City of Livingston

Water Distribution System Master Plan

FINAL

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: Water Distribution System Master Plan - Final

Dear Ms. Kenney:

We are pleased to submit the final report for the City of Livingston (City) Water Distribution System Master Plan. The report presents planning assumptions, the distribution 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 Water Distribution 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 Gutierrez, P.E.
Project Manager

DLS/JLG:dlo

Enclosures: Final Report (15)

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City of Livingston

WATER DISTRIBUTION SYSTEM
MASTER PLAN

July 2007

DRAFT

carollo engineers

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City of Livingston

WATER DISTRIBUTION SYSTEM
MASTER PLAN

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WATER DISTRIBUTION SYSTEM MASTER PLAN

This executive summary presents a brief background of the City of Livingston's (City) water distribution system, the need for this water distribution system master plan, proposed improvements to mitigate existing deficiencies, and proposed improvements for anticipated future growth. A summary of the capital improvement program costs through buildout of the Urban Reserve, including Areas 1 through 8 from the City's annexation and development scenarios (April 2007) is also presented.

ES.1 STUDY OBJECTIVE

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

The objective of the study included the following tasks:

- Establish water system design and planning criteria.
- Evaluate the existing water distribution system using computer hydraulic modeling.
- Perform a demand analysis and review supply capacity.
- Perform a system-wide storage analysis.
- 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. The General Plan delineates potential growth areas and identifies policies directing growth within its sphere of influence (SOI) and future growth boundaries. The 2006 City limits and the SOI encompass approximately 3.2 square miles (2,044 acres) and 4.7[1] square miles

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

(3,002 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. In order to focus the work of this master plan, PMC provided land use scenarios and development assumptions for future growth. 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 water demand coefficient for the Urban Reserve.

This master plan assumes that Areas 1 through 8 and the Urban Reserve represent the future water distribution 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 WATER SYSTEM OVERVIEW

Livingston provides potable water service to its residential, commercial, industrial, and institutional customers within the City limits. The City's municipal water system extracts water from the underground aquifers via a series of groundwater wells distributed throughout the City. The City's water system facilities include eight active groundwater wells, a 1.0 million gallons (MG) potable water storage tank, and over 36 miles of pressured pipes ranging from 2- to 16-inches in diameter (Figure ES.5). Figure ES.6 illustrates the distribution system as modeled for this study.

ES.4 WATER REQUIREMENTS

Historical water consumption and production records were reviewed to determine the daily, monthly, and seasonal fluctuations experienced by the water system. In 2003, the City produced 1.9 billion gallons (5.3 mgd or 5,969 acre-feet) of water servicing a population of approximately 12,600.

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[2] Boundaries based on City's Annexation and Development Scenarios developed by Pacific Municipal Consultants, December 20, 2005 (Appendix A).

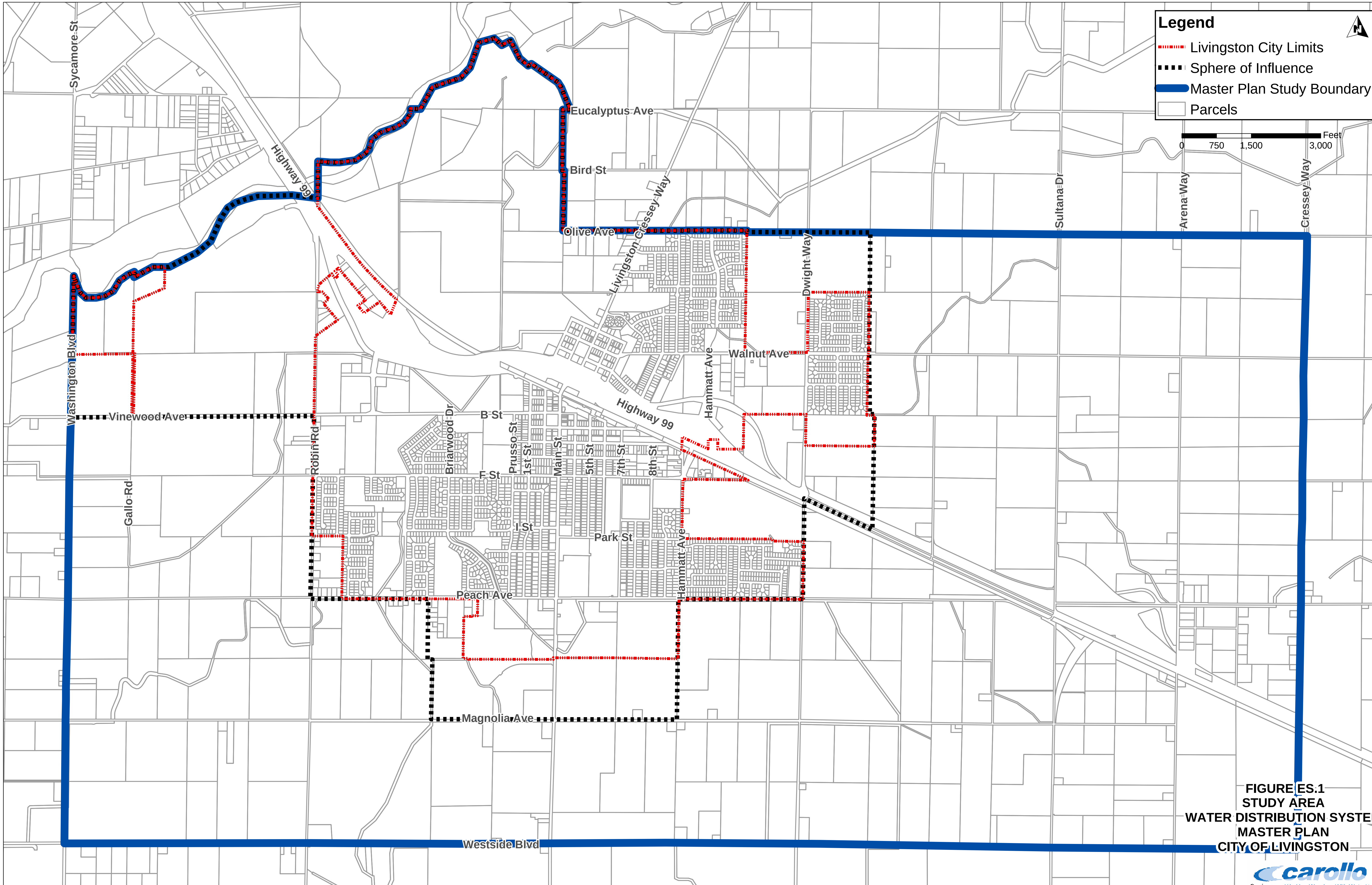

FIGURE ES.1
STUDY AREA
WATER DISTRIBUTION SYSTEM
MASTER PLAN
CITY OF LIVINGSTON

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

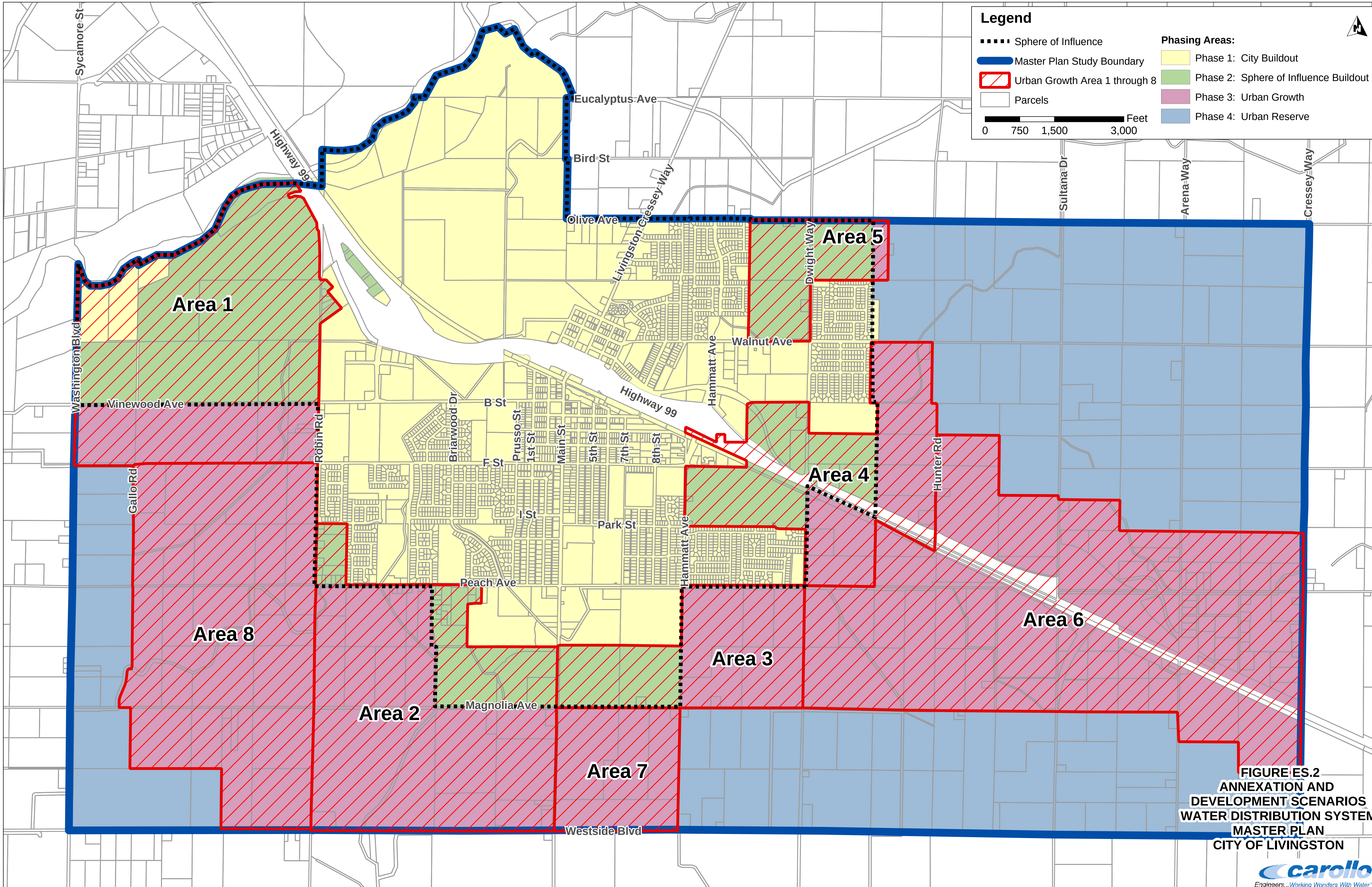

FIGURE ES.2
ANNEXATION AND
DEVELOPMENT SCENARIOS
WATER DISTRIBUTION SYSTEM
MASTER PLAN
CITY OF LIVINGSTON

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

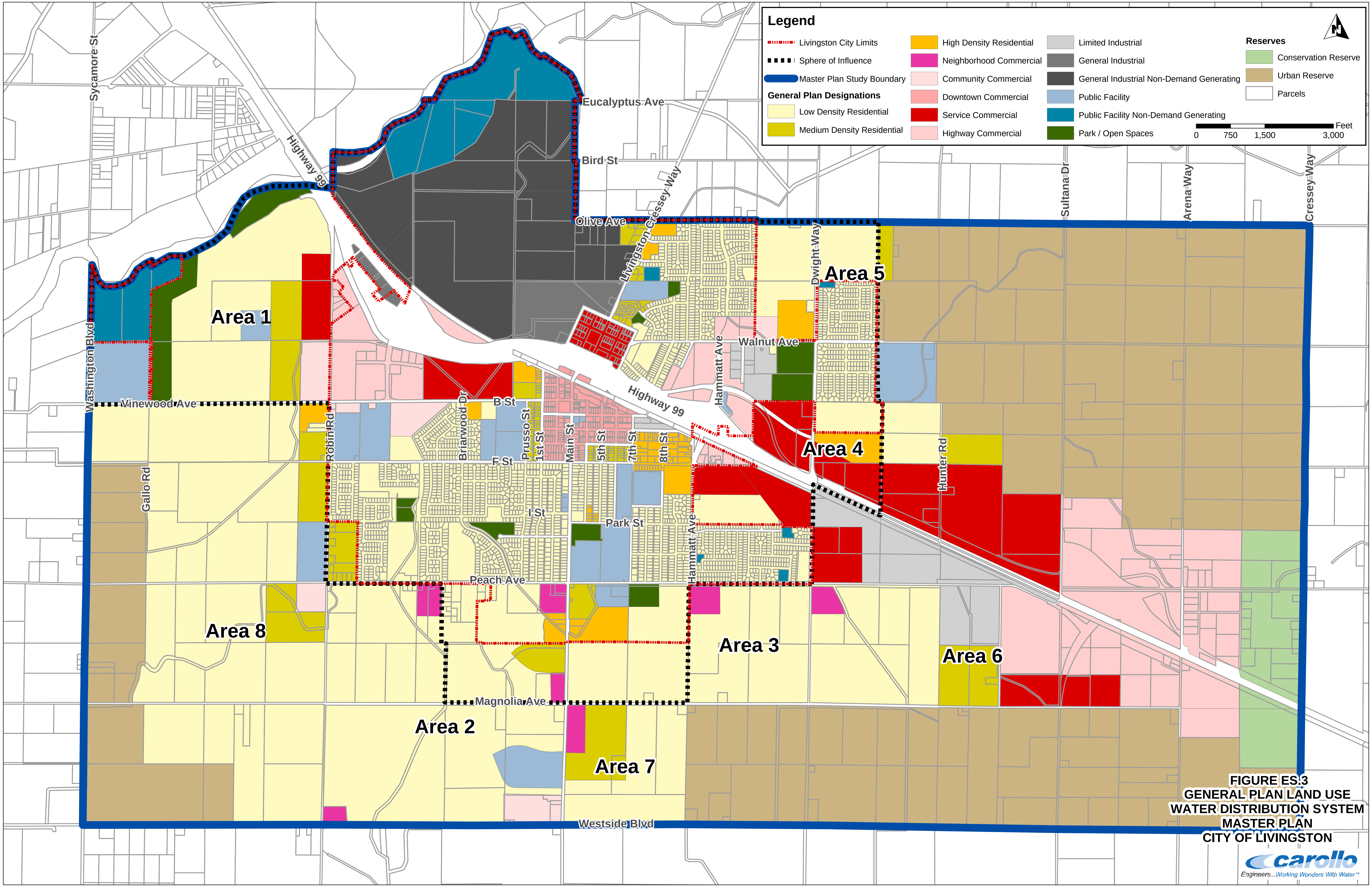

FIGURE ES.3
GENERAL PLAN LAND USE
WATER DISTRIBUTION SYSTEM
MASTER PLAN
CITY OF LIVINGSTON

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

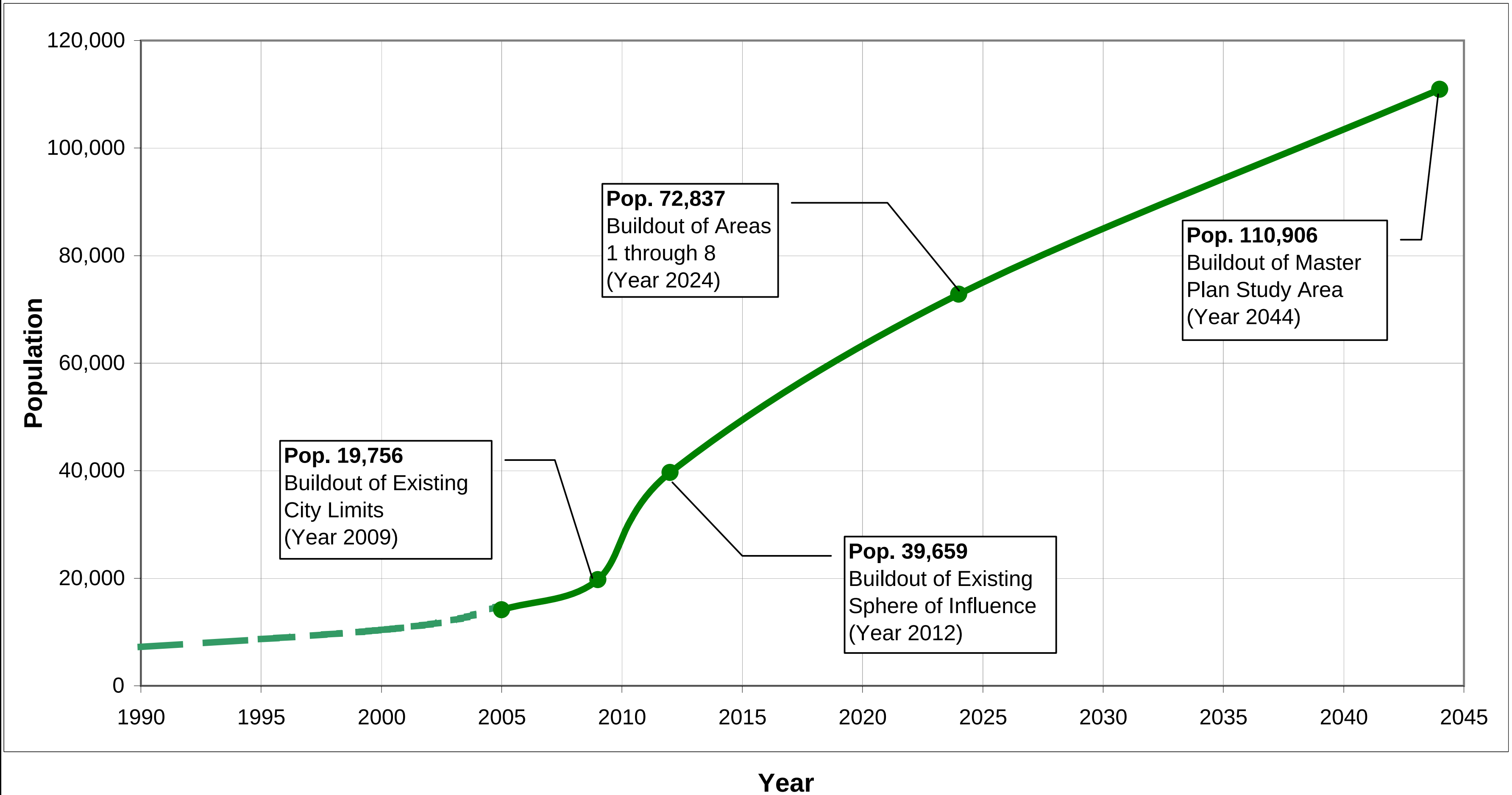

FIGURE ES.4
HISTORICAL AND PROJECTED POPULATION
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

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

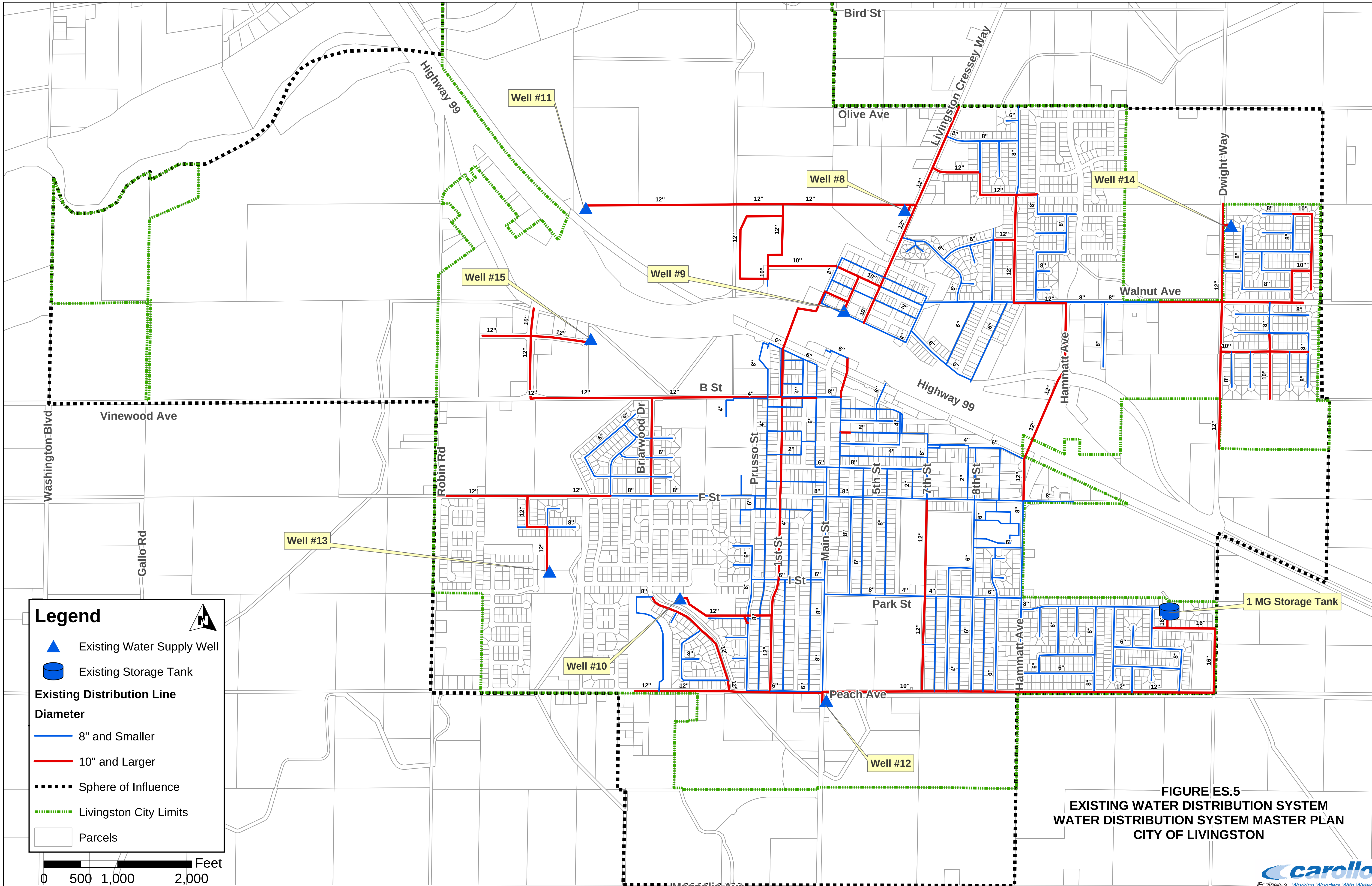

FIGURE ES.5
EXISTING WATER DISTRIBUTION SYSTEM
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

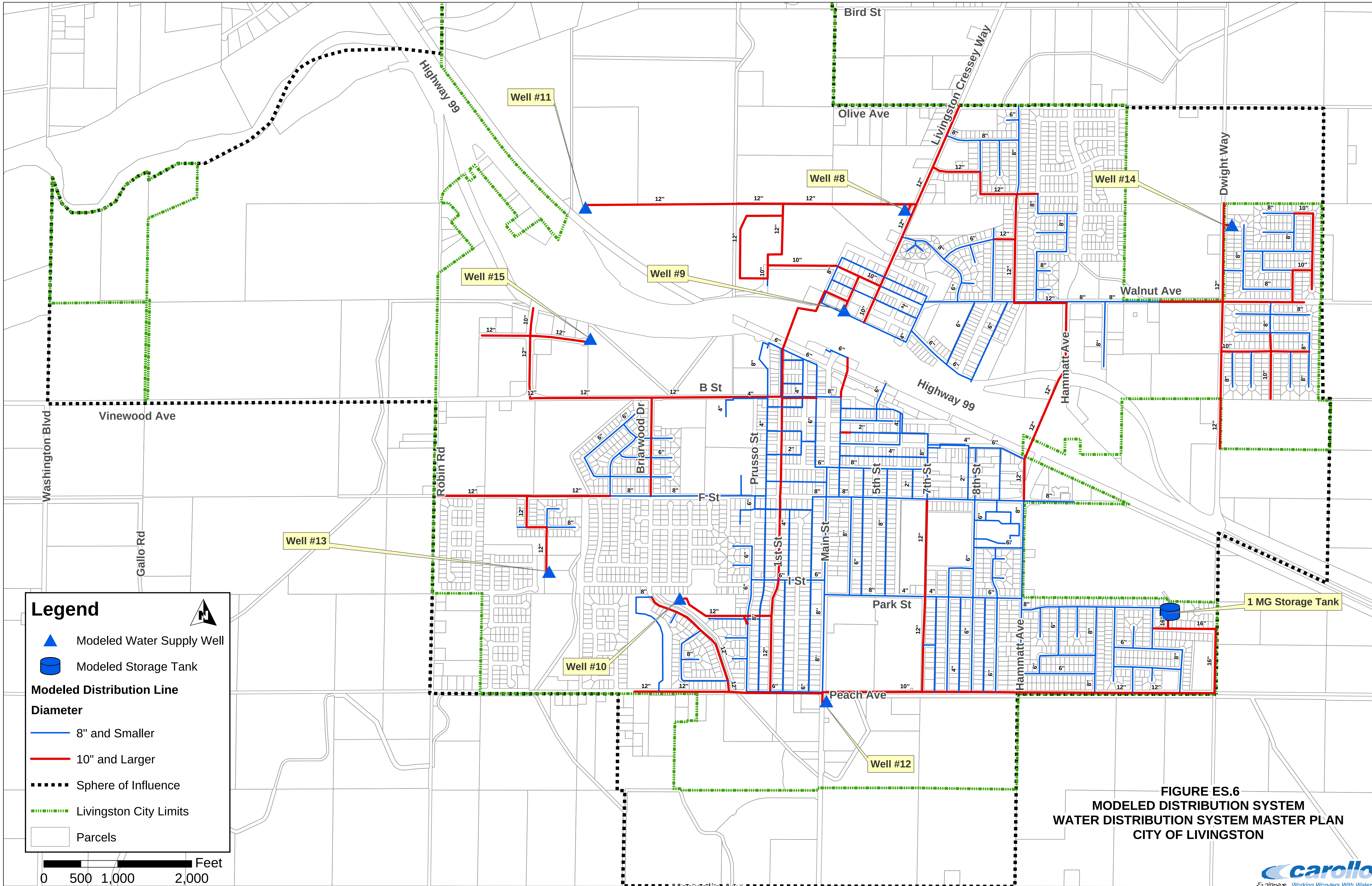

FIGURE ES.6
MODELED DISTRIBUTION SYSTEM
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

The per capita consumption rate is used for estimating the City's future water requirements, evaluating the adequacy of the supply source, and determining storage needs. The consumption rate, expressed in gallons per day per capita (gpcd), is applied to the projected population to yield future water requirements. Over the past 10 years, the consumption rate in the City has ranged between a low of 423 gpcd in 2003 and a high of 628 gpcd in 1999. These are system wide per capita consumption rates. If industrial users are not included, the per capita consumption rates are considerably less. For planning purposes, a consumption rate of 150 gpcd will be used to estimate future water requirements in Livingston.

Based on the City's future population trends, it is anticipated that the City's average day and maximum day requirements at buildout of Areas 1-8 will approach 15.7 mgd (10,903 gpm) and 34.6 mgd (24,035 gpm), respectively.

ES.5 WATER SYSTEM EVALUATION

The City's water supply, storage, and distribution facilities were evaluated based on the analysis and design criteria defined in this study and summarized in Table ES.1. The developed criteria address the water supply capacity, storage capacity, acceptable service pressures, distribution main performance, average annual water demand coefficients, and daily and hourly peaking factors.

A hydraulic water model was assembled and used in evaluating the capacity adequacy of the water distribution facilities. Hydraulic network analysis is a powerful tool used in all aspects of water distribution planning, design, operation, management, emergency response, system reliability analysis, fire flow capacity evaluation, as well as water quality simulations. The hydraulic model evaluation consisted of 24-hour simulations during normal operations of a maximum day demand (MDD) condition. The simulations were used to assist in planning the future water facilities.

ES.6 CONCLUSIONS

The analysis of the City's water system indicates that the water distribution system was planned to meet the needs of existing customers. In fact, and in anticipation of future growth, City staff has planned and constructed water projects in conjunction with new street construction. The project improvements proposed in this master plan are needed to enhance the City's storage and supply capabilities during emergencies and to service future growth. City staff has been planning many of these enhancements, and have initiated their construction prior to the writing of this final report.

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

Table ES.1 Planning and Design Criteria Summary
Water Distribution System Master Plan
City of Livingston

Source of Supply

The adequate source of supply is required to meet:	Maximum Day Demand + 1300 gpm.

Storage

The adequate storage shall meet:	Operational Storage = 25% of Maximum Day Demand Fire Storage = 0.63 MG Emergency Storage = 50% Maximum Day Demand

Distribution Mains

The distribution system should be sized to meet the greater of:	Peak Hour Demand, or Maximum Day Demand + Fire Flow.
Criteria for judging the adequacy of existing pipelines:	Maximum desirable pipeline velocity: 10 feet per second Maximum desirable head loss: 10 feet/1,000 feet

Headloss in Existing Pipes

Headloss in pipes shall be calculated based on the following table:

	Age (Years)					
Pipe Material	**0**	**10**	**20**	**30**	**40**	**50**
Asbestos Cement	125	125	125	125	125	125
Cast Iron	120	110	100	90	80	70
Ductile Iron	130	125	120	115	110	105
Plastic (PVC)	140	140	140	140	140	140
Steel	130	120	110	100	90	80

Service Pressures

The recommended high/low pressures are as follows:	Maximum Pressure =	80 psi
	Minimum Pressure (during Maximum Day) =	40 psi
	Minimum Pressure (during Peak Hour) =	35 psi
	Minimum Residual Pressure (during Fires) =	20 psi

Water Use Peaking Factors

Fluctuations in water demands shall be based on:	Maximum Month Demand =	1.4 x Average Day Demand
	Maximum Day Demand (Residential/Commercial) =	2.6 x Average Day Demand
	Maximum Day Demand (System Wide) =	1.7 x Average Day Demand
	Peak Hour Demand (Residential/Commercial) =	4.4 x Average Day Demand
	Peak Hour Demand (System Wide) =	2.4 x Average Day Demand

Per Capita Water Consumption

Demand forecasting shall be based on:	City-Wide = 150 gpdc

Average Annual Demand Coefficients

These demand coefficients are applied to the gross land use acreages to yield average day water demands:

<u>Land Use Category</u>	Coefficients	
	<u>(gpd/acre)</u>	<u>(gpm/acre)</u>
Low Density/Estate	2,600	1.81
Medium Density	4,600	3.19
High Density	5,200	3.61
Downtown Commercial	1,700	1.18
Neighborhood Commercial	1,700	1.18
Highway Commercial	1,700	1.18
Community Commercial	1,700	1.18
Service Commercial	1,700	1.18
Limited Industrial	1,700	1.18
General Industrial (existing)	102,200	70.97
Public Facility Demand Generating	2,000	1.39
Public Facility Non-Demand Generating	0	0.00
General Industrial Non-Demand Generating	0	0.00
Park/Open Space	500	0.35
Industrial Reserve Non-Demand Generating	0	0.35

Fire Flows

In this study, water system response is adequate when it provides the following flows:	Residential fire flow =	1,200 gpm for a duration of 2 hours
	Commercial fire flow =	2,500 gpm for a duration of 2 hours
	Industrial fire flow =	3,500 gpm for a duration of 3 hours.

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.

While needs for distribution main enhancements are discussed in detail in the report, this section provides a summary of City-wide supply and storage capacity.

ES.6.1 Supply Capacity

The City's total and firm supply capacity from the existing eight groundwater wells is estimated at 10.8[1] mgd and 8.9[1] mgd, respectively. The firm capacity is defined as the total capacity less the largest well (2.0 mgd).

The City-wide supply analysis indicates that the maximum day demand (MDD) is approximately 11.9 mgd in year 2007. Since this demand must be met with the firm supply capacity, the current additional supply needs are calculated at 4.0 mgd (two wells at 2.0 mgd each).

A City-wide supply analysis was performed to provide recommendations for supply facilities to meet the City's needs through buildout conditions. Assuming the existing wells will remain in service at their current capacities, the total recommended increase in the source of supply through the year 2024 is 26 mgd. It is recommended that the City construct 13 new wells. The total recommended increase in the source of supply at buildout of Urban Reserve is 16 mgd (total recommended supply less 2024 available total supply). It is recommended that the City construct eight new wells between 2024 through buildout of the Urban Reserve area.

Please note that this analysis, consistent with established planning criteria, assumes that peak hour demands will be supplied by storage reservoirs. Should the storage upgrades described in this master plan be delayed, additional groundwater wells need to be constructed to meet the peak hour demand requirements. If storage has not been added by 2010, two additional groundwater wells will need to be constructed to meet the peak hour demands for that year. These two wells would be in addition to the wells proposed to meet the maximum day demand condition.

ES.6.2 Storage Capacity

The City's current storage reservoir provides a total of 1 MG for servicing the City's operational, fire, and emergency needs. A City-wide storage analysis indicates that during current conditions, the system can not adequately meet the storage requirements defined in the Planning and Design Criteria chapter of this report.

[1] Excludes Well 10 due to high nitrate levels.

The existing storage requirements for the City total 9.9 MG. Therefore, the existing storage deficiency totals 8.9 MG. The total storage requirements through the buildout Areas 1 through 5 in year 2024 is expected to reach 18.0 MG.

Therefore, an additional storage capacity of 26 MG is required by year 2024. The recommended storage to service the Urban Reserve area includes 11 MG of additional storage.

ES.6.3 Distribution System

The recommended proposed projects consist of new or increased capacity pipelines that are needed to extend service to currently undeveloped areas. These proposed improvements, which are discussed in detail in the report and shown on Figure ES.7, are phased to provide capacity enhancements to the distribution system when they are needed to serve future anticipated developments.

ES.7 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
Water Distribution System Master Plan
City of Livingston

Planning Period	Years	Capital Cost	Current Users	Future Users
Phase I	2007-2009	$15,045,000	$13,932,000	$1,113,000
Phase II	2009-2014	$11,403,000	$3,652,000	$7,751,000
Phase III	2014-2019	$26,583,000	$863,000	$25,720,000
Phase IV	2019-2024	$33,340,000	$0	$33,340,000
Phase V	2024-2044	$42,687,000	$0	$42,687,000
Total		**$129,058,000**	**$18,447,000**	**$110,611,000**

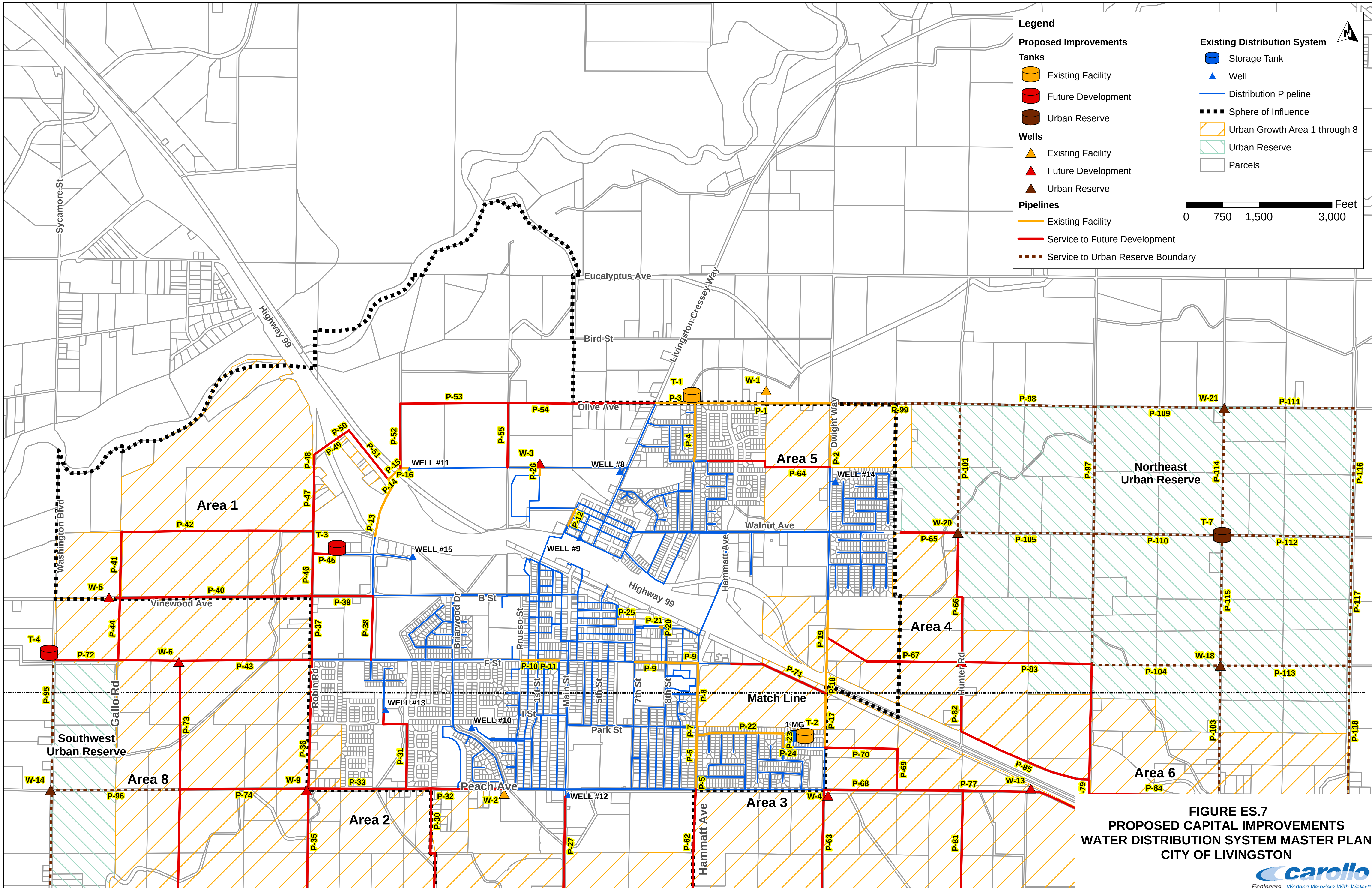

FIGURE ES.7
PROPOSED CAPITAL IMPROVEMENTS
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

Note: Final location of future groundwater wells and storage tanks will be determined in design phase.

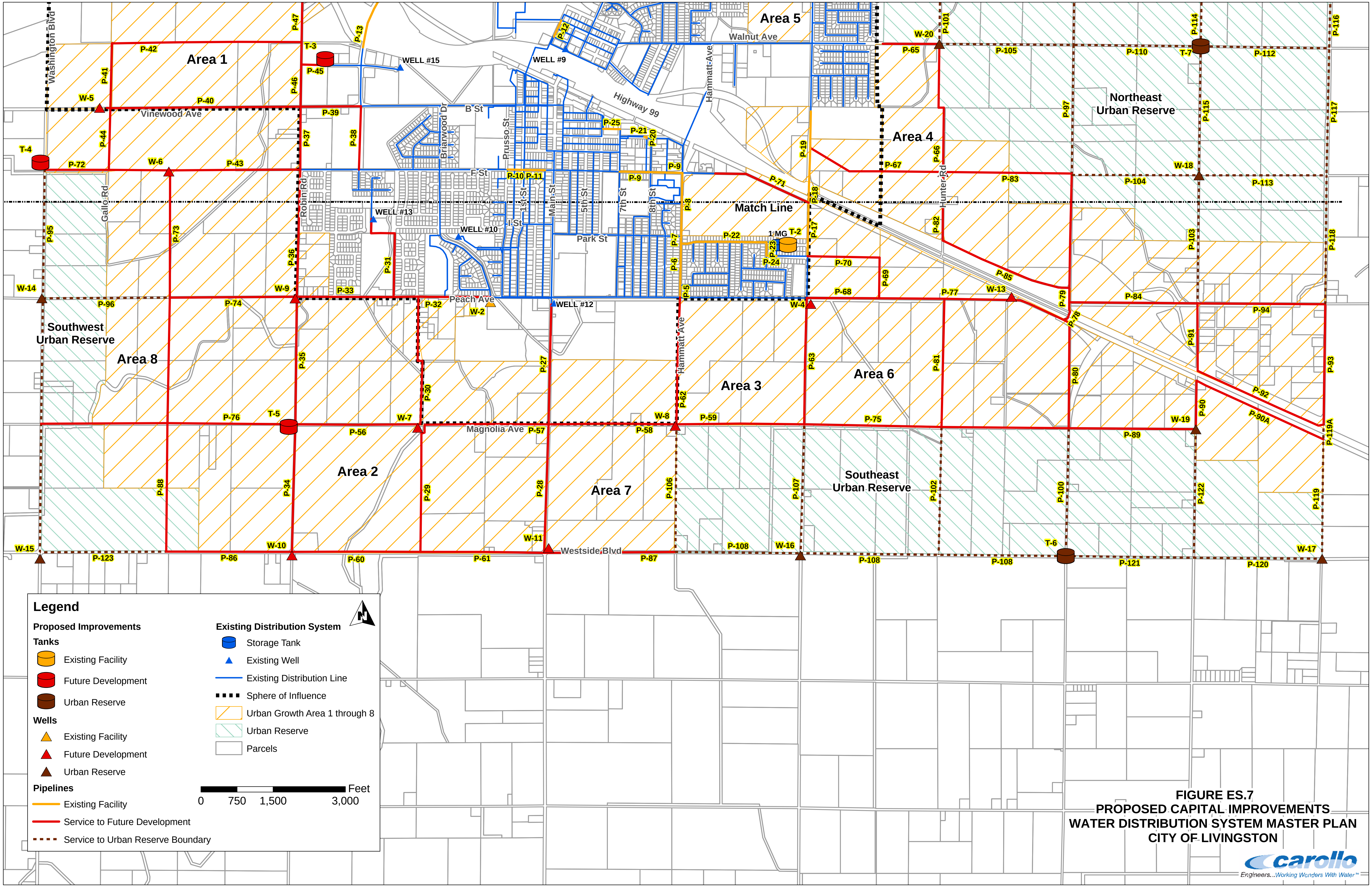

FIGURE ES.7
PROPOSED CAPITAL IMPROVEMENTS
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

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Updated: July 10, 2007

Note: Final location of future groundwater wells and storage tanks will be determined in design phase.

INTRODUCTION

This chapter presents the need for this water 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 water distribution system and associated infrastructure facilities and services customers within the City limits. The previous water system master plan, completed in September 1992 (1992 Plan) included a storage 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.

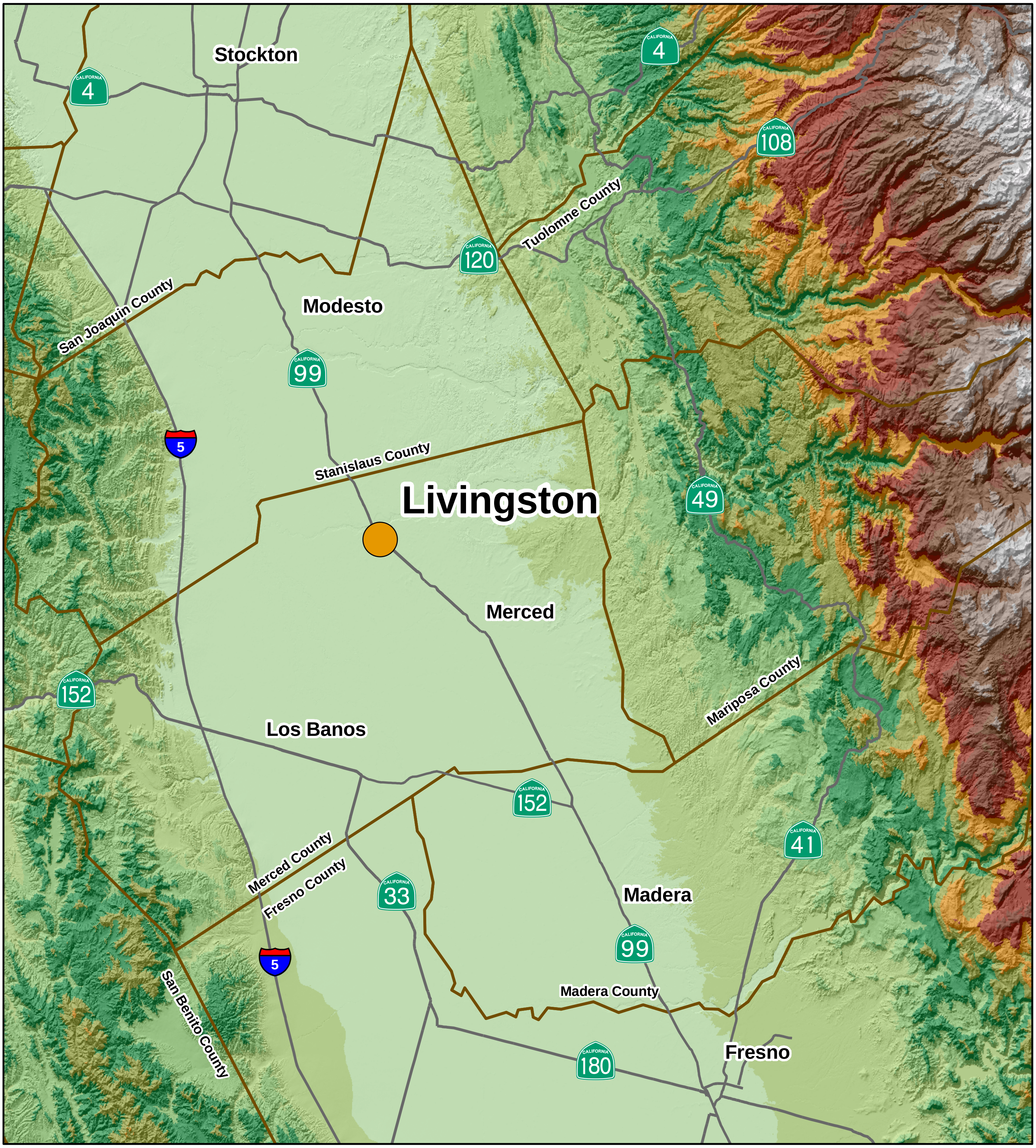
In December 1999, the City updated the General Plan. Since the completion of the General Plan, the City has updated the Sphere of Influence (SOI) and the future growth boundaries. In 2007, the City's planning consultant, Pacific Municipal Consultants (PMC), updated the City's growth plan and land use assumptions for areas outside the current City limits, which identify lands intended for future urbanization. Land use assumptions used in this study are consistent with the General Plan update provided by PMC and describe existing and projected future development within the study area.

1.2 SCOPE AND AUTHORIZATION

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

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

- Establish water system design and planning criteria.
- Evaluate the existing water distribution system using computer hydraulic modeling.
- Perform a demand analysis and review supply capacity.
- Perform a system-wide storage analysis.



Legend

Elevation

High :13,000 Feet

Low : 0 Feet

County Boundary

Major Roads

Miles

0 5 10 20

FIGURE 1.1
REGIONAL LOCATION MAP

WATER DISTRIBUTION
SYSTEM MASTER PLAN
CITY OF LIVINGSTON

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- 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, supply source modifications, etc.), revisions and adjustments to the master plan recommendations would be necessary.

1.3 REPORT ORGANIZATION

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

Chapter 2 - Planning Area Characteristics. This chapter presents a discussion of this study's planning area characteristics, defining the land use classifications and summarizing the historical population trends. City staff provided population projections used to estimate the City's future water requirements.

Chapter 3 - Planning and Design Criteria. The City's water supply, storage, and distribution facilities were evaluated based on the analysis and design criteria defined in this chapter. Historical water consumption and production records were reviewed to determine the daily, monthly, and seasonal fluctuations experienced by the water system. The developed criteria address the water supply capacity, storage capacity, acceptable service pressures, distribution main performance, average annual water demand coefficients, and daily and hourly peaking factors.

Chapter 4 - Existing System and Hydraulic Model. This chapter presents an overview of the City's water supply, distribution, and storage facilities. The chapter also describes the development and calibration of the City's water distribution system hydraulic model. This model was used for identifying existing system deficiencies and for recommending enhancements.

Chapter 5 - Water System Evaluation and Proposed Improvements. This chapter presents the results of the capacity evaluation of the water supply, distribution, and storage facilities. 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 water distribution system. The program is based on the evaluation of the City's water distribution 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 water 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.

ADD	average day demand
AF	acre-feet
ASCE	American Society of Civil Engineers
CIP	capital improvement program
City	City of Livingston
cfs	cubic feet per second
County	County of Merced
DI	ductile iron
DOF	California Department of Finance
DHS	California Department of Health Services
DU	dwelling unit
ENR CCI	Engineering News Record Construction Cost Index

EPA	U.S. Environmental Protection Agency
GIS	geographic information system
fps	feet per second
gpad	gallons per acre per day
gpcd	gallons per capita per day
Water Map	Computer Hydraulic Model developed by MWH Soft
LF	linear feet
LAFCo	Local Agency Formation Commission
LUE	Land Use Element
MDD	maximum day demand
MG	million gallons
MMD	maximum month demand
mgd	million gallons per day
mgm	million gallons per month
mgy	million gallons per year
mgd	million gallons per day
PHD	peak hour demand
ROW	right-of-way
SOI	Sphere of Influence
sq ft	square feet

PLANNING AREA CHARACTERISTICS

This chapter presents a discussion of this study's planning area characteristics, defining the land use classifications and summarizing the historical population trends. City Staff provided population projections used to estimate the City of Livingston's (City) future water requirements.

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. 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 2006 City limits and the SOI encompassed approximately 3.2 square miles (2,044 acres) and 4.7 square miles (3,002 acres), respectively. The Master Plan Study Boundary Area 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, Pacific Municipal Consultants (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).

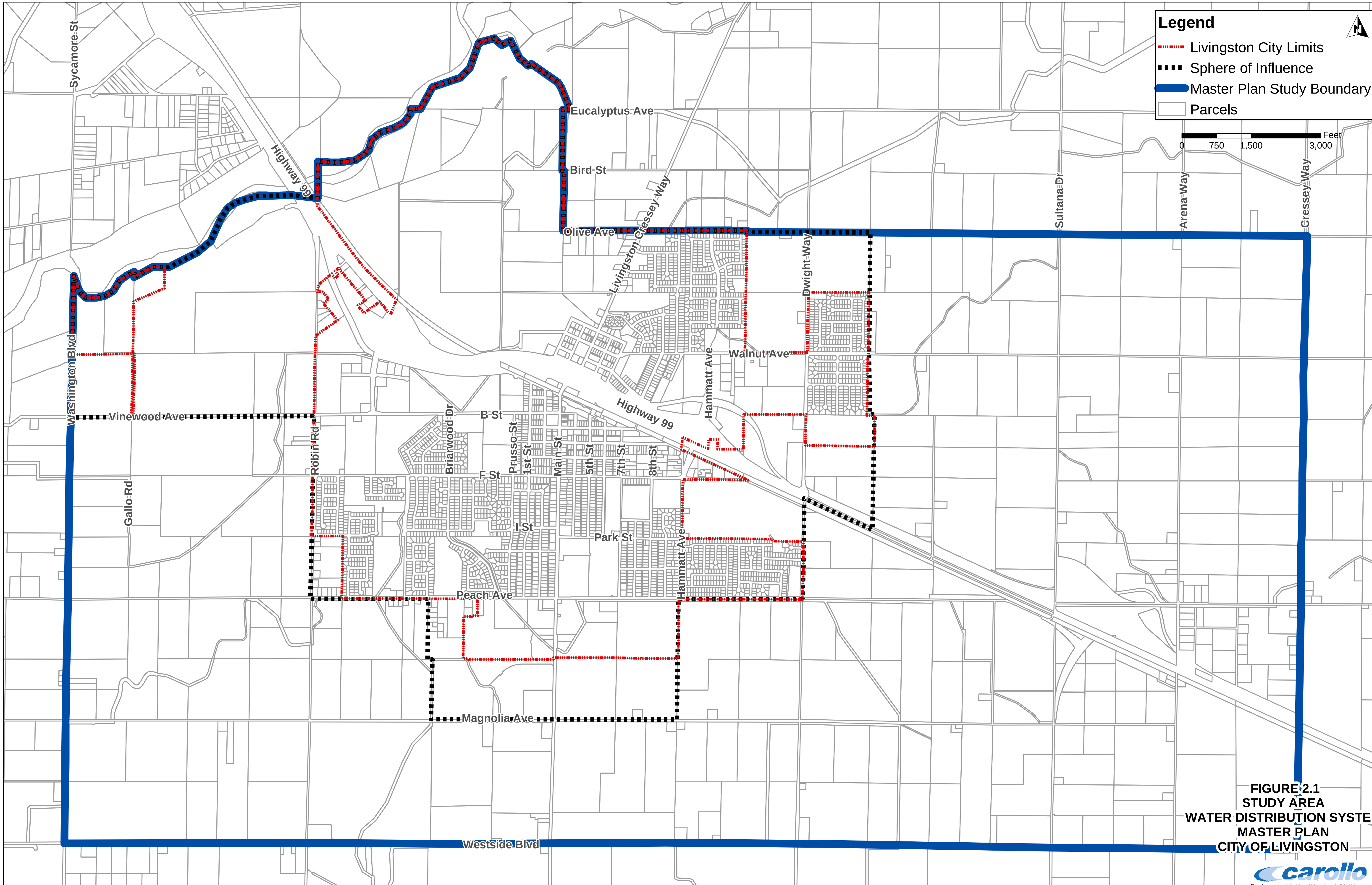

FIGURE 2.1
STUDY AREA
WATER DISTRIBUTION SYSTEM
MASTER PLAN
CITY OF LIVINGSTON

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

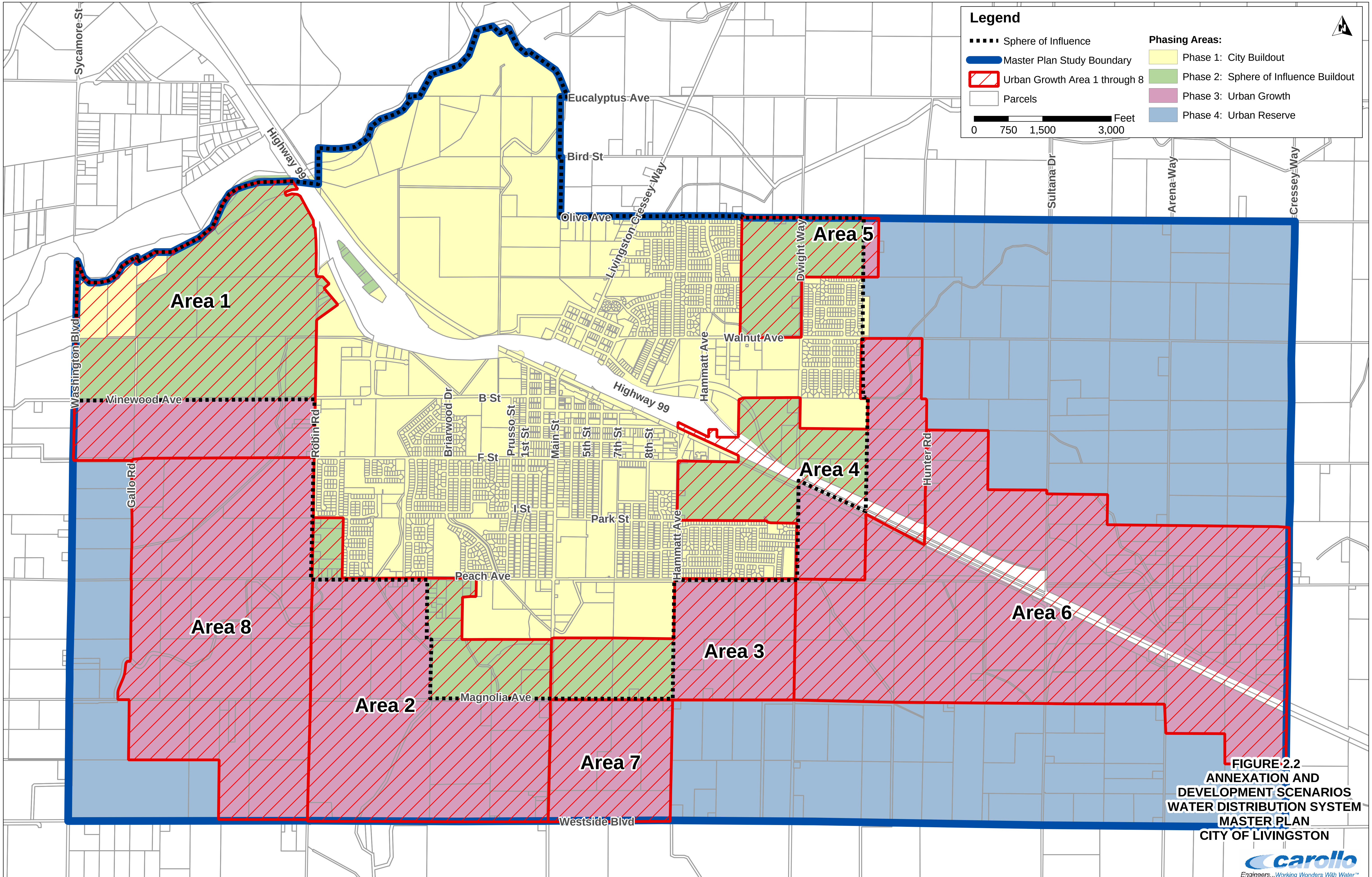

FIGURE 2.2
ANNEXATION AND DEVELOPMENT SCENARIOS
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

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

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 SOIL AND TOPOGRAPHY

The study area falls within the central San Joaquin Valley with the Sierra Nevada Mountain Range to the east and the California Coast Range to the west. The entire study area is flat alluvial terrain. The Merced River borders the City to the north.

2.3 CLIMATE

The City is characterized by an "inland Mediterranean" type climate; the winters are cool and humid and the summers are hot and dry. Historically, 95 percent of the precipitation has occurred between the months October and May. The historical average annual rainfall for Livingston is 10.3-inches, though over 20-inches of precipitation was experienced in 1998 due to the El Nino conditions for the western United States.

In the summer, temperatures average in the low 90 degrees Fahrenheit. In the winter, average high temperatures are in the 50s, but highs in the 30s and 40s can occur on days with persistent fog and low clouds. The average winter daily low temperature is 45 degrees.

2.4 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.

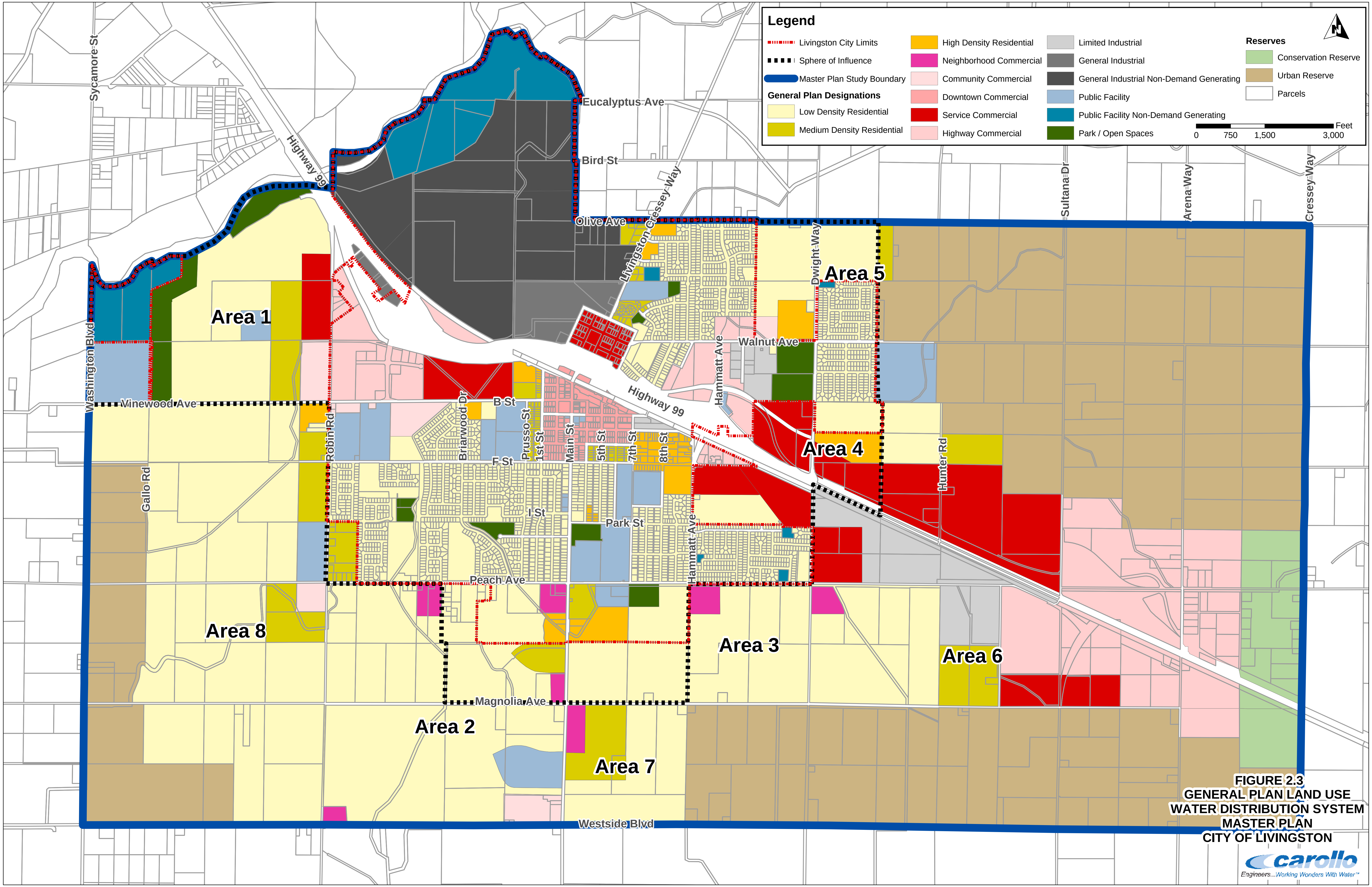

FIGURE 2.3
GENERAL PLAN LAND USE
WATER DISTRIBUTION SYSTEM
MASTER PLAN
CITY OF LIVINGSTON

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
Water Distribution System Master Plan
City of Livingston

Land Use Designation	City Sewer Service Area: 2006 (developed) Sewer Service Area [5] (gr. Ac.)	City Sewer Service Area: Current City Limits [1,2] (gr. Ac.)	City Sewer Service Area: % of Total Service Area (%)	Expansion Areas Outside Current City Limits: 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.

Not all land within the City limit is developed. Table 2.1 tabulates the 2006 developed land within the City limits. The totals for developed land were employed in the calculation of 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 five and eight 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.

2.5 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.

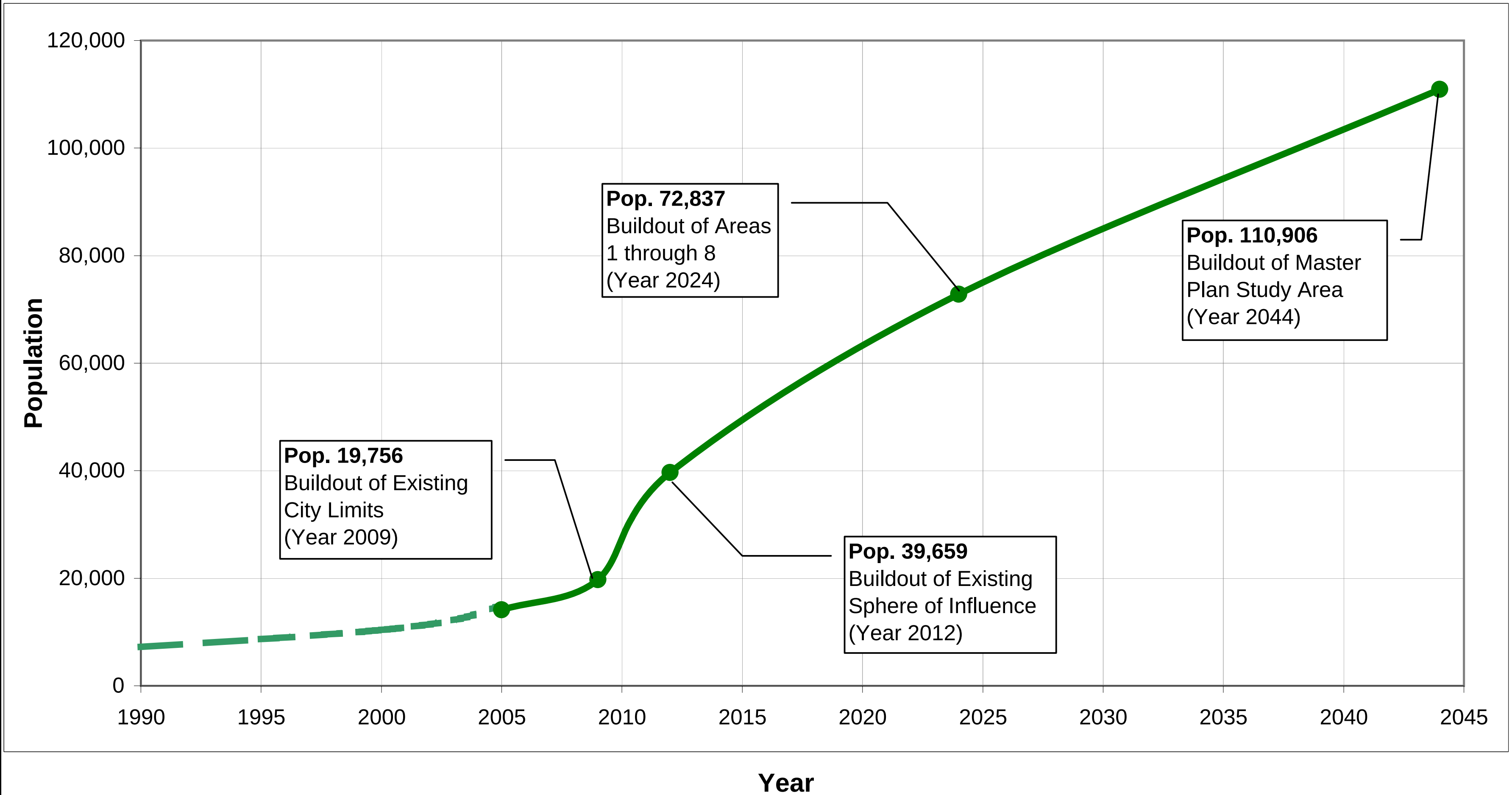

FIGURE 2.4
HISTORICAL AND PROJECTED POPULATION
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

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

PLANNING AND DESIGN CRITERIA

The City of Livingston's (City) water supply, storage, and distribution facilities were evaluated based on the analysis and design criteria defined in this chapter. Historical water consumption and production records were reviewed to determine the daily, monthly, and seasonal fluctuations experienced by the water system. The developed criteria address the water supply capacity, storage capacity, acceptable service pressures, distribution main performance, average annual water demand coefficients, and daily and hourly peaking factors.

3.1 WATER SUPPLY CAPACITY

In determining the adequacy of the water supply facilities, the source must be large enough to meet the varying water demand conditions, as well as provide sufficient water during potential emergencies such as power outages and natural or created disasters.

This study does not include an analysis of the groundwater aquifer yield, however the 2005 UWMP study assumes that future water supply capacity will continue to be extracted from groundwater wells.

Ideally, a water distribution system should be operated at a constant water supply rate with consistent supply from the water source.

3.1.1 Normal Production Capacity

In accordance with industry standard practices and the California Department of Health Services (DHS) criteria for "Adequate Source Capacity" on water supply, the source should be sized to serve the maximum day demand (MDD). On the day of maximum demand, as described above, it is desirable to maintain a water supply rate equal to the MDD rate. Water required for peak hour demand (PHD) or for fire flows would come from storage.

3.1.2 Standby Production Capacity

Standby production capacity is required for system reliability. Under normal operating conditions, it is possible that one or two of the City's wells can be placed out of service during MDD conditions due to equipment malfunction, for servicing, or for water quality concerns. The DHS criterion recommends counting the capacity of the largest well as out of service. According to the City's 2005 UWMP the City should have one or two standby wells with a combined capacity of 2.0 mgd. This surplus is required to mitigate the potential impact of lost production capabilities.

3.1.3 Recommended Supply Capacity

The adequate source of supply for the City will consist of groundwater wells with a firm capacity that can meet the MDD. The system's firm capacity is defined as the total capacity with the largest well out of service.

3.2 STORAGE REQUIREMENTS

The principle function of storage is to provide reserve supply of water for: 1) operational equalization, 2) fire reserve, and 3) emergency needs. Operational storage is directly related to the amount of water necessary to meet peak demands. The intent of operational storage is to provide the difference in quantity between the customer's peak demands and the system's reliable available supply. The volume of water allocated for emergency uses is decided based on the historical record of emergencies experienced, and on the amount of time which is expected to lapse before a hypothetical emergency can be corrected.

3.2.1 Operational Storage

This storage is the amount of desirable stored water in a system to regulate fluctuations in demand so that extreme variations will not be imposed on the source of supply. With operational storage, system pressures are improved and stabilized to better serve customers throughout the service area. Operational storage is commonly estimated between 25 percent and 50 percent of the MDD. This study recommends an operational storage equal to 25 percent of the City's MDD.

3.2.2 Fire Storage

This storage is the amount required when the capacity of the production facilities is insufficient to meet the necessary MDD plus fire flow demands for certain durations of time. The Insurance Service Office (ISO), a non-profit association of insurers that sets guidelines on which it evaluates the relative insurance risks in communities, recommends the provision of a fire flow rate of 3,500 gpm for a duration of 3 hours. This provision, equated to a storage requirement of 0.63 MG, will allow the water system to respond to hypothetical fires in residential, commercial, or industrial areas.

3.2.3 Emergency Storage

This storage is the volume recommended to meet demands during emergency situations such as pipeline failures, major trunk main failures, pump failures, electrical power outages, or natural disasters. The amount of emergency storage included within a particular water distribution system is an owner option, based on an assessment of risk, the desired degree of system dependability, economic considerations, and water quality concerns. In California, emergency storage is usually estimated at 50 to 100 percent of the MDD.

Until recently, historical data indicated a rarity of prolonged power outages in California cities, and thus groundwater aquifers were considered appropriate emergency storage, if pumping methods were reliable. Recent power shortages suggest a need to incorporate this capacity in aboveground storage tanks. Per direction from City staff, emergency storage volume equal to 50 percent of the City's MDD will be used.

3.2.4 Total Storage

The recommended minimum operational storage capacity for Livingston is equal to 25 percent of the maximum day water demand. Additionally, the recommended fire storage capacity will be equivalent to 0.63 MG. The recommended emergency storage is equal to 50 percent of the MDD. This criteria is further summarized with the following equation.

Qs = 25% MDD + Fire Flow + 50% MDD

where, Qs is the Total Required Storage, in gallons

MDD is the maximum day demand, in gallons

Fire Flow is equivalent to 0.63 MG

The City currently operates one ground level storage tank with a capacity of 1.0 MG.

3.3 SERVICE PRESSURES

Pressures maintained within distribution systems vary depending on City criteria and pressure zone topography. It is essential that the water pressure in a consumer's residence or place of business be neither too high nor too low. Low pressures, below 30 pounds per square inch (psi), cause annoying flow reductions when more than one water-using appliance is used. High pressures may cause faucets to leak and valve seats to wear out quickly. Additionally, high service pressures usually result in wasted water and high water utility bills. The Uniform Plumbing Code (UPC) requires water pressures not exceed 80 psi at service connections, unless the service is provided with a pressure-reducing device.

The American Water Works Association (AWWA) Manual on Distribution Network Analysis of Water Utilities (AWWA M-32), indicates that pressures between 30 psi and 90 psi are generally expected during the range of system water demands including: average day demand (ADD), MDD, maximum storage replenishment rate, and PHD. Based on Carollo experience with water system planning, it is recommended that a minimum pressure of 35 psi be maintained during the PHD, while a pressure of 40 psi be maintained during the MDD.

Another service pressure criteria is related to fire flows and was devised to ensure adequate positive pressure head for the booster pumps in the fire trucks. The fire pressure criteria requires a minimum acceptable residual pressure of 20 psi at the connecting hydrant used for fighting the fire.

3.4 DISTRIBUTION MAINS

Transmission grid mains are generally sized to carry the greater of 1) the PHD, or 2) the MDD plus fire flow. Other criteria related to the distribution piping include the maximum and minimum velocities and the maximum allowable friction losses.

High velocities may cause damage to the pipes and to their appurtenances. Normally, velocities of 10 feet per second (fps) (AWWA M-32), or higher, do not cause ill effects if they occur for a limited duration. It is normally good practice to become concerned when pipe velocities exceed 8 fps on a continuous basis.

As long as the maximum velocity criteria and the pressure criteria are not violated, high head loss by itself is not an important factor. However, it may be a warning that the pipe is nearing the limit of its carrying capacity, and may not have sufficient capacity to perform under stringent conditions. It is normally good practice to monitor pipes that have a head loss in excess of 10 feet per 1,000 feet (AWWA M-32).

The roughness coefficients for calculating head loss in pipes will be based on industry standards for similar pipe materials and service age (Table 3.1).

Table 3.1 Pipe Roughness Design Criteria
Water Distribution System Master Plan
City of Livingston

			Age (Years)			
Pipe Material	**0**	**10**	**20**	**30**	**40**	**50**
Asbestos Cement	120	125	125	125	125	125
Cast Iron	120	110	100	90	80	70
Ductile Iron	130	125	120	115	110	105
Plastic (PVC)	140	140	140	140	140	140
Steel	130	120	110	100	90	80

Notes: At age = 0, the roughness coefficients are commonly used values for new pipes. Roughness coefficients decrease with age at a rate that depends on pipe material. For planning purposes, roughness of Asbestos Cement and PVC pipes are assumed constant, while the remaining pipe materials decrease by age.

3.5 HISTORICAL WATER USE

Groundwater is currently the only source of water supply for Livingston. The City's municipal water system extracts its water supply from underground aquifers via eight active groundwater wells scattered throughout the City (Figure 3.1). Water is conveyed from the wells to the consumers via a distribution system with pipe sizes ranging between 2- and

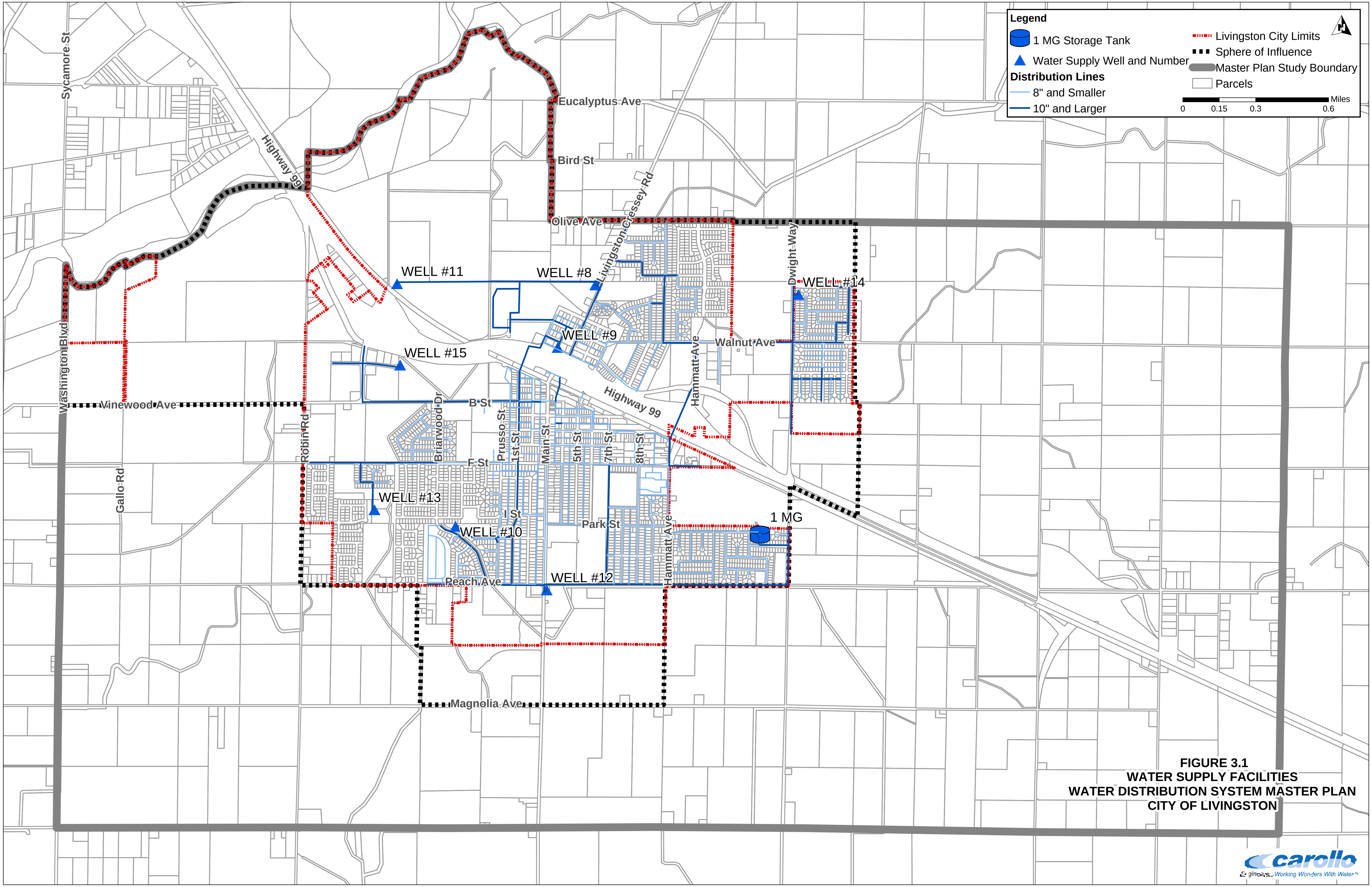

FIGURE 3.1
WATER SUPPLY FACILITIES
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

16-inches in diameter. A 1.0 million gallon (MG) water storage tank currently provides the City's operational storage.

Table 3.2 lists the current capacities of the City's water supply wells, as rated in Well Data Sheets filed with the DHS. The City's current total supply capacity is approximately 7,600 gpm (10.8 MGD).

Table 3.2 Water Supply Wells
Water Distribution System Master Plan
City of Livingston

	Well Capacity[1]		Emergency Supply Capacity		
Well No.	**(gpm)**	**(MGD)**	**Emergency Generator**	**(gpm)**	**(MGD)**
8	1,300	1.9	Yes	1,300	1.9
9	1,300	1.9			
12	1,400	2.0	Yes	1,400	2.0
11	1,000	1.4	Yes	1,000	1.4
12	1,000	1.4			
13	1,000	1.4			
14	1,000	1.4	Yes	1,000	1.4
15[4]	1,000	1.4	Yes	1,000	1.4
Total[3]	**7,600**	**10.8**		**5,700**	**8.1**
Firm	**6,300**	**8.9**			

Notes:
1. Source: California Department of Health Services Fact Sheets.
2. Well No. 10 is on emergency mode due to high levels of nitrates (City staff Oct. 2003)
3. Well No. 10 not included in total or firm capacity.
4. Well No. 15 is not currently owned by the City.

3.5.1 Per-Capita Consumption

The per capita consumption rate is used for estimating the City's future water requirements, evaluating the adequacy of the supply source, and determining storage needs. The consumption rate, expressed in gallons per day per capita (gpcd), is applied to the projected population to yield future water requirements.

Historical Livingston residential per capita water use, based on dividing the residential/commercial customers' water use by the total population, ranged between 145 gpcd (1998) and 186 gpcd (1999). A distribution of demands between residential and commercial use is not available, however City staff indicate that commercial water use is low in Livingston.

When the total City-wide production, including industrial users, is divided by the population, it yields a City-wide per capita water use that is significantly higher. The City-wide per capita water use for Livingston has ranged from 549 gpcd in 1998 to 628 gpcd in 1999. Table 3.3 shows the historical water requirements and per capita consumption from 1995 to 2006.

As the City grows and population increases, the City-wide percentage of industrial water use will decrease, resulting in a reduction in per capita water use. For planning purposes, a residential per-capita water use of 150 gpcd was applied to calculate the future residential and commercial water use for the planning horizon of 2024 and buildout of the Urban Reserve.

3.5.2 Seasonal Demands and Peaking Factors

Peaking factors represent the water use seasonal and daily variations, above or below the average annual water demand. The various peaking conditions are either statistical concepts or numerical values established through a review of historical data and are, at times, adjusted to reflect a level of conservatism.

Peaking conditions that are of particular significance to hydraulic analysis of the water system include the maximum month demand (MMD), MDD, and the PHD. Peaking factors for expressing these demands as a function of the ADD were developed based on the City's demand patterns. Monthly water production data for the past 3 years (2004-2006) were obtained from City Operations Staff, and are summarized in Table 3.4.

3.5.2.1 Maximum Month Demand

The MMD is the highest water demand during a calendar month of the year, usually occurring in Livingston during either June, July or August. The MMD peaking factor is expressed as a multiplier applied to the ADD, and is used primarily in the evaluation of supply capabilities. As shown in Table 3.4, the highest observed MMD peaking factor was 1.42. This factor in not used in this study.

Maximum Month Demand = 1.4 x Average Day Demand

3.5.2.2 Maximum Day Demand

The MDD is the highest water demand during a 24-hour period of the year. The MDD peaking factor is expressed as a multiplier applied to the ADD. Water system sources are typically sized to meet the anticipated MDD of a water system. Maximum day plus fire flows stress the water system in the specific area of the fire and often show existing deficiencies, if any, within the general area of the simulated fire. To evaluate the effect of maximum day plus fire flow throughout a system, the fire flow is simulated at selected critical areas of the

Table 3.3 Historical Water Requirements and Per Capita Consumption (1995-2006)
Water Distribution System Master Plan
City of Livingston

Year	Population[1]	Historical Water Production										Historical
		Annual Production [2]			Monthly Production				Daily Production			Per Capita
					Average	Maximum	Month	Max-to-Avg	Average	Maximum[4]	Max-to-Avg	Consumption
		(AF)	(mgy)	(gpm)	(mgm)	(mgm)	of Occur.	Ratio	(mgd)	(mgd)	Ratio	(gpcd)
1995	8,700	5,558	1,811	3,446	150	220	June	1.47	5.0	n/a	n/a	570
1996	9,000	5,859	1,909	3,632	159	250	August	1.57	5.3	n/a	n/a	581
1997	9,300	6,129	1,997	3,799	166	242	August	1.46	5.5	n/a	n/a	588
1998	9,600	5,895	1,921	3,655	160	221	June	1.38	5.3	n/a	n/a	548
1999	10,000	7,037	2,293	4,363	191	270	July	1.41	6.4	n/a	n/a	628
2000	10,400	6,736	2,195	4,176	182	279	August	1.53	6.1	n/a	n/a	578
2001	10,800	6,834	2,227	4,237	185	263	June	1.42	6.2	n/a	n/a	565
2002	11,700	7,531	2,454	4,669	204	317	August	1.55	6.8	n/a	n/a	575
2003	12,600	5,969	1,945	3,701	166	231	July	1.39	5.5	n/a	n/a	423
2004	13,000	7,516	2,449	4,659	204	287	June	1.41	6.8	n/a	n/a	516
2005	14,135	7,659	2,496	4,748	208	277	July	1.33	6.9	10.2	1.5	484
2006	15,369	7,791	2,539	4,830	212	294	July	1.39	7.1	11.9	1.7	453

Notes:

1. Historical Population Source: California Department of Finance.
2. Annual production records for 1995 to 2003 provided by City staff (June 2004). Production Records for 2004-2006 provided by City Staff (June 2006)
3. Average production is based on the total annual production for that year.
4. Daily data not available before 2005.

Table 3.4 Historical Monthly Water Production (2004 - 2006)
Water Distribution System Master Plan
City of Livingston

Month	Days	Daily Production: Average Day (mgd)	Daily Production: Max Day (mgd)	Peaking Factor: Max Day to Average Day Factor	Monthly Production: Monthly Production (mgm)	Monthly Production: Percent of Annual (%)	Peaking Factor: Month to Avg Month Factor
2004							
January	31	4.23	n/a	n/a	131	7%	0.71
February	28	4.42	n/a	n/a	124	7%	0.67
March	31	5.61	n/a	n/a	174	10%	0.94
April	30	5.27	n/a	n/a	158	9%	0.85
May	31	8.23	n/a	n/a	255	14%	1.37
June	30	7.31	n/a	n/a	219	12%	1.18
July	31	6.90	n/a	n/a	214	12%	1.15
August	31	8.51	n/a	n/a	264	15%	**1.42**
September	30	6.54	n/a	n/a	196	11%	1.06
October	31	5.75	n/a	n/a	178	10%	0.96
November	30	5.86	n/a	n/a	176	10%	0.95
December	31	4.45	n/a	n/a	138	8%	0.74
2005							
January	31	4.07	6.20	1.52	126	7%	0.61
February	28	5.23	7.04	1.35	147	8%	0.70
March	31	5.71	6.33	1.11	177	10%	0.85
April	30	6.71	7.97	1.19	201	11%	0.97
May	31	7.74	8.31	1.07	240	14%	1.15
June	30	8.40	9.10	1.08	252	14%	**1.21**
July	31	8.93	10.18	1.14	277	16%	1.33
August	31	8.39	9.36	1.12	260	15%	1.25
September	30	7.74	8.84	1.14	232	13%	1.12
October	31	7.59	8.56	1.13	235	13%	1.13
November	30	5.95	7.22	1.21	179	10%	0.86
December	31	5.49	6.49	1.18	170	10%	0.82
2006							
January	31	5.50	7.59	1.38	170	10%	0.81
February	28	5.69	7.55	1.33	159	9%	0.75
March	31	5.49	7.62	1.39	170	10%	0.80
April	30	5.58	8.03	1.44	167	9%	0.79
May	31	7.91	10.14	1.28	245	14%	1.16
June	30	9.08	11.72	1.29	272	15%	1.29
July	31	9.49	11.33	1.19	294	17%	**1.39**
August	31	8.93	11.92	1.33	277	16%	1.31
September	30	8.05	9.83	1.22	241	14%	1.14
October	31	7.03	8.65	1.23	218	12%	1.03
November	30	5.46	8.48	1.55	164	9%	0.77
December	31	5.14	7.09	1.38	159	9%	0.75

3-Year Summary (2004 - 2006)

Year	Days	Daily Production: Average Day (mgd)	Daily Production: Max Day (mgd)	Daily Production: Max Day to AveDay Factor	Monthly Production: Average Month (mgm)	Monthly Production: Max Month (mgm)	Peaking Factor: Max Month to-AvgDay Factor
2004	365	6.09	n/a	n/a	186	264	1.42
2005	365	6.83	10.18	1.49	208	277	1.33
2006	365	6.95	11.92	1.72	212	294	1.39

Source: City of Livingston historical water production records.

distribution system. Simulating maximum day plus fire flows also demonstrates the performance of supply sources, booster pumps, and storage tanks operating under stressful conditions.

In general, the MDD is 2.0 to 2.5 times greater than the average annual demand. In Livingston, with industrial customers accounting for approximately 70 percent of the total water use, the historical MDD has been reported at 1.5 times higher than the ADD, as documented in the 1993 Water System Master Plan. The historical 1.5 MDD factor described in the UWMP is a system wide peaking factor accounting for industrial and residential/commercial demands. When the City's industrial demands are not considered the MDD factor for the residential/commercial demands is 2.6. 2005 water demand projections indicate that when the industrial and residential/commercial demands are totaled, the system wide peaking factor is calculated at 1.7 for the current system. As the city grows and the percentage of residential development increases, the system wide peaking factor climbs to 2.2 at ultimate build out.

- Residential/Commercial Maximum Day Demand = 2.6 x Average Day Demand
- System Wide Maximum Day Demand = 1.7 x Average Day Demand (Current)
- System Wide Maximum Day Demand = 2.2 x Average Day Demand (Ultimate)

3.5.2.3 Peak Hour Demand

The PHD is the highest water demand during any one-hour period of the year. The PHD is expressed as a multiplier applied to the average annual demand. PHDs simulate high water use throughout the system during peak demands and identifies areas of the distribution system that experience low pressures.

This condition is similar to applying maximum day plus fire flow; only in this case, the entire system is exposed to stressful conditions. In general, the PHD ranges between 2.5 and 3.5 times greater than the average annual demand. As was the case with the MDD, if the City's industrial demands are not considered, the Residential/Commercial peaking factor is 4.4. In combination with the industrial demands, the system wide PHD factor is 2.4 for the current system. As the city grows and the percentage of residential development increases, the system wide peaking factor climbs to 3.7 at ultimate build out.

- Residential/Commercial Peak Hour Demand = 4.4 x Average Day Demand
- System Wide Peak Hour Demand = 2.4 x Average Day Demand (Current)
- System Wide Peak Hour Demand = 3.7 x Average Day Demand (Ultimate)

3.5.2.4 Daily Diurnal Pattern

In the absence of hourly production records, an hourly diurnal pattern was developed for this study using the recommended peaking factors. As stated earlier, the City's water use

Table 3.5 Daily Diurnal Water Demand Pattern
Water Distribution System Master Plan
City of Livingston

Demand Condition	Time (Hours) 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	24-Hour Average	
Peaking Factors																										
Annual Average Day Residential/Commercial (ADD)	0.55	0.60	0.65	0.75	1.10	1.40	1.67	1.30	1.10	1.05	0.95	1.10	1.00	0.90	0.95	1.00	1.20	1.40	1.25	1.00	0.90	0.80	0.70	0.65	1.00	
Maximum Day Residential/Commercial (MDD)	1.44	1.57	1.70	1.97	2.88	3.67	**4.38**	3.41	2.88	2.75	2.49	2.88	2.62	2.36	2.49	2.62	3.14	3.67	3.28	2.62	2.36	2.10	1.83	1.70	2.62	
Industrial Demands(MDD)	1.00	1.00	1.10	1.25	1.25	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.37	1.25	1.00	1.00	1.00	1.00	1.25	
2006 Water Demands (gpm)																									**(gpm)**	**(MGD)**
Annual Average Day Residential/Commercial (ADD)	878	958	1,038	1,198	1,757	2,236	2,667	2,076	1,757	1,677	1,517	1,757	1,597	1,437	1,517	1,597	1,917	2,236	1,997	1,597	1,437	1,278	1,118	1,038	1,595	2.3
Maximum Day Residential/Commercial (MDD)	2,302	2,511	2,720	3,139	4,603	5,859	6,988	5,440	4,603	4,394	3,975	4,603	4,185	3,766	3,975	4,185	5,022	5,859	5,231	4,185	3,766	3,348	2,929	2,720	4,179	6.0
Industrial Demands (MDD)	3,264	3,264	3,590	4,080	4,080	4,472	4,472	4,472	4,472	4,472	4,472	4,472	4,472	4,472	4,472	4,472	4,472	4,472	4,472	4,080	3,264	3,264	3,264	3,264	4,084	5.9
Total ADD (Industrial plus Residential)	**4,142**	**4,222**	**4,628**	**5,278**	**5,837**	**6,708**	**7,139**	**6,548**	**6,228**	**6,149**	**5,989**	**6,228**	**6,069**	**5,909**	**5,989**	**6,069**	**6,388**	**6,708**	**6,468**	**5,677**	**4,701**	**4,542**	**4,382**	**4,302**	**5,679**	**8.2**
Total MDD (Industrial plus Residential)	**5,565**	**5,775**	**6,310**	**7,218**	**8,683**	**10,330**	**11,460**	**9,912**	**9,075**	**8,865**	**8,447**	**9,075**	**8,656**	**8,238**	**8,447**	**8,656**	**9,493**	**10,330**	**9,702**	**8,265**	**7,030**	**6,612**	**6,193**	**5,984**	**8,263**	**11.9**
Projected Demands: Sphere of Influence (gpm)																									**(gpm)**	**(MGD)**
Annual Average Day (ADD)	5,556	5,764	5,972	6,389	7,847	9,097	10,222	8,681	7,847	7,639	7,222	7,847	7,431	7,014	7,222	7,431	8,264	9,097	8,472	7,431	7,014	6,597	6,181	5,972	7,425	10.7
Maximum Day (MDD)	9,268	9,814	10,686	12,267	16,088	19,755	22,702	18,663	16,480	15,934	14,842	16,480	15,388	14,297	14,842	15,388	17,572	19,755	18,117	14,997	13,089	11,997	10,906	10,360	14,987	21.6
Projected Demands: Urban Reserve Build out (gpm)																									**(gpm)**	**(MGD)**
Annual Average Day (ADD)	9,673	10,250	10,826	11,979	16,014	19,472	22,584	18,319	16,014	15,437	14,284	16,014	14,861	13,708	14,284	14,861	17,166	19,472	17,743	14,861	13,708	12,555	11,402	10,826	14,846	21.4
Maximum Day (MDD)	19,945	21,455	23,298	26,818	37,389	46,850	55,005	43,830	37,789	36,279	33,259	37,789	34,769	31,749	33,259	34,769	40,810	46,850	42,320	34,369	30,515	27,495	24,475	22,965	34,335	49.4

Note: 1) Peaking Factors are multipliers applied to the average annual demands

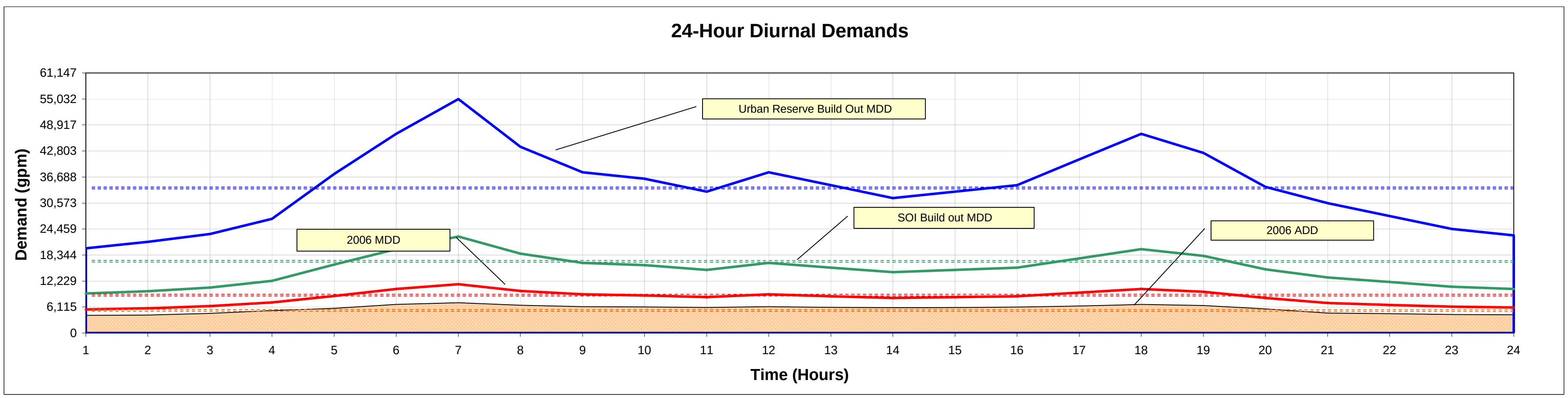

FIGURE 3.2
DAILY DIURNAL WATER DEMAND PATTERN
WATER DISRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

consists of 70 percent industrial and 30 percent residential/commercial demands. Due to this distribution of demands, separate factors were developed for residential/commercial and industrial uses. These peaking factors are shown in Table 3.5 and on Figure 3.1. Table 3.5 includes values for hourly demands during existing and projected MDD conditions. When the two demand patterns are added together an overall MDD Factor of 1.7 was obtained. These diurnal patterns will be used in the hydraulic computer model to perform 24-hour simulations for evaluating the capacity of the City's existing distribution system and for sizing improvement facilities.

3.6 AVERAGE ANNUAL WATER DEMAND COEFFICIENTS

The average annual water demand coefficients are factors, usually expressed in gallons per day per acre (gpdpa), applied to either gross or net acres for calculating the average water demands generated from a particular land use designation. Since some land uses require larger amounts of water than others do, an assessment of water consumption by land category provides a more accurate representation of water demands. The developed factors (Table 3.6) are based on a City-wide water balance for the developed land use acreages.

The water balance of 4,792 gallons per minute (gpm) (6.9 mgd) represents the year 2006 projected water production for the City. The 1993 Plan indicated that industrial customers (Foster Farms) account for about 70 percent of water demands, while commercial, residential, and institutional customers account for the remaining 30 percent.

3.7 PROJECTED WATER REQUIREMENTS

Based on the future trends in population provided by City staff, and the established per capita water consumption rate of 150 gpcd, the City's future water requirements were estimated and summarized in Table 3.7. In addition to the projected average demands, Table 3.7 includes annual estimates for the maximum day and PHDs, through the planning horizon year of 2024 and buildout of the Urban Reserve. Based on these projections, it is anticipated that the City's average day and maximum day requirements for 2024 will approach 15.7 mgd (10,903 gpm) and 33.2 mgd (23,050 gpm), respectively. For the buildout of the Urban Reserve, it is anticipated that the City's average day and max day requirements will approach 21.4 mgd (14,861 gpm) and 48.1 mgd (33,369 gpm), respectively.

3.8 PLANNING AND DESIGN CRITERIA SUMMARY

Table 3.8 provides a summary of the design criteria.

Table 3.6 Existing Water Demand Balance
Water Distribution System Master Plan
City of Livingston

Land Use Designation	2006 (Developed) Water Service Area[1] (gr. Ac.)	% of Total Service Area (%)	Demand Coefficient (gpd/gr. Ac.)	2006 ADD Balance (gpd)	% of Total Demand (%)
Residential					
Low Density/Estate	483	45%	2,600	1,255,800	18%
Medium Density	49	5%	4,600	225,400	3%
High Density	50	5%	5,200	260,000	4%
					25%
Commercial					
Downtown	62	6%	1,700	105,400	2%
Neighborhood	1	0%	1,700	1,700	0%
Community	4	0%	1,700	6,800	0%
Service	29	3%	1,700	49,300	1%
Highway	13	1%	1,700	22,100	0%
Office	0	0%	1,700	0	0%
					3%
Industrial					
Light	23	2%	1,700	39,100	1%
General	46	4%	102,200	4,701,200	68%
					68%
Other					
Public Facility Demand Generating	132	12%	2,000	264,000	4%
Public Facility Non-Demand Generating	97	9%	0	0	0%
General Industrial Non-Demand Generating	34	3%	0	0	0%
Park/Open Space	42	4%	500	21,000	0%
Urban Reserve	0	0%	0	0	0%
Commercial Reserve	0	0%	0	0	0%
					4%
Totals	**1,065**	**100%**		**6,951,800**	**100%**

Notes:

1. Includes all developed lands within the City Boundary in 2006.

Table 3.7 Projected Future Water Requirements
Water Distribution System Master Plan
City of Livingston

Year[1]	Population[1]	Annual Growth	Projected Water Requirements														
			Annual	Avg. Month	Max. Month	Domestic Average Day	Industrial Average Day	Total Average Day[5]		Domestic Maximum Day	Industrial Max Day[10]	Total Maximum Day[7]		Domestic Peak Hour	Industrial Peak Hour	Total Peak Hour[9]	
		(%)	(MG)	(MGM)	(MGM)	(MGD)	(MGD)	(MGD)	(gpm)	(MGD)	(MGD)	(MGD)	(gpm)	(MGD)	(MGD)	(MGD)	(gpm)
2006	15,400	6.2%	2,551	213	276	2.3	4.7	6.9	4,792	6.1	5.9	11.9	8,265	10.1	6.4	16.5	11,479
2007	16,700	6.2%	2,630	219	285	2.5	4.7	7.1	4,931	6.6	5.9	12.4	8,620	11.0	6.4	17.4	12,072
2008	18,200	6.2%	2,712	226	294	2.7	4.7	7.4	5,139	7.2	5.9	13.0	9,030	12.0	6.4	18.4	12,756
2009	19,800	6.2%	2,800	233	303	3.0	4.7	7.6	5,278	7.8	5.9	13.6	9,466	13.0	6.4	19.4	13,486
2010	24,900	25.8%	3,079	257	334	3.7	4.7	8.4	5,833	9.8	5.9	15.6	10,858	16.4	6.4	22.8	15,813
2011	31,400	26.1%	3,435	286	372	4.7	4.7	9.3	6,458	12.3	5.9	18.2	12,632	20.6	6.4	27.0	18,779
2012	39,700	26.4%	3,889	324	421	6.0	4.7	10.6	7,361	15.6	5.9	21.5	14,897	26.1	6.4	32.5	22,566
2013	41,700	5.0%	4,035	336	437	6.3	4.8	11.0	7,639	16.4	6.0	22.4	15,547	27.4	6.6	34.0	23,592
2014	43,900	5.3%	4,156	346	450	6.6	4.8	11.3	7,847	17.3	6.0	23.3	16,148	28.8	6.6	35.4	24,596
2015	46,200	5.2%	4,281	357	464	6.9	4.8	11.7	8,125	18.2	6.0	24.2	16,775	30.4	6.6	36.9	25,645
2016	48,600	5.2%	4,413	368	478	7.3	4.8	12.0	8,333	19.1	6.0	25.1	17,430	31.9	6.6	38.5	26,740
2017	51,100	5.1%	4,550	379	493	7.7	4.8	12.4	8,611	20.1	6.0	26.1	18,113	33.6	6.6	40.1	27,881
2018	53,700	5.1%	4,692	391	508	8.1	4.8	12.8	8,889	21.1	6.0	27.1	18,822	35.3	6.6	41.9	29,067
2019	56,500	5.2%	4,845	404	525	8.5	4.8	13.2	9,167	22.2	6.0	28.2	19,586	37.1	6.6	43.7	30,345
2020	59,500	5.3%	5,010	417	543	8.9	4.8	13.7	9,514	23.4	6.0	29.4	20,405	39.1	6.6	45.7	31,714
2021	62,600	5.2%	5,179	432	561	9.4	4.8	14.1	9,792	24.6	6.0	30.6	21,251	41.1	6.6	47.7	33,128
2022	65,800	5.1%	5,355	446	580	9.9	4.8	14.6	10,139	25.9	6.0	31.9	22,125	43.2	6.6	49.8	34,588
2023	69,200	5.2%	5,541	462	600	10.4	4.8	15.1	10,486	27.2	6.0	33.2	23,053	45.5	6.6	52.0	36,139
2024	72,800	5.2%	5,738	478	622	10.9	4.8	15.7	10,903	28.6	6.0	34.6	24,035	47.8	6.6	54.4	37,782
2025	74,400	2.2%	5,825	485	631	11.2	4.8	15.9	11,042	29.2	6.0	35.2	24,472	48.9	6.6	55.5	38,512
2026	76,000	2.2%	5,913	493	641	11.4	4.8	16.2	11,250	29.9	6.0	35.9	24,908	49.9	6.6	56.5	39,242
2027	77,600	2.1%	6,001	500	650	11.6	4.8	16.4	11,389	30.5	6.0	36.5	25,345	51.0	6.6	57.6	39,972
2028	79,200	2.1%	6,088	507	660	11.9	4.8	16.6	11,528	31.1	6.0	37.1	25,782	52.0	6.6	58.6	40,702
2029	80,900	2.1%	6,181	515	670	12.1	4.8	16.9	11,736	31.8	6.0	37.8	26,246	53.2	6.6	59.7	41,477
2030	82,600	2.1%	6,274	523	680	12.4	4.8	17.1	11,875	32.5	6.0	38.5	26,710	54.3	6.6	60.8	42,253
2031	84,400	2.2%	6,373	531	690	12.7	4.8	17.4	12,083	33.2	6.0	39.2	27,201	55.5	6.6	62.0	43,074
2032	86,200	2.1%	6,471	539	701	12.9	4.8	17.7	12,292	33.9	6.0	39.9	27,692	56.6	6.6	63.2	43,895
2033	88,000	2.1%	6,570	548	712	13.2	4.8	18.0	12,500	34.6	6.0	40.6	28,183	57.8	6.6	64.4	44,717
2034	89,900	2.2%	6,674	556	723	13.5	4.8	18.2	12,639	35.3	6.0	41.3	28,702	59.1	6.6	65.6	45,584
2035	91,800	2.1%	6,778	565	734	13.8	4.8	18.5	12,847	36.1	6.0	42.1	29,220	60.3	6.6	66.9	46,450
2036	93,700	2.1%	6,882	574	746	14.1	4.8	18.8	13,056	36.8	6.0	42.8	29,739	61.6	6.6	68.1	47,317
2037	95,700	2.1%	6,992	583	757	14.4	4.8	19.1	13,264	37.6	6.0	43.6	30,285	62.9	6.6	69.5	48,230
2038	97,800	2.2%	7,107	592	770	14.7	4.8	19.4	13,472	38.4	6.0	44.4	30,858	64.3	6.6	70.8	49,188
2039	99,800	2.0%	7,216	601	782	15.0	4.8	19.7	13,681	39.2	6.0	45.2	31,404	65.6	6.6	72.1	50,100
2040	102,000	2.2%	7,337	611	795	15.3	4.8	20.1	13,958	40.1	6.0	46.1	32,004	67.0	6.6	73.6	51,104
2041	104,100	2.1%	7,451	621	807	15.6	4.8	20.4	14,167	40.9	6.0	46.9	32,577	68.4	6.6	75.0	52,062
2042	106,300	2.1%	7,572	631	820	15.9	4.8	20.7	14,375	41.8	6.0	47.8	33,178	69.8	6.6	76.4	53,066
2043	108,600	2.2%	7,698	641	834	16.3	4.8	21.0	14,583	42.7	6.0	48.7	33,805	71.4	6.6	77.9	54,115
2044	110,900	2.1%	7,824	652	848	16.6	4.8	21.4	14,861	43.6	6.0	49.6	34,433	72.9	6.6	79.4	55,165

Notes

1. Update Population projections were provided by PMC Consultants, dated April 2006)
   - Existing City 2006/2007, population at 15,400
   - Buildout of Existing City Limits in 2009 at 19,756
   - Buildout of Existing Sphere of Influence in 2012 at 39,659
   - Buildout of Areas 1-8 in 2024 at 72,837
   - Buildout of Master Plan Study Area in 2044 at 110,906
2. Projected Per Capita Consumption is estimated at 150 gpdc.
3. Average Annual Demand is based on the total annual production.
4. The Peaking Factors are multipliers applied to the Average Annual Demand, to yield Maximum Month, Maximum Day, and Peak Hour Demands.
5. Average Day Demand is based on the Annual Demand, expressed in daily units.
6. Maximum Month Demand (highest monthly demand), is calculated by applying a multiplier of 1.7 to the Average Day Demand.
7. Maximum Day Demand (highest daily demand), is calculated by applying a multiplier of 2.62 to the Residential/Commercial Average Day Demand plus 1.25 times the Industrial Demand.
8. Peak Hour Demand (highest hourly demand), is calculated by applying a multiplier of 4.8 to the Residential/Commercail Average Day Demand plus 1.37 times the Industrial Demand.
9. Average Day Demands are based on 150 gpdc residential plus industrial demands which increased from 4.5 mgd in 2000 to 4.8 mgd in 2020
10. Industrial Max Day from industrial water meter records.

Table 3.8 Planning and Design Criteria Summary
Water Distribution System Master Plan
City of Livingston

Source of Supply

The adequate source of supply is required to meet: Maximum Day Demand + 1300 gpm.

Storage

The adequate storage shall meet:
- Operational Storage = 25% of Maximum Day Demand
- Fire Storage = 0.63 MG
- Emergency Storage = 50% Maximum Day Demand

Distribution Mains

The distribution system should be sized to meet the greater of:
- Peak Hour Demand, or
- Maximum Day Demand + Fire Flow.

Criteria for judging the adequacy of existing pipelines:
- Maximum desirable pipeline velocity: 10 feet per second
- Maximum desirable head loss: 10 feet/1,000 feet

Headloss in Existing Pipes

Headloss in pipes shall be calculated based on the following table:

	Age (Years)					
Pipe Material	**0**	**10**	**20**	**30**	**40**	**50**
Asbestos Cement	125	125	125	125	125	125
Cast Iron	120	110	100	90	80	70
Ductile Iron	130	125	120	115	110	105
Plastic (PVC)	140	140	140	140	140	140
Steel	130	120	110	100	90	80

Service Pressures

The recommended high/low pressures are as follows:

Maximum Pressure =	80 psi
Minimum Pressure (during Maximum Day) =	40 psi
Minimum Pressure (during Peak Hour) =	35 psi
Minimum Residual Pressure (during Fires) =	20 psi

Water Use Peaking Factors

Fluctuations in water demands shall be based on:

Maximum Month Demand =	1.4 x Average Day Demand
Maximum Day Demand (Residential/Commercial) =	2.6 x Average Day Demand
Maximum Day Demand (System Wide) =	1.7 x Average Day Demand
Peak Hour Demand (Residential/Commercial) =	4.4 x Average Day Demand
Peak Hour Demand (System Wide) =	2.4 x Average Day Demand

Per Capita Water Consumption

Demand forecasting shall be based on: City-Wide = 150 gpdc

Average Annual Demand Coefficients

These demand coefficients are applied to the gross land use acreages to yield average day water demands:

Land Use Category	**Coefficients**	
	(gpd/acre)	**(gpm/acre)**
Low Density/Estate	2,600	1.81
Medium Density	4,600	3.19
High Density	5,200	3.61
Downtown Commercial	1,700	1.18
Neighborhood Commercial	1,700	1.18
Highway Commercial	1,700	1.18
Community Commercial	1,700	1.18
Service Commercial	1,700	1.18
Limited Industrial	1,700	1.18
General Industrial (existing)	102,200	70.97
Public Facility Demand Generating	2,000	1.39
Public Facility Non-Demand Generating	0	0.00
General Industrial Non-Demand Generating	0	0.00
Park/Open Space	500	0.35
Industrial Reserve Non-Demand Generating	0	0.35

Fire Flows

In this study, water system response is adequate when it provides the following flows:

Residential fire flow =	1,200 gpm for a duration of 2 hours
Commercial fire flow =	2,500 gpm for a duration of 2 hours
Industrial fire flow =	3,500 gpm for a duration of 3 hours.

EXISTING SYSTEM AND HYDRAULIC MODEL

This chapter presents an overview of the City's water supply, distribution, and storage facilities, and gives a description of existing system. This chapter also describes the development and calibration of the City's Water Distribution Hydraulic Model.

4.1 SYSTEM OVERVIEW

Livingston provides potable water service to its residential, commercial, industrial, and institutional customers within the City limits. The City's municipal water system extracts water from the underground aquifers via a series of groundwater wells distributed throughout the City. The City's water system facilities include eight active groundwater wells, a 1.0 MG potable water storage tank, and over 36 miles of pressured pipes ranging from 2- to 16-inches in diameter (Figure 4.1).

4.1.1 Supply Capacity

The City relies on groundwater to meet its supply needs. According to the 2000 Urban Water Management Plan, feasible alternative sources do not exist within or nearby the study area. The City must rely on the underlying groundwater basin as an expanding source for future water supply. In 2005 a study was conducted to investigate the groundwater conditions within the master plan boundary (2005 Groundwater Report). Detailed descriptions of the current groundwater conditions can be found in the 2005 Groundwater Report Located in Appendix A.

Table 4.1 lists the capacities of the existing eight-groundwater supply wells, as rated by City staff and documented in maintenance records. The active wells have a current supply capacity of approximately 10.8 mgd (7,500 gpm). The firm capacity, which is defined as the total capacity less one of the largest wells out of service, is approximately 8.9 mgd.
Table 4.1 also shows the system's emergency supply capabilities. Currently, Well No. 10 is non-operational due to high nitrate levels and City staff has indicated that it is not planning to use the well in the future. The City's water system has no current interconnections to any other water system.

4.1.2 Storage Reservoirs

Storage is provided for equalization, fire flow requirements, and emergencies, as defined in the City's planning criteria. The total capacity of the City's existing storage reservoir is 1 MG. This storage tank is located in the southeastern portion of the City and the end of Burgundy Drive west of Dwight Avenue.

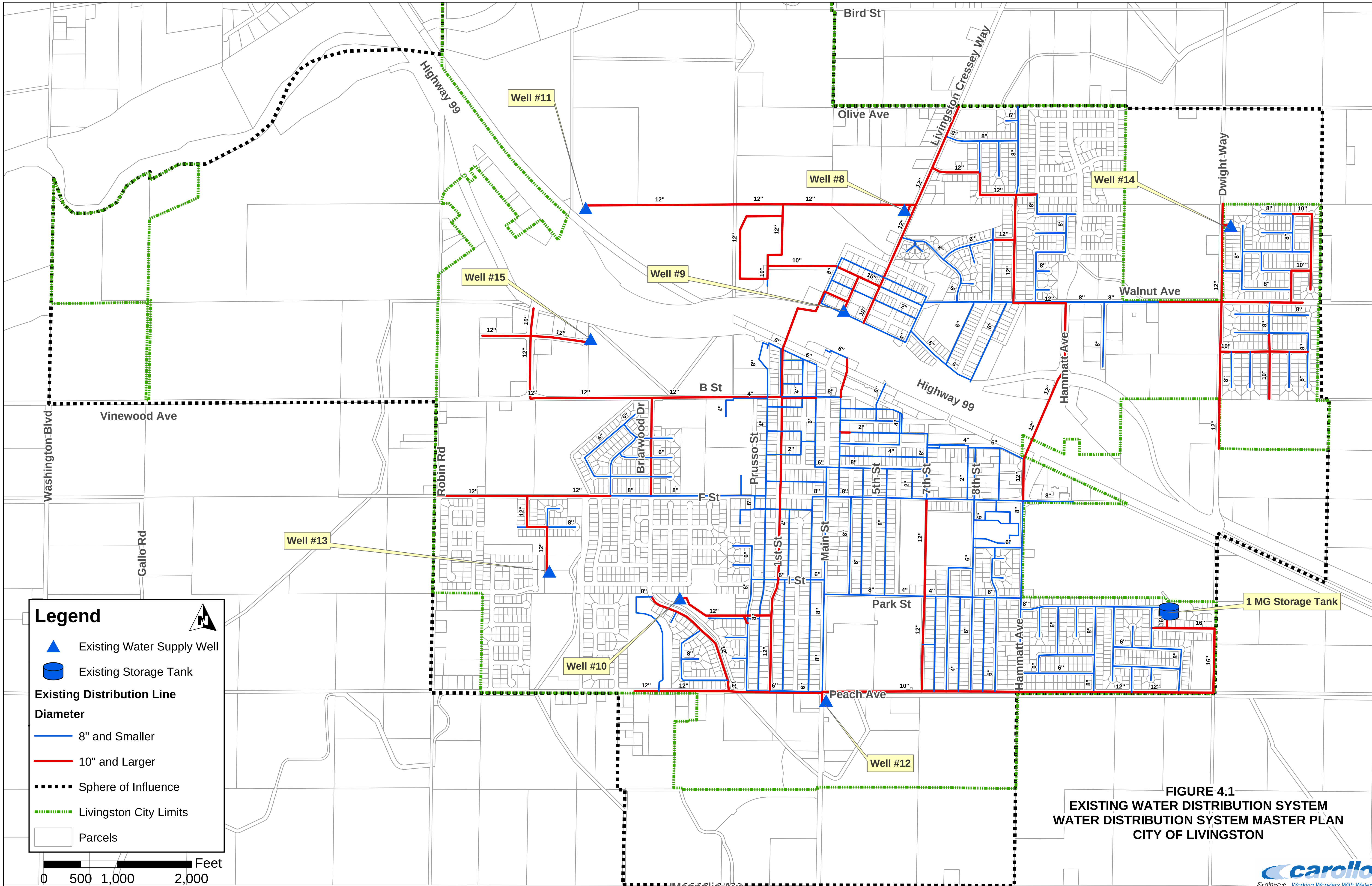

FIGURE 4.1
EXISTING WATER DISTRIBUTION SYSTEM
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

4.2 HYDRAULIC MODEL

Hydraulic network analysis is a powerful tool used in all aspects of water distribution planning, design, operation, management, emergency response, system reliability analysis, fire flow capacity evaluation, as well as water quality simulations. The City's hydraulic model (Figure 4.2) was developed to evaluate the adequacy of the existing distribution system and in planning future facilities.

Table 4.1 Current Groundwater Supply Capacity
Water Distribution System Master Plan
City of Livingston

Well Capacity[1]				Emergency Supply Capacity		
Well No.	**(gpm)**	**(MGD)**	**Status**	**Emergency Generator**	**(gpm)**	**(MGD)**
8	1,300	1.9	Operational	Yes	1,300	1.9
9	1,300	1.9	Operational			
10[3]	1,400	2.0	Emergency[2]	Yes	1,400	2.0
11	1,000	1.4	Operational	Yes	1,000	1.4
12	1,000	1.4	Operational			
13	1,000	1.4	Operational			
14	1,000	1.4	Operational	Yes	1,000	1.4
15[4]	1,000	1.4	Operational	Yes	1,000	1.4
Total	7,600	**10.8**			5,700	**8.1**
Firm	6,300	**8.9**				

Notes:
1. Source: City Staff July 2005.
2. Well No. 10 is in emergency mode due to high levels of nitrates (City Staff October 2003).
3. Not included in Total or Firm capacity.
4. Well No. 15 is not currently owned by the City.

4.2.1 Data Collection and Validation

Data necessary for the development of the hydraulic model were collected from City engineering and operational staff. The data included improvement plans and hard copies of the City’s distribution system maps, which were used as the background for constructing the distribution system piping.

The data validation process included a review by City engineering, operation, and field maintenance staff of the City's existing water plat maps. City staff comments were compared and used to update the developed computer hydraulic model. System operational data were collected from City staff familiar with the day-to-day operation of the water system.

Historical water production data, were obtained and summarized. Current land use information was based on a map obtained from the City's General Plan.

4.2.2 Elements of the Hydraulic Model

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

4.2.2.1 Skeletonizing

Skeletonizing is the process by which water networks 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 delivering water through the system. 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.

In Livingston's case, an effort was made to digitize a majority of the existing distribution pipes, including pipe sizes that are 4-inches in diameter in addition to a large number of critical 2-inch diameter pipes.

4.2.2.2 Pipes and Nodes

Computer modeling requires gathering detailed numerical information on the physical characteristic of the modeled water system, such as pipe sizes (diameters), lengths, and general system geometry.

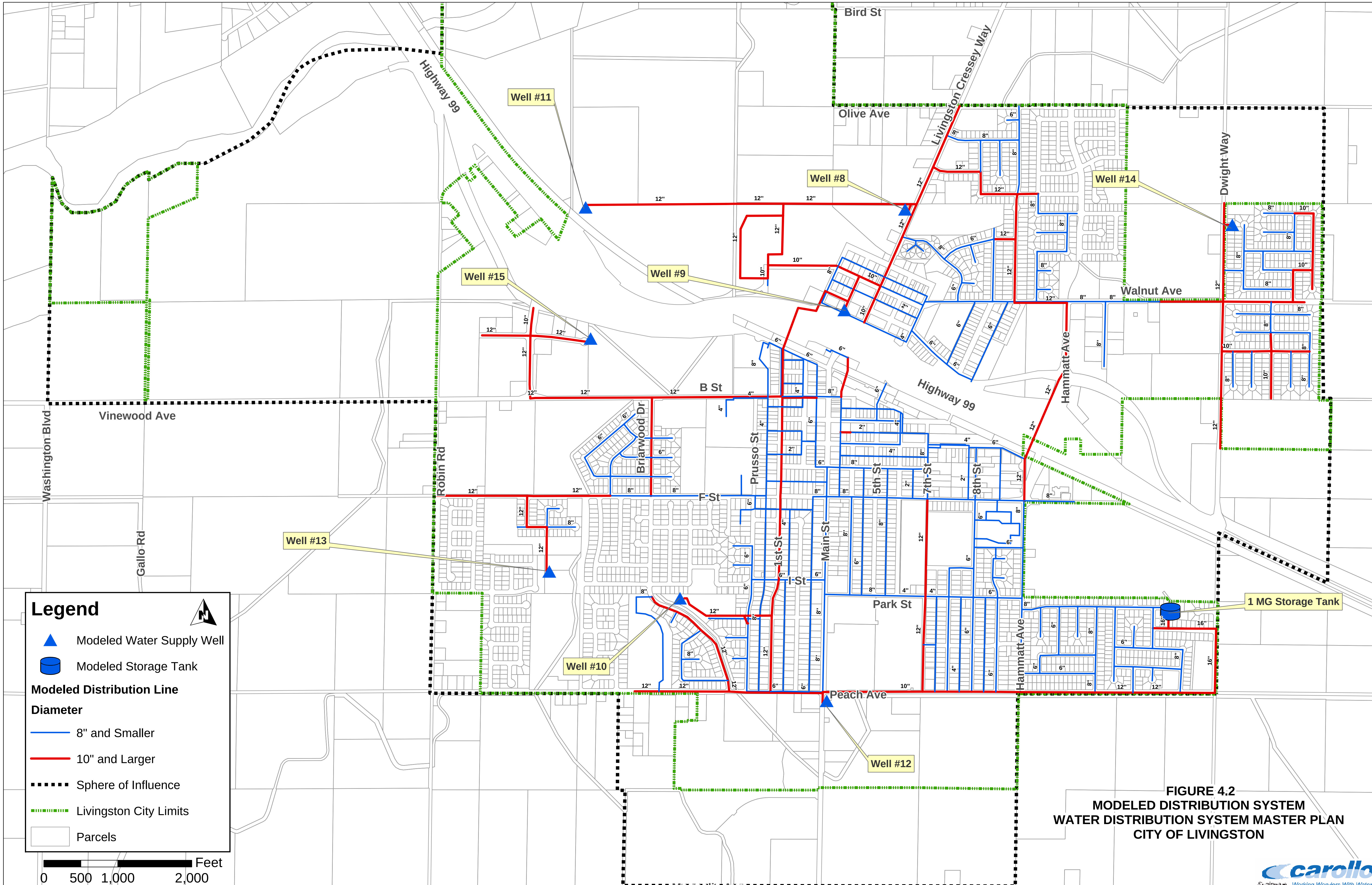

FIGURE 4.2
MODELED DISTRIBUTION SYSTEM
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

Pipes and nodes represent the physical elements describing the water network. A node represents a location in the network where a demand can be applied or water supplied to the system, while a pipe segment represents the actual transmission or distribution pipe itself. Pump performance curve data, defining the operation of the existing pumps and booster stations, were also incorporated in the computer model.

4.2.2.3 Demand Allocation

Allocating water demands to appropriate nodes in the hydraulic model was accomplished in several steps that included an analysis of City-wide land use distribution and review of historical water production records. Water service areas tributary to junction nodes were delineated and the resulting demand calculated by applying land use water coefficients developed in a previous chapter. The resulting total model demands matched the total projected annual demand for the year 2004. Variations to the average demand (maximum day demand and peak hour demand), which were also developed and discussed in a previous chapter, were applied to the model for simulating high demand conditions.

Future water demands through the planning horizon of 2024 and buildout of the Urban Reserve were calculated based on the population projections defined in a previous chapter, and adjusted to reflect the addition of anticipated developments.

4.2.3 Hydraulic Model Calibration

The City’s hydraulic model was calibrated to establish a level of confidence in the pressures and flows that it simulates. Calibration is complicated by the fact that some data are known and unchanging; some are variable over time, while others are estimated.

Pipe information such as diameter, lengths, and location are known. Pump rates and discharge pressures vary over time to respond to variations in consumption. Calibration can be performed for either steady-state or extended-period simulation. Calibration with the extended-period simulation is more difficult than the steady-state calibration and will have a lesser degree of accuracy.

Calibration with steady-state simulation is usually performed on field data that should be collected during the peak hour demand condition. All of the hydrant tests were completed on October 8 and 9, 2003. City staff completed the hydrant tests necessary for the calibration task. The hydrant test locations are shown on Figure 4.3.

In excess of one hundred (100) modeling runs were performed during the calibration process of Livingston’s water hydraulic model. During the calibration, values obtained from the hydrant flow tests were compared to model simulations. The calibration effort yielded a reasonable difference between the field tests and model simulated pressures.

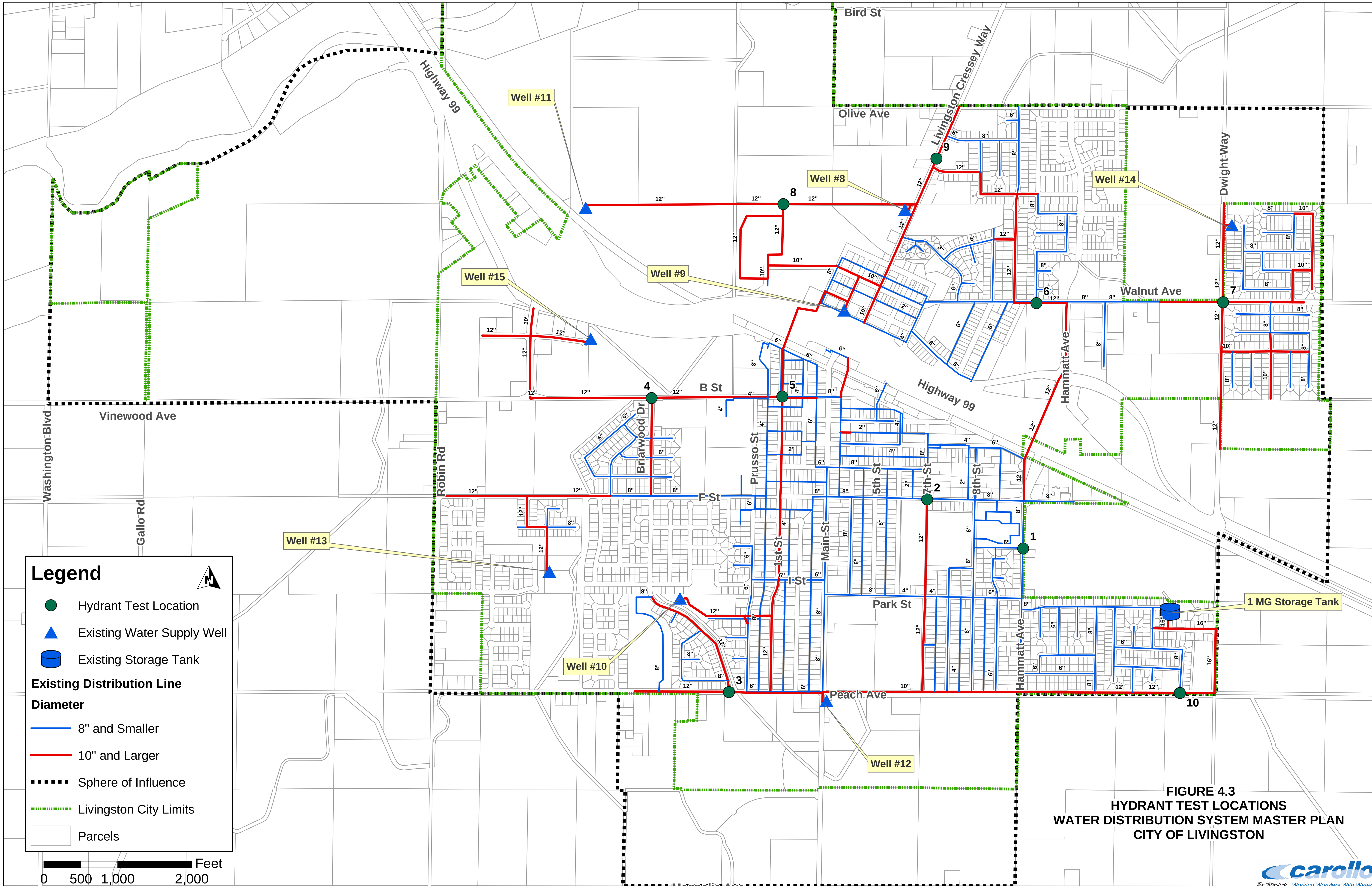

FIGURE 4.3
HYDRANT TEST LOCATIONS
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

The calibrated model serves as an established benchmark for further analysis and evaluation. Pressure and flow values from subsequent analysis included modifications to the calibrated benchmark model by simulating other water consumption patterns, operating scenarios, or additional facilities. Table 4.2 lists the Hydrant Test Locations.

Table 4.2 Fire Hydrant Test Locations
Water System Engineering Feasibility Study
City of Livingston

Test No.	Location Description	Ground Elev (ft)	SHGL (ft)	Model Junction No.
1	Hammet between F Street and Park Street	130	247	284
2	F Street and Seventh Street	130	257	204
3	Peach Ave. at the Monte Cristo Development	130	280	896
4	Winton Parkway and B Street	125	270	578
5	Corner of B Street and First Street	125	272	454
6	Walnut Avenue and Olds Avenue	130	282	330
7	Walnut Avenue and Dwight Avenue	135	262	1
8	In front of Deli Plant on Foster Farms Property	130	277	364
9	On Cressy Way just north of Harvest Avenue	130	273	60
10	Peach Avenue and Amaretto Street	130	259	684

EVALUATION AND PROPOSED IMPROVEMENTS

This chapter provides a discussion of the existing system deficiencies, recommends proposed improvements to mitigate deficiencies based on the design criteria discussed in the previous chapters.

5.1 SUPPLY CAPACITY

The City's total and firm supply capacity, from the existing eight groundwater wells is estimated at 10.8 mgd and 8.9 mgd, respectively. The City-wide supply analysis indicates that the current MDD is approximately 11.9 mgd.

Assuming the existing wells will remain in service and at their current capacities, the total recommended increase in the source of supply is 4.0 mgd. It is recommended that the City construct two new wells, with an approximate individual average capacity of 2.0 mgd (approximately 1,400 gpm). This increase will provide enough capacity to meet existing MDDs with one well out of service.

The analysis (Table 5.1) also estimates future demands based on the population projections based on PMC planning projections (April 2007). The population increases are estimated to reach 24,900 in 2010, 46,200 in 2015, and 72,800 in 2024. For each staged planning period, the table also summarizes the required corresponding supply capacity: 16.4 mgd in 2010, 24.8 mgd in 2015, and 34.6 in 2024.

Assuming the existing wells will remain in service at their current capacities, the total recommended increase in the source of supply through 2024 is 26 mgd (total recommended supply less 2007 available total supply). It is recommended that the City construct 13 new wells by 2024, two of which to mitigate existing deficiencies. The City's Urban Water Management Plan (UWMP) addresses the additional water supply based on the operational conditions and availability of recharge water.

The total recommended increase in the source of supply at buildout of the Urban Reserve is 16 mgd (total recommended supply less 2024 available total supply). It is recommended that the City construct eight new wells to provide supply for the Urban Reserve area.

Please note that this analysis, consistent with established planning criteria, assumes that peak hour demands will be supplied by storage reservoirs. Should the storage upgrades described in this master plan be delayed, additional groundwater wells need to be constructed to meet the peak hour demand requirements. If storage has not been added by 2010, two additional groundwater wells will need to be constructed to meet the peak hour demands for that year. These two wells would be in addition to the wells proposed to meet the maximum day demand condition. Also, some wells in the distribution system may not

Table 5.1 Future Supply and Storage Requirements
Water Distribution System Master Plan
City of Livingston

Supply and Storage	Criteria	2007	2010	2015	2024	2044
1. Population Forecasting						
City Sphere of Influence		16,700	24,900	46,200	72,800	110,900
2. Projected Demands		(MGD)	(MGD)	(MGD)	(MGD)	(MGD)
a. City Wide Average Day Demands	Per Capita Consumption: 150 gpcd + Industrial Demands	7.2	8.4	11.7	15.7	21.4
b. Industrial Demands		4.7	4.7	4.8	4.8	4.8
c. City Wide Maximum Day Demands	MDD = 1.25(Industrial Demands) + 2.6(Residential/Commercial)	12.4	15.6	24.0	34.4	49.3
d. City Wide Peak Hour Demands	PHD = 1.37(Industrial Demands) + 4.4(Residential/Commercial)	17.4	22.8	36.9	54.4	79.4
3. Supply Requirements		(MGD)	(MGD)	(MGD)	(MGD)	(MGD)
a. Required Supply	Supply to meet Max. Day Demands plus Standby 2.0 mgd	14.4	17.6	26.0	36.4	51.3
b. Available Supply (Wells Capacity)		10.8	14.8	18.8	26.8	36.8
c. Recommended Upgrade		4.0	4.0	8.0	10.0	16.0
d. Number of New Wells	Assume 2.0 mgd per new supply well	**2.0**	**2.0**	**4.0**	**5.0**	**8.0**
e. Proposed Total Supply (Well Capacity)		14.8	18.8	26.8	36.8	52.8
4. Storage Requirements (25% Operational; 50% Emergency)		(MG)	(MG)	(MG)	(MG)	(MG)
a. Required Storage						
Operational Storage	**25%** of Maximum Day Demand	3.1	3.9	6.0	8.6	12.3
Fire Flow Storage	3,500 gpm for 3 hours	0.63	0.63	0.63	0.63	0.63
Emergency Storage	**50%** of Maximum Day Demand	6.2	7.8	12.0	17.2	24.6
Total		9.9	12.3	18.6	26.4	37.6
b. Available Storage		1.0	6.0	12.0	19.0	27.0
c. Recommended New Storage		**5.0**	**6.0**	**7.0**	**8.0**	**11.0**
d. Proposed Total Storage		6.0	12.0	19.0	27.0	38.0
5. Alternate Storage Requirements (25% Operational; *0% Emergency*)		(MG)	(MG)	(MG)	(MG)	(MG)
a. Required Storage						
Operational Storage	**25%** of Maximum Day Demand	3.1	3.9	6.0	8.6	12.3
Fire Flow Storage	3,500 gpm for 3 hours	0.63	0.63	0.63	0.63	0.63
Emergency Storage	**0%** of Maximum Day Demand	0.0	0.0	0.0	0.0	0.0
Total		3.7	4.5	6.6	9.2	12.9
b. Available Storage		1.0	4.0	5.0	7.0	10.0
c. Recommended New Storage		**3.0**	**1.0**	**2.0**	**3.0**	**3.0**
d. Proposed Total Storage		4.0	5.0	7.0	10.0	13.0

Notes:
1. Water Use projections are based on 185 gpdc plus an estimated 4.6 - 4.8 mgd industrial flow through the planning horizon 2044.
2. Maximum Day Demands are estimated at 2.6 times the Residential/Commercial ADD plus 1.25 times the Industrial demands.
3. Peak Hour Demands are estimated at 4.4 times the Residential/Commercial ADD plus 1.25 times the Industrial demands.
3. Population Projections based on PMC planning projections (April 2007).
4. Required supply should be equal to the MDD plus additional capacity to account for the largest well out of service.

be currently owned by the City. All groundwater wells, existing and future must comply with current DHS water quality criteria in order to be accepted into the City's distribution system.

5.2 STORAGE CAPACITY

The City's current storage capacity provides a total storage of 1.0 MG for servicing the City's operational, fire, and emergency needs. A City-wide analysis of the storage needs, using the criteria discussed in a previous chapter was conducted. The storage requirements are based on providing emergency storage equivalent to 50 percent of the MDD. Table 5.1 summarizes the results of storage requirements. Also provided in Table 5.1 are the storage requirements if the emergency storage criteria is reduced to zero, and the City relies on wells for the emergency supply.

Table 5.1 indicates a current total deficiency of approximately 8.9 MG. Recognizing that constructing 8.5 MG of new storage in the first year of a CIP is unrealistic, it is recommended that the City construct 5 MG of storage in 2008 and an additional 26 MG before 2024 to mitigate the existing and future storage deficiencies.

Table 5.2 Summarizes the City's existing and recommended storage facilities. The recommendations are in accordance with the currently projected population forecasts and will allow the city to meet storage needs through the residential buildout of the 1999 General Plan. A total of 26 MG of additional storage is recommended by year 2024. Between year 2024 and buildout of the Urban Reserve, an additional 11 MG of storage would be required to service the area. Figure 5.1 shows the proposed location and size for each new storage tank.

5.3 RECOMMENDED IMPROVEMENTS

Based on the evaluation criteria discussed in a previous chapter, the hydraulic model was used to further evaluate the capacity of the existing distribution system. The hydraulic model evaluation consisted of 24-hour simulations during normal operations of a MDD condition. The MDD, the highest daily demand in the year, also includes the maximum anticipated hour demand. Extended period simulations were also used to verify the operational adequacy of the proposed storage tanks.

Fire flows were simulated in conjunction with MDD to identify the capability of the distribution system to respond to hypothetical fires. Only one hypothetical fire was applied during a staged single model simulation, and the magnitude of the fire flow varied depending on the predominant land use density or intensity. For example, 3,500 gpm was simulated in industrial areas and 2,500 gpm in commercial areas. The fire flow was reduced to 1,500 gpm in the residential areas.

Table 5.2 Existing and Recommended Storage Reservoirs
Water System Master Plan
City of Livingston

Reservoir [1]	Reservoir Location/Proposed Reservoir Location	Volume (MG)	Height (ft)	Diameter (ft)
Existing Storage Reservoirs				
T-EX	End of Burgundy Drive	1.00	30	75
	Total Existing Storage Capacity	**1.00**		
Recommended Storage Reservoirs at 2024				
T-1	Olive Avenue Near Olds Avenue	5.00	30	168
T-2	Next to existing 1 MG Storage Reservoir	1.00	30	75
T-3	Gallo Road and Robin Avenue	6.00	30	185
T-4	Flint Avenue and Washington Boulevard	7.00	30	199
T-5	Robin Avenue and Magnolia Avenue	7.00	30	199
	Additional Recommended Storage Capacity	**26.00**		
Recommended Storage Reservoirs at Urban Reserve Build out				
T-6	Westside Boulevard between and Sultana	5.00	30	168
T-7	Walnut Ave and Arena Way	6.00	30	185
	Additional Recommended Storage Capacity	**11.00**		
	Total Storage Capacity at 2024	**27.00**		
	Total Storage Capacity at Urban Reserve Build out	**38.00**		

Notes:
1. Storage reservoir names may need adjustment depending on order of construction.

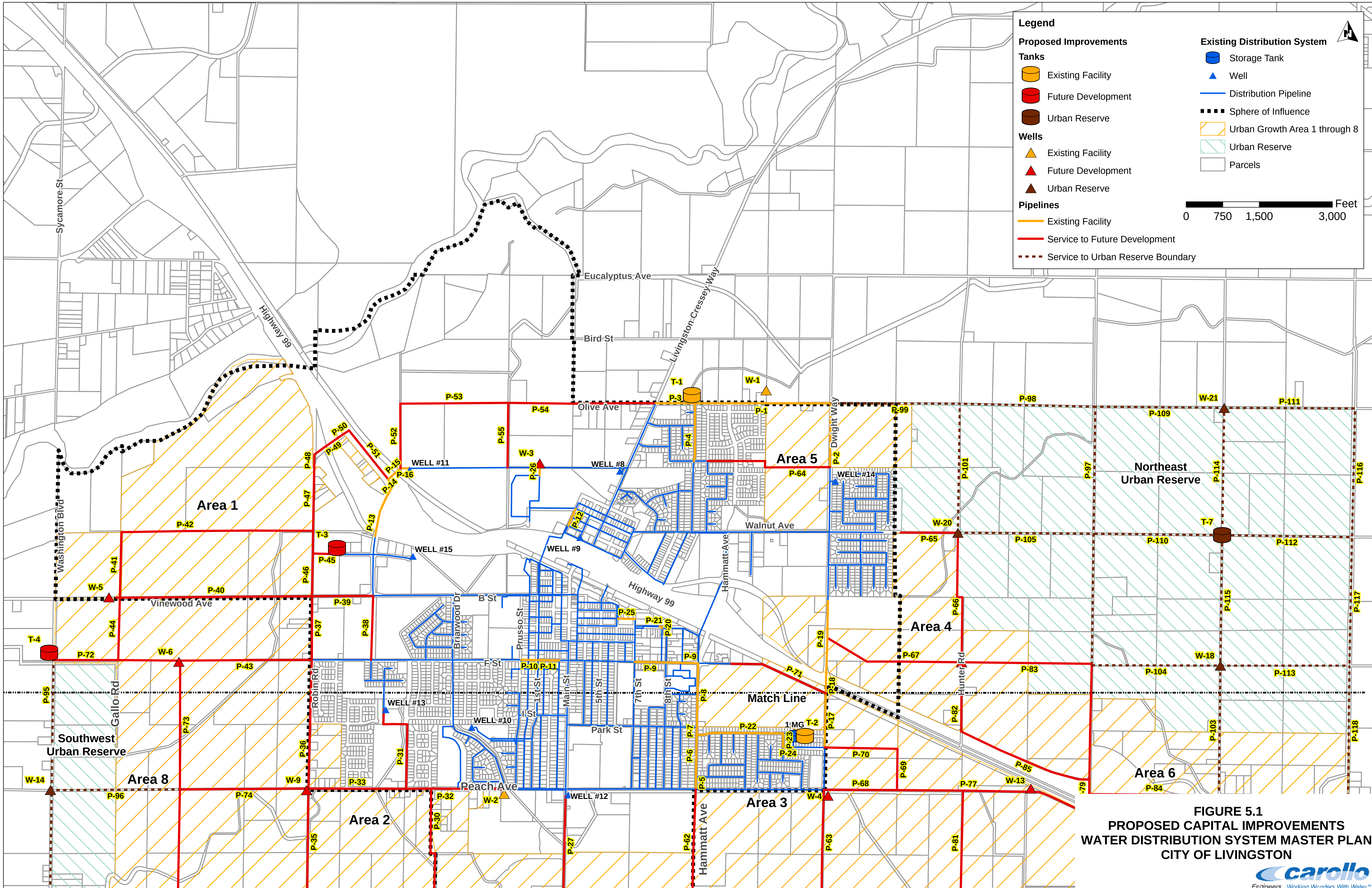

FIGURE 5.1
PROPOSED CAPITAL IMPROVEMENTS
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

Note: Final location of future groundwater wells and storage tanks will be determined in design phase.

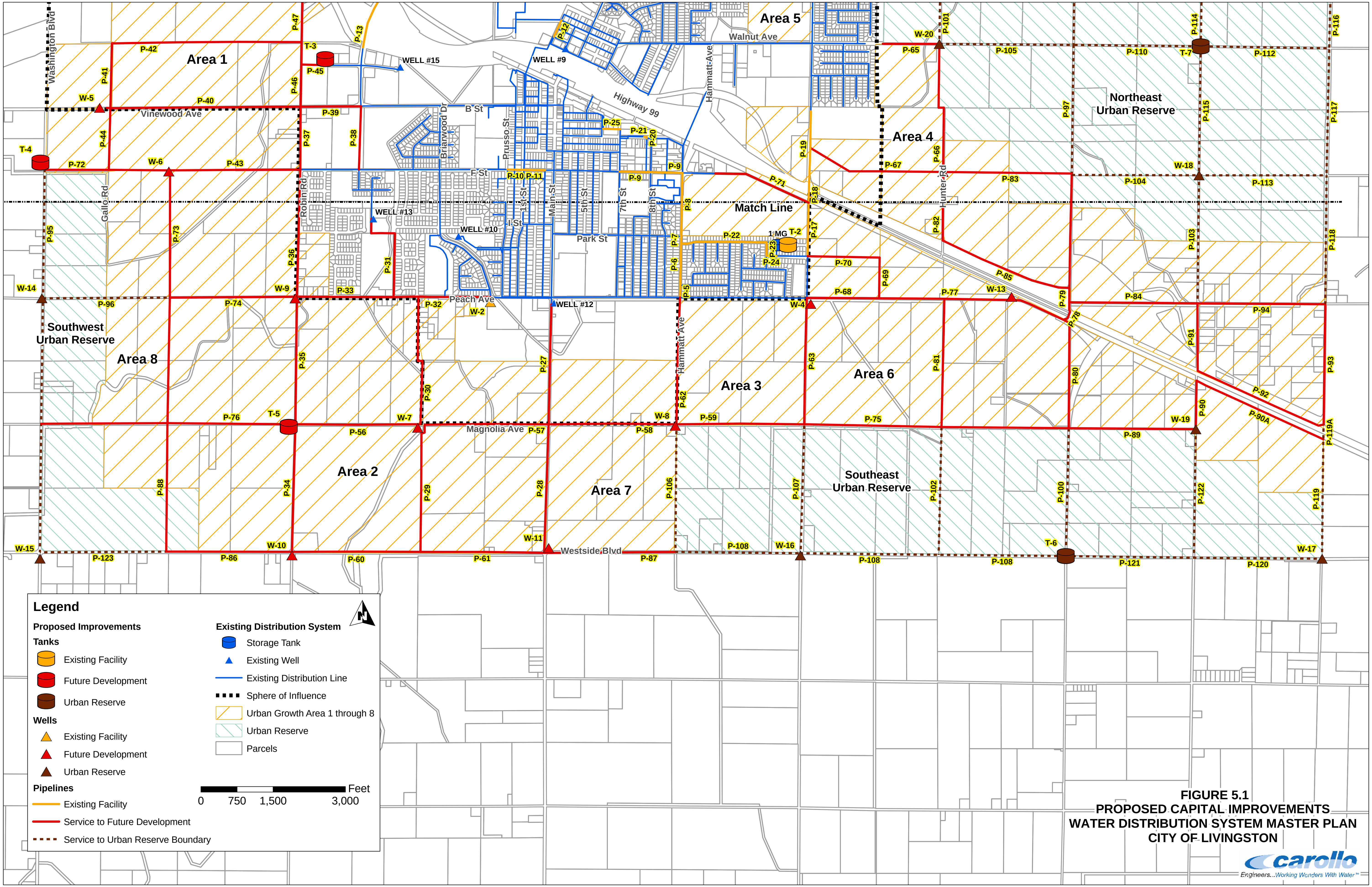

FIGURE 5.1
PROPOSED CAPITAL IMPROVEMENTS
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

Note: Final location of future groundwater wells and storage tanks will be determined in design phase.

Table 5.3 Proposed Improvements
Water Distribution System Master Plan
City of Livingston

No.	Coded No.	Type of Improv.	Description/ Street	Description / Limits	Future Users Benefit	Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Length (ft)
EXISTING FACILITY IMPROVEMENTS								
1	W-1	Supply Well	Olive Avenue	Olive Avenue East of Olds Avenue	0%		1400 gpm	
2	W-2	Supply Well	Near Intersection	Lambrusco Ave. and Peach Ave.	0%		1400 gpm	
3	T-1	Tank[4]	Olive Avenue	Olive Avenue Near Olds Avenue	0%		5.0 MG	
4	T-2	Tank[4]	End of Burgundy Drive	New tank next to existing 1 MG storage tank	0%		1.0 MG	
5	P-1	Pipe	Olive Avenue	Olds Ave to Dwight Ave	75%		12	2,800
6	P-2	Pipe	Dwight Avenue	Olive Ave south to connect with existing 12-inch main on Dwight Ave.	75%		12	1,320
7	P-3	Pipe	Olive Avenue	Cressey Way to Olds Ave	0%		12	810
8	P-4	Pipe	Olds Ave	Olive Avenue to Grapevine Drive	0%	8	16	1,200
9	P-5	Pipe	Hammatt Road	Peach Ave to Johannesburg Dr.	0%	6	12	260
10	P-6	Pipe	Hammatt Road	Johannesburg Dr. to Burgundy Dr.	0%	6	12	870
11	P-7	Pipe	Hammatt Road	Burgundy Dr. to Park St.	0%	8	12	160
12	P-8	Pipe	Hammatt Road	Park St. to F St.	25%	6,8	12	1,320
13	P-9	Pipe	F Street	Hammatt Road to Seventh St.	0%	8	12	1,310
14	P-10	Pipe	F Street	Prusso St. to First St.	0%	4	12	350
15	P-11	Pipe	F Street	First St. to Ally between First St. and Main St.	0%		12	450
16	P-12	Pipe	Stefani Avenue	Crowell St. to Davis St.	0%	4	12	380
17	P-13	Pipe	Winton Parkway	In Caltrans Winton Parkway Bridge to Campbell Blvd.	50%		12	1,270
18	P-14	Pipe	Winton Parkway	From Campbell Blvd to crossing under Railroad	50%		12	175
19	P-15	Casing[1]	Winton Parkway	Crossing Under Railroad	50%		12/32	170
20	P-16	Pipe	Campbell Blvd.	Connect with crossing under railroad to Well No. 11	50%		12	200
21	P-17	Pipe	Dwight Avenue	Claret Dr. to F St.	50%		16	1,120
22	P-18	Casing[1]	Dwight Avenue	Crossing under Railroad and California 99	50%		16/36	330
23	P-19	Pipe	Dwight Avenue	Highway 99 north to connect with existing 12 in line	50%		16	820
24	P-20	Pipe	D Street	West of Eighth St. running perpendicular to traffic flow	0%	4	8	30
25	P-21	Pipe	D Street	West of Eighth St. connection to 8 inch line running east on D St.	0%	4	8	50
26	P-22	Pipe	Burgundy Dr.	Pinot Dr. to Hammat Ave.	0%	8	16	1,780
27	P-23	Pipe	Pinot Dr.	Burgundy Dr. to Claret Dr.	0%	8	16	290
28	P-24	Pipe	Claret Drive	Pinot Drive to connect with existing 16-inch to Storage Tank	0%	8	16	1,201
29	P-25	Pipe	Ally North of D St.	Sixth St. and Seventh St.	0%	4	8	360
30	P-26	Pipe	Foster Farms	Replace Existing 12-inch from main connecting to Well 11and Foster Farms Plant	0%	12	16	161
SERVICE TO FUTURE DEVELOPMENT								
31	W-3	Supply Well	Foster Farms	Connect with line from well No. 11	50%		1400 gpm	
32	W-4	Supply Well[4]	Near Intersection	Peach Avenue and Dwight Avenue	100%		1400 gpm	
33	W-5	Supply Well[4]	Near Intersection	Vinewood Avenue and Gallo Road	100%		1400 gpm	
34	W-6	Supply Well[4]	Flint Avenue	Between Gallo Road and Robin Avenue	100%		1400 gpm	
35	W-7	Supply Well[4]	Near Intersection	Magnolia Avenue between Robin Avenue and Lincoln Boulevard	100%		1400 gpm	
36	W-8	Supply Well[4]	Near Intersection	Hammat Avenue and Magnolia Avenue	100%		1400 gpm	
37	W-9	Supply Well[4]	Near Intersection	Robin Avenue and Peach Avenue	100%		1400 gpm	
38	W-10	Supply Well[4]	Near Intersection	Westside Boulevard and Robin Avenue	100%		1400 gpm	
39	W-11	Supply Well[4]	Near Intersection	Westside Boulevard and Lincoln Boulevard	100%		1400 gpm	
40	W-12	Supply Well[4]	Near Intersection	Hunter Road and Almond Avenue	100%		1400 gpm	
41	W-13	Supply Well[4]	Near Intersection	Peach Ave and California Highway 99	100%		1400 gpm	
42	T-3	Tank[4]	Gallo Road	Gallo Road and Robin Avenue	75%		6.0 MG	
43	T-4	Tank[4]	Flint Avenue	Flint Avenue and Washington Boulevard	100%		7.0 MG	
44	T-5	Tank[4]	Robin Avenue	Robin Avenue and Magnolia Avenue	100%		7.0 MG	
45	P-27	Pipe	Lincoln Boulevard	From Well No.12 to Magnolia Ave	100%		12	1,400
46	P-28	Pipe	Lincoln Boulevard	Magnolia Ave to Westside Blvd	100%		12	2,700
47	P-29	Pipe	Arcadia Avenue	Magnolia Ave to Westside Blvd	100%		12	2,700
48	P-30	Pipe	Arcadia Avenue	Peach south to Magnolia Ave	100%		12	2,700
49	P-31	Pipe	East of Monte Cristo II	Peach Ave to connect with Well No. 13	50%		12	2,120
50	P-32	Pipe	Peach Avenue	Winton Parkway to connect with existing 12-inch line on Peach Ave.	25%		12	750
51	P-33	Pipe	Peach Avenue	Robin Ave to connect with new main from Well No. 13	100%		12	2,000
52	P-34	Pipe	Robin Avenue	Magnolia Avenue to Westside Boulevard	100%		12	2,660
53	P-35	Pipe	Robin Avenue	Peach Ave. south to Magnolia Avenue	100%		12	2,660
54	P-36	Pipe	Robin Avenue	Flint Ave to Peach Ave	100%		12	2,650
55	P-37	Pipe	Robin Avenue	Vinewood Ave to Flint Ave	100%		12	1,320
56	P-38	Pipe	Winton Parkway Extension	B St. to F St.	75%		12	1,330
57	P-39	Pipe	Vinewood Avenue	Winton Parkway to Robin Ave.	100%		12	1,260
58	P-40	Pipe	Vinewood Avenue	West of Robin Ave. to Gallo Rd.	100%		12	4,000
59	P-41	Pipe	Gallo Road	North from Vinewood Ave. to north end of Gallo Road	100%		12	1,350
60	P-42	Pipe	Garibaldi Lateral	West from Robin Ave. along Garibaldi lateral to Gallo Rd.	100%		12	4,000
61	P-43	Pipe	Flint Ave	Robin Ave to Gallo Road	100%		16	3,980
62	P-44	Pipe	Gallo Road.	Flint Ave to Vinewood Ave.	100%		12	1,285
63	P-45	Pipe	Gallo Drive	East end of Gallo Drive to Robin Ave	100%		12	590
64	P-46	Pipe	Robin Avenue	Vinewood Ave to Gallo Drive	100%		12	880
65	P-47	Pipe	Robin Avenue	North from Gallo Drive 1,780 feet	100%		12	1,780
66	P-48	Pipe	Robin Avenue	Robin Ave to Highway 99	100%		12	450
67	P-49	Casing[1]	Robin Avenue	Crossing under California 99	100%		12/32	390
68	P-50	Pipe	Robin Avenue	Highway 99 to Campbell Blvd.	100%		12	270
69	P-51	Pipe	Frontage Road	Southwest of RR to Winton Parkway	50%		12	1,300
70	P-52	Pipe	Well No. 11	North from Well No. 11 1317 ft.	50%		12	1,330
71	P-53	Pipe	Olive Avenue	Hammatt Lateral 2,220 ft west	100%		12	2,220
72	P-54	Pipe	Olive Avenue	Cressey Way to Hammatt Lateral	100%		12	3,030
73	P-55	Pipe	Hammatt Lateral	Olive Ave south to connect with 12 inch line east of Well No.11	100%		12	1,330
74	P-56	Pipe	Magnolia Ave.	Robin Ave to Arcadia Drive	100%		12	2,650
75	P-57	Pipe	Magnolia Ave.	Arcadia Drive to Lincoln Blvd	100%		12	2,600
76	P-58	Pipe	Magnolia Ave.	Lincoln Blvd to Hammatt Road	100%		12	2,600
77	P-59	Pipe	Magnolia Ave.	Hammatt Road to Dwight Ave	100%		12	2,600
78	P-60	Pipe	Westside Drive	Robin Ave to Arcadia Drive	100%		12	2,700
79	P-61	Pipe	Westside Drive	Arcadia Drive to Lincoln Blvd	100%		12	2,600
80	P-62	Pipe	Hammatt Road	Peach Ave. south to Magnolia Ave	100%		12	2,650
81	P-63	Pipe	Dwight Avenue	Peach Ave. south to Magnolia Ave	100%		12	2,630
82	P-64	Pipe	Grapevine Drive	From east end of grapevine Dr. to Dwight	100%		12	2,650
83	P-65	Pipe	Walnut Ave.	Existing 10-inch on Walnut Ave. to Hunter Rd.	100%		12	1,540
84	P-66	Pipe	Hunter Rd.	2,770 ft south from Walnut Ave on Hunter Rd.	100%		12	2,770

Table 5.3 Proposed Improvements
Water Distribution System Master Plan
City of Livingston

No.	Coded No.	Type of Improv.	Description/ Street	Description / Limits	Future Users Benefit	Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Length (ft)
85	P-67	Pipe	Almond Avenue	Hunter Road to Dwight Ave.	100%		12	2,890
86	P-68	Pipe	Peach Avenue	1,500 ft east on Peach Ave.	100%		12	1,500
87	P-69	Pipe	North from Peach Avenue	North from Peach Ave. 850 ft	100%		10	850
88	P-70	Pipe	Claret Drive	East from Dwight Ave 1,500 ft	100%		10	1,500
89	P-71	Pipe	F Street	F Street East along Railroad to Dwight	50%		12	2,090
90	P-72	Pipe	Flint Ave	Washington Boulevard to Gallo Road	100%		16	1,340
91	P-73	Pipe	2,640 w/o Robin Road	Flint Avenue to Peach Avenue	100%		12	2,650
92	P-74	Pipe	Peach Ave	Robin Avenue 2,640 feet west	100%		12	2,640
93	P-75	Pipe	Magnolia Ave	Dwight Avenue to Sultana Drive	100%		12	5,500
94	P-76	Pipe	Magnolia Ave	Robin Avenue 2,640 feet west	100%		12	2,640
95	P-77	Pipe	Peach Ave	3,950 feet on Peach to Sultana Drive	100%		12	3,950
96	P-78	Casing[1]	Sultana Drive	Crossing under California 99	100%		16/36	290
97	P-79	Pipe	Sultana Drive	Almond Avenue to California 99	100%		12	2,830
98	P-80	Pipe	Sultana Drive	Magnolia Avenue to California 99	100%		12	2,330
99	P-81	Pipe	Hunter Road	Peach Avenue to Magnolia Avenue	100%		12	2,670
100	P-82	Pipe	Hunter Road	California 99 Frontage Road to Almond Avenue	100%		12	1,430
101	P-83	Pipe	Almond Avenue	Sultana Drive to Hunter Road	100%		12	2,680
102	P-84	Pipe	Liberty Avenue	Sultana Drive to Arena Way	100%		12	2,660
103	P-85	Pipe	California 99 Frontage Road	Sultana Drive to Hunter Road	100%		12	2,850
104	P-86	Pipe	Westside Boulevard	Robin Avenue 2,640 feet west	100%		12	2,640
105	P-87	Pipe	Westside Boulevard	Lincoln Boulevard to Hammat Avenue	100%		12	2,730
106	P-88	Pipe	Southwest Urban Reserve	Magnolia Avenue to Westside Boulevard	100%		12	2,670
107	P-89	Pipe	Magnolia Ave	Sultana Drive to Arena Way	100%		12	2,660
108	P-90	Pipe	Arena Way	Magnolia Avenue to Highway 99	100%		12	1,100
109	P-90A	Pipe	California 99 Frontage Road	Arena Way to Cressey Way	100%		12	2,900
110	P-91	Pipe	Arena Way	Peach Avenue to Highway 99	100%		12	1,280
111	P-92	Pipe	California 99 Frontage Road	Arena Way to Cressey Way	100%		12	2,900
112	P-93	Pipe	Cressey Way	Highway 99 to Peach Avenue	100%		12	2,600
113	P-94	Pipe	Magnolia Ave	Arena Way to Cressey Way	100%		12	2,660
SERVICE TO URBAN RESERVE BOUNDARY								
114	W-14	Supply Well[4]	Southwest Urban Expansion	Washington Boulevard and Peach Avenue	100%		1400 gpm	
115	W-15	Supply Well[4]	Southwest Urban Expansion	Washington Boulevard and Westside Boulevard	100%		1400 gpm	
116	W-16	Supply Well[4]	Southeast Urban Expansion	Westside Boulevard and Dwight Avenue	100%		1400 gpm	
117	W-17	Supply Well[4]	Southeast Urban Expansion	Cressey Way and Westside Boulevard	100%		1400 gpm	
118	W-18	Supply Well[4]	Northeast Urban Expansion	Arena Way and Almond Avenue	100%		1400 gpm	
119	W-19	Supply Well[4]	Southeast Urban Expansion	Magnolia Avenue and Arena Way	100%		1400 gpm	
120	W-20	Supply Well[4]	Northeast Urban Expansion	Hunter Road and Walnut Avenue	100%		1400 gpm	
121	W-21	Supply Well[4]	Northeast Urban Expansion	Arena Way and Olive Avenue	100%		1400 gpm	
122	T-6	Tank[4]	Westside Boulevard	Westside Boulevard and Sultana	100%		5.0 MG	
123	T-7	Tank[5]	Walnut Avenue	Arena Way and Walnut Avenue	100%		6.0 MG	
124	P-95	Pipe	Washington Boulevard	Flint Avenue to Westside Boulevard	100%		12	8,000
125	P-96	Pipe	Peach Ave	Washington Boulevard 2,640 feet east	100%		12	2,640
126	P-97	Pipe	Sultana Drive	Olive Avenue to Almond Avenue	100%		12	5,280
127	P-98	Pipe	Olive Avenue	Sultana Drive to Hunter Road	100%		12	2,780
128	P-99	Pipe	Olive Avenue	Dwight Avenue to Yamoto Road	100%		12	2,660
129	P-100	Pipe	Sultana Drive	Westside Boulevard to Magnolia Avenue	100%		12	2,660
130	P-101	Pipe	Yamoto Road	Olive Avenue to Walnut Avenue	100%		12	2,790
131	P-102	Pipe	Hunter Road	Magnolia Avenue to Westside Boulevard	100%		12	2,660
132	P-103	Pipe	Arena Way	Liberty Avenue 1,300 feet North	100%		12	2,700
133	P-104	Pipe	Almond Avenue	Arena Way to Sultana Drive	100%		12	2,660
134	P-105	Pipe	Walnut Avenue	Sultana Drive to Hunter Road	100%		12	2,660
135	P-106	Pipe	Hammat Avenue	Magnolia Avenue to Westside Boulevard	100%		12	2,700
136	P-107	Pipe	Dwight Avenue	Magnolia Avenue to Westside Boulevard	100%		12	2,700
137	P-108	Pipe	Westside Boulevard	Hammat Avenue to Sultana Drive	100%		12	8,100
138	P-109	Pipe	Olive Avenue	Sultana Drive to Arena Way	100%		12	2,660
139	P-110	Pipe	Walnut Avenue	Sultana Drive to Arena Way	100%		12	2,660
140	P-111	Pipe	Olive Avenue	Arena Way to Cressey Way	100%		12	2,660
141	P-112	Pipe	Walnut Avenue	Sultana Drive to Arena Way	100%		12	2,660
142	P-113	Pipe	Almond Avenue	Sultana Drive to Arena Way	100%		12	2,660
143	P-114	Pipe	Arena Way	Olive Avenue to Walnut Avenue	100%		12	2,660
144	P-115	Pipe	Arena Way	Walnut Avenue to Almond Avenue	100%		12	2,660
145	P-116	Pipe	Cressey Way	Olive Avenue to Walnut Avenue	100%		12	2,660
146	P-117	Pipe	Cressey Way	Walnut Avenue to Almond Avenue	100%		12	2,660
147	P-118	Pipe	Cressey Way	Almond Avenue to Peach Avenue	100%		12	2,660
148	P-119	Pipe	Cressey Way	Highway 99 to Westside Boulevard	100%		12	2,700
149	P-119A	Casing[1]	Cressey Way	Crossing under California 99	200%		16/36	290
150	P-120	Pipe	Westside Boulevard	Arena Way to Cressey Way	100%		12	2,660
151	P-121	Pipe	Westside Boulevard	Sultana Drive to Arena Way	100%		12	2,660
152	P-122	Pipe	Arena Way	Magnolia Avenue to Westside Boulevard	100%		12	2,700
153	P-123	Pipe	Westside Boulevard	Washington Boulevard 2,640 feet east	100%		12	2,640

Notes:
1. Proposed casings size and carrier pipe size.
2. Location of new water wells and storage reservoirs is preliminary and subject to determination during design phase

Figure 5.1 provides a graphical illustration of the improvements recommended to mitigate capacity deficiencies in the existing water system as identified by the hydraulic analysis. 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. The improvements are further summarized in Table 5.3 with a cross-referenced numbering system. Care was taken to explain each column in the order of its appearance in Table 5.4.

- No.: Number of Improvement
- Coded Number: Assigned number that corresponds to Proposed Improvements Table. This is an alphanumeric number that starts one letter indicating the type of improvement (T = Tank, P = Pipe, W = Well, V = Valve, B = Booster), and continues with a number designating the pressure zone (e.g. 1 = Pressure Zone 1).
- Type of Improvement: storage tanks, wells, pipelines, booster stations, pressure reducing valves (PRVs), jacked steel casings, and standby emergency power generators (EPG).
- Street Description: A street description in which the improvement is proposed.
- Limits: Limits that generally describe the beginning and end of a proposed project. This column is most useful when describing pipeline projects.
- Size/Diameter: This is the size of the proposed improvement. It represents the diameter of the proposed pipelines (in inches), the size of the storage reservoirs (in MG), the size of the wells (in gpm), and the size of the booster stations (in hp). Additionally, for jacked steel casings, the size of the casing as well as the carrier pipe are indicated (in inches).
- Length: Estimated length of the proposed improvement, in feet. It should be noted that the length estimates account for jogs necessary for crossing major obstructions such as a river or a railroad. However, it does not account for rerouting the alignment to avoid unknown conditions.

CAPITAL IMPROVEMENT PROGRAM

This chapter details the cost associated with improvement projects discussed previously and presents the cost estimating criteria and assumptions used in deriving the improvement cost. Table 6.2 details the capital cost associated with the projects presented in the previous section.

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 Engineers, P.C. (Carollo) experience on other projects. The costs estimated for each recommended facility are opinions included in the tables developed with this study. The tables are intended 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 and reservoirs are also presented.

6.1.1 Cost Estimating Accuracy

The cost estimates presented in the project cost 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 American Association of Cost Engineers 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 feasibility study. 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 to the City's distribution system range in size from 4- to 16-inches in diameter. Costs associated with pipelines ranging in size from 4-inches to 36-inches are shown on Table 6.1.

Table 6.1 Pipeline Costs
Water Distribution System Master Plan
City of Livingston

Pipe Size (inches)	$/Lineal Foot
4	39
6	58
8	76
10	95
12	111
14	146
16	187
24	222
30	281
36	328

6.1.3 Pump Stations

Costs associated with new pump station facilities include electrical, instrumentation, pumps, piping, pump station building, valves and other appurtenances required for a finished pump station. Costs not included are fencing, landscaping, roadwork, and piling. These items are not known at this time and may be considered a part of the contingency. A cost curve for pump station estimating is shown on Figure 6.1.

6.1.4 Reservoirs

Estimated reservoir costs include foundation, site preparation, inlet and outlet piping, and mechanical controls. A cost curve for reservoir estimating is shown on Figure 6.2.

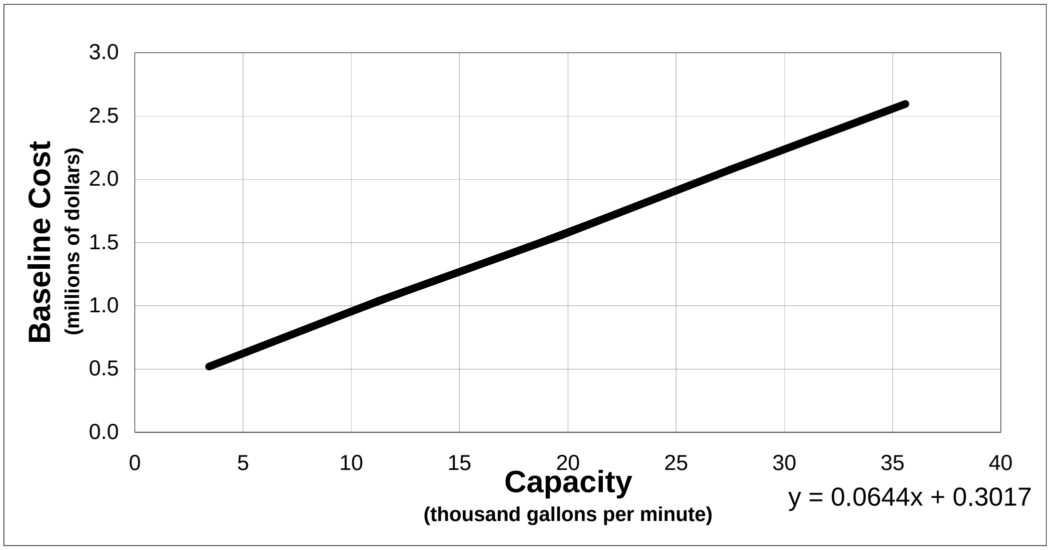

FIGURE 6.1
PUMPING STATION COSTS
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

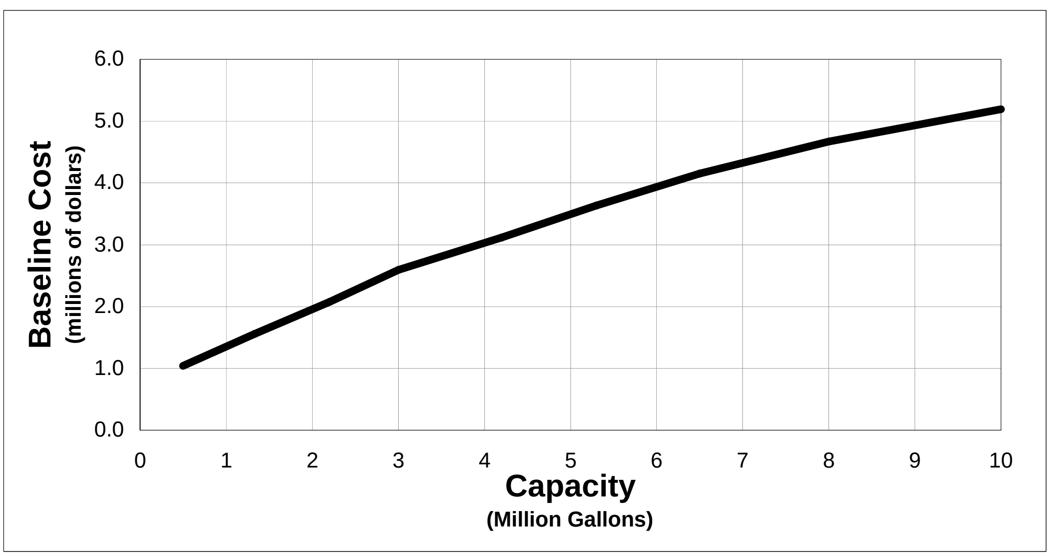

FIGURE 6.2
CONCRETE RESERVOIR COSTS
WATER DISTRIBUTION SYSTEM MASTER PLAN
CITY OF LIVINGSTON

6.1.5 Land Acquisition

Acquisition of property, easements, and right-of-way (ROW) will 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 right-of-way would be utilized wherever possible. Land costs in Merced County are not easily determined, particularly in the project feasibility phase, and variables affecting properties can result in widely varying land prices. Since land acquisition costs are not included in this study, the final capital costs may vary from the estimates presented herein. Exception, based on direction from City staff land acquisition for reservoir sites were included at $200,000 per acre per site.

6.2 CAPITAL IMPROVEMENT PROGRAM

The CIP for the improvements identified by this master plan are presented in Table 6.2. Care was taken to explain each column, in the previous chapter. Additional cost-related explanations are provided herein.

6.2.1 Baseline Construction Cost

This is the total estimated construction cost, in dollars, of the proposed improvement: pipes, wells, tanks, booster stations, pressure reducing valves (PRV), or emergency generators. 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. In the case of jacked steel casings, the unit cost includes the carrier pipe inside the casing.
- Pipe Cost: Estimated cost of the pipeline, calculated by multiplying the estimated length by the unit cost, in dollars.
- Other Infrastructure Facilities Costs: Estimated lump sum costs, in dollars, for the construction of infrastructure utilities, other than pipes. This includes wells, storage tanks, booster pump stations, pressure reducing valves, and emergency generators.

6.2.2 Estimated Construction Cost

Since knowledge about site-specific conditions of each proposed project is limited at the master planning stage, and in accordance with City standards, 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.

Table 6.2 Capital Improvement Program
Water Distribution System Master Plan
City of Livingston

No.	Coded No.	Type of Improv.	Description/ Street	Description / Limits	Design and Construction Status	Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Parallel/ Replace	Length (ft)	Unit Cost ($)	Pipe Cost ($)	Baseline Constr. Cost ($)	Estim. Constr. Cost[2] ($)	Capital Improv. Cost[3] ($)	Phase I 2007-09 ($)	Phase II 2009-14 ($)	Phase III 2014-29 ($)	Phase IV 2019-24 ($)	Phase V Urban Reserve Build out ($)	Future Users Benefit (%)	Total Capital Cost ($)	Future Users Cost ($)	Existing Users Cost ($)
				Itemized Cost Estimate		Pipeline and App. Costs									Capital Improvement Program					Financing			
EXISTING FACILITY IMPROVEMENTS																							
1	W-1	Supply Well	Olive Avenue	Olive Avenue East of Olds Avenue			1400 gpm	New				730,000	876,000	1,314,000	1,314,000					0%	1,314,000	0	1,314,000
2	W-2	Supply Well	Near Intersection	Lambrusco Ave. and Peach Ave.			1400 gpm	New				730,000	876,000	1,314,000	1,314,000					0%	1,314,000	0	1,314,000
3	T-1	Tank[4]	Olive Avenue	Olive Avenue Near Olds Avenue			5.0 MG	New				3,500,000	4,200,000	6,300,000	6,300,000					0%	6,300,000	0	6,300,000
4	T-2	Tank[4]	End of Burgundy Drive	New tank next to existing 1 MG storage tank			1.0 MG	New				1,600,000	1,920,000	2,880,000	2,880,000					0%	2,880,000	0	2,880,000
5	P-1	Pipe	Olive Avenue	Olds Ave to Dwight Ave			12	New	2,800	111	311,158	311,158	373,389	560,000	560,000					75%	560,000	420,000	140,000
6	P-2	Pipe	Dwight Avenue	Olive Ave south to connect with existing 12-inch main on Dwight Ave.			12	New	1,320	111	146,689	146,689	176,026	264,000	264,000					75%	264,000	198,000	66,000
7	P-3	Pipe	Olive Avenue	Cressey Way to Olds Ave			12	New	810	111	90,014	90,014	108,016	162,000	162,000					0%	162,000	0	162,000
8	P-4	Pipe	Olds Ave	Olive Avenue to Grapevine Drive		8	16	Replace	1,200	146	175,465	175,465	210,558	316,000		316,000				0%	316,000	0	316,000
9	P-5	Pipe	Hammatt Road	Peach Ave to Johannesburg Dr.		6	12	Replace	260	111	28,893	28,893	34,672	52,000	52,000					0%	52,000	0	52,000
10	P-6	Pipe	Hammatt Road	Johannesburg Dr. to Burgundy Dr.		6	12	Replace	870	111	96,681	96,681	116,017	174,000	174,000					0%	174,000	0	174,000
11	P-7	Pipe	Hammatt Road	Burgundy Dr. to Park St.		8	12	Replace	160	111	17,780	17,780	21,337	32,000	32,000					0%	32,000	0	32,000
12	P-8	Pipe	Hammatt Road	Park St. to F St.		6,8	12	Replace	1,320	111	146,689	146,689	176,026	264,000	264,000					25%	264,000	66,000	198,000
13	P-9	Pipe	F Street	Hammatt Road to Seventh St.		8	12	Replace	1,310	111	145,577	145,577	174,693	262,000		262,000				0%	262,000	0	262,000
14	P-10	Pipe	F Street	Prusso St. to First St.		4	12	Replace	350	111	38,895	38,895	46,674	70,000		70,000				0%	70,000	0	70,000
15	P-11	Pipe	F Street	First St. to Ally between First St. and Main St.			12	New	450	111	50,008	50,008	60,009	90,000		90,000				0%	90,000	0	90,000
16	P-12	Pipe	Stefani Avenue	Crowell St. to Davis St.		4	12	Replace	380	111	42,229	42,229	50,674	76,000		76,000				0%	76,000	0	76,000
17	P-13	Pipe	Winton Parkway	In Caltrans Winton Parkway Bridge to Campbell Blvd.			12	New	1,270	111	141,132	141,132	169,359	254,000		254,000				50%	254,000	127,000	127,000
18	P-14	Pipe	Winton Parkway	From Campbell Blvd to crossing under Railroad			12	New	175	111	19,447	19,447	23,337	35,000		35,000				50%	35,000	17,500	17,500
19	P-15	Casing[1]	Winton Parkway	Crossing Under Railroad			12/32	New	170	526	89,487	89,487	107,385	161,000		161,000				50%	161,000	80,500	80,500
20	P-16	Pipe	Campbell Blvd.	Connect with crossing under railroad to Well No. 11			12	New	200	111	22,226	22,226	26,671	40,000		40,000				50%	40,000	20,000	20,000
21	P-17	Pipe	Dwight Avenue	Claret Dr. to F St.			16	New	1,120	146	163,767	163,767	196,521	295,000	295,000					50%	295,000	147,500	147,500
22	P-18	Casing[1]	Dwight Avenue	Crossing under Railroad and California 99			16/36	New	330	585	193,011	193,011	231,614	347,000	347,000					50%	347,000	173,500	173,500
23	P-19	Pipe	Dwight Avenue	Highway 99 north to connect with existing 12 in line			16	New	820	146	119,901	119,901	143,881	216,000	216,000					50%	216,000	108,000	108,000
24	P-20	Pipe	D Street	West of Eighth St. running perpendicular to traffic flow		4	8	Replace	30	76	2,281	2,281	2,737	4,000	4,000					0%	4,000	0	4,000
25	P-21	Pipe	D Street	West of Eighth St. connection to 8 inch line running east on D St.		4	8	Replace	50	76	3,802	3,802	4,562	7,000	7,000					0%	7,000	0	7,000
26	P-22	Pipe	Burgundy Dr.	Pinot Dr. to Hammat Ave.		8	16	Replace	1,780	146	260,273	260,273	312,328	468,000	468,000					0%	468,000	0	468,000
27	P-23	Pipe	Pinot Dr.	Burgundy Dr. to Claret Dr.		8	16	Replace	290	146	42,404	42,404	50,885	76,000	76,000					0%	76,000	0	76,000
28	P-24	Pipe	Claret Drive	Pinot Drive to connect with existing 16-inch to Storage Tank		8	16	Replace	1,201	146	175,611	175,611	210,733	316,000	316,000					0%	316,000	0	316,000
29	P-25	Pipe	Ally North of D St.	Sixth St. and Seventh St.		4	8	Replace	360	76	27,373	27,373	32,847	49,000		49,000				0%	49,000	0	49,000
30	P-26	Pipe	Foster Farms	Replace Existing 12-inch from main connecting to Well 11and Foster Farms Plant		12	16	Replace	161	146	23,542	23,542	28,250	42,000		42,000				0%	42,000	0	42,000
SERVICE TO FUTURE DEVELOPMENT																							
31	W-3	Supply Well	Foster Farms	Connect with line from well No. 11			1400 gpm	New				730,000	876,000	1,314,000		1,314,000				50%	1,314,000	657,000	657,000
32	W-4	Supply Well[4]	Near Intersection	Peach Avenue and Dwight Avenue			1400 gpm	New				730,000	876,000	1,314,000		1,314,000				100%	1,314,000	1,314,000	0
33	W-5	Supply Well[4]	Near Intersection	Vinewood Avenue and Gallo Road			1400 gpm	New				730,000	876,000	1,314,000			1,314,000			100%	1,314,000	1,314,000	0
34	W-6	Supply Well[4]	Flint Avenue	Between Gallo Road and Robin Avenue			1400 gpm	New				730,000	876,000	1,314,000			1,314,000			100%	1,314,000	1,314,000	0
35	W-7	Supply Well[4]	Near Intersection	Magnolia Avenue between Robin Avenue and Lincoln Boulevard			1400 gpm	New				730,000	876,000	1,314,000			1,314,000			100%	1,314,000	1,314,000	0
36	W-8	Supply Well[4]	Near Intersection	Hammat Avenue and Magnolia Avenue			1400 gpm	New				730,000	876,000	1,314,000			1,314,000			100%	1,314,000	1,314,000	0
37	W-9	Supply Well[4]	Near Intersection	Robin Avenue and Peach Avenue			1400 gpm	New				730,000	876,000	1,314,000				1,314,000		100%	1,314,000	1,314,000	0
38	W-10	Supply Well[4]	Near Intersection	Westside Boulevard and Robin Avenue			1400 gpm	New				730,000	876,000	1,314,000				1,314,000		100%	1,314,000	1,314,000	0
39	W-11	Supply Well[4]	Near Intersection	Westside Boulevard and Lincoln Boulevard			1400 gpm	New				730,000	876,000	1,314,000				1,314,000		100%	1,314,000	1,314,000	0
40	W-12	Supply Well[4]	Near Intersection	Hunter Road and Almond Avenue			1400 gpm	New				730,000	876,000	1,314,000				1,314,000		100%	1,314,000	1,314,000	0
41	W-13	Supply Well[4]	Near Intersection	Peach Ave and California Highway 99			1400 gpm	New				730,000	876,000	1,314,000				1,314,000		100%	1,314,000	1,314,000	0
42	T-3	Tank[4]	Gallo Road	Gallo Road and Robin Avenue			6.0 MG	New				4,100,000	4,920,000	7,380,000		7,380,000				75%	7,380,000	5,535,000	1,845,000
43	T-4	Tank[4]	Flint Avenue	Flint Avenue and Washington Boulevard			7.0 MG	New				4,700,000	5,640,000	8,460,000			8,460,000			100%	8,460,000	8,460,000	0
44	T-5	Tank[4]	Robin Avenue	Robin Avenue and Magnolia Avenue			7.0 MG	New				4,700,000	5,640,000	8,460,000				8,460,000		100%	8,460,000	8,460,000	0
45	P-27	Pipe	Lincoln Boulevard	From Well No.12 to Magnolia Ave			12	New	1,400	111	155,579	155,579	186,695	280,000			280,000			100%	280,000	280,000	0
46	P-28	Pipe	Lincoln Boulevard	Magnolia Ave to Westside Blvd			12	New	2,700	111	300,045	300,045	360,054	540,000				540,000		100%	540,000	540,000	0
47	P-29	Pipe	Arcadia Avenue	Magnolia Ave to Westside Blvd			12	New	2,700	111	300,045	300,045	360,054	540,000				540,000		100%	540,000	540,000	0
48	P-30	Pipe	Arcadia Avenue	Peach south to Magnolia Ave			12	New	2,700	111	300,045	300,045	360,054	540,000			540,000			100%	540,000	540,000	0
49	P-31	Pipe	East of Monte Cristo II	Peach Ave to connect with Well No. 13			12	New	2,120	111	235,591	235,591	282,709	424,000			424,000			50%	424,000	212,000	212,000
50	P-32	Pipe	Peach Avenue	Winton Parkway to connect with existing 12-inch line on Peach Ave.			12	New	750	111	83,346	83,346	100,015	150,000			150,000			25%	150,000	37,500	112,500
51	P-33	Pipe	Peach Avenue	Robin Ave to connect with new main from Well No. 13			12	New	2,000	111	222,256	222,256	266,707	400,000			400,000			100%	400,000	400,000	0
52	P-34	Pipe	Robin Avenue	Magnolia Avenue to Westside Boulevard			12	New	2,660	111	295,600	295,600	354,720	532,000				532,000		100%	532,000	532,000	0
53	P-35	Pipe	Robin Avenue	Peach Ave. south to Magnolia Avenue			12	New	2,660	111	295,600	295,600	354,720	532,000			532,000			100%	532,000	532,000	0
54	P-36	Pipe	Robin Avenue	Flint Ave to Peach Ave			12	New	2,650	111	294,489	294,489	353,386	530,000			530,000			100%	530,000	530,000	0
55	P-37	Pipe	Robin Avenue	Vinewood Ave to Flint Ave			12	New	1,320	111	146,689	146,689	176,026	264,000			264,000			100%	264,000	264,000	0
56	P-38	Pipe	Winton Parkway Extension	B St. to F St.			12	New	1,330	111	147,800	147,800	177,360	266,000			266,000			75%	266,000	199,500	66,500
57	P-39	Pipe	Vinewood Avenue	Winton Parkway to Robin Ave.			12	New	1,260	111	140,021	140,021	168,025	252,000			252,000			100%	252,000	252,000	0
58	P-40	Pipe	Vinewood Avenue	West of Robin Ave. to Gallo Rd.			12	New	4,000	111	444,511	444,511	533,413	800,000			800,000			100%	800,000	800,000	0
59	P-41	Pipe	Gallo Road	North from Vinewood Ave. to north end of Gallo Road			12	New	1,350	111	150,023	150,023	180,027	270,000			270,000			100%	270,000	270,000	0
60	P-42	Pipe	Garibaldi Lateral	West from Robin Ave. along Garibaldi lateral to Gallo Rd.			12	New	4,000	111	444,511	444,511	533,413	800,000			800,000			100%	800,000	800,000	0
61	P-43	Pipe	Flint Ave	Robin Ave to Gallo Road			16	New	3,980	146	581,959	581,959	698,351	1,048,000			1,048,000			100%	1,048,000	1,048,000	0
62	P-44	Pipe	Gallo Road.	Flint Ave to Vinewood Ave.			12	New	1,285	111	142,799	142,799	171,359	257,000			257,000			100%	257,000	257,000	0
63	P-45	Pipe	Gallo Drive	East end of Gallo Drive to Robin Ave			12	New	590	111	65,565	65,565	78,678	118,000			118,000			100%	118,000	118,000	0
64	P-46	Pipe	Robin Avenue	Vinewood Ave to Gallo Drive			12	New	880	111	97,792	97,792	117,351	176,000			176,000			100%	176,000	176,000	0
65	P-47	Pipe	Robin Avenue	North from Gallo Drive 1,780 feet			12	New	1,780	111	197,807	197,807	237,369	356,000			356,000			100%	356,000	356,000	0
66	P-48	Pipe	Robin Avenue	Robin Ave to Highway 99			12	New	450	111	50,008	50,008	60,009	90,000			90,000			100%	90,000	90,000	0
67	P-49	Casing[1]	Robin Avenue	Crossing under California 99			12/32	New	390	526	205,294	205,294	246,353	370,000			370,000			100%	370,000	370,000	0
68	P-50	Pipe	Robin Avenue	Highway 99 to Campbell Blvd.			12	New	270	111	30,005	30,005	36,005	54,000			54,000			100%	54,000	54,000	0
69	P-51	Pipe	Frontage Road	Southwest of RR to Winton Parkway			12	New	1,300	111	144,466	144,466	173,359	260,000			260,000			50%	260,000	130,000	130,000
70	P-52	Pipe	Well No. 11	North from Well No. 11 1317 ft.			12	New	1,330	111	147,800	147,800	177,360	266,000			266,000			50%	266,000	133,000	133,000
71	P-53	Pipe	Olive Avenue	Hammatt Lateral 2,220 ft west			12	New	2,220	111	246,704	246,704	296,044	444,000			444,000			100%	444,000	444,000	0
72	P-54	Pipe	Olive Avenue	Cressey Way to Hammatt Lateral			12	New	3,030	111	336,717	336,717	404,061	606,000			606,000			100%	606,000	606,000	0
73	P-55	Pipe	Hammatt Lateral	Olive Ave south to connect with 12 inch line east of Well No.11			12	New	1,330	111	147,800	147,800	177,360	266,000			266,000			100%	266,000	266,000	0
74	P-56	Pipe	Magnolia Ave.	Robin Ave to Arcadia Drive			12	New	2,650	111	294,489	294,489	353,386	530,000			530,000			100%	530,000	530,000	0
75	P-57	Pipe	Magnolia Ave.	Arcadia Drive to Lincoln Blvd			12	New	2,600	111	288,932	288,932	346,719	520,000			520,000			100%	520,000	520,000	0
76	P-58	Pipe	Magnolia Ave.	Lincoln Blvd to Hammatt Road			12	New	2,600	111	288,932	288,932	346,719	520,000			520,000			100%	520,000	520,000	0
77	P-59	Pipe	Magnolia Ave.	Hammatt Road to Dwight Ave			12	New	2,600	111	288,932	288,932	346,719	520,000				520,000		100%	520,000	520,000	0
78	P-60	Pipe	Westside Drive	Robin Ave to Arcadia Drive			12	New	2,700	111	300,045	300,045	360,054	540,000				540,000		100%	540,000	540,000	0
79	P-61	Pipe	Westside Drive	Arcadia Drive to Lincoln Blvd			12	New	2,600	111	288,932	288,932	346,719	520,000				520,000		100%	520,000	520,000	0
80	P-62	Pipe	Hammatt Road	Peach Ave. south to Magnolia Ave			12	New	2,650	111	294,489	294,489	353,386	530,000			530,000			100%	530,000	530,000	0

Table 6.2 Capital Improvement Program
Water Distribution System Master Plan
City of Livingston

No.	Coded No.	Type of Improv.	Description/ Street	Description / Limits	Design and Construction Status	Ex. Size/ Diam. (in)	New Size/ Diam. (in)	Parallel/ Replace	Length (ft)	Unit Cost ($)	Pipe Cost ($)	Baseline Constr. Cost ($)	Estim. Constr. Cost[2] ($)	Capital Improv. Cost[3] ($)	Phase I 2007-09 ($)	Phase II 2009-14 ($)	Phase III 2014-29 ($)	Phase IV 2019-24 ($)	Phase V Urban Reserve Build out ($)	Future Users Benefit (%)	Total Capital Cost ($)	Future Users Cost ($)	Existing Users Cost ($)
Itemized Cost Estimate						Pipeline and App. Costs									Capital Improvement Program					Financing			
81	P-63	Pipe	Dwight Avenue	Peach Ave. south to Magnolia Ave			12	New	2,630	111	292,266	292,266	350,719	526,000				526,000		100%	526,000	526,000	0
82	P-64	Pipe	Grapevine Drive	From east end of grapevine Dr. to Dwight			12	New	2,650	111	294,489	294,489	353,386	530,000			530,000			100%	530,000	530,000	0
83	P-65	Pipe	Walnut Ave.	Existing 10-inch on Walnut Ave. to Hunter Rd.			12	New	1,540	111	171,137	171,137	205,364	308,000				308,000		100%	308,000	308,000	0
84	P-66	Pipe	Hunter Rd.	2,770 ft south from Walnut Ave on Hunter Rd.			12	New	2,770	111	307,824	307,824	369,389	554,000				554,000		100%	554,000	554,000	0
85	P-67	Pipe	Almond Avenue	Hunter Road to Dwight Ave.			12	New	2,890	111	321,159	321,159	385,391	578,000				578,000		100%	578,000	578,000	0
86	P-68	Pipe	Peach Avenue	1,500 ft east on Peach Ave.			12	New	1,500	111	166,692	166,692	200,030	300,000				300,000		100%	300,000	300,000	0
87	P-69	Pipe	North from Peach Avenue	North from Peach Ave. 850 ft			10	New	850	95	80,345	80,345	96,414	145,000				145,000		100%	145,000	145,000	0
88	P-70	Pipe	Claret Drive	East from Dwight Ave 1,500 ft			10	New	1,500	95	141,786	141,786	170,143	255,000				255,000		100%	255,000	255,000	0
89	P-71	Pipe	F Street	F Street East along Railroad to Dwight			12	New	2,090	111	232,257	232,257	278,709	418,000			418,000			50%	418,000	209,000	209,000
90	P-72	Pipe	Flint Ave	Washington Boulevard to Gallo Road			16	New	1,340	146	195,936	195,936	235,123	353,000				353,000		100%	353,000	353,000	0
91	P-73	Pipe	2,640 w/o Robin Road	Flint Avenue to Peach Avenue			12	New	2,650	111	294,489	294,489	353,386	530,000				530,000		100%	530,000	530,000	0
92	P-74	Pipe	Peach Ave	Robin Avenue 2,640 feet west			12	New	2,640	111	293,377	293,377	352,053	528,000				528,000		100%	528,000	528,000	0
93	P-75	Pipe	Magnolia Ave	Dwight Avenue to Sultana Drive			12	New	5,500	111	611,203	611,203	733,444	1,100,000				1,100,000		100%	1,100,000	1,100,000	0
94	P-76	Pipe	Magnolia Ave	Robin Avenue 2,640 feet west			12	New	2,640	111	293,377	293,377	352,053	528,000				528,000		100%	528,000	528,000	0
95	P-77	Pipe	Peach Ave	3,950 feet on Peach to Sultana Drive			12	New	3,950	111	438,955	438,955	526,746	790,000				790,000		100%	790,000	790,000	0
96	P-78	Casing[1]	Sultana Drive	Crossing under California 99			16/36	New	290	585	169,616	169,616	203,539	305,000				305,000		100%	305,000	305,000	0
97	P-79	Pipe	Sultana Drive	Almond Avenue to California 99			12	New	2,830	111	314,492	314,492	377,390	566,000				566,000		100%	566,000	566,000	0
98	P-80	Pipe	Sultana Drive	Magnolia Avenue to California 99			12	New	2,330	111	258,928	258,928	310,713	466,000				466,000		100%	466,000	466,000	0
99	P-81	Pipe	Hunter Road	Peach Avenue to Magnolia Avenue			12	New	2,670	111	296,711	296,711	356,053	534,000				534,000		100%	534,000	534,000	0
100	P-82	Pipe	Hunter Road	California 99 Frontage Road to Almond Avenue			12	New	1,430	111	158,913	158,913	190,695	286,000				286,000		100%	286,000	286,000	0
101	P-83	Pipe	Almond Avenue	Sultana Drive to Hunter Road			12	New	2,680	111	297,823	297,823	357,387	536,000				536,000		100%	536,000	536,000	0
102	P-84	Pipe	Liberty Avenue	Sultana Drive to Arena Way			12	New	2,660	111	295,600	295,600	354,720	532,000				532,000		100%	532,000	532,000	0
103	P-85	Pipe	California 99 Frontage Road	Sultana Drive to Hunter Road			12	New	2,850	111	316,714	316,714	380,057	570,000				570,000		100%	570,000	570,000	0
104	P-86	Pipe	Westside Boulevard	Robin Avenue 2,640 feet west			12	New	2,640	111	293,377	293,377	352,053	528,000				528,000		100%	528,000	528,000	0
105	P-87	Pipe	Westside Boulevard	Lincoln Boulevard to Hammat Avenue			12	New	2,730	111	303,379	303,379	364,055	546,000				546,000		100%	546,000	546,000	0
106	P-88	Pipe	Southwest Urban Reserve	Magnolia Avenue to Westside Boulevard			12	New	2,670	111	296,711	296,711	356,053	534,000				534,000		100%	534,000	534,000	0
107	P-89	Pipe	Magnolia Ave	Sultana Drive to Arena Way			12	New	2,660	111	295,600	295,600	354,720	532,000				532,000		100%	532,000	532,000	0
108	P-90	Pipe	Arena Way	Magnolia Avenue to Highway 99			12	New	1,100	111	122,241	122,241	146,689	220,000				220,000		100%	220,000	220,000	0
109	P-90A	Pipe	California 99 Frontage Road	Arena Way to Cressey Way			12	New	2,900	111	322,271	322,271	386,725	580,000				580,000		100%	580,000	580,000	0
110	P-91	Pipe	Arena Way	Peach Avenue to Highway 99			12	New	1,280	111	142,244	142,244	170,692	256,000				256,000		100%	256,000	256,000	0
111	P-92	Pipe	California 99 Frontage Road	Arena Way to Cressey Way			12	New	2,900	111	322,271	322,271	386,725	580,000				580,000		100%	580,000	580,000	0
112	P-93	Pipe	Cressey Way	Highway 99 to Peach Avenue			12	New	2,600	111	288,932	288,932	346,719	520,000				520,000		100%	520,000	520,000	0
113	P-94	Pipe	Magnolia Ave	Arena Way to Cressey Way			12	New	2,660	111	295,600	295,600	354,720	532,000				532,000		100%	532,000	532,000	0
SERVICE TO URBAN RESERVE BOUNDARY																							
114	W-14	Supply Well[4]	Southwest Urban Expansion	Washington Boulevard and Peach Avenue			1400 gpm	New				730,000	876,000	1,314,000					1,314,000	100%	1,314,000	1,314,000	0
115	W-15	Supply Well[4]	Southwest Urban Expansion	Washington Boulevard and Westside Boulevard			1400 gpm	New				730,000	876,000	1,314,000					1,314,000	100%	1,314,000	1,314,000	0
116	W-16	Supply Well[4]	Southeast Urban Expansion	Westside Boulevard and Dwight Avenue			1400 gpm	New				730,000	876,000	1,314,000					1,314,000	100%	1,314,000	1,314,000	0
117	W-17	Supply Well[4]	Southeast Urban Expansion	Cressey Way and Westside Boulevard			1400 gpm	New				730,000	876,000	1,314,000					1,314,000	100%	1,314,000	1,314,000	0
118	W-18	Supply Well[4]	Northeast Urban Expansion	Arena Way and Almond Avenue			1400 gpm	New				730,000	876,000	1,314,000					1,314,000	100%	1,314,000	1,314,000	0
119	W-19	Supply Well[4]	Southeast Urban Expansion	Magnolia Avenue and Arena Way			1400 gpm	New				730,000	876,000	1,314,000					1,314,000	100%	1,314,000	1,314,000	0
120	W-20	Supply Well[4]	Northeast Urban Expansion	Hunter Road and Walnut Avenue			1400 gpm	New				730,000	876,000	1,314,000					1,314,000	100%	1,314,000	1,314,000	0
121	W-21	Supply Well[4]	Northeast Urban Expansion	Arena Way and Olive Avenue			1400 gpm	New				730,000	876,000	1,314,000					1,314,000	100%	1,314,000	1,314,000	0
122	T-6	Tank[4]	Westside Boulevard	Westside Boulevard and Sultana			5.0 MG	New				3,500,000	4,200,000	6,300,000					6,300,000	100%	6,300,000	6,300,000	0
123	T-7	Tank[5]	Walnut Avenue	Arena Way and Walnut Avenue			6.0 MG	New				4,100,000	4,920,000	7,380,000					7,380,000	100%	7,380,000	7,380,000	0
124	P-95	Pipe	Washington Boulevard	Flint Avenue to Westside Boulevard			12	New	8,000	111	889,022	889,022	1,066,827	1,600,000					1,600,000	100%	1,600,000	1,600,000	0
125	P-96	Pipe	Peach Ave	Washington Boulevard 2,640 feet east			12	New	2,640	111	293,377	293,377	352,053	528,000					528,000	100%	528,000	528,000	0
126	P-97	Pipe	Sultana Drive	Olive Avenue to Almond Avenue			12	New	5,280	111	586,755	586,755	704,106	1,056,000					1,056,000	100%	1,056,000	1,056,000	0
127	P-98	Pipe	Olive Avenue	Sultana Drive to Hunter Road			12	New	2,780	111	308,935	308,935	370,722	556,000					556,000	100%	556,000	556,000	0
128	P-99	Pipe	Olive Avenue	Dwight Avenue to Yamoto Road			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
129	P-100	Pipe	Sultana Drive	Westside Boulevard to Magnolia Avenue			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
130	P-101	Pipe	Yamoto Road	Olive Avenue to Walnut Avenue			12	New	2,790	111	310,047	310,047	372,056	558,000					558,000	100%	558,000	558,000	0
131	P-102	Pipe	Hunter Road	Magnolia Avenue to Westside Boulevard			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
132	P-103	Pipe	Arena Way	Liberty Avenue 1,300 feet North			12	New	2,700	111	300,045	300,045	360,054	540,000					540,000	100%	540,000	540,000	0
133	P-104	Pipe	Almond Avenue	Arena Way to Sultana Drive			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
134	P-105	Pipe	Walnut Avenue	Sultana Drive to Hunter Road			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
135	P-106	Pipe	Hammat Avenue	Magnolia Avenue to Westside Boulevard			12	New	2,700	111	300,045	300,045	360,054	540,000					540,000	100%	540,000	540,000	0
136	P-107	Pipe	Dwight Avenue	Magnolia Avenue to Westside Boulevard			12	New	2,700	111	300,045	300,045	360,054	540,000					540,000	100%	540,000	540,000	0
137	P-108	Pipe	Westside Boulevard	Hammat Avenue to Sultana Drive			12	New	8,100	111	900,135	900,135	1,080,162	1,620,000					1,620,000	100%	1,620,000	1,620,000	0
138	P-109	Pipe	Olive Avenue	Sultana Drive to Arena Way			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
139	P-110	Pipe	Walnut Avenue	Sultana Drive to Arena Way			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
140	P-111	Pipe	Olive Avenue	Arena Way to Cressey Way			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
141	P-112	Pipe	Walnut Avenue	Sultana Drive to Arena Way			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
142	P-113	Pipe	Almond Avenue	Sultana Drive to Arena Way			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
143	P-114	Pipe	Arena Way	Olive Avenue to Walnut Avenue			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
144	P-115	Pipe	Arena Way	Walnut Avenue to Almond Avenue			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
145	P-116	Pipe	Cressey Way	Olive Avenue to Walnut Avenue			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
146	P-117	Pipe	Cressey Way	Walnut Avenue to Almond Avenue			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
147	P-118	Pipe	Cressey Way	Almond Avenue to Peach Avenue			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
148	P-119	Pipe	Cressey Way	Highway 99 to Westside Boulevard			12	New	2,700	111	300,045	300,045	360,054	540,000					540,000	100%	540,000	540,000	0
149	P-119A	Casing[1]	Cressey Way	Crossing under California 99			16/36	New	290	585	169,616	169,616	203,539	305,000					305,000	100%	305,000	305,000	0
150	P-120	Pipe	Westside Boulevard	Arena Way to Cressey Way			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
151	P-121	Pipe	Westside Boulevard	Sultana Drive to Arena Way			12	New	2,660	111	295,600	295,600	354,720	532,000					532,000	100%	532,000	532,000	0
152	P-122	Pipe	Arena Way	Magnolia Avenue to Westside Boulevard			12	New	2,700	111	300,045	300,045	360,054	540,000					540,000	100%	540,000	540,000	0
153	P-123	Pipe	Westside Boulevard	Washington Boulevard 2,640 feet east			12	New	2,640	111	293,377	293,377	352,053	528,000					528,000	100%	528,000	528,000	0
													Total Livingston CIP	**129,058,000**	**15,045,000**	**11,403,000**	**26,583,000**	**33,340,000**	**42,687,000**	**Total**	**129,058,000**	**110,611,000**	**18,447,000**

Notes:
1. Proposed casings size and carrier pipe size.
2. Baseline Construction costs plus 20% to account for unforeseen events and unknown conditions.
3. Estimated Construction Cost plus 50% to cover other costs including; engineering, administration, construction inspection, and legal costs.
4. Final location of future groundwater wells to be determined.
5. 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. However land acquisition costs for reservoirs has been included ($100,000 per reservoir incl

6.2.3 Capital Improvement Cost

Other project-related costs have been identified and estimated at 50 percent of the Estimated Construction Costs (per City standards). 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.

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.

6.2.5 Future Users Benefit

This is an opinion of benefit to future users. A zero percent indicates that the improvement benefits existing users, while 100 percent indicates that it benefits future users.

It should be noted that these opinions are based on preliminary project information. 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.

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 water connection fees, are also known as AB1600 provisions, referring to Assembly Bill 1600 that introduced the provision. The provisions, as they relate to water and water 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 preliminary project information, was included in this master plan. Once estimates for specific projects are completed, a more precise allocation may be performed if required by the provisions of the California Government Code Section 66000 and 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.