Mojave IRWM Plan
Integrated Regional Water Management Plan

Final

Mojave Region

Integrated Regional Water Management Plan

Photos Courtesy of Jim Quigg, Eyerly Dickerson, and Jerry Laursen

Kennedy/Jenks Consultants

June 2014

Kennedy/Jenks Consultants

2775 North Ventura Road, Suite 100
Oxnard, California 93036
805-973-5700
805-973-1440 (Fax)

Final Mojave Integrated Regional Water Management Plan

June 2014

Prepared for

Mojave Water Agency
22450 Headquarters Drive
Apple Valley, CA 92345

K/J Project No. 1389002*00

Table of Contents

Table of Contents (cont'd)

Table of Contents (cont'd)

Table of Contents (cont'd)

Table of Contents (cont'd)

Table of Contents (cont'd)

Table of Contents (cont'd)

List of Tables

List of Figures

List of Appendices

Volume II - Appendices

List of Acronyms

ACEC	Area of Critical Environmental Concern
af	acre-feet
afy	acre-feet per year
APG	Adaptation Planning Guide
ARB	California Air Resources Board
AWAC	Alliance for Water Awareness and Conservation
AWWA	American Water Works Association
BAP	Base Annual Production
BDCP	Bay Delta Conservation Plan
BDVWA	Bighorn-Desert View Water Agency
BLM	Bureau of Land Management
BMP	Best Management Practices
CalEMA	California Emergency Management Agency
CalEPA	California Environmental Protection Agency
CAS	Climate Adaptation Strategy
CASGEM	California Statewide Groundwater Elevation Monitoring
CC	Coordinating Committee
CDCA	California Desert Conservation Area
CDFW	California Department of Fish and Wildlife
CDP	Census Designated Place
CDPH	California Department of Public Health
CEC	California Energy Commission
CEDEN	California Environmental Data Exchange Network
CEQA	California Environmental Quality Act
CESA	California Endangered Species Act
CO_2e	carbon dioxide equivalent
cfs	cubic feet per second
CII	Commercial Industrial and Institutional
CIP	Capital Improvement Plan
CLAWA	Crestline-Lake Arrowhead Water Agency
CNDDB	California Natural Diversity Database
COC	Contaminant of Concerns
CPUC	California Public Utilities Commission
CSA	County Service Area
CSD	Community Services District
CUWCC	California Urban Water Conservation Council
CVP	Central Valley Project
CWA	Clean Water Act
CWC	California Water Code
CWP	California Water Plan
DAC	Disadvantaged Community
DBP	Disinfection By-Product
DLP	Deer Lodge Park
DMM	Demand Management Measure
DRWD	Dudley Ridge Water District

List of Acronyms (cont'd)

DWMA	Desert Wildlife Management Area
DWP	Drinking Water Program
DWR	California Department of Water Resources
DWSAP	Drinking Water Source Assessment Protection
EJ	Environmental Justice
ESA	Endangered Species Act
ETo	Evapotranspiration
FAST	Flood Area Safety Taskforce
FEMA	Federal Emergency Management Agency
FESA	Federal Endangered Species Act
FOB	Field Operations Branch
FPA	Free Production Allowance
GAMA	Groundwater Ambient Monitoring and Assessment
GCM	Global Climate Model
GHG	Greenhouse Gas
GIS	Geographic Information System
GPCD	Gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
GWMP	Groundwater Management Plan
GPP	Groundwater Protection Plan
GRI	Get Real Index
GSWC	Golden State Water Company
HDWD	Hi-Desert Water District
HECW	High-efficiency clothes washing machines
HET	High Efficiency Toilets
IOU	Investor Owned Utility
IPCC	Intergovernmental Panel on Climate Change
IRWM	Integrated Regional Water Management
IST	Implementation Support Team
IWM	Integrated Water Management
JBWD	Joshua Basin Water District
JPA	Joint Powers Agreement
LACSD	Lake Arrowhead Community Services District
LAMP	Local Agency Management Plan
LCER	Lewis Center for Education and Research
LID	Low Impact Development
LMP	Land Management Plan
MBA	Mojave Basin Area
MCL	maximum contaminant level
MCLB	Marine Corps Logistics Base
MDAQMD	Mojave Desert Air Quality Management District
MDLT	Mojave Desert Land Trust
MDRCD	Mojave Desert Resource Conservation District
Metropolitan	Metropolitan Water District of Southern California

List of Acronyms (cont'd)

MG	million gallons
MGD	million gallons per day
mg/L	milligram per liter
MHI	Median Household Income
MHR	Mountain High Ski Resort
MOU	Memorandum of Understanding
MRWG	Mojave River Watershed Group
MS4	Municipal Separate Storm Sewer System
MSL	mean sea level
$MTCO_2$	metric tons carbon dioxide
$MTCO_2e$	metric tons carbon dioxide equivalent
MWA	Mojave Water Agency
NAD	North American Datum
NRCS	Natural Resources Conservation Service
NEPA	National Environmental Policy Act
NFIP	National Flood Insurance Program
NGO	Non-governmental organization
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint source
NTU	Nephelometric Turbidity Unit
O&M	Operations and Maintenance
PG&E	Pacific Gas and Electric
POTW	Publicly Owned Treatment Works
ppm	parts per million
PSY	Production Safe Yield
RAP	Region Acceptance Process
RMS	Resource Management Strategy
RTP	Regional Transportation Plan
RWMG	Regional Water Management Group
RWMP	Regional Water Management Plan
RWQCB	Regional Water Quality Control Board
SB	Senate Bill
SCAG	Southern California Association of Governments
SEA	Significant Ecological Area
SFR	Single-Family Residential
SMART	Specific, Measurable, Attainable, Relevant, Time-based
SMCL	Secondary Maximum Contaminant Level
SNMP	Salt and Nutrient Management Plan
SWAMP	Surface Water Ambient Monitoring Program
SWMP	Stormwater Management Program
SWP	State Water Project
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board

List of Acronyms (cont'd)

TAC	Technical Advisory Committee
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Load
TOC	Total Organic Carbon
TPWD	Twentynine Palms Water District
TZ	Transition Zone
US ACOE	US Army Corps of Engineers
USBR	US Department of the Interior Bureau of Reclamation
USCB	US Census Bureau
USDA	US Department of Agriculture
USEPA	US Environmental Protection Agency
USFS	US Forest Service
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
UWMP	Urban Water Management Plan
VALLEY DISTRICT	San Bernardino Valley Municipal Water District
VVWRA	Victor Valley Wastewater Reclamation Authority
WDR	Waste Discharge Requirement
WRDA	Water Resources Development Act
WRP	Water Reclamation Plant
WSA	Water Supply Assessment
WTP	Water Treatment Plant
WWMP	Wastewater Master Plan
WWTP	Wastewater Treatment Plant

Section 1: Introduction

1.1 Background

The Mojave Integrated Regional Water Management Plan (IRWM Plan, Plan) is a product of a long-term collaborative stakeholder process that began with the development of the first IRWM Plan adopted in 2005. This IRWM Plan updates and expands upon the original IRWM Plan, documents progress towards meeting IRWM Plan goals, identifies current regional water resource management needs and issues, and evaluates strategies for addressing the Region's challenges.

This Mojave IRWM Plan update was developed by a Project Team with broad stakeholder input. The Project Team included participants from the Coordinating Committee (described in Section 1.1.5), staff from members of the Regional Water Management Group (RWMG) (described in Section 1.1.4), volunteers from the Region, and the technical, public outreach, and facilitation consultants (Consultant Team).

This section provides an introduction to the Region covered by this IRWM Plan, the Stakeholder Group participation in the development of Plan, and the development, organization and adoption of the Plan.

1.1.1 Formation of the IRWM Region

The IRWM Region currently encompasses the entire Mojave Water Agency (MWA) service area boundaries in addition to recently included expansion areas. The MWA service area boundaries were originally established in 1959 for the purpose of improved management of declining groundwater levels in the Mojave Basin Area, El Mirage Basin, and Lucerne Valley area. Later annexation in 1965 expanded the area to encompass Johnson Valley and Morongo Basin areas as well.

During the 2009 Region Acceptance Process, the California Department of Water Resources (DWR) strongly suggested expansion of the Mojave IRWM Region boundaries to include the upper and lower portions of the Mojave River Watershed. Based on these suggestions, four areas adjacent to the previously established IRWM Planning Region were considered for inclusion. These areas include the:

- Twentynine Palms Area,
- Upper Mojave River Watershed Area,
- Afton Canyon Area (Lower Mojave River Watershed Area), and
- Wrightwood Area.

After meetings to coordinate with the potential stakeholders within these areas, as well as discussions with the existing Mojave IRWM Region stakeholders at their regularly scheduled meetings, these four areas were included in the Region's boundaries for the Mojave IRWM Plan during the 2014 update process. The expansion areas are shown on Figure 1-3. Also, Appendix A.1

contains a letter that the RWMG submitted to DWR on November 21, 2013 discussing the planned changes to the IRWM Plan Region boundaries.

The update of the IRWM Plan was already in progress and certain sections (including Sections 2 and 3) of the IRWM Plan already in draft form when the November 2013 expansion decision was finalized. It was decided that each expansion area would have a separate Section 2 and Section 3, rather than amending the draft work that had already been completed and reviewed by the participants. Therefore, in the following Section 2: Region Description and Section 3: Water Supply and Water Demand, the majority of each section discusses the area within the MWA service area (or boundary of the Region before the expansion areas were added). There are four subsections at the end of each of the two Sections – one for each expansion area – that discuss each expansion area's region description or water supply and water demand.

For the remaining sections (Section 4 - Section 12) of the IRWM Plan, all sections refer to the entire IRWM Plan Region (or the *Mojave Region*), which includes the four expansion areas.

Throughout the rest of this IRWM Plan document, the term *MWA service area* is used to reference only the area within the *MWA service area,* no expansion areas included. For example, the *MWA service area* is used in Section 2.5.1 when population is being discussed. Later in Section 2, all four expansion areas have separate subsections that address their own expansion area population. The term *Mojave Region* is used to refer to the area that includes the MWA service area and the 4 expansion areas. For example, Section 3.4 discusses water quality for the entire Mojave River Watershed, which includes the 4 expansion areas, so these subsections use the term *Mojave Region*.

1.1.2 Regional Features

Mojave River

The Mojave Region is a hydrologically diverse area covering over 5,400 square miles in the California High Desert, in San Bernardino County (see Figure 1-1). The IRWM Region includes portions of both the South Lahontan and Colorado River Hydrologic Regions, as defined by the California Department of Water Resources (DWR) *Draft California Water Plan, Bulletin 160* (DWR 2013a).

As discussed above, the Region now encompasses the entire Mojave River Watershed. The Mojave River Area, making up the larger of the Region's two major surface water drainage features, drains an area of 3,800 square miles. The Morongo Basin/Johnson Valley Area, the Region's smaller drainage area, in contrast has no sizeable river, but rather consists of small ephemeral streams that drain from surrounding mountains into terminal dry lakes (MWA 2004).

In addition to major surface water features, the Region overlies portions or all of 36 local groundwater basins, which are experiencing general declines in water levels. Most of the Mojave Region groundwater is covered by two completed adjudications, relating to the major basins: the Mojave Basin Judgment and the Warren Valley Basin Adjudication, located within the Morongo Basin/Johnson Valley Area ("Morongo").

Figure 1-1
Mojave Region Vicinity Map

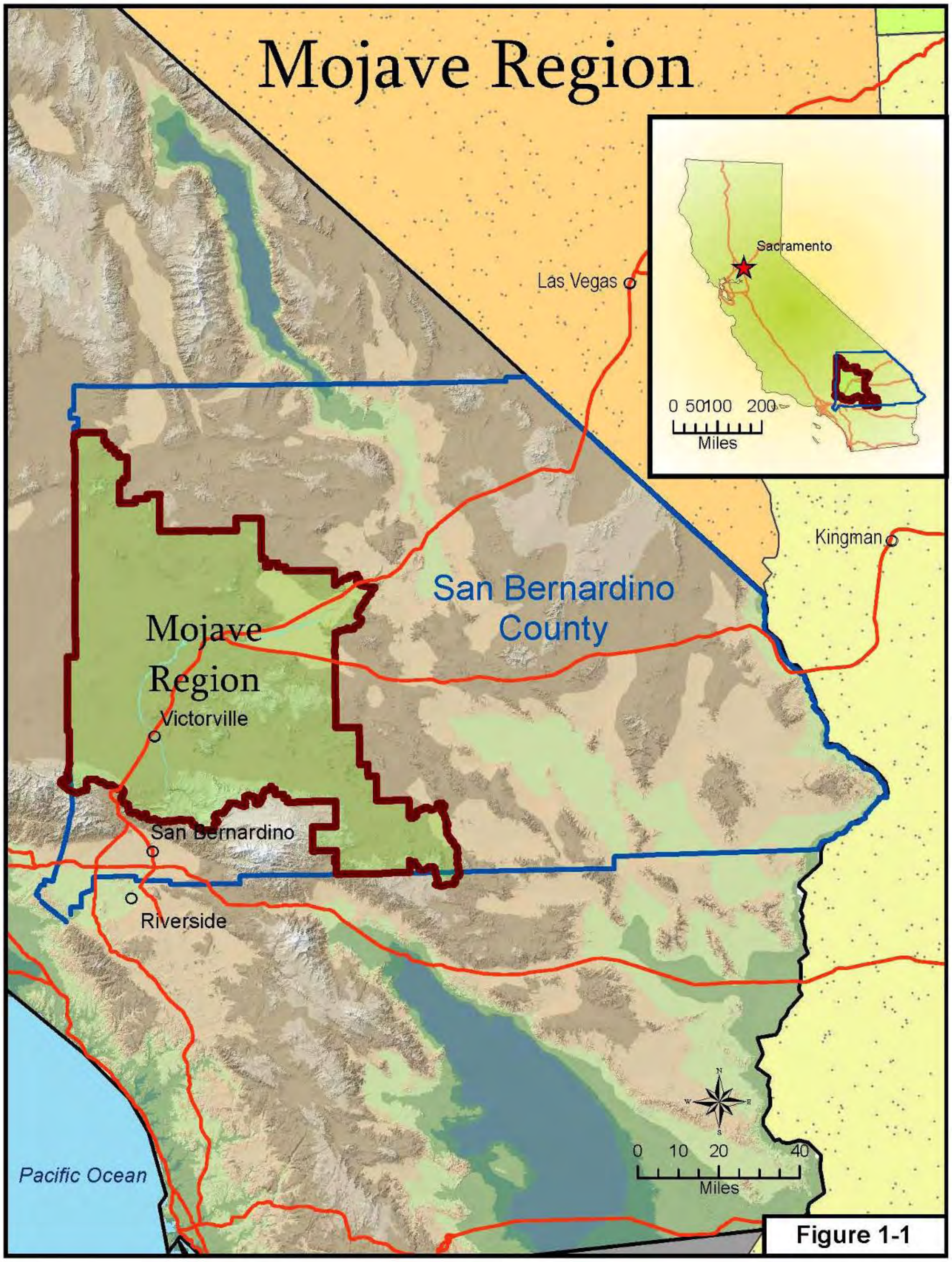


Figure 1-2
Mojave Region Adjudicated Boundary and Subareas

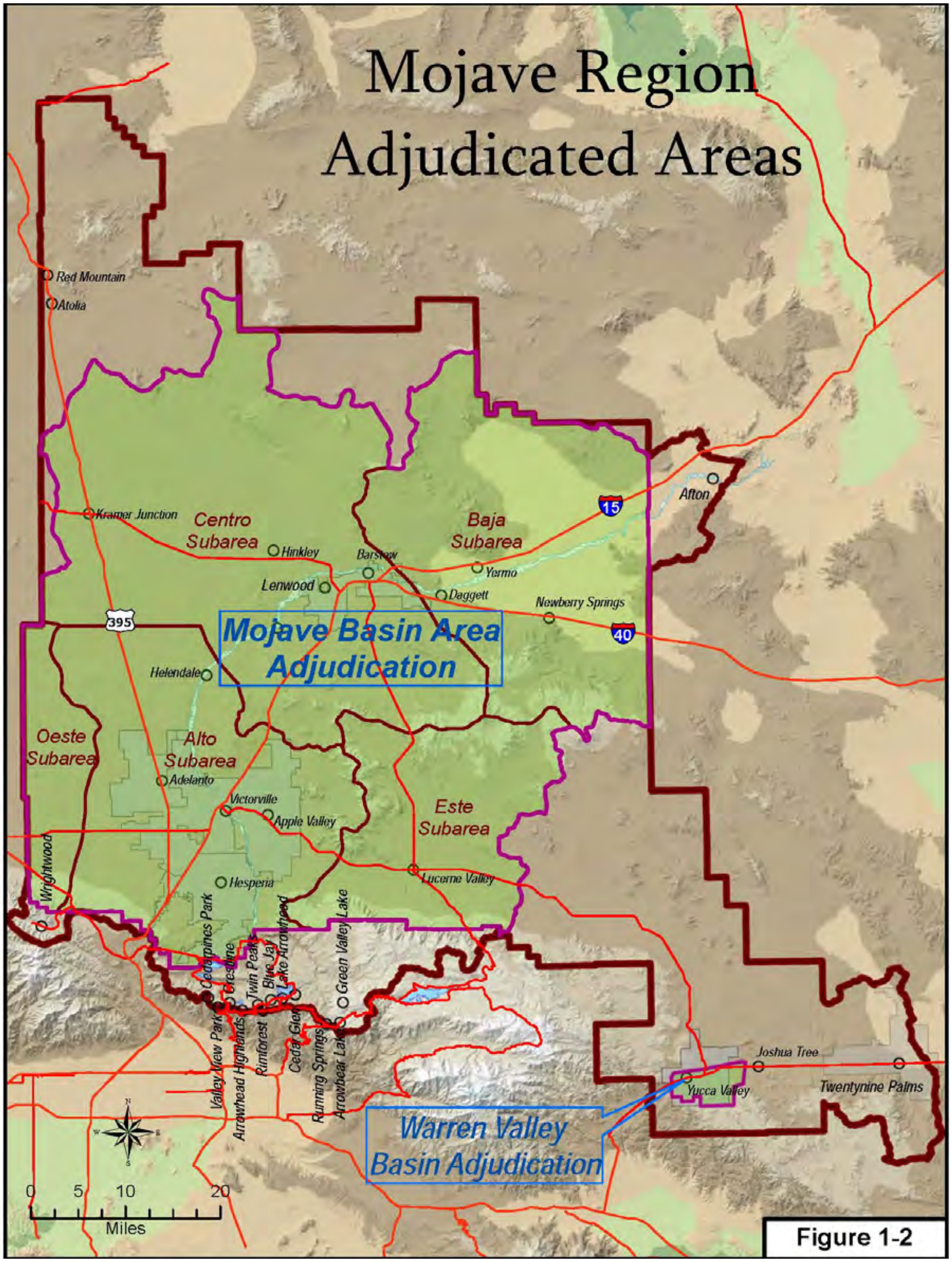
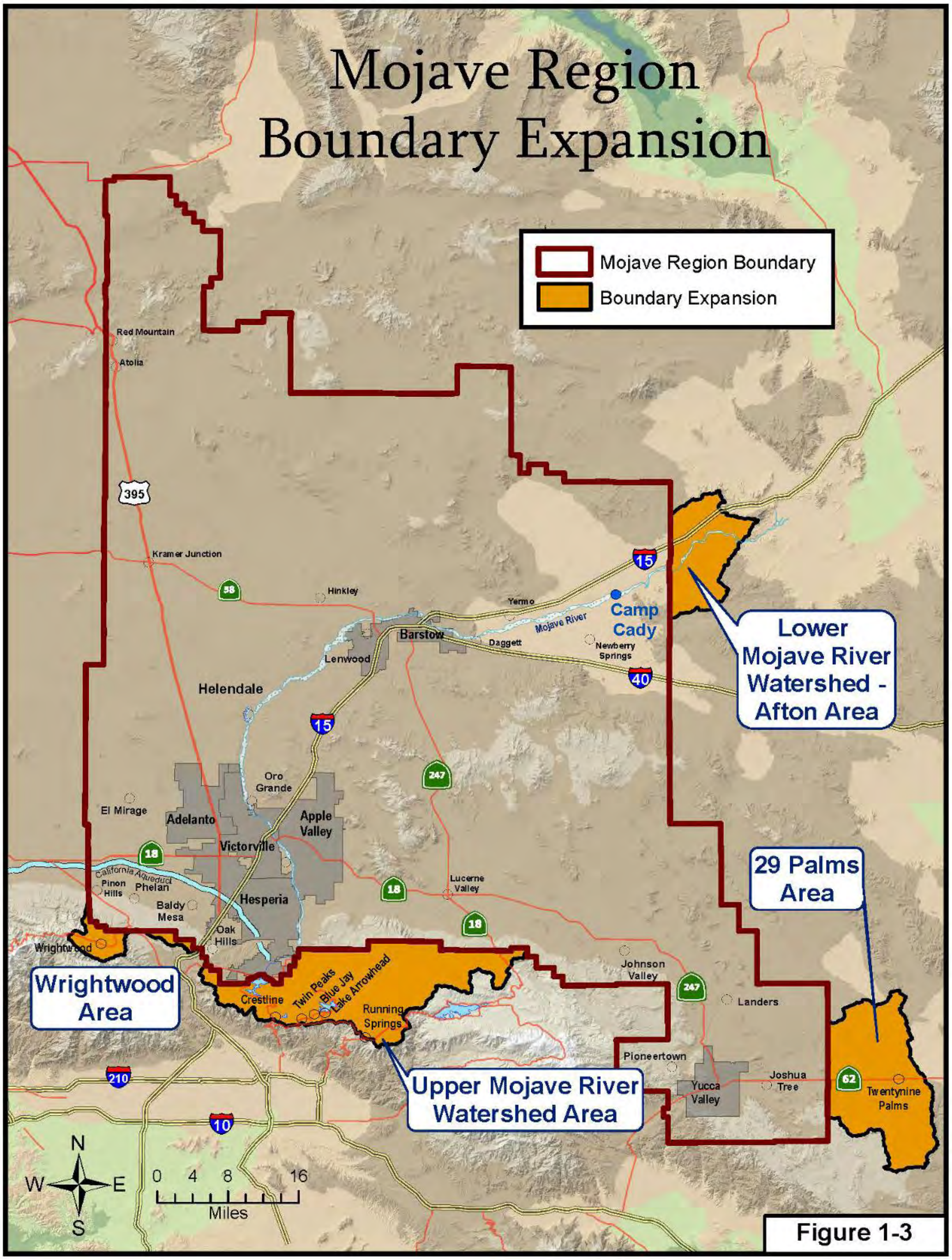


Figure 1-3
Mojave Region Boundary Expansion



For water management purposes, the Mojave Region is generally separated into six management areas, including the five "subareas" of the Mojave River Watershed and associated groundwater basins (Alto, Baja, Centro, Este, and Oeste) and the Morongo Basin/Johnson Valley Area (referred to throughout this document as "Morongo" or the "Morongo Area"). The five subareas were defined under the Mojave Basin Judgment and are referred to as the "Mojave River Groundwater Basin", "Mojave River Area" or "Mojave Basin Area" in this document. Section 2.6.2.3 describes the adjudications within the Region, and depicts the management areas and adjudicated areas within the Region.

It should be noted that the Helendale Fault splits the Este Subarea into two (2) separate subbasins (see Figure 2-1). The southwest portion of the Este subbasin is part of the larger Mojave River Groundwater Basin while the bulk of the Este subbasin lies to the northeast of the Helendale Fault and is part of the Morongo Groundwater Basin. While the northwest portion of the Este subbasin is in the Morongo Groundwater Basin, it is not included in the "Morongo Area" (see Figure 2-8) and it consists of small ephemeral streams that drain from surrounding mountains into terminal dry lakes. Therefore, the subbasin creates an "island effect" due to the hydrogeologic conditions.

Resulting in part from the diversity of water resource challenges and the geographic expanse of the IRWM Region, numerous groups are participating in IRWM Plan development and its on-going implementation. The Mojave IRWM Region encompasses 58 municipal water purveyors with authority over water supply and management in the Region, who share a common interest in enhancing water resource management to improve the reliability and sustainability of available resources (MWA 2009). These water purveyors, along with other numerous public agencies and community groups, are part of the collaborative Mojave IRWM Planning process.

1.1.3 Primary Focal Points for the IRWM Plan

This IRWM Plan was developed to address the standards outlined in the *Integrated Regional Water Management Guidelines for Proposition 84 and 1E (*2012 Guidelines*)* (DWR 2012a) while focusing on the Region's key water management issues and challenges that have been re-evaluated as part of this IRWM Plan update.

As a result, this IRWM Plan integrates components related to all aspects of water management in the Region, including, but not limited to, water supply, water quality, wastewater, recycled water, water conservation, storm water/flood management, watershed planning, climate change, habitat protection and restoration, and stakeholder and public outreach.

During the IRWM Plan update process, fourteen objectives were developed that reflect the broad range of current challenges and opportunities related to integrated water management in the Mojave Region. These objectives, described in detail in Section 4, represent the foundational intent of this IRWM Plan.

1.1.4 Regional Water Management Group

The Mojave RWMG was formed through a Memorandum of Understanding (MOU) among the following agencies:

- Mojave Water Agency

- Victor Valley Wastewater Reclamation Authority
- MWA Technical Advisory Committee
- Mojave Desert Resource Conservation District
- Morongo Basin Pipeline Commission

Mojave's RWMG meets the definition of a RWMG as defined by CWC Section 10539, which states a "RWMG means a group in which three or more local agencies, at least two of which have statutory authority over water supply or water management…"

As stated in the MOU (Appendix A.2), these agencies joined together to develop an IRWM Plan that will:

- Foster coordination, collaboration and communication between agencies responsible for water-related items and interested stakeholders to achieve greater efficiencies, to provide for integration of projects, enhance public services and build public support for vital projects.

- Assist in the development of a comprehensive integrated regional water management plan to facilitate regional cooperation to benefit water supply reliability, water recycling, water conservation, water quality improvement, storm water capture and management, flood management, and environmental and habitat protection and improvements.

In 2009, MWA submitted a Region Acceptance Process (RAP) application for the Mojave IRWM Region, which falls within the Proposition 84 South Lahontan Funding Region and the Colorado River Funding Region (the Mojave Region overlies two funding regions). Following approval of the Mojave Region, MWA began planning to update the Mojave IRWM Plan. This Plan is the culmination of the stakeholder driven process overseen and supported by the RWMG.

The authority and role of each of the public agencies that comprise the RWMG is discussed below.

1.1.4.1 Mojave Water Agency

Formed in 1960 in response to declining groundwater levels and alongside plans for development of the State Water Project, MWA is a regional wholesale provider responsible for managing groundwater resources and for ensuring a reliable water supply within its service area boundaries for present and future beneficial needs. MWA is one of 29 State Water Project contractors permitted to deliver water from the California Aqueduct and MWA imports water from this source as needed. MWA strategically invests in infrastructure, groundwater banking, and conservation to ensure a sustainable water supply. MWA is also responsible for implementing the Mojave Basin Area Judgment, which by court action, adjudicated the rights to produce water from the available natural water supply to better manage groundwater supplies.

MWA has had a leadership role in the development of the Mojave IRWM Plan and organized the planning group which developed the 2004 Mojave IRWM Plan (also known as the 2004 Regional

Water Management Plan (2004 RWMP)) and developed the RAP application. MWA has invited the Stakeholder Group to participate in the planning meetings.

1.1.4.2 Victor Valley Wastewater Reclamation Authority

The Victor Valley Wastewater Reclamation Authority (VVWRA) was originally formed by MWA to help meet the requirements of the federal Clean Water Act and provide wastewater treatment for the growing area. The original treatment plant (Regional 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 and serves portions of Victorville, Hesperia, Apple Valley, and San Bernardino County Service Areas (CSA) 42 and 64.

The Regional Treatment Plant, which has a capacity of 18.0 MGD, 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 Lahontan Regional Water Quality Control Board (RWQCB, 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 as surface water to the Mojave River bed.

1.1.4.3 MWA Technical Advisory Committee

The Technical Advisory Committee to the Mojave Water Agency (TAC) is an independent, voluntary group of water purveyors, pumpers, and other interested parties located within MWA's service area boundaries. The TAC serves as the advisory panel for MWA and provides critical input, including helping to define key issues related to potential water management activities in the Region. The TAC provides a forum for information sharing and discussion of water management issues and solutions and serves as the primary venue through which project ideas will be articulated, evaluated, and prioritized.

The TAC meets bi-monthly in a public forum to discuss common concerns and acts to assist the MWA in pursuit of its legal objectives. For the IRWM Plan, the TAC meeting times were used as the venue to reach the public, because these meetings were already established as being stakeholder meetings for MWA and the Region and it seemed natural and obvious to extend these meetings for the purpose of Plan outreach.

A complete list of entities comprising the Technical Advisory Committee in 2013 is included in Appendix A.3.

1.1.4.4 Mojave Desert Resource Conservation District

Established in March 1951, the Mojave Desert Resource Conservation District (MDRCD) is a non-regulatory special district – operating with the US Department of Agriculture (USDA)/ Natural Resources Conservation Service (NRCS) and other partners - committed to the development of a private land stewardship ethic that promotes long-term sustainability of the Region's rich and diverse natural resource heritage. The MDRCD is bounded to the north by Inyo County, to the south by the San Gabriel/San Bernardino Mountains Mojave Desert watershed boundaries and Riverside

County at its southeastern portion, to the east by the Arizona and Nevada borders, and to the west by Los Angeles County.

1.1.4.5 Morongo Basin Pipeline Commission

The Morongo Basin Pipeline Commission is comprised of five officials, one from each of the member entities of Improvement District M (entities that lie within the greater Morongo Basin/Johnson Valley Area ("Morongo Area") and take water from the Morongo Basin Pipeline), including: Mojave Water Agency, County of San Bernardino Service Area 70, Bighorn-Desert View Water Agency, Hi-Desert Water District (HDWD), and Joshua Basin Water District (JBWD). This Commission addresses issues of interest to the residents in the Morongo Basin and pertinent to the Morongo Basin Pipeline project. The Commission meets quarterly.

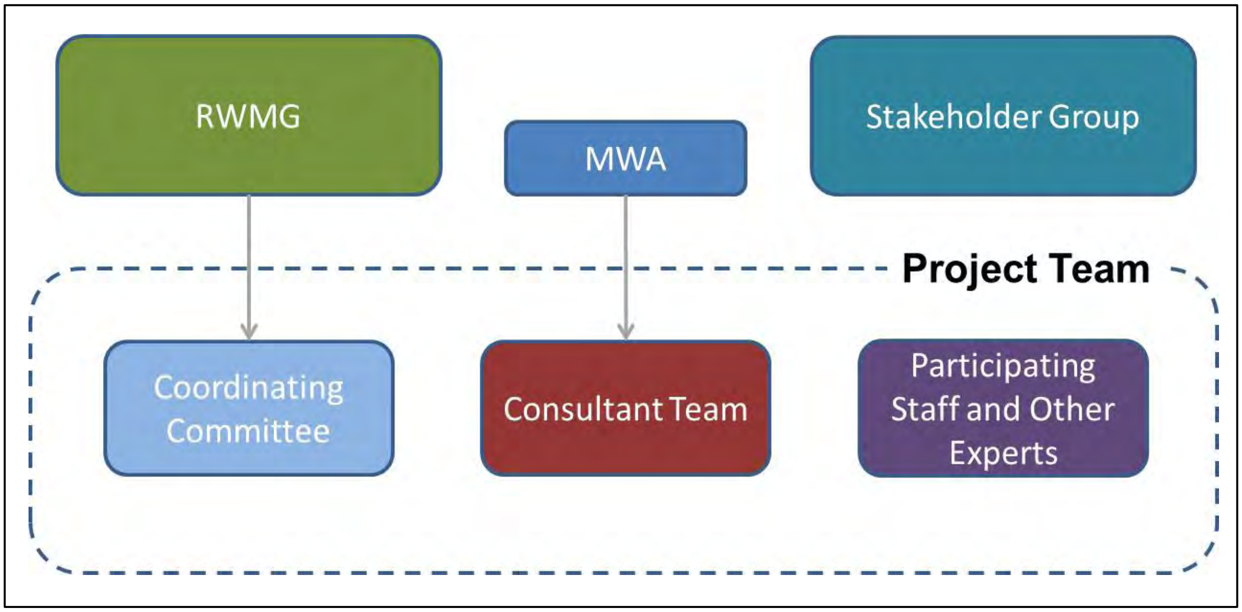
1.1.5 Coordinating Committee

The Region's Coordinating Committee (CC) consists of one staff representative or volunteer Board member and an alternate appointed from each of the agencies and associations that comprise the RWMG. The CC's overall function is to oversee the preparation of the Mojave IRWM Plan through its adoption, including identifying proposed Plan goals and objectives, proposing a process for prioritizing projects, and developing and reviewing drafts of the IRWM Plan.

Members of the CC, staff, and the Consultant Team formed a Project Team Charter which outlines the goals and responsibilities of the CC and establishes shared principles for Plan development (see Appendix A.4). It also included agreements to develop the IRWM Plan in an open and transparent process, encouraged the participation and input of stakeholders, and supported a decision-making process led by broad public agreement wherever possible.

The CC committed to engage the vast array of knowledge and talent among staff and other integrated water resources professionals within the Region, and to do so in a way that fostered professional development and growth among various agency staff while developing the IRWM Plan. The intent was to engage local professionals during the development of the Plan to benefit from their expertise and to prepare them to help implement the Plan after it was developed. The Consultant Team worked closely with designated staff and other experts participating on the Project Team (see Figure 1-4) to develop the Plan and foster professional development.

Figure 1-4
Project Team



1.1.6 Existing IRWM Plans and Previous Planning Efforts

With the recognition that long-range planning is key to sustaining the Region's water resources, MWA and the other various water agencies in the Region have been working for years on collaborative planning documents and efforts to guide water resource management actions.

MWA first prepared a RWMP in 1994 (1994 RWMP) in recognition of the generally deficient water supplies within the MWA and the need to develop a basis for decision-making to manage both local and imported water supplies as a means of eliminating overdraft conditions in the underlying groundwater basins. The 1994 RWMP provided the details for structural and non-structural projects that could be completed in part or in full over three phases ranging from short-term to long-term implementation timelines.

Since that time, several water resource management accomplishments and regional developments prompted MWA to update the 1994 RWMP, including advancements in the basin adjudication process, a more refined understanding of the hydrology and hydrogeology of the service area, population increases, shifts in agricultural and urban water demands, and the growing realization that the Mojave Region can be a strategic element in the long-term management of California's water supplies with nearly two million acre-feet (af) of available storage capacity in the Mojave River Groundwater Basin.

As a result, in 2005, MWA adopted the 2004 RWMP, which updated the 1994 RWMP and served as the Region's first IRWM Plan (and one of the first IRWM Plans in California). The 2004 RWMP was developed in collaboration with local stakeholders, such as water and wastewater agencies, and civic and technical leaders, and evaluated potential water supply projects and programs that provided regional benefits. It provided a road map for long-term water resources management and outlined 60 water resource management actions for the Region. Development of the 2004 RWMP provided a means to 1) review and revise, as necessary, previous estimates of water supply and demand, 2) identify and solicit input from stakeholders with interest in long-term reliable water supplies for the Region, and 3) identify a suite of preliminary alternatives that would help MWA achieve its goals in water supply management through 2020.

Importantly, the Plan has also provided the basis for acquiring state and federal funding for local water supply, conservation, and management projects, enabling a total of $170 million in investments in the Region's water infrastructure and supplies over the last decade. The 2004 RWMP has been used as the foundation for developing this 2014 update of the Mojave IRWM Plan.

1.2 Stakeholder Involvement

Recognizing that the success of any water management plan depends on the degree of involvement with the stakeholder community, broad stakeholder involvement has been and continues to be an essential component of the Mojave IRWM Planning process, as described below.

1.2.1 Overview of Stakeholder Involvement Process

During the development of the 2004 RWMP, significant efforts were made to identify and solicit input from stakeholders with interest in long-term reliable water supplies for the Region from the onset of the process. These efforts involved one-on-one interviews, evaluation of questionnaires and holding meetings with individuals, groups and the TAC. Outreach efforts were directed at stakeholders from local water agencies, state and federal agencies, municipalities, San Bernardino County, and local community groups, including environmental organizations, regulatory agencies, development interests, tribal communities, disadvantaged communities and other community associations.

These stakeholder involvement efforts have been continued and expanded during the 2014 update process. Stakeholders were notified regarding the update process by means of various outreach processes including an IRWM Plan website, emails, newsletters, letters via the US Postal Service, and personal phone calls. The timeline for the IRWM Plan update process was approximately 18 months in length, starting in January 2013 with a kick-off meeting to plan for the nine future stakeholder meetings and completing in June 2014 with adoption of the updated IRWM Plan at the ninth stakeholder meeting. There was one stakeholder meeting approximately every two months. Appendix A.5 contains the summaries of the nine stakeholder meetings that were held for the update to the IRWM Plan.

1.2.2 Stakeholders/Plan Participants

The planning group involved in development of the IRWM Plan update is an inclusive group of participants, including 58 municipal water purveyors, seven municipal and county agencies, fourteen state and federal agencies, and over 30 community interest groups.

Water users and public agencies form the core of the Stakeholder Group in the Region, including water districts, cities, private water suppliers, and agriculture. Additional essential stakeholder involvement includes environmental organizations, regulatory agencies, land use planning authorities, development interests, private stakeholders and community associations. All of these groups have participated in the IRWM Plan update development and its ongoing implementation.

1.2.2.1 Municipal and County Governments

Regardless of whether or not municipalities are water purveyors, they all share a keen interest in their local and regional water supplies. The economic health of a region is tied to its ability to demonstrate that affordable high quality water is going to be available as the Region develops. The following municipalities and county governments are stakeholders of the Mojave IRWM Plan process:

- City of Adelanto
- City of Barstow
- City of Hesperia
- City of Twentynine Palms
- City of Victorville
- San Bernardino County Planning Department
- Town of Apple Valley
- Town of Yucca Valley

1.2.2.2 Wholesale and Retail Water Purveyors, Wastewater Agencies, Flood Management Agencies, and Other Special Districts

Local water-related agencies include wholesale and retail water purveyors, wastewater agencies, flood management agencies, as well as other special districts. Despite varying objectives, these agencies share many common issues associated with local and regional water resources. Each agency has its own set of quantity and quality needs and each agency has individual goals for the regional water system, yet they are all interested in the ability of their individual systems to meet the needs of their customers.

There are currently 58 municipal water purveyors in the Mojave Region, as shown in Table 1-1, including water districts, cities, mutual water companies, and community services districts.

Table 1-1
Municipal Water Purveyors within Region

Municipal Water Purveyors	
1. Apple Valley Foothill County Water District	30. Gordon Acres Water Company
2. Apple Valley Heights County Water District	31. Green Valley Mutual Water Company
3. Apple Valley Ranchos Water Company	32. Helendale Community Services District
4. Apple Valley View Mutual Water Company	33. Hesperia Water District
5. Arrowbear Park County Water District	34. Hi Desert Mutual Water Company
6. Bar H Mutual Water Company	35. Hi-Desert Water District
7. BarLen Mutual Water Company	36. Indian Wells Valley Water District
8. Big Bear Municipal Water District	37. Joshua Basin County Water District
9. Bighorn-Desert View Water Agency	38. Jubilee Mutual Water Company
10. Cedarpines Park Mutual Water Company	39. Juniper-Riviera County Water District
11. Center Water Company	40. Lake Arrowhead Community Services District
12. Chamisal Mutual Water Company	41. Lucerne Valley Mutual Water Company
13. City of Adelanto Water District	42. Lucerne Vista Mutual Water Company
14. County Service Area 42	43. Mariana Ranchos County Water District
15. County Service Area 64	44. Navajo Mutual Water Company
16. County Service Area 70 J	45. Phelan Piñon Hills Community Services District
17. County Service Area 70 W1	46. Rancheritos Mutual Water Company
18. County Service Area 70 W4	47. Rand Communities Water District
19. Crestline Village Water District	48. Running Springs Water District
20. Crestline-Lake Arrowhead Water Agency	49. Sheep Creek Water Company
21. Daggett Community Services District	50. Stoddard Valley Mutual Water Company
22. Desert Dawn Mutual Water Company	51. Strawberry Lodge Mutual Water Company
23. Desert Springs Mutual Water Company	52. Thunderbird County Water District
24. Golden State Water Apple Valley North System	53. Twentynine Palms Water District
25. Golden State Water Apple Valley South System	54. Valley-Enchantment Mutual Water Company
26. Golden State Water Barstow System	55. Valley View Park Mutual Water Company
27. Golden State Water Desert View System	56. Victorville Water District
28. Golden State Water Lucerne Valley System	57. West End Mutual Water Company
29. Golden State Water Company Wrightwood System	58. Yermo Community Services District

Source: MWA's 2012 Water Purveyor Guide and Geographic Information System (GIS) data.

The following flood management agencies, as well as other special districts agencies are stakeholders of the Mojave IRWM Plan process:

- Morongo Basin Pipeline Commission
- Newberry Community Services District
- San Bernardino County Flood Control District

1.2.2.2.1 San Bernardino County Flood Control District

The General Plan for the San Bernardino County Flood Control District (Flood Control District) was created in 1939 under special state legislation. Since its inception, the Flood Control District has developed a very extensive system of flood control and water conservation facilities, including dams, conservation basins, debris basins, channels and storm drains. The purpose of these facilities is to intercept and convey flood flows through and away from developed areas of the County of San Bernardino, as well as to promote water conservation and improved water quality.

The Flood Control District covers the entire County of San Bernardino, including all of the incorporated cities. The Flood Control District is divided into six geographic flood zones (in recognition of the different characteristics and flood control needs in various areas). Zone 4 covers the Mojave Region, from the San Bernardino Mountains to Silver Lakes. The Flood Control District holds fee title or easements on segments of the Mojave River and until the mid-1980's, the Flood Control District maintained a flood channel through the Oro Grande stretch of the River. No channel work has occurred since.

The Flood Control District's funding is primarily derived from property taxes, federal and state aid on specific projects, subdivision and permit fees, rents and royalties, and revenue from local water agencies for water spreading services.

The Flood Control District's principal functions are as follows:

Flood Protection on Major Streams: In cooperation with the federal government, the Flood Control District conducts programs for channel and levee construction, floodwater retention, and debris basin maintenance. Programs or projects are often done in cooperation with the incorporated cities, the US Army Corps of Engineers, and the US Bureau of Reclamation.

Water Conservation: The Flood Control District operates and maintains water conservation basins and spreading grounds.

Storm Drain Construction: The Flood Control District is active in comprehensive storm drain master planning/construction and cooperates with incorporated cities and other agencies in storm drain projects.

Facility Maintenance: The Flood Control District has a proactive maintenance program for its facilities. Regular inspections of the storm drains, channels, and basins are made as required by various state and federal agencies.

National Pollutant Discharge Elimination System: The Flood Control District is the lead permittee in the San Bernardino Valley area-wide NPDES permit with 16 cities as co-permittees.

Flood Operations: During the flood season, the Flood Control District maintains telemetry systems for monitoring rainfall and runoff and dispatches storm patrols as dictated by the projected severity of a storm.

Flood Area Safety Taskforce (FAST): As a result of the October/November fires of 2003, the FAST organization was created.

1.2.2.3 State and Federal Regulatory and Resource Agencies

The involvement of and coordination with state and federal regulatory and resources agencies is essential to the success of the Region's IRWM process. Their roles and responsibilities are to ensure that regulatory compliance standards and goals are incorporated in this IRWM Plan. The development and implementation of recommended projects requires regulatory and environmental approval prior to implementation. In addition, these agencies have provided resources and services that have enabled advancement of the IRWM process, including a variety of services provided by the US Geological Survey to improve understanding of the Region's water resources, including stream gaging, hydrogeologic assessment and modeling. The following agencies have been involved in the update of the Mojave IRWM Plan:

- Army Corps of Engineers
- California Department of Fish and Wildlife
- California Department of Water Resources
- Colorado River Regional Water Quality Control Board
- Lahontan Regional Water Quality Control Board
- State Water Resources Control Board
- US Bureau of Land Management
- US Bureau of Reclamation
- US Department of Agriculture
- US Department of Fish and Wildlife
- US Environmental Protection Agency
- US Forest Service
- US Geological Survey
- US Marine Corps Logistics Base (MCLB)

1.2.2.4 Environmental Community

The Environmental Community includes groups and special districts with specific interests in conservation and protection of the natural resources and habitats within the Region.

- Audubon Society
- California Desert Coalition
- Mojave Desert Resource Conservation District

- Morongo Basin Conservation Association
- Sierra Club
- The Wildlands Conservancy

1.2.2.5 Tribal Community

This IRWM Plan has included the San Manuel Band of Mission Indians and the Twenty-Nine Palms Band of Mission Indians in its Stakeholder Outreach Program, due to the existence of related tribal artifacts and tribal lands located near the Region's boundaries or within the Region. Section 1.2.3.3 discusses the outreach that was completed for the tribal community.

1.2.2.6 Disadvantaged Communities

The inclusion and participation of economically disadvantaged communities (DACs) is considered essential to the Mojave IRWM Plan process, as approximately 80 percent of the Mojave Region qualifies as disadvantaged (see Figure 2-6 in Section 2.5.3). DACs within the IRWM planning region included both rural and urban areas. Among the DACs identified in the Region are the following:

- Adelanto
- Barstow
- Daggett
- El Mirage
- Hinkley
- Johnson Valley
- Joshua Tree
- Kramer Junction
- Landers
- Lenwood
- Lucerne Valley
- Newberry Springs
- Oro Grande
- Pinon Hills
- Pioneertown

- Twentynine Palms
- Yermo
- Yucca Valley
- Portions of Apple Valley, Hesperia, Phelan, and Victorville

1.2.2.7 Wastewater Agencies

Six wastewater agencies serve residents and businesses within the Mojave Region, treating about 20 MGD (about 22,000 acre-feet per year (afy)), and three wastewater agencies serving communities outside the Region discharge about 5 MGD (over 5,000 afy) of treated effluent to the Region:

- Big Bear Area Regional Wastewater Authority
- City of Adelanto
- City of Barstow
- City of Victorville
- Crestline Sanitation District
- Helendale Community Services District
- Lake Arrowhead Community Services District
- Marine Corps Logistics Base – Barstow and Yermo
- Victor Valley Wastewater Reclamation Authority

1.2.2.8 Electrical Corporations

Several electricity generating plants are located within the Mojave Region, including solar and natural gas-fueled power plants. The plants notified of the Plan update include:

- Hi-Desert Power Project
- NextEra Energy – Harper Lake solar plant
- NextEra Energy - Kramer Junction solar plant
- Reliant Energy Coolwater
- Sunray Energy, Inc.

1.2.2.9 Community Organizations

All local and community groups with an interest in the Region's water resource management have an opportunity to provide input on issues and needs associated with their particular location and specific group mission. This type of broad stakeholder involvement is very beneficial to the regional planning process and can provide enhanced opportunities for integrated efforts.

- American Association of Retired Persons (AARP) - Victorville Senior Citizens Center
- Spring Valley Lake Association
- Adelanto Chamber of Commerce
- Apple Valley Chamber of Commerce
- Barstow Chamber of Commerce
- Daggett Chamber of Commerce
- El Mirage Chamber of Commerce
- Helendale Chamber of Commerce
- Hesperia Chamber of Commerce
- Hesperia Kiwanis Club
- High Desert Hispanic Chamber of Commerce
- Jess Ranch Association
- Johnson Valley Improvement Association
- Joshua Tree Chamber of Commerce
- Joshua Basin Citizens Advisory Group
- Landers Chamber of Commerce
- Lucerne Valley Chamber of Commerce
- Newberry Springs / Harvard Property Owners Association
- Oak Hills Chamber of Commerce
- Oro Grande Agriculture
- Pinon Hills Chamber of Commerce

- Rancho Las Flores
- Rolling Start
- San Bernardino County Farm Bureau
- SAV-AG
- Silver Lakes Association
- Victor Valley Museum
- Victor Valley National Association for the Advancement of Colored People (NAACP)
- Victorville African American Chamber
- Victorville Chamber of Commerce
- Yucca Valley Chamber of Commerce

1.2.2.10 Self-Supplied Water Users

A number of self-supplied water users exist within the Mojave Region, ranging from self-supplied homeowners to large industrial and agricultural water users. Two groundwater adjudications exist within the Region – the Mojave Basin Area and Warren Valley Basin Area. The watermasters for each adjudicated basin were included as stakeholders. Additionally, the members of the Watermaster's Subarea Advisory Committees, representing the stipulating parties to the Judgment in each of the subareas of the Mojave Basin Area, were notified and included.

1.2.2.11 Industry Organizations

Organizations from various industry sectors are located within the Mojave Region, including the following organizations involved in the Plan update:

- Association of California Water Agencies
- Building Industry Association
- Southern California Water Agency
- State Water Contractors, Inc.
- Victor Valley Association of Realtors

1.2.2.12 Others

Over 35 individuals were notified or directly participated in the IRWM Plan update. Flyers with information on the public meetings were placed at community-specific venues throughout the Region, were sent to newspapers, medical centers, educational institutions, and other water-related industries, as well as a handful of consulting, engineering, or scientific firms with an interest in the Region's water resources.

1.2.3 Public Outreach Process

1.2.3.1 Inclusive Planning Area Outreach

This IRWM Plan development included evaluating and addressing regional issues while recognizing local interests. To do this, the planning process involved stakeholders and incorporated their input. The general approach to outreach during this planning process involved three key elements:

1. Identify stakeholders including disadvantaged communities and tribes;

2. Hold DAC meetings at various locations within the Region to encourage participation; and

3. Provide multiple opportunities and methods for participation and communication.

As discussed in Section 1.2, the planning process centered on stakeholder input meetings, all of which were open to the public to facilitate participation; attendees were invited to participate through facilitated discussions and review of draft documents; the meetings and opportunities to review and comment on draft documents were announced to a broad distribution list via e-mail and mailed invitations; and meeting materials were made available on the Plan website one week before each stakeholder meeting. The summaries for the public meetings are provided in Appendix A.6.

Public outreach activities throughout the IRWM Plan process are described below:

- **Review of Plan Sections** – The sections of the IRWM Plan were drafted incrementally and provided to stakeholders at multiple points for review and input. The content in draft sections was discussed with stakeholders and refined until there was broad agreement about the content.

- **Stakeholder Meetings** – Nine stakeholder meetings were held throughout the IRWM Plan development process. These meetings provided background on the planning process, identified challenges and opportunities within the Region, drafted and discussed Plan objectives, considered opportunities for coordination among local and regional agencies, presented Plan sections and received comments on Plan sections, and identified and prioritized projects as well as other topics included in the IRWM Plan. In addition, four public workshops/meetings and three DAC meetings were held at various locations around the Region to encourage participation. The four public meetings were held in Lucerne Valley, City of Barstow, City of Victorville, and Newberry Springs. The three DAC meetings were held in Piñon Hills/Phelan, Helendale, and the Town of Yucca Valley. The topics discussed during the course of the stakeholder meetings are summarized in Section 4.2.1.

- **Project Website** – The Mojave IRWM website (http://www.mywaterplan.com) serves as an important tool to solicit involvement from interested parties of the Region as well as to provide information and updates pertinent to the IRWM Planning process. Participation opportunities described on the website include regular public meetings, submittal of written comments, and online surveys. The public meeting dates, agenda and other meeting materials are provided on the website.

- **Electronic and Written Communications** – Email was the main tool used to maintain stakeholder communication and engagement. The email list, which contained approximately 200 entries, as well as a direct mail list of 30, was used to invite participation at the meetings as well as to notify stakeholders that materials were available for review.

- **Newsletter** –The newsletters contained important updates on the IRWM planning process as well as information on upcoming stakeholder meetings.

- **Contact Information** – Both email addresses and phone numbers were made available to any stakeholder or interested party to ask questions or offer comments about the IRWM Plan.

The IRWM Plan website is an important tool for facilitating communication

1.2.3.2 Disadvantaged Community Outreach

The inclusion and participation of DACs is considered to be essential to the Mojave IRWM Plan process, and numerous efforts were conducted to identify needs of, seek input from, and communicate with disadvantaged communities within the IRWM Region.

The outreach effort included special efforts to connect with DACs within the Region. A number of areas throughout the Region are considered DACs, defined as a community with a median household income (MHI) less than 80% of the statewide MHI (2012 Guidelines). Refer to Section 2.5.3 for additional information regarding DACs.

Informational invitations were sent or emailed to water agencies servicing known DACs within the Region, inviting them to stakeholder meetings and soliciting their input to the Plan and Plan projects. Additional information targeting DACs included mailers and focused meetings to engage DACs. As mentioned above, three meetings targeting DAC outreach were held in three locations in the Region. Since the intent of the outreach efforts was to identify the water-related challenges and opportunities of the Mojave Region at the community level, the public workshops and DAC meetings were designed to provide the same information and have similar formats. This allowed flexibility for people to attend any stakeholder meeting of preference and ensure that there were no gaps in the information provided across the Region. Appendix A.7 provides the outreach materials used for the DACs.

Although no organizations specifically addressing Environmental Justice (EJ) concerns have been identified in the Region, opportunities to address EJ issues were coordinated with DAC outreach as appropriate.

1.2.3.3 Tribal Outreach

In May 2013, MWA staff identified tribal lands within the Mojave Region (at the time, the Mojave Region boundary was the same as the MWA service area boundary) to notify the tribes of the intent to update the 2004 IRWM Plan. EPA's California Tribal Lands map (see Appendix A.8 for Tribal outreach materials) was reviewed and it was determined that no tribes existed within the MWA boundary, but that two tribes (1) Twenty-Nine Palms Band of Mission Indians and (2) San Manuel Band of Serrano Mission Indians, were located near the Region's planning area boundary. Therefore both tribes were sent an invitation letter on May 30, 2013 asking them to be a part of the IRWM Plan Update process and to submit comments or attend the community meetings. Appendix A.8 contains the invitation letter and full distribution list of addresses and email addresses.

MWA staff also contacted the San Manuel Band of Serrano Mission Indians later in the IRWM Plan development process when the Tribe did not attend or respond to invitations. Through discussions with the Tribe's Environmental Manager, it was learned that the Serrano Mission Indians have more of a presence in the San Bernardino Mountains and the Santa Ana River watershed. It was further explained by the Environmental Manager that there was no tribal land within the Mojave IRWM Region boundaries but the Band's *ancestral* lands encompass the entirety San Bernardino County.

About six months after the update to the IRWM Plan was underway, the Plan stakeholder group decided to expand the Region boundary per DWR's request and other reasons explained previously in Section 1.1.1. It was determined that one of the IRWM Region expansion areas included the tribal lands of the Twenty-Nine Palms Band of Mission Indians. Therefore, another personal invitation was sent to the Twenty-Nine Palms Band of Mission Indians, later in the IRWM Plan Update process. All documentation for tribal community contact is in Appendix A.8.

1.2.4 Interregional Coordination

While there are six existing IRWM regions adjacent to the Mojave Region as shown on Figure 7-1, there is only a hydrologic connection or watershed function in common with two of the six regions; Antelope Valley which is to the west of the Mojave Region and Inyo-Mono IRWM Region to the north.

During this IRWM Plan update process, members of the Project Team have been participating in DWR's IRWM Roundtable of Regions conference calls and coordination calls with the two neighboring IRWM efforts including Antelope Valley and Inyo-Mono.

1.3 Plan Development

This subsection gives a brief overview of the process of developing this IRWM Plan.

1.3.1 Goals for the IRWM Planning Process

To gain a common framework to guide development of the Plan and clarify its overall intent, the Project Team and the stakeholders developed the following goals for the planning process:

The Plan will define a clear vision for integrated water management in the Mojave Region for the next 20 years, from the perspective of a much longer-term vision for the Region that is broadly supported by the diverse set of stakeholders in the Region.

The Plan will strengthen working relationships and promote additional collaboration to leverage limited resources and improve overall system performance.

The Plan will promote a broader understanding among experts and other stakeholders about the challenges and opportunities of integrated water management in the Mojave Region.

The Plan will engage relevant expertise that exists within local agencies and other stakeholders to help update the IRWM Plan.

The IRWM Plan update process is to be used as a mentoring and developmental opportunity for local participating agency staff and as an organizational capacity-building opportunity for local agencies.

The Plan will be creative, including the identification of likely barriers, when identifying potential resource management strategies and projects. (Think beyond projects and programs with identified sources of funding.)

The IRWM Plan and Salt/Nutrient Management Plan will be developed in close coordination with one another and invite strong participation in the process by regulators and other stakeholders.

The Plan will reinvigorate relationships and increase communication with DACs within the Region, including those located in rural unincorporated areas. Begin by developing up-to-date, comprehensive information about the demographics, geographic locations and the leadership in these communities. Support meaningful participation of representatives of DACs and include relevant content into the IRWM Plan.

A compelling IRWM Plan will be developed that meets state guidelines and supports opportunities to obtain additional financial assistance for implementation of IRWM projects and programs.

The Plan will provide enough economic information to support financial master planning for the Region and other information needed to support local land use planning and decision-making.

The IRWM Plan will be developed on a foundation of solid scientific data concerning existing conditions in the Mojave Region and a comprehensive, objective understanding of those conditions based on proven industry methodologies.

The developed IRWM Plan will support the development of projects and programs required to meet projected future needs, maintain the existing water management system and infrastructure, and build in the resiliency required to deal with potential disruptions to the water supply and other emergencies.

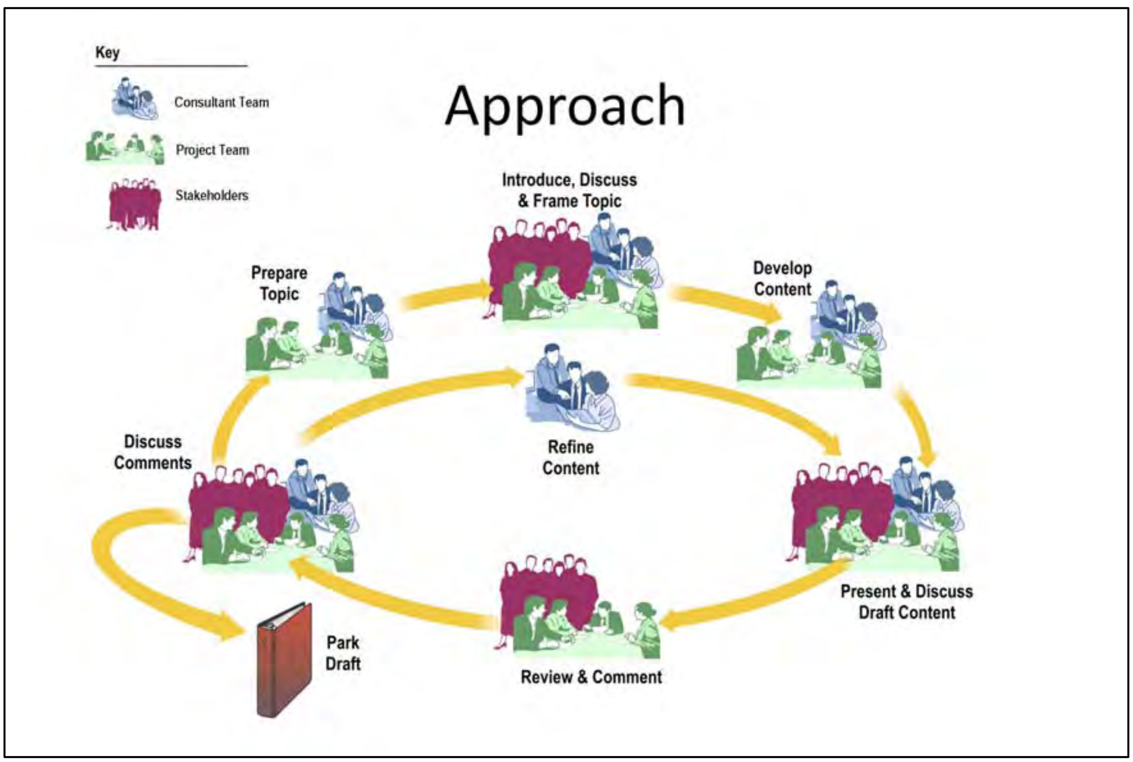
The Plan will consider the system-wide ramifications of all proposed IRWM Plan elements, including but not limited to effects on water treatment, storm drainage, and water runoff on water quality and supply.

1.3.2 Plan Development Process

1.3.2.1 Overview

The IRWM Plan development process was organized around the stakeholder input meetings, as described in Section 1.2.2. A set of Topics for Engagement, discussed in Section 1.3.2.2 were identified at the beginning of the process and scheduled for discussion at specific times during the stakeholder and public outreach process. The Project Team introduced these topics during meetings, and introduced and discussed draft Plan sections addressing these topics at the meetings. The Project Team also invited stakeholders to review these Plan sections and submit written comments after the meetings. The graphic on Figure 1-5 illustrates this interactive and iterative planning process.

Figure 1-5
IRWM Planning Process Approach



1.3.2.2 Topics for Engagement

The Project Team developed the following list of topics to be discussed in a logical sequence that includes all of the content necessary to develop an IRWM Plan consistent with DWR's published standards for IRWM Plans (see 2012 Guidelines). Table 2 in the 2012 Guidelines lists 16 standards that must be covered in the IRWM Plan. The topics discussed (which sometimes addressed two or three of the 16 standards in one topic or meeting) include:

Topic 1: Team Charter

Topic 2: Plan Update Process

Topic 3: Plan Scope

Topic 4: Current Conditions

Topic 5: Future Conditions

Topic 6: Challenges and Opportunities

Topic 7: Potential Projects

Topic 8: Integration

Topic 9: Benefits and Impacts

Topic 10: Project Selection and Priority

Topic 11: Plan Recommendations

Topic 12: Governance

Topic 13: Finance

Topic 14: Plan Performance and Monitoring

See Appendix A.9 for more detail on each topic.

1.3.2.3 Plan Section Development and Refinement

The Project Team presented information related to each of the Topics for Engagement and facilitated collaborative discussions through an interactive process initiated during stakeholder input meetings. Content for most of the topics was discussed in more than one stakeholder input meeting. The Project Team then prepared Draft IRWM Plan content based on the discussion of each topic and posted the content for public review and comment throughout the planning process. The Project Team revised draft content as needed based on comments received by the Stakeholder Group and then offered the revised content for review and comment until the content was broadly accepted by the Stakeholder Group. At the end of the planning process, the Project Team combined and refined the agreed upon content into this IRWM Plan for final public review and member agency adoption.

1.4 Plan Organization

The Project Team fashioned this Mojave IRWM Plan as a narrative, telling the story of the challenges and opportunities of the Region and how those challenges and opportunities informed the Plan objectives, projects, and recommendations.

The Plan includes all of the elements required by the 2012 Guidelines issued by DWR. Appendix H contains a cross-referencing table which describes where each of the Guidelines required elements is presented in the Mojave IRWM Plan. A Salt and Nutrient Management Plan (SNMP) was developed as a separate report in parallel with the IRWM Plan and will be finalized in fall 2014. Also, MWA's 2004 Groundwater Management Plan (GWMP) has been updated and will also be available in fall 2014.

1.5 Plan Adoption

Adoption of the Mojave IRWM Plan:

a. To adopt the Mojave IRWM Plan, the RWMG shall hold a public hearing to notify the public of their intent to adopt an IRWM Plan. A list of entities or individuals that provided comments to the draft IRWM Plan can be found in Appendix A.10.
b. The Mojave IRWM Plan shall be in full effect when at least three (3) public agencies, two (2) of which having statutory authority over water supply and management, sign and return to the RMWG, or their designee, the signature page of the plan.
c. Adoption of the Plan by each entity seeking to do so shall be subject to the internal policies and practices of said entity.

Upon the completion of the IRWM Plan, the RWMG will publish a notice of intention to adopt the Plan in accordance with §6066 of the Government Code and shall adopt the Plan in a public meeting of the RWMG. The governing bodies of each entity that is part of the RWMG will formally adopt the IRWM Plan. Additionally, each project proponent named in an IRWM grant application will also adopt the IRWM Plan.

Section 2: Region Description

2.1 Introduction and Overview

This section discusses why preparation of an IRWM Plan for this Region is appropriate, describes the physical and environmental characteristics of the Region, describes social and demographic characteristics of the Region, and provides an overview of the Region's water system.

The four expansion areas that are newly added to the Region's boundaries as discussed previously in Section 1.1.1 are generally not included in the first nine sections or tables below, but each expansion area has its own separate subsection discussing all applicable section topics starting at Section 2.10.

2.2 Physical Setting

The Mojave Region lies in the California High Desert, which is part of the Mojave Desert (see Figure 2-1). The High Desert Area is located on the northeastern flanks of the San Bernardino and San Gabriel Mountains, which separate the High Desert from the coastal basins and inland valleys of the greater Los Angeles and Orange counties area. These mountains, which reach elevations of over 10,000 feet above sea level, were uplifted along the San Andreas Fault. The High Desert Area is characterized overall as an alluvial plain. This plain consists of valleys and closed basins composed of water-bearing unconsolidated sediments. Hills and low mountains consisting of non-water-bearing consolidated bedrock separate these valleys and basins. The plain is criss-crossed by a series of northwest-trending geologic faults, resulting in offsets of geologic layering and barriers to groundwater flow. Overall, land surface elevations within the Mojave Region range from 5,500 feet above sea level in the San Bernardino Mountains on the southern boundary to 1,500 feet near Afton Canyon on the eastern boundary.

The Mojave Region is divided into two major surface water drainage areas:

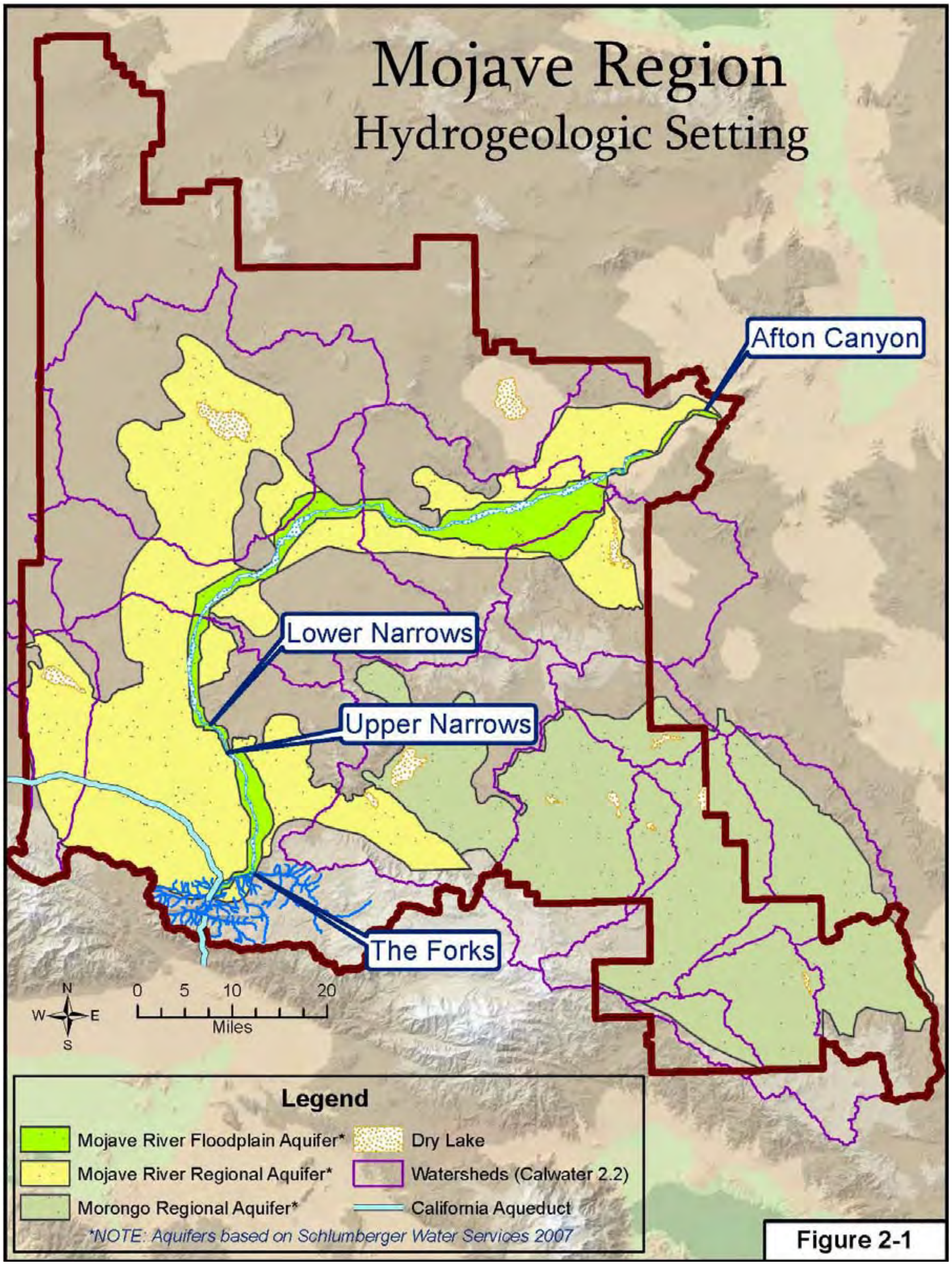
- The Mojave River Area that drains into the Mojave River or local terminal dry lakes. The Mojave River Area is the larger and more developed of the two.
- The Morongo Basin/Johnson Valley Area that drains into the Colorado River drainage or local terminal dry lakes (MWA 2004).

Terminal dry lakes (often referred to as "playas") are lake beds that collect water only during periods when there is sufficient runoff, have no outlet, and lose all their water to evaporation.

The Mojave River is the main surface water drainage feature within the Region. The surface water drainage of the Mojave River covers an area of 3,800 square miles.[1] It is fed by rainfall and snow pack from the San Bernardino Mountains. The river is formed by the confluence of two smaller streams (West Fork Mojave River and Deep Creek) descending from the mountains at a place called The Forks (Figure 2-1).

[1] Stamos et al. 2001

Figure 2-1
Mojave Region Hydrogeologic Setting



From there, the river then runs north and then east for about 100 miles, where it flows through Afton Canyon and terminates at Soda and East Cronese Lakes; these lakes pond water only after major storm events. At present the Mojave River is perennial (continuously flowing) only along a short section downstream of The Forks, in the vicinity of Upper and Lower Narrows and Afton Canyon, and in the section immediately downstream of the Victor Valley Wastewater Reclamation Authority's treatment plant, about 4 miles downstream of the Lower Narrows. However, during and immediately after storms (principally during the winter), the Mojave River flows along several (sometimes all) of its reaches. Most of the river flow occurs immediately after storms.

The Morongo Basin/Johnson Valley area has no sizeable rivers; only small ephemeral streams that collect runoff from surrounding mountains during storms. The mountain stream runoff either percolates into the stream bed or, during large storm events, flows to dry lake beds where it evaporates. The area encompasses parts of five separate surface water drainages – Warren, Copper Mountain, Emerson, Means, and Johnson (MWA 2004).

2.3 Land Use

The MWA service area includes the incorporated cities of Victorville, Adelanto, Hesperia, and Barstow, and the towns of Apple Valley and Yucca Valley, all within the County of San Bernardino.

The San Bernardino County General Plan identifies the Victor Valley area as one of the fastest growing areas in San Bernardino County. This area includes the cities of Victorville, Hesperia, Adelanto, and the town of Apple Valley, which are all located in close proximity to one another. The fastest growing city in this area is currently Adelanto, which is projected to have approximately 2.4 percent annual population growth from 2010 to 2035, based on the Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan (RTP) growth forecast (baseline of 2008). Land in the vicinity of these cities has steadily been converted to more urban uses to accommodate the population growth experienced in these cities.

The Barstow area includes the City of Barstow and surrounding unincorporated communities. Most of the future growth in the Barstow area is anticipated to occur within the incorporated City of Barstow and adjacent unincorporated communities (GSWC 2011).

The Morongo Basin area includes the unincorporated communities of Johnson Valley, Pioneertown, Landers, and Joshua Tree and the incorporated Town of Yucca Valley. Development within this area is concentrated in the Town of Yucca Valley.

Besides suburban and residential development, the Region also supports recreational and agricultural uses and contains a number of energy generation plants and other large utility pipelines. The Region contains a number of state and regional parks including portions of the San Bernardino National Forest, Joshua Tree National Park, and El Mirage, Johnson Valley and Stoddard Valley Off Highway Vehicle Areas. Agricultural uses in the Region occur primarily in the unincorporated areas east of Barstow, in the vicinity of Lucerne Valley and El Mirage, with additional scattered uses along the Mojave River north of Victorville. Wind and solar energy generating plants also dot the Region and electric transmission lines, water, crude oil and natural gas pipelines crisscross the Region (MWA 2004b).

Major existing land use categories within the MWA service area include residential, commercial, industrial, agricultural, and open space public land uses. Open space is the dominant land use within the service area, the large majority of which is owned and managed by federal and state agencies, primarily the US Department of the Interior Bureau of Land Management (BLM). Private (non-government) land is mostly urban, containing residential and commercial development as well as undeveloped acreage. Residential, commercial and industrial land uses are, for the most part, concentrated around the main urban centers, including Victor Valley (Victorville, Hesperia, Apple Valley, and Adelanto), Barstow and the Town of Yucca Valley (SCAG 2012).

The San Bernardino County Assessor's Office locates, inventories, and maintains all taxable property within San Bernardino County. MWA purchased the assessor parcel data for its service area from the San Bernardino County Assessor in 2009. Table 2-1 breaks down the total acreage for each land type. The land type broadly defines the land use for each parcel.

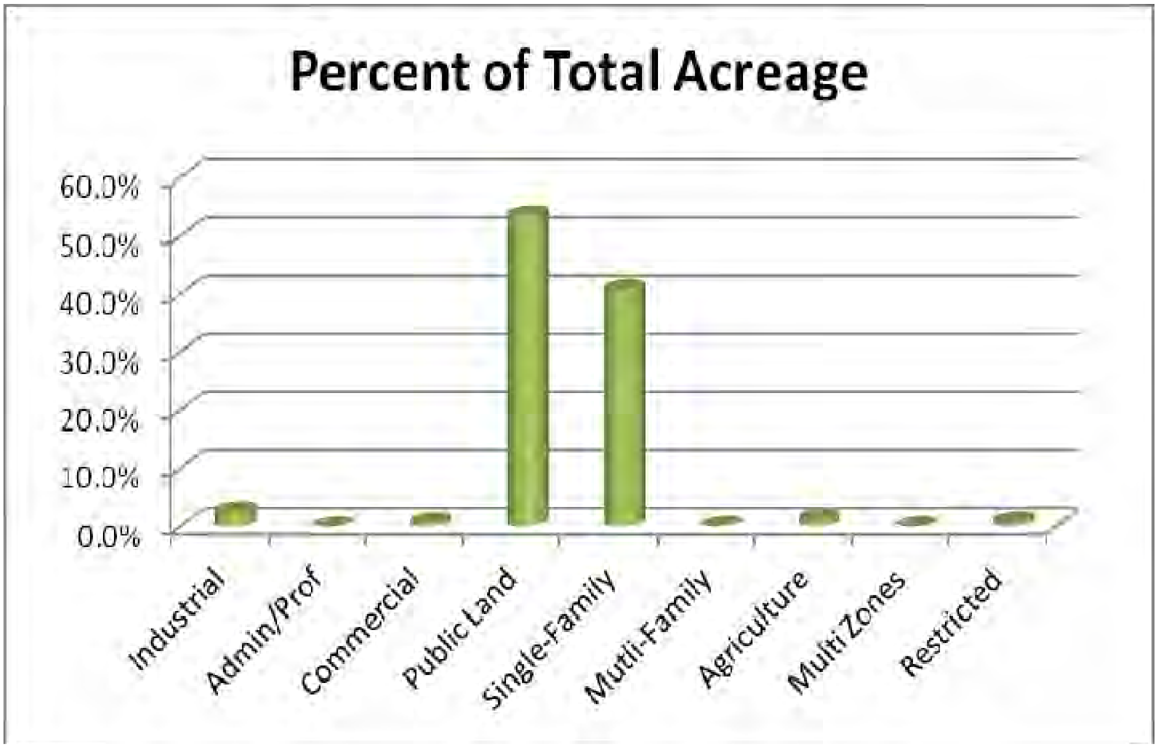
Public land occupies more than 53 percent of the MWA service area's 3.2 million acres, with single-family residential in second place with approximately 40 percent of the total acreage (Table 2-1 and Figure 2-2). Land use patterns within the MWA service area are illustrated on Figure 2-3 and described below.

Table 2-1
MWA Service Area Land Use Distribution

Land Use	Total Acreage	Percent of Total	Acreage Developed
Industrial	82,891	2.6%	7,824
Administrative/Professional	586	0.0%	57
Commercial	22,257	0.7%	6,252
Public Facilities	1,706,198	53.5%	962
Single-Family Residential	1,300,967	40.8%	186,329
Multi-Family Residential	3,423	0.1%	1,457
Agricultural	40,461	1.3%	18,499
Multiple Zonings [a]	1,833	0.1%	685
Restricted	27,862	0.9%	247
Total	**3,186,478**	**100%**	**222,312**

Source: San Bernardino County Assessor, 2009.
Notes:
(a) This type of use provides sites that have mixed zoning uses such as commercial and industrial.

Figure 2-2
MWA Service Area Land Use Distribution



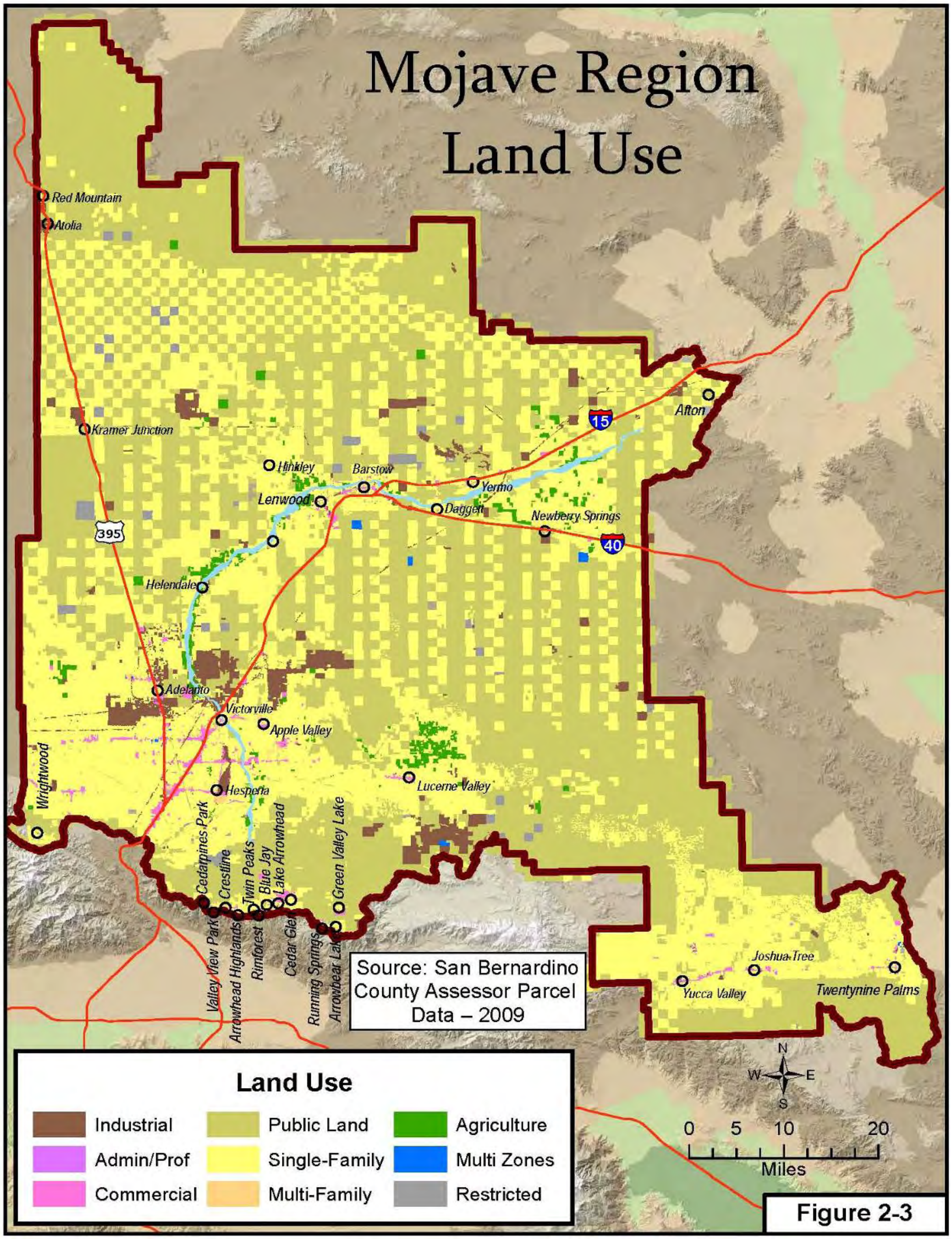
Land Use Policies

There are several land use jurisdictions in the MWA service area; these include the federal government (BLM), the County of San Bernardino (unincorpated areas), the incorporated cities of Adelanto, Barstow, Hesperia, and Victorville, and the Towns of Apple Valley and Yucca Valley. The land use policy documents that govern the MWA service area and their areas of jurisdiction are as follows:

- *West Mojave Plan* (Adopted 2006 and amended Nov. 30, 2007). This is a habitat conservation plan and federal land use plan amendment that presents a comprehensive strategy to conserve and protect the desert tortoise, the Mohave ground squirrel and nearly 100 other sensitive plants and animals and the natural communities of which they are a part, while providing a streamlined program for complying with the requirements of the California and Federal Endangered Species Acts (CESA and FESA, respectively). The BLM adopted the *West Mojave Plan* through amendment of its California Desert Conservation Area (CDCA) Plan and approval of other actions called for by the *West Mojave Plan*.

  The CDCA is a region encompassing over ten million acres of public land in four southern California counties: Imperial, Riverside, San Bernardino and Inyo Counties. These CDCA public lands are managed by the BLM. The BLM is a federal agency responsible for managing the public lands in accordance with federal law, regulation and policy in order to sustain the health, diversity and productivity of the public lands for the use and enjoyment of present and future generations.

Figure 2-3
MWA Service area Land Use Patterns



- *San Bernardino County General Plan* (Adopted March 13, 2007 and amended May 22, 2012). This document covers all of the unincorporated County. The Land Use Element is a guide for the County of San Bernardino's future development. It designates the distribution and general location of land uses, such as residential, retail, industrial, open space, recreation, and public areas. Community Plans also exist for many towns in the unincorporated area with land-use requirements specific to those communities.

  The San Bernardino County Development Code also provides guidelines that protect biological resources. In addition to Land Use Zoning Districts, County Code establishes Biotic Resources Overlays, where standards are implemented to protect and conserve unique, rare, threatened or endangered plants and animals, and their habitats, which have been identified within unincorporated areas of the County. The conditions for approval of land use applications with the Biotic Resource Overlay District must incorporate mitigation measures to protect and preserve identified biotic resources (San Bernardino County 2012 and 2013a).

  Note: San Bernardino County also has a Desert Groundwater Management Ordinance (Code of Ordinances, § 33.06551 - 33.06557), which only apply to those groundwater aquifers that have not been adjudicated by judicial decree, which are located outside of the jurisdictional boundaries of the Mojave Water Agency and Public Water Districts within the Morongo Basin and which are situated in the unincorporated desert region of the County. The purpose of the Ordinance is the protection of groundwater resources within County.

  The public health, safety and general welfare of the people of the State of California and of the County depend upon the continued availability of groundwater through ensuring that extraction of groundwater does not exceed the safe yield of affected groundwater aquifers, considering both the short and long-term impacts of groundwater extraction, including the recovery of groundwater aquifers through natural as well as artificial recharge. This Ordinance augments and supplements the Groundwater Management authority the County may otherwise have pursuant to the Groundwater Management Act (San Bernardino County 2002).

- *1995 City of Adelanto General Plan*. This General Plan encompasses the City of Adelanto and includes major areas planned for general commercial uses, manufacturing and industrial uses, in addition to its residential areas that include multiple family and single-family densities as well as low-density residential development.

  The Conservation and Open Space Element of the General Plan identifies the need to adequately protect and conserve native vegetation and wildlife habitats. Policies contained in the General Plan aim to minimize destruction of biotic resources, to maintain and protect important open space areas, and to protect the integrity of unique habitat and wildlife movement corridors (BLM 2005).

- *City of Barstow General Plan.* In its General Plan, the City of Barstow identifies the areas and designations of future new development including residential, commercial, and industrial in terms of natural resources. The General Plan identifies the following goals: preserving biological resources, conserving suitable habitat for special status species, establishing wildlife and natural area corridors, and maintaining native riparian habitats along the Mojave River (BLM 2005).

- *City of Hesperia General Plan.* Residential uses in the City of Hesperia are concentrated within the center of the town. Lot densities are fairly low and range from rural estate to high residential, while in the western portion of the City, there are more single family residential units. The General Plan emphasizes protection of quality life and includes goals relating to biological resources to preserve sensitive or special status plan and animal species, as well as habitat areas (BLM 2005).

- *2008 City of Victorville General Plan*. The City of Victorville is the Region's most heavily populated urban area, consisting of residential land use which ranges in density from one to 20 dwelling units per acre. Industrial land uses are concentrated within the northwestern corner of the City. Open spaces and some agricultural tracts are concentrated along the Mojave River corridor (SCAG 2012; BLM 2005).

- *Town of Apple Valley General Plan***.** The Town of Apple Valley consists primarily of "community homes", many of which are low to very low density units. Commercial development is concentrated along the major roads and small pockets of industrial land uses are found in the northern portions of the town. The Open Space/Conservation Element addresses protecting the area's natural resources, aiming to preserve native vegetation, landforms and wildlife habitat and preserving the integrity and viability of sensitive habitats within the planning area. Various open space areas are slated to remain in their natural condition, including the Mojave River Valley (BLM 2005).

  In addition to the Town's General Plan, a multi-species habitat conservation plan is being developed to guide conservation efforts, safeguard valuable local features and facilitate compliance with state and federal environmental regulations (Town of Apple Valley 2013).

- *1995 Town of Yucca Valley General Plan.* The Town of Yucca Valley encompasses 24,916 acres over 38 square miles. Development over the past decades has focused along and been most intense adjacent to State Highway 62 (Twentynine Palms Highway), with progressively less dense and more scattered residential development north and south of Highway 62. Industrial land uses are found in a few scattered locations, and the Highway 62 corridor serves the Town and the Region as an integrated mix of commercial businesses.

2.4 Ecological Processes and Environmental Resources

This section describes the basic environmental resources and ecological processes of the Watershed, and also describes relevant issues and existing and potential venues for resolution of these issues.

The Mojave Region is an ecologically highly varied area, with valuable natural resources. Encompassing a vast area of nearly 5,400 square miles within the Mojave Desert, the Region contains diverse landscapes and unique ecosystems that include desert sand dunes, dry lakes, marshes, rugged mountains, oases, and riparian forest. These natural features create valuable habitat that supports a large diversity of biological communities that include numerous sensitive and special status plant and animal species (BLM 2008; USFWS 2011).

The natural ecosystem, comprised of a wide variety of biological resources (plant and animal species), as well as physical attributes (land, water, air and other important natural factors), is a vital resource contributing to the economic and physical wellbeing of the communities of the Mojave Region. Disruption of one factor may intrinsically affect another due to their inter-relationships, and the significance of those effects is difficult to determine without consideration of the whole system. All native species and ecosystems are of aesthetic, ecological, educational, historic, recreational and scientific value.

Ecological processes in the Region that are influenced and improved by resource management strategies are numerous. Of major concern in the Mojave Region is natural water production and watershed protection, which is critical to maintaining a healthy and balanced ecosystem and that which protects plant and wildlife species and provides for regionally valuable recreational uses (e.g., hiking, camping, and many other forms of outdoor recreation).

2.4.1 Sensitive Biological Resources

The Region is host to 47 threatened, endangered, or candidate species, and/or designated critical habitat. These are species of plants and animals that are designated endangered, threatened or rare by the California Department of Fish and Wildlife (CDFW) or the US Department of the Interior and Department of Commerce. A federally listed endangered species is one facing extinction throughout all, or a significant portion of, its geographic range. A federally listed threatened species is one likely to become endangered within the foreseeable future throughout all or a significant portion of its range. The State of California considers an endangered species as one whose prospects of survival and reproduction are in immediate jeopardy; and a threatened species as one present in such small numbers throughout its range that it may become endangered if its present environment worsens. The rare species designation applies only to California native plants.

Candidate species are plants and animals for which the US Fish and Wildlife Service (USFWS) has sufficient information on their biological status and threats to propose them as endangered or threatened under the Endangered Species Act (ESA), but for which development of a proposed listing regulation is precluded by other higher priority listing activities.

Additionally, there are many species whose survival and reproduction in the wild are in immediate jeopardy and are considered to be sensitive to further intrusion upon their habitat. Species that are not listed under the FESA or the CESA, but which nonetheless are declining at a rate that could result in a designation of Endangered, Threatened or Rare, are classified as Species of Special Concern.

Many of the Region's plant and animal species are designated as endangered, threatened, or rare by the CDFW or the US Department of the Interior and Department of Commerce. Table 2-2 lists sensitive and special status species and species of special concern found in the Region and vicinity.

Among the numerous animal species with special protection found in the Region are the desert tortoise, Mohave ground squirrel, Mojave tui chub, and least Bell's vireo, all of which are either threatened or endangered. The Region is also home to various rare plant species, such as the Barstow woolly sunflower and unique plant assemblages, including the oldest creosote specimen and among the largest known creosote rings.

Management efforts are in place to protect, conserve and enhance the biological and natural resources found in this Region that involve participation from local, state, and federal agencies. The California Desert Conservation Area was created under the 1976 Federal Land Policy and Management Act, which designated 25 million acres in the California Desert for special management. The Mojave Region, which lies within this area, encompasses various special management areas, including Areas of Critical Environmental Concern (ACEC), Wilderness areas, and Desert Wildlife Management Area (DWMAs).

ACECs are designated by the BLM and represent and include public lands where special management attention and direction is needed to protect and prevent irreparable damage to important historic, cultural, and scenic values, fish, or wildlife resources or other natural systems or processes; or to protect human life and safety from natural hazards. ACEC designation indicates BLM recognizes the significant values of the area and intends to implement management to protect and enhance the resource values. Wilderness areas are BLM lands, preserved under federal law to protect site values, such as ecologic, scenic, geologic, and historic values (BLM 2011b and c).

DWMAs were established to protect valuable habitat for the desert tortoise, as recommended by the USFWS Recovery Plan for the threatened Mojave population of the desert tortoise. As shown on Figure 2-4, large areas of the Mojave IRWM Region and adjacent desert lands have been designated as critical habitat, essential for the recovery of this species (BLM 2008; USFWS 2011).

Desert Tortoise

Environmental resources within the Region are also managed under the *West Mojave Plan* which applies to BLM-administered public lands across multiple counties and within the Mojave Region. The *West Mojave Plan* provides a comprehensive strategy to conserve and protect nearly 100 sensitive plants and animals, including the desert tortoise and the Mohave ground squirrel, and their natural communities (BLM 2005).

Figure 2-4
Critical Habitat Designation Areas

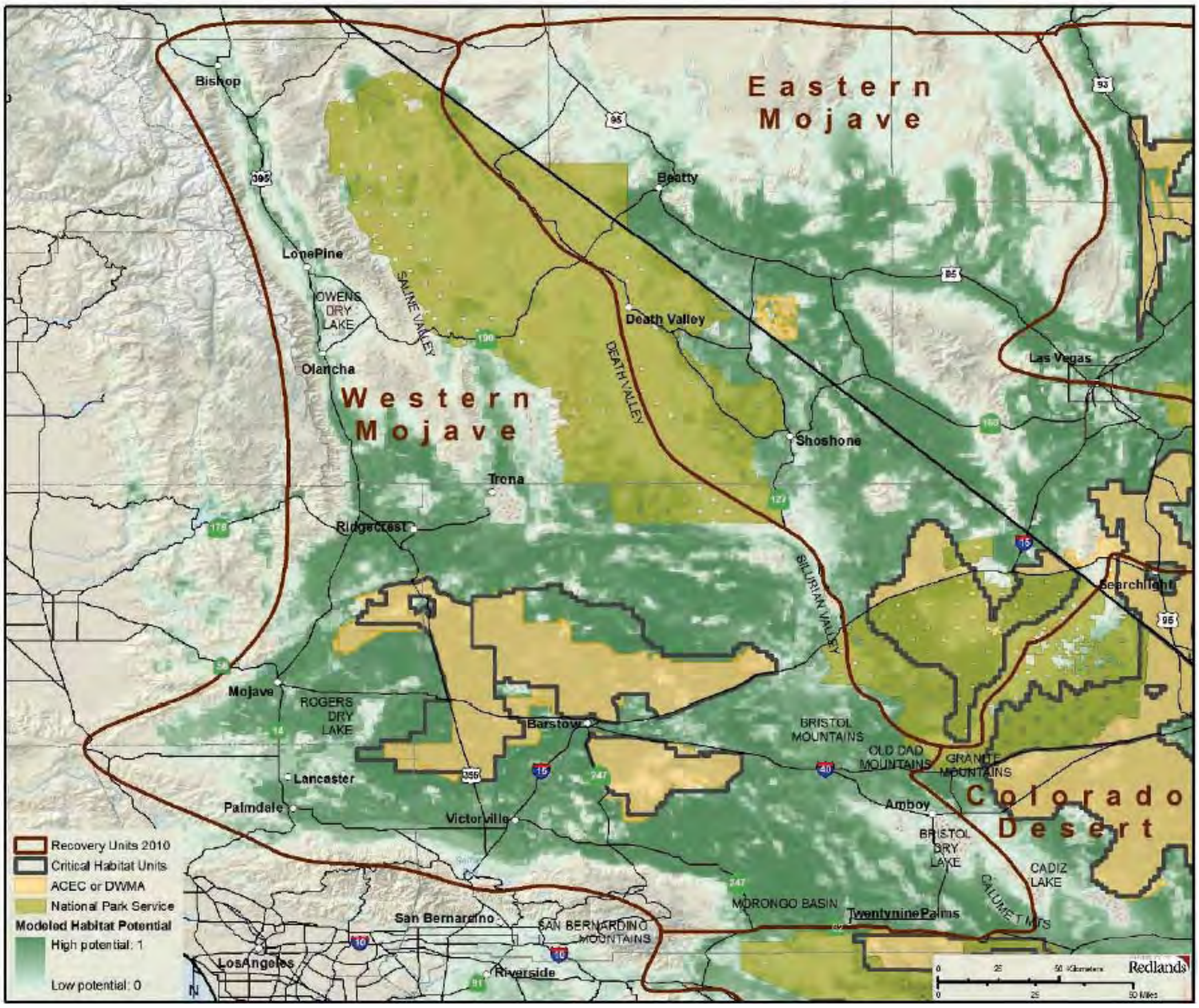


Table 2-2
Sensitive Species in the Mojave Region

Classification	Species
Mammals	American badger, Mohave ground squirrel, Mojave River vole, Nelson bighorn sheep, pallid bat, Stephen's kangaroo rat, San Bernardino Merriam's kangaroo rat, Townsend's big-eared bat, spotted bat, western mastiff bat
Birds	Bald eagle, Bendire's thrasher, brown-crested flycatcher, burrowing owl, California condor, Coastal California gnatcatcher, Cooper's hawk*, Ferruginous hawk*, golden eagle, Inyo California towhee*, least Bell's vireo, LeConte's thrasher, northern harrier, gray vireo, prairie falcon, Southwestern willow flycatcher, Swainson's hawk, western snowy plover, western yellow-billed cuckoo*, yellow-breasted chat, yellow warbler, Yuma clapper rail
Reptiles	Coachella Valley fringe-toed lizard, desert tortoise, Mojave fringe-toed lizard, southwestern pond turtle, San Diego horned lizard
Fish	Colorado pikeminnow, Mojave tui chub*, unarmored threespine stickleback, bonytail chub, razorback sucker
Amphibian	Arroyo southwestern toad*, California red-legged frog*, Mountain yellow-legged frog*
Insects	Quino checkerspot butterfly, Delhi Sands flower-loving fly
Plants	Alkali mariposa-lily, ash-grey paintbrush, Barstow woolly sunflower, Bear Valley sandwort, Big Bear Valley woollypod, California taraxacum, Coachella Valley milk-vetch, crucifixion thorn, Cushenbury buckwheat, Cushenbury milk-vetch, Cushenbury oxytheca, desert cymopterus, Gambel's watercress, Harwood's eriastrum, Lane Mountain milk-vetch, Little San Bernardino Mountains gilia, mentzelia tridentate, Mohave monkeyflower, Mojave fishhook cactus, Mojave spineflower, Mojave tarplant, Mojave tarweed, Nevin's barberry, Norrego milk-vetch, Parish's brittlescale, Parish's daisy, Parish's phacelia, Pedate checker-mallow, purple monkeyflower, Red Rock tarplant*, ribbed cryptantha, salt marsh bird's-beak, San Bernardino aster, San Bernardino bluegrass, San Bernardino milk-vetch, San Bernardino Mountains bladderpod, San Diego ambrosia, slender-horned spineflower, slender-petaled mustard, southern mountain wild-buckwheat, thread-leaved brodiaea, triple-ribbed milk-vetch

Source: USFWS 2013, CEC 2012, BLM 2005.
Notes: As some data are based on larger geographic areas, such as on a county-scale, some species may not be found within the IRWM Region boundaries.
* Species listed here include species classified as rare, threatened, endangered, of special concern, and/or sensitive.

2.4.2 Wildlife Corridors

Wildlife corridors link together areas of suitable wildlife habitat that are otherwise separated by rugged terrain, changes in vegetation, or human disturbance. The fragmentation of open space areas by urbanization creates isolated "islands" of wildlife habitat. In the absence of habitat linkages that allow movement to adjoining open space areas, various studies have concluded that some wildlife species, especially the larger and more mobile mammals, will not likely persist over time in fragmented or isolated habitat areas because they prohibit the infusion of new individuals.

The Mojave River is a Valuable Wildlife Corridor

In addition, such islands often provide the only available habitat for species that occupy the corridor area. Biologists have identified areas that experience recurrent aquatic, riparian, or terrestrial species movement that are crucial to these species as wildlife "corridors" or habitat linkages. These corridors encourage preservation of plant and animal populations by allowing greater access to food and water and a larger gene pool.

The Mojave Region contains various critical connections for wildlife movement. As part of a coordinated statewide effort that helped identify the State's most important wildlife corridors, 46 habitat corridors/linkages were identified for the Mojave and Sonoran Desert areas; 18 of these were found to be landscape corridors, which are large-scale connections between habitat core areas that facilitate animal movements and other essential flows between different landscape sections. Among these corridors, two—Mojave River-Barstow-Camp Cady and Joshua Tree—are located within the Region boundaries and have been identified as severely threatened and top conservation opportunities, as shown on Figure 2-5. Primary threats to natural connectivity that have been identified include roads and urbanization which create barriers to wildlife movement.

The Mojave River-Barstow-Camp Cady Corridor provides connectivity for the arroyo southwestern toad, least Bell's vireo, willow flycatcher, and other riparian birds by providing riparian habitat. The corridor was also identified as a sand source corridor supplying sand to the Kelso Dunes.

The Joshua Tree corridor/linkage provides connection between the Bullion Mountains and the Sheep Hole Mountains, both, north of Joshua Tree National Park and functions as a wildflower and general wildlife corridor (California Wilderness Coalition 2000).

As part of the Open Space Element of the San Bernardino County General Plan, wildlife corridors have also been delineated on a county-wide basis. The majority of these open space corridors are delineated around creek and riparian areas. The largest of these corridors, consisting of various adjacent open space areas, follows the alignment of the Mojave River from south of Hesperia past Barstow to just outside the Region boundaries. The area is planned to be maintained as open space to protect the rare desert riparian habitat (See Figure 2-5) (San Bernardino County 2012).

The western part of the Region is adjacent to Los Angeles County's Antelope Valley Significant Ecological Area (SEA). The Antelope Valley SEA provides connections between the San Gabriel Mountains and the Mojave Desert, thereby allowing for wildlife movement along the drainages, such as Big Rock Creek and into open areas in Kern and San Bernardino Counties. This SEA also includes the southwestern portion of desert tortoise habitat (LA County 2012).

2.4.3 Areas of Ecological Significance in the Region

The following section provides additional information of the areas under special management to protect and preserve the Region's natural resources.

2.4.3.1 Areas of Critical Environmental Concern

Numerous ACECs of ecological significance are located within the Region's boundaries (BLM 2011d), as shown in Table 2-3 and on Figure 2-5.

Table 2-3
Areas of Critical Environmental Concern in the Mojave Region

ACEC Name	Description
Barstow Woolly Sunflower	This 314-acre large area northeast of Kramer Junction protects the Barstow woolly sunflower, an extremely rare plant species limited to the western Mojave Desert. Additional special-status species within the Barstow Woolly Sunflower ACEC include the Mojave spineflower, Mohave ground squirrel, desert tortoise, chisel-toothed kangaroo rat, San Joaquin pocket mouse, kit fox, bobcat, and burrowing owl. Various land sections to the east and west of this area is managed by CDFW for protection of desert plants and animals (BLM 2005; CEC 2012).
Bendire's Thrasher	This ACEC spans over 25,000 acres and two locations, one of which is located within the Mojave IRWM Region, northeast of Victorville. This site has high biological value, particularly for the protection of the Bendire's thrasher, and also provides valuable habitat for desert tortoise and golden eagle (CEC 2012).
Big Morongo Canyon	This 23,400-acre ACEC is managed as a wildlife reserve to protect riparian, wildlife, vegetation, in addition to cultural resource and recreation values. Big Morongo Canyon contains multiple special status and threatened species, many of which are found within riparian habitat, and six distinct plant communities. This ACEC contains two corridors connecting the San Bernardino Mountains to the Little San Bernardino Mountains.  Big Morongo Canyon contains various sensitive habitats, which include Mojave riparian woodland, desert dry wash woodland, freshwater marsh, and Joshua Tree woodland. Special status vegetation species include Triple-ribbed milkvetch and Little San Bernardino Mountains gilia, and the palm oasis represents a unique plant assemblage of this site. Special status wildlife species are found at this site and include: desert tortoise, desert bighorn sheep, mountain lion, mule deer, gambell's quail, burrowing owl, least Bell's vireo, yellow breasted chat, and yellow warbler (CEC 2012). Additional species found in the Morongo area include badger, bobcat, and Pacific kangaroo rat (The Sonoran Institute 2009).
Black Mountain	This ACEC is one of the largest in the western Mojave Desert with almost 62,000 acres. Black Mountain lies northwest of Barstow, entirely within the Superior-Cronese and Fremont-Kramer DWMAs, and in part within the Black Mountain Wilderness. The ACEC contains desert tortoise critical habitat and known occupied habitat for other species, including the Mohave ground squirrel, LeConte's thrasher, desert cymopterus and Barstow woolly sunflower. Nest sites for golden eagle and prairie falcon are also found in this area. Black Mountain has high cultural value and protects prehistoric and Native American resources. This area is considered to contain "the most extensive assemblages of prehistoric petroglyphs in California" (BLM 2005).

Table 2-3
Areas of Critical Environmental Concern in the Mojave Region

ACEC Name	Description
Carbonate Endemic Plants Research Natural Area	This ACEC consists of over 5, 000 acres of public lands southeast of Lucerne Valley. This area protects numerous sensitive plant species and multiple sensitive wildlife species and provides a primary wildlife connectivity zone. Sensitive plant species found at this site include Parish's daisy, Cushenbury milk-vetch, Cushenbury oxythexa, Parish's brittlescale, San Bernardino milk-vetch, frosted mint, alkali mariposa, San Bernardino aster and Big Bear Valley woollypod. Sensitive wildlife species include golden eagle, desert tortoise, San Diego horned lizard, and big horn sheep (CEC 2012).
Coolgardie Mesa	This 13,248-acre ACEC is encompassed by the Superior Cronese DWMA, lying north of Barstow. Coolgardie Mesa was set aside primarily for the protection of Lane Mountain milkvetch and Barstow woolly sunflower. It also provides habitat for the desert tortoise and Mohave ground squirrel (CEC 2012).
Fremont-Kramer Desert Wildlife Management Area (DWMA)	This ACEC, designated as a DWMA, encompasses 511,525 acres including Fremont Valley, Rand Mountains, Red Mountain, Cuddeback Lake, and extends south beyond Kramer Junction. A large portion of its acreage is located within the western part of the Mojave Region. Fremont-Kramer Desert Wildlife Management Area contains Desert Tortoise Critical Habitat which is considered to be essential for recovery of this species. In addition, the area encompasses essential movement corridors which link wildlife habitats in the Western Rand Mountains and Fremont Valley to the Cuddeback Lake area and to both the Golden Valley and Grass Valley Wildernesses. This site provides migratory and nesting habitat to multiple songbirds, including the resident loggerhead shrikes and LeConte's thrashers. Sensitive and unique plant species within this site include the Barstow woolly sunflower, desert cumopterus, and mentzelia tridentata. Sensitive species found at this site include, in addition to those listed above, American badger, Mohave ground squirrel, townsend's big-eared bat, pallid bat, spotted bat, western mastiff bat, golden eagle, prairie falcon, burrowing owl, and long-eared owl (CEC 2012).
Harper Dry Lake	This 475 acre ACEC was established to protect remnant marshes at the southwestern edge of Harper Dry Lake, northwest of Barstow. The lake as well as the marsh and alkali wetland community adjacent to Harper Dry Lake are considered to hold potential for the discovery of rare and restricted-range plant species and provide an important resting site for thousands of migrating birds and attracts resident wetland birds, migratory waterfowl, shorebirds, and birds of prey. Harper Dry Lake has been found to support Western snowy plovers and is considered to be important to the conservation of Western snowy plover nesting habitat. Harper Dry Lake is also recognized as one of 223 nationwide BLM designated Key Raptor Areas and one of seven in the Mojave Desert. These designated areas are significant habitats for birds of prey species and have unusually high raptor nesting densities. Among the bird of prey species known to inhabit Harper Dry Lake are northern harrier, short-eared owl, ferruginous hawk, and long-eared owl. Harper Dry Lake is a Watchable Wildlife site, providing access and facilities for birdwatching and interpretive trails (BLM 2005; CEC 2012).

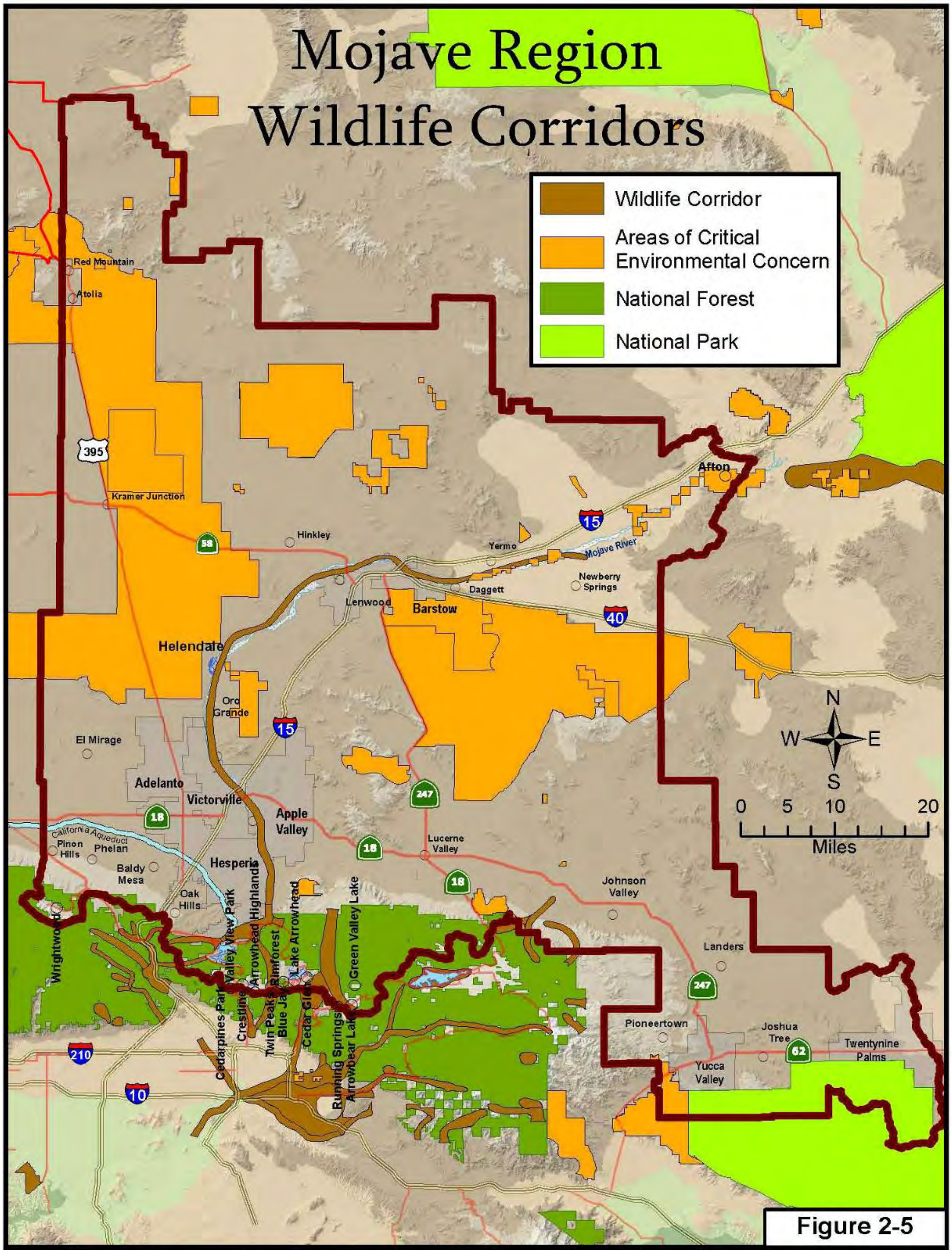
Table 2-3
Areas of Critical Environmental Concern in the Mojave Region

ACEC Name	Description
Juniper Flats	This ACEC is 2,500 acre area of public and private lands in the foothill area south of Apple Valley. This area was originally established as the Juniper Flats Cultural Area where early historic remains are found, such as evidence of cooking tool manufacture and hunting. The area also contains springs and riparian habitat within a dense stand of junipers. Among the sensitive species that find important habitat in Juniper Flats, are the San Diego horned lizard and the gray vireo. (BLM 2005; CEC 2012).
Manix	The Manix ACEC is a 2,897-acre area located approximately 20 miles northeast of Barstow along the Mojave River. This site contains wildlife, paleontological and cultural resources as well as important habitat for the Mojave fringe-toed lizard (BLM 2005).
Mojave Fishhook Cactus	Established in 1984, this ACEC is composed of two parcels, making up 628 acres in the Brisbane Valley, southwest of Barstow. The primary purpose of this ACEC is the protection of the yellow-spined form of the Mojave fishhook cactus and the Mojave monkeyflower (BLM 2005).
Mojave Fringe-toed Lizard	This 25,000 acre ACEC is made up of 10 separate units, portions of which lie within the Mojave IRWM Region, east of Barstow. The protected areas include sand dune ecosystems with associated shade plants, and areas for source sand and wind and sand corridors that are necessary for long-term survivorship of the Mojave fringe-toed lizard which is restricted to these specific sand habitats. Rare vegetation species present at this site include Borrego milk-vetch, ribbed cryptantha, and harwood's eriastrum (BLM 2005).
Mojave Monkeyflower	This ACEC consists of two units, both of which are located within the Region between Barstow and Victorville. This 46,487-acre area provides protection for sensitive and restrictive plant species, particularly the Mojave monkeyflower. This site also includes desert tortoise and provides important wildlife connectivity (CEC 2012).
Ord-Rodman DWMA	This ACEC covers 265,725 acres and generally aligns with boundaries identified within the Desert Tortoise Mojave Population Recovery Plan. This area contains high density desert tortoise habitat and provides tortoise habitat linkage. (CEC 2012).
Parish's Phacelia	This 899 acre ACEC is located within the Superior Cronese DWMA. This site was designated for the protection of the largest known population of Parish's phacelia, a BLM sensitive species (CEC 2012).
Rainbow Basin	Located approximately ten miles north of Barstow, this 4,087-acre ACEC is popular for its colorful rocks and geologic formations. Rainbow Basin protects two nesting sites for prairie falcon and contains habitat for desert tortoise as well as Mohave ground squirrel. (BLM 2005). Rainbow Basin is also of cultural importance, containing late Miocene age fossil assemblages, which are one of the most intensively, studied fossil areas in the country. Rainbow Basin has hosted numerous archaeological sites including petroglyphs and historic mining remnants.

Table 2-3
Areas of Critical Environmental Concern in the Mojave Region

ACEC Name	Description
Red Mountain Spring	This ACEC covers 717 acres in the northeastern side of Red Mountain, in the northwestern corner of the Region. Red Mountain Spring has both significant wildlife resources in addition to prehistoric and historic cultural resources. The area falls within the Mohave Ground Squirrel Conservation Area and the Fremont-Kramer DWMA and contains designated tortoise critical habitat (BLM 2005; CEC 2012).
Rodman Mountains Cultural Area	This ACEC lies largely within the Rodman Mountains Wilderness area, providing 6,024 acres of protection of cultural and wildlife resources. Among the cultural values at this site are the petroglyphs of religious and spiritual significance to Native Americans. The Area contains raptor nests and limited desert tortoise habitat, for which this area is also included in the Ord-Rodman tortoise DWMA (BLM 2005).
Soggy Dry Lake Creosote Rings	This 186-acre ACEC lies east of Lucerne Valley and contains the largest known creosote rings on public lands. The site was designated for protection of an Unusual Plant Assemblage based on its uniqueness, high research value and susceptibility to damage from intensive recreation uses (CEC 2012).
Superior-Cronese	This ACEC covers 629,300 acres and covers desert tortoise critical habitat as identified in the Desert Tortoise Mojave Population Recovery Plan. Similar to the Ord-Rodman DWMA, Superior-Cronese contains high density desert tortoise habitat and provides tortoise habitat linkage. The site contains highest value critical habitat for desert tortoise conservation and recovery. Additional special status plant and animal species found at this site include the Barstow woolly sunflower, crucifixion thorn, desert cymopterus, Mojave monkeyflower, and Mohave ground squirrel. (CEC 2012).
Upper Johnson Valley Yucca Rings	This ACEC is located to the northeast of Lucerne Valley, along the southwestern slope of Fry Mountains. The 320-acre site contains the largest and oldest Mojave Yucca rings known, estimated to be up to 2,250 years old. Similar to the Soggy Dry Lake Creosote Rings site, Upper Johnson Valley Yucca Rings was designated for protection of an Unusual Plant Assemblage based on its uniqueness, high research value and susceptibility to damage from intensive recreation uses (CEC 2012).
West Paradise	This ACEC consists of 1,243 acres, which lie entirely within the Superior Cronese DWMA near Lane Mountain, in the northeastern portion of the Region. All known populations of the Lane Mountain milkvetch outside of the Fort Irwin Expansion Area are located within this site and the Coolgardie Mesa Conservation Area. Important wildlife species found at this site include desert tortoise and Mohave ground squirrel (CEC 2012).

Figure 2-5
Mojave Region Wildlife Corridors



2.4.3.2 Parks, Reserves and Wilderness Areas

Various parks, reserves and wilderness areas within the Region also provide protection for the existing ecological resources as well as recreational and educational opportunities associated to those resources. Below is a description of major parks and other managed areas with ecological significance in the Region.

Black Mountain Wilderness. This wilderness area located northwest of Barstow provides opportunities for hiking, camping, and hunting. Black Mountain wilderness area is dominated by the mesa that rises above volcanic flow features in the northwest corner of the wilderness. A deposit of fine-grained sand dune is found in the southeast corner and significant prehistoric rock art is also contained within the area. Elevations range from 2,080 to 3,940 feet and the wilderness area boasts wildlife such as golden eagles and prairie falcons, as well as spring flower displays (BLM 2005, 2011).

Camp Cady Wildlife Area. This area is a riparian oasis located between Barstow and Afton Canyon on the Mojave River. This site, covering 1,552 acres, is managed by CDFW for the protection of wildlife, serving as a refuge for Mojave tui chub, an endemic endangered fish. Mesquite thickets and riparian forests at the site provide habitat for numerous declining bird species, including, yellow-breasted chat, yellow warbler, summer tanager, LeConte's thrasher and Lucy's Warbler. Notably, Camp Cady has the highest number of Lucy's warbler within the western Mojave Desert. Camp Cady Wildlife Area is an important habitat area for nesting and wintering raptors, including golden eagle, prairie falcon, and ferruginous hawk as well as for the Mojave fringe-toed lizards which find important habitat in the sand dunes and hummocks in the western portion of Camp Cady (BLM 2005).

Grass Valley. This wilderness area extends over 30,000 acres and consists primarily of the Grass Valley itself, with a series of scattered hills that rise up to 600 feet above the desert floor. The dominant vegetation community found in this wilderness is creosote bush scrub with scattered Joshua trees. Wildlife includes various raptors, desert tortoise and Mohave ground squirrel (BLM 2005, 2011a).

Joshua Tree National Park. Joshua Tree National Park extends over nearly 800,000 acres, of which a small portion in the northwest corner of the Park lies within the Mojave IRWM Region. The Park lies in an area where three of California's ecosystems come together: the Colorado Desert, the Mojave Desert and the Little San Bernardino Mountains. The latter two fall within the Region boundaries. Diverse and unique natural features, including sand dunes, dry lakes, flat valleys, rugged mountains, and oases, create habitat for a diversity of biological communities. Within the Mojave Desert portion of the Park, the Joshua tree is a dominant feature in the landscape. The Little San Bernardino Mountains, located in the western part of the Park provide habitat for a community of California juniper and pinyon pine. The Park contains a high diversity of plant and animal species, the latter which include herds of desert bighorn, and six species of rattlesnakes. Over 250 kinds of birds have been recorded at the Park, many of which are migratory species (NPS 2013).

King Clone Ecological Reserve. This 488-acre CDFW reserve is located east of Lucerne Valley, surrounded by the BLM's Johnson Valley Open Area. The site was primarily established to protect ancient creosote bushes, including the oldest known specimen, a circular shrub approximately 11,700 years old (BLM 2005).

Mojave Narrows Regional Park. This Park is owned by the State Wildlife Conservation Board and operated by San Bernardino County Department of Regional Parks. The area comprises 850 acres, of which 450 aces are devoted to habitat. A permanent stream supports extensive riparian forest, providing habitat for numerous species and creating a biological hotspot where 17 sensitive species are found together (BLM 2005).

Newberry Mountains Wilderness. Prominent features of this wilderness area are its rugged volcanic mountains, with elevations reach up to 5,100 feet and deep, maze-like canyons. Wildlife found in this area includes desert bighorn sheep, prairie falcons and golden eagles. Wildflower displays can be seen in Spring along the western area boundary (BLM 2005, 2011a).

Rodman Mountains Wilderness. This wilderness area is located southeast of Barstow, spanning over 34,000 acres. Within this area visitors will observe a series of ridges and valleys that reach up to 5,000 feet, with colorful escarpments and calico-colored mountains. Several natural water "Tanks" are found throughout the wilderness, within ancient lava flows, and during heavy rains, cascades develop along the deep drainage channels. Raptors can be observed at this core raptor breeding area (BLM 2005, 2011a).

West Mojave Desert Ecological Reserve. This CDFW reserve, made up of 22 parcels and covering nearly 12,000 acres, lies within desert tortoise critical habitat and the Fremont-Kramer DWMA. The reserve includes habitat for desert tortoise, Mohave ground squirrel, Le Conte's thrasher and Barstow woolly sunflower, among other species (BLM 2005).

2.5 Social and Cultural Characteristics

2.5.1 Demographics and Population

The MWA service area spans 4,900 square-miles and has a population of approximately 450,000 (MWA 2014b). The MWA service area is made up of relatively small urban centers with fairly low population densities. Table 2-4 shows demographic data for the major cities and towns in the Region.

For water management purposes, the MWA service area is generally separated into six management areas, including the five "subareas" of the Mojave River Watershed and associated groundwater basins (Alto, Baja, Centro, Este, and Oeste) and the Morongo Basin/Johnson Valley Area (referred to throughout this document as "Morongo" or the "Morongo Area").

Table 2-4
Demographic Data for Major MWA Service area Cities and Towns

City/Town	Subarea	Population[a]	Under 18 Years	65 Years and Over	Number of Households	Average Household Size	Median Household Income [b]	Persons Below Poverty Level [b]	Land Area (sq. miles)[c]	Persons (sq. miles)[c]
Adelanto	Alto	32,221	37.2%	4.4%	7,060	4.06	$42,208	27.7%	56	567.1
Apple Valley	Alto	70,172	27.9%	15.4%	22,851	2.97	$50,664	18.6%	73.19	944.6
Barstow	Centro	22,975	29.8%	10.7%	8,264	2.72	$45,417	22.2%	41.38	547
Hesperia	Alto	91,534	32.3%	9.0%	25,088	3.51	$48,624	19.9%	73.1	1233.6
Victorville	Alto	117,597	32.8%	8.1%	30,806	3.47	$52,357	21.8%	73.18	1583.9
Yucca Valley	MB/JV Area	21,009	23.9%	18.5%	7,957	2.54	$45,502	15.5%	40.02	517.3

Source: US Census Bureau: State and County Quick Facts.
Notes:
(a) 2011 estimates.
(b) 2007-2011 estimates.
(c) US Census Bureau 2010.

2.5.1.1 Population Projections

The MWA service area has experienced significant population growth over the last 15 years, with nearly 40 percent growth between 2000 to 2010 located within the Mojave Groundwater Basin (MWA 2011). Based on the SCAG 2012 RTP growth forecast (baseline of 2008), it is predicted that the MWA service area will grow at a rate of approximately 2.2 percent per year through 2035. Table 2-5 uses the assumption that each of the subareas grow at the nearest city-wide rate, with the Baja subarea having the highest annual change in rate at 3.6 percent over the 2010-2035 period. On February 26, 2014, MWA released an update to their demand forecast model that was used in the 2010 Urban Water Management Plan (UWMP). The tables below reflect the updated demand forecast model. The totals do not match MWA's 2010 UWMP because the model was updated to account for population data through 2012 (instead of the previous model that only incorporated population data to 2010).

Table 2-5
Current and Projected Population Estimates – MWA Service Area

Subarea	2010	2015	2020	2025	2030	2035	Annual % Change 2010-2035
Alto	358,228	389,250	432,825	479,786	526,746	573,705	2.4%
Baja	4,729	5,499	6,990	7,661	8,332	9,004	3.6%
Centro	34,167	37,917	43,535	47,010	50,485	53,960	2.3%
Este	7,370	8,149	9,361	10,169	10,977	11,785	2.4%
Oeste	10,595	10,823	11,039	11,738	12,437	13,136	1.0%
Morongo	38,177	39,423	40,918	42,211	43,504	44,798	0.7%
Total Area	**453,266**	**491,061**	**544,668**	**598,575**	**652,481**	**706,388**	**2.2%**

Source: MWA update to its 2010 UWMP demand forecast projection model dated February 26, 2014.

For the MWA 2010 UWMP, a demand forecast model (discussed above) was developed that combines population growth projections with water use data to forecast total water demand in future years. Water uses were broken into specific categories and assumptions made about each category to more accurately project future use.

Current population was estimated using three data sets. Past and current population was taken from 2000 and 2010 Census block data by MWA subarea, selected using the MWA Geographic Information System (GIS). Population from years 2001-2009 and 2011-2012 within incorporated cities was taken from annual California Department of Finance (DOF) estimates. Population in unincorporated areas was correlated to population changes in the nearest incorporated city based on 2000 and 2010 Census data, and then estimated for years where Census data were not available.

Single Family Residential (SFR) and Multi-Family Residential (MFR) populations were separated in the model because conservation factors were applied to SFR water use for future years but not MFR water use. SFR population was estimated using the number of active service connections reported by water retailers and multiplying by household size. Estimations of SFR population based upon service connections were calculated through 2008, and then the ratio of SFR to total population was used to estimate SFR population from 2008 forward. Household size data were taken from the 2000 Census and the American Community Survey 2005-09, and interpolated linearly for intermediate years. MFR population was calculated as total population minus SFR population.

Population estimates for 2010 contained in the 2010 UWMP were slightly low compared to actual Census data when it became available. The actual Census data were used in the February 24, 2014 update of the demand model.

Population growth projections in the model are based upon 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 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. Current population was updated through 2012, but projected population numbers for 2020 and 2035 were kept equal to the original SCAG-based numbers. This changed the growth rate slightly for years 2012-2020.

2.5.2 Economic Factors

The overall economy continues to recover and the State of California has actually started to outpace the nation over the past year. The Mojave Region is no exception to this rule, with consumer and business spending on the rise, local property values increasing, and a short supply of homes available for sale. As the local unemployment rate falls and nonfarm payrolls expand, it is forecasted that the local property market, both on the commercial and residential sides of the market, will continue to improve in 2013-14 and beyond. Interest rates for mortgages remain near all-time lows, which are helping to incentivize new home buyers - a trend that is expected to continue as broader economic conditions in the Mojave Region improve. In addition, despite all of the construction that went on during the California housing bubble, California still maintains the lowest housing vacancy rate in the nation. Therefore, growth is expected to be seen in new residential and nonresidential construction in coming years.

Each of these factors makes it likely that the assessed valuation of real property in the Mojave Region will gradually improve in the years ahead. As property values continue to rise, Proposition 13 (restricted increases in property tax starting in 1976) increases will begin to kick-in. In addition, new and existing home sales will bolster the local assessed valuation of real property base as more homes sell at gradually higher prices. New housing stock will come on-line in the coming years as well which will expand the property tax base further. The forecasted growth of 3%-4% in the Mojave Region assessed valuation of real property is fairly low, but it is better than the past. (Beacon Economics 2012).

The lands within the Mojave Region — in their natural state—provide significant economic benefits for the communities around the desert. Some of the different economic drivers that rely on the desert's resources include outdoor recreation, tourism, and military operations.

Joshua Tree National Park's 800,000 acres just east of the Palm Springs area protect 501 archeological and 88 historical sites. In 2004, Joshua Tree National Park received 1,243,659 visitors. Total visitor spending was $49.3 million. Visitor spending generated $23.2 million worth of personal income, defined as wage and salary income and employee benefits for area residents.

Tourist dollars supported more than 1,152 jobs (National Parks Conservation Association, 2006). Enormous tracts of public lands in the northern part of the Region in the desert near Barstow—are under the BLM control and open to the public.

Military installations located in the Mojave Desert have a significant economic impact on the surrounding communities. The Mojave Desert is home to a number of major military bases, including the Twentynine Palms Marine Corps Air Ground Combat Center, the Marine Corps Logistics Base in Barstow, neighboring Edwards Air Force Base and Fort Irwin National Training Center. The Twentynine Palms base produced $533 million in salaries, services and construction and maintenance contracts in 2004. An estimated $363 million of that money stayed in the Mojave Region (Defenders of Wildlife 2007). It should be noted that federal institutions, particularly military ones discussed above, cannot be compelled to participate in State planning efforts such as this IRWM Plan: they are exempt.

The businesses of the Region are optimistic about the potential for future development. The Region is one of the best places in the world for solar energy development because of its high altitude, the number of sunny days each year, and existing power infrastructure. California's electric utility companies are required to use renewable energy to produce 20 percent of their power by 2010 and 33 percent by 2020.

Many large solar energy projects are being proposed in California's desert area on BLM, state and private lands. In January 2013, MWA identified 31 proposed solar projects, totaling over 3,800 megawatts, in various stages of planning within the Mojave IRWM Region. Most proposed projects will use photovoltaic technologies, however a solar-thermal power plant is currently under construction near Harper Dry Lake and a hybrid power project has been approved in the Victor Valley area. Several wind power testing sites have also been proposed in the Region.

2.5.3 Disadvantaged Communities

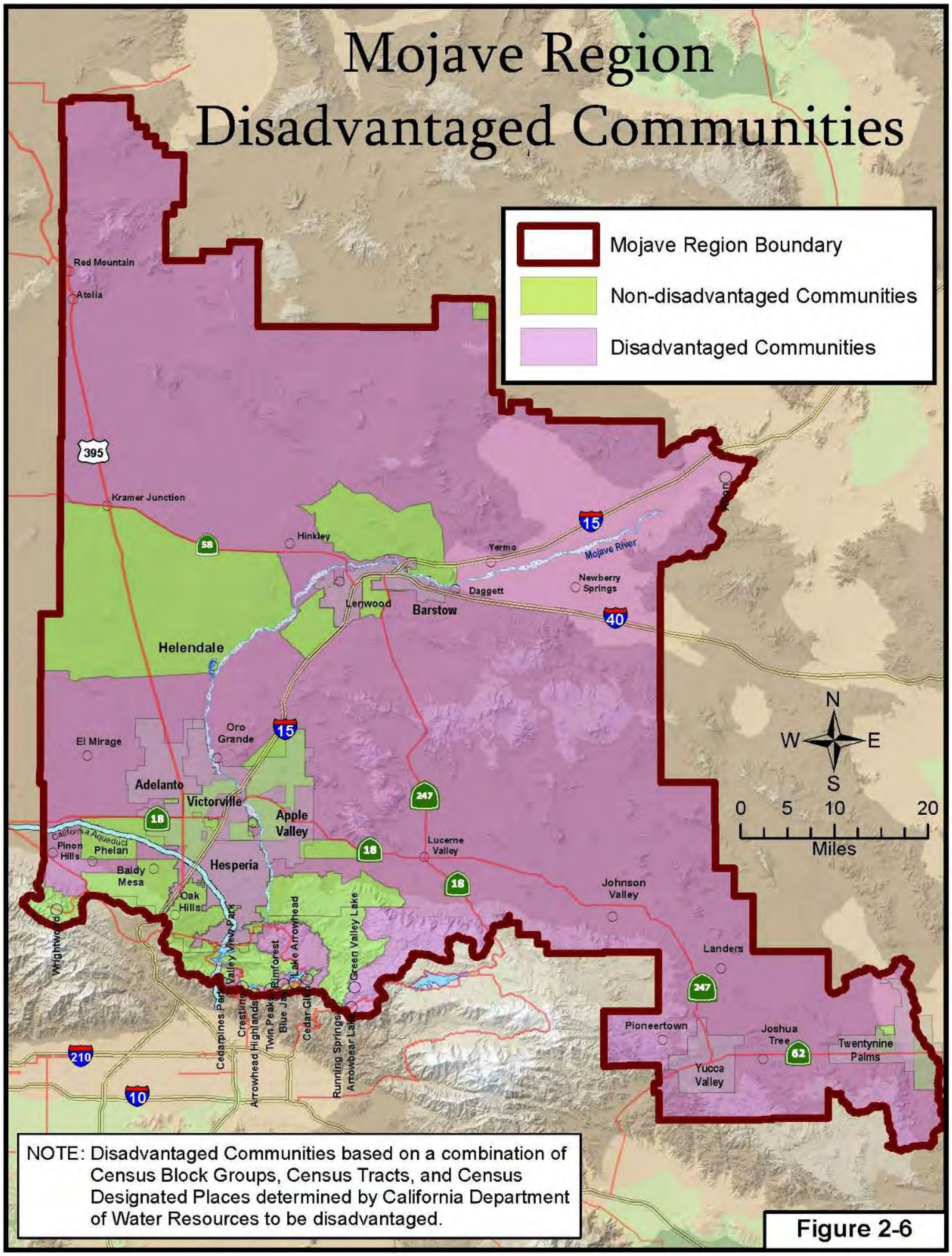
The California Department of Water Resources (DWR) defines a disadvantaged community (DAC) as a municipality, including, but not limited to a city, town or county, or a reasonably isolated and divisible segment of a larger municipality, that has an average median household income (MHI) that is less than 80 percent of the statewide annual MHI. In California, a MHI of less than $48,314 meets this threshold based on 2009 US Census Bureau (USCB) data. A community with an MHI of less than 60 percent of the statewide annual MHI is deemed a severely disadvantaged community. As shown on Figure 2-6, approximately 80 percent of the IRWM Region qualifies as disadvantaged and DACs are located in both rural and urban areas.

2.5.4 Social and Cultural Values

2.5.4.1 Maintenance of Agricultural Character

The San Bernardino County General Plan promotes preservation of agricultural lands in recognition of this important segment of the County's economic base and to encourage the open space values that these lands provide (San Bernardino County 2012). Large parts of the Region are characterized by low-density and rural land uses and the open space values of the Region's agricultural lands contribute to preserving and enhancing the quality life for residents in addition to the Region's biological resources.

Figure 2-6
Mojave Region Disadvantaged Communities



Various agricultural land uses exist within the Mojave Region. Common agricultural activities in the Region include dairies, hay crops such as alfalfa, and orchards such as pistachios. A majority of the active agriculture occurs along the Mojave River in Southern Apple Valley and Hesperia, along the Mojave River between the Lower Narrows and Barstow, in Hinkley, Newberry Springs, Lucerne Valley, and the El Mirage area. The sustainability of agriculture is a significant concern for the Region, particularly in the Newberry Springs area (the Baja subarea of the Mojave River Groundwater Basin), because of continuously declining groundwater levels and because imported State Water Project (SWP) water is relatively unaffordable for current agricultural uses.

There has been a significant decline in agriculture in Lucerne Valley and along the Mojave River in the Oro Grande region – particularly alfalfa and hay crops - since the first recession in the 90's. The number of dairies within the Mojave River Groundwater Basin is also in decline. Commercial agriculture in the Alto Subarea – including the Oro Grande stretch down to Centro – has largely been fallowed due to permanent or annual transfers of agricultural water rights to municipal and industrial entities. Small commercial and hobby farms are becoming established in some communities, along with orchards and various tree crops, which generally consume less water per acre than alfalfa and other hay crops.

2.5.4.2 Cultural Resources

In addition to its unique ecosystems and biological diversity, the Region is characterized by a cultural richness. The area encompasses numerous prehistoric and historic archaeological sites, and traditional cultural sites, many of which are registered historic landmark sites, including the Rodman Mountains Petroglyphs Archaeological District in the Lucerne Valley/ Barstow areas, Twentieth Century Folk Art Environments sites in Hesperia and Yermo, and the Town of Calico (SCAG 2012; San Bernardino County 2012).

Several ACECs designated by BLM for cultural values are found within Region boundaries, many of which are discussed in Section 2.4. These include Big Morongo Canyon, Black Mountain, Juniper Flats, Manix, Rainbow Basin, Red Mountain Spring, and Rodman Mountains Cultural Area.

An additional ACEC of cultural importance is Calico Early Man Site, which is a National Register of Historic Places Property, protecting evidence of possibly the earliest human occupation on the North American continent. This site provides guided tours and interpretive activities for visitors (BLM 2005). Calico is also well-known for Calico Ghost Town, a Regional Park managed by the County of San Bernardino. An abandoned silver mining town from the late 1800s, this town is highly visited for its historical attractions and outdoor recreational opportunities (San Bernardino County 2013b).

2.5.4.3 Maintenance of Recreational Opportunities

The Mojave Region, with its rich biological diversity, unique landscapes and geologic features, as well as valuable cultural resources, provides numerous opportunities for recreation. Popular recreational activities in the Region include, but are not limited to, hiking, camping, off-road vehicle use, bird watching, wildlife and archaeological interpretive tours, and petroglyph visits. Local and regional parks, designated wilderness areas and other managed areas provide enhanced opportunities for locals and visitors to enjoy the Region's offerings. The protection of the Region's open spaces will help maintain ecological diversity and cultural resources, recreational opportunities into the future, thereby contributing to the enhanced quality of life that is envisioned for the Region.

2.5.4.4 Environmental Enhancement

Various special management efforts are in place to protect the environmental resources of the Region, including general plan policies described in Sections 2.3 and 2.4. Additional programs that are contributing to environmental enhancement within the Region include conservation efforts in the Morongo Basin, efforts led by the BLM (as indicated in the *West Mojave Plan)*, and biological resource mitigation requirements identified in the Mojave Basin Judgment.

It has been recognized that the protection and enhancement of the Region's environmental resources should be integrated with management of the Region's water resources. Provisions related to the environmental resources of the Mojave River Groundwater Basin were made in connection with groundwater management in 1996. As part of the Mojave Basin Judgment, mitigation measures were outlined in efforts to protect and enhance the riparian resources within the Basin. Water table standards were proposed by CDFW (then California Department of Fish and Game) and monitoring wells are in place to maintain appropriate groundwater levels. In the case that groundwater levels fall below certain requirements, a Biological Resources Trust Fund was established for implementing necessary management efforts in order to protect the identified riparian resources. These funds can be used by CDFW to conduct activities, such as purchasing water to support riparian areas, fixing wells to supply the water, and preparing a habitat water supply management plan (Judgment Exhibit H).

A crucial effort of environmental enhancement in the Morongo Area of the Region is the Morongo Basin Conservation Priority Setting Project. The Project was developed between 2008 and 2010 in support of ongoing long-term development and conservation efforts in the Morongo Basin. The *2012 Morongo Basin Conservation Priorities Report* (Sonoran Institute) serves as a resource guide helping to inform and support these activities, and to balance environmental protection with the enhancement of social and economic well-being throughout the Morongo Basin area. This planning approach includes involvement from local, state, and federal entities from government, business, and community sectors, among other interested groups. The conservation values identified by this Project include wildlife connectivity and habitat, maintaining community identity, and protecting community views and treasures. As a means of addressing identified priorities numerous action steps have been outlined, such as maintaining forum and dialogue for regional conservation planning, establishing conservation easements and purchasing land for conservation purposes, and enacting incentives and regulation for wildlife-sensitive development. This Project is an important step for environmental enhancement in the Region, particularly in the face of development and growth pressures (Sonoran Institute 2012).

2.5.4.5 California Native American Tribes

Although there are a few Native American tribal reservations in San Bernardino County, there were no identified existing Native American tribal reservations in the MWA service area (SCAG 2012). However, during construction of the Desert Knolls Wash Project (located in the Town of Apple Valley), the San Bernardino County Flood Control District encountered tribal artifacts from burial sites that pertain to San Manuel Band of Mission Indians. While several sources of information were attempted, contact was finally made with the San Manuel Band of Serrano Mission Indians located in Highland, CA (outside of the Mojave Region) and it was discussed that even though tribal land is not within the Mojave planning boundaries, the Band's ancestral land encompasses the entire San Bernardino County. The Tribe was informed of the recently expanded boundaries for the Mojave Region and Stakeholder Group information was provided.

In addition, when the IRWM Plan stakeholder group decided to expand the Region's boundary, it was determined that one of the IRWM Region expansion areas included the tribal lands of the Twenty-Nine Palms Band of Mission Indians. The Tribe has set up an administration that serves the day-to-day needs of the tribal membership and government functions. The numerous programs the Tribe operates under the Tribal government include education and record keeping. The Tribe has grown from having little in the way of economic development in 1995 to self-sufficiency in 2014. The Tribe has looked to economic development opportunities in order to build for its future and provide for the wellbeing of its citizens and the tribal community (Twenty-Nine Palms Band of Mission Indians 2014).

2.6 Hydrologic Features

2.6.1 Watersheds

The Mojave Region includes two major drainage areas: the Mojave River Watershed and the Morongo Basin/Johnson Valley Area Watershed.

The entire Mojave River Watershed is now located in the Region because the four expansion areas have been added to the Region's boundary as discussed earlier in this section. The Mojave River Area drains an area of 3,800 square miles. The watershed drains into the Mojave River or local terminal dry lakes.

The Mojave River is the largest stream in the watershed, originating in the north side of the eastern portion of the San Bernardino Mountains. The River is formed at the junction of streams at the northern foot of the San Bernardino Mountains (see Figure 2-1). From the junction, the River flows in a general northward direction through the City of Victorville, then north and northeastward through the City of Barstow, and eventually through Afton Canyon. There are only few sections of the River that have perennial flows that are fed in dry periods by groundwater, such as within portions of Afton Canyon (USGS 1996 and 2009).However, during and immediately after storms (principally during the winter), the Mojave River flows along several, sometimes all, of its reaches. Most of the river flow occurs immediately after storms.

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 geologic conditions cause groundwater to discharge at land surface, such as near the Helendale or the Waterman Faults (MWA 2011).

The Morongo Basin/Johnson Valley Area Watershed, the Region's smaller drainage area, has no sizeable river, but rather consists of small ephemeral streams that drain surrounding mountains. Captured runoff either percolates into the stream beds or, during large storm events, flows to dry lake beds where it evaporates. The area encompasses parts of six separate surface water drainages: Warren, Copper Mountain, Emerson, Means, Johnson, and Lucerne.

2.6.2 Groundwater Basins

The Mojave Region overlies all or a portion of 36 groundwater basins and subbasins as defined by DWR Bulletin 118-03 (Figure 2-7). 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; the area is referred to as the Mojave Basin Area. Remaining basins in the southeastern Mojave Region are referred to as the Morongo Basin/Johnson Valley Area or "Morongo Area" with the exception of the Lucerne Valley. The Lucerne Valley subbasin splits along the Helendale Fault with the southwest portion in the Mojave River Groundwater Basin and the northeast portion in the Morongo Groundwater Basin. The surface water drainage of Lucerne Valley is in the Colorado River Region but is not included in with the "Morongo Basin Area," thus creating an "island effect" due to the hydrogeologic conditions.

The Mojave River Groundwater Basin is the larger and more developed of the two areas. The 36 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 while the Morongo Area and a portion of the Este Subarea of the Morongo Groundwater Basin are in the Colorado River Hydrologic Region. The 36 groundwater basins and subbasins are listed in Table 2-6 and grouped by the South Lahontan (Region 6) and Colorado River (Region 7) Hydrologic Regions. The Mojave Region 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 2-6; however, because this is such a small overlap, the Mojave Region is not involved with any jurisdictional issues with this groundwater basin.

Table 2-6
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

Table 2-6
DWR Groundwater Basins

DWR Basin	Sub-Basin	Groundwater Basin	Sub-Basin Name	Budget Type[(a)]
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

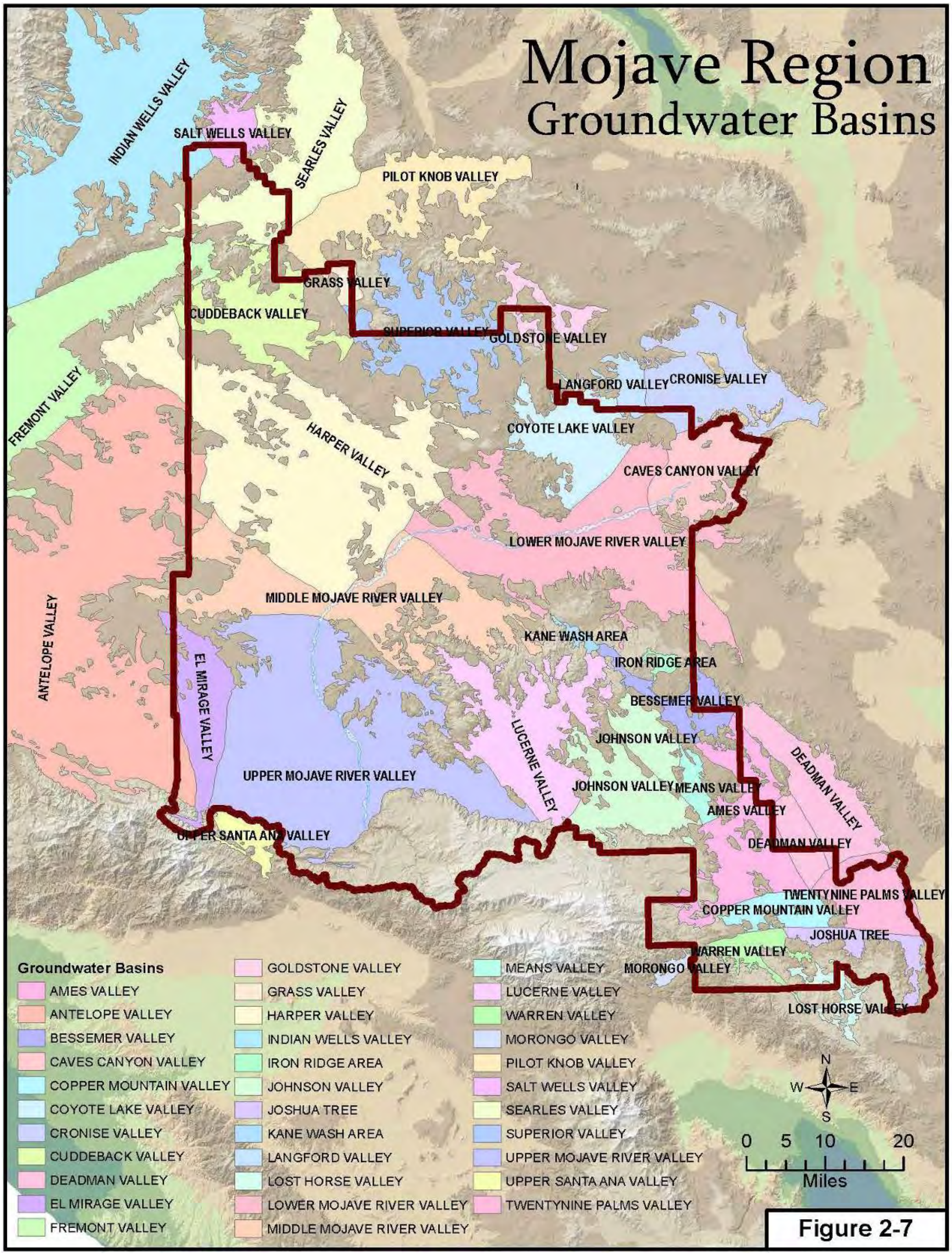
Source: MWA 2010 UWMP.
Notes:
(a) Type A – either a groundwater budget or model exists, or actual extraction data is available. Type C – not enough available data to provide an estimate of the groundwater budget or basin extraction.

2.6.2.1 Mojave River Groundwater Basin

The Mojave River Groundwater Basin, the largest in the Region, encompasses 1,400 square miles (Figure 2-1), and has an estimated total water storage capacity of nearly 5 million acre-feet (af) (Bookman-Edmonston Engineering, Inc. 1994). The Mojave River Groundwater Basin Area is essentially a closed basin which means that very little groundwater enters or exits the basin. However, within the basin, groundwater moves between the different subareas; groundwater-surface water and groundwater-atmosphere interchanges also occur. Approximately 80 percent of the basin's natural recharge is through infiltration from the Mojave River. 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, the US Geological Survey (USGS), and others have resulted in an improved understanding of 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 2-1. 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.

Figure 2-7
Mojave Region Groundwater Basins



2.6.2.2 Morongo Basin/Johnson Valley Area

The Morongo Area represents the DWR groundwater basins east and southeast of Este Subarea that are within the Mojave Region 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 2-8 and include, from northwest to southeast, Johnson Valley, Means Valley, Ames Valley, Warren Valley, and Copper Mountain Valley/Joshua Tree regions. The Morongo Area classifications and boundaries are based on those described in the MWA 2010 UWMP and 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.

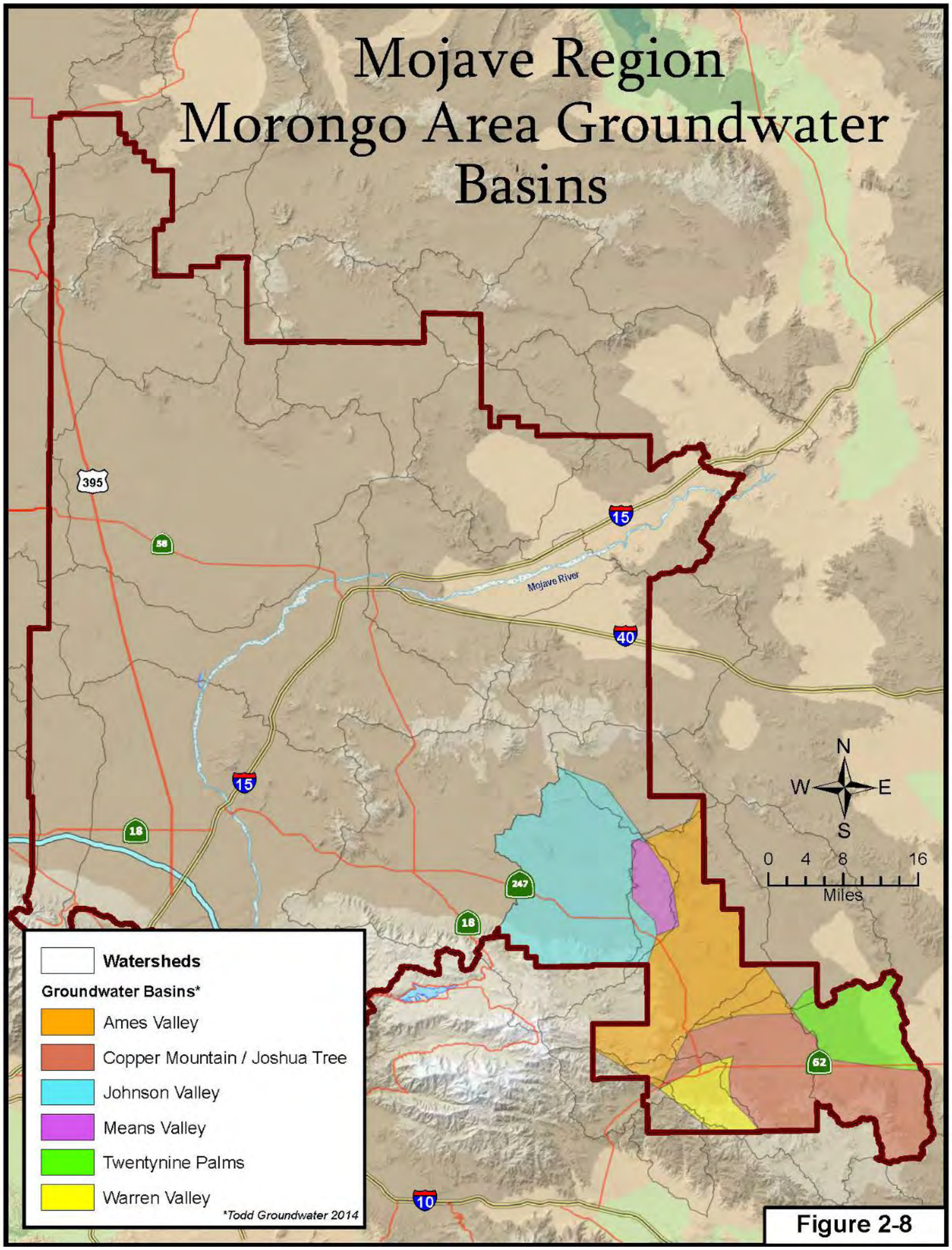
The groundwater basins within the Morongo Area are bounded by the Ord Mountains to the north, the Bullion Mountains to the east, the San Bernardino Mountains to the southwest, and the Pinto and Little San Bernardino Mountains to the south. The larger Morongo Area includes numerous small alluvial basins 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. Tertiary and Quaternary age alluvial sediments form 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 the Mojave Region. 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 (MWA 2011).

2.6.2.3 Adjudication

Two major groundwater basins in the Region are adjudicated basins that are managed by appointed watermasters. In addition to these adjudications described below, the Ames Valley Basin is managed according to the 1991 court-approved agreement made between Hi-Desert Water District (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 County Service Area (CSA) No. 70 and to provide a monitoring and management plan for operation of the Basin with the Ames Valley Recharge Project. The parties have signed an Agreement which includes them in the new management strategy. All signatories will become party to a Stipulated Judgment which will be filed after construction of the facility is complete.

Figure 2-8
Morongo Area Groundwater Basins



2.6.2.3.1 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 Region, 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, MWA 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 acre-feet per year (afy) (Mojave Desert Land Trust) or less who were dismissed from the litigation, and 2) offered 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 County 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 B.1.

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 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.

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 60 percent of BAP for municipal and industrial (M&I) (FPA to be set at 60% of BAP for M&I for the 2013-14 Water Year subject to continued rampdown). Implementation will be held in abeyance for one additional year at 80% subject to court approval (Noting that the original four year abeyance started in the 2009-10 Water Year).
- Este Subarea - 80 percent of BAP (FPA to be set at 80% of BAP for the 2013-14 Water Year). The Subarea may be subject to future rampdown to 65% immediately if water use conditions change.
- Centro Subarea - 80 percent of BAP.
- Baja Subarea – 57.5 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.

2.6.2.3.2 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 and its progressively increasing overdraft led to adjudication of the Warren Valley Basin in 1977. In its Warren Valley Judgment (see Figure 1-2), the court appointed the 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 B.2.

2.6.3 Geology

The geology of the Mojave Basin Area is characterized by sedimentary alluvial basins bordered by igneous and metamorphic mountain ranges and uplands; the uplands dominated by the San Gabriel and San Bernardino Ranges along the Mojave Basin's southern border. A typical geologic cross-section depicting the geologic sequence is shown on Figure 2-9; and geology of the basin is shown on Figure 2-10.[2] The ranges and uplands are composed of pre-Tertiary (greater than 65 million years ago) igneous and metamorphic rocks (labeled as pTb in accompanying figures), and Tertiary (1.64 to 65 million years ago) volcanic and sedimentary rocks (Tv and Ts, respectively). Numerous extensive strike-slip faults trend northwest to southeast across the basin, causing predominantly horizontal displacement (but also vertical displacement for some faults) in the geologic section (MWA 2004).

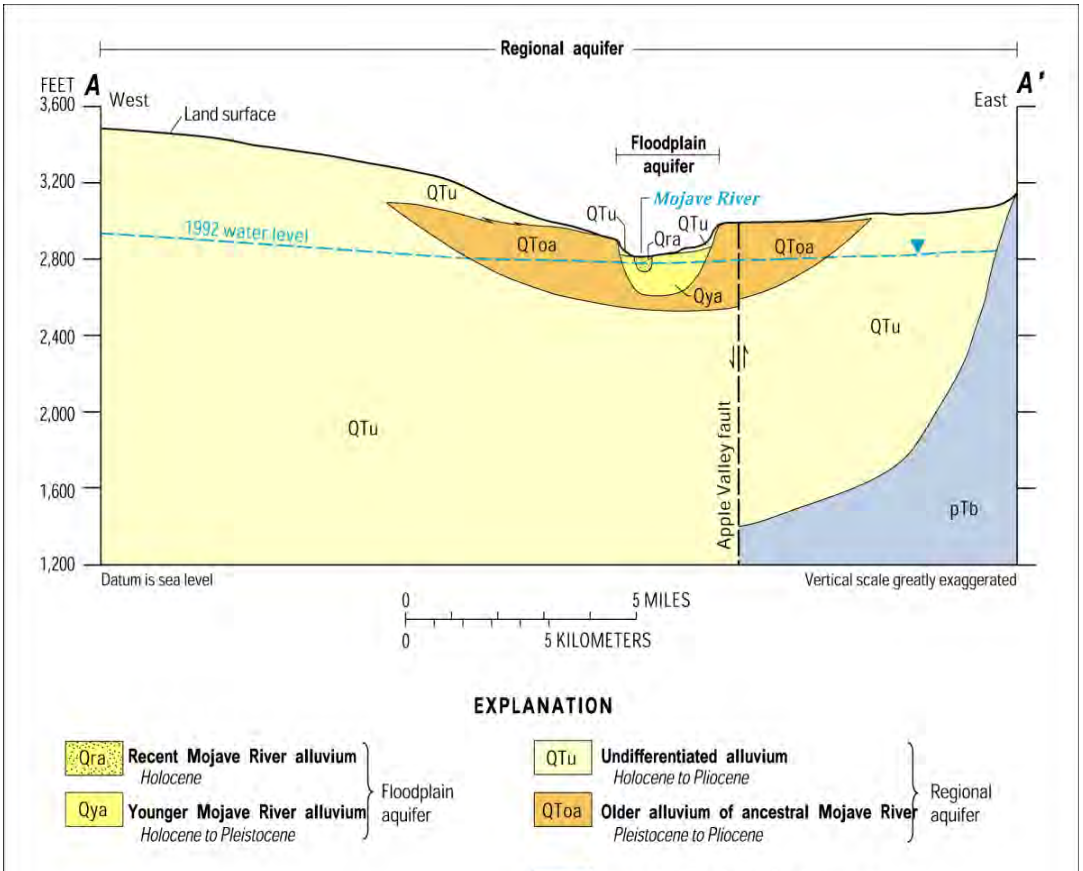
The alluvial basins are composed of Quaternary (0 to1.64 million years ago) unconsolidated river, lake, and playa deposits. The river deposits comprise different ages of granitic sand, silt, and gravel laid down by the Mojave River and its predecessors – the youngest deposits directly surrounding the current river bed, with progressively older deposits further from the river or deeper below it.

[2]Stamos, et al., 2001

Surrounding and underlying the current and ancestral Mojave River alluvium are poorly sorted alluvial deposits from ancestral alluvial fans, braided-streams, lakes or playas.

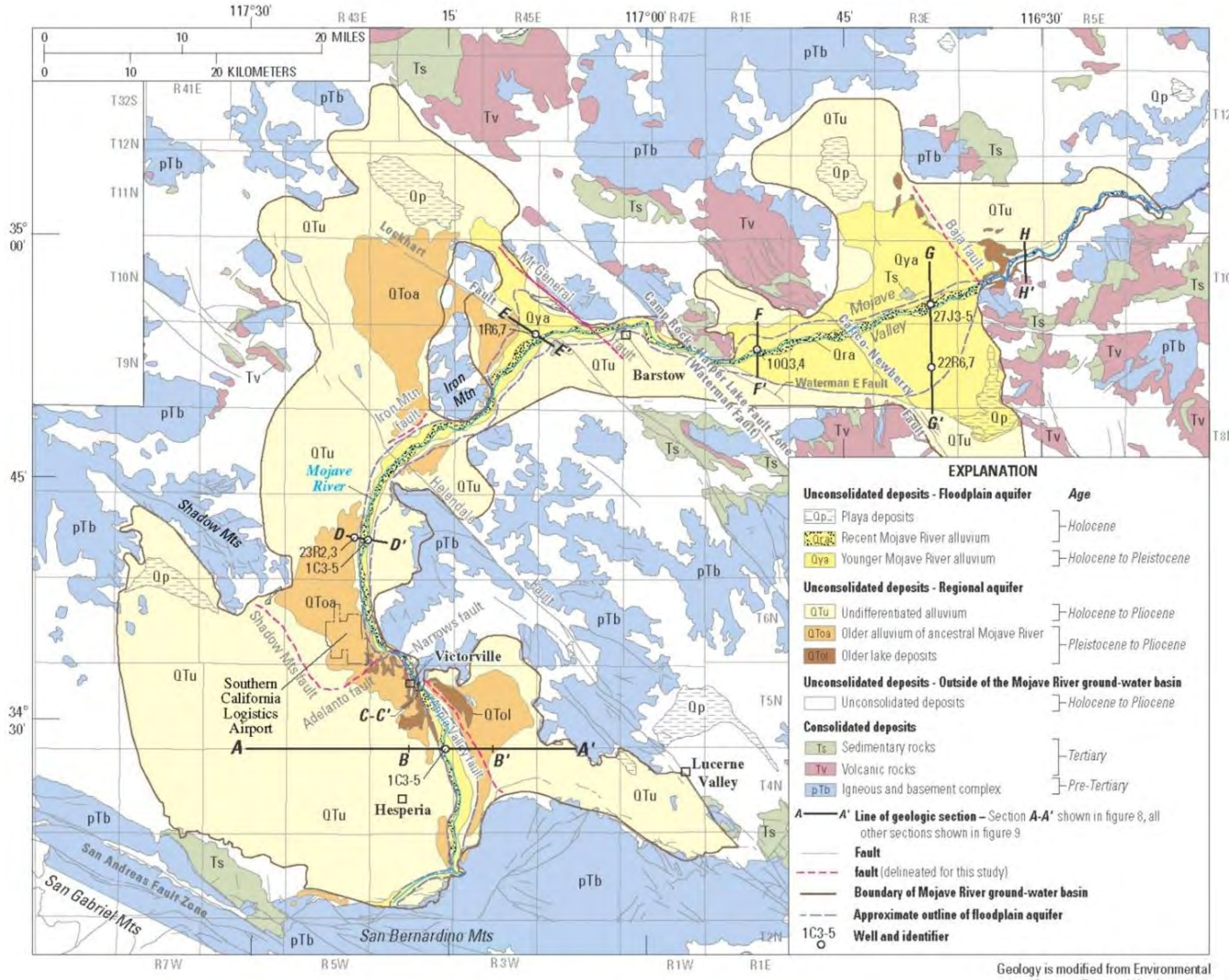
The geology of the Morongo Basin/Johnson Valley Area has not been investigated to the same degree as the Mojave Basin Area. In general, the area is similar to the Mojave Basin Area – sedimentary basins surrounded by igneous/metamorphic mountain ranges/uplands. The sedimentary basins are composed of Quaternary and Tertiary continental deposits (Smith and Pimentel 2000). The mountain ranges include the Ord and Granite Mountains in the north, Bullion Mountains in the east, San Bernardino Mountains in the southwest, and Pinto and Little San Bernardino Mountains in the south. As in the Mojave Basin Area, numerous northwest to southeast trending strike-slip faults traverse the Morongo Basin/Johnson Valley Area (MWA 2011).

Figure 2-9
Typical Geologic Cross-Section of Mojave River Groundwater Basin



Source: Stamos et al. 2001.

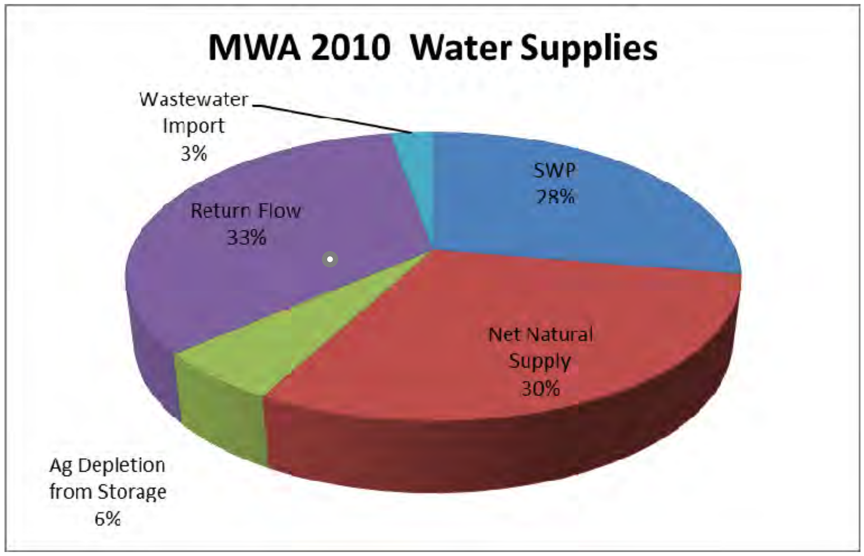
Figure 2-10
Geology of Mojave River Groundwater Basin



Geology is modified from Environmental Systems Research Institute, 1992

2.7 Overview of Water Supplies

Water supply in the MWA service area comes from numerous sources, which include 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 3.2.2.2. Almost all of the water use within the MWA service area is supplied by pumped groundwater. Native surface supply, return flow, and SWP imports recharge the groundwater basins; therefore, water management practices concentrate on long-term methods to ensure sustainability as the groundwater basins are buffered from short-term fluctuations in any part of the water supply. Details on the Region's water supply are provided in Section 3.1 of this IRWM Plan.



2.8 Water Related Infrastructure

As the Region's water wholesaler, MWA and its UWMP serve as a primary component of information for many of the retailer's Plans as defined in the California Water Code. Currently, 47 water retailers exist within MWA boundaries, ten of which were required to prepare a separate UWMP in 2010 (due to having more than 3,000 service connections or serving more than 3,000 afy of water) and are listed in the following subsection. MWA prepared and adopted its 2010 UWMP update in June 2011 (MWA 2011). While the retailers each have water infrastructure for their individual service area, MWA constructs and maintains water infrastructure for its entire service area, which is also discussed below.

2.8.1 Retail Water Purveyors

Thirteen retail purveyors provide water service to approximately 90 percent of the residents within the Mojave Region. The remaining 10 percent of the Region's population is served by small water purveyors with less than 3,000 service connections or serving less than 3,000 afy (and therefore not required to complete an UWMP). Also, a portion of the population is served by private wells and is not served by Urban Water Suppliers or small water purveyors.

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. (Agency still completing their 2010 UWMP.)
- Crestline Lake Arrowhead Water Agency (CLAWA) serving Upper Mojave expansion area. This agency is not a purveyor to MWA but is included in the Region's expanded boundary area discussed in Section 2.10 below.
- 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 (HDWD) service area includes the Town of Yucca Valley and portions of the unincorporated area of San Bernardino County.
- Joshua Basin Water District's (JBWD) 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.
- Lake Arrowhead CSD's (LACSD) serving Upper Mojave expansion area. This agency is not a purveyor to MWA but is included in the Region's expanded boundary area discussed in Section 2.10 below.
- 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.
- Twentynine Palms Water District (TPWD) serving the City of Twentynine Palms. This agency is not a purveyor to MWA but is included in the Region's expanded boundary area discussed in Section 2.10 below.
- 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 retail water purveyors within the Mojave Region that are required to complete UWMPs are shown on Figure 2-11.

2.8.2 Mojave Region Infrastructure

The Mojave Region receives SWP water via MWA, at four locations from the California 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 serves the Oro Grande Wash Recharge Project. The Oro Grande Wash project consists of a pipeline from the aqueduct that recharges a desert wash and serves 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, 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 2-12 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 MWA. It brings water from the California Aqueduct in Hesperia to the Rock Springs and Deep Creek Recharge sites along the Mojave River in south Apple Valley and to several percolation ponds in the Morongo Basin area. Recharge facilities in the Morongo Basin area are located in Landers, Yucca Valley and Joshua Tree to serve production wells owned and operated by BDVWA, HDWD and JBWD. The Morongo Basin Pipeline was completed in 1994 and deliveries began in 1995. The pipeline was financed by MWA, HDWD, JBWD, BDVWA, and San Bernardino CSA 70. Pipeline turnouts exist to serve JBWD, BDVWA, and CSA 70 as well as HDWD (MWA 2011).

The Ames/Reche Basin serves three municipal producers, including HDWD, CSA 70 and BDVWA. Currently HDWD and BDVWA operate the basin under a stipulated judgment and associated Ames Valley Water Basin Agreement.

2.9 Climate

The Mojave Water Agency maintains a regional network of weather monitoring stations throughout the watershed; some funded by MWA and others 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 2-7. 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.

Table 2-7
Climate Data for the Mojave Region

	Barstow			Victorville		
Station:	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
2010	69.2	9.7	65.0	66.2	18.9	59.9
2011	72.2	1.9	64.1	67.1	12.2	59.3
2012	72.6	2.0	66.7	70.2	5.0	62.1
Avg	**71.7**	**5.1**	**65.5**	**67.4**	**7.7**	**60.6**

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

2.9.1 Climate Change

Climate change is driven by increasing concentrations of carbon dioxide and other greenhouse gases that cause an increase in temperature and stress natural systems, such as oceans and the hydrologic cycle. Climate changes that may affect the Mojave IRWM Plan water resources include:

- **Higher temperatures and heat waves** that increase demand for water, especially for agricultural and residential irrigation uses.
- **Water Uncertainty**: A projected overall decrease in precipitation levels coupled with more intense individual storm events may lead to increased flooding. Higher temperatures that may cause more precipitation to fall as rain rather than snow, hasten snowmelt and increase runoff will affect water storage planning. Increased evaporation will create a generally drier climate, with wildfires likely to increase and groundwater basins likely to receive less replenishment.

As part of this IRWM Plan update a Climate Change Assessment was prepared. The Climate Change Assessment provides details on the potential effects of climate change (changes in temperature, changes in precipitation), describes the Region's vulnerability to climate change, and identifies strategies for adapting to climate change. The Climate Change Assessment results are presented in Section 12 of this IRWM Plan update.

Figure 2-11
Water Purveyors with UWMPs

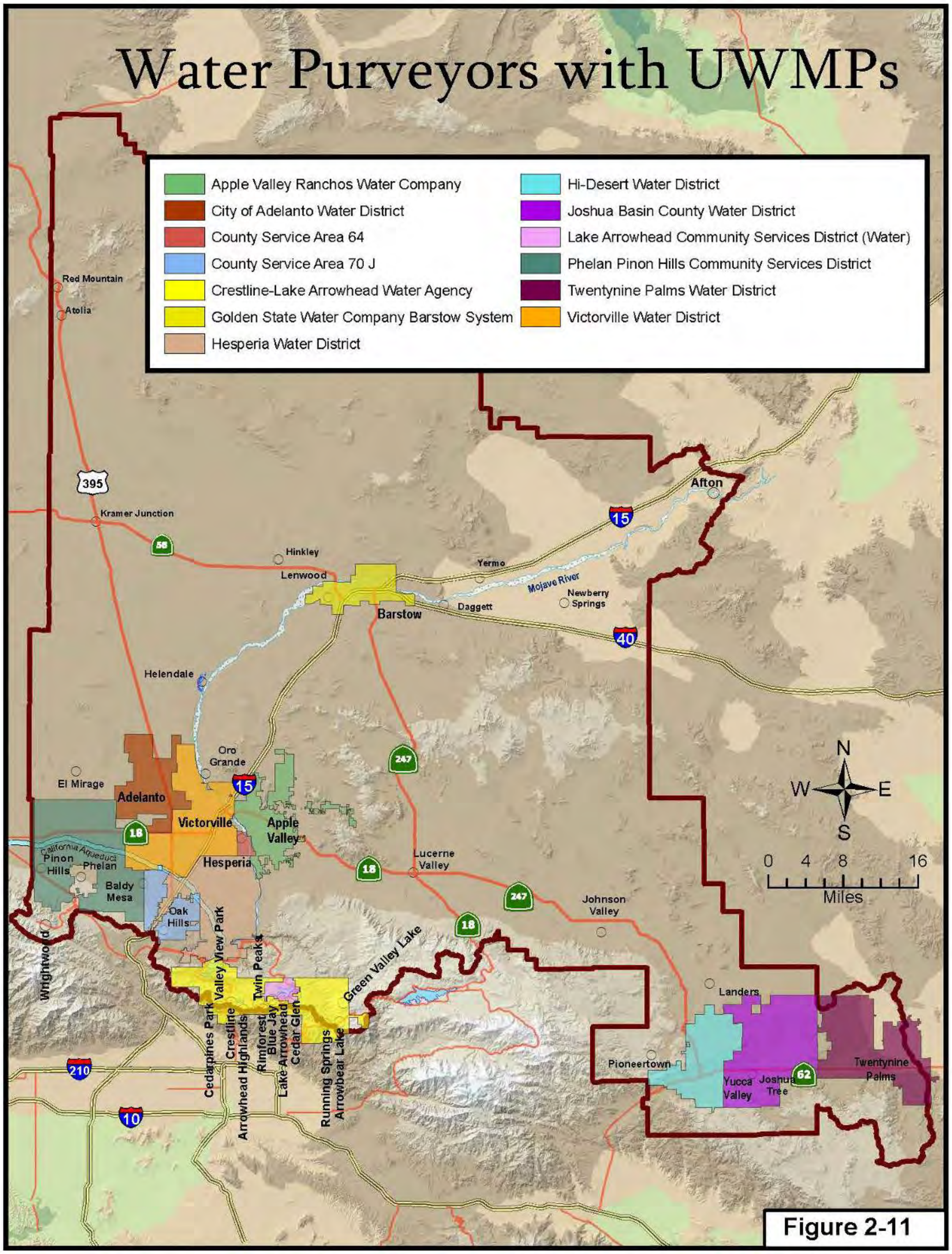
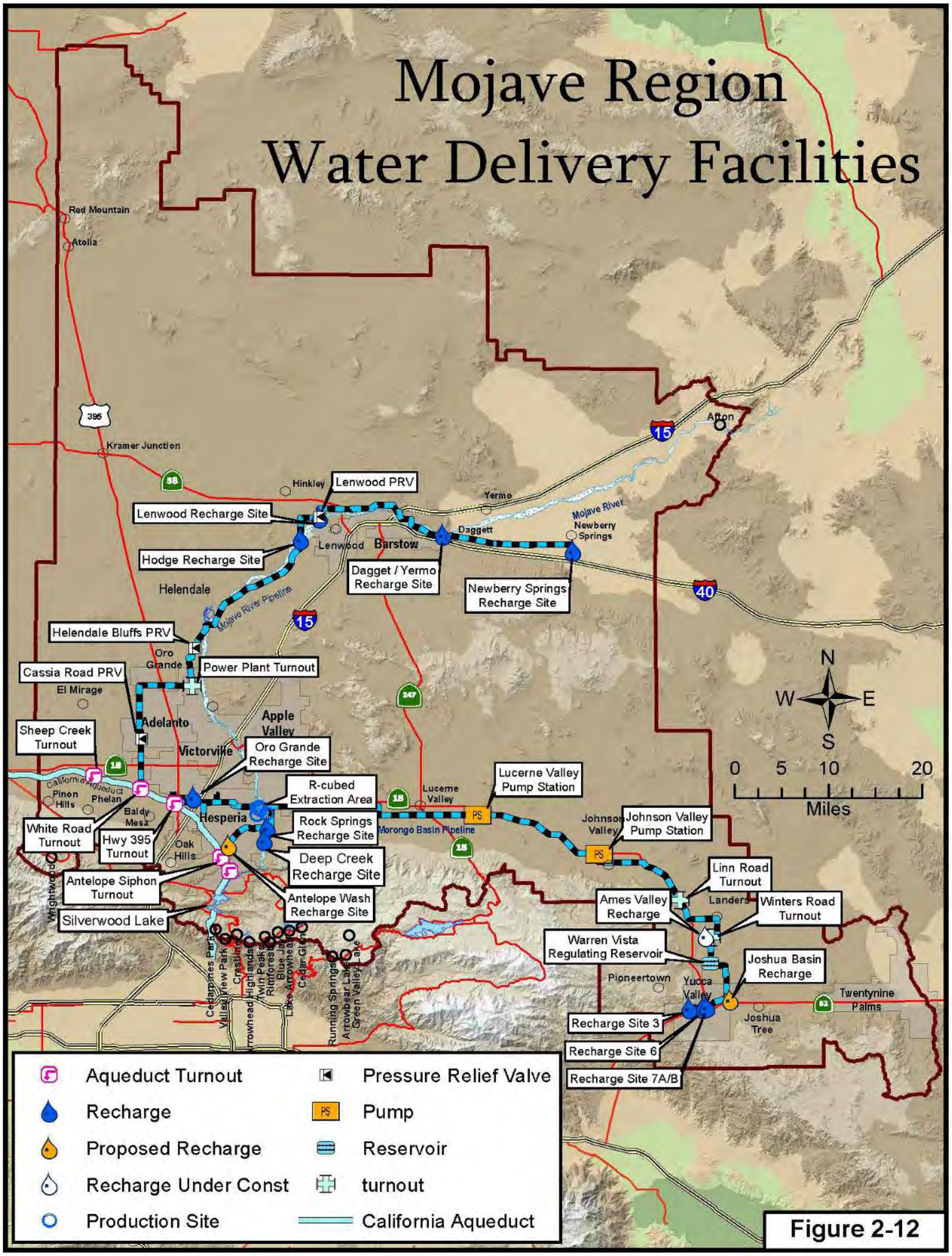


Figure 2-12
MWA Water Delivery Facilities



2.10 Mojave Region Expansion Areas

As described in Section 1, four areas adjacent to the previously established IRWM Planning Region were included in the Mojave Region's boundaries during the 2014 update process. These areas, as shown on Figure 1-3, include the:

- Twentynine Palms Area,
- Upper Mojave River Watershed Area,
- Afton Canyon Area (Lower Mojave River Watershed Area), and
- Wrightwood Area.

Final agreement on the inclusion of these areas occurred while the Plan update was already in progress and certain sections (including Sections 2 and 3) of the IRWM Plan already in draft form. As a result, descriptions of the four expansion areas were developed separately from Section 2 and are included in the following sections. To the extent possible, Area-specific information addresses the same subtopics discussed above for each of the expansion areas.

2.10.1 Twentynine Palms Area

This section describes the physical and environmental characteristics, social and demographic characteristics, and provides an overview of the water system of the Twentynine Palms Area, which has been incorporated into the Mojave Region boundary, as shown on Figure 1-3.

This expansion area (Twentynine Palms Area, Area) includes the City of Twentynine Palms (City) and the Twentynine Palms Water District (TPWD). The City, incorporated in 1987, encompasses 58 square miles and is home to 20,000+ residents. The City is located in the Morongo Basin on the southern edge of the Mojave Desert, roughly 50 miles north of Palm Springs. The TPWD service area encompasses approximately 86.6 square miles and includes the City of Twentynine Palms. The TPWD is located in the high desert of southern California, approximately 90 miles due southeast of the City of Victorville, as shown on Figure 1-3.

2.10.1.1 Physical Setting

The Twentynine Palms Area is located at nearly 2,000 feet in elevation, at the southeastern corner of the Mojave Region. The Area lies within a large alluvial basin bounded on all sides by mountain ranges of various sizes. The basin floor itself has a gentle and fairly uniform slope to the southeast that is broken up by several bedrock outcrops. The most notable of these is Copper Mountain (3,070 feet) which is located just to the west of the City of Twentynine Palms. Low points within the basin floor are locations of internal drainage, and are occupied by playa lakes, which are almost always dry. Playa lakes located within the Mesquite Dry Lakes area are on a small unnamed playa south of Mesquite Dry Lake and two small unnamed playas are on the east side of Copper Mountain (City of Twentynine Palms and TPWD 2013).

2.10.1.2 Land Use

Residential development is currently the single largest land use within the Twentynine Palms Area. Single-family homes make up the majority of residential land use with approximately 80 percent. Other land uses include some multi-family residential units, commercial properties, and minor light industry. In recent years, commercial development has shown an increase, primarily along the Twentynine Palms Highway. There is no community sewage system and wastewater is disposed through individual septic tank and tile field disposal systems (TPWD 2011; City of Twentynine Palms 2012).

2.10.1.2.1 Land Use Policies

The primary land use jurisdictions in the Twentynine Palms Area are the incorporated City of Twentynine Palms and the County of San Bernardino for unincorporated portions. The land use policy documents that govern these areas of jurisdiction are as follows:

- *San Bernardino County General Plan* (Adopted March 13, 2007 and amended May 22, 2012). This document covers all of the unincorporated County. The Land Use Element is a guide for the County of San Bernardino's future development. It designates the distribution and general location of land uses, such as residential, retail, industrial, open space, recreation, and public areas.
- *2012 City of Twentynine Palms General Plan*. This General Plan is based on several Guiding Principles, which are aimed at promoting sustainability, adaptability and a high level of well-being while preserving the City's desert, small-town feel. The Conservation and Open Space Element identifies natural resources of priority to the City in order to preserve and promote the natural integrity of the community in a sustainable manner (City of Twentynine Palms 2012).

2.10.1.3 Ecological Processes and Environmental Resources

The Mojave Region is a highly varied ecological area with valuable natural resources. Valuable natural resources are also found within the Twentynine Palms Area, as described in the next sections.

2.10.1.3.1 Sensitive Biological Resources and Areas of Ecological Significance

The Mojave Region is host to 47 threatened, endangered, or candidate species, and/or designated critical habitat. Species described in Section 2.4 and listed in Table 2-2 may be found within the vicinity of the Twentynine Palms Area. In particular, there is high potential for Desert Tortoise Habitat within this Area, as can be seen on Figure 2-4.

A portion of the Twentynine Palms Area encompasses special management areas, including an ACEC and a DWMA, as described in Table 2-8.

Table 2-8
Areas of Critical Environmental Concern in Twentynine Palms

ACEC Name	Description
Pinto Mountain DWMA	The boundaries of this DWMA encompass 183 square miles, of which the northern portion lies within the Twentynine Palms Area. This DWMA provides high density Desert Tortoise Habitat and highest value critical habitat, as well as critical tortoise habitat linkage (CEC 2012).
Mojave Fringed-toed Lizard	This ACEC consists of ten separate units, within and around the Mojave Region. The unit located within the Twentynine Palms Area falls within the Needles Field Office of the BLM and is bounded by the Sheephole Mountains on the northeast and east, Highway 62 on the south, the Pinto Mountains on the southwest, and Dale Dry Lake on the northwest. This ACEC is important for its active and functioning ecological process of sand transport and sand dune ecosystems, including source sand and sand corridors. These areas protect the limited habitat type, which is necessary for aeolian sand specialists, such as fringe-toed lizards. Rare vegetation species present in this ACEC include Borrego Milk-Vetch, Ribbed Cryptantha and Harwood's Eriastrum (CEC 2012).

2.10.1.3.2 Wildlife Corridors

The Mojave Region contains various critical connections for wildlife movement. Among those linkages is the Joshua Tree-Twentynine Palms Connection, which links the Joshua Tree National Park to the Twentynine Palms Marine Base to the north. The Twentynine Palms Area, which ranges from 2,400 feet to 5,400 feet, provides valuable habitat to numerous wildlife species, including bighorn sheep, mountain lion, mule deer, bobcat, desert tortoise, kit fox, American badger and other small animals. In addition, numerous rare birds use this linkage for foraging and nesting, such as golden eagle, prairie falcon, LeConte's thrasher and Costa's hummingbird (Mojave Desert Land Trust 2013).

More information on Joshua Tree National Park is provided in Section 2.4.

2.10.1.4 Social and Cultural Characteristics

2.10.1.4.1 Demographics and Population

The Twentynine Palms Area is made up of a relatively small urban center with fairly low population densities. Table 2-9 shows demographic data for the City of Twentynine Palms, the only city in the Area.

Table 2-9
City of Twentynine Palms Demographic Data

Population	Under 18 Years	65 Years and Over	Number of Households	Average Household Size	Median Household Income[b]	Persons Below Poverty Level[b]	Land Area (sq. miles)[c]	Persons (sq. miles)[c]
25,713[a]	25.6%	5.8%	7,612	2.73	$43,412	12.9%	59.14	423.5

Source: USCB: State and County Quick Facts, City of Twentynine Palms.
Notes:
(a) These 2012 population estimates include the population of the Twentynine Palms Marine Corps Base, which is not part of this IRWM Plan Area. Therefore, this population does not match the population in Table 2-3.
(b) 2007-2011 estimates.
(c) USCB 2010.

As of 2010, the population within the Area was approximately 18,800. Based on estimates, this population is anticipated to show slow growth in the future, reaching approximately 31,000 by 2035 (TPWD 2011). Population projections are taken from the TPWD 2010 UWMP and are shown in Table 2-10 for both the incorporated and unincorporated portions of the Area, and not including the Marine Base.

Table 2-10
Current and Projected Population Estimates

2010	2015	2020	2025	2030	2035
18,795	22,135	25,476	27,339	29,202	30,931

Source: Twentynine Palms 2010 UWMP, Tables 2-2 and 2-3.

2.10.1.4.2 Economic Factors

In the larger Mojave Region, growth is expected to be seen in new residential and nonresidential construction in coming years. According to the City of Twentynine Palms, commercial development has shown a noticeable increase, primarily along the Twentynine Palms Highway.

The City of Twentynine Palms serves as a valuable access point for many large and small desert destinations, including Joshua Tree National Park, the Marine Base – the largest Marine Corps facility in the world - the Mojave National Preserve, Amboy Crater, and Route 66. As a result, the City offers a variety of accommodations for visitors, including contractors and families visiting the Marine Base. In addition, numerous small businesses form the backbone of the local economy to provide services to residents and visitors (City of Twentynine Palms 2011).

2.10.1.4.3 Disadvantaged Communities

As explained previously in Section 2.5.3, the DWR defines a DAC as a municipality, including, but not limited to a city, town or county, or a reasonably isolated and divisible segment of a larger municipality, that has an average MHI that is less than 80 percent of the statewide annual MHI. For California, a MHI of less than $48,314 meets this threshold based on 2009 USCB data. The City of Twentynine Palms has an MHI of $43,412, based on 2007-2011 estimates, and therefore falls into the category of a DAC (USCB 2013a). In addition, over 50 percent of households in the City of Twentynine Palms have an income less than the MHI (City of Twentynine Palms 2012).

2.10.1.4.4 Social and Cultural Values

Preserving the desert small-town character and the natural and cultural resources of the Area is important to maintain and promote a high level of well-being to residents and visitors in the Twentynine Palms Area.

2.10.1.4.4.1 Cultural Resources

The Twentynine Palms Area and vicinity encompass numerous prehistoric and historic archaeological sites, and traditional cultural sites, many of which are registered historic landmark sites, or other points of interest, as shown in Table 2-11.

Table 2-11
Cultural Sites in Twentynine Palms Area

Name	National Register	California Register	Points of Interest	Address/Location
Barker Dam	X	X		Joshua Tree National Park
Chemehuevi Indian Burial Ground			X	Southeast corner of Adobe Road and Cottonwood Drive
Cow Camp	X	X		Joshua Tree National Park
Desert Queen Mine	X	X		Joshua Tree National Park
Foxtrot Petroglyph Site	X	X		Marine Corps Base
Historic Plaza			X	The Plaza
Homestead Inn			X	74153 Two Mile Road
KB-Ranchotel Bremer Adobe			X	6048 Noel's Knoll
Keys Desert Queen Ranch	X	X		Joshua Tree National Park
Little Church of the Desert			X	6079 Adobe Road
Ryan House and Lost Horse Well	X	X		Joshua Tree National Park
Twentynine Palms Inn			X	73950 Inn Avenue
Twentynine Palms Oasis			X	Southwest corner of National Park Drive and Utah Trail
Wall Street Mill	X	X		Joshua Tree National Park

Source: City of Twentynine Palms General Plan, Table CO-2.

2.10.1.4.4.2 Maintenance of Recreational Opportunities

There are numerous recreational opportunities within the Twentynine Palms Area and vicinity, the most famous of which is the Joshua Tree National Park. In addition, the Area is a prominent location for stargazing, as a result of its clear, dark night skies. The City's General Plan identifies the preservation of the nighttime views as a valuable community resource and has set goals to implement this by mitigating light pollution in and around the City. Actions to preserve these valuable resources and recreational opportunities will contribute to the enhanced quality of life that is envisioned for the Area (City of Twentynine Palms 2012).

2.10.1.4.4.3 California Native American Tribes

This Area is situated within a location historically occupied by the Serrano and the Chemehuevi Native American groups. Various archaeological resources have been identified in connection with these Native American groups around the Oasis of Mara and sand dunes in the northern part of the City (City of Twentynine Palms 2012). The Twenty-Nine Palms Band of Mission Indians have tribal land within the City of Twentynine Palms, on a section of land located immediately adjacent to the Joshua Tree National Park at the furthest south point of Adobe Road. Many historical and Native American archaeological sites are located along the Adobe and National Park Roads' corridors.

2.10.1.5 Hydrologic Features

2.10.1.5.1 Surface Water

In the arid to semi-arid environment of the Twentynine Palms Area, surface water is generally rare, localized, and short-lived. Exceptions exist, especially during extreme events. Surface water may exist in the groundwater basin in three different forms: streamflow, playa lakes, and spring flow.

Water discharging at springs has historically been an important hydrologic feature as the only easily available source of water. In the early 1920's, a line of springs at Twentynine Palms known as the Oasis of Mara was a source of surface water. However, by the 1950s, the oasis no longer showed signs of surface water and the location has not been mentioned in more recent reports as a location of surface discharge. Pools were also once existent at Mesquite Spring, however based on more recent reports; it appears that this area has not had surface flow for several decades.

Stream flows in the Area exist as ephemeral flows from runoff originating in the adjoining mountains in response to the largest storms. The surface water is generally confined within the basins as the streamflow typically either percolates into the alluvial soils in the stream channels near the mountain front or is lost to evaporation. The several surface water drainage basins in the Area ultimately end at a playa lake.

Streamflow measurements reported in 2004, showed highly intermittent flows in the Fortynine Palms Creek, limited to up to 2 days after storms and totaling 74.3 afy over the period of record.

Playa lakes form at the lowest elevations in a number of local surface drainage basins. However, playa lakes in the area are only ephemeral sites of surface water collection and are typically retained for only one to two days.

The Mesquite Dry Lake is about 2.5 miles long, 1 mile wide, and, at an altitude of about 1,760 feet, represents the lowest point in the Twentynine Palms Basin. The southern end of the playa is truncated by a very low fan, which extends across the bottom of the trough between Mesquite Dry Lake and the small unnamed playa to the south that some older maps refer to as Shortz Playa. The drainage to Shortz Playa has been captured by recent headward erosion in the wash that drains to Dale Lake so that Shortz Playa is now largely covered with sand dunes.

Two lesser playas are just east of Copper Mountain. Both lie near the southern edge of the north-south troughs whose eastern sides are formed by the parallel north-trending ridges. Their small drainage areas limit their capacity to retain surface waters (City of Twentynine Palms and TPWD 2013).

2.10.1.5.2 Groundwater Basins

The Area is located within the boundaries of three groundwater basins, identified as the Twentynine Palms Valley Groundwater Basin, the Joshua Tree Groundwater Basin and the Dale Valley Groundwater Basin by DWR Bulletin 118-03 (DWR 2003a). The Area's portion of the Joshua Tree Groundwater Basin has historically been divided into three subbasins: (1) Indian Cove, (2) Fortynine Palms and (3) Eastern. The Twentynine Palms Valley Groundwater Basin consists of the Mesquite Lake Subbasin. The subbasins are shown on Figure 2-13 (TPWD 2014).

The remaining basin, Dale Valley Basin, is located immediately to the east of the Mesquite Lake subbasin. However it does not contain many wells due to high total dissolved solids (TDS) and is not a significant local water resource.

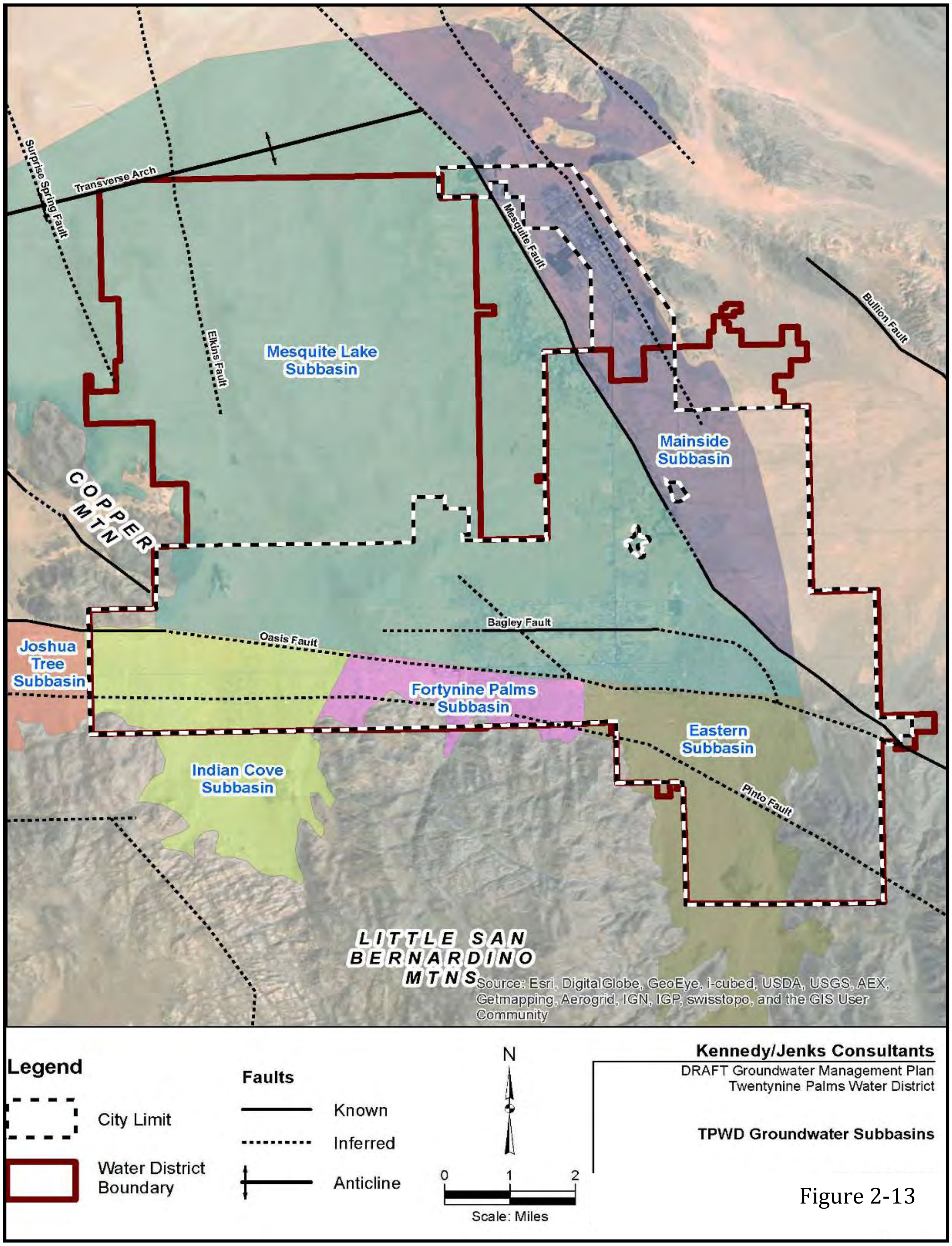
2.10.1.5.2.1 Twentynine Palms Valley Basin

The Twentynine Palms Valley Groundwater Basin encompasses 97.5 square miles and underlies the northern portion of the Twentynine Palms Area. It is bound to the south by the Pinto Mountain fault, the north by the "transverse arch", the west by the Surprise Spring Fault, and the east by the Mesquite Fault. The Basin underlies an alluvial valley in the southern Mojave Desert below the dry Mesquite Lake and the City of Twentynine Palms. Water-bearing materials in the Basin consist of unconfined, unconsolidated to partly consolidated Miocene to Quaternary continental deposits.

The most productive water-bearing deposits are interbedded gravels, conglomerates, and silts deposited in alluvial fan systems. Other, less productive deposits include alluvial channel sands and gravels, active silt, clay, sandy-clay deposits and dune sands. Water-bearing deposits in the Basin are up to 10,000 feet in thickness. Groundwater flows generally from west to east toward Mesquite Lake. The Pinto Mountain fault zone acts as a barrier to groundwater flow and the water level is 100 feet lower in the Twentynine Palms Valley Basin than in the Joshua Tree Basin. The Mesquite fault is also a barrier to groundwater flow, with water levels being 240 feet higher on the eastern border of the Twentynine Palms Valley Basin than in the adjacent Dale Valley Basin. The "transverse arch" on the northern border acts as a partial barrier to groundwater flow to the south, but allows some flow from the Deadman Valley Basin into the Twentynine Palms Valley Basin.

The Mesquite Lake subbasin is bounded by the Surprise Spring Fault on the west and the Mesquite Fault on the east. Separated by the Pinto Mountain Fault to the south are the Indian Cove, Fortynine Palms, and Eastern subbasins. Groundwater levels in the basin are generally stable. Very little data on the depth to bedrock are available for the Twentynine Palms Valley Basin. Water level depths vary widely, ranging from depths of less than 50 feet to more than 400 feet below ground surface (bgs). Water elevations also vary from between 1,700 to 1,850 feet. No water level declines have been observed in the Mesquite Lake subbasin, in the Twentynine Palms Valley Basin (TPWD 2011).

Figure 2-13
Twentynine Palms Area Groundwater Basins



Water quality in the Mesquite Lake subbasin is of lesser quality as compared to the other subbasins used for potable water and treatment for high fluoride levels is required before public distribution and consumption in this subbasin (TPWD 2011).

2.10.1.5.2.2 Joshua Tree Basin

The Joshua Tree Groundwater Basin encompasses 53.8 square miles and underlies an area south of the Pinto Mountain fault beneath the town of Joshua Tree, eastward to immediately south of the City of Twentynine Palms. The Basin's northern area borders the Twentynine Palms Valley Basin along the Pinto Mountain fault. The southern boundary is exposed consolidated basement of the Little San Bernardino Mountains within Joshua Tree National Park. The western boundary of the basin is coincident with a basement constriction located between the towns of Yucca Valley and Joshua Tree. The eastern boundary of the basin lies along a line extending from the southern tip of the Mesquite fault to a basement outcrop of the Little San Bernardino Mountains.

Like the Twentynine Palms Valley Basin, productive water-bearing materials in the basin also consist of unconsolidated to partly consolidated Miocene to Quaternary continental deposits to a depth of 10,000 feet in thickness. However, because the basin incorporates additional areas of shallower alluvial fill, average thickness is about 500 feet. Also similar to the Twentynine Palms Valley Basin, groundwater in the basin typically occurs in interbedded gravels, conglomerates, and silts deposited in alluvial fan systems.

Groundwater generally flows eastward in the region, and travels northward in the Joshua Tree Basin towards the Pinto Mountain fault, then eastward and possibly discharges through the Pinto Mountain fault into the Copper Mountain Basin to the west. However, the Pinto Mountain fault is a groundwater barrier, with water levels about 125 feet lower in the Copper Mountain Valley Basin north of the fault than in the Joshua Tree Basin to the south. The constriction that forms the western boundary of the basin appears responsible for an eastward drop in groundwater level of about 400 feet. Data support that water levels in the basin were dropping by an average of a foot per year from 1973 to 2004 until more production was shifted to the Twentynine Palms Valley Basin to prevent the overdraft.

2.10.1.5.2.3 Dale Basin

The Dale Basin is located immediately to the east of the Mesquite Lake subbasin. Little work has been done on the hydrogeology of the Dale Basin, as it is not a host to significant population, nor does it contain many wells. Its western boundary is the Mesquite Fault, which separates it from the Mesquite Lake subbasin. The northern boundary is the Bullion Mountains. The eastern boundary is the Sheep Hole Mountains. The southern boundary is the Pinto Mountains. The depth to bedrock in this basin is unknown.

Water levels drop eastward across the Mesquite, Bullion, and Cleghorn Lake faults, which indicates that they are partial barriers to groundwater movement. The Mesquite fault displaces water levels by as much as 240 feet.

TDS content is generally less than 2,000 mg/L north of Dale Lake, and about 1,450 mg/L in the central part of the basin. Fluoride concentration is commonly high; water from one well in the central part of the basin contained 6.0 mg/L of fluoride.

The water quality in this basin is generally unsuitable for domestic and agricultural uses. TDS and fluoride concentrations impair domestic use, and boron and sodium concentrations impair agricultural use in this basin (DWR 1979).

Groundwater levels have increased by 0 to 0.7 feet per year in the 7 wells for which records exist, although most of the increases are due to single or few anomalously low water levels at the beginnings of the periods of record. Water levels within this basin have been basically stable since about 1960 (City of Twentynine Palms and TPWD 2013).

2.10.1.6 Overview of Water Supplies

Water supplies for municipal uses are derived solely from groundwater sources and provided by TPWD. Connecting to the Metropolitan Water District of Southern California (Metropolitan) or the Mojave Water Agency for Colorado River or State Water Project supplies, respectively, is not deemed viable for the TPWD.

Overall, potable water is scarce in TPWD as a result of minimal annual rainfall, low recharge and water quality limitations. However, available supplies are anticipated to be sufficient to meet projected demands beyond the year 2035.

Additional details on the Area’s water supply are provided in Section 3.

2.10.1.7 Water Related Infrastructure

Water provided to the Area by TPWD is produced from ten active groundwater wells primarily located along the southern boundary of the Area. Ten wells are located in the Joshua Tree Basin and one well is located in the Twentynine Palms Valley Basin.

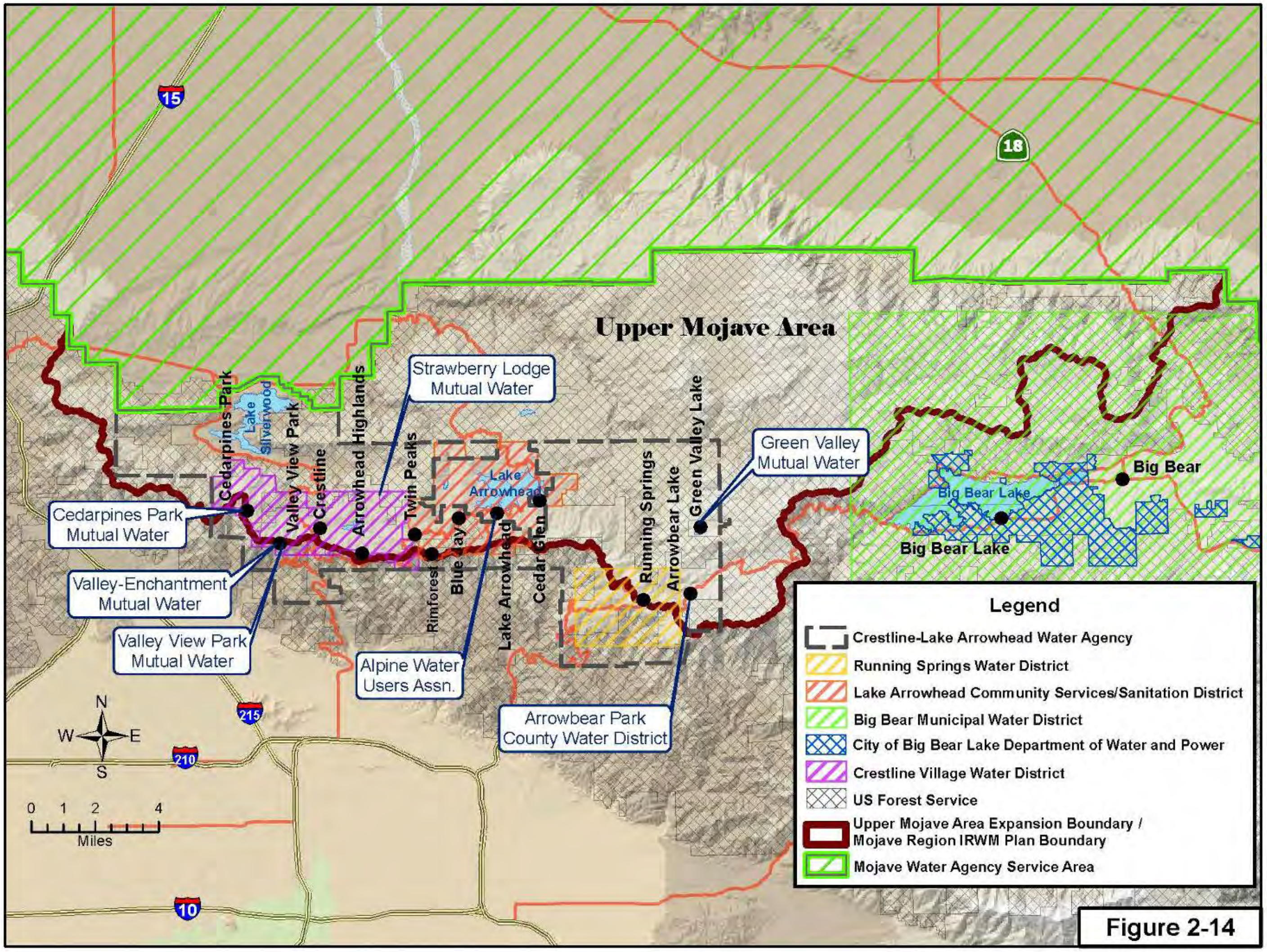
2.10.2 Upper Mojave River Watershed Area

This section describes the physical and environmental characteristics, social and demographic characteristics, and provides an overview of the water system of the Upper Mojave River Watershed Area, which has been incorporated into the Mojave Region Boundary.

This expansion area (Upper Mojave River Watershed Area, Upper Mojave Area or Area) includes the communities of Crestline, Skyland, Valley of Enchantment, Lake Gregory, Valley of the Moon, Cedar Pines Park, Valley View Park, Arrowhead Highlands, Twin Peaks, Blue Jay, Crest Park, Skyforest, Deer Lodge Park, Lake Arrowhead, Cedar Glen, Rimforest, Running Springs, Fredalba, Smile Park, Arrowbear Lake and Green Valley Lake. Water and sanitation services a provided by various agencies. The Area encompasses the majority of the Crestline-Lake Arrowhead Water Agency (CLAWA), Crestline Village Water District boundaries, and Lake Arrowhead Community Services District (LACSD, Lake Arrowhead CSD) boundaries, as well as major portions of Running Springs Water District and Big Bear Municipal Water District. Lake Arrowhead is the largest community in the Upper Mojave Area located 23 miles north of the City of San Bernardino and approximately 90 miles east of Los Angeles, as shown on Figure 1-3. Figure 2-14 shows the Upper Mojave Area in more detail with the various agency boundaries included.

This Area is significant to the Mojave Region as it lies at high elevations in the San Bernardino Mountains where the headwaters of the Mojave River originate.

Figure 2-14
Upper Mojave Area



2.10.2.1 Physical Setting

The Area is located along the southern border of the Mojave Region, on the north slope of the San Bernardino Mountains, which separate the High Desert watersheds from the coastal basins. This Area differs from much of the Mojave Region, through its mountainous terrain, with elevations ranging between approximately 4,600 feet to 6,000 feet. As a result of its altitude, climate features are unique, with summer temperatures generally in the 80s and annual precipitation reaching over 40 inches, falling mostly in the form of snow (LACSD 2011).

Development in the San Bernardino Mountains is naturally constrained by rugged terrain, limited road access, and lack of support infrastructure, as well as by planning and environmental policies which place much of the area off limits to significant development. Most of the mountain area, including the majority of CLAWA's service area, is surrounded by or is within the San Bernardino National Forest. Forest lands are devoted primarily to resource protection and recreational use.

Rainfall and snowpack in this Area create the headwaters that feed the Mojave River, which traverses the Region as the main surface drainage feature. Additionally, this Area encompasses several lakes and reservoirs, including Silverwood Lake, Lake Arrowhead, Lake Gregory, Grass Valley Lake and Green Valley Lake (LACSD 2011).

2.10.2.2 Land Use

The majority of the Area is occupied by the San Bernardino National Forest, particularly in the northern and northeastern portions of the Area.

The southern and southwestern portion of the Area consists in large part of a mountain resort destination. Residential communities here are primarily made up of a mix of full-time and part-time residences, with the majority of residences being seasonal vacation homes generally occupied on weekends and in summer months. The ratio of full-time to part-time residents is approximately 40 percent. Single family units make up the majority of residential land use. In addition, there are other residential units, such as rural living and multiple residential units, and a small number of institutional and commercial properties (LACSD 2011; San Bernardino County 2012).

As shown on Figure 2-14, the majority of the Upper Mojave Area is served water from CLAWA, which contracts for State Water Project water, and in turn sells this water to public and private retail water purveyors in CLAWA's service area.

The majority of the land within CLAWA is uninhabited. In fact, more than half of the land within CLAWA's boundary is part of the San Bernardino National Forest. The mountain communities occupy islands of private land surrounded by National Forest territory. There are three main clusters of developed communities within CLAWA's water service area:

- In the western part of CLAWA's service area are the communities of Crestline, Skyland, Valley of Enchantment, Lake Gregory, Valley of the Moon, Arrowhead Highlands, Valley View Park, and Cedarpines Park.

- In the central part of CLAWA's service area are the communities of Rimforest, Twin Peaks, Blue Jay, Crest Park (Meadowbrook), Skyforest, Cedar Glen, Deer Lodge Park, and Lake Arrowhead (portion within CLAWA's boundary).
- In the eastern part of CLAWA's service area are the communities of Running Springs, Fredalba, Smiley Park, Arrowbear Lake, and Green Valley Lake (CLAWA 2011).

Lake Arrowhead includes commercial areas oriented to tourists and seasonal residents as well as year-round residents. Lake Arrowhead is a summer mountain resort area with the lake being the focal point, providing recreational opportunities in the form of boating, fishing and swimming. The LACSD has three sources of water for potable use; (1) SWP water purchased from CLAWA and San Bernardino Valley Municipal Water District (VALLEY DISTRICT) and delivered ("wheeled") by CLAWA through its system, (2) surface water from Lake Arrowhead, and (3) groundwater from five wells in the Grass Valley groundwater basin.

The land use for the LACSD service area is primarily made up of full-time and part-time residences, with the majority of residences being part-time vacation homes used only on weekends or in the summer. The LACSD 2010 UWMP attempted to quantify or summarize the seasonal or part-time residences using census data. LACSD's water service area lies within what the USCB refers to as the Lake Arrowhead Census Designated Place (CDP). There was an average annual increase of 4.4% in full-time residents for the Lake Arrowhead CDP from 1990 to 2000. Also, in 1990, the ratio of full-time to part-time was 30.6% (2,981/9,759) and in 2000, the same ratio was 39.1% (4,292/10,983). Therefore, approximately only every 1 in 4 people in Lake Arrowhead are full-time residents with the remainder being part-time (LACSD 2011).

2.10.2.2.1 Land Use Policies

The primary land use jurisdiction in the populated Upper Mojave Area is the County of San Bernardino, as the Area is made up of unincorpated communities. Land use policy documents that govern the Area are as follows:

- *San Bernardino County General Plan* (Adopted March 13, 2007 and amended May 22, 2012). This document covers all of the unincorporated County. The Land Use Element is a guide for the County of San Bernardino's future development. It designates the distribution and general location of land uses, such as residential, retail, industrial, open space, recreation, and public areas.

  The San Bernardino County Development Code also provides guidelines that protect biological resources. Districts may be designated in unincorporated areas where special management is necessary in order to protect important habitat.

- *Bear Valley Community Plan*. This Community Plan provides guidance on land use and development in the 135 square mile area surrounding the City of Big Bear Lake. The plan area includes the communities of Baldwin Lake, Big Bear City, Erwin Lake, Fawnskin, Lake Williams, a portion of Moonridge and Sugarloaf. Community priorities identified in the Plan are the environment and community character. As such, the goals and policies focus on the conservation of local natural resources, sustainable development in harmony with the natural surroundings and preservation of the small-town, mountain character of the community (San Bernardino County 2007a).

- *Crest Forest Community Plan*. This Community Plan provides land use guidance for the Crest Forest Community Plan area, which encompasses approximately 18 square miles of unincorporated area located west of Lake Arrowhead and south of Lake Silverwood, which includes the communities of Crestline, Cedar Pines Park, Valley of Enchantment, and the Lake Gregory Village area. With similar community characteristics as surrounding mountain areas, community priorities and policies are also similar with a focus on the environment and community character (San Bernardino County 2007b).

- *Hilltop Community Plan*. This Community Plan provides land use guidance for the approximately 40 square mile Hilltop Community, which lies east of Lake Arrowhead and west of Big Bear Lake. The area encompasses the communities of Running Springs, Arrowbear and Green Valley Lake, as well as other small neighborhoods. With similar community characteristics as surrounding mountain areas, community priorities and policies are also similar with a focus on the environment and community character (San Bernardino County 2007c).

- *Lake Arrowhead Community Plan*. This Community Plan provides guidance for land use and development within the Lake Arrowhead Community Plan area, in consistency with the County General Plan. The approximately 30 square mile area governed by this Plan includes the communities of Agua Fria, Blue Jay, Cedar Glen, Crest Park, Deer Lodge Park, Lake Arrowhead, Rimforest, Skyforest and Twin Peaks. With similar community characteristics as surrounding mountain areas, community priorities and policies are also similar with a focus on the environment and community character (San Bernardino County 2007d).

A large portion of the Area is within the San Bernardino National Forest and primarily falls under the jurisdiction of the US Forest Service (USFS). The main guiding document for land management in this area is the Land Management Plan (LMP) for San Bernardino National Forest, a component of the Southern California National Forests LMP. This land and resource management plan, also known as a Forest Plan, is intended to provide strategic direction to attain social, economic, and ecological sustainability of the national forest. The Forest Plan outlines several goals and objectives to strategically manage the forests and related water resources, including watershed functions and riparian systems (USFS 2005b).

The Southern California National Forests (the Angeles, Cleveland, Los Padres, and San Bernardino National Forests) are developing a proposed amendment for the LMPs adopted in 2006. The proposed amendment would revise land use zone allocations for select areas within the four forests and amend LMP monitoring protocols. This joint planning process will maintain the consistent management direction and format across the four Forests (USFS 2013a).

2.10.2.3 Ecological Processes and Environmental Resources

The Mojave Region is an ecologically highly varied area, with valuable natural resources. Valuable natural resources are also found within the Upper Mojave Area, as described in the next sections.

2.10.2.3.1 Sensitive Biological Resources and Areas of Ecological Significance

The Mojave Region is host to 47 threatened, endangered, or candidate species, and/or designated critical habitat. Species described in Section 2 and listed in Table 2-2 of the IRWM Plan may be found within the Vicinity of the Upper Mojave Area. In addition, the mountainous terrain and mild climate provide habitat for species that may be less common in the lower lying desert areas.

The Upper Mojave Area lies at high elevation within the San Bernardino Mountains. The majority of the Area is National Forest, thereby providing valuable habitat. Plant communities commonly found within this mountainous area include riparian forest, coniferous forest, oak woodlands, and riparian scrub (San Bernardino County 2012). Among the wildlife species found within and in the vicinity of the Upper Mojave Area are the California spotted owl, southwestern willow flycatcher, southern rubber boa, and other commonly spotted animals such as deer, coyote, and gray squirrel (San Bernardino County 2007a).

The San Bernardino County Mountain Region has numerous areas of high biological significance diversity. Among the biologically significant areas is Lake Arrowhead, which provides wintering habitat for the bald eagle (San Bernardino County 2012). In addition, the eastern portion of the Upper Mojave Area falls within the Big Bear-Baldwin Lake-Upper Holcomb Valley. This area is a biological hotspot that supports a high number of unique plant communities, including numerous rare and endemic species. In fact, the general area has been found to support the largest concentration of endemic plants in California, eleven of which are federally listed as threatened or endangered. This area is part of the 35-mile carbonate belt for which critical habitat units were designated in 2002.The limestone features north of Big Bear support plant species endemic to these carbonate substrates, including the federally endangered San Bernardino Mountains bladderpod and Cushenberry buckwheat. (San Bernardino County 2007a; USFWS 2002; USFS 1999).

Holcomb Creek and Deep Creek, which flow through the Upper Mojave Area, are eligible for Wild and Scenic River status and have high ecological value. Deep Creek is a particularly valuable riparian system, providing critical habitat for the arroyo southwestern toad and proposed as critical habitat for the southwestern willow flycatcher. In addition, Deep Creek supports native fish communities, including a population of the Mohave tui chub. Holcomb Creek is known to support willow flycatchers, a federally listed species (USFS 2005b).

2.10.2.3.2 Wildlife Corridors

The Mojave Region contains various critical connections for wildlife movement. Wildlife corridors are highly important in the Upper Mojave Area as the Area lies on the north slope of the San Bernardino Mountains, which separate the High Desert from the coastal basins.

Numerous wildlife corridors, policy zones and buffer zones have been delineated on the County General Plan Open Space Overlay Map. Those corridors and zones found within the Area are described in Table 2-12.

Table 2-12
Wildlife Corridors, Policy Zones and Buffer Zones - Upper Mojave Area

Name (N)	Description
Little Horsethief Canyon (12)	This wildlife corridor provides important riparian habitat and is a valuable open space area serving as a dispersion link for wildlife to the Mojave River.
Lake Silverwood (14)	This policy area encompasses the area surrounding Lake Silverwood, which is used as a seasonal perching site for the endangered bald eagle and provides habitat values for other species in the area.
Grass Valley Creek (16)	This wildlife corridor follows the Grass Valley Creek between the national forest and the Mojave River junction. The area serves as a wildlife dispersion corridor to and from the national forest and provides riparian habitat and potential habitat for least Bell's vireo and Arroyo chub.
Deep Creek Tributary and Mojave River (17)	This wildlife corridor contains riparian habitat, including habitat for least Bell's vireo and native arroyo fish. The area is important as a wildlife dispersion corridor.
Spotted Owl Habitat (18)	This area includes old-growth forest, which provides habitat for southern spotted owl.
Strawberry Creek (20)	This wildlife corridor extends along Strawberry Creek from north of the City of San Bernardino to the national forest and connects to Corridor 16, described above. It encompasses large areas of privately owned lands and provides important habitat values.
Lake Arrowhead (21)	This policy area encompasses the area surrounding Lake Arrowhead, part of which has been extensively urbanized. The area is used as a seasonal perching site for the endangered bald eagle and provides habitat values for other species in the area.
Dispersion Corridor (22)	This wildlife corridor has significance as the last major undeveloped portion of the mountain rim, located between the urbanized areas of Lake Arrowhead and Running Springs. The area provides crucial habitat and serves as a dispersion corridor for wildlife movement between the northern and southern exposures of the national forest.
Deep Creek (23)	This large wildlife corridor runs along City Creek and includes important riparian habitat; it provides an important link between the national forest and the Santa Ana River. The creek supports native fish, including the Santa Ana sucker and Mohave tui chub.
Grapevine Creek (39)	This wildlife corridor contains good riparian habitat of special value due to its proximity to the desert.
Big Bear Lake Watershed (42)	This policy zone encompasses the entire watershed of Big Bear Lake. The area contains numerous specialized habitat areas that support a large number of endangered, as well as commonly occurring montane plant and animal species.
Holcomb Valley (43)	This policy zone lies within the Big Bear Lake watershed and contains several unique mountain habitats. Among the habitat types in this area are pebble plains, which support various endangered species.
Limestone Deposits (45)	This policy zone encompasses an area of limestone deposits along the northern slope of the San Bernardino Mountains. The area provides habitat for Bighorn Sheep and supports various unique plants, including species considered for protection as endangered species.

Source: San Bernardino County 2007 General Plan: Open Space Overlay Map and Open Space Map Information Sheet.

A map of the Mojave Region wildlife corridors is shown on Figure 2-5.

2.10.2.4 Social and Cultural Characteristics

2.10.2.4.1 Demographics and Population

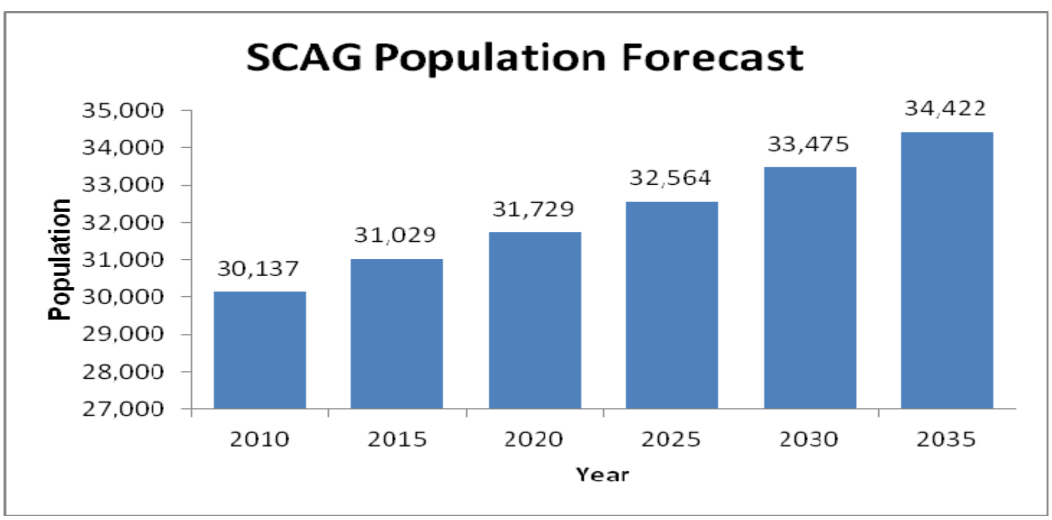
Lake Arrowhead, Crestline, Running Springs, and neighboring communities are part of a mountain resort area, which experiences significant tourism. There is a large seasonal population component as well as a substantial influx of visitors. The visitor/seasonal population is not fully reflected in available demographic statistics, which count mainly year-round residents. Seasonal changes in water demand in the CLAWA service area are quite different from the normal seasonal variation in water use by customers of average Riverside or San Bernardino County water purveyors, which reflect monthly changes in outdoor water use for landscape irrigation, swimming pools, car washing, space cooling, etc. These types of uses are far less prevalent within CLAWA's service area (CLAWA 2011).

Lake Arrowhead includes commercial areas oriented to tourists and seasonal residents as well as year-round residents. Lake Arrowhead is a summer mountain resort area with the lake being the focal point, providing recreational opportunities in the form of boating, fishing and swimming. The land use is primarily made up of full-time and part-time residences, with the majority of residences being part-time vacation homes used only on weekends or in the summer.

The Upper Mojave Area is made up of multiple small communities along the southern/southeastern border of the Area. Population densities are greatest in the vicinity of Lake Gregory, Lake Arrowhead, and Running Springs. As shown on Figure 2-16, the average population for the Area is approximately 0-50 people per square mile (USCB 2009).

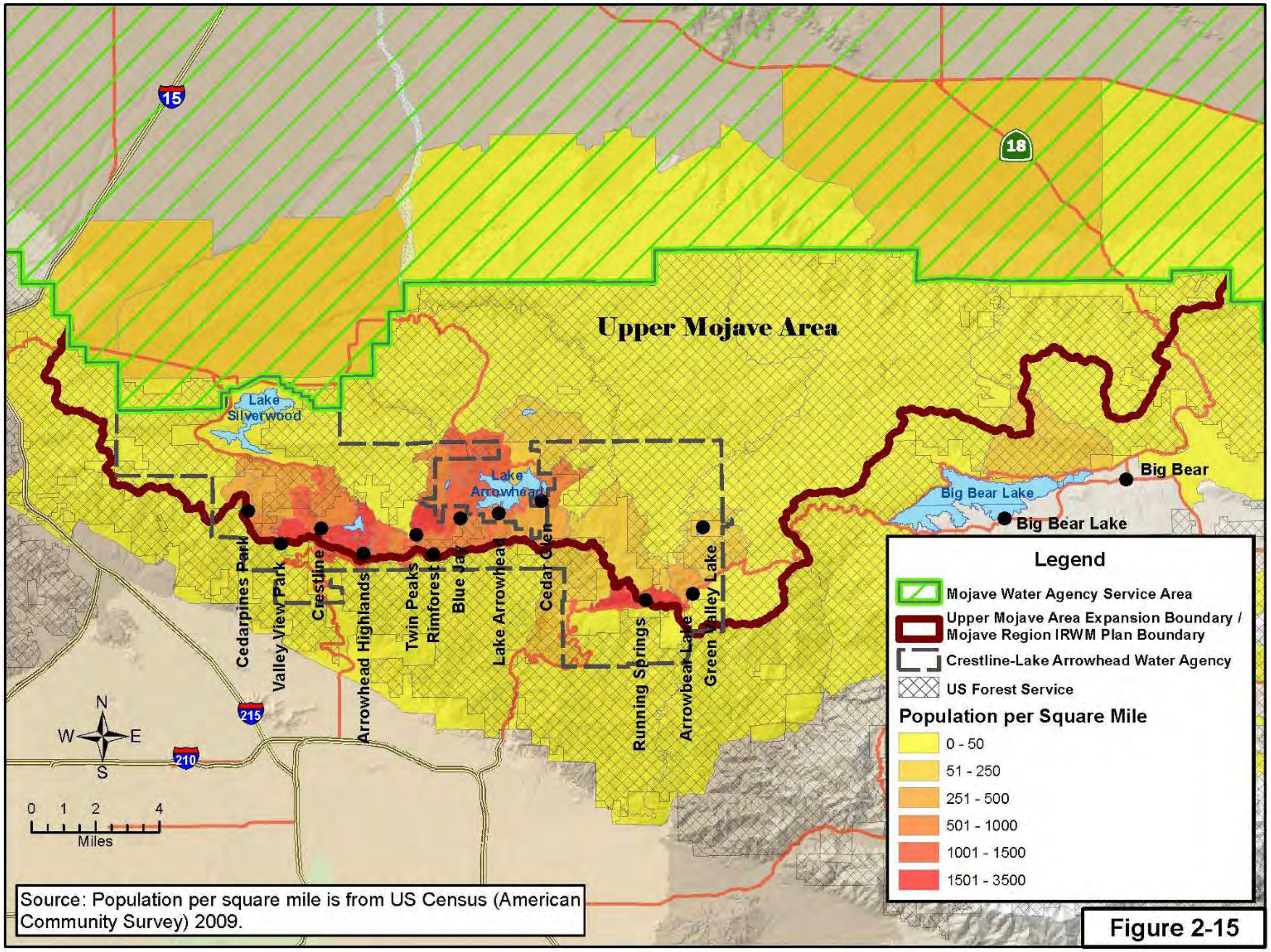
In CLAWA's 2010 UWMP, the SCAG Population Forecast was used to generate the estimated 2010-2035 population for the CLAWA service area, as shown on Figure 2-15 SCAG estimates a population increase of approximately 14.2 percent over a 25-year time period (CLAWA 2011).

Figure 2-15
CLAWA Service Area SCAG Population Forecast



Source: CLAWA 2010 UWMP

Figure 2-16
Population Densities in the Upper Mojave Area



LACSD provided data in their 2010 UWMP and recommended that they be conservative in projecting population for the service area. For the period 2000 through 2010, it was recommended to use the most conservative downward trend of 2%. The initial population from 2000 is from the USCB for the Lake Arrowhead CDP. For the years 2010-2020, the LACSD is projecting no net increase, i.e. no growth, in the population until 2020. After 2020, LACSD staff is projecting that while being conservative and assuming some stabilization of the growth in the area, the following 15 years will have a 0.5% annual increase in the population. Therefore, Table 2-13 shows an overall population decrease from 2005 to 2035 of 0.15% for the LACSD.

Table 2-13
Current and Projected Population Estimates Lake Arrowhead CDP

	2000[(a)]	2005	2010	2015	2020	2025	2030	2035	Annual % Change 2005-2035
Lake Arrowhead CDP [(b)]	8,934	8,041	7,147	7,147	7,147	7,326	7,505	7,683	-0.15%
Grass Valley Block Totals[(b)]	3,010	2,709	2,408	2,408	2,408	2,468	2,528	2,589	-0.15%
Total Lake Arrowhead CDP and Grass Valley Blocks [(b)]	11,944	10,750	9,555	9,555	9,555	9,794	10,033	10,272	-0.15%

Source: LASCD 2010 UWMP.
Notes: Census Block Group Boundaries do not match the LACSD Certificated Water Service Boundary.
(a) Taken from 2000 USCB Data for Lake Arrowhead CDP.
(b) Projected using -2% population decrease from 2000-2010. Then 0% population increase (no growth) from 2010-2020. Finally from 2020-2035, a population increase of 0.5% is projected, based on LACSD staff experience, while being conservative and assuming some stabilization of growth.

2.10.2.4.2 Economic Factors

In the larger Mojave Region, growth is expected to be seen in new residential and nonresidential construction in coming years. According to the Community Plans that apply to the Upper Mojave Area, continued growth is expected for this Area as more people migrate from more urbanized areas to the rural mountain areas.

The Area is an attractive mountain residence and resort destination that offers numerous recreational amenities and scenic resources. Among the many outdoor offerings of the mountain communities are skiing, biking, fishing, hiking and camping. As a result, the San Bernardino County General Plan encourages development and business activities that can capitalize on these offerings and amenities, while keeping development compatible with the natural character of the mountain communities. Expanding tourist attractions, such as hiking and biking trails is also seen as a way to promote economic development in the Area (San Bernardino County 2012).

2.10.2.4.3 Disadvantaged Communities

The DWR defines DAC as a municipality, including, but not limited to a city, town or county, or a reasonably isolated and divisible segment of a larger municipality, that has an average MHI that is less than 80 percent of the statewide annual MHI. A MHI of less than $48,314 meets this threshold based on 2009 USCB data. The Crestline CDP has an MHI of $51,478, based on 2007-2011 estimates, and therefore does not fall into the category of a DAC (USCB 2013b).

2.10.2.4.4 Social and Cultural Values

Preserving the mountain small-town character and the natural and cultural resources of the Area is important to maintain and promote a high level of well-being to residents and continue attracting tourists in the Upper Mojave Area.

While each community of the Upper Mojave Area may have slightly individual concerns, the communities share common community priorities, which focus on the environment and community character. Given the Area's setting within and adjacent to the San Bernardino National Forest, and other local natural resources, communities in the Area emphasize conservation of the natural environment and scenic values and sustainable integration of development with the natural surroundings. Among the County General Plan goals is also the preservation of the dark night sky as a natural resource, which is a unique feature to remote locations as this Area.

The County General Plan encourages identification of cultural resources in order to better protect them from damage or destruction. Culturally significant resources found within the Upper Mojave Area are listed in Table 2-14.

Table 2-14
Cultural Sites in the Upper Mojave Area

Name	National Register of Historic Places	California Register of Historical Resources	California Historic Landmarks	California Points of Historic Interest	Location
Antlers Inn				X	Twin Peaks
Brookings Sawmill Site				X	Arrowbear Lake
Daley Toll Road Monument		X			
Guapiabit				X	Crestline
Holcomb Valley	X	X	X		Big Bear
Hunsaker Flats – Running Springs Logging Wheels Historical Monument				X	Arrowbear Lake
Mormon Road		X			Crestline
Pinecrest Resort Dining Hall				X	San Bernardino National Forest
Rock Camp – Lake Arrowhead				X	Lake Arrowhead
Saddleback Inn Arrowhead				X	Lake Arrowhead
Seely Sawmill Monument				X	Crestline

Source: California State Parks, Office of Historic Preservation, 2013.

Parts of the Area are situated within a location historically occupied by the Serrano Native American Tribe. The Serrano traditional use area encompasses the San Bernardino Mountains from the Cajon Pass to beyond Twentynine Palms (SANBAG 2013). Currently, there are no identified Native American groups living within the Upper Mojave Area.

2.10.2.5 Hydrologic Features

2.10.2.5.1 Surface Water

The Upper Mojave Area encompasses several surface water bodies, including Silverwood Lake and Lake Arrowhead, which act as important water storage reservoirs, and smaller lakes, including Lake Gregory, and Green Valley Lake.

Lake Arrowhead, located at 5,108 feet, serves as a major source of water supplies to LACSD and as a popular recreational destination for hikers, bikers, boaters, and fishers. The reservoir was created in 1922, extends over 782 acres and has a maximum capacity of 47,000 af. Inflows originate from precipitation and surface runoff from Orchard Creek, Cumberland Creek, Fleming Creek, Burnt Mill Creek and Little Bear Creek, as well as subsurface springs (Lake Arrowhead.com 2013; LACSD 2011).

Silverwood Lake, located at about 3,350 feet, is part of the East Branch of the SWP and is the highest elevation reservoir in the entire SWP. The reservoir was formed by the 249-foot Cedar Springs Dam and is primarily fed by SWP water and in part from local Houston Creek. The lake serves as the primary source of water supply to CLAWA and is a state recreation area providing recreational opportunities, including hiking, boating, water-skiing and fishing. The lake is also crossed by the Pacific Crest Trail, a popular scenic hiking trail that runs through California (California State Parks 2013a).

Lake Gregory was created in the late 1930s for water supply purposes, but today serves as a regional park with various recreational opportunities. The lake lies at 4,550 feet and has a surface area of 84 acres. Recreational opportunities in this park include fishing, swimming, boating, and use of two 300-feet water slides, among other options (San Bernardino County 2013c; San Bernardino County 2007b; Crestline Business Council 2005)

Green Valley Lake is a small recreational lake, located at the eastern boundary of the CLAWA service area.

2.10.2.5.2 Groundwater Basins

Groundwater resources are generally limited in the Area due to the local fractured bedrock geology. Groundwater recharge occurs primarily through infiltration and percolation of precipitation and surface runoff in stream channels that flow from local mountains and hills. Groundwater yield of fractured granitic rock is difficult to estimate and the long term reliability of these groundwater resources is not well known.

No groundwater basins have been identified in DWR Bulletin No. 118, within the Area. Groundwater data is generally sparse for the Upper Mojave Area. Studies done within the Lake Arrowhead area provide valuable information to groundwater hydrology in the Area and related findings are likely to be considered applicable to the entire Area based on regional geologic characteristics. Groundwater bearing units within the Lake Arrowhead watershed are divided into multiple subunits, the most important of which is the Grass Valley groundwater basin. The Grass Valley Basin is a hydrologic subunit to the Lake Arrowhead watershed with a drainage area of approximately 2.6 square miles. LACSD currently produces groundwater from five active wells located within the Grass Valley Basin (LACSD 2011).

Aquifers in the Lake Arrowhead area are semi-confined to confined, and some wells flow under artesian conditions (i.e., ground water level above the ground surface). Numerous springs occur where fractures and the shallow ground water table intersect the ground surface and water can also be forced to the surface where a fault displaces fractures in the bedrock (LACSD 2007).

2.10.2.5.3 Geology

Mesozoic-aged granitic rock (i.e., quartz monzonite) underlies the Lake Arrowhead area and most of the Upper Mojave Area, which contains numerous fracture systems related to local and regional faults. At times this bedrock is covered with a very thin alluvial deposit derived from the weathering and erosion of the surrounding mountains, particularly around the lake and in the bottom of valley areas, such as Grass Valley. Based on drilling records, the alluvial material is generally less than 30 feet thick.

In some areas close to Lake Arrowhead, it is likely that the alluvium is in direct hydraulic continuity with the lake. These unconsolidated alluvial deposits are not a viable ground water resource as a result of their shallow depth and limited lateral extent.

Groundwater in the Lake Arrowhead area occurs primarily in the secondary porosity features of the fractured granitic bedrock. Although studies show that the depth of the bedrock aquifer can extend to at least 500 feet below ground surface, the lateral and vertical extent of the aquifer is not known. It is difficult to quantify the amount of groundwater storage capacity in such fractured bedrock systems due to inherently heterogeneous nature of fractures. Additionally, it is very difficult to determine interconnection between fractures, although larger scale features, such as fracture systems and faults may be discernible. As a result a well may intersect only one water-bearing fracture, while a well 100 feet away may intersect numerous water-bearing fractures, thus producing more water than the well intersecting only one fracture (LACSD 2007).

2.10.2.6 Overview of Water Supplies

CLAWA is a public agency that primarily provides wholesale water service from Cedar Pines Park to Green Valley Lake, along with some direct service to retail customers. CLAWA's service area encompasses portions of Crestline, Lake Arrowhead, Running Springs, and other nearby mountain communities that occupy islands of private land surrounded by National Forest territory.

As a wholesaler, CLAWA provides water to 15 water purveyors and one state agency that, in turn, provide municipal water service to residents, businesses, and institutions in their respective service areas.

The areas that are in CLAWA's sphere but not within the current Agency service boundary are: (1) the Lake Arrowhead Exclusion Area; (2) 16 square miles of National Forest land in the Butler Peak/Keller Peak area, at the Agency's east end; and (3) a total of three square miles of primarily National Forest lands in the Cleghorn Pass and Sugarpine Mountain areas, at CLAWA's west and southwest edges, along with a small area south of Crestline.

Near the central part of CLAWA's service area is an area surrounding Lake Arrowhead which chose to be excluded from the Agency's boundary for SWP supplies, relying instead on local water sources. The "Lake Arrowhead Exclusion" area consists of the community surrounding Lake Arrowhead and is currently served by the LACSD. LACSD draws its water from Lake Arrowhead and other local sources; however, LACSD purchases water from CLAWA to serve Deer Lodge Park and approximately 300 residences within the “overlap areas”. The two “overlap areas” are located in the Grandview area on the west side of Lake Arrowhead and in Cedar Glen on the east side of Lake Arrowhead. These two areas are within both CLAWA’s and LACSD’s service area.

The Lake Arrowhead Exclusion is a result of the decision made during the original formation of CLAWA decades ago. The major property owner in Lake Arrowhead elected to exclude the Lake Arrowhead community from CLAWA’s boundaries, confident that local water supplies in Lake Arrowhead would be sufficient to satisfy the needs of that community. In 2005, at LACSD’s request, CLAWA entered into agreements with VALLEY DISTRICT and LACSD, which provided 7,600 af of SWP water over a period of 10-15 or more years, with treatment and delivery capacity through CLAWA’s water transmission system to LACSD as supplemental potable water. An existing 6-inch diameter metered turnout in Crest Park, having a flow capacity of 200-1,500 gallons per minute (gpm), is the connection point for said supplemental water to LACSD. Normally, said supplemental water deliveries to LACSD through this turnout are scheduled to be made during CLAWA’s off-peak months (CLAWA 2011).

2.10.2.7 Water Related Infrastructure

CLAWA’s primary source of supply is surface water from Silverwood Lake, which is part of the East Branch of the SWP. The waters of Silverwood Lake come primarily from the SWP and in small part from Houston Creek. Accordingly, the majority of water delivered to CLAWA’s wholesale and retail customers is from the SWP.

Houston Creek flows into Silverwood Lake when seasonal weather permits. Average Houston Creek appropriations by CLAWA over the past 21 years are approximately 481 afy. Diversions from Houston Creek are made pursuant to two separate permits issued by the State Water Resources Control Board, which combined authorize the appropriation of up to 1,302 afy. One permit authorizes the diversion of up to 1,000 afy, and the other is for up to 300 afy. Prior to issuance of these permits to CLAWA in 1991, this water was un-appropriated (CLAWA 2011).

LACSD encompasses approximately 15 square miles and currently serves approximately 7,800 water customers and 11,000 wastewater customers. The existing water distribution system includes pipelines, pumping stations, storage facilities, regulating stations, and sources of supply. LACSD’s service area ranges approximately 4,700 feet above mean sea level (ft-msl), in the northwest corner, to about 6,000 ft-msl in the southern portion of the service area. LACSD has divided its distribution system into four main pressure zones and 17 sub-zones plus Deer Lodge Park (DLP) area, which are named based on the tanks that serve the zone. There is an additional CLAWA connection that serves exclusively the DLP water system, which is not part of the LACSD’s certificated water service area.

LACSD’s main source of water is stored surface water in Lake Arrowhead. LACSD operates two water treatment plants (WTPs): Bernina and Cedar Glen WTPs. The Bernina WTP has a permitted capacity of 5.0 million gallons per day (MGD). The Cedar Glen WTP has a permitted capacity of 2.0 MGD (LACSD 2008).

2.10.3 Lower Mojave River Watershed, Afton Area

This section describes the physical and environmental characteristics, social and demographic characteristics, and provides an overview of the water system of the Lower Mojave River Watershed, Afton Area, which has been incorporated into the Mojave IRWM Plan boundary.

This 87 square mile expansion area (Lower Mojave River Watershed, Afton Area, or Afton Area) is located within the Mojave Desert, at the northeastern corner of the Mojave Region Boundary. The nearest incorporated urban center is the City of Barstow, located approximately 37 miles west southwest of the Afton Area, as shown on Figure 1-3.

2.10.3.1 Physical Setting

The Afton Area is located the farthest downstream along the Mojave River Watershed of all the areas within the Mojave IRWM Plan Region and is at the lowest elevation of the Region, ranging between 1500-1900 feet above sea level. The Mojave River flows through Afton to its terminus in Silver Lake roughly 15 miles east of the Mojave IRWM Plan boundary.

The Area is virtually uninhabited, with no known permanent population, but contains a campground managed by the BLM near the intersection of Interstate 15 and Afton Road in the northeastern portion of the Area. The Area is probably best known as a recreational destination, attracting hikers, campers, off-road enthusiasts, hunters, and bird-watchers. There is also some evidence of mining activity in the Area. Afton Canyon is one of the few locations in the Region where the Mojave River flows continuously and supports native riparian habitat.

2.10.3.2 Land Use

The Afton Area encompasses an unincorporated area of the County of San Bernardino, dominated by open space land managed primarily by the BLM. The Area consists of 58 percent federal and state lands. The remaining area is privately zoned; only about one percent of which has improved value. Table 2-15 provides an overview of the land use distribution in the Afton Area.

Table 2-15
Afton Area Land Use Distribution

Land Use	Total Acreage	Percent of Total	Acreage Developed
Industrial	1,083	2.0	613
Admin/Prof	0	0	0
Commercial	35	0.1	2
Public Land	32,341	58.3	0
Single-Family	21,332	38.4	0
Multi-Family	0	0	0
Agriculture	0	0	0
Multi Zones	0	0	0
Restricted	348	0.6	24
Easements(1)	377	0.7	0
Total	**55,516**	**100**	**639**

Source: San Bernardino County Assessor, 2009.
Note: (1) These seem to be easement acres that carry no land use type.

2.10.3.3 Ecological Processes and Environmental Resources

The Mojave Region is an ecologically highly varied area, with valuable natural resources. Valuable natural resources are also found within the Afton Area, as described in the following section.

2.10.3.3.1 Sensitive Biological Resources and Areas of Ecological Significance

The Mojave Region is host to 47 threatened, endangered, or candidate species, and/or designated critical habitat. Some of the special status species described in Section 2.4 and listed in Table 2-3 of the IRWM Plan may be found within the Afton Area, such as the yellow warbler and fringe-toed lizard.

As seen on Figure 2-4, the Afton Area falls within an area of high potential for Desert Tortoise Habitat as well as a portion of designated critical habitat units of the Western Mojave Recovery unit. The Area also encompasses ACECs, as described below.

This Area does not include identified wildlife corridors, but the ACECs described in Table 2-16 provide important habitat for desert plant and wildlife species.

Table 2-16
Areas of Critical Environmental Concern in the Afton Area

ACEC Name	Description
Manix	The Manix ACEC is a 2,897 acre area located approximately 20 miles northeast of Barstow along the Mojave River. This site contains wildlife, paleontological and cultural resources as well as important habitat for the Mojave fringe-toed lizard (BLM 2005).
Afton Canyon	This ACEC is located along the Mojave River and encompasses Afton Canyon and adjacent public lands, stretching over 8,277 acres. This ACEC has numerous important values. It is one of three locations where the Mojave River has surface flows, giving it relevant riparian and hydrologic values. These conditions have also created a riparian plant assemblage that is otherwise rare in the desert environment and has enabled development of a high number and diversity of wildlife species within the area. Numerous birds of special management concern are found at this site, including the vermillion flycatcher, summer tanager, yellow warbler, yellow breasted chat, as well as nesting raptors. This site has high scenic and geologic values resulting from unique erosional stratigraphy and Manix fault geology, for which it is often known as the “Grand Canyon of the Mojave.” Conditions at this site have also resulted in high paleontological, historical and Native American values. The hydrology at the site has made this area the focus of human activity for the past 12,000 years, and has made it a significant way station along the historic trade and migration route through the Mojave. It is considered a high potential site for Old Spanish National Historic Trail. This site also includes rare rancholabrean age fossil assemblages (CEC 2012).
Mojave Fringed-toed Lizard	This ACEC consists of ten separate units, within and around the Mojave Region. The unit located within the Afton Area falls within the Barstow Field Office, ending just before the Afton Canyon ACEC. This ACEC is important for its active and functioning ecological process of sand transport and sand dune ecosystems, including source sand and sand corridors. These areas protect the limited habitat type, which is necessary for aeolian sand specialists, such as fringe-toed lizards. Rare vegetation species present in this ACEC include Borrego Milk-Vetch, Ribbed Cryptantha and Harwood’s Eriastrum (CEC 2012).

2.10.3.3.2 Parks, Reserves and Wilderness Areas

The Afton Area includes the BLM's Afton Canyon Natural Area, which is one of the few places where the Mojave River flows aboveground making it an ideal location for bird and wildlife viewing. The area is ideal for hiking, hunting, camping, nature study, rock hounding, horseback riding, and vehicle touring. BLM provides the Afton Canyon Campground which is a first-come first-served fee area, with limited amenities that include tables and fire grates at each campsite and central pit toilets. Campfires are allowed inside the campground.

Route crossing the Mojave River

The Afton Canyon area is a mix of public and private lands including those held by the Union Pacific Railroad.

2.10.3.4 Social and Cultural Characteristics

2.10.3.4.1 Demographics and Population

The Afton Area is an 87 square mile unincorporated area of San Bernardino County, with no permanent population. The Area has transient populations of campers at the Afton Canyon Campground, located near the intersection of Interstate 15 and Afton Road in the northeastern portion of the Area.

2.10.3.4.2 Disadvantaged community

The DWR defines a DAC as a municipality, including, but not limited to a city, town or county, or a reasonably isolated and divisible segment of a larger municipality, that has an average MHI that is less than 80 percent of the statewide annual MHI. A MHI of less than $48,314 meets this threshold based on 2009 USCB data. Although the Afton Area has no permanent population, it falls within a Census tract that qualifies as a DAC.

2.10.3.4.3 Cultural Values

Cultural values are high within the Afton Area due to its location along a historic trade and migration route, also referred to as the Mojave Road. This rugged road stretches approximately 140 miles from Fort Mohave on the Colorado River to Camp Cady, located approximately 20 miles east of Barstow. Early western explorers passing through this Area on this route included Jedediah Smith, Kit Carson and John Charles Fremont (L. Wilcox 2013; BLM 2011a).

Additional details on cultural resources of Afton Canyon are included in Table 2-16.

2.10.3.4.4 Maintenance of Recreational Opportunities

The Afton Canyon area is home to a variety of recreational opportunities, including hiking, hunting, camping, birdwatching, nature study, rock hounding, horseback riding, and off-road vehicle use (BLM 2011a).

2.10.3.4.5 Environmental Enhancement

The BLM initiated the Afton Canyon Riparian Restoration Project in the early 1990's with the objectives of controlling exotic plants, particularly the phreatophyte saltcedar (primarily Tamarix ramosissima, T. parviflora), restoring critical native plant community structural elements and minimizing adverse effects to the riparian zone within the Afton Canyon ACEC. According to the BLM's "Fourth Year Status Report" project activities have resulted in a fairly high degree of saltcedar control and native revegetation is progressing slowly. Project work appears to have improved this stream segment's proper functioning condition from a "non-functioning" to a "functioning at risk" status (BLM 2009). Plans for further exotic plant removal exist.

2.10.3.5 Hydrologic Features

2.10.3.5.1 Surface Water

The Mojave River is the main surface water feature in the Afton Area, which traverses the entire Area. Surface flows rarely extend from the headwaters of the River to the downstream Afton area except during storm events. However, the riparian conditions in this Area are unique, as this is one of three locations where the River has perennial surface flows. Surface flows are, due to local geology. As a result, the Area supports native riparian habitat.

During storm events, high flow rates in the Mojave River can result in surface flows reaching from their origin in the San Bernardino Mountains to the terminus of the River, at Silver Lake near Baker, California.

2.10.3.5.2 Groundwater Basins

The Area lies within the Mojave River Groundwater Basin, almost completely within the Caves Canyon subbasin, as shown on Figure 2-7. A very small portion of the Area, about 270 acres, lies within the Soda Lake Valley subbasin, which is outside the Mojave watershed.

2.10.3.5.3 Geology

The Afton Canyon Area lies within Caves Canyon Valley and Soda Lake Valley. The dominant features in the Area are the surrounding bedrock mountains, alluvial-filled lowlands, and the Mojave River running from west to east through the Area. The surrounding highlands include the Alvord, Bristol, Cady, Cave, Cronise, Kelso, Marl, Soda, Mountain Ranges as well as several hills which protrude from valley floor (DWR 1975). Bedrock highlands consist of Oligocene to Pleistocene sandstone and conglomerate, Proterozoic to Cretaceous gneiss, and Permian to Tertiary granodiorite, quartz monzonite, rhyolite, and basalt. Valley-fill sediments consist of Pliocene to Holocene alluvium (USGS 2005). Average annual precipitation ranges from about 3 to 7 inches (DWR 1975).

Groundwater in the Area is primarily found in alluvium and lake deposits. Alluvial deposits are located along the Mojave River to depths of about 220 feet and, which are further underlain by alluvial deposits and materials associated with Pleistocene Lake Manix. Alluvium is primarily made up of unconsolidated, fine-to coarse-grained sand, pebbles, and boulders with varying amounts of silts and clay (DWR 2003b).

2.10.3.6 Overview of Water Supplies

Water resources in the Afton Canyon Area are nearly exclusively groundwater, with only a minor amount of perennial surface flows.

2.10.4 Wrightwood Area

This section describes the physical and environmental characteristics, social and demographic characteristics, and provides an overview of the water system of the Wrightwood Area, which has been incorporated into the Mojave Region Boundary.

This expansion area (Wrightwood Area) is centered around and encompasses the community of Wrightwood, located in the San Gabriel Mountains. Wrightwood is located 32 miles northwest of the City of San Bernardino and approximately 80 miles east of Los Angeles, as shown on Figure 1-3.

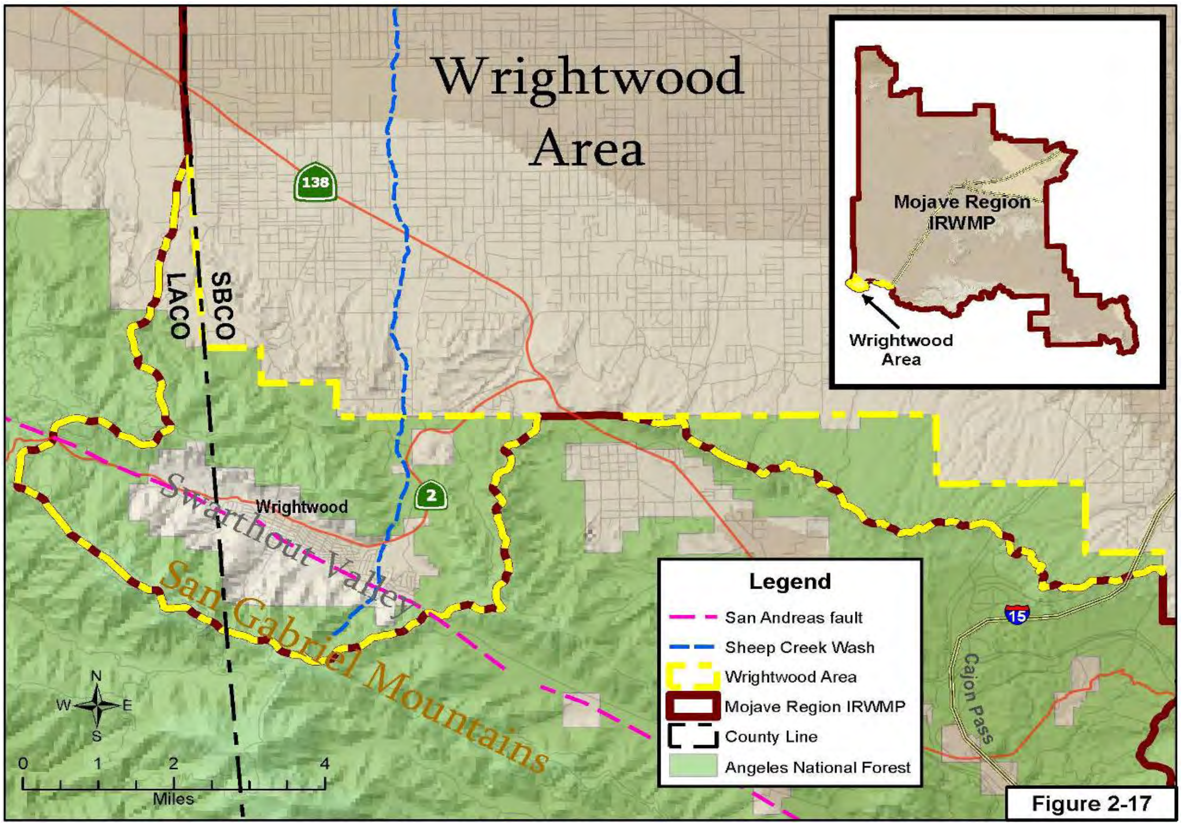
2.10.4.1 Physical Setting

The Area is located at the southwestern corner of the Mojave Region, on the northeast slope of the San Gabriel Mountains, which together with the San Bernardino Mountains; separate the High Desert from the coastal basins. This Area differs from much of the Mojave Region due to its mountainous terrain, lying at an elevation of approximately 6,000 feet. The mountain climate in the Area also differs from much of the Mojave Region with typically cold, snowy winter months and mild to warm summer temperatures.

The small mountain community of Wrightwood is situated in the eastern portion of an area known as the Swarthout Valley, surrounded on all sides by the pine and fir-covered Angeles National Forest. The Swarthout Valley was formed by shifting of the San Andreas Fault, which runs east-west through this Area (WrightwoodCA.com 2013). The Wrightwood Area extends beyond the base of the Valley, encompassing portions of the adjacent mountainous landscape including an extension of Table Mountain to the North and a portion of Blue Ridge and Wright Mountain to the South.

Several canyons branch off from the Swarthout Valley, including Sheep Canyon, Heath Canyon, Acorn Canyon, Flume Canyon, Buford Canyon and Government Canyon (WrightwoodCA.com 2013). The main surface water feature in the Area is Sheep Creek, which traverses the eastern portion of the Area, originating at Wrightwood Mountain and flowing southward into the Mojave Desert. Main tributaries are Sheep Canyon Creek, Heath Canyon Creek and Swarthout Creek, which join at the head of Sheep Creek, just downstream (north) of Highway 2, as shown on Figure 2-17 (San Bernardino County 2011a, 2011b).

Figure 2-17
Wrightwood Area



2.10.4.2 Land Use

The Wrightwood community is completely contained within the Swarthout Valley which is surrounded on all sides by the USFS Lands of the Angeles National Forest. These forest lands primarily fall within the northern and northeastern portions of the Area, north and east of Highway 2, making up a large proportion of total land use (USFS 2013b). Forest lands are devoted primarily to resource conservation and recreational use.

Wrightwood is a small community primarily made up of single residential land use and some multiple residential zones. Most of the residences are occupied by full-time residents. The Area is also a popular mountain resort destination, attracting visitors with its many offerings of snow sports, including the nearby Mountain High Ski Resort, as well as other year-round recreational outdoor activities including camping and hiking (WrightwoodCA.com 2013; San Bernardino County 2012).

The Wrightwood Area is estimated at approximately 16,400 acres (MWA 2014a). Approximately 1,591 of those acres (or about 10% of the Area) are included in the service area for drinking water supplied by the GSWC. As of 2008, approximately 57% of GSWC's service area was developed with a total of 2,696 dwelling units. By 2020, the developed area is anticipated to increase to 68% of the total service area, with 3,024 dwelling units. By 2050, the proportion of area developed is anticipated to grow to 88%, with 3,581 dwelling units (GWSC 2008).

2.10.4.3 Land Use Policies

The primary land use jurisdiction in the populated Wrightwood Area is the County of San Bernardino, which oversees the unincorpated community of Wrightwood. Land use policy is guided by the San Bernardino County General Plan, as described below.

- *San Bernardino County General Plan* (Adopted March 13, 2007 and amended May 22, 2012). This document covers all of the unincorporated County. The Land Use Element is a guide for the County of San Bernardino's future development. It designates the distribution and general location of land uses, such as residential, retail, industrial, open space, recreation, and public areas.

  The San Bernardino County Development Code also provides guidelines that protect biological resources. In addition to Land Use Zoning Districts, County Code establishes Biotic Resources Overlays where standards are implemented to protect and conserve unique, rare, threatened or endangered plants and animals, and their habitats, which have been identified within unincorporated areas of the County. The conditions of approval of land use applications approved with the Biotic Resource Overlay District must incorporate mitigation measures to protect and preserve identified biotic resources (San Bernardino County 2012, 2013a).

A large portion of the Area is covered by the Angeles National Forest, falling under the jurisdiction of the USFS. The main guiding document for land management in this area is the LMP for the Angeles National Forest, a component of the Southern California National Forests Land Management Plan. This land and resource management plan, also known as a Forest Plan, is intended to provide strategic direction to attain social, economic, and ecological sustainability of the national forest. The Forest Plan outlines several goals and objectives to strategically manage the forests and related water resources, including watershed functions and riparian systems (USFS 2005a).

2.10.4.4 Ecological Processes and Environmental Resources

The Mojave Region is an ecologically highly varied area, with valuable natural resources. Valuable natural resources are also found within the Wrightwood Area, as described in the next sections.

2.10.4.4.1 Sensitive Biological Resources and Areas of Ecological Significance

The Mojave Region is host to 47 threatened, endangered, or candidate species, and/or designated critical habitat. Some species described in Section 2.4 and listed in Table 2-2 of the IRWM Plan may be found within the vicinity of the Wrightwood Area. In addition, the mountainous terrain and mild climate provide habitat for species that may be less common in the lower lying desert areas.

The Wrightwood Area lies at high elevations within the San Gabriel Mountains, with a large portion of the Area being National Forest. Vegetative cover in this mountainous area is dominated by coniferous forest, sage brush scrub and chaparral. Wildlife species found in the vicinity and within the Wrightwood Area include bobcat, Western gray squirrel, California ground squirrel, red-tailed hawk, dark-eyed junco, and Nuttall's woodpecker. Sensitive species that may potentially occur in the vicinity of the Area include California mountain king snake, LeConte's thrasher, southcoast marsh vole, and arroyo chub (San Bernardino County 2011c, 2012).

2.10.4.4.2 Wildlife Corridors

The Mojave Region contains various critical connections for wildlife movement. The Wrightwood Area lies within a broader wildlife corridor that connects the San Gabriel Mountains and the San Bernardino Mountains. The Area lies just west of the Lone Pine Canyon wildlife corridor delineated by the County of San Bernardino, which contains important habitat values and enables dispersion of wildlife to and from the forest lands and other open space areas in the vicinity (San Bernardino County 2011c, 2012).

Figure 2-5 locates the wildlife corridors for the Wrightwood Area within the Mojave Region.

2.10.4.5 Social and Cultural Characteristics

2.10.4.5.1 Demographics and Population

The Wrightwood Area is centered on the community of Wrightwood. Based on 2010 census data, Wrightwood had a population of 4,525, which is a nearly 18 percent increase since 2000. The community has a relatively low population density of approximately 760 people per square mile. Racial diversity is very low in the community, with over 90 percent of the population identifying themselves as white. The median age of the total population in 2010 was 44 (USCB 2010).

2.10.4.5.2 Economic Factors

In the larger Mojave Region, growth is expected to be seen in new residential and nonresidential construction in coming years. Similar to anticipated growth in other rural mountain areas, it is possible to expect growth in the Wrightwood Area as people migrate from more urbanized areas to the rural mountain areas.

The Area is an attractive mountain residence and resort destination that offers numerous recreational amenities and scenic resources. Among the many outdoor offerings of this small community are skiing, mountain biking, hiking and camping. The County General Plan encourages development and business activities that can capitalize on these offerings and amenities, while keeping development compatible with the natural character of the mountain communities. Expanding tourist attractions, such as hiking and biking trails is also seen as a way to promote economic development in the Area (WrightwoodCA.com 2013; San Bernardino 2012).

2.10.4.5.3 Disadvantaged Communities

The DWR defines DAC as a municipality, including, but not limited to a city, town or county, or a reasonably isolated and divisible segment of a larger municipality, that has an average MHI that is less than 80 percent of the statewide annual MHI. A MHI of less than $48,314 meets this threshold based on 2009 Census data. The CDP of Wrightwood has an MHI of $80,793, based on 2007-2011 estimates (USCB 2011), and therefore does not fall into the category of a DAC.

2.10.4.5.4 Social and Cultural Values

Preserving the mountain small-town character and the natural and cultural resources of the Area is important to maintain and promote a high level of well-being to residents and continue attracting tourists in the Wrightwood Area.

Numerous County General Plan goals are important to help maintain the residential-recreation character and unique values of the Area. Among these goals is the preservation of the dark night sky as a natural resource, which is a feature unique to remote locations such as this Area. In addition, the County General Plan encourages identification of cultural resources in order to better protect them from damage or destruction. Based on the Office of Historic Preservation website, no historical resources have been identified in the Wrightwood Area.

The Area is situated within the general location historically occupied by the Serrano Native American Tribe, which extended from the eastern portion of the San Gabriel Mountains to the western end of the San Bernardino Mountains (Wrightwoodcalifornia.com 2011). Currently, there are no Native American groups living within the Wrightwood Area.

2.10.4.6 Hydrologic Features

2.10.4.6.1 Surface Water

The main surface water feature in the Area is Sheep Creek, which traverses the eastern portion of the Area, originating at Wrightwood Mountain and flowing southward into the Mojave Desert. Main tributaries to this creek are Sheep Canyon Creek, Heath Canyon Creek and Swarthout Creek, which join at the head of Sheep Creek, just downstream (north) of Highway 2, as shown on Figure 2-17 (San Bernardino County 2011b, 2011c).

2.10.4.6.2 Groundwater Basins

2.10.4.6.3 Geology

A study completed for GSWC in 2004 by Stetson Engineers (Stetson 2004), examined the hydrogeology of the Swarthout Valley in the Wrightwood area. An unnamed creek, locally called Swarthout Creek, drains the Swarthout Valley. The watershed area of Swarthout Creek was estimated at approximately 12,800 acres at the confluence with Sheep Creek. Sheep Creek is an intermittent stream, but may flow year round during wet years. Surface water flows in Swarthout Creek have not been measured. If a runoff coefficient of 0.5 is used, the surface runoff from Swarthout Creek may vary from zero to roughly 22,000 afy at an average of approximately 9,000 afy.

Swarthout Valley is "...a troughlike depression filled with several hundred feet of alluvial fan sediment derived from the surrounding mountains." (SWRCB 1989). The Swarthout Valley was produced by the San Andres Fault zone. Several spays, or secondary faults, diverge to the south from the main trace of the San Andres Fault where the fault zone crosses alluvial fans from the steep canyons on each side of the valley. The main trace of the fault and the spays disrupt groundwater flow coming down the tributary drainages and produce wet environments that foster growth of marsh areas (Weldon, et al.).

Available data from existing wells and test holes that the GSWC drilled indicates that the thickness of the alluvial deposits, primarily sand, may exceed 400 feet in some areas within the Swarthout

Valley. There is insufficient data to determine if the fault structures in the area provide significant barriers to movement of groundwater in the alluvial deposits. Characteristics of the alluvial deposits (transmissivity, hydraulic conductivity, and coefficient of storage) are not available; however, based on geologic information from the test holes, the available storage of the alluvial deposits in the Swarthout Valley is estimated at approximately 54,000 af.

The Swarthout Valley is recharged by percolation of precipitation within the Swarthout Creek watershed. If an infiltration coefficient of 0.2 is used, the groundwater recharge of the Swarthout Valley may vary from zero to roughly 8,500 afy at an average of approximately 3,500 afy (Stetson 2004).

2.10.4.7 Overview of Water Supplies

The Wrightwood System obtains its water supply from local groundwater wells. Groundwater is pumped from eight active groundwater wells located in the local groundwater basin. The system has no emergency interconnections with neighboring agencies and does not receive any imported water supplies. The system has about 34 miles of pipelines that range in diameter from 2 to 10 inches.

2.10.4.8 Water Related Infrastructure

The Wrightwood water system expands over an area with elevations ranging from 5,698 feet above mean sea level (MSL) in the northeastern portion of the service area to about 6,676 feet above MSL in the southwest. As a result, the water system has been divided into 13 pressure zones.

The system is supplied by water from eight active wells, two of which are equipped with treatment filters to remove Iron and Manganese before distribution. Groundwater is pumped directly into the distribution system or into nearby storage tanks. Well water is disinfected with sodium hypochlorite before entering the distribution system.

Mountain High Ski Resort (MHR) owns and operates five wells in the Swarthout Valley. These wells are constructed within the alluvial deposits between Sawmill Canyon and Government Canyon. MHR also owns three wells in Mescal Canyon, west of the Swarthout Valley watershed. These wells serve as the source of water supply for MHR's operation, primarily for making snow (Stetson 2004).

Two neighboring local water agencies (both due north of the Wrightwood Area as shown on Figure 2-11) are the Sheep Creek Water Company and the Phelan Piñon Hills CSD. It is hoped in the future that either of these water agencies might provide additional supplies to the Area as discussed in Section 3.1.2.

Section 3: Water Supply and Water Demand

3.1 Overview of Water Supply

This Section describes the water resources available to the Mojave Region within the Mojave Water Agency (MWA) service area, for the 25-year period covered by the Plan. MWA is the water wholesaler in the Region. With the exception of the Water Quality Section (Section 3.4), the four expansion areas added to the Region during the Integrated Regional Water Management Plan (IRWM Plan) update process are not included in the first six sections below, but each expansion area has its own separate section discussing all applicable topics starting at Section 3.7.

MWA's water resources are summarized in Table 3-1 and discussed in more detail below. Both currently available and planned supplies are discussed.

Table 3-1
MWA 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						
Net Natural Supply[(b)]	54,045	59,973	59,973	59,973	59,973	59,973
Agricultural Depletion from Storage[(c)]	10,425	12,434	7,348	3,517	942	0
Return Flow[(d)]	60,393	65,294	65,587	68,602	71,933	75,852
Wastewater Import[(e)]	4,895	5,274	5,551	5,829	6,107	6,385
Total Existing Supplies	**179,438**	**194,455**	**192,339**	**191,801**	**193,733**	**196,988**
Projected Demands[(f)]	***145,875***	***159,932***	***159,544***	***164,706***	***170,551***	***177,981***

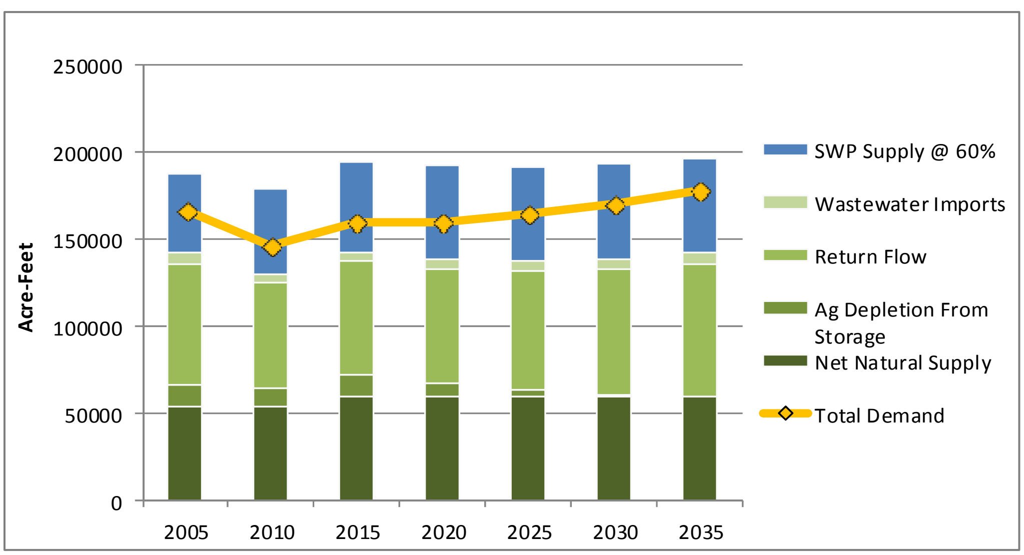
Source: MWA update to its 2010 Urban Water Management Plan (UWMP) demand forecast projection model dated February 26, 2014.
Notes:
(a) Assumes 60% of Table A amount as the long-term supply until 2029 and then assume 61% in 2029 and after, based on the California DWR "State Water Project Final Delivery Reliability Report 2011."
(b) Refer to Section 3.2.2.1 for an explanation of this supply
(c) Refer to Section 3.2.2.2 for an explanation of this supply.
(d) Refer to Section 3.2.2.3 for an explanation of this supply. It was assumed the gallons per capita per day (GPCD) remains at the "moderate" level as defined in Section 3.3.
(e) Refer to Section 3.2.2.4 for an explanation of this supply.
(f) See Section 3.3 Water Demands, Table 3-10, assuming "moderate" conservation.

The MWA service area has four sources of water supply – natural surface water flows, wastewater imports from outside the Region, State Water Project (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 3.2.2.2. 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 the Region 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.

The totals in Table 3-1 reflect an update that MWA recently completed to their demand forecast model that was used in their 2010 UWMP to generate the supply and demand project tables. The tables in this section use the updated demand forecast model; therefore, the totals do not match MWA's 2010 UWMP because of revisions completed by MWA during this IRWM Plan update process. The only water supply substantial change was the elimination of "agricultural depletion from storage" as a water supply, because this is not a sustainable practice. The demand model assumes over the next 20 years the Baja subarea will eventually stop pumping in excess of basin safe yield, through gradual decreases in agricultural water use until the basin is in balance. The water demand model revisions are discussed in Section 3.3.1.

The projected demands shown in Table 3-1 represent total demands within the MWA service area, including pumped groundwater and direct SWP use, assuming "moderate" conservation beyond 2010. This is explained in Section 3.3. 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 on Figure 3-1, demands and supplies were also evaluated with no additional conservation beyond 2010 and extreme conservation, as described in Section 3.3. Tables and charts for those supply and demand projections are included in Appendix C.1.

Figure 3-1
Water Supplies vs. Projected Demands



3.2 Water Supply

3.2.1 Imported Water from the State Water Project

As detailed in MWA's 2010 UWMP, imported water supplies available to MWA consist primarily of SWP supplies. In the early 1960s, the California Department of Water Resources (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 a 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 total about 4.17 million af.

According to the water supply contract between DWR and MWA, revised on October 12, 2009, MWA's maximum annual allocations from the SWP, based on MWA's "Table A Amount," is 82,800 acre-feet per year (afy) from 2010 to 2014; 85,800 afy from 2015 to 2019; and 89,800 afy from 2020 to 2035. Currently MWA's Table A Amount is 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 afy. In 1997, MWA purchased 25,000 afy from Berrenda Mesa Water District, bringing MWA's Table A Amount to 75,800 afy. In 2009, MWA purchased an additional 14,000 afy of Table A from Dudley Ridge Water District in Kings County, which will be transferred incrementally to MWA. The first transfer of 7,000 afy occurred in 2010, with 3,000 afy to be transferred in 2015 and 4,000 afy in 2020 (MWA 2011 UWMP).

3.2.1.1 Factors Affecting SWP Table A Supplies

The amount of SWP water actually available and allocated to SWP contractors each year is dependent on a number of factors including, primarily, the availability of water at the source of supply in northern California, the ability to transport that water from the source to the primary diversion point in the southern Sacramento-San Joaquin Delta and the magnitude of total contractor demand for that water. More detail is found in MWA's 2010 UWMP.

The "State Water Project Delivery Reliability Report*,"* prepared by DWR, assists SWP contractors and local planners in assessing the reliability of the SWP component of their overall supplies. In the "2011 Reliability Report" (DWR 2012b), DWR estimates that for all contractors combined, the SWP can deliver a total Table A supply of 61 percent of total maximum Table A amounts on a long-term average basis, under current conditions and 60 percent of total maximum Table A amounts under future conditions (assumed to be 20 years in the future or 2031). In the worst-case single critically dry year, DWR estimates the SWP can deliver 9 percent of total maximum Table A amounts under current conditions and 11 percent under future conditions. During multiple dry-year periods, DWR estimates the SWP can deliver a total Table A supply averaging 35 to 38 percent of total maximum Table A amounts under current conditions and 30 to 35 percent under future conditions.

Table 3-2 shows MWA's SWP supplies projected to be available to the Region in average/normal years (based on the average delivery over the study's historic hydrologic period from 1922 through 2003). Table 3-2 also summarizes estimated SWP supply availability in the Region 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 historic four-year drought of 1931 through 1934). Supply availability is agency-specific and may differ from combined contractor estimates described above.

Table 3-2
SWP Table A Supply Reliability for MWA (afy)

Wholesaler[a,b] (Supply Source)	2012	2015	2020	2025	2030	2035
Average Water Year[c]	82,800	85,800	89,800	89,800	89,800	89,800
DWR (SWP)						
Table A Supply MWA	49,680	51,480	53,880	53,880	54,778	54,778
% of Table A Amount[d]	60%	60%	60%	60%	61%	61%
Single Dry Year[e]						
DWR (SWP)						
Table A Supply MWA	5,796	6,006	6,286	6,286	9,878	9,878
% of Table A Amount[d]	9%	9%	9%	9%	11%	11%
Multi-Dry Year[f]						
DWR (SWP)						
Table A Supply MWA	28,152	29,172	30,532	30,532	31,430	31,430
% of Table A Amount[d]	34%	34%	34%	34%	35%	35%

Source: MWA update to its 2010 UWMP demand forecast projection model dated February 26, 2014.
Notes:
(a) Supplies to MWA provided by DWR from detailed delivery results from the analyses presented in DWR's "State Water Project Final Delivery Reliability Report 2011." As indicated in the 2011 Reliability Report, the supplies are based on existing SWP facilities and current regulatory and operational constraints.
(b) Table A supplies include supplies allocated in one year that are carried over for delivery the following year.
(c) Based on average deliveries over the study's historic hydrologic period of 1922 through 2003.
(d) Supply as a percentage of MWA's Table A amount of 82,800 afy from 2010 to 2014; 85,800 afy from 2015 to 2019; and 89,800 afy from 2020 to 2035.
(e) Based on the worst case historic single dry year of 1977.
(f) Supplies shown are annual averages over four consecutive dry years, based on the historic four-year dry period of 1931-1934.

3.2.2 Local Water Supplies

3.2.2.1 Net Natural Supply

The MWA service area has an average net natural supply of 59,973 afy, which includes surface water and groundwater flows in the five subareas of the Mojave Basin Area (MBA) and in the Morongo Basin/Johnson Valley Area ("Morongo"), as shown in Table 3-1. The estimates for the MBA are derived by the MBA Watermaster and were used in the updated MWA demand forecast projection model discussed early in this section.

Within the constraints of the Judgment, for the 2010-11 water year, the MBA Watermaster revised the natural supply estimate for the Baja Subarea from 5,500 afy to 11,428 afy (Wagner and Bonsignore 2012). The MBA Watermaster utilizes the projected net natural water supply estimates, consistent with the requirements of the Judgment, to calculate annual yield for each of the five subareas and to define the quantities of water that each stipulating party can produce without incurring replenishment obligations under the Judgment. This determination and other information will ultimately result in the final calculation of Replacement Water and Makeup obligations of the stipulating parties. This procedure has a direct effect on the calculation of the largest demand for imported water supply and has been adjudicated by the Court. It is necessary to maintain the Mojave Basin Area long-term average supply regardless of actual variability in surface water flows.

3.2.2.2 Agricultural Depletion from Storage

Agriculture accounts for the largest water demand in the Baja Subarea. The 2010 UWMP identified 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 previous version (2011) of the MWA demand projection model treated consumptive use of agriculture as a supply derived from storage depletion. Recently, increasing local recognition that this is not a sustainable practice has prompted the revision of the model to reflect a trend in decreasing agricultural production until total groundwater pumping in the Baja Subarea is reduced to a level that no longer depletes groundwater storage.

3.2.2.3 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 MWA's Watermaster Consumptive Water Use Study and Update of Production Safe Yield Calculations for the Mojave Basin Area (MWA 2000). Return flow factors for each category per the study are explained in MWA's 2010 UWMP Section 2.4.3.

On a regional basis, return flow factors 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. The projections for recycled water flows discussed in Section 3.2.4 are separated from the overall return flow numbers shown in Table 3-1, and can therefore be identified as a separate source of supply. The Mojave Basin Area Watermaster is currently evaluating water consumptive use estimates which include return flow calculations. These refined estimates may be used in future regional water budget calculations.

3.2.2.4 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 (LACSD) is imported to the Alto Subarea, and effluent from the Big Bear Area Regional Wastewater Agency is imported to the Este Subarea.

3.2.3 Groundwater

As discussed previously, basins along the Mojave River and adjacent areas are referred to as the Mojave River Groundwater Basin; the area is referred to as the Mojave Basin Area. The remaining basins in the southeastern portion of the MWA service area are referred to as the Morongo Basin/Johnson Valley Area or "Morongo Area".

3.2.3.1 Mojave Basin Groundwater Extractions

Projected groundwater pumping within each subarea of the Mojave Basin Area is summarized in Table 3-3. As described in Section 3 of MWA's 2010 UWMP, 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. The Watermaster assigns a percentage of BAP, known as the variable Free Production Allowance (FPA), for each subarea each year. This FPA is reduced 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 its 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 3-3
Mojave Basin Area Projected Groundwater Production (afy)

Mojave Basin Area[a]	2010	2015	2020	2025	2030	2035
Subareas						
Alto	79,058	86,810	88,323	95,946	104,128	112,307
Baja	23,227	30,238	27,271	23,673	20,065	18,043
Centro	23,132	22,425	23,525	24,194	24,924	25,655
Este	5,785	6,931	7,135	7,307	7,487	7,667
Oeste	5,042	5,663	5,333	5,485	5,648	5,812
Total	**136,244**	**152,067**	**151,587**	**156,605**	**162,252**	**169,484**

Source: MWA update to its 2010 UWMP demand forecast projection model dated February 26, 2014.
Note:
(a) Numbers represent groundwater production only and do not include demands met directly with SWP sources.

Table 3-4 shows the current FPA for water year 2012-2013 for each subarea and the estimated PSY. Also shown in Table 3-4 is the verified production for water year 2011-12 for comparison. FPA as shown in Table 3-4 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.

Table 3-4
Mojave Basin Area Production Safe Yield and Current Free Production Allowance (afy)

Mojave Basin Area	Base Annual Production	2012-2013 FPA	Production Safe Yield	Percent Difference[a]	2011-2012 Verified Production
Subareas					
Alto	116,412	74,485	69,862	4.00%	76,512
Baja	66,157	40,650	20,679	30.20%	29,188
Centro	51,030	41,157	33,375	15.20%	21,326
Este	20,205	16,376	7,156	45.60%	5,433
Oeste	7,095	5,727	4,052	23.60%	4,571

Source: MWA Watermaster Annual Report for Water Year 2011-12.
Note:
(a) This value represents the percent of BAP that PSY departs from FPA.

3.2.3.2 Morongo Basin Groundwater Extractions

Projected groundwater pumping for the Morongo Area is summarized in Table 3-5.

Table 3-5
Morongo Area Projected Groundwater Production (afy)

	2010	2015	2020	2025	2030	2035
Morongo Area[a]	5,666	6,636	6,728	6,871	7,070	7,268

Note:
(a) Groundwater production projections are based on the "moderate" conservation assumptions using the updated (February 26, 2014) MWA demand forecast model.

Two of the Morongo Area groundwater 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) is implementing system improvements including the Ames Valley Recharge Project which is near completion. Local groundwater is currently the sole source of its water supply, but BDVWA has annual nine 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. The Reche Spreading Grounds Recharge Feasibility Study was completed for BDVWA in 2011 including a groundwater model, which documents the ability to store and recover SWP water in the basin (BDVWA 2011).

There are two water supply agreements that are applicable to groundwater basin management in the Morongo Area, including (1) the Warren Valley Basin Agreement, and (2) a court approved agreement between the BDVWA and HDWD in a portion of the Ames Valley basin. It should be noted that the agreement between parties managing groundwater in the Ames Valley basin is being amended by the subparties and is presently under court review. For a description of the original agreements, refer to the 2007 Basin Conceptual Model Report (BDVWA and MWA 2007).

3.2.3.3 Groundwater Banking and Recharge Projects

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

Table 3-6 shows the storage available in MWA's existing bank accounts by subarea as of January 1, 2014. Unless otherwise noted, the water was all excess SWP water that MWA has purchased over 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 Table 3-6. It should be noted that since the 2010 UWMP was completed, the MWA groundwater storage account has increased from approximately 95,000 af to the amount shown in Table 3-6 of over 132,000 af, an increase of approximately 30% in storage.

Table 3-6
Status of MWA Groundwater Storage Accounts

Subarea	MWA-Owned Stored Water[(a)] (af)	Retailer-Owned Stored Water[(b)] (af)	Total Stored Water (af)
Alto	89,785	21,154	110,939
Baja	21,249	0	21,249
Centro	20,230	0	20,230
Este	1,349	0	1,349
Oeste	0	0	0
Morongo	0	0	0
Total	**132,613**	**21,154**	**153,767**

Notes:
(a) MWA's banked groundwater storage accounts as of January 1, 2014.
(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.

Recently completed supply enhancement projects listed in Table 3-7 address the key management issues related to overdraft of groundwater basins, localized water quality issues, and future growth/water demand. These projects supplement the other groundwater recharge programs and facilities operated by MWA throughout the Mojave Region.

Table 3-7
Water Supply Projects and Programs in MWA Service area

Name/Type	Capacity (afy)	MWA Subarea/ Region	Retailer Served	Date Supply Available
Regional Recharge and Recovery Project ("R^3 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 – Completed. Phase 2 – 2015-2020
Oro Grande Wash Recharge	Phase 1 – 4,000, Phase 2 - 8,000 total	Alto	Victorville Water District,	Phase 1 to be completed by July 2016. Phase 2 completion date unknown.
Ames Valley Recharge	1,500	Ames Valley	BDVWA, HDWD, CSA No. 70 W-1, CSA No. 70 W-4	Completed
Warren Basin Recharge Pond No. 3	3,300	Morongo	HDWD	2006
Joshua Basin Recharge	2,000	Morongo	JBWD	2014

3.2.4 Recycled Water

While MWA does not have the authority to determine how or where recycled water is used in the Region, all the local water agencies within the Mojave Region share many issues related to local and regional water supplies. Wastewater agencies that collect and treat wastewater within the Region 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 discussed in Section 3.2.2.4. This section simply identifies existing and projected wastewater flows by the wastewater agencies within the Region, and potential opportunities for the use of recycled water. Such use could serve to augment the overall water portfolio of the Mojave Region. The possible treated wastewater/potential recycled water flow projected to be available is shown in Table 3-8.

Table 3-8
Treated Wastewater/Potential Recycled Water Summary

Agency	Flows (afy)					
	2010	2015	2020	2025	2030	2035
City of Adelanto	2,800	4,481	8,177	12,322	19,042	19,042
City of Barstow	2,240	2,464	2,688	3,025	3,249	3,249
Victorville Water District	1,232	2,800	2,800	2,800	2,800	2,800
Victor Valley Wastewater Reclamation Authority	14,450	16,578	19,042	21,843	24,979	28,564
Helendale Community Service District	672	784	784	896	896	1,008
Hi-Desert Water District	0	0	1,863	2,604	2,737	2,876
Marine Corps Logistics Base	112	112	112	112	112	112
Total	**21,506**	**27,219**	**35,466**	**43,602**	**53,815**	**57,651**

Source: MWA's 2010 UWMP, Table ES-1 with City of Barstow flows updated with Golden State Water Company (GSWC) – Barstow's 2010 UWMP Table 4-13.

3.2.5 Other Water Supply Options

In addition to SWP water supplies and groundwater, the Mojave Region 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 water management strategies for enhancing the long-term reliability of the total mix of supplies currently available to meet water demand in the Region.

3.2.5.1 Water Transfer and Exchanges

An opportunity available to the Region 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 those within the Mojave Region, 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.

3.2.5.2 Opportunities for Short and Long-Term Transfers and Exchanges

As discussed in Section 3.2.1, the Region's average SWP supplies are substantially higher than its current SWP demands, and a majority of the Region's SWP deliveries are used to recharge groundwater conjunctive use programs rather than for direct deliveries, allowing the Region to rely on previously stored groundwater during droughts or outages on the SWP. MWA's current conjunctive use groundwater storage program, which constitutes the Region's primary conjunctive use program, has been in operation since 1991, but has been expanded over time to increase the number of groundwater recharge sites and increase recharge capacities. MWA has built a robust groundwater storage inventory with over 132,000 af stored as of January 2014. With surplus SWP supplies and a mature groundwater storage program, the Mojave Region is in a position to be able to participate in a variety of water transfer opportunities with multiple water agencies. Table 3-9 summarizes the potential water transfer and exchange opportunities identified for the Mojave Region 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) began a Water Exchange Pilot Program in 2003 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. Due to the success of the Pilot Program, in 2011 MWA and Metropolitan entered into a long-term Water Storage Program with similar terms, but expanded the program to allow for up to 390,000 af to be stored and returned between 2011 and 2035. Under the extended Water Storage Program, Metropolitan stored about 60,000 af in 2011 and 2012.

MWA also has a SWP Table A exchange program in place with the Solano County Water Agency (SCWA). This agreement allows MWA to receive Table A deliveries from SCWA during hydrologic periods when SCWA has approved Table A allocations in excess of its 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.

The exchange programs with both Metropolitan and SCWA 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.

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.

Beginning in 2012, MWA has worked closely with Dudley Ridge Water District (DRWD) and other SWP Contractors to expand options for water transfers under the existing Water Supply Contracts between the Contractors and DWR. Among the options being considered are non-permanent sales/transfers of water between two SWP Contractors over multiple years; unbalanced exchanges; a multi-year pool whereby multiple sellers and buyers would agree to buy or sell certain amounts with varying prices depending upon SWP allocations over a two-year period; and sales of water between SWP Contractors that share common agricultural land owners.

Table 3-9
Water Transfer and Exchange Opportunities in Mojave Region

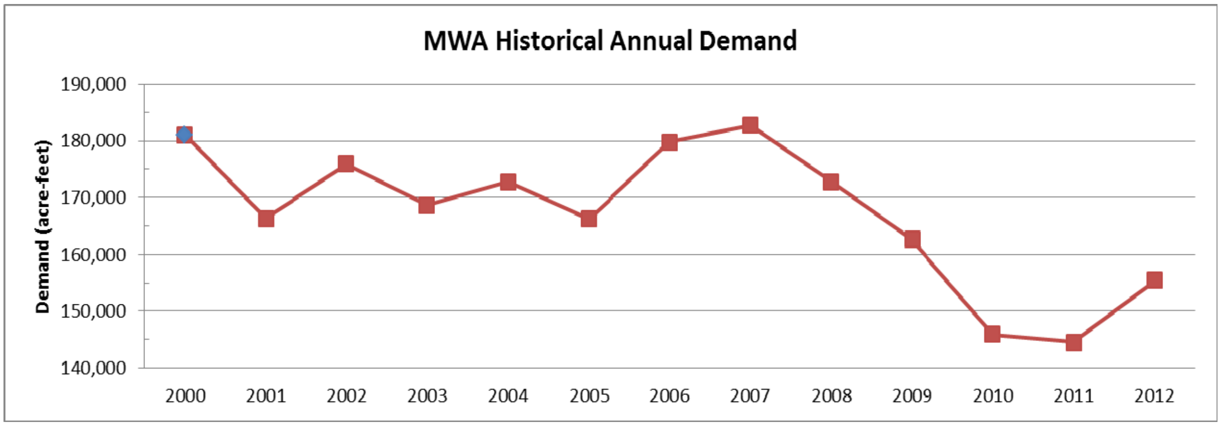
Name/Type	Exchange/Transfer	Duration	Proposed Quantities
Pre-delivery of Unused SWP Supplies	Current water contract	Permanent	Up to 220,000 af total from 2010 to 2030
Solano County Water Agency	Exchange Pilot Program	Ending in 2015. No further action.	Pilot program only
Metropolitan Water District Water Exchange Program	Exchange Pilot Program	Ended in 2010. No further action.	Pilot program only
Antelope Valley-East Kern Groundwater Storage Program	Groundwater storage in AVEK for use by LUZ solar plant during dry years	2011-2035	Up to 3,000 af storage balance
Metropolitan Water District Water Storage Program	Long-Term Storage and Exchange Program	2011 to 2035	Up to 390,000 af from 2011 to 2035
Common Agricultural Landowner Transfers	Non-permanent transfer to SWP Contractors with common landowners to MWA	Under consideration	Not defined
Unbalanced SWP Exchange	Unbalanced exchange program with other SWP contractors	Under consideration	Not defined
Multi-Year Sale/Transfer of SWP Water	Non-permanent sale/ transfer between MWA and another SWP contractor over 2 or more years	Under consideration	Not defined
Multi-Year Sale/Transfer of SWP Water via "Pool"	Non-permanent sale by multiple sellers into a pool with multiple buyers over 2 or more years	Under consideration	Not defined
Other SWP Contractors	Water transfer, exchange, or banking	Under consideration	Not defined
Transfers within Mojave Basin Subareas	BAP and/or FPA	Ongoing	Variable

3.3 Water Demands

A summary of MWA's historical water demand is provided below.

Figure 3-2 illustrates the change in water demand since 2000. The figure includes minimal water producers and two power plants that are supplied directly with SWP water.

Figure 3-2
MWA Historical Annual Demand



For MWA's 2010 UWMP, a demand forecast model was developed (and updated in February 2014, with the results below being from the updated version so they do not match the 2010 UWMP's numbers) that combines population growth projections with water use data to forecast total water demand in future years. Using Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan (RTP) growth forecast (baseline of 2008), it is predicted that population in the MWA service area will grow at a rate of approximately 2.2 percent per year from 2010 through 2035.

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 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 145 GPCD in 2010. At the same time, SFR GPCD in the Morongo Area remained relatively flat at an average of 99 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.

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 2012: GPCD remains flat at the 2012 level (145 GPCD in the Mojave Basin and 99 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 2010Morongo Area level of 113 GPCD, and GPCD in Morongo decreases 5 percent (to 95 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 (129 GPCD by 2020 for Mojave and 97 GPCD by 2020 for Morongo).

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. MWA service area demands are projected to increase at a rate of 0.9 percent per year, slower than population growth of 2.2% discussed in Section 2.5.1, partially because of conservation and partially because some non-retail water uses are not anticipated to increase in the future.

3.3.1 Projected Water Demands

MWA's 2010 UWMP utilized existing land use data and new housing construction information to project water demands in the MWA service area. Table 3-10 summarizes the MWA's service area projected water demands by subarea through 2035, based primarily on the MWA 2010 UWMP (Table 2.3 in UWMP). The totals do not match MWA's 2010 UWMP because of revisions completed by MWA during this IRWM Plan update process, which included updating the actual demand and population data through 2012 (instead of the previous 2009). Other changes to the model are discussed below.

Water demands decreased between 2010 and 2012, and greater levels of conservation were projected for several sectors of demand, decreasing overall demands and decreasing the projected need for imported SWP water through the planning horizon of 2035. SFR water use was projected to become more efficient than projected in the 2010 UWMP (in terms of GPCD) and this had the single largest impact on the reduction in overall projected demand.

Industrial and agricultural water demands increased some between 2010 and 2012, and were accounted for in the model.

Finally, MWA completed an update to the minimal producer production estimates based on a detailed Geographic Information System-based (GIS) accounting of land uses among Minimal Producers (MWA 2011). The analysis estimated the water production of each individual Minimal Producer and found that many Minimal Producers use substantially less than one (1) afy (which had been assumed previously). It is anticipated that these projected demands can be met using the water supplies described earlier in Section 3.2.

Projected demands reflect conservation activities planned by agencies in the MWA service area to comply with Senate Bill 7 of Special Extended Session 7 (SBX7-7). As described in SBX7-7, it is the intent of the California legislature to increase water use efficiency and the legislature has set a goal of a twenty percent per capita reduction in urban water use statewide by 2020. As SBX7-7 applies to retail water suppliers, the following ten retailers must comport with its requirements:

1. City of Adelanto
2. Apple Valley Ranchos Water Company
3. County Service Area (CSA) 64
4. CSA 70J
5. Golden State Water Company
6. Hesperia Water District
7. Hi-Desert Water District
8. Joshua Basin Water District
9. Phelan Piñon Hills Community Services District
10. Victorville Water District

For more detail, see MWA's 2010 UWMP (www.mojavewater.org/files/Final2010UWMP.pdf) and the UWMPs of individual retailers.

Table 3-10
Projected Water Demands by Subarea for MWA Service Area (afy)

Subarea	2010	2015	2020	2025	2030	2035
Alto	81,833	86,810	88,323	95,947	104,128	112,307
Baja	23,227	30,238	27,271	23,673	20,065	18,043
Centro	24,322	23,654	24,754	25,423	26,153	26,884
Este	5,785	6,931	7,135	7,307	7,487	7,667
Oeste	5,042	5,663	5,333	5,485	5,648	5,812
Morongo	5,666	6,636	6,728	6,871	7,070	7,268
Total	**145,875**	**159,932**	**159,544**	**164,706**	**170,551**	**177,981**

Source: MWA's update to the 2010 UWMP demand forecast projection model dated February 26, 2013. The totals do not match MWA's 2010 UWMP completed in June 2011.

3.3.2 Other Factors Affecting Water Demands

Besides population, the major factors that affect water usage are weather and water conservation.

3.3.2.1 Climate

Generally, when the weather is hot and dry, water usage increases. Typically in the Mojave Region, the largest amount of water use occurs during the hot summer months of July through September, whereas the smallest amount of water use occurs in the cooler winter months of January through March.

The extent to which water demand changes is also dependent on the conservation activities imposed. Residential, commercial, and industrial usage can be expected to decrease as a result of the implementation of more aggressive water conservation practices and stricter building codes. The greatest opportunity for conservation in the Mojave Region is in developing greater efficiency and reduction in landscape irrigation as it typically represents as much as 70 percent of the water demand for residential customers, depending on lot size and amount of irrigated turf and plants. Details on planned conservation activities can be found in MWA's 2010 UWMP.

California, as a whole, 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 SWP. The most likely scenarios involve increased temperatures, which will reduce the Sierra Nevada snowpack and shift more runoff to winter months, and accelerate sea level rise. These changes can cause major problems for the maintenance of the present water export system since water supplies are conveyed 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 (DWR 2009). Climate change vulnerabilities in the IRWM Region are discussed in detail in Section 3.6.

3.3.2.2 Water Conservation

Conservation is a key strategy for meeting future demand. MWA and the Alliance for Water Awareness and Conservation (AWAC) have formed water use efficiency goals for the Region. AWAC is a coalition of 25 local water agencies and other regional organizations with the goal of reducing consumption by 20 percent by 2020 for the Mojave Basin Area and 5 percent by 2015 for the Morongo Area. AWAC Goals, updated in 2011 are:

- Serve as a network to assist agencies in educating the public on water conservation.
- Provide resources with a consistent message to help agencies meet their respective conservation goals.
- Maintain current GPCD or lower and continue to position agencies for meeting future conservation needs.
- Exchange ideas between agencies, especially at quarterly meetings.

In addition to local goals, the Water Conservation Bill of 2009, or SBX7-7, provides the regulatory framework to support the statewide reduction in urban per capita water use. Each water retailer must determine and report its existing baseline water consumption and establish an interim target in their 2015 UWMP and a 2020 water use target in GPCD. Although water wholesalers are not required to meet the targets outlined in SBX7-7, MWA implements conservation programs and policies in partnership with and/or on behalf of its water retail agencies. This not only helps the compliance with SBX7-7, it also helps to ensure long-term water supply reliability goals are met. More information on water conservation programs and policies is provided in Section 5: Resource Management Strategies Used to Meet Plan Objectives.

3.4 Water Quality

The Region's water is an important resource and its quality is of vital importance. The quality of water affects the ability to use it, affects the cost of providing treated drinking water, affects habitat conditions, and can impair or enhance recreation.

Water quality management in the MWA service area is therefore focused on maintaining and improving existing water quality and preventing future contamination. Recycled water activities have also been included in this discussion since the recharge of the recycled water may impact water quality.

3.4.1 Water Quality Regulatory Framework

An extensive federal, state, and local regulatory framework has evolved to protect and improve water quality for all beneficial uses. Today, many of these regulations directly influence the water management actions in the Mojave Region. The regulations are designed to support continued, long-term use of the Region's water supplies for drinking water, agricultural, and ecosystem benefits. The 1972 Federal Clean Water Act (CWA) established strategies for managing water quality including: requirements to establish and maintain at least a minimum level of pollutant management using the best available technology; and a water quality based approach that relies on evaluating the condition of surface waters and setting limitations on the amount of pollution that the water can be exposed to without adversely affecting the beneficial uses of those waters.

Section 303(d) of the CWA bridges these two strategies. Section 303(d) of the Clean Water Act requires the identification of water bodies that do not meet, or are not expected to meet, water quality standards (i.e., impaired water bodies). The affected water body, and associated pollutant or stressor, is then prioritized in the 303(d) List. The Clean Water Act further requires the development of a Total Maximum Daily Load (TMDL) for each listing. The list is compiled based on the guidance outlined in the "Water Quality Control Policy for Developing California's Clean Water Act Section 303(d)". There are many resources that provide additional information on state and federal water quality regulations, including the April 2002 California Legislative Report: "Addressing the needs to Protect California's Watersheds: Working with Local Partnerships."

The US Environmental Protection Agency (USEPA), the California State Water Resources Control Board (SWRCB), and Regional Water Quality Control Boards (RWQCBs) have permitting, enforcement, remediation, monitoring, and watershed-based programs to prevent pollution through both the CWA as well as the California Porter-Cologne Water Quality Control Act. Pollution can enter a water body from point sources including wastewater treatment plants (WWTPs), storm water discharges and/or other industries that directly discharge to a water body and from nonpoint sources (NPS) over a broad area, such as runoff from agricultural farmland or grazing areas that can reach waterways. NPS pollution can include pollutants from urban and agricultural runoff and include heavy metals, oils and greases, herbicides, pesticides, and fertilizers. Preventing pollution from most point sources relies on a combination of source control and treatment, while preventing NPS pollution generally involves the use of best management practices (BMPs), efficient water management practices, and source control.

The Federal Safe Drinking Water Act (SDWA) was originally passed by Congress in 1974 to protect public health by regulating the nation's public drinking water supply. The SDWA applies to every public water system in the US. SDWA authorizes the USEPA to set national health based standards for drinking water to protect against both naturally-occurring and man-made contaminants that may be found in drinking water. Originally, SDWA focused primarily on treatment as the means of providing safe drinking water at the tap. Amendments in 1996 greatly enhanced the existing law by recognizing source water protection, operator training, funding for water system improvements, and public information as important components of safe drinking water. Under the SDWA, technical and financial aid is available for certain source water protection activities. The California Department of Public Health (CDPH) is responsible for enforcing the SDWA and California-specific drinking water regulations as defined in Title 22 of the California Code of Regulations.

3.4.1.1 Drinking Water Regulations

The CDPH Drinking Water Program (DWP) regulates public drinking water systems (bottled water or vended water are regulated as food by CDPH's Food and Drug Branch).

DWP consists of three branches: (1) the Northern California Field Operations Branch, (2) the Southern California Field Operations Branch, and (3) the Technical Programs Branch.

The Field Operations Branches (FOBs) are responsible for the enforcement of the federal and California SDWAs and the regulatory oversight of about 7,500 public water systems to assure the delivery of safe drinking water to all Californians. In this capacity, FOB staff perform field inspections, issue operating permits, review plans and specifications for new facilities, take enforcement actions for non-compliance with laws and regulations, review water quality monitoring results, and support and promote water system security. In addition, FOB staff are involved in funding infrastructure improvements, conducting source water assessments, evaluating projects utilizing recycled treated wastewater, and promoting and assisting public water systems in drought preparation and water conservation.

FOB staff work with the USEPA, the SWRCB, RWQCBs, and a wide variety of other parties interested in the protection of drinking water supplies. On the local level, FOB staff work with county health departments, planning departments, and boards of supervisors. Primacy has been delegated by CDPH to certain county health departments for regulatory oversight of small water systems, and FOB staff provide oversight, technical assistance, and training for the local primacy agency personnel.

The Technical Programs Branch is responsible for maintaining the scientific expertise of the Drinking Water Program and for administering the Small Water Systems program. Specific responsibilities include:

- Ensuring that individuals certified as drinking water treatment operators or as distribution system operators meet the educational competence required by law.
- Ensuring that residential water treatment devices sold for purifying water meet appropriate standards.
- Developing monitoring and water quality regulations.
- Conducting special studies on contaminants in drinking water.

- Developing water recycling criteria and regulations, and evaluating water recycling projects and making recommendations to the RWQCBs about public health implications.
- Collecting, compiling, evaluating, and reporting analytical results from laboratories that monitor drinking water for public water systems.

Private domestic wells are not regulated by DWP.

3.4.2 Surface Water Quality

The surface waters within the Mojave Region support a variety of beneficial uses; the list below presents the beneficial use designations for major surface water bodies in the Mojave Region as identified in the Water Quality Control Plans for the Lahontan RWQCB Basin Plan (1994, amended 2005) (Lahontan Basin Plan) and the Colorado River RWQCB Basin Plan (2006) (Colorado River Basin Plan). As discussed in Section 1.1.2 Regional Features, the Mojave Region includes portions of both the South Lahontan and Colorado River DWR-defined Hydrologic Regions and is therefore governed by the two hydrologic regions of the RWQCB; the Lahontan Region and the Colorado River Region (see Figure 3-3). The Basin Plans do not identify beneficial uses for all water bodies in the Mojave Region; however the tributary streams of any specifically identified water body can generally be assumed to have the same beneficial use designations.

1. Municipal and Domestic Supply
2. Agricultural Supply
3. Industrial Service Supply
4. Groundwater Recharge
5. Water Contact and Non-contact Water Recreation
6. Warm and Cold Freshwater Habitat
7. Wildlife Habitat
8. Freshwater Replenishment
9. Water Contact and Non-contact Water Recreation
10. Commercial and Sport fishing
11. Migration of Aquatic Organisms
12. Water Quality Enhancement
13. Rare, Threatened, and Endangered Species

Nearly all water bodies in the Mojave Region support the first six listed beneficial uses. Many of the beneficial uses relating to habitat are supported in the creeks of the Mojave River; the east fork of the West Fork Mojave River is one of the few areas in the Mojave Region that provides cold freshwater habitat and spawning habitat. Rare, threatened, and endangered species beneficial uses are found in streams and many regional lakes or reservoirs, including among others, the Lower Narrows of the Mojave River. Local surface waters are not a direct source of drinking water supply in the Mojave Region, but they are a continual source of recharge to groundwater which is then used to meet municipal water demands.

Figure 3-3
Mojave Region Regional Board Boundaries

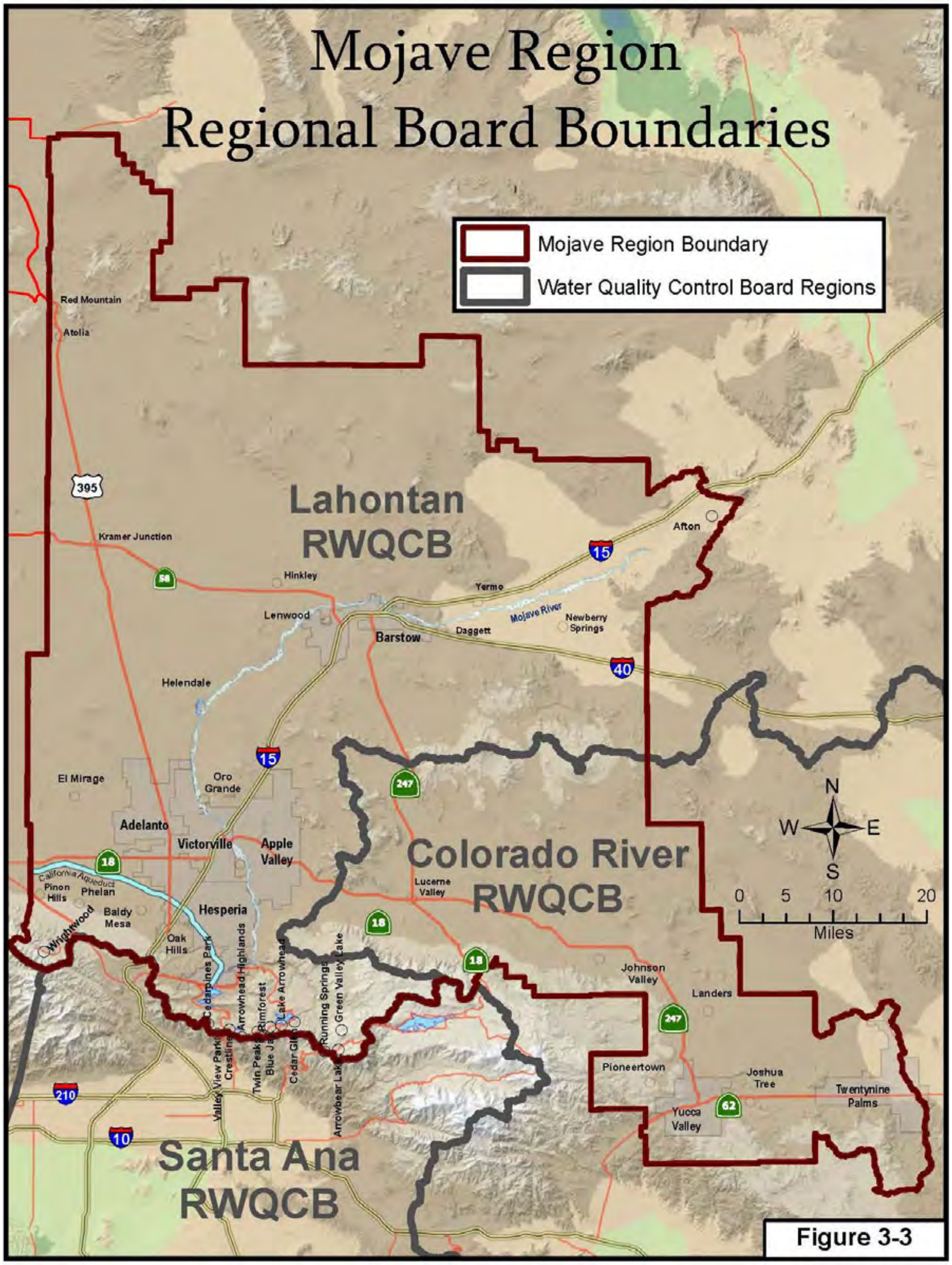


Table 3-11 shows the water quality objectives meant to protect the beneficial uses in the Mojave River Watershed.

Table 3-11
Water Quality Objectives for Waters in the Mojave River Watershed

See Fig. 3-3	Mojave River Reach	TDS[a] (mg/L)	Nitrogen (mg/L)[b]	Chloride (mg/L)[c]	Sulfate (mg/L)	Fluoride (mg/L)	Boron (mg/L)
Inland Surface Waters and Groundwater Basins							
2	W.F. Mojave River (at Lower Narrows)[d]	312	5	-	-	-	-
3	Mojave River (at Barstow)[d]	445	6	-	-	-	-
4	Mojave River (upstream side of Waterman Fault)[d]	560	11	-	-	-	-
5	Mojave River (upstream side of Calico-Newberry Fault)[d]	340	4	-	-	-	-
6	Mojave River (upstream of Camp Cady Ranch Building Complex)[d]	300	1	-	-	-	-
15	W.F. Mojave (above Silverwood Lake)[e]	219	-	8.4	34	0.26	0.02
16	East Fork of W.F. Mojave[e]	140	-	12.7	10.7	0.23	0.06
17	Silverwood Reservoir[e]	220	-	55	20	-	-
18	Mojave River (at Forks)[e]	-	-	55	35	1.5	0.2
19	Mojave River (at Victorville)[e]	-	-	75	40	0.2	0.2

Source: Lahontan Basin Plan Tables 3-20, 3-21 and Figures 3-13, 3-14.
Notes:
(a) TDS = Total Dissolved Solids
(b) mg/L Nitrogen as NO_3.
(c) The RWQCB has adopted revised Site-Specific Objectives (SSOs) for chloride. See RWQCB Order No. R4-2008-012.
(d) Values shown are maximum objective values.
(e) Values shown are annual average objective values.

The 2010 Section 303(d) Impaired Water bodies List for the Mojave River Watershed was approved by the SWRCB on September 21, 2009 and was approved by the USEPA on October 11, 2011. There are some constituents that have been identified on the 2010 303(d) list to cause impairments in Reaches 5, 6 and 7 of the Mojave River, and portions of Sheep Creek and Crab Creek, also in the Region. Figure 3-4 shows the various reaches of the Mojave River.

Figure 3-4
Mojave River Reaches for Water Quality Objectives

In addition to identifying impaired water bodies, the RWQCB is required to develop a TMDL for each pollutant/water body combination identified in the 303(d) listing. The TMDL is designed to control the amount of the pollutant entering the water body so that the beneficial use of the water body can be restored. The Lahontan and Colorado River Regional Boards have developed several TMDLs for the Mojave Region and have plans to develop more in the future. Table 3-12 provides a summary of the current listings of impaired water bodies in the Mojave Region, based on the 2010 303(d) list. TMDLs are scheduled to be completed by 2021 for all of these listed water bodies and associated pollutants.

Table 3-12
2010 303(d) List of Impaired Water Bodies in the Mojave River Watershed

Waterbody	Pollutant	Potential Sources	Basin Plan Objective	Data Ranges Measured	Estimated Size Affected (miles)	Proposed/ Approved TMDL Completion
Crab Creek	TDS	Unknown	83 mg/L annual average	90-176 mg/L annual averages	6	2021
Holcomb Creek	TDS	Unknown	83 mg/L annual average	70-190 mg/L	19	2021
Mojave River (Mojave Forks Reservoir outlet to Upper Narrows)	Fluoride	Natural	0.2 mg/L annual average	0.2-5.5 mg/L	15	2021
Mojave River (Upper Narrows to Lower Narrows)	Fluoride	Natural	0.2 mg/L	0.3-0.6 mg/L	4	2021
	Sulfates	Nonpoint, Natural	40 mg/L annual average	42.8-53.4 mg/L annual averages	4	2021
	TDS	Unknown	312 mg/L	197-496 mg/L	4	2021
Silverwood Lake[(a)]	Mercury, Polychlorinated biphenyls (PCBs)		0.002 mg/L (0.002 mg/kg), 0.0005 mg/L	15 of 16 samples exceed 0.2 mg/kg	N/A	2025
Lake Arrowhead[(a)]	Mercury		0.002 mg/L (0.002 mg/kg)	12 of 16 samples exceed 0.2 mg/kg	N/A	2025
Lake Gregory[(a)]	Mercury		0.002 mg/L (0.002 mg/kg)	5 of 13 samples exceed 0.2 mg/kg	N/A	2025
Sheep Creek	Nitrate	Unknown	0.3 mg/L annual average as nitrate	0.458-0.893 mg/L annual averages	2	2021
	TDS	Unknown	56 mg/L annual average	101-196 mg/L	2	2021

Source: SWRCB 2010 Integrated Report
http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2010.shtml
Notes:
(a) Lahontan RWQCB June 2014 Meeting "Proposed New and Revised Section 303(d) Listings for 2012".

3.4.3 Potable Water Quality

The previous section discussed surface water quality as it pertained to pollution and the natural environment. This section identifies water quality regulations related to potable water delivered to customers and provides a general description of the water quality of both imported water and local groundwater supplies.

3.4.3.1 Imported Water Quality

Imported water in the Mojave Region consists of SWP supplies. 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 Bay 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 MWA's 2010 UWMP, SWP supplies are received at four MWA turnouts off the East Branch of the SWP, located in the southwestern corner of the MWA service area.

An important property of SWP water is the chemical make-up, which may fluctuate and is influenced by its passage through the Delta. The Delta is basically a very large marsh (or estuary) with large masses of plants and peat soils. These contribute organic materials to the water. Salt water can also move into the Delta from San Francisco Bay and the Pacific Ocean. This brings in salts, notably bromide and chloride. Chloride levels from the Delta may elevate local chloride levels. Additionally, disinfectant by-products (DBPs) are generated when bromide and organic materials react with disinfectants such as ozone and chlorine.

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 are readily available from 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. A cooperative study between the Lahontan RWQCB and MWA was completed in 2007 to address salt balance within the MWA service area. Model results 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 MWA basin(s) (Schlumberger 2007).

3.4.3.2 Groundwater Quality

3.4.3.2.1 Naturally Occurring Contamination

Impairment of groundwater can be assessed by comparing the water quality parameters to all of the applicable beneficial uses for the Mojave Basin. In the Lahontan Region, there are five (5) beneficial uses of the groundwater in the Mojave Basin: Drinking Water, Agriculture, Freshwater Replenishment, Industrial Service Supply and Aquaculture. These five beneficial uses are described in the Water Quality Control Plan for the Lahontan Region (Basin Plan) and apply to groundwaters in the Mojave Basin that fall in the Lahontan Region. There may be a different number and type of beneficial uses for those groundwaters in the Mojave Basin that fall within the Colorado River Region. Contamination can exist when a constituent's concentration exceeds the level that would impair any of the applicable beneficial uses for that particular groundwater; not just drinking water or irrigation use.

Groundwater is used throughout the Region for drinking water and irrigation supplies. The impairment of groundwater for the beneficial use of drinking water is determined by comparing concentrations of constituents of concern in the groundwater against drinking water maximum contaminant levels (MCLs) and agricultural water quality parameters needed for specific crops. MCLs consist of primary and secondary MCLs. Primary MCLs are assigned to constituents for which a health-based risk is associated with consumption of water that exceeds a particular concentration. Secondary MCLs are assigned to constituents for which there is no health risk, but for which there may be aesthetic concerns above a particular concentration.

The Region's groundwater basins contain numerous areas with water quality issues. Key contaminants include arsenic, nitrates, iron, manganese, Chromium VI, and TDS. Some of these are naturally occurring in desert environments while others are associated with human activities. 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.

Numerous studies have characterized groundwater quality in the Mojave Region. Despite local groundwater quality degradation in Barstow and variability elsewhere, these studies generally confirmed the suitability of groundwater for beneficial uses in the Region. According to the most recent hydrogeologic study completed in the Centro Subarea, general mineral quality is affected by the barrier effects of the Helendale and Waterman faults, leaching from evaporative lake deposits (and other geochemical processes) and effluent discharges from the Barstow WWTP (MWA 2013).

Additionally, maximum groundwater concentrations measured over the past 10 to 20 years were plotted for selected inorganic constituents (including TDS, arsenic, boron, chromium, fluoride, nitrate, and perchlorate) to identify areas that are potentially degraded by common naturally-occurring and anthropogenic contaminants. Areas of degraded groundwater quality in terms of TDS occur near Barstow and the Harper Lake area.

Arsenic is a naturally occurring element in groundwater. Ingestion of arsenic can result in short-term discomfort and long-term health effects such as skin discoloration, circulatory system impacts and increased cancer risks, and in high concentrations, arsenic consumption can lead to death. CDPH has established a primary MCL of 10 ppb for arsenic. Arsenic can also be toxic to plants, but the toxicity varies depending on plant species. The 100 ppb irrigation water quality target is a research based recommendation. Within the Mojave Region arsenic concentrations have been measured at levels above the MCL in the Transition Zone (TZ) portion of the Alto Subarea, located in northern Alto, Baja and Morongo subbasins.

Nitrate in irrigation water helps to stimulate plant growth; an irrigation water quality target for nitrate has not been established. In drinking water, high nitrate levels water can have acute health problems in infants less than six months, causing a condition known as blue baby syndrome. Long-term health impacts in adults are not well-known. Nitrate concentrations have been measured at levels far below the primary MCL across the Region.

TDS concentrations in the groundwater are influenced by the chemistry of the aquifer and quality of water recharging the aquifer. TDS is not a health hazard, but can be an aesthetic issue and can shorten the useful life of pipes and water-based appliances in homes and businesses. The CDPH secondary MCL for TDS is 500 parts per million (ppm). For irrigation, high TDS waters may cause low soil permeability, lead to increased irrigation requirements and can result in reduced yields. The California Environmental Protection Agency (CalEPA) recommends a TDS target of 450 ppm for no effects on the most sensitive crops. TDS concentrations in groundwater appear to be increasing in the Region, and some areas are experiencing TDS concentrations in excess of 500 ppm – the secondary MCL. Because the Mojave Basin Area and Morongo Area are considered closed basins, salts that are added to the locally generated wastewater, contained in the imported and local reclaimed wastewater and imported with SWP supplies are mostly not removed from the basin. Population increases and the associated larger volumes of wastewater entering into the Region's basins have contributed to the increasing trend in TDS concentrations in local groundwater.

Iron and manganese are both naturally occurring elements in groundwater and often occur together. High levels of these contaminants in drinking water are not known to pose direct adverse health risks. However high levels of iron and manganese in drinking and irrigation water can be associated with aesthetic issues and can cause damages and reduced effectiveness of water distribution and treatment systems. Within the Region, iron and manganese levels have been detected above the MCL, only in the Alto TZ subbasin (MWA 2011).

3.4.3.2.2 Human Caused Contamination

Groundwater contamination resulting from the influence of human beings on nature or anthropogenic pollutants is also an issue in the Mojave Region. A summary of the nature and status of key groundwater contamination issues is presented below.

<u>Contribution of Agriculture and Dairies on Salt and Nutrients</u>

Nitrate and nitrite are naturally-occurring anions and are most commonly produced for use in agricultural fertilizers because of their high solubility and biodegradability. Nitrate and nitrite are also present in raw and treated wastewater. These sources can pose risks to urban and rural drinking water supplies. The federal and state MCL is 10 mg/L for nitrate-nitrite measured as N (nitrogen) (MWA, 2013). In the Lahontan Region, the dairy and agricultural contribution of salts and nitrates can be seen from current and legacy dairy operations and from wastewater treatment plants. One example is in the Hinkley Valley, where the background groundwater is considered to be excellent water quality and the nitrate concentrations in the background groundwater are generally less than a few parts per million and. However, there are two documented nitrate hot spots likely due to legacy dairy operations where nitrate concentrations range from the teens to well over 100 mg/L nitrate as N (Lahontan RWQCB 2014b). The Lahontan RWQCB has made addressing the salt and nutrients contribution in the Region a 2014 priority as documented during their February 2014 meeting.

Barstow Perchlorate

Perchlorate is both a naturally occurring and human-made chemical that is used as a solid rocket fuel oxidizer. It is also used in fireworks, flares and explosives. The natural form is commonly found in desert environments. Perchlorate can also be present in degraded bleach and in some fertilizers. Perchlorate is a regulated drinking water contaminant in California, with an MCL of 6 µg/L.

In the Barstow area, perchlorate concentrations above the MCL were detected in multiple municipal and domestic production wells in December 2010. Through an ongoing site assessment with groundwater and soil sampling, the RWQCB has determined that improper disposal of firework-producing chemicals at one residence north of the Mojave River is the source of contamination. Alternative remediation actions will be considered once the extent of contamination is fully characterized (MWA 2013).

PG&E Hinkley

Extensive investigations by Pacific Gas and Electric (PG&E) Generating Station have identified a plume of groundwater polluted by Hexavalent Chromium (Cr-VI), which leaked from onsite wastewater ponds. The current dimensions of the plume are approximately two miles in length and one-quarter mile in width. PG&E no longer uses Cr-VI in its facility operations and has implemented an aggressive corrective action program to monitor and remediate locally polluted groundwater. Current activities are focused on characterizing the horizontal and vertical extent of the plume, which has migrated in some areas (MWA 2013).

3.4.4 Water Quality Considerations for Recycled Water Use

The SWRCB adopted a statewide Recycled Water Policy (Policy) on February 3, 2009 to establish uniform requirements for the use of recycled water. The purpose of this Policy is to increase the use of recycled water from municipal wastewater sources in a manner that implements state and federal water quality laws. The Policy states that salts and nutrients from all sources, including recycled water, should be managed on a basin wide or watershed wide basis in a manner that ensures attainment of water quality objectives and protection of beneficial uses.

The SWRCB finds that the appropriate way to address salt and nutrient issues is through the development of regional or subregional salt and nutrient management plans rather than through imposing requirements solely on individual recycled water projects. Salt and nutrient plans must include a basin/sub basin wide monitoring plan that specifies an appropriate network of monitoring locations. The monitoring plan should be site specific and must be adequate to provide a reasonable, cost-effective means of determining whether the concentrations of salt, nutrients and other constituents of concern as identified in the salt and nutrient management plans are consistent with applicable water quality objectives.

A Salt and Nutrient Management Plan has been prepared concurrently with this update to the IRWM Plan.

3.4.5 Wastewater and Recycled Water Quality

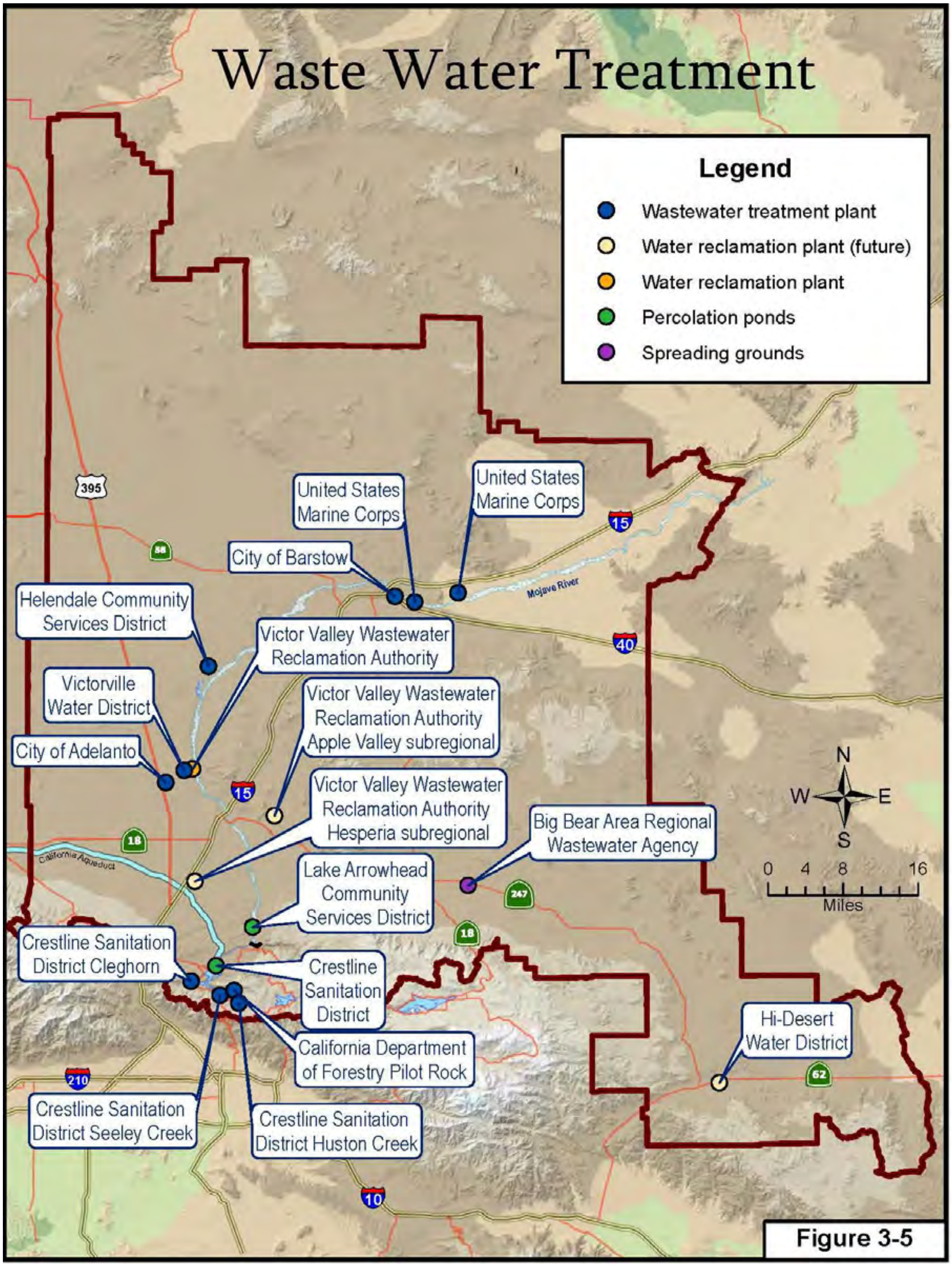
Table 3-13 identifies the local water, wastewater, imported wastewater, and planning agencies that are within the Mojave Region and could potentially have a role in any recycled water activities. Local water agencies within the Region share many issues related to local and regional water supplies. Wastewater agencies that collect and treat wastewater within the Region 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 3-13. In addition, various land use planning agencies with general land use plans are included because they will coordinate where future growth is to occur.

Table 3-13
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
Joshua Basin Water District			San Bernardino County Planning Department
San Bernardino County Service Areas 42 and 64			Town of Apple Valley
Victorville Water District			Town of Yucca Valley

Wastewater discharges in the Region consist of land application. For wastewater treatment plants that rely on land disposal, wet weather can increase soil saturation and decrease percolation rates, thereby leading to unintentional wastewater discharges. For the location of each wastewater treatment plant, see Figure 3-5.

Figure 3-5
Mojave Region Wastewater Treatment facilities



3.5 Flood Protection and Stormwater Management

Flood protection and stormwater management together represent another important aspect of water quantity, and can also affect water quality and environmental resources. A combination of hydrology, basin topography, land use, and natural and human caused geomorphic processes contribute to the flooding that occurs in the Mojave Region. The Region contains several areas designated to be within the 100-year and 500-year floodplains as defined by the Federal Emergency Management Agency (FEMA) as shown on Figure 3-6. Lands within these flood-prone zones are private or publically owned; contain mixed land use activities with differing land values. Reducing flood risk in these areas is a significant challenge in the Region. The main area of the Mojave Region at risk for flooding is the Mojave River Watershed. Some flooding also occurs in the Morongo Basin area due to Yucca Creek as discussed in the following subsection.

Flood management facilities have been constructed over the years and many studies have occurred and continue to occur to address these areas by federal, state, and local agencies such as the US Army Corps of Engineers (US ACOE), DWR, San Bernardino County Flood Control District, City of Adelanto, City of Barstow, City of Hesperia, City of Victorville, and the Towns of Apple Valley and Yucca Valley.

A 100-year floodplain is defined as the extent of a flood that has a statistical probability of occurring once in 100 years. Floods of this extent may occur more than once every 100 years, and floods of even greater extent are possible. Most state, federal and local floodplain protection planning is based upon the 100-year floodplain. Floodplains often include wetland and riparian areas which may extend beyond the limits of the 100-year floodplain. Riparian areas are typically defined as the terrestrial moist soil zone immediately adjacent to wetlands, lakes, and both perennial and intermittent streams.

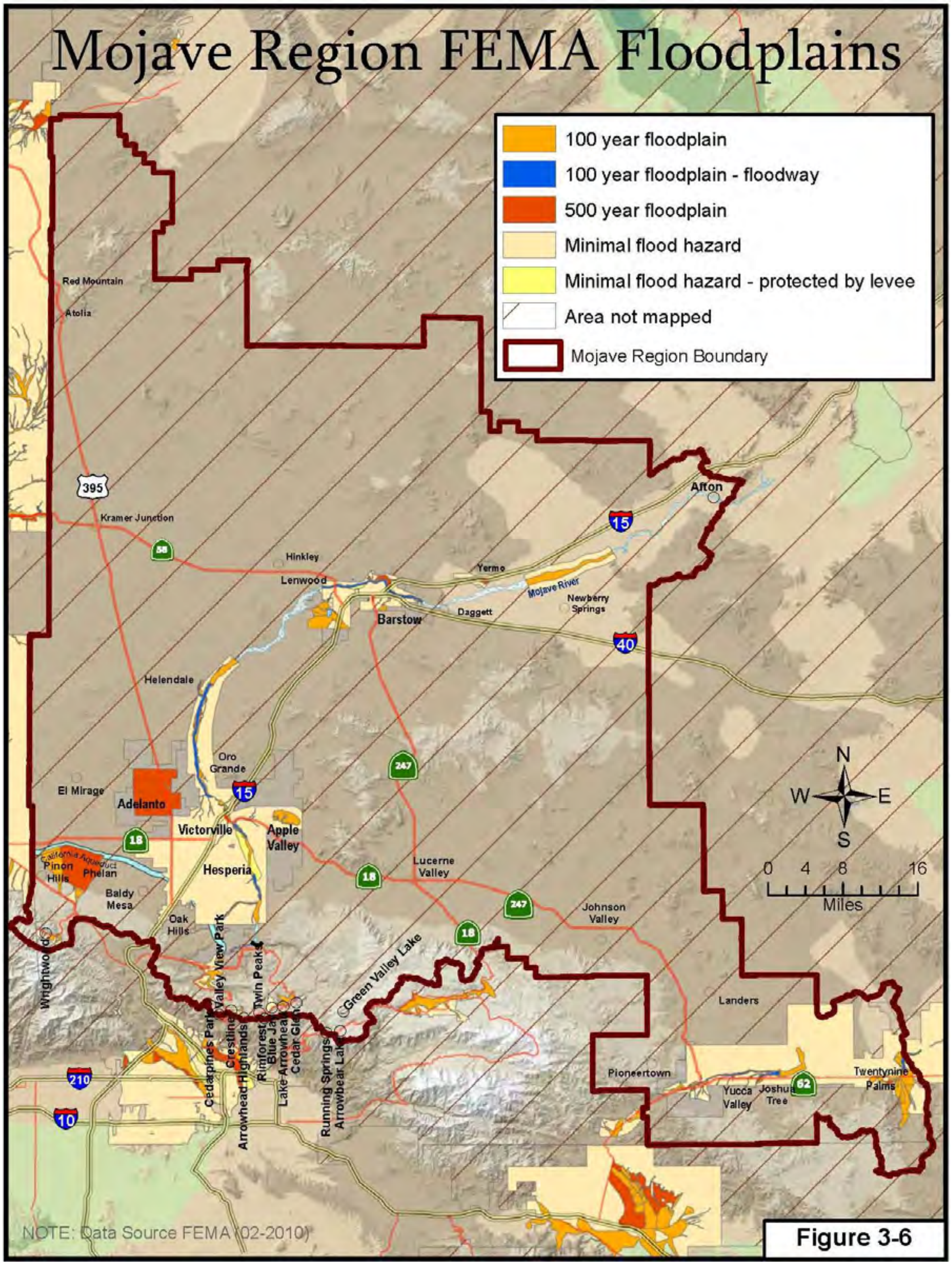
In addition to the values of flood control, water quality protection, base flow augmentation, and wildlife habitat, floodplains and riparian areas can provide opportunities for dispersed recreation, access points for water contact recreation, and open space for aesthetic enjoyment. As all of these values can be impacted by development or other disturbances in the floodplain and riparian areas; therefore protection measures are necessary (Lahontan RWQCB 2005).

Effective stormwater management serves multiple functions. It can reduce the risk of localized flooding, improve water quality in surface streams and rivers, and provide a source of secondary source of supply. Addressing stormwater management issues could also minimize damage related to local flooding. By better managing stormwater discharges (by impounding this water), municipalities would be able to treat and store the runoff to be gradually released and/or eventually reused, thereby minimizing the risk of flooding and preserving the quality of susceptible waterbodies.

3.5.1 History of Floods in Region

The Mojave Region generally experiences infrequent precipitation; however it can occasionally experience high intensity storms, which makes flash floods common occurrences in the area. The arid and often sparsely vegetated desert environment has little capacity to absorb high intensity rainfall and therefore normally dry or ephemeral streambeds can quickly develop into raging torrents of water in a short period of time.

Figure 3-6
Mojave Region FEMA Floodplains



The Mojave River has the propensity for large flood events, although many reaches of the Mojave River remain dry for the greater part of the year. Historically, the most severe floods occurred along the Mojave River near Victorville which is just downstream of where the Mojave River emerges from the San Bernardino Mountains. The majority of flooding takes place during the rainy season from December to March, when multi-day, widespread storms saturate the headwaters (US ACOE 1969). However, localized flooding also occurs throughout the Mojave Basin as a result of summertime thunderstorms. Historically flood durations have been short, generally about a half day. The largest flood of record occurred on March 2, 1938 when a peak discharge of 70,600 cubic feet per second (cfs) in the Mojave River at Victorville damaged railroad and highway bridges and agricultural lands adjacent to the river (US ACOE 1969). The second largest flood, which reached 37,500 cfs at Victorville, occurred on January 25, 1969. In response to this event, residents in lowlands adjacent to the Mojave River were forced to evacuate and parts of crossings were washed out.

Other smaller but notable floods at Victorville occurred in February 1932, November 1965 and April 1958 (US ACOE 1969). Often floods are thought of as destructive; however, in the desert environment it is also important to note that they can be the source of important groundwater recharge. For example, wet years 1969 and 1978 generated floods of 18,000 cfs at Afton and 24,800 cfs at Deep Creek respectively and contributed 245,000 af and 282,000 af to groundwater recharge respectively (USBR 2013).

In the Morongo Basin area, the main drainage channel running east to west through the Yucca Valley area is Yucca Creek, which has numerous tributaries of various sizes along the length of the stream. Intense storms can result in significant volumes of water and sediment being transported from the mountain areas, flooding properties and depositing sediment and debris in properties and roadways (Warren Valley Basin Watermaster 1991 and Town of Yucca Valley 2007). Similar flash flood events occur in many areas across the Mojave Region, including Lucerne and Apple Valley.

For the portion of the Mojave Region that is within the Colorado River Hydrologic Region, flood control projects are limited in scope. Most of the reservoirs, levees, channels, and debris basins address local problems.

3.5.1.1 Mojave River Adjudication Restrictions for Stormwater Flow

The Adjudication of the Mojave Basin Area included an injunction against diverting stormwater flow away from downstream users of the Mojave River. So while it may appear prudent that the City of Victorville construct necessary stormwater detention basins along the Mojave River for flood damage prevention, no such projects are allowed under the Judgment, if the project will directly reduce the amount of stormwater flow that would otherwise go through the naturally occurring hydrologic regime to a downstream user such as the City of Barstow. The other example of what the Adjudication prevents is any projects that alters the bed of the Mojave River and reduces the surface area over which stormwater currently flows.

The Adjudication does not prevent any flood control agency or municipality from taking emergency action as necessary to protect the physical safety of its residents and its structures from flooding. However, any emergency action must minimize any reduction in the quantity of stormwater flow.

3.5.2 Flood Management Infrastructure

As discussed above, the Region has experienced severe and widespread flooding throughout its history. Several major drainage basins have the potential to subject residents and structures to a high risk of flooding. In addition, the cumulative increase in impervious surfaces has increased problems related to surface run-off. While complete avoidance or protection through control facilities is not practical, considerable improvement can be made through both structural and non-structural methods.

Flood management infrastructure helps provide valuable flood protection to residents and farmland throughout the Region. The infrastructure has been constructed by multiple private, local, state, and federal agencies responsible for flood management. Major flood protection infrastructure, including basins, spreading grounds, channels, and flood control systems are shown on Figure 3-7 and are also listed in Appendix C.2.

For the Mojave River Watershed, one primary flood infrastructure is at confluence of Deep Creek and the West Fork Mojave River meet at a location called "the Forks," which is the beginning of the Mojave River. Stormflow at the Forks is regulated by an ungated dam referred to the Forksite Dam or Mojave River Dam, maintained by the US ACOE. The Mojave River Dam serves to attenuate peak flows during large storm events and prevent downstream flooding. The flow at this location constitutes the primary water supply to the main stem of the Mojave River; consequently, the combined data from the Deep Creek and West Fork gages represent the total flow at the headwaters of the Mojave River.

At the local level, while there are two existing storage reservoirs in the Mojave Region, the Mojave River Dam and Lake Silverwood, MWA is not allowed to store stormwater in these reservoirs because the Mojave Basin Adjudication (discussed in Section 2.6.2) includes an injunction against diverting storm flows as discussed in Section 3.5.1.1. Therefore, MWA is restricted by the adjudication on certain types of flood infrastructure uses.

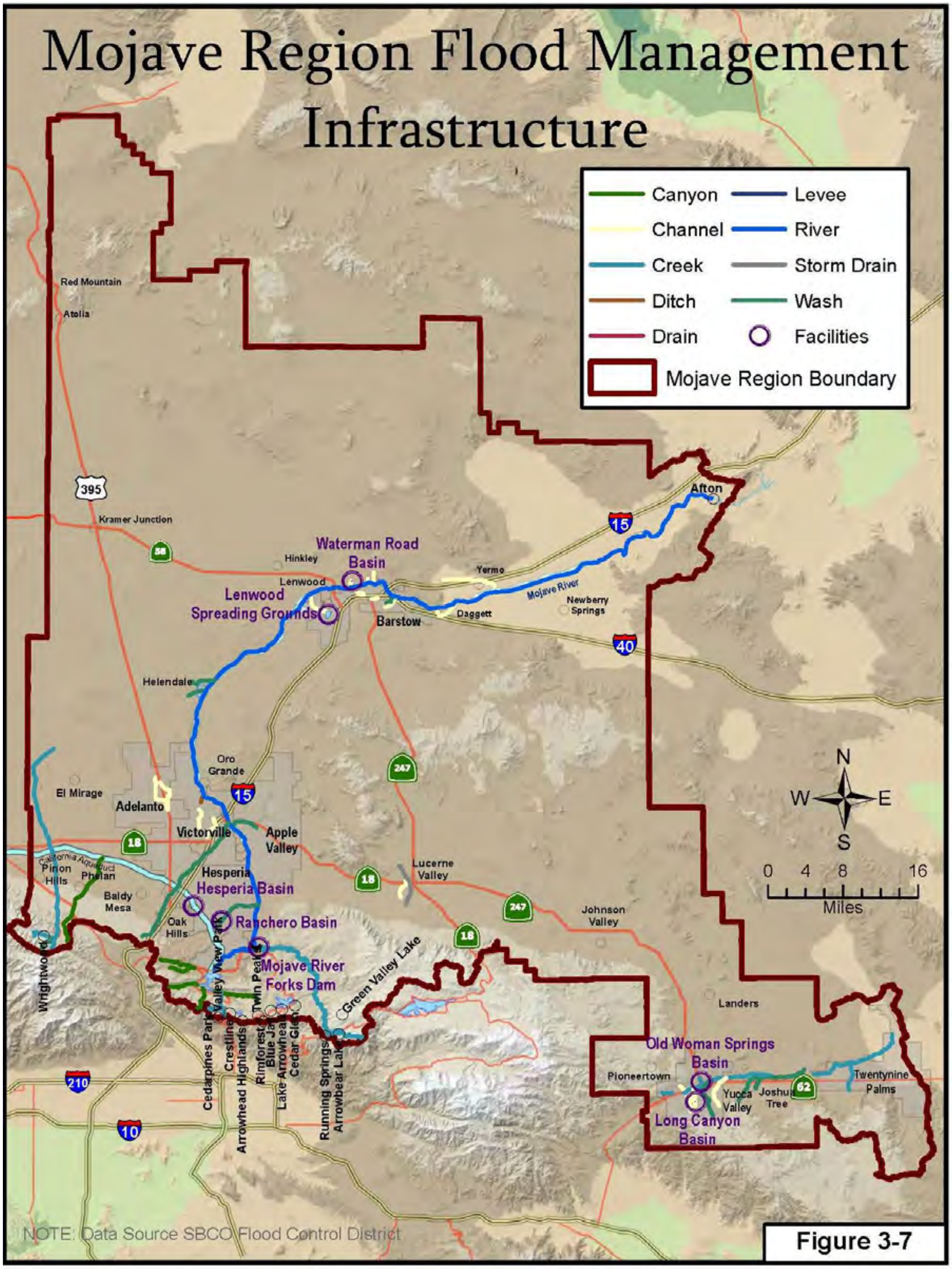
Table 3-14 summarizes the planned existing and future flood management projects as listed currently by the Region's Flood Control District.

Table 3-14
Mojave Region Flood Control District Existing and Future Projects

Type of Project	Existing/Future	Name of Project
Construction	All Existing	Mojave River I-15 Levee
		Amethyst Basin (Oro Grande)
		Sheep Creek repair
Design, Right-of-Way, and/or Environmental Phases	All Existing	Hesperia Detention Basin
Design	All Future	Desert Knolls III
		Hesperia Detention Basin
		Kitchen Wash
		Mojave River Phase II
		Oro Grande Detention Basin
		Extension of Victorville Line E-01

Source: San Bernardino County, 2012.

Figure 3-7
Flood Management Infrastructure



3.5.3 Regulatory Requirements for Stormwater Management

The Federal Clean Water Act was amended in 1987 to bring urban runoff discharges from municipal separate storm sewer systems (MS4s) under the National Pollutant Discharge Elimination System (NPDES). As defined in USEPA regulations, an MS4 "means a conveyance or system of conveyances including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains." USEPA delegated to the Lahontan and Colorado River RWQCBs the authority to adopt and enforce discharge permits in the Mojave Region. There is a Phase I or II permit required depending on the municipality's population as discussed below.

The 1987 amendments require municipalities to effectively prohibit non-stormwater discharges to MS4s and to implement controls (best management practices, or BMPs) to reduce pollutants in stormwater to the maximum extent practicable. USEPA promulgated regulations to implement the amendments in two phases. Phase I permit requirements apply to larger (municipalities serving over 100,000 people) MS4s and were promulgated in 1990.

On April 30, 2003 as part of Phase II, the SWRCB issued a General Permit for the Discharge of Storm Water from Small MS4s (WQ Order No. 2003-0005-DWQ) to provide permit coverage for smaller municipalities (population less than 100,000), including non-traditional Small MS4s, which are facilities such as military bases, public campuses, prison and hospital complexes. The Phase II Small MS4 General Permit covers Phase II Permittees statewide. On February 5, 2013 the Phase II Small MS4 General Permit was adopted and became effective on July 1, 2013.

3.5.3.1 Phase I Requirements

The 1990 Phase I requirements specified that applications for MS4 permits include a Storm Water Management Plan which provides for comprehensive efforts to:

- Educate and inform the public regarding proper management and disposal of toxic materials. Maintain streets, roads, highways, and storm drains to minimize conveyance of pollutants.
- Require new development and redevelopment projects to incorporate post-construction pollution controls.
- Minimize application of pesticides and fertilizers by public and private entities.
- Control sediment and other pollutants from construction sites.
- Inspect industrial facilities and require elimination of pollutant sources.
- Monitor stormwater discharges, report activities and evaluate effectiveness.

The Regional Board may also require additional specific programs or actions in permittees' Storm Water Management Plans, including implementation of TMDLs.

3.5.3.2 Phase II Requirements

Phase II municipalities are covered under a single, statewide Storm Water NPDES permit. The SWRCB has established statewide requirements for Phase II Storm Water Management Plans. As with Phase I, these plans must incorporate public education and outreach; public participation/ involvement; illicit discharge detection and elimination; construction site runoff control; post-construction runoff control; and pollution prevention/good housekeeping to reduce pollutant discharges to the "maximum extent practicable." Phase II municipalities must also perform inspections and monitoring.

3.5.3.3 Statewide General Permits

The SWRCB has also adopted statewide general permits for stormwater discharges associated with construction activity, industrial activity, and utilities other than water suppliers. To be covered under these statewide permits, public and private entities engaged in these activities must file a Notice of Intent with the state and prepare a Storm Water Pollution Prevention Plan (SWPPP).

3.5.3.4 Implementation of Phase I and Phase II in the Mojave Region

In the Mojave Region, no municipalities are large enough to be required to comply with the Phase I or II permit regulations within the Colorado River Regional Board area. However, in the Lahontan Regional Board area, there are municipalities required to comply with Phase II Small MS4 General Permit requirements, which are discussed below.

In accordance with the SWRCB Water Quality Order No. 2003-0005-DWQ and NPDES General Permit No. CAS000004, the Town of Apple Valley, Cities of Hesperia and Victorville, and County of San Bernardino, collectively referred to as the Mojave River Watershed Group (MRWG), submitted a Notice of Intent (NOI) and Stormwater Management Program (SWMP) to the Lahontan RWQCB in August 2003 requesting coverage under the Phase II Small MS4 General Permit. The *Stormwater Management Plan for the Mojave River Watershed* (2003) describes control measures for protecting area water quality from stormwater and non-stormwater discharges, particularly for the urbanized portion of the watershed. The Lahontan RWQCB accepted the SWMP and issued coverage under the Phase II permit to the MRWG in February 2005 (MRWG 2012).

The watershed management program provisions in the MS4 permit allow flexibility to develop programs in order to address the highest watershed priorities and achieve compliance with permit requirements, including TMDLs, receiving water limitations, and non-storm water action levels. These programs focus on designated watershed management areas, such as the Mojave River Watershed Management Area. An integrated monitoring and assessment program is required in order to assess progress towards meeting applicable limitations. Starting in 2015, an adaptive management process will be required annually in order to enhance effectiveness of the watershed management program.

3.6 Vulnerability to Climate Change

This section provides a discussion of the projected climate change impacts in the Region as well as a summary of the key vulnerabilities of the Region to climate change. The more detailed Climate Change Vulnerability Checklist is found in Appendix C.3.

The USBR prepared a climate change assessment for the Mojave River Watershed. The final report, *Mojave River Watershed Climate Change Assessment* (USBR 2013), assessed future surface water supplies, projected potential changes in flood frequency, and conducted a greenhouse gas (GHG) emissions inventory. Section 12: Climate Change discusses the results of the USBR's assessment.

3.6.1 Projected Climate Change Impacts

Climate change is driven by increasing concentrations of carbon dioxide and other greenhouse gases that cause an increase in temperature and stress natural systems, such as oceans and the hydrologic cycle. Climate changes that may affect the Mojave Region water resources include:

- Higher temperatures and heat waves that increase demand for water, especially for agricultural and residential irrigation uses.
- Water Uncertainty: A projected overall decrease in precipitation levels coupled with more intense individual storm events may lead to increased flooding. Higher temperatures that may cause more precipitation to fall as rain rather than snow, hasten snowmelt and increase runoff will affect water storage planning. Increased evaporation will create a generally drier climate with groundwater basins likely to receive less replenishment.

3.6.2 Summary of Climate Change Vulnerability Checklist

Since the Mojave Region has unique vulnerabilities to climate change, assessing these vulnerabilities is the first step in considering potential changes in future climate. For the purposes of this report, vulnerability is defined as the degree to which a system is exposed to, susceptible to, and able to cope with and adapt to, the adverse effects of climate change. The vulnerability assessment highlights the water-related resources that are important to the Region and are sensitive to climate change. These resources may require further analysis and consideration, and may direct some IRWM Plan objectives. The vulnerability assessment may also identify water-related resources which are relatively resilient to climate change and therefore do not warrant additional analysis.

The Climate Change Vulnerability Checklist encompasses seven (7) major topic areas that include:

1. Water Demand
2. Water Supply
3. Water Quality
4. Sea Level Rise
5. Flooding
6. Ecosystem and Habitat Vulnerability
7. Hydropower

Of these areas, water supply, water demand, water quality, flooding, ecosystem and habitat vulnerability, and hydropower are likely to be of greatest concern to the Region. The completed checklist can be found in Appendix C.3 while the prioritization of these vulnerabilities is found in Section 4: Objectives. Section 12 describes the prioritized vulnerabilities, along with the potential effects of climate change on Mojave Region agencies and IRWM planning in more detail.

3.7 Mojave Region Expansion Areas

As described in Sections 1 and 2, four areas adjacent to the previously established IRWM Planning Region were included in the Mojave Region's boundaries during the 2014 update process. These areas, as shown on Figure 1-3, include the:

- Twentynine Palms Area,
- Upper Mojave River Watershed Area,
- Afton Canyon Area (Lower Mojave River Watershed Area), and
- Wrightwood Area.

Final agreement on the inclusion of these areas occurred while the Plan update process was underway and the Plan's Water Supply and Demand Section had already been completed. As a result, water resources descriptions of these Areas were developed separately from Section 3 and are included in the following sections. To the extent possible, Area-specific information addresses the same subtopics discussed above for each of the expansion areas.

3.7.1 Twentynine Palms Area

3.7.1.1 Water Supply

This section describes the water resources available to the Twentynine Palms Area from Twentynine Palms Water District (TPWD), for the 25-year period covered by the IRWM Plan. Water supplies for this Area are derived solely from groundwater sources, as shown in Table 3-15 and discussed in further detail below.

Table 3-15
Current and Planned Water Supplies (afy)

Water Supply Source	2010	2015	2020	2025	2030	2035
Groundwater Supplies	2,977	6,985	6,985	6,985	6,985	6,985
Projected Demands	2,674	3,645	4,195	4,502	4,808	5,093

Source: TPWD 2010 UWMP, Tables 3-2 and 2-8.

Potable water is scarce in the Area for several reasons. The Area receives an average of only four inches of annual rainfall. There is negligible infiltration and recharge of direct precipitation in areas where the alluvial deposits are thick and a substantial amount of runoff is lost to evaporation after flowing into the groundwater basin. In addition to the scarce sources, there are water quality issues in the groundwater due to naturally occurring soluble minerals, such as fluoride, that make some of the water unsuitable for drinking water prior to treatment. Despite limited water resources, available groundwater supplies are sufficient to meet projected demands beyond the year 2035, as seen in Table 3-15.

As mentioned in Section 2.10.1.7, water provided to the Twentynine Palms Area by TPWD is produced from ten active groundwater wells primarily located along the southern boundary of the Area. Ten wells are located in the Joshua Tree Basin and one well is located in the Twentynine Palms Valley Basin.

TPWD does not receive water from a wholesaler. Connection to imported water from either Metropolitan (Colorado River supplies) or MWA (SWP supplies) does not appear to be a viable option for the TPWD. The TPWD is not within the service area of either wholesale agency and would be required to annex to those service areas to receive supplies. Metropolitan's closest facilities are more than 45 miles southwest of the TPWD; MWA's facilities extend into Joshua Tree, approximately 15 miles west of the TPWD (TPWD 2011).

3.7.1.1.1 Projected Future Water Supplies

No additional sources of water are anticipated to be available to the TPWD in the future. Future water supply is expected to be 100% from local groundwater basins. As discussed previously in Section 2.10.1.5, local groundwater is produced from the Mesquite Lake subbasin (Twentynine Palms Basin) and the Joshua Tree Basin – which has three subbasins, as shown on Figure 2-13, the Indian Cove, the Fortynine Palms, and the Eastern subbasins.

Total pumping capacity of TPWD's wells is 6,340 gallons per minute (gpm) or a maximum of 10,248 afy. However, due to the overdraft of the groundwater basin, in Bulletin 118-03 DWR has recommended 1,400 afy of pumping from each the Indian Cove and Fortynine Palms subbasins (both in the Joshua Tree Basin). The TPWD also has a pumping capacity of 490 gpm (790 afy) from the Eastern subbasin of the Joshua Tree Basin. This amount along with the 2,100 gpm capacity (3,395 afy) in Mesquite Lake subbasin (part of the Twentynine Palms Valley Basin) yields a total of approximately 6,985 afy of available future groundwater supply (Table 3-16). There is the potential to expand the Mesquite Lake subbasin facilities to include another well if needed in the future. This additional well would improve reliability by allowing for redundancy in the Mesquite Lake subbasin as well as increasing pumping capacity.

Table 3-16
Groundwater Pumping Capacity

Basin Name	Pumping Capacity (gpm)	Pumping Capacity (afy)
Twentynine Palms Valley Basin		
Mesquite Springs Subbasin[(a)]	2,100	3,395
Joshua Tree Basin		
Fortynine Palms Subbasin[(b)]	870	1,400
Eastern Subbasin[(a)]	490	790
Indian Cove Subbasin[(b)]	870	1,400
Total	**4,330**	**6,985**

Notes:
(a) Pumping capacity of TPWD.
(b) DWR recommended pumping limit to prevent overdraft (DWR 1984, 2004).

3.7.1.1.1.1 Groundwater Extractions

Historical pumping and water deliveries by the TPWD have steadily increased since its formation in the mid-1950s. Annual pumping in the 1990s regularly exceeded 900 million gallons, approximately 2,760 afy, with average daily delivery per service connection slightly under 400 gallons. Total water demand in the TPWD was 2,977 afy in 2010 (assuming unaccounted for water is included in this total), with a projected demand of 5,119 af in 2035, based on TPWD's 2010

UWMP (TPWD 2011). Table 3-17 and Table 3-18 show the historical and projected amounts of groundwater pumping, from 2005 through 2035, respectively.

Table 3-17
Historic Amount of Groundwater Pumped (af)

Basin Name(s)	2005	2006	2007	2008	2009	2010
Mesquite Springs Basin	798	787	814	940	969	927
Joshua Tree Basin						
Fortynine Palms Subbasin	950	1,021	1,090	908	987	1,099
Eastern Subbasin	263	339	516	458	530	405
Indian Cove Subbasin	1,142	1,193	908	691	637	546
Total	**3,152**	**3,340**	**3,328**	**2,998**	**3,123**	**2,977**
% of Total Water Supply	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Source: TPWD 2010 UWMP, Table 3-4.

Table 3-18
Amount of Groundwater Projected to Be Pumped (af)

Basin Name(s)	2015	2020	2025	2030	2035
Mesquite Springs Basin	1,179	1,308	1,404	1,499	1,588
Joshua Tree Basin					
Fortynine Palms Subbasin	1,202	1,333	1,431	1,528	1,619
Eastern Subbasin	645	716	768	820	869
Indian Cove Subbasin	775	859	922	985	1,044
Total	**3,801**	**4,216**	**4,525**	**4,833**	**5,119**
% of Total Water Supply	**100%**	**100%**	**100%**	**100%**	**100%**

Source: TPWD 2010 UWMP, Table 3-5.

As discussed in TPWD's 2010 UWMP, three factors affect the availability of groundwater supplies: (1) sustainability of the groundwater resource to meet pumping demand on a renewable basis, (2) water quality issues from fluoride and TDS, and (3) protection of groundwater sources (wells) from known contamination, or provisions for treatment in the event of contamination. Twentynine Palms is dependent on groundwater and to maintain reliability of that source, the TPWD is currently implementing the Groundwater Basin Management Objectives to meet demand, as discussed in its 2010 UWMP.

3.7.1.1.1.2 Groundwater Recharge

Overdraft is considered a challenge for reliability of supply and may be reduced through artificial recharge. Artificial recharge would occur through the collection of natural runoff as no imported surface or recycled water supplies (see TPWD's 2010 UWMP Section 3.4.1) are available to the Area. Currently, there are no artificial recharge operations in the TPWD. However, a project to implement a feasible stormwater recharge project near the western boundary of the TPWD in cooperation with Joshua Basin Water District (JBWD) is included in this Plan for future development.

3.7.1.1.2 Recycled Water

TPWD does not have a municipal sewer system or a centralized wastewater treatment plant. The construction of a centralized system has been studied in cooperation with the City to address groundwater quality concerns from septic use if they arise in the future. However, at this time there are no opportunities for water recycling or programs that include recycled water.

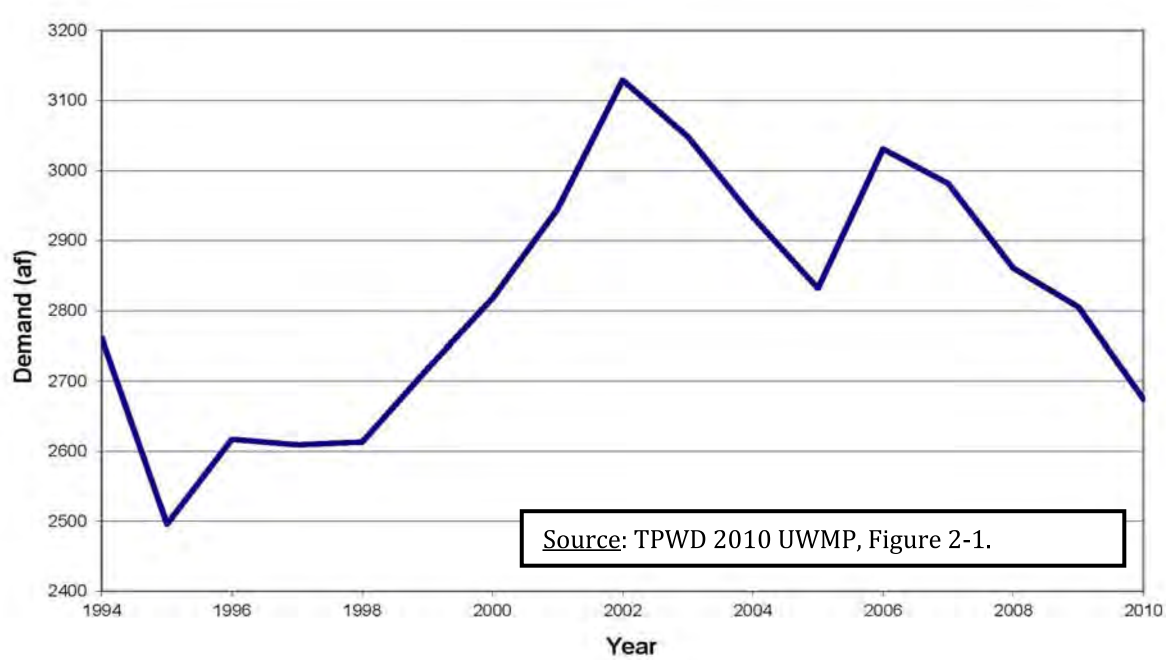
3.7.1.1.3 Other Water Supply Options

No alternative sources to groundwater are anticipated to be available in the future. However, the TPWD continues to evaluate the potential of expanding infrastructure to meet future demands in the case that they exceed current supply projections.

3.7.1.2 Water Demands

As shown on Figure 3-8, the historical total annual demand for the Twentynine Palms Area between 1994 and 2010, has shown a slight decrease on average. The TPWD water demand during 2010 was 2,674 af. Based on the most recent water usage data available from TPWD for March 2010 through February 2012, total annual water use for 2012 was estimated to be 2,552 afy, of which over 80 percent is used by residential connections (City of Twentynine Palms and TPWD, 2013). Water demand in the Area is anticipated to increase in response to population increase and groundwater will continue to be the sole source for meeting future demand.

Figure 3-8
Twentynine Palms Area Historical Annual Total Demand



In recent years, water conservation has become an increasingly important factor in water supply planning in California as a whole and in the Twentynine Palms Area. In the future, residential, commercial, and industrial usage can be expected to decrease as a result of the implementation of Plumbing Code requirements and more aggressive water conservation practices.

3.7.1.2.1 Projected Water Demands

Historic customer demands and historic and projected population estimates were used to project future water demands in the Area. By 2035, water use in the Area is projected to increase to 5,093 af, as shown in Table 3-19.

Table 3-19
Projected Water Demands for Twentynine Palms Area

	2015	2020	2025	2030	2035
Demand (afy)[(a)]	3,645	4,195	4,502	4,808	5,093

Source: TPWD 2010 UWMP, Table 2-8.
Note: (a) Actual demands may vary by approximately plus or minus 10 percent due to hydrological conditions.

Besides population, the major factors that affect water usage are weather and water conservation. These estimates do not include reduction from demand management practices. A discussion on how climate may affect water demands is provided in Section 3.6 of this IRWM Plan.

3.7.1.3 Water Quality

Due to the Area's dependence on groundwater resources, groundwater quality management is of vital importance and the management focus is on maintaining and improving existing water quality and preventing future contamination.

Local groundwater is typically of good quality and does not have microbial water quality problems. Even so, disinfectants are added to local groundwater when it is pumped by wells to protect public health due to the many septic tanks that may be a source of microbial contamination. Local groundwater has very little total organic carbon (TOC) and generally has very low concentrations of bromide, minimizing potential for disinfection by-product (DBP) formation. Taste and odor problems from algae are not an issue with local groundwater sources.

There is no known contamination in the Area although there are concerns about naturally-occurring high levels of fluoride, arsenic and TDS in specific areas of the TPWD. TDS and nitrate levels are measured to determine associated impacts. The historic and current use of septic tank systems for wastewater disposal is a concern to groundwater quality but nitrate levels are stable and continue to be well below the MCL as discussed in further detail below.

3.7.1.3.1 Fluoride

The soils in the TPWD service area are high in fluoride, which is dissolved in the groundwater during percolation. The high fluoride content renders the groundwater unusable for potable purposes without treatment. Fluoride concentrations increase when stormwater runoff percolates through soils with naturally elevated levels of fluoride. Fluoride deposits can also go into solution when there is a significant increase in groundwater flow, producing fluoride levels above State standards.

Fluoride concentrations within the Area are intermediate with respect to regional values, but are generally higher than the MCL of 2 mg/L. The TPWD has received a fluoride variance from the CDPH, allowing an average MCL of 3 mg/L. This variance sunsets in 2023.

Fluoride concentrations range between 0.34 to 2.7 mg/L in the TPWD service area. The lowest fluoride concentrations are present in the area south of the Pinto Mountain Fault and the highest concentrations are found in the northern half of the TPWD. The average fluoride level is 1.43 mg/L.

Water quality in the Indian Cove subbasin is typically good, and fluoride concentrations tend to increase with increasing groundwater temperature. As regional water temperatures decrease so does the associated higher fluoride concentrations in the southern portions of the subbasin.

Water in the Eastern subbasin has elevated fluoride levels, especially near Well No. 1 (typically between 3 and 8 mg/L). Therefore Well No. 1 is used for non-potable water only. Fluoride levels near Well No. 16, however, are typically below 2 mg/L. Thus Well No. 16 (490 gpm pumping capacity) can still be used for potable water purposes; however, it is vulnerable to septic and activities associated with higher populations.

Water quality in the Fortynine Palms subbasin is similar to that of the Indian Cove and Eastern subbasins, with fluoride levels below 3 mg/L and TDS levels below 250 mg/L. The two wells located in this subbasin are also vulnerable to septic tanks and higher population centers.

In the Mesquite Lake subbasin, fluoride levels are higher, above 10 mg/L in some places and between 3 and 10 mg/L throughout the rest of the subbasin. The well located in this subbasin is not as vulnerable to septic tanks as those located in higher population centers.

The TPWD maintains acceptable levels of fluoride through the use of wells with lower levels of fluoride being pumped as much as possible when water demand on the system dictates. In April 2004, the CDPH issued a permit to the TPWD allowing full operation of the Twentynine Palms Fluoride Removal Plant. The plant treats groundwater from the Mesquite Lake subbasin to reduce fluoride to levels below the MCL, allowing it to be used for drinking water. The plant also includes the flexibility to remove arsenic and radon, if it becomes necessary to do so (TPWD 2011).

3.7.1.3.2 Groundwater Quality Threats from Septic Systems

In response to recent increased concern for threats to groundwater quality from septic tanks, the City and the TPWD prepared a Groundwater Protection Plan (GPP) and a Wastewater Master Plan (WWMP) to assess and mitigate the long-term potential impacts to groundwater quality from the use of septic tanks. A long-term groundwater quality monitoring plan was developed to protect groundwater resources and to establish appropriate management practices for wastewater within a Local Agency Management Plan (LAMP).

For the purpose of the GPP, nitrate and TDS were considered as the main contaminants of concern (COCs) to assess the potential impact on groundwater quality from septic tanks. Results showed that, in general, nitrate and TDS concentrations in the TPWD wells are stable (City of Twentynine Palms and TPWD 2013).

3.7.1.3.3 Total Dissolved Solids and Salts

The TDS content of groundwater within the Area ranges from about 100 to 350 mg/L. Lowest TDS concentrations usually occur south of the Pinto Mountain Fault, with a wide range of values occurring east of the Mesquite Fault. Groundwater TDS concentrations typically increase through natural mineral resources and recharge of septic effluent but remain below the CDPH secondary MCL limit of 500 mg/L.

The groundwater south of the Pinto Mountain Fault is bicarbonate type with a low TDS and calcium and sodium as the predominant cations. Groundwater between the Mesquite and Pinto Mountain Faults is also bicarbonate type, with sodium as the primary cation. The central and western portions of the Mesquite Lake subbasin have sodium-sulfate type water. East of the Mesquite Fault, the water type varies considerably from sodium-bicarbonate to sodium-sulfate. Due to these various sources of natural minerals, the TPWD monitors this constituent for the potential of elevated levels (TPWD 2011).

In the Indian Cove, Fortynine Palms and Eastern subbasins, historical TDS data is relatively stable and no obvious increasing trend has been noted. High TDS concentrations have been detected in shallow monitoring wells in the Mesquite Lake subbasin. It is believed that these elevated concentrations may be associated with buried lake deposits and not septic tanks (City of Twentynine Palms and TPWD 2013).

3.7.1.3.4 Nitrate

The Nitrate (as NO3) concentrations in the TPWD water supply wells range from non-detect to 28 mg/l for nitrate, which are below the nitrate MCL.

In the Indian Cove subbasin, nitrate concentrations have been measured well below the MCL and have shown no apparent increasing trend since the early 1980s. In the Fortynine Palms subbasin, all wells are below the MCL for nitrate. Only one well, Well #4, shows a clear increasing trend with the current nitrate concentration, which may be attributable to a vertical conduit and immediate proximity of improperly abandoned septic tanks. TPWD is planning to destroy this well. In the Eastern subbasin, nitrate has been below the MCL and stable.

In the Mesquite Lake subbasin, historical data are available since 2005 from one supply well (WTP-1), where levels have consistently been non-detect.

Elevated nitrate concentrations have been noted at a few individual wells, potentially resulting from septic tank contamination. However, the presence of elevated nitrate concentrations in these areas reflect localized conditions and may not represent significant impact to the regional beneficial use of groundwater in the Mesquite Lake subbasin. Additional monitoring efforts through the LAMP should provide additional understanding of potential sources and impacts (City of Twentynine Palms and TPWD 2013).

3.7.1.4 Flood Management

Flood hazards in the Twentynine Palms Area can develop from flash flooding down natural ephemeral stream channels, constructed channels, and from sheet flooding across the alluvial fans, plains and valleys where the majority of the urban development lies.

The southern part of the City of Twentynine Palms can receive runoff from canyons in Joshua Tree National Park and from the Pinto Mountains to the east. Most of the development in the area has occurred with little alteration of the natural terrain. As a result, some structures may lie within and near the flow paths of small natural channels. Most streets also follow natural contours and may cross flow paths, making them vulnerable to flooding. Additionally, many roads in residential areas are unpaved and more vulnerable to erosion and sedimentation from stormflows.

Flood zones identified in Flood Insurance Maps generally occur in low-lying parts of the City that are most heavily populated, as well as some washes that convey flows to and from these areas. Residential areas that have been affected by recurrent flooding include areas within the broad wash between Joshua Tree National Park and the Pinto Mountains, as well as in an area known as the Smoke Tree area that lies within the outwash plain along the base of the mountains. Flooding along Twentynine Palms Highway and Adobe Road has occurred in the past, but has been significantly reduced through the placement of a dry well at the intersection (City of Twentynine Palms 2012).

3.7.1.4.1 Flood Management Infrastructure

There is one major local flood control channel, the Twentynine Palms Channel. It passes through the highly populated central part of the City and releases water into a natural wash to the north of the City. A smaller, tributary channel also exists and will eventually become part of a larger proposed channel named Pinto Cove. Flood control is also provided by the 49 Palms Spreading Grounds, a catchment area located at the mouth of Fortynine Palms Canyon, which retains floodwaters for groundwater recharge and directs remaining flows into the Twentynine Palms Channel. Donnell Basin, a smaller, but better-defined graded basin adjacent to the channel, also enhances recharge and flood protection. These basins, as well as the flood control channel, are owned and maintained by the County of San Bernardino (City of Twentynine Palms 2012).

3.7.1.5 Vulnerability to Climate Change

Vulnerabilities to climate change in the Twentynine Palms Area are largely consistent with those throughout the Mojave Region. These vulnerabilities are described in more detail in Section 3.6.

3.7.2 Upper Mojave River Watershed Area

3.7.2.1 Water Supply

This section describes the water resources available to the Upper Mojave River Watershed Area (Upper Mojave Area or Area) from CLAWA and LACSD, for the 25-year period covered by the IRWM Plan. Water supplies are derived from SWP water, groundwater and local surface water sources, as described in Table 3-20.

Table 3-20
Upper Mojave Area Current and Planned Water Supplies (afy)

	2010	2015	2020	2025	2030	2035
CLAWA						
SWP Supplies(a,b)	2,900	3,480	3,480	3,480	3,480	3,480
Local Surface Water(c)	481	481	481	481	481	481
Total CLAWA Supplies	**3,381**	**3,961**	**3,961**	**3,961**	**3,961**	**3,961**
LACSD						
CLAWA Overlap(d)	62	62	62	62	62	62
CLAWA II(e)	150	150	150	0	0	0
Lake Arrowhead Surface Water(f)	1,566	1,566	1,566	1,566	1,566	1,566
Groundwater Basin(g)	192	225	225	225	225	225
Recycled Water Supply(h)	127	200	200	200	200	200
Total LACSD Supplies	**1,908**	**1,941**	**1,941**	**1,791**	**1,791**	**1,791**
Total Upper Mojave Area Supplies	**5,289**	**5,902**	**5,902**	**5,752**	**5,752**	**5,752**

Sources: CLAWA, 2010 UWMP, Table 5. LACSD, 2010 UWMP, Table 3-1.
Notes:
(a) 2010 availability based upon approved DWR Table A allocation percentage of 50%.
(b) Future availability based upon SWP long term reliability of 60%.
(c) Average total surface water available from Houston Creek via Lake Silverwood from 1989-2010.
(d) CLAWA Overlap agreement – See 2010 UWMP for details. This supply is already accounted for in total CLAWA Supplies; therefore, this number is NOT included in the Total LACSD Supplies.
(e) See LACSD 2010 UWMP for details. Assumes CLAWA II agreement is NOT extended to 2035. The 150 afy is only an estimate; agreement is NOT limited to 150 afy.
(f) See LACSD 2010 UWMP. Per SWRCB Order WR 2006-0001.
(g) See LACSD 2010 UWMP. Provided per LACSD Engineering Staff.
(h) Recycled Water Phase I delivery to Lake Arrowhead Country Club (LACC) came on-line in the summer 2010. This supply is already accounted for by LACC in agreement dated November 27, 2007; therefore, this number is NOT included in the Total Supply.

3.7.2.1.1 Imported Water from the SWP

CLAWA is one of 29 agencies authorized to receive direct water deliveries from the SWP pursuant to a contract with DWR. Under that contract, CLAWA's SWP "Table A" allocation is 5,800 afy. As explained previously in Section 3.2.1, "Table A" supplies refer to the maximum amount of water that each contractor is entitled to receive on an annual basis from the SWP and that amount is set forth in "Table A" of each contract with DWR. Using the "2011 Reliability Report" (DWR 2012b), DWR estimates that for all contractors combined, the SWP can deliver a total Table A supply of 61 percent of total maximum Table A amounts on a long-term average basis, under current conditions and 60 percent of total maximum Table A amounts under future conditions (assumed to be 20 years in the future or 2031). Accordingly, based on CLAWA's Table A amount of 5,800 afy, CLAWA can only plan on receiving an average of 3,480 afy over the next 20-year projection (CLAWA 2011).

For LACSD, SWP water is currently being supplied to small portions of the Arrowhead Woods community through the CLAWA Overlap Agreement, also known as CLAWA I, which was brought on-line in 2003. A second source of SWP water, known as CLAWA II, is the CLAWA and VALLEY

DISTRICT agreement, which was approved by the three agencies (LACSD, CLAWA and VALLEY DISTRICT), and came on-line in 2006.

The CLAWA I turnout connection is located in the northwestern portion of the LACSD near the intersection of Brentwood Drive and Oakmont Drive. This connection currently provides approximately 62 afy of imported water (based on historic metered sales), and serves the small portion of the service area known as the Overlap Area. The second intertie, which provides imported water under CLAWA II, is located on Rim of the World Drive near Burnt Mill Road. The LACSD has an agreement with CLAWA to take 7,600 af of water over a 10 to 15 year period. There is an additional CLAWA connection that serves exclusively the Deer Lodge Park (DLP) water system, which is not part of the LACSD's certificated water service area.

3.7.2.1.2 Local Surface Waters

While CLAWA's primary source of water supply is the SWP, CLAWA also holds rights to an intermittent local water supply. In 1978, CLAWA applied to the SWRCB to appropriate local water from Houston Creek which is tributary to Lake Silverwood. In 1991, the SWRCB issued two permits which allow CLAWA to appropriate up to 1,302 afy from that source. Actual diversion quantities vary depending upon annual amounts of precipitation and are limited according to the amount of return flow to the Mojave watershed each year. The current (1989-2010) average amount of water appropriated is 481 afy. This local water is in addition to CLAWA's allotment of 5,800 afy of SWP Table A water (CLAWA 2011).

Lake Arrowhead provides water supplies for the service area of the LACSD. Water is treated at two water treatment plants, Cedar Glen Water Treatment Plant and Bernina Water Treatment Plant, before being distributed by the LACSD. As of 2008, lake withdrawals by LACSD have been limited to 1,566 afy as part of an order issued by the SWRCB. These limits were set in an effort to maintain lake levels for both domestic water uses and as a recreational amenity (LACSD 2011).

3.7.2.1.3 Groundwater

Groundwater resources are generally limited in the Area due to the local fractured bedrock geology. LACSD produces groundwater from the Grass Valley Basin, which is the primary groundwater bearing unit within the Lake Arrowhead watershed.

3.7.2.1.3.1 Groundwater Extractions

LACSD currently owns and operates five active wells. The wells pump groundwater from the Grass Valley Basin into the distribution system after being treated. The total capacity of LACSD wells of the Grass Valley Basin is 370 gpm. The future net average groundwater production is projected to be 225 afy through 2035.

Recent historical and project groundwater pumping for LACSD is summarized in Table 3-21 and Table 3-22, respectively.

Table 3-21
LACSD Historical Groundwater Pumped for Potable Use (afy)

	2005	2006	2007	2008	2009	2010
Grass Valley Basin	39.77	109.52	61.52	100.24	144.62	191.54

Source: LACSD, 2010 UWMP, Table 3-5. Based on LACSD Water Operations Monthly Reports.

Table 3-22
LACSD Projected Groundwater Production (afy)

	2010	2015	2020	2025	2030	2035
Grass Valley Basin	191.54	225	225	225	225	225

Source: LACSD, 2010 UWMP, Table 3-6.

3.7.2.1.3.2 Groundwater Banking and Recharge

Groundwater banking programs for the Upper Mojave Area involve storing available SWP or other surface water supplies during wet years in groundwater basins in, for example, the San Joaquin Valley. During water shortages, the stored water could be pumped out and conveyed through the California Aqueduct to CLAWA on behalf of LACSD as the banking partner, or used by the farmers in exchange for their surface water allocations, which would be delivered to CLAWA on behalf of LACSD through the California Aqueduct. With recent developments in conjunctive use and groundwater banking, significant opportunities exist to improve water supply reliability for LACSD (LACSD 2011).

3.7.2.1.4 Recycled Water

To date, CLAWA has made no use of recycled water. There are a number of reasons for this. First, the Lahontan RWQCB has had a longstanding prohibition against the use of recycled water at elevations above 3,200 feet in the San Bernardino Mountains. In January 2003, a request for a Basin Plan Amendment was filed. The amendment allowed the discharge of treated waters that are of waste origin above 3,200-foot elevation. In early September 2003, the RWQCB recommended approval of the Basin Plan Amendment. The amendment was reviewed and approved by the SWRCB and the USEPA in 2004. As discussed below, these changes have allowed recycled water projects to proceed to some extent.

Second, because of the climate, topography, and development patterns in the mountains, there are very few sizable landscaped areas where recycled water could potentially be used for irrigation. Third, for the same reasons, total landscaped area is extremely low, since most lots have little landscaped area. Fourth, there are no industrial uses that can use recycled water in the CLAWA service area; hence there is no potential market for industrial use of recycled water. Most commercial uses are also fairly small.

In its 2010 UWMP, CLAWA assumed that all recycled water supply and use will be handled by others due to the fact that CLAWA does not have any wastewater treatment facilities or a recycled water distribution system (CLAWA 2011).

LACSD currently serves a small amount of recycled water to irrigation customers. In 2010, 127 af was delivered to the Lake Arrowhead Country Club golf course from its Recycled Water Phase I Project.

At the April 14, 2009 LACSD Board of Directors meeting, the Board by consensus directed District staff to discontinue the pursuit of additional recycled water for customers until the economics of adding those customers become practical. Board members emphasized that this item be shelved for only a few years due to the probable cost increase of purchasing supplemental water. As described in the LACSD's 2009 Phase 2 RW Feasibility Study (IEC 2009), under the most optimistic pipeline proposal, recycled water is simply uneconomical to provide for discretionary uses such as landscape irrigation.

Based on the April 14, 2009 LACSD Board decision on recycled water, the total potential annual recycled water demand that is cost effective to serve is approximately 200 afy, which is the capacity of the Phase I Recycled Water project, completed in 2010. Table 3-23 summarizes the projected future use of recycled water (LACSD 2011).

Table 3-23
Recycled Water Projections

	Flows (afy)					
	2010	**2015**	**2020**	**2025**	**2030**	**2035**
LACSD[(a)]	200	200	200	200	200	200

Source: LACSD, 2010 UWMP, Table 4-8.
Note: (a) Phase I Recycled Water project capacity.

3.7.2.1.5 Other Water Supply Options

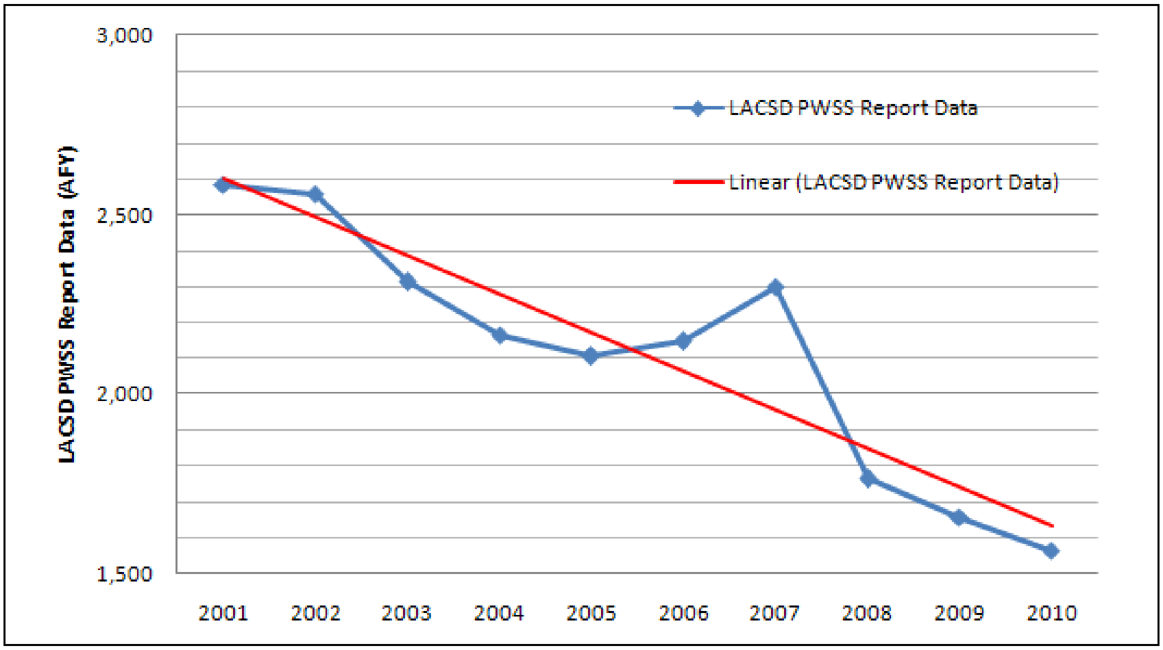
In addition to SWP water supplies and groundwater, LACSD is exploring other options to improve water supply reliability. Potential water transfer opportunities are likely to originate distant from LACSD, which would require additional infrastructure. Agencies that could potentially deliver water to LACSD are CLAWA, MWA, and VALLEY DISTRICT (LACSD 2011).

CLAWA has an agreement with LACSD and VALLEY DISTRICT to deliver water from VALLEY DISTRICT to the Lake Arrowhead Woods area, for use by LACSD and CLAWA when needed (CLAWA 2011).

3.7.2.2 Water Demands

Water demands in the LACSD service area have shown a downward trend for several years, in parallel with population declines. Data from the Public Water System Statistics (PWSS) report from 2001 through 2010, showed a 4.4 percent annual decline in water sent to the LACSD distribution system, as shown on Figure 3-9.

Figure 3-9
LACSD PWSS Report Data 2001-2010



Source: LACSD, 2010 UWMP.

3.7.2.2.1 Projected Water Demands

Water demands are projected to increase through 2035 in connection with anticipated population growth in the Upper Mojave Area. Table 3-24 and Table 3-25 show projected water demands for the CLAWA and LACSD service areas, respectively.

Table 3-24
CLAWA Projected Water Demand (afy)

Year	Multiple Dry Year Delivery	Single Dry Year Delivery	Average Year Delivery	Wet Year Delivery
2011	1,200	1,060	1,000	600
2015	1,800	1,590	1,500	875
2020	2,300	2,000	1,900	1,125
2025	2,525	2,200	2,090	1,250
2030	2,700	2,375	2,250	1,350
2035	2,850	2,500	2,370	1,425

Source: CLAWA, 2010 UWMP. Table 4A.

Table 3-25
LACSD Projected Water Demand (afy)

	2005	2010	2015	2020	2025	2030	2035
Water Demand[a]	2,105	1,565	1,565	1,565	1,604	1,644	1,685
GPCD[b] (No Conservation)	175	146	146	146	146	146	146
SBX7-7 Req'd GPCD[c]	N/A	183	172	162	162	162	162
SBX7-7 Savings[d]	N/A	0	0	0	0	0	0
Water Demand w/ Conservation[e]	N/A	1,565	1,565	1,565	1,604	1,644	1,685

Source: LACSD, 2010 UWMP. Table 2-4.
Notes:
(a) LACSD's demand projections without conservation.
(b) Calculated using the estimated population from 2010 UWMP, Table 2-1.
(c) See 2010 UWMP, Table 2-3.
(d) Calculated as the difference between the projected GPCD without conservation and the SBX7-7 Required GPCD times the population.
(e) LACSD's demand projections with conservation using the SBX7-7 requirements. The demands are the same with and without conservation.

3.7.2.3 Water Quality

Water quality in the Upper Mojave Area is generally of high quality and is not anticipated to experience significant changes in the near future.

The Crestline Sanitation District, Running Springs Water District, and LACSD provide wastewater collection and treatment service within the CLAWA service area (CLAWA 2011).

3.7.2.3.1 Surface Water Quality

Due to the nature of the small watershed contributing flows to Lake Arrowhead, the water quality of the lake is very high. Except for two constituents, turbidity and bacteria, the untreated lake water meets or exceeds the State's primary and secondary regulations for finished water (LACSD 2001). Influent turbidities rarely exceed 1.0 nephelometric turbidity units (NTU) and final water turbidities normally range from 0.02 to 1.0 NTUs. Total mineral content is generally less than 100 mg/l. No significant changes to water quality are anticipated from LACSD water management practices.

A watershed sanitary survey was originally completed in 1995 to determine the vulnerability of the lake to contaminants. That survey was updated in 2001 and again most recently in 2009; it concluded that the lake is at low risk for contamination, with the greatest potential being the proximity to the lake of the wastewater pump stations and the wastewater collection system (LACSD 2011).

3.7.2.3.2 Imported Water Quality

CLAWA and VALLEY DISTRICT receive SWP water from Lake Silverwood. Both agencies provide SWP water to LACSD's service area. The source of SWP water is rain and snow from the Sierra Nevada, Cascade, and Coastal mountain ranges. The water quality of the SWP has been discussed previously in Section 3.4.3.1.

All surface waters can have taste and odor problems caused by the growth of algae in reservoirs, such as Silverwood Lake. Under certain conditions, algae can grow in large mats, which then die, releasing foul smelling chemicals. Although harmless, the taste and odor causing chemicals can generally be very unpleasant for consumers.

SWP water meets or exceeds applicable standards. However, there is concern with some constituents that are approaching SWP acceptance criteria, particularly arsenic. As of January 2006, the Federal arsenic MCL was revised to 10 micrograms per liter (μg/L) (down from 50 μg/L), which will have significant impacts on water utilities in California that will need to install or modify treatment to remove arsenic. Additionally, this lowering of the standard likely will affect what the DWR will establish as the appropriate criteria for arsenic in water added to the SWP system, which is currently set at 4 μg/L (LACSD 2011).

3.7.2.3.3 Groundwater Quality

LACSD obtains its groundwater from five wells in the Grass Valley groundwater basin, located to the west of Lake Arrowhead. LACSD's treated groundwater currently meets all regulatory requirements.

During the past years, LACSD has taken hundreds of water samples in order to determine the presence of any radioactive, biological, inorganic, volatile organic, or synthetic organic contaminants. The state allows LACSD to monitor for certain substances less than once per year because the concentrations of these substances do not change frequently.

LACSD's efforts to increase its water supply have meant that customers receive both imported water and groundwater now, instead of water derived only from Lake Arrowhead. The result is that customers have noticed a difference in how this water tastes. LACSD's groundwater has a four times higher calcium carbonate content than water from Lake Arrowhead. Water high in calcium carbonate is often called "hard." The imported water from CLAWA, while not as hard as groundwater, also has higher calcium carbonate content than water from Lake Arrowhead. To improve the taste of hard water, LACSD has decided to blend groundwater and overlap water with lake water at the Bernina water treatment plant (LACSD 2011).

3.7.2.4 Vulnerability to Climate Change

Vulnerabilities to climate change in the Upper Mojave Area are generally consistent with those throughout the Mojave Region. These vulnerabilities are described in more detail in Section 3.6.

3.7.3 Lower Mojave River Watershed, Afton Area

3.7.3.1 Water Supply

Water resources in the Afton Canyon Area are nearly exclusively groundwater. Historically, perennial surface water flow existed in several locations along the reach of the Mojave River. Today, however, due to upstream pumping along the River, only a minor amount of perennial stream flow exists in Afton Canyon (MWA 2013).

3.7.3.2 Local Surface Waters

Surface water flows in the Mojave River through the Afton Canyon area average 8,200 afy (Mojave Basin Area Watermaster 2013).

3.7.3.3 Groundwater

Groundwater levels in the Area are stable to gradually declining (DWR 1975). One well (SWN: 11N05E16J01) showed a decline of approximately 20 feet over a 60 year period (USGS 2013).

There is virtually no groundwater extraction in the Area.

According to data in DWR Bulletin 118, groundwater in the Area is of a sodium chloride and sodium bicarbonate type, often in combination with sulfate. Total dissolved solids range from about 600 mg/L to 1,300 mg/L with an average of about 1,000 mg/L, which is considered very high. Groundwater tends to be inferior for irrigation or domestic use (DWR 1975).

3.7.3.4 Flood Management

The Mojave River Watershed is a major area at risk for flooding in the Mojave Region. Flood management and flood infrastructure in the greater Mojave Region, and as applicable to the Afton Area, are discussed in Section 3.5 of this IRWM Plan.

3.7.3.5 Vulnerability to Climate Change

Vulnerabilities to climate change in the Afton Area are generally consistent with those throughout the Mojave Region. These vulnerabilities are described in more detail in Section 3.6.

3.7.4 Wrightwood Area

3.7.4.1 Water Supply

This section describes the water resources available to the Wrightwood Area from GSWC, including existing and planned supplies for a 2035 scenario. Water demands are met by local groundwater supplies. The Area does not import water or use surface waters to meet water demands.

3.7.4.1.1 Groundwater

The Wrightwood water system obtains its water supply from local groundwater, pumped from eight active wells located in the local groundwater basin. Pumping occurs from several canyon underflows, Swarthout Valley and Sheep Creek in the Wrightwood Area adjacent to Highway 2. An additional standby well exists in the system.

The total groundwater production capacity of the eight active groundwater wells is 1,980 gpm. Total firm capacity is 1,630 gpm and is defined as the available capacity with the largest pumping unit out of service. The systemwide storage capacity totals approximately 1.5 million gallons (MG).

Using the total and firm production capacities and the storage allocations presented above, along with total existing demands presented in GSWC's *2013 Wrightwood System Water Master Plan* (GSWC 2013b*),* Table 3-26 summarizes the results of the Wrightwood supply and storage analysis for the existing system. Table 3-27 presents the summary of the Wrightwood Area supply and demand for 2035.

Table 3-26
Wrightwood Area Existing Supply and Demand

	Avg. Day (24 hrs)	Max Day (24 hrs)	Peak Hour (4 hrs)	Max Day + Fire Flow (2 hrs)	Units
Total Demands	426	758	1,137	3,258	gpm
Demand Volume	0.61	1.09	0.27	0.39	MG
Available Production	1,980	1,630	1,630	1,980	gpm
Available Storage	0	0	0.09	0.30	MG
Total Available Supply	2.85	2.35	0.48	0.54	MG
Supply Surplus	2.24	1.26	0.21	0.15	MG

Source: GSWC 2013 Master Plan, Table 5-20.

Table 3-27
Wrightwood Area 2035 Supply and Demand

	Avg. Day (24 hrs)	Max Day (24 hrs)	Peak Hour (4 hrs)	Max Day + Fire Flow (2 hrs)	Units
Demands	508	883	1,325	3,383	gpm
Total Demands	0.73	1.27	0.32	0.41	MG
Available Production	1,980	1,630	1,630	1,980	gpm
Available Storage	0	0	0.11	0.30	MG
Total Supplies	2.85	2.35	0.50	0.54	MG
Supply Surplus	2.12	1.08	0.18	0.13	MG

Source: GSWC 2013 Master Plan, Table 5-28.

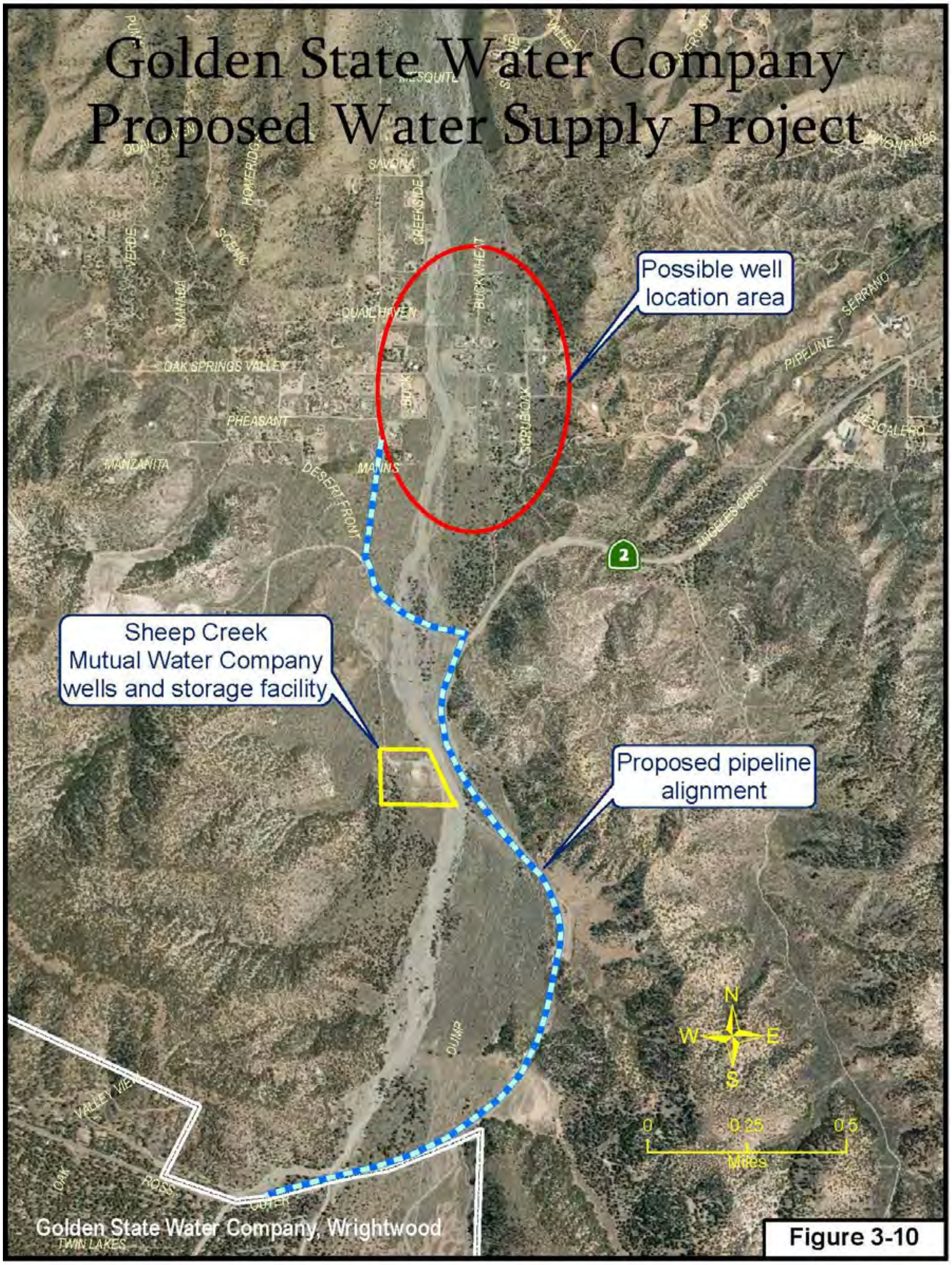
GSWC's systemwide supply data show that supplies are sufficient to meet system demands during normal hydrologic years. During dry years or prolonged drought periods, well capacities are reduced due to lowered groundwater levels and, in some cases wells are idled as a result of depleted groundwater conditions. These conditions have resulted in insufficient supplies to meet systemwide demands. An interconnection with the Sheep Creek Water Company was planned in 2007 to help the Wrightwood System to meet demands during these dry periods; this was denied by the California Public Utilities Commission (CPUC), which regulates GSWC since it is an investor-owned public utility.

3.7.4.1.2 Other Water Supply Options

GSWC is considering the installation of a groundwater well near Desert Front Road, just south of Highway 2 as shown on Figure 3-10, which would include a pump station and transmission main to transport groundwater from this new groundwater well location to GSWC's existing water supply facilities located in the higher elevations - near the southwest corner of GSWC's service area in Wrightwood. Since the project is costly, GSWC is also seeking other potential sources of funding for the project.

GSWC has also considered constructing a pipeline from their existing Wrightwood System (located in south Wrightwood Area) to an interconnection with Phelan Piñon Hills CSD or Sheep Creek Water Company near this Highway 2 location. GSWC has property in the Alto Subarea and it planned to construct a well that could wheel water through either of the neighboring water agencies. That plan was denied by the CPUC, as it determined that GSWC did not have a problem with water supply.

Figure 3-10
GSWC's Proposed Water Supply Projects



The current project that GSWC has submitted as a grant application to the California Safe Drinking Water State Revolving Fund constructs the pipeline (from GSWC's existing water supply facilities located at the higher elevations in the southwest Wrightwood Area) to Desert Front Road, where a groundwater well is also planned for construction. The well will provide supplemental water from that location. The concern or risk associated with this project is that the new groundwater well could potentially cause Wrightwood's water levels to decline, although there is currently no evidence indicating that this would happen.

No other water supply options are currently planned.

3.7.4.2 Water Demands

The existing demands represent a baseline for evaluating the existing system and to project future demands. The data used to develop the existing demands was based on historical water production data provided by GSWC.

It was assumed that the historical water production equaled the historical water demand (including non-revenue water, which is defined as the difference between the total amount of water produced from water supply sources and the total amount of water delivered to customers). Using historical annual water production from 2002 to 2011, the average water demand for this period was 0.25 afy/ connection.

GSWC estimated their existing water demands for this system by multiplying the number of 2011 active service connections by the 10-year average demand per connection, resulting in an existing demand for the Wrightwood System of 682 afy.

The projected annual water demands up to year 2030 were obtained from GSWC's 2008 Water Master Plan for the Wrightwood System and are based on the projected number of service connections. These projected annual water demands were further extrapolated to year 2035 to determine the projected water use of 819 afy, as shown in GSWC's 2013 Master Plan.

3.7.4.3 Water Quality

Water supplies in the Wrightwood Area are derived from local groundwater sources. Of the eight active wells in the water supply system, two are equipped with treatment filters to remove Iron and Manganese using pyrolusite adsorption. Sodium hypochlorite is injected at each wellhead for disinfection purposes, before the water enters the distribution system.

Water quality sampling is performed at the source and within the distribution system to ensure compliance with drinking water standards. Monitoring frequency depends on the parameter tested and the concentration of the constituent, and ranges from weekly to once every 9 years.

Currently, source and distribution water quality complies with all federal and state drinking water requirements (GSWC 2013a). Treatment is required at some sites to meet specific MCLs.

3.7.4.4 Vulnerability to Climate Change

Vulnerabilities to climate change in the Wrightwood Area are generally consistent with those throughout the Mojave Region. These vulnerabilities are described in more detail in Section 3.6.

Section 4: Objectives

The objectives presented in this section represent the foundational intent of this Integrated Regional Water Management Plan (IRWM Plan). Objectives have measurable outcomes that will be used to evaluate the successfulness of implementation of the IRWM Plan. Formulating meaningful and relevant objectives for the Mojave Region required significant collaboration and collective interaction among participating stakeholders. Developing the objectives took place over an 11 month period with about 15 conversations among various combinations of the Project Team, Stakeholder Group, and the Consultant Team. The draft objectives were circulated for review and comment to the stakeholders four times to allow for thorough consideration and refining of what ultimately sets the direction of the Plan.

4.1 Planning Process

People familiar with the broad discipline of planning recognize that different agencies and organizations may use similar terms in slightly different ways in their processes. During the Mojave IRWM Plan update process, the Consultant Team established and used the following set of terms:

- Planning Process Goals
- Plan Objectives

Within this Plan, the term goal is used to mean a desired outcome or result for which effort will be made to accomplish. The ***Planning Process Goals*** set near the beginning of the Plan development process describe what the Project Team intended to accomplish by the time the Plan is adopted (see Section 1.3.1).

The **Plan objectives** were developed using the "SMART" criteria, meaning that each objective should be Specific, Measurable, Attainable, Relevant, and Time-based. When crafted properly, SMART objectives help to promote actions that lead to measurable results. Objectives written using the SMART format are designed to allow people to measure and track progress toward improving integrated water management within the Region over time.

Early in the planning process, the stakeholders agreed the Mojave IRWM Plan would only have measureable objectives and not include any higher-level "Goals" because objectives would be sufficient to align stakeholders and focus implementation efforts.

The Plan objectives were developed between January and November 2013 using an iterative and collaborative approach that included two phases:

- Identify challenges and opportunities within the Region
- Propose draft Plan objectives, discuss, review and refine

The first step in developing Plan objectives was to identify the water related challenges and opportunities that people believed to be important in the Region now. Identification and discussion of challenges and opportunities began early in the Plan development process, ultimately leading to the Plan objectives. Once the Stakeholder Group had identified a representative list of challenges and opportunities (see Section 4.2), Plan objectives were proposed by individual Stakeholders, the Consultant Team and members of the Project Team. The draft Plan objectives were discussed, reviewed and refined over several months until broad agreement was reached on the Plan objectives listed in Section 4.3.

4.2 Challenges and Opportunities

4.2.1 Introduction

This section describes the major challenges and opportunities related to integrated regional water management in the Mojave Region. These challenges and opportunities were identified through multiple meetings with stakeholders and were formed by the information presented in Sections 2 and 3 of this IRWM Plan. The term "challenges and opportunities" is used to mean the water-related items of interest or concern within the Region. The list does not distinguish whether a particular item is a challenge or an opportunity, because that designation often depends on the perspective of the reader. Given the diversity of interests and values within the Region, one person's challenge may very well be seen as an opportunity by someone else. By including both challenges and opportunities, stakeholders were able to reach broad agreement that these are the topics that warrant consideration and focus within the Mojave IRWM Plan.

Over the course of several conversations, the Project Team began grouping the challenges and opportunities into some major themes, which are listed below in no particular order:

- Coordination
- Engagement
- Disadvantaged Community Needs
- Water Supplies
- Water Quality
- Finance and Affordability
- Risk and Uncertainty
- Mojave Basin Area Judgment and Water Rights
- Project Ideas

The initial categories of challenges and opportunities developed with stakeholders participating in the Plan update process were also presented by the Project Team at a series of public workshops to get broader input. The public workshops were held throughout the Region, and participants in those workshops were asked to rank the importance of the challenges and opportunities that had been identified and to offer other challenges or opportunities that they felt should be addressed in the Mojave IRWM Plan. The results of the public workshops are presented in the following subsection. After that, the section describes in more detail each of the major themes and the specific concerns with each, as well as pertinent information from the public workshops for each theme.

4.2.1.1 Public Workshops

Community engagement has been critical to the update process, with the key focus being identifying community-specific concerns and needs relating to water resources. The IRWM Plan Project Team held seven public workshops throughout the Region to guide the update of the IRWM Plan, ensure that the Plan and its objectives reflect and support meeting the needs of the community, increase public participation and obtain meaningful input from a diverse range of community members.

All of the workshops and meetings had similar formats consisting of a brief presentation on the process being used to update the IRWM Plan followed by small group discussion sessions. Several common areas of concern emerged during the small group discussion sessions from all the meetings and workshops. These common areas of concern were similar to the challenges and opportunities originally identified by the stakeholders and Project Team. The common areas of concern described during the public workshops are shown below:

- Water Supply and Conservation
- Water Quality Cost of Water Resources
- Water Rights
- Stormwater and Flood Management
- Growth and Land Use Natural Resource Management
- Limited Water Resources
- Limited Funding Resources To Address Water-Related Needs
- Need For Regional Collaboration To Carry Out Projects
- Climate Change

The top three areas of concern that workshop participants ranked as most relevant to their community were: (1) water supply and conservation, (2) water quality and (3) cost of water resources. Table 4-1 lists all of the water related topics that workshop participants said they thought was an area of concern for their community or within the Mojave Integrated Planning Region. The table shows how participants at each workshop prioritized their concern about the different water related topics for their location.

Table 4-1
Stakeholder Workshop Prioritization of Water-Related Topics

Water-Related Topics	Lucerne Valley	Barstow	Victorville	Newberry Springs	Piñon Hills/ Phelan	Helendale	Yucca Valley	Total Votes	% of All Votes
Water Supply and Conservation	22	13	5	20	6	10	20	**96**	**26%**
Water Quality	16	13	3	5	6	6	16	**65**	**18%**
Cost of Water Resources	15	14	4	9		3	14	**59**	**16%**
Water Rights	19	2		15	1	2	2	**41**	**11%**
Stormwater and Flood Management	18		1	4	6	1	9	**39**	**11%**
Growth and Land Use	7		4	3	6		7	**27**	**7%**
Natural Resource Management (habitat protection)	1			4	3	1	3	**12**	**3%**
Education[(a)]			1				7	**8**	**2%**
Climate Change	1	1		1		1	3	**7**	**2%**
Recycled Water[(a)]						5		**5**	**1%**
Hauled Water Issues[(a)]	3							**3**	**1%**
Gray Water Issues[(a)]	1							**1**	**0.2%**
Grant Writing and Tracking – Connect the needs with the funding sources[(a)]									

Note: (a) These items were proposed by workshop participants.

The challenges and opportunities identified through Stakeholder meetings and community workshops are described in the following sections. For further background and context, see Section 2: Region Description and Section 3: Water Supply and Water Demand.

4.2.2 Coordination

The key issues, needs, challenges, and priorities for the Mojave Region with respect to coordination include the following, which are discussed in greater detail below:

- Recognize that multiple types of plans and authorities exist within the Region and the IRWM Plan needs to consider these and plan to coordinate implementation where relevant and practical;
- Establish a common management vision, goals, and objectives related to integrated water management for the Region;
- Implementing projects requires coordination and cooperation through the life of the project from concept, design, financing, permitting, construction, maintenance, etc. Engage the necessary organizations and interests early in the process;
- Recognize and encourage close interconnection between land use planning and water management;
- How to prioritize projects for consideration of limited grant funds?

4.2.2.1 Plans and Authorities in Region

The relationships among the Region's land use planning entities such as cities and the County, and the Regional Water Management Group (RWMG) are sturdy enough to serve as bases for increased collaboration. As detailed in Section 1, the RWMG's goal is to:

- Foster coordination, collaboration and communication between agencies responsible for water-related items and interested stakeholders to achieve greater efficiencies, to provide for integration of projects, enhance public services and build public support for vital projects.

The RWMG and land use managers need to consider ways to improve collaboration on a variety of topics and areas of focus through creation of subcommittees and other forums to track related issues such as floodplain management, flood control planning, groundwater management, treatment and conveyance facilities, stormwater management, water conservation efforts, watershed management, recreational area management, land use changes, general plan updates, water supply for emergency planning during a catastrophic outage, and habitat management.

In the past much of the collaboration and coordination on these issues occurred through the development and implementation of formal documents, such as urban water management plans (UWMPs), adjudications, general plans, groundwater management plans, flood insurance studies, watershed assessments, and watershed sanitary surveys. The IRWM Plan provides an opportunity to improve collaboration by increasing public participation and by increasing awareness of these plans in the land use and water planning decision making processes. Going forward, the RWMG is committed to collaborate with land use managers in the planning and development of projects that address water resources-related objectives.

Effective management of the Region's water resources also requires effective ongoing communication and collaboration between land and water resource managers and stewards. These relationships are further discussed in Section 11.

4.2.2.2 Establish Common Management Vision

Cities and counties (for unincorporated areas) are the regulatory agencies responsible for land use planning within the State of California. Land use regulations and policies such as general plans, zoning ordinances, California Environmental Quality Act (CEQA) compliance, and permit conditions can be valuable policy and implementation tools for effective water management. The California Government Code establishes requirements for the development of General Plans to guide land use decisions, in which water resources play an important role. Water resources is typically not an 'element' of a General Plan, but is discussed within the context of the General Plans required 'elements'; land use, circulation, housing, conservation, open space, noise, and safety.

Land uses within the Mojave Region are provided for in local and regional policies and regulations, including the San Bernardino County General Plan (Adopted March 13, 2007 and amended May 22, 2012), and the various city and town general plans as detailed in Section 2.3.1 Land Use Policies. These policies would guide consideration of the regional challenge of potential land use allegations.

Recent legislation has also addressed the gap between land use planning and water resource management. In 2001, two water supply planning bills, Senate Bill (SB) 610 and SB 221, were enacted that require greater coordination and more extensive data to be shared between water suppliers and local land use agencies for large development projects and plans.

SB 610, codified as Water Code sections 10910 and 10911, requires the public water system that may supply water to a proposed residential development project of more than 500 dwelling units (or a commercial/industrial development project with similar water use), to prepare a water supply assessment for use by the lead planning agency in its compliance with CEQA. Such a water supply assessment (WSA) is performed in conjunction with the land use approval process associated with the project and must include an evaluation of the sufficiency of the water supplies available to the water supplier serving the project to meet existing and anticipated future demands.

SB 221 requires projects which include tentative tract maps for over 500 dwelling units to obtain verification from the water system operator that will supply the project with water, that it has a sufficient water supply to serve the proposed project and all other existing and planned future uses, including agricultural and industrial uses, in its area over a 20-year period, even in multiple dry years. SB 221 is intended as a “fail safe” mechanism to ensure that collaboration on finding the needed water supplies to serve a new large subdivision occurs before construction begins.

Additionally, water suppliers must coordinate with land use planning agencies in the development of their UWMPs, which include projections of future water demand and water supply availability during normal and dry periods. Water agencies and land use planning agencies within the Region are working together to ensure adequate management and planning for water supplies to meet the needs of growing communities. One of the prominent related efforts is the San Bernardino Countywide Vision Water Element, which encourages collaboration among business, residents, municipal governments, and water agencies to ensure sustainable water supplies. This group is working together to develop a comprehensive countywide strategy and has conducted a countywide water inventory through 2035.

Coordination was discussed at several of the stakeholder workshops/meetings held during the update of the IRWM Plan development. Participants encouraged improved collaboration between agencies to help resolve water-related issues, coordinate mutually beneficial projects, offset project costs and better manage water demand. By engaging the necessary organizations and interests early in the planning process, the success of the implementation of the IRWM Plan and projects is more likely.

The discussion of how to prioritize projects for consideration of limited grant funds is discussed in Section 4.7: Finance and Affordability.

4.2.3 Engagement

The key issues, needs, challenges, and priorities for the Mojave Region with respect to engagement include the following, which are discussed in greater detail below:

- Ensure that both the Colorado River Regional Water Quality Control Board (RWQCB) and the Lahontan RWQCB are participating in the IRWM planning process;
- A proactive approach is required to encourage engagement by all those who can benefit from the IRWM Plan but who may not yet recognize or understand that;

- Encourage participation by all agencies with some responsibility for water management or activities that affect water management in the Region;
- Ensure disadvantaged communities (DACs) are represented in the process;
- How to engage disinterested citizens and organizations?
- Minimal producers (individuals producing 10 acre-feet (af) or less of water within the boundaries of the Mojave Basin Area Judgment) need a voice in the process;
    - There are 13 minimum water producers in the Baja subarea who do not know they are minimum water producers; why they should participate in the IRWM planning process, or how they can participate?

As discussed in Section 1.2: Stakeholder Involvement, the update to the IRWM Plan process has expanded upon the significant efforts made to identify and solicit input from stakeholders with interest in long-term reliable water supplies for the Region from the 2004 Regional Water Management Plan (RWMP), which included 44 water agencies, 11 municipal and county agencies, six state and federal agencies, and over 25 community interest groups.

Stakeholders were notified regarding the Plan update process by various means of outreach processes including an IRWM Plan website, emails, newsletters, letters via the US Postal Service, and personal phone calls.

4.2.4 Disadvantaged Community Needs

A majority of the Mojave Region is comprised of Disadvantaged Communities (DACs) (see Figure 2-6), defined by the State as any community where the median household income (MHI) is below 80% of the statewide MHI. Three of the seven public workshops were developed specifically to reach residents of DACs in the Region, while the other four were geared to all residents of the Region regardless of income level. The Public Workshops and DAC Meetings provided the same information in the same format.

For the DAC Meetings, effort was made to publish notices of the meetings in places where potential participants would see the notices. For example, popular ethnic grocery stores, community halls, and senior centers were all sought as ideal locations for flyers to be posted. Where appropriate, the meeting flyers were translated into Spanish and posted and the meeting handout materials were also available in Spanish. The Project Team had Spanish speaking presenters attend the DAC meetings where a high Spanish speaking population turnout was expected.

For more detailed information on the stakeholder engagement process, DAC participations and specifics of workshops and meetings see Section 1.2: Stakeholder Involvement.

The key issues, needs, challenges, and priorities for the Mojave Region with respect to disadvantaged communities include the following:

- Understand the needs of different DAC communities in the Region;
- Help educate communities about requirements and opportunities;
- Support DACs to apply for assistance;

- Help improve water management systems, including water quality, that serve DACs.

4.2.5 Water Supplies

The key issues, needs, challenges, and priorities for the Mojave Region with respect to water supply needs include the following, which are discussed in greater detail below:

- Expect increasing competition between different water uses in the Region;
- Provide sufficient supplies to support additional growth (residential, commercial, and industrial) in the Region;
- Encourage and support additional water conservation;
- Expand use of reclaimed water;
- Create additional opportunities for recharge;
- Look for new supplies;
- Use ordinance(s) to encourage desired behaviors;
- Will there be any protection against selling of water between subareas and/or outside the Region?
- Alternative water conservation methods are needed in the Baja subarea.

As competition for water supplies throughout California grows more intense, water users are being asked to make use of limited resources in an efficient manner. Some recent regulatory requirements require additional steps towards efficient water use; the Water Conservation Act of 2009 (SBX7-7) requires a 20% statewide reduction in per capita water use by 2020 for urban water suppliers. The Region's ten urban water suppliers (detailed in Section 3.3.1), are implementing plans to achieve their specific water use targets to comply with direction provided by the state Department of Water Resources (DWR). Some of the methods being used by urban water suppliers include water conservation best management practices (BMPs) as defined by the California Urban Water Conservation Council.

Sustainable, reliable water supplies are necessary to maintain the Region's economic viability and ecological health, but climate change could affect the availability of water supplies in the future. Large variations in the weather patterns would affect the municipalities, farmers, and streams receiving water from all of their sources. In many cases, improvements to infrastructure to better distribute surface water supplies around the Region so that they may be used conjunctively with groundwater would improve resilience responses to the potential effects of climate change. However, the impacts of climate change on the Region are difficult to predict; current information from climate change models is not sufficiently precise to demonstrate specific impacts to water supply reliability within the Region. Yet it is likely that climate change will impact imported State Water Project (SWP) supplies through time; DWR has analyzed these potential future impacts in its regular publication of the *State Water Project Delivery Reliability Report*.

Pubic meeting workshop participants discussed less predictable water supplies, citing concerns about groundwater overdraft related to pumping by large well owners and new developments, contamination of groundwater basins and other water quality issues limiting supply availability as well as reductions in imported water. Participants also were concerned with opportunity costs of not storing local and imported water when it is available for future use.

The Mojave Region watershed has numerous and significant water resource management and environmental stewardship challenges. These often occur when resources are managed for conflicting uses, such as between land use development and habitat conservation.

Mojave Region water suppliers are tasked with balancing the water needs of sensitive environmental areas with the water needs of their stakeholders, and ensuring that natural resources and habitats are shielded from potential adverse impacts associated with water resource management. Environmental water demands (including the quantity, timing, duration, and frequency of flows required by plants, wildlife, and fisheries) can conflict with water supply demands for agricultural irrigation and/or urban and industrial development. Opportunities exist for water managers to balance the needs of the environment along with agricultural, industrial and municipal needs.

4.2.6 Water Quality

Quality of local groundwater supplies in general is good throughout the Region, is suitable for agricultural purposes, and meets drinking water standards. Exceptions are areas that have exceeded the drinking water standards called maximum contaminant levels (MCLs) for a variety of compounds. Some of these are due to human factors, for example, there are areas in the Region that have elevated nitrate levels in groundwater due to septic tank discharges. Some contaminants, such as hexavalent chromium, arsenic, and fluoride, are naturally occurring in certain areas of the Region.

The key issues, needs, challenges, and priorities for the Mojave Region with respect to water quality include the following, which are discussed in greater detail below:

- Closed basin with no outfall for discharge so increase in salts is a continuous challenge;
- Concern for meeting water quality regulations in certain groundwater subareas;
- Existing septic systems contributing nitrates to groundwater;
- Changes in imported water quality;
- Handling emerging contaminants;
- Implement watershed protections;
- Presence of natural constituents of concern in water supplies;
- Threats from improper well abandonment;
- Deal with contamination of groundwater from previous (historical) land uses.

4.2.6.1 Mojave Region is Closed Basin

As described in Section 2.6.2, the Mojave Region is a closed topographic basin with no outlet to the ocean. Therefore, any reuse, recharge, or treated effluent (recycled water) generated in the Mojave Region must be percolated, reused, evaporated, or transpired by plants. This places great responsibility on the Region's water managers and wastewater treatment providers in the Mojave

Region to provide alternative effluent management methods while still being compliant with their Waste Discharge Requirements (WDRs).

4.2.6.2 Water Quality Regulations

Section 3.4: Water Quality explained that the Mojave Region is governed by two RWQCBs – the Lahontan and the Colorado River. Therefore both of these Regional Boards have a *Water Quality Control* **Plan** *for the* **Basin** (**Basin Plan**) that details the surface water and groundwater quality that is acceptable for beneficial uses.

The California Department of Public Health (CDPH) is responsible for enforcing the SDWA and California-specific drinking water regulations. Many Mojave Region water sources contain high levels of total dissolved solids (TDS), particularly groundwater, recycled water, and SWP supplies (SWP supply has TDS concentrations and salinity that are variable depending on the time and type of year as well as pumping patterns). TDS is a common water quality parameter used to measure salinity of water supplies. Threshold ranges for taste and odor, known as secondary maximum contaminant levels (SMCLs), have been established by CDPH. The recommended range for TDS is between 500 mg/L and 1,000mg/L, whereas a short-term[3] SMCL of 1,500 mg/L also exists.

Public Meeting Workshop participants identified water quality issues related to the high numbers of septic systems located in proximity to the groundwater basins that serve as their community's water source.

The following land uses and human activities can contribute to the degradation of soils, water bodies, and habitat and can make watershed management more difficult. While some of the listed activities have been described under several earlier topics, they are emphasized here because of their importance to the stakeholders:

- Alteration of the natural landscape for any purpose, creating disturbed soils susceptible to erosion, and requiring installation of minimum control measures prescribed for National Pollutant Discharge Elimination System (NPDES) stormwater management permit compliance;
- Application or accidental release of potentially contaminating substances or prohibited waste discharges to water supplies, including wastewater system overflows, septic system failures, water treatment byproducts, pest abatement, improper disposal of litter or refuse, and lack of stormwater management;
- Removal of natural vegetation and wildlife habitat, including destruction of wetlands and waterways;
- Improper livestock husbandry and other poorly implemented agriculture, industry, and commercial stormwater quality BMPs; and
- Potential for conflict between land and water use for: (a) recreation and tourism, (b) agriculture, and (c) opportunities to restore and preserve the environment.

[3] Defined as only for existing community water systems on a temporary basis pending construction of treatment facilities or development of acceptable new water sources.

4.2.6.2.1 Handling Emerging Contaminants

Constituents/Chemicals of Emerging Concern (CECs), including pesticides, pharmaceuticals, personal care products, and endocrine disruptors, are a class of chemicals for which there are no established water quality standards. CECs may be present in waters at very low concentrations and are now detected as a result of more sensitive analytical methods. CECs are addressed in the most recent draft of the CDPH Groundwater Replenishment Reuse Regulations, which recommends monitoring of selected health-based and treatment performance indicator CECs for groundwater recharge projects using recycled water. In its Recycled Water Policy, the State Water Resources Control Board (SWRCB) requires that Salt and Nutrient Management Plans (SNMPs) include a provision for monitoring of CECs consistent with recommendations by CDPH. Accordingly, recycled water project sponsors, including water suppliers, water reclamation plants, and water treatment plants, will be responsible for satisfying these monitoring requirements in the future.

Challenges to achieving and maintaining compliance with applicable regulatory requirements may include:

- **Compliance with Environmental Mandates:** Depending upon the extent and jurisdiction of a water management project, water agencies must comply with some or all of the following regulations and agencies:
  - California Environmental Quality Act
  - National Environmental Policy Act (if a Federal interest exists)
  - California Department of Fish and Wildlife
  - US Army Corps of Engineers (US ACOE)
  - Lahontan and/or Colorado River RWQCBs
  - US Fish and Wildlife Service
  - California Department of Public Health
- **Compliance with Flood Protection Permitting:** Environmental permits from the US ACOE and the RWQCB are typically required to construct flood protection or stream restoration projects and maintain existing facilities, even for routine maintenance of channels, including dredging, bank repair, and vegetation management. Flood protection agencies must also cooperate with efforts by Federal and state wildlife agencies and non-governmental organizations (NGOs) to maintain and restore critical habitat and assist species recovery. In each case, the local flood protection agency must evaluate and mitigate, if necessary, the effects of these projects on conveyance of flood flows. The time and cost associated with obtaining these permits are a considerable burden on the local agencies.

Public Meeting Workshop participants attributed water quality issues to a number of factors:

- Increased exposure to contaminants due to sources migrating from adjacent basins;
- Irrigation and maintenance of recreation and agricultural uses such as golf courses and alfalfa farms;
- Industrial dumping;

- Mining activities;
- Improper use of abandoned wells.

4.2.7 Finance and Affordability

The key issues, needs, challenges, and priorities for the Mojave Region with respect to finance and affordability include the following, which are discussed in greater detail below:

- How to maintain and improve systems while keeping water supplies affordable?
- Facing increasing costs to meet regulations.
- Want to keep high desert a viable option for new development.
- How to address challenges and opportunities without obvious revenue sources?

Finance and affordability were recurring themes at the Public Meeting Workshops. The theme was primarily tied to ongoing issues of decreased supply linked to overdraft of local groundwater basins previously caused by lack of regulation. Some stakeholders feel new development and unstructured growth are the causes of decreased supply and still others voiced concern that inadequate fee structures were the reason for the financial difficulties that many water agencies are facing.

One of the toughest challenges identified during the workshops was inadequate financial resources to fund efforts to resolve local and regional water issues and special projects. Participants also identified potential opportunities for resolving some of the fiscal challenges that included replacing septic systems with sewer, providing incentive programs to promote and increase conservation practices, and expanding and improving existing infrastructure to increase water efficiency.

Grant funding consideration is an important element of the IRWM Plan implementation funding method and is discussed in more detail in various sections of this Plan, including Sections 8.3.9 and 9.1.

4.2.8 Risk and Uncertainty

The key issues, needs, challenges, and priorities for the Mojave Region with respect to risk and uncertainty include the following, which are discussed in greater detail below:

- Plan for changes in the Sacramento-San Joaquin Delta;
- Prepare for earthquake or other cause for disruption to imported water deliveries;
- Reduce damages from stormwater and flood events;
- Consider potential impacts from climate change.

4.2.8.1 Delta Changes

The Mojave Region relies heavily on imported SWP water that flows through the Sacramento-San Joaquin Delta and is conveyed to the Region for groundwater recharge. However, the long-term reliability of this water supply is unknown because of a variety of issues including infrastructure reliability, endangered species regulations, water quality, sea level rise, ecosystem restoration, political interests and more.

Approximately 1,600 miles of levees that are part of the California Central Valley Flood Control System, and another 1,000 miles of local levees, constructed in an attempt to protect the Central Valley and Delta regions from flooding (DWR 2005) and protect Delta water supplies. In the event of a massive failure of these levees, the quality of Delta water could be severely compromised as salt water rushed in from the Bay to equalize water pressure. This would immediately affect the water supplies, since the SWP pumping plant would need to be shut down to prevent further saltwater intrusion.

Many groups within the state are working to improve the Delta's habitat, ecosystem function and water conveyance systems but have conflicting visions of how to resolve the many issues associated with the Delta. Because of the Mojave Region's dependence on the Delta for critical SWP water supply, the uncertainty of the Delta's future is a significant concern that must be addressed by water supplies and considered in the integrated planning process.

4.2.8.2 Stormwater and Flood Events

Floods occur when runoff exceeds the capacity of a river or stream channel, overflowing into adjacent low-lying lands called floodplains. Human activities in floodplain areas are often exposed to flood damage.

Physical damage from floods includes the following:

- Inundation of structures, causing water damage to structural elements and contents;
- Erosion or scouring of stream banks, roadway embankments, foundations, footings for bridge piers, and other features;
- Impact damage to structures, roads, bridges, culverts, and other features from high-velocity flow and from debris carried by floodwaters. Such debris may also accumulate on bridge piers and in culverts, increasing loads on these features or causing overtopping or backwater effects;
- Destruction of crops, erosion of topsoil, and deposition of debris and sediment on croplands.

Floods also cause economic losses through closure of businesses and government facilities, disruption of communications and the provision of utilities such as water and sewer, result in excessive expenditures for emergency response, and generally disturb the normal functions of a community. Flood management strategies recommended in this document will serve as guidelines to address concerns and prevent some of the damage listed above.

Several local land use entities, including the County of San Bernardino, participate in the National Flood Insurance Program (NFIP) as administered by the Federal Emergency Management Agency (FEMA). By adopting flood damage prevention ordinances to regulate development in special flood hazard areas, private property owners in participating communities are allowed to purchase affordable flood insurance through NFIP, while the community retains its eligibility to receive certain federally backed monies and disaster relief funds.

The FEMA Flood Insurance Rate Map for the Mojave Region designates multiple areas as "High Risk," areas with a 1 percent or greater risk of flooding in any year and a 26 percent chance of flooding over the life of a 30-year mortgage. The area at greatest flood risk is the area along the Mojave River.

Flood management is generally guided by local, State, and Federal entities but relies upon the local communities for implementation. Local communities like cities and counties, through the adoption of ordinances and the formation of special districts, manage development in floodplains and implement flood mitigation projects that prevent flood damages.

4.2.8.3 Climate Change Impacts

Climate change is driven by increasing concentrations of carbon dioxide and other greenhouse gases that cause an increase in temperature and stress natural systems, such as oceans and the hydrologic cycle. Climate changes that may affect Mojave Region water resources include:

- **Higher Temperatures and Heat Waves:** that increase demand for water, especially for agricultural and residential irrigation uses.
- **Water Uncertainty**: A projected overall decrease in precipitation levels coupled with more intense individual storm events may lead to increased flooding. In addition, increasing development along the Mojave River leads to increased flood risk for developing areas that are located within the floodplain. Higher temperatures that may cause more precipitation to fall as rain rather than snow, hasten snowmelt and increase runoff, which will affect water storage planning. Increased evaporation will create a generally drier climate, with wildfires likely to increase and groundwater basins likely to receive less natural replenishment (USBR 2013).

Section 12 of this IRWM Plan describes potential effects of climate change on Mojave Region agencies and IRWM planning in more detail.

4.2.9 Mojave Stipulated Judgment and Water Rights

The key issues, needs, challenges, and priorities for the Mojave Region with respect to the Mojave Basin Area Judgment and water rights include the following, which are discussed in greater detail below:

- Questions about purchases of water rights;
- Hydrologic relationships between Subareas;
- Consider economic impacts on rural communities;
- Pumping water outside the Mojave Basin Area Judgment. This is associated with new producers that were not in existence at the time the adjudication was completed.

The Adjudication of the Mojave Basin Area was the legal process that allocated the right to produce water from the available natural water supply. The Riverside Superior Court bound the stipulating parties (users who signed the agreement and agreed with the adjudication) 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 Mojave Water Agency (MWA) as Watermaster of the Mojave Basin Area.

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 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.

Several people who participated in the public workshops in Lucerne Valley and Newberry Springs expressed concerns about the implementation of the Judgment and the effect of rampdowns on the community and the large farms in the Baja Subarea. Similar comments were raised during other Stakeholder meetings. These stakeholders repeatedly expressed interest in working with the County of San Bernardino and others in the Region to try and reduce or mitigate the difficult effects being felt by people in their part of the Mojave Region.

4.2.10 Coordination with Neighboring IRWM Plan Region Opportunities

As discussed in Section 7.2.3, of the six neighboring IRWM Plan regions adjacent to the Mojave Region, only coordination with the Antelope Valley IRWM Region to the west and the Inyo-Mono Region to the north appear beneficial to the Mojave Region due to lack of hydrologic connection or watershed function in common between the remaining planning areas. IRWM regions that make up the Lahontan Funding Region have been actively discussing how to better coordinate respective IRWM efforts in regards to coordinating funding opportunities during the development of this IRWM Plan.

4.2.11 Land Subsidence

Another challenge is subsidence (consolidation of the aquifer causing decreased ground levels) due to groundwater pumping. According to US Geological Survey (USGS), pumping of groundwater from the Mojave River and Morongo groundwater basins in the Mojave Region resulted in water-level declines of more than 30 meters (100 feet) between the 1950s and the 1990s (USGS and MWA 2003).

Interferometric synthetic aperture radar (InSAR) methods were used to determine the location, extent, and magnitude of vertical land-surface changes in the Mojave River and Morongo Groundwater Basins for various time intervals between 1992 and 1999. The interferograms show subsidence ranging from 45 to 90 mm (0.15 to 0.3 ft) in four areas of these two groundwater basins—the El Mirage, Lucerne Valley, Newberry Springs, and Lockhart–Harper Lake (dry) areas.

In all four areas, water-level data indicate that water levels in the 1990s were near or below historically low levels. This decline in groundwater levels can cause land subsidence. In the Lucerne Valley area, about 90 mm (0.3 ft) of subsidence was measured between 1992 and 1999 in an area where ground-water levels declined 30 m (100 ft) between the 1950s and 1993 but stabilized in the mid and late 1990s. Stable groundwater levels and temporally coincident subsidence indicates that fine-grained parts of the aquifer system may be compacting residually, still equilibrating with reduced pressures in the coarser grained parts of the aquifer system caused by groundwater-level declines that occurred prior to 1993 (USGS and MWA 2003).

Land subsidence results in the following impacts:

- Development of cracks, fissures, sink-like depressions and soft spots;
- Change in natural drainage patterns often resulting in increased areas of flooding or increased erosion;
- Degradation of groundwater quality;
- Permanent reduction in groundwater storage capacity;
- Change in gradient in gravity pipelines (sanitary and storm sewers) often resulting in lost capacity;
- Damage to well casings, pipelines, buildings, roads, railroads, bridges, levees, etc.;
- Costs associated with repairs and rebuilding;
- Costs associated with construction of new facilities such as pumping stations for gradient changes;
- Reduction in land value;
- Lawsuits;
- Increased pumping costs.

The USGS continues to monitor land-subsidence across portions of the Mojave River and Morongo Groundwater Basins as part of the cooperative water resources program between the USGS and MWA. The USGS reviews updated data of the four areas previously identified as having experienced land-subsidence, the El Mirage, Lucerne Valley, Newberry Springs, and Lockhart–Harper Lake (dry) areas, roughly every five years as part of this ongoing study.

4.3 Plan Objectives

At the first stakeholders meeting, the existing IRWM Plan objectives from the 2004 MWA Regional Water Management Plan (2004 RWMP) were presented and new objectives were proposed that met the SMART criteria (see Section 4.1). The first-draft Plan objectives were presented at the March 5, 2013 Stakeholder meeting and discussed, reviewed, and refined over the following nine months, leading to the 14 broadly supported Plan objectives listed below. The Plan objectives are organized according to the nine (9) major themes identified for the challenges and opportunities.

Given the number of objectives and range of activities needed to meet them, the Project Team and stakeholders decided to prioritize the objectives to help focus efforts during Plan implementation. The Project Team set initial priorities for the objectives by evaluating their **importance** and **urgency**. The **importance** assigned to each objective reflects the significance or consequence to the Region as a whole of satisfying that objective compared with other objectives. The **urgency** assigned to each objective reflects the degree to which that objective warrants speedy attention or action compared with other objectives. The preliminary prioritization was then presented during stakeholder meetings and reviewed, discussed, and refined.

Table 4-2summarizes the objectives. To further prioritize the objectives, four tiers were created and each objective was assigned to a tier depending upon the Importance and Urgency ranking of the objective. Objectives with a High Importance and High Urgency were assigned to Tier 1, objectives with a High Importance and Medium Urgency were assigned to Tier 2, and so on. The indexing of objectives into tiers is illustrated on Figure 4-1. Table 4-3 groups the objectives according to tier. This prioritizing of objectives will be used later in the planning process to guide the ranking of project proposals, as explained in Section 6.

Table 4-2
Summary of Objectives

Summary of Objective	Title of Objective[a]	Importance[b]	Urgency[c]
1. Balance average annual future water demands with available future supplies to ensure sustainability throughout the Region between now and the 2035 planning horizon and beyond.	*Balance future water demands*	High	High
2. Continue improving regional water use efficiency by implementing a portfolio of conservation actions that are regionally cost-effective.	*Improving regional water use efficiency*	High	Medium
3. Maintain stability in previously overdrafted groundwater basins and reduce overdraft in groundwater basins experiencing ongoing water table declines.	*Maintain stability in overdrafted groundwater basins*	High	High
4. Address the State policy goal of reducing reliance on the Delta by meeting water demands with alternative sources of supply during times when SWP supplies are reduced or unavailable due to droughts, outages, environmental and regulatory restrictions, or other reasons.	*Reduce reliance on Delta*	High	Medium
5. Optimize the use of the Region's water-related assets to maximize available supplies to meet projected demands while mitigating against risks. Water-related assets to be optimized include financial resources, groundwater storage programs, available imported water supplies, transfer and exchange opportunities, available physical infrastructure, and management policies.	*Optimize Region's water- related assets*	High	Medium
6. Prevent land subsidence throughout the Region.	*Prevent land subsidence*	Low	Low

Table 4-2
Summary of Objectives

Summary of Objective	Title of Objective[a]	Importance[b]	Urgency[c]
7. Provide support and assistance to disadvantaged communities and help facilitate projects and programs that benefit those communities.	*Support to DACs*	High	High
8. Improve environmental stewardship related to waterways and water management in the Region.	*Improve environmental stewardship*	High	Medium
9. Improve floodplain management throughout the Plan area.	*Improve floodplain management*	High	Medium
10. Preserve water quality as it relates to local beneficial uses of water supplied by each source, including groundwater, stormwater, surface water, imported water, and recycled water.	*Preserve water quality*	High	Medium
11. Obtain financial assistance from outside sources to help implement this Plan across a range of project sizes during the planning horizon.	*Obtain financial assistance*	High	Medium
12. Improve public awareness of water supply, conservation, water quality, and environmental stewardship challenges and opportunities throughout the planning horizon.	*Improve public awareness*	High	Medium
13. Identify and establish reliable funding sources to maintain, modernize and improve water infrastructure to ensure a high quality, resilient and reliable water supply.	*Establish reliable funding sources*	Medium	Medium
14. Increase the use of recycled water in the Region while maintaining compliance with the Mojave Basin Area Judgment as applicable.	*Increase use of recycled water*	Medium	Medium

Notes:
(a) The title of the objective is used in later sections for ease of reference.
(b) The "importance" assigned to each objective reflects the significance or consequence to the Region of satisfying this objective compared with other objectives.
(c) The "urgency" assigned to each objective reflects the degree to which this objective warrants speedy attention or action compared with other objectives.

Table 4-3
Objectives Arranged by Importance/Urgency

	Summary of Objective	Importance[a]	Urgency[b]
	Tier 1 Priority Objectives		
1.	Balance average annual future water demands with available future supplies to ensure sustainability throughout the Region between now and the 2035 planning horizon and beyond.	High	High
3.	Maintain stability in previously overdrafted groundwater basins and reduce overdraft in groundwater basins experiencing ongoing water table declines.	High	High
7.	Provide support and assistance to disadvantaged communities and help facilitate projects and programs that benefit those communities.	High	High
	Tier 2 Priority Objectives		
2.	Continue improving regional water use efficiency by implementing a portfolio of conservation actions that are regionally cost-effective.	High	Medium
4.	Address the State policy goal of reducing reliance on the Delta by meeting water demands with alternative sources of supply during times when SWP supplies are reduced or unavailable due to droughts, outages, environmental and regulatory restrictions, or other reasons.	High	Medium
5.	Optimize the use of the Region's water-related assets to maximize available supplies to meet projected demands while mitigating against risks. Water-related assets to be optimized include financial resources, groundwater storage programs, available imported water supplies, transfer and exchange opportunities, available physical infrastructure, and management policies.	High	Medium
8.	Improve environmental stewardship related to waterways and water management in the Region.	High	Medium
9.	Improve floodplain management throughout the Plan area.	High	Medium
10.	Preserve water quality as it relates to local beneficial uses of water supplied by each source, including groundwater, stormwater, surface water, imported water, and recycled water.	High	Medium
11.	Obtain financial assistance from outside sources to help implement this Plan across a range of project sizes during the planning horizon.	High	Medium
12.	Improve public awareness of water supply, conservation, water quality, and environmental stewardship challenges and opportunities throughout the planning horizon.	High	Medium
	Tier 3 Priority Objectives		

Table 4-3
Objectives Arranged by Importance/Urgency

Summary of Objective		Importance[a]	Urgency[b]
13.	Identify and establish reliable funding sources to maintain, modernize and improve water infrastructure to ensure a high quality, resilient and reliable water supply.	Medium	Medium
14.	Increase the use of recycled water in the Region while maintaining compliance with the Mojave Basin Area Judgment as applicable.	Medium	Medium
Tier 4 Priority Objectives			
6.	Prevent land subsidence throughout the Region.	Low	Low

Notes:
(a) The "importance" assigned to each objective reflects the significance or consequence to the Region of satisfying this objective compared with other objectives.
(b) The "urgency" assigned to each objective reflects the degree to which this objective warrants speedy attention or action compared with other objectives.

4.3.1 Plan Objectives Qualitative and Quantitative Measurements

The narrative that follows presents the full statement of each objective, along with how to qualitatively and quantitatively measure whether it has been accomplished.

1. Balance average annual future water demands with available future supplies to ensure sustainability throughout the Region between now and the 2035 planning horizon and beyond.
    a. Measured by forecasted average annual demand (adjusted by expected levels of conservation) at different times through the planning period compared with forecasted average annual available water supplies at different times through planning period.

2. Continue improving regional water use efficiency by implementing a portfolio of conservation actions that are regionally cost-effective.
    a. Continue reducing urban per-capita water use through all available actions that are regionally cost-effective. Measured by time series of annual per-capita water use.
    b. Increase agricultural water use efficiency by moving towards efficient water management practices for sustainable agriculture. Measured by the number of farms utilizing viable best management practices, including irrigation practices, equipment, and crop types.
    c. Increase industrial water use efficiency by moving towards applicable best management practices. Measured by the number of industries utilizing viable best water conserving management practices, equipment and technologies.

Figure 4-1
Plan Objectives Arranged by Priority

Urgency \ Importance	Low	Medium	High
High	**Tier 2**	**Tier 1**	**Tier 1** Obj. 1 - Balance Supply & Demand Obj. 3 – Maintain Stable GW Basins Obj. 7 – Support & Assist DACs
Medium	**Tier 3**	**Tier 3** Obj. 13 – Establish Reliable Maintenance Funding Obj. 14 – Increase Use of Recycled Water	**Tier 2** Obj. 2 – Improve Water Use Efficiency Obj. 4 – Reduce Reliance on Delta Obj. 5 – Optimize Use of Assets Obj. 8 – Improve Environmental Stewardship Obj. 9 – Improve Floodplain Mgmt. Obj. 10 – Preserve Water Quality Obj. 11 – Obtain Financial Assistance Obj. 12 – Improve Public Awareness
Low	**Tier 4** Obj. 6 – Prevent Land Subsidence	**Tier 3**	**Tier 2**

3. Maintain stability in previously overdrafted groundwater basins and reduce overdraft in groundwater basins experiencing ongoing water table declines.
    a. Measured by long-term stability of groundwater levels in the regional monitoring well network and mass water balance calculations by subarea.

4. Address the State policy goal of reducing reliance on the Delta by meeting water demands with alternative sources of supply during times when SWP supplies are reduced or unavailable due to droughts, outages, environmental and regulatory restrictions, or other reasons.
    a. Measured by comparing banked or reserve water supplies with water needs to meet a 6-year drought or 3-year outage on the SWP.

5. Optimize the use of the Region's water-related assets to maximize available supplies to meet projected demands while mitigating against risks. Water-related assets to be optimized include financial resources, groundwater storage programs, available imported water supplies, transfer and exchange opportunities, available physical infrastructure, and management policies.
   a. Measured by available SWP supplies stored, used locally, transferred or exchanged vs. available SWP supplies unused or lost.
   b. Measured by financial resources that originate outside of the Region and are made available to improve integrated water management within the Region.
   c. Measured by long-term cost savings created by improvements in operational efficiency, reduced energy consumption, reduced system failures and repairs, etc.

6. Prevent land subsidence throughout the Region.
   a. Maintain groundwater levels to prevent future land subsidence.
   b. Measured by monitoring land surface changes, every five years, in areas of known historic subsidence.

7. Provide support and assistance to disadvantaged communities and help facilitate projects and programs that benefit those communities.
   a. Measured by the number of projects and programs implemented and the investments made on an ongoing basis that benefit disadvantaged communities.

8. Improve environmental stewardship[4] related to waterways and water management in the Region.
   a. Measured by acres of sensitive environmental/habitat areas restored or new sensitive environmental/habitat areas set aside for protection.
   b. Measured by the number of new recreational or educational projects that are connected to environmental stewardship programs.
   c. Measured by protection and restoration of riparian habitat areas as identified in Exhibit H of the Mojave Basin Area Judgment.

9. Improve floodplain management throughout the Plan area.
   a. Increase coordination between agencies to establish programs and projects related to floodplain management that have multiple benefits/multiple uses. Measured by the number of new multi-benefit/multi-use floodplain projects or programs established.
   b. Coordination between multiple agencies to reduce risk of flood damage through proactive operations along the flood prone areas. Measured by reduction in monetary impact of flood damage compared to damage caused by historical floods of similar magnitude.

[4] Environmental stewardship is defined here as a commitment to manage and protect natural resources and ecosystems in a sustainable manner that ensures they are available for future generations.

10. Preserve water quality as it relates to local beneficial uses of water supplied by each source, including groundwater, stormwater, surface water, imported water, wastewater, and recycled water.
    a. Regular summaries of key water quality constituents for various water supplies as they relate to the local beneficial uses.
11. Obtain financial assistance from outside sources to help implement this Plan across a range of project sizes during the planning horizon.
    a. Obtain outside financial assistance for small water systems,[5] measured by the number of small systems that acquired outside funding and the amount of funding acquired.
    b. Obtain outside financial assistance for other projects and programs (not within small water systems), measured by the amount of outside funds acquired.
12. Improve public awareness of water supply, conservation, water quality, and environmental stewardship challenges and opportunities throughout the planning horizon.
    a. Measured by the results of regular surveys that gauge awareness regarding these topics.
    b. Measured by documented outreach to all stakeholder types as listed in the IRWM guidelines.
13. Identify and establish reliable funding sources to maintain, modernize and improve water infrastructure to ensure a high quality, resilient and reliable water supply.
    a. Measured regularly by the estimated cost of deferred maintenance.
    b. Measured by the number of water systems that improve operations to withstand or reduce the number of system failures and improve system efficiencies.
14. Increase the use of recycled water in the Region while maintaining compliance with the Mojave Basin Area Judgment as applicable.
    a. Measured by changes in the volume of recycled water being used in the Region.

4.4 Prioritized Climate Change Vulnerabilities

The climate change vulnerabilities identified in Section 3 were prioritized according to their relative linkage to Plan objectives. Table 4-4 summarizes the climate change vulnerabilities with their associated objectives and ranking priorities:

[5] For the purposes of measuring benefit towards this objective, water systems will be considered "small" if they deliver less than 3,000 AF per year or have fewer than 3,000 service connections.

Table 4-4
Summary of Ranked Climate Change Vulnerabilities

Climate Change Vulnerability Area /Sub-topic		Associated Objectives	Tier Ranking Priority
Water Demand	1.1 There are major industries that require cooling/process water in the Region.	2, 5, 14	2 (High, Medium)
	1.2 Water use varies more than 50% seasonally in parts of the Region.	2, 5	2 (High, Medium)
	1.5 Water use curtailment measures are effective and can harden demand.	2, 5	2 (High, Medium)
Water Supply	2.1 A portion of the water supply comes from snowmelt through the SWP.	1, 4, 5	1 (High, High)
	2.2 The Region relies on water diverted from the Delta or imported from other climate-sensitive systems outside the Region.	1, 4, 5	1 (High, High)
	2.6 The Region has invasive species management issues at facilities, conveyance structures or in habitat areas.	2, 5, 8	2 (High, Medium)
Water Quality	3.1 Increased wildfires are a threat in the Region.	9 and 10	2 (High, Medium)
	3.2 Part of the Region relies on surface water bodies with current or recurrent water quality issues related to eutrophication, such as algal blooms.	2, 5, 10	2 (High, Medium)
Flooding	5.1 The Region has critical infrastructure that lies within the 200-year floodplain.	2, 5, 9	2 (High, Medium)
	5.4 Flood control facilities have been insufficient in the past.	2, 5, 9	2 (High, Medium)
	5.5 Post-wildfire floods are a concern in parts of the Region.	9 and 10	2 (High, Medium)
Ecosystem and Habitat Vulnerability	6.1 The Region includes inland aquatic habitats vulnerable to erosion and sedimentation issues.	8	2 (High, Medium)
	6.3 Climate-sensitive fauna or flora populations live in the Region.	8	2 (High, Medium)
	6.4 Endangered and threatened species exist in the Region.	8	2 (High, Medium)
	6.8 The Region uses water from the Bay-Delta which is a habitat described in the Endangered Species Coalition's Top 10 habitats vulnerable to climate change.	8	2 (High, Medium)
Hydropower	7.1 Energy needs in the Region are expected to increase in the future. As a result, there are future plans for hydropower generation facilities or conditions for hydropower generation in the Region	2 and 5	2 (High, Medium)

Section 5: Resource Management Strategies Used to Meet Plan Objectives

A resource management strategy (RMS) is a project, program, or policy that helps local agencies manage their water and related resources. The intent of the RMS standard is to encourage diversification of water management approaches as a way to mitigate for future uncertainties, including the effects of climate change. The California Department of Water Resources (DWR) *Integrated Regional Water Management Guidelines for Proposition 84 and 1E* (2012 Guidelines) (DWR 2012a), require that the Integrated Regional Water Management Plan (IRWM Plan) document the range of RMS considered to meet the IRWM objectives and identify which RMS were incorporated into the Mojave IRWM Plan. The effects of climate change on the IRWM Region must be factored into the consideration of RMS. RMS to be considered must include, but are not limited to, the RMS found in Volume 2 of the *California Water Plan (CWP) Update 2009*. The 2012 Guidelines also acknowledge that DWR is in the process of developing the CWP Update 2013, which may include additional or different RMS and DWR encourages but does not require consideration of alternative RMS from the draft CWP Update 2013.

Accordingly, this section describes how the Consultant Team reviewed each RMS during the development of the objectives for the IRWM Plan and applicable RMS were subsequently considered during the project development phase of the planning process. Each RMS selection was based on both the strategies included in the 2004 Regional Water Management Plan (2004 RWMP) and the latest set of statewide water management goals and RMS developed by DWR as part of the CWP Update processes for both 2009 and 2013 (now underway). The IRWM Plan incorporates an extensive range of RMS that includes most of the RMS on DWR's latest list. The section provides a brief description of each RMS along with which Mojave Region objectives each strategy will help the Region achieve.

5.1 Resource Management Strategy Summary

Table 5-1 presents the RMS lists from both the CWP Update 2009 and the draft CWP Update 2013. They are largely similar but with a few term changes and additions made in the 2013 draft. In the CWP Update 2009, DWR identified 32 RMS organized into six categories (reflecting six common statewide goals, along with an "other" category for a few additional strategies):

- Reduce Water Demand
- Improve Operational Efficiency and Transfers
- Increase Water Supply
- Improve Water Quality
- Improve Flood Management
- Practice Resources Stewardship

In the draft CWP Update 2013 now in development, DWR presents an updated set of 36 RMS organized into seven main categories. A new seventh category, People and Water, has been added along with four new RMS: land use planning and management, sediment management, outreach and education, and water-dependent cultural resources. This IRWM Plan update process makes use of the draft CWP Update 2013 RMS list.

Each RMS determined to be applicable to the Region is followed by a ✓, and the RMS not applicable to the Region are followed by an ×. Applicable RMS are those which could help address the major water-related challenges and opportunities and contribute to achieving the IRWM Plan objectives discussed in Section 4.

Table 5-1
Overview of Resource Management Strategies

CWP Management Objectives	Resource Management Strategies
Reduce Water Demand	Agricultural Water Use Efficiency ✓ Urban Water Use Efficiency ✓
Improve Operational Efficiency and Transfers	Conveyance – Delta ✓ Conveyance – Regional/Local ✓ System Reoperation ✓ Water Transfers ✓
Increase Water Supply	Conjunctive Management & Groundwater Storage ✓ Desalination × Precipitation Enhancement × Municipal Recycled Water ✓ Surface Storage – CALFED ✓ Surface Storage – Regional/local ✓
Improve Water Quality	Drinking Water Treatment and Distribution ✓ Groundwater Remediation/Aquifer Remediation ✓ Matching Water Quality to Use ✓ Pollution Prevention ✓ Salt and Salinity Management ✓ Urban Runoff Management ✓
Improve Flood Management	Flood Management ✓
Practice Resources Stewardship	Agricultural Lands Stewardship ✓ Ecosystem Restoration ✓ Forest Management ✓ Land Use Planning and Management ✓ Recharge Area Protection ✓ Sediment Management ×* Watershed Management ✓
People and Water	Economic Incentives ✓ Outreach and Engagement* ✓ Water and Culture* ✓ Water-dependent Recreation ✓
Other	Crop idling, dew vaporization×, fog collection× irrigated land retirement, rain fed agriculture×, and waterbag transport×

Notes:
*New resource management strategies from draft CWP Update 2013.
✓ RMS potentially applicable to Mojave Region.
× RMS not applicable to Mojave Region.

Each RMS is described below, with discussion of how it could contribute to meeting specific IRWM Plan objectives and whether the RMS is applicable to the Region. An overview of the connection between selected RMS and Plan objectives is shown in Table 5-2.

5.2 RMS Relevant to the Mojave IRWM Region

5.2.1 Reduce Water Demand

These two management strategies address water conservation or efforts to reduce the amount of water that is used for both agricultural activities and urban use, including residential, commercial, and industrial uses.

5.2.1.1 Agricultural Water Use Efficiency

The agricultural water use efficiency strategy involves measures that reduce the amount of water used for agricultural irrigation while maintaining agricultural productivity. This strategy includes improvements in irrigation technology and water management that directly increase water use efficiency, as well as education and training efforts that lead to improved water management.

The agricultural water use efficiency strategy addresses IRWM Plan Objective 2: *Improving regional water use efficiency*. For agriculture specifically, the objective is intended to increase agricultural water use efficiency by moving towards efficient water management practices for sustainable agriculture. The strategy could be implemented in the Region through irrigation audits to identify ways to promote efficient water use and improvement of irrigation systems, among other approaches.

5.2.1.2 Urban Water Use Efficiency

Urban water use efficiency involves technological or behavioral improvements that address indoor and outdoor residential, and commercial, industrial, and institutional (CII) water uses. It is a key component of SBX7-7 (see section 5.2.1.3), which requires all retail urban water suppliers (those with more than 3,000 connections or supplying more than 3,000 acre-feet per year) to increase water use efficiency in an effort to meet the statewide goal of a 20% reduction in per capita water use by 2020. This strategy includes improvements in technology or water management that lower water use or increase beneficial uses from existing water supplies and can include recycled water as a strategy. This strategy also includes outreach and educational programs and other measures that cause adoption of technological improvements or behavioral changes that reduce per capita water demand.

The strategy addresses four of the 14 IRWM Plan objectives, including Objective 1: *Balance future water demands;* Objective 2: *Improving regional water use efficiency*; Objective 3: *Maintain stability in overdrafted groundwater basins*; and Objective 5: *Optimize Region's water- related assets*. Compliance with SBX7-7 is required of retail urban water suppliers as part of urban water management planning. Wholesalers are not subject to the demand reductions targets but are obligated to assist their retailers in achieving their targets. While smaller water suppliers will likely coordinate their efforts, they are not subject to specific requirements.

Table 5-2
Selected Resource Management Strategies vs. IRWM Plan Objectives

Selected Resource Management Strategies	Mojave IRWM Plan Objectives													
	1.Balance future water demands	3. Maintain stability in overdrafted	7. Support to DACs	2. Improving regional water use efficiency	4. Reduce reliance on Delta	5. Optimize Region's water related assets	8. Improve environmental stewardship	9. Improve floodplain management	10. Preserve water quality	11. Obtain financial assistance	12. Improve public awareness	13. Establish reliable funding sources	14. Increase use of recycled water	6. Prevent land subsidence
Strategies to Reduce Water Demand														
Agricultural Water Use Efficiency				✓										
Urban Water Use Efficiency	✓	✓		✓		✓								
Strategies to Improve Operational Efficiency and Transfers														
Conveyance – Delta				✓	✓									
Conveyance – Regional/Local				✓			✓							
System Reoperation				✓		✓								
Water Transfers	✓			✓		✓								
Strategies to Increase Water Supply														
Conjunctive Management and Groundwater Storage	✓	✓												
Municipal Recycled Water	✓	✓											✓	
Surface Storage – CALFED														
Surface Storage – Regional	✓	✓												

Table 5-2
Selected Resource Management Strategies vs. IRWM Plan Objectives

Selected Resource Management Strategies	Mojave IRWM Plan Objectives													
	1.Balance future water demands	3. Maintain stability in overdrafted	7. Support to DACs	2. Improving regional water use efficiency	4. Reduce reliance on Delta	5. Optimize Region's water related assets	8. Improve environmental stewardship	9. Improve floodplain management	10. Preserve water quality	11. Obtain financial assistance	12. Improve public awareness	13. Establish reliable funding sources	14. Increase use of recycled water	6. Prevent land subsidence
Strategies to Improve Water Quality														
Drinking Water Treatment/Distribution									✓		✓			
Groundwater/Aquifer Remediation	✓	✓							✓					
Matching Water Quality to Use	✓	✓							✓				✓	
Pollution Prevention							✓							
Salt and Salinity Management	✓	✓							✓					
Urban Runoff Management									✓					
Strategies to Improve Flood Management														
Flood Management								✓						
Strategies to Practice Resource Stewardship														
Agricultural Lands Stewardship							✓				✓			
Ecosystem Restoration							✓		✓					
Forest Management								✓	✓					
Land Use Planning and Management	✓	✓				✓								
Recharge Area Protection	✓	✓					✓							

Table 5-2
Selected Resource Management Strategies vs. IRWM Plan Objectives

Selected Resource Management Strategies	Mojave IRWM Plan Objectives													
	1.Balance future water demands	3. Maintain stability in overdrafted	7. Support to DACs	2. Improving regional water use efficiency	4. Reduce reliance on Delta	5. Optimize Region's water related assets	8. Improve environmental stewardship	9. Improve floodplain management	10. Preserve water quality	11. Obtain financial assistance	12. Improve public awareness	13. Establish reliable funding sources	14. Increase use of recycled water	6. Prevent land subsidence
Watershed Management						✓	✓				✓			
Strategies for People and Water														
Economic Incentives										✓		✓		
Outreach and Engagement	✓	✓		✓		✓								
Water and Culture	✓			✓		✓								
Water-dependent Recreation							✓				✓			

The following section describes the water conservation requirements, programs and practices of the Mojave Region including Mojave Water Agency (MWA), individual cities and water agencies, and groups of entities within the Region.

5.2.1.3 Summary of Regulatory Requirements

There are significant new requirements since the 2004 RWMP with respect to urban water conservation in California, these include:

- amendments to the Urban Water Management Planning Act (UWMP Act, Act),
- passage of AB 1420 (2007),
- passage of the Water Conservation Bill of 2009 (SBX7-7), and
- changes to the California Urban Water Conservation Council (CUWCC) Best Management Practices (BMPs) (equivalent to UWMP Act Demand Management Measures (DMMs) for those agencies that are not CUWCC signatories).

Water agencies participating in the IRWM Plan are subject to all of these new requirements. The following sections describe these requirements in more detail.

5.2.1.3.1 Urban Water Management Plans and AB 1420

In 1983, the California Urban Water Management Planning Act (Act) was added to the California Water Code (Division 6 Part 2.6) with the signing of Assembly Bill 797 and has since been amended several times. The Act requires water suppliers with over 3,000 customers or that supply over 3,000 acre-feet of water annually to prepare Urban Water Management Plans (UWMP) and submit the plans to DWR. The plans must be updated at least every five years in years that end in 0 or 5.

To meet the requirements of the Act, UWMPs must address a number of topics including current and future water supply availability, projected demands for the next 20 years, reliability of supplies, supply and demand comparisons, the potential for recycling, penalties for wasting water, analysis of impacts on revenues from reductions in water deliveries, measures to overcome revenue impacts, water conservation programs and plans, and water shortage contingency plans.

Cities and water agencies within the Mojave IRWM Plan boundaries have developed and adopted UWMPs to comply with the Act. Entities with adopted UWMPs are listed below:

- City of Adelanto
- Apple Valley Ranchos Water Company (serving Apple Valley)
- County Service Area (CSA) 64 (serving Spring Valley Lake area)
- CSA 70J (*2010 UWMP is still in progress*) (serving Oak Hills area)
- Crestline Lake Arrowhead Water Agency (CLAWA) (serving Upper Mojave expansion area)
- Golden State Water Company (serving Barstow area)
- Hesperia Water District (City of Hesperia)
- Hi-Desert Water District (serving Yucca Valley)
- Joshua Basin Water District (serving Joshua Tree)

- Lake Arrowhead Community Service District (CSD) (serving Upper Mojave expansion area)
- Phelan Piñon Hills CSD (serving Phelan and Piñon Hills area)
- Victorville Water District (City of Victorville)
- Twentynine Palms Water District (serving the City of Twentynine Palms)
- Mojave Water Agency

The DMMs specified in the Act are the same as the CUWCC BMPs. Although not all of the water suppliers are signatory to the CUWCC's Memorandum of Understanding Regarding Urban Water Conservation in California (MOU), the Act requires compliance with the DMMs (described in Section 5.2.1.3.3). The BMPs and the DMMs are considered functionally equivalent and are used interchangeably for the purposes of this Section.

The most significant conservation-related changes to the Act result from the passage of AB 1420 and the Water Conservation Bill of 2009 (SBX7-7), described in the following sections. Both laws identify specific per capita or volumetric demand reduction targets and/or conservation activities that an agency must implement.

5.2.1.3.2 AB 1420

AB 1420, which passed in 2007 and went into effect January 2009, changed the funding eligibility requirements of Section 10631.5 of the Water Code. For any urban water supplier to be eligible for grant or loan funding administered by DWR, the State Water Resources Control Board (SWRCB) or the Bay-Delta Authority (such as funding programs under Propositions 50 and 84), the supplier must show implementation of water use efficiency DMMs listed and described in the Act or show the schedules and budgets by which the supplier will begin implementing them. AB 1420 ties eligibility for grant funding to compliance with the MOU.

5.2.1.3.3 Demand Management Measures / Best Management Practices

The DMMs are intended to reduce current and future water demands through more efficient water use. Additional programs may be necessary during periodic water supply shortages. The DMM descriptions, methods to evaluate effectiveness and estimated water savings associated with the DMMs are taken from the CUWCC MOU (CUWCC 2002, revised 2008). Five agencies in the Region are currently members of the CUWCC: MWA, Crestline Lake Arrowhead Water Agency, Golden State Water Company (which supplies water to the Barstow area), and Lake Arrowhead CSD.

The MOU and BMPs were last revised and accepted by CUWCC members in 2008. The 14 Best Management Practices (BMP) are now organized into five categories; Table 5-3 shows the revised BMP categories. Two of the categories—Utility Operations and Education—are termed "Foundational BMPs", because they are considered to be essential water conservation activities and are required as ongoing best practices. The water savings from Foundational BMPs are "non-quantifiable." The category of Foundational BMPs is a significant shift in the revised MOU because, as a required best practice, they are not eligible for a cost-effectiveness exemption as they had been in the past.

The remaining BMPs are termed "Programmatic BMPs" and are organized into Residential; CII; and Landscape categories. Each BMP has specifically defined activities based on an agency's demographics and water use characteristics, and are considered complete once these activity levels are reached.

The revised BMP organization is also reflected in the 2010 UWMPs DMM compliance requirements. A summary of the DMMs described in the Act and the current CUWCC BMP organization is presented in Table 5-3.

Table 5-3
CUWCC BMP and UWMP DMMs Organization and Names

CUWCC BMP Organization and Names (2009 MOU)				UWMP DMMs	
Type	**Category**	**BMP #**	**BMP Name**	**DMM #**	**DMM Name**
Foundational	Operations Practices	1.1.1	Conservation Coordinator	L	Water conservation coordinator
		1.1.2	Water Waste Prevention	M	Water waste prohibition
		1.1.3	Wholesale Agency Assistance Programs	J	Wholesale agency programs
		1.2	Water Loss Control	C	System water audits, leak detection, and repair
		1.3	Metering with Commodity Rates for All New Connections and Retrofit of Existing Connections	D	Metering with commodity rates for all new connections and retrofit of existing connections
		1.4	Retail Conservation Pricing	K	Conservation pricing
	Education Programs	2.1	Public Information Programs	G	Public information programs
		2.2	School Education Programs	H	School education programs
Programmatic	Residential	3.1	Residential assistance program	A	Water survey programs for single-family residential and multifamily residential customers[(a)]
				B	Residential plumbing retrofit
		3.2	Landscape water survey	A	Water survey programs for single-family residential and multifamily residential customers[(a)]
		3.3	High-Efficiency Clothes Washing Machine Financial Incentive Programs	F	High-efficiency washing machine rebate programs
		3.4	WaterSense Specification (WSS) toilets	N	Residential ultra-low-flush toilet replacement programs
	Commercial, Industrial, and Institutional	4	Commercial, Industrial, and Institutional	I	Conservation programs for commercial, industrial, and institutional accounts

Table 5-3
CUWCC BMP and UWMP DMMs Organization and Names

CUWCC BMP Organization and Names (2009 MOU)				UWMP DMMs	
Type	Category	BMP #	BMP Name	DMM #	DMM Name
	Landscape	5	Landscape	E	Large landscape conservation programs and incentives

Note:
(a) Components of DMM A (Water survey programs for single-family residential and multifamily residential customers) apply to both BMP 3.1 (Residential assistance program) and BMP 3.2 (Landscape water survey).

A key intent of the recent MOU revision was to provide retail water agencies with more flexibility in meeting requirements and allow them to choose program options most suitable to their specific needs. Therefore, as alternatives to the traditional requirements, compliance with the BMP water savings goals can be accomplished in one of three ways: (1) accomplishing the specific measures as listed in each BMP (BMP list), (2) accomplishing a set of measures which achieves equal or greater water savings, referred to the "Flex Track Menu," and (3) accomplishing a set water savings goals as measured in gallons per capita per day (GPCD) consumption. The three options are described below. Under all three compliance paths, water agencies must separately satisfy the two foundational BMPs.

The traditional **BMP list option** (1) was the only approach until the MOU was revised in 2008. This method defines specific programs (for example: plumbing fixture or appliance rebates, landscape audits, and water budgets). Based on the agencies' service area characteristics, required activity levels for each program are determined that result in an achieved level of water savings.

Under the **Flex Track option** (2), an agency is responsible for achieving water savings greater than or equal to those it would have achieved using the BMP list items. The CUWCC has developed three Flex Track Menus – Residential, CII, and Landscape – and each provides a list of program options that may be implemented in part or in any combination to meet the water savings goal of that BMP. Custom measures can also be developed and require documentation on how savings were realized and the method and calculations for estimating savings. An agency may elect to adopt additional or alternative measures, in part or in any combination, as described in the Flex Track Menus, provided that the demonstrated water savings in the Flex Track Menu activities are equal to or greater than the water savings that would be achieved by the BMP measures.

The **GPCD option** (3) sets a water use reduction goal of 18 percent reduction by 2018 (for the purpose of using the same timeframe as the CUWCC MOU). Agencies which choose a GPCD Compliance approach will be counting overall water savings of the quantifiable measures from the BMP list or Flex Track Menu plus additional savings achieved through implementation of the Foundational BMPs. A retail water agency can choose a starting point as either its 2006 potable water use per capita or the average annual potable water use per capita for the years 1997 through 2006. The CUWCC then provides biannual targets as a percentage reduction of the baseline.

Programmatic BMPs are required by retail suppliers only. As a wholesaler, MWA is only required to implement a subset of the Foundational BMPs. MWA is implementing these and working with water agencies and cities both individually and collectively through the Alliance for Water Awareness and Conservation (AWAC) to promote the efficient use of water.

Table 5-4 shows the compliance option and status of the water retailers in the Region that were required to complete a 2010 UWMP. The three retail suppliers that are CUWCC signatories have chosen the GPCD option, while the others are implementing a DMM approach.

Table 5-4
DMM Compliance Methods

Agency	CUWCC Signatory	Compliance Strategy	Status
City of Adelanto	No	DMM	Implementing
Apple Valley Ranchos Water Company	Yes	GPCD (233 gpcd)	Currently at 2018 target
CSA 64	No	DMM	Implementing
CSA 70J		*2010 UWMP is still in progress*	
GSWC - Barstow	Yes	GPCD (235 gpcd)	Currently at 2018 target
Hesperia Water District	No	DMM	Implementing
Hi-Desert Water District	No	DMM	Implementing
Joshua Basin Water District	No	DMM	Implementing
Lake Arrowhead CSD	Yes	GPCD (189 gpcd)	Currently at 2018 target
MWA[(a)]	Yes	DMM	In compliance
Phelan Piñon Hills CSD	No	DMM	Implementing
Twentynine Palms Water District	No	DMM	Implementing
City of Victorville - VWD	No	DMM	Implementing

Note: (a) MWA, as a wholesaler, is only required to implement Foundational DMMs.

The retailers are implementing a variety of conservation programs, which are described in their 2010 UWMPs. Table 5-5 shows the implementation status of the specific DMMs.

DMM 1. Water survey programs for single-family and multi-family customers

Residential surveys, carried out by agency staff or contractors, can identify some of the more common residential water wasting practices. A typical survey includes checking for leaking faucets and toilets, identifying older fixtures that do not meet current water conserving plumbing standards, checking irrigation systems for leaks and proper coverage, reviewing or developing irrigation schedules and setting irrigation controllers accordingly, and checking the water meter.

Implementation Status: This DMM is being implemented to some degree in all water service areas, where it is cost-effective.

Conservation Savings: A potential for water savings exists if the surveys identify water-wasting practices that can be changed. Water savings vary depending on the water fixture and the type of repair or retrofit, ranging from 20 to 40 GPCD for single and multi-family residences respectively (CUWCC 2009).

Table 5-5
Implementation Status for DMMs

Entity	Implementation Approach	Water survey programs for single-family and multi-family customers	Residential plumbing retrofit	System water audits, leak detection, and repair	Metering and commodity rates for new connections and retrofit of existing connections	Large landscape conservation programs and incentives	High-efficiency washing machine rebate programs	Public information programs	School education programs	Conservation programs for commercial, industrial, and institutional accounts	Wholesale agency programs	Conservation pricing	Water conservation coordinator	Water waste prohibition	Residential ultra-low-flush toilet replacement programs
City of Adelanto	DMM	*	*	Y	Y	*	*	*	*	*	N/A	P	Y	Y	*
Apple Valley RWC	GPCD	Currently meeting its 2018 target of 233 gpcd and all foundational BMPs													
CSA 64	DMM	Y	P	Y	Y	Y/*	D	Y/*	Y/*	P	N/A	Y/*	Y/*	Y	P
CSA 70J		*2010 UWMP is still in progress*													
GSWC - Barstow	GPCD	Currently meeting its 2018 target of 235 gpcd and all foundational BMPs													
Hesperia WD	DMM	Y	C-E	Y	Y	Y	C-E	Y	Y/*	P	N/A	Y	Y	Y	Y
Hi-Desert WD	DMM	Y	Y	Y	Y	Y	C-E	Y/*	Y/*	Y	N/A	Y	Y	Y	Y
Joshua Basin WD	DMM	Y	Y	Y	Y	Y	D	Y	Y	Y	N/A	Y	Y	Y	*
Lake Arrowhead CSD	GPCD	Currently meeting its 2018 target of 189 gpcd and all foundational BMPs													
MWA	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Y	Y	N/A	Y	N/A	Y	N/A	N/A
Phelan Piñon Hills CSD	DMM	*	*	Y	Y	*	*	*	*	Y/*	N/A	Y	Y/*	Y	Y/*
Twentynine Palms WD	DMM	C-E	C-E	Y	Y	C-E	C-E	Y	Y	C-E	N/A	Y	Y	Y	C-E
City of Victorville - VWD	DMM	Y	Y	Y	Y	Y	*	Y/*	Y/*	Y	N/A	Y	Y	N	P

Notes:
* implemented through AWAC or MWA
P Planned
D discontinued
C-E Cost-effectiveness exemption
N/A - Not applicable

DMM 2. Residential plumbing retrofit

Retrofitting residences with water efficient plumbing fixtures can be cost effective and reduce per capita indoor water consumption, particularly in residences constructed prior to 1992. Typical retrofit programs involve replacing old fixtures with low-flow showerheads and faucet aerators or retrofitting with water conserving toilets (as needed).

Implementation Status: Plumbing fixture standards are being enforced throughout the basin. Retrofit programs are being implemented in most of the water service areas, where it is cost-effective.

Conservation Savings: *Water savings vary depending on the water fixture replaced. Estimates of anticipated water savings from showerhead retrofit range from 5.2 to 5.5 GPCD for single and multi-family residences respectively (CUWCC 2011).*

DMM 3. System water audits, leak detection, and repair

Full-scale water system audits estimate water lost due to leaks in the supply system. If the audit results indicate a significant quantity of water is not accounted for, a leak detection and repair effort may be warranted. The goals of modern water loss control methods include both an increase in water use efficiency in the utility operations and proper economic valuation of water losses to support water loss control activities. In May 2009 the American Water Works Association (AWWA) published the 3rd Edition M36 Manual Water Audits and Loss Control Programs (M36). The DMM incorporates these new water loss management procedures and applies them in California. Agencies are provided with AWWA's Water Audit Software free of charge and required to complete their standard water audit and water balance and report the results.

Implementation Status: This DMM is Foundational and being implemented to some degree in all water service areas. The full M36 analysis has not yet been implemented across the board.

Conservation Savings: *There is no method to quantify the savings of this DMM.*

DMM 4. Metering and commodity rates for new connections and retrofit of existing connections

The most equitable way to charge for water is through rates based on the quantity consumed. This DMM requires the metering of service connections and billing of customers by volume of use. According to current law, all new connections must be metered. Programs can be developed to retrofit existing unmetered connections.

Implementation Status: This DMM is Foundational and all of the water service areas are in compliance. All existing connections are metered and water meter installation is required for new construction. Metered connections are billed by volume of use.

Conservation Savings: *Metered water service connections can save up to 20% compared to unmetered connections (CUWCC 2002). There is no method to quantify the savings of this DMM.*

DMM 5. Large landscape conservation programs and incentives

Irrigation accounts for a large portion of urban water use in California. Irrigation water use varies dramatically depending on water pricing and availability, plant choice, geographic locations, seasonal conditions, and the level of commitment to sound water efficiency practices. The goal of this DMM is that irrigators, with assistance from water agencies, achieve a higher level of water use efficiency consistent with the actual irrigation needs of the plant materials.

Techniques to improve water use efficiency of large landscapes include designing and using evapotranspiration-based water use budgets, providing notices each billing cycle showing the relationship between the budget and actual consumption, providing customer notices at the start and end of the irrigation season alerting them to check their irrigation systems and make changes as necessary, marketing landscape surveys to existing accounts with large landscapes providing information on climate-appropriate landscape design, efficient irrigation equipment/management to new customers and change-of-service customer accounts, providing rebates for turf replacement and more

Implementation Status: This DMM is being implemented in all but one of the water service areas, where it is cost-effective.

Conservation Savings: *Savings estimates for landscape improvements vary widely. The CUWCC assumes the landscape BMP will result in a 15%-20% reduction in demand for landscape irrigation by affected accounts (http://www.cuwcc.org/mou/bmp5-landscape.aspx).*

DMM 6. High-efficiency clothes washing machine rebate programs

High-efficiency clothes washing machines (HECWs) save water and energy needed to heat water. The DMM requires incentives for or ordinances requiring the purchase of HECWs that meet an average water factor value of 5.0.

Implementation Status: For the most part, the washing machine rebate programs were implemented as a regional grant-funded program through MWA and/or AWAC that began in 2008. The funding was expended in 2009 and the program is no longer offering rebates. For a number of retailers, it is not cost-effective to implement the program otherwise. AWAC, in collaboration with MWA and retail purveyors, will continue to apply for grants to re-fund the program.

Conservation Savings: *The estimate of reliable annual water savings per replacement of a low-efficiency washing machine with a high-efficiency washing machine is 27.95 gallons per day (gpd) (CUWCC, 2009).*

DMM 7. Public information programs

Public information programs to promote the wise use of water and the related benefits are in place throughout the MWA service area. Programs include providing speakers to employees, community groups and the media; using paid and public service advertising; using bill inserts; providing information on customers' bills showing use in gallons per day for the last billing period compared to the same period the year before; providing public information to promote wise water use practices; and coordinating with other government agencies, industry groups, public interest groups, and the media.

Implementation Status: This DMM is Foundational; MWA, the AWAC and all cities and water agencies have public information programs.

Conservation Savings: *There is no method to quantify the savings of this DMM.*

DMM 8. School education programs

School education programs promote wise water use and related benefits. Programs include working with school districts and private schools in the area to provide instructional assistance, educational materials, and classroom presentations that identify urban, agricultural, and environmental issues and conditions in the local watershed. Education materials should meet the state education framework requirements, and grade appropriate materials should be distributed to grade levels K-3, 4-6, 7-8, and high school.

Implementation Status: This DMM is Foundational and being implemented in all but one of the water service areas.

Conservation Savings: *There is no method to quantify the savings of this DMM.*

DMM 9. Conservation programs for Commercial, Industrial and Institutional accounts

CII water use varies dramatically between business sectors as well as within a given water agency's territory. The goal of this DMM is to implement comprehensive yet flexible BMPs, allowing each water agency to tailor implementation to fit local needs and opportunities. Water conservation efforts for CII water users include replacement of existing high-water-using toilets and urinals, incentives for pre-rinse spray valve replacements, cooling towers retrofits and more. Water use surveys are a common CII approach – they generally include a site visit, an evaluation of all water-using apparatus and processes, and a customer report identifying recommended efficiency measures, their expected payback, and available agency incentives.

Implementation Status: This DMM is being implemented through local and regional efforts in most of the water service areas where it is cost-effective.

Conservation Savings: *Commercial water reduction from DMMs such as interior and landscape water surveys, plumbing codes, and other factors is estimated at 12% (CUWCC 2002), CII High Efficiency Toilets (HETs) save about 26 gpd, pre-rinse spray valves save 200-500 gpd depending on the size of the facility and cooling tower retrofits can save up to 27-gpd (CUWCC 2011).*

Industrial DMMs such as waste discharge fees, new technologies, water surveys, plumbing codes and other factors (including savings accounted for in other DMMs) are estimated to save about 15% (CUWCC 2002). Institutional water reductions vary significantly.

DMM 10. Wholesaler agency programs

This DMM applies only to wholesalers and therefore only to MWA. The requirement is that wholesalers provide financial and technical support as appropriate and beneficial to retail water agencies to advance water conservation efforts and effectiveness.

Implementation Status: MWA is assisting other agencies in the basin with water conservation through a number of efforts. These are discussed in Section 5.2.1.4 Coordinated Water Conservation Efforts.

Conservation Savings: *There is no method to quantify the savings of this DMM.*

DMM 11. Conservation pricing

Conservation pricing provides incentives to customers to reduce average use, peak use, or both. Such pricing includes rates designed to recover the cost of providing service and billing for water and sewer service based on metered water use. Conservation pricing is also characterized by one or more of the following components: rates in which the unit rate is constant regardless of the quantity used (uniform rates) or increases as the quantity used increases (increasing block rates); seasonal rates or excess-use surcharges to reduce peak demands during summer months; or rates based on the long-term marginal cost or the cost of adding the next unit of capacity to the system.

Implementation Status: This DMM is Foundational and all of the cities and water agencies currently bill for water based on conservation priced commodity rates.

Conservation Savings: *There is no method to quantify the savings of this DMM.*

DMM 12. Water conservation coordinator

Water conservation coordinators and support staff (if necessary) perform a number of functions including coordination and oversight of conservation programs and DMM implementation, preparation of reports, promotion of water conservation issues to the city or water agency senior management, coordination of agency conservation programs with operations and planning staff, preparation of annual conservation budgets, and preparation of the conservation elements of the agency's UWMP.

Implementation Status: This DMM is Foundational and MWA, AWAC and all of the cities and water agencies have staff that is dedicated to serving in this capacity.

Conservation Savings: *There is no method to quantify the savings of this DMM.*

DMM 13. Water waste prohibition

Water waste prohibitions involve enacted and enforced measures prohibiting gutter flooding, single pass cooling systems in new connections, nonrecirculating systems in all new conveyer car wash and commercial laundry systems, and nonrecycling decorative water fountains.

Implementation Status: This DMM is Foundational and ordinances prohibiting water waste have been adopted in all but one of the water service areas.

Conservation Savings: *There is no method to quantify the savings of this DMM.*

DMM 14. Residential toilet replacement programs

Toilet replacement programs replace existing high-water-using toilets with toilets flushing at 1.6 gallons or less in single-family and multi-family residences. An equivalent program is a retrofit on resale requirement. Retrofit on resale is now required statewide through Senate Bill (SB) 407 which went into effect January 1, 2014. The bill requires that on or before January 1, 2017, all noncompliant plumbing fixtures in any single-family residential property be replaced with water-conserving plumbing fixtures, and by January 1, 2019 in multifamily residential and commercial properties.

Implementation Status: This DMM is currently being implemented both locally and regionally in most of the water service areas.

Conservation Savings: *Water savings depend on the type of toilets replaced but can range from about 26 to 45 gallons per day for a single and multi-family HETs (1.28 gpf). New toilets on the market flushing at 0.8 gpf can save significantly more.*

5.2.1.3.4 Water Conservation Bill of 2009

The Water Conservation Bill of 2009 (SBX7-7) is one of four policy bills enacted as part of the November 2009 Comprehensive Water Package (Special Session Policy Bills and Bond Summary). SBX7-7 provides the regulatory framework to support the 20 percent statewide reduction in urban per capita water use described in the DWR 20 X 2020 Water Conservation Plan (DWR 2010). Compliance with the urban water conservation elements of SBX7-7 requires that each retail water supplier determine and report its existing baseline water consumption and establish future water use targets in GPCD; reporting began with the 2010 UWMP.

The two primary calculations required by SBX7-7 are:

1. Base Daily Water Use calculation (average GPCD used in past years)
2. Compliance Water Use Target (target GPCD in 2015 and 2020)

The 2010 UWMPs detail the calculations utilized to determine suppliers' SBX7-7 baseline use and 2015 and 2020 targets. Most of the suppliers in the Region are already at or below their 2020 per capita goal. Table 5-6 provides individual agency's baseline and targets.

Table 5-6
SBX7-7 Status (all units in GPCD)

Agency	Baseline	2015 Target	2020 Target	Current Use	SBX7-7 Status
City of Adelanto	321.8	262.9	203.9	137 (2010)	Currently at 2020 target
Apple Valley Ranchos Water Company	306	245	275	219 (2009)	Currently at 2020 target
CSA 64	412	371	330	292 (2010)	Currently at 2020 target
CSA 70J	*2010 UWMP is still in progress*				
GSWC - Barstow	287	258	229	213 (2010)	Currently at 2020 target
Hesperia Water District	207	185	165	156 (2009)	Currently at 2020 target
Hi-Desert Water District	123	120	117	122 (2009)	On track
Joshua Basin Water District	164	160	156	151 (2009)	Currently at 2020 target
LACSD	183	172	162	151 (2009)	Currently at 2020 target
MWA	N/A				
Phelan Piñon Hills CSD	184.7	173.1	161.5	131 (2010)	Currently at 2020 target
TPWD	147	141	135	127 (2010)	Currently at 2020 target
VWD	208	234	208	176 (2010)	Currently at 2020 target

5.2.1.4 Coordinated Water Conservation Efforts

In addition to the water conservation efforts of individual water agencies and cities, there are a number of cooperative efforts underway in the Region. These efforts include partnerships between MWA and a number of individual entities and groups of entities such as water agencies, cities, colleges, other educational institutions, and the Mojave Desert Resource Conservation District. These partnerships, formed through MOUs, are described below.

5.2.1.4.1 Alliance for Water Awareness and Conservation

MWA first started addressing and quantifying conservation goals in its *2004* 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 2003, local stakeholders decided that a united regional water conservation program was needed and the AWAC was formed. The AWAC is a collaborative group of over twenty agencies committed to achieving water conservation goals within MWA service area. 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.

The AWAC helps identify the appropriate mix, market penetration, budget and schedule for implementation of demand management measures in order to achieve the desired water reduction goals. Initially the AWAC is targeting outdoor irrigation where there is the greatest potential for significant reduction in water use. The primary targeted audiences are:

- New and existing home owners
- Commercial, industrial and institutional water users
- Landscape suppliers
- Professional and commercial landscapes
- Retail water providers and cities
- Developers

Alliance for Water Awareness and Conservation Participants

1. City of Adelanto
2. Apple Valley Country Club
3. Town of Apple Valley
4. Apple Valley Ranchos Water Company
5. City of Barstow
6. Barstow College
7. Bighorn-Desert View Water Agency
8. Bureau of Land Management
9. Bureau of Reclamation
10. Copper Mountain College
11. City of Hesperia
12. Hi-Desert Water District
13. Mojave Desert Resource Conservation District
14. Mojave Water Agency
15. Mojave Weed Management Area
16. San Bernardino County Special Districts, Water/Sanitation Division
17. Golden State Water Company
18. Victor Valley College
19. Victor Valley Wastewater Reclamation Authority
20. Victorville Water District (City of Victorville)
21. Town of Yucca Valley

Cities and water agencies, through the AWAC, will determine actual reductions in water use. This can be accomplished by establishing baseline annual per capita water use in the cities and comparing this to annual per capita water use data as programs are implemented.

Current participants in the AWAC are listed in the sidebar table.

5.2.1.4.2 MWA and Lewis Center for Education and Research MOU

MWA and the Lewis Center for Education and Research (LCER) have entered into an MOU for raising water awareness of the High Desert community. According to the MOU, topics include improving understanding of:

- the role water resources play in supporting beneficial uses by all consumers within the High Desert
- sensitive biotic components of the High Desert ecosystem that are dependent on surface and near surface water
- concerns and consequences related to a declining water table
- best resource conservation practices for reducing consumptive uses of water
- how land use activities can impact water supply, water quality and biotic resources

According to the MOU, the two entities are working together in order to:

1. Coordinate an educational program that will expose students and citizens throughout the region to the value and benefit natural water resources provide to the community, thereby increasing the community's understanding of the importance of long-term management of the region's water resources.
2. Provide a learning environment for LCER students in an attempt to further understanding of the region's water resources and their role in the management of those resources.
3. Establish specific time schedules prior to program development and implementation in order to carry out the objectives of the MOU.

5.2.1.4.3 MWA and Mojave Desert Resource Conservation District MOU

The MWA and the Mojave Desert Resource Conservation District (MDRCD) have entered into an MOU to heighten the public's awareness of ways to conserve water and convert high water use landscaping to low-maintenance trees and scrubs. This will be accomplished through at least the following:

- Publishing educational materials
- Developing demonstration projects

Under the MOU, MWA has also worked with the MDRCD to remove invasive species along the Mojave River and will continue to do so.

5.2.1.4.4 MWA and Mojave Weed Management Area MOU

MWA, the Mojave Desert Resource Conservation District, and seventeen other entities have entered into an MOU to work to prevent and control weeds throughout the Mojave Desert in California. Invasive weed species can crowd out native species and increase evapotranspiration of water supplies. Weed control and prevention will be accomplished in many ways, but specifically the MWA has agreed to:

- Participate in seeking grants to fund weed management efforts in cooperation with the Mojave Weed Management Area partners and other organizations attempting to manage weeds
- Promote the control and treatment of weeds on MWA property
- Support efforts to educate the public about weeds, their identification, prevention, and methods of control

5.2.1.4.5 MWA and Copper Mountain College MOU

The MWA and the Copper Mountain College have entered into an MOU to increase awareness about the need to manage and conserve the water resources of the Morongo Basin and to provide practical solutions to conserve water. The partners will work to achieve these goals through at least the following efforts:

- Developing a college curriculum that will provide educational opportunities in the area of natural plant vegetation and conservation programs
- Developing demonstration gardens

5.2.1.4.6 MWA and Barstow Community College MOU

Similar to the Copper Mountain College MOU, MWA and the Barstow Community College have entered into an MOU to increase awareness about the need to manage and conserve High Desert water resources and to provide practical solutions regarding water-wise habits. The partners will work to achieve these goals through at least the following efforts:

- Developing a college curriculum and present workshops that advance public education related to water availability, quality, use, conservation-based best management practices, and the management practices that directly encourage High Desert water consumers to support a sustainable approach to water resource management
- Developing a plan to expand the current demonstration garden

5.2.1.4.7 MWA and Victor Valley College MOU

Similar to the Copper Mountain College and Barstow Community College MOUs, MWA and the Victor Valley College have entered into a MOU to create a greater awareness about the need to manage and conserve High Desert water resources and to provide practical solutions that will promote efficient use of water. The partners will work to achieve these goals through at least the following efforts:

- Developing a water conservation curriculum that will culminate in students receiving a Water Conservation Technician certificate
- Developing a Conservation Outreach Day for the public with workshops on drip irrigation design and the use of adaptive plants
- Expanding the GIS curriculum to facilitate water conservation mapping and other natural resource management projects

5.2.1.5 Program Results

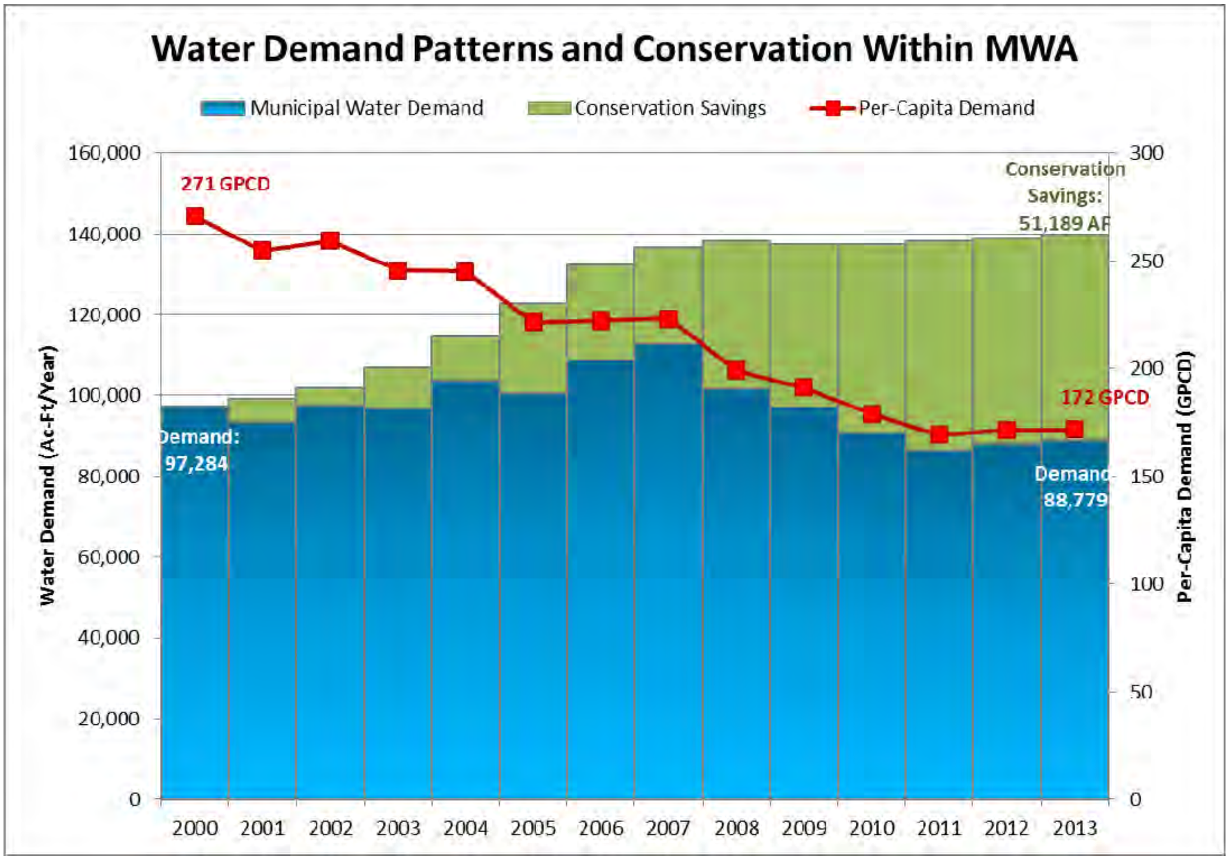
Conservation is a crucial element of the Region's water supply management program and therefore tracking the savings from conservation activities is an integral and evolving element of the program. As discussed in Section 5.2.1.3.3, water savings are achieved through a combination of active (programmatic) 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. Monitoring water use patterns helps measure program success and inform future planning.

Water savings measured by MWA indicate that AWAC participants, and therefore a large portion of the Mojave Region, are well on track to meeting its AWAC goals. Between 2000 and 2013, per capita use dropped by about 37 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 5-1 shows municipal production over time coupled with per capita use and population growth for the Mojave Groundwater Basin. Municipal production has fallen approximately 9 percent or 8,500 acre-feet (af) between 2000 and 2013; at the same time population grew by over 40 percent. The savings of 51,200 af represent how much higher use would have been without conservation activities and efficiency standards.

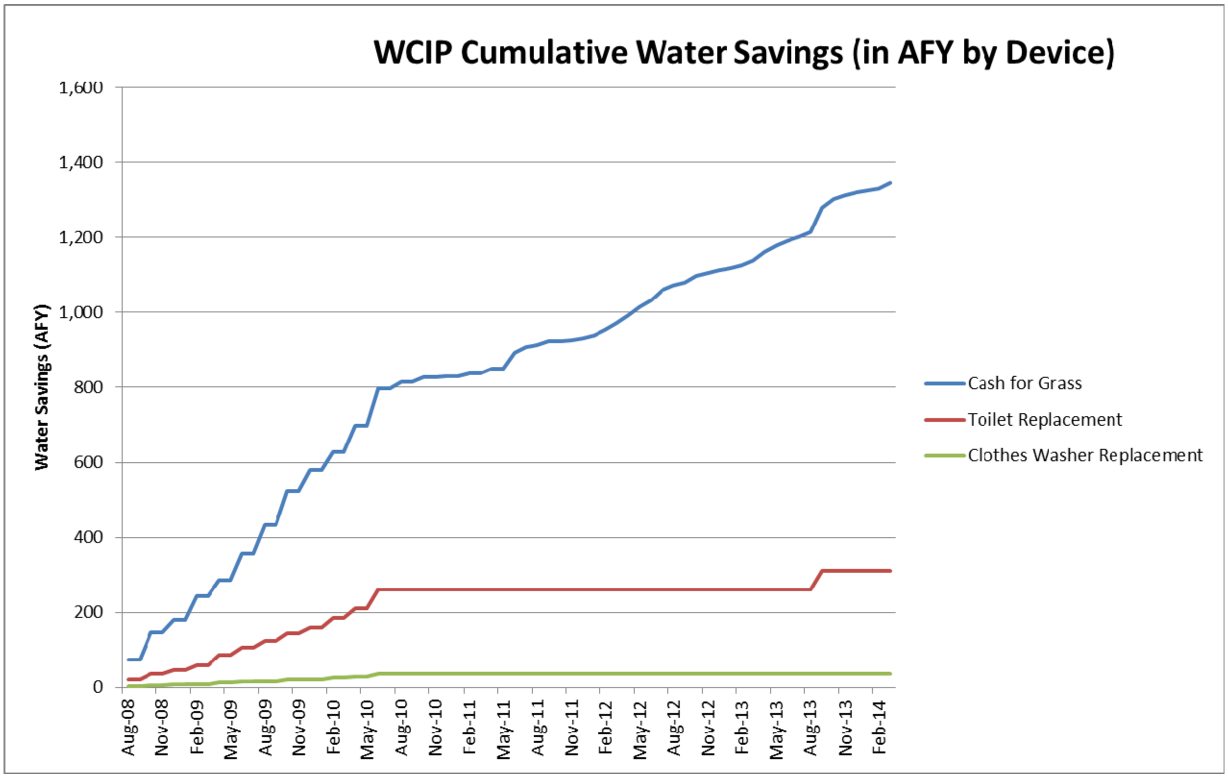
Figure 5-1
Water Use Patterns and Conservation within MWA



The savings in Figure 5-1 represent the impacts of both the passive and active programs. Further, based on an analytical approach, calculations indicate that water conservation incentive program activities saved about 1,350 acre-feet per year (afy) since August 2008 (Figure 5-2). 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 avoided cost approach recommended by the CUWCC. Savings from HETs and 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 5-2
Savings from Conservation Incentives



AWAC participants are on track to meeting, and potentially even exceeding, AWAC water reduction goals, with municipal per capita consumption having dropped from 271 to 172 GPCD since 2000. These activities have allowed AWAC participants to meet their SBX7-7 requirements as well. Additional agencies within the Mojave Region are also successfully meeting SBX7-7 targets. Through aggressive programs, planning and collaboration population growth and demand have successfully been decoupled from historic patterns. The Region's water suppliers continue to work together through a variety of incentive, outreach, education and support programs to ensure long-term supply reliability as well as insulation from short-term variations. Programs may be expanded and/or altered through time to take advantage of regional cooperation.

5.2.2 Improve Operational Efficiency and Transfers

5.2.2.1 Conveyance – Delta

Delta conveyance refers to the movement of water within the network of streams, sloughs, and channels of the Sacramento-San Joaquin Delta and out of the Delta through constructed water conveyance systems. This strategy deals with the management of Delta inflows and exports to meet various demands, including municipal, industrial, and agricultural water supply, navigation, recreation, habitat, and flood conveyance.

This RMS is relevant to the Mojave Region because it includes entities that divert water from the Delta, specifically via the State Water Project (SWP). Stream flow in the Delta and its tributaries is important for the life-cycle of several species of native fish, for water quality, for recreation, and for other uses. This RMS is aligned with Plan Objective 2: *Improving regional water use efficiency* and Objective 4: *Reducing reliance on the Delta*.

5.2.2.2 Conveyance – Regional/Local

Regional/local conveyance means the use of both natural waterways and built infrastructure to move water to areas where it is needed or away from areas to protect existing resources. This strategy covers the distribution and conveyance of local sources of water and imported water to improve water supply, water quality, recreation, habitat, and flood management.

For the Mojave Region, this RMS addresses conveyance activities outside the Delta, including conveyance from and through the watershed to the Mojave River. It is related to the conjunctive management and groundwater storage RMS. It aligns with Objective 2: *Improving regional water use efficiency;* and Objective 8: *Improve environmental stewardship*.

5.2.2.3 System Reoperation

System reoperation involves changes to the operation of water systems to address existing problems, increase water supply reliability, or adapt to future changes. The strategy includes reoperation of surface water storage facilities, groundwater systems, and associated conveyance infrastructure, which is directly related to the conjunctive management and groundwater storage RMS. System re-operation may improve the efficiency of existing uses, or may increase the emphasis of one use over another.

In the Mojave Region, this RMS aligns with Objective 2: *Improving regional water use efficiency* and Objective 5: *Optimize the Region's water-related assets* and likely will be integral to meeting the water supply demands of the Region.

5.2.2.4 Water Transfers

Water transfers are voluntary exchanges of water or water rights among water users. A water transfer can be a change in the point of diversion, place of use, or type of use. Water transfers typically occur using one of the following: transfer of water from reservoirs that would otherwise have been carried over to the following year; use of groundwater instead of surface water deliveries and transfer of the surface water rights; transfer of previously banked groundwater; reduction of existing consumptive use and transfer of the resulting water savings; and reduction of water losses and transfer of the recovered water.

Due to the Mojave Judgment being in place for the Mojave Groundwater Basin, water transfers within the Mojave Groundwater Basin are required to follow the rules outlined in the Judgment and such water transfers as described above may not be allowed.

This RMS could help achieve Objective 1: *Balance future water demands;* Objective 2: *Improving regional water use efficiency;* and Objective 5: *Optimize the Region's water-related assets.*

5.2.3 Increase Water Supply

5.2.3.1 Conjunctive Management and Groundwater Storage

Conjunctive management is the coordinated use of surface water and groundwater to maximize the water available to a region. This strategy involves recharge of groundwater basins when excess surface water is available. In general, throughout the entire Mojave Region, the conjunctive management and groundwater storage RMS is already actively practiced because of the availability of additional imported (SWP) water supplies to be purchased by MWA and then stored in the groundwater basins until needed at a future date. This RMS will likely be an important element of achieving Objectives 1 and 3, which focus on water supply.

5.2.3.2 Desalination ✗

Desalination refers to treatment processes that remove salts from water to achieve salinity concentrations that are acceptable for municipal and agricultural uses. The desalination strategy covers treatment of seawater as well as brackish water. Desalination technologies may also be used to treat wastewater to produce high quality recycled water. In California, the principal method for desalination is reverse osmosis. This process can be used to remove salt as well as specific contaminants in water such as disinfection byproduct precursors, volatile organic compounds, nitrates, and pathogens.

This RMS may eventually become viable in portions of the Region where groundwater has high salinity concentrations to achieve the Objectives 1 and 3, which focus on water supply and Objective 10, which preserves water quality. However, the use of desalination within the Region likely will present significant challenges, such as how to dispose of the resulting brine. Another drawback is that desalination tends to require significant energy use and could contribute to greenhouse gas emissions. While this strategy could reduce negative impacts during drought conditions, this RMS is not being considered for Region implementation at this time because of the factors described above.

5.2.3.3 Precipitation Enhancement ✗

Precipitation enhancement, commonly called “cloud seeding,” artificially stimulates clouds to produce more rainfall or snowfall than they would naturally. Cloud seeding injects special substances into clouds that enable snowflakes and raindrops to form more easily.

This RMS is not being considered at this time, as the feasibility of precipitation enhancement activities in the Region is not known and funding for research and implementation of such projects has been largely unavailable.

5.2.3.4 Municipal Recycled Water

Water recycling is the treatment and reuse of wastewater and, under this strategy, encompasses the process of treating wastewater, storing, distributing, and using the recycled water. The recycled municipal water strategy applies specifically to the application of municipal wastewater with the intention of putting the water to a beneficial use that would not occur through discharge of the wastewater.

As discussed in Section 3: Water Supply and Demand, this RMS is implemented to a limited extent in the Region, largely as a means of wastewater disposal. In select instances where wastewater discharge requirements result in highly treated wastewater, this RMS is being expanded to meet Objective 14: *Increase use of recycled water* and will also assist in meeting the two objectives that focus on water supply, Objectives 1 and 3.

5.2.3.5 Surface Storage – CALFED

The CALFED *Record of Decision* (2000) identified five potential surface storage reservoirs that are being investigated by DWR, the US Bureau of Reclamation, and local water interests. Building one or more of the reservoirs would be part of CALFED's long-term comprehensive plan to restore ecological health and improve water management of the Bay-Delta. The projects include: Shasta Lake Water Resources Investigation, North-of-the-Delta Offstream Storage (Sites Reservoir), In-Delta Storage Project, Los Vaqueros Reservoir Expansion, Upper San Joaquin River Basin Storage Investigation (Temperance Flat Reservoir). By 2013, Final Environmental Impacts Studies and Reports are anticipated to be complete for the surface storage projects, with the decision phase ending in 2014 (DWR 2010). These analyses will help determine if the water agencies in the Region will be willing to financially participate in the construction and operations and maintenance of either of these surface storage options in the future.

5.2.3.6 Surface Storage – Regional/Local

Surface storage consists of the collection and storage of water within on-stream or off-stream reservoirs for later release. This strategy includes the use of surface storage for water supply as well as flood management. While there is one potential storage option in the Mojave Region, the Mojave River Dam, MWA is not allowed pursuant to the Mojave Basin Adjudication (discussed in Section 2.6.2) to capture any storm flow and use for storage. Therefore, on a local basis, MWA does not use this RMS due to the Adjudication.

Surface storage has played an important role in California where the pattern and timing of water use does not always match the natural runoff pattern. Most California water agencies rely on surface storage as a part of their water systems. Over the last few years, MWA has taken advantage of an agreement they have with the SWP to store available excess SWP water in the San Luis Reservoir (owned and operated by SWP), located approximately 60 miles south of Sacramento in the western San Joaquin Valley. The reservoir stores water exported from the San Joaquin-Sacramento River Delta. Water is pumped uphill into the reservoir from the O'Neill Forebay which is fed by the California Aqueduct and is released back into the forebay to continue downstream to the Mojave Region along the aqueduct as needed. Completed in 1967, the 12,700 acre reservoir is a joint use facility, being a part of both the California SWP and Central Valley Project.

For example, during 2011 and 2012, MWA stored 65,000 af of its surplus SWP water allocation in the San Luis Reservoir and then during the dry years of 2013 and 2014, MWA was able to sell a portion of the stored water to other agencies and deliver a portion locally. Because the timing of when SWP water is available can be unpredictable, this was an excellent opportunity provided to MWA via its SWP contract.

This RMS is critical to meeting the two objectives that focus on water supply, which are Objectives 1 and 3.

5.2.4 Improve Water Quality

5.2.4.1 Drinking Water Treatment and Distribution

This strategy focuses on ensuring that water provided for human consumption is safe for drinking. Drinking water treatment includes physical, biological, and chemical processes that treat, blend, or condition water to meet potable water standards. Drinking water distribution includes the storage, pumping, and delivery of potable water to customers. This strategy includes measures within both the treatment processes and distribution system operations that are necessary to produce and maintain safe drinking water quality.

One of the challenges discussed in Section 4 relates to manage drinking water to obtain water quality standards, which can be achieved through the water treatment process. This RMS can help achieve Objective 10: *Preserve water quality* and also assist in meeting Objective 12: *Improve public awareness.*

5.2.4.2 Groundwater Remediation/Aquifer Remediation

Groundwater and aquifer remediation is the improvement of groundwater quality to meet intended beneficial uses. Groundwater impairment may be the result of naturally occurring constituents or anthropogenic contamination. The groundwater and aquifer remediation strategy includes both passive techniques, which allow for *in situ* degradation, and dispersion of contaminants and active treatment, which removes the contaminants through chemical, biological, or physical processes.

Mojave Region groundwater basins contain numerous areas with water quality issues. Key contaminants include arsenic, nitrates, iron, manganese, Chromium VI, chlorinated solvents, petroleum hydrocarbons, perchlorate, and total dissolved solids (TDS). Measurements in excess of drinking water standards have been found for some of these constituents within the Region. Groundwater remediation activities and/or source control actions are currently occurring in locations within the Plan area where anthropogenic activities have caused pollution. For example, Chrome VI removal is occurring in the Hinkley Community and jet fuel removal activities are underway in north Victorville in the groundwater beneath the former George Air Force Base. If successful, this RMS could contribute to achieving the Objective 10: *Preserve water quality* and will also assist in meeting the two objectives that focus on water supply, which are Objectives 1 and 3.

5.2.4.3 Matching Quality to Use

This strategy is based on the recognition that not all water uses require the same quality water. This strategy thereby aims to optimize water resources by directing higher-quality sources of water to end uses that require higher quality and sources of lower-quality water to applications where the lower quality is adequate to the use. For example, high quality water sources can be used for drinking and industrial purposes that benefit from higher quality water, and lesser quality water can be adequate for uses such as irrigation. Further, some new water supplies, such as recycled water, can be treated to a wide range of purities that can be matched to different uses. This strategy reduces the treatment costs associated with water supply and optimizes water resource supplies.

Not all water uses require the same quality of water or level of water treatment. Potable water should be reserved for those uses that require potable water standards (e.g., drinking water supplies), while other uses that do not require potable water (industrial, construction, landscape and agricultural irrigation) can use recycled water. Various laws are in place to ensure water quality matches use, including Title 22, Chapter 4 of the California Code of Regulations (Title 22). Title 22 identifies several levels of recycled water based on level of treatment and disinfection, including for example: Disinfected Tertiary Recycled Water. Title 22 further identifies allowable uses for each of these different levels of recycled water based on the potential impacts to public health.

The proposed Subregional Water Reclamation Plants (WRPs) planned for construction by Victor Valley Wastewater Reclamation Authority (VVWRA) will produce Title 22 disinfected tertiary recycled water, suitable for the anticipated use of recycled water for industrial and landscape irrigation.

Matching quality of water to use is not limited to recycled water. For example, water high in nitrate must be blended in order to make this water appropriate for drinking water. However, this same water, if managed properly, can be used for irrigation. Water high in nitrate is only recommended for certain types of crops and must be applied in combination with the right fertilizers. For some applications, nitrate in irrigation water reduces the need to apply fertilizers with nitrogen.

This strategy aims to optimize water resources by directing higher-quality sources of water to end uses that require that higher quality, such as drinking water or certain industrial processes, and sources of lower-quality water to applications where the lower quality is adequate to the use. This strategy reduces the treatment costs associated with water supply. This RMS is not formally used within the Region at this time, but it could be more fully explored to achieve Objective 10: *Preserve water quality* and Objective 14*: Increase the use of recycled water* and will also assist in meeting the two objectives that focus on water supply, Objectives 1 and 3.

There are three examples in the Region where this strategy is already occurring with positive results. In the Hinkley area, Pacific Gas & Electric (PG&E) is employing groundwater extraction as a hexavalent chromium plume containment strategy combined with application of extracted groundwater to cultivate crops where microbial activity in the soil promotes the reduction of hexavalent chromium to the relatively insoluble trivalent chromium. Groundwater is extracted and applied to crops via a drip irrigation system. In the Lucerne Valley area, Big Bear Area Regional Wastewater Agency (BBARWA) discharges undisinfected secondary treated recycled water to irrigate fodder and fiber crops with overflow diverted to earthen ponds. In Hesperia, the Lake Arrowhead Community Services District (Lake Arrowhead CSD) discharges treated wastewater to irrigate fodder crops and percolation ponds.

5.2.4.4 Pollution Prevention

The pollution prevention strategy addresses wastewater treatment plants, stormwater discharges, agricultural runoff, and unauthorized land uses. The Lahontan and Colorado River Regional Water Quality Control Boards (RWQCBs) seek to avoid pollution in the Mojave Region by regulating discharges from various land uses, industrial uses, septic systems, leaking underground storage tanks, and by controlling dredging. This strategy includes efforts to identify sources of pollutant load, reduce pollution-causing activities, and capture pollutants before they enter waterways.

This RMS is important for the Region, as it is relevant to multiple objectives, including Objective 8: *Improve environmental stewardship.* Implementation of programs such as the RWQCB's Total

Maximum Daily Load (TMDL) program and their National Pollutant Discharge Elimination System (NPDES) are key to Integrated Water Management (IWM) in the Region. Improving water quality by protecting source water is consistent with a watershed management approach to water resources problems.

5.2.4.5 Salt and Salinity Management

Salts are materials that originate from dissolution or weathering of rocks and soils, the term "salinity" describes the condition where these dissolved minerals are present. While generally beneficial when present in low concentrations, salinity very quickly becomes a problem when consumptive use and evaporation concentrate salts to levels that adversely impact beneficial uses. Water reuse can contribute to increased salinity since each use subjects the water to evaporation and additional dissolved salts will be picked up when this water resource passes through soil.

Salt and salinity management requires an understanding of how salts enter the Region and are diluted and displaced within the Region; as such, the salt and salinity management strategy includes studies on regional salt loading and the extent and magnitude of a region's salt problems. It also includes steps that reduce salt inputs and sequester or dispose of salts. The closed basin of the Mojave Watershed within the Region represents a challenge to salt and salinity management. A Salt and Nutrient Management Plan was prepared concurrently with the IRWM Plan to address this RMS. By achieving Objective 10: *Preserve water quality,* the Mojave Region will contribute to applying this RMS successfully in ways that could help provide water supplies of appropriate quality, as described in Objectives 1 and 3.

5.2.4.6 Urban Runoff Management

The urban runoff management strategy involves the collection, conveyance, and treatment of stormwater and dry weather runoff to improve flood management, water quality, or water supply. Urban runoff management is linked to several other resource strategies including pollution prevention, land use management, watershed management, water use efficiency, recycled water, protecting recharge areas, and conjunctive management. The IRWM Plan acknowledges the importance of this RMS, particularly as it relates to the pollution prevention RMS. This strategy aligns with Objective 10: *Preserve water quality* to improve the quality of urban runoff.

5.2.5 Improve Flood Management

5.2.5.1 Flood Management

This RMS for flood management is unique to the other strategies in the CWP Update 2013 in that it contains multiple approaches within a single RMS. Flood management is complex and is still relatively new to the CWP. For Update 2013, this flood management RMS provides local and regional water managers a broader perspective of the flood management tools that are available and their interrelationships. In future CWP updates and as flood management becomes more integrated into the CWP, more than one RMS for flood management could be developed.

In traditional flood management, the overarching purpose is to separate flood waters from people and property that could be harmed. In contrast, IWM seeks a balance between exposure of people and property to flooding, the quality and functioning of ecosystems, the reliability of water supply and water quality, and economic stability including both economic and cultural considerations. This shift changes the focus of flood management from a local to a system-wide context.

Traditional flood management approaches inadvertently allowed development in floodplains, putting people and property at risk. An IWM approach is balanced and leads to addressing a wide variety of needs.

Flood management includes a wide range of management actions, which can be grouped into four general approaches: Nonstructural Approaches, Restoration of Natural Floodplain Functions, Structural Approaches, and Emergency Management. These approaches and the management actions within them serve as a toolkit of potential actions that local, state, and federal agencies can use to address flood-related issues and advance IWM.

Structural approaches to flood management include flood infrastructure, reservoir and floodplain storage and operations, and operations and maintenance (O&M). Nonstructural approaches to flood management include land use planning and floodplain management.

This RMS aligns with Plan Objective 9 which is considered high-importance, medium urgency and specifically addresses floodplain management. It reflects the fact that, as discussed in Section 3.5, the Mojave River Watershed in the Region is prone to flood damage. Implementation of this strategy involves the recognition that flood risk management is a complex topic requiring significant interaction with state and federal agencies, includes an injunction from the adjudication of the Mojave Basin Area against diverting stormwater flow away from downstream users of the Mojave River, and that not all flooding is harmful, as there is a discrete relationship between natural floodplain operations related to groundwater recharge and ecosystem habitat restoration.

5.2.6 Practice Resource Stewardship

5.2.6.1 Agricultural Lands Stewardship

The agricultural lands stewardship strategy includes measures that promote the continued use of agricultural lands and protect natural resources through the maintenance of agricultural lands. Erosion control measures are an example of agricultural land stewardship practices that support the viability of croplands while offering water resource benefits. This strategy contributes to the protection of open space and the traditional characteristics of rural communities. Further, it helps landowners maintain their farms and ranches rather than being forced to sell their land because of pressure from urban development.

This is an important RMS for the Region because of the agricultural values held throughout it. There are several organizations in the Region such as the Mojave Desert Resource Conservation District, the US Department of Agricultural Natural Resources Conservation Service, the Bureau of Reclamation and MWA that are active in applying this RMS that will facilitate meeting the education and awareness focus for Objective 12: *Increase public awareness* and Objective 8: *Improve environmental stewardship.*

5.2.6.2 Ecosystem Restoration

Ecosystem restoration addresses natural landscapes and biological communities that have been modified by past activities. This strategy aims to increase the diversity of native species and biological communities and the abundance and connectivity of habitats, particularly in aquatic, riparian, and floodplain ecosystems. The strategy includes protection and recovery of at-risk species, wetlands restoration and construction, floodplain reconnection, and invasive species removal. Ecosystem restoration improves the condition of our modified natural landscapes and biotic communities to provide for the sustainability and for the use and enjoyment of these ecosystems by current and future generations.

This RMS is a high priority to the Mojave Region because it helps improve environmental stewardship related to waterways and water management as detailed in Objective 8: *Improve environmental stewardship*. This RMS also supports watershed management, decreasing pollution, and promoting water quality improvements.

5.2.6.3 Forest Management

California's major water development projects rely on water produced in forested watersheds. Almost all forest management activities can affect water quantity and quality. This strategy focuses on those forest management activities that are designed to improve the availability and quality of water for downstream users, on both publicly and privately owned forest lands. Examples of forest management activities include vegetation and fuels management to enhance soil moisture, groundwater recharge and streamflows.

This RMS aligns with Objective 10: *Preserve water quality* to reduce the risk of large erosion events and Objective 9: *Improve floodplain management* to reduce the physical damage from floods such as erosion or scouring of stream banks. Ecosystem restoration, erosion control for pollution prevention, and watershed management preserve the productivity of fresh water resources in forested locations and work toward meeting water quality objectives throughout the Region's watershed.

5.2.6.4 Land Use Planning and Management

The land use planning and management strategy incorporates consideration of water supply availability, water quality requirements, and flooding and drainage into land use decisions. Integrating land use and water management consists of planning for the housing and economic development needs of a growing population while providing for the efficient use of water, water quality, energy, and other resources. The way in which the land is used – the pattern and type of land use and transportation, and the level of intensity – has a direct relationship to water supply and quality, flood management, and other water issues. For example, more compact development within existing urban areas can limit development in the floodplains, leading to improved flood management. Low impact development and stormwater recharge strategies can also provide benefits related to flood management, as well as water quality and water supply. The water use projections contained in this IRWM Plan were derived using population and economic growth forecasts prepared by land use agencies within the Region. Because of this, water planning and land use planning will be effectively coordinated.

This RMS aligns with water supply and growth as detailed in Objective 1: *Balance future water demands*; Objective 3: *Maintain stability in overdrafted groundwater basins; and* Objective *5: Optimize Region's water-related assets.*

5.2.6.5 Recharge Areas Protection

The recharge area protection strategy includes the protection and enhancement of groundwater recharge areas. Since much of the Region is not urbanized, access to recharge areas is often retained, and some agricultural areas are used, in part, for groundwater recharge. This strategy includes methods such as low-impact development and land conservation to help areas suitable for recharge remain accessible. It also includes measures to protect groundwater recharge areas from contamination. As some portions of the Region are solely dependent on groundwater, this RMS aligns particularly well with the Objective 1: *Balance future water demands* and Objective 3: *Maintain stability in previously overdrafted groundwater basins, both of* which are of high importance to the Region. Also the strategy aligns with Objective 8: *Improve environmental stewardship.*

5.2.6.6 Sediment Management ✘

Sediment management is an important strategy for water resources management, as the presence or absence of sediment may have significant impacts on water and its beneficial uses. For example, sedimentation can create water quality impairments through increased turbidity and through transportation of pollutants and nutrients. Depending on the dynamics of a certain system, sedimentation can create or impair streambed and lakebed habitat. Additionally, deposited sediment can reduce hydraulic capacity of stream channels, which can lead to increased flood risks, and can also reduce reservoir storage capacity over time, thereby affecting the availability of water supply and floodwater storage volume. Due to the dynamics of sedimentation, this strategy is optimally implemented on a watershed-side scale with the goal to create a more natural equilibrium across the watershed.

At this time, because the Region does not have difficulties with either erosion of channels or sediments plugging recharge areas, this RMS is not being considered for Region implementation This RMS may eventually become viable in portions of the Region if channel erosion were to become an issue to achieve the Objective 10, which preserves water quality.

5.2.6.7 Watershed Management

The watershed management strategy uses watershed boundaries as the basis for managing natural resources. Watershed management is the process of creating and implementing plans, programs, projects, and activities to restore, sustain, and enhance watershed functions. A primary objective of watershed management is to increase and sustain a watershed's ability to provide for the diverse needs of the communities that depend on it, from local to regional to state and federal stakeholders. The watershed is an appropriate scale to coordinate and integrate management of the numerous physical, chemical, and biological processes that make up a river basin ecosystem. It serves well as a common reference unit for the many different policies, actions, and processes that affect the system. Using the watershed as a basic management unit also provides a basis for greater integration and collaboration.

The Mojave Region is a good example of a geographical watershed. Managing the water and environmental resources within the Mojave Region, as is being investigated through this IRWM Plan, is a means of watershed management. This RMS aligns with almost all of the objectives, including education and awareness focus included in Objective 5: *Optimize Region's water-related assets* as well as Objective 12: *Increase public awareness*. The IRWM planning process has established and enhanced relationships that seek to improve the sustainability and benefits derived from resources of the Region's watershed, particularly as they relate to meeting Objective 8: *Improve environmental stewardship*.

5.2.7 People and Water

5.2.7.1 Economic Incentives (Loans, Grants, Water Pricing)

Economic incentives are financial assistance and pricing policies to influence water management. Such incentives can promote implementation of projects that improve water management and protect water resources. Economic incentives can also influence the amount of use, time of use, wastewater volume, and source of supply. Economic incentives may include low-interest loans, grants, and water pricing rates. Free services, rebates, and the use of tax revenues to partially fund water services also have a direct effect on the prices paid by the water users. Governmental financial assistance can provide incentives for resource plans by regional and local agencies. Also, government financial assistance can help water agencies make subsidies available to their water users for a specific purpose.

Economic incentives are financial tools such as grants, loans, rebates, and water pricing to influence water management. Such incentives can promote implementation of projects that improve water management and protect water resources. In addition, water rate incentives can be used to promote more efficient use of water. This RMS aligns with Objective 11: *Obtain financial assistance* and Objective 13: *Establish reliable funding sources*. Resource managers within the Region are evaluating opportunities to more fully develop this RMS to achieve the objectives so the projects in the IRWM Plan can be implemented.

5.2.7.2 Outreach and Engagement

Outreach and engagement is the use of tools and practices by water agencies to allow public groups and individuals to contribute to beneficial water management outcomes. The goal of this strategy is to create a knowledgeable group of citizens that can effectively participate in public water resource discussions and debates. Conducting outreach and engagement activities helps promote collaboration and interdisciplinary approaches to solving problems, including resolving conflicts and addressing multiple interests and needs. Outreach and engagement efforts can include ensuring access to water management information and decision-making, informing and educating the public, as well as facilitating opportunities for direct action and volunteer programs.

Similar to the urban water use efficiency strategy discussed in Section 5.2.1.2, this strategy also includes outreach and engagement efforts and other collaborative measures that can cause adoption of technological improvements or behavioral changes that reduce per capita water demand. The strategy addresses four of the 14 IRWM Plan objectives, including Objective 1: Balance future water demands; Objective 2: Improving regional water use efficiency; Objective 3: Maintain stability in overdrafted groundwater basins; and Objective 5: Optimize Region's water-related assets.

5.2.7.3 Water and Culture

There is great diversity in the ways that water is perceived, valued, and used from a cultural standpoint and some cultural relationships to water may not be readily apparent. Improving the understanding of how water management may affect cultural values, uses, and practices, and in turn how these factors alter water management will help inform policies and decisions.

This RMS can help achieve Objective 1: Balance future water demands; Objective 2: Improving regional water use efficiency; and Objective 5: Optimize the Region's water-related assets.

5.2.7.4 Water-Dependent Recreation

This strategy seeks to maintain and enhance recreational activities dependent on water, including fishing, swimming, waterfowl hunting and birding, boating, canoeing, and kayaking, as well as activities that do not require water but are enhanced by it, including wildlife viewing, picnicking, camping, hiking, biking, and riding on trails. Many recreational lakes are located within the IRWM Region, as well as hiking trails in riparian areas and wildlife associated with those lands. This RMS meets the Objective 12: *Increase public awareness* and Objective 8: *Improve environmental stewardship*.

5.2.8 Other Strategies

In addition to the 30 main RMS described above, the CWP Update 2013 lists and describes other strategies that have potential to contribute to meeting one or more resource management objectives, such as water supply augmentation and water quality enhancements. It is important to note that the CWP Update 2013 recognizes that these strategies have limited capacity for strategically addressing long-term regional water planning needs and in some cases may still require further research and development.

5.2.8.1 Crop Idling for Water Transfers

With crop idling for water transfers, irrigated lands are removed from production or dry farmed to make water available for transfer. The Region may want to consider this strategy.

5.2.8.2 Dewvaporation or Atmospheric Pressure Desalination ✘

Atmospheric pressure desalination involves evaporation of brackish water for collection of condensate across a heat transfer wall. This technology is still under development for small-scale applications and is not a feasible RMS for the Region.

5.2.8.3 Fog Collection ✘

Fog collection involves the use of nets or other structures to collect the moisture in fog. While coastal vegetation naturally collects moisture from fog for a significant portion of water needs in California, fog collection has not been practiced as a management strategy in the state. The inland location and topographical and climatic conditions in the Region are not conducive to intense fog development throughout the year, rendering fog collection an infeasible RMS for the Region.

5.2.8.4 Irrigated Land Retirement

The irrigated land retirement strategy permanently removes farmland from irrigated agriculture. This strategy may be pursued to make water available for transfer or to solve drainage-related problems. As in crop-idling, individual farmers may seasonally or annually retire land from irrigation based on available water supply, which could reduce water demand and improve water supply reliability for other beneficial uses. Implementation of this strategy should be done with consideration and respect for regional cultural values, which includes preservation of valuable agricultural economic outputs. When using this strategy of permanently idling the land, consideration should be given to some form of land treatment to prevent the loss of topsoil and associated sand migration issues associated with wind erosion.

5.2.8.5 Rainfed Agriculture ✘

Rainfed agriculture relies solely on rainfall to provide all crop consumptive water use. Implementation of rainfed agriculture, also known as dry farming, requires matching cropping patterns to precipitation patterns, likely resulting in single cropping, most often used with crops that produce low economic returns such as hay. In California, where little precipitation occurs during the spring and summer growing seasons, the use of this strategy is limited. The arid climate in the Mojave Region is not conducive to implementation of this strategy in the Region.

5.2.8.6 Waterbag Transport/Storage Technology ✘

The waterbag transport/storage technology strategy takes water from coastal areas with unallocated freshwater supplies, stores it in inflatable bladders, and delivers it to another coastal area. This technology currently has limited capacity for strategically addressing long-term regional water planning needs and may require further research and development before full-scale implementation. As a result of the current stage of this technology and the fact that the Region is not located in a coastal location, this RMS is currently not considered for implementation in the Mojave Region.

5.2.9 Strategies Related to Climate Change

Please refer to the Climate Change Section 12 for the state and regional adaptation strategies recommended for the Mojave Region.

Section 6: Project Review and Prioritization

This section describes the process used to solicit, screen, review, and select projects for inclusion in the Mojave Integrated Regional Water Management Plan (IRWM Plan) and prioritize the projects. The process was designed to identify projects, programs, and actions that contribute towards achievement of the Region's IRWM Plan objectives.

This section also lists projects prioritized by importance and urgency. The "importance" assigned to each project reflects the significance or consequence of implementing this project compared with other projects within the Region. The "urgency" assigned to each project reflects the degree to which it warrants speedy attention or action compared with other projects.

6.1 Project Solicitation and Integration Process

The process used to identify projects to include in the Mojave IRWM Plan included several steps:

1. Stakeholders throughout the Region worked together in a collaborative process to identify challenges and opportunities.
2. Based on the challenges and opportunities, developed Plan objectives that identify the desired integrated water management outcomes for the Region.
3. Prioritized the Plan objectives according to importance and urgency.
4. Described water management strategies and desired integration.
5. Described desired types of project proposals to be considered for inclusion in the Plan.
6. Issued a *Call for Projects* on July 1, 2013.
7. Project Proponents completed and submitted one or more *Project Identification Forms* by August 1, 2013.
8. Issued a second *Call for Projects* on August 13, 2013 to provide stakeholders with an opportunity to discuss, refine, and further integrate project ideas.
9. Project Team reviewed proposed projects and made recommendations.
    a. Project Team compiled a list of submitted projects.
    b. Project Team reviewed proposed projects based on information provided by proponents according to the screening criteria.
    c. Project Team identified any proposed projects that did not meet the screening thresholds.
    d. Project Team ranked the selected projects according to the priorities of the objectives they contributed toward and the other factors listed below.
10. Project Team presented initial recommendations based on results of screening, selection, and prioritization of projects during Stakeholder Meeting in August 2013.
11. Provided project proponents and other stakeholders opportunities for review, clarification, discussion and refinement of proposed projects.

12. Project Team reviewed comments, clarifications, and refinements of proposed projects and adjusted recommendations for project inclusion and prioritization based on discussions with the Stakeholder Group. Presented recommendations and discussed during Stakeholder Meeting in November 2013.
13. Issued a special *Call for Projects* on December 17, 2013 for potential project proponents located within the areas recently included due to the expanded Mojave IRWM Planning Region. The Stakeholders agreed to conduct this special call for projects based on a request from a stakeholder from the areas recently included who had not heard about the initial two *Call for Projects* in time to respond.
14. Provided project proponents and other stakeholders opportunities for review, clarification, discussion, and refinement of newly added projects.
15. Project Team reviewed comments, clarifications, and refinements of proposed projects and adjusted recommendations for project inclusion and prioritization as needed. Presented recommendations and discussed during Stakeholder Meeting in February 2014. The recommended prioritized project list was approved by broad agreement among the Project Team and the Stakeholder Group.

6.1.1 Development of the Project List

The project solicitation process began with a description of how potential project submittals would be evaluated and considered for inclusion into the IRWM Plan using the following set of forms and instructions:

- *Call for Projects Short Form,*
- *Call for Projects Long Form,*
- *Project Long Form Instructions,* and
- *Project Submittal Instructions Form* (see Appendix D.1).

The Consultant Team created the forms, which were to be populated with project details by project proponents. The Short Form is a two page form that captures the minimum amount of information required to submit a project. The Long Form is a more comprehensive form that can be used for well-developed project proposals. The Project Team determined that all potential projects, programs, or actions must be submitted using one of the two *Call for Projects Forms* in order to provide a way in which the characteristics of projects could be compared side by side. The Consultant Team discussed and made available for comment a draft list of project evaluation criteria that would be included in the *Project Information Form* (included in both the Short and Long Project Forms). These draft criteria were chosen to facilitate project comparison, review, selection, and prioritization.

The Project Team described from the beginning and throughout the effort that the project review and selection process would not be prescriptive. That is, projects would not be included or prioritized on the basis of a formulaic evaluation. The Consultant Team described how it would receive, review, and evaluate all submitted *Project Information Forms,* and then propose whether each project should be included in the IRWM Plan and if recommended for inclusion, would also recommend a priority level for each project. The recommendations from the Consultant Team were then reviewed and discussed with the Project Team and adjustments were made to the recommendations. These recommendations would then serve as a starting place for discussion among the Stakeholder Group, and the final decision about projects would be reached through broad agreement.

The Project Team distributed *Project Information Forms* (Appendix D.1) to all interested stakeholders and issued the initial *Call for Projects* for July 1, 2013. The Project Information Forms were discussed at the June 6, 2013 stakeholder meeting. Also, the *Call for Projects* and *Project Information Form* were posted to the IRWM Plan website and emailed to the stakeholder distribution list. Stakeholders were given one month to identify projects for potential Plan inclusion and submit completed forms to the Mojave Project Team. The project forms were required to be submitted via mail, email, or in person to Mojave Water Agency (MWA) Headquarters; after submission, the information was compiled in a database. No efforts were made to verify the information submitted by each project proponent. When the information submitted was not clear to the Consultant Team, additional information was requested at the next stakeholder meeting, the requested information was published on the IRWM Plan website, or proponents were contacted directly for clarification. All of the information submitted by project proponents was made available for stakeholder review and comment on the Mojave IRWM website.

Stakeholders were invited to submit any projects, programs, and action ideas they believed could contribute to fulfilling the Plan objectives irrespective of the project's current funding, level of development, or readiness to proceed. The Project Team wanted to identify projects and programs that were implementable and "ready to proceed" as well as other ideas that had not yet been developed into mature project proposals. This approach was intended to encourage stakeholders to be creative, share information, and identify a wide range of opportunities that could help contribute to fulfillment of the IRWM Plan objectives.

The Project Team received 115 project submittals during the first *Call for Projects*. The initial screening and review of the projects revealed that there were possible opportunities for additional integration and regionalization of project efforts. For example, several organizations submitted project ideas for educational and public outreach type programs, which could potentially be combined into a single regional effort or a few collaborative efforts.

For these reasons, a second *Call for Projects* was issued on August 13, 2013 to provide stakeholders with an opportunity to discuss, refine, and further integrate project ideas. A project integration workshop was held September 5, 2013 at MWA headquarters for interested stakeholders to ask questions about the process, discuss the projects submitted to date, the types of projects submitted and the potential to expand and/or integrate similar projects to maximize opportunities for the Region. Several projects were integrated and new projects were submitted during the second *Call for Projects*, yielding a final total of 128 submittals with 63 of these individual projects being combined into 15 integrated projects, leaving a total of 72 viable projects to be included in the IRWM Plan. Eight (8) project submittals were not included in the IRWM Plan for various reasons. Information about the project submittals that were screened out is shown in Appendix D.2b.

A special *Call for Projects* was issued on December 17, 2013 for potential project proponents located within the areas recently included due to the expanded Mojave IRWM Planning Region. The Stakeholders agreed to conduct this special call for projects based on a request from a stakeholder from one of the areas recently included who had not heard about the initial two *Call for Projects* in time to respond. One (1) new project was submitted during the special call for projects. The project submittal was reviewed and ranked with the other projects that had been submitted previously, and was approved by the stakeholders at the February 6, 2014 meeting.

Therefore, the Mojave Region has included 73 projects in this version of the Mojave IRWM Plan, including the 15 integrated projects that each combined multiple project ideas into one project.

6.1.2 Future Updates to the Project List

As described in Section 8: Implementation Framework , the Regional Water Management Group (RWMG) can hold a *Call for Projects* and update the IRWM Plan Project list at any time. Revision of the IRWM Plan Project list does not require that the entire IRWM Plan be revised and re-adopted; rather the updated project list can be amended to the existing plan following the decision making process described in Section 8.

The Coordinating Committee (CC) and Implementation Support Team (discussed in Section 8) will provide periodic opportunities for regional stakeholders to propose changes to the list of projects included in the Plan; the list is intended to be updated at least every other year. New projects concepts, or revisions to projects already included in the Plan, may be submitted at a future date to be considered for inclusion in the Mojave IRWM Plan according to criteria to be provided by the Implementation Support Team at the time of the new *Call for Projects*. Projects also may be removed at the request of that project's proponent or once the project has been completed. For these changes, the CC and the Implementation Support Team may choose to use the same project submittal, review, and selection process used during Plan development, or it may modify the process before inviting potential revisions. Any future updates to the project list will be included in Appendix D.3 to this Plan and also will be posted to the IRWM website: www.mywaterplan.com.

6.2 Project Screening Criteria, Prioritization Scheme, and Project Review and Prioritization

As introduced above, the process to decide which projects to include in the Plan and how to prioritize them relied on information submitted by the proponents that addressed a list of project criteria; expert judgment about the relevancy of the submitted projects; and stakeholder discussions.

6.2.1 Screening Criteria

Submitted projects were initially screened to determine if the proposed project was appropriate for potential inclusion in the Mojave IRWM Plan. In order to be recommended for inclusion in the Mojave IRWM Plan, the proposed project needed to:

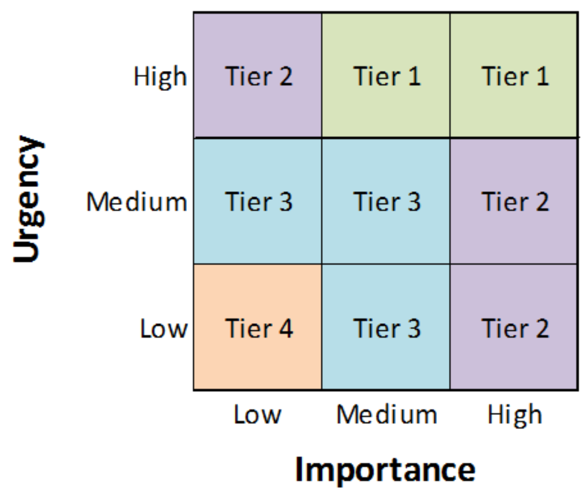
1. Contribute toward meeting one or more Plan objectives.
2. Appear to be technically feasible.
3. Appear to be economically feasible.
4. Not cause significant unmitigated negative impacts.

5. Have a committed project proponent that has the capacity to implement the project.

6.2.2 Prioritization Scheme

The Plan objectives and projects were ranked according to their importance and urgency and then grouped into up to four tiers of priority as shown in Figure 6-1. The "importance" assigned to each objective (or project) reflects the relative significance or consequence of satisfying this objective (or project) as compared to other objectives (or projects) within the Mojave Region. The "urgency" assigned to each objective (or project) reflects the relative degree to which this objective (or project) warrants speedy attention or action as compared to other objectives (or projects).

Figure 6-1
Original Prioritization Scheme



6.2.3 Project Review and Prioritization

The projects that met the screening criteria were reviewed according to the following factors based on information provided by the project proponents:

1. How the project contributes to the Mojave IRWM Plan objectives (projects with larger contributions and that address multiple objectives are preferred).

2. How the project is related to resource management strategies (projects that diversify the water management portfolio are preferred).

3. Technical feasibility of the project (projects with more definitive demonstration of technical feasibility are preferred).

4. Specific benefits to critical Disadvantaged Community (DAC) water issues (projects that help address critical water supply and water quality needs of DACs are encouraged).

5. Specific benefits to critical water issues for Native American tribal communities (projects that help address critical water supply and water quality needs of Native American tribal communities are encouraged).

6. Environmental Justice Considerations (projects that can reduce inequitable distribution of environmental burdens (i.e., pollution, industrial facilities) and access to environmental goods (i.e., clean water and air, parks, recreation, etc.) are preferred).

7. Project Costs and Financing (projects with well-defined costs and identified funding sources are preferred).

8. Economic Feasibility (projects shown to be either cost-effective or to have a positive benefit-cost ratio are preferred).

9. Project Status (readiness to proceed may influence the priority given).

10. Strategic considerations for IRWM Plan implementation (projects with clear analyses related to the proposed implementation approach and Plan objectives are preferred).

11. Contribution of the project in adapting to the effects of climate change (projects that contribute to adaptations that can lessen the negative impacts of climate change are encouraged).

12. Contribution of the project in reducing greenhouse gas (GHG) emissions as compared to project alternatives (projects that help reduce the GHG emissions in the Region are preferred).

Projects that met the screening criteria and were reviewed were assigned a rating for importance and urgency and then placed into one of four tiers of projects as shown in Figure 6-1. Projects were initially prioritized based on the priority ranking of the primary objective(s) most likely impacted by the project. This perspective helped identify projects, programs, and actions that water managers may choose to pursue first to address the Region's water-related challenges and opportunities.

Earlier in the planning process, the IRWM Plan objectives had been prioritized based on their relative importance and urgency. Based on extensive discussions during Stakeholder meetings, each Plan objective received a ranking of either high or medium for importance, and a ranking of either high, medium, or low for urgency (as described in Section 4). During the project evaluation and prioritization phase, the Project Team assessed which objective(s) each project would likely contribute to the most and recommended an importance and urgency priority to the project that matched the identified importance and urgency of the primary objective(s) it addressed. Where projects are expected to contribute to multiple objectives, the Consultant Team used judgment in recommending a priority to the project.

Project submittals that were determined to not satisfy the screening criteria were not included for various reasons, including not having a viable project sponsor, the applicant withdrew the submittal or the applicant did not respond to a request for additional information about the project submittal, or there were concerns about potential unmitigated negative impacts. A total of eight (8) project submittals that were received were not included in the Plan, as shown in Appendix D.2b.

The preliminary project priorities assigned based on the primary objectives for the project did not produce sufficient distribution of projects across the priority rankings. Subsequent adjustments to project priorities were considered based on the review factors as listed earlier in this Section. However, many of the proposed projects were in the conceptual stage of development and therefore many of the project submittals did not provide sufficient detail to make priority recommendations based on the review factors listed above. In order to further refine the project prioritization, the Project Team reviewed each project submittal and assigned a "Get Real Index" (GRI) on a scale of 1 to 3 according to the information in the project submittal and what local experts knew about the proposed project.

GRI = 1 - Well advanced, ready to proceed.

GRI = 2 - Very likely – there is momentum, funding and a committed sponsor.

GRI = 3 - Needs work – not yet ready to move into implementation, no demonstrated momentum.

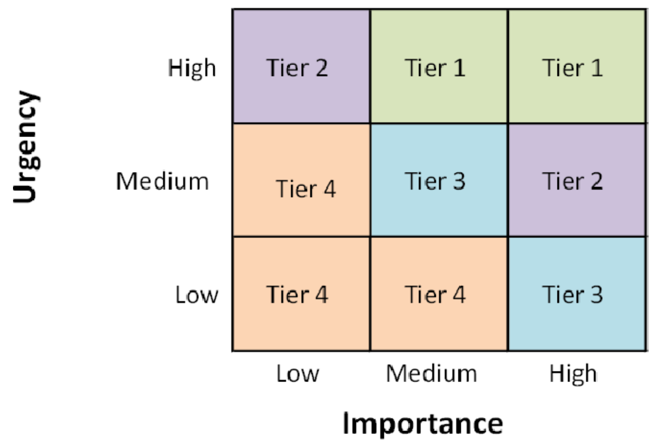
Projects that were assigned a GRI = 3 were then reclassified as follows:

- Projects that were preliminarily ranked in High Importance/<u>High</u> Urgency or High Importance/<u>Medium</u> Urgency that were assigned a GRI = 3 (or not really ready to advance) were moved down in ranking to High Importance/Low Urgency.
- Projects that were initially ranked in Medium Importance/<u>Medium</u> Urgency that were assigned a GRI = 3 (or not really ready to advance) were moved down in ranking to Medium Importance/<u>Low</u> Urgency.

During the project screening and prioritization process results, the original prioritization scheme shown in Figure 6-1 was modified to provide more meaningful distinctions between tiers. The revised prioritization scheme is shown in Figure 6-2. This project screening and prioritization process led to an approved list of projects which was broadly agreed upon among the stakeholders as shown in Appendix D.2.

Inclusion of a project on this list represents that the Stakeholder Group broadly agrees that this proposed project is important for the Region and that the proposed project could potentially contribute toward one or more of the Plan objectives. Inclusion on this list does not guarantee that the project will be implemented, and does not authorize specific project implementation actions. The specific authorization and decisions related to individual project implementation will be handled by the project proponent(s) and must follow all required processes and approvals.

Figure 6-2
Revised Prioritization Scheme



The project prioritization process described above was a useful method to help the Team understand and compare the attributes of the broad range of projects under consideration. Project review, screening, and prioritization did not consider whether a potential project may be eligible to receive Proposition 84 or 1E grant funds.

6.3 Summary of Projects Received

The projects that were submitted by stakeholders in response to the three *Call for Projects* demonstrate the breadth of activities needed to meet the Mojave Region's integrated water management objectives. These 73 projects were submitted by 23 different organizations. They address, to some extent, all 14 of the IRWM Plan objectives. They range from large-scale drinking water supply projects to habitat restoration programs, flood management projects, and conservation and education projects such as "Cash for Grass." They suggest an even broader range of projects and programs than meeting the current IRWM Plan objectives, presenting multiple opportunities for continued resource and project integration.

The included projects are summarized in Table 6-1 below according to project categories and types. The table illustrates the broad variety of types of projects, programs, and actions submitted. Feasibility studies are project ideas where the proponent is not sure whether it will pencil out to proceed with full implementation. Implementable programs and projects are programs (such as a water conservation program) or physical facilities or capital projects that have been developed sufficiently to proceed with implementation in the near future. Planning projects are studies or evaluations of various actions, and do not include constructed or programmatic implementation.

Table 6-1
Summary of Project Submittals by Project Category and Project Type

Project Category	Project Types			
	Conceptual/ Feasibility Study	Design, Design/Construction, Design/Implementation	Implementable Project/Program	Plan/Design/ Construct
Baja/Ag Issues	2	2	1	0
Conservation & Education	2	0	5	0
Environmental & Recreation	1	0	2	0
Flood Management	7	1	2	1
Individual or Small Systems Improvements	8	0	3	2
Other	4	0	2	0
Wastewater/Recycled Water	7	1	6	0
Water Supply/Recharge	7	3	3	1
TOTAL	**38**	**7**	**24**	**4**

6.4 Prioritized Project List

Using the process described in Section 6.2.3, the projects were prioritized according to urgency and importance. The project list sorted by importance and urgency was presented and discussed with the Project Team and in facilitated stakeholder meetings on December 16, 2013 and February 6, 2014. The projects included are summarized in Table 6-2 by importance and urgency. Appendix D.2c includes the list of projects sorted by importance and urgency.

Table 6-2
Summary of Projects by Importance and Urgency

Importance, Urgency	TOTAL
High Importance, High Urgency	14
High Importance, Medium Urgency	16
High Importance, Low Urgency	42
Medium Importance, High Urgency	0
Medium Importance, Medium Urgency	0
Medium Importance, Low Urgency	1
TOTAL	**73**

All projects included in the Mojave IRWM Plan are important to meet the objectives of the Mojave Region. The CC will encourage and support actions that advance all of the projects, regardless of their priority. However, the CC expects to focus its attention on supporting the implementation of the 14 projects with high importance and high urgency. The projects prioritized in Tier 1 during the 2013/2014 project prioritization process are listed in Table 6-3.

6.4.1 Project Lists Sorted in Other Ways

Because of the number of projects submitted and the variety of factors considered for prioritization, a number of lists were prepared to present the projects in multiple ways (Appendix D.2). Stakeholders can examine them to find new perspectives on the projects and collaboration opportunities. The lists were sorted by these characteristics:

- Project Summary – Appendix D.2a
- Project Submittals Screened Out – Appendix D.2b
- Ranked List of Projects by Objective – Appendix D.2c
- Summary Table of Projects by Priority – Appendix D.2d
- Table of Projects by Number and Title – Appendix D.2e

Table 6-3
High-Importance/High-Urgency Projects

Project No.	Original Project No.	Project Title	Lead Agency/ Organization	Primary Objectives[a]	Importance	Urgency	Tier for Ranking	Get Real Rank
18R	18	Commercial/Industrial/ Multi-Family Cash for Grass Program	Alliance for Water Awareness and Conservation	2,12	H	H	1	1
60R	60	Reorganization between two adjacent small water agencies (BDVWA and CSA 70 Zone W-1 [Landers])	Bighorn-Desert View Water Agency (BDVWA)	7,5	H	H	1	1
92R	92	Wastewater Reclamation Project	Hi-Desert Water District	7,10	H	H	1	1
93	93	Apple Valley & Hesperia Subregional Water Reclamation Facilities	Victor Valley Wastewater Reclamation Authority	4,14	H	H	1	1
1011	**	Antelope Valley Wash / Ranchero Basin Recharge Ponds	City of Hesperia, MWA	3	H	H	1	1
19	19	Conceptual Planning for Hinkley's Community Drinking Water System	MWA/Lahontan Regional Water Quality Control Board (RWQCB) /Department of Public Health (DPH) grant	7	H	H	1	2
32	32	Helendale Community Services District (CSD) Tertiary Treatment Upgrade	Helendale CSD	10,1,3	H	H	1	2
57	57	Recycled Water Distribution System	City of Hesperia	1, 14	H	H	1	2
95	95	Adelanto Pearmain Relief Sewer Line	City of Adelanto	7,10	H	H	1	2
106	106	Sheep Creek Recharge Basin and Two Wells	Phelan Piñon Hills CSD	7	H	H	1	2

Table 6-3
High-Importance/High-Urgency Projects

Project No.	Original Project No.	Project Title	Lead Agency/ Organization	Primary Objectives[(a)]	Importance	Urgency	Tier for Ranking	Get Real Rank
116	116	Replacement Water Supply for Perchlorate/Nitrate Affected Groundwater - Barstow Area	MWA/Lahontan RWQCB/DPH grant	7,5	H	H	1	2
1003	**	Assistance Program for Small Drinking Water Systems	MWA, San Bernardino County Environmental Health Services	7,11	H	H	1	2
1004	**	Baja Sustainability Initiative #1 (Agricultural Water Conservation and Base Annual Production Right (BAP) Acquisition Program)	MWA	1,3,7	H	H	1	2
1012	**	Cedar Street / Bandicoot Detention Basin	City of Hesperia, MWA	3,5,9	H	H	1	2

Notes:

(a) Refer to Table 4-2 in Section 4, for a summary of the objectives. The following is a brief list of the objectives by title: Objective 1: *Balance future water demands*; Objective 2: *Improving regional water use efficiency*; Objective 3: *Maintain stability in overdrafted groundwater basins*; Objective 4: *Reduce reliance on Delta*; Objective 5: *Optimize Region's water-related assets*; Objective 6: *Prevent land subsidence*; Objective 7: *Support to DACs*; Objective 8: *Improve environmental stewardship*; Objective 9: *Improve floodplain management*; Objective 10: *Preserve water quality*; Objective 11: *Obtain financial assistance*; Objective 12: *Improve public awareness*; Objective 13: *Establish reliable funding sources*; Objective 14: *Increase use of recycled water*.

Section 7: Impacts and Benefits

7.1 Plan Level Impacts and Benefits

This section contains a discussion of potential impacts and benefits of implementation of the Mojave *Integrated Region Water Management Plan* (IRWM Plan) update, including those within and between regions, and those potentially affecting disadvantaged and Native American Tribal communities. Consistent with the California Department of Water Resources (DWR) requirements as described in the *Integrated Regional Water Management Guidelines for Proposition 84 and 1E* (2012 Guidelines) (DWR 2012a), the discussion is not exhaustive but rather provides a screening level analysis to help any reader of the Mojave IRWM Plan generally understand the impacts and benefits of implementing the IRWM Plan. This overview of impacts and benefits will serve as a benchmark to help the IRWM planners assess whether the anticipated benefits of the IRWM Plan have been realized and/or unanticipated impacts have occurred.

Impacts and benefits will be analyzed in more detail prior to implementation of specific projects. As appropriate, as project concepts are further developed and advanced for approval, detailed environmental impact assessments will be conducted in accordance with the California Environmental Quality Act (CEQA) and, if applicable, the National Environmental Policy Act (NEPA). The status of CEQA/NEPA review varies by project and was collected and recorded during the project review process (see Section 6.2.3 in Section 6 for further information on the project review process). Project information is available online at the Mojave IRWM Plan website.

For the purposes of characterizing potential impacts and benefits of IRWM Plan implementation, a list of potential project types was developed. The list reflects DWR's latest set of primary management objectives for the *California Water Plan*[6] *(CWP) Update 2013* (DWR 2013a) and the *CWP Update 2009* (DWR 2009), the Mojave IRWM Plan set of Resource Management Strategies presented in Section 5, and the current list of projects submitted for consideration as part of this IRWM Plan update process. Table 7-1 presents the list of project types evaluated in this section and shows how this project list relates to DWR's most recent set of broad management priorities as laid out in the draft CWP Update 2013.

This section will be reviewed and updated during normal plan management activities as part of the regular Plan re-assessment and readoption process, which occurs on a five-year cycle. See Section 8.4 Plan Updates and Changes, for a description of the Plan update process.

[6] In accordance with the 2012 Guidelines, report preparers have used the 2013 California Water Plan Update to guide development of both the Resource Management Strategies and the list of project types for the impacts and benefits assessment in this IRWM Plan update. While the 2012 Guidelines direct IRWM preparers to use the adopted 2009 CWP Update, they acknowledge that DWR is in the process of preparing the 2013 CWP Update and recommend but do not mandate use of the 2013 CWP draft information. The 2013 CWP Update draft plan elements have been used in this process.

Table 7-1
Project Categories and Types Evaluated in This Section

CWP 2013 Update Management Objectives	Project Categories and Types
Reduce Water Demand	**Water Conservation and Demand Management** • Urban Water Use Efficiency
Increase Water Supply Improve Operational Efficiency	**Water Supply Enhancement** • Infrastructure Reliability • Surface Water Supply • Groundwater Management • Water Reuse • Stormwater Capture • Desalination
Improve Water Quality	**Water Quality Protection and Improvement** • Water, Wastewater Treatment Facilities • Pollution Prevention and Runoff Management • Aquifer Remediation • Salt and Salinity Management
Improve Flood Management	**Flood Management** • Flood Management Facilities, Floodplain Protection
Practice Resource Stewardship	**Watershed Management** • Watershed Erosion Control, Land Stewardship **Habitat Protection and Restoration** • Habitat Protection and Improvement • Ecosystem Restoration and Wetland Creation
People and Water	**Public Access, Recreation and Use** **Planning, Modeling and Monitoring Tools** **Education, Outreach and Incentives**

7.2 Benefits of Plan Implementation

7.2.1 Plan Benefits

The updated Mojave IRWM Plan documents a shared vision for integrated water management and outlines a cooperative approach to achieve that vision. It will provide regional water resources benefits largely by fostering improved coordination, collaboration, and communication among entities in the Region. Such collaboration is supported both by the Plan development process and the resulting newly-formed Plan framework.

Development of the Plan has helped strengthen the working relationships of water management professionals and interested stakeholders throughout the Region, along with facilitating partnerships between local, state, and federal entities. Several IRWM Plan projects have been integrated; for example, the *Individual or Small System Improvements Integrated Project* includes 13 multiple agency efforts to implement projects within the Region. During the planning process, management agencies identified areas where cooperative efforts could lead to greater efficiencies and more effective service. Several agencies have described their ongoing monitoring and data collection projects. Shared awareness of these monitoring locations and data collection efforts will help other agencies avoid duplication of efforts and help expand understanding of information needs.

For example, using the collaborative results from the integration process, conservation and education resources have been pooled into three integrated regional projects rather than scattered throughout the Region.

The IRWM Plan process fosters coordination, collaboration and communication among entities in the Region and has resulted in greater efficiencies (e.g., efforts are not duplicated, information is shared), will enhance public services, and will facilitate public support for watershed projects. This collaborative approach to regional planning helps ensure that multiple aspects of watershed planning are considered together rather than allowing one particular geographic area or project type to dominate. It helps share benefits and impacts instead of allowing one group or geographic area to reap benefits while another withstands impacts. Also, regional planning helps ensure that projects designed to achieve one particular objective (e.g., water supply) will be supportive of (or at least compatible with) other objectives (e.g., flood management, water quality, or habitat preservation).

The IRWM Plan will allow otherwise separate agencies to speak as a region and to improve policies, regulations and laws related to water demand, water supply, water quality, operational efficiency, and resource stewardship.

The 73 projects identified by this Plan meet, at some level, all 14 Plan objectives described in Section 4. While periodic updates and addition of projects will be needed, over the 25-year horizon of the Plan, implementation of the planned projects will produce multiple benefits. An overview is provided below.

- **Reduce Water Demand and Improve Water Supply** – Projects related to demand management and water supply include stormwater capture (consistent with rules in the Mojave Basin Area Adjudication), groundwater recharge, and development of recycled water supplies. Stormwater capture and subsequent groundwater recharge provides for increased use of local supplies rather than imported water in groundwater basins where permitted. These projects assist in maintaining the long-term sustainability of the groundwater supply. Depending on project specifics, these projects can also serve to decrease peak flood flows and provide opportunities for habitat improvement and restoration. Recycled water supplies, likewise, decrease demand for imported water. Recycled water can offset potable water demand, recharge groundwater, and be used to create and restore wetland areas. Projects aimed at more efficient water use will result in lower unit demands, less energy use for treatment and delivery of water, and, potentially, a reduced need for expansion of water supply infrastructure.

  In the Mojave Region, imported water (SWP) is used efficiently and effectively to augment local groundwater. As detailed in Mojave Water Agency's 2010 Urban Water Management Plan (MWA 2011), groundwater banking programs involve storing available SWP surface water supplies during wet years in groundwater basins in, for example, the Mojave Region. Water is 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 can 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. This activity also allows MWA to take advantage of wet year supplies because of the abundant groundwater storage available in MWA's groundwater basins. As of January 1, 2014, this concept had helped MWA to store over 132,000 acre-feet (af) of excess SWP, stored by MWA over the past years and stored in various groundwater basins for use when SWP is limited or there are groundwater shortages.

- **Improve Operational Efficiency –** Several projects are proposed to improve water infrastructure, including projects for intertie improvements, consolidation of small water companies, and projects to replace outdated and poorly functioning infrastructure. These projects have benefits related to reduced maintenance costs and decreased system water loss. For example, in the case of the Sewer Lift Station Nos. 1 and 3 Improvements (Project #130), a primary water quality benefit would be the reduced risk of damage to the sewer and potential for a sewage spill. As another example, reorganization between two adjacent small water agencies (Project #60R), would result in economies of scale, as well as increased transparency and local representation. The project will also help reduce greenhouse gas (GHG) emissions by reducing necessary transportation of materials and/or equipment between Victorville and Landers, as well as reducing travel of customers. In addition, projects which improve operational efficiency can reduce GHG emissions by reducing energy use and system losses, thereby providing climate change mitigation benefits.

- **Improve and Protect Water Quality –** Mojave IRWM Plan projects include actions to reduce contaminants in water sources by addressing such causes as sanitary sewer overflows by completing sewer lift station improvements and by constructing recycled water treatment plants. The primary benefit from these water quality projects is the reduced potential for human and ecological exposure to potentially harmful substances. These projects will also improve the effectiveness of both water and wastewater treatment processes and help meet established regulatory requirements. Besides improving drinking water quality, these projects will benefit other types of water users, such as agricultural users and water-dependent wildlife habitat.

- **Improve Flood and Stormwater Management** – A large number of Plan projects focus on reducing flood damage and improving stormwater management. These include projects intended to capture stormwater (in basins where this is permitted) and recharge the groundwater basin, in order to help minimize storm water damage and increase groundwater supplies. Implementation will help avoid damage to property from floods, reduce flood-related impacts to agricultural activities, and address some pollutant sources by improving stormwater management. The Plan also documents opportunities for agencies in the Region to coordinate with neighboring regions and state and federal agencies to improve flood management planning and response actions.

- **Improve Resource Stewardship** – The Plan projects include invasive species removal programs and overall habitat improvement projects. Proposed projects will attempt to prevent infestation of non-native plant species and increase the number of new recreational or educational projects that are connected to these stewardship programs. Additional projects will improve overall habitat quality by restoring and rehabilitating native vegetation in riparian corridors. Projects related to education focus on improving understanding of citizens' relationship with the watershed. These projects encourage citizens to be good resource stewards and to support the integrated watershed management actions necessary to provide public safety and support a stable economy. Benefits of the Plan include broader-scale, regionally coordinated efforts to approach these complex challenges.

7.2.2 Plan Beneficiaries

Accomplishment of the IRWM objectives and projects will benefit the Region as a whole, not just areas in the vicinity of individual projects. The potential beneficiaries of the IRWM Plan are residents of the Region, water agencies, local, state, and federal agencies, businesses, wildlife and associated habitats, neighboring regions, disadvantaged communities (DACs),[7] Native American Tribes, and others within the jurisdictions served by Plan projects. These beneficiaries are represented by members of the Regional Water Management Group (RWMG) and the larger IRWM Plan Stakeholder Group.

Forty-nine projects were identified by project proponents as benefiting a DAC, including six of these projects that are integrated projects and combined an additional thirty-eight small DAC benefiting projects. These projects range from water supply and wastewater infrastructure projects to rehabilitation projects. DACs are expected to play a role in projects by sponsoring or cosponsoring some of them throughout Plan implementation.

From early in the planning process, Native American tribes were invited to participate actively in Plan development, including development of objectives. At the beginning of the IRWM Plan Update process, no known tribes were located inside the Mojave Region boundaries but two Tribes near the Region's boundaries were invited to participate. When the Mojave Region's boundary expanded, the Twenty-Nine Palms Band of Mission Indians was determined to be within the Region's boundaries and a personal invitation was sent to the Tribe to encourage their attendance and participation. During the Plan development is completed, the stakeholders, including this Tribe, are encouraged to continue their participation and to submit additional projects for inclusion in the Plan that can further benefit the Tribe.

[7] As described in Section 2, a DAC is defined as having an annual median household income that is less than 80 percent of the statewide annual median household income.

Table 7-2 summarizes the benefits and impacts of the IRWM Plan implementation.

Table 7-2 Potential Benefits and Impacts from Plan Implementation

	Within IRWM Region		Interregional	
	Potential Benefits	**Potential Impacts**	**Potential Benefits**	**Potential Impacts**
Projects to Improve Water Supply and Manage Demand	• Enhanced supply reliability. • Improved groundwater management. • Reduced water demands. • Less energy usage for treatment and delivery of water. • Avoided need to expand water supply infrastructure. • Benefits extend to broad Region, including disadvantaged communities (DACs).	• Development of water supply projects could result in ground disturbance and have temporary impacts to aesthetics, air quality, biological resources, cultural resources, noise, soils, and transportation systems. • No environmental justice or negative impacts to DACs are anticipated.	• Improved water supply reliability and reduced water demands within the Region during critical dry years could improve regional and statewide water supply reliability. • Reduced demand for potable water would reduce demands for Sacramento-San Joaquin Delta water during critical dry years and this would have benefits outside of the Mojave Region.	• Increased water supply demand would tax the demands on the Sacramento-San Joaquin Delta water during dry years and could potentially increase environmental effects. This is avoidable if reliance of imported water is limited during critical dry years.
Projects to Improve Operational Efficiency	• Improve economic stability and environmental conditions that would otherwise deteriorate with water scarcity.	• Cumulative effects of short- and long-term transfers could have impacts on habitat, water quality, and wildlife caused by substituting groundwater for surface water; changing the location, timing, and quantity of surface diversions.	• Transfers, exchanges, banking and recharge can be accomplished utilizing existing infrastructure in ways that reduce pumping of both surface and groundwater and thus energy demands.	• Possible increase in salt loading to certain groundwater basins from imported supplies in limited areas of the Region where salt concentrations in groundwater fall below imported supply concentrations, such as the Upper Mojave Basin, specifically the Alto Floodplain, Alto Narrows Floodplain, and Alto Mid Regional subregions.

Table 7-2 Potential Benefits and Impacts from Plan Implementation

	Within IRWM Region		Interregional	
	Potential Benefits	**Potential Impacts**	**Potential Benefits**	**Potential Impacts**
Projects to Improve and Protect Water Quality	• Reduced human and ecological exposure to pollutants. • Improved drinking water supply and wastewater treatment regulatory compliance. • Preservation of aquatic habitat. • Better agricultural yields. • Improvement of water-based recreation. • Benefits extend to broad Region, including DACs.	• Projects to improve water quality that involve construction could result in temporary impacts to aesthetics, air quality, biological resources, cultural resources, noise, soils, and transportation systems. • No environmental justice or DAC impacts are anticipated.	• Improved water quality in the Mojave Region would also benefit the downstream users of the Mojave River and associated groundwater basins.	• No interregional impacts are anticipated.
Flood and Stormwater Management Projects	• Reduced erosion. • Reduced flood damage. • Reduced agricultural loss. • Reduced pollutants from stormwater. • Benefits extend to broad Region, including DACs.	• Flood risk reduction projects could result in ground disturbance and have temporary impacts to aesthetics, air quality, biological resources, cultural resources, noise, soils, and transportation systems. • Depending on the location of the flood-related project, there could be inequitable distribution of impacts affecting disadvantaged or minority communities.	• Due to the Mojave Basin Adjudication restrictions on diverting downstream stormwater flow, no interregional benefits are anticipated.	• Due to the Mojave Basin Adjudication restrictions on diverting downstream stormwater flow, no interregional impacts are anticipated.

Table 7-2 Potential Benefits and Impacts from Plan Implementation

	Within IRWM Region		Interregional	
	Potential Benefits	**Potential Impacts**	**Potential Benefits**	**Potential Impacts**
Projects to Improve Resource Stewardship	• Improved habitat quality. • Reduced risk to native species from invasives. • Improved water supply, reduced water loss by native plant uptake. • Improved water quality. • Benefits extend to broad Region, including DACs. • Water conservation due to invasive species removal.	• Projects to remove invasive species could have temporary negative impacts to aesthetics, biological resources, cultural resources, and soils. • No environmental justice or negative impacts to DACs are anticipated.	• Prevention and removal of invasive species in the Region would reduce the transport and deposition of invasive species to the downstream users of the Mojave River.	• No interregional impacts are anticipated.
Conservation and Educational Projects	• Increased public involvement and awareness of resource stewardship and watershed protection. • Increased public support of Plan projects. • Benefits extend to broad Region, including DACs.	• None	• Improved public awareness about watershed protection and public support of IRWM projects could benefit public support of neighboring IRWM planning efforts.	• No interregional impacts are anticipated.
Actions to Adapt to Climate Change	Actions to respond to climate change will occur in conjunction with the projects described above, as appropriate.			
Actions to Reduce Greenhouse Gas Emissions	Actions to help reduce greenhouse gas emissions will occur in conjunction with the projects described above, as appropriate.			

7.2.3 Interregional Benefits

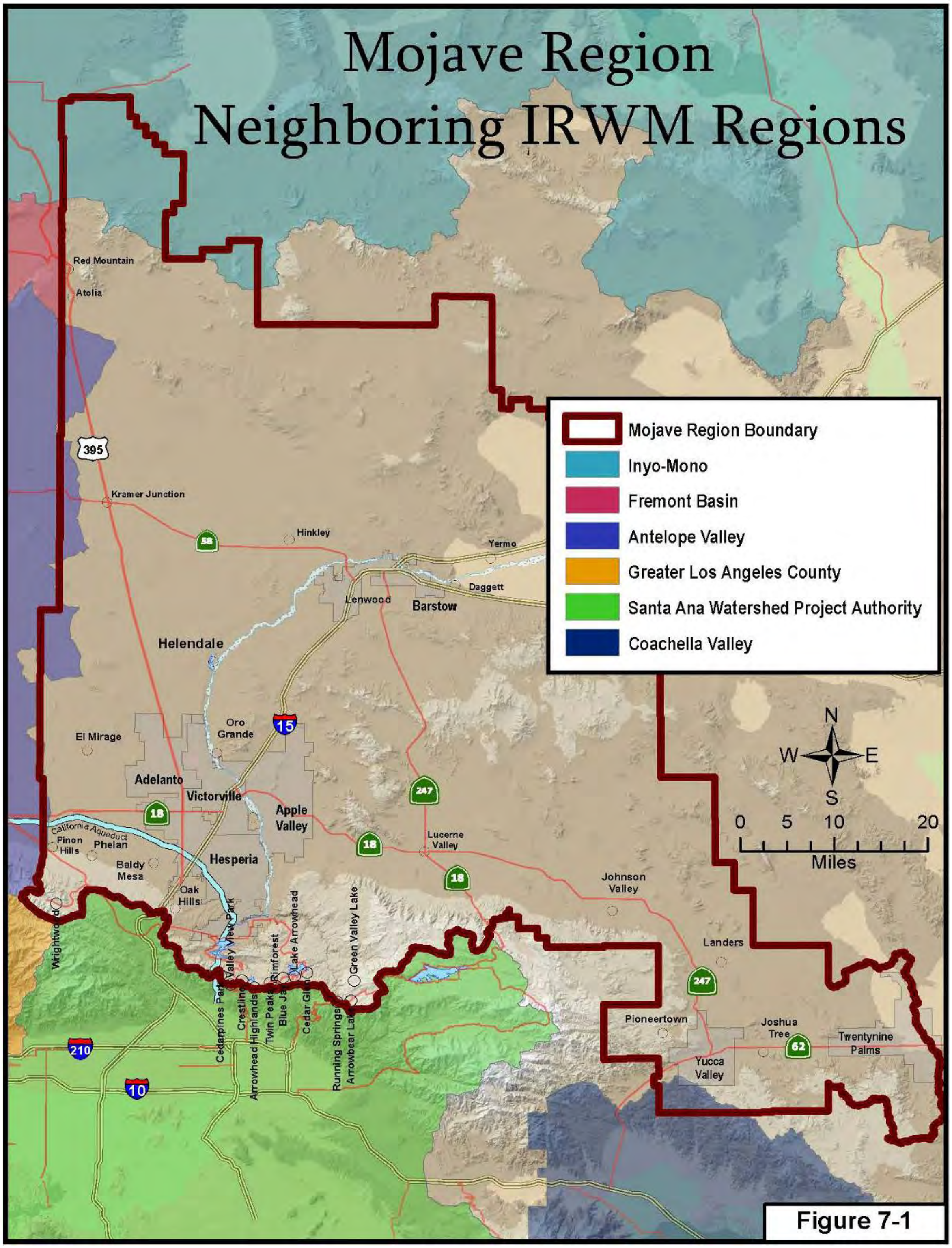
Coordination with and recognition of potential nexus with adjacent IRWM Plans prepared by other Regions, if appropriate, is important to the Mojave IRWM Plan, and the most direct way to maximize interregional benefits. The Mojave Region is adjacent to six existing IRWM regions as shown on Figure 7-1:

1. The Inyo-Mono IRWM Region extends to the far northwest corner of the Mojave Region (see Figure 7-1) and the two regions share a portion of the Indian Wells-Searles groundwater basin within northern San Bernardino County. As a result of this overlap, the two IRWM Plan efforts have communicated during development and refinement of the respective IRWM Plans.
2. The Fremont Basin IRWM Region occupies an enclosed watershed in the southern half of the Lahontan Hydrologic Region. It fills an existing void area and is surrounded by the Inyo-Mono to the North, Kern to the west, Antelope Valley to the south, and Mojave to the east. Small parts of the watershed are included in the boundaries of neighboring IRWM regions, but there are no significant overlaps. The only entity with water management authority thus far that has agreed to form the RWMG is the City of California City. At the time this update to the Mojave IRWM Plan was completed in 2014, the California City Council was working on a Memorandum of Understanding (MOU) with the Mojave Public Utilities District and the Antelope Valley-East Kern Water Agency to possibly form an Integrated Regional Water Management Group.
3. The Greater Los Angeles County IRWM Region is adjacent to the southwest corner tip Mojave Region for approximately five miles. Because this is such a relatively small portion of the Region's boundary and was created only after the Mojave expanded boundary areas were included for this update of the IRWM Plan, no contact has been made with the Los Angeles Region at this time.
4. The Santa Ana Watershed Project Authority IRWM Region is immediately south of the Mojave Region, but is located in the South Coast Hydrologic Region due to the separation caused by the crest of the San Bernardino Mountains. There is no hydrologic connection or watershed function in common between the planning areas.
5. The Coachella Valley IRWM Region shares a common boundary with the southeastern corner of the Mojave Region, in the Colorado River Hydrologic Region. This southeastern boundary approximates the drainage divide in mountainous terrain for the San Bernardino Mountains (and Little San Bernardino Mountains), and little or no water, either surface or groundwater, is likely to move across this boundary.

Because the Mojave Region is bound by the San Bernardino Mountains (and Little San Bernardino Mountains) to the south, southeast, and southwest, coordination with agencies and organizations outside of these ranges, in Riverside County, for example, would provide little benefit. However, there exists the potential for interregional benefits and impacts from coordination with agencies and organizations in the Antelope Valley IRWM Region which lies to the west and the Inyo-Mono Region to the north.

Implementation of this IRWM Plan includes a provision to identify opportunities as they arise to find synergies with these other regional IRWM Plans so that interregional benefits can be realized.

Figure 7-1
Neighboring IRWM Regions



7.3 Impacts of Plan Implementation

Negative impacts that may be associated with the Plan projects include (1) short-term, site-specific impacts related to site grading and construction, and (2) long-term impacts associated with project operation. For the purposes of this Plan, impacts are discussed at a screening level below.

During project planning, project-specific and/or programmatic environmental compliance processes (consistent with CEQA and, if applicable, the NEPA) will be used to evaluate the significance of project impacts. Under CEQA, impacts determined to be significant must be mitigated to a level of non-significance (unless the lead agency makes findings of overriding consideration). The IRWM Plan itself does not lead directly to the implementation of any specific project; as a result, the IRWM Plan is exempt from CEQA. The following provisions of the State CEQA Guidelines apply:

- Statutory Exemption (15262 for Feasibility and Planning Studies)
- Categorical Exemption (15306-Information Collection)

CEQA review associated with specific projects by relevant agencies will evaluate impacts in much greater detail than is given in the discussion below.

- **Aesthetics** – Projects that include construction activities and new infrastructure could affect aesthetics. However, projects will likely be constructed in areas that are already disturbed or include mitigation measures to return disturbed areas to their pre-construction conditions.
- **Air Quality** – Short-term air quality impacts could result from construction of Plan projects. However, through the CEQA process, potential air emissions would be minimized through application of best management practices (BMPs) identified by the air quality management district or mitigation measures.
- **Biological Resources** – Short-term biological impacts could result from construction activities as well as non-native plant removal. Most of these negative effects would be avoided or minimized through mitigation efforts related to CEQA. Additionally, several of the IRWM Plan objectives focus on preservation and improvement of ecosystem health and would thus result in a net increase of benefits to biological resources.
- **Cultural Resources** – Impacts to cultural resources (historical, archeological, and paleontological resources) could result from construction of Plan projects. As part of the CEQA process, it will be necessary to develop mitigation measures to avoid or minimize any such impacts. In addition, if tribes are identified, the RWMG will include them in the process during the IRWM updates and participation could include informal consultation on projects that could impact cultural resources.
- **Geology and Soils** – Plan projects with the potential to impact geologic resources would be required to undergo geological feasibility studies, which would specify the appropriate engineering standards the contractor would have to comply with during construction to mitigate project site geological and soil impacts.

- **Hydrology and Water Quality** – Impacts to hydrology and water quality are anticipated to be generally beneficial because Plan projects are intended to improve water supply reliability and water quality in the long term. For short-term erosion or sedimentation, project-specific BMPs would be identified as part of the National Pollutant Discharge Elimination System (NPDES) or local permitting process.

  Some of the proposed Plan projects involve flood and stormwater management that could impact flows downstream of the Mojave River. These issues could merit analysis in project-specific CEQA documentation.

- **Land Use and Planning** – The Plan projects were screened for their compatibility with other planning documents for the Region, including local and regional general plans. No significant land use changes or inconsistencies with policies are anticipated. In fact, collaboration between land use and water management agencies could reduce incompatibilities in the future.

- **Noise** – Noise impacts could result from construction activities from some of the proposed projects. However, through the CEQA process, most of these impacts would be minimized by mitigation efforts. No long-term noise impacts are expected.

- **Population and Housing** – No adverse impacts to population and housing are anticipated. Plan implementation would help to meet the water demands of the existing and anticipated future population.

- **Public Services and Utilities** – Many of the Plan projects are intended to enhance water supply and water quality and improve storm water and flood management. Such projects would benefit the utilities and service systems in the Region.

- **Recreation** – One of the objectives of the IRWM Plan is to preserve and enhance water-dependent recreation; recreation impacts are likely to be beneficial.

- **Transportation and Circulation** – Transportation and circulation could be temporarily impacted during construction of some of the Plan projects. Construction can temporarily increase traffic congestion because of transportation of equipment and trips by workers. Construction near roadways can result in temporary lane closures and detours. However, through the CEQA process, most of these activities would be avoided or minimized. No long-term transportation and circulation impacts are expected.

Section 8: Implementation Framework

8.1 Background

This section presents a summary of the procedures, intentions, and plans for implementation of the updated Mojave IRWM Plan. The title "Implementation Framework" was selected because this section does not portray formal agreements among the Regional Water Management Group (RWMG) or other plan implementation participants, but rather presents a framework for actions and methods that the Region intends to proceed with going forward in implementation of the Plan. This section documents the relationships and decision making structure used during the development of the updated IRWM Plan, sets forward a proposed framework for plan implementation, guidelines for performance monitoring to track progress, and offers specific recommendations for the first two years of plans implementation activities. Perhaps more than any other section, this section is intended to serve as the cornerstone of critical actions the Region must implement to ensure a successful IRWM program into the future.

One of the key considerations for developing and implementing an IRWM Plan is the governance structure chosen to perform the tasks necessary to develop and implement the Plan. This section describes the governance structure used for developing the Mojave Plan and proposes a governance structure to be used to implement and update the Plan over the next 25 years consistent with the California Department of Water Resources (DWR) *Integrated Regional Water Management Guidelines for Proposition 84 and 1E* (2012 Guidelines) (DWR 2012a).

8.2 Governance Structure Used for Plan Development

In 2013, the Mojave RWMG was formed through a Memorandum of Understanding (MOU) to update the IRWM Plan for the Mojave Region of the Proposition 84 Lahontan and Colorado River Hydrologic Regions, among the following agencies:

- Mojave Water Agency (MWA) (statutory authority for water management)
- Victor Valley Wastewater Reclamation Authority (statutory authority for water management)
- MWA Technical Advisory Committee (an independent group of volunteers from throughout the Mojave Region who meet regularly to discuss water management challenges and opportunities and make recommendations to the Mojave Water Agency)
- Mojave Desert Resource Conservation District (statutory authority for water management)
- Morongo Basin Pipeline Commission (statutory authority for water management)

The agencies participating in the MOU, signed on February 28, 2013, became the RWMG for the Mojave IRWM Plan. The MOU also established a Coordinating Committee (CC) comprised of staff members of the MOU signatories to lead the development of an updated IRWM Plan for the Mojave Region. The CC entered into a charter on April 25, 2013 to further clarify the agreements made in the MOU. The MOU and the charter established the overall parameters of governance for developing the updated Mojave IRWM Plan.

The RWMG decided that the updated Mojave IRWM Plan would be developed by a Project Team with broad stakeholder input. The Project Team included participants from the CC, staff from members of the RWMG, volunteers from the Region, and the technical, public outreach, and facilitation consultants (Consultant Team).

The Consultant Team's activities to help develop the IRWM Plan were funded by contributions from members of the RWMG.

The Project Team invited representatives of other agencies, nonprofit groups, nongovernmental organizations, government entities, and the public to participate as equals during stakeholder input meetings to inform the content of the IRWM Plan. This group of participants was referred to as the Stakeholder Group.

8.2.1 Roles and Responsibilities

The CC and Project Team committed to engage the vast array of knowledge and talent among staff and other integrated water resources professionals within the Region, and to do so in a way that fostered professional development and growth among agency staff while developing the IRWM Plan. The intent was to engage local professionals during the development of the IRWM Plan to benefit from their expertise and to prepare them to help implement the Plan after it was developed. The Consultant Team worked closely with designated staff and other experts participating on the Project Team to develop the Plan and foster professional development where feasible.

The CC consists of one staff representative or volunteer Board member and an alternate appointed from each of the agencies and associations that comprise the RWMG. The CC's overall function is to oversee the preparation of the Mojave IRWM Plan through its adoption, including identifying proposed Plan objectives, proposing a process for prioritizing projects, and developing and reviewing drafts of the IRWM Plan.

The Consultant Team was responsible for leading the efforts to develop the Plan with guidance and oversight provided by the CC and the Project Team. Following are the roles and responsibilities of the CC and Consultant Team.

Coordinating Committee and Project Team Roles

1. Provide guidance and oversight to the Consultant Team.
2. Participate in CC and stakeholder input meetings.
3. Communicate with the RWMG members and other interested parties throughout the Plan development process.
4. Review and comment on draft materials prepared by the Consultant Team.
5. Make decisions as described below.

Consultant Team Roles

1. Design the process for Plan development.
2. Engage with potential participants.
3. Gather information and synthesize into Plan content that meets the 2012 Guidelines.
4. Design, prepare for, and facilitate meetings with the CC, Project Team and the Stakeholder Group to develop the information needed for the IRWM Plan.
5. Draft content for the Plan and circulate for review.
6. Review comments and revise draft sections of the Plan as appropriate.

Stakeholder Group Roles

1. Review and discuss draft content prepared by the Project Team.
2. Participate in stakeholder input meetings and provide input regarding the content of the updated Mojave IRWM Plan.
3. Share information from the IRWM Plan update process with other interested members of their communities.
4. Participate in the decision making process described below.

8.2.2 Public Involvement Processes

As described in Section 1: Introduction, the Project Team developed and implemented a broad public involvement process to ensure any interested stakeholders had multiple opportunities to inform the Plan development process and help shape Plan content. The Project Team posted public notices of their intent to prepare the Mojave IRWM Plan in several newspapers within the Region. They also created an e-mail distribution list that includes all potentially affected agencies, non-governmental organizations, and other interested parties. The e-mail list was used to circulate an electronic newsletter periodically, to send invitations to upcoming meetings, and to invite comments on draft sections of the Plan as they were posted for public review. Meetings were held at various locations within the Region to encourage broad stakeholder participation, with emphasis on Disadvantaged Communities (DAC).

The Project Team also developed and maintained an IRWM Plan website at www.mywaterplan.com. The website included meeting announcements, meeting agendas and materials, draft sections of the Plan, and meeting summaries from meetings already conducted. The Project Team also designated a Mojave Public Information Coordinator and provided an e-mail address and phone number that anyone could use to learn more about the Plan development process.

8.2.3 Decision Making

The approach to decision making used during the development of the IRWM Plan update is called facilitated broad agreement. The Project Team presented content through an interactive process with the intent to reach broad agreement with the Stakeholder Group on the IRWM Plan content. The Project Team presented and discussed draft information in public meetings and also provided draft documents for review, comment, and discussion. All decisions related to the draft Plan content were made successfully using this approach.

If for some reason broad agreement could not be reached between the Project Team and the Stakeholder Group related to specific items with a reasonable amount of time and effort, the Consultant Team was prepared to request that the CC discuss the item(s) where broad agreement could not be reached and then vote to direct the Consultant Team on how to proceed. The CC agreed that any matters brought to vote would be decided by a simple majority.

8.2.4 Balanced Access and Opportunity for Participation

The Project Team conducted outreach, created content and facilitated stakeholder input meetings. Representatives of other agencies, nonprofit groups, nongovernmental organizations, government organizations, and the public were invited to participate as equals during stakeholder input meetings to inform the content of the IRWM Plan. As described above, this group of participants is referred to as the Stakeholder Group. All interested participants were encouraged to participate in stakeholder input meetings, discuss draft content of the IRWM Plan, and disseminate information from the stakeholder input meetings to the general public. During the stakeholder input meetings, all of which have been sound recorded for review, all interested participants were invited to participate as equals in the interaction to reach broad agreement on the content to be included in the Plan.

The Project Team also conducted targeted outreach intended to foster dialog with tribal communities and representatives of the disadvantaged communities within the Region. These groups were contacted like all the other public involvement process was conducted within the Region as discussed in Section 8.2.2; by telephone, letters, e-mails, and in person meetings.

8.2.5 Internal and External Communication

The Project Team prepared communication materials regarding development of the IRWM Plan for distribution, posting on the IRWM Plan website, and made the materials available for use in meetings with governing boards and other interested parties.

The Consultant Team communicated regularly with the Project Team via calls or in-person meetings.

8.2.6 Coordination with Neighboring IRWM Efforts, State Agencies, and Federal Agencies

Project Team members have also met and coordinated with neighboring IRWM planning efforts, other local, state, and federal agencies. Various members of the Project Team have been participating in coordination calls or in-person coordination meetings with two neighboring IRWM efforts. Members of the Consultant Team have corresponded with and phoned a number of staff within DWR and other federal agencies that have interests within the Region.

8.3 Governance Structure for Plan Implementation

Once the Mojave IRWM Plan has been adopted, the focus of the RWMG will change significantly. Some of the activities conducted during Plan development will continue, but the emphasis will shift from planning toward implementation and tracking of progress.

8.3.1 Highlights of Proposed Governance Structure for Plan Implementation

This portion of the section contains a summary of the proposed governance structure for implementation of the Mojave IRWM Plan.

- Continue with a Mojave RWMG formed by a MOU.
- Continue with a CC made up of representatives from the RWMG.
- Establish an IRWM Plan Implementation Support Team (IST) (similar to the Project Team that has helped develop the updated Plan).
- The decisions authorized by the member agencies of the RWMG will continue to be made using the decision making approach employed during development of the updated Mojave IRWM Plan.
- The CC or IST may form subcommittees to focus on specific topics.

Table 8-1 presents more details about the anticipated activities, participants, and roles for implementing the Plan.

Table 8-1
Activities, Participants, and Roles for Implementing the Mojave IRWM Plan

Activities	RWMG	CC	IST	Stakeholder Group / Subcommittees	Project Proponents
1. Promote Progress on Plan Objectives					
Foster Collaboration	Authorize	Lead	Lead	Participate	Participate
Gather Data Related to Progress	"	Support	"	"	"
Synthesize Data Related to Progress	"	"	"	"	"
Report On Plan Progress	"	"	"	"	"
2. Conduct Stakeholder Meetings					
Schedule Meetings	Authorize	Participate	Lead	Support	Support
Prepare Agendas	"	"	"	"	"
Prepare Content	"	"	"	"	"
Facilitate Meetings	"	"	"		
Prepare Meeting Summaries	"	"	"		
3. Engage Public					
Maintain Email List	Authorize	Support	Lead	Support	Support
Develop Content	"	"	"	"	"
Send Announcements / Invitations	"	"	"	"	"
4. Maintain Mojave IRWM Plan Website[(a)]					
Update Content	Authorize	Support	Lead	Support	Support
Administer Site	"	"	"	"	"
5. Update Mojave IRWM Plan					
Receive Project Submittals	Authorize	Support	Lead	Support	Submit Potential Projects
Review and Update Objectives	Authorize	Participate and Decide if Necessary[(b)]	Lead	Participate	Participate
Revise Project List	"	"	"	"	"
Revise Project Priorities	"	"	"	"	"
Revise Plan Content	"	"	"	"	"
6. Pursue Grant Funds for Implementation					
Identify Grant Opportunities	Authorize	Participate	Lead	Support	Support
Select Projects for Inclusion in Grant Applications	"	Participate and Decide if Necessary[(b)]	"	Participate	Participate
Prepare and Submit Grant Applications[(b)]	"	"	"	"	"

Table 8-1
Activities, Participants, and Roles for Implementing the Mojave IRWM Plan

Activities	RWMG	CC	IST	Stakeholder Group / Subcommittees	Project Proponents
Identify One or More Willing Fiscal Agent(s) to Manage Grant Funds (If Received) on Behalf of the RWMG[(b]	Authorize	Lead	Lead	Support	One or More Agency Or Organization Serve As Fiscal Agent
7. Coordinate with Related Efforts					
Coordinate with Neighboring IRWM Regions	Authorize	Support	Lead	Support	Support
Coordinate with Local, State, and Federal Agencies	"	"	"	"	"
8. Foster Effective Communication					
Facilitate Efficient and Effective Communication Within Implementing Agencies and Stakeholders	Authorize	Participate	Lead	Support	Support
Facilitate Efficient and Effective Communication Outside of Mojave Region	"	"	"	"	"
9. Manage and Share Related Data and Information					
Identify Data and Operational Data That Should Be Measured and Managed To Meet Plan Objectives	Authorize	Support	Lead	Support	Support
Gather The Needed Data and Information	"	"	Coordinate with Existing Agencies	"	"
Store and Manage Needed Information	"	"	"	"	"
10. Finance Implementation Coordination Activities					
Set Annual Operating Budget for Implementation Coordination	Authorize and possibly provide funds	Provide Guidance	Lead	Support	Support
Manage Expenditures of Implementation Coordination Activities	Authorize and Invite Financial Participation as Needed	"	"	"	"

Notes:
(a) This topic will focus on data that are currently collected.
(b) "Decide if Necessary" means that the Project Team and the Stakeholders were not able to reach broad agreement and the CC will decide based on majority vote.

8.3.2 Roles and Responsibilities

8.3.2.1 Regional Water Management Group

The current structure of the RWMG authorized the formation of the Coordinating Committee and Project Team that has functioned well for managing the update of the IRWM Plan and providing guidance and oversight to the Consultant Team and the stakeholders during Plan development. Therefore, the Project Team recommended and the Stakeholder Group agreed that the Region will continue with a similar approach to governance through the initial phases of Plan Implementation. Each existing member of the RWMG formed to develop the updated IRWM Plan will be invited to participate as a member of the RWMG for implementation. A draft MOU amendment has been prepared (see Appendix A.2) to establish a RWMG responsible to support the implementation of the adopted Mojave IRWM Plan. It is anticipated that the MOU amendment will be executed around the same time the IRWM Plan is adopted and that the MOU will include the terms described below:

- The RWMG intends to support the activities of existing agencies and organizations within the Region to accomplish the objectives in the adopted Mojave IRWM Plan. The primary roles of the RWMG are to foster collaboration to accomplish Plan objectives, track and report on implementation progress, and provide a mechanism to revise and update the Mojave IRWM Plan.
- The RWMG must have at least three agencies or organizations, two of which have authority over water, in order to form and function.
- Each signatory agrees to designate a primary and alternate representative to serve on the RWMG CC.
- Regular participation in CC activities is required.

8.3.2.2 Coordinating Committee and Implementation Support Team Roles

The main purpose of the CC and IST is to provide leadership and focus toward long-term collaboration and cooperation among implementing agencies and organizations to meet the Plan objectives.

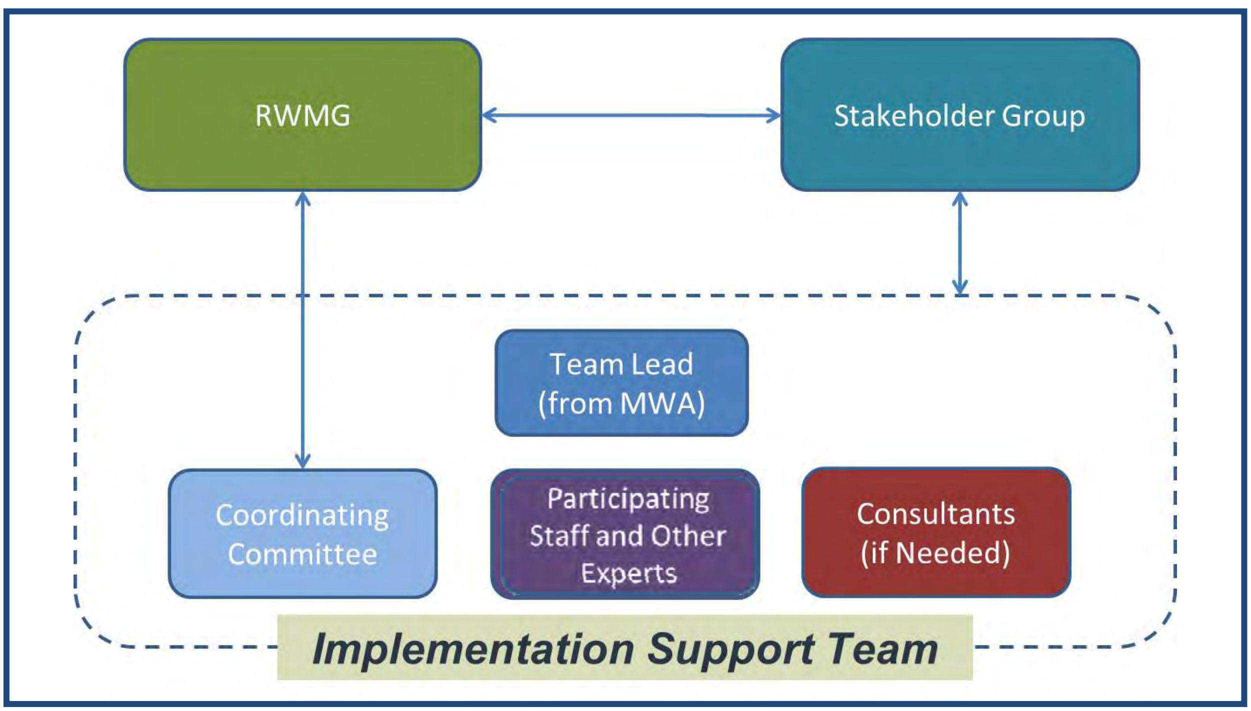
The Mojave CC will consist of designated representatives (primary and alternate) of each organization within the RWMG.

The IST will consist of the CC and other staff or representatives from members of agencies and organizations responsible for various aspects of integrated water management in the Region. The Mojave Water Agency will provide a professional staff person to serve as the Team Leader for the IST. Members that served on the Project Team during the development of the Plan will automatically become members of the IST. Additional members may be added to the IST by the CC with input from the Stakeholder Group. Members of the IST must be knowledgeable about one or more aspects of integrated water management and must commit to regular participation in IST meetings. The IST will work closely with the CC, designated staff and other experts participating on the IST (see Figure 8-1) to maintain the Plan and foster project implementation. The IST will coordinate the activities of subcommittees (if any are formed) including tracking of subcommittee membership, scope of subcommittee activities, and maintaining documentation of subcommittee recommendations to the IST.

The primary roles of the IST and CC (on behalf of the RWMG) include:

- Promote progress toward accomplishing IRWM Plan objectives.
- Conduct stakeholder meetings related to Plan implementation, performance tracking, and Plan updates.
- Cooperate with project proponents to help implement projects listed in the IRWM Plan.
- Foster continued and effective communication among stakeholders within the Region that support implementation of the Mojave IRWM Plan.
- Maintain and update the MyWaterPlan.com website.
- Update the Mojave IRWM Plan as needed.
- Track grant and other funding opportunities to help project proponents implement projects included in the Mojave IRWM Plan; Lead grant application efforts with appropriate project proponents.
- Coordinate with neighboring IRWM efforts, state agencies, and federal agencies.
- Track and report on progress toward meeting the Plan objectives.
- Manage and share data and information relevant to Plan implementation.

Figure 8-1
Implementation Support Team



8.3.2.3 *Stakeholders and Project Proponents*

One of the most important aspects of Plan implementation is the process to ensure that the public and interested stakeholders continue to be involved. Stakeholder roles and responsibilities include, at minimum, the following:

- Stakeholder Input meetings will be conducted by the IST at least once every six months to discuss relevant topics of progress on implementation of the Mojave IRWM Plan. The CC or IST may convene additional meetings as desired to support fulfilling the objectives of the Plan.
- Due to the large geographic extent of the Region, the IST will provide an opportunity for stakeholders to participate remotely in the stakeholder meetings. The opportunity for stakeholders to participate in meetings from a remote location could include conference calls, web interface, or other technologies that allow for reasonable interaction while the meeting is in progress.
- The IST will maintain a contact e-mail and phone number for people to send comments or ask questions about the Mojave IRWM Plan.
- The IST will maintain the Mojave stakeholder e-mail list and send updates and meeting invitations as appropriate.

Project proponents include agencies or entities that have submitted projects that they intend to sponsor during implementation and that have been included in the Mojave IRWM Plan. Information on and a summary list of all IRWM Plan projects is maintained at the IRWM Plan website (www.mywaterplan.com). It is envisioned that the project proponents will have the following roles and responsibilities:

1. Provide project-specific information for the regional project database that may aid in advancing the Plan's regional objectives.
2. Seek opportunities to integrate, where possible and practical, Plan projects in the database to most efficiently achieve the regional objectives. This process may be initiated and facilitated at stakeholder meetings, but it is expected that project proponents will further develop these opportunities outside of that forum.
3. Provide updated project-specific information for the regional project database as necessary to reflect major project milestones (e.g., CEQA completion, 100% design, construction underway, construction complete, and project completion). This particular role is a critical element of Plan implementation and is in the best interest of the project proponents, since having updated information available will help projects when applying for financial assistance.
4. Participate in stakeholder meetings to educate others about the proponent's project(s) in the database. This will happen naturally as a result of casual collaboration with others but may also be in the form of presentations at stakeholder meetings.
5. Identify a point person for each project, who will provide, in a timely manner, to the IST and/or consultant, requested information for projects for inclusion in a grant application.

6. Identify a point person for each project who will provide, in a timely manner, to the grantee and/or consultant, requested information for projects selected for funding through a funding agency.
7. Comply with grant requirements, as identified by the funding agency, to qualify for grant funding.

8.3.3 Meeting Notices

This summary is not intended to be inclusive of all requirements of the Ralph M. Brown Act, but merely to provide a discussion of some of the key aspects that appear to apply to Plan implementation. The Mojave IRWM meetings, including CC meetings, will follow Brown Act provisions. The Brown Act is contained in Section 54950 et seq. of the *California Government Code* and sets forward specific requirements for noticing about meetings, the way meeting agendas are established, and discussions among legislative bodies outside meetings. Brown Act provisions will apply to all CC and RWMG stakeholder meetings. Meetings are required to be held within the Region boundaries. Remote meetings (such as teleconference calls) are permitted so long as all teleconference locations are identified in the meeting notice and these locations are made available to the public (see *California Government Code* Section 54953 for teleconferencing).

Meeting notices with agendas must be posted 72 hours prior to the meeting; special and emergency meetings are allowed with shorter notices under special circumstances. The public will be afforded opportunities to comment before or while agenda items are covered and time will need to be set aside for members of the public to comment on items that are applicable to the RWMG but are not otherwise agendized.

All actions of the RWMG must be taken in public. There are also special provisions for closed session meetings, such as dealing with pending litigation and personnel issues. There are many exemptions and other protocols to the Brown Act; details can be found in the California Attorney General's Office pamphlet *The Brown Act: Open Meetings for Local Legislative Bodies*, 2003 and other similar guidance materials.

8.3.4 Decision Making

Decisions authorized by the RWMG will continue to be made using facilitated broad agreement as during the development of the Plan. The IST will set agendas, interact with stakeholders, and foster collaborative decisions as described in Table 8-1.

When decisions are needed, the facilitator of the meeting will assess whether broad agreement has been reached. If not, discussions will continue to try to reach broad agreement. The IST may choose to have a Team member facilitate stakeholder meetings or retain an outside facilitator as needed.

If for some reason broad agreement cannot be reached between the IST and the Stakeholder Group related to specific items within a reasonable amount of time and effort, the IST Leader may request that the CC conduct a vote to decide how to proceed. When a vote is requested, each member of the RWMG will have one vote and a simple majority vote will determine the outcome.

8.3.5 Balanced Access and Opportunity for Participation

Balanced access and opportunity for public participation will be accomplished through multiple avenues of communication and engagement between the CC, the IST, and stakeholders including, at a minimum, the following:

- All interested participants are invited to participate as equals during stakeholder input meetings to reach broad agreement on the implementation of the Plan.
- The IST will continue to foster dialog with community members, tribes and representatives of DACs within the Region as needed to support meeting the objectives of the Plan.
- Meeting materials and other relevant information will be posted to the IRWM Plan website (www.mywaterplan.com) and any interested person or organization will be invited to review and comment.

8.3.6 Internal and External Communication

The IST will prepare communication materials for distribution, posting on the project website, and for use in meetings with governing boards and other interested parties.

The IST will conduct stakeholder input meetings that are announced and open to any stakeholder.

IST members will meet and coordinate with neighboring IRWM planning efforts, other local, state, and federal agencies as they relate to accomplishing the objectives in the Mojave IRWM Plan.

8.3.7 Coordination with Neighboring IRWM Efforts, State Agencies, and Federal Agencies

Members of the IST will engage with neighboring IRWM efforts and continue to communicate with DWR and other state and federal agencies that have interests in or could impact meeting the objectives of the Plan.

8.3.8 Long-term Implementation of the IRWM Plan

Implementation of the Mojave IRWM Plan will rely on actions taken by existing agencies and organizations within the Region. The RWMG as represented by the CC and in cooperation with the IST will provide leadership for fostering cooperation, continuing coordination, tracking of Plan performance, and updating of the Mojave IRWM Plan. (Note: the tracking of Plan Performance does not replace required regulatory reporting by specific agencies within the Region and the Plan Performance tracking is being done to monitor progress on Plan implementation and provide information that can be useful for continuing implementation of, updating or amending the Plan.)

8.3.8.1 Track Progress for IRWM Plan Implementation

The broad recommendations for monitoring plan performance implementation are summarized below and are intended to serve as a road map to the CC. Section 10.4 addresses in more detail the recommendations for how the stakeholders decided to monitor the IRWM Plan objectives to ensure progress was being made.

Track progress on Plan objectives:

a) Gather data related to progress.

b) Synthesize data related to progress.

c) Report on Plan progress.

d) Manage and share related data and information.

Identify the data that should be measured and managed to meet the objectives of the IRWM Plan with a focus on data that are currently collected:

a) Gather the needed data and information.

b) Store and manage it.

c) Provide access to it.

8.3.9 Research Grant Opportunities for Plan Implementation

The IST and MWA staff will work together to research, identify and support the pursuit of grant funds that could help implement the projects and meet the objectives included in the Mojave IRWM Plan. The RWMG will not serve as a fiscal agent for grant funds, but rather will identify a willing agency or organization with the appropriate authority and financial conditions to serve as a fiscal agent on behalf of the Region for each specific grant opportunity that is pursued.

The fiscal agent(s) may distribute grant funds to other project proponents within the Region according to the specific terms of the grant program that provides funds. The project proponents whom receive grant funds will be responsible to complete their project(s) as described in the relevant grant application and/or grant agreement. The fiscal agent will not be responsible to fund or complete projects for other project proponents outside of the specific commitments made in a particular grant agreement.

The IST will track the amount of grant funds brought into the Region to support implementation of the Mojave IRWM Plan and the specific projects being funded (or partially funded) with grant funds. The IST will include this information in their annual report of Plan performance.

8.4 Plan Updates and Changes

The Mojave IRWM Plan is a living document and it is anticipated that changes will be required as additional information is collected, as objectives are refined and better understood, as new projects are developed, and as the collaborative relationships between the RWMG and stakeholders continue to develop. Changes to the IRWM Plan will follow the similar, publically open and accessible process that this IRWM Plan update process followed. A specific protocol for minor revisions and amendments to the Plan is documented in the following section.

- The IST will review the Mojave IRWM Plan at least once every five years to determine if the content of the Plan needs to be changed in a significant way other than the minor revisions and amendments of the objectives and projects as described below.

- If significant changes are needed, the CC and IST will lead the process for revising the Plan. Once substantial revisions are made, the IST will request that RWMG members and project proponents adopt the revised plan.

8.4.1 Revising and Amending the IRWM Plan

Minor revisions or amendments to the IRWM Plan may be made without requiring a complete readoption of the IRWM Plan. Minor revisions or amendments specifically include changes to the project lists and refinements to the Plan objectives. Other changes to the Mojave IRWM Plan may be considered minor revisions or amendments if deemed to be so by the CC with support by broad agreement of the Stakeholder Group. Any proposed minor revisions or amendments to the IRWM Plan will follow the decision making process listed in Section 8.3.4. Once recommended revisions or amendments are approved according to the decision making process, the revisions or amendments will be considered an official part of the adopted Mojave IRWM Plan and will be posted to the Plan website.

- The IST will invite stakeholders and project proponents at least once every two years minimum to submit additional projects for consideration to be included in the IRWM Plan or updates to projects already included in the IRWM Plan. The IST will publicize the opportunity and process to submit new projects (or updates) for consideration. The IST will present and discuss the potential amendments to the project list within the Mojave Plan in one or more stakeholder input meetings.
- The CC can issue a Call for Projects and update the IRWM Plan Project list at any time. Revision of the IRWM Plan Project list does not require that the entire IRWM Plan be revised and readopted; rather the updated project list can be amended to the existing plan according to the decision making process described in Section 8.3.4.

Section 9: Finance

Securing adequate funding for program planning and implementation is one of the biggest challenges facing integrated planning efforts. Successful Integrated Regional Water Management Plan (IRWM Plan) implementation requires both capital and/or planning costs associated with project implementation as well as ongoing funding to support their continued operation, maintenance and administration.

This section identifies various funding sources and their associated requirements and guidelines to assist with implementation of the Mojave IRWM Plan. Appendix E provides a summary of funding opportunities by local, state, and federal funding sources and provides contact information for each program.

The following sections identify various funding sources, their associated requirements and guidelines to assist with implementation of the Plan.

9.1 Local Funding Sources

The first Mojave IRWM Plan (MWA 2004 Regional Water Management Plan/IRWM Plan/Groundwater Management Plan (GWMP)/Urban Water Management Plan (2004 RWMP)) was developed in 2004. This 2004 RWMP guided significant investments for local water supply, conservation, and management projects. The Mojave Water Agency has acquired over $450 million in grant funding from state and federal sources to help improve the Mojave Region's water infrastructure and supplies. A summary of projects that benefited from such funding include the following:

Morongo Basin Pipeline

- Ames Valley Recharge
- Water Conservation Incentive Program
- Deep Creek Recharge Project
- Joshua Basin Recharge
- Oro Grande Wash Recharge
- Regional Recharge and Recovery Project (R^3 Project)

Other agencies within the Region have also invested heavily and have acquired additional grant funding to help implement the 2004 RWMP.

Opportunities to obtain grant funding to help implement the Region's priority projects continue to be available. Many of these grant opportunities require that the local project proponent provide matching funds ("local match") and guarantee funds for operations and maintenance once a project or program is constructed or implemented. The source of the local match and funds for operations and maintenance may include water and wastewater general funds; capital improvement funds; development impact fees; and general funds from local cities, county departments, other local agencies, private organizations, member dues, etc. Local taxpayers may also fund these projects through rate increases, bond measures, and tax increases.

9.1.1 Capital Improvements Program Funding (Revenue Bonds, Certificates of Participation)

Water districts, as well as other government entities (e.g., counties and cities), can raise funds by issuing municipal bonds or certificates of participation. Bonds and certificates of participation are governed by an extensive system of laws and regulations. Under these systems, investors provide immediate funding for the promise of later repayment. Generally, bonds and certificates of participation are used for capital improvement projects. In the case of a water district, bonds and certificates are secured by revenues from the water system and by property taxes received by the agency. In some instances, voter approval will be necessary to secure funding for the debt, including any low interest California State loans.

9.1.2 Property Tax Assessment (Assessed Valuation)

General property taxes are a large source of revenue for water-related projects and agencies in the Region. These funds can be used for general expenditures, capital improvements, and to service bond and certificate debt. While this is a large and important source of funding for local agencies, in some cases, the state of California can divert these funds, thus rendering them unavailable. In addition, revenue from property taxes can fluctuate with the real estate market.

9.1.3 Special Property Tax Assessment and Fees

In some instances, special voter approved tax assessments or fees may be or can become available for funding projects. These special taxes are generally restricted in nature and can only be directed toward the purpose they were intended when the vote took place. The vote can be through the California Proposition 218 process, ballot measure, or through the formation of a special assessment district.

9.1.4 Water Leasing

Some water agencies sometimes have sources of water available to them that they do not need for immediate water demands. In such instances, the agency may sell their right to use that surplus water supply to another water agency for a specified amount of time and can use the funds to pay for projects.

9.1.5 Water User Fees

For water agencies, funding for operation and maintenance of water-related projects often comes from user fees, which are charges for water delivered to a home or business, or charges for wholesale water supplies. In addition to these fees, many water agencies also charge "hook-up" or "connection" fees – charges for providing facilities to provide water services to a new development. These fees are also known as "facility capacity fees." Facility capacity fee revenue is difficult to forecast due to the unpredictable timing of development activity. Development activity depends on real estate demands, the regional economy, and land use planning activity. Revenue from user fees and water charges can also fluctuate with the regional economy, short-term water use reductions or restrictions, and precipitation.

9.1.6 Wastewater Fees

Similar to water usage or connection fees, monthly fees may also be imposed on customers connected to the sewer system in order to pay for the cost of treating the wastewater. These fees, collected for example by the cities of Adelanto, Barstow, Hesperia, Victorville, and Twentynine Palms, the Victor Valley Wastewater Reclamation Authority (VVWRA), Helendale Community Services District (CSD), Lake Arrowhead CSD, Crestline Sanitation District and the Marine Corps Logistics Base (MCLB), help cover costs to maintain, replace and repair the sewer pipes that collect sewage from homes and businesses and transport the sewage to treatment facilities. Within the Mojave Region, the VVWRA service area includes the cities of Adelanto, Hesperia and Victorville, the Town of Apple Valley, and County Service Areas #42 (Oro Grande) and #64 (Spring Valley Lake).

9.1.7 Investor Owned Utility Investments

Investor owned utility (IOU) investments can also support the objectives of the Mojave IRWM Plan. For example, the California Public Utilities Commission (CPUC), which regulates IOUs, is formalizing their process and developing a policy framework to guide the regulation of recycled water development, production and sales. IOUs may have significant incentives to expand recycled water when offered a favorable rate of return on their investments.

9.1.8 Capacity and Development Fees

The terms “capacity fee” and/or “development fee” are used often interchangeably with other similar terms in the water utility industry to describe a fee or charge that recovers capital costs associated with system growth. The fee is intended to represent the unit cost of providing the capacity required to serve new development. Also known as tap fees, impact fees, plant investment fees, and other terms, a development fee is a one-time charge for new connections to the system, and is designed to recover capital investment to provide capacity to new growth. Development fees are also assessed to existing connections/customers to the extent the demand for service from said customer is increased (e.g., a customer’s demand for service increases to the extent that a larger meter or service line is required).

9.2 State of California

Potential funding for IRWM Plan implementation may be available through various state programs, including Propositions 84, 1E, and 50. The discussion below and Table 9-2 provide information on current state funding opportunities.

POTENTIAL STATE FUNDING SOURCES FOR IRWM PLAN IMPLEMENTATION:

- Proposition 84
- Proposition 1E
- Proposition 50
- Other (Pending Legislation, State Revolving Fund)

9.2.1 Propositions 84 and 1E

Proposition 84, The Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Protection Act of 2006 (Public Resources Code § 75001, et seq.), was passed by California voters in the November 2006 general election. Proposition 84 may provide the most flexible source of grant funding to the Region in the near-term and has been implemented by agencies such as California Department of Public Health (CDPH), California Department of Water Resources (DWR) and the State Water Resources Control Board (SWRCB).

Proposition 1E, the Disaster Preparedness and Flood Protection Bond Act of 2006, encourages new investments for flood protection and stormwater management programs (SWMP).

Specific grant funding programs available under these propositions are highlighted below:

9.2.1.1 Integrated Regional Water Management

DWR offers grants for projects that assist local public agencies to meet the long-term water needs of the state including the delivery of safe drinking water and the protection of water quality and the environment. Proposition 84 allocated $1 billion to integrated regional water management planning and implementation grants; of this amount, $27 million is earmarked for award to the Lahontan Hydrologic Region and $36 million for the Colorado River Hydrologic Region. After awards of the two rounds of planning and implementation grants, the remaining balance of funds for the Lahontan and Colorado River Funding Areas is approximately $10 million and $16.7 million,[8] respectively (or 42 percent of the initial bond allocation for the combined two funding areas).

As part of Proposition 84 DWR offers two types of IRWM Plan related grants:

1. **Planning grants**: These grants focus on activities such as IRWM Plan development and special studies, which include climate change plans, salt and nutrient management plans and more. Under Proposition 84 there have been two different planning grant opportunities (referred to as Round 1 and Round 2). Planning Grant Round 1 awards occurred in February 2011. Planning Grant Round 2 awards were announced in November 2012. Currently, there are no additional planning grants rounds proposed.

2. **Implementation grants**: These grants focus on implementation activities such as construction projects, water conservation projects, habitat restoration projects and more. Three rounds of implementation grants plus a special drought funding round are anticipated. Round 1 implementation grant awards were made in May 2011 and final Round 2 awards were made in February 2014. The remaining $272 million of the $1 billion authorized will be awarded via the "2015 IRWM Implementation Solicitation," which has an undetermined schedule at this time. However, a portion of these funds are being made available for drought relief programs. See Section 9.2.3: *Potential State Drought Funding* for the available emergency funding specifically for drought projects available in 2014 through the Prop 84 IRWM Plan grant process.

---

[8] Per the DWR workshop handouts on February 25, 2014, concerning drafting revised IRWM guidelines and Round 3 implementation grant proposal solicitation package.

In order to be eligible for implementation grants, projects must be part of integrated regional water management plans. Under DWR *Integrated Regional Water Management Guidelines for Proposition 84 and 1E* (2012 Guidelines) (DWR 2012a), projects eligible for integrated regional water management plan funding include:

- Programs for water supply reliability, water conservation, and water use efficiency
- Stormwater capture, storage, treatment, and management
- Removal of invasive non-native plants, the creation and enhancement of wetlands, and the acquisition, protection, and restoration of open space and watershed lands
- Non-point source pollution reduction, management, and monitoring
- Groundwater recharge and management projects
- Contaminant and salt removal through reclamation, desalting, and other treatment technologies
- Water banking, water exchange, water reclamation, and improvement of water quality
- Planning and implementation of multipurpose flood control programs that: protect property; improve water quality, stormwater capture and percolation; and protect or improve wildlife habitat
- Watershed management planning and implementation
- Demonstration projects to develop new drinking water treatment and distribution methods

Pending legislation may alter the types of projects eligible for funding as part of an IRWM Plan.

9.2.1.2 CDPH - Emergency Clean Water Grant Program

CDPH offers grants with Proposition 84 funding for projects that address emergency and urgent situations related to drinking water supplies. Eligible projects include, but are not limited to, provision of alternate water supplies, improvements to existing water systems to avoid contamination, establishment of new connections, and purchase and installation of water treatment equipment. The program is open to local water suppliers. Additional information found here: http://www.cdph.ca.gov/services/funding/Pages/Prop84.aspx

9.2.1.3 DWR – Local Levee Assistance Program

DWR provides Proposition 84 grant funds for projects that evaluate levees or other flood control structures (not part of the State Plan of Flood Control) through geotechnical studies and for the design, repair and improvement of damaged levees or other unstable flood control structures. These grants are available to local public agencies. Up to $2 million are available per levee evaluation project and up to $5 million are available per critical repair project. http://www.water.ca.gov/floodmgmt/fpo/sgb/llap/

9.2.1.4 DWR – Flood Protection Corridor Program

DWR awards grant funds to public agencies and non-profit organizations for flood risk reduction projects in floodplains through primarily non-structural flood management methods (e.g., detention basins, levee removal). All projects must include wildlife habitat enhancement and/or agricultural land preservation. The maximum grant amount per eligible project is $5 million. Funds are provided through Proposition 84 and 1E. http://www.water.ca.gov/floodmgmt/fpo/sgb/fpcp/

9.2.1.5 DWR – Flood Control Subventions Program

DWR provides financial assistance to local agencies implementing federally authorized flood control projects and watershed protection flood prevention projects authorized by the Natural Resources Conservation Service. The percentage of the state cost share for reimbursable costs ranges from 50 to 70 percent. Claims are accepted on a continuous basis and paid based on availability of state funds. http://www.water.ca.gov/floodmgmt/fpo/sgb/fcs/

9.2.1.6 DWR – Urban Streams Restoration Program

DWR awards grant funds, from remaining Proposition 84 and 13 allocations, to public agencies and non-profit organizations to help local communities reduce urban flooding and erosion, restore environmental values and promote community stewardship of urban streams. Examples include creek cleanups, eradication of exotic or invasive plants, bioengineering bank stabilization projects, acquisition of parcels critical for flood management and coordination of community involvement in projects. Up to $1 million is available per project. http://www.water.ca.gov/urbanstreams/

9.2.2 Proposition 50

The Water Security, Clean Drinking Water, Coastal and Beach Protection Act of 2002, Water Code §79500, et seq., was passed by California voters in the November 2002 general election. Proposition 50 authorized $3,440,000,000 in general obligation bonds, to be repaid from the State's General Fund, to fund a variety of water projects including: specified CALFED Bay-Delta Program projects including urban and agricultural water use efficiency projects; grants and loans to reduce Colorado River water use; purchasing, protecting and restoring coastal wetlands near urban areas; competitive grants for water management and water quality improvement projects; development of river parkways; improved security for state, local and regional water systems; and grants for desalination and drinking water disinfecting projects. Many grant programs funded by Proposition 50 have concluded, but those funding programs still accepting applications are summarized below.

9.2.2.1 DWR – Contaminant Removal

DWR (previously funded through CDPH) provides funds for contaminant treatment or removal technology pilot and demonstration studies for specific categories of contaminants including petroleum, perchlorate, heavy metals, pesticides, and herbicides. Grants are a minimum of $50,000, up to a maximum of $5,000,000. A 50 percent match is required, but this requirement is waived in part or in full for Disadvantaged Communities and small water systems. Public water systems and public entities are eligible for this funding program.
http://www.water.ca.gov/grantsloans/grants/prop50sdw.cfm

9.2.2.2 DWR – UV and Ozone Disinfection

Grants to support projects using ultraviolet or ozone for disinfection of drinking water are also offered by DWR (previously funded through CDPH). A funded project must address a drinking water compliance violation, surface water treatment requirements, or other mandatory disinfection requirement. Public water systems are eligible for this funding program.
http://www.water.ca.gov/grantsloans/grants/prop50sdw.cfm

9.2.3 Potential State Drought Funding

On March 1, 2014, California Governor Jerry Brown signed a pair of emergency drought relief bills passed by the Assembly and Senate. One bill focused on drought relief policy Senate Bill (SB) 104 and the other focused on drought relief funding SB 103.

The majority of the funding provisions (summarized in Table 9-1) are included in SB 103, with the exception of funding for the IRWM Program, which is included in SB 104. DWR is working on expedited solicitation for this “2014 Drought Solicitation” ($200 million available funding) with the anticipated draft schedule as follows:

- Draft Proposal Solicitation Package (PSP) expected about April 1st and final PSP about June 1st.
- Application due approximately August 1st.
- Anticipate awarding funds in early Fall 2014.
- IRWM Plans must be approved by DWR before awards. Awards must be made to adopted, approved IRWM Plans.

DWR anticipates funding four (4) classes of projects:

1. Projects that address water quality or ecosystem conflicts created by the drought.
2. Water supply reliability and delivery of safe drinking water.
3. Water conservation programs and measures that are “not locally cost effective,” which is where the annual cost exceeds annual benefit. Agencies should currently be implementing cost-effective BMPs. One example could be leak detection and repair. Leak detection is typically cost effective, but repair is usually expensive and may not be cost-effective.
4. “Drought preparedness” as defined in 2012 Guidelines under *Statewide Priorities* (conservation, conjunctive use, irrigation efficiency).

Table 9-1
Potential State Drought Grants

Agency	Eligible Applicants	Funding Amount	Process to Apply	Actions Funded: *Water Efficient Irrigation*	*Water Efficient Fixtures*	*Water Use Education*	*Water Supply Augmentation*	*Energy Efficiency Projects that Result in Water Savings*	*Emergency Water Supplies*	***Other***
California Conservation Corps (CCC)	Certified community conservation corps	$13,000,000	Unknown	x	x	x				Water conservation and fuel load reduction
CCC	Schools, public agencies, commercial properties	$5,000,000	Unknown	x	x			x		For water efficient landscaping, irrigation and replacement of plumbing fixtures, outreach and education and energy projects that contribute to energy/water conservation
CCC	Public lands	$5,000,000	Unknown							Fuel load reduction.
CA Dept of Food and Agriculture	Farmers/agribusiness	$10,000,000	Unknown	x			x	x		
CA DWR	Unknown	$37,500,000	Unknown							Flood management projects that also provide water supply benefits.
CA DWR	Participants in IRWM Plans	$200,000,000 Drought Specific Funding	Similar to past IRWM Plan grant solicitations. Guidelines anticipated April, applications August 2014.	x	x		x	x	x	This money is only for near-term drought response actions. Higher priority to fund areas hardest hit by drought (e.g., areas with declared drought emergencies).
CA DWR	Participants in IRWM Plans	$272,000,000 IRWM Plan Prop 84 Round 2015	Similar to past IRWM grant solicitations. Summer 2015.	x	x		x	x	x	Generally will fund any water supply, flood control, and habitat restoration projects.

Table 9-1
Potential State Drought Grants

				Actions Funded						
Agency	**Eligible Applicants**	**Funding Amount**	**Process to Apply**	*Water Efficient Irrigation*	*Water Efficient Fixtures*	*Water Use Education*	*Water Supply Augmentation*	*Energy Efficiency Projects that Result in Water Savings*	*Emergency Water Supplies*	***Other***
SWRQB	Disadvantaged Communities (DAC)	$4,000,000	Applications through Cleanup and Abatement Account. SWRCB also coordinating with RWQCB and CDPH to identify applicants.						x	Interim emergency drinking water to DACs.
California DPH	Public Water Systems	$15,000,000	Contact must be made with local CDPH Drinking Water Program Office.						x	Up to $500,000 per project to address drought-related drinking water emergencies.

9.2.4 Other State Funding

9.2.4.1 California Department of Conservation

Funding under this program is provided to support long-term private stewardship of agricultural lands through the use of agricultural conservation easements. Grants are available to fund easement purchases and planning projects which increase the capacity of local land trusts which hold easements.

9.2.4.2 California Energy Commission (CEC) – Energy Efficiency Financing

The California Energy Commission provides one (1) percent interest loans to eligible entities, including special districts, for energy efficiency projects, feasibility studies, and implementing energy-saving and renewable energy measures. Eligible uses include, but are not limited to, lighting, motors or variable frequency drives, pumps, insulation, HVAC, energy generation and cogeneration. http://www.energy.ca.gov/efficiency/financing/

9.2.4.3 California Energy Commission (CEC) – Geothermal Resources Development Account

Funding under this program is available for all aspects of geothermal research, resources development, demonstration, commercialization, planning, environmental enhancement and impact mitigation. Projects with duration of up to three years are considered for funding. Solicitations are generally offered every other year and there is no minimum or maximum funding level. http://www.energy.ca.gov/contracts/geothermal.html

9.2.4.4 California State Parks – Land and Water Conservation Fund

This program helps fund projects that include acquisition or development of outdoor recreation areas and facilities. Priority development projects include trails, campgrounds, picnic areas, natural areas and cultural areas for recreational use. There is a competitive, local agency program and a non-competitive state agency program. This is a reimbursement only program with a minimum match requirement of 50 percent. http://www.parks.ca.gov/?page_id=21360

9.2.4.5 California State Parks – Habitat Conservation Fund

This program allocates funds to support nature interpretation and other non-capital outlay programs which bring urban residents into park and wildlife areas, to protect various plant and animal species or to acquire or develop wildlife corridors and trails. Projects include acquisition, restoration, or enhancement of habitat and nature interpretation, educational or enrichment programs. Approximately $2 million is available annually.
http://www.parks.ca.gov/?page_id=21361

9.2.4.6 California Wildlife Conservation Board (WCB) – Ecosystem Restoration on Agricultural Lands

This program is intended to financially assist landowners in developing wildlife friendly practices on their properties that can be sustained and co-exist with agricultural activities. Projects may include habitat restoration and enhancement of water corridors on agricultural lands, vegetated filter strips and wildlife buffers, riparian and floodplain restoration, restoration and enhancement of native grasslands, and more. There is no minimum or maximum grant request. Grants typically range from $75,000 to $500,000. https://www.wcb.ca.gov/Programs/AgriculturalLands.aspx

9.2.4.7 California Wildlife Conservation Board (WCB) – Habitat Enhancement and Restoration Program

Financial assistance is provided under this program for the restoration and enhancement of fish and wildlife resources. Eligible projects include native fisheries restoration, restoration of wetlands, in-stream restoration projects, including removal of fish barriers and other obstructions and other projects that improve the quality of native habitat throughout the state. Projects must receive a recommendation from the California Department of Fish and Wildlife (CDFW). https://www.wcb.ca.gov/Programs/HabitatEnhancement.aspx

9.2.4.8 California Wildlife Conservation Board – Rangeland, Grazing Lands and Grassland Protection Program

This program provides funding to achieve the objectives of the California Rangeland, Grazing Land and Grassland Protection Program. Projects must protect the integrity of the rangeland, grazing lands and grasslands. The WCB encourages project to be developed with partners attempting to address regional landscape issues. There is no minimum or maximum grant request. https://www.wcb.ca.gov/Programs/Rangeland.aspx

9.2.4.9 California Wildlife Conservation Board – Riparian Habitat Conservation Program

Funding is provided under this program with the intent of protecting, preserving, restoring, and enhancing riparian habitat throughout California. Projects may include, but are not limited to bank stabilization and revegetation, restoration of riparian vegetation on flood-prone land, installation of fencing along the riparian corridor to control and/or manage livestock or wildlife, and removal of nonnative invasive plant species and restoration of native riparian vegetation. https://www.wcb.ca.gov/Programs/Riparian.aspx

9.2.4.10 DWR – Drainage Reuse Program

Under this program, DWR provides funds for research and study projects that develop methods for reusing subsurface agricultural drainage. Grants of up to $200,000 per project are available through Proposition 204 funds. http://www.water.ca.gov/drainage/

9.2.4.11 DWR – New Local Water Supply Construction Loans

Under this program, DWR provides loans to local public agencies for projects. Eligible projects include canals, dams, reservoirs, desalination facilities, groundwater extraction facilities, or other construction or improvements which will remedy existing water supply problems. Loans for construction projects can be provided for up to $5 million, with an interest rate equal to those of the general obligation bonds sold to finance the program. http://www.water.ca.gov/grantsloans/prop82/

9.2.4.12 DWR – Water Desalination Program

This program supports brackish water and seawater desalination as a water supply or quality option. The primary grant program goal is to create new or alternative potable water supplies from saline water that is not currently being beneficially used, with Total Dissolved Solids concentrations exceeding 1,000 mg/L. http://www.water.ca.gov/desalination/

9.2.4.13 Department of Housing and Community Development – Community Development Block Grant

The California Department of Housing and Community Development provides grants to cities and counties with a program emphasis on creating or retaining jobs for low-income workers in rural communities. Activities may include housing rehabilitation and public improvements, which may involve among other things, water, wastewater and other infrastructure projects as well as feasibility studies. Funding is provided under the entitlement program, whereby specified entitlement areas receive annual funding, and the non-entitlement or State-administered program. The amount of each entitlement grant is determined based on a formula. Grant award limits under the non-entitlement program typically average $1,500,000.
http://www.hcd.ca.gov/fa/cdbg/index.html

9.2.4.14 State Revolving Fund

The Federal Safe Drinking Water Act Amendments of 1996 authorized the creation of a revolving fund program for public water system infrastructure needs specific to drinking water. There is similar state legislation and the Safe Drinking Water State Revolving Fund reflects the intent of federal and state laws to provide grant funding or low-interest loans to correct deficiencies in public water systems based on a prioritized system. There are three different entities that provide loans and/or grants under the State Revolving Fund (SRF).

9.2.4.14.1 CDPH – Safe Drinking Water SRF

Under this SRF program, CDPH provides loans to assist public water systems in achieving and maintaining compliance with the Safe Drinking Water Act. Up to $500,000 is available for planning studies and up to $20 million is available per construction project. Disadvantaged community systems can obtain a zero interest loan and may be eligible for partial grant funding. All applications to this program are initially made for loans, however financial review may determine if grant funds apply.

Within the Safe Drinking Water SRF, the Consolidation Incentive program promotes consolidation of larger systems with nearby noncompliant systems. Under this incentive program, lower ranked projects that don't usually receive SRF invitations can become eligible for SRF funding.
http://www.cdph.ca.gov/services/funding/Pages/SRF.aspx

9.2.4.14.2 I-Bank – Infrastructure SRF

The California Infrastructure and Economic Development Bank, also known as I-Bank, provides financing to local municipal entities for construction and/or repair of publicly owned water supply, treatment and distribution systems, and drainage, and flood control facilities. In addition to water-related projects, loans are available for public infrastructure projects that include parks and

recreational facilities and environmental mitigation.
http://www.ibank.ca.gov/infrastructure_loans.htm

9.2.4.14.3 SWRCB – Clean Water SRF

SWRCB also provides financing for wastewater treatment facility construction projects and expanded use projects, such as nonpoint source and estuary projects. Funding options are available to public agencies, as well as non-profit organizations and Native American tribes, with no maximum funding limit.
http://www.waterboards.ca.gov/water_issues/programs/grants_loans/srf/

9.2.4.15 SWRCB – Federal 319 Program

This program, administered by the SWRCB, is a nonpoint source pollution control program that is focused on controlling activities that impair beneficial uses and on limiting pollutant effects caused by those activities. The program is federally funded on an annual basis. Project proposals that address Total Maximum Daily Load (TMDL) implementation and those that address problems in impaired waters are favored in the selection process. There is also a focus on implementing management activities that reduce and/or prevent release of pollutants that impair surface and ground waters. Nonprofit organizations, local government agencies including special districts, tribes, and educational institutions qualify. State or federal agencies may qualify if they are collaborating with local entities and are involved in watershed management or proposing a statewide project. http://www.waterboards.ca.gov/water_issues/programs/grants_loans/319h/

9.2.4.16 SWRCB – Water Recycling Funding Program

This is a long-term program operated by the SWRCB that offers grants and low-interest loans for the planning, design and construction of water recycling facilities. Grants are provided for facilities planning studies to determine the feasibility of using recycled water to offset the use of fresh/potable water from state and/or local supplies. Pollution control studies, in which water recycling is an alternative, are not eligible. Planning grants are limited to 50 percent of eligible costs, up to $75,000. Construction grants are limited to 25 percent of project costs or $5,000,000, whichever is less. Only public agencies are eligible. The Water Recycling Funding Program receives funding from various sources, including Proposition 50 and the SRF. Due to the varying funding sources, preferences for funding can vary. For example, funding from Proposition 50 gives preference to those recycling projects that result in benefits to the Delta.
http://www.waterboards.ca.gov/water_issues/programs/grants_loans/water_recycling/

9.2.4.17 SWRCB – Cleanup and Abatement Account

This account generally provides public agencies with grants for emergency cleanup or abatement of conditions of pollution where no viable responsible parties are available to undertake the work. Funds can be used for, among other things, waste cleanup and abatement of effects of a waste, and remedying a significant water pollution problem. Requests for funding can be made on a continuous basis and funding amounts are generally determined on a case by case basis.
http://www.waterboards.ca.gov/water_issues/programs/grants_loans/caa/

9.2.4.18 SWRCB – Agricultural Drainage Loan Program

The Water Conservation and Water Quality Bond Law of 1986 provides funds for this program with the intent to address treatment, storage, conveyance, or disposal of agricultural drainage water that threatens water of the State. Loans are available for implementation projects and feasibility studies with a funding cap of $20 million and $100,000, respectively. As of the beginning of 2012, less than $7 million was available for funding under this program.
http://www.waterboards.ca.gov/water_issues/programs/grants_loans/agdrain/agdrain_loan.shtml

9.2.4.19 SWRCB – Agricultural Drainage Management Loan Program

Similar to the Agricultural Drainage Loan Program, this program provides loans for addressing treatment, storage, conveyance, or disposal of agricultural drainage water that threatens waters of the State. Funds for this program come from Proposition 204, and are available in amounts up to $5 million for implementation projects and $100,000 for feasibility studies. Approximately $10 million in funds are still available.
http://www.waterboards.ca.gov/water_issues/programs/grants_loans/agdrain/agdrain_mgmt.shtml

9.2.4.20 SWRCB – Underground Storage Tank Cleanup Fund

Funds provided through the Barry Keene Underground Storage Tank Cleanup Fund Act of 1989 provide means for petroleum underground storage tank owners and operators to meet federal and state requirements, in addition to assisting in covering unexpected and catastrophic expenses associated with the cleanup of leaking petroleum underground storage tanks. Special programs include, among others, the Orphan Site Cleanup Fund, which provides loans up to $1.5 million per occurrence in the case of no viable financially responsible party, and the Replacing, Removing or Upgrading Underground Storage Tanks Program, which provides loans of up to $750,000 for complying with continuing regulatory requirements.
http://www.waterboards.ca.gov/water_issues/programs/ustcf/

9.3 Federal Funding

This section includes a discussion of funds available through various federal programs and specifies eligibility requirements. A summary of potential federal funding sources is provided in Appendix E.

9.3.1 Environmental Protection Agency – Source Reduction Assistance

The purpose of the Pollution Prevention Program that provides Source Reduction Assistance is to prevent and reduce the generation of pollutants at the source and ultimately provide an overall benefit to the environment. Primary goals of the program are to reduce the generation of greenhouse gas emissions to mitigate climate change, reduce the manufacture and use of hazardous materials to improve human and ecological health, reduce the use of water and conserve other natural resource to protect ecosystems, create business efficiencies that derive economic benefits and improve environmental performance, and institutionalize and integrate pollution prevention practices through government services, policies, and initiatives. Region participation is dependent on the specific Request for Proposal, which is released annually. Additional information is found here: http://www.epa.gov/region09/funding/funding-sources/source-reduction.html

9.3.2 US Environmental Protection Agency – Wetlands Program Development Grants

This program seeks projects that promote the coordination and acceleration of research, investigations, experiments, training, demonstrations, surveys, and studies relating to the causes, effects, extent, prevention, reduction, and elimination of water pollution. The US Environmental Protection Agency (USEPA) has identified three priority areas: (1) the development of a comprehensive monitoring and assessment program; (2) the improvement of the effectiveness of compensatory mitigation; and (3) the refinement of the protection of vulnerable wetlands and aquatic resources. Award range depends on available funding. A 25 percent match is required. Eligible entities include states, tribes, local governments, interstate associations, intertribal consortia, and national non-profit, non-governmental organizations. http://water.epa.gov/grants_funding/wetlands/grantguidelines/

9.3.3 USEPA – Five Star Restoration Program

This program is a partnership among various entities, including the USEPA, National Association of Counties and National Fish and Wildlife Foundation. This program provides challenge grants, technical support and opportunities for information exchange to facilitate community-based wetland, riparian and coastal habitat restoration projects. In addition to on the ground restoration, key elements of project funded by this program include meaningful environmental education, diverse partnerships, and measurable ecological and educational/social benefits. Grant awards range from $25,000 to $35,000 on average and require fifty percent match. http://water.epa.gov/grants_funding/wetlands/restore/index.cfm

9.3.4 USEPA – Urban Waters Small Grants

This program helps fund research, studies, training, and demonstration projects that will advance the restoration of urban waters by improving water quality through activities that also support community revitalization and other local priorities. Projects must include one of three project types: community greening and green infrastructure, communities and water quality data, integration of water quality and community development in planning. In addition, projects must meet all program objectives, which include objectives to address local urban water quality issues; engage, educate and empower; support community priorities; involve underserved communities. Grant awards are limited to $60,000, with a $2,500 minimum cost share requirement. http://www2.epa.gov/urbanwaters/urban-waters-small-grants

9.3.5 National Fish and Wildlife Service – Environmental Solutions for Communities Grant Program

Under this program, the National Fish and Wildlife Foundation in partnership with Wells Fargo, provide financial assistance to help communities create a more sustainable future with highly-visible projects that link economic development and community well-being to the stewardship and health of the environment. Priority areas include, but are not limited to, projects that enhance stewardship on private agricultural lands to enhance water quality, quantity, and/or wildlife habitat; conservation projects that protect and restore local habitats and natural areas; demonstration projects that showcase innovative cost-effective and environmentally-friendly approaches to improve environmental conditions within urban communities. This annual

opportunity provides grants up to $100,000.
http://www.nfwf.org/environmentalsolutions/Pages/2014rfp.aspx

9.3.6 National Park Service – Rivers, Trails, and Conservation Assistance (RTCA) Program

The purpose of this program is to conserve rivers, preserve open space, and develop trails and greenways. The program provides staff assistance, but not funding, to meet this intent. Projects will be evaluated on how successfully they meet the following criteria: (1) a clear anticipated outcome leading to on-the-ground success; (2) commitment, cooperation, and cost-sharing by interested public agencies and non-profit organizations; (3) opportunity for significant public involvement; (4) protection of significant natural and/or cultural resources and enhancement of outdoor recreational opportunities; and (5) consistency with the National Park Service mission. Eligible organizations include non-profits, community groups, tribes or tribal governments, and state or local government agencies. http://www.nps.gov/orgs/rtca/index.htm

9.3.7 US Department of Agriculture (USDA) – Community Facilities Grants

This program provides grants to assist in the development of essential community facilities in rural areas and towns of up to 20,000 people. Grant funds can be used to construct, enlarge, or improve community facilities, including for community and public services, health care, and public safety. Generally funding is used for project under special initiatives, such as federally supported initiatives. http://www.rurdev.usda.gov/had-cf_grants.html

9.3.8 USDA – Emergency Community Water Assistance Grants

This program provides funding to assist rural communities (of up to 10,000 people) that have experienced a significant decline in quantity or quality of drinking water due to an emergency, or in which such decline is considered imminent, to obtain or maintain adequate quantities of water that meets the standards set by the Safe Drinking Water Act. There are two levels of funding limits depending on project types, ranging from $150,000 to $500,000.
http://www.rurdev.usda.gov/UWP-ecwag.htm

9.3.9 USDA – Rural Development, Water and Waste Disposal Program

The Water and Waste Disposal Program provides financial assistance in the form of grants and loans for the development and rehabilitation of water, wastewater, and storm drain systems within rural communities, with a population less than 10,000 persons. The intent of the program is to improve rural economic development and improve public health and safety. Funds can be used for construction, land acquisition, legal fees, engineering fees, capitalized interest, equipment, initial operation and maintenance costs, project contingencies, and other costs necessary for the completion of the project. There are no funding limits, but the average project size is between $3 and $5 million. Applications are continuously accepted. http://www.rurdev.usda.gov/UWP-dispdirectloansgrants.htm

Additional Rural Development Grant Assistance Program details can be found here:
www.rurdev.usda.gov/ca

9.3.10 USDA Natural Resources Conservation Service Grants

The Natural Resources Conservation Service (NRCS) provides funding opportunities for agriculturalists and others through various programs. Eligible agricultural producers, landowners and tribes may apply for financial assistance to help implement conservation practices or establish conservation easements, and grants may be available for eligible groups and organizations to promote new conservation technologies. Local Agricultural producers have benefited from the Environmental Quality Incentives Program (EQIP) to improve irrigation efficiency on their crops. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/?cid=stelprdb1048817

9.3.11 US Bureau of Reclamation – WaterSMART Grant Programs

This grant program is intended to fund collaborative local projects that improve water conservation and management through advanced technology and conservation markets. Through this program, federal funding is provided to irrigation and water districts for up to 50 percent of the cost of projects involving conservation, efficiency and water marketing. Eligible applicants include irrigation and water districts and state governmental entities with water management authority. Applicants must be located in the western US (California is an eligible area). Applicants do not have to be part of a Reclamation project but proposals with a connection to Reclamation will receive more weight in the evaluation process. Past and proposed programs have included Water and Energy Efficiency Grants, Advanced Water Treatment Pilot and Demonstration Projects, and Grants to Develop Climate Analysis Tools. Funding opportunities vary depending on available program funding. http://www.usbr.gov/WaterSMART/

9.3.12 US Bureau of Reclamation – Desalination and Water Purification Research and Development

This program funds research and development projects with the main goals to (1) augment supply of usable water in the United States, (2) understand environmental impacts of desalination and develop approaches to minimize impacts relative to other water supply alternatives, (3) develop approaches to lower financial costs of desalination to make it an attractive option relative to other alternatives in locations where traditional sources of water are inadequate. http://www.usbr.gov/research/AWT/DWPR/

9.3.13 US Fish and Wildlife Service (USFWS) – North American Wetlands Conservation Act Grant

This grant program provides funds for projects that provide long-term protection of wetlands, and the fish and wildlife that depend upon wetlands. Applicants must provide local match equal to that requested. The Small Grants Program provides up to $75,000 in funding and the Standard Grants Programs averages $40 million annually for the whole US and is applicable to projects exceeding $75,000. Entities that are eligible include organizations and individuals who have developed partnerships to carry out wetlands conservation projects in the US, Canada, and Mexico. Small Grants only apply to the US Applications are continuously accepted by the USFWS for this grant. http://www.fws.gov/birdhabitat/Grants/NAWCA/index.shtm

9.3.14 USFWS – Partners for Fish and Wildlife Program

This program provides cost-share funding and technical assistance to private land owners and their local partners. Assistance is given to restore streams, wetlands and other native habitat on private property. Highest priority projects are those that restore native habitat and provide long-term benefits to Federal trust species, including anadromous fish, migratory birds, and rare or listed species. Projects are developed year round. http://www.fws.gov/partners/

9.3.15 Federal Emergency Management Agency – Pre-Disaster Mitigation Program

This program provides grants to assist in cost-effective mitigation activities that complement comprehensive mitigation programs, reduce injuries, loss of life, and damage and destruction of property. Grants are available for developing Local Hazard Mitigation Plans (LHMPs) and for implementing mitigation projects prior to a disaster event, including but not limited to structure demolition or relocation, structural retrofitting, and minor localized flood reduction projects. Applications are submitted to California Emergency Management Agency (CalEMA) for consideration of annual federal solicitations.
http://www.calema.ca.gov/HazardMitigation/Pages/Grants.aspx

9.3.16 Federal Legislation

Specific congressional authorizations and funding may be obtained to study, build, and construct specific projects in the Region. Potential sources include legislation and funding associated with renewal of the Clean Water Act (CWA), the Safe Drinking Water Act (SDWA), and appropriations for specific agencies, such as the US Army Corps of Engineers (US ACOE) and the USEPA.

The Water Resources Development Act (WRDA) authorizes projects and policies of the Civil Works program of the US ACOE. The US ACOE is a federal agency in the Department of Defense with military and civilian responsibilities. At the direction of Congress, US ACOE plans, builds, operates, and maintains a wide range of water resources facilities in US states and territories. The agency's traditional civil responsibilities have been creating and maintaining navigable channels and controlling floods. However, in the last two decades, Congress has increased US ACOE's responsibilities in ecosystem restoration, municipal water and wastewater infrastructure, disaster relief, and other activities. WRDA often includes specific authorizations for federal, regional, and local projects. Inclusion in WRDA authorizes a given project but does not guarantee funding for a specific project.

Local projects can also receive authorization and federal funding as part of appropriations for the USEPA. The USEPA will enter into assistance agreements with local agencies to fund studies and projects associated with: (1) various environmental requirements (e.g., wastewater treatment); (2) identifying, developing, and/or demonstrating necessary pollution control techniques to prevent, reduce, and eliminate pollution; and/or (3) evaluating the economic and social consequences of alternative strategies and mechanisms for use by those in economic, social, governmental, and environmental management positions.

9.4 IRWM Project Funding

Securing funding for IRWM Plan projects is a significant issue for the IRWM Plan implementation. The Mojave Region has had success in implementing projects identified in the 2004 RWMP by making local investments and securing financial assistance through a variety of sources. Funding opportunities are typically focused on a specific resource management strategy or policy issue, so those projects that may rank highest in importance or priority to stakeholders may or may not be the first to be funded. The Coordinating Committee (CC), project proponents and stakeholders agree that it will be important to be flexible and responsive to financial assistance opportunities as they arise.

Table 9-2 documents a sample of previous, ongoing and near-term funding for the Mojave IRWM Plan. In the past, local entities have planned, implemented, and funded construction and operation of water-related projects. These local sources of funds may be available to fund Plan projects or to provide the local match. The projects described are a subset of the project list and are meant to convey the breadth of potential funding sources.

During the preparation of applications for the various financial assistance opportunities, the financing elements and certainty of the proposed funding will be evaluated in more detail for potential eligible projects. For each funding source identified, suitable projects on the Plan projects list will be put forward in an application. A summary of funding needs and the funding status for each Plan project will be prepared as appropriate for each financial assistance application. This summary will include estimates of outside funding assistance, amount of matching funds, type of matching funds, and whether the matching funds have been secured.

An additional valuable resource for identifying financial assistance opportunities is the California Financing Coordinating Committee. The California Financing Coordinating Committee hosts annual Funding Fairs that are open to the public. The fairs provide opportunities for project proponents to obtain information about currently available infrastructure grant, loan and bond financing programs and options. http://www.cfcc.ca.gov/funding_fairs.htm.

9.4.1 Tier 1 Project Funding

All project proponents with projects ranked in Tier 1 (high importance, high priority), were asked to complete a financing questionnaire and submit to the finance member of the Project Team, who then tabulated the information into various funding categories, including a breakdown of local agency participation. The questionnaire also asked that the project proponents describe the various funding sources for their project and the likelihood of the availability of those sources, as well as the certainty in future operations and maintenance (O&M) revenues to cover costs. The results are shown in Table 9-3.

Table 9-2
IRWM Plan Funding: Past, Ongoing and Near-Term Examples

Activity Description	Approximate Total Cost	Funding Source and % Total Cost	Funding Certainty/Longevity	O&M Finance Source	O&M Finance Certainty
Special Studies Climate Change	$100,000	USBR through grant	Completed.	N/A	N/A
Special Studies Salt and Nutrient Management Plan	$271,000	VVWRA		N/A	N/A
Water Conservation Incentive Program	$3.3 million	Awarded $2 million in Proposition 84 IRWM grant, $250k from Prop 50 funds, and MWA paid $1.1 million.	Grant funds included in Proposition 84 grant award, local funds contributed by project sponsors	N/A	N/A
Implementation Project - Invasive species Removal Mojave River	$3.4 million	$1.1 million Natural Resources Conservation Service (NRCS) grant, $250k from Prop 50 funds, and MWA paid $2.1 million.	Completed	N/A	N/A
Implementation Project - Regional Recharge and Recovery (R3) Project	$54.2 million	$24.5 million in DWR Prop 50 funds and $10.8 million in Title XVI grant funds[(a)] and MWA paid $18.9 million.	Completed.	MWA	100%
Implementation Project - Oro Grande Recharge Project	$8.6 million	$3.5 million in Challenge grant funds[(a)], City of Victorville paid $2.5 million and MWA paid $2.6 million.	Completed.	MWA	100%

(a) Grants were the result of the American Recovery and Reinvestment Act (ARRA) stimulus funds and are administered by the US Bureau of Reclamation.

Table 9-3a
Mojave IRMW Plan Financing Tier 1 Projects (Project Details)

Proj. No.	Project Name	Project Sponsor	Project Begin	Project End	Current Status
106	Sheep Creek Recharge Basin & Two Wells	Phelan Piñon Hills Community Service District (PPHCSD)	2/1/2020	9/1/2020	Conceptual Planning
18R	Commercial/Industrial/Multi-Family Cash for Grass	Mojave Water Agency (MWA)	7/1/2014	6/30/2014	Ready for Implementation
1012	Cedar Street/Bandicoot Detention Basin	City of Hesperia	7/1/2012	7/1/2017	Eng. 90%;CEQA complete
1011	Antelope Valley Wash/Ranchero Basin Recharge	City of Hesperia	7/1/2013	7/1/2023	Prelim. eng. has begun to identify affected properties and ROW requirements
32	Tertiary Treatment Upgrade	Helendale CSD	1/1/2015	6/30/2016	Completed plans and studies
60R	Reorganization between 2 small water agencies	Bighorn-Desert View Water Agency	2/1/2014	1/1/2017	In LAFCO proceedings
92R	Wastewater Reclamation Project	Hi-Desert Water District	5/19/2007	5/19/2022	Design for collection 80% complete, facility design scheduled to begin FY 14/15
93	Apple Valley & Hesperia Subregional Water Reclamation Facilities	VVWRA	9/1/2014	9/1/2016	Approving financial plan and rate ordinances - bid for construction in 5/2014
95	Adelanto Pearmain Relief Sewer Line	City of Adelanto	11/1/2014	2/1/2015	Ready to bid for construction
1004	Baja Sustainability Initiative #1 (Ag Water Conservation & Base Annual Production Right Acquisition Program)	MWA/Mojave Desert Resource Conservation District	7/1/2014	6/30/2015	Preliminary planning stage for rolling out programs
1003	Assistance Program for Small Drinking Water Systems- identification of potential projects	MWA	7/1/2013	ongoing	Hired California Rural Water Association (CRWA), work started
1003A	Water Well #10	Helendale CSD	2/1/2017	2/1/2018	Not started
19	Assistance Program for Small Drinking Water Systems- Hinkley's Community Drinking Water System Feasibility Study	MWA	11/1/2013	6/1/2016	Hired CRWA, work started
116	Assistance Program for Small Drinking Water Systems- Barstow Perchlorate/Nitrate Feasibility Study	MWA	11/1/2013	6/1/2016	Hired CRWA, work started

TABLE 9-3b
Mojave IRWM Plan Financing Tier 1 Projects (Financing Details)

Proj. No.	Project Name	Est. Capital Cost (2014 dollars)	Total Local Funding	State and Federal Grant Funding	Grant Funding Type	Funding Certainty/Longevity	O&M Finance Source	O&M Finance Certainty
106	Sheep Creek Recharge Basin & Two Wells	$3,500,000	$1,500,000[a]	$2,000,000	Seeking $1 million in state grants and $1 million in federal grants – type not identified.	MWA funding not committed. PPHCSD portion not funded as of IRWM Plan adoption.	Secured by water rates.	Yes, estimated at $20k/year.
18R	Commercial/Industrial/ Multi-Family Cash for Grass	$2,000,000	$0	$2,000,000	$1 million from USBR Title XVI WaterSMART grant and $1 million from Prop 84 grant.	Grant funding not secured.[b]	N/A	N/A
1012	Cedar Street/Bandicoot Detention Basin	$25,700,000	$19,700,000[c]	$6,000,000	Prop 84	Grant funding not secured.	Property Taxes	Yes, estimated O&M is unknown.
1011	Antelope Valley Wash/Ranchero Basin Recharge	$23,000,000	$17,000,000[c]	$6,000,000	Prop 84	Grant funding not secured.	Property Taxes	Yes, estimated O&M is unknown.
32	Helendale CSD Tertiary Treatment Upgrade	$3,523,500	$523,500[d]	$3,000,000	SWRCB SRF and Recycling Program	Grant funding not secured.	Sewer Rates	Yes, estimated at $750k/year.
60R	Reorganization between 2 small water agencies	$342,000	$342,000[e]	$0	N/A	N/A	Water Rates	Yes
92R	Wastewater Reclamation Project	$121,497,000	$110,265,000[f]	$11,232,000	USBR Title XVI, Prop 84, and Cleanup & Abatement Grant.	Most grant funding secured; assessment district vote to approve SRF loan likely to pass	Sewer Rates	Yes, estimated at $2,170k/ year.
93	Apple Valley & Hesperia Subregional Water Reclamation Facilities	$51,000,000	$39,000,000[g]	$12,000,000	USBR Title XVI, SWRCB Water Recycling Grant, and Prop 84	$9 million in grants secured, applications submitted for another $3 million	Sewer fees	Yes, estimated at $1,400k/ year.
95	Adelanto Pearmain Relief Sewer Line	$1,200,000	$1,200,000[h]	$0	N/A	N/A	Sewer Rates	Yes, estimated at $10k/ year.

TABLE 9-3b
Mojave IRWM Plan Financing Tier 1 Projects (Financing Details)

Proj. No.	Project Name	Est. Capital Cost (2014 dollars)	Total Local Funding	State and Federal Grant Funding	Grant Funding Type	Funding Certainty/Longevity	O&M Finance Source	O&M Finance Certainty
1004	Baja Sustainability Initiative #1 (Ag Water Conservation & Base Annual Production Right Acquisition Program)	$5,500,000	$500,000(i)	$5,000,000	USBR Title XVI WaterSMART and Prop 84 – each for $2.5 million.	Water purchase funded, grant funding for agriculture conservation not secured.	N/A	No O&M required so certainty is N/A.
1003	Assistance Program for Small Drinking Water Systems- identification of potential projects	$500,000	$500,000(i)	$0	N/A	Fully funded.	Property Taxes	Yes, estimated at $200k/ year.
1003A	Water Well #10	$1,500,000	$1,000,000(j)	$500,000	Assistance Program for Small Systems (CDPH).	Reserve funds available in 2016/17; other sources not secured.	Water Rates	Yes, estimated at $75k/ year.
19	Hinkley's Community Drinking Water System Feasibility Study	$20,000	$20,000(i)	$0	N/A	Fully funded.	N/A	N/A
116	Barstow Perchlorate/Nitrate Feasibility Study	$20,000	$20,000(i)	$0	Not identified.	Fully funded.	N/A	N/A

(a) Two sources: PPHCSD has committed $500k and will be requesting MWA to commit $1million.
(b) Indicates that no grant application has been submitted.
(c) Source is the County of San Bernardino.
(d) Source is Helendale CSD.
(e) Source is BDVWA.
(f) SRF loans totaling approximately $110,265,000 will be issued requiring an approval vote by ratepayers.
(g) SRF loans totaling approximately $39 million will be issued with no approval vote required.
(h) Source is the City of Adelanto.
(i) Source is MWA.
(j) Source is Helendale CSD for $500k and SRF loans totaling approximately $500k will be issued with no approval vote required.

Section 10: Data Management, Technical Analyses, and Plan Performance

This section is organized into two parts to summarize the data management, technical analyses, and performance of the Mojave Integrated Regional Water Management Plan (IRWM Plan). Sections 10.1 and 10.2 describe the data management efforts and technical analyses conducted during preparation of the IRWM Plan. Sections 10.3 and 10.4 examine monitoring, ongoing data management, and plan performance during implementation, and describes how performance data will be used to improve future versions of the IRWM Plan.

In general, the success of the IRWM Plan will depend on how well each of the individual Plan objectives is accomplished. The 14 objectives, detailed in Section 4, were developed and given measurable targets by the Plan participants through a collaborative process. These measurable objectives, implemented through Plan projects, should allow progress of the IRWM Plan to be assessed through time, and will help to determine its overall success for the Region.

10.1 Data Management and Technical Analyses for Plan Preparation

The Mojave IRWM Plan documents the results of a collaborative effort of over 50 public agencies with varying water, resource management and flood management responsibilities, as well as numerous other interested entities. The IRWM Plan was prepared using information and guidance provided by the Regional Water Management Group (RWMG) and Stakeholder Group. The IRWM Plan in turn, will be used by these same entities to guide and support their future water management efforts.

Extensive information and data on the Region have been prepared by various entities. That information was reviewed and evaluated as part of this IRWM Plan and served as the foundation for the development of this Plan, as described below.

10.1.1 Existing Information and Reports

The following documents contain the baseline information used in the development of the IRWM Plan. A brief summary of the reports, identification of who participates in their preparation and identification of the type of information generated by the document is provided for each report listed.

10.1.1.1 Water Resource Management Reports

These reports document the reliability and availability of the Region's water supplies to meet current and projected demands. These reports include both urban water management plans (UWMPs) and groundwater management plans (GWMPs).

The California Urban Water Management Planning Act applies to public and private municipal water suppliers with more than 3,000 connections or supplying more than 3,000 acre-feet per year (afy). The act requires suppliers to describe and evaluate sources of water supply, evaluate potential demands for water, efficient uses of water via certain demand management measures (DMMs), implementation strategy and schedule, and other relevant information and programs.

This information is used by the urban water supplier to develop a UWMP, which is submitted to California Department of Water Resources (DWR) in years ending in five and zero (e.g., 2000, 2005, 2010).

AB 3030, the California Groundwater Management Act, authorized local agencies to prepare GWMPs for groundwater basins not subject to adjudication or other form of regulation. AB 3030 lays out a procedure for development of a GWMP. The act also specifies twelve technical components which can be included in a GWMP, including replenishment strategy, mitigation of overdraft, mitigation of contaminated groundwater, and avoidance of saline intrusion. Recent updates to AB 3030 have been adopted, which further refine and augment the content of GWMPs.

10.1.1.1.1 2010 Mojave Water Agency UWMP

The *2010 Mojave Water Agency UWMP* was prepared for the Mojave Water Agency (MWA) wholesale service area, which encompasses the service areas of forty-six local retail water agencies. The 2010 UWMP contains information on water use, water resources, recycled water, water quality, reliability planning, DMMs, and water shortage contingency planning within the service area. The 2010 UWMP will be updated in 2015.

The ten retail water purveyors within the MWA service area required to prepare their own UWMPs are as follows:

- City of Adelanto (*2010 UWMP*): The service area encompasses approximately 7,300 customers within the 50 square mile area. Groundwater is drawn from the Alto Subarea of the Mojave Basin.

- Apple Valley Ranchos Water Company (*2010 UWMP*): The approximately 50 square mile service area encompasses the majority of the Town of Apple Valley and portions of the unincorporated area of San Bernardino. Over 62,000 people are served by local groundwater.

- San Bernardino County Service Area (CSA) 64 (*2010 UWMP*): The CSA 64 service area covers approximately four square miles with a population of over 9,800 in the unincorporated area of San Bernardino County, including the Spring Valley Lake Community.

- CSA 70J (still preparing its *2010 UWMP*): The County Service Area includes the Oak Hills Community.

- Golden State Water Company (GSWC) – Barstow System (formerly Southern California Water Company) (*2010 UWMP*): The Barstow System serves approximately 30,600 people within the City of Barstow and surrounding unincorporated area.

- Hesperia Water District (*2010 UWMP*): The District's service area mostly matches the boundaries of the City of Hesperia, encompassing 74 square miles, with a population of over 90,000.

- Hi-Desert Water District (*2010 UWMP*): The District serves customers within a 57-square mile service area, which includes the Town of Yucca Valley and surrounding unincorporated areas.

- Joshua Basin Water District (*2010 UWMP*): The District was formed in 1963 and serves nearly 10,000 people within a 100-square mile service area.

- Phelan Piñon Hills Community Services District (PPHCSD) (*2010 UWMP*): PPHCSD was formed in 2008 and was formerly CSA 70L. The service area encompasses approximately 118 square miles and serves over 20,800 people.

- Victorville Water District (*2010 UWMP*): This District was formed through the consolidation of the Baldy Mesa Water District and the Victor Valley County Water District into the City of Victorville in 2007. The Service Area encompasses approximately 85 square miles with a population of over 100,000.

As described in Section 1, four areas adjacent to the previously established IRWM Planning Region were included in the Mojave Region's boundaries during the 2014 update process. These areas, as shown on Figure 1-3, include:

- Twentynine Palms Area

- Upper Mojave River Watershed Area

- Afton Canyon Area (Lower Mojave River Watershed Area)

- Wrightwood Area

The four expansion areas were not included in MWA's 2010 UWMP because they are outside the MWA service area. The following water purveyors within these four expansion areas are required to prepare their own UWMPs:

- Crestline-Lake Arrowhead Water Agency (2010 UWMP): This agency primarily provides wholesale water service from Cedar Pines Park to Green Valley Lake, along with some direct service to retail customers. Approximately 2,750 permanent residents are served across a service area of approximately 150 square miles in the San Bernardino Mountains.

- Lake Arrowhead Community Services District (2010 UWMP): This Special District provides water and wastewater services to an area encompassing approximately 15 square miles, within the Lake Arrowhead Census Designated Place (CDP). This CDP has a population of over 7,100.

- Twentynine Palms Water District (2010 UWMP): The District encompasses an area of approximately 86.6 square miles and includes the City of Twentynine Palms. Over 18,800 residents receive water services within the service area.

10.1.1.1.2 2004 Mojave Water Agency RWMP/GWMP/IRWM Plan

In 2005, MWA adopted the 2004 Regional Water Management Plan (2004 RWMP), which served as the Mojave Region's first IRWM Plan and additionally served as a Groundwater Management Plan (GWMP) and UWMP. The RWMP was developed in collaboration with local stakeholders, such as water and wastewater agencies, and evaluates potential water supply projects and programs that provide regional benefit. It has provided a road map for long-term, balanced water resources management in the MWA service area and outlined 60 water resource management actions for the Region. The RWMP has also provided a basis for acquiring State and Federal funding for local water supply, conservation and management projects and has enabled significant investments in the Region's water infrastructure and supplies over the last decade. The 2004 RWMP has been used as the foundation for developing this 2014 Mojave IRWM Plan. The IRWM Plan is anticipated to be updated approximately every five years (as described in Section 8.4).

10.1.1.1.3 Mojave Basin Area Watermaster Annual Reports

The Mojave Basin Area Watermaster is, by order of the 1996 Judgment, required to file an Annual Report with the Court detailing its activities for the water year. Data and information contained in the reports, include, but are not limited to the following:

- Review of Watermaster activities
- Hydrologic data (include runoff, precipitation, water levels, and other data)
- Status of replacement and makeup water obligations
- Purchases of and recharge with supplemental water
- Proposed free production allowances for subareas
- Summary of water production
- Transfers of base annual production rights, free production allowance and prior year carryover
- Financial report, proposed budget, and assessment rates
- Biological Trust Fund financial report

The Mojave Basin Area Watermaster has filed twenty annual reports with the Court upon filing of its Annual Report for the 2012-13 Water Year on May 1, 2014. The annual reports can be found here: http://www.mojavewater.org/annual_report.html.

10.1.1.1.4 Warren Valley Basin Watermaster Annual Reports

Since 1992, the Warren Valley Basin Watermaster has been required to provide annual reports to the Court as a result of the 1977 Judgment. Initially, annual reports reported on water levels in the basin for purposes of making safe yield determinations. As of 1997, a groundwater monitoring program was implemented for basin management, and annual reports include information on the conditions affecting water supply, use and disposal to ensure adequate water in storage.

Annual reports are based on an October 1 through September 30 water year. The Warren Valley Basin Watermaster reports on precipitation, water demands, production, water deliveries, water levels and trends. Information is obtained from various sources, including records on file with Hi-Desert Water District (HDWD), MWA, State Water Resources Control Board, and Yucca Valley California Department of Forestry. The latest annual report available is the 2011-2012 report. The annual reports can be found here: http://www.hdwd.com/annual-reports/.

10.1.1.1.5 Warren Valley Basin Management Plan

Originally adopted in 1991, the Warren Valley Basin Management Plan was revised in 1996 subsequent to the restructuring of the Watermaster Board, release of additional basin studies and revision of the safe yield of the basin. The Management Plan provides a viable plan to effectively address overdraft in the basin. Based on established management objectives, the Management Plan includes program element recommendations to guide management activities over the short term and into the long term. Among various recommended actions are implementation of water quality and basin monitoring plans, evaluation of the opportunities for interagency conjunctive use, and evaluation of additional recharge basins.

10.1.1.1.6 Twentynine Palms Water District (TPWD) Groundwater Management Plan (GWMP) Update

The TPWD 2008 GWMP Update provides an update to the District's 2001 GWMP to incorporate required elements of the amended California Water Code. The 2008 Update also includes revised descriptions of the District's groundwater basins to reflect updates to Bulletin 118 as well as updates to the District's groundwater management activities. The Plan describes the basin management objectives used to define the quantitative goals that guide management activities of the District's groundwater sources, which include the Twentynine Palms Valley Groundwater Basin and portions of the Joshua Tree Groundwater Basin.

In addition to the GWMP, TPWD prepared a Groundwater Protection Plan (GPP) in 2013, which also provided relevant information for this IRWM Plan. The GPP was developed to assess and mitigate the long-term potential impacts to groundwater quality from the use of septic tanks.

10.1.1.2 Facilities Plans and Master Plans

A facilities plan and/or master plan is a physical development plan that provides the framework by which future planning decisions are made. It is an action plan for a particular resource or service such as recycled water, flood control, and wastewater facilities.

10.1.1.2.1 2005 VVWRA Sewerage Facilities Plan

The Victor Valley Wastewater Reclamation Authority (VVWRA) is a Joint Powers Agreement (JPA) that owns and operates wastewater collection and treatment facilities in the Town of Apple Valley, the City of Hesperia, City of Victorville, Southern California Logistics Airport, and San Bernardino CSAs 42 and 64. A Sewerage Facilities Plan was initially developed in 1997, including information on population growth, projected wastewater flows, interceptor capacity, regional wastewater treatment, subregional reclamation facilities, and water recycling through 2020. Since then, the Plan has been amended three times, in 2000, 2002, and 2005 to reflect more current conditions and updated projections. The 2005 Plan outlines the capital improvement projects for implementation through 2025, including expansion of the regional wastewater treatment plant, presented in the adopted Capital Improvement Plan (CIP).

10.1.1.2.2 2007 City of Adelanto Sewer Master Plan

The City of Adelanto Water Department provides water and wastewater service to over 27,000 residents. In 2007, a Sewer Master Plan was completed with the purpose of conducting a comprehensive review of the existing sewer system and wastewater treatment plant. The Plan helped identify system deficiencies, and recommend improvements and potential expansions necessary to maintain a reliable sewage conveyance and treatment system within the service boundaries of the City of Adelanto. Conclusions presented in the Plan include proposed expansion of the current system to accommodate growth anticipated for the City.

10.1.1.2.3 2009 City of Barstow Sewer Master Plan (Draft)

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 City of Barstow developed a “Draft Sewer Master Plan” in November 2009 in an effort to evaluate the existing wastewater disposal and treatment system and the potential for recycled water use. The current treatment plant is anticipated to be expanded to accommodate anticipated growth and a recycled water system may be constructed in conjunction with new planned developments.

10.1.1.2.4 2008 City of Hesperia Water Master Plan

The City of Hesperia currently relies entirely on groundwater as its only source of water supply. The City’s water system is managed by the Hesperia Water District, which is a subsidiary special district of the City. A hydraulic model was used to analyze the existing water system, proposed water facilities, and various “what-if” scenarios. The computer analysis assisted in the identification and selection of infrastructure and operational improvements to help the City meet its goals.

10.1.1.2.5 2008 City of Hesperia Recycled Water Master Plan

The purpose of this study was to develop a Recycled Water Master Plan for the City of Hesperia that evaluated the feasibility and identified the system requirements to develop a recycled water system within the study area, including a CIP.

The City of Hesperia currently does not provide recycled water to any customers due to the distance (15 miles) between the VVWRA plant and the City. However, one of the projects submitted to this IRWM Plan by the City of Hesperia was for the Recycled Water Distribution Pipeline Project that would connect the planned VVWRA 4.0-mgd subregional reclamation facility in Hesperia, construction is estimated for 2014 to 2016, to potential recycled water customers which includes a golf course. The Project is listed in Table 6-3. The Recycled Water Master Plan identified recycled water irrigation customers, commercial and industrial customers, and future developments. When irrigation and customer demand is low, the reclaimed water produced by the VVWRA 4.0 mgd facility will be discharged into nearby percolation basins.

10.1.1.2.6 2008 City of Hesperia Wastewater Master Plan

Geographically, approximately five (5) percent of the study area is currently served by sewers that ultimately flow to a regional wastewater treatment plant (WWTP) owned and operated by the

VVWRA. The remaining area is undeveloped or served by on-site septic systems. The City of Hesperia's wastewater system is managed by the Hesperia Water District, which is a subsidiary special district of the City. The overall goals of this Wastewater Master Plan are as follows: (1) Create an updated computer model by incorporating new facilities, new pipelines, and proposed new developments. (2) Incorporate the area's growing development patterns into the wastewater production projections. (3) Evaluate what improvements are needed or will be needed to meet current and future wastewater production. (4) Maximize the efficiency of system operations for these changes. (5) Establish realistic cost estimates for the recommended capital improvements.

10.1.1.2.7 2009 Hi-Desert Water District (HDWD) Sewer Master Plan

The HDWD service area includes the Town of Yucca Valley and portions of the unincorporated area of San Bernardino County. HDWD finalized the Sewer Master Plan in 2009, which provides an update to its 1998 Wastewater Collection and Treatment Master Plan. HDWD plans to connect the majority of its water customers to a new wastewater collection and treatment system as a means of protecting groundwater quality in the area. The Sewer Master Plan will help planning of the proposed sewer system. A sewer hydraulic model developed as part of the Plan helps identify necessary infrastructure for the proposed sewer system and evaluates the sewer system under projected future conditions. In addition, the Plan presents a CIP to identify and prioritize sewer infrastructure projects to support anticipated growth.

10.1.1.2.8 Golden State Water Company (GSWC) 2013 Region III Water Master Plan - Wrightwood System

This 2013 Water Master Plan updates the water demand projection estimates from the 2008 Water Master Plan. The Wrightwood supply and storage analysis for the existing system is included, using the total and firm production capacities and the storage allocations, along with total existing demands. These projected annual water demands were extrapolated to 2035 to determine the projected water use of 819 afy. Currently, source and distribution water quality complies with all federal and state drinking water requirements.

10.1.1.3 Resource Conservation Plans

10.1.1.3.1 West Mojave Plan

The West Mojave Plan is an amendment to the California Desert Conservation Area Plan, a federal land use plan. The Plan was adopted in 2006 by Bureau of Land Management (BLM) and presents a comprehensive strategy to conserve and protect the desert tortoise, the Mohave ground squirrel and nearly 100 other sensitive plants and animals and the natural communities of which they are a part, while providing a streamlined program for complying with the requirements of the California and federal Endangered Species Acts (CESA and FESA, respectively). The West Mojave Plan was developed in collaboration with numerous agencies, local jurisdictions and other stakeholders vested in the future of the western Mojave Desert.

West Mojave Plan documents, including the Final Environmental Impact Statement/Report, are available on the following BLM webpage: http://www.blm.gov/ca/st/en/fo/cdd/wemo.html

10.1.1.3.2 2012 Morongo Basin Conservation Priorities Report

The *2012 Morongo Basin Conservation Priorities Report*, developed by the Sonoran Institute, serves as a resource guide helping to inform and support conservation activities, and to balance environmental protection with the enhancement of social and economic well-being throughout the Morongo Basin area. The report is a result of ongoing long-term development and conservation efforts in the Morongo Basin. As a means of addressing identified priorities numerous action steps have been outlined, which include actions such as maintaining a forum and dialogue for regional conservation planning, establishing conservation easements and purchasing land for conservation purposes, and enacting incentives and regulations for wildlife-sensitive development.

10.1.1.3.3 2011 Revised Recovery Plan for the Mojave Population of the Desert Tortoise

Revised Recovery Plan for the Mojave Population of the Desert Tortoise from US Fish and Wildlife Service (USFWS) provides a roadmap for the recovery of the desert tortoise. The Plan identifies threats to the species and suggests actions to promote full recovery and ultimately delisting of the population. Resource management in the Mojave Region is highly relevant to the species recovery as large areas of the Mojave Region are designated as desert tortoise critical habitat.

10.1.1.3.4 2012 A Linkage Network for the California Deserts

This 2012 Report is a result of multi-stakeholder collaboration on the California Desert Connectivity Project, which was initiated to identify areas essential to the restoration of ecological connectivity and conservation of biodiversity in California's deserts. The linkage conservation plan serves as a guide for various agencies such as the US Department of the Interior Bureau of Land Management, organizations and individuals, including local jurisdictions, transportation agencies, regulatory agencies, land management and wildlife agencies, conservation organizations and property owners, to help sustain and enhance biodiversity and ecosystem processes with implementation of the linkage designs outlined in the plan.

10.1.1.3.5 Senate Bill 7 of Special Extended Session 7 (SBX7-7)

Codified in California Water Code Sections 10608 and 10800-10853, creates a framework to reduce California's per capita water consumption 20% by 2020. The law establishes methods for urban retail water suppliers to determine their urban water use target. The bill also requires urban water suppliers to set an interim urban water use target and meet that target by December 31, 2015. SBX7-7 also requires agricultural water suppliers to implement efficient water management practices and prepare, adopt, and periodically revise agricultural water management plans to document their water conservation efforts. DWR is required to work cooperatively with the California Urban Water Conservation Council in achieving the goals of SBX7-7. Implementation of SB7X-7 requirements is resulting in changes in local land use planning practice to encourage and require reductions in per capita consumption.

10.1.1.4 Water Quality Plans and Reports

10.1.1.4.1 *Basin Plans*

The Mojave Region lies within the jurisdiction of two Regional Water Quality Control Boards (RWQCB): the Lahontan and the Colorado River Basin RWQCBs. Both of these RWQCBs implement Water Quality Control Plans (Basin Plans) that are applicable to portions of the Mojave Region.

These Basin Plans are the basis for RWQCB regulatory programs, outlining water quality standards for surface waters and groundwater in the Region.

The Plans are designed to preserve and enhance water quality and protect the beneficial uses of water within the region's jurisdiction. Specifically, the Basin Plans designate beneficial uses for surface waters and groundwater, set narrative and numerical objectives that must be attained or maintained to protect the designated beneficial uses and conform to the state's anti-degradation policy, and describes implementation programs to protect all waters in the Region. The Basin Plan implements numerous state and federal laws, most importantly the federal Clean Water Act and the State Porter-Cologne Water Quality Control Act, and incorporates various other pertinent water quality policies and regulations. As conditions change, such as the identification of new Total Maximum Daily Loads (TMDLs) or water quality standards, the Basin Plan is amended. Following adoption by the RWQCB, the Basin Plan and subsequent amendments are subject to approval by the State Water Resources Control Board (SWRCB), the State Office of Administrative Law, and the United States Environmental Protection Agency (USEPA).

10.1.1.4.2 *Lahontan RWQCB Basin Plan and Amendments*

The Lahontan RWQCB Basin Plan took effect in 1995. The Lahontan RWQCB encompasses an area of 33,131 square miles and includes the eastern slopes of the Warner Mountains and Sierra Nevada, the northern slopes of the San Bernardino and San Gabriel Mountains, the southern slopes of the Tehachapi Mountains, and other ranges. The Mojave River Watershed is located in the South Lahontan Basin.

10.1.1.4.3 *Colorado River RWQCB Basin Plan and Amendments*

The Basin Plan of the Colorado River was adopted in 2006. The Colorado River RWQCB covers approximately 20,000 square miles in the southeastern portion of California, including all of Imperial County and portions of San Bernardino, Riverside, and San Diego Counties. The southeastern portion of the Mojave Region falls within the Colorado River Region.

10.1.1.4.4 *Annual Consumer Confidence Reports*

Consumer Confidence Reports are required by the California Health and Safety Code §116470, as well as the SDWA and USEPA. These reports include information on a system's source water, the levels of any detected contaminants, and compliance with drinking water regulations, plus some educational material. Contaminants typically reported include turbidity, coliform, lead/copper, unregulated contaminants, and those contaminants of concern specific to a particular location. The annual Consumer Confidence Reports provided by the Region's local water purveyors inform customers on the quality of their water based on the most current data. Each report contains a summary of thousands of water quality tests performed in the respective service area, as well as discussions of noteworthy contaminants, updates on regulatory news, tips on indoor and outdoor water conservation and other useful water-related information.

10.1.1.5 City, County, and Federal Land Use Plans

Land use plans provide for the scientific, aesthetic, and orderly disposition of land, resources, facilities and service of urban and rural communities. General plans are a compendium of city or county policies regarding long-term development, in the form of maps and accompanying text. In California, general plans have seven mandatory elements (circulation, conservation, housing, land use, noise, open space, safety and seismic safety) and may include any number of optional elements (such as water, air quality, economic development, hazardous waste, and parks and recreation). Most local general planning documents generally have identified water management resource strategies that integrate with land use planning efforts. By law, each city and county is required to update the Housing Element of its general plan every five years and the Governor's Office of Planning and Research recommends that the remaining elements be reviewed every eight to ten years.

The following General Plans provided relevant information for the development of the Mojave IRWM Plan:

- 1995 City of Adelanto General Plan
- 1997 City of Barstow General Plan
- 1999 City of Big Bear Lake General Plan
- 2010 City of Hesperia General Plan
- 2012 City of Twentynine Palms General Plan
- 2008 City of Victorville General Plan
- 2009 Town of Apple Valley General Plan
- 1995 Town of Yucca Valley General Plan
- 2012 San Bernardino County General Plan

Community Plans developed as part of the County of San Bernardino General Plan also provided relevant information for this IRWM Plan and include:

- 2008 Bear Valley Community Plan
- 2007 Crest Forest Community Plan
- 2007 Hilltop Community Plan
- 2007 Homestead Valley Community Plan
- 2007 Joshua Tree Community Plan
- 2007 Lake Arrowhead Community Plan
- 2007 Lucerne Valley Community Plan
- 2013 Oak Hills Community Plan
- 2007 Phelan/Pinion Hills Community Plan

10.2 Data Management

As part of IRWM Plan implementation, data will be collected to support assessment of project and Plan performance.

The process for managing and disseminating this information to stakeholders is discussed below. In addition, opportunities for data collection have been identified and a process for integrating collected information into statewide programs is described.

Apart from those containing sensitive information, publicly funded data and materials are made available to the public via the Mojave IRWM Plan website (www.mywaterplan.com) in an easily accessible and searchable format.

10.2.1 Data Collection Techniques

One of the primary methods for gathering data is outreach to the project proponents. Periodically the IRWM Plan Coordinating Committee (CC) and/or the Implementation Support Team (IST) will contact the project proponents via email or mail, and request that they complete a template form to assist in updating their information in the regional project database.

The status of each project will be collected via a regional project database maintained by MWA and will contain standardized items for each project, including keywords such as location, participating organizations, budget, status, etc. The CC and/or the IST will make periodic calls for project proponents to update their information – this will most likely be via a template form that is emailed to all the proponents with the standard information needing to be completed and then returned via email or mail. This will help to ensure that the project information is current. As the data needs of the Region continue to evolve, the regional project database can be updated by appending new fields. By addressing these needs, the CC will ensure that the projects directory provides a useful platform for the future planning needs of the Region.

Another way data is collected is through grant management requirements. For example, a typical IRWM Plan Proposition 84 grant has a monitoring plan requirement that might include the following details:

- Project Performance Measures Table that typically contains:

  a) Baseline conditions,

  b) Brief discussion of monitoring systems to be utilized,

  c) Methodology of monitoring,

  d) Frequency of monitoring, and

  e) Location of monitoring points.

10.2.2 Data Management and Dissemination

A variety of steps will be required for IRWM Plan implementation, including adoption, implementation of priority projects, and updated approaches to data management as needs evolve. Successful completion of each of these steps will require effective data management and dissemination, as described below.

Information will be collected and compiled at two levels, including the project level and the IRWM Plan level. Table 10-1 identifies the types of activities that will be undertaken as part of IRWM Plan implementation.

Table 10-1
IRWM Plan Data Management Responsibilities

Level	Responsible Party[(a)]	Data Management and Dissemination Task	Frequency
Project Level	Project Proponents	• Compile and maintain project implementation information through monitoring program implementation. • Disseminate project implementation information, as necessary, to meet applicable reporting requirements. • Disseminate project implementation information, as appropriate, to Stakeholder Group.	• Quarterly, or as dictated by grant reporting requirements. • Annually or bi-annually, in response to CC requests.
IRWM Plan Level	IRWM Plan CC and IST	• Compile information prepared by Project Proponents into regional outlook. • Disseminate regional outlook to stakeholders.	• Bi-annually, in response to CC requests.

Note: (a) Tasks, frequency, and responsible parties assume adequate funding and other resources are available.

Compiling or reviewing this information on a regional scale will enable the IRWM Plan CC and IST to communicate effectively about the contribution of the projects to the Regional objectives.

As shown in Table 10-1, data will be collected at the project level, reported and compiled on the website, and then reviewed and disseminated through the website. These data on the website may be further disseminated through other means. Data management and dissemination responsibilities at each level are described below.

10.2.3 Project-Level Data Management and Dissemination

At the project level, project proponents will be responsible for submitting information on project implementation status as well as evaluating project performance with respect to the performance measures identified for each project.

A large quantity of information on Plan projects will be developed and collected as part of IRWM Plan implementation and performance assessment. This information will range from water supply and demand information to recycled water usage, water quality data, floodplain reduction project information, stormwater runoff quality and quantity, and habitat mapping information. Section 10.3 lists examples of existing Mojave Region monitoring efforts, and provides examples of performance metrics and the variety and types of information to be gathered at the project level.

10.2.4 Plan-Level Data Management and Dissemination

As described earlier in Section 10.2.1 and assuming sufficient funding and other resources are available, future work will be guided by the CC and IST. As part of this process, the CC will collect the information from the project proponents to assess IRWM Plan performance in contributing to the IRWM Plan objectives. The CC can compile, along with information from ongoing planning efforts like UWMPs, Master Plans, Conservation Plans, and General Plans and manage this information, and ultimately disseminate these data to the public.

As future work is completed, the various city, county and water agencies will provide data to the CC in electronic format. Existing regional data collection sources (such as those identified in Table 10-2) may also be reviewed for their applicability in assessing Plan performance, as resources and funds permit. As appropriate, these data will be maintained, along with project-specific data and information compiled CC on the IRWM Plan website.

IRWM Plan stakeholders and the general public will be informed of the process and online data availability through email announcements and postings on the Mojave IRWM Plan website. An archive of past meetings will be kept on the website along with relevant meeting materials. For additional information on anticipated stakeholder involvement during Plan implementation, please refer to Section 11: Coordination and Outreach.

Currently, very few California State databases have the same format, but there are future plans for achieving this as required by statute. Some State databases, including California Statewide Groundwater Elevation Monitoring (CASGEM) and Surface Water Ambient Monitoring Program (SWAMP), have a particular format for submission of data which for the most part mirrors the Region’s data design maintained by MWA. However, when communicating with State databases there will be a certain amount of data manipulation required so that MWA’s system can provide these data in a format compatible with particular State database requirements. This can be accomplished by creating templates for data collection from MWA’s system and formatting into what is needed by the required State database.

For geospatial data collected by RWMG members, data maintained by the Region will be accompanied by applicable metadata that describes each data set (including projection and datum information, dataset description, data lineage, etc.). For projection, the State Plane Coordinate System used is the North American Datum (NAD) 83 (Feet California Zone V). This is primarily used for regional data because it minimizes distortion from a spatial aspect. Also, MWA uses ESRI geographic information system (GIS) software that automatically creates metadata with data lineage. MWA has internal standards for formatting data that provides the basic information to anyone wanting to use these data.

10.3 Existing Data Collection and Monitoring Efforts

Within the Region there is an existing system in place for collecting data on groundwater and surface water supplies and water quality. Collection of data can be used to help quickly identify data gaps, assess project and program performance, support statewide data needs, and integrate with other regional and statewide programs.

The Mojave Region is comprised of multiple stakeholders with resource management duties. As such these agencies regularly collect and disseminate data as part of their normal operation. The Mojave Region RWMG will take advantage of these resource activities to collect data and disseminate data to stakeholders, the public, and the state.

Data are vitally important to agencies trying to maximize operating efficiency and design projects with limited budgets. The types of data available, current relevance and trends, and knowledgeable people that can interpret these data are all important. Equally important is the opportunity for federal and state agencies to view local data for their own monitoring needs and to better understand local conditions.

Table 10-2 documents how data are currently collected and shared in the Region.

Table 10-2
Data Collection and Sharing

Data Management Activity	Protocol
Typical Data Collection Techniques	**Water Supply and Demand.** Water data related to supply and demand are collected by the water agencies/cities consistent with the California Urban Water Management Planning Act and the Groundwater Management Act. These activities ensure that monthly and annual data on water demand and production are collected. This information is forwarded to MWA, the Region's water manager, on a periodic time interval so all entities are up-to-date on future supply and demand needs. **Population and Land Use Trends**. Land use entities with jurisdiction in the Region collect data consistent with California Government Code (Sections 65000 et seq.) and use these data to prepare "a comprehensive, long-term general plan for physical development." This information is also forwarded to MWA so regional water supply and demands can be addressed. **Water Quality**. Under Health & Safety Code §116470, water agencies must collect data on the raw water and provide annual reports on the quality of the water supplied to customers. Under §303 of the Clean Water Act, dischargers to waterways must collect and report data on the water quality of their discharges. Besides data collected by agencies in their resource management roles, as part of the IRWM Plan, stakeholders are invited to provide data, reports, or studies to benefit information contained in the IRWM Plan.
Responsibility for Maintaining Data	Resource agencies providing water supplies, sanitary services, or regulating land use have the responsibility to maintain these data consistent with the laws described above (Water Code, California Government Code, Clean Water Act). The CC and IST will require project proponents implementing projects as part of the IRWM Program to collect and maintain data generated as part of their project (ambient groundwater quality, treated water quality, amount of invasive species removal, volume of water treated, amount of pipeline improved or replaced) during project implementation.

Table 10-2
Data Collection and Sharing

Data Management Activity	Protocol
Data Validation/Quality Assurance	Data collected by resource management agencies is done based on specific protocols established by regulatory agencies such as the DWR, the California Department of Public Health (CDPH), and the RWQCBs. These protocols and submittal of data to these agencies provides quality assurance and quality control. In addition, water supply data, land use data, and water quality data are regularly published and become part of planning documents vetted in public hearings (e.g., urban water management plans).
Data Sharing	The Mojave Region has undertaken two planning studies (Climate Change Assessment and the Salt and Nutrient Management Plan for the Mojave Region) to be included as part of this IRWM Plan update. These data associated with these studies will be transferred and shared in the IRWM Plan update. Several actions will be taken to keep the RWMG, stakeholders, and other interested parties informed about these implementation projects: • Posting of implementation project description and contact information on IRWM Plan website. • Posting (during project implementation) of project progress reports on IRWM Plan website. • Upon project completion, posting of a summary of project evaluation measures, targets, and performance of the project compared to the target. • Regular progress reports during stakeholder meetings. These actions will make the CC, IST, stakeholders, and other interested parties aware of the types of projects and data being collected in the Region and will make it possible for interested persons to acquire regional data. The IRWM Plan website will provide links to further facilitate data sharing. Links will direct visitors to the relevant water agency websites, relevant land use agency websites, and State database websites (California Environmental Data Exchange Network (CEDEN), CASGEM, SWAMP, Groundwater Ambient Monitoring and Assessment (GAMA)).
Data Consistency with State Databases	To make data from the Region accessible and compatible with State databases, the RWMG will require that implementation projects clearly delineate the nature of the data being collected (parameters, units), the timeframe associated with these data, and the location associated with these data. There are currently four (4) monitoring entities for the CASGEM Program crossing the Mojave IRWM Region boundary, which include (1) MWA, (2) Indian Wells Valley Cooperative Groundwater Management Group, (3) Twentynine Palms Water District, and (4) Antelope Valley State Water Contractors Association. The CASGEM monitoring entities adjacent to the Mojave IRWM Region boundary include the three entities listed above (with the exception of MWA and the following: (1) San Bernardino Valley Municipal Water District, (2) Big Bear City Community Services District. They report available groundwater level data to the CASGEM Program semiannually (two (2) times per year) and they have coordinated among themselves so any overlap areas within the neighboring regions are only recorded by one entity, thus avoiding unnecessary duplication of efforts. MWA will continue in this role and provide data consistent with the CASGEM Program. Mojave IRWM Plan projects affecting surface water will be required to report ambient surface water conditions to SWAMP (or its successor program) before taking actions that could affect ambient water quality.

10.3.1 Monitoring Programs

As a regional groundwater manager, MWA fills the role for monitoring regional groundwater quantity and quality, and has implemented programs to accomplish this. The SWRCB is the primary agency responsible for regulatory water quality management issues in California. Much of the responsibility for implementation of the SWRCB's policies is delegated to nine RWQCBs. The Lahontan RWQCB and Colorado River RWQCB overlie the Mojave Region.

Court-ordered requirements compel collection of data focused on components of the water balance, which the Agency measures, compiles, and disseminates. Cooperators in monitoring efforts include local water agencies, independent well owners, and the US Geological Survey (USGS). Information collected or compiled by the various agencies is utilized by local water managers and the Watermasters (MWA 2004).

Table 10-3 shows the programs and responsible parties collecting data and examples of existing monitoring efforts in the Mojave Region. Implementing agencies lead the effort to collect and disseminate monitoring data. The responsible agencies listed generate these data at the local level. It may be possible to utilize these existing programs to support Plan performance assessment.

10.3.1.1 AB 3030 Groundwater Management Plans (GMWPs)

The 2004 RWMP contained components included in California Water Code Sections 10750-10753.10 related to GWMPs. The California State Legislature passed Assembly Bill 3030 (AB 3030) during the 1992 legislative session allowing local agencies to develop GWMPs. Senate Bill 1938 was passed by the Legislature on September 16, 2002 and made changes and additions to sections of the Water Code created by AB 3030. The 2004 RWMP addressed all the relevant components related to GWMPs in the Water Code, as well as the components recommended by DWR in California's Groundwater, Bulletin 118 (DWR 2003).

California Water Code Sections 10750, et seq., originally enacted by Assembly Bill 3030 (AB 3030) in 1993, allow local entities to develop local GWMPs with the intent to encourage cooperative management of local groundwater resources. The GWMP describes groundwater management program activities that will be implemented upon adoption of the GWMP, which, among other components, may include a program for monitoring of groundwater levels and storage.

MWA, in collaboration with other local water agencies, is in the process of developing a GWMP in parallel with this IRWM Plan.

Table 10-3
Examples of Existing Monitoring Efforts

Program Title	Implementing Agency	Details	Responsible Agency	Update / Sampling Frequency
Annual Self-Monitoring Recycled Water Reports	Wastewater/ water/recycled water agencies	Reports on recycled water analysis, recycled water used, list of users, total daily deliveries, site inspections, effluent violations and corrective actions, updates to future plans to expand recycled water program and any special studies or projects.	Permitted wastewater/	Annually, due March 15
California Natural Diversity Database (CNDDB)	California Department of Fish and Wildlife (CDFW)	Data repository for endangered/native species sightings and population locations, but no comprehensive monitoring program.	CDFW	Ongoing
CASGEM	DWR	Groundwater elevation monitoring program to track seasonal and long-term trends in groundwater elevations in California's groundwater basins.	Local Monitoring Entities	Two times per year, starting in 2012.
Drinking Water Source Assessment and Protection Program (DWSAP)	CA Department of Public Health (CDPH)	Monitors and assesses the quality of surface and groundwater sources according to federal and state standards for drinking water. Identifies potential contaminating activities within the source watershed - Safe Drinking Water Act (SDWA).	Water supply agencies	Updated when deemed necessary by CDPH
GAMA	SWRCB	Statewide groundwater quality monitoring and assessment program mandated by the Groundwater Quality Monitoring Act of 2001. Participation by private drinking well operators is encouraged through the Voluntary Domestic Well Assessment Project.	SWRCB, USGS, voluntary local participation	Regional assessments every 10 years, trend monitoring every 3 years
Habitat Conservation Plans	Various agencies and organizations	Conservation planning for special-status species in a defined geographic area; Contains mitigation to offset development and monitoring requirements to measure success of restored and protected areas.	Various agencies and organizations	Varies
MWA Water Quality Monitoring Program	MWA	Monitoring of general water chemistry such as general minerals, metals, major cations and anions.	MWA	Varies/ ongoing
NPDES, Municipal Stormwater Permits	SWRCB	Issued to countywide collaboratives for management plan-based approach to implementing stormwater pollution prevention Best Management Practices (BMPs). The permit conditions require monitoring of BMPs.	Local municipalities and agencies	Permits are renewed every 5 years

Table 10-3
Examples of Existing Monitoring Efforts

Program Title	Implementing Agency	Details	Responsible Agency	Update / Sampling Frequency
NPDES, Waste Discharge Requirements (WDRs)	RWQCB	Wastewater Treatment Plants/Publicly Owned Treatment Works (POTWs) are required to monitor for many constituents including the following: Carbonaceous Biochemical Oxygen Demand (CBOD), total suspended solids, oil and grease, chlorine residue, pH, fecal coliform, and toxicity in effluent discharged. Annual Self-Monitoring reports are required.	Publicly Owned Treatment Works (POTWs)	Annually, Ongoing
Source water quality monitoring	Water supply agencies	Monitoring for contaminants such as radionuclides, organic chemicals, inorganics, and microbes in source and treated supplies.	Water supply agencies	Varies/ ongoing
SWAMP	SWRCB	Statewide monitoring effort designed to assess the conditions of surface waters in streams, rivers, lakes, and estuaries throughout the state. Monitoring efforts vary by RWQCB. However, sampling methods are standardized across the State.	RWQCB	As funding allows
Treated water quality monitoring	Water supply agencies	Monitoring for contaminants such as radionuclides, organic chemicals, inorganics, microbes, disinfectants, and disinfection byproducts in treated supplies.	Water supply agencies	Varies/ ongoing
UWMP	DWR	Monitors urban water supply and demand. UWMP and updates approved and deemed complete by DWR.	Water supply agencies	UWMP updates required every five years.
Watershed Sanitary Surveys	CDPH	Agency specific documents which assess existing water quality within a watershed and identify specific water treatment processes for the source waters for the purposes of human consumption.	Water supply agencies	Updated every 5 years

10.3.1.2 Groundwater Monitoring Program

Two major groundwater basins in the Region, Mojave and Warren Valley, are adjudicated basins that are managed by appointed watermasters. For these adjudicated basins, groundwater monitoring is prescribed according to the adjudications. Annual reports are required by the Watermaster on water levels and matters that may impact safe yield.

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 (1996). Monitoring activities currently performed by the Watermaster include water production and verification, water level measurement, and water quality (MWA 2011).

By order of the Mojave Basin Area Judgment, the Mojave Basin Area Watermaster reports and interprets monitoring data to ensure that the mandates of the Judgment are enforced. The MWA Board acts as the Watermaster. Monitoring requirements are described in the Judgment After Trial (1996) and in the Mojave Basin Area Watermaster Annual Reports. The Watermaster is currently responsible for reporting the following types of data in the Mojave Basin Area:

- Verification of reported groundwater production
- Mojave River flows
- Precipitation
- Wastewater discharges
- Subsurface flow
- State Water Project and wastewater imports
- Groundwater levels
- Ungaged surface water inflows
- Consumptive use

A more detailed description of the Watermaster monitoring activities can be found in Appendix F.

MWA, as part of its role as Watermaster, maintains records of producers, production wells, and annual production from parties to the Judgment. Water production within each of the five subareas is tracked 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, described below, along with production records to make recommendations regarding the sustainable yield for each of the subareas.

In partnership with USGS under a cooperative water resources program, as well as DWR and other agencies, MWA is actively engaged in extensive monitoring of climatic conditions, streams, groundwater levels, and water quality. MWA has constructed numerous groundwater monitoring wells, including variable-depth piezometers along the Mojave River and dedicated monitoring wells in the vicinity of active MWA enhanced recharge facilities. Altogether, MWA maintains a comprehensive monitoring network consisting of approximately 850 monitoring wells for regular measurements of water levels and water quality in select wells. Using these data, MWA tracks water level trends and fluctuations throughout the service area. Many of these wells are also sampled periodically for water quality. Figure 10-1 shows the locations of groundwater and surface water monitoring sites (MWA 2004; 2011; 2013).

MWA has also provided funding and technical support of hydrogeological studies and field investigations to characterize hydrogeologic conditions and to site and monitor enhanced recharge facilities. The most recent study was completed in 2013, which integrates understanding of the hydrogeology and water supply and demand conditions in the Centro and Baja Management Subareas to support basin management (MWA 2013).

10.3.1.3 Groundwater Quality Monitoring

The cooperative water resources program between MWA and USGS includes a network of approximately 850 wells from which approximately 150 water quality samples are collected annually. Individual water purveyors are required by CDPH to monitor and report drinking water quality. Water quality enforcement responsibilities reside with the RWQCBs and the CDPH.

10.3.1.4 Drinking and Surface Water Quality Monitoring

Drinking and surface water quality is monitored through the following means.

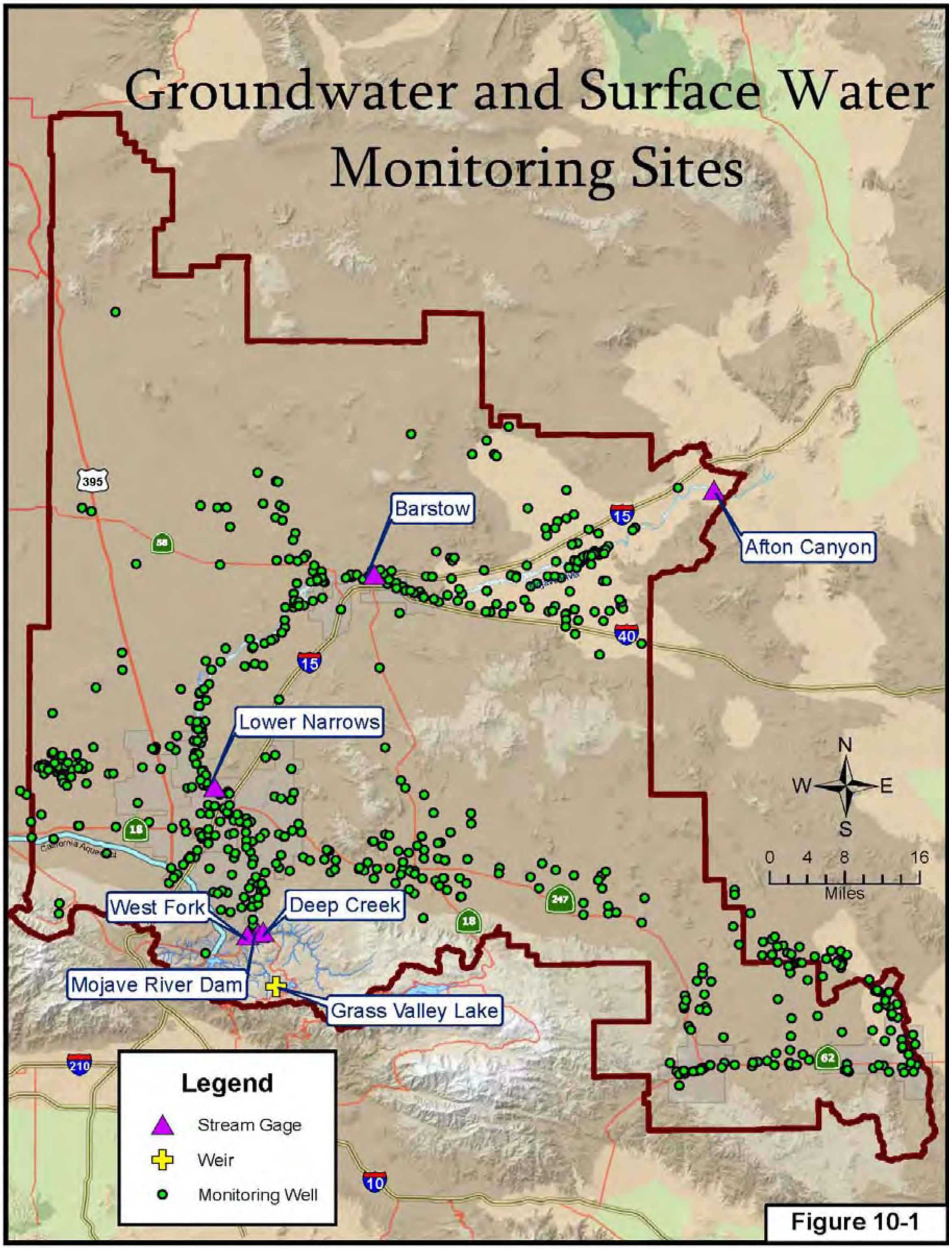
10.3.1.4.1 Safe Drinking Water Act (SDWA) Compliance Monitoring and Reporting

All public water systems are required to produce water that complies with the SDWA. To this end, specific monitoring information is required and collected routinely. Results of the monitoring are reported to CDPH. In addition, monitoring information is required to be published in an annual Consumer Confidence Report as described below in Section 10.3.3.2.

10.3.1.4.2 Unregulated Contaminant Monitoring Rule Results

The 1996 SDWA Amendments mandate that the USEPA publish a list of unregulated contaminants that may pose a potential public health risk in drinking water. This list is called the Contaminant Candidate List. The initial 1998 accounting listed 60 contaminants. USEPA uses this list to prioritize research and data collection efforts for future rulemaking purposes. The 1996 SDWA Amendments incorporated a tiered monitoring approach. The rule required all large public water systems and a nationally representative sample of small public water systems serving less than 10,000 people to monitor the contaminants. The information from the monitoring program for the Region are compiled and submitted to the state.

Figure 10-1
Groundwater/Surface Water Monitoring Sites



10.3.1.4.3 Monitoring Done as Part of TMDL Implementation

As conditions change in the Region, such as the identification of new TMDLs or water quality standards, the Lahontan and Colorado River RWQCB Basin Plans are amended. Compliance monitoring is required by both RWQCBs, and performed on an ongoing basis in order to determine if a watershed is in compliance with an identified TMDL. A compliance monitoring program for implementing a TMDL would generally include the anticipated compliance points for the monitoring program, parameters to be measured, analytical methods and their sensitivity for reliably detecting the regulated chemicals, frequency of measurements, etc. With such information it will be possible to evaluate whether the proposed compliance monitoring could be expected to be adequate for detecting significant violations of the requirements set forth in the TMDL.

10.3.1.5 Surface Water Flow Monitoring

10.3.1.5.1 USGS

As part of the cooperative water services program with MWA, the USGS operates and maintains the following gaging stations on the Mojave River:

- Deep Creek and West Fork near Hesperia
- Mojave River at Lower Narrows near Victorville
- Mojave River near Barstow
- Mojave River at Afton

Flows from these gaging stations are reported to the Mojave Basin Area Watermaster and are used to determine annual water balances within each subarea. Interflow between basins is estimated in this process. Flow from the Transition Zone into the Centro Subarea is a key part of the Watermaster's water balance. At one time, an additional gaging station was placed in the vicinity of the Transition Zone/Centro boundary. However, it was not possible to obtain reliable flow measurement at this station because of a lack of hydraulic control and shifting riverbed conditions. The Watermaster currently assumes the Mojave River flow at this location is equal to the base flow determined at the Lower Narrows plus the amount of reclaimed water discharged into the Mojave River by VVWRA.

10.3.2 Data Reporting

10.3.2.1 Municipal National Pollutant Discharge Elimination System Permits

The USEPA established the NPDES and respective stormwater programs under the Clean Water Act of 1972. Phase II of the Stormwater Program, issued in 1999, requires small municipal separate storm sewer systems (MS4s) in urbanized areas to obtain NPDES permit coverage to regulate discharges to surface waters, or stormwater discharges. The USEPA has delegated enforcement authority to the SWRCB and its respective RWQCB. Lahontan, Region 6, is the Regional Board that oversees the regulated small MS4s within the Mojave River Watershed.

Subsequently, the SWRCB adopted a General Permit for the Discharge of stormwater from small MS4s, Water Quality Order No. 2003-0005-DWQ, NPDES General Permit No. CAS000004.

Permittees included the City of Hesperia, City of Victorville, Town of Apple Valley, and the County of San Bernardino. Together these agencies have formed the Mojave River Watershed Group (MRWG).

Since inception, the MRWG has developed a Stormwater Management Program (SWMP); implemented a public education and outreach program inclusive of disseminating bilingual educational materials consisting of various tip cards and Best Management Practices (BMP) posters, educating the youth of the community through school assemblies; encouraged public involvement through large and small clean-up events and public workshops; developed a storm drain map detailing level of threat zones as a management tool to assist in tracking spills and prioritizing high risk areas; held staff trainings; developed a model stormwater ordinance and various guidance documents for agency customization; and collaborated on other implementation efforts, as well as policies and procedures that assisted in meeting the General Permit requirements. Collectively, member agencies have been able to increase water quality improvements and reduce program costs for certain components of the permit requirements such as public education and outreach; and public involvement.

In February of 2013, the SWRCB adopted a new Phase II General Permit, Water Quality Order No. 2013-0001-DWQ, NPDES General Permit No. CAS000004, which took effect July 1, 2013. As with the prior permit, the MRWG group member agencies are co-permittees. The new permit includes further, more stringent mandates than that of the previous permit. Continuing pooling efforts, cost sharing and collaboration for implementation is the consensus among the MRWG and most advantageous to the member agencies.

Each year, the agencies are required to submit a report to the Lahontan RWQCB, summarizing stormwater activities undertaken as part of the program in the previous 12 months. The annual reports include summaries of measurable goal accomplishments, performance indicators, and trend analysis. Compliance under this program will result in enhanced data collection and reporting (MRWG 2012; Hesperia 2011).

10.3.2.2 CUWCC MOU

The *Memorandum of Understanding (MOU) Regarding Urban Water Conservation in California* was originally executed in 1991 by the members of the California Urban Water Conservation Council (CUWCC). Although not all California water suppliers are signatories to the CUWCC's MOU, the MOU includes several water conservation BMPs intended to reduce California's long-term urban water demands, and signatory agencies report progress on their implementation to the CUWCC.

Section 5.2.1.3 explains in detail about the Region's role with the CUWCC.

10.3.3 Data Gaps and Potential New Data Collection Programs

While extensive water resources monitoring is ongoing in the Region, additional opportunities exist for data gathering to fill gaps and expand knowledge about the Region's remaining water resources. Some potential additional data gathering opportunities, to fill perceived gaps, are illustrated in Table 10-4. Additional data gathering will occur as time and funding allows.

Table 10-4
Data Gaps and Potential Regional Data Sharing Opportunities

Data Gap	Program Type	Potential Implementing Agency	Program Description
Wastewater and Recycled Water			
Compilation of Regional Recycled Water Information	Regional Recycled Water Reporting	RWQCB	Regional compilation of quantity and quality of recycled water produced and used within the Region. This system would track and encourage utilization of recycled water to conserve potable supplies. Information is already provided to RWQCB.
Groundwater Level			
Compilation of Groundwater Level Information	Regional Water Reporting	MWA and Purveyors	Regional compilation of groundwater level data produced and used within the Region. This system would track and provide regular data quality assurance.
Flood Protection and Stormwater Management			
Compilation of Regional Storm Drainage Information	Regional Storm Drainage Mapping	RWQCB	Collaborative effort to develop a regional map showing locations of creeks, underground culverts, storm drains, and flood control channels. This information will improve regional efforts for habitat restoration and flood control.
Floodplain Management Information	Regional Monitoring of Floodplains	County SB Flood and others	Regional mapping and monitoring of floodplains, including acreage protected, connectivity, and management techniques. Currently the County of San Bernardino maps do not provide a regional overview. Monitoring information would facilitate planning, design, and execution of flood-protection projects.
Watershed Management, Habitat Protection, and Restoration			
Regional Stream Channel Maps	Regional Monitoring of Stream Channel Functioning	CDFW	Regional mapping and monitoring of channel bed and bank conditions, including extent of functioning riparian corridors. Regional mapping and monitoring of sediment source, transport, and depositional areas. This information will be useful to monitor the success of creek restoration projects, assess the need for future restoration efforts, and track habitat conditions for wildlife and aquatic habitat. Due to the extent of urbanization in the Region, these data should be gathered in conjunction with local flood control and stormwater management agencies.

Table 10-4
Data Gaps and Potential Regional Data Sharing Opportunities

Data Gap	Program Type	Potential Implementing Agency	Program Description
Regional Wildlife Corridor, Population, and Biodiversity Information	Regional Monitoring of Wildlife Corridors, Populations, and Biodiversity	CDFW	Establish a regional monitoring system for wildlife corridors, populations, and species richness (for amphibians, birds, and mammals). This could expand upon the California Natural Diversity Database focusing solely on population monitoring within the Region.
Regional Invasive Species Information	Regional Monitoring of Invasive Species	CDFW, USFWS	Regional monitoring program for presence and absence of invasive plant species. The program would provide information to target eradication and restoration activities.
Regional At-Risk Native Species Monitoring	Regional Monitoring of Native At-Risk and Special Status Species	CDFW, UFWS	Regional program to track presence and absence of at-risk native and special status species in the Mojave Region.

While such a regional data integration approach may be valuable in concept, it is important to consider the potential costs and administrative/management commitments such an effort would entail. Table 10-4 lists potential implementing agencies for each potential program. Potential implementing agencies were identified based on their wide jurisdiction and access to these data needed to develop the recommended compilations and reports. Implementation of these monitoring and reporting programs would require resources beyond those of the IRWM Plan CC.

Whether or not the IRWM Plan is the appropriate venue to fill gaps in regional monitoring is a subject that will continue to be explored as the Plan is implemented. Stakeholders, project proponents, regional organizations, DWR, and the public will be invited to engage in a broader discussion of Plan and regional monitoring efforts and needs.

10.3.4 Validation and QA/QC Measures

MWA currently posts water level and water quality data to the USGS National Water Information System (NWIS) website (and a portion of the above to the CASGEM site). MWA regularly publishes technical maps/documents and posts on the MWA website as a course of business. Professional staff review and publish products/data and make these data/products easily accessible to the public in a variety of formats. Product recommendations and any data correction requests from stakeholders are always encouraged by MWA staff.

10.3.5 Supporting Statewide Data Needs

As described in Table 10-3, a wealth of information is collected by individual Mojave Region agencies and water resource programs. While a limited number of programs compile and assess water resources data for the Region, it is not clear whether new regional assessments versus more efficient coordination of existing efforts would lead to more useful regional information. As future work is completed, the Mojave Region's data library of relevant water resources information and data that have been collected by projects implemented under IRWM Plan will grow. Whether the library can become a more comprehensive resource throughout the Region has yet to be determined. As such, the process represents an important first step toward developing a regional perspective on water resources management information.

Data and conclusions developed through the Mojave IRWM Plan assessment process may be used by state agencies for developing regional fact sheets and determining regional funding priorities. In addition, DWR may use the information developed through future work to support updates to the California Water Plan (Bulletin 160), which is updated on a five-year cycle. Periodic information updates could be coordinated with the California Water Plan update. Another opportunity for data coordination may exist with the Lahontan and Colorado River RWQCBs. The RWQCBs are currently reviewing new data standardization and data provision requirements to accompany 401 Water Quality Certification. If this program becomes formalized, additional opportunities for regional data integration may arise. Such requirements and standards would provide data at the project-level scale that could then be aggregated for a regional interpretation. Coordination with the Lahontan and Colorado River RWQCBs will continue with implementation of the Mojave IRWM Plan.

In addition to compiling water resources data and information about Mojave Region IRWM Projects, the project performance data collected in the Mojave Region will be available to support continuing statewide data collection programs. Data collection methods described in Table 10-2 will enable data from the Region to be accessible and compatible with State databases and applicable statewide data collection programs such as the SWAMP and the GAMA programs, and the California Environmental Data Exchange Network (CEDEN). These programs are discussed earlier in Section 10.3.1. Upon completion of the IRWM Plan performance assessment, project-specific data, along with the associated quality assurance/quality control information, will be available in a format that can easily be integrated into statewide data collection and tracking programs. As appropriate, the CC will also encourage project proponents to contribute data to the California Environmental Resources Evaluation System (CERES), an information system developed by the California Resources Agency to facilitate access to natural resource data.

10.4 Plan Performance and Monitoring

This IRWM Plan is a dynamic document and is part of an ongoing effort to achieve integrated water management within the Mojave Region. The IRWM process, through stakeholder participation and plan revisions, will continue for many years and will serve to help address the water management issues facing the Region. As a consequence, IRWM Plan objectives, regional priorities, and statewide priorities will continue to be reviewed for relevance and will be modified as needed to ensure the overall IRWM Plan reflects current needs and priorities of the Region as they change and continues to be effective at supporting wise implementation. Additionally, candidate projects will be reviewed and evaluated on a regular basis to ensure that current Plan objectives will be met and that the resulting Plan projects offer the greatest benefit(s) possible. Periodically, the list of Plan projects will be updated to address revised IRWM Plan objectives and state and regional priorities.

This ongoing review and update process allows the Plan to utilize an adaptive management approach, thereby allowing the IRWM Plan to evolve in response to changing conditions and as better data is developed. IRWM Plan revisions will result in:

1. Updated evaluation of information and data related to watershed conditions

2. Evaluation of implemented projects/actions and their contribution to meeting IRWM Plan objectives

3. Revised objectives, strategies, and projects based on new conditions and past project results

As projects are implemented in the Region, project performance will be assessed and outcomes will be monitored, and the results from this monitoring will be used to guide future project implementation. If monitoring reveals, for example, that a project is progressing as planned and regional changes do not necessitate revisiting project implementation, then changes to project prioritization would not be anticipated. However, if monitoring reveals that a project, or suite of projects, are not producing the anticipated results, corrective actions (whether improving a specific project, changing the project prioritization, strengthening the measures by which those projects are being monitored, etc.) can be implemented. This information will feed into future updates of the Plan and keep it a living document.

10.4.1 Evaluation of Plan Performance

The Region's widespread geography, diverse population divided among various water-related entities, and breadth of projects require a multi-faceted performance monitoring strategy. The intent of measuring the Plan performance monitoring objectives is to ensure:

- The RWMG is making progress towards meeting the objectives and implementing the projects listed in the Plan

- Each project is monitored to comply with all applicable rules, laws, and permit requirements

One aspect of evaluating Plan performance includes tracking and reporting the progress made toward implementing Plan projects. Project proponents are responsible for developing and implementing Plan projects. Project proponents will be asked by the IST to report on the progress of their implementation annually or as appropriate.

A second aspect of evaluating Plan performance includes tracking and reporting specific performance metrics that represent how the Region is doing towards meeting each Plan objective. Table 10-5 lists the Plan objectives and their respective approach to evaluating progress towards the target. This matrix was decided upon at two Stakeholder Group meetings (December 16, 2013 and February 6, 2014) using an iterative approach to finalize the necessary information.

Table 10-6 displays the processes to be used to evaluate Plan performance.

Table 10-5
Plan Performance Monitoring Objectives for the Mojave IRWM Plan

Summary of Objective	Quantitative Measurement	Target	Approach
1. Balance average annual future water demands with available future supplies to ensure sustainability throughout the Region between now and the 2035 planning horizon and beyond.	Measured by forecasted average annual demand (adjusted by expected levels of conservation) at different times through the planning period compared with forecasted average annual available water supplies at different times through planning period.	Water supply and demands are balanced throughout Region over entire planning period.	Compare every five years when UWMP is complete. 2015 is next date for comparison.
2. Continue improving regional water use efficiency by implementing a portfolio of conservation actions that are regionally cost-effective.	a. Continue reducing urban per-capita water use through all available actions that are regionally cost-effective. Measured by time series of annual per-capita water use. b. Increase agricultural water use efficiency by moving towards efficient water management practices for sustainable agriculture. Measured by the number of farms utilizing viable best management practices, including irrigation practices, equipment, and crop types. c. Increase industrial water use efficiency by moving towards applicable best management practices. Measured by the number of industries utilizing viable best water conserving management practices, equipment and technologies.	a. Continue to reduce annual per-capita water use until we reach 100 gallons per capita per day in the Region. Reduce per capita consumption by 2.5% per year. b. Continue to reduce agricultural water use as measured by acre- feet per acre (af/acre) of crop. Reduce Regional agricultural consumption by 1% per year c. Continue to reduce the water used by industrial application. Reduce Regional industrial consumption by 1% per year.	a. Measure the municipal water use divided by the population in gallons per capita per day, on an annual basis.[9] b. Measure the amount of water applied in af/acre of agricultural use, on an annual basis. c. Measure the amount of water pumped by industrial water users, on an annual basis.

[9] The 2010 UWMPs require more than this per DWR's *20x2020 Water Conservation Plan* (Senate Bill 7 of Special Extended Session 7 (SBX7-7)).

Table 10-5
Plan Performance Monitoring Objectives for the Mojave IRWM Plan

Summary of Objective	Quantitative Measurement	Target	Approach
3. Maintain stability in previously overdrafted groundwater basins and reduce overdraft in groundwater basins experiencing ongoing water table declines.	Measured by long-term stability of groundwater levels in the regional monitoring well network and mass water balance calculations by subarea.	For basins not in overdraft: no negative change in groundwater level. For basins currently in overdraft, reduce trend in overdraft by 50% by 2025 and reduce overdraft to 0 by 2035.	Select key groundwater level indicator wells for each subarea. Establish trend based upon past five (5) years. Report progress annually.
4. Address the State policy goal of reducing reliance on the Delta by meeting water demands with alternative sources of supply during times when State Water Project (SWP) supplies are reduced or unavailable due to droughts, outages, environmental and regulatory restrictions, or other reasons.	Measured by comparing banked or reserve water supplies with water needs to meet a 6-year drought or 3-year outage on the SWP.	At least 75,000 af banked groundwater regionally.	Report annual banked and reserve water supplies and compared to targets. Update target every five years based upon the greater of: • Three (3) years projected SWP demands; or • Six (6) years projected SWP demands less SWP water available during worst 6 dry years per SWP delivery reliability report.

Table 10-5
Plan Performance Monitoring Objectives for the Mojave IRWM Plan

Summary of Objective	Quantitative Measurement	Target	Approach
5. Optimize the use of the Region's water-related assets to maximize available supplies to meet projected demands while mitigating against risks. Water-related assets to be optimized include financial resources, groundwater storage programs, available imported water supplies, transfer and exchange opportunities, available physical infrastructure, and management policies.	a. Measured by available SWP supplies stored, used locally, transferred or exchanged vs. available SWP supplies unused or lost. b. Measured by financial resources that originate outside of the Region and are made available to improve integrated water management within the Region. c. Measured by long-term cost savings created by improvements in operational efficiency, reduced energy consumption, reduced system failures and repairs, etc.	a. 95% of available SWP supplies used, transferred, or exchanged over 5 year period. b. $20 million every 5 years in revenues or value received through transfers, sales, or exchanges of SWP water. c. Get estimated savings from project proponents.	a. Compare annual SWP supplies available vs amount used, transferred or exchanged using a 5-year running average. b. 5-year running total reported annually. c. Put this in questionnaire to project proponents and ask them to estimate their savings, using 10-15% as an example.
6. Prevent land subsidence throughout the Region.	Measured by monitoring land surface changes, every five years, in areas of known historic subsidence.	Target is 0 subsidence.	USGS study[10] is completed every 10 years, which will be used.
7. Provide support and assistance to disadvantaged communities and help facilitate projects and programs that benefit those communities.	Measured by the number of projects and programs implemented and the investments made on an ongoing basis that benefit disadvantaged communities.	Target is ten (10) implemented projects, programs, or investments that help meet Plan objectives for DACs over the next five (5) years.	Annual tracking of projects or programs implemented for DACs.

[10] http://ca.water.usgs.gov/mojave/subsidence.html

Table 10-5
Plan Performance Monitoring Objectives for the Mojave IRWM Plan

Summary of Objective	Quantitative Measurement	Target	Approach
8. Improve environmental stewardship related to waterways and water management in the Region.	a. Measured by acres of sensitive environmental/habitat areas restored or new sensitive environmental/habitat areas set aside for protection. b. Measured by the number of new or enhanced recreational or educational projects that are connected to environmental stewardship programs. c. Measured by protection and restoration of riparian habitat areas as identified in Exhibit H of the Mojave Basin Area Judgment. d. Measured by new environmental habitat (wetlands) created.	a. To be determined. b. To complete a minimum of two (2) projects per year. c. To be determined. d. To complete one project every five years.	a. The Mojave Desert Resource Conservation District (MDRCD) will provide the information to MWA on an annual basis. b. Establish a data base that includes entities such as cities, water companies, school districts, etc. that are capable of completing recreational or educational projects related to environmental stewardship. Contact these entities semi-annually to determine the status of any projects they may have that fulfill the objective. c. MDRCD will provide the information to MWA on an annual basis. d. MDRCD will provide the information to MWA on an annual basis.

Table 10-5
Plan Performance Monitoring Objectives for the Mojave IRWM Plan

Summary of Objective	Quantitative Measurement	Target	Approach
9. Improve floodplain management throughout the Plan area.	a. Increase coordination between agencies to establish programs and projects related to floodplain management that have multiple benefits/multiple uses. Measured by the number of new multi-benefit/multi-use floodplain projects or programs established. b. Coordination between multiple agencies to reduce risk of flood damage through proactive operations along the flood prone areas. Measured by reduction in monetary impact of flood damage compared to damage caused by historical floods of similar magnitude.	a. Using projects from this IRWM Plan, the target is five (5) new multi-benefit/multi-use floodplain projects or programs implemented within the next 10 years. b. Use a 20% reduction in monetary impact of flood damage as compared to last flood of similar magnitude.	a. Track based on annual project status reports and summary of coordination activities related to relevant projects. b. Use the annual review of flood events in the Region. If a flood event occurred, compare monetary impact to last flood of similar magnitude.
10. Preserve water quality as it relates to local beneficial uses of water supplied by each source, including groundwater, stormwater, surface water, imported water, and recycled water.	Regular summaries of key water quality constituents for various water supplies as they relate to the local beneficial uses.	Maintain the water quality objectives in the Lahontan and the Colorado River RWQCB Basin Plans.	
11. Obtain financial assistance from outside sources to help implement this Plan across a range of project sizes during the planning horizon.	a. Obtain outside financial assistance for small water systems,[11] measured by the number of small systems that acquired outside funding and the amount of funding acquired. b. Obtain outside financial assistance for other projects and programs (not within small water systems), measured by the amount of outside funds acquired.	a. Target is 25% of total investments made for Plan projects over the next five years. b. Target is 25% of total investments (not within small systems) in projects and programs over the next five years.	a. Track expenditures and outside financial assistance (including grants and cost savings due to discounted loans) for projects being implemented through annual project summaries. b. Same method as “a” above.

[11] For the purposes of measuring benefit towards this objective, water systems will be considered “small” if they deliver less than 3,000 afy or have fewer than 3,000 service connections.

Table 10-5
Plan Performance Monitoring Objectives for the Mojave IRWM Plan

Summary of Objective	Quantitative Measurement	Target	Approach
12. Improve public awareness of water supply, conservation, water quality, and environmental stewardship challenges and opportunities throughout the planning horizon.	a. Measured by the results of regular surveys that gauge awareness regarding these topics. b. Measured by documented outreach to all stakeholder types as listed in the IRWM guidelines.	a. Conduct an annual citizen survey gauging public awareness of water supply, conservation and water quality. b. Conduct two outreach programs in each of our subareas per year i.e. Morongo, Alto, Baja, Centro, Este and Oeste.	a. Maintain a 75% level of concern regarding water supply, conservation and water quality throughout the region (very concerned + somewhat concerned). b. Work collaboratively with various organizations to partner in the development of outreach events.
13. Identify and establish reliable funding sources to maintain, modernize and improve water infrastructure to ensure a high quality, resilient and reliable water supply.	a. Measured regularly by the estimated cost of deferred maintenance. b. Measured by the number of water systems that improve operations to withstand or reduce the number of system failures and improve system efficiencies.	a. To be determined. b. To be determined.	a. Refer to California Assembly Bill (AB) 240 and AB 54.[12] Recommended to set up a subcommittee to establish criteria and targets after adoption of IRWM Plan and reference current laws that require tracking of deferred maintenance. b. Same method as "a" above.
14. Increase the use of recycled water in the Region while maintaining compliance with the Mojave Basin Area Judgment as applicable.	Measured by changes in the volume of recycled water being used in the Region.	Double recycled water use (purple pipe; not total discharges from wastewater treatment plants) over next 10 years.	Compare annual recycled water volumes to 2010 volume.

[12] Both require a mutual water company that operates a public water system to maintain a financial reserve fund to be used for repairs and replacements to its water productions, transmission and distribution facilities at a level sufficient for continuous operation of facilities in compliance with the federal Safe Drinking Water Act.

Table 10-6
Processes for Measuring Plan Performance

Portion of IRWM Plan	Responsible Group/Agency
Implementation Evaluation	The RWMG will be responsible for evaluating IRWM Plan implementation performance based on information collected and reported by the IST.
Frequency of Evaluation	The RWMG will evaluate progress toward meeting the objectives in the IRWM Plan annually, although some objectives are measured every 5 years.
Tracking Implementation	Data, project descriptions, maps, and contact information for implementation projects will be posted on the IRWM Plan website. Upon project completion, there will be a posting of a summary of project evaluation measures, targets, and performance of the project compared to the target. This data will make it possible to determine how projects are advancing IRWM Plan objectives. The RWMG will be responsible (with support from the IST) for tracking IRWM Plan implementation and ensuring implementation project data is available to the RWMG, stakeholders, and other interested parties.
Improving Implementation of Future Projects	“Lessons Learned” will be incorporated during each update of the IRWM Plan. A Plan update has the benefit of input from the RWMG and the broader Stakeholder Group. During Plan updates objectives and measures are reviewed, refined, and revised if necessary to reflect evolving regional conditions and needs and to incorporate new data. Applicable Resource Management Strategies, to meet objectives, will also be re-evaluated during each update.
Responsibility for Project Specific Monitoring Plans	Each project proponent will have the responsibility for development of project-specific monitoring plans and will be responsible for project-specific monitoring activities.
Timing of Project Specific Monitoring Plans	Project specific monitoring plans shall be prepared prior to the start of project construction or implementation.
Contents of Project-Specific Monitoring Plans	Project specific monitoring plans shall include, at the minimum, the following: A description of what is being monitored. Examples include: • The amount of recycled water production • Number of customers connecting to a recycled water system • Reduction in water demand • Change in invasive species cover • Change in dissolved oxygen, pH, temperature, turbidity, salinity • Change in average number of different species occurring within a given area (habitat diversity) A description of measures to remedy problems encountered during monitoring. A description of the location of monitoring and monitoring frequency. A description of monitoring protocols and methodologies, and assignment of the responsibility for monitoring. A description of what data will be shared with the IRWM Plan stakeholders and with what frequency. Identification of what State databases information will be provided to, and requirements for data submittal. Resources and procedures to ensure the monitoring schedule will be maintained (e.g., identify responsible parties and alternates and funding for monitoring).

10.4.2 Plan Performance to Date

Over the last several years, and since development of the 2004 RWMP, progress has been made in meeting the original objectives to 1) balance future water demands with available supplies and 2) maximize the overall beneficial use of water throughout the Region.

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 10-7 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 10-7
Plan Performance to Date

Name/Type	Planned Delivery (afy)	MWA Subarea/ Region	Date Supply Available
Regional Recharge and Recovery Project (“R^3 Project”)	Phase 1 – 15,000 Phase 2 - 40,000 total	Alto	Phase 1 – 2013 Phase 2 – 2015-2020
Deep Creek Recharge	Up to 35,000	Alto	2012
Oro Grande Wash Recharge	6,000	Alto	2013
Ames Valley Recharge	1,500	Ames Valley	2011
Joshua Basin Recharge	1,000	Joshua Tree	2014
Antelope Valley Wash Recharge	3,500	Alto	2019-2022

The Region has seen various actions to enhance water supply. This includes advancement on the Regional Recharge and Recovery Project. With completion of Phase 1, this conjunctive use project will provide 15,000 afy in additional supply for major water providers in the Mojave Basin. When fully complete, this project will provide a total of 40,000 afy additional water supply.

The Mojave River Pipeline, extending 76 miles from the California Aqueduct in the Phelan area to recharge sites along the Mojave River, was completed in 2006. The pipeline now has the capacity to deliver up to 45,000 afy to the Mojave Basin to offset depletion of native water supplies.

Various management actions involving conservation, storage agreements, and water transfers/water banking have also taken place in the Region, as listed below:

- Cash for Grass Program: Started in 2008; as of March 2014 the program has removed 3.5 million square feet of turf saving 1,100 afy.

- Exchange program with Metropolitan Water District of Southern California (Metropolitan): Began in 2003; as of January 2014, 103 thousand acre-feet (TAF) stored with MWA via the program and 66 TAF returned to Metropolitan.

- Exchange program with Solano County Water Agency (SCWA): Began in 1997; as of January 2014, 15,000 acre-feet stored with MWA via the program and 5,500 acre-feet returned to SCWA.

- MWA groundwater banking program: storage account balance (all basins) at 133 TAF as of January 2014.

Section 11: Coordination and Outreach

Management of water and other related resources within this Region is complex and has many interdependencies. Furthermore, the authorities and responsibilities for managing resources are spread across many different agencies, organizations, and other stakeholders. This complexity and the network of shared responsibilities create the need for robust and effective coordination.

Coordination is one of the most essential components of the Integrated Regional Water Management Plan (IRWM Plan). This Section describes both the coordination and outreach with local agencies and the broader public undertaken as part of the IRWM Plan development, and the coordination and outreach intended to be done to keep improving integrated water management throughout the Mojave Region and neighboring areas.

11.1 Coordination between Plan Participants and the Public

The Mojave IRWM Planning process has been and continues to be highly accessible to the public with multiple opportunities and methods implemented to encourage participation by the public. As discussed in more detail in Section 1.2, the planning process centered on stakeholder input meetings, all of which were open to the public to facilitate participation. Meeting attendees were invited to participate through facilitated discussions and review of draft documents. Various outreach methods were used to coordinate public participation, including announcements via e-mail to a broad distribution list, mailed invitations, and use of the project website, which was continuously updated with information pertinent to the ongoing IRWM Planning process. In addition, e-mail addresses and phone numbers of relevant IRWM Plan contacts were made available to any stakeholder or interested party to ask questions or offer comments about the IRWM Plan.

11.2 Coordination with State and Federal Agencies

11.2.1 Participation in IRWM Plan Development

Involvement of and coordination with state and federal agencies is considered to be essential to the success of the IRWM process of the Mojave Region. These agencies can provide services and up-to-date information related to the resources they are tasked with managing and protecting, thereby contributing to enhanced understanding and management of the Region's resources. Numerous state and federal agencies have actively participated during Plan preparation (as listed in Section 1.2.2).

In general, state and federal agency stakeholders:

- Participated in Stakeholder Group meetings
- Reviewed and commented on IRWM Plan sections
- Provided guidance on project ranking
- State agencies submitted candidate projects

In addition, several agencies, including the Lahontan Regional Water Quality Control Board (RWQCB) and the Mojave Desert Resource Conservation District (MDRCD) staff participated on the Project Team to work out the details of the IRWM Plan, as needed.

11.2.2 Participation in IRWM Plan Implementation

Continued coordination with state and federal agencies will occur on an as-needed basis for implementation of specific projects and during Plan performance evaluations and future Plan updates. It is anticipated that state and federal agencies will continue to participate in the IRWM Plan as stakeholders and project sponsors. Ongoing participation by these entities will enhance the technical data and knowledge associated with implementation of the IRWM Plan. These agencies may also be able to identify and recommend potential sources for funding IRWM Plan implementation.

Future coordination with state and federal agencies will be essential during project planning and implementation, when consultation will occur during environmental document preparation and permitting prior to construction as well as the preparation of applications for financial assistance. This coordination may include the following agencies:

- California Department of Fish and Wildlife (CDFW) and US Fish and Wildlife Service (USFWS). CDFW and USFWS oversee implementation of the California and Federal Endangered Species Act and regulate activities that may impact endangered species and their habitats (Fish and Game Code, Sections 2050 *et seq*.). Any Plan projects with potential impacts to sensitive species will require coordination with these agencies. CDFW also oversees any activity that will substantially modify a river, stream, or lake (Fish and Game Code Sections 1600 et seq.). Before undertaking any activity that would result in modification of a river, stream, or lake, it will be necessary to obtain a Lake or Streambed Alteration Agreement from CDFW.
- California Department of Public Health (CDPH). CDPH regulates public water systems, including allowable treatment technologies for drinking water and the treatment and distribution of recycled water. Any Plan projects that involve treatment of drinking water or recycled water will require coordination with CDPH.
- Lahontan and Colorado River Regional Water Quality Control Boards (RWQCBs). The Mojave Region is regulated by the Lahontan RWQCB in the northern portion of the Region and the Colorado River RWQCB in the remaining southern area. The RWQCBs set goals for groundwater and surface water quality in their respective jurisdictions. Based on these goals, the RWQCBs regulate discharges to groundwater and surface water, including stormwater runoff. Any IRWM Plan projects that could result in stormwater runoff or which could result in a change in discharges to surface or groundwater may have to coordinate with one or both of the RWQCBs.

  Under the federal Clean Water Act Section 401, every applicant for a federal permit or license for any activity which may result in a discharge to a water body must obtain State Water Quality Certification (called a 401 Certification) to ensure that the proposed project will not violate state water quality standards. Most 401 Certifications are issued in connection with the US Army Corps of Engineers (US ACOE) permits for dredge and fill discharges. The RWQCBs review projects for 401 Certification.

- US Army Corps of Engineers. The US ACOE has regulatory authority over all discharges of dredge and fill materials within navigable waters and waters (such as intermittent streams and wetlands) with significant connection to navigable waters. The US ACOE regulates such projects through the issuance of permits. Any IRWM Plan projects that could result in discharge of dredge and fill material to a water body may have to coordinate with the US ACOE. Also, the US ACOE could be a potential partner to address flood management for the Region.

11.3 Plan Relationship to Local Water Planning and Implementation

The California Water Plan notes that coordination in water planning at all levels is essential for the successful management of California's water system in the face of increasing challenges due to climate change, growing water demand and uncertainty regarding availability of water from the Sacramento-San Joaquin Delta. Accordingly, this section discusses the relationships between the IRWM Plan and local water planning efforts and documents the local water plans on which the IRWM Plan is based. The intent of coordinating the IRWM Plan with local water planning efforts is to ensure that the IRWM Plan is consistent with local water plans and reflects current, relevant elements of local water planning and water issues common within the Mojave Region.

This Plan will support local water management organizations in making decisions about local actions that help accomplish a shared vision for the whole Region. The Plan also will help local organizations cooperate more effectively on actions they can accomplish better together than alone.

In the Region are 61 local organizations and 14 state and federal agencies that have authority and/or responsibility for managing water resources, including water supply, water quality, flood protection, and watershed management. See section 1.2.2 for the complete list of stakeholders. A subset of these organizations joined together to form the Mojave Regional Water Management Group (RWMG) (see Section 1). The RWMG members have presented their perspectives along with inviting participation by all other organizations with an interest in water management in the Region during development of the Plan. The governance approach developed for Plan implementation (see Section 8) will provide continuing opportunities for interested water management organizations to discuss and coordinate planning and implementation actions within the context of the Plan and its updates.

Information and perspectives from local water planning efforts are woven throughout the Mojave IRWM Plan in several layers of detail. Plan development involved incorporating elements of local water resource management planning documents along with information available in other local planning documents, such as general plans. For example, the larger cities/agencies that deliver more than 3,000 acre-feet per year (afy) of potable water or have more than 3,000 connections are required by state law to prepare Urban Water Management Plans (UWMPs), and have been prepared by 13 water purveyors in the Mojave Region, as listed in Section 2.8.1. The UWMPs must include 20-year water demand forecasts and descriptions of water conservation programs intended to meet statewide goals to reduce per capita urban water use 20% by 2020; these forecasts and conservation planning efforts have been incorporated into this Plan.

Climate change is a growing concern of water managers and could increase the variability of seasonal runoff and affect water quality, among other factors. The extent of planning related to climate change varies widely across the Region. Climate change adaptation is often included in other local planning efforts, such as water supply reliability planning in support of an UWMP. Climate action adaptation and mitigation strategies identified in local planning documents have been considered and incorporated into the Plan. For instance, they were considered during completion of the required Climate Change Vulnerability Checklist (Appendix C.3). Anticipated climate change factors also were woven into several of the challenges and opportunities listed in Section 4 (e.g., “Climate Change Impacts”) and were carried forward into the Plan objectives (also Section 4).

The Plan sections on resource management strategies (Section 5) and project review and prioritization (Section 6) respond to the Plan’s identified challenges and opportunities and the related objectives. As the Plan was developed, each portion drew on information from local water management plans as well as current perspectives offered by local planners themselves.

11.4 Coordination between Water Management and Local Land Use Planning

The intent of this section is to describe the communication between land use managers in the area and the RWMG as part of Plan preparation. Water management and land use are inherently linked in that the activities and processes that occur on the land directly affect the use and movement of water within a watershed. These linkages between land use and the hydrologic cycle, and similarly between water management and the ability to support particular land uses, are important to consider when making decisions about either land or water. The California Department of Water Resources (DWR) recognizes these linkages and legislation requires that IRWM Plans describe the relationships and interactions between regional planning efforts fostered by the RWMG and local water and land use planning. This section describes how land use planning and decision making are coordinated with water management planning and implementation within the Region and highlights opportunities for improved coordination.

11.4.1 Relation to Local Land Use Planning

Within the Mojave Region, local land use planning is the responsibility of the County of San Bernardino, five cities and three towns, the Bureau of Land Management (BLM), US Bureau of Reclamation (USBR), the San Bernardino National Forest and the CDFW. Land use planning and decision-making have a direct linkage to water management planning and implementation. Collaboration among land use managers and water managers is often a challenge, despite efforts by the State of California to link land use and water management decisions.

In the Mojave Region, cities such as Adelanto, Barstow, Hesperia, Twentynine Palms, and Victorville, are the responsible agencies for land use planning in incorporated communities, and the San Bernardino County is the responsible agency for land use planning in unincorporated areas. Public lands in the Mojave Region are managed by BLM, San Bernardino National Forest, USBR and CDFW. Land use in the Region includes large parcels of public lands, which occupy approximately 53 percent of the land area, followed by residential land uses covering approximately 40 percent (San Bernardino County 2009).

Within the Mojave Region, most land use planning efforts are focused on changes from agricultural and open space land uses to urban land uses. Currently, coordination between land use planners and water managers primarily occurs during the entitlement phase of an urban development project, including zoning decisions, proof of water availability and stormwater management measures to reduce the impacts of urbanization, when building permits are issued. As the groundwater management plan is updated, maps showing zones of recharge for local water supplies will be provided to all land use authorities in the Region.

11.4.2 Mandated Collaboration between Water and Land Use Planning

State legislation has been enacted to address the gap between land use planning and water resource management. In 2001, two water supply planning bills, Senate Bill (SB) 610 and SB 221, were enacted that require greater coordination and more extensive data to be shared between water suppliers and local land use agencies for large development projects and plans:

- SB 610, Water Code sections 10910 and 10911, requires the public water system that may supply water to a proposed residential development project of more than 500 dwelling units (or a development project with similar water use), or more than a ten percent increase in equivalent residential service connections (applicable for developments in water systems with less than 5,000 connections), to prepare a water supply assessment (WSA) for use by the lead land use planning agency in its compliance with the California Environmental Quality Act (CEQA). A WSA is performed in conjunction with the land use approval process associated with the project and must include an evaluation of the sufficiency of the water supplies available to the water supplier to meet existing and anticipated future demands.
- SB 221 requires projects that include tentative tract maps for over 500 dwelling units to obtain verification from the water system operator that will supply the project with water, that it has a sufficient water supply to serve the proposed project and all other existing and planned future uses, including agricultural and industrial uses, in its area over a 20 year period, even in multiple dry years. SB 221 is intended as a “fail safe” mechanism to ensure that collaboration on finding the needed water supplies to serve a new large subdivision occurs before construction begins. In most cases, an SB 610 WSA has been developed prior to this step.

It is important to note that WSAs, which are often based on UWMPs, are only performed for development that meets certain size criteria. There is not an assured process in place for understanding and addressing the cumulative impact of multiple smaller developments that do not require WSAs.

As growth in the Mojave Region continues, the preparation of WSAs or written verifications pursuant to these bills may become increasingly common, if large developments are proposed. In the absence of large developments, land use planning entities and water management entities should coordinate to assess water supply and infrastructure sufficiency by water purveyors for all projects. This may include an assessment of cumulative need for water by a range of small projects.

Water resources play an important role in the land use decisions that are made under the guidance of general plans. Water resources is typically not an ‘element’ of a general plan, but is discussed within the context of the general plan required ‘elements’; land use, circulation, housing, conservation, open space, noise, and safety (e.g., the 2007 San Bernardino County General Plan includes water under the Conservation Element, the City of Victorville General Plan discusses water resources under the Resources Element, and the City of Barstow General Plan discusses water resources under its Natural Factors Element). Therefore, general plan development, implementation and updates provide a forum for coordination and collaboration between land use planning agencies and water managers. However, a challenge for land use planning is that general plan updates are not always prepared on a consistent basis and can take a long time to complete.

Additional collaborative forums not specifically related to the IRWM have contributed to the IRWM program through meeting attendance, submitting projects and other collaborative efforts. Therefore, the common memberships provide opportunities for additional interaction and collaboration among land use planning and water management entities in the Region. Examples of collaboration efforts from regional to local are described below:

- **San Bernardino Countywide Vision Water Element** – The Countywide Vision is a movement sponsored by San Bernardino County to bring in the local leaders of education, environment, housing, image, infrastructure, economy, public safety, wellness, quality of life and water together to develop a common set of unified goals and objectives for the entire county. The MWA is a leader in the Countywide Vision Water Element Group and helps guide the policies and partnerships that will ensure a sustainable water supply for the entire San Bernardino County.

- **2010 Regional Urban Water Management Plan**– The MWA, working closely with its MWA Technical Advisory Committee (TAC) and local major water purveyors, developed a strategy for a master UWMP that major water purveyors could reference. The process involved working on a regional water supply projection model that included all of the major water purveyors in the region. Individual urban water suppliers utilized this common model and associated water projections for their individual UWMPs. This collaborative approach to water demand forecasting ensured that the region understood the collective regional water supply and approached meeting future water demands as a region rather than individual purveyors.

- **Annual San Bernardino County Water Conference** – These conferences provides a forum for collaboration among premier water experts, business leaders and community stakeholders to work to identify long-range solutions that ensure a reliable water supply for the County and beyond. The conference enables the public to engage with business, community and civic leaders to discuss issues such as the state's water resources, supply versus demand situation, financing and next steps in dealing with these issues. August 2014, will mark the eighth annual conference. (http://www.sbcwater.com/)

- **Basin Wide Foundation** – This Foundation was formed in 1996 with the purpose to partner with other organizations throughout the Morongo Basin in developing programs intended to enhance the quality of life for residents of the many encompassed communities and for the Morongo Basin as a whole. The Foundation aims to guide, to inspire and provide tools to all non-profit organizations to help them fulfill their mission and strive towards success. Each year, the foundation hosts a one-day workshop geared to non-profit organizations, their Executive Directors, Board of Directors, staff and volunteers.

- **High Desert Water Summit -** The 2013 event aimed to initiate dialogue among the Region's leaders to plan the High Desert's future with an eye towards ensuring a sustainable water supply to support growth. It was sponsored by the Mojave Water Agency, Opportunity High Desert, the Building Industry Association-Baldy View Chapter, and Apple Valley Ranchos Water Company.

The relationships among the Region's land use planning entities, other water management entities, and the RWMG are sturdy enough to serve as bases for increased collaboration. The RWMG and land use managers are considering ways to improve collaboration on a variety of topics and areas of focus through creation of subcommittees and other forums to track related issues such as floodplain management, flood control planning, stormwater management, water conservation efforts, watershed management, land use changes, and habitat management.

As noted above, much of the collaboration and coordination on these issues in the past occurred through the development and implementation of formal documents, such as UWMPs, general plans, groundwater management plans, flood insurance studies, watershed assessments, watershed sanitary surveys, and SWMPs. The IRWM Plan provides an opportunity to improve collaboration by increasing public participation and by increasing awareness of these plans in the land use and water planning decision-making processes. Going forward, the RWMG and Implementation Support Team (IST) are committed to collaborate with land use managers in the planning and development of projects that address water resources-related objectives.

11.4.3 Participation by Local Planning Entities in the IRWM Plan

Within the Mojave Region, generally good foundational relationships exist between land use planning entities, the RWMG and other water management entities. Local planning entities, including municipal and County government planning staff, County and local special districts, such as the Mojave Desert Resource Conservation District, and other entities such as realtor associations have participated in development of the IRWM Plan and will continue to provide an important connection to integrate land use planning and water resource management in the Region. See Section 1.2.2 for the complete list of stakeholders. As participating stakeholders and technical advisory committee members, planning agencies along with the general Stakeholder Group have actively participated in IRWM Plan meetings, provided information and data necessary to update the IRWM Plan, provided input to objectives, project ranking, and may sponsor projects to implement the IRWM Plan. In addition to direct stakeholder participation, UWMP preparation and the adjudications in the Region are currently important means for collaboration between land use planning and water management planning in the Region.

11.5 Dynamics and Coordination between Local Planning and IRWM Planning

The following section describes the direct linkages and dynamics between the IRWM Plan and other local planning documents and efforts. As described in Section 10, numerous plans and studies related to land use and water resource management and planning in the Mojave Region have been reviewed to support the development of this IRWM Plan. The IRWM Plan contains information from efforts that have occurred throughout the Region and is consistent with and supports locally-led planning and implementation of integrated water management. The IRWM Plan does not replace or supersede local planning; rather, it aggregates and synthesizes information from numerous existing plans and perspectives and helps inform local planners about the broader objectives and challenges within the Region.

11.5.1 Plan Consistency

11.5.1.1 Consistency and Coordination between Local Water Plan Content and the IRWM Plan

Steps have been implemented to preclude inconsistencies between the IRWM Plan and local water plans. These steps include using current water resources plans as source material for the IRWM Plan, extensive participation by local and state water resource planners, requesting adoption of the IRWM Plan by project proponents, and using compliance with specified local plans as eligibility criteria for proposed projects.

11.5.1.2 Considering Updates to Local Plans

The existing approach to coordinate local planning efforts with IRWM Planning will continue into the future. The list of plans consulted for this IRWM Plan can be referenced for future planning and may be revised during future IRWM Plan updates. Updates to local plans can be reflected in future IRWM Plan updates.

This Plan will support local water management organizations in making local decisions and taking local actions that help accomplish a shared vision for the entire Region. The Plan will also help local organizations cooperate more effectively on actions they can accomplish better together than alone.

11.5.1.3 Resolving Inconsistencies with Local Water Plans

Any potential inconsistencies between plans will be addressed on a case by case basis if discovered. In the event that inconsistencies between a local water plan and the IRWM Plan are identified, IRWM Plan participants will resolve the inconsistency through direct consultation with the agency that prepared the plan.

11.5.1.4 How Regional Planning Efforts Feed Back to Local Planning Efforts

While local and regional planning forms the foundation of the IRWM Plan, the IRWM Plan provides opportunities for regional planning to inform local plans. The collaborative planning that occurs through the IRWM Plan process, and adoption of the IRWM Plan by project proponents, will inevitably feed into local planning in multiple ways (e.g., reflecting regional objectives, policies and projects in local plans). Participation in the IRWM Plan process to develop regional solutions to the challenges faced by individual agencies can help each agency meet its objectives, forge connections among agency personnel that persist outside the IRWM Plan context, and enrolls agency planners and decision makers in the benefits of cooperative regional planning.

Climate change presents many challenges for water resources agencies that demand a regional approach. Advancements in research in this dynamic field may frequently outpace local planning. Section 12: Climate Change identifies vulnerabilities for water resources and adaptation strategies (e.g., flood management should be integrated with watershed management on open space, agricultural, wildlife areas, and other low-density lands to better utilize natural floodplain processes and restore, maintain and improve existing flood control and riparian corridors). That analysis will feed back to local planning efforts through briefings to the Coordinating Committee (CC) and IST and commitments by IRWM Plan participants to incorporate information into future local planning efforts.

11.5.1.5 Mechanisms to Ensure Consistency between IRWM Plan Projects and Other Plans

There are a number of mechanisms already in place to ensure consistency between IRWM Plan projects and other local and regional plans:

- ***Permits and Approvals***. Issuance of permits and other approvals often is contingent on consistency with applicable plans. Examples include:
  - Lahontan (Region 6) and Colorado River (Region 7) (RWQCB - *Water Quality Control Plan Lahontan Basin* and *Water Quality Control Plan Colorado River.*
  - Mojave Desert Air Quality Management District – Clean Air Plan
- ***California Environmental Quality Act (CEQA).*** CEQA requires Environment Impact Reports to discuss inconsistencies between a project and applicable plans; some criteria for determining the significance of environmental impacts are based on plan or policy consistency, and require mitigation to resolve inconsistencies.
- ***National Environmental Policy Act (NEPA).*** NEPA requires Environmental Impact Statements to discuss conformance with comprehensive plans and zoning, and requires mitigation to resolve inconsistencies.
- ***Retail UWMPs Compared to Wholesale UWMPs*** for consistency and to verify water supply is available.
- ***General Plan Consistency Determinations*** by cities and counties are typically required for water resources projects, although the findings may be advisory in some cases.

Many IRWM Plan participants are directly involved in local water resources planning for their respective agencies and were involved in crafting the Plan objectives and submitting the proposed IRWM Plan projects identified in Appendix D. Water resource managers were involved throughout the IRWM Plan process, serving as members of the CC and Project Team, and providing input at various meetings. Their knowledge and expertise of local plans influence all aspects of the IRWM Plan, including development of IRWM Plan objectives, selection of resource management strategies to implement, the project selection process, and review of all IRWM Plan sections, among other things.

11.6 Public Outreach/Disadvantaged Community Outreach

11.6.1 Disadvantaged Community Outreach

As defined by the *Integrated Regional Water Management Guidelines for Proposition 84 and 1E (2012 Guidelines)* (DWR 2012a), a disadvantaged community (DAC) is a municipality, including, but not limited to a city, town or county, or a reasonably isolated and divisible segment of a larger municipality, that has an average median household income (MHI) that is less than 80 percent of the statewide annual MHI. In 2010, 80 percent of the State of California's MHI was $48,706. As described in Section 2.5.3, approximately eighty percent of the Mojave Region qualifies as disadvantaged and DACs are located in both rural and urban areas. In efforts to provide "a safe, clean, affordable, and sufficient water supply to meet the needs of California residents, farms, and businesses" (California Water Code (CWC) §79501(b)) and to encourage participation, outreach efforts were directed at DACs. Three of the seven public workshops were developed specifically to reach residents of DACs in the Region, while the other four were geared to all residents of the Region regardless of income level.

The top two priority topics that DAC workshop participants ranked as most relevant to their community were: (1) water supply and conservation and (2) water quality. These were also the top two priority topics for the remaining four Public workshop attendees, indicating that concerns for DACs in the Region are similar to those for the public in general. The full list of priority topics identified by workshop location is shown in Table 4-1.

A small water systems subcommittee has been established by the Implementation Support Team, which includes any agency involved in water resources (small systems) and DACs.

11.6.2 Environmental Justice

Environmental justice as defined by the State of California relates to the fair distribution of environmental benefits and burdens. Environmental justice communities in California are often identified as those where residents are predominantly low-income or minorities, where residents have been excluded from the environmental policy setting or decision-making process, where they are subject to a disproportionate impact from one or more environmental hazards, and where residents experience disparate implementation of environmental regulations, requirements, practices and activities in their communities.

Location of water infrastructure including sewage treatment plants and recycling facilities can place a burden on nearby communities due to odors, effluent, sewage back-ups and industrial buildings. At a statewide level, identifying the location of disadvantaged and environmental justice communities is an important step in ensuring that agencies, stakeholders and the general public can determine the impact of operations and plans on these communities. As the Region continues to develop, care will need to be taken to prevent creating environmental justice issues that unfairly affect certain communities.

The IRWM Planning process, with its broad stakeholder involvement, can help promote environmental justice within the Region, helping to create the same degree of protection from environmental and health hazards as well as equal access to the decision-making process. The IRWM Plan objectives, taking actions within the watershed to adapt to climate change, and promoting projects and actions that reduce greenhouse gas emissions, should be consistently applied to future projects so as to ensure greatest regional benefits without placing an undue burden on a specific community.

Section 12: Climate Change

12.1 Introduction

California faces the prospect of significant water management challenges related to climate change and is already experiencing a wide array of effects. Impacts that are currently occurring and that are projected to continue include increased temperatures, sea level rise, a reduced winter snowpack, and altered precipitation patterns, including more frequent and intense storm events (CalEMA and CNRA 2012).

While it is clear that actions must be taken to reduce greenhouse gas (GHG) emissions to mitigate impacts on global climate, adaptation to already-occurring impacts is also crucial to continue to effectively manage the State's water resources. Water resource managers and customers can play key roles in improving water and energy efficiency, reducing GHG emissions, and improving stewardship of the State's natural resources (California Department of Water Resources 2008).

One significant step is to have climate change integrated into the Integrated Regional Water Management Plans (IRWM Plans). The California Department of Water Resources (DWR) *Integrated Regional Water Management Guidelines for Proposition 84 and 1E* (2012 Guidelines) (DWR 2012a) was used for guidance in developing this Plan section. Those guidelines require that the IRWM Plan:

- Describe, consider, and address the effects of climate change on the region and disclose, consider, and reduce where possible GHG emissions when developing and implementing projects.
- Identify climate change impacts and address adapting to changes in the amount, intensity, duration, timing, and quality of runoff and recharge.
- Consider the effects of sea-level rise on water supply conditions and identify suitable adaptation measures.

In addition, future updates should describe policies and procedures that promote adaptive management; and minimize risk, damage and loss due to climate change impacts.

Mojave Water Agency (MWA) contracted with the Technical Service Center of the US Bureau of Reclamation (USBR) to prepare a climate change assessment of the Mojave River Watershed. The analysis consisted of three tasks:

1. Assess future surface water supplies, including native flows and imports.
2. Project potential changes in flood frequency.
3. Conduct a GHG emissions inventory for the water sector.

The final report, *Mojave River Watershed Climate Change Assessment* (USBR Climate Report) (USBR 2013) (included as Appendix G of this report), was used as the basis for much of the following subsections.

The following sections are intended to focus on assessing the potential climate change vulnerabilities of the Mojave Region's water resources, identifying climate change adaptation strategies; with the overall goal of instilling climate change adaptation as an overarching theme throughout the IRWM Plan.

12.2 Legislative and Policy Context

12.2.1 Current Regulatory Constraints

12.2.1.1 USEPA Mandatory Reporting of Greenhouse Gases Rule

The US Environmental Protection Agency (USEPA) Reporting Rule, which started in 2011, requires reporting for 2010 emissions for sources or single facilities with more than 25,000 metric tons carbon dioxide equivalent ($MTCO_2e$) annually. The rule can be found at: http://www.epa.gov/climatechange/emissions/ghgrulemaking.html.

12.2.1.2 Title V of the Clean Air Act

Title V of the federal Clean Air Act reauthorization (1990) requires each state to develop a permit-to-operate system and emission fee program for major sources of air pollution. Title V only applies to "major sources." USEPA defines a major source as a facility that emits, or has the potential to emit any criteria pollutant or hazardous air pollutant at levels equal to or greater than the Major Source Thresholds. The Major Source Thresholds for criteria pollutants may vary depending on the attainment status (e.g., marginal, serious, extreme) of the geographic area and the criteria pollutant or hazardous air pollutant in which the facility is located.

Title V permit holders must incorporate GHG requirements when renewing or revising a permit. USEPA has continued to pursue regulations to address issues related to climate change. The USEPA already requires large emissions sources (greater than 25,000 $MTCO_2e$) to annually report their emissions. As well, the USEPA has published rules to start directly regulating GHG emissions under the Clean Air Act. Under the USEPA's Tailoring Rule, facilities responsible for nearly 70 percent of the nation's GHG emissions will be subject to GHG emissions permits.

None of the water utilities in the Region are currently subject to these federal regulations because none own or operate a single facility that meets the current emissions threshold of 25,000 $MTCO_2e$ per year.

12.2.1.3 AB 32 Global Warming Solutions Act and Executive Order S-3-05

California continues to lead the nation in developing public policy responses to address issues related to climate change and GHG emissions — most notably through the implementation of Assembly Bill 32 (AB 32). AB 32 established GHG emission reduction targets for California and put the California Air Resources Board (ARB) in charge of implementation and rulemaking through the development of the "Scoping Plan." AB 32 aims to reduce statewide GHG emissions to 1990 levels (427 million $MTCO_2e$) by 2020. California is currently at about 469 million $MTCO_2e$, and under the business-as-usual case, most recently updated in 2010, 2020 emissions are expected to be about 507 million $MTCO_2e$. In order to meet the 2020 target, California will need to reduce GHG emissions by about 80 million $MTCO_2e$, an approximate 16 percent reduction from the state's projected 2020 emissions, by 2020. To meet these targets a two percent reduction is needed each year for the next ten years. To accomplish the goal the state is pursuing a number of direct regulations and market-based mechanisms that have been laid out in a Scoping Plan. The core measures of the Scoping Plan are tailpipe standards, transportation and land-use changes, low carbon fuel standard, enhanced energy efficiency, a Renewables Portfolio Standard of 20 percent by 2010 and 33 percent by 2020, and a Cap-and-Trade program. More information about the Scoping Plan can be found at: http://www.arb.ca.gov/cc/scopingplan/scopingplan.htm.

12.2.1.4 California ARB's Mandatory Greenhouse Gas Reporting Regulation

ARB's Mandatory Reporting Rule requires the state's largest emitters (single sources with GHG emissions greater than 25,000 $MTCO_2e$ per year) to annually report and verify their GHG emissions. The rules were revised to harmonize the state's reporting rules with the USEPA's Mandatory Reporting Rule and streamline the reporting and verification process for sources with GHG emissions between 10,000 and 25,000 $MTCO_2e$. ARB finalized the proposed changes in 2011. The rule can be found at: http://www.arb.ca.gov/cc/ccei.htm.

12.2.1.5 Cap-and-Trade Rule and Compliance Offsets

The most far-reaching regulatory action to emerge from AB 32 is the development of rules implementing a Cap-and-Trade Rule for California. Under Cap-and-Trade, an overall limit on GHG emissions from capped sectors has been established and will be lowered every year until 2020. Facilities subject to the cap are able to trade permits to emit GHGs or acquire offsets from uncapped sectors. Starting in 2012, entities with GHG emissions greater than 25,000 $MTCO_2e$ in process and combustion emissions (not indirect electricity emissions) are subject to this cap. More information about the Cap-and-Trade regulation can be found at:
http://www.arb.ca.gov/cc/capandtrade/capandtrade.htm

The Cap-and-Trade Rule effectively puts a price on GHG emissions and implicitly on energy (transportation fuel and electricity) prices. While water utilities in the Region may not be directly subject to a cap on emissions, they may be subject to higher prices for fossil fuels and electricity. Water utilities may also see carbon prices manifested in its supply chain as suppliers pass their compliance and higher energy costs onto their customers. It should be noted that as of the date of this IRWM Plan, the DWR and the State Water Project (SWP) have been determined by ARB to be ineligible for offsets under the Cap-and-Trade Rule. This will have the effect of raising power costs for the SWP and its contractors, such as MWA.

The Cap-and-Trade regulation covers 360 businesses representing 600 facilities and is divided into two broad phases: an initial phase which began in 2012 that includes all major industrial sources along with utilities; and, a second phase that starts in 2015 and brings in distributors of transportation fuels, natural gas and other fuels.

Companies have not been given a specific limit on their GHG emissions but must supply a sufficient number of allowances (each covering the equivalent of one ton of carbon dioxide) to cover their annual emissions. Each year, the total number of allowances issued in the state drops, requiring companies to find the most cost-effective and efficient approaches to reducing their emissions. By the end of the regulation in 2020, there will be a 15 percent reduction in GHG emissions compared to today, reaching the same level of emissions as the state experienced in 1990, as required under AB 32.

To ensure a gradual transition, ARB has provided significant free allowances to all industrial sources during the initial period (2012-2014). Companies that need additional allowances to cover their emissions can purchase them at regular quarterly ARB auctions, or buy them on the market. Electric utilities have also been given allowances and they are required to sell these allowances and dedicate the revenue generated for the benefit of their ratepayers and to help achieve AB 32 goals.

Eight percent of a company's emissions can be covered using credits from compliance-grade offset projects, promoting the development of beneficial environmental projects in the forestry and agriculture sectors. Included in the regulation are four protocols, or systems of rules, covering carbon accounting rules for offset credits in forestry management, urban forestry, dairy methane digesters, and the destruction of existing banks of ozone-depleting substances in the US (mostly in the form of refrigerants in older refrigeration and air-conditioning equipment) (California ARB 2010).

California is coordinating the development of its regulation with the Western Climate Initiative, which is a multi-jurisdictional initiative to develop regional market-based mechanisms (i.e., Cap-and-Trade program) to reduce GHG emissions. The rationale for a broader regional approach is that it could provide greater flexibility for emitters in how, when and where to achieve emissions reductions; and create a more fluid and robust marketplace for trading.

12.2.1.6 Mojave Desert Air Quality Management District (MDAQMD) Guidance for CEQA Greenhouse Gas Significance Thresholds

Consistent with Senate Bill (SB) 97, projects subject to California Environmental Quality Act (CEQA) review must estimate GHG emissions and consider potential impacts, and projects with potential significant impacts must consider mitigating project related emissions.

Mojave Desert Air Quality Management District

In 2007, the California Legislature directed the Natural Resources Agency to develop specific guidelines for lead agencies on how to quantify, evaluate and mitigate a project's potential GHG emissions and climate change impacts. Under the guidelines, finalized in February 2010, a lead agency must calculate GHG emissions from a project, assess the impacts of these emissions, make a significance determination, and if necessary consider mitigation measures. The definitions of significant impacts and determination of significance thresholds are subject to interpretation of pre-existing CEQA guidelines and jurisprudence.

MDAQMD developed "CEQA and Federal Conformity Guidelines" in August 2011. Under the Federal Clean Air Act the MDAQMD has adopted federal attainment plans for ozone and particulate matter (PM-10) (up to 10 micrometers in size) and has dedicated staff to reviewing projects to ensure that the projects will not: (1) cause or contribute to any new violation of any air quality standard; (2) increase the frequency or severity of any existing violation of any air quality standard; or (3) delay timely attainment of any air quality standard or any required interim emission reductions or other milestones of any federal attainment plan. These Guidelines are intended to assist persons preparing environmental analysis or review documents for any project within the jurisdiction of the MDAQMD by providing background information and guidance on the preferred analysis approach (MDAQMD 2011).

12.2.1.7 Executive Order S-13-08

By Executive Order S-13-08, the California Governor directed the California Natural Resources Agency, DWR, the Office of Planning and Research, the California Energy Commission, State Water Resources Control Board, and other State agencies to research and advance California's ability to adapt to the impacts of climate change. Results of this work include the California Sea Level Rise Assessment and the California Climate Change Adaptation Strategy.

12.2.1.8 California Ocean Protection Council Resolution

The California Ocean Protection Council Resolution adopted March 11, 2011 requires that projects or programs funded by the State of California consider sea level rise.

12.2.1.9 Potential Regulatory Constraints

12.2.1.9.1 USEPA Greenhouse Gas Tailoring Rule

USEPA is considering rules targeting sources below 50,000 short tons CO_2e (about 45,000 $MTCO_2e$) by 2016. The current rule applies to sources greater than 75,000 short tons CO_2e (about 68,000 $MTCO_2e$). USEPA is also reviewing an accounting approach for biogenic emissions sources.

In its final Tailoring Rule, USEPA committed to exclude sources with GHG emissions below 50,000 short tons CO_2e (about 45,000 $MTCO_2e$) per year from new permitting requirements through at least 2016. During this period, USEPA plans to conduct a study of the permitting burdens that would exist if the Tailoring Rule were to be applied to smaller sources. Based on the outcome of the study USEPA may expand the Tailoring Rule to include additional small sources or permanently exclude them from a GHG permitting system.

As currently adopted, the Tailoring Rule does not distinguish between GHG emissions from fossil and biologically derived fuels. USEPA concluded a public comment period in September 2010 seeking information on approaches to account for GHG emissions from bioenergy and other biogenic sources. USEPA is under considerable political pressure to revisit the decision to treat emissions from biomass the same as emissions from fossil fuels. No decision has yet been made on this issue.

12.2.1.9.2 Federal Cap-and-Trade Program or other Market-Based Mechanism to Create a Price for GHGs or Carbon

While the Clean Air Act allows USEPA to use economic incentives, including emissions trading programs, to control emissions; the prospects for legislation establishing a national economy wide Cap-And–Trade program, or alternative carbon pricing policies such as a carbon tax, are highly unlikely in the near-term. Congress may act to increase incentives for energy efficiency and renewable energy production. The most likely mechanism for renewable resources incentives is through a federal clean energy standard that would include nuclear energy resources. Enactment of a federal clean energy standard is unlikely to impact the Region as none of the current federal policy proposals would preempt California's far more ambitious renewable energy portfolio standard.

12.2.1.9.3 AB 32 Scoping Plan Water Sector Recommendations

In addition to regulatory approaches to meet the state GHG emissions reduction goals; the ARB Scoping Plan calls for the "water sector" to implement six voluntary measures to achieve 4.8 million $MTCO_2e$ in emissions reductions by the year 2020. The measures include: increased water use efficiency, broader implementation of water recycling, improvements to the energy efficiency of the state's water and wastewater infrastructure, low impact development techniques, development of in-conduit hydroelectric and wastewater treatment renewable energy resources, and instituting a public goods charge to finance investments in water conservation and water sector energy efficiency (California ARB 2008).

Both the Association of California Water Agencies and the California Association of Sanitation Agencies have active programs to track and monitor the development of any legislation or regulatory initiatives to mandate these measures.

The Scoping Plan was first considered by the Board in 2008 and must be updated every five years. At the time this IRWM Plan was updated, the ARB is currently in the process of updating the Scoping Plan. Details regarding this update will allow past performance to be evaluated and policies to be re-assessed.

12.3 Climate Change Projections

12.3.1 Climate Change Modeling and Scenarios

The Intergovernmental Panel on Climate Change (IPCC) Special Report on Emissions Scenarios provides a family of common scenarios that cover a range of plausible trends in GHG emissions over the 21st century as a result of economic, technological, and population change (IPCC 2007). The amount and the rate of accumulation of GHG in the atmosphere will determine the effect of climate change. The IPCC scenarios are only a sample of the potential climate outcomes; they contain a level of uncertainty, and they have no probabilities assigned to them.

The California Water Plan (CWP) 2009, the CWP 2013 Update and the California Bay Delta Conservation Plan (BDCP) are examples of recent planning documents that the two GHG emission scenarios have been utilized. Scenario A2 (Medium–High Emissions) assumes higher GHG emissions and high growth in population and represents a more competitive world that lacks cooperation in sustainable development (similar to "business as usual"), while B1 (lower Emissions) is a lower GHG emission scenario that represents social consensus and action for sustainable development. Generally, the B1 scenario might be most appropriately viewed as an optimistic "best case" or "policy" scenario for emissions which will require fundamental shifts in global policy, while A2 is more of a *status quo* scenario reflecting real-world conditions incorporating incremental improvements and may be the more realistic choice for decision-makers to use for climate adaptation planning. To date, actual global emissions have more closely tracked, and even exceeded, the A2 scenario put forth in 2000.

Climate change assessments are performed using the output of computer models that project future conditions via inputs from GHG emission scenarios. These models are not predictive, but provide projections of potential future climate scenarios that can be used for planning purposes. The primary climate variables projected by global climate models (GCMs) that are important for water resources planning in California are changes in air temperature, changes in precipitation patterns, and sea-level rise. A set of six GCMs were run for the two GHG emissions scenarios, A2 and B1, and downscaled to locations in California.

Based on historical simulations, the six selected models are capable of producing a reasonable representation of California's seasonal precipitation and temperature, variability of annual precipitation, and the El Niño/Southern Oscillation (Cayan, Tyree, and Lacobellis 2012).

12.3.2 Statewide Climate Change Projections

All of the models show increased warming throughout the 21st century, with average annual air temperature increasing about 2°F to 5°F by 2050. In 2009, the Congressional Budget Office provided an overview of the current understanding of the impacts of climate change in the United States. They note that warming will tend to be greater at high latitudes and in the interiors of the United States. Future climate conditions will feature less snowfall and more rainfall, less snowpack development and earlier snowmelt runoff. Warming will lead to more intense and heavy rainfall that will tend to be interspersed with longer relatively dry periods.

Overall temperatures are expected to rise substantially throughout this century. During the next few decades, scenarios project average temperature to rise between 1 and 2.3°F; however, the projected temperature increases begin to diverge at mid-century so that, by the end of the century, the temperature increases projected in the higher emissions scenario (A2) are approximately twice as high as those projected in the lower emissions scenario (B1). These projections also differ depending on the time of year and the type of measurement (highs vs. lows), all of which have different potential effects to the state's ecosystem health, agricultural production, water use and availability, and energy demand (Cal-Adapt 2014). There is greater agreement and higher confidence in temperature change and less confidence in precipitation changes.

The Mediterranean seasonal precipitation pattern is expected to continue during the 21st century, with most of the precipitation occurring during winter from North Pacific storms. The hydro-climate is expected to be influenced by the El Niño-Southern Oscillation with alternating periods of wet and dry water years. In the Sierra Nevada Mountains, there will be some shift to more winter precipitation occurring as rain instead of snow, with a reduction in snowpack accumulation and shifts in runoff patterns, especially during the summer and fall.

On average, the projections show little change in total annual precipitation in California. Furthermore, among several models, precipitation projections do not show a consistent trend during the next century.

Sea-level rise is expected to increase the risk of coastal erosion and flooding along the California coast, and higher water levels due to sea-level rise could magnify the adverse impact of storm surges and high waves. Sea level has already risen 7 inches along the California coast and it is estimated to rise an additional 4-16 inches by mid-century and 7-55 inches by 2100. Increased sea level will increase pressure on the Delta's levee system and could lead to breaches. Higher sea levels may also increase saltwater intrusion making some groundwater resources unusable and increasing surface water (Cal-Adapt 2014).

Impacts to assets from extreme high tides in addition to net increases in sea level will likely result in increased inundation frequency, extents, and depths leading to catastrophic flooding and coastal erosion. Understanding the extent, depth and duration of inundation and the patterns of erosion will be necessary for characterizing infrastructure vulnerability in coastal areas.

12.3.3 Mojave Region Climate Change Projections

There is a large body of existing climate change research. The following section is based on the USBR Climate Report, discussed previously as being completed specifically for this IRWM Plan. This summary identifies relevant studies of historical trends and future projections of climate variables for the region. Much of the information is summarized from a recent USBR report *Literature Synthesis on Climate Change Implications for Water and Environmental Resources* (Spears et al. 2011). The studies referenced here cover a range of geographic extents but all are relevant to the USBR Lower Colorado Region, of which the Mojave River Groundwater Basin is a part.

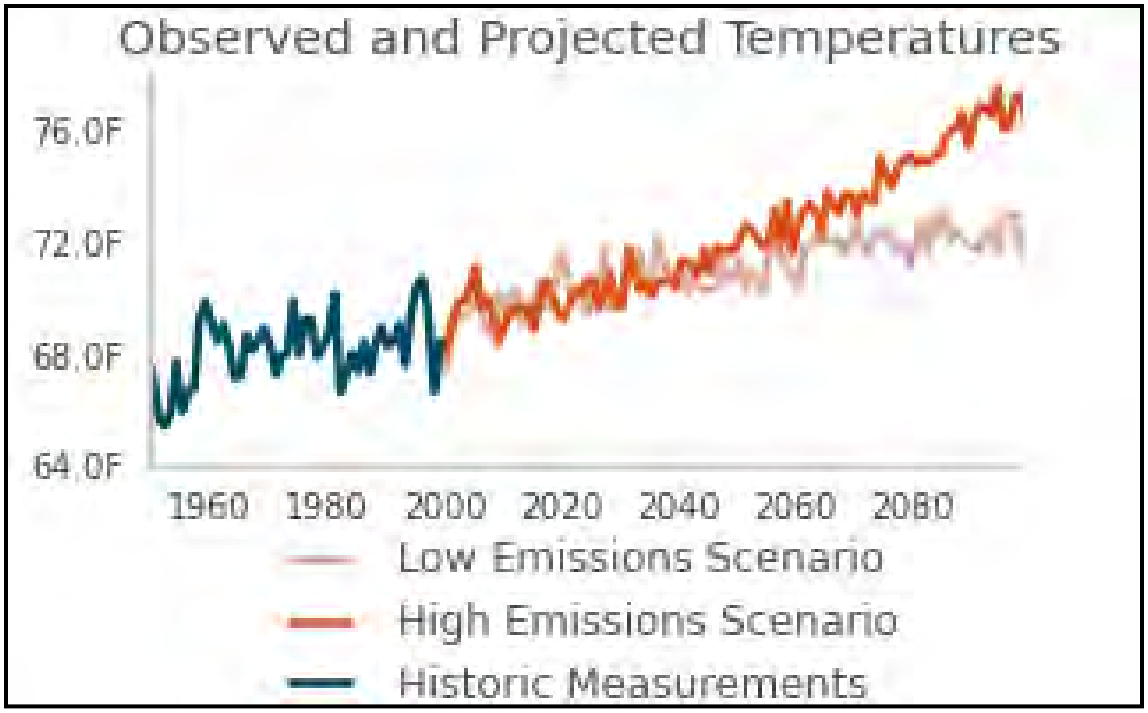
As discussed in Section 2.6.2, basins along the Mojave River and adjacent areas are referred to as the Mojave River Groundwater Basin; the area is referred to as the Mojave Basin Area. Remaining basins in the southeastern Mojave Region are referred to as the Morongo Basin/Johnson Valley Area or “Morongo Area”.

In general, scenarios for the Region identify an overall decrease in precipitation levels coupled with more intense individual storm events that may lead to increased flooding. Higher temperatures that may cause more precipitation to fall as rain rather than snow, hasten snowmelt and increase runoff, will affect water storage planning. Increased evaporation will create a generally drier climate, with wildfires likely to increase and groundwater basins likely to receive less replenishment.

The *State Water Project Delivery Final Delivery Reliability Report 2011* (DWR 2012b) (the most recent version available at the time of this IRWM Plan) projects a temperature increase of 1.3° to 4.0 °F by mid-century and 2.7° to 8.1° F by the end of the 21st century, and that increased temperatures will lead to less snowfall at lower elevations and decreased snowpack. By mid-century it is predicted that Sierra Nevada snowpack will reduce by 25 percent to 40 percent of historical average. Decreased snowpack is projected to be greater in the northern Sierra Nevada, closer to the origin of SWP water, than in the southern Sierra Nevada. Furthermore, an increase in “rain on snow” events may lead to earlier runoff. Given these changes water shortages worse than the 1977 drought could occur one out of every six to eight years by the middle of the 21st century and one out of every two to four years by the end of 21st century. Increased demand combined with declining flows will likely lead to decreased carryover storage from year to year.

The historical average temperature in the Region is about 68.4°F, the low and high emission scenarios project an increase of about 3.9 to 7.1°, for the low and high emissions scenarios respectively. The B1 and A2 scenarios for San Bernardino County are presented in Figure 12-1 (http://cal-adapt.org/tools/factsheet/). Individual locations within the Region are also available at caladapt.org.

Figure 12-1
San Bernardino County Observed and Projected Temperatures



Source: Cal-Adapt.org

The USBR Climate Report examines water supply projections in the Region by analyzing the spatial distribution of simulated decadal temperature and precipitation for the Mojave Region. The median temperature change for the 2020s, 2050s and 2070s decades relative to the 1990s shows a spatially consistent increasing temperature trend. There is a slight increase in precipitation in the 2020s followed by progressively larger decreases in the 2050s and 2070s. Trends are, for the most part, spatially consistent, however there is slightly lower precipitation projected in the headwaters.

Although there is less confidence in projections for precipitation change for *middle* latitude regions (Dai 2006), projected precipitation changes for *subtropical* latitudes are generally more consistent and suggest a tendency toward less annual precipitation, reduced basin-wide runoff decreased soil moisture and increased evapotranspiration (Milly et al. 2005, Seager et al. 2007, IPCC 2007, Cayan et al. 2010, Gutzler and Robbins 2010). However, it should be noted that the GCMs used in the IPCC Fourth Assessment Report (FAR) have been found to poorly simulate characteristics of the summer monsoon circulation, which is important to the Lower Colorado River Region (Lin et al. 2008).

Dominguez et al. (2010) found that future aridity of the Lower Colorado River Region will be dramatically amplified during La Niña conditions, which will be much more severe – warmer and drier – than during the historic period. Furthermore, Gutowski et al. (2008) predict that climate change will likely cause precipitation to be less frequent but more intense in many areas and that precipitation extremes are very likely to increase.

Changes in precipitation natural variability combined with a warming trend may impact water demand in addition to supply. Increased temperatures are predicted to lengthen the growing season for agricultural crops but crop irrigation water requirements is expected to vary. This change could increase agricultural water demand if farming practices are able to adapt to the opportunity by planting more crop cycles per growing season. In general increases in minimum and maximum temperatures, length of heat waves, and length of frost free season suggest increases in demand for water and electric power.

12.4 Vulnerability to Climate Change

Identification of watershed characteristics that could potentially be vulnerable to future climate change is the first step in assessing the climate change vulnerabilities in the Region. In the context of this analysis, vulnerability is defined as the degree to which a system is exposed to, susceptible to, and able to cope with and adapt to, the adverse effects of climate change, consistent with the definition in the recently issued DWR's *2011 Climate Change Handbook for Regional Water Planning* (DWR 2011) and consistent with the 2012 Guidelines. This section identifies the potential climate change vulnerabilities of the Mojave Region's water resources.

12.4.1 Vulnerable Watershed Characteristics

Table 12-1 provides a summary list of water-related resources that are considered important in the Mojave Region and that are potentially vulnerable to future climate change. The table provides the main water planning categories applicable to the Region and a general overview of the qualitative assessment of each category with respect to anticipated climate change impacts.

There has been extensive scientific research on climate change impacts and findings have been published in a vast collection of peer-reviewed technical literature. However, much of the available information lacks specific tools on how to apply impacts in the context of addressing climate change impacts on water resources. In addition, far less information is available on subregional or local geographic areas because the spatial resolution of the existing climate change models is still quite low and precipitation projections cannot be easily converted directly into surface runoff and groundwater recharge to connect changes with local water resources planning activities. The USBR Climate Report begins to explore climate change impacts on water supplies and flood events in the Mojave Region, providing the foundation for the subsequent sections.

This section presents the vulnerability of each sector identified in Table 12-1 with respect to climate change projections given the existing tools and available data. This is an initial attempt using projections specific to the Mojave Region for the vulnerability assessment in support of the IRWM Plan. The outcome of this initial assessment is intended to help understand the potential impacts, to integrate climate change into long-term planning, and to improve understanding of the uncertainties associated with climate change effects.

It should be noted that only those water-related resources likely to be vulnerable to climate change are considered in the analysis provided in the following subsections.

Table 12-1
Climate Change Vulnerability Assessment Checklist

Watershed Characteristics	General Overview of Vulnerabilities
Water Demand	**Urban and Agricultural Water Demand** – Changes to hydrology in the Region as a result of climate change could lead to changes in water demand, both in quantities and patterns. Increased irrigation (outdoor landscape or agricultural) is anticipated to occur with temperature rise, increased evaporation losses with warmer temperature, and a longer growing season. Water treatment and distribution systems are most vulnerable to increases in maximum day demand.
Water Supply	**SWP Imported Water** – SWP water is an important portion of the water resources available to the Region. Potential impacts on SWP water availability resulting from climate change directly affect the amount of imported water supply delivered to the Region. **Regional Groundwater** – Changes in local hydrology could affect natural recharge to the local groundwater aquifers and the quantity of groundwater that could be pumped sustainably over the long-term in the Region. Decreased inflow from more flashy or more intense runoff, increased evaporative losses, warmer and shorter winter seasons can alter natural recharge of groundwater. Furthermore, reductions in imported SWP supply due to climate change would lead to less water supply available for managed recharge of local groundwater basins and increased stresses on local supplies. **Regional Surface Water -** Although future projections suggest that small changes in total annual precipitation over the Region will not change much, there may be changes in timing with reductions in the spring and more intense rainfall in the winter.
Water Quality	**SWP Imported Water** – For sources derived from the Delta, sea-level rise could result in increases in chloride and bromide (a disinfection by-product (DBP) or DBP precursor), potentially requiring changes in treatment for drinking water. Increased temperature could result in an increase in algal blooms, taste and odor events, and a general increase in DBP formation. **Regional Surface Water** – Increased temperature could result in lower dissolved oxygen in streams forming anoxic conditions and algal blooms. Decrease in annual precipitation could result in higher concentrations of contaminants in streams during droughts or in association with flushing rain events. Increased wildfire events and flashier storms could also increase turbidity loads to riparian systems.
Sea Level Rise	The Region is not directly subject to sea level rise. However, potential effects of sea level rise may affect SWP water supply conditions. As discussed above, the principal concern is an increase in Delta salinity from sea water intrusion. As sea level rise is not a direct regional concern, it is not evaluated further in this assessment.

Table 12-1
Climate Change Vulnerability Assessment Checklist

Watershed Characteristics	General Overview of Vulnerabilities
Flooding	Climate change projections are not sensitive enough to assess short-term extreme events such as flooding, but the general expectation is that more intense storms would occur thereby leading to more frequent flooding and increasing the risk of direct flood impacts in the Region.
Ecosystem and Habitat	Changes in temperature, precipitation patterns and fire occurrences due to climate change can alter ecosystems that provide habitat for California's native species. These impacts can result in species loss, increased invasive species ranges, loss of ecosystem functions, and increased stresses on sensitive systems, including existing riparian and/or wetland areas in the Region.
Hydropower	SWP and other hydropower sources, existing or planned, could be diminished by the timing and amount of runoff as a result of climate change, which could affect the timing and amount of energy produced by these hydropower sources.

12.4.2 Water Demand

Historically agricultural water use has dominated demand in the Region but in recent years there has been a transition toward increased urban demand. Between 1995 and 2000 the Mojave River Groundwater Basin transitioned from mostly agriculture to mostly urban demands, while the Morongo Area has only urban demands.

Water demand will be impacted by changes in precipitation coupled with a warming trend. Increased temperatures are predicted to lengthen the growing season for agricultural crops. Increasing air temperature will result in increased evaporation leading to drier soils, increased plant evapotranspiration (ET), and a longer growing season. Higher temperatures and heat waves can be expected to increase demand for water, especially for agricultural and residential irrigation uses. Higher temperature generally increases ET rates; but some research studies also suggest higher CO_2 levels and higher temperature increase rates of plant growth, and can shorten the time to plant maturity (Hanak and Lund 2008). This would reduce the overall plant water uptake, partially compensating for potential reductions in agricultural water supply. Thus, the net effect on agricultural crops is still uncertain (Kiparsky and Gleick 2005) and remains an important area of on-going research.

Higher temperatures are likely to increase water demand; however there are insufficient data available to quantify the effect from increasing temperatures resulting from climate change. Qualitatively, the ET projections with climate change suggest water demand for agriculture in the Region is anticipated to increase during months where ET is high and decrease in months where ET is low. As a result of increased ET, urban water demand is anticipated to increase because of greater outdoor water use for landscape irrigation.

MWA's 2010 Urban Water Management Plan (UWMP) (MWA 2011) assumed that net natural supply, agricultural depletion from storage and return flows do not vary based on year type.

Projections were that demand would increase 10 percent in dry years and the groundwater banking supply available in the year that it was needed would be used assuming it was 100% available during single dry years and the total divided by 4(4-year dry period) and therefore assumed a maximum of 25% available during multiple-dry year. As an example, as detailed in Section 3.2.5.2, on January 1, 2014, MWA had over 132,000 acre feet (af) of banked groundwater supply available. Therefore, if necessary in 2014, a supply of 33,000 af is available during multiple dry years and 132,000 af during single dry years.

As discussed in Section 2.5.1, population is projected to increase nearly 2.2 percent annually through 2035 to over 700,000 for the MWA service area. Projected demands updated since the 2010 UWMP (discussed in Section 3.3) assume moderate conservation and indicate that total demand will increase from 160,000 af in 2015 to approximately 178,000 af by 2035.

Demand management is an important adaptation given decreased water supply as a result of climate change and is a crucial element of the MWA's water supply management program. Population growth and per-capita municipal production volume data have been tracked and correlated with the implementation of regional conservation activities since 2003. As shown previously for the MWA service area on Figure 5-1, municipal production has fallen approximately 9 percent or 8,500 af between 2000 and 2013; at the same time population grew by over 40 percent. It is estimated that use would have been about 51,200 af higher without conservation activities and efficiency standards.

12.4.3 Water Supply

For long-term water supply planning, coping with variability is a challenge. With potential additional changes imposed by climate change, there will be a heightened need to evaluate and respond to increased water supply variability. The water supply impacts of climate change are a key issue in the Mojave Region. Task 1 of the USBR Climate Report focuses entirely on impacts on surface water supply for MWA, including local surface water and imported SWP supplies. The following reflects the results of that analysis. For more detailed information on the methodology and results, refer to the report directly located in Appendix G.

Water supplies in the Mojave Region are comprised of natural surface water flows, wastewater imports from outside the Region, SWP imports and return flow from pumped groundwater not consumptively used. SWP supplies derive from Sierra Nevada snowmelt and the Sacramento-San Joaquin Delta and are subject to climate variability at those sources. Almost all of the water use within the Region is supplied by pumped groundwater replenished by native surface supply, return flow and SWP imports recharge.

12.4.3.1 SWP Imports

MWA has a contract for 82,800 af of SWP Table A amount. From 1999 to 2009 the agency imported 21,688 acre-feet per year (afy) on average (MWA 2011). About 3,500 af is purchased by the Hi-Desert Water District (HDWD) and delivered to the Warren Valley subbasin using the Morongo pipeline. In addition to offsetting the water supply deficit, the SWP water delivered through the Morongo pipeline is used to increase groundwater storage. Analysis of SWP deliveries shows that a total of roughly 451,000 af was delivered from 1978 to 2013. Although MWA has not been requesting its entire entitlement, from 1972 to 2001, it did receive all of the water it requested 75 percent of the time. On average, MWA received 88 percent of its total request but in the 2001 drought, it only received 39 percent of requested water (MWA 2004). As of 2010, average year SWP import availability is estimated to be 49,680 af for an average year, 5,796 af for a dry year and 28,152 af for multiple dry years (MWA 2011).

SWP water accounts for about one-third of the water resources available to the Region. DWR developed projections of SWP exports by water year type (wet, above normal, average, below normal, dry, and critical for the period) that illustrate how water availability could be influenced by climate change (DWR 2012b). Table 12-2 shows estimated SWP Table A deliveries by water year type under future conditions with and without climate change. The estimated SWP exports in Table 12-2 reported by DWR for the 82 years of hydrologic data (water years 1922 to 2003) were averaged according to water year type. This representation shows how the estimated SWP exports would vary by hydrologic year types over the entire 82 years of the modeling analysis. Overall, the future conditions with climate change forecast lower deliveries under all water year types, with the largest difference for dry years. Deliveries, under future conditions with and without climate change respectively, decrease by as little as 51 thousand acre-feet (taf) (5 percent) during critical years to as much as 371 taf (20 percent) during dry years.

Table 12-2
Estimated SWP Exports By Water Year Type – Future Conditions With and Without Climate Change

Water Year Type	Future Conditions (2050) with Climate Change (taf)	Future Conditions (2050) without Climate Change (taf)	Difference, Future with and without Climate Change (taf)	(%)
Wet	2,998	3,240	-242	-8
Above Normal	2,706	2,857	-152	-6
Below Normal	2,634	2,802	-168	-6
Dry	1,817	2,188	-371	-20
Critical	1,132	1,183	-51	-5
Average of all Water Years	2,363	2,574	-211	-9

Source: Estimated SWP exports are based on the 82 years of hydrologic data (water years 1922-2003) from Draft Technical Addendum to the 2011 SWP Reliability Report, Table 12 SWP Table A Deliveries for Future Conditions. Hydrologic data were averaged according to water year types based on DWR's Sacramento Valley water year index (http://cdec.water.ca.gov/cgi-progs/iodir/WSIHIST).

The USBR Climate Report examined median projected flows at three US Geological Survey (USGS) gaging stations near the headwaters of the Mojave River: the Deep Creek, West Fork, and Lower Narrows. The first two locations capture the two primary tributaries to the Mojave River before the confluence at the Forks. The Lower Narrows is on the main stem of the Mojave River, downstream of where it emerges from the mountains.

All median projected flows are positive in 2020 but seasonal results vary. For example, the median trend in April-July runoff is expected to be negative. Furthermore the range of the ensemble predictions includes both increases and decreases in annual flow. Natural flows were also projected out to the 2050s and 2070s. Results show greater decreases in flows moving further into the future especially in the spring/summer runoff season (April-July). Analysis of climate forcings in the

Region show slight declines in precipitation with large variability and clear increase in temperature with diverging uncertainty bounds.[13]

It is likely that changes in supply will be felt more severely in some areas of the Mojave Region than in others. For example, the Morongo Area relies almost entirely on SWP imports so it may not be impacted as greatly by declines in natural flows. Furthermore, increases in temperature will likely impact demand differently, depending on the primary water uses (e.g., agricultural uses vs. urban). Results from the USBR Climate Report do not cover potential changes in wastewater discharge which could be an important factor in locations like the Este Subarea.

The USBR Climate Report plots exceedance probability curves from the MWA delivery data provided in the SWP 2011 Reliability Report Technical Memorandum (Figure 12-2). The Assessment modeled two scenarios: ***existing hydrology***, where historical hydrology for 1922-2003 was repeated assuming 2011 land use and demand patterns, and ***future hydrology*** where the historical climate record was perturbed using a single climate change projection and interpolated for a 2031 level of climate change. Except in the case of very high and very low flows, the expected delivery volume for a given exceedance probability is generally greater for the future scenario than the historical scenario.

Overall results for the 2020 time period indicate a slight increase in annual natural flows (less than 5 percent) and SWP deliveries slightly lower than previous estimates used in MWA planning studies (the 2010 MWA UWMP estimated deliveries of 54 TAF).

12.4.3.2 Groundwater

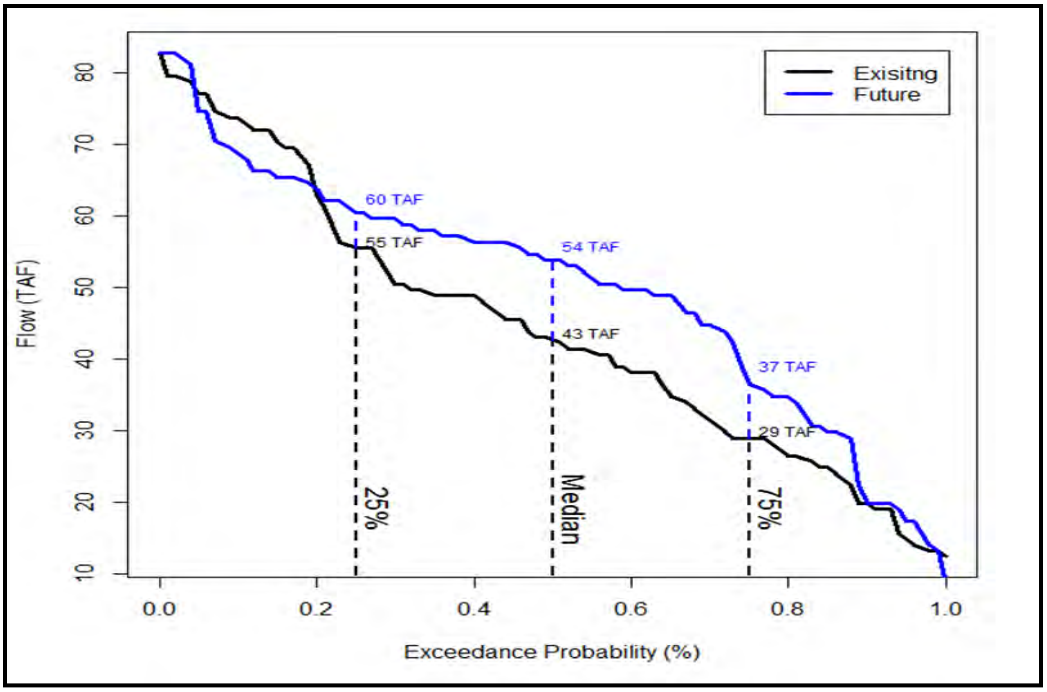
Groundwater overdraft has long been a significant issue for the Mojave Region. Section 2.6.2: Groundwater Basins provides more background about the two basins in the Mojave Region. Each basin is summarized below.

Most of the groundwater pumping occurs along the Mojave River. The Mojave Groundwater Basin is the largest groundwater resource in the MWA service area (with about 5 million af of storage capacity). Roughly 90 percent of the recharge in this Groundwater Basin originates in the San Gabriel and San Bernardino Mountains (Hardt 1971). The majority (about 80 percent) of the recharge comes from infiltration from the Mojave River, but infiltration also occurs from storm runoff in the mountains and human-induced recharge from irrigation, wastewater, fish hatcheries, and imported water. Groundwater from the Basin is discharged by well pumping, evaporation, transpiration, seepage into dry lakes, and seepage into the Mojave River.

The Morongo Groundwater Basin is slightly smaller than the Mojave Groundwater Basin (1,000 square miles versus 1,400 square miles), and only 60 percent of this area is within the MWA service area. This Basin contains a large number of closed and connected sub-basins, and has been divided into as many as 17 sub-basins in past investigations. Similar to the Mojave Groundwater Basin, groundwater is recharged by infiltration of water from ephemeral streams and human-induced recharge. Groundwater is discharged through well pumping, evaporation through the soil, transpiration by plants, and seepage into dry lakes.

[13] For more detailed results and discussion of the model see Task 1 of the USBR Climate Report.

Figure 12-2
Projected SWP Deliveries Based on Projections Using Existing and Future Climate Change Conditions



Source: Mojave River Watershed Climate Change Assessment

12.4.4 Water Quality

Improving water quality is an IRWM Plan objective that may be impacted by climate change. Studies of potential climate change impacts on water quality exist, but few trends in relationships between hydroclimate (hydrology and weather variables) have been identified. Increasing temperature and changes in precipitation patterns are key climate vulnerabilities important to the Region. Other potential factors that could affect water quality in the Region include increased wildfire risk and expansion of invasive species. Sea-level rise in the Sacramento-San Joaquin Delta may impact water quality of imported SWP water.

Key water quality issues for the Region include (see Section 3.4):

- Total dissolved solids (TDS)
- Toxic pollutants
- Nonpoint source pollution

Surface waters in the Region are expected to be more directly vulnerable to water quality impacts of climate change, while water quality impacts to groundwater sources would be indirect. Key surface water sources include imported and local surface water bodies.

12.4.4.1 Imported Water

SWP water is vulnerable to potential effects of climate change at the source in the Delta and in storage in groundwater basins as a banked water supply for the future. Sea-level rise will increase the intrusion of salinity into the Delta and its exported water. This will increase chloride and bromide (a DBP precursor that is also a component of sea water) concentrations in the SWP imported water. In addition, decreased freshwater flows into the Delta could increase organic matter, which contribute to disinfection by-product formation, in the SWP water.

12.4.4.2 Regional Surface Waters

Regional surface waters consist primarily of ephemeral streams. Water quality impacts to surface waters due to climate change include increased temperature and more frequent intense storm events. A previous study of the correlation between stream temperatures and air temperature found that surface water temperatures increased 0.4 to 0.6°F for each 1°F rise in air temperature (Morrill, Bales, and Conklin 2005). Increased water temperature generally reduces dissolved oxygen and can promote algal blooms if nutrients are available in the source. Increased intense storm events can transport sediments and other pollutants into and along streams, while long periods of low flow can increase concentrations of pollutants from other sources. Increased wildfires may contribute to increased turbidity.

12.4.4.3 Regional Groundwater

Any water quality impacts to groundwater sources due to climate change are expected to be indirect, and primarily due to decreased recharge from lower precipitation and increased use of groundwater to make up loss of imported water. Decreased recharge and increased groundwater pumping may allow concentrations of groundwater contaminants such as arsenic, nitrates, Chromium VI and TDS to increase in local basins, which may trigger additional treatment requirements and increase groundwater treatment costs.

12.4.5 Flooding

Flooding is a significant issue for the Region and is the focus of Task 2 of the USBR Climate Report.

The Mojave River has the propensity for large flood events, although many reaches of the Mojave River remain dry for the greater part of the year. Historically, the most severe floods occurred along the Mojave River near Victorville which is just downstream of where the Mojave River emerges from the San Bernardino Mountains. The majority of flooding takes place during the rainy season from December to March, when multi-day, widespread storms saturate the headwaters (US ACOE 1969). However, localized flooding also occurs throughout the Region as a result of summertime thunderstorms.

Flooding can be an extremely costly and destructive natural disaster and the Region has been subject to flood events in the past. *California's Flood Future* indicates that within San Bernardino County, crops valued at $2.2 million are located within a 100-year floodplain and up to $7.9 million within a 500-year floodplain (DWR 2013b). Additionally, the regional population currently exposed to 100-year and 500-year floodplains may increase due to expected growth in population and development in the Region. Thus, a change in flood risk is a potential significant effect of climate change that could have great implications for the Region.

A projected overall decrease in precipitation levels coupled with more intense individual storm events may lead to increased flooding in the Region. Flood risks are greatest if flood conveyance channels, storm drains and natural streambeds lack sufficient capacity to convey these intense flows.

The duration of flooding events is likely to increase if precipitation and storm surge events become more intense. More intense storms would produce higher peak flows in urbanized areas. This may result in increased in-channel erosion as sediment is scoured and vegetation washed out. Increased frequency of landslides and sediment erosion into flood control channels may be expected. The projections of increased wildfire during the extended dry periods may also increase erosion that further reduces channel capacity.

For Task 2 of the USBR Climate Report, the future flood frequencies at two USGS station locations on the Mojave River were analyzed, with the locations being the inflow to the Mojave River Dam and the Lower Narrows near Victorville. Analysis focused on two flood rates, 7,250 cubic feet per second (cfs) and 23,500 cfs, because these are the flows at which the Mojave River Dam starts to attenuate flows and the maximum flow rate through the dam, respectively.

Results for both stations show variability between projections that spans both increased and decreased flood frequency. Overall, results do not indicate a clear increase in flood risk for either location. This finding makes sense in the context of the results reported in Task 1 which shows a clear increasing temperature trend and a very slight negative trend in precipitation with significant variability between scenarios. Similarly, while the central tendency of the projections is for little or no change in flood frequency, there are still multiple (equally likely) projections that indicate both significant increases and significant decreases in the future.

While the flood frequency analysis takes advantage of state of the art statistical methods, all results are driven by projections for future temperature and precipitation. There is significant variability between projections and all values must be considered equally likely. Furthermore, the projected climate variables are downscaled from global circulation models that are run on a very coarse resolution. This methodology also has limited ability to capture localized convective storms that can result in flooding.

More frequent flooding may disrupt key services and facilities, and could impact areas beyond the immediate flood zone. More frequent flooding would have economic impacts from lost wages and lower productivity in the aftermath of floods with disadvantaged communities bearing a proportionately higher burden in most areas of California. In the longer term there would be more losses, claims and higher insurance rates due to greater risks. Deeper and longer duration flooding would increase the cost of repair after flood event and disrupt access to goods and services for longer periods of time.

In some ways, risk of flood from climate change could be more problematic than water supply. Water supply issues usually arise over a period of months to years, allowing time to respond to changes. In contrast, while large floods are relatively infrequent, they are swift and devastating if preparations are insufficient. There is no window to prepare for a flood once the flood waters arrive; floods must be addressed through advance preparation and quick response in the course of an event. Greater flood risk should be considered when evaluating new development in the floodplain.

12.4.6 Ecological Health and Habitat

The Mojave Region is an ecologically diverse area with biodiversity and species uniquely adapted to the desert region (see Section 2.4). The Region is host to numerous federally and state-listed species and includes large tracts of designated critical habitat. Because many of the Region's species are adapted to very specialized conditions, their survival is fragile and their adaptability to climate change impacts is lower.

The Southwest deserts, which include the Mojave Desert, are identified among one of the Endangered Species Coalitions' "Top 10 Places to Save for Endangered Species in a Warming World" (ESC 2011). This report states that temperature increases and precipitation changes experienced across the nation are most severe in the Southwest deserts. Increased duration and severity of droughts can therefore have a proportionately greater impact on the Region's ecosystems. Additionally, the increased spread of invasive species, which may contribute to more frequent and severe fires can further harm the Region's ecosystems and species.

These potential impacts lend great importance to the protection and preservation of the Region's natural resources.

12.4.7 Hydropower

The Region benefits from SWP power generation by passing on sales revenues to MWA. The SWP requires dependable, economical power to pump water to areas served by the Project's contractors. Since 1984 SWP power requirements have ranged from more than 8 billion kilowatt-hours (kWh) a year, as in 1990, to under 4 billion kWh, as in 1995.

To provide some of that power, DWR included a system of power and power recovery plants in the SWP system. In 1983, DWR became a bulk power utility, capable of selling, exchanging, and purchasing energy from other utilities. Other energy sources come from long-term contracts with other utilities and joint development of facilities such as Castaic Power Plant on the West Branch of the SWP.

Today the SWP is one of California's larger energy producers and a major consumer of electricity. How much power SWP facilities consume depends on contractor requests for water and the amount of water available for delivery. In an average water supply year, SWP hydroelectric power plants and a partially SWP owned coal-fired plant in Nevada produce about 5.9 billion kWh. Of that total, 4.5 billion kWh come from hydroelectric generation.

When SWP power requirements are less than power resources, the DWR sells surplus power to help defray the cost of water deliveries. The SWP's flexible pumping operations help it to manage its power needs. This flexibility is allowed by Project reservoirs, which temporarily store water until it is needed to meet the daily and seasonal demands of its contracting agencies.

To reduce power costs, pumping is minimized during on-peak hours when power prices are highest. Maximum pumping is scheduled during off-peak periods (nights, weekends and holidays) when power costs are cheaper. Thus the SWP can purchase, when needed, inexpensive surplus generation from other power suppliers for its pumping operations.

The SWP also can sell surplus power when its power needs are less than its resources. The revenue from these sales helps keep the net cost of water deliveries affordable.

12.5 Vulnerability Prioritization

This section discusses a list of prioritized watershed characteristics based on the vulnerability assessment presented in the earlier subsections. The watershed vulnerability assessment identifies the water resources characteristics for each sector considered to be most vulnerable to potential climate change projections. These sector vulnerabilities were discussed with the stakeholders to help develop adaptive strategies that respond to potential climate change impacts. Based on that discussion, the prioritization of vulnerability areas is as follows:

1. Water Supply
2. Water Demand
3. Water Quality, Flooding, Ecosystem and Habitat, Hydropower – all tied for third

The vulnerability assessment and prioritization was conducted based on data currently available and inputs from the Consultant Team, Project Team and finally stakeholders involved in the preparation of this Plan for the Region. This assessment can be improved in the future with further data gathering and analyzing of the prioritized vulnerabilities.

The vulnerability prioritization is intended to identify the high priority vulnerability areas (water supply and water demand) and medium priority areas (water quality, flooding, ecosystem and habitat, and hydropower). The prioritization is used to order the following discussion about adaptation strategies.

12.5.1 Mitigation and Adaptation Strategies

There are two main strategies to deal with climate change – mitigation strategies and adaptation strategies. Mitigation strategies combat climate change by directly reducing GHG emissions or minimize increases in GHG emissions while adaptation strategies generally refer to efforts that deal with the impacts of climate change.

12.5.1.1 Statewide Mitigation Strategies

Typically mitigation or GHG reduction measures are accomplished by implementing specific energy efficiency programs or projects, installing renewable energy projects, implementing waste-to-energy projects at wastewater treatment plants, promoting carbon sequestration, and conducting water efficiency and demand reduction programs. All of these measures either directly create carbon-free energy or reduce the need for generation of electricity from fossil fuel-fired electric plants.

The AB 32 Scoping Plan contains the main strategies California will use to reduce GHG emissions that cause climate change. The scoping plan has a range of GHG reduction actions which include: direct regulations, alternative compliance mechanisms, monetary and non-monetary incentives, voluntary actions, and market-based mechanisms such as a cap-and-trade system (California ARB 2008).

Section 17 of the AB 32 Scoping Plan discusses the mitigation measures or strategies for the Water sector. Table 12-3 below shows the five areas from which specific GHG reduction measures will be identified and implemented.

Table 12-3
Ab 32 Scoping Plan Water Sector Mitigation Measures

Measure Description	GHG Reduction by 2020 ($MMTCO_2$)
Water Use Efficiency	1.4
Water Recycling	0.3
Water System Energy Efficiency	2.0
Reuse Urban Runoff	0.2
Increase Renewable Energy Production	0.9
Total GHG Reductions	**4.8**

Energy and GHG Master Plans by individual water and wastewater agencies are a good way of identifying a specific portfolio of projects that reduce energy use and GHG emissions, while lowering the agencies' operating costs.

12.5.2 Statewide Adaptation Strategies for the Water Sector

The goal of adaptation is to minimize risks associated with anticipated impacts and take advantage of beneficial opportunities that may arise from climate change. Adaptation strategies are developed in conjunction with climate change mitigation strategies, which may overlap. For example, promoting water and energy efficiency are both climate change mitigation and adaptation strategies. Adaptation strategies discussed in this section provide the Region with guidance related to projects that will enhance the Region's preparedness to plan and react to these potential impacts.

In 2009, California adopted a statewide *Climate Adaptation Strategy* (CAS) that summarizes climate change impacts and recommends adaptation strategies across seven sectors: Public Health, Biodiversity and Habitat, Oceans and Coastal Resources, Water, Agriculture, Forestry, and Transportation and Energy. The 2009 CAS was the first of its kind in the usage of downscaled climate models to more accurately assess statewide climate impacts as a basis for providing guidance for establishing actions that prepare, prevent, and respond to the effects of climate change (CNRA 2009).

Specific adaptive water management strategies for the water sector were developed by the DWR. DWR is addressing climate change impacts through mitigation and adaptation measures to ensure that Californians have an adequate water supply, reliable flood control, and healthy ecosystems now and in the future (DWR 2008).

DWR developed the following 10 statewide adaptation strategies for the Water Management Sector:

Strategy 1:	Provide sustainable funding for statewide and integrated regional water management.
Strategy 2:	Fully develop the potential of integrated regional water management.
Strategy 3:	Aggressively increase water use efficiency.
Strategy 4:	Practice and promote integrated flood management.
Strategy 5:	Enhance and sustain ecosystems.
Strategy 6:	Expand water storage and conjunctive management of surface and groundwater resources.
Strategy 7:	Fix Delta water supply, quality, and ecosystem conditions.
Strategy 8:	Preserve, upgrade and increase monitoring, data analysis and management.
Strategy 9:	Plan for, and adapt to, sea-level rise.
Strategy 10:	Identify and fund focused climate change impacts and adaptation research and analysis.

These statewide strategies provide guidance specifically aimed at addressing the impacts of climate change. Some of DWR's strategies can be directly applied to Regional Management Strategies, while others are supportive of regional efforts that are discussed in the following section.

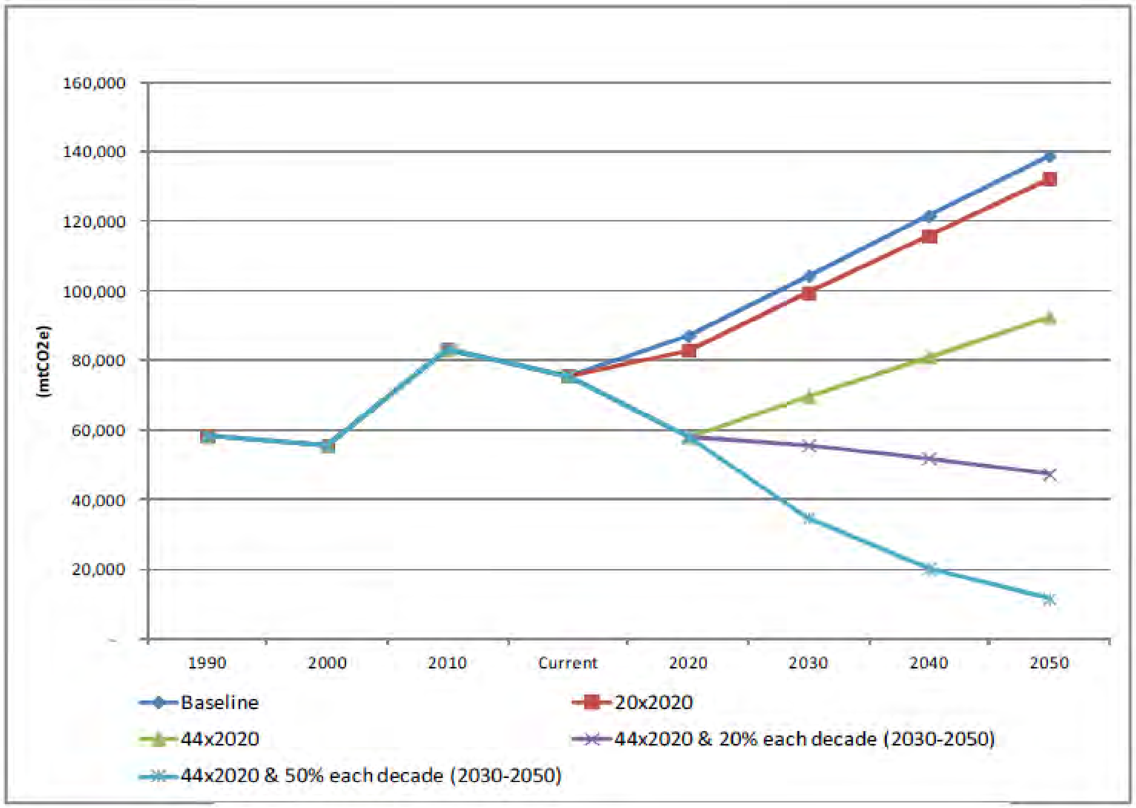
12.5.3 Regional Mitigation Strategies

Task 3 of the USBR Climate Report was to evaluate GHG emissions for the MWA service area from 1990 through 2050. Overall, it can be concluded that while reducing local and imported water demands could contribute to reducing GHG emissions, a combination of measures will likely be necessary to achieve GHG emission reduction and water conservation targets mandated by California's legislation. These statewide targets are specifically laid out in AB 32 and Senate Bill 7 of Special Extended Session 7 (SBX7-7). As described above, AB 32 requires every major financial sector in California, including water, to reduce GHG emissions to 1990 levels by 2020. Further, it aims to reduce GHG emissions to 80 percent below 1990 levels by 2050. SBX7-7 sets a target of 20 percent per capita reduction in urban water use statewide by 2020.

The USBR has developed a GHG Emissions Calculator to help assess GHG emissions in relation to water supply alternatives. The analysis conducted in the USBR Climate Report evaluated whether water conservation measures alone would be enough to meet AB 32 GHG emission reduction targets in the MWA service area. Results show that meeting AB 32 emission targets will require water use reductions beyond 20 percent by 2020, as prescribed by SBX7-7. More specifically, meeting AB 32 emission targets with water conservation alone would require reducing water use by 44 percent to meet the 2020 emissions target and significant additional water conservation in subsequent years. These water savings and their relation to emission reductions are described below for the MWA service area.

In Figure 12-3, four water conservation scenarios are compared to the no action scenario; a task accomplished using the GHG Emissions Calculator. Based on what would actually be needed to meet the AB 32 2050 GHG emissions target of 80 percent below the 1990 levels, the scenario required incorporates the 44 percent reduction in water use in 2020 and further per capita water use reduction of 50 percent each decade from 2030 through 2050. These scenarios are hypothetical, based on water conservation as the only GHG emissions reducing actions.

Figure 12-3
Comparison of GHG Emissions For The MWA Service Area



Source: Mojave River Watershed Climate Change Assessment, Figure 34

In addition to water conservation, there are various other means for reducing GHG emissions in the water sector, such as those discussed in the AB 32 Scoping Plan and listed above, in Table 12-3.

12.5.4 Adaptation Strategies

The 2012 California Climate Adaptation Planning Guide (APG) provides guidance to support regional and local communities in proactively addressing the unavoidable consequences of climate change. The APG provides a step-by-step process for local and regional climate vulnerability assessment and adaptation strategy development (CalEMA and CNRA 2012).

Potential adaptation strategies have been identified for each watershed characteristic, starting with the highest priorities developed in the climate change vulnerability area analysis. This list of strategies will allow the stakeholders to incorporate climate change adaptation in projects developed and evaluated as part of the IRWM Plan process.

General

- Large water and wastewater agencies could conduct Energy and GHG Master Plans to assess their energy and carbon footprints, and create an Action Plan of strategies for greater energy efficiency and GHG emission reductions. Fully exploring the Water-Energy-Carbon nexus can identify opportunities for energy savings and GHG emission reductions through water operations, programs, and projects. Incorporate climate change adaptation into relevant local and regional plans and projects.
- Establish a climate change adaptation public outreach and education program.
- Build collaborative relationships between regional entities and neighboring communities to promote complementary adaptation strategy development and regional approaches.
- Establish an ongoing monitoring program to track local and regional climate impacts and adaptation strategy effectiveness.

Water Supply

Climate change projections suggest continued highly variable annual precipitation with slightly drier climate in the Sierra Nevada Mountains by mid-century. The overall impact will include reductions in imported water from the SWP and possibly greater reliance on groundwater supplies.

Suggested regional adaptation strategies to address potential reductions in water supply include the following:

- Expand water storage and conjunctive management of surface and groundwater resources.
- Address the State policy goal of reducing reliance on the Delta by promoting and investing in projects and programs that allow the Region to meet water demands with alternative sources of supply and/or demand management actions during times when imported supplies from the Delta are reduced or unavailable due to dry years, droughts, system outages, environmental and regulatory restrictions, or other reasons.
- Enhance use of recycled water for appropriate uses as a drought-proof water supply.
- Enhance practices of water exchanges and water banking outside the Region to supplement water supply.
- Encourage local agencies to develop and implement AB 3030 Groundwater Management Plans (GWMPs) as a fundamental component of the IRWM Plan.
- Develop plans for local agencies in the Region to monitor the elevation of their groundwater basins.
- Encourage cities and the county agencies in the Region to adopt local ordinances that protect the natural functioning of groundwater recharge areas.

Water Demand

Climate change projections suggest increases in average annual air temperature by 2050 and increased evaporative losses are expected to increase outdoor urban, industrial cooling, and agricultural water demands.

Suggested regional adaptation strategies to address potential increases in water demand include the following:

- Aggressively increase water use efficiency.
- Encourage agricultural users to adopt efficient water management practices.
- Encourage landscape water users to adopt efficient water management practices.
- Encourage development of more efficient cooling technology.

Water Quality

Climate change projections suggest increased temperature and continued highly variable annual precipitation with slightly drier climate by mid-century that could degrade water quality.

Suggested regional adaptation strategies to address potential water quality impacts include the following:

- Support DWR strategies that protect or enhance water quality delivered by the SWP.
- Consider water quality improvements associated with water transfers and water banking on regional water supply.
- Consider riparian forest projects that provide cooling for habitat (see Ecosystem Health and Habitat).
- Encourage projects that improve water quality of contaminated groundwater sources.
- Increase implementation of low impact development (LID) techniques to improve stormwater management.
- Comply with National Pollutant Discharge Elimination System permits to ensure water quality protection.

Flooding

Climate change projections are not sensitive enough to assess short term extreme events such as flooding, but the general expectation is that more intense storms will occur leading to more frequent and deeper flooding, which may last longer if drainage is impaired.

Suggested regional adaptation strategies to address potential increases in flood risk include:

- Improve emergency preparedness, response, evacuation and recovery plans in anticipation of potential increases in extreme events.

- Practice and promote coordinated and integrated flood management among water and flood management agencies. For example, flood management should be integrated with groundwater recharge as well as watershed management on open space, agricultural, wildlife areas, and other low-density lands to better utilize natural floodplain processes.
- Encourage policies that promote LID to maintain or restore historical hydrological characteristics.
- Consider policies or incentives to relocate infrastructure that is damaged or destroyed due to flooding to low-risk areas.
- Develop coordinated multi-agency/multi-jurisdiction plans to mitigate future risks of flooding, landslide, and related impacts through concurrent adoption of updated plans and policies.
- Implement National Flood Insurance Program (NFIP) activities to minimize and avoid new infrastructure or capital improvements in flood hazard areas.
- Restore, maintain and improve existing flood control and riparian corridors.
- Implement plans and policies aimed at restricting development in floodplains and landslide hazard areas.

Ecosystem and Habitat

Climate change projections of increasing annual average temperature suggest potential environmental stressors that may affect the sustainability of existing ecosystems and habitat.

Suggested regional adaptation strategies to address potential Ecosystem Health and Habitat impacts include the following:

- Promote water resources management strategies that restore and enhance ecosystem services.
- Provide or enhance connected "migration corridors" for animals and plants to promote increased biodiversity and allow the plants and animals to move to more suitable habitats to avoid serious impacts and support increased biodiversity.
- Consider projects that provide seasonal aquatic habitat in streams and support corridors of native riparian forests that create shaded riverine and terrestrial habitat.

Hydropower

Climate change projections suggest continued highly variable annual precipitation with slightly drier climate by mid-century, affecting hydropower generation. Strategies to address potential reductions in hydropower generated by the SWP include the following:

- Support potential solar and wind power options within the SWP service area and the Mojave Region.

12.6 Next Steps for Future IRWM Plan Updates

12.6.1 Updates on Climate Change Research

Research on the climate change impacts on water resources is ongoing and continues to evolve with further analysis and more refined methodologies. During the preparation of this update to the Mojave IRWM Plan, key literature resources on climate change have been reviewed. New scientific findings should be reviewed periodically and incorporated into the climate change vulnerability assessment, especially the findings pertinent to the sectors most vulnerable to climate change in the Region. Consideration should be given to forming a Regional user's forum to facilitate networking among water resources planners to exchange ideas on how to incorporate latest tools or science into local planning.

12.6.2 Climate Change Models and Scenarios

The Climate Change Center of the California Energy Commission prepares periodic reports on climate model simulations for California and some specific Regions. It also maintains the Cal-Adapt site and updates the modeling tools as new climate change modeling results become available from the IPCC, based on more refined data. Agencies within the Region should explore ways where existing and updated climate models, and other available climate change tools and projections for the Region, can be used for future vulnerability assessments updated in future versions of the Plan.

12.6.3 Vulnerability Assessment Update and Data Improvement

The USBR Climate Report conducted in this update to the Mojave IRWM Plan is qualitative in some areas due to limited data, high level of uncertainty, and, in some cases, because impacts to a given sector are not expected to be severe. The intent of future data gathering is to address gaps in the current vulnerability assessment, to improve the understanding of climate change impacts and vulnerabilities, and to enable more quantitative analyses. Recommended future data gathering efforts should include data that facilitate more quantitative analysis of the vulnerability, as described in the following sections. Data gathering efforts should also be considered in the context of the current and proposed projects and funding available. Consideration should be given to coordinated multi-agency funding of more localized modeling, projections, and more rigorous vulnerability analysis of the more critical areas.

Potential areas of future data gathering efforts are described for the priority sectors identified earlier. The recommendations focus initially on the top two priority sectors; namely, water supply, water demand. Then the lowest priority sectors (all tied for third place) are discussed and include water quality, flooding, ecosystem health and habitat, and hydropower. Thus the Region should prioritize data gathering efforts for the sectors most vulnerable to climate change impacts.

<u>Water Supply</u>

Suggestions for future data gathering efforts to quantify the climate change effects on water supply include the following:

- Update DWR SWP Delivery Reliability Report projections - DWR provides an updated analysis and report every two years.

- Update available groundwater supply projections – Groundwater production in a given year varies depending on hydrologic conditions. Changes in local hydrology and natural recharge are anticipated to have a direct impact on available groundwater storage and may affect current safe operating ranges. Updates on the groundwater safe operating ranges will be needed when further assessments of water supply vulnerability to climate change are performed for future Plan updates.
- Evaluate the effects of reduction in precipitation from climate change on the groundwater operational ranges.

Water Demand

Suggestions for future data gathering efforts to quantify the climate change effects on municipal and agricultural water demand include the following (note these efforts will require coordination among water purveyors who use different data collection systems):

- Collect and analyze historical seasonal and monthly records of water demand data and weather (e.g., air temperature, ET, and precipitation) for each subarea to quantify the weather effects on water use and seasonal variations in response to changes in historical temperature.
- Collect and analyze historical seasonal and monthly records of water demand data for each purveyor in each subarea to demonstrate purveyor-specific patterns in response to changes in climate.
- Based on the water demand and temperature data, develop regression analyses correlating water demand to temperature on a maximum day, monthly, and seasonal bases for each subarea and each purveyor as practical. The historical responses can be used to infer future response to the projected changes in temperature with climate change.
- Characterize the variations in indoor and outdoor water use, both for each subarea and each purveyor. Future data gathering should focus on the seasonal and monthly patterns both in indoor and outdoor usage to evaluate the effects of weather conditions on each use category.
- Collect and analyze historical agricultural water demand to quantity the weather effects on water use and seasonal variations in response to changes in historical temperature.

Water Quality

The assessment of the vulnerability of water quality relied on California Climate Change Center model outputs for annual air temperature increases and precipitation changes and prior studies of how water quality in the Region may be affected by these climate change impacts.

Suggestions for future data gathering efforts to quantify the climate change effects on water quality include analyzing data collected from historical storm events to improve the understanding of regional water quality and how it may be impacted by climate change.

Flooding

A quantitative assessment of the potential impacts of climate change on flooding cannot be performed as climate projections are not sensitive enough to project short-term extreme events such as flooding (flooding from sea level rise can be looked at more quantitatively). Task 2 of the USBR Climate Report begins to examine the impacts on flood frequency. Suggestions for future data gathering efforts to address the potential climate change effects on flooding include the following:

- Perform an inventory of runoff monitoring stations in the Region to see if a more robust runoff record can be developed. Those data may allow an analysis of historical storm events correlated with precipitation events as well as annual precipitation to provide a better understanding of conditions that may lead to more extreme flooding conditions.

As recommended by DWR's *Climate Change Handbook for Regional Water Planning*, future work should focus on gathering the 200-year floodplain maps for the Region after DWR develops them under the authorization of SB 5 enacted in 2007. Currently, the 100-year and 500-year floodplain maps are available from the Federal Emergency Management Agency (FEMA). Additional information on the DWR's Best Available Maps (BAM) program can be found at the following website: http://gis.bam.water.ca.gov/bam/.

- Coordinate with the Region stakeholders for advanced flood preparation and quick response and document the protocol(s).
- Perform an inventory of critical infrastructure located in floodplains, especially those that were impacted during the historical flood events in 1969 and 1983.
- Update the projections of runoff with climate change as updates from Cal-Adapt become available.
- Work with local flood plain managers and/or equivalent to determine areas of concern as information from FEMA evolves.

Ecosystem & Habitat

Adaptive management strategies need to be developed that can accommodate changing climatic conditions. This may require new management goals as it may not be possible to restore historical systems. Goals may have to be set based on anticipated future conditions.

Suggestions for future data gathering efforts to address the potential climate change effects on ecosystem and habitat include the following:

- Vulnerability analysis of how climate change may affect specific habitats and inform future open space or buffer acquisition programs.

Hydropower

The Region relies on hydropower produced outside the Region for a portion of its energy portfolio, which may include planned local production in the future. Future data gathering or assessment efforts to quantify the potential impacts of climate change on hydropower include:

- Agencies relying on hydropower for a portion of their energy supply may need to consider how reductions in hydropower availability can be replaced by other energy sources and how those sources impact their GHG footprints.
- Agencies that operate their own hydropower facilities should consider opportunities to modify their reservoir operations to optimize both water supply and hydropower production under future climate change scenarios.

12.6.4 Create a GHG Baseline

Each agency involved in the update to the Mojave IRWM Plan should create an agency-specific comprehensive GHG inventory. A comprehensive inventory would use a well-established protocol to calculate all of the GHG emissions created by each agency. In the absence of agency specific GHG inventories, gross GHG emissions can be calculated by developing agency-specific GHG intensity factors. An agency-specific GHG intensity factor calculates the estimated metric tons of CO_2 per af of water delivered or million gallons of wastewater treated by the agency ($MTCO_2$/af). Knowing this will enable an estimation of the GHG emission baseline for a particular agency and the Region. It will also allow for the estimation of the GHG emission reductions associated with an individual project or strategy that reduces water demand.

For each of the appropriate stakeholder water or wastewater agencies, data will need to be collected for actual annual electricity, natural and fleet fuel used, as well as the amount of SWP imported water and other suppliers. Using known GHG intensity factors for SWP water supplies, electrical supplies, natural gas and fleet fuel and applying these factors to the amount an agency uses, GHG emissions ($MTCO_2$/year) can be estimated for each agency. By dividing the total emissions by the total af of water delivered or the million gallons of wastewater treated, agency-specific GHG intensity factors ($MTCO_2$/af) can be developed. The calculation should use data from the same year. While not as precise and accurate as a comprehensive GHG inventory, a GHG intensity factor will create an estimated baseline of GHG emissions for each agency and the Region.

12.6.5 Quantify Adaption and Mitigation Strategies at the Project Level

As part of this update to the Mojave IRWM Plan, the climate change impacts of specific projects proposed for implementation are being considered by a rough qualitative assessment of whether or not certain adaptation strategies apply or if a project reduces GHG emissions. No quantitative performance measurements are used to score the projects. Future Plan updates may have the data available to further quantify climate change adaptation and mitigation strategies and apply them at the project level. For each proposed project it may be desirable to identify GHG emissions and to identify and evaluate GHG reduction amounts. Proposed projects could be evaluated against the project GHG Baseline and evaluated for their ability to reduce agency-specific GHG intensity factors.

12.6.6 Develop Performance Metrics

As part of future Plan updates, the Region may choose to develop performance metrics specific to water and wastewater projects and climate change. Proposed IRWM Plan projects would be evaluated against these metrics and these metrics would provide a measure of Plan performance.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2011. *Public Health Assessment for Barstow Marine Corp Logistics Base*.

ATSDR. 1999. *Public Health Assessment* Public Health Statement for Total Petroleum Hydrocarbons (TPH).

Apple Valley Ranchos Water Company. 2011. *2010 Urban Water Management Plan*. Prepared by Kennedy/Jenks Consultants. June.

Bighorn-Desert View Water Agency (BDVWA). 2011. *Reche Spreading Grounds Recharge Feasibility Study*. Prepared by Todd Engineers. February.

BDVWA and Mojave Water Agency. 2007. *Basin Conceptual Model and Assessment of Water Supply and Demand for the Ames Valley, Johnson Valley, and Means Valley Groundwater Basins.* Prepared by Kennedy/Jenks/Todd LLC. April.

Beacon Economics, 2012, Mojave Water Agency *2012 Assessed Valuation Forecast*.

Bureau of Land Management (BLM). 2011a. *Afton Canyon Natural Area*. http://www.blm.gov/ca/st/en/fo/barstow/afton.html. Accessed on December 10, 2013.

BLM. 2011b. BLM Website – *Wilderness Areas*. http://www.blm.gov/ca/st/en/prog/wilderness/wa/list_wa.html. Accessed on April 25, 2013.

BLM. 2011c. BLM Website – *Areas of Critical Environmental Concern*. http://www.blm.gov/nv/st/en/fo/lvfo/blm_programs/lvfo_recreation/accessing_your_public/acec_information.html. Accessed on May 1, 2013.

BLM. 2011d. GeoCommunicator. http://www.geocommunicator.gov/blmMap/Map.jsp?MAP=SiteMapper Accessed on April 24, 2013.

BLM. 2009. *Afton Canyon Riparian Restoration Project Fourth Year Status Report*. Available on BLM website: http://www.blm.gov/ca/st/en/fo/barstow/sltcdr97pa1.html Accessed on December 23, 2013.

BLM. 2008. *Rand Mountains Management Area*. Education and Permit Program Map. http://www.blm.gov/pgdata/etc/medialib/blm/ca/pdf/pdfs/ridgecrest_pdfs.Par.12750.File.dat/RMMA_MapBrochure_1007.pdf. Accessed on April 23, 2013.

BLM. 2005. *West Mojave Plan* - Vol.1 Chapter 1 of Proposed Plan/Final EIS/EIR.

Cal-Adapt. 2014. Cal-Adapt Website – Temperature: Decadal Averages Map. http://cal-adapt.org/temperature/decadal/. Accessed on May 7, 2014.

California Air Resources Board (ARB). 2010. Press Release: California Air Resources Board Gives Green Light to California's Emissions Trading Program. December. http://www.arb.ca.gov/newsrel/newsrelease.php?id=170. Accessed on May 7, 2014.

California ARB. 2008. Climate Change Scoping Plan. *A Framework for Change*. December. http://www.arb.ca.gov/cc/scopingplan/document/adopted_scoping_plan.pdf

California Emergency Management Agency (CalEMA) and California Natural Resources Agency (CNRA). 2012. *California Adaptation Planning Guide*. July.

California Energy Commission (CEC). 2012. *Desert Renewable Energy Conservation Plan* – Description and Comparative Evaluation of Draft DRECP Alternatives, Appendix D. December. http://www.drecp.org/documents/docs/alternatives_eval/Appendices/Appendix_D/. Accessed on December 9, 2010.

California Natural Resources Agency (CNRA). 2009. *2009 California Climate Adaptation Strategy*. http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf

California State Parks, Department of Parks and Recreation. 2013a. *Silverwood Lake State Recreation Area*. http://www.parks.ca.gov/?page_id=650 Accessed on December 6, 2013.

California State Parks, Office of Historic Preservation. 2013b.*California Historical Resources*. http://ohp.parks.ca.gov/ListedResources/?view=county&criteria=36 Accessed on December 6, 2013.

California State Senate. 2010. Senate Bill 7 of Special Extended Session 7 (SBX7-7) (Steinberg).

California State Senate. 2006. Senate Bill 1087.

California State Senate. 2002. Senate Bill 1938.

California Water Code, Section 10631.

California Water Code, Section 10750-10753.10.

California Water Code, Section 13750.5.

California Water Code, Section 375.

California Water Code, Section 1211.

California Water Code, Sections 1810-1814 ("KATZ Law").

California Wilderness Coalition. 2000. *http://www.calwild.org/linkages/*

Cayan, D.R., M. Tyree and S. Lacobellis. 2012. Climate Change Scenarios for the San Francisco Region. *Public Interest Energy Research*, California Energy Commission, Sacramento, CA. CEC-500-2012-042.

Cayan, D.R., T. Das, D.W. Pierce, T.P. Barnett, M. Tyree, and A. Gershunova. 2010. "Future dryness in southwest US and the hydrology of early 21st century drought." *Proceeding of the National Academy of Sciences,* (in press).

CH2M Hill. 2002. *Groundwater Elevation Measurement and Interim Corrective Action Measures Report*, Third Quarter – 2002, Calnev Pipe Line Company – Barstow Terminal.

City of Adelanto. 2011. *2010 Urban Water Management Plan*. Prepared by Psomas. June.

City of Big Bear Lake. 1999. *General Plan*. August.

City of Hesperia, 2013. *NPDES Stormwater Permit Implementation Agreement.* Staff Report for December 17, 2013 City Council Meeting. City of Hesperia, CA.

City of Twentynine Palms. 2012. *General Plan Update*. April.

City of Twentynine Palms. City Website: Visitors Info, About Twentynine Palms, 2011. http://www.ci.twentynine-palms.ca.us/About_29Palms.76.0.html Accessed on December 14, 2013.

City of Twentynine Palms and Twentynine Palms Water District . 2013. *Draft Final Twentynine Palms Groundwater Protection Plan*, November.

Colorado River Regional Water Quality Control Board (RWQCB). 1993. *Water Quality Control Plan for the Colorado River Basin Region.* Amended June 2006.

Crestline Business Council. 2005. *Welcome to Lake Gregory*. http://www.cityofcrestline.com/lakegregory.html Accessed on December 14, 2013.

Crestline-Lake Arrowhead Water Agency. 2011. *2010 UWMP*. Prepared by Albert A. Webb Associates. August.

California Urban Water Conservation Council (CUWCC). 2011. Estimated Water Savings - Annual Water Savings updated: 4-28-2011.

CUWCC. 2009. Research and Evaluation Committee Report to Steering Committee August 13, 2009.

Dai, A. 2006. *Precipitation Characteristics in Eighteen Coupled Climate Models*. *J. Climate,* 19: 4605-4630.

Defenders of Wildlife. 2007. *Economic Oasis: Revealing the True Value of the Mojave Desert. Washington, D.C.*

Department of Water Resources, California (DWR). 2013a. *Public Review Draft California Water Plan Update 2013*. CA Department of Water Resources, Sacramento, CA.

DWR. 2013b. *California's Flood Future, Recommendations for Managing the State's Flood Risk.* November 2013. http://www.water.ca.gov/sfmp/resources/California_Flood_Future.pdf

DWR. 2012a. *Integrated Regional Water Management Guidelines for Proposition 84 and 1E*, November 2012.

DWR. 2012b. *State Water Project Final Delivery Reliability Report 2011*. June.

DWR, 2011. *Climate Change Handbook for Regional Water Planning*.

DWR 2010. *The State Water Project Delivery Reliability Report* 2009.

DWR. 2009. *Final California Water Plan Update 2009*. Integrated Water Management Bulletin 160. CA Department of Water Resources, Sacramento, CA.

DWR. 2008. *Managing an Uncertain Future: Climate Change Adaptation Strategies for California's Water. http://www.water.ca.gov/climatechange/docs/ClimateChangeWhitePaper.pdf*

DWR. 2005. Flood Warnings.

DWR, 2003a. California's Groundwater Bulletin 118. Update 2003. Sacramento, CA.

DWR. 2003b. California's Groundwater Bulletin 118, Caves Canyon Valley Groundwater Basin. http://www.water.ca.gov/pubs/groundwater/bulletin_118/basindescriptions/6-38.pdf

DWR. 1984. *Twentynine Palms Ground Water Study*.

DWR. 1979. *Sources of Powerplant Cooling Water in the Desert Area of Southern California-Reconnaissance Study*. Bulletin 91-24.

DWR. 1975, *California's Ground Water*, California Department of Water Resources, Bulletin No. 118. http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm

DWR, State Water Resources Control Board, California Bay-Delta Authority, California Energy Commission, California Department of Public Health, California Public Utilities Commission, California Air Resources Board, with assistance from California Urban Water Conservation Council and U.S. Bureau of Reclamation (California Department of Water Resources et al.). 2010. *20x2020 Water Conservation Plan*. Sacramento, CA. February.

Endangered Species Coalition (ESC). 2011. *It's Getting Hot Out There: Top 10 Places to Save for Endangered Species in a Warming World*. http://oceana.org/sites/default/files/reports/digital_endangered_report.pdf

Golden State Water Company (GSWC). 2013. *Consumer Confidence Report on Water Quality for 2012 – Wrightwood Water System*.

GSWC. 2013a. *Wrightwood System Water Master Plan*.

GSWC. 2011. *Final 2010 Urban Water Management Plan, Barstow*. Barstow, CA. Prepared by Kennedy/Jenks Consultants, July.

GSWC. 2008. *Region III Water Master Plan* Wrightwood System.

Groisman, P.Y., and R.W. Knight. 2008. *Prolonged dry episodes of the conterminous United States: New tendencies emerged during the last 40 years*. *J. Climate,* 21:1850-1862.

Guegan, M., K. Madani, and C.B. Uvo. 2012. *Climate Change Effects on the High-Elevation Hydropower System with Consideration of Warming Impacts on Electricity Demand and Pricing*. California Energy Commission Publication No. CEC-500-020.

Gutowski, W.J., et al. 2008. *Causes of Observed Changes in Extremes and Projections of Future Changes in Weather and Climate Extremes in a Changing Climate.* Regions of Focus: North America, Hawaii, Caribbean, and U.S. Pacific Islands. T.R. Karl, G.A. Meehl, C.D. Miller, S.J. Hassol, A.M. Waple, and W.L. Murray (eds.). A report by the U.S. Climate Change Science Program and the subcommittee on Global Change Research. Washington, DC.

Gutzler, D.S., and T.O. Robbins. 2010. "Climate variability and projected changes in the western United States: regional downscaling and drought statistic." *Climate Dynamics,* DOI 10:1007/s00382-010-0838-7.

Hanak, E. and J. Lund. 2008. *Adapting California's Water Management to Climate Change*. November 2008.

Hardt, W.F. 1971. *Hydrologic Analysis of Mojave River Basin, California, Using Electric Analog Model.* US Geological Survey, US Geological Survey, Menlo Park, CA. August.

Hesperia Water District/City of Hesperia. 2011*. 2010 Urban Water Management Plan*. Prepared by Kennedy/Jenks Consultants. August.

Hi-Desert Water District. 2011*. 2010 Urban Water Management Plan*. Prepared by Kennedy/Jenks Consultants. June.

Infrastructure Engineering Corporation (IEC), 2009. *Final Draft Phase 2 Recycled Water System Feasibility Study Report*. March.

Intergovernmental Panel on Climate Change (IPCC). 2007. "The Physical Science Basis," contribution of Working Group I to *The Fourth Assessment Report of the Intergovernmental Panel on Climate Change.* Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor, and H.L. Miller (eds.). Cambridge University Press, Cambridge, United Kingdom and New York, New York. 996 pp.

Izbicki, John. A. 2004. *Source and Movement of Ground Water in the Western Part of the Mojave Desert, Southern California, USA*. US Geological Survey Water-Resources Investigations Report 03-4313, Prepared in cooperation with Mojave Water Agency. Sacramento, CA.

Izbicki, John A; Michel, Robert L. U.S. Geological Survey: 2004. *Movement and age of ground water in the western part of the Mojave Desert,* Southern California, USA.

Jacobs Engineering Group. 1995. Draft Remedial Investigation Report for Operable Unites 1 & 2, vol. 1 of 10. Marine Corps Logistics Base, Barstow, California. July 1995.

Joshua Basin Water District. 2011*. 2010 Urban Water Management Plan*. Prepared by Kennedy/Jenks Consultants. June.

Kiparsky, M., and P.H. Gleick. 2005. Climate Change and California Water Resources: A Survey and Summary of the Literature. Prepared by Pacific Institute for California Energy Commission.

Knowles, N., M. Dettinger, and D. Cayan. 2007. *Trends in Snowfall Versus Rainfall for the Western united States,* 1941-2001. Prepared for California Energy Commission Public Interest Energy Research Program, Project Report CEC-500-2007-032.

Lahontan RWQCB. 2014. Meeting of April 9 and 10, 2014 Item 10: Adoption Of The Priority List for the Emergency, Abandoned, Recalcitrant (Ear) Account, Fiscal Year 2014-2015 Underground Storage Tank (UST) Case No. 6B3600350T (Unauthorized Release Form date January 15, 1991).

Lahontan RWQCB. 2014b. Human Caused Contamination for Mojave Region obtained via personal communication (email) with staff.

Lahontan RWQCB. 2013. Water Quality Discharge Spill Reports for Mojave Region obtained via personal communication (email) with staff.

Lahontan RWQCB. 1995. *Water Quality Control Plan for the Lahontan Region.* Amended 2005.

Lake Arrowhead Community Services District (LACSD). 2011. *Final 2010 Urban Water Management Plan*. Prepared by Kennedy/Jenks Consultants. June.

LACSD. 2008. Water Facilities Master Plan. Prepared by CH2MHill. March.

LACSD. 2007. Integrated Water Resources Program Report. Prepared by RMC Water and Environment. December.

LACSD. 2001. Watershed Sanitary Survey.

Lake Arrowhead.com. 2013. Lake Arrowhead. http://www.lakearrowhead.com/

Lewis, R.E. 1972. *Ground-water Resources of the Yucca Valley-Joshua Tree Area.* San Bernardino County, California. USGS Open-File Report.

Lin, J. B.E. Mapes, K.M. Weickmann, G.N. Kiladis, S.D. Schuber, M.J. Suarez, J.T. Bacmeister, and M. Lees. 2008. "North American monsoon and convectively coupled equatorial waves simulated by IPCC AR4 Coupled GCMs." *J. Climate*, 21:2919-2937.

Los Angeles County. 2012. Draft General Plan - Appendix E.

MacDonald, G.M., et al. 2008. "Climate Warming and 21st Century Drought in Southwestern North America." *Eos Trans. AGU,* 89(9), doi:10.1029/2008EO090003.

Mendez, G.O. and A.H. Christensen. 1997. *Regional Water Table (1996) And Water-Level Changes In The Mojave River, The Morongo, And The Fort Irwin Ground-Water Basins, San Bernardino County, California.* U.S. Geological Survey Water-Resources Investigations Report 97-4160. 34 p.

Milly, P.C.D., K.A. Dunne, and A.V. Vecchia. 2005. "Global pattern of trends in streamflow and water availability in changing climate." *Nature*, 438: 347-350.

Mojave Basin Area Judgment, 1996. *Judgment After Trial, City of Barstow et al. Vs. City* *of Adelanto et al.* Superior Court Case No. 208568, Riverside County, CA.

Mojave Basin Area Watermaster. 2013. Watermaster Annual Report for Water Year 2011-12. Page 19. May 1.

Mojave Desert Air Quality Management District (MDAQMD). 2011. California Environmental Quality Act (CEQA) and Federal Conformity Guidelines. August. http://www.mdaqmd.ca.gov/Modules/ShowDocument.aspx?documentid=2910 Accessed on May 7, 2014.

Mojave Desert Land Trust (MDLT). 2013. The Wildlife Linkage Campaign. http://www.mojavedesertlandtrust.org/linkcampaign.php Accessed on April 25, 2013.

Mojave River Watershed Group (MRWG). 2012. Mojave River Watershed Group Small Municipal Separate Storm Sewer System General Permit Waste Discharge Identification Number 6B336SM40301 *Fiscal Year 2011-12 Annual Report*. Prepared by California Watershed Engineering. Anaheim, CA. September 7. http://www.sbcounty.gov/dpw/mojave_river/pdf/2012-09-10MRWG2011-12AnnualReport.PDF

MRWG. 2003. *Stormwater Management Plan for the Mojave River Watershed*.

Mojave Water Agency (MWA). 2014a. Email from MWA staff on January 16, 2014, using geographic information system (GIS) to calculate Wrightwood Area boundary size.

MWA. 2014b. Email from MWA staff on February 26, 2014, Update to the 2010 UWMP Demand Forecast Model.

MWA. 2013. *Final Report Conceptual Hydrogeologic Model and Assessment of Water Supply and Demand for the Centro and Baja Management Subareas Mojave River Groundwater Basin.* Prepared by Todd Engineers with Kennedy/Jenks Consultants. July.

MWA. 2012. Water Purveyor Geographic Guide and Contact Information.

MWA, 2011*. 2010 Urban Water Management Plan*, Mojave Water Agency, Apple Valley, CA. Prepared by Kennedy/Jenks Consultants. June.

MWA. 2009. Integrated Regional Water Management Plan, Region Acceptance Process. April.

MWA. 2004. *2004 Regional Water Management Plan (Integrated Regional Water Management Plan, Groundwater Management Plan, Urban Water Management Plan)* Mojave Water Agency, Apple Valley, CA. Prepared by Schlumberger Water Services, Apple Valley, CA. Adopted February 2005.

MWA. 2004b. *Mojave Water Agency 2004 Regional Water Management Plan – Program Environmental Impact Report, SCH#: 2003101119.* Prepared by Schlumberger Water Services, Apple Valley, CA. September.

MWA. 2000. *Watermaster Consumptive Use Study and Update of Production Safe Yield Calculations for the Mojave Basin Area*. Prepared by Webb Associates.

MWA 1994. *Mojave Water Agency Regional Water Management Plan.* Prepared by Bookman-Edmonston Engineering, Inc., Glendale, CA.

Morrill, J.C., R.C. Bales, and M.H. Conklin 2005. Estimating Stream Temperature from Air Temperature: Implications for Future Water Quality. *Journal Environmental Engineering*, 131(1), 139-146.

Mote, P.W., A.F. Hamlet, M.P. Clark, and D.P. Lettenmaier. 2005. "Declining mountain snowpack in western North America." *Bull. Amer. Meteor. Soc.*, 86:39-49.

National Parks Conservation Association. 2006. *The U.S. National Park System An Economic Asset at Risk.* Prepared by Hardner & Gullison Associates, LLC. May.

National Park Service (NPS). 2013. Joshua Tree National Park. http://www.nps.gov/jotr/index.htm

Penrod, K., P. Beier, E. Garding, C. Cabanero. 2012. *A Linkage Network for the California Deserts*. February. http://www.scwildlands.org/reports/ALinkageNetworkForTheCaliforniaDeserts.pdf

Phelan Piñon Hills Community Services District (PPHCSD). 2011. *2010 Urban Water Management Plan*. Prepared by Psomas. June.

Roadside Thoughts. 2013. Afton, California. http://www.roadsidethoughts.com/ca/afton-xx-san-bernardino-census.htm. Accessed on December 10, 2013.

Ryan, M.G., S.R. Archer, R. Birdsey, C. Dahm, L. Heath, J. Hicke, D. Hollinger, T. Huxman, G. Okin, R. Oren, J. Randerson, and W. Schlesinger. 2008. "Land Resources." *The Effects of climate change on Agriculture, Land Resources, water Resources and Biodiversity in the United States.* A report by the U.S. Climate Change Science program and the subcommittee of Global Change Research, Washington, DD. 362 pp.

San Bernardino Associated Governments (SANBAG). 2013. *San Bernardino County Regional Greenhouse Gas Emissions Inventories and Reduction Plan*. Environmental Impact Report. Volume III: Draft EIR, Section 4.2, City of Big Bear Lake. October.

San Bernardino County. 2013. *Oak Hills Community Plan*.

San Bernardino County. 2013a. County of San Bernardino 2007 Development Code. July.

San Bernardino County. 2013b. San Bernardino County Regional Parks – Calico Ghost Town. http://cms.sbcounty.gov/parks/Parks/CalicoGhostTown.aspx. Accessed on April 25, 2013.

San Bernardino County. 2013c. San Bernardino County Regional Parks, Lake Gregory Regional Park. http://cms.sbcounty.gov/parks/Parks/LakeGregoryRegionalPark.aspx

San Bernardino County. 2012. *County of San Bernardino 2007 General Plan*. May.

San Bernardino County. 2011a. *Multi-Jurisdictional Hazard Mitigation Plan Update.* San Bernardino County. October.

San Bernardino County. 2011b. Sheep Creek Channel Invert Restoration Project – Mitigated Negative Declaration/Initial Study. Department of Public Works. December.

San Bernardino County. 2011c. Biological Resources Report, Sheep Creek at Lone Pine Canyon Road. Department of Public Works. November 2011. http://www.sbcounty.gov/dpw/public_notices/pdf/Sheep-Creek/Appendix-B.pdf

San Bernardino County. 2009. Assessor Parcel data for Region in electronic format. Office of the Assessor.

San Bernardino County. 2007a. *Bear Valley Community Plan*.

San Bernardino County. 2007b. *Crest Forest Community Plan*.

San Bernardino County. 2007c. *Hilltop Community Plan*.

San Bernardino County. 2007d. *Lake Arrowhead Community Plan*.

San Bernardino County. 2007e. *Homestead Valley Community Plan*.

San Bernardino County. 2007f. *Lucerne Valley Community Plan*.

San Bernardino County. 2007g. *Phelan/Piñon Hills Community Plan*.

San Bernardino County. 2002. California Code of Ordinances.

San Bernardino County, County Service area (CSA) 64. 2012. *2010 Urban Water Management Plan*. Prepared by RBF Consulting Consultants. July.

San Bernardino County, Town of Apple Valley, City of Hesperia, City of Victorville. 2003. Stormwater Management Program for the Mojave River Watershed. http://www.waterboards.ca.gov/water_issues/programs/stormwater/swmp/mojave_swmp.pdf

Science and Collaboration for Connected Wildlands. 2009. *California Desert Connectivity Project*. http://www.scwildlands.org/projects/desert.aspx. Accessed on May 1, 2013.

Seager R., M. Ting, I. Held, Y. Kushnir, J. Lu, G. Vecchi. 2007. "Model Projections of an Imminent Transition to a More Arid Climate in Southwestern North America." *Science,* 316(5828): 1181-1184.

Smith, G.A. and Pimentel, M.I. 2000. Regional Water Table (1998) and Ground-Water-Level Changes in the Mojave River and the Morongo Ground-Water Basins, San Bernardino County, California. Water-Resources Investigations Report 00-4090, U.S. Geological Survey, Sacramento, CA.

Sonoran Institute. 2012. *Morongo Basin Conservation Priorities Report – A Strategy for Preserving Conservation Values*.

Sonoran Institute. 2009. *Morongo Basin Alternative Futures*. http://www.sonoraninstitute.org/morongo-basin-alternative-futures.html. Accessed on April 25, 2013.

Southern California Association of Government (SCAG) 2012. *Final Program Environmental Impact Report*. March.

Spears, M., A. Harrison, V. Sankovich, J. Soddel, and L. Brekke. 2011. "Literature Synthesis on Climate Change Implications for Water and Environmental Resources, second edition." Technical Memorandum 86-68210-2010-03. Prepared by Bureau of Reclamation Technical Service Center Water Resources Planning and Operations Support Group Water and Environmental Resources Division.

Stamos, C.L., Martin, P., Nishikawa, T., and Cox, B.F. 2001 *Simulation of Ground-Water Flow in the Mojave River Basin, California*. Water-Resources Investigations Report 01-4002 Version 3, US Geological Survey, Sacramento, CA.

State Water Resources Control Board (SWRCB). 2010, *2010 Integrated Report (Clean Water Act Section 303(d) List / 305(b) Report) — Statewide.* Sacramento, CA.

SWRCB. 1989. Report of Investigation, Complaint Regarding Unnamed Stream Tributary to Sheep Creek, San Bernardino County. March 30.

Stetson Engineering. 2004. *Evaluation Of Potential Impacts Of The Mountain High Resort's Extraction On Hydrogeology Of The Swarthout Valley*. August.

Town of Apple Valley. 2013. Town of Apple Valley Website: Multi-Species Habitat Conservation Plan. http://www.applevalley.org/Index.aspx?page=895. Accessed on April 25, 2013.

Town of Yucca Valley, 2007. *Old Town Yucca Valley Specific Plan Program EIR*. August.

Twenty-Nine Palms Band of Mission Indians. 2014. http://29palmstribe.com/tribaladmin.html. Accessed on June7, 2014.

Twentynine Palms Water District (TPWD). 2014. *Draft Twentynine Palms Groundwater Management Plan 2014 Update*, March.

TPWD. 2011. *2010 Urban Water Management Plan*, June.

TPWD. 2008. *Groundwater Management Plan Update*, Final Report, December.

US Army Corps of Engineers (US ACOE) 1969, "Flood Plain Information Mojave River (Vicinity of Victorville); San Bernardino County California," Prepared for San Bernardino County by Corps of Engineers, U.S. Army Los Angeles District, California.

US Bureau of Reclamation (USBR). 2013. *Mojave River Watershed Climate Change Assessment*. Prepared by: Water and Environmental Resources Division (86-68200), Water Resources Planning and Operations Support Group (86-68210). August.

USBR. 2003. Environmental Water Account (EWA) Draft EIS/EIR Volume 1, Chapter 16: Power, July 2003.

US Census Bureau. 2013a. *State and County QuickFacts*, City of Twentynine Palms.

US Census Bureau. 2013b. *State and County QuickFacts*, Crestline CDP.

US Census Bureau. 2010. Demographic Profile Data, Wrightwood Census Designated Place (CDP), California. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1. Accessed on December 6, 2013.

US Census Bureau. 2007-2011 American Community Survey 5-Year Estimates, Selected Economic Characteristics, Wrightwood CDP, California. http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=ACS_11_5YR_DP03&prodType=table. Accessed on December 6, 2013.

US Fish and Wildlife Service (USFWS). 2011. *Revised Recovery Plan for the Mojave Population of the Desert Tortoise*.

USFWS. 2002. News Release – Critical Habitat Designated for Five Carbonate Plants from the San Bernardino Mountains. December. http://www.fws.gov/carlsbad/NR/5carbplants_fch_NR.appvd.pdf

USFWS. Endangered Species. Species by County Report. http://ecos.fws.gov/tess_public/countySearch!speciesByCountyReport.action?fips=06071. Accessed on May 25, 2013.

US Forest Service (USFS). 2013. *Final Supplemental Environmental Impact Statement.* US Department of Agriculture Forest Service Pacific Southwest Region R5-MB-265. November 2013.

USFS. 2013. National Forest Locator Map. http://www.fs.fed.us/locatormap/#. Accessed on December 6, 2013.

USFS. 2005a. *Land Management Plan – Part 2 Angeles National Forest Strategy*.

USFS. 2005b. *Land Management Plan – Part 2 San Bernardino Forest Strategy*.

USFS. 1999. Southern California Mountains and Foothills Assessment – Habitat and Species Conservation Issues. Chapter 7 – Areas of High Ecological Significance. December.

US Geologic al Survey (USGS). 2013, National Water Information System. http://nwis.waterdata.usgs.gov/nwis/gwlevels?site_no=350230116264001&agency_cd=USGS&format=gif Accessed December 10, 2013.

USGS. 2009. *Desert Landforms and Surface Processes in the Mojave National Preserve and Vicinity – Mojave River.* http://pubs.usgs.gov/of/2004/1007/river.html Accessed on May 30, 2013.

USGS. 2005. *Preliminary integrated databases for the United States - Western States: California, Nevada, Arizona, and Washington*, Edition: Version 1.0. Source: http://pubs.usgs.gov/of/2005/1305/#CA.

USGS. 1996. *Ground-Water and Surface-Water Relations along the Mojave River, Southern California.* Sacramento, California.

USGS and MWA, Sneed, Ikehara, Stork, Amelung, and Galloway. 2003. *Detection and Measurement of Land Subsidence Using Interferometric Synthetic Aperture Radar and Global Positioning System*, San Bernardino County, Mojave Desert, California.

Victorville Water District. 2011*. 2010 Urban Water Management Plan*. Prepared by Carollo Engineers. May.

Wagner and Bonsignore. 2012. *Analysis of Baja Water Supply and Outflow*. February 22.

Warner, R.E. and K.M. Hendrix. 1984. *California Riparian Systems: Ecology, Conservation and Productive Management*. University of California Press, Berkeley, California. 1035 pp.

Warren Valley Basin Watermaster, 1996. *Warren Valley Basin Management Plan Addendum.* Yucca Valley, CA. November.

Warren Valley Basin Watermaster, 1991. *Warren Valley Basin Management Plan*. Prepared by Kennedy/Jenks/Chilton. January.

Weldon, Fumal, Powers, Pezzopane, and Hamilton. Structure and Earthquake Offsets on the San Andres Fault at the Wrightwood California Paleoseismic Site, Bulletin of the Seismological Society of America, no date

Wilcox, Len. 2013. Mojave Road – And Adventure Through Time. On DesertUSA. com. http://www.desertusa.com/desert-trails/mojave-road-page2.html Accessed on December 23, 2013.

WrightwoodCA.com. 2013. http://www.wrightwoodca.com/wrightwood-canyons-and-valleys/canyon.php?view&canyon=1. Accessed on December 6, 2013.

Wrightwoodcalifornia.com. 2011. Wrightwood History. http://wrightwoodcalifornia.com/history-of-wrightwood/page-01.01.html. Accessed on December 6, 2013.