TABLE OF CONTENTS

TABLE OF CONTENTS

List of Tables

TABLE OF CONTENTS

TABLE OF CONTENTS

List of Figures

TABLE OF CONTENTS

1.1 BACKGROUND AND PURPOSE

The genesis for the Mission Springs Water District (MSWD), located in Desert Hot Springs, California is a water well that was dug in the Desert Hot Springs area in or around 1913. Over the next ten years, this well was subsequently lost or abandoned, and in the 1920s, a homesteader named Bill Anderson dug and drilled a new well to the depth of 170 feet. This well provided a steady and quality source of water. In 1933, L.W. Coffee, with the help of Earl Howard, a local well driller, drilled a new well at the Anderson Well site to a depth of 333 feet to meet the increased water supply needs of the area. This well provided the needed resources to begin development of the local area. Development continued to increase, and by 1940, a water distribution system was established to deliver water to various properties. Growth in the 1940s led to the development of the Old Mutual Water Company to provide groundwater to the community of Desert Hot Springs, California. In May 1948, the Old Mutual Water Company was incorporated into the Desert Hot Springs Water Company (DHSWC). In 1953, the Desert Hot Springs County Water District (DHSCWD) purchased the DHSWC and in 1987 renamed it the Mission Springs Water District to symbolize and reflect the fact that the local water supply source is from the Mission Creek Groundwater Sub-basin via deep wells.

The population growth in and around the Desert Hot Springs area has continued to increase at varying rates over the years. In 1953, the MSWD water system provided service to 504 customers that encompassed approximately one square mile. In 2004, the MSWD water system has grown to include over 9,600 customers covering approximately 135 square miles. Today, MSWD water supply and distribution system includes three separate and distinct water supply and distribution systems (Figure 1-1) with the largest of these three systems serving the community of Desert Hot Springs and surrounding communities including West Garnet, located south of Interstate 10 (I-10) and West of Indian Avenue, and North Palm Springs. The two smaller systems; Palm Springs Crest System and West Palm Springs Village System, are located approximately 5 miles west of Desert Hot Springs. These two communities are located on the north side of I-10 abutting the Morongo Indian Reservation.

The MSWD has and is experiencing very rapid population growth particularly over the last 5 years. This trend is expected to continue into the foreseeable future and therefore planning for new water supply will be very critical. MSWD has for many years recognized the need to properly plan and implement improvements to meet existing and future domestic water needs but in conjunction, provide and enhance water distribution system facilities that will maintain their function during seismic events. The purpose for this comprehensive water system master plan is to build on the previous water resources planning efforts commissioned by the MSWD to address the District's current and future water supply, treatment, and distribution system needs over the next 25 years. This document will also provide support to MSWD to update their 2000 Urban Water Management Planning Act of 1983 (AB 797).

1.2 SCOPE

Funding for the preparation of this water system master plan (WMP) was made possible in part by a FY 2004 Energy and Water Appropriations Bill that included planning and technical assistance through the Water Resources Development Act (WRDA) Section 219(23) Environmental Infrastructure Grant Program. The U.S. Army Corps of Engineers (USACE) is

Insert

Figure 1-1
Vicinity Map

assisting the MSWD in the preparation of this WMP. The USACE retained URS Corporation (URS), through Contract DACW09-03-D-0016 to conduct an evaluation of the existing water system and to prepare a comprehensive master plan that will address the District's needs over the next 25 years. The comprehensive water system master plan goals and objectives are to:

a. Review and update population projects incorporating local/regional land use plans for a 25-year planning horizon period.

b. Review and update domestic water requirements based on historical water use and incorporating possible water conservation strategies.

c. Evaluate the need for additional water supplies to meet current and future water demands, including the importation of water from outside MSWD.

d. Evaluate water quality issues identified in other reports to determine current and future water treatment requirements.

e. Update an existing hydraulic model (H2Onet) of MSWD water supply and distribution system and calibrate the model using flow measurements taken from selected MSWD fire hydrants.

f. Conduct an evaluation of the existing water distribution system utilizing the calibrated hydraulic modeling software.

g. Evaluate existing water distribution system facilities to meet the current and projected 25-year Maximum Day water demands plus fire flow requirements and identify improvements (2010, 2015, 2020, and 2025) to address deficiencies.

h. Evaluate the seismic reliability of existing water facilities and recommend improvements for increasing the reliability of the system to remain operational after a seismic event.

i. Prepare a 20-year System Improvement Plan in 5-year increments that identifies improvements and related costs for recommended water supply and distribution facilities.

1.3 PREVIOUS REPORTS AND REFERENCES

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1.4 ABBREVIATIONS

The following are the abbreviations that are used in this report:

AAD	Annual Average Day
ac-ft	acre-feet
CDHS	California Department of Health Services
CGS	State of California Geologic Survey
CIP	Capital Improvement Program
CVWD	Coachella Valley Water District
DHS	Desert Hot Springs
DHSCWD	Desert Hot Springs County Water District
DHSWC	Desert Hot Springs Water Company
DWA	Desert Water Agency
EPS	Extended Period Simulation
ft	feet
g	gravity
gpcd	gallons per capita per day
gpm	gallons per minute
GTC	
HE	Harvey Economics
ICI	Industrial-Commercial-Institutional
MCL	Maximum Contaminant Level
MD	Maximum Day
MFR	Multi-family Residential
mg	million gallons
mgd	million gallons per day
MH	Maximum Hour
msl	mean sea level
MSWD	Mission Springs Water District
MWD	Metropolitan Water District (of California)
PGA	Peak Ground Acceleration
prv	pressure-reducing valve
psi	pounds per square inch
SCE	Southern California Edison
SFR	Single-family Residential
SWP	State Water Project
URS	URS Corporation
USACE	United States Army Corps of Engineers
USBR	United States Bureau of Reclamation
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
WMP	Water Master Plan
MDD	Maximum Day Demand
MHD	Maximum Hour Demand (a.k.a. Peak Hour Demand)

1.5 ELEVATION DATUM

All elevations referred to in this report are based on USGS datum.

2.1 INTRODUCTION

The MSWD has and is experiencing very rapid population growth particularly over the last 5 years. This trend is expected to continue into the foreseeable future and therefore planning for new water supply and distribution facilities will be very critical. MSWD has for many years recognized the need to properly plan and implement improvements to meet existing and future domestic water needs but in conjunction, provide and enhance water distribution system facilities that will maintain their functionality during seismic events. The purpose for this comprehensive water system master plan is to build on previous water resources planning efforts commissioned by the MSWD to address the District's current and future water supply, treatment, and distribution system needs over the next 20 years. This document will also provide support to MSWD to update their 2000 Urban Water Management Planning Act of 1983 (AB 797).

This section provides a summary of URS findings and recommendations to meet MSWD water supply and distribution systems needs over the next 20 years. Specifically, our findings and recommendations are contained within the following categories and are further discussed below.

- Customers and Population,
- Water Requirements,
- Water Supplies,
- Water Distribution System Analysis,
- Water Distribution System Improvement Plan, and
- Capital Improvement Program.

2.2 CUSTOMERS AND POPULATION

Growth in population and housing has been significant across the Coachella Valley over the past 15 years. Growth in the more established City of Palm Springs was slower, as build out in that community is near, and land prices have become relatively higher than in the rest of the Valley. Growth was most rapid in the eastern Valley cities of Cathedral City, Palm Desert and Indio, while growth was slower in the smaller and more expensive communities of Indian Wells and Rancho Mirage. Growth in the Valley was slowest in the furthest east city of Coachella and the furthest west and north city of DHS. Experts and community members expect that as the fast-growing communities from the 90s and early 2000s approach build out and experience higher land prices, growth is expected to spillover more significantly into Coachella and DHS over the next 15 years.

Summary data on historical beginning of year service connections for the District-wide total are presented in Table 2-1. SFR service connections across the District have increased by about 235 per year between 1991 and 2000 and by 480 per year from 2000 through 2005; recent growth has increased notably. MFR and commercial service connections showed much slower growth and comprise only about 9 percent of connections by 2005. Other service connections steadily rose over this same time period as demand for schools, irrigation and tract construction water increased with growth in SFR connections.

Table 2-1
Annual Service Connections for the District-wide Total, 1991 to 2005

Year	SFR	MFR	Commercial	Other	Total
1991	5,595	578	244	108	6,525
1992	5,803	599	257	175	6,834
1993	6,048	618	259	131	7,056
1994	6,431	651	273	139	7,494
1995	6,362	602	256	125	7,345
1996	6,347	614	260	135	7,356
1997	6,341	602	258	132	7,333
1998	6,298	595	256	148	7,297
1999	6,359	601	262	161	7,383
2000	6,464	605	308	168	7,545
2001	6,584	614	269	187	7,654
2002	6,700	616	276	179	7,771
2003	7,008	618	281	192	8,099
2004	7,543	620	280	217	8,660
2005	8,883	627	284	262	10,056

Source: MSWD data, 2005.

Growth in SFR and other service connections for the District-wide total has been substantial and accelerating across the District but primarily in the MSWD system over the past 15 years. Growth in MFR and commercial service connections has been much slower as demand for that type of housing and the commercial services to meet residential growth has been limited. Experts, developers and community members expect that demand for additional SFR service connections and the commercial services and other water uses, such as irrigation and tract construction water, will increase dramatically over the next 15 years.

Growth patterns in MSWD are changing rapidly. MSWD added about 230 SFR service connections per year from 1991 through 2005, and about 500 per year from 2000 through 2005. The DHS Planning Department and MSWD report that developers plan to construct about 12,300 new single-family homes over the next 10 to 15 years, equating to an annual growth rate of between 820 and 1,230 new SFR service connections. Neither DHS nor MSWD has experienced such a level of growth before, but historical precedent in the Coachella Valley indicates that it is supportable. La Quinta, for example, added nearly 1,150 new housing units per year from 2000 through 2005. There remains some uncertainty as to whether this level of development is feasible in MSWD, as there is no historic precedent for it, and the market for developments like many of those proposed in their particular locations (some far from DHS city center) are untested. The next five years of intense development will reveal much about this area's true growth potential.

For forecasts of both service connections and water usage in MSWD, HE developed two scenarios: a baseline growth scenario that assumes all proposed SFR development as of May 2005 will occur by 2020, at a rate of roughly 820 new homes per year; and a second, high growth scenario that assumes this same level of SFR development will occur in only 10 years, by 2015, or at a rate of 1,230 new homes per year. These scenarios incorporate both new tract development and infill construction as proposed by developers. HE assumed that growth would occur at a constant absolute rate over the initial 10 to 15 year building period.

Historical precedent suggests that these levels of growth are possible but not sustainable over the long term as DHS approaches limitations of available land, infill development build out and higher land costs that discourage such rapid growth. Uncertainty about SFR growth also increases further out in time. HE adopted the assumptions that MSWD's growth rate in SFR service connections will drop to 25 percent of the initial rate of growth in the baseline scenario and to 50 percent of the initial rate of growth in the high growth scenario. HE did not forecast future MFR, commercial or other types of service connections for this study. HE's baseline forecasts of SFR service connections for the District-wide total are presented in Table 2-2.

Table 2-2
Projected SFR Connections and Population for Baseline Scenario, 2005 to 2035

Year	SFR Service Connections	Population
2005	9,140	23,000
2010	13,200	31,000
2015	17,300	39,000
2020	21,400	48,000
2025	22,400	50,000
2030	23,400	52,000
2035	24,400	54,000

Source: Harvey Economics, 2005

HE's high growth forecasts of SFR service connections for the District-wide Total are presented in Table 2-3 below.

Table 2-3
Projected SFR Service Connections, High Growth Scenario, 2005 to 2035

Year	SFR Service Connections	Population
2005	9,140	23,000
2010	15,300	35,000
2015	21,500	48,000
2020	24,600	54,000
2025	27,700	61,000
2030	30,800	67,000
2035	33,900	73,000

Source: Harvey Economics, 2005

HE projects that in the high growth scenario, MSWD will add roughly 1,230 new SFR service connections per year from 2005 through 2015 followed by about 620 new connections per year from 2015 through 2035. Again, most new development will occur on the fringes of the developed parts of DHS, namely in the northeast and northwest corners of the city. HE incorporates these overall baseline and high growth forecasts of SFR service connections into its water demand projections and sets forth a geographical pattern to this development and water demands in its small area water demand forecasts in Section 4 of this report.

For forecasts of both service connections and water usage in MSWD, HE developed two scenarios: a baseline growth scenario that assumes all proposed residential development as of May 2005 will occur by 2020, or roughly 820 new homes per year; and a second, high growth scenario that assumes this same level of development will occur in only 10 years, by 2015, or 1,230 new homes per year. These scenarios incorporate both new tract development and infill construction as proposed by developers. HE assumed that growth would occur at a constant, absolute number each year over the initial 10 to 15 year building period.

Historical precedent suggests that these levels of growth are possible but not sustainable over the long term as DHS approaches limitations of available land, infill development build out, and higher land costs that discourage such rapid growth. This long-term slowdown is not related to cyclicality, which is smoothed out in long term forecasting, but rather diminished capacity for growth. HE adopted the assumptions that MSWD’s growth rate in single-family residential service connections will drop to 25 percent of the initial rate of growth in the baseline scenario and to 50 percent of the initial rate of growth in the high growth scenario. These two scenarios resulted in average annual growth rates of 510 and 825 new SFR service connections per year, respectively, from 2005 through 2035.

2.3 WATER REQUIREMENTS

MSWD has experienced significant growth in water use across the District since 1991. The District’s annual usage has increased by more than 4,000 acre-feet from 1991 to 2005 as MSWD added more than 3,500 SFR service connections during that period.

In 2004, MSWD adopted two major conservation policy statements: a water conservation master plan and water efficient landscaping guidelines. The water conservation master plan identifies several key areas in which MSWD will pursue more efficient water use practices, namely: efficient landscaping guidelines (adopted three months after the master plan); efficient landscaping requirements for new development; landscape education center and xeriscape demonstration garden; efficient landscaping incentives; conservation education programs in schools, community and bimonthly billing information; tiered water pricing that encourages conservation; updated water shortage ordinance; water audits for the largest users; and rebates for water efficient plumbing fixtures. The District intends to strongly pursue these conservation measures over the coming years; therefore, HE adopted a lower average water use factor (described below) for SFR service connections to reflect those future water savings.

HE analyzed the District’s unaccounted-for-water, as well, and determined that from 1999 through 2005, the proportion of total demand estimated to be unaccounted-for-water had risen, from about 8 percent in 1999 to 11 percent in 2005. HE adopted a 10 percent unaccounted-for-water use factor for 2005 that will drop to 8 percent by 2010 through 2035 as MSWD aggressively invests in significant capital improvements as a part of this master planning process. HE applied this loss factor to total metered water demands from all sectors to derive MSWD’s total water demands for each year through 2035. In its water conservation master plan, MSWD has identified several important operational improvements that will lead to savings of unaccounted-for-water, namely: better infrastructure operations and maintenance, including leak detection and repairs, metering and meter replacement, system flushing, tank cleaning and maintenance and valve maintenance and mapping; recycled water program for irrigation of large spaces; and reclamation of highly mineralized groundwater.

HE evaluated MFR water usage with respect to planned MFR development within the District. As of May 2005, developers had proposed 110 new MFR housing units, and HE applied similar growth assumptions for MFR housing units as for SFR service connections. Under the baseline scenario, developers will build all 110 MFR units by 2020, and then the growth rate will drop to 25 percent of that initial rate with another 30 MFR units by 2035. These 140 MFR units represent an increase in MFR units within the District of about 7 percent, which HE assumed as the increase in MFR water demands by 2035, applied in a straightline increase from 2005.

HE examined commercial and other water usage in relation to SFR water usage, which makes up the majority of MSWD's demand and which appears to drive these other two categories of water use. From 1992 through 2005, commercial water use as a proportion of SFR water use held fairly constant at around 16 percent. HE assumed commercial water demands will remain at this proportion to SFR water demands through 2035 under both scenarios. From 1992 through 2005, other water use as a proportion of SFR water use rose slowly, with some variation, from around 20 percent to over 30 percent. HE assumed that other water use as a proportion of SFR water use will continue to rise slowly from 2005 through 2035 in a similar fashion, from 29 percent in 2005 to 31 percent in 2035, under both scenarios. By bringing together projections of future SFR, MFR, commercial, and other water demands across the District and by then applying the unaccounted-for-water use factor described above, HE completed its forecasts of total future water demands for MSWD through 2035.

HE projected future SFR water use was based on information from MSWD and the DHS Planning Department about new development in the DHS area, combined with the 520-gallons per SFR service connection per day water usage factor. HE's baseline scenario forecasts of water use by category plus total water demands, including unaccounted-for-water, for the District-wide total are presented in Table 2-4 below.

Table 2-4
Projected Baseline Scenario, Water Use by Category and Total Water Demands, District-Wide Total, 2005 to 2035, in Acre-Feet per Year

Year	SFR	MFR/Mobile	Commercial	Other	Total	Total with Losses
2005	5,300	1,500	800	1,500	9,100	10,100
2010	7,700	1,500	1,200	2,300	12,700	13,800
2015	10,100	1,600	1,600	3,000	16,300	17,700
2020	12,500	1,600	2,000	3,800	19,900	21,600
2025	13,000	1,600	2,100	3,900	20,600	22,400
2030	13,600	1,600	2,200	4,100	21,500	23,400
2035	14,200	1,600	2,300	4,400	22,500	24,500

Source: Harvey Economics, 2005.

HE projects that under the baseline scenario, MSWD will realize more than 14,000 acre-feet of additional water demands by 2035, including unaccounted-for-water, driven primarily by SFR growth. Almost all the new SFR development and water demands will locate on the fringes of the developed parts of DHS, namely in the northeast and northwest corners of the city, including the far northwest region that surrounds California Highway 62.

HE's high growth scenario projections of water use by category and total water demands, including unaccounted-for-water, for the District-wide total are presented in Table 2-5 below.

Table 2-5
Projected High Growth Scenario, Water Use by Category and Total Water Demands, District-Wide Total, 2005 to 2035, in Acre-Feet per Year

Year	SFR	MFR/Mobile	Commercial	Other	Total	Total with Losses
2005	5,300	1,500	800	1,500	9,100	10,100
2010	8,900	1,500	1,400	2,600	14,400	15,700
2015	12,500	1,500	2,000	3,700	19,700	21,400
2020	14,300	1,600	2,300	4,300	22,500	24,500
2025	16,100	1,600	2,600	4,900	25,200	27,400
2030	17,900	1,600	2,900	5,500	27,900	30,300
2035	19,700	1,700	3,200	6,000	30,600	33,300

Source: Harvey Economics, 2005.

HE projects that under the high growth scenario, MSWD annual water demands will increase by more than 23,000 acre-feet by 2035, including unaccounted-for-water, driven primarily by SFR growth. Again, most of the new SFR development and water demands will locate on the fringes of the developed parts of DHS, namely in the northeast and northwest corners of the city, including the far northwest region that surrounds California Highway 62.

2.4 WATER SUPPLIES

2.4.1 Current Sources of Water Supply

The primary source of water supply for each of the three water systems is groundwater obtained through production wells. The MSWD Service area currently includes seven wells that supply the MSWD System, with two additional wells being installed in 2005, and two wells each for the Palm Springs Crest System and the West Palm Springs Village System. An emergency source of water for MSWD is the Coachella Valley Water District (CVWD). MSWD currently has two inter-connections with the CVWD that can be used to provide emergency water to the Main System on a temporary and very limited basis.

A third source of water is obtained through an agreement between the Desert Water Agency (DWA) and the Metropolitan Water District of Southern California (MWD) to exchange Colorado River water for State Project Water (SWP) water. DWA obtains this water through a turnout from the Colorado River Aqueduct and manages a recharge facility near the turnout that enables the water (when it is available) to replenish the aquifer used by MSWD.

2.4.2 Groundwater Withdrawals and Recharge

Regional groundwater levels in the Mission Creek Sub-Basin have been declining since the early 1950s due to scarce annual precipitation and groundwater extractions, and numerous studies have been undertaken to evaluate historical impacts and estimate likely future impacts to groundwater levels in the sub-basin. Groundwater level data indicate that since 1952, groundwater levels have declined at a rate of 0.5 to 1.5 feet per year. Multiple investigators, considering different time periods, have estimated rates of overdrafting from the aquifer between 3,900 and 12,884 acre-feet per year. Slade (2000) calculated the loss of groundwater from the sub-basin as 5,340 acre-feet per year between 1978 and 1997. This estimate was based on a previous GTC (1979) report and an evaluation of historical water records for CVWD Well No. 3407, which showed a 1½-foot-per-year decline in groundwater levels. Krieger and Stewart (2005) used the Slade/GTC assumptions and more recent groundwater levels (1998 through 2004) to estimate an overdrafting rate of 9,700 acre-feet per year for the northwesterly three-quarters of the sub-basin, and 12,884 acre-feet per year for the entire sub-basin.

Because of continued concerns over the consistent drop in groundwater levels, MSWD hired Psomas to further evaluate the loss of groundwater in storage. In their study, Psomas (2004) used two methods, which agreed well, to analyze groundwater levels in the Mission Creek Sub-Basin. The Psomas study suggests that the Mission Creek Sub-Basin is being overdrafted at a rate of 3,900-4,400 acre-feet per year. It should be noted that Psomas did not include any groundwater recharge using imported water in its water balance calculation, such as the 4,700 acre-feet of water that was recharged in November and December of 2002 via the Mission Creek recharge facility. Psomas had concerns about the reliability of this source since it depends upon the availability of water from MWD and the exchange agreement with DWA.

However, the most recent revision to the MSWD’s Urban Water Management Plan (UWMP, or Plan) (2006) recognizes the existence and operation of the MSWD’s groundwater recharge facilities as an element of the basin wide groundwater system, helping to offset declines in basin groundwater levels. Additionally, the Plan accounts for recharge from treated wastewater.

In view of the information contained in the various studies regarding capacity and actual storage in the sub-basin, the current and anticipated rate of overdrafting from the sub-basin, and the MSWD water management plan, it can be safely stated, the Mission Springs Sub-Basin will provide an adequate supply of groundwater into the distant future.

2.4.3 Future Annual System Requirements

Table 2-6 summarizes the existing water supply of each water system and primary service zone to the projected ADD and MDD for the years 2010, 2015, 2020, and 2025, quantifies either the projected surplus or shortfall, and indicates the number of additional wells required to meet the projected demands in each of the study years. This analysis indicates that MSWD will need 17 additional groundwater wells to provide supply capacity and reliability by 2025.

Table 2-6

Comparison of Existing Water Supply Capacity vs. Projected MDD

Well Supply Zone	Study Year	Projected ADD (mgd)	Projected MDD[1] (mgd)	2005 Supply 24-Hour Continuous Pumping[2] (mgd)	2005 Supply Off Peak Hour Pumping Only[3] (mgd)	Available Supply 24-hr Pumping w/o Largest Well[4] (mgd)	Most Critical Surplus or Shortfall[5] (mgd)	Number of Additional Wells Needed	Comments
All MSWD Zones	2010	13.79	27.58	23.29	17.47	n/a	n/a	5	capacity varies
	2015	18.81	37.62	23.29	17.47	n/a	n/a	6	capacity varies
	2020	21.54	43.08	23.29	17.47	n/a	n/a	3	capacity varies
	2025	24.08	48.16	23.29	17.47	n/a	n/a	2	capacity varies
							Total Wells Needed	**16**	
				West Palm Springs Village System					
Wells 26 & 26A	2010	0.14	0.29	0.53	0.42	0.20	-0.09	1	275 gpm well
	2015	0.19	0.38	0.53	0.42	0.20	-0.18	0	
	2020	0.21	0.43	0.53	0.42	0.20	-0.23	0	
	2025	0.24	0.48	0.53	0.42	0.20	-0.28	0	
							Total Wells Needed	**1**	
				Palm Springs Crest System					
Wells 25 & 25A	2010	0.07	0.14	1.06	0.84	0.27	0.13	0	
	2015	0.10	0.20	1.06	0.84	0.27	0.07	0	
	2020	0.11	0.21	1.06	0.84	0.27	0.06	0	
	2025	0.13	0.25	1.06	0.84	0.27	0.02	0	
							Total Wells Needed	**0**	

Source: Demands provided by Harvey Economics, 2005 and Well Capacities based on pumping data provided by MSWD, 2005

1 MDD computed using the ADD and a multiplier of 2.0

2 24-Hour Pumping Available Supply computed by converting the measured pumping capacity from gpm to mgd.

3 Off-Peak Pumping is MSWD's normal operating mode in which its wells are only operated during the electrical off-peak hours (18 hours between 5:30 PM and 11:30 AM) as a cost-saving measure. Off-Peak Hour Pumping supply computed by multiplying the 24 hour pumping capacity by the ration of 19/24. .

4 24-Hour Pumping w/o Largest Well. Supply computed by subtracting the largest well capacity from the 24-hour continuous pumping supply.

5 The Most Critical Surplus (Available Supply exceeds Demand) or Shortfall (MDD exceeds Available Supply) is computed by subtracting the MDD from each of the three pumping scenarios, and accounting for whether they are pumping either 18 hours or 24 hours. The largest surplus or shortfall that is computed using these three calculations is shown.

6 24-Hour The number of required wells (if any) is computed by dividing the Most Critical Shortfall by the minimum assumed capacity of each well (typically up to a maximum of 1,500 gpm or 1.62 mgd for an 18-hour pumping period per day for any one well).

2.5 WATER DISTRIBUTION SYSTEM ANALYSIS

The existing MSWD water distribution system serves up to 24 different pressure service zones. In general, the MSWD standard pressure zones are reflective of existing storage tank overflow elevations, hence the term "913 Zone" in which the water storage tank overflow is at 913 ft msl. Therefore, pressure zone designations are expressed in terms of the tank overflow elevation and hence state the static hydraulic grade line of that particular service zone. As development in the

MSWD occurs, numerous storage tanks were constructed and some at varying elevations, which were not consistent with an overall primary pressure zone. One of the comprehensive water master planning goals is to consolidate the 24 different pressure service zones into primary pressure service zones.

Based on current and future water distribution system hydraulic requirements, URS is recommending nine primary pressure service zones to include 913 Zone, 1070 Zone, 1240 Zone, 1400 Zone, 1530 Zone, 1630 Zone, 1800 Zone, 1975 Zone, and 2155 Zone (see Figure 2-1). Table 2-7 shows the minimum and maximum static pressures for each of the primary pressure zones. Topographic (ground) elevations are provided to show and define the extent of the each individual zones. These primary pressure zones have or will in the future contain water storage facilities, if required, to meet peak hour and fire flow demands, groundwater wells to provide a source of supply for max day demands within the zone, booster pumping capability to move water to higher service zone, and water transmission mains within the service zone distribution system.

Table 2-7

Conceptual Pressure Zone Summary

Zone	Minimum Topographic Elevation (ft)	Maximum Topographic Elevation (ft)	Minimum Static Pressure (psi)	Maximum Static Pressure (psi)
913	635	800	49	120
1070	800	970	43	117
1240	970	1,140	43	117
1400	1,140	1,300	43	113
1530	1,300	1,430	43	100
1630	1,430	1,530	43	87
1800	1,530	1,700	43	117
1975	1,700	1,880	41	119
2155	1,880	2,060	41	119

Table 2-8 summarizes the existing system ability to meet the hydraulic analysis criteria. A sufficient supply of water (supply) must be available to meet the projected MDD generated by each of the systems for each study year. As done previously, the evaluation will consider not only the capacity of the water supply system assuming continuous pumping, but will also look at each primary pressure zone with off-peak hour pumping, as well as the situation when the largest well that serves the particular zone is off-line. The supply criteria is the ability of groundwater wells within each primary pressure zone to meet MDD without use of storage facilities.

Water storage tanks within a primary pressure zone must be capable of providing operational storage, fire flow storage, and emergency storage. Operational storage (25% of MDD) is considered to be the volume of storage required to supply the difference between available supply and fluctuating max hour demands. Fire flow storage is the volume of water required to provide fire flow for a 2-hour duration. Fire flow used for storage analysis is based on 1,000 gpm. Emergency storage (75% of MDD) is the volume required to meet system demands during an emergency situation such as supply failures, pipeline, power outages, and/or natural disasters. Each primary pressure zone storage volume is evaluated based on the combined storage criteria,

Insert

Figure 2-1
Pressure Zone Boundaries
(copy of Fig 9-1)

which considers operational and emergency storage. The total volume should equal two days of ADD. Distribution analysis considers whether or not the water distribution pipeline network meets residual pressure and velocity criteria based on an AAD, MDD plus fire flow, and MHD.

A critical analysis is determining water distribution system performance is to evaluate fire flows within the system during maximum day demands. As shown in Figure 2-2, the MSWD system is not able to consistently meet the 1,000 gpm fire flow demand within the system. The older water system contains approximately 50 miles of 4-in and smaller diameter pipe that should be replaced over an extended period.

Fire Flow capacity analysis is based upon the ability of the water distribution system within the primary pressure zones to convey 1,000 gpm fire flow requirement for single family residential and maintain a minimum residual system pressure of 20 psi. The zones that do not meet the system analysis criteria have portions of the system which have an available fire flows lower than the minimum standard of 500 gpm.

Table 2-8

Summary of Existing System Analysis Results

	Does the entire zone meet system analysis criteria?			
Zone	**Supply**	**Storage**	**Distribution**	**Fire Flow**
913	Yes	Yes	Yes	Yes
1070	Yes	NO	NO	NO
1240	Yes	Yes	NO	NO
1400	NO	Yes	NO	NO
1530	NO	NO	NO	NO
1630	NO	NO	Yes	NO
Cottonwood	Yes	NO	NO	NO
Woodridge	Yes	NO	NO	NO

2.6 WATER DISTRIBUTION SYSTEM IMPROVEMENT PLAN

Utilizing the calibrated MSWD hydraulic model, URS prepared a hydraulic model for each planning horizon in order to evaluate and analyze the water distribution system ability to meet project water demands. The 20 year system improvement plan is intended to present major water facility improvements; groundwater wells/treatment, storage tanks, booster pump stations, and primary distribution pipelines to address existing system deficiencies as well as meet future growth. Pipeline lengths presented below are estimates and could change base on route alignment studies. Table 2-9 summarizes the major future improvements, which are required at five-year intervals between 2005 and 2025 to meet the projected high growth scenario system demands. Although the results shown in Table 2-8 may indicate that the existing system meets system analysis criteria, future improvements (see Table 2-9) may be required to meet projected system demands.

Insert

Figure 2-2
Fire Flow and MDD Scenario Model Results
(copy of Fig 8-6)

Table 2-9

Summary of Future Improvements

Zone	Component	2010	2015	2020	2025
913	Supply	none	none	none	none
	Storage	none	none	none	none
	Boosters	none	none	none	none
	Distribution	none	1,300 lf, 12-in	none	none
1070	Supply	none	none	none	none
	Storage	(1) 2.50 mg tank	none	none	none
	Boosters	none	(1) 1.3 mgd	none	none
	Distribution	3,200 lf, 16-in	none	none	none
1240	Supply	none	none	none	none
	Storage	(1) 1.5 mg	none	none	none
	Boosters	none	none	none	none
	Distribution	12,900 lf, 16-in	none	none	none
1400	Supply	(2) 2,000 gpm	(3) 2,000 gpm	(2) 1,500 gpm	(1) 1,500 gpm
	Storage	(1) 5.0 mg (1) 1.0 mg	(1) 5.0 mg	none	(1) 5.0 mg
	Boosters	(1) 0.7 mgd	none	none	none
	Distribution	9,500 lf, 8-in 29,300 lf, 24-in	2,600 lf, 12-in 2,800 lf, 16-in 2,700 lf, 20-in	none	none
1530	Supply	(2) 2,000 gpm	(1) 1,500 gpm	none	none
	Storage	(1) 1.0 mg	(1) 4.0 mg	none	none
	Boosters	none	none	none	none
	Distribution	21,600 lf, 12-in 19,000 lf, 16-in 19,700 lf, 24-in	2,600 lf, 16-in 2,800 lf 20-in	2,800 lf, 16-in	none
1630	Supply	(1) 1,500 gpm	(1) 1,500 gpm	none	none
	Storage	(1) 1.0 mg (1) 1.5 mg (1) 2.5 mg	none	none	none
	Boosters	(1) 1.5 mgd	none	none	none
	Distribution	7,600 lf, 12-in	none	none	none
1800	Supply	none	(1) 1,500 gpm	(1) 1,500 gpm	(1) 1,500 gpm
	Storage	none	(1) 1.0 mg	none	none
	Boosters	none	(1) 7.5 mgd	none	none
	Distribution	none	8,300 lf, 8-in 19,200 lf, 20-in	none	none
1975	Supply	none	none	none	none
	Storage	none	none	(1) 2.0 mg	none
	Boosters	none	none	(1) 3.5 mgd	none
	Distribution	none	none	8,200 lf, 12-in	none

Table 2-9

Summary of Future Improvements

Zone	Component	2010	2015	2020	2025
2155	Supply	none	none	none	none
	Storage	none	none	none	none
	Boosters	none	none	none	(1) 3.5 mgd
	Distribution	none	none	none	200 lf, 16-in
Cottonwood (1630-C)	Supply	(1) 1,500 gpm	none	none	none
	Storage	(1) 1.0 mg	none	none	none
	Boosters	(1) 2.2 mgd	none	none	none
	Distribution	none	none	3,500 lf, 20-in	none
Woodridge (1800-W)	Supply	none	none	none	none
	Storage	0.5 mg	none	none	none
	Boosters	none	none	none	none
	Distribution	none	none	none	none

2.7 CAPITAL IMPROVEMENT PROGRAM

Based on the water distribution system improvement plan presented above, URS prepared a Capital Improvement Program (CIP) presented in Table 2-10 that estimates the capital costs for these improvements through year 2025. The estimated capital improvement costs based on 2005 dollars is approximately $130 million. Because of the increases in water demands associated with the high growth scenario, a significant portion of the future improvements will likely be required prior to 2010. In fact, the improvements required to meet the projected 2010 system demand will require approximately 56% of the total estimated funding ($73 million) for future improvements. The primary facilities contained in this cost are groundwater wells and water storage in the respective primary pressure zones.

Based upon prioritization of future improvements, some of these improvements that are required prior to 2010 could be delayed until later. These subjective judgments, which in some cases are based upon the desired level of reliability, are beyond the scope of this report. The CIP and future improvements should be evaluated periodically to compare the assumptions made in this report with the actual growth and demands in the system.

Table 2-10

Cost Estimate Summary for Future Improvements

		Planning Year / Cost				
Zone	Category	2010	2015	2020	2025	Subtotal
913	Supply	$0	$0	$0	$0	$0
	Storage	$0	$0	$0	$0	$0
	Boosters	$0	$0	$0	$0	$0
	Distribution	$0	$262,080	$0	$0	$262,080
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000

Table 2-10

Cost Estimate Summary for Future Improvements

Zone	Category	Planning Year / Cost 2010	2015	2020	2025	Subtotal
913 Zone Total		**$250,000**	**$512,080**	**$250,000**	**$250,000**	**$1,262,080**
1070	Supply	$0	$0	$0	$0	$0
	Storage	$3,225,600	$0	$0	$0	$3,225,600
	Boosters	$0	$594,048	$0	$0	$594,048
	Distribution	$860,160	$0	$0	$0	$860,160
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1070 Zone Total		**$4,335,760**	**$844,048**	**$250,000**	**$250,000**	**$5,679,808**
1240	Supply	$0	$0	$0	$0	$0
	Storage	$2,378,880	$0	$0	$0	$2,378,880
	Boosters	$0	$0	$0	$0	$0
	Distribution	$3,467,520	$0	$0	$0	$3,467,520
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1240 Zone Total		**$6,096,400**	**$250,000**	**$250,000**	**$250,000**	**$6,846,400**
1400	Supply	$1,680,000	$2,772,000	$1,848,000	$924,000	$7,224,000
	Storage	$6,672,960	$4,737,600	$0	$4,737,600	$16,148,160
	Boosters	$319,872	$0	$0	$0	$319,872
	Distribution	$12,166,560	$2,184,000	$0	$1,243,200	$15,593,760
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1400 Zone Total		**$21,089,392**	**$9,943,600**	**$2,098,000**	**$7,154,800**	**$40,285,792**
1530	Supply	$1,848,000	$924,000	$0	$0	$2,772,000
	Storage	$1,935,360	$4,032,000	$0	$0	$5,967,360
	Boosters	$0	$0	$0	$0	$0
	Distribution	$19,797,120	$0	$0	$0	$19,797,120
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1530 Zone Total		**$23,830,480**	**$5,206,000**	**$250,000**	**$250,000**	**$29,536,480**
1630	Supply	$924,000	$924,000	$0	$0	$1,848,000
	Storage	$7,539,840	$0	$0	$0	$7,539,840
	Boosters	$685,440	$0	$0	$0	$685,440
	Distribution	$1,532,160	$0	$0	$0	$1,532,160
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1630 Zone Total		**$10,931,440**	**$1,174,000**	**$250,000**	**$250,000**	**$12,605,440**
1800	Supply	$0	$924,000	$924,000	$924,000	$2,772,000
	Storage	$0	$1,935,360	$0	$0	$1,935,360
	Boosters	$0	$3,427,200	$0	$0	$3,427,200
	Distribution	$0	$7,845,600	$0	$0	$7,845,600
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1800 Zone Total		**$250,000**	**$14,382,160**	**$1,174,000**	**$1,174,000**	**$16,980,160**
1975	Supply	$0	$0	$0	$0	$0
	Storage	$0	$0	$2,284,800	$0	$2,284,800
	Boosters	$0	$0	$1,599,360	$0	$1,599,360
	Distribution	$0	$0	$1,653,120	$0	$1,653,120
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000

Table 2-10

Cost Estimate Summary for Future Improvements

Zone	Category	Planning Year / Cost 2010	2015	2020	2025	Subtotal
1975 Zone Total		**$250,000**	**$250,000**	**$5,787,280**	**$250,000**	**$6,537,280**
2155	Supply	$0	$0	$0	$0	$0
	Storage	$0	$0	$0	$0	$0
	Boosters	$0	$0	$0	$1,599,360	$1,599,360
	Distribution	$0	$0	$0	$67,200	$67,200
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
2155 Zone Total		**$250,000**	**$250,000**	**$250,000**	**$1,916,560**	**$2,666,560**
1630-C	Supply	$0	$0	$0	$924,000	$924,000
	Storage	$1,935,360	$0	$0	$0	$1,935,360
	Boosters	$1,005,312	$0	$0	$0	$1,005,312
	Distribution	$1,176,000	$0	$0	$0	$1,176,000
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1630-C Zone Total		**$4,366,672**	**$250,000**	**$250,000**	**$1,174,000**	**$6,040,672**
1800-W	Supply	$0	$0	$0	$0	$0
	Storage	$1,209,600	$0	$0	$0	$1,209,600
	Boosters	$0	$0	$0	$0	$0
	Distribution	$0	$0	$0	$0	$0
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1800-W Zone Total		**$1,459,600**	**$250,000**	**$250,000**	**$250,000**	**$2,209,600**
GRAND TOTAL		***$73,109,744***	***$33,311,888***	***$11,059,280***	***$13,169,360***	***$130,650,272***

3.1 CUSTOMERS AND POPULATION

The MSWD currently serves potable water to nearly 11,000 water taps or service connections throughout its service area, which encompasses the City of Desert Hot Springs (DHS) plus unincorporated Riverside County surrounding DHS and to the west of DHS, including the Palm Springs Crest and West Palm Springs Village areas. These metered service connections include single family and multifamily residential homes, mobile homes and mobile home parks, commercial businesses such as hotels and retail establishments, schools, MSWD properties, and park and landscape irrigation.[1]

MSWD has experienced considerable growth in service connections since 1991; the District added more than 3,500 single family residential connections between 1991 and 2005. MSWD's population has increased with this residential growth. As part of this master planning process for MSWD, Harvey Economics (HE) prepared profiles of the District's historical growth in service connections, population and housing. HE then developed forecasts of MSWD's future growth in those same categories based upon local data sources with consideration of other growth forecasts for the Coachella Valley.

3.1.1 Methodology and data sources

To profile the District's historical growth in population and housing, HE collected data from the US Census Bureau, California Department of Finance and Southern California Association of Governments. These organizations track population and total housing units (including occupied, vacant and seasonal homes) for each of the Coachella Valley cities – Cathedral City, Coachella, DHS, Indian Wells, Indio, La Quinta, Palm Desert, Palm Springs and Rancho Mirage. As these cities annexed additional lands and the new homes built on them since 1990, or as infill development progressed, these cities' populations and housing stocks have increased. HE gathered data for 1990, 2000 and 2005 where available.

To approximate the population and housing stock within MSWD's boundaries, HE relied upon US Census Bureau data for MSWD's Census tracts in 1990 and 2000 and upon Southern California Association of Government (SCAG) projections for the six Census tracts in 2005. These SCAG forecasts were completed in 2004. HE collected data at the US Census tract level, including two tracts in 1990 and six tracts in 2000. HE was able to closely approximate MSWD's boundaries with Census tracts in 2000. The US Census Bureau changed the boundaries of US Census tracts within MSWD's service zone between 1990 and 2000. HE adjusted the numbers from 1990 tract 445.01 to reflect an approximation of 1990 MSWD population.

To profile MSWD's historical growth in service connections, HE acquired water service data from the District for 1991 through 2005 for the three systems, MSWD, Palm Springs Crest and West Palm Springs Village. These records showed bimonthly numbers of service connections in each of the District's service classes, including single family residential, multifamily residential,

[1] This report refers to three systems within the Mission Springs Water District, namely the MSWD system, the West Palm Springs Village System and the Palm Springs Crest System. Although traditionally the Mission Springs Water District is referred to as MSWD, for purposes of distinguishing between the MSWD system and the District, when referring to the District as a whole, this report uses the term District-wide total.

mobile homes, commercial classes and other classes, primarily irrigation and tract construction water.

To project future growth in MSWD's service connections, HE consulted with experts on growth and change in the Coachella Valley, including MSWD, Coachella Valley Water District, California Department of Finance, Riverside County, Coachella Valley Economic Partnership, Coachella Valley Association of Governments, Desert Hot Springs Chamber of Commerce, City of Desert Hot Springs, Palm Springs Unified School District, Building Industry Association – Desert Chapter, Metropolitan Water District and SCAG. HE also analyzed historical growth patterns in other Coachella Valley cities to determine what level of growth one might reasonably expect in MSWD's service zones.

Finally, HE projected population estimates for MSWD based on US Census Bureau data from 2000 for the Census tracts in the District. HE incorporated an average occupancy rate for the new housing units and an average population density, or persons per occupied housing unit, to estimate future populations. HE then applied the service connection forecasts to the ultimate water demand projections in the next section of this report.

3.1.2 Historical population and housing growth

HE obtained historical population and housing data for DHS, for the Census tracts that encompass MSWD and for other Coachella Valley Cities from the US Census Bureau and from SCAG for 1990, 2000 and 2005, where available. Data on historical population for DHS and for MSWD's Census tracts are presented in Table 3-1 below. The population of DHS grew by a little more than 500 persons per year, on average, between 1990 and 2005, at an annual average rate of 3.4 percent. The Census tracts that approximate MSWD grew at an annual average rate of 3.5 percent, or nearly 900 persons per year. The population of DHS and these Census tracts grew more quickly between 2000 and 2005 than between 1990 and 2000.

Table 3-1

Population in the City of Desert Hot Springs and MSWD Census Tracts, 1990 to 2005

Description	1990 Population	2000 Population	2005 Population
City of Desert Hot Springs	11,668	16,582	19,386
Census Tract 445.02 *****	15,201	—	—
Census Tract 445.01 *****	4,269	—	—
Census Tract 445.06 *****	—	5,844	7,178
Census Tract 445.07 *****	—	4,428	5,454
Census Tract 445.08 *****	—	4,795	6,267
Census Tract 445.09 *****	—	2,811	3,470
Census Tract 445.10 *****	—	4,692	5,843
Census Tract 445.03 *****	—	3,544	4,682
MSWD Approximation	19,500	26,100	32,900

Sources: 1990 and 2000 US Census Bureau and 2005 CA Dept Finance for DHS, SCAG for tracts

***** Adjusted for portion in 445.04, delineated in 2000, that is not in the MSWD service zone.

For Comparison with the City of Desert Hot Springs and MSWD, data on population growth in other Coachella Valley cities are presented below in Table 3-2. The near eastern Valley cities of

Cathedral City, Palm Desert, Indio and La Quinta grew most quickly from 1990 through 2005, while the farthest east City of Coachella grew more slowly in the 1990s and picked up steam from 2000 to 2005. Indian Wells, Palm Springs and Rancho Mirage experienced the slowest growth in the Valley, though they, too, increased their population growth rates from 2000 to 2005. The highest growth rate was about 3,400 persons per year in Indio from 2000 through 2005. DHS ranked sixth in growth in the Valley over the 15-year time period.

Table 3-2
Historic Population in the Coachella Valley Cities, 1990 to 2005

Description	Population Statistics			Annual Growth Statistics	
	1990	2000	2005	1990 to 2000	2000 to 2005
Cathedral City	30,085	42,647	50,632	1,256	1,597
Coachella	16,896	22,724	30,764	583	1,608
Desert Hot Springs	11,668	16,582	19,386	491	561
Indian Wells	2,647	3,816	4,781	117	193
Indio	36,793	49,116	66,118	1,232	3,400
La Quinta	11,251	23,694	36,145	1,244	2,490
Palm Desert	23,252	41,155	49,280	1,790	1,625
Palm Springs	40,181	42,807	45,731	263	585
Rancho Mirage	9,778	13,249	16,416	347	633

Sources: 1990 and 2000 US Census Bureau and 2005 CA Dept Finance for DHS, SCAG for tracts

Data on historical housing growth in DHS and in MSWD are displayed below in Table 3-3. The stock of total housing units in DHS – including single family, multifamily and mobile home housing units – grew by nearly 170 units per year, on average, between 1990 and 2005, at an annual average rate of 2.6 percent. The Census tracts that approximate MSWD added housing stock at an annual average rate of 2.7 percent, or more than 350 units per year. Housing stocks grew more quickly between 2000 and 2005 than between 1990 and 2000.

Table 3-3
Total Housing Units in the City of Desert Hot Springs and MSWD Census Tracts, 1990 to 2005

Description	1990 Housing Units	2000 Housing Units	2005 Housing Units
City of Desert Hot Springs	5,494	7,034	8,016
Census Tract 445.02	8,049	—	—
Census Tract 445.01 *	2,700	—	—
Census Tract 445.06 *	—	2,886	3,564
Census Tract 445.07 *	—	1,853	2,201
Census Tract 445.08 *	—	2,354	2,866
Census Tract 445.09 *	—	1,484	1,724
Census Tract 445.10 *	—	1,753	2,055
Census Tract 445.03 *	—	2,995	3,609
MSWD Approximation	10,700	13,300	16,000

Sources: 1990 and 2000 US Census Bureau and 2005 CA Dept Finance for DHS, SCAG for tracts
***** Adjusted for portion in 445.04, delineated in 2000, that is not in the MSWD service zone.

For comparison with DHS and MSWD, data on total housing units in other Coachella Valley cities are presented below in Table 3-4. The eastern Valley cities of Cathedral City, Palm Desert, Indio and La Quinta grew most quickly from 1990 through 2005, while the farthest east city of Coachella grew more slowly over the same time period. Indian Wells, Palm Springs and Rancho Mirage experienced the slowest growth in the Valley, though they, too, increased their housing growth rates from 2000 to 2005. The highest growth rate was about 1,150 housing units per year in La Quinta from 2000 through 2005. DHS ranked sixth in housing unit growth in the Valley over the 15-year time period.

Table 3-4
Total Housing Units in the Coachella Valley Cities, 1990 to 2005

Description	Housing Units			Annual Growth Statistics	
	1990	2000	2005	1990 to 2000	2000 to 2005
Cathedral City	15,229	17,893	20,670	266	555
Coachella	3,830	5,024	6,624	119	320
Desert Hot Springs	5,494	7,034	8,016	154	196
Indian Wells	3,019	3,843	4,685	82	168
Indio	13,028	16,909	22,257	388	1,070
La Quinta	6,426	11,812	17,549	539	1,147
Palm Desert	18,248	28,021	32,711	977	938
Palm Springs	30,517	30,823	32,083	31	252
Rancho Mirage	9,360	11,816	13,950	246	427

Sources: 1990 and 2000 US Census Bureau and 2005 CA Dept Finance for DHS, SCAG for tracts

Growth in population and housing has been significant across the Coachella Valley over the past 15 years. Growth in the more established City of Palm Springs was slower, as buildout in that community is near, and land prices have become relatively higher than in the rest of the Valley. Growth was most rapid in the eastern Valley cities of Cathedral City, Palm Desert and Indio, while growth was slower in the smaller and more expensive communities of Indian Wells and Rancho Mirage. Growth in the Valley was slowest in the furthest east city of Coachella and the furthest west and north city of DHS. Experts and community members expect that as the fast-growing communities from the 90s and early 2000s approach buildout and experience higher land prices, growth is expected to spillover more significantly into Coachella and DHS over the next 15 years.

3.1.3 Historical service connection growth

HE obtained historical service connection data for MSWD from the District for the three water systems and for all types of connections from 1991 through 2005. The District collects data bimonthly on numbers of service connections, and total service connections in each system are tallied only six times per year. Data for the beginning of the year (January-February) service connections in the MSWD system are presented in Table 3-5 below. Single family residential (SFR) service connections increased by nearly 230 per year between 1991 and 2004, while multifamily residential and mobile home (MFR) service connections and commercial connections increased much more slowly. Other service connections proliferated notably over this time period as the demand for irrigation, schools and tract construction water rose.

Table 3-5
Annual Service Connections in the MSWD System, 1991 to 2005

Year	SFR	MFR	Commercial	Other	Total
1991	5,472	574	243	105	6,394
1992	5,673	595	256	172	6,696
1993	5,911	613	258	128	6,910
1994	6,285	646	272	134	7,337
1995	6,210	597	255	121	7,183
1996	6,198	609	259	131	7,197
1997	6,189	598	257	128	7,172
1998	6,141	591	255	144	7,131
1999	6,204	597	261	155	7,217
2000	6,303	601	308	164	7,376
2001	6,423	610	269	181	7,483
2002	6,534	612	276	174	7,596
2003	6,836	614	281	183	7,914
2004	7,361	616	280	210	8,467
2005	8,643	623	284	251	9,801

Data on historical beginning of year service connections in the West Palm Springs Village system are presented in Table 3-6 below. SFR service connections increased by about 4 per year between 1991 and 2004, though growth was much higher in 2004 with 26 new connections added to the system. MFR service connections and commercial connections showed no growth and comprise only one connection by 2005. Other service connections steadily proliferated over this time period as the demand for irrigation, schools and tract construction water increased with growth in SFR connections.

Table 3-6
Annual Service Connections in the West Palm Springs Village System, 1991 to 2005

Year	SFR	MFR	Commercial	Other	Total
1991	80	1	1	3	85
1992	86	1	1	3	91
1993	90	1	1	3	95
1994	97	1	1	5	104
1995	99	1	1	4	105
1996	100	1	1	4	106
1997	98	1	1	4	104
1998	98	1	1	4	104
1999	98	1	1	4	104
2000	102	1	0	4	107
2001	100	1	0	6	107
2002	105	1	0	5	111
2003	108	1	0	5	114
2004	110	1	0	7	118

Table 3-6
Annual Service Connections in the West Palm Springs Village System, 1991 to 2005

Year	SFR	MFR	Commercial	Other	Total
2005	136	1	0	9	146

Starting with 1991, beginning of year service connections in the Palm Springs Crest system are presented in Table 3-7 below. SFR service connections increased by about 4 per year between 1991 and 2004, though growth was much higher in 2004 with 32 new connections added to the system. MFR service connections and commercial connections showed no growth and comprise only three connections by 2005. Other service connections were somewhat sporadic as demand for irrigation and tract construction water varied with growth in SFR connections.

Table 3-7
Annual Service Connections in the Palm Springs Crest System, 1991 to 2005

Year	SFR	MFR	Commercial	Other	Total
1991	43	3	0	0	46
1992	44	3	0	0	47
1993	47	4	0	0	51
1994	49	4	0	0	53
1995	53	4	0	0	57
1996	49	4	0	0	53
1997	54	3	0	0	57
1998	59	3	0	0	62
1999	57	3	0	2	62
2000	59	3	0	0	62
2001	61	3	0	0	64
2002	61	3	0	0	64
2003	64	3	0	4	71
2004	72	3	0	0	75
2005	104	3	0	2	109

Finally, summary data on historical beginning of year service connections for the District-wide total are presented in Table 3-8. The District-wide total is the sum of Table 3-5 (MSWD System), Table 3-6 (West Palm Springs Village System), and Table3-7 (Palm Springs Crest System). SFR service connections across the District increased by about 235 per year between 1991 and 2000 and by 480 per year from 2000 through 2005; recent growth has increased notably. MFR and commercial service connections showed much slower growth and comprise only about 9 percent of connections by 2005. Other service connections steadily rose over this same time period as demand for schools, irrigation and tract construction water increased with growth in SFR connections.

Table 3-8
Annual Service Connections for the District-wide Total, 1991 to 2005

Year	SFR	MFR	Commercial	Other	Total
1991	5,595	578	244	108	6,525
1992	5,803	599	257	175	6,834
1993	6,048	618	259	131	7,056
1994	6,431	651	273	139	7,494
1995	6,362	602	256	125	7,345
1996	6,347	614	260	135	7,356
1997	6,341	602	258	132	7,333
1998	6,298	595	256	148	7,297
1999	6,359	601	262	161	7,383
2000	6,464	605	308	168	7,545
2001	6,584	614	269	187	7,654
2002	6,700	616	276	179	7,771
2003	7,008	618	281	192	8,099
2004	7,543	620	280	217	8,660
2005	8,883	627	284	262	10,056

Growth in SFR and other service connections for the District-wide total has been substantial and accelerating across the District but primarily in the MSWD system over the past 15 years. Growth in MFR and commercial service connections has been much slower as demand for that type of housing and the commercial services to meet residential growth has been limited. Experts, developers and community members expect that demand for additional SFR service connections and the commercial services and other water uses, such as irrigation and tract construction water, will increase dramatically over the next 15 years.

3.1.4 Projected SFR service connection growth

HE forecasted future SFR service connections based on information from MSWD and the DHS Planning Department about new development in the DHS area. HE combined the information from these two sources, which was not consistent, by assuming that MSWD had the best information about location and relative numbers of new SFR housing units across the District and by assuming that DHS had the best information about the total number of new homes to be built, including recently proposed developments that were not in official documents as of May 2005.

Growth patterns in MSWD are changing rapidly. MSWD added about 230 SFR service connections per year from 1991 through 2005, and about 500 per year from 2000 through 2005. The DHS Planning Department and MSWD report, however, that developers plan to construct about 12,300 new single family homes over the next 10 to 15 years, equating to an annual growth rate of between 820 and 1,230 new SFR service connections. Neither DHS nor MSWD has experienced such a level of growth before, but historical precedent in the Coachella Valley indicates that it is supportable. La Quinta, for example, added nearly 1,150 new housing units per year from 2000 through 2005. There remains, however, some uncertainty as to whether this level of development is feasible in MSWD, as there is no historic precedent for it, and the market for developments like many of those proposed in their particular locations (some far from DHS city center) are untested. The next five years of intense development will reveal much about this area's true growth potential.

These new SFR homes in and around DHS are in various stages of proposal and development. According to data from DHS in May 2005, nearly 5,000 of the homes proposed are in tracts that are already under construction. Another 5,000 homes are in tracts with approved plans or maps of the developments. About 1,000 homes are in tracts where developers have submitted plans and/or maps for DHS's approval. More than 1,200 homes are in tracts where developers have submitted applications for construction. Those developments under construction or approved by the Planning Commission are clearly more likely to occur than those recently submitted or merely contemplated. There are varying levels of certainty about whether these homes will be built in the next 10 to 15 years. But it is likely that if these particular developments do not move forward, developers will propose alternate development plans in the intervening years.

For forecasts of both service connections and water usage in MSWD, HE developed two scenarios: a baseline growth scenario that assumes all proposed SFR development as of May 2005 will occur by 2020, at a rate of roughly 820 new homes per year; and a second, high growth scenario that assumes this same level of SFR development will occur in only 10 years, by 2015, or at a rate of 1,230 new homes per year. These scenarios incorporate both new tract development and infill construction as proposed by developers. HE assumed that growth would occur at a constant absolute rate over the initial 10 to 15 year building period.

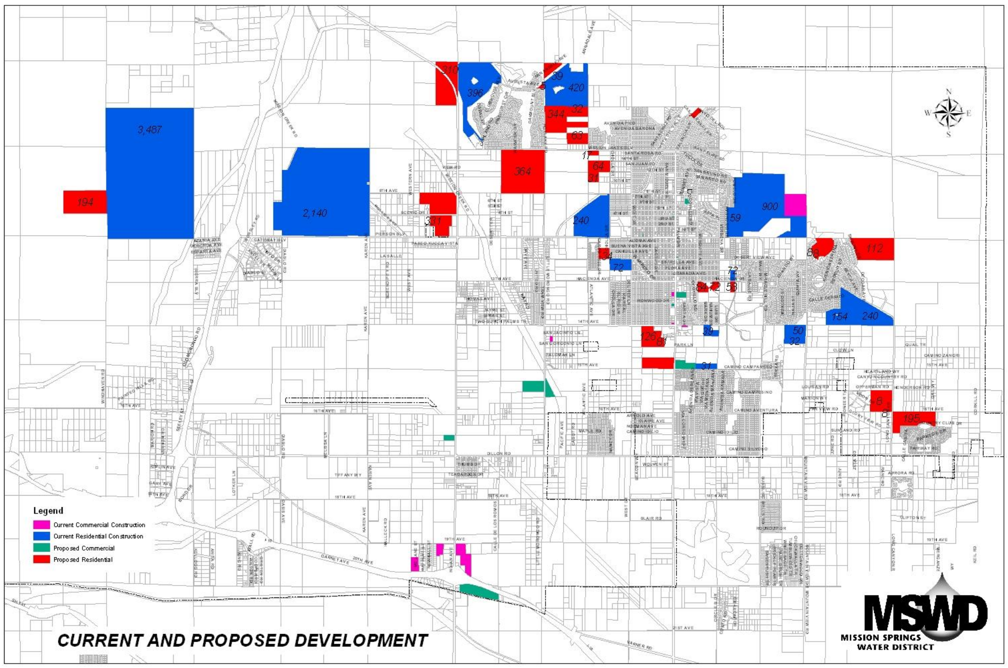
Historical precedent suggests that these levels of growth are possible but not sustainable over the longterm as DHS approaches limitations of available land, infill development buildout and higher land costs that discourage such rapid growth. Uncertainty about SFR growth also increases further out in time. HE adopted the assumptions that MSWD's growth rate in SFR service connections will drop to 25 percent of the initial rate of growth in the baseline scenario and to 50 percent of the initial rate of growth in the high growth scenario. HE did not forecast future MFR, commercial or other types of service connections for this study. HE's baseline forecasts of SFR service connections for the District-wide Total are presented in Table 3-8 below.

Table 3-9
Projected SFR Service Connections, Baseline Scenario, 2005 to 2035

Year	SFR Service Connections
2005	9,140
2010	13,200
2015	17,300
2020	21,400
2025	22,400
2030	23,400
2035	24,400

HE predicts that under the baseline scenario, MSWD will add roughly 820 new SFR service connections per year from 2005 through 2020 followed by about 200 new connections per year from 2020 through 2035. MSWD's map of anticipated new development projects with numbers of housing units expected in each one is displayed in Figure 3-1 below. The map demonstrates that most new development will occur on the fringes of the developed parts of DHS, namely in the northeast and northwest corners of the city, including the far northwest region that surrounds California Highway 62. HE proposes a geographical pattern to this development in its small area forecasts of water demand in Section 4 of this report.

Figure 3-1
MSWD Map of New Development with Proposed Numbers of Housing Units



HE's high growth forecasts of SFR service connections for the District-wide total are presented in Table 3-9 below.

Table 3-10
Projected SFR Service Connections, High Growth Scenario, 2005 to 2035

Year	SFR Service Connections
2005	9,140
2010	15,300
2015	21,500
2020	24,600
2025	27,700
2030	30,800
2035	33,900

HE projects that in the high growth scenario, MSWD will add roughly 1,230 new SFR service connections per year from 2005 through 2015 followed by about 620 new connections per year from 2015 through 2035. Again, most new development will occur on the fringes of the developed parts of DHS, namely in the northeast and northwest corners of the city. HE incorporates these overall baseline and high growth forecasts of SFR service connections into its water demand projections and sets forth a geographical pattern to this development and water demands in its small area water demand forecasts in Section 4 of this report.

3.1.5 Projected population growth

HE projected the District's estimated population based upon its projections of SFR service connections and upon US Census data from 2000 on occupancy rates and density in the Census tracts that encompass MSWD, which are presented in Table 3-10 below. MSWD's Census tracts had a year 2000 weighted average occupancy rate (weighted on occupied housing units) of 74 percent. This means that roughly 74 percent of total housing units in MSWD are occupied year round and are not temporarily vacant or vacant for seasonal use. MSWD's Census tracts had a year 2000 persons per occupied housing unit of 2.7. HE employed these averages to estimate the District's population from 2005 through 2035.

Table 3-11
Total Housing Unit Occupancy Rates and Persons per Occupied Housing Unit for DHS and Census Tracts of MSWD, Year 2000

Geographic Description	Occupancy Rate, year 2000	Persons per Occupied Housing Unit, year 2000
City of Desert Hot Springs	83%	2.80
Census Tract 445.06	69%	2.92
Census Tract 445.07	75%	3.16
Census Tract 445.08	81%	2.47
Census Tract 445.09	81%	2.32
Census Tract 445.10	88%	2.99
Census Tract 445.03	48%	2.39
MSWD Approximation	74%	2.71

Sources: 1990 and 2000 US Census Bureau and 2005 CA Dept Finance for DHS, SCAG for tracts

HE's forecasts of baseline scenario population for the District-wide total are provided in Table 3-11 below. HE projects that MSWD will add roughly 1,600 persons per year from 2005 through 2020 and 400 persons per year each year from 2020 through 2035. This growth is tied closely to new SFR service connections.

Table 3-12
Baseline Scenario MSWD Population Projections, 2005 to 2035

Year	Persons
2005	23,000
2010	31,000
2015	39,000
2020	48,000

Table 3-12
Baseline Scenario MSWD Population Projections, 2005 to 2035

Year	Persons
2025	50,000
2030	52,000
2035	54,000

HE's projections of high growth scenario population for the District-wide total are provided in Table 3-12 below. HE projects that MSWD will add roughly 2,400 persons per year from 2005 through 2015 and 1,200 persons per year each year from 2015 through 2035. This growth is tied closely to new SFR service connections.

Table 3-13
High Growth Scenario, MSWD Population Projections, 2005 to 2035

Year	Persons
2005	23,000
2010	35,000
2015	48,000
2020	54,000
2025	61,000
2030	67,000
2035	73,000

HE projected future population in the District primarily as a means to check the reasonableness of the forecasts of SFR service connections. HE compared MSWD's rate of population growth under these two scenarios with other population forecasts in the Coachella Valley and Riverside County and with historical population growth in the Coachella Valley.

Historic precedent suggests that these levels of growth in MSWD are possible. Indio, Palm Desert and La Quinta have all achieved annual growth rates of higher than 2,400 persons per year, though none of them appear to have sustained such growth for long periods. Palm Springs and Coachella at various times have also reached high growth rates above 1,200 persons per year, though again, the sustainability of such growth over long periods is somewhat questionable. These growth rates are based upon the State of California's annual estimates of population in between official decennial Census counts, so these annual growth rates might be imprecise.

Population and housing forecasts from the Coachella Valley and Riverside County also corroborate HE's projection of SFR service connections in MSWD. The Palm Springs Unified School District estimates that the MSWD will see some 9,400 new SFR homes over the next seven years, through 2012. This equates to a growth rate of 1,340 new homes per year, as compared with HE's high growth scenario rate of 1,230 new homes per years. Similarly, SCAG forecasts through 2030 population growth rates in the Census tracts that encompass MSWD of 1,300 to 2,200 new persons per year.

Riverside County predicts a population growth rate for the county through 2050 of about 2.2 percent from 2000 through 2050, compared with HE's baseline and high growth scenario population growth rates of roughly 2.9 and 3.9 percent, respectively. CVWD's Water Management Plan forecasts an annual population growth rate for the Western Coachella Valley, including Cathedral City, Palm Springs, Palm Desert, Rancho Mirage, Indian Wells and DHS, of 1.6 percent through 2035. The same plan projects future annual permanent (non-seasonal) population growth in the entire CVWD at 1.8 percent through 2035. HE believes that the County and CVWD projections have not been updated to reflect very recent growth experience and developer plans in parts of the Coachella Valley.

3.2 SUMMARY

HE consulted with many experts and community members in MSWD, in DHS and in the Coachella Valley to assess the level of growth that is expected to occur in SFR service connections across the District through 2035. HE analyzed historic growth patterns in the region and other forecasts of growth across the Valley to check the reasonableness of the forecasts. The growth predicted in MSWD is aggressive and sustained, but it appears realistic given developers' intense interest in DHS and MSWD and given the high level of continuing interest in the Coachella Valley for new residents and the businesses that follow them.

Growth patterns in MSWD are changing rapidly at the time of this master plan preparation. MSWD added about 230 single family residential service connections per year from 1991 through 2005, and about 500 connections per year from 2000 through 2005. The City of Desert Hot Springs Planning Department reports, however, a planned 12,300 new single family homes ready to be built from 2005 through 2010 or 2015, at an annual growth rate of 820 to 1,230 single family residential service connections. Neither DHS nor MSWD has experienced such a level of growth before, but other Coachella Valley communities have experienced such growth spurts in the past.

For forecasts of both service connections and water usage in MSWD, HE developed two scenarios: a baseline growth scenario that assumes all proposed residential development as of May 2005 will occur by 2020, or roughly 820 new homes per year; and a second, high growth scenario that assumes this same level of development will occur in only 10 years, by 2015, or 1,230 new homes per year. These scenarios incorporate both new tract development and infill construction as proposed by developers. HE assumed that growth would occur at a constant, absolute number each year over the initial 10 to 15 year building period.

Historical precedent suggests that these levels of growth are possible but not sustainable over the longterm as DHS approaches limitations of available land, infill development buildout, and higher land costs that discourage such rapid growth. This long-term slowdown is not related to cyclicality, which is smoothed out in long term forecasting, but rather diminished capacity for growth. HE adopted the assumptions that MSWD's growth rate in single family residential service connections will drop to 25 percent of the initial rate of growth in the baseline scenario and to 50 percent of the initial rate of growth in the high growth scenario. These two scenarios resulted in average annual growth rates of 510 and 825 new SFR service connections per year, respectively, from 2005 through 2035. HE incorporates these service connection forecasts into projections of future MSWD water demands in Section 4 of this report

4.1 WATER REQUIREMENTS

As of 2004, MSWD served about 10,000 acre-feet of potable water to nearly 11,000 service connections throughout its service zone, including the City of Desert Hot Springs (DHS) and unincorporated Riverside County around DHS, including the Palm Springs Crest and West Palm Springs Village areas. MSWD serves potable water to single family and multifamily residential homes, mobile homes and mobile home parks, commercial businesses such as hotels and retail establishments, schools, MSWD properties, and park and landscape irrigation.[2]

MSWD has experienced significant growth in water use across the District since 1991. The District's annual usage has increased by more than 4,000 acre-feet from 1991 to 2005 as MSWD added more than 3,500 SFR service connections during that period.

4.1.1 Methodology and Data Sources

As part of this master planning process for MSWD, HE prepared profiles of the District's historical growth in water usage for SFR, MFR, commercial and other water usage categories. HE then developed forecasts of MSWD's future growth in those same categories for the District as a whole and for smaller areas within the District.

To profile the District's historical growth in water usage, HE collected data directly from MSWD. The District tracks water usage by type of metered user, including SFR, MFR, commercial classes and other classes of water use, such as irrigation, schools and tract construction water. MSWD also tracks water usage separately for its three water systems, MSWD system, West Palm Springs Village system and Palm Springs Crest system. MSWD then records unaccounted-for-water for the overall system by comparing metered sales to metered water production from the District's groundwater wells. Unaccounted-for-water, as measured by MSWD, includes leaks, evaporation and any mismetering of water usage or water production. Metered sales plus unaccounted-for-water equals total water production, which reflects the District's total demand for water.

From that historical profile of water usage, HE analyzed patterns of water use to determine the water use factors or assumptions that could be applied to develop water demand projections. HE first examined the patterns of SFR usage per service connection per day. In 1991, average annual water use per SFR service connection per day was 481 gallons; by 2004, that usage factor had risen to 563 gallons. MSWD's average gallons per SFR service connection per day over that time period was roughly 520 gallons, which HE incorporated into its projections of water demands from SFR service connections in the District. HE multiplied projected total SFR service connections by 520 gallons per SFR service connection per day throughout each year to derive total SFR water demands through 2035. This average is lower than typical usage since 1998; it assumes future conservation measures that MSWD and DHS will be implementing from 2005 forward, based on discussions with MSWD officials.

[2] This report refers to three systems within the Mission Springs Water District, namely the MSWD system, the West Palm Springs Village System and the Palm Springs Crest System. Although traditionally the Mission Springs Water District is referred to as MSWD, for purposes of distinguishing between the MSWD system and the District, when referring to the District as a whole, this report uses the term, District wide total.

In 2004, MSWD adopted two major conservation policy statements: a water conservation master plan and water efficient landscaping guidelines. The water conservation master plan identifies several key areas in which MSWD will pursue more efficient water use practices, namely: efficient landscaping guidelines (adopted three months after the master plan); efficient landscaping requirements for new development; landscape education center and xeriscape demonstration garden; efficient landscaping incentives; conservation education programs in schools, community and bimonthly billing information; tiered water pricing that encourages conservation; updated water shortage ordinance; water audits for the largest users; and rebates for water efficient plumbing fixtures. The District intends to strongly pursue these conservation measures over the coming years; therefore, HE adopted this lower average water use factor for SFR service connections to reflect those future water savings.

HE analyzed the District's unaccounted-for-water, as well, and determined that from 1999 through 2005, the proportion of total demand estimated to be unaccounted-for-water had risen, from about 8 percent in 1999 to 11 percent in 2005. HE adopted a 10 percent unaccounted-for-water use factor for 2005 that will drop to 8 percent by 2010 through 2035 as MSWD aggressively invests in significant capital improvements as a part of this master planning process. HE applied this loss factor to total metered water demands from all sectors to derive MSWD's total water demands for each year through 2035. In its water conservation master plan, MSWD has identified several important operational improvements that will lead to savings of unaccounted for water, namely: better infrastructure operations and maintenance, including leak detection and repairs, metering and meter replacement, system flushing, tank cleaning and maintenance and valve maintenance and mapping; recycled water program for irrigation of large spaces; and reclamation of highly mineralized groundwater.

HE evaluated MFR water usage with respect to planned MFR development within the District. As of May 2005, developers had proposed 110 new MFR housing units, and HE applied similar growth assumptions for MFR housing units as for SFR service connections. Under the baseline scenario, developers will build all 110 MFR units by 2020, and then the growth rate will drop to 25 percent of that initial rate with another 30 MFR units by 2035. These 140 MFR units represent an increase in MFR units within the District of about 7 percent, which HE assumed as the increase in MFR water demands by 2035, applied in a straightline increase from 2005. Longer term, MFR might accelerate, but there is no basis for assuming that increase in this master plan. Similarly, under the high growth scenario, HE assumed that developers will build the 110 proposed MFR housing units by 2015, followed by a drop in the MFR growth rate to 50 percent of the initial rate, with an additional 110 units built through 2035. Those 220 MFR units represent a 10 percent increase in MFR housing units, which HE applied to increase the District's MFR water demands through 2035 on a straightline basis.

HE examined commercial and other water usage in relation to SFR water usage, which makes up the majority of MSWD's demand and which appears to drive these other two categories of water use. From 1992 through 2005, commercial water use as a proportion of SFR water use held fairly constant at around 16 percent. HE assumed commercial water demands will remain at this proportion to SFR water demands through 2035 under both scenarios. From 1992 through 2005, other water use as a proportion of SFR water use rose slowly, with some variation, from around 20 percent to over 30 percent in that 13 year period. HE assumed that other water use as a proportion of SFR water use will continue to rise slowly from 2005 through 2035 in a similar fashion, from 29 percent in 2005 to 31 percent in 2035, under both scenarios. By bringing together projections of future SFR, MFR, commercial and other water demands across the District and by then applying the unaccounted-for-water use factor described above, HE completed its forecasts of total future water demands for MSWD through 2035.

In its final step of water demand projections, HE developed and applied a strategy to allocate these District-wide demands to smaller areas throughout MSWD. The small area forecasts began with an allocation of demands between the MSWD, West Palm Springs Village (WPSV) and Palm Springs Crest (PSC) water systems. HE examined the relative proportion of total District water demands that each system comprised each year from 1991 through 2004. The proportions trended toward 98.5 percent of total water demands for the MSWD system, 1 percent for the WPSV system and 0.5 percent for the PSC system. HE held these proportions constant through 2035 under both scenarios. Under the baseline scenario, this assumption results in growth of about 7 and 5 new SFR service connections per year in the WPSV and PSC systems, respectively. Under the high growth scenario, the consequent growth rate is about 10 and 8 new SFR service connections per year for the WPSV and PSC systems, respectively. Longer term, it is possible that growth is these other areas might increase, but HE has no basis for incorporating that assumption into these projections.

HE then developed an allocation strategy to small areas for the water demands of the MSWD system. HE relied primarily on MSWD's new development map (please see Table 3-9) to locate current water usage using visual densities implied on the map and to locate future water usage based on where and how many new SFR housing units developers propose to build across the District. HE first assigned proportions of current and future water usage to each Census tract that comprises MSWD, and all new growth is expected to occur within these tracts. The final step was to assign proportions of current and future water use to the various small areas, or pressure zones, within each Census tract in the same manner of visual densities for current water use and location of future growth for new water use. Not all growth is anticipated to occur within existing MSWD pressure zones, so HE assigned any new growth outside these existing zones to the nearest practical pressure zone for allocation purposes. Finally, HE tallied the demands from each Census tract in each pressure zone to develop total MSWD system water demands through 2035 for each pressure zone across the system.

4.1.2 Historical Water Use

Data on past annual total water use and production for the MSWD system are presented in Table 4-1 below.

Table 4-1
Annual Water Use and Production in the MSWD System, 1991 to 2004

Year	Annual Water Usage (ac-ft)					Annual Production (ac-ft)
	SFR	MFR	Commercial	Other	Total	
1991	2,990	1,180	853	498	5,521	—
1992	3,083	1,294	538	794	5,708	—
1993	3,215	1,300	539	779	5,833	6,562
1994	3,753	1,614	640	1,086	7,093	6,784
1995	3,533	1,290	602	742	6,167	6,723
1996	3,736	1,376	693	863	6,668	7,142

Table 4-1
Annual Water Use and Production in the MSWD System, 1991 to 2004

Year	Annual Water Usage (ac-ft)					Annual Production (ac-ft)
	SFR	MFR	Commercial	Other	Total	
1997	3,639	1,279	636	912	6,467	7,146
1998	3,523	1,209	583	870	6,186	7,241
1999	3,787	1,369	671	1,146	6,973	7,627
2000	3,955	1,578	719	1,057	7,309	7,854
2001	3,928	1,457	665	1,083	7,133	7,843
2002	4,108	1,435	669	1,162	7,374	8,102
2003	4,318	1,468	690	1,097	7,572	8,567
2004	4,944	1,548	715	1,647	8,854	10,039

SFR water use increased by nearly 4 percent per year between 1991 and 2004, while MFR and commercial water use increased much more slowly. Other water use proliferated notably over this time (and more quickly than SFR) as the demand for irrigation, schools and tract construction water rose in response to SFR development. District water production increased at about 4 percent annually.

Data on historical annual total water use and production in the WPSV system are presented in Table 4-2.

Table 4-2
Annual Water Use and Production in the West Palm Springs Village System, 1991 to 2004

Year	Annual Water Usage (ac-ft)					Annual Production (ac-ft)
	SFR	MFR	Commercial	Other	Total	
1991	32	0	0	50	82	—
1992	34	0	0	50	84	—
1993	35	0	0	51	86	107
1994	49	0	0	68	117	120
1995	46	1	0	51	98	113
1996	48	0	0	37	85	95
1997	50	1	0	42	93	103
1998	44	0	0	40	84	92
1999	46	0	0	27	73	84
2000	48	0	0	36	85	104
2001	47	0	0	41	87	78
2002	53	0	0	44	97	123
2003	51	0	0	45	96	114
2004	56	0	0	33	89	99

SFR water use increased by about 4.3 percent per year between 1991 and 2004, while MFR and commercial water use both decreased over the same period. Other water use also declined from 1991 through 2004, as did groundwater production.

Data on historical annual total water use and production in the PSC system are presented in Table 4-3.

Table 4-3
Annual Water Use and Production in the Palm Springs Crest System, 1991 to 2004

Year	Annual Water Usage (ac-ft)					Annual Production (ac-ft)
	SFR	MFR	Commercial	Other	Total	
1991	17	5	0	0	23	—
1992	22	8	0	0	30	—
1993	27	9	0	0	37	47
1994	29	10	0	0	39	52
1995	26	10	0	0	36	52
1996	25	18	0	0	42	55
1997	25	16	0	0	41	48
1998	26	14	0	0	41	49
1999	30	14	0	0	46	51
2000	32	13	0	0	45	53
2001	34	16	0	0	50	59
2002	36	15	0	0	51	58
2003	35	10	0	0	45	55
2004	39	11	0	0	50	59

SFR water use increased by about 6.6 percent per year between 1991 and 2004, while MFR water use increased somewhat more slowly, and commercial and other water use remained absent in this system. Water production increased at about 2.1 percent annually.

Finally, summary data on historical annual water use and production for the District-wide total are presented in Table 4-4.

Table 4-4
Annual Water Use and Production for the District-Wide Total, 1991 to 2004

Year	Annual Water Usage (ac-ft)					Annual Production (ac-ft)
	SFR	MFR	Commercial	Other	Total	
1991	3,039	1,185	853	548	5,626	—
1992	3,139	1,302	538	844	5,823	—
1993	3,278	1,309	539	830	5,956	6,716
1994	3,831	1,624	640	1,154	7,249	6,957
1995	3,605	1,301	602	793	6,301	6,889
1996	3,808	1,394	693	900	6,795	7,292
1997	3,714	1,296	636	954	6,601	7,297
1998	3,594	1,224	583	910	6,311	7,382
1999	3,863	1,384	671	1,175	7,092	7,763
2000	4,035	1,591	719	1,094	7,439	8,010
2001	4,009	1,474	665	1,124	7,271	7,979
2002	4,197	1,450	669	1,207	7,523	8,283

Table 4-4
Annual Water Use and Production for the District-Wide Total, 1991 to 2004

Year	Annual Water Usage (ac-ft)					Annual Production (ac-ft)
	SFR	MFR	Commercial	Other	Total	
2003	4,405	1,478	690	1,141	7,714	8,736
2004	5,039	1,558	715	1,679	8,992	10,197

SFR water use across the District increased by about 4 percent per year between 1991 and 2004. MFR and commercial water use grew more slowly and comprised about 25 percent of water use by 2005. Other water use increased considerably over this same time period as demand for schools, irrigation and tract construction water increased in response to SFR water use. Water production increased by about 4 percent annually.

Growth in SFR and other water use for the District-wide Total has been increasing across the District but primarily in the MSWD system over the past 15 years. Growth in MFR and commercial water use has been much slower as demand for that type of housing and the commercial services to meet residential growth has been limited. Experts, developers and community members expect that demand for additional SFR water use and the commercial services and other water uses, such as irrigation and tract construction water, will increase dramatically over the next 15 years. Water production has increased to meet demands and will continue to do so into the future.

Water demands in MSWD appear to have some seasonality, but because MSWD tracks water usage bimonthly, those seasonal patterns are somewhat unclear. In most years, the months of peak usage are September-October. The shoulder months of higher usage vary, beginning in May-June to July-August and ending in November-December or January-February. The usefulness of forecasting seasonality patterns into the future is limited, given this situation.

4.1.3 Future Water Use

HE developed one water use factor from these historical data, namely the 520 gallons per SFR service connection per day mentioned earlier, that it incorporated into water demand forecasts. To forecast MFR, commercial and other water uses, HE incorporated proportional analysis based on SFR and MFR development in the District.

HE projected future SFR water use was based on information from MSWD and the DHS Planning Department about new development in the DHS area, combined with the 520 gallons per SFR service connection per day water usage factor. HE's baseline scenario forecasts of water use by category plus total water demands, including unaccounted-for-water, for the District-wide Total are presented in Table 4-5 below.

Table 4-5
Projected Baseline Scenario, Water Use by Category and Total Water Demands,
District-Wide Total, 2005 to 2035, in Acre-Feet per Year

Year	SFR	MFR/Mobile	Commercial	Other	Total	Total with Losses
2005	5,300	1,500	800	1,500	9,100	10,100

Table 4-5
Projected Baseline Scenario, Water Use by Category and Total Water Demands, District-Wide Total, 2005 to 2035, in Acre-Feet per Year

Year	SFR	MFR/Mobile	Commercial	Other	Total	Total with Losses
2010	7,700	1,500	1,200	2,300	12,700	13,800
2015	10,100	1,600	1,600	3,000	16,300	17,700
2020	12,500	1,600	2,000	3,800	19,900	21,600
2025	13,000	1,600	2,100	3,900	20,600	22,400
2030	13,600	1,600	2,200	4,100	21,500	23,400
2035	14,200	1,600	2,300	4,400	22,500	24,500

HE projects that under the baseline scenario, MSWD will realize more than 14,000 acre-feet of additional water demands by 2035, including unaccounted-for-water, driven primarily by SFR growth. Almost all the new SFR development and water demands will locate on the fringes of the developed parts of DHS, namely in the northeast and northwest corners of the city, including the far northwest region that surrounds California Highway 62.

HE's high growth scenario projections of water use by category and total water demands, including unaccounted-for-water, for the District-wide total are presented in Table 4-6 below.

Table 4-6
Projected High Growth Scenario, Water Use by Category and Total Water Demands, District-Wide Total, 2005 to 2035, in Acre-Feet per Year

Year	SFR	MFR/Mobile	Commercial	Other	Total	Total with Losses
2005	5,300	1,500	800	1,500	9,100	10,100
2010	8,900	1,500	1,400	2,600	14,400	15,700
2015	12,500	1,500	2,000	3,700	19,700	21,400
2020	14,300	1,600	2,300	4,300	22,500	24,500
2025	16,100	1,600	2,600	4,900	25,200	27,400
2030	17,900	1,600	2,900	5,500	27,900	30,300
2035	19,700	1,700	3,200	6,000	30,600	33,300

HE projects that under the high growth scenario, MSWD annual water demands will increase by more than 23,000 acre-feet by 2035, including unaccounted-for-water, driven primarily by SFR growth. Again, most of the new SFR development and water demands will locate on the fringes of the developed parts of DHS, namely in the northeast and northwest corners of the city, including the far northwest region that surrounds California Highway 62.

4.1.4 Small Area Water Use Forecasts

HE developed small area forecasts for MSWD based on a proportional analysis of overall District water demands allocated first between the three water systems, MSWD, WPSV and PSC, and then between the six US Census tracts in the District, and finally between the small areas, or pressure zones, scattered across the District. The final results of this allocation of total water demands across the District's three water systems under the baseline scenario are displayed in Table 4-7 below.

Table 4-7
Total Water Demand Projections for the Three MSWD Systems,
Baseline Scenario, in Acre-Feet per Year

Year	MSWD	WPSV	PSC	Total
2005	9,950	100	50	10,100
2010	13,590	140	70	13,800
2015	17,430	180	90	17,700
2020	21,280	220	110	21,610
2025	22,060	220	110	22,390
2030	23,050	230	120	23,400
2035	24,130	250	120	24,500

Note: Totals may not sum exactly due to rounding.

The bulk of growth in water demands under the baseline scenario will occur within the MSWD system. Growth in the WPSV and PSC systems will be slow and negligible compared with total District water demands. The results of the allocation of total water demands across the District's three systems under the high growth scenario are displayed in Table 4-8 below.

Table 4-8
Total Water Demand Projections for the Three MSWD Systems,
High Growth Scenario, in Acre-Feet per Year

Year	MSWD	WPSV	PSC	Total
2005	9,950	100	50	10,100
2010	15,460	160	80	15,700
2015	21,080	210	110	21,400
2020	24,130	250	120	24,500
2025	26,990	270	140	27,400
2030	29,850	300	150	30,300
2035	32,800	330	170	33,300

Note: Totals may not sum exactly due to rounding.

HE also allocated total water demands under both scenarios to the small areas, or pressure zones, scattered throughout MSWD. The results of that allocation under the baseline and high growth scenarios are displayed in Tables 4-9 and 4-10, respectively, on the next page.

HE estimates that the most significant growth in water demands will occur in the Gateway, Terrace, Mission Lakes, Northridge and Annandale pressure zones. These zones cover the northeast and northwest corners of DHS and the far northwest corner of MSWD around California Highway 62 that will experience the most notable SFR development. Other zones will also experience some growth but on a much smaller scale. These growth patterns hold true under both the baseline and high growth scenarios.

Table 4-9
Total Water Demand Forecasts by MSWD Pressure Zones, Baseline Scenario, in Acre-Feet per Year

Year	Quail	Valley View	Reduced Valley View East	Overhill	Reduced Overhill East	Gateway	Two Bunch	Terrace	Desert View	Redbud	Highland	Mission Lakes	Vista	Reduced Vista	Northridge	Reduced Northridge	Annandale	Reduced Annandale	Total
2005	460	330	70	260	70	200	1,210	2,540	1,040	300	100	420	700	140	1,120	230	730	50	9,970
2010	520	330	110	260	70	1,300	1,290	2,670	1,150	300	150	590	700	140	1,540	230	2,200	60	13,610
2015	590	330	150	260	70	2,460	1,380	2,810	1,270	300	200	770	700	140	1,980	230	3,750	70	17,460
2020	860	440	150	370	70	3,340	1,520	2,940	1,280	300	270	900	830	140	2,310	240	5,290	70	21,320
2025	910	460	150	390	70	3,510	1,560	3,000	1,280	300	280	920	850	140	2,370	240	5,580	70	22,080
2030	980	490	150	420	70	3,730	1,620	3,070	1,280	300	300	950	880	140	2,450	240	5,950	70	23,090
2035	1,060	520	150	450	70	3,970	1,680	3,140	1,280	300	320	980	910	140	2,530	240	6,350	70	24,160

Note: Pressure zones Reduced Valley View West and Reduced Overhill West have no service provided to them and are not included in these small area forecasts.
Source: Harvey Economics, 2005.

Table 4-10
Total Water Demand Forecasts by MSWD Pressure Zones, High Growth Scenario, in Acre-Feet per Year

Year	Quail	Valley View	Reduced Valley View East	Overhill	Reduced Overhill East	Gateway	Two Bunch	Terrace	Desert View	Redbud	Highland	Mission Lakes	Vista	Reduced Vista	Northridge	Reduced Northridge	Annandale	Reduced Annandale	Total
2005	460	330	70	260	70	200	1,210	2,540	1,040	300	100	420	700	140	1,120	230	700	50	9,890
2010	560	330	130	260	70	1,860	1,340	2,730	1,200	300	170	680	700	140	1,760	230	2,930	60	15,390
2015	670	330	190	260	70	3,560	1,470	2,920	1,360	300	250	950	700	140	2,410	230	5,190	70	21,000
2020	900	410	190	340	70	4,230	1,630	3,080	1,370	300	300	1,050	800	140	2,660	240	6,350	70	24,060
2025	1,110	490	190	420	70	4,850	1,780	3,230	1,380	300	350	1,140	890	140	2,890	250	7,430	70	26,910
2030	1,320	570	190	500	70	5,470	1,930	3,380	1,390	300	400	1,230	980	140	3,120	260	8,510	70	29,760
2035	1,530	650	190	580	70	6,110	2,090	3,530	1,400	300	450	1,330	1,080	140	3,360	270	9,630	70	32,710

Note: Pressure zones Reduced Valley View West and Reduced Overhill West have no service provided to them and are not included in these small area forecasts.
Source: Harvey Economics, 2005.

4.2 SUMMARY

Assuming current trends continue, HE projects significant growth in water demands for MSWD over the next 30 years, driven primarily by SFR development. Under the baseline scenario, the District’s annual water demands will grow by more than 14,000 acre-feet by 2035, whereas under the high growth scenario, MSWD will face new water demands of about 23,000 acre-feet annually. The growth will focus in the northeast and northwest corners of the District, where there is open and attractive land and where developers are planning to build thousands of new housing units. Growth in MFR and commercial demands will be modest, but other water demands will continue to increase in response to SFR development and irrigation. Overall, these significant increases in water demands will require considerable investments in new infrastructure.

5.1 INTRODUCTION

The MSWD Service zone consists of three separate water supply and distribution systems, which are defined by the California Department of Health Services as:

- MSWD System-the largest water system, which includes the City of Desert Hot Springs and several surrounding smaller communities including Painted Hills.
- Palm Springs Crest System-the eastern most of the two small systems
- West Palm Springs Village System-the western most of the two small systems

The existing MSWD System is a combination of water distribution systems, some of which are interconnected and others that are completely independent. The Palm Springs Crest and West Palm Springs Village systems are located about 5 miles from the Desert Hot Springs System and there are no interconnects between the systems. Because of the distance and topographical constraints, there are currently no plans to integrate these three systems together.

The primary source of water supply for each of the three water systems is groundwater obtained through production wells. Figure 5-1 illustrates the location of these wells to serve the water systems described above. The MSWD Service area currently includes seven wells that supply the MSWD System, with two additional wells being installed in 2005, and two wells each for the Palm Springs Crest System and the West Palm Springs Village System.

An emergency source of water for MSWD is the Coachella Valley Water District (CVWD). MSWD currently has two inter-connections with the CVWD that can be used to provide emergency water to the MSWD System on a temporary and very limited basis.

A third source of water is obtained through an agreement between the Desert Water Agency (DWA) and the Metropolitan Water District of Southern California (MWD) to exchange Colorado River water for State Water Project (SWP) water. DWA obtains this water through a turnout from the Colorado River Aqueduct and manages a recharge facility near the turnout that enables the water (when it is available) to replenish the aquifer used by MSWD. The MSWD water supply must be capable of meeting a full range of domestic and fire flow water demands. As described in Section 3, the population of the study area has been growing at a very fast pace for the last five years, and is forecasted to continue for the next twenty years. The current and projected average annual daily and maximum day water demands for the MSWD are presented in Table 5-1.

Section 5 discusses the existing hydrogeologic setting for the MSWD Service area, the ability of the existing production well systems to meet current demand, the need for additional wells to meet projected demands over the twenty-year study period, and six other water sources available to MSWD to bolster its groundwater supply.

5.2 HYDROGEOLOGIC SETTING

Groundwater is the primary source of water for the MSWD, thus an understanding of the existing hydrogeologic setting is useful for understanding the water supply issues facing MSWD.

Insert

Figure 5-1

Existing Wells and Wells in Design / Construction

Table 5-1

Current and Projected Water Demands (High Growth Scenario)

Study Year	Annual Demand (Ac-Ft/year)	ADD (mgd)	MDD (mgd)
MSWD System			
2005	9,940	8.88	17.75
2010	15,450	13.79	27.59
2015	21,070	18.81	37.63
2020	24,130	21.55	43.09
2025	26,980	24.09	48.18
West Palm Springs Village System			
2005	100	0.09	0.18
2010	160	0.14	0.29
2015	210	0.19	0.38
2020	250	0.22	0.45
2025	270	0.24	0.48
Palm Springs Crest System			
2005	50	0.04	0.09
2010	80	0.07	0.14
2015	110	0.10	0.20
2020	120	0.11	0.21
2025	140	0.13	0.25

Source: Harvey Economics, 2005

5.2.1 Groundwater Basins

MSWD is located in the northwestern portion of the Upper Coachella Valley, in eastern Riverside County. Its service zone contains a portion of the Upper Coachella Groundwater Basin and includes Mission Creek Sub-Basin, Garnet Hill Sub-Basin, Whitewater Sub-Basin, San Gorgonio Pass Sub-Basin, and the Desert Hot Springs Sub-Basin, as presented in Figure 5-1. These sub-basins were formed by the large and active faults that make up the San Andreas Fault system. All of the sub-basins, except for Desert Hot Springs, are “cold-water” basins that can provide potable water. The Desert Hot Springs Sub-Basin is a “hot-water” basin that is highly mineralized, with water temperatures exceeding 100 degrees Fahrenheit. This water is very valuable to the local economy, as it is the lifeblood of the numerous spa resorts and hotels within the city of Desert Hot Springs.

Although the MSWD service area boundary overlies several sub-basins, Figure 5-1 indicates that currently all of the producing water supply wells for the MSWD system are located within the Mission Creek Sub-Basin. The Palm Springs Crest System and the West Palm Springs Village System are both supplied by wells that draw from the Cabazon Storage Unit of the San Gorgonio Pass Sub-Basin.

The Mission Creek Sub-Basin is located between the Desert Hot Springs Sub-Basin and the Garnet Hill Sub-Basin and covers about 77 square miles. It is bounded on the south by the Banning Fault, on the north and east by the Mission Creek Fault, and on the west by limited water-bearing rocks of the San Bernardino Mountains. Differential movement along these faults has created effective barriers to groundwater flow by deforming the sedimentary deposits and displacing water-bearing deposits[SDM1].

The San Gorgonio Pass Sub-Basin is formed by the San Bernardino Mountains to the north and the San Jacinto Mountain Range to the south. The Banning Fault lies on the north edge of the sub-basin. The eastern edge of this sub-basin, where it abuts the Whitewater Sub-Basin, is not clearly defined. The Cabazon Storage Unit occupies an area of approximately 20 square miles.

The Desert Hot Springs Sub-Basin is located between the San Bernardino Mountains to the north and the Mission Creek Sub-Basin. It is bounded on the south by the Mission Creek Fault. As mentioned previously, it is a producer of mineralized, hot water that feeds the local spa resort industry. The water temperatures of 34 wells measured in the spring of 1961 (DWR) ranged from 82 degrees F to 200 degrees F, with the average value being 118 degrees F. Some of the thermal water in this sub-basin moves through the Mission Creek Fault and may have an effect on the wells in the northern part of the Mission Creek Sub-Basin.

The Garnet Hill Sub-Basin is located between the Mission Creek Sub-Basin and the Whitewater Sub-Basin, and is defined by the Garnet Fault to the south and the Banning Fault to the north.

The main water bearing units of the local sub-basins are relatively undisturbed and un-consolidated Holocene and late Pleistocene alluvial deposits, and terrace deposits. These deposits form alluvial fans due to erosion from the surrounding San Bernardino and Little San Bernardino Mountains. The individual beds are lenticular in shape and not extensive, but coalesce with other beds to form larger water bearing areas. Water bearing units include Pleistocene, Cabazon fanglomerate, and Ocotillo conglomerate formations and Upper Pleistocene and Holocene alluvium.

Sediments are reported to be as deep as 7000 feet in the Coachella Valley (California Department of Water Resources (DWR) Bulletin No. 118 (2004)). However, these sediments are only as deep as 4600 feet under the MSWD Service zone. The water bearing deposits, which include the Ocotillo conglomerate, Cabazon fanglomerate, and alluvium, range up to 2000 feet thick in some parts of the Mission Creek Sub Basin. Water quality becomes more saline at depth and poor hydraulic connection exists between shallow and deeper deposits. Some confined conditions exist as indicated by flowing wells; however, much of the groundwater may occur in an unconfined state throughout the sub-basin. GTC (1979) indicates that the thickness of the water bearing sediments is estimated to range from 600 feet to 1100 feet.

5.2.2 Groundwater Levels and Pumping

The San Andreas Fault system has a dramatic impact on groundwater levels within MSWD. Previous studies have shown that the various faults that make up the fault system act as effective barriers to groundwater flowing from north to south through the area. Groundwater levels and sometimes temperatures on the north and south sides of each fault are significantly different. Groundwater levels are generally higher on the north side of the fault because of its barrier effect, to the extent that springs have been recorded on the north. Thus the groundwater levels within the Mission Creek Sub-Basin are generally higher in the southern portion of the sub-basin because of the influence of the Banning Fault. On the other hand, groundwater temperatures in the sub-basin are generally higher to the north because of the influence of the Desert Hot Springs Sub-Basin.

Existing groundwater levels vary throughout the Mission Creek Sub-Basin. Psomas (2004) reports that water levels in domestic wells range from about 140 feet to 720 feet below ground surface, with the average depth to water being 372 feet. Based on information obtained from selected MSWD wells across the sub-basin, 2004 groundwater levels ranged from 698 to 718 feet above mean sea level (msl). Figure 5-2 presents the 2004 groundwater elevation contour map for the portion of the Mission Creek Sub-Basin where the most groundwater pumping is occurring. (Psomas, 2004).

Groundwater is extracted from the Mission Creek Sub-Basin both by public agencies (MSWD and CVWD) and by private entities such as golf courses, resorts, and domestic wells. Psomas (2004) reports that public well pumping extracts the highest amount of groundwater annually, followed by private golf course and resort pumping. The amount of domestic pumping is difficult to estimate due to the lack of a comprehensive data on well locations, current use, and pumping rates.

In 2003, MSWD reported groundwater extraction in the Mission Creek Sub-Basin to be 8,567 acre-feet for MSWD and 4,425 acre-feet for CVWD. Psomas (2004) reported that the major private users, including Hidden Springs Country Club, Mission Lake Country Club, and Desert Sand Resort, extracted approximately 1,510 acre-feet of groundwater. Pumping from the domestic wells in the MSWD system was estimated by Psomas (2004) to be 225 acre-feet (200 wells each extracting groundwater at a rate of 1,000 gallons per day). The combined groundwater extraction from all wells in the sub-basin for 2003 is thus estimated at 14,727 acre-feet per year.

Water levels in the eastern portion of the Cabazon Storage Unit, which supplies water to the Palm Springs Crest and West Palm Springs Village systems, can be inferred from measurements in MSWD Well Nos. 25, 25A, 26, and 26A. Slade (2000) indicates that water levels in Well Nos. 25 and 26 vary in response to the amount of precipitation, and actually rose between 1967 and 1998. Since 2001, however, water levels in Well 25 and Well 26 have fallen 17 feet and 15 feet, respectively.

The MSWD is currently supplied by a total of 11 wells that feed the various distribution systems, with two more wells planned to be placed in service in 2005/2006. The locations of the wells can be seen in Figure 5-1. Table 5-2 provides the pressure zone served, horsepower, pump setting, and the capacity for each well.

MSWD System: The MSWD System is served by seven existing wells and two new wells that are to be completed in 2005/2006. The nine wells will have a total estimated pumping capacity of 13,175 gallons per minute (gpm), or about 19 million gallons per day (mgd). These wells are scattered throughout the water distribution system, and all but one are located in the Mission Creek Sub-Basin. One of the new wells, the Garnet Well, is located in the Garnet Hill Sub-Basin.

Insert

Figure 5-2
2004 Groundwater Elevations

Table 5-2

Existing Well Information, MSWD Service Zone

Well Designation	Pressure Zone Served	Motor (hp)	Pump Setting (ft)	Capacity (gpm)	Capacity (mgd)	Capacity (ac ft/yr)	Efficiency (%)
				MSWD System			
22	Terrace	400	493	1,750	2.52	2,822	72.8
24	Terrace	600	529	1,200	1.73	1,938	51.3
27	Valley View	200	262	1,100	1.58	1,770	66.8
28	Annandale	600	632	1,900	2.74	3,058	65.9
29	Terrace	350	403	1,700	2.45	2,744	74.0
30	Mission Lakes	250	655	825	1.19	1,333	66.8
31	Two Bunch	350	250	1,900	2.73	3,058	69.1
32 (Little Morongo)	913	—	—	2,000	2.88	3,226	—
33 (Garnet)	913	—	—	800	1.15	1,288	—
	Subtotal			**13,175**	**18.97**	**21,246**	—
				West Palm Springs Village System			
26	W. Palm Springs Village	100	245	350	0.50	560	52.4
26A	W. Palm Springs Village	30	450	170	0.25	280	—
	Subtotal			**520**	**0.75**	**840**	—
				Palm Springs Crest System			
25	Palm Springs Crest	125	420	400	0.79	885	61.9
25A	Palm Springs Crest	40	500	175	0.27	302	69.8
	Subtotal			**575**	**1.06**	**1187**	—
	TOTAL			**14,285**	**20.78**	**23,275**	—

Source: MSWD, 2005, including efficiencies generated by Southern California Edison.

The calculation of the total existing water supply capacity includes the following new wells:

§ Well 32 (Little Morongo), located just west of Little Morongo Road and north of Dillon Road, is scheduled to be on line by July 2005. This well will serve the 913 Pressure Zone, and tests have shown it to be an excellent producer. Rated capacity will be at 2,000 gpm, but the measured production is 3,500 gpm with about 26 feet of drawdown.

§ Well 33 (Garnet), located just west of Little Morongo Road and north of 20th Avenue, is in the Garnet Hill Sub-Basin and is scheduled to be on line by the first quarter of 2006. This well will also serve the 913 Pressure Zone. Tests have shown that the rated capacity will only be about 800 gpm.

Palm Springs Crest System: Two wells, Well 25 and Well 25A, are currently the only sources of water supply for the Palm Springs Crest System. Well 25 has been in operation since 1958, whereas Well 25A was installed in September 2002 to provide a redundant source of water.

West Palm Springs Village System: Two wells, Well 26 and Well 26A, are the only sources of water supply for the West Palm Springs Village System. Well 26 has been in operation since 1928, and is currently the main source of water for this system. Well 26A was installed in November 2001 to provide a redundant source of water. This well was shut down in early 2002 because high uranium concentrations, originating from natural sources, were measured in the water from the well. MSWD has recently installed a wellhead treatment system that reduces uranium levels to below drinking water standards.

5.2.3 Water Balance

Regional groundwater levels in the Mission Creek Sub-Basin have been declining since the early 1950s due to scarce annual precipitation and groundwater extractions, and numerous studies have been undertaken to evaluate historical impacts and estimate likely future impacts to groundwater levels in the sub-basin. Groundwater level data indicate that since 1952, groundwater levels have declined at a rate of 0.5 to 1.5 feet per year. Multiple investigators, considering different time periods, have estimated rates of overdrafting from the aquifer between 3,900 and 12,884 acre-feet per year. Slade (2000) calculated the loss of groundwater from the sub-basin as 5,340 acre-feet per year between 1978 and 1997. This estimate was based on a previous GTC (1979) report and an evaluation of historical water records for CVWD Well No. 3407, which showed a 1½-foot-per-year decline in groundwater levels. Krieger and Stewart (2005) used the Slade/GTC assumptions and more recent groundwater levels (1998 through 2004) to estimate an overdrafting rate of 9,700 acre-feet per year for the northwesterly three-quarters of the sub-basin, and 12,884 acre-feet per year for the entire sub-basin.

Because of continued concerns over the consistent drop in groundwater levels, MSWD hired Psomas to further evaluate the loss of groundwater in storage. In their study, Psomas (2004) used two methods, which agreed well, to analyze groundwater levels in the Mission Creek Sub-Basin. The Psomas study suggests that the Mission Creek Sub-Basin is being overdrafted at a rate of 3,900-4,400 acre-feet per year. It should be noted that Psomas did not include any groundwater recharge using imported water in its water balance calculation, such as the 4,700 acre-feet of water that was recharged in November and December of 2002 via the Mission Creek recharge facility. Psomas had concerns about the reliability of this source since it depends upon the availability of water from MWD and the exchange agreement with DWA.

However, the most recent revision to the MSWD's Urban Water Management Plan (UWMP, or Plan) (2006) recognizes the existence and operation of the MSWD's groundwater recharge facilities as an element of the basin wide groundwater system, helping to offset declines in basin groundwater levels. Additionally, the Plan accounts for recharge from treated wastewater. Table 5-3 below shows the anticipated future groundwater balance of the Mission Springs Sub-Basin aquifer as determined in the 2005 UWMP.

Table 5-3
(Table 4.2-1 of 2005 Urban Water Management Plan)
MSWD Water Balance
(AF – all numbers rounded to nearest 100 AF)

Year	Mission Creek Sub-Basin Recharge[1]	CVWD Sub-Basin Production[2]	Surplus GW Recharge[3]	Total MSWD Demand[4]	Recharge from 35% Return Flow[5]	Net Recharge Available [6]	Total MSWD GW Demand[7]	Net Balance [8]
2005	27,000	5,000	22,000	9,200	3,200	25,200	9,200	16,000
2010	11,200	4,000	7,200	14,400	5,000	12,200	14,400	(2,200)
2015	14,100	5,500	8,600	19,800	6,900	15,500	17,800	(2,300)
2020	16,100	7,100	9,000	22,500	7,900	16,900	17,200	(300)
2025	17,800	8,900	8,900	25,200	8,800	17,700	19,100	(1,400)
2030	19,100	10,700	8,400	27,900	9,800	18,200	21,200	(3,000)

[1] From Table 2-13 in CVWD 2005 UWMP for Mission Creek Spreading Facility; 2005 value from Nov. 9, 2005 email from Dave Luker (General Manager of DWA) to Arden Wallum (General Manager of MSWD)

[2] From Table 3-3 in CVWD 2005 UWMP for Mission Creek Sub-Basin

[3] Difference between Mission Creek Sub-basin Recharge and CVWD Production

[4] Total Projected MSWD demand including recycled water demand (refer to subsequent tables in this section)

[5] Naturally occurring recharge from return flow (35% of Total MSWD Demand)

[6] Net Recharge Available = Surplus GW Recharge + Recharge from Return Flow

[7] Total MSWD GW Demand (excludes recycled water demand)

[8] Net Balance = Total MSWD GW Demand – Net Recharge Available

Table 5-3 reflects more potential influences to groundwater levels, and presents a more detailed picture of future impacts to the aquifer, than the earlier studies. Accordingly, the Plan acknowledges that surplus recharge to the aquifer can occur in wet years such as 2005. Overall, however, under conditions of "normal" precipitation, the Plan predicts annual overdrafts of the aquifer ranging from 300 to 3,000 acre-feet.

According to the Plan, the estimated recharge potential of the new 60-acre facility range from 15,000 to 60,000 acre-feet per year, depending on the quantity and timing of water availability. The recharge of at least 15,000 acre-feet of imported water per year for 25 years is a key component of the UWMP. In accordance with the Plan, MSWD will work with DWA and the CVWD to protect the Sub-Basin as a source of water via implementation of a Ground Water Replenishment and Assessment Program (GWRAP).

DWR (1964) estimated total groundwater storage capacity for the Mission Creek Sub-Basin to be 2.6 million acre-feet (MAF). A reevaluation by DWR in 1987 revised this storage capacity estimate to approximately 2.2 MAF. GTC (1979) estimated that actual groundwater in storage in the Mission Creek Sub-Basin (within the MSWD boundaries) was 1.44 million acre-feet in 1978. For the GTC study, the sub-basin was separated into two zones: 1) Zone A (western portion of the sub-basin) was estimated to contain 558,576 acre-feet, while Zone B (eastern portion of the sub-basin) was estimated to contain 890,130 acre-feet. Currently, all of MSWD's wells are located in Zone B.

DWR (1987) estimated the total storage capacity of the Cabazon Storage Unit, San Gorgonio Sub-Basin, to be 1,152,000 acre-feet, and the actual groundwater storage at that time to be 640,000 acre-feet. Since groundwater levels in that basin has decreased since that date, the actual groundwater storage has also decreased. The USGS is currently studying the Cabazon Storage Unit to more clearly define the geohydrologic characteristics of the area. MSWD is one of eight agencies financially participating in the USGS studies.

In view of the information contained in the various studies regarding capacity and actual storage in the sub-basin, the current and anticipated rate of overdrafting from the sub-basin, and the MSWD water management plan, it can be safely stated, the Mission Springs Sub-Basin will provide an adequate supply of groundwater into the distant future.

5.3 GROUNDWATER SUPPLY

This section will evaluate the existing capabilities of the three existing water supply systems that make up the MSWD Service area with respect to the existing and projected demands developed in Section 4, Water Requirements, and previously presented in Table 5-1.

A sufficient supply of water must be available to meet the current MDD generated by each of the systems. The evaluation of whether the existing water supply systems have sufficient capacity to meet the estimated 2005 demand will be focused on the capacity and reliability of each of the water supply systems, based on the following three pumping scenarios:

- Continuous 24 Hours Per Day Pumping
- Off-Peak Pumping Only. This is MSWD's normal operating mode in which its wells are only operated during the electrical off-peak hours (18 hours between 5:30 PM and 11:30 AM) as a cost-saving measure.
- Continuous 24-Hours Per Day Pumping Without Largest Well. The reliability of any water supply system is an important consideration. Well production for any particular well could suddenly cease due to mechanical problems caused by the pump, motor, well shaft, or transmission piping. Also, electrical outages or telemetry failure could terminate well production. In addition, well capacity could slowly decrease due to aging of the well. Water quality issues could also remove a well from the system. Finally, well capacity could also be reduced because the expanding cone of depression impacts hidden barriers. The reliability of each of the Well Supply Zones was analyzed by evaluating the impacts on the system assuming that the largest well that serves that Well Supply Zone is temporary out of service.

The reliability of the system has been improved by MSWD's purchase of two mobile, trailer-mounted generators capable of providing an alternate source of power in case the main power supply serving a particular well goes down. The generators can be described as follows:

- A 275-kilowatt generator that is large enough to provide power to any well 100 HP or less, which includes Well Nos. 25, 25A, 26, and 26A.

§ A 600-kilowatt generator that can provide sufficient power to any well 350 HP or less, which includes Well Nos. 27, 29, 30, and 31.

The other three wells, Nos. 22, 24, and 28, are too large for a mobile system.

Of the wells having less than 350 HP, Well 29 is the only one that has been retrofitted with a manual transfer switch so that the generator can be plugged in and the main power supply disconnected. Well Nos. 27, 30, and 31 are scheduled to be retrofitted in the next few years.

In addition, the reliability and flexibility of the water supply system is enhanced by the occurrence of valves that separate several of the Well Supply zones. These valves are normally closed to keep the supply zones isolated from one another, but can be manually opened to allow supplemental water from one zone into another that may be experiencing higher than normal demands.

5.3.1 Current Demand vs. Supply

To evaluate the adequacy of the existing water supply for the MSWD Service area, it is necessary to evaluate each of the three systems: MSWD, West Palm Springs Village, and Palm Springs Crest on an individual basis. Also, since the MSWD system is composed of several individual well supply “regions” that are separated from each other by normally closed valves, a separate analysis is conducted for each well supply region (Figure 5-3) to assess the water supply capacity and reliability to meet existing domestic demands.

Insert

Figure 5-3
Designated Water Supply Regions (2005)

Table 5-4 identifies the demands for the service zones that comprise each of the five designated Well Supply Regions, which are presented in Figure 5-3.

Table 5-4

Calculation of Demands for the Well Supply Regions

Well Supply Region	Groundwater Supply		Service zones (SA)	
	Well	Capacity (mgd)	Name	2005 Average Annual Demand (mgd)
I	22	2.52	Terrace	2.27
	24	1.73	Quail	0.41
	29	2.45	Desert View	0.93
	31	2.73	Northridge	1.00
	32 (Little Morongo)	2.88	Reduced Northridge	0.21
	—	—	Redbud	0.27
	—	—	Vista	0.63
	—	—	Reduced Vista	0.13
	—	—	Highland	0.09
	—	—	Two Bunch	1.08
Region I Totals	**Capacity**	**12.31**	**Demand**	**7.00**
II	27	1.58	Valley View	0.29
	—	—	Overhill	0.23
	—	—	Reduced Overhill	0.06
	—	—	Gateway	0.18
Region II Totals	**Capacity**	**1.58**	**Demand**	**0.77**
III	28	2.74	Annandale	0.63
	—		Reduced Annandale	0.04
Region III Totals	**Capacity**	**2.74**	**Demand**	**0.67**
IV	30	1.19	Mission Lakes	0.38
Region IV Totals	**Capacity**	**1.19**	**Demand**	**0.38**
V	33 (Garnet)	1.15	913 Zone	0.06
Region V Totals	**Capacity**	**1.15**	**Demand**	**0.06**

Sources: Water Demands provided by Harvey Economics and Well Capacities developed based on pumping data provided by MSWD,2005

Table 5-5 compares the estimated 2005 average day and maximum day demands to the existing water supply of each water system assuming three scenarios described previously. The surplus or shortfall was calculated for each scenario, but only the value determined for the most critical of the three scenarios is presented. Finally the number of wells required to either reduce any capacity shortfall or to improve the reliability is identified for each Well Supply Region, assuming that a new well would have a average capacity of 1,500 gpm (2.16 mgd for a 24-hour pumping scenario).

Based on this analysis, as further described below, well supply regions I and II require additional well capacity to meet demand while other well supply regions, including Region I, requires additional wells for reliability purposes.

Table 5-5

Comparison of Existing Groundwater Supply Capacity versus 2005 MDD

Groundwater Supply Region / Wells	2005 ADD (mgd)	2005 MDD[1] (mgd)	2005 Supply 24-hr Pumping[2] (mgd)	2005 Supply 18-hr Pumping[3] (mgd)	2005 Supply 24-hr Pumping w/o Largest Well[4] (mgd)	Critical Surplus or Shortfall[5] (mgd)	Estimated Wells Required[6]
MSWD System							
Region I / Wells 22, 24, 29, 31 & 32	7.00	14.00	12.31	9.23	9.43	-4.77	3
Region II / Well 27	0.77	1.54	1.58	1.19	0	-1.54	1
Region III / Well 28	0.67	1.34	2.73	2.05	0	-1.34	1
Region IV / Well 30	0.38	0.76	1.19	0.89	0	-0.76	1
Region V / Well 33	0.06	0.12	1.15	0.86	0	-0.12	1
Total	**8.88**	**17.76**	**18.96**	**14.22**	—	—	**7**
West Palm Springs Village System							
Wells 26 & 26A	0.09	0.18	0.53	0.40	0.2	0.02	0
Palm Springs Crest System							
Wells 25 & 25A	0.04	0.09	1.06	0.80	0.27	0.18	0

Source: Demands provided by Harvey Economics, 2005 and Well Capacities based on pumping data provided by MSWD, 2005

1 MDD computed using the ADD and a multiplier of 2.0

2 24-Hour Pumping Available Supply computed by converting the measured pumping capacity from gpm to mgd.

3 Off-Peak Pumping is MSWD's normal operating mode in which its wells are only operated during the electrical off-peak hours (18 hours between 5:30PM one day and 11:30AM the following day) as a cost-saving measure. Off-Peak Hour Pumping supply computed by multiplying the 24-hour pumping capacity by the ratio of 18/24.

4 This scenario is a measure of supply redundancy and reliability. It is based upon the 24-Hour Pumping scenario w/o Largest Well in service. Supply is computed by subtracting the largest well capacity from the 24-hour continuous pumping supply.

5 The Most Critical Surplus (Available Supply exceeds Demand) or Shortfall (MDD exceeds Available Supply) is computed by first subtracting the MDD from each of the three Pumping Scenarios. The greatest shortfall that is computed using these three calculations is shown.

6 The number of required wells (if any) is computed by dividing the Most Critical Shortfall (based on either capacity or reliability) by the average assumed capacity (1500 gpm, or 1.62 mgd in a 18-hour pumping day) of a new well,

MSWD System: The evaluation of the water supply for each of the Well Supply Regions in the MSWD System will only consider MSWD's production well capacity. Additional sources of supply, such as the emergency inter-connections with the CVWD will not be included.

Well Supply Region I. The combined capacity of the 5 wells (Wells Nos. 22, 24, 29, 31 & 32-Little Morongo) significantly exceeds the 2005 ADD (7.00 mgd) of this well supply region. However, since the 2005 MDD is estimated at 14.00 mgd, and the total capacity of the 5 wells assuming 24-hour pumping) is only 12.31 mgd, this supply zone will have difficulty meeting the demands on the peak days of the year. The worst-case scenario is when MDD is compared to the

Off-Peak Hour Pumping Only scenario, which limits the effective capacity of the wells to 9.23 mgd. If the largest well, Well 32 (Little Morongo), is off line the supply is reduced to 9.43 mgd. An additional 3 wells are needed to provide a sufficient and reliable water supply.

Well Supply Region II. Well 27 can easily meet the 2005 ADD of 0.77 mgd using the current operational mode of pumping during the off-peak hours. However, meeting the MDD of 1.54 mgd will require 24-hour pumping. The reliability of this system is less than optimum since it is dependent on only one well. If Well 27 does need to be taken off-line, an alternate water supply is available by manually opening normally closed valves between Well Supply Region I and Well Supply Region II. The wells in Well Supply Region I have ample capacity to serve both Supply Regions I and II on an average day, but will have problems during peak demands. Since this supply region is served by only one well, the installation of an additional well would greatly improve the reliability of the water supply system.

Well Supply Region III. Well 28 can easily meet both the 2005 average day (0.67 mgd) and maximum day (1.34 mgd) demands using the current operational mode of pumping during the off-peak hours. The reliability of this system is also less than desirable since it is dependent on only one well. If Well 28 does need to be taken off-line, an alternate water supply is available by manually opening a normally closed valve between Well Supply Region I and Well Supply Region III. The wells in Well Supply Region I have ample capacity to serve both Supply Regions I and III on an average day, but will have problems during peak demands. Since this supply region is served by only one well, the installation of an additional well would greatly improve the reliability of the water supply system.

Well Supply Region IV. Well 30 can also easily meet both the 2005 average day (0.38 mgd) and maximum day (0.76 mgd) demands using the current operational mode of pumping during the off-peak hours. As with the other systems that depend upon a single well, the reliability of this system could be improved. If Well 30 does need to be taken off-line, an alternate water supply is available by manually opening a normally closed valve between Well Supply Region I and Well Supply Region IV. The wells in Well Supply Region I have ample capacity to serve both Supply Regions I and IV on an average day, but will not be able to meet the high demands of both systems on a very hot summer day. Since this supply region is served by only one well, the installation of an additional well would greatly improve the reliability of the water supply system.

Well Supply Region V. The Garnet well can also easily meet both the 2005 average day (0.06 mgd) and maximum day (0.12 mgd) demands using the current operational mode of pumping during the off-peak hours. As with the other systems that depend upon a single well, the reliability of this system could be improved. If Well 33 (Garnet) does need to be taken off-line, an alternate water supply is available by manually opening a normally closed valve between Well Supply Region II and Well Supply Region V. The wells in Well Supply Region II have ample capacity to serve both Supply Region II and V on an average day, but will not be able to meet the high demands of both systems on a very hot summer day. Since this supply region is served by only one well, the installation of an additional well would greatly improve the reliability of the water supply system.

West Palm Springs Village System: Table 5-5 indicates that the West Palm Springs Village water supply system (Wells 26 and 26A) has sufficient pumping capacity to meet the 2005 demands for this area, assuming either continuous pumping or pumping only during off-peak hours. The reliability of the system is very good since both wells have the individual capacity to meet the 2005 MDD if one well needs to be taken off line for some reason.

Palm Springs Crest System: Table 5-5 indicates that the Palm Springs Crest water supply system (Wells 25 and 25A) has sufficient pumping capacity to meet the 2005 demands for of this area, assuming either continuous pumping or pumping only during off-peak hours. The reliability of the system is very good since both wells have the individual capacity to meet the 2005 MDD if one well needs to be taken off line for some reason.

5.3.2 Projected Demand

Section 4 projects that the water demands will increase significantly over the 20-year study period. A sufficient supply of water must be available to meet the projected MDD generated by each of the systems for each study year. As done previously, the evaluation will consider not only the capacity of the water supply system assuming continuous pumping, but will also look at each system with off-peak hour pumping, as well as the situation when the largest well that serves the particular zone is off-line.

With respect to the MSWD system, the analysis will evaluate the projected demands on existing well supply for each of the primary zones. These primary service zones do not correlate with the five Well Supply Regions used in the analysis of the existing 2005 water supply system. The demands for each of the current service zones were instead assigned to the most appropriate primary service zone, as described later in this report. Additional information, which explains how these demands were allocated to the primary service zones, may be found in Section 9**.**

Table 5-6 compares the existing water supply of each water system and primary service zone to the projected ADD and MDD for the years 2010, 2015, 2020, and 2025, quantifies either the projected surplus or shortfall, and indicates the number of additional wells required to meet the projected demands in each of the study years. The 2005 water supply includes additional wells that will be constructed in the northwest portion of MSWD by developers. It is assumed that two wells, each being capable of producing 1,500 gpm, will be in place by the year 2010. The additional wells identified in this section are inclusive of the wells identified previously in Table 5-5.

Table 5-6

Comparison of Existing Water Supply Capacity vs. Projected MDD

Well Supply Zone	Study Year	Projected ADD (mgd)	Projected MDD[1] (mgd)	2005 Supply 24-Hour Continuous Pumping[2] (mgd)	2005 Supply Off Peak Hour Pumping Only[3] (mgd)	2005 Supply 24-Hour Pumping w/o Largest Well[4] (mgd)	Most Critical Surplus or Shortfall[5] (mgd)	Number of Additional Wells Needed	Comments
				MSWD System					
913	2010	0.09	0.17	4.03	3.02	1.15	0.98	0	
	2015	0.13	0.25	4.03	3.02	1.15	0.9	0	
	2020	0.13	0.25	4.03	3.02	1.15	0.9	0	
	2025	0.13	0.25	4.03	3.02	1.15	0.9	0	
						Wells Needed (Zone 913)		**0**	

Table 5-6

Comparison of Existing Water Supply Capacity vs. Projected MDD

Well Supply Zone	Study Year	Projected ADD (mgd)	Projected MDD[1] (mgd)	2005 Supply 24-Hour Continuous Pumping[2] (mgd)	2005 Supply Off Peak Hour Pumping Only[3] (mgd)	2005 Supply 24-Hour Pumping w/o Largest Well[4] (mgd)	Most Critical Surplus or Shortfall[5] (mgd)	Number of Additional Wells Needed	Comments
1070	2010	1.50	2.99	8.1	6.14	5.22	2.23	0	
	2015	1.63	3.27	8.1	6.08	5.22	1.96	0	
	2020	1.84	3.68	8.1	6.08	5.22	1.54	0	
	2025	2.03	4.06	8.1	6.08	5.22	1.16	0	
							Wells Needed (Zone 1070)	**0**	
1240 & 1400a	2010	3.42	6.83	14.84	11.13	11.96	4.30	0	
	2015	3.75	7.50	13.61	10.01	10.73	2.71	0	
	2020	4.13	8.26	12.02	9.02	9.14	0.76	0	
	2025	4.54	9.08	10.74	8.06	7.86	-1.03	1	1,500 gpm each
							Wells Needed (Zone 1240 & 1400a)	**1**	
1400b	2010	4.79	9.57	7.79	5.84	4.91	-3.73	2	2,000 gpm each
	2015	7.30	14.06	6.91	5.18	4.03	-8.88	3	2,000 gpm each
	2020	8.26	16.52	5.74	4.31	2.86	-12.22	1	1,500 gpm each
	2025	9.36	18.71	4.56	3.42	1.68	-15.29	2	1,500 gpm each
							Wells Needed (Zone 1400b)	**8**	
1530 & 1630a & 1630c	2010	3.30	6.60	5.51	4.13	3.35	-2.47	2	2,000 gpm each
	2015	4.51	9.02	5.51	4.13	3.35	-4.89	1	1,500 gpm each
	2020	4.55	9.09	5.51	4.13	3.35	-4.96	0	
	2025	4.78	9.56	5.51	4.13	3.35	-5.43	0	
							Wells Needed (Zones 1530, 1630a, 1630c)	**3**	
1630b	2010	0.71	1.45	0	0	0	-1.42	1	1,500 gpm each
	2015	1.12	2.23	0	0	0	-2.23	1	1,500 gpm each
	2020	1.13	2.26	0	0	0	-2.26	0	
	2025	1.18	2.36	0	0	0	-2.36	0	
							Wells Needed (Zone 1630b)	**2**	
1800 & 1975 & 2155	2010	0.00	0	0	0	0	0	0	
	2015	0.50	0.99	0	0	0	-0.99	1	1,500 gpm each
	2020	1.30	2.61	0	0	0	-2.61	1	1,500 gpm each
	2025	2.04	4.08	0	0	0	-4.08	1	1,500 gpm each
							Wells Needed (Zone 1800)	**3**	
All MSWD Zones	2010	**13.79**	**27.58**	**23.29**	**17.47**	**n/a**	**n/a**	**5**	
	2015	**18.81**	**37.62**	**23.29**	**17.47**	**n/a**	**n/a**	**6**	
	2020	**21.54**	**43.08**	**23.29**	**17.47**	**n/a**	**n/a**	**2**	
	2025	**24.08**	**48.16**	**23.29**	**17.47**	**n/a**	**n/a**	**4**	
							Total New Wells Needed	**17**	
West Palm Springs Village System									

Table 5-6

Comparison of Existing Water Supply Capacity vs. Projected MDD

Well Supply Zone	Study Year	Projected ADD (mgd)	Projected MDD[1] (mgd)	2005 Supply 24-Hour Continuous Pumping[2] (mgd)	2005 Supply Off Peak Hour Pumping Only[3] (mgd)	2005 Supply 24-Hour Pumping w/o Largest Well[4] (mgd)	Most Critical Surplus or Shortfall[5] (mgd)	Number of Additional Wells Needed	Comments
1600-C	2010	0.14	0.29	0.53	0.40	0.20	-0.09	1	275 gpm each
	2015	0.19	0.38	0.53	0.40	0.20	-0.18	0	
	2020	0.21	0.43	0.53	0.40	0.20	-0.23	0	
	2025	0.24	0.48	0.53	0.40	0.20	-0.28	0	
							Total Wells Needed	**1**	
				Palm Springs Crest System					
1800-W	2010	0.07	0.14	1.06	0.80	0.27	0.13	0	
	2015	0.10	0.20	1.06	0.80	0.27	0.07	0	
	2020	0.11	0.21	1.06	0.80	0.27	0.06	0	
	2025	0.13	0.25	1.06	0.80	0.27	0.02	0	
							Total Wells Needed	**0**	

Source: Demands provided by Harvey Economics, 2005 and Well Capacities based on pumping data provided by MSWD, 2005

1 MDD computed using the ADD and a multiplier of 2.0

2 24-Hour Pumping Available Supply computed by converting the measured pumping capacity from gpm to mgd.

3 Off-Peak Pumping is MSWD's normal operating mode in which its wells are only operated during the electrical off-peak hours (18 hours between 5:30 PM and 11:30 AM) as a cost-saving measure. Off-Peak Hour Pumping supply computed by multiplying the 24 hour pumping capacity by the ration of 19/24. .

4 24-Hour Pumping w/o Largest Well. Supply computed by subtracting the largest well capacity from the 24-hour continuous pumping supply.

5 The Most Critical Surplus (Available Supply exceeds Demand) or Shortfall (MDD exceeds Available Supply) is computed by subtracting the MDD from each of the three pumping scenarios, and accounting for whether they are pumping either 18 hours or 24 hours. The largest surplus or shortfall that is computed using these three calculations is shown.

6 24-Hour The number of required wells (if any) is computed by dividing the Most Critical Shortfall by the minimum assumed capacity of each well (typically up to a maximum of 1,500 gpm or 1.62 mgd for an 18-hour pumping period per day for any one well).

MSWD System: As with the evaluation of the existing 2005 condition, this evaluation of the water supply for each of the Well Supply Zones within the MSWD System will only consider MSWD's production well capacity. Additional sources of supply, such as the emergency inter-connections with the CVWD will not be included.

Zone 913. The existing supply provided by the soon-to-be-completed Well 32 (Little Morongo) and Well 33 (Garnet) will be more than adequate to meet the future demands of this zone when considering all three pumping scenarios through the year 2025. It appears that no additional wells are required for this zone through the year 2025.

Zone 1070. The existing supply provided by Wells Nos. 27 and 31 as well as pumpage from Zone 913, will be more than adequate to meet the future demands of this zone when considering all three pumping scenarios through the year 2025. It appears that no additional wells are required for this zone through the year 2025.

Zones 1240/1400a. Zone 1240 will be served by Wells Nos. 22, 24, and 29, as well as pumpage from Zone 1070 (which is supplied by Wells Nos. 27 and 31, as well as Well Nos. 32 (Little Morongo) and 33 (Garnet). Zone 1400b will be served by pumpage from Zone 1240. These two Well Supply Zones have been combined because the analysis indicates that individually each zone could experience a relatively small shortfall (125 gpm shortfall for Zone 1240 and 600 gpm shortfall for Zone 1400a) of water by 2025 when the largest well (Well 32, Little Morongo) would be out of service. However, when combined, the loss of Well 32 (Little Morongo) is not as critical and the analysis indicates that only one 1,500 gpm well is required for the combined zones through the year 2025.

Z***one 1400b.*** Zone 1400b will be served by Well 28 as well as pumpage from Zone 1240. This is the largest consuming Well Supply Zone in the MSWD system and the analysis indicates that the existing supply will not be able to meet the average daily demand (let alone the MDD) as early as the year 2010, even with 24-hour pumping. The most critical scenario is during off-peak pumping when the wells will be only pumping for 18 hours per day and the available supply is reduced to 5.84 mgd for a projected MDD of 9.57 mgd. Thus, it is recommended that two additional wells (capable of 2,000 gpm each) be constructed between now and 2010 to increase the reliability of the system. To keep up with the continued increase in demand beyond 2010, three additional 2,000 gpm wells are required by 2015, followed by one additional 1,500 gpm well by 2020 and two additional 1,500 gpm wells by 2025. A total of eight additional wells are recommended to serve the projected demands for Zone 1400b through 2025.

Zones 1530/1630a/1630c. Zones 1530, 1630a, and 1630c will be served by Well 30 as well as the new wells currently being proposed for the new developments along Worsley Road. The analysis assumed that the developers would install two additional wells (Wells 34F and 35F) each having a minimum capacity of 1,500 gpm (2.16 mgd assuming 24 hour pumping). Assuming these new wells are installed by 2010, Zones 1530, 1630a, and 1630c will have sufficient combined pumping capacity (with 24-hour pumping) to nearly meet the projected MDD in that year. The most critical scenario is during off-peak pumping when the wells will be only pumping for 18 hours per day and the available supply is reduced to 4.13 mgd vs. a projected MDD of 6.60 mgd. Thus, it is recommended that two additional wells capable of producing at least 2,000 gpm be installed prior to 2010 to increase the reliability of meeting this demand in this zone. By 2015, the increase in demand will be such that one additional 1,500 gpm well will be required to meet the projected MDD through 2025. Thus, a total of three additional wells are recommended to serve these pressure zones through 2025.

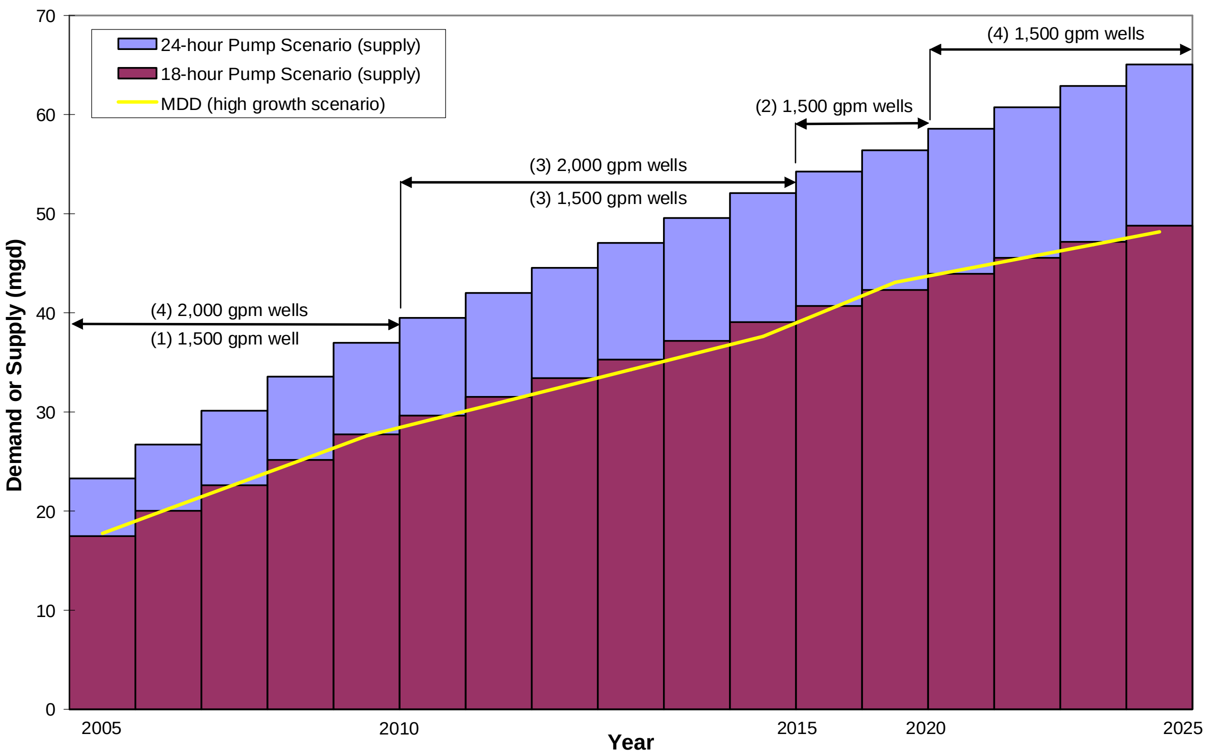
Zone 1630b. Zone 1630b would be served by pumpage from Zone 1530, however by 2010, the demand in the 1530 zone has increased to the point where there is no excess water available for Zone 1630b. It is recommended that one new well having a minimum capacity of 1,500 gpm be installed as soon as possible to meet the expected 2010 demand. The increase in demand will continue such that one additional 1,500-gpm well will be required by 2015. Thus, a total of 2 wells are required to meet the projected MDD through 2025.

Zones 1800/1975/2155. Projected demands in these new pressure zones will be completely supplied by new wells. It is recommended that a new well, having a minimum capacity of 1,500 gpm, be installed by 2010 to meet the new growth in this area. Additional 1,500-gpm wells will be required by 2015 and 2020 to meet the expected increase in demand. Thus, a total of 3 new wells are required to meet the demands through the year 2025.

Figure 5-4 shows the projected demands based upon the high growth scenario and a supply plan for meeting these demands. Two supply curves are shown: 1) Projected supply capacity for the 18-hour off-peak pumping scenario, and 2) Projected supply capacity assuming 24-hour pumping. Because of the uncertainty of demand projections, standard engineering practice is to propose a supply plan that keeps a minimum of five years ahead of the demands. However, the growth within MSWD and the number of wells (11 wells by 2010) required for keeping five years ahead of that growth is so great that the standard engineering practice does not seem practical. The 18-hour pumping supply plan presented in Figure 5-4 is less aggressive (only 5 wells by 2010) than standard practice in that it closely tracks the projected demand curve. If the demand grows at a faster pace, the 24-hour pumping scenario curve shows that MSWD still has sufficient excess capacity to use. MSWD needs to monitor the progress of new developments and the related water demands to ensure that required well capacity and reliability will be available in a timely manner.

Figure 5-4

Well Supply Capacity versus MDD for 18-hour and 24-hour Pumping Scenarios



West Palm Springs Village System: Table 5-6 indicates that the existing West Palm Springs Village water supply system (Wells 26 and 26A) has sufficient pumping capacity under normal operating (off-peak hour pumping) conditions to meet the ADD of this area throughout the entire study period. However, by 2020, pumping during the peak hours will be required to meet its obligations on the higher demand days. The reliability of the system is less than desired since taking Well 25 off-line would result in a supply that is insufficient to meet the MDD by 2010, and even the ADD by the year, 2020. It is recommended that the MSWD install one additional well having a minimum capacity of 275 gpm as soon as possible to increase the reliability of the system to meet the 2010 demands.

Palm Springs Crest System: Table 5-6 indicates that the existing Palm Springs Crest water supply system (Wells 25 and 25A) has sufficient pumping capacity to meet the projected needs of this area through study year 2025, assuming either continuous pumping or pumping only during off-peak hours. The reliability of the system is also projected to be very good since both wells have the individual capacity to meet the projected demands if one well needs to be taken off-line for some reason. It appears that no additional wells are required for this system through the year 2025.

5.3.3 Potential Well Locations

The previous section identified the need for up to 17 additional production wells to satisfy the high growth scenario and corresponding projected MSWD MDD demands through study year 2025. The required start up year for each well was determined based on the projected demands within the Primary Service Zones. Because of the uncertainty regarding the timing of demand projections, the intent is that sufficient well capacity should exist five years ahead of the study year that indicates a shortfall. For example, if a shortfall is determined to occur by 2020, (that is, sometime between 2015 and 2020) then it would be prudent to add the necessary additional wells by 2015 to ensure that the projected demands will be met during the subsequent 5-year time period. However, the projected increase in demand (and corresponding shortfall) over the time period, 2005-2010 is so great that MSWD should make every attempt to get ahead of the demand curve.

The Primary Service Zone designates the area where existing and future water demand will occur, not necessarily where future wells will be physically located. Well designation assumes that new wells installed by the developers along Worsley Road will be numbered in order as Well Nos. 34 and 35; thus the remainder of the additional new wells would be numbered in chronological order of installation starting with Well 36 (serving the West Palm Springs Village System) and finishing with Well 53. Conceptual well locations (Figure 5-5) and average production capacities were based on existing well drilling information as well as information on the Mission Springs groundwater basin. Final well locations and expected production rates will be determined based on future well installations.

The conceptual locations of future wells are based on the following factors:

- Adequate groundwater quality/quantity is based on published Mission Creek subbasin geohydrologic existing conditions that were extrapolated from other areas.
- Minimize potential impacts of existing septic systems. MSWD estimates that there are between 7,000 and 8,000 developed parcels within the district boundary that are not connected to the wastewater sewer system. Individual, privately owned disposal systems consisting mainly of septic tanks followed by either vertical seepage pits or horizontal leach lines, provides the sewerage disposal for a number of these parcels. Septic disposal systems not designed or installed correctly are potential sources of contamination to the existing aquifer, and thus locating new production wells away from any dense concentrations of these systems is prudent and sound practice.

Insert

Figure 5-5
Conceptual Well Locations

- Proximity to existing/proposed water distribution storage tanks and transmission lines-from an operational perspective would be beneficial. New wells within the vicinity of a storage tank could allow groundwater to be pump directly into the tank rather than the system. Costs would also decrease if new wells were adjacent to existing transmission lines, such that the number and length of new pipes would be minimized.
- New well locations will require Chlorination facilities and facilities either a storage tank of oversized transmission main to provide the required Chlorine contact time.
- As new wells are placed into production, information obtain should be used to re-evaluate future well locations and the number of future wells needed.
- Existing wells should be reviewed for the opportunity of increasing their production rates.

5.4 IMPORTED WATER SUPPLY OPTIONS

As discussed previously, the principal water source for the MSWD is groundwater. In addition, MSWD has several other sources of water that are either currently available or may be available in the near future:

- Emergency water from CVWD (Existing Source)
- Groundwater Recharge from Colorado River Aqueduct (Existing Source)
- Direct Use of Colorado River Aqueduct water (Future Option)
- Use of State Water Project water (Future Option)

5.4.1 Emergency Water from CVWD

There are two inter-connections with the CVWD that allow water to be conveyed between the MSWD and CVWD systems. The two connections both feed the Two Bunch Pressure Zone and are situated at the following locations:

- A 6-inch connection located at Little Morongo Road and Dillon Road
- An 8-inch connection located at Bubbling Wells Road and Camino Aventura.

The capacity of the emergency interties was estimated assuming a design flow of 5 feet per second. Estimated capacity of the 6-inch and 8-inch connections is 450 gpm and 775 gpm, respectively. The emergency water can only be used for the Two Bunch and the Terrace pressure zones, and conveying it to the Terrace zone requires significant effort on the part of the MSWD. Since the Two Bunch Pressure Zone is one of the lowest pressure zones in the MSWD System, pumping emergency water to other pressure zones requires opening various normally closed valves and utilizing a pump to boost from the Two Bunch Pressure Zone into the Terrace Pressure Zone.

5.4.2 Mission Creek Sub-Basin Recharge

The overdraft condition, discussed previously, in the Mission Creek Sub-Basin has led MSWD to pursue recharge (spreading) operations in the sub-basin. Spreading water provides more flexibility as to when the MSWD can take delivery of the untreated water. Generally, MWD charges less per acre-foot of water if that water can be delivered during low demand periods (i.e. winter). Fortunately, this timing also corresponds to the most efficient recharge period because evaporation will be lessened during the cooler times of the year. This program is essential to the short-term maintenance of groundwater levels in the Sub-Basin. As demand increases, long-term groundwater levels will continue to decrease with recharge not having a significant effect.

DWA is the MSWD's wholesale supplier for the California State Water Project. As a State Water Contractor, it is entitled to State Water Project (SWP) water. A conveyance system to provide SWP water directly to the Coachella Valley currently does not exist. However, the Colorado River Aqueduct (CRA) does go through the valley. DWA has entered into an agreement with MWD to exchange SWP water for CRA water.

In 1997, MWD tapped into the CRA for DWA and installed a 48-inch turnout just south of Indian Avenue and west of Worsley Road. DWA acquired approximately 190 acres of land in the vicinity of the turnout in order to construct spreading ponds to hold the Colorado River water as it percolates downward into the Mission Creek Sub-Basin. A test well was also installed by DWA to monitor the flow of water underground. DWA completed construction of 60 acres of recharge basins as the Mission Creek Recharge Facilities in June 2002. Recharge commenced in November 2002 with 4,733 acre-feet of water introduced into the basins in the remainder of 2002. A lack of available water resulted in no recharge in 2003. An additional 5,564 acre-feet of water was recharged in October, November, and December of 2004. Because of the very wet conditions in 2005, recharge between January and May of that year totaled 6,500 acre-feet.

DWA personnel indicate that the number of basins in operation depends upon the availability of water. In 2005, only about two-thirds (40 acres) of the 60 acres of basins were being used at one time. Based on the current excellent recharge rate of about 4 feet per day, and accounting for some downtime for maintenance, the 60 acres of basins could recharge as much as 60,000 acre-feet per year, which far exceeds the currently available supply. Even if recharge rates decreased over time to as little as 1 foot per day, the capacity would still be at least 15,000 acre-feet per year.

The possibility of continued recharge depends largely on the availability of future water from the MWD's Colorado River Aqueduct and on exchange agreements with DWA. This source of water does provide a significant amount of inflow to the northwesterly portion of the Mission Creek Sub-Basin and reduces the amount of overdrafting of the aquifer. In addition, assuming that sufficient water is available, this recharge facility provides for conjunctive use possibilities, such as water banking of Colorado River water. Because of the excess capacity and the lack of available water, DWA does not have any plans for expanding the facility any time soon. Even if water was available, most of the remaining 130 acres not currently used for recharge are located in Mission Creek, and any facilities constructed in the creek would be subject to damage from flood events. Any expansion of the recharge facilities would most likely require the purchase of additional land.

5.4.3 Direct Use of Colorado River Aqueduct water

Rather than recharging Colorado River (CRA) water, as discussed in the previous section, this option would consist of directly introducing CRA water into the MSWD water system. The main components are: 1) importing Colorado River water, 2) providing the necessary treatment to potable water quality, and 3) distributing treated water to the MSWD Service area. MSWD would use DWA's existing connection to the CRA located near Indian Avenue and Worsley Road to import the water. However, this option would also require the construction of a water treatment plant and new transmission pipelines to connect the aqueduct turnout to the water treatment plant and to the District's existing distribution system. .

5.4.4 Use of State Water Project Water

This option would consist of adding State Water Project water to MSWD's source water portfolio. DWA and CVWD currently have entitlements to 171,000 acre-feet of SWP water, but cannot use it directly because of the lack of conveyance facilities. As discussed previously, DWA instead exercises its entitlements in an exchange with MWD for Colorado River water delivered through the CRA. However, this arrangement has several issues that make it less desirable than directly receiving SWP water:

- Colorado River water is saltier than SWP water, resulting in lower consumer satisfaction and higher operation and maintenance costs
- Colorado River water has known chemical contaminants, such as perchlorate.
- SWP water comes from a different source than Colorado River water and may be available when CRA supplies are low, thus providing more flexibility for the supplier.

Currently, the State Water Project brings water from Northern California to two locations near MSWD: Beaumont, California, located approximately 26 miles from Desert Hot Springs, and Yucca Valley, about 20 miles from Desert Hot Springs. There are several options being considered for extending the SWP into the Coachella Valley:

- San Gorgonio Pass Water Agency (SGPWA) is considering constructing a pipeline that extends from Beaumont to a proposed recharge facility in the Cabazon area to recharge SWP water. Several alignments for pipelines capable of conveying design flows between 16 cfs (11,500 acre-feet per year) and 113 cfs (81,500 acre-feet per year) were identified and evaluated (Boyle, 2003). Estimated costs for the various pipeline alignments varied from $17.6 million to $19.8 million.
- CVWD and DWA are currently conducting a preliminary engineering study to assess options for bringing SWP water to the Coachella Valley. The two main options being considered are: 1) constructing a pipeline from Devils Canyon to Yucca Valley and then southward to the Windy Point Recharge Facility in the White Water area (104 miles at a cost of $1.2 billion); and 2) constructing a pipeline through the San Gorgonio Pass to recharge water in the Windy Point Recharge Facility, a distance ranging from 42 to 60 miles with costs ranging from $687 million to $734 million. Although bringing the water through the San Gorgonio Pass is shorter, this route involves other challenges such as construction through urban areas, crossing obstructions (freeways, flood control channels, and major utilities), endangered species and access through Native American land. The preliminary study is nearing completion and should be available for public review in July/August 2005.

Conversations with both the SGPWA and the CVWD/DWA team indicate that both entities are interested in working with the MSWD to define MSWD's future water requirements and together developing a plan to meet those requirements using SWP water. (personal communications with SGPWA and CVWD, June 2005)

5.5 OTHER WATER SUPPLY OPTIONS

The following water supply options can assist the MSWD in reducing overdraft of the aquifer and providing an adequate supply to its customers:

- Water Conservation
- Recycled Water
- Pumping and Treatment of Desert Hot Springs Sub-Basin Groundwater

5.5.1 Water Conservation

Water conservation is an excellent method of decreasing the required water supply. MSWD currently promotes water conservation through the following programs:

- Conservation pricing
- Ordinance prohibiting wasting of water
- Landscape guidelines
- Free water audits to all customers
- Promotes enforcement of City/County water conservation requirements
- Educational programs/outreach
- Public outreach/water issues study group (WISG)

With regard to the last item, the WISG has been established by MSWD to inform the community leaders about significant water issues, including water supply, water quality, water law, and an overview of the District.

5.5.2 Recycled Water

Recycled water is defined by the California Water Code as "water, which, as a result of treatment of waste, is suitable for a direct beneficial use or a controlled use that would not otherwise occur and is therefore considered a valuable resource." The availability of recycled water is limited to water generated as part of the wastewater treatment associated with sewage colleted from sewered residential, commercial, and industrial properties. One advantage of recycled water is that the amount of available recycled water generally increases with the amount of potable water used by the community.

MSWD currently operates two wastewater treatment plants located in the MSWD system, serving a total of about 6,000 developed parcels. The Alan L. Horton Wastewater Treatment Plant provides secondary treatment to the sewerage generated by customers hooked up to the system. The Horton plant currently has a permitted capacity of 2.0 mgd (2,815 acre-feet per year). The Desert Crest Treatment Plant is a much smaller system with 180,000 gpd (200 acre-feet per year) capacity, which serves various developments, as well as the Desert Crest Country Club and Holmes Mobile Home Park. MSWD has estimated that the amount of water recharged in this manner is just over 1,000 acre-feet per year. MSWD also has plans for a new regional wastewater treatment plant that will be constructed near I-10 and Indian Avenue.

The disposal of effluent from both the Horton and Desert Crest treatment plants is accomplished by utilizing percolation ponds located within the plants on the southwest (cold water) side of the Mission Creek Fault. In addition, effluent is used for irrigation and wash down at the plants. The District's wastewater treatment plants currently treat wastewater using a secondary treatment process.

Potential uses for recycled water can be divided into the following five major categories:

- Groundwater recharge
- Surface irrigation for food crops, parks and playgrounds, schoolyards, residential landscaping, golf courses, cemeteries, and freeway landscaping.
- Impoundments for recreation, fish hatcheries, landscape ponds
- Cooling for industrial and commercial applications
- Other Uses, such as flushing toilets, priming drain traps, structural fire fighting, decorative fountains, commercial laundries, industrial boiler feed, soil compaction, mixing concrete, and dust control on roads and streets

Direct reuse for most of the above uses would require that the plant effluent be treated using a tertiary process. This method would require a significant investment in improved treatment facilities, more extensive effluent quality monitoring program, a separate piping and pumping distribution system, as well as increased administrative costs related to metering, billing, and regulatory compliance. There are currently no significantly large manufacturing and irrigation users near the Horton WWTP or the MWD turnout that could be potential customers for non-potable water. However, the future Highland Falls, Stoneridge and Tuscan Hills golf course developments are being designed to utilize recycled water. The MSWD is currently conducting preliminary investigations into the feasibility of using reclaimed water from the Horton WWTP and from the future regional WWTP for non-potable uses.

MSWD, supported by funding from the US Bureau of Reclamation (USBR), is in the process of developing an Integrated Water Resource Plan to assist in future decision-making regarding water resources. The first phase, called the Phase I Water Recycling Appraisal study, was completed and included an evaluation of the following:

- Water Resources Availability, which includes a general overview of the Mission Creek Sub-Basin, identification of water resources, and concluded with a determination that the sub-basin is in an overdraft condition.
- Water Quality, which includes a general overview of the water quality of the Mission Creek Sub-Basin and potential threats to the existing water quality with a special emphasis on potential impacts from the more than 5000 septic tanks currently in use in the study area.
- Groundwater Monitoring Program, which describes existing groundwater monitoring along with a recommended program that includes water level monitoring and water quality sampling. This section also provides recommendations for a Groundwater Management Plan.
- Quantification of Recycled Water, which identifies surface irrigation and groundwater recharge as potential uses of recycled water, estimates the quantity of available recycled water for the near term (2009) to be 4 mgd vs. an estimated demand of 5.3 mgd from the

golf courses, and that the supply will grow to 25 mgd at full build-out of the study area, and estimates the potential costs associated with additional treatment and conveyance facilities required for the use of recycled water.

- Conceptual Recycled Water Management Options, which describes a conceptual approach to using recycled water for various uses in the Mission Creek Sub-Basin.

The District is intent on making reclaimed water a significant component of its future water supply portfolio.

5.5.3 Pumping and Treatment of Desert Hot Springs Sub-Basin Groundwater

The mineralized groundwater found in the Desert Hot Springs Sub-Basin is a resource that could be utilized to meet the future water demands within the MSWD Service zone boundaries. Implementing this option would require the construction of several shallow production wells, a water treatment plant, and transmission piping to connect to the existing MSWD water systems. Disposal of the brine concentrate that is created as a waste product of the treatment process is also an issue that needs to be addressed.

The MSWD should give careful consideration before tapping into the Desert Hot Springs Sub-Basin. As discussed earlier, this water feeds the local spa resort industry, which provides greater than 40 percent of the income for the local community. Very little is known about the geohydrology of this sub-basin and the extraction of groundwater (whether of low or high temperature) could have unintended consequences. Because of the value of this resource to the local economy, it is recommended that MSWD do the following:

- Undertake a detailed geological exploration plan to fully characterize the Desert Hot Springs Sub-Basin
- Develop a set of guidelines for managing and protecting this resource.

6.1 INTRODUCTION

MSWD water supply source is from groundwater and not surface water sources, which allow a lower level of treatment requirements, based on Federal and State regulations. MSWD being a public water supply system must adhere and meet all Federal and State regulations regarding treatment and distribution of potable water.

Based on MSWD water supply from groundwater sources, URS conducted an analysis of existing well water quality and treatment requirements. At this time, MSWD provides water disinfection by chlorination at each well head.

6.2 WATER QUALITY

Water quality for public drinking water systems is regulated by the U.S. Environmental Protection Agency (U.S. EPA and the California Department of Health Services (CDHS). The Safe Drinking Water Act has established national primary and secondary drinking water standards for public water systems (see Appendix A) CDHS water quality regulations (Title 22 standards) are shown in Appendix A and compared with EPA water quality regulations. Through primacy the State of California has established more stringent standards than those enacted by EPA. Primary drinking water standards include regulations over the following type of constituents: turbidity, microorganisms, disinfection byproducts, disinfectants, inorganic chemicals, organic chemicals, and radionuclides. Secondary drinking water standards include the following componants: aluminum, chloride, color, corrosivity, fluoride, foaming agents, and odor.

Mission Springs, Coachella Valley, and the Desert Water Agency provide water supply to MSWD water systems. For each MSWD well, water quality is tested in accordance with Federal and CDHS requirements. Table 6.1 is a listing of existing wells and associated pumping capacities within MSWD and Coachella Valley Water District.

Table 6-1

Water Supply from Local Groundwater Wells

Mission Springs Water District		**Coachella Valley Water District**	
Wells	**Capacity (gpm)**	**Wells**	**Capacity (gpm)**
Well 22	1,750	Well A	3,405
Well 24	1,200	Well B	3,408
Well 25	400	Well C	3,409
Well 25A	175	Well D	3,410
Well 26	350	–	–
Well 26A	170 (out-of-service)	–	–
Well 27	1,100	–	–
Well 28	1,900	–	–
Well 29	1,700	–	–
Well 30	825	–	–
Well 31	1,900	–	–
Well 32	2,000	–	–
Well 33	800	–	–

URS has reviewed the water quality testing data received from the respective agencies and has identified water quality parameters that are equal to or exceed the published regulatory standards. The wells and the specific standards in question are presented below and is based on laboratory data received between the years 1989 and 2003.

- Well 24 reported to have a gross alpha value of 15 pCi/L that is the maximum limit for primary drinking water and Title 22 standards.
- Well 24 reported that the secondary standard of 500 mg/l for TDS was exceeded in the year 1999 at 535 mg/L and was generally high for the years 1993, 1997, and 2002.
- Well 24 had a violation of the concentration of Lindane (a pesticide) at 0.4 µg/L in 1989. The recommended primary drinking water and Title 22 limit is 0.2 mg/L. In the year 1992 Lindane was not detected.
- Well 26 had a reading of 6 µg/L for antimony that is also the maximum recommended value under the primary drinking water and Title 22 standards.
- Well 26A had high uranium values from 19 to 21.3 pCi/L for 6 consecutive samples in the years 2001 to 2004. The maximum Title 22 drinking water concentration is 20 pCi/L.
- Well 26A had gross alpha counts of 23 to 27 pCi/L for three samples taken in 2001 through 2002. The Title 22 standard is 15 pCi/L.

Coachella Valley Water District:

No water quality standards were exceeded for Coachella Valley's four wells 3405 (Years 2002, 2003, and 2004), 3408 (Years 2002 and 2004), 3409 (Year 2004), and 3410 (Years 2002 and 2004).

Desert Water Agency:

At this time the DWA has not operate any ground water wells for the supply of potable water, thus no water quality standards were tested. The DWA does have a program where they pump water from the Colorado River and spread it on fields to help recharge the aquifer. To date there is no water quality testing information available from this aquifer recharge program.

URS has not received any microbial testing data on the existing wells and hence as with most wells we assume that there is no microbial contamination. If there were microbial contamination due to the influence of surface water or septic tanks, a complete treatment system as required for surface water would be required. For wells microbial contamination of ground water by surface water from the DWA may become a factor. Monitoring for microbial contamination should be conducted where DWA water may influence ground water quality.

In summary it appears that the water quality for the two water agencies is generally within federal and state standards with the exception previously noted. Due to its high uranium and gross alpha values, Mission Springs Well 26A is presently not in operation. Well 24 had a violation of its Lindane limit in 1989 but has not had any violations since. Well 26 had the maximum antimony concentration in 1989 but has not had any other high concentrations since.

6.3 WATER TREATMENT FOR WELLS

The existing treatment for well water is the addition of liquid sodium hypochlorite at the wellhead to maintain a chlorine residual in the distribution system. According to District personnel the chlorine dosage is typically 0.5 mg/L. There are no provisions for chlorine contact time other than in the distribution system at the present time. There are some water system customers located near the wells that are affected by a strong taste and odor in the event of high chlorine doses, and do not receive sufficient disinfection contact time to fully comply with current California drinking water regulations.

Based on the water quality testing data from the respective wells, the required treatment will generally be chlorination. However, California regulations do not require disinfection in accordance with CT limits for groundwater unless the well is under the direct influence of surface water. California regulatory personnel do encourage at least a four log virus inactivation as a preventative measure in the event the well becomes contaminated from surface water, septic tanks, or sources of pathogens. In addition to chlorination, Well 26A may require further treatment to comply with regulations because of high levels of uranium and gross alpha counts.

Based on EPA guideline values for a water temperature of 20°C and a pH of 6.0 to 9.0, the recommended CT value for a 4-log reduction of viruses is three (3.0). At 0.5 mg/L of free chlorine residual and a contact efficiency factor of 0.7, the time required for chlorine contact time is nine (9) minutes.

The District has standardized on providing an injection point at the well discharge for liquid sodium hypochlorite followed by a collection tank or what the District calls a “suction tank” at each new well head or well field discharge. The collection tank is intended to provide a supply of water for the distribution system booster pumps that pump water from the tank into the water distribution system. With appropriate baffling the suction tank could be sized to provide a nine-minute hydraulic retention time. If the existing wells are unable to be retrofitted for the suction tank, then the distribution system pipe after the high service pumping would be sized to provide nine minutes of hydraulic retention prior to the first customer. The suction tank or the distribution system contact time requires plug flow of the water for the contact time of nine minutes.

At each well head the following water treatment process or delivery components are recommended:

- Liquid sodium hypochlorite 55 gallon drum storage with secondary containment (Note that for a 1,500 gpm production rate and a dosage of 0.5 mg/L of chlorine, the 12.5% liquid sodium hypochlorite feed rate is approximately nine (9.0) gallons/day. The chlorine demand will add to this amount but probably not significantly unless iron, manganese, or other oxidizable components are present.
- Sodium hypochlorite metering pumps (one duty/one standby per well head)
- Sodium hypochlorite diffuser assembly
- A plug flow chlorine contact basin or pipeline sized for a CT of three (3.0), based upon 4-log virus reduction
- Well start-up pump-to-waste valve

Figure 6.1 is a diagram of a typical wellhead and chlorine addition layout that can be used through out the District. Also presented in Table 6-2 are lengths of various sizes of pipe required for a nine-minute hydraulic retention time for chlorine contact.

Figure 6-1

Typical Well Head Disinfection Schematic for Nine-minute Hydraulic Detention Time

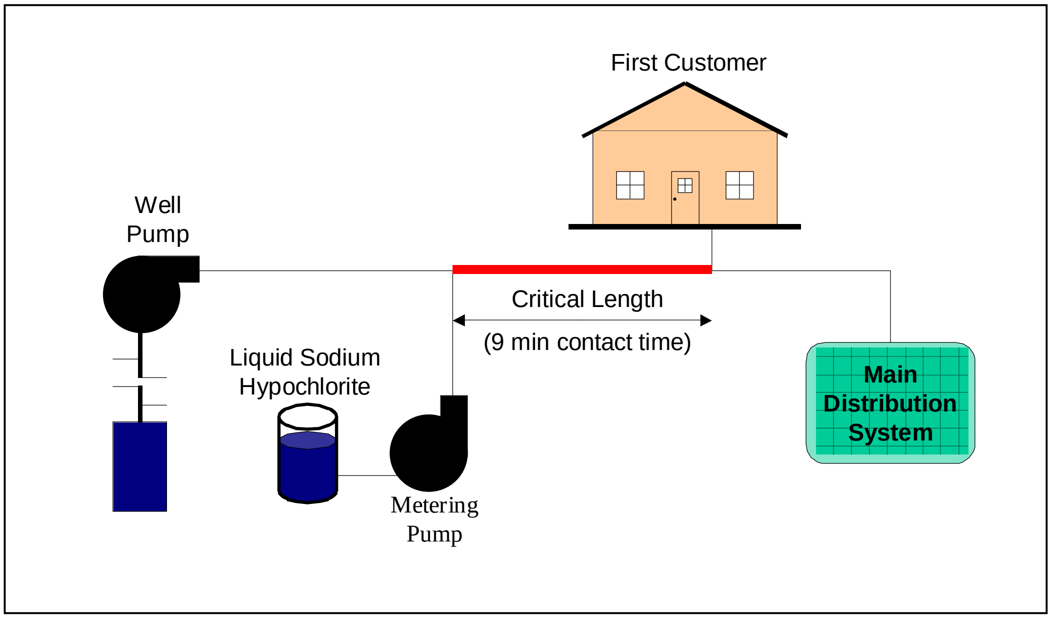


Table 6-2

Typical Length of Pipe Required for Nine-minute Hydraulic Detention Time

Pipe Diameter (in)	‡ Critical Length (ft)
8	5,170
10	3,310
12	2,300
18	1,025
24	575
30	370
36	255
48	145

Note: these calculations assume a capacity of 1,500 gpm per well with a pH of 8.0 and a temperature of 20°C

‡ Figure 6-1 shows the location of the *Critical Length* pipeline

6.4 WATER TREATMENT FOR WELLS PUMPING FROM RECHARGED AQUIFERS

At this time the District has only limited experience using DWA water and spreading fields. Based on the DWA water having high TDS and at times iron concentrations exceeding the recommended secondary drinking water standards it is recommended that water quality pumped from the recharged aquifer be monitored closely for turbidity, microbial contamination, TDS, and iron. If the monitoring reveals that there is no direct influence of surface water (i.e.

spreading fields) then the process and delivery components as recommended for the other wells will be adequate. If the monitoring indicates the well near the spreading fields is affected under the influence of surface water then full treatment as required for surface water is likely to be required. The only relief from full treatment will be to negotiate filtration credits for the well and thus delete the need for the coagulation and settling processes. In this case, the direct filtration and disinfection treatment processes would be required. Based on conversions with CDHS staff, the determination of filtration credits for application to wells under the influence of surface water are subject to a case-by-case evaluation.

If the wells are determined to not be under the influence of surface water and the iron and TDS concentrations are within the secondary drinking water standards, then water treatment requirements can be the same as for wells pumping from non-recharged aquifers.

Using the spreading field the percolation of water into the aquifer is expected to result in the oxidation of iron and it being retained in the gravel and soil material under the spreading field thereby lowering the average concentration to below secondary drinking water standards.

At this time removal of TDS to acceptable secondary drinking water standards has not been confirmed with actual results in the District. It is recommended that the aquifers that are being recharged be monitored to determine if TDS concentrations are being effectively reduced due to the percolation of the water down into the aquifer.

6.5 WATER TREATMENT FOR EXISTING WELLS

Based on the required CT and hydraulic detention time of nine minutes for a 4-log reduction of viruses, the existing wells and connecting distribution piping were evaluated to determine whether or not additional improvements are required.

Table 6-3 presents all of the existing MSWD wells with their production flow rates, and the size and length of distribution system pipe before the first customer. Based on the well production rate and distribution pipe length and related water volume before the first customer, it was found that there is adequate disinfection contact time in the distribution system piping for all but three wells: Well 22, Well 29, and Well 31.

Table 6-3

Disinfection Contact Time Analysis for Well Supply Facilities

Well	Capacity	Req'd Volume (cf)	Pipe Size (in)	Pipe Length (ft)	Available Volume (cf)	Are improvements required?	Comments
22	1,750	2,105	16	1,040	1,451	Yes	See Note 1
24	1,200	1,444	16	1,821	2,541	NO	
27	1,100	1,323	12	5,020	3,941	NO	
28	1,900	2,286	16	1,774	2,476	NO	
29	1,700	2,045	16	975	1,361	Yes	See Note 2
30	825	993	12	2,195	1,723	NO	
31	1,900	2,286	12	1,384	1,086	Yes	See Note 3
33	800	962	16	1,090	1,521	NO	
32	2,000	2,406	n/a	n/a	n/a	NO	Tank & pipe volume

Table 6-3

Disinfection Contact Time Analysis for Well Supply Facilities

Well	Capacity	Req'd Volume (cf)	Pipe Size (in)	Pipe Length (ft)	Available Volume (cf)	Are improvements required?	Comments
25	400	481	8	3,257	1,136	NO	
25A	175	211	8	700	244	NO	
26	350	421	8	1,616	564	NO	
26A	170	205	6	650	128	Yes	See Note 4

Note 1 : 8" Pipe along Littleton Morongo between Acoma Avenue and Desert View
Note 2 : Disconnect 12" pipe with 16" transmission main at Ironwood and Cholla
Note 3 : 12" Pipe along Dillon Road between Indian Avenue and Well #31
Note 4 : 8" Pipe along San Pierre between Hacienda Avenue and Well #26A

7.1 INTRODUCTION

As shown in Figure 7-1, the existing MSWD distribution system consists of three independent water distribution systems: (1) MSWD portion —which encompasses the town of Desert Hot Springs, (2) Palm Springs Crest, and (3) West Palm Springs Village. The service zones of the combined MSWD distribution system are each classified as either a primary pressure zone or a reduced pressure service zone. These two categories of pressure service zones identify the service zones that are and are not regulated by pressure reducing valves (PRVs). MSWD is the largest of the three systems. The MSWD distribution system was planned and developed in phases to meet specific residential/commercial development needs. As the MSWD system began to expand rapidly over the last 15 years, these numerous pressure service zones both primary and reduced pressure zones became an encumbrance to meet future development needs while maintaining reliability and flexibility. The purpose of this section is to identify the existing distribution facilities within the current pressure zones and to relate these components to the primary pressure service zones.

The Palm Springs Crest System and the West Palm Springs Village System serve Woodridge and Cottonwood, respectively and contain both primary pressure and reduce pressure zones. Both systems have wells and storage facilities.

Section 7.2 present the existing components of the primary pressure service zones and the reduced pressure service zones, respectively. For clarity, the discussion in each of these sections system components is organized in terms of the MSWD standard pressure zones.

7.2 MSWD SYSTEM

The existing MSWD water distribution system serves up to 24 different pressure service zones through the two categories identified above. In general, the MSWD standard pressure zones are reflective of existing storage tank overflow elevations, hence the term “913 Zone” in which the water storage tank overflow is at 913 ft msl. Therefore, pressure zone designations are expressed in terms of the tank overflow elevation and hence the static hydraulic grade line of that particular service zone. As development of the MSWD occurred, numerous storage tanks were constructed and some at varying elevations, which were not consistent with in a primary pressure zone. One of the comprehensive water master planning goals is to consolidate the 24 different pressure service zones into primary pressure service zones.

Based on current and future water distribution system hydraulic requirements, URS is recommending primary pressure service zones to include 913 Zone, 1070 Zone, 1240 Zone, 1400 Zone, 1530 Zone, 1630 Zone, and 1840 Zone. Table 7-1, Figure 7-2, and Figure 7-3 shows the minimum and maximum static pressures for each of the zones and associated system components. These also indicated the ranges for the topographic (ground) elevations, which are used to define the extent of the individual zones. These primary pressure zones have or will in the future contain water storage facilities, if required, to meet peak hour and fire flow demands, groundwater wells to provide a source of supply for max day demands within the zone, booster pumping capability to move water to higher service zones, and water transmission mains within the service zone distribution system.

Insert

Figure 7-1
Existing MSWD Water System

Insert

Figure 7-2
Existing 2005 MSWD System

Insert

Figure 7-3

Existing 2005 MSWD Palm Spring Crest / West Palm Springs System

Table 7-1

Primary Pressure Zone Summary

Zone	Minimum Topographic Elevation (ft)	Maximum Topographic Elevation (ft)	Minimum Static Pressure (psi)	Maximum Static Pressure (psi)
913	635	800	49	120
1070	800	970	43	117
1240	970	1,140	43	117
1400	1,140	1,300	43	113
1530	1,300	1,430	43	100
1630	1,430	1,530	43	87
1800	1,530	1,700	43	117
1975	1,700	1,880	41	119
2155	1,880	2,060	41	119

The following subsections provide a further description of the water distribution facilities within each the respective primary pressure zones. These facilities include supply, storage, booster station, and distribution system components.

7.2.1 913 Zone

The 913 Zone formerly known as the Reduced Valley View Zone was regulated by PRV-10 and PRV-11. The 913 Zone is the lowest primary service zone within the MSWD water system. Recently, MSWD installed a new 2 mg tank at an overflow elevation 913 ft. msl, and hence, the naming of this primary service zone as “913 Zone”. In addition to the new tank, two wells serve within the service zone through the new water storage tank. It also contains a booster pump station to deliver water to a higher primary service zones. As shown in Table 7-1, the 913 Zone serves portions of the system from elevation 635 ft to elevation 800 ft.

7.2.1.1 Water Supply

As shown in Table 7-2, two wells (Well 32 and 33) provide the water supply for the 913 Zone residential and commercial uses. These wells provide a combined discharge capacity of 2,800 gpm.

Table 7-2

Existing Groundwater Wells, 913 Zone

Well	Pressure Zone (ft)	Associated Storage	Motor (Hp)	Standing Water Level (ft)	Efficiency (%)	Ground Elevation (ft)	TDH (ft)	Capacity (gpm)
32	913	913 Tank	150	700±	83	900	240	2,000
33	913	913 Tank	60	700±	83	787	164	800
				Total				**2,800**

Source: data from MSWD and Section 5.0 of this report

7.2.1.2 Storage Tanks

MSWD recently completed a new 2.0 mg storage facility in the 913 Zone. As shown in Table 7-3, the 913 Zone Storage Tank provides a storage capacity of 2.0 mg. In addition, the tank provides suction storage for the Garnet Booster Pump Station, which provides an additional 55,000 gallons of storage, but this storage is only used to supply suction head to the booster pumps.

Table 7-3

Existing Water Storage Tanks, 913 Zone

Storage Facility	Pressure Zone (ft)	Floor Elevation (ft)	High Water Elevation (ft)	Height (ft)	Diameter (ft)	Storage Volume (mg)
913 Tank	913	888	913	25	127	2.0
		Total				**2.0**

Source: 2005 MSWD system data

7.2.1.3 Booster Stations

As shown in Table 7-4, the Garnet Booster Station is the only booster station in the 913 Zone. This booster station consists of two booster pumps with space to accommodate future pumps. Table 7-4 shows the performance parameters for the entire booster station, which has capacity to pump 1,066 gpm with 128 ft of total head.

Table 7-4

Existing Booster Pumps, 913 Zone

Pump Designation	Pump Horsepower (Hp)	Discharge Pressure (psi)	Pump Efficiency (%)	Pump Type	Total Head (ft)	Capacity (gpm)
Garnet Booster Station	45	61	80	Vertical Turbine	128	1,066
			Total			**1,066**

Source: 2005 MSWD system data

7.2.1.4 Distribution System

Based on the 913 Zone system hydraulic pressure requirements, 913 Zone will provide water service to residential and commercial customers located between topographic elevations of 635 and 800 ft. msl. In the past, the 913 Zone was a reduced pressure zone from the 1070 Zone that was regulated by PRV-10 and PRV-11. Currently, PRV-10 remains operational and PRV-11 is normally closed. Because of topographic constraints, PRV-10 is required to serve the upper portion of the former Reduced Valley View service zone.

7.2.2 1070 Zone

The 1070 Zone serves the primary pressure zone within the Two Bunch and Valley View service zones. As shown in Table 7-1, the 1070 Zone serves portions of the system from topographic elevation 800 ft (msl) to topographic elevation 970 ft (msl). This zone gets is name from the overflow elevation of the tanks that service this zone. The 1070 Zone includes groundwater wells, storage tanks, booster pump stations, and distribution system components, such as pipelines and valves. The following sections present some key operational details of the water system infrastructure in the 1070 Zone.

7.2.2.1 Water Supply

As shown in Table 7-5, Well 27 and Well 31 provide 1070 Zone with a combined groundwater supply of approximately 3,000 gpm. These two wells do not provide water for the same primary pressure service zones. Well 32 and Well 33 (from the 913 Zone) can also deliver water to the Two Bunch storage facility to serve the 1070 Zone. The total well capacity for this zone is 5,800 gpm.

Table 7-5

Existing Groundwater Wells, 1070 Zone

Well	Pressure Zone (ft)	Associated Storage	Motor (Hp)	Standing Water Level (ft)	Efficiency (%)	Ground Elevation (ft)	TDH (ft)	Capacity (gpm)
27	1,070	Valley View	200	702	62	879	381	1,100
31	1,070	Two Bunch	350	713	68	877	447	1,900
32	1,070	Two Bunch	150	700±	83	900	240	2,000
33	1,070	Two Bunch	60	700±	83	787	164	800
Total								**5,800**

Source: data from MSWD and Section 5.0 of this report

Well 27 delivers water to the Valley View service zone and to the Valley View tank, which has a capacity of 0.31 mg. A normally closed valve separates Well 27 from the Two Bunch service zone. The reduced pressure service zone in the 913 Zone draws water from the Valley View service zone through PRVs. Thus, Well 27 serves both Zone 1070 and Zone 913.

Well 31 provides water to the Two Bunch service zone, which includes two storage tanks. Water from Well 31 is separated from the Valley View and Terrace service zones by normally closed valves.

7.2.2.2 Storage Tanks

The 1070 Zone contains three tanks, which are described in the Table 7-6. Although these three tanks reside in the same pressure zone, these tanks do not provide water storage for the same service zone.

Table 7-6
Existing Water Storage Tanks, 1070 Zone

Storage Facility	Pressure Zone (ft)	Bottom Elevation (ft)	High Water Elevation (ft)	Height (ft)	Diameter (ft)	Storage Volume (mg)
Valley View	1,070	1,046	1,070	24	47	0.31
Two Bunch #1	1,070	1,046	1,070	24	55	0.43
Two Bunch #2	1,070	1,046	1,070	24	85	1.02
		Total				**1.76**

Source: 2004 MSWD system data

The Valley View tank (0.31 mg storage capacity), which stores water for the Valley View service zone, obtains its source water from Well 27. An altitude valve is located below the tank and above the Valley View service zone, but it is not currently in service. The Valley View tank also provides water storage for the Valley View booster pump station, which conveys water from the 1070 Zone to the 1240 Zone and the Overhill service zone. The Two Bunch storage facility includes two separate tanks with a combined storage capacity of 1.45 mg. Both tanks at the Two Bunch storage facility deliver water exclusively to the Two Bunch service zone. Well 31 provides the water source for this storage facility.

7.2.2.3 Booster Stations

As shown in Table 7-7, the 1070 Zone (Valley View Booster Station)contains a booster station with two booster pumps. This facility draws water from the Valley View tank and pumps water to the Overhill service zone and the Overhill tank, which are both located within the 1400 Zone. The two pumps at the Valley View booster pump station provide 323 ft of additional head and a total discharge capacity of 710 gpm. The pump efficiency and the total head data are based upon July 2003 system information. The 1070 Booster Station, located at the Well 32/Little Morongo 913 tank site, pumps water from the 913 Zone to the Two Bunch 1070 Zone.

Table 7-7
Existing Booster Pumps, 1070 Zone

Pump Designation	Pump Horsepower (Hp)	Discharge Pressure (psi)	Pump Efficiency (%)	Pump Type	Total Head (ft)	Capacity (gpm)
Valley View Booster 1	60	150	71.6	Vertical Turbine	323	354
Valley View Booster 2	60	150	72.0	Vertical Turbine	323	356
1070 Booster Station (2 pumps)	75	98	80	Vertical Turbine	222	956
			Total			**1,666**

Source: 2004 MSWD system data

7.2.2.4 Distribution System

The distribution system in the 1070 Zone conveys water to the Valley View and Two Bunch service zones, which are separated by a normally closed valve. Two other normally closed valves in the distribution system separate the Two Bunch service zone from the Terrace service zone, along the 1070 Zone boundary. In addition, PRV 13, which is normally closed, is used to separate the Terrace service zone from the Two Bunch service zone.

There are two major distribution pipelines within the 1070 Zone. The first and largest of the two is a 16-inch pipeline, which connects the Two Bunch storage facility with the Two Bunch service zone. The second is a 12-inch pipeline, which connects the Valley View storage facility with the Valley View service zone. This 12-inch pipeline also connects the Valley View service zone with Well 27. A normally closed valve along this pipeline separates both the Valley View service zone and Well 27 from both Well 31 and the Two Bunch service zone.

7.2.3 1240 Zone

The 1240 Zone, which is the second lowest primary pressure zone, is only part of the MSWD water system and serves the primary pressure service zones within the communities of Quail, Reduced Overhill, and Terrace. The 1240 Zone includes groundwater wells, storage tanks, booster pump stations, and distribution system components, such as pipelines and valves. The following sections present some key operational details of the water system infrastructure in Zone 1240.

7.2.3.1 Supply

The 1240 Zone includes the groundwater Wells 22, 24 and 29, which are described in Table 7-8. The total source capacity of the three wells is 4,650 gpm. Each of these three wells provides water to the Terrace service zone and to the Terrace tanks in the 1240 Zone.

Table 7-8
Existing Groundwater Wells, 1240 Zone

Well	Pressure Zone (ft)	Associated Storage	Motor (Hp)	Standing Water Level (ft)	Efficiency (%)	Ground Elevation (ft)	TDH (ft)	Capacity (gpm)
22	1240	Terrace & Quail	400	703	68	1,106	568	1,750
24	1240	Terrace & Quail	600	700	49	1,096	580	1,200
29	1240	Terrace & Quail	350	699	76	1,014	574	1,700
				Total				**4,650**

Source: data from MSWD and Section 5.0 of this report

7.2.3.2 Storage

The 1240 Zone tanks are identified in Table 7-9. The total storage volume for these four steel tanks is approximately 7.1 million gallons.

Table 7-9
Existing Water Storage Tanks, 1240 Zone

Storage Facility	Pressure Zone (ft)	Bottom Elevation (ft)	High Water Elevation (ft)	Height (ft)	Diameter (ft)	Storage Volume (mg)
Terrace West	1,240	1,220	1,240	20	135	2.14
Terrace Middle	1,240	1,220	1,240	20	125	1.84
Terrace East	1,240	1,220	1,240	20	135	2.14
Quail Road	1,240	1,216	1,240	24	85	1.02
		Total				**7.14**

Source: 2004 MSWD system data

The three Terrace tanks deliver water via gravity to the Terrace service zone, and provide the largest volume of stored water in the MSWD system (approximately 6.1 million gallons). The tanks also provide pump suction water for four booster pumps that transfer water from the Terrace tanks to the High Northridge service zone and the High Northridge tank. Another set of booster pumps transfer water from the Terrace tanks to the High Desert View service zone, and the High Desert View tanks. In addition, the same booster pumps transfers water from the Terrace tanks to the Quail Road tank and the Low Desert View tanks.

The Low Desert View tanks with a combined storage volume of 0.35 million gallons are currently used as reserve water storage. The overflow elevation of the Low Desert View tanks is at an elevation of 1,291 ft, which is above the 1240 Zone boundary. Two pressure-reducing valves (PRV 1 and PRV 2), which are normally closed, separate the Low Desert View water from the 1240 Zone system. The closure of these PRVs removes the two Low Desert View tanks from service.

The Quail Road tank receives water from the booster pumps that are located below the Terrace Tanks. Because the Quail Road tank has the same overflow elevation as the Terrace tanks, the system uses an altitude valve to prevent the booster pumps from overtopping the Quail Road tank. The Quail Road tank then provides gravity-feed water delivery to the Quail service zone.

7.2.3.3 Booster Stations

The Terrace Booster Pumping Station, which consists of six pumps, is located below the three tanks at the Terrace storage facility. The 1240 Zone booster pumps are summarized in Table 7-10. The Terrace booster station pumps water to both the Desert View tank and the Quail tank. The Two Bunch Booster station pumps water from the 1070 Zone to the Terrace service zone in the 1240 Zone.

Table 7-10
Existing Booster Pumps, 1240 Zone

Pump Designation	Pump Horsepower (Hp)	Discharge Pressure (psi)	Pump Efficiency (%)	Pump Type	Total Head (ft)	Capacity (gpm)
Terrace Booster 1	50	131	53	Submersible	283	325
Terrace Booster 2	50	132	71	Vertical Turbine	291	486
Terrace Booster 3	75	135	72	Vertical Turbine	293	630
Terrace Booster 4	75	136	72	Vertical Turbine	295	777
Terrace Booster 5	60	78	55	Vertical Turbine	180	683
Terrace Booster 6	60	80	55	Vertical Turbine	190	804
Two Bunch Booster Station (2 pumps)	60	91	83	Vertical Turbine	181	1,066
			Total			**4,771**

Source: 2004 MSWD system data

7.2.3.4 Distribution

The 1240 Zone distribution system includes the areas of Terrace and Quail service zones. Emergency connections may be established between the Annandale and Terrace service zones through opening a normally closed valve. Another emergency connect could be established between the Terrace service zone and the Two Bunch tanks through a PRV, which is normally closed.

7.2.4 1400 Zone

The 1400 Zone, which is the third primary pressure zone, is also part of the MSWD water system and serves the primary pressure service zones within the Overhill, Annandale, and Desert View service zones. In addition, the 1400 Zone supplies water to the reduced pressure services area within the Northridge, Annandale, and Overhill service zones (see Section 7.3). The 1400 Zone includes groundwater wells, storage tanks, booster pump stations, and distribution system components, such as pipelines and valves. The following sections present some key operational details of the water system infrastructure in Zone 1400.

7.2.4.1 Supply

The 1400 Zone is supplied with groundwater from four wells, which are identified in the Table 7-11. Well 28 provides source water to the Annandale service zone and the Annandale tank. Well 27 supplies the source for the Overhill tank and service zone through operation of the Valley View pump station. Well 22, Well 24, and Well 29 provide the source of water for Desert View tanks and service zone through the Terrace booster pump station. The combined source capacity of these four wells is approximately 7,650 gpm.

Table 7-11
Existing Groundwater Wells, 1400 Zone

Well	Pressure Zone (ft)	Associated Storage	Motor (Hp)	Standing Water Level (ft)	Efficiency (%)	Ground Elevation (ft)	TDH (ft)	Capacity (gpm)
22	1,400	Desert View	400	703	68	1,106	568	1,750
24	1,400	Desert View	600	700	49	1,096	580	1,200
27	1,400	Overhill	200	702	62	879	381	1,100
28	1,400	Annandale	600	697	66	1,244	731	1,900
29	1,400	Desert View	350	699	76	1,014	574	1,700
				Total				**7,650**

Source: data from MSWD and Section 5.0 of this report

7.2.4.2 Storage

The tanks that serve the 1400 Zone tanks are described in Table 7-12. The total storage capacity of the four tanks is approximately 4.4 million gallons. The Overhill, Annandale, and Desert View storage tanks are each separated by long distances. Only the Annandale and Dessert View tanks can be interconnected.

Table 7-12
Existing Water Storage Tanks, 1400 Zone

Storage Facility	Pressure Zone (ft)	Bottom Elevation (ft)	High Water Elevation (ft)	Height (ft)	Diameter (ft)	Storage Volume (mg)
Overhill	1,400	1,380	1,400	20	47	0.27
Annandale	1,400	1,376	1,400	24	135	2.57
High Desert View #1	1,400	1,377	1,400	24	60	0.51
High Desert View #2	1,400	1,377	1,400	24	87	1.07
			Total			**4.42**

Source: 2004 MSWD system data

In general, the Overhill and Annandale tanks deliver water to separate service zones within the 1400 Zone. The Overhill tank provides gravity water service to the Overhill service zone. The Overhill booster pump station transfers water from the Overhill tank to the Gateway service zone, which is in the 1530 Zone. The Annandale tank delivers water via gravity system to the Annandale service zone. It also serves the reduced pressure Annandale service zone, which is regulated by PRV 9.

The High Desert View Tanks #1 and #2 deliver water via gravity to the High Desert View service zone. These tanks also provide water to the former Reduced Desert View service zone, which was removed from service in 2004 and split between the Terrace and High Desert View service zones. The High Desert View tanks have a combined capacity of 1.58 million gallons and do not have any booster pumps at the site.

7.2.4.3 Booster Stations

The 1400 Zone is currently served by two booster stations: Overhill and Low Desert View. These are facilities are summarized in Table 7-13. The Overhill booster station transfers water from the Overhill tank to the Gateway service zone and also to the Gateway tank. Specifically, the Overhill pump station has two operational pumps. The Low Desert View Pumping Station is located at the Low Desert View tanks and is comprised of three pumps. Only two of the Low Desert View pumps are listed because one of the Low Desert View pumps is out of service. The Low Desert View booster pump station delivers water to the Red Bud storage tanks.

Table 7-13
Existing Booster Pumps, 1400 Zone

Pump Designation	Pump Horsepower (Hp)	Discharge Pressure (psi)	Pump Efficiency (%)	Pump Type	Total Head (ft)	Capacity (gpm)
Overhill Booster 1	30	70	67	Vertical Turbine	145	259
Overhill Booster 2	30	82	78	Vertical Turbine	173	412
Low Desert View Booster 1	25	116	47	Submersible	236	269
Low Desert View Booster 2	25	116	42	Submersible	236	249
		Total				**1,189**

Source: 2004 MSWD system data

7.2.4.4 Distribution

The distribution system within the1400 Zone includes the service zones of Desert View, Annandale, and Overhill. The Overhill service zone water distribution system is connected via PRV 14 to provide water service to the reduced Overhill East service zone. PRV 15 is designed to serve the Overhill West area, which currently has no services.

Similarly, the Annandale service zone also provides water to the Annandale reduced pressure service zone through PRV 9. There is only one connection from the Annandale service zone to reduced Annandale reduced pressure service zone.

The Reduced Desert View service zone was taken off pressure regulators and split between the Terrace and High Desert View service zones.

7.2.5 1530 Zone

The 1530 Zone, which is the fourth primary pressure zone, is also part of the MSWD water system and serves the primary pressure service zones within the following communities: Gateway, Mission Lakes, Northridge, and Red Bud. In addition, the 1630 Zone supplies water to the reduced pressure service zone within Vista. The 1530 Zone includes storage tanks, booster pump stations, and distribution system components, such as pipelines and valves. The following sections present some key operational details of the water system infrastructure in the 1530 Zone.

7.2.5.1 Supply

The 1530 Zone receives groundwater from Well 30, which delivers water to the Mission Lakes service zone and storage tank. All other source water, which enters the 1530 Zone originates from the lower zones, and is delivered by booster pump stations. For example, the two Terrace booster pump stations transfer source water from Well 22, Well 24, and Well 29 to High Northridge. The Terrace Booster Station also delivers water to the Low Desert View Booster Station, which conveys water to the Red Bud service area. Similarly, service water for Gateway comes from Well 27, and is transferred through the operation of the Valley View and Overhill booster stations. Table 7-14 describes the parameters of the well that serve the 1530 Zone.

Table 7-14
Existing Groundwater Wells, 1530 Zone

Well	Pressure Zone (ft)	Associated Storage	Motor (Hp)	Standing Water Level (ft)	Efficiency (%)	Ground Elevation (ft)	TDH (ft)	Capacity (gpm)
30	1530	Mission Lakes	250	707	66	1,282	864	825
22	1530	High Northridge & Red Bud	400	703	68	1,106	568	1,750
24	1530	High Northridge & Red Bud	600	700	49	1,096	580	1,200
29	1530	High Northridge & Red Bud	350	699	76	1,014	574	1,700
27	1530	Gateway	200	702	62	879	381	1,100
				Total				**6,575**

Source: data from MSWD and Section 5.0 of this report

7.2.5.2 Storage

The 1530 Zone tanks are identified in Table 7-15. The total storage capacity of the four tanks is approximately 3.6 million gallons.

Table 7-15
Existing Storage Tanks, 1530 Zone

Storage Facility	Pressure Zone (ft)	Bottom Elevation (ft)	High Water Elevation (ft)	Height (ft)	Diameter (ft)	Storage Volume (mg)
Gateway	1,530	1,506	1,530	24	43	0.26
Mission Lakes	1,530	1,494	1,530	36	96	1.95
High Northridge	1,530	1,514	1,530	16	105	1.04
Redbud	1,535	1,503	1,535	32	41	0.32
		Total				**3.57**

Source: 2004 MSWD system data

The Gateway tank delivers water by gravity to the Gateway service zone, and supplies water to the Gateway booster pumping station, which is located above the Gateway tank and serves a portion of the 1630 Zone.

The Mission Lakes tank delivers water to the Mission Lakes service zone. In addition PRV 6 and PRV 8, which are normally closed, can be opened to send water from Mission Lakes to Annandale in an emergency situation. The Mission Lake tank exclusively serves the Mission Lakes service zone and is not equipped with booster pumps.

The High Northridge tank provides service to the High Northridge service zone, which is connected to the High Northridge reduced pressure service zone. PRV 4 and PRV 5 regulate two pipelines that supply the High Northridge reduced pressure service zone. This dual PRV system provides feed into the reduced pressure system. Another pipeline from the High Northridge tank delivers water to the Low Northridge tank, which has an overflow elevation of 1,509 ft. To prevent overfilling from the High Northridge tank to the Low Northridge tank, an altitude valve is used. The Low Northridge tank provides suction for the Low Northridge booster pumping station, which serves the Vista service zone in the 1630 Zone and the Vista reduced pressure service zone in the 1530 Zone.

The Annandale tank delivers water via gravity feed to the Annandale service zone, which is also connected to the Annandale reduced pressure service zone. Service to the reduced Annandale service zone is regulated through a single PRV connection, PRV 9.

The Gateway service zone and the Gateway tank are separated from the core MSWD water system. Specifically, the Gateway tank provides gravity water service to the Gateway service zone and provides water to the Gateway booster pump station, which transfers water from the Gateway tank to the Gateway Hydro service zone in the 1630 Zone.

7.2.5.3 Booster Stations

The Gateway, Northridge and Redbud Booster Pumping Station are the booster pumping stations contained in the 1530 Zone. The Gateway booster station transfers water from the Gateway tank into the Gateway Hydro service zone. The Low Northridge booster pumping station transfers water from the Low Northridge tank into the Vista service zone and the Vista tank. The Redbud booster pumping station transfers water into the Highland service zone and the Highland tank. The 1530 Zone booster pumps are summarized in Table 7-16.

Table 7-16
Existing Booster Pumps, 1530 Zone

Pump Designation	Discharge Capacity (gpm)	Pump Horsepower (Hp)	Discharge Pressure (psi)	Pump Efficiency (%)	Pump Type	Total Head (ft)
Low Northridge Booster 1	286	20	66	47	Submersible	129
Low Northridge Booster 2	331	20	67	54	Submersible	132
Redbud Booster 1	302	20	68	40	Submersible	131
Redbud Booster 2	382	20	70	52	Submersible	135
Gateway Fire Pump	-	25	-	-	Vertical Turbine	-
Gateway Hydro Booster 1	-	10	-	-	Centrifugal	90

Pump Designation	Discharge Capacity (gpm)	Pump Horsepower (Hp)	Discharge Pressure (psi)	Pump Efficiency (%)	Pump Type	Total Head (ft)
Gateway Hydro Booster 2	-	10	-	-	Centrifugal	85

Source: 2004 MSWD system data

7.2.5.4 Distribution

The 1530 Zone distribution system includes the Gateway, Mission Lakes, Northridge and Redbud water distribution areas.

The Gateway service zone distribution system receives its water from the Gateway tank and Overhill booster pumping station. A portion of the Gateway tank capacity is used for the Gateway Hydro service zone. The Gateway water distribution system is separated from the core part of the MSWD water system. Well 27 provides the sole source for the interconnected service zones of Gateway, Overhill, Valley View, and the 913 Zone. Thus, Well 27 supplies water to the following pressure zones: 913, 1070, 1240, 1400, 1530, and 1630. An emergency inner connect, through a normally closed valve, can be established to deliver water from Well 31 to this portion of the MSWD system.

The Gateway Hydro system is higher in elevation than the gateway tank and has a single connection through the Gateway pumping station. The Gateway booster pump station and the Gateway Hydro tank maintain minimum flow and system pressure. The Gateway booster pump station also includes a fire pump to provide sufficient fire flow because there is no upper level storage facility to provide fire flow by gravity-feed to this portion of the Gateway service zone.

The Mission Lakes service zone is supplied from the Mission Lakes storage tank. An emergency interconnection can be established to deliver water from the Mission Lakes area to the Annandale service zone via PRV 6 and PRV 8, which are both normally closed.

The High Northridge tank provides service to the High Northridge service zone. The High Northridge distribution system also provides water service to the High Northridge reduced pressure service zone. PRV 4 and PRV 5 regulate water delivery to the High Northridge reduced pressure service zone. Mission Lakes and High Northridge can be interlinked through a normally closed valve, but current conditions and line sizes limit flow.

The Redbud water service zone receives water from the Redbud tank and the Low Desert View pump station.

7.2.6 1630 Zone

The 1630 Zone, which is the fifth primary pressure zone, is also part of the MSWD water system and serves the primary pressure service zones within the Vista and Highland communities. In addition, the 1630 Zone supplies water to the reduced pressure service zone within Vista, which is part of the 1530 Zone. The 1630 Zone includes storage tanks, booster pump stations, and distribution system components, such as pipelines and valves. The following sections present some key operational details of the water system infrastructure in the 1630 Zone.

7.2.6.1 Supply

The 1630 Zone does not have any groundwater wells. All source water coming into the 1630 Zone comes from the water in the lower zones and is pumped multiple times to reach the higher zones within the water system. Table 7-17 shows the capacities of the three well, which can provide water to this zone.

Table 7-17
Existing Groundwater Wells, 1630 Zone

Well	Pressure Zone (ft)	Associated Storage	Motor (Hp)	Standing Water Level (ft)	Efficiency (%)	Ground Elevation (ft)	TDH (ft)	Capacity (gpm)
22	1530	High Northridge & Red Bud	400	703	68	1,106	568	1,750
24	1530	High Northridge & Red Bud	600	700	49	1,096	580	1,200
29	1530	High Northridge & Red Bud	350	699	76	1,014	574	1,700
			Total					**4,650**

Source: data from MSWD and Section 5.0 of this report

7.2.6.2 Storage

The 1630 Zone tanks are described in Table 7-18. These two tanks have a combined storage capacity of 360,000 gallons.

Table 7-18
Existing Water Storage Tanks, 1630 Zone

Storage Facility	Pressure Zone (ft)	Bottom Elevation (ft)	High Water Elevation (ft)	Height (ft)	Diameter (ft)	Storage Volume (mg)
Highland	1,630	1,645	1,661	16	25	0.06
Vista	1,630	1,605	1,637	32	40	0.30
		Total				**0.36**

Source: 2004 MSWD system data

The Highland and Vista tanks are currently the only water storage facilities in the 1630 Zone. The Vista tank has an overflow elevation of 1,637 ft, and is hydraulically separate from the Highland tank. The Vista tank provides gravity service to the Vista service zone. Likewise, the Highland tank provides gravity service to the Highland service zone.

7.2.6.3 Booster Stations

The only booster pumping station in the 1630 Zone is the Vista booster pump station, which utilizes two pumps to transfer water from the 1630 Zone to the Vista Hydro service zone. Similar to the Gateway Hydro service zone, the Vista Hydro service zone is regulated by a hydro-pneumatic tank that supplies pressure to the upper portion of the service zone. The 1630 Zone booster pumps are summarized in Table 7-19.

Table 7-19
Existing Booster Pumps, 1630 Zone

Pump Designation	Capacity (gpm)	Pump Horsepower (Hp)	Pump Type	Total Head (ft)
Vista Hydro B1	93	5	Centrifugal	95
Vista Hydro B2	93	5	Centrifugal	90

Source: 2004 MSWD system data

7.2.6.4 Distribution

The 1630 Zone includes the Vista and Highland service zones. The Vista distribution system receives its water from the Vista tank. A reduced pressure service zone called Reduced Vista has a single connection to the Vista distribution system through PRV 3.

The Highland service zone receives its water from the Highland tank and the Redbud booster pump station (1530 Zone). No PRVs area used to regulate water delivery in this portion of the system.

7.2.7 Vista Hydro Tank Zone

The Vista Hydro system is higher in elevation than the Vista tank and has a single connection via the Vista booster pumping station. the Vista pump station is equipped with a hydro-pneumatic tank, however thee is no fire pump in the Vista booster pump station. The Vista pumping station and the Vista Hydro tank maintain system flow and pressure. There is not an upper level tank in the Vista Hydro distribution system to provide fire flow by gravity.

7.3 PALM SPRINGS CREST SYSTEM

7.3.1 Woodridge 1840 Zone

The Woodridge 1840 Zone is part of the Palm Springs Crest System, which exclusively serves the Woodridge service zone. This system consists of two groundwater wells (Well 25 and Well 25A) and the Woodridge storage tank, which is located at a pressure zone of 1840 and has a storage capacity of 0.12 mg. The majority of the Woodridge development has its pressure regulated by the Woodridge tank. The entire Woodridge system is independent from both the MSWD water system and the Cottonwood water system. The Reduced Woodridge Zone is regulated by PRV 16 and is served by the Woodridge Zone tank and wells, previously mentioned.

7.3.1.1 Supply

Table 7-20 shows the parameters for the two wells, which serve the 1840 Zone. The total production capacity of these two wells is 575 gpm.

Table 7-20
Existing Groundwater Wells, 1840 Zone

Well	Pressure Zone (ft)	Associated Storage	Motor (Hp)	Standing Water Level (ft)	Efficiency (%)	Ground Elevation (ft)	TDH (ft)	Capacity (gpm)
25	1840	Woodridge	125	1200	70	1480	729	400
25A	1840	Woodridge	40	1275	61	1640	695	175
			Total					**575**

Source: data from MSWD and Section 5.0 of this report

7.3.1.2 Storage

There is currently only one storage facility for the 1840 Zone. A basic description of this facility is provided in Table 7-21. The storage capacity is approximately 116,000 gallons.

Table 7-21
Existing Water Storage Tanks, 1840 Zone

Storage Facility	Pressure Zone (ft)	Bottom Elevation (ft)	High Water Elevation (ft)	Height (ft)	Diameter (ft)	Storage Volume (mg)
Woodridge Tank	1840	1,818	1,840	22	30	0.12
		Total				**0.12**

Source: 2004 MSWD system data

7.3.1.3 Booster Stations

Currently this zone does not contain booster stations.

7.3.1.4 Distribution

As previously mentioned, this system receives water from two wells, which deliver water to a single storage facility. This zone does not have any areas that are regulated by pressure reducing valves.

7.4 WEST PALM SPRINGS VILLAGE SYSTEM

7.4.1 Cottonwood 1630 Zone

The Cottonwood 1630 Zone is a part of the West Palm Springs Village water system, an independent water system, which is separated from both the Palm Springs Village System and the MSWD Desert Hot Spring System. Groundwater from Well 26 and Well 26a is pumped through the Cottonwood service zone to the Cottonwood tank, which provides service to the 1632 pressure zone and has a storage capacity of 0.28 mg. The Cottonwood tank provides water service directly to the Cottonwood service zone. This system does not use any PRVs to regulate system pressures.

7.4.1.1 Supply

As shown in Table 7-22, the Cottonwood 1630 Zone is supplied by two wells. However, Well 26A is currently out-of-service, but has an approximate production capacity of 170 gpm. Without this well, the total supply for this zone is only 350 gpm.

Table 7-22
Existing Groundwater Wells, 1630 Zone

Well	Pressure Zone (ft)	Associated Storage	Motor (Hp)	Standing Water Level (ft)	Efficiency (%)	Ground Elevation (ft)	TDH (ft)	Capacity (gpm)
26	1630	Cottonwood	100	1,163	47	1,348	485	350
26A	1630	Cottonwood	30	1,210	-	1,508	296	170
			Total					**520**

Source: data from MSWD and Section 5.0 of this report

7.4.1.2 Storage

There is currently only one storage facility for the Cottonwood 1630 Zone. A basic description of this facility is provided in Table 7-23. The storage capacity is approximately 116,000 gallons.

Table 7-23
Existing Water Storage Tanks, 1840 Zone

Storage Facility	Pressure Zone (ft)	Bottom Elevation (ft)	High Water Elevation (ft)	Height (ft)	Diameter (ft)	Storage Volume (mg)
Cottonwood Tank	1840	1,818	1,840	22	30	0.28
		Total				**0.28**

Source: 2004 MSWD system data

7.4.1.3 Booster Stations

Currently this zone does not contain any booster stations.

7.4.1.4 Distribution

As previously mentioned, this system receives water from one well, which deliver water to a single storage facility. This zone does not have any areas that are regulated by pressure reducing valves.

7.5 MSWD SYSTEM REDUCED PRESSURE ZONES

Pressure Reducing Valves (PRVs) are incorporated into the water system to reduce pressures from one zone to another zone, where a direct connection to an upper water storage tank is not practical. MSWD prefers to not create additional reduced pressure service zones. Furthermore, MSWD plans to incorporate the existing reduced pressure service into the standard MSWD pressure zones. The following pressure zones contain reduced pressure service zones: 913, 1240, 1400, and 1530. Hereafter, Section 7.3 contains a brief discussion of reduced pressure service zones and a summary of system PRVs.

7.5.1 913 Zone Pressure Reduction

The lowest pressure zone currently in the MSWD system is the 913 Zone. In the past, the 913 Zone was a reduced pressure zone from the 1070 Zone that was regulated by PRV10 and PRV11. Previously the 913 Zone received water from the Valley View tank. However, 2005 system improvements to the 913 Zone added a new well (Well#32) and a two million gallon tank. PRV10 remains operational and PRV11 is normally closed. Thus, the 913 Zone no longer functions as a reduced pressure service zone.

7.5.2 1240 Zone Pressure Reduction

The 1400 Zone provides water for the reduced pressure service zones within Annandale and Overhill East, which are both located within the 1240 Zone. Respectively, PRV 9 and PRV 14 regulate the water supply to the service zones within Annandale and Overhill East.

7.5.3 1400 Zone Pressure Reduction

Through two pipelines, the 1530 Zone supplies water to the Northridge reduced pressure service zone within the 1400 Zone. PRV 4 and PRV 5 regulate the water conveyed through these two pipelines.

7.5.4 1530 Zone Pressure Reduction

PRV 3 regulates water that is delivered from the 1630 Zone to the reduced pressure service zone within Vista development in the 1530 Zone. There are no other reduce pressure service zones with the 1530 Zone.

7.6 PALM SPRINGS CREST SYSTEM REDUCED PRESSURE ZONES

7.6.1 Reduced Woodridge Zone

The reduced Woodridge Zone is supplied with water from the Woodridge Zone and is regulated by PRV16.

7.7 WEST PALM SPRINGS VILLAGE SYSTEM REDUCED PRESSURE ZONES

There are no reduced pressure zones in the existing West Palm Springs Village System.

7.8 EXISTING SYSTEM SUMMARY

The location and function of PRVs, which regulate the reduced pressure service zones, are summarized in Table 7-24.

Table 7-24

Existing PRV Locations, Combined MSWD System

Valve	Installation Point	PRV Size	Upstream Service zone	Downstream Service zone	Upstream (psi)	Downstream (psi)	Comments
1	West Drive & San Juan Road	6”	High Northridge	Annandale	138	76	Normally Closed
2	12th Street and Santa Cruz Street	6"	High Northridge	Annandale	60	18	Normally Closed
3	Mission Lakes & Santa Cruz	6"	Vista	Reduced Vista	150	65	-
4	Mesquite & 8th Street	6"	High Northridge	Reduced High Northridge	110	70	Dual feed to Reduced High Northridge
5	Verbena & Terrace	4"	High Northridge	Reduced High Northridge	150	68	Dual feed to Reduced High Northridge
6	Oakmount & Leith	6”	Mission Lakes	Annandale	125	56	Normally Closed
7	Clubhouse & Warwick	4”	-	-	-	-	Removed
8	Spyglass & Clubhouse	4”	Mission Lakes	Annandale	124	56	Normally Closed
9	Dale Ave. & Pierson	6"	Annandale	Reduced Annandale	160	65	-
10	Wall Rd & Garnet	6"	Valley View	913 Zone	110	50	Dual feed to 913 Zone
11	Indiana (Teagarden) & 19th Ave	10"	Valley View	913 Zone	120	90	Dual feed to 913 Zone
12	Palm & Ironwood	14”	-	-	-	-	Removed
13	Little Morongo & 15th Ave	14”	Terrace	Two Bunch	125	50	Normally Closed
14	Valley View & Smoke Tree	6"	Overhill	Reduced Overhill East	140	70	-

Table 7-24

Existing PRV Locations, Combined MSWD System

Valve	Installation Point	PRV Size	Upstream Service zone	Downstream Service zone	Upstream (psi)	Downstream (psi)	Comments
15	Desert View & Mountain View	6"	-	-	110	40	Removed
16	Calsman & Rushmore - Old Painted Hills	6"	Woodridge	-	110	50	-

Generally, reduced pressure service zones (such 913 Zone and Reduced High Northridge) are fed by two PRV stations, which regulate system pressures to the reduced zone. This system looping provides better pressures and flows than a single feed would provide. On the other hand, the reduced pressure zones of Woodridge, Overhill West, Overhill East, Annandale and Vista all have a single PRV connection to the adjacent distribution system, which is located at a higher elevation.

As shown in the Table 7-25, the MSWD water system has approximately 1.26 million linear feet of pipeline. This includes the MSWD System, the West Palm Springs System, and the Palm Springs Crest System.

Table 7-25

Existing Distribution System, Mode Pipeline Summary

Pipe Diameter (Inch)	Length (ft)
2	6,174
4	249,658
5	25,132
6	280,362
8	371,228
10	33,932
12	192,553
14	555
16	104,078
Total	**1,263,672**

Source: MSWD system data

MSWD maintains numerous metered water services, mostly residential. The residential services are typically ¾-inch size. Commercial services typically have two 2-inch metered connections. One for domestic usage and the second is used for irrigation.

Known areas of un-metered water include fire fighting, system leaks, groundwater well discharges to atmosphere prior to entering the distribution system, tank overflows, pipeline breaks, and meter calibration. The percentage of unaccounted for water is about 8 to 9 percent. All water used for construction is typically metered.

7.9 SEISMIC ASSESSMENT

7.9.1 Introduction

This section of the report provides a preliminary assessment of the seismic risk (the potential for unacceptable structural behavior and damage in an earthquake) of the water supply facilities of MSWD in Desert Hot Springs, California.

The MSWD water supply facilities currently consist of 27 active sites. These include eleven well sites and sixteen tank sites. The number of tanks varies from one to three tanks at each of these tank sites.

In providing this preliminary seismic assessment, the following work was performed:

a. The severity of the seismic hazard (in particular the severity of ground shaking) that is likely at each of the tank sites was estimated using the United States Geological Survey (USGS) seismic hazard maps as described in Section 7.9.2. The potential for surface fault rupture affecting each tank site and a similar potential for surface fault rupture affecting the pipelines and distribution piping systems was assessed by referring to both USGS topographic maps and State of California Geological Survey (CGS) Special Study Zone maps.

b. A structural engineer surveyed each of the twenty-seven sites. In this survey, each storage tank and its critical equipment were observed and photographed. Structural seismic deficiencies were noted.

c. The accumulated information was compiled into this report, together with general recommendations for mitigating the observed seismic risk.

Although the seismic hazard assessments were performed using public domain data from the USGS and from the CGS, the seismic vulnerability and seismic risk assessment were performed by applying engineering judgment to the visual observations made during the field survey. No drawings or other construction data were available for more formal assessment of any of the tanks or other equipment.

7.9.2 Seismic Hazard Assessment

7.9.2.1 Seismic Hazards

The MSWD is located in perhaps the most seismically active area of California, immediately adjacent to the San Andreas fault system.

Seismic hazards are a description of the nature of the geologic effects of an earthquake. The two hazards of greatest concern are strong ground shaking and surface fault rupture. These two seismic hazards were addressed as described below. A secondary seismic hazard, that of seismic-induced landslide, was addressed indirectly on a preliminary basis.

A detailed geology/seismology study was not performed as part of this project. However, a preliminary seismic hazard assessment was made for each tank site, which consisted of three specific hazards. The evaluation of these seismic hazards consisted of the following:

a. A preliminary estimate of probable seismic ground shaking intensity was made using the seismic hazard maps published by the United States Geological Survey (USGS) and as constructed by the USGS working in collaboration with the California Geological Survey (CGS).

b. A preliminary assessment was made to determine the likelihood of the tank sites being impacted by the effects of surface fault rupture. This was done by plotting the sixteen tank sites, eleven well sites and the distribution pipelines onto the CGS maps for surface fault rupture hazard zones and overlaid on the USGS topographic map. The CGS maps for surface fault rupture hazard zones are also known as the Alquist-Priolo Earthquake Fault Zone Maps. The basis for the assessment of seismic ground shaking intensity was the set of coordinates (latitude and longitude) of sixteen tank sites as supplied to URS by MSWD.

c. Tank site inspections and USGS topographical maps were used to assess the potential for seismic-induced landslide. Those tanks where significant variations in topography were found adjacent to the tank site were considered to be the most critical. A geological assessment of the risk of seismically-induced landslide was not made. Tanks may be at risk from seismic induced landslide by either actual sliding or damage by landslide debris from above.

7.9.2.2 Seismic Ground Shaking Estimates

In the first of these seismic hazard assessment tasks, the estimates of probable seismic ground shaking intensity have been characterized by the peak ground accelerations (PGA) that have a specific probability of occurring and / or being exceeded at each tank site. Two values of these seismic-induced ground accelerations appear in Table 7-26 for each of the tank sites. These are given as fractions of “g” where “g” is the acceleration due to gravity.

Table 7-26

Probable Ground Accelerations at MSWD Tank Sites

Site Name	North Latitude	West Longitude	Soil Type	Peak Seismically Induced Horizontal Ground Acceleration (g)	
				475 Year Average Recurrence Interval	2,475 Year Average Recurrence Internal
Redbud	33.960	-116.4689	D	0.668	1.074
Highland	33.961	-116.4661	D	0.667	1.072
Quail	33.943	-116.4503	CD	0.715	1.172
Two Bunch	33.949	-116.4875	C	0.745	1.224
Vista	33.984	-116.4928	BC	0.636	1.006
Low NorthRidge	33.975	-116.4903	CD	0.656	1.046
NorthRidge	33.977	-116.4908	CD	0.652	1.038
Terrace	33.967	-116.4944	D	0.679	1.092
Annandale	33.991	-116.5256	C	0.659	1.05
Mission Lakes	33.988	-116.5311	C	0.664	1.06
High Desert View	33.959	-116.4725	CD	0.671	1.078
Low Desert View	33.956	-116.4744	CD	0.675	1.087

Table 7-26

Probable Ground Accelerations at MSWD Tank Sites

Site Name	North Latitude	West Longitude	Soil Type	Peak Seismically Induced Horizontal Ground Acceleration (g)	
				475 Year Average Recurrence Interval	2,475 Year Average Recurrence Internal
Gateway	33.962	-116.5911	D	0.738	1.217
Overhill	33.939	-116.6003	D	0.743	1.233
Valley View	33.934	-116.5828	D	0.735	1.219
Cottonwood	33.939	-116.6950	D	0.702	1.154
Woodridge	33.940	-116.7214	D	0.662	1.077

Note: Latitude and Longitude at each tank were supplied by MSWD

The two values for PGA in Table 7-26 represent the following earthquake ground shaking scenarios:

1. The peak seismically-induced ground acceleration for which there is a 10 percent chance of exceedance in a fifty-year period. This is mathematically equivalent to saying that such a PGA has an average recurrence interval of roughly 475 years.
2. The peak seismically-induced ground acceleration for which there is a 2 percent chance of exceedance in a fifty-year period. This is mathematically equivalent to saying that such a PGA has an average recurrence interval of roughly 2,475 years.

The 475-year and 2475-year average recurrence intervals are the standard criteria used for the design of structures to resist forces caused by earthquake ground shaking. Historically, most building codes used the ground motion intensity corresponding to the 475-year average recurrence interval to establish seismic design forces. However, new building codes are using the ground motion intensity corresponding to the 2475-year average recurrence interval to set seismic design forces.

It can be seen that the peak ground accelerations for the 475-year seismic event is generally in the range of 0.7 g. The PGA for the 2,475-year seismic event is generally in the range of 1.0 g to 1.2 g. Such values for ground accelerations are among the highest of any sites in California. The proximity to the San Andreas Fault zone results in a high likelihood that the MSWD sites will experience *very* strong seismic shaking within the next 50 years.

7.9.2.3 Surface Fault Rupture –Tanks

Figure 7-4 provides an overlay of the tank and well sites and distribution pipelines onto the California Special Studies Zones (Alquist-Priolo Zones) earthquake fault zone map. These maps depict the fault zones, and in particular, the areas where surface fault rupture must be considered as a credible possibility.

Several of the tank sites appear to be immediately adjacent to or directly over fault zones. Surface fault rupture appears to be a potential concern for the following tanks:

- Two Bunch Tanks
- Woodridge Tank

- Cottonwood Tank

Valley View and Overhill Tanks are also sufficiently close to the Alquist-Priolo zone for fault rupture to be a concern.

7.9.2.4 Surface Fault Rupture –Pipelines and Distribution Systems

As can be seen in Figure 7-4, various pipelines and distribution piping systems are vulnerable to fault rupture in several locations. These include the following areas:

- West and South of Woodridge Tank
- South-east of Cottonwood Tank
- South of Overhill Tank
- East of Valleyview Tank
- South of Well 27 and Well 31
- South and West of Mission Lakes Tank and Annandale Tank (includes a 16” diameter main).
- South and West of the Terrace Tanks (includes three 16 “diameter mains).
- South of Two-Bunch Tanks (includes a 16” diameter main).
- South of Quail Tank

Insert

Figure 7-4
Existing Seismic Map

7.9.2.5 Earthquake –Induced Landslide

The USGS topographical maps were consulted to determine which tanks were adjacent to steep slopes, with slopes either below the tank site or above the tank site. Since a geological assessment of the slope at each site was not made, this information provides only a preliminary indication that there may be a potential for seismically-induced landslide

The tanks which appear to be located on or near such steep slopes, include the following:

- Mission Lakes
- Annandale
- Vista
- Low Northridge
- High Desert View
- Highland
- Redbud
- Overhill
- Woodridge

7.9.3 Structural Vulnerability and Seismic Risk

A field survey of MSWD facilities was conducted on January 19 and 20, 2005. This section summarizes observations made by URS during this field survey. In particular, this section will focus on those features that appear to present excessive seismic vulnerability, and therefore, present seismic risk in an environment having a potential for very strong ground shaking.

The observations made during the field survey are summarized in Table 7-27. This table lists all of the sites, and all of the items of equipment that were observed.

Table 7-27

Seismic Survey Results Summary

Site Num	Site Name	Equipment Type	Description	Seismic Deficiency	Comments	Recommendation
1	Well 22	pump		no negative comment	See Section 7.9.3	
1	Well 22	transformer	sitting on concrete pad	no visible anchorage or lateral restraint.	Edison co. equipment. See Section 7.9.3	Section 7.9.1
1	Well 22	electrical panel	sheet metal cabinet	See Section 7.9.3	middle cabinets; 2 bolts on lhs, none on rhs.	Section 7.9.3
1	Well 22	bleach cabinet	plastic cabinet	See Section 7.9.3		Section 7.9.2
2	Well 24.	pump		no negative comment	See Section 7.9.3	

Table 7-27

Seismic Survey Results Summary

Site Num	Site Name	Equipment Type	Description	Seismic Deficiency	Comments	Recommendation
2	Well 24.	electrical panel	sheet metal cabinet	See Section 7.9.3	middle cabinet: 4 bolt holes but no bolts	Section 7.9.3
2	Well 24.	transformer	sitting on conc. Pad	no visible anchorage or lateral restraint.	Edison Co. equipment. See Section 7.9.3	Section 7.9.1
2	Well 24.	bleach cabinet	plastic cabinet	See Section 7.9.3		Section 7.9.2
3	Well 28	pump		no negative comment	See Section 7.9.3	
3	Well 28	electrical panel	sheet metal cabinet	See Section 7.9.3	Four anchor bolts are visible in center Section 7.; wiring looks flexible, so will probably not rupture in sliding or uplift.	Section 7.9.3
3	Well 28	transformer	round transformers -- behind fence.	No visible anchorage, but reviewed only from distance	Edison company equipment. See Section 7.9.3	Section 7.9.1
3	Well 28	bleach cabinet	plastic cabinet	See Section 7.9.3	Cabinet restrained by pipes driven into soil	Section 7.9.2
4	Well 30	pump		No negative comment	See Section 7.9.3	
4	Well 30	electrical panel	sheet metal cabinet	See Section 7.9.3	Appear to be four bolts in center section.	Section 7.9.3
4	Well 30	transformer		No visible anchorage		Section 7.9.1
4	Well 30	bleach cabinet	plastic cabinet -- restrained	See Section 7.9.3	Cabinet restrained by pipes driven into soil	Section 7.9.2
5	Mission Lakes Tank					
5	Mission Lakes Tank	Steel Tank	1.95 million gallons; 96 foot diameter; height = 36'-0";	No anchorage. See Section 7.9.3, inlet-outlet pipe has inadequate flexibility;	Constructed in 1971; Solar Power; Thus no motor control panel; operating water height = 34'-3";	Section 7.9.4
5	Mission Lakes Tank			Relatively Low H / D;	H / D = 0.375; uplift still an issue	
6	Annandale Tank					
6	Annandale Tank	Steel Tank	2.5 million gallons; 135 feet diameter; height = 24'-0";	No foundation, no anchorage. See Section 7.9.3	Inlet-Outlet pipe not visible; Apparently through floor; Tank Constructed in 1989 with D100; Solar Power (no MCP);	Section 7.9.4, freeboard only

Table 7-27

Seismic Survey Results Summary

Site Num	Site Name	Equipment Type	Description	Seismic Deficiency	Comments	Recommendation
6	Annandale Tank			Low H / D; May be O.K.	H / D = 0.18;	
7	Vista Tank					
7	Vista Tank	Steel Tank	0.3 million gallons; 40 foot diameter; Height = 32-0"; Overflow height = 31 ft.	No foundation, no anchorage. See Section 7.9.3; inlet-outlet pipe has inadequate flexibility	Constructed 1966; H / D = 0.8;	Section 7.9.4
7	Vista Tank	Hydro-pneumatic Tank	horizontal tank; on concrete saddles;	Can move longitudinally; This might break pipe at bottom on west end; See picture 40;	O.K. for transverse motion.	Strap vessel down to saddles to provide greater frictional resistance to longitudinal sliding;
7	Vista Tank	Electrical Panel	Sheet metal cabinet;	See Section 7.9.3	A couple of bolts visible; some missing	Section 7.9.3
7	Vista Tank	Transformer	On telephone pole			Section 7.9.1
8	High Northridge Tank					
8	High Northridge Tank	Steel Tank	1 million gallons; Diameter = 105 feet; Height = 16 feet;	Possibly O.K.; no foundation, no anchorage; inlet-outlet pipe has inadequate flexibility; See Section 7.9.3	Low wide tank; may be O.K. without anchorage except for rigid piping; 1981 Construction to AWWA Appendix C.	
8	High Northridge Tank				H / D = 0.15;	Section 7.9.4, freeboard only
9	Low Northridge Tank				Not inspected; tank to be abandoned; booster pumps will be moved to High Northidge site;	
10	Terrace Tank					
10	Terrace Tank	Three Steel Tanks; listed below		all three tanks are without foundations, and are unanchored;		

Table 7-27

Seismic Survey Results Summary

Site Num	Site Name	Equipment Type	Description	Seismic Deficiency	Comments	Recommendation
10	Terrace Tank			inlet-outlet pipes on all three tanks have inadequate flexibility		
10	Terrace Tank	Tank #2	2 million gallons; 135 foot diameter; 20 feet nominal height	above -- See Section 7.9.3	Constructed in 1984; AWWA D100 Appendix C; H / D = 0.15;	Section 7.9.4 freeboard only
10	Terrace Tank	Tank #1	1.75 million gallons; 125 foot diameter; 20 foot nominal height;	Above -- See Section 7.9.3	Constructed in 1968; AWWA; H / D = 0.16;	Section 7.9.4 freeboard only
10	Terrace Tank	Tank #3	2.0 million gallons; 135 foot diameter; LL @ 19 feet; Shell height = 20 feet;	above -- See Section 7.9.3	Constructed in 1992; H / D = 0.15;	Section 7.9.4 freeboard only
10	Terrace Tank	Six booster pumps		No negative comments	See Section 7. 3.5;	
10	Terrace Tank	Electrical Panels	sheet metal cabinets	See Section 7.9.3	Appears to have bolts in center section.	Section 7.9.3
10	Terrace Tank	Dbl Electrical panel		See Section 7.9.3	Serves Booster pumps 5 & 6;	Section 7.9.3
10	Terrace Tank	Electrical Panel		See Section 7.9.3	Serves Booster pumps 1 thru 4; Some bolts are visible	Section 7.9.3
10b	Low Desert View Tank				Not inspected; tank will be abandoned; booster pumps will remain in service	
11	High Desert View Tank					
11	High Desert View Tank	Two steel tanks; Listed Below;		Neither tank is anchored; However both seem to be on concrete ringwall foundations.	Solar Power; no power to telemetry; Therefore there is no electrical panel;	
11	High Desert View Tank			Inlet-outlet pipes have inadequate flexibility in both tanks.		

Table 7-27

Seismic Survey Results Summary

Site Num	Site Name	Equipment Type	Description	Seismic Deficiency	Comments	Recommendation
11	High Desert View Tank	Tank #1	Capacity= 0.5 million gallons; diameter = 60 feet; shell height = 24 feet;	See Section 7.9.3	Eastern-most of the two tanks, liquid level at 23 feet; Constructed in 1993; AWWA D100-84, Appendix C. H / D = 0.4;	Section 7.9.4
11	High Desert View Tank	Tank #2	Capacity = 1.0 million gallons; diameter = 87 feet; shell height = 24 feet;	See Section 7.9.3	Western-most of the two tanks; liquid level at 23 feet; Constructed in 1992; AWWA D100-84, Appendix C. H / D = 0.28;	Section 7.9.4 freeboard only
12	Red Bud Tank					
12	Red Bud Tank	steel tank	Capacity = 0.3 million gallons; diameter = 41 feet; height = 32 feet;	No foundation, unanchored; See Section 7.9.3	1959 Construction by C B & I; H / D = 0.78	Section 7.9.4
12	Red Bud Tank			inlet-outlet pipe has inadequate flexibility for uplift;		
12	Red Bud Tank	two booster pumps		no negative comments	See Section 7.9.3	
12	Red Bud Tank	electrical panel		None obvious except small bolts;	Newly installed; appears to be bolted (even though bolts appear small); It's on two concrete piers.	Section 7.9.3
12	Red Bud Tank	two transformers	on power pole	None obvious;		Section 7.9.1
13	Highland Tank				solar power; therefore no electrical panel	
13	Highland Tank	steel tank;	Capacity = 0.05 million gallons; Diameter = 25 feet; Height = 16 feet;	no foundation; unanchored; See Section 7.9.3	no name plate; H / D = 0.64;	Section 7.9.4
13	Highland Tank			inlet-outlet pipe has inadequate flexibility to withstand uplift;		
14	Qual Tank					

Table 7-27

Seismic Survey Results Summary

Site Num	Site Name	Equipment Type	Description	Seismic Deficiency	Comments	Recommendation
14	Qual Tank	Steel Tank	Capacity = 1.0 million gallons; Diameter = 85 feet; Height = 24 feet;	no foundation; unanchored; See Section 7.9.3	Constructed in 1989; Separate inlet and outlet lines; H / D = 0.28;	Section 7.9.4 freeboard only
14	Qual Tank		inlet piping inside block wall enclosure;		Appears to have adequate flexibility to withstand tank uplift;	
14	Qual Tank		outlet piping	outline line has inadequate flexibility to withstand uplift		
15	Two Bunch Tank	Two Tanks;		Inlet-outlet piping has inadequate flexibility to withstand tank uplift in both tanks.	Solar Power; no electrical panel;	
15	Two Bunch Tank	Tank #1;	Capacity = 0.42 million gallons; Diameter = 55 feet; Height = 24 feet;	no foundation; unanchored; See Section 7.9.3	Bolted tank; Old oil tank installed in 1973; H / D = 0.43;	Section 7.9.4
15	Two Bunch Tank	Tank #2;	Capacity = 1 million gallons; diameter =85 feet; height = 24 feet;	no foundation; unanchored; See Section 7.9.3	H / D = 0.28;	Section 7.9.4 freeboard only
16	Well 29					
16	Well 29	pump and well piping		none obvious; no negative comment	pump base appears to be welded to insert plates; See Section 7.9.3	
16	Well 29	transformer;	sitting on concrete pad, but no visible anchorage or lateral restraint;	no anchorage visible; See Section 7.9.3	Edison Company equipment.	Section 7.9.1
16	Well 29	Bleach Tank in Cabinet	Plastic tank, plastic cabinet	See Section 7.9.3		Section 7.9.2
16	Well 29	Electrical Panel	Sheet Metal Cabinet	See Section 7.9.3	In center section of cabinet, there appears to be two bolts on the right side, but none on the left side;	Section 7.9.3

Table 7-27

Seismic Survey Results Summary

Site Num	Site Name	Equipment Type	Description	Seismic Deficiency	Comments	Recommendation
17	Well 27				no electrical panel or transformer; both are at well 31; Well 31 is adjacent to well 27;	
17	Well 27	pump and well piping		none obvious;	no negative comment; See Section 7.9.3	
17	Well 27	Bleach cabinet;	Plastic bleach tank in plastic cabinet;	See Section 7.9.3		Section 7.9.2
18	Well 31				Adjacent to Well 27;	
18	Well 31	pump and well piping		none obvious;	no negative comment; See Section 7.9.3	
18	Well 31	Bleach Cabinet;	Plastic bleach tank in plastic cabinet;	See Section 7.9.3		Section 7.9.2
18	Well 31	Transformer	On concrete pad; but no visible anchorage	See Section 7.9.3	Edison company equipment;	Section 7.9.1
18	Well 31	Electrical Panel	Sheet metal panel	See Section 7.9.3	In center section of cabinet, there appears to be two bolts in front but none in the back (bolt holes but no anchor bolts).;	Section 7.9.3
19	Valley View Tank					
19	Valley View Tank	Steel tank	Capacity = 0.3 million gallons; diameter = 47 feet; height = 24 feet;	no foundation; no anchorage; See Section 7.9.3	Constructed in 1980; Says AWWA D-100; H / D = 0.51;	Section 7.9.4
19	Valley View Tank			inlet-outlet pipe has inadequate flexibility to withstand tank uplift.		
19	Valley View Tank	Two Booster pumps		none obvious;	no negative comment; See Section 7.9.3	
19	Valley View Tank	Electrical Cabinet		See Section 7.9.3	some holes without bolts in front frame on left side; There are thee bolts in front door frame in right hand cabinet;	Section 7.9.3
19	Valley View Tank	Transformers	3 transformers on power pole		Edison Company Equipment;	Section 7.9.1
20	Well 25					

Table 7-27

Seismic Survey Results Summary

Site Num	Site Name	Equipment Type	Description	Seismic Deficiency	Comments	Recommendation
20	Well 25	pump and well piping		none obvious;	no negative comment; See Section 7.9.3	
20	Well 25	Bleach tank in Cabinet	Plastic tank in wood cabinet; Same equipment as previously described.	See Section 7.9.3		Section 7.9.2
20	Well 25	electrical panel	sheet metal cabinet	See Section 7.9.3	thee out of four anchor bolts present in center section.	Section 7.9.3
21	Well 25A					
21	Well 25A	well piping;		none obvious;	Pump is down in well (not visible); No negative comment; See Section 7.9.3	
21	Well 25A	Bleach tank in cabinet	plastic cabinet	See Section 7.9.3		Section 7.9.2
21	Well 25A	electrical panel	sheet metal cabinet	See Section 7.9.3	Two cabinet sections instead of three; four anchor bolts for four holes on right side; one bolt for four holes on left side;	Section 7.9.3
21	Well 25A	transformer	sitting on concrete pad	No anchorage visible; See Section 7.9.3	Edison Company equipment;	Section 7.9.1
22	Wood Ridge Tank				Solar Powered; No electrical panel;	
22	Wood Ridge Tank	steel tank	capacity = 0.1 million gallons; height = 22 feet;	Non obvious	Appears to be new tank; Installed in 2003; on concrete pad; 1 1 / 2 inch anchor bolts; Photo 138; (H / D about 1.0);	Freeboard only
22	Wood Ridge Tank		inlet-outlet - out to the side with flex coupling before bending down;		inlet-outlet looks O.K.	
23	Cotton-wood Tank				solar powered; no electrical panel;	
23	Cotton-wood Tank	steel tank (bolted)	Capacity = 0.28 million gallons; Diameter = 55 feet; Height = 16 feet;	no foundation; no anchorage; See Section 7.9.3	low / wide profile (H / D < 0.3); may be O.K.	Section 7.9.4 freeboard only

Table 7-27

Seismic Survey Results Summary

Site Num	Site Name	Equipment Type	Description	Seismic Deficiency	Comments	Recommendation
23	Cotton-wood Tank		overflow height = 15.6 feet;	inlet-outlet pipe has inadequate flexibility to withstand tank uplift; freeboard less than slosh wave ht. ;		
24	Well 26A				Well 26A is off line at the time of survey; however, it is expected to be back in service within a month. No bleach tank present, but will be installed before used in service.	
24	Well 26A	well piping;		none obvious;	Pump is down in well (not visible); No negative comment; See Section 7.9.3	
24	Well 26A	transformer	sitting on concrete pad, but no visible anchorage or lateral restraint;	no visible anchorage; See Section 7.9.3	Edison Company Equipment;	Section 7.9.1
24	Well 26A	electrical panel	sheet metal cabinet	See Section 7.9.3		Section 7.9.3
25	Well 26					
25	Well 26	pump and well piping		none obvious;	No negative comment; See Section 7.9.3	
25	Well 26	bleach cabinet	cabinet not restrained with pipes; cabinet is within a three-sided "stockade";	Neither equipment within cabinet nor cabinet itself appear to be adequately restrained;	Bleach tank sitting directly on containment pallet; no white stand; wood "stockade" does not guarantee that cabinet can't fall.	Section 7.9.2
25	Well 26	electrical panel	Sheet metal cabinet -- two Section 7.s;	See Section 7.9.3	In left side of cabinet, one anchor bolt out of four missing (three are installed); In right side, no bolts visible (all are omitted);	Section 7.9.3
25	Well 26	transformers	three transformers on power pole;		Edison Company Equipment;	Section 7.9.1
26	Overhill Tank					

Table 7-27

Seismic Survey Results Summary

Site Num	Site Name	Equipment Type	Description	Seismic Deficiency	Comments	Recommendation
26	Overhill Tank	Steel Tank	capacity = 0.267 million gallons; Diameter = 47 feet; Height = 21 feet;	No foundation; not anchored;	Tank was placed here in 1989 as replacement tank for previous tank damaged in White-Water earthquake. H / D = 0.45;	Section 7.9.4
26	Overhill Tank		overflow height = 19.8 feet;	inlet-outlet has inadequate flexibility to withstand tank uplift;		
26	Overhill Tank	Bleach Tank in Cabinet	Bleach tank inside cabinet; Plastic Cabinet is restrained;	See Section 7.9.3		Section 7.9.2
26	Overhill Tank	Electrical Panel	Sheet metal cabinet;	See Section 7.9.3	There is some weld connecting cabinet to embed plates in concrete pad. In addition, there are some bolts -- 3 in front of frame;	Section 7.9.3
26	Overhill Tank	Two booster pumps		No negative comment; See Section 7.9.3		
26	Overhill Tank	transformers	three transformers on power pole		Edison Company equipment.	Section 7.9.1
27	Gateway Tank				Gateway Tank may be taken out of service in a couple of years; therefore, probably retrofit is not warranted.	
27	Gateway Tank	steel tank	Capacity = 0.25 million gallons; diameter = 43 feet; height = 24'-6";	None obvious.	Concrete pad, 1 3/4 inch anchor bolts; bolt spacing is about 8 1/2 feet.	None
27	Gateway Tank	hydro-pneumatic tank	Horizontal tank on steel saddles	None obvious		none
27	Gateway Tank		steel saddle connections	None obvious	Steel saddle bottom plates bolted to face-down channel; channel flanges welded to bearing plate;	
27	Gateway Tank				bearing plate bolted to concrete pedestal;	

Table 7-27

Seismic Survey Results Summary

Site Num	Site Name	Equipment Type	Description	Seismic Deficiency	Comments	Recommendation
27	Gateway Tank	Fire water pump		No negative comment; See Section 7.9.3		none
27	Gateway Tank	Electrical Panel	Sheet metal cabinet	See Section 7.9.3	Two anchor bolts are visible; But there are holes without bolts;	none
27	Gateway Tank	Transformers	on power pole		Edison Company equipment	none
27	Gateway Tank	booster pumps	two small pumps on pad	No negative comment		none

The following paragraphs provide descriptions of the “general case”, or a generic set of observations for several of the types of equipment. The characteristics and configurations of these types of equipment were sufficiently similar that common descriptions were convenient and more efficiently presented.

The types of equipment for which a standard set of observations appear here include electrical panels (also designated as motor control panels or MCPs), bleach cabinets (which contain sodium hypochlorite tanks and pumps), transformers, and the steel tanks. Also, a general section is presented on pumps and piping (other than inlet-outlet piping at the tanks).

7.9.3.1 Transformers

Grade mounted transformers are found at all well sites and at tank sites with large booster pumps. Grade-mounted and pole-mounted transformers are all owned and maintained by Southern California Edison(SCE).

Grade-mounted transformers are not visibly anchored to their concrete foundation pads. However, during the field survey, it was not apparent if the transformers are anchored internally. In subsequent correspondence, SCE and confirmed that these facilities are internally anchored. In any case, MSWD should ask SCE for confirmation of the seismic adequacy of these facilities. A typical SCE grade-mounted is shown in Figure 7-5.

Figure 7-5

Typical SCE Grade Mounted Transformer in the MSWD

Power pole mounted transformers were observed at many sites. These types of transformers are generally found at tank sites with small booster pumps or other light electrical demands. MSWD should also ask SCE for confirmation of the seismic adequacy of these pole-mounted facilities. A typical SCE pole-mounted is shown in Figure 7-6.

Figure 7-6

Typical SCE Pole-Mounted Transformer in the MSWD

7.9.3.2 Bleach Cabinets and Contents

The bleach cabinets (typically) contain a small plastic tank, which contains the bleach (sodium hypochlorite), a metal stand (typically painted white), which directly supports the bleach tank, a small metering pump, and a “spill containment pallet”. The latter is a black plastic frame, which supports both the white metal frame and the small pump. The above listed equipment items are housed within a cabinet that with one exception, was constructed of a plastic material).

Without exception, the bleach tank is neither anchored to its white metal support frame nor otherwise braced or restrained so as to provide resistance to horizontal seismic motion. The white metal frame is neither attached nor anchored to the spill containment pallet or otherwise restrained. The pump is not anchored to its support (the black spill containment pallet), nor is it other wise restrained. The black plastic spill containment pallet is not anchored nor otherwise restrained against horizontal seismic motions.

The plastic cabinet is restrained by four vertical galvanized steel pipes that appear to be driven into the soil immediately adjacent to the edge of the concrete foundation pads. Two of the pipes are in the back of the cabinet, and there is one pipe at each end of the cabinet.

It appears that all of the interior equipment items could slide or tip. However, the restraints provided for the cabinets (the four pipes driven into the ground adjacent to the concrete pad) would seem to provide adequate seismic resistance to prevent the cabinet as whole from moving (tipping or sliding). So even though the interior equipment could potentially tip or slide within the cabinets, the cabinet would probably prevent wholesale movement.

The consequences of a bleach tank spilling its contents within a cabinet are probably relatively minor and would be more of an inconvenience than a danger. However, if many such tanks were to spill and be out of commission following a strong earthquake, it might take many hours to put them back into service. Additionally, disinfection would not be provided in the event of a spilled bleach tank. A typical MSWD bleach cabinet with related equipment is shown in Figure 7-7.

Figure 7-7

Typical MSWD Bleach Cabinet Disinfection Facility

7.9.3.3 Electrical Panels

The electrical panels (motor control panels) are sheet metal cabinets containing electrical equipment and controls for pumps. They are fairly light-weight and have either two or three sections. Since they carry high voltage, it was not possible to open all sections of the panels to verify whether they were anchored or not. However, as a rough generalization, anchor bolts were provided in only about half of the visible bolt holes in the bottom cabinet frame members.

Entries in Table 7-27 for the electrical panels indicate the number of bolts that were visible relative to the bolt-holes that are provided for anchoring the units. A typical MSWD motor control panel is shown in Figure 7-8.

Figure 7-8

Typical MSWD Motor Control Panel

7.9.3.4 Steel Tanks

The steel tanks are, of course, the heart of the MSWD water system. With only two exceptions, the tanks are not anchored, and most are not constructed on concrete foundations. Many foundations consist of gravel pads, or in a few cases, the supporting material appears to be simply earth. In addition, may of the tanks are of an age that pre-dates seismic design requirements for water tanks.

Unanchored steel tanks must resist the overturning effects of horizontal seismic forces by the weight of uplifted fluid. This is reasonably feasible for tanks with large diameters and low height-to-diameter ratios (H / D ratios), where the bottom plates have been properly designed to resist such uplift. A detailed study has not been made of the tanks because it is outside the scope of work for this project. However, in the severe seismic environment adjacent to the San Andreas fault, it will likely be very difficult for water tanks with H / D ratios greater than 0.3 to resist strong seismic ground shaking. Where not anchored to a concrete foundation, storage tanks will be very vulnerable to a strong earthquake, which is likely to occur sometime in the Desert Hot Springs area. H / D ratios for MSWD tanks are listed in Table 7-27.

Common damage scenarios for steel tanks in strong earthquakes include the following:

A. “Elephant’s foot” buckling of steel tank shells.

B. Rupture of a tank bottom (usually at the bottom-to-shell weld) as an unanchored tank attempts to uplift and mobilize water weight to resist overturning.

C. Rupture of inlet-outlet piping that has inadequate flexibility to accommodate uplift of an unanchored tank.

D. Damage to tank roof and upper shell due to inadequate freeboard. This permits impact of a sloshing wave against the roof.

The first two damage scenarios listed above (*Scenario A* and *Scenario B*) are the most critical and the most likely to occur.

As previously discussed, all but two of the District’s tanks are anchored. Unanchored tanks in the Mission Springs Water District System are very susceptible to damage *Scenario A* and *Scenario B*, above.

Unanchored tanks with inadequate flexibility of inlet and outlet piping are also susceptible to *Scenario C*, which becomes critical if *Scenario A* and *Scenario B* do not occur. In general, most tanks are provided with a single coupling on the inlet-outlet piping. Some tanks have no couplings at all. The single coupling can compensate for small, long-term movement such as differential settlement. However, a single coupling is not adequate to provide flexibility for the movement that may occur during a significant seismic event. Figure 7-9 shows a typical MSWD unanchored tank with a single inlet-outlet pipeline coupling. Figure 7-10 shows a typical MSWD unanchored tank without a coupling on inlet-outlet piping connection.

Figure 7-9

Unanchored MSWD Tank with Inlet-Outlet Pipeline Coupling

Figure 7-10

Unanchored MSWD Tank without an Inlet-Outlet Pipeline Coupling

Not all of the tanks in the MSWD are susceptible to damage Scenario D above, which describes roof-damage resulting from the impact of water wave action. Although this damage scenario may require a tank to be removed from service for repairs, it rarely will be severe enough to cause a tank to lose storage capacity.

The tanks shown Table 7-28 have Height-to-Diameter (H / D) ratios greater than 0.3. Based upon professional judgment, these facilities have a high risk (potential) of experiencing one or more of the first three damage scenarios, previously listed.

Table 7-28

Risk Assessment of MSWD Storage Facilities

Tank	Storage Volume (mg)	Construction Year	H / D Ratio
Mission Lakes	1.9	1971	0.37
Vista	0.3	1966	0.80
High Desert View Tank #1	1.1	1993	0.40
Red Bud	0.3	1959	0.78
Highland	0.1	--	0.64
Two Bunch Tank #1	0.4	1973	0.43
Valley View	0.3	1980	0.51
Overhill	0.3	1989	0.45

7.9.3.5 Pumps and Piping

In general, the well pumps, booster pumps, and the piping that serves these pumps were observed, but no explicit or systematic features of seismic vulnerability were observed. This is not to suggest that the pumps (such as well pumps) and to the piping that attaches to them cannot be damaged in a very strong earthquake. However, defects or structural deficiencies in these items were not immediately obvious, and for the most part are believed to be secondary.

7.9.4 Seismic Recommendations

7.9.4.1 Transformers

Grade mounted and pole mounted transformers are all owned and maintained by Southern California Edison (SCE).

We recommend that MSWD formally request SCE provide information as to the seismic resistance of their transformers, both grade-mounted and power pole-mounted and to provide either standard seismic anchorage details and / or seismic calculations.

We further recommend that MSWD request that Edison provide reasonable assurance that their equipment will continue to function following an earthquake on the San Andreas fault system of a magnitude and with ground shaking intensity postulated by USGS for a 475-year average recurrence.

7.9.4.2 Bleach Tank Cabinets

As described in Section 7.9.3.2, the bleach tank cabinets appear to be securely restrained. However, the equipment within the cabinets, including the bleach tank, the stands, which support the tanks and the bleach pump, appear to be totally unrestrained within the cabinet. As stated in Section 7.9.3.2, tipping of the bleach tank, loss of its bleach contents, and loss of function of the bleach pump would all be inconvenient. However, none of these scenarios is immediately life threatening.

If the consequences of losing the function of the bleach tanks are considered unacceptable to MSWD, then URS recommends that a system of straps or ties of the various items to the cabinet be designed and installed. Such a system would at least minimize the likelihood that the bleach tanks would spill their contents, and thus minimize the disruption to treating the well water following a major earthquake.

7.9.4.3 Electrical Panels

In Section 7.9.3.3, the random omission of anchor bolting was described. Overall, for the electrical panels that were surveyed, (mostly the middle sections of three-section cabinets), about half the anchor bolts were present, and roughly half were missing. About half of the bolt holes intended for anchorage were without bolts.

The electrical panels are sheet metal, and are therefore relatively light-weight. However, because of the very severe seismic environment, unanchored or inadequately anchored electrical panels will probably tip over.

The URS recommendation is that all of the electrical panels at all of the MSWD sites be reviewed, and all sections of the cabinets be properly anchored. All of the intended anchor bolts should be installed in the bolt holes provided by the manufacturer.

7.9.4.4 Recommendations for Tanks

Based on our experience with water systems in past earthquakes, the tanks are the most vulnerable and the most critical items in the MSWD water supply system. In section 7.9.3.4, the possibility of water tank vulnerability was described. In particular, we are most concerned by (a) older tanks that were not designed to resist seismic forces, (b) taller tanks (those unanchored tanks with larger Height-to-Diameter (H / D) ratios such as those with H / D greater than 0.3), and (c) those which are located directly above populated areas.

We recommend that the set of eight tanks listed in Section 7.9.3.4 be reviewed in greater detail for their seismic resistance. We recommend that these suspect tanks be reviewed in a sequence that gives priority to those subject to the above areas of concern. Namely those that are located above populated areas, those that are taller (larger H / D ratios), and those that are older should be given priority for detailed seismic review.

Based on the proposed review of seismic resistance, it may be discovered that some of these eight critical tanks possess adequate resistance, and some may not. Those that are excessively vulnerable to the very strong seismic motions that could potentially affect the Desert Hot Springs area may have to undergo a program of seismic risk reduction including removal and replacement. Depending on the specific nature and extent of the seismic deficiencies that are found, those tanks found deficient may have to be strengthened, or provided with flexible piping and automatic isolating valves. It may also be possible to reduce risk by lowering the operating fill height that is used for standard operations of these tanks, or remove and replace the existing tanks with larger tanks to meet projected future demands.

7.9.4.5 Recommendations for Surface Fault Rupture –Tanks

In Section 7.9.2.3, it was noted that five of the tanks are either immediately adjacent to the San Andreas fault zone if not directly on it. These five tanks are the following:

- Two Bunch Tanks
- Cottonwood Tank
- Woodridge Tank
- Valley View Tank (Secondary Risk)
- Overhill Tank (Secondary Risk)

It is URS's recommendation that a more careful geological study of the relationship of these tanks to the adjacent fault traces be made, and that this study assess the likelihood that each of these tanks might be affected by surface fault rupture.

If it is found for any of these tanks that surface fault rupture is indeed possible (on either the main San Andreas fault zone or from secondary fault splays), then URS recommends that the following possibilities be considered. The first possibility is to move the tank at least 50 feet from any such rupture hazard. The 50 feet figure is the standard distance for set-back from an active fault zone required by the State of California Special Study Zone legislation (often called the Alquist-Priolo Act) for new construction.

A second possibility is to install a shut-off valve on the pipeline leading to the tank outside of the Special Studies Zone, and be prepared (after the earthquake) to operate without that tank on line.

7.9.4.6 Recommendations for Surface Fault Rupture –Pipelines

In Section 7.9.2.4, a series of areas of pipeline and distribution piping systems were listed which potentially could be ruptured in the event that the San Andreas Fault suffers surface fault displacements. Large surface fault displacements must be considered a distinct possibility on much of the San Andreas Fault Zone, and therefore, these pipeline and distribution piping systems must be considered at risk.

We make a set of recommendations for at least the larger lines (say 10 inch diameter and larger) that enter or traverse the immediate fault vicinity (e.g., are in the California Special Studies Zone for Surface Fault Rupture). Our recommendation is as follows:

a. Install flexible couplings where the line enters, and where it leaves the fault zone.

b. Install isolation valves (automatic shut-off valves) at the sides of the fault zone.

c. Stockpile temporary repair equipment for ruptured mains (or even smaller distribution piping) such as fire hoses, etc. Fire hoses can be connected to fire hydrants to cross ruptured fault zones to provide emergency fire flow.

d. Stockpile a reasonable amount of piping and be prepared to repair the ruptured mains as quickly as possible.

7.9.4.7 Recommendations for Earthquake –Induced Landslide

In Section 7.9.2.5, a series of tanks were listed that are sited on or adjacent to steep slopes. For both the cases of the tank on top of the slope, or at the bottom, an unstable slope poses a risk to tank operation. We recommend that the geotechnical / geological characteristics of each of these tank sites be investigated at least to the extent that it can be determined whether the potential for earthquake-induced landslide is credible or not.

8.1 INTRODUCTION

Based on the existing water system described in Section 7, URS conducted a distribution system analysis utilizing hydraulic modeling software (WaterCad). This section describes the results of the existing system distribution system analysis. The existing water distribution system hydraulic model was calibrated based on fire hydrant flow tests conducted by URS and MSWD personnel. Once calibration was field verified, URS evaluated the capacity of the MSWD water distribution system to meet 2005 demands for the following scenarios: ADD, MDD, MHD, and MDD plus fire flow. The results of this analysis are presented below.

8.2 SYSTEM ANALYSIS CRITERIA

The criteria used to evaluate the MSWD water system is based on published standards and current MSWD parameters for supply, storage, and distribution system components. Based on current MSWD records, the ADD was determined to be 8.01 million gallons per day (mgd) or 5,564 gallons per minute (gpm). The AAD based upon demand projections from Harvey Economics, the 2005 ADD calculated for the model is 6,256 gpm. Table 8-1 describes the peaking coefficients or factors for maximum day and maximum hour. The maximum day factor is used to represent the ratio between MDD and ADD (MDD/ADD). Similarly, the maximum hour factor represents the ratio between MHD and ADD (MHD/ADD).

According to a Riverside County fire official, a reasonable minimum requirement for fire flow in the MSWD system is 1,500 gpm for commercial and 1,000 gpm for residential. Typical published standards for fire flow indicate a range between 500 gpm and 2,000 gpm for single-family residential areas. For existing system model analysis, an absolute minimum fire flow of 500 gpm will be used for evaluation. The water distribution model analyzed system performance under a residual system pressure of 20 psi.

Table 8-1

2005 Existing Model Development Criteria

Average Day Total System Demand (gpm)	Maximum Day Factor (MDD/ADD)	Peak Hour Factor (MHD/ADD)	Absolute Minimum Fire Flow (gpm)
6,256	2.0	4.0	500

8.2.1 Supply

It is common practice to require sufficient source treatment capacity to meet MDD. Generally, water systems should not rely on storage capacity to provide water to meet the MDD. In addition, systems that are dependent upon groundwater supply should generally be designed to meet the MDD with the largest well out of service. This provides a level of redundancy for system reliability. In some cases inner-connections in the distribution system can be established to provide adequate supply redundancy. Otherwise, it may be advisable to develop additional sources to increase the reliability of water supply for the distributions system.

8.2.2 Storage

Terminal Water Storage facilities are vital to the safe and reliable operation of a water distribution system. Water distribution system storage capacity can be divided into three categories: (1) operational storage, (2) fire flow storage, and (3) emergency storage.

Operational Storage is considered the volume of storage required to supply the difference between available day supply (source) and fluctuating system demands. When source capacity is sufficient to meet the MDD, operational storage capacity can be approximated as the volume required to meet the difference between the maximum day and MHDs (storage to meet peak demands). Without performing detailed diurnal curve calculations, the minimum operational storage is estimated at 25 percent of the MDD. With adequate operational storage, system pressures can be effectively stabilized and regulated.

Fire flow storage is the volume of water required to provide a specific fire flow for a specific duration. These vary from community to community and system to system. Typically, the local Fire Marshall will establish flow and duration requirements based upon the published guidelines in the Uniform Fire Code and recommendations from the Insurance Service Office, which is a non-profit group that evaluates insurance risks for communities. The MSWD standard for fire flow volume requires sufficient storage to provide a fire flow of 1,000 gpm for a duration of two hours, which equates to a storage volume of 120,000 gallons that is added to the operation storage.

Emergency storage is the volume required to meet system demands during emergency situations such as supply failures, pipeline failures, power outages, or natural disasters (Mays, 1999). Typically, emergency storage is determined, as may be appropriate, by individual systems, and is based upon appropriate levels of risk and desired level of reliability. It is common to provide for reduced demands during emergencies. Based on levels of risks, emergency storage in MSWD is based on the combination of emergency storage and operation storage equaling two days of ADD. Therefore, the emergency storage volume is equal to75 percent of the MDD.

8.2.3 Distribution System

The distribution analysis criteria include evaluation parameters for the following four scenarios: ADD, MDD, MHD, and MDD plus fire flow demand. Table 8-2 provides a summary of the distribution analysis parameters that are presented in this section.

8.2.3.1 Average Day Demand

The ADD scenario should be analyzed to evaluate maximum system pressures and maximum velocity. MSWD standards require system pressure to be less than 120 psi and pipeline velocity to be less than 5 fps during an ADD scenario. Although 120 psi is the maximum allowable pressure, pressures over 80 psi (Uniform Plumbing Code) may require pressure-reducing valves at individual services to prevent damage to appliances and fixtures.

8.2.3.2 Maximum Day Demand

The MDD scenario should be analyzed according to maximum velocity and minimum pressure requirements. MSWD standards require that system pressures exceed 40 psi and that pipeline velocity be less than 8 fps during a MDD scenario.

8.2.3.3 Maximum Hour Demand

The MHD scenario should be analyzed according to minimum pressure. MSWD standards require that system pressures be greater than 30 psi during a MHD scenario.

8.2.3.4 Fire Flow

The fire flow demand scenario consists of the MDD plus fire flow demand. As previously mentioned, the minimum commercial and residential fire flows are 1,500 gpm and 1,000 gpm, respectively. MSWD standards require that velocities be less than 6.5 fps during a fire flow demand scenario. Also, it is common practice to require a minimum system residual fire flow pressure of 20 psi.

Table 8-2

Summary of Distribution System Parameters

Minimum Pressures (psi)			Maximum Pressure (psi)	Maximum Velocity (fps)		
MDD	MDD + Fire Flow	MHD	ADD	ADD	MDD	MDD + Fire Flow
40	20	30	120	5	6.5	8

8.3 WATER DEMANDS

Specific details regarding the development of the MSWD water distribution model can be found in Volume 2 of the report. In summary, the model was calibrated to match existing field conditions and system demands, as described in Section 8.2.

The water distribution system model for MSWD was created using *WaterCad v.7.5*. MSWD provided supporting data for the model, which included system maps, meter data, and descriptions of major components, such as pump stations, wells, tanks, and pressure reducing valves. Water usage estimates were based on MSWD monthly billing records.

Table 8-3 shows the demands for the following three scenarios: average day, maximum day, and maximum hour, per the ratios previously established.

Table 8-3

Summary of Pressure Zone Demands

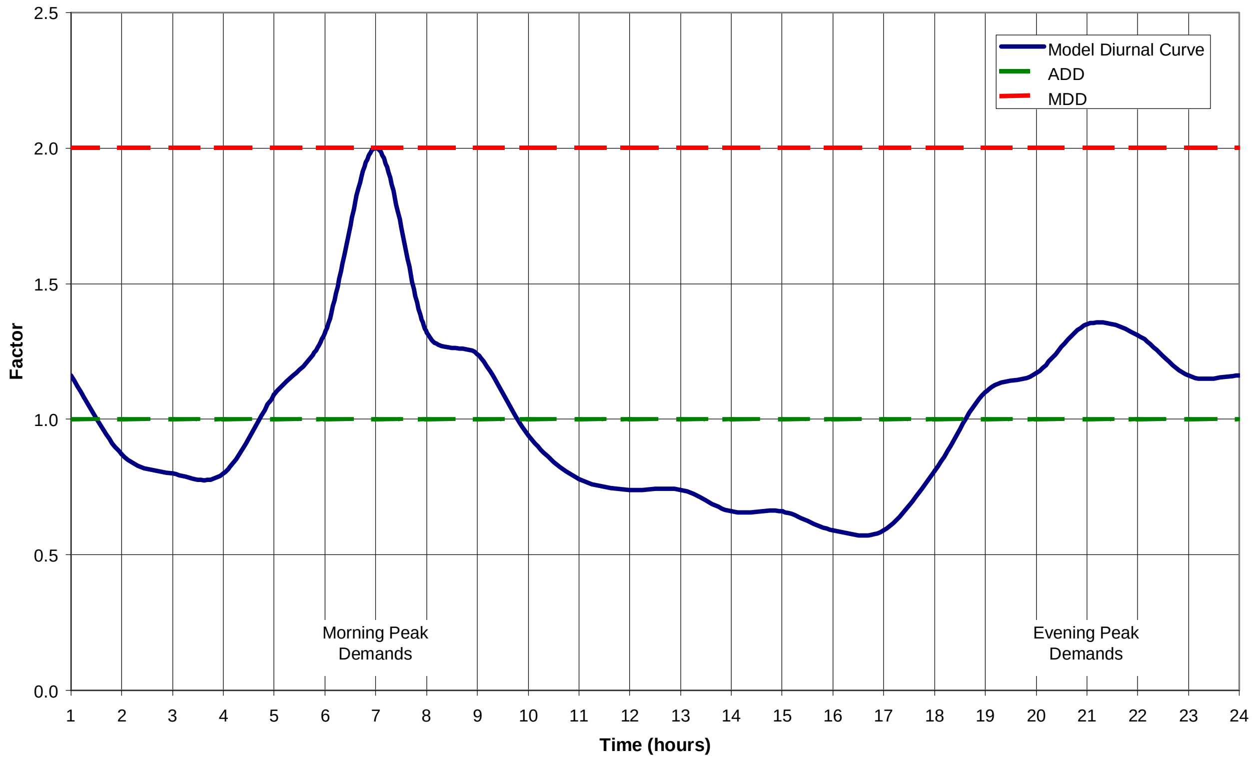
Pressure Zone	ADD (gpm)	MDD (gpm)	MHD (gpm)
913	43.5	87.0	174.0
1070	954.5	1,909.0	3,818.0
1240	1,860.0	3,720.0	7,440.0
1400	1,314.5	2,629.0	5,258.0
1530	1,407.5	2,815.0	5,630.0

1630	583.0	1,166.0	2,332.0
1630-Cottonwood	62.0	124.0	248.0
1840-Woodridge	31.0	62.0	124.0
TOTAL	**6,256**	**12,512**	**25,024**

An extended period simulation (EPS) model was created using a diurnal curve, which was based on recorded tank water levels at Cottonwood and Annandale tanks. This model diurnal curve data is illustrated below in Figure 8-1. The model diurnal curve is based on the average of the four Cottonwood and Annandale diurnal curves. The ADD and MDD factors are illustrated, which are 1.0 and 2.0—respectively.

Figure 8-1

System Diurnal Curve Data



8.4 MODEL CALIBRATION

The 2004 existing MSWD water distribution system was hydraulically modeled utilizing using *WaterCad v.7.5*. This modeling software from Haestad Methods provides tools for assistance in calibrating the model. Specifically, the calibration was done in both a steady state (static mode) and extended period simulation (dynamic mode) to provide a full and accurate representation of the water distribution system.

As part of the model calibration, URS worked with MSWD to gather real data based upon fire hydrant flow tests. During August 2004, representatives from URS and MSWD measured flow from eighteen (18) fire hydrants. After initial attempts to complete the model calibration, URS determined that six (6) of the original fire hydrants required further testing. The District conducted the additional fire flow testing in May 2005, as shown in Figure 8-2 and summarized in Table 8-4. The extended period simulation (EPS) model calibration results were coordinated with SCADA data that was provided by MSWD. The following steps were performed to calibrate the model to the hydrant test results:

- Checked the model initial conditions such as the water supply flow rate and system demand flow rate;
- Verified PRV settings and tank water levels;
- Verified closing valves, especially at service zone boundaries;
- Revised pipe sizes and lengths;
- Adjusted pipe C-factors;
- Checked water demand allocations;
- Verified pump curves and control methods; and
- Corrected service zone boundaries.

Table 8-4 and Table 8-5 summarize the model calibration results. Residual pressure in the model differed from the reported field conditions. According to American Water Works Association (AWWA) standards, a 10% difference is allowed in the calibration of the model with the existing system. The additional eight (8) fire flow tests were completed to verify the differences in calibration that were greater than 10%. These tests were performed in the field on MSWD fire hydrants. Table 8-4 shows the results of the fire flow testing completed during August 2004. The results from six of these tests differed from the preliminary model results by more than 10%. Residual pressures were off due to the variable size of testing components. Both static and residual pressures were off due to unknown headloss through PRV #16. Field data collected at the discharge head of Well 26A do not reflect active pipeline network pressure.

Insert

Figure 8-2
Fire Flow Test Locations

Table 8-4

Orginal Fire Hydrant Test Results, August 2004 Testing

Location	Model Node	Flow (gpm)	Static Pressure			Residual Pressure		
			Field Test (psi)	Modeled Results (psi)	Diff. (%)	Field Test (psi)	Modeled Results (psi)	Diff. (%)
Flora Ave. West of Palm	J-989C	900	105	105	0	100	98	2
Encanto & Via Domingo	J-1790	1,470	125	94	**25**	100	72	**28**
Calle Amapolla & Calle Cerrito	J-1760	725	91	41	**55**	77	33	**57**
Quinta Way & Via Domingo	J-1716B	530	55	97	**-76**	35	61	**-74**
Inaja @ Arena Blanca	J-970D	200	46	41	10	1	5	N/A
Vista Del Valle & South of Casa Grande	J-1238	1,200	110	114	-4	100	97	3
Palm Dr & South of Casa Grande	J-1229	1,350	91	94	-3	82	75	9
Valaraiso	J-1291	1,190	85	84	1	82	74	9
Mesquite & Yuca	J-1341D	1,000	92	95	-2	78	80	-3
5th Street between Palm Drive and Avenida	J-928C	1,455	110	39	**65**	100	30	**70**
Mesquite & 1st Street	J-937C	750	64	63	1	42	62	**-48**
Foxdale & ½ Block North from Desert View	J-1348	700	115	124	-8	35	86	**-146**
Club Circle Ct	J-2145	700	115	116	-1	87	92	-5
Park Side	J-2362	1,130	101	102	-1	87	80	9
Via Vista	J-1556A	840	92	98	-7	70	64	8
Avenida Florecienta	J-1520A	1,060	95	91	4	82	86	-4
Tram & 14th	J-936A	1,350	90	98	-9	85	83	3
13th & Tram Blvd.	J-941A	1,350	90	90	0	85	83	3

Table 8-5 shows the results of the fire flow testing completed during May 2005. The results form three of these tests differed from the preliminary model results by more than 10%.

Table 8-5

Additional Fire Hydrants Test Results, May 2005 Testing

Location	Node	Flow (cfs)	Static Pressure			Residual Pressure		
			Field Test (psi)	Modeled Results (psi)	Difference %	Field Test (psi)	Modeled Results (psi)	Difference %
Southeast corner of Cottonwood Rd/Calico	J-3250	850	70	76	-9	27	62	**-130** [1]
Southwest corner of Hadley Way and Kimdale	J-3178	555	80	78	3	45	57	**-27** [2]

Table 8-5

Additional Fire Hydrants Test Results, May 2005 Testing

Location	Node	Flow (cfs)	Static Pressure			Residual Pressure		
			Field Test (psi)	Modeled Results (psi)	Difference %	Field Test (psi)	Modeled Results (psi)	Difference %
Corner of Aintree and Rushmore	J-3129	350	50	42	**16**	45	38	**16** [3]
2004 Fire Flow Testing Location #11	J-997B	700	65	65	0	50	50	0
2004 Fire Flow Testing Location #3	J-1758	700	75	76	-1	65	67	-3
2004 Fire Flow Testing Location #2	J-1790	960	105	112	-7	90	92	-2
2004 Fire Flow Testing Location #4	J-1784	785	100	100	0	70	69	1
2004 Fire Flow Testing Location #12	J-1360	1,220	100	102	-2	90	87	3

1. Residual pressures were off due to the using of variable size of testing components.

2. Both static and residual pressures were off due to unknown headloss through PRV #16.

3. Field data collected at the discharge head of Well 26A do not reflect the active pipeline network pressure.

Model calibration with field conditions required the adjustment of Hazen-Williams Constants (C-factors) in the hydraulic model. These adjustments were based on field tests that were conducted in August 2004. For a given pipe in the model, the C-factor represents the roughness and ultimately the flow capacity of the pipe. Larger C-factors indicate smoother pipe and hence greater flow capacity. The field data indicates that most of pipes that were tested have C-value over 100, while two 6-inch pipes in the system have very low C-factor values of 47. The pipe C-values in the model was assigned based on the field test data and typically ranged between 100 and 130. A C-factor of 130 corresponds to new cast-iron pipe of any size, and a C-factor of 100 corresponds approximately to a 20 year-old cast-iron pipeline that is 12-inches in diameter. For cast-iron pipe, a C-factor of 47 corresponds to cast-iron pipe that older than 40 years.

8.5 OVERALL SYSTEM ANALYSIS

The overall system analysis evaluates (1) supply capacity, (2) storage capacity, and (3) distribution facilities (pressure and velocity). This is completed in two parts. First, the entire system is evaluated. Second, individual zones are considered. It is appropriate to analyze the entire system and individual zones separately. For example, the entire system may have sufficient total storage capacity, but a few individual zones or service zones may not have sufficient storage volume. In this case, future improvements of the distribution system may be configured to better utilize system storage facilities.

8.5.1 Primary Service Zones

This section provides a brief analysis of the entire MSWD system based upon supply, storage, distribution, and fire flow parameters. Table 8-3 provides a summary of the system demands for each of the MSWD primary pressure zones. These demands were used to analyze the water system performance according to the criteria outlined in the previous section.

8.5.1.1 Supply Analysis

Because individual wells do not serve individual pressure zones, it is difficult to effectively analyze the supply capacity on a primary service zone-by-zone basis. The wells in the MSWD system typically serve multiple pressure zones. For example, wells 22, 24, and 29 each serve the following zones: 1240, 1400, 1530, and 1630. Under these circumstances it is not feasible to accurately determine the quantity of water from each of the three wells that serves each of the four zones. The supply analysis results shown in Table 5-5 indicate that a total of four wells are required during an 18-hour pumping scenario—MSWD normally does not pump during the peak power demand period between 11:30 AM and 5:30 PM and. To provide reliability for the groundwater supply, there should also be sufficient supply capacity, during a 24-hour pumping scenario, for meet the maximum day demand with the largest capacity well out of service. According to the reliability analysis criteria, Table 5-5 shows that an additional three wells are required to provide supply capacity reliability. Therefore, a total of seven wells are required to provide to sufficient capacity to meet the 2005 MDD. Each of the wells required is assumed to provide a minimum supply capacity of 1.500 gpm.

Table 8-6

Additional Wells Required for Capacity and Reliability

Capacity	**Reliability**
18-hour Pumping Scenario	**24-hour Pumping Scenario w/o Largest Well in Service**
(3) 1,500 gpm wells	(7) 1,500 gpm wells

8.5.1.2 Storage Analysis

The total MDD for the combined MSWD water distribution system is 18.02 mgd. The following are the minimum requirements for operational, fire flow and emergency storage:

- Operational storage is 25% of the MDD or 4.50 mg
- Fire flow storage is 1,000 gpm for 2 hours or 0.12 mg
- Emergency storage is 75% of the MDD or 13.52 mg.

Table 8-7 shows that the total minimum required storage for the system is approximately 18.14 mg, which is the sum of the operational, fire flow, and emergency storage requirements shown above.

Table 8-7

Minimum System Storage Requirements

Operational Storage (mg)	Fire Flow Storage (mg)	Emergency Storage (mg)	Minimum Required Storage (mg)
4.50	0.12	13.52	**18.14**

Table 8-8 shows that the system provides at total storage capacity of approximately 20.2 million gallons, which is sufficient storage capacity to meet the ADD for two days or to meet the MDD for one day—without using additional source water. It is also nearly two times greater than the minimum required system storage shown in Table 8-7. Although the system may provide sufficient storage capacity for the combine system demands, individual pressure zones or service zones may not have access to sufficient storage, due to limitations in the existing distribution system. Therefore, each individual service zone must also be analyzed to assess storage capacity throughout the system. These analyses can be found in Section 8.6 for the each of the primary pressure zones.

Table 8-8

Existing Water Storage Tanks

Pressure Zone	Storage Facility	Storage Volume (mg)	Total Zone Storage Volume (mg)	Required Storage Volume (mg)	Comment
913	913 Zone	2.00	2.00	0.25	Meets Criteria
1070	Two Bunch Palm #1	0.43			
1070	Two Bunch Palm #2	1.02			
1070	Valley View	0.31	1.76	2.87	Does not meet criteria
1240	Low Desert View #1	0.26			
1240	Low Desert View #2	0.10			
1240	Quail Road	1.02			
1240	Terrace #1	1.83			
1240	Terrace #2	2.14			
1240	Terrace #3	2.14	7.48	5.48	Meets Criteria
1400	Annandale	2.57			
1400	High Desert View #1	1.07			
1400	High Desert View #2	0.51			
1400	Overhill	0.27	4.42	3.91	Meets Criteria
1530	Gateway	0.26			
1530	High Northridge	1.04			
1530	Low Northridge	0.21			
1530	Mission Lakes	1.95			
1530	Redbud	0.32	3.78	4.17	Does not Meet Criteria
1630	Highland	0.06			
1630	Vista	0.30	0.36	1.80	Does not meet criteria
1630-C	Cottonwood	0.28	0.28	0.30	Does not meet criteria
1840-W	Woodridge	0.12	0.12	0.21	Does not meet criteria

8.5.1.3 Distributions Analysis

Table 8-9 shows the highest pressures in each service zone during the ADD, which are the worst-case for high pressures in each service zone. As shown in Table 8-9 and Figure 8-2, the maximum pressures during an ADD scenario, for all but two service zones, exceeded 120 psi. These high pressures are typically found at the lower elevations of each pressure zone.

The red nodes in Figure 8-2 indicate portions of the system with pressures greater than 120 psi. As shown in Table 8-7, for example, pressures in the High Northridge service zone (1530 Zone) reach as high as 166 psi.

Based on previous system design criteria, 120 psi is the maximum pressure allowed in the MSWD during the ADD scenario. Future improvements could resolve these high pressures by adjusting the distribution system to place these border areas within a different primary pressure zone.

Table 8-9

ADD Scenario, Highest System Pressure in Each Primary Service Zone

Pressure Zone	Service Zone	ADD High Pressures (psi)	Model Node
913	913 Zone	85	J-1402
1070	Two Bunch	139	J-1502
1070	Valley View	129	J-PRV11UP
1240	Quail Road	122	J-1304E
1240	Terrace	137	J-929
1400	High Desert View	143	J-1722B
1400	Overhill	154	J-559
1400	Annandale	148	J-844
1530	High Northridge	166	J-1372
1530	Redbud	145	J-2157
1530	Gateway	114	J-611
1530	Mission Lakes	140	J-799
1630	Vista	147	J-1274
1630	Highland	132	J-1273
1630-C	Cottonwood	133	J-3242
1840-W	Woodridge	126	J-3188

Table 8-10 shows the lowest pressures in each service zone during MDD, which indicates the worst-case for low pressures in each service zone for this demand scenario. According to system analysis criteria, the minimum system pressure during MDD scenario is 40 psi. The red nodes in Figure 8-4 indicate portions of the system with pressures less than 40 psi. As shown in Table 8-10, only three of the 16 service zones have minimum pressures greater than 40 psi during the MDD scenario: Vista, Redbud, and Highland. Future improvements should be designed to resolve these pressure deficiencies through measures such as adjustments to pressure zone boundaries and new booster station facilities. These problem areas will be discussed zone by zone later in the report.

Insert

Figure 8-3
Existing ADD Scenario Model Results

Insert

Figure 8-4
Existing MDD Scenario Model Results

Insert

Figure 8-5
Existing MHD Scenario Model Results

Table 8-10

MDD Scenario, Lowest System Pressure in Each Service Zone

Pressure Zone	Service Zone	MDD Low Pressures (psi)	Model Node
1630	Vista	42	J-1208D
1530	High Northridge	34	J-403
913	913 Zone	21	J-1432
1070	Two Bunch	38	J-1571B
1400	High Desert View	23	J-1704
1840	Woodridge	2	J-3101
1530	Redbud	47	J-2109
1630	Highland	49	J-2202
1240	Quail Road	30	J-2302
1630-C	Cottonwood	10	J-3203
1070	Valley View	8	J-406
1400	Overhill	23	J-503
1530	Gateway	22	J-656
1530	Mission Lakes	26	J-721
1400	Annandale	35	J-804
1240	Terrace	22	J-913C

The red nodes in Figure 8-5 indicate portions of the system with pressures less than the 30 psi standard for the MHD. Table 8-11 shows the lowest pressures in each service zone during the MHD, which presents the worst-case for low pressures in each service zone for this demand scenario. Only six of the 16 service zones have minimum pressures greater than 30 psi during the maximum hour demand scenario: Vista, High Northridge, Two Bunch, Redbud, Highland, and Annandale. As previously mentioned, future improvements will be designed to mitigate these pressure deficiencies. The service zones with low pressures problem will be discussed zone by zone in subsequent sections.

Table 8-11

Maximum Hour Demand Scenario, Lowest System Pressure in Each Service Zone

Pressure Zone	Service Zone	MHD Low Pressures (psi)	Model Node
1630	Vista	36	J-1205
1530	High Northridge	31	J-1350D
913	913 Zone	21	J-1432
1070	Two Bunch	36	J-1205
1400	High Desert View	23	J-1704
1840	Woodridge	2	J-3101
1530	Redbud	42	J-2109
1630	Highland	48	J-2202
1240	Quail Road	29	J-2302
1630-C	Cottonwood	9	J-3251

Table 8-11

Maximum Hour Demand Scenario, Lowest System Pressure in Each Service Zone

Pressure Zone	Service Zone	MHD Low Pressures (psi)	Model Node
1070	Valley View	7	J-406
1400	Overhill	22	J-503
1530	Gateway	16	J-656
1530	Mission Lakes	26	J-721
1400	Annandale	33	J-1349D
1240	Terrace	0	J-970D

During the ADD scenario, the maximum allowable velocity is 5 fps. Table 8-12 shows the highest water velocities in each service zone during the ADD, which presents the worst-case for high pressures in each service zone for this demand scenario.Only the following service zones have velocities greater than the 5 fps standard: High Northridge, Woodridge, Gateway, and Terrace. These velocity problems are linked to headloss and pipeline capacity, which will be resolved with the implementation of future improvements and adjustments to pressure zone boundaries.

Table 8-12

ADD Scenario, Highest Water Velocity in Each Service Zone

Pressure Zone	Service Zone	AAD High Velocities (fps)	Model Pipe ID	From Node ID	To Node ID
1630	Vista	2	2419	J-1517	J-1516
1530	High Northridge	12	P4991	J-1362D	J-1363D
913	913 Zone	2	P-9137	J-1406	J-1403
1070	Two Bunch	5	4567	J-WELL31D	J-1501
1400	High Desert View	4	P-TERRACEB56	J-TERRACEB56	J-1771B
1840	Woodridge	23	P-WELL24S	WELL-24	PMP-WELLP24
1530	Redbud	1	3247	J-2124	J-2121
1630	Highland	1	872	J-823	J-824
1240	Quail Road	1	4505	J-2335	J-2334
1630-C	Cottonwood	2	268	J-3242	J-WELL26
1070	Valley View	3	P-5003	J-WELLP27D	J-436
1400	Overhill	2	266	J-3240	J-3242
1530	Gateway	5	P-GateW2	J-GateW2	T-GatewayHydro
1530	Mission Lakes	3	738	J-705	J-706
1400	Annandale	1	808	J-821	J-878A
1240	Terrace	6	1178	J-WELL22	J-947

According to the system analysis criteria, the maximum allowable velocity for the MDD is eight fps. Table 8-13 shows the highest velocities in each service zone during the MDD, which presents the worst-case for high velocities in each service zone for this demand scenario. Only three service zones exceed this limit: High Northridge, Woodridge, and Terrace. Future improvements will be designed to resolve these issues.

Table 8-13
MDD Scenario, Highest Water Velocity in Each Service Zone

Pressure Zone	Service Zone	MDD High Velocities (fps)	Model Pipe ID	From Node ID	To Node ID
1630	Vista	4	1464	J-1202	J-1201
1530	High Northridge	12	P4991	J-1362D	J-1363D
913	913 Zone	2	P-9137	J-1406	J-1403
1070	Two Bunch	5	4567	J-WELL31D	J-1501
1400	High Desert View	4	P-TERRACEB56	J-TERRACEB56	J-1771B
1840	Woodridge	23	P-WELL24S	WELL-24	PMP-WELLP24
1530	Redbud	2	3247	J-2124	J-2121
1630	Highland	1	668	J-447	J-448
1240	Quail Road	3	4505	J-2335	J-2334
1630-C	Cottonwood	2	268	J-3242	J-WELL26
1070	Valley View	3	P-5003	J-WELLP27D	J-436
1400	Overhill	2	794	J-702	J-701
1530	Gateway	5	P-GateW2	J-GateW2	T-GatewayHydro
1530	Mission Lakes	2	738	J-705	J-706
1400	Annandale	2	808	J-821	J-878A
1240	Terrace	6	P4993	J-1362D	J-1301D

Table 8-14 shows the highest velocities in each service zone during the MHD, which presents the worst-case for high velocities in each service zone for this demand scenario. Only the High Northridge and Woodridge service zones have velocities greater than 10 fps, which is a typical standard for maximum system velocity.

Table 8-14
MHD Scenario, Highest Water Velocity in Each Service Zone

Pressure Zone	Service Zone	MHD High Velocities (fps)	Model Pipe ID	From Node ID	To Node ID
1630	Vista	7	1464	J-1202	J-1201
1530	High Northridge	12	P4991	J-1362D	J-1363D
913	913 Zone	2	P-9137	J-1406	J-1403
1070	Two Bunch	5	4567	J-WELL31D	J-1501
1400	High Desert View	5	P-5017	J-1727	J-1726
1840	Woodridge	23	P-WELL22D	PMP-WELLP22	J-WELL22
1530	Redbud	3	3247	J-2124	J-2121
1630	Highland	2	4431	J-2205	J-2204
1240	Quail Road	5	4505	J-2335	J-2334
1630-C	Cottonwood	2	268	J-3242	J-WELL26
1070	Valley View	3	P-WELL27D	PMP-WELLP27	J-WELLP27D
1400	Overhill	2	50	J-3129	J-3107
1530	Gateway	5	P-TERRACEB1S	J-TERRACEB1S	PMP-TERRACEB1
1530	Mission Lakes	3	P-5070	J-765	J-708
1400	Annandale	4	808	J-821	J-878A
1240	Terrace	9	P-5500	J-910D	J-920D

8.5.1.4 Fire Flow Analysis

As shown in Table 8-15, the lowest available fire flow in each one of the pressure zones that is less than the absolute minimum fire flow of 500 gpm and less than the local minimum fire flow requirements of 1,000 gpm for residential and 1,500 gpm for commercial developments. The fire flow results are based upon maintaining a minimum residual system pressure of 20 psi. Although each of these service zones may have portions that provide sufficient fire flow, Table 8-15 indicates that there are portions of several service zones where the available fire flow is well below the absolute minimum standard (500 gpm). In the model, approximately 25% of the existing system has available fire flow less than 1,000 gpm, and approximately 10% of the system has available fire flows less than 500 gpm. Future improvements will resolve these fire flow deficiencies through the upgrade of existing pipelines, installation of additional pipelines, and the adjustment of pressure zone boundaries.

Table 8-15

MDD + Fire Flow Demand Scenario, Lowest Available Fire Flow in Each Service Zone

Pressure Zone	Service Zone	Lowest Available Fire Flow (gpm) †	Highest Available Fire Flow (gpm) †
1630	Vista	225	2,597
1530	High Northridge	446	3,000
913	913 Zone	584	3,000
1070	Two Bunch	228	3,000
1400	High Desert View	383	3,000
1840	Woodridge	149	1,260
1530	Redbud	161	2,002
1630	Highland	722	3,000
1240	Quail Road	777	2,202
1630	Cottonwood	372	1,322
1070	Valley View	534	3,000
1400	Overhill	467	1,142
1530	Gateway	73	3,000
1530	Mission Lakes	680	2,376
1400	Annandale	73	3,000
1240	Terrace	120	3,000

† Based upon the model constraint of 20 psi residual system pressure

Figure 8-6 shows the results of the fire flow analysis. Nodes in the water distribution model with fire flows greater than 1,000 gpm are shown in green. Yellow nodes indicate that the fire flow is less than 1,000 gpm but greater than 500 gpm. Red nodes indicate that the fire flow is less than 500 gpm.

Insert

Figure 8-6
Fire Flow and MHD Scenario Model Results

8.6 PRIMARY SERVICE ZONE ANALYSIS

This section evaluates the supply capacity, storage capacity, distribution system performance (pressures and velocities), and available fire flow in each of the primary service zones. A “Meets Criteria” or “Does Not Meet Criteria” rating is given to each service zone for in four the evaluation categories previously mentioned. Section 8.2 outlines the system evaluation criteria that is used to determine the ratings for each zone.

8.6.1 Existing 913 Zone

The results of the 913 Zone analyses are summarized in Table 8-16. This zone appears to meet each of the four analysis criteria. Details for each analysis are provided in the following sections.

Table 8-16

913 Zone Existing Water System Criteria Summary

Supply Analysis	Storage Analysis	Distribution Analysis	Fire Flow Analysis
MEETS CRITERIA	MEETS CRITERIA	MEETS CRITERIA	MEETS CRITERIA

8.6.1.1 Supply

The existing 913 Zone appears meet the supply analysis criteria. As presented in Table 5-5 and Table 5-6 (see Section 5.3), existing system wells do not provide sufficient supply to meet reliability guidelines and capacity requirements for the five groundwater supply regions. The 913 Zone covers portions of both Well Supply Region I and V. Because individual wells do not serve individual pressure zones, it is not practical to try to determine supply capacity surplus or deficiency in each primary pressure zone. For example, wells 22, 24, and 29 each serve the following zones: 1240, 1400, 1530, and 1630. Also, wells 32 and 33 serve the 913 Zone and the 1070 Zone. Under these circumstances it is not feasible to accurately determine the quantity of water from each well that serves each primary pressure zone.

8.6.1.2 Storage

As shown in Table 8-3, the MDD for the 913 Zone is 87 gpm or 0.13 mgd. The operational storage requirement for the 913 Zone is 25% of MDD, which is approximately 0.03 mg. The required fire flow storage volume for the 913 Zone is 0.12 mg (based upon 1,000 gpm for two hours). Emergency storage is 75% of the MDD or 0.09 mg. Thus, the available storage shown in Table 8-17 of 2.0 mg is greater than the operational, fire flow, and emergency storage requirements for the 913 Zone, which is 0.25 mg. Therefore, this zone meets the storage capacity criteria.

Table 8-17

913 Zone Existing Water Storage Summary

Storage Facility	Storage Volume (mg)
913 Zone Tank	2.00
Total Storage	**2.00**
Minimum Required Storage (mg)	**0.25**
Capacity Analysis	**MEETS CRITERIA**

8.6.1.3 Distribution

Table 8-18 summarizes the resulting pressures from the analyses for each scenario. These pressures meet the pressure analysis criteria (see Section 8.2.3). Table 8-19 shows the maximum velocities for each demand scenario. The velocities are well below the analysis criteria maximum values (see Section 8.2.3). Pipe P-9137 resides between the model nodes J-1406 and J-1403. Thus, the 913 Zone meets the distribution system analysis criteria for pressures and velocities.

Table 8-18

913 Zone Existing System Pressure Summary

Pressure Zone	Service Zone	ADD Maximum Pressure (psi)	Model Node	MDD Minimum Pressure (psi)	Model Node	MHD Minimum Pressure (psi)	Model Node
913	913	84.83	J-1402	20.65	J-1432	20.59	J-1432

Table 8-19

913 Zone Existing System Velocity Summary

Pressure Zone	Service Zone	ADD Maximum Velocity (fps)	Model Pipe ID	MDD Maximum Velocity (fps)	Model Pipe ID	MHD Maximum Velocity (fps)	Model Pipe ID
913	913	1.70	P-9137	1.70	P-9137	1.70	P-9137

8.6.1.4 Fire Flow

Figure 8-6 and Table 8-15 present the results of the fire flow analysis. With a residual pressure of 20 psi, the model shows that the lowest available fire flow in the 913 Zone is approximately 580 gpm and that the highest available fire flow is greater than 1,000 gpm. According to the model, approximately 1/3 of the 913 Zone may have an available fire flow less than 1,000 gpm, but no portion of the 913 Zone appears to have fire flow less than 500 gpm. Therefore, this zone meets the absolute minimum fire flow analysis criteria of 500 gpm.

8.6.2 Existing 1070 Zone

The results of the 1070 Zone analyses are summarized in Table 8-20. This zone appears to meet the supply analysis criteria. Details for each analysis are provided in the following sections.

Table 8-20

1070 Zone Existing Water System Criteria Summary

Supply Analysis	Storage Analysis	Distribution Analysis	Fire Flow Analysis
MEETS CRITERIA	DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA

8.6.2.1 Supply

The existing 1070 Zone appears to meet the supply analysis criteria. As presented in Table 5-5 and Table 5-6 (see Section 5.3), existing system wells appear to provide sufficient supply to meet reliability guidelines and capacity requirements for the five groundwater supply regions. The 1070 Zone covers portions of both Well Supply Region I and V. Because individual wells do not serve individual pressure zones, it is not practical to try to determine supply capacity surplus or deficiency in each primary pressure zone. For example, wells 22, 24, and 29 each serve the following zones: 1240, 1400, 1530, and 1630. Also, wells 32 and 33 serve the 913 Zone and the 1070 Zone. Under these circumstances it is not feasible to accurately determine the quantity of water from each well that serves each primary pressure zone.

8.6.2.2 Storage

As shown in Table 8-3, the MDD is 1,909 gpm or 2.75 mgd. The operational storage requirement for the 1070 Zone is 25% of maximum daily demand, which is approximately 0.69 mg. The required fire flow storage volume for the 1070 Zone is 0.12 mg (based upon 1,000 gpm for two hours). Emergency storage is 75% of the MDD or 2.06 mg. Thus, the available storage shown in Table 8-21 of 1.45 mg is less than the operational, fire flow, and emergency storage requirements for the 1070 Zone, which is 2.87 mg. Therefore, the 1070 Zone does not meet the criteria for the storage capacity analysis, and is deficient approximately 1.42 mg.

Table 8-21

1070 Zone Existing Water Storage Summary

Storage Facility	Storage Volume (mg)
Two Bunch #1	0.43
Two Bunch #2	1.02
Valley View	0.31
Total Storage (mg)	**1.76**
Minimum Required Storage (mg)	**2.87**
Capacity Analysis	**DOES NOT MEET CRITERIA**

8.6.2.3 Distribution

Table 8-22 show the results of the 1070 Zone pressure analysis for each demand scenario. The highest average day pressures for both service zones are greater than the maximum allowable pressure of 120 psi. For the maximum day scenario, pressures are below the standard of 40 psi. For the maximum hour scenario, only Valley View has pressures below the analysis criteria minimum of 30 psi. Therefore, due to high pressures during average day and low pressures during maximum day and maximum hour demand scenarios, the 1070 Zone does not meet the criteria for the pressure analysis.

Table 8-22
1070 Zone Existing System Pressure Summary

Pressure Zone	Service Zone	ADD Maximum Pressure (psi)	Model Node	MDD Minimum Pressure (psi)	Model Node	MHD Minimum Pressure (psi)	Model Node
1070	Two Bunch	138.97	J-1502	38.38	J-1571B	36.26	J-1205
1070	Valley View	129.04	J-PRV11up	8.42	J-406	6.69	J-406

Table 8-23 shows that the 1070 Zone velocities meet the analysis criteria standards described in Section 8.2.3. Therefore, this zone passes the velocity analysis, but does not meet the criteria for the pressure analysis.

Table 8-23
1070 Zone Existing System Velocity Summary

Pressure Zone	Service Zone	ADD Maximum Velocity (fps)	Model Pipe ID	MDD Maximum Velocity (fps)	Model Pipe ID	MHD Maximum Velocity (fps)	Model Pipe ID
1070	Two Bunch	5.00	4567	5.07	4567	5.12	4567
1070	Valley View	3.29	P-5003	3.34	P-5003	3.40	Well27D

8.6.2.4 Fire Flow

Figure 8-6 and Table 8-15 present the results of the fire flow analysis. With a residual pressure of 20 psi, the model shows that the lowest available fire flow in the 1070 Zone is approximately 230 gpm and that the highest available fire flow is greater than 1,000 gpm. According to the model, approximately 10% of the 1070 Zone may have an available fire flow less than 1,000 gpm, but approximately 5% of the 1070 Zone appears to have fire flow less than 500 gpm. Therefore, this zone does not meet the absolute minimum fire flow analysis criteria of 500 gpm.

8.6.3 Existing 1240 Zone

The results of the 1240 Zone analyses are summarized in Table 8-24. This zone does not meet the distribution or fire flow analysis criteria. Details for each analysis are provided in the following sections.

Table 8-24
1240 Zone Existing Water System Criteria Summary

Supply Analysis	Storage Analysis	Distribution Analysis	Fire Flow Analysis
MEETS CRITERIA	MEETS CRITERIA	DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA

8.6.3.1 Supply

The existing 1240 Zone appears to meet the supply analysis criteria. As presented in Table 5-5 and Table 5-6 (see Section 5.3), existing system wells appear to provide sufficient supply to meet reliability guidelines and capacity requirements for the five groundwater supply regions. The 1240 Zone covers a portion of Well Supply Region I . Because individual wells do not serve individual pressure zones, it is not practical to try to determine supply capacity surplus or deficiency in each primary pressure zone. For example, wells 22, 24, and 29 each serve the following zones: 1240, 1400, 1530, and 1630. Also, wells 32 and 33 serve the 913 Zone and the 1070 Zone. Under these circumstances it is not feasible to accurately determine the quantity of water from each well that serves each primary pressure zone

8.6.3.2 Storage

As shown in Table 8-3, the MDD is 3.720 gpm or 5.36 mgd. The operational storage requirement for the 1240 Zone is 25% of maximum daily demand, which is approximately 1.34 mg. The required fire flow storage volume for the 1240 Zone is 0.12 mg (based upon 1,000 gpm for two hours). Emergency storage is 75% of the MDD or 4.02 mg. Thus, the available storage shown in Table 8-25 of 7.48 mg is greater than the operational, fire flow, and emergency storage requirements for the 1240 Zone, which is 5.48 mg. Therefore, this zone meets the storage capacity analysis criteria.

Table 8-25
1240 Zone Existing Water Storage Summary

Storage Facility	Storage Volume (mg)
Low Desert View #1	0.26
Low Desert View #2	0.10
Quail Road	1.01
Terrace #1	1.83
Terrace #2	2.14
Terrace #3	2.14
Total Storage (mg)	**7.48**
Minimum Required Storage (mg)	**5.48**
Capacity Analysis	**MEETS CRITERIA**

8.6.3.3 Distribution

Table 8-26 show the results of the 1240 Zone pressure analysis for each demand scenario. The highest average day pressures for both service zones are greater than the maximum allowable pressure of 120 psi. For the maximum day scenario, pressures are below the standard of 40 psi. For the maximum hour scenario, both service zones have pressures below the analysis criteria minimum of 30 psi. Therefore, due to high pressures during average day and low pressures during maximum day and maximum hour demand scenarios, the 1240 Zone does not meet the criteria for the pressure analysis.

Table 8-26

1240 Zone Existing System Pressure Summary

Pressure Zone	Service Zone	ADD Maximum Pressure (psi)	Model Node	MDD Minimum Pressure (psi)	Model Node	MHD Minimum Pressure (psi)	Model Node
1240	Quail	121.80	J-1304E	30.20	J-2302	28.93	J-2302
1240	Terrace	136.98	J-929	21.62	J-913C	0.00	J-970D

Table 8-27 shows that the Quail service zone velocities meet the analysis criteria standards described in Section 8.2.3. Although the Terrace service zone velocities are a little high, they still meet the analysis criteria. Therefore, this zone passes the velocity analysis, but does not meet the criteria for the pressure analysis.

Table 8-27

1240 Zone Existing System Velocity Summary

Pressure Zone	Service Zone	ADD Maximum Velocity (fps)	Model Pipe ID	MDD Maximum Velocity (fps)	Model Pipe ID	MHD Maximum Velocity (fps)	Model Pipe ID
1240	Quail	1.45	4505	2.90	4505	5.00	4505
1240	Terrace	5.58	1178	5.70	P4993	8.65	P-5500

8.6.3.4 Fire Flow

Figure 8-6 and Table 8-15 present the results of the fire flow analysis. With a residual pressure of 20 psi, the model shows that the lowest available fire flow in the 1240 Zone is approximately 120 gpm and that the highest available fire flow is greater than 1,000 gpm. According to the model, approximately 22% of the 1240 Zone may have an available fire flow less than 1,000 gpm, but approximately 18% of the 1240 Zone appears to have fire flow less than 500 gpm. Therefore, this zone does not meet the absolute minimum fire flow analysis criteria of 500 gpm.

8.6.4 Existing 1400 Zone

The results of the 1400 Zone analyses are summarized in Table 8-28. This zone does not meet the analysis criteria for supply, distribution, or fire flow. Details for each analysis are provided in the following sections.

Table 8-28

1400 Zone Existing Water System Criteria Summary

Supply Analysis	Storage Analysis	Distribution Analysis	Fire Flow Analysis
DOES NOT MEET CRITERIA	MEETS CRITERIA	DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA

8.6.4.1 Supply

The 1400 Zone does not meet the supply analysis criteria. As presented in Table 5-5 and Table 5-6 (see Section 5.3), existing system wells do not provide sufficient supply to meet reliability guidelines and capacity requirements for the five groundwater supply regions. The 1400 Zone covers a portion of Well Supply Region I, II, and III. Because individual wells do not serve individual pressure zones, it is not practical to try to determine supply capacity surplus or deficiency in each primary pressure zone. For example, wells 22, 24, and 29 each serve the following zones: 1240, 1400, 1530, and 1630. Also, wells 32 and 33 serve the 913 Zone and the 1070 Zone. Under these circumstances it is not feasible to accurately determine the quantity of water from each well that serves each primary pressure zone

8.6.4.2 Storage

As shown in Table 8-3, the MDD is 2,629 gpm or 3.79 mgd. The operational storage requirement for the 1400 Zone is 25% of maximum daily demand, which is approximately 0.95 mg. The required fire flow storage volume for the 1400 Zone is 0.12 mg (based upon 1,000 gpm for two hours). Emergency storage is 75% of the MDD or 2.84 mg. Thus, the available storage shown in Table 8-29 of 4.42 mg is greater than the operational, fire flow, and emergency storage requirements for the 1400 Zone, which is 3.91 mg. Therefore, this zone passes the storage capacity analysis.

Table 8-29
1400 Zone Existing Water Storage Summary

Storage Facility	Storage Volume (mg)
Annandale	2.57
High Desert View #1	1.07
High Desert View #2	0.51
Overhill	0.27
Total Storage (mg)	**4.42**
Minimum Required Storage (mg)	**3.91**
Capacity Analysis	**MEETS CRITERIA**

8.6.4.3 Distribution

Table 8-30 show the results of the 1400 Zone pressure analysis for each demand scenario. The highest average day pressures from each service zone are greater than the maximum allowable pressure of 120 psi. For the maximum day scenario, pressures are below the standard of 40 psi. For the maximum hour scenario, the High Desert View and Overhill service zones have pressures below the analysis criteria minimum of 30 psi. Therefore, due to high pressures during average day and low pressures during maximum day and maximum hour demand scenarios, the 1400 Zone does not meet the criteria for the pressure analysis.

Table 8-30

1400 Zone Existing System Pressure Summary

Pressure Zone	Service Zone	ADD Maximum Pressure (psi)	Model Node	MDD Minimum Pressure (psi)	Model Node	MHD Minimum Pressure (psi)	Model Node
1400	High Desert View	143.25	J-1722B	22.90	J-1704	22.63	J-1704
1400	Annandale	147.83	J-844	34.79	J-804	33.17	J-1349D
1400	Overhill	154.49	J-559	22.52	J-503	21.99	J-503

Table 8-31 shows that velocities in each of the service zones meet the analysis criteria standards described in Section 8.2.3. Therefore, this zone passes the velocity analysis, but does not meet the criteria for the pressure analysis

Table 8-31

1400 Zone Existing System Velocity Summary

Pressure Zone	Service Zone	ADD Maximum Velocity (fps)	Model Pipe ID	MDD Maximum Velocity (fps)	Model Pipe ID	MHD Maximum Velocity (fps)	Model Pipe ID
1400	High Desert View	4.46	P-Terrace B56	4.52	P-Terrace B56	4.96	P-5017
1400	Annandale	1.06	808	2.12	808	3.65	808
1400	Overhill	2.16	266	2.15	794	2.15	50

8.6.4.4 Fire Flow

Figure 8-6 and Table 8-15 present the results of the fire flow analysis. With a residual pressure of 20 psi, the model shows that the lowest available fire flow in the 1400 Zone is approximately 70 gpm and that the highest available fire flow is greater than 1,000 gpm. According to the model, approximately 27% of the 1400 Zone may have an available fire flow less than 1,000 gpm, but approximately 3% of the 1400 Zone appears to have fire flow less than 500 gpm. Therefore, this zone does not meet the absolute minimum fire flow analysis criteria of 500 gpm.

8.6.5 Existing 1530 Zone

The results of the 1530 Zone analyses are summarized in Table 8-32. This zone does not meet the analysis criteria for each of the four categories. Details for each analysis are provided in the following sections.

Table 8-32

1530 Zone Existing Water System Criteria Summary

Supply Analysis	Storage Analysis	Distribution Analysis	Fire Flow Analysis
DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA

8.6.5.1 Supply

The 1530 Zone does not meet the supply analysis criteria. As presented in Table 5-5 (see Section 5.3.1), existing system wells do not provide sufficient supply to meet reliability guidelines and capacity requirements for the five groundwater supply regions. The 1530 Zone covers a portion of Well Supply Region I, II, and IV. Because individual wells do not serve individual pressure zones, it is not practical to try to determine supply capacity surplus or deficiency in each primary pressure zone. For example, wells 22, 24, and 29 each serve the following zones: 1240, 1400, 1530, and 1630. Also, wells 32 and 33 serve the 913 Zone and the 1070 Zone. Under these circumstances it is not feasible to accurately determine the quantity of water from each well that serves each primary pressure zone.

8.6.5.2 Storage

As shown in Table 8-3, the MDD is 2,815 gpm or 4.05 mgd. The operational storage requirement for the 1530 Zone is 25% of maximum daily demand, which is approximately 1.01 mg. The required fire flow storage volume for the 1530 Zone is 0.12 mg (based upon 1,000 gpm for two hours). Emergency storage is 75% of the MDD or 3.04 mg. Thus, the available storage shown in Table 8-33 of 3.78 mg is less than the operational, fire flow, and emergency storage requirements for the 1530 Zone, which is 4.17 mg. Therefore, this zone does not meet the storage capacity analysis criteria and is deficient approximately 0.39 mg.

Table 8-33
1530 Zone Existing Water Storage Summary

Storage Facility	Storage Volume (mg)
Gateway	0.26
High Northridge	1.04
Low Northridge	0.21
Mission Lakes	1.95
Redbud	0.32
Total Storage (mg)	**3.78**
Minimum Required Storage (mg)	**4.17**
Capacity Analysis	**DOES NOT MEET CRITERIA**

8.6.5.3 Distribution

Table 8-34 show the results of the 1530 Zone pressure analysis for each demand scenario. The highest average day pressures from each service zones, except Gateway, are greater than the maximum allowable pressure of 120 psi. For the maximum day scenario, pressures are below the standard of 40 psi, except in the Redbud service zone. For the maximum hour scenario, the High Desert View and Overhill service zones have pressures below the analysis criteria minimum of 30 psi, except in the Redbud service zone. Therefore, due to high pressures during average day and low pressures during maximum day and maximum hour demand scenarios, the 1530 Zone does not meet the criteria for the pressure analysis.

Table 8-34
1530 Zone Existing System Pressure Summary

Pressure Zone	Service Zone	ADD Maximum Pressure (psi)	Model Node	MDD Minimum Pressure (psi)	Model Node	MHD Minimum Pressure (psi)	Model Node
1530	High Northridge	165.47	J-1372	34.09	J-403	30.81	J-1350D
1530	Redbud	144.74	J-2157	46.98	J-2109	41.76	J-2109
1530	Gateway	114.23	J-611	22.10	J-656	16.52	J-656
1530	Mission Lakes	139.57	J-799	26.35	J-721	25.72	J-721

Table 8-35 shows that velocities in each of the service zones meet the analysis criteria standards described in Section 8.2.3, with the exception of the High Northridge service zone. Therefore, this zone does not meet the criteria for the velocity analysis and does not meet the criteria for the pressure analysis.

Table 8-35
1530 Zone Existing System Velocity Summary

Pressure Zone	Service Zone	ADD Maximum Velocity (fps)	Model Pipe ID	MDD Maximum Velocity (fps)	Model Pipe ID	MHD Maximum Velocity (fps)	Model Pipe ID
1530	High Northridge	11.57	P4991	11.79	P4991	12.11	P4991
1530	Redbud	0.93	3247	1.86	3247	3.20	3247
1530	Gateway	5.48	P-GateW2	5.48	P-GateW2	5.48	P-Terrace B1S
1530	Mission Lakes	2.68	738	2.33	738	2.69	P-5070

8.6.5.4 Fire Flow

Figure 8-6 and Table 8-15 present the results of the fire flow analysis. With a residual pressure of 20 psi, the model shows that the lowest available fire flow in the 1530 Zone is approximately 70 gpm and that the highest available fire flow is greater than 1,000 gpm. According to the model, approximately 26% of the 1530 Zone may have an available fire flow less than 1,000 gpm, but approximately 17% of the 1530 Zone appears to have fire flow less than 500 gpm. Therefore, this zone does not meet the absolute minimum fire flow analysis criteria of 500 gpm.

8.6.6 Existing 1630 Zone

The results of the 1630 Zone analyses are summarized in Table 8-36. This does not meet the analysis criteria for supply, storage, or fire flow. Details for each analysis are provided in the following sections.

Table 8-36

1630 Zone Existing Water System Criteria Summary

Supply Analysis	Storage Analysis	Distribution Analysis	Fire Flow Analysis
DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA	MEETS CRITERIA	DOES NOT MEET CRITERIA

8.6.6.1 Supply

The 1630 Zone does not meet the supply analysis criteria. As presented in Table 5-5 (see Section 5.3.1), existing system wells do not provide sufficient supply to meet reliability guidelines and capacity requirements for the five groundwater supply regions. The 1630 Zone covers a portion of Well Supply Region I. Because individual wells do not serve individual pressure zones, it is not practical to try to determine supply capacity surplus or deficiency in each primary pressure zone. For example, wells 22, 24, and 29 each serve the following zones: 1240, 1400, 1530, and 1630. Also, wells 32 and 33 serve the 913 Zone and the 1070 Zone. Under these circumstances it is not feasible to accurately determine the quantity of water from each well that serves each primary pressure zone

8.6.6.2 Storage

As shown in Table 8-3, the MDD is 1,166 gpm or 1.68 mgd. The operational storage requirement for the 1630 Zone is 25% of maximum daily demand, which is approximately 0.42 mg. The required fire flow storage volume for the 1630 Zone is 0.12 mg (based upon 1,000 gpm for two hours). Emergency storage is 75% of the MDD or 1.26 mg. Thus, the available storage shown in Table 8-37 of 0.36 mg is much less than the operational, fire flow, and emergency storage requirements for the 1630 Zone, which is 1.80 mg. Therefore, this zone does not meet the criteria for the storage capacity analysis with a deficiency of approximately 1.44 mg.

Table 8-37

1630 Zone Existing Water Storage Summary

Storage Facility	Storage Volume (mg)
Highland	0.06
Vista	0.30
Total Storage (mg)	**0.36**
Minimum Required Storage (mg)	**1.80**
Capacity Analysis	**DOES NOT MEET CRITERIA**

8.6.6.3 Distribution

Table 8-38 shows the results of the 1630 Zone pressure analysis for each demand scenario. The highest average day pressures from each service zones are greater than the maximum allowable pressure of 120 psi. For the maximum day scenario, pressures are above the minimum standard of 40 psi.. For the maximum hour scenario, the pressures are above the analysis criteria minimum of 30 psi. Therefore, the 1630 Zone passes the pressure analysis.

Table 8-38

1630 Zone Existing System Pressure Summary

Pressure Zone	Service Zone	ADD Maximum Pressure (psi)	Model Node	MDD Minimum Pressure (psi)	Model Node	MHD Minimum Pressure (psi)	Model Node
1630	Vista	146.71	J-1274	42.01	J-1208D	34.56	J-719
1630	Highland	132.40	J-1273	48.50	J-2202	48.35	J-2202

Table 8-39 shows that velocities in each of the service zones meet the analysis criteria standards described in Section 8.2.3. Therefore, this zone passes the velocity analysis and passes the pressure analysis.

Table 8-39

1630 Zone Existing System Velocity Summary

Pressure Zone	Service Zone	ADD Maximum Velocity (fps)	Model Pipe ID	MDD Maximum Velocity (fps)	Model Pipe ID	MHD Maximum Velocity (fps)	Model Pipe ID
1630	Vista	1.98	2419	3.95	1464	6.81	1464
1630	Highland	0.67	872	1.34	668	2.32	4431

8.6.6.4 Fire Flow

Figure 8-6 and Table 8-15 present the results of the fire flow analysis. With a residual pressure of 20 psi, the model shows that the lowest available fire flow in the 1630 Zone is approximately 225 gpm and that the highest available fire flow is greater than 1,000 gpm. According to the model, approximately 20% of the 1630 Zone may have an available fire flow less than 1,000 gpm, but approximately 5% of the 1630 Zone appears to have fire flow less than 500 gpm. Therefore, this zone does not meet the absolute minimum fire flow analysis criteria of 500 gpm.

8.6.7 Existing Cottonwood 1630 Zone

The results of the Cottonwood 1630 Zone (1630-C Zone) analyses are summarized in Table 8-40. This zone meets only the supply analysis criteria. Details for each analysis are provided in the following sections.

Table 8-40

Cottonwood 1630 Zone Existing Water System Criteria Summary

Supply Analysis	Storage Analysis	Distribution Analysis	Fire Flow Analysis
MEETS CRITERIA	DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA

8.6.7.1 Supply

Figure 8-6 shows the supply analysis of the existing water system. The analysis assumes no pumping during the SCE peak power demand period between 5:30 AM and 11:30 AM. The results of the analysis indicate that Well 26 supply the existing Cottonwood Zone sufficiently to meet MDD with the pumps operating on an 18-hour per day pump scenario with a surplus supply capacity of approximately 0.2 mgd. Therefore, the Cottonwood Zone meets the criteria for supply capacity.

8.6.7.2 Storage

As shown in Table 8-3, the MDD is 124 gpm or 0.18 mg. The operational storage requirement for the Cottonwood 1630 Zone is 25% of maximum daily demand, which is approximately 0.04 mg. The required fire flow storage volume for the Cottonwood 1630 Zone is 0.12 mg (based upon 1,000 gpm for two hours). Emergency storage is 75% of the MDD or 0.13 mg. Thus, the available storage shown in Table 8-41 of 0.28 mg is less than the operational, fire flow, and emergency storage requirements for the Cottonwood 1630 Zone, which is 0.30 mg. Therefore, this zone does not meet the criteria for the storage capacity analysis with a deficiency of approximately 0.02 mg.

Table 8-41

Cottonwood 1630 Zone Existing Water Storage Summary

Storage Facility	Storage Volume (mg)
Cottonwood	0.28
Total Storage (mg)	**0.28**
Minimum Required Storage (mg)	**0.30**
Capacity Analysis	**DOES NOT MEET CRITERIA**

8.6.7.3 Distribution

Table 8-42 shows the results of the Cottonwood 1630 Zone pressure analysis for each demand scenario. The highest average day pressures for the zone is greater than the maximum allowable pressure of 120 psi. For the maximum day scenario, pressures are much lower than the minimum standard of 40 psi. For the maximum hour scenario, the pressures are much lower than the analysis criteria minimum of 30 psi. Therefore, the Cottonwood 1630 Zone does not meet the criteria for the pressure analysis.

Table 8-42

Cottonwood 1630 Zone Existing System Pressure Summary

Pressure Zone	Service Zone	ADD Maximum Pressure (psi)	Model Node	MDD Minimum Pressure (psi)	Model Node	MHD Minimum Pressure (psi)	Model Node
1630-C	Cottonwood	132.92	J-3242	10.13	J-3203	9.46	J-3251

Table 8-43 shows that velocities in each of the service zones meet the analysis criteria standards described in Section 8.2.3. Therefore, this zone passes the velocity analysis, but does not meet the criteria for the pressure analysis.

Table 8-43

Cottonwood 1630 Zone Existing System Velocity Summary

Pressure Zone	Service Zone	ADD Maximum Velocity (fps)	Model Pipe ID	MDD Maximum Velocity (fps)	Model Pipe ID	MHD Maximum Velocity (fps)	Model Pipe ID
1630-C	Cottonwood	2.17	268	2.18	268	2.19	268

8.6.7.4 Fire Flow

Figure 8-6 and Table 8-15 present the results of the fire flow analysis. With a residual pressure of 20 psi, the model shows that the lowest available fire flow in the Cottonwood Zone is approximately 370 gpm and that the highest available fire flow is greater than 1,000 gpm. According to the model, approximately 95% of the Cottonwood Zone may have an available fire flow less than 1,000 gpm, but approximately 7% of the Cottonwood Zone appears to have fire flow less than 500 gpm. Therefore, this zone does not meet the absolute minimum fire flow analysis criteria of 500 gpm.

8.6.8 Existing Woodridge 1840 Zone

The results of the 1840 Zone analyses are summarized in Table 8-44. This zone failed both the distribution analysis and the fire flow analysis. Details for each analysis are provided in the following sections.

Table 8-44

1840 Zone Existing Water System Criteria Summary

Supply Analysis	Storage Analysis	Distribution Analysis	Fire Flow Analysis
MEETS CRITERIA	DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA	DOES NOT MEET CRITERIA

8.6.8.1 Supply

Figure 8-6 shows the supply analysis of the existing water system. The analysis assumes no pumping during the SCE peak power demand period between 5:30 AM and 11:30 AM. The results of the analysis indicate that Well 26 supply the existing Woodridge Zone sufficiently to meet MDD with the pumps operating on an 18-hour per day pump scenario with a surplus supply capacity of approximately 0.6 mgd. Therefore, the Woodridge Zone meets the criteria for supply capacity.

8.6.8.2 Storage

As shown in Table 8-3, the MDD is 62 gpm or 0.09 mg. The operational storage requirement for the 1840 Zone is 25% of maximum daily demand, which is approximately 0.02 mg. The required fire flow storage volume for the 1840 Zone is 0.12 mg (based upon 1,000 gpm for two hours). Emergency storage is 75% of the MDD or 0.07 mg. Thus, the available storage shown in Table 8-45 of 0.12 mg is much less than the operational, fire flow, and emergency storage requirements for the 1840 Zone, which is 0.21 mg. Therefore, this zone does not meet the criteria for the storage capacity analysis with a deficiency of approximately 0.09 mg.

Table 8-45

Woodridge 1840 Zone Existing Water Storage Summary

Storage Facility	Storage Volume (mg)
Woodridge	0.12
Total Storage (mg)	**0.12**
Minimum Required Storage (mg)	**0.21**
Capacity Analysis	**DOES NOT MEET CRITERIA**

8.6.8.3 Distribution

Table 8-46 shows the results of the 1840 Zone pressure analysis for each demand scenario. The highest average day pressure for the zone is greater than the maximum allowable pressure of 120 psi. For the maximum day scenario, pressures are much lower than the minimum standard of 40 psi. For the maximum hour scenario, the pressures are much lower than the analysis criteria minimum of 30 psi. Therefore, the 1840 Zone does not meet the criteria for the pressure analysis.

Table 8-46

Woodridge 1840 Zone Existing System Pressure Summary

Pressure Zone	Service Zone	ADD Maximum Pressure (psi)	Model Node	MDD Minimum Pressure (psi)	Model Node	MHD Minimum Pressure (psi)	Model Node
1840-W	Woodridge	125.85	J-3188	1.91	J-3101	1.69	J-3101

As shown in Table 8-47, for each demand scenario, the highest velocity in the Woodridge 1840 Zone distribution system is much greater than the analysis criteria maximum allowable velocities shown in Section 8.2.3. Therefore, this zone does not meet the criteria for the velocity analysis, but passes the pressure analysis.

Table 8-47

Woodridge 1840 Zone Existing System Velocity Summary

Pressure Zone	Service Zone	ADD Maximum Velocity (fps)	Model Pipe ID	MDD Maximum Velocity (fps)	Model Pipe ID	MHD Maximum Velocity (fps)	Model Pipe ID
1840-W	Woodridge	22.64	P-Well24S	22.87	P-Well24S	23.21	P-Well22D

8.6.8.4 Fire Flow

Figure 8-6 and Table 8-15 present the results of the fire flow analysis. With a residual pressure of 20 psi, the model shows that the lowest available fire flow in the Woodridge Zone is approximately 370 gpm and that the highest available fire flow is greater than 1,000 gpm. According to the model, approximately 66% of the Woodridge Zone may have an available fire flow less than 1,000 gpm, but approximately 17% of the Woodridge Zone appears to have fire flow less than 500 gpm. Therefore, this zone does not meet the absolute minimum fire flow analysis criteria of 500 gpm

8.7 SUMMARY

Table 8-48 summarizes the existing system ability to meet the hydraulic analysis criteria.

Table 8-48

Summary of Existing System Analysis Results

	Does the entire zone meet system analysis criteria?			
Zone	**Supply**	**Storage**	**Distribution**	**Fire Flow**
913	Yes	Yes	Yes	Yes
1070	Yes	NO	NO	NO
1240	Yes	Yes	NO	NO
1400	NO	Yes	NO	NO
1530	NO	NO	NO	NO
1630	NO	NO	Yes	NO
Cottonwood	Yes	NO	NO	NO
Woodridge	Yes	NO	NO	NO

Supply is analyzed in terms of groundwater production into the specific primary pressure zone, and storage is analyzed in terms two days of ADD volume available in storage tanks. Distribution analysis considers whether or not the system meets pressure and velocity criteria. Fire Flow capacity analysis is based upon determining the flow capacity available at model nodes with a minimum pressure of 20 psi. The primary service zones that do not meet the system criteria typically have portions of the system which have an available fire flows lower than the absolute minimum standard of 500 gpm.

The 913 Zone does not have sufficient supply capacity (see Table 5-5) but meets the criteria for fire flow, storage capacity, and distribution system capacity. The 1070 Zone lacks supply, storage, distribution, and fire flow capacity. The 1240 Zone has sufficient storage capacity, but has deficiencies in supply, distribution, and fire flow capacity. The 1400 Zone has sufficient storage capacity, but has deficiencies in supply, distribution, and fire flow capacity. The 1530 Zone lacks supply, storage, distribution, and fire flow capacity. The 1630 Zone has sufficient distribution capacity, but is deficient in supply, storage, and fire flow capacity. The Cottonwood and Woodridge Zones have sufficient supply, but lack storage, supply, distribution, and fire flow capacity.

9.1 INTRODUCTION

This section presents recommended water distribution facilities improvements that will be required to meet future growth over the next 20 years while maintaining upgrading and enhancing facilities to meet the areas of concern discussed earlier. These future enhancements include supply, storage, booster station, and distribution system improvements. The 20-year Capital Improvement Program (CIP) components are outlined for the combined MSWD water distribution system on five-year intervals for the following years: 2010, 2015, 2020, and 2025. The proposed improvements are a “snap shot” in time and should be reviewed annually to determine the appropriateness as growth occurs.

9.1.1 Primary Pressure Zones

A major emphasis in the recommended water distribution facilities is based on reconfiguration of primary pressure zone boundaries to resolve concerns over high and low pressures along existing pressure zone boundaries as well as to reduce the number of pressure zones. URS recommends that the system be organized into nine pressure zones shown in Figure 9-1. The range of topographic elevations and static system pressures for each of the primary pressure zones are both shown in Table 9-1. These pressure zone parameters were used to redefine the pressure zones throughout the combined MSWD system. New primary pressure zones have been established for the two highest topographic regions (Zone 1975 and Zone 2155) in order to meet the projected growth. Figure 9-2 shows the location of the pressure zone outlined below in Table 9-1.

Table 9-1

Summary of Primary Pressure Zones

Primary Pressure Zone	Minimum Topographic Elevation (ft)	Maximum Topographic Elevation (ft)	Minimum Static Pressure (psi)	Maximum Static Pressure (psi)
913	635	800	49	120
1070	800	970	43	117
1240	970	1140	43	117
1400	1140	1300	43	113
1530	1300	1430	43	100
1630	1430	1530	43	87
1800	1530	1700	43	117
1975	1700	1880	41	119
2155	1880	2060	41	119

9.1.2 Future Demands

Future water system demands are divided according to the primary pressure zone boundaries. Thus, water demands are redistributed according to primary pressure zone changes to accurately model the projected future conditions. The MDD for each zone (Table 9-2) is the basis for developing supply, storage, and booster pumping capacity requirements.

Insert

Figure 9-1
Pressure Zone Boundaries Year 2010-2025

Table 9-2

Projected MDD forPrimary Pressure Zones

Primary Pressure Zone	Service Zones	2005 MDD (gpm)	2010 MDD (gpm)	2015 MDD (gpm)	2020 MDD (gpm)	2025 MDD (gpm)
913	Reduced Valley View	87	119	173	173	175
1070	Valley View, Two Bunch	1,909	2,079	2,264	2,552	2,818
1240	Terrace, Quail, Reduced Overhill	3,720	4,331	4,706	5,231	5,585
1400	Overhill, Annandale, High Desert View, Reduced High Northridge	2,629	7,057	10,553	12,266	13,877
1530	Mission Lakes, Gateway, High Northridge, Redbud	2,815	3,173	4,446	4,591	4,870
1630	Highland, Vista, Gateway Hydro	1,166	2,400	3,295	3,295	3,295
1800	future development only	0	0	690	690	690
1975	future development only	0	0	0	1,124	1,124
2155	future development only	0	0	0	0	1,021
1800-W	Woodridge	62	99	136	149	174
1630-C	Cottonwood	124	198	261	310	335
	TOTAL	**12,512**	**19,456**	**26,524**	**30,380**	**33,964**

The MDD is based upon the high growth scenario provided by Harvey Economics, as described in Section 4 of this report.

9.2 SERVICE ZONE IMPROVEMENT PLANS

Utilizing the calibrated MSWD hydraulic model, URS prepared a hydraulic model for each planning horizon (i.e. 2010, 2015, 2020, and 2025) in order to meet future demands presented in previous sections as well as address current system problems. The 20 year system improvements described in the following sections and shown in Figure 9-2 are intended to represent major system facility improvements required for the specific planning horizon. We anticipate that these proposed improvements might be either accelerated or delayed based on actual growth conditions but should provide reasonableness based on the high growth scenario presented in Section 4. URS has also presented future improvements (Figure 9-2, 9-3, 9-4a, and 9-4b) based on expansion of the MSWD water distribution system hydraulic profile presented in Section 7. These figures in conjunction with the discussion of the individual primary pressure zone improvement below, provides MSWD a representation of each improvement to the over system. Minor system improvements such as those required to serve specific developments are not within the scope of this master plan. Although this report does not present minor improvements that will be required for individual development projects, it does provide a guide for MSWD to effectively set requirements for key system components such as large distribution pipelines, storage, and booster pumps, as required.

Insert

Figure 9-2
Future Proposed System Years 2010-2025

Insert

Figure 9-3

Hydraulic Profile – Future 2025 MSWD System

Insert

Figure 9-4
Hydraulic Profile – Future 2025 MSWD System

Figure 9-5

Hydraulic Profile – Future 2025 MSWD System

9.2.1 913 Zone

As shown in Table 9-2, the 913 Zone MDD is expected to more than double (200%) over the next twenty years (2005 to 2025). MSWD is currently installing a 2.0 mg tank and well within this zone, which should address needs in the foreseeable future. The future improvements required in the 913 Zone are summarized below in Table 9-3. The improvements are planned for 2010, which corresponds to the projected development pattern of the High Growth Scenario. These conceptual master plan improvements consist of 1,218 LF of 16-inch water line and appurtenances from the future Garnet booster station to the 913 Zone tank. Although no other improvements are shown in the 2010-2025 CIP, other minor improvements to the 913 Zone may be required as the system evolves. The components described in Table 9-3 are the major improvements that will be required to meet the projected High Growth Scenario demands for the 913 Zone.

Table 9-3

Future System Improvements for the 913 Zone

System Components	2010	2015	2020	2025
Supply – Wells	none	none	none	none
Storage – Tanks	none	none	none	none
Booster Stations	none	none	none	none
Distribution – Major Pipelines	none	1,300 lf, 12-in	none	none

9.2.1.1 Supply Improvements

No additional wells are required to meet the demands of the 913 Zone in the years between 2010 and 2025 because of the new well recently installed. Under the current assumptions, from which the demand projections were based, there is not a foreseeable need for additional wells in this zone (see Table 5-6, Section 5).

9.2.1.2 Storage Improvements

As shown below in Table 9-4, the 913 Zone will not likely require additional storage to meet the future demands of the MSWD system in the year 2025. A new 2.0 mg storage tank was recently constructed in the 913 Zone. This facility provides sufficient storage capacity for the next twenty-year period 2005 to 2025.

Table 9-4

Storage Improvements – Future 913 Zone

Year	Zone	Service zones	2025 MDD (mgd)	Fire Storage (mg)	Operational + Emergency Storage (mg)	Required Volume (mg)	2005 Available Storage (mg)	Needed Volume (mg)	Conceptual Location
n/a	913	Reduced Valley View	0.25	0.12	0.25	0.37	2.00	**0**	n/a

9.2.1.3 Booster Station Improvements

Booster stations recently constructed in the 913 Zone provide sufficient capacity (see Section 7 for specific details). Under the conditions considered for the analysis in this master plan, additional booster stations are not be required to meet the demands of the 2025 system. However, if the actual system design diverts from the assumptions made in this master plan report, additional booster stations may be required.

9.2.1.4 Distribution System Improvements

Table 9-5 shows the required pipeline improvements for the 913 Zone. Specifically, these distribution system improvements are required from the future Garnet booster station to the 913 Zone tank. This future pipeline is shown in Figure 9-2.

Table 9-5

Distribution Improvements – Future 913 Zone

Zone	Year	Name	Description	Size (in)	Length (ft)
913	2015	913 Zone Tank & Garnet Pump Piping	Connection from Z913 tank to Z1070 system	12	1,300

9.2.2 1070 Zone

As shown in Table 9-2, the 1070 Zone MDD is projected to increase by approximately 48% during the twenty-year period between 2005 and 2025. Table 9-6 shows summarizes the system improvements required in the 1070 Zone to meet future demands between the years 2010 and 2025. The future improvements for the 1070 Zone are expected to occur during 2010 and 2015.

Table 9-6

Future System Improvements for the 1070 Zone

System Components	2010	2015	2020	2025
Supply – Wells	none	none	none	none
Storage – Tanks	(1) 2.50 mg tank	none	none	none
Boosters – Pumps	none	(1) 1.3 mgd	none	none
Distribution – Major Pipelines	3,200 lf, 16-in	none	none	none

9.2.2.1 Supply Improvements

No additional wells are required to meet the demands of the 1070 Zone in the years between 2010 and 2025. Under the current assumptions, from which the demand projections were based, there is not a foreseeable need for additional wells in this zone (see Table 5-6, Section 5).

9.2.2.2 Storage Improvements

Table 9-7 shows that the 1070 Zone requires approximately an additional 2.5 mg of storage capacity in 2010, which should be located along Dillon Road between Well27 and the existing

Valley View Tank. The anticipated location of this future storage facility is shown in Figure 9-2. This new storage facility is required to meet reliability requirements associated with fire storage, operational storage, and emergency storage. This tank will be primarily supplied by Well 27, and should be equipped with an altitude valve to effectively control the filling of the tank.

Table 9-7

Storage Improvements – Future 1070 Zone

Year	Zone	Service zones	2025 MDD (mgd)	Fire Storage (mg)	Operational + Emergency Storage (mg)	Required Volume (mg)	2005 Available Storage (mg)	Needed Volume (mg)	Conceptual Location
2010	1070	Valley View, Two Bunch	4.06	0.12	4.06	4.18	1.76	**2.42**	Between Well 27 & Valley View Tank

9.2.2.3 Booster Station Improvements

The 1070 Zone an a new in the year 2015. This booster station is described below in Table 9-8. The location of this booster station is shown in Figure 9-2. The Future Garnet booster station will convey water from Well 33 to the Two Bunch tanks (1070 Zone) and service zone.

Table 9-8

Booster Station Improvements – Future 1070 Zone

Zone	Year	Name	Flow (mgd)	Head (ft)	Calculated Hp	Design Hp
1070	2015	Future Garnet	1.3	220	59	75

9.2.2.4 Distribution System Improvements

Table 9-9 shows the major pipeline improvements required for the 1070Zone. During 2015, approximately 400 LF of 6-inch pipeline is required. For future 1070 Zone developments, these improvements should be considered minimum development standards. Figure 9-2 indicates the location of the future pipeline improvement projects described in Table 9-11. The Future 1070 Tank Piping is required to deliver water to the future 1070 Zone tank. The Future Valley View Pump Piping near the Valley View tank is intended to increase system pipeline capacity in this area.

Table 9-9

Distribution Improvements – Future 1070 Zone

Zone	Year	Name	Description	Size (in)	Length (ft)
1070	2010	Future 1070 Tank Piping	From new Z1070 tank at Power Line Rd & Karen Ave to existing line at Dillon Rd & Karen Ave	16	3,200

9.2.3 1240 Zone

Table 9-2 shows that the MDD in the 1240 Zone is expected to increase by 50% during the twenty years between 2005 and 2025. As shown in Table 9-10 below, the only major improvement required for the 1240 Zone between the years 2010 and 2025 is a 20-in diameter pipeline. However, this does not mean that other minor system improvements will not be required for MSWD operation and maintenance program and for serving future developments within the 1240 Zone.

Table 9-10

Future System Improvements for the 1240 Zone

System Components	2010	2015	2020	2025
Supply – Wells	none	none	none	none
Storage – Tanks	(1) 1.5 mg	none	none	none
Boosters – Pumps	none	none	none	none
Distribution – Major Pipelines	12,900 lf, 16-in	none	none	none

9.2.3.1 Supply Improvements

No additional wells are required to meet the demands of the 1070 Zone in the years between 2010 and 2025. Under the current assumptions, from which the demand projections were based, there is not a foreseeable need for additional wells in this zone (see Table 5-6, Section 5).

9.2.3.2 Storage Improvements

Table 9-11 shows that the 1240 Zone requires approximately an additional 1.5 mg of storage capacity in 2015, which should be located adjacent to the existing Two Bunch tank. The existing storage capacity of the 1240 Zone is sufficient to meet the demands of the future system.

Table 9-11

Storage Improvements – Future 1240 Zone

Year	Zone	Service zones	2025 MDD (mgd)	Fire Storage (mg)	Operational + Emergency Storage (mg)	Required Volume (mg)	2005 Available Storage (mg)	Needed Volume (mg)	Conceptual Location
2015	1240	Terrace, Quail, Reduced Overhill	8.21	0.12	8.21	8.33	7.13	**1.20**	Adjacent to existing Two Bunch tank

9.2.3.3 Booster Station Improvements

According the hydraulic model of the water distribution system, new booster stations are not required for the 1240 Zone to meet demands between the years 2010 and 2025. The existing Low Desert View booster station provides sufficient capacity for anticipated future needs (see Section 7 for details regarding this facility).

9.2.3.4 Distribution System Improvements

Table 9-12 shows the major pipeline improvements required for the 1070Zone. During 2015, approximately 400 LF of 6-inch pipeline is required. For future 1070 Zone developments, these improvements should be considered minimum development standards. Figure 9-2 indicates the location of the future pipeline improvement projects described in Table 9-11. The Future 1070 Tank Piping is required to deliver water to the future 1070 Zone tank. The Future Valley View Pump Piping near the Valley View tank is intended to increase system pipeline capacity in this area.

Table 9-12

Distribution Improvements – Future 1240 Zone

Zone	Year	Name	Description	Size (in)	Length (ft)
1240	2010	Future Piping	Z1240 connection from Long Canyon Rd & 15th Ave to Hacienda Ave & Two Bunch Palms Trail	20	12,900

9.2.4 1400 Zone

The 1400 Zone is expected to be the fastest growing zone in the entire MSWD water system. As shown in Table 9-2, the MDD in the 1400 Zone is expected to increase by over five times (528%) during the twenty-year period between 2005 and 2025. Table 9-13 shows summarizes the system improvements required in the 1400 Zone to meet future demands between the years 2010 and 2025. The 2010 CIP contains the all of the future system improvements, with the exception of the future wells required.

Table 9-13

Future System Improvements for the 1400 Zone

System Components	2010	2015	2020	2025
Supply – Wells	(2) 2,000 gpm	(3) 2,000 gpm	(2) 1,500 gpm	(1) 1,500 gpm
Storage – Tanks	(1) 5.0 mg (1) 1.0 mg	(1) 5.0 mg	none	(1) 5.0 mg
Boosters – Pumps	(1) 0.7 mgd	none	none	none
Distribution – Major Pipelines	9,500 lf, 8-in 29,300 lf, 24-in	2,600 lf, 12-in 2,800 lf, 16-in 2,700 lf, 20-in	none	none

9.2.4.1 Supply Improvements

As shown in Table 9-14, approximately eleven (11) additional wells are required to meet the future demands of the 1400 Zone. For calculation purposes, each of these wells is assumed to provide between 1,500 gpm and 2,000 gpm. It is expected that the actual numbers will vary according to the actual capacities of the wells that are developed. Figure 9-2 presents conceptual locations of the future wells described in Table 9-14. In Table 9-14, the future wells are shown for the 1400 Zone serve only the main body of the zone (1400b), which is not connected to the other portion of the 1400 Zone (1400a) that has comparatively little demand. During analysis of the pressure zones it was determined that it is not practical to connect 1400a with 1400b (see Table 5-6, Section 5 for calculations).

Table 9-14

Future Supply Improvements for the 1400 Zone

(Wells) Year	Zone	Wells Required	Reason for Need
n/a	1400a	0	n/a
(2) 2010, (3) 2015, (2) 2020, (1) 2025	1400b	8	Reliability

9.2.4.2 Storage Improvements

Table 9-15 shows the storage improvements required to serve the future 1400 Zone. For 2010 there are two separate storage facilities required to serve the two subsections of the 1400 Zone: 1400a and 1400b. Because the 1400 Zone is not completely inner-connected, separate storage facilities are required to provide sufficient storage to the separate service zones in the 1400 Zone. The location of these storage facilities is shown in Figure 9-2. Because it is not practical to connect the 1400 Zone divisions (1400a and 1400b), separate future storage improvement are required to meet anticipated demands in each portion of the 1400 Zone. For the 1400a Zone, a 1.0 mg storage tank is required, which could be placed adjacent to the existing Overhill Tank. As required for the 1400b Zone, three 5.0 mg storage tanks could be located near 59/900 proposed development or along Pierson Road, east of Highway 62.

Table 9-15

Storage Improvements – Future 1400 Zone

Year	Zone	Service zones	2025 MDD (mgd)	Fire Storage (mg)	Operational + Emergency Storage (mg)	Required Volume (mg)	2005 Available Storage (mg)	Needed Volume (mg)	Conceptual Location
2010	1400a	Overhill	0.87	0.12	0.87	0.99	0.27	**-0.72**	Near existing tank
2010	1400b	Annandale, High Desert View, Reduced High Northridge	18.71	0.12	18.71	18.83	4.15	**-14.68**	Near existing tank, and near proposed 59/900 development.

9.2.4.3 Booster Station Improvements

The 1400 Zone requires a booster station in 2010. As shown in Table 9-16, the booster station must be at least 50 Hp and deliver 0.5 mgd with a head of 165 ft. This is the only booster station that will likely be required to meet the future demands of the 1400 Zone. Figure 9-2 shows the location of the future 1400 Zone booster station. The Future Valley View booster station is designed to deliver water from the Valley View Tank (1070 Zone) to the Overhill Tank (1400 Zone) and service zone.

Table 9-16

Booster Station Improvements – Future 1400 Zone

Zone	Year	Name	Flow (mgd)	Head (ft)	Calculated Hp	Design Hp
1400	2015	Future Valley View	0.5	345	31	50

9.2.4.4 Distribution System Improvements

During 2010, the 1400 Zone requires seven major pipeline projects. These are summarized below in Table 9-17. The alignment of these future pipeline improvement projects is shown Figure 9-2.

Table 9-17

Distribution Improvements – Future 1400 Zone

Zone	Year	Description	Size (in)	Length (ft)
1400	2010	Connection between HDV tanks and new booster station to exist systm	8	2,100
1400	2010	Connection between new Z1400 wells and existing system	8	7,400
1400	2015	Connection between new Z1400 wells and existing system	12	2,600
1400	2015	Connection between new Z1400 wells and existing system	16	2,800
1400	2015	Connection between new Z1400 wells and existing system	20	2,700
1400	2010	From 8th St & Little Morongo Rd to Terrace tanks & booster station	24	10,100
1400	2010	Terrace tanks & booster station and new Z1400 tank	24	6,800
1400	2010	Pierson Blvd connection to new Z1400 tank	24	4,400
1400	2010	Connection between new Z1400 wells and existing system	24	8,000

9.2.5 1530 Zone

As shown in Table 9-2, the 1530 Zone MDD is expected to increase by 73% during the twenty years between 2005 and 2025. Table 9-18 shows the future improvements for the 1530 Zone. These include two storage facilities and several major pipeline projects during the 2010 CIP and the 2015 CIP. The majority of the future improvements for the 1530 Zone are expected to occur during the 2010 CIP. During the 2015 CIP, one supply facility and one storage facility will also be required. The most significant of the future improvements for this zone are the distribution system improvements or major pipelines.

Table 9-18

Future System Improvements for the 1530 Zone

System Components	2010	2015	2020	2025
Supply – Wells	(2) 2,000 gpm	(1) 1,500 gpm	none	none
Storage – Tanks	(1) 1.0 mg	(1) 4.0 mg	none	none
Boosters – Pumps	none	none	none	none
Distribution – Major Pipelines	21,600 lf, 12-in 19,000 lf, 16-in 19,700 lf, 24-in	2,600 lf, 16-in 2,800 lf 20-in	2,800 lf, 16-in	none

9.2.5.1 Supply Improvements

As shown below in Table 9-19, three additional wells are required to meet the future demands of the 1530 Zone. Each of these two wells is assumed to provide approximately 1,500 gpm. It is expected that the actual numbers will vary according to the actual capacities of the wells that are developed. Figure 9-2 shows conceptual locations of the future wells (see Table 5-6, Section 5 for calculations).

Table 9-19

Future Supply Improvements for the 1530 Zone

(Wells) Year	Zone	Wells Required	Reason for Need
(2) 2010, (1) 2015	1530	3	Reliability

9.2.5.2 Storage Improvements

Table 9-20 shows that two storage facilities are required to meet the future demands in the 1530 Zone. The conceptual locations are merely possible locations and may be subject to change. Figure 9-2 presents the locations for the two required future storage facilities in the 1530 Zone. Although the existing Redbud tank has an available storage volume of 0.32 mg, it has been marked for replacement by MSWD and is not counted in the available storage volume shown in Table 9-20.

Table 9-20

Storage Improvements – Future 1530 Zone

Year	Zone	Service zones	2025 MDD (mgd)	Fire Storage (mg)	Operational + Emergency Storage (mg)	Required Volume (mg)	2005 Available Storage (mg)	Needed Volume (mg)	Conceptual Location
2015	1530	Mission Lakes, Gateway, High Northridge	6.81	0.12	6.81	6.93	3.25	**-3.68**	Near 2140 development
2010	1530	Redbud	0.45	0.12	0.45	0.57	0	**-0.57**	Near existing tank

9.2.5.3 Booster Station Improvements

As shown in Table 9-21, an additional booster station is required in the 1530 Zone to meet system requirements between the year 2010 and 2025. This booster station should have a minimum capacity of 0.8 mgd. In addition, the Terrace B5/6 Booster Station should be retired as part of the 2010 CIP. Figure 9-2 shows the location of the future 1530 Zone booster station.

Table 9-21

Booster Station Improvements – Future 1530 Zone

Zone	Year	Name	Flow (mgd)	Head (ft)	Calculated Hp	Design Hp
1530	2010	High Desert View	0.8	165	23	50

9.2.5.4 Distribution System Improvements

As shown in Table 9-22, all of the distribution system improvements are required during the 2010 CIP. These pipeline projects are shown in the map presented in Figure 9-2.

Table 9-22

Distribution Improvements – Future 1530 Zone

Zone	Year	Description	Size (in)	Length (ft)
1530	2010	Connection to future development and bypass exist PRV (Yucca Drive and Verbena Drive)	12	2,100
1530	2010	Connection from Mission Lake Blvd & Indian Ave to exist HNR tank	12	15,600
1530	2010	Pipeline replacement to increase capacity from Mesquite Ave & 5th St to exist Terrace tanks	12	1,000
1530	2010	Connection between new Z1530 wells and existing system	12	2,900
1530	2010	Connection to future Z1530 well	16	10,000
1530	2015	Connection to future Z1530 well	16	2,600
1530	2020	Connection to future Z1530 well	16	2,800
1530	2010	Connection from Mission Lake Blvd & Clubhouse Blvd to exist Mission Lakes tank	16	6,600
1530	2010	Connection between new Z1530 wells and existing system	16	2,400
1530	2015	Connection between new Z1530 wells and existing system	20	2,800
1530	2010	From Z1530 tank to existing Gateway tank	24	18,200
1530	2010	Connection from Mission Lake Blvd & Indian Ave to exist HNR tank	24	1,500

9.2.6 1630 Zone

As shown in Table 9-2, the 1630 Zone MDD is expected to increase approximately 2.8 times (280%) during the next twenty years from 2005 to 2025. Table 9-23 shows the future improvement required for the 1630 Zone. The system improvements primarily occur during the 2010 CIP. The majority of the future improvements are expected to occur during the 2010 CIP. An additional well will be required during the 2015 CIP.

Table 9-23

Future System Improvements for the 1630 Zone

System Components	2010	2015	2020	2025
Supply – Wells	(1) 1,500 gpm	(1) 1,500 gpm	none	none
Storage – Tanks	(1) 1.0 mg (1) 1.5 mg (1) 2.5 mg	none	none	none
Boosters – Pumps	(1) 1.5 mgd	none	none	none
Distribution – Major Pipelines	7,600 lf, 12-in	none	none	none

9.2.6.1 Supply Improvements

As shown below in Table 9-24, two additional wells are required to meet the future demands of the 1630 Zone. For calculation purposes, each of these wells is assumed to provide approximately 1,500 gpm. It is expected that the actual numbers will vary according to the actual capacities of the wells that are developed. Figure 9-2 shows conceptual locations of the future wells in this zone (see Table 5-6, Section 5 for calculations). The future 1630 Zone wells will supply water to the future 1630 Zone storage facilities.

Table 9-24

Future Supply Improvements for the 1630 Zone

(Wells) Year	Zone	Wells Required	Reason for Need
(1) 2010, (1) 2015	1630b	1	Capacity

9.2.6.2 Storage Improvements

Table 9-25 describes the four storage facilities that are required in the 1630 Zone to meet future demands. The anticipated locations of these storage facilities are shown in Figure 9-2.

Table 9-25

Storage Improvements – Future 1630 Zone

Year	Zone	Service Zones	2025 MDD (mgd)	Fire Storage (mg)	Operational + Emergency Storage (mg)	Required Volume (mg)	2005 Available Storage (mg)	Needed Volume (mg)	Conceptual Location
2010	1630	Vista	1.68	0.12	1.68	1.80	0.30	**-1.50**	Near existing tank
2010	1630	Gateway (old Hydro)	2.36	0.12	2.36	2.48	0	**-2.50**	Future Z1630 Tank
2010	1630	Highland	0.62	0.12	0.62	0.74	0	**-1.00**	Near existing tank

9.2.6.3 Booster Station Improvements

As shown in Table 9-26, one booster station is required for the 1630 Zone during 2010. This booster station must provide at least 120 ft of head and a flow of 1.5 mgd. Figure 9-2 shows the probable location of this future booster station. The future High Northridge booster station will pull water from the High Northridge tank and deliver it to the Future Vista tank (1630 Zone).

Table 9-26

Booster Station Improvements – Future 1630 Zone

Zone	Year	Name	Flow (mgd)	Head (ft)	Calculated Hp	Design Hp
1630	2010	New High Northridge	1.5	120	38	50

9.2.6.4 Distribution System Improvements

As shown in Table 9-27, the future distribution improvements for the 1630 Zone all occur during 2010. The locations of these pipeline improvement projects as shown in Figure 9-2.

Table 9-27

Distribution Improvements – Future 1630 Zone

Zone	Year	Description	Size (in)	Length (ft)
1630	2010	Z1530 tank to Z1630 tank; Sierra Blvd and Pierson Blvd to north of intersection at Diablo Rd and Pierson Blvd.	12	6,900
1630	2010	Connection from exist HNR tank to new HNR booster station and the existing system	12	700

9.2.7 1800 Zone

Table 9-28 shows the system improvements required for the 1800 Zone. The majority of these improvements are expected to occur during 2010 and 2015. The 1800 Zone is primarily a new pressure zone that will be created as growth increases beyond the extents of the existing system. As shown in Table 9-27, the future 1800 Zone does not contain a large service zone. Consequently, the demand in the zone will likely be lower than the other zones. The three wells shown in the 1800 Zone also provide supply capacity to the 1975 Zone and the 2155 Zone.

Table 9-28

Future System Improvements for the 1800 Zone

System Components	2010	2015	2020	2025
Supply – Wells	none	(1) 1,500 gpm	(1) 1,500 gpm	(1) 1,500 gpm
Storage – Tanks	none	(1) 1.0 mg	none	none
Boosters – Pumps	none	(1) 7.5 mgd	none	none
Distribution – Major Pipelines	none	8,300 lf, 8-in 19,200 lf, 20-in	none	none

9.2.7.1 Supply Improvements

As shown in Table 9-29, one additional well during 2025 is required to meet the future demands of the 1800 Zone. The probable location of this future well is shown in Figure 9-2 (see Table 5-6, Section 5 for calculations). These three wells also provide supply capacity to the 1975 Zone and the 2155 Zone.

Table 9-29

Future Supply Improvements for the 1800 Zone

(Wells) Year	Zone	Wells Required	Reason for Need
(1) 2015, (1) 2020, (1) 2025	1800	3	Capacity

9.2.7.2 Storage Improvements

There are two storage facilities that are required to meet the future demands in the 1800 Zone. These are described below in Table 9-30. Figure 9-2 shows the location of these two future storage improvement projects.

Table 9-30

Storage Improvements – Future 1800 Zone

Year	Zone	Service Zones	2025 MDD (mgd)	Fire Storage (mg)	Operational + Emergency Storage (mg)	Required Volume (mg)	2005 Available Storage (mg)	Needed Volume (mg)	Conceptual Location
2015	1800	future development	0.83	0.12	0.83	0.95	0	**1.00**	NE corner of 3487 development

9.2.7.3 Booster Station Improvements

According the hydraulic model of the water distribution system, new booster stations are not required for the 1800 Zone to meet demands between the years 2010 and 2025.

9.2.7.4 Distribution System Improvements

Two major pipeline projects are required to meet the needs of the 1800 Zone. These improvements are outlined below in Table 9-31. The alignment of these pipeline improvement projects is shown in Figure 9-2. The 11,535 LF of 16-inch pipeline is designed to connect the future 1800 Zone storage tank with the future 1630 Zone tank.

Table 9-31

Distribution Improvements – Future 1800 Zone

Zone	Year	Description	Size (in)	Length (ft)
1800	2015	From Z1800 tank to Z1630 tank	8	8,300
1800	2015	Connection from Z1800 wells and Z1800 tank	20	19,200

9.2.8 1975 Zone

Table 9-32 shows the system improvements required for the 1975 Zone, which primarily occur during 2020. The majority of these improvements are expected to occur as part of the 2020 CIP. The supply capacity for this zone is provided by well shown in the future 1800 Zone.

Table 9-32

Future System Improvements for the 1975 Zone

System Components	2010	2015	2020	2025
Supply – Wells	none	none	none	none
Storage – Tanks	none	none	(1) 2.0 mg	none
Boosters – Pumps	none	none	(1) 3.5 mgd	none
Distribution – Major Pipelines	none	none	8,200 lf, 12-in	none

9.2.8.1 Supply Improvements

The supply capacity for the future 1975 Zone will be provided by the wells associated with the future 1800 Zone. Booster stations will deliver water to the 1975 Zone. The conceptual locations of the future wells ares shown in Figure 9-2 (see Table 5-6, Section 5 for calculations).

9.2.8.2 Storage Improvements

As shown in Table 9-33, the 1975 Zone only requires one new storage facility (2.0 mg) during 2020. The location of this storage facility is shown in Figure 9-2.

Table 9-33

Storage Improvements – Future 1975 Zone

Year	Zone	Service Zones	2025 MDD (mgd)	Fire Storage (mg)	Operational + Emergency Storage (mg)	Required Volume (mg)	2005 Available Storage (mg)	Needed Volume (mg)	Conceptual Location
2020	1975	future development	1.66	0.12	1.66	1.78	0	**-1.78**	NW corner of 3487 development

9.2.8.3 Booster Station Improvements

The 1975 Zone requires a single booster station during 2020. This booster station is described below in Table 9-34. Figure 9-2 shows the location of this future booster station.

Table 9-34

Booster Station Improvements – Future 1975 Zone

Zone	Year	Name	Flow (mgd)	Head (ft)	Calculated Hp	Design Hp
1975	2020	Future Development	3.5	200	152	175

9.2.8.4 Distribution System Improvements

As shown in Table 9-35, there is one major pipeline required for the 1975 Zone during 2020. The alignment of this future pipeline improvement project is shown in Figure 9-2.

Table 9-35

Distribution Improvements – Future 1975 Zone

Zone	Year	Description	Size (in)	Length (ft)
1975	2020	From Z1800 tank to Z1975 tank	12	8,200

9.2.9 2155 Zone

Table 9-36 shows the system improvements required for the 1975 Zone, which exclusively occur during 2025. The future improvements for the 1975 Zone are expected to occur as part of the 2025 CIP.

Table 9-36

Future System Improvements for the 2155 Zone

System Components	2010	2015	2020	2025
Supply – Wells	none	none	none	none
Storage – Tanks	none	none	none	none
Boosters – Pumps	none	none	none	(1) 3.5 mgd
Distribution – Major Pipelines	none	none	none	200 lf, 16-in

9.2.9.1 Supply Improvements

The supply capacity for the future 2155 Zone will be provided by the wells associated with the future 1800 Zone. Booster stations will deliver water to the 2155 Zone. The conceptual location of the future wells are shown in Figure 9-2 (see Table 5-6, Section 5 for calculations).

9.2.9.2 Storage Improvements

As shown in Table 9-37, the 2155 Zone is conceptually designed to be supplies from booster stations. However, a volume of 1.2 mg is required in 2025 to meet operational, emergency, and fire flow storage standards. Figure 9-2 shows the expected location of the future storage facilities in the 2155 Zone.

Table 9-37

Storage Improvements – Future 2155 Zone

Year	Zone	Service Zones	2025 MDD (mgd)	Fire Storage (mg)	Operational + Emergency Storage (mg)	Required Volume (mg)	2005 Available Storage (mg)	Needed Volume (mg)	Conceptual Location
n/a	2155	future development	1.66	0.12	1.66	1.78	0.00	**1.78**	n/a served by booster station

9.2.9.3 Booster Station Improvements

One booster station is required to meet the future demands of the 2155 Zone. As shown in Table 9-38, this booster station must pump at least 3.5 mgd at a head of 200 ft. Figure 9-2 shows the location of the future booster station for the 2155 Zone.

Table 9-38

Booster Station Improvements – Future 2155 Zone

Zone	Year	Name	Flow (mgd)	Head (ft)	Calculated Hp	Design Hp
2155	2025	Future Development	3.5	200	152	175

9.2.9.4 Distribution System Improvements

As shown in Table 9-39, there is one major pipeline required for the 2155 Zone during 2025. The alignment of this future pipeline improvement project is shown in Figure 9-2.

Table 9-39

Distribution Improvements – Future 2155 Zone

Zone	Year	Description	Size (in)	Length (ft)
2155	2025	From Z1975 tank to Z2155 booster station	16	200

9.2.10 Cottonwood Zone

Table 9-40 shows the system improvements required for the Cottonwood Zone. The future improvements for the Cottonwood Zone are expected to occur prior to 2010.

Table 9-40

Future System Improvements for the Cottonwood Zone

System Components	2010	2015	2020	2025
Supply – Wells	(1) 1,500 gpm	none	none	none
Storage – Tanks	(1) 1.0 mg	none	none	none
Boosters – Pumps	(1) 2.2 mgd	none	none	none
Distribution – Major Pipelines	none	none	3,500 lf, 20-in	none

9.2.10.1 Supply Improvements

As shown in Table 9-41, the future demands of the Cottonwood Zone require one additional well with an approximate capacity of 1,500 gpm. The conceptual location of this future well is shown in Figure 9-2 (see Table 5-6, Section 5 for calculations).

Table 9-41

Supply Improvements—Future Cottonwood Zone

(Wells) Year	Zone	Wells Required	Reason for Need
(1) 2010	2155	1	Capacity

9.2.10.2 Storage Improvements

As shown in Table 9-42, the Cottonwood Zone is conceptually designed to be supplies from booster stations. However, a volume of 1.0 mg is required during 2010 to meet operational, emergency, and fire flow storage standards. Figure 9-2 shows the expected location of the future storage facilities in the Cottonwood Zone. Although the existing Cottonwood storage facility has a capacity of 0.28 mg, it is scheduled to be replaced, and is not include in the available storage volume in Table 9-43.

Table 9-42

Storage Improvements – Future Cottonwood Zone

Year	Zone	Service Zones	2025 MDD (mgd)	Fire Storage (mg)	Operational + Emergency Storage (mg)	Required Volume (mg)	2005 Available Storage (mg)	Needed Volume (mg)	Conceptual Location
2010	1630-C	future development	0.48	0.12	0.48	0.60	0	**0.60**	Adjacent to existing tank.

9.2.10.3 Booster Station Improvements

As shown in Table 9-43, an emergency booster pump station is required by MSWD to permit deliver water from the Cottonwood Zone to the Woodridge Zone during an emergency. This booster station may need to deliver approximately 1,500 gpm.

Table 9-43

Booster Station Improvements – Future Cottonwood Zone

Zone	Year	Name	Flow (mgd)	Head (ft)	Design Hp
1600-C	2010	Emergency Booster	2.2	250	200

9.2.10.4 Distribution System Improvements

As shown in Table 9-44, a future 20-in diameter pipeline (approximately 3,500 lf) is required to connect the Cottonwood Zone with the Woodridge Zone to provide a means to moving water between the two zone during an emergency. These two zones will be separated by normally closed valves.

Table 9-44

Distribution Improvements – Future Cottonwood Zone

Zone	Year	Name	Location	From	To	Size (in)	Length (ft)
1630-C	2020	Interconnection	Between zones	Cottonwood Zone	Woodridge Zone	20	3,500

9.2.11 Woodridge Zone

Table 9-45 shows the system improvements required for the Cottonwood Zone, which exclusively occur during 2025. The future improvements for the Cottonwood Zone are expected to prior to 2010.

Table 9-45

Future System Improvements for the Woodridge Zone

System Components	2010	2015	2020	2025
Supply – Wells	none	none	none	none
Storage – Tanks	0.5 mg	none	none	none
Boosters – Pumps	none	none	none	none
Distribution – Major Pipelines	none	none	none	none

9.2.11.1 Supply Improvements

No major supply improvements are anticipated for the Woodridge Zone between 2005 and 2025.

9.2.11.2 Storage Improvements

As shown in Table 9-46, the Woodridge Zone is conceptually designed to be supplied by booster stations. However, a volume of 0.50 mg is required during 2010 to meet operational, emergency, and fire flow storage standards. Figure 9-2 shows the expected location of the future storage facilities in the Woodridge Zone.

Table 9-46

Storage Improvements – Future Woodridge Zone

Year	Zone	Service Zones	2025 MDD (mgd)	Fire Storage (mg)	Operational + Emergency Storage (mg)	Required Volume (mg)	2005 Available Storage (mg)	Needed Volume (mg)	Conceptual Location
2010	1840-C	future development	0.25	0.12	0.25	0.37	0.12	**0.25**	TBD

9.2.11.3 Booster Station Improvements

No major booster improvements are anticipated for the Woodridge Zone between 2005 and 2025.

9.2.11.4 Distribution System Improvements

No major distribution improvements are anticipated for the Woodridge Zone between 2005 and 2025

10.1 INTRODUCTION

The financial data in this section is based upon **conceptual planning** (Class 5) and constitutes a conceptual-level engineer's estimate of probable costs and should not be used for construction purposes. Specifically, the estimated capital costs are based on 2005 dollars. These cost estimates are based on traditional practices of the construction industry. As such, URS does not control the cost of labor, materials, equipment or a contractor's method of determined prices and competitive bidding practices or market conditions. Furthermore, the estimates contained herein represent the professional judgment of URS design professionals, using current information available at the time of preparation.

The cost estimates developed in this report utilize the American Association of Cost Engineers International (AAECI) definition for cost estimate classes:

- **Class 5:** Conceptual Planning
- **Class 4:** Detailed Study or Planning
- **Class 3:** Analysis of Preliminary Design
- **Class 2:** Control or 50-70% Design
- **Class 1:** Final Definition or 100% Design

Each of these estimate classes carries its own level of contingency based upon the level of risk associated with the corresponding level of project definition. A general definition of contingency is provided in the AACEI Standard 10S-90:

> "**Contingency** is an amount added to an estimate to allow for unknown items, conditions, or events that experience shows will likely occur. Typically, estimated using statistical analysis or judgment based on past project experience. Contingency usually excludes: (1) major scope changes such as changes in end product specifications, capacities, and location of the project; (2) extraordinary events such as major strikes and earthquakes; (3) escalation and currency effects."

The following is the range of accuracy, which should be provided by each of the five cost estimate classes as recommended by AACEI:

- **Class 5** cost estimates (conceptual) should be between 200% and 50% (+100% to –50%) of the anticipated bid price.
- **Class 4** cost estimates (planning level) should be between 150% and 70% (+50% to - –30%) of the anticipated bid price.
- **Class 3** cost estimates (preliminary design) should be between 130% and 85% (+30% to –15%) of the anticipated bid price.
- **Class 2** cost estimates (50% to 70% design completion) should be between 120% and 90% (+20% to –10%) of the anticipated bid price.
- **Class 1** cost estimates (90% design completion and later-submittals) should be between 115% and 95% (+15% to –5%) of the anticipated bid price.

In developing engineering estimates of probable cost there may be items, which cannot be accurately quantified because of lack of detail. The following are recommended minimums allowances that should be used in the preparation of cost estimates:

- Conceptual (Class 1) level estimates—40% allowance
- Planning (Class 2) level estimates—30% allowance
- Preliminary (Class 3) level design estimates—20% allowance
- 50% design (Class 4) level estimates—15% allowance
- Final plans and specifications (Class 5) level estimates—10% allowance

10.2 20 YEAR CAPITAL IMPROVEMENT PROGRAM

Cost estimate were developed for four categories of system components: supply, storage, boosters, and distribution. Supply refers to groundwater production wells; storage refers to reinforced concrete storage tanks; boosters refer to booster pump stations; and distribution refers to pipelines and related appurtenances such as valves.

10.2.1 Production Well Cost

Based upon averages from MSWD well production data, each new well is assumed to produce 1,500 gpm. From recent MSWD projects, the cost to equip each well is estimate to be approximately $550,000.

10.2.2 Booster Station Cost

MSWD booster pump station data indicates the recent construction of a 1.54 mgd booster station cost approximately $418,000, which is roughly $272,000 per mgd capacity of the booster station. This cost does not include upsizing of system mains for treatment needs. Cost estimates assume pad-mounted booster pumps and include associated electrical improvements

10.2.3 Pipeline and Appurtenance Cost

Table 10-1 shows the unit cost data used to develop estimates for future pipeline improvements. The cost data were obtained from MSWD and include complete installation of the pipeline according to MSWD standards (i.e. pipe, appurtenances, backfill, excavation, compaction, cathodic protection).

Table 10-1

Pipeline Cost Estimate Data

Pipeline Diameter	Unit Cost per LF
6-in	$80
8-in	$100
12-in	$120
16-in	$160
20-in	$200
24-in	$240
30-in	$300
36-in	$360

Source: MSWD

10.2.4 Storage Tank Cost

Table 10-2 shows the unit cost estimate data for post-tensioned wire wrap concrete storage tanks. These data were obtained from DYK. As the tank storage volume increases, the cost per million gallons of volume decreases. In developing cost estimates the required storage volume was generally round up to take advantage of the decreasing cost per volume.

Table 10-2

Storage Tank Cost Estimate Data

Tank Capacity (mg)	Cost per gallon	Estimated Cost
1.0	$0.96	$960,000
1.5	$0.79	$1,180,000
2.0	$0.68	$1,360,000
3.0	$0.56	$1,680,000
4.0	$0.50	$2,000,000
5.0	$0.47	$2,350,000
7.0	$0.45	$3,150,000

Note: estimate includes tank structure & standard appurtenances; Source: DYK, 2005

10.2.5 Seismic Retrofits

To improve the system reliability to withstand minor seismic tremors, retrofits of major tanks and pipeline should be considered annually for the CIP. A approximately $250,000 every five years for each zone should be budgeted for each zone to complete minor seismic retrofits on existing facilities to improve the reliability of the MSWD water system. Over the 20-year period between 2005 and 2025, this would result in approximately $1.0 million in system improvements for each zone. This is merely a rough estimate to approximate the minimum funding that should be considered for seismic retrofits. Further study and analysis is required to develop a more accurate estimate for budgeting purposes. For example, replacement of existing tanks may be more economical that attempting to perform seismic retrofits these storage facilities.

10.2.6 Prioritization of Improvements

Future improvements are categorized according to supply, storage, distribution, booster station, and seismic components. Well production facilities are given the highest priority, which are followed by storage facilities, distribution, booster station improvements, and seismic retrofits—in order of decreasing level of priority.

10.2.7 913 Zone

Table 10-3 shows the cost estimate for the anticipated future improvements (Section 9) required to serve the 913 Zone. The main improvement project for this zone is a 16-inch pipeline, approximately 1,220 ft long. This pipeline is required to connect the additional future booster pumps to the existing system. This project will also require a full replacement of the existing booster station manifold pipeline to increase booster station pump capacity.

Table 10-3

913 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #1: Future Pipeline from Garnet Booster Station to Z913 Tank to Z1070							
913	2015	Distribution	12-in pipeline	1,300	LF	$ 120	$ 156,000
						Subtotal A	$ 156,000
						General Contingency (40%)	$ 62,400
						Subtotal B	$ 218,400
						Engineering, Legal, Administrative (20%)	$ 43,680
						Project #1 Total	$ 262,080
			Grand Total (913 Zone)				$ 262,080

10.2.8 1070 Zone

Table 10-4 presents the cost estimates for the future improvements (Section 9) required to meet the project demands of the 1070 Zone. These improvement projects include storage, distribution, and booster station components. Prior to 2010, this zone requires 1.5 mg of additional storage and 3,135 LF of 16-in pipeline. Prior to 2015 a 1.2 mgd booster station, a 0.4 mgd booster station, and approximately 400 LF of a 6-in pipeline is required to meet projected demands in the 1070 Zone.

According to the demand projection for the 1070 Zone, no supply improvements are required between 2005 and 2025. The estimated cost for the improvements shown in Table 10-4 is $4,032,798.

Table 10-4

1070 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost

Table 10-4

1070 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #2: Future Tank between Well 27 and Valley View Tank							
1070	2010	Storage	2.5 mg storage tank	1	LS	$1,600,000	$1,600,000
1070	2010	Storage	Site Improvements (10% tank cost)	1	LS	$160,000	$160,000
1070	2010	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$160,000	$160,000
						Subtotal A	$1,920,000
						General Contingency (40%)	$768,000
						Subtotal B	$2,688,000
						Engineering, Legal, Administrative (20%)	$537,600
						Project #2 Total	$3,225,600
Project #3: Future pipeline from new Z1070 tank to existing line at Dillon Rd & Karen Ave							
1070	2010	Distribution	16-in pipeline, north of Dillon Rd.	3,200	LF	$160	$512,000
						Subtotal A	$512,000
						General Contingency (40%)	$204,800
						Subtotal B	$716,800
						Engineering, Legal, Administrative (20%)	$143,360
						Project #3 Total	$860,160
Project #4: Future Garnet Booster Station							
1070	2015	Booster	1.3 mgd capacity	1	LS	$353,600	$353,600
						Subtotal A	$353,600
						General Contingency (40%)	$141,440
						Subtotal B	$495,040
						Engineering, Legal, Administrative (20%)	$99,008
						Project #4 Total	$594,048
			Grand Total (1070 Zone)				$4,679,808

10.2.9 1240 Zone

Based upon water distribution system modeling results, it is anticipated that a 20-in pipeline is the will be required to serve the 1240 Zone in 2010 (see Table 10-5). Major supply, storage, or booster improvements are not required to meet the projected future demands for the 1240 Zone between 2005 and 2025. However, minor improvements will be required to meet the demands of future developments. Some significant improvements may be required as the actual system growth occurs and deviates from the assumptions made within the scope of this study.

Table 10-5

1240 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #5: Future Pipeline from Hacienda Ave to Quail Road Tank							
1240	2010	Distribution	16-in pipeline	12,900	LF	$ 160	$ 2,064,000
						Subtotal A	$ 2,064,000
						General Contingency (40%)	$ 825,600
						Subtotal B	$ 2,889,600
						Engineering, Legal, Administrative (20%)	$ 577,920
						Project #5 Total	$ 3,467,520
Project #6: Future Tank adjacent to existing Two Bunch Tank							
1240	2010	Storage	1.5 mg storage tank	1	LS	$ 1,180,000	$ 1,180,000
1240	2010	Storage	Site Improvements (10% tank cost)	1	LS	$ 118,000	$ 118,000
1240	2010	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 118,000	$ 118,000
						Subtotal A	$ 1,416,000
						General Contingency (40%)	$ 566,400
						Subtotal B	$ 1,982,400
						Engineering, Legal, Administrative (20%)	$ 396,480
						Project #6 Total	$ 2,378,880
			Grand Total (1240 Zone)				$5,846,400

10.2.10 1400 Zone

Table 10-6 shows the future improvements (Section 9) required to meet demands in the 1400 Zone through the year 2025. Before 2010 the 1400 Zone requires various supply, storage, booster, and distribution improvements. The estimated cost of the improvements shown in Table 10-6 is $25,284,000.

Table 10-6

1400 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #7: Future Z1400 Wells							
1400	2010	Supply	2,000 gpm wells	2	EA	$ 500,000	$ 1,000,000
						Subtotal A	$ 1,000,000
						General Contingency (40%)	$ 400,000
						Subtotal B	$ 1,400,000
						Engineering, Legal, Administrative (20%)	$ 280,000
						Project #7 Total	$ 1,680,000

Table 10-6

1400 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #8: Future Overhill Tank							
1400	2010	Storage	1.0 mg Tank	1	LS	$ 960,000	$ 960,000
1400	2010	Storage	Site Improvements (10% tank cost)	1	LS	$ 96,000	$ 96,000
1400	2010	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 96,000	$ 96,000
						Subtotal A	$ 1,152,000
						General Contingency (40%)	$ 460,800
						Subtotal B	$ 1,612,800
						Engineering, Legal, Administrative (20%)	$ 322,560
						Project #8 Total	$ 1,935,360
Project #9: Future Z1400 Tank-1							
1400	2010	Storage	5.0 mg tank	1	LS	$ 2,350,000	$ 2,350,000
1400	2010	Storage	Site Improvements (10% tank cost)	1	LS	$ 235,000	$ 235,000
1400	2010	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 235,000	$ 235,000
						Subtotal A	$ 2,820,000
						General Contingency (40%)	$ 1,128,000
						Subtotal B	$ 3,948,000
						Engineering, Legal, Administrative (20%)	$ 789,600
						Project #9 Total	$ 4,737,600
Project #10: Future Z1400 Tank-2							
1400	2015	Storage	5.0 mg tank	1	LS	$ 2,350,000	$ 2,350,000
1400	2015	Storage	Site Improvements (10% tank cost)	1	LS	$ 235,000	$ 235,000
1400	2015	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 235,000	$ 235,000
						Subtotal A	$ 2,820,000
						General Contingency (40%)	$ 1,128,000
						Subtotal B	$ 3,948,000
						Engineering, Legal, Administrative (20%)	$ 789,600
						Project #10 Total	$ 4,737,600
Project #11: Future Z1400 Tank-3							
1400	2025	Storage	5.0 mg tank	1	LS	$ 2,350,000	$ 2,350,000
1400	2025	Storage	Site Improvements (10% tank cost)	1	LS	$ 235,000	$ 235,000
1400	2025	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 235,000	$ 235,000
						Subtotal A	$ 2,820,000
						General Contingency (40%)	$ 1,128,000
						Subtotal B	$ 3,948,000
						Engineering, Legal, Administrative (20%)	$ 789,600
						Project #11 Total	$ 4,737,600
Project #12: Future High Desert View Booster Station							
1400	2010	Booster	0.7 mgd capacity	1	LS	$ 190,400	$ 190,400

Table 10-6

1400 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
						Subtotal A	$ 190,400
						General Contingency (40%)	$ 76,160
						Subtotal B	$ 266,560
						Engineering, Legal, Administrative (20%)	$ 53,312
						Project #12 Total	$ 319,872
Project #13: Future 1400 Zone Wells							
1400	2015	Supply	2,000 gpm wells	3	EA	$ 550,000	$ 1,650,000
						Subtotal A	$ 1,650,000
						General Contingency (40%)	$ 660,000
						Subtotal B	$ 2,310,000
						Engineering, Legal, Administrative (20%)	$ 462,000
						Project #13 Total	$ 2,772,000
Project #14: Future 1400 Zone Well							
1400	2020	Supply	1,500 gpm wells	2	EA	$ 550,000	$ 1,100,000
						Subtotal A	$ 1,100,000
						General Contingency (40%)	$ 440,000
						Subtotal B	$ 1,540,000
						Engineering, Legal, Administrative (20%)	$ 308,000
						Project #14 Total	$ 1,848,000
Project #15: Future 1400 Zone Well							
1400	2025	Supply	1,500 gpm wells	1	EA	$ 550,000	$ 550,000
						Subtotal A	$ 550,000
						General Contingency (40%)	$ 220,000
						Subtotal B	$ 770,000
						Engineering, Legal, Administrative (20%)	$ 154,000
						Project #15 Total	$ 924,000
Project #16: Future pipeline between HDV tanks and new booster station to exist system							
1400	2010	Distribution	8-in pipeline	2,100	LF	$ 100	$ 210,000
						Subtotal A	$ 210,000
						General Contingency (40%)	$ 84,000
						Subtotal B	$ 294,000
						Engineering, Legal, Administrative (20%)	$ 58,800
						Project #16 Total	$ 352,800
Project #17: Future pipeline between new Z1400 wells and existing system							
1400	2025	Distribution	8-in pipeline	7,400	LF	$ 100	$ 740,000
						Subtotal A	$ 740,000
						General Contingency (40%)	$ 296,000
						Subtotal B	$ 1,036,000

Table 10-6

1400 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
						Engineering, Legal, Administrative (20%)	$ 207,200
						Project #17 Total	$ 1,243,200
Project #18: Future pipeline between new Z1400 wells and existing system							
1400	2015	Distribution	12-in pipeline	2,600	LF	$ 120	$ 312,000
1400	2015	Distribution	16-in pipeline	2,800	LF	$ 160	$ 448,000
1400	2015	Distribution	20-in pipeline	2,700	LF	$ 200	$ 540,000
						Subtotal A	$ 1,300,000
						General Contingency (40%)	$ 520,000
						Subtotal B	$ 1,820,000
						Engineering, Legal, Administrative (20%)	$ 364,000
						Project #18 Total	$ 2,184,000
Project #19: Future pipeline from 8th St & Little Morongo Rd to Terrace tanks & booster station							
1400	2010	Distribution	24-in pipeline	10,100	LF	$ 240	$ 2,424,000
						Subtotal A	$ 2,424,000
						General Contingency (40%)	$ 969,600
						Subtotal B	$ 3,393,600
						Engineering, Legal, Administrative (20%)	$ 678,720
						Project #19 Total	$ 4,072,320
Project #20: Future pipeline from Terrace tanks & booster station and new Z1400 tank							
1400	2010	Distribution	24-in pipeline	6,800	LF	$ 240	$ 1,632,000
						Subtotal A	$ 1,632,000
						General Contingency (40%)	$ 652,800
						Subtotal B	$ 2,284,800
						Engineering, Legal, Administrative (20%)	$ 456,960
						Project #20 Total	$ 2,741,760
Project #21: Future pipeline from Pierson Blvd connection to new Z1400 tank							
1400	2010	Distribution	24-in pipeline	4,400	LF	$ 240	$ 1,056,000
						Subtotal A	$ 1,056,000
						General Contingency (40%)	$ 422,400
						Subtotal B	$ 1,478,400
						Engineering, Legal, Administrative (20%)	$ 295,680
						Project #21 Total	$ 1,774,080
Project #22: Future pipeline between new Z1400 wells and existing system							
1400	2010	Distribution	24-in pipeline	8,000	LF	$ 240	$ 1,920,000
						Subtotal A	$ 1,920,000
						General Contingency (40%)	$ 768,000
						Subtotal B	$ 2,688,000
						Engineering, Legal, Administrative (20%)	$ 537,600

Table 10-6

1400 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
						Project #22 Total	$ 3,225,600
			Grand Total (1400 Zone)				$ 39,285,792

10.2.11 1530 Zone

Table 10-7 shows the future improvements (Section 9) required to meet demands in the 1530 Zone through the year 2025. Before 2010 the 1530 Zone requires various supply, storage, booster, and distribution improvements. The estimated cost of the improvements shown in Table 10-7 is $27,894,000.

Table 10-7

1530 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #23: Future 1530 Zone Well							
1530	2010	Supply	2,000 gpm wells	2	EA	$ 550,000	$ 1,100,000
						Subtotal A	$ 1,100,000
						General Contingency (40%)	$ 440,000
						Subtotal B	$ 1,540,000
						Engineering, Legal, Administrative (20%)	$ 308,000
						Project #23 Total	$ 1,848,000
Project #24: Future Redbud Tank							
1530	2010	Storage	1.0 mg storage tank	1	LS	$ 960,000	$ 960,000
1530	2010	Storage	Site Improvements (10% tank cost)	1	LS	$ 96,000	$ 96,000
1530	2010	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 96,000	$ 96,000
						Subtotal A	$ 1,152,000
						General Contingency (40%)	$ 460,800
						Subtotal B	$ 1,612,800
						Engineering, Legal, Administrative (20%)	$ 322,560
						Project #24 Total	$ 1,935,360
Project #25: Future 1530 Zone Well							
1530	2015	Supply	1,500 gpm wells	1	EA	$ 550,000	$ 550,000
						Subtotal A	$ 550,000
						General Contingency (40%)	$ 220,000
						Subtotal B	$ 770,000
						Engineering, Legal, Administrative (20%)	$ 154,000
						Project #25 Total	$ 924,000

Table 10-7

1530 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #26: Future Tank Near 2140 development							
1530	2015	Storage	4.0 mg storage tank	1	LS	$ 2,000,000	$ 2,000,000
1530	2015	Storage	Site Improvements (10% tank cost)	1	LS	$ 200,000	$ 200,000
1530	2015	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 200,000	$ 200,000
						Subtotal A	$ 2,400,000
						General Contingency (40%)	$ 960,000
						Subtotal B	$ 3,360,000
						Engineering, Legal, Administrative (20%)	$ 672,000
						Project #26 Total	$ 4,032,000
Project #27: Future pipeline to future development and bypass exist PRV (Yucca Drive and Verbena Drive)							
1530	2010	Distribution	12-in pipeline	2,100	LF	$ 120	$ 252,000
						Subtotal A	$ 252,000
						General Contingency (40%)	$ 100,800
						Subtotal B	$ 352,800
						Engineering, Legal, Administrative (20%)	$ 70,560
						Project #27 Total	$ 423,360
Project #28: Future pipeline from Mission Lake Blvd & Indian Ave to exist HNR tank							
1530	2010	Distribution	12-in pipeline	15,600	LF	$ 120	$ 1,872,000
1530	2010	Distribution	24-in pipeline	1,500	LF	$ 240	$ 360,000
						Subtotal A	$ 2,232,000
						General Contingency (40%)	$ 892,800
						Subtotal B	$ 3,124,800
						Engineering, Legal, Administrative (20%)	$ 624,960
						Project #28 Total	$ 3,749,760
Project #29: Pipeline replacement to increase capacity from Mesquite Ave & 5th St to exist Terrace tanks							
1530	2010	Distribution	12-in pipeline	1,000	LF	$ 120	$ 120,000
						Subtotal A	$ 120,000
						General Contingency (40%)	$ 48,000
						Subtotal B	$ 168,000
						Engineering, Legal, Administrative (20%)	$ 33,600
						Project #29 Total	$ 201,600
Project #30: Future pipeline between new Z1530 wells and existing system							
1530	2010	Distribution	12-in pipeline	2,900	LF	$ 120	$ 348,000
1530	2010	Distribution	16-in pipeline	2,400	LF	$ 160	$ 384,000
						Subtotal A	$ 732,000
						General Contingency (40%)	$ 292,800
						Subtotal B	$ 1,024,800
						Engineering, Legal, Administrative (20%)	$ 204,960
						Project #30 Total	$ 1,229,760

Table 10-7

1530 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #31: Future pipeline to future Z1530 well							
1530	2010	Distribution	16-in pipeline	10,000	LF	$ 160	$ 1,600,000
						Subtotal A	$ 1,600,000
						General Contingency (40%)	$ 640,000
						Subtotal B	$ 2,240,000
						Engineering, Legal, Administrative (20%)	$ 448,000
						Project #31 Total	$ 2,688,000
Project #32: Future pipeline to future Z1530 well							
1530	2010	Distribution	16-in pipeline	2,600	LF	$ 160	$ 416,000
						Subtotal A	$ 416,000
						General Contingency (40%)	$ 166,400
						Subtotal B	$ 582,400
						Engineering, Legal, Administrative (20%)	$ 116,480
						Project #32 Total	$ 698,880
Project #33: Future pipeline to future Z1530 well							
1530	2010	Distribution	16-in pipeline	2,800	LF	$ 160	$ 448,000
						Subtotal A	$ 448,000
						General Contingency (40%)	$ 179,200
						Subtotal B	$ 627,200
						Engineering, Legal, Administrative (20%)	$ 125,440
						Project #33 Total	$ 752,640
Project #34: Future pipeline from Mission Lake Blvd & Clubhouse Blvd to exist Mission Lakes tank							
1530	2010	Distribution	16-in pipeline	6,600	LF	$ 160	$ 1,056,000
						Subtotal A	$ 1,056,000
						General Contingency (40%)	$ 422,400
						Subtotal B	$ 1,478,400
						Engineering, Legal, Administrative (20%)	$ 295,680
						Project #34 Total	$ 1,774,080
Project #35: Future pipeline between new Z1530 wells and existing system							
1530	2010	Distribution	20-in pipeline	2,800	LF	$ 200	$ 560,000
						Subtotal A	$ 560,000
						General Contingency (40%)	$ 224,000
						Subtotal B	$ 784,000
						Engineering, Legal, Administrative (20%)	$ 156,800
						Project #35 Total	$ 940,800
Project #36: Future pipeline from Z1530 tank to existing Gateway tank							
1530	2010	Distribution	24-in pipeline	18,200	LF	$ 240	$ 4,368,000

Table 10-7

1530 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
						Subtotal A	$ 4,368,000
						General Contingency (40%)	$ 1,747,200
						Subtotal B	$ 6,115,200
						Engineering, Legal, Administrative (20%)	$ 1,223,040
						Project #36 Total	$ 7,338,240
			Grand Total (1530 Zone)				$ 28,536,480

10.2.12 1630 Zone

Table 10-8 shows the future improvements (Section 9) required to meet demands in the 1630 Zone through the year 2025. Before 2010 the 1630 Zone requires various supply, storage, booster, and distribution improvements. The estimated cost of the improvements shown in Table 10-8 is $13,982,640.

Table 10-8

1630 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #37: Future Z1630 Tank Next to Existing Highland Tank							
1630	2010	Storage	1.0 mg Tank (1.0 mg red'd)	1	LS	$ 960,000	$ 960,000
1630	2010	Storage	Site Improvements (10% tank cost)	1	LS	$ 96,000	$ 96,000
1630	2010	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 96,000	$ 96,000
						Subtotal A	$ 1,152,000
						General Contingency (40%)	$ 460,800
						Subtotal B	$ 1,612,800
						Engineering, Legal, Administrative (20%)	$ 322,560
						Project #37 Total	$ 1,935,360
Project #38: Future 1630 Zone Wells							
1630	2010	Supply	1,500 gpm wells	1	EA	$ 550,000	$ 550,000
						Subtotal A	$ 550,000
						General Contingency (40%)	$ 220,000
						Subtotal B	$ 770,000
						Engineering, Legal, Administrative (20%)	$ 154,000
						Project #38 Total	$ 924,000
Project #39: Future Z1630 Tank next to Existing Vista Tank							

Table 10-8

1630 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
1630	2010	Storage	1.5 mg Tank (1.1 mg red'd)	1	LS	$ 1,180,000	$ 1,180,000
1630	2010	Storage	Site Improvements (10% tank cost)	1	LS	$ 118,000	$ 118,000
1630	2010	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 118,000	$ 118,000
						Subtotal A	$ 1,416,000
						General Contingency (40%)	$ 566,400
						Subtotal B	$ 1,982,400
						Engineering, Legal, Administrative (20%)	$ 396,480
						Project #39 Total	$ 2,378,880
Project #40: Future Z1630 Tank (new development site)							
1630	2010	Storage	2.5 mg storage tank	1	LS	$ 1,600,000	$ 1,600,000
1630	2010	Storage	Site Improvements (10% tank cost)	1	LS	$ 160,000	$ 160,000
1630	2010	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 160,000	$ 160,000
						Subtotal A	$ 1,920,000
						General Contingency (40%)	$ 768,000
						Subtotal B	$ 2,688,000
						Engineering, Legal, Administrative (20%)	$ 537,600
						Project #40 Total	$ 3,225,600
Project #41: Future High Northridge Booster Station							
1630	2010	Boosters	1.5 mgd capacity	1	LS	$ 408,000	$ 408,000
						Subtotal A	$ 408,000
						General Contingency (40%)	$ 163,200
						Subtotal B	$ 571,200
						Engineering, Legal, Administrative (20%)	$ 114,240
						Project #41 Total	$ 685,440
Project #42: Future 1630 Zone Wells							
1630	2015	Supply	1,500 gpm wells	1	EA	$ 550,000	$ 550,000
						Subtotal A	$ 550,000
						General Contingency (40%)	$ 220,000
						Subtotal B	$ 770,000
						Engineering, Legal, Administrative (20%)	$ 154,000
						Project #42 Total	$ 924,000
Project #43: Future pipeline from Z1530 tank to Z1630 tank							
1630	2010	Distribution	12-in pipeline	6,900	LF	$ 120	$ 828,000
						Subtotal A	$ 828,000
						General Contingency (40%)	$ 331,200
						Subtotal B	$ 1,159,200
						Engineering, Legal, Administrative (20%)	$ 231,840
						Project #43 Total	$ 1,391,040

Table 10-8

1630 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #44: Future pipeline from exist HNR tank to new HNR booster station and the existing system							
1630	2010	Distribution	12-in pipeline	700	LF	$ 120	$ 84,000
						Subtotal A	$ 84,000
						General Contingency (40%)	$ 33,600
						Subtotal B	$ 117,600
						Engineering, Legal, Administrative (20%)	$ 23,520
						Project #44Total	$ 141,120
			Grand Total (1630 Zone)				$ 11,605,440

10.2.13 1800 Zone

Table 10-9 shows the future improvements (Section 9) required to meet demands in the 1800 Zone through the year 2025. Before 2015 the 1800 Zone requires various supply, storage, booster, and distribution improvements. The estimated cost of the improvements shown in Table 10-9 is $7,605,024.

Table 10-9

1800 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #45: Future Z1800 Tank at NE corner of 3487 development							
1800	2015	Storage	1.0 mg storage tank	1	LS	$ 960,000	$ 960,000
1800	2015	Storage	Site Improvements (10% tank cost)	1	LS	$ 96,000	$ 96,000
1800	2015	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 96,000	$ 96,000
						Subtotal A	$ 1,152,000
						General Contingency (40%)	$ 460,800
						Subtotal B	$ 1,612,800
						Engineering, Legal, Administrative (20%)	$ 322,560
						Project #45 Total	$ 1,935,360
Project #46: Future Z1800 Booster Station							
1800	2015	Boosters	7.5 mgd capacity	1	LS	$ 2,040,000	$ 2,040,000
						Subtotal A	$ 2,040,000
						General Contingency (40%)	$ 816,000
						Subtotal B	$ 2,856,000
						Engineering, Legal, Administrative (20%)	$ 571,200
						Project #46 Total	$ 3,427,200
Project #47: Future Pipeline From Z1800 tank to Z1630 tank							
1800	2015	Distribution	8-in pipeline	8,300	LF	$ 100	$ 830,000

Table 10-9

1800 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
						Subtotal A	$ 830,000
						General Contingency (40%)	$ 332,000
						Subtotal B	$ 1,162,000
						Engineering, Legal, Administrative (20%)	$ 232,400
						Project #47 Total	$ 1,394,400
Project #48: Future Z1800 Well (also supplies 1975 Zone and 2155 Zone)							
1800	2015	Supply	1,500 gpm wells	1	EA	$ 550,000	$ 550,000
						Subtotal A	$ 550,000
						General Contingency (40%)	$ 220,000
						Subtotal B	$ 770,000
						Engineering, Legal, Administrative (20%)	$ 154,000
						Project #48 Total	$ 924,000
Project #49: Future Z1800 Well (also supplies 1975 Zone and 2155 Zone)							
1800	2020	Supply	1,500 gpm wells	1	EA	$ 550,000	$ 550,000
						Subtotal A	$ 550,000
						General Contingency (40%)	$ 220,000
						Subtotal B	$ 770,000
						Engineering, Legal, Administrative (20%)	$ 154,000
						Project #49 Total	$ 924,000
Project #50: Future Z1800 Well (also supplies 1975 Zone and 2155 Zone)							
1800	2025	Supply	1,500 gpm wells	1	EA	$ 550,000	$ 550,000
						Subtotal A	$ 550,000
						General Contingency (40%)	$ 220,000
						Subtotal B	$ 770,000
						Engineering, Legal, Administrative (20%)	$ 154,000
						Project #50 Total	$ 924,000
Project #51: Future Pipeline from Z1800 wells and Z1800 tank							
1800	2015	Distribution	20-in pipeline	19,200	LF	$ 200	$ 3,840,000
						Subtotal A	$ 3,840,000
						General Contingency (40%)	$ 1,536,000
						Subtotal B	$ 5,376,000
						Engineering, Legal, Administrative (20%)	$ 1,075,200
						Project #51 Total	$ 6,451,200
			Grand Total (1800 Zone)				$ 15,980,160

10.2.14 1975 Zone

Table 10-10 shows the future improvements (Section 9) required to meet demands in the 1975 Zone through the year 2025. Before 2020 the 1975 Zone requires various supply, storage, booster, and distribution improvements. The estimated cost of the improvements shown in Table 10-10 is $5,461,344.

Table 10-10

1975 Zone Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #52: Future Z1975 Tank							
1975	2020	Storage	2.0 mg storage tank	1	LS	$ 1,360,000	$ 1,360,000
						Subtotal A	$ 1,360,000
						General Contingency (40%)	$ 544,000
						Subtotal B	$ 1,904,000
						Engineering, Legal, Administrative (20%)	$ 380,800
						Project #52 Total	$ 2,284,800
Project #53: Future Z1975 Booster Station							
1975	2020	Booster	3.5 mgd capacity	1	LS	$ 952,000	$ 952,000
						Subtotal A	$ 952,000
						General Contingency (40%)	$ 380,800
						Subtotal B	$ 1,332,800
						Engineering, Legal, Administrative (20%)	$ 266,560
						Project #53 Total	$ 1,599,360
Project #54: Future Pipeline from Future Z1800 Tank to Future Z1975 Tank							
1975	2020	Distribution	12-in pipeline	8,200	LF	$ 120	$ 984,000
						Subtotal A	$ 984,000
						General Contingency (40%)	$ 393,600
						Subtotal B	$ 1,377,600
						Engineering, Legal, Administrative (20%)	$ 275,520
						Project #54 Total	$ 1,653,120
			Grand Total (1975 Zone)				$ 5,537,280

10.2.15 2155 Zone

Table 10-11 shows the future improvements (Section 9) required to meet demands in the 2155 Zone through the year 2025. Before 2025 the 2155 Zone requires various supply, booster, and distribution improvements. The estimated cost of the improvements shown in Table 10-11 is $3,839,472.

Table 10-11

2155 Zone Cost Estimate for Future Improvements

Zone	Year	Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #55: Future Z2155 Booster Station							
2155	2025	Booster	3.5 mgd capacity	1	LS	$ 952,000	$ 952,000
						Subtotal A	$ 952,000
						General Contingency (40%)	$ 380,800
						Subtotal B	$ 1,332,800
						Engineering, Legal, Administrative (20%)	$ 266,560
						Project #55 Total	$ 1,599,360
Project #56: Future pipeline from Z1975 tank to Z2155 booster station							
1630	2025	Distribution	16-in pipeline	200	LF	$ 200	$ 40,000
						Subtotal A	$ 40,000
						General Contingency (40%)	$ 16,000
						Subtotal B	$ 56,000
						Engineering, Legal, Administrative (20%)	$ 11,200
						Project #56 Total	$ 67,200
			Grand Total (2155 Zone)				$ 1,666,560

10.2.16 Cottonwood Zone (1630-C)

Table 10-12 shows the improvements required to meet the future demands of the Cottonwood Zone. It is anticipated that future improvements will primarily consist of adding storage capacity to the system before the planning year 2010.

Table 10-12

Cottonwood Zone (1630-C) Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #57: Future Cottonwood Tank							
1630-C	2010	Storage	1.0 mg tank capacity	1	LS	$ 960,000	$ 960,000
1630-C	2010	Storage	Site Improvements (10% tank cost)	1	LS	$ 96,000	$ 96,000
1630-C	2010	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 96,000	$ 96,000
						Subtotal A	$ 1,152,000
						General Contingency (40%)	$ 460,800
						Subtotal B	$ 1,612,800
						Engineering, Legal, Administrative (20%)	$ 322,560
						Project #57 Total	$ 1,935,360
Project #58: Future Cottonwood Tank							
1630-C	2010	Distribution	Future 20-in Connection with Woodrige System	3,500	LF	$ 200	$ 700,000
						Subtotal A	$ 700,000

Table 10-12

Cottonwood Zone (1630-C) Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
						General Contingency (40%)	$ 280,000
						Subtotal B	$ 980,000
						Engineering, Legal, Administrative (20%)	$ 196,000
						Project #58 Total	$ 1,176,000
Project #59: Future Cottonwood Zone Emergency Booster for delivery to Woodrige Zone							
1630-C	2010	Boosters	2.2 mgd capacity	1	LS	$ 598,400	$ 598,400
						Subtotal A	$ 598,400
						General Contingency (40%)	$ 239,360
						Subtotal B	$ 837,760
						Engineering, Legal, Administrative (20%)	$ 167,552
						Project #59 Total	$ 1,005,312
Project #60: Future Cottonwood Zone Well							
1630-C	2025	Supply	1,500 gpm wells	1	EA	$ 550,000	$ 550,000
						Subtotal A	$ 550,000
						General Contingency (40%)	$ 220,000
						Subtotal B	$ 770,000
						Engineering, Legal, Administrative (20%)	$ 154,000
						Project #60 Total	$ 924,000
			Grand Total (Cottonwood Zone)				$ 5,040,672

10.2.17 Woodridge Zone (1800-W)

Table 10-13 shows the improvements required to meet the future demands of the Woodridge Zone. These improvements are associated with the increased storage capacity required to meet future demands in this zone.

Table 10-13

Woodridge Zone (1800-W) Cost Estimate for Future Improvements

Zone	Year	Component Category	CIP Item Description	Quantity	Unit	Unit Cost	Cost
Project #61: Future Woodrige Tank							
1800-w	2010	Storage	0.5 mg storage tank	1	LS	$ 600,000	$ 600,000
1800-w	2010	Storage	Site Improvements (10% tank cost)	1	LS	$ 60,000	$ 60,000
1800-w	2010	Storage	Yard Piping & associated appurtenances (10%)	1	LS	$ 60,000	$ 60,000
						Subtotal A	$ 720,000
						General Contingency (40%)	$ 288,000
						Subtotal B	$ 1,008,000
						Engineering, Legal, Administrative (20%)	$ 201,600

Project #61 Total	$ 1,209,600
Grand Total (Woodridge Zone)	$ 1,209,600

An interconnection between the Cottonwood Zone and Woodridge Zone is currently being considered as a means to share water between the two disconnected zones during emergencies. This would increase the storage and supply reliability in both of these zones. This will require approximately 3,500 LF of pipeline to connect the two systems. Because the important details such as alignment and the year for these improvements are not yet determined, this cost estimate does not include an estimate for this conceptual improvement project.

10.3 SUMMARY

Table 10-14 indicates that the estimated cost of the major improvements required to meet system demands through year 2025 is approximately $131 million. According to increases in water demands associated with the High Growth Scenario, a significant portion of the future improvements will likely be required prior to 2010. In fact, the improvements required to meet the 2010 system demand will require approximately 56% of the total estimated funding ($73 million) for conceptual future improvements. Roughly 25% of funding is required between 2010 and 2015 ($33 million), 8% of the funding is required between 2015 and 2020 ($11 million), and 10% of the funding is required between 2020 and 2025 ($13 million).

Based upon MSWD prioritization of future improvements, some of the improvements that are required prior to 2010 could be delayed until later. These subjective judgments, which in some cases are based upon the desired level of reliability, are beyond the scope of this report. The financial plan in this section and future improvements should be evaluated periodically to compare the assumptions made in this report with the actual growth and demands of the future system. By so doing, the MSWD CIP can be adjusted appropriately on an annual basis.

Modeling results indicate that the 1240 Zone does not require major improvements to meet projected demands through the year 2025. However, minor improvements will be required as the actual system growth occurs and actual demands deviate from the assumptions made within the scope of this study.

Table 10-14

Cost Estimate Summary for Future Improvements

		Planning Year / Cost				
Zone	**Category**	**2010**	**2015**	**2020**	**2025**	**Subtotal**
913	Supply	$0	$0	$0	$0	$0
	Storage	$0	$0	$0	$0	$0
	Boosters	$0	$0	$0	$0	$0
	Distribution	$0	$262,080	$0	$0	$262,080
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
913 Zone Total		**$250,000**	**$512,080**	**$250,000**	**$250,000**	**$1,262,080**
1070	Supply	$0	$0	$0	$0	$0
	Storage	$3,225,600	$0	$0	$0	$3,225,600

Table 10-14

Cost Estimate Summary for Future Improvements

Zone	Category	Planning Year / Cost 2010	2015	2020	2025	Subtotal
	Boosters	$0	$594,048	$0	$0	$594,048
	Distribution	$860,160	$0	$0	$0	$860,160
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1070 Zone Total		**$4,335,760**	**$844,048**	**$250,000**	**$250,000**	**$5,679,808**
1240	Supply	$0	$0	$0	$0	$0
	Storage	$2,378,880	$0	$0	$0	$2,378,880
	Boosters	$0	$0	$0	$0	$0
	Distribution	$3,467,520	$0	$0	$0	$3,467,520
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1240 Zone Total		**$6,096,400**	**$250,000**	**$250,000**	**$250,000**	**$6,846,400**
1400	Supply	$1,680,000	$2,772,000	$1,848,000	$924,000	$7,224,000
	Storage	$6,672,960	$4,737,600	$0	$4,737,600	$16,148,160
	Boosters	$319,872	$0	$0	$0	$319,872
	Distribution	$12,166,560	$2,184,000	$0	$1,243,200	$15,593,760
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1400 Zone Total		**$21,089,392**	**$9,943,600**	**$2,098,000**	**$7,154,800**	**$40,285,792**
1530	Supply	$1,848,000	$924,000	$0	$0	$2,772,000
	Storage	$1,935,360	$4,032,000	$0	$0	$5,967,360
	Boosters	$0	$0	$0	$0	$0
	Distribution	$19,797,120	$0	$0	$0	$19,797,120
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1530 Zone Total		**$23,830,480**	**$5,206,000**	**$250,000**	**$250,000**	**$29,536,480**
1630	Supply	$924,000	$924,000	$0	$0	$1,848,000
	Storage	$7,539,840	$0	$0	$0	$7,539,840
	Boosters	$685,440	$0	$0	$0	$685,440
	Distribution	$1,532,160	$0	$0	$0	$1,532,160
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1630 Zone Total		**$10,931,440**	**$1,174,000**	**$250,000**	**$250,000**	**$12,605,440**
1800	Supply	$0	$924,000	$924,000	$924,000	$2,772,000
	Storage	$0	$1,935,360	$0	$0	$1,935,360
	Boosters	$0	$3,427,200	$0	$0	$3,427,200
	Distribution	$0	$7,845,600	$0	$0	$7,845,600
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1800 Zone Total		**$250,000**	**$14,382,160**	**$1,174,000**	**$1,174,000**	**$16,980,160**
1975	Supply	$0	$0	$0	$0	$0
	Storage	$0	$0	$2,284,800	$0	$2,284,800
	Boosters	$0	$0	$1,599,360	$0	$1,599,360
	Distribution	$0	$0	$1,653,120	$0	$1,653,120
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1975 Zone Total		**$250,000**	**$250,000**	**$5,787,280**	**$250,000**	**$6,537,280**
2155	Supply	$0	$0	$0	$0	$0
	Storage	$0	$0	$0	$0	$0

Table 10-14

Cost Estimate Summary for Future Improvements

Zone	Category	Planning Year / Cost 2010	2015	2020	2025	Subtotal
	Boosters	$0	$0	$0	$1,599,360	$1,599,360
	Distribution	$0	$0	$0	$67,200	$67,200
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
2155 Zone Total		**$250,000**	**$250,000**	**$250,000**	**$1,916,560**	**$2,666,560**
1630-C	Supply	$0	$0	$0	$924,000	$924,000
	Storage	$1,935,360	$0	$0	$0	$1,935,360
	Boosters	$1,005,312	$0	$0	$0	$1,005,312
	Distribution	$1,176,000	$0	$0	$0	$1,176,000
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1630-C Zone Total		**$4,366,672**	**$250,000**	**$250,000**	**$1,174,000**	**$6,040,672**
1800-W	Supply	$0	$0	$0	$0	$0
	Storage	$1,209,600	$0	$0	$0	$1,209,600
	Boosters	$0	$0	$0	$0	$0
	Distribution	$0	$0	$0	$0	$0
	Seismic	$250,000	$250,000	$250,000	$250,000	$1,000,000
1800-W Zone Total		**$1,459,600**	**$250,000**	**$250,000**	**$250,000**	**$2,209,600**
GRAND TOTAL		***$73,109,744***	***$33,311,888***	***$11,059,280***	***$13,169,360***	***$130,650,272***

Appendix A
Water Quality Standards

MISSION SPRINGS WATER DISTRICT COMPREHENSIVE WATER SYSTEM MASTER PLAN

Prepared for
Mission Springs Water District
66575 Second Street
Desert Hot Springs, CA 92240-3711

URS Corporation
8181 East Tufts Avenue
Denver, Colorado 80237

Harvey Economics
600 South Cherry
Glendale, CO 80246

Project No. 29874168
November 30, 2005
Revision: June, 2007

EPA National Primary Drinking Water Standards

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Acrylamide	TT[8]	Nervous system or blood problems;	Added to water during sewage/wastewater increased risk of cancer treatment	zero
OC	Alachlor	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops	zero
R	Alpha particles	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation	zero
IOC	Antimony	0.006	Increase in blood cholesterol; decrease in blood sugar	Discharge from petroleum refineries; fire retardants; ceramics; electronics; solder	0.006
IOC	Arsenic	0.010 as of 1/23/06	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards, runoff from glass & electronics production wastes	0
IOC	Asbestos (fibers >10 micrometers)	7 million fibers per Liter (MFL)	Increased risk of developing benign intestinal polyps	Decay of asbestos cement in water mains; erosion of natural deposits	7 MFL
OC	Atrazine	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops	0.003
IOC	Barium	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits	2
OC	Benzene	0.005	Anemia; decrease in blood platelets; increased risk of cancer	Discharge from factories; leaching from gas storage tanks and landfills	zero
OC	Benzo(a)pyrene (PAHs)	0.0002	Reproductive difficulties; increased risk of cancer	Leaching from linings of water storage tanks and distribution lines	zero
IOC	Beryllium	0.004	Intestinal lesions	Discharge from metal refineries and coal-burning factories; discharge from electrical, aerospace, and defense industries	0.004
R	Beta particles and photon emitters	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation	zero
DBP	Bromate	0.010	Increased risk of cancer	Byproduct of drinking water disinfection	zero
IOC	Cadmium	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints	0.005
OC	Carbofuran	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa	0.04
OC	Carbon tetrachloride	0.005	Liver problems; increased risk of cancer	Discharge from chemical plants and other industrial activities	zero
D	Chloramines (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort, anemia	Water additive used to control microbes	MRDLG=4[1]

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Chlordane	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide	zero
D	Chlorine (as Cl_2)	MRDL=4.0[1]	Eye/nose irritation; stomach discomfort	Water additive used to control microbes	MRDLG=4[1]
D	Chlorine dioxide (as ClO_2)	MRDL=0.8[1]	Anemia; infants & young children: nervous system effects	Water additive used to control microbes	MRDLG=0.8[1]
DBP	Chlorite	1.0	Anemia; infants & young children: nervous system effects	Byproduct of drinking water disinfection	0.8
OC	Chlorobenzene	0.1	Liver or kidney problems	Discharge from chemical and agricultural chemical factories	0.1
IOC	Chromium (total)	0.1	Allergic dermatitis	Discharge from steel and pulp mills; erosion of natural deposits	0.1
IOC	Copper	TT[7]; Action Level = 1.3	Short term exposure: Gastrointestinal distress. Long term exposure: Liver or kidney damage. People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits	1.3
M	*Cryptosporidium*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
IOC	Cyanide (as free cyanide)	0.2	Nerve damage or thyroid problems	Discharge from steel/metal factories; discharge from plastic and fertilizer factories	0.2
OC	2,4-D	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops	0.07
OC	Dalapon	0.2	Minor kidney changes	Runoff from herbicide used on rights of way	0.2
OC	1,2-Dibromo-3-chloropropane (DBCP)	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards	zero
OC	o-Dichlorobenzene	0.6	Liver, kidney, or circulatory system problems	Discharge from industrial chemical factories	0.6
OC	p-Dichlorobenzene	0.075	Anemia; liver, kidney or spleen damage; changes in blood	Discharge from industrial chemical factories	0.075
OC	1,2-Dichloroethane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	1,1-Dichloroethylene	0.007	Liver problems	Discharge from industrial chemical factories	0.007
OC	cis-1,2-Dichloroethylene	0.07	Liver problems	Discharge from industrial chemical factories	0.07
OC	trans-1,2-Dichloroethylene	0.1	Liver problems	Discharge from industrial chemical factories	0.1
OC	Dichloromethane	0.005	Liver problems; increased risk of cancer	Discharge from drug and chemical factories	zero
OC	1,2-Dichloropropane	0.005	Increased risk of cancer	Discharge from industrial chemical factories	zero
OC	Di(2-ethylhexyl) adipate	0.4	Weight loss, live problems, or possible reproductive difficulties	Discharge from chemical factories	0.4
OC	Di(2-ethylhexyl) phthalate	0.006	Reproductive difficulties; liver problems; increased risk of cancer	Discharge from rubber and chemical factories	zero
OC	Dinoseb	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables	0.007
OC	Dioxin (2,3,7,8-TCDD)	0.00000003	Reproductive difficulties; increased risk of cancer	Emissions from waste incineration and other combustion; discharge from chemical factories	zero
OC	Diquat	0.02	Cataracts	Runoff from herbicide use	0.02
OC	Endothall	0.1	Stomach and intestinal problems	Runoff from herbicide use	0.1

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Endrin	0.002	Liver problems	Residue of banned insecticide	0.002
OC	Epichlorohydrin	TT[8]	Increased cancer risk, and over a long period of time, stomach problems	Discharge from industrial chemical factories; an impurity of some water treatment chemicals	zero
OC	Ethylbenzene	0.7	Liver or kidneys problems	Discharge from petroleum refineries	0.7
OC	Ethylene dibromide	0.00005	Problems with liver, stomach, reproductive system, or kidneys; increased risk of cancer	Discharge from petroleum refineries	zero
IOC	Fluoride	4.0	Bone disease (pain and tenderness of the bones); Children may get mottled teeth	Water additive which promotes strong teeth; erosion of natural deposits; discharge from fertilizer and aluminum factories	4.0
M	*Giardia lamblia*	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Glyphosate	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use	0.7
DBP	Haloacetic acids (HAA5)	0.060	Increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Heptachlor	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide	zero
OC	Heptachlor epoxide	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor	zero
M	Heterotrophic plate count (HPC)	TT[3]	HPC has no health effects; it is an analytic method used to measure the variety of bacteria that are common in water. The lower the concentration of bacteria in drinking water, the better maintained the water system is.	HPC measures a range of bacteria that are naturally present in the environment	n/a
OC	Hexachlorobenzene	0.001	Liver or kidney problems; reproductive difficulties; increased risk of cancer	Discharge from metal refineries and agricultural chemical factories	zero
OC	Hexachlorocyclopentadiene	0.05	Kidney or stomach problems	Discharge from chemical factories	0.05
IOC	Lead	TT[7]; Action Level = 0.015	Infants and children: Delays in physical or mental development; children could show slight deficits in attention span and learning abilities; Adults: Kidney problems; high blood pressure	Corrosion of household plumbing systems; erosion of natural deposits	zero
M	*Legionella*	TT[3]	Legionnaire's Disease, a type of pneumonia	Found naturally in water; multiplies in heating systems	zero
OC	Lindane	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens	0.0002
IOC	Mercury (inorganic)	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands	0.002
OC	Methoxychlor	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock	0.04
IOC	Nitrate (measured as Nitrogen)	10	Infants below the age of six months who drink water containing nitrate in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	10
IOC	Nitrite (measured as Nitrogen)	1	Infants below the age of six months who drink water containing nitrite in excess of the MCL could become seriously ill and, if untreated, may die. Symptoms include shortness of breath and blue-baby syndrome.	Runoff from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits	1

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Oxamyl (Vydate)	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes	0.2
OC	Pentachlorophenol	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood preserving factories	zero
OC	Picloram	0.5	Liver problems	Herbicide runoff	0.5
OC	Polychlorinated biphenyls (PCBs)	0.0005	Skin changes; thymus gland problems; immune deficiencies; reproductive or nervous system difficulties; increased risk of cancer	Runoff from landfills; discharge of waste chemicals	zero
R	Radium 226 and Radium 228 (combined)	5 pCi/L	Increased risk of cancer	Erosion of natural deposits	zero
IOC	Selenium	0.05	Hair or fingernail loss; numbness in fingers or toes; circulatory problems	Discharge from petroleum refineries; erosion of natural deposits; discharge from mines	0.05
OC	Simazine	0.004	Problems with blood	Herbicide runoff	0.004
OC	Styrene	0.1	Liver, kidney, or circulatory system problems	Discharge from rubber and plastic factories; leaching from landfills	0.1
OC	Tetrachloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from factories and dry cleaners	zero
IOC	Thallium	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories	0.0005
OC	Toluene	1	Nervous system, kidney, or liver problems	Discharge from petroleum factories	1
M	Total Coliforms (including fecal coliform and *E. coli*)	5.0%[4]	Not a health threat in itself; it is used to indicate whether other potentially harmful bacteria may be present[5]	Coliforms are naturally present in the environment as well as feces; fecal coliforms and *E. coli* only come from human and animal fecal waste.	zero
DBP	Total Trihalomethanes (TTHMs)	0.10 0.080 after 12/31/03	Liver, kidney or central nervous system problems; increased risk of cancer	Byproduct of drinking water disinfection	n/a[6]
OC	Toxaphene	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle	zero
OC	2,4,5-TP (Silvex)	0.05	Liver problems	Residue of banned herbicide	0.05
OC	1,2,4-Trichlorobenzene	0.07	Changes in adrenal glands	Discharge from textile finishing factories	0.07
OC	1,1,1-Trichloroethane	0.2	Liver, nervous system, or circulatory problems	Discharge from metal degreasing sites and other factories	0.20
OC	1,1,2-Trichloroethane	0.005	Liver, kidney, or immune system problems	Discharge from industrial chemical factories	0.003
OC	Trichloroethylene	0.005	Liver problems; increased risk of cancer	Discharge from metal degreasing sites and other factories	zero
M	Turbidity	TT[3]	Turbidity is a measure of the cloudiness of water. It is used to indicate water quality and filtration effectiveness (e.g., whether disease-causing organisms are present). Higher turbidity levels are often associated with higher levels of disease-causing micro-organisms such as viruses, parasites and some bacteria. These organisms can cause symptoms such as nausea, cramps, diarrhea, and associated headaches.	Soil runoff	n/a
R	Uranium	30 ug/L as of 12/08/03	Increased risk of cancer, kidney toxicity	Erosion of natural deposits	zero

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

	Contaminant	MCL or TT[1] (mg/L)[2]	Potential health effects from exposure above the MCL	Common sources of contaminant in drinking water	Public Health Goal
OC	Vinyl chloride	0.002	Increased risk of cancer	Leaching from PVC pipes; discharge from plastic factories	zero
M	Viruses (enteric)	TT[3]	Gastrointestinal illness (e.g., diarrhea, vomiting, cramps)	Human and animal fecal waste	zero
OC	Xylenes (total)	10	Nervous system damage	Discharge from petroleum factories; discharge from chemical factories	10

NOTES

1 Definitions

- Maximum Contaminant Level Goal (MCLG)—The level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
- Maximum Contaminant Level (MCL)—The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration. MCLs are enforceable standards.
- Maximum Residual Disinfectant Level Goal (MRDLG)—The level of a drinking water disinfectant below which there is no known or expected risk to health. MRDLGs do not reflect the benefits of the use of disinfectants to control microbial contaminants.
- Maximum Residual Disinfectant Level (MRDL)—The highest level of a disinfectant allowed in drinking water. There is convincing evidence that addition of a disinfectant is necessary for control of microbial contaminants.
- Treatment Technique (TT)—A required process intended to reduce the level of a contaminant in drinking water.

2 Units are in milligrams per liter (mg/L) unless otherwise noted. Milligrams per liter are equivalent to parts per million (ppm).

3 EPA's surface water treatment rules require systems using surface water or ground water under the direct influence of surface water to (1) disinfect their water, and (2) filter their water or meet criteria for avoiding filtration so that the following contaminants are controlled at the following levels:

- *Cryptosporidium* (as of 1/1/02 for systems serving >10,000 and 1/14/05 for systems serving <10,000) 99% removal.
- *Giardia lamblia*: 99.9% removal/inactivation
- Viruses: 99.99% removal/inactivation
- *Legionella:* No limit, but EPA believes that if *Giardia* and viruses are removed/inactivated, *Legionella* will also be controlled.
- Turbidity: At no time can turbidity (cloudiness of water) go above 5 nephelolometric turbidity units (NTU); systems that filter must ensure that the turbidity go no higher than 1 NTU (0.5 NTU for conventional or direct filtration) in at least 95% of the daily samples in any month. As of January 1, 2002, for systems servicing >10,000, and January 14, 2005, for systems servicing <10,000, turbidity may never exceed 1 NTU, and must not exceed 0.3 NTU in 95% of daily samples in any month.
- HPC: No more than 500 bacterial colonies per milliliter
- Long Term 1 Enhanced Surface Water Treatment (Effective Date: January 14, 2005); Surface water systems or (GWUDI) systems serving fewer than 10,000 people must comply with the applicable Long Term 1 Enhanced Surface Water Treatment Rule provisions (e.g. turbidity standards, individual filter monitoring, *Cryptosporidium* removal requirements, updated watershed control requirements for unfiltered systems).
- Filter Backwash Recycling: The Filter Backwash Recycling Rule requires systems that recycle to return specific recycle flows through all processes of the system's existing conventional or direct filtration system or at an alternate location approved by the state.

4 No more than 5.0% samples total coliform-positive in a month. (For water systems that collect fewer than 40 routine samples per month, no more than one sample can be total coliform-positive per month.) Every sample that has total coliform must be analyzed for either fecal coliforms or *E. coli* if two consecutive TC-positive samples, and one is also positive for *E. coli* fecal coliforms, system has an acute MCL violation.

5 Fecal coliform and *E. coli* are bacteria whose presence indicates that the water may be contaminated with human or animal wastes. Disease-causing microbes (pathogens) in these wastes can cause diarrhea, cramps, nausea, headaches, or other symptoms. These pathogens may pose a special health risk for infants, young children, and people with severely compromised immune systems.

6 Although there is no collective MCLG for this contaminant group, there are individual MCLGs for some of the individual contaminants:

- Haloacetic acids: dichloroacetic acid (zero); trichloroacetic acid (0.3 mg/L)
- Trihalomethanes: bromodichloromethane (zero); bromoform (zero); dibromochloromethane (0.06 mg/L)

7 Lead and copper are regulated by a Treatment Technique that requires systems to control the corrosiveness of their water. If more than 10% of tap water samples exceed the action level, water systems must take additional steps. For copper, the action level is 1.3 mg/L, and for lead is 0.015 mg/L.

8 Each water system must certify, in writing, to the state (using third-party or manufacturers certification) that when it uses acrylamide and/or epichlorohydrin to treat water, the combination (or product) of dose and monomer level does not exceed the levels specified, as follows: Acrylamide = 0.05% dosed at 1 mg/L (or equivalent); Epichlorohydrin = 0.01% dosed at 20 mg/L (or equivalent).

LEGEND

D	Dinsinfectant	IOC	Inorganic Chemical	OC	Organic Chemical
DBP	Disinfection Byproduct	M	Microorganism	R	Radionuclides

National Secondary Drinking Water Standards

National Secondary Drinking Water Standards are non-enforceable guidelines regulating contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. EPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards.

Contaminant	Secondary Standard
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

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MAXIMUM CONTAMINANT LEVELS AND REGULATION DATES FOR DRINKING WATER CONTAMINANTS USEPA VS CDHS

SEPTEMBER 2003

Contaminant	USEPA MCL (mg/L)	USEPA Date[a]	CDHS MCL (mg/L)	CDHS Effective Date
Inorganics				
Aluminum	0.05 to 2[b]	1/91	1 0.2[b]	2/25/89 9/8/94
Antimony	0.006	7/92	0.006	9/8/94
Arsenic	0.05 0.01	eff: 6/24/77 2001	0.05	77
Asbestos	7 MFL[c]	1/91	7 MFL[c]	9/8/94
Barium	1 2	eff: 6/24/77 1/91	1	77
Beryllium	0.004	7/92	0.004	9/8/94
Cadmium	0.010 0.005	eff: 6/24/77 1/91	0.010 0.005	77 9/8/94
Chromium	0.05 0.1	eff: 6/24/77 1/91	0.05	77
Copper	1.3[d]	6/91	1[b] 1.3[d]	77 12/11/95
Cyanide	0.2	7/92	0.2 0.15	9/8/94 6/12/03
Fluoride	4 2[b]	4/86 4/86	2	4/98
Lead	0.05[e] 0.015[d]	eff: 6/24/77 6/91	0.05 [e] 0.015[d]	77 12/11/95
Mercury	0.002	eff: 6/24/77	0.002	77
Nickel	Remanded		0.1	9/8/94
Nitrate	(as N) 10	eff: 6/24/77	(as N03) 45	77
Nitrite (as N)	1	1/91	1	9/8/94
Total Nitrate/Nitrite (as N)	10	1/91	10	9/8/94
Selenium	0.01 0.05	eff: 6/24/77 1/91	0.01 0.05	77 9/8/94
Thallium	0.002	7/92	0.002	9/8/94
Radionuclides				
Uranium	30 ug/L	12/7/00	20 pCi/L	1/1/89
Combined radium-226 & 228	5 pCi/L	eff: 6/24/77	5 pCi/L	77
Gross Alpha particle activity	15 pCi/L	eff: 6/24/77	15 pCi/L	77
Gross Beta particle activity	dose of 4 millirem/yr	eff: 6/24/77	50 pCi/L[f]	77
Strontium-90	8 pCi/L	eff: 6/24/77 now covered by Gross Beta	8 pCi/L[f]	77
Tritium	20,000 pCi/L	eff: 6/24/77 now covered by Gross Beta	20,000 pCi/L[f]	77

Contaminant	USEPA MCL (mg/L)	USEPA Date[a]	CDHS MCL (mg/L)	CDHS Effective Date
VOCS				
Benzene	0.005	6/87	0.001	2/25/89
Carbon Tetrachloride	0.005	6/87	0.0005	4/4/89
1,2-Dichlorobenzene	0.6	1/91	0.6	9/8/94
1,4-Dichlorobenzene	0.075	6/87	0.005	4/4/89
1,1-Dichloroethane	-	-	0.005	6/24/90
1,2-Dichloroethane	0.005	6/87	0.0005	4/4/89
1,1-Dichloroethylene	0.007	6/87	0.006	2/25/89
cis-1,2-Dichloroethylene	0.07	1/91	0.006	9/8/94
trans-1,2-Dichloroethylene	0.1	1/91	0.01	9/8/94
Dichloromethane	0.005	7/92	0.005	9/8/94
1,3-Dichloropropene	-	-	0.0005	2/25/89
1,2-Dichloropropane	0.005	1/91	0.005	6/24/90
Ethylbenzene	0.7	1/91	0.68 0.7 0.3	2/25/89 9/8/94 6/12/03
Methyl-tert-butyl ether (MTBE)	-	-	0.005[b] 0.013	1/7/99 5/17/00
Monochlorobenzene	0.1	1/91	0.03 0.07	2/25/89 9/8/94
Styrene	0.1	1/91	0.1	9/8/94
1,1,2,2-Tetrachloroethane	-	-	0.001	2/25/89
Tetrachloroethylene	0.005	1/91	0.005	5/89
Toluene	1	1/91	0.15	9/8/94
1,2,4 Trichlorobenzene	0.07	7/92	0.07 0.005	9/8/94 6/12/03
1,1,1-Trichloroethane	0.200	6/87	0.200	2/25/89
1,1,2-Trichloroethane	0.005	7/92	0.032 0.005	4/4/89 9/8/94
Trichloroethylene	0.005	6/87	0.005	2/25/89
Trichlorofluoromethane	-	-	0.15	6/24/90
1,1,2-Trichloro-1,2,2-Trifluoroethane	-	-	1.2	6/24/90
Vinyl chloride	0.002	6/87	0.0005	4/4/89
Xylenes	10	1/91	1.750	2/25/89
SOCS				
Alachlor	0.002	1/91	0.002	9/8/94
Atrazine	0.003	1/91	0.003 0.001	4/5/89 6/12/03
Bentazon	-	-	0.018	4/4/89
Benzo(a) Pyrene	0.0002	7/92	0.0002	9/8/94
Carbofuran	0.04	1/91	0.018	6/24/90
Chlordane	0.002	1/91	0.0001	6/24/90
Dalapon	0.2	7/92	0.2	9/8/94
Dibromochloropropane	0.0002	1/91	0.0001 0.0002	7/26/89 5/3/91
Di(2-ethylhexyl)adipate	0.4	7/92	0.4	9/8/94
Di(2-ethylhexyl)phthalate	0.006	7/92	0.004	6/24/90
2,4-D	0.1 0.07	eff: 6/24/77 1/91	0.1 0.07	77 9/8/94
Dinoseb	0.007	7/92	0.007	9/8/94

Contaminant	USEPA MCL (mg/L)	USEPA Date[a]	CDHS MCL (mg/L)	CDHS Effective Date
Diquat	0.02	7/92	0.02	9/8/94
Endothall	0.1	7/92	0.1	9/8/94
Endrin	0.0002 0.002	eff: 6/24/77 7/92	0.0002 0.002	77 9/8/94
Ethylene Dibromide	0.00005	1/91	0.00002 0.00005	2/25/89 9/8/94
Glyphosate	0.7	7/92	0.7	6/24/90
Heptachlor	0.0004	1/91	0.00001	6/24/90
Heptachlor Epoxide	0.0002	1/91	0.00001	6/24/90
Hexachlorobenzene	0.001	7/92	0.001	9/8/94
Hexachlorocyclopentadiene	0.05	7/92	0.05	9/8/94
Lindane	0.004 0.0002	eff: 6/24/77 1/91	0.004 0.0002	77 9/8/94
Methoxychlor	0.1 0.04	eff: 6/24/77 1/91	0.1 0.04 0.03	77 9/8/94 6/12/03
Molinate	-	-	0.02	4/4/89
Oxamyl	0.2	7/92	0.2 0.05	9/8/94 6/12/03
Pentachlorophenol	0.001	1/91	0.001	9/8/94
Picloram	0.5	7/92	0.5	9/8/94
Polychlorinated Biphenyls	0.0005	1/91	0.0005	9/8/94
Simazine	0.004	7/92	0.010 0.004	4/4/89 9/8/94
Thiobencarb	-	-	0.07 0.001[b]	4/4/89 4/4/89
Toxaphene	0.005 0.003	eff: 6/24/77 1/91	0.005 0.003	77 9/8/94
2,3,7,8-TCDD (Dioxin)	$3x10^{-8}$	7/92	$3x10^{-8}$	9/8/94
2,4,5-TP (Silvex)	0.01 0.05	eff: 6/24/77 1/91	0.01 0.05	77 9/8/94
Disinfection Byproducts				
Total trihalomethanes	0.100 0.080	11/29/79 eff: 11/29/83 eff: 1/1/02 [g]	0.100	3/14/83
Total haloacetic acids	0.060	eff: 1/1/02 [g]		
Bromate	0.010	eff: 1/1/02 [g]		
Chlorite	1.0	eff: 1/1/02 [g]		
Treatment Technique				
Acrylamide	TT[h]	1/91	TT[h]	9/8/94
Epichlorohydrin	TT[h]	1/91	TT[h]	9/8/94

a. "eff." indicates the date the MCL took effect; any other date provided indicates when USEPA established (i.e., published) the MCL.
b. Secondary MCL.
c. MFL = million fibers per liter, with fiber length > 10 microns.
d. Regulatory Action Level; if system exceeds, it must take certain actions such as additional monitoring, corrosion control studies and treatment, and for lead, a public education program; replaces MCL.
e. The MCL for lead was rescinded with the adoption of the regulatory action level described in footnote d.
f. MCLs are intended to ensure that exposure above 4 millirem/yr does not occur.
g. Effective for surface water systems serving more than 10,000 people; effective for all others 1/1/04.
h. TT = treatment technique, because an MCL is not feasible.