CITY OF HESPERIA

Final Report

Water Master Plan

July 2008

carollo
Engineers...Working Wonders With Water™

carollo

Engineers...Working Wonders With Water™

75 YEARS Working Wonders

July 30, 2008
7287A.00

City of Hesperia
9700 Seventh Avenue
Hesperia, CA 92345

Attention: Mr. Scott Priester, AICP
Director of Development Services

Subject: Final Water Master Plan

Dear Mr. Priester:

Enclosed is a copy of the final Water Master Plan. Thank you for the opportunity to work with the City on this project. We enjoyed working with you and your staff and look forward to continuing our relationship with the City. Please feel free to contact me if you have any questions on this Plan.

Sincerely,

CAROLLO ENGINEERS, P.C.

Gary Meyerhofer, P.E.
Partner

REGISTERED PROFESSIONAL ENGINEER
GARY J. MEYERHOFER
GM
No. 29483
Exp. 3/31/09
CIVIL
STATE OF CALIFORNIA

GM:alh

Enclosures: Final Water Master Plan Report

CITY OF HESPERIA

WATER MASTER PLAN

TABLE OF CONTENTS

Page No.

CHAPTER 2 - EXISTING SYSTEM FACILITIES

CHAPTER 3 - WATER DEMANDS

CHAPTER 4 - WATER SUPPLY

CHAPTER 8 - STORAGE ANALYSIS

CHAPTER 9 - CAPITAL IMPROVEMENT PROGRAM

LIST OF TABLES

LIST OF FIGURES

ES.1 INTRODUCTION

The City of Hesperia (City) lies within an area that is commonly referred to as the high desert in Southern California. It is located in the northern portion of San Bernardino County (County), California, approximately 30 miles north of the City of San Bernardino. In 1975, the Hesperia Water District (District) was formed as a self-governed special district that was originally a part of Victor Valley County Water District (VVCWD). In 1988, the City was incorporated and in 1992, the District was reorganized as a subsidiary special district of the City. The City Council serves as the District's Board of Directors. Today, the City encompasses an area of approximately 74 square miles. The primary existing service area is shown on Figure ES.1 and is the boundary limit of the study area for this Water Master Plan (Master Plan).

Currently, the City is experiencing rapid growth as lower housing costs entice more residents to the area. The City currently relies entirely on groundwater as its only source of water supply. The City's potable water system is managed by the District, which is a subsidiary special district of the City. The District provides utility service for the water and sewer system within the City and operates as a self-sustaining utility business enterprise.

Through a competitive selection process, Carollo Engineers (Carollo) was selected to prepare this Master Plan to aid in the planning of the City's water supplies, water system improvements, and system operations. This report is one in a four-system study. The other three are the Urban Water Management Plan, the Wastewater Master Plan and the Recycled Water Master Plan.

ES.2 EXISTING WATER SYSTEM FACILITIES

The City's distribution system conveys water to its customers through about 550 miles of buried pipelines. The distribution system includes 15 wells, 6 booster pumping stations (BPSs) (consisting of 22 active booster pumps and 1 fire booster pump), 13 water storage reservoirs, and 44 pressure-regulating stations. Figure ES.2 shows the location of each of the facilities. Detailed information on all of these existing facilities is included in Chapter 2 of this Master Plan.

The City has divided its distribution system into four primary pressure zones designated as Zones 1, 2, 3, and 4 to accommodate the varying elevations within the service area. The City's water system provides service to customers with elevations from about 2,800 feet

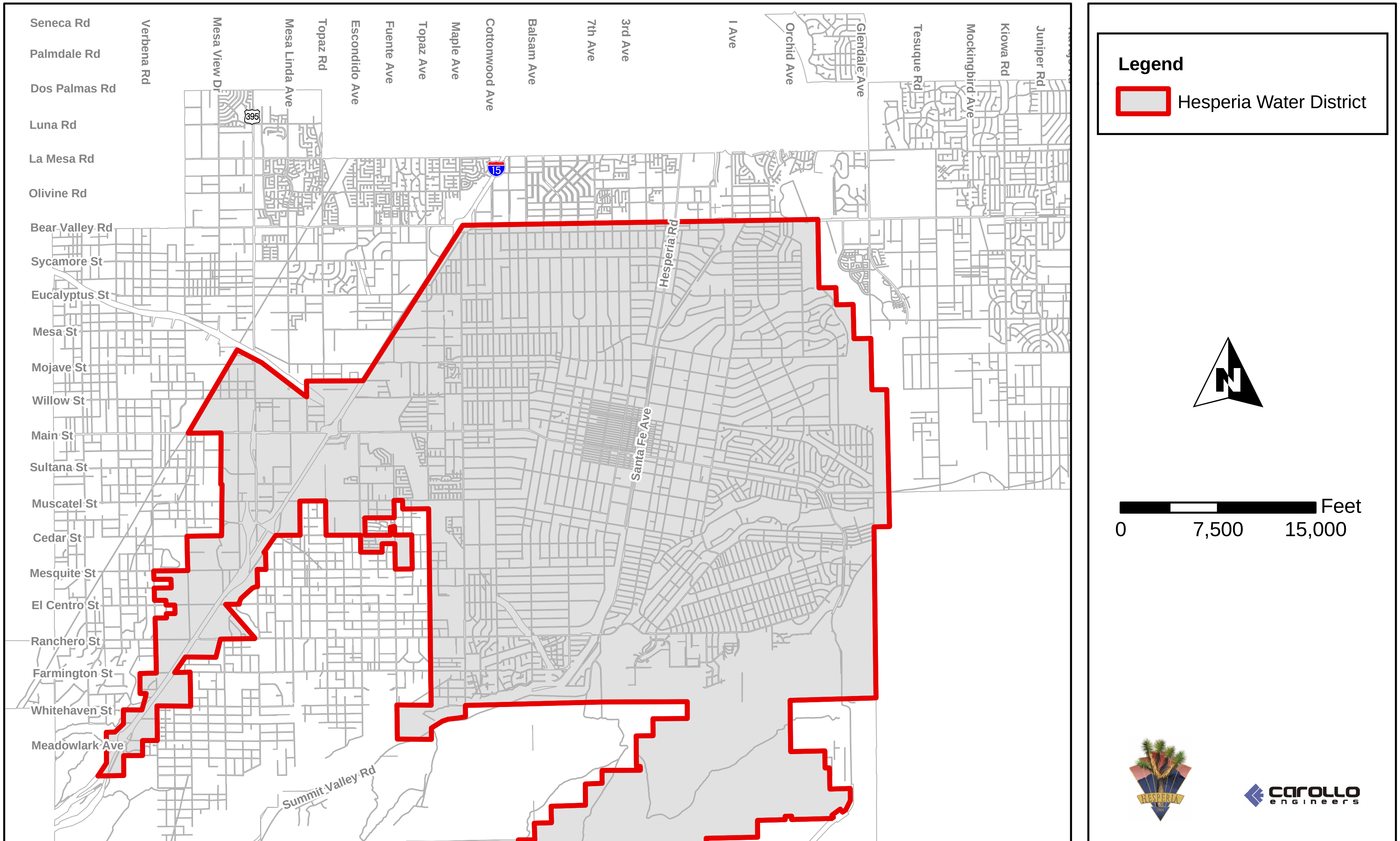


FIGURE ES.1
STUDY AREA MAP

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

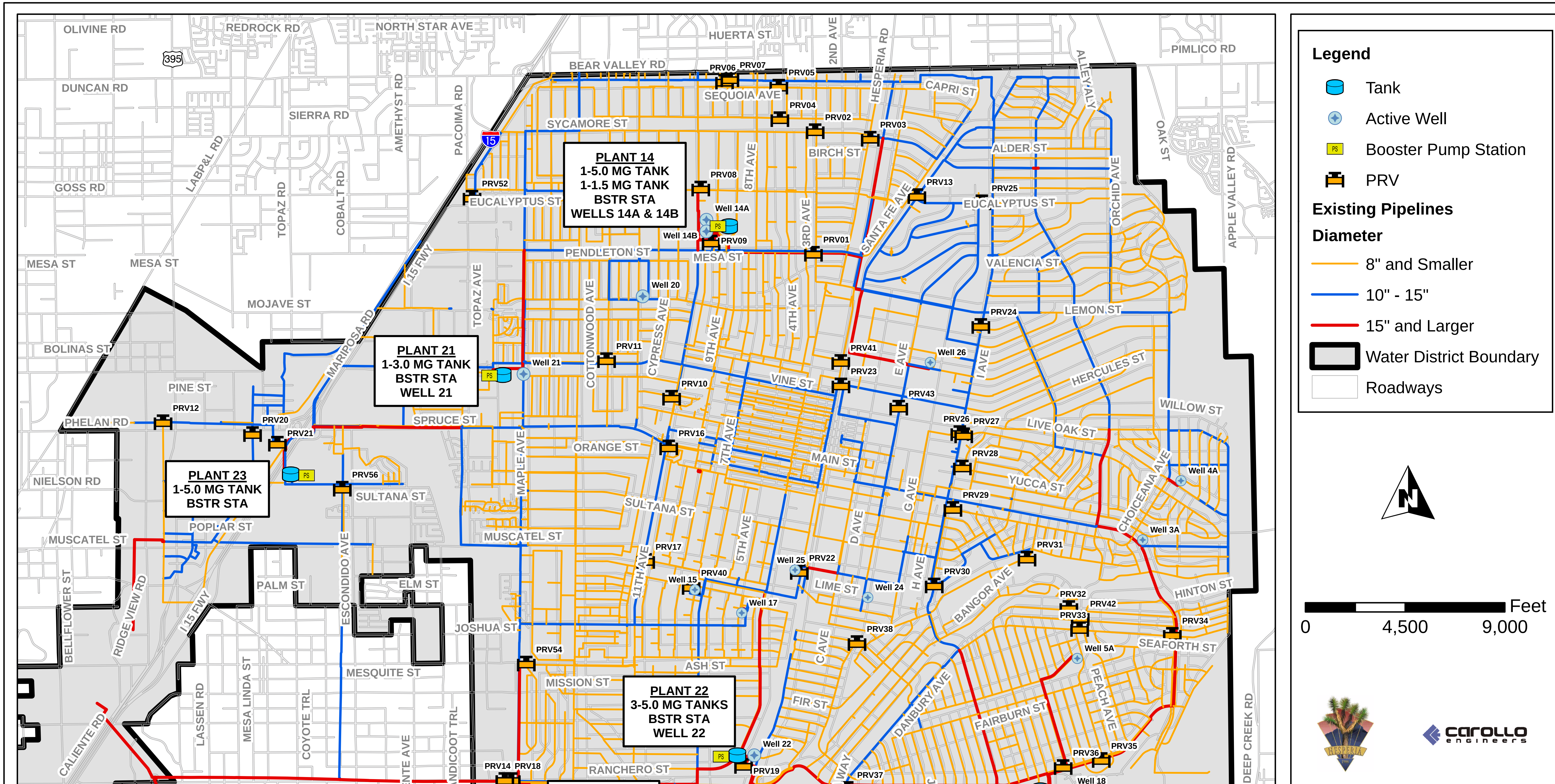


FIGURE ES.2
EXISTING WATER FACILITIES

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

above mean sea level (ft-msl) (Zone 1) to 3,500 ft-msl (Zone 4). Two of the primary zones are divided into subzones to deliver water to the required elevations. Zone 2 contains four distinct subzones, which serve various areas of the primary zone. Zone 3 consists of one primary zone and one subzone.

ES.3 WATER DEMANDS

The City's average rate of water consumption for the past 7 years is about 15,260 acre-feet per year (ac-ft/yr) (excluding unaccounted-for water). Overall, consumption has been increasing over the years. The City's annual average water production is about 15,700 ac-ft/yr or 13.6 million gallons per day (mgd) for the past 7 years. The City's rapid growth rate will likely result in higher average day demands (ADD) than would be derived from averaging usage over the past 7 years. Therefore, the ADD were calculated based on the average usage per service connection (667 gpd/connection from Table 3.3) and the current number of service connections (23,363 connections from Table 3.3). As a result, the value used as the City's existing ADD for this report was about 10,400 gpm (15 mgd). The details of the City's historical water demands are presented in Chapter 3.

ES.3.1 Projected Water Demands

Population projections for the City were obtained from the Southern California Association of Governments (SCAG). These studies were based on pre-2003 population trends, which do not reflect the explosive growth rates seen in more recent years. Therefore, population estimates were calculated based on estimated development projections provided by the City's planning department. This methodology was thought to be more accurate than the SCAG projections.

The City's planning department provided estimates of percent developed, density, and land use type for each planning year in this study. Analyzing the projected population with the planned developments, the projected water demands for each planning year were determined. The calculation excluded the North Summit Valley development project, because available plans are still in the rough planning stages at the time of this report preparation . The projected water demands used in this Master Plan are listed in Table ES.1. The details of these projections are presented in Chapter 3.

Table ES.1 Projected Water Demands
Water Master Plan Update
City of Hesperia

Planning Period	Estimated ADD		Estimated MDD		Estimated PHD (gpm)
	(gpm)	(mgd)	(gpm)	(mgd)	
2007	10,417	15.0	18,122	26.1	30,276
2012	18,700	26.9	32,538	46.9	54,230

Table ES.1 Projected Water Demands (Continued) Water Master Plan Update City of Hesperia					
Planning Period	**Estimated ADD**		**Estimated MDD**		**Estimated PHD (gpm)**
	(gpm)	**(mgd)**	**(gpm)**	**(mgd)**	
2017	25,741	37.1	44,789	64.5	74,649
2022	31,427	45.3	54,683	78.7	91,138
2027	34,390	49.5	59,839	86.2	99,731
2032	36,078	52.0	62,776	90.4	104,626

Notes:
(1) Peaking factor MDD / ADD is 1.74.
(2) Peaking factor PHD / ADD is 2.90.

ES.4 WATER SUPPLY

The City currently pumps 100 percent of its total annual water supply from groundwater. The City's 13 active wells are used to pump groundwater from the Alto Subarea subbasin, which is a subbasin of the Mojave River Groundwater Basin (Basin). The Basin is recharged by rainfall and snowmelt from the local mountains as well as imported water. The Mojave Water Agency (MWA) Board of Directors serves as the entity responsible for managing the use, replenishment, and protection of the groundwater basin. Because the water quality of the groundwater meets state and federal standards, the wells pump directly into the City's distribution system or into storage reservoirs after disinfection. These sources are discussed in detail in Chapter 4.

The Basin has been in overdraft for several years with individual subareas experiencing varying degrees of overdraft. Recently, water rights within the Basin have been the subject of litigation. The Superior Court's stipulated judgment for the adjudication of the Basin identified the MWA as the State Water Project (SWP) water contractor, having both the authority and obligation to secure supplemental water as part of the physical solution to the existing and projected future overdraft within the Basin. MWA currently serves as the Watermaster for the judgment.

As one of 29 State Water contractors with access to the SWP, the MWA has an entitlement of 75,800 ac-ft/yr to supplement the water sources for the member agencies of the MWA. To help reduce overdrafts, the MWA has made releases of this imported water into the Basin as recharge. Releases from the Rock Springs Outlet directly recharge the Alto Subarea, which is the City's pumping source.

ES.4.1 Future Water Supply Sources

Developing future supply sources by conserving the current supply or creating new supplies is important for the City as demands increase. Various water supply sources were evaluated in Chapter 4 of this Master Plan.

One possible measure includes reducing water demand through water conservation. Voluntary or enforced water conservation measures will contribute to a decrease in existing water consumption. The City has implemented several water conservation programs to reduce the overall system demands and the need to increase water supply. In general, the City's customers have been responsive to requests to conserve water during periods of drought. The water conservation programs are described in more detail in Chapter 7 of this Master Plan.

Another option is to help expand instantaneous sources of existing groundwater water supplies. The amount of groundwater that the City can extract continues to be limited by the MWA. Any amount over the extraction rate imposed by MWA, will cost the City to recharge the groundwater basin. The City currently has a groundwater level monitoring program to assess the impacts from declining groundwater levels on energy cost and production rate. During the past ten years, the City has investigated numerous options to increase the supply of groundwater available for the City's system. Today, the City continues to investigate developing additional water wells in the proximity of the Mojave River to enhance the reliability of its water supplies. Increased groundwater production is the most feasible alternative to implement.

Currently, the City does not use imported water. However, access to untreated imported SWP water is readily available because the California Aqueduct traverses the City's service area. The cost of treatment for direct use of SWP would significantly increase the cost of this resource and could make this alternative cost prohibitive. The second alternative would use SWP to recharge the groundwater basin. The cost of this alternative may be competitive with the cost to have MWA replenish the basin, but the City could choose to recharge where it provides the most benefit to the City. It is recommended that the City further evaluate the feasibility of using SWP for either direct use or groundwater recharge. This source may be required in the future to avoid overdraft of the Basin.

Another source that can supplement groundwater wells could be recycled water. The City could either use tertiary treated wastewater from the VVWRA or provide a local recycled water supply by constructing Water Reclamation Plants (WRPs) within the City. The sizing and locations of these WRPs are described in the wastewater master plan update, while the sizing of a recycled water system is described in detail in the Recycled Water Master Plan.

ES.4.2 Future Water Supply Requirements

An important element of this Master Plan is to plan for adequate water supplies to accommodate the increasing water demands through the planning periods identified in this

Master Plan. The production capacity needed is based on supplying the maximum day demands (MDD) with the largest well out of service in each major pressure zone. The City's existing firm supply capacity is 18,529 gpm (from Table 4.3). When the City's maximum day production requirements exceed its firm supply capacity, then additional wells will be required. Table ES.2 presents the City's water supply requirements through the year 2032. It should be noted that six new wells would be required to meet the City's demands before the planning year 2012.

Table ES.2 Cumulative Number of New Wells
Water Master Plan Update
City of Hesperia

Planning Year	Annual Average Water Supply Needs(1) (gpm)	Maximum Day Production Requirements(1) (gpm)	Available Firm Supply Capacity(2) (gpm)	Additional Capacity Needed (gpm)	Culmulative Estimated Number of New Wells Needed(3)
2007	10,417	18,122	18,529	0	0
2012	18,700	32,538	24,429	8,109	6
2017	25,741	44,789	24,429	20,360	14
2022	31,427	54,683	24,429	30,254	20
2027	34,390	59,839	24,429	35,410	24
2032	36,078	62,776	24,429	38,347	26

Notes:
(1) Source: Table 3.10.
(2) Source: Table 4.3.
(3) Assumes an average production capacity of 1,500 gpm for new wells.

ES.5 HYDRAULIC COMPUTER MODEL DEVELOPMENT

A hydraulic computer model was developed and calibrated using data collected from a typical maximum demand week to accurately analyze the City's water system. The City determined that July 24 through July 30 was the maximum demand week in 2005. As a result, this model calibration relied on supervisory control and data acquisition (SCADA) hourly trending for this 7-day period in 2005 to match hourly predictions in the model.

In conjunction with this SCADA data, the City also provided all well and booster on/off setpoints and booster pump sequencing (lead, lag, etc.) The hydraulic model applied these SCADA on/off settings provided by the City as well as compared the 'in-the-field' settings shown in the hourly SCADA trending. Where there were discrepancies between City provided setpoints and SCADA trending, it was agreed that the SCADA trending would govern, as this reflected what occurred in the field on that day. This calibration process did reveal relatively minor anomalies in City's data, which were addressed and adjusted accordingly during the calibration process. Based on the discussion with City staff, it was determined that the hydraulic model was closely calibrated to the SCADA data. A detailed discussion of the model development, field testing, and calibration is presented in Chapter 5 of this Master Plan.

ES.6 WATER SYSTEM ANALYSIS AND RECOMMENDED IMPROVEMENTS

The calibrated hydraulic computer model was used to analyze the existing and future water systems. Various scenarios were developed to analyze the water system under a variety of conditions. Hydraulic modeling results were evaluated for these conditions and compared to minimum performance criteria developed for this Master Plan. The water system was analyzed for ADD, MDD, peak hour demands (PHD), and MDD plus fire flow demands. In simulations where the model results indicated that the system did not meet the identified minimum performance criteria, recommended improvements were identified that would improve the system performance to the minimum acceptable level. A discussion of the detailed analysis is presented in Chapter 6. All improvements described below are included in the capital improvement program (CIP) presented in Chapter 9.

ES.6.1 Fire Flow Improvements

Using the calibrated computer model, fire flows were analyzed at numerous locations throughout the City’s distribution system. Several groups of projects were identified to improve the ability of the City’s water system to provide fire flow demands at a minimum residual pressure of 20 psi. The recommended pipeline improvement projects under existing demand and system configuration condition are shown on Figure ES.3. The total cost of these projects is estimated at about $41 million (January 2007 dollars), based on the cost assumptions presented in Chapter 9.

ES.6.2 Improvements to Correct System Pressures and Velocities

The calibrated computer model was used to analyze areas of low pressure and high velocity within the distribution system. The existing and future planning years were evaluated using ADD conditions. Based on the analysis presented in Chapter 6, the estimated pressure distribution for future planning years was similar to the existing system with pressures greater than 120 psi occurring, on average, in 20 percent of the system. These analyses included all required future facilities to meet projected demands.

The model results showed relatively few pipelines with high water velocities. However, 11 pipelines, mostly located in Zone 2, were identified to exhibit high water velocities. For ease of scheduling, deficient pipelines were grouped with other improvement projects for efficient construction. The recommended velocity improvement projects are shown on Figure ES.4 to mitigate the deficiencies. These improvements were categorized as near-term improvements, as they should be implemented as soon as possible to meet existing system criteria.

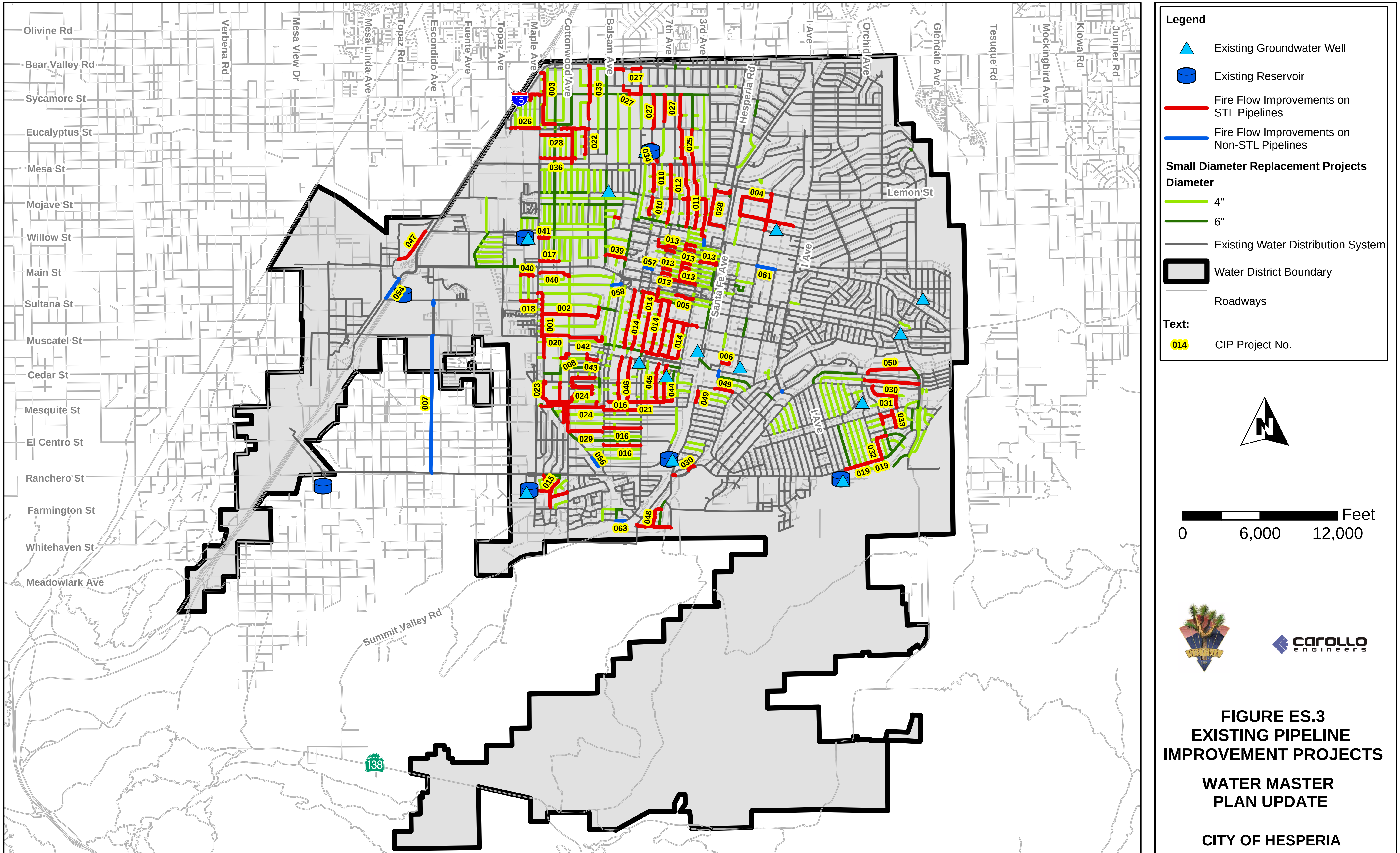
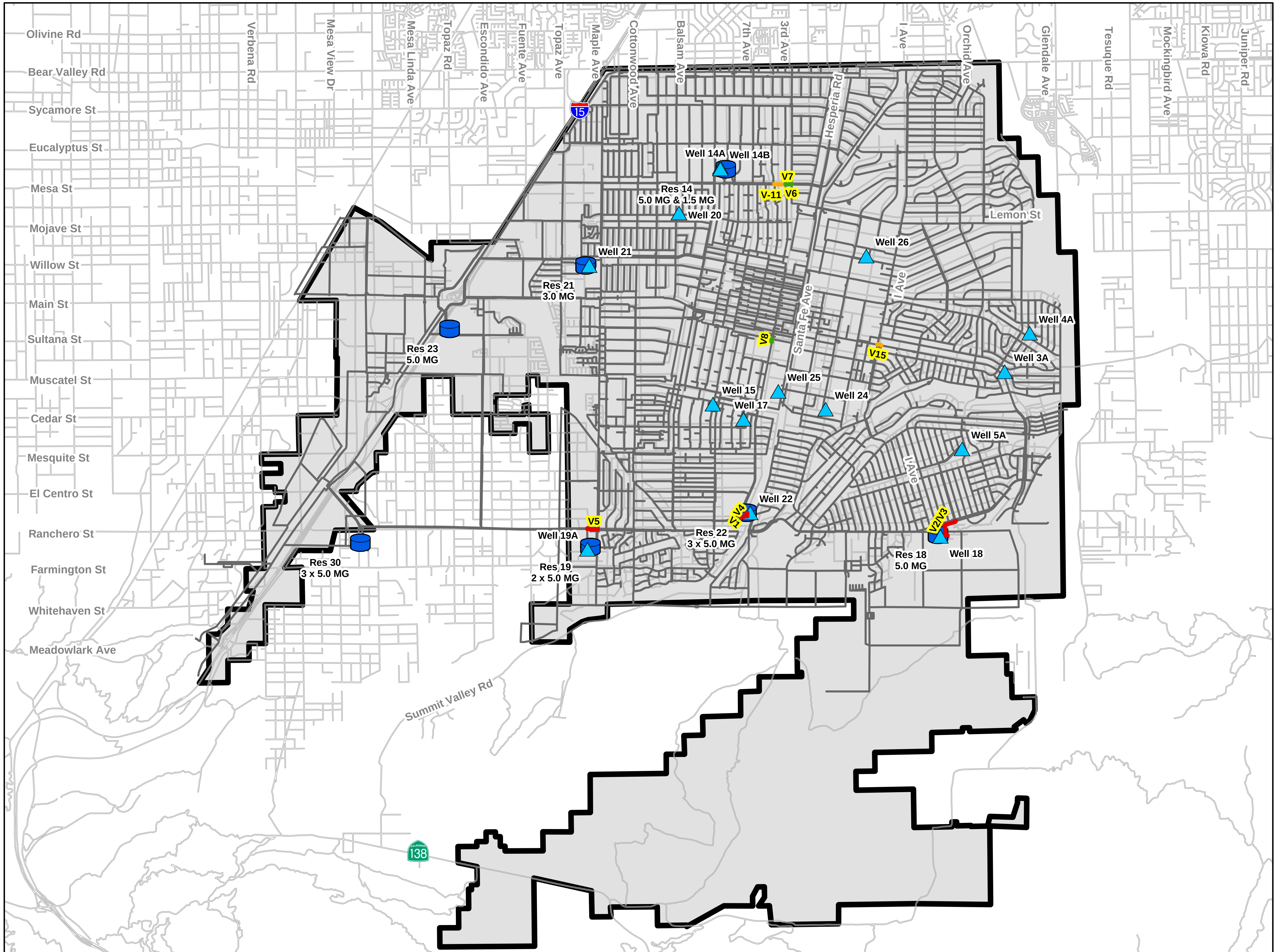


FIGURE ES.3
EXISTING PIPELINE IMPROVEMENT PROJECTS

WATER MASTER PLAN UPDATE

CITY OF HESPERIA



Legend

- Existing Groundwater Well
- Existing Reservoir

Velocity Improvement Project Installation Year

- Near Term
- 2007 - 2012
- 2013 - 2017
- Future Water Distribution System
- Water District Boundary
- Roadways

Text:

- V-11 CIP Project No.

Feet
0 6,000 12,000

carollo engineers

FIGURE ES.4
VELOCITY IMPROVEMENT PROJECTS

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

ES.6.3 Future Facility Improvements

The calibrated computer model was used to analyze the future need for additional facilities within the distribution system. The addition of new facilities was based on the assumption that the largest wells in Zone 1 and Zone 2 are not operational. Based on the analysis in Chapter 6, new wells, booster pumping stations, and pipelines were identified. Table ES.4 presents the total number of recommended facilities for the future planning years. The recommended future pipeline improvement projects are shown on Figure ES.5 to meet projected MDD. The total cost of these projects is estimated at about $139.7 million (January 2007 dollars).

Table ES.3 Recommended Facilities for Future Planning Years
Water Master Plan Update
City of Hesperia

	Proposed Facility				
			Pipeline (ft)		
Planning Year	**Well (qty)**	**Booster Pumps (qty)**	**Distribution Pipes**	**Pumping Lanes**	**Total**
2012	5	20	167,780	13,300	181,500
2017	9	9	34,860	59,670	95,000
2022	6	4	-	-	0
2027	4	4	-	-	0
2032	2	0	559,670	75,950	636,000
Total	**26**	**37**	**763,000**	**149,500**	**912,500**

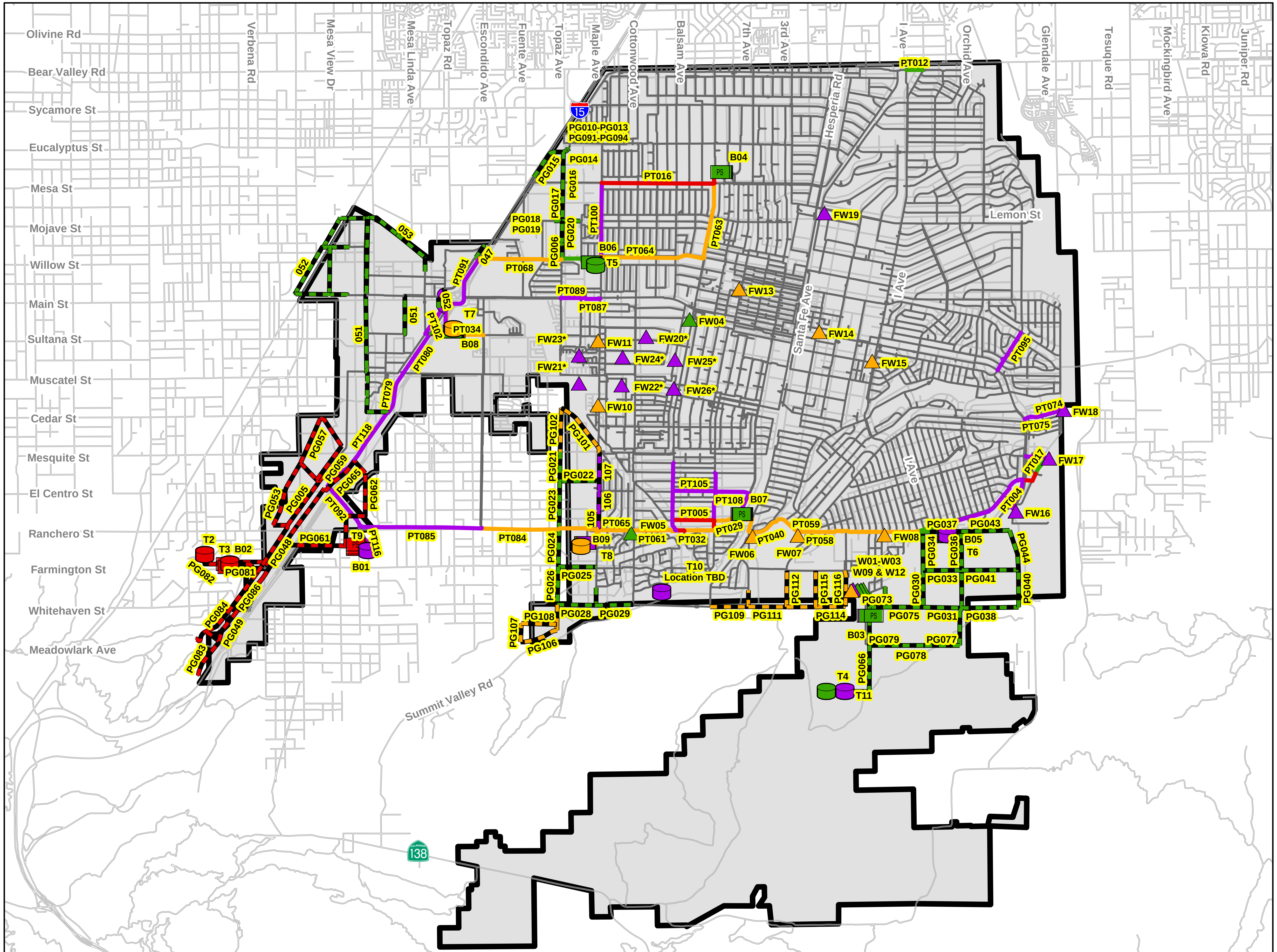
ES.7 CONSERVATION ANALYSIS

Two types of conservation analyses were conducted as part of this Master Plan, a Time of Use Analysis and a Water Conservation Analysis. These analyses are described below.

ES.7.1 Time of Use Analysis

Energy use is a significant cost to cities and agencies that must continuously pump water through their distribution systems. The City’s demands have increased, while storage facilities have remained constant. As a result, the wells and booster pumping stations are operating nearly 24 hours per day during the summer to meet the projected MDD. This continuous pumping incurs the costly energy rates during times of high use.

The City recognizes the potential cost savings in modifying this operation condition. Therefore, an off-peak pumping, or Time of Use (TOU), analysis was performed for future planning years, to determine the estimated energy savings. Southern California Edison (SCE) will offer the City discounted energy rates, provided the City does not operate its



Legend

Proposed Reservoir Installation Year
- Near Term
- 2007 - 2012
- 2013 - 2017
- 2018 - 2032

Proposed Groundwater Well Installation Year
- 2007 - 2012
- 2013 - 2017
- 2018 - 2032

Proposed Booster Station Installation Year
- Near Term
- 2007 - 2012
- 2013 - 2017
- 2018 - 2032

Growth Area Improvement Project Installation Year
- Near Term
- 2007 - 2012
- 2013 - 2017
- 2018 - 2032

Pumping Lane Improvement Project Installation Year
- Near Term
- 2007 - 2012
- 2013 - 2017
- 2018 - 2032
- Future Water Distribution System
- Water District Boundary

Text:
- V-11 CIP Project No.
- * Location TBD

N

Feet
0 6,000 12,000

carollo engineers

FIGURE ES.5
FUTURE PIPELINE IMPROVEMENT PROJECTS

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

pumps during a predefined time. The City proposes to not pump during the energy peak hours of 1:00 p.m. through 5:00 p.m.

Supplemental facilities are required to accommodate the reduced supply from TOU conditions. Based on the analyses in Chapter 7, six new wells with an average capacity of 1,500 gpm, 14.5 MG of additional storage capacity throughout the entire system, and 17,000 feet of new pipelines were added to the system to meet the ultimate demands in year 2032 and implement TOU pumping. This results in an additional cost of $15.5 million (January 2007 dollars). This equates to an annual cost of $850,000 when these capital projects are depreciated over a 50-year period and 5 percent interest. Compared to the amount of potential energy savings, it was determined that it is not cost-effective to implement TOU operations for the City at this time.

ES.7.2 Water Conservation Analysis

Water conservation is important in the high desert area of Southern California due to the limited groundwater supplies. The City has several existing and planned conservation measures that it would like to implement to help manage the increasing water demands. As a result, plans for about 10 percent demand reduction by 2022 and up to 20 percent demand reduction by 2032, were analyzed to determine the potential reduction of future facilities.

Based on the analyses in Chapter 7, several wells and pipelines could be removed from the CIP list if the planned water demand reduction is met. Stringent conservation could result in a cost savings of up to $14 million (January 2007 dollars).

ES.8 STORAGE ANALYSIS

This analysis evaluated the ability of the City's storage facilities to meet the requirements for operational, fire, and emergency storage.

A detailed analysis was performed system-wide for the City's water system. Based on the analysis presented in Chapter 8, several new facilities are required in future planning years to meet the established criteria for operational, fire, and emergency storage. Table ES.4 summarizes the recommended storage improvements as shown, 43.0 MG of additional storage is recommended to be installed by 2032 at a cost of $35.4 million.

Table ES.4 Recommended Storage Improvements by Planning Year and Zone
Water Master Plan Update
City of Hesperia

Planning Year	Zone	Proposed Facility	Volume (MG)
Near Term	5	New Zone 5 Reservoir	5
	6	New Hydro-pneumatic Tank	-

Table ES.4 Recommended Storage Improvements by Planning Year and Zone (Continued)
Water Master Plan Update
City of Hesperia

Planning Year	Zone	Proposed Facility	Volume (MG)
2012	2	New Reservoir (No. 21A)	5
	RLF	New Reservoir (No. RLF-1)	5
	4	Emergency Generator at New BPS from Zone 4 to 5	-
	5	Emergency Generator at New BPS from Zone 5 to 6	-
2017	3	New Reservoir (No. 23A)	3
	4	New Reservoir (No. 19C)	5
	1	Emergency Generator at BPS of Plant No. 18	-
	RLF	Emergency Generator at Well No. RLF-1	-
	RLF	Emergency Generator at Well No. RLF-2	-
2022	1	New Reservoir (No. 18A)	5
	4	New Reservoir (No. 30D)	5
	3	Emergency Generator at BPS of Plant No. 19A	-
	2	Emergency Generator at Well No. 24	-
	RLF	Emergency Generator at Well No. RLF-3	-
2027	4	New Zone 4 Reservoir	5
	RLF	New Reservoir (No. RLF-2)	5
	2	Emergency Generator at Well No. 20	-
2032	1	Emergency Generator at BPS of Plant No. 14	-
	2	Emergency Generator at BPS of Plant No. 21	-
	1	Emergency Generator at Well No. 5A	-
	1	Emergency Generator at Well No. 26	-
Total			43.0

ES.9 CAPITAL IMPROVEMENT PROGRAM

The recommended CIP improvement projects for the City are summarized by project type and by phase. Phase 1 (Near Term) improvements include fire flows, velocity, and steel pipe improvement projects. Phase 2 (2007-2012) and Phase 3 (2013-2017) improvements include facilities needed to correct low-pressure problems or are developer driven. Phase 4 (2018-2032) improvements include facilities that would not be required until sometime in the future. Table ES.6 summarizes the improvements identified in this Master Plan, which have an estimated capital cost of $292 million.

Table ES.6 Phasing of CIP by Improvement Type
Water Master Plan Update
City of Hesperia

Improvement Type	Near Term ($M)	2007-2012 ($M)	2013-2017 ($M)	2018-2032 ($M)	Total ($M)
Existing Fire Flow	41.0	0.0	0.0	0.0	41.0
Existing Velocity	0.9	0.1	0.2	0.0	1.1
Existing Steel Pipe	0.0	0.0	37.3	37.3	74.7
Future Booster Pump Stations	0.0	6.3	3.4	2.4	12.1
Future Wells	0.0	7.3	13.1	17.8	38.2
Future Pipeline	16.6	32.5	21.8	18.6	89.4
Future Storage	4.3	7.9	6.6	16.6	35.4
Totals	**62.7**	**54.1**	**82.3**	**92.7**	**291.8**

Notes:
(1) Estimated Project Costs are based on January 2007 dollars and include estimated engineering, legal and administrative costs, and a contingency, but excludes costs for land acquisition and off-site facilities.

INTRODUCTION

1.1 GENERAL

The City of Hesperia (City) lies within an area that is commonly referred to as the high desert in Southern California. It is located in the northern portion of San Bernardino County (County), California, approximately 30 miles north of the City of San Bernardino. Figure 1.1 shows a vicinity map indicating the nearby cities and towns.

The City currently relies entirely on groundwater as its only source of water supply. The City's potable water system is managed by the Hesperia Water District (District), which is a subsidiary special district of the City.

The City retained Carollo Engineers (Carollo) to prepare this Water Master Plan Update (Master Plan) to aid in the planning of its water supplies, water system improvements, and system operations.

The overall goals of this Water Master Plan are:

1. To update the City's existing water system computer model by incorporating facilities and pipelines that were constructed since the model was last updated and to calibrate the updated model.
2. To incorporate the area's growing development patterns into the water supply and demand projections.
3. To use, create, and calibrate a hydraulic computer model to evaluate what improvements are needed or will be needed to meet current and future water demands.
4. To identify capital improvements or operational changes necessary to meet current and upcoming water quality regulations.
5. To maximize the efficiency of system operations for these changes.
6. To establish cost estimates for the recommended capital improvements.

The hydraulic model was used to analyze the existing water system, proposed water facilities, and various "what-if" scenarios. The computer analysis assisted in the identification and selection of infrastructure and operational improvements to help the City meet its goals.

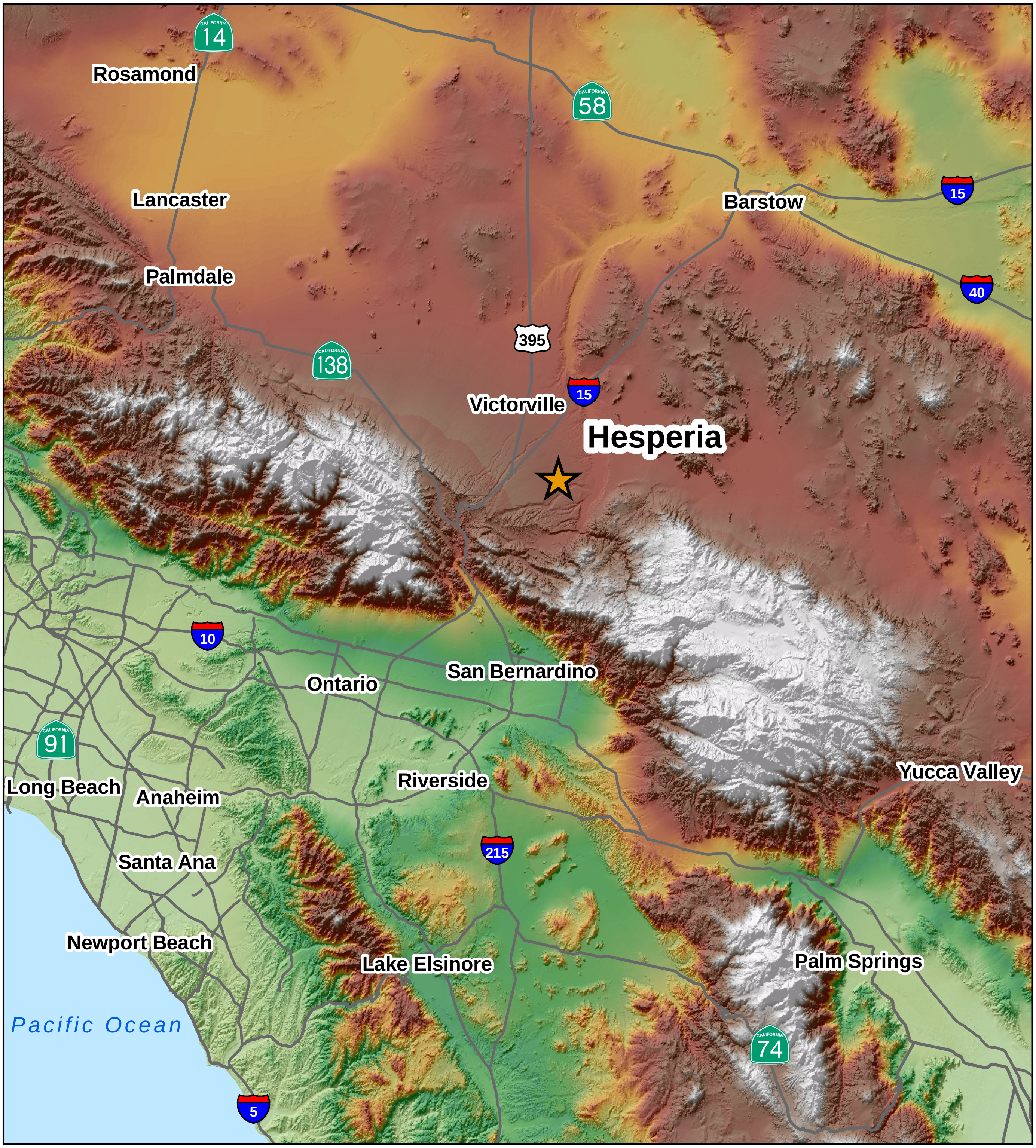


FIGURE 1.1
VICINITY MAP

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

1.2 CHAPTER OBJECTIVES

This chapter discusses fundamental information such as:

1. History of the City and District.
2. The objectives of this Master Plan report.
3. Assumptions used to evaluate the existing system.
4. The analysis and sizing criteria set forth and used to analyze the water system.
5. The organizational method of this report.
6. A list of the abbreviations used throughout this report.
7. A list of unit conversions provided to assist the reader convert the units shown to another set of units.

1.3 HISTORY OF THE CITY OF HESPERIA AND HESPERIA WATER DISTRICT

It is believed that the first Native American tribes to inhabit the area, today known as the City of Hesperia, were the Mojave Indians, with evidence suggesting that the hub of their settlement was near the Mojave River in a southeast section of Hesperia. By the 1800s, the first easterners began exploring and establishing trails near the headwaters of the Mojave River. In 1847, the first railroad tracks were built through the area, and in 1885, the area was officially named "Hesperia."

In 1885, Joseph Widney acquired the township of Hesperia and soon after formed the Hesperia Land and Water Company. During the late 1800s and early 1900s, the main water users were ranchers and visitors traveling through Hesperia.

In 1975, the District was formed as a self-governed special district that was originally a part of Victor Valley County Water District (VVCWD). This water system was purchased by the District from the VVCWD and included the area that was previously governed by the Hesperia Land and Water Company.

In 1988, the City was incorporated and in 1992, the District was reorganized as a subsidiary special district of the City. The City Council serves as the District’s Board of Directors.

The District provides utility service for the water and sewer system within the City of Hesperia and operates as a self-sustaining utility business enterprise. Income generated by the District is from water and sewer service charges in addition to facility connection fees.

Today, the City encompasses an area of approximately 74 square miles. The primary existing service area is shown in Figure 1.2 and is the general boundary of the study area for this Master Plan.

The climate within the City is typical of a desert climate, which includes hot, dry summers and cool winters. Temperatures in the summer months vary between an average low of 60 degrees Fahrenheit (degrees F) and an average high of 99 degrees F. In the winter months, the average low and high temperatures are 34 to 63 degrees F, respectively. Average annual precipitation is about 6.4 inches.

1.4 WATER MASTER PLAN OBJECTIVES

This Master Plan has been prepared to provide a reference document for the existing water system operations and maintenance and a framework for future water system planning. The plan objectives can be divided into four primary categories: facilities planning, supply/demand, operations, and capital improvements.

1.4.1 Facilities Planning Objectives

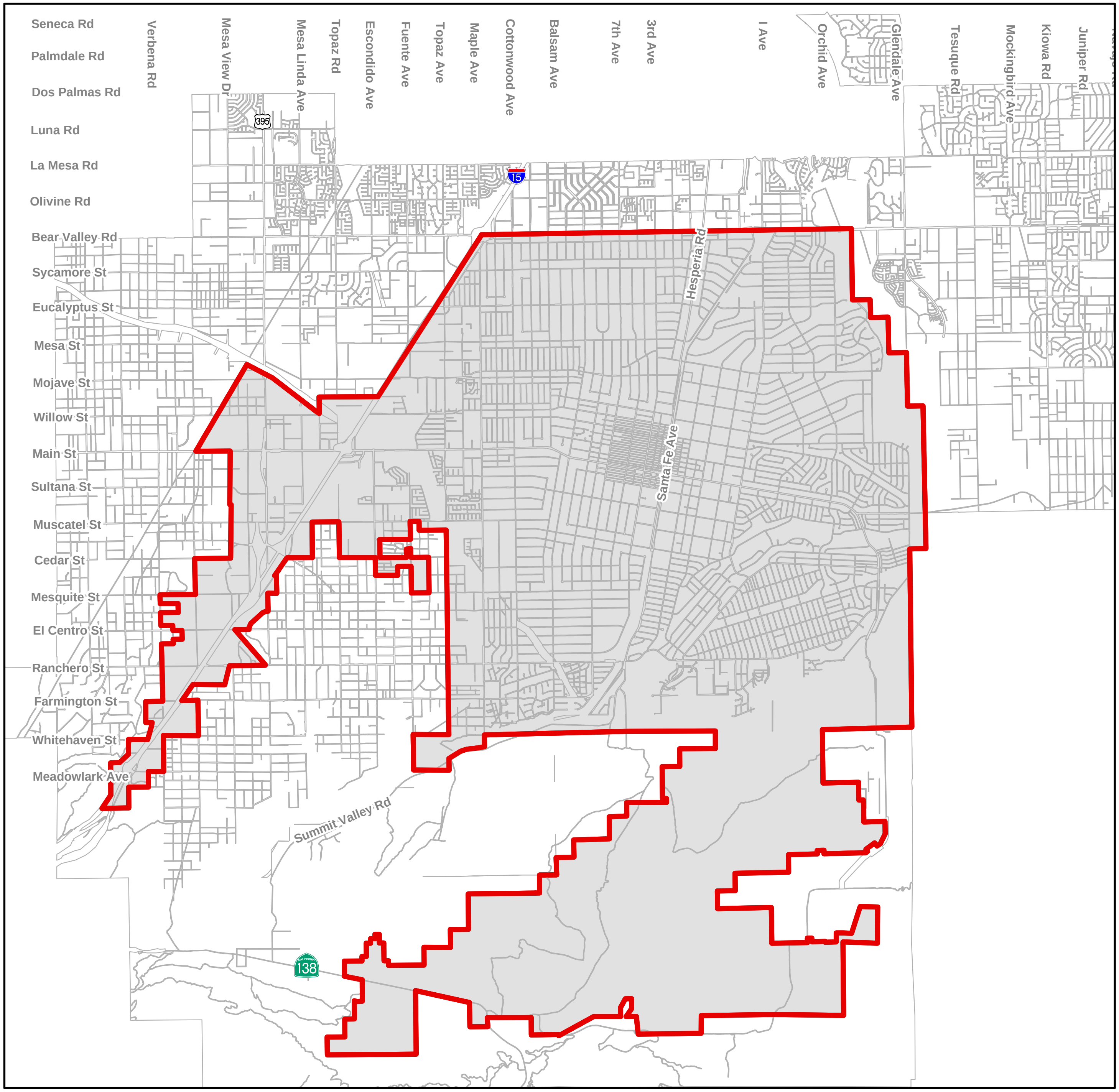
The objectives of the Master Plan with respect to water system facilities planning include:

1. Develop performance criteria for both existing and proposed water facilities.
2. Incorporate water demands into the computer model based on the City's existing and proposed land use types and associated densities.
3. Use the computer model to conduct hydraulic analyses of the existing water system and identify current deficiencies in existing water system facilities.
4. Identify and evaluate system improvements that will alleviate existing system deficiencies.
5. Incorporate projected water demands into the model and identify future system improvements that will be needed to meet the future demands.

1.4.2 Supply/Demand Objectives

The objectives of the Master Plan with respect to water supply and demand are to:

1. Review and tabulate the City's current water supplies.
2. Tabulate historic water production and consumption.
3. Forecast future water demands based upon projected development.
4. Compare water supplies and demands to determine the adequacy of the City's sources of local and imported water supplies.
5. Tabulate present and future water supplies and the facilities required to optimize usage of local water supplies.



Legend

Hesperia Water District

Feet

0 7,500 15,000

FIGURE 1.2
STUDY AREA MAP

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

6. Review and summarize water quality and proposed regulations that may have an impact on local water supplies.

1.4.3 Operational Objectives

The objectives of the Master Plan with respect to water system operations include:

- Perform hydraulic analyses of the water system using the computer model to evaluate operations of the current and future water systems.
- Review operational issues and develop strategies for water system reliability and operational cost-effectiveness.

1.4.4 Capital Improvement Objectives

The objectives of the Master Plan with respect to the capital improvements are to:

- Estimate the capital costs for and develop a capital improvement program (CIP) for recommended water system improvements.
- Develop a phased project list to prioritize future water system improvement projects.

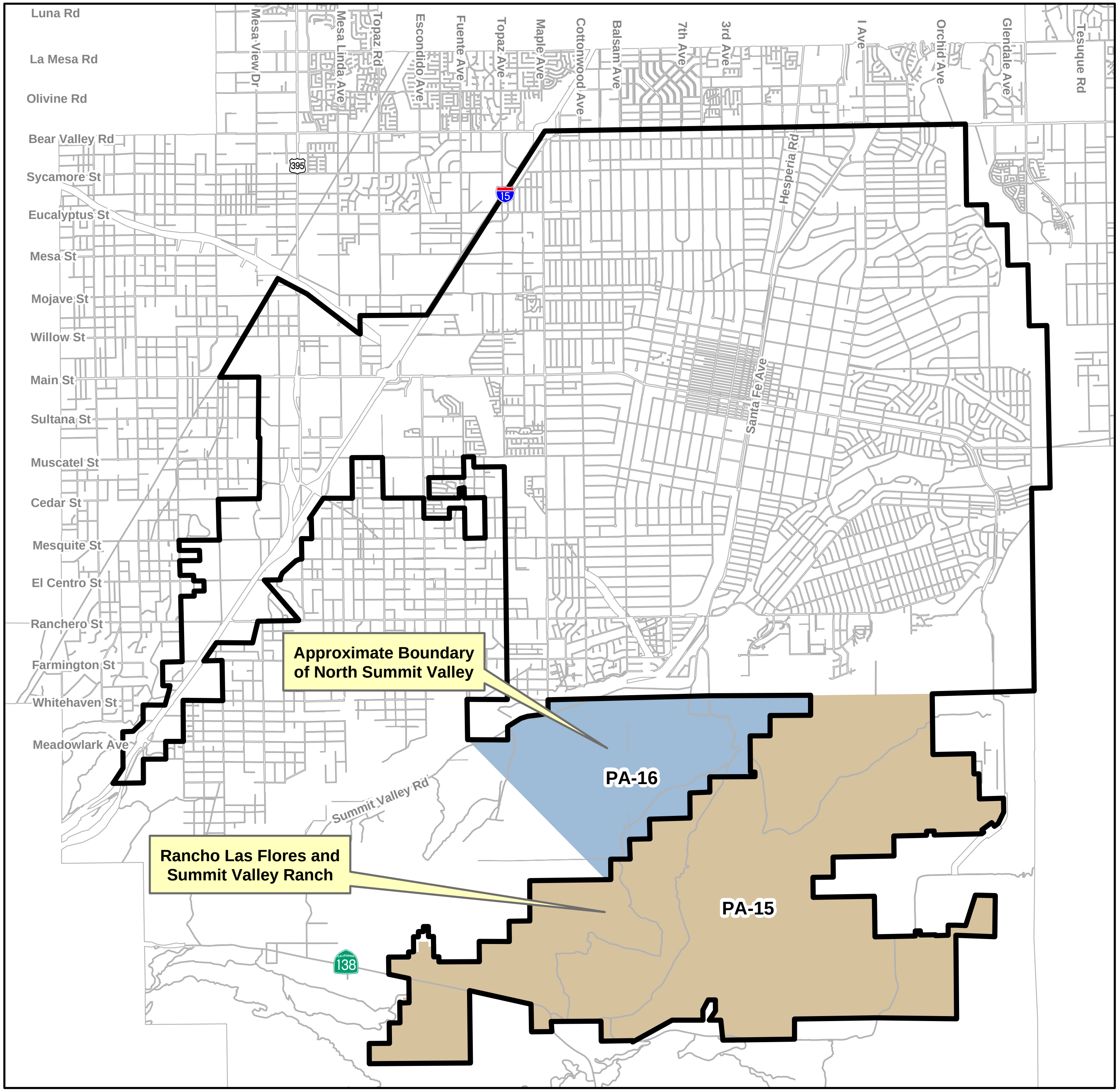
1.5 MASTER PLAN ASSUMPTIONS

Portions of this Master Plan have been based on fundamental assumptions that were established throughout the project. The City and Carollo discussed these assumptions and agreed that they resulted in a reasonable approach to developing the Master Plan.

The end of 2005 was assumed to represent the status of the City's existing water system for this Master Plan. This allowed for the use of a full calendar year of data and provided a current picture of the City's existing system. The years 2012, 2017, 2022, 2027, and 2032 were used as future planning years throughout this Master Plan.

1.5.1 Major Development Projects

The City has identified three large development projects that could have a significant impact on the water system. These are the Rancho Las Flores (RLF), Summit Valley Ranch (SVR), and North Summit Valley (NSV) developments. Planning for the RLF and SVR projects has been combined for this Master Plan. These projects have a significant amount of planning work completed and have already been annexed into the City. The RLF and SVR projects were assumed to be within the study area for this Master Plan. The NSV project, on the other hand, is in the early conceptual stages and is outside the Hesperia city limits. Therefore, the NSV was considered outside the study area for this Master Plan. Figure 1.3 shows the approximate locations of these projects relative to the City.



Legend

Hesperia Water District Service Boundary and Study Area

Major Developments

North Summit Valley Development (PA-16)

Rancho Las Flores and Summit Valley Ranch Developments (PA-15)

Feet

0 7,500 15,000

FIGURE 1.3
MAJOR DEVELOPMENT PROJECTS

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

1.6 MASTER PLAN ANALYSIS AND SIZING CRITERIA

To help quantify the performance objectives outlined above, a minimum acceptable level of service needed to be established to help identify deficiencies in existing facilities as well as to help determine the need for, and size of, proposed improvements. The criteria listed below were established to quantify the minimum service requirements for the water system and to be the minimum acceptable conditions under which the water system would be considered adequate. The criteria were intended to be used to analyze existing facilities and design proposed improvements. Where applicable, the source of these criteria is provided in endnotes.

1. The water provided to the City's consumers shall meet all federal, state, and local regulations governing water quality for potable use.
2. The water system shall be capable of providing the minimum fire flow as determined in this Master Plan with a minimum residual pressure of 20 psi (AWWA)[1].
3. The water system shall be capable of providing at least 40 psi (California Department of Health Services (CDHS)) for the following demand periods: average day, maximum day, and peak hour. A maximum static pressure should be maintained below 80 psi. Where the maximum pressure exceeds 80 psi, individual pressure regulators should be equipped at connections in accordance with the Uniform Plumbing Code (UPC). The maximum pressure at any service connection should not exceed 150 psi.
4. The maximum velocity in any proposed pipeline should be in accordance with the following guidelines (Standard Practice):

	Desired Range	**Questionable Range**	**Deficient Range**
Average Day Analysis	0 to 5 fps	5 to 7 fps	Over 7 fps
Maximum Day and Peak Hour Analysis	0 to 7 fps	7 to 10 fps	Over 10 fps
Fire Flow Analysis	0 to 15 fps	-	Over 15 fps

Pipes with velocities in the questionable range should be reviewed on an individual basis. Those with velocities in the Deficient Range should be considered for replacement or paralleling.

5. The water system and each pressure zone shall have at least two independent supply sources (AWWA). Where water is pumped from another zone, the booster pumping station shall have a backup pump online and be equal in size to the largest pump in the station. The station shall also have a backup (or secondary) power source. A portable generator is considered acceptable as a backup power source for the booster station.

6. The water system shall have adequate storage (AWWA)[2] for all of the following: operational storage, fire flow, and emergency storage. Operational storage shall be at least 25 percent of the maximum day demands (MDDs). Storage for fire flows shall be at least the largest volume determined for any fire flow and shall be available within each pressure zone (either directly or from a higher zone). Emergency storage shall be as determined within the master plan. The sum of the operational storage, fire flow, and emergency storage volumes shall be the minimum required storage for the water system.

7. The water system and each pressure zone shall be capable of providing adequate service (as defined in this subsection) for each of the following emergency scenarios:

    a. Loss of the largest water supply source in Zones 1 and 2 for 1 week of average day demands.

    b. A Citywide power outage for 24 hours of MDDs.

8. To meet pressure and velocity objectives, the following criteria are recommended for new pipelines. The minimum diameter for new pipelines shall be 8 inches, except in short cul-de-sac streets where 6-inch diameter pipe may be used beyond the last hydrant. In commercial and business areas, the minimum diameter for new pipelines shall be 12 inches. These diameters shall not preclude the use of larger diameters when needed to meet the minimum fire flows or other criteria. All pipelines shall be looped (excluding short cul-de-sac streets) to prevent one pipeline outage from disrupting service to an area. An exception may be granted by the City's Engineer in special situations (AWWA)[3].

9. Operational improvements are difficult to quantify. Nevertheless, proposed operational improvements that increase the system reliability or efficiency, or reduce the cost to deliver water, should be examined. Where a benefit is found, the proposed improvement should be recommended.

1.7 ORGANIZATION OF THIS REPORT

This report has been structured to help City staff easily locate and identify information regarding the City's water system. The following list provides a brief description of the information provided in each section:

- The Executive Summary (Chapter ES) provides an overview of the Master Plan process and document.
- Chapter 1 describes the Master Plan objectives and performance criteria.
- Chapter 2 identifies the major facilities in the City's existing water system.
- Chapter 3 presents the current and projected water demands.
- Chapter 4 evaluates the City's historical and future water supplies.

- Chapter 5 describes the hydraulic computer model development and calibration.
- Chapter 6 describes the hydraulic modeling results for the existing and future systems.
- Chapter 7 presents the conservation analyses.
- Chapter 8 evaluates the results of the storage analysis.
- Chapter 9 presents the capital improvement program and the estimated capital costs associated with those improvements.

1.8 ABBREVIATIONS

The following is a list of abbreviations used in this report:

AC	asbestos cement (this is a common material for water pipelines)
ac-ft	acre-foot (one acre-foot of water is equal to 325,829 gallons)
ACWA	Association of California Water Agencies
ADD	average day demands
ac-ft/yr	acre-feet/year
AWWA	American Water Works Association
Basin	Mojave River Groundwater Basin
BPS	booster pumping station
BMWD	Baldy Mesa Water District
Carollo	Carollo Engineers
ccf	one hundred cubic feet
CDHS	California Department of Health Services
cfs	cubic feet per second
CREEC	California Regional Environmental Education Community
DI	ductile iron (this is a common material for water pipelines)
DIP	ductile-iron pipe
DMM	Demand Management Measure
du/acre	dwelling unit per acre
DWR	Department of Water Resources
EPS	extended period simulation (special type of hydraulic model simulation)
ES	Executive Summary
ETo	evapotranspiration-based
FCV	flow control valve
FPA	Free Production Allowance
fps	feet per second

ft	feet
ft-msl	feet above mean sea level
GIS	Geographic Information Systems
gpcd	gallons per capita-day
gpd	gallons per day
gpd/ac	gallons per day per acre (volume of water used per acre of land)
gpm	gallons per minute
HGL	hydraulic grade line
hp	horsepower
HWL	high water level
kWh	kilo Watt-hours
Master Plan	Water Master Plan
MDD	maximum day demands
MEEC	Mojave Environmental Education Consortium
MG	million gallons
mgd	million gallons per day
msl	mean sea level
MWA	Mojave Water Agency
MWD	Metropolitan Water District of Southern California
NCGV	normally closed gate valves
NFPA	National Fire Protection Association
NSV	North Summit Valley
PA	planning area
PRS	pressure regulating station
PRV	pressure regulating valve
psi	pounds per square inch (measure of pressure)
PSV	pressure sustaining valve
PVC	polyvinyl chloride (this is a common material for water pipelines)
RLF	Rancho Las Flores
RWMP	Recycled Water Master Plan
SBCFD	San Bernardino County Fire Department
SCADA	Supervisory Control and Data Acquisition
SCAG	Southern California Association of Governments
SCE	Southern California Edison
STL	steel
SVR	Summit Valley Ranch

SWP	California State Water Project
TDH	total dynamic head
TOU	Time of use
UFC	Uniform Fire Code
ULFT	Ultra Low Flush Toilet
UPC	Uniform Plumbing Code
USGS	United States Geologic Survey
UWMP	Urban Water Management Plan
UWMPA	Urban Water Management Planning Act
VVWD	Victor Valley Water District
VVWRA	Victor Valley Wastewater Reclamation Authority

1.9 UNIT CONVERSION

This report uses standard engineering units when reporting volumes, flow rates, etc. However, the use of selected units when discussing different aspects of the water system can make comparisons difficult if the proper conversion factors are not known. This section provides a list of conversion factors that are commonly used to convert values from one unit to another.

1.9.1 Volume

Two common units used in the water industry to measure volume are acre-feet and gallons (or million gallons). Water production is often reported in terms of acre-feet (ac-ft). Stored water, such as in a reservoir, is commonly measured in million gallons (MG). Conversion factors are listed below for the units of volume used in this report. To convert a volume from MG to the equivalent volume in units of ac-ft, the value in MG should be multiplied by 3.0691 to convert the value into ac-ft (see conversion factor below).

- Convert MG to ac-ft: Multiply by 3.0691.
- Convert ac-ft to MG: Multiply by 0.32583.

1.9.2 Flow Rate

Common units used to report flow rates include acre-feet per year, cubic feet per second, gallons per day, gallons per minute, and million gallons per day. Flow rates may represent instantaneous flows, such as cfs or gpm, or flow rates over a longer period, i.e., ac-ft/yr. Conversion factors for many units of flow rate are listed below. To convert a flow rate from ac-ft/yr to gpm, multiply by the factor 0.621 from the list below.

1. Convert ac-ft/yr to cfs: Multiply by 0.001381.
2. Convert ac-ft/yr to gpd: Multiply by 892.7.

3. Convert ac-ft/yr to gpm: Multiply by 0.621.
4. Convert ac-ft/yr to mgd: Multiply by 0.000893.
5. Convert cfs to ac-ft/yr: Multiply by 724.
6. Convert cfs to gpd: Multiply by 646,300.
7. Convert cfs to gpm: Multiply by 448.8.
8. Convert cfs to mgd: Multiply by 0.646.
9. Convert gpd to ac-ft/yr: Multiply by 0.00112.
10. Convert gpd to cfs: Multiply by 0.000001547.
11. Convert gpd to gpm: Multiply by 0.0006944.
12. Convert gpd to mgd: Multiply by 0.000001 (or divide by one million).
13. Convert gpm to ac-ft/yr: Multiply by 1.61.
14. Convert gpm to cfs: Multiply by 0.002228.
15. Convert gpm to gpd: Multiply by 1,440.
16. Convert gpm to mgd: Multiply by 0.00144.
17. Convert mgd to ac-ft/yr: Multiply by 1,120.
18. Convert mgd to cfs: Multiply by 1.547.
19. Convert mgd to gpd: Multiply by 1,000,000.
20. Convert mgd to gpm: Multiply by 694.4.

1.10 ACKNOWLEDGEMENTS

1.10.1 City of Hesperia Council

Rita Vogler, Mayor.

Mike Leonard, Mayor Pro Tem.

Tad Honeycutt, Council Member.

Thurston Smith, Council Member.

Ed Pack, Council Member.

1.10.2 City of Hesperia Management Staff

Mike Podegracz, P.E., City Manager.

Scott Priester, Director of Development Services.

John R. Leveillee, P.E., City Engineer.

Dale Burke, Public Works Manager.

Jeff Bennington, Public Works Supervisor - Water.

Wayne Vogel, Maintenance Crew Supervisor.

Dave Reno, Principal Planner.

1.10.3 Carollo Engineers

Jim Meyerhofer, P.E., Partner-in-Charge.

Gary Meyerhofer, P.E., Project Manager.

Inge Wiersema, P.E., Project Engineer.

Rebecca Li, P.E., Staff Engineer.

Debra Dunn, Graphics and GIS.

1.10.4 Carollo's Subconsultants

Paul Hauffen, IDModeling, Hydraulic Computer Modeling.

---

[1] American Water Works Association (AWWA) M31, Manual of Water Supply Practices, Distribution System Requirements for Fire Protection, Chapter 2, Section: Rates of Water Use; Fire Marshall, National Fire Protection Association (NFPA).
[2] AWWA M32, Manual of Water Supply Practices, Distribution Network Analysis for Water Utilities, Chapter 3, Section: Design Criteria as Analysis Considerations.
[3] AWWA M31, Manual of Water Supply Practices, Distribution System Requirements for Fire Protection, Chapter 2, Section: Distribution System Appurtenances.

EXISTING SYSTEM FACILITIES

2.1 GENERAL

The Hesperia Water District (District), which is a subsidiary special district of the City of Hesperia (City), manages an existing potable water system that includes 15 wells, 6 booster pumping stations (22 booster pumps), 13 water storage reservoirs, and 44 pressure regulating stations (PRS). The system consists of four primary pressure zones with five subzones and serves approximately 23,400 potable water service connections. The City obtains all of its water supply from local groundwater wells. The hydraulic profile schematic of the City's water system is shown in Figure 2.1

2.2 CHAPTER OBJECTIVES

This chapter discusses the features of the following existing facilities:

- Pressure zones.
- Groundwater wells.
- Storage facilities.
- Booster pumping stations.
- Pressure-regulating stations.
- Pipelines.

2.3 PREVIOUS WATER MASTER PLANS

In 1983, So & Associates Engineers, Inc., created and prepared the first water system master plan for the City. This master plan provided recommendations for water system improvements for growth projected through a 20-year period. To continue with planned water management, So & Associates, Inc. prepared an update of the master plan in August 2002.

The City's 2002 Master Plan identified 11 operating wells, 6 booster stations, 10 storage tanks, and 43 pressure reducing stations. The combined capacity of the wells was approximately 16,000 gpm or 23.0 mgd. Some of the recommended improvements for Year 2001 through 2005 have been constructed, such as three additional wells, various pipeline replacements, and two new reservoirs. The City's 2002 Master Plan was based on development trends prior to 2003. However, growth in the high desert region changed significantly beginning in 2003. The rate of growth and new construction, which occurred after the 2002 Master Plan, more than doubled the projections which were previously assumed. As a result, the City retained SouthWest Engineers and IDModeling, Inc., to

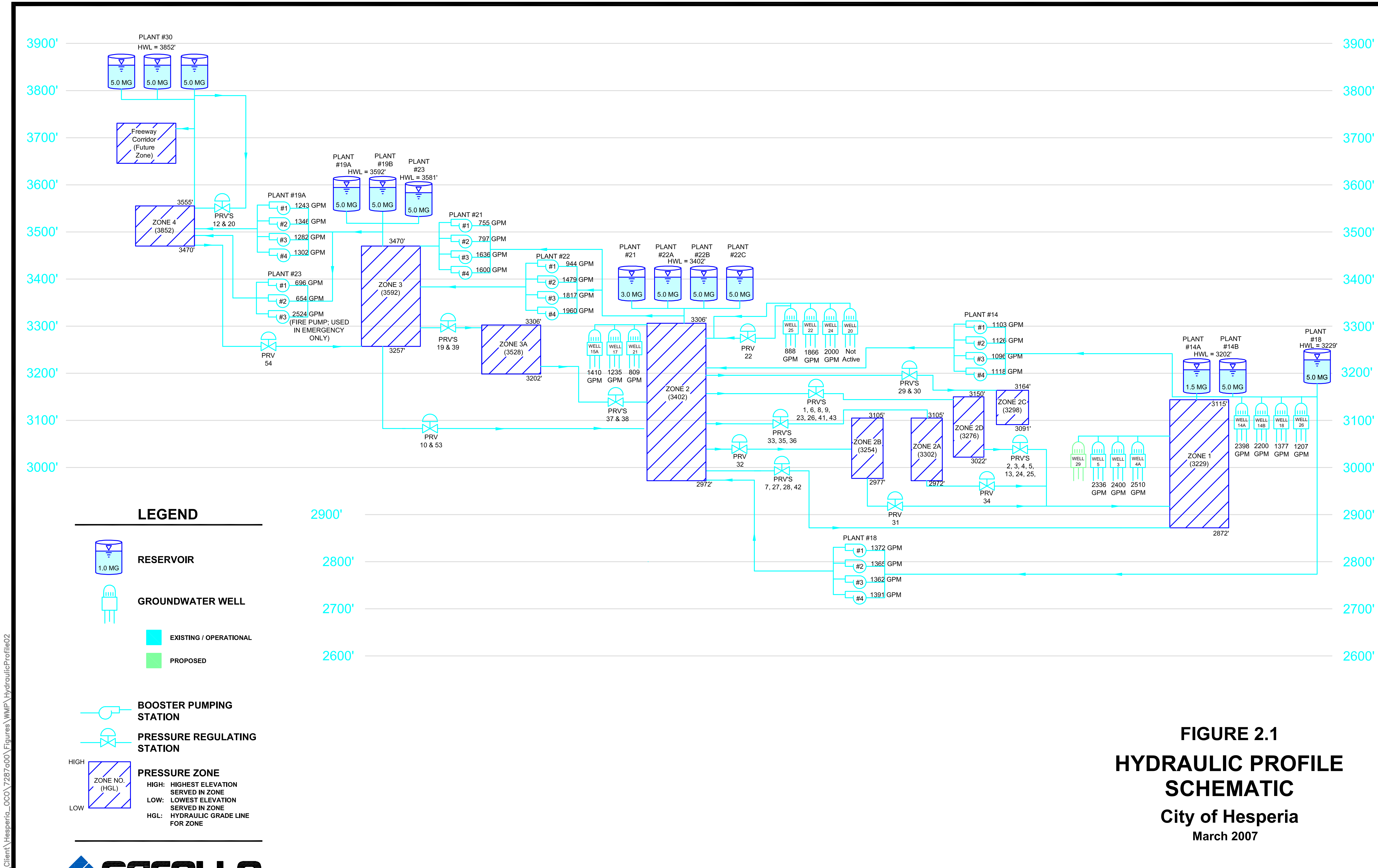


FIGURE 2.1

HYDRAULIC PROFILE SCHEMATIC

City of Hesperia

March 2007

carollo engineers

H:\Client\Hesperia_OCO\7287a00\Figures\WMP\HydraulicProfile02 update and calibrate the hydraulic model for the 2002 Master Plan to reflect facilities and demands up to 2004. This model was used as the basis for updating this Master Plan.

2.4 PRESSURE ZONES

Water systems are typically divided into different hydraulic regions, known as pressure zones, to maintain adequate pressures throughout the distribution system in spite of varying topography. A hydraulic grade line (HGL) is typically identified for each pressure zone to indicate the normal maximum level of water available to the pressure zone. The high water levels in reservoirs are usually set to maintain these HGLs.

The City's service area ranges in elevation from approximately 2,785 ft-msl in the northeastern portion of the service area to about 3,735 ft-msl in the southern portion. The City has divided its distribution system into four primary pressure zones and five subzones as shown in Figure 2.2. A description of the City's pressure zones is shown in Table 2.1.

Table 2.1 Pressure Zone Summary
Water Master Plan Update
City of Hesperia

Pressure Zone	HGL (ft-msl)	Elevations Served (ft-msl)	Storage (Tank Nos.)	Groundwater (Well Nos.)
1	3,229	2,872 - 3,115	14A 14B 18	3, 4A, 5, 14A, 14B, 18, and 26
2	3,402	2,972 - 3,306	21 22A 22B 22C	15A, 17, 20, 21, 22, 24, and 25
2A	3,302	2,971 - 3,184	N/A	N/A
2B	3,254	3,037 - 3,100	N/A	N/A
2C	3,298	3,100 - 3,189	N/A	N/A
2D	3,276	3,022 - 3,171	N/A	N/A
3	3,592	3,257 - 3,470	19A 19B 23	19A
3A	3,528	3,164 - 3,410	N/A	N/A
4	3,852	3,470 - 3,555	30	N/A

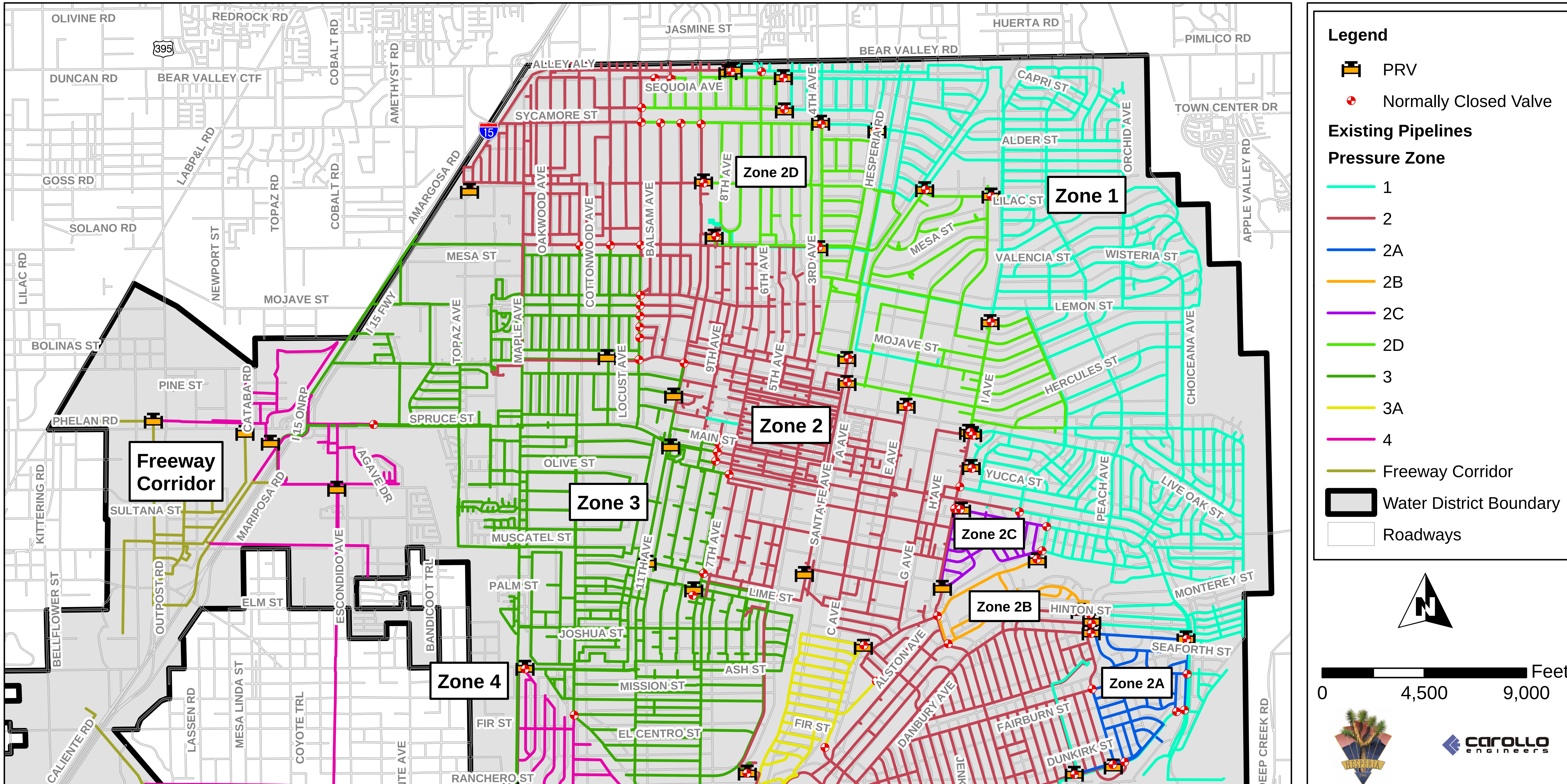


FIGURE 2.2
EXISTING SYSTEM PRESSURE ZONES

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

2.5 WATER SUPPLY SOURCES

2.5.1 Groundwater

The City has 15 groundwater wells within its service area that are used to pump groundwater from the Alto Subarea sub-basin, which is contained within the Mojave River Groundwater Basin, into the distribution system. The locations of these groundwater wells are identified in Figure 2.3. Because the water quality of the groundwater meets state and federal standards, the wells pump directly into the City's distribution system or into nearby holding tanks without the need for treatment. Prior to discharging groundwater into the system, a disinfectant (calcium hypochlorite) is added to the water. The location and hydraulic data for these wells are listed in Table 2.2. As shown in Table 2.2, the instantaneous capacity from all of the City's existing wells is about 23,139 (33.3 mgd). However, much of this production capacity is only needed during the peak summer months. The average water use is much less than the available capacity. This additional capacity is needed to provide the increased demands during the summer period and to provide adequate reliability to assure that water will be available when it is needed.

2.5.2 Surface Water

2.5.2.1 <u>California State Water Project</u>

The main transport structure of the State Water Project (SWP) is the California Aqueduct, which conveys surface water from Northern California to Southern California. This facility is managed by the Department of Water Resources (DWR). The aqueduct is a concrete-lined water transport channel that is about 450 miles in length.

In the Mojave Desert region, the Mojave Water Agency (MWA) is the SWP water contractor. The MWA has an entitlement of 75,800 ac-ft/yr to supplement the water sources for the members of the MWA. To help reduce overdrafts, the MWA has made releases of this imported water into the Mojave River Groundwater Basin as recharge. Releases from the Rock Springs Outlet directly recharge the Alto Subarea, which is the City's pumping source.

2.6 STORAGE FACILITIES

2.6.1 Finished Water Reservoirs

Water distribution systems rely on stored water to help equalize fluctuations between supply and demand, to supply sufficient water for firefighting, and to meet demands during an emergency or an unplanned outage of a major source of supply. The City's water system has a total of 13 reservoirs that have a total current storage capacity of 59.5 MG. Detailed information for each of the reservoirs is presented in Table 2.3. The location of these reservoirs is shown in Figure 2.3.

Table 2.2 Groundwater Well Data Summary
Water Master Plan Update
City of Hesperia

Well Number	Location	Zone Served	Status	Year Drilled	Ground Elevation (ft-msl)	Backup Power		Disinfection		Motor Size[2] (hp)	TDH[2] (ft)	Well Capacity[2] (gpm)
						Y/N	Type	Y/N	Type[1]			
3	18712 Main Street	1	Active	1982	3,006	N	N/A	Y	Chlorination	400	454	2,336
4A	18950 Vine Street	1	Active	1988	2,961	N	N/A	Y	Chlorination	450	590	2,250
5	18295 Redding Street	1	Active	1987	3,109	N	N/A	Y	Chlorination	400	459	2,610
14A[4]	11020 10th Avenue	1	Active	1986	3,170	N	N/A	Y	Chlorination	400	444	2,398
14B[4]	11020 10th Avenue	1	Active	1987	3,170	N	N/A	Y	Chlorination	300	447	2,000
15A	15680 Palm Street	2	Active	1983	3,332	N	N/A	Y	Chlorination	300	671	1,410
17	8484 4th Avenue	2	Active	1978	3,308	N	N/A	Y	Chlorination	300	634	1,235
18	7292 Paisley Avenue	1	Active	1984	3,185	N	N/A	Y	Chlorination	300	463	1,377
19A	7034 Maple Avenue	3	Active	2004	3,567	N	N/A	Y	Chlorination	300	800	928
20	10610 Redlands Avenue	2	Active	1981	3,216	N	N/A	N	N/A	300	[3]	1,800[3]
21	10071 Tamarisk Avenue	2	Active	1984	3,365	N	N/A	Y	Chlorination	250	655	809
22	7499 3rd Avenue	2	Active	1986	3,364	Y	Diesel Generator	Y	Chlorination	450	607[3]	1,891[3]
24	16852 Lime Street	2	Active	1989	3,234	N	N/A	Y	Chlorination	400	700	2,000
25	8734 Hesperia Road	2	Active	1987	3,257	N	N/A	Y	Chlorination	200	625	888
26	17282 Mojave Street	1	Active	1986	3,100	N	N/A	Y	Chlorination	300	439	1,207
											TOTAL EXISTING CAPACITY[4]	**23,139**

Notes:
(1) Chlorination consists of calcium hypochlorite disinfection.
(2) Source Data: Pump Check, Pumping System Analysts Hydraulic Test Report, 2003 (see Appendix A).
(3) No data available on Pump Check, Pumping System Analysts Hydraulic Test Report. Data shown is estimated.
(4) Wells 14A and 14B split time. Both wells are not on at the same time. Capacities shown exclude Well 14B.

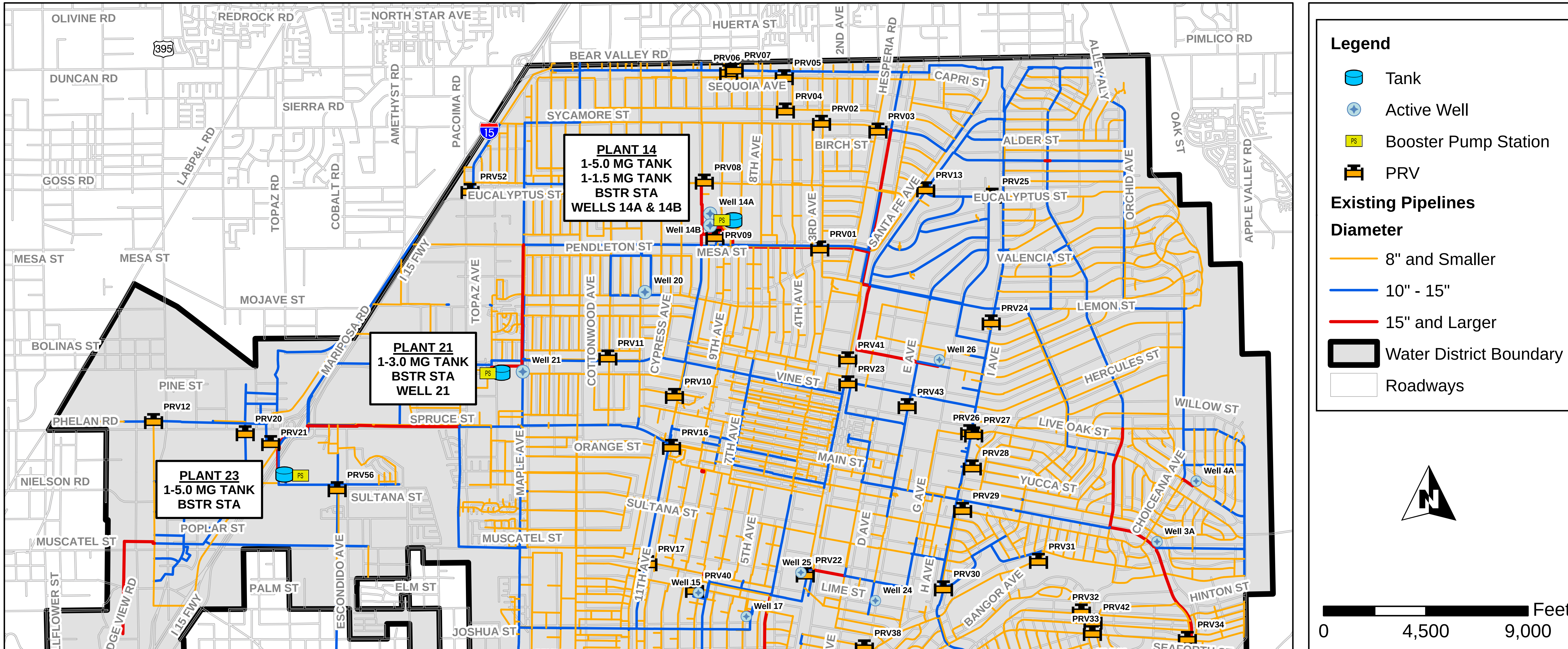


FIGURE 2.3
EXISTING WATER FACILITIES

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

Table 2.3 Finished Water Storage Reservoirs
Water Master Plan Update
City of Hesperia

Description	Type	Base Elevation (ft-msl)	Diameter (ft)	Overflow Height (ft)	Overflow HWL (ft-msl)	Pressure Zone	Capacity (MG)
Plant #14A	Welded Steel	3,170	94	35	32	1	1.5
Plant #14B	Welded Steel	3,170	160	35	32	1	5.0
Plant #18	Welded Steel	3,197	150	35	32	1	5.0
Plant #19A	Welded Steel	3,560	160	35	32	3	5.0
Plant #19B	Welded Steel	3,560	160	35	32	3	5.0
Plant #21	Welded Steel	3,364	114	40	38	2	3.0
Plant #22A	Welded Steel	3,364	150	40	38	2	5.0
Plant #22B	Welded Steel	3,364	150	40	38	2	5.0
Plant #22C	Welded Steel	3,364	150	40	38	2	5.0
Plant #23	Welded Steel	3,549	158	35	32	3	5.0
Plant #30	Welded Steel	3,820	165	35	32	4	5.0
Plant #30B	Welded Steel	3,820	165	35	32	4	5.0
Plant #30C	Welded Steel	3,820	165	35	32	4	5.0
						TOTAL STORAGE VOLUME	**59.5**

2.7 BOOSTER PUMPING STATIONS

Booster pumping stations (BPS) deliver water from lower pressure zones into higher pressure zones. Multiple pumps at each station, or multiple pump stations that serve the same pressure zone, help to increase water system reliability by allowing water to be boosted into that zone if one pump is out of service. In addition, critical booster pumping stations may be equipped with emergency power supplies in case of failure of the primary power source.

The City has six booster pumping stations throughout the service area. Table 2.4 lists detailed information about each of the pumps for all of the booster pumping stations. The locations of the City's existing booster stations are shown in Figure 2.3.

Table 2.4 Booster Pumping Stations
Water Master Plan Update
City of Hesperia

Facility Name	Location	Pressure Zone: Suction	Pressure Zone: Discharge	Pump Type	Backup Power Source	Pump Number	Ground Elevation (ft-msl)	Nameplate Horsepower (hp)	Design Head (ft)	Design Capacity (gpm)
Plant #14 B-1	11020 10th Avenue	1	2	Turbine Booster	No	1	3,170	100	204	1,103
Plant #14 B-2				Turbine Booster		2		100	204	1,126
Plant #14 B-3				Turbine Booster		3		100	202	1,096
Plant #14 B-4				Turbine Booster		4		100	203	1,118
Plant #18 B-1	7292 Paisley Road	1	2	Turbine Booster	No	1	3,197	100	171	1,372
Plant #18 B-2				Turbine Booster		2		100	171	1,365
Plant #18 B-3				Turbine Booster		3		100	173	1,362
Plant #18 B-4				Turbine Booster		4		100	173	1,391
Plant #19A B-1	7034 Maple Avenue	3	4	Turbine Booster	No	1	3,560	150	270	1,243
Plant #19A B-2				Turbine Booster		2		150	270	1,346
Plant #19A B-3				Turbine Booster		3		150	273	1,282
Plant #19A B-4				Turbine Booster		4		150	273	1,302
Plant #21 B-1	10071 Tamarisk Avenue	2	3	Turbine Booster	No	1	3,364	75	203	755
Plant #21 B-2				Turbine Booster		2		75	203	797
Plant #21 B-3				Turbine Booster		3		125	217	1,636
Plant #21 B-4				Turbine Booster		4		125	211	1,600
Plant #22 B-1	7499 3rd Avenue	2	3 (Future Rancho Los Flores)	Turbine Booster	Diesel Generator	1	3,364	75	192	944
Plant #22 B-2				Turbine Booster		2		125	201	1,479
Plant #22 B-3				Turbine Booster		3		150	207	1,817
Plant #22 B-4				Turbine Booster		4		200	206	1,960
Plant #23 B-1	12900 Nelson Road	3	4 Hydrozone	Turbine Booster	Diesel Generator	1	3,549	20	58	696
Plant #23 B-2				Turbine Booster		2		20	59	654
Plant #23 Fire Pump				Centrifugal		3		100	99	2,524

Notes:
(1) Source Data: Pump Check, Pumping System Analysts Hydraulic Test Report, 2003 (see Appendix A).

2.8 PRESSURE-REGULATING STATIONS

Pressure regulating stations (PRS) allow distribution systems to transfer water from higher pressure zones to lower pressure zones without exceeding the allowable pressures in the lower zones or completely draining the pressure out of the higher zone. The water is transferred through a valve that reduces the pressure to a specified pressure setting (pressure-reducing feature), while maintaining the pressure in the upper pressure zones (pressure-sustaining feature). That is, the pressure-sustaining valves will not allow water to transfer into the lower pressure zone if the pressure in the upper zone drops below a preset level. The pressure sustaining feature prevents a main break, or similar emergency, in the lower pressure zone does not drain too much water from the upper pressure zone. Many PRSs are also outfitted with pressure-relief valves that allow water to bleed from the higher pressure zone into the lower pressure zone if the pressure gets too high in the upper zone. This can occur if a reducing valve sticks open.

The City maintains 45 PRSs, while there is only one pressure-relief valve within the distribution system. The locations of the PRSs are shown in Figure 2.3. Detailed information for each pressure-regulating valve at the various stations is shown in Table 2.5.

Table 2.5 Pressure-Regulating Stations Data Summary
Water Master Plan Update
City of Hesperia

PRV No.	Location	Station Elevation (ft-msl)	Pressure Zone Upstream	Pressure Zone Downstream	Valve Size (in)	Valve Type	Pressure Setting (psi)
1	Southwest corner of Mesa/3rd	3,127	2	2d	6”	Cla-Val	55
2	Northwest corner of 3rd/Sycamore	3,080	2d	1	4”	Cla-Val	60
					8”	Cla-Val	55
3	Southeast corner of 1st/Sycamore	3,059	2d	1	4”	Cla-Val	60
4	On Manzanita between 5th/6th	3,080	2d	1	2”	Cla-Val	45
5	On Sequoia between 5th/6th	3,069	2d	1	2”	Cla-Val	45
6	On 9th between Bear Valley/ Sequoia	3,086	2	2d	2”	Cla-Val	60
					6”	Cla-Val	55
7	On easement east of 9th between Bear Valley and Sequoia	3,083	2	1	4”	Cla-Val	70
					8”	Cla-Val	65

Table 2.5 Pressure-Regulating Stations Data Summary (Continued)
Water Master Plan Update
City of Hesperia

PRV No.	Location	Station Elevation (ft-msl)	Pressure Zone Upstream	Pressure Zone Downstream	Valve Size (in)	Valve Type	Pressure Setting (psi)
8	In Eucalyptus easement between 11th and 10th	3,150	2	2d	6”	Cla-Val	45
9	At Plant #14 north of Mesa	3,171	2	2d	4”	Cla-Val	45
					8”	Cla-Val	40
10	On Cajon west of 11th	3,260	3	2	4”	Cla-Val	60
11	On Locust north of Willow	3,290	3	3	6”	Cla-Val	Bypass
12	Main St./Hwy. 395	3,562	J(1)	4	4”	Cla-Val	80
					8”	Cla-Val	75
13	Santa Fe/ Hercules	3,060	2d	1	4”	Cla-Val	50
					8”	Cla-Val	45
14	Northeast corner of E St./Mission	3,552	4	4	2”	Cla-Val	Out of Service
15	On Orange east of 9th	3,275	3	2	6”	Cla-Val	65 (Inactive)
16	On Main St. east of 11th	3,280	3	3	N/A	Cla-Val	Off-line
17	On 11th north of Lime	3,345	3	3	6”	Cla-Val	90
18	On Ranchero west of Maple (in front of Plant #19)	3,557	4	4	4”	Cla-Val	70
					8”	Cla-Val	65
19	Plant #22 east of 3rd	3,360	3	3a	4”	Cla-Val	68
					10”	Cla-Val	64
20	Southwest corner of Cataba/ Main St. (in front of Bob’s Big Boy)	3,517	J(1)	4	4”	Cla-Val	85
					6”	Cla-Val	80
21	South of Main St. and west of Freeway	3,519	4	4	2”	Cla-Val	Bypass
					6”	Cla-Val	Bypass
22	On Muscatel east of Well	3,256	Well #25(2)	2	2”	Cla-Val	40
					6”	Cla-Val	35

Table 2.5 Pressure-Regulating Stations Data Summary (Continued)
Water Master Plan Update
City of Hesperia

PRV No.	Location	Station Elevation (ft-msl)	Pressure Zone Upstream	Pressure Zone Downstream	Valve Size (in)	Valve Type	Pressure Setting (psi)
23	Hercules/Santa Fe (manhole)	3,156	2	2d	4” 8”	Cla-Val Cla-Val	50 45
24	On I north of Verde (manhole)	3,041	2d	1	4” 8”	Cla-Val Cla-Val	85 80
25	Eucalyptus St. and G Ave.	3,026	2d	1	8” 4”	Cla-Val Cla-Val	50 55
26	On I north of Live Oak	3,103	2	2d	4” 8”	Cla-Val Cla-Val	75 70
27	Northeast corner of Live Oak/I	3,101	2	1	2”	Cla-Val	70
28	Northwest corner of Mango/Smoke Tree	3,117	2	1	4”	Cla-Val	60
29	Northeast corner I/Walnut (200 ft. east on Walnut)	3,148	2	2c	2” 6”	Cla-Val Cla-Val	65 60
30	On I south of Aspen	3,189	2	2c	6” 8”	Cla-Val Cla-Val	45 35
31	On Buckthorn south of Orange	3,082	2b	1	4” 6”	Cla-Val Cla-Val	45 40
32	On Bangor northeast corner at Hinton	3,081	2	2b	4” 6”	Cla-Val Cla-Val	75 70
33	Northeast corner of Danbury/Peach	3,091	2	2a	2”	Cla-Val	70
34	Northeast corner of Danbury/Lake Arrowhead	2,980	2a	1	3” 6”	Cla-Val Cla-Val	Not in Service
35	On Ranchero south of Peach	3,152	2	2a	4”	Cla-Val	65
36	Northwest corner of Ranchero/ El Cerrito	3,184	2	2a	4” 8”	Cla-Val Cla-Val	40 35
37	Southeast corner of Danbury/ Ranchero	3,283	3a	2	4”	Cla-Val	60

Table 2.5 Pressure-Regulating Stations Data Summary (Continued)
Water Master Plan Update
City of Hesperia

PRV No.	Location	Station Elevation (ft-msl)	Pressure Zone Upstream	Pressure Zone Downstream	Valve Size (in)	Valve Type	Pressure Setting (psi)
38	Joshua St. and E Avenue	3,240	3a	2	6”	Cla-Val	40
39	Santa Fe/Halinor (near Airport)	3.390	3	3a	6”	Cla-Val	60
40	Plant #15 north of Palm	3,329	3	3	4”	Cla-Val	80
41	Hesperia Rd./ Mojave	3,154	2	2d	4” 6”	Cla-Val Cla-Val	50 45
42	East of Peach Ave. and west of Lawn St.	3,085	2	1	2”	Cla-Val	35
43	North of Willow/ E Avenue	3,134	2	2d	12”	Cla-Val	45
54	Mesquite and Aqueduct	3,476	4	3	4” 6”	Cla-Val Cla-Val	50 45

Notes:
(1) Freeway Corridor is a region that lies along Interstate 15 freeway that was annexed to the City and was originally served by San Bernardino County Service Area 70-Improvement Zone J. This Master Plan does not identify Freeway Corridor as an existing zone, but as a future zone as it will be integrated into the City’s system.
(2) PRV is located directly off the discharge line of the well.

2.9 EMERGENCY INTERCONNECTIONS

Water distribution systems are often connected to neighboring water systems to allow the sharing of supplies during short-term emergencies or during planned shutdowns of a primary supply source.

Currently, the City has emergency interconnections with the County of San Bernardino Special District (Freeway Corridor) and is working on creating additional interconnections with Baldy Mesa Water District (BMWD) and Victor Valley Water District (VVWD).

2.10 TRANSMISSION AND DISTRIBUTION PIPELINES

The City’s service area includes approximately 550 miles of pipelines ranging in size from 2 to 24 inches in diameter. The majority of the City’s transmission and distribution mains generally consist of 4- to 12-inch diameter pipelines. Pipelines 16 inches in diameter and larger are considered transmission mains, while all smaller pipes are considered distribution mains. The majority of the pipelines, about 70 percent, are made of polyvinyl chloride (PVC) or steel. Other pipe materials include asbestos cement (27 percent), cement mortar lined (2 percent), and ductile iron (3 percent). Table 2.6 lists the estimated footage of each material by diameter.

Table 2.6 Length of Pipelines by Material Type and Diameter
Water Master Plan Update
City of Hesperia

Pipe Diameter (in)	Length of Pipe (ft) by Pipe Material						Total Length (ft)
	UNK	ACP	CML	DIP	PVC	STL	
4	13,554	29,345	151	690	38,040	596,034	677,814
6	3,959	53,126	377	6,235	50,866	138,624	253,187
8	50,614	357,378	13,425	23,293	636,785	70,855	1,152,350
10	131	4,573			979	873	6,557
12	60,447	237,483	4,901	42,724	303,569	27,542	676,666
14		283					283
16	5,642	15,144	2,964	781	15,715	7,981	48,227
18	8,567	41,251	15,051	7,164	22,189	1,264	95,486
20			3,414				3,414
24	347	728	5,324	2,692	5,499		14,589
Totals (ft)	**143,260**	**739,311**	**45,607**	**83,578**	**1,073,314**	**843,173**	**2,928,063**

Notes:
UNK: Unknown
ACP: Asbestos Cement Pipe
CML: Cement Mortar Lined
DIP: Ductile Iron Pipe
PVC: Polyvinyl Chloride
STL: Steel Pipe

WATER DEMANDS

3.1 GENERAL

Water demands (or water use) represent water that leaves the distribution system through metered or unmetered connections, or at pipe joints (leaks) or breaks. These demands include metered water use and unaccounted-for-water or water that leaves the system without being metered. Water demands occur throughout the distribution system based on the number and type of consumers in each location. Water demands vary throughout the day, resulting in a diurnal demand pattern that typically includes one peak in the morning and a second in the evening. Demands also vary seasonally, with the peak demands typically occurring during summer months.

To accurately analyze the City of Hesperia's (City) water system, a practical method of allocating the water demands within the distribution system is essential. One commonly used method of grouping water users is based on their land use (or zoning). Land use can be a very good measure of water use. In addition, land use information is readily available and can be applied to existing areas as well as future development projects. Using this method, the water demands were calculated using the acreage of a specified area (called a planning area) and a water demand factor, which represents a measure of water use per acre, based on the land use or density of the area. The resulting calculated demands represent average day demands (ADD). Water system demands for other demand periods, such as maximum day demand (MDD) and peak hour demand (PHD), were also developed and calibrated.

3.2 CHAPTER OBJECTIVES

This chapter discusses various aspects of the water system demands for the City to:

- Document historical water use/existing water demands.
- Identify unaccounted-for water.
- Locate undeveloped (vacant) and underdeveloped areas.
- Determine water demands for the existing system.
- Identify proposed development projects (where unknown).
- Calculate peaking factors for various demand periods.
- Establish fire flow requirements for the water system.
- Estimate future water demands.

3.3 HISTORICAL WATER USE

3.3.1 Historical Metered Water Consumption

The City's metered water consumption for the last seven years is summarized in Table 3.1. This data represents the amount of water sold to all of the City's customers and does not include unaccounted-for water use.

Table 3.1 Historical Metered Water Consumption
Water Master Plan Update
City of Hesperia

Year	Annual Metered Water Use(1) (ac-ft/yr)
1999	13,937
2000	14,526
2001	14,441
2002	15,399
2003	15,160
2004	16,135
2005	15,849

Notes:
(1) Excludes unaccounted-for water.
Source: Department of Water Resources, Public Water System Statistics, metered water deliveries, as submitted by City of Hesperia.

3.3.2 Unaccounted-for Water Use

The portion of the water system demands that cannot be measured or accounted for directly is known as unaccounted-for water usage. Unaccounted-for water usage is always present in water systems. Unaccounted-for water can be attributed to many factors. Some of the most common factors include leaks in pipelines, main breaks, fire hydrant testing, flushing, storage tank drainage and maintenance, inaccurate meters, and unmetered services. The sources of the unaccounted-for water are difficult, if not impossible, to pinpoint. Therefore, for master planning purposes, it is assumed that the amount of unaccounted-for water is distributed equally throughout the water distribution system. The water system analysis must include the unaccounted-for water usage so that the total water production will balance with the total water demand. One way to estimate the amount of unaccounted-for water usage is to subtract the known water demands (consumption records) from the water production totals. According to AWWA, well-operated water systems should have less than 10-percent unaccounted-for water.

The City's unaccounted-for water use was determined for the last seven years. Table 3.2 presents the annual unaccounted-for water for the years 1999 through 2005. The average unaccounted-for water use for this period is about 3 percent. Since the historical average is less than 10 percent, the system was considered acceptable.

Table 3.2	Unaccounted-for Water Use Water Master Plan Update City of Hesperia		
Year	**Annual Metered Water Use[1] (ac-ft/yr)**	**Annual Water Production[2] (ac-ft/yr)**	**Unaccounted-For Water Use (%)**
1999	13,937	14,922	7%
2000	14,526	15,163	4%
2001	14,441	14,553	1%
2002	15,399	15,294	<1%
2003	15,160	14,804	<1%
2004	16,135	16,634	3%
2005	15,849	15,779	<1%
Average	**15,064**	**15,307**	**2%**

Notes:
(1) Data source: Table 3.1.
(2) Data source: Table 4.1.

3.3.3 Total Historical Water Demands

Table 3.3 presents the annual total water demands (including unaccounted-for water) for the last 7 years. Table 3.3 also lists the number of service connections per year and calculates the average water use per connection. As shown in this table, the average water demand for the last seven years has been about 15,307 ac-ft/yr (13.7 mgd). For this same period, the average use per connection has been about 677 gpd per connection. From Table 3.3, the water use per connection can vary by about 8 percent higher or lower than the average.

Table 3.3	Historical Water Demands per Connection Water Master Plan Update City of Hesperia		
Year	**Service Connections[1] (#)**	**Demand per Connection (gpd/connection)**	**Historical Water Demands[2] (ac-ft/yr)**
1999	19,510	683	14,922
2000	18,837	733	15,163
2001	19,305	675	14,553
2002	20,018	682	15,294
2003	20,644	633	14,804
2004	22,414	663	16,634
2005	23,363	603	15,779
Average	**20,121**	**667**	**15,307**

Notes:
(1) Source: Department of Water Resources, Public Water System Statistics as submitted by City of Hesperia. Values include unaccounted-for water.
(2) Data source: Table 4.1. Includes unaccounted-for water use.

3.4 LAND USE AND POPULATION

Land use can be used to identify the quantity of water use for a given area, as well as requirements for fire flows, throughout the service area. Historical water demands can be calibrated to existing land use, if undeveloped (vacant) and underdeveloped areas are accounted for. Land use based water demand calculations allow the calculation of estimated water demands for existing as well as future planning years. In other words, the future development of existing undeveloped land can be used to project future increases in water demands.

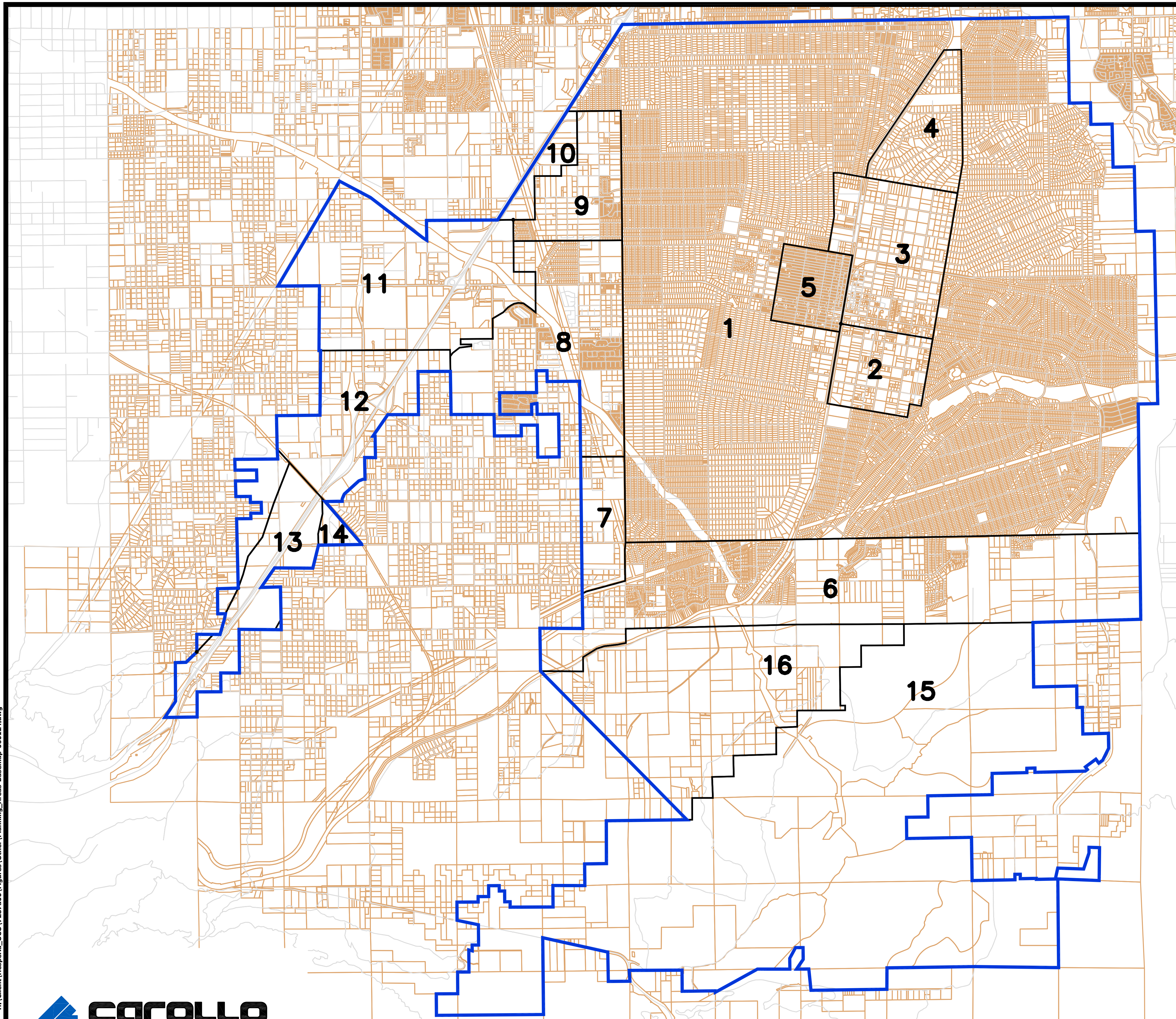
3.4.1 Planning Areas

To simplify the process of estimating the existing and future land uses within the City's service area, the 16 planning areas identified by the City's planning department were used. The areas are numbered PA-1 through PA-16. The boundaries of these planning areas are shown in Figure 3.1. Table 3.4 provides a brief description of the 16 planning areas.

Table 3.4 Planning Areas
Water Master Plan Update
City of Hesperia

Planning Area	Description	Area (acres)
PA-1	Main City Area	19,593
PA-2	Main Street Corridor - Neighborhood District	638
PA-3	Main Street Corridor - Industrial District	1,375
PA-4	Industrial District	728
PA-5	Main Street Corridor - City Center District	466
PA-6	Southern District	4,212
PA-7	Western District - Residential	490
PA-8	Southwestern District - Residential	2,197
PA-9	Freeway Corridor - North District - Residential	787
PA-10	Freeway Corridor - North District	244
PA-11	Freeway Corridor - Main Street District	2,397
PA-12	Freeway Corridor - HWY 395	1,169
PA-13	Freeway Corridor - South District - Commercial	937
PA-14	Freeway Corridor - South District - Residential	392
PA-15	Rancho Las Flores (RLF) and Summit Valley Ranch (SVR)	10,868
PA-16(1)	North Summit Valley (NSV)	3,052
	Total (all 16 planning areas)	**49,547(2)**
	Total without NSV (existing service area)	**46,496(2)**

Notes:
(1) PA-16 is outside the City limits and not within the City's service area.
(2) Totals may not agree with the sum of the planning areas due to rounding.



Legend

Study Area Boundary

1 Planning Area

0 6000' 12000'

Figure 3.1

Planning Areas

Water Master Plan Update

City of Hesperia

carollo engineers

3.4.2 Land Use

A spreadsheet was developed to tabulate the area, percent developed, density, and land-use type for each planning area. The City's planning department provided estimates of percent developed, density, and land use type for each planning year in this study. The detailed calculations are provided in Appendix B. The resulting land use is summarized by planning year in Table 3.5. Note that this table does not include the North Summit Valley development project (NSV) (PA-16) and that the total service area does not change through the year 2030. Since PA-16 is not currently a part of the City's service area and planning for the NSV project was considered conceptual at best, this area was not included in this master plan.

Table 3.5 Projected Land Use by Planning Year
Water Master Plan Update
City of Hesperia

Land Use Type	Area by Planning Year (acres)[1]					
	2007	**2012**	**2017**	**2022**	**2027**	**2032**
Low-Density Res	13,061	19,811	24,858	28,969	30,148	31,755
High-Density Res	628	1,010	1,318	1,568	1,759	1,848
Commercial	797	1,443	2,312	2,909	3,292	3,424
Industrial	364	715	1,071	1,378	1,621	1,751
OS/Vacant	31,645	23,517	16,936	11,671	9,676	7,718
Total Area[2]	**46,496**	**46,496**	**46,496**	**46,496**	**46,496**	**46,496**

Notes:
(1) Excludes NSV (PA-16). Detailed calculations are provided in Appendix B.
(2) Totals may not agree with sum due to rounding.

It should be noted that the open space/vacant areas decrease at a rate equal to the rate of increase of the other land-use types. This indicates that the total area is not changing, but instead, the vacant lands are becoming developed. Knowing this rate of increase allows the increased water demands to be calculated as well.

3.4.3 Population Projections

The water system's service area generally coincides with the City boundary. Therefore, projected population studies for the City were used to estimate population within the service area. Population studies were obtained from the Southern California Association of Governments (SCAG) for the City. These studies were based on pre-2003 population trends, which do not reflect the explosive growth rates seen in more recent years. Therefore, population estimates were calculated based on estimated development projections provided by the City's planning department (See Appendix B). This methodology was thought to be more accurate than the SCAG projections. A more conservative method allows for the planning of new facilities to be in place before future development is complete. Table 3.6 compares the population projections developed for this master plan to the population projections obtained from SCAG.

Table 3.6 Current and Projected Study Area Population
Water Master Plan Update
City of Hesperia

	2007	2012	2017	2022	2027	2032
SCAG Estimates[1]	82,000	95,800	117,568	139,049	159,638	179,383
City of Hesperia Estimates[2]	82,556	116,534	136,118	153,773	167,039	179,383
City vs. SCAG (% difference)	0.7%	21.5%	15.8%	10.6%	4.6%	-2.3%
Annual Increase over 5-Year Period (%/year)		7.1%	3.2%	2.5%	1.7%	1.4%

Notes:
(1) Population Projections Source: SCAG.
(2) Population Projections Source: See Appendix B. Excludes RLF, SVR, and NSV.

3.5 WATER DEMANDS

Water demands are not constant within the service area, and therefore cannot simply be evenly distributed to all areas of the service area. To obtain an accurate representation of the water demands placed on the system, geographical allocation of the appropriate water demands must be considered. Actual demands vary from user to user depending on many factors, but land use is one of the primary determining factors for estimating water demands. Using land use to estimate water demands is common in master planning because the information is readily available, is relatively accurate, and can be used for existing areas as well as future developments. Therefore, distributing water demands throughout the water system based on land use can be an accurate method of demand distribution.

3.5.1 Water Demand Factors

Water demand factors were developed to provide a means to estimate water demands from a given amount and type of land use. For residential land uses, the water demands were based on the estimated occupancy of the dwellings. For low-density residential dwelling units, an occupancy rate of 3.3 people per dwelling unit was assumed. An occupancy rate of 2.7 people per dwelling unit was assumed for high-density residential dwelling units. The water demand factor for all residential developments was assumed to be 160 gpcd. Commercial development was assigned a water demand factor of 2,000 gpd/ac, and industrial development was assigned a water demand factor of 3,000 gpd/ac.

3.5.2 Peaking Factors

To determine the water demands for conditions other than an average day's water use, peaking factors were developed. Peaking factors account for fluctuations in demands on a daily or hourly basis. For example, during hot summer days, water use is typically higher than on a cold winter day. Common peaking factors include factors for MDD and PHD periods. Peaking factors are determined using the water system demands for a selected period and dividing the quantity by the ADDs. The MDD factor, for example, is determined by comparing the water demands for the day of the year with the highest daily water demand to the ADDs.

Variations in water demand also occur during a 24-hour period. In residential areas, there are often two peak use periods, in the morning and again in the late afternoon. Areas that have automatic sprinkler systems for irrigation may also see peak periods late at night through the early morning hours. System-wide peaking factors can be difficult to determine. An hourly water use curve, known as the system diurnal curve, is often developed for water systems to help identify how demands change throughout the day. This curve can be used to develop hourly factors used by the computer model. The following is a discussion of the peaking factors developed for this study.

3.5.2.1 Average Day Demand

The ADD is calculated by dividing the total annual water demand (including unaccounted-for water) by the number of days in that year. To account for years with extremely high or low usage, several years (such as 3, 5, or 10 years) can be averaged. Unfortunately, the City's rapid growth rate will likely result in higher ADDs than would be derived from averaging usage over the past seven years. Therefore, the ADDs were calculated based on the average usage per service connection (667 gpd/connection from Table 3.3) and the current number of service connections (23,363 connections from Table 3.3). The resulting ADD was estimated at about 15.0 mgd (10,417 gpm).

3.5.2.2 Maximum Day Peaking Factor

Typically, historical water production records over several years are used to establish the MDD/ADD peaking factor. However, in discussions with the City, it was determined that data from 2005 would yield a more conservative and accurate MDD. Therefore, all modeling was done based on year 2005 data. The City provided daily water production records that identified the day with the maximum production for the year 2005. This daily production rate was compared to the average production rate for the same year to obtain a ratio that represents the MDD/ADD peaking factor. The City's 2005 MDD occurred on July 29, 2005. The total production for this date was 26.1 mgd (18,122 gpm). Based on the ADD in 2005 of 15.0 mgd, the MDD/ADD peaking factor used in this Master Plan is 1.74.

3.5.2.3 Peak Hour Peaking Factor

The PHDs represents the highest water demands on the maximum demand day. The PHD represents the highest 1-hour demand period that the system would experience. The Peak Hour peaking factor developed for the City's water system was based on the highest hourly production data and hourly reservoir levels that occurred during the maximum demand week of July 24, 2005 through July 30, 2005. This includes the MDD for the year. The data for this week was provided from the City's Supervisory Control and Data Acquisition (SCADA) system. The peak hour occurred on July 25, 2005, between 9:00 p.m. and 10:00 p.m. The flow rate during this hour was about 30,276 gpm. Based on the ADD of 10,417 gpm for 2005, the resulting peaking factor for PHDs is 2.90 times ADD.

3.5.2.4 Diurnal Demand Pattern

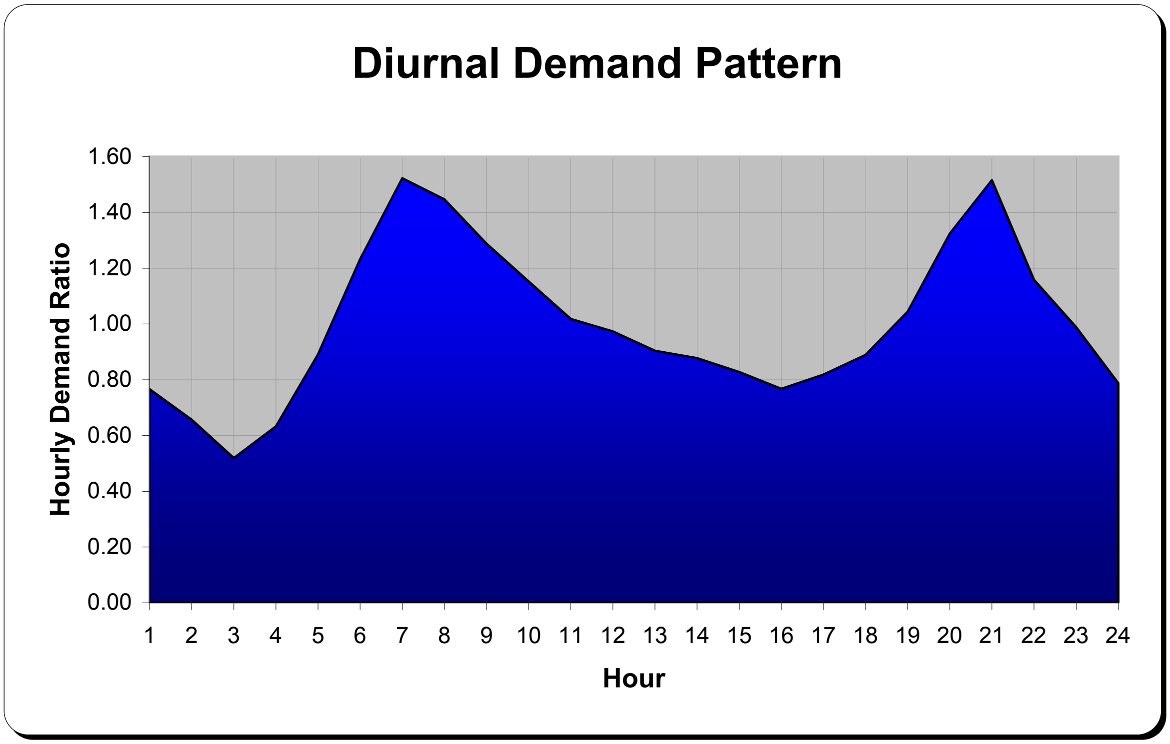
The hourly production records and reservoir levels for the maximum week of 2005 were used to establish a maximum day diurnal demand pattern for the City's water system. Using the SCADA data obtained for the maximum demand week of July 24, 2005 through July 30, 2005, the average demand for each hour for the week was determined. The demand pattern was established by comparing this average demand over each hour to the average hourly demand for the week. Figure 3.2 presents the resulting hourly demand factors and illustrates the diurnal demand pattern for the maximum week.

3.5.3 Existing System Demands

Table 3.7 summarizes the existing water system demands for the three demand periods: ADDs, MDDs, and PHDs. The ADDs are based on the average water demand per connection and the number of connections at the end of 2005. MDDs and PHDs were established using hourly production and reservoir levels provided from the City's SCADA system.

Table 3.7 Existing System Demands
Water Master Plan Update
City of Hesperia

		Existing System Demand	
Simulation Period	**Peaking Factor**	**(gpm)**	**(mgd)**
Average Day Demands	1.00	10,417	15.0
Maximum Day Demands	1.74	18,122	26.1
Peak Hour Demands	2.90	30,276	n/a



7-Day Average Hourly Demand Pattern

Time	Demand Ratio	Time	Demand Ratio
12:00 a.m. - 1:00 a.m.	0.77	12:00 p.m. - 1:00 p.m.	0.90
1:00 a.m. - 2:00 a.m.	0.66	1:00 p.m. - 2:00 p.m.	0.88
2:00 a.m. - 3:00 a.m.	0.52	2:00 p.m. - 3:00 p.m.	0.83
3:00 a.m. - 4:00 a.m.	0.63	3:00 p.m. - 4:00 p.m.	0.77
4:00 a.m. - 5:00 a.m.	0.89	4:00 p.m. - 5:00 p.m.	0.82
5:00 a.m. - 6:00 a.m.	1.23	5:00 p.m. - 6:00 p.m.	0.89
6:00 a.m. - 7:00 a.m.	1.52	6:00 p.m. - 7:00 p.m.	1.04
7:00 a.m. - 8:00 a.m.	1.45	7:00 p.m. - 8:00 p.m.	1.32
8:00 a.m. - 9:00 a.m.	1.29	8:00 p.m. - 9:00 p.m.	1.52
9:00 a.m. - 10:00 a.m.	1.15	9:00 p.m. - 10:00 p.m.	1.16
10:00 a.m. - 11:00 a.m.	1.02	10:00 p.m. - 11:00 p.m.	0.99
11:00 a.m. - 12:00 p.m.	0.97	11:00 p.m. - 12:00 a.m.	0.79

H:\Client\Hesperia_OCO\7287a00\Excel\[DiurnalCurve15.xls]Figure3.2

Figure 3.2
Diurnal Demand Pattern
Water Master Plan Update
City of Hesperia

carollo engineers

3.5.4 Fire Flow Demands

In addition to providing adequate water supply and pressure to serve residential, commercial, and industrial water demands placed on the system, the water system should also deliver an adequate supply for fire fighting. Since fires can occur at any time, the water system should be ready at all times to provide the required flow with an adequate residual pressure. The water system should be capable of providing the fire flow during MDD conditions.

To determine the capacity of the system to provide adequate fire flows, it was necessary to establish minimum demand requirements to be applied to various locations throughout the distribution system, as well as a minimum residual and system pressure. In master planning, the fire flow demands are usually based on the type of land use in the area of the fire flow. For example, a residential area may require a minimum fire flow of 1,500 gpm, while an industrial area may require 4,000 gpm.

The San Bernardino County Fire Department (SBCFD) is the agency responsible for establishing fire flow requirements for the City's service area. SBCFD was contacted to obtain their current fire flow regulations and criteria. Table 3.8 summarizes the fire flow requirements used in this Master Plan.

Table 3.8 Fire Flow Requirements
Water Master Plan Update
City of Hesperia

Land Use	Minimum Flow Required (gpm)	Minimum Residual Pressure (psi)	Minimum Duration (hrs)	Required Fire Storage Volume (MG)
Single-Family Residential	1,500	20	2	0.18
Multi-Family Residential	2,500	20	2	0.3
Public Facility	3,500	20	3	0.63
Commercial	3,500	20	3	0.63
Industrial	4,000	20	4	0.96
Hospital	4,000	20	4	0.96

3.5.5 Projected Water Demands

Water demands were estimated for future planning years using the planning areas identified in Figure 3.1, the general plan land use from Table 3.5, and the peaking factors from Table 3.7. The resulting water demand projections are shown in Table 3.9.

Table 3.9 Projected Water Demands
Water Master Plan Update
City of Hesperia

Planning Period	Estimated ADD (gpm)	Estimated ADD (mgd)	Estimated MDD (gpm)	Estimated MDD (mgd)	Estimated PHD (gpm)
2007	10,417	15.0	18,122	26.1	30,276
2012	18,700	26.9	32,538	46.9	54,230
2017	25,741	37.1	44,789	64.5	74,649
2022	31,427	45.3	54,683	78.7	91,138
2027	34,390	49.5	59,839	86.2	99,731
2032	36,078	52.0	62,776	90.4	104,626

Notes:
(1) Peaking factor MDD/ADD is 1.74.
(2) Peaking factor PHD/ADD is 2.90.
(3) See Appendix B for detailed calculations.
(4) Numbers may vary slightly from Appendix B based on conversion factor used.

WATER SUPPLY

4.1 GENERAL

The goal of the City of Hesperia (City) is to evaluate what improvements are needed or will be needed to provide a safe and reliable water supply to meet existing and future needs. The City's supplies must meet current water quality regulations and address pending water quality regulations to assure its availability in the future.

Currently, the City relies entirely on groundwater as its source of water. The City has 13 active wells that pump groundwater from the basin that underlies the City, directly into the distribution system. The City is planning to add recycled water as another source of water for irrigation, commercial use, and other non-potable demands. The amount of recycled water produced will offset an equivalent amount of potable water. Therefore, the potable water system will benefit directly from the use of recycled water. The projected recycled water demands and the proposed recycled water system are discussed in detail in the City's Recycled Water Master Plan (RWMP).

4.2 CHAPTER OBJECTIVES

This chapter discusses the following aspects of the City's water supplies:

- Document production rates over the past 5 years.
- Discuss impacts on the City's groundwater supplies.
- Evaluate the benefits from the use of recycled water supplies.
- Identify future water supply needs.

4.3 HISTORICAL WATER PRODUCTION

Over the last 5 years, the City has produced an average of 15,833 ac-ft/yr of potable water. Table 4.1 summarizes the total historical water production for each of the City's groundwater wells over the last 5 years.

Because water demands increase significantly during the hotter summer months, the City must produce more water during this period to meet the increase in demands. Table 4.2 summarizes the monthly production from the City's groundwater wells for the years 2000 through 2005.

Table 4.1 Historical Water Production by Well
Water Master Plan Update
City of Hesperia

Year(1)	Historical Water Supply by Well (ac-ft/yr)															Total Water Produced (ac-ft/yr)
	3A	4A	5A	14A	14B	15A	17	18	19A	20	21	22	24	25	26	
2000	2,558	0	2,253	1,444	0	1,251	1,042	1,757	0	801	938	2,113	0	499	505	15,163
2001	1,456	0	1,933	1,612	0	1,406	1,173	1,803	0	760	805	2,080	0	585	941	14,553
2002	2,220	0	2,762	1,519	0	1,428	875	1,740	0	3	779	2,097	0	1,076	794	15,294
2003	1,679	0	2,343	1,660	0	1,561	507	1,894	0	0	1,047	2,419	0	1,060	635	14,804
2004	1,836	0	2,427	2,422	421	1,558	1,353	1,886	0	0	702	1,909	0	1,078	1,042	16,634
2005	1,420	0	1,848	2,177	976	1,667	1,296	690	0	0	864	1,675	1,325	1,054	789	15,779
Average	**1,862**	**0**	**2,261**	**1,806**	**698**	**1,478**	**1,041**	**1,629**	**0**	**261**	**856**	**2,049**	**221**	**1,031**	**784**	**15,371**

Notes:
(1) Data source: City of Hesperia, Monthly Well Production Data provided by City staff. Includes unaccounted-for water use.

Table 4.2 Historical Monthly Water Production
Water Master Plan Update
City of Hesperia

Month	Historic Groundwater Production Per Year (ac-ft/yr) 2000	2001	2002	2003	2004	2005	Percent of Production (%)
January	771	665	733	787	801	698	5.7%
February	673	524	809	624	671	629	5.7%
March	836	777	993	781	1,039	821	5.7%
April	1,151	989	1,246	945	1,211	1,223	7.1%
May	1,538	1,553	1,499	1,384	1,591	1,587	9.7%
June	1,754	1,763	1,726	1,719	1,953	1,804	11.4%
July	1,924	1,871	1,981	1,947	2,248	2,135	12.7%
August	1,882	1,907	1,872	1,864	2,220	2,023	12.4%
September	1,552	1,585	1,657	1,645	1,923	1,653	10.7%
October	1,277	1,328	1,060	1,476	992	1,287	8.3%
November	930	883	962	845	992	1,043	5.7%
December	875	707	755	786	992	876	5.0%
Total	**15,163**	**14,553**	**15,294**	**14,804**	**16,634**	**15,779**	**100.0%**

4.4 EXISTING WATER SUPPLY SOURCES

4.4.1 Groundwater

The City currently pumps 100 percent of its total annual water supply from groundwater. The City’s 13 active wells are used to pump groundwater from the Alto Subarea sub-basin, which is a sub-basin of the Mojave River Groundwater Basin (Basin). The Basin is recharged by rainfall and snowmelt from the local mountains as well as imported water. The Mojave Water Agency (MWA) Board of Directors serves as the entity responsible for managing the use, replenishment, and protection of the groundwater basin. Because the water quality of the groundwater meets state and federal standards, the wells pump directly into the City’s distribution system or into nearby holding tanks after disinfection.

The Basin has been in overdraft for several years with individual subareas experiencing varying degrees of overdraft. In 1994, the MWA adopted a Regional Water Management Plan for the area within its boundaries. This plan was updated in two phases, with a draft report for Phase I completed in April 2002. The plan establishes the framework for managing future water supply within MWA’s boundaries.

Recently, water rights within the Mojave River Basin have been the subject of litigation. The Riverside County Superior Court’s stipulated judgment for the adjudication of the Mojave River Groundwater Basin identified the MWA as the California State Water Project (SWP) water contractor, having both the authority and obligation to secure supplemental water as part of the physical solution to the existing and projected future overdraft within the Mojave River Basin.

To maintain proper water balances within each subarea, the judgment established a decreasing Free Production Allowance (FPA) in each subarea during the first 5 years and provides for the Court to review and adjust, as appropriate, the FPA for each subarea annually thereafter. Any producer who produces, in any year, an amount of water in excess of that producer's share of the FPA for a subarea must pay the Watermaster a Replacement Water Assessment or lease carryover water rights from another party to satisfy the obligation. The Replacement Water Assessment for a producer is equal to the number of ac-ft of excess production by that producer multiplied by the Replacement Water Assessment rate per acre-foot as adopted annually by the Watermaster. MWA currently serves as the Watermaster for the judgment.

4.4.2 Imported Water Supplies

In the Mojave Desert region, the MWA is the SWP water contractor responsible for managing the area's water resources. As one of 29 state water contractors with access to the SWP, the MWA has an annual entitlement of 75,800 ac-ft to supplement the water sources for the member agencies of the MWA. To help reduce overdrafts, the MWA has made releases of this imported water into the Basin as recharge. Releases from the Rock Springs Outlet directly recharge the Alto Subarea.

The main transport structure of the SWP is the California Aqueduct, which conveys surface water from Northern California to Southern California. This facility is managed by the Department of Water Resources (DWR). The aqueduct is a concrete-lined channel that is about 450 miles in length.

4.4.3 Emergency Interconnections

Currently, the City has emergency interconnections with the County of San Bernardino Special District (Freeway Corridor) and is in the process of establishing additional connections with Baldy Mesa Water District (BMWD) and Victor Valley Water District (VVWD).

4.5 FUTURE WATER SUPPLY SOURCES

An important element of this Water Master Plan Update is to plan adequate water supplies to accommodate the increasing water demands through the planning periods 2012, 2017, 2022, 2027, and 2032. Possible future sources of water supply include additional groundwater production, imported water from SWP, recycled water, and conservation. The following subsections describe additional actions that the City has taken toward investigating additional sources of supply, as well as regional issues that may affect future water supplies for the City.

4.5.1 Water Conservation

Voluntary or enforced water conservation measures will contribute to a decrease in existing water consumption. The City has implemented several water conservation programs to reduce the overall system demands and the need to increase water supply. In general, the City's customers have been responsive to requests to conserve water during periods of drought. The water conservation programs are described in more detail in Chapter 7 of this Master Plan.

4.5.2 Groundwater

The amount of groundwater that the City can extract continues to be monitored by the MWA. Any amount over the extraction rate imposed by MWA will cost the City to recharge the groundwater basin. The City currently has a groundwater level monitoring program to assess the impacts from declining groundwater levels on energy cost and production rate.

The City's primary wells are generally located near the Mojave River. These wells pump into the lower pressure zones. Booster pumps are available to pump this groundwater from the lower zones into the higher zones. Although this method requires more energy for pumping compared to drilling a well in the proximity of a higher pressure zone, it allows the City to place wells in better groundwater producing regions to achieve higher production rates. Based on the United States Geologic Survey (USGS) groundwater pumping and water level monitoring data and the City's own experience, wells located closer to the Mojave River provide the best production rates.

As described under the evaluation criteria in Chapter 1, the City's supply facilities must be capable of producing maximum day demands (MDD) for the entire water system if the largest supply source is out of service in Zones 1 and 2. The production capacity without the largest supply source is commonly referred to as the firm supply capacity. To establish the City's firm supply capacity, the largest producing wells in Zone 1 (Well 5) and Zone 2 (Well 24) were removed from the total available supply. The City's supply wells and their available capacities are summarized in Table 4.3. As shown, the combined capacity available to the City is 23,139 gpm. Excluding Well No. 5 establishes the City's existing firm supply capacity as 18,529 gpm.

Table 4.3 Water Supply Source Production Capacity
Water Master Plan Update
City of Hesperia

Supply Source	Zone	Normal Capacity (gpm)
Well 3A	1	2,336
Well 4A	1	2,250
Well 5A	1	2,610[(1)]
Well 14A	1	2,398

Table 4.3 Water Supply Source Production Capacity (Continued)
Water Master Plan Update
City of Hesperia

Supply Source	Zone	Normal Capacity (gpm)
Well 14B[2]	1	2,000 (inactive)
Well 15A	2	1,410
Well 17	2	1,235
Well 18	1	1,377
Well 19A	3	928
Well 20	2	1,800
Well 21	2	809
Well 22	2	1,891
Well 24	2	2,000[1]
Well 25	2	888
Well 26	1	1,207
Maximum Instantaneous Capacity		**23,139**
Existing Total Firm Capacity		**18,529[4]**
Well 29[3]	1	2,500
Well 31[3]	3	1,400
Well 32[3]	3	2,000
Total Firm Capacity (by 2012)		**24,429[4]**

Notes:
(1) Largest wells in Zone 1 and 2 were excluded when calculating the City's firm well capacity.
(2) Well is not in operation when Well 14A is activated. Source: Table 2.2. Capacity is excluded from total.
(3) Planned well is to be on line by 2008.
(4) Total Firm Capacity assumes that the largest supply source is unavailable.

The City has plans to install three new wells (Wells 29, 31, and 32) by 2012. This will increase the City's firm well capacity to 24,429 gpm. During the past 10 years, the City has investigated numerous options to increase the supply of groundwater available for the City's system. Today, the City continues to investigate developing additional water wells in the proximity of the Mojave River to enhance the reliability of its water supplies.

4.5.3 Imported Water

The City does not currently use imported water. However, access to untreated imported SWP water is readily available because the California Aqueduct traverses the City's service area. The City has considered using this resource in two different ways: direct use and recharge.

Direct use of SWP would require treatment before the water could be used for potable purposes. The cost of treatment would significantly increase the cost of this resource and could make this alternative cost prohibitive.

The second alternative would use SWP to recharge the groundwater basin. This water would then eventually be pumped for use by the City's wells. In this alternative, the natural filtering processes of the soils are use to make the water suitable for use. The cost of this alternative may be competitive with the cost to have MWA replenish the basin, but the City could choose to recharge where it provides the most benefit to the City. It is recommended that the City further evaluate the feasibility of using SWP for either direct use or groundwater recharge. This source may be required in the future to avoid overdraft of the Basin.

4.5.4 Recycled Water

Another source that can supplement groundwater wells could be recycled water. The City could either use tertiary treated wastewater from the Victor Valley Wastewater Reclamation Authority (VVWRA) or provide a local recycled water supply by constructing Water Reclamation Plants (WRPs) within the City. The sizing and locations of these WRPs are described in the wastewater master plan update, while the sizing of a recycled water system is described in detail in the RWMP.

Septic discharges, including those in the City, indirectly contribute to the water production capacity in the basin. However, a more efficient use of this wastewater would be to collect and treat it for reuse in agricultural and landscape irrigation.

The VVWRA is a Joint Powers Authority that provides treatment and distribution of reclaimed water for its member entities, which include Apple Valley, Hesperia, Victorville, Southern California Logistics Airport, Oro Grande, and Spring Valley Lake. Currently, VVWRA pumps 1.5 mgd of treated effluent to the Westwinds Golf Course for irrigation. The VVWRA, with input from the City, currently has plans to construct a 4.0-mgd subregional reclamation facility; construction is scheduled to begin in 2010 and completed by 2012. The reclaimed water produced by the facilities will be discharged into nearby percolation basins when irrigation and customer demand is low. A second 4.0-mgd facility is planned; construction is scheduled to begin in 2014 and completed by 2016.

Concurrent with this Water Master Plan Update, the City is also preparing a Recycled Water Master Plan to optimize the use of recycled water within the City limits and a

Wastewater Master Plan. Both plans identify three WRPs that are proposed to create a local recycled water supply source and replace the treatment of wastewater by the VVWRA. WRP-1 is proposed in the north-western part of the City, just north of Main Street and west of Interstate 15. WRP-2 is proposed near the intersection of Osbrink Drive and Santa Fe Avenue East. WRP-3 is proposed in the north-eastern part of the Rancho Las Flores Development (RLF). A separate WRP is planned to be constructed for the first phase of the RLF development. This plant, the RLF WRP No. 1, will treat the flows collected from the southern portion of this development and will be located just north of Highway 173, in the southern part of the development. These three plants will provide a local source of recycle water supply to the customers identified in the RWMP.

4.5.5 Planned Conservation Programs

The City is currently working to develop and implement additional water conservation measures that may help reduce future water demands. These programs are described in more detail in Chapter 7 of this Master Plan.

4.6 WATER SUPPLY RELIABILITY

The City's water supplies consist entirely of groundwater pumped from the local groundwater basin. Within the service area, certain pressure zones may be dependent on the operation of booster pumping stations to deliver water to a higher pressure zone. If one of these sources of supply were out of service for an extended duration while experiencing high demands, the City could rely on stored water in one or more of the City's existing reservoirs to help deal with the loss on a short-term basis, but additional supplies would be required for a longer term outage.

Because water levels in groundwater wells do not change significantly from month to month (water level drops approximately 2 feet/year), the primary concern regarding lost well production is the loss of the primary energy source, usually electricity. The operation of the City's groundwater wells and booster pumping stations is dependent on the availability of electricity to run the facilities. Therefore, backup or alternative energy sources (i.e., on-site or portable generators that run on propane, natural gas, or diesel), which are available at some of the City's facilities, help to improve the reliability of the groundwater wells and booster pumping stations. In addition, the City's multiple wells provide redundancy in the system, reducing the likelihood that all groundwater wells will be out of service simultaneously.

4.7 PROJECTED WATER SUPPLY REQUIREMENTS

The City's water supply requirements are based on the projected water demands from Table 3.11. The production capacity needed is based on supplying the MDD with the largest well out of service. The City's existing firm supply capacity is 18,529 gpm (from Table 4.3). When the City's maximum day production requirements exceed its firm supply capacity, then additional wells will be required. Table 4.4 presents the City's water supply requirements through the year 2032. It should be noted that six new wells would be required to meet the City's demands before the planning year 2012.

Table 4.4 Cumulative Number of New Wells
Water Master Plan Update
City of Hesperia

Planning Year	Annual Average Water Supply Needs[1] (gpm)	Maximum Day Production Requirements[1] (gpm)	Available Firm Supply Capacity[2] (gpm)	Additional Capacity Needed[3] (gpm)	Estimated Number of New Wells Needed[4][5]
2007	10,417	18,122	18,529	0	0
2012	18,700	32,538	24,429	8,109	6
2017	25,741	44,789	24,429	20,360	14
2022	31,427	54,683	24,429	30,254	20
2027	34,390	59,839	24,429	35,410	24
2032	36,078	62,776	24,429	38,347	26

Notes:
(1) Source: Table 3.9.
(2) Source: Table 4.3.
(3) Additional capacity needed is maximum day production requirement minus the available firm capacity.
(4) Well production capacity of the first 19 new wells are listed in Table 6.3.
(5) Assumes an average production capacity of 1,500 gpm for the remaining new wells.

HYDRAULIC COMPUTER MODEL DEVELOPMENT

5.1 GENERAL

A hydraulic computer model of the water distribution system is an important tool for any analysis of the water system and especially for a water master plan. The widespread use of personal computers and availability of modeling software has made network analysis modeling efficient and practical for any water system. Hydraulic modeling can be used to analyze existing water systems, future water systems, or even specific improvements to the existing water system. In master planning, the computer model assists in measuring system performance, in analyzing operational improvements, and in developing a systematic method of determining the size and timing required for new facilities. The hydraulic model allows numerous scenarios to be analyzed relatively quickly and easily and provides answers to many “what if” questions.

The Hydraulic Model is composed of three main parts:

1. The data file for geographic location of facilities.
2. The database that defines the physical system. This database is linked to the geographic data file.
3. A computer program “calculator” that solves a series of hydraulic equations to define the performance of the water system in terms of pressure and flow.

The geographic data file provides water system facility locations; it is typically represented as an AutoCAD or geographic information systems (GIS) file. Elements used in this file to model system facilities include pipes, nodes, control valves, pumps, tanks, and reservoirs.

The database includes water system facility information such as facility sizing and geometries, operational characteristics, and production/consumption data. Facility sizing and geometries include length and diameter of pipe, tank dimensions, valve sizing, and pumping curves. Operational characteristics include parameters that control how facilities move water through the system, such as pump control settings, control valve settings, or main line valve closures. Data for production and consumption determine where the water enters, exits, and fluctuates in the distribution system.

The computer program “calculator” analyzes the hydraulic information in the database file and generates results for pressures, flow rates, and operating statuses. The key to maximizing use of the hydraulic model is to correctly interpret results and understand how the water distribution system is being impacted. This understanding enables the engineer to be proactive in developing solutions to existing and future water system goals and objectives. With this approach, the hydraulic model is then used as a tool to identify the adequacy of system performance and manage proactive solutions to maintain system criteria.

5.2 CHAPTER OBJECTIVES

This chapter discusses the following elements involved in updating and developing the City of Hesperia's (City's) hydraulic computer model:

1. Hydraulic Model and Software Overview.
2. Pipeline Improvement Projects.
3. Service Node Development and Demand Distributions.
4. Demand Peaking and Diurnals.
5. Booster Pumping Stations.
6. Well Pumps.
7. Valves: Pressure Regulating and Normally Closed.
8. Database Management.

5.3 EXISTING COMPUTER MODEL

The City's original hydraulic computer model was created for the 2002 Water Master Plan, by So & Associates, Inc. The hydraulic modeling software selected for the 2002 Master Plan was H_2ONET® Analyzer (H_2ONET®). Creation of the model included an "all-pipe" network, excluding service and hydrant laterals. Simulations for the 2002 Plan were run as Steady State Snapshots of a single-demand condition.

Due to the City's rapid rate of growth and infrastructure improvements, the hydraulic computer model was updated in 2004 and is currently being updated for this Master Plan. All subsequent model simulations have been further developed for extended period simulation (EPS), which simulates varying water usage over a selected period. Well and booster pump controls were incorporated into the model to simulate supervisory control and data acquisition (SCADA) readings for calibration.

A general summary of the City's current hydraulic model of its existing water system includes the following (the future service area of County Service Area Zone-J was not included):

1. Pipeline Segments: 4,360.
2. Junctions Nodes: 3,101.
3. Reservoirs: Seven.
4. Booster Pumps: 40.
5. Pressure Regulating Valves (PRVs): 66.
6. Normally Closed Valves: 73.

The following sections of this chapter include detailed descriptions and the corresponding data for each model element.

5.4 SOFTWARE SELECTION

The City has worked with and has been satisfied with the H_2ONET® hydraulic modeling software. As a result, H_2ONET®, version 5.2, developed by MWHSoft, Inc., was selected as the network analysis software for use with the Master Plan. The program uses a proven hydraulic modeling engine and advanced features and capabilities to help manage the City's 4,360-pipe network model. This software runs inside of AutoCAD and uses all its functionality. Since the City works with AutoCAD on a daily basis for construction drawings, pipeline design, development tracts, and more, this platform remains a practical solution for City staff and meets the needs of this Master Plan.

Future platforms for hydraulic computer modeling may be reevaluated should the City implement an enterprise-wide database to supplement its existing AutoCAD platform with the ESRI platform of ArcGIS.

5.5 MODEL DEVELOPMENT

The development of the City's hydraulic computer modeled has been ongoing since its creation in 2002 and has primarily included pipeline upgrades to the system and a general rescaling of demand to reflect the current demand conditions of the time. As the City's hydraulic computer model operates inside of AutoCAD, this process has been relatively efficient in the sharing or referencing of similar file-types to denote system upgrades, facility configurations, and system connections.

5.5.1 Facilities

In H_2ONET®, facilities in the distribution system are either model as a node or a link. Pipe is the only element that is modeled as a link. Junction, pump, valve, tank, and reservoir are all modeled as individual nodes. A node contains geometry data that provides the coordinates (x,y,z) of the facility while a link contains geometry data that indicates the "To" and "From" nodes of the pipe.

This Master Plan incorporated the latest round of updating and brought model facilities, demands, peaking factors, controls, and calibrations up to date with the latest City data sources. Some of the data sources used in this update included improvement site-maps (provided by SouthWest Engineers), hourly production data, SCADA trending, pump tests, pumping groundwater level data, and SCADA controls. Highlights of the City's computer hydraulic model upgrade include:

1. Over 35 miles of pipeline replacement projects.
2. Newly added Reservoirs at Plants 22 and 30.

3. Newly added Wells at Plants 4A, 14B, and 24.
4. Upgraded Booster Pumps at Plant 22.
5. 2005 Update of System Demands and Demand Distribution.
6. 2005 Update of Peaking Factors.

The objective in updating model elements with recent information is to increase the level of confidence in the model results. This Master Plan will consider the model “calibrated” when the model results match field readings within a specified tolerance. Therefore, model calibration will produce a level of confidence in the subsequent recommendations made in this Master Plan.

The major water system facilities included in the computer model and their hydraulic relationship within the existing system are shown in Figure 2.1. This figure is a schematic layout of the zone connections, booster pump stations, wells, control valves, and reservoirs; pressure zone boundaries are also shown.

It should be noted that the City’s hydraulic model currently includes a portion of the County Service Area Zone-J. This area was recently annexed for City water service and has been redesignated as the Freeway Corridor. The City has requested that Freeway Corridor not be included in the “Existing” Hydraulic model calculations and calibrations and be rescheduled with a “near-term” designation for subsequent near-term analyses. As such, the Freeway Corridor has remained in the model, and removed from the active, existing model calibrations and identification of existing deficiencies. All facilities mentioned and described in this section refer to the portion for the hydraulic model, which was used to define “Existing” facilities, and therefore does not include Freeway Corridor facilities. The Freeway Corridor will be included in near-term model analyses and discussions to evaluate the most effective method of service to this newly annexed portion of the water system.

5.5.1.1 <u>Pipelines</u>

The computer modeling software used for this Master Plan, H_2ONET®, allows the water system facilities to be drawn over a map of the service area in real world scale. Using this approach, the program can automatically calculate the pipe length from the scaled drawing.

Additionally, this background layer allows the modeler to view the locations of actual facilities, commercial areas, rights-of-way, etc., with respect to the location of modeled facilities.

The City’s hydraulic computer model consists of 4,360 modeled pipe segments in total. These include pipes from 2-inch to 24-inch diameter, which were required for distribution and transmission main conveyance for hydraulic analyses. The hydraulic model program automatically creates “dummy” pipe segments at the upstream and downstream sides of pumps and valves to transfer water from one zone to another zone. Approximately 320 of these pipe segments exist in the City's hydraulic model for pump and valve connection only. These pipes were not included in updating and system pipe length calculations.

Before running the computer model, the database was updated to reflect the City's most recent pipeline improvement projects. Southwest Engineers, located in Hesperia, provided replacement project location maps to assist with this updating. The majority of upgrades had included replacement of steel pipe with 4-inch or 6-inch diameter with 8-inch (or greater) PVC pipelines. Appendix C includes tables that show the original pipelines and materials, as compared to the new pipelines and materials input into the model to reflect conditions through 2005.

As of 2000, the City has invested in approximately 98 miles of pipeline improvements across its four primary pressure zones. Pressure Zone 1 received the most pipeline improvements with just over 13 miles of total pipeline replace. The 2005 hydraulic computer model reflects these upgrades and therefore is representative of the City's pipeline system as of 2005.

Pipeline roughness coefficients are required for the hydraulic calculations of the model and are not typically taken directly from utility records or maps. Roughness coefficients are driven by the age and material of the pipelines and have a direct impact on the head losses and resulting pressures in the water system. Typically, roughness coefficients range from 70 for poor conditioned, unlined piping to 130 for new conditioned, lined piping. Calibration based on roughness coefficients was not in the scope of this project as the hydraulic model was measured against hourly SCADA readings. Pipelines in the City's model were therefore assigned roughness coefficients that fell within industry accepted guidelines for a given pipeline diameter, material, and age.

The majority of the pipelines throughout the distribution system consist of the following materials: asbestos cement (AC), polyvinyl chloride (PVC), ductile, ductile-iron pipe (DIP), and steel (STL). Transmission mains, pipes 12 inches and above, are primarily made of AC pipe. These pipe materials have a relatively stable coefficient of friction over time.

5.5.1.2 Junction Nodes

Junction nodes are placed in the model where two or more pipes connect, at the location where a change in diameter occurs, and where water enters or exits the system. The minimum information required by H_2ONET® for junction nodes includes: a unique identification number, the ground elevation, the water demand and/or fire flow (if any).

Elevations in the hydraulic model were assumed accurate. Elevation contours were generated from the H_2ONET® database and used to interpolate an elevation to any junction node that was added to the database. These contours were then used to interpolate elevations on new junction nodes for the 2005 hydraulic model. Elevations in this model ranged from 2,854 feet in the lowest pressure zone (Zone 1) to 3,818 feet in the highest pressure zone (Zone 4). A breakdown of elevations per pressure zone has been provided in Table 5.1.

Table 5.1 Elevations by Pressure Zone
Water Master Plan Update
City of Hesperia

Pressure Zone	Elevation (feet)			Number of Junction Nodes
	Highest	Lowest	Differential	
1	3,198	2,854	344	591
2	3,375	3,078	297	1,010
2A	3,184	2,971	213	62
2B	3,100	3,037	63	20
2C	3,189	3,100	89	38
2D	3,171	3,022	149	220
3	3,567	3,213	354	754
3A	3,410	3,164	246	85
4	3,818	3,415	403	233
			Total	**3,013**

5.5.1.3 Service Nodes

Demands were assigned to service nodes in the City's water model. Nodes, which are created for reasons other than demands or hydrant locations, typically do not have to meet water system design criteria and therefore can become extraneous data in the model database. For example, nodes which were created on a transmission main, at a pump or valve to help define facility geometry, or to represent gate valves at an intersection were typically not assigned a water demand, and are considered non-service nodes. The remaining nodes at intersections, on distribution mains within a street, at cul-de-sacs to represent a demand at a dead end, at a hydrant location, and similar were considered service nodes.

These service nodes were identified with a "Y" and non-service nodes were identified with an "N" in the model database using a field called "SERV_NODE." Upon attributing the "SERV_NODE" field, 2,650 service nodes resulted. This field allows for querying of the database to easily calculate or assign demand. This also creates the ability to narrow the scope of the output to minimize potential for error. By default, H_2ONET® will display results for all 3,013 junctions. By applying the "Service Nodes" selection to the output, this creates a report of nearly 400 fewer junctions, which are not hydraulically significant (design criteria would not apply). The resulting database provides only junction nodes that must meet design criteria.

Similarly, fire flows were assigned to service nodes to represent hydrant locations and where it was known that a hydrant existed nearby. Fire flows were not assigned to nodes that fell within the non-service node category.

The City's model has been created with the ability to query all service nodes and all hydrant nodes. There have been two fields created in the model database to assist with this:

1. PHMINPRESS = Peak Hour Minimum Pressure:
   All nodes considered as a service node were assigned a value of "40" in this field. Attributing the node with a value provides the ability to query on all nodes which contain a "40" in the "PHMINPRESS" field. This value also represents the desired minimum design pressure under the maximum day demand (MDD) and peak hour demand conditions.

2. FFMINPRESS = Fire flow Minimum Pressure:
   All nodes which were considered service nodes and those which were located near a hydrant were assigned a value of "20" in this field. Attributing the node with a value provides the ability to query on all nodes which contain a "20" in the "FFMINPRESS" field for global identification of hydrant locations and bulk-assignments of fire flows. The value of "20" also represents the minimum residual pressure under an assigned fire flow.

Fire flows were assigned to junction nodes by land use type based on the fire flow criteria established in Chapter 3 of this 2005 Plan.

5.5.1.4 Groundwater Wells

Wells in H_2ONET® are modeled using a pump and a reservoir. For the well pumps, the City also provided Southern California Edison (SCE) pump test data for pumps at each of the well sites. Similar to the booster pumping station (BPS), the well pumps were modeled as either single designed point or multi-point depending on the SCE test data.

The information required to model the reservoir includes the type and head. The reservoir was modeled as constant-head reservoir (with no geometry), which maintains a constant water level regardless of the volume pumped out of the reservoir. The water level of each well was established using the drawdown elevation of the wells.

5.5.1.5 Reservoirs

In H_2ONET®, storage reservoirs are called tanks. Several types of tanks are available to allow flexibility in modeling the actual field conditions. Tank types available in H_2ONET® include cylindrical tanks, variable-head tanks, variable-area tanks and fixed head reservoirs with unlimited capacity.

5.5.1.5.1 *Cylindrical Tanks*

Modeled cylindrical tanks require a base elevation (tank pad elevation), a high and low water level, initial water level, and a diameter. The program uses this information to calculate a volume and produce a tank filling and draining rate. The cylindrical tank is assumed as filling and draining proportional with a cylinder geometric shape.

The City owns and operates 13 cylindrical tanks across its four primary pressure zones. Total storage volume among the 13 storage tanks is 59.5 MG. The City's hydraulic model uses seven tank elements to simulate these 13 field-tanks and uses one tank element with an equivalent diameter to multiple tanks on one site-location. For modeling purposes, the calculation of equivalent diameters is accurate volumetrically and allows the model to converge and produce results. Simulating multiple tanks at one site location causes storage and supply to oscillate between adjacent tanks due to minimal head loss occurring between them. The hydraulic impact of this scenario fills/drains the tanks repeatedly, making it difficult for the model to reach a solution within the specified number of iterations.

The hydraulic computer model has made use of as-built and SCADA information provided by the City to populate the tank hydraulic model database. Data provided below in Table 5.2 summarizes the information used for hydraulic calculations and general project reference.

Table 5.2 Reservoir Model Data
Water Master Plan Update
City of Hesperia

Description	Model ID No.	Diameter	Base Elevation (ft-MSL)	Maximum Water Level(1) (ft)
Plant #14A	RES14	94	3,170	32
Plant #14B	RES14	160	3,170	32
Plant #18	RES18	150	3,197	32
Plant #19A	RES19	160	3,560	32
Plant #19B	RES19	160	3,560	32
Plant #21	RES21	114	3,364	38
Plant #22A	RES22	150	3,364	38
Plant #22B	RES22	150	3,364	38
Plant #22C	RES22	150	3,364	38
Plant #23	RES23	158	3,549	32
Plant #30	RES30	165	3,820	32
Plant #30B	RES30	165	3,820	32
Plant #30C	RES30	165	3,820	32

Notes:
(1) Water level is feet above base elevation.

Tanks at Plants 22 and 30 shown above were recently added to increase the total storage volume at the respective plant site. Plant 22 added one 5.0-MG tank to its existing volume of 10.0 MG. Therefore, the total storage volume at Plant 22 is 15.0 MG. This volume was added to the model by adjusting the equivalent diameter for the representative cylindrical tank at Plant 22. Plant 30 is recently completed with the addition of two 5.0-MG tanks to increase its storage volume to 15.0 MG. The additional 10.0-MG tank storage was added to the hydraulic model volume as near-term facilities.

5.5.1.5.2 *Fixed Head Reservoirs*

Reservoirs are used in the model to simulate points in the system where there is a fixed hydraulic grade line, or a constant source of supply. For the purpose of the City's updated hydraulic model, reservoirs were used to simulate the groundwater pumping level on the suction side of all well pumps. The well pumps from this dedicated groundwater point and into the system or into a cylindrical tank (shown in Table 5.2). As there are currently 15 well pumps, the City's H_2ONET® model contains 14 reservoirs, or one for each well facility (two wells are located at one site).

Groundwater pumping levels were input as the reservoir hydraulic grade line (HGL) using SCE tested pumping levels from July of 2003. Hydraulic modeled reservoirs and pumping levels have been summarized in Table 5.3.

Table 5.3 Groundwater Wells Model Data
Water Master Plan Update
City of Hesperia

Well No.	Model ID No.	Groundwater Pumping Level (ft)
3A	WELL3A	2,776
4A	WELL4A	2,791
5A	WELL5A	2,776
14A	WELL14A	2,751
14B	WELL14B	2,764
15	WELL15	2,745
17	WELL17	2,761
18	WELL18	2,759
19A	WELL19A	2,731
20	WELL20	2,757
21	WELL21	2,739
22	WELL22	2,786
24	WELL24	2,793
25	WELL25	2,767
26	WELL26	2,775

5.5.1.6 Booster Pumping Stations

There are two applications for a pump in the hydraulic model and both are applicable to the City's water system.

The booster pump is typically housed with several other pumps, which work in a lead/lag sequence, as the booster pump station. The booster station boosts water from a lower zone to a higher zone to feed demands and/or fill a higher-pressure zone tank.

The well pump is used to extract water from the aquifer into the water system or into a tank. The "well" is created when a well pump is connected, on its suction side, to a fixed head reservoir, which is used to emulate the fixed hydraulic grade line that is the groundwater pumping level. The well pump extracts water from the upstream reservoir and can provide an unlimited supply of water due to its simulated fixed HGL. These fixed head reservoir values may require adjustment on a seasonal basis since the aquifer levels will fluctuate with rain events, recharge, and pumping.

Information required to model each pump includes a unique identification number, elevation (well elevation), diameter, and type. Pumps can be modeled in several ways including water horsepower, single-design point (i.e., design flow and total dynamic head), or multi-point (i.e., characteristic pump curve using three or more operating points). The most accurate of these methods is to use the actual pump curve from the manufacturer for the trim of the pump installed. This method takes into account the change in the pumps' efficiency along the entire pump curve. There is an inverse relationship between the Head and Flow values, which causes the pump to deliver less pumping head as flow increases, and more pumping head as flow decreases.

For this analysis, actual pump curves were not available. However, the City did provide power company (SCE) pump test data from the last quarter of 2003 for all well and booster pumps. Depending on the number of test points for each pump test, a single-design point or a multi-point can be used. For this master plan analysis, the pumps were modeled using the single-design point. This design point can be expanded using assumptions within the H_2ONET® modeling program, to develop a complete pumping curve. Given the Design Point, H_2ONET® completes the pump curve under the following assumptions:

1. Shutoff Head = Design Head * 1.33.
2. Design Head, Flow = User Input, from Pumping Tests.
3. Maximum Flow = Design Flow * 2.

Table 5.4 summarizes each pump that has been input to the model under existing conditions. This table has calculated the pump curve points outlined above, which constitutes the pump curve used in the H_2ONET® program.

Table 5.4 Booster Pumping Stations/Well Pump Model Data
Water Master Plan Update
City of Hesperia

Facility Name	Pump No.	Model ID No.	Ground Elevation (ft-MSL)	Design Head (ft)	Design Flow Rate (gpm)
Booster Pumping Stations					
Plant #14	1	PS14_PMP1	3,170	204	1,103
	2	PS14_PMP2		204	1,126
	3	PS14_PMP3		202	1,096
	4	PS14_PMP4		203	1,118
Plant #18	1	PS18_PMP1	3,197	171	1,372
	2	PS18_PMP2		171	1,365
	3	PS18_PMP3		173	1,362
	4	PS18_PMP4		173	1,391
Plant #19A	1	PS19_PMP1	3,560	273	1,243
	2	PS19_PMP2		270	1,346
	3	PS19_PMP3		270	1,282
	4	PS19_PMP4		273	1,302
Plant #21	1	PS21_PMP1	3,364	211	755
	2	PS21_PMP2		203	797
	3	PS21_PMP3		217	1,636
	4	PS21_PMP4		203	1,600
Plant #22	1	PS22_PMP1	3,364	192	944
	2	PS22_PMP2		201	1,479
	3	PS22_PMP3		207	1,817
	4	PS22_PMP4		206	1,960
Plant #23	1	PS23_PMP1	3,549	58	696
	2	PS23_PMP2		59	654
	Fire Pump	PS23_PMP3		99	2,524
Well Pump Stations					
Well #3A	1	WELL3A_PMP	3,006	454	2,336
Well #4A	1	WELL4A_PMP	2,961	590	2,250
Well #5A	1	WELL5A_PMP	3,109	459	2,610
Plant #14	1	WELL14A_PMP	3,170	444	2,398
	2	WELL14B_PMP	3,170	447	2,000

Table 5.4	Booster Pumping Stations/Well Pump Model Data (Continued) Water Master Plan Update City of Hesperia				
Facility Name	**Pump No.**	**Model ID No.**	**Ground Elevation (ft-MSL)**	**Design Head (ft)**	**Design Flow Rate (gpm)**
Well #15	1	WELL15_PMP	3,332	671	1,410
Well #17	1	WELL17_PMP	3,308	634	1,235
Plant #18	1	WELL18_PMP	3,185	463	1,377
Well #19A	1	WELL19A_PMP	3,567	800	928
Well #20(1)	1	WELL20_PMP	3,216	N/A	N/A
Plant #21	1	WELL21_PMP	3,365	655	809
Plant #22	1	WELL22_PMP	3,364	607	1,891
Well #24	1	WELL24_PMP	3,241	700	2,000
Well #25	1	WELL25_PMP	3,257	625	888
Well #26	1	WELL26_PMP	3,100	439	1,207

Notes:
(1) Well is off-line during the model calibration process.

The managing of when these pumps turn on or off is dictated by SCADA operational controls implemented to the model. The City's SCADA system controls pumps' on and off status based on tank level or system pressure. As a controlling tank drains, for example, the filling pump will turn "on" once it sees the tank reaching a predefined low-point. SCADA settings have been provided by the City for each booster and well pump. These settings have been programmed into the City's hydraulic model to help simulate system-operating behavior given varying demand conditions.

City SCADA settings are applicable under all demand conditions, with the exception of the City's heaviest demand period. During this period, typically considered as the Maximum Week, City staff has noted that the quantity of demand compared with the City's pumping and storage supplies cause each tank and pump station to act similar to a forebay-system, where water is not stored as much as it is transferred from one zone to the next. Accordingly, the water system does not see the default SCADA controls during this demand period because the water that enters a tank becomes the water that is boosted to the next higher zone for demand and is then drained to the lower zone through the pressure regulating station (PRS). Therefore, to match SCADA tank trending provided, the $H_2ONET^{®}$ model used a subset of controls created to emulate how City tanks fill and drain during this Maximum Week period. Appendix D summarizes the controls used to achieve calibration during this Maximum Week demand period.

5.5.1.7 <u>System Valves</u>

Hydraulic modeling valves are typically used to control or manage pressures or flows in the water system. There are several different types of valves which H_2ONET® can model. The City's hydraulic computer model however, uses two different types of valves to simulate City operations: the gate valve and the PRV.

5.5.1.7.1 *Gate Valves*

The gate valve is a mechanism installed in a pipe that allows that pipe to be opened, closed, or throttled. Typically, these valves are installed at pipeline intersections to allow piping sections to be isolated to minimize the number of customers affected during a main repair or main break. Additionally, gate valves allow separation between high and low-pressure zones to allow that zone to operate within acceptable pressure criteria.

The City's hydraulic computer model has included 74 of these types of valves, which are considered normally closed gate valves (NCGV). These NCGVs are assigned an initial status of "Closed" and can be manually reopened at any time for operational analyses. In the City's model, the NCGVs have been created where a closed pipe existed to separate pressure zones. This promotes flexibility in the model for potential pressure zone adjustments (simply open the pipe to establish a new pressure zone).

The NCGVs were labeled consecutively within a pressure zone using a designation of "ZV" (for "Zone Valve"), a setting of "0" (zero flow allowed), and the upstream and downstream zone of separation. "ZV16_2_1" would be an example of a NCGV which is the 16th valve created to separate Pressure Zone 2 from Zone 1.

5.5.1.7.2 *Pressure Regulating Valves*

PRVs are used to lower the energy gradient from a higher zone to a lower zone, where pressures within the higher zone might be reaching the desired maximum water system pressures. PRVs may assist with providing a section of the system that may not be large enough to justify storage and pumping, with adequate supply. PRVs may also serve as backup or emergency sources of supply to other zones.

All PRVs have been labeled with a "PRV" designation in the hydraulic computer model. The City's PRV stations have one or two PRVs within them. The single-valve stations have been appended with an "S" and the multiple valve have been appended with a "1" or a "2". The larger diameter valve was given the "1" designation and the smaller diameter valve was given the "2" designation. Typical City operations has the smaller diameter valve operating first and when this valve cannot maintain the downstream lower pressure on its own, the larger diameter valve will turn on as support. To emulate this, controls have been added to the larger diameter PRV which enables the valve only when the downstream pressure exceeds its setting. PRV station 18 is the only exception to this operating sequence. PRV 18 operates the larger valve first and the smaller valve as backup. Appendix E summarizes the hydraulic computer model's existing PRVs and NCGVs.

The City maintains four primary pressure zones and five subzones. Zones 2A, 2B, 2C, and 2D are subzones of primary Zone 2, and Zone 3A is a subzone of primary Zone 3. PRVs are the sole source of supply to these subzones. The PRVs and NCGVs will play an important role in evaluating new zoning configurations to minimize subzones and enhance system circulation and redundancy.

5.6 BASE DEMAND ALLOCATION

Hydraulic model demand allocation is largely driven by the amount of data available to correlate water usage with a customer location or land use type within the service area. This geographic connection allows for accurate demand assignments to the hydraulic model junction, which is nearest to the tributary aggregate water usage. There are several methods to approach the demand allocation process. The selected approach depends on the following factors:

1. Density (percent built-out), Land Uses (primarily residential, mix of residential, commercial, industrial, etc.), and number connected pressure zones.
2. Production data available to generate a total demand, including unaccounted-for water, to be assigned to the model.
3. Land Use data available for calculation of a water duty factor (gpd/acre).
4. Customer Meter data available to allocate usage to a demand polygon area.
5. GIS parcel layer and land use maps available for the geographic correlation.

The City operates AutoCAD, which is a drafting software tool, and currently does not employ a GIS database. Additionally, the City's customer database is transitioning to a Sequel Server database, which will provide more functionality, reporting, tracking, and enterprise usage among City staff. At the time of this Master Plan however, the customer meter database presented limited information.

The City is approximately 34 percent developed within the service area. Approximately 66 percent of the service area remains for growth. Over the next 20 years therefore, direction and rate of growth may vary greatly. Additionally, the City serves several different land use types. Although primarily residential and zoned for residential land use, the City does currently serve corridors of commercial and industrial land uses. With the addition of County Service Area Zone-J, North Summit Valley (NSV), the Rancho Las Flores (RLF), and Summit Valley Ranch (SVR) developments, the City's service will be expanding rapidly while increasing its commercial land use types. Lastly, the City regularly transfers water between zones and does not currently service one zone without being served by a booster station or PRV from another zone. This factor alone makes demand allocations extremely important, as this will dictate the zone water transfers.

Therefore, the City percent build-out and land uses served, zone connectivity and water transfers between them, the availability of land use files in AutoCAD, and having access to production data became the driving factors in selecting a water production and land use combination for demand allocations and projections.

5.6.1 Planning Areas to Service Nodes

Carollo Engineers (Carollo) worked closely with City staff to generate reasonable and conservative planning area densities for existing and planning periods. Land use water duty factors and developed densities were used to generate water demands within unique planning areas (PAs) as explained in Chapter 3 of this Master Plan. This approach produced water demand assignments, which were specific to each PA for existing, 2012, 2017, 2022, 2027, and 2032.

As summarized in this Chapter, under Section 5.6.1: Junction Nodes, the water system model is typically made up of service nodes and non-service nodes. Hydraulic model non-service nodes may fall under the following categories:

1. Junctions upstream and downstream of a pump and valve station (suction and discharge sides) – these junctions are typically on the low-end or high-end of the pressure criteria due to the proximity from the booster pump. There are typically not services at these locations and it would be unrealistic to analyze a fire flow at these locations.
2. Junctions that are connected to a transmission main, typically a pipeline 12-inches or greater.
3. Junctions that are downstream of a tank and only used to denote a change in pipeline diameter.

These junctions were assigned an “N” to the SERV_NODE field created in the computer model database. The remaining junctions were attributed a “Y” in the SERV_NODE field. The junctions with the “Y” attribute are defined in this Master Plan as Service Nodes. These are the junctions that received a water system demand and will be used to maintain pressure and fire flow criteria when identifying deficiencies.

With the PAs and Service Nodes defined, the PA polygon layer was overlaid on top of the computer model. A spatial join was used to assign all Service Nodes within the PA polygon the PA designation. These designations are outlined and discussed in Chapter 3. With each service node in the model assigned the PA designation, the hydraulic model database was then linked to the PA database to calculate water demands in the model for existing and all planning periods. This database connection, allowed the total water demand for a given PA to be divided by the total number of Service Nodes with that PA designation. Each node within the PA was then evenly distributed the total PA demand.

This approach allowed the water demand allocations to incorporate City staff input regarding PAs, densities, and growth rates. The existing average day demands (ADD), also defined as the Base Demand, produced a water demand per pressure zone ratio, which brought about 50 percent of total system demand to Zone 2 and approximately 20 percent of system demand to Zone 1. The PA allocation also generated an approximate demand per Service Node as shown in Table 5.5.

Table 5.5 Existing Water Demand by Pressure Zone by Service Node
Water Master Plan Update
City of Hesperia

Pressure Zone	Percent Distribution by Pressure Zone(1)	System ADD (gpm)	Demand to Zone (gpm)	Total Service Nodes	ADD by Node (gpd/service node)
1	16.7	10,417	2,012	530	5,024
2	47.1	10,417	5,281	1150	6,510
3	26.7	10,417	2,103	765	5,553
4	9.5	10,417	1,020	173	8,693
		Total	**10,417**	**2,618**	

Notes:
(1) As derived from Planning Area assignments.

5.7 PEAKING FACTORS AND SCENARIOS

Scenarios are created in the model to capture a unique set of conditions specific to a hydraulic analysis. Scenarios might include existing or future demands, ADD, or MDD, existing versus proposed developments, etc. The operational definition of a scenario may be considered a “what-if.” “What-if” the demand changes in this hydraulic simulation? How does that affect the water system? There were several what-ifs or scenarios developed for this Master Plan hydraulic model. The primary reason for scenarios in this Master Plan were due to changing demands over planning periods which caused a unique set of facilities to be added per planning period to support the demand and deficiencies caused by the demand.

5.7.1 Existing Scenarios and Peaking Factors

The Base Demand, or Base Scenario, is created in the model to represent the existing ADD. This Master Plan considers the existing ADD equal to 10,417 gpm, or approximately 15.0 mgd. Hourly production data for the 2005 maximum week, July 24 through July 30, was used to calculate the MDD. It was found that the average demand within this week (the average of the maximum week) was calculated as 18,122 gpm. This maximum day demand creates a MDD/ADD ratio of 1.74, which is applied to the hydraulic model as a factor multiplied against existing ADD. This new, MDD condition in the hydraulic is defined as a unique Scenario to preserve its demand condition. Note that the existing ADD and MDD maintain the same demand allocations.

The City wished to use this model to realize operational benefits as well as Master Plan benefits. As such, the goal of this hydraulic model went beyond capturing a snapshot of demands, but rather to have the model react to changing demand conditions over a worst-case demand condition. With this, the MDD discussed above were used as the basis to apply diurnal curves. The diurnal curve applies hourly peaking factors to the demand in the hydraulic model and thus performs hydraulic simulations hourly to generate results such as tanks filling/draining and pumps turning on/off per the input SCADA controls. The diurnal curve used in this hydraulic model was derived from hourly production and SCADA trending data and summarized in Chapter 3.

The diurnal curve developed was applied to the MDD and a simulation was run for a period of 168 hours, or 7 days. This scenario, defined as the maximum week, became the target scenario to achieve calibration. A summary of the scenarios developed in the model for existing demand conditions and calibration are as follows:

1. 2005_ADD = 2005 ADD:
   a. Snapshot of ADD = 10,417 gpm.
   b. Used as Base Demand from which all other scenarios are derived.
2. 2005_MAX_WEEK = July 24th through July 30th:
   a. MDD = 1.74 * ADD.
   b. Snapshot of MDD = 18,122.
   c. Maximum Week diurnal curve applied for 168 hours:
      1) Hydraulic Model MDD over 7 days = 27,098 gpm vs. a SCADA measured MDD = 27,303 gpm.
      2) Hydraulic Model Minimum Day Demand over 7 days = 4,810 gpm vs. a SCADA measured Minimum Day Demand = 4,773 gpm.
      3) Hydraulic Model ADD over 7 days = 16,034 gpm vs. SCADA measured Minimum Day Demand = 16,115 gpm.

The results produced from the 2005_MAX_WEEK scenario were the basis for strategic model adjustments, City staff input, and further data refinement which produced a hydraulic computer model that closely emulates performance in the field.

5.7.2 Model Calibration

Achieving calibration in the hydraulic model indicates that the computer model will produce similar system performance and hydraulic results to the results observed in the field under similar, known conditions. The process of calibrating calls for model adjustments to be made to simulate in-the-field conditions and produce results that converge towards the observed field results, within an accepted tolerance. Once the model is calibrated, it can be used as a tool to effectively predict system performance under different demand, fire flow, and other operational conditions.

Therefore, the modeler's effectiveness at reaching this state of calibration is directly related to the quality of data used to create the computer model. If the data has been input with a low confidence level, for example, then it is likely that hydraulic model/system assumptions will have to be made to complete the model creation phase. This yields model adjustments being made with a low confidence level during the calibration process, resulting in a model whose results will diverge from - rather than converge on - actual field conditions.

Conversely, if the model has been input with data of a high confidence level, the likelihood that the model will produce like-field results is much improved. Moreover, the adjustments made to the higher-confidence-level model are more likely to be system conditions or status that were unknown to the water system operators such as a closed or partially closed valve, a different valve setting, or an unintended connection. These are some of the benefits of the hydraulic model, as both the engineer and water system operators gain a better understanding of the water system. This results in an opportunity to improve operations based on this new understanding.

5.7.2.1 City Model Calibration

The City's hydraulic model has been updated with a high level of confidence for this Master Plan, as indicated from the previous sections of this Chapter and subsequent sections providing results of model calibration. Of primary importance to the City was the evaluation of transmission lanes for future conveyance of lower pressure zone supply to upper pressure zone storage tanks and the determination of pump energy costs via the model's energy simulations. These goals required the development of an EPS model that promotes tank draining in response to system demand and filling in response to well and booster pumping from lower zones.

While other forms of calibration involve adjustment of hydraulic model roughness coefficients, the City's objectives for transmission main and energy evaluations called for calibration adjustments specifically to well and booster pumping controls during the Maximum Week condition. With the reasonable emulation of City tank levels, the hydraulic model proved effective in reacting to City diurnal demands while allowing model tanks to fill and drain within the allowed tolerance of City-provided SCADA trending data. The calibrated hydraulic model, combined with City operational knowledge, introduced a high level of confidence to these operational evaluations.

5.7.3 Supervisory Control and Data Acquisition Data

The City's SCADA system allows for dynamic readings of tank, well, and booster pumping station levels, flows, and pressures, respectively.

The City had determined that July 24 through July 30 is typical of a maximum demand week. As a result, this model calibration relied on SCADA hourly trending for this 7-day period in 2005 to match hourly predictions in the model. It is worthy of note that although 2005 data was used to calibrate, this maximum week condition is a standard operational scenario within the City and it was therefore agreed that 2005 would be a sufficient representation of typical maximum day operations.

The City provided hourly, 7-day SCADA trending for all tank levels, booster pumping flows, and discharge pressures. In conjunction with this SCADA data, the City also provided all well and booster on/off setpoints and booster pump sequencing (lead, lag, etc.) The hydraulic model applied these SCADA on/off settings provided by the City as well as compared the 'in-the-field' settings shown in the hourly SCADA trending. Where there were discrepancies between City provided setpoints and SCADA trending, it was agreed that the SCADA trending would govern as this reflected what occurred in the field on that day. This calibration process did reveal relatively minor anomalies in City data that were addressed and adjusted accordingly during the calibration process.

5.7.4 Field Testing

Field testing is typical of calibration necessary for hydraulic model roughness coefficient calibration. As explained, the focus of this Master Plan was the Extended Period Simulations, which more closely rely on SCADA system controls. As a result, the extent of field testing for this calibration involved the previously summarized receipt of SCADA data.

5.7.5 Calibration Results

Calibration spreadsheets enabling an easy and accurate comparison of hydraulic model results with SCADA trending comparisons were developed with the provision of SCADA data. As hydraulic model results were generated, hourly tank levels were copied and pasted from the model results into the calibration spreadsheet where 7-day tank graphs were updated to determine a reasonable match to the City's SCADA data. The development of 7-day graphs allowed the color-coding of model vs. SCADA tank level, facilitating the identification of differences between the two parameters.

As discussed with City staff several times to discuss the calibration of this hydraulic model and the results provided herein. It has been agreed between all parties involved in this Master Plan that this hydraulic model accurately performs and reacts similarly to the City's water system. It was determined that the hydraulic model was closely calibrated to the SCADA data.

EXISTING AND FUTURE SYSTEM ANALYSIS

6.1 GENERAL

In master planning, the computer model assists in measuring system performance, analyzing operational improvements, and developing a systematic method of determining the size and timing required for new facilities. The calibrated model can be used to analyze existing water systems, future water systems, or even specific improvements to the existing water system. By analyzing numerous scenarios relatively quickly, the model provides answers to many “what if” questions. The computer program analyzes all of the information in the system data file and generates results in terms of pressures, flow rates, and operating status. The key to the use of the computer model is correctly interpreting these results and understanding how the water distribution system is affected.

City of Hesperia (City) staff and Carollo Engineers (Carollo) met monthly throughout the calibration process to provide feedback on the accuracy of the hydraulic model. This on-going communication helped increase the level of confidence in the results of the model analyses. The City’s distribution system was simulated through various demand and supply conditions to provide information on system deficiencies and potential resolutions.

6.2 CHAPTER OBJECTIVES

The goals of this chapter of the Water Master Plan Update are to:

1. Summarize model simulations.
2. Evaluate the system fire flow deficiencies.
3. Present the existing and future system deficiencies identified by the model simulations.
4. Evaluate the system pressures and velocities.
5. Recommend facilities that mitigate the identified system deficiencies.
6. Identify small diameter pipelines that are of high priority to replace during the City’s annual pipeline replacement program.

6.3 MODEL SIMULATIONS

The hydraulic model was used to address key water system operational issues and to assist the City with effective planning for current needs and future growth. The model is capable of performing two types of calculations, steady state and extended period. A steady state calculation represents a snapshot of the system for one instant in time. This type of calculation is most commonly used to analyze the worst-case scenarios within a system, such as peak hour or fire flow demands, as these demands frequently control design decisions.

However, because water systems are not truly steady, there are certain modeling scenarios for which a steady state analysis is limited. An extended period simulation (EPS) performs the analysis over a specified duration of time. The results from this calculation can be used to monitor daily fluctuations of tank volumes, analyze energy usage, and prepare for planned operational shutdowns or emergency scenarios. EPS runs provide a way to identify problems associated with these types of scenarios. This City's hydraulic model was calibrated using EPS, the calculated maximum week diurnal curve, and Supervisory Control and Data Acquisition (SCADA) control settings provided by the City.

Table 6.1 identifies the general model simulations that were performed for this project and lists the demand set that was used for each scenario, as well as the operational control set. Additional model simulations were conducted for time-of-use pumping and water conservation. These simulations are presented and discussed in detail in Chapter 7 of this Master Plan.

Table 6.1 Model Simulations
Water Master Plan Update
City of Hesperia

Simulation	Existing	2012	2017	2032	Duration	Demands	Operational Controls
Average Day	X	X	X	X	Steady State	ADD	Typical Operations
Maximum Day	X	X	X	X	Steady State	MDD	Typical Operations
Peak Hour	X	X	X	X	Steady State	PHD	Typical Operations
EPS	X	X	X	X	72 Hours	MDD	Typical Operations
Fire Flow	X	X	X	X	Steady State	MDD	Typical Operations

For each planning year, water demands generated by proposed development and/or redevelopment were added to the model to develop the total projected water demand requirements on the City's system. Planning years analyzed were the existing system and future systems for years 2012, 2017, and 2032. Planning Year 2032 was considered the build-out condition and includes improvement projects that may be required for 2022 and 2027. It is recommended that the City perform a Water Master Plan Update within the next 5 to 10 years to revisit the next 10-year planning horizon.

6.4 DISTRIBUTION SYSTEM MODELING RESULTS

The hydraulic model simulations summarized in Table 6.1 were run for the City's existing and proposed future distribution systems to identify deficiencies and operational inefficiencies as well as to evaluate proposed or recommended system improvements. Location of pressure deficiencies were screened to ensure that only junction nodes that represent service nodes and fire hydrants were considered where system pressure did not provide the targeted pressure. Therefore, only junction nodes designated as service nodes or fire hydrants were used in determining pressure deficiencies.

Where existing system deficiencies were identified, system improvements were modeled to verify that the improvements would mitigate the deficiencies. In some cases, more than one alternative was available. Competing improvements providing the same level of service were reviewed and evaluated to select a recommended alternative.

System deficiencies and the improvements to mitigate the deficiencies were categorized based on their purpose as either a health/safety improvement (such as improving fire flows), a reliability improvement (such as adding another groundwater well), or an operational improvement (such as adding a transmission main). Where there was overlap between these classifications, a judgment was made to put the improvement into the most appropriate category.

6.4.1 Fire Flow Analysis

Water availability for fire protection needs is essential for a water system. If the fire department has the mechanical capability to draw more water during a fire, it will continue to pump despite the fact that it may introduce a very low or even negative pressure somewhere in the water system. Therefore, the water system must be capable of handing a fire flow demand without creating low pressures in the system.

The fire flow demands identified in Table 3.9 of Chapter 3 were added to the MDD and distributed to various junction nodes in the hydraulic computer model. This included a myriad of combinations that the computer program was able to analyze relatively quickly. Recommended improvements resulting from the analyses were then incorporated into the future distribution system and modeled. This evaluation was performed to ensure that the recommended improvements met future demand conditions as well.

It is important to distribute the fire flow simulations across the City's entire system and each pressure zone. Table 6.2 presents the distribution obtained by pressure zone. The table demonstrates that there is adequate coverage across the distribution system.

Table 6.2 Existing Fire Flow Simulation Distribution by Zone
Water Master Plan Update
City of Hesperia

Pressure Zone	Number of Fire Flow Simulations	% of Total
Zone 1	475	21.2%
Zone 2(1)	929	41.4%
Zone 3(1)	638	28.5%
Zone 4	182	8.1%

Table 6.2	Existing Fire Flow Simulation Distribution by Zone (Continued) Water Master Plan Update City of Hesperia	
Pressure Zone	**Number of Fire Flow Simulations**	**% of Total**
Zone 5	13	0.6%
Zone 6	5	0.2%
Total	**2,242**	**100.0%**

Notes:
(1) Subzones are included.

In performing fire flow simulations in the hydraulic model, it is worth noting that a fire flow at a demand point may be split between two or three fire hydrants, depending on the location of the fire flow demand within the land use category. This is to simulate what would typically happen in the field as a single point fire flow demand at one hydrant is not practical.

6.4.1.1 Existing Fire Flow Deficiencies

For this Master Plan, undersized pipelines are existing pipelines with diameters less than or equal to 6 inches. The City plans to replace these small diameter pipes in its annual pipeline replacement program. With over 150 miles of undersized pipelines, a method to help prioritize replacements would be beneficial.

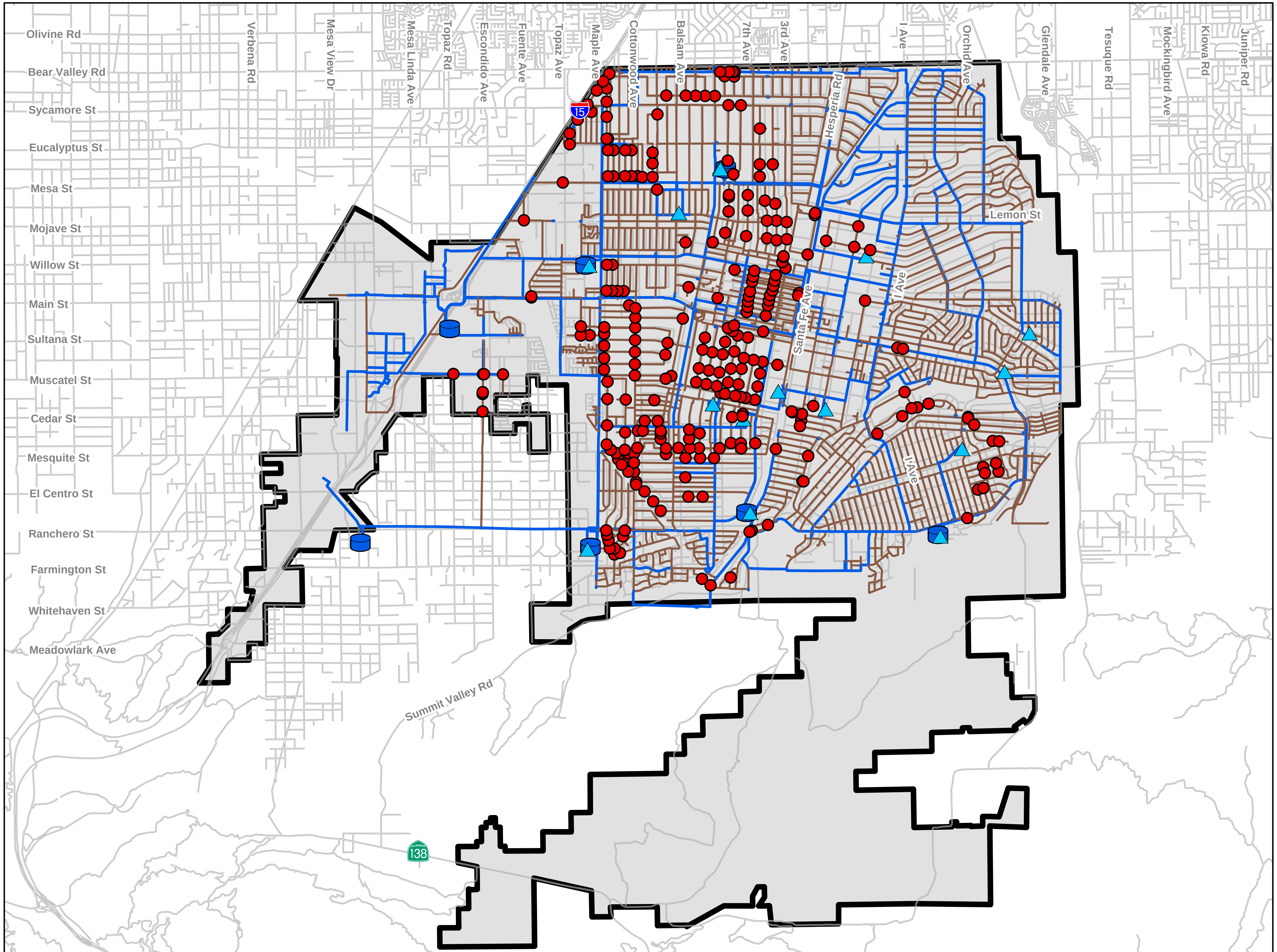
Based on the results of the hydraulic model, the majority of fire flow deficiencies come from undersized steel pipelines. Approximately 52 miles of undersized steel pipelines require upsizing to mitigate fire flow deficiencies. In addition, approximately 10 miles of non-steel pipelines, larger than or equal to 8 inches in diameter, require upsizing.

Based on the degree of deficiency, using the pressure differential at any location, the improvement projects were prioritized. The greater the deficiency, the higher the project was listed. Therefore, lower improvement project numbers identify a higher priority. To assist in field construction, projects were also grouped by street/neighborhoods for ease of project scheduling practicality. Figure 6.1 presents the existing fire flow deficiencies and locations.

Analyses of future planning years and associated demands were performed. The results identified a few pipelines that required upsizing in 2012. However, there were no further fire flow deficiencies in future planning years.

6.4.2 System Pressure and Velocity Analysis

The hydraulic model was analyzed to determine pressure and velocity deficiencies that do not meet the criteria identified in Chapter 1. Consistently low pressures at any location may require rezoning of pressure zones or additional isolation valves. Higher velocities may represent a bottle-neck in the system, causing pumps operate more frequently than



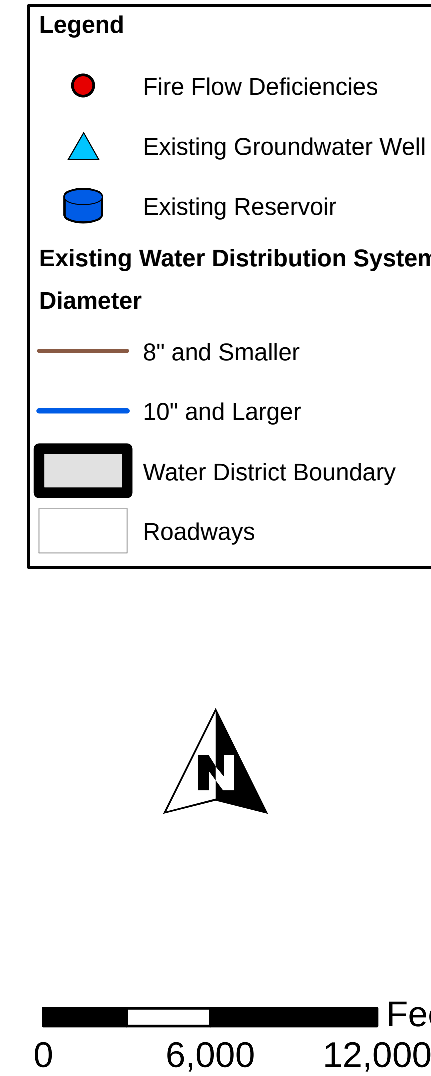


FIGURE 6.1
FIRE FLOW DEFICIENCIES

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

necessary. Mitigating the velocity deficiencies would reduce system head loss and allow pumps to operate efficiently. The following sections evaluate the pressure and velocity simulations and presents the associated results.

6.4.2.1 System Pressures

The City's distribution system is unique in its hydraulic and operational landscape. Because of the tanks, wells, and booster pump elevations, including the City's topography, typical operating pressures range from 40 psi to 150 psi. This also reflects the ability of the existing system to provide adequate flow and meet current water demands.

For the City's system, pressures up to 150 psi were considered acceptable. In the past, the City has evaluated the options to reduce the higher pressures in the system by creating additional sub-zone. However, a new sub-zone would require additional maintenance for the new valves to isolate zones. After consideration and review, the City concluded that installing high-pressure pipe and/or localized residential pressure reducing valves were more cost effective.

With City input and review, graphical representation of the pressure distribution throughout the water system were generated from the calibrated model and are presented in Figure 6.2. The "near-term" simulation includes the addition of Wells 29, 31, and 32 as well as the inclusion of Freeway Corridor. This region adds a new pressure sub-zone to Zone 4 and is served by Plant 30. Figure 6.2 illustrates the pressure distribution within the City's system with the inclusion of the Freeway Corridor. This figure shows that approximately 20 percent of the City's pressure distribution will operate above 120 psi, including the Freeway Corridor.

Under this condition, the southern area of Zone 1 shows pressures as high as 150 psi and two nodes with pressures of 175 psi. This is due to the addition of Well 29 in this zone. It is recommended that the City evaluate the use of localized pressure reducers to mitigate these two high-pressure locations.

The estimated pressure distribution for future planning years 2012, 2017, and 2032 were evaluated using ADD conditions. The results were similar to the existing system with pressures greater than 120 psi occurring in 20 percent (2012), 15 percent (2017), and 25 percent (2032) of the system. These analyses included all required future facilities to meet projected demands.

The results of the existing system simulations did not show any major for pressure deficiencies. However, it is recommended that localized pressure reducing valves mitigate the two high pressure points located in Zone 1.

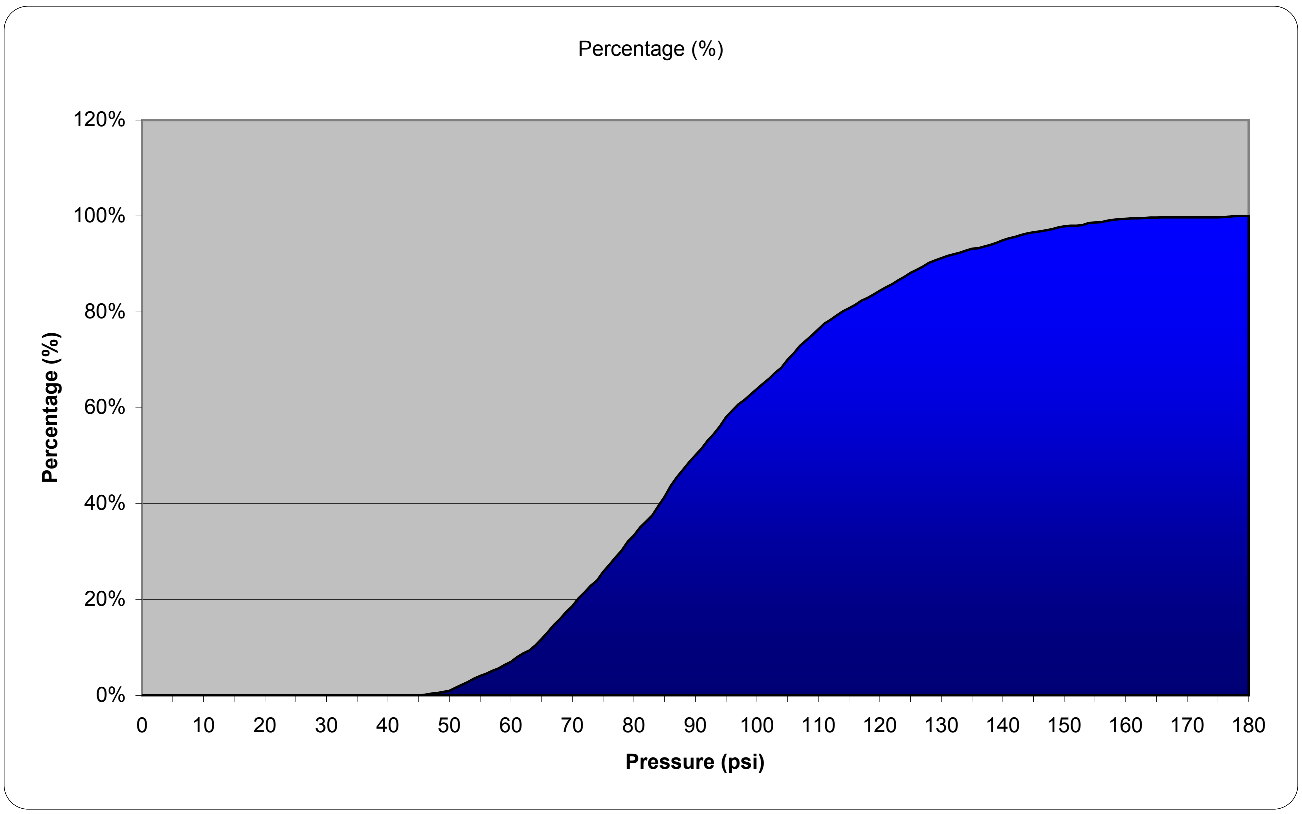


Figure 6.2
Existing Pressure Distribution
Water Master Plan Update
City of Hesperia

carollo engineers

6.4.2.2 System Velocities

High velocities in water pipelines can scour the pipe lining material and cause valves to leak or fail. In addition, increased velocities contribute to increased head loss, resulting in a less efficient water distribution system. Higher velocities may be acceptable for short-term operation, such as when needed in fighting fires. The City's distribution system was analyzed to identify areas that experienced high velocities (the criterion was identified in Chapter 1 of this report).

The scenarios used to analyze the system for pressure deficiencies were also used to evaluate the velocities under different conditions (ADD, MDD, and PHD). During ADD periods, the desired velocity is less than 5 feet per second (fps), with velocities between 5 to 7 fps being questionable. During MDD and PHD, the desired velocity is less than 7 fps, with velocities between 7 to 10 fps considered questionable.

Model results showed relatively few pipelines with high velocities. However, 11 pipelines, mostly located in Zone 2, were identified to exhibit high velocities. For ease of scheduling, deficient pipelines were grouped with other improvement projects for efficient construction. Figure 9.2 in Chapter 9 presents the improvement projects recommended to mitigate the velocity deficiencies.

6.4.2.3 Steel Pipelines

The existing distribution system consists of about 150 miles of undersized steel pipelines. Approximately one-third of these pipelines were identified as fire flow deficient and denoted as near term replacements from planning year 2007 to planning year 2012. It is recommended that the remaining pipelines be replaced and upsized on an annual and aggressive pipeline replacement program during planning years 2012 and 2022. This would allow the City to have 10 miles of pipeline replacement each year after the fire flow pipeline improvements.

6.4.3 Future System Analyses

With continued growth in the City, significant demands will be added to the existing system. Per Table 3.10, the City's existing MDD is 18,122 gpm (26.1 mgd). By year 2032, the demand is projected to increase to 62,776 gpm (90.4 mgd); more than three times the current MDD. The conveyance of this additional demand will place capacity constraints on the existing transmission mains. Also, extensions to the system are required to provide water supply to the developing areas.

The locations of new wells, booster pumping stations, and transmission pipelines were reviewed with the City and entered into the hydraulic model to verify the effectiveness of their placement. These facilities were analyzed under EPS conditions that minimize head loss and maximize pumping efficiencies. As new wells were proposed for each planning period, the City's piping system was evaluated to determine adequate sizing to allow each proposed well to deliver flow at its design point. Similarly, each additional booster station was analyzed to verify the adequate delivery water and meet increased demands.

The following criteria were used to select optimal locations for the transmission mains:

1. Near high velocity pipelines that connect directly to or from a pump station or well. These existing transmission mains were ideal locations to add a parallel line.
2. Hydraulic model identified where new transmission mains would be beneficial to fill a tank or maximize well capacities.

The pipelines which are responsible for well and booster station supply distribution have been termed "pumping lanes" and have been highlighted as integral components to the expansion of the City's water system and are central to this discussion.

6.4.3.1 Proposed Wells

As listed in Table 4.3, the City's near term distribution system includes a total of 18 wells (including Wells 29, 31, and 32) with a total firm capacity of 24,429 gpm. The amount of water supply in a water system is based on the MDD, because this is the minimum water demand that the system must meet. Based on the projected water demand for 2032 (62,776 gpm) and the current well capacities, a minimum of 38,347 gpm of additional water supply is required. This equates to 26 wells as listed in Table 6.3.

As a result, the City's should more than double the amount of well facilities in its distribution system. To determine the most effective locations for the new wells, a meeting that included review of the Mojave Water Agency Groundwater Report by Richard Slade & Associates, was held to apply a method of site selection. Based on discussion with City staff, the following guidelines for locating a site were created:

1. Identify known high groundwater levels. Areas near the Mojave River are found in the southeast portion of Zone 1.
2. Use land which the City has purchased or is able to purchase.
3. Identify strategic areas near existing transmission pipelines.
4. Identify strategic areas near existing reservoirs, which have likelihood to drain more easily than to fill.

Once the locations were selected, hydraulic model input data for the new wells were estimated to be similar to the nearest well. Table 6.3 summarizes the proposed wells to support the projected water demands through 2032.

Eight additional wells were added after the selection meeting with the City. Well 46 in the higher elevations of Zone 1 was proposed near Lemon Street and Mauna Loa Street. This location provides a direct water supply feed to Tank 14 and connects to the current pumping line for the existing Well 26. The remaining five new wells are proposed in Zone 3.

Table 6.3 Proposed Wells
Water Master Plan Update
City of Hesperia

Model ID	Zone	Flow (gpm)	Head (ft)	Location	Planning Year
WELL 1	RLF	1,750	700	Proposed South of Vista Lane and Pawpaw Avenue	2012
WELL 2	RLF	1,750	700	Proposed South of Vista Lane and Pawpaw Avenue	2012
WELL 3	RLF	1,500	700	Proposed South of Vista Lane and Pawpaw Avenue	2012
WELL 4	RLF	1,500	700	Proposed South of Vista Lane and Pawpaw Avenue	2022
WELL 5	RLF	1,500	700	Proposed South of Vista Lane and Pawpaw Avenue	2027
WELL-PMP-33	3	1,200	850	Eleventh and Main Street	2012
WELL-PMP-34	3	1,250	820	Ranchero Road and Cottonwood	2012
WELL-PMP-35	2	1,800	620	Ranchero and Santa Fe Avenue	2017
WELL-PMP-36	2	1,800	620	Ranchero and Chase Avenue	2017
WELL-PMP-37	2	1,800	620	Ranchero Road and Lyons	2017
WELL-PMP-38	3	1,200	820	Maple Avenue, North of Cedar	2017
WELL-PMP-39	3	1,200	820	Sultana and Maple Street	2017
WELL-PMP-40	2	1,200	620	Seventh and Cajon Street	2017
WELL-PMP-41	2	1,200	620	C Avenue and Main Street	2017
WELL-PMP-42	2	1,200	620	I Avenue and Olive Street	2017
WELL-PMP-43	1	2,000	420	Capella and Arrowhead Lake Road	2017
WELL-PMP-44	1	2,000	500	Capella and Seaforth	2022
WELL-PMP-45	1	2,000	500	Monterey and Glendale Avenue	2022
WELL-PMP-46	1	1,200	500	Lemon Street and Santa Fe Avenue	2022

Table 6.3 Proposed Wells (Continued)
Water Master Plan Update
City of Hesperia

Model ID	Zone	Flow (gpm)	Head (ft)	Location	Planning Year
WELL-PMP-47	3	1,500	TBD	TBD	2022
WELL-PMP-48	3	1,500	TBD	TBD	2022
WELL-PMP-49	3	1,500	TBD	TBD	2027
WELL-PMP-50	3	1,500	TBD	TBD	2027
WELL-PMP-51	3	1,500	TBD	TBD	2027
WELL-PMP-52	3	1,500	TBD	TBD	2032
WELL-PMP-53	3	1,500	TBD	TBD	2032
Total Additional Capacity		39,550			

The locations for these new wells require further review by the City. The addition of the 26 wells brings the total proposed well capacity to approximately 39,550 gpm, for a total of approximately 63,979 gpm to meet projected 2032 MDD with the largest wells in Zone 1 (Well 5) and Zone 2 (Well 24) out of service.

6.4.3.2 Proposed Booster Pump Stations

The majority of the proposed wells are located in the lower pressure zones, where water supply is readily available. However, increased demands are projected throughout the distribution system. To provide additional flow to the higher-pressure zones, several new pumping stations are recommended. The build-out year of 2032 was used to size the new pump stations and to upsize existing stations.

The simulations showed that the most undersized pump station in the existing system is located at Plant 23. This booster pump station is equipped with relatively low head pumps to serve a localized region of Zone 4. The current capacity does provide enough head to fill Tank 30. In addition, the City has experienced problems in the past with filling this tank. To alleviate both of these issues, a larger pump station at Plant 23 is recommended.

The BPS requires the largest upsizing is the station located at Plant 22. Plants 18 and 22 both have groundwater wells that supply their respective pressure zones, which decreases the need for pumping. However, to meet the demands at the higher pressure zones, where direct well supply is minimal, Plant 22 must be designed to deliver water to these zones. Table 6.4 summarizes the proposed booster pumps for existing and future demand conditions.

Table 6.4 Proposed Booster Pumps
Water Master Plan Update
City of Hesperia

Model ID[1]	Zone	Flow (gpm)	Planning Year
PS_A_PMP1	5	1,500	2012
PS_A_PMP2	5	1,500	2012
PS_A_PMP3_FIRE	5	4,000	2012
PS_B_PMP1	6	1,400	2012
PS_B_PMP2_FF	6	3,500	2012
PS_RLF_1	RLF	2,625	2017
PS_RLF_2	RLF	2,625	2012
PS_RLF_3	RLF	2,625	2017
PS_RLF_4	RLF	2,625	2022
PS_RLF_FF	RLF	2,000	2012
PS14_PMP1	2	2,000	2012

Table 6.4 Proposed Booster Pumps (Continued)
Water Master Plan Update
City of Hesperia

Model ID(1)	Zone	Flow (gpm)	Planning Year
PS14_PMP2	2	2,000	2012
PS14_PMP3	2	2,000	2012
PS14_PMP4	2	2,000	2022
PS14_PMP5_FIRE	2	4,000	2012
PS18_PMP_1	2	3,000	2012
PS18_PMP_2	2	3,000	2012
PS18_PMP_3	2	3,000	2012
PS18_PMP_4	2	3,000	2017
PS19_PMP_1	4	3,000	2017
PS19_PMP_2	4	3,000	2017
PS19_PMP_3	4	3,000	2017
PS19_PMP_4	4	3,000	2027
PS21_PMP_1	3	1,800	2012
PS21_PMP_2	3	1,800	2012
PS21_PMP_3	3	1,800	2017
PS21_PMP_4	3	1,800	2027
PS22_PMP1	3	3,000	2012
PS22_PMP2	3	3,000	2012
PS22_PMP3	3	3,000	2017
PS22_PMP4	3	3,000	2027
PS22_PMP5_FIRE	3	3,000	2022
PS23_PMP_1	4	1,300	2012
PS23_PMP_2	4	1,300	2012
PS23_PMP_3	4	1,300	2022
PS23_PMP_4	4	1,300	2027
PS23_PMP_5_FIRE	4	4,000	2017

Notes:
(1) PS denotes Pump Station; PMP_X denotes the pump number in that station.

6.4.3.3 Proposed Transmission Main/Pumping Lanes

The City currently has several primary pumping lanes, which are aligned with the current location of well supplies and to higher-pressure zones. Based on City topology, water is pumped from the east side to the southwest region of the service area. Based on the hydraulic analysis, two new primary pumping lanes are recommended for the system.

Figure 6.3 shows the location of the proposed primary and secondary pumping lanes. Detailed discussion of each is presented in the following section. These improvements are also identified in Chapter 9.

6.4.3.3.1 *Pumping Lane 1*

Pumping Lane-1 (PL1) consists of transmission pipelines from wells in the southeasterly portion of the system (near the Mojave River) to Plant 18, from Plant 18 to Plant 22, from Plant 22 to Plant 19, and from Plant 19 to Plant 30. To assist with analysis and discussion, PL1 was subdivided into secondary pumping lanes identified as PL1A, PL1B, PL1C, and PL1D. A detailed discussion for each is presented in the following sections.

6.4.3.3.1. PL1A - Pipes from Wells in Southeast to Plant 18

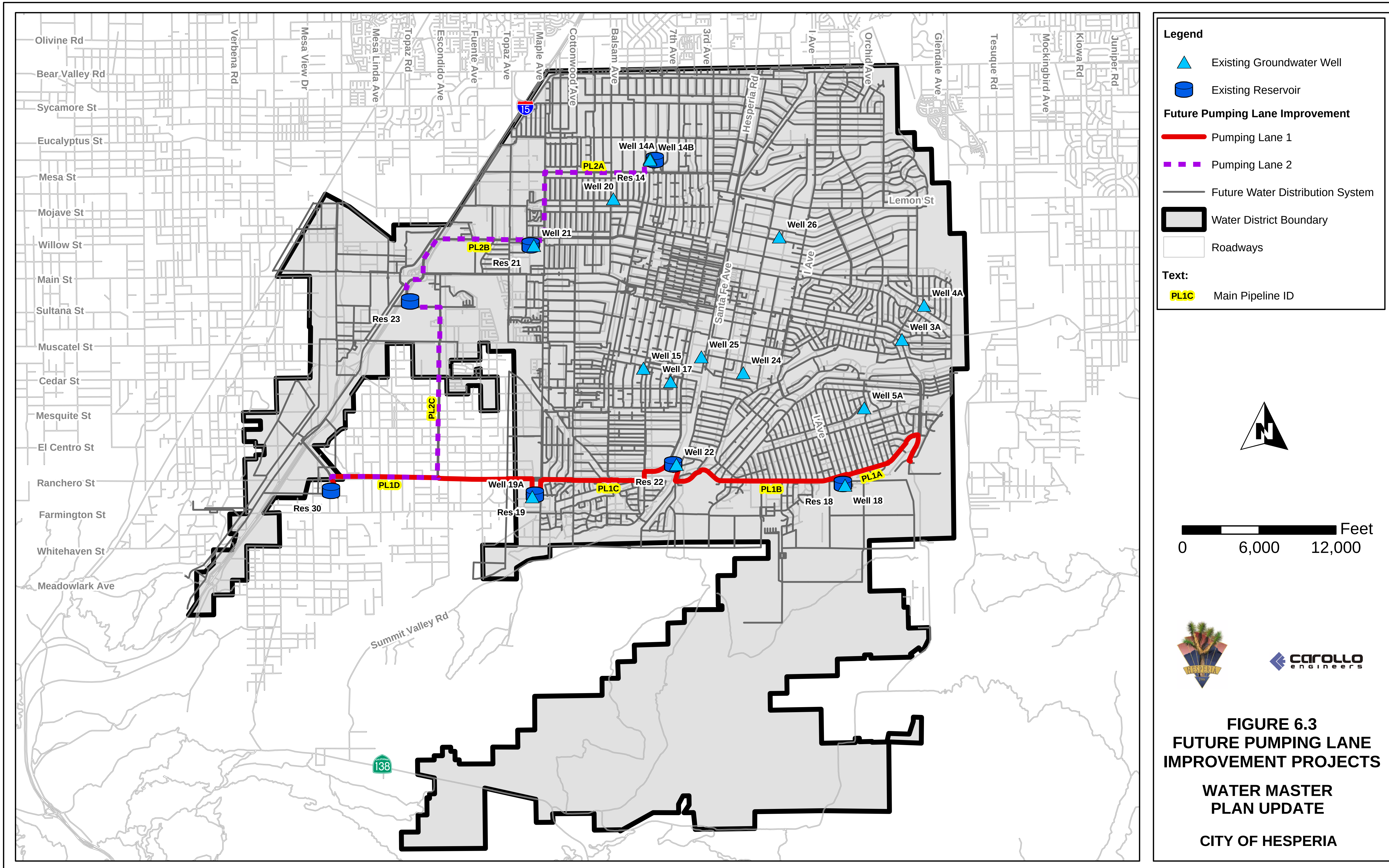
With the recent addition of Well 29, the hydraulic model analysis shows that additional piping is required to operate this well at its operating design point. Approximately 1,200 feet of 16-inch diameter parallel piping was proposed from the well pump and terminating at Outer Lake Arrowhead Road. In future system analyses, additional wells facilities demonstrated a need for more piping to reduce head loss. Approximately 6,000 feet of 24-inch diameter piping was proposed along Ranchero Road to Plant 18.

6.4.3.3.1. PL1B - Pipe from Plant 18 to Plant 22

This pumping lane is along Ranchero Road and includes four proposed wells along its route. This route also conveys supply from the existing wells in Zone 1 and Tank 18. As a result, PL1B is one of the largest capacities of pumping lanes within the system. An existing pipe on Ranchero Road, an 18-inch diameter pipeline, exhibited very high velocities during planning years 2012 and 2017. It was proposed that approximately 17,000 feet of 24-inch diameter pipeline parallel to the existing 18-inch diameter pipeline would adequately transfer water supply from all of the well sources tributary to Plant 22 and allow the area to operate more efficiently.

6.4.3.3.1. PL1C - Pipe from Plant 22 to Plant 19

Currently, a 14-inch diameter pipeline crossing the California Aqueduct on Ranchero Road results in a minor bottleneck to the existing pumping lane. To mitigate the resulting operational inefficiencies and high velocities, a pumping lane is proposed in this area. It consists of approximately 3,200 feet of pipeline ranging from 12- to 18-inch diameter near


Legend
Existing Groundwater Well
Existing Reservoir
Future Pumping Lane Improvement
Pumping Lane 1
Pumping Lane 2
Future Water Distribution System
Water District Boundary
Roadways
Text:
PL1C Main Pipeline ID
Feet
0 6,000 12,000
FIGURE 6.3
FUTURE PUMPING LANE IMPROVEMENT PROJECTS
WATER MASTER PLAN UPDATE
CITY OF HESPERIA
Olivine Rd
Bear Valley Rd
Sycamore St
Eucalyptus St
Mesa St
Mojave St
Willow St
Main St
Sultana St
Muscatel St
Cedar St
Mesquite St
El Centro St
Ranchero St
Farmington St
Whitehaven St
Meadowlark Ave
Summit Valley Rd
Lemon St
Well 14A
Well 14B
Res 14
Well 20
Well 21
Res 21
Res 23
Well 26
Well 4A
Well 3A
Well 25
Well 15
Well 17
Well 24
Well 5A
Well 22
Res 22
Well 19A
Res 19
Res 30
Res 18
Well 18
PL1A
PL1B
PL1C
PL1D
PL2A
PL2B
PL2C

Plant 22, and about 1,000 feet of 12- to 16-inch diameter parallel pipelines crossing the Aqueduct. To alleviate other nearby constraints and maximize pump efficiencies, improvements were extended to Plant 19.

6.4.3.3.1. PL1D - Pipe from Plant 19 to Plant 30

Plant 30 receives water supply from one source: Plant 19. PL1D represents the pumping lane from Plant 19, which continues west on Ranchero Road to the tank at Plant 30. The existing transmission main along this route, an 18-inch diameter pipeline, does not meet design requirements for planning year 2017. Therefore, a parallel pipeline of about 9,800 feet of 18-inch diameter pipeline is proposed.

6.4.3.3.2 *Pumping Lane 2*

Pumping Lane-2 (PL2) is a new set of pipelines that consists of transmission pipelines from Plant 14 to Plant 21, from Plant 21 to Plant 23, and from Plant 23 to Plant 30. Analyses showed the pumping lane improved the operational issues in the affected area. To assist with analysis and discussion, PL2 was subdivided into various secondary pumping lanes identified as PL2A, PL2B, and PL2C. A detailed discussion for each is presented in the following sections.

6.4.3.3.2. PL2A - Pipe from Plant 14 to Plant 21

This segment includes two main pipelines. One traverses from Mesa Street West to Maple Street and south to Plant 21. The second path is from Eleventh Street south to Willow Street and west to Plant 21. Both mains consist of 10-, 12-, and 18-inch diameter pipelines before converging at Maple Street and Willow Street, respectively, at which point a single 24-inch diameter pipeline conveys supplies into the tank at Plant 21. With existing operational inefficiencies, parallel pipelines are proposed from Plant 14, along Mesa Street west to Maple Street.

These improvements include about 9,000 feet of 16-inch diameter pipeline, which parallel the existing pipelines in Mesa Street. The additional capacity provided the tank at Plant 21 with a fill-trend and met the required demands. Additional improvements for this pumping lane consisted of approximately 17,000 feet of 12- and 16-inch diameter parallel pipelines throughout the reaches of Maple Street to Plant 21 and Eleventh Street to Willow Street, then to Plant 21.

6.4.3.3.2. PL2B - Pipe from Plant 21 to Plant 23

This pumping lane consists of 18- to 20-inch diameter transmission mains of about 14,000 feet from Plant 21 to Plant 23. The pipe route begins at Plant 21 and continues west on Live Oak Street, then south on Mariposa Street, and ending at Plant 23. The phasing of these improvements will begin in 2012 and continue incrementally to Plant 21 by 2032.

6.4.3.3.2. <u>PL2C - Pipe from Plant 23 to Plant 30</u>

This is a new pumping lane and includes a segment of piping that was introduced as part of the Freeway Corridor service area. The improvement connects Plant 23 to Plant 30 and is proposed to be installed by 2012. The proposed route begins at Plant 23, continues to Mariposa Avenue, and extends south to the railroad tracks near El Centro Street. From this location, the route continues southeast, along the railroads tracks, to Plant 30. The piping consists of about 6,000 feet of 18-inch diameter pipeline and 6,000 feet of 24-inch diameter pipeline.

6.4.4 New Growth Areas

As the City grows, the outlying regions where development is proposed will require new facilities including pipes, tanks, pumps, and valves. Two main areas of the City are the Freeway Corridor and the Rancho Las Flores (RLF) development. New pressure zones are required to serve these developments described below.

6.4.4.1 <u>Freeway Corridor</u>

A substantial area of new growth is currently being termed by the City as the “Freeway Corridor.” This area lies near Zone 4 along Interstate 15 (I-15) and extends south to the high point of the Cajon Pass. Based on the City’s topography, the southern area has high elevations and the northern area has low elevations. The proposed land consists of commercial and industrial use.

Since the Freeway Corridor extends south of I-15, two additional pressure zones are needed to serve at the appropriate pressure. These new pressure zones were designated as Zone 5, operating at a hydraulic grade line (HGL) of 4,050 feet, and Zone 6, operating at a HGL of 4,300 feet. It is recommended that a new pump station be located at Plant 30 in Zone 4 to pump to the proposed Zone 5 tank and provide water supply to this pressure zone. A hydro-pneumatic tank is proposed in Zone 6 to service the highest elevations in the system. In addition, 12- and 16-inch diameter backbone pipelines were added to serve these new zones

6.4.4.2 <u>Rancho Las Flores</u>

Another major growth area is the RLF development in the southeast region of the system at the approximated elevation of 3,140 feet to 3,660 feet. Four new pressure zones, including one hydro-pneumatic zone, are proposed for this development per the *Design Criteria Memorandum for the Rancho Las Flores Water Reclamation Plant* prepared by Boyle Engineering in July 2006. This plan has been prepared for the RLF that identifies the facilities needed to accommodate the projected water demand. For this Master Plan, the recommended facilities in the proposed Zone RLF include five proposed wells and a dedicated pump station in Zone 2 to serve the RLF. One pressure-reducing station is proposed for the RLF, which would serve the southeast area of Zone 2.

6.4.4.3 Other Growth Areas

Other projected growth areas in the City are located within the existing pressure zones and do not require the creation of new zones. Zones 3A and 4 include future facilities with extended piping to new areas. These facilities are sized to meet existing and future demands.

6.5 RECOMMENDATIONS

Recommendations presented in this chapter were shown to be effective at mitigating fire flow, pressure, velocity, and future facility deficiencies in the system. Summary of the improvements are listed below:

Existing System Improvements:

- 54 miles of pipeline improvements for fire flow deficiencies.
- 1 mile of pipeline improvements for velocity deficiencies.
- 100 miles of steel pipeline replacement.

Future System Improvements:

- 26 new groundwater wells.
- Nine proposed booster pump stations.
- 84 miles of proposed pipeline.

WATER CONSERVATION ANALYSIS

7.1 GENERAL

Managing water demands in the high desert, where rapid population growth has had a significant impact on local groundwater levels, can be a major factor in future facility costs. Several methods may be used to reduce water demand and, consequently, costs. Implementation of a time-of-use pumping program, though increasing required supplemental facilities, could be offset with reduced energy costs. Reduced demand could potentially downsize the size and number of future facilities and provide a major source of cost savings. Effective existing and future conservation measures are the foundation on which demand reductions can be attained. Each of these methods is discussed in this chapter.

7.2 CHAPTER OBJECTIVES

The goals of this chapter of the Water Master Plan Update are to:

1. Provide potential time-of-use (TOU) energy savings and list of required supplemental facilities with associated costs.
2. Discuss downsizing of future facilities through conservation efforts.
3. Identify the City of Hesperia’s (City's) existing conservation measures and estimate their effectiveness.
4. Discuss proposed additional conservation measures.
5. Provide recommendations to help measure the effectiveness of all the conservation measures.

7.3 TIME OF USE ANALYSIS

Energy use is a significant cost to cities and agencies that must continuously pump water through their distribution systems. The City’s demands have increased, while storage facilities have remained constant. As a result, the wells and booster pumping stations are operating nearly 24 hours per day during the summer to meet the projected MDD. This continuous pumping incurs the costly energy rates during times of high use.

The City recognizes the potential cost savings in modifying this operation condition. Therefore, an off-peak pumping, or TOU, analysis was performed for future planning years to determine the estimated energy savings. Southern California Edison (SCE) will offer the City discounted energy rates provided the City does not operate its pumps during a predefined time. It is recommended that no pumping will take place during the energy peak hours of 1:00 p.m. to 5:00 p.m.

Analyses for off-peak pumping were performed based on three conditions. The first condition was that the City would be able to obtain and use enough additional storage to meet demands when wells and booster pumps are off-line. The second was that the system would require increased flow to fill reservoirs as well as meeting current demands. This would allow the reservoirs to have sufficient capacity to meet demands during off-peak pumping hours. This also requires larger diameter pumping lane pipelines to transmit the higher flow. The third condition was that some additional wells and larger boosters stations would be required to deliver the added volume water supply.

The analysis performed in this Master Plan was for planning year 2032. Using the ultimate build-out condition, the number of additional facilities and associated costs incurred for TOU pumping were obtained. Tables 7.1, 7.2, and 7.3 present the supplemental facilities that would be required to meet projected demands and implement TOU pumping. By evaluating ultimate demand conditions, the total cost and potential cost savings determine if the TOU operating strategy is a cost-effective option for the City.

Table 7.1 Supplemental Well Facilities Required to Implement TOU
Water Master Plan Update
City of Hesperia

Proposed Facility	Zone	Flow (gpm)	Head (ft)	Location
TOU-01	1	1,500	420	Ranchero Road and Niles Drive
TOU-02	1	1,500	500	Lake Arrowhead Road and Mono Drive
TOU-03	2	1,500	620	Willow and Eleventh Avenue
TOU-04	2	1,500	620	Ranchero and Earnart Avenue
TOU-05	3	1,500	820	Main and Maple Avenue
TOU-06	RLF	1,500	700	Ryeland and Vista Avenue

Table 7.2 Supplemental Storage Facilities Required to Implement TOU
Water Master Plan Update
City of Hesperia

Zone	Proposed Volume for 2032 (MG)	Additional Volume Required for TOU (MG)
1	16.5	1.4
2	23.0	4.2
3	23.0	2.2
4	20.0	3.6

Table 7.2	Supplemental Storage Facilities Required to Implement TOU (Continued) Water Master Plan Update City of Hesperia

Zone	Proposed Volume for 2032 (MG)	Additional Volume Required for TOU (MG)
5	5.0	0.3
6	0.1	0.2
RLF	5.0	2.6
Total	**92.6**	**14.4**

Table 7.3	Supplemental Pipelines Required to Implement TOU Water Master Plan Update City of Hesperia

Proposed Pipeline(1)	Zone	Length (ft)	Proposed 2032 Diameter (in)	Proposed TOU 2032 Diameter (in)
PROP_1114	2	459	24	32
PROP_1116	2	457	24	32
PROP_1118	2	472	24	32
PROP_1120	2	479	24	32
PROP_1136_TNK22_IN	2	634	32	36
PROP_1148	3	1,092	12	16
PROP_1150	3	607	12	16
PROP_1180_TNK18_IN	1	1,727	24	32
PROP_1222	4	173	12	16
PROP_1232	2	666	24	32
PROP_1234	2	719	24	32
PROP_1236	2	2,814	24	32
PROP_1250	4	222	20	24
PROP_1360	3	382	16	20
PROP_1362	3	2,724	16	20
PROP_1382	4	163	16	20
PROP_1486	3	818	12	16
PROP_1508	4	98	12	16
PROP_PS18_OUT	2	786	32	36
PROP_RES21_IN	2	850	24	32
RES19_IN_OUT_2010	3	759	24	32

Notes:
(1) The pipes are denoted by their Model ID number.

From the Tables 7.2 and 7.3, six new wells with an average capacity of 1,500 gpm, 14.5 MG of additional storage capacity throughout the entire system, and 17,000 feet of new pipelines were added to the system to meet the ultimate demands in year 2032 and implement TOU pumping. This results in an additional cost of $15.5 million (January 2007 dollars). This equates to an annual cost of $850,000 when these capital projects are depreciated over a 50-year period and 5 percent interest. Compared to the amount of potential energy savings, it was determined that it is not cost-effective to implement TOU operations for the City at this time. Detail costs are listed in the Capital Improvements Program chapter (Chapter 9).

7.4 WATER CONSERVATION ANALYSIS

Water conservation is important in the High Desert area of Southern California due to the limited groundwater supply. The City has several existing and planned water conservation measures it would like to implement to help manage the increasing water demands caused by rapid growth. As a result, plans for about 10-percent demand reduction by 2022 and up to 20-percent demand reduction by 2032 were analyzed to determine the potential reduction of future facilities.

This water demand reduction requires the review of the facilities proposed for planning year 2032. The goal is to reduce the amount and size of proposed facilities.

The first scenario analyzed was planning year 2032, since the ultimate condition would help determine the most critical facilities required. Planning year 2022 could then be analyzed, knowing which facilities were of importance to projected demands. The first scenario applied a 20-percent demand reduction into the system and evaluated the potential downsizing of pipelines, wells, and pumping facilities. Potential storage facility reductions are presented in Chapter 8. With the demand reductions, the distribution system must still operate according to the criteria listed in Chapter 1. Therefore, the following criteria were used to evaluate the system for each planning year.

1. Wells in higher pressure zones help fill higher zone tanks, which increases the City's overall supply reliability. The wells therefore were not selected for removal.

2. Pipelines throughout the system were typically downsized to no less than 8 inches in diameter. Transmission lanes that were associated with well or booster pump facilities and greater than or equal to 16 inches in diameter would be reduced to 12 inches in diameter, minimum.

3. No pipeline would be downsized to 8 inches in diameter. Therefore, pipelines that were already proposed as 12 inches in diameter were not considered for diameter reduction.

4. The maximum velocity criteria noted in Chapter 1 were maintained.

The hydraulic model simulation for each planning year was performed with the current proposed pipeline diameter and facilities and then with the downsized diameters and the reduced number of facilities. The results of these analyses are presented in Tables 7.4 and 7.5.

Table 7.4 Potential Well Facility Reduction with Water Conservation
Water Master Plan Update
City of Hesperia

Planning Year	Demand Reduction	Proposed Facility	Zone	Design Flow (gpm)
2022	10%	WELL_PMP_37	1	1,800
2032	20%	WELL_PMP_40	2	1,200
2032	20%	WELL_PMP_41	2	1,200
2032	20%	WELL_PMP_42	2	1,200
2032	20%	WELL_PMP_45	1	2,000

As shown in Table 7.4, approximately one well and four wells can be minimized if 10 percent or 20 percent of water conservation is realized respectively.

Table 7.5 Potential Pipeline Reduction with Conservation
Water Master Plan Update
City of Hesperia

Planning Year	Demand Reductio n	Proposed Pipeline[1]	Zone	Length (ft)	Proposed Diameter (in)	Proposed Conservation Diameter (in)
2022	**10%**	2562_1_TNK18_IN	1	1,790	18	12
		PROP_1176	1	370	24	20
		PROP_1178	1	5,451	24	20
		PROP_P1018_2010	1	1,319	16	12
		PROP_P1020	1	590	16	12
		PROP_P1022	1	650	16	12
		PROP_1114	2	459	24	20
		PROP_1116	2	457	24	20
		PROP_1118	2	472	24	20
		PROP_1120	2	479	24	20
		PROP_1122	2	658	18	12
		PROP_1136_TNK22_IN	2	634	32	24
		PROP_1156	2	394	16	12
		PROP_1232	2	666	24	20
		PROP_1234	2	719	24	20

Table 7.5 Potential Pipeline Reduction with Conservation (Continued)
Water Master Plan Update
City of Hesperia

Planning Year	Demand Reduction	Proposed Pipeline[1]	Zone	Length (ft)	Proposed Diameter (in)	Proposed Conservation Diameter (in)
		PROP_1236	2	2,814	24	20
		PROP_1238	2	970	32	24
		PROP_1240	2	503	32	24
		PROP_1242	2	327	32	24
		PROP_1312	2	609	24	20
		PROP_1314	2	424	24	20
		PROP_1316	2	132	24	20
		PROP_1318	2	403	24	20
		PROP_1320	2	501	24	20
		PROP_1322	2	533	24	20
		PROP_1324	2	481	24	20
		PROP_1326	2	489	24	20
		PROP_1328	2	518	24	20
		PROP_1330	2	502	24	20
		PROP_1332	2	502	24	20
		PROP_1334	2	511	24	20
		PROP_1336	2	515	24	20
		PROP_1338	2	513	24	20
		PROP_1340	2	1,233	24	20
		PROP_1342	2	793	24	20
		PROP_1448	2	5,288	16	12
		PROP_1452	2	7,291	16	12
		PROP_1454	2	7,860	16	12
		PROP_PS21_IN	2	573	24	24
		PROP_RES21_IN	2	850	24	24
		PROP_1138	3	312	32	24
		PROP_1140	3	1,813	24	20
		PROP_1142	3	717	16	12
		PROP_1360	3	382	16	12
		PROP_1362	3	2,724	16	12
		PROP_1364	3	347	32	24
		PROP_1450	3	1,638	20	16

Table 7.5 Potential Pipeline Reduction with Conservation (Continued)
Water Master Plan Update
City of Hesperia

Planning Year	Demand Reduction	Proposed Pipeline[1]	Zone	Length (ft)	Proposed Diameter (in)	Proposed Conservation Diameter (in)
		PROP_1494	3	2,569	16	12
		PROP_1496	3	996	16	12
		PROP_1498	3	796	16	12
		PROP_1514	3	5,746	20	16
		PROP_1570	3	666	24	20
		PROP_P1102_PS19_IN	3	395	32	24
		PROP_PS23_IN_TNK23IN	3	270	20	20
		PROP_RES23_IN_OUT	3	118	24	24
		RES19_IN_OUT_2010	3	759	24	24
		PROP_1166	4	344	18	12
		PROP_1170	4	1,985	18	12
		PROP_1210	4	3,080	18	12
		PROP_1224	4	3,283	18	12
		PROP_1250	4	222	20	16
		PROP_1572	4	627	16	12
		PROP_1576	4	147	16	12
		PROP_P1026	4	6,327	24	20
		PROP_P1100_PS19_OUT	4	193	32	24
		PROP_PS23_OUT	4	213	24	24
		PROP_P1006_2006	3A	1,188	20	16
2032	**20%**	PROP_1100	1	138	12	0
		PROP_1102	1	1,319	12	0
		PROP_1104	1	1,022	12	0
		PROP_1106	1	239	12	0
		2562_1_TNK18_IN	1	1,790	18	12
		PROP_1176	1	370	24	20
		PROP_1178	1	5,451	24	20
		PROP_P1018_2010	1	1,319	16	12
		PROP_P1020	1	590	16	12
		PROP_P1022	1	650	16	12
		PROP_1114	2	459	24	20
		PROP_1116	2	457	24	20
		PROP_1118	2	472	24	20

Table 7.5 Potential Pipeline Reduction with Conservation (Continued)
Water Master Plan Update
City of Hesperia

Planning Year	Demand Reduction	Proposed Pipeline[1]	Zone	Length (ft)	Proposed Diameter (in)	Proposed Conservation Diameter (in)
		PROP_1120	2	479	24	20
		PROP_1122	2	658	18	12
		PROP_1136_TNK22_IN	2	634	32	24
		PROP_1156	2	394	16	12
		PROP_1232	2	666	24	20
		PROP_1234	2	719	24	20
		PROP_1236	2	2,814	24	20
		PROP_1238	2	970	32	24
		PROP_1240	2	503	32	24
		PROP_1242	2	327	32	24
		PROP_1312	2	609	24	20
		PROP_1314	2	424	24	20
		PROP_1316	2	132	24	20
		PROP_1318	2	403	24	20
		PROP_1320	2	501	24	20
		PROP_1322	2	533	24	20
		PROP_1324	2	481	24	20
		PROP_1326	2	489	24	20
		PROP_1328	2	518	24	20
		PROP_1330	2	502	24	20
		PROP_1332	2	502	24	20
		PROP_1334	2	511	24	20
		PROP_1336	2	515	24	20
		PROP_1338	2	513	24	20
		PROP_1340	2	1,233	24	20
		PROP_1342	2	793	24	20
		PROP_1448	2	5,288	16	12
		PROP_1452	2	7,291	16	12
		PROP_1454	2	7,860	16	12
		PROP_RES21_IN	2	850	24	20
		PROP_1138	3	312	32	24
		PROP_1140	3	1,813	24	20
		PROP_1142	3	717	16	12

Table 7.5 Potential Pipeline Reduction with Conservation (Continued)
Water Master Plan Update
City of Hesperia

Planning Year	Demand Reduction	Proposed Pipeline[1]	Zone	Length (ft)	Proposed Diameter (in)	Proposed Conservation Diameter (in)
		PROP_1362	3	2,724	16	12
		PROP_1364	3	347	32	24
		PROP_1374	3	3,114	20	16
		PROP_1450	3	1,638	20	16
		PROP_1456_PS21_OUT	3	615	18	12
		PROP_1458_TNK23_IN	3	3,700	18	12
		PROP_1494	3	2,569	16	12
		PROP_1496	3	996	16	12
		PROP_1498	3	796	16	12
		PROP_1514	3	5,746	20	16
		PROP_1570	3	666	24	20
		PROP_1588	3	3,134	24	20
		PROP_1590	3	4,762	24	20
		PROP_1592	3	2,861	24	20
		PROP_P1102_PS19_IN	3	395	32	24
		PROP_PS23_IN_TNK23IN	3	270	20	16
		PROP_RES23_IN_OUT	3	118	24	20
		PROP_1170	4	1,985	18	12
		PROP_1210	4	3,080	18	12
		PROP_1224	4	3,283	18	12
		PROP_1244	4	5,408	18	12
		PROP_1246	4	8,374	18	12
		PROP_1380	4	3,918	16	12
		PROP_1382	4	163	16	12
		PROP_1572	4	627	16	12
		PROP_1576	4	147	16	12
		PROP_P1026	4	6,327	24	20
		PROP_P1100_PS19_OUT	4	193	32	24
		PROP_PS23_OUT	4	213	24	20
		PROP_P1006_2006	3A	1,188	20	16

Notes:
(1) The pipes are denoted by their Model ID number.

As shown in Table 7.5, 17 and 23 miles of pipeline can be downsized when 10 percent or 20 percent water conservation is realized, respectively.

7.5 CONSERVATION MEASURES

The City prepared a 2005 Urban Water Management Plan (UWMP) that was submitted to the Department of Health and Service at the end of 2005. The water conservation activities described in the 2000 UWMP and 2005 UWMP are discussed is this section.

7.5.1 Description of Existing Measures

The City evaluated the cost-effectiveness of potential water conservation measures, as reported in the 2000 Urban Water Management Plan. Table 7.6 shows the estimated costs, water savings, and avoided water cost for seven conservation measures. All measures were estimated to be cost-effective (i.e., less than or equal to the City's avoided water cost).

Table 7.6 Summary of Potential Water Conservation Program Costs and Savings
Water Master Plan Update
City of Hesperia

Conservation Measure	10-Year Estimated Cumulative Program Costs(1)	Cumulative 10-Year Water Savings (AF)	Estimated Cumulative 10-Year Avoided Water Cost(1)
1. School Education	$134,432	1,232	$228,044
2. Public Information	$548,161	3,853	$710,301
3. Customer Audits	$83,492	1,209	$218,014
4. Retrofits	$210,195	1,794	$335,673
5. Demonstration Gardens	$91,924	1,656	$301,566
6. Landscape Ordinance	$85,285	1,524	$276,993
Total	**$1,153,489**	**11,268**	**$2,070,591**

Notes:
(1) Costs given as present worth in 2000 dollars based on an interest rate of 7.625%.
(2) Source: Table 13, City of Hesperia 2000 Urban Water Management Plan.

The City has implemented school and public education programs, including building several demonstration gardens; and plumbing retrofits (distribution of kits that include low flow showerhead, faucet flow restrictors, toilet tank displacement devices, garden trigger spray nozzle, and leak detection devices). Ordinance No. 31, adopted by the City on April 26, 1990, outlines actions to address emergency or drought-related water shortages. Under a Stage 2, Threatened Water Supply Storage scenario, exterior landscape plans for new multi-family, commercial and industrial development must include use of drought-resistant plants and turf, limit turf area to 20 percent of landscaped area, use timed irrigation systems, and be approved by the City prior to starting water service.

Customer audits, grey water systems, and a landscape ordinance for normal conditions have not been implemented.

Table 7.7 summarizes the status of Demand Management Measures (DMM) specified in California's Urban Water Management Planning Act (UWMPA).

Table 7.7 Demand Management Measures
Water Master Plan Update
City of Hesperia

Demand Management Measure		Implemented	Planned for Implementation	Not Applicable
DMM 1:	Water Survey Programs		X	
DMM 2:	Residential Plumbing Retrofit	X		
DMM 3:	Water System Audits		X	
DMM 4:	Metering with Commodity Rates	X		
DMM 5:	Landscape Irrigation Programs		X	
DMM 6:	Washing Machine Rebate Program		X	
DMM 7:	Public Information	X		
DMM 8:	School Education	X		
DMM 9:	Commercial, Industrial and Institutional Programs	X		
DMM 10:	Wholesale Agency Programs			X
DMM 11:	Conservation Pricing	X		
DMM 12:	Water Conservation Coordinator	X		
DMM 13:	Water Waste Prohibition	X		
DMM 14:	Ultra Low Flush Toilet Replacement		X	

Notes:
(1) Source: City of Hesperia 2005 Urban Water Management Plan.

The above measures are more fully described in Chapter 7 of the City's 2005 Urban Water Management Plan.

Per discussion with the City's new water conservation specialist, 2005/06 activities through April 2006 include:

1. Participated in several community events.

2. Distributed approximately 400 water conservation kits at events and through the water billing department.

3. Conducted eight school presentations on water conservation.

4. Conducted a Water Awareness Coloring Contest, garnering participation by 3,500 students.

5. Visited over 700 residents and gave them water conservation literature.

6. Visited over 40 commercial properties and met with landscapers about excessive water runoff.

Plans for the remainder of 2006 include:

1. Continue the “runoff rover” program, where the conservation specialist identifies properties with excessive landscape runoff by driving around town during early morning hours. The specialist meets with the owner and landscaper to discuss resolution of the problem and how to monitor their landscape infrastructure for leaks. While HWD is not currently exercising its right to discontinue service as per the City’s Water Waste Ordinance No. 14.18.020, the conservation specialist is maintaining a log of offenders, and will consider taking further action for repeat offenders.

2. Water conservation specialist to attend an AWWA Water Conservation Plan training course.

3. Implement a water audit program.

4. Purchase 400 rain sensors for distribution to residential and commercial customers. The sensors attach to existing irrigation systems and automatically turn off irrigation water when it rains.

5. Purchase nine weather stations with sensors that shut off the water in the event of high winds, rain, or cold weather.

A program to replace high water use spray nozzle(s) located in restaurants, institutions, and commercial facilities with water-efficient models that use less hot water is planned for 2007. Water-efficient models use 1.6 gallons of water per minute, compared to 2 to 6 gallons per minute with standard valves. San Antonio’s program estimates water and wastewater savings of 100 to 300 gallons of hot water per day.[1]T

7.5.2 Effectiveness of Existing Water Conservation Program

Given that residential use accounts for over 85 percent of water use in the City, and that conservation measures implemented to date primarily impact residential users, the overall effectiveness of the water conservation program can be measured by a reduction in gallons used per capita per day (gpcd). This figure is calculated by dividing the residential water use by population.

It appears that the City’s water conservation program is reducing per capita water use. Table 7.8 shows that water use by the City’s residential customers has declined from

175 gpcd in 1999 to 162 gpcd in 2004. The U.S. average gpcd for people living in single-family homes is 101 gpcd.[2]

Table 7.8 Historical Water Use (gallons per capita per day)
Water Master Plan Update
City of Hesperia

Year	Residential Water Use (100 cu. ft.)(1)	Population(2)	Gallons per Capita per Day(3)
1999	5,311,098	62,091	175
2000	5,535,879	63,589	178
2001	5,493,139	64,479	175
2002	5,913,972	65,589	185
2003	5,754,515	67,843	174
2004	6,020,992	76,114	162
		Six-Year Average	**175**

Notes:
(1) SFR + MFR Metered Water Deliveries per Public Water System Statistics reports filed with Department of Water Resources.
(2) Population figures for 1999-2001 per Chapter 2, Exhibit 2-1, City of Hesperia 2002 Water Master Plan, So & Associates. Figures for 2002-2004 per Public Water System Statistics reports.
(3) Calculated.

Due to limited resources, the City has not collected data on the performance of specific water conservation measures implemented to date.

7.5.3 Additional Conservation Programs

Identifying and evaluating conservation measures is an important part of the planning process. Conservation measures should be selected that can save the most water for the lowest cost. Other factors may also impact the selection. Criteria to consider when selecting conservation measures for implementation include: program costs, cost-effectiveness and rate-payer impacts, ease of implementation, staff resources and capability, consistency with other programs, regulatory approvals and legal issues or constraints, environmental impacts, public acceptance, and timeliness of savings.

Good sources of information that describe measures and how to evaluate their water saving potential, benefits and costs, and implementation considerations include the resources referenced in Section 1.1.2.1 as well as:

1. *California Urban Water Conservation Council BMPs* (Best Management Practices). <http://www.cuwcc.com/memorandum.lasso>

2. *Water Conservation Best Management Practices Guide*, Texas Water Development Board Report 362, Water Conservation Implementation Task Force, 2004.

7.5.4 Water Conservation Plan

To maximize the effectiveness of investments in water conservation measures, the City should first develop a comprehensive water conservation plan that includes setting goals, analyzing and selecting a package of cost-effective conservation measures, and developing implementation plans and evaluation methodologies. Detailed guidelines for developing such plans can be found in the following sources:

1. Water Conservation Programs – A Planning Manual, American Water Works Association, 2005.

2. Handbook of Water Use and Conservation, Vickers, Amy, Water Plow Press, 2001.

3. Guidelines for Water Conservation Plans, US EPA, 1998. <http://www.epa.gov/owm/water-efficiency/webguid.htm>

7.5.5 Additional Conservation Measures

Over 85 percent of water use in the City is residential, and 60 percent of that is for outdoor use, so it makes sense to prioritize measures to reduce outdoor residential use. Studies have also shown that the largest use of residential indoor water is toilet flushing, followed by clothes washers.[3]

The following is a short (and not exhaustive) list of conservation measures that have been implemented elsewhere that the City can consider to enhance their water conservation efforts.

7.5.5.1 <u>Extend Water Efficient Landscape Ordinance to Normal Conditions</u>

In April 1990, HWD passed Ordinance No. 31, which outlines voluntary water conservation and water use restrictions during water supply shortages and emergencies. During Stage 2, or a Threatened Water Supply Shortage situation, requirements include:

1. Exterior landscape plans be approved by HWD for new multi-family, commercial and industrial development.

2. Drought-resistance plants and turf must be used, with turf limited to 20 percent of the landscaped area.

3. Timed irrigation systems must be used.

The City could amend the ordinance to extend some or all of the above requirements to single family homes and/or make them apply under normal conditions, rather than just in water shortage situations.

7.5.5.2 Retrofit Upon Sale Ordinance and/or Ultra Low Flush Toilet Rebate Program

The City's 2000 Urban Water Management Plan reported that 2,250 homes plus a large percentage of the 935 mobile homes within the HWD are pre-1980, which presents an opportunity to reduce water use through a toilet retrofit program. Los Angeles, San Diego, and Santa Monica have passed retrofit-on-resale ordinances to accelerate fixture replacement. The ordinances require that all non-conserving toilets and showerheads be replaced with water-efficient models when a property is sold. All three cities support their retrofit-on-resale ordinances with rebates.

Effective in 1980, the maximum flushing volume of new toilets sold in California was limited to 3.5 gallons per flush. The *1992 National Energy Policy Act,* effective January 1994, limited the flushing volume of new toilets to 1.6 gallons per flush. Assuming five flushes per day, replacing 3.5-gallon toilets in 1980 to 1993 homes can save about 9.5 gpcd[3], or almost 6 percent of 2004 daily usage of 162 gpcd. Replacing toilets in pre-1980 homes could save even more, on average 20 gpcd[4], or 12 percent of 2004 usage, as the older toilets use 5 to 7 gallons per flush.

7.5.5.3 Excess Use Surcharge

Albuquerque, New Mexico applies a surcharge of 21 cents per unit when customers' use exceeds 200 percent of the winter average usage. Residential winter average is calculated as the average for all meters of the same size. This strategy targets outdoor water usage, which may be a useful strategy for the City, where 60 percent of the residential consumption is for outdoor use.

7.5.5.4 Seasonal Irrigation Program (SIP)

Seasonal Irrigation Program (SIP) is a weekly customer advisory service of how much to water landscape based on daily evapotranspiration (ET), weather data, type of grass and sun exposure. The ET/SIP concept was tested in San Antonio, Texas for five years and has shown that the average homeowner saves over 5,000 gallons of water per month.[5]

7.5.5.5 Water Smart Home Program

Homebuilders can build water conservation measures into new homes, and qualify them under a Water Smart program. The Metropolitan Water District of Southern California gives homebuilders an incentive of $2,500 per home. In Southern Nevada, homebuilders pay the Water Authority for the right to use the Water Smart brand. Water Smart homes include water-efficient landscaping and irrigation systems, hot water recirculation systems and water-efficient appliances, saving 30 percent of typical use.

7.5.5.6 Golf Course Ordinance

The City could pass an ordinance requiring all golf courses to be operated in accordance with designated current Best Management Practices. Alabama; King County, Washington; and Florida, among others, have developed BMPs for golf course maintenance, which include water conservation measures. The ordinance could further stipulate that golf courses must also be consistent with the U.S. Golf Association "Environmental Principles for Golf Courses in the United States", as well as be located, designed and operated to minimize natural resources impacts. Sarasota County, Florida passed such an ordinance in 2003, which further requires new golf courses be "designed, constructed, certified, and managed in accordance with the Audubon International Signature Program for new golf courses or a similarly recognized golf course environmental certification program."

7.5.5.7 Irrigation Shut-Off Devices

Sarasota County, Florida also passed an ordinance that mandates irrigation shut-off devices be installed for all automatic systems, including those already installed.

7.5.6 Grants

There are grant programs available to implement water conservation programs. Resources to monitor for grant opportunities include:

1. Federal grants searchable database - www.grants.gov
2. California Urban Water Conservation Council - http://www.cuwcc.com/hotnews.lasso
3. U.S. Bureau of Reclamation Southern California Area Office - http://www.usbr.gov/lc/socal/wtrcons.html
4. U.S. Bureau of Reclamation 2025 - http://www.doi.gov/water2025/RFP2006/
5. California – Department of Water Resources Office of Water Use Efficiency - http://www.owue.water.ca.gov/index.cfm

7.5.6.1 Groundwater Educational Mini-Grant

The Mojave Water Agency provides up to $5,000 annually for $500 mini-grants that are awarded competitively to applicants for projects that actively engage project participants in the learning process. Possible projects include: sponsor Project WET seminars for teachers; produce a water conservation calendar for community distribution using children's art; involve high school students in performing water audits; or any number of other projects. One teacher bought water meters and had her students install them on showerheads to measure the amount of water used for showers in several homes. The City could apply for several mini-grants and/or encourage local schools to do so.

http://www.lewiscenter.org/local/gem.php

7.5.7 Measurement of Effectiveness of Conservation Elements

There are several benefits of evaluating the effectiveness of water conservation measures:

1. To review whether the program is meeting established goals.

2. To adjust programs that are not meeting goals.

3. To better project water demand.

4. To evaluate performance of pilot programs prior to full-scale implementation.

Ideally, an evaluation method is developed for each goal when setting the goals, and a performance evaluation that compares actual performance to goals is done at least annually, before the utility's annual budget is developed.

The American Water Works Association (AWWA) recently published "Water Conservation Programs – A Planning Manual," which recommends tracking four elements to assist in program evaluation:

1. Measure water savings – collect water use data before, during, and after implementation of a measure. Water savings estimates can also be calculated or adopted from the literature. Water savings from some measures, such as public education or hiring a water conservation coordinator, cannot be quantified. Savings from other measures, such ultra low flow toilet retrofits, can be calculated fairly easily by tracking the number of units installed, using the product specification and making some assumptions about use. Still others, such as large landscape audits, can be estimated per the literature. One source for such estimates is the California Urban Water Conservation Council Memorandum of Understanding (http://www.cuwcc.org/m_bmp.lasso) that lists water savings assumptions for each conservation measure.

2. Compare actual performance to goals.

3. Compare actual costs to budgeted costs.

4. Monitor how receptive customers are to the various conservation measures. Customer surveys can be used determine acceptance/barriers to conservation measures. Surveys can also be used to monitor progress of public education programs.

Many large utilities produce annual reports on their water conservation programs that include evaluations. A couple of good examples that can be found on the Internet are:

1. East Bay Municipal Utility District Annual Reports - http://www.ebmud.com/conserving_&_recycling/ conservation_publications/default.htm (scroll down)

2. Seattle/King County Regional Water Conservation Accomplishment Reports - http://www.seattle.gov/util/About_SPU/Water_System/Reports/ Conservation_Accomplishments/index.asp

In addition to the resources noted in sections 1.1.2. and 1.1.2.1 of this report, the AWWA published *Evaluating Urban Water Conservation Programs: A Procedures Manual* in 1993 that is a useful guide to developing evaluation procedures.

7.5.8 Alliance for Water Awareness and Conservation

The City is a member of the Alliance for Water Awareness and Conservation (AWAC), formed in 2003 to develop a regional water conservation program. The goal of the program is to reduce regional water use by 10 percent gross per capita by 2010 and 15 percent gross per capita by 2015. One of the aims of the AWAC is to provide "local communities with tools to effectively reduce per capita consumption to targeted goals."

AWAC is currently in the process of developing program evaluation methodology, and recently designated the year 2000 as the baseline for annual per capita water use, against which future per capita use can be compared as programs are implemented. As an active member of AWAC, Hesperia can leverage its efforts in developing evaluation methodologies for its own programs.

---

[1] http://www.saws.org/conservation/commercial/restaurant.shtml
[2] Wayne B. Solley, Robert R. Pierce, and Howard A. Perlman, *Estimated Use of Water in the United States in 1995*, p. 24.
[3] Mayer, Peter, D. Bennett, W.B. DeOreo, R. Harris, D. Muir, *Great Expectations – Actual Water Savings With the Latest High-Efficiency Residential Fixtures and Appliances*, Water Sources 2002 Conference Proceedings.)
[4] Vickers, Amy, *Handbook of Water Use and Conservation*, Water Plow Press, 2001.
[5] http://www.saws.org/conservation/SIP/

STORAGE ANALYSIS

8.1 GENERAL

Water distribution systems often rely on stored water to:

- Help equalize fluctuations between supply and demand.
- Supply sufficient water for fire fighting.
- Meet demands during an emergency or unplanned outage of a major supply source.

Adequate storage requirements include the sum of these volumes for operational, fire, and emergency storage. This analysis evaluates the ability of the City of Hesperia (City) storage facilities to meet the storage requirements for the water system. The resulting volume must be allocated to the pressure zones where the demands are, or within a higher-pressure zone (if there are pressure-regulating stations (PRSs) available that allow the water to flow into the lower zone). In addition, the water system was evaluated to determine if the existing PRSs allowed sufficient water to flow into the lower zones.

8.2 CHAPTER OBJECTIVES

The goals of this chapter of the Master Plan Report are to:

1. Establish storage needs for each pressure zone in the distribution system.
2. Determine where storage deficiencies exist.
3. Recommend facilities that mitigate the identified storage deficiencies.

8.3 STORAGE CRITERIA

8.3.1 Operational Storage

The required volume of water for operational storage is determined by the volume required for regulating the difference between the rate of supply and the daily variations (peaks) in water usage. This difference results in the lowest and highest operating levels in the reservoirs under normal conditions. The resulting volume must be allocated to either the pressure zones (where the demands are) or in a higher-pressure zone (for use by the lower zone).

American Water Works Association (AWWA) Manuals of Standard Practices M31 and M42 suggests that a minimum operational storage volume between 20 percent and 40 percent of the maximum day demand (MDD) is appropriate for mid-sized potable water distribution systems. The calibrated hydraulic model was used to evaluate the storage needs. It was recommended that 30 percent of MDD would provide adequate operational storage for the City's distribution system.

8.3.2 Fire Storage

The volume of water storage required for fire fighting is a function of the instantaneous flow rate required to fight the fire, the duration of the fire flow, and the number of fire flows that occur before the volume can be replenished. The fire flow requirements listed in Table 3.9 were used to establish the flow rate and duration for each type of fire.

The City's practice is to maintain sufficient fire flow storage within each pressure zone to fight one fire in each zone simultaneously. Therefore, fire flow storage from a reservoir in an upper zone was not credited to lower zones unless the lower zone had no other storage available. The land use category present in each zone that results in the highest fire flow storage requirement governs the sizing of the fire flow storage component in that zone. The minimum fire flow storage by zone and system-wide is presented in Table 8.1.

Table 8.1 Storage Requirements of Fire Storage
Water Master Plan Update
City of Hesperia

Pressure Zone	Governing Land Use	Fire Flow (gpm)	Minimum Duration (hrs)	Fire Flow Storage (MG)
Zone 1	Industrial	4,000	4	1.0
Zone 2	Industrial	4,000	4	1.0
Zone 3	Commercial	3,500	3	0.6
Zone 4	Industrial	4,000	4	1.0
Zone 5	Industrial	4,000	4	1.0
Zone 6	Commercial	3,500	3	0.6
Zone 7	Low Density Residential	1,500	2	0.2
Total for Planning Year 2007(1)				**3.5**
Total for Planning Year 2012 and beyond(2)				**5.3**

Notes:
(1) Based on total of Zones 1 through 4
(2) Based on total of Zones 1 through 7

8.3.3 Emergency Storage

An emergency source is a dedicated source of water that can be used as a backup supply in the event a major supply is interrupted. This can be provided by water from a second independent source, by water stored in reservoirs, or a combination of both.

Water systems with multiple sources of supply frequently consider emergency storage as a practical, but relatively short-term, supply source for emergencies. However, longer-term storage requires significantly more storage.

Numerous scenarios could be considered to evaluate the necessary emergency storage. After evaluating various scenarios and identifying which were considered reasonable emergency scenarios that may occur within the City's system, the following criteria were established:

1. Loss of the largest water supply source in Zone 1 (Well 5A) and Zone 2 (Well 24) for seven days under ADD conditions.
2. City-wide loss of power (electricity) for 24 hours under MDD conditions.

The emergency storage required for each pressure zone was based on the most severe of these two conditions. The amount of emergency storage available with any system improvements is calculated by planning year for ADD and MDD demand conditions by subtracting the required fire flow and operational storage from the existing storage capacity of 59.5 MG. The available emergency storage decreases over time as demand and therefore operational and fire flow storage requirements increase. The results are presented in Table 8.2.

Table 8.2 Emergency Storage by Planning Year
Water Master Plan Update
City of Hesperia

Planning Year	Demand Condition	Demand (gpm)	Demand(1) (mgd)	Existing Storage(2) (MG)	Operational Storage(3) (MG)	Fire Flow Storage(4) (MG)	Emergency Storage Available(5) (MG)
2007	ADD	10,417	15.0	59.5	4.5	3.5	51.5
	MDD	18,122	26.1	59.5	7.8	3.5	48.2
2012	ADD	18,700	26.9	59.5	8.1	5.3	46.1
	MDD	32,538	46.9	59.5	14.1	5.3	40.2
2017	ADD	25,741	37.1	59.5	11.1	5.3	43.1
	MDD	44,789	64.5	59.5	19.3	5.3	34.9
2022	ADD	31,427	45.3	59.5	13.6	5.3	40.6
	MDD	54,683	78.7	59.5	23.6	5.3	30.6
2027	ADD	34,390	49.5	59.5	14.9	5.3	39.4
	MDD	59,839	86.2	59.5	25.9	5.3	28.4
2032	ADD	36,078	52.0	59.5	15.6	5.3	38.6
	MDD	62,776	90.4	59.5	27.1	5.3	27.1

Notes:
(1) Per Table 3.10.
(2) Per Table 2.3.
(3) Based on 30 percent of the ADD or MDD.
(4) Per Table 8.1.
(5) Existing Storage minus Operational Storage and minus Fire Flow Storage.

8.4 STORAGE ANALYSIS

A spreadsheet model was developed to analyze the City's storage requirements on a zone-by-zone basis. This spreadsheet model provides the capability to analyze each pressure zone using ADD and MDD periods for existing and future years. Using this storage analysis model, simulations were conducted for planning years 2007, 2012, 2017, 2022, 2027, and 2032. The results of these analyses are included in Appendix F. The summary of the analysis with the largest source out of service is presented in Table 8.3, while the power outage analysis is summarized in Table 8.4.

Discussions of the storage analysis for the entire system and by pressure zone are provided below.

8.4.1 System-Wide Storage Analysis

The system-wide storage analysis is an examination of the supply sources for the water system with respect to the loss of one or more sources for a specified amount of time. The analysis evaluates the water system's ability to meet the existing and projected demands. The two emergency scenarios identified in Section 8.3.3 were evaluated to determine the most severe condition for each planning year. The results of this analysis are presented in Table 8.3.

As shown in Table 8.3, the total firm groundwater supply from the existing wells (18,529 gpm) and the available emergency storage under ADD conditions (51.5 MG) are sufficient to meet provide seven days of ADD under existing conditions. The first planning year that shows a storage/supply deficit is 2022. Due to an increase in water demands, there is a 30 MG deficit over a 7-day period when no new reservoirs or groundwater wells are constructed. This deficit increases to nearly 79 MG by year 2032.

As shown in Table 8.4, the available groundwater supply under a power outage is limited to the combined production of Wells 22 and two additional wells by using the portable 400-hp generators. It is assumed that these generators would be used for the largest wells in Zone 1 (Well 5A) and Zone 2 (Well 20). The combined supply capacity with the backup power facilities is approximately 6,500 gpm or 9.4 mgd. These supplies combined with the available emergency storage under MDD conditions is sufficient to meet one day of MDD under existing conditions. The first planning year that shows a storage/supply deficit is 2017. Due to an increase in water demands, there is a 20 MG when no new reservoirs or groundwater wells are constructed. This deficit increases to nearly 54 MG by year 2032.

These deficits can be addressed by constructing more storage reservoir capacity of adding water supply sources, such as groundwater wells.

Table 8.3 Storage Analysis - Largest Source out of Service
Water Master Plan Update
City of Hesperia

Planning Year	Demands			Available Supplies				Storage/ Supply Deficit (MG)
	ADD (mgd)	MDD (mgd)	Required Demand[1] (MG)	Firm Well Capacity[2] (gpm)	Total Well Supply (MG)	Emergency Storage[3] (MG)	Total Supply (MG)	
2007	15.0	26.1	105.0	18,529	186.8	51.5	238.3	none
2012	26.9	46.9	188.5	24,429	246.2	46.1	292.4	none
2017	37.1	64.5	259.5	24,429	246.2	43.1	289.3	none
2022	45.3	78.7	316.8	24,429	246.2	40.6	286.9	29.9
2027	49.5	86.2	346.7	24,429	246.2	39.4	285.6	61.0
2032	52.0	90.4	363.7	24,429	246.2	38.6	284.9	78.8

Notes:
(1) 7 days of ADD.
(2) Based on outage of two largest wells in Zone 1 (Well 5A) and Zone 2 (Well 24). Per Table 4.3.
(3) Available emergency storage under ADD conditions per Table 8.2.

Table 8.4 Storage Analysis - Power Outage
Water Master Plan Update
City of Hesperia

Planning Year	Demands: ADD (mgd)	Demands: MDD (mgd)	Demands: Required Demand(1) (MG)	Available Supplies: Available Well Capacity(2) (gpm)	Available Supplies: Total Well Supply (MG)	Available Supplies: Emergency Storage(3) (MG)	Available Supplies: Total Supply (MG)	Storage/ Supply Deficit (MG)
2007	15.0	26.1	26.1	6,501	9.4	48.2	57.5	none
2012	26.9	46.9	46.9	6,501	9.4	40.2	49.5	none
2017	37.1	64.5	64.5	6,501	9.4	34.9	44.2	20.3
2022	45.3	78.7	78.7	6,501	9.4	30.6	40.0	38.8
2027	49.5	86.2	86.2	6,501	9.4	28.4	37.7	48.4
2032	52.0	90.4	90.4	6,501	9.4	27.1	36.5	53.9

Notes:
(1) 24 hours of MDD.
(2) Based on operation of Wells 22 (back-up generator) and Wells 5A and 20 (two portable generators). Per Table 4.3.
(3) Available emergency storage under MDD conditions per Table 8.2.

8.4.2 Zone 1

This pressure zone has three storage reservoirs that total about 11.5 MG. The storage analysis for 2007 identifies a need for 0.96 MG for fire storage, 1.60 MG for operational storage, and 5.34 MG for emergency storage. The total storage needed in Zone 1 is about 7.9 MG. There is sufficient emergency supply to meet the storage demands in this zone.

In 2012 and 2017, the required storage is 9.50 MG and 10.10 MG, respectively. Although these storage needs can be met by the available storage in this zone, analysis shows a storage deficit by 2017 in Zone 2. To mitigate the deficient supply in Zone 2, it is recommended that an on-site generator be provided at the booster station at Plant No. 18 to transfer water to the nearby deficient zone.

In 2022 and 2027, the required storage is 10.88 MG and 11.37 MG, respectively. Although the storage needs can be met by the available storage in this zone, analysis shows a storage deficit in the higher zones. By placing a new 5-MG reservoir in Zone 1, water can efficiently be transferred to the upper zones using existing facilities.

In 2032, this pressure zone will have four storage reservoirs that total about 16.5 MG. The storage analysis identifies a need for 0.96 MG for fire storage, 2.55 MG for operational storage, and 8.48 MG for emergency storage. The total storage needed in Zone 1 for this planning year is 11.99 MG. Although the storage needs can be met by the available storage in this zone, analysis shows a storage deficit in the higher zones. It is recommended that an on-site generator be provided at the booster station at Plant No. 14 to supplement Plant No. 18 and transfer water to Zone 2. Also, it is recommended to add on-site generators at Wells 5A and 26 to provide required supplies to nearby deficient zones via existing booster stations.

8.4.3 Zone 2

Zone 2 currently has four storage tanks totaling 18.0 MG. Well 22, which is available since it has an existing on-site generator, is located within Zone 2 and contributes about 2.75 MG of emergency supply. Therefore, the total available storage is 20.72 MG. The storage analysis for the existing system identifies a need for 0.96 MG for fire storage, 4.21 MG for operational storage, and 14.02 MG for emergency storage. The total storage needed in Zone 2 is about 19.19 MG. There is sufficient emergency supply to meet the storage demands in this zone.

In 2012 and 2017, the required storage is 24.27 MG and 27.36 MG, respectively. A new 5-MG reservoir is recommended in this zone for a total storage capacity of 25.72 MG. The remaining storage deficit in 2017 can be supplied from existing booster stations or PRVs.

In 2022 and 2027, the required storage is 30.18 MG and 33.10 MG, respectively. It is recommended that additional equivalent storage be provided through existing wells with new on-site generators; Well 24 by 2022 and Well 20 by 2027. This option provides about 6 MG of additional emergency supply, while adding reliability to the existing water system.

In 2032, the total storage required is 35.10 MG. With the total available storage of 31.20 MG, this pressure zone has a net deficiency that can be met from boosting water from Zone 1. In addition, Zone 3 has deficient storage that can be met from a surplus in Zone 1. It is recommended to add an on-site generator at the booster station at Plant No. 21 to help transfer water from Zone 1 through Zone 2 to Zone 3.

8.4.4 Zone 3

This pressure zone has three storage reservoirs providing a total available volume of 15 MG. The storage analysis for 2007 identifies a need for 0.63 MG for fire storage, 1.68 MG for operational storage, and 5.58 MG for emergency storage. The total storage needed in Zone 3 is 7.89 MG. In 2012, the required storage increases to 12.08 MG. For both years, there is sufficient emergency supply to meet the storage demands in this zone.

In 2017, the storage analysis identifies a need for 0.63 MG for fire storage, 3.18 MG for operational storage, and 10.59 MG for emergency storage. The total storage needed is 14.40 MG. Although these storage needs can be met by the available storage in this zone, analysis shows a storage deficit in Zone 2, Zone 4, and proposed Zones 6 and RLF. Placing a new 3-MG reservoir and a 5-MG reservoir in this zone would mitigate deficiencies in other zones as well as provide the required additional storage in this zone in future planning years.

By 2022, the required storage increases to 16.13 MG as does the storage deficit in Zone 4. By adding an on-site generator at the booster station of Plant 19A, deficient storage in other zones can be met through existing PRVs or the booster station as required. Additional storage in Zone 3 provides flexibility to provide water efficiently to either higher or lower zones throughout the system.

In 2027 and 2032, the required storage is 17.55 MG and 18.43 MG, respectively. Although these storage needs can be met by the available storage in this zone, analysis shows a system wide storage deficit for these planning years. Placing new reservoirs in Zone 3 in the previous planning years help provide an efficient way to transfer water to the nearby upper and lower zones using most of the existing facilities.

8.4.5 Zone 4

Zone 4 currently has three storage tanks with a total available capacity of 15 MG. The 2007 storage analysis identifies a need for 0.96 MG for fire storage, 0.81 MG for operational storage, and 2.71 MG for emergency storage. The total storage needed in Zone 4 is 4.48 MG. The storage required for 2012 increases to 10.66 MG. Although these storage needs can be met by the available storage in this zone, analysis shows a storage deficit in proposed Zone 6 (see Section 8.4.1.6). It is recommended that a new booster pump station with an on-site generator be constructed by 2012 at zone 5 to boost water to Zone 6.

By 2017 and 2022, the storage needed increases significantly to 18.52 MG and 25.36 MG, respectively. This zone requires 5 MG of additional storage by 2022 and 5 MG of additional storage by 2027 for a total of 25 MG by 2027. Although the required storage for 2027 and 2032 increase to 29.57 MG and 30.27 MG, respectively, the demands can be met from the lower zones through the proposed booster pumping station.

8.4.6 Zones 5 and 6

These two pressure zones are proposed zones for future planning years to better serve the higher elevations of Zone 4 within the system and to serve the newly annexed Freeway Corridor. Zone 5 is a small zone that requires a total storage of 3.64 MG by 2032. Subsequently, Zone 6 is to be fed from the lower Zone 5. Zone 6 is slightly smaller than Zone 5 and has a total required storage of 2.09 MG. Based on the results of the analyses, a new Zone 5 booster station and an on-site generator in the Near Term would mitigate any storage deficiency by transferring water from the lower zone to the proposed higher zone. In addition, a new 5-MG reservoir in Zone 5 in the Near Term would provide the required storage for all future planning years.

8.4.7 RLF Pressure Zones

To effectively incorporate the water system within the Rancho Los Flores (RLF) development, it is recommended that a separate pressure zone be designated for this region. Based on its location, Zone RLF would have a hydraulic grade line (HGL) slightly higher than that of Zone 2. It is recommended that a new 5-MG reservoir be constructed at the creation of this pressure zone. In 2012, the storage analysis identifies a need for 0.18 MG for fire storage, 1.71 MG for operational storage, and 5.69 MG for emergency storage. The total storage needed in this zone is 7.58 MG. The new 5 MG reservoir and water boosted from Zone 2 are able to meet the required storage needs in this planning year.

In 2017 and 2022, the storage needs increase significantly to 14.96 MG and 20.24 MG, respectively. As emergency back up generators are essential to reliability in a water system, it is recommended that on-site generators be installed at two of the proposed wells in Zone RLF by 2017 and at one additional well by 2022. This supply would provide an additional 7.34 MG of water to this zone by 2022, with the remaining storage deficit provided by Zone 2 via existing booster pumps.

By 2027, the other zones will have increased storage needs and will not be able to provide Zone RLF with supplemental waters. This system-wide storage deficit instigates the need for a second 5-MG reservoir in Zone RLF, which will also be sufficient for 2032 storage requirements.

8.5 RECOMMENDED STORAGE IMPROVEMENTS

The storage analysis resulted in a list of storage improvements necessary to provide adequate capacity for operational, fire, and emergency storage requirements. Table 8.5 summarizes the recommended improvements. Table 8.5 does not include any improvements for 2007 as the analysis shows that the existing system meets all storage and supply requirements.

Table 8.5 Recommended Storage Improvements by Planning Year and Zone
Water Master Plan Update
City of Hesperia

Planning Year	Zone	Proposed Facility	Volume (MG)
Near Term	5	New Zone 5 Reservoir	5
	6	New Hydro-pneumatic Tank	-
2012	2	New Reservoir (No. 21A)	5
	RLF	New Reservoir (No. RLF-1)	5
	4	Emergency Generator at New BPS from Zone 4 to 5	-
	5	Emergency Generator at New BPS from Zone 5 to 6	-
2017	3	New Reservoir (No. 23A)	3
	4	New Reservoir (No. 19C)	5
	1	Emergency Generator at BPS of Plant No. 18	-
	RLF	Emergency Generator at Well No. RLF-1	-
	RLF	Emergency Generator at Well No. RLF-2	-
2022	1	New Reservoir (No. 18A)	5
	4	New Reservoir (No. 30D)	5
	3	Emergency Generator at BPS of Plant No. 19A	-
	2	Emergency Generator at Well No. 24	-
	RLF	Emergency Generator at Well No. RLF-3	-
2027	4	New Zone 4 Reservoir	5
	RLF	New Reservoir (No. RLF-2)	5
	2	Emergency Generator at Well No. 20	-
2032	1	Emergency Generator at BPS of Plant No. 14	-
	2	Emergency Generator at BPS of Plant No. 21	-
	1	Emergency Generator at Well No. 5A	-
	1	Emergency Generator at Well No. 26	-
Total			**43.0**

As shown in Table 8.5, a total of 43.0 MG of new storage reservoirs, six new emergency generators at BPS, and six new emergency generators for groundwater wells are recommended. These facilities are included in the CIP of this Master Plan.

The system-wide deficiencies identified in Table 8.3 (largest source out of service) and Table 8.4 (Power Outage) are all addressed when these storage, backup power, and the supply recommendations listed in Table 6.3 are implemented. The results with these recommendations in place are presented in Table 8.6 and Table 8.7.

8.5.1 Impacts of Conservation and Recycled Water

Further storage analyses were conducted to determine the impact of conservation and recycled water on the water system with respect to the proposed storage improvement projects. To be consistent with the conservation analysis performed in Chapter 7, two conditions were analyzed. One incorporated 10-percent demand reduction through conservation by 2022. The second analyzed a 20-percent demand reduction through conservation by 2032.

The projected demands identified in the Recycled Water Master Plan (RWMP) were used to calculate the reduction in potable water demand by planning year. This demand reduction was incorporated into the storage analyses to determine the impact of its use to the recommended storage improvements. The analyses showed that the implementation of recycled water and a projected 20-percent demand reduction had a significant impact on the number of required storage facilities.

Table 8.8 presents a matrix with future planning years and the different demand reduction conditions that could impact the storage facilities. The table lists the facilities that would no longer be required if certain reductions were made.

These alternative water sources could potentially save the City the cost of two emergency generators and up to seven reservoirs. The ultimate savings in facility construction are contingent on maintaining the alternative water sources in previous years. For example, in 2032, the removable reservoirs and emergency generators listed are dependent on maintaining a 20-percent demand reduction through conservation in 2022 and 2027. If not, additional storage would be required to meet the storage needs.

The cost savings from these storage improvement projects may be compared to the costs of building the recycled water system and encouraging conservation efforts to determine the exact monetary benefits. However, the environmental and long-term community benefits may override these costs. Stringent adherence to demand reduction would be necessary to mitigate the need for future storage facilities.

Table 8.6 Storage Analysis - Largest Source out of Service WITH improvements
Water Master Plan Update
City of Hesperia

Planning Year	Demands			Available Supplies				Storage/ Supply Deficit (MG)
	ADD (mgd)	MDD (mgd)	Required Demand(1) (MG)	Firm Well Capacity(2) (gpm)	Total Well Supply (MG)	Emergency Storage(3) (MG)	Total Supply (MG)	
2007	15.0	26.1	105.0	18,529	186.8	51.5	238.3	none
2012	26.9	46.9	188.5	32,129	323.9	56.1	380.0	none
2017	37.1	64.5	259.5	43,279	436.3	66.1	502.4	none
2022	45.3	78.7	316.8	48,679	490.7	73.6	564.3	none
2027	49.5	86.2	346.7	55,779	562.3	82.4	644.6	none
2032	52.0	90.4	363.7	63,986	645.0	81.6	726.6	none

Notes:
(1) 7 days of ADD.
(2) Based on outage of two largest wells in Zone 1 (Well 5A) and Zone 2 (Well 24) after implementing the new wells recommendations listed in Table 6.3.
(3) Available emergency storage under ADD conditions per Table 8.2 plus new storage per Table 8.7.

Table 8.7 Storage Analysis - Power Outage WITH improvements
Water Master Plan Update
City of Hesperia

Planning Year	Demands			Available Supplies				Storage/ Supply Deficit (MG)
	ADD (mgd)	MDD (mgd)	Required Demand[(1)] (MG)	Available Well Capacity[(2)] (gpm)	Total Well Supply (MG)	Emergency Storage[(3)] (MG)	Total Supply (MG)	
2007	15.0	26.1	26.1	16,406	23.6	48.2	71.8	none
2012	26.9	46.9	46.9	16,406	23.6	50.2	73.8	none
2017	37.1	64.5	64.5	16,406	23.6	57.9	81.5	none
2022	45.3	78.7	78.7	16,406	23.6	63.6	87.2	none
2027	49.5	86.2	86.2	16,406	23.6	71.4	95.0	none
2032	52.0	90.4	90.4	16,406	23.6	70.1	93.7	none

Notes:
(1) 24 hours of MDD.
(2) Based on operation of Wells 5A, 22, 24, 26, and three 1,500 gpm RLF wells (back-up generators) and Wells 14A and 20 (two portable generators).
(3) Available emergency storage under ADD conditions per Table 8.2 plus new storage per Table 8.7.

Table 8.8 Storage Reduction due to Conservation and Recycled Water
Water Master Plan Update
City of Hesperia

Planning Year	Alternative Water Source[1]	Proposed Facility Not Required								
		Reservoir							Emergency Generator at:	
		#21A	#23A	#30D	#18A	#19C	Z4[2]	RLF-2	Well #20	Well #26
2012	Recycled Water Only	X								
	10% Conservation Only									
	10% Conservation and RW									
	20% Conservation Only									
	20% Conservation and RW									
2017	Recycled Water Only	X	X							
	10% Conservation Only									
	10% Conservation and RW									
	20% Conservation Only									
	20% Conservation and RW									
2022	Recycled Water Only	X	X						X	
	10% Conservation Only	X	X						X	
	10% Conservation and RW	X	X	X	X				X	
	20% Conservation Only									
	20% Conservation and RW									

Table 8.8 Storage Reduction due to Conservation and Recycled Water (Continued)
Water Master Plan Update
City of Hesperia

Planning Year	Alternative Water Source[1]	Proposed Facility Not Required								
		Reservoir							Emergency Generator at:	
		#21A	#23A	#30D	#18A	#19C	Z4[2]	RLF-2	Well #20	Well #26
2027	Recycled Water Only	X	X						X	
	10% Conservation Only	X	X						X	
	10% Conservation and RW	X	X	X	X				X	
	20% Conservation Only									
	20% Conservation and RW									
2032	Recycled Water Only	X	X						X	X
	10% Conservation Only									
	10% Conservation and RW									
	20% Conservation Only			X	X		X	X	X	X
	20% Conservation and RW	X	X	X	X	X	X	X	X	X

Notes:
(1) RW indicates recycled water.
(2) Z4 refers to the new 5-MG Reservoir in Zone 4 in addition to #30D.
(3) Shaded areas indicate the water supply condition is not available for this planning year.

CAPITAL IMPROVEMENT PROGRAM

9.1 GENERAL

The capital improvement program (CIP) is an important element of a master plan. The CIP summarizes the recommended facilities, identifies the estimated costs of these facilities, and develops a timetable for the implementation of the recommendations. Recommended improvements from the various analyses performed were included in the CIP to provide a comprehensive picture of improvements for the City of Hesperia (City).

9.2 CHAPTER OBJECTIVES

The goals of this chapter of the CIP are to:

1. Summarize the recommended improvements and estimated project costs.
2. Prioritize the recommended improvements and identify the planning period in which the improvements should be constructed.

9.3 GENERAL COST ASSUMPTIONS

Cost estimates presented in this Master Plan are based on the current Engineering News Record (ENR) cost index for the Los Angeles metropolitan area of 8,871 published in January 2007. Future adjustments of cost estimates presented in this report can be estimated by increasing the estimated capital cost by the ratio of the future ENR to 8,871.

Cost estimates developed for this Master Plan are based on January 2007 dollars. Total project cost estimates include estimated costs for construction, engineering, legal, administration, construction management, and contingency. Estimated construction costs are based on historical bids submitted by contractors for similar projects designed by Carollo Engineers (Carollo). The estimated costs of engineering, legal, administration, and construction management were assumed to be 35 percent of the estimated construction cost. A contingency of 25 percent of the estimated direct construction cost was also included in the total project cost estimates.

Table 9.1 General Project Cost Assumptions
Water Master Plan Update
City of Hesperia

Description	Value
Engineering, Administration, Legal, and Construction Management	35% of the construction cost estimate
Contingency	25% of the direct construction cost estimate

The cost estimates are based on current perceptions of conditions at the project locations. These estimates reflect Carollo's professional opinion of costs at this time and are subject to change as the project design matures. Carollo has no control over variances in the cost of labor, materials, equipment, services provided by others, contractor's methods of determining prices, competitive bidding or market conditions, practices, or bidding strategies. Carollo cannot and does not warrant or guarantee that proposals, bids, or actual construction costs will not vary from the costs presented herein.

9.3.1 Estimated Project Costs for Pipelines

The project costs for distribution pipelines and transmission mains were estimated using unit costs as listed in Table 9.1. This unit cost was assumed to include the material and installation only. Cost for engineering, legal, administration, construction management, and contingency were not included in the listed unit costs. The acquisition costs of land or easements are not included in the pipeline cost estimates.

Table 9.2 Unit Cost for Distribution pipelines and Transmission Mains
Water Master Plan Update
City of Hesperia

Diameter (in)	Unit Cost ($/ft)
8	$80
12	$100
16	$130
18	$150
20	$170
24	$200
30	$230
32	$250
36	$270
42	$310
48	$360

9.3.2 Estimated Project Costs for Pressure Reducing Stations

The project costs for pressure reducing stations (PRS) were assumed to include the material and installation, engineering, legal, administration, construction management, and contingency. The cost of acquisition of land or easements is not included in these cost estimates. Table 9.3 lists the estimated project costs for the miscellaneous valves identified in this Master Plan.

Table 9.3	Estimated Project Costs for Pressure Reducing Stations Water Master Plan Update City of Hesperia
Description	**Estimated Project Cost**
PRS with 6-inch or 8-inch diameter valves	$150,000 each
PRS with 12-inch diameter valves	$200,000 each

9.3.3 Estimated Project Costs for Booster Pumping Stations

The estimated project costs for booster pumping stations was estimated using the following equation:

Estimated Pumping Station Project Cost = $1.7 * 10^{(0.7583*\log(Q)+3.1951)}$;
where Q is in gpm

Source: Pumping Station Design, Sanks et al. (adjusted to January 2007 dollars)

This equation includes estimated costs for engineering, legal, administration, construction management, and contingency. For booster pumping stations, this equation was multiplied by a factor of 0.33 to account for the reduced costs in the City. However, to estimate the cost of wells, the equation was used as is.

The estimated pumping station project costs do not include operation and maintenance (O&M) costs to operate the station. The acquisition cost of land or easements is not included in the pumping station cost estimates.

9.3.4 Estimated Project Costs for Wells

The estimated project costs for groundwater wells were estimated using the equation for booster pumping stations in Section 9.3.3. Additional costs were added for drilling of the well and on-site generators. Table 9.4 lists the estimated unit costs for drilling and on-site generators.

Table 9.4	Estimated Project Costs for Wells and On-Site Generators Water Master Plan Update City of Hesperia
Description	**Estimated Unit Cost**
Drilling of Well	$780,000 each
Equipping Well Facility	See Section 9.3.3
On-Site Generator (less than 2,000 gpm capacity)	$100,000 each
On-Site Generator (2,000 gpm capacity and greater)	$200,000 each

The project costs include material and installation, engineering, legal, administration, construction management, and contingency. The estimated well project costs do not include O&M costs to operate the pump. The cost of acquisition of land or easements is not included in the well pumping station cost estimates.

9.3.5 Estimated Project Costs for Reservoirs

The project costs for reservoirs were assumed to include the material and installation, engineering, legal, administration, construction management, and contingency. It was also assumed that the facilities would be aboveground steel tanks. The cost of acquisition of land or easements is not included in these cost estimates. Table 9.5 lists the estimated project unit costs for reservoirs per gallon.

Table 9.5 Estimated Project Costs for Reservoirs
Water Master Plan Update
City of Hesperia

Description	Estimated Project Unit Cost
Less than 1.0 MG Reservoir	$1.75/gallon
1.0 MG up to 1.5 MG Reservoir	$1.50/gallon
1.5 MG up to 2.0 MG Reservoir	$1.25/gallon
2.0 MG up to 2.5 MG Reservoir	$1.00/gallon
Greater than 2.5 MG Reservoir	$0.75/gallon

9.4 CAPITAL IMPROVEMENT PROGRAM

9.4.1 Phasing Periods

The recommended improvements identified in this Master Plan include the recommended facilities identified in Chapters 6, 7, and 8. The improvements were prioritized into three categories:

1. Phase 1 (Near Term):
    a. These are health and safety related, such as improvements that are needed for fire flows.
    b. These improvements should be implemented immediately; therefore, they have been scheduled for implementation as soon as possible. The estimated planning year for this category in the CIP lists is identified as near term.
2. Phase 2 (2007-2012):
    a. These are typically operational improvements that improve system pressure, improve the City’s ability to use groundwater, or are developer driven for a project that is planned within this timeframe.
    b. These improvements are also important and are scheduled for implementation between within the next 5 years. The estimated planning year for this category in the CIP lists is identified as 2012.

3. Phase 3 (2013-2017):

    a. These are typically operational improvements that improve system pressure, improve the City's ability to use groundwater, or are developer driven for a project that is planned within this timeframe.

    b. These improvements are also important and are scheduled for implementation within the next 10 years. The estimated planning year for this category in the CIP lists is identified as 2017.

4. Phase 4 (2018-2032):

    a. While important, these improvements are not as essential as those that fall under the first three categories are. Typical improvements for this category include developer-driven improvements that may not be required until 2022, up to 2032. This category also includes other miscellaneous facilities.

    b. These improvements are scheduled for implementation within the next 15 to 25 years or beyond. The estimated planning year for this category in the CIP lists is identified as 2032.

9.4.2 Existing System Improvements

The improvements identified in chapter 6, 7, and 8 to address system deficiencies are:

- 54 miles of pipeline improvements for fire flow deficiencies.
- 1 mile of pipeline improvements for velocity deficiencies.
- 100 miles of steel/small diameter pipeline replacements.

The existing system pipeline improvements are shown in Figure 9.1, while the velocity improvements are shown in Figure 9.2.

It should be noted that the majority of the fire flow deficiencies are small diameter pipelines and steel pipeline that are being upgraded to 8-inch diameter pipelines as part of the City's on-going pipeline replacement program. The 54 miles of fire flow improvements are phased in the first planning period (2007-2012), while the 100 miles of steel/small diameter replacements are phased in the two subsequent planning periods (2013-2017 and 2018-2022). With this phasing, the City will have a fairly uniform pipeline replacement rate of approximately 10 miles/year.

Table 9.6 lists the estimated costs for the recommended CIP projects for the improvements listed above. A detailed list of the small diameter pipeline replacements is included in Appendix G.

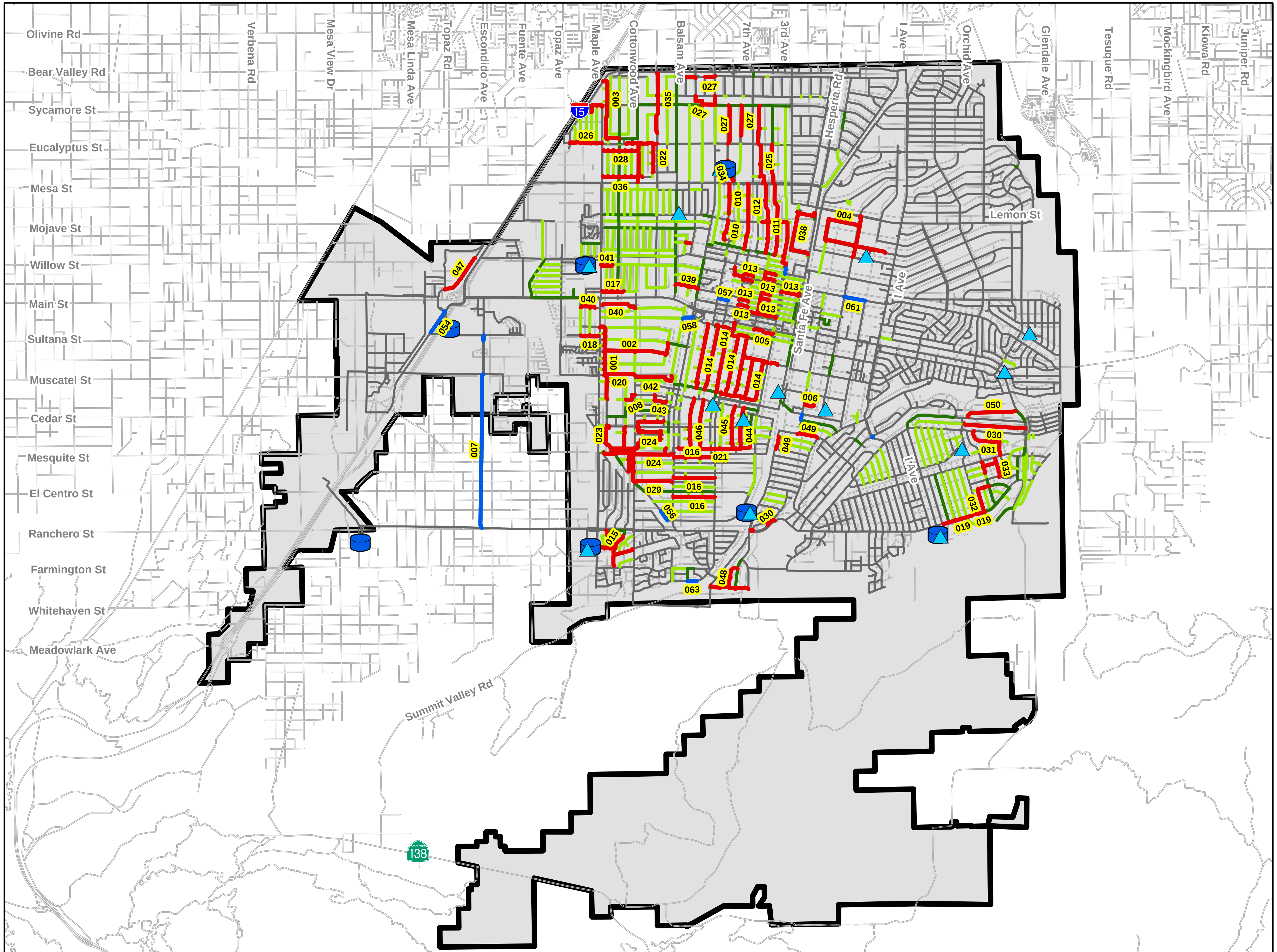
Table 9.6 **Existing System Improvement Projects**
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Estimated Project Cost[3]
Improvements for Fire Flow Deficiencies									
Improvements for existing small diameter steel pipes									
01-50	***Subtotal***	***277,603***			See Appendix F for a Detailed List			Near Term	$39,309,000
								SUBTOTAL	**$39,309,000**
Improvements for existing pipes with diameter 8" and larger									
054	PROP_1220	1,849	12	4	PL	FF_LT20PSI	MARIPOSA AVE FROM SULTANA NORTH	Near Term	$312,000
055	PROP_P542_2006	420	8	2	NEW	FF_LT0PSI	THIRD AVE. FROM WILLOW ST. TO CASHET ST.	Near Term	$57,000
056	PROP_P730_2006	808	8	3	NEW	FF_LT0PSI	AQUEDUCT FROM RODEO ST. TO WELLS FARGO ST	Near Term	$109,000
057	PROP_P478_2006	629	8	2	NEW	FF_LT20PSI	W OF EIGHTH ST. BETWEEN SMOKETREE AND JUNIPER ST	Near Term	$85,000
058	PROP_P830_2006	727	8	3	NEW	FF_LT0PSI	CONNECTING ELEVENTH AND HICKORY S. OF MAIN ST.	Near Term	$98,000
059	PROP_P598_PR_IN_2006	88	8	2	NEW	FF_LT0PSI	I AVE AND BANGOR AVE PRV PIPING	Near Term	$12,000
059	PROP_P598_PROUT_2006	72	8	2	NEW	FF_LT0PSI	I AVE AND BANGOR AVE PRV PIPING	Near Term	$10,000
060	PROP_P474_2006	377	8	2	NEW	FF_LT20PSI	EIGHTH ST. BETWEEN CHESTNUT ST AND SMOKETREE ST	Near Term	$51,000
061	PROP_P554_2006	439	8	2	NEW	FF_LT20PSI	C AVE FROM PALM ST. TO LIME ST.	Near Term	$59,000
061	PROP_P556_2006	1,470	12	2	NEW	FF_LT20PSI	LIVE OAK ST. FROM E AVE. AND G AVE.	Near Term	$248,000
062	PROP_1222	173	12	4	PL	FF_LT20PSI	MARIPOSA AVE FROM SULTANA NORTH	Near Term	$29,000
062	PROP_PRV56_1_IN	117	8	4	NEW	FF_LT20PSI	ESCONDIDO AVE, S. OF SULTANA	Near Term	$16,000
062	PROP_PRV56_1_OUT	113	6	4	NEW	FF_LT20PSI	ESCONDIDO AVE, S. OF SULTANA	Near Term	$15,000
062	PROP_PRV56_2_IN	129	8	4	NEW	FF_LT20PSI	ESCONDIDO AVE, S. OF SULTANA	Near Term	$17,000
062	PROP_PRV56_2_OUT	112	8	4	NEW	FF_LT20PSI	ESCONDIDO AVE, S. OF SULTANA	Near Term	$15,000
062	PROP_PV56-IN	57	12	4	NEW	FF_LT20PSI	ESCONDIDO AVE, S. OF SULTANA	Near Term	$10,000
062	PROP_PV56-OUT	92	12	4	NEW	FF_LT20PSI	ESCONDIDO AVE, S. OF SULTANA	Near Term	$15,000
063	PROP_P1004_2006	677	8	3A	NEW	FF_LT0PSI	HALINOR ST. TO GREENWOOD ST.	Near Term	$91,000
	Subtotal	***8,349***						**SUBTOTAL**	**$1,249,000**
Pressure Reducing Valve Improvements									
VLV1	PRV56-1	N/A	6	4	PRV	002_PIPE0062	ESCONDIDO AND SULTANA	Near Term	$150,000
VLV1	PRV56-2	N/A	8	4	PRV	002_PIPE0062	ESCONDIDO AND SULTANA	Near Term	$150,000
VLV2	PROP_PRV_2_2B	N/A	6	2B	PRV	001_PIPE0059	BANGOR AND I AVE	Near Term	$150,000
								SUBTOTAL	**$450,000**
								Total Estimated Fire Flow Improvement Cost	**$41,008,000**

Notes:
(1) CIP Projects are numbered in order of priority.
(2) Abbreviations listed in this column are as follows: "NEW" - new pipe to be installed where no current pipeline exists; "PL" - a parallel pipeline is recommended next to the existing; "RP" - a pipeline replacement is recommended.
(3) Estimated Project Costs are based on January 2007 dollars and include estimated engineering, legal, and administrative costs and a contingency. Costs were rounded to the nearest $1,000.

Table 9.6	Existing System Improvement Projects (Continue) Water Master Plan Update City of Hesperia								
Improvement Project No.[1]	**Model ID**	**Length (ft)**	**Size (in)**	**Zone**	**Facility Description[2]**	**Deficiency**	**Location**	**Estimated Planning Year**	**Estimated Project Cost [3]**
Improvements for Velocity Deficiencies									
V1	PROP_1542	344	18	3	PL	In Pipe to BPS	PLANT 22	Near Term	$87,000
V2	PROP_1550	488	18	1	PL	In Pipe to BPS	ARRWHD RD TO TANK 18	Near Term	$123,000
V3	PROP_1524	1,442	18	1	PL	In Pipe to BPS	ARRWHD RD TO TANK 18	Near Term	$365,000
V4	PROP_1552	591	18	2	PL	In Pipe to BPS	PLANT 22	Near Term	$150,000
V5	PROP_1534	594	12	4	PL	In Pipe to BPS	RANCHERO & MAPLE	Near Term	$100,000
V5	PROP_1554	117	12	4	PL	In Pipe to BPS	RANCHERO & MAPLE	Near Term	$20,000
	Subtotal	***3,574***						**SUBTOTAL**	**$845,000**
V6	PROP_1568	104.1	8	2D	PL	Velocity	MESA & FOURTH AVE	2012	$14,000
V7	PROP_1566	301.49	8	2	PL	Velocity	MESA & THIRD AVE	2012	$41,000
V8	PROP_1564	269.34	8	2	PL	Velocity	OLIVE ST & THIRD AVE	2012	$36,000
	Subtotal	***675***						**SUBTOTAL**	**$91,000**
V11	PROP_1574	808.71	8	2	PL	Velocity	FOURTH AVE. AND MESA ST	2017	$109,000
V15	PROP_1578	322.95	8	2	PL	Velocity	MAIN & I AVE.	2017	$44,000
	Subtotal	***1,132***						**SUBTOTAL**	**$153,000**
								Total Estimated Velocity Improvement Cost	**$1,089,000**
Inprovements for Small Diameters Steel Pipeline Replacement									
000	***Subtotal***	**276,524**			See Appendix G for a Detailed List			2017	**$37,330,000**
								SUBTOTAL	**$37,330,000**
000	***Subtotal***	**276,524**			See Appendix G for a Detailed List			2022	**$37,330,000**
								SUBTOTAL	**$37,330,000**
								Total Estimated Steel Pipeline Replacement Cost	**$74,660,000**
								Total Existing System Improvement Cost	**$116,757,000**

Notes:
(1) CIP Projects are numbered in order of priority. "V" indicates a velocity improvement.
(2) Abbreviations listed in this column are as follows: "NEW" - new pipe to be installed where no current pipeline exists; "PL" - a parallel pipeline is recommended next to the existing; "RP" - a pipeline replacement is recommended.
(3) Estimated Project Costs are based on January 2007 dollars and include estimated engineering, legal, and administrative costs and a contingency. Costs were rounded to the nearest $1,000.



Legend

- Existing Groundwater Well
- Existing Reservoir
- Fire Flow Improvements on STL Pipelines
- Fire Flow Improvements on Non-STL Pipelines

Small Diameter Replacement Projects
Diameter

- 4"
- 6"
- Existing Water Distribution System
- Water District Boundary
- Roadways

Text:

014 CIP Project No.

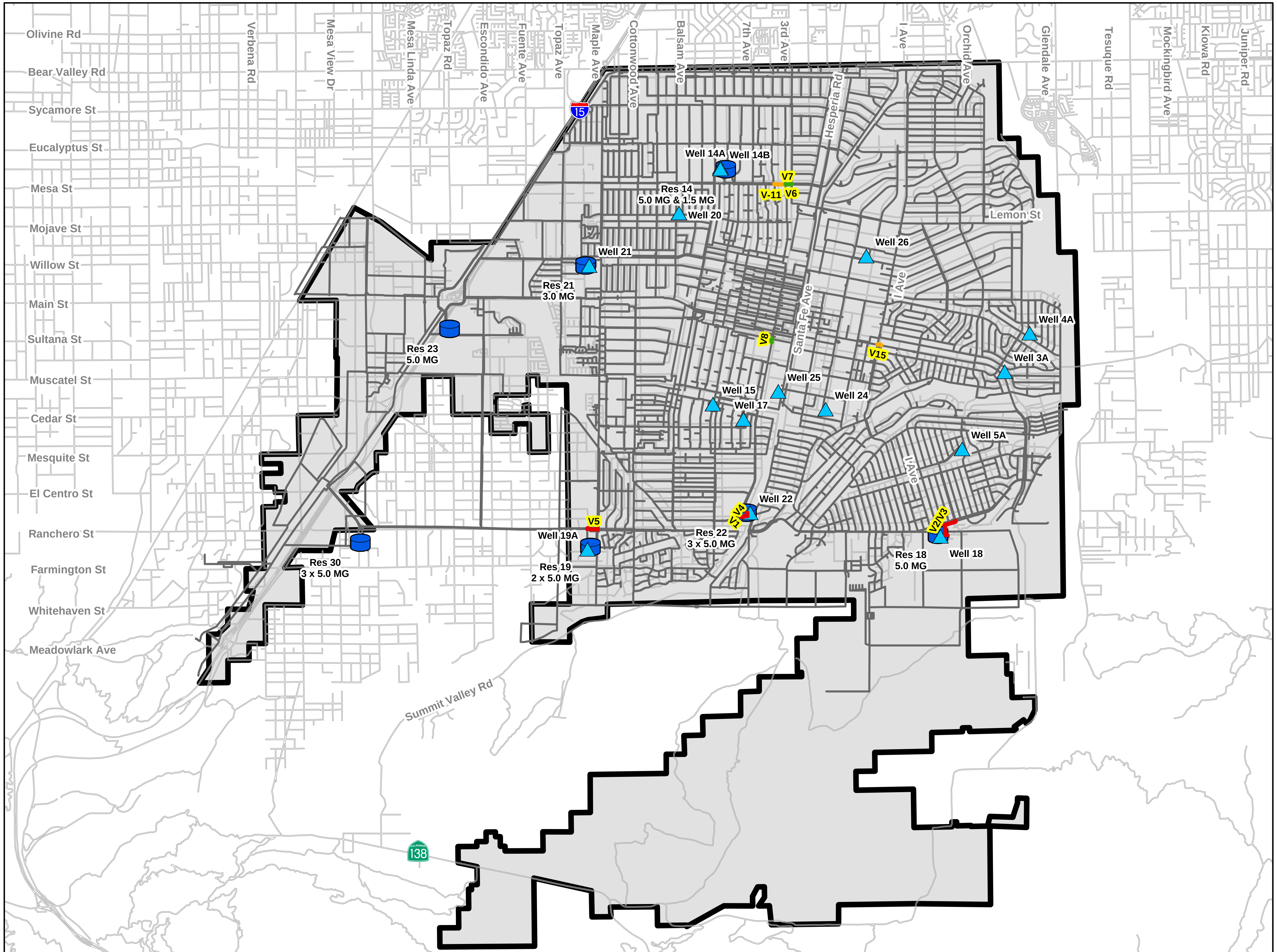
Feet
0 6,000 12,000

carollo engineers

FIGURE 9.1
EXISTING PIPELINE IMPROVEMENT PROJECTS

WATER MASTER PLAN UPDATE

CITY OF HESPERIA



Legend

- Existing Groundwater Well
- Existing Reservoir

Velocity Improvement Project Installation Year

- Near Term
- 2007 - 2012
- 2013 - 2017
- Future Water Distribution System
- Water District Boundary
- Roadways

Text:

- V-11 CIP Project No.

N

Feet

0 6,000 12,000

carollo engineers

FIGURE 9.2
VELOCITY IMPROVEMENT PROJECTS

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

9.4.3 Future Facility Improvements

In Chapter 6, several scenarios were used to analyze the system under different water supply conditions. Projects were proposed in areas where increased demands would benefit from new facilities. The following future system improvements identified to serve the increased water demands:

- 26 new groundwater wells
- 10 new storage (43.7 MG)
- 9 proposed booster pumping stations
- 84 miles of proposed pipelines

Table 9.7 summarizes the recommended future booster pump and well facility improvement projects and lists their estimated costs. Table 9.8 summarizes the recommended pipeline improvements, with necessary pumping lane piping identified under a separate heading. Table 9.9 lists the estimated cost of all storage improvements. The locations of each of the future pipeline improvements are presented in Figure 9.3.

9.4.4 Impact of Time of Use

Analyses were performed in Chapter 7 to determine the supplemental facilities that would be required to meet the projected water demands while using the time of use program offered by Southern California Edison (SCE). Table 9.10 summarizes the estimated cost for the additional storage, well, and pipeline improvements. As shown, the total estimated cost of these facilities is about $15.6 million, which equates to an annual cost of $855,000 when using a depreciation period of 50 years and 5 percent interest. It was determined that it is not cost-effective to implement these facilities and TOU operations as the capital cost are much greater than the energy savings.

9.4.5 Conservation and Recycled Water

Analyses were performed in Chapter 8 to determine the impact of water conservation and recycled water on the required future storage facilities. Either and both could potentially have a significant impact on the total recommended capacity. Tables 9.11 and 9.12 summarize the potential cost savings for the different conditions that may be planned and still meet the required emergency storage needs and projected demands. The end cost savings presumes that 10 percent conservation is instigated by 2022 and a 20 percent demand reduction is attained by 2032. Table 9.11 shows the potential savings in additional storage if water conservation and/or use of recycled water are implemented. As shown, a cost saving of $25.2 million, or 9 percent of the total CIP cost, can be realized if 20 percent of water conservation and the use of recycled water are implemented. Table 9.12 shows a total saving of $14.2 million (5 percent of CIP) in wells and pipelines. Hence, water conservation and recycled water use could reduce the water system CIP by $40 million or 14 percent due to downsizing of transmission pipelines, storage reservoirs, and new well capacity.

Table 9.7 Future Booster Pump and Well Facility Improvement Projects
Water Master Plan Update
City of Hesperia

Proposed Facility Improvement Project No.	Pump No.	Model ID	Flow (gpm)	Design Head (ft)	From Zone	To Zone	Facility Description[1]	Reason for Improvement/ Deficiency	Location	Estimated Planning Year	Estimated Project Cost[2]
Proposed Wells											
FW01	N/A	PROP_RLF_WELL_1	1,750	700	GW	RLF	RP	Booster Station	RLF ZONE	2012	$1,547,000
FW02	N/A	PROP_RLF_WELL_2	1,750	700	GW	RLF	RP	Booster Station	RLF ZONE	2012	$1,547,000
FW03	N/A	PROP_RLF_WELL_3	1,500	700	GW	RLF	RP	Booster Station	RLF ZONE	2012	$1,462,000
FW04	N/A	PROP_WELL_PMP_33	1,200	850	GW	3	NEW	Water Supply	ELEVENTH & MAIN ST	2012	$1,356,000
FW05	N/A	PROP_WELL_PMP_34	1,250	820	GW	3	NEW	Water Supply	RANCHERO RD. AND COTTONWOOD	2012	$1,374,000
										SUBTOTAL	**$7,286,000**
Proposed Booster Stations											
B01	B101	PROP_PS_A_PMP1	1,500	275	4	5	NEW	Increased Growth	FWY_CORR	2012	$225,000
	B102	PROP_PS_A_PMP2	1,500	275	4	5	NEW	Increased Growth	FWY_CORR	2012	$225,000
	B103	PROP_PS_A_PMP3_FIRE	4,000	250	4	5	NEW	Increased Growth	FWY_CORR	2012	$474,000
B02	B201	PROP_PS_B_PMP1	1,400	286	5	6	NEW	Increased Growth	FWY_CORR	2012	$214,000
	B202	PROP_PS_B_PMP2_FF	3,500	270	5	6	NEW	Increased Growth	FWY_CORR	2012	$428,000
B03	B301	PROP_PS_RLF_1	2,625	250	2	RLF_3500	NEW	Increased Growth	RLF ZONE	2012	$344,000
	B302	PROP_PS_RLF_FF	2,000	250	2	RLF_3500	NEW	Increased Growth	RLF ZONE	2012	$280,000
B04	B401	PROP_PS14_PMP1	2,000	250	1	2	RP	Booster Station	PLANT 14	2012	$280,000
	B402	PROP_PS14_PMP2	2,000	250	1	2	RP	Booster Station	PLANT 14	2012	$280,000
	B403	PROP_PS14_PMP3	2,000	250	1	2	RP	Booster Station	PLANT 14	2012	$280,000
	B404	PROP_PS14_PMP5_FIRE	4,000	280	1	2	RP	Booster Station	PLANT 14	2012	$474,000
B05	B501	PROP_PS18_PMP_1	3,000	260	1	2	RP	Booster Station	PLANT 18	2012	$381,000
	B502	PROP_PS18_PMP_2	3,000	260	1	2	RP	Booster Station	PLANT 18	2012	$381,000
	B503	PROP_PS18_PMP_3	3,000	260	1	2	RP	Booster Station	PLANT 18	2012	$381,000
B06	B601	PROP_PS21_PMP_1	1,800	275	2	3	RP	Booster Station	PLANT 21	2012	$259,000
	B602	PROP_PS21_PMP_2	1,800	275	2	3	RP	Booster Station	PLANT 21	2012	$259,000
B07	B701	PROP_PS22_PMP1	3,000	310	2	3	RP	Booster Station	PLANT 22	2012	$381,000
	B702	PROP_PS22_PMP2	3,000	310	2	3	RP	Booster Station	PLANT 22	2012	$381,000
B08	B801	PROP_PS23_PMP_1	1,300	280	3	4	RP	Booster Station	PLANT 23	2012	$202,000
	B802	PROP_PS23_PMP_2	1,300	280	3	4	RP	Booster Station	PLANT 23	2012	$202,000
										SUBTOTAL	**$6,331,000**
Proposed Wells											
FW06	N/A	PROP_WELL_PMP_35	1,800	620	GW	2	NEW	Water Supply	RANCHERO AND SANTA FE AVE	2017	$1,563,000
FW07	N/A	PROP_WELL_PMP_36	1,800	620	GW	2	NEW	Water Supply	RANCHERO AND CHASE AVE	2017	$1,563,000
FW08	N/A	PROP_WELL_PMP_37	1,800	620	GW	2	NEW	Water Supply	RANCHERO RD. AND LYONS	2017	$1,563,000
FW10	N/A	PROP_WELL_PMP_38	1,200	820	GW	3	NEW	Water Supply	MAPLE AVE., N. OF CEDAR	2017	$1,356,000
FW11	N/A	PROP_WELL_PMP_39	1,200	820	GW	3	NEW	Water Supply	SULTANA AND MAPLE ST	2017	$1,356,000
FW12	N/A	PROP_WELL_PMP_40	1,200	620	GW	2	NEW	Water Supply	SEVENTH & CAJON ST	2017	$1,356,000
FW13	N/A	PROP_WELL_PMP_41	1,200	620	GW	2	NEW	Water Supply	C AVE. AND MAIN ST	2017	$1,356,000
FW14	N/A	PROP_WELL_PMP_42	1,200	620	GW	2	NEW	Water Supply	I AVE. AND OLIVE ST	2017	$1,356,000
FW15	N/A	PROP_WELL_PMP_43	2,000	420	GW	1	NEW	Water Supply	CAPELLA AND ARRWHD LAKE RD	2017	$1,629,000
										SUBTOTAL	**$13,098,000**
Proposed Booster Stations											
	B303	PROP_PS_RLF_2	2,625	250	2	RLF_3500	NEW	Increased Growth	RLF ZONE	2017	$344,000
	B304	PROP_PS_RLF_3	2,625	250	2	RLF_3500	NEW	Increased Growth	RLF ZONE	2017	$344,000
	B504	PROP_PS18_PMP_4	3,000	260	1	2	RP	Booster Station	PLANT 18	2017	$381,000
B09	B901	PROP_PS19_PMP_1	3,100	300	3	4	RP	Booster Station	PLANT 19	2017	$390,000
	B902	PROP_PS19_PMP_2	3,100	300	3	4	RP	Booster Station	PLANT 19	2017	$390,000
	B903	PROP_PS19_PMP_3	3,100	300	3	4	RP	Booster Station	PLANT 19	2017	$390,000
	B603	PROP_PS21_PMP_3	1,800	275	2	3	RP	Booster Station	PLANT 21	2017	$259,000

Table 9.7	Future Booster Pump and Well Facility Improvement Projects Water Master Plan Update City of Hesperia											
Proposed Facility Improvement Project No.	Pump No.	Model ID	Flow (gpm)	Design Head (ft)	From Zone	To Zone	Facility Description[1]	Reason for Improvement/ Deficiency	Location	Estimated Planning Year	Estimated Project Cost[2]
	B703	PROP_PS22_PMP3	3,000	310	2	3	RP	Booster Station	PLANT 22	2017	$381,000
	B803	PROP_PS23_PMP_5_FIRE	4,000	280	3	4	RP	Booster Station	PLANT 23	2017	$474,000
										SUBTOTAL	**$3,353,000**
Proposed Wells											
FW09	N/A	PROP_RLF_WELL_4	1,500	700	GW	RLF	RP	Booster Station	RLF ZONE	2022	$1,462,000
FW16	N/A	PROP_WELL_PMP_44	2,000	500	GW	1	NEW	Water Supply	CAPELLA AND SEAFORTH	2022	$1,629,000
FW17	N/A	PROP_WELL_PMP_45	2,000	500	GW	1	NEW	Water Supply	MONTEREY AND GLENDALE AVE	2022	$1,629,000
FW18	N/A	PROP_WELL_PMP_46	1,200	500	GW	1	NEW	Water Supply	LEMON ST AND SANTA FE AVE	2022	$1,356,000
FW20	N/A	PROP_WELL_PMP_47	1,500		GW	3	NEW	Water Supply	TBD	2022	$1,462,000
FW21	N/A	PROP_WELL_PMP_48	1,500		GW	3	NEW	Water Supply	TBD	2022	$1,462,000
										SUBTOTAL	**$9,000,000**
Proposed Booster Stations											
	B305	PROP_PS_RLF_4	2,625	250	2	RLF_3500	NEW	Increased Growth	RLF ZONE	2022	$344,000
	B405	PROP_PS14_PMP4	2,000	250	1	2	RP	Booster Station	PLANT 14	2022	$280,000
	B704	PROP_PS22_PMP5_FIRE	3,000	310	2	3	RP	Booster Station	PLANT 22	2022	$381,000
	B804	PROP_PS23_PMP_3	1,300	280	3	4	RP	Booster Station	PLANT 23	2022	$202,000
										SUBTOTAL	**$1,207,000**
Proposed Wells											
FW19	N/A	PROP_RLF_WELL_5	1,500	700	GW	RLF	RP	Booster Station	RLF ZONE	2027	$1,462,000
FW22	N/A	PROP_WELL_PMP_49	1,500		GW	3	NEW	Water Supply	TBD	2027	$1,462,000
FW23	N/A	PROP_WELL_PMP_50	1,500		GW	3	NEW	Water Supply	TBD	2027	$1,462,000
FW24	N/A	PROP_WELL_PMP_51	1,500		GW	3	NEW	Water Supply	TBD	2027	$1,462,000
										SUBTOTAL	**$5,848,000**
Proposed Booster Stations											
	B904	PROP_PS19_PMP_4	3,100	300	3	4	RP	Booster Station	PLANT 19	2027	$390,000
	B604	PROP_PS21_PMP_4	1,800	275	2	3	RP	Booster Station	PLANT 21	2027	$259,000
	B705	PROP_PS22_PMP4	3,000	310	2	3	RP	Booster Station	PLANT 22	2027	$381,000
	B805	PROP_PS23_PMP_4	1,300	280	3	4	RP	Booster Station	PLANT 23	2027	$202,000
										SUBTOTAL	**$1,232,000**
Proposed Wells											
FW25	N/A	PROP_WELL_PMP_52	1,500	500	GW	3	NEW	Water Supply	TBD	2032	$1,462,000
FW26	N/A	PROP_WELL_PMP_53	1,500	500	GW	3	NEW	Water Supply	TBD	2032	$1,462,000
										SUBTOTAL	**$2,924,000**
									Total Estimated Booster Station and Well Facility Improvement Cost		**$50,279,000**

Notes:
(1) Abbreviations listed in this column are as follows: "NEW" - new facility is to be installed where no current one exists; "RP" - a facility replacement is recommended.
(2) Estimated Project Costs are based on January 2007 dollars and include estimated engineering, legal, and administrative costs and a contingency. All well costs include the cost of drilling and equipping. Costs were rounded to the nearest $1,000.

Table 9.8 **Future Pipeline Improvement Projects**
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Size (in)	Zone	Facility Description[2]	Purpose of Improvement	Location	Estimated Planning Year	Estimated Project Cost[3]
Pipeline Improvements									
PG001	PRO_P120	439	16	5	NEW	Increased Growth	FWY_CORR	Near Term	$96,000
PG002	PRO_P150	1,213	12	6	NEW	Increased Growth	FWY_CORR	Near Term	$205,000
PG003	PRO_P30	583	16	5	NEW	Increased Growth	FWY_CORR	Near Term	$128,000
PG004	PRO_P40	990	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$167,000
PG005	PRO_P60	3,700	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$624,000
PG046	PROP_P100	2,006	16	6	NEW	Increased Growth	FWY_CORR	Near Term	$440,000
PG047	PROP_P1024	1,673	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$282,000
PG048	PROP_P110	3,162	16	5	NEW	Increased Growth	FWY_CORR	Near Term	$694,000
PG049	PROP_P120	2,035	12	6	NEW	Increased Growth	FWY_CORR	Near Term	$343,000
PG050	PROP_P122	3,362	12	6	NEW	Increased Growth	FWY_CORR	Near Term	$567,000
PG051	PROP_P124_PRV_IN	1,020	12	6	NEW	Increased Growth	FWY_CORR	Near Term	$172,000
PG052	PROP_P126_PRV_OUT	101	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$17,000
PG053	PROP_P128	2,814	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$475,000
PG054	PROP_P130	1,926	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$325,000
PG055	PROP_P132	1,625	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$274,000
PG056	PROP_P134	201	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$34,000
PG057	PROP_P136	3,390	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$572,000
PG058	PROP_P138	2,475	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$418,000
PG059	PROP_P140	2,901	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$490,000
PG060	PROP_P142	1,538	16	5	NEW	Increased Growth	FWY_CORR	Near Term	$337,000
PG061	PROP_P148	4,298	18	5	NEW	Increased Growth	FWY_CORR	Near Term	$1,088,000
PG062	PROP_P150	6,356	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$1,073,000
PG063	PROP_P152	1,117	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$188,000
PG064	PROP_P154	3,149	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$531,000
PG065	PROP_P156	3,003	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$507,000
PG071	PROP_P200	1,071	16	6	NEW	Increased Growth	FWY_CORR	Near Term	$235,000
PG081	PROP_P50	3,315	16	5	NEW	Increased Growth	FWY_CORR	Near Term	$727,000
PG082	PROP_P55	1,528	16	5	NEW	Increased Growth	FWY_CORR	Near Term	$335,000
PG083	PROP_P70	1,936	12	6	NEW	Increased Growth	FWY_CORR	Near Term	$327,000
PG084	PROP_P80	1,991	16	6	NEW	Increased Growth	FWY_CORR	Near Term	$437,000
PG085	PROP_P85	917	12	6	NEW	Increased Growth	FWY_CORR	Near Term	$155,000
PG086	PROP_P90	3,465	16	6	NEW	Increased Growth	FWY_CORR	Near Term	$760,000
PG087	PROP_PRV_A_IN	152	8	5	NEW	Increased Growth	FWY_CORR	Near Term	$20,000
PG088	PROP_PRV_A_OUT	321	8	4	NEW	Increased Growth	FWY_CORR	Near Term	$43,000
PG089	PROP_PRV_B_IN	604	12	6	NEW	Increased Growth	FWY_CORR	Near Term	$102,000
PG090	PROP_PRV_B_OUT	96	12	5	NEW	Increased Growth	FWY_CORR	Near Term	$16,000
PG095	PROP_PS_A_OUT	478	20	5	NEW	Increased Growth	FWY_CORR	Near Term	$137,000
PG096	PROP_PSA_IN	679	20	4	NEW	Increased Growth	FWY_CORR	Near Term	$195,000
PG099	PROP_Z6_HYDRO_IN	136	16	6	NEW	Increased Growth	FWY_CORR	Near Term	$30,000
PG100	PROP_Z6_HYDRO_OUT	154	16	6	NEW	Increased Growth	FWY_CORR	Near Term	$34,000
PT011	PROP_1122	658	18	2	PL	Pumping Lane	ELEVENTH & MESA	Near Term	$167,000
PT013	PROP_1156	394	16	2	PL	Pumping Lane	PLANT 14	Near Term	$86,000
PT016	PROP_1454	7,860	16	2	PL	Pumping Lane	MESA, FROM MAPLE TO ELEVENTH	Near Term	$1,724,000
PT030	PROP_1142	717	16	3	PL	Pumping Lane	SEVENTH, FROM RANCHERO TO WELLS FARGO	Near Term	$157,000

Table 9.8	Future Pipeline Improvement Projects Water Master Plan Update City of Hesperia									
Improvement Project No.[1]	**Model ID**	**Length (ft)**	**Size (in)**	**Zone**	**Facility Description[2]**	**Purpose of Improvement**	**Location**	**Estimated Planning Year**	**Estimated Project Cost[3]**
PT033	PROP_1150	607	12	3	PL	Pumping Lane	RANCHERO, FROM SEVENTH TO ELEVENTH	Near Term	$102,000
	Subtotal	***82,159***						**SUBTOTAL**	**$15,836,000**
Transmission Main Improvements									
PT001	PROP_P1020	590	16	1	PL	Pumping Lane	CAPELLA AVE FROM ROYCE TO RANCHERO RD	Near Term	$129,000
PT002	PROP_P1022	650	16	1	PL	Pumping Lane	RANCHERO RD FROM CAPELLA TO ARRWHD RD	Near Term	$143,000
PT005	PROP_1484	2,849	12	3	PL	Pumping Lane	WELLSFARGO, FROM SEVENTH TO ELEVENTH	Near Term	$481,000
	Subtotal	***4,089***						**SUBTOTAL**	**$753,000**
Pipeline Improvements									
051	PROP_1214	1,035	12	4	RP	FF_GTOE8IN_LT0PSI	HWY 395 FROM JOSHUA ST TO THREE FLAGS	2012	$175,000
051	PROP_1216	697	12	4	RP	FF_GTOE8IN_LT0PSI	HWY 395 FROM THREE FLAGS TO MUSCATEL	2012	$118,000
051	PROP_1218	2,738	12	4	NEW	FF_LT0PSI	MESA LINDA FROM SULTANA TO W. MAIN ST	2012	$462,000
051	PROP_1400	380	12	4	RP	FF_GTOE8IN_LT0PSI	HWY 395 FROM MUSCATEL TO SCARBOROUGH ST	2012	$64,000
051	PROP_1402	1,048	12	4	RP	FF_GTOE8IN_LT0PSI	HWY 395 FROM SCARBOROUGH ST TO POPLAR ST	2012	$177,000
051	PROP_1404	1,374	12	4	RP	FF_GTOE8IN_LT0PSI	HWY 395 FROM POPLAR ST TO SULTANA	2012	$232,000
051	PROP_1406	2,684	12	4	RP	FF_GTOE8IN_LT0PSI	HWY 395 FROM SULTANA TO W. MAIN ST	2012	$453,000
052	PROP_1186	3,862	12	4	NEW	FF_LT20PSI	EASEMENT ON WEST HESP. BOUNDARY	2012	$652,000
052	PROP_1188	2,350	12	4	NEW	FF_LT20PSI	EASEMENT ON WEST HESP. BOUNDARY	2012	$397,000
052	PROP_1190	1,349	8	4	NEW	FF_LT20PSI	MOLINA ST. FROM W. HESP. BOUNDARY TO CALIENTE RD	2012	$182,000
052	PROP_1192	452	8	4	NEW	FF_LT20PSI	MOLINA ST. FROM W. HESP. BOUNDARY TO CALIENTE RD	2012	$61,000
052	PROP_1194	3,323	8	4	NEW	FF_LT20PSI	LOS BANOS FROM W MAIN ST. TO YUCCA TERRACE	2012	$449,000
052	PROP_1202	1,303	12	4	RP	FF_GTOE8IN_LT20PSI	W. MAIN ST AND E. OF LOS BANOS RD	2012	$220,000
052	PROP_1204	2,440	12	4	RP	FF_GTOE8IN_LT20PSI	W. MAIN ST LOS BANOS RD TO MONTE VISTA DR	2012	$412,000
052	PROP_P1008_2006	846	12	3A	PL	FF_LT20PSI	KEY POINTE FROM I-15 TO W. MAIN ST	2012	$143,000
053	PROP_1196	2,434	12	4	NEW	FF_LT20PSI	AQUEDUCT FROM HWY 295 EAST	2012	$411,000
053	PROP_1198	2,532	12	4	NEW	FF_LT20PSI	AQUEDUCT FROM CATABA RD WEST	2012	$427,000
053	PROP_1200	967	12	4	NEW	FF_LT20PSI	CATABA RD. FROM POWER EASEMENT TO WHITE FOX TRAIL	2012	$163,000
053	PROP_1206	674	12	4	RP	FF_GTOE8IN_LT20PSI	SMOKE TREE RD. FROM MERITIO RD. TO HWY 395	2012	$114,000
053	PROP_1208	1,288	12	4	RP	FF_GTOE8IN_LT20PSI	SMOKE TREE RD. FROM MERITIO RD. TO HWY 395	2012	$217,000
053	PROP_1408	1,219	12	4	RP	FF_GTOE8IN_LT20PSI	HWY 395 FROM W. MAIN ST. TO WHITE FOX TRAIL	2012	$206,000
053	PROP_1410	2,018	12	4	RP	FF_GTOE8IN_LT20PSI	HWY 395 FROM WHITE FOX TRAIL TO MOLINA ST	2012	$341,000
053	PROP_1412	2,015	12	4	RP	FF_GTOE8IN_LT20PSI	HWY 395 FROM MOLINA TO SMOKETREE	2012	$340,000
053	PROP_1414	1,203	12	4	RP	FF_GTOE8IN_LT20PSI	HWY 395 FROM W. MAIN ST. TO WHITE FOX TRAIL	2012	$203,000
053	PROP_1416	2,010	12	4	RP	FF_GTOE8IN_LT20PSI	HWY 395 FROM WHITE FOX TRAIL TO MOLINA ST	2012	$339,000
053	PROP_1418	2,011	12	4	RP	FF_GTOE8IN_LT20PSI	HWY 395 FROM MOLINA TO SMOKETREE	2012	$339,000
PG006	PROP_1182_2010	1,034	12	3	NEW	Increased Growth	TOPAZ AVE, FROM LIVE OAK TO MESA AVE	2012	$174,000
PG007	PROP_1526	77	12	4	NEW	Increased Growth	WHITE HAVEN FROM TOPAZ TO MAPLE AVE	2012	$13,000
PG008	PROP_1528	110	12	4	NEW	Increased Growth	FARMINGTON FROM TOPAZ TO MAPLE AVE	2012	$19,000
PG009	PROP_1530	93	12	4	NEW	Increased Growth	S OF MISSION FROM TOPAZ TO MAPLE AVE	2012	$16,000
PG010	PROP_3897	43	12	2	NEW	Increased Growth	N OF MESA, ALONG TOPAZ AND MARIPOSA, S OF EUCALYPTUS ST	2012	$7,000
PG011	PROP_3898	52	12	2	NEW	Increased Growth	N OF MESA, ALONG TOPAZ AND MARIPOSA, S OF EUCALYPTUS ST	2012	$9,000
PG012	PROP_3899	51	12	3	NEW	Increased Growth	N OF MESA, ALONG TOPAZ AND MARIPOSA, S OF EUCALYPTUS ST	2012	$9,000
PG013	PROP_3900	42	12	3	NEW	Increased Growth	N OF MESA, ALONG TOPAZ AND MARIPOSA, S OF EUCALYPTUS ST	2012	$7,000
PG014	PROP_5000	366	12	3	NEW	Increased Growth	N OF MESA, ALONG TOPAZ AND MARIPOSA, S OF EUCALYPTUS ST	2012	$62,000
PG015	PROP_5001	2,917	12	3	NEW	Increased Growth	N OF MESA, ALONG TOPAZ AND MARIPOSA, S OF EUCALYPTUS ST	2012	$492,000
PG016	PROP_5002	2,121	12	3	NEW	Increased Growth	N OF MESA, ALONG TOPAZ AND MARIPOSA, S OF EUCALYPTUS ST	2012	$358,000

Table 9.8 Future Pipeline Improvement Projects
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Size (in)	Zone	Facility Description[2]	Purpose of Improvement	Location	Estimated Planning Year	Estimated Project Cost[3]
PG017	PROP_5003	2,649	12	3	NEW	Increased Growth	TOPAZ AVE, FROM LIVE OAK TO MESA AVE.	2012	$447,000
PG018	PROP_5004	564	12	3	NEW	Increased Growth	MOJAVE ST. FROM TAMARISK TO BALDY LN	2012	$95,000
PG019	PROP_5005	1,247	12	3	NEW	Increased Growth	MOJAVE ST. FROM TAMARISK TO BALDY LN	2012	$210,000
PG020	PROP_5006	1,651	12	3	NEW	Increased Growth	TOPAZ AVE, FROM LIVE OAK TO MESA AVE.	2012	$279,000
PG021	PROP_5015	2,015	12	4	NEW	Increased Growth	TOPAZ AVE. FROM WHITE HAVEN TO CACTUS ST	2012	$340,000
PG022	PROP_5016	2,622	12	4	NEW	Increased Growth	S OF MISSION FROM TOPAZ TO MAPLE AVE	2012	$442,000
PG023	PROP_5017	3,308	16	4	NEW	Increased Growth	TOPAZ AVE. FROM WHITE HAVEN TO CACTUS ST	2012	$726,000
PG024	PROP_5018	2,622	12	4	NEW	Increased Growth	TOPAZ AVE. FROM WHITE HAVEN TO CACTUS ST	2012	$442,000
PG025	PROP_5019	2,532	12	4	NEW	Increased Growth	FARMINGTON FROM TOPAZ TO MAPLE AVE	2012	$427,000
PG026	PROP_5020	2,623	12	4	NEW	Increased Growth	TOPAZ AVE. FROM WHITE HAVEN TO CACTUS ST	2012	$443,000
PG027	PROP_5021	1,224	12	4	NEW	Increased Growth	MAPLE AVE FROM WHITE HAVEN TO JENNY ST	2012	$207,000
PG028	PROP_5022	2,606	12	4	NEW	Increased Growth	WHITE HAVEN FROM TOPAZ TO MAPLE AVE	2012	$440,000
PG029	PROP_5028	2,583	12	4	NEW	Increased Growth	WHITE HAVEN FROM MAPLE AVE TO COTTONWOOD	2012	$436,000
PG030	PROP_5042	2,547	24	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$860,000
PG031	PROP_5043	2,662	16	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$584,000
PG032	PROP_5044	2,618	12	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$442,000
PG033	PROP_5045	2,668	12	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$450,000
PG034	PROP_5046	2,668	24	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$900,000
PG035	PROP_5047	335	24	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$113,000
PG036	PROP_5048	2,679	20	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$769,000
PG037	PROP_5049	2,671	16	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$586,000
PG038	PROP_5050	2,637	12	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$445,000
PG039	PROP_5051	1,301	12	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$219,000
PG040	PROP_5053	2,582	12	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$436,000
PG041	PROP_5054	2,634	12	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$444,000
PG042	PROP_5055	1,306	12	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$220,000
PG043	PROP_5056	3,337	12	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$563,000
PG044	PROP_5057	2,825	12	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$477,000
PG045	PROP_5060	60	24	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$20,000
PG066	PROP_P158	6,151	24	RLF_3500	NEW	Increased Growth	RLF TANK TRANSMISSION	2012	$2,076,000
PG067	PROP_P160	275	12	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$46,000
PG068	PROP_P162	391	24	RLF_3500	NEW	Increased Growth	RLF PS SUCTION	2012	$132,000
PG069	PROP_P166_RLF_PS_IN	293	8	2	NEW	Increased Growth	RFL DEVELOPMENT	2012	$40,000
PG070	PROP_P170_RLF_PS_OUT	301	8	RLF_3500	NEW	Increased Growth	RFL DEVELOPMENT	2012	$41,000
PG072	PROP_P24	999	12	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$169,000
PG073	PROP_P26	1,099	24	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$371,000
PG074	PROP_P28	1,408	8	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$190,000
PG075	PROP_P30	2,648	24	2	NEW	Increased Growth	BTWN OXFORD AND LAKE ARRWHD, N OF WHITEHAVEN S OF RANCHERO	2012	$894,000
PG076	PROP_P32	2,339	20	RLF_3500	NEW	Increased Growth	RLF DEVELOPMENT BACKBONE	2012	$671,000
PG077	PROP_P38	2,518	24	RLF_3500	NEW	Increased Growth	RLF DEVELOPMENT BACKBONE	2012	$850,000
PG078	PROP_P40	1,705	24	RLF_3500	NEW	Increased Growth	RLF DEVELOPMENT BACKBONE	2012	$575,000
PG079	PROP_P44	2,029	24	RLF_3500	NEW	Increased Growth	RLF DEVELOPMENT BACKBONE	2012	$685,000
PG080	PROP_P48	1,855	24	RLF_3500	NEW	Increased Growth	RLF PS DISCHARGE	2012	$626,000
PG091	PROP_PRV52_1_IN	44	8	3	NEW	Increased Growth	N OF MESA, ALONG TOPAZ AND MARIPOSA, S OF EUCALYPTUS ST	2012	$6,000
PG092	PROP_PRV52_1_OUT	44	8	2	NEW	Increased Growth	N OF MESA, ALONG TOPAZ AND MARIPOSA, S OF EUCALYPTUS ST	2012	$6,000
PG093	PROP_PRV52_2_IN	42	8	3	NEW	Increased Growth	N OF MESA, ALONG TOPAZ AND MARIPOSA, S OF EUCALYPTUS ST	2012	$6,000

Table 9.8 Future Pipeline Improvement Projects
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Size (in)	Zone	Facility Description[2]	Purpose of Improvement	Location	Estimated Planning Year	Estimated Project Cost[3]
PG094	PROP_PRV52_2_OUT	42	8	2	NEW	Increased Growth	N OF MESA, ALONG TOPAZ AND MARIPOSA, S OF EUCALYPTUS ST	2012	$6,000
PG097	PROP_RLF_PS_FF_IN	489	8	2	NEW	Increased Growth	RFL DEVELOPMENT	2012	$66,000
PG098	PROP_RLF_PS_FF_OUT	506	8	2	NEW	Increased Growth	RFL DEVELOPMENT	2012	$68,000
	Subtotal	***140,112***						**SUBTOTAL**	**$28,449,000**
Transmission Main Improvements									
PT006	2562_1_TNK18_IN	1,790	18	1	RP	Pumping Lane	PLANT 18	2012	$453,000
PT007	PROP_1114	459	24	2	PL	Pumping Lane	RANCHERO, FROM PAISLEY TO WINDSOR	2012	$155,000
PT008	PROP_1116	457	24	2	PL	Pumping Lane	RANCHERO, FROM WINDSOR TO MINSTEAD	2012	$154,000
PT009	PROP_1118	472	24	2	PL	Pumping Lane	RANCHERO, FROM MINSTEAD TO SHERBORN	2012	$159,000
PT010	PROP_1120	479	24	2	PL	Pumping Lane	RANCHERO, FROM SHERBORN TO KINGSTON	2012	$162,000
PT012	PROP_1134	1,153	12	1	NEW	Pumping Lane	BEAR VALLEY & I AVE	2012	$194,000
PT014	PROP_1180_TNK18_IN	1,727	24	1	PL	Pumping Lane	PLANT 18	2012	$583,000
PT015	PROP_1450	1,638	20	3	PL	Pumping Lane	LIVE OAK, FROM TOPAZ TO TAMARISK	2012	$470,000
PT017	PROP_P1018_2010	1,319	16	1	PL	Pumping Lane	CAPELLA, FROM SEAFORTH TO ROYCE	2012	$289,000
PT018	PROP_PS14_IN	311	24	2	RP	PS	PLANT 14	2012	$105,000
PT019	PROP_PS14_OUT	255	24	2	RP	PS	PLANT 14	2012	$86,000
PT020	PROP_PS18_OUT	786	32	2	NEW	PS	PLANT 18	2012	$332,000
PT021	PROP_PS21_IN	573	24	2	NEW	PS	PLANT 21	2012	$193,000
PT022	PROP_PS22_IN	344	32	3	NEW	PS	PLANT 22	2012	$145,000
PT023	PROP_PS22_OUT	219	32	3	NEW	PS	PLANT 22	2012	$92,000
PT024	PROP_PS23_IN_TNK23IN	270	20	3	RP	PS	PLANT 23	2012	$77,000
PT025	PROP_PS23_OUT	213	24	4	RP	PS	PLANT 23	2012	$72,000
PT026	PROP_RES21_IN	850	24	2	RP	In Pumping Lane	PLANT 21	2012	$287,000
	Subtotal	***13,316***						**SUBTOTAL**	**$4,008,000**
Pipeline Improvements									
PG101	PROP_1532	3,639	12	4	NEW	Increased Growth	AQUEDUCT & TOPAZ AVE	2017	$614,000
PG102	PROP_5012	3,055	12	4	NEW	Increased Growth	AQUEDUCT & TOPAZ AVE	2017	$516,000
PG103	PROP_5013	548	12	4	NEW	Increased Growth	AQUEDUCT & TOPAZ AVE	2017	$92,000
PG104	PROP_5023	1,365	12	4	NEW	Increased Growth	SOUTHWEST CORNER OF WHITE HAVEN AND TOPAZ AVE	2017	$230,000
PG105	PROP_5024	408	12	4	NEW	Increased Growth	SOUTHWEST CORNER OF WHITE HAVEN AND TOPAZ AVE	2017	$69,000
PG106	PROP_5025	2,677	12	4	NEW	Increased Growth	SOUTHWEST CORNER OF WHITE HAVEN AND TOPAZ AVE	2017	$452,000
PG107	PROP_5026	1,279	12	4	NEW	Increased Growth	SOUTHWEST CORNER OF WHITE HAVEN AND TOPAZ AVE	2017	$216,000
PG108	PROP_5027	2,469	12	4	NEW	Increased Growth	SOUTHWEST CORNER OF WHITE HAVEN AND TOPAZ AVE	2017	$417,000
PG109	PROP_5033	2,648	12	3A	NEW	Increased Growth	SOUTHWEST OF RYELAND AND FARMDALE RD	2017	$447,000
PG110	PROP_5034	1,147	12	3A	NEW	Increased Growth	MIDDLETON FROM WHITE HAVEN TO JENNY ST	2017	$193,000
PG111	PROP_5035	2,649	12	3A	NEW	Increased Growth	SOUTHWEST OF RYELAND AND FARMDALE RD	2017	$447,000
PG112	PROP_5036	2,522	12	3A	NEW	Increased Growth	SOUTHWEST OF RYELAND AND FARMDALE RD	2017	$426,000
PG113	PROP_5037	2,015	12	3A	NEW	Increased Growth	SOUTHWEST OF RYELAND AND FARMDALE RD	2017	$340,000
PG114	PROP_5038	2,061	12	3A	NEW	Increased Growth	SOUTHWEST OF RYELAND AND FARMDALE RD	2017	$348,000
PG115	PROP_5039	2,502	12	3A	NEW	Increased Growth	SOUTHWEST OF RYELAND AND FARMDALE RD	2017	$422,000
PG116	PROP_5040	2,491	12	3A	NEW	Increased Growth	SOUTHWEST OF RYELAND AND FARMDALE RD	2017	$420,000
PG117	PROP_P168_RLF_PS_IN	293	8	2	NEW	Increased Growth-PS	RLF DEVELOPMENT	2017	$40,000
PG118	PROP_P172_RLF_PS_OUT	300	8	RLF_3500	NEW	Increased Growth-PS	RLF DEVELOPMENT	2017	$41,000
PG119	PROP_P176_RLF_PS_IN	388	8	2	NEW	Increased Growth-PS	RLF DEVELOPMENT	2017	$52,000
PG120	PROP_P180_RLF_PS_OUT	405	8	RLF_3500	NEW	Increased Growth-PS	RLF DEVELOPMENT	2017	$55,000

Table 9.8	Future Pipeline Improvement Projects Water Master Plan Update City of Hesperia								
Improvement Project No.[1]	Model ID	Length (ft)	Size (in)	Zone	Facility Description[2]	Purpose of Improvement	Location	Estimated Planning Year	Estimated Project Cost[3]
	Subtotal	***34,862***						**SUBTOTAL**	**$5,837,000**
Transmission Main Improvements									
PT027	PROP_1136_TNK22_IN	634	32	2	PL	Pumping Lane	PLANT 22	2017	$267,000
PT028	PROP_1138	312	32	3	PL	Pumping Lane	PLANT 22	2017	$131,000
PT029	PROP_1140	1,813	24	3	PL	Pumping Lane	THIRD, FROM SEVENTH TO PLANT 22	2017	$612,000
PT031	PROP_1144	1,060	12	3	PL	Pumping Lane	RANCHERO, FROM SEVENTH TO ELEVENTH	2017	$179,000
PT032	PROP_1148	1,092	12	3	PL	Pumping Lane	RANCHERO, FROM SEVENTH TO ELEVENTH	2017	$184,000
PT034	PROP_1164	2,325	12	4	PL	Pumping Lane	SULTANA, FROM MARIPOSA TO ESCONDIDO	2017	$392,000
PT035	PROP_1166	344	18	4	PL	Pumping Lane	SULTANA & MARIPOSA	2017	$87,000
PT036	PROP_1168	1,706	12	4	PL	Pumping Lane	MARIPOSA, FROM PLANT 23 TO MAIN	2017	$288,000
PT037	PROP_1170	1,985	18	4	PL	Pumping Lane	RANCHERO, FROM TOPAZ TO MAPLE	2017	$502,000
PT038	PROP_1232	666	24	2	PL	Pumping Lane	RANCHERO, FROM CHASE TO BANGOR	2017	$225,000
PT039	PROP_1234	719	24	2	PL	Pumping Lane	RANCHERO, FROM BANGOR TO ALSTON	2017	$243,000
PT040	PROP_1236	2,814	24	2	PL	Pumping Lane	RANCHERO, FROM E AVE TO SANTA FE	2017	$950,000
PT041	PROP_1238	970	32	2	PL	Pumping Lane	SANTA FE, FROM RANCHERO TO PLANT 22	2017	$409,000
PT042	PROP_1240	503	32	2	PL	Pumping Lane	PLANT 22	2017	$212,000
PT043	PROP_1242	327	32	2	PL	Pumping Lane	PLANT 22	2017	$138,000
PT044	PROP_1312	609	24	2	PL	Pumping Lane	RANCHERO, FROM KINGSTON TO I AVE	2017	$206,000
PT045	PROP_1314	424	24	2	PL	Pumping Lane	RANCHERO, FROM I AVE TO OXFORD	2017	$143,000
PT046	PROP_1316	132	24	2	PL	Pumping Lane	RANCHERO & OXFORD	2017	$44,000
PT047	PROP_1318	403	24	2	PL	Pumping Lane	RANCHERO, FROM OXFORD TO NEWHALL	2017	$136,000
PT048	PROP_1320	501	24	2	PL	Pumping Lane	RANCHERO, FROM NEWHALL TO MONTROSE	2017	$169,000
PT049	PROP_1322	533	24	2	PL	Pumping Lane	RANCHERO, FROM MONTROSE TO LYONS	2017	$180,000
PT050	PROP_1324	481	24	2	PL	Pumping Lane	RANCHERO, FROM LYONS TO KENYON	2017	$162,000
PT051	PROP_1326	489	24	2	PL	Pumping Lane	RANCHERO, FROM KENYON TO JENKENS	2017	$165,000
PT052	PROP_1328	518	24	2	PL	Pumping Lane	RANCHERO, FROM JENKENS TO HASTINGS	2017	$175,000
PT053	PROP_1330	502	24	2	PL	Pumping Lane	RANCHERO, FROM HASTINGS TO GLIDER	2017	$169,000
PT054	PROP_1332	502	24	2	PL	Pumping Lane	RANCHERO, FROM GLIDER TO FARMDALE	2017	$169,000
PT055	PROP_1334	511	24	2	PL	Pumping Lane	RANCHERO, FROM FARMDALE TO EARNHART	2017	$173,000
PT056	PROP_1336	515	24	2	PL	Pumping Lane	RANCHERO, FROM EARNHART TO DAYTON	2017	$174,000
PT057	PROP_1338	513	24	2	PL	Pumping Lane	RANCHERO, FROM DAYTON TO CENTURY	2017	$173,000
PT058	PROP_1340	1,233	24	2	PL	Pumping Lane	RANCHERO, FROM CENTURY TO DANBURY	2017	$416,000
PT059	PROP_1342	793	24	2	PL	Pumping Lane	RANCHERO, FROM DANBURY TO CHASE	2017	$268,000
PT060	PROP_1360	382	16	3	PL	Pumping Lane	RANCHERO, FROM ELEVENTH CROSSING CA AQUEDUCT	2017	$84,000
PT061	PROP_1362	2,724	16	3	PL	Pumping Lane	RANCHERO, FROM AQUEDUCT TO COTTONWOOD	2017	$598,000
PT062	PROP_1364	347	32	3	PL	Pumping Lane	PLANT 22	2017	$146,000
PT063	PROP_1448	5,288	16	2	PL	Pumping Lane	ELEVENTH, FROM WILLOW TO MESA	2017	$1,160,000
PT064	PROP_1452	7,291	16	2	PL	Pumping Lane	WILLOW, FROM MAPLE TO ELEVENTH	2017	$1,599,000
PT065	PROP_1494	2,569	16	3	PL	Pumping Lane	RANCHERO, FROM COTTONWOOD TO MAPLE	2017	$563,000
PT066	PROP_1496	996	16	3	PL	Pumping Lane	MAPLE FROM RANCHERO RD. TO PLANT 19	2017	$218,000
PT067	PROP_1498	796	16	3	PL	Pumping Lane	MAPLE AVE TO PLANT 19 ALONG CROMDALE	2017	$175,000
PT068	PROP_1514	5,746	20	3	PL	Pumping Lane	LIVE OAK, FROM MARIPOSA TO TOPAZ	2017	$1,648,000
PT069	PROP_1570	666	24	3	PL	Pumping Lane	QUINN COURT S. OF WILLOW VINE	2017	$225,000
PT070	PROP_1572	627	16	4	PL	Pumping Lane	RANCHERO & MAPLE	2017	$138,000
PT071	PROP_1576	147	16	4	PL	Pumping Lane	RANCHERO & MAPLE	2017	$32,000

Table 9.8 **Future Pipeline Improvement Projects**
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Size (in)	Zone	Facility Description[2]	Purpose of Improvement	Location	Estimated Planning Year	Estimated Project Cost[3]
PT072	RES19_IN_OUT_2010	759	24	3	PL	Pumping Lane	PLANT 19	2017	$256,000
PT084	PROP_1244	5,408	18	4	PL	Pumping Lane	RANCHERO, FROM TOPAZ TO ESCONDIDO	2017	$1,369,000
	Subtotal	***59,672***						**SUBTOTAL**	**$15,952,000**
Pipeline Improvements									
PG121	PROP_1376	722	12	3	PL	FF_LT20PSI	AMARGOSA, FROM WEST MAIN TO AMARGOSA	2032	$122,000
PG122	PROP_1506	116	12	4	PL	FF_LT20PSI	I-15 & MARIPOSA	2032	$20,000
PG123	PROP_1508	98	12	4	PL	FF_LT20PSI	I-15 & MARIPOSA	2032	$17,000
PG124	PROP_1510	225	12	4	PL	FF_LT20PSI	I-15 & MARIPOSA	2032	$38,000
PG125	PROP_1512	208	12	4	PL	FF_LT20PSI	I-15 & MARIPOSA	2032	$35,000
PG126	PROP_1544	1,187	12	4	PL	FF_LT20PSI	MAPLE, FROM RANCHERO TO VICTOR	2032	$200,000
PG127	PROP_1546	1,415	12	4	PL	FF_LT20PSI	MAPLE, FROM VICTOR TO EL CENTRO	2032	$239,000
PG128	PROP_1548	2,651	12	4	PL	FF_LT20PSI	MAPLE, FROM EL CENTRO TO MESQUITE	2032	$447,000
	Subtotal	***6,622***						**SUBTOTAL**	**$1,118,000**
Transmission Main Improvements									
PT003	PROP_1176	370	24	1	PL	Pumping Lane	ARRWHD RD TO TANK 18	2032	$125,000
PT004	PROP_1178	5,451	24	1	PL	Pumping Lane	ARRWHD RD TO TANK 18	2032	$1,840,000
PT073	PROP_1100	138	12	1	PL	Pumping Lane	GLENDALE & MONTEREY	2032	$23,000
PT074	PROP_1102	1,319	12	1	PL	Pumping Lane	MONTEREY, FROM DEL MAR TO GLENDALE	2032	$223,000
PT075	PROP_1104	1,022	12	1	PL	Pumping Lane	MONTEREY, FROM ROYCE TO DEL MAR	2032	$172,000
PT076	PROP_1106	239	12	1	PL	Pumping Lane	MONTEREY, FROM ARROWHEAD LAKE TO ROYCE	2032	$40,000
PT077	PROP_1108	2,169	12	1	NEW	Pumping Lane	ARROWHEAD LAKE, FROM CALPELLA TO RANCHERO	2032	$366,000
PT078	PROP_1146	1,354	12	3	PL	Pumping Lane	SEVENTH, FROM WELLS FARGO TO LARCH	2032	$228,000
PT079	PROP_1210	3,080	18	4	NEW	Pumping Lane	I-15, FROM JOSHUA TO MUSCATEL	2032	$780,000
PT080	PROP_1224	3,283	18	4	NEW	Pumping Lane	I-15, FROM MUSCATEL TO SULTANA	2032	$831,000
PT081	PROP_1226	156	12	1	NEW	Pumping Lane	ARROWHEAD LAKE & CALPELLA	2032	$26,000
PT082	PROP_1228	1,010	12	1	PL	Pumping Lane	SEAFORTH, FROM ROYCE TO CAPELLA	2032	$170,000
PT083	PROP_1230	500	12	1	PL	Pumping Lane	SEAFORTH, FROM ARROWHEAD LAKE TO ROYCE	2032	$84,000
PT085	PROP_1246	8,374	18	4	PL	Pumping Lane	RANCHERO, FROM ESCONDIDO TO PLANT 30	2032	$2,120,000
PT086	PROP_1250	222	20	4	PL	Pumping Lane	PLANT 23	2032	$64,000
PT087	PROP_1366	1,018	12	3	PL	Pumping Lane	MAIN, FROM TAMARISK TO MAPLE	2032	$172,000
PT088	PROP_1368	410	12	3	PL	Pumping Lane	MAIN & TAMARISK	2032	$69,000
PT089	PROP_1370	1,412	12	3	PL	Pumping Lane	MAIN, FROM TOPAZ TO TAMARISK	2032	$238,000
PT090	PROP_1372	86	12	3	PL	Pumping Lane	MAIN & TOPAZ	2032	$15,000
PT091	PROP_1374	3,114	20	3	PL	Pumping Lane	MARIPOSA, FROM MAIN TO LIVE OAK	2032	$893,000
PT092	PROP_1380	3,918	16	4	PL	Pumping Lane	PLANT 30, FROM RANCHERO TO MARIPOSA	2032	$859,000
PT093	PROP_1382	163	16	4	PL	Pumping Lane	PLANT 30 & RANCHERO	2032	$36,000
PT094	PROP_1388	541	12	1	PL	Pumping Lane	CHOICEANA, CROSSING RAILROAD TO VINE	2032	$91,000
PT095	PROP_1390	851	12	1	PL	Pumping Lane	CHOICEANA, FROM OLEMA TO LIVE OAK	2032	$144,000
PT096	PROP_1392	442	12	1	PL	Pumping Lane	CHOICEANA, FROM FELTON TO OLEMA	2032	$75,000
PT097	PROP_1394	433	12	1	PL	Pumping Lane	CHOICEANA, FROM JUNIPER TO FELTON	2032	$73,000
PT098	PROP_1396	417	12	1	PL	Pumping Lane	CHOICEANA, FROM YUCCA TO JUNIPER	2032	$70,000

Table 9.8 **Future Pipeline Improvement Projects**
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Size (in)	Zone	Facility Description[2]	Purpose of Improvement	Location	Estimated Planning Year	Estimated Project Cost[3]
PT099	PROP_1398	446	12	1	PL	Pumping Lane	CHOICEANA, FROM MAIN TO YUCCA	2032	$75,000
PT100	PROP_1420	5,115	12	2	PL	Pumping Lane	MAPLE, FROM WILLOW TO MESA	2032	$863,000
PT101	PROP_1456_PS21_OUT	615	18	3	PL	Pumping Lane	PLANT 21	2032	$156,000
PT102	PROP_1458_TNK23_IN	3,700	18	3	PL	Pumping Lane	MARIPOSA, FROM PLANT 23 TO MAIN	2032	$936,000
PT103	PROP_1462	136	8	1	PL	Pumping Lane	JUNIPER & CHOICEANA	2032	$18,000
PT104	PROP_1464	737	12	3	PL	Pumping Lane	SEVENTH, FROM LARCH TO EL CENTRO	2032	$124,000
PT105	PROP_1466	2,932	12	3	PL	Pumping Lane	EL CENTRO, FROM SEVENTH TO ELEVENTH	2032	$495,000
PT106	PROP_1468	679	12	3	PL	Pumping Lane	ELEVENTH, FROM EL CENTRO TO FIR	2032	$115,000
PT107	PROP_1470	1,595	12	3	PL	Pumping Lane	THIRD, FROM PLANT 22 TO EL CENTRO	2032	$269,000
PT108	PROP_1472	2,430	12	3	PL	Pumping Lane	EL CENTRO, FROM SEVENTH TO THIRD	2032	$410,000
PT109	PROP_1474	710	12	3	PL	Pumping Lane	ELEVENTH, FROM FIR TO MISSION	2032	$120,000
PT110	PROP_1476	696	12	3	PL	Pumping Lane	ELEVENTH, FROM MISSION TO ASH	2032	$117,000
PT111	PROP_1482	1,365	12	3	PL	Pumping Lane	SEVENTH, FROM EL CENTRO TO MISSION	2032	$230,000
PT112	PROP_1486	818	12	3	PL	Pumping Lane	ELEVENTH, FROM RANCHERO TO WELLS FARGO	2032	$138,000
PT113	PROP_1488	695	12	3	PL	Pumping Lane	ELEVENTH, WELLS FARGO TO RODEO	2032	$117,000
PT114	PROP_1490	700	12	3	PL	Pumping Lane	ELEVENTH, FROM RODEO TO LARCH	2032	$118,000
PT115	PROP_1492	729	12	3	PL	Pumping Lane	ELEVENTH, FROM LARCH TO EL CENTRO	2032	$123,000
PT116	PROP_2020_TNK30_IN	825	24	4	NEW	Pumping Lane	TANK 30	2032	$278,000
PT117	PROP_P1006_2006	1,206	20	3A	PL	Pumping Lane	PLANT 23 & MARIPOSA	2032	$346,000
PT118	PROP_P1026	6,327	24	4	NEW	Pumping Lane	I-15, FROM MARIPOSA TO JOSHUA	2032	$2,135,000
PT119	PROP_P1110	2,000	16	4	NEW	Pumping Lane	I-15, FROM SULTANA TO PLANT 23	2032	$439,000
	Subtotal	***75,947***						**SUBTOTAL**	**$17,449,000**
								Total Estimated Future Pipeline Improvement Cost	**$89,402,000**

Notes:
(1) If a CIP number is identified, projects are numbered in order of priority.
(2) Abbreviations listed in this column are as follows: "NEW" - new pipe to be installed where no current pipeline exists; "PL" - a parallel pipeline is recommended next to the existing; "RP" - a pipeline replacement is recommended.
(3) Estimated Project Costs are based on January 2007 dollars and include estimated engineering, legal, and administrative costs and a contingency. Costs were rounded to the nearest $1,000.

Table 9.9 Future Storage Improvement Projects
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID/ Improvement Facility	Volume (MG)	Operating HGL (ft)	Zone	Facility Description	Reason for Improvement/ Deficiency	Location	Estimated Planning Year	Estimated Project Cost[2]
T2	PROP_ZONE_5_TANK	5	4,050	5	Reservoir at Zone 5	Increased Growth	FWAY_CORR	Near Term	$3,750,000
T3	PROP_Z6_HYDRO	–	4,300	6	New Hydropneumatic Tank	Increased Growth	FWAY_CORR	Near Term	$525,000
								SUBTOTAL	**$4,275,000**
T4	RLF_PROPOSED_TANK	5	3,500	RLF_3500	Reservoir #RLF-1	Increased Growth	RLF ZONE	2012	$3,750,000
T5	PROP_RES21	5	3,402	2	Reservoir #21A	Additional Storage Required	PLANT 21	2012	$3,750,000
N/A	Included in Table 9.7	N/A	N/A	4	BPS FROM ZONE 4 TO 5	Increased Growth		2012	INCL
EG.1	N/A	N/A	N/A	4	Emergency Generator at Zone 4 to 5 BPS	Increased Growth		2012	$200,000
N/A	Included in Table 9.7	N/A	N/A	5	BPS FROM ZONE 5 TO 6	Increased Growth		2012	INCL
EG.2	N/A	N/A	N/A	5	Emergency Generator at Zone 5 to 6 BPS	Additional Storage Required		2012	$200,000
								SUBTOTAL	**$7,900,000**
T7	PROP_RES23	3	3,581	3	Reservoir #23A	Additional Storage Required	PLANT 23	2017	$2,250,000
T8	PROP_RES19_2015	5	3,592	3	Reservoir #19C	Additional Storage Required	PLANT 19	2017	$3,750,000
EG.3	N/A	N/A	N/A	1	Emergency Generator at BPS of Plant #18	Increased Growth	PLANT 18	2017	$200,000
EG.4	N/A	N/A	N/A	RLF_3500	Emergency Generator at Well #RLF-1	Additional Storage Required	WELL RLF-1	2017	$200,000
EG.5	N/A	N/A	N/A	RLF_3500	Emergency Generator at Well #RLF-2	Additional Storage Required	WELL RLF-2	2017	$200,000
								SUBTOTAL	**$6,600,000**
T6	PROP_RES18	5	3,229	1	Reservoir #18A	Additional Storage Required	PLANT 18	2022	$3,750,000
T9	PROP_RES30_2020	5	3,852	4	Reservoir #30D	Additional Storage Required	PLANT 30	2022	$3,750,000
EG.6	N/A	N/A	N/A	3	Emergency Generator at BPS of Plant #19	Increased Growth	PLANT 19	2022	$200,000
EG.7	N/A	N/A	N/A	2	Emergency Generator at Well #24	Additional Storage Required	WELL 24	2022	$200,000
EG.8	N/A	N/A	N/A	RLF_3500	Emergency Generator at Well #RLF-3	Additional Storage Required	WELL RLF-3	2022	$200,000
T-10	PROP_ZONE_4_TANK	5	3,852	4	Reservoir at Zone 4	Additional Storage Required	ZONE 4	2027	$3,750,000
T-11	RLF_PROPOSED_TANK	5	3,500	RLF_3500	Reservoir #RLF-2	Increased Growth	RLF ZONE	2027	$3,750,000
EG.9	N/A	N/A	N/A	2	Emergency Generator at Well #20	Additional Storage Required	WELL 20	2027	$200,000
EG.10	N/A	N/A	N/A	1	Emergency Generator at BPS of Plant #14	Increased Growth	PLANT 14	2032	$200,000
EG.11	N/A	N/A	N/A	2	Emergency Generator at BPS of Plant #21	Increased Growth	PLANT 21	2032	$200,000
EG.12	N/A	N/A	N/A	1	Emergency Generator at Well #5	Additional Storage Required	WELL 5	2032	$200,000
EG.13	N/A	N/A	N/A	1	Emergency Generator at Well #26	Additional Storage Required	WELL 26	2032	$200,000
								SUBTOTAL	**$16,600,000**
								Total Estimated Storage Improvement Cost	**$35,375,000**

Notes:
(1) If a CIP number is identified, projects are numbered in order of priority.
(2) Estimated Project Costs are based on January 2007 dollars and include estimated engineering, legal, and administrative costs and a contingency. Costs were rounded to the nearest $1,000.

Table 9.10 Supplemental CIP Facilities for TOU
Water Master Plan Update 9000
City of Hesperia

Proposed Facility Improvement Project No.	Pump No.	Model ID	Flow (gpm)	Design Head (ft)	From Zone	To Zone	Facility Description[(1)]	Reason for Improvement/ Deficiency	Location	Estimated Project Cost[(2)]
Proposed Wells										
TOU-01	N/A	WELL_PMP_50_TOU[A]	1,500	420	GW	1	NEW	Water Supply	Ranchero Road and Niles Drive	$1,462,000
TOU-02	N/A	WELL_PMP_51_TOU[B]	1,500	500	GW	1	NEW	Water Supply	Lake Arrowhead Road and Mono Drive	$1,462,000
TOU-03	N/A	WELL_PMP_52_TOU[C]	1,500	620	GW	2	NEW	Water Supply	Willow and Eleventh Avenue	$1,462,000
TOU-04	N/A	WELL_PMP_53_TOU[D]	1,500	620	GW	2	NEW	Water Supply	Ranchero and Earnart Avenue	$1,462,000
TOU-05	N/A	WELL_PMP_54_TOU[E]	1,500	820	GW	3	NEW	Water Supply	Main and Maple Avenue	$1,462,000
TOU-06	N/A	RLF_WELL_6_TOU[F]	1,500	700	GW	RLF	NEW	Water Supply	Ryeland and Vista Avenue	$1,462,000
									SUBTOTAL	**$8,772,000**
Additional Storage										
TOU-07	N/A	14.5 MG of Total Storage				ALL	NEW	Storage	System Wide	$5,800,000
									SUBTOTAL	**$5,800,000**
				Length (ft)		**Zone**	**Original Size (in)**	**TOU Size (in)**		**Additional Pipeline Costs**
Pipeline Improvements										
TOU-08	N/A	PROP_1114		459		2	24	32		$37,000
TOU-09	N/A	PROP_1116		457		2	24	32		$37,000
TOU-10	N/A	PROP_1118		472		2	24	32		$38,000
TOU-11	N/A	PROP_1120		479		2	24	32		$38,000
TOU-12	N/A	PROP_1136_TNK22_IN		634		2	32	36		$25,000
TOU-13	N/A	PROP_1148		1,092		3	12	16		$44,000
TOU-14	N/A	PROP_1150		607		3	12	16		$24,000
TOU-15	N/A	PROP_1180_TNK18_IN		1,727		1	24	32		$138,000
TOU-16	N/A	PROP_1222		173		4	12	16		$7,000
TOU-17	N/A	PROP_1232		666		2	24	32		$53,000
TOU-18	N/A	PROP_1234		719		2	24	32		$58,000
TOU-19	N/A	PROP_1236		2,814		2	24	32		$225,000
TOU-20	N/A	PROP_1250		222		4	20	24		$9,000
TOU-21	N/A	PROP_1360		382		3	16	20		$15,000
TOU-22	N/A	PROP_1362		2,724		3	16	20		$109,000
TOU-23	N/A	PROP_1382		163		4	16	20		$7,000
TOU-24	N/A	PROP_1486		818		3	12	16		$33,000
TOU-25	N/A	PROP_1508		98		4	12	16		$4,000
TOU-26	N/A	PROP_PS18_OUT		786		2	32	36		$31,000
TOU-27	N/A	PROP_RES21_IN		850		2	24	32		$68,000
TOU-28	N/A	RES19_IN_OUT_2010		759		3	24	32		$61,000
			Subtotal	***17,101***					**SUBTOTAL**	**$1,061,000**
									Total Estimated Improvement Cost for Supplemental TOU Facilities	**$15,633,000**

Notes:
(1) Abbreviations listed in this column are as follows: "NEW" - new facility is to be installed where no current one exists; "RP" - a facility replacement is recommended.
(2) Estimated Project Costs are based on January 2007 dollars and include estimated engineering, legal, and administrative costs and a contingency. All well costs include the cost of drilling and equipping. Costs were rounded to the nearest $1,000.

Table 9.11	Cost Savings for Future Storage Improvement Projects Water Master Plan Update City of Hesperia		
System Condition	**Planning Year**	**Removable Proposed Facility**	**Estimated Cost(2) Savings**
Reclaimed Water Only	2012	Reservoir #21A	($6,400,000)
	2017	Reservoir #21A, #23A	
	2022	Reservoir #21A, #23A, EG at Well #20	
	2027	Reservoir #21A, #23A, EG at Well #20	
	2032	Reservoir #21A, #23A, EG at Well #20 & #26	
10% Conservation Only	2022	Reservoir #21A, #23A, EG at Well #20	($6,200,000)
	2027	Reservoir #21A, #23A, EG at Well #20	
10% Conservation and RW	2022	Reservoir #21A, #23A, #30D, #18A, EG at Well #20	($13,700,000)
	2027	Reservoir #21A, #23A, #30D, #18A, EG at Well #20	
20% Conservation Only	2032	Reservoir #30D, #18A, Z4, RLF-2, EG at Well #20 & #26	($15,400,000)
20% Conservation and RW	2032	Reservoir #21A, #23A, #30D, #18A, #19C, Z4, RLF-2, EG at Well #20 & #26	($25,150,000)

Notes:
(1) Estimated Cost Savings are based on January 2007 dollars and include estimated engineering, legal, and administrative costs and a contingency. Costs were rounded to the nearest $1,000.

Table 9.12 Potential Facility Reduction with Conservation
Water Master Plan Update
City of Hesperia

Proposed Facility Improvement Project No.	Pump No.	Model ID	Flow (gpm)	Design Head (ft)	From Zone	To Zone			Estimated Cost(2) Savings
Removable Wells									
Con-01	N/A	WELL_PMP_37	1,800	-	GW	1			($1,563,000)
Con-02	N/A	WELL_PMP_40	1,200	-	GW	2			($1,356,000)
Con-03	N/A	WELL_PMP_41	1,200	-	GW	2			($1,356,000)
Con-04	N/A	WELL_PMP_42	1,200	-	GW	2			($1,356,000)
Con-05	N/A	WELL_PMP_45	2,000	-	GW	1			($1,629,000)
								SUBTOTAL	**($7,260,000)**
				Length (ft)		**Zone**	**Original Size (in)**	**Conservation Size (in)**	
Removable Pipeline Improvements									
Con-06	N/A	2562_1_TNK18_IN		1,790		1	18	12	($183,000)
Con-07	N/A	PROP_1176		370		1	24	20	($25,000)
Con-08	N/A	PROP_1178		5,451		1	24	20	($371,000)
Con-09	N/A	PROP_P1018_2010		1,319		1	16	12	($90,000)
Con-10	N/A	PROP_P1020		590		1	16	12	($40,000)
Con-11	N/A	PROP_P1022		650		1	16	12	($44,000)
Con-12	N/A	PROP_1114		459		2	24	20	($31,000)
Con-13	N/A	PROP_1116		457		2	24	20	($31,000)
Con-14	N/A	PROP_1118		472		2	24	20	($32,000)
Con-15	N/A	PROP_1120		479		2	24	20	($33,000)
Con-16	N/A	PROP_1122		658		2	18	12	($67,000)
Con-17	N/A	PROP_1136_TNK22_IN		634		2	32	24	($86,000)
Con-18	N/A	PROP_1156		394		2	16	12	($27,000)
Con-19	N/A	PROP_1232		666		2	24	20	($45,000)
Con-20	N/A	PROP_1234		719		2	24	20	($49,000)
Con-21	N/A	PROP_1236		2,814		2	24	20	($191,000)
Con-22	N/A	PROP_1238		970		2	32	24	($132,000)

Table 9.12 Potential Facility Reduction with Conservation
Water Master Plan Update
City of Hesperia

Proposed Facility Improvement Project No.	Pump No.	Model ID	Flow (gpm)	Design Head (ft)	From Zone	To Zone			Estimated Cost(2) Savings
Con-23	N/A	PROP_1240		503		2	32	24	($68,000)
Con-24	N/A	PROP_1242		327		2	32	24	($44,000)
Con-25	N/A	PROP_1312		609		2	24	20	($41,000)
Con-26	N/A	PROP_1314		424		2	24	20	($29,000)
Con-27	N/A	PROP_1316		132		2	24	20	($9,000)
Con-28	N/A	PROP_1318		403		2	24	20	($27,000)
Con-29	N/A	PROP_1320		501		2	24	20	($34,000)
Con-30	N/A	PROP_1322		533		2	24	20	($36,000)
Con-31	N/A	PROP_1324		481		2	24	20	($33,000)
Con-32	N/A	PROP_1326		489		2	24	20	($33,000)
Con-33	N/A	PROP_1328		518		2	24	20	($35,000)
Con-34	N/A	PROP_1330		502		2	24	20	($34,000)
Con-35	N/A	PROP_1332		502		2	24	20	($34,000)
Con-36	N/A	PROP_1334		511		2	24	20	($35,000)
Con-37	N/A	PROP_1336		515		2	24	20	($35,000)
Con-38	N/A	PROP_1338		513		2	24	20	($35,000)
Con-39	N/A	PROP_1340		1,233		2	24	20	($84,000)
Con-40	N/A	PROP_1342		793		2	24	20	($54,000)
Con-41	N/A	PROP_1448		5,288		2	16	12	($360,000)
Con-42	N/A	PROP_1452		7,291		2	16	12	($496,000)
Con-43	N/A	PROP_1454		7,860		2	16	12	($534,000)
Con-46	N/A	PROP_1138		312		3	32	24	($42,000)

Table 9.12 Potential Facility Reduction with Conservation
Water Master Plan Update
City of Hesperia

Proposed Facility Improvement Project No.	Pump No.	Model ID	Flow (gpm)	Design Head (ft)	From Zone	To Zone			Estimated Cost[(2)] Savings
Con-47	N/A	PROP_1140		1,813		3	24	20	($123,000)
Con-48	N/A	PROP_1142		717		3	16	12	($49,000)
Con-49	N/A	PROP_1360		382		3	16	12	($26,000)
Con-50	N/A	PROP_1362		2,724		3	16	12	($185,000)
Con-51	N/A	PROP_1364		347		3	32	24	($47,000)
Con-52	N/A	PROP_1450		1,638		3	20	16	($111,000)
Con-53	N/A	PROP_1494		2,569		3	16	12	($175,000)
Con-54	N/A	PROP_1496		996		3	16	12	($68,000)
Con-55	N/A	PROP_1498		796		3	16	12	($54,000)
Con-56	N/A	PROP_1514		5,746		3	20	16	($391,000)
Con-57	N/A	PROP_1570		666		3	24	20	($45,000)
Con-58	N/A	PROP_1588		395		3	32	24	($54,000)
Con-62	N/A	PROP_PS23_IN_TNK23IN		344		4	18	12	($35,000)
Con-63	N/A	PROP_RES23_IN_OUT		1,985		4	18	12	($202,000)
Con-64	N/A	PROP_1170		3,080		4	18	12	($314,000)
Con-65	N/A	PROP_1210		3,283		4	18	12	($335,000)
Con-66	N/A	PROP_1224		222		4	20	16	($15,000)
Con-67	N/A	PROP_1244		627		4	16	12	($43,000)
Con-68	N/A	PROP_1246		147		4	16	12	($10,000)
Con-69	N/A	PROP_1380		6,327		4	24	20	($430,000)
Con-70	N/A	PROP_1382		193		4	32	24	($26,000)
Con-72	N/A	PROP_1576		1,188		3A	20	16	($81,000)

Table 9.12	Potential Facility Reduction with Conservation Water Master Plan Update City of Hesperia								
Proposed Facility Improvement Project No.	Pump No.	Model ID	Flow (gpm)	Design Head (ft)	From Zone	To Zone			Estimated Cost(2) Savings
Con-73	N/A	PROP_P1026		138		1	12	0	($28,000)
Con-74	N/A	PROP_P1100_PS19_OUT		1,319		1	12	0	($269,000)
Con-75	N/A	PROP_PS23_OUT		1,022		1	12	0	($208,000)
Con-76	N/A	PROP_P1006_2006		239		1	12	0	($49,000)
								SUBTOTAL	**($6,982,000)**
								Total Estimated Cost Savings for Conservation	**($14,242,000)**

Notes:
(1) Abbreviations listed in this column are as follows: "NEW" - new facility is to be installed where no current one exists; "RP" - a facility replacement is recommended.
(2) Estimated Project Costs are based on January 2007 dollars and include estimated engineering, legal, and administrative costs and a contingency. All well costs include the cost of drilling and equipping.

9.4.6 Summary of Recommended Improvement Costs

Using the phasing periods identified in Section 9.4.1, all of the recommended CIP improvement projects for the City were summarized by project type and priority level in Table 9.13. The estimated cost of engineering, legal, administration, construction management, as well as the estimated contingency, are shown in Table 9.1.

Table 9.13 Phasing of CIP by Improvement Type
Water Master Plan Update
City of Hesperia

Improvement Type	Near Term ($M)	2007-2012 ($M)	2013-2017 ($M)	2018-2032 ($M)	Total ($M)
Existing Fire Flow	41.0	0.0	0.0	0.0	41.0
Existing Velocity	0.9	0.1	0.2	0.0	1.1
Existing Steel Pipe	0.0	0.0	37.3	37.3	74.7
Future Booster Pump Stations	0.0	6.3	3.4	2.4	12.1
Future Wells	0.0	7.3	13.1	17.8	38.2
Future Pipeline Improvements	16.6	32.5	21.8	18.6	89.4
Future Storage	4.3	7.9	6.6	16.6	35.4
Totals	**62.7**	**54.1**	**82.3**	**92.7**	**291.8**

Notes:
(1) Estimated Project Costs are based on January 2007 dollars and include estimated engineering, legal and administrative costs, and a contingency, but excludes costs for land acquisition and off-site facilities.

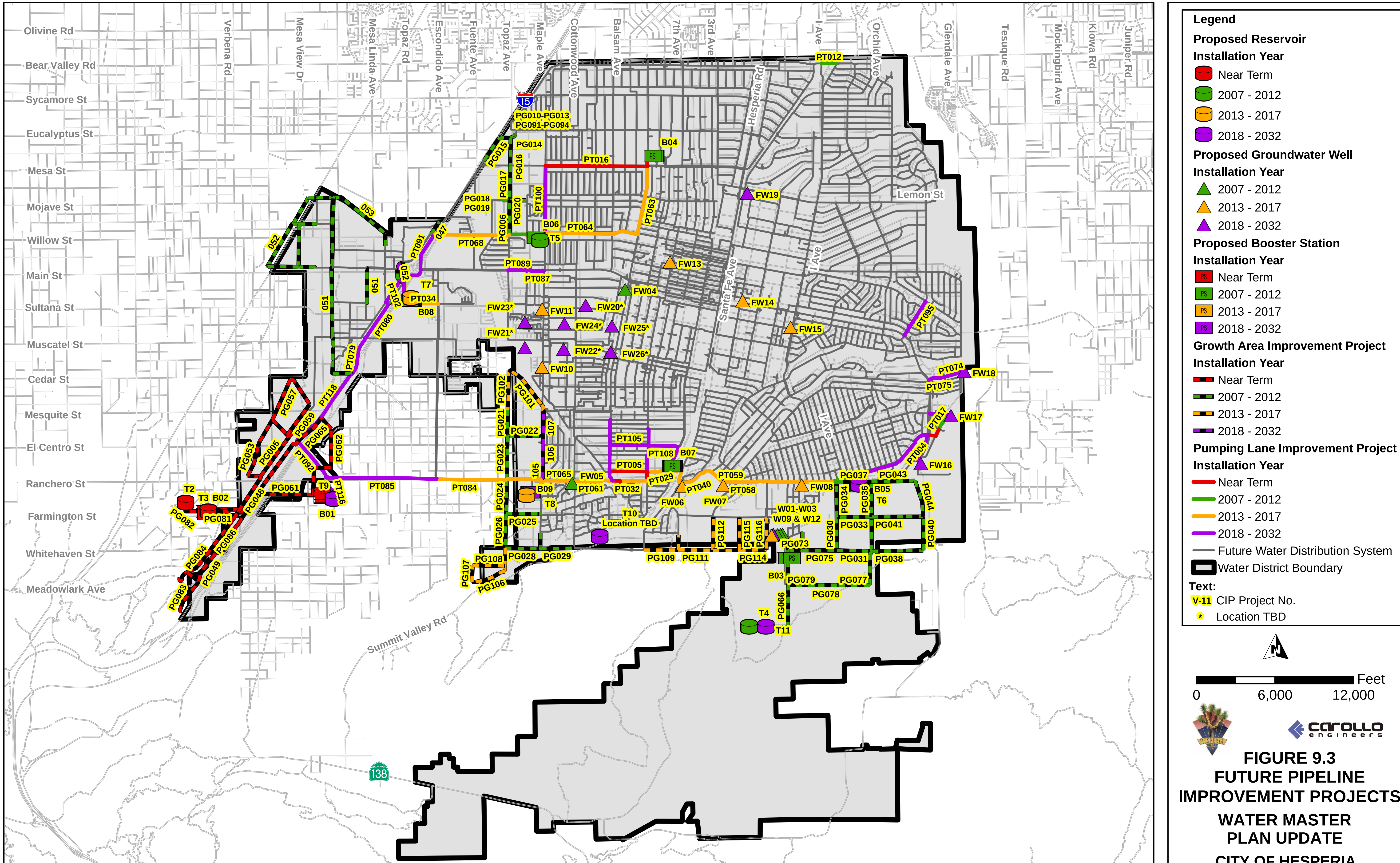


FIGURE 9.3
FUTURE PIPELINE IMPROVEMENT PROJECTS

WATER MASTER PLAN UPDATE

CITY OF HESPERIA

APPENDIX A

PUMP CHECK - PUMPING SYSTEMS ANALYSTS
WELL AND BOOSTER PUMP - HYDRAULIC TEST REPORTS

Appendix A.1

WELL PUMPS
YEAR 2003

PUMP CHECK

Pumping Systems Analysts
Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
18712 Main Street

Test Date: 10/23/03
Pump type: DWT
Plant: Well #3

A test was made on this well pump and the following information was obtained.

EQUIPMENT

PUMP:	No Data	SERIAL:	N/A
MOTOR:	US	SERIAL:	G11601/S08S0660550R-
H.P.	400.0	LAT/LON:	34.24.832n117.15.266w
METER:	V349R-006041		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	97.0	107.0	118.5
Discharge head, feet	224.1	247.2	273.7
Standing water level, feet	217.5		
Drawdown, feet	12.4	11.3	9.6
Pumping water level, feet	229.9	228.8	227.1
Total pumping head, feet	454.0	476.0	500.8
Gallons per minute flow	**2336**	**2008**	**1740**
Gallons per foot of drawdown	188.4	177.7	181.2
Acre feet pumped per 24 hours	10.322	8.873	7.687
KW input to motor	280.7	269.2	259.0
HP input to motor	376.1	360.7	347.0
Motor load, % BHP	87.4	83.9	80.7
Measured speed of pump, RPM	1784		
KWH per acre foot	652.6	728.2	808.5
Overall plant efficiency in %	**71.2**	**66.9**	**63.4**

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517
"Pump Testing, The Service That Pays For Itself"

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
18295 Redding Street

Test Date: 10/23/2003
Pump type: DWT
Plant: Well #5

A test was made on this well pump and the following information was obtained.

EQUIPMENT

PUMP:	Peerless	SERIAL:	249271
MOTOR:	US	SERIAL:	R05-R0810402-GT
H.P.	400.0	LAT/LON:	34.23.955n117.15.846w
METER:	V349R-000204		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	55.0	68.0	79.0
Discharge head, feet	127.1	157.1	182.5
Standing water level, feet	314.5		
Drawdown, feet	17.7	16.0	14.7
Pumping water level, feet	332.2	330.5	329.2
Total pumping head, feet	459.3	487.6	511.7
Gallons per minute flow	**2610**	**2445**	**2332**
Gallons per foot of drawdown	147.4	152.8	158.7
Acre feet pumped per 24 hours	11.532	10.805	10.306
KW input to motor	309.3	307.1	310.5
HP input to motor	414.5	411.6	416.1
Motor load, % BHP	98.4	97.8	98.8
Measured speed of pump, RPM	1785		
KWH per acre foot	643.8	682.2	723.1
Overall plant efficiency in %	**73.0**	**73.1**	**72.4**

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
11020 10th Avenue

Test Date: 11/05/2003
Pump type: DWT
Plant: Well #14

A test was made on this well pump and the following information was obtained.

EQUIPMENT

PUMP:	Peerless	SERIAL:	F31531
MOTOR:	Yaskawa	SERIAL:	0071803101
H.P.	400.0	LAT/LON:	34.26.997n117.19.145w
METER:	V349R-006028		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	11.0	21.0	39.0
Discharge head, feet	25.4	48.5	90.1
Standing water level, feet	404.1		
Drawdown, feet	14.8	14.0	13.1
Pumping water level, feet	418.9	418.1	417.2
Total pumping head, feet	444.3	466.6	507.3
Gallons per minute flow	**2398**	**2307**	**2138**
Gallons per foot of drawdown	162.0	164.8	163.2
Acre feet pumped per 24 hours	10.595	10.195	9.446
KW input to motor	319.7	320.6	320.3
HP input to motor	428.4	429.6	429.2
Motor load, % BHP	99.6	99.9	99.8
Measured speed of pump, RPM	1787		
KWH per acre foot	724.2	754.7	813.9
Overall plant efficiency in %	**62.8**	**63.3**	**63.8**

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517

"Pump Testing, The Service That Pays For Itself"

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
15680 Palm

Test Date: 11/05/2003
Pump type: DWT
Plant: Well 15A

A test was made on this well pump and the following information was obtained.

EQUIPMENT

PUMP:	Ingersoll Rand	SERIAL:	0683-9048
MOTOR:	US	SERIAL:	S02-R3430563-GT
H.P.	300.0	LAT/LON:	34.24.437n117.19.269w
METER:	V349R-000576		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	36.5	46.5	57.5
Discharge head, feet	84.3	107.4	132.8
Standing water level, feet	555.5		
Drawdown, feet	31.4	30.2	29.0
Pumping water level, feet	586.9	585.7	584.5
Total pumping head, feet	671.2	693.1	717.3
Gallons per minute flow	**1410**	**1332**	**1231**
Gallons per foot of drawdown	44.9	44.1	42.5
Acre feet pumped per 24 hours	6.232	5.885	5.440
KW input to motor	273.1	271.5	269.9
HP input to motor	366.0	363.8	361.7
Motor load, % BHP	115.9	115.2	114.5
Measured speed of pump, RPM	1783		
KWH per acre foot	1051.8	1107.2	1190.7
Overall plant efficiency in %	**65.3**	**64.1**	**61.7**

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
8484 4th Avenue

Test Date: 10/23/2003
Pump type: DWT
Plant: Well #17

A test was made on this well pump and the following information was obtained.

EQUIPMENT

PUMP:	Worthington	SERIAL:	N/A
MOTOR:	Yaskawa	SERIAL:	226244101
H.P.	300.0	LAT/LON:	34.24.294n117.18.798w
METER:	V349R-000552		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	37.5	46.5	58.0
Discharge head, feet	86.6	107.4	134.0
Standing water level, feet	531.8		
Drawdown, feet	15.2	14.4	13.9
Pumping water level, feet	547.0	546.2	545.7
Total pumping head, feet	633.6	653.6	679.7
Gallons per minute flow	**1235**	**1176**	**1137**
Gallons per foot of drawdown	81.2	81.7	81.8
Acre feet pumped per 24 hours	5.455	5.197	5.026
KW input to motor	216.6	212.0	210.2
HP input to motor	290.2	284.1	281.6
Motor load, % BHP	90.0	88.1	87.3
Measured speed of pump, RPM	1784		
KWH per acre foot	952.8	979.0	1003.7
Overall plant efficiency in %	**68.1**	**68.3**	**69.3**

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7292 Paisley Road

Test Date: 11/04/2003
Pump type: DWT
Plant: Well #18

A test was made on this well pump and the following information was obtained.

EQUIPMENT

PUMP:	Peerless	SERIAL:	2426729
MOTOR:	Yaskawa	SERIAL:	4338091001
H.P.	300.0	LAT/LON:	34.25.006n117.16.126w
METER:	V349R-000236		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	16.5	25.5	36.0
Discharge head, feet	38.1	58.9	83.2
Standing water level, feet	383.5		
Drawdown, feet	41.7	38.3	33.1
Pumping water level, feet	425.2	421.8	416.6
Total pumping head, feet	463.3	480.7	499.8
Gallons per minute flow	**1377**	**1232**	**1063**
Gallons per foot of drawdown	33.0	32.2	32.1
Acre feet pumped per 24 hours	6.084	5.444	4.696
KW input to motor	211.4	203.9	193.3
HP input to motor	283.2	273.3	259.0
Motor load, % BHP	87.8	84.7	80.3
Measured speed of pump, RPM	1781		
KWH per acre foot	833.8	899.0	987.7
Overall plant efficiency in %	**56.9**	**54.7**	**51.8**

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517

"Pump Testing, The Service That Pays For Itself"

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
10071 Tamarisk Avenue

Test Date: 11/05/2003
Pump type: DWT
Plant: Well #21

A test was made on this well pump and the following information was obtained.

EQUIPMENT

PUMP:	Peerless	SERIAL:	F24551
MOTOR:	Yaskawa	SERIAL:	3271331701
H.P.	250.0	LAT/LON:	34.26.037n117.21.026w
METER:	V249M-123		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	13.0	24.0	39.0
Discharge head, feet	30.0	55.4	90.1
Standing water level, feet	601.3		
Drawdown, feet	23.8	22.2	19.6
Pumping water level, feet	625.1	623.5	620.9
Total pumping head, feet	655.1	678.9	711.0
Gallons per minute flow	**809**	**767**	**672**
Gallons per foot of drawdown	34.0	34.5	34.3
Acre feet pumped per 24 hours	3.573	3.387	2.970
KW input to motor	178.2	174.8	169.8
HP input to motor	238.8	234.2	227.5
Motor load, % BHP	88.3	86.6	84.2
Measured speed of pump, RPM	1785		
KWH per acre foot	1196.9	1238.2	1372.1
Overall plant efficiency in %	**56.0**	**56.1**	**53.0**

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517

"Pump Testing, The Service That Pays For Itself"

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7499 3rd Avenue

Test Date: 11/06/2003
Pump type: DWT
Plant: Well #22

A test was made on this well pump and the following information was obtained.

EQUIPMENT

PUMP:	Peerless	SERIAL:	87-34496
MOTOR:	Yaskawa	SERIAL:	0078314601
H.P.	450.0	LAT/LON:	34.23.11n117.18.46w
METER:	V349R-000517		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	16.0	26.0	46.0
Discharge head, feet	37.0	60.1	106.3
Standing water level, feet	n/a		
Drawdown, feet	n/a	n/a	n/a
Pumping water level, feet	n/a	n/a	n/a
Total pumping head, feet	n/a	n/a	n/a
Gallons per minute flow	**1866**	**1816**	**1717**
Gallons per foot of drawdown	n/a	n/a	n/a
Acre feet pumped per 24 hours	8.246	8.027	7.589
KW input to motor	341.2	344.4	346.5
HP input to motor	457.2	461.5	464.3
Motor load, % BHP	94.5	95.4	96.0
Measured speed of pump, RPM	1787		
KWH per acre foot	993.1	1029.8	1095.8
Overall plant efficiency in %	**n/a**	**n/a**	**n/a**

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

We were unable to measure the water level with our sounder line and the air line was inoperative. Therefore, we were unable to determine the total pumping head and the overall plant efficiency.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517

"Pump Testing, The Service That Pays For Itself"

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
8734 Hesperia Road

Test Date: 10/23/2003
Pump type: DWT
Plant: Well #25

A test was made on this well pump and the following information was obtained.

EQUIPMENT

PUMP:	No Data	SERIAL:	N/A
MOTOR:	Yaskawa	SERIAL:	2255361203
H.P.	200.0	LAT/LON:	34.24.565n117.18.288w
METER:	ZYA084-328533		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	59.0	67.5	77.5
Discharge head, feet	136.3	155.9	179.0
Standing water level, feet	474.4		
Drawdown, feet	14.7	14.3	13.9
Pumping water level, feet	489.1	488.7	488.3
Total pumping head, feet	625.4	644.6	667.3
Gallons per minute flow	**888**	**864**	**809**
Gallons per foot of drawdown	60.4	60.4	58.2
Acre feet pumped per 24 hours	3.922	3.818	3.575
KW input to motor	155.5	152.1	152.2
HP input to motor	208.4	203.9	203.9
Motor load, % BHP	95.9	93.8	93.8
Measured speed of pump, RPM	1789		
KWH per acre foot	951.7	956.5	1021.8
Overall plant efficiency in %	**67.3**	**69.0**	**66.8**

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
17282 Mojave Street

Test Date: 10/23/2003
Pump type: DWT
Plant: Well #26

A test was made on this well pump and the following information was obtained.

EQUIPMENT

PUMP:	No Data	SERIAL:	N/A
MOTOR:	GE	SERIAL:	P D 111056
H.P.	300.0	LAT/LON:	34.26.110n117.17.204w
METER:	ZYA084-328530		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	48.0	59.5	68.5
Discharge head, feet	110.9	137.4	158.2
Standing water level, feet	322.3		
Drawdown, feet	5.6	4.6	3.2
Pumping water level, feet	327.9	326.9	325.5
Total pumping head, feet	438.8	464.3	483.7
Gallons per minute flow	**1207**	**969**	**720**
Gallons per foot of drawdown	215.6	210.7	225.0
Acre feet pumped per 24 hours	5.334	4.282	3.181
KW input to motor	174.7	168.0	161.9
HP input to motor	234.0	225.1	216.9
Motor load, % BHP	74.7	71.9	69.3
Measured speed of pump, RPM	1789		
KWH per acre foot	785.8	941.5	1221.5
Overall plant efficiency in %	**57.1**	**50.5**	**40.5**

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

Appendix A.2

BOOSTER PUMPS
YEAR 2003

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
11020 10th Avenue

Test Date: 11/04/2003
Pump type: TB
Plant: Plant #14 Booster #1

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Simmons	SERIAL:	N/A
MOTOR:	GE	SERIAL:	N/A
H.P.	100.0	LAT/LON:	34.27.009n117.19.139w
METER:	V349R-000289		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	100.0	123.5	144.0
Discharge head, feet	231.0	285.3	332.6
Suction head, PSI	11.5	11.5	11.5
Suction head, feet	26.6	26.6	26.6
Total pumping head, feet	204.4	258.7	306.1
Gallons per minute flow	**1103**	**974**	**805**
Acre feet pumped per 24 hours	4.876	4.305	3.558
KW input to motor	82.7	80.3	75.6
HP input to motor	110.8	107.6	101.3
Motor load, % BHP	106.6	103.5	97.5
Measured speed of pump, RPM	1791		
KWH per acre foot	407.1	447.7	510.0
Overall plant efficiency in %	**51.4**	**59.1**	**61.4**
Shut off head in feet 400			

Test 1 was the normal operation of the pump at the time of the test. Test 2 results were obtained by throttling the pump discharge. Test 3 results were obtained by throttling the pump discharge at near design.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
11020 10th Avenue

Test Date: 11/04/2003
Pump type: TB
Plant: Plant #14 Booster #2

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Simmons	SERIAL:	N/A
MOTOR:	GE	SERIAL:	SD194052
H.P.	100.0	LAT/LON:	34.27.009n117.19.139w
METER:	V349R-000289		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	100.0	124.0	146.0
Discharge head, feet	231.0	286.4	337.3
Suction head, PSI	11.5	11.5	11.5
Suction head, feet	26.6	26.6	26.6
Total pumping head, feet	204.4	259.9	310.7
Gallons per minute flow	**1126**	**1045**	**834**
Acre feet pumped per 24 hours	4.974	4.619	3.686
KW input to motor	82.7	80.9	76.0
HP input to motor	110.8	108.4	101.8
Motor load, % BHP	106.6	104.3	98.0
Measured speed of pump, RPM	1794		
KWH per acre foot	399.0	420.3	494.8
Overall plant efficiency in %	**52.4**	**63.3**	**64.3**
Shut off head in feet 410			

Test 1 was the normal operation of the pump at the time of the test. Test 2 results were obtained by throttling the pump discharge. Test 3 results were obtained by throttling the pump discharge at near design.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
11020 10th Avenue

Test Date: 11/04/2003
Pump type: TB
Plant: Plant #14 Booster #3

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Simmons	SERIAL:	N/A
MOTOR:	GE	SERIAL:	TD241050
H.P.	100.0	LAT/LON:	34.27.009n117.19.139w
METER:	V349R-000289		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	99.0	123.0	143.0
Discharge head, feet	228.7	284.1	330.3
Suction head, PSI	11.5	11.5	11.5
Suction head, feet	26.6	26.6	26.6
Total pumping head, feet	202.1	257.6	303.8
Gallons per minute flow	**1096**	**975**	**804**
Acre feet pumped per 24 hours	4.841	4.308	3.553
KW input to motor	80.0	78.8	74.5
HP input to motor	107.2	105.6	99.8
Motor load, % BHP	103.1	101.6	96.0
Measured speed of pump, RPM	1791		
KWH per acre foot	396.6	439.0	503.2
Overall plant efficiency in %	**52.2**	**60.1**	**61.8**
Shut off head in feet 400			

Test 1 was the normal operation of the pump at the time of the test. Test 2 results were obtained by throttling the pump discharge. Test 3 results were obtained by throttling the pump discharge at near design.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
11020 10th Avenue

Test Date: 11/04/2003
Pump type: TB
Plant: Plant #14 Booster #4

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Simmons	SERIAL:	N/A
MOTOR:	GE	SERIAL:	TD241051
H.P.	100.0	LAT/LON:	34.27.009n117.19.139w
METER:	V349R-000289		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	99.5	123.5	146.0
Discharge head, feet	229.8	285.3	337.3
Suction head, PSI	11.5	11.5	11.5
Suction head, feet	26.6	26.6	26.6
Total pumping head, feet	203.3	258.7	310.7
Gallons per minute flow	**1118**	**996**	**823**
Acre feet pumped per 24 hours	4.940	4.401	3.637
KW input to motor	80.0	78.1	72.7
HP input to motor	107.2	104.7	97.4
Motor load, % BHP	103.1	100.7	93.7
Measured speed of pump, RPM	1791		
KWH per acre foot	388.7	425.9	479.7
Overall plant efficiency in %	**53.5**	**62.2**	**66.3**
Shut off head in feet 403			

Test 1 was the normal operation of the pump at the time of the test. Test 2 results were obtained by throttling the pump discharge. Test 3 results were obtained by throttling the pump discharge at near design.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517

"Pump Testing, The Service That Pays For Itself"

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7292 Paisley Road

Test Date: 11/04/2003
Pump type: TB
Plant: Plant #18 Booster #1

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peabody Floway	SERIAL:	90-02216
MOTOR:	GE	SERIAL:	YEG451013
H.P.	100.0	SCE Ref:	13903
METER:	V349R-000249		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	89.0	107.5	124.5
Discharge head, feet	205.6	248.3	287.6
Suction head, PSI	15.0	15.0	15.0
Suction head, feet	34.7	34.7	34.7
Total pumping head, feet	170.9	213.7	252.9
Gallons per minute flow	**1372**	**1174**	**1081**
Acre feet pumped per 24 hours	6.062	5.190	4.775
KW input to motor	65.8	68.1	68.9
HP input to motor	88.2	91.3	92.3
Motor load, % BHP	84.1	87.1	88.1
Measured speed of pump, RPM	1791		
KWH per acre foot	260.5	314.9	346.3
Overall plant efficiency in %	**67.2**	**69.4**	**74.8**
Shut off head in feet 395			

Test 1 was the normal operation of the pump at the time of the test. Test 2 results were obtained by throttling the pump discharge. Test 3 results were obtained by throttling the pump discharge at near design.

Due to an inadequate water measurement test location, the gallons per minute shown and the resulting overall plant efficiency should be considered approximate rather than actual.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517

"Pump Testing, The Service That Pays For Itself"

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7292 Paisley Road

Test Date: 11/04/2003
Pump type: TB
Plant: Plant #18 Booster #2

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peabody Floway	SERIAL:	90-02217
MOTOR:	GE	SERIAL:	YEG 453020
H.P.	100.0	SCE Ref:	13904
METER:	V349R-000249		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	89.0	107.5	125.5
Discharge head, feet	205.6	248.3	289.9
Suction head, PSI	15.0	15.0	15.0
Suction head, feet	34.7	34.7	34.7
Total pumping head, feet	170.9	213.7	255.3
Gallons per minute flow	**1365**	**1189**	**1077**
Acre feet pumped per 24 hours	6.032	5.253	4.760
KW input to motor	65.9	68.4	69.3
HP input to motor	88.3	91.7	92.9
Motor load, % BHP	84.2	87.4	88.6
Measured speed of pump, RPM	1793		
KWH per acre foot	262.2	312.5	349.4
Overall plant efficiency in %	**66.7**	**70.0**	**74.8**
Shut off head in feet 397			

Test 1 was the normal operation of the pump at the time of the test. Test 2 results were obtained by throttling the pump discharge. Test 3 results were obtained by throttling the pump discharge at near design.

Due to an inadequate water measurement test location, the gallons per minute shown and the resulting overall plant efficiency should be considered approximate rather than actual.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517

"Pump Testing, The Service That Pays For Itself"

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7292 Paisley Road

Test Date: 11/04/2003
Pump type: TB
Plant: Plant #18 Booster #3

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peabody Floway	SERIAL:	90-02218
MOTOR:	GE	SERIAL:	YEG 454024
H.P.	100.0	SCE Ref:	13905
METER:	V349R-000249		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	90.0	108.0	125.0
Discharge head, feet	207.9	249.5	288.8
Suction head, PSI	15.0	15.0	15.0
Suction head, feet	34.7	34.7	34.7
Total pumping head, feet	173.3	214.8	254.1
Gallons per minute flow	**1362**	**1231**	**1071**
Acre feet pumped per 24 hours	6.020	5.439	4.733
KW input to motor	66.8	68.2	69.3
HP input to motor	89.5	91.4	92.9
Motor load, % BHP	85.4	87.2	88.6
Measured speed of pump, RPM	1793		
KWH per acre foot	266.3	300.9	351.4
Overall plant efficiency in %	**66.6**	**73.1**	**74.0**
Shut off head in feet 400			

Test 1 was the normal operation of the pump at the time of the test. Test 2 results were obtained by throttling the pump discharge. Test 3 results were obtained by throttling the pump discharge at near design.

Due to an inadequate water measurement test location, the gallons per minute shown and the resulting overall plant efficiency should be considered approximate rather than actual.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7292 Paisley Road

Test Date: 11/04/2003
Pump type: TB
Plant: Plant #18 Booster #4

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peabody Floway	SERIAL:	90-02219
MOTOR:	GE	SERIAL:	YEG 454022
H.P.	100.0	SCE Ref:	13906
METER:	V349R-000249		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	90.0	108.5	126.0
Discharge head, feet	207.9	250.6	291.1
Suction head, PSI	15.0	15.0	15.0
Suction head, feet	34.7	34.7	34.7
Total pumping head, feet	173.3	216.0	256.4
Gallons per minute flow	**1391**	**1221**	**1062**
Acre feet pumped per 24 hours	6.145	5.397	4.692
KW input to motor	66.0	68.2	68.7
HP input to motor	88.4	91.4	92.1
Motor load, % BHP	84.4	87.2	87.8
Measured speed of pump, RPM	1792		
KWH per acre foot	257.8	303.3	351.4
Overall plant efficiency in %	**68.8**	**72.9**	**74.7**
Shut off head in feet 397			

Test 1 was the normal operation of the pump at the time of the test. Test 2 results were obtained by throttling the pump discharge. Test 3 results were obtained by throttling the pump discharge at near design.

Due to an inadequate water measurement test location, the gallons per minute shown and the resulting overall plant efficiency should be considered approximate rather than actual.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517

"Pump Testing, The Service That Pays For Itself"

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7034 Maple Avenue

Test Date: 11/06/2003
Pump type: TB
Plant: Plant #19A Booster #1

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peabody Floway	SERIAL:	91-01994
MOTOR:	US	SERIAL:	G51056/U12U1790382 R-1
H.P.	150.0	LAT/LON:	34.22.850n117.20.856w
METER:	ZYA084-328531		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	128.0	161.0	181.0
Discharge head, feet	295.7	371.9	418.1
Suction head, PSI	11.0	11.0	11.0
Suction head, feet	25.4	25.4	25.4
Total pumping head, feet	270.3	346.5	392.7
Gallons per minute flow	**1243**	**1153**	**984**
Acre feet pumped per 24 hours	5.491	5.095	4.349
KW input to motor	95.6	102.6	103.7
HP input to motor	128.1	137.5	139.0
Motor load, % BHP	81.5	87.4	88.4
Measured speed of pump, RPM	1782		
KWH per acre foot	417.9	483.3	572.3
Overall plant efficiency in %	**66.2**	**73.4**	**70.2**
Shut off head in feet 601			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7034 Maple Avenue

Test Date: 11/06/2003
Pump type: TB
Plant: Plant #19A Booster #2

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peabody Floway	SERIAL:	91-01993
MOTOR:	US	SERIAL:	G31036/U12U1790382R-2
H.P.	150.0	LAT/LON:	34.22.850n117.20.856w
METER:	ZYA084-328531		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	128.0	156.0	180.5
Discharge head, feet	295.7	360.4	417.0
Suction head, PSI	11.0	11.0	11.0
Suction head, feet	25.4	25.4	25.4
Total pumping head, feet	270.3	335.0	391.5
Gallons per minute flow	**1346**	**1192**	**1028**
Acre feet pumped per 24 hours	5.946	5.267	4.545
KW input to motor	98.8	101.8	103.3
HP input to motor	132.4	136.4	138.4
Motor load, % BHP	84.2	86.8	88.0
Measured speed of pump, RPM	1781		
KWH per acre foot	398.8	463.9	545.5
Overall plant efficiency in %	**69.4**	**73.9**	**73.5**
Shut off head in feet 611			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517

"Pump Testing, The Service That Pays For Itself"

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report
Since 1958
(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7034 Maple Avenue

Test Date: 11/06/2003
Pump type: TB
Plant: Plant #19A Booster #3

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peabody Floway	SERIAL:	91-01992
MOTOR:	US	SERIAL:	G51036-U12U1790382R-4
H.P.	150.0	LAT/LON:	34.22.850n117.20.856w
METER:	ZYA084-328531		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	129.0	159.0	180.0
Discharge head, feet	298.0	367.3	415.8
Suction head, PSI	11.0	11.0	11.0
Suction head, feet	25.4	25.4	25.4
Total pumping head, feet	272.6	341.9	390.4
Gallons per minute flow	**1282**	**1153**	**1034**
Acre feet pumped per 24 hours	5.666	5.095	4.568
KW input to motor	98.8	102.7	104.0
HP input to motor	132.4	137.6	139.4
Motor load, % BHP	84.2	87.5	88.6
Measured speed of pump, RPM	1779		
KWH per acre foot	418.5	483.7	546.4
Overall plant efficiency in %	**66.7**	**72.3**	**73.1**
Shut off head in feet 599			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517
"Pump Testing, The Service That Pays For Itself"

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7034 Maple Avenue

Test Date: 11/06/2003
Pump type: TB
Plant: Plant #19A Booster #4

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peabody Floway	SERIAL:	91-01991
MOTOR:	US	SERIAL:	G51056/U12U1790582F
H.P.	150.0	LAT/LON:	34.22.850n117.20.856w
METER:	ZYA084-328531		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	129.0	158.0	180.0
Discharge head, feet	298.0	365.0	415.8
Suction head, PSI	11.0	11.0	11.0
Suction head, feet	25.4	25.4	25.4
Total pumping head, feet	272.6	339.6	390.4
Gallons per minute flow	**1302**	**1193**	**1024**
Acre feet pumped per 24 hours	5.754	5.271	4.524
KW input to motor	101.0	103.9	104.7
HP input to motor	135.3	139.2	140.3
Motor load, % BHP	86.1	88.5	89.2
Measured speed of pump, RPM	1781		
KWH per acre foot	421.3	473.1	555.4
Overall plant efficiency in %	**66.2**	**73.5**	**71.9**
Shut off head in feet 598			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517

"Pump Testing, The Service That Pays For Itself"

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
10071 Tamarisk Avenue

Test Date: 11/05/2003
Pump type: TB
Plant: Plant #21 Booster #1

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Aurora	SERIAL:	V86-70165A
MOTOR:	US	SERIAL:	R-B409-00-298
H.P.	75.0	LAT/LON:	34.26.037n117.21.026w
METER:	ZYA085-145096		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	100.0	119.0	141.0
Discharge head, feet	231.0	274.9	325.7
Suction head, PSI	12.0	12.0	12.0
Suction head, feet	27.7	27.7	27.7
Total pumping head, feet	203.3	247.2	298.0
Gallons per minute flow	**755**	**686**	**596**
Acre feet pumped per 24 hours	3.338	3.031	2.635
KW input to motor	50.1	50.4	50.0
HP input to motor	67.1	67.5	67.0
Motor load, % BHP	84.2	84.7	84.1
Measured speed of pump, RPM	1787		
KWH per acre foot	360.2	399.1	455.3
Overall plant efficiency in %	**57.8**	**63.4**	**67.0**
Shut off head in feet 438			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
10071 Tamarisk Avenue

Test Date: 11/05/2003
Pump type: TB
Plant: Plant #21 Booster #2

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Aurora	SERIAL:	V86-70165 B
MOTOR:	US	SERIAL:	R-B409-00-298
H.P.	75.0	LAT/LON:	34.26.057n117.21.026w
METER:	ZYA085-145096		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	100.0	121.0	142.0
Discharge head, feet	231.0	279.5	328.0
Suction head, PSI	12.0	12.0	12.0
Suction head, feet	27.7	27.7	27.7
Total pumping head, feet	203.3	251.8	300.3
Gallons per minute flow	**797**	**686**	**586**
Acre feet pumped per 24 hours	3.524	3.030	2.590
KW input to motor	50.4	51.1	50.4
HP input to motor	67.5	68.5	67.5
Motor load, % BHP	84.7	85.9	84.7
Measured speed of pump, RPM	1788		
KWH per acre foot	343.3	404.7	467.0
Overall plant efficiency in %	**60.6**	**63.7**	**65.8**
Shut off head in feet 425			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
10071 Tamarisk Avenue

Test Date: 11/05/2003
Pump type: TB
Plant: Plant #21 Booster #3

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	No Data	SERIAL:	N/A
MOTOR:	US	SERIAL:	B412/P07P1900371L-02
H.P.	125.0	LAT/LON:	34.26.057n117.21.026w
METER:	ZYA085-145096		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	106.0	122.0	140.0
Discharge head, feet	244.9	281.8	323.4
Suction head, PSI	12.0	12.0	12.0
Suction head, feet	27.7	27.7	27.7
Total pumping head, feet	217.1	254.1	295.7
Gallons per minute flow	**1636**	**1585**	**1341**
Acre feet pumped per 24 hours	7.230	7.005	5.927
KW input to motor	107.1	108.1	106.9
HP input to motor	143.5	144.9	143.2
Motor load, % BHP	109.5	110.6	109.3
Measured speed of pump, RPM	1780		
KWH per acre foot	355.5	370.4	432.8
Overall plant efficiency in %	**62.5**	**70.2**	**69.9**
Shut off head in feet 393			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
10071 Tamarisk Avenue

Test Date: 11/05/2003
Pump type: TB
Plant: Plant #21 Booster #4

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	No Data	SERIAL:	N/A
MOTOR:	US	SERIAL:	B412/P07P1900371L-01
H.P.	125.0	LAT/LON:	34.26.057n117.21.026w
METER:	ZYA085-145096		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	103.5	120.0	141.0
Discharge head, feet	239.1	277.2	325.7
Suction head, PSI	12.0	12.0	12.0
Suction head, feet	27.7	27.7	27.7
Total pumping head, feet	211.4	249.5	298.0
Gallons per minute flow	**1600**	**1506**	**1226**
Acre feet pumped per 24 hours	7.068	6.655	5.416
KW input to motor	107.0	108.5	107.3
HP input to motor	143.4	145.4	143.8
Motor load, % BHP	109.4	111.0	109.7
Measured speed of pump, RPM	1779		
KWH per acre foot	363.3	391.3	475.5
Overall plant efficiency in %	**59.5**	**65.3**	**64.1**
Shut off head in feet 396			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7499 3rd Avenue

Test Date: 11/06/2003
Pump type: TB
Plant: Plant #22 Booster #1

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peerless	SERIAL:	248172
MOTOR:	US	SERIAL:	G94781/Y09Y1180239R-3
H.P.	75.0	LAT/LON:	34.23.11n117.18.46w
METER:	V349R-000292		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	96.0	112.0	125.0
Discharge head, feet	221.8	258.7	288.8
Suction head, PSI	13.0	13.0	13.0
Suction head, feet	30.0	30.0	30.0
Total pumping head, feet	191.7	228.7	258.7
Gallons per minute flow	**944**	**820**	**731**
Acre feet pumped per 24 hours	4.173	3.622	3.228
KW input to motor	53.1	54.0	53.6
HP input to motor	71.2	72.4	71.8
Motor load, % BHP	89.3	90.8	90.1
Measured speed of pump, RPM	1780		
KWH per acre foot	305.4	357.8	398.5
Overall plant efficiency in %	**64.3**	**65.4**	**66.5**
Shut off head in feet 395			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

The available water measurement location does not meet recommended industry standards. We recommend 8-10 diameters of straight pipe for the ideal test location.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7499 3rd Avenue

Test Date: 11/06/2003
Pump type: TB
Plant: Plant #22 Booster #2

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peerless	SERIAL:	248173
MOTOR:	US	SERIAL:	P02N3530167R-1
H.P.	125.0	LAT/LON:	34.23.11n117.18.45w
METER:	V349R-000292		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	100.0	116.0	132.0
Discharge head, feet	231.0	268.0	304.9
Suction head, PSI	13.0	13.0	13.0
Suction head, feet	30.0	30.0	30.0
Total pumping head, feet	201.0	237.9	274.9
Gallons per minute flow	**1479**	**1372**	**1158**
Acre feet pumped per 24 hours	6.535	6.063	5.118
KW input to motor	84.5	85.6	83.6
HP input to motor	113.2	114.7	112.0
Motor load, % BHP	85.2	86.3	84.3
Measured speed of pump, RPM	1781		
KWH per acre foot	310.3	338.9	392.0
Overall plant efficiency in %	**66.3**	**71.9**	**71.8**
Shut off head in feet 382			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7499 3rd Avenue

Test Date: 11/06/2003
Pump type: TB
Plant: Plant #22 Booster #3

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peerless	SERIAL:	249031
MOTOR:	US	SERIAL:	6375/P02N329R116R-3
H.P.	150.0	LAT/LON:	34.23.11n117.18.46w
METER:	V349R-000292		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	102.5	122.0	140.0
Discharge head, feet	236.8	281.8	323.4
Suction head, PSI	13.0	13.0	13.0
Suction head, feet	30.0	30.0	30.0
Total pumping head, feet	206.7	251.8	293.4
Gallons per minute flow	**1817**	**1550**	**1194**
Acre feet pumped per 24 hours	8.031	6.850	5.275
KW input to motor	111.0	114.0	109.7
HP input to motor	148.7	152.8	147.0
Motor load, % BHP	92.2	94.7	91.1
Measured speed of pump, RPM	1784		
KWH per acre foot	331.7	399.4	499.1
Overall plant efficiency in %	**63.8**	**64.5**	**60.2**
Shut off head in feet 397			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
7499 3rd Avenue

Test Date: 11/06/2003
Pump type: TB
Plant: Plant #22 Booster #4

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peerless	SERIAL:	260260
MOTOR:	US	SERIAL:	R01P3210706R-1
H.P.	200.0	LAT/LON:	34.23.11n117.18.46w
METER:	V349R-000292		

TEST RESULTS

	TEST 1	TEST 2	TEST 3
Discharge, PSI	102.0	127.0	143.5
Discharge head, feet	235.6	293.4	331.5
Suction head, PSI	13.0	13.0	13.0
Suction head, feet	30.0	30.0	30.0
Total pumping head, feet	205.6	263.3	301.5
Gallons per minute flow	**1960**	**1746**	**1479**
Acre feet pumped per 24 hours	8.661	7.716	6.535
KW input to motor	117.6	121.2	118.7
HP input to motor	157.6	162.4	159.1
Motor load, % BHP	73.3	75.5	74.0
Measured speed of pump, RPM	1788		
KWH per acre foot	325.9	377.0	435.9
Overall plant efficiency in %	**64.6**	**71.5**	**70.8**
Shut off head in feet 409			

Test 1 was the normal operation of the pump at the time of the test. The other results were obtained by throttling the pump discharge.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report
Since 1958
(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
12900 Nelson Road

Test Date: 11/06/2003
Pump type: TB
Plant: Plant #23 Booster #1

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP: Peerless
MOTOR: US
H.P. 20.0
METER: P0726-7482

SERIAL: 249118
SERIAL: R02P3060461F-2
LAT/LON: 34.25.181n117.22.846w

TEST RESULTS

	TEST 1	TEST 2
Discharge, PSI	40.0	51.0
Discharge head, feet	92.4	117.8
Suction head, PSI	15.0	14.0
Suction head, feet	34.7	32.3
Total pumping head, feet	57.8	85.5
Gallons per minute flow	**696**	**410**
Acre feet pumped per 24 hours	3.077	1.812
KW input to motor	12.2	10.5
HP input to motor	16.3	14.1
Motor load, % BHP	72.3	62.3
Measured speed of pump, RPM	1779	
KWH per acre foot	95.2	139.1
Overall plant efficiency in %	**62.1**	**62.9**

Shut off head in feet 106

Test 1 was at full speed at normal system pressure.

Test 2 was with the discharge valve partially throttled.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517
"Pump Testing, The Service That Pays For Itself"

PUMP CHECK
Pumping Systems Analysts
Hydraulic Test Report
Since 1958
(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
12900 Nelson Road

Test Date: 11/06/2003
Pump type: TB
Plant: Plant #23 Booster #2

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peerless	SERIAL:	249119
MOTOR:	US	SERIAL:	R02P3060461F-1
H.P.	20.0	LAT/LON:	34.25.181n117.22.846w
METER:	P0726-7482		

TEST RESULTS

	TEST 1	TEST 2
Discharge, PSI	40.0	51.5
Discharge head, feet	92.4	119.0
Suction head, PSI	14.5	16.0
Suction head, feet	33.5	37.0
Total pumping head, feet	58.9	82.0
Gallons per minute flow	**654**	**336**
Acre feet pumped per 24 hours	2.889	1.484
KW input to motor	10.9	9.2
HP input to motor	14.6	12.3
Motor load, % BHP	64.6	54.6
Measured speed of pump, RPM	1778	
KWH per acre foot	90.5	148.8
Overall plant efficiency in %	**66.6**	**56.4**
Shut off head in feet 99		

Test 1 was at full speed at normal system pressure.

Test 2 was with the discharge valve partially throttled.

If you have any questions please contact Jon Lee at (909) 684-9801.

PUMP CHECK

Pumping Systems Analysts

Hydraulic Test Report

Since 1958

(909) 684-9801 • Lic. 408415 • Fax (909) 684-2988

Hesperia Water District
12900 Nelson Road

Test Date: 11/06/2003
Pump type: CB
Plant: Plant 23 Fire Pump

A test was made on this booster pump and the following information was obtained.

EQUIPMENT

PUMP:	Peerless	SERIAL:	449846
MOTOR:	Marathon	SERIAL:	09-03919-7/14-03
H.P.	100.0	LAT/LON:	34.25.181n117.22.846w
METER:	P0726-7482		

TEST RESULTS

	TEST 1
Discharge, PSI	51.0
Discharge head, feet	117.8
Suction head, PSI	8.0
Suction head, feet	18.5
Total pumping head, feet	99.3
Gallons per minute flow	**2524**
Acre feet pumped per 24 hours	11.154
KW input to motor	90.1
HP input to motor	120.7
Motor load, % BHP	112.3
Measured speed of pump, RPM	1780
KWH per acre foot	193.9
Overall plant efficiency in %	**52.4**
Shut off head in feet 142	

Test 1 was conducted at near design.

If you have any questions please contact Jon Lee at (909) 684-9801.

P.O. Box 5646, Riverside, California 92517

"Pump Testing, The Service That Pays For Itself"

APPENDIX B

POPULATION AND WATER DEMAND PROJECTIONS
CITY OF HESPERIA

Population and Water Demand Projections for Year 2005
Water Master Plan
City of Hesperia Water District

Description	Values	
Area of All Planning Areas	49,548	acres
	77.42	sq. mi.
Main City Area (PA 1 thru 5)	22,800	acres
	35.63	sq. mi.
Without RLF, SVR & NSV (PA 1 thru 14)		
Single Family Dwelling Units	19,927	du
Multi Family Dwelling Units	6,221	du
Total Population	82,556	people
Unit Water Demand	193	gpcd
Total Water Demand	15.90	MGD
	17,804	ac-ft/yr
With RLF & SVR but without NSV (PA 1 thru 15)		
Single Family Dwelling Units	19,927	du
Multi Family Dwelling Units	6,221	du
Total Population	82,556	people
Unit Water Demand	193	gpcd
Total Water Demand	15.90	MGD
	17,804	ac-ft/yr
With RLF, SVR & NSV (PA 1 thru 16)		
Single Family Dwelling Units	19,927	du
Multi Family Dwelling Units	6,221	du
Total Population	82,556	people
Unit Water Demand	193	gpcd
Total Water Demand	15.90	MGD
	17,804	ac-ft/yr

Water Demand Fraction by Land Use Type
Water Master Plan
City of Hesperia Water District

Description		Percent
Without RLF, SVR & NSV (PA 1 thru 14)		
Residential		83.1%
Commercial		10.0%
Industrial		6.9%
	Total	100%
With RLF & SVR but without NSV (PA 1 thru 15)		
Residential		83.1%
Commercial		10.0%
Industrial		6.9%
	Total	100%
With RLF, SVR & NSV (PA 1 thru 16)		
Residential		83.1%
Commercial		10.0%
Industrial		6.9%
	Total	100%

Water Demands by Pressure Zone
Water Master Plan
City of Hesperia Water District

Pressure Zone	Area (acres)	Demands (gpd)	Percent (%)
Zone 1	6,936	3,070,299	19.3%
Zone 2 (A-D)	12,454	8,058,730	50.7%
Zone 3 (A)	8,553	3,145,531	19.8%
Zone 4	9,095	1,557,086	9.8%
Zone 5	1,128	50,540	0.3%
Zone 6	512	13,879	0.1%
Zone RLF	10,868	0	0.0%
Total	**49,548**	**15,896,065**	**100.0%**
		11,039 gpm	

Appendix B

Population and Water Demand Projections for Year 2010
Water Master Plan
City of Hesperia Water District

Description	Values
Area of All Planning Areas	49,548 acres
	77.42 sq. mi.
Main City Area (PA 1 thru 5)	22,800 acres
	35.63 sq. mi.
Without RLF, SVR & NSV (PA 1 thru 14)	
Single Family Dwelling Units	26,112 du
Multi Family Dwelling Units	11,209 du
Total Population	116,434 people
Unit Water Demand	203 gpcd
Total Water Demand	23.66 MGD
	26,500 ac-ft/yr
With RLF & SVR but without NSV (PA 1 thru 15)	
Single Family Dwelling Units	32,301 du
Multi Family Dwelling Units	11,209 du
Total Population	136,858 people
Unit Water Demand	197 gpcd
Total Water Demand	26.93 MGD
	30,160 ac-ft/yr
With RLF, SVR & NSV (PA 1 thru 16)	
Single Family Dwelling Units	32,301 du
Multi Family Dwelling Units	11,209 du
Total Population	136,858 people
Unit Water Demand	197 gpcd
Total Water Demand	26.93 MGD
	30,160 ac-ft/yr

Water Demand Fraction by Land Use Type
Water Master Plan
City of Hesperia Water District

Description		Percent
Without RLF, SVR & NSV (PA 1 thru 14)		
Residential		78.7%
Commercial		12.2%
Industrial		9.1%
	Total	100%
With RLF & SVR but without NSV (PA 1 thru 15)		
Residential		81.3%
Commercial		10.7%
Industrial		8.0%
	Total	100%
With RLF, SVR & NSV (PA 1 thru 16)		
Residential		81.3%
Commercial		10.7%
Industrial		8.0%
	Total	100%

Water Demands by Pressure Zone
Water Master Plan
City of Hesperia Water District

Pressure Zone	Area (acres)	Demands (gpd)	Percent (%)
Zone 1	6,936	3,776,605	14.0%
Zone 2 (A-D)	12,454	10,306,460	38.3%
Zone 3 (A)	8,553	5,065,691	18.8%
Zone 4	9,095	4,287,540	15.9%
Zone 5	1,128	189,902	0.7%
Zone 6	512	34,697	0.1%
Zone RLF	10,868	3,267,792	12.1%
Total	**49,548**	**26,928,686**	**100.0%**
		18,700 gpm	

Appendix B

Population and Water Demand Projections for Year 2015
Water Master Plan
City of Hesperia Water District

Description	Values	
Area of All Planning Areas	49,548	acres
	77.42	sq. mi.
Main City Area (PA 1 thru 5)	22,800	acres
	35.63	sq. mi.
Without RLF, SVR & NSV (PA 1 thru 14)		
Single Family Dwelling Units	28,625	du
Multi Family Dwelling Units	15,428	du
Total Population	136,118	people
Unit Water Demand	218	gpcd
Total Water Demand	29.62	MGD
	33,171	ac-ft/yr
With RLF & SVR but without NSV (PA 1 thru 15)		
Single Family Dwelling Units	41,003	du
Multi Family Dwelling Units	15,428	du
Total Population	176,966	people
Unit Water Demand	204	gpcd
Total Water Demand	36.15	MGD
	40,491	ac-ft/yr
With RLF, SVR & NSV (PA 1 thru 16)		
Single Family Dwelling Units	42,733	du
Multi Family Dwelling Units	15,428	du
Total Population	182,675	people
Unit Water Demand	203	gpcd
Total Water Demand	37.07	MGD
	41,514	ac-ft/yr

Water Demand Fraction by Land Use Type
Water Master Plan
City of Hesperia Water District

Description		Percent
Without RLF, SVR & NSV (PA 1 thru 14)		
Residential		73.5%
Commercial		15.6%
Industrial		10.9%
	Total	100%
With RLF & SVR but without NSV (PA 1 thru 15)		
Residential		78.3%
Commercial		12.8%
Industrial		8.9%
	Total	100%
With RLF, SVR & NSV (PA 1 thru 16)		
Residential		78.9%
Commercial		12.5%
Industrial		8.7%
	Total	100%

Water Demands by Pressure Zone
Water Master Plan
City of Hesperia Water District

Pressure Zone	Area (acres)	Demands (gpd)	Percent (%)
Zone 1	6,936	4,039,727	10.9%
Zone 2 (A-D)	12,454	11,670,129	31.5%
Zone 3 (A)	8,553	6,083,990	16.4%
Zone 4	9,095	7,763,644	20.9%
Zone 5	1,128	603,508	1.6%
Zone 6	512	369,784	1.0%
Zone RLF	10,868	6,535,584	17.6%
Total	**49,548**	**37,066,367**	**100.0%**
		25,741 gpm	

Population and Water Demand Projections for Year 2020
Water Master Plan
City of Hesperia Water District

Description	Values	
Area of All Planning Areas	49,548	acres
	77.42	sq. mi.
Main City Area (PA 1 thru 5)	22,800	acres
	35.63	sq. mi.
Without RLF, SVR & NSV (PA 1 thru 14)		
Single Family Dwelling Units	31,244	du
Multi Family Dwelling Units	18,766	du
Total Population	153,773	people
Unit Water Demand	225	gpcd
Total Water Demand	34.56	MGD
	38,705	ac-ft/yr
With RLF & SVR but without NSV (PA 1 thru 15)		
Single Family Dwelling Units	48,043	du
Multi Family Dwelling Units	18,766	du
Total Population	209,210	people
Unit Water Demand	208	gpcd
Total Water Demand	43.43	MGD
	48,639	ac-ft/yr
With RLF, SVR & NSV (PA 1 thru 16)		
Single Family Dwelling Units	51,504	du
Multi Family Dwelling Units	18,766	du
Total Population	220,631	people
Unit Water Demand	205	gpcd
Total Water Demand	45.25	MGD
	50,685	ac-ft/yr

Water Demand Fraction by Land Use Type
Water Master Plan
City of Hesperia Water District

Description	Percent
Without RLF, SVR & NSV (PA 1 thru 14)	
Residential	71.2%
Commercial	16.8%
Industrial	12.0%
Total	100%
With RLF & SVR but without NSV (PA 1 thru 15)	
Residential	77.1%
Commercial	13.4%
Industrial	9.5%
Total	100%
With RLF, SVR & NSV (PA 1 thru 16)	
Residential	78.0%
Commercial	12.9%
Industrial	9.1%
Total	100%

Water Demands by Pressure Zone
Water Master Plan
City of Hesperia Water District

Pressure Zone	Area (acres)	Demands (gpd)	Percent (%)
Zone 1	6,936	4,383,093	9.7%
Zone 2 (A-D)	12,454	12,918,508	28.5%
Zone 3 (A)	8,553	6,851,793	15.1%
Zone 4	9,095	10,786,506	23.8%
Zone 5	1,128	916,799	2.0%
Zone 6	512	528,310	1.2%
Zone RLF	10,868	8,869,872	19.6%
Total	**49,548**	**45,254,881**	**100.0%**
		31,427 gpm	

Appendix B

Population and Water Demand Projections for Year 2025
Water Master Plan
City of Hesperia Water District

Description	Values	
Area of All Planning Areas	49,548	acres
	77.42	sq. mi.
Main City Area (PA 1 thru 5)	22,800	acres
	35.63	sq. mi.
Without RLF, SVR & NSV (PA 1 thru 14)		
Single Family Dwelling Units	33,351	du
Multi Family Dwelling Units	21,104	du
Total Population	167,039	people
Unit Water Demand	229	gpcd
Total Water Demand	38.17	MGD
	42,753	ac-ft/yr
With RLF & SVR but without NSV (PA 1 thru 15)		
Single Family Dwelling Units	50,150	du
Multi Family Dwelling Units	21,104	du
Total Population	222,476	people
Unit Water Demand	211	gpcd
Total Water Demand	47.04	MGD
	52,688	ac-ft/yr
With RLF, SVR & NSV (PA 1 thru 16)		
Single Family Dwelling Units	54,846	du
Multi Family Dwelling Units	21,104	du
Total Population	237,973	people
Unit Water Demand	208	gpcd
Total Water Demand	49.52	MGD
	55,465	ac-ft/yr

Water Demand Fraction by Land Use Type
Water Master Plan
City of Hesperia Water District

Description	Percent
Without RLF, SVR & NSV (PA 1 thru 14)	
Residential	70.0%
Commercial	17.2%
Industrial	12.7%
Total	100%
With RLF & SVR but without NSV (PA 1 thru 15)	
Residential	75.7%
Commercial	14.0%
Industrial	10.3%
Total	100%
With RLF, SVR & NSV (PA 1 thru 16)	
Residential	76.9%
Commercial	13.3%
Industrial	9.8%
Total	100%

Water Demands by Pressure Zone
Water Master Plan
City of Hesperia Water District

Pressure Zone	Area (acres)	Demands (gpd)	Percent (%)
Zone 1	6,936	4,601,375	9.3%
Zone 2 (A-D)	12,454	14,206,795	28.7%
Zone 3 (A)	8,553	7,480,468	15.1%
Zone 4	9,095	12,649,884	25.5%
Zone 5	1,128	1,105,644	2.2%
Zone 6	512	607,878	1.2%
Zone RLF	10,868	8,869,872	17.9%
Total	**49,548**	**49,521,917**	**100.0%**
		34,390 gpm	

Population and Water Demand Projections for Year 2030
Water Master Plan
City of Hesperia Water District

Description	Values	
Area of All Planning Areas	49,548	acres
	77.42	sq. mi.
Main City Area (PA 1 thru 5)	22,800	acres
	35.63	sq. mi.
Without RLF, SVR & NSV (PA 1 thru 14)		
Single Family Dwelling Units	35,016	du
Multi Family Dwelling Units	22,100	du
Total Population	175,223	people
Unit Water Demand	229	gpcd
Total Water Demand	40.14	MGD
	44,953	ac-ft/yr
With RLF & SVR but without NSV (PA 1 thru 15)		
Single Family Dwelling Units	52,699	du
Multi Family Dwelling Units	22,100	du
Total Population	233,577	people
Unit Water Demand	212	gpcd
Total Water Demand	49.47	MGD
	55,410	ac-ft/yr
With RLF, SVR & NSV (PA 1 thru 16)		
Single Family Dwelling Units	57,395	du
Multi Family Dwelling Units	22,100	du
Total Population	249,074	people
Unit Water Demand	209	gpcd
Total Water Demand	51.95	MGD
	58,187	ac-ft/yr

Water Demand Fraction by Land Use Type
Water Master Plan
City of Hesperia Water District

Description		Percent
Without RLF, SVR & NSV (PA 1 thru 14)		
Residential		69.9%
Commercial		17.1%
Industrial		13.1%
	Total	100%
With RLF & SVR but without NSV (PA 1 thru 15)		
Residential		75.5%
Commercial		13.8%
Industrial		10.6%
	Total	100%
With RLF, SVR & NSV (PA 1 thru 16)		
Residential		76.7%
Commercial		13.2%
Industrial		10.1%
	Total	100%

Water Demands by Pressure Zone
Water Master Plan
City of Hesperia Water District

Pressure Zone	Area (acres)	Demands (gpd)	Percent (%)
Zone 1	6,936	4,875,700	9.4%
Zone 2 (A-D)	12,454	15,091,495	29.0%
Zone 3 (A)	8,553	7,866,118	15.1%
Zone 4	9,095	12,958,697	24.9%
Zone 5	1,128	1,181,550	2.3%
Zone 6	512	642,575	1.2%
Zone RLF	10,868	9,336,624	18.0%
Total	**49,548**	**51,952,759**	**100.0%**
	36,078 gpm		

2004-2005 AND 2005-2006 PIPELINE UPDATES MODEL DATA

2004-2005 and 2005-2006 Pipeline Updates Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ORIGINAL DIAM. (in)	NEW DIAM (in)	ORIGINAL MATERIAL	NEW MATERIAL	LENGTH (feet)	IMPROVE_YR	PRESSURE ZONE
334	4	8	STL	PVC	119.36	2004-05	1
400	4	8	STL	PVC	55.35	2004-05	1
402	4	8	STL	PVC	119.91	2004-05	1
403	4	8	STL	PVC	83.21	2004-05	1
405	4	8	STL	PVC	118.64	2004-05	1
173	4	8	STL	PVC	1,428.72	2004-05	1
174	4	8	STL	PVC	1,572.75	2004-05	1
401	4	8	STL	PVC	1,386.48	2004-05	1
404	4	8	STL	PVC	1,359.44	2004-05	1
423	4	8	STL	PVC	1,359.54	2004-05	1
472	4	8	STL	PVC	1,698.36	2004-05	1
473	4	8	STL	PVC	2,756.42	2004-05	1
474	4	8	STL	PVC	341	2004-05	1
489	4	8	STL	PVC	1,200.94	2004-05	1
512	4	8	STL	PVC	1,861.73	2004-05	1
513	4	8	STL	PVC	429.68	2004-05	1
514	4	8	STL	PVC	536.36	2004-05	1
515	4	8	STL	PVC	2,149.21	2004-05	1
516	4	8	STL	PVC	958.17	2004-05	1
517	4	8	STL	PVC	642.03	2004-05	1
518	4	8	STL	PVC	430.39	2004-05	1
519	4	8	STL	PVC	994.93	2004-05	1
520	4	8	STL	PVC	514.51	2004-05	1
521	4	8	STL	PVC	531.17	2004-05	1
523	4	8	STL	PVC	706.14	2004-05	1
570	4	8	STL	PVC	2,168.67	2004-05	1

2004-2005 and 2005-2006 Pipeline Updates Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ORIGINAL DIAM. (in)	NEW DIAM (in)	ORIGINAL MATERIAL	NEW MATERIAL	LENGTH (feet)	IMPROVE_YR	PRESSURE ZONE
581	4	8	STL	PVC	811.19	2004-05	1
582	4	8	STL	PVC	981.03	2004-05	1
593	4	8	STL	PVC	981.05	2004-05	1
1787	4	8	STL	PVC	1,379.19	2005-06	1
1831	4	8	STL	PVC	1,383.57	2005-06	1
1834	4	8	STL	PVC	260.49	2005-06	1
1835	4	8	STL	PVC	668.61	2005-06	1
1836	4	8	STL	PVC	656.57	2005-06	1
1837	4	8	STL	PVC	324.05	2005-06	1
1839	4	8	STL	PVC	659.84	2005-06	1
1840	4	8	STL	PVC	605.09	2005-06	1
1844	4	8	STL	PVC	483.51	2005-06	1
2642	4	8	STL	PVC	444	2004-05	1
2643	4	8	STL	PVC	1,046.40	2004-05	1
2644	4	8	STL	PVC	444.51	2004-05	1
2654	4	8	STL	PVC	1,108.64	2004-05	1
2655	4	8	STL	PVC	1,057.77	2004-05	1
2656	4	8	STL	PVC	455.59	2004-05	1
2657	4	8	STL	PVC	446.56	2004-05	1
2658	4	8	STL	PVC	1,069.13	2004-05	1
2659	4	8	STL	PVC	346.6	2004-05	1
347	6	8	STL	PVC	1,116.19	2004-05	1
348	6	8	STL	PVC	1,697.42	2004-05	1
351	6	8	STL	PVC	650.32	2004-05	1
439	6	8	STL	PVC	299.83	2004-05	1
440	6	8	STL	PVC	378.7	2004-05	1

2004-2005 and 2005-2006 Pipeline Updates Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ORIGINAL DIAM. (in)	NEW DIAM (in)	ORIGINAL MATERIAL	NEW MATERIAL	LENGTH (feet)	IMPROVE_YR	PRESSURE ZONE
441	6	8	STL	PVC	420.39	2004-05	1
442	6	8	STL	PVC	413.54	2004-05	1
443	6	8	STL	PVC	1,566.79	2004-05	1
471	6	8	STL	PVC	1,251.00	2004-05	1
511	6	8	STL	PVC	390.25	2004-05	1
1841	6	8	STL	PVC	1,311.16	2005-06	1
1842	6	8	STL	PVC	437.15	2005-06	1
1843	6	8	STL	PVC	647.75	2005-06	1
1868	6	8	STL	PVC	673.53	2005-06	1
1869	6	8	STL	PVC	673.26	2005-06	1
1870	6	8	STL	PVC	423.01	2005-06	1
525	8	8	STL	PVC	561.13	2004-05	1
529	8	8	STL	PVC	490.08	2004-05	1
534	8	8	STL	PVC	293.47	2004-05	1
540	8	8	STL	PVC	971.74	2004-05	1
557	8	8	STL	PVC	724.1	2004-05	1
559	8	8	STL	PVC	1,324.68	2004-05	1
438	4	8	STL	PVC	65	2004-05	1
549	4	8	STL	PVC	107.99	2004-05	1
577	4	8	STL	PVC	96.65	2004-05	1
587	4	8	STL	PVC	86.51	2004-05	1
591	4	8	STL	PVC	98.57	2004-05	1
1829	4	8	STL	PVC	76.19	2005-06	1
1845	4	8	STL	PVC	70.08	2005-06	1
1846	4	8	STL	PVC	55.26	2005-06	1
1847	4	8	STL	PVC	57.16	2005-06	1

2004-2005 and 2005-2006 Pipeline Updates Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ORIGINAL DIAM. (in)	NEW DIAM (in)	ORIGINAL MATERIAL	NEW MATERIAL	LENGTH (feet)	IMPROVE_YR	PRESSURE ZONE
425	6	8	STL	PVC	314.24	2004-05	1
2515	6	8	STL	PVC	417.41	2004-05	1
2516	6	8	STL	PVC	565.74	2004-05	1
2524	6	8	STL	PVC	714.43	2004-05	1
2526	6	8	STL	PVC	1,005.91	2004-05	1
2527	6	8	STL	PVC	405.08	2004-05	1
2528	6	8	STL	PVC	587.39	2004-05	1
2529	6	8	STL	PVC	305.31	2004-05	1
2556	6	8	STL	PVC	112.96	2004-05	1
568	4	8	STL	PVC	113.92	2004-05	1
573	4	8	STL	PVC	129.29	2004-05	1
1828	4	8	STL	PVC	129.78	2005-06	1
1848	4	8	STL	PVC	115.17	2005-06	1
1872	4	8	STL	PVC	123.78	2005-06	1
179	6	8	AC	PVC	356.83	2004-05	1
543	6	8	AC	PVC	127.58	2004-05	1
147	8	8	AC	PVC	108.77	2004-05	1

2004-2005 and 2005-2006 Pipeline Updates Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ORIGINAL DIAM. (in)	NEW DIAM (in)	ORIGINAL MATERIAL	NEW MATERIAL	LENGTH (feet)	IMPROVE_YR	PRESSURE ZONE
149	8	8	AC	PVC	81.47	2004-05	1
178	8	8	AC	PVC	239.77	2004-05	1
422	8	8	AC	PVC	109.51	2004-05	1
424	8	8	AC	PVC	76.53	2004-05	1
437	8	8	AC	PVC	72.19	2004-05	1
522	8	8	AC	PVC	103.87	2004-05	1
524	8	8	AC	PVC	726.41	2004-05	1
528	8	8	AC	PVC	101.88	2004-05	1
533	8	8	AC	PVC	217.61	2004-05	1
541	8	8	AC	PVC	361.88	2004-05	1
542	8	8	AC	PVC	237.28	2004-05	1
558	8	8	AC	PVC	370.42	2004-05	1
560	8	8	AC	PVC	244.28	2004-05	1
561	8	8	AC	PVC	401.5	2004-05	1
564	8	8	AC	PVC	1,819.33	2004-05	1
583	8	8	AC	PVC	100.79	2004-05	1
594	8	8	AC	PVC	101.55	2004-05	1
2650	8	8	AC	PVC	122.76	2004-05	1
2651	8	8	AC	PVC	79.38	2004-05	1
2652	8	8	AC	PVC	109.86	2004-05	1
2653	8	8	AC	PVC	58.65	2004-05	1
2660	8	8	AC	PVC	69.9	2004-05	1
563	8	8	AC	PVC	808.26	2004-05	1
				ZONE 1 SUBTOTAL (FT)	***70,814***		
				ZONE 1 SUBTOTAL (MILES)	***13.41***		

2004-2005 and 2005-2006 Pipeline Updates Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ORIGINAL DIAM. (in)	NEW DIAM (in)	ORIGINAL MATERIAL	NEW MATERIAL	LENGTH (feet)	IMPROVE_YR	PRESSURE ZONE
5041	12	12	STL	PVC	1,995.79	2004-05	2
1721	3.5	8	STL	PVC	365.31	2005-06	2D
1724	3.5	8	STL	PVC	2,235.26	2005-06	2D
1692	4	8	STL	PVC	552.52	2005-06	2D
1693	4	8	STL	PVC	685.7	2005-06	2D
1694	4	8	STL	PVC	659.19	2005-06	2D
1695	4	8	STL	PVC	672.06	2005-06	2D
1696	4	8	STL	PVC	678.9	2005-06	2D
1752	4	8	STL	PVC	1,214.44	2005-06	2D
1753	4	8	STL	PVC	1,271.98	2005-06	2D
1755	4	8	STL	PVC	2,101.46	2005-06	2D
1756	4	8	STL	PVC	1,604.26	2005-06	2D
1757	4	8	STL	PVC	1,371.33	2005-06	2D
1758	4	8	STL	PVC	661.55	2005-06	2D
1759	4	8	STL	PVC	661.99	2005-06	2D
1782	4	8	STL	PVC	555.75	2005-06	2D
1783	4	8	STL	PVC	255.25	2005-06	2D
1784	4	8	STL	PVC	1,269.19	2005-06	2D
1786	4	8	STL	PVC	1,374.06	2005-06	2D
1795	4	8	STL	PVC	624.08	2005-06	2D
1802	4	8	STL	PVC	607.35	2005-06	2D
1811	4	8	STL	PVC	2,693.53	2005-06	2D
1830	4	8	STL	PVC	572.18	2005-06	2D
1832	4	8	STL	PVC	302.87	2005-06	2D
1874	4	8	STL	PVC	541.51	2005-06	2D
1875	4	8	STL	PVC	899.36	2005-06	2D

2004-2005 and 2005-2006 Pipeline Updates Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ORIGINAL DIAM. (in)	NEW DIAM (in)	ORIGINAL MATERIAL	NEW MATERIAL	LENGTH (feet)	IMPROVE_YR	PRESSURE ZONE
1881	4	8	STL	PVC	523.11	2005-06	2D
1882	4	8	STL	PVC	1,312.84	2005-06	2D
1883	4	8	STL	PVC	1,284.00	2005-06	2D
1886	4	8	STL	PVC	1,781.94	2005-06	2D
1889	4	8	STL	PVC	637.79	2005-06	2D
1890	4	8	STL	PVC	561.19	2005-06	2D
1891	4	8	STL	PVC	1,800.18	2005-06	2D
1892	4	8	STL	PVC	1,687.86	2005-06	2D
1902	4	8	STL	PVC	1,265.20	2005-06	2D
1904	4	8	STL	PVC	652.69	2005-06	2D
1905	4	8	STL	PVC	733.56	2005-06	2D
1730	6	8	STL	PVC	658.56	2005-06	2D
1731	6	8	STL	PVC	643.78	2005-06	2D
1785	6	8	STL	PVC	1,226.15	2005-06	2D
1800	6	8	STL	PVC	565.31	2005-06	2D
1893	6	8	STL	PVC	660.82	2005-06	2D
1896	6	8	STL	PVC	601.64	2005-06	2D
1899	6	8	STL	PVC	661.59	2005-06	2D
1900	6	8	STL	PVC	700.12	2005-06	2D
1901	6	8	STL	PVC	627.39	2005-06	2D
1903	6	8	STL	PVC	794.88	2005-06	2D
1906	6	8	STL	PVC	622.15	2005-06	2D
1778	4	8	STL	PVC	119.53	2005-06	2D
1779	4	8	STL	PVC	79.81	2005-06	2D
1780	4	8	STL	PVC	104.57	2005-06	2D
1816	4	8	STL	PVC	69.22	2005-06	2D

2004-2005 and 2005-2006 Pipeline Updates Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ORIGINAL DIAM. (in)	NEW DIAM (in)	ORIGINAL MATERIAL	NEW MATERIAL	LENGTH (feet)	IMPROVE_YR	PRESSURE ZONE
1817	4	8	STL	PVC	64.77	2005-06	2D
1819	4	8	STL	PVC	83.43	2005-06	2D
1820	4	8	STL	PVC	69.61	2005-06	2D
1876	4	8	STL	PVC	97.15	2005-06	2D
1894	4	8	STL	PVC	66.18	2005-06	2D
1897	4	8	STL	PVC	59.78	2005-06	2D
1898	4	8	STL	PVC	62.67	2005-06	2D
1821	4	8	STL	PVC	112.61	2005-06	2D
1826	4	8	STL	PVC	169.22	2005-06	2D
1888	4	8	STL	PVC	120.67	2005-06	2D
1788	6	8	AC	PVC	71.9	2005-06	2D
1789	6	8	AC	PVC	67.62	2005-06	2D
1790	6	8	AC	PVC	61.56	2005-06	2D
1791	6	8	AC	PVC	38.64	2005-06	2D
1909	8	8	AC	PVC	98.75	2005-06	2D
3838	8	8	AC	PVC	98.95	2005-06	2D
				ZONE 2 SUBTOTAL (FT)	***48,146***		
				ZONE 2 SUBTOTAL (MILES)	***9.12***		

2004-2005 and 2005-2006 Pipeline Updates Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ORIGINAL DIAM. (in)	NEW DIAM (in)	ORIGINAL MATERIAL	NEW MATERIAL	LENGTH (feet)	IMPROVE_YR	PRESSURE ZONE
2122	4	6	STL	PVC	295.49	2004-05	3
2123	4	8	STL	PVC	996.58	2004-05	3
2124	4	8	STL	PVC	1,313.72	2004-05	3
2130	4	8	STL	PVC	1,546.01	2004-05	3
2924	4	8	STL	PVC	2,290.61	2004-05	3
2926	4	8	STL	PVC	2,673.97	2004-05	3
2927	4	8	STL	PVC	2,684.70	2004-05	3
3677	4	8	STL	PVC	1,574.34	2004-05	3
2107	6	12	STL	PVC	361.63	2004-05	3
2127	6	8	STL	PVC	966.67	2004-05	3
2128	6	8	STL	PVC	567.03	2004-05	3
2129	6	8	STL	PVC	478.17	2004-05	3
2109	8	16	STL	PVC	381.07	2004-05	3
2120	8	12	STL	PVC	350.2	2004-05	3
2121	8	12	STL	PVC	611.92	2004-05	3
2125	8	12	STL	PVC	322.13	2004-05	3
2126	8	12	STL	PVC	350.9	2004-05	3
2131	8	12	STL	PVC	396.92	2004-05	3
2132	8	12	STL	PVC	358.19	2004-05	3
2283	6	12	AC	PVC	281.88	2004-05	3
2284	6	12	AC	PVC	131.04	2004-05	3
2276	8	8	AC	PVC	85	2004-05	3
2277	8	12	AC	PVC	140.32	2004-05	3
2278	8	12	AC	PVC	142.28	2004-05	3
				ZONE 3 SUBTOTAL (FT)	***19,301***		
				ZONE 3 SUBTOTAL (MILES)	***3.66***		

2004-2005 and 2005-2006 Pipeline Updates Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ORIGINAL DIAM. (in)	NEW DIAM (in)	ORIGINAL MATERIAL	NEW MATERIAL	LENGTH (feet)	IMPROVE_YR	PRESSURE ZONE
2101	4	8	STL	PVC	1,030.33	2004-05	4
2106	4	8	STL	PVC	375.57	2004-05	4
2165	4	8	STL	PVC	1,673.33	2004-05	4
2166	4	8	STL	PVC	1,218.47	2004-05	4
2167	4	8	STL	PVC	669.19	2004-05	4
2168	4	8	STL	PVC	657.76	2004-05	4
2169	4	8	STL	PVC	746.31	2004-05	4
2170	4	8	STL	PVC	674.97	2004-05	4
2172	4	8	STL	PVC	515.72	2004-05	4
2178	4	8	STL	PVC	2,614.92	2004-05	4
2179	4	8	STL	PVC	2,679.85	2004-05	4
2181	4	8	STL	PVC	2,745.39	2004-05	4
2182	4	8	STL	PVC	1,261.68	2004-05	4
2183	4	8	STL	PVC	1,255.73	2004-05	4
2184	4	8	STL	PVC	616.3	2004-05	4
2185	4	8	STL	PVC	1,389.26	2004-05	4
2186	4	8	STL	PVC	579.38	2004-05	4
2187	4	8	STL	PVC	928.35	2004-05	4
2188	4	8	STL	PVC	1,304.65	2004-05	4
2189	4	8	STL	PVC	2,201.62	2004-05	4
2191	4	8	STL	PVC	1,964.48	2004-05	4
2192	4	8	STL	PVC	604.12	2004-05	4
3602	4	8	STL	PVC	208.1	2004-05	4
3603	4	8	STL	PVC	658.25	2004-05	4
3642	4	8	STL	PVC	1,147.84	2004-05	4
2048	6	8	STL	PVC	692.82	2004-05	4

2004-2005 and 2005-2006 Pipeline Updates Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ORIGINAL DIAM. (in)	NEW DIAM (in)	ORIGINAL MATERIAL	NEW MATERIAL	LENGTH (feet)	IMPROVE_YR	PRESSURE ZONE
2103	6	8	STL	PVC	1,048.35	2004-05	4
2171	6	8	STL	PVC	392.67	2004-05	4
2173	6	8	STL	PVC	452.59	2004-05	4
2174	6	8	STL	PVC	418.26	2004-05	4
2175	6	8	STL	PVC	429.31	2004-05	4
2176	6	8	STL	PVC	420.31	2004-05	4
2177	6	8	STL	PVC	330.06	2004-05	4
2108	8	8	STL	PVC	532.94	2004-05	4
2190	4	8	STL	PVC	2,411.61	2004-05	4
2939	4	8	STL	PVC	81.86	2004-05	4
2940	4	8	STL	PVC	90.82	2004-05	4
2941	4	8	STL	PVC	80.59	2004-05	4
2942	4	8	STL	PVC	63.23	2004-05	4
3601_2	NEW PIPE	24	DIP	DIP	5,323.93	2004-06	4
2210	6	8	AC	PVC	579.56	2004-05	4
2214	6	8	AC	PVC	163.3	2004-05	4
				ZONE 4 SUBTOTAL (FT)	***43,234***		
				ZONE 4 SUBTOTAL (MILES)	***8.19***		
				TOTAL LENGTH (FT)	***181,495***		
				TOTAL LENGTH (MILES)	***34.37***		

APPENDIX D

BOOSTER AND WELL PUMP MODEL DATA

Booster and Well Pump Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	STATUS	CONTROLLING METHOD	CONTROLLED BY	CONDITION	VALUE
		PUMP STATIONS			
PS14_PMP1	0: Closed	By Node Level	RES21	0: Above	34.30
PS14_PMP1	1: Open	By Node Level	RES21	1: Below	28.40
PS14_PMP2	0: Closed	By Node Level	RES21	0: Above	34.80
PS14_PMP2	1: Open	By Node Level	RES21	1: Below	28.00
PS14_PMP3	0: Closed	By Node Level	RES21	0: Above	34.50
PS14_PMP3	1: Open	By Node Level	RES21	1: Below	28.60
PS14_PMP4	0: Closed	By Node Level	RES21	0: Above	34.00
PS14_PMP4	1: Open	By Node Level	RES21	1: Below	29.00
PS18_PMP1	1: Open	By Node Level	RES22	1: Below	25.80
PS18_PMP1	0: Closed	By Node Level	RES22	0: Above	28.50
PS18_PMP2	1: Open	By Node Level	RES22	1: Below	33.00
PS18_PMP2	0: Closed	By Node Level	RES22	0: Above	34.80
PS18_PMP3	1: Open	By Node Level	RES22	1: Below	32.80
PS18_PMP3	0: Closed	By Node Level	RES22	0: Above	34.60
PS18_PMP4	1: Open	By Node Level	RES22	1: Below	32.60
PS18_PMP4	0: Closed	By Node Level	RES22	0: Above	34.60
PS19_PMP1	0: Closed	By Node Level	RES30	0: Above	30.50
PS19_PMP1	1: Open	By Node Level	RES30	1: Below	28.40
PS19_PMP2	0: Closed	By Node Level	RES30	0: Above	30.80
PS19_PMP2	1: Open	By Node Level	RES30	1: Below	28.00
PS21_PMP1	1: Open	By Node Level	RES23	1: Below	29.00
PS21_PMP1	0: Closed	By Node Level	RES23	0: Above	31.50
PS21_PMP2	1: Open	By Node Level	RES23	1: Below	28.00
PS21_PMP2	0: Closed	By Node Level	RES23	0: Above	31.00
PS21_PMP3	1: Open	By Node Level	RES23	1: Below	28.50
PS21_PMP3	0: Closed	By Node Level	RES23	0: Above	31.30
PS22_PMP1	1: Open	By Node Level	RES19	1: Below	27.00
PS22_PMP1	0: Closed	By Node Level	RES19	0: Above	29.00
PS22_PMP2	1: Open	By Node Level	RES19	1: Below	26.80
PS22_PMP2	0: Closed	By Node Level	RES19	0: Above	28.80
PS22_PMP3	1: Open	By Node Level	RES19	1: Below	27.20
PS22_PMP3	0: Closed	By Node Level	RES19	0: Above	29.20

Booster and Well Pump Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	STATUS	CONTROLLING METHOD	CONTROLLED BY	CONDITION	VALUE
		PUMP STATIONS			
PS22_PMP4	1: Open	By Node Level	RES19	1: Below	26.50
PS22_PMP4	0: Closed	By Node Level	RES19	0: Above	28.60
PS23_PMP1	1: Open	By Node Level	PS23_OUT	1: Below	39.00
PS23_PMP1	0: Closed	By Node Level	PS23_OUT	0: Above	50.00
		WELLS			
WELL14A_PMP	1: Open	By Node Level	RES14	1: Below	21.50
WELL14A_PMP	0: Closed	By Node Level	RES14	0: Above	24.50
WELL15_PMP	0: Closed	By Node Level	RES22	0: Above	34.70
WELL15_PMP	1: Open	By Node Level	RES22	1: Below	32.00
WELL17_PMP	0: Closed	By Node Level	RES22	0: Above	35.00
WELL17_PMP	1: Open	By Node Level	RES22	1: Below	31.50
WELL18_PMP	1: Open	By Node Level	RES18	1: Below	32.00
WELL18_PMP	0: Closed	By Node Level	RES18	0: Above	34.00
WELL21_PMP	0: Closed	By Node Level	RES21	0: Above	34.00
WELL21_PMP	1: Open	By Node Level	RES21	1: Below	25.00
WELL22_PMP	1: Open	By Node Level	RES22	1: Below	31.50
WELL22_PMP	0: Closed	By Node Level	RES22	0: Above	35.50
WELL25_PMP	0: Closed	By Node Level	RES22	0: Above	34.60
WELL25_PMP	1: Open	By Node Level	RES22	1: Below	31.20
WELL26_PMP	0: Closed	By Node Level	RES14	0: Above	24.00
WELL26_PMP	1: Open	By Node Level	RES14	1: Below	20.00
WELL3A_PMP	0: Closed	By Node Level	RES18	0: Above	34.50
WELL3A_PMP	1: Open	By Node Level	RES18	1: Below	31.50
WELL5A_PMP	0: Closed	By Node Level	RES18	0: Above	34.20
WELL5A_PMP	1: Open	By Node Level	RES18	1: Below	30.00

APPENDIX E

VALVE MODEL DATA

Valve Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ELEVATION (FT)	DIAMETER (in)	SETTING (psi)	FROM ZONE	TO ZONE
PRESSURE REGULATING STATIONS					
PRV01-S	3,127.00	6	55	2	1
PRV02-1	3,080.00	8	55	2D	1
PRV02-2	3,080.00	4	60	2D	1
PRV03-S	3,059.00	4	60	2D	1
PRV04-S	3,080.00	2	45	2D	1
PRV05-S	3,069.00	2	45	2D	1
PRV06-1	3,086.00	6	55	2	1
PRV06-2	3,086.00	2	60	2	1
PRV07-1	3,083.00	8	65	2	1
PRV07-2	3,083.00	4	70	2	1
PRV08-S	3,150.00	6	45	2	1
PRV09-1	3,171.00	8	40	2	1
PRV09-2	3,171.00	4	45	2	1
PRV10-S	3,260.00	4	60	3	1
PRV11-S	3,290.00	6	0	3	1
PRV13-1	3,060.00	8	45	2D	1
PRV13-2	3,060.00	4	50	2	1
PRV14-S	3,552.00	2	0	4	1
PRV15-S	3,275.00	6	65	3	2
PRV16-1	3,280.00	6	0	3	2
PRV16-2	3,280.00	4	0	3	2
PRV17-S	3,345.00	6	90	3	2
PRV18-1	3,557.00	8	65	4	2
PRV18-2	3,557.00	4	70	4	3
PRV19-1	3,360.00	10	64	3	3
PRV19-2	3,360.00	4	68	3	2A
PRV21-1	3,519.00	6	0	4	2A
PRV21-2	3,519.00	2	0	4	2B
PRV22-1	3,256.00	6	35	2	2B
PRESSURE REGULATING STATIONS					

Valve Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ELEVATION (FT)	DIAMETER (in)	SETTING (psi)	FROM ZONE	TO ZONE
PRV22-2	3,256.00	2	40	2	2C
PRV23-1	3,156.00	8	45	2	2C
PRV23-2	3,156.00	4	50	2	2C
PRV24-1	3,041.00	8	80	2D	2C
PRV24-2	3,041.00	4	85	2D	2D
PRV25-1	3,026.00	8	50	2D	2D
PRV25-2	3,026.00	4	55	2D	2D
PRV26-1	3,103.00	8	70	2	2D
PRV26-2	3,103.00	4	75	2	2D
PRV27-S	3,101.00	2	70	2	2D
PRV28-S	3,117.00	4	60	2	2D
PRV29-1	3,148.00	6	60	2	2D
PRV29-2	3,148.00	2	65	2	2D
PRV30-1	3,189.00	8	45	2	2D
PRV30-2	3,189.00	6	45	2	2D
PRV31-1	3,082.00	6	40	2B	2D
PRV31-2	3,082.00	4	45	2B	2D
PRV32-1	3,081.00	6	70	2	2Q
PRV32-2	3,081.00	4	75	2	2Q
PRV33-S	3,091.00	2	70	2	3A
PRV34-1	2,980.00	6	0	2A	3A
PRV34-2	2,980.00	3	0	2A	3A
PRV35-S	3,152.00	4	65	2	3Q
PRV36-1	3,184.00	8	35	2	3Q
PRV36-2	3,184.00	4	40	2	3Q
PRV37-S	3,283.00	4	60	3A	3Q
PRV38-S	3,240.00	6	65	3A	3Q
PRV39-S	3,390.00	6	60	3	3Q
PRESSURE REGULATING STATIONS					
PRV40-S	3,329.00	4	80	3	4Q
PRV41-1	3,154.00	6	45	2	4Q

Valve Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ELEVATION (FT)	DIAMETER (in)	SETTING (psi)	FROM ZONE	TO ZONE
PRV41-2	3,154.00	4	50	2	4Q
PRV42-S	3,085.00	2	35	2	4Q
PRV43-S	3,134.00	12	45	2	4Q
PRV53-1	3,317.00	6	45	3	4Q
PRV53-2	3,317.00	4	50	3	4Q
PRV54-1	3,476.00	6	45	4	4Q
PRV54-2	3,476.00	4	50	4	4Q

Valve Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ELEVATION (FT)	DIAMETER (in)	SETTING (psi)	FROM ZONE	TO ZONE
NORMALLY CLOSED GATE VALVES					
ZV1_2_2D	3,086.00	8		2	1
ZV1_2A_1	2,980.00	8		2A	1
ZV1_2B_1	3,082.00	8		2B	1
ZV1_2C_1	3,105.00	8		2C	1
ZV1_2D_1	3,076.00	8		2D	1
ZV1_3_2	3,242.00	8		3	1
ZV1_3A_2	3,240.00	8		3A	1
ZV1_4_3	3,468.00	8		4	1
ZV1_4_3A	3,360.00	16		4	1
ZV10_2_2D	3,171.00	12		2	1
ZV10_3_2	3,237.00	8		3	1
ZV11_2_2D	3,127.00	8		2	1
ZV11_3_2	3,260.00	12		3	1
ZV12_2_2D	3,090.00	8		2	1
ZV12_3_2	3,251.00	12		3	1
ZV13_2_2D	3,156.00	12		2	1
ZV13_3_2	3,256.00	8		3	1
ZV14_2_2D	3,134.00	12		2	1
ZV14_3_2	3,259.00	12		3	1
ZV15_2_2D	3,090.00	8		2	1
ZV15_3_2	3,264.00	8		3	1
ZV16_2_1	3,101.00	8		2	2
ZV16_3_2	3,261.00	6		3	2
ZV17_2_1	3,117.00	8		2	2
ZV17_3_2	3,317.00	6		3	2
ZV18_2_1	3,138.00	8		2	2
ZV18_2_2C	3,153.00	8		2	2
ZV18_3_2	3,334.00	12		3	2
NORMALLY CLOSED GATE VALVES					
ZV19_2_2C	3,148.00	8		2	2

Valve Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ELEVATION (FT)	DIAMETER (in)	SETTING (psi)	FROM ZONE	TO ZONE
ZV19_3_3A	3,360.00	16		3	2
ZV2_2_2D	3,115.00	8		2	2
ZV2_2A_1	2,964.00	8		2A	2
ZV2_2C_1	3,097.00	8		2C	2
ZV2_2D_1	3,069.00	4		2D	2
ZV2_3_2	3,226.00	8		3	2
ZV2_3A_2	3,164.00	8		3A	2
ZV2_4_3	3,476.00	6		4	2
ZV20_2_2B	3,100.00	12		2	2
ZV20_3_3A	3,390.00	8		3	2
ZV21_2_2C	3,092.00	8		2	2
ZV23_2_2B	3,081.00	8		2	2
ZV25_2_1	3,080.00	8		2	2
ZV26_2_1	3,085.00	4		2	2
ZV28_2_2A	3,091.00	8		2	3
ZV29_2_2A	3,127.00	8		2	3
ZV3_2_2D	3,115.00	8		2	3
ZV3_2A_1	2,985.00	8		2A	2A
ZV3_2C_1	3,115.00	8		2C	2A
ZV3_2D_1	3,080.00	4		2D	2A
ZV3_3_2	3,212.00	10		3	2A
ZV3_3A_2	3,210.00	8		3A	2A
ZV3_4_3	3,468.00	8		4	2B
ZV30_2_2A	3,152.00	6		2	2B
ZV31_2_2A	3,138.00	4		2	2C
ZV32_2_2A	3,184.00	8		2	2C
ZV4_2_2D	3,138.00	8		2	2C
NORMALLY CLOSED GATE VALVES					
ZV4_2A_1	3,060.00	12		2A	2D
ZV4_2D_1	3,080.00	8		2D	2D
ZV4_3_2	3,230.00	12		3	2D

Valve Model Data
Water Master Plan Update
City of Hesperia

MODEL ID	ELEVATION (FT)	DIAMETER (in)	SETTING (psi)	FROM ZONE	TO ZONE
ZV4_3A_2	3,283.00	8		3A	2D
ZV5_2_2D	3,147.00	6		2	2D
ZV5_2D_1	3,059.00	8		2D	2D
ZV5_3_2	3,238.00	4		3	2D
ZV6_2_2D	3,136.00	4		2	2D
ZV6_2D_1	3,060.00	12		2D	2D
ZV6_3_2	3,250.00	12		3	2D
ZV7_2_2D	3,133.00	4		2	2D
ZV7_2D_1	3,026.00	12		2D	2D
ZV7_3_2	3,253.00	4		3	2D
ZV8_2_2D	3,119.00	4		2	2D
ZV8_2D_1	3,041.00	12		2D	2D
ZV8_3_2	3,261.00	4		3	3A
ZV9_2_2D	3,150.00	6		2	3A
ZV9_3_2	3,270.00	8		3	3A

APPENDIX F

STORAGE ANALYSIS BY ZONES

Appendix F.1 Storage Analysis by Pressure Zone for Planning Year 2007
Water Master Plan Update
City of Hesperia

Description/Criteria (HGLof Pressure Zone)	Units	Pressure Zone 1 (3229)	2 (3402)	3 (3592)	4 (3852)	5 (4034)	6 (4292)	RLF (3484)	Totals
Demands for 2007									
Average Day	gpm	2,012	5,281	2,103	1,020	-	-	-	10416
	MGD	2.90	7.60	3.03	1.47	-	-	-	15.0
Maximum Day	gpm	3,501	9,189	3,659	1,776	-	-	-	18125
	MGD	5.04	13.23	5.27	2.56	-	-	-	26.1
Required Fire Flow	gpm	4,000	4,000	3,500	4,000	-	-	-	
Fire Flow Duration	hrs	4.0	4.0	3.0	4.0	-	-	-	
Demand Reduction for 2007									
Conservation Efforts	gpm	0	0	0	0	0	0	0	0
	MGD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Reclaimed Water Usage	gpm						0	0	0
	MGD						0.00	0.00	0
Required Storage									
Operational Storage (30% of MDD)	MG	1.51	3.97	1.58	0.77	-	-	-	7.83
Emergency Storage (1.0 x MDD)	MG	5.04	13.23	5.27	2.56	-	-	-	26.10
Fire Storage	MG	0.96	0.96	0.63	0.96	-	-	-	3.51
Total Volume Required	**MG**	**7.51**	**18.16**	**7.48**	**4.29**	**-**	**-**	**-**	**37.44**
Available Storage Capacity									
Existing Tanks	MG	11.50	18.00	15.00	15.00	-	-	-	59.50
Proposed Tanks	MG	-	-	-	-	-	-	-	0.00
Total Available Storage	**MG**	**11.50**	**18.00**	**15.00**	**15.00**	**-**	**-**	**-**	**59.50**
Emergency Well Capacity									
Available Wells	gpm	-	-	-	-	-	-	-	0.00
Wells with Backup Power	gpm	1,207	3,691	-	-	-	-	-	4898.00
Proposed Backup Power	gpm	-	-	-	-	-	-	-	
	MGD	1.74	5.32	-	-	-	-	-	7.05
Equivalent Storage Capacity	**MG**	**1.74**	**5.32**	**-**	**-**	**-**	**-**	**-**	**7.06**
Net Storage Available									
Storage Surplus or (Deficit)	MG	5.73	5.16	7.52	10.71	-	-	-	29.12
Provided through PRVs to this zone	MG	-	-	-	-	-	-	-	0.00
Provided from PRVs from this zone	MG	-	-	-	-	-	-	-	0.00
Provided through BPSs to this zone	MG	-	-	-	-	-	-	-	0.00
Provided from BPSs from this zone	MG	-	-	-	-	-	-	-	0.00
Net Available Storage	**MG**	**5.73**	**5.16**	**7.52**	**10.71**	**-**	**-**	**-**	**29.12**

H:\Client\Hesperia_OCO\7287a00\Excel\[Storage_Analysis_Hesperia-17-RL-NoElec.xls]Summary

Appendix F.2 **Storage Analysis by Pressure Zone for Planning Year 2012**
Water Master Plan Update
City of Hesperia

Description/Criteria (HGLof Pressure Zone)	Units	Pressure Zone 1 (3229)	2 (3402)	3 (3592)	4 (3852)	5 (4034)	6 (4292)	RLF (3484)	Totals
Demands for 2012									
Average Day	gpm	2,623	7,158	3,518	2,978	132	24	2,269	18701
	MGD	3.78	10.31	5.07	4.29	0.19	0.03	3.27	26.9
Maximum Day	gpm	4,564	12,454	6,121	5,181	230	42	3,949	32540
	MGD	6.57	17.93	8.81	7.46	0.33	0.06	5.69	46.9
Required Fire Flow	gpm	4,000	4,000	3,500	4,000	4,000	3,500	1,500	
Fire Flow Duration	hrs	4.0	4.0	3.0	4.0	4.0	3.0	2.0	
Demand Reduction for 2012									
Conservation Efforts	gpm	0	0	0	0	0	0	0	0
	MGD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Reclaimed Water Usage	gpm						0	0	0
	MGD						0.00	0.00	0
Required Storage									
Operational Storage (30% of MDD)	MG	1.97	5.38	2.64	2.24	0.10	0.02	1.71	14.06
Emergency Storage (1.0 x MDD)	MG	6.57	17.93	8.81	7.46	0.33	0.06	5.69	46.85
Fire Storage	MG	0.96	0.96	0.63	0.96	0.96	0.63	0.18	5.28
Total Volume Required	**MG**	**9.50**	**24.27**	**12.08**	**10.66**	**1.39**	**0.71**	**7.58**	**66.19**
Available Storage Capacity									
Existing Tanks	MG	11.50	18.00	15.00	15.00	-	-	-	59.50
Proposed Tanks	MG	-	5.00	-	-	5.00	-	5.00	15.00
Total Available Storage	**MG**	**11.50**	**23.00**	**15.00**	**15.00**	**5.00**	**-**	**5.00**	**74.50**
Emergency Well Capacity									
Available Wells	gpm	-	-	-	-	-	-	-	0.00
Wells with Backup Power	gpm	1,207	3,691	-	-	-	-	5,100	9998.00
Proposed Backup Power	gpm	-	-	-	-	-	-	-	
	MGD	1.74	5.32	-	-	-	-	7.34	14.40
Equivalent Storage Capacity	**MG**	**1.74**	**5.32**	**-**	**-**	**-**	**-**	**7.34**	**14.40**
Net Storage Available									
Storage Surplus or (Deficit)	MG	3.74	4.05	2.92	4.34	3.61	(0.71)	4.76	22.71
Provided through PRVs to this zone	MG	-	1.13	-	-	-	-	-	1.13
Provided from PRVs from this zone	MG	-	-	(1.13)	-	-	-	-	-1.13
Provided through BPSs to this zone	MG	-	-	-	-	2.10	0.71	2.58	5.39
Provided from BPSs from this zone	MG	-	(2.58)	-	(2.10)	(0.71)	-	-	-5.39
Net Available Storage	**MG**	**3.74**	**2.60**	**1.79**	**2.24**	**5.00**	**-**	**7.34**	**22.71**

H:\Client\Hesperia_OCO\7287a00\Excel\[Storage_Analysis_Hesperia-17-RL-NoElec.xls]Summary

Appendix F.3 Storage Analysis by Pressure Zone for Planning Year 2017
Water Master Plan Update
City of Hesperia

Description/Criteria (HGLof Pressure Zone)	Units	Pressure Zone 1 (3229)	2 (3402)	3 (3592)	4 (3852)	5 (4034)	6 (4292)	RLF (3484)	Totals
Demands for 2017									
Average Day	gpm	2,805	8,104	4,225	5,392	419	257	4,539	25741
	MGD	4.04	11.67	6.08	7.76	0.60	0.37	6.54	37.1
Maximum Day	gpm	4,881	14,102	7,352	9,381	729	447	7,897	44789
	MGD	7.03	20.31	10.59	13.51	1.05	0.64	11.37	64.5
Required Fire Flow	gpm	4,000	4,000	3,500	4,000	4,000	3,500	1,500	
Fire Flow Duration	hrs	4.0	4.0	3.0	4.0	4.0	3.0	2.0	
Demand Reduction for 2017									
Conservation Efforts	gpm	0	0	0	0	0	0	0	0
	MGD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Reclaimed Water Usage	gpm						0	0	0
	MGD						0.00	0.00	0
Required Storage									
Operational Storage (30% of MDD)	MG	2.11	6.09	3.18	4.05	0.32	0.19	3.41	19.35
Emergency Storage (1.0 x MDD)	MG	7.03	20.31	10.59	13.51	1.05	0.64	11.37	64.50
Fire Storage	MG	0.96	0.96	0.63	0.96	0.96	0.63	0.18	5.28
Total Volume Required	**MG**	**10.10**	**27.36**	**14.40**	**18.52**	**2.33**	**1.46**	**14.96**	**89.13**
Available Storage Capacity									
Existing Tanks	MG	11.50	18.00	15.00	15.00	-	-	-	59.50
Proposed Tanks	MG	-	5.00	8.00	-	5.00	-	5.00	23.00
Total Available Storage	**MG**	**11.50**	**23.00**	**23.00**	**15.00**	**5.00**	**-**	**5.00**	**82.50**
Emergency Well Capacity									
Available Wells	gpm	-	-	-	-	-	-	-	0.00
Wells with Backup Power	gpm	1,207	3,691	-	-	-	-	5,100	9998.00
Proposed Backup Power	gpm	-	-	-	-	-	-	-	
	MGD	1.74	5.32	-	-	-	-	7.34	14.40
Equivalent Storage Capacity	**MG**	**1.74**	**5.32**	**-**	**-**	**-**	**-**	**7.34**	**14.40**
Net Storage Available									
Storage Surplus or (Deficit)	MG	3.14	0.96	8.60	(3.52)	2.67	(1.46)	(2.62)	7.77
Provided through PRVs to this zone	MG	-	5.08	-	-	-	-	-	5.08
Provided from PRVs from this zone	MG	-	-	(5.08)	-	-	-	-	-5.08
Provided through BPSs to this zone	MG	-	1.34	-	3.52	-	1.46	4.78	11.10
Provided from BPSs from this zone	MG	(1.34)	(4.78)	(3.52)	-	(1.46)	-	-	-11.10
Net Available Storage	**MG**	**1.80**	**2.60**	**-**	**-**	**1.21**	**-**	**2.16**	**7.77**

H:\Client\Hesperia_OCO\7287a00\Excel\[Storage_Analysis_Hesperia-17-RL-NoElec.xls]Summary

Appendix F.4 Storage Analysis by Pressure Zone for Planning Year 2022
Water Master Plan Update
City of Hesperia

Description/Criteria (HGLof Pressure Zone)	Units	Pressure Zone 1 (3229)	2 (3402)	3 (3592)	4 (3852)	5 (4034)	6 (4292)	RLF (3484)	Totals
Demands for 2022									
Average Day	gpm	3,044	8,971	4,758	7,491	637	367	6,160	31427
	MGD	4.38	12.92	6.85	10.79	0.92	0.53	8.87	45.3
Maximum Day	gpm	5,296	15,610	8,279	13,034	1,108	638	10,718	54683
	MGD	7.63	22.48	11.92	18.77	1.60	0.92	15.43	78.7
Required Fire Flow	gpm	4,000	4,000	3,500	4,000	4,000	3,500	1,500	
Fire Flow Duration	hrs	4.0	4.0	3.0	4.0	4.0	3.0	2.0	
Demand Reduction for 2022									
Conservation Efforts	gpm	0	0	0	0	0	0	0	0
	MGD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Reclaimed Water Usage	gpm						0	0	0
	MGD						0.00	0.00	0
Required Storage									
Operational Storage (30% of MDD)	MG	2.29	6.74	3.58	5.63	0.48	0.28	4.63	23.63
Emergency Storage (1.0 x MDD)	MG	7.63	22.48	11.92	18.77	1.60	0.92	15.43	78.75
Fire Storage	MG	0.96	0.96	0.63	0.96	0.96	0.63	0.18	5.28
Total Volume Required	**MG**	**10.88**	**30.18**	**16.13**	**25.36**	**3.04**	**1.83**	**20.24**	**107.66**
Available Storage Capacity									
Existing Tanks	MG	11.50	18.00	15.00	15.00	-	-	-	59.50
Proposed Tanks	MG	5.00	5.00	8.00	5.00	5.00	-	5.00	33.00
Total Available Storage	**MG**	**16.50**	**23.00**	**23.00**	**20.00**	**5.00**	**-**	**5.00**	**92.50**
Emergency Well Capacity									
Available Wells	gpm	-	-	-	-	-	-	-	0.00
Wells with Backup Power	gpm	1,207	3,691	-	-	-	-	5,100	9998.00
Proposed Backup Power	gpm	-	-	-	-	-	-	-	
	MGD	1.74	5.32	-	-	-	-	7.34	14.40
Equivalent Storage Capacity	**MG**	**1.74**	**5.32**	**-**	**-**	**-**	**-**	**7.34**	**14.40**
Net Storage Available									
Storage Surplus or (Deficit)	MG	7.36	(1.86)	6.87	(5.36)	1.96	(1.83)	(7.90)	-0.76
Provided through PRVs to this zone	MG	-	1.51	-	-	-	-	-	1.51
Provided from PRVs from this zone	MG	-	-	(1.51)	-	-	-	-	-1.51
Provided through BPSs to this zone	MG	-	5.37	-	5.36	-	1.83	7.90	20.46
Provided from BPSs from this zone	MG	(5.37)	(7.90)	(5.36)	-	(1.83)	-	-	-20.46
Net Available Storage	**MG**	**1.99**	**(2.88)**	**-**	**-**	**0.13**	**-**	**-**	**-0.76**

H:\Client\Hesperia_OCO\7287a00\Excel\[Storage_Analysis_Hesperia-17-RL-NoElec.xls]Summary

Appendix F.5 Storage Analysis by Pressure Zone for Planning Year 2027
Water Master Plan Update
City of Hesperia

Description/Criteria (HGLof Pressure Zone)	Units	Pressure Zone 1 (3229)	2 (3402)	3 (3592)	4 (3852)	5 (4034)	6 (4292)	RLF (3484)	Totals
Demands for 2027									
Average Day	gpm	3,195	9,866	5,195	8,785	768	422	6,160	34390
	MGD	4.60	14.21	7.48	12.65	1.11	0.61	8.87	49.5
Maximum Day	gpm	5,560	17,166	9,039	15,285	1,336	735	10,718	59839
	MGD	8.01	24.72	13.02	22.01	1.92	1.06	15.43	86.2
Required Fire Flow	gpm	4,000	4,000	3,500	4,000	4,000	3,500	1,500	
Fire Flow Duration	hrs	4.0	4.0	3.0	4.0	4.0	3.0	2.0	
Demand Reduction for 2027									
Conservation Efforts	gpm	0	0	0	0	0	0	0	0
	MGD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Reclaimed Water Usage	gpm						0	0	0
	MGD						0.00	0.00	0
Required Storage									
Operational Storage (30% of MDD)	MG	2.40	7.42	3.90	6.60	0.58	0.32	4.63	25.85
Emergency Storage (1.0 x MDD)	MG	8.01	24.72	13.02	22.01	1.92	1.06	15.43	86.17
Fire Storage	MG	0.96	0.96	0.63	0.96	0.96	0.63	0.18	5.28
Total Volume Required	**MG**	**11.37**	**33.10**	**17.55**	**29.57**	**3.46**	**2.01**	**20.24**	**117.30**
Available Storage Capacity									
Existing Tanks	MG	11.50	18.00	15.00	15.00	-	-	-	59.50
Proposed Tanks	MG	5.00	5.00	8.00	10.00	5.00	-	10.00	43.00
Total Available Storage	**MG**	**16.50**	**23.00**	**23.00**	**25.00**	**5.00**	**-**	**10.00**	**102.50**
Emergency Well Capacity									
Available Wells	gpm	-	-	-	-	-	-	-	0.00
Wells with Backup Power	gpm	1,207	3,691	-	-	-	-	5,100	9998.00
Proposed Backup Power	gpm	-	-	-	-	-	-	-	
	MGD	1.74	5.32	-	-	-	-	7.34	14.40
Equivalent Storage Capacity	**MG**	**1.74**	**5.32**	**-**	**-**	**-**	**-**	**7.34**	**14.40**
Net Storage Available									
Storage Surplus or (Deficit)	MG	6.87	(4.78)	5.45	(4.57)	1.54	(2.01)	(2.90)	-0.40
Provided through PRVs to this zone	MG	-	-	-	-	-	-	-	0.00
Provided from PRVs from this zone	MG	-	-	-	-	-	-	-	0.00
Provided through BPSs to this zone	MG	-	4.80	-	5.04	0.47	2.01	2.90	15.22
Provided from BPSs from this zone	MG	(4.80)	(2.90)	(5.04)	(0.47)	(2.01)	-	-	-15.22
Net Available Storage	**MG**	**2.07**	**(2.88)**	**0.41**	**-**	**-**	**-**	**-**	**-0.40**

H:\Client\Hesperia_OCO\7287a00\Excel\[Storage_Analysis_Hesperia-17-RL-NoElec.xls]Summary

Appendix F.6 **Storage Analysis by Pressure Zone for Planning Year 2032**
Water Master Plan Update
City of Hesperia

Description/Criteria (HGLof Pressure Zone)	Units	Pressure Zone 1 (3229)	2 (3402)	3 (3592)	4 (3852)	5 (4034)	6 (4292)	RLF (3484)	Totals
Demands for 2032									
Average Day	gpm	3,386	10,480	5,463	8,999	821	446	6,484	36078
	MGD	4.88	15.09	7.87	12.96	1.18	0.64	9.34	52.0
Maximum Day	gpm	5,891	18,235	9,505	15,658	1,428	776	11,282	62776
	MGD	8.48	26.26	13.69	22.55	2.06	1.12	16.25	90.4
Required Fire Flow	gpm	4,000	4,000	3,500	4,000	4,000	3,500	1,500	
Fire Flow Duration	hrs	4.0	4.0	3.0	4.0	4.0	3.0	2.0	
Demand Reduction for 2032									
Conservation Efforts	gpm	0	0	0	0	0	0	0	0
	MGD	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0
Reclaimed Water Usage	gpm						0	0	0
	MGD						0.00	0.00	0
Required Storage									
Operational Storage (30% of MDD)	MG	2.55	7.88	4.11	6.76	0.62	0.34	4.87	27.13
Emergency Storage (1.0 x MDD)	MG	8.48	26.26	13.69	22.55	2.06	1.12	16.25	90.41
Fire Storage	MG	0.96	0.96	0.63	0.96	0.96	0.63	0.18	5.28
Total Volume Required	**MG**	**11.99**	**35.10**	**18.43**	**30.27**	**3.64**	**2.09**	**21.30**	**122.82**
Available Storage Capacity									
Existing Tanks	MG	11.50	18.00	15.00	15.00	-	-	-	59.50
Proposed Tanks	MG	5.00	5.00	8.00	10.00	5.00	-	10.00	43.00
Total Available Storage	**MG**	**16.50**	**23.00**	**23.00**	**25.00**	**5.00**	**-**	**10.00**	**102.50**
Emergency Well Capacity									
Available Wells	gpm	-	-	-	-	-	-	-	0.00
Wells with Backup Power	gpm	1,207	3,691	-	-	-	-	5,100	9998.00
Proposed Backup Power	gpm	-	-	-	-	-	-	-	
	MGD	1.74	5.32	-	-	-	-	7.34	14.40
Equivalent Storage Capacity	**MG**	**1.74**	**5.32**	**-**	**-**	**-**	**-**	**7.34**	**14.40**
Net Storage Available									
Storage Surplus or (Deficit)	MG	6.25	(6.78)	4.57	(5.27)	1.36	(2.09)	(3.96)	-5.92
Provided through PRVs to this zone	MG	-	-	-	-	-	-	-	0.00
Provided from PRVs from this zone	MG	-	-	-	-	-	-	-	0.00
Provided through BPSs to this zone	MG	-	9.29	1.43	6.00	0.73	2.09	3.96	23.50
Provided from BPSs from this zone	MG	(9.29)	(5.39)	(6.00)	(0.73)	(2.09)	-	-	-23.50
Net Available Storage	**MG**	**(3.04)**	**(2.88)**	**-**	**-**	**-**	**-**	**-**	**-5.92**

H:\Client\Hesperia_OCO\7287a00\Excel\[Storage_Analysis_Hesperia-17-RL-NoElec.xls]Summary

IMPROVEMENT PROJECTS FOR 4" AND 6" STEEL PIPELINE REPLACEMENTS

Appendix G **Improvement Projects for 4" and 6" Steel Pipeline Replacements**
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost[3]
Existing Small Diameter (4" & 6") Pipeline Replacement for Fireflow										
001	PROP_P750_2006	361	8	3	NEW	FF_LT-500PSI	OLIVE ST, FROM MAPLE TO PARALLEL E. OF MAPLE	Near Term	8.75	$42,188
001	PROP_P756_2006	431	8	3	RP	FF_SP_LT-500PSI	E OF MAPLE PARALLEL, FROM MUSCATEL TO OLIVE ST.	Near Term	8.75	$50,625
001	PROP_P758_2006	472	8	3	RP	FF_SP_LT-500PSI	E OF MAPLE PARALLEL, FROM MUSCATEL TO OLIVE ST.	Near Term	8.75	$55,688
001	PROP_P760_2006	438	8	3	RP	FF_SP_LT-500PSI	E OF MAPLE PARALLEL, FROM MUSCATEL TO OLIVE ST.	Near Term	8.75	$52,313
001	PROP_P762_2006	515	8	3	RP	FF_SP_LT-500PSI	E OF MAPLE PARALLEL, FROM MUSCATEL TO OLIVE ST.	Near Term	8.75	$60,750
001	PROP_P764_2006	468	8	3	RP	FF_SP_LT-500PSI	E OF MAPLE PARALLEL, FROM MUSCATEL TO OLIVE ST.	Near Term	8.75	$55,688
001	PROP_P766_2006	492	8	3	RP	FF_SP_LT-500PSI	E OF MAPLE PARALLEL, FROM MUSCATEL TO OLIVE ST.	Near Term	8.75	$57,375
001	PROP_P768_2006	453	8	3	RP	FF_SP_LT-500PSI	E OF MAPLE PARALLEL, FROM MUSCATEL TO OLIVE ST.	Near Term	8.75	$54,000
001	PROP_P770_2006	512	8	3	RP	FF_SP_LT-500PSI	E OF MAPLE PARALLEL, FROM MUSCATEL TO OLIVE ST	Near Term	8.75	$60,750
002	PROP_P824_2006	2,200	8	3	RP	FF_SP_LT-500PSI	POPLAR ST. FROM MAPLE TO PINON AVE.	Near Term	8.75	$259,875
002	PROP_P826_2006	2,188	8	3	RP	FF_SP_LT-500PSI	POPLAR ST. FROM MAPLE TO PINON AVE.	Near Term	8.75	$258,188
002	PROP_P828_2006	888	8	3	RP	FF_SP_LT-500PSI	PINON AVE. FROM POPLAR TO SULTANA ST	Near Term	8.75	$104,625
003	PROP_P202_2006	187	8	2	NEW	FF_LT-500PSI	N. OR EUCALYPTUS, E. OF OAKWOOD AVE	Near Term	8.75	$21,938
003	PROP_P204_2006	801	8	2	RP	FF_SP_LT-500PSI	N. OR EUCALYPTUS, E. OF OAKWOOD AVE	Near Term	8.75	$94,500
003	PROP_P210_2006	254	8	2	NEW	FF_LT-500PSI	CONNECTING TO FRONTAGE RD	Near Term	8.75	$30,375
003	PROP_P212_2006	525	8	2	RP	FF_SP_LT-500PSI	W OF HEMLOCK, N. OF EUCALYPTUS, S. OF SEQUOIA	Near Term	8.75	$62,438
003	PROP_P214_2006	944	8	2	RP	FF_SP_LT-500PSI	W OF HEMLOCK, N. OF EUCALYPTUS, S. OF SEQUOIA	Near Term	8.75	$111,375
003	PROP_P216_2006	279	8	2	RP	FF_SP_LT-500PSI	W OF HEMLOCK, N. OF EUCALYPTUS, S. OF SEQUOIA	Near Term	8.75	$33,750
003	PROP_P298_2006	848	8	2	RP	FF_SP_LT-500PSI	W OF HEMLOCK, N. OF EUCALYPTUS, S. OF SEQUOIA	Near Term	8.75	$99,563
003	PROP_P300_2006	1,548	8	2	RP	FF_SP_LT-500PSI	W OF HEMLOCK, N. OF EUCALYPTUS, S. OF SEQUOIA	Near Term	8.75	$182,250
004	PROP_P600_2006	764	12	2	RP	FF_SP_LT-500PSI	E AVE. FROM MAPLE TO MOJAVE ST	Near Term	7.50	$116,438
004	PROP_P602_2006	1,547	12	2	RP	FF_SP_LT-500PSI	E AVE. FROM MAPLE TO MOJAVE ST	Near Term	7.50	$234,563
004	PROP_P604_2006	695	12	2	RP	FF_SP_LT-500PSI	E AVE. FROM MAPLE TO MOJAVE ST	Near Term	7.50	$106,313
004	PROP_P606_2006	211	12	2	RP	FF_SP_LT-500PSI	E AVE. FROM MAPLE TO MOJAVE ST	Near Term	7.50	$32,063
004	PROP_P608_2006	2,073	12	2	RP	FF_SP_LT-500PSI	NEAR INTERSECTION OF C AVE. AND MAUNA LOA ST.	Near Term	7.50	$315,563
004	PROP_P610_2006	3,728	8	2	RP	FF_SP_LT-500PSI	NEAR INTERSECTION OF C AVE. AND MAUNA LOA ST.	Near Term	8.75	$440,438
004	PROP_P612_2006	1,186	12	2	RP	FF_SP_LT0PSI	FRESNO ST. FROM E AVE. TO I AVE	Near Term	7.50	$180,563
004	PROP_P614_2006	1,121	12	2	RP	FF_SP_LT0PSI	FRESNO ST. FROM E AVE. TO I AVE	Near Term	7.50	$170,438
005	PROP_P434_2006	679	8	2	RP	FF_SP_LT-500PSI	BETWEEN WALNUT & ORANGE, W. OF 3RD ST	Near Term	8.75	$81,000
005	PROP_P436_2006	770	8	2	RP	FF_SP_LT-500PSI	BETWEEN WALNUT & ORANGE, W. OF 3RD ST	Near Term	8.75	$91,125
006	PROP_P206_2006	146	8	2	RP	FF_SP_LT-500PSI	E. OF C AVE, S. OF MUSCATEL	Near Term	8.75	$16,875
006	PROP_P208_2006	627	8	2	RP	FF_SP_LT-500PSI	E. OF C AVE, S. OF MUSCATEL	Near Term	8.75	$74,250
007	PROP_P1000_2006	8,071	16	4	PL	FF_LT-500PSI	ESCONDIDO AVE, RANCHERO RD TO MUSCATEL	Near Term	7.19	$1,566,000
007	PROP_P1002_2006	2,634	16	4	PL	FF_LT-500PSI	ESCONDIDO AVE, RANCHERO RD TO MUSCATEL	Near Term	7.19	$511,313
008	PROP_P744_2006	974	8	3	NEW	FF_LT-500PSI	CONNECTING PALM ST. TO NEAR OAKWOOD AVE. W. OF COTTONWOOD	Near Term	8.75	$114,750
009	PROP_P404_2006	342	8	2	NEW	FF_LT-500PSI	HERCULES ST, CONNECTING CYPRESS AND REDLANDS AVE	Near Term	8.75	$40,500
010	PROP_P480_2006	579	8	2	RP	FF_SP_LT0PSI	NORTH & SOUTH OF MAUNA LOA AVE., PARALLEL W. OF NINTH AVE.	Near Term	8.75	$67,500
010	PROP_P482_2006	948	8	2	RP	FF_SP_LT0PSI	NORTH & SOUTH OF MAUNA LOA AVE., PARALLEL W. OF NINTH AVE.	Near Term	8.75	$111,375
010	PROP_P516_2006	187	8	2	RP	FF_SP_LT0PSI	NORTH & SOUTH OF MAUNA LOA AVE., PARALLEL W. OF NINTH AVE.	Near Term	8.75	$21,938
010	PROP_P518_2006	1,039	8	2	RP	FF_SP_LT0PSI	NORTH & SOUTH OF MAUNA LOA AVE., PARALLEL W. OF NINTH AVE.	Near Term	8.75	$123,188
010	PROP_P520_2006	180	8	2	RP	FF_SP_LT0PSI	NORTH & SOUTH OF MAUNA LOA AVE., PARALLEL W. OF NINTH AVE.	Near Term	8.75	$21,938
010	PROP_P522_2006	828	8	2	RP	FF_SP_LT0PSI	NORTH & SOUTH OF MAUNA LOA AVE., PARALLEL W. OF NINTH AVE.	Near Term	8.75	$97,875
011	PROP_P354_2006	400	8	2	NEW	FF_LT0PSI	MAUNA LOA BETWEEN FIFTH & SIXTH AVE	Near Term	8.75	$47,250
011	PROP_P356_2006	773	8	2	NEW	FF_LT0PSI	MAUNA LOA BETWEEN FOURTH & FIFTH AVE	Near Term	8.75	$91,125
011	PROP_P358_2006	765	8	2	NEW	FF_LT0PSI	MAUNA LOA BETWEEN THIRD AND FOURTH AVE	Near Term	8.75	$91,125
011	PROP_P502_2006	1,087	8	2	RP	FF_SP_LT0PSI	BETWEEN MESA AND N. OF HERCULES, BETWEEN THIRD AND FIFTH AVE	Near Term	8.75	$128,250
011	PROP_P504_2006	1,239	8	2	RP	FF_SP_LT0PSI	BETWEEN MESA AND N. OF HERCULES, BETWEEN THIRD AND FIFTH AVE	Near Term	8.75	$146,813
011	PROP_P506_2006	1,074	8	2	RP	FF_SP_LT0PSI	BETWEEN MESA AND N. OF HERCULES, BETWEEN THIRD AND FIFTH AVE	Near Term	8.75	$126,563
011	PROP_P508_2006	1,380	8	2	RP	FF_SP_LT0PSI	BETWEEN MESA AND N. OF HERCULES, BETWEEN THIRD AND FIFTH AVE	Near Term	8.75	$163,688
011	PROP_P510_2006	127	8	2	RP	FF_SP_LT0PSI	BETWEEN MESA AND N. OF HERCULES, BETWEEN THIRD AND FIFTH AVE	Near Term	8.75	$15,188
011	PROP_P512_2006	1,226	8	2	RP	FF_SP_LT0PSI	BETWEEN MESA AND N. OF HERCULES, BETWEEN THIRD AND FIFTH AVE	Near Term	8.75	$145,125
011	PROP_P514_2006	1,225	8	2	RP	FF_SP_LT0PSI	BETWEEN MESA AND N. OF HERCULES, BETWEEN THIRD AND FIFTH AVE	Near Term	8.75	$145,125
011	PROP_P530_2006	1,206	8	2	RP	FF_SP_LT0PSI	BETWEEN MESA AND N. OF HERCULES, BETWEEN THIRD AND FIFTH AVE	Near Term	8.75	$141,750
011	PROP_P532_2006	1,495	8	2	RP	FF_SP_LT0PSI	BETWEEN MESA AND N. OF HERCULES, BETWEEN THIRD AND FIFTH AVE	Near Term	8.75	$177,188
011	PROP_P534_2006	1,410	8	2	RP	FF_SP_LT0PSI	BETWEEN MESA AND N. OF HERCULES, BETWEEN THIRD AND FIFTH AVE	Near Term	8.75	$167,063

Appendix G	Improvement Projects for 4" and 6" Steel Pipeline Replacements Water Master Plan Update City of Hesperia									
Improvement Project No.(1)	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description(2)	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost(3)
011	PROP_P536_2006	1,272	8	2	RP	FF_SP_LT0PSI	BETWEEN MESA AND N. OF HERCULES, BETWEEN THIRD AND FIFTH AVE	Near Term	8.75	$150,188
011	PROP_P538_2006	396	8	2	RP	FF_SP_LT0PSI	N. OR HERCULES AND W. OF THIRD ST	Near Term	8.75	$47,250
011	PROP_P540_2006	606	8	2	RP	FF_SP_LT0PSI	S. OR HERCULES AND W. OF THIRD ST	Near Term	8.75	$70,875
012	PROP_P492_2006	900	8	2	RP	FF_SP_LT0PSI	W. OF SEVENTH, S. OF MESA AND N. OR HERCULES	Near Term	8.75	$106,313
012	PROP_P494_2006	1,045	8	2	RP	FF_SP_LT0PSI	W. OF SEVENTH, S. OF MESA AND N. OR HERCULES	Near Term	8.75	$123,188
012	PROP_P524_2006	826	8	2	RP	FF_SP_LT0PSI	W. OF SEVENTH N. OF MAUNA LOA	Near Term	8.75	$97,875
012	PROP_P526_2006	1,095	8	2	RP	FF_SP_LT0PSI	W. OF SEVENTH N. OF MAUNA LOA	Near Term	8.75	$129,938
012	PROP_P528_2006	824	8	2	RP	FF_SP_LT0PSI	W. OF SEVENTH N. OF MAUNA LOA	Near Term	8.75	$97,875
013	PROP_P304_2006	77	8	2	NEW	FF_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$8,438
013	PROP_P306_2006	398	8	2	NEW	FF_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$47,250
013	PROP_P308_2006	181	8	2	NEW	FF_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$21,938
013	PROP_P310_2006	91	8	2	NEW	FF_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$10,125
013	PROP_P312_2006	335	8	2	NEW	FF_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$38,813
013	PROP_P314_2006	357	8	2	NEW	FF_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$42,188
013	PROP_P316_2006	361	8	2	NEW	FF_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$42,188
013	PROP_P318_2006	362	8	2	NEW	FF_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$42,188
013	PROP_P320_2006	371	8	2	NEW	FF_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$43,875
013	PROP_P322_2006	355	8	2	NEW	FF_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$42,188
013	PROP_P324_2006	711	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$84,375
013	PROP_P332_2006	677	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$79,313
013	PROP_P336_2006	745	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$87,750
013	PROP_P340_2006	174	8	2	NEW	FF_LT0PSI	DOWNTOWN AREA ON EIGHTH AVE. FROM VINE TO WILLOW ST.	Near Term	8.75	$20,250
013	PROP_P342_2006	922	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$109,688
013	PROP_P346_2006	671	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$79,313
013	PROP_P350_2006	648	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$75,938
013	PROP_P360_2006	680	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$81,000
013	PROP_P364_2006	739	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$87,750
013	PROP_P372_2006	730	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$86,063
013	PROP_P376_2006	1,263	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$148,500
013	PROP_P378_2006	210	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$25,313
013	PROP_P380_2006	688	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$81,000
013	PROP_P384_2006	740	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$87,750
013	PROP_P386_2006	665	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$79,313
013	PROP_P390_2006	648	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$75,938
013	PROP_P392_2006	685	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$81,000
013	PROP_P396_2006	639	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$75,938
013	PROP_P398_2006	728	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$86,063
013	PROP_P400_2006	804	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$94,500
013	PROP_P402_2006	625	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$74,250
013	PROP_P562_2006	750	8	2	RP	FF_SP_LT0PSI	DOWNTOWN AREA FROM SEVENTH TO THIRD, FROM MAIN TO WILLOW	Near Term	8.75	$87,750
014	PROP_P406_2006	762	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$116,438
014	PROP_P408_2006	699	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$106,313
014	PROP_P410_2006	269	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$40,500
014	PROP_P412_2006	1,507	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$229,500
014	PROP_P414_2006	774	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$118,125
014	PROP_P416_2006	793	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$119,813
014	PROP_P418_2006	822	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$97,875
014	PROP_P420_2006	1,150	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$135,000
014	PROP_P422_2006	924	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$109,688
014	PROP_P424_2006	2,747	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$324,000
014	PROP_P426_2006	433	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$50,625
014	PROP_P428_2006	365	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$43,875
014	PROP_P430_2006	704	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$82,688
014	PROP_P438_2006	128	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$18,563
014	PROP_P440_2006	175	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$27,000
014	PROP_P442_2006	283	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$42,188

Appendix G	Improvement Projects for 4" and 6" Steel Pipeline Replacements Water Master Plan Update City of Hesperia									
Improvement Project No.[1]	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost[3]
014	PROP_P444_2006	169	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$25,313
014	PROP_P446_2006	221	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$33,750
014	PROP_P448_2006	959	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$113,063
014	PROP_P450_2006	956	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$113,063
014	PROP_P452_2006	860	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$101,250
014	PROP_P456_2006	54	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$6,750
014	PROP_P458_2006	56	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$6,750
014	PROP_P460_2006	337	12	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	7.50	$50,625
014	PROP_P462_2006	757	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$89,438
014	PROP_P464_2006	893	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$104,625
014	PROP_P466_2006	993	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$118,125
014	PROP_P468_2006	1,253	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$148,500
014	PROP_P470_2006	1,171	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$138,375
014	PROP_P472_2006	525	8	2	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$62,438
014	PROP_P840_2006	528	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$62,438
014	PROP_P842_2006	1,007	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$118,125
014	PROP_P844_2006	1,350	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$160,313
014	PROP_P846_2006	904	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$106,313
014	PROP_P848_2006	1,036	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$123,188
014	PROP_P852_2006	440	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$52,313
014	PROP_P854_2006	998	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$118,125
014	PROP_P856_2006	1,327	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$156,938
014	PROP_P858_2006	2,093	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$248,063
014	PROP_P860_2006	395	8	3	PL	FF_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$47,250
014	PROP_P862_2006	483	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$57,375
014	PROP_P864_2006	1,013	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$119,813
014	PROP_P866_2006	1,311	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$155,250
014	PROP_P868_2006	902	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$106,313
014	PROP_P870_2006	1,020	8	3	RP	FF_SP_LT0PSI	S OF ORANGE AND N. OF LIME ST., BETWEEN TENTH AND THIRD ST.	Near Term	8.75	$119,813
015	PROP_P982_2006	826	8	4	RP	FF_SP_LT0PSI	S. OF RANCHERO RD., N. OF FRMNGTON, W. OF CTNWD, E. OF MAPLE	Near Term	8.75	$97,875
015	PROP_P984_2006	466	8	4	RP	FF_SP_LT0PSI	S. OF RANCHERO RD., N. OF FRMNGTON, W. OF CTNWD, E. OF MAPLE	Near Term	8.75	$55,688
015	PROP_P986_2006	518	8	4	RP	FF_SP_LT0PSI	S. OF RANCHERO RD., N. OF FRMNGTON, W. OF CTNWD, E. OF MAPLE	Near Term	8.75	$60,750
015	PROP_P988_2006	434	8	4	RP	FF_SP_LT0PSI	S. OF RANCHERO RD., N. OF FRMNGTON, W. OF CTNWD, E. OF MAPLE	Near Term	8.75	$50,625
015	PROP_P990_2006	401	8	4	RP	FF_SP_LT0PSI	S. OF RANCHERO RD., N. OF FRMNGTON, W. OF CTNWD, E. OF MAPLE	Near Term	8.75	$47,250
015	PROP_P992_2006	572	8	4	RP	FF_SP_LT0PSI	S. OF RANCHERO RD., N. OF FRMNGTON, W. OF CTNWD, E. OF MAPLE	Near Term	8.75	$67,500
015	PROP_P994_2006	455	8	4	RP	FF_SP_LT0PSI	S. OF RANCHERO RD., N. OF FRMNGTON, W. OF CTNWD, E. OF MAPLE	Near Term	8.75	$54,000
015	PROP_P996_2006	333	8	4	RP	FF_SP_LT0PSI	S. OF RANCHERO RD., N. OF FRMNGTON, W. OF CTNWD, E. OF MAPLE	Near Term	8.75	$38,813
015	PROP_P998_2006	1,082	8	4	RP	FF_SP_LT0PSI	S. OF RANCHERO RD., N. OF FRMNGTON, W. OF CTNWD, E. OF MAPLE	Near Term	8.75	$128,250
015	PROP_P1010_2006	433	8	4	RP	FF_SP_LT0PSI	S. OF RANCHERO RD., N. OF FRMNGTON, W. OF CTNWD, E. OF MAPLE	Near Term	8.75	$50,625
015	PROP_P1012_2006	949	8	4	RP	FF_SP_LT0PSI	S. OF RANCHERO RD., N. OF FRMNGTON, W. OF CTNWD, E. OF MAPLE	Near Term	8.75	$111,375
016	PROP_P890_2006	855	8	3	RP	FF_SP_LT0PSI	E. OF ELEVENTH, W. OF SEVENTH, NEAR ASH, MISSION, EL CENTRO	Near Term	8.75	$101,250
016	PROP_P892_2006	2,070	8	3	RP	FF_SP_LT0PSI	E. OF ELEVENTH, W. OF SEVENTH, NEAR ASH, MISSION, EL CENTRO	Near Term	8.75	$244,688
016	PROP_P894_2006	1,107	8	3	RP	FF_SP_LT0PSI	E. OF ELEVENTH, W. OF SEVENTH, NEAR ASH, MISSION, EL CENTRO	Near Term	8.75	$129,938
016	PROP_P896_2006	1,014	8	3	RP	FF_SP_LT0PSI	E. OF ELEVENTH, W. OF SEVENTH, NEAR ASH, MISSION, EL CENTRO	Near Term	8.75	$119,813
016	PROP_P898_2006	851	8	3	RP	FF_SP_LT0PSI	E. OF ELEVENTH, W. OF SEVENTH, NEAR ASH, MISSION, EL CENTRO	Near Term	8.75	$101,250
016	PROP_P900_2006	845	8	3	RP	FF_SP_LT0PSI	E. OF ELEVENTH, W. OF SEVENTH, NEAR ASH, MISSION, EL CENTRO	Near Term	8.75	$99,563
016	PROP_P902_2006	1,037	8	3	RP	FF_SP_LT0PSI	E. OF ELEVENTH, W. OF SEVENTH, NEAR ASH, MISSION, EL CENTRO	Near Term	8.75	$123,188
016	PROP_P904_2006	1,010	8	3	RP	FF_SP_LT0PSI	E. OF ELEVENTH, W. OF SEVENTH, NEAR ASH, MISSION, EL CENTRO	Near Term	8.75	$119,813
016	PROP_P906_2006	150	8	3	RP	FF_SP_LT0PSI	E. OF ELEVENTH, W. OF SEVENTH, NEAR ASH, MISSION, EL CENTRO	Near Term	8.75	$18,563
017	PROP_P800_2006	356	8	3	RP	FF_SP_LT0PSI	JUNIPER ST., FROM HEMLOCK TO LINCOLN AVE	Near Term	8.75	$42,188
017	PROP_P802_2006	438	8	3	RP	FF_SP_LT0PSI	JUNIPER ST., FROM HEMLOCK TO LINCOLN AVE	Near Term	8.75	$52,313
017	PROP_P804_2006	428	8	3	RP	FF_SP_LT0PSI	JUNIPER ST., FROM HEMLOCK TO LINCOLN AVE	Near Term	8.75	$50,625
017	PROP_P806_2006	452	8	3	RP	FF_SP_LT0PSI	JUNIPER ST., FROM HEMLOCK TO LINCOLN AVE	Near Term	8.75	$54,000
018	PROP_P790_2006	658	8	3	RP	FF_SP_LT0PSI	SULTANA RD. FROM MAPLE TO TAMARISK	Near Term	8.75	$77,625
018	PROP_P792_2006	665	8	3	RP	FF_SP_LT0PSI	SULTANA RD. FROM MAPLE TO TAMARISK	Near Term	8.75	$79,313
019	PROP_P546_2006	405	8	2	RP	FF_SP_LT0PSI	RANCHERO RD. FROM SAN BRUNO TO PAISLEY AVE	Near Term	8.75	$47,250

Appendix G **Improvement Projects for 4" and 6" Steel Pipeline Replacements**
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost[3]
019	PROP_P548_2006	440	8	2	RP	FF_SP_LT0PSI	RANCHERO RD. FROM SAN BRUNO TO PAISLEY AVE	Near Term	8.75	$52,313
019	PROP_P550_2006	444	8	2	RP	FF_SP_LT0PSI	RANCHERO RD. FROM SAN BRUNO TO PAISLEY AVE	Near Term	8.75	$52,313
019	PROP_P552_2006	447	8	2	RP	FF_SP_LT0PSI	RANCHERO RD. FROM SAN BRUNO TO PAISLEY AVE	Near Term	8.75	$52,313
019	PROP_P584_2006	449	8	2	RP	FF_SP_LT0PSI	RANCHERO RD. FROM SAN BRUNO TO PAISLEY AVE	Near Term	8.75	$52,313
019	PROP_P586_2006	309	8	2	RP	FF_SP_LT0PSI	RANCHERO RD. FROM SAN BRUNO TO PAISLEY AVE	Near Term	8.75	$37,125
019	PROP_P588_2006	96	8	2	RP	FF_SP_LT0PSI	RANCHERO RD. FROM SAN BRUNO TO PAISLEY AVE	Near Term	8.75	$11,813
019	PROP_P590_2006	440	8	2	RP	FF_SP_LT0PSI	RANCHERO RD. FROM SAN BRUNO TO PAISLEY AVE	Near Term	8.75	$52,313
020	PROP_P736_2006	609	8	3	NEW	FF_LT0PSI	S. OF MUSCATEL, BETWEEN COTTONWOOD AND E. OF MAPLE AVE	Near Term	8.75	$72,563
020	PROP_1502	1,291	8	3	PL	FF_SP_LT0PSI	HEMLOCK & PALM	Near Term	8.75	$151,875
020	PROP_1504	693	8	3	PL	FF_SP_LT0PSI	HEMLOCK & JOSHUA	Near Term	8.75	$81,000
020	PROP_P738_2006	1,281	8	3	RP	FF_SP_LT0PSI	S. OF MUSCATEL, BETWEEN COTTONWOOD AND E. OF MAPLE AVE	Near Term	8.75	$151,875
020	PROP_P740_2006	2,187	8	3	RP	FF_SP_LT0PSI	MUSCATEL, BETWEEN COTTONWOOD AND E. OF MAPLE AVE	Near Term	8.75	$258,188
021	PROP_P908_2006	824	8	3	RP	FF_SP_LT0PSI	N. OR MESQUITE FROM ELEVENTH TO FOURTH AVE	Near Term	8.75	$97,875
021	PROP_P910_2006	658	8	3	RP	FF_SP_LT0PSI	N. OR MESQUITE FROM ELEVENTH TO FOURTH AVE	Near Term	8.75	$77,625
021	PROP_P912_2006	848	8	3	RP	FF_SP_LT0PSI	N. OR MESQUITE FROM ELEVENTH TO FOURTH AVE	Near Term	8.75	$99,563
021	PROP_P914_2006	641	8	3	RP	FF_SP_LT0PSI	N. OR MESQUITE FROM ELEVENTH TO FOURTH AVE	Near Term	8.75	$75,938
021	PROP_P916_2006	871	8	3	RP	FF_SP_LT0PSI	N. OR MESQUITE FROM ELEVENTH TO FOURTH AVE	Near Term	8.75	$102,938
021	PROP_P918_2006	319	8	3	RP	FF_SP_LT0PSI	N. OR MESQUITE FROM ELEVENTH TO FOURTH AVE	Near Term	8.75	$37,125
021	PROP_P920_2006	399	8	3	RP	FF_SP_LT0PSI	N. OR MESQUITE FROM ELEVENTH TO FOURTH AVE	Near Term	8.75	$47,250
021	PROP_P922_2006	909	8	3	RP	FF_SP_LT0PSI	N. OR MESQUITE FROM ELEVENTH TO FOURTH AVE	Near Term	8.75	$108,000
021	PROP_P932_2006	1,098	8	3	RP	FF_SP_LT0PSI	W. OF EIGHTH AVE. BETWEEN N OR MESQUITE AND N. OR PALM AVE.	Near Term	8.75	$129,938
021	PROP_P934_2006	472	8	3	RP	FF_SP_LT0PSI	W. OF EIGHTH AVE. BETWEEN N OR MESQUITE AND N. OR PALM AVE.	Near Term	8.75	$55,688
021	PROP_P936_2006	1,938	8	3	RP	FF_SP_LT0PSI	W. OF EIGHTH AVE. BETWEEN N OR MESQUITE AND N. OR PALM AVE.	Near Term	8.75	$229,500
022	PROP_P240_2006	496	12	2	RP	FF_SP_LT0PSI	EUCALYPTUS FROM OAKWOOD TO LOCUST	Near Term	7.50	$75,938
022	PROP_P242_2006	400	12	2	RP	FF_SP_LT0PSI	EUCALYPTUS FROM OAKWOOD TO LOCUST	Near Term	7.50	$60,750
022	PROP_P244_2006	376	8	2	RP	FF_SP_LT0PSI	EUCALYPTUS FROM OAKWOOD TO LOCUST	Near Term	8.75	$43,875
022	PROP_P246_2006	370	8	2	NEW	FF_LT0PSI	EUCALYPTUS FROM OAKWOOD TO LOCUST	Near Term	8.75	$43,875
022	PROP_P248_2006	398	8	2	RP	FF_SP_LT0PSI	EUCALYPTUS FROM OAKWOOD TO LOCUST	Near Term	8.75	$47,250
022	PROP_P250_2006	311	8	2	NEW	FF_LT0PSI	EUCALYPTUS FROM OAKWOOD TO LOCUST	Near Term	8.75	$37,125
022	PROP_P252_2006	657	8	2	RP	FF_SP_LT0PSI	W. OF LOCUST BETWEEN EUCALYPTUS AND LILAC	Near Term	8.75	$77,625
022	PROP_P254_2006	788	8	2	RP	FF_SP_LT0PSI	W. OF LOCUST BETWEEN EUCALYPTUS AND LILAC	Near Term	8.75	$92,813
022	PROP_P256_2006	652	8	2	RP	FF_SP_LT0PSI	W. OF LOCUST BETWEEN EUCALYPTUS AND LILAC	Near Term	8.75	$77,625
023	PROP_P700_2006	441	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$52,313
023	PROP_P702_2006	855	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$101,250
023	PROP_P704_2006	1,258	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$148,500
023	PROP_P706_2006	528	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$62,438
023	PROP_P714_2006	1,048	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$123,188
023	PROP_P716_2006	713	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$84,375
023	PROP_P718_2006	273	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$32,063
023	PROP_P720_2006	484	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$57,375
023	PROP_P722_2006	695	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$82,688
023	PROP_P724_2006	668	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$79,313
023	PROP_P726_2006	762	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$89,438
023	PROP_P746_2006	426	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$50,625
023	PROP_P748_2006	1,233	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$145,125
023	PROP_P872_2006	904	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$106,313
023	PROP_P874_2006	871	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$102,938
023	PROP_P876_2006	439	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$52,313
023	PROP_P878_2006	466	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$55,688
023	PROP_P880_2006	879	8	3	RP	FF_SP_LT0PSI	E. OF AQUEDUCT & W. OF COTTONWOOD, N. & S. OF MESQUITE	Near Term	8.75	$104,625
024	PROP_P684_2006	841	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$99,563
024	PROP_P686_2006	943	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$111,375
024	PROP_P688_2006	450	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$54,000
024	PROP_P690_2006	425	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$50,625
024	PROP_P692_2006	425	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$50,625
024	PROP_P694_2006	1,293	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$151,875

Appendix G Improvement Projects for 4" and 6" Steel Pipeline Replacements
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost[3]
024	PROP_P696_2006	353	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$42,188
024	PROP_P698_2006	2,176	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$256,500
024	PROP_P732_2006	169	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$20,250
024	PROP_P734_2006	235	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$27,000
024	PROP_P882_2006	2,242	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$264,938
024	PROP_P884_2006	548	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$64,125
024	PROP_P886_2006	245	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$28,688
024	PROP_P888_2006	417	8	3	RP	FF_SP_LT0PSI	N. OF JOSHUA TO MESQUITE, BETWEEN COTTNWD AND ELEVENTH AVE	Near Term	8.75	$48,938
025	PROP_P638_2006	1,403	8	2D	RP	FF_SP_LT0PSI	W. OF FOURTH AVE. BETWEEN EUCALYPTUS AND MESA RD	Near Term	8.75	$165,375
025	PROP_P640_2006	1,347	8	2D	RP	FF_SP_LT0PSI	W. OF FOURTH AVE. BETWEEN EUCALYPTUS AND MESA RD	Near Term	8.75	$158,625
025	PROP_P642_2006	1,618	8	2D	RP	FF_SP_LT0PSI	W. OF FIFTH AVE. BETWEEN SYCAMORE AND EUCALYPTUS	Near Term	8.75	$190,688
025	PROP_P644_2006	1,162	8	2D	RP	FF_SP_LT0PSI	W. OF FIFTH AVE. BETWEEN SYCAMORE AND EUCALYPTUS	Near Term	8.75	$136,688
025	PROP_P646_2006	1,464	8	2D	RP	FF_SP_LT0PSI	W. OF FIFTH AVE. BETWEEN EUCALYPTUS RD AND MESA RD	Near Term	8.75	$172,125
025	PROP_P648_2006	929	8	2D	RP	FF_SP_LT0PSI	W. OF FIFTH AVE. BETWEEN EUCALYPTUS RD AND MESA RD	Near Term	8.75	$109,688
025	PROP_P650_2006	832	8	2D	RP	FF_SP_LT0PSI	W. OF FIFTH AVE. BETWEEN EUCALYPTUS RD AND MESA RD	Near Term	8.75	$97,875
026	PROP_P226_2006	425	12	2	PL	FF_LT0PSI	EUCALYPTUS ST FROM MAPLE TO MARIPOSA AVE	Near Term	7.50	$64,125
026	PROP_P228_2006	430	12	2	PL	FF_LT0PSI	EUCALYPTUS ST FROM MAPLE TO MARIPOSA AVE	Near Term	7.50	$65,813
026	PROP_P230_2006	381	12	2	PL	FF_LT0PSI	EUCALYPTUS ST FROM MAPLE TO MARIPOSA AVE	Near Term	7.50	$57,375
026	PROP_P232_2006	411	12	2	PL	FF_LT0PSI	EUCALYPTUS ST FROM MAPLE TO MARIPOSA AVE	Near Term	7.50	$62,438
026	PROP_P234_2006	421	12	2	PL	FF_LT0PSI	EUCALYPTUS ST FROM MAPLE TO MARIPOSA AVE	Near Term	7.50	$64,125
026	PROP_P236_2006	304	12	2	PL	FF_LT0PSI	EUCALYPTUS ST FROM MAPLE TO MARIPOSA AVE	Near Term	7.50	$45,563
026	PROP_P238_2006	160	12	2	PL	FF_LT0PSI	EUCALYPTUS ST FROM MAPLE TO MARIPOSA AVE	Near Term	7.50	$23,625
027	PROP_P656_2006	2,723	12	2D	RP	FF_SP_LT0PSI	TENTH AVE. S. OF SYCAMORE AND N. OR EUCALYPTUS ST	Near Term	7.50	$413,438
027	PROP_P658_2006	657	8	2D	RP	FF_SP_LT0PSI	ELEVENTH FROM SYCAMORE RD. TO MANZANITA AVE	Near Term	8.75	$77,625
027	PROP_P662_2006	2,148	12	2D	RP	FF_SP_LT0PSI	EIGHTH AVE. S. OF SYCAMORE AND N. OR EUCALYPTUS ST	Near Term	7.50	$325,688
027	PROP_P670_2006	1,094	8	2D	NEW	FF_LT0PSI	ELEVENTH FROM SYCAMORE RD. TO MANZANITA AVE	Near Term	8.75	$129,938
027	PROP_P672_2006	916	8	2D	RP	FF_SP_LT0PSI	SYCAMORE FROM HICKORY TO ELEVENTH AVE	Near Term	8.75	$108,000
027	PROP_P676_2006	715	8	2D	NEW	FF_LT0PSI	SEQUOIA ST. FROM PINON AVE TO CYPRESS ST	Near Term	8.75	$84,375
027	PROP_P678_2006	714	8	2D	NEW	FF_LT0PSI	SEQUOIA ST. FROM HICKORY TO ELEVENTH AVE	Near Term	8.75	$84,375
028	PROP_P286_2006	360	8	2	RP	FF_SP_LT20PSI	APPLETON ST FROM MAPLE AVE. TO COTTONWOOD AVE	Near Term	8.75	$42,188
028	PROP_P288_2006	418	8	2	RP	FF_SP_LT20PSI	APPLETON ST FROM MAPLE AVE. TO COTTONWOOD AVE	Near Term	8.75	$48,938
028	PROP_P290_2006	427	8	2	RP	FF_SP_LT20PSI	APPLETON ST FROM MAPLE AVE. TO COTTONWOOD AVE	Near Term	8.75	$50,625
028	PROP_P292_2006	459	8	2	RP	FF_SP_LT20PSI	APPLETON ST FROM MAPLE AVE. TO COTTONWOOD AVE	Near Term	8.75	$54,000
028	PROP_P294_2006	475	8	2	RP	FF_SP_LT20PSI	APPLETON ST FROM MAPLE AVE. TO COTTONWOOD AVE	Near Term	8.75	$55,688
028	PROP_P296_2006	462	8	2	RP	FF_SP_LT20PSI	APPLETON ST FROM MAPLE AVE. TO COTTONWOOD AVE	Near Term	8.75	$54,000
029	PROP_P728_2006	2,525	8	3	RP	FF_SP_LT20PSI	FIR ST. FROM COTTONWOOD AVE TO ELEVENTH AVE.	Near Term	8.75	$298,688
030	PROP_P192_2006	702	8	1	RP	FF_SP_LT0PSI	WESTLAWN FROM PEACH TO ARROWHEAD LAKE RD	Near Term	8.75	$82,688
030	PROP_P970_2006	167	8	3A	RP	FF_SP_LT20PSI	GREVILLEA ST AND RANCHERO RD	Near Term	8.75	$20,250
030	PROP_P972_2006	185	8	3A	RP	FF_SP_LT20PSI	GREVILLEA ST AND RANCHERO RD	Near Term	8.75	$21,938
030	PROP_P974_2006	613	8	3A	RP	FF_SP_LT20PSI	RANCHERO RD & C AVE	Near Term	8.75	$72,563
030	PROP_P193_2006	3,553	8	1	RP	FF_SP_LT0PSI	WESTLAWN FROM PEACH TO ARROWHEAD LAKE RD	Near Term	8.75	$420,188
031	PROP_P564_2006	1,860	8	2	RP	FF_SP_LT0PSI	TEMECULA AVE, S. OF DANBURY AVE	Near Term	8.75	$219,375
031	PROP_P566_2006	489	8	2	RP	FF_SP_LT0PSI	TEMECULA AVE, S. OF DANBURY AVE	Near Term	8.75	$57,375
031	PROP_P568_2006	948	8	2	RP	FF_SP_LT0PSI	LASSEN AVE., N. OF SEAFORTH	Near Term	8.75	$111,375
032	PROP_P592_2006	1,602	8	2	RP	FF_SP_LT0PSI	SAN BRUNO ST., S. OF PLUMAS ST	Near Term	8.75	$189,000
032	PROP_P594_2006	433	8	2	RP	FF_SP_LT0PSI	PLUMAS ST., W. OF ARCADIA ST	Near Term	8.75	$50,625
032	PROP_P596_2006	429	8	2	RP	FF_SP_LT0PSI	PLUMAS ST., W. OF ARCADIA ST	Near Term	8.75	$50,625
033	PROP_P570_2006	368	8	2	RP	FF_SP_LT0PSI	ARCADIA AVE, S. OF SEAFORTH	Near Term	8.75	$43,875
033	PROP_P572_2006	467	8	2	RP	FF_SP_LT0PSI	ARCADIA AVE, S. OF SEAFORTH	Near Term	8.75	$55,688
033	PROP_P574_2006	955	8	2	RP	FF_SP_LT0PSI	MECCA ST., W. OF GAYLOP AVE	Near Term	8.75	$113,063
033	PROP_P576_2006	367	8	2	RP	FF_SP_LT0PSI	GAYLOP AVE., S. OF SEAFORTH	Near Term	8.75	$43,875
033	PROP_P578_2006	638	8	2	RP	FF_SP_LT0PSI	GAYLOP AVE., S. OF SEAFORTH	Near Term	8.75	$75,938
033	PROP_P580_2006	363	8	2	RP	FF_SP_LT0PSI	GAYLOP AVE., N. OF FAIRBURN ST	Near Term	8.75	$42,188
033	PROP_P582_2006	113	8	2	RP	FF_SP_LT0PSI	GAYLOP AVE., N. OF FAIRBURN ST	Near Term	8.75	$13,500
034	PROP_P652_2006	504	12	2D	RP	FF_SP_LT0PSI	TENTH AVE., N. OF MESA ST.	Near Term	7.50	$75,938
034	PROP_P654_2006	1,144	12	2D	RP	FF_SP_LT0PSI	TENTH LOOP, S. OF EUCALYPTUS	Near Term	7.50	$173,813

Appendix G	Improvement Projects for 4" and 6" Steel Pipeline Replacements Water Master Plan Update City of Hesperia									
Improvement Project No.[1]	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost[3]
035	PROP_P266_2006	1,329	8	2	RP	FF_SP_LT0PSI	LOCUST AVE. FROM , N. OF EUCALYPTUS, S. OF BEAR VALLEY RD	Near Term	8.75	$156,938
035	PROP_P268_2006	733	8	2	RP	FF_SP_LT0PSI	LOCUST AVE. FROM , N. OF EUCALYPTUS, S. OF BEAR VALLEY RD	Near Term	8.75	$86,063
035	PROP_P270_2006	714	8	2	RP	FF_SP_LT0PSI	LOCUST AVE. FROM , N. OF EUCALYPTUS, S. OF BEAR VALLEY RD	Near Term	8.75	$84,375
035	PROP_P272_2006	1,664	8	2	RP	FF_SP_LT0PSI	LOCUST AVE. FROM , N. OF EUCALYPTUS, S. OF BEAR VALLEY RD	Near Term	8.75	$195,750
036	PROP_P258_2006	452	12	2	RP	FF_SP_LT0PSI	COTTONWOOD FROM EUCALYPTUS ST TO LILAC ST	Near Term	7.50	$69,188
036	PROP_P260_2006	1,839	12	2	RP	FF_SP_LT0PSI	COTTONWOOD FROM EUCALYPTUS ST TO LILAC ST	Near Term	7.50	$280,125
036	PROP_P262_2006	472	12	2	RP	FF_SP_LT0PSI	COTTONWOOD FROM EUCALYPTUS ST TO LILAC ST	Near Term	7.50	$72,563
036	PROP_P264_2006	357	8	2	NEW	FF_LT0PSI	LILAC ST. FROM MAPLE TO COTTONWOOD AVE.	Near Term	8.75	$42,188
036	PROP_P274_2006	362	8	2	RP	FF_SP_LT0PSI	LILAC ST. FROM MAPLE TO COTTONWOOD AVE.	Near Term	8.75	$42,188
036	PROP_P276_2006	414	8	2	RP	FF_SP_LT0PSI	LILAC ST. FROM MAPLE TO COTTONWOOD AVE.	Near Term	8.75	$48,938
036	PROP_P278_2006	413	8	2	RP	FF_SP_LT0PSI	LILAC ST. FROM MAPLE TO COTTONWOOD AVE.	Near Term	8.75	$48,938
036	PROP_P280_2006	449	8	2	RP	FF_SP_LT0PSI	LILAC ST. FROM MAPLE TO COTTONWOOD AVE.	Near Term	8.75	$52,313
036	PROP_P282_2006	469	8	2	RP	FF_SP_LT0PSI	LILAC ST. FROM MAPLE TO COTTONWOOD AVE.	Near Term	8.75	$55,688
036	PROP_P284_2006	470	8	2	RP	FF_SP_LT0PSI	LILAC ST. FROM MAPLE TO COTTONWOOD AVE.	Near Term	8.75	$55,688
037	PROP_P218_2006	151	12	2	PL	FF_LT0PSI	SYCAMORE FROM MAPLE TO MARIPOSA	Near Term	7.50	$23,625
037	PROP_P220_2006	372	12	2	PL	FF_LT0PSI	SYCAMORE FROM MAPLE TO MARIPOSA	Near Term	7.50	$55,688
037	PROP_P222_2006	407	12	2	PL	FF_LT0PSI	SYCAMORE FROM MAPLE TO MARIPOSA	Near Term	7.50	$62,438
037	PROP_P224_2006	362	12	2	PL	FF_LT0PSI	SYCAMORE FROM MAPLE TO MARIPOSA	Near Term	7.50	$55,688
037	PROP_P302_2006	380	8	2	RP	FF_SP_LT0PSI	PRIMROSE AVE., S. OF SYCAMORE	Near Term	8.75	$45,563
038	PROP_P616_2006	3,939	8	2	RP	FF_SP_LT0PSI	S. OF LEMON, E. OF HESPERIA RD - LOOP	Near Term	8.75	$465,750
038	PROP_P618_2006	1,296	8	2D	RP	FF_SP_LT0PSI	S. OF LEMON, E. OF HESPERIA RD - LOOP	Near Term	8.75	$153,563
038	PROP_P626_2006	222	8	2D	RP	FF_SP_LT0PSI	HESPERIA RD. AND S. OF LEMON ST	Near Term	8.75	$27,000
039	PROP_P836_2006	998	8	3	RP	FF_SP_LT0PSI	SMOKETREE BETWEEN BALSAM AND ELEVENTH ST	Near Term	8.75	$118,125
039	PROP_P838_2006	737	8	3	RP	FF_SP_LT0PSI	SMOKETREE BETWEEN BALSAM AND ELEVENTH ST	Near Term	8.75	$87,750
040	PROP_P784_2006	698	8	3	RP	FF_SP_LT0PSI	YUCCA BETWEEN TAMARISK AND MAPLE AVE	Near Term	8.75	$82,688
040	PROP_P786_2006	425	8	3	RP	FF_SP_LT0PSI	YUCCA BETWEEN TAMARISK AND MAPLE AVE	Near Term	8.75	$50,625
040	PROP_P820_2006	1,912	8	3	RP	FF_SP_LT0PSI	YUCCA ST. BETWEEN MAPLE AND COTTONWOOD AVE.	Near Term	8.75	$226,125
040	PROP_P822_2006	578	8	3	RP	FF_SP_LT0PSI	YUCCA ST. BETWEEN MAPLE AND COTTONWOOD AVE.	Near Term	8.75	$67,500
041	PROP_P814_2006	217	8	3	NEW	FF_LT0PSI	LIVE OAK BETWEEN MAPLE AND VICTORY AVE	Near Term	8.75	$25,313
041	PROP_P816_2006	387	8	3	RP	FF_SP_LT0PSI	LIVE OAK BETWEEN MAPLE AND VICTORY AVE	Near Term	8.75	$45,563
041	PROP_P818_2006	455	8	3	RP	FF_SP_LT0PSI	LIVE OAK BETWEEN MAPLE AND VICTORY AVE	Near Term	8.75	$54,000
042	PROP_P778_2006	2,295	8	3	RP	FF_SP_LT0PSI	MUSCATEL BETWEEN COTTONWOOD AND HICKORY AVE	Near Term	8.75	$271,688
042	PROP_P780_2006	807	8	3	RP	FF_SP_LT0PSI	MUSCATEL BETWEEN COTTONWOOD AND HICKORY AVE	Near Term	8.75	$96,188
043	PROP_P680_2006	390	8	3	RP	FF_SP_LT0PSI	BETWEEN PALM AND ELM ST. W. OF HICKORY AVE	Near Term	8.75	$45,563
043	PROP_P682_2006	881	8	3	RP	FF_SP_LT0PSI	BETWEEN PALM AND ELM ST. W. OF HICKORY AVE	Near Term	8.75	$104,625
044	PROP_P946_2006	376	8	3	RP	FF_SP_LT0PSI	BETWEEN FOURTH AND FIFTH, N. OF MESQUITE ST	Near Term	8.75	$43,875
044	PROP_P948_2006	1,112	8	3	RP	FF_SP_LT0PSI	BETWEEN FOURTH AND FIFTH, N. OF MESQUITE ST	Near Term	8.75	$131,625
044	PROP_P950_2006	794	8	3	RP	FF_SP_LT0PSI	BETWEEN FOURTH AND FIFTH, N. OF MESQUITE ST	Near Term	8.75	$94,500
044	PROP_P952_2006	225	8	3	RP	FF_SP_LT0PSI	BETWEEN FOURTH AND FIFTH, N. OF MESQUITE ST	Near Term	8.75	$27,000
044	PROP_P954_2006	501	8	3	RP	FF_SP_LT0PSI	BETWEEN FOURTH AND FIFTH, N. OF MESQUITE ST	Near Term	8.75	$59,063
045	PROP_P938_2006	488	8	3	RP	FF_SP_LT0PSI	BETWEEN FIFTH AND SIXTH AVE, N. OF MESQUITE ST	Near Term	8.75	$57,375
045	PROP_P940_2006	1,119	8	3	RP	FF_SP_LT0PSI	BETWEEN FIFTH AND SIXTH AVE, N. OF MESQUITE ST	Near Term	8.75	$131,625
045	PROP_P942_2006	739	8	3	RP	FF_SP_LT0PSI	BETWEEN FIFTH AND SIXTH AVE, N. OF MESQUITE ST	Near Term	8.75	$87,750
045	PROP_P944_2006	820	8	3	RP	FF_SP_LT0PSI	BETWEEN FIFTH AND SIXTH AVE, N. OF MESQUITE ST	Near Term	8.75	$96,188
046	PROP_P924_2006	706	8	3	RP	FF_SP_LT0PSI	BETWEEN NINTH AND TENTH AVE, N. OF MESQUITE AVE AND S. OF LIME AVI	Near Term	8.75	$82,688
046	PROP_P926_2006	678	8	3	RP	FF_SP_LT0PSI	BETWEEN NINTH AND TENTH AVE, N. OF MESQUITE AVE AND S. OF LIME AVI	Near Term	8.75	$79,313
046	PROP_P928_2006	208	8	3	RP	FF_SP_LT0PSI	BETWEEN NINTH AND TENTH AVE, N. OF MESQUITE AVE AND S. OF LIME AVI	Near Term	8.75	$25,313
046	PROP_P930_2008	2,104	8	3	RP	FF_SP_LT0PSI	BETWEEN NINTH AND TENTH AVE, N. OF MESQUITE AVE AND S. OF LIME AVI	Near Term	8.75	$248,063
047	PROP_P1014_2006	3,152	8	3A	PL	FF_SP_LT0PSI	AMARGOSA & LIVE OAK	Near Term	8.75	$372,938
047	PROP_P1016_2006	1,115	8	3A	PL	FF_SP_LT0PSI	AMARGOSA & PALMETTO	Near Term	8.75	$131,625
048	PROP_P958_2006	732	8	3A	RP	FF_SP_LT0PSI	JENNY ST. FROM MIDDLETON TO SANTA FE	Near Term	8.75	$86,063
048	PROP_P960_2006	698	8	3A	RP	FF_SP_LT0PSI	JENNY ST. FROM MIDDLETON TO SANTA FE	Near Term	8.75	$82,688
048	PROP_P962_2006	423	8	3A	RP	FF_SP_LT0PSI	JENNY ST. FROM MIDDLETON TO SANTA FE	Near Term	8.75	$50,625
048	PROP_P964_2006	954	8	3A	RP	FF_SP_LT0PSI	JENNY ST. FROM MIDDLETON TO SANTA FE	Near Term	8.75	$113,063
048	PROP_P966_2006	783	8	3A	RP	FF_SP_LT0PSI	CURELANE AVE. FROM JENNY ST. TO SUMMIT VALLEY RD.	Near Term	8.75	$92,813
048	PROP_P968_2006	1,042	8	3A	RP	FF_SP_LT0PSI	CURELANE AVE. FROM JENNY ST. TO SUMMIT VALLEY RD.	Near Term	8.75	$123,188

Appendix G	Improvement Projects for 4" and 6" Steel Pipeline Replacements Water Master Plan Update City of Hesperia										
Improvement Project No.[1]	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost[3]
049	PROP_P976_2006	1,427	8	3A	RP	FF_SP_LT0PSI	JOSHUA ST FROM C AVE TO E AVE	Near Term	8.75	$168,750
049	PROP_P978_2006	471	8	3A	RP	FF_SP_LT0PSI	SANTA FE AVE. BETWEEN SAGE ST. & ALLTHORN ST	Near Term	8.75	$55,688
049	PROP_P980_2006	451	8	3A	RP	FF_SP_LT0PSI	SANTA FE AVE. BETWEEN SAGE ST. & ALLTHORN ST	Near Term	8.75	$54,000
050	PROP_P200_2006	3,451	8	1	RP	FF_SP_LT0PSI	SUTTER ST. FROM HINTON ST. TO ARROWHD LAKE RD	Near Term	8.75	$408,375
	Subtotal	***277,603***						**SUBTOTAL**		**$34,553,250**
Existing Small Diameter (4" & 6") Pipeline Replacement										
000	2950	2,676	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$315,563
000	1708	2,369	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$280,125
000	3927	151	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$18,563
000	496	931	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$109,688
000	500	112	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$13,500
000	597	611	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$72,563
000	2054	1,151	8	4	RP	Upsize Existing 4" Pipe		2032	8.75	$136,688
000	2063	1,263	8	4	RP	Upsize Existing 4" Pipe		2032	8.75	$148,500
000	2067	1,546	8	4	RP	Upsize Existing 4" Pipe		2032	8.75	$182,250
000	2070	2,213	8	4	RP	Upsize Existing 4" Pipe		2032	8.75	$261,563
000	2098	1,029	8	4	RP	Upsize Existing 4" Pipe		2032	8.75	$121,500
000	2099	393	8	4	RP	Upsize Existing 4" Pipe		2032	8.75	$47,250
000	2100	499	8	4	RP	Upsize Existing 4" Pipe		2032	8.75	$59,063
000	2116	1,185	8	3A	RP	Upsize Existing 4" Pipe		2032	8.75	$140,063
000	2134	2,663	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$313,875
000	2135	2,697	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$318,938
000	2136	2,703	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$318,938
000	2138	285	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	2141	290	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	2142	2,897	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$342,563
000	2145	289	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	2146	288	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	2147	2,891	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$340,875
000	2148	1,280	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$151,875
000	2151	2,649	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$312,188
000	2154	2,636	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$310,500
000	2158	289	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	2159	305	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	2161	305	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	2162	287	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	2164	744	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$87,750
000	2196	363	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$42,188
000	2197	453	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$54,000
000	2198	239	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$28,688
000	2208	577	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$67,500
000	2351	861	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$101,250
000	2474	439	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$52,313
000	2475	1,363	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$160,313
000	2477	666	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$79,313
000	2478	370	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$43,875
000	2482	1,127	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$133,313
000	2486	1,127	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$133,313
000	2487	464	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$54,000
000	2496	971	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$114,750
000	2497	447	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$52,313
000	2498	1,565	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$185,625
000	2500	335	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	2507	3,331	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$393,188
000	2508	3,339	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$394,875
000	2509	3,335	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$393,188

Appendix G Improvement Projects for 4" and 6" Steel Pipeline Replacements
Water Master Plan Update
City of Hesperia

Improvement Project No.(1)	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description(2)	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost(3)
000	2510	1,848	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$217,688
000	2513	1,782	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$210,938
000	2514	2,072	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$244,688
000	2521	853	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$101,250
000	2522	645	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$75,938
000	2523	410	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$48,938
000	2525	1,663	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$195,750
000	2532	1,206	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$141,750
000	2533	1,502	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$177,188
000	2537	1,085	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$128,250
000	2558	3,343	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$394,875
000	2564	411	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$48,938
000	2568	886	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$104,625
000	2569	1,103	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$129,938
000	2570	235	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$27,000
000	2571	235	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$27,000
000	2577	2,286	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$270,000
000	2578	2,473	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$291,938
000	2579	2,600	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$307,125
000	2580	2,633	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$310,500
000	2581	3,339	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$394,875
000	2601	604	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$70,875
000	2603	194	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$23,625
000	2604	331	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	ZV26_2_1_OUT	51	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$6,750
000	2739	419	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$48,938
000	2740	250	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$28,688
000	2741	264	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$30,375
000	2748	2,303	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$271,688
000	2752	2,432	8	3A	RP	Upsize Existing 4" Pipe		2032	8.75	$286,875
000	2754	2,234	8	3A	RP	Upsize Existing 4" Pipe		2032	8.75	$263,250
000	2822	800	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$94,500
000	2828	1,104	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$129,938
000	2829	1,401	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$165,375
000	2830	1,712	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$202,500
000	2831	2,039	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$241,313
000	2921	1,353	8	3A	RP	Upsize Existing 4" Pipe		2032	8.75	$160,313
000	2922	1,218	8	3A	RP	Upsize Existing 4" Pipe		2032	8.75	$143,438
000	2937	270	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$32,063
000	2938	304	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	2954	1,298	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$153,563
000	2955	617	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$72,563
000	2959	220	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$25,313
000	2961	164	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$18,563
000	2967	318	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	2968	406	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$47,250
000	2969	283	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	2970	312	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	2982	351	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$42,188
000	2984	266	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$32,063
000	2985	272	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$32,063
000	2987	308	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	2993	862	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$101,250
000	2995	350	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$40,500
000	2996	2,314	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$273,375
000	2998	903	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$106,313

Appendix G	Improvement Projects for 4" and 6" Steel Pipeline Replacements Water Master Plan Update City of Hesperia									
Improvement Project No.[1]	**Model ID**	**Length (ft)**	**Proposed Size (in)**	**Zone**	**Facility Description[2]**	**Pressure Deficiency**	**Location**	**Estimated Planning Year**	**Unit Cost ($/dia-in/ ft)**	**Estimated Project Cost[3]**
000	3000	778	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$91,125
000	3002	2,935	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$345,938
000	3003	593	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$70,875
000	3004	504	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$59,063
000	3005	506	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$59,063
000	3006	1,204	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$141,750
000	3007	557	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$65,813
000	3008	1,209	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$143,438
000	3009	698	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$82,688
000	3011	611	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$72,563
000	3012	509	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$60,750
000	3018	186	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$21,938
000	3024	286	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	3025	313	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3026	329	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	3027	329	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	3029	326	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	3034	347	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$40,500
000	3039	144	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$16,875
000	3042	315	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3043	327	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	3044	297	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	3045	346	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$40,500
000	3046	295	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	3047	286	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	3048	284	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	3049	310	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3050	312	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3051	320	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3052	329	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	3053	308	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3054	325	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	3055	312	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3056	331	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	3059	315	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3060	311	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3061	323	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	3062	333	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	3063	308	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3064	314	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3065	349	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$40,500
000	3073	318	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3076	341	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$40,500
000	3077	336	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$40,500
000	688	1,066	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$126,563
000	3088	1,671	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$197,438
000	3094	1,498	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$177,188
000	3099	1,414	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$167,063
000	3103	1,812	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$214,313
000	3106	267	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$32,063
000	3119	344	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$40,500
000	3197	4,643	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$548,438
000	3209	294	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	3211	288	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	3212	287	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	3217	310	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125

Appendix G	Improvement Projects for 4" and 6" Steel Pipeline Replacements Water Master Plan Update City of Hesperia									
Improvement Project No.[1]	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost[3]
000	3221	293	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	3222	283	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	3238	1,426	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$168,750
000	3241	3,276	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$386,438
000	3242	2,271	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$268,313
000	3245	2,668	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$315,563
000	3246	842	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$99,563
000	3247	825	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$97,875
000	3249	688	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$81,000
000	3250	658	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$77,625
000	3252	2,259	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$266,625
000	3254	2,255	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$266,625
000	3255	2,140	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$253,125
000	3256	3,295	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$389,813
000	3257	3,415	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$403,313
000	3258	571	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$67,500
000	3259	316	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	3260	1,854	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$219,375
000	3261	2,194	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$259,875
000	3264	2,152	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$254,813
000	3265	270	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$32,063
000	3269	268	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$32,063
000	3271	249	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$28,688
000	3277	2,136	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$251,438
000	3279	1,902	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$224,438
000	3333	243	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$28,688
000	3348	1,955	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$231,188
000	3378	2,003	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$236,250
000	3381	2,110	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$249,750
000	3382	2,023	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$239,625
000	3387	1,756	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$207,563
000	3388	1,498	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$177,188
000	3389	1,250	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$146,813
000	3394	424	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$50,625
000	3395	421	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$48,938
000	3399	1,808	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$214,313
000	3400	1,818	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$214,313
000	3401	1,823	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$216,000
000	3402	1,829	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$216,000
000	3403	1,805	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$212,625
000	3406	390	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$45,563
000	3407	425	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$50,625
000	3408	423	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$50,625
000	3409	425	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$50,625
000	974	725	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$86,063
000	975	629	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$74,250
000	976	668	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$79,313
000	977	2,214	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$261,563
000	978	2,232	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$263,250
000	984	694	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$82,688
000	988	619	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$72,563
000	998	139	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$16,875
000	999	323	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	1015	2,793	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$329,063
000	1023	133	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$15,188
000	1024	119	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$13,500

Appendix G Improvement Projects for 4" and 6" Steel Pipeline Replacements
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost[3]
000	1026	139	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$16,875
000	1029	132	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$15,188
000	1030	130	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$15,188
000	1033	145	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$16,875
000	1034	140	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$16,875
000	1035	132	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$15,188
000	1036	154	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$18,563
000	1037	805	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$94,500
000	1038	813	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$96,188
000	1039	801	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$94,500
000	1040	130	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$15,188
000	1041	101	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$11,813
000	1044	693	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$82,688
000	1045	1,302	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$153,563
000	1046	692	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$81,000
000	1047	588	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$69,188
000	1048	688	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$81,000
000	1049	810	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$96,188
000	1050	145	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$16,875
000	1051	110	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$13,500
000	1052	796	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$94,500
000	1053	628	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$74,250
000	1054	801	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$94,500
000	1055	153	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$18,563
000	1056	114	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$13,500
000	1057	154	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$18,563
000	1060	623	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$74,250
000	1062	574	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$67,500
000	1064	152	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$18,563
000	1065	793	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$92,813
000	1066	156	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$18,563
000	1067	629	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$74,250
000	1068	629	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$74,250
000	1069	1,365	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$162,000
000	1070	1,365	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$162,000
000	1071	1,367	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$162,000
000	1074	218	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$25,313
000	1075	1,391	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$163,688
000	1076	1,224	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$145,125
000	1078	1,218	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$143,438
000	1079	1,215	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$143,438
000	1084	163	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$18,563
000	1085	1,218	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$143,438
000	1114	1,361	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$160,313
000	1115	1,361	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$160,313
000	1169	1,529	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$180,563
000	1190	199	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$23,625
000	1214	1,675	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$197,438
000	1215	302	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	1216	1,269	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$150,188
000	1218	446	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$52,313
000	1219	889	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$104,625
000	1221	291	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	1224	641	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$75,938
000	1225	299	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	1232	211	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$25,313

Appendix G	Improvement Projects for 4" and 6" Steel Pipeline Replacements Water Master Plan Update City of Hesperia									
Improvement Project No.[1]	**Model ID**	**Length (ft)**	**Proposed Size (in)**	**Zone**	**Facility Description[2]**	**Pressure Deficiency**	**Location**	**Estimated Planning Year**	**Unit Cost ($/dia-in/ ft)**	**Estimated Project Cost[3]**
000	1233	98	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$11,813
000	1235	485	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$57,375
000	1236	309	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	1237	321	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	1241	1,349	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$158,625
000	1242	344	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$40,500
000	1243	341	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$40,500
000	1244	308	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	1249	210	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$25,313
000	1252	314	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	1275	472	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$55,688
000	1277	271	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$32,063
000	1278	257	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$30,375
000	1280	284	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	1283	286	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	1284	239	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$28,688
000	1287	329	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	1288	306	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	1289	262	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$30,375
000	1292	299	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	1293	269	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$32,063
000	1294	300	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	1295	282	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	1313	1,240	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$146,813
000	1314	636	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$75,938
000	1315	1,707	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$200,813
000	1316	992	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$116,438
000	1317	1,290	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$151,875
000	1323	788	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$92,813
000	1324	450	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$52,313
000	1325	449	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$52,313
000	1326	361	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$42,188
000	1330	1,529	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$180,563
000	1331	1,528	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$180,563
000	1338	351	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$42,188
000	1339	1,531	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$180,563
000	1340	1,532	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$180,563
000	1341	439	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$52,313
000	1342	460	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$54,000
000	1343	428	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$50,625
000	1344	424	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$50,625
000	1345	420	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$48,938
000	1346	391	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$45,563
000	1351	1,526	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$180,563
000	1352	1,527	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$180,563
000	1353	1,528	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$180,563
000	1354	1,530	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$180,563
000	1357	1,532	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$180,563
000	1358	381	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$45,563
000	1360	299	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	1361	844	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$99,563
000	1362	795	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$94,500
000	1363	775	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$91,125
000	1388	1,018	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$119,813
000	1390	1,265	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$150,188
000	1391	462	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$54,000

Appendix G	Improvement Projects for 4" and 6" Steel Pipeline Replacements Water Master Plan Update City of Hesperia									
Improvement Project No.(1)	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description(2)	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost(3)
000	1392	439	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$52,313
000	1406	1,761	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$207,563
000	1407	1,759	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$207,563
000	1408	1,762	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$207,563
000	1410	1,761	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$207,563
000	1411	1,761	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$207,563
000	1412	1,765	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$209,250
000	1413	1,764	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$209,250
000	1417	1,235	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$145,125
000	1418	1,217	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$143,438
000	1419	1,710	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$202,500
000	1420	1,651	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$195,750
000	1421	1,652	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$195,750
000	1422	254	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$30,375
000	1423	390	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$45,563
000	1424	388	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$45,563
000	1425	421	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$48,938
000	1426	417	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$48,938
000	1427	474	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$55,688
000	1428	443	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$52,313
000	1429	443	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$52,313
000	1430	398	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$47,250
000	1432	372	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$43,875
000	813	540	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$64,125
000	814	891	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$104,625
000	830	1,263	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$148,500
000	836	898	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$106,313
000	857	2,287	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$270,000
000	880	115	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$13,500
000	881	224	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$27,000
000	882	216	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$25,313
000	973	3,183	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$376,313
000	1456	1,846	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$217,688
000	1458	1,256	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$148,500
000	1465	2,626	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$310,500
000	1477	312	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	1479	390	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$45,563
000	1491	2,330	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$275,063
000	1492	290	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	1493	281	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	1494	272	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$32,063
000	1495	326	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	1497	2,658	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$313,875
000	1503	211	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$25,313
000	1504	256	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$30,375
000	1505	362	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$42,188
000	1509	309	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	1516	2,650	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$312,188
000	1525	308	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$37,125
000	1526	303	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$35,438
000	1533	238	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$28,688
000	1534	292	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$33,750
000	1536	368	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$43,875
000	1537	2,531	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$298,688
000	1538	2,558	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$302,063
000	1542	185	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$21,938

Appendix G	Improvement Projects for 4" and 6" Steel Pipeline Replacements Water Master Plan Update City of Hesperia									
Improvement Project No.[1]	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost[3]
000	1545	235	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$27,000
000	1547	2,527	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$298,688
000	1549	2,179	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$258,188
000	1550	2,530	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$298,688
000	1551	1,825	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$216,000
000	1552	1,159	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$136,688
000	1588	1,824	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$216,000
000	1589	1,825	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$216,000
000	1590	1,861	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$219,375
000	1592	216	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$25,313
000	1649	2,697	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$318,938
000	1671	328	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$38,813
000	1673	2,285	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$270,000
000	1681	2,698	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$318,938
000	1688	656	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$77,625
000	1689	716	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$84,375
000	1698	2,465	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$291,938
000	1699	2,639	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$312,188
000	1709	2,608	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$308,813
000	1710	2,593	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$307,125
000	1719	483	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$57,375
000	1723	396	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$47,250
000	1727	390	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$45,563
000	1729	2,594	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$307,125
000	1745	1,869	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$221,063
000	1746	1,955	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$231,188
000	1794	68	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$8,438
000	1796	103	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$11,813
000	1806	417	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$48,938
000	1807	417	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$48,938
000	1810	474	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$55,688
000	1822	2,689	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$317,250
000	ZV2_2D_1_IN	48	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$5,063
000	1865	94	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$11,813
000	1866	88	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$10,125
000	1867	80	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$10,125
000	2636	1,804	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$212,625
000	2637	1,800	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$212,625
000	2638	1,793	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$212,625
000	2639	1,790	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$210,938
000	3424	2,647	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$312,188
000	3625	1,084	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$128,250
000	3678	1,512	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$178,875
000	3679	690	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$81,000
000	3680	553	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$65,813
000	3805	99	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$11,813
000	3880	446	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$52,313
000	3924	93	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$11,813
000	3932	2,562	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$302,063
000	ZV8_2_2D_IN	63	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$6,750
000	ZV7_2_2D_OUT	41	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$5,063
000	ZV6_2_2D_OUT	40	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$5,063
000	ZV31_2_2A_IN	32	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$3,375
000	ZV8_3_2_OUT	25	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$3,375
000	ZV7_3_2_OUT	30	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$3,375
000	ZV5_3_2_OUT	27	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$3,375

Appendix G Improvement Projects for 4" and 6" Steel Pipeline Replacements
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost[3]
000	4039	69	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$8,438
000	4040	131	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$15,188
000	3306	60	8	4	RP	Upsize Existing 4" Pipe		2032	8.75	$6,750
000	3597	109	8	4	RP	Upsize Existing 4" Pipe		2032	8.75	$13,500
000	ZV8_3_2_IN	25	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$3,375
000	ZV5_3_2_IN	23	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$3,375
000	ZV7_3_2_IN	20	8	3	RP	Upsize Existing 4" Pipe		2032	8.75	$1,688
000	ZV6_2_2D_IN	36	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$5,063
000	ZV7_2_2D_IN	35	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$3,375
000	ZV8_2_2D_OUT	63	8	2D	RP	Upsize Existing 4" Pipe		2032	8.75	$6,750
000	ZV26_2_1_IN	49	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$5,063
000	ZV31_2_2A_OUT	30	8	2A	RP	Upsize Existing 4" Pipe		2032	8.75	$3,375
000	ZV2_2D_1_OUT	42	8	1	RP	Upsize Existing 4" Pipe		2032	8.75	$5,063
000	1045_1	753	8	2	RP	Upsize Existing 4" Pipe		2032	8.75	$89,438
000	298	130	8	1	RP	Upsize Existing 6" Pipe		2032	8.75	$15,188
000	2069	433	8	4	RP	Upsize Existing 6" Pipe		2032	8.75	$50,625
000	2102	489	8	4	RP	Upsize Existing 6" Pipe		2032	8.75	$57,375
000	2104	388	8	4	RP	Upsize Existing 6" Pipe		2032	8.75	$45,563
000	2025	443	8	4	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	2114	1,412	8	3A	RP	Upsize Existing 6" Pipe		2032	8.75	$167,063
000	2119	700	8	3A	RP	Upsize Existing 6" Pipe		2032	8.75	$82,688
000	2143	2,710	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$320,625
000	2149	1,931	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$227,813
000	2205	439	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	2206	481	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$57,375
000	2215	748	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$87,750
000	2503	496	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$59,063
000	2504	460	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$54,000
000	2505	821	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$96,188
000	2511	1,440	8	1	RP	Upsize Existing 6" Pipe		2032	8.75	$170,438
000	2520	320	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$37,125
000	2530	787	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$92,813
000	2531	432	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$50,625
000	2538	521	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$60,750
000	2557	3,347	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$394,875
000	2582	3,707	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$437,063
000	2747	2,688	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$317,250
000	2846	520	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$60,750
000	2973	313	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$37,125
000	2974	382	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$45,563
000	2975	2,053	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$243,000
000	2976	324	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$38,813
000	3013	634	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$74,250
000	3014	644	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$75,938
000	3015	160	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$18,563
000	3016	643	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$75,938
000	3017	624	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$74,250
000	626	997	8	1	RP	Upsize Existing 6" Pipe		2032	8.75	$118,125
000	677	795	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$94,500
000	692	449	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	694	929	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$109,688
000	3108	1,991	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$234,563
000	3109	945	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$111,375
000	3190	285	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$33,750
000	3191	312	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$37,125
000	3192	745	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$87,750

Appendix G Improvement Projects for 4" and 6" Steel Pipeline Replacements
Water Master Plan Update
City of Hesperia

Improvement Project No.(1)	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description(2)	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost(3)
000	3193	40	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$5,063
000	3194	197	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$23,625
000	3196	442	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	3198	818	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$96,188
000	3199	264	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$30,375
000	3203	335	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$38,813
000	3231	414	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$48,938
000	3234	325	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$38,813
000	3236	719	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$84,375
000	3262	694	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$82,688
000	3263	586	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$69,188
000	3349	582	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$69,188
000	3374	596	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$70,875
000	3375	566	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$67,500
000	3376	802	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$94,500
000	3377	2,009	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$237,938
000	3379	309	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$37,125
000	3380	396	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$47,250
000	3383	500	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$59,063
000	3384	470	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$55,688
000	3385	444	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	3386	434	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$50,625
000	3390	371	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$43,875
000	3391	1,812	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$214,313
000	3392	640	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$75,938
000	985	659	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$77,625
000	986	716	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$84,375
000	987	489	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$57,375
000	1077	156	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$18,563
000	1080	176	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$20,250
000	1081	194	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$23,625
000	1082	368	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$43,875
000	1083	356	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$42,188
000	1112	1,589	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$187,313
000	1113	394	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$47,250
000	1170	630	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$74,250
000	1171	741	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$87,750
000	1200	738	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$87,750
000	1223	361	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$42,188
000	1226	301	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$35,438
000	1227	491	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$57,375
000	1228	146	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$16,875
000	1231	369	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$43,875
000	1234	790	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$92,813
000	1246	341	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$40,500
000	1247	304	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$35,438
000	1248	794	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$94,500
000	1250	357	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$42,188
000	1274	286	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$33,750
000	1318	1,174	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$138,375
000	1321	354	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$42,188
000	1322	304	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$35,438
000	1327	494	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$59,063
000	1328	468	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$55,688
000	1329	570	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$67,500
000	1332	449	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313

Appendix G Improvement Projects for 4" and 6" Steel Pipeline Replacements
Water Master Plan Update
City of Hesperia

Improvement Project No.[1]	Model ID	Length (ft)	Proposed Size (in)	Zone	Facility Description[2]	Pressure Deficiency	Location	Estimated Planning Year	Unit Cost ($/dia-in/ ft)	Estimated Project Cost[3]
000	1333	449	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	1334	437	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	1335	455	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$54,000
000	1336	445	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	1337	460	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$54,000
000	1347	417	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$48,938
000	1348	425	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$50,625
000	1349	417	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$48,938
000	1350	389	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$45,563
000	1355	1,529	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$180,563
000	1356	390	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$45,563
000	1359	186	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$21,938
000	1364	442	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	1365	333	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$38,813
000	1366	381	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$45,563
000	1389	469	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$55,688
000	1393	443	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	1394	418	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$48,938
000	1395	459	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$54,000
000	1396	420	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$48,938
000	1397	389	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$45,563
000	1398	386	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$45,563
000	1399	263	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$30,375
000	1409	1,762	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$207,563
000	1414	447	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	1415	443	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$52,313
000	1416	424	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$50,625
000	1431	1,608	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$190,688
000	1435	466	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$55,688
000	1436	382	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$45,563
000	1449	350	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$40,500
000	821	1,287	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$151,875
000	952	488	8	1	RP	Upsize Existing 6" Pipe		2032	8.75	$57,375
000	954	518	8	1	RP	Upsize Existing 6" Pipe		2032	8.75	$60,750
000	1457	678	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$79,313
000	1523	364	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$42,188
000	1529	362	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$42,188
000	1535	27	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$3,375
000	1539	294	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$35,438
000	1532	909	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$108,000
000	1531	335	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$38,813
000	1540	1,897	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$224,438
000	1544	2,635	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$310,500
000	1682	2,701	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$318,938
000	1683	713	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$84,375
000	1684	639	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$75,938
000	ZV5_2_2D_IN	44	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$5,063
000	1686	813	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$96,188
000	1687	1,239	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$146,813
000	1690	641	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$75,938
000	1697	1,919	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$226,125
000	1711	895	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$106,313
000	1714	945	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$111,375
000	1717	857	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$101,250
000	1751	1,250	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$148,500
000	1798	244	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$28,688

Appendix G	Improvement Projects for 4" and 6" Steel Pipeline Replacements Water Master Plan Update City of Hesperia									
Improvement Project No.[1]	**Model ID**	**Length (ft)**	**Proposed Size (in)**	**Zone**	**Facility Description[2]**	**Pressure Deficiency**	**Location**	**Estimated Planning Year**	**Unit Cost ($/dia-in/ ft)**	**Estimated Project Cost[3]**
000	1801	856	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$101,250
000	1803	462	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$54,000
000	1804	883	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$104,625
000	1808	1,586	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$187,313
000	1812	1,108	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$131,625
000	1823	881	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$104,625
000	1824	315	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$37,125
000	2633	451	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$54,000
000	2641	1,797	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$212,625
000	3626	392	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$45,563
000	3709	272	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$32,063
000	3762	232	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$27,000
000	3763	76	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$8,438
000	ZV30_2_2A_IN	46	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$5,063
000	3798	58	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$6,750
000	3799	796	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$94,500
000	3800	2,134	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$251,438
000	3801	561	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$65,813
000	3802	430	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$50,625
000	ZV17_3_2_IN	36	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$3,375
000	3918	1,279	8	4	RP	Upsize Existing 6" Pipe		2032	8.75	$151,875
000	ZV16_3_2_OUT	25	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$3,375
000	3587	648	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$75,938
000	ZV6_3_2_OUT	28	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$3,375
000	ZV2_4_3_IN	58	8	4	RP	Upsize Existing 6" Pipe		2032	8.75	$6,750
000	3896	51	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$6,750
000	3895	54	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$6,750
000	1703	51	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$6,750
000	1263	46	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$5,063
000	2350	58	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$6,750
000	3248	116	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$13,500
000	4055	56	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$6,750
000	ZV2_4_3_OUT	49	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$5,063
000	ZV6_3_2_IN	22	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$3,375
000	ZV16_3_2_IN	25	8	3	RP	Upsize Existing 6" Pipe		2032	8.75	$3,375
000	ZV17_3_2_OUT	33	8	2	RP	Upsize Existing 6" Pipe		2032	8.75	$3,375
000	ZV5_2_2D_OUT	40	8	2D	RP	Upsize Existing 6" Pipe		2032	8.75	$5,063
000	ZV30_2_2A_OUT	44	8	2A	RP	Upsize Existing 6" Pipe		2032	8.75	$5,063
	Subtotal	***553,049***					**SUBTOTAL (SMALL DIAMETER PIPELINES)**			**$65,316,375**
							SUBTOTAL (SMALL DIAMETER PIPELINES FOR FIREFLOW)			**$34,553,250**
							TOTAL REPLACEMENT COST			**$99,869,625**

Notes:
(1) CIP Projects are numbered in order of priority. Projects noted as "000" indicate that the existing 4" and 6" steel piping should be replaced, but only after the replacement of the higher priority pipelines.
(2) Abbreviations listed in this column are as follows: "NEW" - new pipe to be installed where no current pipeline exists; "PL" - a parallel pipeline is recommended next to the existing; "RP" - a pipeline replacement is recommended.
(3) Estimated Project Costs are based on January 2007 dollars and include estimated engineering, legal, and administrative costs and a contingency. Costs were rounded to the nearest $1,000.