storm runoff from the City's sanitary sewer system. Information provided by the City's consultant, included as Appendix C of this master plan, indicates that a proposed 30-inch diameter storm drain could divert storm runoff currently entering the City's sanitary sewer facilities along Stefani Avenue into a storm detention basin. The cost for implementing this storm drain project is estimated at approximately $800,000.

Implementing this storm drain project is beneficial from a financial perspective because the avoided costs for improving the sewer collection system are greater than the storm drain project costs. The increase in wastewater collection and pumping capital costs to convey both sanitary sewer and storm runoff is approximately $3.34 million. The increase in cost results from larger pipe sizes, more pipe replacements and larger lift station capacity requirements if storm runoff continues to combine with sanitary sewer. These costs do not include the increase in treatment plant capacity required to treat storm runoff.

The net reduction in costs attributed to implementing the storm drain project is approximately $2.54 million. Of this amount, the projected savings to existing users is approximately $820,000 and the savings to future users is approximately $1.72 million. This master plan recommends implementing the storm drain project as an effective approach for providing relief to the Stefani Avenue trunk sewer and the 99 Lift Station.

6.2.4.1.1 *CIP Prioritization*

The proposed CIPs that mitigate existing deficiencies or will serve approved or pending subdivisions should be constructed as soon as possible. The proposed CIPs that fall into this category include the Stefani Avenue Trunk and the Narada Way lift station. Improvements to the Narada Way lift station were completed.

The remaining improvements and their prioritization is directly connected to the schedule for developing Areas 1 through 8 and the Urban Reserve. As these areas develop, the existing facility improvements and new service extensions to serve Areas 1 through 8 must also be developed.

Assumptions were made regarding the timing of development for the eight areas. These assumptions dictated the phasing of the improvement to serve each area. If development in Livingston progresses at a slower or more rapid pace, then appropriate adjustments to the phasing schedule in Table 6.2 should be made.

The CIP phasing in Table 6.2 also depends on the City's approach to resolving the combined storm water and sanitary sewer collection system. If the system continues to operate under existing conditions, then the timeframe to implement improvements on the Vinewood Avenue Trunk will move up because the available capacity in the pipeline will be exceeded as the community continues to grow.

6.3 FUNDING AND FINANCING OPTIONS

Utility rates and connection fees are collected to pay off debt financing, to fund capital improvements, and to pay operations and maintenance costs. Connection fees are charges, imposed by local agencies on new developments, for recovering the capital costs of public facilities needed to service those developments. These fees and charges must satisfy the provisions of California Government Code Section 66000, which went into effect on January 1, 1989. These provisions, for water and sewer connection fees, are also known as AB 1600 provisions, referring to Assembly Bill 1600 that introduced the provision. The provisions, as they relate to water and sewer connection fees, dictate that the ".... charges do not exceed the estimated reasonable cost of providing the service for which the fee or charge is imposed..."

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

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

An opinion of benefit to future users, based on future average sewer flows, was included in this master plan. Once estimates for specific projects are completed, a more precise allocation may be performed if required by the provisions of the California Government Code Section 66000 and AB 1600.

New development is defined as any land use change or construction that takes place after the funding procedures recommended in this plan are adopted. Existing development includes properties where no new construction or redevelopment occurs. Due to state law and political realities, the funding and financing options available differ somewhat for these two categories.

Table 6.2 Capital Improvement Program
Wastewater Collection System Master Plan
City of Livingston

Coded No.	Type of Improv.	Description/ Street	Description / Limits	Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Parallel/ Replace	Length (ft)	Unit Cost ($)	Pipe Cost ($)	Baseline Construction Cost ($)	Estim. Construction Cost[1] ($)	Capital Improvement Cost[2,3] ($)	Phase I 2006-10 ($)	Phase II 2010-15 ($)	Phase III 2015-2024 ($)	Phase IV 2024-2044 ($)	Future Users Benefit (%)	Total Capital Cost ($)	Future Users Cost ($)	Existing Users Cost ($)
	Pipeline and Lift Station Unit Costs									Itemized Cost Estimate							Financing			
EXISTING FACILITY IMPROVEMENTS																				
Stefani Avenue Trunk																				
S-1	Pipe	Stefani Ave.	99 Lift Station to Davis Street	12	15	Replace	730	200	145,653	145,653	174,784	262,000	262,000				49%	262,000	128,380	133,620
S-2	Pipe	Stefani Ave.	Davis St. to Livingston/Cressey Way	12	15	Replace	818	200	163,212	163,212	195,854	294,000	294,000				100%	294,000	294,000	0
S-3	Pipe	Livingston/Cressey Way	Alley south of Swan to Nut Tree Rd.	12	15	Replace	1,610	200	321,236	321,236	385,483	578,000	578,000				100%	578,000	578,000	0
S-4	Pipe	Nut Tree Rd.	Livingston/Cressey Way to Olds Ave.	8	10	Replace	1,589	185	294,400	294,400	353,279	530,000	530,000				100%	530,000	530,000	0
S-5	Pipe	Narada Way	Upstream of Narada Lift Station	8	10	Replace	128	185	23,715	23,715	28,458	43,000	43,000				100%	43,000	43,000	0
LS	Lift Station	Narada Way	Upgrade existing lift station with 2, 125 gpm pumps		250 gpm	Upgrade			310,000	310,000	372,000	558,000	558,000				100%	558,000	558,000	0
Vinewood Avenue Trunk																				
V-1	Pipe	Gallo Rd.	WWTP to Vinewood Ave.	-	42	Parallel	3,380	606	2,049,130	2,049,130	2,458,956	3,688,000		3,688,000			100%	3,688,000	3,688,000	0
V-2	Pipe	Vinewood Ave.	East of Gallo Rd. to Robin Ave.	-	27	Parallel	3,656	280	1,022,052	1,022,052	1,226,462	1,840,000		1,840,000			100%	1,840,000	1,840,000	0
V-3	Pipe	Vinewood Ave.	Robin Ave. to Briarwood Dr.	-	24	Parallel	2,965	242	718,362	718,362	862,035	1,293,000		1,293,000			100%	1,293,000	1,293,000	0
V-4	Pipe	B Street	Briarwood Dr. to alley near Prusso St.	-	21	Parallel	1,757	234	410,278	410,278	492,333	738,000		738,000			100%	738,000	738,000	0
F Street Trunk																				
F-1	Pipe	B Street	Prusso Street to F St.	-	27	Parallel	3,224	280	901,284	901,284	1,081,541	1,622,000	1,622,000				77%	1,622,000	1,249,097	372,903
F-2	Pipe	F St.	6th St. to east of Hammatt Ave.	10	24	Replace	1,907	242	462,029	462,029	554,435	832,000	832,000				100%	832,000	832,000	0
SERVICE TO FUTURE DEVELOPMENT [4]																				
Gallo Trunk: Area 1																				
G-1	Pipe	North of Vinewood Ave.	Area 1 to Gallo Rd.	-	15	New	2,689	200	536,524	536,524	643,828	966,000	966,000				100%	966,000	966,000	0
Ranchwood Trunk: Area 1, 2, 3, 6, 7, 8 and Urban Reserve																				
R-1	Pipe	East of Gallo Rd.	Vinewood to future F Street extension	-	42	New	1,419	606	860,269	860,269	1,032,322	1,548,000	1,548,000				100%	1,548,000	1,548,000	0
R-2	Pipe	East of Gallo Rd.	Future F Street extension to Magnolia Ave.	-	42	New	5,271	606	3,195,543	3,195,543	3,834,652	5,752,000	5,752,000				100%	5,752,000	5,752,000	0
R-3	Pipe	Magnolia	East of Gallo Rd. to west of Main St.	-	42	New	7,272	606	4,408,650	4,408,650	5,290,379	7,936,000		7,936,000			100%	7,936,000	7,936,000	0
R-4	Pipe	Magnolia	West of Main St. to east of Dwight Way	-	36	New	7,378	409	3,016,991	3,016,991	3,620,390	5,431,000		2,715,500	2,715,500		100%	5,431,000	5,431,000	0
R-5	Pipe	Magnolia	East of Dwight Way to west of Sultana Drive	-	30	New	3,382	329	1,112,299	1,112,299	1,334,758	2,002,000			2,002,000		100%	2,002,000	2,002,000	0
R-6	Pipe	Magnolia	West of Sultana Drive to west of Arena Way	-	27	New	2,615	280	731,035	731,035	877,243	1,316,000			1,316,000		100%	1,316,000	1,316,000	0
R-7	Pipe	Magnolia	West of Arena Way to Highway 99	-	24	New	2,360	242	571,782	571,782	686,139	1,029,000			1,029,000		100%	1,029,000	1,029,000	0
R-8	Pipe	Arena Way	Highway 99 to F Street	-	24	New	4,370	242	1,058,767	1,058,767	1,270,520	1,906,000				1,906,000	100%	1,906,000	1,906,000	0
R-9	Pipe	Arena Way	F Street to Vinewood Ave.	-	21	New	1,350	234	315,239	315,239	378,287	567,000				567,000	100%	567,000	567,000	0
R-10	Pipe	Arena Way	Vinewood Avenue to Walnut Ave.	-	18	New	1,320	215	283,633	283,633	340,359	511,000				511,000	100%	511,000	511,000	0
R-11	Pipe	Walnut Avenue	Arena Way to Sultana Drive	-	15	New	2,760	200	550,690	550,690	660,828	991,000				991,000	100%	991,000	991,000	0
R-12	Force Main	Highway 99 Crossing	At Highway 99 Crossing - Directional Drilling		12	New	500	300	150,000	150,000	180,000	270,000				270,000	100%	270,000	270,000	0
R-13	Casing Pipe	Highway 99 Crossing	Casing Pipe at Highway 99 Crossing		36	New	500	409	204,459	204,459	245,350	368,000				368,000	100%	368,000	368,000	0
LS	Lift Station	Highway 99 Crossing	New Lift Station with 4, 800 gpm pumps		3,200 gpm	New			1,267,182	1,267,182	1,520,618	2,281,000				2,281,000	100%	2,281,000	2,281,000	0

Table 6.2 Capital Improvement Program
Wastewater Collection System Master Plan
City of Livingston

				Pipeline and Lift Station Unit Costs						Itemized Cost Estimate							Financing			
Coded No.	Type of Improv.	Description/ Street	Description / Limits	Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Parallel/ Replace	Length (ft)	Unit Cost ($)	Pipe Cost ($)	Baseline Construction Cost ($)	Estim. Construction Cost[1] ($)	Capital Improvement Cost[2,3] ($)	Phase I 2006-10 ($)	Phase II 2010-15 ($)	Phase III 2015-2024 ($)	Phase IV 2024-2044 ($)	Future Users Benefit (%)	Total Capital Cost ($)	Future Users Cost ($)	Existing Users Cost ($)
F Street Extension: Area 4 (south):																				
FE-1	Pipe	F St.	Hammatt Ave. to east of Hammatt Ave.	-	12	New	1,100	190	208,625	208,625	250,349	376,000		376,000			100%	376,000	376,000	0
FE-2	Pipe	Highway 99 Frontage	East of Hammatt Ave. to terminus point	-	12	New	9,280	190	1,760,032	1,760,032	2,112,039	3,168,000		3,168,000			100%	3,168,000	3,168,000	0
LS	Lift Station	F St.	Pump wastewater from Area 4 to F St. Trunk with 3, 250 gpm pumps	-	750 gpm	New			916,117	916,117	1,099,340	1,649,000		1,649,000			100%	1,649,000	1,649,000	0
Area 4 Trunk: Area 4 (north) and Urban Reserve																				
A4-1	Pipe	Future Campbell Blvd.	Hammatt Ave. to Dwight Way	-	10	New	1,509	185	279,578	279,578	335,493	503,000	503,000				100%	503,000	503,000	0
A4-2	Pipe	Future Dwight Way	Lift station to upstream point	-	18	New	835	215	179,419	179,419	215,303	323,000	323,000				100%	323,000	323,000	0
A4-3	Pipe	Undeveloped Area	Area 4 Future Development	-	15	New	2,050	200	409,027	409,027	490,832	736,000		736,000			100%	736,000	736,000	0
A4-4	Pipe	Undeveloped Area	Urban Reserve Future Development	-	12	New	4,725	190	896,137	896,137	1,075,365	1,613,000			1,613,000		100%	1,613,000	1,613,000	0
A4-5	Force Main	Highway 99 Crossing	Forcemain at Highway 99 Crossing	-	18	New	1,782	215	382,904	382,904	459,485	689,000	689,000				100%	689,000	689,000	0
A4-6	Force Main	Highway 99 Crossing	Forcemain at Highway 99 Crossing-Direction Drilling	-	18	New	500	450	225,000	225,000	270,000	405,000	405,000				100%	405,000	405,000	0
A4-7	Casing Pipe	Highway 99 Crossing	Casing Pipe at Highway 99 Crossing	-	36	New	500	409	204,459	204,459	245,350	368,000	368,000				100%	368,000	368,000	0
LS	Lift Station	Future Dwight Way	Pump wastewater from Area 4/6 to F St. Trunk with 4, 500 gpm pumps		2,000 gpm	New			1,082,904	1,082,904	1,299,485	1,949,000	1,949,000				100%	1,949,000	1,949,000	0
Dwight Way Extension: Area 5																				
DE-1	Pipe	Dwight Way	Oak St. north to terminus point	-	10	New	1,700	185	314,965	314,965	377,958	567,000		567,000			100%	567,000	567,000	0
Area 6 Trunk: Area 6 (north)																				
A6-1	Pipe	Future highway frontage road	Dwight Way to Sultana Drive	-	12	New	6,026	190	1,142,883	1,142,883	1,371,460	2,057,000		2,057,000			100%	2,057,000	2,057,000	0
A6-2	Pipe	Future Peach Ave.	Sultana Dr. to study boundary	-	12	New	1,350	190	256,039	256,039	307,247	461,000		461,000			100%	461,000	461,000	0
Main Street Lift Station and Forcemain																				
M-1	Pipe	Main Street	Peach Ave. to Park St.	-	8	New	2,688	148	396,570	396,570	475,884	714,000	714,000				100%	714,000	714,000	0
M-2	Pipe	Main Street	F St. to Park St.	-	15	New	1,531	200	305,473	305,473	366,568	550,000	550,000				100%	550,000	550,000	0
LS	Lift Station	Main Street	Main St. and Peach Ave. 2, 150 gpm pumps	-	300 gpm	New			862,995	862,995	1,035,594	1,553,000	1,553,000				100%	1,553,000	1,553,000	0
											Total Livingston CIP	**62,833,000**	**20,039,000**	**27,224,500**	**8,675,500**	**6,894,000**	**Total**	**62,833,000**	**62,326,477**	**506,523**

Notes:

1. Baseline Construction costs plus 20% to account for unforseen events and unknown conditions.
2. Estimated Construction Cost plus 50% to cover other costs including; engineering, administration, construction inspection, and legal costs.
3. Land acquisition costs, which may be required for some of the proposed improvements, can widely vary and are NOT included in this capital improvement program.
4. Does not include Wastewater Treatment Plant improvement costs from Appendix D.

APPENDIX A - PACIFIC MUNICIPAL CONSULTANTS LAND USE AND POPULATION PROJECTIONS

Updated Land Use Area Calculations
General Plan Update
April 2007

Population Projections

Phase	Area of Development	Year Completed	Total Population*
-	Existing City (2004)	Current	13,000
1	Buildout of Existing City Limits	2009	19,756
2	Buildout of Existing Sphere of Influence	2012	39,659
3	Buildout of Areas 1-8	2024	72,837
4	Buildout of Master Plan Study Area	2044	110,906

** Assumes 4.34 persons per household per the City's Housing Element*

Land Use Summary Tables

Area 1

	2006 Figures					2007 Figures				
Land Use	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**
Low-Density Residential	76.2	17.2%	4.5 dwelling units/acre	342	1,484	332.39		4.5 dwelling units/acre	1,495	6,488
Medium-Density Residential	239.8	54.0%	9 dwelling units/acre	2,158	9,365	49.43		9 dwelling units/acre	444	1,926
High-Density Residential	52.6	11.8%	20 dwelling units/acre	1,052	4,565	7.18		20 dwelling units/acre	143	620
Neighborhood Commercial	28	6.3%				-				
Community						19.46				

Commercial										
Service Commercial						27.61				
Highway Commercial						4.91				
Office	2.2	0.5%				-				
Light Industrial						-				
General Industrial						7.00				
Public Facilities						99.98				
Parks and Open Space	45.1	10.2%				34.24				
Urban Reserve						-				
Industrial Reserve						18.89				
TOTAL	**443.9**	**100%**		**3,552**	**15,414**	**601.10**			**2,082**	**9,034**

Area 2

	2006 Figures					**2007 Figures**				
Land Use	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**
Low-Density Residential	303.3	53.2%	4.5 dwelling units/acre	1,364	5,919	490.76		4.5 dwelling units/acre	2,208	9,582
Medium-Density Residential	114.3	20.0%	9 dwelling units/acre	1,028	4,461	32.87		9 dwelling units/acre	295	1,280
High-Density Residential	22.7	4.0%	20 dwelling units/acre	454	1,970	0.23		20 dwelling units/acre	4	17
Neighborhood Commercial	41	7.2%				17.75				
Community Commercial						18.87				
Service Commercial						-				
Highway Commercial						-				

Office						-				
Light Industrial						-				
General Industrial						-				
Public Facilities	24.4	4.3%				26.88				
Parks and Open Space	64.3	11.3%				-				
Urban Reserve						-				
Industrial Reserve						-				
TOTAL	**570**	**100%**		**2,846**	**12,350**	**587.37**			**2,507**	**10,879**

Area 3

	2006 Figures					**2007 Figures**				
Land Use	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**
Low-Density Residential	228	85.1%	4.5 dwelling units/acre	1,026	4,452	256.41		4.5 dwelling units/acre	1,153	5,004
Medium-Density Residential	8	3.0%	9 dwelling units/acre	72	312	-		9 dwelling units/acre	-	-
High-Density Residential						0.05		20 dwelling units/acre	1	4
Neighborhood Commercial	12	4.5%				10.17				
Community Commercial						-				
Service Commercial						-				
Highway Commercial						-				
Office						-				
Light Industrial						-				
General Industrial						-				
Public Facilities						-				

Parks and Open Space	20	7.4%				7.20				
Urban Reserve						-				
Industrial Reserve						-				
TOTAL	**268**	**100%**		**1,098**	**4,764**	**273.83**			**1,154**	**5,008**

Area 4

	2006 Figures					**2007 Figures**				
Land Use	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**
Low-Density Residential	130	39.4%	4.5 dwelling units/acre	585	2,539	88.15		4.5 dwelling units/acre	396	1,718
Medium-Density Residential	10	3.0%	9 dwelling units/acre	90	391	-		9 dwelling units/acre	-	-
High-Density Residential						18.01		20 dwelling units/acre	360	1,562
Neighborhood Commercial						-				
Community Commercial						-				
Service Commercial	100	30.3%				170.64				
Highway Commercial						-				
Office						-				
Light Industrial	30	9.1%				28.70				
General Industrial						-				
Public Facilities	50	15.2%				38.43				
Parks and Open Space	10	3.0%				0.02				
Urban Reserve						2.31				
Industrial Reserve						-				
TOTAL	**330**	**100%**		**675**	**2,930**	**346.25**			**756**	**3,280**

Area 5

	2006 Figures					2007 Figures				
Land Use	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**
Low-Density Residential	107	85.6%	4.5 dwelling units/acre	481	2,087	95.98		4.5 dwelling units/acre	431	1,870
Medium-Density Residential	10	8.0%	9 dwelling units/acre	90	390	9.65		9 dwelling units/acre	86	373
High-Density Residential						14.33		20 dwelling units/acre	286	1,241
Neighborhood Commercial						-				
Community Commercial						5.25				
Service Commercial						-				
Highway Commercial						-				
Office						-				
Light Industrial						-				
General Industrial						-				
Public Facilities						0.05				
Parks and Open Space	8	6.4%				-				
Urban Reserve						0.60				
Industrial Reserve						-				
TOTAL	**125**	**100%**		**571**	**2,477**	**125.85**			**803**	**3,484**

Area 6

	2006 Figures					2007 Figures				
Land Use	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**
Low-Density Residential	142.8	18.2%	4.5 dwelling units/acre	642	2,786	164.10		4.5 dwelling units/acre	738	3,202
Medium-Density Residential	56.6	7.2%	9 dwelling units/acre	509	2,209	56.38		9 dwelling units/acre	507	2,200
High-Density Residential						14.62		20 dwelling units/acre	292	1,267
Neighborhood Commercial	10	1.3%				8.48				
Community Commercial						-				
Service Commercial	189.0	24.2%				368.84				
Highway Commercial	261.2	33.4%				167.92				
Office						-				
Light Industrial	115.3	14.7%				92.55				
General Industrial						-				
Public Facilities						-				
Parks and Open Space	8	1.0%				-				
Urban Reserve						0.48				
Commercial Reserve						155.17				
TOTAL	**782.9**	**100%**		**1,151**	**4,995**	**1,028.52**			**1,537**	**4,689**

Area 7

	2006 Figures					2007 Figures				
Land Use	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**
Low-Density Residential	110	70.5%	4.5 dwelling units/acre	495	2,148	107.41		4.5 dwelling units/acre	483	2,096
Medium-Density Residential	24	15.4%	9 dwelling units/acre	216	937	39.74		9 dwelling units/acre	357	1,549
High-Density Residential						-		20 dwelling units/acre	-	-
Neighborhood Commercial	12	7.7%				9.72				
Community Commercial						-				
Service Commercial						-				
Highway Commercial						-				
Office						-				
Light Industrial						-				
General Industrial						-				
Public Facilities						-				
Parks and Open Space	10	6.4%				-				
Urban Reserve						-				
Industrial Reserve						-				
TOTAL	**156**	**100%**		**711**	**3,086**	**156.87**			**840**	**3,645**

Area 8

	2006 Figures					2007 Figures				
Land Use	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**	**Acreage**	**Percent of Total**	**Density**	**Units**	**Population**
Low-Density Residential	572.3	88.5%	4.5 dwelling units/acre	2,575	11,175	572.25		4.5 dwelling units/acre	2,575	11,175
Medium-Density Residential	45.4	7.0%	9 dwelling units/acre	408	1,770	48.38		9 dwelling units/acre	435	1,887
High-Density Residential						-		20 dwelling units/acre	-	-
Neighborhood Commercial	9.2	1.4%				-				
Community Commercial						9.25				
Service Commercial						-				
Highway Commercial						-				
Office						-				
Light Industrial						-				
General Industrial						-				
Public Facilities	19.7	3.1%				19.09				
Parks and Open Space						-				
Urban Reserve						1.47				
Industrial Reserve						-				
TOTAL	**646.6**	**100%**		**2,983**	**12,945**	**650.44**			**3,010**	**13,062**

Area 9

(Outside Proposed SOI)

Land Use	Acreage	Percent of Total	Density	Units	Population
Low-Density Residential	3.22		4.5 dwelling units/acre		
Medium-Density Residential	3.05		9 dwelling units/acre		
High-Density Residential	-		20 dwelling units/acre		
Neighborhood Commercial	-				
Community Commercial	-				
Service Commercial	2.63				
Highway Commercial	0.30				
Office	-				
Light Industrial	-				
General Industrial	-				
Public Facilities	-				
Parks and Open Space	-				
Urban Reserve	2,217.86				
Commercial Reserve	0.01				
County	0.01				
TOTAL	**2,227.09**				

			Residential			Commercial				Office	Industrial		Public Facility	Parks/ Open Space	Reserve		
	Land Use	**TOTAL**	**LDR**	**MDR**	**HDR**	**NC**	**CC**	**SC**	**HC**	**O**	**LI**	**GI**	**PF**	**POS**	**IR**	**CR**	**UR**
Area 1	Acreage	**601.09**	332.39	49.43	7.18	0	19.46	27.61	4.91	0	0	7	99.98	53.13	0	0	0
	Percentage of Total Acreage	**100%**	55.30%	8.22%	1.19%	0.00%	3.24%	4.59%	0.82%	0.00%	0.00%	1.16%	16.63%	8.84%	0.00%	0.00%	0.00%
	Density (du/acre)		4.5	9	20												
	Units	**2082**	1495	444	143												
	Population	**9034**	6488	1926	620												
Area 2	Acreage	**587.37**	490.76	33.1	0	17.75	18.87	0	0	0	0	0	26.88	0	0	0	0
	Percentage of Total Acreage	**100%**	83.55%	5.64%	0.00%	3.02%	3.21%	0.00%	0.00%	0.00%	0.00%	0.00%	4.58%	0.00%	0.00%	0.00%	0.00%
	Density (du/acre)		4.5	9	20												
	Units	**2507**	2208	295	4												
	Population	**0**															
Area 3	Acreage	**273.83**	256.43	0.00	0.00	10.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.20	0.00	0.00	0.00
	Percentage of Total Acreage	**100%**	93.65%	0.00%	0.00%	3.72%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.63%	0.00%	0.00%	0.00%
	Density (du/acre)		4.5	9	20												
	Units	**1154**	1153	0	1												
	Population	**0**															
Area 4	Acreage	**346.25**	88.54	0.00	18.01	0.00	0.00	171.05	0.00	0.00	28.81	0.00	39.84	0.00	0.00	0.00	0.00
	Percentage of Total Acreage	**100%**	25.57%	0.00%	5.20%	0.00%	0.00%	49.40%	0.00%	0.00%	8.32%	0.00%	11.51%	0.00%	0.00%	0.00%	0.00%
	Density (du/acre)		4.5	9	20												
	Units	**756**	396	0	360												
	Population	**0**															
Area 5	Acreage	**125.85**	95.03	9.76	15.11	0	5.95	0	0	0	0	0	0.05	0	0	0	0.6
	Percentage of Total Acreage	**100%**	75.51%	7.76%	12.01%	0.00%	4.73%	0.00%	0.00%	0.00%	0.00%	0.00%	0.04%	0.00%	0.00%	0.00%	0.48%
	Density (du/acre)		4.5	9	20												
	Units	**803**	431	86	286												
	Population	**0**															
Area 6	Acreage	**1034.06**	165.53	73.99	0	8.48	0	156.01	382.43	0	92.42	0	0	0	0	155.2	0
	Percentage of Total Acreage	**100%**	16.01%	7.16%	0.00%	0.82%	0.00%	15.09%	36.98%	0.00%	8.94%	0.00%	0.00%	0.00%	0.00%	15.01%	0.00%
	Density (du/acre)		4.5	9	20												
	Units	**1537**	738	507	292												
	Population	**0**															
Area 7	Acreage	**156.87**	107.41	39.74	0	9.72	0	0	0	0	0	0	0	0	0	0	0
	Percentage of Total Acreage	**100%**	68.47%	25.33%	0.00%	6.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
	Density (du/acre)		4.5	9	20												
	Units	**840**	483	357	0												
	Population	**0**															
Area 8	Acreage	**650.44**	573.72	48.38	0	0	9.25	0	0	0	0	0	19.09	0	0	0	1.47
	Percentage of Total Acreage	**100%**	88.20%	7.44%	0.00%	0.00%	1.42%	0.00%	0.00%	0.00%	0.00%	0.00%	2.93%	0.00%	0.00%	0.00%	0.23%
	Density (du/acre)		4.5	9	20												
	Units	**3010**	2575	435	0												
	Population	**0**															
Area Outside Proposed SOI	Acreage	**2227.09**	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2227.09
	Percentage of Total Acreage	**100%**	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
	Density (du/acre)																
	Units	**0**															
	Population	**0**															

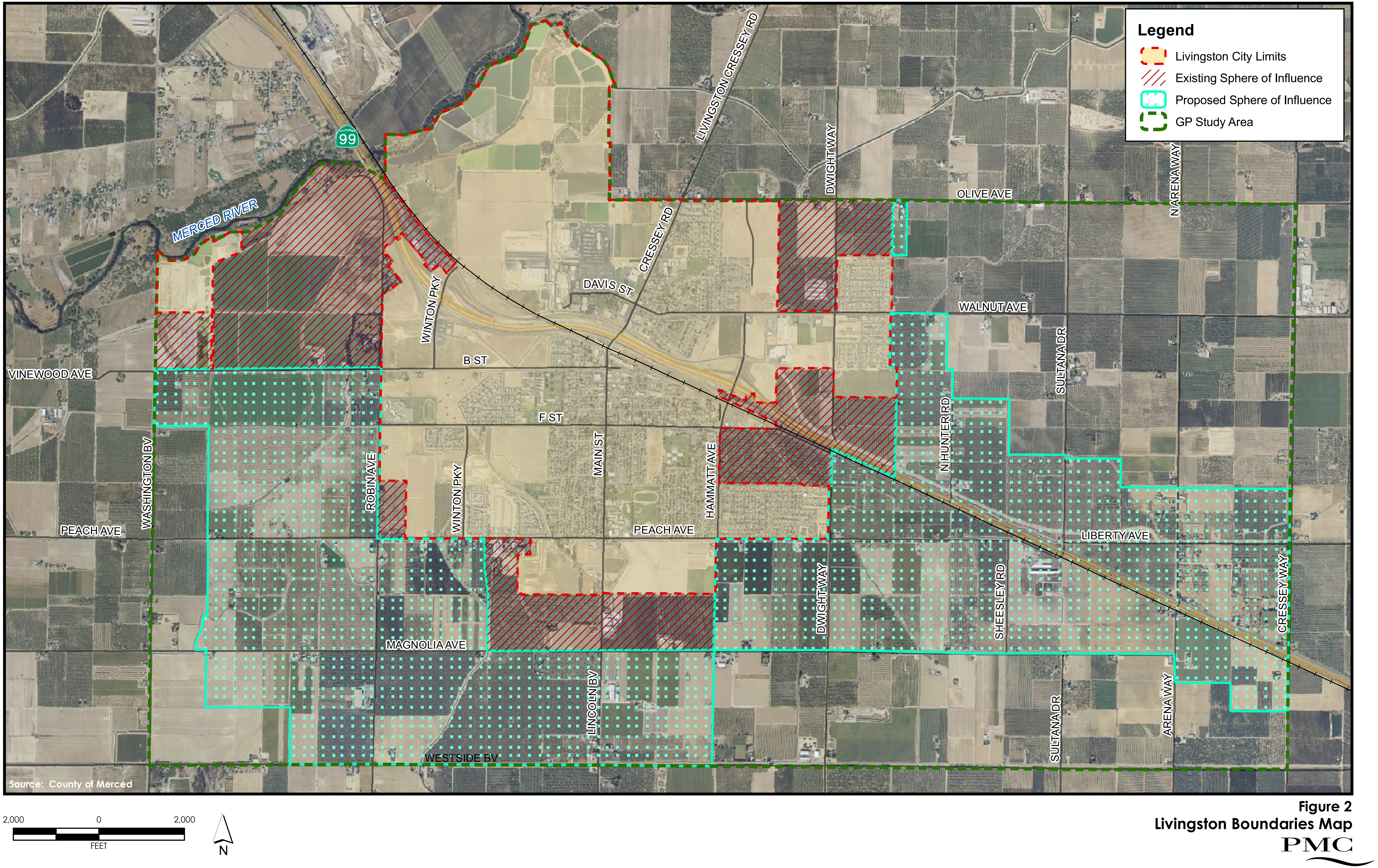
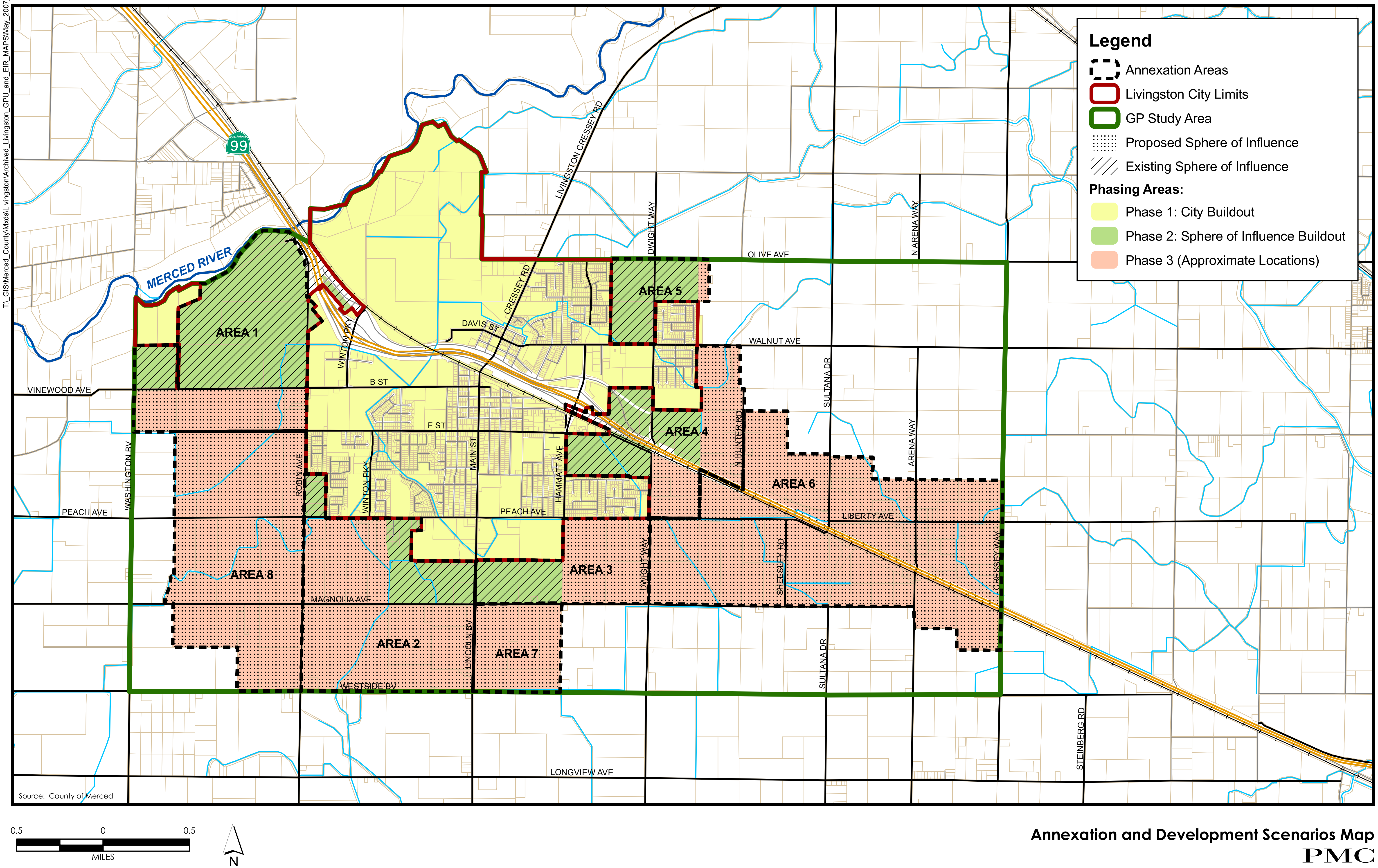
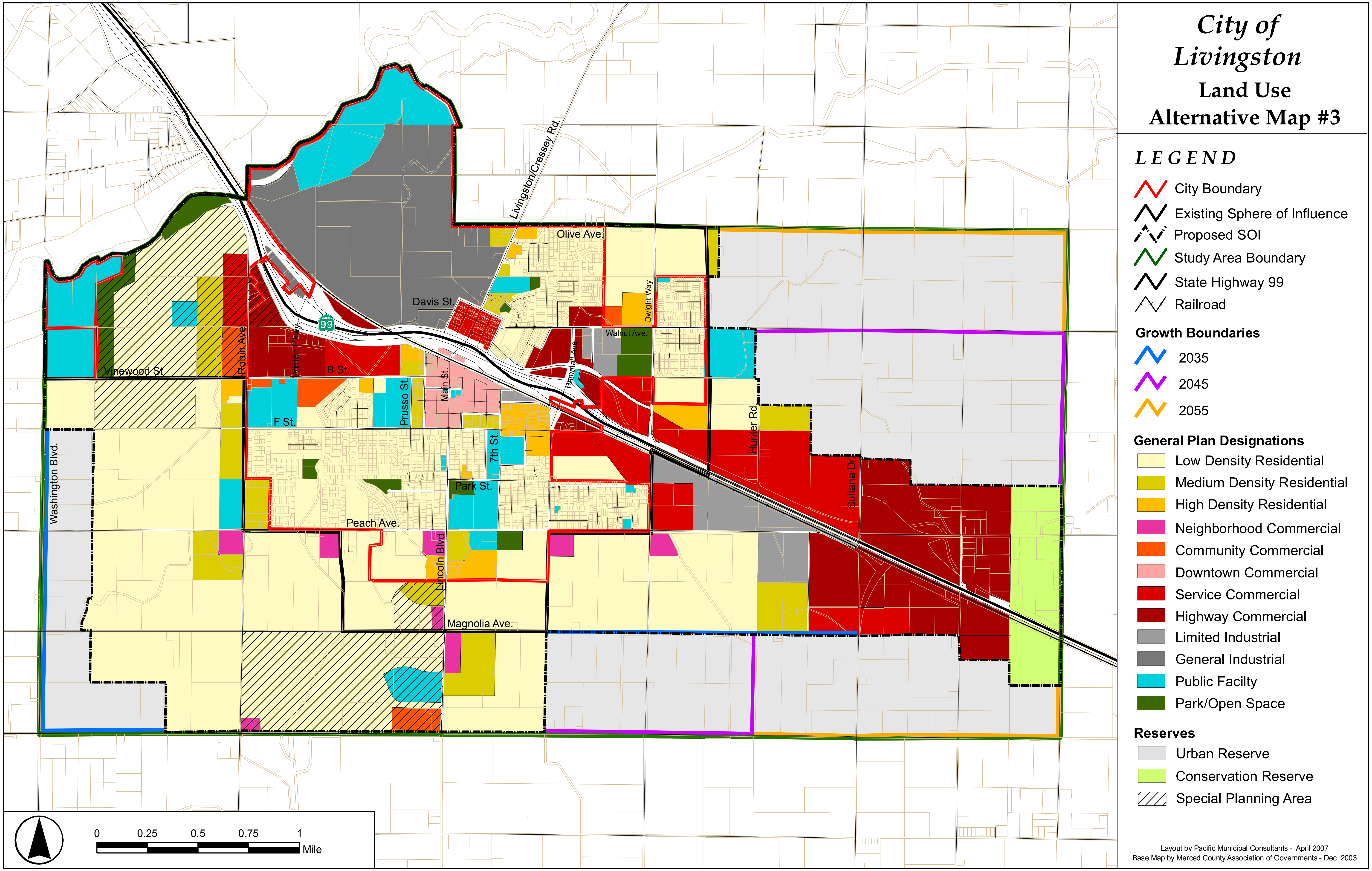


Figure 2
Livingston Boundaries Map



Annexation and Development Scenarios Map

PMC



City of Livingston
Land Use
Alternative Map #3
LEGEND
City Boundary
Existing Sphere of Influence
Proposed SOI
Study Area Boundary
State Highway 99
Railroad
Growth Boundaries
2035
2045
2055
General Plan Designations
Low Density Residential
Medium Density Residential
High Density Residential
Neighborhood Commercial
Community Commercial
Downtown Commercial
Service Commercial
Highway Commercial
Limited Industrial
General Industrial
Public Facilty
Park/Open Space
Reserves
Urban Reserve
Conservation Reserve
Special Planning Area
Olive Ave.
Livingston/Cressey Rd.
Davis St.
Dwight Way
Walnut Ave.
99
Robin Ave
Vinewood St
B St.
F St.
Prusso St.
Main St.
7th St.
Park St.
Peach Ave.
Lincoln Blvd
Magnolia Ave.
Washington Blvd.
Hunter Rd.
Sultana Dr.
0
0.25
0.5
0.75
1
Mile
Layout by Pacific Municipal Consultants - April 2007
Base Map by Merced County Association of Governments - Dec. 2003

APPENDIX B - V&A CONSULTING ENGINEERS, INC.
SANITARY SEWER FLOW-MONITORING STUDY

Sanitary Sewer Flow Monitoring Study
Master Plan
City of Livingston, California
by V&A Consulting Engineers, Inc.
Submitted under separate cover to the City, July 2004.

APPENDIX C - HARRIS AND ASSOCIATES STORM DRAIN MASTER PLAN AT STEFANI AVENUE

From: "James H. Nelson" <jnelson@stormwaterconsulting.com>
To: "Tony Akel (E-mail)" <takel@carollo.com>
Date: 9/10/2004 2:37:32 PM
Subject: City of Livingston - Storm Drain Interflow into Sanitary Sewer at Stefani

Tony:

As we discussed during our telephone conference last week, we are providing you with a drainage map and cost estimate depicting the storm drainage infrastructure that will be required to intercept storm drainage currently entering the City's sanitary sewer facilities along Stefani Street and convey it to an acceptable master planned storm drainage facility. The 10-year storm flow is about 20 cfs (arriving in a combination of storm drain flows and surface flows) and we would propose to capture this flow in a 30" RCP storm drain and convey it to the regional detention facility that will serve Drainage Zone F. As shown, the effective cost of doing this is about $773,000. Based on statements that you have made, we are assuming that you have concluded that continuing to accommodate this storm drainage in the City's sanitary sewer system as a long term solution is more expensive than $773,000, and therefore, we intend to incorporate this additional storm drainage infrastructure improvement into our preparation of the Storm Drainage Master Plan.

Please feel free to call if you have any questions.

Jim

Jim Nelson, P.E.
Storm Water Consulting, Inc.
1899 Sapphire Way
El Dorado Hills, CA 95762

ph (916) 801-3962
www.stormwaterconsulting.com

CC: <sroberts@harris-assoc.com>, <jlocaso@harris-assoc.com>, <nanda@sngassociates.com>

Scale: 1" = 1000'

DRAINAGE ZONE "F"

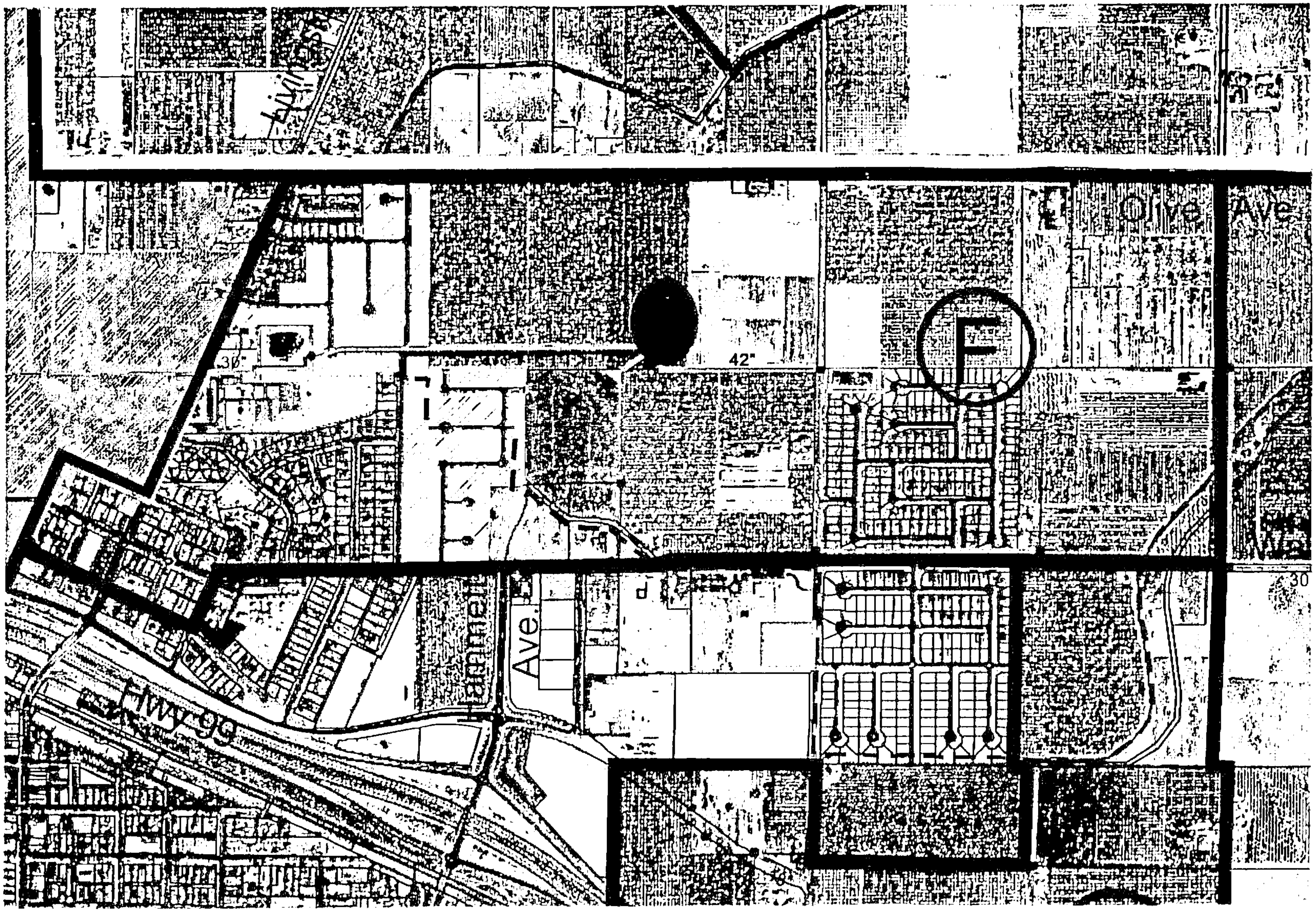


Exhibit X

City of Livingston - Storm Water Master Plan 2004

Drainage Infrastructure Cost Estimate for Capturing Storm Drain Flows at Stefani and Incorporating Required Storm Drains and Capacity Improvements into Drainage Zone F Infrastructure

DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL COST
Construction of Major Facilities				
Detention Basin F (Additional Storage Needed)	6	AF	$ 10,000	$ 60,000
Force Main (@ Det. Basin F, Proportional Share)	1	LS	$ 7,000	$ 7,000
Construction of Storm Drains				
30" SD	4,960	LF	$ 80	$ 396,800
Subtotal of Construction				**$ 463,800**
Design & Planning @ 10% of Construction Subtotal				**$ 46,380**
Construction Management @ 10% of Construction Subtotal				**$ 46,380**
Contingency @ 15% of Construction Subtotal				**$ 69,570**
Program Implementation @ 5% of Construction Subtotal				**$ 23,190**
Land Acquisition				
Right-of-Way (Additional Detention Area)	1.00	AC	$ 100,000	$ 100,000
30" SD Easement (Proportional Share)	0.10	AC	$ 100,000	$ 10,000
30" SD Easement	0.14	AC	$ 100,000	$ 14,000
Subtotal of Land Acquisition				**$ 124,000**
TOTAL ESTIMATED COST				**$ 773,320**

APPENDIX D - WASTEWATER TREATMENT PLANT CAPACITY ANALYSIS, CAROLLO ENGINEERINGS, DECEMBER 2005

City of Livingston

WASTEWATER TREATMENT PLANT
CAPACITY ANALYSIS

FINAL

December 2005

carollo engineers

December 16, 2005
6267B.02

City of Livingston
1416 "C" Street
Livingston, CA 95334

Attention: Mr. Nanda Gottiparthy, P.E., City Engineer

Subject: Wastewater Treatment Plant Capacity Analysis

Dear Mr. Gottiparthy:

In accordance with Task 2 of our proposal, we are providing you with five copies of the final Wastewater Treatment Plant Capacity Analysis. We will email you a PDF copy on December 20, 2005.

We are also sending one copy directly to Paul Creighton Director of Public Works.

If you have any questions, please do not hesitate to call.

Sincerely,

CAROLLO ENGINEERS, P.C.

David L. Stringfield, P.E.
Partner

Barry E. Hampson, P.E.
Project Manager

DLS/BEH:dlo

Enclosures: Five Copies of Final

cc: Paul Creighton, Director of Public Works, with attachment

7580 NORTH INGRAM AVENUE, SUITE 112 • FRESNO, CALIFORNIA 93711 • (559) 436-6616 • FAX (559) 436-1191

City of Livingston

WASTEWATER TREATMENT PLANT
CAPACITY ANALYSIS

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WASTEWATER TREATMENT PLANT CAPACITY ANALYSIS

1.0 OBJECTIVE

The objective of this wastewater treatment plant (WWTP) capacity analysis is to quantify available capacity to accommodate future growth and to determine phased improvements necessary to serve the City of Livingston (City) through the year 2050, which is estimated ultimate buildout design year. Capacity will be assessed for the following:

1. Existing design capacity of 2003 expansion
2. Amount allowable development before the expansion of the WWTP is required.
3. Remaining capacity to serve current City limits.
4. Capacity needed to serve Areas 1 through 5 of City's annexation and development scenarios (additional 4,467 acres).

The second objective is to determine the future land requirements for each expansion and to provide planning level capital costs estimates for each expansion. The planning level capital estimates will be based on year 2005 costs and will be separated by the facilities to provide the treatment capacity for existing and approved equivalent dwelling units (EDU's) and costs for required capacity for future equivalent dwelling units. The current development in Livingston is primarily residential with minor commercial and industrial facilities, so the equivalent dwelling units are approximately equal to the number of households provided with sewer service.

2.0 FLOWS AND LOADING PROJECTIONS

2.1 Flow Projections

Table 1 presents population and flow projections based on design years. Population projections were provided by Pacific Municipal Consultants (PMC) on October 6, 2005, and are included in Appendix A. Based on review of populations and flows for the year 2004 and 2005, the calculated per capita flows were 85 gpcpd (gallons per capita per day). Based on service billings in 2005 of 2,480 services, the calculated average persons per service was 5.2 persons/services. City staff noted that they plan on using 4.34 persons per service, reduced from 4.66 in the general plan. At a meeting with City staff on August 23, 2005 it was decided that future flow projections be based on 90 gpcd instead of 85 gpcd to account for an expected lower persons/service in the future.

Table 1 also presents Average Day Maximum Maximum Flows (ADMMF), which are approximately 110 percent of Average Annual Wastewater Flows (AAWF).

Peak hour flows (PHF) are used to design headworks and hydraulic capacity of pipelines and treatment units. The existing plant was designed for a PHF of 3.68 mgd but it has been able to process more than 3.68 mgd of wet weather flows during the peak hour in wet months. The peaking factor in 2005/2004 was approximately 3.6 times the AWWF. However, the future peak hour flows up to year 2050 are based on a peaking factor of 2.9 times the AAWF. This is still a relatively high peaking factor for the San Joaquin Valley and may be reduced by removing storm water from the collection system.

As noted in Table 1, the capacity of the existing oxidation ditch plant is estimated to be reached in the year 2008. Because of the acceleration in growth of the City, the design year of the existing facility is projected to be 2008 instead of 2017 as was projected in the year 2001 preliminary design report that was used for USDA funding.

Table 1 Population and Flow Projections for Design of WWTF
Wastewater Treatment Plant Capacity Analysis
City of Livingston

		Flow		
Year	**Population(1)**	**Average(2) Annual Wastewater Flow (AAWF) (mgd)**	**Average Day(3) Maximum Month (ADMMF) (mgd)**	**Peak Hour Flow(4)(5) (PHF) (mgd)**
2000	10,400	0.88	0.97	3.68
2004	12,500	1.07	1.17	3.68
2005	13,000	1.12	1.23	3.68
2006	20,682	1.86	2.04	5.39
2008(6)	24,154	2.17	2.39	6.29
2014	31,271	2.81	3.09	8.15
2019	39,517	3.56	3.92	10.32
2029	47,763	4.30	4.73	13.17
2050	66,400	6.00	6.60	17.4
Buildout(7)	114,093	10.2	11.3	24.5

(1) 2005 population as of July 2005.
(2) Flows projected at 90 gpcpd based on future 3.5 persons per dwelling unit.
(3) 110 percent of AAWF.
(4) Peak hour flow (PHF), in wet weather based on Collection System Flow Analysis.
(5) Flow of 3.68 mgd is based on normal wet well levels. During wet weather inflow of storm water raises wet well levels so existing pumps can pump greater than 3.68 mgd. Future PHF based on 2.9 x AAWF up to 2050. Used 2.4 x AAWF for Max Buildout.
(6) Design capacity of existing WWTP may be reached in year 2008.
(7) SOI plus Area 1-8 Buildout, plus Urban Reserve Buildout.

3.0 PLANT LOADINGS

Table 2 presents the projected BOD loadings for the respective design years. BOD loadings are used to access the treatment capacity. As shown in Table 2, the BOD loadings are also projected to meet the existing WWTP design loading by the year 2008.

Table 2 Projected BOD Loading
Wastewater Treatment Plant Capacity Analysis
City of Livingston

Design Year	Average Annual BOD, mgd$^{(1)}$	Max BOD, mgd(1) Dry Weather	Design Loading BOD, lbs/day (AAWF)
2004	269	310	2,945
2005	234	330	3,080
2008	270	330	5,119
2010	270	330	5,972
2029	270	330	11,834
2050	270	330	16,510

(1) Data for years 2004 and 2005 based on actual measurements. Loading projected as noted for future years.
(2) Existing WWTP capacity projected may be reached in year 2008.

4.0 DESIGN FLOWS REQUIRED FOR DEVELOPMENT SCENARIOS

Table 3 presents for estimated WWTP flows for development scenarios and what year the estimated design AAWF's will be reached.

The existing WWTP constructed in year 2003 is adequate to serve development within the existing city limits. The city limits include approximately 2,053 acres. Applying the sewer flow coefficients (gpd/acre) developed in the master plan, the average annual flow at buildout is 1.96 mgd. Based on Table 1, this capacity is estimated to be reached some time between 2007 and 2008. There are several development project proposals for annexation currently being processed through LAFCO. The City should evaluate timing of the various projects and adopt policies to address capacity allocation among projects within city limits versus projects in proposed annexation areas. If projects within the city limits are not ready for construction before projects in the annexation areas, the City could allocate some existing WWTP capacity to annexation areas, while the City plans and constructs the expansion of the WWTP to double the capacity.

Table 3	Estimate WWTP Flows Wastewater Treatment Plant Capacity Analysis City of Livingston		
Development Scenarios	**Population**	**Average Annual Wastewater Flow, AAWF, mgd**	**Estimate Year AAWF Flow Reached**
Year 2005 plus currently approved developments(1)	14,085	1.27	2006
Existing City limits	19,903	1.80	2008
Estimated year 2029(1)	47,763	4.30	2029
Existing City Limits Plus Areas 1 to 8	66,400	6.0	2050

(1) 2005 and 2029 population provided by Pacific Municipal Consultants (PMC) see Appendix A.

5.0 CAPITAL COST OF WWTP EXPANSION TO DOUBLE TREATMENT CAPACITY

5.1 2008 Expansion Requirements

Figure 1 shows the location of the existing WWTP and Percolation Pond Nos. 1 to 8. Appendix B includes an aerial photo taken in September 1998 of the area directly west of the WWTP. Figure 2 shows a preliminary site plan for the 2008 and future expansions. The 2008 expansion includes a new headworks to totally replace the existing headworks, new second oxidation ditch, two new secondary clarifiers, and second RAS/WAS pump station. Additional plant facilities are shown on Figure 2 as explained as follows.

The capacity of the existing WWTP is estimated to be exceeded in the year 2008. Therefore, the City should begin planning for the 2008 expansion immediately. The existing WWTP was master planned to add a second oxidation ditch and two more clarifiers to double the treatment capacity from approximately 2.0 mgd ADMMF to 4.0 mgd ADMMF.

The existing headworks was modified during the 2003 expansion to provide a peak hour pumping capacity to 3.68 mgd. Because of storm water entering the sanitary sewer system, this peak flow is currently exceeded during significant rainfall events. Therefore, the headworks will require replacing.

Table 4 presents the preliminary project costs of a recommended treatment plant expansion for the year 2008.

Table 4 includes costs to purchase an additional 20 acres of land west of the existing WWTP to construct additional percolation ponds to serve increased wastewater flows. The cost in Table 4 includes cost for excavating pond material and stock piling that material on existing land owned by the City. Table 4 also shows a credit if developers pay to remove the excess soil to be used in developments throughout the City.

The two new deeper percolation Ponds Nos. 7 and 8, constructed in 2003, have performed better than expected. These two ponds were constructed to an operating depth of 13 and 11 feet respectively, whereas the existing Ponds 1 to 6 only have an operating depth of 4 feet. These deeper ponds were constructed into a more permeable sand layer, whereas the existing shallow ponds are into a layer with more clay. Based on operating experience since 2003, both Ponds 7 and 8 are estimated to have a percolation capacity for 2.04 to 2.17 mgd, average annual wastewater flow (AAWF). Existing Ponds 7 and 8 comprise a land area of 19 to 20 acres. Therefore with every expansion of approximately 2.0 mgd, 20 acres of percolation ponds are estimated to be required. The first 20 additional acres should be a acquired by the City by January to April 2007.Since land acquisition normally takes considerable time, the City should begin negotiations with a landowner to the west of the existing treatment plant (see Figure 1 and Appendix B).

5.2 Additional Plant Facilities

With an expanded WWTP, additional facilities may be required for proper treatment and operation. These facilities are noted in Table 5 and are discussed as follows:

5.2.1 Centrifuge Building

In order to construct the second oxidation ditch, sludge drying beds Nos. 4A and 4B will be taken out of services. Also, as Livingston expands there will be development to the east and south of the WWTP. Sludge drying beds may not be acceptable to future residents and businesses near the WWTP. For this preliminary capacity analysis, the City should consider constructing a centrifuge building to dewater biosolids to 20 percent solids for hauling off to a licensed biosolids recycling facility. Based on preliminary analysis it is estimated that Livingston’s future biosolids could be dewatered within a two-story building containing 2 to 3 centrifuges. During detailed facility planning, centrifuges would be evaluated against other

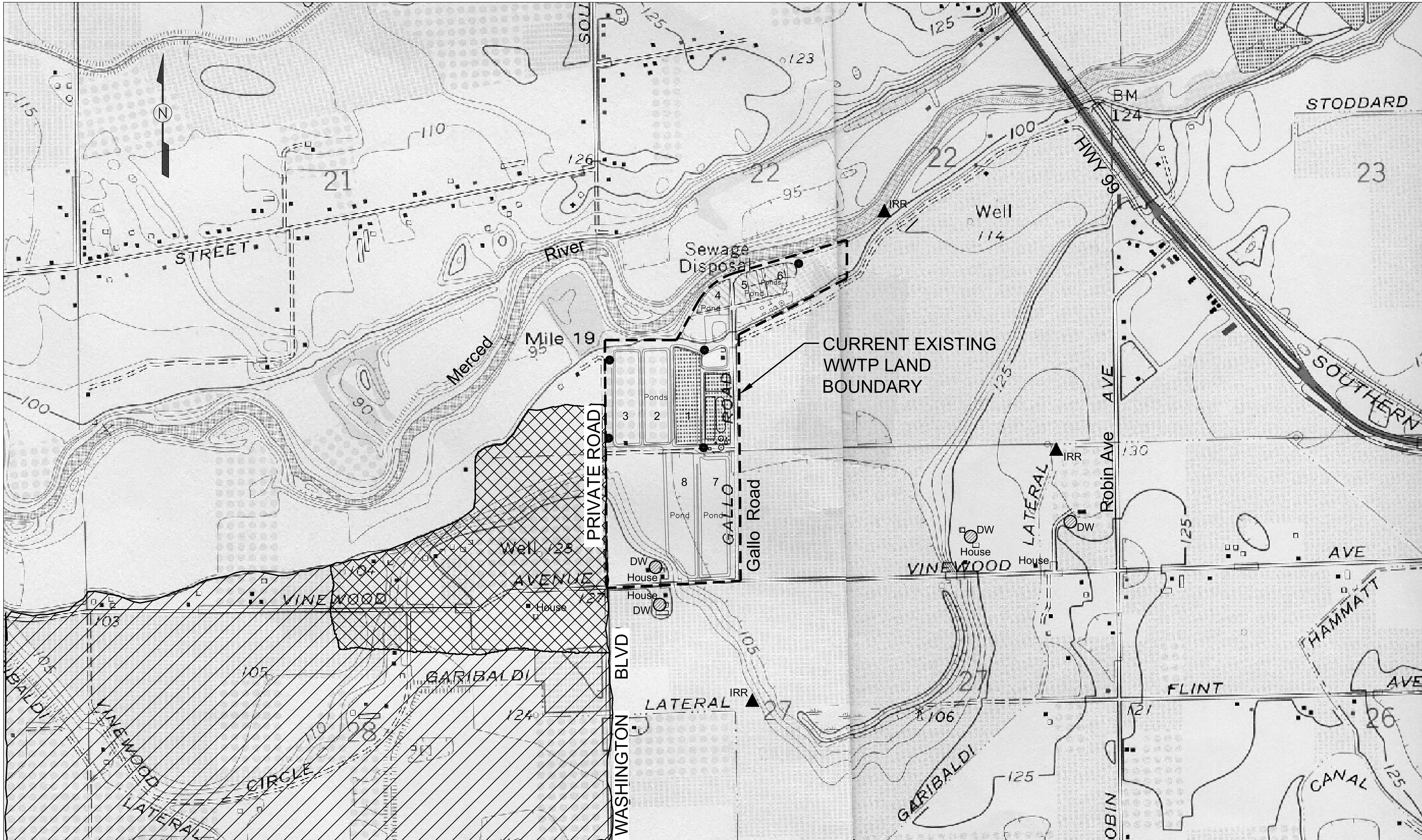
Table 4	Preliminary Project Cost for 2008 WWTF Expansion(1) Wastewater Treatment Plant Capacity Analysis City of Livingston	
Item No.	**Item Description**	**Total Project Cost in September 2005 Dollars**
1	New Headworks and Pump Station	$5,010,000
2	Oxidation Ditch No. 2	$3,934,000
3	Secondary Clarifiers No. 3 and 4	$2,130,000
4	RAS/WAS Pump Station No. 2	$1,380,000
5	Paving of Gallo Road	$250,000
6	Landscaping Allowance	$325,000
7	Plant Water No 2 pumps and Chlorination Allowance	$250,000
8	Effluent Pump Station for new Ponds	$800,000
9	20 Acres of Percolation Ponds 9 and 10	$900,000
10	Developer Credit for Removing Soil	($350,000)
11	Demolition of existing Primary Plant and Headworks	$251,000
	Estimate Project Cost	**$14,880,000**
	Land purchase estimate 20 more acres at $200,000/acre(2)	$4,000,000
	Estimated Project Delivery Costs	**$18,880,000**

(1) Includes: Estimated Contractor's costs, Estimating Contingencies at 20%; Design Engineering, Construction Engineering. Construction Contingency, Legal and Administrative cost at 30% (includes WDR permit processing).
(2) Assumed cost of land to account for potential appreciation of land values and eminent domain costs.

mechanical dewatering machinery. Based on what Carollo has done for the Cities of Reedley and Chico California, the centrifuge building costs have been included in Table 5.

5.2.2 Operations and Maintenance Buildings

In Table 5 a total of $2,030,000 in Project costs has been included as an allowance for new operation and maintenance buildings. The existing buildings were constructed years ago and are not sufficient to operate and maintain a 4.0 mgd wastewater treatment plant. The programming of these buildings will be done in the detailed facility-planning phase. The preliminary cost of the operations building, which will include a new laboratory, is based on a 2,100 square feet floor plan Carollo has designed for the City of Pismo Beach. The maintenance building is a Butler type building with rough dimensions of 2,000 square feet.



LEGEND

- ● Monitoring Well
- ⊘ Domestic Well
- ▲ Irrigation Well
- ■ □ Building
- — — Existing City Boundary Around WWTP
- "Target Area to Secure 80 to 100 Acres Future Percolation Ponds"
- "See Appendx B for Aerial Photo of this Area"

0 1/4 1/2 Mile
Graphic Scale

FIGURE 1
EXISTING WASTEWATER TREATMENT PLANT
City of Livingston
Wastewater Treatment Plant Capacity Analysis

carollo engineers

H:\Client\Livingston_FNO\6267B02\Dwg Proposal\FIG 1 12-16-05 08:21am ptorstensen XREFS: USGS;

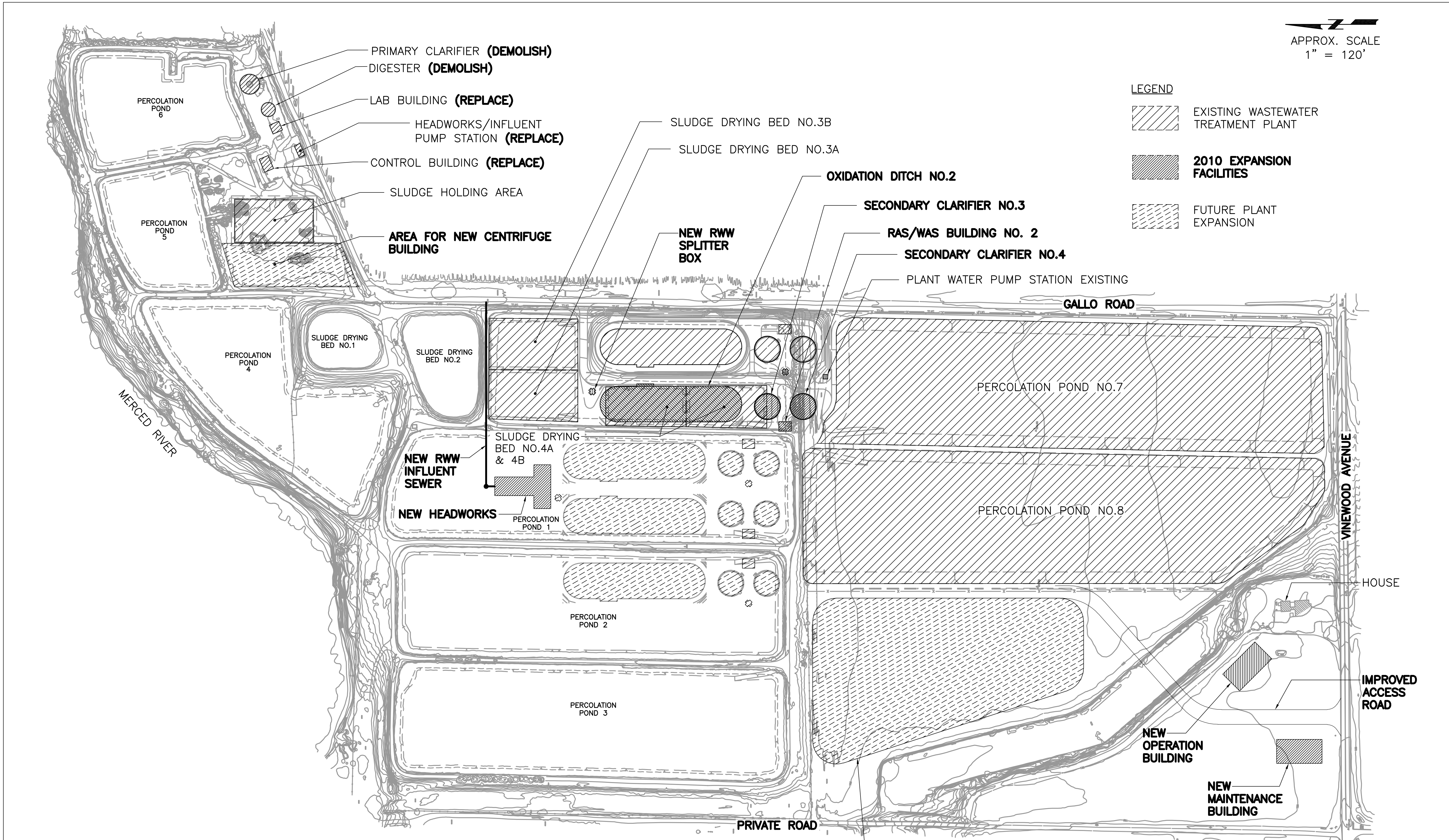


FIGURE 2
PRELIMINARY SITE PLAN FOR WWTP EXPANSION

City of Livingston
Wastewater Treatment Plant Capacity Analysis

carollo engineers

H:\Client\Livingston_FNO\6267B02\Dwg Proposal\FIG 2 12-16-05 07:58am ptorstensen XREFS: LIVTOPO; Y-5101; C-NEWBLDS

Table 5	Preliminary Project Costs for Additional Facilities[1] Wastewater Treatment Plant Capacity Analysis City of Livingston	
Items	**Item Descriptions**	**Total Project Costs in September 2005 Dollars**
1	Centrifuge Building	$3,970,000
2	New Operations Building	$1,120,000
3	New Maintenance Building	$910,000
	Estimate Project Costs	**$6,000,000**

(1) Includes: Estimated Contractor's costs, Estimating Contingencies at 20%, Design Engineering, Construction Engineering, Construction Contingency, Legal and Administrative cost at 30%

5.2.3 Title 22 Filtration and Disinfection

Livingston's current WWTP relies on secondary treatment with denitrification facilities and percolating treated effluent to groundwater. As Livingston develops into a larger City, recycled wastewater will become an asset. Many cities in California are using this asset by constructing Title 22 Filtration and Disinfection facilities to provide recycled water for landscape irrigation or unrestricted use for agriculture. Demand for Title 22 recycled water is usually not as high as the wastewater available. For preliminary planning, it has been assumed that the City could construct a 1.0 mgd Title 22 Filtration and Disinfection facility to provide recycled water for landscape irrigation. In addition, the City should implement requirements for developers to install "purple" pipe for developments to irrigate common landscaped areas; parks, greenbelts, medians, golf courses and Caltrans Right of Ways. Caltrans has a policy throughout the state to utilize recycled water when it is made available to them. The estimated capital costs for a 1.0 mgd Title 22 Filtration and Disinfection Facility is included in Table 6.

6.0 FEASIBILITY OF SATELLITE WASTEWATER TREATMENT PLANTS

Larger cities like Merced and Clovis have recently evaluated satellite WWTP. In the case of Merced, it was decided that satellite plants were not cost efficient when 40-year life cycle costs are taken into account. Clovis decided to construct a satellite plant because "in part" the City of Fresno was not moving fast enough to add capacity for Clovis.

Table 6	Preliminary Project Costs for 1.0 mgd Title 22 Recycle Water Facilities[1] Wastewater Treatment Plant Capacity Analysis City of Livingston	
Item Number	**Item Descriptions**	**Total Project Costs in September 2005 Dollars**
1	1.0 Mgd Title 22 Filters and Disinfection	$3,130,000
2	Recycled Water Storage Lined Basin	$700,000
3	Recycled Water Pump Station	$520,000
	Estimate Project Costs	**$4,350,000**

(1) Includes: Estimated Contractor's costs, Estimating Contingencies at 20%, Design Engineering, Construction Engineering, Construction Contingency, Legal and Administrative at 30%

The RWQCB generally does not want a community to use satellite WWTP's if a current plant is permitted. RWQCB will probably make it difficult during the environmental review process to approve a satellite WWTP. Based on review of Figure 2, Livingston has the land area to treat flows at a centralized site. However, in the future Livingston's need for additional percolation pond area may force the City to a direct discharge to Merced River. Issues such as these should be evaluated in a detailed facility plan.

7.0 SCHEDULE FOR YEAR 2008 EXPANSION

Based on information presented in this technical memorandum, it is apparent that Livingston will require an expanded treatment facility to be operational by the year 2008. Carollo recommends that this expansion essentially double the capacity of the existing plant from 2.0 to 4.0 mgd, Average Day Maximum Month Flow (ADMMF). The 2003 expansion was master planned to add the 2008 expansion facilities as shown in Figure 2.

Table 7 presents a suggested schedule to accomplish the 2008 WWTP expansion.

Table 7 Suggested Schedule for 2008 WWTP Expansion
Wastewater Treatment Plant Capacity Analysis
City of Livingston

Fiscal Year	Completion Dates	Action Required	Estimated Project Costs[1]
05/06	October 2005	Preliminary Capacity Analysis	$15,000
05/06	May 2006	Facilities Plan and EIR	$200,000
06/07	Jan. 2007	Detail Design	$1,200,000
07/08	April 2008	Construction 50% complete	$7,000,000[2]
08/09	August 2008	Construction 80% complete	$5,000,000
08/09	December 2008	New 4.0 mgd Plant Operational	$3,465,000
		Total Estimated Project Costs [1]	$16,880,000

(1) Based on Year 2005 prices included in Table 4. Does not include additional facilities from Table 5 or 6.

(2) FY 07/08 costs include $2,000,000 to purchase 20 acres for additional percolation ponds.

APPENDIX A - CORRESPONDENCE WITH PACIFIC MUNICIPAL CONSULTANTS (PMC)

From: Tony Akel
To: Barry Hampson
Date: 10/6/2005 10:28:28 AM
Subject: Fwd: City of Livingston Master Plan Updates

Hi Barry,

This is the official email with updated population projections. We will be referring to this email in our ater System and Collection System Updates.

Tony

>>> "Sara Gerster" <sgerster@pacificmunicipal.com> 10/05/05 4:43 PM >>>
Hello all:

Well, it has taken a while to get to this point and I appreciate your patience. Attached you will find a summary of land use assumptions for use in the Master Plan Updates for the City of Livingston along with an accompanying map. There are 3 additional areas (6-8) that have been added since the original land use information was provided. These new areas are consistent with those listed in PMC's July memo requesting cost and budget adjustments for the additional work. However, two of the areas have grown in size: Area 6 has increased by about 300-400 acres and Area 8 has increased by about 18 acres. Should this increase require additional adjustments to your original time and budget revisions, please contact Donna with the City of Livingston.

I will be on vacation from the 6th of Oct through the 17th of Oct. I know I have impeccable timing for sending this information out - sorry about that. However, if there are any immediate questions, feel free to call me on my cell at (209) 484-7184 until this Friday. I will do my best to answer your questions while I am out of the office. I will be out of the country all next week however and won't be available at all. Donna with the City may also be contacted with questions - particularly concerning any contract amendments to be made as the City will be handling those transactions. Stephanie Berg with PMC will also be available to answer some questions and she can be reached at (530) 750-7076.

Enjoy,
Sara Gerster

CC: David Stringfield

The City of Livingston has experienced rapid growth in recent years. Between 1990 and 2000, the population of the City of Livingston increased 43%. At the time of the adoption of the 1999 General Plan, Livingston was predicted to be one of the fastest growing communities in the County of Merced over the next 10-15 years.

The 1999 General Plan estimated the City population in 2003 would reach 12,600. However, the City estimates that in early 2004 the population already reached 13,000, and that growth rates projected in the General Plan were being exceeded such that the population would increase substantially faster than anticipated in the existing document.

Land Use and Development

Building permits issued for the last two years have averaged approximately 150 in number and have been for single-family residential development only. However, several new residential developments within the City Limits received approval in 2004 and several more are under review for anticipated approval in 2005 and 2006. There are currently over 1,500 total lots that are either approved or in process: 679 lots received final map approval and have not yet had building permits pulled; 180 lots have received tentative map approval; and, another 677 lots are in process for tentative map approval.

Of those developments approved, a portion have been beyond the current City limits and have necessitated annexation. In January 2005, Merced County LAFCo approved an annexation application for a 22-acre, 97-unit and another annexation application has been filed for a 38.2-acre, 160-unit residential development along the southern City limit. Almost two-thirds of those lots currently under tentative tract map review, but not yet approved, are located outside the City limits and will require annexation. Virtually all significantly sized residential parcels in the City limit are entitled, under construction or are currently pursuing entitlements for development. Buildout of the residential capacity of the City limit is therefore a certainty in the coming years, perhaps in five years if market conditions remain strong.

In addition to those maps already approved or in process, the City has had two conceptual development plans filed for projects that encompass about 400 acres each: the Gallo project encompasses approximately 440 total acres with 360 acres located within the existing Sphere of Influence; and, the Ranchwood project encompasses approximately 380 total acres with 80 acres located within the existing Sphere of Influence. There has also been additional development interest in lands beyond the existing Sphere of Influence and development interest is expected to remain strong.

Growth

The current growth estimates assume a 4% to 6% percent growth rate over the next 20 years, with a higher rate of growth over the next 5 to 6 years and a slight decline in the years following. However, due to the number of lots either approved or under review (approximately 4 times the level seen in previous years), known projects of substantial size, and the high level of developer interest in lands both within and outside the existing Sphere of Influence, those growth rates are expected to be surpassed. In response to this increased activity, the City has undertaken an effort to revise their infrastructure Master Plans as well as update their General Plan to properly plan for the future anticipated growth.

Based on the current map activity and future known projects, the City expects market demand to remain strong and anticipates the following population projections which assume a higher rate of growth over the next 4 to 5 years and a slight decline in the years following.

Year	Number of Low Density Permits Issued	Number of Medium Density Permits Issued	Number of High Density Permits Issued	Population	Growth Rate
Existing				13,000	
2004	250			14,085	8.3%
2005	300	80		15,387	9.2%
2006	280	100	20	17,123	11.3%
2007	260	120	20	18,859	10.1%
2008	260	120	40	20,682	9.7%
2009	200	145	55	22,418	8.4%
2010	200	145	55	24,154	7.7%
2011	200	145	55	25,890	7.2%
2012	180	170	65	27,691	7.0%
2013	180	170	65	29,492	6.5%
2014	160	190	60	31,271	6.0%
2019	800	950	150	39,517	5.3%
2029	800	950	150	47,763	4.2%

Development Scenario

Based on development interest within and outside the Sphere of Influence, as well as a City interest in developing lands in the vicinity of the future Highway 99/Sultana Drive interchange east of the City, the following approach has been adopted by the City to identify lands on which entitlements, and some development, are anticipated within the next ten years:

- Land within the existing City Limit
- Land within the 1999 General Plan Sphere of Influence, including
    - Phase I Gallo project (approximately 360 acres), including low, medium and high density residential; neighborhood and highway commercial; planned development; mixed use; park/open space
    - Phase I Del Valle project (approximately 38 acres), including low and medium density residential; park land
    - Phase I Ranchwood (Magnolia Grove) project (approximately 40 acres), including medium density residential; park land
- Later phases of the Ranchwood Project (approximately 340 acres), including low, medium and high density residential; commercial; elementary school; sports complex; 2 lakes/storm drainage ponds; park land

- Later phases of the Del Valle Homes project (approximately 86 acres), including low density residential; park land
- Later phases of the Gallo project (approximately 40 acres), including medium and high density residential; commercial
- Lands at the southeast corner of Peach Avenue and Robin Avenue (approximately 150 acres), including low density residential; commercial
- Elementary school site at the northwest corner of Peach Avenue and Robin Avenue (approximately 19 acres)
- Lands along the west side of Robin Avenue north of the proposed elementary school site (approximately 18 acres), including low density residential
- Lands at the northeast corner of the City on the south side of Olive Avenue (approximately 7 acres), including a senior residential project
- Lands at the southeast corner of Magnolia Avenue and Lincoln Boulevard (approximately 152 acres) including low and medium density residential; commercial; park land
- Lands along the Highway 99 corridor east of the City, out toward the vicinity of the future Hwy 99/Sultana Drive interchange (approximately 800 acres), including highway commercial; service commercial; light industrial; low and medium density residential; park land

These lands are therefore included in the Master Plans and their associated Fee Programs as areas of concentration for which detailed improvement recommendations are identified.

Phasing Assumptions

A map showing the phasing assumptions for the preferred annexation and development scenario has been attached and depicts the following:

Phase 1: Buildout of vacant lands within the existing City limits. Expected to occur within approximately five years.

Phase 2: Annexation and buildout of lands within the existing City Sphere of Influence. City will focus annexation and prezoning efforts over the following three years on land currently within the Sphere of Influence.

Phase 3: Annexation and buildout of lands within the designated areas (1-8). City will consider amendments to its Sphere of Influence within the following two years that will allow for adjustments to allow annexation and development of approximately 1,950 acres of land.

Phase 4: While other lands in the City's Study Area boundary may ultimately be annexed in the coming decades, the Master Plans will address such areas only at a conceptual level.

The following table represents the preferred development scenario and buildout populations for the City's Master Plan Study Area.

Phase	Area of Development	Year Completed	Population*
-	Existing City (2004)	Current	13,000
1	Buildout of Existing City Limits	2009	19,756
2	Buildout of Existing Sphere of Influence	2012	39,659
3	Buildout of Areas 1-8	2024	66,157
4	Buildout of Master Plan Study Area	2044	94,189

** Assumes 4.34 persons per household per the City's Housing Element*

Detailed Level of Analysis

For those areas currently within the City limits, land uses should be assumed to develop consistent with the General Plan land use designation. For those areas within the existing Sphere of Influence and for Areas 1-8, the following pages include tables depicting the breakdown of land uses as well as population projections within each of the 8 areas identified. These lands are anticipated to develop over the next 10 years.

Area 1

Land Use	Acreage	Percent of Total	Density	Units	Population
Low-Density Residential	76.2	17.2%	4.5 dwelling units/acre	343	1,488
Medium-Density Residential	239.8	54.0%	9 dwelling units/acre	2,158	9,367
High-Density Residential	52.6	11.8%	20 dwelling units/acre	1,052	4,566
Neighborhood Commercial	28	6.3%			
Office	2.2	0.5%			
Parks and Open Space	45.1	10.2%			
TOTAL	**443.9**	**100%**		**3,553**	**15,420**

Area 2

Land Use	Acreage	Percent of Total	Density	Units	Population
Low-Density Residential	303.3	53.2%	4.5 dwelling units/acre	1,365	5,923
Medium-Density Residential	114.3	20.1%	9 dwelling units/acre	1,029	4,465
High-Density Residential	22.7	4.0%	20 dwelling units/acre	454	1,970
Neighborhood Commercial	41	7.2%			
Parks and Open Space	64.3	11.3%			
Public Facilities (school site)	24.4	4.3%			
TOTAL	**570**	**100%**		**2,848**	**12,358**

Area 3

Land Use	Acreage	Percent of Total	Density	Units	Population
Low-Density Residential	228	85.1%	4.5 dwelling units/acre	1,026	4,453
Medium-Density Residential	8	3.0%	9 dwelling units/acre	72	312
Neighborhood Commercial	12	4.5%			
Parks and Open Space	20	7.5%			
TOTAL	**268**	**100%**		**1,098**	**4,765**

Area 4

Land Use	Acreage	Percent of Total	Density	Units	Population
Low-Density Residential	130	40%	4.5 dwelling units/acre	585	2,539
Medium-Density Residential	10	3%	9 dwelling units/acre	90	391
Service Commercial	100	30%			
Light Industrial	30	9%			
Parks and Open Space	10	3%			
Public Facilities (High School)	50	15%			
TOTAL	**330**	**100%**		**675**	**2,930**

Area 5

Land Use	Acreage	Percent of Total	Density	Units	Population
Low-Density Residential	107	86%	4.5 dwelling units/acre	482	2,090
Medium-Density Residential	10	8%	9 dwelling units/acre	90	391
Parks and Open Space	8	6%			
TOTAL	**125**	**100%**		**572**	**2,480**

Area 6

Land Use	Acreage	Percent of Total	Density	Units	Population
Low-Density Residential	142.8	18.2%	4.5 dwelling units/acre	643	2,789
Medium-Density Residential	56.6	7.2%	9 dwelling units/acre	509	2,211
Service Commercial	151.3	19.3%			
Parks and Open Space	8	1.0%			
Neighborhood Commercial	10	1.3%			
Light Industrial	153	19.5%			
Highway Commercial	261.2	33.4%			
TOTAL	**782.9**	**100%**		**1,152**	**5,000**

Area 7

Land Use	Acreage	Percent of Total	Density	Units	Population
Low-Density Residential	110	70.5%	4.5 dwelling units/acre	485	2,148
Medium-Density Residential	24	15.4%	9 dwelling units/acre	216	937
Neighborhood Commercial	12	7.7%			
Parks and Open Space	10	6.4%			
TOTAL	**156**	**100%**		**711**	**3,086**

Area 8

Land Use	Acreage	Percent of Total	Density	Units	Population
Low-Density Residential	18.5	48.4%	4.5 dwelling units/acre	83	361
Public Facilities (Elementary School)	19.7	51.6%			
TOTAL	**19.7**	**100%**		**83**	**361**

General Level of Analysis

Beyond the 8 areas identified above, the City has identified a Master Plan Study Boundary, coinciding with the City's desired ultimate Sphere of Influence, for which Master Plan improvements are recommended at a more general level. These lands are generally assumed to build out with a land use pattern similar to that anticipated in the existing City Limits and the detailed areas. These lands are anticipated to develop over the next 10 to 20 years.

The ratios to be used for land use assumptions within the Master Plan Study Area Boundary, yet outside the areas identified above, are as follows:

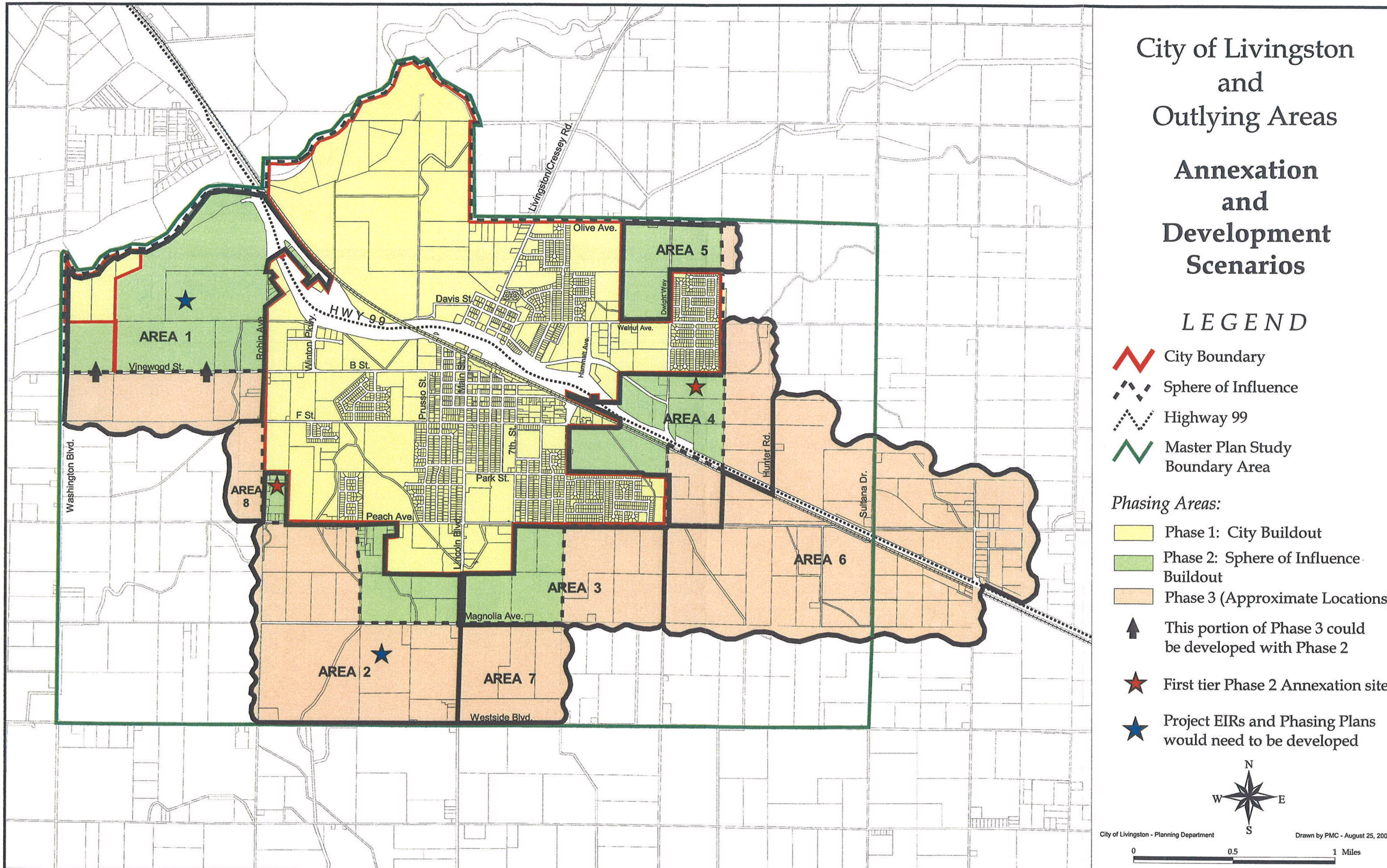
Land Use	***Percent***
Low-Density Residential	41.1%
Medium-Density Residential	17.0%
High-Density Residential	2.8%
Mixed Use/Office	0.1%
Neighborhood Commercial	3.8%
Service Commercial	9.3%
Highway Commercial	9.6%
Light Industrial	6.7%
Parks/Open Space	6.1%
Public Facilities	3.5%
TOTAL	**100.0%**

Land Use Assumptions

The following assumptions have been made for the land uses:

- Commercial is assumed to develop with a Floor Area Ratio (FAR) of 0.25
- Industrial is assumed to develop with a FAR of 0.30
- Those areas that are not yet built out but are designated "Neighborhood Commercial" and "Community Commercial" will likely be mixed-use, involving about 2/3 retail or shopping-oriented uses (for either neighborhood- or community-serving retail) and 1/3 office or similar uses.

NOTE: This information has been provided in prior memos and has not changed.


City of Livingston
and
Outlying Areas
Annexation
and
Development
Scenarios
LEGEND
City Boundary
Sphere of Influence
Highway 99
Master Plan Study
Boundary Area
Phasing Areas:
Phase 1: City Buildout
Phase 2: Sphere of Influence
Buildout
Phase 3 (Approximate Locations)
This portion of Phase 3 could
be developed with Phase 2
First tier Phase 2 Annexation sites
Project EIRs and Phasing Plans
would need to be developed
N
W
E
S
City of Livingston - Planning Department
Drawn by PMC - August 25, 2005
0
0.5
1 Miles
AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
AREA 6
AREA 7
AREA 8
HWY 99
Livingston/Cressey Rd.
Olive Ave.
Davis St.
Dwight Way
Walnut Ave.
Hammatt Ave.
Vinewood St.
Robin Ave.
Winton Pkwy.
B St.
F St.
Prusso St.
Main St.
7th St.
Park St.
Peach Ave.
Lincoln Blvd.
Magnolia Ave.
Westside Blvd.
Washington Blvd.
Hunter Rd.
Sultana Dr.

APPENDIX B - AERIAL PHOTO OF AREA WEST OF THE WWTP (SEPTEMBER 16, 1998)

Send To Printer   Back To TerraServer   Change to 8.5x11 Print Size   Show Grid Lines   Change to Portrait

USGS **4 km W of Livingston, California, United States** 16 Sep 1998

0 100M   0 100yd

Image courtesy of the U.S. Geological Survey