Final 2010 Urban Water Management Plan

Adopted : June 9, 2011

Prepared for:

Mojave Water Agency

Prepared by:

Kennedy/Jenks Consultants

June 2011

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Final 2010 Urban Water Management Plan

June 2011

Prepared for

Mojave Water Agency
22450 Headquarters Drive
Apple Valley, CA 92345

K/J Project No. 1089001*00

RESOLUTION NO. 924-11
A RESOLUTION OF THE BOARD OF DIRECTORS
OF THE MOJAVE WATER AGENCY APPROVING
THE 2010 URBAN WATER MANAGEMENT PLAN

The Board of Directors of the Mojave Water Agency hereby finds and declares as follows:

WHEREAS, Chapter 97 of Appendices to the Water Code ("MWA Law") enabled formation of the Mojave Water Agency, and prescribes the powers and duties of the MWA; and,

WHEREAS, Section 15 (a) of said Chapter 97 declares that "The Agency may do any and every act necessary so that sufficient water may be available for any present or future beneficial use or uses of the lands or inhabitants of the agency including without limiting the generality of the foregoing, irrigation, domestic, fire protection, municipal, commercial, industrial, and recreational uses."; and,

WHEREAS, Subsection (11) of Section 15 (b) of said Chapter 97 empowers the Agency "To gather data for, and to develop and implement, after consultation and coordination with all public and private water entities who are in any way affected, management and master plans to mitigate the cumulative overdraft of groundwater basins, to monitor the condition of the groundwater basins, to pursue all necessary water conservation measures, and to negotiate for additional water supplies from all federal, state and other sources."; and,

WHEREAS, the California Urban Water Management Planning Act requires a water supplier with over 3,000 customers or that supplies over 3,000 acre-feet of water per year to prepare an Urban Water Management Plan (UWMP) every 5 years ending in 0 and 5; and,

WHEREAS, in December of 2005, the Agency adopted a 2005 UWMP; and,

WHEREAS, a 2010 UWMP was developed after extensive review and discussion with the Technical Advisory Committee to the Mojave Water Agency during ten meetings, and reviewed and discussed with the Board of Directors during several meetings; and,

WHEREAS, a public hearing to receive comments on the 2010 UWMP has been duly publicly noticed and was conducted by this Board of Directors on May 5, 2011.

NOW THEREFORE, IT IS RESOLVED, that the Board of Directors hereby approves the "Mojave Water Agency 2010 Urban Water Management Plan."

ADOPTED this 9th day of June, 2011.

SIGNED:

Art Bishop, President
Mojave Water Agency

ATTEST:

Doug Shumway, Secretary
Mojave Water Agency

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Executive Summary

ES-1 Overview

This document presents the Urban Water Management Plan 2010 (Plan) for the Mojave Water Agency (Agency, MWA) wholesale service area. This Overview chapter describes the general purpose of the Plan, discusses Plan implementation, and provides general information about MWA, retail water purveyors, and service area characteristics.

An Urban Water Management Plan (UWMP) is a planning tool that generally guides the actions of water management agencies. It provides managers and the public with a broad perspective on a number of water supply issues. It is not a substitute for project-specific planning documents, nor was it intended to be when mandated by the State Legislature.

The California Urban Water Management Planning Act (Act) requires preparation of a plan that:

- Accomplishes water supply planning over a 20-year period in five year increments. (MWA and the retailers are going beyond the requirements of the Act by developing a plan which spans 25 years.)
- Identifies and quantifies adequate water supplies, including recycled water, for existing and future demands, in normal, single-dry, and multiple-dry years.
- Implements conservation and efficient use of urban water supplies. Significant new requirements for quantified demand reductions have been added by the enactment of Senate Bill 7 of Special Extended Session 7 (SBX7-7), which amends the Act.

The MWA has encouraged community participation in water planning. For the current Plan, public sessions were held for review and to solicit input on the Draft Plan before its adoption. Interested groups were informed about the development of the Plan along with the schedule of public activities. MWA coordinated the preparation of the Plan with the local community. MWA notified the cities and counties within its service area of the opportunity to provide input regarding the Plan. Monthly Technical Advisory Committee (TAC) meetings were held at MWA between March and August 2010, and bi-monthly TAC meetings from October 2010 thru April 2011, where the retail purveyors and other public entities were invited to hear discussions on the development, status, and progress of MWA's 2010 UWMP.

ES-2 Water Use

The Water Use chapter describes historic and current water usage and the methodology used to project future demands within the MWA service area. Water usage is divided into sectors such as residential, industrial, institutional, landscape, agricultural, and other purposes. To undertake this evaluation, existing land use data and new housing construction information were compiled from each of the retail water purveyors and projections prepared in the Mojave Water Agency 2004 Regional Water Management Plan (RWMP).[1] The RWMP is the master plan for MWA water management activities through the year 2020. This information was then compared

[1] Schlumberger Water Services, September 2004, "Mojave Water Agency 2004 Regional Water Management Plan."

to historical trends for new water service connections and customer water usage information. In addition, weather and water conservation effects on historical water usage were factored into the evaluation.

For the 2010 UWMP, a demand forecast model was developed that combines population growth projections with water use data to forecast total water demand in future years. Population data for 2000 through 2010 were estimated by subarea by MWA. Using draft Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan (RTP) growth forecast (baseline of 2008), it is predicted that population in the Mojave Water Agency service area will grow at a rate of approximately 2.5 percent per year from 2010 through 2035. The assumption is made that each of the subareas grow at a rate correlated with the nearest city-wide rate, with the Alto subarea having the highest annual change in rate at 2.7 percent over the 2010-2035 period.

Demand projections were based largely on population growth. Past and current population data were available by subarea and by retail water purveyor. Population and demand projections were provided to the retailers to use in their own UWMP's if desired; however, only projections by subarea have been included in the MWA UWMP.

Water uses were broken into specific categories, with demand forecasts for each category modeled based upon historical trends and anticipated changes in future trends. The water uses identified include those supplied by retail water purveyors, non-retail parties to the Mojave Basin Area Judgment, Minimal Producers, and customers that MWA provides directly with State Water Project (SWP) water. Retail water uses include Single-Family and Multi-Family Residential, Commercial Industrial and Institutional (CII), Unaccounted, Landscape Irrigation, and an "Other" category. Non-retail uses include Industrial, Recreational Lakes and Fish Hatcheries, Minimal Producers, Golf Courses, and Agriculture. Retail uses were generally correlated with population growth and non-retail uses were evaluated based upon a variety of factors.

Water use in the Single-Family Residential (SFR) use sector decreased in the Mojave Basin Area from 214 gallons per capita per day (GPCD) in 2000 to 152 GPCD in 2010. At the same time, SFR GPCD in the Morongo Area remained relatively flat at an average of 113 GPCD. While a significant reduction in per-capita use has occurred in the Mojave Basin over the past decade, GPCD is still substantially higher than in the Morongo Area. Voluntary conservation programs, State-Mandated GPCD reductions, tiered rate structures at the retail level, and the continuously increasing cost of water will all influence future water demands. Recognizing these factors and that a substantial potential still exists for reductions in SFR per-capita use, it is assumed in the plan that a moderate amount of additional conservation will be attained in the SFR use sector. Regional demands are projected to increase at a rate of 1.4 percent per year, slower than population growth, partially because of conservation and partially because some non-retail water uses are not anticipated to increase in the future.

Return flow is calculated as a percent of the water production for each water use category and is approximately 50 percent of production for retail uses, and varies substantially by type of use for non-retail uses.

ES-3 Water Resources

The MWA has four sources of water supply – natural surface water flows, wastewater imports from outside the MWA service area, SWP imports, and return flow from pumped groundwater not consumptively used. A fifth source, "Agricultural Depletion from Storage," is also shown as a supply and is described in Section 3.3.2. In MWA's demand forecast projection model, natural and SWP supply are expressed as an annual average, although both sources of supply vary significantly from year to year. Almost all of the water use within MWA is supplied by pumped groundwater. Native surface supply, return flow, and SWP imports recharge the groundwater basins; therefore, water management practices render the annual fluctuations in these sources of supply relatively insignificant for water supply planning. MWA has an average natural supply of 54,045 acre-feet per year (afy). SWP supplies average 54,778 afy, based upon a reliability factor of 61 percent of MWA's "Table A Amount" through the end of the planning period. Supplies from return flows increase over the planning period, due to increased groundwater pumping, as does imported wastewater.

Figure ES-1 presents all available supplies compared with total demands, with local supplies shaded green and wholesale (SWP) supplies shaded blue. Available supplies are sufficient to meet projected demands beyond 2035. It should be noted that return flow as a supply is shown to increase over time because it is a function of water demand.

Water demands and supplies were also evaluated out 50 years to the year 2060, shown in Figure ES-2. This is beyond the 20-year planning horizon required by the UWMP Act and included in this plan, and projections beyond 2035 are for informational purposes only. However, they give some insight into when in the future demands might exceed current supplies. It is assumed on Figure ES-2 that demands continue to increase at the same rate through 2060. The projection indicates that current supplies are sufficient to meet demands through 2044, assuming SWP supplies remain constant at the 2035 availability.

Figure ES-1
Water Supplies vs. Projected Demands Through 2035

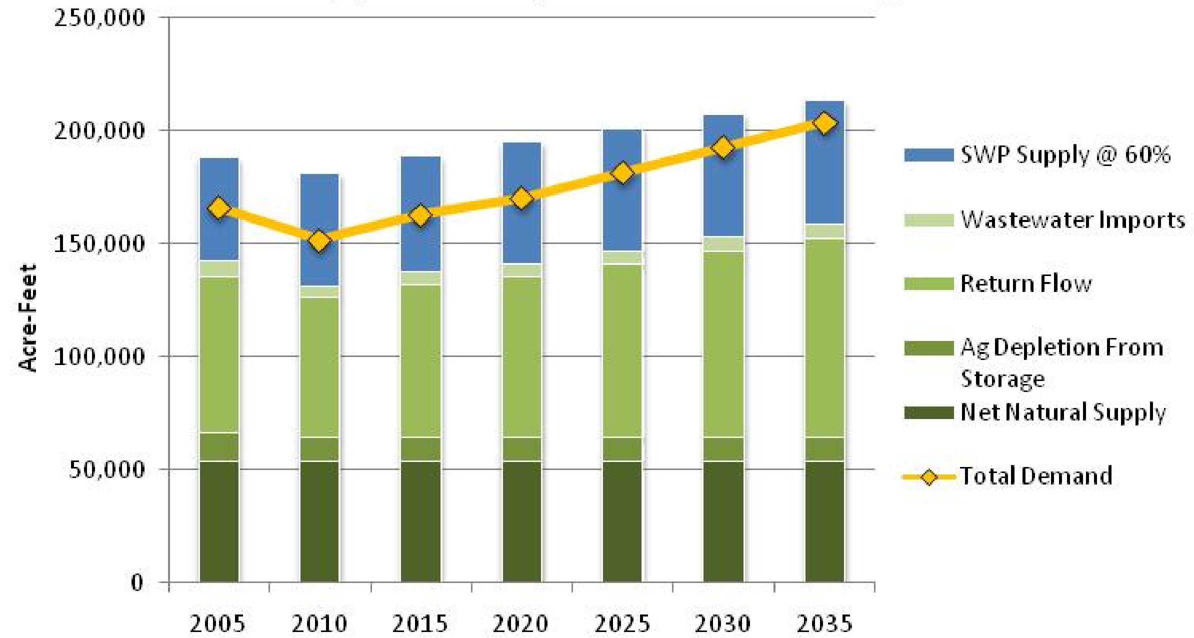
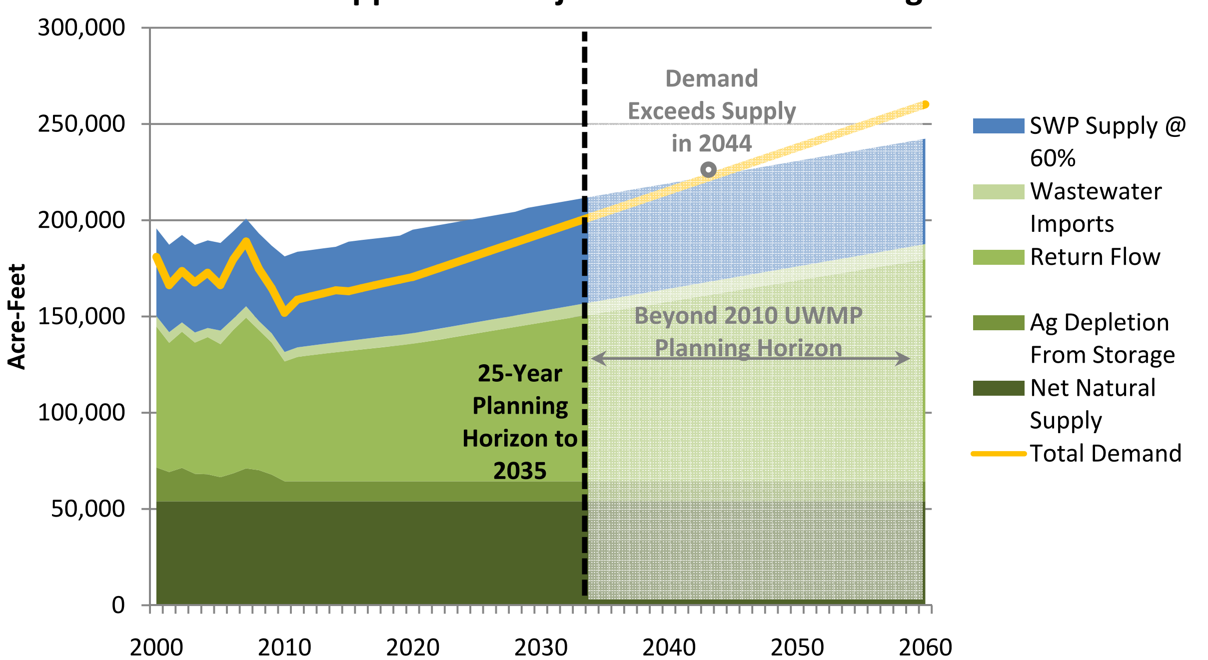


Figure ES-2
Water Supplies vs. Projected Demands Through 2060



ES-4 Recycled Water

MWA does not have the authority to determine how or where recycled water is used. This chapter simply identifies existing and projected wastewater flows by the wastewater agencies within the MWA service area, and potential opportunities for the use of recycled water. Such use could serve to augment the overall water portfolio of the MWA service area. The possible treated wastewater/potential recycled water flow projected to be available is shown in Table ES-1.

TABLE ES-1
TREATED WASTEWATER/POTENTIAL RECYCLED WATER SUMMARY

	Flows (AFY)					
Agency	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
City of Adelanto[(a)]	2,800	4,481	8,177	12,322	19,042	19,042
City of Barstow[(a)]	2,800	4,929	7,057	9,185	11,313	11,313
Victorville Water District[(a)]	1,232	2,800	2,800	2,800	2,800	2,800
Victor Valley Wastewater Reclamation Authority[(a)]	14,450	16,578	19,042	21,843	24,979	28,564
Helendale Community Service District[(b)]	672	784	784	896	896	1,008
Hi-Desert Water District[(a)]	0	0	1,863	2,604	2,737	2,876
Marine Corps Logistics Base[(a)]	112	112	112	112	112	112
Total	**22,066**	**29,684**	**39,835**	**49,762**	**61,879**	**65,715**

Notes:
(a) See Table 4-8.
(b) See Table 4-4.

ES-5 Water Quality

This Chapter provides a general description of the water quality of both imported water and groundwater supplies. MWA water supplies meet all Environmental Protection Agency (EPA) and State water quality requirements. Water quality does not currently affect the reliability of supplies.

ES-6 Reliability Planning

The UWMP Act requires urban water suppliers to assess water supply reliability by comparing total projected water use with the expected water supply over the next twenty years in five year increments. The Act also requires an assessment for a single-dry year and multiple-dry years. In preparation for years when imported supplies are significantly reduced, MWA has developed a groundwater banking program which stores surplus SWP supplies in local groundwater basins. As of December 2010, MWA banked 95,454 acre-feet (af), not including retailer-owned banked water. During years when imported supplies are reduced below demands, MWA draws from banked supplies.

The water supplies and demands for MWA's service area go beyond the Act requirements by analyzing a 20-year planning period. For example, supplies and demands were analyzed in the event that a single-dry year occurs, similar to the drought that occurred in California in 1977 (the driest year on record). During such a dry year, SWP availability is anticipated to be reduced to 7 percent in 2009 and 11 percent in 2029. Table ES-2 summarizes the existing and planned supplies available to meet demands during a single-dry year. Demand during dry years was assumed to increase by 10 percent due to increased irrigation needs. MWA has adequate supplies to meet demands during average, single-dry, and multiple-dry years throughout the 20-year planning period.

TABLE ES-2
PROJECTED SINGLE-DRY YEAR SUPPLIES AND DEMAND (AFY)

Water Supply Source	2010	2015	2020	2025	2030	2035
Existing Supplies						
Wholesale (Imported)						
SWP[(a)]	5,796	6,006	6,286	6,286	9,878	9,878
Local Supplies[(b)]						
Net Natural Supply	54,045	54,045	54,045	54,045	54,045	54,045
Agricultural Depletion from Storage	10,425	10,425	10,425	10,425	10,425	10,425
Return Flow	62,220	67,766	71,353	76,862	82,364	87,857
Wastewater Import	5,304	5,397	5,491	5,789	6,087	6,385
Groundwater Banking Projects[(b,c,d)]	29,284	35,838	39,946	46,507	49,467	56,009
Total Existing Supplies	**167,074**	**179,477**	**187,546**	**199,914**	**212,266**	**224,599**
Planned Supplies						
Groundwater Banking Projects[(e)]	0	0	0	0	0	0
Total Supplies	**167,074**	**179,477**	**187,546**	**199,914**	**212,266**	**224,599**
Total Estimated Demands[(f)]	***167,074***	***179,477***	***187,546***	***199,914***	***212,266***	***224,599***

Notes:

(a) SWP supplies are calculated by multiplying MWA's Table A amount by percentages of single-dry deliveries projected to be available for the worst case single dry year of 1977 (7% in 2009 and 11% in 2029), taken from Tables 6.40 and 6.13 of DWR's 2009 SWP Reliability Report.

(b) Taken from Chapter 3 Water Resources, Table 3-1.

(c) Assumed 100% available during single-dry year. Refer to Section 6.3.2.

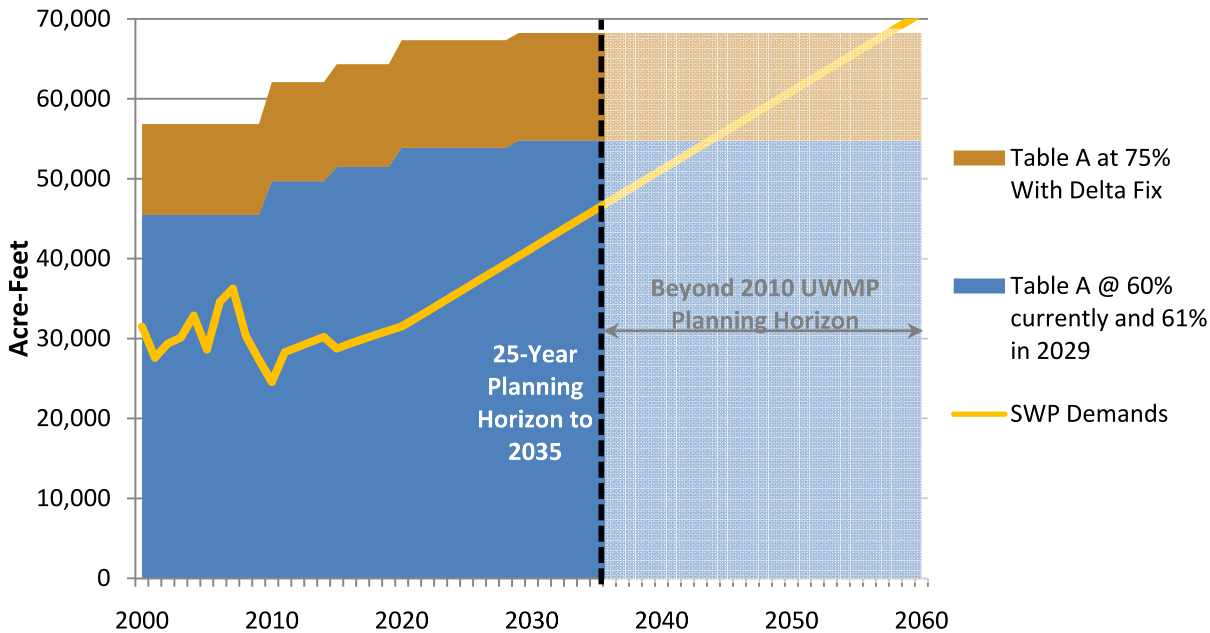
(d) Existing banked SWP water in MWA groundwater storage accounts (See Section 6.3.3 and Table 3-13). This does not include any retailers' stored water. Amounts reflect stored water needed to meet demand after all other supplies are used.

(e) Planned banked supplies are not needed under a single-dry year scenario (current banked amounts are sufficient to meet demands).

(f) See Chapter 2 Water Use, Table 2-3, assuming "moderate" conservation. Also assumes increase in total demand of 10 percent during dry years.

The Plan acknowledges that, on average, SWP reliability is anticipated to equal 60 to 61 percent of MWA's "Table A Amount," based on the 2009 SWP Delivery Reliability analysis prepared by the Department of Water Resources for MWA. However, SWP reliability may increase to 75 percent in the future if Delta conveyance facilities are built ("Delta Fix"). MWA's water supply projections do not rely on a Delta Fix, but do recognize the potential for increased SWP reliability due to a Delta Fix. Figure ES-3 presents a visual display of how MWA's Table A amount will be able to meet anticipated demand for imported supply using long-term average trends in SWP supply with and without a Delta Fix.

Figure ES-3
State Water Project Supplies vs. SWP Demands

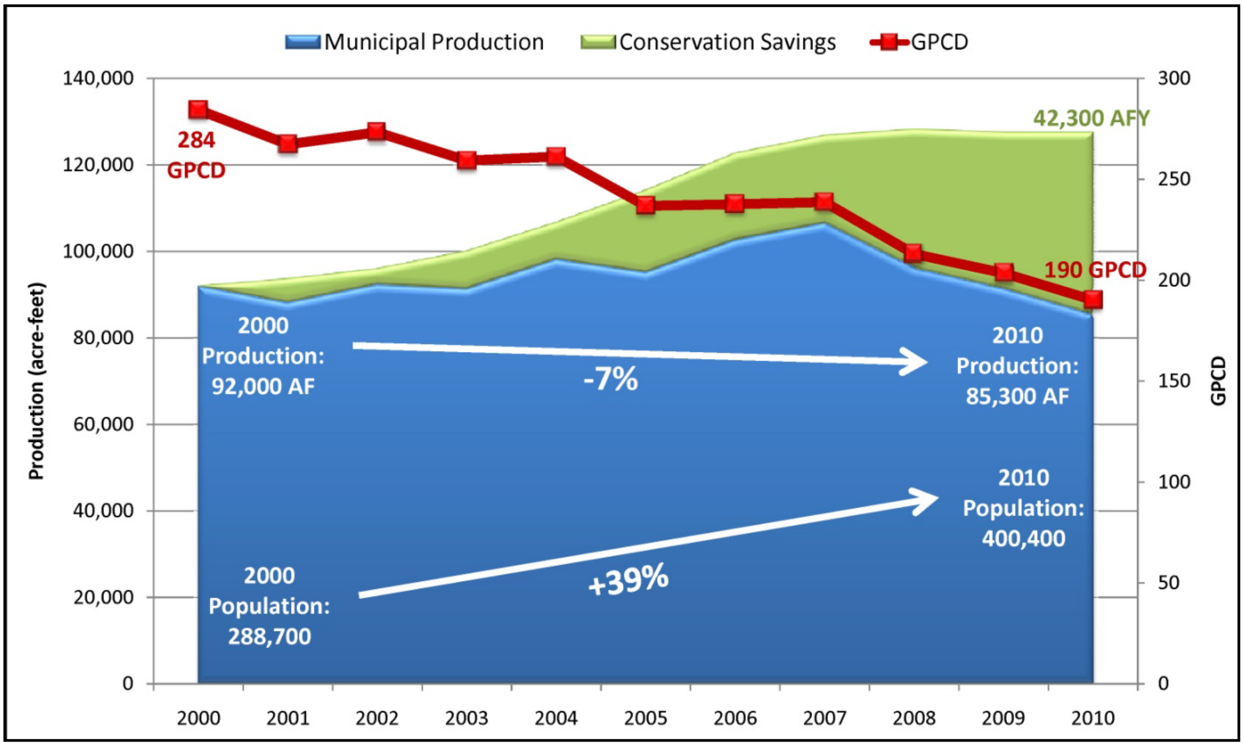


ES-7 Water Demand Management Measures

MWA and the Alliance for Water Awareness and Conservation (AWAC) have formed water use efficiency goals for the region encompassed by MWA. AWAC is a coalition of 25 local water agencies and other regional organizations with the goal of promoting efficient water use and increasing the community's awareness of the importance of water conservation. AWAC set a goal of achieving a reduction in per capita water use of 20 percent by 2020 in the Mojave Basin Area and 5 percent by 2015 in the Morongo Area. Water savings data indicate that the MWA service area is well on track to meeting its AWAC goals. Since 2000, per capita use has dropped by about 33 percent and since 2004, when the AWAC goals were set, per capita use has dropped by about 27 percent. It is expected that some portion of the recent reduction in use is related to the economic downturn and may show some "bounce back" as conditions recover, however the overall trend in the MWA service area points to consistent and sustained reductions in per capita water use.

Population growth and per capita municipal production volume data have been tracked and correlated with the implementation of the AWAC regional conservation activities starting in August 2003. Figure ES-4 shows municipal production over time coupled with per capita use and population growth for the Mojave Groundwater Basin. Municipal production has fallen approximately 7 percent or 6,700 af between 2000 and 2010; at the same time population grew by almost 40 percent. The savings of 42,300 af represent how much higher use would have been without any reduction in per-capita use.

FIGURE ES-4
WATER USE PATTERNS AND CONSERVATION FOR MOJAVE GROUNDWATER BASIN



ES-8 Water Shortage Contingency Planning

MWA is in an excellent position to handle a six-month emergency outage scenario, due to the storage of SWP water in local groundwater basins it has undertaken over the last several years and the long term buffering capacity of local aquifers. As mentioned in Section ES-6, MWA currently has 95,454 af banked in groundwater storage, not including water banked in individual retailer storage accounts. For the six-month outage, no additional conservation would be required.

Section 1: Introduction

1.1 Overview

This document presents the wholesale Urban Water Management Plan 2010 (Plan) for the Mojave Water Agency (Agency, MWA) service area. This chapter describes the general purpose of the Plan, discusses Plan implementation, and provides general information about MWA, retail water purveyors, and service area characteristics. A list of acronyms and abbreviations is also provided.

1.2 Purpose

An Urban Water Management Plan (UWMP) is a planning tool that generally guides the actions of water management agencies. It provides managers and the public with a broad perspective on a number of water supply issues. It is not a substitute for project-specific planning documents, nor was it intended to be when mandated by the State Legislature. For example, the Legislature mandated that a plan include a Section which "describes the opportunities for exchanges or water transfers on a short-term or long-term basis." (California Urban Water Management Planning Act, Article 2, Section 10630(d).) The identification of such opportunities, and the inclusion of those opportunities in a general water service reliability analysis, neither commits a water management agency to pursue a particular water exchange/transfer opportunity, nor precludes a water management agency from exploring exchange/transfer opportunities not identified in the plan. When specific projects are chosen to be implemented, detailed project plans are developed, environmental analysis, if required, is prepared, and financial and operational plans are detailed.

In short, this Plan is a management tool, providing a framework for action, but not functioning as a detailed project development or action. It is important that this Plan be viewed as a long-term, general planning document, rather than as an exact blueprint for supply and demand management. Water management in California is not a matter of certainty, and planning projections may change in response to a number of factors. From this perspective, it is appropriate to look at the Plan as a general planning framework, not a specific action plan. It is an effort to generally answer a series of planning questions including:

- What are the potential sources of supply and what is the reasonable probable yield from them?
- What is the probable demand, given a reasonable set of assumptions about growth and implementation of good water management practices?
- How well do supply and demand figures match up, assuming that the various probable supplies will be pursued by the implementing agency?

Using these "framework" questions and resulting answers, the implementing agency will pursue feasible and cost-effective options and opportunities to meet demands. MWA will explore enhancing basic supplies from traditional sources such as the State Water Project (SWP) as well as other options. These include demand management, groundwater extraction, water exchanges, recycling, desalination, and water banking/conjunctive use. Specific planning efforts will be undertaken in regard to each option, involving detailed evaluations of how each option would fit into the overall supply/demand framework, how each option would impact the environment, and how each option would affect customers. The objective of these more detailed evaluations would be to find the optimum mix of conservation and supply programs that ensure that the needs of the customers are met.

The California Urban Water Management Planning Act (Act) requires preparation of a plan that:

- Accomplishes water supply planning over a 20-year period in five year increments. (MWA and the retailers are going beyond the requirements of the Act by developing a plan which spans 25 years.)
- Identifies and quantifies adequate water supplies, including recycled water, for existing and future demands, in normal, single-dry, and multiple-dry years.
- Implements conservation and efficient use of urban water supplies. Significant new requirements for quantified demand reductions have been added by the enactment of SBX7-7, which amends the Act.

A checklist to ensure compliance of this Plan with the Act requirements is provided in Appendix A.

In short, the Plan answers the question: *Will there be enough water for the communities within the Mojave Water Agency in future years, and what mix of programs should be explored for making this water available?*

It is the stated goal of MWA to manage water resources through or in conjunction with the State Water Project to meet future demands while maintaining independence during periods of water shortages. Based on conservative water supply and demand assumptions over the next 25 years in combination with conservation of non-essential demand during certain dry years, the Plan successfully achieves this goal. It is important to note that this document has been completed to address regional resource management and does not address the particular conditions of any specific retail water agency or entity within the MWA service area. The retailers within MWA service area are preparing their own separate UWMPs, but MWA has coordinated with the retailers during development of this Plan to ensure a level of consistency with the retailers.

1.3 Implementation of the Plan

The MWA service area includes the service areas of forty-six (46) local retail water agencies, with ten being required to prepare an individual UWMP because they provide water to more than 3,000 service connections or supplies more than 3,000 acre-feet (af) of water annually. The ten retail water purveyors within MWA's service area that are required to prepare their own UWMP are as follows:

- City of Adelanto
- Apple Valley Ranchos Water Company
- San Bernardino County Service Area (CSA) 64

- CSA 70J
- Golden State Water Company (GSWC) – Barstow system (formerly Southern California Water Company)
- Hesperia Water District
- Hi-Desert Water District
- Joshua Basin Water District
- Phelan Piñon Hills Community Services District (PPHCSD) (this Community Services District (CSD) was formed in 2008 and used to be CSA 70L)
- Victorville Water District (formed through the consolidation of the Baldy Mesa Water District and the Victor Valley County Water District into the City of Victorville in 2007)

This subsection provides the cooperative framework within which the Plan will be implemented including agency coordination, public outreach, and resources maximization.

1.3.1 Cooperative Preparation of the Plan

Wholesale water agencies are permitted by the State to either work independently to develop a wholesale UWMP or they can coordinate their planning with retail agencies within their service area to develop a cooperative regional plan. The former approach has been adopted by the MWA; however, the Plan was developed with a high degree of coordination with the retail water agencies within the MWA service area. Water resource specialists with expertise in water resource management were retained to assist the local water agencies in preparing the details of their Plans. Agency coordination for this Plan is summarized in Table 1-1.

TABLE 1-1
AGENCY COORDINATION SUMMARY

	Participated in UWMP Development	Received Copy of Draft	Comment on Draft	Attended Public Meetings	Contacted for Assist	Sent Notice of Intent to Adopt
City of Adelanto	✓	✓		✓	✓	✓
Apple Valley Ranchos Water Company	✓	✓		✓	✓	✓
California Department of Water Resources		✓				✓
County Service Area (CSA) 64	✓	✓		✓	✓	✓
CSA 70J	✓	✓		✓	✓	✓
Golden State Water Company	✓	✓		✓	✓	✓
Hesperia Water District	✓	✓		✓	✓	✓
Hi-Desert Water District	✓	✓		✓	✓	✓
Joshua Basin Water District	✓	✓	✓	✓	✓	✓
Phelan Piñon Hills CSD	✓	✓	✓	✓	✓	✓
San Bernardino County Planning Department		✓				✓
Town of Apple Valley		✓				✓
Victorville Water District	✓	✓		✓	✓	✓

1.3.2 Plan Adoption

MWA began preparation of this Plan for the MWA service area in December 2009. The final draft of the Plan was adopted by the Agency Board in June 2011 and submitted to DWR within 30 days of Board approval. This Plan includes all information necessary to meet the requirements of Water Conservation Act of 2009 (Wat. Code, §§ 10608.12-10608.64) and the Urban Water Management Planning Act (Wat. Code, §§ 10610-10656).

1.3.3 Public Outreach

The MWA has encouraged community participation in water planning. For the current Plan, public sessions were held for review and to solicit input on the Draft Plan before its adoption. Interested groups were informed about the development of the Plan along with the schedule of public activities. Notices of the Public Hearing were published in the local press. Copies of the Draft Plan were made available at the water agencies' offices, local public libraries and sent to the County of San Bernardino as well as interested parties.

MWA coordinated the preparation of the Plan with the local community. MWA notified the cities and counties within its service area of the opportunity to provide input regarding the Plan. Monthly Technical Advisory Committee (TAC) meetings were held at MWA between March and August 2010, and bi-monthly TAC meetings from October 2010 thru April 2011, where the retail purveyors and other public entities were invited to hear discussions on the development, status, and progress of MWA's 2010 UWMP. Table 1-2 presents a timeline for public participation during the development of the Plan. A copy of the public outreach materials, including paid advertisements, newsletter covers, website postings, and invitation letters are attached in Appendix B.

TABLE 1-2
PUBLIC PARTICIPATION TIMELINE

Date	Event	Description
March 3, 2010	Kick-off Community Workshop	Describe UWMP requirements and process
April 7, 2010	General Information	Information about UWMP Development Process
April 8, 2010	Wholesale UWMP decision	Board of Directors decided to develop a wholesale-only UWMP but provide assistance to retail water agencies as needed for consistency
May 12, 2010	Model Review	Demand Forecast Model Described
June 2, 2010	SBX7-7 Calculations	Draft SBX7-7 Calculations for Retailers Provided
July 7, 2010	DMM Workshop	Demand Management Measures Workshop for Retailers
August 4, 2010	General Progress Update	Update to TAC on status of plan writing
October 6, 2010	DWR SBX7-7 Methodologies	Description of DWR 20x2020 calculation methodologies 1 thru 3
December 8, 2010	Preliminary Draft Projections	Preliminary Draft population and water demand projections for MWA and retailers
January 27, 2011	Draft UWMP Workshop	Workshop for MWA Board of Directors
February 2, 2011	General Progress Update	Update to TAC on status of plan writing

Date	Event	Description
February 5, 2011	Notice to Cities and County	Start of 60-day notice
April 5, 2011	Public Notice	Start of 30-day Notice of Public Hearing
April 6, 2011	Draft UWMP Workshop	Workshop for TAC to review Draft UWMP
April 14, 2011	Draft UWMP Workshop	Workshop for MWA Board of Directors
May 5, 2011	First MWA Public Hearing	Review contents of Draft UWMP and take comments at MWA Board Meeting
June 9, 2011	Second MWA Public Hearing	UWMP considered for adoption by the MWA Board
July 2011	Plan Submittal	File Final UWMP with DWR within 30 days of adoption

The components of public participation include:

Local Media

- Paid advertisements in local newspapers

Community-based Outreach

- Building Industry Association
- Chambers of Commerce included in MWA Service Area
- Farm Bureau
- Sierra Club
- Various property owners associations
- Victor Valley Museum
- Victor Valley NAACP
- Victorville AARP

Water Agencies Public Participation

- Presentation(s) to MWA Board and Technical Advisory Committee – see Table 1-2
- Notice sent to subarea advisory committee members

City/County & Other Government Outreach

- Meetings with various City Planning and Land Use Agencies – see Table 1-1
- Notice sent to various Local, County, State, and Federal agencies

Public Availability of Documents

- Mojave Water Agency website
- Local libraries

1.3.4 Resources Maximization

Several documents were developed to enable MWA to maximize the use of available resources and minimize use of imported water, including the *Mojave Water Agency 2004 Regional Water Management Plan* (Regional Plan), which included:

- Integrated Regional Water Management Plan
- Groundwater Management Plan
- Urban Water Management Plan

Chapter 3 of this Plan describes in detail the water supply available to MWA and the retail purveyors for the 20-year period covered by this Wholesale Plan. Additional discussion regarding documents developed to maximize resources is included in Section 3.3 and Chapter 6.

1.4 Water Management Within the MWA Service Area

1.4.1 Mojave Water Agency

The MWA was founded July 21, 1960, due to concerns over declining groundwater levels. The Agency was created for the explicit purpose of doing "*any and every act necessary, so that sufficient water may be available for any present or future beneficial use of the lands and inhabitants within the Agency's jurisdiction*."[2] The Mojave Water Agency is one of 29 State Water Project (SWP) contractors that together provide 20 million Californians with drinking water and irrigation water for 750,000 acres of farmland. MWA serves an area of 4,900 square miles of the High Desert in San Bernardino County as shown on the vicinity map on Figure 1-1.

For management purposes, the Mojave Water Agency generally separates its service area into six management areas, including the five subareas of the adjudicated Mojave Basin Area (Alto, Baja, Centro, Este, and Oeste) and the Morongo Basin/Johnson Valley Area (referred to throughout this document as "Morongo" or the "Morongo Area"). Section 1.4.2 describes the adjudications within the MWA, and Figure 1-2 depicts the management areas and adjudicated areas within the MWA.

[2] MWA Law, Chapter 97-1.5, dated July 21, 1960.

FIGURE 1-1
MWA VICINITY MAP

MWA currently has a contract for up to 82,800 acre-feet per year (afy) of “Table A” (a schedule of the maximum amount of water any SWP contractor can receive annually according to its contract with the state) water from the SWP through 2014, with an additional 3,000 af beginning in 2015 and another 4,000 in 2020, for a total of 89,800 af. Due to reliability issues, actual SWP supply is reduced to an estimated long-term average of 60 percent of total Table A[3] (53,880 afy of long-term supply in 2020), with 61 percent of total Table A (54,778 afy) being available from 2029 and after.

Though the reliability of SWP water is variable due to weather-related issues and environmental factors, SWP water remains an important supplemental water supply source for the MWA service area in the long-term. An important element to enhancing the long-term water supply reliability of SWP supplies is the effective use of water banking/conjunctive use programs, such as those described in this Plan.

1.4.2 Adjudications within the MWA Service Area

Mojave Basin Area

The Adjudication of the Mojave Basin Area (see Figure 1-2) was the legal process that allocated the right to produce water from the available natural water supply. Until adjudication proceedings were initiated and an independent Court issued the Mojave Basin Area Judgment, water production rights and obligations had never been defined in the Mojave Basin. Triggered by the rapid growth within the Mojave Water Agency service area, particularly in the Victor Valley area (The cities of Adelanto, Apple Valley, Hesperia, Victorville and surrounding communities), the City of Barstow and the Southern California Water Company filed a complaint in 1990 against upstream water users claiming that the increased withdrawals and lowering of groundwater levels reduced the amount of natural water available to downstream users. The complaint requested that 30,000 af of water be made available to the Barstow area annually and that MWA obtain supplemental water for use in other areas of MWA’s service area.

About a year later, the Mojave Water Agency filed a cross-complaint which declared that the native waters of the Mojave River and underlying groundwater were insufficient to meet the current and future demands made upon them. The cross-complaint asked the court to determine the water rights of all surface water and groundwater users within the Mojave Basin Area and the Lucerne and El Mirage Basins. During the following two years, negotiations resulted in a proposed Stipulated Judgment that: 1) formed a minimal class of producers using 10 afy or less who were dismissed from the litigation, and 2) offered a physical solution (an equitable remedy designed to alleviate overdrafts in a basin, consistent with the constitutional mandate to prevent waste and unreasonable water use and to maximize the beneficial use of the limited resource) for water production by the remaining producers. The Riverside Superior Court bound the stipulating parties to the Stipulated Judgment in September 1993, and further bound the non-stipulating parties to the terms of the Stipulated Judgment in January 1996 following trial. The Court appointed MWA as Watermaster of the Mojave Basin Area. The text of the Stipulated Judgment can be found in Appendix C.

Some of the non-stipulating parties appealed the Judgment of the Superior Court and the Appellate Court issued a final decision in June 1998. The final decision of the Appellate Court

[3] DWR State Water Project Delivery Reliability Report 2009.

held the stipulating parties to the terms of the Stipulated Judgment, but excluded the appealing parties, with the exception of one appellant who sought a revised water production right under the Judgment. MWA requested the California Supreme Court to review the Appellate Court's decision in July 1998. The Supreme Court affirmed the Appellate Court's decision in August 2000, regarding the Stipulated Judgment and the exclusion of the appealing parties from the Judgment, but over-turned the decision of the Appeals Court as to the one party seeking additional production rights. Since 1996, most of the appealing parties have stipulated to the Judgment.

For management purposes under the Mojave Basin Judgment, MWA split the Mojave River watershed and associated groundwater basins into five separate "subareas." The locations of the five subareas; 1) Oeste, 2) Este, 3) Alto, 4) Centro and 5) Baja are shown on Figure 1-2. The subarea boundaries are generally based on hydrologic divisions defined in previous studies (California Department of Water Resources (DWR) 1967), evolving over time based on a combination of hydrologic, geologic, engineering and political considerations. Also for the purposes of implementing the Judgment, the northern part of the Alto Subarea was defined as a sub-management unit – the Alto Transition Zone; this zone was created to acknowledge local geology and to better address the water flow from Alto to Centro.

The Mojave Basin Judgment assigned Base Annual Production (BAP) rights to each producer using 10 afy or more, based on historical production during the period 1986-1990. Parties to the Judgment are assigned a variable Free Production Allowance (FPA), which is a uniform percentage of BAP set for each subarea each year by the Watermaster. This percentage is reduced or "ramped-down" over time until total FPA comes into balance with available non-SWP supplies. The FPA is set as follows for each subarea for water year 2011-2012:

- Alto Subarea - 80 percent of BAP for agriculture and 60 percent of BAP for municipal and industrial

- Oeste Subarea - 80 percent of BAP for agriculture and 65 percent of BAP for municipal and industrial

- Este Subarea - 80 percent of BAP

- Centro Subarea - 80 percent of BAP

- Baja Subarea – 62.5 percent of BAP

Any water user that pumps more than their FPA must purchase SWP replenishment water from the Watermaster equal to the amount of production in excess of the FPA, or transfer unused FPA from another party within the subarea.

Warren Valley Basin

The Warren Valley Basin adjudicated area is located within the Morongo Basin/Johnson Valley Area ("Morongo"). Groundwater from the Warren Valley Basin is used to supply the Town of Yucca Valley and its environs. Extractions from the Warren Valley Basin began exceeding supply in the 1950s. The progressively increasing overdraft led to adjudication of the Warren Valley Basin in 1977. In its Warren Valley Judgment (see Figure 1-3), the court appointed the

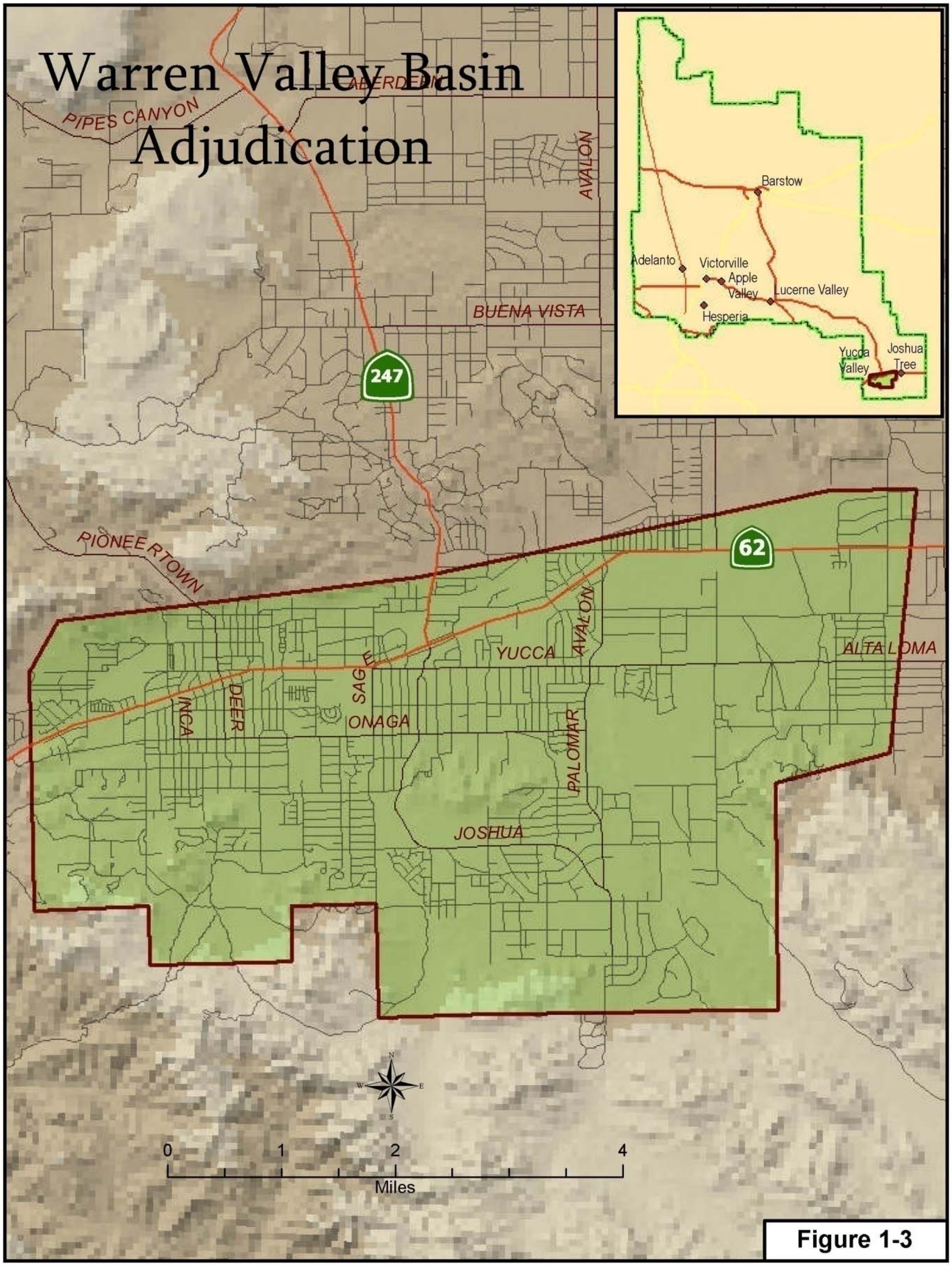
Hi-Desert Water District (HDWD) as Watermaster and ordered it to develop a physical solution for halting overdraft. Objectives identified by the Watermaster Board included managing extraction, importing water supplies, conserving stormwater, encouragement of conservation and reclamation, and protecting groundwater quality. A Basin Management Plan was adopted that called for importing SWP water from MWA through the then-proposed Morongo Basin Pipeline to balance demand and replenish past overdraft. The text of the Warren Valley Judgment can be found in Appendix D.

Ames Valley Basin

Although not a full adjudication, the court approved Ames Valley Basin Water Agreement is a 1991 Agreement between HDWD and Bighorn-Desert View Water Agency (BDVWA) for the construction and operation of the HDWD Mainstream Well in the Ames Valley Basin. At the time the Agreement was entered, the HDWD service area included areas within the Ames Valley Basin and the Warren Valley Basin. That agreement is currently being expanded to include all pumpers in the Ames Valley including CSA No. 70 and to provide a monitoring and management plan for operation of the Basin with the Ames Valley Recharge Project.

FIGURE 1-2
MWA ADJUDICATED BOUNDARY AND SUBAREAS

FIGURE 1-3
WARREN VALLEY BASIN ADJUDICATED BOUNDARY



1.4.3 Retail Water Purveyors

Ten retail purveyors provide water service to most residents within the MWA service area. All the retailers listed below, except those noted, supply water to their customers from local groundwater, which is replenished by MWA imported water.

- City of Adelanto's Water Department provides water service to the residents of Adelanto.
- Apple Valley Ranchos Water Company's (AVRWC's) service area covers approximately 50 square miles within Apple Valley and portions of the unincorporated area of San Bernardino County.
- CSA 64's service area includes the Spring Valley Lake community.
- CSA 70J's service area includes the Oak Hills community.
- Golden State Water Company's (GSWC) service area includes customers living in and around the City of Barstow.
- Hesperia Water District's service area includes the City of Hesperia.
- Hi-Desert Water District's service area includes the Town of Yucca Valley and portions of the unincorporated area of San Bernardino County.
- Joshua Basin Water District's service area includes portions throughout a 96-square mile area between Yucca Valley, Twentynine Palms, Joshua Tree National Park and the Twentynine Palms Marine Corps Base.
- Phelan Piñon Hills CSD's service area includes approximately 118 square miles of unincorporated area located at the transition between the foothills of the San Gabriel Mountains and southwestern portion of the Mojave Desert. The CSD was formed in 2008 after the dissolution of CSA 70L and all water and capacity rights and interests of the previous CSA were succeeded.
- Victorville Water District was consolidated by action of the Local Agency Formation Commission beginning August 15, 2007, from the Baldy Mesa Water District, Victor Valley Water District and the City of Victorville Water Department. The City of Victorville also has a connection from the MWA Mojave River Pipeline to provide SWP water for cooling a power plant. This same source is used to treat and then inject SWP water into the local groundwater basin for use when supplies for the power plant are not available from SWP.

The service areas of MWA and the retail water purveyors required to complete UWMPs are shown on Figure 1-4.

As of 2009, the ten (10) large retail water purveyors served approximately 121,800 connections, as presented in Table 1-3.

TABLE 1-3
RETAIL WATER PURVEYORS 2009 SERVICE AREA INFORMATION

Retail Water Purveyor	Service Area (sq. miles)	Connections
City of Adelanto	54	7,657
Apple Valley Ranchos Water Company	50	18,805
County Service Area (CSA) 64	3	3,743
CSA 70J	23[(a)]	3,013[(b)]
Golden State Water Company - Barstow	33.6	9,302
Hesperia Water District	74	25,838
Hi-Desert Water District	57	9,705
Joshua Basin Water District	96	4,426
Phelan Piñon Hills Community Services District (CSD)	118	6,769
Victorville Water District	85	32,561
	Total	**121,819**

Source is DWR annual Public Water System Statistics records.
Notes:
(a) Estimated from GIS data.
(b) Only 2008 data was available.

1.5 Climate

The Mojave Water Agency maintains a regional network of weather monitoring stations throughout the watershed; some are funded by MWA and others are maintained by various local and federal government agencies and citizen observers programs. The stations collect various weather data on temperature, precipitation, and evaporation. Rain gages are mostly located within the Mojave Basin Area and the surrounding mountains.

Representative precipitation, temperature, and average evapotranspiration (ETo) data are reported in Table 1-4. Runoff in the upper watershed contributes substantially more to the recharge of the basin than precipitation falling in the basin. Average rainfall within the lower lying areas of the Mojave Basin Area and Morongo Area is roughly five to seven inches per year. The large variation in annual rainfall within the surrounding mountains directly affects the annual water supply of the basin.

FIGURE 1-4
MWA SERVICE AREA AND LARGE RETAIL WATER PURVEYORS

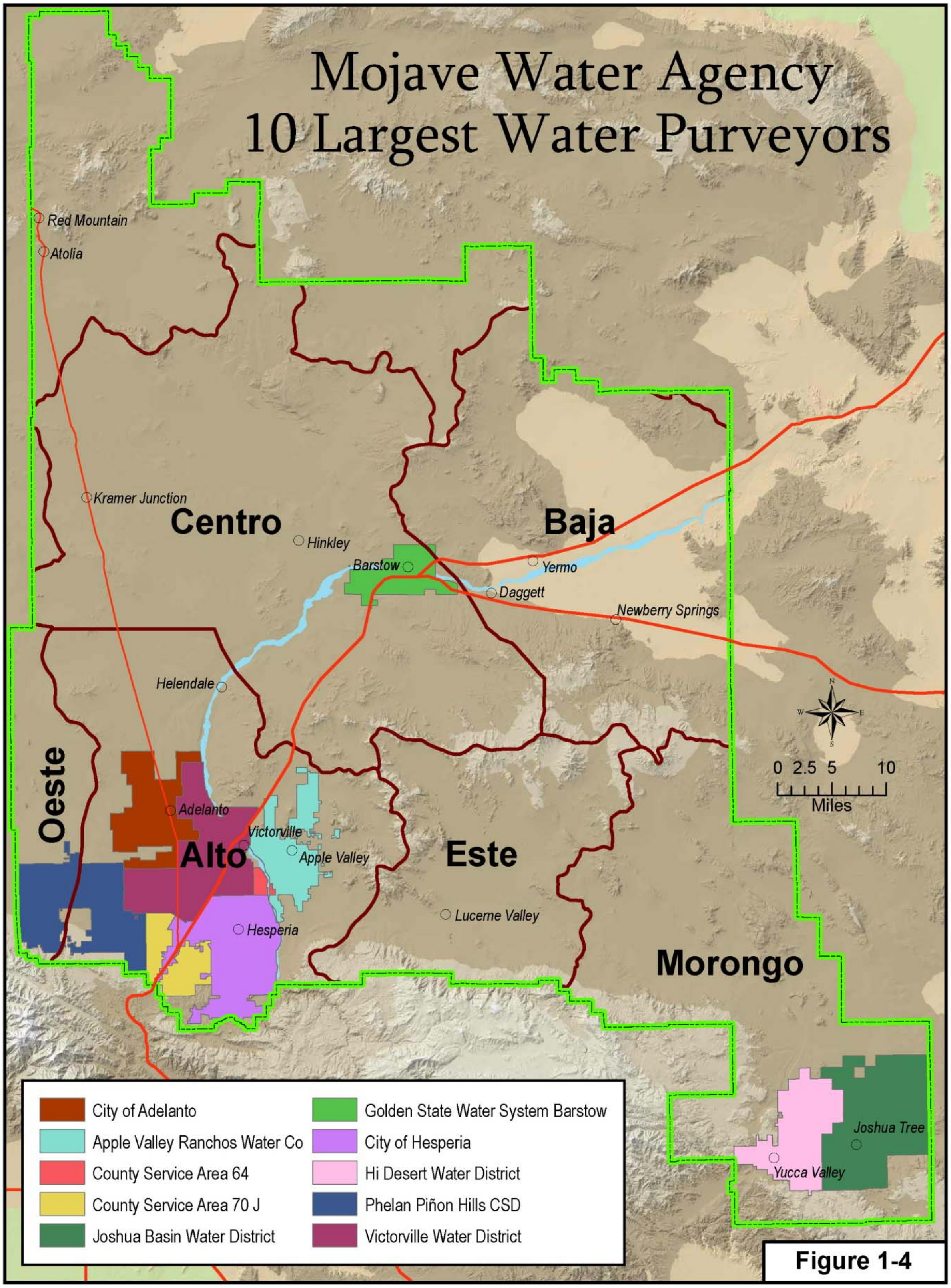


TABLE 1-4
CLIMATE DATA FOR THE MOJAVE WATER AGENCY

Station:	Barstow			Victorville		
	Total ETo (in)	Total Precip (in)	Avg Air Tmp (F)	Total ETo (in)	Total Precip (in)	Avg Air Tmp (F)
1997	73.1	11.6	66.1	68.4	6.4	61.4
1998	66.0	4.7	63.0	62.0	11.4	58.3
1999	74.0	2.6	64.7	67.8	3.2	60.0
2000	74.9	1.5	66.3	68.4	3.4	61.2
2001	74.8	5.7	66.6	67.3	6.9	61.5
2002	74.6	8.3	65.9	69.6	2.4	61.0
2003	71.8	4.5	66.6	66.6	12.4	61.5
2004	71.9	8.8	65.3	66.2	13.6	60.6
2005	66.6	13.2	64.7	64.6	13.2	60.6
2006	70.2	2.1	65.6	68.1	4.1	60.8
2007	70.4	1.6	66.4	71.2	3.3	61.5
2008	73.2	2.7	66.1	68.7	3.7	61.3
2009	71.0	1.5	65.4	66.1	3.0	58.9
Avg	**71.7**	**5.3**	**65.6**	**67.3**	**6.7**	**60.7**

Sources:
http://www.wrcc.dri.edu/cgi-bin/cliMAIN.pl?cavict+sca
http://wwwcimis.water.ca.gov/cimis/frontMonthlyEToReport.do

1.6 Potential Effects of Global Warming

A topic of growing concern for water planners and managers is global warming and the potential impacts it could have on California's future water supplies. DWR's California Water Plan Update 2009 considers how climate change may affect water availability, water use, water quality, and the ecosystem.[4]

Volume 1, Chapter 5 of the California Water Plan, "Managing an Uncertain Future," evaluated three different scenarios of future water demand based on alternative but plausible assumptions on population growth, land use changes, water conservation and also future climate change might have on future water demands. Future updates will test different response packages, or combinations of resource management strategies, for each future scenario. These response packages help decision-makers, water managers, and planners develop integrated water management plans that provide for resources sustainability and investments in actions with more sustainable outcomes. Further detailed guidance is currently being developed by the State of California and the United States (US) Environmental Protection Agency for use in integrated regional water management planning.

1.7 Other Demographic Factors

Over the past decade the area (along with most of California) experienced significant increases in both single family and multi-family residential construction, as well as in commercial and industrial construction. As the local population has increased, the demand for water has also increased. However, the recent economic downturn, coupled with a three-year dry period

[4] Final California Water Plan Update 2009 Integrated Water Management: Bulletin 160.

during 2007-2010 when water conservation was promoted to consumers, has reduced demand on what may be an interim basis.

1.8 List of Abbreviations and Acronyms

The following abbreviations and acronyms are used in this report.

AB	Assembly Bill
ACOE	US Army Corps of Engineers
Act	California Urban Water Management Planning Act
af	acre-feet
afy	acre-feet per year
Agency	Mojave Water Agency
AVEK	Antelope Valley-East Kern Water Agency
AVRWC	Apple Valley Ranchos Water Company
AWAC	Alliance for Water Awareness and Conservation
AWWA	American Water Works Association
AWWARF	American Water Works Association Research Foundation
BAP	Base Annual Production
Basin	Mojave River Groundwater Basin
BBARWA	Big Bear Area Regional Wastewater Agency
BDCP	Bay Delta Conservation Plan
BDVWA	Bighorn-Desert View Water Agency
BMOs	Basin Management Objectives
BMPs	Best Management Practices
CCF	One Hundred Cubic Feet
CCR	Consumer Confidence Report
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CII	Commercial Industrial and Institutional
CIMIS	California Irrigation Management Information System
County	San Bernardino County
CSA	County Service Area
CSD	Community Services District
CUWCC	California Urban Water Conservation Council
CVP	Central Valley Project
DBP	Disinfection by-products
Delta	Sacramento-San Joaquin Delta
DFG	California Department of Fish and Game
DMM	Demand Management Measures
DOF	California Department of Finance
DPSG	Dr. Pepper Snapple Group

DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
EC	Electrical conductivity
Edison	Southern California Edison
EDU	Equivalent Dwelling Unit
EIR	Environmental Impact Report
EPA	Environmental Protection Agency
ESRI	Environmental Systems Research Institute
ETo	Evapotranspiration
FPA	Free Production Allowance
GIS	Geographic Information System
GPCD	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
GSWC	Golden State Water Company
GW	Groundwater
GWMP	Groundwater Management Plan
HDPP	High Desert Power Project
HDWD	Hi-Desert Water District
HECW	high efficiency clothes washers
HET	high efficiency toilet
JBWD	Joshua Basin Water District
MAF	million acre-feet
M&I	Municipal and Industrial
MCL's	Maximum Contaminant Levels
MCLB	Marine Corps Logistics Base
MBAW	Mojave Basin Area Watermaster
MEEC	Mojave Environmental Education Consortium
Metropolitan	Metropolitan Water District of Southern California
MFR	Multi-Family Residential
MGD	million gallons per day
mg/L	milligrams per liter
MP	Minimal Producers
Morongo	Morongo Basin/Johnson Valley Area
MOU	Memorandum of Understanding
MMRP	Mitigation, Monitoring and Reporting Program
MWA, Agency	Mojave Water Agency
NPDES	National Pollutant Discharge Elimination System
PG&E	Pacific Gas & Electric
PID	Public Improvement District
Plan	Urban Water Management Plan 2010
PPHCSD	Phelan Piñon Hills Community Services District

PSY	Production Safe Yield
PUC	California Public Utilities Commission
PWSS	Public Water System Statistics
R^3	Regional Recharge and Recovery Project
RAP	Remedial Action Plan
Regional Board	Lahontan Regional Water Quality Control Board
RO	Reverse Osmosis
RTP	Regional Transportation Plan
Regional Plan, RWMP	2004 Integrated Regional Water Management Plan
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
SBX7-7	Senate Bill 7 of Special Extended Session 7
SD	Sanitation District
SCAG	Southern California Association of Governments
SCG	Southern California Gas
SCLA	Southern California Logistics Airport
SDD	Special Districts Department
SFR	Single Family Residential
SWP	State Water Project
TAC	Technical Advisory Committee
TAZ	Traffic Analysis Zones
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
umhos/cm	Micromhos per centimeter
USGS	US Geological Survey
UWMP	Urban Water Management Plan
VVWRA	Victor Valley Wastewater Reclamation Authority
VWD	Victorville Water District
WC	water conservation
WCIP	Water Conservation Incentive Program
WIRP	Water Infrastructure Restoration Program
WRF	Water Reclamation Facility
WRP	Wastewater Reclamation Plant
WWTP	Wastewater Treatment Plant

Section 2: Water Use

2.1 Overview

This chapter describes historic and current water usage and the methodology used to project future demands within Mojave Water Agency's (MWA's) service area. Water usage is divided into sectors such as residential, industrial, institutional, landscape, agricultural, and other purposes. To undertake this evaluation, existing land use data and new housing construction information were compiled from each of the retail water purveyors and projections prepared in the Mojave Water Agency 2004 Regional Water Management Plan (RWMP).[5] The RWMP is the master plan for MWA water management activities through the year 2020. This information was then compared to historical trends for new water service connections and customer water usage information. In addition, weather and water conservation effects on historical water usage were factored into the evaluation.

For the 2010 UWMP, a demand forecast model was developed that combines population growth projections with water use data to forecast total water demand in future years. Water uses were broken out into specific categories and assumptions made about each to more accurately project future use. Three separate data sets were collected and included in the model: current population, current water use by type, and projected population.

2.2 Population

Population data for 2000 through 2010 were estimated by subarea by MWA. Using draft Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan (RTP) growth forecast (baseline of 2008), it is predicted that the Mojave Water Agency service area will grow at a rate of approximately 2.5 percent per year from 2010 through 2035. Table 2-1 uses the assumption that each of the subareas grow at the nearest city-wide rate, with the Alto subarea having the highest annual change in rate at 2.7 percent over the 2010-2035 period.

TABLE 2-1
CURRENT AND PROJECTED POPULATION ESTIMATES - MWA SERVICE AREA

Subarea	2005	2010	2015	2020	2025	2030	2035	Annual % Change 2010-2035
Alto	302,389	341,421	387,124	432,826	479,786	526,746	573,705	2.7%
Baja	5,414	5,570	6,280	6,990	7,661	8,332	9,004	2.5%
Centro	34,716	36,145	39,840	43,535	47,010	50,485	53,960	2.0%
Este	6,680	7,695	8,528	9,361	10,169	10,977	11,785	2.1%
Oeste	9,206	9,582	10,310	11,038	11,738	12,437	13,136	1.5%
Morongo	36,434	36,944	38,931	40,918	42,211	43,504	44,798	0.9%
Total MWA Region	**394,839**	**437,357**	**491,013**	**544,668**	**598,575**	**652,481**	**706,388**	**2.5%**

Note: 2010 data is current based upon 2009 estimate and is not a projected number.

[5] Schlumberger Water Services, September 2004, "Mojave Water Agency 2004 Regional Water Management Plan."

Current population was estimated using three data sets. Baseline population was derived from 2000 Census Block data by subarea using a Geographic Information System (GIS). Population data for the Year 2008 and 2009 was derived from the Environmental Systems Research Institute (ESRI) 2008 and 2009 estimates by Block Group using a GIS dataset purchased from Primary Data Source, a distributor of ESRI products. The geographies of some Block Groups, which are larger than Blocks, did not match up well with MWA subarea boundaries, decreasing the accuracy of the ESRI dataset. To correct this problem, the over-counted or under-counted populations were accounted for by adding or removing those geographic areas to the totals using 2000 Census Block data interpolated forward to 2008 based upon the population change from 2000-2008 of the original ESRI Block Group subsets. Population from years 2001-2007 was interpolated using Single Family Residential house construction data from the San Bernardino County Assessor. ESRI did not publish Block Group estimates for 2010 because U.S. Census “actuals” are available instead. However, the Census data was not available in-time for the completion of this report, so population in 2010 was assumed to be equal to 2009. MWA boundaries and subareas are indicated on Figure 1-2, in the previous chapter.

Population growth projections in the model are based upon preliminary projections from the SCAG for their 2012 RTP. The “2012 projections” have a 2008 baseline, with projections for 2020 and 2035 for cities and for the county’s total unincorporated population. The 2012 projections will not be final until the RTP is adopted by SCAG, but are considered a better alternative than the adopted SCAG “2008 projections,” with a 2005 baseline, which contained very aggressive growth rates. In MWA staff’s opinion, the 2008 projections have become obsolete both because of the significant local growth that occurred after the 2005 baseline and overly aggressive future growth assumptions.

The disadvantage of the 2012 projections is they are only available by incorporated city—and have not yet been disaggregated into Traffic Analysis Zones (TAZ’s—similar size to Census Tracts), making it not possible to select SCAG’s projections for other geographies, such as unincorporated areas, subareas, or retail purveyor boundaries.

In order to make the 2012 SCAG projections useful to the MWA service area, the projections by city served as the basis for projecting population growth in other geographies, based upon the change in population from 2000-2008 for the subject area relative to the nearest city or cities. Subarea population was calculated as (population in cities) plus (unincorporated population). City population projections were taken from SCAG. Unincorporated population is assumed to grow at the same ratio relative to the city populations as what occurred from 2000-2008. Population projections were also developed for retail purveyors using the same method, as an option for them to use in their own 2010 Urban Water Management Plan’s (UWMP’s). For retailers that were located mostly within a city boundary, the SCAG projected growth rate for the city was applied to the retailer service area.

Approximately 10 percent of MWA's service area population is served by small water purveyors with less than 3,000 service connections or serving less than 3,000 afy. Also, a portion of the population is served by private wells and is not served by Urban Water Suppliers or small water purveyors. The sum of the MWA’s subarea populations (Table 2-1) is larger than the sum of the purveyors’ service area populations reported in their UWMPs due to there being multiple purveyors present in MWA’s service area that serve less than 3,000 service connections or supply less than 3,000 acre-feet (af) of water annually, and residential dwellings that are supplied with their own wells.

2.3 Historic Water Use

Predicting future water supply requires accurate historic water use patterns and water usage records. Figure 2-1 illustrates the change in water demand since 2000. Please note the Figure includes minimal water producers and two power plants that are supplied directly with State Water Project (SWP) water.

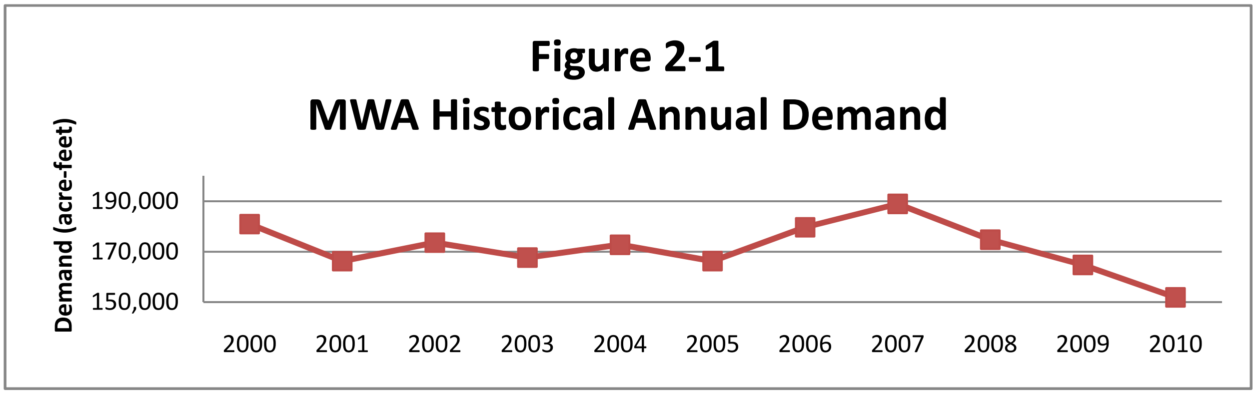


Table 2-2 presents the total water demand by subarea, including direct SWP supplies and Groundwater Pumping amounts, which are the historical groundwater pumping quantities for the Mojave Water Agency from 2000 through 2010.

TABLE 2-2
TOTAL WATER DEMAND BY SUBAREA (AFY)

Subarea	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Alto	90,801	84,968	88,968	93,108	97,776	97,491	103,413	106,838	95,552	91,531	87,001
Baja	41,020	37,661	38,931	32,871	31,769	28,484	32,118	35,735	33,514	29,279	23,653
Centro	30,695	26,127	26,946	24,534	24,399	22,563	24,313	26,262	25,843	25,644	25,071
Este	8,008	7,510	7,688	6,860	7,537	6,981	8,411	8,050	8,299	7,101	5,863
Oeste	5,016	4,462	5,248	4,962	5,430	4,882	5,152	5,690	5,766	5,207	4,502
Mojave Basin Area Total[(a)]	**175,540**	**160,728**	**167,781**	**162,335**	**166,911**	**160,401**	**173,407**	**182,575**	**168,974**	**158,762**	**146,090**
Morongo[(b)]	5,440	5,524	5,831	5,348	5,861	5,879	6,300	6,403	5,797	5,990	5,794
Total MWA	**180,980**	**166,252**	**173,612**	**167,683**	**172,772**	**166,280**	**179,707**	**188,978**	**174,771**	**164,752**	**151,884**

Notes:
(a) DWR Public Water System Statistics data for municipal water production, Mojave Basin Area Watermaster Annual Reports, Appendix L in water years (ending September 30) for non-municipal production (industrial, agricultural, lakes, and golf courses), plus minimal producers (estimated at 7,100 afy) and two power plants that are supplied directly with SWP water have been added to totals.
(b) MWA's Demand Forecast Model from historical data.

2.4 Projected Water Use

2.4.1 Water Use Data Collection

Current water use data were collected and broken out by water use sector into as much detail as possible, to allow for detailed analysis and for making different assumptions about each type of water use for future years. These assumptions became the basis for projections developed in MWA's population and water demand forecast computer model. Data was compiled from various sources, depending upon what data were available.

Mojave Basin Area Watermaster water-year data were used for minimal producers (individuals producing 10 acre-feet (af) or less of water within the boundaries of the Mojave Basin Area Judgment) and all parties to the Mojave Basin Area Judgment except water retailers. For retailers, the California Department of Water Resources (DWR) annual Public Water System Statistics (PWSS) (2009) data were used, if available, because they break out metered water deliveries by customer class and number of connections by customer class. Where DWR data were not available, water production and connection data were gathered from a combination of sources that provided a complete data set, including annual reports to the California Department of Public Health (CDPH), surveys sent out to retail water purveyors by the Alliance for Water Awareness and Conservation (AWAC), and data provided directly to MWA by retailers.

The combined data sources were considered accurate because for the Mojave Basin Area, combined yearly water use totals by subarea were generally within 2 percent of Mojave Basin Area Watermaster ("Watermaster") verified annual production numbers. In addition to water use data, the number of residential service connections was collected for each retailer to estimate service area population and per capita water use.

2.4.2 Water Use Projection Methodology

Water uses were broken into 11 categories, and assumptions were made about each to determine projections. Demand projections were based largely on population growth. Past and current population data were available by subarea and by retail water purveyor. Population and demand projections were provided to the retailers to use in their own UWMP's if desired; however, only projections by subarea have been included in the MWA UWMP.

The water uses identified below include those supplied by retail water purveyors as well as other parties to the Mojave Basin Area Judgment, Minimal Producers, and customers that MWA provides directly with SWP water. Retail water uses include Single-Family and Multi-Family Residential, Commercial Industrial and Institutional (CII), Unaccounted, Landscape Irrigation, and the "Other" category. Non-retail uses include Industrial, Recreational Lakes and Fish Hatcheries, Minimal Producers, Golf Courses, and Agriculture. Each category is explained and the assumptions used in the projection model are described below:

1. Single Family Residential (SFR): Single Family detached dwellings. SFR projections were made based upon gallons per capita per day (GPCD) and population (GPCD was converted to acre-feet per year (afy), multiplied by yearly SFR population to calculate demand in afy). The GPCD in years 2000-2010 was calculated in the model by converting total SFR demand to Gallons per Day and dividing by SFR population. A significant downward trend in GPCD has occurred within the Mojave Basin Area (from

214 GPCD in 2000 to 152 GPCD in 2010), while in the Morongo Basin/Johnson Valley Area ("Morongo") the GPCD is already low and has not changed significantly (average 113 GPCD from 2000 to 2010). Three possibilities were developed to book-end the possible range in future SFR GPCD based upon varying levels of conservation:

a. No conservation beyond the year 2010: GPCD remains flat at the 2010 level (152 GPCD in the Mojave Basin and 113 GPCD in the Morongo Area). This represents the high end of the range.

b. Extreme conservation on a regional basis: GPCD in the Mojave Basin decreases by 2020 to the current Morongo Area level of 113 GPCD, and GPCD in Morongo decreases 5 percent (to 107 GPCD). This represents the low end of the range.

c. Moderate conservation. Halfway between the high end of the range and the low end of the range as defined above (133 GPCD by 2020 for Mojave and 110 GPCD by 2020 for Morongo).

While a significant reduction in per-capita use has occurred in the Mojave Basin over the past decade, GPCD is still substantially higher than in the Morongo Area. Voluntary conservation programs, State-Mandated GPCD reductions, tiered rate structures at the retail level, and the continuously increasing cost of water will all influence future water demands. Recognizing these factors and that a substantial potential still exists for reductions in SFR per-capita use, Moderate conservation is anticipated to be the most likely future scenario, and is used in the SFR component of demand forecasts shown later in this chapter and in Chapter 3.

2. Multiple Family Residential (MFR): The MFR category is comprised of apartments, condominiums, townhouses, duplexes, and mobile home parks. Use is projected to increase in proportion to overall population growth, with a 2010 baseline.

3. Industrial Users: This category contains industrial use by entities that are parties to the Mojave Basin Area Judgment. Industrial users connected to municipal water systems are not included in this category, but are grouped in with the Commercial/Industrial/Institutional (CII) category. Because of the wide variety of industrial producers, they were grouped into categories and assumptions made for each category for expected future water use. Specific major projects that are currently in development stages were included in the projections:

- Power Plants: Power plant water use has declined from 7,800 af in 2000 to 6,100 af in 2010. Existing power plants are not anticipated to increase water use, and speculation about potential new power plants in the High Desert cannot be quantified at this time. High Desert Power Project is provided directly with SWP water but is anticipated to be using 100 percent recycled water by 2015, reducing its SWP demand to zero. The LUZ Solar Plant in Kramer Junction is also provided directly with SWP water at an average of 1,300 afy, and is expected to use the same amount of SWP water in the future. Future regional power plant water use is projected to remain flat starting in 2015.

- Cement Plants: Operate either in on/off mode, but cannot increase production due to plant limitations, environmental and air permit issues. If demand exceeds production capacity, cement is imported. Future cement plant water use is assumed to equal the yearly average from 2000-2010.

- Ready-Mix Cement and Aggregate/Batch Plants: Production is primarily a factor of new construction rather than total population in the area. Population growth is projected to be relatively linear, so demand is projected to equal the yearly average from 2000-2010.
- Compressor Stations (gas lines): The compressor stations are owned by Pacific Gas & Electric (PG&E) and Southern California Gas (SCG) for major gas lines that run to the Los Angeles area. The water is used for cooling. Use has increased about 30 percent from 2000-2010, and is projected to remain at the 2010 level in future years.
- Railroads: Railroad use has declined significantly since 2000 and is projected to remain at the 2010 level in future years.
- Mining: Mining water use has remained relatively flat and is projected to continue at the average of 2000-2010 use for future years.
- Other: Other use was identified as primarily temporary transfers of production rights for specific road construction projects. This temporary use of water is not expected to continue in future years; therefore future water use in this category is projected to be zero.
- Dr Pepper/Snapple: Construction of this facility at Southern California Logistics Airport (SCLA) was completed in 2010. The plant is currently operating and is expected to use an average of 400 afy, which is assumed to remain constant in future years.

4. Commercial/Institutional/Industrial (CII): Called Commercial/Institutional in the DWR 2009 reporting instructions, and defined as "Retail establishments, office buildings, laundries, schools, prisons, hospitals, dormitories, nursing homes, hotels" (not intended to include Industrial/Manufacturing). However, nearly all water retailers included metered industrial use in with this category, primarily because they do not separate commercial and industrial customers in their billing systems. Industry included in this category is considered "baseline use" because it accounts primarily for smaller industries and shops associated with the local population, and is expected to grow with population.

   A linear regression method, based upon current population and CII demands, was used to determine the relationship between population growth and CII usage and to project forward using linear regression. Future CII demand is correlated to population using the following formula:

   CII demand = -49.85 + 0.0295x   where x is the current population

   Because the growth is unpredictable, the model does not assume any conservation in this category.

5. Recreational Lakes and Fish Hatcheries: Jess Ranch Hatchery and Fishing Lake, Spring Valley Lake, Silver Lakes, California Department of Fish and Game hatchery, Mojave Narrows Regional Park, and Lakes in the Baja subarea. Excludes Hesperia Lake, which is accounted for in Hesperia Water District's demand numbers.

Recreational Lake use is projected to remain flat at the average of 2000-2010 yearly demand.

6. Unaccounted: Calculated as the difference between total water production and metered deliveries reported by retail water purveyors. From 2000-08, Unaccounted water averaged 8 percent of total municipal production. For retailers that had only total production data available, 8 percent of production was allocated into the unaccounted category. Unaccounted water decreased substantially starting in 2008, and according to representatives from the retail water purveyors, this is due to a variety of efforts recently undertaken by many of the retailers to reduce their unaccounted water losses. The makeup of this category is not entirely known; however, it is likely that this difference is comprised of water pumped to waste from production wells, lost to leaks, and from meter inaccuracies. With a 2010 baseline, unaccounted use is projected to increase in proportion with increases in municipal production.
7. Minimal Producers (MP): Producers of 10 af or less within the boundaries of the Mojave Basin Area Judgment; primarily homeowners with their own wells. MP use is projected to increase in proportion with increases in overall population.
8. Golf Courses: It is anticipated that substantial population growth will generate demand for new Golf Courses. Golf Course water use is projected to increase proportionally with increases in population.
9. Other: Defined in the DWR 2009 reporting instructions as "fire suppression, street cleaning, line flushing, construction meters, temporary meters." These uses are assumed to grow with population. Construction water is likely to have varied significantly over the 2000-2010 period due to changing rates of growth, so "Other" use is projected to increase in proportion with increases in population based upon the average per-capita use for the period of 2000-2010.
10. Landscape Irrigation: Defined in the DWR 2009 reporting instructions as "parks, play fields, cemeteries, median strips, and golf courses." This use category increased at a faster pace than population during the period of 2000-08, most likely because medians and street landscaping were developed primarily in the construction boom during that period. With 2010 as a baseline, Landscape Irrigation use is projected to increase in proportion with increases in population.
11. Agriculture: Projected to remain flat at the 2010 level.

Table 2-3 summarizes the MWA's projected water demands by subarea through 2035.

TABLE 2-3
PROJECTED WATER DEMANDS
BY SUBAREA FOR MWA (AF)

Subarea	2005	2010	2015	2020	2025	2030	2035
Alto	97,491	87,001	93,994	99,440	108,851	118,262	127,674
Baja	28,484	23,653	24,413	24,834	25,212	25,573	25,919
Centro	22,563	25,071	26,278	27,149	28,028	28,908	29,787
Este	6,981	5,863	6,607	6,771	6,970	7,170	7,369
Oeste	4,882	4,503	4,767	4,930	5,089	5,247	5,404
Morongo	5,879	5,794	7,102	7,372	7,590	7,809	8,028
Total	**166,280**	**151,885**	**163,161**	**170,496**	**181,740**	**192,969**	**204,181**

Note: Totals by subarea from MWA's demand forecast model, including all water use categories as described in Section 2.4.2 assuming moderate conservation.

2.4.3 Return Flow

The Mojave Water Agency has four sources of water supply – natural surface water flows, SWP imports, treated wastewater imports from outside the MWA service area, and return flow from pumped ground water not consumptively used. In the projection model, natural and SWP supply are expressed as an annual average, although both sources of supply vary significantly from year to year. Almost all of the water use within MWA is supplied by groundwater. Native surface supply, SWP, and wastewater imports recharge the groundwater basins; therefore, water management practices render the annual fluctuations in these sources of supply relatively unimportant for long-term water supply planning.

Return flow is calculated as a percent of the water production for each water use category, per the methodology outlined in the MWA "Watermaster Consumptive Water Use Study and Update of Production Safe Yield Calculations for the Mojave Basin Area" completed by Webb Associates in February 2000 (2000 MWA Consumptive Use Study). Return flow factors for each category per the Study are explained below. The Watermaster is currently developing revised return flow factors to reflect changes in water use over the past decade. The revised numbers are anticipated to be available in 2011, and will replace the factors listed below, if different in future planning documents.

1. All municipal uses (SFR, MFR, CII, Unaccounted, Landscape Irrigation, and Other): 50 percent of production. Embedded within this calculation is return flow from effluent generated by municipal wastewater treatment facilities within MWA (directly recycled or recharged to groundwater). Only imported wastewater (described in Chapter 3) is accounted for as a separate supply in Table 3-1, and all other wastewater/recycled water is a component of the "Return Flow" category of supply.
2. Industrial producers: No return flow.
3. Recreational Lakes: total production minus calculated consumptive use. Consumptive use equals the annual surface evaporation rate (5.6 feet in the Alto Subarea, 6.7 feet in the Centro and Baja subareas) multiplied by lake surface area.

Return flow equals 22 percent of recreational lake production in Alto and 16 percent of production in Centro and Baja.[6] No recreational lakes in other subareas.

4. Minimal Producers: 50 percent of production.
5. Golf Courses: total production minus calculated consumptive use. Consumptive use equals the net irrigation acreage times the consumptive use factor identified in the Webb study. Return flow equals 49 percent of production of the golf course in Alto and 57 percent of production in Centro. No golf courses in other subareas.
6. Agriculture: total production minus calculated consumptive use. Consumptive use equals the net irrigated acreage times the appropriate consumptive use factor identified in the Webb study. Return flow is calculated as a percent of agricultural production for each subarea: Alto, 46.5 percent; Baja, 37.2 percent; Centro, 39.2 percent; Este, 41.8 percent; Oeste, 48.5 percent.

2.4.4 Morongo Area SWP Demand Projection

During the stakeholder review process for the UWMP demand forecast model, it was pointed out to MWA staff that assumptions about SWP demands for the Morongo Area should be looked at in more detail due to differences in urban water use and geology in the Morongo Area compared to the Mojave Basin area. In the model it is assumed water retailers in the Morongo Area that currently have or have planned SWP recharge projects will generate a demand for imported water from the SWP equal to (total pumping) minus (return flow) minus (natural supply). SWP demand projections in the model represent the combined demands from the Bighorn-Desert View Water Agency (BDVWA), Hi-Desert Water District (HDWD), Joshua Basin Water District (JBWD), San Bernardino County Special Districts Department (SDD) service areas and a small number of individual domestic pumpers.

Indoor water uses create a return flow (either through septic or sewer systems), but those flows may not reach the groundwater depending upon the location of the discharge relative to the aquifer. A recent study by MWA of the Apple Valley Ranchos Water Company service area indicates local indoor use averages 60 GPCD. Currently there are no sewer systems in the Morongo area, and it is assumed that return flows occur on the properties on which the water uses take place and that return flows reach the groundwater (GW) only where properties directly overlie defined GW basins. GIS analysis was conducted to determine the location of water-using properties relative to groundwater basins. Using GIS, all parcels with recorded improvements according to San Bernardino County Assessor data (i.e., developed properties) located in the Morongo area were identified. Out of 18,884 developed parcels, 86 percent overlie GW basins and 14 percent are outside GW basin boundaries. In addition to return flows from septic tanks, return flow from golf course irrigation in Yucca Valley is estimated at 25 percent of pumping. In the demand model, golf course production is projected to be 500 afy in future years, which is equivalent to the current golf course water rights.

Based upon the analysis above, return flow in the model was calculated as (60 GPCD) x (Morongo population) x (86%). For 2008, the result was 2,156 af. To validate this method, return flows were estimated in a similar manner for the Warren Basin and compared to recent

[6] Based upon 1996-97 water year production numbers. Return flow was calculated as (total production) minus (consumptive use) divided by total production (%). This percentage return flow factor was applied to all years.

return flow estimates by the US Geological Survey (USGS).[7] There were 7,094 improved parcels that overlaid the Warren Basin in 2009 (GIS parcel data analysis). Based on 2009 estimates by Census Block Group provided by ESRI of 2.35 persons per household and an 82.0 percent occupancy rate, the resulting return flow value is 923 afy, which is comparable to the USGS/HDWD estimate of 880 af in 2008.

SWP demands for the Morongo area are calculated as (total pumping) minus (return flows) minus (natural supply). Based upon the return flow and natural supply estimates above, the resulting SWP demand for the Morongo area was 1,460 af in 2008 and is projected to increase to between 3,000 and 3,300 af by 2035, depending on the level of conservation assumed. This assumes all water retailers are utilizing SWP water to meet demands in excess of return flow and natural supply.

2.5 Other Factors Affecting Water Usage

A major factor that affects water usage is weather. Historically, when the weather is hot and dry, water usage increases. The amount of increase varies according to the number of consecutive years of hot, dry weather and the conservation activities imposed. During cool, wet years, historical water usage has decreased to reflect less water usage for exterior landscaping. This factor is discussed below in detail.

2.5.1 Weather Effects on Water Usage

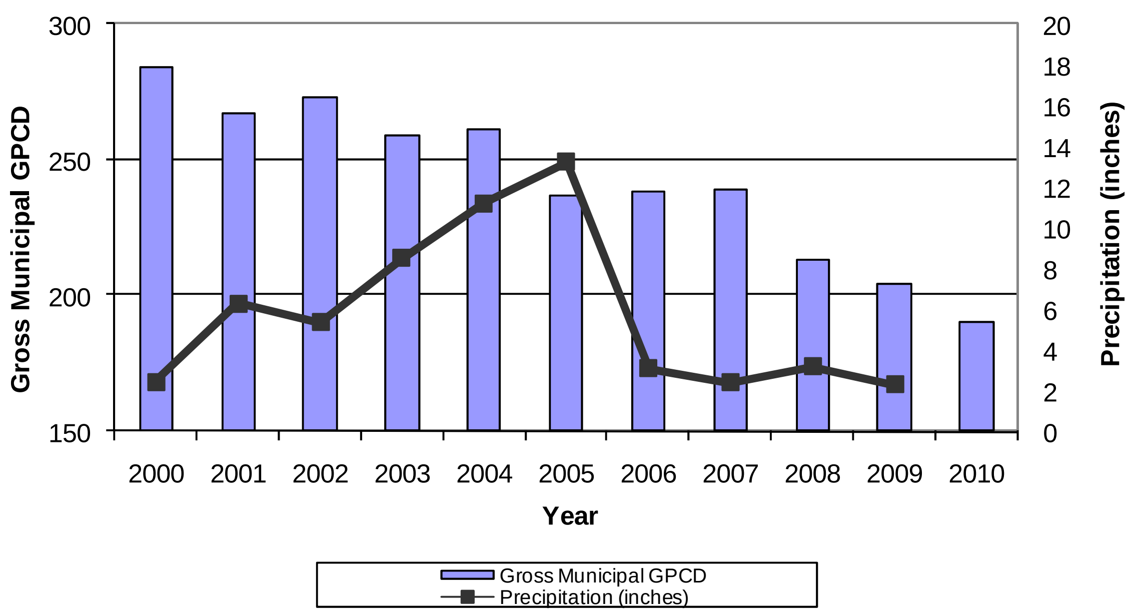
California faces the prospect of significant water management challenges due to a variety of issues including population growth, regulatory restrictions and climate change. Climate change is of special concern because of the range of possibilities and their potential impacts on essential operations, particularly operations of the State Water Project. The most likely scenarios involve accelerated sea level rise and increased temperatures, which will reduce the Sierra Nevada snowpack and shift more runoff to winter months. These changes can cause major problems for the maintenance of the present water export system through the fragile levee system of the Sacramento-San Joaquin Delta. The other much-discussed climate scenario or impact is an increase in precipitation variability, with more extreme drought and flood events posing additional challenges to water managers.[8]

These changes would impact MWA's water supply by changing how much water is available, when it is available, how it can be captured and how it is used due to changes in priorities. Expected impacts to the SWP imported water supply include pumping less water south of the Delta due to reduced supply, and pumping more local groundwater to augment reductions in surface water supplies and reliability issues since groundwater is a more reliable source of water.

[7] "Warren Basin Water Storage and Balance" spreadsheet developed by High-Desert Water District with the assistance of the US Geological Survey (written correspondence, 2010).
[8] Final California Water Plan Update 2009 Integrate Water Management: Bulletin 160.

Historically, MWA's gross municipal production per-capita usage for the Mojave Basin Area has fluctuated from 190 to 284 GPCD, as shown on Figure 2-2. Please note that the precipitation data used in the Figure is the average of the Barstow and the Victorville California Irrigation Management Information System (CIMIS) weather stations. CIMIS is a program in the California Department of Water Resources (DWR) that manages a network of over 120 automated weather stations in the state of California. While historically this variation in range of water use shown on Figure 2-2 was primarily due to seasonal weather variations, with the unusual economic events of the recent years and the effects of conservation, the weather may not be the only impact on the drop in usage for the GPCD.

Figure 2-2
Historical MWA Mojave Basin Area Gross Municipal GPCD*



*Precipitation data was averaged from California Irrigation Management Information System (CIMIS) Stations Barstow No. 134 and Victorville No. 117.

2.5.2 Conservation Effects on Water Usage

In recent years, water conservation has become an increasingly important factor in water supply planning in California. Since the 2005 UWMP there have been a number of regulatory changes related to conservation including new standards for plumbing fixtures, a new landscape ordinance, a state retrofit on resale ordinance, new Green Building standards, target demand reduction goals and more.

In 2003, MWA, retail water agencies, and others formed the AWAC. The mission of the AWAC, a coalition of 25 regional organizations, is to promote the efficient use of water and increase communities' awareness of conservation as an important tool to help ensure an adequate water supply. The AWAC have developed water conservation measures that include public information and education programs and have set a regional water use reduction goal of 15 percent gross per capita by 2015.

Through its Water Conservation Incentive Program (WCIP), MWA has been supporting regional conservation. The Cash for Grass program has been particularly successful, and has caused the removal of an estimated 2.9 million square feet of turf and saved about 500 af of water per year.

Section 3: Water Resources

3.1 Overview

This Section describes the water resources available to the Mojave Water Agency (MWA) for the 25-year period covered by the Plan. These are summarized in Table 3-1 and discussed in more detail below. Both currently available and planned supplies are discussed.

TABLE 3-1
SUMMARY OF CURRENT AND PLANNED WATER SUPPLIES (AFY)

Water Supply Source	2010	2015	2020	2025	2030	2035
Existing Supplies						
Wholesale (Imported)						
SWP [(a)]	49,680	51,480	53,880	53,880	54,778	54,778
Local Supplies[(b)]						
Net Natural Supply	54,045	54,045	54,045	54,045	54,045	54,045
Agricultural Depletion from Storage[(c)]	10,425	10,425	10,425	10,425	10,425	10,425
Return Flow[(d)]	62,220	67,766	71,353	76,862	82,364	87,857
Wastewater Import[(e)]	5,304	5,397	5,491	5,789	6,087	6,385
Groundwater Banking Projects[(f)]						
Total Existing Supplies	**181,674**	**189,113**	**195,194**	**201,001**	**207,699**	**213,490**
Projected Demands[(g)]	**151,885**	**163,161**	**170,496**	**181,740**	**192,969**	**204,181**

Notes:
(a) Assumes 60% of Table A amount as the long-term supply until 2029 and then assume 61% in 2029 and after, based on the California Department of Water Resources 2009 contractor Delivery Reliability Report for MWA.
(b) Source: MWA's demand forecast model.
(c) Refer to Section 3.3.2 for an explanation of this supply.
(d) Refer to Section 3.3.3 for an explanation of this supply. It was assumed the GPCD remains at the "moderate" level as defined in Chapter 2.
(e) See Chapter 4 Recycled Water, Table 4-6.
(f) Groundwater Banking (stored groundwater) would only be used in drought conditions. For this reason, Groundwater Banking is not included in the total supply available in a Normal Year. See Table 3-13 for details.
(g) See Chapter 2 Water Use, Table 2-3, assuming "moderate" conservation.

The MWA has four sources of water supply – natural surface water flows, wastewater imports from outside the MWA service area, SWP imports, and return flow from pumped groundwater not consumptively used. A fifth source, "Agricultural Depletion From Storage," is also shown as a supply and is described in Section 3.3.2. In MWA's demand forecast projection model, natural and SWP supply are expressed as an annual average, although both sources of supply vary significantly from year to year. Almost all of the water use within MWA is supplied by pumped groundwater. Native surface supply, return flow, and SWP imports recharge the groundwater basins; therefore, water management practices render the annual fluctuations in these sources of supply relatively unimportant for water supply planning. MWA has an average natural supply of 54,045 acre-feet per year (afy) as shown in Table 3-1.

The projected demands shown in Table 3-1 represent total demands within MWA, including pumped groundwater and direct SWP use, assuming "moderate" conservation beyond 2010 as explained previously in Section 2.4. Figure 3-1 presents all available supplies compared with total demands, with local supplies shaded green and wholesale (SWP) supplies shaded blue. Available supplies are sufficient to meet projected demands beyond the year 2035. It should be noted that return flow as a supply is shown to increase over time because it is a function of water demand. In addition to the projections shown in Figure 3-1, demands and supplies were also evaluated with no additional conservation beyond 2010 and extreme conservation, as described in Section 2.4). Tables and charts for those supply and demand projections are included in Appendix E.

Water demands and supplies were also evaluated out 50 years to the year 2060, shown in Figure 3-2. This is beyond the 20-year planning horizon included in this plan and projections beyond 2035 are for informational purposes only. However, they give some insight into when in the future demands might exceed current supplies. It is assumed on Figure 3-2 that demands continue to increase at the same rate through 2060. The projection indicates that current supplies are sufficient to meet demands through 2044, assuming SWP supplies remain constant at the 2035 availability. See Appendix E for supply/demand forecasts through 2060 based upon no conservation and extreme conservation.

Figure 3-1

Water Supplies vs. Projected Demands Through 2035

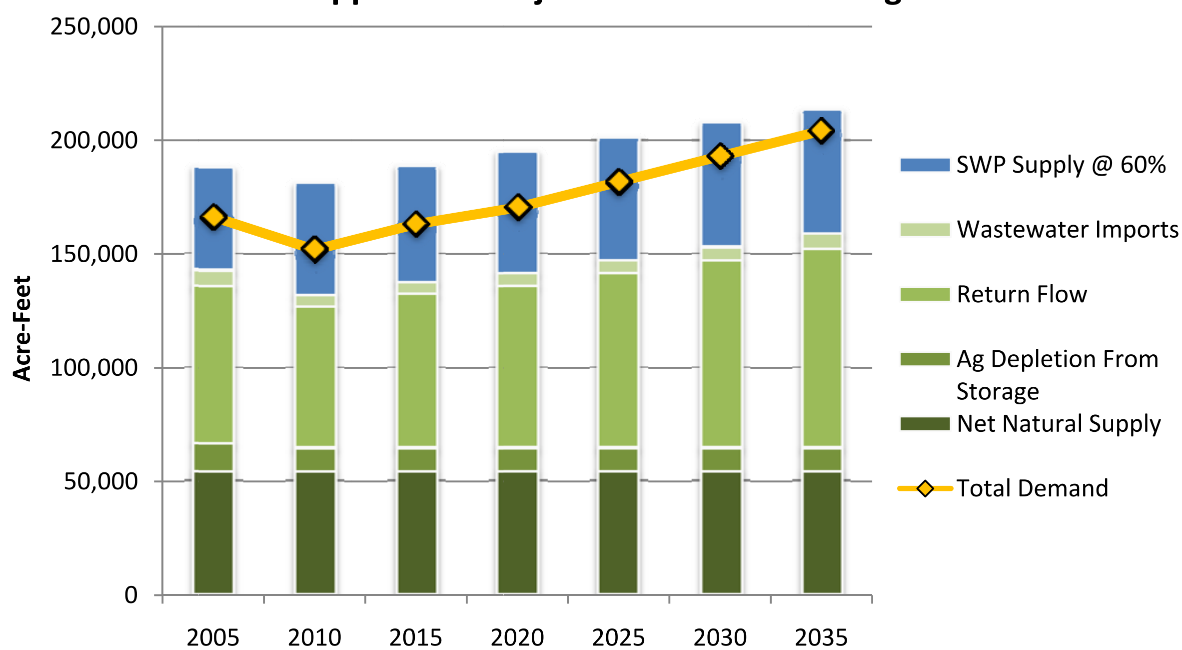
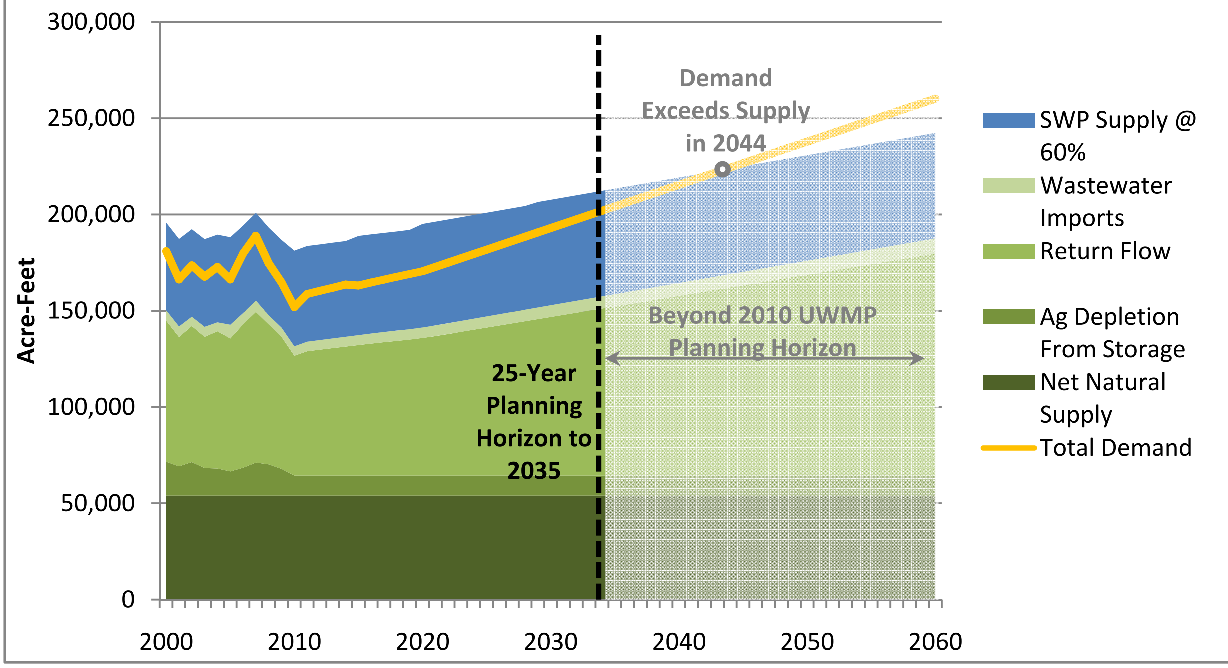


Figure 3-2
Water Supplies vs. Projected Demands Through 2060



The term "dry" is used throughout this chapter and in subsequent chapters concerning water resources and reliability as a measure of supply availability. As used in this Plan, dry years are those years when supplies are the lowest, which occurs primarily when precipitation is lower than the long-term average precipitation. The impact of low precipitation in a given year on a particular supply may differ based on how low the precipitation is, or whether the year follows a high-precipitation year or another low-precipitation year. For the State Water Project (SWP), a low-precipitation year may or may not affect supplies, depending on how much water is in SWP storage at the beginning of the year. Also, dry conditions can differ geographically. For example, a dry year can be local to the MWA service area (thereby affecting local groundwater replenishment and production), local to northern California (thereby affecting SWP water deliveries), or statewide (thereby affecting both local groundwater and the SWP). When the term "dry" is used in this Plan, statewide drought conditions are assumed, affecting both local groundwater and SWP supplies at the same time.

3.2 Wholesale (Imported) Water Supplies

3.2.1 Imported Water Supplies

Imported water supplies available to MWA consist primarily of the SWP supplies. According to the water supply contract between the California Department of Water Resources (DWR) and MWA revised on October 12, 2009, MWA's maximum annual entitlement from the SWP ("Table A amount") is 82,800 afy from 2010 to 2014; 85,800 afy from 2015 to 2019; and 89,800 afy from 2020 to 2035.

The SWP is the largest state-built, multi-purpose water project in the country. It was authorized by the California State Legislature in 1959, with the construction of most facilities completed by

1973. Today, the SWP includes 28 dams and reservoirs, 26 pumping and generating plants, and approximately 660 miles of aqueducts. The primary water source for the SWP is the Feather River, a tributary of the Sacramento River. Storage released from Oroville Dam on the Feather River flows down natural river channels to the Sacramento-San Joaquin River Delta (Delta). While some SWP supplies are pumped from the northern Delta into the North Bay Aqueduct, the vast majority of SWP supplies are pumped from the southern Delta into the 444-mile-long California Aqueduct. The California Aqueduct conveys water along the west side of the San Joaquin Valley to Edmonston Pumping Plant, where water is pumped over the Tehachapi Mountains and the California Aqueduct then divides into the East and West Branches. MWA delivers its SWP supplies to use within the local groundwater basins through extensive transmission pipeline systems and direct releases from Silverwood Lake, a SWP regulating reservoir.

In the early 1960s, DWR began entering into individual SWP Water Supply Contracts with urban and agricultural public water supply agencies located throughout northern, central, and southern California for SWP water supplies. MWA is one of 29 water agencies (commonly referred to as "contractors") that have an SWP Water Supply Contract with DWR.

Each SWP contractor's SWP Water Supply Contract contains a "Table A," which lists the maximum amount of water an agency may request each year throughout the life of the contract. Table A is used in determining each contractor's proportionate share, or "allocation," of the total SWP water supply DWR determines to be available each year. The total planned annual delivery capability of the SWP and the sum of all contractors' maximum Table A amounts was originally 4.23 million acre-feet (af). The initial SWP storage facilities were designed to meet contractors' water demands in the early years of the SWP, with the construction of additional storage facilities planned as demands increased. However, essentially no additional SWP storage facilities have been constructed since the early 1970s. SWP conveyance facilities were generally designed and have been constructed to deliver maximum Table A amounts to all contractors. After the permanent retirement of some Table A amount by two agricultural contractors in 1996, the maximum Table A amounts of all SWP contractors now totals about 4.17 million af.

As mentioned above, currently, MWA is entitled to 82,800 afy of SWP water. Prior to two purchases by MWA of additional Table A supplies, MWA's Table A amount was 50,800 af. In 1997, MWA purchased 25,000 af from Berrenda Mesa Water District, bringing MWA's Table A amount to 75,800 af. In 2009, MWA purchased an additional 14,000 af of Table A from Dudley Ridge Water District in Kings County, which will be transferred incrementally to MWA. The first transfer of 7,000 af occurred in 2010, with 3,000 af to be transferred in 2015 and 4,000 af in 2020. These transfers are reflected in Table 3-3 below, which indicates MWA's Table A amounts from 2010 to 2035.

While Table A identifies the maximum annual amount of water an SWP contractor may request, the amount of SWP water actually available and allocated to SWP contractors each year is dependent on a number of factors and can vary significantly from year to year. The primary factors affecting SWP supply availability include hydrology, the amount of water in SWP storage at the beginning of the year, regulatory and operational constraints, and the total amount of water requested by SWP contractors.

Imported SWP water has been historically supplied to the MWA through the Mojave River and Morongo Basin pipelines and released from Silverwood Lake. Table 3-2 presents historical total

SWP deliveries to MWA. Table 3-3 presents MWA's SWP demand projections provided to DWR (MWA's wholesale supplier), according to the water supply contract revised in October 2009.

TABLE 3-2
HISTORICAL TOTAL SWP DELIVERIES

Year	Deliveries (afy)[(a)]	Year	Deliveries (afy)[(b)]
1978	22,500	**1994**	17,652
1979	0	**1995**	8,740
1980	0	**1996**	7,427
1981	0	**1997**	14,040
1982	0	**1998**	5,892
1983	24,489	**1999**	8,071
1984	0	**2000**	11,362
1985	0	**2001**	4,320
1986	0	**2002**	4,218
1987	0	**2003**	39,242
1988	0	**2004**	12,840
1989	0	**2005**	33,323
1990	0	**2006**	33,927
1991	3,423	**2007**	20,064
1992	10,674	**2008**	17,007
1993	11,487	**2009**	21,528

Notes:
(a) Source: Mojave Water Agency
(b) Deliveries from 1978 to 2001 include releases from Lake Silverwood, Rock Springs, Hodge, Lenwood, the Morongo Basin Pipeline, and to the LUZ Solar facility at Kramer Junction. Deliveries from 2002 to 2009 also include releases to Daggett, Newberry Springs, Oro Grande, Local Construction Projects and High Desert Power Project.

TABLE 3-3
CURRENT AND PLANNED WHOLESALE WATER SUPPLIES (AFY)

Water Supply Sources	2010	2015	2020	2025	2030	2035
California State Water Project (SWP)	82,800	85,800	89,800	89,800	89,800	89,800

3.2.2 Imported Water Supply Reliability

The amount of the SWP water supply delivered to the state water contractors in a given year depends on a number of factors, including the demand for the supply, amount of rainfall, snowpack, runoff, water in storage, pumping capacity from the Delta, and legal/regulatory constraints on SWP operation. Water delivery reliability depends on three general factors: the availability of water at the source, the ability to convey water from the source to the desired point of delivery, and the magnitude of demand for the water. Urban SWP contractors' requests for SWP water, which were low in the early years of the SWP, have been steadily increasing over time, which increases the competition for limited SWP dry-year supplies. Regulatory constraints also change over time and have become increasingly more restrictive.

In an effort to assess the impacts of these varying conditions on SWP supply reliability, DWR issued its "State Water Project Delivery Reliability Report 2009" (2009 SWP) update in August 2010. The biennial Report assists SWP contractors in assessing the reliability of the SWP component of their overall supplies. The 2009 SWP Report updates DWR's estimate of the current (2009) and future (2029) water delivery reliability of the SWP. The updated analysis shows that the primary component of the annual SWP deliveries (referred to as Table A deliveries) will be less under current and future conditions, when compared to the preceding report (State Water Project Delivery Reliability Report 2007). The report discusses areas of significant uncertainty to SWP delivery reliability:

- Restrictions on SWP and Central Valley Project (CVP) operations due to the State and federal biological opinions to protect endangered fish such as delta smelt and spring-run salmon;
- Climate change and sea level rise, which is altering the hydrologic conditions in the State;
- The vulnerability of Delta levees to failure due to floods and earthquakes.

"Water delivery reliability" is defined as the annual amount of water that can be expected to be delivered with a certain frequency. SWP delivery reliability is calculated using computer simulations based on 82 years of historical data.

The 2009 SWP Report shows a continuing erosion of the ability of the SWP to deliver water. For current conditions, the dominant factor for these reductions is the restrictive operational requirements contained in the federal biological opinions. Deliveries estimated for the 2009 Report are reduced by the operational restrictions of the biological opinions issued by the U.S. Fish and Wildlife Service in December 2008 and the National Marine Fisheries Service in June 2009 governing the SWP and Central Valley Project operations. The 2005 and 2007 SWP Reports were based on less restrictive operational rules.

For future conditions, the 2009 SWP Report includes the potential effects of climate change to estimate future deliveries. The changes in run-off patterns and amounts are included along with a potential rise in sea level. Sea level rise has the potential to require more water to be released to repel salinity from entering the Delta in order to meet the water quality objectives established for the Delta. The 2005 SWP Report did not include any of these potential effects. For the 2007 SWP Report, the changes in run-off patterns and amounts were incorporated into the analyses, but the potential rise in sea level was not.

These updated analyses in the 2009 SWP Report indicate that the SWP, using existing facilities operated under current regulatory and operational constraints and future anticipated conditions, and with all contractors requesting delivery of their full Table A amounts in most years, could deliver 60 percent of Table A amounts on a long-term average basis. DWR also prepared Delivery Reliability Reports (DRRs) for long-term average SWP supplies to individual SWP contractors based upon the unique conditions that impact each contractor. The DRR for MWA indicated average reliability would be 60 percent in 2009 and will increase to 61 percent in 2029. Table 3-4 provides the projected SWP water available to MWA over the next 25 years, based on the MWA's maximum Table A amounts from 2010 to 2035 and the supply reliability analyses provided in the 2009 SWP Report and associated DRR.

TABLE 3-4
CURRENT AND PLANNED WHOLESALE WATER SUPPLIES AVAILABLE
(LONG-TERM AVERAGE)

Wholesaler (Supply Source)	2010	2015	2020	2025	2030[(a)]	2035[(b)]
California State Water Project (SWP)						
% of Table A Amount Available	60%	60%	60%	60%	61%	61%
Anticipated Deliveries (afy)	49,680	51,480	53,880	53,880	54,778	54,778

Notes:
(a) Assumes 61% of Table A amount from 2029 and after.
(b) The DWR SWP Delivery Reliability Report 2009 projects SWP supplies to 2029. This 2010 UWMP covers the period from 2010 to 2035. Therefore, the available supplies from 2030 to 2035 are assumed to be the same as in 2029.

The values shown in Table 3-4 cover the period 2009 – 2029 based on the DWR estimates at the 2009 level for the current conditions and at the 2029 level for future conditions. Although the 2009 Report presents an extremely conservative projection of SWP delivery reliability, particularly in light of events occurring since its release, because it is based on the most up-to-date modeling by DWR, it remains the best available information concerning the SWP for use in preparing this Plan.

The 2009 SWP Reliability Report also includes analyses of SWP operational restrictions that took effect in 2008 and 2009 due to various court rulings regarding federal biological opinions. The overall result has been "erosion of the SWP to deliver water." The Report identifies several emerging factors related to these court rulings that have the potential to affect the availability and reliability of SWP supplies. The reliability analysis is located in Chapter 6, "Reliability Planning;" a detailed legal analysis of these factors is attached as Appendix F.

While the primary supply of water available from the SWP is allocated Table A supply, SWP supplies in addition to Table A water may periodically be available, including "Article 56C" carryover water, "Article 21" water, Turnback Pool water, and DWR Dry Year Purchase Programs. Pursuant to the long-term water supply contracts, SWP contractors have the opportunity to carry over a portion of their allocated water approved for delivery in the current year for delivery during the next year. Contractors can "carry over" water under Article 56C of the SWP long-term water supply contract with advance notice when they submit their initial request for Table A water, or within the last three months of the delivery year. The carryover program was designed to encourage the most efficient and beneficial use of water and to avoid obligating the contractors to "use or lose" the water by December 31 of each year. The water supply contracts state the criteria of carrying over Table A water from one year to the next. Normally, carryover water is water that has been exported during the year, has not been delivered to the contractor during that year, and has remained stored in the SWP share of San Luis Reservoir to be delivered during the following year. Storage for carryover water no longer becomes available to the contractors if it interferes with storage of SWP water for project needs (DWR, 2009).

Article 21 water (which refers to the SWP contract provision defining this supply) is water that may be made available by DWR when excess flows are available in the Delta (i.e., when Delta outflow requirements have been met, SWP storage south of the Delta is full, and conveyance capacity is available beyond that being used for SWP operations and delivery of allocated and scheduled Table A supplies). Article 21 water is made available on an unscheduled and interruptible basis and is typically available only in average to wet years, generally only for a limited time in the late winter.

The Turnback Pool is a program where contractors with allocated Table A supplies in excess of their needs in a given year may turn back that excess supply for purchase by other contractors who need additional supplies that year. The Turnback Pool can make water available in all types of hydrologic years, although generally less excess water is turned back in dry years.

As urban SWP contractor demands increase in the future, the amount of water turned back and available for purchase will likely diminish. In critical dry years, DWR has formed Dry Year Water Purchase Programs for contractors needing additional supplies. Through these programs, water is purchased by DWR from willing sellers in areas that have available supplies and is then sold by DWR to contractors willing to purchase those supplies.

Because the availability of these supplies is somewhat uncertain, they are not included as supplies to MWA in this Plan. However, MWA's access to these supplies when they are available may enable it to improve the reliability of its SWP supplies beyond the values used throughout this report.

3.2.3 Existing Supply Facilities

MWA receives SWP water at four locations off the aqueduct. The first of four turnouts to the MWA service area is located at Sheep Creek, which is essentially a stub out in the Phelan Area and not used at this time. Second is the Mojave River turnout, also known as the White Road Siphon, located southwest of the City of Victorville and serves the Mojave River Pipeline. The third turnout is the Highway 395 turnout, located southwest of the boundary dividing the City of Victorville from the City of Hesperia, which is being developed for the Oro Grande Wash Recharge Project. The Oro Grande Wash project is discussed later in this chapter and consists of a pipeline from the aqueduct that will recharge a desert wash and serve the southern Victorville area. The fourth and last turnout is known as the Morongo Siphon (or Antelope Siphon Turnout) and serves the Morongo Basin Pipeline. In addition, the MWA takes water delivery from Cedar Springs Dam at Silverwood Lake through controlled releases to the Mojave River. To distribute the supply of water to the points of demand, MWA has taken a central role in designing and constructing the Morongo Basin and Mojave River pipelines, which extend from the California Aqueduct. Figure 3-3 shows the location of the MWA turnouts and existing and planned water delivery facilities.

The Mojave River Pipeline extends approximately 76 miles from the California Aqueduct to recharge sites along the Mojave River. The large-diameter pipeline project was started in 1996 and completed in 2006 to deliver up to 45,000 afy to the Mojave Basin Area to offset growing depletion of native water supplies caused by the region's growth and the overpumping of groundwater. There are four groundwater recharge basins that have been constructed at Hodge, Lenwood, Daggett/Yermo, and Newberry Springs.

The Morongo Basin Pipeline is a 71-mile underground pipeline built by the MWA. It brings water from the California Aqueduct in Hesperia to the Rock Springs Recharge site along the Mojave River in south Apple Valley and to percolation ponds in the Hi-Desert Water District (HDWD) in Yucca Valley. Water flowing through the pipeline is diverted to recharge ponds in an effort to reduce overdraft in the Warren Valley Basin. The Morongo Basin Pipeline was completed in 1994 and deliveries began in 1995. The pipeline was financed by MWA, the HDWD, the Joshua

Basin Water District (JBWD), the Bighorn-Desert View Water Agency (BDVWA), and San Bernardino County Service Area 70 (CSA 70). Pipeline turnouts exist to serve JBWD, BDVWA, and CSA 70 as well as HDWD.

3.3 Local Water Supplies

MWA's local supply of water includes natural surface water flows, return flow from pumped groundwater not consumptively used, and wastewater imports from outside the MWA service area. All three sources are discussed in the following subsections.

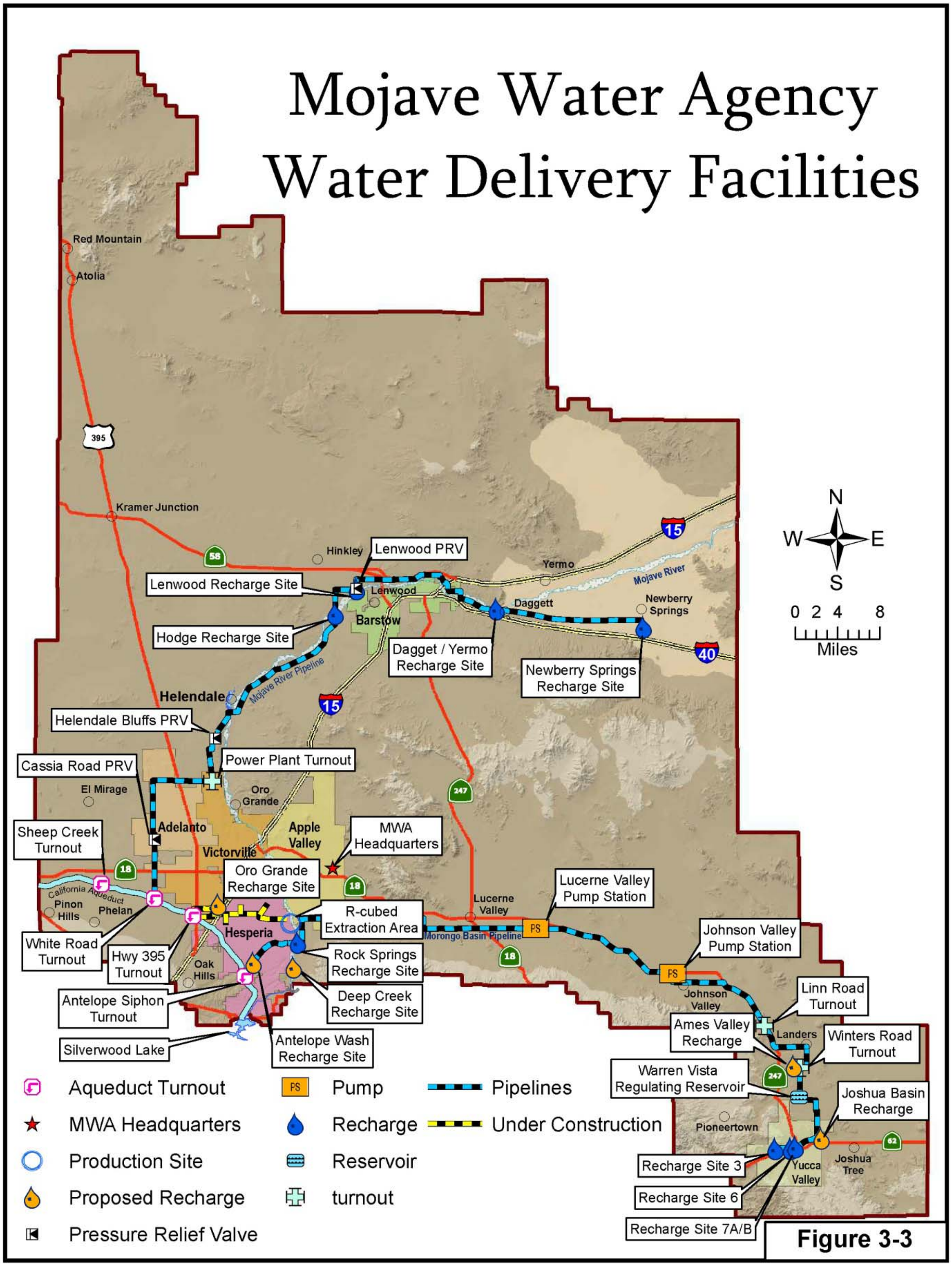
A fourth source, "Agricultural Depletion From Storage," is also shown as a supply and is described in Section 3.3.2.

3.3.1 Net Natural Supply

MWA has an average natural supply of 54,045 afy, including surface water and groundwater flows in the five subareas of the Mojave Basin Area and in the Morongo Basin/Johnson Valley Area ("Morongo"), as shown in Table 3-1. The estimates for the Mojave Basin Area are derived from Watermaster estimates, which are long-term natural supply estimates taken from Table 5-2 of the "MBAW Report to the Court."[9] The Watermaster utilizes these estimates, consistent with the requirements of the Judgment After Trial adjudicating water rights in the Mojave Basin Area ("Mojave Basin Judgment"),[10] to calculate annual yield for each of the five subareas and from that the quantities of water that each stipulating party to the Judgment will be able to produce without incurring replenishment obligations under the Mojave Basin Judgment. This determination and other information will ultimately result in the final calculation of Replacement Water and Makeup obligations of the stipulating parties. This has a direct effect on the calculation of the single largest demand for imported water supply, and has been adjudicated by the Court. Therefore, it is necessary to maintain the Mojave Basin Area long-term average supply regardless of actual variability in surface water flows that may affect calculations under the Judgment. The Morongo Area net natural supplies are estimated from studies prepared on the individual regions and aggregated for the total. Long-term average natural supplies include wet and dry periods, which fluctuate substantially from year to year but are consistent over the long-term. ***Water management practices render the annual fluctuations in these sources of supply relatively unimportant for long-term water supply planning.***

[9] Mojave Basin Area Watermaster Annual Report for Water Year 2008-09.
[10] See Appendix D.

FIGURE 3-3
MWA WATER DELIVERY FACILITIES



3.3.2 Agricultural Depletion from Storage

Agriculture accounts for the largest water demand in the Baja Subarea. Table 3-1 identifies Agricultural Depletion from Storage as a local supply. Baja agricultural producers have repeatedly reported to Watermaster (and the court) that they will not be able to purchase supplemental water. Consequently, Baja producers rely on storage depletion as a supply. Therefore, in order to avoid showing demand from Baja agriculture on imported water supplies, the MWA projection model treats consumptive use of agriculture as a supply derived from storage depletion (Table 3-1).

3.3.3 Return Flow

A portion of the water pumped from the ground is returned to the groundwater aquifer and becomes part of the available water supply; this is defined as the return flow. For example, nearly all indoor water use returns to the basin either by percolation from septic tanks or treated wastewater effluent produced by municipal wastewater facilities. The portion of the groundwater pumped that does not return to the aquifer is referred to as consumptive use.

Return flow shown in Table 3-1 is calculated as a percent of the previous years' water production for each water use category, per the methodology outlined in the Albert A. Webb Associates Study[11] prepared in 2000. Return flow factors per the Webb Study were explained previously in Chapter 2 and, on a regional basis, average approximately 40 percent of the groundwater production. The return flows shown in Table 3-1 represent aggregate flows from all sources. Return flows from municipal demands are calculated as 50 percent of total municipal groundwater production, with a portion of those flows resulting from septic tanks and a portion from recycled wastewater. The projections for recycled water flows in Chapter 4 are embedded within the overall return flow numbers shown in Table 3-1, and are therefore not identified as a separate source of supply.

3.3.4 Wastewater Import

Treated wastewater effluent is imported to MWA from three wastewater entities serving communities in the San Bernardino Mountains outside MWA's service area. Treated wastewater effluent from the Crestline Sanitation District and Lake Arrowhead Community Services District is imported to the Alto Subarea, and effluent from the Big Bear Area Regional Wastewater Agency is imported to the Este Subarea. Wastewater imports from outside MWA are recharged into the Mojave River Groundwater Basin and represent a relatively small portion of MWA's overall water supply portfolio, and are described in more detail in Chapter 4 Recycled Water.

3.4 Groundwater

This Section presents information about MWA's groundwater supplies, including a summary of the adopted Groundwater Management Plan (GWMP).

[11] Mojave Basin Area Watermaster Consumptive Water Use Study and Update of Production Safe Yield Calculations for the Mojave Basin Area. Albert A. Webb Associates, February 16, 2000.

3.4.1 Groundwater Basin Description

The MWA service area overlies all or a portion of 36 groundwater basins and subbasins as defined by DWR Bulletin 118-03. Collectively, these basins and subbasins are grouped into two larger hydrogeologically distinct areas. Basins along the Mojave River and adjacent areas are referred to as the Mojave River Groundwater Basin. Remaining basins in the southeastern MWA service area are referred to as the Morongo Basin/Johnson Valley Area or "Morongo Area". The Mojave River Groundwater Basin is the larger and more developed of the two areas. These basins overlie two broad hydrologic regions also defined in DWR Bulletin 118-03. Most of the Mojave River Groundwater Basin lies within the South Lahontan hydrologic region. The Morongo Area and the Este Subarea of the Mojave River Groundwater Basin lie in the Colorado River hydrologic region. The 36 groundwater basins and subbasins as defined in the DWR Bulletin 118 are listed in Table 3-5 and grouped by the South Lahontan (Region 6) and Colorado River (Region 7) hydrologic regions. The MWA service area also overlaps a small portion of a DWR basin in the South Coast hydrologic region (Region 8) as shown by the last subbasin in Table 3-5. Figure 3-4 shows the DWR groundwater basins and the MWA service area boundary.

TABLE 3-5
DWR GROUNDWATER BASINS

DWR Basin	Sub-Basin	Groundwater Basin	Sub-Basin Name	Budget Type[(a)]
South Lahontan Hydrologic Region				
6-35		Cronise Valley		C
6-36	6-36.01	Langford Valley	Langford Well Lake	C
6-37		Coyote Lake Valley		A
6-38		Caves Canyon Valley		A
6-40		Lower Mojave River Valley		A
6-41		Middle Mojave River Valley		A
6-42		Upper Mojave River Valley		A
6-43		El Mirage Valley		A
6-44		Antelope Valley		A
6-46		Fremont Valley		C
6-47		Harper Valley		A
6-48		Goldstone Valley		C
6-49		Superior Valley		C
6-50		Cuddeback Valley		C
6-51		Pilot Knob Valley		C
6-52		Searles Valley		C
6-53		Salt Wells Valley		C
6-54		Indian Wells Valley		A
6-77		Grass Valley		C
6-89		Kane Wash Area		C
Colorado River Hydrologic Region				
7-10		Twentynine Palms Valley		C
7-11		Copper Mountain Valley		A
7-12		Warren Valley		A
7-13	7-13.02	Deadman Valley	Surprise Spring	C
7-13	7-13.01	Deadman Valley	Deadman Lake	C
7-15		Bessemer Valley		C
7-16		Ames Valley		C
7-17		Means Valley		C
7-18	7-18.01	Johnson Valley	Soggy Lake	C
7-18	7-18.02	Johnson Valley	Upper Johnson Valley	C
7-19		Lucerne Valley		A
7-20		Morongo Valley		C
7-50		Iron Ridge Area		C
7-51		Lost Horse Valley		C
7-62		Joshua Tree		A
8-2	8-2.05	Upper Santa Ana Valley	Cajon	C

Notes:
Source: DWR
(a) Type A – either a groundwater budget or model exists, or actual extraction data is available. Type C – not enough available data to provide an estimate of the groundwater budget or basin extraction.

There have been many different and conflicting references to the basins, subbasins, and/or subareas within the MWA service area. For the purposes of this report, the two larger areas are referred to as the Mojave Basin Area and the Morongo Basin/Johnson Valley Area ("Morongo Area"). The Mojave Basin Area groundwater basin has been further divided into subareas for groundwater management and/or adjudication purposes. Subareas within the Mojave River

Groundwater Basin include Oeste, Alto, Este, Centro and Baja as defined in the Mojave Basin Judgment and shown on Figure 3-4.

The Morongo Area represents the DWR groundwater basins east and southeast of Este Subarea that are within the MWA service area and the Morongo Area. The Morongo Area has been divided into regions based on faults, groundwater divides, and existing DWR groundwater basin boundaries. These Regions are shown on Figure 3-5 and include, from northwest to southeast, Johnson Valley, Means Valley, Ames Valley, Warren Valley, and Copper Mountain Valley/Joshua Tree regions. These Region classifications and boundaries have been revised slightly from those used in the 2004 RWMP, based on recent evaluations in the Ames and Means Valleys (Kennedy/Jenks/Todd, 2007). Revisions include the separation of Means Valley from the former Ames/Means Subbasin and expansion of the Ames Valley Region to the east based on groundwater flow and existing DWR basin boundaries (Figure 3-5).

FIGURE 3-4
DWR GROUNDWATER BASINS WITHIN MWA

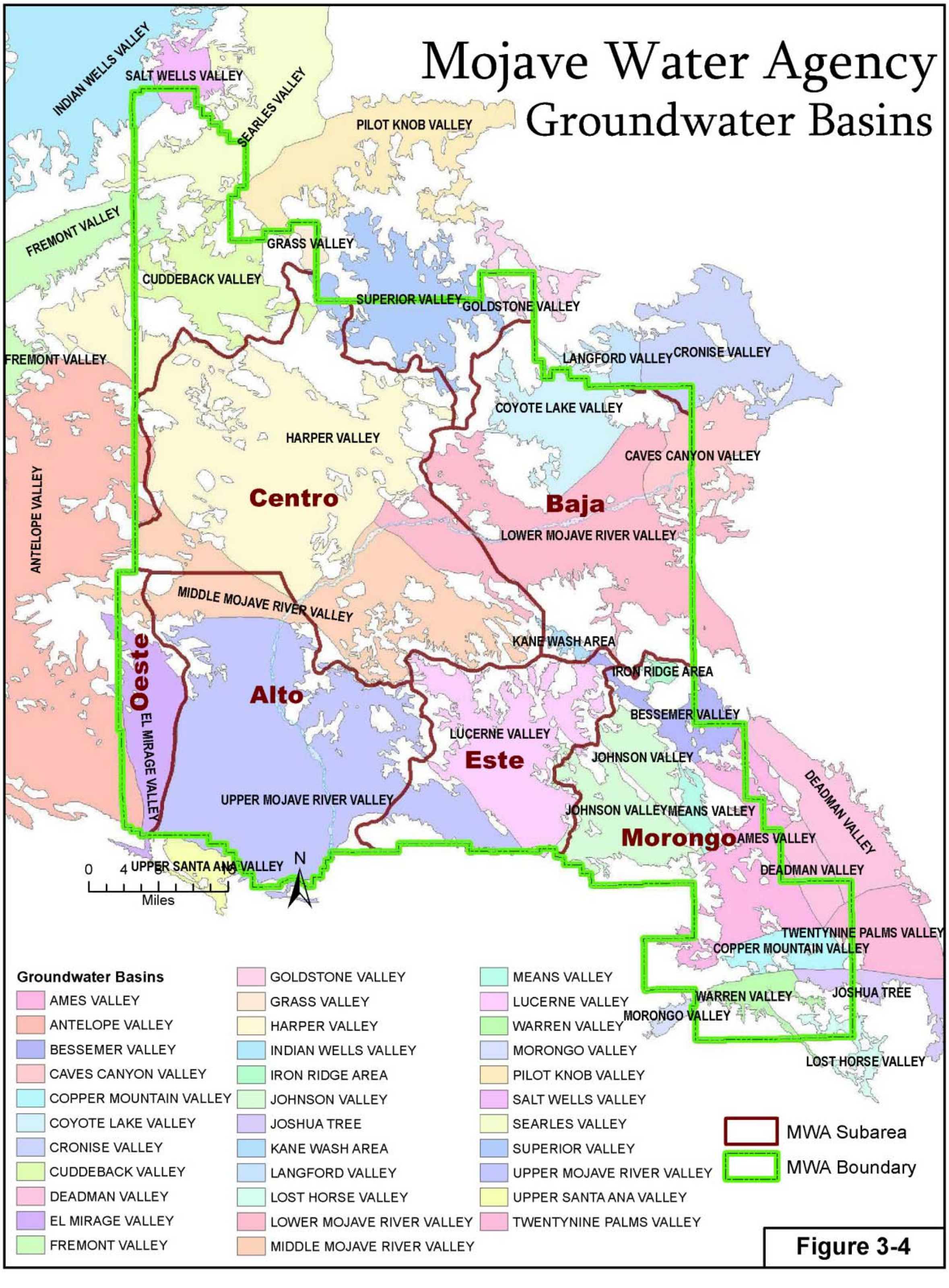
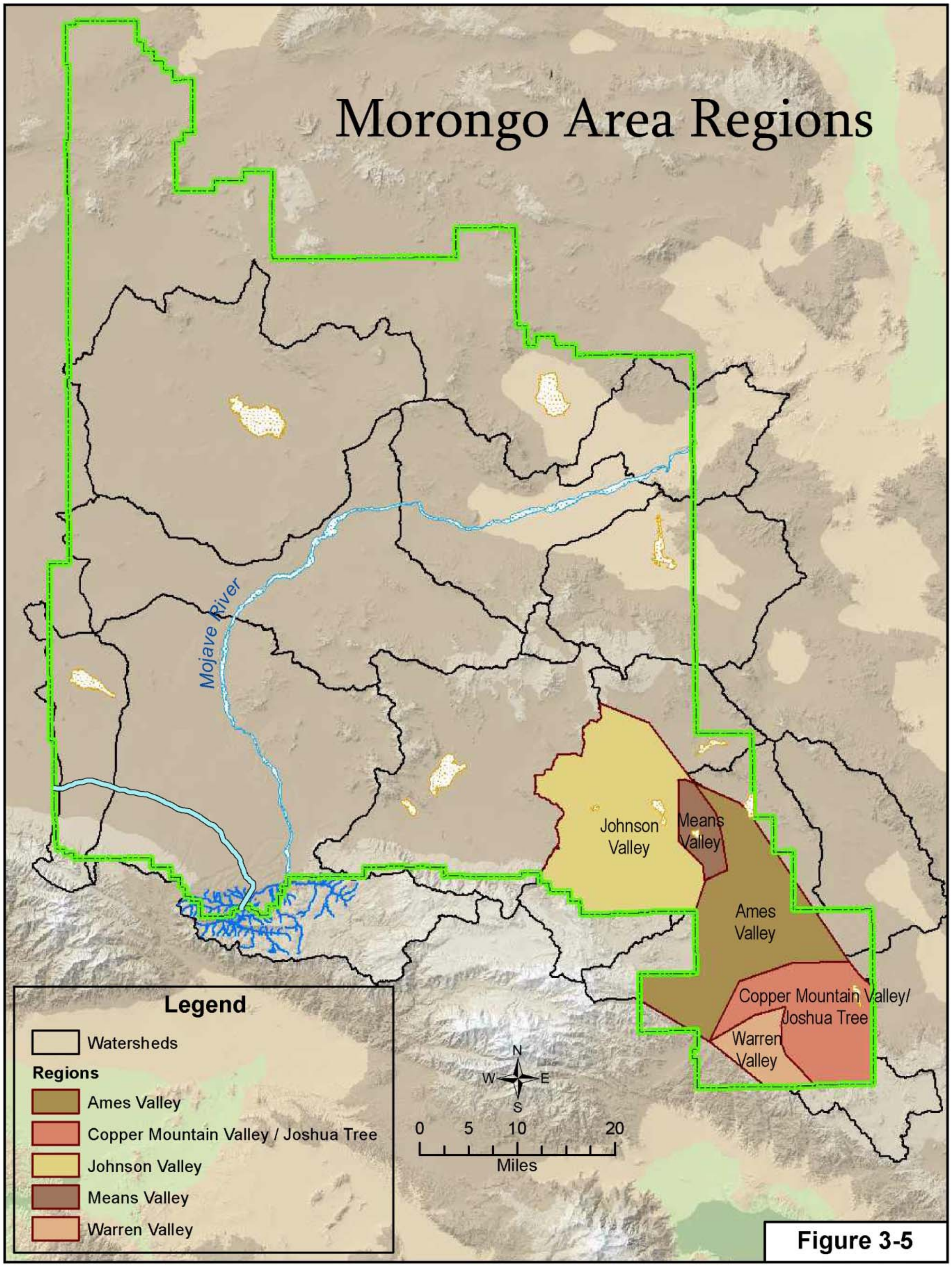


FIGURE 3-5
MORONGO AREA REGIONS



3.4.2 Adopted Groundwater Management Plan

The California State Legislature passed Assembly Bill 3030 (AB 3030) during the 1992 legislative session allowing local agencies to develop Groundwater Management Plans (GWMPs). The legislation declares that groundwater is a valuable resource that should be carefully managed to ensure its safe production and quality. The legislation also encourages local agencies to work cooperatively to manage groundwater resources within their jurisdiction. Senate Bill 1938 (SB 1938) was passed by the Legislature September 16, 2002 and made changes and additions to sections of the Water Code created by AB 3030.

MWA's 2004 Regional Water Management Plan (RWMP), adopted on February 24, 2005 by Resolution 798-05, also serves as the GWMP for MWA as it contains all the relevant components related to Groundwater Management Plans in California Water Code Sections 10750-10753.10., as well as the components recommended by DWR in California's Groundwater, Bulletin 118 (DWR, 2003). The 2004 RWMP Update (refer to Appendix G) both complements and formalizes a number of existing water supply and water resource planning and management activities in the MWA service area that overlies several groundwater basins (see above), as defined by DWR in Bulletin 118.

As part of the 2004 RWMP Update, the following Basin Management Objectives (BMOs) were established to plan water supplies through 2020:

- Balance future water demands with available supplies recognizing the need to:
  - Stabilize the groundwater basin storage balance over long-term hydrologic cycles
  - Protect and restore riparian habitat areas as identified in the Mojave Basin Area Judgment and the Department of Fish & Game Habitat Water Supply Management Plan
  - Limit the potential for well dewatering, land subsidence, and migration of poor quality water
  - Maintain a sustainable water supply through extended drought periods
  - Select projects with the highest likelihood of being implemented
- Maximize the overall beneficial use of water throughout MWA by:
  - Supplying water in quantity and of quality suitable to the various beneficial uses
  - Addressing issues throughout the MWA service area recognizing the interconnection and interaction between different areas
  - Distributing benefits that can be provided by MWA in an equitable and fair manner
  - Ensuring that costs incurred to meet beneficial uses provide the greatest potential return to beneficiaries of the project(s)
  - Avoiding redirected impacts

- Identifying sustainable funding sources including consideration of affordability

Balancing future water demands with available supplies will increase water supply reliability by preventing continued overdraft of the groundwater. With groundwater storage stabilized, there will be groundwater available during surface water supply shortages and delivery interruptions. With a balanced basin, groundwater elevations will be relatively stable. This will reduce the potential for land subsidence and associated aquifer compaction.

The adopted 2004 RWMP also identified several water supply projects and management actions to provide a means to achieve the BMOs. Management actions can be grouped into the following seven major elements:

1. Monitoring regional groundwater quantity and quality
2. Improve characterization of the basin
3. Continue long-term planning
4. Groundwater protection
5. Construction and implementation
6. Financing
7. Public participation

Included in the 2004 RWMP and GWMP is the assumption that the Mojave Basin adjudication will continue to be implemented. The MWA Board acts as Watermaster for administration of the Mojave Basin Area Judgment. In the Mojave Basin Area, the Mojave Basin Area Judgment requires that annual water production records be collected and verified by producers exceeding 10 afy of production within each of the five Mojave Basin Area subareas. As the current Court-appointed Watermaster, much of the monitoring and studies in the Mojave Basin Area is conducted by MWA, based on the monitoring requirements described in the Judgment After Trial (1996). Data collected are reported in the Mojave Basin Area Watermaster Annual Reports to satisfy the mandates of the monitoring requirements. The Warren Valley Basin is also subject to a Court judgment that is administered by the Hi-Desert Water District acting as the Court-appointed Watermaster. The Management Actions identified neither supersede nor conflict with the Mojave Basin Area Judgment or the Warren Valley Judgment. All provisions of these Judgments are integral parts of the foundation of this Plan.

In addition to conducting regional groundwater management, MWA has also engaged with the U.S. Geological Survey (USGS) in a cooperative water resources program by which the USGS assists MWA with monitoring activities in their service area. MWA currently maintains a monitoring network of approximately 900 monitoring wells for regular measurements of water levels. Many of these wells are also sampled periodically for water quality. Using these data, MWA tracks water level trends and fluctuations throughout the service area. Groundwater production in the Mojave Basin is monitored and managed by the Watermaster.

As part of basin characterization activities, six groundwater models have been developed in the MWA service area to aid in management of groundwater. MWA continues to apply and refine these models in key management areas to better manage water quantity and quality.

3.4.3 Mojave River Groundwater Basin

The predominant groundwater basin within the MWA service area is the Mojave River Groundwater Basin that encompasses 1,400 square miles as outlined on Figure 3-6, and having an estimated total water storage capacity of nearly 5 million af (Bookman-Edmonston Engineering, Inc., 1994).

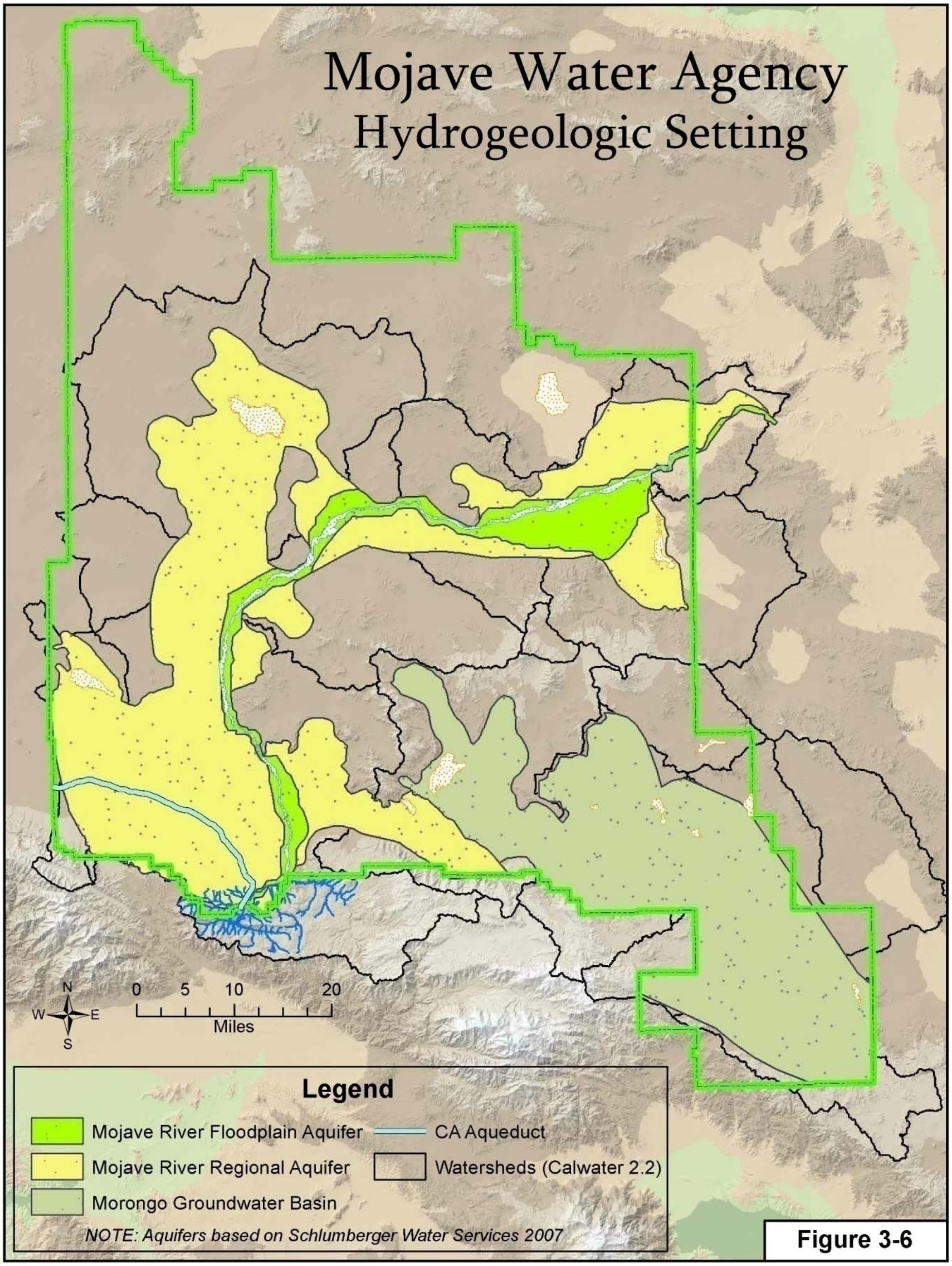
In the Mojave River Groundwater Basin, the Mojave River is the largest stream, originating near the Cajon Pass - a low-elevation gap in the San Bernardino Mountains. With the exception of small streams in the San Gabriel and the San Bernardino Mountains and short reaches of the Mojave River, there are no perennial streams in the Mojave Basin Area. Prior to ground-water development, the Mojave River flowed at a series of discharge areas near Victorville, at Camp Cady, at Afton Canyon, and at other areas where faults cause groundwater to discharge at land surface, such as near the Helendale or the Waterman Faults. Under present-day conditions the Mojave River does not flow perennially except at the Narrows near Victorville, downstream from the Victorville municipal wastewater treatment plant (an area known locally as the "Transition Zone"), and near Afton Canyon (Izbicki, 2004).

The Mojave River Groundwater Basin Area is essentially a closed basin – very little groundwater enters or exits the basin. However, within the basin groundwater movement occurs between the different subareas, as well as groundwater-surface water and groundwater-atmosphere interchanges. Groundwater is recharged into the basin predominantly by infiltration of water from the Mojave River, which accounts for approximately 80 percent of the total basin natural recharge. Other sources of recharge include infiltration of storm runoff from the mountains and recharge from human activities such as irrigation return flows, wastewater discharge, and enhanced recharge with imported water (Stamos et al., 2001). Over 90 percent of the basin groundwater recharge originates in the San Gabriel and San Bernardino Mountains (Hardt 1971). Groundwater is discharged from the basin primarily by well pumping, evaporation through soil, transpiration by plants, seepage into dry lakes where accumulated water evaporates, and seepage into the Mojave River.

Recent investigations by MWA, USGS, and others have resulted in an improved understanding the geology and hydrogeology of the Mojave Basin Area. Specifically, a more refined examination of the hydrostratigraphy has allowed for differentiation between the more permeable Floodplain Aquifer that has a limited extent along the Mojave River and the more extensive but less permeable Regional Aquifer (Stamos et al., 2001). The aerial extent of the Floodplain and Regional aquifers is shown on Figure 3-6. In the Mojave Basin Area, Alto, Centro, and Baja subareas contain both the Floodplain Aquifer and the Regional Aquifer while Oeste and Este subareas only contain the Regional Aquifer.

The Floodplain Aquifer is composed of sand and gravel weathered from granitic rocks of the San Gabriel and the San Bernardino Mountains and deposited in a fluvial depositional environment. These highly permeable sediments can yield large quantities of water to wells. The Floodplain Aquifer is directly recharged by infiltration of surface flows from the Mojave River during the winter rainy season (Figure 3-6). Recharge is greater near the mountain front where surface flows are more frequent.

FIGURE 3-6
HYDROGEOLOGIC SETTING



The Regional Aquifer underlies and surrounds the Floodplain Aquifer with interconnected alluvial fan and basin fill deposits that drain toward the Mojave River (Figure 3-6). In some areas, permeable deposits from the ancestral Mojave River are present, but overall the aquifer is much less permeable than the Floodplain Aquifer. The Regional Aquifer is generally recharged by groundwater movement from the Floodplain Aquifer to the Regional Aquifer, infiltration of runoff from the higher altitudes of the San Gabriel and San Bernardino Mountains, and smaller amounts of runoff from local intermittent streams and washes (Izbicki, 2004).

Prior to recent population growth, most of the groundwater production occurred in the Floodplain Aquifer. Groundwater production was initially developed along the Mojave River in the early 1900s. In the mid-1950's, groundwater production had increased to about 190,000 af, with most of the production still occurring along the river. By 1994, about half of the total basin production came from wells located away from the Mojave River in the Regional Aquifer (Stamos et al., 2001). The increase in water production and the re-distribution of pumping in the basin have significantly influenced the interaction between the Floodplain and Regional Aquifers. Prior to development in the area, groundwater flowed primarily from the Regional Aquifer into the Floodplain Aquifer. However, vertical groundwater gradients have been reversed in recent years, and downward flow from the Floodplain Aquifer is currently the primary recharge mechanism for the Regional Aquifer (Stamos et al., 2001).

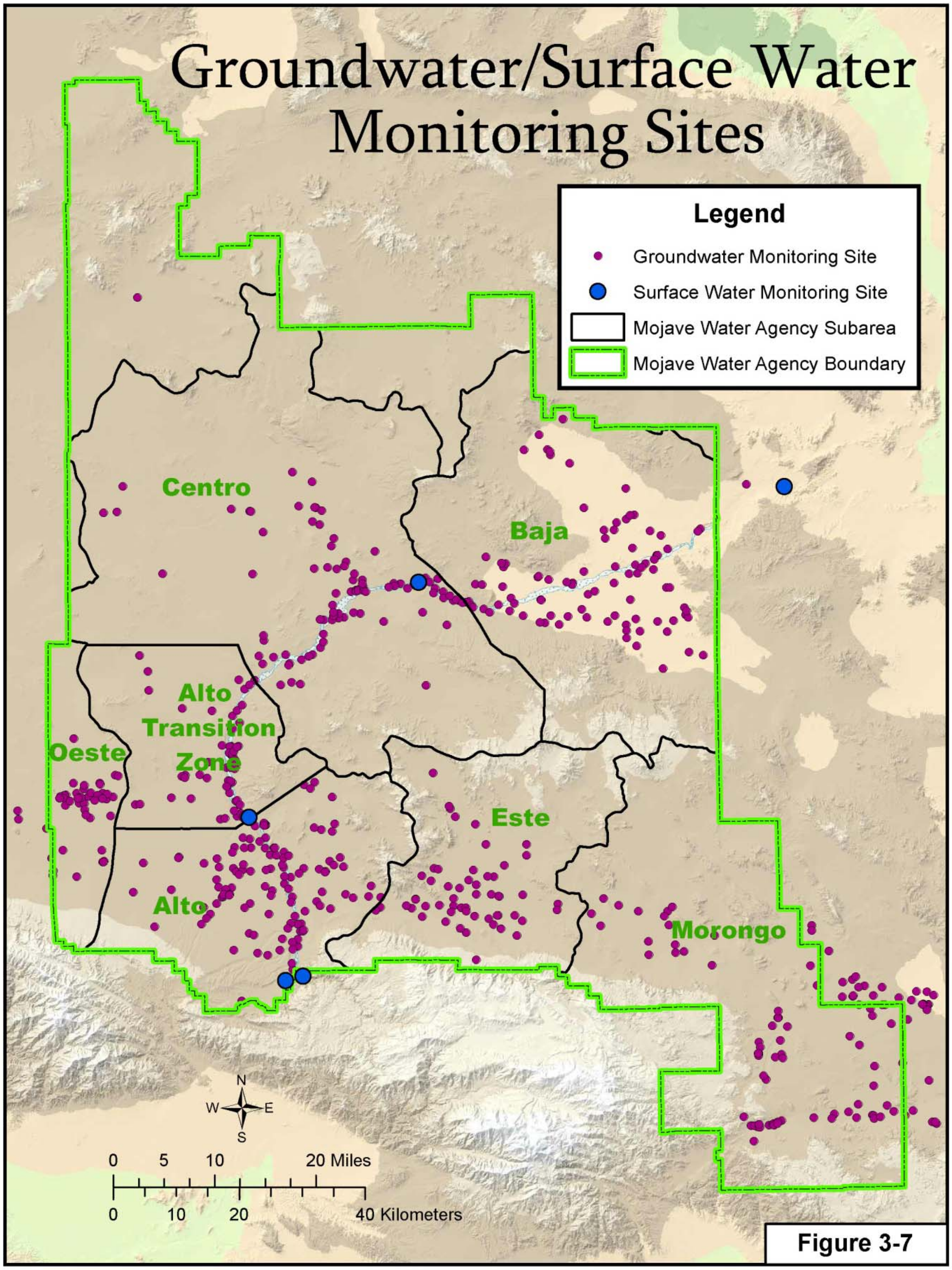
3.4.3.1 Groundwater Levels

Essentially all water supplies within MWA are pumped from the local groundwater basins and groundwater levels generally have been declining for the past 50 years or more. Adjudication proceedings were initiated due to concerns that rapid population growth would lead to further overdraft. The resulting Mojave Basin Area Judgment requires that additional surface water be imported to help balance the basins (MWA, 2004).

The MWA maintains a comprehensive groundwater monitoring program consisting of over 900 monitoring wells. The Mojave Basin Area Watermaster tracks water production within each of the five subareas in the Mojave Basin Area as part of the Watermaster's investigation into subarea conditions and recommendations on groundwater pumping amounts. The Watermaster relies on the MWA groundwater level monitoring program along with production records to make recommendations regarding the sustainable yield for each of the subareas. Figure 3-7 shows the locations of groundwater level monitoring. A summary of the recent water level trends for each of the five subareas in the Mojave Basin Area is presented below.

Alto Subarea - Alto subarea water levels near the Mojave River are relatively stable exhibiting seasonal fluctuations with rising levels in winter and declining levels in summer. It is expected that under current pumping conditions and long-term average flows in the river, water levels in the Floodplain Aquifer will generally remain stable. Water levels in the western portion of Alto in the Regional Aquifer exhibit declines consistent with heavy pumping and limited local recharge. Water levels in the eastern portion of Alto indicate similar trends although to a lesser extent; most likely due to limited pumping in the regional aquifer east of the river and possibly higher localized septic return flow due to the lack of sewers in some areas. Continued pumping in depleted areas of the Regional Aquifer may result in long-term local negative impacts such as declining yields and water quality problems. As a whole, the Alto subarea appears to be in regional balance although portions of the subarea have shown continued historical declines.

FIGURE 3-7
GROUNDWATER/SURFACE WATER MONITORING SITES



Localized declines in water levels may be ameliorated by a redistribution of groundwater production and return flows (e.g. construction of local wastewater treatment plants).

Centro Subarea - Water levels in Centro have been relatively stable with seasonal fluctuations and declines during dry years followed by recovery during wet periods. Water levels in the Harper Lake area indicate a slow recovery due primarily to reduced pumping during the past several years. Declines in water levels in wells in the vicinity of Hinkley (away from the river) show the effects of pumping and limited recharge, primarily due to agriculture.

Baja Subarea - Baja water levels continue to decline due to over-pumping and limited recharge. Wells near the river in the Daggett area respond to recharge when it is available but experience water level declines immediately following storm events. Water levels elsewhere in Baja, especially areas away from the Mojave River, indicate declines that are not positively impacted from storm events.

Este Subarea - Water levels in Este have remained stable for the past several years indicating a relative balance between recharge and discharge.

Oeste Subarea – Hydrographs for the southern portion of Oeste Subarea indicate a long-term decline in water levels, but declines in most wells appear relatively small (less than or about one foot per year) (Watermaster, 2010). More significant declines occur locally, especially in the vicinity of heavy pumping. Water levels in the north to central portion of Oeste near El Mirage indicate relatively stable conditions.

3.4.3.2 Available Groundwater Supplies

Recent and projected groundwater pumping within each subarea of the Mojave Basin Area is summarized in Tables 2-2 (see Chapter 2) and 3-6, respectively. In the Mojave Basin Area, Base Annual Production (BAP) rights were assigned by the Mojave Basin Area Judgment to each producer using 10 afy or more, based on historical production. BAP is defined as the producer's highest annual use verified for the five-year base period from 1986-90. Parties to the Judgment are assigned a variable Free Production Allowance (FPA) by the Watermaster, which is a percentage of BAP set for each subarea for each year. The allocated FPA represents each producer's share of the water supply available for that subarea. This FPA is reduced or "ramped-down" over time until total FPA comes into balance with available supplies.

Production Safe Yield (PSY) is also determined for each subarea for each year. The PSY in each subarea is assumed to equal the average net natural water supply plus the expected return flow from the previous year's water production. Exhibit H of the Judgment requires that in the event the FPA exceeds the estimated PSY by five percent or more of BAP, Watermaster recommends a reduction in FPA equal to, but not more than, a full five percent of the aggregate subarea BAP. Any water user that pumps more than their FPA in any year is required to buy "Replacement Water" equal to the amount of production in excess of the FPA. Replacement Obligations can be satisfied either by paying the Mojave Basin Area Watermaster to purchase imported water from MWA or by temporarily transferring unused FPA within that subarea from another party to the Judgment.

TABLE 3-6
MOJAVE BASIN AREA PROJECTED GROUNDWATER PRODUCTION (AFY)

Mojave Basin Area[(a)]	2010	2015	2020	2025	2030	2035
Subareas						
Alto	84,226	93,994	99,440	108,851	118,262	127,674
Baja	23,653	24,413	24,834	25,212	25,573	25,919
Centro	23,881	25,088	25,959	26,838	27,718	28,597
Este	5,863	6,607	6,771	6,970	7,170	7,369
Oeste	4,503	4,767	4,930	5,089	5,247	5,404
Total	**142,126**	**154,869**	**161,934**	**172,960**	**183,970**	**194,963**

Note:
(a) Acre-foot numbers represent groundwater production only and do not include demands met directly with SWP sources.

Table 3-7 shows the current FPA for water year 2010-2011 for each subarea and the estimated PSY. Also shown in Table 3-7 is the verified production for water year 2009-10 for comparison. Free Production Allowance as shown in Table 3-7 is greater than PSY by more than 5 percent in four of the five subareas. Water levels remain stable in most areas currently because verified production is less than the available supply. Based on these recommendations, agricultural producers in Alto and Oeste have an established FPA that is currently 80 percent of their BAP for the 2010-2011 water year. FPA for Alto municipal and industrial use and for Oeste municipal and industrial have been reduced to 60 percent and 65 percent of their BAP, respectively. FPA for all uses in Centro and Este remain at 80 percent of BAP. All production in the Baja Subarea has been ramped-down to 62.5 percent of BAP, principally due to the extent of the overdraft and the predominance of agricultural production in Baja, which precludes the opportunity to have industrial and municipal producers achieve balance through a disproportionate share of the ramp-down, as is the case in Alto and Oeste. Given the constraints imposed by the Judgment and direction from the Court regarding ramp-down, it is the Watermaster's recommendation to the Court that the FPA be set as follows for each subarea for water year 2011-2012:

- Alto Subarea - 80 percent of BAP for agriculture and 60 percent of BAP for municipal and industrial
- Oeste Subarea - 80 percent of BAP for agriculture and 65 percent of BAP for municipal and industrial[(1)]
- Este Subarea[(2)] - 80 percent of BAP
- Centro Subarea - 80 percent of BAP
- Baja Subarea – 62.5 percent of BAP

(1) FPA to be set at 65% of Base Annual Production for the 2011-12 Water Year subject to continued ramp-down. Implementation will be held in abeyance for 4 years (starting in the 2009-10 Water Year) at 80% subject to court approval.
(2) FPA to be set at 80% of Base Annual Production for the 2010-11 Water Year. The Este Subarea may be subject to future ramp-down to 65% immediately if water use conditions change.

TABLE 3-7
MOJAVE BASIN AREA PRODUCTION SAFE YIELD AND CURRENT FREE PRODUCTION ALLOWANCE (AFY)

Mojave Basin Area	Base Annual Production	2010-2011 FPA	Production Safe Yield	Percent Difference[1]	2009-2010 Verified Production
Subareas					
Alto	116,412	74,534	69,862	4.00%	78,493
Baja	66,157	43,863	20,679	35.00%	21,539
Centro	56,269	45,349	33,375	21.30%	21,847
Este	20,205	16,376	7,156	45.60%	4,848
Oeste	7,095	5,727	4,052	23.60%	4,342

Source: Annual Watermaster Reports.
(1) This value represents the percent of BAP that PSY departs from FPA.

Table 3-8 summarizes the net average annual water supply estimates for each of the subareas that comprise the Mojave Basin Area. The net average water yield of the entire Mojave Basin Area is about 51,925 afy. The long-term average natural supply is shown under single- and multiple-dry years as well as average years because the long-term average includes dry periods, and any single or multiple-year dry cycle does not impact the long-term yield of the basins.

TABLE 3-8
MOJAVE BASIN AREA GROUNDWATER BASIN SUPPLY RELIABILITY

Anticipated Supply	Normal Year [a] (afy)	Single-Dry Water Year (afy)	Multiple Dry Water Year (afy)
Subareas			
Alto	25,900	25,900	25,900
Baja	5,500	5,500	5,500
Centro	18,500	18,500	18,500
Este	875	875	875
Oeste	1,150	1,150	1,150
Total	**51,925**	**51,925**	**51,925**

Note:
(a) Water supply balance in Table 5-2 from the Annual Watermaster Reports, based on long-term average supply during the adjudicated hydrologic base period during water years 1930-1931 through 1989-1990.

Adequacy of Supply

Essentially all of the water used within the MWA is supplied by pumping groundwater. The physical solution to the Mojave Basin Judgment sets limits on the amount of groundwater production that can occur in each subarea without incurring an obligation to buy imported water. Subareas upstream have an annual obligation to provide specific inflows to subareas downstream based on long-term averages between 1931 and 1990.

Because water use within the MWA service area is supplied entirely by groundwater, MWA does not have any inconsistent water sources that cause reduced deliveries to users within the service area. Natural supply estimates are based on the long-term averages which account for inconsistency in supplies (i.e. historic periods of drought are included in the long-term average).

A potential exception is any area where water quality could limit use as a potable supply. Wellhead treatment or provision of an alternative supply is planned for these areas.

MWA directly supplies imported SWP water to two power plants. The supply to the High Desert Power Project (HDPP) is annual, interruptible and only available if adequate SWP water is available on a year-to-year basis. The HDPP is converting to recycled water and has stored SWP water in the Mojave River Groundwater Basin to offset shortages. In September 2010, HDPP signed an agreement to purchase 4,000 afy of recycled water from the City of Victorville, which can come from any combination of SWP, recycled water from Victor Valley Wastewater Reclamation Authority (VVWRA), or the City of Victorville's new recycled treatment plant at the Southern California Logistics Airport (SCLA) site. As of 2015, the HDPP will be using 100 percent recycled water and will no longer rely on the SWP. The other power plant (LUZ Solar Plant) is entirely dependent upon SWP water delivered by exchange through the Antelope Valley-East Kern Water Agency (AVEK) system. LUZ currently has water stored in the Alto Subarea to offset potential SWP delivery reductions when allocations are low.

Sustainability

Producers in each subarea are allowed to produce as much water as they need annually to meet their requirements, subject only to compliance with the physical solution set forth in the Mojave Basin Area Judgment. An underlying assumption of the Judgment is that sufficient water will be made available to meet the needs of the Basin in the future from a combination of natural supply, imported water, water conservation, water reuse and transfers of FPA among parties.

MWA is actively operating recharge sites for conjunctive use along the Mojave River Pipeline and Morongo Basin Pipeline. Recharge sites including Hodge, Lenwood, Daggett, Newberry Springs, and Rock Springs Outlet provide MWA with the ability to recharge SWP water into subareas where replacement water is purchased. These sites also provide MWA with the ability to bank excess SWP water as available.

Water levels within each of the five subareas are evaluated as part of the Watermaster's investigation into subarea conditions and recommendations on FPA. The Judgment does not specifically require that Watermaster consider changes in water levels in its investigation but Paragraph 24 (o) of the Judgment requires Watermaster to consider changes in water in storage. Rising and falling water levels within the Mojave Basin Area are indications of changes in storage over time. If after full implementation of the Judgment, water levels continue to fall in certain parts of the Basin Area, the Court, at Watermaster's recommendation may direct recharge or reductions in water production as necessary to achieve long term sustainability. Such action is not anticipated given the current projections of use and availability of supplemental water to MWA. However, the Judgment is a protective tool to protect sustainability.

3.4.4 Morongo Basin/Johnson Valley Area

The groundwater basins within the Morongo Basin/Johnson Valley Area ("Morongo Area") are bounded by the Ord and Granite Mountains to the north, the Bullion Mountains to the east, the San Bernardino Mountains to the southwest, and the Pinto and Little San Bernardino Mountains to the south. The larger Morongo Area includes numerous small alluvial basins that maintain relatively compartmentalized groundwater flow systems typically terminating in dry lakes scattered throughout the area (Lewis, 1972; Mendez and Christensen, 1997). These smaller alluvial basins are separated by faults and bedrock outcrops.

DWR defines about 15 groundwater basins that cover a portion of the Morongo Area as defined in this plan (Figure 3-4). Several of these basins lie mostly outside of the MWA service area, have low population, and are essentially undeveloped with respect to groundwater. The remaining basins have been grouped into five regions for the Morongo Area as previously described and shown on Figure 3-5.

The hydrogeology of the Morongo Area has not been investigated to the same extent as the Mojave River Groundwater Basin, but recent investigations have resulted in an improved understanding, especially in areas where the need for active groundwater management has been identified. These basins were formed in the Tertiary Period from movement along the San Andreas Fault to the south and the Garlock Fault to the north, creating the Mojave structural block (Norris and Webb, 1990). As such, the Morongo Area is characterized by numerous northwest trending strike-slip faults. The San Bernardino Mountains and bedrock underlying the groundwater basins consist mainly of Jurassic and Cretaceous granitic rocks. The bedrock surface dips steeply to the north and east, providing a large thickness of alluvial sediments a short distance from the mountain front. The Tertiary and Quaternary age alluvial sediments are the main aquifers in the groundwater basin.

Groundwater flow in the Morongo Area is generally from south to north in Johnson Valley and from west to east-northeast elsewhere in the area. Natural recharge originates from the mountains on the southern and western boundaries of the Area, resulting in groundwater flow gradients to the north, east, and south adjacent to the boundaries, before turning to the east-northeast. The east-northeast flow direction is maintained to the eastern boundary of MWA. Groundwater flow is complicated locally by pumping, faulting, shallow bedrock, and enhanced recharge basins. For example, in the vicinity of the developed area of Yucca Valley, groundwater flow is controlled to some extent by local recharge basins.

3.4.4.1 Available Groundwater Supplies

Recent historical and projected groundwater pumping for the Morongo Area is summarized in Tables 3-9 and 3-10.

TABLE 3-9
MORONGO AREA
HISTORICAL GROUNDWATER PRODUCTION (AFY) BY WATER YEAR

	2005	2006	2007	2008	2009
Morongo Area	5,879	6,300	6,403	5,797	5,990

Source: Production data reported by retail water agencies plus MWA estimate of minimal producers (approximately 200 afy) within the Morongo Area.

TABLE 3-10
MORONGO AREA PROJECTED GROUNDWATER PRODUCTION (AFY)

	2010	2015	2020	2025	2030	2035
Morongo Area[(a)]	5,794	7,102	7,372	7,590	7,809	8,028

Note:
(a) Groundwater production projections are based on the “Moderate” conservation assumptions using the MWA demand forecast model.

Two of the Morongo Area regions have been documented as having either historical or current overdraft conditions including the Ames Valley and Copper Mountain Valley/Joshua Tree regions. MWA is currently assisting the retailers in these regions with enhanced recharge projects to alleviate overdraft and provide an alternative source of water supply.

In the Ames Valley and Johnson Valley regions, the Bighorn-Desert View Water Agency (BDVWA) has implemented a Water Infrastructure Restoration Program (WIRP) that outlines specific system improvements to remediate deficiencies in infrastructure and operations. Two WIRP projects that are near completion include the Ames Valley Recharge Project (see Section 3.6) and a Groundwater Management Plan (BDVWA GWMP). Local groundwater is currently the sole source of its water supply, but BDVWA has annual 9 percent capacity in the Morongo Basin Pipeline and may purchase SWP water from MWA. Although the infrastructure needed to deliver SWP water to the Ames Valley region already exists, additional facilities are needed to convey imported SWP water to spreading grounds for recharge, storage, and subsequent recovery. A Feasibility Study, including a groundwater model, is scheduled for completion in 2011 and documents the ability to store and recover SWP water in the basin.

The BDVWA GWMP is being developed for the BDVWA in parallel with the Recharge Feasibility Study. The BDVWA GWMP will provide groundwater management strategies for a long-term sustainable supply from the Ames Valley groundwater subbasin including enhanced aquifer recharge and pumping restrictions. The plan is also scheduled for completion in 2011.

BDVWA is the Lead Agency for the WIRP and the GWMP, but the implementation also includes other participating agencies. MWA is a financial participant, while Hi-Desert Water District (HDWD) and San Bernardino County Service Area (CSA) No. 70 are cooperative partners who will benefit through participation in the groundwater storage and recovery program. The GWMP will address the purchase of SWP water for recharge and pumping restrictions in the event that overdraft conditions are not controlled.

To assist with the Joshua Tree subbasin overdraft, the Joshua Basin Recharge Project (see Section 3.6) will create a mechanism for the Joshua Basin Water District (JBWD) to make use of SWP water via the Morongo Basin Pipeline. Currently, JBWD has an agreement in place with MWA in which JBWD has an annual 27 percent capacity in the Morongo Basin Pipeline and may purchase SWP water via the Morongo Basin Pipeline. However, currently they cannot access this SWP water without the extension of the Morongo Basin Pipeline and construction of recharge facilities that would occur under the proposed Project. The Joshua Basin Recharge Project provides needed recharge into the Joshua Tree subbasin to relieve overdraft conditions.

Table 3-11 summarizes the net average annual water supply estimates for each of the regions that comprise the Morongo Area. The net average water yield of the entire Morongo Area is about 2,120 afy. These numbers generally represent the perennial yield of the basins based on varying levels of data as summarized below.

For the Ames Valley Region, a perennial yield of 900 afy was derived from recent groundwater modeling by Todd Engineers for BDVWA. Data and analyses will be documented in the Draft Feasibility Study for the Ames Valley Recharge Project scheduled to be finalized in 2011. The methodology used in the model was more rigorous than the water balance approach used in a 2007 analysis (Kennedy/Jenks/Todd, 2007). For that study, an average annual recharge of 686 afy was estimated for the Ames Valley based on a percentage of rainfall in the upper reaches of the contributing watershed. For the feasibility study, a more detailed approach considered runoff coefficients for various precipitation amounts and retention time between runoff and recharge. The revised approach indicated an average annual recharge of 765 afy for a model period that represented 85 percent of normal rainfall. When normalized to rainfall, an average annual recharge of about 900 afy was estimated. Although the model also considered septic return flows, those totals are not included in the perennial yield calculation.

Current production wells in the Ames Valley are located to limit subsurface outflow from the recharge project's subbasin and should be able to capture perennial yield as needed. In addition, the supply estimate of 900 afy is somewhat under-estimated, given that no recharge or groundwater storage was assigned to a large downgradient area that has not been adequately investigated due a lack of significant groundwater development.

The supplies shown in Table 3-11 for the Johnson Valley and Means Valley regions are 900 afy and 20 afy, respectively. These estimates of perennial yield were derived from a water balance from the 2007 basin conceptual model report (Kennedy/Jenks/Todd, 2007). Groundwater supplies for Copper Mountain Valley/Joshua Tree and the Warren Valley are documented in the 2004 USGS Evaluation completed by Nishikawa, Izbicki et al. in cooperation with JBWD (USGS Nishikawa, Izbicki, et al., 2004) and the 2003 USGS Evaluation completed by Nishikawa, Densmore et al. in cooperation with HDWD (USGS Nishikawa, Densmore et al., 2003), respectively.

The perennial yields described above are maintained for both a single-dry year and multiple-dry year scenarios in Table 3-11. Although recharge to the groundwater basin is typically less during dry years, the perennial yield values account for the transient nature of recharge in the groundwater system. Due to the time lag associated between recharge and change in groundwater storage near supply wells, these basins are considered reliable in both dry and wet years if long-term overdraft is avoided.

As discussed later in this Chapter, MWA has planned for water shortages by banking excess and available SWP in the groundwater basins for use at a later time. MWA also improves their reliability of water supply by using some of this banked water as operational storage during the year. Table 3-13 shows the storage available in MWA's existing banked accounts by subarea. For operational reliability, a portion of the banked supply is used to accommodate the day to day or month to month variances in supply that can occur during the year and leave retailers short of supply.

TABLE 3-11
MORONGO BASIN/JOHNSON VALLEY AREA GROUNDWATER BASINS SUPPLY RELIABILITY

Anticipated Supply	Normal Year[(a)] (afy)	Single-Dry Water Year (afy)	Multiple Dry Water Year (afy)
Regions			
Ames Valley[(b)]	900	900	900
Johnson Valley[(c)]	900	900	900
Means Valley[(c)]	20	20	20
Copper Mountain Valley/Joshua Tree[(d)]	200	200	200
Warren Valley[(e)]	100	100	100
Total	**2,120**	**2,120**	**2,120**

Notes:

(a) To avoid double counting with MWA's demand forecast model which includes return flows from septic tanks, this normal year has been calculated as the safe or perennial yield of the basin and does not include return flows in the safe yield calculation.

(b) Todd Engineers is completing a "Hydrogeologic Feasibility Study and Groundwater Management Plan for the Ames/Reche Project" for the Bighorn Desert View Water Agency, in 2011, that will better define the Ames Valley perennial yield. The perennial yield of 900 afy shown above represents subsurface inflow/recharge to the region only and no return flows are included.

(c) Source: "Basin Conceptual Model and Assessment of Water Supply and Demand for the Ames Valley, Johnson Valley, and Means Valley Groundwater Basins", April 2007, Kennedy/Jenks/Todd. Tables in ES.

(d) USGS Nishikawa, Izbicki et al., 2004.

(e) USGS Nishikawa, Densmore et al., 2003.

There are three water supply agreements that are applicable to groundwater management in the Morongo Area, including (1) the Warren Valley Basin Agreement, (2) a court approved agreement between the BDVWA and HDWD in a portion of the Ames Valley basin and (3) an agreement for the users of the Morongo Basin Pipeline. The purpose of the agreement is to improve reliability of the shared water supply.

The Warren Valley Basin Agreement is an agreement between MWA, HDWD, and the Warren Valley Basin Watermaster. This agreement affects the use of the Morongo Basin Pipeline including pipeline users in the Ames Valley, Means Valley, and Johnson Valley groundwater basins. The primary purpose of the agreement is to more efficiently use available water supply and to provide supplemental water to the Watermaster in the event that water levels drop too low to support the adjudicated water rights.

The Ames Valley Basin Water Agreement is a 1991 Agreement between HDWD and BDVWA for the construction and operation of the HDWD Mainstream Well in the Ames Valley basin. At the time the Agreement was entered, the HDWD service area included areas within the Ames Valley basin and the Warren Valley basin. That agreement is currently being expanded to include all pumpers in the Ames Valley including CSA No. 70 and to provide a monitoring and management plan for operation of the basin with the Ames Valley Recharge Project.

The Morongo Basin Pipeline Agreement of 1991 is an agreement between BDVWA, HDWD, JBWD, CSA No. 70, and MWA for construction, operation, and financing of the Morongo Basin Pipeline Project.

Adequacy of Supply

The entire Morongo Area has limited natural supply, with a large portion of the Area relying on MWA's ability to provide SWP water through the Morongo Basin Pipeline. The Warren Basin (i.e. Town of Yucca Valley) was the first to experience obvious overdraft issues and relies on imported water and the three associated recharge sites to support the adjudication. Remaining water districts in the region consisting of BDVWA, CSA No. 70, and JBWD are at or close to surpassing their natural supply and these agencies plan recharge facilities in the immediate near future to address their own supply issues. The Morongo Basin Pipeline has capacity to deliver water to the benefit of the BDVWA, HDWD, JBWD and the CSA No. 70.

Sustainability

The Warren Valley adjudication mandates that groundwater extraction from the basin does not exceed the estimated annual supplies and empowers the HDWD as Watermaster to enforce pumping limits as mandated by the Court. The Watermaster performs monitoring in accordance with the Rules and Regulations of the Warren Valley Watermaster (1995). Monitoring activities currently performed by the Watermaster include water production and verification, water level measurement, and water quality.

In the Ames Valley, BDVWA, MWA, HDWD, and CSA No. 70 are currently negotiating an agreement to sustainably manage the Ames Valley Region. This agreement will replace the 1991 Stipulated Judgment and will be incorporated into the GWMP. Collectively, the agreement and GWMP will provide the institutional framework for the purchase, recharge, and recovery of imported SWP water through the Morongo Basin Pipeline Agreement. A basin-wide groundwater monitoring program will provide the necessary data for effective management into the future.

For the Copper Mountain Valley/Joshua Tree Region, ongoing implementation of an enhanced recharge project and the GWMP will ensure sustainability in the region. In the Johnson Valley Region, BDVWA is undertaking an evaluation of the estimated water supply as part of their WIRP as discussed previously. The Means Valley Region is small and sparsely populated with only limited domestic groundwater development. No impediments to sustainable management are envisioned for these regions.

3.4.5 Potential Supply Inconsistency

Because water use within the MWA service area is supplied almost entirely by groundwater, MWA does not have any inconsistent water sources that cause reduced deliveries to users within the service area. A potential exception is areas where water quality could limit use as a potable supply or the LUZ Solar Power Plant which is supplied directly with SWP and has no alternative supply. Procurement of alternative supplies is planned for these areas. While many of the sources that recharge the groundwater basin have high annual variability, including flows on the Mojave River and supplies from the State Water Project, the groundwater basins used within the MWA service area are sufficiently large to allow for continued water use during dry periods with only a temporary decline in groundwater levels (MWA, 2004).

MWA's groundwater basins contain numerous areas with water quality issues, as described in Chapter 5. Key contaminants include arsenic, nitrates, iron, manganese, Chromium VI, and total dissolved solids (TDS). Measurements in excess of drinking water standards have been found for many of these constituents in local areas of each subarea in the Mojave Basin Area and each region within the Morongo Area. Ongoing water quality monitoring allows identification of more sensitive areas. Groundwater pumping in these areas will have to be avoided, treated or blended.

Another potential water quality issue facing MWA is the accumulation of salt in the groundwater basins. Because the Mojave River Basin and Morongo Areas are closed basins, salts concentrated in the locally-generated wastewater, salts contained in the imported reclaimed wastewater, and salts in the SWP supplies have few to no natural outlets from the basin. Although SWP supply introduces salts into the system, the concentrations of key salt constituents are often less than ambient concentrations, resulting in some improvement in local water quality.

From 2005-2009, an average of about 4,800 afy of imported wastewater was discharged into the MWA from outside its boundary. In 2010, an average of approximately 49,680 afy of SWP water was imported. By 2020, MWA is planning to increase its SWP utilization to 53,880 afy, which will further increase the introduction of salts into the system. In an effort to understand potential long-term water quality changes that may occur in the basin over time due to the long-term effects of wastewater and importation of SWP water into the MWA service area, the Lahontan Regional Water Quality Control Board (RWQCB) and the MWA worked cooperatively to develop a salt balance model for the MWA service area. The model was finalized in 2007 and generally showed that the importation of SWP water mitigated the long-term effects of salt loading (TDS increases) primarily caused by population increases and the associated larger volumes of wastewater entering into the basin(s).

Over the past several years, the MWA has made efforts to greatly increase the understanding of the water quantity and quality of the groundwater basins that lie within its service area. The Agency currently maintains a monitoring network of approximately 900 monitoring wells that record water levels on a regular basis. Many monitoring wells in the MWA monitoring network are sampled to analyze water quality. Additional information concerning water quality issues and replacement capacity is also provided in Chapter 5.

3.5 Transfers, Exchanges, and Groundwater Banking Programs

In addition to SWP water supplies and groundwater, MWA is currently exploring opportunities to purchase water supplies from other water agencies and sources. Transfers, exchanges, and groundwater banking programs, such as those described below, are important elements to enhancing the long-term reliability of the total mix of supplies currently available to meet water demand.

3.5.1 Transfers and Exchanges

An opportunity available to MWA to increase water supplies is to participate in voluntary water transfer programs. Since the drought of 1987-1992, the concept of water transfers has evolved into a viable supplemental source to improve supply reliability. The initial concept for water transfers was codified into law in 1986 when the California Legislature adopted the “Katz” Law (California Water Code, Sections 1810-1814) and the Costa-Isenberg Water Transfer Law of 1986 (California Water Code, Sections 470, 475, 480-483). These laws help define parameters for water transfers and set up a variety of approaches through which water or water rights can be transferred among individuals or agencies.

According to the California Water Plan Update 2009, up to 27 million afy of water are delivered for agricultural use every year. Over half of this water use is in the Central Valley, and much of it is delivered by, or adjacent to, SWP and Central Valley Project (CVP) conveyance facilities. This proximity to existing water conveyance facilities could allow for the voluntary transfer of water to many urban areas, including MWA, via the SWP. Such water transfers can involve water sales, conjunctive use and groundwater substitution, and water sharing and usually occur as a form of spot, option, or core transfers agreement. The costs of a water transfer would vary depending on the type, term, and location of the transfer. The most likely voluntary water transfer programs would probably involve the Sacramento or southern San Joaquin Valley areas.

One of the most important aspects of any resource planning process is flexibility. A flexible strategy minimizes unnecessary or redundant investments (or stranded costs). The voluntary purchase of water between willing sellers and buyers can be an effective means of achieving flexibility. However, not all water transfers have the same effectiveness in meeting resource needs. Through the resource planning process and ultimate implementation, several different types of water transfers could be undertaken.

3.5.2 Opportunities for Short and Long-Term Transfers and Exchanges

Prior to purchases of Table A amount (permanent transfers) from other water agencies, MWA's Table A amount was 50,800 afy. In January 1997, MWA purchased 25,000 af of Table A from Berrenda Mesa Water District/Kern County Water Agency. It was transferred to MWA in 1998, bringing MWA's Table A to 75,800 afy. In October 2009, MWA purchased 14,000 af from Dudley Ridge Water District; the transfer of Table A from Dudley to MWA is occurring in 3 stages:

- 7,000 af in 2010 for a total of 82,800;
- 3,000 af in 2015 for a total of 85,800;
- 4,000 af in 2020 for a total of 89,800

Table 3-12 summarizes the potential water transfer and exchange opportunities identified by MWA at this time. One option of utilizing unused SWP water would be to transfer a portion of it to another party as part of a storage agreement or exchange program. MWA and Metropolitan Water District of Southern California (Metropolitan) agreed on a Water Exchange Pilot Program with the goals of facilitating a water exchange in the short-term and helping to determine the feasibility of a similar long-term exchange program between the two parties. Under the terms of the Exchange Pilot Program, Metropolitan delivers to MWA up to 75,000 af of its SWP deliveries or other water. In exchange, in years when Metropolitan requests water, MWA will provide Metropolitan water through exchange of MWA's SWP deliveries for that year. This program ended in 2010 when MWA returned the remainder of the exchange water to Metropolitan. Through the program, there were two deliveries to storage by Metropolitan in 2003 and 2005 for a total of almost 45,000 af. No long-term arrangement has been pursued, but there may be opportunities in the future for additional short- or long-term exchanges with Metropolitan.

MWA also has a Table A exchange program in place with the Solano County Water Agency (SCWA). This agreement allowed MWA to receive Table A deliveries from the SCWA during hydrologic periods when the SCWA had approved Table A allocations in excess of their needs. MWA is no longer storing SCWA water for future exchanges; however, MWA is still returning previously-stored water to SCWA under the program. The remaining amounts of exchange water expire in 2014 and 2015, and when that water is returned the program will end.

Although the exchange programs with both Metropolitan and SCWA are limited in scope and duration, they represent the types of exchange opportunities MWA and other SWP contractors have to maximize their utilization of available water supplies from the SWP. MWA continues to explore opportunities for these types of exchanges.

Another MWA transfer program consists of an existing agreement to transfer up to 2,250 afy to the Antelope Valley-East Kern Water Agency (AVEK). The water is transported by AVEK to the LUZ Solar Power Plant located near Kramer Junction within the MWA service area.

In addition, the rules of the Mojave Basin Area Judgment allow for the possibility of in-basin transfers. Under the rules of the Judgment, producers are allowed to sell or lease unused BAP and FPA to other parties within the same subarea. This mechanism primarily allows industrial and municipal users to purchase BAP from agricultural or other users to augment their ability to pump water.

TABLE 3-12
WATER TRANSFER AND EXCHANGE OPPORTUNITIES IN MWA SERVICE AREA

Name/Type	Exchange/Transfer	Duration	Proposed Quantities
Pre-delivery of Unused SWP Supplies	Current water contract	Permanent	Up to 220,000 acre-feet total from 2010 to 2030
Solano County Water Agency	Exchange Pilot Program	Ending in 2015. No further action.	Pilot program only
Metropolitan Water District Water Exchange Program	Exchange Pilot Program	Ended in 2010. No further action.	Pilot program only
Other SWP Contractors	Water transfer, exchange, or banking	Under consideration	Not defined
Transfers within Mojave Basin Subareas	Base Annual Production (BAP) and/or Free Production Allowance (FPA)	Ongoing	Variable

Source: MWA.

3.5.3 Groundwater Banking Programs

With recent developments in conjunctive use and groundwater banking, significant opportunities exist to improve water supply reliability for MWA. Conjunctive use is the coordinated operation of multiple water supplies to achieve improved supply reliability. Most conjunctive use concepts are based on storing surface water supplies in a local groundwater basin during times of surplus for use during dry periods when surface water supplies would likely be reduced.

Groundwater banking programs involve storing available SWP surface water supplies during wet years in groundwater basins in, for example, the San Joaquin Valley. Water would be stored either directly by surface spreading or injection, or indirectly by supplying surface water to farmers for use in lieu of their intended groundwater pumping. During water shortages, the stored water could be extracted and conveyed through the California Aqueduct to MWA as the banking partner, or used by the farmers in exchange for their surface water allocations, which would be delivered to MWA as the banking partner through the California Aqueduct. Several conjunctive use and groundwater banking opportunities are available to MWA.

MWA has its own conjunctive use program to take advantage of the fact that the available MWA SWP supply on average is still greater than the demand in the service area. MWA is able to store this water for future use when SWP supplies are not available. This activity also allows MWA to take advantage of wet year supplies because of the abundant groundwater storage available in the Basins. This concept is used in the planned water supply projects such as the Regional Recharge and Recovery Project, discussed in more detail in the following section.

In 2006, MWA adopted a "Water Banking Policy" to guide the Agency in determining where water will be "banked". Banking targets were established for each groundwater basin where banking may occur under this Policy to prioritize where available water will be banked. The targets are generally based on the calculation of three times the non-agricultural water demand (groundwater production) within the Subarea. Current targets are as follows:

- Alto Subarea – 261,000 af
- Centro Subarea – 33,000 af
- Baja Subarea – 31,000 af
- Este Subarea – 5,000 af
- Oeste Subarea – 6,000 af
- Morongo Area - 21,000 af

Table 3-13 shows the storage available in MWA's existing banked accounts by subarea as of December 31, 2010. Unless otherwise noted, the water was all excess SWP water that MWA has purchased over the past years and stored in various groundwater basins for use when SWP is limited or there are groundwater shortages. MWA will continue to make such purchases when available to ensure the supply of water to their retailers. Some individual retailers in the MWA service area have their own individual banked storage accounts that are included in a separate column in the table below.

TABLE 3-13
STATUS OF MWA GROUNDWATER STORAGE ACCOUNTS

Subarea	MWA-Owned Stored Water[(a)] (af)	Retailer-Owned Stored Water[(b)] (af)	Total Stored Water (af)
Alto	58,592	28,851	87,443
Baja	18,128	0	18,128
Centro	17,377	0	17,377
Este	1,357	0	1,357
Oeste	0	0	0
Morongo	0	17,146	17,146
Total	**95,454**	**45,997**	**141,451**

Notes:
(a) MWA's banked groundwater storage accounts as of December 31, 2010.
(b) Retailer-owned water is owned by one of MWA's retailer agencies and consists of excess SWP purchased by MWA and then bought by the retailer.

3.6 Planned Water Supply Projects and Programs

The MWA operates under a Regional Water Management Plan, which was revised in 2004 and adopted on February 24, 2005. The 2004 RWMP defines MWA's overall water management objectives for the period of 2004 through 2020 and identifies a variety of potential projects and programs that might be developed to balance future water demands with available supplies and to maximize the overall beneficial use of water throughout the MWA's service area. The adopted RWMP projected that groundwater overdraft, combined with expected growth and associated increasing demand for water, were projected to result in a substantial groundwater recharge requirement by 2020. The 2004 RWMP notes that there are two fundamental actions that could be taken to address the problem of groundwater overdraft and future growth/water demand:

(1) Supply enhancement projects, either involving groundwater recharge or an increase in groundwater efficiency; and

(2) Management actions involving conservation, storage agreements, and water transfers/water banking.

Supply enhancement projects listed in Table 3-14 and briefly described below have the potential to address the key management issues related to overdraft of groundwater basins, localized water quality issues, and future growth/water demand. These projects are being planned to supplement the other groundwater recharge programs and facilities operated by MWA throughout their service area mentioned previously.

TABLE 3-14
PLANNED WATER SUPPLY PROJECTS AND PROGRAMS IN MWA SERVICE AREA

Name/Type	Planned Delivery (afy)	MWA Subarea/ Region	Retailer Served	Date Supply Available
Regional Recharge and Recovery Project[a] ("R³ Project")	Phase 1 – 15,000 Phase 2 - 40,000 total	Alto	AVRWC, Adelanto, Hesperia Water District, CSA 64, Victorville Water District, Golden State Water Company	Phase 1 – 2012 Phase 2 – 2015-2020
Oro Grande Wash Recharge [a]	8,000	Alto	Victorville Water District,	2012
Ames Valley Recharge[b]	1,500	Ames Valley	BDVWA, HDWD, CSA No. 70 W-1, CSA No. 70 W-4	2011
Joshua Basin Recharge[c]	1,000	Joshua Tree	JBWD	2012-2013
Antelope Valley Wash Recharge[d]	3,500	Alto	Hesperia Water District	2015

Notes:
(a) Project is currently being advertised for bid.
(b) Feasibility study is currently being completed for project.
(c) NEPA was completed March 2011.
(d) Source: MWA staff.

3.6.1 Regional Recharge and Recovery Project (“R^3 Project”)

The Regional Recharge and Recovery Project, known as “R^3,” is a conjunctive use project currently under construction that will store SWP water underground in the local aquifer and later recover and distributes the water to local retail water purveyors. R^3 is part of a comprehensive solution developed by the MWA and the region’s stakeholders to ensure a sustainable water supply for the region. R^3 is an integral part of the Regional Water Management portfolio identified in MWA’s 2004 Regional Water Management Plan. The project will deliver SWP water from an SWP turnout in Hesperia to a recharge site in the floodplain aquifer along the Mojave River in Hesperia and southern Apple Valley. MWA-owned production wells on either side of the Mojave River located immediately downstream of the recharge site will then recover and deliver the stored water through pipelines directly to retail water agencies.

This project will provide a new source of supply for major water providers in the Mojave Basin and offset their need to continue excessive pumping within the declining regional aquifer system. Water providers that benefit from the R^3 Project could include the Apple Valley Ranchos Water Company, City of Adelanto, City of Hesperia, Golden State Water Company, San Bernardino County Service Area 64 and the Victorville Water District. Phase 1 of the project (15,000 afy of supply) has an estimated completion date of 2012. Phase 2 is planned to be completed after 2015.

3.6.2 Oro Grande Wash Recharge

The Oro Grande Wash Recharge project is currently under construction. When complete, the project will have a recharge capacity of 8,000 af based upon nine months of operation per year. The project recharge facilities would be located at a site downstream on the Oro Grande Wash near the Green Tree Golf Course, the southern portion of the Oro Grande Wash downstream and north of the California Aqueduct and Goss Road/Eucalyptus Avenue. The project includes three primary components: California Aqueduct intake structure/turnout facilities, conveyance pipeline and Oro Grande Wash recharge facilities.

3.6.3 Ames Valley Recharge

The Ames Valley Recharge project will deliver SWP water to the Ames Valley for recharge at the Pipes Wash Spreading Grounds to mitigate historical overdraft conditions in the Region. This project was originally identified as the Ames/Means Valley Recharge Project in the 2004 RWMP, but since recharge is occurring only in the Ames Valley, it is referred to as the Ames Valley Recharge Project in this document. The recharge project will serve water agencies using groundwater in the basin including BDVWA, HDWD, and CSA No. 70. BDVWA, in cooperation with MWA, is implementing the project, which consists of a feasibility study, approximately 0.75 miles of conveyance pipeline to connect to the Morongo Basin Pipeline, recharge to the Pipes Wash, and the installation of monitoring wells. The initial recharge capacity is planned at 1,500 afy.

3.6.4 Joshua Basin Recharge

Joshua Basin Water District Recharge and Pipeline will create a mechanism for the JBWD to make use of SWP water via the Morongo Basin Pipeline. The JBWD is part of Improvement District M and therefore is paying a share of the debt associated with the construction of the

Morongo Pipeline facilities. The project is just beginning construction and is expected to provide recharge of 1,000 afy into the Joshua Tree Subbasin in 2012.

3.6.5 Antelope Valley Wash Recharge

Antelope Valley Wash Recharge ponds could provide groundwater recharge capacity of 3,500 afy upgradient from the City of Hesperia wells. The Hesperia Master Plan of drainage identifies a 65-acre site for a storm water detention basin in the Antelope Valley Wash south of Ranchero Road. In addition to storm water detention, the site might be able to accommodate groundwater recharge. The Morongo Basin Pipeline passes by this area and would be the source of recharge water.

3.7 Development of Desalination

The California UWMP Act requires a discussion of potential opportunities for use of desalinated water (Water Code Section 10631[i]). MWA has initiated efforts to determine additional source of future supply with potential options including desalination credits (MWA, 2004). However, at this time, none of the opportunities are practical or economically feasible for MWA, and MWA has no current plans to pursue them. Therefore, desalinated supplies are not included in the supply summaries in this Plan. However, should a future opportunity emerge for MWA to consider development of desalination, these potential future supply opportunities are described in the following section, including opportunities for desalination of brackish water, groundwater, and seawater.

3.7.1 Opportunities for Brackish Water and/or Groundwater Desalination

As discussed in Chapter 5, the groundwater supplies in the MWA service area are not considered brackish in nature, and desalination is not required. There are brackish supplies near the dry lakes but it is not practical to pump, treat and potentially induce migration of better quality water to the dry lake areas and potentially cause subsidence. However, MWA and the retail water purveyors could partner with other SWP contractors and provide financial assistance in construction of other regional groundwater desalination facilities in exchange for SWP supplies. The desalinated water would be supplied to users in communities near the desalination plant, and a similar amount of SWP supplies would be exchanged and allocated to MWA from the SWP contractor. A list summarizing the groundwater desalination plans of other SWP contractors is not available; however, MWA would begin this planning effort should the need arise.

In addition, should an opportunity emerge with a local agency other than an SWP contractor, an exchange of SWP deliveries would most likely involve a third party, such as Metropolitan Water District. Most local groundwater desalination facilities would be projects implemented by retailers of SWP contractors and, if an exchange program was implemented, would involve coordination and wheeling of water through the contractor's facilities to MWA.

3.7.2 Opportunities for Seawater Desalination

Because the MWA service area is not in a coastal area, it is neither practical nor economically feasible for MWA to implement a seawater desalination program. However, similar to the brackish water and groundwater desalination opportunities described above, MWA could provide financial assistance to other SWP contractors in the construction of their seawater desalination facilities in exchange for SWP supplies.

Section 4: Recycled Water

4.1 Overview

This Section of the Plan describes the existing and future recycled water opportunities available to the MWA service area. The description includes estimates of potential supply and demand for 2010 to 2035 in five year increments. MWA does not have the authority to determine how or where recycled water is used. This chapter simply identifies existing and projected wastewater flows by the wastewater agencies within the MWA service area, and potential opportunities for the use of recycled water.

4.2 Recycled Water Plan

Table 4-1 identifies the local water, wastewater, imported wastewater, and planning agencies that are within MWA's service area and could potentially have a role in any recycled water activities related to MWA. Local water agencies within the MWA service area share many issues related to local and regional water supplies. Wastewater agencies that collect and treat wastewater within the MWA service area share a common interest in maximizing the beneficial uses of treated wastewater. Wastewater is also imported to the Mojave Basin Area from several agencies as shown in Table 4-1. Lastly, the various planning agencies with general land use plans are included because they will coordinate where future growth is to occur.

TABLE 4-1
PARTICIPATING AGENCIES IN RECYCLED WATER

Water Agencies	Wastewater Agencies	Imported Wastewater Agencies	Planning Agencies
City of Adelanto	City of Adelanto	Lake Arrowhead CSD	City of Adelanto
Golden State Water Company - Barstow	City of Barstow	Big Bear Area Regional Wastewater Agency	City of Barstow
Helendale Community Services District (CSD)	Helendale (CSD)	Crestline Sanitation District (SD)	City of Hesperia
Hesperia Water District	Marine Corps Logistics Base (MCLB)		City of Victorville
Hi-Desert Water District	Victor Valley Wastewater Reclamation Authority (VVWRA)		San Bernardino County Department of Public Works and Flood Control
San Bernardino County Service Areas 42 and 64			San Bernardino County Planning Department
Victorville Water District			Town of Apple Valley
			Town of Yucca Valley

Currently, MWA has a documented 2004 Regional Water Management Plan (RWMP) that serves to identify any wastewater treatment plans that may provide recycled water within its service area. Also, some of the wastewater agencies listed above have been coordinating recycled water usage on a regional level and that is discussed in the following sections.

4.3 Potential Sources of Recycled Wastewater

There are two categories of potential sources of recycled water in the MWA service area: wastewater generated within the service area and wastewater imported into the service area.

1. **<u>Wastewater Generated Within MWA:</u>** The City of Adelanto, the City of Barstow, Victorville Water District, the Helendale Community Services District (CSD) and the Victor Valley Wastewater Reclamation Authority (VVWRA) provide wastewater collection and treatment services within the MWA boundary. The VVWRA serves portions of Victorville, Hesperia, Apple Valley, and San Bernardino County Service Areas 42 and 64. Helendale CSD serves the community of Silver Lakes. Also, the US Marine Corps has a Marine Corps Logistics Base (MCLB), at Barstow and has two on-site wastewater treatment facilities for the Base population. The remainder of the wastewater generated within the MWA service area is handled by individual septic systems.

   VVWRA was originally formed by the Mojave Water Agency to help meet the requirements of the federal Clean Water Act and provide wastewater treatment for the growing area. The original treatment plant, with supporting pipelines and infrastructure, began operating in 1981, providing tertiary level treatment for up to 4.5 million gallons per day (MGD). The VVWRA is now a joint powers authority and public agency of the state of California.

2. **<u>Imported Wastewater:</u>** Wastewater is imported to the MWA service area from the Lake Arrowhead Community Services District (LACSD), Big Bear Area Regional Wastewater Agency (BBARWA), and Crestline Sanitation District (SD). Treated wastewater from the Lake Arrowhead CSD is discharged into retention ponds adjacent to the Mojave River near the Hesperia Lakes recreation area. Wastewater from the BBARWA is discharged onto alfalfa crops or a retention basin within the Este Subarea. The Crestline SD wastewater is used for pasture irrigation at the Los Flores Ranch with some discharge making its way off the ranch and into the West Fork of the Mojave River.

4.3.1 Existing Wastewater Treatment Facilities

4.3.1.1 The City of Adelanto

The City of Adelanto operates a 1.5 MGD activated sludge wastewater treatment facility through an operations and maintenance contract. According to the City's "Sewer Master Plan" completed in December 2007, the facility treated in excess of 2.1 MGD of wastewater in 2007 and discharged this quantity to percolation ponds in northern Adelanto.

4.3.1.2 The City of Barstow

The City of Barstow collects wastewater through a system constructed starting in 1939. Barstow currently contracts out the operation of its wastewater collection and treatment system. The system has the capacity to treat an average flow of 4.5 MGD (peak flow of 7.6 MGD) through aeration basins, secondary clarifiers, a chlorine contact chamber, and a chlorine contact lagoon. After treatment, the effluent is discharged to ponds and an irrigated field adjacent to the Mojave River and the treatment facilities. In 2009, the City of Barstow's average treated wastewater flow was 2.4 MGD. With anticipated growth, the treatment plant is anticipated to be expanded to 5.5 MGD by 2030 plus an additional 4.6 MGD capacity West Side Wastewater Treatment Plant

(WWTP) is required at a new site. The City of Barstow's "Draft Sewer Master Plan" completed in November 2009, assumed that the Sun Valley Golf Course would be a primary user of recycled water and that a recycled water system may be constructed as part of the infrastructure of many new planned developments in the area of the new West Side WWTP site.

4.3.1.3 Victorville Water District

The Victorville Water District (VWD) has constructed a wastewater treatment plant at the Southern California Logistics Airport (SCLA) to process waste from the Dr. Pepper/Snapple processing and bottling plant and sanitary wastewater from portions of the City of Victorville. The treatment plant is sized for treating 1.0 MGD of industrial wastewater flows and 1.5 MGD of sanitary flows from the City of Victorville. Industrial wastewater consists of food and beverage clients in the SCLA Industrial Park as well as from the Dr. Pepper Snapple Group (DPSG). The Treatment Plant is designed in a modular fashion consisting of equalization, aeration and anaerobic sludge holding tanks and membrane bioreactor tanks.

The effluent is discharged as recycled water (disinfected, tertiary recycled water as defined in California Code of Regulations, Title 22) for use as coolant at the High Desert Power Project (HDPP) and irrigation at the Westwinds Golf Course. Disinfected treated effluent is delivered to the two recycled water users via an approximate 1.8 mile distribution pipeline. At the Westwinds Golf Course, recycled water is stored in a 1.0 million gallon elevated storage tank.

The sludge drying beds have a single membrane liner to protect against leakage. The dried sludge will be removed and disposed of off-site to a legal disposal site.

The 2.5 MGD Treatment Plant came on-line in July 2010, with current flows at approximately 1.1 MGD. VWD signed an agreement with High Desert Power Project (HDPP) to sell up to 4,000 acre-feet (af) of recycled water each year, which can come from any combination of State Water Project (SWP), recycled water through the VVWRA regional treatment plant or recycled water from the City's new treatment plan. HDPP has been generating electricity at SCLA since 2003 and recently obtained a state permit to use recycled water for cooling the plant.

4.3.1.4 Victor Valley Wastewater Reclamation Authority

VVWRA conveys wastewater using 41.5 miles of interceptor sewer and two pump stations to its Regional Wastewater Treatment Plant. Approximately 12.6 MGD was treated at the VVWRA facility in 2009, which has a capacity of 18.0 MGD. Processes employed include screening, grit removal, primary clarification, biological oxidation of wastes with complete nitrification and partial denitrification, secondary clarification, coagulation, flocculation, filtration, and disinfection. Dissolved air flotation thickening and anaerobic digestion stabilizes biosolids that are then dewatered and dried prior to disposal via direct agricultural land application or by mixing with finished compost for agricultural markets.

The treated wastewater effluent is then discharged directly into the Mojave River channel downstream from the Lower Narrows or percolated into ponds in the Floodplain Aquifer.

In 2002, VVWRA submitted an application to the Lahontan Regional Water Quality Control Board (Regional Board) for a master water recycling permit in order to use up to 1,680 acre-feet per year (afy) of recycled water for irrigation of the Westwinds Golf Course at the SCLA. At the time, the Golf Course utilized potable groundwater from the underlying Mojave River aquifer.

The California Department of Fish and Game (DFG) objected to the use of recycled water at the golf course as it would reduce stream flow, decrease the amount of flow necessary to maintain riparian habitat in the Alto Transition Zone and decrease the amount of water that could be extracted from the overdrafted Mojave groundwater basin. In June 2003, the Regional Board approved Order R6V-2003-028, Water Recycling Requirements for VVWRA and Victorville Water District, Westwinds Golf Course.

In order to assure the viability of the riparian area in the Transition Zone, the DFG and VVWRA entered into a Memorandum of Understanding (MOU) regarding VVWRA current and future discharges into the Mojave River Transition Zone. The general terms of the MOU are that DFG will not appeal or challenge the Regional Board's Order. In turn, VVWRA will continue to discharge 9,000 af annually from the Regional Treatment Facility and will also discharge not less than 20 percent of the amount of treated wastewater resulting from any increases in the amount of daily influent wastewater flow to the VVWRA Regional Treatment Plant. A copy of the MOU is included in Appendix H.

The Regional Treatment Plant is currently capable of treating a portion of the flow to a tertiary level and the remaining flow to a secondary level for percolation. A majority of the tertiary treated wastewater is discharged into the Mojave River Basin and a smaller amount is currently used to irrigate landscaping at the treatment plant and the nearby Westwinds Golf Course. The capacity of the Regional Treatment Plant was increased to its current 18.0 MGD capacity in 2009. Also, the Regional Board Order R6V-2008-004 along with the National Pollutant Discharge Elimination System (NPDES) Permit No. CA0102822 allows the facility to discharge up to 14.0 MGD of tertiary-treated effluent to surface water, which is the Mojave River.

4.3.1.5 Helendale CSD

A smaller wastewater agency within the MWA service area is the Helendale CSD which serves a population of approximately 7,000 in the Silver Lakes community. In 2006, the formation of the Helendale CSD began with the dissolution of County Service Area 70 Improvement Zone B. (CSA 70C). In 2002, the CSA 70C completed their *Final Master Sewer Plan*, (2002 CSA 70C Sewer Master Plan) which described the existing wastewater treatment plant as capable of handling 1.2 MGD of average flow and having sufficient capacity beyond Year 2020 based on current projected growth. In 2009, the average daily flow was 0.57 MGD, which was the same as the projected 2005 flow in the 2002 CSA 70B Sewer Master Plan. Since the resulting wastewater flows are lower than projected (2009 flows equal projected 2005 flows), the existing treatment plant should have adequate capacity to the Year 2020 as predicted in the 2002 Sewer Master Plan. Also, if the growth rate accelerates, the existing 1.2 MGD plant can be expanded.

4.3.1.6 US Marine Corps Logistics Base

Another small wastewater agency within the MWA service area is the United States Marine Corps MCLB at Barstow that is separated into two divisions: (1) Nebo and (2) Yermo Annex, with both divisions providing wastewater treatment services. The 2009 effluent flows were as follows:

- Nebo Main Base - 11.42 million gallons (0.03 MGD)
- Yermo Annex - 31.37 million gallons (0.09 MGD)

The disposal plan for both treatment facilities is to discharge fully treated water to percolation ponds. However, in 2009 for the Nebo Main Base, no secondary treated flow was percolated due to the effluent being evaporated in the existing oxidation ponds. The Nebo Base is undergoing an upgrade of the existing secondary treatment facilities to tertiary treatment. The upgrade is expected to be operational in 2012, when the existing oxidation ponds will be bypassed and the tertiary treated flow will be sent directly to the percolation ponds. The planned Regional Board permitted capacity is expected to be 225,000 gallons per day (gpd).

The Yermo Annex was recently upgraded to produce tertiary treated effluent and has a permitted capacity of 180,000 gpd.

4.3.1.7 Imported Wastewater

Table 4-2 summarizes the wastewater flows imported into the Mojave basin from 2006 to the present. As can be seen from the table, in 2009, the Alto Subarea received 1,432 af from the Lake Arrowhead CSD, discharged into retention ponds along the Mojave River about two miles downstream of the Forks, just south of the City of Hesperia. The Forks is located where the Mojave River is formed by the confluence of two smaller streams (Deep Creek and West Fork) descending from the mountains near the southeast corner boundary of the City of Hesperia and north of Silverwood Lake. The Crestline SD discharged 714 af in 2009 into the Alto subarea upstream of the West Fork gage at the Los Flores Ranch. In 2009, the Este Subarea received 2,436 af from the Big Bear Area Regional Wastewater Agency discharged near Camp Rock Road and Highway 247 in the Lucerne Valley.

TABLE 4-2
IMPORTED WASTEWATER FLOW (AFY)

Agency	2006	2007	2008	2009	Average Flow (afy)
Lake Arrowhead CSD	1,504	1,677	1,277	1,432	1,473
Crestline SD	819	674	799	714	752
Big Bear Area Regional Wastewater Agency	2,848	2,399	2,700	2,436	2,596
Total Imported WW	**5,171**	**4,750**	**4,776**	**4,582**	**4,821**

Source: MWA Watermaster Reports.
Data in water years starting in October.

4.3.2 Planned Improvements and Expansions

4.3.2.1 The City of Adelanto

The City of Adelanto is currently constructing a 2.5 MGD upgrade that will increase its wastewater treatment capabilities to 4.0 MGD and produce treated water that can be used for lawn/public parks irrigation, construction and dust control and other beneficial uses.

According to the City of Adelanto's *2007 Sewer Master Plan*, after the initial expansion is completed to 4.0 MGD, the ultimate capacity for the WWTP is planned to be 8.0 MGD, when the City nears build-out. Also, two sub-regional wastewater treatment plants (6.0 MGD and 3.0 MGD) are proposed to be constructed in incremental capacities. Because no exact dates were provided for the planned expansions in the *2007 Sewer Master Plan*, the dates used in the summary tables at the end of this Section are assumed.

The funding requirements for the planned treatment facilities were also presented in the *2007 Sewer Master Plan*, with estimated construction costs at approximately $122M.

4.3.2.2 The City of Barstow

The City of Barstow's *2009 Draft Sewer Master Plan* recommends that the existing WWTP will require an expansion of 1.0 MGD when the projects within the Public Improvement District (PID) Scenario (PID No.'s 77-1, 81-1 and 83-1) approach build-out. By the year 2020, the City of Barstow should construct a new 2.2 MGD West Side WWTP and by year 2030, the City should expand the West Side WWTP by 2.4 MGD to 4.6 MGD.

Expanding the existing WWTP's capacity by approximately 1.0 MGD will tend to maximize the capacity of the existing interceptor sewer system. In addition to matching existing interceptor and WWTP capacities, there is another advantage to a West Side WWTP, water recycling. It is assumed that the Sun Valley Golf Course would be a primary user of recycled water and that a recycled water system may be constructed as part of the infrastructure of many new planned developments.

The funding requirements for the planned WWTP Capital Improvements have an estimated total cost of $158.8M, which includes estimated construction costs plus 40 percent for Professional Services and Contingencies, the *2009 Draft Sewer Master Plan.*

4.3.2.3 Victorville Water District

VWD's newly constructed wastewater treatment plant is expandable to 5 MGD, but at this time VWD has no plans to expand the plant. In VWD staff discussions, it was pointed out that the 2.5 MGD capacity treatment plant was constructed specifically to accommodate HDPP. While the existing wastewater flows into the treatment plant are at approximately 1.1 MGD, VWD staff confirms that within five years, or by 2015, the treatment plant flows will be at full capacity and will remain that way most likely for the next twenty years.

4.3.2.4 Victor Valley Wastewater Reclamation Authority

VVWRA wastewater flow projections were developed based upon the estimated sewered population and a wastewater flow of approximately 80 gallons per person per day. Also, flow contributions from septic abandonment and commercial, industrial, and institutional sources were estimated and included.

Table 4-3 shows that from 2009 to 2035, the VVWRA average daily flow is anticipated to increase from 12.6 MGD to 25.5 MGD, which is an annual increase of 2.8 percent. In addition to the resident population, the wastewater flow projections include commercial business, industries, institutions (schools, hospitals, prisons, etc.), and septic conversions to the sewer system.

TABLE 4-3
PROJECTED VVWRA FLOW BASED ON HISTORICAL GROWTH RATES

Year	Flow, MGD	Growth (%)
2008	12.26	
2009	12.6	2.8%
2010	12.9	2.8%
2011	13.3	2.8%
2012	13.7	2.8%
2013	14.1	2.8%
2014	14.4	2.8%
2015	14.8	2.8%
2016	15.3	2.8%
2017	15.7	2.8%
2018	16.1	2.8%
2019	16.6	2.8%
2020	17.0	2.8%
2021	17.5	2.8%
2022	18.0	2.8%
2023	18.5	2.8%
2024	19.0	2.8%
2025	19.5	2.8%
2026	20.0	2.8%
2027	20.6	2.8%
2028	21.1	2.8%
2029	21.7	2.8%
2030	22.3	2.8%
2031	22.9	2.8%
2032	23.5	2.8%
2033	24.2	2.8%
2034	24.9	2.8%
2035	25.5	2.8%

Source: VVWRA Flow Projection Update, April 2009. Prepared by RBF Consulting.
Source document only projects to Year 2022, so it is assumed that from 2022-2035, the same growth rate will continue as previously estimated.

Since 2005, VVWRA has violated water discharge requirements as set forth by the Regional Board. Specifically, in February 2008, the Regional Board issued Cease and Desist Order R6V-2008-005 due to VVWRA discharge affecting the water for municipal and domestic supply. The discharge caused nitrate-nitrogen concentrations in underlying groundwater to exceed or threaten to exceed a water quality objective in the Basin Plan.[12]

The Order states that the existing Regional Treatment Plant does not include wastewater treatment for nitrogen removal and facilities that provide nitrogen will not be constructed until 2009-2011. Among the requirements of the Order, interim effluent limitations for ammonia-nitrogen and nitrate-nitrogen removal were specified. Additionally, the Order specifies facility improvement actions to occur in less than five years.

[12] Local Agency Formation Commission County of San Bernardino Staff Report, dated October 9, 2009.

A revised Phase III upgrade project to the Regional Treatment Plant is anticipated to have improved nitrogen removal technology and be able to meet the new permit effluent limits by mid-2012.

As an additional measure to mitigate the reduced capacity from the nitrogen removal required, VVWRA is planning to construct sub-regional wastewater treatment plants in the town of Apple Valley, the City of Hesperia, and a possible third location to be determined. These smaller plants will recycle water for local landscape irrigation near the site of treatment. In turn, this will reduce the treatment demand on the Regional Treatment Plant. Moreover, the Hesperia and South Apple Valley interceptors are reaching capacity and the sub-regional plants will provide a long-term solution. Further, the move to constructing sub-regional treatment plants to capture and treat wastewater in Hesperia and Apple Valley would provide capacity at the Regional Treatment Plant for the City of Victorville, CSA 42, and CSA 64.

In the long-run, the capacity of the sub-regional plants, pump stations, and percolation ponds will require future expansion in order to meet the processing demands generated by Apple Valley and Hesperia. Additionally, it is likely that the sub-regional plants will require the same level of regulatory requirements regarding nitrogen as the Regional Treatment Plant. The estimated completion date of the sub-regional plants is unknown.

The conceptual details of the plants are:

- **Town of Apple Valley** – 1.0 MGD facility located in the Town, adjacent to the Otoe Road Pump Station in the southwest corner of Brewster Park. The facility will initially have a capacity to treat 1.0 MGD, expandable to 4.0 MGD, providing recycled water to the public parks.
- **City of Hesperia** – 1.0 MGD facility located in the City, on city-owned property northwest of the intersection of Interstate 15 and Main Street. The facility will initially have a capacity to treat 1.0 MGD, expandable to 4.0 MGD, providing recycled water to the residential communities and commercial businesses along the I-15 corridor.
- **City of Hesperia** – 2.0 MGD pump station and 3-mile force main located in the City beginning near the intersection of Mauna Loa Street and Maple Avenue.

During the development of MWA's UWMP, concerns were raised about the possibility that VVWRA's planned sub-regional plants could impact the water supply balances assumed in the UWMP by changing the location and amount of effluent wastewater flows that are returning to groundwater. A change in groundwater supplies has the potential to increase the demands for imported SWP water beyond those otherwise anticipated in the UWMP. These concerns were addressed in an analysis conducted by MWA staff.[13]

VVWRA's existing Regional Treatment Plant, located on Shay Road, currently discharges effluent in the Transition Zone (TZ) portion of the Alto Subarea, located in northern Alto and downstream of the Victor Valley area. Effluent flows to the TZ meet anthropogenic (human) consumptive demands in the TZ, but flows in substantial excess of consumptive use tend to flow to the Centro subarea, becoming supply for Centro. The planned sub-regional plants would be

[13] This analysis was presented by MWA staff to the MWA Planning Resources and Technology Committee on March 1, 2011 and the Alto Subarea Advisory Committee on June 2, 2011.

located in Hesperia and Apple Valley, and would either supply recycled water directly to customers or recharge the treated effluent to groundwater in the southern Alto area. Sewage flows to the VVWRA's Regional Treatment Plant originate from municipal uses in the Victor Valley, located primarily in southern Alto. If effluent discharges from the Regional Treatment Plant continue to increase as development increases, a greater portion of the return flows generated in southern Alto become diverted to the TZ, causing a potential imbalance in assumed water supply by decreasing return flows to southern Alto but increasing unused supplies to Centro. Conversely, if flows to the Regional Treatment Plant were reduced and instead directed toward sub-regional plants, water supplies to the TZ would be reduced, with the potential of causing groundwater levels to decline and water supplies to Centro to decline.

The analysis prepared by MWA staff attempted to "book-end" the possible future outcomes, impacts to basin balance and SWP demands through the year 2035, with or without the construction of sub-regional plants. Several scenarios were developed and evaluated based upon projected wastewater flows, including a scenario that staff felt was the most realistic based upon existing and planned wastewater infrastructure. In the realistic scenario, total wastewater flows to VVWRA roughly doubled, with the sub-regional plants operating at build-out capacity and about two-thirds of future flows still going to the Regional Treatment Plant. Analysis of the realistic scenario determined that it would not cause a material increase in demand for imported water supply when compared to other possible wastewater scenarios.

The funding requirements for the "future CIP Projects" have an estimated total cost of $42.7M, per the Local Agency Formation Commission County of San Bernardino Staff Report, dated October 9, 2009.

4.3.2.5 Helendale CSD

The projected average flow at 100 percent build-out of Phase I for Helendale is 1.0 MGD, with the entire Helendale CSD build-out projected average flow being 1.9 MGD. In 2005 and in 2009, the average daily flow was 0.57 MGD, so 100 percent build-out of Phase I has not occurred yet and is not projected to occur until after 2035. Table 4-4 summarizes the Helendale CSD projected wastewater flow through 2035.

TABLE 4-4
PROJECTED HELENDALE CSD WASTEWATER FLOW

Year	Estimated EDUs	Average Daily Flow, MGD
2005	2,328	0.57
2010	2,543	0.62
2015	2,759	0.68
2020	2,974	0.73
2025	3,189	0.78
2030	3,404	0.83
2035	3,619	0.89

Source: 2002 CSA 70C Sewer Master Plan. Assumed 245 gallons per day per equivalent dwelling unit (EDU). From 2025-2035, it is assumed that the same growth rate will continue as previously estimated.

The 2002 CSA 70C Sewer Master Plan included cost estimates for the sewer system improvements for the 20-year planning period and water reuse within the Helendale CSD service area, which included the construction of an additional percolation pond and planning for the addition of tertiary filtration facility (for water recycling/reuse) and water reuse in accordance with Title 22 regulations.

4.3.2.6 MCLB

Future wastewater demands are expected to remain at their current 2009 rate until 2035 because there are no planned US Marine Corps Base expansions at this time.

4.3.2.7 Hi-Desert Water District

Hi-Desert Water District (HDWD) serves potable water to a population of approximately 25,000. Based on the growth projections shown in HDWD's 2010 Draft UWMP, the District should plan for a population of over 30,000 by 2035. In order to protect groundwater quality in the area, the HDWD is planning to connect the majority of its water customers to a new wastewater collection and treatment system.

All of the customers within the HDWD service area currently dispose of their wastewater using individual sewage disposal systems, or septic tanks. In 2009, the District adopted a revised "Sewer Master Plan" (SMP). The SMP includes the three-phase development of new sewer collection and treatment systems. As discussed in the report, the SMP plans for a water reclamation facility (WRF) involving the construction and installation of the Hi-Desert WRF. Because much of the wastewater will now be diverted to the new WRF rather than septic tanks, the District has decided that all treated effluent will be diverted to groundwater recharge. There will be no direct reuse of recycled water.

District staff has revised the capacity and scale of the SMP since publication of the report in 2009. Initial phasing will include a 1.5 mgd WRF for Phase 1. Additional capacity for Phase 2 and 3 is expected to be 0.5 mgd per phase. The WRF will produce effluent through tertiary advanced treatment that will be delivered to recharge basins at the treatment site and percolated into the east subbasin of the Warren Valley Groundwater Basin.

The Phase 1 sewer collection system will focus on the urban development in close proximity to State Highway 62 (Twentynine Palms Highway). In December 2010, the Lahontan Regional Water Quality Control Board (RWQCB) proposed amending the existing Basin Plan for the Colorado River Basin Region and prohibits septic tank discharges in the Town of Yucca Valley (Town), which is HDWD's Service Area, to mitigate and eliminate the threat of nitrate contamination to groundwater due to septic tank discharges. Because the Town lacks a municipal wastewater collection and treatment system, all residents and businesses in Yucca Valley use septic systems and subsurface disposal systems to treat and dispose of domestic wastewater.

Like many areas in California, the Town has experienced periods of rapid population growth and localized increases in septic system density, such as along the main business corridor, one of the areas addressed by this prohibition. This rise in system density in certain areas, combined with system failures due to age or inadequate maintenance in the Town as a whole, presents a significant threat to public health for Town residents due to increased wastewater loading to the vadose zone (unsaturated soil strata), and impacts to local groundwater used for municipal supply from nitrates, pathogens, and salts (total dissolved solids).

The prohibition bans discharges of wastes from septic systems in Phases 1, 2, and 3 in the Town, pursuant to a time schedule, with the prohibition becoming effective for Phase 1 (essentially the main business corridor in Town) by March 17, 2016. This is the planned timing to have Phase 1 of the proposed WRF constructed.

Table 4-5 summarizes the HDWD projected wastewater flow through 2035.

TABLE 4-5
PROJECTED HDWD WASTEWATER FLOW

Year	Average Daily Flow, AFY	Treatment Capacity, MGD
2010	820	0
2015	820	0
2020	1,863[(a)]	2.0
2025	2,604	2.5
2030	2,737	2.5
2035	2,876	2.5

Source: HDWD's staff.

(a) Phase 1 of the WRF Project is expected to be on-line in 2016, which will comply with the Regional Board's Order R7-2011-0004. Assumed that Phases 2 and 3 capacities came on-line by 2020 and 2025, respectively and capacity is 0.5 mgd for each phase.

HDWD is considered a disadvantaged community with a median income lower than the State and National averages. Therefore HDWD is seeking grants and other low cost financing to fund their WRF Project. HDWD is working on a finance plan that will outline the best alternatives to fund the project. A capital cost estimate for Phase 1, which will include the treatment plant and collection system will be determined on an Equivalent Dwelling Unit (EDU) basis with a Single Family Residence being used as the base unit, one (1) EDU = 210 gallons of wastewater/day, which is the basis of cost analysis for determining wastewater flows and sizing for system capacity.[14]

- Assessment Cost by EDU = $10,220 (assume 30 percent Grants)
- Annual Assessment[15] = $620 per year / $52 per month

4.3.2.8 Summary of Planned Wastewater Treatment Capacity

While some of the wastewater agencies are planning to expand their treatment capacity in the near future to be able to produce recycled water, others will continue to use their existing secondary treatment facilities.

Table 4-6 provides the projected imported wastewater flow for the MWA service area from the Lake Arrowhead CSD, Crestline SD, and BBARWA, as discussed in Section 4.3.1.7. Using the 2009 flows listed in Table 4-2, the projections have been estimated using the MWA demand forecast model and assuming approximately a one (1) percent increase from 2010 through 2035.

[14] HDWD January 2009 Sewer Master Plan and Preliminary Design Report.

[15] Based on tax assessment debt financed over 25 years at a combined rate of 3.5%. These costs are typically financed through an Assessment District.

TABLE 4-6
PROJECTED IMPORTED WASTEWATER FLOW

Imported Wastewater Agency[a]	Flow (afy)					
	2010	2015	2020	2025	2030	2035
Lake Arrowhead CSD	1,406	1,467	1,527	1,622	1,717	1,812
Crestline SD	839	875	912	968	1,025	1,081
Big Bear Area Regional Wastewater Agency	3,059	3,055	3,052	3,199	3,345	3,492
Total	**5,304**	**5,397**	**5,491**	**5,789**	**6,087**	**6,385**

Note:
(a) 2010 data is actual. Projections made using MWA's demand forecast model assuming approximately a 1% increase from 2010 to 2035.

Table 4-7 provides the projected wastewater treatment capacity for the MWA service area.

TABLE 4-7
PROJECTED CAPACITY WASTEWATER COLLECTED AND TREATED

Wastewater Collected and Treated in Service Area	Capacity (MGD)					
	2010	2015	2020	2025	2030	2035
City of Adelanto[a]	4.0	4.0	8.0	11.0	17.0	17.0
City of Barstow[b]	4.6	4.6	7.7	7.7	10.1	10.1
Victorville Water District[c]	2.5	2.5	2.5	2.5	2.5	2.5
VVWRA[d]	18.0	20.0	30.0	32.0	36.0	38.0
Helendale CSD[e]	1.2	1.2	1.2	1.2	1.2	1.2
MCLB[f]	0.8	0.4	0.4	0.4	0.4	0.4
Hi-Desert Water District[g]	0.0	0.0	2.0	2.5	2.5	2.5
Total	**31.1**	**32.7**	**51.8**	**57.3**	**69.7**	**71.7**

Notes:
(a) In the City's "2007 Sewer Master Plan", no exact dates are given for the planned expansions, so the dates provided in the table are assumed. All flow will meet Title 22 requirements for recycled water standards.
(b) Dates are taken from the City's "2009 Draft Sewer Master Plan." All flow will meet Title 22 requirements for recycled water standards.
(c) Victorville Water District information came from Lahontan Regional Board Order No. R6V-2010-0023.
(d) Provided by VVWRA staff.
(e) 2002 CSA 70B Sewer Master Plan stated the existing treatment plant is capable of handling 1.2 MGD of average flow and has sufficient capacity beyond Year-2020 based on current projected growth.
(f) 2010 capacity is 0.18 MGD (Yermo Annex) +.6 MGD (secondary treated only) (Nebo). 2012 capacity and beyond is 0.18 MGD (Yermo Annex) +.225 MGD (Nebo). Both are tertiary treated capacities.
(g) See Table 4-5.

4.3.3 Summary of Available Source Water Flows

Within the MWA service area, there are currently two sources of recycled water (VVWRA and the Victorville Water District); however there are several other sources (all wastewater flows) of potential recycled water within MWA's service area that may soon be treated to become recycled water. The possible source wastewater flow projected to be available is shown in Table 4-8.

TABLE 4-8
SUMMARY OF AVAILABLE SOURCE WASTEWATER FLOW

Source	2010 Flow (MGD)	Projected Flow (MGD)	Projected to be Available for Non-Potable Use (afy)	Date for Flow Projection
City of Adelanto[a]	2.5	17.0	19,044	2030
City of Barstow[b]	2.5	10.1	11,314	2030
Victorville Water District[c]	1.1	2.5	2,801	2030
VVWRA[d]	12.9	22.3	24,981	2030
Helendale CSD[e]	0.6	0.8	896	2030
MCLB[f]	0.1	0.1	112	2030
Hi-Desert Water District[g]	0.0	2.4	2,737	2030
Imported WW[h]	4.7	5.4	6,087	2030
Total	**24.4**	**60.6**	**67,972**	

Notes:
(a) Flows assumed from the City's "2007 Sewer Master Plan." All flow will meet Title 22 requirements for recycled water standards.
(b) Flows assumed from the City's "2009 Draft Sewer Master Plan." All flow will meet Title 22 requirements for recycled water standards.
(c) See Section 4.3.2.3.
(d) Taken from Table 4-3.
(e) Taken from Table 4-4.
(f) Flows are to remain at 2009 rates in the future.
(g) Taken from Table 4-5.
(h) Taken from Table 4-6.

4.4 Recycled Water Demand

In this section, current recycled water use is discussed, and potential recycled water users within MWA's service area are identified. For each potential user, estimates are provided for annual demand. A plan for encouraging and optimizing the use of recycled water is also discussed.

4.4.1 Current Use

In 2010, recycled water started being used by the Victorville Water District for the HDPP power plant cooling system. Before this, recycled water was being used at VVWRA's treatment facility for landscape irrigation at the VVWRA on-site composting facility for processing, dust control and fire protection and for irrigation at the Westwinds Golf Course. Most of the treated wastewater effluent is recharged to the groundwater basin. Because the Mojave Basin is essentially a closed basin, these supplies contribute to the overall water supply of the area.

Table 4-9 provides a summary of existing recycled water use.

TABLE 4-9
EXISTING RECYCLED WATER USES

Type of Use	Treatment Level	Actual 2009 Use (afy)
HDPP – cooling system	Disinfected tertiary	Use started in 2010
Landscape – Golf course	Disinfected tertiary	383[a]
	Total	**383**

(a) VVWRA Discharge Monitoring Report 2009, dated February 24, 2010.

4.4.2 Potential Users

Many wastewater agencies within MWA's service area have completed planning documents for recycled water and determined potential users in their specific service area. As part of the UWMP requirements, the potential uses of recycled water need to be identified and listed. Therefore, the following list identifies the planned recycled water agency planning to develop recycled water and their proposed usage type.

- City of Adelanto - Reuse for landscape irrigation in schools and parks.
- City of Barstow - Reuse for landscape irrigation on the Sun Valley Golf Course.
- Victorville Water District - Reuse for landscape irrigation on golf course and cooling for power plant.
- VVWRA - Reuse for landscape irrigation on golf courses, parks, municipalities, and schools. Also cooling for power plant.
- Helendale CSD - Reuse is unknown at this time.
- MCLB – Reuse is for groundwater recharge.
- HDWD - Reuse is unknown at this time.

Based on the assumption that all of the additional flows would be recycled, and that the possible users are identified, the projected recycled wastewater that will be produced and used is shown in Table 4-10.

TABLE 4-10
POTENTIAL RECYCLED WATER PROJECTIONS

	Flows (MGD)					
Agency	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
City of Adelanto[(a)]	2.5	4.0	7.3	11.0	17.0	17.0
City of Barstow[(a)]	2.5	4.4	6.3	8.2	10.1	10.1
Victorville Water District[(a)]	1.1	2.5	2.5	2.5	2.5	2.5
VVWRA[(a)]	12.9	14.8	17.0	19.5	22.3	25.5
Helendale CSD[(b)]	0.6	0.7	0.7	0.8	0.8	0.9
MCLB[(a)]	0.1	0.1	0.1	0.1	0.1	0.1
Total	**19.7**	**26.5**	**33.9**	**42.1**	**52.8**	**56.1**

Notes:
(a) See Table 4-8.
(b) See Table 4-4.

The recycled water projects from all of the agencies listed in Table 4-10 will potentially be funded from local funds, a number of federal or state grants and low-interest loans obtained through the State Revolving Fund. In some cases, consultants have been retained to provide engineering and environmental documentation services for the sub-regional treatment facilities. The cost of providing recycled water, transmission infrastructure, and ownership of distribution facilities has yet to be determined. The recycling programs will address a number of issues in the MWA service area. The need for additional collection and transmission facilities and the need for additional treatment capacity will all contribute to these programs.

The funding requirements of each of the various recycled water plans by each specific agency were discussed previously in Section 4.3.2.

4.4.3 Projected Recycled Water Demand

Potential recycled water demand has not yet been evaluated by the Cities within the MWA service area. While some cities are in the planning stages and plan to produce recycled water, they are not yet at the planning level and thus have not actually developed customer lists at this point in time. They are assuming that potential customers are there, once the recycled water is available.

4.4.4 Projected Recycled Water Comparison

MWA's 2005 UWMP projected a total recycled water usage from VVWRA of 8,390 afy by the year 2010. Approximately 216 afy was served in 2010 to the Westwinds Golf Course of SCLA for landscape irrigation. The remainder of the treated wastewater effluent from the VVWRA Regional treatment plant was discharged into the Mojave River and thus indirectly percolated to the groundwater basin. Table 4-11 provides a comparison of the 2005 projected demand versus the actual 2010 use. The difference in the projected 2005 use and the actual 2010 use is because the projection for 2010 did not anticipate the growth in wastewater flows that occurred because of rapid growth in population within the areas served by VVWRA. An additional factor was that all the excess treated effluent is discharged to the Mojave River or discharged into the groundwater basin because additional recycled water users have not been established at this time.

TABLE 4-11
RECYCLED WATER USES - 2005 PROJECTION COMPARED WITH 2010 ACTUAL

User Type	2005 Projection for 2010 (afy)	2010 Actual Use (afy)
Recycled	8,390[a]	216[b]
Groundwater Recharge	10,295[a]	14,525[c]
Total	**18,685**	**14,471**

Notes:
(a) 2004 RWMP Supplement A 2005 UWMP Update, December 2005.
(b) VVWRA Discharge Monitoring Report 2010, dated February 21, 2011.
(c) Mojave Basin Area Watermaster Annual Report Water Year 2009-2010, dated May 1, 2011.

4.5 Methods to Encourage Recycled Water Use

The retail water purveyors are the entities that will develop future recycled water delivery systems. Methods to encourage recycled water use, such as financial incentives, will be analyzed at the retail level.

Section 5: Water Quality

5.1 Overview

The quality of any natural water is dynamic in nature. This is true for the State Water Project (SWP) water brought into the MWA service area. During periods of intense rainfall or snowmelt, routes of surface water movement are changed; new constituents are mobilized and enter the water while other constituents are diluted or eliminated. The quality of water changes over time. These same basic principles apply to groundwater. Depending on water depth, groundwater will pass through different layers of rock and sediment and leach different materials from those strata. Water quality is not a static feature of water, and these dynamic variables must be recognized.

Water quality regulations also change. This is the result of the discovery of new contaminants, changing understanding of the health effects of previously known as well as new contaminants, development of new analytical technology, and the introduction of new treatment technology. All retail water purveyors are subject to drinking water standards set by the Federal Environmental Protection Agency (EPA) and the California Department of Public Health (CDPH). Mojave Water Agency (MWA) imports SWP water for groundwater basin recharge. Retail purveyors extract groundwater from these groundwater basins for delivery.

This Section provides a general description of the water quality of both imported water and groundwater supplies. A discussion of potential water quality impacts on the reliability of these supplies is also provided.

Several state, regional and county agencies have jurisdiction and responsibility for monitoring water quality and contaminant sites. Programs administered by these agencies include basin management, waste regulation, contaminant cleanup, public outreach, and emergency spill response.

5.2 Imported Water Quality

MWA provides imported SWP water to its service area. The source of SWP water is rain and snow from the Sierra Nevada, Cascade, and Coastal mountain ranges. This water travels to the Sacramento-San Joaquin Delta, which is a network of natural and artificial channels and reclaimed islands at the confluence of the Sacramento and San Joaquin rivers. The Delta forms the eastern portion of the San Francisco estuary, receiving runoff from more than 40 percent of the state's land area. It is a low-lying region interlaced with hundreds of miles of waterways. From the Delta, the water is pumped into a series of canals and reservoirs, which provides water to urban and agricultural users throughout the San Francisco Bay Area and Central and Southern California. As discussed in Chapter 3, MWA receives SWP water at four locations off the East Branch of the SWP. Figure 3-3 shows the location of the MWA turnouts.

One important property of SWP water is the mineral content. SWP water is generally low in dissolved minerals, such as calcium, magnesium, sodium, potassium, iron, manganese, nitrate, and sulfate. Most of these minerals do not cause health concerns. Nitrate is the main exception, as it has significant health effects for infants; however, the nitrate content of SWP water is very low. Also of significance is the chloride content. Although not a human health risk, chloride can have a negative impact on agricultural activities and regulatory compliance for local sanitation agencies. The chloride content of SWP water varies widely from well over 100 milligrams per liter (mg/L) to below 40 mg/L, depending on Delta conditions.

Since SWP water imports to the Mojave River Basin will be persistent, long term, and increasing, these imports are deemed to be a significant factor in the long term salt balance in the Mojave River Groundwater Basin. Data regarding the quantity and quality of SWP water delivered to the MWA service area readily available from the California Department of Water Resources (DWR). Although the quality of SWP water varies seasonally, for the period between 2005 and 2009 the average total dissolved solids (TDS) concentration has been approximately 269 mg/L for the Mojave River Groundwater Basin (see Figure 5-6 in the following section). A cooperative study between the Lahontan Regional Water Quality Control Board and the MWA was completed in 2007 to address salt balance within the MWA service area. Section 5.3 includes a description of the study and resulting water quality model.

5.3 Groundwater Quality

Over the past several years, the MWA has made efforts to greatly increase the understanding of the water quantity and quality of the groundwater basins that lie within its service area. The Agency currently maintains a monitoring network of approximately 900 monitoring wells that record water levels on a regular basis. Many monitoring wells in the MWA monitoring network are sampled to test for water quality. The collected water samples are generally tested for the following:

- Inorganics
- Metals
- General Mineral
- Isotopes (sometimes)

MWA has chosen the above suite of analytes to determine the overall native water quality of their groundwater basins and to determine if the water quality characteristics of the basins are changing over time.

MWA's groundwater basins contain numerous areas with water quality issues. Key contaminants include arsenic, nitrates, iron, manganese, Chromium VI, and TDS. Measurements in excess of drinking water standards have been found for some of these constituents within the Mojave River Basin and the Morongo Basin/Johnson Valley Area ("Morongo"). Groundwater in these areas may have to be treated prior to consumption.

Another potential water quality issue facing MWA is the accumulation of salt in the groundwater basins. Because the Mojave Basin Area and Morongo Area are considered closed basins, salts added to the locally generated wastewater, salts contained in the imported reclaimed wastewater and salts in the State Water Project (SWP) supplies are mostly not removed from the basin.

From 2005-2009, an annual average of approximately 4,800 acre-feet per year (afy) of imported wastewater was discharged into the MWA service area. In 2010, approximately 49,680 acre-feet (af) of SWP water is anticipated to be imported annually. By 2020, MWA is planning to increase its annual SWP utilization to 53,800 af, which will further increase the introduction of salts into the system.

In an effort to understand potential long-term water quality changes that may occur in the MWA's groundwater basins over time due to the long-term effects of wastewater and importation of SWP water into the MWA service area, the Lahontan Regional Water Quality Control Board (RWQCB) and the MWA worked cooperatively to develop a regional salt balance model for the MWA service area. The model was finalized in 2007 and generally showed that the importation of SWP water mitigated the long-term effects of salt loading (TDS increases) primarily caused by population increases and the associated larger volumes of wastewater entering into the basin(s) (2007 Schlumberger).

Groundwater quality for a number of constituents including nitrates, manganese, fluoride, iron, arsenic, and TDS are presented for each subarea on Figures 5–1 through 5-6, respectively. These figures have been provided by MWA and the data range is from January 2005 through November 2009. Groundwater quality can vary throughout a subarea, but the figures represent the average of available data, and give a good overall picture of the water quality in each. It should be noted that groundwater production occurs in some areas with known water quality issues, which can increase the average concentration of a particular constituent for a given subbasin. Examples include arsenic concentrations detected in wells in the vicinity of Pioneer Town (within the Morongo Area) and iron and manganese in the southern Alto Transition Zone. While the levels of constituents in these isolated areas can be above the regulatory compliance maximum contaminant levels (MCL's), these are local issues pertaining to certain potentially producible areas and zones within a basin. Producible areas within a particular basin that are affected by constituents over the MCL can be avoided or treated prior to use as necessary. An example of the aforementioned is the wellhead treatment of arsenic by the City of Victorville for groundwater produced from some of their wells.

FIGURE 5-1
NITRATES[16]

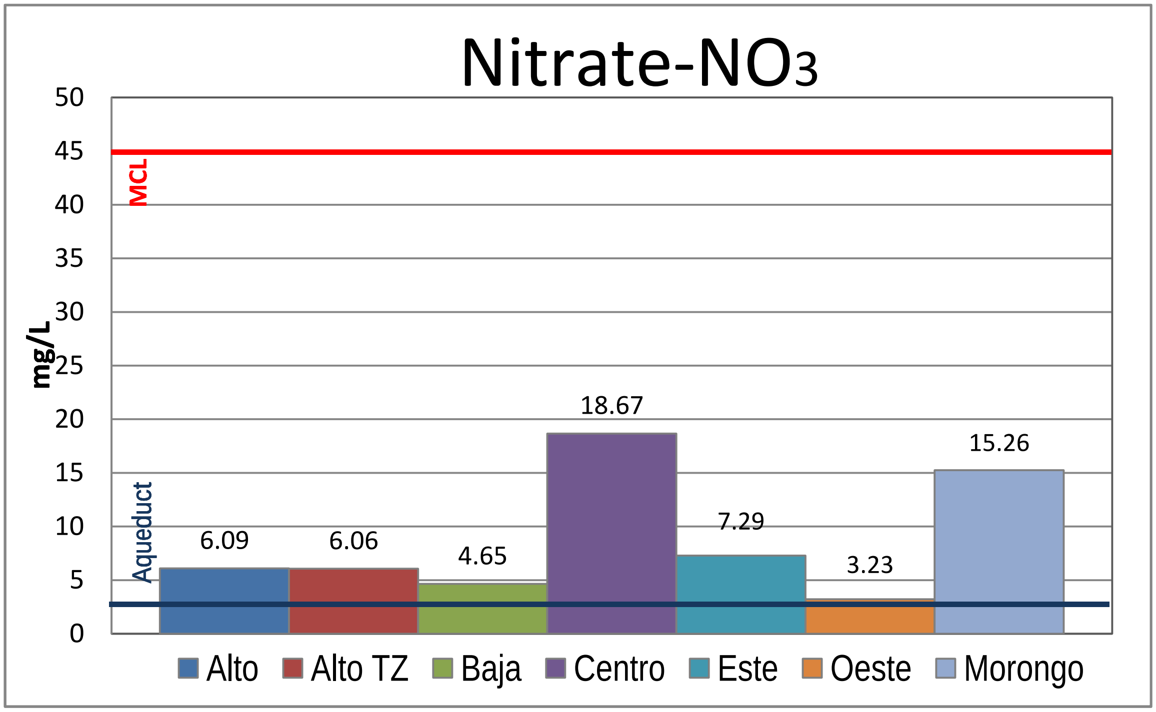
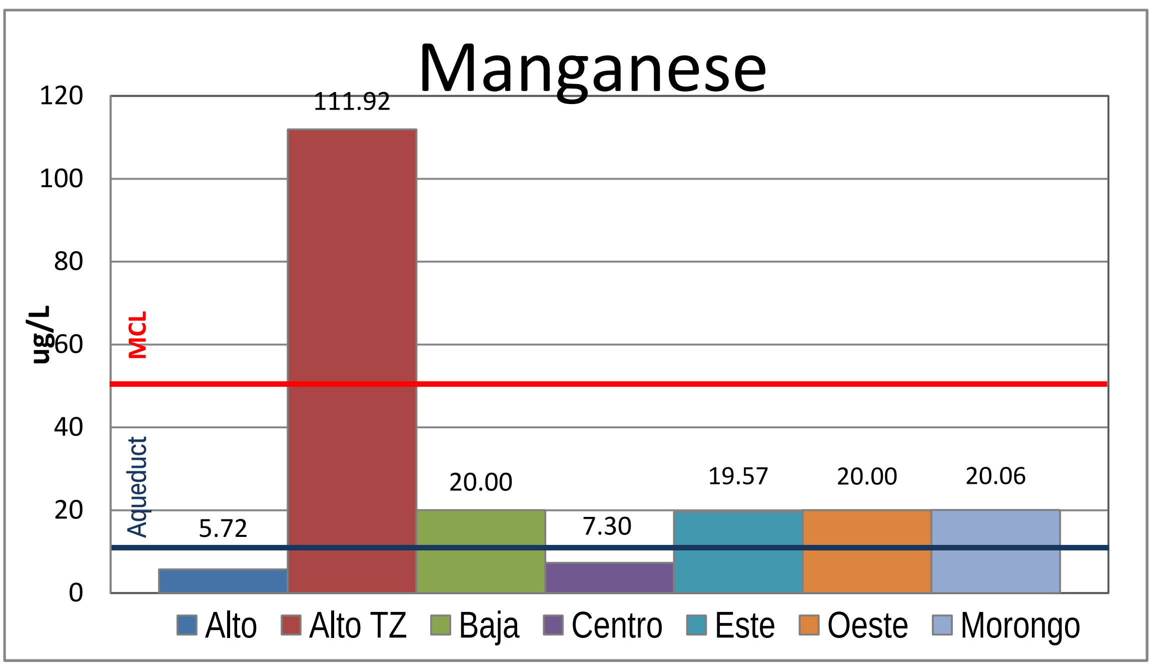


FIGURE 5-2
MANGANESE[12]



[16] Dataset date range: 01/2005 to 11/2009. Raw data source is MWA. Data source for 5-year average: CDPH. Data source for Aqueduct 5-year average: MWA and Victorville Water District.

FIGURE 5-3
FLUORIDE[12]

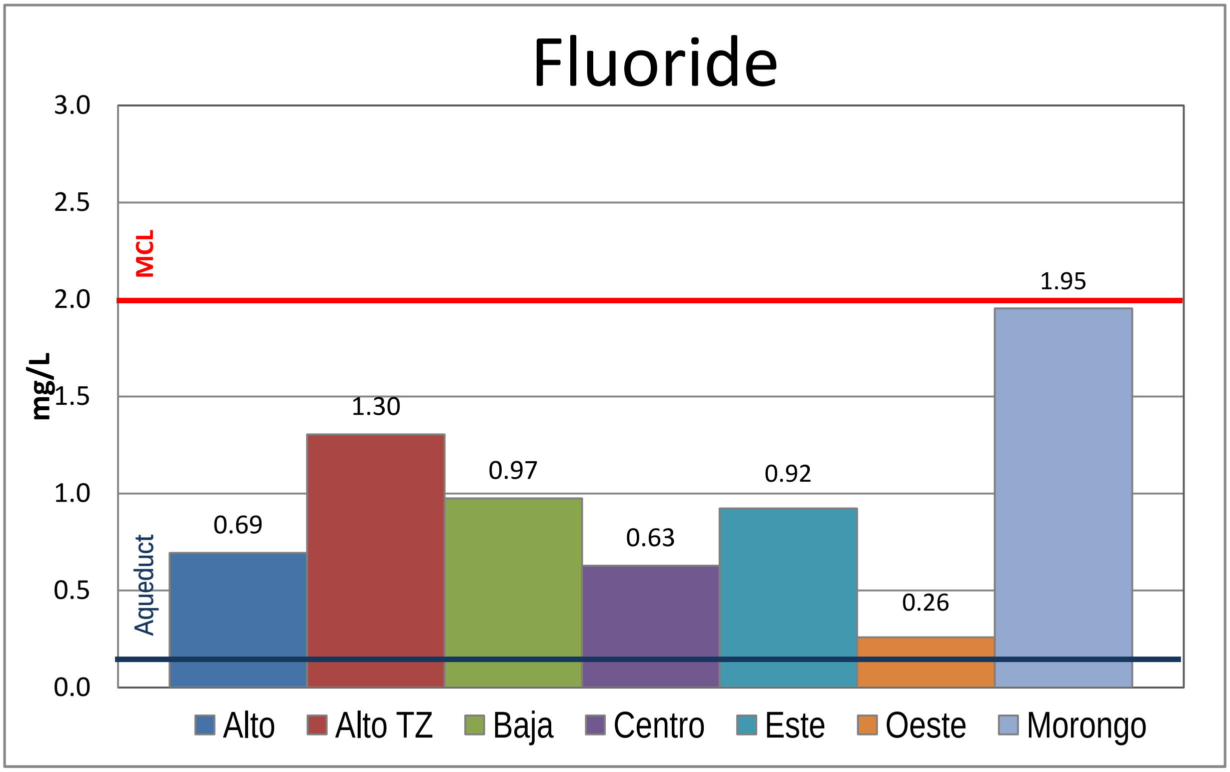
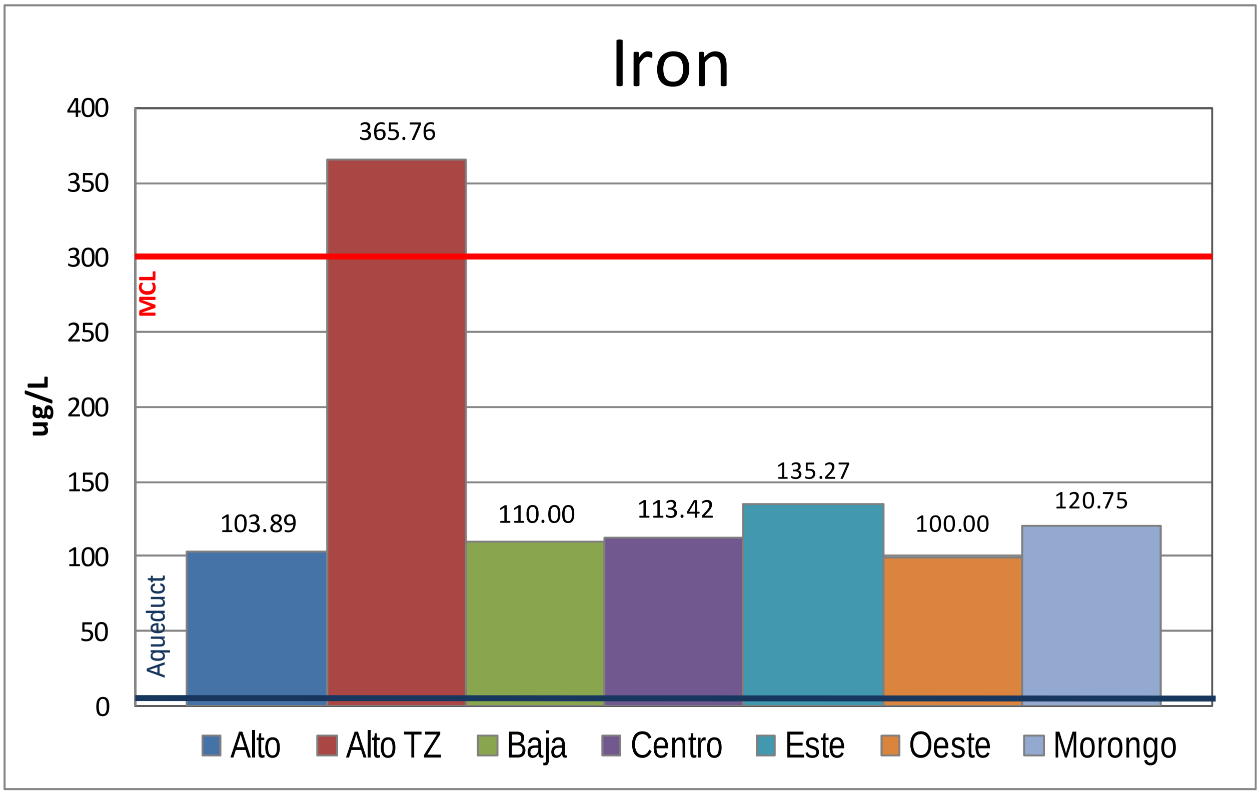


FIGURE 5-4
IRON[17]



[17] Dataset date range: CDPH 01/2005 to 11/2009 - Aqueduct 07/2008 to 11/2010. Raw data source is MWA. Data source for 5-year average: CDPH. Data source for Aqueduct 3-year average: DWR. Data source for MCL: State of California. Caveats: CDPH Groundwater samples were undifferentiated and were for both "total iron" and "dissolved iron". For the Iron by subarea, this acts to probably inflate the iron values. Local Aqueduct samples were for "total iron." Additional data for "dissolved iron" was obtained from DWR for Check 41 (Tehachapi Afterbay). Although this is a reduced time series, this is considered to be the best available representative data.

FIGURE 5-5
ARSENIC[12]

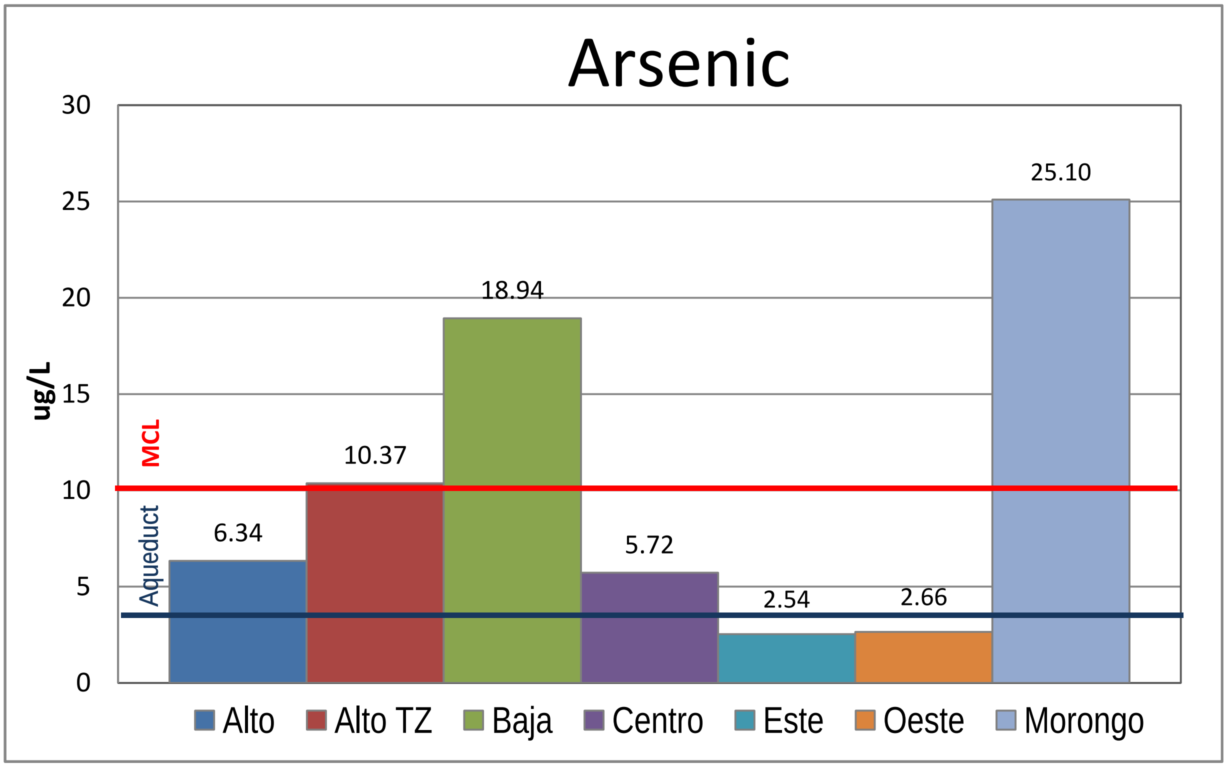
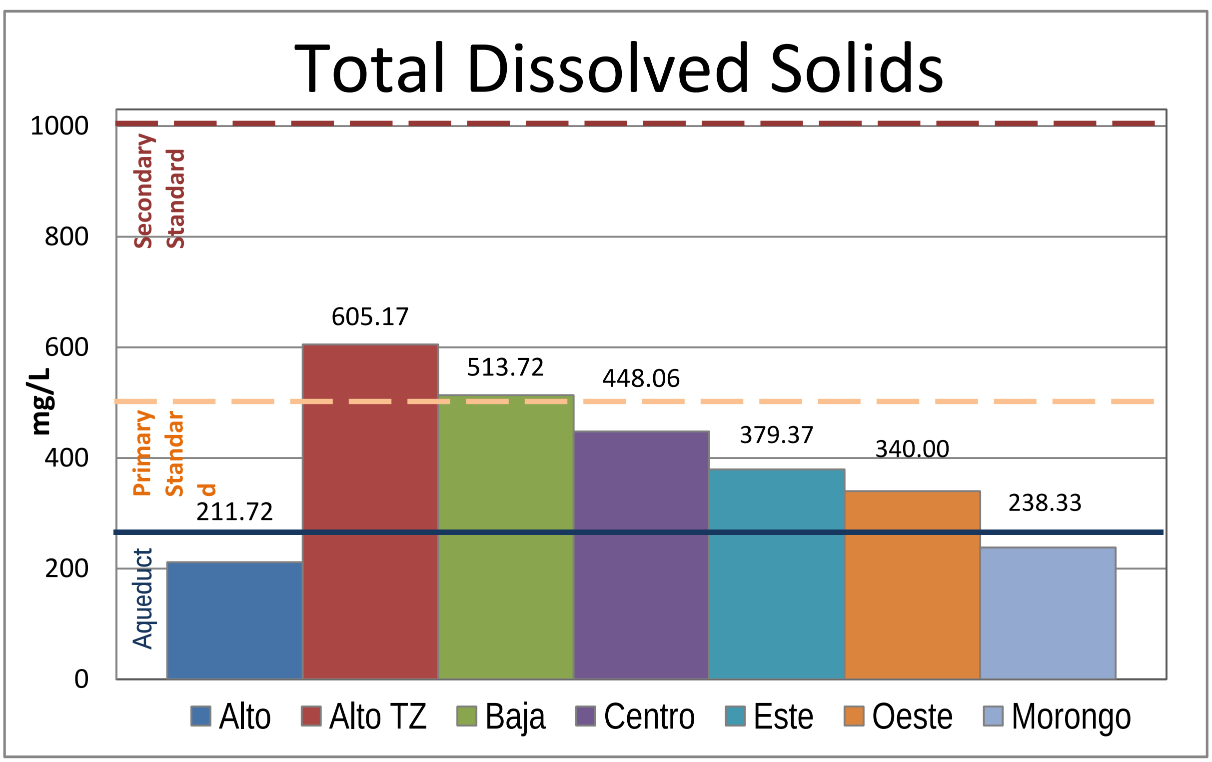


FIGURE 5-6
TDS[12]



5.4 Groundwater Protection

The general goal of groundwater protection activities is to maintain the groundwater and the aquifer to ensure a reliable high quality supply. Activities to meet this goal include continued and increased monitoring, data sharing, education and coordination with other agencies that have local or regional authority or programs. To increase its groundwater protection activities, MWA has been taking the following actions as presented below.

5.4.1 Water Quality Monitoring

Water quality sampling has been performed continuously in the Mojave Service Area since the early 1900's. As a result, an extensive body of water quality data is available. The 2007 Groundwater Analysis (2007 Schlumberger) highlighted the many strengths and weaknesses of these data.

The frequency and spatial distribution of historic groundwater sampling in the region by multiple entities has been highly variable in response to funding cycles, changes in responsibility, and short term or localized priorities. As a result, although adequate field and laboratory practices were generally maintained, the existing body of data lacks the consistency and some of the key elements of information required for more sophisticated modeling at a regional scale using currently available state-of-the-art tools and techniques. However, the available data is diverse, widely distributed, of reasonable quality, and therefore suitable for qualitative and limited quantitative regional modeling as performed in the 2007 Groundwater Analysis project.

Notwithstanding the above, as a result of the 2007 Groundwater Analysis project, it was possible to make a number of recommendations for future actions;

- Responsibility – Many agencies currently have partial and overlapping jurisdiction over water quality sampling and database management. However, no one agency is charged with maintenance of a single consistent water quality database. There are drawbacks to this situation from a historical perspective. Unless some deliberate action is taken it is reasonable to expect this condition to persist into the future.

- Water Quality Data – The 2007 Groundwater Analysis project highlighted deficiencies in the available data, particularly with respect to depth specific sampling. More comprehensive regional monitoring programs will allow better resource management in the future. More frequent and depth specific sampling, as well as wider distribution of monitoring wells is needed. Expanded monitoring programs may require more sophisticated field procedures and/or permanent monitoring installations, both of which tend to increase data acquisition cost. It is strongly recommended that further modeling efforts be utilized to optimize design and planning of future data acquisition campaigns.

- Project Specific Monitoring – The water quality planning model was used to estimate the future impact of various management actions. This analysis showed, for example, that the Regional Recharge and Recovery Project, known as "R^3," (described in Chapter 3 previously) has a favorable moderate overall impact on water quality. It is recommended that an optimized water quality monitoring program be conducted in conjunction with the R^3 program implementation. The results may be used to improve future predictions.

- Future Modeling Requirements – The data from MWA's monitoring program, used to initiate the database was complete and consistent with respect to geo-referencing, constituents, quality indicators, etc. However, some of the older data gathered and archived over several decades by various other agencies lacks the information required to verify sample integrity, location, or depth. This may be due to the original sampling and analysis procedures, or the data lost in the archival process. However, as a result of MWA's continuing monitoring program the overall consistency of the database will improve over time. With given detailed localized analysis of the available data, more sophisticated modeling should be possible at a local, project specific, scale.

5.4.2 Recharge Site Management Activities

Currently, MWA only considers recharge in areas where the groundwater quality is not impaired or known to have any constituents of concern. Because MWA does not currently own any retail water production wells, it cannot control where the retail water purveyors locate their production wells. However, if a retailer chooses to locate a production well near or in an area with impaired groundwater quality, then the retailer is responsible for treating or correcting the constituent causing the concern.

Uncertainty surrounding the overall long-term effects of human influences on the TDS levels in closed basins such as the Mojave Basin has drawn a great deal of attention in recent years. The concept of assimilative capacity has been developed to represent the remaining capability of a system at a point in time to assimilate input of a foreign or toxic substance before a given threshold is reached. The threshold is generally related to some health standard.

Although no formal definition of assimilative capacity for TDS has been found, for the purpose of this Plan an ad-hoc definition has been adopted as "the ability of the surface and groundwater system to sustain long-term influx of TDS from internal and external anthropogenic (human) sources."

The TDS load in a basin at any point in time is a function of an initial water quality plus the cumulative sum of all TDS sources and sinks during the study period. The 2007 Schlumberger Report concludes that model findings would suggest that the MWA basin(s) assimilative capacity may be managed through monitoring, modeling and management actions.

5.4.3 Hazardous Materials Response

Currently, local and county hazardous materials teams handle responses to hazardous materials incidents. Increased coordination between MWA and hazardous materials teams will allow for assessment of the potential for chemical spills to impact groundwater and recharge sites.

The Lahontan Regional Water Quality Control Board (RWQCB) has worked with MWA in the past to share data and help assess situations where contamination may affect water wells. MWA has and will assist regulatory agencies as needed, while regulatory agencies have relied on MWA as a data repository or utilized some of MWA's monitoring network in the past.

5.5 Water Quality Impacts On Reliability

5.5.1 Groundwater

The quality of water dictates numerous management strategies a water purveyor will implement, including, but not limited to, the selection of raw water sources, treatment alternatives, blending options, and modifications to existing treatment facilities. Maintaining and utilizing high quality sources of water simplifies management strategies by increasing water supply alternatives, water supply reliability, and decreasing the cost of treatment. Maintaining high quality source water allows for efficient management of water resources by minimizing costs.

Maintaining the quality of water supplies increases the reliability of each source by ensuring that deliveries are not interrupted due to water quality concerns. A direct result from the degradation of a water supply source is increased treatment cost before consumption. The poorer the quality of the source water, the greater the treatment cost. Groundwater may degrade in quality to the point that is not economically feasible for treatment. In this scenario the degraded source water is taken off-line. This in turn can decrease water supply reliability by potentially decreasing the total supply and increasing demands on alternative water supplies.

Currently, water quality does not materially affect water supply reliability in the region. Maintaining the current level of quality is vital to maintaining a reliable water supply. Some small areas have undesirable local concentrations of some constituents for which wellhead treatment or an alternative water supply has been identified as a remedial action.

Limiting migration of poor quality water is an objective of the MWA. A goal of the MWA's regional monitoring program is to detect long-term changes in groundwater quality. This includes migration of poor quality water. By understanding the occurrence and movement of poor quality groundwater, management actions can be taken to avoid these areas and/or limit migration of poorer quality water into regions of higher quality water. Monitoring along with water management actions will help maintain and increase long-term water supply reliability.

One of the ways limiting migration has been addressed is through the installation of multi-level monitoring wells to facilitate water quality sampling and wellhead monitoring at discreet levels within the well. This technique has been used successfully to identify the source of arsenic and other constituents of concern, often found in deeper aquifer zones, to ensure that new wells being constructed do not facilitate the migration of poor quality water into high quality water within a well column. This information has been particularly critical to development of new production wells to serve the R^3 Project and identifying the source of known arsenic in groundwater in Hesperia and southern Apple Valley.

Section 6: Reliability Planning

6.1 Overview

The Act requires urban water suppliers to assess water supply reliability that compares total projected water use with the expected water supply over the next twenty years in five year increments. The Act also requires an assessment for a single-dry year and multiple-dry years. This chapter presents the reliability assessment for Mojave Water Agency's (MWA's) service area.

As stated in MWA's *2004 Regional Water Management Plan*, the general goal of MWA's groundwater protection activities is to maintain the groundwater and the aquifer to ensure a reliable high quality supply. This Plan helps MWA to achieve this goal even during dry periods based on a conservative water supply and demand assumptions over the next 25 years, as discussed in the following sections.

6.2 Reliability of Water Supplies

Each water supply source has its own reliability characteristics. In any given year, the variability in weather patterns around the state may affect the availability of supplies to the MWA's service area differently. For example, from 2000 through 2002, southern California experienced dry conditions in all three years. During the same period, northern California experienced one dry year and two average years. MWA's service area is typical in terms of water management in southern California; local groundwater supplies are used to a greater extent when imported supplies are less available due to dry conditions in the north, and larger amounts of imported water supplies are used during periods when northern California has wetter conditions. This pattern of "conjunctive use" has been in effect since State Water Project (SWP) supplies first came to the MWA's service area in 1978. SWP supplies have supplemented the overall supply of the MWA service area, which previously depended solely on local groundwater supplies.

To supplement these local groundwater supplies, MWA contracted with the California Department of Water Resources (DWR) for delivery of SWP water, providing an imported water supply to the groundwater basins. However, the variability in SWP supplies affects the ability of the Agency to meet the overall water supply needs for the service area. While each of the groundwater basin's available supply sources have some variability, the variability in SWP supplies has the largest effect on overall supply reliability.

As discussed in Section 3.2, each SWP contractor's Water Supply Contract contains a Table A amount that identifies the maximum amount of water that the contractor may request. However, the amount of SWP water actually allocated to contractors each year is dependent on a number of factors than can vary significantly from year to year. The primary factors affecting SWP supply availability include hydrologic conditions in northern California, the amount of water in SWP storage reservoirs at the beginning of the year, regulatory and operational constraints, and the total amount of water requested by the contractors. The availability of SWP supplies to MWA and the other SWP contractors is generally less than their full Table A amounts in many years and can be significantly less in very dry years.

DWR's "State Water Project Delivery Reliability Report 2009" (2009 SWP Reliability Report), issued in August 2010, assists SWP contractors in assessing the reliability of the SWP component of their overall supplies. The Report updates DWR's estimate of the current (2009) and future (2029) water delivery reliability of the SWP. The updated analysis shows that the primary component of the annual SWP deliveries (referred to as Table A deliveries) will be less under current and future conditions, when compared to the preceding report (SWP Delivery Reliability Report 2007).

In the 2009 Report, DWR presents the results of its analysis of the reliability of SWP supplies, based on model studies of SWP operations. In general, DWR model studies show the anticipated amount of SWP supply that would be available for a given SWP water demand, given an assumed set of physical facilities and operating constraints, based on 82 years of historic hydrology. The results are interpreted as the capability of the SWP to meet the assumed SWP demand, over a range of hydrologic conditions, for that assumed set of physical facilities and operating constraints. In these model studies, DWR assumed existing SWP facilities and operating constraints for both the 2009 and 2029 studies. The primary differences between the two studies are an increase in projected SWP contractor demands and an increase in projected upstream demands (which affects SWP supplies by reducing the amount of inflows available for the SWP). DWR presents the anticipated future SWP delivery reliability resulting from these studies as a percent of full contractor Table A amounts, which is 60 percent of Table A as the long-term average supply. DWR also prepared Deliver Reliability Reports (DRRs) for individual SWP contractors, with MWA's reliability projected to be 60 percent until 2029, and then 61 percent in 2029 and after.

The 2009 SWP Reliability Report also includes analyses of various SWP operational restrictions that took effect in 2008 and 2009 due to various court rulings regarding federal biological opinions. The overall result has been "erosion of the SWP to deliver water." The Report identifies several emerging factors related to these court rulings that have the potential to affect the availability and reliability of SWP supplies. Although the 2009 Report presents an extremely conservative projection of SWP delivery reliability, particularly in light of events occurring since its release, it remains the best available information concerning the SWP. A detailed legal analysis of these SWP factors is attached as Appendix F.

6.3 Average, Single-Dry, and Multiple-Dry Year Planning

As discussed previously in Chapter 3, the MWA has five sources of water supply – SWP imported water, natural surface water flow, "agricultural depletion from storage", return flow from pumped groundwater not consumptively used, and wastewater imports from outside the MWA service area. What is unusual about MWA is that almost all of the water use within MWA is supplied by pumped groundwater. Native surface supply and SWP imports recharge the groundwater basins and are not supplied directly to any retailers, with the exception of two power plants.

These supplies are available to meet demands during average, single-dry, and multiple-dry years. The following sections elaborate on the different supplies available to MWA during each of the various dry year conditions and what supplies can be expected. Included in the return flow supply is the recycled water used within MWA's service area. Each subsection will explain the criteria used for estimating single-dry and multiple dry supplies that are then used in the comparison tables in Section 6.4.

6.3.1 Wholesale Imported State Water Project Supply

For this Plan, the availability of SWP supplies to MWA was estimated by multiplying MWA's Table A amount (82,800 acre-feet per year (afy) in 2010 and 89,800 in 2030) by the delivery percentages from DWR's 2009 SWP Reliability Report, discussed below. The three hydrologic conditions required to be evaluated for all UWMPs include:

1) an average year condition,
2) a single-dry year condition, and
3) a multiple-dry year condition,

The delivery percentages used for SWP imported water for each of the above conditions were taken from DWR's 2009 Report based on the 82-year average, 1977, and the 1931-1934 average, for the average year, single-dry year, and multiple-dry year conditions, respectively. The delivery percentages are detailed in Table 6-1 for MWA.

TABLE 6-1
WHOLESALE SUPPLY RELIABILITY:
SINGLE-DRY YEAR AND MULTIPLE-DRY YEAR CONDITIONS

Wholesaler[(a)]	Average Year[(b)]	Single-Dry Year[(c)]	Multiple-Dry Year[(d)]
California State Water Project (SWP)			
2010			
% of Table A Amount Available	60%	7%	34%
Anticipated Deliveries (afy)	49,680	5,796	28,152
2030			
% of Table A Amount Available[(e)]	61%	11%	35%
Anticipated Deliveries (afy)	54,778	9,878	31,430

Notes:
(a) The percentages of Table A amount projected to be available are taken from Table 6.4 and 6.13 of DWR's State Water Project Delivery Reliability Report 2009 (August 2010). Supplies are calculated by multiplying MWA's Table A amount of 82,800 af (2010) or 89,800 af (2030) by these percentages.
(b) Assumes 60% of Table A amount as the long-term supply until 2029 and then assume 61% in 2029 and after, based on the California Department of Water Resources 2009 contractor Delivery Reliability Report for MWA
(c) Based on the worst case historic single dry year of 1977.
(d) Supplies shown are annual averages over four consecutive dry years, based on the worst-case historic four-year drought of 1931-1934.
(e) See Table 6.13 in DWR's SWP 2009 Report. Table A amount is 89,800 afy.

The DWR analyses projected that the SWP deliveries during multiple-dry year periods could average about 34 to 35 percent of Table A amounts and could drop as low as 7 to 11 percent during an unusually dry single year. Table 6-1 summarizes the estimated SWP supply availability in a single dry year (based on a repeat of the worst-case historic hydrologic conditions of 1977) and over a multiple dry year period (based on a repeat of the worst-case historic four-year drought of 1931-1934). During a single-dry or critical year in 2010, as defined by the Sacramento River Index, the SWP will be able to supply an average of 5,796 acre-feet (af) to MWA. Similarly in 2010, during a multiple-dry year period (1931-1934), MWA's SWP supply is estimated at 28,152 afy.

The values shown in Table 6-1 cover the period 2009 – 2029 based on the DWR estimates at the 2009 level for the current conditions and at the 2029 level for future conditions. Therefore, in for a single-dry or critical year in 2035, the SWP will be able to supply an average of 9,878 af to

MWA. Similarly in 2035, during a multiple-dry year period, MWA's SWP supply is estimated at 31,430 afy.

Although the 2009 Report presents an extremely conservative projection of SWP delivery reliability, particularly in light of events occurring since its release, because it is based on the most up-to-date modeling by DWR, it remains the best available information concerning the SWP for use in preparing this Plan.

6.3.2 Local Supplies

The MWA local water supplies are each discussed below with an explanation of how the estimates by supply source were derived for average, single-dry and multiple-dry year periods.

6.3.2.1 Net Natural Supply

MWA has an average natural supply of 54,045 afy, including surface and subsurface water flows to the five subareas in the Mojave Basin area and to the Morongo Area, as shown in Table 3-1. Because the definition of the net natural supply is long-term natural supply estimates, the supplies are going to remain constant regardless of any annual changes in hydrology. Annual fluctuations in natural surface flows do not impact the long-term sustainability of the groundwater basins; therefore, the supply is assumed to be 100 percent available in single-dry year and multiple-dry year conditions.

6.3.2.2 Agricultural Depletion from Storage

As previously discussed in Section 3.3, agricultural production in excess of natural yield is still occurring in the Baja Subarea. The overproduction is not offset by Replacement Water purchases of imported SWP supply. The overproduction results in depletion of groundwater in storage. Therefore, the MWA demand forecast model considers water consumptively used by agriculture in Baja as supply derived from storage depletion. Please refer to Section 3.3.2 for a description of Agriculture Depletion from Storage.

The source of this supply originates as groundwater in the Mojave River Basin and is a function of agricultural groundwater production. Therefore, in both single-dry year and multiple-dry year conditions, this "depletion from storage" is assumed to occur 100 percent of the time.

6.3.2.3 Return Flow

As previously discussed in Section 3.3, the return flow is supplied from pumped groundwater not consumptively used, so while the primary source is groundwater, the return flow also includes any wastewater treated effluent discharged into the basin and recycled water as discussed in the subsection below.

In both dry year conditions: single-dry year and multiple-dry year, the return flow supply is assumed to remain 100 percent available because return flow is a direct function of water demands, which tend to increase rather than decrease, during periods of dry weather.

Treated Wastewater Effluent

Treated wastewater effluent is available from a number of agencies within the MWA service area. Treated wastewater as a source of supply has the advantage of consistently being available during any type of single-dry, or multiple-dry year. The water agencies and cities planning wastewater facilities as discussed in Chapter 4 of this Plan.

Even though MWA currently has no rights to any of the treated wastewater or recycled water, the regional water supply balance still benefits from these supplies because the groundwater basin is a closed system. While 2009 production of wastewater treatment plants totaled approximately 22,068 afy (19.7 MGD), within MWA's service area, the majority of this is currently recharged to the groundwater basins. In Table 3-1, the treated wastewater supply is included in the return flow, as it is in the MWA demand forecast model.

In this Plan, because of the consistency advantage with wastewater, 100 percent of the existing supply of treated wastewater is assumed to be available, which is 22,068 afy in an average year, a single-dry year, and in each year of a multiple-dry year period. As shown in Table 4-10, the supply of treated wastewater is projected to increase to a total of 62,843 afy (56.1 MGD) by 2035. Similar to the existing treated wastewater supply, 100 percent of the 62,843 afy of planned treated wastewater supply is assumed to be available in an average year, a single-dry year, and in each year of a multiple-dry year period.

6.3.2.4 Local Supply Summary - Groundwater

The sum of the natural surface water flows, agricultural depletion from groundwater storage, and return flow from pumped groundwater not consumptively used is the total local supplies for MWA. Therefore, the total local supply added to the SWP imported supply is the combined total required Mojave Basin Area and the Morongo Area.

Total groundwater supplies (as shown in Table 3-6) from the Mojave Basin Area are projected to be 140,000 to 190,000 afy in average years and in dry years due to the adjudication of the basin, which include SWP deliveries. However, as shown in Table 3-8, the net average yield from the Mojave Basin Area is projected to be approximately 51,925 afy in average and dry years. Supplies from the Morongo Area are projected to be approximately 2,120 afy (Table 3-11) in average years and in dry years. The projected groundwater supplies used in this Plan are generally the midpoints of the ranges mentioned above.

6.3.3 Banked Groundwater Storage

Since 2006, MWA has created its own conjunctive use program to take advantage of the fact that the available MWA SWP supply on average is still greater than the demand in the service area so MWA has been able to store the water in various groundwater basins for future use when SWP supplies are not available or there are groundwater shortages.

During normal and wet years, MWA delivers SWP water in excess of local demands and stores the surpluses as a part of the groundwater storage program. During dry years when SWP supplies are not sufficient to meet demands, MWA debits from banked supplies to meet demands. Some retail water agencies also have banked storage accounts which they may choose to draw from during any year, regardless of weather conditions. Table 3-13 in Chapter 3 shows the storage available as of December 31, 2010, in MWA's existing banked accounts by subarea. The individual retailers' banked storage accounts are included in a separate column in that table. Currently, MWA has 95,454 af of banked groundwater for future use. Retailers of MWA have a total of 45,997 af.

6.3.4 Additional Planned Banking

MWA's 2004 Regional Water Management Plan identifies a need for Supply enhancement projects to address the problem of groundwater overdraft and future growth/water demand. As described in Section 3.5, in 2006 MWA adopted a "Water Banking Policy" which established groundwater banking targets for each Subarea for the purpose of providing dry-year supplies. MWA will continue to deliver and store surplus SWP water pursuant to those banking targets, which are higher than the amounts needed to meet single- and multiple-dry year demands for banked water as identified in this UWMP. MWA's planned recharge projects are listed in Table 3-14.

During single-dry and multiple-dry year conditions, MWA will debit water from banked supplies as needed.

6.4 Supply And Demand Comparisons

The available supplies and water demands for MWA's service area were analyzed to assess the region's ability to satisfy demands during three scenarios: an average water year, single-dry year, and multiple-dry years. The tables in this Section present the supplies and demands for the various drought scenarios for the projected planning period of 2010-2035 in five year increments. Table 6-2 presents the base years for the development of water year data. Tables 6-3, 6-4, and 6-5 at the end of this Section summarize, respectively, Average Water Year, Single-Dry Water Year, and Multiple-Dry Year supplies.

TABLE 6-2
BASIS OF WATER YEAR DATA

Water Year Type	Base Years	Historical Sequence
Average Water Year	Average	1922-2003
Single-Dry Water Year	1977	--
Multiple-Dry Water Years	1931-1934	--

6.4.1 Average Water Year

Table 6-3 summarizes MWA's water supplies available to meet demands over the 20-year planning period during an average/normal year. For SWP supplies it is 60 percent of Table A as the long-term average supply until 2029, and then 61 percent in 2029 and after. As presented in the table, MWA's water supply is broken down into existing and planned water supply sources, including wholesale (imported) water, local supplies, and planned recharge programs.

6.4.2 Single-Dry Year

The water supplies and demands for MWA's service area over the 20-year planning period were analyzed in the event that a single-dry year occurs, similar to the drought that occurred in California in 1977. During a single-dry year, SWP availability is anticipated to be reduced to 7 percent in 2009 and 11 percent in 2029. Table 6-4 summarizes the existing and planned supplies available to meet demands during a single-dry year. Demand during dry years was assumed to increase by 10 percent due to increased irrigation needs.

6.4.3 Multiple-Dry Year

The water supplies and demands for MWA's service area over the 20-year planning period were analyzed in the event that a four-year multiple-dry year event occurs, similar to the drought that occurred during the years 1931 to 1934. During multiple-dry years, SWP availability is anticipated to be reduced to 34 percent in 2009 and 35 percent in 2029. Table 6-5 summarizes the existing and planned supplies available to meet demands during multiple-dry years. Demand during dry years was assumed to increase by 10 percent.

6.4.4 Summary of Comparisons

As shown in the analyses above, MWA has adequate supplies to meet demands during average, single-dry, and multiple-dry years throughout the 20-year planning period.

TABLE 6-3
PROJECTED AVERAGE/NORMAL YEAR SUPPLIES AND DEMAND (AFY)

Water Supply Source	2010	2015	2020	2025	2030	2035
Existing Supplies						
Wholesale (Imported)						
SWP[(a)]	49,680	51,480	53,880	53,880	54,778	54,778
Local Supplies[(a)]						
Net Natural Supply	54,045	54,045	54,045	54,045	54,045	54,045
Agricultural Depletion from Storage	10,425	10,425	10,425	10,425	10,425	10,425
Return Flow	62,220	67,766	71,353	76,862	82,364	87,857
Wastewater Import	5,304	5,397	5,491	5,789	6,087	6,385
Groundwater Banking Projects[(b)]	0	0	0	0	0	0
Total Existing Supplies	**181,674**	**189,113**	**195,194**	**201,001**	**207,698**	**213,490**
Total Estimated Demands[(c)]	***151,885***	***163,161***	***170,496***	***181,740***	***192,969***	***204,181***

Notes:
(a) Taken from Chapter 3 Water Resources, Table 3-1.
(b) Not needed during average/normal years.
(c) See Chapter 2 Water Use, Table 2-3, assuming "moderate" conservation.

TABLE 6-4
PROJECTED SINGLE-DRY YEAR SUPPLIES AND DEMAND (AFY)

Water Supply Source	2010	2015	2020	2025	2030	2035
Existing Supplies						
Wholesale (Imported)						
SWP[(a)]	5,796	6,006	6,286	6,286	9,878	9,878
Local Supplies[(b)]						
Net Natural Supply	54,045	54,045	54,045	54,045	54,045	54,045
Agricultural Depletion from Storage	10,425	10,425	10,425	10,425	10,425	10,425
Return Flow	62,220	67,766	71,353	76,862	82,364	87,857
Wastewater Import	5,304	5,397	5,491	5,789	6,087	6,385
Groundwater Banking Projects[(b,c,d)]	29,284	35,838	39,946	46,507	49,467	56,009
Total Existing Supplies	**167,074**	**179,477**	**187,546**	**199,914**	**212,266**	**224,599**
Planned Supplies						
Groundwater Banking Projects[(e)]	0	0	0	0	0	0
Total Supplies	**167,074**	**179,477**	**187,546**	**199,914**	**212,266**	**224,599**
Total Estimated Demands[(f)]	***167,074***	***179,477***	***187,546***	***199,914***	***212,266***	***224,599***

Notes:
(a) SWP supplies are calculated by multiplying MWA's Table A amount by percentages of single-dry deliveries projected to be available for the worst case single dry year of 1977 (7% in 2009 and 11% in 2029), taken from Tables 6.40 and 6.13 of DWR's 2009 SWP Reliability Report.
(b) Taken from Chapter 3 Water Resources, Table 3-1.
(c) Assumed 100% available during single-dry year. Refer to Section 6.3.2.
(d) Existing banked SWP water in MWA groundwater storage accounts (See Section 6.3.3 and Table 3-13). This does not include any retailers' stored water. Amounts reflect stored water needed to meet demand after all other supplies are used.
(e) Planned banked supplies are not needed under a single-dry year scenario (current banked amounts are sufficient to meet demands).
(f) See Chapter 2 Water Use, Table 2-3, assuming “moderate” conservation. Also assumes increase in total demand of 10 percent during dry years.

TABLE 6-5
PROJECTED MULTIPLE-DRY YEAR SUPPLIES AND DEMAND (AFY)

Water Supply Source	2010	2015	2020	2025	2030	2035
***Existing Supplies*[(a)]**						
Wholesale (Imported)						
SWP[(b)]	28,152	29,172	30,532	30,532	31,430	31,430
Local Supplies[(c)]						
Net Natural Supply	54,045	54,045	54,045	54,045	54,045	54,045
Agricultural Depletion from Storage	10,425	10,425	10,425	10,425	10,425	10,425
Return Flow	62,220	67,766	71,353	76,862	82,364	87,857
Wastewater Import	5,304	5,397	5,491	5,789	6,087	6,385
Groundwater Banking Projects[(c,d,e,f)]	6,928	12,672	15,700	22,261	23,864	23,864
Total Existing Supplies	**167,074**	**179,477**	**187,546**	**199,914**	**208,215**	**214,006**
Planned Supplies						
Groundwater Banking Projects[(g)]	0	0	0	0	4,051	10,593
Total Supplies	**167,074**	**179,477**	**187,546**	**199,914**	**212,266**	**224,599**
***Total Estimated Demands*[(h)]**	***167,074***	***179,477***	***187,546***	***199,914***	***212,266***	***224,599***

Notes:

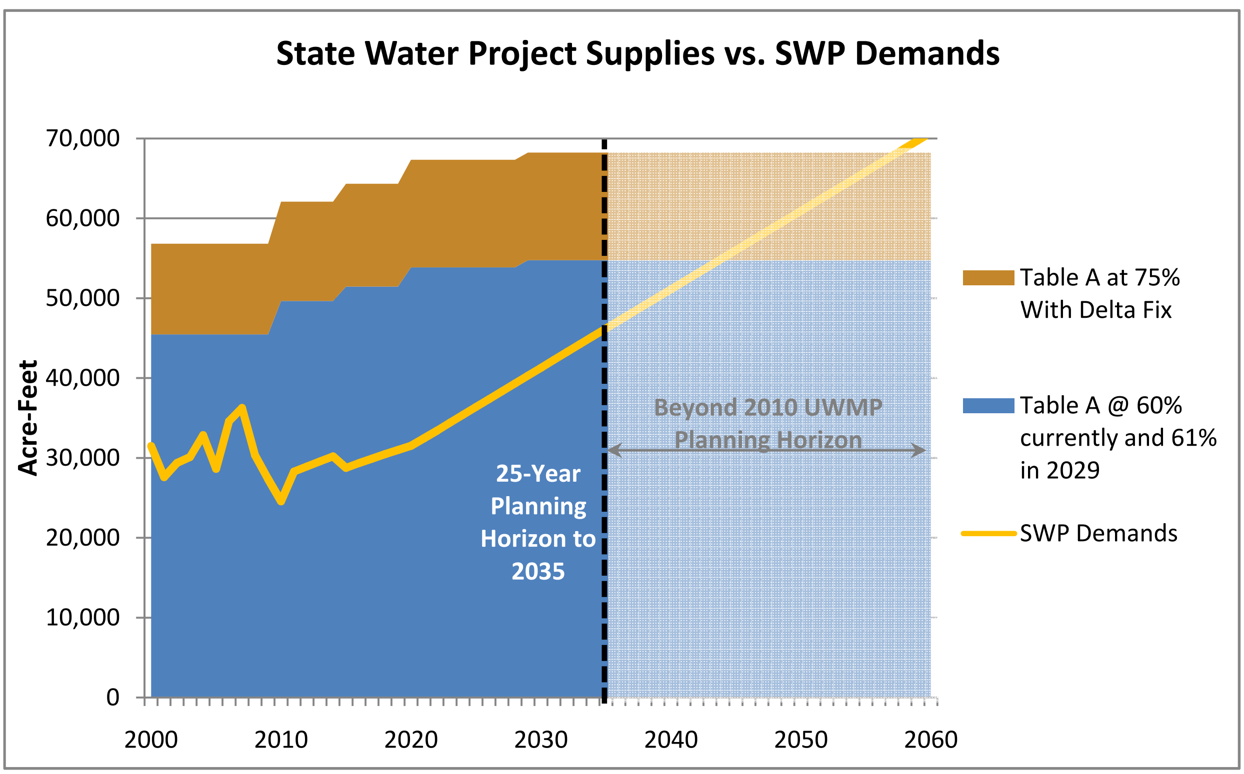
(a) Supplies shown are annual averages over four consecutive dry years (unless otherwise noted).
(b) SWP supplies are calculated by multiplying MWA's Table A amount by percentages of multiple-dry deliveries projected to be available for the worst case four-year drought of 1931-1934 (34% in 2009 and 35% in 2030), taken from Tables 6.4 and 6.13 of DWR's 2009 SWP Reliability Report.
(c) Taken from Chapter 3 Water Resources, Table 3-1.
(d) Assumed 100% available during multiple-dry year. Refer to Section 6.3.2.
(e) Existing banked SWP water in MWA groundwater storage accounts (See Section 6.3.3 and Table 3-13). This does not include any retailers' stored water. Amounts reflect stored water needed to meet demand after all other supplies are used.
(f) Assumed a maximum of 25% available during multiple-dry year. Based on total amount of storage available divided by 4 (4-year dry period).
(g) Amounts reflect additional banked supplies needed to meet a multiple-dry year scenario. MWA will continue to bank SWP supplies to meet dry-year needs as identified in the UWMP and in accordance with its Water Banking Policy (see Sections 3.5.3 and 6.3.4). Planned water supply projects will contribute to MWA's increased ability to bank SWP water in the future (see Section 3.6 and Table 3-14).
(h) Chapter 2 Water Use, Table 2-3, assuming "moderate" conservation. Also assumes increase in total demand of 10 percent during dry years.

6.4.5 Potential Future SWP Supplies

An ongoing planning effort to increase long-term supply reliability for both the SWP and Central Valley Project (CVP) is taking place through the Bay Delta Conservation Plan (BDCP). The co-equal goals of the BDCP are to improve water supply and restore habitat in the Delta. The BDCP is being prepared through a collaboration of state, federal, and local water agencies, state and federal fish agencies, environmental organizations, and other interested parties. Several "isolated conveyance system" alternatives are being considered in the plan which would divert water from the North Delta to the South Delta where water is pumped into the south-of-Delta stretches of the SWP and CVP. The new conveyance facilities would allow for greater flexibility in balancing the needs of the estuary with reliable water supplies. In December 2010, DWR released a "Highlights of the BDCP" document which summarizes the activities and expected outcomes of the BDCP. The results of preliminary analysis included in the document indicate the proposed conveyance facilities may increase the combined average long-term water supply to the SWP and CVP from 4.7 million acre-feet (MAF) per year to 5.9 MAF/year. This would represent an increase in reliability for State Water Project contractors from 60 percent to 75 percent. Planned completion of the BDCP and corresponding environmental analysis is early-2013.

Figure 6-1 presents a visual display of how MWA's Table A amount will be able to meet various demand estimates using long-term average trends in SWP supply.

FIGURE 6-1
SWP SUPPLY VS. SWP DEMAND



Section 7: Water Demand Management Measures

7.1 Overview

In 2006 Mojave Water Agency (MWA) became a signatory to the Memorandum of Understanding Regarding Water Conservation in California (MOU) of the California Urban Water Conservation Council (CUWCC) and is firmly committed to the implementation of the Best Management Practices (BMPs) or Demand Management Measures (DMMs). The CUWCC is a consensus-based partnership of agencies and organizations concerned with water supply and conservation of natural resources in California. By becoming a signatory, MWA agreed to implement a series of locally cost-effective conservation methods in the MWA service area through cooperation with, and participation of, the retail water purveyors.

Those signing the CUWCC MOU have pledged to develop and implement fourteen comprehensive conservation BMPs. The MOU was compiled with two primary purposes: to expedite implementation of reasonable water conservation measures in urban areas; and, to establish assumptions for use in calculating estimates of reliable future water conservation savings resulting from proven and reasonable conservation measures.

The MOU and BMPs were revised by the CUWCC in 2008. The revised BMPs now contain a category of “Foundational BMPs” that signatories are expected to implement as a matter of their regular course of business. These include Utility Operations (metering, water loss control, pricing, conservation coordinator, wholesale agency assistance programs, and water waste ordinances) and Public Education (public outreach and school education programs). These revisions are reflected in the reporting database starting with reporting year 2009.

The new category of foundational BMPs is a significant shift in the revised MOU. For MWA and other wholesalers these changes do not represent a substantive shift in requirements.

7.2 Conservation Program Background

MWA is a wholesale water agency serving ten (10) retail water purveyors that are required to complete an 2010 Urban Water Management Plan (UWMP) due to having more than 3,000 connections or delivering more than 3,000 acre-feet per year (afy). MWA and these ten retailers are therefore subject to the Urban Water Management Planning Act, AB 1420 and SBX7-7 requirements, in addition to the commitment of compliance with the BMPs as a signatory to the MOU. In the MWA service area, demand management is addressed both at the local (retail agency) and wholesale level.

MWA first started addressing and quantifying conservation goals in its 2004 Regional Water Management Plan (RWMP), which called for a reduction in the water consumption by ten percent in the Mojave River Basin and five percent in the Morongo Area by the year 2020. The conservation priorities identified in the Plan were based on the CUWCC’s 14 BMPs.

In August of 2003, local stakeholders decided that a united regional water conservation program was needed and the Alliance for Water Awareness and Conservation (AWAC) was formed. Among other things, AWAC expanded the conservation goals identified in the RWMP to

20 percent by 2020 for the Mojave Basin Area and 5 percent by 2015 for the Morongo Area; this goal was adopted by MWA in 2006 and supersedes the RWMP goal. The AWAC goal is a locally determined baseline and savings reduction target that predates the adoption of SBX7-7 and therefore is not intended to be consistent with the new requirement, although they may be complimentary.

According to the enabling MOU, the purpose of the AWAC is to "provide a vehicle to attract support for a regional water conservation program and coordinate implementation of activities by forming partnerships to obtain common, measurable goals." AWAC set three goals that aim to change water-use habits and empower High Desert communities with the tools to ensure adequate supplies of water for future generations:

1. Educate the local communities with the understanding of the importance of water conservation;
2. Provide the local communities with the tools to effectively reduce per capita consumption to targeted goals; and,
3. Reduce regional water use by 10 percent gross per capita by 2010 and 20 percent gross per capita by 2020 (5 percent in the Morongo Area by 2015) to achieve a sustainable, reliable supply to meet regional water demands.

In addition to its participation in the AWAC, MWA has signed MOUs with a number of local education centers, special districts and other agencies to create greater awareness about the need to manage and conserve water resources. These collaborations include: Lewis Center for Educational Research, Mojave Desert Resource Conservation District, Mojave Weed Management Area, Copper Mountain College, Barstow Community College and the Victor Valley Community College.

As the water wholesaler for the region, MWA is responsible for the implementation only of a subset of the BMPs. To date, four of the retail agencies within MWA have independently signed the MOU. In response, MWA has taken a leadership role in the implementation and support of a number of the BMPs that that extend beyond the MOU's wholesaler responsibilities.

Table 7-1 provides a summary of MWA's status in implementing the BMP requirements. The reporting forms have been submitted to the CUWCC and are included in Appendix I. MWA is implementing all of the BMPs applicable to wholesale water suppliers.[18]

[18]Water Loss Control and the AWWA M36 process are not applicable to MWA's operations; this is discussed further in Section 7.3.3.

TABLE 7-1
BMP STATUS

BMP	Status
Water Loss Control	N/A
Public Information	✓
School Education	✓
Wholesale Agency Programs	(a)
Conservation Coordinator	✓

Note: (a) CUWCC doesn't provide coverage report.

The following sections provide more detail on MWA's conservation programs and compliance with the BMPs.

7.3 Utility Operations

7.3.1 Water Conservation Coordinator

MWA has a two full-time staff that work exclusively on developing and implementing water conservation (WC) programs.

7.3.2 Wholesale Agency Assistance Programs

MWA provides both technical and financial assistance to the retail agencies for implementing conservation programs and strategies. MWA works with water agencies and cities individually, collectively and through AWAC to provide conservation support. Table 7-2 shows the number of retailers participating in the various MWA programs.

MWA provides the following support to its retailers, individually or through AWAC:

- Free conservation devices: faucet aerators, showerheads, and hose nozzles
- Washing machine rebates: $175 each
- Residential High Efficiency Toilet (HET) rebates: up to $165 each
- Small to large landscape rebates: $0.50 per ft^2 of turf converted to desert adaptive landscaping with 25 percent canopy coverage
- Public Information and Education Programs

MWA is also developing a program to provide technical support to its retailers for addressing the new American Water Works Association (AWWA) requirements for System Water Audit BMP implementation.

TABLE 7-2
MWA ASSISTANCE PROGRAMS

Program Activities	Number of Agencies Assisted per Year 2007	2008	2009	2010
Landscape Programs	N/A	14	14	14
Residential Retrofit	27	28	28	29
Washing Machines	N/A	20	20	20
Public Information	27	28	28	29
School Education	27	28	28	29
Water Waste	2	4	5	5
WC Coordinator	27	28	28	29
HET Replacements	N/A	21	23	23

7.3.3 Water Loss Control

This requirement is not applicable because MWA does not own or operate a distribution system. The water received from the State Water Project goes directly into groundwater recharge without treatment or distribution. MWA is planning the Regional Recharge and Recovery Project, known as "R^3," which is a conjunctive use project that stores SWP water underground in the local aquifer and later recovers and distributes the water to local retail water purveyors. Once the first phase of "R^3" is complete, scheduled for 2012, then MWA will own a distribution system and this requirement will need to be considered again.

7.4 Education

7.4.1 Public Information Programs

Public information programs that promote efficient water use are implemented throughout the service area. MWA works in conjunction with AWAC to provide outreach, educational and informational materials and literature; public service announcements and paid advertisements; flyers and bill inserts for retailers; conservation website; and articles in newsletters, Chamber of Commerce publications and regional newspapers (Table 7-3). Additionally, MWA assists in hosting and staffing workshops on conservation, sponsors and hosts public events and booths at community functions, and works with retailers to further their conservation goals through special projects based on their individual needs.

TABLE 7-3
PUBLIC INFORMATION EVENTS

Activity	Number Of Events 2006	2007	2008	2009	2010
Paid Advertising			9	4	25
Public Service Announcement			600	250	250
Bill Insert/ Newsletter/Brochure			25	25	10
Demonstration Garden	4	5	5	6	7
Special/Media Events			14	16	10
Speaker's Bureau			15	9	4

7.4.2 School Education Programs

School education programs are run by the retailers with MWA's support. MWA provides literature, staff support and in-kind services through funding for, and participation in, teacher training workshops known as "Project Wet". These training courses on water education curriculum are done in collaboration with the retailers and the Mojave Environmental Education Consortium (MEEC).

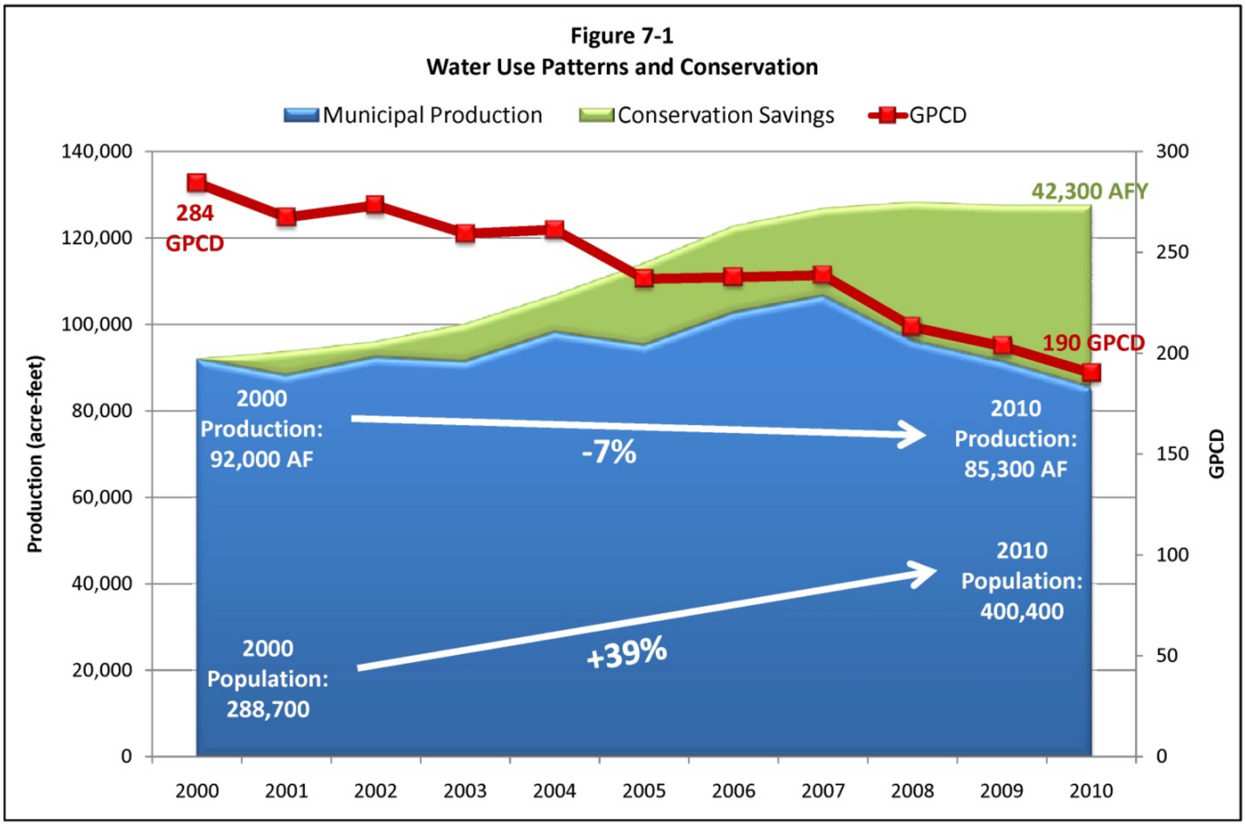
7.5 Program Results

Conservation is a crucial element of MWA's water supply management program and therefore tracking the savings from conservation activities is an integral and evolving element of the program. Water savings are achieved through a combination of active (programmatic) and passive (foundational) programs. Active programs include incentives, conversions and retrofits and typically are measurable and quantifiable. Passive savings are a result of activities such as outreach, education, regulations and standards — programs which are typically more challenging to quantify. In an attempt to measure program success and inform future planning MWA monitors water use patterns and utilizes an analytic approach based on common assumptions and models.

Water savings indicate that MWA is well on track to meeting its AWAC goals. Since 2000, per capita use has dropped by about 33 percent and since 2004, when the AWAC goals were set, per capita use has dropped by about 27 percent. It is expected that some portion of the recent reduction in use is related to the economic downturn and may show some bounce back as conditions recover, however the larger trend in the service area points to consistent and sustained reductions in per capita use.

Population growth and per-capita municipal production volume data have been tracked and correlated with the implementation of the AWAC regional conservation activities starting in August 2003. Figure 7-1 shows municipal production over time coupled with per capita use and population growth for the Mojave Groundwater Basin. Municipal production has fallen approximately 7 percent or 6,700 acre-feet (af) between 2000 and 2010; at the same time population grew by almost 40 percent. The savings of 42,300 af represent how much higher use would have been without conservation activities and efficiency standards.

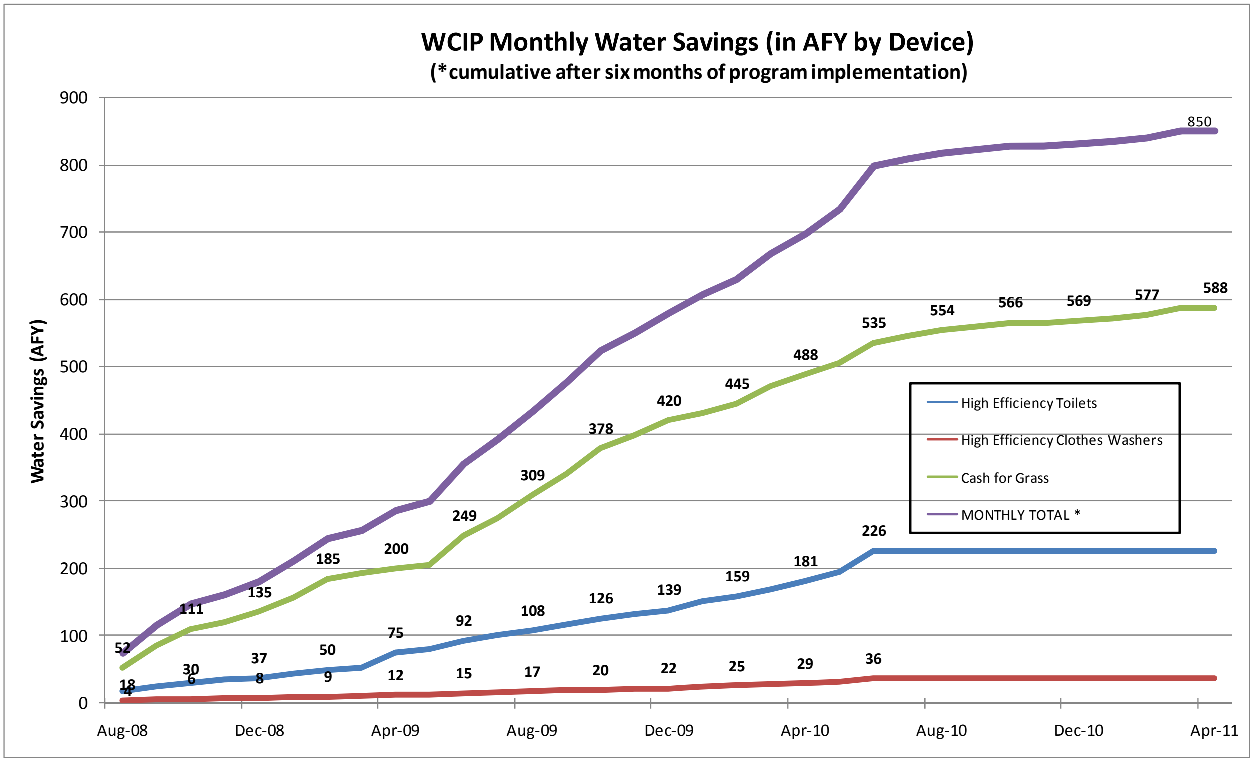
FIGURE 7-1
WATER USE PATTERNS AND CONSERVATION FOR MOJAVE GROUNDWATER BASIN



The savings in Figure 7-1 represent the impacts of both the foundational and active programs. MWA also applies an analytic approach to determine and predict impacts of its programmatic activities. The calculations indicate that water conservation incentive program activities saved about 850 afy since August 2008 (Figure 7-2). The largest portion of the savings is from the turf replacement program (Cash For Grass), followed by toilet and washer replacements.

The savings calculations are based on the fresh water avoided cost approach recommended by the CUWCC. Savings from HETs and High Efficiency Clothes Washers (HECWs) are estimated based on CUWCC water savings studies. Landscape conversion calculations are based on recorded evapotranspiration rates and other regional climatic factors which are used to develop a water savings coefficient that is applied to the number of units or area of landscape converted and rebated.

FIGURE 7-2
SAVINGS FROM CONSERVATION INCENTIVES



7.6 Conclusion

MWA is on track to meeting, and potentially even exceeding, its AWAC water reduction goals with municipal per capita consumption having dropped from 284 to 190 gpcd since 2000. This reduction provides both long-term supply reliability as well as insulation from short-term variations. Through aggressive programs and wholesale planning and collaboration, MWA has succeeded in decoupling population growth and demand from historic patterns. MWA continues to work with its retailers on a voluntary basis through a variety of incentive, outreach, education and support programs.

Section 8: Water Shortage Contingency Planning

8.1 Overview

Water supplies may be interrupted or reduced significantly in a number of ways, such as a drought which limits supplies, an earthquake which damages water delivery or storage facilities, a regional power outage, or a toxic spill that affects water quality. This chapter of the Plan describes how Mojave Water Agency (MWA) plans to respond to such emergencies so that emergency needs are met promptly and equitably.

Cities and water agencies within MWA rely on large groundwater reserves to meet potable water supply needs. During previous drought periods, municipal water suppliers continued to draft from these reserves to meet customer needs without imposing restrictions on water use, but at rates exceeding natural replenishment in most areas. The large groundwater basin in the area serves as a reservoir and buffers the impacts of seasonal and year-to-year variations in precipitation and surface water deliveries. The area aquifers are expected to be in balance in the near future due to the combination of water imports, State-mandated conservation requirements, and/or production "ramp-down." During multiple-year droughts or State Water Project outages, the basin will continue to be pumped to meet demands. Actions of the MWA to address water shortages are summarized below.

8.2 Coordinated Planning

The Mojave Water Agency was formed to manage water resources within the Agency's service area. In this capacity, MWA has been planning and implementing projects to increase water supply reliability and prevent future water shortages. MWA is a State Water Project (SWP) contractor and has a contract Table A amount of 82,800 af. This water is diverted from the California Aqueduct and distributed to recharge sites throughout the area to replace groundwater withdrawn by retailers. Deliveries from the SWP are variable and MWA's full Table A amount is not available every year. During dry and multiple dry years, it is expected that SWP deliveries will be significantly reduced.

The Mojave Basin Judgment calls for charging groundwater producers for use above their production allowance and using these funds to import "Replacement Water" from the SWP so that over time extractions come into balance with available supplies. Similar principles are employed in the Warren Valley Basin to achieve long-term balance of supply and demand. Once the basin is in balance it will be less impacted by fluctuations in deliveries of water from the SWP.

For the Morongo Basin/Johnson Valley Area ("Morongo Area"), as previously discussed in Section 3.4.4, there are three water supply agreements that deal with coordinated water supplies throughout the area, including (1) the Warren Valley Basin Agreement, (2) a Stipulated Judgment in a portion of the Ames Valley basin and (3) an agreement for the users of the Morongo Basin Pipeline.

For the non-adjudicated regions in the Morongo Area such as Joshua Basin, Johnson Valley, and the Means Valley, each of these groundwater basins is being coordinated by MWA as well.

Joshua Basin Water District (JBWD) is the retailer using the supply from the Joshua Tree/Copper Mountain Valley Region and is currently about to begin construction on recharge basins that will supply SWP water to the groundwater basins so the current overdraft conditions can be lessened. For the Johnson Valley Region, because the area is not yet populated, the water supply in the basin is not an issue. However, MWA is monitoring the basin so when development does occur, MWA will have a data set to act from. This is also true for the Means Valley Region, which is small and sparsely populated with only limited domestic groundwater development.

8.2.1 MWA and the Retail Water Purveyors

All of the retail water agencies within MWA boundaries that are required to complete their own individual 2010 UWMPs, have Water Shortage Contingency Plans included in their 2010 UWMPs which are not discussed in this section.

The Water Shortage Contingency Plans of these retail agencies utilize a variety of methods to reduce water demand including mandatory prohibitions on water wasting, voluntary water conservation measures, mandatory water conservation measures and prohibitions on certain uses of water during severe shortages, specific triggering mechanisms for determining the appropriate stage of alert, and water supply allotments for each stage of alert. As a wholesale agency, MWA does not have the authority to impose mandatory restrictions on retail customers due to water shortages. Therefore, this level of contingency planning is conducted by the retail water agencies.

8.3 Minimum Water Supply Available During Next Three Years

The minimum water supply available during the next three years would occur during a three-year multiple-dry year event between the years 2011 and 2013. MWA actively implements a conjunctive use program utilizing State Water Project water to recharge local aquifers. In addition to meeting Replacement Water obligations under the Mojave Basin Area Judgment, when SWP supplies are high (in surplus of Replacement Water needs), MWA meets the imported demands of individual stakeholders and also stores surplus water in local aquifers. When SWP supplies are low during dry periods, groundwater storage is used to meet demands. As shown in Table 8-1, the total supplies are approximately 165,000 acre-feet per year (afy) during the next three years. It is assumed that reduced SWP supplies will be met with pumping from groundwater storage, with the total water demand remaining the same as during normal years. When comparing these supplies to the demand projections provided in Chapters 2 and 6 of this Plan, MWA has adequate supplies available to meet projected demands should a multiple-dry year period occurring during the next three years and SWP imported supply be reduced.

TABLE 8-1
ESTIMATE OF MINIMUM SUPPLY FOR THE NEXT THREE YEARS

Source	Supply (afy)		
	2011	**2012**	**2013**
Existing Supplies			
Wholesale (Imported)			
SWP Table A Supply[(a)]	28,152	28,152	28,152
Local Supply[(b)]			
Net Natural Supply	54,045	54,045	54,045
Agricultural Depletion from Storage	10,425	10,425	10,425
Return Flow	64,583	65,395	66,204
Wastewater Import	5,323	5,341	5,360
Recharge Banking Projects[(b,c)]	0	0	0
Total Existing Supplies	**162,528**	**163,358**	**164,186**
Total Estimated Demands[(d)]	***158,702***	***160,359***	***162,010***

Notes:
(a) SWP supplies are calculated by multiplying MWA's Table A amount of 82,800 af by 34% of total deliveries projected to be available based on the worst-case historic four-year drought of 1931-1934. See Table 6-1.
(b) Taken from Chapter 3 Water Resources, Table 3-1. Local supplies are assumed to be 100% available. Only SWP supplies are reduced.
(c) Not needed in this scenario.
(d) See Chapter 2 Water Use, Table 2-3, assuming "moderate" conservation.

8.4 Actions to Prepare For Catastrophic Interruption

8.4.1 General

The MWA service area is bounded on the west by a major portion of the San Andreas Fault. A major earthquake along the southern portion of the San Andreas Fault would affect the MWA service area. The California Division of Mines and Geology has stated two of the aqueduct systems that import water to southern California (including the California Aqueduct) could be ruptured by displacement on the San Andreas Fault, and supply may not be restored for a three to six-week period. The situation would be further complicated by physical damage to pumping equipment and local loss of electrical power.

DWR has a contingency aqueduct outage plan for restoring the California Aqueduct to service should a major break occur, which it estimates would take approximately four months to repair.

Experts agree it may be at least three days after the earthquake before outside help could get to the area. Extended supply shortages of both groundwater and imported water, due to power outages and/or equipment damage, would be severe until the water supply could be restored.

Power outages currently do not affect MWA because they do not own or operate any wells or distribution systems. However, MWA is planning the Regional Recharge and Recovery Project, known as "R^3," which is a conjunctive use project that stores SWP water underground in the local aquifer and later recovers and distributes the water to local retail water purveyors as an additional supply. Once the first phase of R^3 is complete, scheduled for 2012, then MWA will be pumping groundwater and a power outage could affect the water supply from the R^3 project but local retailers will still have their own production wells to rely on.

Each of the retailers that will be served by the R^3 project will take delivery at a regulating reservoir. The MWA has stressed to the retailers that R^3 cannot be their primary source of supply or available for peaking – they will have to maintain a primary system of wells and associated storage separate from R^3.

For the retailer water agencies, all of the water systems have some form of storage as both regulating reservoirs and emergency supply. MWA does not monitor the various pressure zones that the retailers operate and the storage that they actually have available to them. The public would be asked to reduce consumption to minimum health and safety levels, extending the supply to seven days. This would provide sufficient time to restore a significant amount of groundwater production. After the groundwater supply is restored, the pumping capacity of the retail purveyors could meet the reduced demand until such time that the imported water supply was reestablished. Updates on the water situation would be made as often as necessary.

The area's water sources are generally of good quality, and no insurmountable problems resulting from industrial or agricultural contamination are foreseen. If contamination did result from a toxic spill or similar accident, the contamination would be isolated and should not significantly impact the total water supply. In addition, such an event would be addressed in the retailers' emergency response plan.

8.4.2 SWP Emergency Outage Scenarios

In addition to earthquakes, the SWP could experience other emergency outage scenarios. Past examples include slippage of aqueduct side panels into the California Aqueduct near Patterson in the mid-1990s, the Arroyo Pasajero flood event in 1995 (which also destroyed part of Interstate 5 near Los Banos), and various subsidence repairs needed along the East Branch of the Aqueduct since the 1980s. All these outages were short-term in nature (on the order of weeks), and DWR's Operations and Maintenance Division worked diligently to devise methods to keep the Aqueduct in operation while repairs were made. Thus, the SWP contractors experienced no interruption in deliveries.

One of the SWP's important design engineering features is the ability to isolate parts of the system. The Aqueduct is divided into "pools." Thus, if one reservoir or portion of the California Aqueduct is damaged in some way, other portions of the system can still remain in operation. The primary SWP facilities are shown on Figure 8-1.

Other events could result in significant outages and potential interruption of service. Examples of possible nature-caused events include a levee breach in the Delta near the Harvey O. Banks Pumping Plant, a flood or earthquake event that severely damaged the Aqueduct along its San Joaquin Valley traverse, or an earthquake event along either the West or East Branches. Such events could impact some or all SWP contractors south of the Delta.

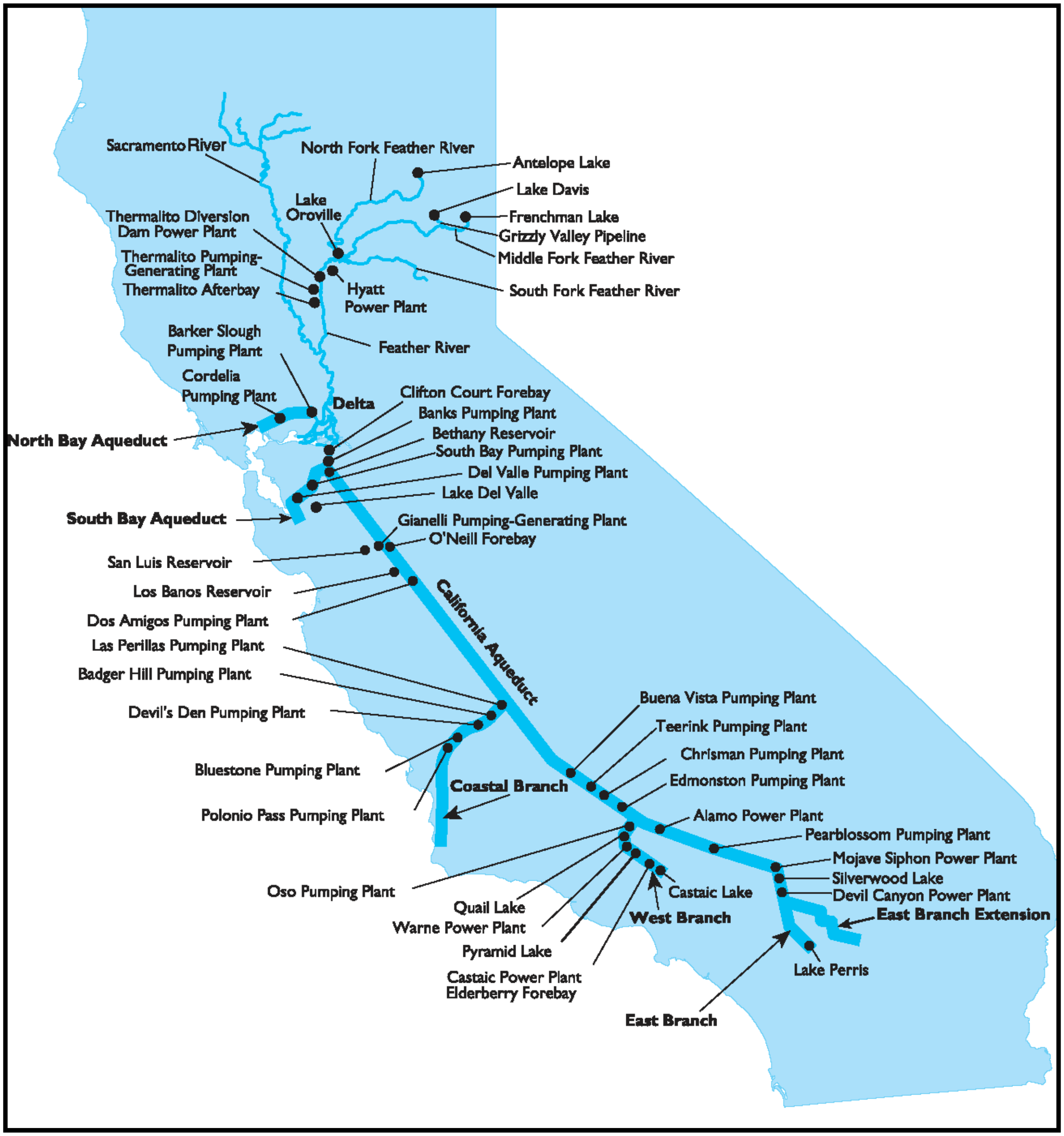
The response of DWR, MWA, and other SWP contractors to such events would be highly dependent on the type and location of any such event. In typical SWP operations, water flowing through the Delta is diverted at the SWP's main pumping facility, located in the southern Delta, and is pumped into the California Aqueduct. During the relatively heavier runoff period in the winter and early spring, Delta diversions generally exceed SWP contractor demands, and the excess is stored in San Luis Reservoir. Storage in SWP aqueduct terminal reservoirs, such as Pyramid and Castaic Lakes, is also refilled during this period. During the summer and fall, when diversions from the Delta are generally more limited and less than contractor demands, releases from San Luis Reservoir are used to make up the difference in deliveries to contractors. The SWP share of maximum storage capacity at San Luis Reservoir is 1,062,000 af.

MWA receives its SWP deliveries through the East Branch of the California Aqueduct. The other contractors receiving deliveries from the East Branch are Metropolitan Water District, Antelope Valley-East Kern Water Agency, Palmdale Water District, Crestline-Lake Arrowhead Water Agency, Desert Water Agency, San Gabriel Valley Municipal Water District, San Bernardino Valley Municipal Water District, San Gorgonio Pass Water Agency, and Coachella Valley Water District. The East Branch has two terminal reservoirs, Silverwood Lake and Lake Perris, which were designed to provide emergency storage and regulatory storage (i.e., storage to help meet peak summer deliveries) for several of the East Branch contractors. However, MWA does not have contract rights to storage capacity in those reservoirs.

In addition to SWP storage south of the Delta in San Luis and the terminal reservoirs, a number of contractors have stored water in groundwater banking programs in the San Joaquin Valley, and many also have surface and groundwater storage within their own service areas.

Three scenarios that could impact the delivery to MWA of its SWP supply or other supplies delivered to it through the California Aqueduct are described below. For each of these scenarios, it was assumed that an outage of six months could occur. MWA's ability to meet demands during the worst of these scenarios is presented following the scenario descriptions.

FIGURE 8-1
PRIMARY SWP FACILITIES



Scenario 1: Levee Breach Near Banks Pumping Plant

As demonstrated by the June 2004 Jones Tract levee breach and previous levee breaks, the Delta's levee system is fragile. The SWP's main pumping facility, Banks Pumping Plant, is located in the southern Delta. Should a major levee in the Delta near these facilities fail catastrophically, salt water from the eastern portions of San Francisco Bay would flow into the Delta, displacing the fresh water runoff that supplies the SWP. All pumping from the Delta would be disrupted until water quality conditions stabilized and returned to pre-breach conditions. The re-freshening of Delta water quality would require large amounts of additional Delta inflows, which might not be immediately available, depending on the timing of the levee breach. The Jones Tract repairs took several week s to accomplish and months to complete; a more severe breach could take much longer, during which time pumping from the Delta might not be available on a regular basis.

Assuming that the Banks Pumping Plant would be out of service for six months, DWR could continue making at least some SWP deliveries to all southern California contractors from water stored in San Luis Reservoir. The water available for such deliveries would be dependent on the storage in San Luis Reservoir at the time the outage occurred and could be minimal if it occurred in the late summer or early fall when San Luis Reservoir storage is typically low.

Scenario 2: Complete Disruption of the California Aqueduct in the San Joaquin Valley

The 1995 flood event at Arroyo Pasajero demonstrated vulnerabilities of the California Aqueduct (the portion that traverses the San Joaquin Valley from San Luis Reservoir to Edmonston Pumping Plant). Should a similar flood event or an earthquake damage this portion of the aqueduct, deliveries from San Luis Reservoir could be interrupted for a period of time. DWR has informed the SWP contractors that a four-month outage could be expected in such an event. MWA's assumption is a six-month outage.

Arroyo Pasajero is located downstream of San Luis Reservoir and upstream of the primary groundwater banking programs in the San Joaquin Valley. Assuming an outage at a location near Arroyo Pasajero that resulted in the California Aqueduct being out of service for six months, supplies from San Luis Reservoir would not be available to those SWP contractors located downstream of that point. This would include MWA.

Scenario 3: Complete Disruption of the East Branch of the California Aqueduct

The East Branch of the California Aqueduct begins at a bifurcation of the Aqueduct south of Edmonston Pumping Plant, which pumps SWP water through and across the Tehachapi Mountains. From the point of bifurcation, the East Branch is an open canal. Water is conveyed through the canal to the Pearblossom Pumping Plant, where the first of four turnouts to the MWA service area is located at the Sheep Creek, which is essentially a stub out in Phelan area and not used at this time. The second is the Mojave River turnout, also known as the White Road Siphon, located north of Lake Silverwood. The third turnout is new and is the Highway 395 turnout which is being developed for the Oro Grande Wash Recharge Project. The fourth and last turnout is known as the Morongo Siphon and was constructed to supply Morongo Basin Pipeline which releases SWP water in the Alto Subarea near the City of Hesperia and to Yucca Valley. In addition, occasionally, MWA takes water delivery from Cedar Springs Dam at Silverwood Lake, for groundwater recharge. Figure 3-3 shows the location of the MWA turnouts.

If a major earthquake (an event similar to or greater than the 1994 Northridge earthquake) were to damage a portion of the East Branch, deliveries could be interrupted. The exact location of such damage along the East Branch would be key to determining emergency operations by DWR and the East Branch SWP contractors. For this scenario, it was assumed that the East Branch would suffer a single-location break and deliveries of SWP water from north of the Tehachapi Mountains or of contractor water stored in groundwater banking programs in the San Joaquin Valley would not be available. It was also assumed that Silverwood and Perris dams would not be damaged by the event and that water in Silverwood and Perris Lakes would be available to the three East Branch SWP contractors that have capacity rights in them.

In any of these three SWP emergency outage scenarios, DWR and the SWP contractors would coordinate operations to minimize supply disruptions. Depending on the particular outage scenario or outage location, some or all of the SWP contractors south of the Delta might be affected. But even among those contractors, potential impacts would differ given each contractor's specific mix of other supplies and available storage. During past SWP outages, the SWP contractors have worked cooperatively to minimize supply impacts among all contractors. Past examples of such cooperation have included certain SWP contractors agreeing to rely more heavily on alternate supplies, allowing more of the outage-limited SWP supply to be delivered to other contractors; and exchanges among SWP contractors, allowing delivery of one contractor's SWP or other water to another contractor, with that water being returned after the outage was over.

Of these three SWP outage scenarios, the East Branch outage scenario presents the worst-case scenario for MWA. In this scenario, MWA would rely solely on local supplies. An assessment of the supplies available to meet demands in MWA's service area during a six-month East Branch outage and the additional levels of conservation projected to be needed are presented in Table 8-2 for 2010 through 2035.

During an outage, the local supplies available would consist of groundwater. It was assumed that local well production would be unimpaired by the outage and that the outage would occur during a year when average/normal supplies would be available. Note that adequate well and aquifer capacity exists to pump at levels higher than those assumed in this assessment, particularly during a temporary period such as an outage. However, to be conservative, groundwater production was assumed to be one-half of annual supplies.

Table 8-2 shows that, for a six-month emergency outage, MWA is in an excellent position to handle the emergency outage due to all of the water banking it has been storing over the last several years and the long term buffering capacity of local aquifers. Currently, MWA has 95,454 acre-feet banked in groundwater storage, not including water banked under individual retailer storage accounts. For the six months, no additional conservation would be required. Additionally, it is likely that potential cooperation among SWP contractors and/or temporarily increased retail purveyor groundwater production during such an outage could increase supplies so that lower amounts, or even no amount, of additional conservation would be needed and the banked water could be saved for future emergency. In an emergency such as this, these levels of additional conservation would likely be achieved through voluntary conservation, but mandatory measures would be enacted by the retailers if needed.

TABLE 8-2
PROJECTED SUPPLIES AND DEMANDS DURING
SIX-MONTH DISRUPTION OF IMPORTED SUPPLY SYSTEM

Water Supply Source	2010	2015	2020	2025	2030	2035
Local Supplies[a]						
Existing Supplies[b]						
Net Natural Supply	27,023	27,023	27,023	27,023	27,023	27,023
Agricultural Depletion from Storage	5,213	5,213	5,213	5,213	5,213	5,213
Return Flow	31,110	33,883	35,677	38,431	41,182	43,929
Wastewater Import	2,652	2,699	2,746	2,895	3,044	3,193
Recharge Banking Projects[c]	9,945	12,763	14,589	17,308	20,023	22,733
Total Existing Local Supplies	**75,943**	**81,581**	**85,248**	**90,870**	**96,485**	**102,091**
Demands						
Total Estimated Demands[d]	***75,943***	***81,581***	***85,248***	***90,870***	***96,485***	***102,091***

Notes:
(a) Assumes complete disruption in SWP supplies and in deliveries through the California Aqueduct for six months.
(b) See Table 3-1. Annual supplies from Table 3-1 have been divided by 2 to represent 6 months of supply.
(c) See Table 3-13 for MWA's Groundwater storage accounts as of December 31, 2010. This does not include any retailers' stored water.
(d) Demands are assumed to be one-half of average/normal year demands, assuming "moderate" conservation (see Table 2-3).

8.4.3 Regional Power Outage Scenarios

For a major emergency such as an earthquake, Southern California Edison (Edison) has declared that in the event of an outage, power would be restored within a 24 hour period. For example, following the 1994 Northridge earthquake, Edison was able to restore power within 19 hours. Edison experienced extensive damage to several key power stations, yet was still able to recover within a 24-hour timeframe.

8.5 Mandatory Prohibitions During Shortages

As explained earlier, MWA is not a direct purveyor of retail water supplies and does not have any emergency powers or the authority to implement water shortage plans within its boundaries. It relies instead on efforts of the individual cities and water agencies. However, MWA does have an Ordinance No. 9 that allows the Agency to sell and deliver SWP water to these entities. MWA Ordinance 9 requires customers taking direct delivery of SWP water from MWA to maintain a backup supply in the event of outages or shortages in supply from the SWP. MWA informs customers under Ordinance 9 that supplies are variable and interruptible, with no guarantee of a specified delivery quantity. Ordinance 9 is MWA's only authority to reduce water supplies to its customers during shortages. However, customers under ordinance 9 represent only a small portion of the overall water use within the MWA service area, with a majority of water users receiving water supply from groundwater production. Highlights of the Ordinance (Appendix J) are discussed below:

- Each application shall contain such information as is necessary to assure the Board of MWA that the application is for service of a wholesale nature and that the MWA will not thereby become subject to the obligations of a retail water purveyor providing direct retail service to consumers. In the event the Applicant seeks a waiver of such requirement, the application shall so state and there shall be attached thereto a statement of the reasons for seeking a waiver any documentary evidence in support thereof.

- Each application shall contain information indicating that the Applicant is capable of sustaining its service requirements from independent sources during the period of any interruption or curtailment of service from Agency facilities. In no instance shall MWA be the sole source of water supply to any water retailer for any development within the retailer's service area.

- In any year in which there may occur a shortage in available supply of SWP, the MWA shall reduce the delivery of SWP proportionately to all parties to which the MWA supplies water, including Improvement District M of Division 2 (entities that lie within the greater Morongo Basin/Johnson Valley Area ("Morongo Area") and take water from the Morongo Basin Pipeline). It is provided that the MWA may apportion available SWP on some other basis if such is required to meet minimum demands for domestic supply, fire protection, fire suppression or sanitation to a specific area of the Agency during the year. No vested rights are obtained by the Customer upon the sale and delivery of water apportioned by this Section nor are any such rights inferred by virtue of an MWA decision to provide water to a Customer in a specific year.

8.6 Consumptive Reduction Methods During Restrictions

As explained in the previous section, MWA does not have the power to implement mandatory prohibitions during water supply shortages, with the exception of customers receiving direct SWP supplies under MWA Ordinance No. 9.

8.7 Penalties for Excessive Use

The penalties for excessive water use are stated in the text of the Judgment for the Mojave Groundwater Basin and the text of the Warren Valley Judgment for the Warren Groundwater Basin. The Court has continuing jurisdiction for the Mojave Basin Area Judgment and water producers in noncompliance can readily be taken to court.

8.8 Financial Impacts of Actions During Shortages

There will be no financial impacts to MWA during a water shortage because of the available water that is banked in the MWA service area and able to be sold to retailers.

8.9 Water Shortage Contingency Resolution

As explained in Section 8.5, the only ordinance or resolution that MWA has for assisting in water shortages is Ordinance 9, which only deals with a small portion of the water users within MWA service area.

8.10 Mechanism to Determine Reductions in Water Use

As explained in Section 8.5, MWA does not have the power to implement mandatory prohibitions during water supply shortages, with the exception of customers receiving direct SWP supplies under MWA Ordinance No. 9.

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