Table of Contents for the Colorado River Report

Tables

Figures

Boxes

Colorado River Hydrologic Region

Colorado River Hydrologic Region Summary

Despite the subtropical desert climate, reliable water supplies for the Colorado River Hydrologic Region have made it possible to establish, maintain, and even expand, the key local industries – agriculture, recreation, and tourism. At the same time, the region's topographic landscape, shaped by tectonic and past volcanic activities, remains as scenic and beautiful. This includes the Salton Sea which is sustained by agricultural tailwater, tilewater, treated and untreated urban wastewater flows. Water agencies in the region have not stopped planning and implementing programs and projects to maintain the quality and quantity of water supplies, particularly groundwater, for the future. This includes water use efficiency conservation and groundwater storage and conjunctive use programs and water supply transfers. Activities are also underway to protect and enhance the region's important environmental resources; in particular the Salton Sea which provides critical habitat for resident and migratory birds.

Current State of the Region

Setting

The Colorado River Hydrologic Region (region) is located in southeastern California and contains 12 percent of the state's land area. The Colorado River provides most of the eastern boundary, and the border with Mexico forms the southern boundary (Figure CR-1). The region includes Imperial County and portions of Riverside, San Bernardino, and San Diego counties.

PLACEHOLDER Figure CR-1 Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Geology and climate shape the topography of the Colorado River region. Numerous faults exist, including the San Andreas fault, and they are responsible for the mountainous terrain in the north and the large valleys and plains in the south. The northern third of the region is part of the Mojave Desert and features small to moderate mountain ranges, dormant volcano cinder cones, hills, and narrow and U-shaped valleys. The San Bernardino and San Jacinto mountains in the north have peaks at or above 10,000 feet above sea level. The remainder of the region, which is part of the Sonoran Desert, is less mountainous, and is dominated by the Salton Sea and the Imperial, Coachella, Palo Verde, and Bard valleys. The Salton Sea is the largest lake in California and is sustained mostly by agricultural runoff from the Imperial and Coachella valleys. The Salton Sea provides critical nesting habitat for migratory birds in the Pacific Flyway.

Coachella and Imperial valleys are to the north and south of the Salton Sea, respectively. Palo Verde and Bard valleys are on the western bank of the Colorado River. The surface of the Salton Sea and some of the land in the Coachella and Imperial valleys are as much as 230 feet below sea level. Most of the agricultural and urban land uses for the region are in these valleys. The Imperial Valley contains most of the agricultural area uses, and the Coachella Valley has most of the urban areas. Native vegetation in the creosote bush scrub classification is able to survive the hot summers and sparse rainfall common to the valleys and plains. In the mountains, the cooler and wetter climate supports vegetation in the pinyon-juniper woodland class. Major rivers in the region are the Colorado and Whitewater; and the Alamo and New which function as conduits for agriculture and urban runoff from the Imperial Valley in the U.S. and the Mexicali Valley in Mexico. Most other rivers, streams, and washes, such as the Piute Wash and San Felipe Creek, are intermittent or dry. Playas, or dry lakebeds, are common in the eastern portions of the region. Major water conveyance facilities are the All-American and Coachella canals.

The Colorado River region has two of the state's largest public parks. The 600,000 acre Anza-Borrego Desert State Park is west of the Salton Sea in the Santa Rosa, Borrego, and Vallecitos mountains. Joshua Tree National Park is in the Little San Bernardino Mountains.

Watersheds

Many of the prominent watersheds in the Colorado River Hydrologic Region offer combinations of native vegetation and man-made environmental, urban, and agricultural land and water uses. Included are the Salton Sea Transboundary watershed, located in both the Coachella and Imperial Planning Areas (PA), the Imperial Reservoir and Lower Colorado River watersheds in the Colorado River PA, and the watersheds for San Felipe, Fish, Vallecito, and Carrizo creeks in the Borrego PA. Other key watersheds, largely devoid of urban and agricultural uses, include the Havasu-Mojave Lakes and Piute in the Colorado River PA and the Southern Mojave in the Twenty-nine Palms-Lanfair PA.

Salton Sea Transboundary Watershed

The Salton Sea Transboundary watershed stretches over two counties, Imperial and Riverside, encompasses about one-third of the land area of the hydrologic region. It also includes most of the Coachella and Imperial Valley PAs. Key hydrologic features are the Salton Sea, the Whitewater River in the north, the Alamo and New rivers in the south, and San Felipe Creek in the west. The watershed has been designated as a Category 1 (impaired) watershed using the criteria in the 1997 California Unified Watershed Assessment.

The most prominent of the features is the Salton Sea. The lake was created more than 100 years ago by a levee break in the Colorado River. Presently, it has a surface area of 376 square miles and 105 miles of shoreline. The elevation of the water surface is about 232 feet below sea level. One of the major functions of the Salton Sea is to serve as a sump for agricultural tail water and for urban treated and untreated wastewater flows from the Imperial and Coachella valleys and Mexico. Although its reputation for recreation and sports fishing has diminished in recent years, the sea still provides critical habitat for migratory birds in the Pacific Flyway. The Sonny Bono Salton Sea National Wildlife Refuge is an important wetland area. Because drainage is internal, salts tend to concentrate in the sea's water, and the nutrients enhance the formation of eutrophic conditions.

An important function of the watershed is that it provides critical habitat for migratory birds in the Pacific Flyway. The native and man-made wetlands on the shoreline of the Sea provide habitat for Eared Grebes, White-faced Ibis, American White Pelicans, Yuma Clapper Rail, Black Skimmers, Double-breasted Cormorants, and Gull-billed Terns, just a few of the species of birds which can be found during winter nesting. The population of the nesting birds is often in the hundreds and thousands. The Sea is important, as the fishery serves as a food source for the birds.

To the north of the Salton Sea is the Coachella Valley which has a blend of urban and agriculture land uses, with a greater emphasis on the former. To the south is the Imperial Valley which features major agricultural land uses and operations. Over 400,000 acres of land are utilized in crop production annually in the Imperial Valley. Two aqueducts are in operation, the All-American and Coachella canals which transport Colorado River water supplies to both areas. Groundwater supplies are also important, especially in the Coachella Valley PA. Major cities include Indio, Palm Springs, Cathedral City, and Palm Desert in the Coachella Valley, El Centro, Brawley, and Calexico in the Imperial Valley.

Salinity levels of the Sea are critical issues. The inflows from the different sources identified above are contributing as much as 4.5 million tons of salts each year. In 2012, the level of salts was 53 ppt; the Pacific Ocean's level is 35 ppt. Salinity levels are slightly higher because of the decrease in flows from Mexico and below-average precipitation. In 2017, the end of mitigation deliveries as specified in the 2003 Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement, Exhibit B, could exacerbate salinity levels. Local fish and invertebrate species will be impacted by the higher levels of salinity which would then impact migratory and shore-line birds.

The water quality issues posed by the New and Alamo Rivers have been documented in the last California Water Plan. The New River transports treated and untreated urban wastewater and untreated agricultural tail water from the Mexicali Valley, treated urban wastewater, treated industrial and agricultural tail and drain water from the Imperial Valley to the Sea. The Alamo River carries some treated urban wastewater, but, as does the drainage systems in Imperial and Coachella Valleys, carries mostly agricultural tail and drain water flows to the Sea. Two important projects are underway to address the quality concerns in the rivers. The Imperial County Farm Bureau manages a voluntary TMDL Compliance program in Imperial Valley. The goal of the program is to decrease the sediment loads being transported into the Salton Sea from the fields. Interested farmers received information on Best Management Practices which can be integrated into their farming operations to decrease sediment and nutrient runoffs from their fields. The second project is the New River Wetlands Project, began in 2003. It is a collaborative project which includes U. S. Congressman Duncan Hunter (R-Alpine), Desert Wildlife Unlimited, the IID, and the USBR and its goals are to construct aeration ponds and establish two small wetlands on the New River to help with the cleanup of the water downstream from the International Border. These sites have been constructed. A third area was completed to the northeast of the City of Brawley on the Alamo River. A maximum of twelve wetland areas will be constructed, with most for the New River. The construction of the three areas was a collaboration between the USBR and Imperial Irrigation District and was made possible through federal funding. Many other agencies and organizations have participated in the project including Imperial County, U. S. Environmental Protection Agency, U.S. Fish and Wildlife Service, California Department of Fish and Wildlife, and Citizen Congressional Task force on the new River. The areas have also become small ecosystems, attracting birds and fish. They have also become popular fishing spots for local area residents.

Salton Sea

The Salton Sea is the largest inland lake in California. It does not have any outlet to the Pacific Ocean or Gulf of California, drainage of all surface water in the watershed is internal, all surface water flows to the Sea. Although its physical characteristics have fluctuated over the years, the Sea has remained relatively constant over the past two decades. Its size, shape, and volume has been sustained by annual inflow of 1.3 MAF of agricultural tail and drain water, IID QSA mitigation discharges, surface runoff, treated and untreated urban wastewater flows from the Coachella, Imperial, and Mexicali valleys, and a small amount of subsurface flow. Runoff from precipitation also contributes; 3 inches of rainfall over a 380 square mile area (about 60,000 AF). Because of the extremely arid climate, evaporation of water from the Sea is about equivalent to the quantities of inflow water, 1.3 MAF. Total volume of water in the Sea is estimated at 7.5 MAF. The only characteristic that has changed is the elevation of the water surface. At the end of 2012, the elevation of the surface was -231.72 feet below sea level, which is a decline of about 2.3 feet since 2008. The decline is the result of decreased flows from Mexico and below average precipitation. Average depth is slightly less than 30 feet, with its deepest spot determined to be 51 feet.

The sources of water for the Salton Sea are agricultural surface tailwater and tile drain water, operational spills, treated and untreated municipal and industrial wastewater, and urban runoff from the Imperial Valley, Coachella Valley, and the Calexico Valley in Mexico. From Imperial County and Mexico, flows in the New and Alamo rivers consists of agricultural drain flows and urban wastewater flows from Mexico. The water quality concerns stem from the presence of untreated and partially-treated urban wastewater flows from the Mexicali Valley and the presence of pesticides, nutrients, selenium, and silt from the agricultural operations. From the north, the Whitewater River provides agricultural tailwater and tile drainage flows and urban runoff.

Salt Creek, which drains portions of the Orocopia and Chuckwalla mountains to the east of the sea, and Whitewater River provide some freshwater inflows to the Salton Sea.

San Felipe Creek, Fish Creek, Vallecito Creek, and Carrizo Creek Watersheds

Watersheds associated with San Felipe, Fish, Vallecito, and Carrizo creeks are within and outside of the Anza-Borrego Desert State Park in eastern San Diego County with portions extending into Imperial County and north into Riverside County. These areas provide natural habitat for migratory birds and other wildlife, including 12 State- or federal-listed rare, threatened, or endangered species. Including land within the State park, the combined watersheds cover over 700,000 acres.

The riparian areas have been identified as key habitat for the birds and other wildlife. These include the natural groves of the California Fan Palms, mesquite woodland, and wet meadows or marshes. Management efforts are under way to preserve and improve the critical habitat areas, which include removal of invasive plant species (i.e. salt cedar) to allow the native plants and animals to redevelop.

In January 2013, the USFWS issued Rule No. FWS-R2-ES-2011-0053 that established the criteria for identifying and maintaining habitat for the Southwestern Willow Flycatcher, which is on the federal ESA list. Critical habitat for the Flycatcher was identified on segments of San Felipe Creek, a portion of which is located on land of the Iipay Nation of the Santa Ysabel Tribe. The USFWS is working with the tribe on maintenance operations for the habitat.

Other Watersheds

Colorado River, Twentynine Palms-Lanfair, and Chuckwalla PAs all have recognized watersheds. For the Colorado River PA, watersheds include Havasu-Mojave Lakes, Piute Wash, Imperial Reservoir, and the Lower Colorado River; these watersheds extend eastward into Nevada and Arizona. Scattered urban land uses exist in each watershed. Agricultural uses are prominent in the Imperial Reservoir and Lower Colorado River areas. Minor water quality concerns persist in the Havasu-Mohave Lakes and Piute Wash areas.

Southern Mojave watershed is in both the Twentynine Palms-Lanfair and Chuckwalla PAs. Portions of the San Bernardino and San Jacinto mountains and several smaller mountain ranges provide most of the boundaries for this watershed. Much of the watershed is devoid of urban and agricultural land uses. The exceptions are Lucerne Valley, which has urban areas and agriculture, and Yucca Valley, which has only urban areas.

Groundwater Aquifers

Groundwater resources in the Colorado River Hydrologic Region are supplied by both alluvial and fractured rock aquifers. Alluvial aquifers are composed of sand and gravel or finer grained sediments, with groundwater stored within the voids, or pore space, between the alluvial sediments. Fractured-rock aquifers consist of impermeable granitic, metamorphic, volcanic, and hard sedimentary rocks, with groundwater being stored within cracks, fractures, or other void spaces. The distribution and extent of alluvial and fractured-rock aquifers and water wells vary within the Region. Many groundwater basins are bounded by faults that act as groundwater barriers. A brief description of the aquifers for the Region is provided below.

Alluvial Aquifers

The Colorado River Hydrologic Region contains 64 DWR Bulletin 118-2003 recognized alluvial groundwater basins and subbasins which underlie approximately 13,100 square miles, or 66 percent of the hydrologic region. The majority of the groundwater in the Region is stored in alluvial aquifers. Figure CR-2 shows the location of the alluvial groundwater basins and subbasins and Table CR-1 lists the associated names and numbers. The most heavily used groundwater basins in the region include Borrego Valley, Warren Valley, Lucerne Valley, and Coachella Valley.

PLACEHOLDER Figure CR-2 Alluvial Groundwater Basins and Subbasins within the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-1 Alluvial Groundwater Basins and Subbasins within the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

The Borrego Valley Groundwater Basin includes three aquifers, an upper unconfined aquifer of alluvium, a middle aquifer of alluvium, and a lower aquifer of more consolidated deposits.

The Warren Valley Groundwater Basin's primary groundwater-bearing strata are the recent and older alluvial deposits composed of unconsolidated gravels, sands, and finer sediments derived from igneous and metamorphic rocks of the adjacent highlands. The unconsolidated alluvial deposit varies in thickness from 90 feet to greater than 800 feet, while the maximum thickness of alluvial deposits is approximately 3,100 feet (Kennedy Jenks, 1991).

The Lucerne Valley Groundwater Basin's principal aquifer is composed of unconsolidated to semi-consolidated alluvium and dune sand deposits. The deposits include gravel, sand, and minor amounts of silt, clay, and occasional boulders. The alluvial thickness averages approximately 600 feet and has a maximum thickness of 1,800 feet. Numerous faults which affect groundwater flow include the Helendale, Lucerne Lake, Lenwood, Camp Rock, Old Woman Springs, and the North Frontal thrust system.

The Coachella Valley Groundwater Basin is composed of four subbasins - Indio (also known as Whitewater), Mission Creek, Desert Hot Springs, and San Gorgonio Pass. The primary alluvial aquifer in the northwestern portion of the basin is unconfined and about 2,000 feet in thickness. Three aquifers exist within the central and southern portions of the basin - a semi-perched aquifer up to 100 feet in thickness is found at or near the surface; below the semi-perched aquifer is the upper aquifer, which is 100 to 300 feet in thickness; and the lower aquifer is semi-confined to confined and is the most important groundwater source in the central and southern portions of the valley (CVWD, 2002). The upper and lower aquifers are separated by a zone of clay that is 100 to 200 feet thick.

Fractured-Rock Aquifers

Groundwater extracted by wells located outside of the alluvial basins shown in Figure CR GW 1 is supplied largely from fractured rock aquifers. Although fractured-rock aquifers are less productive (10 gallons per minute or less) compared to the alluvial aquifers in the Region, they commonly serve as the sole source of water and a critically important water supply for many communities.

More detailed information regarding the aquifers is available online from Water Plan Update 2013 Vol. 4 Reference Guide – California's Groundwater Update 2013, or DWR Bulletin 118-2003.

Well Infrastructure and Distribution

Well logs submitted to DWR for water supply wells completed during 1977 through 2010 were used to evaluate the distribution of water wells and the uses of groundwater in the Colorado River Hydrologic Region. The number and distribution of wells in the Region are grouped according to their location by county, and according to six most common well use types: domestic, irrigation, public supply, industrial, monitoring, and other. Public supply wells include all wells identified in the well completion report as municipal or public. Wells identified as "other" include a combination of the less common well types, such as stock wells, test wells, or unidentified wells (no information listed on the well log).

Two counties were included in the analysis of well infrastructure for the Colorado River Hydrologic Region. Imperial County is fully contained within the Colorado River Hydrologic Region, while Riverside County is partially within the South Coast Hydrologic Region. Well log information listed in Table CR-2 and illustrated in Figure CR-3 show that the distribution and number of wells vary widely by county and by use. The total number of wells installed in the Region between 1977 and 2010 is approximately 13,200 and almost entirely in Riverside County. The low well count in Imperial County is due to the fact that its water use is mostly met by water from the Colorado River via the All-American Canal.

PLACEHOLDER Table CR-2 Number of Well Logs by County and use for Colorado River Hydrologic Region (1977-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Figure CR-3 Number of Well Logs by County and Use for the Colorado River

Hydrologic Region (1977-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Figure CR-4 shows that domestic wells make up the majority of well logs (61 percent) for the Region, the second most being monitoring wells, which account for about 17 percent of well logs. Communities with a high percentage of monitoring wells compared to other well types may indicate the presence of groundwater quality monitoring to help characterize groundwater quality issues. Although there is a large agricultural presence in portions of the Region, irrigation wells only make up about 11 percent of well logs.

PLACEHOLDER Figure CR-4 Percentage of Well Logs by Use for the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Figure CR-5 shows a cyclic pattern of well installation for the Region, with new well construction ranging from about 200 to 700 wells per year. The large fluctuation of domestic well drilling is likely associated with population booms and residential housing construction. Between 1980 and 1990, Riverside County experienced about 75 percent increase in the number of residents and was the fastest-growing county in California. An economic downturn in the early 1990s resulted in a decline in the population growth and associated new well installation. Beginning in 2000, the rise in the number of domestic wells installed is likely attributed to the resurgence in residential housing construction. Similarly, the 2007 to 2010 decline in domestic well drilling is likely due to declining economic conditions and related drop in housing construction.

PLACEHOLDER Figure CR-5 Number of Well Logs Filed per Year by Use for the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

The onset of monitoring well installation in the mid- to late-1980s is likely associated with Federal underground storage tank programs signed into law in the mid-1980s.

As Figure CR-5 shows, irrigation well installation is more closely related to climate conditions, cropping trends and surface water supply cutbacks. Most of the irrigation wells in the Region are associated with Riverside County agricultural and golf course use.

More detailed information regarding assumptions and methods of reporting well log information is available online from Water Plan Update 2013 Vol. 4 Reference Guide – California’s Groundwater Update 2013.

California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization

The Legislature in 2009, as part of a larger package of water-related bills, passed Senate Bill 7x 6 (SBx7 6; Part 2.11 to Division 6 of the California Water Code § 10920 et seq.), requiring that groundwater elevation data be collected in a systematic manner on a Statewide basis and be made readily and widely available to the public. DWR was charged with administering the program, which was later named the "California Statewide Groundwater Elevation Monitoring" or "CASGEM" Program. The new legislation requires DWR to identify the current extent of groundwater elevation monitoring within each of the alluvial groundwater basins defined under Bulletin 118-03. The legislation also requires DWR to prioritize groundwater basins to help identify, evaluate, and determine the need for additional groundwater level monitoring by considering available data. Box CR-1 provides a summary of these data considerations and resulting possible prioritization category of basins. More detailed information on groundwater basin prioritization is available online from Water Plan Update 2013 Vol. 4 Reference Guide – California's Groundwater Update 2013.

PLACEHOLDER Box CR-1 California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization Data Considerations

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Figure CR-6 shows the groundwater basin prioritization for the Colorado River Hydrologic Region. Of the 64 basins within the Region, two basins were identified as high priority (Indio and San Gorgonio Pass subbasins of Coachella Groundwater Basin), four basins as medium priority, nine as low priority, and the remaining 49 basins as very low priority. Table CR-3 lists the high and medium CASGEM priority groundwater basins for the Region. The six high and medium priority basins account for about 65 percent of the population and about 78 percent of groundwater use for the region. The basin prioritization could be a valuable tool to help evaluate, focus, and align limited resources for effective groundwater management, and reliability and sustainability of groundwater resources.

PLACEHOLDER Figure CR-6 CASGEM Prioritization for Groundwater Basins in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-3 CASGEM Prioritization for Groundwater Basins in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Colorado River Hydrologic Region Groundwater Monitoring Efforts

Groundwater resource monitoring and evaluation is a key aspect to understanding groundwater conditions, identifying effective resource management strategies, and implementing sustainable resource management practices. California Water Code (§10753.7) requires local agencies seeking state funds administered by DWR to prepare and implement groundwater management plans that include monitoring of groundwater levels, groundwater quality degradation, inelastic land subsidence, and changes in surface water flow and quality that directly affect groundwater levels or quality. This section summarizes some of the groundwater level, groundwater quality, and land subsidence monitoring efforts within the Colorado River Hydrologic Region. Groundwater level monitoring well information includes only active monitoring wells – those wells that have been measured since January 1, 2010. Additional information regarding the methods, assumptions, and data availability associated with the groundwater monitoring is available online from Water Plan Update 2013 Vol. 4 Reference Guide – California's Groundwater Update 2013.

Groundwater Level Monitoring

A list of the number of monitoring wells in the Colorado River Hydrologic Region by monitoring agencies, cooperators, and CASGEM monitoring entities is provided in Table CR-4. The locations of these monitoring wells by monitoring entity and monitoring well type are shown in Figure CR-7. Table CR-4 shows that a total of 512 wells in the Region have been actively monitored for groundwater levels since 2010. The groundwater level monitoring wells are categorized by the type of well use and include domestic, irrigation, observation, public supply, and other. Groundwater level monitoring wells identified as "other" include a combination of the less common well types, such as stock wells, test wells, industrial wells, or unidentified wells (no information listed on the well log). Wells listed as "observation" also include those wells described by drillers in the well logs as "monitoring" wells. Domestic wells are typically relatively shallow and are in the upper portion of the aquifer system, while irrigation wells tend to be deeper and are in the middle-to-deeper portion of the aquifer system. Some observation wells are constructed as a nested or clustered set of dedicated monitoring wells, designed to characterize groundwater conditions at specific and discrete production intervals throughout the aquifer system. Figure CR-8 shows that wells identified as other account for more than 78 percent of the monitoring wells in the Region, and that only two domestic wells are used for monitoring.

PLACEHOLDER Table CR-4 Groundwater Level Monitoring Wells by Monitoring Entity in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Figure CR-7 Monitoring Well Location by Agency, DWR Cooperator, and CASGEM Monitoring Entity in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Figure CR-8 Percentage of Monitoring Wells by Use in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Groundwater Quality Monitoring

Groundwater quality monitoring is an important aspect to effective groundwater basin management and is one of the components that are required to be included in groundwater management planning in order for local agencies to be eligible for state funds. Numerous state, federal, and local agencies participate in groundwater quality monitoring efforts throughout California. A number of the existing groundwater quality monitoring efforts were initiated as part of the Groundwater Quality Monitoring Act of 2001, which implemented goals to improve and increase the statewide availability of groundwater quality data. A summary of the larger groundwater quality monitoring efforts and references for additional information are provided below.

Regional and statewide groundwater quality monitoring information and data are available on the State Water Resources Control Boards (SWRCB) Groundwater Ambient Monitoring and Assessment (GAMA) website and the GeoTracker GAMA groundwater information system developed as part of the Groundwater Quality Monitoring Act of 2001. The GAMA website describes GAMA program and provides links to all published GAMA and related reports. The GeoTracker GAMA groundwater information system geographically displays information and includes analytical tools and reporting features to assess groundwater quality. This system currently includes groundwater data from the SWRCB, Regional Water Quality Control Boards (RWQCBs), California Department of Public Health (CDPH), Department of Pesticide Regulation (DPR), DWR, USGS and Lawrence Livermore National Laboratory (LLNL). In addition to groundwater quality data, GeoTracker GAMA has more than 2.5 million depth to groundwater measurements from the Water Boards and DWR, and also has oil and gas hydraulically fractured well information from the California Division of Oil, Gas, and Geothermal Resources.

Table CR-5 provides agency-specific groundwater quality information. Additional information regarding assessment and reporting of groundwater quality information is furnished later in this report.

PLACEHOLDER Table CR-5 Sources of Groundwater Quality Information

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Land Subsidence Monitoring

Land subsidence has been shown to occur in areas experiencing significant declines in groundwater levels. The USGS and the Mojave Water Agency worked cooperatively to monitor and investigate the occurrence of land subsidence in the Mojave Water Agency portion of the Colorado River Hydrologic Region. Additional land subsidence monitoring and reporting using a GPS monitoring network and InSAR data have been conducted in Coachella Valley portion of the Region by Ikehara in 1997, and by Sneed and Brandt in 2007. Results associated with these monitoring efforts are provided at a later section. Additional information regarding land subsidence in California is available online from Water Plan Update 2013 Vol. 4 Reference Guide – California's Groundwater Update 2013.

Groundwater Occurrence and Movement

Aquifer conditions and groundwater levels change in response to varying supply, demand, and climate conditions. During dry years or periods of increased groundwater use, seasonal groundwater levels tend to fluctuate more widely and, depending on annual recharge conditions, may result in a long-term decline in groundwater levels, both locally and regionally. Depending on the amount, timing, and duration of groundwater level decline, nearby well owners may need to deepen wells or lower pumps to regain access to groundwater.

Lowering of groundwater levels can also impact the surface water–groundwater interaction by inducing additional infiltration and recharge from surface water systems, by reducing the groundwater discharge to surface water base flow and wetlands areas. Extensive lowering of groundwater levels can also result in land subsidence due to the dewatering, compaction, and loss of storage within finer grained aquifer systems.

During years of normal or above normal precipitation, or during periods of low groundwater use, aquifer systems tend to recharge and respond with rising groundwater levels. As groundwater levels rise, they reconnect to surface water systems, contributing to surface water base flow or wetlands, seeps, and springs.

The movement of groundwater is from areas of higher hydraulic potential to areas of lower hydraulic potential, typically from higher elevations to lower elevations. The direction of groundwater movement can also be influenced by groundwater extractions. Where groundwater extractions are significant, groundwater may flow towards the extraction point. Rocks with low permeability can restrict groundwater flow through a basin. For example, a fault may contain low permeability materials and restrict groundwater flow.

Depth to Groundwater

The depth to groundwater has a direct bearing on the costs associated with well installation and groundwater extraction operations. Understanding the local depth to groundwater can also provide a better understanding of the local interaction between the groundwater table and the surface water systems, and the contribution of groundwater aquifers to the local ecosystem. Resource and time constraints compounded with a lack of availability of comprehensive dataset in DWR's Water Data Library, depth-to-groundwater contours for the Colorado River Hydrologic Region could not be developed as part of the groundwater content enhancement for the CWP Update 2013. Depth-to-groundwater measurements for the Borrego Valley portion of the Region are available online via DWR's Water Data Library, DWR's CASGEM system, and the USGS National Water Information System. Coachella Valley groundwater level data may be obtained from the Final Program Environmental Impact Report for the Coachella Valley Water Management Plan (2002), the Coachella Valley Water District Engineer's 2010-2011 Report, and the Coachella Valley Water Management Plan 2010 Update. Lucerne Valley groundwater level information is included in the change in storage thesis conducted by Napoli (2004).

Groundwater Elevations

Groundwater elevation contours can help estimate the direction of groundwater movement and the gradient, or rate, of groundwater flow. Resource and time constraints compounded with a lack of availability of comprehensive dataset in DWR's Water Data Library, groundwater elevation contours for the Colorado River Hydrologic Region could not be developed as part of the groundwater content enhancement for the CWP Update 2013. Several local agencies independently or cooperatively monitor the groundwater levels in the basins they operate and produce groundwater elevation maps. In addition to the references and online links provided above, groundwater elevation maps for the Borrego Valley are available from the USGS (Moyle, 1982), DWR Southern Region Office, the Borrego Water District Integrated Water Resource Management Plan (2009), and the 2011 San Diego County General Plan update, Appendix A.

Ecosystems

Salton Sea

Serving as wintering habitat for migratory and shoreline birds, ranging in number from hundreds of thousands to the low one million, are the Sony Bono Salton Sea National Wildlife Refuge and the Wister Unit of the Imperial Wildlife Area. The SBSSNWR, established on the southern shores of the Salton Sea in 1930, consists of 830 acres of land maintained as wetlands with an additional 870 acres planted to forage crops such as alfalfa, wheat, rye grass, and Sudan grass. The habitat was created for the endangered Yuma Clapper Rail and American Avocet. The WUIWA, located on the southeastern shore, occupies a little more than 7,900 acres of land. It includes salt marshes, freshwater ponds, and native, undeveloped lands.

The California Legislature enacted legislation in 2003 as part of the QSA/Transfer Agreements that directed the California Resources Agency (now the Natural Resources Agency) to prepare a restoration study and a programmatic environmental document to explore ways to restore important ecological functions of the Salton Sea (Sea) and to develop a preferred restoration alternative. The Salton Sea Ecosystem Restoration Program Programmatic Environmental Impact Report (PEIR) was completed in 2007. The Secretary of the Resources Agency, based on the information contained in the PEIR, recommended to the Legislature a preferred alternative for ecosystem restoration with an estimated cost of over $9 billion and the creation of a Salton Sea Restoration Council. To date, the Legislature has not provided funding to implement the preferred alternative. In 2010, the Legislature enacted Senate Bill 51 which established the Salton Sea Restoration Council as a state entity under the Natural Resources Agency to oversee the restoration of the Salton Sea (Ducheny). However, the Legislature has not yet appropriated funds for the Council and is debating eliminating the Council altogether.

This mitigation water is the subject of a new petition filed jointly by Imperial and San Diego. The petition asks the State Board to eliminate the requirement for mitigation water from the year 2014 to 2017, unless the Legislature by 2014 adopts a comprehensive and fully-funded plan to restore the Salton Sea. Instead of providing mitigation water, Imperial and San Diego would rather implement what they call "accelerated alternative mitigation," which aims to improve habitat even as it would reduce inflow to the Salton Sea. This would free up additional water to be transferred. The petition also asks the State Board to approve a schedule allowing transfer of that water currently reserved for the Salton Sea between 2014 and 2017.

Mojave Desert Natural Reserve

The southeastern portion of the Mojave Natural Preserve is located in the Twentynine Palms-Lanfair PA. Despite arid conditions, a diverse collection of animals and plants have been able to settle and continue to flourish in the preserve. Natural seeps and springs are sufficient to support native vegetation, including yucca, creosote bush, cactus, relict white firs and chaparral, and the Joshua tree. The vegetation provides habitat to numerous animals and birds, including bighorn sheep, desert tortoises, hawks, and eagles.

Flood

Flooding is a significant issue in the Colorado River Hydrologic Region, and exposure to a 500-year flood event would threaten 38 percent of the population, more than $20 billion dollars of assets (crops, buildings, and public infrastructure), and over 180 sensitive species. Even with this level of exposure, public awareness about flooding is inadequate because most events occur as a result of infrequent, high-intensity, summer storms.As a result of the terrain of this area, alluvial fan formations are common. An alluvial fan flooding can occur when a high intensity rainfall event washes sediment from sparsely vegetated steep slopes from mountains or valleys. The reminder of the hydrologic region is part of the Sonoran Desert, is less mountainous, and is dominated by the Salton Sea and the Imperial, Coachella, and Palo Verde valleys.

Major rivers in the hydrologic region are the Colorado, Alamo, New, and Whitewater. Most other rivers, streams, and washes, such Piute Wash and San Felipe Creek, are intermittent or normally dry. All other streams in the hydrologic region having significance to flood management terminate in the Salton Sea except Quail Wash, which ends at Coyote Lake.

In the Colorado River Hydrologic Region twenty-four local flood management projects or planned improvements are identified in the Colorado River Hydrologic Region. Twenty-one projects have costs totaling $70 million while the remaining projects do not have costs associated with them at this time. There is one local planned project that implements an Integrated Water Management (IWM) approach to flood management, the Cushenbury Flood Detention Basin and the San Jacinto River Gap Project. For a complete list of projects, refer to California's Flood Future Report Attachment G: Risk Information Inventory Technical Memorandum.

Floods can be caused heavy by rainfall; by dams, levees, or other engineered structures failing; or by extreme wet-weather patterns. Flooding from snowmelt typically occurs in the spring and has a lengthy runoff period. Flooding from rainfall occurs in the winter and early spring, particularly when storms arriving from the Gulf of Alaska draw moisture-laden air from the tropics.

Historic Floods

Damaging floods occurred in the region in 1916 when high water in the Colorado River caused flooding at Brawley, which was repeated in 1921. In 1927, flood-stage flows in the Whitewater River washed out roads and bridges in Thousand Palms and Palm Desert. The U.S. Geological Survey estimated that the Whitewater River at White Water exceeded the 100-year flood stage in March 1938 when it isolated Palm Springs and caused several deaths.

In November of 1965 floods along the Whitewater River washed out 22 county roads. There were scour and damage to 13 miles of channel between Cathedral City and the Salton Sea. Two thousand acres of agricultural lands were flooded with erosion or silting. Citrus and date groves suffered heavy damages. Whitewater River flooding caused three fatalities and $3 million in damages. Flooding of Tahquitz Creek washed out many roads and damaged bridge abutments on State Highway 111. Floodwaters swept 50 cars into streams and drainage channels of Tahquitz Creek and Whitewater River. Flooding of Big and Little Morongo Washes eroded roads at dip crossings, damaged homes, and swept away several cars.

In January and February of 1969 a flow of wet, tropical air from Hawaii to Southern California in January caused intense rainfall and consequent flooding in the Whitewater River basin, culminating in severe damage to roads and property in the Palm Springs area. In February, a flood struck Riverside County causing widespread inundation. Severe residential and highway damages occurred along the Whitewater River and the San Gorgonio River at Cabazon. Much agricultural damage was caused by flooding of the Whitewater River.

In September 1976, Tropical Storm Kathleen brought heavy rains of about 10 inches to some desert areas. San Felipe Creek overflowed and damaged 390 acres of agricultural land, irrigation works, and roads. Carrizo Wash washed out roads and rail lines. Ocotillo was flooded by Myer Creek, which left behind 1 to 3 feet of silt and mud damaging many homes and other structures. Three fatalities occurred in the Ocotillo area. Two people died on Interstate 8 when it washed out. Major flood damages occurred to Interstate 8, State Highway 98, and the San Diego and Arizona Eastern Railroad lines.

For a complete record of floods, refer California Flood Future Report Attachment C: Flood History of California Technical Memorandum.

Climate

Most of the Colorado River Region has a subtropical desert climate with hot summers and short, mild winters. The mountain ranges on the northern and western borders, in particular the San Bernardino and San Jacinto mountains, create a rain shadow effect for most of the region. Annual average rainfall amounts range from a little over 6 inches to less than 3 inches. Most of the precipitation for the region occurs in the winter and spring. However, monsoonal thunderstorms, spawned by the movement of subtropical air from the south, do occur in the summer and can generate significant rainfall in some years. Higher annual rainfall amounts and milder summer temperatures occur in the mountains to the north and west. Clear and sunny conditions typically prevail, and the region receives 85 to 90 percent of the maximum possible sunshine each year; the highest value in the United States.

Table CR-6 presents annual averages of maximum and minimum temperatures and annual totals of precipitation as measured by 5 weather stations of the California Irrigation Management Information System (CIMIS) and historical information from the Western Regional Climate Center for 2005 through 2010 in the Colorado River region. Maximum and minimum temperatures and reference evapotranspiration values remained very stable during the period. Measured rainfall during 2006 through 2010 reflected the dry hydrologic conditions in the region and roughly corresponds with the conditions that were occurring statewide. Precipitation amounts rebounded in 2010. A little over 6 inches of rain was measured at the IID headquarters in Imperial in 2010. During the period, the region was not impacted by the normal frequency of summer monsoonal thunderstorms; it was unusually quiet. The lack of rainfall does not directly impact planting decisions by farmers in the region; however, drought on the Colorado River Upper Basin watershed will have future impacts and PVID fallowing programs may grow in response to added water requirements in the South Coast should other supplies decrease.

PLACEHOLDER Table CR-6 Colorado River Hydrologic Region Annual Averages of Temperatures and Precipitation

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Being dependent on the Colorado River for preponderance, if not all, of its water resource, the Colorado Region is directly impacted by the hydrology of the Colorado River Upper Basin, which experienced a protracted multi-year drought which began in October 1999, ended in 2011 and resumed in 2012. In the summer of 1999, Lake Powell was essentially full with reservoir storage at 97 percent of capacity. However, it became evident with precipitation totals at only 30 percent of average for October, November, and December that the stage was set for the low runoff that occurred in 2000 and has continued with the exception of 2010 through the end of 2012 and into 2013.

In the late 1990s, Lake Powell inflow was above average and the lake stayed full from 1995 through 1999. As late as September 1999, Lake Powell remained 95 percent full. However, Lake Powell inflow from 2000 through 2004 was about half of what is considered average. The 2002 inflow was the lowest recorded since Lake Powell began filling in 1963. By August 2011, unregulated inflow volume to Lake Powell increased to 120 percent of average; however, in 2012 the basin returned to drought conditions.

Table CR-7 presents unregulated inflow into Lake Powell as a percent of historic average inflow, showing the potential impact of the Colorado River Upper Basin drought and climate change on California's

Colorado River Hydrologic Region. Flows into Lake Mead mimic those of Lake Powell, and USBR on January 1, 2013, declared Lake Mead to be in a shortage condition under the terms of the 2007 Colorado River Interim Guidelines for Lower Basin Shortages (2007 Interim Guidelines).

PLACEHOLDER Table CR-7 Unregulated Inflow to Lake Powell

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Demographics

Population

Colorado River Hydrologic Region population in 2010 was 747,100. This is a 23 percent increase in population from 2000, but only a 5 percent increase from 2005. Slower growth in the last 5 years is a reflection of the serious impacts of the recession that started in September 2008. In 2010, about 83 percent of the population in the region was located in the Coachella Valley PA (459,200 or 61 percent) and Imperial Valley PA (165,600 or 22 percent). Of the remaining 122,300 residents, the Twentynine Palms-Lanfair PA had 73,100.

In the Coachella Valley, many of the residents reside in golf- and resort- cities in the northwest portion of the valley. These include Cathedral City (2010 population - 51,200), Palm Desert (2010 population - 48,400), Palm Springs (2010 population - 44,600), Coachella (2010 population - 40,700), Banning (2010 population - 29,600), and Desert Hot Springs (2010 population - 25,900). In the southeast, the cities provide more service support for the surrounding agricultural operations; included are Indio (2010 population - 76,000) and Coachella (2010 population - 40,700).

In the Imperial Valley, cities and towns provide support for the major agricultural and some energy, State prison, and Homeland Security operations throughout the area. Consumer services are also provided for residents and businesses located in the Mexicali Valley across the international border. Important cities include El Centro (2010 population - 42,600), Calexico (2010 population – 38,600), Brawley (2010 population – 24,950), and Imperial (2010 population – 14,800); and across the border in Mexico, the municipality of Mexicali (2012 population – 936,800). The community of Ocotillo (population 266) obtains water from the Ocotillo-Coyote Wells Groundwater Basin, a USEPA-designated sole-source aquifer and further development in that area is therefore not likely.

In Homestead and Coyote valleys in the Twentynine Palms-Lanfair PA, growing cities include Yucca Valley (2010 population – 20,700) and Twenty-nine Palms (2010 population – 25,068).

In the Colorado River PA, the City of Blythe (2010 population - 20,800) provides support for agricultural operations in the Palo Verde Valley. To the north is the City of Needles (2010 population – 4,800) in the Mohave Valley. Although there are no incorporated cities, the community of Winterhaven and widely-dispersed residents in the Bard Valley, and west of Yuma, Arizona, represent about 3,200 permanent residents.

Tribal Communities

Native American Tribes with territory in the Colorado River region include the Agua Caliente Band of Cahuilla Indians, Augustine Band of Mission Indians (Cahuilla), Cabazon Band of Mission Indians, Chemehuevi Tribal Council, Fort Mohave Tribe, Morongo Band of Mission Indians, Torres-Martinez Band of Desert Cahuilla Indians, and the Twenty-Nine Palms Band of Mission Indians. In the Coachella Valley, Tribal land alternates with those that are publicly and privately owned. One-mile square Tribal parcels alternate with one-mile square municipal parcels.

A Native American tribe may be federally recognized, and the federal government may set aside lands for Tribes as reservations. In California these reservations are often named "Rancherias." One interpretation of the Spanish term Rancheria is small Indian settlement. Granted tribal lands are listed in Table CR-8.

PLACEHOLDER Table CR-8 [Title to come]

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Disadvantaged Communities

Imperial Valley Region

An evaluation of 2010 Census data determined the disadvantaged communities (DAC) within the Region. The state defines a DAC by using the median household income (MHI). A community is disadvantaged if MHI is less than 80 percent of the statewide median household income. A severely disadvantaged community (SDAC) is a community with a median household income less than 60 percent of the statewide median. According to the 2010 Census data, the California statewide MHI was $60,883. Thus, county subdivisions, census designated places, and cities with an MHI of $48,706 or less were DACs. Those county subdivisions, census designated places, and cities with an MHI of $36,530 or less were considered SDACs. The MHI in the Imperial Region was $36,202 based on U.S. Census Bureau Estimates for 2010.

The City of Imperial does not meet the definition of a DAC. All other communities have MHIs below the threshold of 80 percent of the statewide MHI ($48,706). Of the 19 locations in the Region, 18 meet the definition of a DAC. Of those 18 DACs, 10 meet the definition of a SDAC.

To comply with US Environmental Protection Agency (EPA) requirements and avoid termination of canal water service, residents in the IID service area who do not receive treated water service must obtain alternative water service for drinking and cooking from a state-approved provider. To avoid penalties that could exceed $25,000 a day, IID strictly enforces this rule.

Other than folks in Ocotillo, who access a sole source aquifer, virtually no one in the Imperial Region has wells for domestic use. That is because of the high salinity of the groundwater. There are a few wells in the East Mesa that serve as sources for irrigation water.

Coachella Valley Region

In the Coachella Valley Region, the DAC issues are water, sewer and storm water related. Many rural mobile home communities that house the Coachella Valley's significant farm and service industry labor do not have access to public water and sewer infrastructure. The cost to extend public infrastructure to these communities is estimated to be above the $20 million range and funding of that magnitude is unavailable. The private sewer infrastructure serving these communities is often undersized or otherwise failing. The private wells serving these communities often lack treatment infrastructure needed for removal of naturally occurring contaminants like arsenic. Identifying the locations and magnitude of these communities is also challenging due to language barriers, fear of government, and access to private land. Regional Flood Control facilities are not in place because the cost to build them exceeds the monetary value of the community infrastructure needing protection. The Coachella Valley Region Water Management Group (CVRWMG) is working to identify and implement lower-cost, near-term solutions that may be implemented with available grant funds thus improving these conditions in the interim period until permanent infrastructure can be funded.

Mojave Region

In the Mojave Region, the median household income (MHI) was $50,636 according to 2010 Census data, however many areas within the Region are disadvantaged. In the Colorado River Hydrologic Region portion of the Mojave Region, the MHI was $42,604 and in the Lahontan Hydrologic Region portion of the Mojave Region, the MHI was $52,021. Most of the rural, outlying areas in the Region were DACs, while some of the more developed, urban areas were not. Four of the six incorporated cities in the Region were DACs, while the City of Victorville and Town of Apple Valley were not.

Many of the small water systems serving rural disadvantage communities need improvements to increase their reliability, including ongoing maintenance and system deterioration problems, leak repairs, water storage reservoirs or other infrastructure to meet fire flow and outage needs, and other issues. Most of these systems do not have the staffing levels or expertise to pursue outside funding for projects that would address these problems. The Region is developing a program that would help connect these systems with available state or federal funding.

Other Communities

The City of Blythe, by state standards, is a Disadvantaged Community (DAC). Per the 2010 Census, the median household income is $46,235 which is less than 75% of the California median household income. Because of the limited household income, rates, fees, and assessments are extremely difficult to absorb within personal budgets. With this fact, water infrastructure is deteriorating to a point that could adversely affect public health. This social injustice is exacerbated by the transient nature of our population attributed to the state prisons within our community.

Other communities that have DACs include: Borrego Springs, Salton City, Bombay Beach, Palo Verde, Blythe and Winterhaven.

Land Use Patterns

Despite the extremely arid conditions, three of southern California's major agricultural areas are located in the Colorado River region. These are Imperial Valley (Imperial PA), Coachella Valley (Coachella PA), and the Palo Verde and Bard Valleys (Colorado River PA). The mild winters allow for an all-year regimen, and reliable water and good soils allow a wide range of permanent and annual crops, including table grapes, dates, citrus, vegetables of all kinds, and field crops, including alfalfa, wheat grain, Bermuda and Klien grass, and cotton. Multiple cropping is widely utilized. Even livestock is an important product, particularly cattle and sheep. The region, especially the Imperial Valley, is a valuable component in the nation's agricultural scheme.

Total irrigated land in the Colorado River region was 571,950 acres in 2010 and the total crop production was 645,970 acres. More than 73,000 acres of the land farmed was multiple-cropped. By comparison, 587,000 acres of land were under cultivation in 2005, with 659,320 acres of total product (reductions of

2.5 percent and 2.0 percent, respectively). This change over the last five years is because of the implementation of land-fallowing programs in the Imperial and Palo Verde valleys. The land fallowing program in Imperial Valley helps IID meet water transfer obligations from the federal QSA, while land fallowing in Palo Verde Valley is a result of an agreement between the Metropolitan Water District of Southern California (MWDSC) and the Palo Verde Irrigation District (PVID).

Table CR-9 shows the harvested acres of the top six crops in the Colorado River region in 2010.

PLACEHOLDER Table CR-9 Top Six Crops of Colorado River Hydrologic Region, 2010 (Acres)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

With more than 425,000 acres of farmland in production in 2010, Imperial Valley continued to be the most productive area in the region. It has been nicknamed as the nation's winter vegetable wonderland, producing a variety of vegetables between the fall and spring each year. The crops include winter- and spring- harvested lettuce, broccoli, carrots, cantaloupes, and onions. In 2010, about 93,000 acres of vegetables were harvested in Imperial Valley.

Livestock forage and field crops are also very important in the Imperial Valley. Alfalfa continues to be the crop with the high acreage total for the valley with 138,000 acres in 2010. Other important field and forage crops include wheat and other grains, 55,600 in 2010, Bermuda, klein, and other pasture grasses, 70,000 in 2010, Sudan grass, 52,800 acres in 2010. Classified as a field crop, valley farmers planted and harvested 26,100 acres of sugar beets for 2010, most of which is processed for sugar at a local refinery. Annual variations in the planted and harvested acreage for the various crops in the valley do occur, depending on anticipated and actual market conditions. Cotton was once very important in Imperial Valley in the 1980s, however, only 9,000 acres was planted in 2005 and less than 3,200 acres in 2010.

About 20 percent of the harvested alfalfa and forage crop acres was consumed locally by the 298,000 head of cattle corralled in the valley's feedlots in 2010. In fact, cattle was the second highest revenue-making agricultural commodity in the valley, with a gross value of $267 million in 2010. That year, head and leaf lettuce grossed a combined $290 million. Other important livestock raised in the valley was sheep, 140,000 head in 2010.

To the north of the Imperial Valley lies another key agricultural operational center, the Coachella Valley (Coachella PA). Agriculture is quite different here. Although Imperial and Coachella valleys are quite similar, climate-wise, less land is farmed in Coachella Valley. This was about 48,000 acres in 2010. The types of crops produced were also different, more permanent crops than row crops. Almost 75 percent of the farmed land is devoted to citrus, dates, and vineyards in 2010. Field and forage crops acres were very small. A variety of vegetables crops were grown, including peppers; but only a relatively small amount of lettuce. Dates are probably the most distinctive Coachella crop, with data palm orchards in operation on 8,100 acres in 2010. Gross revenue that year for date was $36 million. Equally important is the PA's table grape vineyards, especially the Flame seedless variety. In 2010, almost 12,000 acres of grape vineyards were in production which yielded $92 million in gross sales. Harvested citrus fruit netted $87 million in sales.

On the eastern border of the hydrologic region is the third key agricultural center in the region; this is the

Colorado River PA. Agricultural operations occur mostly in the Palo Verde Valley (70,000 acres of irrigated land today in response to the land fallowing agreement between PVID and MWDSC. Over 100,000 acres were farmed before the agreement.). However, operations continue to exist in the Mohave Valley, which is north of the City of Needles (3,700 acres of irrigated land), and in the Bard Valley in the southeast corner of California, west of Yuma, Arizona (16,000 acres of irrigated land). Cropping patterns in each area are different. In the Palo Verde Valley, alfalfa was produced on over 43,000 acres which is more than half of land under cultivation annually. Cotton remains important with more than 9,000 acres planted for 2010. In the Mohave Valley, alfalfa, cotton, and grain crops are the main crops produced and in the Bard Valley, it is winter vegetables, citrus fruit, and dates. In 2010, more than 13,000 acres of vegetable crops were produced on just 16,000 acres of land. The Bard Valley is also known for its date orchards; more than 1,000 acres of date orchards are in production.

Two other smaller agricultural production centers in the region include the approximately 3,100 acres of citrus fruit orchards and nursery-grown palms in Borrego Valley in eastern San Diego County, and the 1,000 acres of citrus and vineyards in Cadiz Valley in east-central San Bernardino County.

Most of the urban land uses for the Colorado River region are in the Coachella, Imperial Valley, and Twenty-nine Palms Lanfair planning areas, with the heaviest concentration in Coachella PA. The uses include single-family and multi-family dwellings, strip malls and shopping centers, and more than 100 public and private country clubs and golf courses. In the Coachella Valley, most of the older uses are located on or near State Highway 111. The newer urban uses have continued to expand from this core to the north and southeast for more than 2 decades in support of recreation and tourism, particularly golf. However, that pace began to slow about 4 years ago in response to the recent recession. In the Imperial Valley and southeastern portion of the Coachella Valley, the commercial and industrial uses in the cities generally support local agricultural operations; packing houses and farm equipment sales and repairs. In addition, the residential and commercial lands in the Imperial Valley have undergone some expansion in support of new homeowners and consumers both locally and from the Mexicali Valley in Mexico.

Naval and military training facilities and other preserved or managed public lands are everywehere in the region. This includes several large national and State parks, recreation and wilderness areas, and wildlife refuges. Indian tribes and associated reservations also maintain a significant presence in the region. Indian-operated casinos and resorts along the Colorado River north of Needles, north of the City of Palm Springs, and near the community of Cabazon west of Palm Springs are a convenient alternative for southern Californians who enjoy the attractions of Las Vegas, NV.

Nationally known parks in the region include Joshua Tree National Park, the Mojave National Scenic Preserve, Anza-Borrego State Park, and the Salton Sea and Picacho State Recreation areas. Other lands are also set aside for preservation or other land management purposes, including national recreation and wilderness areas, wildlife refuges, tribal reservations, and US Navy facilities.

Regional Resource Management Conditions

Water in the Environment

The largest water body in the region is the Salton Sea, a saline body of water with an area of about 525 square miles (15 mi by 35mi) and maximum depth of about 50 feet. In 2010, the concentration of total dissolved solids in the sea was about 53,000 milligrams per liter, which is about 50 percent greater than that of ocean water. Under the terms of the QSA and related agreements, IID continues to operate a fallowing program to meet requirements for Salton Sea mitigation established by the SWRCB as part of its review and approval of the IID/San Diego County Water Authority (SDCWA) Water Transfer. In the remaining years of the mitigation requirement, 2012-2017, IID will deliver 45, 70, 90, 110, 130, 150 TAF (consumptive use volume at Imperial Dam), respectively. From 2003 through 2011, 165,000 AF of mitigation water have been delivered to the Salton Sea under this program.

Other than Salton Sea mitigation water, most of the environmental applied water demand in the region is for the Sonny Bono Salton Sea National Wildlife Refuge, DFW's Imperial Wildlife Area, wetland areas on the shore of the Salton Sea, including the 85-acre Desert Cahuilla Wetland on the northwestern tip of the sea.

The Salton Sea ecosystem remains a critical link on the international Pacific Flyway. It provides wintering habitat for migratory birds, including some species whose diets are based exclusively on fish. For the California Water Plan Update 2009, the expected average annual inflows to the Salton Sea for a 25-year time frame were about 962,000 acre-feet per year, based on estimates using the Salton Sea Accounting Model (SSAM).

Imperial Irrigation District delivers water to the Sonny Bono Salton Sea National Wildlife Refuge Complex, the Imperial Wildlife Area, Wister Unit (no water is delivered to the Finney-Ramer Unit), IID's managed marsh and some private wetlands in the Imperial Valley PA. For 2009, about 30.3 TAF was delivered to these areas.

Water Supplies

Surface Water Supply

Urban, agricultural, environmental, and energy water demands in the Colorado River Hydrologic Region are met with surface water supplies from the Colorado River, groundwater, and recycled water. Water supplies from the Colorado River meet all or portions of the agricultural and urban water demands in the Imperial, Palo Verde, Coachella, and Bard valleys. The Palo Verde Irrigation District operates facilities which divert water supplies from the Colorado River for its agricultural customers. For the Bard Valley, Colorado River water supplies are diverted to the area through the Yuma Project facilities, which are operated by the USBR. Colorado River water supplies are transported to the Imperial Irrigation District through the All-American Canal for its agricultural customers and for the urban customers of the public and investor-owned water agencies in the valley. The recently concrete-lined Coachella Canal transports river water, taken at Drop 1 along the All-American Canal, into the Coachella Valley for agricultural and some urban uses. The Colorado River is an interstate and international river with use apportioned among the seven Colorado River Basin states and Mexico by a complex body of statutes, decrees, and court decisions known collectively as the "Law of the River" (see Table CR-19 Key elements of the Law of the River and Table CR-20 Annual intrastate apportionment of water from the Colorado River mainstream within California under the Seven Party Agreement).

Total water supplies required to meet the demands in the Region between 2006 and 2009 ranged from 4064 TAF to 4,533 TAF. Over 80 percent of the totals for each year were met by Colorado River supplies (see Figure CR-9 Colorado River Hydrologic Region Inflows and Outflows). Groundwater supplies were slightly less than 10 percent of the totals.

PLACEHOLDER Figure CR-9 Colorado River Hydrologic Region Inflows and Outflows in 2010

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

The State Water Project (SWP) and recycled and local surface water supplies provide the remainder of water to the region. SWP supplies are obtained through an exchange agreement between the CVWD, DWA, and MWDSC. No facilities exist today to deliver SWP supplies to the Coachella Valley contractors. However, through the agreement, the MWDSC releases the combined SWP allocations for the CVWD and DWA into the Whitewater River from its Colorado River Aqueduct. These releases recharge the upper groundwater basin of the Coachella Valley and the Slission Creek groundwater basin. In exchange, MWDSC receives the two agencies' annual allocations through SWP facilities. The CVWD treats urban wastewater flows and makes the recycled water supplies available for non-potable uses such as irrigations of golf courses.

The CVWD and DWA continue work with water agencies outside of the region to augment its SWP deliveries and assist with local groundwater management activities. In addition to the advanced delivery of Colorado River water, CVWD, DWA, and MWDSC agreed to the terms of a second agreement, the 2003 Exchange Agreement. MWDSC transferred 100 TAF of its SWP allocation to both agencies; 89 TAF to CVWD and 11 TAF to DWA. In 2007, the agencies agreed to transfer agreements with the Berenda Mesa Water District and the Tulare Lake Water Basin Storage District for the transfer of additional SWP supplies; for 16 TAF and 7 TAF respectively. CVWD has also entered into agreements for the one-time transfer of non-SWP water supplies to its service area with the Rosedale-Rio Bravo Water Storage District, for banked Kern River flood waters and DMB Pacific, Inc. for "nickel" water from the Kern County Water Agency's Kern River Restoration and Water Supply Program.

Groundwater Supply

The amount and timing of groundwater extraction, along with the location and type of its use, are fundamental components for building a groundwater basin budget and identifying effective options for groundwater management. While some types of groundwater extractions are reported for some California basins, the majority of groundwater pumpers are not required to monitor, meter, or publicly record their annual groundwater extraction amounts. Groundwater supply estimates furnished herein are based on water supply and balance information derived from DWR land use surveys, and from groundwater supply information voluntarily provided to DWR by water purveyors or other state agencies.

Groundwater supply is reported by water year (October 1 through September 30) and categorized according to agriculture, urban, and managed wetland uses; the associated information is presented by planning area, county, and by the type of use. Reference to total water supply represents the sum of surface water and groundwater supplies in the Region, and does not take into account local reuse.

Many of the alluvial valleys in the Region are underlain by groundwater aquifers that are the sole source of water for local communities and farming operations. But not all groundwater sources are suitable for potable uses because of water quality issues as discussed later in the Report.

2005 – 2010 Average Annual Groundwater Supply

Table CR-10a provides the 2005 - 2010 average annual groundwater supply by planning area and by type of use, while Figure CR-10 depicts the planning area locations and the associated 2005 - 2010 groundwater supply in the Region.

The estimated average annual 2005-2010 total water supply for the Region is about 4 million acre-feet (MAF). Out of the 4 MAF total supply, groundwater supply is 380 TAF and represents 9 percent of the Region's total water supply; 57 percent (330 TAF) of the overall urban water use and one percent (50 TAF) of the overall agricultural water use being met by groundwater. No groundwater resources are used for managed wetland applications in the Region. Although Statewide, groundwater extraction in the Region accounts for only about two percent of California's 2005 - 2010 average annual groundwater supply, it accounts for 100 percent of the supply for some local communities in the Region and is used to help facilitate local conjunctive water management.

Regional totals for groundwater based on county area will vary from the planning area estimates shown in Table CR-GW 9a because county boundaries do not necessarily align with planning area or hydrologic region boundaries. Imperial County is fully located within the Colorado River Hydrologic Region, while Riverside, San Bernadino, and San Diego counties are partially contained within the Region. Groundwater supply for San Diego County and San Bernadino county are reported for the South Coast Hydrologic Region and South Lahontan Hydrologic Region, respectively. For the Colorado River Hydrologic Region, county groundwater supply is reported for Imperial and Riverside counties (see Table CR-GW 9b). Groundwater contributes 34 percent of the total water supply for Riverside County and a relatively small amount for Imperial County. Groundwater supplies within these counties are used primarily to meet urban use, with 496 TAF (57 percent) of the groundwater is used to meet urban use in Riverside County.

The most important groundwater basin in the Colorado River Hydrologic Region is the Coachella Valley Groundwater Basin in the Coachella Planning Area. As noted previously, this basin has four sub-basins, Indio (also known as Whitewater), Mission Creek, Desert Hot Springs, and San Gorgonio Pass. The largest of the subbasins is Whitewater. Although there is no physical boundary, the Whitewater Basin is divided into two basins, Upper and lower Whitewater River Sub-basin Areas of Benefit. Although the Whitewater basin in not adjudicated, the upper basin is managed by the CVWD and Desert Water Agency (DWA) and the lower basin is managed by CVWD. As shown in Table CR-GW 9a and Figure CR-GW 9, Coachella Planning Area is the largest user of groundwater in the Region with an average annual groundwater supply equal to 315 TAF (83 percent of the total groundwater supply for the Region), with groundwater contributing to 42 percent of the average annual water supply within the planning area.

In the Coachella Valley, public agencies such as CVWD, DWA, and Mission Springs Water District (MSWD) and private parties pump groundwater to meet urban and agricultural water uses. Agreements in place allow local water districts in the Coachella Valley to reduce the decline in groundwater levels resulting from overdraft. The agreement between CVWD and DWA to bring SWP supplies into the valley was an important step. In 1984, another agreement was reached among CVWD, DWA, and MWDSC for water banking which allowed for advanced deliveries of Colorado River water into the Coachella Valley during periods of high flows on the river. These supplies helped speed the pace of groundwater replenishment of the basin and provided water for future uses. However, groundwater levels continue to decline in much of the basin. Under the 1984 agreement, MWDSC was permitted to bank up to 600 thousand acre-feet of surface water in the Coachella Valley Groundwater Basin. When withdrawals were required, MWDSC would use its Colorado River surface water along with SWP allocations from CVWD and DWA, and CVWD and DWA would use the banked groundwater until the volume stored under this agreement was depleted.

Although groundwater supply for Twenty-Nine Palms-Lanfair, Chuckwalla, and Colorado River Planning Areas amounts to 42 TAF (11 percent of the total groundwater supply for the Region), these areas are almost 100 percent reliant on groundwater to meet their agricultural and/or urban water uses.

The Twentynine Palms Groundwater Basin is located on the north-eastern part of the Twenty-Nine Palms-Lanfair Planning Area and it lies beneath the City of Twentynine Palms, the US Marine Corps facility, and Mesquite Lake; groundwater levels in the basin are generally stable. Groundwater also supports the agricultural operation in the Cadiz Valley located in this planning area.

The Warren Valley Groundwater Basin located on the western part of Twenty-Nine Palms-Lanfair Planning Area had seen significant groundwater overdraft and declining groundwater levels. The Mojave Water Agency constructed a 71-mile pipeline from the California Aqueduct near the City of Hesperia to serve the communities of Landers, Yucca Valley, and Joshua Tree. The Hi-Desert Water District has been taking water from the pipeline since 1995 to recharge the previously overdrafted Warren Valley Groundwater Basin. The area had been under court ordered development limitations before the pipeline was completed.

The Borrego Valley Groundwater Basin in San Diego County is the sole source of supply for the local urban and many agricultural water users. Groundwater levels have been falling steadily beginning in the 1940s and the levels have declined more than 100 feet in many parts of the basin since that time.

The groundwater beneath the agricultural area of the Imperial Valley is too saline to be used without treatment.

More detailed information regarding groundwater water supply and use analysis is available online from Water Plan Update 2013 Vol. 4 Reference Guide – California's Groundwater Update 2013.

PLACEHOLDER Table CR-10a Colorado River Hydrologic Region Average Annual Groundwater Supply by Planning Area (PA) and Type of Use (2005-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-10b Colorado River Hydrologic Region Average Annual Groundwater Supply by County and Type of Use (2005-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Figure CR-10 Contribution of Groundwater to the Colorado River Hydrologic Region Water Supply by Planning Area (PA) (2005-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Annual Groundwater Supply Trend

Changes in annual groundwater supply and type of use may be related to a number of factors, such as changes in surface water availability, urban and agricultural growth, market fluctuations, and water use efficiency practices.

Figures CR-10a and 10b summarize the 2002 through 2010 groundwater supply trends for the Colorado River Hydrologic Region. The right side of Figure CR-10a illustrates the annual amount of groundwater versus surface water supply, while the left side identifies the percent of the overall water supply provided by groundwater relative to surface water. The center column in the figure identifies the water year along with the corresponding amount of precipitation, as a percentage of the 30-year running average for the Region. Figure CR-10b shows the annual amount and percentage of groundwater supply trends for meeting urban, agricultural, and managed wetland uses.

Figures CR-10a indicates that the annual water supply for the Region has remained relatively stable between 2002 and 2010, which is likely due to a relatively stable surface water supply for the Region. Between 2002 and 2010, groundwater supply ranged from 350 to 500 TAF per year and provided from 8 to 12 percent of the overall water supply. Even during the extremely dry years of 2006 and 2007, groundwater supply contributed to only about 10 percent of the total water supply. Figures CR-10a indicates that groundwater supply meeting urban use ranged from 80 to 90 percent of the annual groundwater extraction, with the remaining groundwater extraction meeting agricultural use.

PLACEHOLDER Figure CR-10a Colorado River Hydrologic Region Annual Groundwater Water Supply Trend (2002-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Figure CR-10b Colorado River Hydrologic Region Annual Groundwater Supply Trend by Type of Use (2002-2010)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Water Uses

The 1931 Seven Party Agreement established annual apportionments of Colorado River water (consumptive use volume at the river) for California agencies. These were further quantified in the 2003 Colorado River Water Delivery Agreement: federal QSA (CRWDA). In accordance with the terms of the CRWDA Exhibit B, by 2026 and through 2037, or 2047, IID net consumptive use of Colorado River water is to be reduced by 492.2 annually, while CVWD net consumptive use is to increase by 94 TAF annually (Table CR-11).

PLACEHOLDER Table CR-11 Quantification and Annual Approved Net Consumptive Use of Colorado River Water by California Agricultural Agencies

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

For the period 2006 to 2010, annual urban and agricultural water demands in the Colorado River

Hydrologic Region ranged from 4,394 TAF to 4,870 TAF. Total demands decreased slightly in 2009 probably because increased water use efficiency program activities and the ongoing recession which started in 2008.

About 75 percent of the total demands in the region came from agriculture for 2006-2010, and a majority of that was from the Imperial Valley PA. Annual total applied water demands for agriculture ranged between 4,226 TAF and 3,817 TAF. In the Colorado River PA, agricultural demands were lower for the period than before 2005. This is largely attributable to water transfer agreement between PVID and MWDSC that have resulted fallowing about 20 percent of the irrigated area in the PVID service area.

For the period between 2006 and 2010, more than half of the urban demands in the Colorado River region occurred in the Coachella Valley PA. Annual total applied water demands for urban ranged between 696 TAF and 551 TAF, including imported supplies used for recharge of groundwater basins. Most of the Coachella Valley, Ocotillo, and Borrego Springs urban demands were met through groundwater supplies. In the Imperial and Brad valleys and for some water users in the southern Coachella Valley PA, treated Colorado River supplies are utilized. In the Imperial Valley, rural residents must obtain drinking and cooking water service from a State-approved provider.

Crops in the Colorado River region are irrigated with both traditional and modern irrigation technology. In the Palo Verde, Imperial and Bard valleys, traditional head ditches are used with furrow and border-strip irrigation. Furrow irrigation, which is the predominate practice, was successfully introduced over two decades ago for irrigating alfalfa and is now an accepted approach for about one-third of the alfalfa acres in Imperial Valley. Siphon tubes are common for applying water to vegetables, melons, citrus, sugar beets, and cotton. Border-strip systems continue to be used for alfalfa, grain, and Sudan, Bermuda, and Klein grasses. Farmers use hand-move sprinkler systems for seed germination and during the first weeks of growth. Farmers then switch to furrow irrigation until harvest. The use of plastic mulch on the planting beds to regulate warmth and moisture for some vegetables, including certain varieties of melons, is becoming more frequent. In the past decade, we have seen increased planting of wide-bed lettuce and spinach in these valleys, with irrigation handled almost exclusively by hand-move sprinklers.

Irrigation operations are a bit different in the Coachella Valley. Both traditional and more modern irrigation technologies are in use. For truck and field crops, it is common to see fields irrigated with hand move sprinklers for seed germination and early stages of growth; after which farmers switch to furrows until harvest. However, farmers are increasingly using subsurface drip irrigation systems, buried plastic drip lines, throughout an entire growing season. Bell and other varieties of peppers are often irrigated this way. Mature date trees in the Coachella Valley are mostly irrigated with large, wide furrows, but drip systems are being used for many of the younger trees. Citrus trees and grape vineyards are irrigated exclusively with drip systems. For the vineyards, the drip lines are attached to the trellises about two feet above the ground. Many of the vineyards also have a system of sprinklers perched above the plants that are used to minimize damage from extreme climate conditions such as frost. Center pivot systems are being used only in the Mohave Valley where only field crops are grown.

Although water supplies are reliable and relatively inexpensive, the region’s water agencies, farmers, urban and renewable energy water users are fully aware of the need to manage and use those supplies efficiently. In agriculture, this involves using Efficiency Water Management Practices (EWMP) so that water is applied when and where it is needed while reducing surface runoff and deep percolation.

Growers are also interested in improving their irrigation distribution uniformity, which by increasing yield may reduce the amount of water needed to produce a given yield and may also reduce deep percolation in parts of the fields that otherwise might be over irrigated. The expansion of surface and subsurface micro-irrigation systems has been an important step toward meeting these goals. Traditional irrigation systems (furrows, border-strip, and sprinklers) are being operated to minimize evaporation, excessive tailwater runoff, and deep percolation. Laser-leveling, particularly for around 90 percent of the fields in Imperial Valley, has been important in improving on-farm water use efficiency.

For the agricultural water delivery agencies, efficient water use involves practices that reduce operational spill and canal and lateral seepage and that support growers' efforts by operating the delivery systems so that farmers receive the water they need water when and where they need it. Agencies are also working with farmers to introduce tailwater return systems and other on-farm efficiency conservation practices.

Agricultural operations throughout the region benefit from technical services on irrigation management provided by the water (IID, CVWD, and PVID) and government (NRCS, UCCE and USBR) agencies. To assist farmers who are scheduling irrigations to match crop evapotranspiration and other requirements, these agencies continue to work with DWR to provide adequate coverage of the region's climatology with weather stations of the CIMIS network. All of the major agricultural areas in the regions are now adequately covered by CIMIS stations. With a vastly improve internet, farmers feel at ease to access the real-time climate data being measured by the stations and utilize them in their irrigation operations. IID downloads, stores and uses the CIMIS record as part of its input for water balance calculations.

For urban water users in the region, water agencies are implementing many of the Urban Best Management Practices (BMP) programs and policies. Many of the agencies provide speakers and distribute and post water use efficiency information as part of their public and school water education programs. The CVWD and Indio Water Authority provide indoor water use efficiency kits for local homeowners. The IWA has started and the Mission Springs Water District (MSWD) will soon provide home survey services for their residential customers. The CVWD has several rebate programs, as does IID. CVWD recently began a program for homeowners for the installation of High Efficiency Toilets and IID has a program for low-flow shower heads. Another CVWD program provides financial assistance to homeowners who convert their exterior landscape from a turf grass dominant design to one emphasizing water-efficient plants and xeriscaping; the IWA has a similar program.

In compliance with Water Conservation in Landscaping Act, cities and water agencies in the Coachella Valley recently adopted a uniform landscape ordinance which provides governance for landscape designs for new developments. The goal of the ordinances is to seek significant reductions in demands for exterior landscaping in the future and provide criteria for the reduction of turf grass for golf courses. Both the CVWD and MSWD provide technical assistance to its community for the compliance with their respective ordinances. The CVWD provides technical assistance to golf courses on irrigation system issues, checks for compliance with approved plan designs, and monitors the facilities for maximum water allowance compliance.

The Borrego Water District is implementing a vigorous water conservation program with rebates and turf removal incentives. The PVID has implemented an extensive fallowing program to reduce its agricultural water use and make that water available to MWDSC. The IID has implemented, continues to implement and is planning additional efficiency conservation programs to meet its CRWDA water transfer reduction obligation which ramp up from 136,500 acre-feet in 2009 to 487,500 acre-feet in 2026, in the largest agricultural to urban water transfer in California's history. For IID water conservation program activities, see section on Integrated Regional Water Management.

Drinking Water

The region has an estimated 129 community drinking water systems. The majority (some 89 percent) of these systems are considered as small, serving less than 3,300 people, with most small water systems serving less than 500 people (see Table CR-12). Small and very small water systems face unique financial and operational challenges in providing safe drinking water. Given their customer base, many cannot develop or access the technical, managerial and financial resources needed to comply with new and existing regulations. These water systems may be geographically isolated, and their staff often lacks the time or expertise to make needed infrastructure repairs, install/and or operate treatment systems; and/or develop comprehensive source water protection plans, financial plans and/or asset management plans (USEPA 2012).

In contrast, medium and large water systems account for around 21% of region's drinking water systems; however, these systems deliver drinking water to 95% of the region's population (see Table CR-12). These systems generally have the financial resources to hire staff who oversees daily operations and maintenance needs, and who plan for future infrastructure replacement and capital improvements. This helps to ensure that existing and future drinking water standards can be met. It also provides resources needed to be competitive for State and federal grant programs; which, for small and very small agencies are often inaccessible due to their low levels of staffing and financial resources.

PLACEHOLDER Table CR-12 Summary of Large, Medium, Small, and Very Small Community Drinking Water Systems in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Water Conservation Act of 2009 (SB x7-7) Implementation Status and Issues

Fourteen Colorado River urban water suppliers have submitted 2010 urban water management plans to DWR. The Water Conservation Law of 2009 (SBx7-7) required urban water suppliers to calculate baseline water use and set 2015 and 2020 water use targets. Based on data reported in the 2010 urban water management plans, the Colorado River Hydrologic Region had a population-weighted baseline average water use of 380 gallons per capita per day and an average population-weighted 2020 target of 312 gallons per capita per day. The Baseline and Target Data for individual Colorado River urban water suppliers is available on the Department of Water Resources (DWR) Urban Water Use Efficiency website.

The Water Conservation Law of 2009 (SBx7-7) required agricultural water suppliers to prepare and adopt agricultural water management plans by December 31, 2012, and update those plans by December 31, 2015, and every 5 years thereafter. One Colorado River agricultural water supplier has submitted a 2012 agricultural water management plan to DWR.

Water Balance Summary

The water balances in the Colorado River Hydrologic Region are compiled by Detailed Analysis

Unit/County are, then rolled up into the six planning areas in the region, see Table CR-13. There are no instream requirements or wild and scenic rivers in this hydrologic region and managed wetlands exist in only one planning area (Imperial Valley, PA 1006).

Palms-Lanfair Planning Area (PA 1001) lies primarily in San Bernardino County and is the northwestern-most PA in the region. The urban use averages about 20 TAF, with more than five times as much water used outdoors as indoors. Agricultural applied water averages about 11 TAF.

Supplies consist primarily of groundwater extraction in the amount of about 26 TAF, with about 9-11 TAF re-percolating into the groundwater basin. The area also receives some State Water Project water in the amounts of 2-5 TAF.

The Coachella Planning Area (PA 1002) is more populated than PA 1001, with about 290-540 TAF annual urban applied water. 225-300 TAF of this water use is for external municipal and large landscape water use. Most of the total urban applied water exceeding about 360 TAF is recharged back into the groundwater basin. Agricultural applied water use is about 270 TAF.

The Colorado River is the primary source of supply in PA 1002, with the area receiving more than 300 TAF annually. The area also gets varying amounts from the State Water Project, from 1 to 172 TAF. Groundwater is also extracted in drier years.

The Chuckwalla Planning Area (PA 1003) has very low urban and agricultural water use. Urban use is about 2-2.3 TAF per year, while the agricultural use ranges from 2.4 to 2.8 TAF. Water supply is primarily groundwater extraction, with about 100 acre-feet of supply from the Colorado River.

The Colorado River Planning Area (PA 1004) is the eastern-most planning area in the Colorado River hydrologic region. The urban water use is about 13 to 14 TAF and the agricultural applied water ranges from just below 600 taf to nearly 800 taf. These come almost exclusively from the Colorado River, with small amounts from reuse and groundwater.

The Borrego Planning Area (PA 1005) has less urban and agricultural applied water than PA 1004. Urban applied water ranged from about 8-9 TAF from 2006-2009, then dropped to about 7 TAF in 2010. Ag applied water was about 43-45 TAF. About 40 percent of the supplies come from groundwater and 60 percent from the Colorado River.

The Imperial Valley Planning Area (PA 1006) has the second highest urban use in the Colorado River hydrologic region and the highest agricultural use. Urban use ranges from 86 to 88 TAF, a little more than half of which is used for energy production. Agricultural applies water ranges from about 2.1 to 2.5 million acre-feet, with an additional 650 to 700 TAF evaporating or seeping into the ground during conveyance. This planning area also contains the only managed wetlands in the Colorado River Hydrologic Region, consuming about 30 TAF of water annually.

Supplies in PA 1006 come from the Colorado River, with about 500-550 TAF being reused, including 145-200 TAF from intra-regional transfers (from another planning area).

PLACEHOLDER Figure CR-11 Colorado River Hydrologic Region Water Balance, 2001-2010 (thousand acre-feet)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-13 Colorado River Hydrologic Water Balance Summary, 2001-2010

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Project Operations

Imperial Irrigation District System Conservation Plan

As part of the QSA, work is underway on an ambitious project by the IID to increase the operational efficiency of its water conveyance system. The project is called the "System Conservation Plan" and will address five key system upgrades. They are: (1) upgrades to the existing supervisory control and data acquisition system, (2) construction of mid-lateral reservoirs, (3) construction of lateral interties, (4) construction of the mid-valley collector system, and (5) installation of non-leak gates. The lateral interties would collect operational spills occurring in one lateral and transport them to other laterals or canals in the areas. The project will also improve gate measurement procedures. Seventeen separate tasks have been identified in the project. Another important program that continues to operate is main canal seepage interception program. In 2009, the IID reports that it constructed 22 seepage interception facilities to capture water supplies lost canal and lateral seepage. These actions are in response to the IID study entitled "Efficiency Conservation Definite Plan that was released in 2007. That study identified on-farm programs, delivery system improvements, and financial incentives that would yield conserved water supplies for transfer under the Federal Quantification Settlement Agreement.

The IID completed the automation project of the Vail Canal of its water conveyance system in 2011. Automation of check structures and lateral headings in the canal improves the accuracy of measurement of water flows, steadiness of flows in the canal, and coordination and reliability of irrigation water deliveries service to customers. Construction of the Warren H. Brock Storage Reservoir was completed in 2010 which permits underutilized water supplies being delivered in the All-American Canal to be stored temporarily for later use. The facility is located about 25 miles west of Yuma, Arizona and consists of two basins which can hold up to 8 TAF each.

Water Quality

The Colorado River Hydrologic Region includes 28 major watersheds or "hydrologic units" and has water bodies of statewide, national, and international significance such as the Salton Sea and the Colorado River.

Water quality concerns exist in all of the watersheds in the Colorado River region. This section is intended to identify the highest priority water quality issues in the watersheds within this region. Some of the regional specific issues that have been identified, but not prioritized, are:

- Surface water quality monitoring
- Quality of imported water

- On-site treatment systems
- Nitrates
- Leaking underground storage tanks (USTs)
- Water quality impacts of animal feeding and dairy operations

Agricultural / Irrigated Lands Regulatory Program

The Water Boards oversees the Irrigated Lands Regulatory program with the objective of preventing agricultural discharges from impairing the waters that receive these discharges. This program requires water quality monitoring of receiving waters and corrective actions when impairments occur. In the Colorado River region, the Colorado River Basin Regional Water Quality Control Board (RWQCB) has begun implementing this program by adopting conditional waiver of waste discharge requirements (WDR) for agricultural operations in the Palo Verde Valley, Mesa, and Bard Unit of Reservation Division. Colorado River Basin RWQCB staff are working with interested parties in the Coachella Valley and Imperial Valley to develop conditional waiver of WDRs for agricultural operations in these areas.

New River Pollution

The New River is severely polluted by waste discharges from domestic, agricultural, and industrial sources in Mexico and the Imperial Valley. New River pollution threatens public health, prevents supporting healthy ecosystems for wildlife and other biological resources in the New River, and contributes to the water quality problems of the Salton Sea. Based on the most recent available data, the following water quality problems are evident in the New River on the U.S. side of the U.S.-Mexico International Boundary:

- Pathogens, low dissolved oxygen (DO), toxicity, trash, selenium, sediment/silt, chlordane, dichlorodiphenyltrichloroethane (DDT), dieldrin, toxaphene, polychlorinated byphenyls (PCBs), hexaclorobenzene (HCB), nutrients, and mercury.

In the past two decades, great progress has been made on both sides of the border to improve water quality, however the New River still remains impaired under the Clean Water Act for nearly a dozen pollutants, including pathogens. In 2011, a *Strategic Plan: New River Improvement Project* was prepared in a collaborative effort to identify strategies to fully address the problems and impairments that remain in the New River. The plan is available at:
http://www.calepa.ca.gov/Border/CMBRC/2011/StrategicPlan.pdf

Groundwater Quality

The chemical character of groundwater in the Colorado River Hydrologic Region is variable. Cation concentration is dominated by sodium with calcium common and magnesium appearing less often. Bicarbonate is usually the dominant anion, although sulfate and chloride waters are also common. In basins with closed drainages, water character often changes from calcium-sodium bicarbonate near the margins to sodium chloride or chloride-sulfate beneath a dry lake. It is not uncommon for concentrations of dissolved constituents to rise dramatically toward a dry lake where saturation of mineral salts is reached. An example of this is found in Bristol Valley Groundwater Basin (groundwater basin number 7-8; see Table CR-1 and Figure CR-2), where the mineral halite (sodium chloride) is formed and then mined by evaporation of groundwater in trenches in Bristol (dry) Lake. The total dissolved solids content of groundwater is high in many of the basins in the Region. High fluoride content is common; sulfate content occasionally exceeds drinking water standards; and high nitrate content is common, especially in agricultural areas.

Several State and federal GAMA-related groundwater quality reports that help assess and outline the groundwater quality conditions for the Colorado River region are listed in Table CR-14.

PLACEHOLDER Table CR-14 GAMA Groundwater Quality Reports for the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Groundwater Quality at Community Drinking Water Wells

In general, drinking water systems in the region deliver water to their customers that meet federal and State drinking water standards. Recently the Water Board completed its report to the legislature titled "Communities that rely on a Contaminated Groundwater Source for Drinking Water." The report focused on chemical contaminants found in active groundwater wells used by community water systems which are defined as public water systems that serve at least 15 service connections used by yearlong residents or regularly serve at least 25 yearlong residents (Health & Safety Code Section 116275). The findings of this report reflect the raw, untreated groundwater quality and not necessarily the water quality that is served to these communities.

The estimated 129 community water systems in the region use 377 active wells. A total of 51 active wells or 14% are affected by one or more chemical contaminants that exceed a maximum contaminant level (MCL) (see Table CR-14a). These affected wells are used by 24 community water systems in the region, with 17 of the 24 affected community water systems serving small communities that often need financial assistance to construct a water treatment plant or alternate solution to meet drinking water standards (see Table CR-14b). The most prevalent groundwater contaminants affecting community drinking water wells in the region include gross alpha particle activity, uranium, arsenic, and fluoride (see Table CR-14c). In addition, a total of 23 wells are affected by multiple contaminants with 15 of these wells exceeding both the gross alpha particle activity and uranium MCLs.

PLACEHOLDER Table CR-14a Summary of Community Drinking Water Wells in the Colorado River Hydrologic Region that Exceed a Primary Maximum Contaminant Level Prior to Treatment

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-14b Percentage of Small, Medium and Large Community Drinking Water Systems in the Colorado River Hydrologic Region that Rely on One or More Contaminated Groundwater(s)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-14c Summary of Contaminants Affecting Community Drinking Water Systems in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Groundwater Quality – GAMA Priority Basin Project

The GAMA Priority Basin Project was initiated to provide a comprehensive baseline of groundwater quality in the state by assessing deeper groundwater basins that account for over 95 percent of all groundwater used for public drinking water. The GAMA Priority Basin Project is grouped into 35 groundwater basin groups statewide called “study units,” and is being implemented by the SWRCB, the U.S. Geological Survey (USGS), and the Lawrence Livermore National Laboratory.

The GAMA Priority Basin Project tests for constituents that are a concern in public supply wells and include a) Field Parameters, b) Organic Constituents, c) Pesticides, d) Constituents of Special Interest, e) Inorganic Constituents, f) Radioactive Constituents, and g) Microbial Constituents.

For the Colorado River Hydrologic Region, the USGS has completed Data Summary Reports for following study units:

- Borrego Valley, Central Desert, and Low-Use Basins of the Mojave and Sonoran Deserts
- Coachella Valley
- Colorado River

These study units all reside in the Colorado River Hydrologic Region with the exception of the Low-Use Basins of the Mojave and Sonoran Deserts which are located in both the South Lahontan and Colorado River Hydrologic Regions. For comparison purposes only, groundwater quality results from these Data Summary Reports were compared against the following public drinking water standards established by CDPH and/or the US Environmental Protection Agency (USEPA). These standards included primary maximum contaminant levels (MCLs), secondary maximum contaminant levels (SMCLs), notification levels (NLs), and lifetime health advisory levels (HALs). The summary of untreated groundwater quality results for these study units is shown in Table CR-15. In addition to these Data Summary Reports, USGS has completed some Assessment Reports and Fact Sheets for the Region as also listed in Table CR-15.

PLACEHOLDER Table CR-15 Summary of Groundwater Quality Results for the Colorado River Hydrologic Region from GAMA Data Summary Reports and San Diego County Domestic Well Project

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Groundwater Quality at Domestic Wells

Private Domestic wells are typically used by either single family homeowners or other groundwater-reliant systems which are not regulated by the State. Domestic wells generally tap shallower groundwater making them more susceptible to contamination. Many of these well owners are unaware of the quality of the well water, because the State does not require them to test their water quality. Although private domestic well water quality is not regulated by the State, it is a concern, to local health and planning agencies, and to State agencies in charge of maintaining water quality.

In an effort to assess domestic well water quality, the SWRCB’s GAMA Domestic Well Project samples domestic wells for commonly detected chemicals, at no cost to well owners who voluntarily participate in the program. Results are shared with the well owners and used by the GAMA Program to evaluate the quality of groundwater used by private well owners. As of 2011, the GAMA Domestic Well Project had sampled 1,146 wells in six county Focus Areas (Monterey, San Diego, Tulare, Tehama, El Dorado and

Yuba Counties).

The GAMA Domestic Well Project tests for chemicals that are most commonly a concern in domestic well water, which include a) Bacteria (Total and Fecal Coliform), b) General Minerals (sodium, bicarbonate, calcium, others), c) General Chemistry Parameters (pH, TDS, others), d) Inorganics (lead, arsenic and other metals) and nutrients (nitrate, others), and e) Organics (benzene, toluene, PCE, MTBE, and others). In addition, groundwater samples have been analyzed for chemicals of concern that may occur in some areas of California, these include radionuclides, perchlorate, pesticides, and hexavalent chromium (Cr 6).

The GAMA Domestic Well Project sampled a total of 137 private domestic wells in 2008 and 2009 in San Diego County that included 9 private domestic wells located in the Colorado River Hydrologic Region. Of the 9 sampled private domestic wells, four were located within the Borrego Valley basin, and the other five wells were located in fractured rock areas. San Diego county was selected for sampling due to the large number of private domestic wells located within the county and the availability of well-owner data. It is estimated that more than 500,000 people live in unincorporated areas of San Diego county. Due in part to the high population in unincorporated areas and the local climate, San Diego county pumps an estimated 33 million gallons per day and ranks second in California in terms of domestic well water use accounting for approximately 12 percent of California's total domestic well water withdrawals (SWRCB 2010).

For comparison purposes only, groundwater quality results were compared against public drinking water standards established by CDPH. These standards included primary MCLs, SMCLs, and NLs. The summary of untreated groundwater quality results for the 9 private domestic wells in the Region is also shown in Table CR-15.

Groundwater Protection

Within the Colorado River Hydrologic Region, there is an effort underway to protect groundwater supplies from contamination by onsite wastewater treatment (septic) systems.

In response to declining groundwater levels in the Warren Valley Groundwater Basin by as much as 300 feet, the Hi-Desert Water District instituted a groundwater recharge program in 1995 using imported surface water to recharge the groundwater basin. The groundwater recharge program resulted in an increase in groundwater levels by up to 250 feet near the area of the recharge ponds. However as the groundwater levels increased, some wells showed an increase in nitrate contamination. Wells that previously had a nitrate concentration of 10 mg/L now have nitrate concentrations greater than the CDPH nitrate MCL of 45 mg/L (as NO3). A USGS study completed in 2003 evaluated the sources of the high-nitrate concentrations that appeared after the implementation of the groundwater recharge program and found that leachate from septic systems was the primary source of the high-nitrate concentrations measured in the basin (Nishikawa, T. 2003). Recently in 2011, the Colorado River Basin RWQCB adopted a resolution that prohibits the use of septic systems in the Town of Yucca Valley to protect groundwater from additional nitrate contamination.

Similarly, the nearby Town of Joshua Tree utilizes groundwater for municipal supply and septic systems for wastewater disposal. To protect groundwater resources from degradation, the Joshua Tree Water District has contracted with the USGS to investigate the unsaturated zone of their subbasin. The objectives of the study are to (1) evaluate the potential for artificial recharge, (2) evaluate flow and nitrate transport in the unsaturated zone, and (3) develop a flow and transport model to investigate impacts from land use and septic load on groundwater quality. The long-term cumulative impact from wastewater discharges is an on-going concern for the Joshua Tree Water District, and alternative wastewater treatment and disposal strategies may need to be considered to protect local groundwater supplies.

Land Subsidence

In the Colorado River Hydrologic Region, researchers have investigated the occurrence of land subsidence in Lucerne Valley and Coachella Valley. Between 1950 and 1990 (MWA, 2004), groundwater levels in Lucerne Valley steadily declined. In 1980, DWR Bulletin 118 identified the Lucerne Valley Groundwater Basin as being in a state of overdraft. As mentioned previously, to prevent further overdraft, Lucerne Valley was included in the 1996 groundwater rights adjudication of the Mojave Ground Basin.

Using InSAR data and working with the Mojave Water Agency, in 2003, Sneed et. al., identified approximately two feet of subsidence at three GPS monitoring points in the Lucerne (Dry) Lake area between 1969 and 1998. In 2012, the Mojave Water Agency reported that groundwater levels in the Este Subarea, which includes Lucerne Valley, have remained stable for the past several years, suggesting a relative balance between recharge and discharge.

Groundwater extractions in the Coachella Valley Groundwater Basin resulted in a water level decline as much as 50 feet during the 1920s through the 1940s. In 1949, the Coachella Branch of the All-American Canal began transporting Colorado River water into the valley. The importation of Colorado River water alleviated some of the groundwater demand, and groundwater levels recovered in some areas. However, since the late 1970s, groundwater extractions have increased because the water use could not be met by the imported water alone. By 2005, the groundwater levels in many wells had declined by 50 to 100 feet (Sneed and Brandt, 2007), and the water levels have continued to decline thereafter (CVWD, 2010).

An investigation of land subsidence in Coachella Valley by Ikehara and others (1997) determined up to 0.5 feet of subsidence occurred between 1930 and 1996. In 2007, Sneed and Brandt investigated Coachella Valley subsidence using a GPS monitoring network and InSAR data. Results from the GPS monitoring indicated as much as 1.1 feet of subsidence in the Coachella Valley between 1996 and 2005, while the InSAR data identified subsidence of between 0.36 to 1.08 feet during the same time period.

Local water management efforts are utilizing conjunctive use and water conservation measures to reduce overdraft; however, unless long-term groundwater decline can be halted, the potential for land subsidence remains. Additional information regarding land subsidence is available online from Water Plan Update 2013 Vol. 4 Reference Guide – California's Groundwater Update 2013.

Groundwater Level Trends

The groundwater level hydrographs presented in this section are intended to help tell a story about how the local aquifer systems respond to changing groundwater pumping quantity and to the implementation of resource management practices. The hydrographs are designated according to the State Well Number System (SWN), which identifies each well by its location using the public lands survey system of township, range, section, and tract.

Hydrograph 02S01E33J004S (Figure CR-12a) is located near the San Gorgonio River north of Banning. The well depth and construction details are unknown, but monitoring results indicate the well is likely constructed in the unconfined aquifer comprised of Holocene alluvium and possibly within the Pliocene to Pleistocene alluvial sediments of the San Timoteo Formation. The area surrounding the well is sparsely developed and characterized by small residential, industrial, and commercial land use. The hydrograph shows small to large seasonal fluctuations, with a 70 to 80 foot swing in groundwater levels in response to extended periods of above and below normal precipitation. Single year rebound in groundwater levels between 30 to 40 feet are shown to follow the high precipitation years of 1978, 1993, 1998, and 2005. Although the aquifer shows large fluctuations in groundwater levels associated with periods of wet and dry conditions, the long-term aquifer response to changes in groundwater pumping appears to be relatively stable and sustainable.

PLACEHOLDER Figure CR-12a Groundwater Level Trends in Selected Wells in the Colorado River Hydrologic region – Hydrograph 02S01E33J004S

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Hydrograph 07S08E34G001S (Figure CR-12b) is located in the southern portion of the Indio (Whitewater) subbasin within the larger Coachella Valley Groundwater Basin, just northwest of the Salton Sea. The well is completed in the alluvial portion of the aquifer and is used for irrigating agricultural crops. The hydrograph shows that groundwater levels steadily decreased by about 50 feet between 1926 and 1949. In 1949, the Coachella Canal began importing water from the Colorado River to help alleviate the heavy reliance on groundwater resources within the valley. The in-lieu recharge associated with conjunctive management of imported Colorado River and local groundwater resources contributed to rising groundwater levels to rise over the next few decades. During this period, groundwater levels recovered to pre-1925 levels, with the peak at about 35 feet below ground surface during the late 1960's. Beginning in the early 1970s and continuing through the early 2000s, groundwater levels once again started a steady decline of over 75 feet due to increases in groundwater extraction to meet increases in agricultural use (CVWD, 2010). Since the 2003, groundwater levels have begun to once again somewhat recover due to increases in surface water allocations resulting from several water exchange agreements. These include the 2003 agreement of the CVWD and DWA with the MWDSC to acquire State Water Project water for use in Coachella Valley; because no physical facilities exist to deliver State Water Project water to Coachella Valley, the CVWD exchanges the agreed allocation of SWP water for Colorado River water via the Colorado River Aqueduct. In 2004 and in 2007, the CVWD purchased additional imported water supplies from the Tulare Lake Basin Water Storage District in Kings County. In 2007, the CVWD and the DWA also completed State Water Project transfer agreements with the Berrenda Mesa Water District in Kern County. Besides completing these exchange agreements, the CVWD also operates three water recycling facilities to provide water for landscape and golf course irrigation (CVWD, 2010).

PLACEHOLDER Figure CR-12b Groundwater Level Trends in Selected Wells in the Colorado River Hydrologic region – Hydrograph 07S08E34G001S

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Hydrograph 16S20E27B001S (Figure CR-12c) is located adjacent to the All-American Canal, approximately 15 miles west of Yuma in the southeastern corner of the Imperial Valley Groundwater Basin. The well is constructed in the Holocene and late Tertiary upper and lower aquifers which are primarily composed of alluvial deposits. The hydrograph shows an increase in groundwater levels of about 12 feet between 1987 and 2000. Between 2000 to 2006 seasonal fluctuations in groundwater levels ranged from three to five feet per year, with the spring-to-spring change in groundwater levels remaining relatively steady during this time. From 2006 to the present, spring groundwater levels have steadily declined at a rate of about 5 feet per year. The steady drop of the groundwater level is likely attributed to the lining of the All-American Canal with construction beginning in 2007. The groundwater levels in the vicinity of this well are expected to continue to decline due to the ongoing reduction in infiltration from the lined All-American Canal. Eventually, groundwater level is expected to lower to a new equilibrium level, based on changes in infiltration. Periods of drought and high precipitation do not appear to dramatically affect groundwater levels in the area.

PLACEHOLDER Figure CR-12c Groundwater Level Trends in Selected Wells in the Colorado River Hydrologic region – Hydrograph 16S20E27B001S

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Change in Groundwater Storage

Change in groundwater storage is the difference in stored groundwater volume between two time periods. Examining the annual change in groundwater storage over a series of years helps identify the aquifer response to changes in climate, land use, or groundwater management over time. If the change in storage is negligible over a period represented by average hydrologic and land use conditions, the basin is considered to be in equilibrium under the existing water use scenario and current management practices. However, declining storage over a period characterized by average hydrologic and land use conditions does not necessarily mean that the basin is being managed unsustainably or subject to conditions of overdraft. Utilization of groundwater in storage during years of diminishing surface water supply, followed by active recharge of the aquifer when surface water or other alternative supplies become available, is a recognized and acceptable approach to conjunctive water management. Additional information regarding the risks and benefits of conjunctive use are presented in Volume 3, Chapter 8 of CWP Update 2013.

Resource and time constraints compounded with a lack of availability of comprehensive dataset in DWR’s Water Data Library, changes in groundwater storage estimates for basins within the Colorado River Hydrologic Region were not developed as part of the groundwater content enhancement for the CWP Update 2013. Some local groundwater agencies within the Region periodically develop change in groundwater storage estimates for basins within their service area. Examples of local agencies who have determined change in storage include the Mojave Water Agency, Hi-Desert Water District, and the CVWD. Borrego Valley groundwater storage estimates have been developed as part of the San Diego County 2011 General Plan Update.

Drinking Water Quality

In general, drinking water systems in the region deliver water to their customers that meet federal and State drinking water standards. In February 2012, the State Water Resources Control Board and Water

Resources Quality Control Boards (Water Boards) published a draft statewide assessment of community water systems that rely on contaminated groundwater. This draft report identified 24 community drinking water systems in the region that rely on at least one contaminated groundwater well as a source of supply (See Table CR-16). Gross alpha particle activity, uranium, arsenic, and fluoride are the most prevalent groundwater contaminants affecting community drinking water wells in the region (see Table CR-17). The majority of the affected water systems are small water systems which often need financial assistance to construct a water treatment plant or alternate solution to meet drinking water standards. Furthermore, the systems are likely to be serving Disadvantaged Communities (DACs).

PLACEHOLDER Table CR-16 Summary of Small, Medium, and Large Community Drinking Water Systems in the Colorado River Hydrologic Region that Rely on One or More Contaminated Groundwater Well(s)

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-17 Summary of Contaminants Affecting Community Drinking Water Systems in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Flood Management

Traditionally, the approach to flood management was to develop narrowly focused flood infrastructure projects. This infrastructure often altered or confined natural watercourses, which reduced the chance of flooding thereby minimizing damage to lives and property. This traditional approach looked at floodwaters primarily as a potential risk to be mitigated, instead of as a natural resource that could provide multiple societal benefits.

Today, water resources and flood planning involves additional demands and challenges, such as multiple regulatory processes and permits, coordination with multiple agencies and stakeholders, and increased environmental awareness. These additional complexities call for an Integrated Water Management approach, that incorporates natural hydrologic, geomorphic, and ecological processes to reduce flood risk by influencing the cause of the harm, including the probability, extent, or depth of flooding (flood hazard). Some agencies are transitioning to an IWM approach. IWM changes the implementation approach based on the understanding that water resources are an integral component for sustainable ecosystems, economic growth, water supply reliability, public health and safety, and other interrelated elements. Additionally, IWM acknowledges that a broad range of stakeholders might have interests and perspectives that could positively influence planning outcomes.

An example of this is the Cushenbury Flood Detention Basin. The project is proposed to capture runoff from the San Bernardino Mountains in the Lucerne Valley Sub-basin. Currently, large storm flows drain to dry lake beds in the area that have low percolation rates. Consequently, the majority of water that drains to the lake beds is lost to evaporation and never enters the basin. The project would divert storm flows to detention basins with high rates of percolation to decrease losses from evaporation. Flooding can deliver either environmental destruction or environmental benefits. Ecosystems can be devastated by extreme floods that wash away habitat, leaving deposits of debris and contaminants. Development in floodplains has reduced the beneficial connections between different types of habitat and adjacent floodway corridors; however, well-functioning floodplains deliver a variety of benefits. Floodplains provide habitat for a significant variety of plant and wildlife species. Small, frequent flooding can recharge groundwater basins and improve water quality by filtering impurities and nutrients, processing organic wastes, and controlling erosion.

Flood management challenges in the Colorado River Hydrologic Region include:

- Flood control in the desert presenting different challenges than flooding in the rest of the state
- Outdated and undersized infrastructure
- Lack of regional perspective, real need for regional planning efforts

The identified issues were based upon interviews with six agencies with varying levels of flood management responsibilities in each county of the state. The agencies with flood management responsibility in the Colorado River Hydrologic Region that participated in the meeting include Imperial County Department of Planning and Development Services, Imperial Irrigation District, Coachella Valley Water District, and Riverside County Flood Control and Water Conservation. The agencies were asked about the status of flood management in their respective areas of responsibility.

Flood Hazards

Of California's 10 hydrologic regions, the Colorado River Hydrologic Region has the lowest annual precipitation. Consequently, most of the natural streams are ephemeral; the exceptions are the Colorado, New, and Alamo rivers. The low annual rainfall amounts and the sparse vegetation in the region's watersheds give rise to braided streams with steep channel slopes. In these watercourses, short-duration, high intensity rainfall from summer monsoonal thunderstorms or winter storms can result in flash floods and debris flows. Many areas in the region are still vulnerable to flood-caused damages. Flood hazards in the region include these representative situations (for specific instances, see Challenges).

- Some existing culverts and channels do not have sufficient capacity to carry flow resulting from the runoff event having a 1 percent chance of being exceeded in any year.
- Population growth and the ensuing development increase the area of impervious surface without sufficient mitigation, increasing peak runoff.
- High intensity storms combined with steep stream gradients and granular bed material to produce flash floods and debris flows.
- Alluvial fan flooding endangers some communities.
- Some locations are threatened with ponding of runoff behind seaside dikes.

Damage Reduction Measures

Most flood events in the Colorado River region occur in as a result of high-intensity summer storms and take the form of flash or alluvial fan flooding. Flood exposure identifies who and what is impacted by flooding. Two flood event levels are commonly used to characterize flooding:

- 100-Year Flood is a shorthand expression for a flood that has a 1-in-100 probability of occurring in any given year. This can also be expressed as the 1 percent annual chance of, or "1 percent annual chance flood" for short.
- 500-Year Flood has a 1-in-500 (or 0.2 percent) probability of occurring in any given year.

In the Colorado River Hydrologic Region more than 227,000 people and over $20 billion in assets are exposed to the 500-year flood event. Table CR-18 provides a snapshot of people, structures, crop value, and infrastructure, exposed to flooding in the region. Over 185 State and Federal threatened, endangered, listed, or rare plant and animal species exposed to flood hazards are distributed throughout the Colorado

River Hydrologic Region.

PLACEHOLDER Table CR-18 Flood Exposure in the Colorado River Hydrologic Region Exposures to the 100-Year and 500-Year Flood Events

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Water Governance

The Colorado River is an interstate and international river with use apportioned among the seven Colorado River Basin states and Republic Mexico by a complex body of statutes, agreements, decrees, and court decisions known collectively as the "Law of the River." As stated in the Colorado River Waters Delivery Agreement: Federal QSA (CRWDA), consumptive use for Colorado River apportionment is defined as "diversion of water from the mainstream of the Colorado River, including water drawn from the mainstream by underground pumping, net of measured and unmeasured return flows."

The following tables describe the legal mandates governing the uses of Colorado River water by California.

PLACEHOLDER Table CR-19 Key Elements of the Law of the Colorado River

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-20 Annual Intrastate Apportionment of Water from the Colorado River Mainstream within California under the Seven Party Agreement

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-21 Annual Apportionment of Use of Colorado River Water Interstate/International

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Legal challenges made against the Quantification Settlement Agreement and Related Agreements resulted in the filing of 11 lawsuits. Five were dismissed, with those remaining consolidated for trial. In 2010, the trial court ruled that an important agreement in the QSA, the QSA Joint Powers Agreement, was invalid because of a violation related to the appropriation clause (article XVI, section 7) of the California Constitution. This ruling also invalidated 11 other agreements in the QSA. However, in December 2011, the Third District Court of Appeal reversed the trial court ruling and permitted the water agencies to continue with the QSA implementation. In early 2012, the California Supreme Court declined to hear arguments for the lawsuits. The Court of Appeals ruling ordered some the litigation back to the trial court for further proceedings.

As part of its long-term planning process, the IID has developed and approved the following Interim Water Supply Policy for Non-Agricultural Projects (IWSP) and Equitable Distribution Plan (EDP). Although preliminary, the IWSP supports economic growth in Imperial Valley. It assures that all approved future non-agricultural (municipal and industrial) projects in the Valley will have water supplies available to them. It also provides guidelines on whether the projects need water supply assessments \verifications (SB 610\SB221) and identifies alternative actions that developers can take supplement the water supplies for their project (implement urban best management practices). Fees are assessed on most projects which are then used to help fund local IRWM efforts. The EDP provides guidelines for the agency to enforce when potable water supplies are exceeded by demands. The policy applies to all users of water in the IID service area, farmers, home and business owners, and industries. It was amended in 2013 to provide guidelines on how to address annual overruns in Colorado River diversions.

Two groundwater basins in the region are bound by adjudication judgments: the Warren Valley and Beaumont groundwater basins.

The Warren Valley Groundwater Basin adjudication judgment was finalized in 1977. The court appointed Hi-Desert Water District as the watermaster and ordered the agency to develop a plan to halt the overdraft of the basin. In 1991, the Warren Valley Basin Management Plan was released with recommendations that included managing extractions, importing water supplies, conserving storm water flows, encouraging water conservation and recycling, and protecting the quality of the groundwater supplies.

The Beaumont (Groundwater) Basin adjudication judgment was finalized in 2004. The Superior Court appointed a committee to serve as the watermaster. The committee includes representatives from the cities of Banning and Beaumont, Beaumont-Cherry Valley Water District, South Mesa Mutual Water Company, and the Yucaipa Valley Water District. The judgment established the annual extraction quantities for the parties that were classified as either overlying owners or appropriators.

Flood Governance

Agencies with Flood Responsibilities

California's water resource development has resulted in a complex, fragmented, and intertwined physical and governmental infrastructure. Although primary responsibility might be assigned to a specific local entity, aggregate responsibilities are spread among more than 65 agencies in the Colorado River Hydrologic Region with many different governance structures. A list of agencies can be found in the California's Flood Future Report Attachment E: Information Gathering Technical Memorandum. Agency roles and responsibilities can be limited by how the agency was formed, which might include enabling legislation, a charter, a memorandum of understanding with other agencies, or facility ownership.

The Colorado River hydrologic region contains floodwater storage facilities and channel improvements funded and/or built by State and Federal agencies. Flood management agencies are responsible for operating and maintaining approximately 1,800 miles of levees, 17 dams and reservoirs and, 10 debris basins within the Colorado River Hydrologic Region. For a list of major infrastructure, refer California's Flood Future Report Attachment E: Information Gathering Technical Memorandum.

Flood Management Governance and Laws

Water Code Division 5, Sections 8,000 - 9,651 has special significance to flood management activities and is summarized in California's Flood Future Report Attachment E: Information Gathering Technical Memorandum.

Recently, a number of laws regarding flood risk and land use planning were enacted in 2007. These laws establish a comprehensive approach to improving flood management by addressing system deficiencies, improving flood risk information, and encouraging links between land use planning and flood management. Two of the Assembly Bills (AB) that the California legislature passed are summarized below.

- AB 70 (2007) Flood Liability — provides that a city or county might be responsible for its reasonable share of property damage caused by a flood, if the State liability for property damage has increased due to approval of new development after January 1, 2008.
- AB 162 (2007) General Plans — requires annual review of the land use element of general plans for areas subject to flooding, as identified by FEMA or DWR floodplain mapping. The bill also requires that the safety element of general plans provide information on flood hazards. Additionally, AB 162 requires the conservation element of general plans to identify rivers, creeks, streams, flood corridors, riparian habitat, and land that might accommodate floodwater for purposes of groundwater recharge and stormwater management.

State Funding Received

State funding awarded for planning and implementation of water-related infrastructure in the region through spring of 2013 has been a total of $12 million. Imperial Irrigation District received a planning grant for $1M. Coachella Valley Water District received a planning grant for $1M. Following that, Coachella Valley Water District received an implementation grant for $4M. Mojave Water Agency received an implementation grant for $6M.

Groundwater Governance

California does not have a statewide management program or statutory permitting system for ground-water. However, one of the primary vehicles for implementing local groundwater management in California is a Groundwater Management Plan (GWMP). Some agencies utilize their local police powers to manage groundwater through adoption of groundwater ordinances. Groundwater management also occurs through other avenues such as basin adjudication, Integrated Regional Water Management plans, Urban Water Management plans, and Agriculture Water Management plans.

Groundwater Management Assessment

Figure CR-13 shows the location and distribution of the GWMPs within the Colorado River Hydrologic Region based on a GWMP inventory developed through a joint DWR/ACWA online survey and follow-up communication by DWR in 2011-2012. Table CR-22 furnishes a list of the same. GWMPs prepared in accordance with the 1992 AB 3030 legislation, as well as those prepared with the additional required components listed in the 2002 SB 1938 legislation are shown. Information associated with the GWMP assessment is based on data that was readily available or received through August 2012. Requirements associated with the 2011 AB 359 (Huffman) legislation, related to groundwater recharge mapping and reporting, did not take effect until January 2013 and are not included in the 2012 GWMP assessment effort.

PLACEHOLDER Figure CR-13 Location of Groundwater Management Plans in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-22 Groundwater Management Plans in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

The GWMP inventory indicates that four groundwater management plans exists within the Region. Three of the GWMPS are fully contained within the Region and one plan includes portions of the adjacent South Lahontan Hydrologic Region. All four of the GWMPs cover areas overlying Bulletin 118-03 alluvial groundwater basins. However, one plan also includes areas that are not identified in Bulletin 118-03 as alluvial basins. One of the plans is a Water Management Plan that also includes surface water management and meets the requirements of a GWMP. Collectively, the four GWMPs cover approximately 2,000 square miles. This includes about 1,500 square miles (11 percent) of the Bulletin 118-03 alluvial groundwater basin area in the Region. All four GWMPs have been developed or updated to include the SB 1938 requirements and are considered active for the purposes of the California Water Plan Update 2013 GWMP assessment.

Based on the information compiled through inventory of the GWMPs, an assessment was made to understand and help identify groundwater management challenges and successes in the Region, and provide recommendations for improvement. Information associated with the GWMP assessment is based on data that were readily available or received through August 2012 by DWR. The assessment process is briefly summarized below.

The California Water Code §10753.7 requires that six components be included in a groundwater management plan for an agency to be eligible for state funding administered by DWR for groundwater projects, including projects that are part of an integrated regional water management program or plan (see Table CR-23). Three of the components also contain required subcomponents. The requirement associated with the 2011 AB 359 (Huffman) legislation, applicable to groundwater recharge mapping and reporting, did not take effect until January 2013 and was not included in the current GWMP assessment. In addition, the requirement for local agencies outside of recognized groundwater basins was not applicable for any of the GWMPs in the region.

In addition to the six required components, Water Code §10753.8 provides a list of twelve components that may be included in a groundwater management plan (Table CR-23). Bulletin 118-2003, Appendix C provides a list of seven recommended components related to management development, implementation, and evaluation of a GWMP, that should be considered to help ensure effective and sustainable groundwater management plan (CR-23).

As a result, the GWMP assessment was conducted using the following criteria:

- How many of the post SB 1938 GWMPs meet the six required components included in SB 1938 and incorporated into California Water Code §10753.7?
- How many of the post SB 1938 GWMPs include the twelve voluntary components included in California Water Code §10753.8?

How many of the implementing or signatory GWMP agencies are actively implementing the seven recommended components listed in DWR Bulletin 118 - 2003?

PLACEHOLDER Table CR-23 Assessment of Groundwater Management Plan Components

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

In summary, assessment of the groundwater management plans in the Colorado River Hydrologic Region indicates the following:

- Three of the four GWMPs adequately address all of the required components listed under Water Code §10753.7; one plan that fails to meet all the required components, does not address the BMO and Monitoring Protocol subcomponents for inelastic subsidence and surface water-groundwater interaction. Analysis of the GWMPs for other Regions also reveals that when a plan lacks BMO details for surface water and groundwater interaction, it generally lacks details for Monitoring Protocols as well.
- One of the four GWMPs incorporates the 12 voluntary components listed in Water Code §10753.8, two plans incorporate 11 of the voluntary components, and one plan incorporates seven of the voluntary components.
- Three of the four GWMPs include six of the seven components and one GWMP includes five of the seven components recommended in Bulletin 118-03.

The DWR/ACWA survey asked respondents to identify key factors that contributed to the successful implementation of the agency's GWMP. Three agencies from the Region participated in the survey. All three responding agencies identified broad stakeholder participation, collection and sharing of data, developing an understanding of common interest, adequate funding, outreach and education, and adequate time as key factors for a successful GWMP implementation. Having adequate surface water supplies, surface water storage and conveyance, and developing and using a water budget were also identified as important factors.

Survey participants were also asked to identify factors that impeded implementation of the GWMP. Respondents pointed to a lack of adequate funding as the greatest impediment to GWMP implementation. Funding is a challenging factor for many agencies because the implementation and the operation of groundwater management projects typically are expensive and because the sources of funding for projects typically are limited to either locally raised monies or to grants from State and federal agencies. The lack of broad stakeholder participation, unregulated groundwater pumping, lack of governance, lack of surface storage and conveyance, and lack of groundwater supply were also identified as factors that impede the successful implementation of GWMPs.

Finally, the survey asked if the respondents were confident in the long-term sustainability of their current groundwater supply. Two respondents felt long-term sustainability of their groundwater supply was possible while one respondent did not believe long-term sustainability was possible.

The responses to the survey are furnished in Table CR-24a and CR-24b. More detailed information on the DWR/ACWA survey and assessment of the GWMPs are available online from Water Plan Update 2013 Vol. 4 Reference Guide – California's Groundwater Update 2013.

PLACEHOLDER Table CR-24a Factors Contributing to Successful Groundwater Management Plan

Implementation in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-24b Factors Limiting Successful Groundwater Management Plan Implementation in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Groundwater Ordinances

Groundwater ordinances are laws adopted by local authorities, such as cities or counties, to manage groundwater. The most common ordinances are associated with groundwater wells. These ordinances regulate well construction, abandonment, and destruction (see Table CR-25a).

Special Act Districts

Greater authority to manage groundwater has been granted to a few local agencies or districts created through a special act of the Legislature. Only one special act district is located in the Colorado River Hydrologic Region. The Desert Water Agency imports water to its service area, replenishes local groundwater supplies, and collects fees necessary to support a groundwater replenishment program.

Court Adjudication of Groundwater Rights

Another form of groundwater management in California is through the courts. The court typically appoints a water master to administer the judgment to ensure that annual groundwater extractions follow the terms of the adjudication and to periodically report to the court. There are currently 24 groundwater adjudications in California. The Colorado River Hydrologic Region contains three of those adjudications (see Table CR-25b).

Due to heavy groundwater use and declining groundwater levels, water rights were adjudicated in Warren Valley Basin, with the adjudication judgment finalized in 1977. The court appointed Hi-Desert Water District as the watermaster and ordered the district to develop a plan to halt the overdraft of the basin. In 1991, the Warren Valley Basin Management Plan was released with recommendations that included managing extractions, importing water supplies, conserving storm water flows, encouraging water conservation and recycling, and protecting the quality of the groundwater supplies.

The Mojave Groundwater Basin adjudication judgment was finalized in 1996. The Superior Court appointed the Mojave Water Agency to serve as the watermaster to ensure that the conditions set forth in the adjudication are followed. The judgment established Free Production Allowance (FPA) for the water producers, which is the amount of water that a producer can pump for free during a year without having to pay for replacement water. A producer who needs more FPA than its assigned value must pay for the excess water used either by arranging to transfer the desired amount from another producer or by buying the amount required from the Watermaster. As indicated in Table CR-24b, the Lucerne Valley Basin in the Colorado River Hydrologic Region is included in this adjudication.

The Beaumont Groundwater Basin adjudication judgment was finalized in 2004. The Superior Court appointed a committee to serve as the watermaster. The committee includes representatives from the cities of Banning and Beaumont, Beaumont-Cherry Valley Water District, South Mesa Mutual Water Company, and the Yucaipa Valley Water District. The judgment established the annual extraction quantities for the parties that were classified as either overlying owners or appropriators. As indicated in Table CR-24b, the San Gorgonio Pass subbasin of the Coachella Valley Groundwater Basin in the Colorado River Hydrologic Region is included in this adjudication.

PLACEHOLDER Table CR-25a Groundwater Ordinances that Apply to Counties in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

PLACEHOLDER Table CR-25b Groundwater Adjudications in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Other Groundwater Management Planning Efforts

Groundwater management also occurs through other avenues such as Integrated Regional Water Management plans, Urban Water Management plans, and Agriculture Water Management plans. Box CR-2 summarizes these other planning efforts.

PLACEHOLDER Box CR-2 Other Groundwater Management Planning Efforts in the Colorado River Hydrologic Region

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Current Relationships with Other Regions and States

A new five-year agreement was reached between the United States and Mexico which provides for an exchange of 95 TAF of Mexico's share of Colorado River water for financial assistance with the repairs of damage to water delivery infrastructure in the Mexicali Valley caused by the 2010 El Mayor-Cucapah Earthquake. The agreement is formally known as Minute No. 319, "Interim International Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April 2010 Earthquake in the Mexicali Valley, Baja California." It was negotiated by the officials from the United States and Mexico on the International Boundary and Water Commission. Several hundred miles of irrigation canals were damaged by the seismic event; impacting about 80,000 acres of farmland in the valley. The Metropolitan Water District of Southern California (Metropolitan), the Southern Nevada Water Authority, and Central Arizona Water Conservation District will collectively provide $10 million to assist in the repairs, technical improvements, and modernization of the water delivery infrastructure. Metropolitan will contribute $5 million towards the costs and will receive 47.5 TAF of water supplies.

The agreement also contains guidelines for determining Colorado River water deliveries to Mexico in relation to storage conditions in Lake Mead. Mexico has the option to bank Colorado River water supplies for future use and the United States and Mexico will cooperate on a pilot project to enhance riparian vegetation areas along the Colorado River and delta region, both in Mexico.

The land fallowing and water supply transfer program between the Palo Verde Irrigation District and the Metropolitan Water District of Southern California is being implemented smoothly. The 35-year program that began in 2009 is to provide between 29.5 TAF and 118.0 TAF of water annually for MWDSC, help with stabilization of the local economy in the Palo Verde Valley, and provide financial assistance for specific local community improvement programs. In 2009, about 129 TAF of water supplies were transferred; in 2010, it was a little more than 116 TAF.

During the Colorado River Upper Basin drought years of 2009 and 2010, these two agencies worked together to move additional Colorado River water supplies to MWDSC's service area. In calendar year 2010, MWDSC received a little more than 32 TAF of water supplies from PVID to help mitigate the impacts of the drought.

The projects completed for the 1988 Water Conservation Agreement between the Imperial Irrigation District and MWDSC permits the transfer of conserved water supplies to MWDSC's service area. In 2009, about 89 TAF of water supply was transferred to the MWDSC, in 2010, it was 97 TAF.

CVWD and the DWA continue to reach out to water agencies outside of the region to acquire new SWP water supplies to help with the management of the local groundwater basins. Long-term water transfer agreements were reached with the Berenda Mesa Water District and Tulare Lake Water Basin Storage District. Short-term agreements were also reached with the Rosedale-Rio Bravo Water Storage District and DMB Pacific, Inc. Additional exchange agreements between CVWD, DWA, and MWDSC were also reached that would allow for import of SWP supplies purchased during DWR's Dry Year program.

Other important water transfer agreements continue to be implemented in accordance with the QSA. The transfers include agencies within and outside of the region. These are the San Diego County Water Authority-Imperial Irrigation District and the Coachella Valley Water District and IID water transfer agreements. The quantities of water supplies to be transferred will originate from the implementation of on-farm and water conveyance water use efficiency programs. For the SDCWA-IID agreement, the annual amount of water to be transferred from the IID to SDCWA will be 200 TAF. Water supplies are now being transferred, from a combination of savings and land fallowing, and full delivery is projected for 2021. The maximum amount of water supplies to be transferred in the CVWD-IID agreement will be 103 TAF. This is expected to be achieved by 2026.

Regional Water Planning and Management

The Colorado River Hydrologic Region's two main outside water resources, Northern California and the Colorado River, are of concern. The Coachella Valley's share of SWP water from Northern California is being temporarily reduced by up to one-third after a 2008 federal court ruling affecting 25 million Californians. Simultaneously, the worst drought in 500 years has reduced flows on the Colorado River to about half of normal, and storage in Lake Mead and Lake Powell are also at about 50 percent.

Years after desert farmers reduced their water use, CVWD is building the $70 million Mid-Valley Pipeline. The pipeline will provide about 50 of the valley's 124 golf courses with Colorado River water for irrigation, leaving higher-quality aquifer water for drinking use. Another $40 million project to build a new groundwater recharge facility south of La Quinta will use Colorado River water to replenish the east valley portion of the underground aquifer.

Flood management in the future will require unprecedented integration among traditionally varying agencies that have overlapping and sometimes conflicting goals and objectives. More reliable funding and improved agency alignment are required at all levels. Updated technical and risk management approaches will be needed to protect the public from flooding by assessing risk, as well as by improving flood readiness, making prudent land use decisions, and promoting flood awareness. Project implementation methods could benefit from IWM-based approaches to leverage the limited funding and other flood management resources. In short, future solutions should be aligned with broader watershed-wide goals and objectives and must be crafted in the context of IWM.

Integrated Regional Water Management Coordination and Planning

Integrated Regional Water Management (IRWM) promotes the coordinated development and management of water, land, and related resources to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. Flood management is a key component of an integrated water management strategy.

Four Integrated Regional Water Management regions have been formed for the Colorado River Hydrologic Region. They are identified as the Anza-Borrego Desert, Coachella Valley, Imperial and the southern portion of Mojave Desert. Presently, the members of each group are either in the process of developing a suitable IRWM Plan for their area or updating an existing Plan to meet current standards. IRWM members and stakeholders have reached out to a wide range of interest groups for assistance with the development of strategies to resolve present-day and future water management challenges in the region. The Colorado River region has several disadvantaged communities and the IRWM groups are involving them in the planning process. Interest has grown for the IRWM activities as local agencies have come to recognize that regional integration can enhance their collective power and ability to manage the region's water resources in a sustainable way.

As a result of IRWM planning efforts, local agencies and stakeholders in the region have developed an array of projects and programs to meet their water management objectives. The array includes projects that will sustain existing and future surface water and groundwater supplies and protects the environment. The region is now poised to begin implementation of projects that have been developed through the planning process including recycled water expansion, desalters, pipeline interconnection, habitat restoration and invasive species control, stormwater capture and reuse, and water use efficiency programs. Important projects include City of Imperial's Keystone Water Reclamation Facility; the IWA Recycled Water Program which promotes groundwater recharge (replenishment) and increased reliability; the Smart Water Conservation Programs (a project that utilizes a variety of education and outreach methods to increase water conservation throughout the Coachella Valley); East Brawley Groundwater Desalination Project, and the East Wide Channel, Long Canyon and Tributaries Master Plan project (improve current detention dams, levees and reservoirs near the mouths of Long Canyon and West Wide Canyon make stormwater collection/capture more efficient and flood waters more manageable in Coachella Valley).

Other examples of IRWM planning and implementation activities include the Mojave IRWM group facilitating water conservation programs and, with the funding aid, complete a recharge project in the Joshua Basin. The Coachella Valley RWMG is including integrated flood management and a ground water monitoring strategy into its IRWM plan update and has received implementation funds to treat arsenic in the water supply of disadvantaged communities. Priorities for the Imperial Valley RWMG include protecting its sole-source aquifer in the Ocotillo area and managing groundwater to include desalination and storage.

Implementation Activates (2009-2013)

Drought Contingency Plans

In their preparations of Urban Water Management Plans, most water agencies in the Colorado River region also updated existing Water Supply Shortage Contingency Plans. These documents describe the different actions that will be undertaken to mitigate the impacts caused by either natural or man-made water supply shortages. Actions include the stages of supply shortages, actions to be taken at each stage, programs and policies which will be implemented to decrease demands (including restrictions on certain kinds of water uses), procedures to monitor uses, and penalties for those who do not comply with specific orders. The plans also outline short-term and long-term strategies to supplement existing water supplies to lessen the impacts of shortages during real emergencies.

For over two decades, the Coachella Valley Water District and Desert Water Agency have taken the necessary steps to replenish and store water supplies in the Whitewater groundwater basin in the Coachella Valley. As reported in the Water Supply section, CVWD and DWA have entered into agreements with various agencies, including the Metropolitan Water District of Southern California, Berenda Mesa Water District and Tulare Lake Water Basin Storage District to bring additional SWP water supplies into the region for the purpose of groundwater recharge. These additional supplies would then be available to them in the event of possible future shortfalls from the SWP and Colorado River.

Accomplishments

In the Colorado River Hydrologic Region, a number of flood risk management recommendations were accomplished as described below:

- DWR has created a climate change handbook to help local agencies incorporate climate change into planning activities. In addition, the State of California has developed a statewide climate change adaptation strategy, requested that the National Academy of Science establish an expert panel to report on impacts of sea level rise, and issued interim guidance to agencies on planning for sea level rise in designated coastal and floodplain areas.
- DWR has collaborated with the USACE to produce *California's Flood Future: Recommendations for Managing the State's Flood Risk*, which will help guide local, State, and Federal decisions about policies and financial investments related to improved public safety and flood management throughout California. Information for the California's Flood Future Report was provided by 142 public agencies located in all 58 counties, as well as by State and Federal agencies.
- IRWM planning guidelines were revised to incorporate flood management into the process giving credit for including these flood benefits in Integrated Water Management projects.
- Comments and recommendations from the Flood Risk Management Strategy in the 2009 California Water Plan were used to inform:
- SFMP California's Flood Future Report
- IRWM planning

Water Code Section 8307 links flood liability with local planning decisions. Cities and counties now share flood litigation liability with the State over unreasonably approved new development on previously undeveloped areas

Ecosystem Restoration

Environmental Mitigation Projects

Although the All-American and Coachella Canal lining projects were completed several years ago, environmental mitigation projects associated with both are currently underway. For the Coachella Canal project, seven important mitigation projects and related activities were identified. Some of the projects have been completed and includes the Dos Palmas Water Supply System. This conveyance facility transports diverted water supplies from the Coachella Canal to specific locations for the recharge of groundwater in confined and unconfined aquifers and for the irrigation of marsh and aquatic vegetation in the Dos Palmas Conservation Area on the east-northeast shoreline area of the Salton Sea. Two important projects are occurring in the Dos Palmas area. The first requires the maintenance of the existing Core Marsh\aquatic habitat and monitoring of bird species including the Yuma Clapper Rail. The second project involves the restoration of the native habitat (about 352 acres). This second phase began in 2008 and after the clearing of salt cedar plants is complete, will involve the planting of other desert riparian species including wolf berry, honey mesquite, ironwood, and palo verde.

Environmental mitigation requirements for the All-American Canal Lining Project (AACLP) include the Chanan Remington Memorial Wetland Enhancement Area. This restored freshwater marsh is providing habitat for a diversity of species, including mesquite and cottonwood trees. All non-native weed populations have been controlled and the freshwater marsh habitat has expanded almost four-fold to nearly twenty-four acres. Both the California black rail and the Yuma clapper rail are present at the site and are likely nesting. Groundwater elevations were monitored to generate baseline conditions for the Chanan Remington Memorial Wetland Enhancement area prior to the lining of the All-American Canal. Results have shown that there are no significant changes to groundwater levels between pre and post canal lining; monitoring will continue through 2014. Other environmental mitigation requirements of the AACLP include dune restoration. The area is monitored for sand accumulation and botanical species and results show that the site has been colonized by both native and nonnative species with a low vegetative cover overall. Silt fencing to encourage sand accumulation will be installed as part of the active restoration phase. Native seed has also been collected and stored for a more active approach to restoration activities. A Post Construction Monitoring Plan for Large Mammals was implemented. This plan differed from the original monitoring plan by reducing aerial surveys. The latest deer survey results show that deer are utilizing the rip-rap under the I-8 Bridge for access to the canal water and are also utilizing both wildlife water guzzlers constructed as mitigation for the AACLP.

The Memorandum of Agreement to provide an endowment for California Department of Fish and Wildlife to purchase canal water for a fishing pond in the Imperial Valley is currently being drafted as mitigation for the project related loss of canal fishery habitat.

Lower Colorado River Multi-Species Conservation Program

Progress is being made to implement the $26 million LCR-MSCP. The program activities are separated into nine different categories, which include fish augmentation, species research, and system monitoring. Work has been initiated on a number of programs including those involving system monitoring and conservation area development and management. New habitat was created at the Palo Verde Ecological Preserve.

Habitat Mitigation Programs

Two environmental mitigation projects are underway in the region compliance with requirements of the QSA. They are the Burrowing Owl Burrow Avoidance Program and the Managed Marsh Project. As part of the Joint Powers Authority (includes the IID, SDCWA, CVWD, and CDFW) which provides funding and management of the projects, the IID is moving forward with the implementation of both. Achievements in the Burrowing Owl Burrow Avoidance Program include: (1) provides on-site monitoring during O & M operations to help maintenance crews identify and avoid sensitive burrowing habitats, (2) provides semi-annual training to IID staff on the owl habitat, and (3) the modification of existing and development of new strategies to mitigate the impacts of these maintenance activities. One of the strategies is the construction of artificial burrows. The second program consists of the planning and construction of a managed marsh or wetland for small animals and birds. In 2009, construction was completed on a 365-acre habitat in the northeast corner of the IID service area. A variety of plants in the riparian-woodland, emergent wetlands, and scrub categories were planted in addition to the construction of small ponds pools of water. A two-phased expansion is being planned and area could grow to 959 acres.

Salton Sea Species Conservation Habitat Project

Habitat values at the Salton Sea continue to decline as salinity increases and as water levels recede. To address near-term loss and degradation of habitat during the period prior to implementation of a larger restoration plan, the California Legislature appropriated funds for the purpose of implementing conservation measures necessary to protect the fish and wildlife species dependent on the Salton Sea. California Department of Fish and Wildlife was given authority, under Fish and Wildlife Code 2932, to pursue this objective. The 2009 Species Conservation Habitat (SCH) Project set forth a plan to create approximately 2,400 acres of shallow pond habitat at the sea to support fish populations which in turn would support bird populations. In August 2011 the Salton Sea SCH Project Draft EIS/EIR was issued. As of March 2013, no habitat had been constructed under the Salton Sea SCH Shallow Habitat Project.

The Legislature appropriated $5.4 million in Proposition 84 funds for the SCH Project. An additional $20 million in Proposition 84 funds will need to be appropriated and placed in the Salton Sea Restoration Fund for completion of the project (Chapter 5). The Salton Sea Mitigation Fund (up to $30 million) would be used for operations and maintenance of the project. Through the Salton Sea Financial Assistance Program (FAP) stakeholders can participate in the restoration process of the Salton Sea using funds provided by Proposition 84. The FAP will provide grant monies to eligible applicants (local agencies, nonprofit organizations, tribes, universities, and State and federal agencies) for projects that conserve fish and wildlife within the Salton Sea ecosystem. CDFW and CDWR released the final documents for the Salton Sea Financial Assistance Program in July 2012, with proposals due Sept 10, 2012. On April 8, 2013, $3 million were awarded to projects for this Program.

Along the Colorado River, several national wildlife areas have been established. Managed by the USFWS, these include the Havasu National Wildlife Refuge, Imperial National Wildlife Refuge, and Cibola National Wildlife Refuge. The facilities occupy land in California as well as in Arizona. Lush riparian habitats have been established in both refuges, creating important habitat for both permanent and migratory birds and other wildlife.

A number of federally-designated wilderness areas have been established in the Colorado River Hydrologic Region. These areas are managed by one of the following federal agencies, USBLM, USFWS, or the USFS. Some of the larger designated areas are in the southern portion of the Mojave Desert Preserve. These include the Turtle Mountain Wilderness Area (177,000 acres) and the Palen-McCoy Wilderness Area (259,000 acres). The latter is known for its desert ironwood trees. Other wilderness areas that exist along the Colorado River include the Chemehuevi Mountains and Big Maria Mountains wilderness areas.

Coachella Valley Multiple Species Habitat Conservation Plan

In 2008, USFWS and CDFW both issued permits for the Coachella Valley Multiple Species Habitat Conservation Plan. The Coachella Valley Conservation Commission which is comprised of representatives from State, County, and City agencies and other important organizations was formed to implement the action items in the plan. Work is underway to develop and approve management plans and monitor activities for six environmental areas identified in the plan. Management activities would include the acquisition of land, strategies for the protection of endangered species and their habitats, and strategies to mitigate impacts from regional climate change. Activities and programs that have been taken can be found in the 2011 Annual Report.

Lower Colorado Multi-Species Conservation Program

Since 2005, over 700 acres of new habitat have been established, and new habitat continues to be developed in the Palo Verde Ecological Preserve in the Colorado River PA. This includes the planting of trees and shrubs including cottonwood trees, several varieties of willow trees, and mesquite. Future activities will include the identification and establishment of ponds off of the main channel of the Colorado River. These would provide aquatic habitat for razorback sucker, bonytail, and flannel mouth sucker fish species. Surveys are continuing to determine the number of birds and land animals which live in the preserve. The Lower Colorado River MSCP Steering Committee annual work and accomplishments may be found online.

Environmental and Habitat Protection and Improvement

Elements of the biological mitigation measures from the Imperial Irrigation District's (IID) 2002 Draft Habitat Conservation Plan are being used as the agency implements its Water Conservation and Transfer Project in compliance with provisions of the Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003 (CRWDA). The measures are required under the existing incidental take authorizations pursuant to the Endangered Species Act (ESA) and California Endangered Species Act (CESA). The IID is preparing the Habitat Conservation Plan (HCP) and Natural Communities Conservation Plan (NCCP) that will contain modified or new mitigation and conservation measures not included in the 2002 Draft HCP and not evaluated in the Transfer Project Final Environmental Impact Report/Environmental Impact Statement (EIR/EIS).

In 2012, IID and USFWS announced plans for the joint preparation of the Subsequent EIR/Supplement EIS to the Final EIR/EIS for the IID Water Conservation and Transfer Project. The document will evaluate proposed changes to the Transfer Project and modifications to the mitigation requirements in the Transfer Project, the draft 2002 Habitat Conservation Plan, and draft Natural Community Conservation Plan.

Water Self Sufficiency

USBR Colorado River Study

The sustainability of the Colorado River water supplies was examined in a new study released by the

USBR in 2012. The study is entitled "Colorado River Basin - Water Supply and Demand Study." With contributions from stakeholders throughout the Colorado River watershed, the study attempts to define the water supply and use imbalances which may occur 50 years into the future and demonstrate the effectiveness of possible strategies or portfolios (actions and programs) that might be used to mitigate the imbalances. The hydrology of the watershed is examined under historic conditions and with emphasis on any conditions that may be impacted by global climate change. Water demands in the watershed were made under different economic scenarios. Regardless of the conditions, municipal and industrial uses are expected to increase in response to population growth. The Colorado River supplies will be stressed if no actions are taken. The study concludes that the implementation of strategic plans or portfolios (resource management strategies) can limit the impacts of the problems. Programs and actions in the plans include urban and agricultural water use efficiency programs, utilization of recycled water and other alternative sources of potable water supplies, and water supply transfer and exchange agreements.

Water Transfer

In 2003, IID implemented a land fallowing program within its service area to generate water to fulfill the SDCWA water transfer and the Salton Sea mitigation delivery schedules. In 2006-2007, 169 fields (17,984.4 acres) were fallowed, which yielded just over 96 thousand acre-feet. For 2006-2007, 150 fields (16,172 acres) were fallowed, which yielded over 89 thousand acre-feet.

For the Federal Quantification Settlement Agreement, the IID implemented a land fallowing program to generate water supplies to fulfill the SDCWA water transfer and the Salton Sea mitigation delivery schedules. For fiscal year 2010-2011, about 9,330 acres of land was fallowed and the yield (at the farm gate) was 50,266 AF. In fiscal year 2011-2012, 5,796 acres were fallowed and the yield was 30,134 AF.

Imperial Irrigation District – Land Fallowing Program

In compliance with the QSA, the IID continues to implement its voluntary land fallowing to generate conserved water supplies to meet its obligations for the mitigation of Salton Sea impacts related to water supplies transfers out of Imperial Valley, These supplies are also used in the IID\SDCWA water supply transfer agreement and Colorado River overrun payback obligations. In fiscal year 2003-2004, the IID reports that 5,764 acres were fallowed with 38,641 AF of water supply conserved to meet these obligations. In 2009-2010, 17,854 acres were fallowed with 99,360 AF of supplies conserved and in 2010-2011, it was 16,651 acres and 90,981 AF. The program ends in 2017.

Water Quality and Supplies

Water Quality of Drain Water

Additional programs are underway in the Imperial Valley to manage water conveyance system and tail water drain vegetation and control soil erosion. In 2010, the Imperial Irrigation District approved and began implementation of its Vegetation Management Plan. Important goals of the plan included: (1) the control and management of undesirable plants in its water conveyance canals and tail water drains, (2) control soil erosion and remove suspended sediments in tail water flows in the drains, (3) maintain the slopes of the drains, and (4) promote the growth of desirable plants. Implementation activities include the training of water agency personnel in the identification of beneficial and non-beneficial plants, utilization of excavator-mounted laser GPS-controlled cleaning equipment to eliminate the undesirable vegetation and maintain the slopes of the unlined drains, and repairing infrastructure.

With Proposition 50 and 84 funding, the IID is also commenced with actions to meet TMDL goals established in its Drain Water Quality Improvement Plan. The GPS-controlled equipment mentioned previously was acquired through this program. Other activities include the training of operators of this equipment, enforcement of tail water box compliance, implementing action to address high silt levels in some drains in the valley, conducting a study to determine the feasibility of using vegetation for drain slope stability, and monitor the quality of flows in the drains. These activities will assist the IID in meeting its TMDL goal of a 50 percent decrease in silt in drain water flows.

Groundwater Storage

Greater cooperation is occurring between water agencies within and outside of the Coachella Valley to address the overdraft of the local groundwater basin. Programs described in Bulletin 160-2009 are continuing to be implemented. They include the advanced storage agreement between CVWD, DWA, and MWDSC regarding Colorado River supplies and the 75 year project between CVWD and IID that would permit the latter agency to store a portion of its Colorado River supplies in the Whitewater Groundwater Basin. This is in addition to long- and short-term transfers of SWP water supplies between CVWD and DWA and water agencies in the San Joaquin Valley.

For the upper or northern portion of the Whitewater Groundwater Basin, the SWP supplies received through the exchange program are released into the Whitewater River channel which eventually percolates and recharges the basin. In the lower or southern portion of the basin, CVWD operates the Thomas E. Levy Groundwater Replenishment Facility which is located near Lake Cahuilla and recently activated the Martinez Canyon Pilot Recharge Facility in the same part of the Coachella Valley. Colorado River water supplies are used for the recharge operations at these facilities. About 32,250 AF was recharged at the Thomas e. Levy facility.

Water recycling continues to expand in the region. CVWD is currently operating six wastewater treatment plants. Flows from three of the facilities are used to irrigate greenbelts and golf courses, while some of the supplies are used to recharge groundwater. In 2010, total recycled water use was about 16 thousand acre-feet. The district projects recycled water use to increase to slightly below 30 thousand acre-feet per year by 2030.

Urban Water Conservation

CVWD has updated and approved a revised landscape ordinance for customers within its service area. With this update, the CVWD hopes to decrease overall water use, eliminate the runoff of irrigation water into the streets, and limit turf grass allowance for golf courses.

The Twentynine Palms Water District has been implementing very aggressive water audit, leak detection, and water main replacement programs for the past decade. The agency conducts a very efficient preventive maintenance program and detects and repairs leaks in its distribution system quickly. Annual unaccounted water losses have been reduced by over 90 percent.

Water and Wastewater Treatment

For several years, the City of Blythe has been able to treat and deliver potable water supplies to its residential and commercial customers with its new water treatment facility. Completed in 2007, the facility has two 1,500 gpm wells, new filtration equipment, and reservoir storage. The new wells has allowed the City to terminate other wells in its service area which have had problems with bacterial contamination and groundwater pollution problems.

Design activities are nearing completion for the City of Imperial's Keystone Regional Water Reclamation Facility. The facility will provide wastewater treatment for urban residents and businesses in an area which includes the City of Imperial, southern portion of the City of Brawley, and the Imperial Community College. It will be able treat wastewater flows up to 5 MGD and produce Table 22 recycled water supplies. Potential users of the recycled water have been identified.

New River

In addition to the establishment of the three wetland sites, discussions are moving ahead for the development and finalization of a strategic plan for the New River that would identify specific actions to address public health concerns and help meet environmental and water quality benchmarks for the Salton Sea. The plan is a part of the New River Improvement Project and is being developed under the guidance of the City of Calexico and the California-Mexico Border Relations Council under the authority granted by AB 1079 (Perez, 2009). Cal EPA is also technical support. A framework for a plan was released in July 2012. Possible actions which could be taken include the installation of screens to collect the large items and trash floating in the river and the construction of a treatment plant for the removal of contaminants and raw sewage in the water. The actions in this proposed strategic plan would be performed in conjunction with activities currently underway. This would include the partial treatment of the water in the New River in Mexico before it flows into the United States, the voluntary TMDL compliance program being implemented by the farmers in the Imperial Valley, and the Drain Water Improvement Program by the Imperial Irrigation District.

This is not the sole activity concentrating on the New River. The U. S. Environmental Protection Agency will also examine the problems of the New River as part of its Border 2020 Plan. A citizens' action group, the Calexico New River Committee, also released a report with its recommendations to mitigate the problems.

Other Accomplishments

Solar Power Plants

Due to its favorable climate, planning and installation activities continue for new solar power plants in the Colorado River region. The expansion is in response to State energy policies which require electric utilities to use power from renewable resources for 33 percent of its power by 2020. Both the United States Bureau of Land Management and California Energy Commission are playing important roles in the planning and construction process. These facilities will use groundwater supplies, however, the annual water demands are expected to be small. Construction is underway for some of the facilities. These include the Desert Sunlight Solar Farm and Genesis Solar Project; both of which are near the City of Blythe. In the NEPA\CEQA process are the McCoy Solar Energy Project (near the City of Blythe), Desert Harvest Solar Project (near the community of Desert Center, Riverside County), Ocotillo Sol Project (Imperial Valley), and the Chevron Lucerne Valley Solar Project (Lucerne Valley, San Bernardino County).

Challenges

Threatened or endangered fish species on the main stem of the Colorado River include the Colorado pikeminnow, razorback sucker, humpback chub, and bonytail chub. Efforts to protect these fish may impact reservoir operations and streamflow in the main stem and tributaries, which are critically important to California's ability to store and divert Colorado River water supplies. Other species of concern in the basin include the bald eagle, Yuma clapper rail, black rail, southwestern willow flycatcher, yellow warbler, vermilion flycatcher, yellow-billed cuckoo, and Kanab ambersnail.

The region faces challenges in intra-regional planning and management including how to better integrate land use and water plans and resolve conflicts within the region related to new water demands and future land use changes. The major source of water to the region, the Colorado River, is vulnerable because of the prolonged Colorado River Basin drought. In addition, the region is characterized by cities and unincorporated communities that are spread over large areas resulting in high cost of projects and making outreach to remote and isolated communities difficult. However, the projects that have been developed through the planning efforts are expected to produce regional benefits that include water quality improvement, enhancement of water supply reliability, ecosystem improvement, flood control enhancement, enhanced partnerships and public participation, understanding of water-related issues, and improved water management.

Vulnerabilities to the SWP water supplies also exist. The Coachella Valley Water District and Desert Water Agency are being subjected to reductions in their annual allocations because of federal court rulings on Delta diversions.

The IRWM process has provided a rare opportunity for increased water management coordination and collaboration among agencies in the region, even as the region is faced with significant water resources challenges. Increasing use of recycled water is helping to offset the use of groundwater for non-potable uses, resulting in energy savings and reduced costs of pumping from deep wells. Recycled water distribution systems are being expanded to maximize the use of recycled water in the region. Inter-agency partnerships on regional projects would help alleviate challenges associated with bringing recycled water supply to customers and upgrading of existing treatment facilities to provide tertiary treatment and improved opportunities to reuse the water.

The freshwater marshes and wetlands of Salton Sea face rising salinity through evaporation and declining water elevations. At the same time, prolonged Colorado River Basin drought and climate change scenarios point to decreased runoff to the Colorado River. Preservation and restoration of these water sources and the quality of their water is critical to the survival and propagation of numerous wildlife species.

Excessive pumping has put many of the groundwater basins in the region in a state of overdraft causing groundwater levels to decrease considerably in many areas and raising significant concern about water quality degradation and land subsidence. There is a need to diversify water portfolio components to reduce pressure on the use of groundwater in addition to promoting water use efficiency and conservation.

Elevated levels of arsenic in the groundwater, degradation from salts in using Colorado River water for recharge and irrigation, and saline intrusion from Salton Sea have all led to water quality issues. Similarly, failing septic systems and a high density of septic tanks and leach fields in some areas have the potential to contaminate the local groundwater basins. Reducing groundwater overdraft and developing and implementing a Salts and Nutrients Management Plan and conversion of septic tanks to sewer system will help alleviate these problems.

As mentioned earlier, the region has many DACs scattered over a large area with many falling into the category of Severely Disadvantaged Communities (SDACs). Tribal lands have their own unique challenges. Lack of adequate water and wastewater infrastructure is prevalent in these communities. Many of them have expressed concerns that their needs are being neglected in favor of the urban areas. Engaging DACs and sustaining their involvement is a necessary first step in providing access and affordability to safe drinking water and wastewater systems for these communities.

Flood Challenges

Although characterized by very low annual precipitation, the region is subject to local thunderstorms that cover smaller areas and result in high-intensity precipitation of short duration. In the late 1970's, severe flood damage occurred to homes and businesses in many cities in the Coachella Valley region and, as a result, flood control infrastructure was constructed in the early 1980's with the help of the U.S. Army Corps of Engineers (USACE) and local funding. However, many areas still lack flood control facilities and are vulnerable to devastating alluvial fan flash riverine flooding (more discussion of alluvial fan flooding can be found in the Alluvial Fan Task Force report (URL)). In some areas, the lack of a regional agency with jurisdiction over multiple service areas and a stable funding mechanism has been identified as the largest constraint to solving stormwater and flood problems. The lack of adequate stormwater management and conveyance infrastructure is, however, pervasive throughout the hydrologic region and remains the biggest constraint to economic development of planned urban areas.

Flood management in the Colorado River Hydrologic Region of California has a unique set of challenges that were identified during meetings with local agencies. These challenges include:

- Flood control in the desert presenting different challenges than flooding in the rest of the state
- Inadequate agency alignment
- Right-of-way restrictions that impact projects and future management options
- Outdated and undersized infrastructure
- Inconsistent and unreliable funding
- Lack of regional perspective, real need for regional planning efforts
- Agencies need more clearly designed and articulated roles and responsibilities
- Inadequate public and policymaker awareness and education
- Permitting that is overly complex, involves too many agencies, takes too long, and is costly
- Land use conflicts

Looking to the Future

Future Conditions

Future Water Demand

In this section a description is provided for how future Colorado River hydrologic region water demands might change under scenarios organized around themes of growth and climate change described earlier. The change in water demand in the Colorado River region from 2006 to 2050 is estimated for agriculture and urban sectors under 9 growth scenarios and 13 scenarios of future climate change. The climate change scenarios included the 12 Climate Action Team scenarios described earlier and a 13th scenario representing a repeat of the historical climate (1962-2006) to evaluate a "without climate change" condition.

Urban Demand

Figure CR-14 shows a box plot of change in urban water demand under 9 growth scenarios for the Colorado River region with variation shown across 13 scenarios of future climate including one scenario representing a repeat of the historical climate. A box plot is a graphical representation showing the minimum, 25th percentile, median, 75th percentile, and maximum values. The red dot shows the mean or average value. The change in water demand is the difference between the historical average for 1998 to 2005 and future average for 2043 to 2050. Urban demand is the sum of indoor and outdoor water demand where indoor demand is assumed not to be affected by climate. Outdoor demand, however, is dependent on climate factors like amount of precipitation falling and the average air temperature. Urban demand increased under all 9 growth scenarios tracking with population growth. On average, it increased by about 440 thousand acre-feet under the three low population scenarios, 690 thousand acre-feet under the three current trend population scenarios and about 940 thousand acre-feet under the three high population scenarios when compared to historical average of about 490 thousands-acre-feet. The results show change in future urban water demands are less sensitive to housing density assumptions or climate change than to assumptions about future population growth.

PLACEHOLDER Figure CR-14 Change in Urban Water Demand

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Agricultural Demand

Figure CR-15 shows a box plot of statewide change in agricultural water demand in the Colorado River Region under 9 growth scenarios with variation shown across 13 scenarios of future climate including one scenario representing a repeat of the historical climate. A box plot is a graphical representation showing the minimum, 25th percentile, median, 75th percentile, and maximum values. The red dot shows the mean or average value. The change in water demand is the difference between the historical average for 1998 to 2005 and future average for 2043 to 2050. Agricultural water demand decreases under all future scenarios due to reduction in irrigated lands as a result of urbanization and background water conservation when compared with historical average water demand of about 3490 thousand acre-feet. Under the three low population scenarios, the average reduction in water demand was about 1630 thousand acre-feet while it was about 1700 thousand acre-feet for the three high population scenarios. For the three current trend population scenarios, this change was about 1660 thousand acre-feet. The results show that low density housing would result in more reduction in agricultural demand since more lands are lost under low-density housing than high density housing.

PLACEHOLDER Figure CR-15 Change in Agricultural Water Demand

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Integrated Water Management Plan Summaries

Inclusion of the information contained in IRWMP's into the CWP Regional Reports has been a common suggestion by regional stakeholders at the Regional outreach meetings since the inception of the IRWM program. To this end the California Water Plan has taken on the task of summarizing readily available Integrated Water Management Plan in a consistent format for each of the regional reports. This collection of information will not be used to determine IRWM grant eligibility.

This effort is ongoing and will be included in the final CWP updates and should include up to 4 pages (one fold out 11x17 double sided) for each IRWMP in the regional reports.

In addition to these summaries being used in the regional reports we intend to provide all of the summary sheets in one IRWMP Summary "Atlas" as an article included in Volume 4. This atlas will, under one cover, provide an "at-a-glance" understanding of each IRWM region and highlight each region's key water management accomplishments and challenges. The atlas will showcase how the dedicated efforts of individual regional water management groups (RWMGs) have individually and cumulatively transformed water management in California.

All IRWMP's are different in how are organized and therefore finding and summarizing the content in a consistent way proved difficult. It became clear through these efforts that a process is needed to allow those with the most knowledge of the IRWMP's, those that were involved in the preparation, to have input on the summary. It is the intention that this process be initiated following release of the CWP Update 2013 and will continue to be part of the process of the update process for Update 2018. This process will also allow for continuous updating of the content of the atlas as new IRWMP's are released or existing IRWMP's are updated.

Resource Management Strategies

This section is under development

Drinking Water Treatment & Distribution

Conjunctive Management and Groundwater Storage

Conjunctive management, or conjunctive use, refers to the coordinated and planned use and management of both surface water and groundwater resources to maximize the availability and reliability of water supplies in a region to meet various management objectives. Managing both resources together, rather than in isolation, allows water managers to use the advantages of both resources for maximum benefit. Additional information regarding conjunctive management in California as well as discussion on associated benefits, costs, and issues can be found online from Water Plan Update 2013 Vol. 3 Ch. 9 Conjunctive Management and Groundwater Storage Resource Management Strategy.

A survey undertaken in 2011-2012 jointly by DWR and ACWA to inventory and assess conjunctive management projects in California is summarized in Box CR-3. More detailed information about the survey results and a statewide map of the conjunctive management projects and operational information, as of July 2012, is available online from Water Plan Update 2013 Vol. 4 Reference Guide – California's Groundwater Update 2013.

PLACEHOLDER Box CR-3 Statewide Conjunctive Management Inventory Effort in California

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Conjunctive Management Inventory Results

Of the 89 conjunctive management programs identified in California, only one program is located in the Colorado River Hydrologic Region. The program consists of a direct groundwater percolation program started in 1991 with Mojave Water Agency identified as the lead agency and the administrator/operator of the project. The goals and objectives of this conjunctive management program are to address groundwater overdraft correction. Annual recharge and extraction amounts vary year to year. Current recharge and extraction capacity is estimated at 50,000 acre-feet per year, while the cumulative recharge capacity is estimated at 390,000 acre-feet. Efforts are currently underway to increase program capacity. The State Water Project was identified as the source of program water. Current operating cost for the program is estimated at $900,000 per year. Project cost was identified as the most significant constraint for the program. Limited aquifer storage was determined to be a moderate constraint, while other constraints include political, legal, institutional, and water quality issues.

Climate Change

For over two decades, the State and federal governments have been preparing for climate change effects on natural and built systems with a strong emphasis on water supply. Climate change is already impacting many resource sectors in California, including water, transportation and energy infrastructure, public health, biodiversity, and agriculture (USGRCP, 2009; CNRA, 2009). Climate model simulations, based on the Intergovernmental Panel on Climate Change's 21st century scenarios, project increasing temperatures in California, with greater increases in the summer. Projected changes in annual precipitation patterns in California will result in changes to surface runoff timing, volume, and type (Cayan, 2008). Recently developed computer downscaling techniques indicate that California flood risks from warm-wet, atmospheric river type storms may increase beyond those that we have known historically, mostly in the form of occasional more-extreme-than-historical storm seasons (Dettinger, 2011).

Currently, enough data exist to warrant the importance of contingency plans, mitigation (i.e., reduction) of greenhouse gas (GHG) emissions, and incorporating adaptation strategies (i.e., methodologies and infrastructure improvements that benefit the region at present and into the future). While the State of California is taking aggressive action to mitigate climate change through reducing emissions from greenhouse gases and implementing other measures (CARB, 2008), global impacts from carbon dioxide and other GHGs that are already in the atmosphere will continue to impact climate through the rest of the century (IPCC, 2007; UNEP, 2009).

Resilience to an uncertain future can be achieved by implementing adaptation measures sooner rather than later. Because of the economic, geographical, and biological diversity of California, vulnerabilities and risks from current and future anticipated changes are best assessed on a regional basis. Many resources are available to assist water managers and others in evaluating their region-specific vulnerabilities and identifying appropriate adaptive actions (USEPA and DWR, 2011; Cal-EMA and CNRA, 2012a).

Observations

Regionally-specific temperature observations can be retrieved through the Western Regional Climate Center (WRCC)*. Locally in the Colorado River region within the WRCC Sonoran Desert climate region, mean temperatures have increased by about 0.9 to 2.0 °F (0.5 to 1.1 °C) in the past century, with minimum and maximum temperatures increasing by about 1.6 to 2.7 °F (0.9 to 1.5 °C) and by 0.2 to 1.5 °F (0.1 to 0.8 °C), respectively (WRCC, 2012). Within the WRCC Mohave Desert climate region, mean temperatures have increased by about 1.2 to 2.4 °F (0.7 to 1.3 °C) in the past century, with minimum and maximum temperatures increasing by about 1.5 to 2.6 °F (0.8 to 1.4 °C) and by 0.9 to 2.3 °F (0.5 to 1.3 °C), respectively (WRCC, 2012).

The Colorado River region also is currently experiencing impacts from climate change through changes in statewide precipitation and surface runoff volumes, which in turn affect availability of local and imported water supplies. During the last century, the average early snowpack in the Sierra Nevada, which is an important source of water for parts of the Colorado River region through the SWP, decreased by about ten percent, which equates to a loss of 1.5 million acre-feet of snowpack storage (DWR, 2008).

Water supplies coming from the Colorado River Basin outside California are also decreasing (CNRA, 2009). Similar climate effects, although much more variable, are occurring in the Rocky Mountains snowpack that supplies the Colorado River, another important source of water for the Colorado River region (Christensen, et al., 2004; Mote, et al., 2005; Williamson, et al., 2008; Guido, 2008). Even though variability exists in the snowpack levels of the Rocky Mountains and spatial patterns of trends are not consistent, streamflows in the Colorado River appear to be peaking earlier in the year (Stewart, et al., 2005; Garfin, 2005), and the average water yield of the Colorado River could be reduced by 10 to 20 percent due to climate change (USBR, 2011).

Sea level rise, although not a direct impact to the Colorado River region, degrades the quality of the region's imported water from the Delta, as well as increases salinity intrusion and impacts the Delta levee infrastructure, requiring substantial capital investments by the public. According to the California Climate Change Center, sea level rose seven inches (18 cm) along California's coast during the past century (DWR, 2008; CNRA 2009).

Projections and Impacts

Temperature projections are in wide agreement on a warming trend statewide. By 2050, mean temperatures are projected to increase in the Colorado River region by 2 to 4 °F (1.1 to 2.2 °C) during winter and by 3 to 5 °F (1.7 to 2.8 °C) during summer (Cal-EMA and CNRA, 2012b). By the end of this century in 2100, mean temperatures are projected to increase about 5 to 8 °F (2.8 to 4.4 °C) during winter and up to 6 to 9 °F (3.3 to 5.0 °C) during summer (Cal-EMA and CNRA, 2012b). Pierce, et al. (2012) offer a more sophisticated modeling study, which projects that by 2070 the annual mean temperature will increase by 4.7 °F (2.6 °C) for the WRCC Sonoran Desert climate region, with increases of 3.6 °F (2.0 °C) during the winter months and 5.4 °F (3.0 °C) during summer. The WRCC Mohave Desert climate region has similar projections with annual mean temperatures increasing by 4.9 °F (2.7 °C), winter temperatures increasing by 3.6 °F (2.0 °C), and summer temperatures increasing by 5.9 °F (3.3 °C) (Pierce, et al., 2012).

Most climate simulations used by the 2009 Climate Action Team report project drier conditions in California (CNRA, 2009). Changes in annual precipitation across California, either in timing or total amount, will result in changes to the type of precipitation (rain or snow) in a given area and to the timing and volume of surface runoff. Precipitation projections from climate models for California are not all in agreement, but most anticipate drier conditions in the southern part of California, with heavier and warmer winter precipitation in the north (Pierce, et al., 2012). Because there is less scientific detail on localized precipitation changes, there exists a need to adapt to this uncertainty at the regional level (Qian, et al., 2010).

The Sierra Nevada snowpack, a source of water through the SWP, is expected to continue to decline as warmer temperatures raise the elevation of snow levels, reduce spring snowmelt, and increase winter runoff. Basing upon historical data and modeling, researchers at Scripps Institution of Oceanography project that, by the end of this century, the Sierra snowpack will experience a 48 to 65 percent loss from its average at the end of the previous century. In addition, earlier seasonal flows will reduce the flexibility in how the state manages its reservoirs to protect communities from flooding while ensuring a reliable water supply.

Although annual precipitation will vary by area, reduced snow and precipitation in the Sierra Nevada range and the Colorado River basin will affect the imported water supply for the Colorado River region and cause potential overdrafting of the region's groundwater basins. Of California's ten hydrologic regions, the Colorado River region has the lowest annual precipitation (DWR, 2009). Projections for the Colorado River region indicate that the annual rainfall will decrease in the more urbanized areas, with the southern Imperial County getting about 0.5 inches (1.3 cm) of less rain and the more eastern desert areas seeing little change (Cal-EMA and CNRA, 2012b).

On the other hand, extremes in California's precipitation are projected to increase with climate change (Dettinger, 2012). Recent computer downscaling techniques indicate that California flood risks from warm-wet, atmospheric river type storms may increase beyond those that we have known historically, mostly in the form of occasional more-extreme-than-historical storm seasons (Dettinger, 2011). Winter runoff could result in flashier flood hazards. Higher flow volumes will scour stream and flood control channels, degrading habitats already impacted by shifts in climate and placing additional stress on special-status species. The lower deserts of the Colorado River region are susceptible to flooding, which is a concern in the Borrego and Coachella Valleys. The Whitewater River has caused severe flooding back in 1965, 1969, and 1976 (DWR, 2009). The occasional summer monsoonal thunderstorms that the lower deserts experience could increase in frequency and intensity and result in flash floods and debris flows, especially in areas with alluvial fans.

Changes in climate and runoff patterns may create competition among sectors that utilize water. The agricultural demand within the region could increase due to higher evapotranspiration rates caused by increased temperatures. Prolonged drought and decreased water quality could further diminish the viability of intermittent streams characteristic of this region and the Salton Sea, the state's largest lake. The Salton Sea is a critical stop for migratory birds on the Pacific and Central Flyways, and, as the lake's level declines and sediments currently underwater get exposed, birds and fish would be impacted and increased amounts of windborne dust could affect human health in the Coachella and Imperial Valleys, as well as in Mexico (USGS, 2007; Pitzer, 2013).

Environmental water supplies would need to be retained for managing flows in habitats for aquatic and migratory species throughout the dry season not only for the Salton Sea, but also for the region's imported water. Currently, Delta pumping restrictions are in place to protect endangered aquatic species. Climate change is likely to further constrain the management of these endangered species and the state's ability to provide water for other uses. For the Colorado River region, this would further reduce supplies available for import through the SWP during the non-winter months (Cayan, 2008; Hayhoe, 2004). The U.S. Bureau of Reclamation's (USBR) Lower Colorado Region, which serves as the water master for the lower Colorado River, must also balance water supply with demand, including water-dependent ecological systems and habitats, hydroelectric generation, water quality, and recreation (USBR, 2011). USBR's Colorado River Basin Study confirms a range of potential future imbalances between water supply and water demand, as well as a need for an approach that applies a multitude of options at all levels to address such imbalances (USBR, 2012).

Prolonged drought events are likely to continue and further impact the availability of local and imported surface water and contribute to the depletion of groundwater supplies. With increasing temperatures, net evaporation from reservoirs is projected to increase by 15 to 37 percent (Medellin-Azuara, et al., 2009; CNRA, 2009). The Colorado River Basin is a critical source of water for the Colorado River region. Although the existing storage capacity for the Colorado River has provided the ability to meet water demands during sustained droughts, droughts of greater severity have occurred and will likely occur again in the future (USBR, 2011). According to the USBR, droughts lasting five or more years are projected to occur 50 percent of the time over the next 50 years (USBR, 2012).

Higher temperatures and decreased moisture during the summer and fall seasons, particularly in the mountain reaches of the lowland desert area, will increase vulnerability to wildfire hazards in the Colorado River region and impact local watersheds, though the extent to which climate change will alter existing risk to wildfires is variable (Westerling and Bryant, 2006). Little change is projected for most of the region, except for the Mecca San Gorgonio and San Jacinto Mountains, which are likely to have one and half to two times more wildfires (Cal-EMA and CNRA, 2012b). However, early snowmelt and drier conditions will increase the size and intensity of these fires (Westerling, 2012).

Furthermore, wildfires can contribute to debris flow flooding in vulnerable communities in the foothills of the Colorado River region. Past events have shown flooding to be a real concern after fires occur. The community of Borrego Springs was flooded in 2003 by storm water runoff flowing from the Ranchita area that had earlier been scorched by fire (DWR, 2009). The highly unpredictable nature of alluvial fans within a region can create flooding situations dependent on rain, vegetation, and wildfires (Stuart, 2012).

A recent study that explores future climate change and flood risk in the Sierras, using downscaled simulations (refining computer projections to a scale smaller than global models) from three global climate models (GCMs) under an accelerating GHG emissions scenario that is more reflective of current trends, indicates a tendency toward increased three-day flood magnitude. By the end of the 21st century, all three projections yield larger floods for both the moderate elevation northern Sierra Nevada watershed and for the high elevation southern Sierra Nevada watershed, even for GCM simulations with 8 to15 percent declines in overall precipitation. The increases in flood magnitude are statistically significant for all three GCMs for the period 2051 to 2099. By the end of the 21st Century, the magnitudes of the largest floods increase to 110 to 150 percent of historical magnitudes. These increases appear to derive jointly from increases in heavy precipitation amount, storm frequencies, and days with more precipitation falling as rain and less as snow. The frequency of floods by the end of this century increased for two of the models, but remained constant or declined for the third model. (Das, et al., 2011.)

Even though this study focused on the Sierras, these scenarios could potentially be indicative of other regional settings already experiencing flooding risks. Therefore, it is essential for local agencies to take action and be ready to adapt to climate change to protect the well-being of local communities.

Adaptation

Changes in climate have the potential to impact the region, upon which the State depends for its economic and environmental benefits. These changes will increase the vulnerability of natural and built systems in the region. Impacts to natural systems will challenge aquatic and terrestrial species by diminishing water quantity and quality and shifting eco-regions. Built systems will be impacted by changing hydrology and runoff timing, loss of natural snowpack storage, making the region more dependent on surface storage in reservoirs and groundwater sources. Preparing for increased future water demand for both natural and built systems may be particularly challenging with less natural storage and less overall supply.

The Colorado River region contains a diverse landscape with different climate zones, making it difficult to find one-size-fits-all adaptation strategies. Water managers and local agencies must work together to determine the appropriate planning approach for their operations and communities. While climate change adds another layer of uncertainty to water planning, it does not fundamentally alter the way water managers already address uncertainty (USEPA and DWR, 2011). However, stationarity (the concept that natural systems fluctuate within an unchanging envelope of variability) can no longer be assumed, so new approaches will likely be required (Milly, et al., 2008). Whatever planning approach is used, it is necessary for water managers and communities to start implementing adaptation measures sooner than later in order to be prepared for current and future changes.

IRWM planning is an example of a framework that allows water managers to address climate change on a smaller, more regional scale. Climate change is now a required component of all IRWM plans. IRWM regions must identify and prioritize their specific vulnerabilities, and identify adaptation strategies that are most appropriate for sub-regions. Planning strategies to address vulnerabilities and adaptation to climate change should be both proactive and adaptive, starting with low-regret strategies that benefit the region in the present-day, while adding future flexibility and resilience under uncertainty.

Water supplies within California are already stressed because of current demand and expected population growth. Even though the Colorado River region represents about two percent of the State's population, it grew by 18 percent between 2000 and 2005 (DWR, 2009). The uncertainty on the extent of these environmental changes will no doubt reduce the ability of local agencies to meet the water demand for the Colorado River region, if these agencies are not adequately prepared.

Adaptation strategies to consider for managing water in a changing climate include developing coordinated plans for mitigating future flood, landslide, and related impacts, implementing activities to minimize and avoid development in flood hazard areas, restoring existing flood control and riparian and stream corridors, implementing tiered pricing to reduce water consumption and demand, increasing regional natural water storage systems, and encouraging low impact development to reduce storm water flows, and promoting economic diversity and supporting alternative irrigation techniques within the agriculture industry. To further safeguard water supplies, other promising strategies include adopting more water-efficient cropping systems, investing in water saving technologies, and developing conjunctive use strategies. In addition, tracking forest health in the mountain areas and reducing accumulated fuel load will provide a more resilient watershed ecosystem that can mitigate for floods and droughts. (DWR, 2008; Hanak and Lund, 2011; Cal-EMA and CNRA, 2012c; CNRA, 2012; Jackson, et al., 2012.)

Local, state, and federal agencies face the challenge of interpreting climate change data and determining which methods and approaches are appropriate for their planning needs. The Climate Change Handbook for Regional Water Planning provides an analytical framework for incorporating climate change impacts into a regional and watershed planning process and considers adaptation to climate change (USEPA and DWR, 2011). This handbook provides guidance for assessing the vulnerabilities of California's watersheds and regions to climate change impacts, and prioritizing these vulnerabilities.

Central to adaptation in water management is full implementation of IRWM plans that address regionally appropriate practices that incorporate climate change adaptation. These IRWM plans, along with regional flood management plans, can integrate water management activities that connect corridors and restore native aquatic and terrestrial habitats to support the increase in biodiversity and resilience for adapting to changes in climate (CNRA, 2009). However, with limited funds the Regional Water Management Groups (RWMGs) must prioritize their investments.

Already RWMGs in the Colorado River region are taking action. The Mojave RWMG is implementing projects that assist in adapting to climate change. The Mojave RWMG has facilitated water conservation projects and has received funding to complete a recharge project in the Joshua Basin. The Coachella Valley RWMG is integrating flood management and including a ground water monitoring strategy into its IRWM plan update and has received implementation funds to treat arsenic in the water supply of disadvantaged communities. Priorities for the Imperial Valley RWMG include protecting its sole-source aquifer in the Ocotillo area and managing groundwater to include desalination and storage.

Additional work is underway to better understand impacts of climate change and other stressors on water supply and demand for the Colorado River region. USBR has completed a basin study to define current and future imbalances in water supply and demand in the Colorado River Basin and the adjacent areas of the Basin States, including California, that receive Colorado River water (USBR, 2011; USBR, 2012). Through this study, USBR developed and analyzed adaptation and mitigation strategies to resolve those imbalances. Future actions must occur to implement these solutions; therefore, USBR is coordinating with the Basin States, Tribes, conservation organizations, and other stakeholders (USBR, 2012).

DWR is assisting the Anza-Borrego RWMG by documenting the past, present, and range of foreseeable future conditions within the local groundwater basins of the Borrego Valley and summarizing the information in an Anza-Borrego Desert Region Summary report. USBR also is collaborating with the Borrego Water District and other local water agencies in a basin study specific to California's Colorado River region to assess the effects of prolonged drought, population growth, and climate change, and to develop adaptation strategies for the region to handle future water supply and water quality demands (USBR, 2010).

The Salton Sea Species Conservation Habitat Project completed a Draft Environmental Impact Statement/ Environmental Impact Report that discussed climate change impacts and provided an analysis of GHG emissions (USACE and CNRA, 2011), and the Cities of Palm Desert and Palm Springs have conducted GHG emissions inventories and adopted GHG targets (DeShazo and Matute, 2012). According to the Luskin Center for Innovation report, roughly one third of southern California cities have taken steps towards reducing GHG emissions (DeShazo and Matute, 2012), but more work still needs to be done, not only in mitigating for but also in adapting to climate change.

Strategies to manage local water supplies must be developed with the input of multiple stakeholders (Jackson, et al., 2012). While both adaptation and mitigation are needed to manage risks and are often complementary and overlapping, there may be unintended consequences if efforts are not coordinated (CNRA, 2009).

The Imperial Valley RWMG recognizes the disconnect between land use planning and water supply within its area and has brought land use representatives from Imperial County, local cities, and unincorporated towns into its IRWM membership in updating its IRWM plans and prioritizing its projects. A mitigation policy for cumulative impact of development within the region is one of the priorities for the Imperial Valley RWMG. Another example of integrating across sectors is a tool developed by the California State University at San Bernardino – Water Resources Institute developed in partnership with DWR, which is a web-based portal for land use planning in alluvial fans and uses an integrated approach in assessing hazards and resources (http://aftf.csusb.edu/; Lien-Longville, 2012).The State of California has developed additional on-line tools and resources to assist water managers, land use planners, and local agencies in adapting to climate change. These tools and resources include the following:

- *2009 California Climate Adaptation Strategy* (http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf), which identifies a variety of strategies across multiple sectors (other resources can be found at http://www.climatechange.ca.gov/adaptation/strategy/index.html)
- *California Adaptation Planning Guide* (http://resources.ca.gov/climate_adaptation/local_government/adaptation_planning_guide.html), developed into four complementary documents by the California Emergency Management Agency and the California Natural Resources Agency to assist local agencies in climate change adaptation planning
- *Cal-Adapt* (http://cal-adapt.org/), an on-line tool designed to provide access to data and information produced by California's scientific and research community
- *Urban Forest Management Plan Toolkit* (www.UFMPtoolkit.com), sponsored by the California Department of Forestry and Fire Management to help local communities manage urban forests to deliver multiple benefits, such as cleaner water, energy conservation, and reduced heat-island effects
- *California Climate Change Portal* (http://www.climatechange.ca.gov/)
- *DWR Climate Change* website (http://www.water.ca.gov/climatechange/resources.cfm)
- *The Governor's Office of Planning and Research* website (http://www.opr.ca.gov/m_climatechange.php)

There are several Resource Management Strategies found in Volume 3 of the California Water Plan Update 2013 that not only assist in meeting water management objectives but also provide benefits for adapting to climate change, including the following:

- Agricultural and Urban Water Use Efficiency
- Water Transfers
- Conjunctive Management and Groundwater Storage
- Desalination
- Recycled Municipal Water
- Surface Storage – Regional/Local
- Drinking Water Treatment and Distribution
- Groundwater/Aquifer Remediation
- Pollution Prevention
- Salt and Salinity Management
- Agricultural Land Stewardship
- Economic Incentives
- Ecosystem Restoration
- Forest Management

- Land Use Planning and Management
- Recharge Area Protection
- Watershed Management
- Integrated Flood Management

The myriad of resources and choices available to managers can seem overwhelming, and the need to take action given uncertain future conditions is daunting. There are many low-regret actions that water managers in the Colorado River region can take to prepare for climate change, regardless of the magnitude of future warming. These low-regret actions involve adaptation options where moderate levels of investment increase the capacity to cope with future climate risks (The World Bank, 2012).

Water managers and others will need to consider both the natural and built environments as they plan for the future. Stewardship of natural areas and protection of biodiversity are critical for maintaining ecosystem services important for human society, such as flood management, carbon sequestration, pollution remediation, and recreation. Land use decisions are central components in preparing for and minimizing the impacts from climate change (CNRA, 2009). Increased cross-sector collaboration among water managers, land use planners and ecosystem managers provides opportunities for identifying common goals and actions needed to achieve resilience to climate change and other stressors.

Mitigation

California's water sector has a large energy footprint, one that includes extraction, conveyance, treatment, distribution, and use (see CA Water Today, Water-Energy, Volume 1). Reducing emissions of GHGs is a State mandate, and water managers can support this effort by considering energy intensity in the decision making process. This is the first California Water Plan Update to provide energy intensity information related to regional water management.

One important way water managers can incorporate mitigation of GHG emissions in water management and planning is to compare energy intensity of various water supplies available to meet demand within each hydrologic region. Energy intensity is closely related to the GHG emissions, but not identical, depending on type of energy used (see CA Water Today, Water-Energy, Volume 1). Water use efficiency and related best management practices can also mitigate climate change (See Volume 3, Resource Management Strategies).

In this regional report the energy intensity, or embedded energy, includes the amount of energy needed to move the water only from its source to a centralized delivery location, such as a water treatment plant or a SWP delivery turnout. None of the energy required for water treatment, distribution, nor end use is included. The energy intensity information presented here does not take into account hydroelectricity generation (see Hydroelectricity discussion, below). Further, energy intensity should not be confused with total energy—that is, the amount of energy (e.g., kWh) required to deliver all of the water from a water source to customers within the region. Energy intensity here focuses not on the total amount of energy used to deliver water, but rather the energy required to deliver a single unit of water (in kWh/acre-foot). In this way, energy intensity gives a normalized metric which can be used to compare alternative water sources.

Figure CR-16 compares the amount of energy associated with delivery of one acre-foot of water. Water types not available in this region are indicated. Some types of water flow by gravity to the centralized delivery location and, therefore, do not require any energy to pump or move, including Reuse, Instream Environmental, and Inflow and Storage. Recycled Water and Desalination are covered in the below, not in Figure CR-16. An equivalent energy-intensity comparison could not be made with these water types due to extensive or additional water treatment required for such sources to be viable, such as additional treatment required in meeting recycled water standards. (For detailed descriptions of the methodology used for the water types presented, see Technical Guide, Volume 5.)

PLACEHOLDER Figure CR-16 Energy Intensity per acre foot of Water

[Any draft tables, figures, and boxes that accompany this text for the public review draft are included at the end of the report.]

Recycled Water

Local water sources require less energy, provide a sustainable water supply, and reduce the amount needed from imported water. Use of recycled water provides opportunities to reduce the water sector's energy and carbon footprint for climate change adaptation and mitigation. According to various studies, recycled water is among the least energy-intensive options to consider (Wilkinson, et al., 2005). However, additional factors must be included not normally considered for other water sources. These factors include the transportation of water from secondary wastewater treatment plants (WWTPs) to tertiary WWTPs and the tertiary treatment of that water. The proximity of these WWTPs to each other and the proximity to existing and potential storage sites and customers will determine the viability of recycled water within an area, as well as the energy intensity of such a water source.

Recycled water could reduce energy use and carbon footprint in a diversified water management portfolio. However, energy intensity of recycled water in each water supply and operation system could be different depending on actual energy inputs related to complex factors, including 1) the quality of source water, 2) the energy intensity of the technologies used to treat the source water to regulatory standards needed by end users, 3) the distance to transport recycled water to end users, and 4) the efficiency of the conveyance, distribution and treatment facilities and systems. Because of the complexities involved, the evaluation of the energy intensity of recycled water is best suited on a more local or project scale, rather than regional scale; therefore, recycled water is not included in Figure CR-16.

Desalination – Brackish and Seawater

Desalination systems, using reverse osmosis, are being used in California, mostly for brackish groundwater. Energy factors to be considered for desalinated water not only include the conveyance or extraction of the water source (whether it be from brackish or seawater), but also the energy required for desalinating water for potable use. The energy intensity for desalination is almost entirely related to the salinity level and the water temperature of the source water. As a result, brackish water requires less energy to treat than ocean water. The energy intensity of pumping and treating brackish ground water by desalination can range from about 400-1,700 KWh per acre feet, while that for seawater can range from about 4,000-7,000 KWh per acre feet (CEC, 2006). Ocean desalination plants are in operation in the state, but they are small in size at this point. Several demonstration plants have been, or are operating as a prelude to larger plants. One large capacity (25,000 AF/Y) plant is under construction in southern California; others are in the planning and development stage. Although seawater desalination has potential as a marginal supply within a water management portfolio to adapt drought from climate change, it has a tradeoff for climate change mitigation with its high energy and carbon footprint.

Hydropower

The energy intensity numbers in Figure CR-16 do not include energy generated at hydroelectric generating stations associated with the State Water Project, Central Valley Project, Colorado River Aqueduct, local import projects, or local surface water projects. Because these reservoirs were constructed and are operated for multiple benefits including flood protection, recreation, water supply, environmental flow management, and hydroelectricity generation, there are several reasonable ways that energy generation at these facilities can be handled. Wilkinson (2000) suggests the following methodology:

"Power generated by water systems separate from the delivery and conveyance systems is not included in the calculations. This is because power would be generated in any event, regardless of the ultimate use of the water, and whether power is generated or not does not influence the energy requirements for delivery and use. For example, hydro-power generation from water flowing from northern California to the Delta is not counted in this analysis because it would be generated whether the water flows out the Golden Gate or is pumped out of the delta to southern California in the SWP. The calculations for the SWP therefore start at the delta. (This methodology is not intended to diminish the role and importance of hydro-power production. The consideration is strictly the correct methodology for assessment of the total embodied energy in each unit of water used in a specific location.) Power generated as part of the conveyance systems, however, is counted because it is directly related to the volumes of water pumped through the system. (For example, power recovered from the Warne and Castaic plants on the west branch of the SWP recover a portion of the energy inputs in the system from the Banks through Wind Gap pumping plants in the Central Valley and the Edmonston and Oso pumping plants that lift water over the Tehachapi Mountains. Total energy requirements are adjusted to credit back to the system the power generation against the pumping requirements to a given point in the system.)"

In contrast to Wilkinson (2000), _____ have suggested that completely omitting hydroelectric generation from energy intensity calculations systematically overstates the energy intensity of water from these projects and arbitrarily truncates the energy accounting by not considering the entire system.

In these regional reports, energy generated at upstream multi-purpose reservoirs has been omitted from the calculation of energy intensity.

*The WRCC has temperature and precipitation data for the past century. Through an analysis of National Weather Service Cooperative Station and PRISM Climate Group gridded data, scientists from the WRCC have identified 11 distinct regions across the state for which stations located within a region vary with one another in a similar fashion. These 11 climate regions are used when describing climate trends within the state (Abatzoglou, et al., 2009). DWR's hydrologic regions, however, do not correspond directly to WRCC's climate regions. A particular hydrologic may overlap more than one climate region and, hence, have different climate trends in different areas. For the purpose of this regional report, climate trends of the major overlapping climate regions are considered to be relevant trends for respective portions of the overlapping hydrologic region.

References

References Cited

State Water Resources Control Board. 2013. “Communities that Rely on Contaminated Groundwater Source for Drinking Water, Report to the Legislature”. [Website]. Viewed online at: http://www.waterboards.ca.gov/water_issues/programs/gama/ab2222/docs/ab2222.pdf

Mathany, T.M., Wright, M.T., Beuttel, B.S., and Belitz, Kenneth, 2012, Groundwater-quality data in the Borrego Valley, Central Desert, and Low-Use Basins of the Mojave and Sonoran Deserts study unit, 2008–2010—Results from the California GAMA Program: U.S. Geological Survey Data Series 659, 100 p. Viewed online at: http://pubs.usgs.gov/ds/659/pdf/ds659.pdf

Goldrath, Dara A., Wright, Michael T., and Belitz, Kenneth, 2009, Ground-water quality data in the Coachella Valley study unit, 2007: Results from the California GAMA Program: U.S. Geological Survey Data Series 373, 70 p. Available at http://pubs.usgs.gov/ds/373

Goldrath, D.A., Wright, M.T., and Belitz, Kenneth, 2010, Groundwater-quality data in the Colorado River study unit, 2007: Results from the California GAMA program: U.S. Geological Survey Data Series 474, 66 p. Available at http://pubs.usgs.gov/ds/474/

State Water Resources Control Board, 2010, Groundwater Ambient Monitoring and Assessment Domestic Well Project Groundwater Quality Report San Diego County Focus Area. Available at: http://www.waterboards.ca.gov/gama/docs/sdreport.pdf

Nishikawa, T., Densmore, J.N., Martin, P., and Matti, J. 2003. Evaluation of the Source and Transport of High Nitrate Concentrations in Ground Water, Warren Subbasin, California. Available at: http://www.waterboards.ca.gov/coloradoriver/water_issues/programs/basin_planning/docs/yuccavalley/appnd_a.pdf

Abatzoglou, J.T., K.T. Redmond, and L.M. Edwards. 2009. Classification of Regional Climate Variability in the State of California. Journal of Applied Meteorology and Climatology, 48, 1527-1541.

(CARB) California Air Resources Board. 2008. Climate Change Scoping Plan: A Framework for Change. http://www.arb.ca.gov/cc/scopingplan/document/scopingplandocument.htm.

(DWR) California Department of Water Resources. 2008. Managing an Uncertain Future: Climate Change Adaptation Strategies for California’s Water.

(DWR) California Department of Water Resources. 2009. California Water Plan Update 2009: Colorado River Integrated Water Management. Bulletin 160-09, Volume 3, Regional Reports.

(Cal-EMA and CNRA) California Emergency Management Agency and California Natural Resources Agency. 2012a. California Adaptation Planning Guide (four documents). (http://resources.ca.gov/climate_adaptation/local_government/adaptation_planning_guide.html).

(Cal-EMA and CNRA) California Emergency Management Agency and California Natural Resources Agency. 2012b. California Adaptation Planning Guide: Understanding Regional Characteristics. http://resources.ca.gov/climate_adaptation/docs/APG_Understanding_Regional_Characteristics.pdf.

(Cal-EMA and CNRA) California Emergency Management Agency and California Natural Resources Agency. 2012c. California Adaptation Planning Guide: Identifying Adaptation Strategies. http://resources.ca.gov/climate_adaptation/docs/APG_Identifying_Adaptation_Strategies.pdf.

(CNRA) California Natural Resources Agency. 2009. 2009 California Climate Adaptation Strategy. http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf.

(CNRA) California Natural Resources Agency. 2012. Draft California Climate Adaptation Strategy Update 2012: Draft Outline Water Sector Adaptation to Climate Change Impacts. (DWR draft outline: http://www.water.ca.gov/climatechange/docs/WaterSectorStrategiesSASC-draft.pdf)

Cayan, D. 2008. Climate Change Scenarios for the California Region. Climatic Change, 87(s1), 21-S42.

Christensen, Niklas S., Andrew W. Wood, Nathalie Voisin, et al. 2004. Effects of Climate Change on the Hydrology and Water Resources of the Colorado River Basin. Climatic Change, vol 62, pp. 337 - 363.

Das, Tapash, Michael D. Dettinger, Daniel R. Cayan, and Hugo G. Hidalgo. 2011. Potential increase in floods in California's Sierra Nevada under future climate projections. Climatic Change, 2011.

DeShazo, J.R. and Juan Matute. 2012. Progress Report: Climate Action Planning in Southern California. Luskin Center for Innovation, Luskin School of Public Affairs, University of California – Los Angeles. http://luskin.ucla.edu/sites/default/files/Luskin%20Climate%20Report.pdf.

Dettinger, Michael. 2011. Climate Change, Atmospheric Rivers, and Floods in California – A Multimodel Analysis of Storm Frequency and Magnitude Changes. Journal of the American Water Resources Association.

Dettinger, Michael. 2012. DWR Workshop: Climate Change, Extreme Weather, and Southern California Floods (http://www.water.ca.gov/climatechange/docs/013112agenda.pdf). Climate Change, Extreme Precipitation, and Atmospheric Rivers presentation. http://www.water.ca.gov/climatechange/docs/dwr_extremes_wkshop_jan2012-MikeDettinger131.pdf.

Guido, Zack. 2008. Mountain Snowpack in the West and Southwest. Southwest Climate Change Network. http://www.southwestclimatechange.org/impacts/water/snowpack.

Hanak, Ellen and Jay R. Lund. 2011. Adapting California's Water Management to Climate Change. Springer Science+Business Media B.V., DOI 10.1007/s10584-011-0241-3. http://www.waterlawsymposium.com/sites/default/files/Hanak&Lund_climatic_change.pdf.

Hayhoe, Katharine, et al. 2004. Emissions Pathways, Climate Change, and Impacts on California. Proceedings of the National Academy of Science. Volume 101: 34.

(IPCC) Intergovernmental Panel on Climate Change. 2007. IPCC Fourth Assessment Report: Climate Change 2007: Synthesis Report. http://www.ipcc.ch/publications_and_data/ar4/syr/en/main.html

Jackson, Louise, Van R. Haden, Stephen M. Wheeler, Allan D. Hollander, Josh Perlman, Toby O'Geen, Vishal K. Mehta, Victoria Clark, John Williams, and Ann Thrupp (University of California, Davis). 2012. Vulnerability and Adaptation to Climate Change in California Agriculture. California Energy Commission. Publication number: CEC-500-2012-031. http://www.energy.ca.gov/2012publications/CEC-500-2012-031/CEC-500-2012-031.pdf.

Lien Longville, Susan. January 31, 2012. DWR Workshop: Climate Change, Extreme Weather, and Southern California Floods (http://www.water.ca.gov/climatechange/docs/013112agenda.pdf). Reducing Impacts of Climate Change, Extreme Weather, and Southern California Floods: Case Study in Implementation of the Integrated Approach for Sustainable Development on Alluvial Fans presentation. http://www.water.ca.gov/climatechange/docs/Longville_AFTF2012Jan31_ClimateChangeExtremeWeatherSouthernCalifornia-SusanLien131.pdf.

Medellin-Azuara, Josué, Christina R. Connell, Kaveh Madani, Jay R. Lund, and Richard E. Howitt. 2009. Water Management Adaptation with Climate Change. PIER Research Report, CED-500-2009-049-D, Sacramento, CA: California Energy Commission.

Milly, P.C.D., Julio Betancourt, Malin Falkenmark, Robert M. Hirsch, Zbigniew W. Kundzewicz, Dennis P. Lettenmaier, and Ronald J. Stouffer. 2008. Stationarity is Dead: Whither Water Management? Science 319: 573-574. http://wwwpaztcn.wr.usgs.gov/julio_pdf/milly_et_al.pdf.

Mote, P. W., A. F. Hamlet, M. Clark, and D. P. Lettenmaier. 2005. Declining mountain snowpack in western North America. Bulletin of the American Meteorological Society 86(1):39-49.

Pierce, D.W., T. Das, D.R. Cayan, E.P. Maurer, N.L. Miller, Y. Bao, M. Kanamitsu, K. Yoshimura, M.A. Snyder, L.C. Sloan, G. Franco, and M. Tyree. 2012. Springer-Verlag, DOI 10.1007/s00382-012-1337-9. http://meteora.ucsd.edu/cap/pdffiles/Pierce_etal_2012_CD.pdf.

Qian, Yun, Steven J. Ghan, and L. Ruby Leung. 2010. Downscaling Hydroclimatic Changes Over the Western US Based on CAM Subgrid Scheme and WRF Regional Climate Simulations. International Journal of Climatology, April.

Stewart, I. T., D. R. Cayan and M. D. Dettinger. 2005. Changes toward earlier streamflow timing across western North America. Journal of Climate 18:1136–1155.

Stuart, Mark. 2012. DWR Workshop: Climate Change, Extreme Weather, and Southern California Floods (http://www.water.ca.gov/climatechange/docs/013112agenda.pdf). Alluvial Fan Task Force: Mission, History, and Outcomes presentation. http://www.water.ca.gov/climatechange/docs/Mark%20Stuart_AFTF2012Jan31_ClimateChangeExtremeWeatherSoCalFlooding%20Final-MarkStuart131.pdf.

The World Bank. 2012. Climate Change: Adaptation Guidance Notes - Key Words and Definitions. http://climatechange.worldbank.org/content/adaptation-guidance-notes-key-words-and-definitions.

(USACE and CNRA) U.S. Army Corps of Engineers and California Natural Resources Agency. 2011. Salton Sea Species Conservation Habitat Project: Draft Environmental Impact Statement/Environmental Impact Report. http://www.water.ca.gov/saltonsea/habitat/eir2011.cfm.

(USBR) U.S. Bureau of Reclamation. 2010. Southeast California Regional Basin Study factsheet. http://www.usbr.gov/WaterSMART/bsp/docs/fy2010/SE_CA_Regional_Factsheet_Final.pdf.

(USBR) U.S. Bureau of Reclamation. 2011. Colorado River Basin Water Supply and Demand Study: Basin Study Program Fact Sheet. http://www.usbr.gov/lc/region/programs/crbstudy/FactSheet_May2011.pdf.

(USBR) U.S. Bureau of Reclamation. 2012. Colorado River Basin Water Supply and Demand Study: Executive Summary. http://www.usbr.gov/WaterSMART/bsp/index.html.

(USEPA and DWR) U.S. Environmental Protection Agency, Region 9 and California Department of Water Resources. 2011. Climate Change Handbook for Regional Water Planning. http://www.water.ca.gov/climatechange/CCHandbook.cfm.

(USGS) U.S. Geological Survey. 2007. The USGS Salton Sea Science Office fact sheet. http://pubs.usgs.gov/fs/2007/3097/.

Westerling, Anthony. 2012. DWR Workshop: Climate Change, Extreme Weather, and Southern California Floods (http://www.water.ca.gov/climatechange/docs/013112agenda.pdf). Climate Change and Wildfire Extremes presentation. http://www.water.ca.gov/climatechange/docs/DWR_extremes-Tony%20Westerlling131.pdf.

Westerling, Anthony and Benjamin Bryant. 2006. Climate Change and Wildfire in and around California: Fire Modeling and Loss Modeling. A Repot from California Climate Change Center, CEC 500-2006-190-SF. http://ulmo.ucmerced.edu/pdffiles/06CEC_WesterlingBryant.pdf.

(WRCC) Western Region Climate Center. 2012. Climate Variability in the State of California. Journal of Applied Meteorology and Climatology, 48, 1527-1541. (On-line data citation, accessed 10/3/2012: http://www.wrcc.dri.edu/monitor/cal-mon/frames_version.html)

Williamson, Sean, Matthias Ruth, Kim Ross, and Daraius Irani. 2008. Economic Impacts of Climate

Additional References

Change on Colorado: A Review and Assessment Conducted by the Center for Integrative Environmental Research, University of Maryland. http://www.cier.umd.edu/climateadaptation/Colorado%20Economic%20Impacts%20of%20Climate%20Change.pdf.

Celeste Alvarez, “The Building of Future Wetlands Depends on Funding,” Imperial Valley Press. August 12, 2012.

Quellette, Michelle and Cushman, Melissa R., “Court Upholds California’s Landmark Quantification Settlement Agreement. Legal Alert. December 8, 2011

Brownstein, Hyatt, Farber, and Schreck, “Court of Appeal Reinstates Historic Quantification Settlement Agreements. December 14, 2011.

Varin, Elizabeth, “QSA will not be heard at Supreme Court.” Imperial Valley Press, January 17, 2012.

2009 California Climate Adaptation Strategy (http://resources.ca.gov/climate_adaptation/docs/Statewide_Adaptation_Strategy.pdf), which identifies a variety of strategies across multiple sectors (other resources can be found at http://www.climatechange.ca.gov/adaptation/strategy/index.html)

California Adaptation Planning Guide (http://resources.ca.gov/climate_adaptation/local_government/adaptation_planning_guide.html), developed into four complementary documents by the California Emergency Management Agency and the California Natural Resources Agency to assist local agencies in climate change adaptation planning

Cal-Adapt (http://cal-adapt.org/), an on-line tool designed to provide access to data and information produced by California’s scientific and research community

Urban Forest Management Plan Toolkit (www.UFMPtoolkit.com), sponsored by the California Department of Forestry and Fire Management to help local communities manage urban forests to deliver multiple benefits, such as cleaner water, energy conservation, and reduced heat-island effects

California Climate Change Portal (http://www.climatechange.ca.gov/)

DWR Climate Change website (http://www.water.ca.gov/climatechange/resources.cfm)

The Governor's Office of Planning and Research website (http://www.opr.ca.gov/m_climatechange.php)

1/ Coachella Valley Water District, October 19, 2012 e-mail to DWR.

(Environmental mitigation projects for the All-American Canal Lining Project being developed with assistance from the Imperial Irrigation District. October 23, 2012.)

Mike Lee, “New Plan Could Revive Filthy New River,” San Diego Union-Tribune. July 15, 2012. http://www.utsandiego.com/news/2012/jul/15/new-plan-could-revive-filthy-new-river/

Bernice Young, “Californians Push for New River Cleanup in Health Plan.” California Watch. October 4, 2011. http://californiawatch.org/dailyreport/Californians-push-new-river-cleanup-health-plans-12915

Imperial Irrigation District. 2009 Annual Water Report.

Imperial Irrigation District. 2010 Annual Water Report.

Imperial Irrigation District. IID Interim Water Supply Policy for Non-Agricultural Projects.

Imperial Irrigation District. Resolution No. 13-2013. Exhibits 1 and 2.

International Boundary and Water Commission. United States and Mexico. Minute No. 319. Interim internation Cooperative Measures in the Colorado River Basin Through 2017 and Extension of Minute 318 Cooperative Measures to Address the Continued Effects of the April, 2010 Earthquake in the Mexicali Valley, Baja California. November 20, 2012.

Tony Perry and Richard Marosi, "U. S., Mexico Reach Pact on Water." Los Angeles Time, November 20, 2012.

http://en.wikipedia.org/2010_Baja_California_Earthquake

Personal Communications

Many emails and telephone calls were exchanged between Southern Region staff and Imperial Irrigation District, Coachella Valley Water District, and other entities.

Colorado River Board of Southern California provided valuable comments and critiques.

Table of Contents

This is set up to generate a list of all text styled as “Update 2013 heading 1” through “Update 2013 heading 5.” It can be modified to collect any styles you want. You may change what it gathers by selecting the line of text below; right-clicking; and choosing Edit Field, Table of Contents, Options.

Table Mentions
This is set up to generate a list of all text marked as a table mention, using the letter T as the table identifier.

No table of figures entries found.

Table Titles
This is set up to generate a list of all text styled as "Update 2013 table title."

Figure Mentions

This is set up to generate a list of all text marked as a figure mention, using the letter F as the table identifier.

No table of figures entries found.

Figure Titles

This is set up to generate a list of all text styled as “Update 2013 figure title.”

Box Titles
This is set up to generate a list of all text styled as "Update 2013 box title," which may be used as for placeholders.

Box Mentions
This is set up to generate a list of all text marked as a reference to a box, using the letter B as the table identifier.

No table of figures entries found.

Acronyms and Abbreviations
This is set up to generate a list of all text marked as an acronym/abbreviation, using the letter A as the table identifier.

No table of figures entries found.

Citations
This is set up to generate a list of all text marked as a citation, using the letter C as the table identifier.

No table of figures entries found.

Miscellaneous This is set up to generate a list of all text marked as miscellaneous [river names, region names, or anything else you'd like to gather into a list], using the letter M as the table identifier.
No table of figures entries found.
Glossary **This is set up to generate a list of all text marked as a glossary entry, using the letter Z as the table identifier.**
No table of figures entries found.

Table CR-1 Alluvial Groundwater Basins and Subbasins within the Colorado River Hydrologic Region

Basin/Subbasin		Basin Name	Basin/Subbasin	Basin Name
7-1		Lanfair Valley	7-28	Vallecito-Carrizo Valley
7-2		Fenner Valley	7-29	Coyote Wells Valley
7-3		Ward Valley	7-30	Imperial Valley
7-4		Rice Valley	7-31	Orocopia Valley
7-5		Chuckwalla Valley	7-32	Chocolate Valley
7-6		Pinto Valley	7-33	East Salton Sea
7-7		Cadiz Valley	7-34	Amos Valley
7-8		Bristol Valley	7-35	Ogilby Valley
7-9		Dale Valley	7-36	Yuma Valley
7-10		Twentynine Palms Valley	7-37	Arroyo Seco Valley
7-11		Copper Mountain Valley	7-38	Palo Verde Valley
7-12		Warren Valley	7-39	Palo Verde Mesa
7-13		Deadman Valley	7-40	Quien Sabe Point Valley
	7-13.01	Deadman Lake	7-41	Calzona Valley
	7-13.02	Surprise Spring	7-42	Vidal Valley
7-14		Lavic Valley	7-43	Chemehuevi Valley
7-15		Bessemer Valley	7-44	Needles Valley
7-16		Ames Valley	7-45	Piute Valley
7-17		Means Valley	7-46	Canebrake Valley
7-18	7-18.01	Johnson Valley Area	7-47	Jacumba Valley
	7-18.01	Soggy Lake	7-48	Helendale Fault Valley
	7-18.02	Upper Johnson Valley	7-49	Pipes Canyon Fault Valley
7-19		Lucerne Valley	7-50	Iron Ridge Area
7-20		Morongo Valley	7-51	Lost Horse Valley
7-21		Coachella Valley	7-52	Pleasant Valley
	7-21.01	Indio	7-53	Hexie Mountain Area
	7-21.02	Mission Creek	7-54	Buck Ridge Fault Valley
	7-21.03	Desert Hot Springs	7-55	Collins Valley
	7-21.04	San Gorgonio Pass	7-56	Yaqui Well Area
7-22		West Salton Sea	7-59	Mason Valley
7-24		Borrego Valley	7-61	Davies Valley
7-25		Ocotillo-Clark Valley	7-62	Joshua Tree
7-26		Terwilliger Valley	7-63	Vandeventer Flat
7-27		San Felipe Valley		

Table CR-2 Number of Well Logs by County and Use for the Colorado River Hydrologic Region (1977 - 2010)

County	Total Number of Well Logs by Well Use						Total Well Records
	Domestic	Irrigation	Public Supply	Industrial	Monitoring	Other	
Riverside	8,048	1,421	466	74	2,086	758	**12,853**
Imperial	48	9	6	11	206	68	**348**
Total Well Records	**8,096**	**1,430**	**472**	**85**	**2,292**	**826**	**13,201**

Table CR-3 CASGEM Prioritization for Groundwater Basins in the Colorado River Hydrologic Region

Basin Prioritization	Count	Basin/Subbasin Number	Basin Name	Subbasin Name	2010 Census Population
High	1	7-21.01	Coachella Valley	Indio	368,860
High	2	7-21.04	Coachella Valley	San Gorgonio Pass	29,550
Medium	1	7-21.03	Coachella Valley	Desert Hot Springs	22,568
Medium	2	7-24	Borrego Valley		3,853
Medium	3	7-12	Warren Valley		22,860
Medium	4	7-21.02	Coachella Valley	Mission Creek	18,974
Low	9	See *Water Plan Update 2013 Vol. 4 Reference Guide – California's Groundwater Update 2013*			
Very Low	49	See *Water Plan Update 2013 Vol. 4 Reference Guide – California's Groundwater Update 2013*			
Totals:	**64**		**Population of Groundwater Basin Area:**		**723,100**

Table CR-4 Groundwater Level Monitoring Wells by Monitoring Entity in the Colorado River Hydrologic Region

State and Federal Agencies	Number of Wells
DWR	0*
USGS	360
Total State and Federal Wells:	**360**
Monitoring Cooperators	**Number of Wells**
Bighorn-Desert View Water Agency	13
Hi Desert County Water District	15
Joshua Basin County Water District	3
Mojave Water Agency	30
Total Cooperator Wells:	**61**
CASGEM Monitoring Entities	**Number of Wells**
Borrego Water District	8
Coachella Valley Water District	44
Mission Springs Water District	4
San Gorgonio Pass Water Agency	18
Twentynine Palms Water District	17
Total CASGEM Monitoring Entities:	**91**
Grand Total:	**512**

*Table includes groundwater level monitoring wells having publicly available online data. DWR currently monitors 75 wells in the Colorado River Hydrologic Region; however, not all of these data are publicly available due to privacy agreements with well owners or operators.

Table represents monitoring information as of July, 2012

Table CR-5 Sources of Groundwater Quality Information for the Colorado River Hydrologic Region

Agency	Links to Information

State Water Resources Control Board	• **Groundwater**
	  • Communities that Rely on a Contaminated Groundwater Source for Drinking Water
	  • Nitrate in Groundwater: Pilot Projects in Tulare Lake Basin/Salinas Valley
	  • Hydrogeologically Vulnerable Areas
	  • Aquifer Storage and Recovery
	  • Central Valley Salinity Alternatives for Long-Term Sustainability (CV-Salts)
	• **GAMA**
	  • GeoTracker GAMA (Monitoring Data)
	  • Domestic Well Project
	  • Priority Basin Project
	  • Special Studies Project
	  • California Aquifer Susceptibility Project
	• **Contaminant Sites**
	  • Land Disposal Program
	  • Department of Defense Program
	  • Underground Storage Tank Program
	  • Brownfields

California Department of Public Health	• **Division of Drinking Water and Environmental Management**
	  • Drinking Water Source Assessment and Protection (DWSAP) Program
	  • Chemicals and Contaminants in Drinking Water
	  • Chromium-6
	  • Groundwater Replenishment with Recycled Water

Department of Water Resources	• **Groundwater Information Center**
	  • Bulletin 118 Groundwater Basins
	  • California Statewide Groudwater Elevation Monitoring (CASGEM)
	  • Groundwater Level Monitoring
	  • Groundwater Quality Monitoring
	  • Well Construction Standards
	  • Well Completion Reports

Department of Toxic Substances Control	• EnviroStor

Department of Pesticide Regulation	• **Groundwater Protection Program**
	  • Well Sampling Database
	  • Groundwater Protection Area Maps

U.S. Environmental Protection Agency	US EPA STORET Environmental Data System
United States Geological Survey	USGS Water Data for the Nation

Table CR-6 Colorado River Hydrologic Region Annual Averages of Temperatures and Precipitation

Year	Average Temperatures Maximum (F^o)	Average Temperatures Minimum (F^o)	Average Daily Temperatures (F^o)	Average Annual Precipitation (in)	Average ETo (in) [a]
2005	86.41	56.19	71.07	3.62	68.81
2006	87.11	55.79	71.21	0.95	71.66
2007	86.90	55.21	70.98	1.26	70.57
2008	87.19	55.86	71.56	1.77	70.71
2009	87.25	55.15	71.46	1.23	71.84
2010	86.02	55.61	70.97	3.42	71.13

Source: California Irrigation Management Information System.

[a] ETo – Reference evapotranspiration.

Table CR-9 Top Six Crops of Colorado River Hydrologic Region, 2009 (Acres)
(Will be updated to 2010 numbers)

Crop	Harvested Acres
Alfalfa	171,000
Wheat and other grains	116,300
Pasture including Bermuda	88,200
Lettuce and salad greens [a]	46,000
Sudan grass	41,400
Citrus and subtropical fruit including dates	32,500

[a] Total harvested acres of all truck and vegetables crops was 140,100.
Harvested acres for cole crops (broccoli, cauliflower, cabbage) was 23,500.

Table CR-10a Colorado River Hydrologic Region Average Annual Groundwater Supply by Planning Area (PA) and by Type of Use (2005-2010)

Colorado River Hydrologic Region		Agriculture Water Use Met by Groundwater		Urban Water Use Met by Groundwater		Managed Wetlands Water Use Met by Groundwater		Total Water Use Met by Groundwater	
PA Number	PA Name	TAF	% of Supply	TAF	% of Supply	TAF	% of Supply	TAF	% of Supply
1001	Twenty-Nine Palms - Lanfair	11.1	100	15.3	82	0.0	0	26.4	89
1002	Coachella	21.0	7	294.4	66	0.0	0	315.4	42
1003	Chuckwalla	2.6	100	2.1	100	0.0	0	4.7	100
1004	Colorado River	0.4	100	10.4	100	0.0	0	10.9	2
1005	Borrego	14.9	34	7.4	92	0.0	0	22.3	43
1006	Imperial Valley	0.0	0	0.1	0	0.0	0	0.1	0
	2005-10 Annual Average Total:	**50.1**	**1%**	**329.7**	**57%**	**0.0**	**0%**	**379.8**	**9%**

Note: 1) TAF = thousand acre-feet.
2) Percent of supply is the percent of the total water supply that is provided by groundwater.
3) 2005-10 precipitation equals 91% of the 30-yr average.

Table CR-10b Colorado River Hydrologic Region Average Annual Groundwater Supply by County and by Type of Use (2005-2010)

Colorado River Hydrologic Region	Agriculture Water Use Met by Groundwater		Urban Water Use Met by Groundwater		Managed Wetlands Water Use Met by Groundwater		Total Water Use Met by Groundwater	
County	TAF	% of Supply	TAF	% of Supply	TAF	% of Supply	TAF	% of Supply
Imperial	0.0	0%	1.1	1%	0	0%	1.1	0%
Riverside	138.6	14%	495.9	57%	0	0%	634.5	34%
2005-10 Annual Ave. Total:	138.6	4%	497.0	52%	0	0%	635.7	14%

Note: 1) TAF = thousand acre-feet.
2) Percent of supply is the percent of the total water supply that is provided by groundwater.
3) 2005-10 precipitation equals 91% of the 30-yr average.

Table CR-13 GAMA Groundwater Quality Reports for the Colorado River Hydrologic Region

Data Summary Reports • Borrego Valley, Central Desert, and Low-Use Basins • Coachella Valley • Colorado River
Assessment Reports • Status of Groundwater Quality in the California Desert Region, 2006-2008: California GAMA Priority Basin Project
Fact Sheets • Groundwater Quality in the Coachella Valley, California • Groundwater Quality in the Colorado River Basins, California
Domestic Well Project • San Diego County Focus Area
Other Relevant Reports • Communities that Rely on a Contaminated Groundwater Source for Drinking Water

Table CR-14a Summary of Community Drinking Water Wells in the Colorado River Hydrologic Region that Exceed a Primary Maximum Contaminant Level Prior to Treatment

	Community Water System[1] Wells
Number of *Affected Wells*[2]	51
Total Wells in the Region	377
Percentage of *Affected Wells*[2]	14%

Table CR-14b Percentage of Small, Medium, and Large Community Drinking Water Systems in the Colorado River Hydrologic Region that Rely on One or More Contaminated Groundwater Well(s)

	Community Water Systems[1]		
	Number of *Affected Water Systems*[3]	Total Water Systems in the Region	Percentage of *Affected Water Systems*[3]
Small Systems Pop ≤ 3,300	17	102	17%
Medium Systems 3,301 – 10,000 (Pop)	2	12	17%
Large Systems Pop > 10,000	5	15	33%
TOTAL	**24**	**129**	**19%**

Table CR-14c Summary of Contaminants Affecting Community Drinking Water Systems in the Colorado River Hydrologic Region

Principal Contaminant (PC)	Number of ***Affected Water Systems***[3] (PC exceeds the Primary MCL)	Number of ***Affected Wells***[2,4,5] **(**PC exceeds the Primary MCL)
Gross alpha particle activity	13	23
Uranium	10	17
Arsenic	9	19
Fluoride	7	13
Nitrate	1	2
Chromium, Total	1	1
Perchlorate	1	1

Notes:

1. "*Community Water System*" means a public water system that serves at least 15 service connections used by yearlong residents or regularly serves at least 25 yearlong residents of the areas served by the system (Health & Safety Code Section 116275)

2. "*Affected Wells*" exceeded a Primary Maximum Contaminant Level prior to treatment at least twice from 2002 to 2010. Gross alpha levels were used as a screening assessment only and did not consider uranium correction.

3. "*Affected Water Systems*" are those with one or more wells that exceed a Primary Maximum Contaminant Level prior to treatment at least twice from 2002 to 2010. Gross alpha levels were used as a screening assessment only and did not consider uranium correction.

4. 21 wells are affected by 2 contaminants (15 of the 21 wells exceed both the Uranium and Gross alpha particle activity MCLs).

5. 2 wells are affected by 3 contaminants.

Table CR-15 Summary of Groundwater Quality Results for the Colorado River Hydrologic Region from GAMA Data Summary Reports and San Diego County Domestic Well Project

Constituent	Health Based Threshold	No. of Detections Greater Than Health Based Threshold					
		Borrego Valley (8 Wells)	Central Desert (15 Wells)	Low-Use Basins (11 Wells)	Coachella Valley (35 wells)	Colorado River (28 wells)	San Diego County (9 wells)
Inorganic Constituents	MCL/NL/ HAL	0					
Arsenic	MCL		1	2	5	2	
Boron	NL			1	2	3	
Fluoride	MCL		1	4	5	5	1
Molybdenum	HAL		1	2	2	1	
Uranium	MCL		1			2	1
Strontium	HAL				2	2	
Organic Constituents							
VOCs	MCL	0	0	0	0	0	0
Pesticides	MCL	0	0	0	0	0	
Constituents of Special Interest							
Perchlorate	MCL	0	0	0	2	0	
NDMA	NL	0	0	0			
1,2,3 TCP	NL				0	0	
Radioactive Constituents	MCL						
Gross Alpha	MCL	0	3	0	0	6	1
Secondary Standards							
Chloride	SMCL			2	1	7	
Iron	SMCL					5	2
Manganese	SMCL				1	15	2
Sulfate	SMCL	1		3	7	21	
Total Dissolved Solids	SMCL	3	1	7	9	26	1

Sources:

1. USGS Report on Groundwater-quality data in the Borrego Valley, Central Desert, and Low-Use Basins of the Mojave and Sonoran Deserts study unit 2008–2010.
2. USGS Report on Ground-water quality data in the Coachella Valley study unit, 2007
3. USGS Report on Groundwater-quality data in the Colorado River study unit, 2007
4. SWRCB GAMA – Domestic Well Project, Groundwater Quality Data Report San Diego County Focus Area, 2010

Notes:

1. MCL – Maximum Contaminant Level (State and/or Federal)
2. NL – Notification Level (State)
3. HAL – Lifetime Health Advisory Level (USEPA)
4. SMCL – Secondary Maximum Contaminant Level (State)
5. VOC – Volatile Organic Compound
6. TDS – Total Dissolved Solids
7. Low-Use Basin area includes 29 wells in both Colorado River and South Lahontan Hydrologic Regions. 11 wells are in the Colorado River Region (Shown in USGS Report Figures 5E – 5H)

Table CR-16 Summary of Small, Medium, and Large Community Drinking Water Systems in the Colorado River Hydrologic Region that Rely on One or More Contaminated Groundwater Well(s)

Community Drinking Water Systems and Groundwater Wells Grouped by Water System Population	No. of Affected Community Drinking Water Systems	No. of Affected Community Drinking Water Wells
Small Systems ≤ 3,300	17	31
Medium Systems 3,301 – 10,000	2	7
Large Systems > 10,000	5	13
Total	24	51

Source: Water Boards 2012 Draft Report on “Communities that Rely on Contaminated Groundwater”

Note: Affected Wells exceeded a Primary Maximum Contaminant Level prior to treatment at least twice from 2002 to 2010. Gross alpha levels were used as a screening assessment only and did not consider uranium correction.

Table CR-18 Flood Exposure in the Colorado River Hydrologic Region Exposures to the 100-Year and 500-Year Flood Events

Segment Exposed	1% (100-yr) Floodplain	0.2% (500-yr) Floodplain
Population	31,400, 5%	227,100, 38%
Structure and Content Value	$2.5 billion	$20.6 billion
Crop Value	$146.1 million	$275.7 million
Crop (acres)	49,000	79,100
Tribal Lands (acres)	29,154	57,499
Essential Facilities (count)	20	113
High Potential-Loss Facilities (count)	10	15
Lifeline Utilities (count)	9	22
Transportation Facilities (count)	180	319
Department of Defense Facilities (count)	4	4
State and Federal Threatened, Endangered, Listed ,and Rare Plants [a]	78	85
State and Federal Threatened, Endangered, Listed ,and Rare Animals [a]	99	101

Source: SFMP California's Flood Future Report.

Note:
[a] Many Sensitive Species have multiple occurrences throughout the state and some have very large geographic footprints that may overlap more than one analysis region. As a result, a single Sensitive Species could be counted in more than one analysis region. Because of this the reported statewide totals will be less than the sum of the individual analyses regions.

Table CR-19 Key Elements of the Law of the Colorado River

Document	Date	Main purpose
Colorado River Compact	1922	The Upper and Lower Basin are each provided a basic apportionment of 7.5 MAF annually of consumptive use. The Lower Basin is given the right to increase its consumptive use by an additional 1.0 MAF annually.
Boulder Canyon Project Act	1928	Authorized USBR to construct Hoover Dam and the All-American Canal (including the Coachella Canal), and gave congressional consent to the Colorado River Compact. Apportioned the Lower Basin's 7.5 MAF among the states of Arizona (2.8 MAF), California (4.4 MAF), and Nevada (0.3 MAF). Provided that all users of Colorado River water stored in Lake Mead must enter into a contract with USBR for use of the water.
California Limitation Act	1929	Confirmed California's share of the 7.5 MAF Lower Basin allocation to 4.4 MAF annually, plus no more than half of any surplus waters.
California Seven-Party Agreement	California Seven-Party Agreement	An agreement among seven California water agencies/districts to recommend to the Secretary of Interior how to divide use of California's apportionment among the California water users.
US-Mexican Water Treaty	1944	Apportions Mexico a supply of 1.5 MAF annually of Colorado River water, except under surplus or extraordinary drought conditions.
US Supreme Court Decree in Arizona v. California, et al.	1964, supplemented 1979	Rejected California's argument that Arizona's use of water from the Gila River, a Colorado River tributary, constituted use of its Colorado River apportionment. Ruled that Lower Basin states have a right to appropriate and use tributary flows before the tributary co-mingles with the Colorado River. Mandated the preparation of annual reports documenting the uses of water in the three Lower Basin states. Quantifies tribal water rights for specified tribes, including 131,400 afy for diversion in California. Quantified Colorado River mainstream present perfected rights in the Lower Basin states.
Colorado River Basin Project Act	1968	Authorized construction of the Central Arizona Project. Requires Secretary of the Interior to prepare long-range operating criteria for major Colorado River reservoirs.
Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs	1970, amended 2005	Provided for the coordinated operation of reservoirs in the Upper and Lower Basins and set conditions for water releases from Lake Powell and Lake Mead.
Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003	2003	Complex package of agreements that, in addition to many other important issues, further quantifies priorities established in the 1931 California Seven-Party Agreement and enables specified water transfers (such as the water conserved through lining of the All-American and Coachella canals to SDCWA) in California.

Source: Adapted from USBR 2008c

Table CR-20 Annual Intrastate Apportionment of Water from the Colorado River Mainstream within California under the Seven Party Agreement [a]

Priority Number	Apportionment
Priority 1	Palo Verde Irrigation District (based on area of 104,500 acres).
Priority 2	Lands in California within USBR's Yuma Project (not to exceed 25,000 acres).
Priority 3	Imperial Irrigation District and lands served from the All American Canal in Imperial and Coachella Valleys, and Palo Verde Irrigation District for use on 16,000 acres in the Lower Palo Verde Mesa.
Priorities 1 through 3 collectively are not to exceed 3.85 maf/yr. The Seven Party Agreement did not quantify the division of this volume among the three parties. Priorities 1-3 were further defined in the 2003 Quantification Settlement Agreement.	
Priority 4	MWDSC for coastal plain of Southern California-550,000 af/yr.
Priority 5	An additional 550,000 af/yr to MWDSC, and 112,000 af/yr for the City and County of San Diego. [b]
Priority 6	Imperial Irrigation District and lands served from the All American Canal in Imperial and Coachella Valleys, and Palo Verde Irrigation District for use on 16,000 acres in the Lower Palo Verde Mesa, for a total not to exceed 300 taf/yr.
Total of Priorities 1 through 6 is 5.362 maf/yr.	
Priority 7	All remaining water available for use in California, for agricultural use in California's Colorado River Basin.

[a] Indian Tribes and miscellaneous present perfected right holders that are not encompassed in California's Seven Party Agreement have the right to divert up to approximately 90 taf /yr (equating to about 50 taf/yr of consumptive use) within California's 4.4 maf basic apportionment. Present consumptive use under these miscellaneous and Indian present perfected rights is approximately 15 taf/yr.

[b] Subsequent to execution of the Seven Party Agreement, MWDSC, SDCWA, and the city of San Diego executed a separate agreement transferring its apportionment to MWDSC.

[c] Under the Colorado River Water Delivery Agreement: Federal Quantification Settlement Agreement of 2003, MWD (and SDCWA) gained access to water that may be available under Priority 6 and 7.

NOTE: (amounts represent consumptive use)

Table CR-21 Annual Apportionment of Use of Colorado River Water Interstate/International

Description	Amount
Upper Basin. Required to deliver 75 maf over a 10-year period measured at Lee Ferry. (small portion of Arizona, Colorado, New Mexico, Utah, and Wyoming)	7.5 maf
Lower Basin. (portions of Arizona, Nevada, California, and Utah draining below Lee Ferry)	7.5 maf plus 1 maf
Republic of Mexico [a]	1.5 maf
Total	17.5 maf [b]

[a] Plus 200 taf of surplus water, when available as determined by the United States. Water delivered to Mexico must meet specified salinity requirements. During an extraordinary drought or other cause resulting in reduced uses in the United States, deliveries to Mexico would be reduced proportionally with uses in the United States.

[b] The total volume is (7.5 + 7.5 + 1.0 + 1.5) = 17.5 maf/yr. Note that this total refers to all waters of the Colorado River System, which is defined as that portion of the Colorado River and its tributaries in the United States.

NOTE: Amounts represent consumptive use; taf = thousand acre-feet; maf = million acre-feet

Table CR-22 Groundwater Management Plans in the Colorado River Hydrologic Region

Map Label	Agency Name	GWMP Title	Date	County	Basin Number	Basin Name
CR-1	**Borrego Water District**	Borrego	2006	Imperial	7-24	Borrego Valley
	No signatories on file					
CR-2	**Twentynine Palms**	GWMP	2008	San Bernardino	7-9	Dale Valley
	No signatories on file				7-10	Twentynine Palms
					7-62	Joshua Tree
CR-3	**Coachella Valley**	Coachella	2010	Riverside, Imperial, San	7-21.01	Indio
	No signatories on file				7-21.02	Mission Creek
					7-21.03	Desert Hot Springs
					7-22	West Salton Sea
					7-31	Orocopia Valley
					7-32	Chocolate Valley
					7-33	East Salton Sea
SL-4 (CR-4)	**Mojave Water District**	2004 Regional	2004	San Bernardino, Kern, Los Angeles	6-35	Cronise Valley
	No signatories on file				6-38	Caves Canyon
					6-40	Lower Mojave
					6-41	Middle Mojave
					6-42	Upper Mojave
					6-44	Antelope Valley
					6-46	Fremont Valley
					6-48	Goldstone Valley
					6-49	Superior Valley
					6-50	Cuddeback Valley
					6-51	Pilot Knob Valley
					6-52	Searles Valley
					6-53	Salt Wells Valley
					6-54	Indian Wells Valley
					6-77	Grass Valley
					6-89	Kane Wash Area
					7-11	Copper Mountain
					7-12	Warren Valley
					7-13.01	Deadman Lake
					7-13.02	Surprise Spring
					7-15	Bessemer Valley
					7-16	Ames Valley
					7-18.01	Soggy Lake
					7-18.02	Upper Johnson
					7-19	Lucerne Valley
					7-20	Morongo Valley
					7-50	Iron Ridge Area
					7-51	Lost Horse Valley
					7-62	Joshua Tree

Table CR-GW-23 Assessment of Ground Water Management Plan Components

SB 1938 Ground Water Management Plan Required Components	Plans that meet requirements
Basin Management Objectives (BMO)	75%
BMO: Monitoring/Management Groundwater Levels	100%
BMO: Monitoring Groundwater Quality	100%
BMO: Inelastic Subsidence	75%
BMO: SW/GW Interaction & Affects to Groundwater Levels & Quality	75%
Agency Cooperation	100%
Map	100%
Map: Groundwater basin area	100%
Map: Area of local agency	100%
Map: Boundaries of other local agencies	100%
Recharge Areas (1/1/2013)	Not Assessed
Monitoring Protocols (MP)	75%
MP: Changes in groundwater levels	100%
MP: Changes in groundwater quality	100%
MP: Subsidence	75%
MP: SW/GW Interaction & Affects to Groundwater Levels & Quality	75%
SB 1938 Voluntary Components	**Plans that include components**
Saline Intrusion	50%
Wellhead Protection & Recharge	100%
Groundwater Contamination	100%
Well Abandonment & Destruction	100%
Overdraft	75%
Groundwater Extraction & Replenishment	75%
Monitoring	100%
Conjunctive Use Operations	100%
Well Construction Policies	100%
Construction and Operation	50%
Regulatory Agencies	100%
Land Use	75%
Bulletin 118-03 Recommended Components	**Plans that include components**
Groundwater Management Plan Guidance	75%
Management Area	100%
Basin Management Objectives - Goals, & Actions	100%
Monitoring Plan Description	25%
IRWM Planning	75%
GMP Implementation	100%
GMP Evaluation	100%

Table CR-24a Factors Contributing to Successful Groundwater Management Plan Implementation in the Colorado River Hydrologic Region

Factors Contributing to Success	Respondents
Data collection and sharing	3
Developing an understanding of common interest	3
Funding	3
Outreach and education	3
Sharing of ideas and information with other water resource managers	3
Water budget	3
Broad stakeholder participation	2
Time	2
Adequate regional and local surface storage and conveyance systems	2
Adequate surface water supplies	2

Table CR-24b Factors Limiting Successful Groundwater Management Plan Implementation in the Colorado River Hydrologic Region

Limiting Factors	Respondents
Funding for groundwater management projects	3
Funding for groundwater management planning	2
Unregulated Pumping	1
Groundwater Supply	1
Participation across a broad distribution of interests	1
Lack of Governance	1
Surface storage and conveyance capacity	1
Understanding of the local issues	0
Access to planning tools	0
Outreach and education	0
Data collection and sharing	0
Funding to assist in stakeholder participation	0

Table CR-25a Groundwater Ordinances that Apply to Counties in the Colorado River Hydrologic Region

County	Groundwater Management	Guidance Committees	Export Permits	Recharge	Well Abandonment & Destruction	Well Construction Policies
Imperial	Y*	Y	Y	Y	-	-
San Bernardino	Y**	-	-	-	Y	Y
San Diego	Y***	-	-	-	-	-
Riverside	-	-	-	-	Y	Y

* Provides for the reduction of extractions to eliminate existing or threatened conditions of overdraft.
** One provision is to ensure that groundwater extractions do not exceed safe yields.
*** One provision requires developers to demonstrate adequate groundwater supplies for a proposed project.

Table CR-25b Groundwater Adjudications in the Colorado River Hydrologic Region

Court Judgment	Colorado River HR Basin/Subbasin	Basin Number	County	Judgment Date
Warren Valley Basin	Warren Valley Basin	7-12	San Bernardino	1977
Mojave Basin Area	Lucerne Valley Basin	7-19	San Bernardino	1996
Beaumont Basin	San Gorgonio Pass Subbasin of Coachella Valley Basin	7-21.04	Riverside	2004

Note: Table represents information as of April, 2013

Figure CR-2 Alluvial Groundwater Basins and Subbasins within the Colorado River Hydrologic Region

Figure CR-3 Number of Well Logs by County and Use for the Colorado River Hydrologic Region (1977 – 2010)

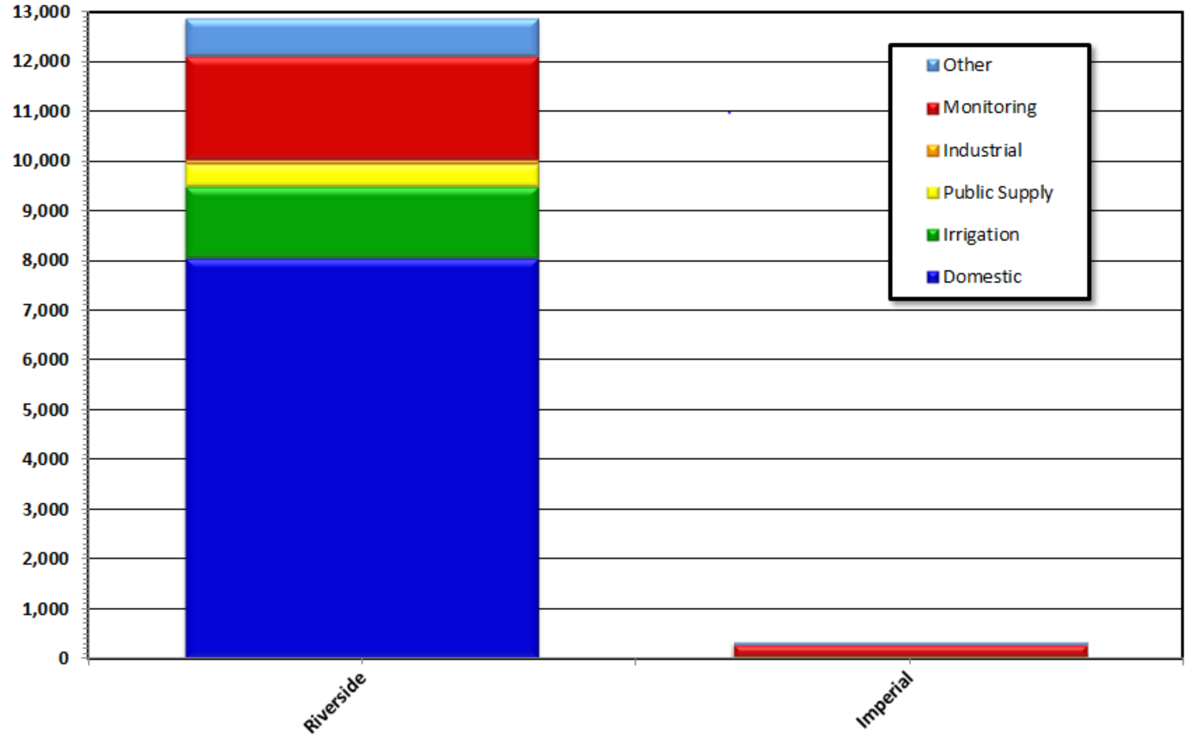


Figure CR-4 Percentage of Well Logs by Use for the Colorado River Hydrologic Region (1977 – 2010)

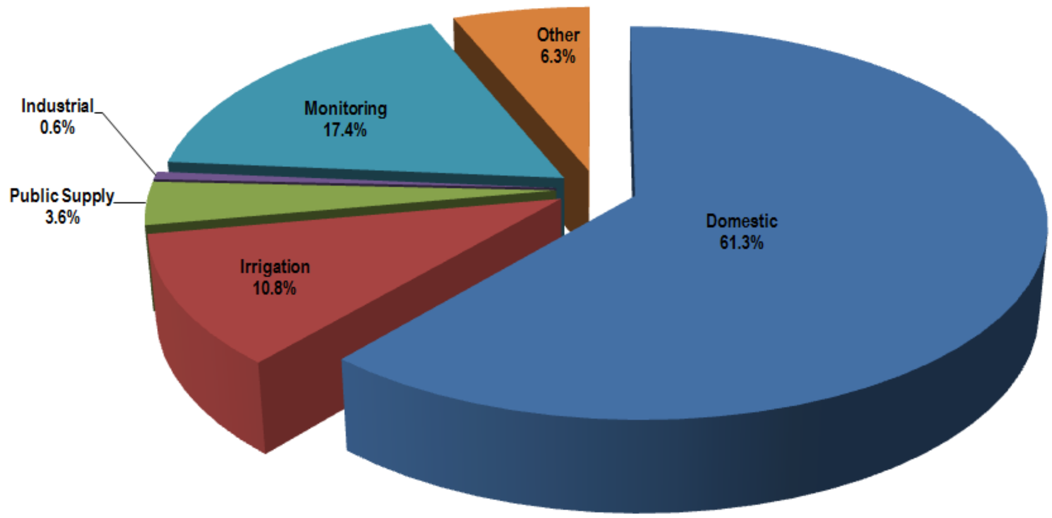


Figure CR-5 Number of Well Logs Filed per Year by Use for the Colorado River Hydrologic Region (1977 – 2010)

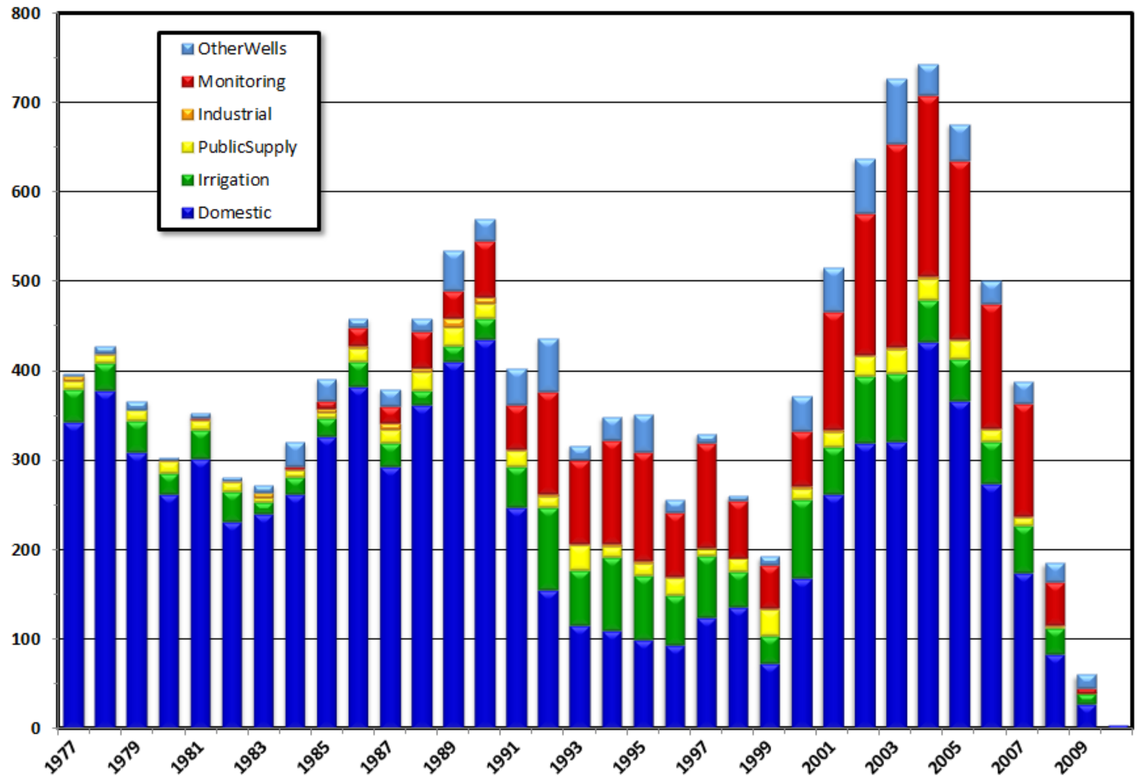


Figure CR-6 CASGEM Prioritization for Groundwater Basins in the Colorado River Hydrologic Region

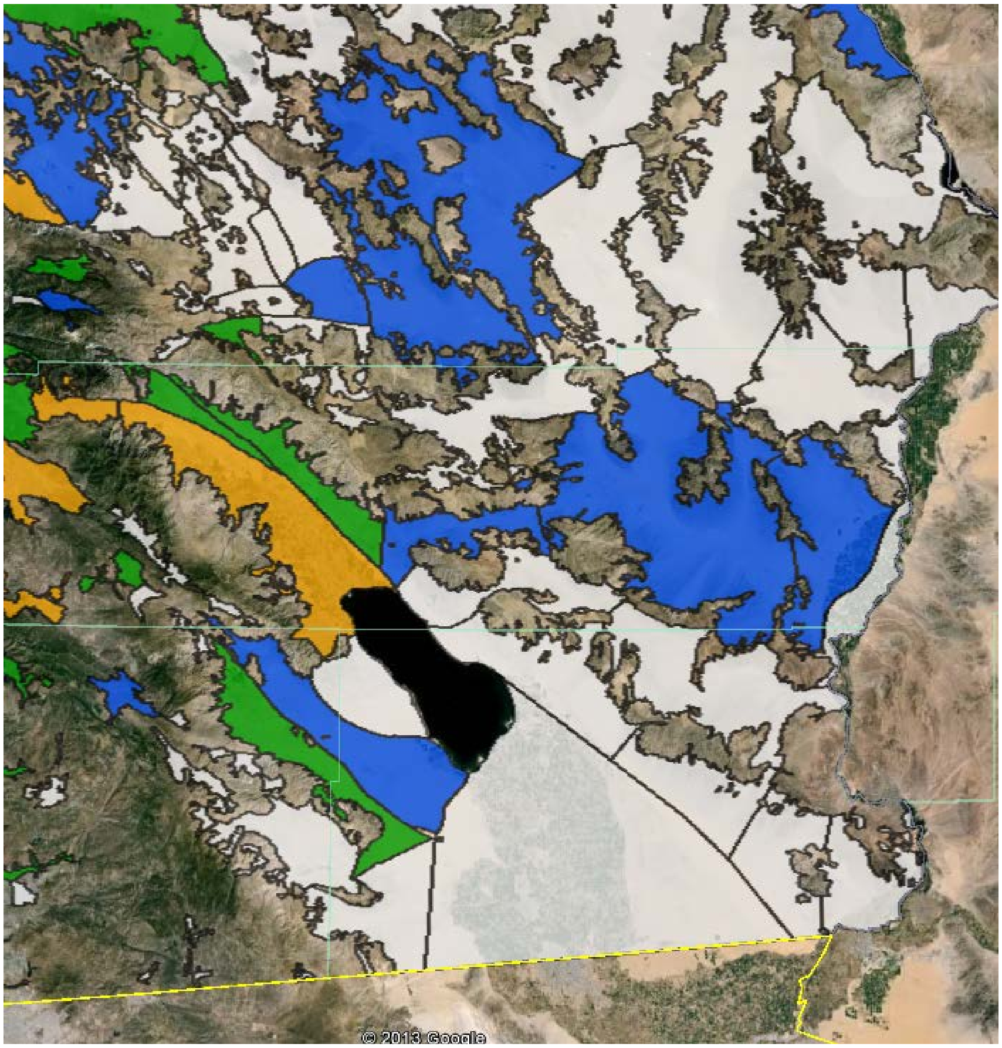
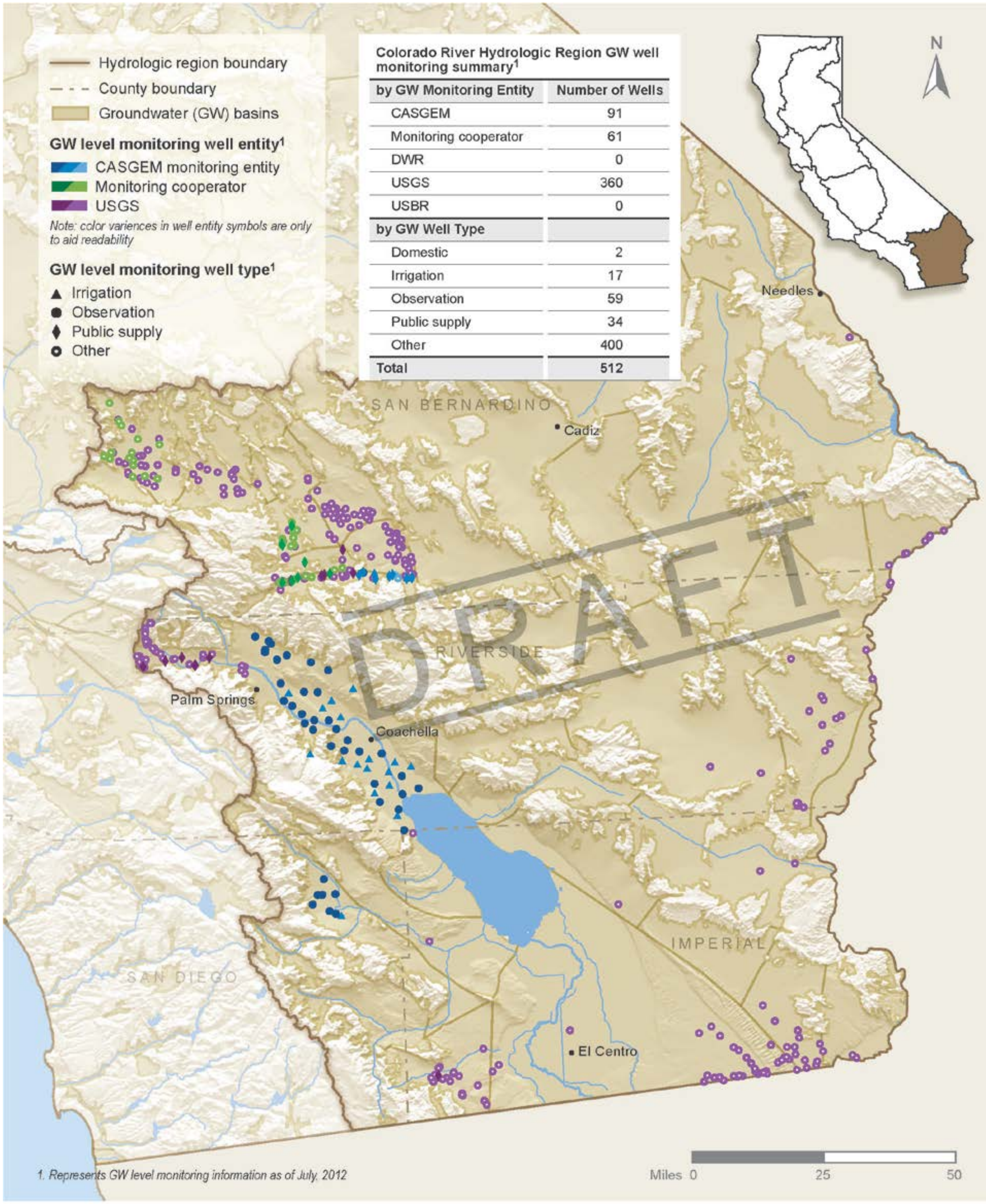


Figure CR-7 Monitoring Well Location by Agency, DWR Cooperator, and CASGEM Monitoring Entity in the Colorado River Hydrologic Region



Source: Department of Water Resources, CWP 2013

Figure CR-8 Percentage of Monitoring Wells by Use in the Colorado River Hydrologic Region

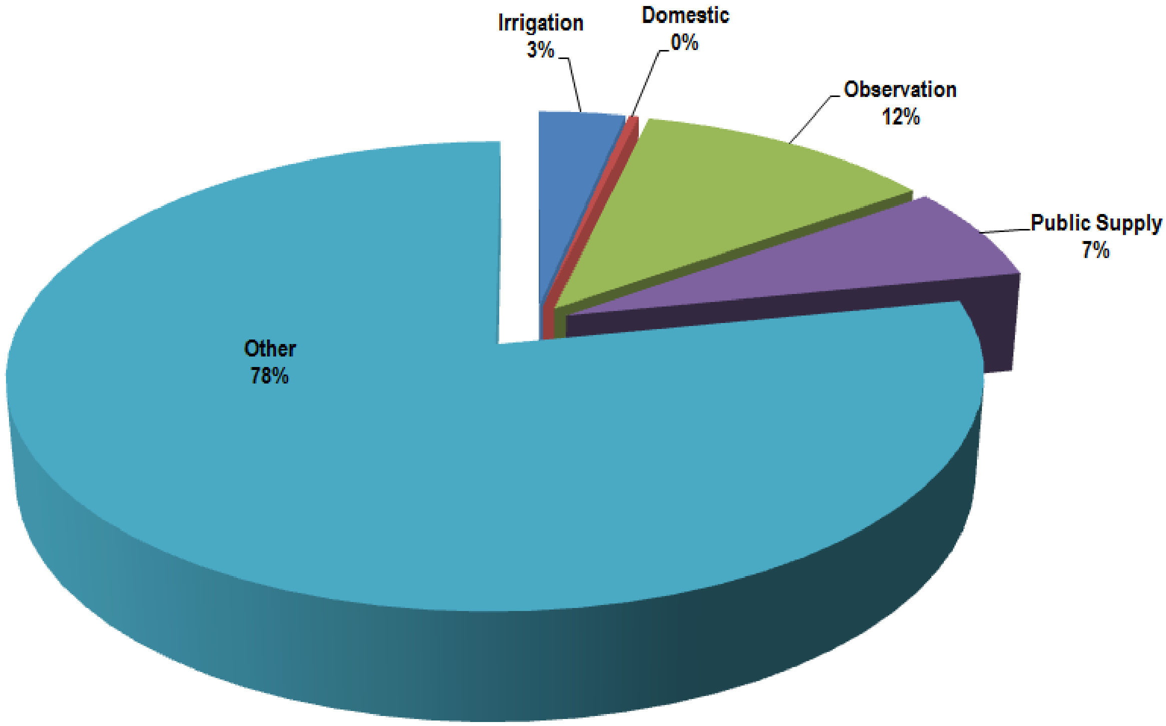


Figure CR-9 Contribution of Groundwater to the Colorado River Hydrologic Region Water Supply by Planning Area (2005-2010)

(Note: this Figure will be replaced by a similar map showing Colorado River HR Planning Areas and the contribution by groundwater)

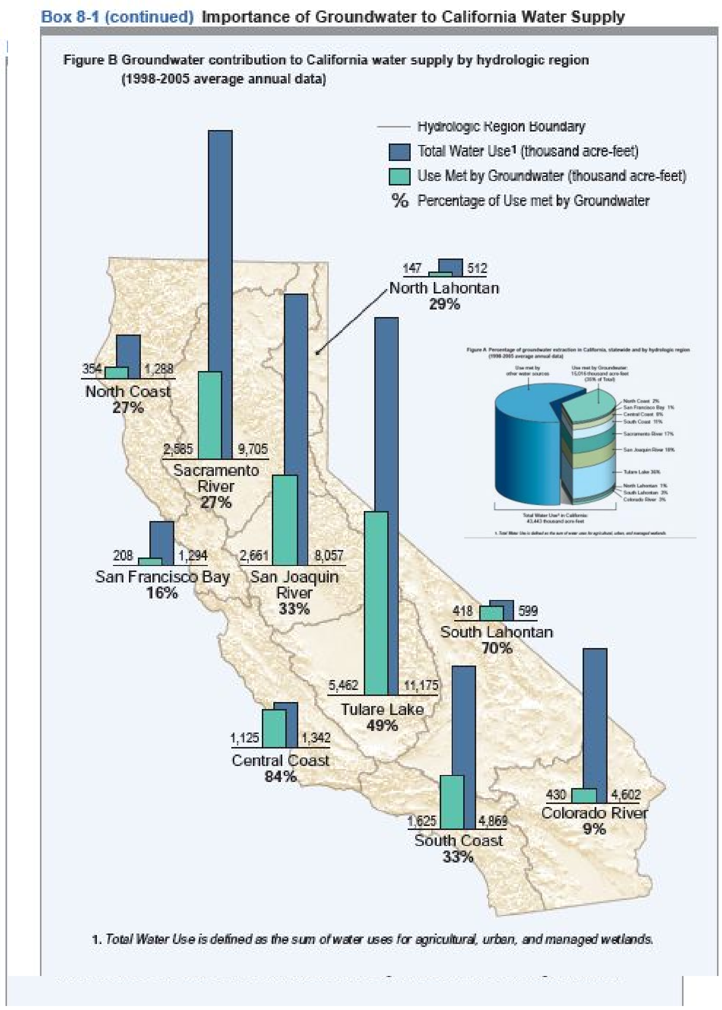


Figure CR-10a Colorado River Hydrologic Region Annual Groundwater Water Supply Trend (2002-2010)

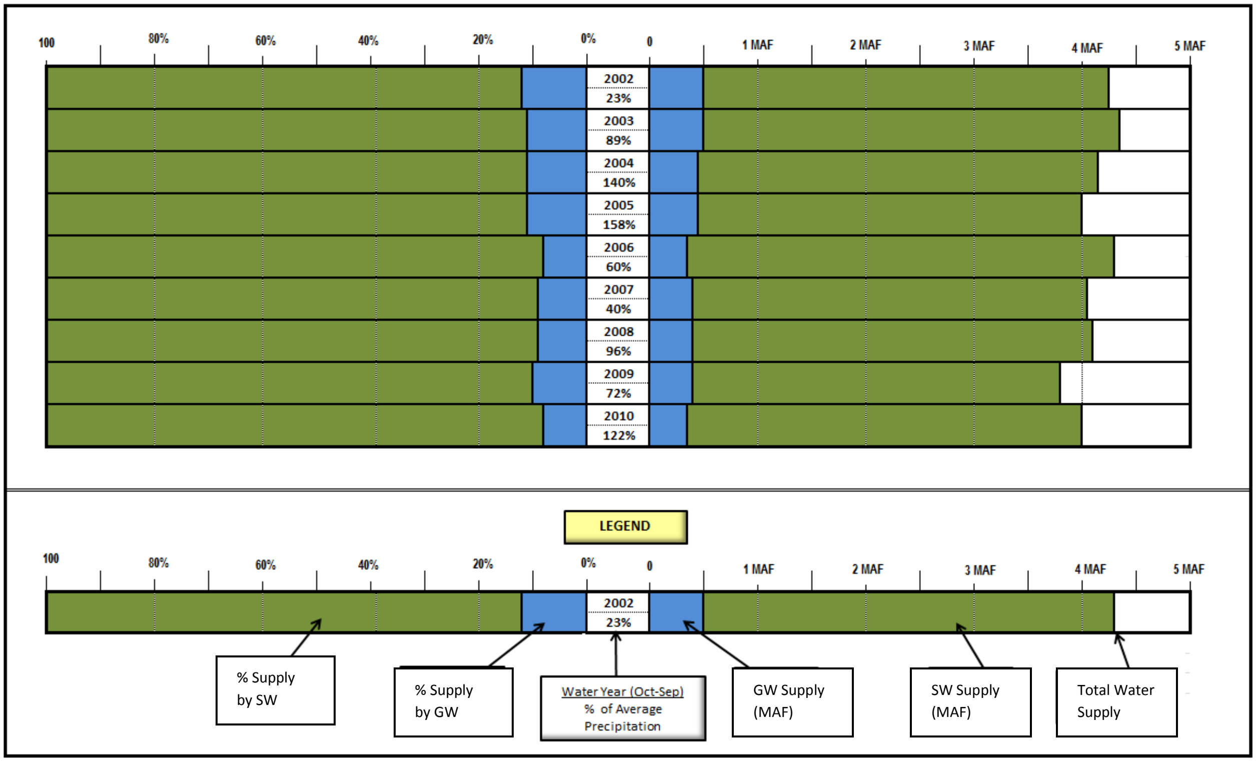


Figure CR-10b Colorado River Hydrologic Region Annual Groundwater Supply Trend by Type of Use (2002-2010)

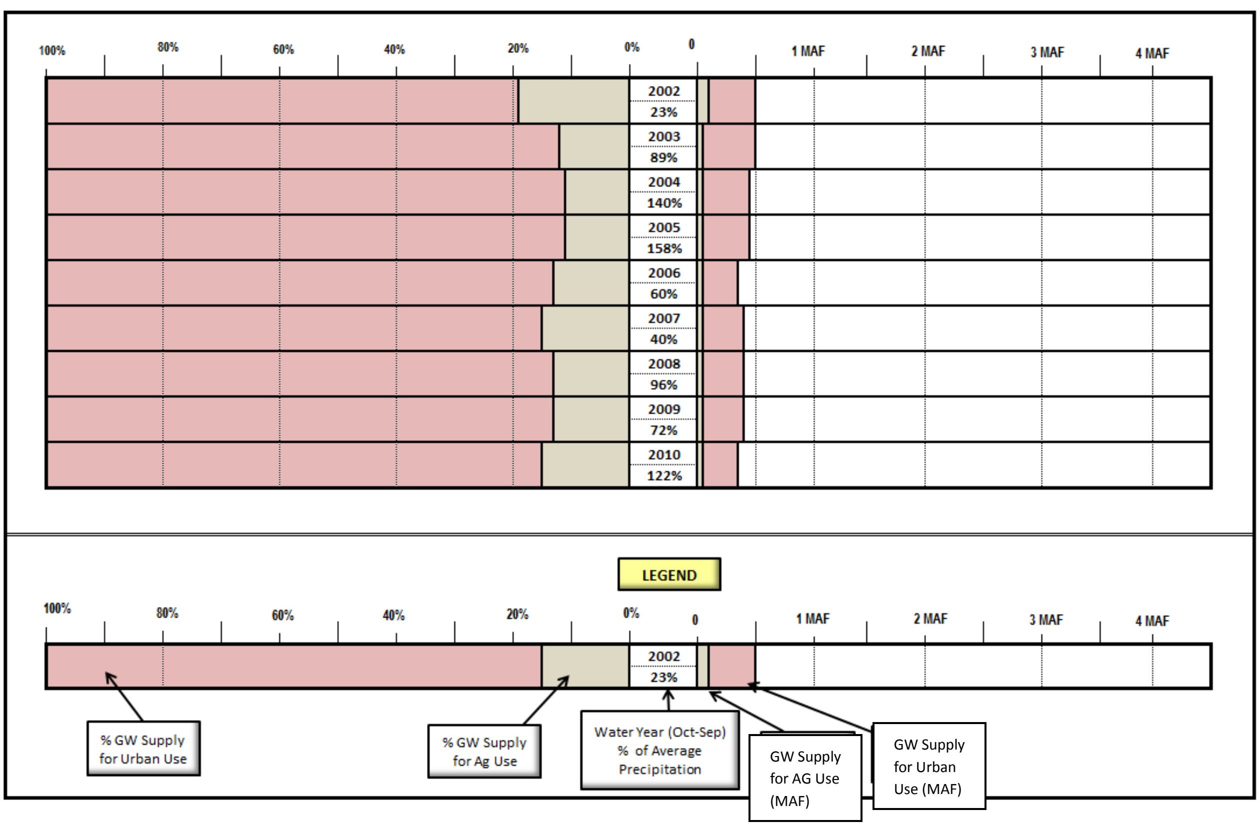
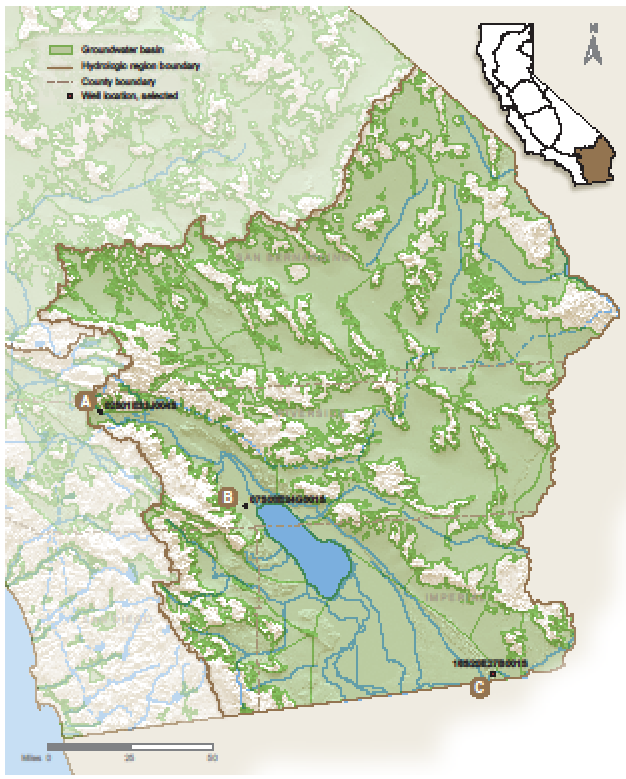


Figure CR-12a Groundwater Level Trends in Selected Wells in the Colorado River Hydrologic Region

Volume X - The Volume Title

Figure X-x Colorado River hydrographs

Regional locator map



Aquifer response to changing demand and management practices

Hydrographs were selected to help tell a story of how local aquifer systems respond to changing groundwater demand and resource management practices. Additional detail is provided within the main text of the report.

A Hydrograph 02S01E33J004S (San Gorgonio Subbasin): highlights groundwater level changes in the aquifer in response to seasonal fluctuations. Although the aquifer shows large fluctuations in groundwater levels associated with the periods of wet and dry conditions, the overall aquifer response to long-term changes in demand appears to be relatively stable.

B Hydrograph 07S08E34G001S (Indio Subbasin): illustrates how conjunctive management via in-lieu recharge can help stabilize aquifer conditions.

C Hydrograph 16S20E27B001S (Imperial Valley Groundwater Basin): shows the impact of reduced infiltration on the groundwater levels due to the lining of the All-American Canal which began in 2007.

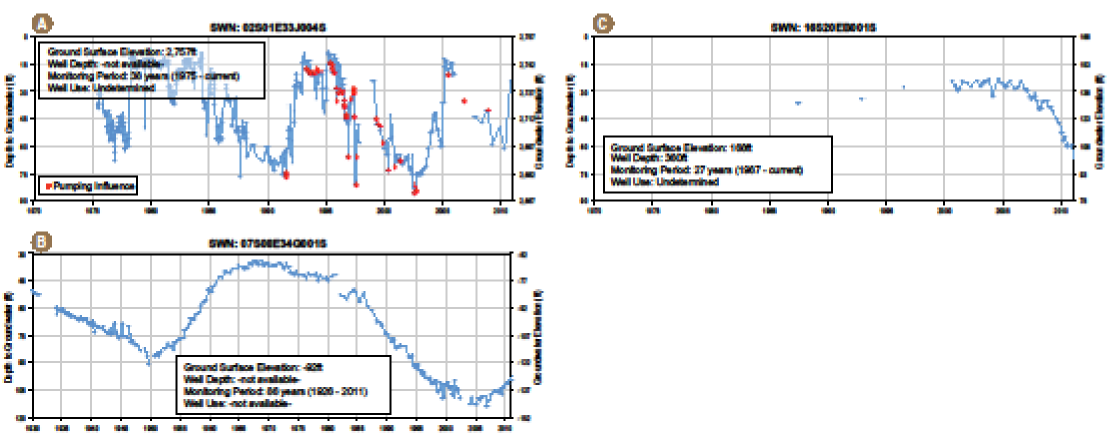
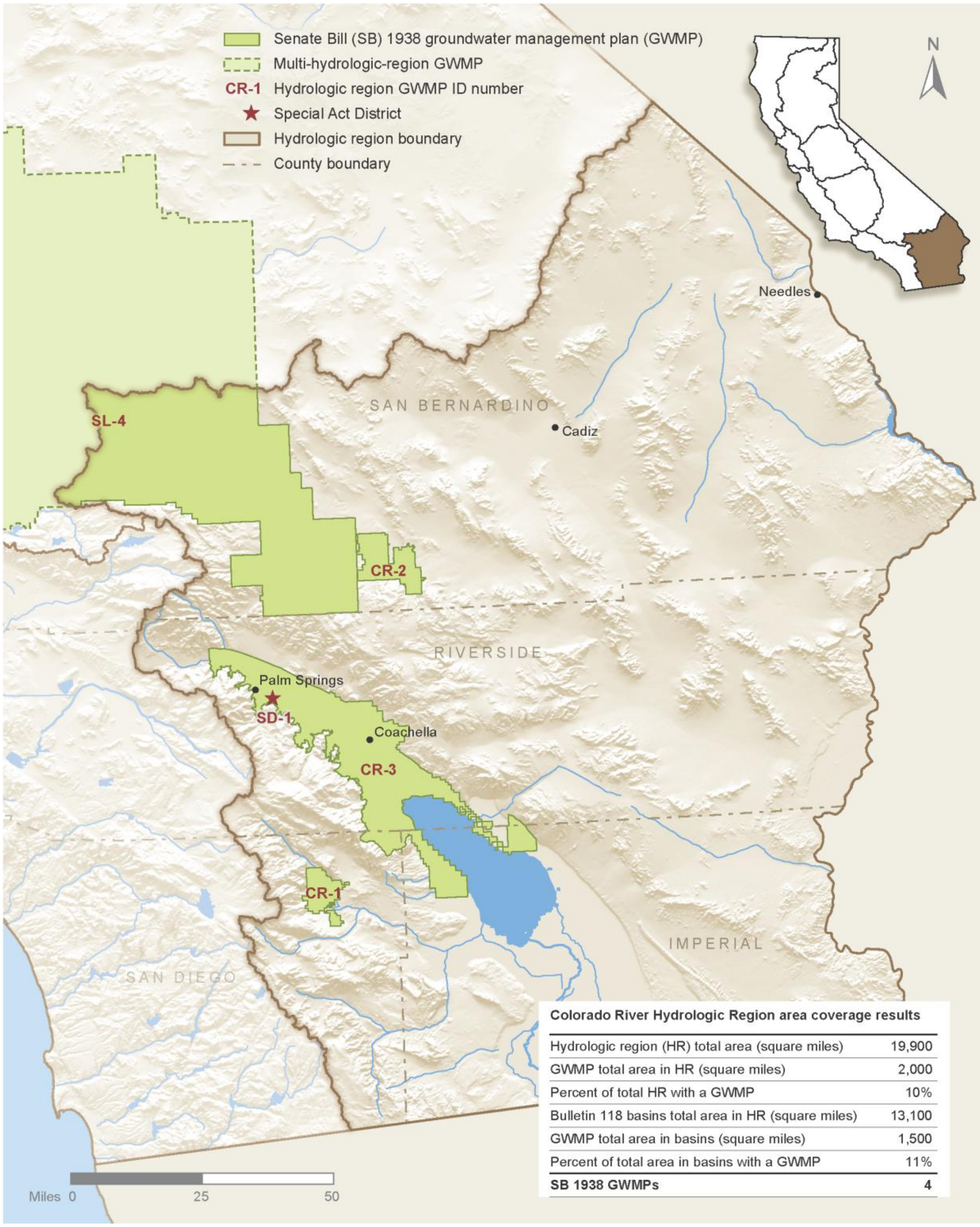


Figure CR-GW 8 Location of Groundwater Management Plans in the Colorado River Hydrologic Region (This map will be updated)



Colorado River Hydrologic Region area coverage results	
Hydrologic region (HR) total area (square miles)	19,900
GWMP total area in HR (square miles)	2,000
Percent of total HR with a GWMP	10%
Bulletin 118 basins total area in HR (square miles)	13,100
GWMP total area in basins (square miles)	1,500
Percent of total area in basins with a GWMP	11%
SB 1938 GWMPs	**4**

Figure CR-14 Change in Urban Water Demand

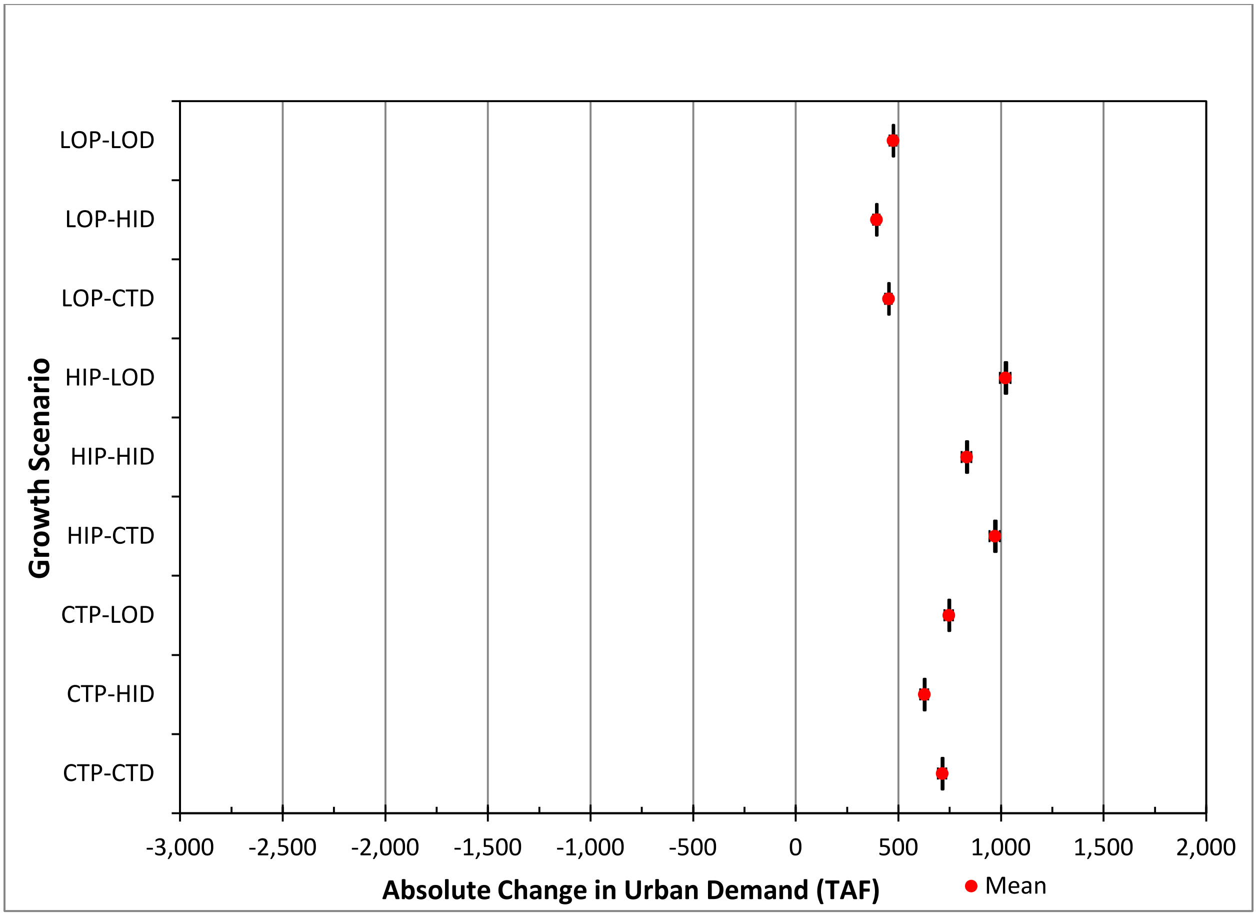
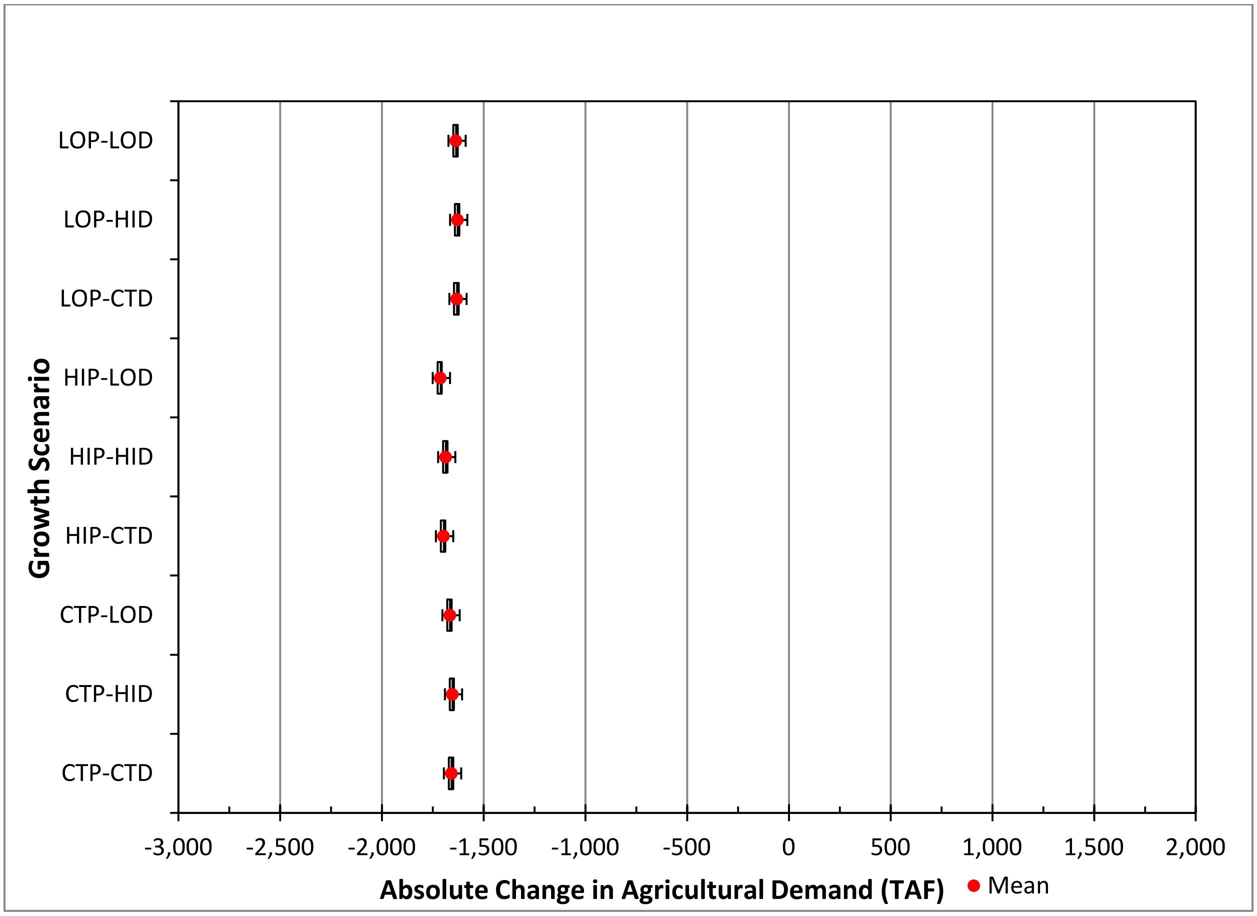


Figure CR-15 Change in Agricultural Water Demand



Box CR-1 California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization Data Considerations

Senate Bill 7x 6 (SBx7 6; Part 2.11 to Division 6 of the California Water Code § 10920 et seq.) requires, as part of the CASGEM program, DWR to prioritize groundwater basins to help identify, evaluate, and determine the need for additional groundwater level monitoring by considering available data listed below:.

1. The population overlying the basin,
2. The rate of current and projected growth of the population overlying the basin,
3. The number of public supply wells that draw from the basin,
4. The total number of wells that draw from the basin,
5. The irrigated acreage overlying the basin,
6. The degree to which persons overlying the basin rely on groundwater as their primary source of water,
7. Any documented impacts on the groundwater within the basin, including overdraft, subsidence, saline intrusion, and other water quality degradation, and
8. Any other information determined to be relevant by the DWR.

Using groundwater reliance as the leading indicator of basin priority, DWR evaluated California's 515 alluvial groundwater basins and categorized them into five groups:

- Very High
- High
- Medium
- Low
- Very Low

Box CR-2 Other Groundwater Management Planning Efforts in the Colorado River Hydrologic Region

The Integrated Regional Water Management plans, Urban Water Management plans, and Agriculture Water Management plans in the Colorado River Hydrologic Region that also include components related to groundwater management are briefly discussed below.

Integrated Regional Water Management Plans

There are four IRWM regions covering a portion of the Region. Three regions have adopted IRWM plans and one region is currently developing an IRWM plan. The Mojave Water Agency Regional Water Management Plan intends to use a combination of surface water, groundwater, and conservation to prevent long-term declines in groundwater storage, prevent land subsidence, and provide a sustainable water supply to meet current and future water demands.

The Coachella IRWM plan goals include specific objectives including managing groundwater levels, importing water, improving surface water quality, optimizing conjunctive use opportunities, addressing the water-related needs of local Native American culture, maximizing local water supply through water conservation, recycling, and capturing infiltration and runoff, and maintaining the affordability of water to users in the region.

The Imperial IRWM plan goals include diversifying the regional water supply sources, protecting or improving water quality, protecting and enhancing wildlife habitat, providing flood protection and stormwater management, and developing regional policies for groundwater management.

Urban Water Management Plans

Urban Water Management plans are prepared by California's urban water suppliers to support their long-term resource planning and to ensure adequate water supplies are available to meet existing and future water uses. Urban use of groundwater is one of the few uses that meter and report annual groundwater extraction volumes. The groundwater extraction data is currently submitted with the Urban Water Management plan and then manually translated by DWR staff into a database. Online methods for urban water managers to directly enter their water use along with their plan updates is currently under evaluation and review by DWR. Because of the time-line, the plans could not be reviewed for assessment for Water Plan Update 2013.

Agricultural Water Management Plans

Agricultural Water Management plans are developed by water and irrigation districts to advance the efficiency of farm water management while benefitting the environment. New and updated Agricultural Water Management plans addressing several new requirements were submitted to DWR by December 31, 2012 for review and approval. These new or updated plans provide another avenue for local groundwater management, but because of the time-line, the plans could not be reviewed for assessment for Water Plan Update 2013.

Box CR-3 Statewide Conjunctive Management Inventory Effort in California

The effort to inventory and assess conjunctive management projects in California was conducted through literature research, personal communication, and documented summary of the conjunctive management projects. The information obtained was validated through a joint DWR-ACWA survey. The survey requested the following conjunctive use program information:

1. Location of conjunctive use project;
2. Year project was developed;
3. Capital cost to develop the project;
4. Annual operating cost of the project;
5. Administrator/operator of the project; and
6. Capacity of the project in units of acre-feet.

To build on the DWR/ACWA survey, DWR staff contacted by telephone and email the entities identified to gather the following additional information:

1. Source of water received;
2. Put and take capacity of the groundwater bank or conjunctive use project;
3. Type of groundwater bank or conjunctive use project;
4. Program goals and objectives; and
5. Constraints on development of conjunctive management or groundwater banking (recharge) program.

Statewide, a total of 89 conjunctive management and groundwater recharge programs were identified. Conjunctive management and groundwater recharge programs that are in the planning and feasibility stage are not included in the inventory.