DRAFT Table of Contents

Section 3: Water Supply and Water Demand

3.1 Overview of Water Supply

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

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

Water Supply Source	2010	2015	2020	2025	2030	2035
Existing Supplies						
Wholesale (Imported)						
SWP[(a)]	49,680	51,480	53,880	53,880	54,778	54,778
Local Supplies						
Net Natural Supply[(b)]	54,045	59,973	59,973	59,973	59,973	59,973
Agricultural Depletion from Storage[(c)]	10,425	11,053	3,391	0	0	0
Return Flow[(d)]	60,393	64,421	63,016	66,333	70,855	75,366
Wastewater Import[(e)]	4,895	4,585	4,883	5,181	5,479	6,385
Total Existing Supplies	**179,438**	**191,512**	**185,143**	**185,367**	**191,085**	**196,502**
Projected Demands[(f)]	***145,875***	***158,185***	***154,403***	***160,578***	***169,829***	***179,056***

Notes:
Source: MWA update to its 2010 Urban Water Management Plan (UWMP) demand forecast projection model dated July 11, 2013.
(a) Assumes 60% of Table A amount as the long-term supply until 2029 and then assume 61% in 2029 and after, based on the California Department of Water Resources 2011 SWP "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 3-9, assuming "moderate" conservation.

Comment [SC1]: These are going to change once I get revised numbers from Tim

The Mojave Region 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 projected demands shown in Table 3-1 represent total demands within the Mojave Region, 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 in 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 3-A.

Insert Figure 3-1 after Tim finalizes supplies.

3.2 Water Supply

3.2.1 Imported Water from the State Water Project

As detailed in MWA's 2010 Urban Water Management Plan (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 an SWP Water Supply Contract with DWR.

Each SWP contractor's SWP Water Supply Contract contains a "Table A," which lists the maximum amount of water an agency may request each year throughout the life of the contract. Table A is used in determining each contractor's proportionate share, or "allocation," of the total SWP water supply DWR determines to be available each year. The total planned annual delivery capability of the SWP and the sum of all contractors' maximum Table A amounts was originally 4.23 million acre-feet (af). The initial SWP storage facilities were designed to meet contractors' water demands in the early years of the SWP, with the construction of additional storage facilities planned as demands increased. However, essentially no additional SWP storage facilities have been constructed since the early 1970s. SWP conveyance facilities were generally designed and have been constructed to deliver maximum Table A amounts to all contractors. After the permanent retirement of some Table A amount by two agricultural contractors in 1996, the maximum Table A amounts of all SWP contractors now 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 2012), 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-year dry 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)[(a)(b)]

Wholesaler (Supply Source)	2012	2015	2020	2025	2030	2035
Average Water Year[(c)]						
DWR (SWP)						
Table A Supply MWA	50,508	52,338	54,778	54,778	54,778	53,880
% of Table A Amount[(d)]	61%	61%	61%	61%	61%	60%
Single Dry Year[(e)]						
DWR (SWP)						
Table A Supply MWA	7,452	7,722	8,082	8,082	8,082	9,878
% of Table A Amount[(d)]	9%	9%	9%	9%	9%	11%
Multi-Dry Year[(f)]						
DWR (SWP)						
Table A Supply MWA	28,980	30,030	31,430	31,430	31,430	30,532
% of Table A Amount[(d)]	35%	35%	35%	35%	35%	34%

Notes:
Source: MWA 2010 UWMP.
(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 Mojave Region 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.

Within the constraints of the Judgment, the MBA Watermaster Engineer recently revised the net natural supply for the Baja Subarea up from 5,500 afy to 11,428 afy (Wagner and Bonsignore, 2012). Further details of the projected net natural water supply for the Baja Subarea are provided in the recently finalized Conceptual Hydrogeologic Model and Assessment of Water Supply and Demand for the Centro and Baja Management Subareas Mojave River Groundwater Basin (BCM Study) completed by MWA (MWA 2013).

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

Comment [MLC2]: This is confusing: is this paragraph about ag depletion and what defines that or is it about Baja subarea? Can it be re-worded?

3.2.2.3 Return Flow

A portion of pumped groundwater returns to the 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 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 (Webb, 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 and a portion from recycled wastewater. The projections for recycled water flows discussed in Section 3.2.4 are embedded within the overall return flow numbers shown in Table 3-1, and are therefore not identified as a separate source of supply.

3.2.2.4 Wastewater Import

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

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 Mojave Region 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, below. 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)

Comment [SC3]: Tim – Do I need to update this? If so, where do I get numbers?

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

Note:
Source: MWA 2010 UWMP Table 3-6.
(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 2010-2011 for each subarea and the estimated PSY. Also shown in Table 3-4 is the verified production for water year 2009-10 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	2010-2011 FPA	Production Safe Yield	Percent Difference[1]	2009-2010 Verified Production
Subareas					
Alto	116,412	74,534	69,862	4.00%	78,493
Baja	66,157	43,863	20,679	35.00%	21,539
Centro	56,269	45,349	33,375	21.30%	21,847
Este	20,205	16,376	7,156	45.60%	4,848
Oeste	7,095	5,727	4,052	23.60%	4,342

Source: MWA 2010 UWMP Table 3-7.
(1) This value represents the percent of BAP that PSY departs from FPA.

MWA's 2011 UWMP summarizes the net average annual water supply estimates for each of the subareas that comprise the Mojave Basin Area. The net average water yield of the entire Mojave Basin Area is about 57,853 afy.

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]	5,794	7,102	7,372	7,590	7,809	8,028

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

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

In the Ames Valley and Johnson Valley regions, the Bighorn-Desert View Water Agency (BDVWA) 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 9 percent capacity in the Morongo Basin Pipeline and may purchase SWP water from MWA. Although the infrastructure needed to deliver SWP water to the Ames Valley region already exists, additional facilities are needed to convey imported SWP water to spreading grounds for recharge, storage, and subsequent recovery. 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 three water supply agreements that are applicable to groundwater management in the Morongo Area, including (1) the Warren Valley Basin Agreement, (2) a court approved agreement between the BDVWA and HDWD in a portion of the Ames Valley basin and (3) an agreement for the users of the Morongo Basin Pipeline. The purpose of the agreement is to improve reliability of the shared water supply. For details on the 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 December 31, 2010. 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.

Comment [SC4]: Tim – Can we get updated info?

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	58,592	28,851	87,443
Baja	18,128	0	18,128
Centro	17,377	0	17,377
Este	1,357	0	1,357
Oeste	0	0	0
Morongo	0	17,146	17,146
Total	**95,454**	**45,997**	**141,451**

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

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 MOJAVE REGION

Name/Type	Capacity (AFY)	MWA Subarea/ Region	Retailer Served	Date Supply Available
Regional Recharge and Recovery Project ("R³ Project")	Phase 1 – 15,000 Phase 2 - 40,000 total	Alto	AVRWC, Adelanto, Hesperia Water District, CSA 64, Victorville Water District, Golden State Water Company	Phase 1 – Completed. Phase 2 – 2015-2020
Oro Grande Wash Recharge	8,000	Alto	Victorville Water District,	Completed.
Ames Valley Recharge	1,500	Ames Valley	BDVWA, HDWD, CSA No. 70 W-1, CSA No. 70 W-4	Completed

Notes:
(a)

Comment [SC5]: Lance/Tim – do you have time frame of completion? Is it soon? If not, I would delete from list.

Comment [SC6]: Same as above.

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 chapter 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**

Notes:
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 130,000 af stored as of January 2013. 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 an 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

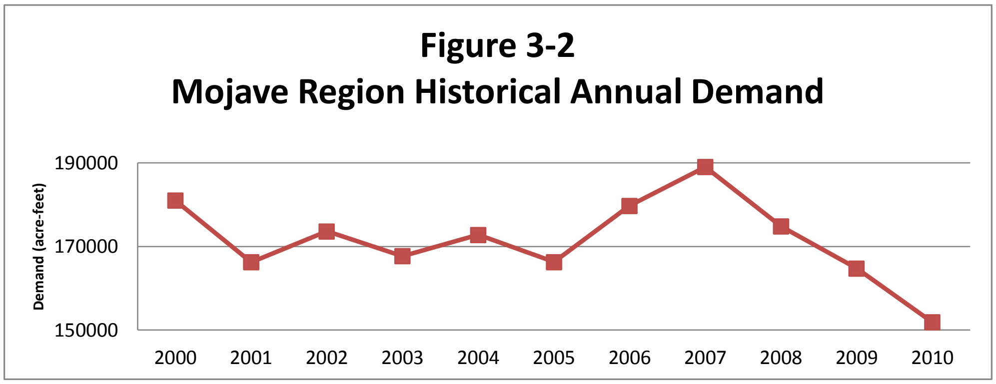
Name/Type	Exchange/Transfer	Duration	Proposed Quantities
Pre-delivery of Unused SWP Supplies	Current water contract	Permanent	Up to 220,000 acre-feet total from 2010 to 2030
Solano County Water Agency	Exchange Pilot Program	Ending in 2015. No further action.	Pilot program only
Metropolitan Water District Water Exchange Program	Exchange Pilot Program	Ended in 2010. No further action.	Pilot program only

Name/Type	Exchange/Transfer	Duration	Proposed Quantities
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 acre-foot storage balance
Metropolitan Water District Water Storage Program	Long-Term Storage and Exchange Program	2011 to 2035	Up to 390,000 acre-feet 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 the Region'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.



For MWA's 2010 UWMP, a demand forecast model was developed that combines population growth projections with water use data to forecast total water demand in future years. Using Southern California Association of Governments (SCAG) 2012 Regional Transportation Plan (RTP) growth forecast (baseline of 2008), it is predicted that population in the Mojave Region will grow at a rate of approximately 2.5 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 152 GPCD in 2010. At the same time, SFR GPCD in the Morongo Area remained relatively flat at an average of 113 GPCD. While a significant reduction in per-capita use has occurred in the Mojave Basin over the past decade, GPCD is still substantially higher than in the Morongo Area. Voluntary conservation programs, State-Mandated GPCD reductions, tiered rate structures at the retail level, and the continuously increasing cost of water will all influence future water demands. Recognizing these factors and that a substantial potential still exists for reductions in SFR per-capita use, it is assumed in the plan that a moderate amount of additional conservation will be attained in the SFR use sector. Regional demands are projected to increase at a rate of 1.4 percent per year, slower than population growth, partially because of conservation and partially because some non-retail water uses are not anticipated to increase in the future.

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 Mojave Region. Table 3-10 summarizes the Mojave Region's 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 ?????, MWA completed a recent update to the minimal producer production estimates based a detailed GIS-based accounting of land uses among MPs (MWA 2010 UWMP). 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 was assumed in the 2000 Webb Study). It is anticipated that these projected demands can be met using the water supplies described above.

Projected demands reflect conservation activities planned by agencies in the Mojave Region 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

Comment [SC7]: Tim - can you fill in?

Comment [MLC8]: Remind me: did they include recycled in the demand reductions? They can.

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 MOJAVE REGION (AFY)

Subarea	2010	2015	2020	2025	2030	2035
Alto	81,834	85,220	83,608	90,721	98,390	106,059
Baja	23,227	30,206	27,190	25,140	25,472	25,782
Centro	24,322	23,654	24,754	25,423	26,153	26,884
Este	5,785	6,915	7,086	7,253	7,429	7,604
Oeste	5,041	5,554	5,037	5,170	5,315	5,459
Morongo	5,666	6,636	6,728	6,871	7,070	7,268
Total	***145,875***	***158,185***	***154,403***	***160,578***	***169,829***	***179,056***

Source is MWA's update to the 2010 UWMP demand forecast projection model dated July 11, 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 accelerated 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[1]. 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 6: Reliability Management Strategies.

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.

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

Water quality management in the Mojave Region 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 EPA, 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 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 United States. SDWA authorizes the US EPA 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 Safe Drinking Water Acts (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 US EPA, 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:

1. ensuring that individuals certified as drinking water treatment operators or as distribution system operators meet the educational competence required by law.
2. ensuring that residential water treatment devices sold for purifying water meet appropriate standards.
3. developing monitoring and water quality regulations
4. conducting special studies on contaminants in drinking water contaminants.
5. developing water recycling criteria and regulations, and evaluating water recycling projects and making recommendations to the RWQCBs about public health implications.
6. 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 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 Basin Plan). As discussed in Section 1.1.1, Regional Features, the Mojave Region includes portions of both the South Lahontan and Colorado River DWR-defined Hydrologic Regions and is therefore governed by both hydrologic region RWQCBs. The Basin Plans do not identify beneficial uses for all water bodies in the Region; however the tributary streams of any specifically identified water body can generally be assumed to have the same beneficial use designations.

7. Municipal and Domestic Supply
8. Agricultural Supply
9. Industrial Service Supply
10. Groundwater Recharge
11. Water Contact and Non-contact Water Recreation
12. Warm and Cold Freshwater Habitat
13. Wildlife Habitat
14. Freshwater Replenishment
15. Water Contact and Non-contact Water Recreation
16. Commercial and Sportfishing
17. Migration of Aquatic Organisms
18. Water Quality Enhancement
19. Rare, Threatened, and Endangered Species

Nearly all water bodies in the 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 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 Region, but they are a continual source of recharge to groundwater which is then used to meet municipal water demands.

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

	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 GW Basins						
West Fork (W.F.) Mojave River[d]	245	6	-	-	-	-
W.F. Mojave River (at Lower Narrows) [d]	312	5	-	-	-	-
Mojave River (at Barstow) [d]	445	6	-	-	-	-
Mojave River (upstream side of Waterman Fault) [d]	560	11	-	-	-	-
Mojave River (upstream side of Calico-Newberry Fault) [d]	340	4	-	-	-	-
Mojave River (upstream of Camp Cady Ranch Building Complex) [d]	300	1	-	-	-	-
W.F. Mojave (above Silverwood Lake)[e]	219	-	8.4	34	0.26	0.02
East Fork of W.F. Mojave[e]	140	-	12.7	10.7	0.23	0.06
Silverwood Reservoir[e]	220	-	55	20	-	-
Mojave River (at Forks) [e]	-	-	55	35	1.5	0.2
Mojave River (at Victorville) [e]	-	-	75	40	0.2	0.2

Source: Lahontan Basin Plan, Tables 3-20, 3-21 and Figure 3-13..
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 Waterbodies List for the Mojave River Watershed was approved by the SWRCB on September 21, 2009 and was approved by the US EPA 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 within the Region. Figure 3-3 shows the various reaches of the Mojave River.

Insert Figure 3-3 here (RWQCB figure of Mojave River) – still need to modify and insert

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 Region and have plans to develop more in the future. Table 3.12 provides a summary of the current listings of impaired water bodies of 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
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
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

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 Region.

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

Since SWP water imports to the Mojave River Basin will be persistent, long term, and increasing, these imports are deemed to be a significant factor in the long term salt balance in the Mojave River Groundwater Basin. Data regarding the quantity and quality of SWP water delivered to the Mojave Region 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 Mojave Region. 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 Region's basin(s) (2007 Schlumberger).

3.4.3.2 Groundwater Quality

3.4.3.2.1 Naturally Occurring Contamination

Groundwater is used throughout the Region for drinking water and irrigation supplies. Impairment of groundwater can be assessed 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 2011 BCM Study 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.

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.

Groundwater quality varies across the Baja Subarea but is generally suitable for beneficial uses. Groundwater from most wells located along the Mojave River has a signature similar to that of Mojave River water. The general mineral quality is influenced by leaching from evaporative lake deposits and geochemical changes as groundwater flows toward dry lakes. Also, areas of degraded groundwater quality (high TDS) occur near Yermo and near Troy Dry Lake.

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 Alto TZ, 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 under 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 ppm. For irrigation, high TDS waters may cause low soil permeability, lead to increased irrigation requirements and can result in reduced yields. The California EPA 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 primary drinking water standard. 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.

The effect of irrigation drainage on the receiving ground water is highly variable. For instance, in the Owens Valley, irrigation has produced no appreciable effect on the ground water quality due to the low mineral content of the irrigation supply water and the relatively minor amount of irrigated acreage. However, along the Mojave River, irrigation drainage has noticeably contributed to localized increases in mineral and nitrate content of the underlying ground water (Lahontan Basin Plan, 2005).

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. These sites are discussed below. TO BE COMPLETED.

Comment [SC9]: Still to be completed.

PG&E Hinkley

Extensive investigations by Pacific Gas and Electric (PG&E) Generating Station have identified a plume of groundwater degraded 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 degraded 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 sub-regional 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 IRWM Plan Update and is provided in Appendix 3-X.

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 3-4

Community wastewater systems serve an important function in protecting groundwater from degradation. However, unauthorized wastewater releases due to inadequate infrastructure have the potential to impact the quality of the groundwater in negative ways. Discharge violations from the sanitary sewer for the last five years are shown in Table 3-14 totaling over 1,000 discharge violations (Lahontan RWQCB, 2013).

Comment [SC10]: Lance/Tim- Do we want to show this? Mary Lou said it seems relevant. Projects may be submitted to address this

Septic system contamination of groundwater is also possible through leachfield overflow or percolation through groundwater of nutrients or disease-causing pathogens and coliform bacteria. There were ???? septic systems in Mojave watershed-mainly around ???

Comment [SC11]: Emailed CDPH and RWQCB to get numbers

TABLE 3-14
LAHONTAN RWQCB DISCHARGE VIOLATIONS

Facility Name	Agency	Regulatory Permit	Order No.	Violations Within 5 Years
Mojave River Fish Hatch	CA Dept. Of Fish & Game	NPDES Permit	R6V-2011-0081	27
Victor Valley Muni WWTP	Victor Valley Wastewater Reclamation Authority	NPDES Permit	R6V-2008-0004	71
Adelanto WWTP	Adelanto Public Utility Auth	WDR	R6V-2002-0050	713
Barstow WWTF Mojave River Bed	City of Barstow	WDR	94-026	117
Fort Irwin WWTF	CH2M Hill	WDR	04-005	42
Nebo Domestic WTF	US Marine Corps Logistic Base (MCLB) Barstow	WDR	01-020	14
Yermo Domestic WTF	MCLB Barstow	WDR	01-042	46

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 3-5. 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 below.

Flood management facilities have been constructed over the years and many studies have and continue to occur to address these areas by federal, state, and local agencies such as the US Army Corps of Engineers (USACOE), California Department of Water Resources (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, protection measures are necessary (Lahontan Basin Plan Chapter 4, 2005).

Insert paragraph here tying flood protection stormwater management together and explain why should be done together.

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.

The US Department of the Interior Bureau of Reclamation Technical Service Center (Bureau) completed three tasks for MWA related to climate change assessment for this IRWM Plan. One task was evaluate the climate change impacts on flood flow frequency in the Mojave River Watershed and parts of that Draft Task Report are included below, as relevant.

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 (Corps of Engineers, 1969). However, localized flooding also occurs throughout the 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 (Corps of Engineers, 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 (Corps of Engineers, 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 (Buono and Lang, 1980). (Bureau 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 Plan, 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.

3.5.2 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 3-6 and are also listed in Table 3-15.

Insert Table 3-15 Flood Infrastructure

Insert Figure 3-6 Flood Infrastructure

3.5.3 Flood Management Projects

Comment [MLC12]: Does anything capture and percolate water?

Table 3-16 summarizes the planned existing and future flood management projects as listed currently by the Region's Flood Control District.

TABLE 3-16
MOJAVE REGION FLOOD CONTROL DISTRICT EXISTING AND FUTURE PROJECTS

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

Notes:
Source: San Bernardino County, 2012.

3.5.4 Regulatory Requirements for Stormwater Management

The County of San Bernardino, the Town of Apple Valley, and the Cities of Victorville and Hesperia have been issued a Phase II, Municipal Stormwater Permit by the Lahontan RWQCB for the urbanized portion of the Mojave River Watershed. These agencies collectively known as the Mojave Watershed Group, prepared the *Stormwater Management Plan for the Mojave River Watershed* (2003), which describes control measures for protecting area water quality from stormwater and non-stormwater discharges.

The Phase II Small Municipal Separate Storm Sewer System (MS4) General Permit program is intended to address potentially adverse impacts to surface water quality by instituting the use of controls on unregulated sources of stormwater discharges that have the greatest likelihood of causing continued environmental degradation. Stormwater discharges from MS4s in urbanized areas are a concern because of the potential for these discharges to contain pollutants. Concentrated development in urbanized areas substantially increases impervious surfaces, such as city streets, driveways, parking lots, and sidewalks, on which pollutants from concentrated human activities can settle and remain until a storm event washes them into nearby storm drains.

Common pollutants include pesticides, fertilizers, oil and grease, trash and other debris, metals, and sediment. Another concern is the possible illicit connections of sanitary sewers, which can result in high levels of fecal coliform bacteria entering the storm drain system. Stormwater runoff can pick up and transport these and other potentially harmful pollutants and discharge them untreated to waterways. Under some circumstances, these discharges can result in a loss in aesthetic value and contaminate local drinking water supplies.

In accordance with the SWRCB Water Quality Order No. 2003-0005-DWQ and National Pollutant Discharge Elimination System (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) agencies, 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 Lahontan RWQCB accepted the SWMP and issued coverage under the Phase II permit to the MRWG Permittees in February 2005 (Mojave River Watershed Group, 2012).

The main purpose of the MS4 permit is to implement effective pollution prevention programs that will reduce the discharge of pollutants from the storm drain system in order to protect receiving waters and their beneficial uses. The MS4 permit requirements primarily focus on the following areas:

- Non-stormwater discharge prohibitions
- TMDL water quality based effluent limitations
- Receiving water limitations
- Watershed management program provisions
- Minimum control measures

Standard provisions of the MS4 permit that constitute minimum control measures to be implemented include the following categories:

- <u>Public Information and Participation Program,</u> to increase public knowledge of stormwater issues, improve stormwater-related behavior and engage diverse socio-economic and ethnic groups.

- <u>Industrial/Commercial Facilities Program</u>, designed to prevent illicit discharges and reduce discharges into the MS4 and receiving waters through monitoring and education.

- <u>Planning and Land Development,</u> applicable to new development and redevelopment, requirements under this provision include implementing smart growth and low impact development strategies, minimizing impervious surfaces, implementing hydromodification control BMPs and increasing the control and beneficial use of stormwater runoff.

- <u>Development Construction Program</u>, requiring each permittee to establish an erosion and sediment control ordinance for soil-disturbing construction projects and to implement a program to prevent construction-related pollution discharges.

- <u>Public Agency Activities Program,</u> to control stormwater pollution impacts from permittee-owned and operated facilities and activities.

- <u>Illicit Connections and Illicit Discharges Elimination Program</u>, to detect, investigate, and eliminate illicit connections and discharges to the MS4.

These programs may be implemented in accordance with the requirements listed in the MS4 permit or addressed within an approved watershed management program. 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

Results from US Bureau of Reclamation Report Tasks to be summarized and inserted here.

3.6.1 Projected Climate Change Impacts

3.6.2 Summary of Climate Change Vulnerability Checklist

3.6.2.1 Flooding

3.6.2.2 Water Demand

3.6.2.3 Water Supply

3.6.2.4 Water Quality

3.6.2.5 Ecosystem and Habitat Vulnerability

3.7 Summary of Major Water Issues and Problems

To be completed.

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Add list of retailers 2010 UWMPs to references.