# California's Groundwater Update 2013

## A Compilation of Enhanced Content for California Water Plan Update 2013

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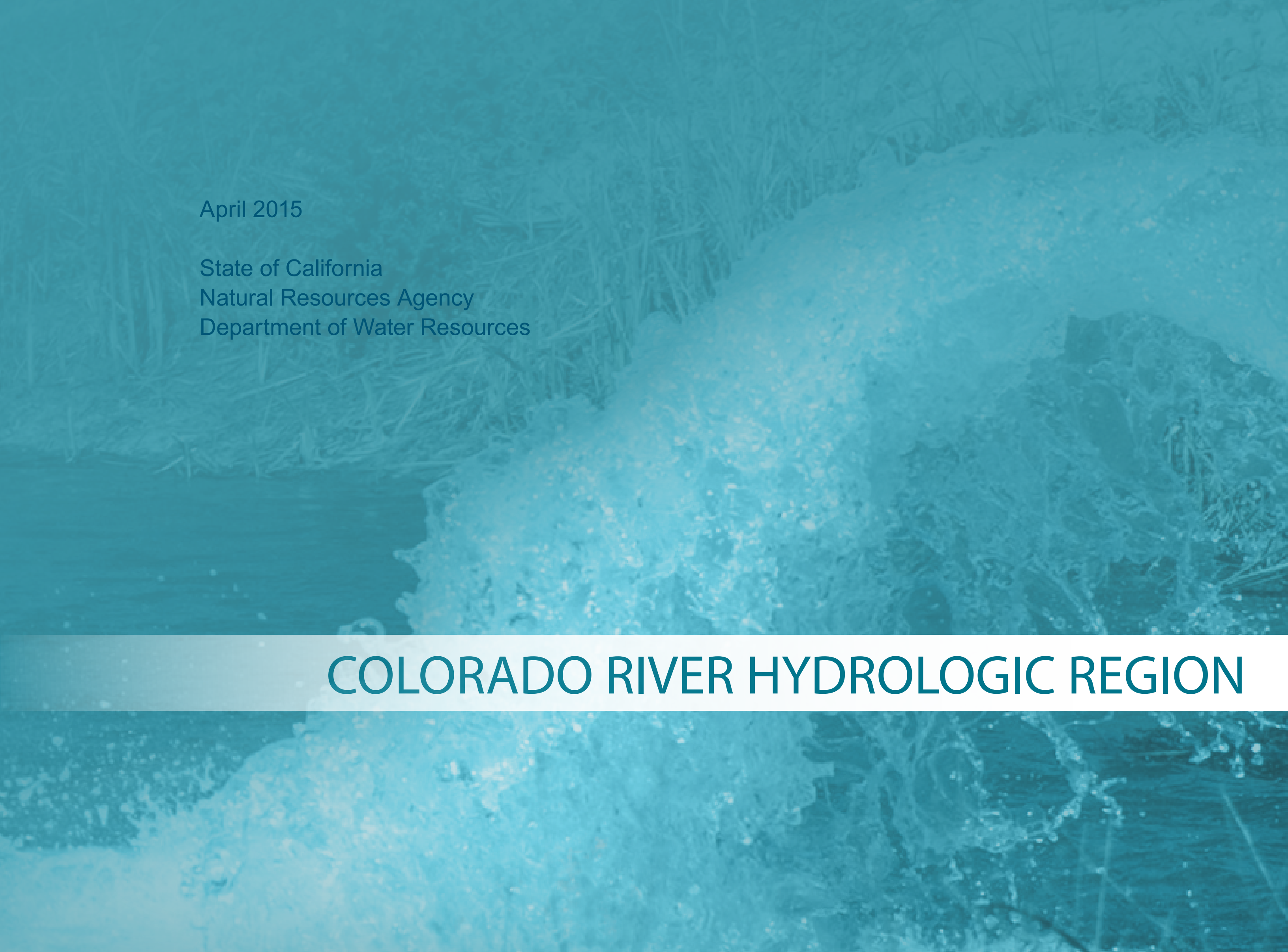

## COLORADO RIVER HYDROLOGIC REGION

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## Acronyms and Abbreviations Used in This Chapter

| | |
|---|---|
| AAC | All-American Canal |
| AB | Assembly Bill |
| ACWA | Association of California Water Agencies |
| af/yr. | acre-feet per year |
| AWMP | agricultural water management plan |
| CASGEM | California Statewide Groundwater Elevation Monitoring |
| CDPH | California Department of Public Health |
| Colorado River region | Colorado River Hydrologic Region |
| CVWD | Coachella Valley Water District |
| CWP | California Water Plan |
| CWS | community water system |
| DAU | detailed analysis unit |
| DPR | California Department of Pesticide Regulation |
| DWA | Desert Water Agency |
| DWR | California Department of Water Resources |
| FPA | Free Production Allowance |
| GAMA | Groundwater Ambient Monitoring and Assessment |
| gpm | gallons per minute |
| GPS | global positioning system |
| GWMP | groundwater management plan |
| HAL | health advisory level |
| HDWD | Hi-Desert Water District |
| InSAR | Interferometric synthetic aperture radar |
| IRWM | integrated regional water management |
| IWA | Indio Water Authority |
| LLNL | Lawrence Livermore National Laboratory |
| maf | million acre-feet |
| MCL | maximum contaminant level |
| MSWD | Mission Springs Water District |
| MWA | Mojave Water Agency |
| NL | notification level |
| PA | Planning Area |
| RWMG | regional water management group |
| RWQCB | regional water quality control board |
| SB | Senate Bill |
| SB X7-7 | Water Conservation Bill of 2009 |
| SMCL | secondary maximum contaminant level |
| SWN | State Well Number |
| SWP | State Water Project |
| SWRCB | State Water Resources Control Board |
| taf | thousand acre-feet |
| TDS | total dissolved solids |
| USGS | U.S. Geological Survey |
| UWMP | urban water management plan |

# Chapter 12. Colorado River Hydrologic Region Groundwater Update

## Introduction

The primary goal of the Colorado River Hydrologic Region (Colorado River region) groundwater update is to expand information about region-specific groundwater conditions for *California Water Plan Update 2013*, and to guide more informed groundwater management actions and policies. A second goal is to steadily improve the quality of groundwater information in future California Water Plan (CWP) updates to a level that will enable regional water management groups (RWMGs) to accurately evaluate their groundwater resources and implement management strategies that can meet local and regional water resource objectives within the context of broader statewide objectives. The final goal is to identify data gaps and groundwater management challenges meant to serve as a guidepost for prioritizing future data collection and funding opportunities relevant to the region.

This regional groundwater update is not intended to provide a comprehensive and detailed examination of local groundwater conditions, or be a substitute for local studies and analysis. Where information is readily available, the update does report some aspects of the regional groundwater conditions in greater detail.

The Colorado River region, depicted in Figure 12-1, covers about 19,900 square miles and includes Imperial County and portions of San Bernardino, Riverside, and San Diego counties. Significant geographic features include parts of the Mojave and Colorado deserts, numerous valleys such as Coachella Valley and Imperial Valley, the San Bernardino and San Jacinto mountain ranges, and the largest body of water in California — the Salton Sea. This region also includes the Colorado, Alamo, New, and Whitewater rivers.

The climate in the region is semi-arid to arid. With an average annual precipitation of 5.5 inches and a runoff volume of 200 thousand acre-feet (taf), the Colorado River region is the most arid of all the hydrologic regions in California. Information from the 2010 Census indicates an overall population of approximately 750,000, with slightly more than half living in the area overlying the Indio Subbasin of the Coachella Valley Groundwater Basin, and about one-quarter living in the area overlying the Imperial Valley Groundwater Basin. Most of the remaining region is sparsely populated.

The groundwater update for the Colorado River region provides an overview and assessment of the region's groundwater supply and development, groundwater use, monitoring efforts, aquifer conditions, and various management activities, and it identifies challenges and opportunities associated with sustainable groundwater management. The regional update starts with a summary of findings, examines groundwater data gaps, and makes recommendations to further improve the overall sustainability of groundwater resources. This is followed by a comprehensive overview of relevant groundwater topics.

## Figure 12-1 Colorado River Hydrologic Region

## Findings, Data Gaps, and Recommendations

The following information is specific to the Colorado River region and summarizes the findings, data gaps, and recommendations.

### Findings

The bulleted items presented in this section are adopted from more comprehensive information presented in this chapter, and generally reflect information that was readily available through August 2012. Much of the groundwater information, including well infrastructure discussions, water supply analysis, and groundwater management plan (GWMP) reviews, are new to this update of the CWP. The groundwater data presented in this document will be used as the foundation for the next update to the California Department of Water Resources (DWR) Bulletin 118 and CWP, with the goal of generating information that can be used to make informed decisions to sustainably manage California's groundwater resources. The following information highlights the groundwater findings for the Colorado River region.

#### Groundwater Supply and Development

- The Colorado River region contains 64 DWR Bulletin 118-2003 recognized alluvial groundwater basins and subbasins underlying approximately 13,100 square miles, or 66 percent of the hydrologic region (Figure 12-2 and Table 12-1).
- The total number of wells completed in the Colorado River region between 1977 and 2010 is approximately 13,201, with more than 97 percent of the wells located in Riverside County. The small number of wells in Imperial County is a function of the county's extensive surface water supplies and water conveyance infrastructure (Figure 12-3 and Table 12-2).
- Based on the California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization completed in December 2013, two subbasins in the Colorado River region are identified as high priority, four basins and subbasins are identified as medium priority, nine basins or subbasins are listed as low priority, and 49 basins or subbasins are listed as very low priority. The six basins designated as high or medium priority include 76 percent of the annual groundwater use and 64 percent of the 2010 population living within the region's groundwater basin boundaries (Figure 12-6 and Table 12-3).

#### Groundwater Use and Aquifer Conditions

- The 2005-2010 average annual total water supply for the Colorado River region, based on planning area boundaries, is estimated at 4.3 million acre-feet (maf). Water demands in the region are met through a combination of Colorado River water, imported surface water supplies, groundwater, and reused/recycled water supplies (Figure 12-7).
- Groundwater contributes about 9 percent (380 taf) of the 2005-2010 average annual total water supply for the Colorado River region. (Figure 12-7).
- Groundwater supplies, based on average annual estimates for 2005-2010, contribute 1 percent of the supply to meet total agricultural water uses and 53 percent of the supply to meet total urban water uses. No groundwater is used for managed wetland applications in the Colorado River region (Table 12-4).

- Between 2002 and 2010, annual groundwater use in the Colorado River region ranged between 338 taf (in 2010) and 501 taf (in 2002) and contributed 8 percent to 11 percent of the annual water supply (Figure 12-8).
- Of the groundwater pumped on an annual basis between 2002 and 2010, 81 percent to 89 percent of the groundwater was used for urban purposes (Figure 12-9).

### Groundwater Monitoring Efforts

- There are 512 wells actively monitored for groundwater-level information in the Colorado River region (Figure 12-10 and Table 12-7).
- There are an estimated 129 community water systems (CWSs) in the Colorado River region, with an estimated 377 active CWS wells; 51 of the CWS wells (14 percent) are identified as being affected by one or more chemical contaminants that exceed a maximum contaminant level (MCL). The affected wells are used by 24 CWSs in the region, with the majority of the affected systems serving small communities. The most prevalent groundwater contaminants affecting community drinking water wells in the region include gross alpha particle activity, uranium, arsenic, and fluoride. In addition, 23 regional wells are affected by multiple contaminants (Tables 12-10, 12-11, and 12-12).
- In the Colorado River region, researchers have investigated the occurrence of land subsidence in Lucerne Valley and in Coachella Valley. Interferometric synthetic aperture radar (InSAR) data were used to identify approximately 2 feet of land subsidence at three global positioning system (GPS) monitoring points in the Lucerne (Dry) Lake area between 1969 and 1998. Results from GPS monitoring indicated as much as 1.1 feet of subsidence in the Coachella Valley between 1996 and 2005 (see the "Land Subsidence" section and Appendix F).

### Groundwater Management and Conjunctive Management

- There are four GWMPs in the Colorado River region that collectively cover about 11 percent of the Bulletin 118-2003 alluvial basin area within the region and about 10 percent of the overall region (Figure 12-12 and Table 12-14).
- DWR's assessment of GWMPs in the Colorado River region determined that all four of the GWMPs have been developed or updated to include the legislative requirements of Senate Bill (SB) 1938 and are considered "active" for the purposes of the GWMP assessment. Three GWMPs in the region address all of the required components identified in California Water Code Section 10753.7 (Figure 12-12 and Table 12-15).
- Of the 89 agencies or programs identified as operating a conjunctive management or groundwater recharge program in California, just two programs are located in the Colorado River region. The Mojave Water Agency (MWA) and the Coachella Valley Water District (CVWD) operate direct percolation spreading basins to recharge unconfined aquifers in the region. The effort to fully characterize the 89 conjunctive management programs was largely limited because numerous agencies were reluctant to make details about their groundwater recharge operations publically available (Appendix D).

## Data Gaps

Gaps in groundwater information are separated into the following three categories: data collection and analysis, basin assessments, and sustainable management. Where possible, the discussion of data gaps is specific to the Colorado River region. However, many of the identified gaps are applicable to several or all hydrologic regions in California. Addressing these data gaps at both the local level and State agency level will help ensure that groundwater resources throughout California are better characterized and sustainably managed.

### Data Collection and Analysis

Although the general characterization of some alluvial aquifer systems in the Colorado River region is satisfactory, there is a need to further improve the characterization of many of the region's aquifers, especially those aquifers that serve disadvantaged communities. More data is always necessary to better understand basin-wide and region-wide groundwater levels, groundwater quality, groundwater use, and the interaction between surface water and groundwater.

Information related to groundwater extraction, groundwater use, managed and natural recharge, and groundwater basin budgets in the Colorado River region is limited. Much of the related information has been estimated primarily through water supply balance and land use information derived from DWR's land use surveys. Little or no information is known, or is publically available, about the fractured-bedrock aquifers in the Colorado River region and how they interact with the region's alluvial aquifer systems.

Some local water agencies in the Colorado River region are collecting appropriate groundwater data, conducting necessary analyses, and are sustainably managing their basins using their existing authorities. However, locally collected and analyzed data, which could be used by RWMGs and State agencies to better characterize the groundwater basins in the Colorado River region, are generally not readily available.

### Basin Assessments

Region-wide depth-to-groundwater information and annual estimates of change in groundwater in storage are not well understood for many of the groundwater basins in the Colorado River region.

The quality of groundwater in the Colorado River region is variable. Some areas of the region have been studied by local agencies and the U.S. Geological Survey (USGS), but most basins do not have comprehensive groundwater quality information.

In the Colorado River region, researchers have investigated the occurrence of land subsidence in the Lucerne and Coachella valleys, but no comprehensive land subsidence investigations have been conducted throughout the region.

There are two groundwater recharge or conjunctive use projects in the Colorado River region that were identified as part of the statewide conjunctive management survey, but some additional projects may be in the planning or feasibility stage. The survey conducted as part of *California Water Plan Update 2013* was unable to collect comprehensive information about many statewide programs; as a result, a general understanding of the effectiveness of the State's groundwater recharge and conjunctive management programs could not be determined. In addition, it is unknown whether local agencies have complied with the groundwater recharge mapping requirements of Assembly Bill (AB) 359, which went into effect on January 1, 2013.

### Sustainable Management

The four active GWMPs in the Colorado River region that meet some or all of the SB 1938 groundwater management requirements cover 11 percent of the alluvial groundwater basin area. A key gap to implementing sustainable groundwater management practices at the local level is the limited authority of some agencies to assess management fees, restrict groundwater extraction, and regulate land use in groundwater-short areas.

## Recommendations

While much information is known about some of the groundwater basins in the Colorado River region, comprehensive information that could provide a realistic water budget to determine groundwater sustainability in the region is largely unknown. To better characterize and sustainably manage the region's groundwater resources, the following recommendations are made for the Colorado River region:

- Increase collection and analysis of groundwater level, quality, use, and extraction data, as well as information regarding the surface water-groundwater interaction in alluvial aquifers, to a level that allows for development of groundwater budgets, groundwater supply forecasting, and assessment of sustainable groundwater management practices.
- Increase land subsidence monitoring to quantify the permanent loss of groundwater storage throughout the region caused by excessive groundwater pumping.
- Continue to monitor groundwater quality throughout the region to better determine sources of natural and anthropogenic contamination, and comply with all groundwater quality protection strategies recommended by the Colorado River Regional Water Quality Control Board.
- Update all existing GWMPs to meet the standards set forth in California Water Code Section10750 et seq., and ensure that GWMPs are prepared for all high- and medium-priority groundwater basins identified by the CASGEM Basin Prioritization process.
- To determine the extent and effectiveness of any new or proposed groundwater recharge or conjunctive management programs in the Colorado River region, DWR should work with local water managers to complete the conjunctive management survey information and ensure that the groundwater recharge mapping requirements of AB 359 are met.
- Ensure local agency goals, actions, and plans for sustainable groundwater management are compatible with a minimum set of goals and actions established by the overlying integrated regional water management (IRWM) plan.
- Provide local and regional agencies the authority to assess fees, limit groundwater extraction, and restrict land use in groundwater-short areas as needed, to better establish a path toward sustainable groundwater management.
- Develop annual groundwater management reports that summarize groundwater management goals, objectives, and performances measures, current and projected trends for groundwater extraction, groundwater levels, groundwater quality, land

subsidence, and surface water-groundwater interaction. Annual reports should also evaluate how existing groundwater management practices contribute toward sustainable groundwater management and proposed actions for improvements.

## Groundwater Supply and Development

This section provides an overview of the key aquifer systems that contribute groundwater to the regional supply, the well infrastructure used to develop these supplies, and an introduction to groundwater basin prioritization for the region.

Groundwater resources in the Colorado River region are supplied by both alluvial aquifers and by fractured-rock aquifers. Alluvial aquifers are comprised of sand and gravel or finer-grained sediments, with groundwater stored in the voids, or pore space, between the alluvial sediments. Fractured-rock aquifers consist of impermeable metamorphic, volcanic, and hard sedimentary rocks, with groundwater stored in cracks, fractures, or other void spaces. The distribution and extent of the alluvial and fractured-rock aquifers, and the location of well development, varies significantly within the Colorado River region. A brief description of the alluvial and fractured-rock aquifers for the region is provided in the following paragraphs. Additional information regarding alluvial and fractured-rock aquifers is available online at http://www.water.ca.gov/groundwater/bulletin118/index.cfm.

### Alluvial Aquifers

The Colorado River region contains 64 alluvial groundwater basins and subbasins recognized by DWR Bulletin 118-2003. These groundwater basins and subbasins underlie approximately 13,100 square miles, or 66 percent of the hydrologic region. The majority of the groundwater used in the Colorado River region is stored in alluvial aquifers. A detailed description of aquifers within this hydrologic region is beyond the scope of this chapter. This section includes a brief summary of the major groundwater basins and aquifers in the Colorado River region. Additional information regarding groundwater basins in this hydrologic region may be obtained online from DWR Bulletin 118-2003 or DWR Bulletin 118 Groundwater Basin Maps and Descriptions. Figure 12-2 shows the locations of the alluvial groundwater basins and subbasins in the region, and Table 12-1 lists the names and numbers associated with the alluvial groundwater basins and subbasins.

Groundwater extracted by wells located outside of the alluvial basins is supplied largely from fractured-rock aquifers. In some cases, groundwater stored in a thin overlying layer of alluvial deposits or a thick soil horizon may also contribute to a well's groundwater supply.

Borrego Valley, Warren Valley, Lucerne Valley, and Coachella Valley groundwater basins are among the basins in the region with the greatest groundwater extraction. Because of heavy groundwater use and declining groundwater levels, the Warren and Lucerne valleys' groundwater basins were adjudicated in 1977 and 1996, respectively. Watermasters in the respective groundwater basins ensure that groundwater extraction follow the terms of the adjudications. The Coachella Valley Groundwater Basin is divided into four subbasins managed by CVWD, the Desert Water Agency (DWA), the Mission Springs Water District (MSWD), and the Indio Water Authority (IWA).

**Figure 12-2 Alluvial Groundwater Basins and Subbasins in the Colorado River Hydrologic Region**

**Table 12-1 Alluvial Groundwater Basins and Subbasins in 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 | 7-37 | Arroyo Seco Valley |
| 7-11 | | Copper Mountain | 7-38 | Palo Verde Valley |
| 7-12 | | Warren Valley | 7-39 | Palo Verde Mesa |
| 7-13 | | Deadman Valley | 7-40 | Quien Sabe Point |
| | 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 |
| 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 | | |

### Borrego Valley Groundwater Basin

The Borrego Valley Groundwater Basin (7-24) underlies a valley in the southwestern part of the hydrologic region. The basin is bound by the Santa Rosa Mountains on the north, the San Ysidro Mountains on the west, the Coyote Creek and Superstition Mountain faults on the northeast, and Fish Creek and the Coyote Mountains on the southwest. Borrego Springs is located in the northern portion of the valley where water is extracted for municipal, recreational, and agricultural uses. Three aquifers are interpreted to underlie the valley, an upper unconfined aquifer of alluvium, a middle aquifer of alluvium, and a lower aquifer of more consolidated deposits (California Department of Water Resources 1984). The upper aquifer is thickest in the northern portion of the basin. Groundwater is the sole source of supply for the valley, and groundwater levels have declined more than 100 feet in many parts of the basin since the 1940s.

### Warren Valley Groundwater Basin

The Warren Valley Groundwater Basin (7-12) is an alluvial aquifer that underlies about 27 square miles of the Warren Valley in the northwestern part of the region. The valley is bound by the Sawtooth Mountains on the north and west and the Little San Bernardino Mountains on the south and east. The primary groundwater-bearing deposits in the Warren Valley Groundwater Basin 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 1991). The aquifer is recharged by percolation of ephemeral streamflow from adjacent highlands and by water from the State Water Project (SWP). Because of high rates of groundwater extraction and declining groundwater levels, water rights were adjudicated in Warren Valley in 1977. A watermaster ensures that annual groundwater extractions are within the terms of the adjudication.

### Lucerne Valley Groundwater Basin

The Lucerne Valley Groundwater Basin (7-19) underlies about 230 square miles and is bound by the Granite Mountains on the west, the White Mountains on the south, the Ord Mountains and the Kane Wash Area Groundwater Basin on the north, and the Fry Mountains and Fry Valley on the east. The 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 at least 1,800 feet (California Department of Water Resources 2003). Older alluvial deposits of Tertiary age are deposited adjacent to mountain fronts and in the central portion of the basin. The Tertiary deposits vary between 600 to 1,000 feet in thickness under most of Lucerne Valley. Fine-grained playa deposits in the western part of the basin separate the aquifer system into an upper unconfined zone and a lower confined zone; the aquifer is unconfined in the other portions of the basin. The aquifer is recharged by runoff from adjacent mountains. Faults which affect groundwater flow include the Helendale, Lucerne Lake, Lenwood, Camp Rock, Old Woman Springs, and the North Frontal thrust system. Because of high rates of groundwater extraction and declining groundwater levels, water rights were adjudicated in Lucerne Valley in 1996. A watermaster ensures that annual groundwater extractions are within the terms of the adjudication.

### Coachella Valley Groundwater Basin

The Coachella Valley Groundwater Basin (7-21) is divided into four subbasins: Indio Groundwater Subbasin (7-21.01), Mission Creek Groundwater Subbasin (7-21.02), Desert Hot Springs Groundwater Subbasin (7-21.03), and San Gorgonio Pass Groundwater Subbasin (7.21.04) (California Department of Water Resources 2003). The basin is bound by the Upper Santa Ana Valley on the west, the Santa Rosa Mountains on the south-southwest, the Salton Sea on the south, the San Bernardino Mountains on the north, the Little San Bernardino Mountains on the northeast, and the Orocopia Valley on the east. The primary water-bearing deposits in the northwestern portion of the Coachella Valley Groundwater Basin are composed of Holocene alluvial fan and terrace deposits and the Pleistocene Ocotillo Conglomerate, Cabezon Fanglomerate, and San Timoteo Formation. The primary alluvial aquifer in the northwestern portion of the basin is unconfined and is about 2,000 feet in thickness (California Department of Water Resources 2003).

Three aquifers exist in the central and southern portions of the basin. A semi-perched aquifer as much as 100 feet in thickness is found at or near the surface (Coachella Valley Water District 2010). Below the semi-perched aquifer is the upper aquifer, which is 100 to 300 feet in thickness (Coachella Valley Water District 2010). The lower aquifer is semi-confined to confined, and is the most important groundwater source in the central and southern portions of the valley (Coachella Valley Water District 2002). The upper and lower aquifers are separated by a zone of clay 100 to 200 feet thick. Natural groundwater recharge is from precipitation and runoff from the adjacent highlands. In addition to natural recharge from precipitation and runoff from the surrounding highlands, the CVWD operates multiple facilities where water from the SWP and from the Colorado River is used to recharge the basin (Coachella Valley Water District 2010).

## Fractured-Rock Aquifers

Fractured-rock aquifers are typically found in the mountain and foothill areas adjacent to the alluvial groundwater basins. Because of the highly variable nature of the void spaces in fractured-rock aquifers, wells drawing from fractured-rock aquifers tend to have less capacity and less reliability than wells drawing from alluvial aquifers. On average, wells drawing from fractured-rock aquifers yield less than 10 gallons per minute (gpm). Although fractured-rock aquifers are less productive compared to the alluvial aquifers in the region, they are commonly the sole source of water and a critically important water supply for many communities. A detailed description of the fractured-rock aquifers in the Colorado River region is beyond the scope of this analysis for the *California Water Plan Update 2013*.

## Well Infrastructure

A key aspect to understanding the region's groundwater supply and development is identifying the age, distribution, and type of wells that have been drilled in the region. A valuable source of well information is the well completion reports, or well logs, submitted by licensed well drillers to the landowner, the local county department of environmental health, and DWR. Among other things, well logs commonly identify well location, construction details, borehole geology data, installation date, and type of well use.

Well drillers have been required by law to submit well logs to the State since 1949. California Water Code Section 13751 requires drillers who construct, alter, abandon, or destroy a well, to submit a well log to DWR within 60 days of the completed work. Confidentiality requirements (California Water Code Section 13752) limit access to the well logs to governmental agencies conducting studies, to the owner of the well, and to persons performing environmental cleanup studies.

Well logs submitted to DWR for wells completed from 1977 through 2010 were used to evaluate the distribution and the uses of groundwater wells in the region. DWR does not have well logs for all the wells completed in the region; for some well logs, information regarding well location or use is inaccurate, incomplete, ambiguous, or missing. As a result, some well logs could not be used in the evaluation. However, for a regional-scale evaluation of well installation and distribution, the quality of the data is considered adequate and informative. Additional information regarding assumptions and methods of reporting well-log information to DWR is in Appendix A.

The number and distribution of wells in the Colorado River 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 on the well completion report as municipal or public. Wells identified as “other” include the less common types of wells, such as stock wells, test wells, or unidentified wells (no information listed on the well log).

The Colorado River region includes a portion of San Bernardino, Riverside, and San Diego counties, and all of Imperial County. Well-log data for counties that fall within multiple hydrologic regions were assigned to the hydrologic region containing a majority of alluvial groundwater basins in the region. Unfortunately, a significant number of well logs for Riverside and San Diego counties exist in both the South Coast and Colorado River hydrologic regions, while portions of San Bernardino County wells also fall in the South Lahontan and South Coast hydrologic regions.

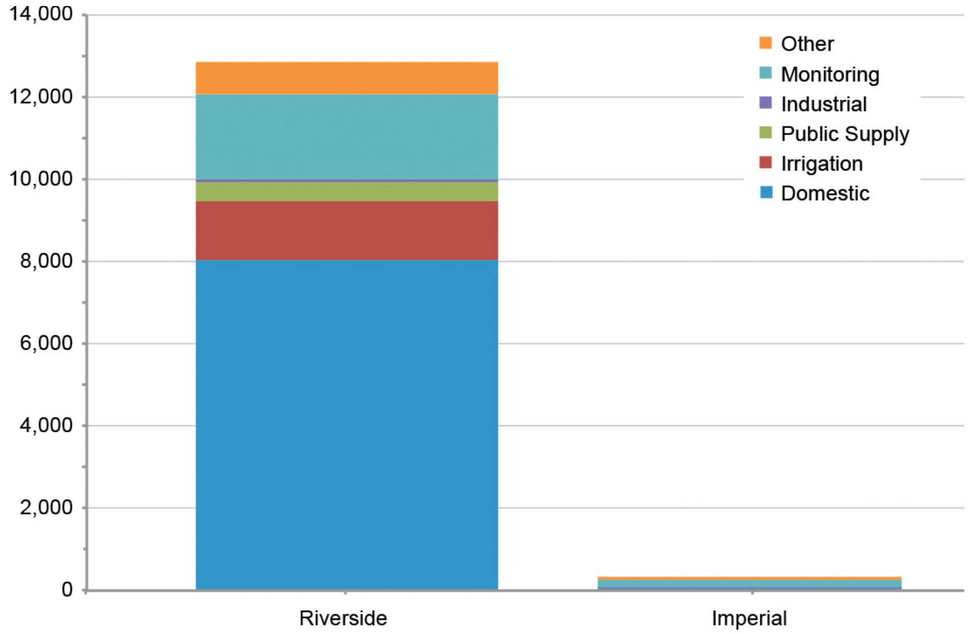
Only the wells logs submitted for Imperial and Riverside counties are included in the well-log analysis for the Colorado River region. The number and type of wells listed by county are not necessarily indicative of the number and type of wells in the hydrologic region area. Information regarding San Diego and San Bernardino county wells is provided in the South Coast and South Lahontan hydrologic region chapters of this report.

Table 12-2 lists the number of well logs received by the DWR for wells completed in the Colorado River region from 1977 to 2010. Figures 12-3 and 12-4 provide an illustration of this data by county and for the region as a whole.

**Table 12-2 Number of Well Logs, by Well Use and by County, 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** |

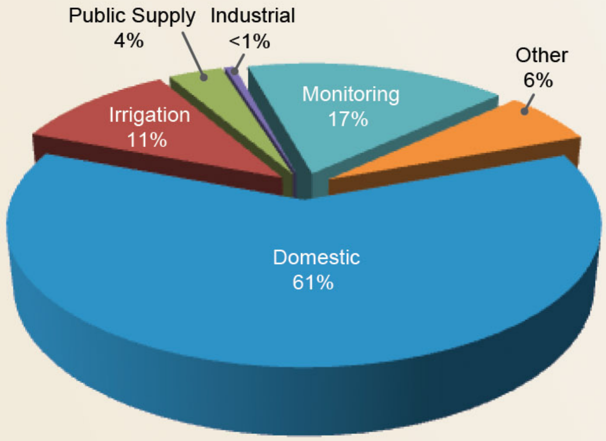
**Figure 12-3 Number of Well Logs by County and Use for the Colorado River Hydrologic Region (1977-2010)**




*Prepared by California Department of Water Resources for California's Groundwater Update 2013*

Table 12-2 and Figure 12-3 show that the distribution and number of wells vary widely by county and by use. The total number of wells completed in the Colorado River region between 1977 and 2010 is approximately 13,201, with more than 97 percent of the wells located in Riverside County. The small number of wells in Imperial County is a result of the county's extensive surface water supplies and water conveyance infrastructure. Imperial County's water demand is met almost entirely by water from the Colorado River via the All-American Canal (AAC). Records indicate that 74 domestic, irrigation, public supply, and industrial wells were completed in Imperial County between 1977 and 2010. As shown on Table 12-2, 60 percent of the wells located in Imperial County are monitoring wells.

**Figure 12-4 Percentage of Well Logs by Type of Use for the Colorado River Hydrologic Region (1977-2010)**




**Colorado River Well Logs Summary by Well Type**

| Well Type | Number of Well Logs |
|---|---:|
| Domestic | 8,096 |
| Irrigation | 1,430 |
| Public Supply | 472 |
| Industrial | 85 |
| Monitoring | 2,292 |
| Other | 826 |
| **Total** | **13,201** |

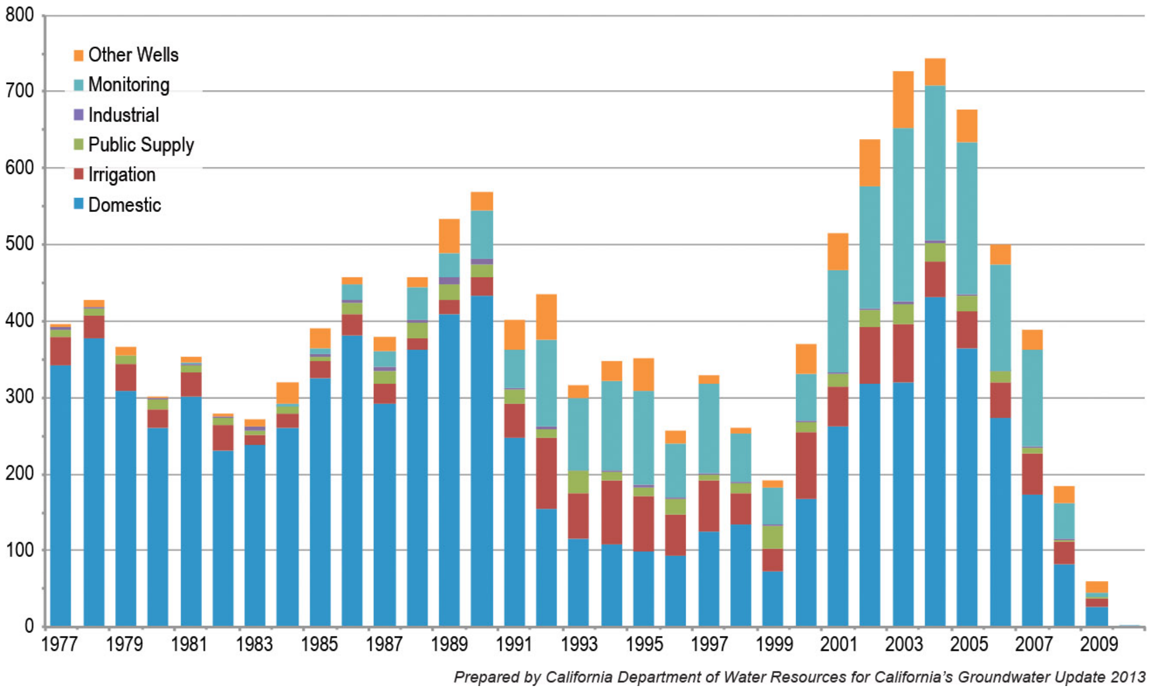
*Prepared by California Department of Water Resources for California's Groundwater Update 2013*

Figure 12-4 displays the percentages of wells, by well use, for the Colorado River region between 1977 and 2010. Figure 12-4 shows that domestic, irrigation, and monitoring wells account for nearly 90 percent of all wells installed in the region, with domestic wells comprising 61 percent and monitoring wells accounting for about 17 percent of well logs on file. Statewide, domestic and monitoring wells average about 54 and 24 percent, respectively, of the total number of wells.

In addition to analyzing the number of wells by location and use, well logs were analyzed by well installation date (Figure 12-5). Evaluating the number and types of wells completed over time can help offer a perspective on the average age of the existing well infrastructure and the general pattern of wells installed during various hydrologic and economic cycles.

Figure 12-5 shows a cyclic pattern of well installation for the Colorado River region, with new well construction ranging from less than 200 to more than 700 wells per year, not counting the incomplete records from 2008-2010. Multiple factors are known to affect the annual number and type of wells drilled. Some of these factors include the annual variations in climate, economy, agricultural cropping trends, or alternative water supply availability.

**Figure 12-5 Number of Well Logs per Year, by Well Use, for the Colorado River Hydrologic Region (1977-2010)**




Large fluctuations in the numbers of domestic wells completed are likely associated with fluctuations in population growth and residential housing construction trends. Between 1980 and 1990, Riverside County experienced a 76 percent increase in the number of residents and was the fastest-growing county in California. As shown on Figure 12-5, domestic wells during this time were the dominant type of well completed in the Colorado River region. An economic downturn in the early 1990s resulted in a decline in the population growth and a corresponding decline in the completion of new wells. Beginning in 2000, the rise in the number of domestic wells completed is likely attributed to the resurgence in residential housing construction. Similarly, the 2007 to 2010 decline in domestic well completion was likely caused by declining economic conditions and a drop in new home construction. The apparent decline in well completions during 2007 through 2010 shown in Figure 12-5 is also largely caused by DWR's backlog in processing the well logs received during that time.

Irrigation well completions are more closely related to climate, cropping trends, and availability of surface water supply. Figure 12-5 shows increased completions of irrigation wells following dry year conditions. Most of the irrigation wells are associated with Riverside County agricultural and golf course use.

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. Starting in 1984, the State of California Underground Storage Tank program took effect. The program provided partial reimbursement of expenses associated with the cleanup of leaking underground storage tanks and quickly resulted in an increase in the installation of groundwater quality monitoring wells. Beginning in 1987, changes in California Water Code Section 13751 required well drillers to begin submitting well logs for monitoring well completions. Well logs typically do not distinguish between monitoring wells installed as part of a groundwater cleanup project as opposed to those installed primarily to collect changes in groundwater levels. However, information on the well logs supports a conclusion that the majority of the monitoring wells were completed for use in environmental assessments and remediation projects related to leaking underground storage tanks, waste disposal sites, or hazardous chemical spills. Prior to about 1987, less than about 20 monitoring wells were installed per year. After 1998, the number of monitoring wells increased from approximately 30 wells per year to almost 230 wells per year.

## CASGEM Basin Prioritization

As part of the California's 2009 Comprehensive Water Package legislation (SB X7-6), DWR implemented the CASGEM Program. The SB X7-6 Groundwater Monitoring legislation added Part 2.11 to Division 6 of the California Water Code (Section 10920 et seq.), which established provisions and requirements for local agencies to develop and conduct groundwater-level monitoring programs. The legislation requires DWR to identify the current extent of groundwater elevation monitoring in each of the alluvial groundwater basins defined under Bulletin 118-2003 and to prioritize those basins, so as to help identify, evaluate, and determine the need for additional groundwater-level monitoring. The basin prioritization process directs DWR to consider, to the extent available, all of the following data components:

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 in the basin, including overdraft, subsidence, saline intrusion, and other water quality degradation.
8. Any other information determined to be relevant by the department.

Using groundwater reliance as the leading indicator of basin priority, DWR evaluated California's 515 groundwater basins and categorized them into four prioritization groups: high, medium, low, and very low.

Table 12-3 lists the high and medium CASGEM priority groundwater basins for the Colorado River region. The final full listing of the CASGEM groundwater basin prioritization is provided in Appendix B. Figure 12- 6 shows the groundwater basin prioritization for the region. Of the 64 basins in the Colorado River region, two basins were identified as high priority (Indio and San Gorgonio Pass groundwater subbasins), four basins were identified as medium priority, nine were listed as low priority, and the other 49 basins are listed as very low priority.

**Table 12-3 CASGEM Prioritization for Groundwater Basins in the Colorado River Hydrologic Region**

| Basin Priority | 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 | 7-12 | Warren Valley | | 22,860 |
| Medium | 2 | 7-21.02 | Coachella Valley | Mission Creek | 18,974 |
| Medium | 3 | 7-21.03 | Coachella Valley | Desert Hot Springs | 22,568 |
| Medium | 4 | 7-24 | Borrego Valley | | 3,853 |
| Low | 9 | See Appendix B | | | |
| Very Low | 49 | See Appendix B | | | |
| **Total** | **64** | **Population of Colorado River Groundwater Basin Area:** | | | **723,094**[a] |

Notes:

[a] Population of groundwater basin area includes the population of all basins within the Colorado River Hydrologic Region

Ranking as of December 2013.

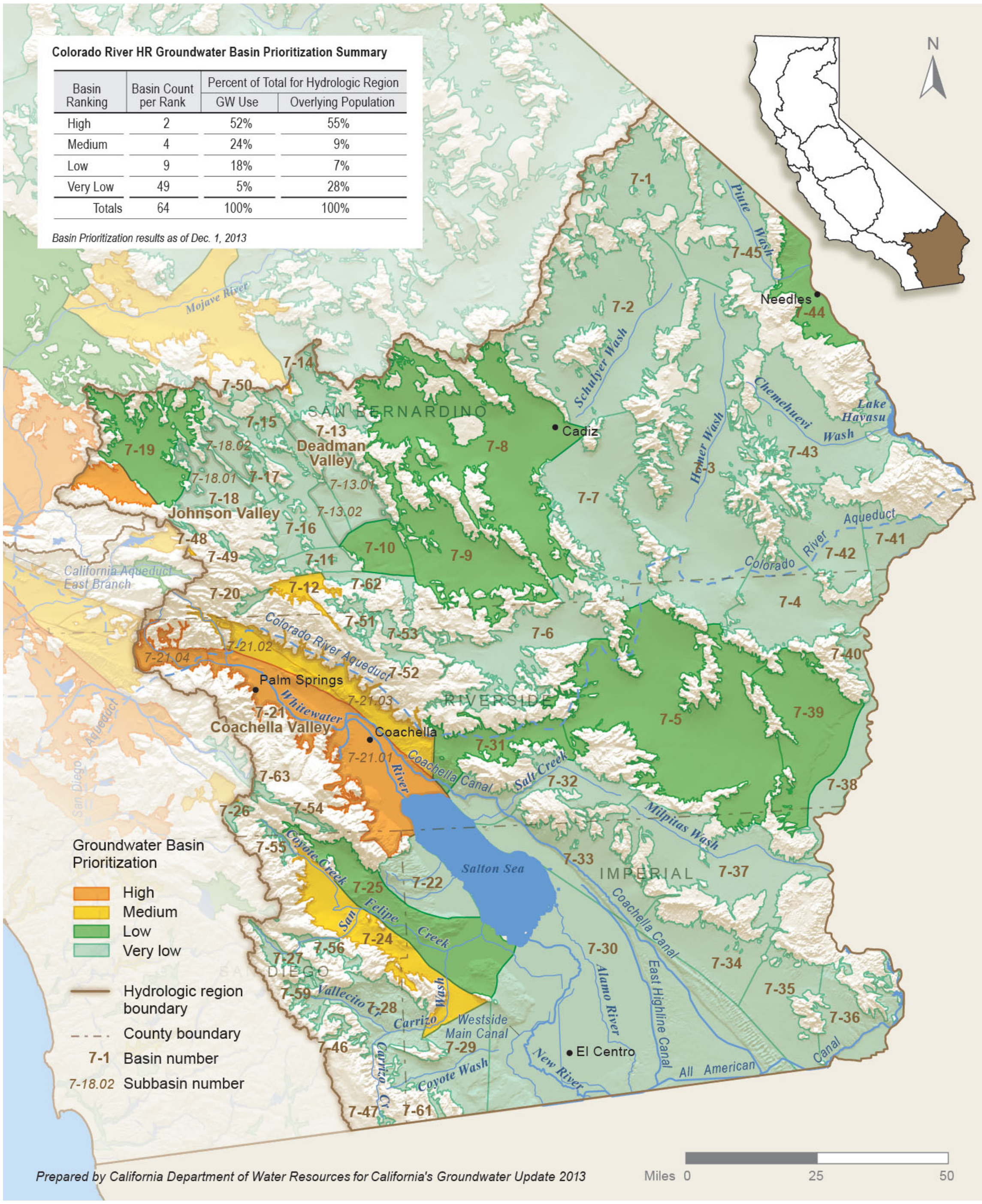
Senate Bill X7-6 (SB X7-6; Part 2.11 to Division 6 of the California Water Code Section 10920 et seq.) requires, as part of the California Statewide Groundwater Elevation Monitoring Program, the California Department of Water Resources to prioritize groundwater basins to help identify, evaluate, and determine the need for additional groundwater-level monitoring by considering available data that include the population overlying the basin, the rate of current and projected growth of the population overlying the basin, the number of public supply wells that draw from the basin, the total number of wells that draw from the basin, the irrigated acreage overlying the basin, the degree to which persons overlying the basin rely on groundwater as their primary source of water, any documented effects on the groundwater within the basin, including overdraft, subsidence, saline intrusion, and other water quality degradation, and any other information determined to be relevant by the California Department of Water Resources.

Using groundwater reliance as the leading indicator of basin priority, the California Department of Water Resources evaluated California's 515 alluvial groundwater basins and categorized them into four groups — high, medium, low, and very low.

Although the primary intent of basin prioritization is to assist DWR in implementing the CASGEM Program, which is based on the comprehensive set of data included in the analysis, basin prioritization is a valuable statewide tool to help evaluate, focus, and align limited resources. Basin prioritization is also an important tool to implement effective groundwater management practices by improving the statewide reliability and sustainability of groundwater resources.

In the Colorado River region, implementation of sustainable groundwater resource management should focus initially on the six basins listed in Table 12-3 as having a high or medium priority. The six basins designated as high or medium priority include 76 percent of the annual groundwater use and 64 percent of the 2010 population that overlies the groundwater basins in the region.

## Figure 12-6 CASGEM Groundwater Basin Prioritization for the Colorado River Hydrologic Region



## Groundwater Use

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

Groundwater extraction estimates derived from land and water use methods typically assume that local surface water supplies are the first to be used to meet local water demands. Once surface water supplies have been fully allocated, if crop demand and water balance information indicates that additional water supplies are needed, groundwater supplies are then applied until the full water use is met and the overall supply and use for the area is balanced. For agricultural areas employing conjunctive management practices, which may involve frequent exchanges between surface water and groundwater supplies, making accurate estimates of annual groundwater extraction by using the land and water use method can be challenging.

DWR water supply and balance data are collected and analyzed by hydrologic regions, which largely correspond to watershed boundaries. The land and water use data are first compiled and analyzed by detailed analysis units (DAUs). Water supply and balance data for DAUs are then compiled into larger planning areas and then into hydrologic regions, and finally into a statewide water supply and balance estimate. To assist local resource planning, DWR also generates water supply and balance information by county. Although some local groundwater management groups independently develop groundwater extraction estimates for their local groundwater basins, DWR does not currently generate groundwater use information by groundwater basin area.

Water use is reported by water year (October 1 through September 30), and categorized according to urban, agriculture, and managed wetland uses. Reference to total water supply for a region represents the sum of surface water supplies, groundwater supplies, and reused/recycled water supplies. Reused/recycled water supplies also include desalinated water supplies. Groundwater use information is presented by planning area, county, and type of use. Additional information regarding water use analysis is provided in Appendix A and Appendix C.

### 2005-2010 Average Annual Groundwater Supply

Water demands in the Colorado River region are met through a combination of Colorado River water, imported surface water, local groundwater, and recycled water supplies. The 2005-2010 average annual total water supply for the region, based on planning area assumptions and boundaries, is estimated at 4,272 taf, with 91 percent of the total supply met by Colorado River surface water. Groundwater extraction in the Colorado River region accounts for about 2 percent of California’s 2005-2010 average annual groundwater use.

Approximately 9 percent (380 taf) of the total water supply is met by groundwater, with the remaining supply met by SWP, local supplies, and recycled water. However, groundwater provides for 100 percent of the supply for some communities in the region and is an important resource to help facilitate conjunctive management in the region.

### Groundwater Use by Planning Area Boundaries

The Colorado River region includes six planning areas. Table 12-4 lists the 2005-2010 average annual total water supply met by groundwater, by planning area and by type of use, and shows the quantity and percentage of groundwater contributing to the total water supply for the region. Table 12-5 identifies the percentage of annual groundwater supply used in the Colorado River region, according to planning area and type of use. Figure 12-7 shows the planning areas for the region and illustrates the groundwater use information presented in Table 12-4 and Table 12-5.

As shown on Table 12-5, the 2005-2010 average total water supply for the Colorado River region is 4,272 taf, with groundwater contributing about 9 percent (380 taf) of the region's total supply. Although 9 percent of the region's total water supply is met by groundwater, groundwater supplies meet about 53 percent (330 taf) of the region's total urban water use. Groundwater supplies contribute 1 percent (50 taf) of the region's agricultural total water use. No groundwater is used for managed wetland applications in the Colorado River region.

Groundwater resources for the Twentynine Palms-Lanfair, Chuckwalla, and Colorado River planning areas account for 11 percent (42 taf) of the total groundwater use for the region; however, communities in many of these areas are 100 percent reliant on groundwater to meet their agricultural and urban water demands. Groundwater use in the Coachella Planning Area (PA) accounts for 83 percent (315 taf) of the total groundwater use in the region, and groundwater contributes to 42 percent of the average annual water supply in the Coachella PA.

### Groundwater Use by County Boundaries

Groundwater supply and use was also calculated by county. County boundaries do not align with planning area or hydrologic region boundaries, so regional totals for groundwater based on county area will vary from the estimates using planning area boundaries shown in Table 12-4. Imperial County is fully within the Colorado River region, while Riverside, San Bernardino, and San Diego counties are partially in the Colorado River region. For the Colorado River region, county groundwater use is only reported for Imperial and Riverside counties. Groundwater use for San Diego County is found in the South Coast Hydrologic Region report, and groundwater use for San Bernardino County is found in the South Lahontan Hydrologic Region report. Tables showing groundwater use for all 58 California counties are provided in Appendix C.

**Table 12-4 Average Annual Groundwater Supply and Percentage of Total Water Supply, According to Planning Area and Type of Use, for the Colorado River Hydrologic Region (2005-2010)**

| Colorado River Hydrologic Region | | Agriculture Use Met by Groundwater | | Urban Use Met by Groundwater | | Managed Wetlands Use Met by Groundwater | | Total Water Use[a] Met by Groundwater | |
|---|---|---|---|---|---|---|---|---|---|
| PA Number | PA Name | taf | %[b] | taf | %[b] | taf | %[b] | taf | % |
| 1001 | Twentynine Palms-Lanfair | 11.1 | 100% | 15.3 | 82% | 0.0 | 0% | 26.4 | 89% |
| 1002 | Coachella | 21.0 | 8% | 294.4 | 60% | 0.0 | 0% | 315.4 | 42% |
| 1003 | Chuckwalla | 2.6 | 100% | 2.1 | 95% | 0.0 | 0% | 4.7 | 98% |
| 1004 | Colorado River | 0.4 | 0% | 10.4 | 78% | 0.0 | 0% | 10.8 | 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% |
| **2005-2010 Annual Average HR Total** | | **50.1** | **1%** | **329.7** | **53%** | **0.0** | **0%** | **379.7** | **9%** |

Notes:
HR = hydrologic region, PA = planning area, taf = thousand acre-feet.
[a] Total water use = groundwater + surface water + reuse.
[b] Percent use is the percent of the total water supply met by groundwater, by type of use.
2005-2010 precipitation equals 91 percent of the 30-year average for the Colorado River Hydrologic Region.

**Table 12-5 Percent of Average Annual Groundwater Supply, According to Planning Area and Type of Use for the Colorado River Hydrologic Region (2005-2010)**

| Colorado River Hydrologic Region | | Agriculture Use of Groundwater | Urban Use of Groundwater | Managed Wetlands Use of Groundwater | Groundwater Use by HR |
|---|---|---|---|---|---|
| PA Number | PA Name | %[a] | %[a] | %[a] | %[b] |
| 1001 | Twentynine Palms-Lanfair | 42% | 58% | 0% | 7% |
| 1002 | Coachella | 7% | 93% | 0% | 83% |
| 1003 | Chuckwalla | 56% | 44% | 0% | 1% |
| 1004 | Colorado River | 4% | 96% | 0% | 3% |
| 1005 | Borrego | 67% | 33% | 0% | 6% |
| 1006 | Imperial Valley | 0.0% | 100% | 0% | 0% |
| **2005-2010 Annual Average HR Total** | | **13%** | **87%** | **0%** | **100%** |

Notes:
HR = hydrologic region, PA = planning area.
[a] Percent use is average annual groundwater use by planning area and type of use, compared to the total groundwater use for the hydrologic region.
[b] Percent of hydrologic region total groundwater use.

**Figure 12-7 Groundwater Use and Total Water Supply Met by Groundwater, by Planning Area, in the Colorado River Hydrologic Region (2005-2010)**

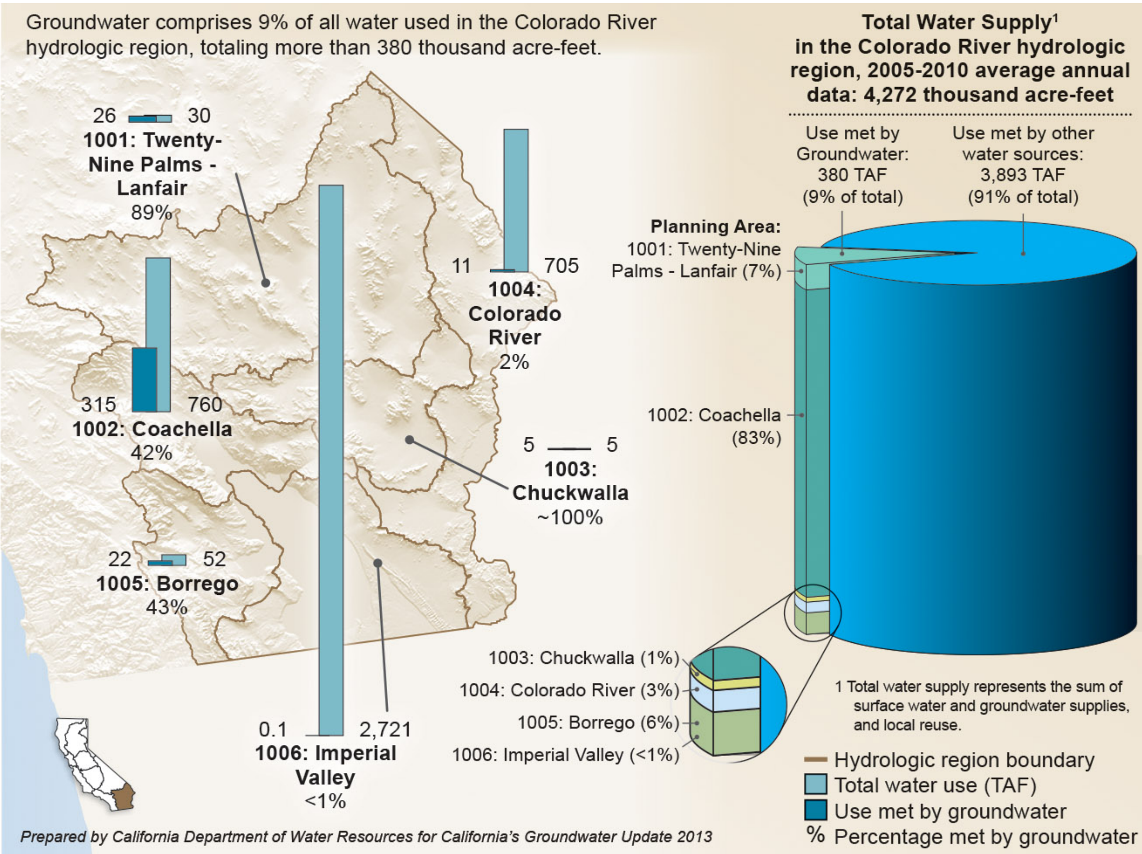



Table 12-6 lists the 2005-2010 average annual groundwater use by county, by type of use, and by the percent that groundwater contributes to the total water supply of Imperial and Riverside counties. As indicated on Table 12-6, the total groundwater use in Imperial and Riverside counties totals approximately 636 taf, which differs from the 380 taf of groundwater use when assuming planning area boundaries in the Colorado River region. Table 12-6 shows that groundwater meets 13 percent of the total water supply demand for the two counties, with almost all of the groundwater being extracted from Riverside County. Imperial County uses 1 taf, which meets 100 percent of the county's urban needs but none of its agricultural needs.

**Table 12-6 Groundwater Use and Percentage of Total Water Supply Met by Groundwater, According to County and Type of Use, for the Colorado River Hydrologic Region (2005-2010)**

| Colorado River Hydrologic Region | Agriculture Use Met by Groundwater | | Urban Use Met by Groundwater | | Managed Wetlands Use Met by Groundwater | | Total Water Use Met by Groundwater | |
|---|---|---|---|---|---|---|---|---|
| **County** | **taf** | **%[a]** | **taf** | **%[a]** | **taf** | **%[a]** | **taf** | **%** |
| Imperial | 0.0 | 0% | 1.1 | 1% | 0 | 0% | 1.1 | 0% |
| Riverside | 138.6 | 15% | 495. | 54% | 0 | 0% | 634.5 | 34% |
| **2005-2010 Annual Average** | **138.6** | **4%** | **497.** | **49%** | **0** | **0%** | **635.7** | **13%** |

Notes:
taf = thousand acre-feet.
[a] Percent use is the percent of the total water supply met by groundwater, by type of use.
2005-2010 precipitation equals 91 percent of the 30-year average for the hydrologic region.

## Change in Annual Groundwater Use

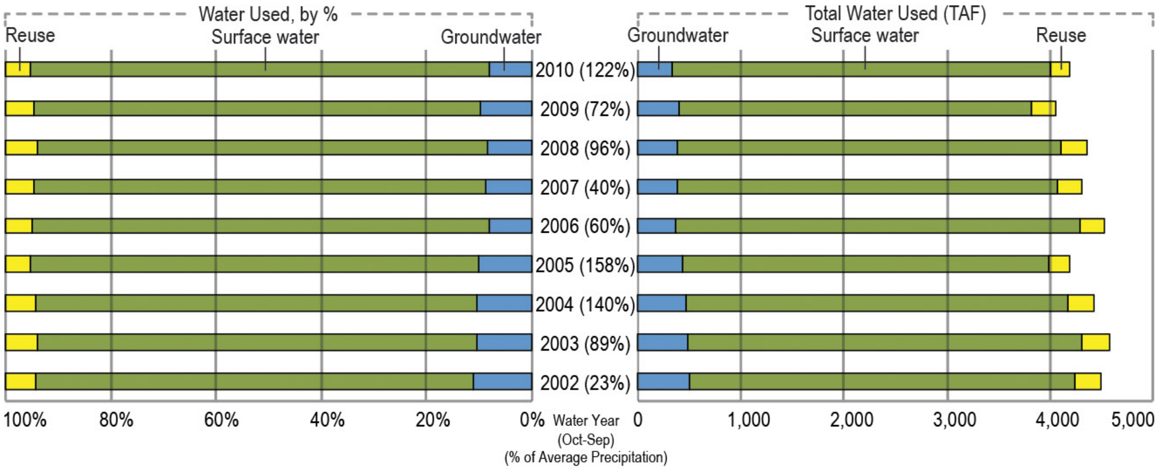
Changes in annual amount and type of groundwater use may be related to a number of factors, such as changes in surface water availability, urban and agricultural growth, economic fluctuations, and water-use efficiency practices.

Figure 12-8 illustrates the 2002 through 2010 water supply trend for the Colorado River region, while Figure 12-9 shows the annual amount and percentage of groundwater supply used to meet urban and agricultural demand during the same period. The right side of Figure 12-8 illustrates the total water supply volume by supply type (groundwater, surface water, and reused/recycled water), while the left side shows the percentage of the overall water supply met by those sources of water. The center column in both figures identifies the water year, along with the corresponding amount of precipitation, as a percentage of the previous 30-year average for the hydrologic region. There are no managed wetland demands identified in the region.

As shown in Figure 12-8, the total annual water supply for the Colorado River region has remained relatively stable between 2002 and 2010, which is likely attributable to a relatively stable surface water supply for the region. Between 2002 and 2010, the annual total water supply for the Colorado River region fluctuated between 4,052 taf in 2009 and 4,589 taf in 2003. Between 2002 and 2010, groundwater supply ranged between 338 taf and 501 taf per year and met between 8 and 11 percent of the annual total water supply for the region. Even during the dry years of 2006 and 2007, groundwater supplies were used to meet 8 and 9 percent, respectively, of the total water supply for the region. Reuse water met between 5 and 6 percent of the total water supply needs in the Colorado River region during this time.

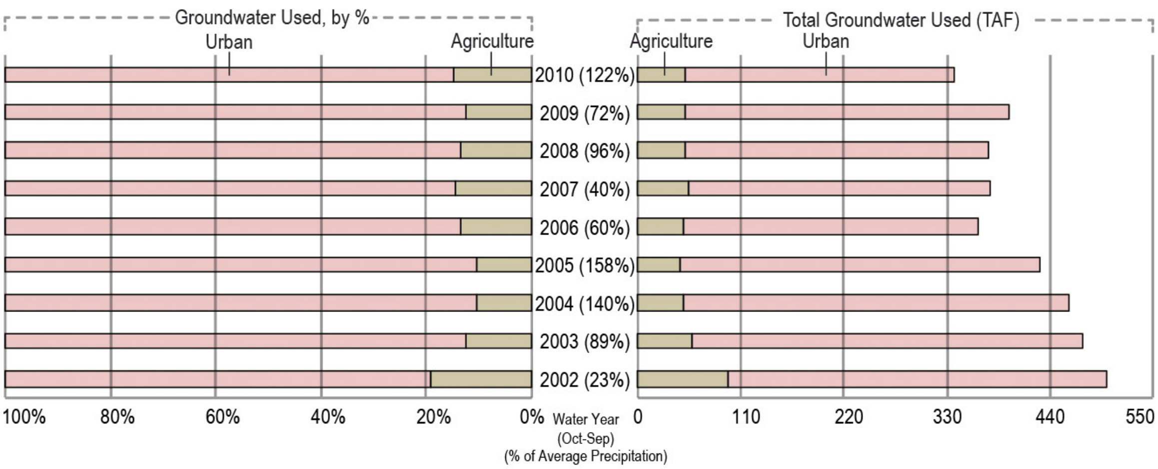
Figure 12-9 shows the 2002-2010 groundwater supply trend by urban, agricultural, and managed wetland uses in the Colorado River region. The right side of Figure 12-9 illustrates the annual volume of groundwater extraction by type of use, while the left side shows the percentage of groundwater extraction by type of use. Groundwater use for urban demand ranged from 81 to 89 percent of the annual groundwater extraction for the region, with the remaining groundwater extraction being used to meet agricultural demand.

**Figure 12-8 Annual Surface Water and Groundwater Supply Trend for the Colorado River Hydrologic Region (2002-2010)**




*Prepared by California Department of Water Resources for California's Groundwater Update 2013*

**Figure 12-9 Annual Groundwater Supply Trend by Type of Use for the Colorado River Hydrologic Region (2002-2010)**




*Prepared by California Department of Water Resources for California's Groundwater Update 2013*

## 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 Section 10753.7 requires local agencies seeking State funds administered by DWR to prepare and implement GWMPs 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. The protocols associated with groundwater monitoring can vary greatly depending on the local conditions; but overall, monitoring protocols should be designed to generate information that promotes efficient and effective groundwater management.

This section summarizes some of the groundwater level, groundwater quality, and land subsidence monitoring activities in the Colorado River region. The summary includes publically available groundwater data compiled by DWR, State Water Resources Control Board (SWRCB), California Department of Public Health (CDPH), and the USGS. Information regarding the groundwater monitoring methods, assumptions, and data availability is provided in Appendix A.

### Groundwater-Level Monitoring

State and federal agencies with groundwater-level monitoring programs in the region include DWR and the USGS. Groundwater-level monitoring is also performed by CASGEM-designated monitoring entities, as well as local cooperators who measure, or contract others to measure, groundwater levels. Groundwater-level information presented in this section represents data publically available through DWR or USGS online information systems. Privately collected and locally maintained groundwater-level information is not discussed in this section. The groundwater-level information in this section only includes active monitoring wells, or those wells that have been measured since January 1, 2010, and monitoring groups that have entered data into the CASGEM or USGS online databases as of July 2012. Because monitoring programs are frequently adjusted to meet changing demands and management actions, groundwater-level information presented for the Colorado River region may not represent the most current information available. Updated groundwater-level information may be obtained online from the DWR CASGEM Program Web site (http://www.water.ca.gov/groundwater/casgem/), and through the USGS National Water Information System (http://waterdata.usgs.gov/nwis).

A list of the number of monitoring wells in the Colorado River region by monitoring agencies, cooperators, and CASGEM-designated monitoring entities is provided in Table 12-7. The locations of these monitoring wells, by monitoring entity and monitoring well type, are shown in Figure 12-10.

Table 12-7 shows that 512 wells in the Colorado River region are actively monitored for groundwater-level information. DWR's Southern Region Office also collects groundwater level data from an additional 70 monitoring wells in two of the region's 64 basins and subbasins; however, those data are not included in the monitoring well summary because of confidentiality agreements that limit public availability of the data. The USGS monitoring network consists of 360 wells in 26 basins and subbasins. Four cooperators and five CASGEM monitoring entities monitor a combined 152 wells in six basins and subbasins in the Colorado River region. The locations of groundwater-level monitoring wells for many of the CASGEM monitoring entities correlates with basins identified as having a high to medium priority under the CASGEM groundwater basin prioritization.

### Table 12-7 Groundwater-Level Monitoring Wells, by Monitoring Entity, for the Colorado River Hydrologic Region

| State and Federal Agencies | Number of Wells |
|---|---|
| California Department of Water Resources | 0[a] |
| U.S. Geological Survey | 360 |
| U.S. Bureau of Reclamation | 0 |
| **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 Entity Wells** | **91** |
| **Total Hydrologic Region Monitoring Wells** | **512** |

Notes:
CASGEM = California Statewide Groundwater Elevation Monitoring Program.
[a] DWR currently monitors 70 wells in the hydrologic region and the data are not publicly available as a result of privacy agreements with well owners or operators.
Table represents monitoring information as of July 2012.
Table includes groundwater-level monitoring wells having publically available online data.

Most of the groundwater-level monitoring networks include a variety of well-use types. The groundwater-level monitoring wells are categorized by the type of well use and include irrigation, domestic, 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. Some of the domestic and irrigations wells used for groundwater-level monitoring include actively operated wells, and some consist of older inactive or unused wells.

Typically, domestic wells are relatively shallow and screened in the upper portion of the aquifer system, while irrigation wells tend to be constructed deeper in the aquifer system. Consequently, groundwater-level data collected from domestic wells typically represent shallow aquifer conditions, while groundwater-level data from irrigation wells represent middle-to-deep aquifer conditions. Some observation wells are constructed as a nested or clustered set of dedicated monitoring wells, designed to characterize groundwater conditions at very specific and discrete production intervals throughout the aquifer system.

Figure 12-10 indicates what agency collects the groundwater elevation data and graphically displays groundwater-level monitoring wells by use. A percentage breakdown of the groundwater-level monitoring wells by use, illustrated by the pie chart, indicates that wells identified by use as “other” account for more than 78 percent of the groundwater-level monitoring wells in the region. Many of these wells are located in the Twentynine Palms, Imperial Valley, and Warren Valley groundwater basins. Public supply and observation wells comprise 7 and 12 percent of the monitoring wells, respectively, while irrigation wells account for 3 percent. Just two domestic wells are part of the groundwater level monitoring grid for the region.

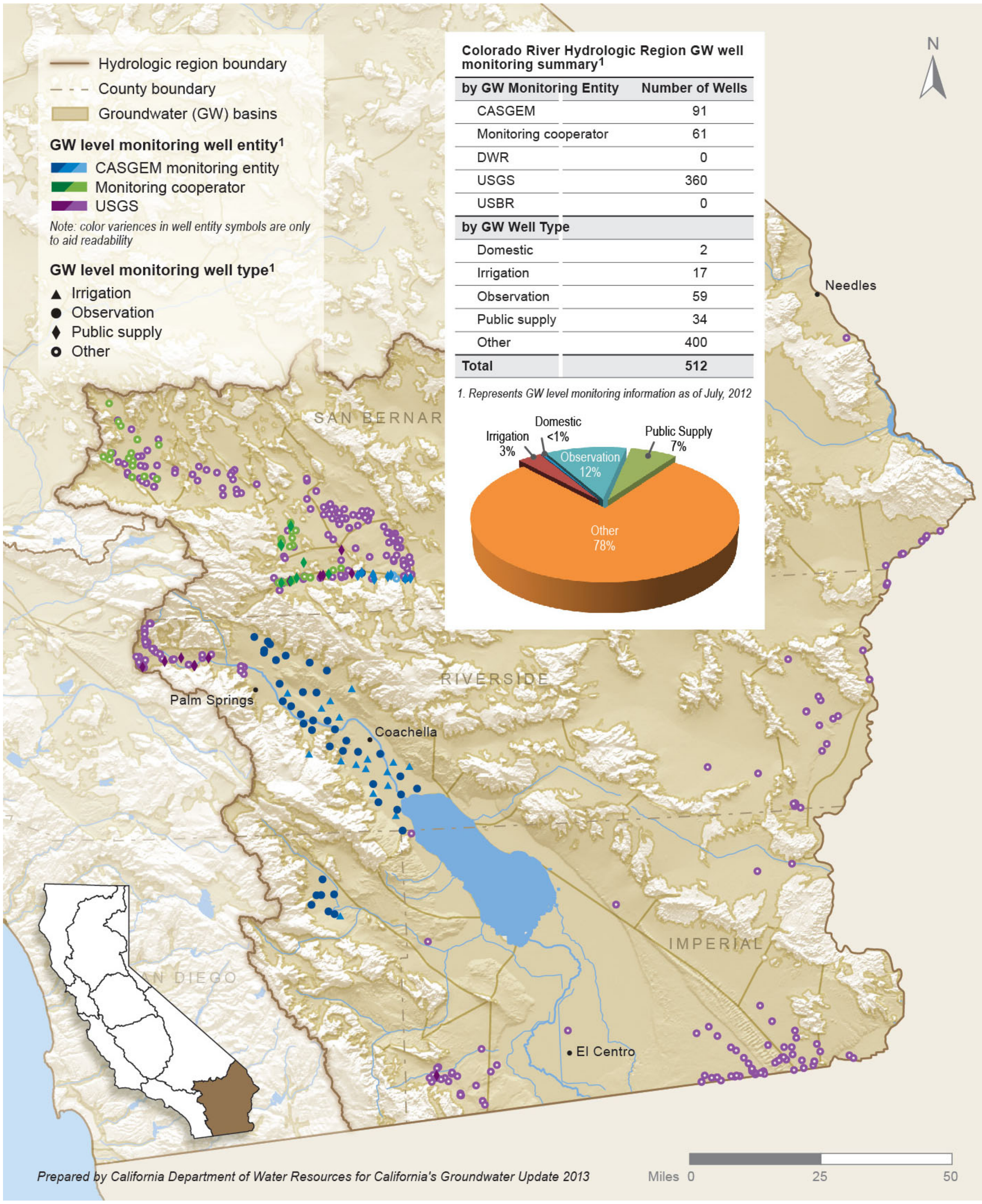
### Groundwater-Quality Monitoring

Groundwater quality monitoring is an important aspect of effective groundwater basin management and is one of the required groundwater management planning components under California Water Code Section 10753.7. Groundwater quality monitoring and assessment evaluates current conditions, can be used to establish groundwater quality thresholds, and can help guide management decisions. Without sufficient groundwater quality monitoring it is almost impossible to determine if groundwater problems exist, or to forecast the potential for future problems that may warrant management actions. Many local, regional, and State agencies have statutory responsibility or authority to collect water quality and water use/level data and information; however, monitoring is inconsistent throughout the state, with significant regional variation in parameters monitored, monitoring frequency, and data availability. In spite of these inconsistencies, there are excellent examples of groundwater monitoring programs being implemented at the local, regional, and State levels.

A number of existing groundwater quality monitoring efforts were initiated as part of the Groundwater Quality Monitoring Act of 2001, implementing goals to improve and increase the statewide availability of groundwater quality data. A comprehensive presentation of the Colorado River region groundwater-quality monitoring results is beyond the scope of this chapter. A summary of the statewide and regional groundwater-quality monitoring results and information is provided below.

Regional and statewide groundwater-quality monitoring information and data are available to the public on DWR’s Water Data Library (http://www.water.ca.gov/waterdatalibrary/), the SWRCB’s Groundwater Ambient Monitoring and Assessment (GAMA) Web site (http://www.waterboards.ca.gov/gama/geotracker_gama.shtml), and the GeoTracker GAMA Web site (http://geotracker.waterboards.ca.gov/). The GAMA Program was created in 2000 by the SWRCB to better understand California’s groundwater quality issues. The GAMA Program was later expanded, as part of the Groundwater Quality Monitoring Act of 2001, resulting in a publicly accepted plan to monitor and assess groundwater quality in basins that account for more than 95 percent of the state’s groundwater use. The GAMA Web site includes a description of the GAMA program and also provides links to published GAMA documents and related reports.

**Figure 12-10 Monitoring Well Location by Agency, Monitoring Cooperator, and CASGEM Monitoring Entity for the Colorado River Hydrologic Region**




| by GW Monitoring Entity | Number of Wells |
|---|---|
| CASGEM | 91 |
| Monitoring cooperator | 61 |
| DWR | 0 |
| USGS | 360 |
| USBR | 0 |
| **by GW Well Type** | |
| Domestic | 2 |
| Irrigation | 17 |
| Observation | 59 |
| Public supply | 34 |
| Other | 400 |
| **Total** | **512** |

GeoTracker GAMA is an online groundwater information system that provides the public with access to groundwater quality data. The data is geographically displayed and includes analytical tools and reporting features to assess groundwater quality conditions. GeoTracker GAMA allows users to search for more than 60 million standardized analytical test results from over 200,000 wells and contains more than 125 million data records. These data records were obtained from different sources, such as the SWRCB, regional water quality control boards (RWQCBs), CDPH, California Department of Pesticide Regulation (DPR), USGS, and Lawrence Livermore National Laboratory (LLNL). In addition to groundwater quality data, GeoTracker GAMA contains more than 2.5 million depth-to-groundwater measurements from DWR and the RWQCBs. GeoTracker GAMA also contains hydraulically fractured oil and gas well information from the California Division of Oil, Gas, and Geothermal Resources. Groundwater quality data in DWR's Water Data Library primarily includes baseline minerals, metals, and nutrient data associated with regional monitoring.

Table 12-8 provides agency-specific groundwater quality information. Additional information regarding assessment and reporting of groundwater quality information is listed under the "Aquifer Conditions" section of this chapter.

### Land Subsidence Monitoring

Land subsidence has been shown to occur in areas having a significant decline in groundwater levels. When groundwater is extracted from aquifers in sufficient quantity, the groundwater level is lowered and the water pressure that supports the skeletal structure of the sediment grains decreases. A decrease in water pressure causes more weight from the overlying sediments to be supported by the sediment grains in the aquifer. In unconsolidated deposits, the increased weight from overlying sediments may compact the fine-grained sediments and permanently decrease both the porosity of the aquifer and the ability of the aquifer to store water. The partial collapse of the aquifer's skeletal structure results in the subsidence of the land surface overlying the aquifer. *Elastic land subsidence* is the reversible and temporary fluctuation of the earth's surface in response to seasonal periods of groundwater extraction and recharge. *Inelastic land subsidence* is the irreversible and permanent decline in the earth's surface as a result of the collapse or compaction of the pore structure in the fine-grained portions of an aquifer system (U.S. Geological Survey 1999).

The USGS and MWA cooperatively monitored and investigated the occurrence of land subsidence in the MWA portion of the Colorado River region. Additional land subsidence monitoring and reporting using a GPS monitoring network and InSAR data have been conducted in the Coachella Valley portion of the Colorado River region by Ikehara et al. in 1997, and by Sneed and Brandt in 2007. Results associated with these monitoring activities are provided under the "Aquifer Conditions" section of this chapter. Additional information regarding land subsidence in California is provided in Appendix F.

## Aquifer Conditions

Aquifer conditions and groundwater levels change in response to varying supply, demand, and weather conditions. 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 a result, if groundwater levels rise sufficiently, water table aquifers can reconnect to surface water systems and contribute to the overall base flow, or discharge directly to the surface via wetlands, seeps, and springs.

## Table 12-8 Sources of Groundwater Quality Information for the Colorado River Hydrologic Region

| Agency | Links to Information |
|---|---|
| **State Water Resources Control Board** http://www.waterboards.ca.gov/ | **Groundwater** http://www.waterboards.ca.gov/water_issues/programs/#groundwater<br>• Communities that Rely on a Contaminated Groundwater Source for Drinking Water http://www.waterboards.ca.gov/water_issues/programs/gama/ab2222/index.shtml<br>• Nitrate in Groundwater: Pilot Projects in Tulare Lake Basin/Salinas Valley http://www.waterboards.ca.gov/water_issues/programs/nitrate_project/index.shtml<br>• Hydrogeologically Vulnerable Areas http://www.waterboards.ca.gov/gama/docs/hva_map_table.pdf<br>• Aquifer Storage and Recovery http://www.waterboards.ca.gov/water_issues/programs/asr/index.shtml<br>• Central Valley Salinity Alternatives for Long-Term Sustainability [CV-Salts] http://www.waterboards.ca.gov/centralvalley/water_issues/salinity/<br>**Groundwater Ambient Monitoring and Assessment (GAMA) Program** http://www.waterboards.ca.gov/gama/index.shtml<br>• GeoTracker GAMA (Monitoring Data) http://www.waterboards.ca.gov/gama/geotracker_gama.shtml<br>• Domestic Well Project http://www.waterboards.ca.gov/gama/domestic_well.shtml<br>• Priority Basin Project http://www.waterboards.ca.gov/water_issues/programs/gama/sw_basin_assesmt.shtml<br>• Special Studies Project http://www.waterboards.ca.gov/water_issues/programs/gama/special_studies.shtml<br>• California Aquifer Susceptibility Project http://www.waterboards.ca.gov/water_issues/programs/gama/cas.shtml<br>**Contaminant Sites**<br>• Land Disposal Program http://www.waterboards.ca.gov/water_issues/programs/land_disposal/<br>• Department of Defense Program http://www.waterboards.ca.gov/water_issues/programs/dept_of_defense/<br>• Underground Storage Tank Program http://www.waterboards.ca.gov/ust/index.shtml<br>• Brownfields http://www.waterboards.ca.gov/water_issues/programs/brownfields/ |
| **California Department of Public Health** http://www.cdph.ca.gov/Pages/DEFAULT.aspx | **Division of Drinking Water and Environmental Management** http://www.cdph.ca.gov/programs/Pages/DDWEM.aspx<br>• Drinking Water Source Assessment and Protection (DWSAP) Program http://www.cdph.ca.gov/certlic/drinkingwater/Pages/DWSAP.aspx<br>• Chemicals and Contaminants in Drinking Water http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Chemicalcontaminants.aspx<br>• Chromium-VI http://www.cdph.ca.gov/certlic/drinkingwater/Pages/Chromium6.aspx<br>• Groundwater Replenishment with Recycled Water http://www.cdph.ca.gov/HealthInfo/environhealth/water/Pages/Waterrecycling.aspx |

| Agency | Links to Information |
|---|---|
| **California Department of Water Resources** http://www.water.ca.gov/ | Groundwater Information Center http://www.water.ca.gov/groundwater/index.cfm<br>• Bulletin 118 Groundwater Basins http://www.water.ca.gov/groundwater/bulletin118/gwbasins.cfm<br>• California Statewide Groundwater Elevation Monitoring (CASGEM) http://www.water.ca.gov/groundwater/casgem/<br>• Groundwater-Level Monitoring http://www.water.ca.gov/groundwater/data_and_monitoring/gw_level_monitoring.cfm<br>• Groundwater Quality Monitoring http://www.water.ca.gov/groundwater/data_and_monitoring/gw_quality_monitoring.cfm<br>• Well Construction Standards http://www.water.ca.gov/groundwater/wells/standards.cfm<br>• Well Completion Reports http://www.water.ca.gov/groundwater/wells/well_completion_reports.cfm |
| **California Department of Toxic Substance Control** http://www.dtsc.ca.gov/ | EnviroStor http://www.envirostor.dtsc.ca.gov/public/ |
| **California Department of Pesticide Regulation** http://www.cdpr.ca.gov/ | Groundwater Protection Program http://www.cdpr.ca.gov/docs/emon/grndwtr/index.htm<br>• Well Sampling Database http://www.cdpr.ca.gov/docs/emon/grndwtr/gwp_sampling.htm<br>• Groundwater Protection Area Maps http://www.cdpr.ca.gov/docs/emon/grndwtr/gwpa_maps.htm |
| **U.S. Environmental Protection Agency** http://www.epa.gov/safewater/ | U.S. Environmental Protection Agency STORET Environmental Data System http://www.epa.gov/storet/ |
| **U.S. Geological Survey** http://ca.water.usgs.gov/ | U.S. Geological Survey Water Data for the Nation http://waterdata.usgs.gov/nwis |

During dry years or periods of increased groundwater use, seasonal groundwater levels tend to fluctuate more extensively and, depending on annual recharge conditions, may respond with a long-term decline in local and regional groundwater levels. Depending on the amount, timing, and duration of groundwater-level decline, affected well owners may need to deepen wells or lower pumps to regain access to groundwater.

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

The conditions of all basins and aquifers in the Colorado River region will not be reported in this chapter. Selected areas will be included for discussion in the following sections addressing groundwater-level trends, groundwater quality, and land subsidence. Additional external coordination, data collection, and analysis will be required to expand the discussion to include more areas of the region.

## Groundwater Occurrence and Movement

Groundwater comes from infiltration of precipitation and of water from streams, canals, and other surface water systems and moves from higher to lower elevations. Under predevelopment conditions, the occurrence and movement of groundwater was largely controlled by the surface and the subsurface geology, the size and distribution of the natural surface water systems, the average annual hydrology, and the regional topography. But many decades of high-volume groundwater extraction considerably affect the natural occurrence and movement of groundwater. Areas of high groundwater extraction tend to redirect and capture groundwater underflow that may otherwise have contributed to nearby surface water systems, leading to varying degrees of surface water depletion. High-capacity wells, screened over multiple aquifer zones also lend themselves to vertical aquifer mixing, which can additionally alter natural groundwater flow conditions. In addition, infiltration along unlined water conveyance canals, percolation of applied irrigation water, and direct recharge programs create significant groundwater recharge areas where none previously existed.

### Depth to Groundwater

Understanding the local depth to groundwater provides a better awareness of these factors:

- Potential interaction between groundwater and surface water systems.
- Relationship between land use and groundwater levels.
- Potential for land subsidence.
- Groundwater contributions to the local ecosystems.
- Costs associated with well installation and groundwater extraction.

Under predevelopment aquifer conditions, changes in the depth to groundwater will generally correlate with ground surface elevation. For example, with increasing ground surface elevation, there is a corresponding increase in the depth to groundwater. In high-use basins or in conjunctively managed basins, the correlation between depth to water and ground surface elevation will eventually start to break down and show significant variability. This can occur even in areas where there is little change in ground surface elevation.

No detailed depth-to-groundwater information was generated for the Colorado River region as part of *California Water Plan Update 2013*. Depth-to-groundwater data for some of the groundwater basins in the Colorado River region are available online via DWR's Water Data Library (http://www.water.ca.gov/waterdatalibrary/), DWR's CASGEM (http://www.water.ca.gov/groundwater/casgem/system), and the USGS National Water Information System (http://waterdata.usgs.gov/nwis/gw). Coachella Valley groundwater-level data may be obtained from the Final Program Environmental Impact Report for the Coachella Valley Water Management Plan (2002) (http://www.cvwd.org/news/publicinfo/CVWD_Final_PEIR.pdf), the Coachella Valley Water District Engineer's 2010-2011 Report (http://www.cvwd.org/news/publicinfo/2010_06_22_Engineering_Report-Lower_WWR-2010-2011-w160000(FINAL052510).pdf), and the Coachella Valley Water Management Plan 2010 Update (http://www.cvwd.org/news/publicinfo/2010_12_02_CVWMP_Update_Draft.pdf). Lucerne Valley groundwater-level information is included in the change in storage thesis conducted by Napoli and Laton (2004) (http://groundwater.fullerton.edu/groundwater/Old/Past_and_Present_Student_Projects_Thesis_files/Thesis napoli.pdf).

### Groundwater Elevations

Depth-to-groundwater measurements can be converted to groundwater elevations if the elevation of the ground surface is known. Groundwater elevation contours provide a good regional estimate of the occurrence and movement of groundwater. Similar to topographic contours, the pattern and spacing of groundwater elevation contours can be used to help estimate the direction of groundwater movement and the gradient, or rate, of groundwater flow. DWR monitors the depth to groundwater in some groundwater basins in the Colorado River region, though groundwater elevation contours were not developed. Several local agencies independently or cooperatively measure groundwater levels and produce groundwater contour maps for basins within their jurisdictions. In addition to the references and online links provided in the previous section, groundwater contour maps for the Borrego Valley are available from the USGS (Moyle 1982), DWR's Southern Region Office, the Borrego Water District's *Integrated Water Resource Management Plan* (2009), and Appendix A of the 2011 San Diego County General Plan update.

### Groundwater-Level Trends

Depth-to-water measurements collected from a particular well over time can be plotted to create a hydrograph. Hydrographs assist in the presentation and analysis of seasonal and long-term groundwater-level variability and trends over a time. Because the highly variable nature of the aquifer systems in each groundwater basin, and because of the variable nature of annual groundwater extraction, recharge, and surrounding land use practices, the hydrographs selected for discussion do not attempt to illustrate or depict average aquifer conditions over a broader region. Rather, the hydrographs were selected to help tell a story of how the local aquifer systems respond to changing groundwater extractions and implementation of resource management practices.

The hydrographs are identified according to the State Well Number (SWN) system. The SWN identifies a well by its location using the U.S. Public Lands Survey System of township, range, and section. More information on the SWN system is provided in DWR's *Water Facts* No. 7 (http://www.water.ca.gov/pubs/conservation/waterfacts/numbering_water_wells_in_california__water_facts_7_/water_facts_7.pdf).

Figure 12-11 shows hydrograph examples for four selected groundwater elevation monitoring wells in the Colorado River region and provides a brief explanation of the hydrograph "story." Detailed information about each hydrograph can be found in the following paragraphs.

## Figure 12-11 Groundwater Hydrographs for the Colorado River Hydrologic Region, Page 1

### Aquifer response to changing demand and management practices

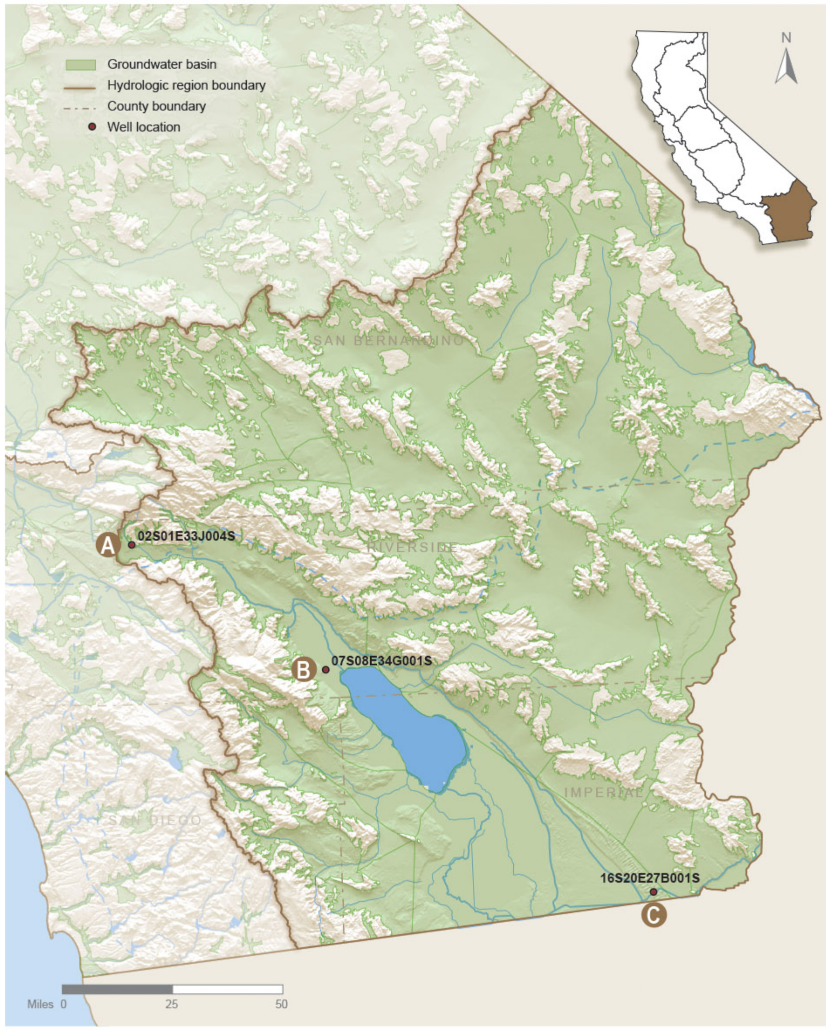
Hydrographs were selected to help tell a story of how local aquifer systems respond to changing groundwater demand and resource management practices. Additional detail is provided within the main text of the report.

**A Hydrograph 02S01E33J004S:** shows the aquifer response to the long-term hydrologic cycles and season variations associated with local precipitation conditions. Despite the large fluctuations in the groundwater levels, the overall aquifer response to long-term changes in demand appears to be relatively stable.

**B Hydrograph 07S08E34G001S:** highlights the long-term impact of unsustainable reliance on groundwater supplies. The early declining trend in groundwater levels was reversed by introducing imported surface water deliveries in 1950s. The latter declining trend was stabilized by conjunctive management of surface water and groundwater supplies beginning in 2005.

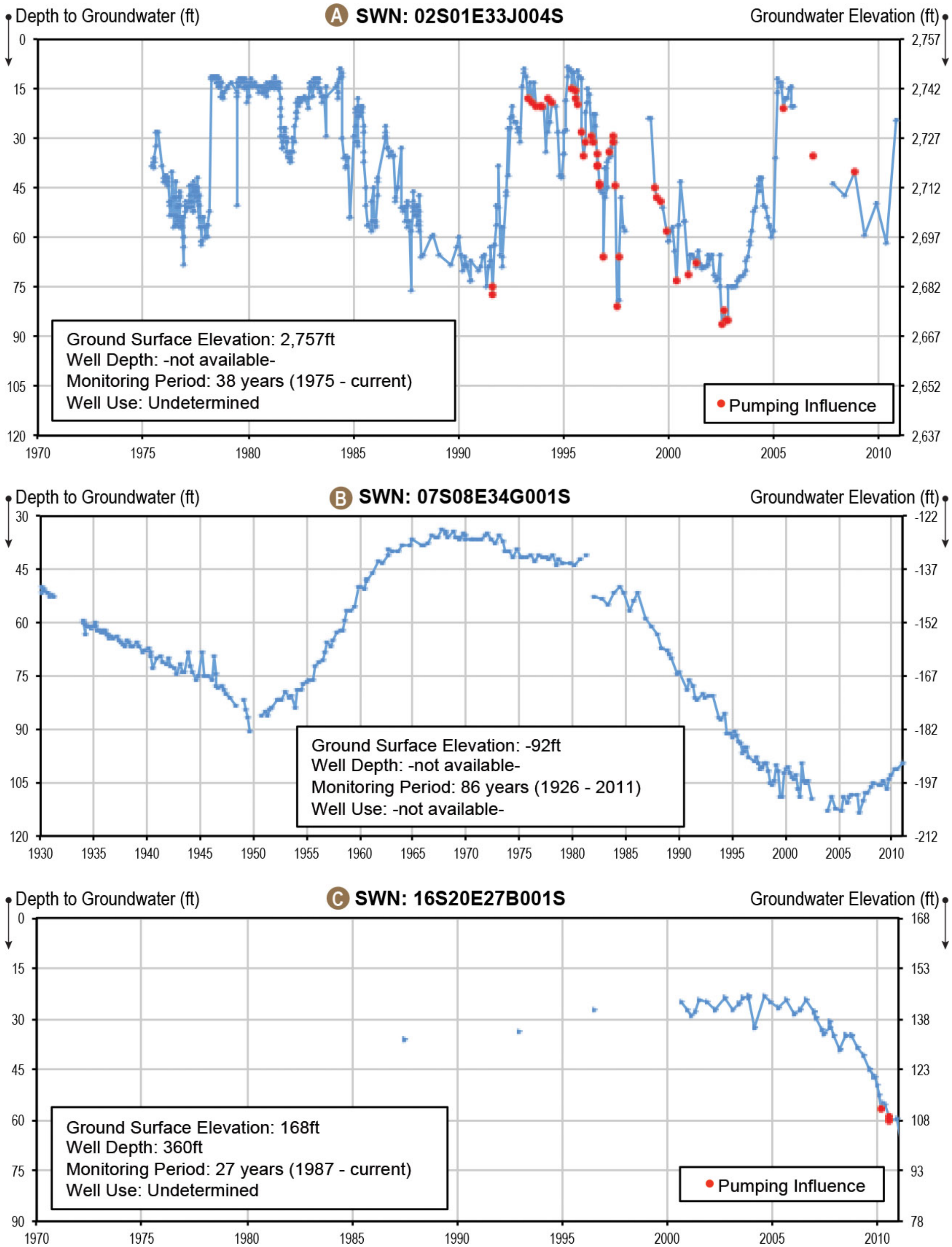
**C Hydrograph 16S20E27B001S:** illustrates the interplay between the groundwater aquifer and the nearby surface water conveyance. The unconfined aquifer is replenished in summer and fall when the canal runs full and vice-versa in winter and spring. Sudden drop in the seasonal variation corresponds with the lining of All American Canal in 2007.

Regional locator map




*Prepared by California Department of Water Resources for California's Groundwater Update 2013*

## Figure 12-11 Groundwater Hydrographs for the Colorado River Hydrologic Region, Page 2



### *Hydrograph 02S01E33J004S*

Figure 12-11a is a hydrograph for well 02S01E33J004S located in the San Gorgonio Groundwater Subbasin portion of the Coachella Valley Groundwater Basin. The hydrograph depicts the aquifer responses to seasonal weather and pumping variations and to periods of high and low precipitation, as well.

The well is constructed at the base of an alluvial fan in a sparsely developed area adjacent to the San Gorgonio River. The sparse developments in the area include residential, industrial, and commercial land use. 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. Groundwater-level measurements have been recorded weekly to monthly from 1975 to 2005 and semi-annually to annually beginning in 2006.

The hydrograph shows small to large seasonal fluctuations and as much as 80-foot swings in groundwater levels in response to extended periods of high and low precipitation. Single year rebounds of 30 to 40 feet in groundwater levels are shown to follow the high precipitation years of 1978, 1993, 1998, 2005, and 2010. During the years with high precipitation, the hydrograph shows that the aquifer is recharged to nearly the ground surface, possibly representing full aquifer conditions. Although the aquifer in this portion of the basin shows large fluctuations in groundwater levels associated with periods of wet and dry conditions, the overall aquifer response to long-term changes in demand appears to be relatively stable. The San Gorgonio Groundwater Subbasin is designated as a CASGEM high-priority groundwater basin as a result of groundwater reliance, public supply well density, and projected population growth.

### *Hydrograph 07S08E34G001S*

Figure 12-11b is a hydrograph for well 07S08E34G001S located northwest of the Salton Sea in the southern portion of the Indio (Whitewater) Groundwater Subbasin. This hydrograph depicts various trends in the groundwater level and how the addition of imported surface water can help increase aquifer sustainability by facilitating conjunctive management. Well 07S08E34G001S is completed in the alluvial portion of the aquifer and is used for agricultural irrigation. Groundwater levels have been measured in this well at least semi-annually to quarterly since 1926. The Indio Groundwater Subbasin is designated as a CASGEM high-priority groundwater basin because of groundwater reliance, public supply well density, and projected population growth.

The hydrograph shows that groundwater levels steadily declined 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 in the valley. In-lieu recharge associated with conjunctive management of imported Colorado River water and local groundwater resources contributed to rising groundwater levels 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 1960s. Beginning in the early 1970s and continuing through the early 2000s, groundwater levels once again began a steady decline and lowered more than 75 feet as a result of increases in groundwater extraction to meet increasing agricultural demand (Coachella

Valley Water District 2010). Groundwater levels began to recover in 2003 because of increases in surface water allocations, thereby reducing the demand for groundwater.

In 2003, CVWD and DWA formed an exchange agreement with the Metropolitan Water District of Southern California to acquire SWP water for use in Coachella Valley. Because no physical facilities exist to deliver SWP water to Coachella Valley, the CVWD exchanges the agreed allocation of SWP water for Colorado River water via the Colorado River Aqueduct (Coachella Valley Water District 2010). 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 completed SWP transfer agreements with the Berrenda Mesa Water District in Kern County. To reduce the groundwater demand, the CVWD also operates three water recycling facilities which provide water for landscape and golf course irrigation (Coachella Valley Water District 2010).

### *Hydrograph 16S20E27B001S*

Figure 12-11c is a hydrograph for well 16S20E27B001S located adjacent to AAC in the southeastern portion of the Imperial Valley Groundwater Basin. The hydrograph depicts a relatively stable long-term groundwater level followed by a sharp and steady decline in 2007. This well is constructed in alluvial deposits in an uninhabited area of the Imperial Sand Dunes. Locally confined aquifer conditions may be present because of fine-grained prehistoric lake deposits. Groundwater-level measurements were first recorded in 1987 and then recorded sporadically until 2000. Since 2000, groundwater-level measurements have been recorded at least quarterly each year.

The hydrograph shows a 12-foot increase in groundwater levels between 1987 and 2000. Seasonal fluctuations in groundwater levels between 2000 and 2006 ranged from 3 to 5 feet per year, with the spring-to-spring change in groundwater levels remaining relatively steady during this time. From 2006 to 2010, spring groundwater levels have steadily declined at a rate of about 5 feet per year. The steady decline of the groundwater level is likely attributed to the lining of the AAC which began construction in 2007. The groundwater levels in the vicinity of this well are expected to continue to decline as a result of the reduction of surface water loss and infiltration from the AAC. Eventually, groundwater levels will lower to a new equilibrium level based on the reduced water infiltration. Periods of drought and high precipitation do not appear to dramatically affect groundwater levels in this well. The Imperial Valley Groundwater Basin is designated as a CASGEM very-low-priority basin because of limited groundwater reliance, low population, and public supply-well density.

## Change in Groundwater in Storage

*Change in groundwater in storage* is the difference in groundwater volume between two different time periods. Change in groundwater in storage is calculated by multiplying the difference in groundwater elevation between two monitoring periods, by the overlying groundwater basin area, and by the estimated specific yield or volume of pore space from which water may be extracted.

Examining the annual change in groundwater in storage over a series of years helps identify aquifer response to changes in hydrology, land use, and groundwater management. If the volumetric change in storage is negligible over a period represented by average hydrologic and land use conditions, the basin is considered to be in equilibrium. Declining groundwater levels and reduction of groundwater in storage during years of average hydrology and land use do not always indicate basin overdraft or unsustainable management; typically, some additional investigation is required. Use 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 conjunctively managing a groundwater basin. Additional information regarding risks and benefits of conjunctive management in California can be found in *California Water Plan Update 2013,* Volume 3, Chapter 9, "Conjunctive Management and Groundwater Storage."

Change-in-groundwater-in-storage estimates for the Colorado River region were not developed for *California Water Plan Update 2013*. Some local groundwater agencies within the Colorado River region periodically develop change-in-groundwater-in-storage estimates for basins in their service area. Developing annual change-in-groundwater-in-storage estimates allows local groundwater managers to evaluate changing storage trends against changing land use patterns, weather variability, and sustainability potential. Examples of local agencies that determined change in storage include MWA, Hi-Desert Water District (HDWD), and CVWD. Borrego Valley change-in-groundwater-in-storage estimates have been developed by DWR Southern Region Office and as part of the *San Diego County 2011 General Plan Update*.

## Groundwater Quality

The chemical character of groundwater in the Colorado River region is variable. Cation concentrations in groundwater are dominated by sodium, with progressively lesser amounts of calcium and magnesium. Bicarbonate is typically 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 at Bristol Valley Groundwater Basin, where the mineral halite (sodium chloride) is formed and then mined by evaporation of groundwater in the trenches of Bristol (dry) Lake. The total dissolved solids (TDS) content of groundwater is high in many of the basins in this 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 below in Table 12-9.

### Table 12-9 GAMA Groundwater Quality Reports for the Colorado River Hydrologic Region

**Data Summary Reports**

- Borrego Valley, Central Desert, and Low-Use Basins
  http://pubs.usgs.gov/ds/659
- Coachella Valley
  http://www.waterboards.ca.gov/gama/docs/coachella_dsr.pdf
- Colorado River
  http://www.waterboards.ca.gov/gama/docs/coloradoriver_rpt.pdf

**Assessment Reports**

- Status of Groundwater Quality in the California Desert Region, 2006-2008: California GAMA Priority Basin Project
  http://pubs.usgs.gov/sir/2012/5040/pdf/sir20125040.pdf

**Fact Sheets**

- Groundwater Quality in the Coachella Valley, California
  http://pubs.usgs.gov/fs/2012/3098/pdf/fs20123098.pdf
- Groundwater Quality in the Colorado River Basins, California
  http://pubs.usgs.gov/fs/2012/3034/pdf/fs20123034.pdf

**Domestic Well Project**

- San Diego County Focus Area
  http://www.waterboards.ca.gov/gama/domestic_well.shtml#sandiegocfa

**Other Relevant Reports**

- Communities that Rely on a Contaminated Groundwater Source for Drinking Water
  http://www.waterboards.ca.gov/water_issues/programs/gama/ab2222/index.shtml

### Groundwater Quality at Community Drinking Water Wells

The SWRCB recently completed a 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 CWSs. A *CWS* is defined under California Health and Safety Code (Section 116275) as a “public water system that serves at least 15 service connections used by year-long residents or regularly serve at least 25 year-long residents of the area served by the system.” CWSs serve the same group of people, year round, from the same group of water sources. The findings of this report reflect the raw, untreated groundwater quality and do not necessarily reflect the final quality of groundwater delivered to these communities.

In the Colorado River region there are an estimated 129 CWSs with an estimated 377 active CWS wells. Table 5.10-10 shows that 51 of the 377 CWS wells (14 percent) are identified as being affected by one or more chemical contaminants that exceed an MCL. Of the 51 affected CWS wells, 24 are used by the 129 CWSs in the region. The majority of these affected systems serve small communities which commonly require financial assistance to construct water treatment facilities or alternative solutions to meet drinking water standards (Table 12-11). The most prevalent groundwater contaminants affecting community drinking water wells in the region include gross alpha particle activity, uranium, arsenic, and fluoride (Table 12-12). In addition, 23 wells are affected by multiple contaminants, with 40 of the wells exceeding both the gross alpha particle activity and uranium MCLs.

### Table 12-10 Community Drinking Water Wells that Exceed a Primary Maximum Contaminant Level Prior to Treatment in the Colorado River Hydrologic Region

| Well Information | Community Water System[a] Wells |
|---|---|
| Number of Affected Wells[b] | 51 |
| Total Wells in the Region | 377 |
| Percentage of Affected Wells[b] | 14% |

Source: State Water Resources Control Board's report to the Legislature, *Communities that Rely on a Contaminated Groundwater Source for Drinking Water* (2013).

Notes:

[a] Community water system means a public water system that serves at least 15 service connections used by year-long residents or regularly serves at least 25 year-long residents of the areas served by the system (Health and Safety Code Section 116275).

[b] 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 12-11 Community Drinking Water Systems that Rely on Contaminated Groundwater Wells in the Colorado River Hydrologic Region

| System Information | Community Water Systems[a] | | |
|---|---|---|---|
| | Number of Affected Water Systems[b] | Total Water Systems in the Region | Percentage of Affected Water Systems[b] |
| Small Systems Population ≤ 3,300 | 17 | 102 | 17% |
| Medium Systems Population 3,301-10,000 | 2 | 12 | 17% |
| Large Systems Population > 10,000 | 5 | 15 | 33% |
| **Total** | **24** | **129** | **19%** |

Source: State Water Resources Control Board's report to the Legislature, *Communities that Rely on a Contaminated Groundwater Source for Drinking Water* (2013).

Notes:

[a] Community water system means a public water system that serves at least 15 service connections used by year-long residents or regularly serves at least 25 year-long residents of the areas served by the system (Health and Safety Code Section 116275).

[b] 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.

State small water systems are not included. These systems serve five to 14 service connections and do not regularly serve water to more than 25 people. In general, state small water systems are regulated by local county environmental health departments.

**Table 12-12** **Contaminants Affecting Community Drinking Water Systems in the Colorado River Hydrologic Region**

| Principal Contaminant (PC) | Number of Affected Water Systems[b] (PC exceeds the Primary MCL) | Number of Affected Wells[c,d,e] (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 |

Source: State Water Resources Control Board’s report to the Legislature, *Communities that Rely on a Contaminated Groundwater Source for Drinking Water* (2013).

Notes:

MCL = maximum contaminant level (State and/or federal).

[a] Community water system means a public water system that serves at least 15 service connections used by year-long residents or regularly serves at least 25 year-long residents of the areas served by the system (Health and Safety Code Section 116275).

[b] 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.

[c] 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.

[d] Twenty-one wells are affected by two contaminants (15 of the 21 wells exceed both the uranium and gross alpha particle activity maximum contaminant levels).

[e] Two wells are affected by three contaminants.

### 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 domestic well owners are unaware of the quality of the well water because the State does not require well owners 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. These constituents include the following:

- Bacteria (Total and Fecal Coliform).
- General Minerals (sodium, bicarbonate, calcium, others).

- General chemistry parameters (pH, TDS, others).
- Inorganics (lead, arsenic and other metals) and nutrients (nitrate, others).
- Organics (benzene, toluene, PCE, MTBE, and others).

In addition to the above constituents, the GAMA Domestic Well Project may analyze for locally-known chemicals of concern. Some of these chemicals include radionuclides, perchlorate, pesticides, and chromium VI.

In 2008 and 2009, the GAMA Domestic Well Project sampled 137 private domestic wells in San Diego County, including nine private domestic wells located in the Colorado River region. Of the nine sampled private domestic wells, four of the wells were located within the Borrego Valley Groundwater Basin, and the other five wells were located in fractured-rock areas. San Diego County was selected for sampling because of the large number of private domestic wells located in the county and the availability of well owner information. It is estimated that more than 500,000 people live in unincorporated areas of San Diego County.

Groundwater quality results were compared to three public drinking water standards established by CDPH: primary MCLs, secondary maximum contaminant levels (SMCLs), and notification levels (NLs). These water quality standards were used for comparison purposes only, since private domestic well water quality is not regulated by the State.

Sampling results for the nine wells within the Colorado River region show that three constituents in two wells were detected at concentrations above their respective MCL. The three constituents were fluoride, gross alpha activity, and uranium. The gross alpha activity and uranium were detected above the MCL in one well, and fluoride was found in another well. In addition, four chemical constituents were detected above the SMCL. These constituents included iron, manganese, TDS, and electrical conductivity. Manganese and iron were also detected in two different wells, total dissolved solids and electrical conductivity were detected above the SMCL in one well. A summary of the untreated groundwater quality sampling results for the nine Colorado Region domestic wells are shown in Table 12-13.

### Groundwater Quality — GAMA Priority Basin Project

The GAMA Priority Basin Project was initiated to provide a comprehensive baseline of groundwater quality in the state and assess deeper groundwater basins that account for more than 95 percent of all groundwater used for public drinking water supply. The GAMA Priority Basin Project is grouped into 35 groundwater basin groups statewide called "study units," and is being implemented by the SWRCB, the USGS, and the LLNL.

The GAMA Priority Basin Project tests for constituents that are a concern in public supply wells. The list of constituents includes:

- Field Parameters.
- Organic Constituents.
- Pesticides.
- Constituents of Special Interest.
- Inorganic Constituents.
- Radioactive Constituents.
- Microbial Constituents.

For the Colorado River region, the USGS has completed data summary reports for the 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 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. Groundwater quality results from these data summary reports were compared against the following public drinking water standards established by CDPH or by the U.S. Environmental Protection Agency. These standards include primary MCLs, SMCLs, NLs, and lifetime health advisory levels (HALs). A summary of untreated groundwater quality results for these study units is listed in Table 12-13. In addition to these data summary reports, USGS has completed some assessment reports and fact sheets for the Colorado River region. The fact sheets are listed in Table 12-9.

### Groundwater Quality Protection

There has been an effort in the Colorado River region to protect groundwater supplies from contamination by onsite wastewater treatment (septic) systems. In response to declining groundwater levels in the Warren Valley Groundwater Basin, in 1995 the HDWD instituted a groundwater recharge program that used imported surface water as the source for recharge. The groundwater recharge program resulted in an increase in groundwater levels by as much as 250 feet near the area of the recharge ponds. 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 $NO_3$). 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 Warren Valley Groundwater Basin (Nishikawa et al. 2003). 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 uses 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 groundwater 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 effects from land use and septic load on groundwater quality. The long-term cumulative effect from wastewater discharges is an ongoing concern for the Joshua Tree Water District, and alternative wastewater treatment and disposal strategies may need to be considered to protect local groundwater supplies.

**Table 12-13 Groundwater Quality Results from GAMA Data Summary Reports from GAMA Summary Reports for the Colorado River Hydrologic Region**

| Constituent | Health Based Threshold | Number of Detections Greater Than Health Based Threshold | | | | | |
|---|---|---|---|---|---|---|---|
| | | Borrego Valley | Central Desert | Low-Use Basins[a] | Coachella Valley | Colorado River | San Diego County |
| Number of Wells | | 8 | 15 | 29 | 35 | 28 | 9 |
| **Inorganic Constituents** | | | | | | | |
| Arsenic | MCL | - | 1 | 6 | 5 | 2 | - |
| Boron | NL | - | - | 4 | 2 | 3 | - |
| Molybdenum | HAL | - | 1 | 5 | 2 | 1 | - |
| Uranium | MCL | - | 1 | 1 | - | 2 | 1 |
| Fluoride | MCL | - | 1 | 8 | 5 | 5 | 1 |
| Nitrite + Nitrate | MCL | - | - | 2 | - | - | - |
| Strontium | HAL | - | - | - | 2 | 2 | - |
| **Organic Constituents** | | | | | | | |
| VOCs | MCL | - | - | - | - | - | - |
| Pesticides | MCL | - | - | - | - | - | - |
| **Constituents of Special Interest** | | | | | | | |
| Perchlorate | MCL | - | - | - | 2 | - | - |
| NDMA | NL | - | - | - | - | - | - |
| 1,2,3 TCP | NL | - | - | - | - | - | - |
| **Radioactive Constituents** | | | | | | | |
| Gross Alpha | MCL | - | 3 | 2 | - | 6 | 1 |
| **Secondary Standards** | | | | | | | |
| Chloride | SMCL | - | - | 3 | 1 | 7 | - |
| Iron | SMCL | - | - | - | - | 5 | 2 |
| Manganese | SMCL | - | - | 1 | 1 | 15 | 2 |
| Sulfate | SMCL | 1 | - | 5 | 7 | 21 | - |
| Total Dissolved Solids | SMCL | 3 | 1 | 16 | 9 | 26 | 1 |

Sources:
U.S. Geological Survey report, *Groundwater Quality Data in the Borrego Valley, Central Desert, and Low-Use Basins of the Mojave and Sonoran Deserts study unit 2008-2010*; U.S. Geological Survey report, *Groundwater Quality Data in the Coachella Valley Study Unit, 2007*; U.S. Geological Survey report, *Groundwater Quality Data in the Colorado River Study Unit, 2007*; State Water Resources Control Board's Groundwater Ambient Monitoring Assessment Program report, *Domestic Well Project, Groundwater Quality Data Report San Diego County Focus Area, 2010*.

Notes:
GAMA = Groundwater Ambient Monitoring and Assessment Program, HAL = lifetime health advisory level (U.S. Environmental Protection Agency), MCL = maximum contaminant level (State and/or federal), NL = notification level (State), SMCL = secondary maximum contaminant level (State), TDS = total dissolved solids, VOC = volatile organic compound.
[a] The low-use basin area includes wells sampled in both Colorado River and South Lahontan hydrologic regions.

## Land Subsidence

In the Colorado River region, researchers have investigated the occurrence of land subsidence in Lucerne Valley and Coachella Valley. Historically, the Lucerne Valley has been used primarily for agriculture; currently, the area is used for both agricultural and residential development. Between 1950 and 1990 (Mojave Water Agency 2004), groundwater levels in Lucerne Valley steadily declined. In 1980, DWR Bulletin 118-80 identified the Lucerne Valley Groundwater Basin as being in a state of overdraft. To prevent further overdraft, Lucerne Valley was included in the 1996 groundwater rights adjudication of the Mojave Groundwater Basin area.

InSAR data were used to identify approximately two feet of land subsidence at three GPS monitoring points in the Lucerne (Dry) Lake area between 1969 and 1998 (Sneed et al. 2003). Sneed also determined that, between 1969 and 1998, about 0.3 foot of subsidence occurred southeast of Lucerne Lake, and about 0.2 foot of subsidence occurred along the western shore of the lake. In 2012, MWA 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. If the groundwater levels in the Lucerne Valley Groundwater Basin remain stable or rise, the potential for further land subsidence can be reduced.

Water from the Coachella Valley Groundwater Basin has been an important resource for the agricultural, municipal, and recreational developments in the Coachella Valley since the 1920s. Groundwater extractions resulted in a water level decline as much as 50 feet during the 1920s through the 1940s. In 1949, the Coachella Branch of the AAC 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 demand 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 (Coachella Valley Water District 2010).

An investigation of land subsidence in Coachella Valley by Ikehara et al. (1997) determined as much as 0.5 foot 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. The Sneed and Brandt investigation also suggests that the subsidence rates increased significantly between 2000 and 2005.

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 in California is provided in Appendix F.

## Groundwater Management

In 1992, the California Legislature provided an opportunity for formal groundwater management with the passage of AB 3030, the Groundwater Management Act (California Water Code Section 10750 et seq.). *Groundwater management*, as defined in DWR's Bulletin 118-2003, is "the planned and coordinated monitoring, operation, and administration of a groundwater basin, or portion of a basin, with the goal of long-term groundwater resource sustainability." Groundwater management needs are generally identified and addressed at the local level in the form of GWMPs. If disputes over how groundwater should be managed cannot be resolved at the local level, additional actions, such as enactment of ordinances by local entities with jurisdiction over groundwater, passage of laws by the Legislature, or decisions made by the courts (basin adjudications) may be necessary to resolve the conflict. Under current practice, DWR advances irrigation efficiency that benefits both farms and the environment. IRWM planning is a collaborative effort to regionally identify and align all aspects of water resource management and planning. Given California's reliance on groundwater to meet municipal, agricultural, and environmental needs, developing a thorough understanding of the planning, implementation, and effectiveness of existing groundwater management in California is an important first step toward sustainable management of this valuable resource.

DWR's Groundwater Web site (http://water.ca.gov/groundwater/) has the latest information on California's groundwater management planning efforts and includes a summary of the Sustainable Groundwater Management Act, enacted in September 2014. The Sustainable Groundwater Management Act, a three-bill legislative package, includes the provisions of SB 1168 (Pavley), AB 1739 (Dickinson), and SB 1319 (Pavley). The act mandates the formation of locally controlled groundwater sustainability agencies in high- and medium-priority groundwater basins with the goal of sustainably managing local groundwater resources. Many of the newly established components of the act are based on the required, voluntary, and recommended groundwater management components assessed in the following sections.

The following sections provide an inventory and assessment of GWMPs, groundwater basin adjudications, county ordinances, and other groundwater planning activities in the Colorado River region.

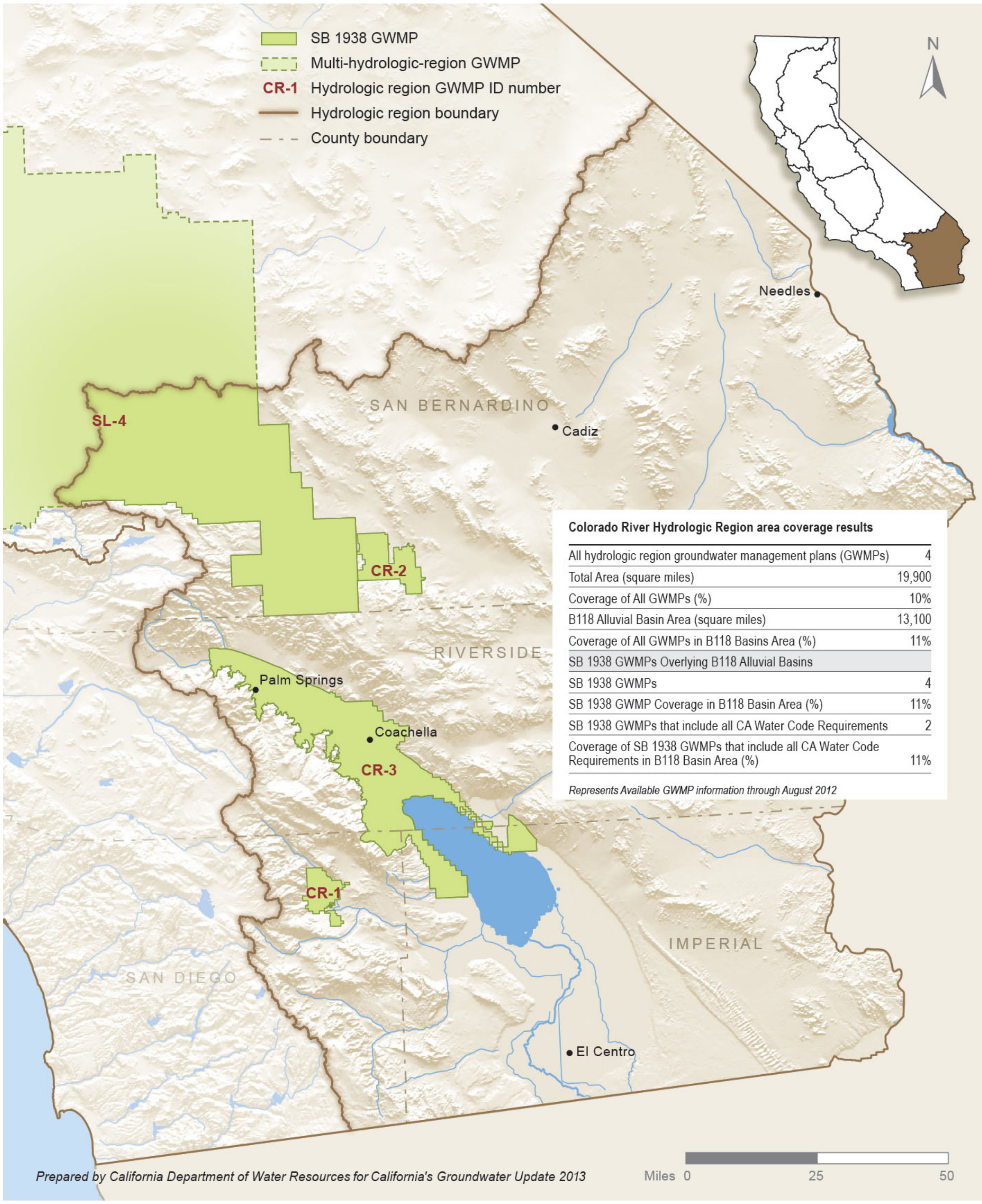
### Groundwater Management Plan Inventory

Groundwater management information included in this chapter is based on GWMP documents that were readily available or submitted to DWR as of August 2012. The inventory of GWMPs identifies adopting and signatory agencies, the date of plan adoption, the location of plans by county, and the groundwater basins the plans cover. The inventory also provides the number of GWMPs developed based on AB 3030 (1992) legislation and the number developed or updated to meet the additional groundwater management requirements associated with SB 1938 (2002).

The Colorado River region includes 13,100 square miles of Bulletin 118-2003 alluvial groundwater basins. Figure 12-12 shows the location and distribution of the GWMPs in the Colorado River region and indicates pre- versus post-SB 1938 GWMPs. Table 12-14 lists the results of the GWMP inventory for the region by adopting agency, signatories, plan date, and groundwater basin.

There are four submitted GWMPs in the Colorado River region, representing 11 percent of the alluvial groundwater basin area within the Colorado River region. Three of the four GWMPs are fully contained within the Colorado River region, with one plan including portions of the adjacent South Lahontan Hydrologic Region. All four GWMPs cover areas overlying alluvial groundwater basins identified in Bulletin 118-2003. One plan also includes areas not identified in Bulletin 118-2003 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 a 2,000 square mile area. Of the 2,000 square miles, about 1,500 square miles overlie Bulletin 118-2003 alluvial groundwater basins. The inventory and assessment of GWMPs in the Colorado River region determined that all four GWMPs have been developed or updated to include the SB 1938 requirements and are considered “active” for the purposes of the GWMP assessment. The four active GWMPs also cover all six of the basins identified as high or medium priority under the CASGEM Basin Prioritization project. These priority basins account for about 64 percent of the population that overlies the groundwater basin and about 76 percent of groundwater use for the region.

## Figure 12-12 Groundwater Management Plans in the Colorado River Hydrologic Region




| Colorado River Hydrologic Region area coverage results | |
|---|---|
| All hydrologic region groundwater management plans (GWMPs) | 4 |
| Total Area (square miles) | 19,900 |
| Coverage of All GWMPs (%) | 10% |
| B118 Alluvial Basin Area (square miles) | 13,100 |
| Coverage of All GWMPs in B118 Basins Area (%) | 11% |
| SB 1938 GWMPs Overlying B118 Alluvial Basins | |
| SB 1938 GWMPs | 4 |
| SB 1938 GWMP Coverage in B118 Basin Area (%) | 11% |
| SB 1938 GWMPs that include all CA Water Code Requirements | 2 |
| Coverage of SB 1938 GWMPs that include all CA Water Code Requirements in B118 Basin Area (%) | 11% |

*Represents Available GWMP information through August 2012*

## Table 12-14 Groundwater Management Plans in the Colorado River Hydrologic Region

| Map Label | Agency Name | Date | County | Basin Number | Basin Name |
|---|---|---|---|---|---|
| CR-1 | **Borrego Water District** | 2006 | Imperial | 7-24 | Borrego Valley |
| | No signatories on file | | | | |
| CR-2 | **Twentynine Palms Water District** | 2008 | San Bernardino | 7-9 | Dale Valley |
| | No signatories on file | | | 7-10 | Twentynine Palms |
| | | | | 7-62 | Joshua Tree |
| CR-3 | **Coachella Valley Water District** | 2010 | Riverside, Imperial, San Diego | 7-21.01 | Indio Subbasin |
| | No signatories on file | | | 7-21.02 | Mission Creek Subbasin |
| | | | | 7-21.03 | Desert Hot Springs Subbasin |
| | | | | 7-22 | West Salton Sea |
| | | | | 7-31 | Orocopia Valley |
| | | | | 7-32 | Chocolate Valley |
| | | | | 7-33 | East Salton Sea |
| SL-4 | **Mojave Water Agency** | 2004 | San Bernardino, Kern, Los Angeles | 6-35 | Cronise Valley |
| | No signatories on file | | | 6-38 | Caves Canyon Valley |
| | | | | 6-40 | Lower Mojave River |
| | | | | 6-41 | Middle Mojave River |
| | | | | 6-42 | Upper Mojave River |
| | | | | 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 Valley |
| | | | | 7-12 | Warren Valley |
| | | | | 7-13.01 | Deadman Lake |
| | | | | 7-13.02 | Surprise Spring |

| Map Label | Agency Name | Date | County | Basin Number | Basin Name |
|---|---|---|---|---|---|
| | | | | 7-15 | Bessemer Valley |
| | | | | 7-16 | Ames Valley |
| | | | | 7-18.01 | Soggy Lake Subbasin |
| | | | | 7-18.02 | Upper Johnson Valley Subbasin |
| | | | | 7-19 | Lucerne Valley |
| | | | | 7-20 | Morongo Valley |
| | | | | 7-50 | Iron Ridge Area |
| | | | | 7-51 | Lost Horse Valley |
| | | | | 7-62 | Joshua Tree |

Note: Table reflects the plans that were received by August 2012.

## Groundwater Management Plan Assessment

In 2011 and 2012, DWR partnered with the Association of California Water Agencies (ACWA) to survey local water agencies about their groundwater management, conjunctive water management, and water-banking practices, and to build a better understanding of existing groundwater management efforts in California. In addition to the information gleaned from the DWR/ACWA groundwater management survey, DWR independently reviewed the GWMPs to assess the following information:

- How many of the post SB 1938 GWMPs meet the six required components included in SB 1938 and incorporated into California Water Code Section 10753.7.
- How many of the post SB 1938 GWMPs include the 12 voluntary components included in California Water Code Section 10753.8.
- How many of the implementing or signatory GWMP agencies are actively implementing the seven recommended components listed in DWR Bulletin 118-2003.

Groundwater management planning information collected through the DWR/ACWA survey and through DWR's assessment is not intended to be punitive. It is widely understood that effective groundwater management in California is rife with jurisdictional, institutional, technological, and fiscal challenges. DWR is committed to assisting local agencies develop and implement effective, locally planned, and locally controlled groundwater management programs. DWR is also committed to helping promote State and federal partnerships, and to coordinating with local agencies to expand groundwater data collection, management, and planning activities that promote effective local groundwater management. The overall intent of the GWMP assessment is to help identify groundwater management challenges and successes, and provide recommendations for local and statewide improvement.

As previously mentioned, information associated with the GWMP assessment is based on data that were 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 GWMP assessment effort conducted as part of *California Water Plan Update 2013*. The following information will only address the active plans that were determined by DWR to meet some or all of the SB 1938 requirements.

### Required GWMP Components

California Water Code Section 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 IRWM program or plan. The required components of a GWMP are:

1. **Basin Management Objectives**: Basin management objectives include:
    A. Components relating to the monitoring and managing of groundwater levels in the groundwater basin.
    B. Groundwater quality degradation.
    C. Inelastic land surface subsidence.
    D. Changes in surface flow and surface water quality that directly affect groundwater levels or quality or are caused by groundwater pumping in the basin.
    E. Description of how recharge areas identified in the plan substantially contribute to the replenishment of the groundwater basin.
2. **Agency Cooperation**: The plan will involve other agencies that enable the local agency to work cooperatively with other public entities whose service area or boundary overlies the groundwater basin.
3. **Mapping**: The plan will include a map detailing the area of the groundwater basin, as defined in DWR's Bulletin 118-2003, the area of the local agency subject to the plan, as well as the boundaries of other local agencies that overlie the basin for which the agency is developing a GWMP.
4. **Recharge Areas**: Beginning January 1, 2013, the GWMP shall include a map identifying the recharge areas for the groundwater basin, and provide the map to the appropriate local planning agencies and all interested persons after adopting the GWMP.
5. **Monitoring Protocols**: The local agency shall adopt monitoring protocols designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence (in basins for which subsidence has been identified as a potential problem), and flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater pumping in the basin.
6. **GWMPs Located Outside Bulletin 118-2003–Recognized Groundwater Basins**: Plans located outside the DWR Bulletin 118-2003–recognized alluvial groundwater basins will incorporate the above components and shall use geologic and hydrologic principles appropriate to those areas.

Three of the six components include subcomponents that were also evaluated. The requirement to develop a map of recharge areas was not required until January 1, 2013; consequently, the requirement was not evaluated. In addition, the requirement for local agencies located outside a Bulletin 118-2003–recognized groundwater basin was not applicable for any of the GWMPs in the Colorado River region.

DWR determined that three of the four active GWMPs incorporated all of the required components. Table 12-15 identifies the percentage of the three active plans that meet the required components and subcomponents of California Water Code 10753.7. A detailed description of the individual component assessment presented next.

**Table 12-15 Assessment for GWMP Requirement Components in the Colorado River Hydrologic Region**

| Senate Bill 1938 Required Components | Percentage of Plans that Meet Requirement |
|---|---|
| Basin Management Objectives | 75% |
| BMO: Monitoring/Management Groundwater Levels | 100% |
| BMO: Monitoring Groundwater Quality | 100% |
| BMO: Inelastic Subsidence | 75% |
| BMO: SW/GW Interaction and Affects to Groundwater Levels and 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 (January 1, 2013) | Not Assessed |
| Monitoring Protocols | 75% |
| MP: Changes in Groundwater Levels | 100% |
| MP: Changes in Groundwater Quality | 100% |
| MP: Subsidence | 75% |
| MP: SW/GW Interaction and Affects to Groundwater Levels and Quality | 75% |
| **Met all Required Components, and Subcomponents** | **75%** |

Notes:
GW = groundwater, SW = surface water.
Table reflects assessment results of Senate Bill 1938 plans that were received by August 2012.

### *Basin Management Objectives*

The BMOs assessment consists of four required subcomponents that were individually assessed. The subcomponents include the monitoring and management of (1) groundwater levels, (2) groundwater quality, (3) inelastic land subsidence, and (4) surface water-groundwater interaction.

The assessment indicated that three of the four GWMPs met the overall BMO requirement by providing measurable objectives and actions that will occur when specific conditions are met for each of the BMO subcomponents. One GWMP did not meet the overall BMO component, but did have the required information for two of the four BMO subcomponents; as a result, the GWMP was found to be in partial compliance.

The BMO subcomponents that were not addressed in the partially compliant GWMP were the planning requirements for the monitoring and management of inelastic land subsidence and the interaction of surface water and groundwater.

#### *Mapping*

The mapping requirement of SB 1938 has three subcomponents. The GWMPs are required to provide one or more maps that depict the GWMP area, the associated Bulletin 118-2003 groundwater basin(s), and all neighboring agencies located in the basin(s). The GWMP assessment determined that all four GWMPs met the three requirements for mapping.

#### *Monitoring Protocols*

The monitoring protocol component consists of four subcomponents. In accordance with the requirements of SB 1938, GWMPs are required to establish monitoring protocols for assessing groundwater levels, groundwater quality, inelastic land subsidence, and surface water and groundwater interaction.

The overall results of the assessment for the monitoring protocols component are similar to the BMO component. The monitoring protocols assessment determined that three of four GWMPs met each of the required monitoring protocol subcomponents. The GWMP which did not meet all of the BMO subcomponents lacked monitoring protocols for inelastic land subsidence and the interaction of surface water and groundwater levels and how they relate to water quality and groundwater pumping.

### Voluntary GWMP Components

In addition to the six required components, California Water Code Section 10753.8 provides a list of 12 components that may be included in a GWMP. The voluntary components include the following:

1. The control of saline water intrusion.
2. Identification and management of wellhead protection areas and recharge areas.
3. Regulation of the migration of contaminated groundwater.
4. The administration of a well abandonment and well destruction program.
5. Mitigation of conditions of overdraft.
6. Replenishment of groundwater extracted by water producers.
7. Monitoring of groundwater levels and storage.
8. Facilitating conjunctive use operations.
9. Identification of well construction policies.
10. The construction and operation by the local agency of groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.
11. The development of relationships with State and federal regulatory agencies.
12. The review of land use plans and coordination with land use planning agencies to assess activities which create a reasonable risk of groundwater contamination.

The percentage of GWMPs in the Colorado River region that included the voluntary components is shown on Table 12-16. The assessment of some voluntary components was expanded to include subcomponents, which aided in determining a level of inclusion; however, reporting was not done on a subcomponent level. In many cases, if the GWMP included one of more of the subcomponents, the plan was considered to fully meet the voluntary component.

### Table 12-16 Assessment of GWMP Voluntary Components in the Colorado River Hydrologic Region

| Voluntary Components | Percentage of Plans that Include Component |
|---|---|
| Saline Intrusion | 50% |
| Wellhead Protection and Recharge | 75% |
| Groundwater Contamination | 75% |
| Well Abandonment and Destruction | 75% |
| Overdraft | 100% |
| Groundwater Extraction and Replenishment | 100% |
| Monitoring Groundwater Levels and Storage | 100% |
| Conjunctive Use Operations | 100% |
| Well Construction Policies | 100% |
| Construction and Operation | 50% |
| Regulatory Agencies | 100% |
| Land Use | 100% |

Note: Table reflects assessment results of Senate Bill 1938 plans that were received by August 2012.

Table 12-16 shows that all four of the GWMPs in the Colorado River region included the voluntary components of overdraft, groundwater extraction and replenishment, groundwater monitoring, conjunctive use operations, well construction policies, regulatory agencies, and land use. Three of the GWMPs include the protection of wellhead and recharge areas, groundwater contamination, and well abandonment policies. Half of the GWMPs discuss the control of saline intrusion or the construction and operation projects, including groundwater contamination cleanup, recharge, storage, conservation, water recycling, and extraction projects.

It is not clear from the assessment whether the low percentages of GWMPs that include saline intrusion activities was attributed to the GWMP not being updated to incorporate this activity, or whether the agencies felt addressing saline intrusion was not needed, or both. Many of these GWMP projects can take years to plan, fund, and finally implement, and continuing to update GWMPs with newly required component activities can be time consuming and expensive. Based on DWR's discussions with a several GWMP entities around the State, it was apparent that agencies do not regularly update their GWMP as new projects are implemented. Thus, it is likely that the construction and operation of newly developed projects have not been listed in the most recent GWMP document.

In summary, one of the four GWMPs in the Colorado River region incorporated all 12 of the voluntary components. Two plans incorporated 11 of the voluntary components, and one plan incorporated seven of the voluntary components.

### Bulletin 118-2003–Recommended GWMP Components

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. The recommended components include:

1. **Guidance**: Establish an advisory committee to assist in GWMP development and implementation.
2. **Management Area**: Describe the physical setting, aquifer characteristics, and background data.
3. **BMOs, Goals, and Actions**: Describe how the current or planned actions help to meet the overall management objectives and goals.
4. **Monitoring Plan Description**: Describe groundwater monitoring type, location, frequency, and aquifer interval.
5. **IRWM Planning**: Describe efforts to coordinate with other land use or water management planning.
6. **Implementation**: Develop status reports with management actions, monitoring activities, basin conditions, and achievements.
7. **Evaluation**: Develop periodic assessment of conditions versus management objectives.

Table 12-17 identifies the percentage of the active GWMPs in the Colorado River region that include the seven recommended suggestions outlined in Bulletin 118-2003. Results from the GWMP assessment determined all of the GWMPs discussed the plan's management area, referenced current or future IRWM planning and participation, GWMP implementation, and periodic evaluation. Three of the four GWMPs include plans to create an advisory committee to guide planning and implementation. The same percentage of plans stated how each of the adopted management objectives helps to attain their goals and described how current and planned actions by the managing entity will help meet the adopted management objectives. The component that was most commonly discussed with insufficient detail was the monitoring plan description.

In summary, three of the four GWMPs in the Colorado River region incorporated six of the seven recommended components in Bulletin 118-2003, and the fourth GWMP incorporated five of the recommended seven components.

### DWR/ACWA Survey — Key Factors for Successful GWMP Implementation

As noted in the previous section, DWR partnered with ACWA to survey its member agencies on various topics covering groundwater management. The survey respondents were asked to provide feedback on which components helped make their GWMP implementation successful. The participants were asked to provide additional insights and list additional components, but not to rank their responses in terms of importance. Three agencies from the Colorado River region participated in the survey. Table 12-18 is a summary of the responses from the three agencies.

### Table 12-17 Assessment of DWR Bulletin 118-2003 Recommended Components in the Colorado River Hydrologic Region

| Recommended Components | Percentage of Plans that Include Component |
|---|---|
| GWMP Evaluation | 100% |
| GWMP Implementation | 100% |
| Management Area | 100% |
| BMOs, Goals, and Actions | 100% |
| GWMP Guidance | 75% |
| IRWM Planning | 75% |
| Monitoring Plan Description | 25% |

Notes:
BMO = basin management objective, GWMP = groundwater management plan,
IRWM = integrated regional water management.
Table reflects assessment results of Senate Bill 1938 plans that were received by August 2012.

### Table 12-18 Survey Results for Key Components Contributing to Successful GWMP Implementation in the Colorado River Hydrologic Region

| Key Components that Contributed to Success | Respondents |
|---|---|
| Sharing of Ideas and Information with other Water Resource Managers | 2 |
| Data Collection and Sharing | 3 |
| Adequate Surface Water Supplies | 2 |
| Adequate Regional and Local Surface Storage and Conveyance Systems | 2 |
| Outreach and Education | 3 |
| Developing an Understanding of Common Interest | 3 |
| Broad Stakeholder Participation | 3 |
| Water Budget | 2 |
| Funding | 3 |
| Time | 3 |

Note:
Results from an online survey sponsored by the California Department of Water Resources and conducted by the Association of California Water Agencies — 2011 and 2012.

Data collection, information sharing, developing an understanding of common interest, and stakeholder participation were reported as important components to their groundwater management planning successes. Having adequate surface water supplies, as well as adequate storage and infrastructure systems, were also deemed important. In addition, sufficient funding and time necessary to develop a GWMP were indicated as factors important to success. Further research is needed to better understand the key factors that contribute to successful implementation of effective groundwater management.

### DWR/ACWA Survey — Key Factors Limiting GWMP Success

Survey participants were also asked to identify key factors they felt impeded implementation of their local GWMP. Table 12-19 indicates limited funding was an impediment to the success of groundwater planning. Funding is a challenging factor for many local agencies because the implementation and the operation of groundwater management projects are typically expensive and because the sources of funding for projects are typically limited to either locally raised funds or to grants from State and federal agencies. Data collection and sharing was an additional concern. The unregulated pumping of groundwater, the lack of broad stakeholder participation, lack of governance, lack of surface storage and conveyance, and lack of groundwater were also identified as factors that impede the successful implementation of GWMPs. Further research is needed to understand the extent to which these limitations affect implementation of effective groundwater management.

### DWR/ACWA Survey — Opinions of Groundwater Sustainability

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.

## Groundwater Ordinances

Groundwater ordinances are laws adopted by local authorities, such as cities or counties, to manage groundwater. In 1995, the California Supreme Court declined to review a lower court decision (*Baldwin v. Tehama County*) that says State law does not occupy the field of groundwater management and does not prevent cities and counties from adopting ordinances to manage and regulate groundwater. Since 1995, the *Baldwin v. Tehama County* decision has remained untested. As a result, the precise nature and extent of the police power of cities and counties to regulate groundwater is still uncertain.

There are a number of groundwater ordinances that have been adopted by counties in the Colorado River region. The most common ordinances are associated with groundwater wells. These ordinances regulate well construction, abandonment, and destruction; however, none of the ordinances provide for comprehensive groundwater management. Table 12-20 lists the ordinances adopted in the Colorado River region.

**Table 12-19 Survey Results for Factors that Limited the Successful GWMP Implementation in the Colorado River Hydrologic Region**

| Limiting Factors | Respondents |
|---|---|
| Participation Across a Broad Distribution of Interests | - |
| Data Collection and Sharing | - |
| Funding for Groundwater Management Planning | 2 |
| Funding for Groundwater Management Projects | 3 |
| Funding to Assist in Stakeholder Participation | 1 |
| Understanding of the Local Issues | - |
| Outreach and Education | - |
| Groundwater Supply | 1 |
| Surface Storage and Conveyance Capacity | 1 |
| Access to Planning Tools | - |
| Unregulated Pumping | 1 |
| Lack of Governance | 1 |

Note:
Results from an online survey sponsored by the California Department of Water Resources and conducted by the Association of California Water Agencies — 2011 and 2012.

**Table 12-20 Groundwater Ordinances for the Colorado River Hydrologic Region**

| County | Groundwater Management | Guidance Committees | Export Permits | Recharge | Well Abandonment and Destruction | Well Construction Policies |
|---|---|---|---|---|---|---|
| Imperial | Yes[a] | Yes | Yes | Yes | - | - |
| San Bernardino | Yes[b] | - | - | - | Yes | Yes |
| San Diego | Yes[c] | - | - | - | - | - |
| Riverside | - | - | - | - | Yes | Yes |

Notes:
[a] Provides for the reduction of extractions to eliminate existing or threatened conditions of overdraft.
[b] One provision is to ensure that groundwater extractions do not exceed safe yields.
[c] One provision requires developers to demonstrate adequate groundwater supplies for a proposed project.
Table represents information as of August 2012.

## Special Act Districts

Greater authority to manage groundwater has been granted to a few local agencies created through a special act of the Legislature. The specific authority of each agency varies, but the agencies can be grouped into two general categories: (1) agencies having authority to limit export and extraction (upon evidence of overdraft or threat of overdraft) or, (2) agencies lacking authority to limit extraction, but having authority to require reporting of extraction and to levy replenishment fees.

There are many special act districts established by the Legislature consisting of different authorities that may or may not have groundwater management authority. It was not part of the scope for *California Water Plan Update 2013* to identify individual types of special act districts or provide a listing of the established agencies. This chapter includes the GWMPs that were produced by these agencies and submitted to DWR, as discussed in the previous section.

## Court Adjudication of Groundwater Rights

Another form of groundwater management in California is through the courts. When the groundwater resources do not meet water demands in an area, landowners may turn to the courts to determine how much groundwater can be rightfully extracted by each overlying landowner or appropriator. The court typically appoints a watermaster to administer the judgment and to periodically report to the court.

There are currently 24 groundwater adjudications in California. The Colorado River region contains three of those adjudications. Table 12-21 provides a list of the adjudications. Figure 12-13 shows the location of groundwater adjudications in the Colorado River region.

Due to heavy groundwater use and declining groundwater levels, groundwater rights in Warren Valley Groundwater Basin were adjudicated in 1977. The court appointed HDWD 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 MWA 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 12-21, the Lucerne Valley Groundwater Basin in the Colorado River 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 12-21, the San Gorgonio Pass Groundwater Subbasin of the Coachella Valley Groundwater Basin in the Colorado River region is included in this adjudication.

**Table 12-21 Groundwater Adjudications in the Colorado River Hydrologic Region**

| ID | Court Judgment | Basin Number | Basin Name | County | Judgment Date |
|---|---|---|---|---|---|
| A-23 | Warren Valley Basin | 7-12 | Warren Valley Basin | San | 1977 |
| A-8 | Mojave Basin Area | 7-19 | Lucerne Valley Basin | San | 1996 |
| A-1 | Beaumont Basin | 7-21.04 | San Gorgonio Pass Subbasin | Riverside | 2004 |

Note:
Table represents information as of April 2013.

**Figure 12-13 Groundwater Adjudications in the Colorado River Hydrologic Region**

## Other Groundwater Management Planning Efforts

Groundwater management is also occurring through other avenues. IRWM incorporates the physical, environmental, societal, economic, legal, and jurisdictional aspects of water management into regional solutions through open and collaborative stakeholder process to promote sustainable water use. UWMPs incorporate long-term resource planning to meet existing and future water demands. AWMPs advance irrigation efficiency that benefits both farms and the environment.

### Integrated Regional Water Management Plans

IRWM improves water management and supports economic stability, environmental stewardship, and public safety. IRWM plans involve multiple agencies, stakeholders, individuals and groups, and cross jurisdictional, watershed, and political boundaries. The methods used in IRWM planning include developing water management strategies that relate to water supply and water quality, water-use efficiency, operational flexibility, stewardship of land and natural resources, and groundwater resources. Statewide, the majority of IRWM plans address groundwater management in the form of goals, objectives, and strategies. They defer implementation of groundwater management and planning to local agencies through local GWMPs. However, a few IRWM plans actively manage groundwater. Efforts by these IRWM RWMGs include creating groundwater contour maps for basin operations criteria, monitoring groundwater elevations, and monitoring groundwater quality.

There are four IRWM regions covering a portion of this hydrologic region. Three regions have adopted IRWM plans and one region is currently developing an IRWM plan. The MWA IRWM plan crosses into the adjacent South Lahontan Hydrologic Region — providing guidance on water management and water supply sustainability. The plan discusses objectives and management strategies related to stabilizing groundwater storage, protecting and restoring riparian habitat, and preventing groundwater quality degradation. The MWA RWMG uses 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 Valley IRWM plan consists of five water purveyors within the Coachella Valley region. Portions of the Coachella Valley IRWM plan region are known to have water quality issues as well as groundwater overdraft and associated land subsidence. The goals of the Coachella Valley RWMG include protecting or improving water quality, providing a reliable and sustainable water supply, and coordinating water resource management activities. To achieve these goals, the IRWM plan lists 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 Valley IRWM plan was developed to provide guidance on water management planning and to support project implementation. This plan contains cost-effective water management strategies for providing a reliable water supply and defines the long-term needs and water infrastructure priorities for the planning group. The 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.

Figure 12-14 shows the areas of the Colorado River region covered by IRWM plans as of September, 2011. Table 12-22 lists the status of the IRWM planning areas by hydrologic region. More information about IRWM planning can be found at http://www.water.ca.gov/irwm/index.cfm.

### Urban Water Management Plans

UWMPs 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 demands. UWMPs include system descriptions, demands, and supplies, as well as water shortage reliability and water shortage contingency planning. In addition, the Water Conservation Bill of 2009 (SB X7-7) requires that urban water suppliers:

- Develop a single standardized water use reporting form for urban water suppliers.
- Develop method(s) by July 1, 2011to identify per capita targets, and update those methods in four years to meet the 20-percent-reduction goal by 2020.
- Develop technical methodologies and criteria for calculating all urban water use.
- Convene a task force to develop alternative best management practices for commercial, industrial, and institutional water use.

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 UWMP 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 UWMP updates are being evaluated. Additional information regarding urban water management and UWMPs can be found at http://www.water.ca.gov/urbanwatermanagement/.

**Table 12-22 Status of Integrated Regional Water Management Plans in the Colorado River Hydrologic Region**

| Hydrologic Region | IRWM Plan Name | Date | IRWM Plan Status | IRWM Map Number |
|---|---|---|---|---|
| Colorado River | Anza Borrego Desert | | In Progress | 3 |
| Colorado River | Coachella Valley | 2010 | Active | 5 |
| Colorado River | Imperial | 2012 | Active | 12 |
| Colorado River/ South Lahontan | Mojave Water Agency Regional Water Management Plan | 2004 | Active | 18 |
| | | | IRWM Planning Regions: | 4 |
| | | | Active IRWM Plans: | 3 |
| | | | IRWM Plans In Development: | 1 |
| | | | IRWM Plans that Cross Hydrologic Boundaries: | 1 |

Note:
IRWM = integrated regional water management.
Table represents information as of August 2012.

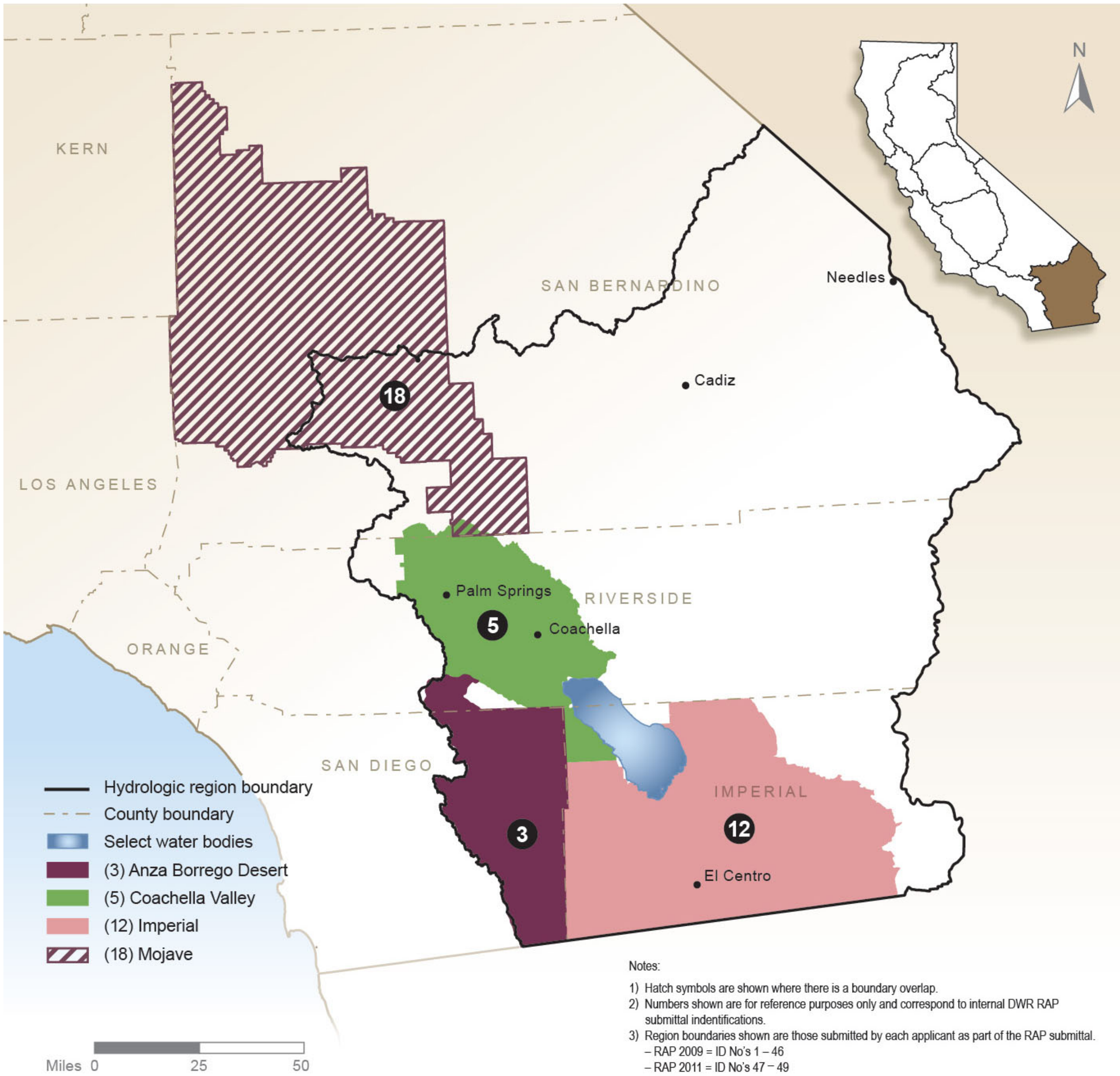
### Agricultural Water Management Plans

AWMPs are developed by water and irrigation districts to advance the efficiency of farm water management while benefitting the environment. The AWMPs provide another avenue for local groundwater management. Some of the efficient water management practices being implemented include controlling drainage problems through alternative use of lands, using recycled water that otherwise would not be used beneficially, improvement of on-farm irrigation systems, and lining or piping ditches and canals. In addition, SB X7-7 requires that agricultural water suppliers:

- Report the status of AWMPs and efficient water management plans, and evaluate their effectiveness.
- Adopt regulations for measuring the volume of water delivered and for adopting a pricing structure based on quantity delivered.
- Develop a method for quantifying efficiency of agriculture water use and a plan for implementation.
- Propose new statewide targets for regional water management practices for recycled water, brackish groundwater, and stormwater runoff.
- Promote implementation of regional water management practices through increased incentives and removal of barriers.

New and updated AWMPs addressing the SB X7-7 requirements were required to be submitted to DWR by December 31, 2012, for review and approval. More information about AWMPs can be found at http://www.water.ca.gov/wateruseefficiency/agricultural/agmgmt.cfm.

**Figure 12-14 Integrated Regional Water Management Plans in the Colorado River Hydrologic Region**




*Prepared by California Department of Water Resources for California's Groundwater Update 2013*

## Conjunctive Management Inventory

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.

Conjunctive use of surface water and groundwater has been utilized in the Colorado River region for decades. To meet water demand, groundwater use is supplemented by surface water from the Colorado River and the SWP. Surface water is used to replenish aquifers. Many agencies have erected systems of barriers to allow more efficient percolation of ephemeral runoff from surrounding mountains.

As part of *California Water Plan Update 2013*, an inventory and assessment of conjunctive management programs was conducted. The overall intent of this effort was to (1) provide a statewide summary of conjunctive water management program locations, operational methods, and capacities; and (2) identify the challenges, successes, and opportunities for growth. The results of the inventory would be shared with policy-makers and other stakeholders to enable an informed decision-making process regarding groundwater and its management. Additional information regarding conjunctive management in California, as well as a discussion of associated benefits, costs, and issues can be found in *California Water Plan Update 2013,* Volume 3, Chapter 9, "Conjunctive Management and Groundwater Storage."

The statewide conjunctive management inventory and assessment consisted of literature research, an online survey, personal communication with local agencies, and a documented summary of the conjunctive management programs in California. Information from these efforts was compiled into a comprehensive spreadsheet of projects and historic operational information, which was updated and enhanced from a coordinated DWR/ACWA survey.

The online survey administered by ACWA requested the following conjunctive management program information from its member agencies:

- Location of conjunctive use project.
- Year project was developed.
- Capital cost to develop the project.
- Annual operating cost of the project.
- Administrator/operator of the project.
- Capacity of the project in units of acre-feet.

Although initial response to the DWR/ACWA survey was encouraging, the number of survey participants and the completeness of those responses were limited. In an attempt to build on the survey and develop a greater understanding of the size and diversity of conjunctive management projects in California, staff from each of DWR's four region offices in the Division of Integrated Regional Water Management contacted, either by telephone or through e-mail, each of the entities identified as having a conjunctive management program. DWR's follow-up information requested additional details regarding:

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

Statewide, 89 conjunctive management and groundwater recharge programs were identified. Because of confidentiality concerns expressed by some local agencies, information for some existing conjunctive management programs was not reported. Conjunctive management and groundwater recharge programs in the planning and feasibility stage were not included in the inventory.

A statewide map and series of tables listing the conjunctive management projects identified by DWR and grouped by hydrologic region, with information specific to the 11 questions noted in this section, are provided in Appendix D. The project locations shown on the map represents the implementing agency's office address and does not represent the project location.

### Conjunctive Management Inventory Results

Of the 89 agencies or programs identified as operating a conjunctive management or groundwater recharge program in California, two programs are located in the Colorado River region. The following information summarizes the details provided to DWR by MWA and CVWD.

According to MWA, the location of their conjunctive management program includes groundwater basins located in both the Colorado River region and the South Lahontan Hydrologic Region; in the Colorado River region, the program is located in the Warren Valley Groundwater Basin (7-12). The conjunctive management program operated by MWA consists of a direct groundwater percolation program developed in 1991, with MWA identified as the lead agency and the administrator/operator of the project. The goals and objectives of its conjunctive management program are to address groundwater overdraft correction.

Annual recharge and extraction amounts vary year-to-year and depend on other factors, such as surface water availability and overall water demand. The current annual recharge capacity of the direct percolation program operated by MWA is estimated at 50,000 acre-feet per year (af/yr.), while the cumulative recharge capacity is estimated at 390 taf. Similarly, the annual extraction capacity of the program is 50,000 af/yr., and the cumulative volume withdrawn from the operation is 390 taf. Efforts are currently underway to increase program capacity. The SWP was identified as the source of surface water for the program. The current operating cost for the program is estimated at $900,000 per year. MWA identified project cost as the most significant constraint for the program. Limited aquifer storage was determined to be a moderate constraint, while other minimal constraints include political, legal, institutional, and water quality issues.

CVWD started replenishing groundwater through direct percolation basins in 1973 in the Upper Whitewater River Groundwater Basin; the project location is the Indo Groundwater Subbasin (7-21.01). The current recharge capacity of the CVWD's groundwater replenishment program ranges from 0 to 300,000 af/yr., while the cumulative recharge volume is estimated at approximately 2.4 maf at the end of 2010. Colorado River water and SWP water were identified as the sources of recharge water for the program. Program operating costs were identified as the most significant constraint for the recharge program, as the annual operating costs of the program was reported to be $9 million per year. Limited aquifer storage was reported to be a moderate constraint, while other constraints include political, legal, institutional, and water quality issues.

Additional information describing conjunctive management practices in California, as well as discussion on associated benefits, costs, issues, and concerns, can be found in *California Water Plan Update 2013,* Volume 3, Chapter 9, "Conjunctive Management and Groundwater Storage."

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**Edmund G. Brown Jr.**
Governor
State of California

**John Laird**
Secretary for Natural Resources
Natural Resources Agency

**Mark Cowin**
Director
Department of Water Resources