California's Groundwater Update 2013

A Compilation of Enhanced Content for California Water Plan Update 2013

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SOUTH COAST HYDROLOGIC REGION

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Acronyms and Abbreviations Used in This Chapter

1,1-DCA	1,1-Dichloroethane
1,1-DCE	1,1-Dichloroethylene
1,2-DCA	1,2-Dichloroethane
1,2,3-TCP	Trichloropropane
AB	Assembly Bill
ACWA	Association of California Water Agencies
AWMP	agriculture water management plan
BMO	basin management objective
CASGEM	California Statewide Groundwater Elevation Monitoring
CDPH	California Department of Public Health
cm	centimeters
CPLAOC	Coastal Plains of Los Angeles and Orange County
CWP	California Water Plan
CWS	community water system
DAU	detailed analysis unit
DBCP	1,2-Dibromo-3-chloropropane
DWSAP	Drinking Water Source Assessment and Protection Program
DWR	California Department of Water Resources
EPA	U.S. Environmental Protection Agency
Freon 11	Trichlorofluoromethane
GAMA	Groundwater Ambient Monitoring and Assessment
gpm	gallons per minute
GWMP	groundwater management plan
GWRS	Groundwater Replenishment System

HAL	health advisory level
IRWM	integrated regional water management
LLNL	Lawrence Livermore National Laboratory
maf	million acre-feet
MCL	maximum contaminant level
mm	millimeters
MOU	memorandum of understanding
MTBE	methyl tertiary butyl ether
MWD	Metropolitan Water District of Southern California
NDMA	N-Nitrosodimethylamine
NL	notification level
OCWD	Orange County Water District
PA	Planning Area
PCE	tetrachloroethylene
pH	measure of acidity or alkalinity
RWMG	regional water management group
RWQCB	regional water quality control board
SB X7-6	2009 Comprehensive Water Package legislation
SB X7-7	Water Conservation Bill of 2009
SB	Senate Bill
SBVMWD	San Bernardino Valley Municipal Water District
SMCLs	secondary maximum contaminant levels
SNMP	salt and nutrient management plan
South Coast region	South Coast Hydrologic Region
STORET	Storage and Retrieval Environmental Data System
SWM	State Well Number

SWP	State Water Project
SWRCB	State Water Resources Control Board
taf	thousand acre-feet
TCE	trichloroethylene
TDS	total dissolved solids
USGS	U.S. Geological Survey
UWCD	United Water Conservation District
UWMP	urban water management plan
Ventura IRWM Plan	Watershed Coalition of Ventura County IRWM Plan
VOC	volatile organic compound
WRD	Water Replenishment District of Southern California

Chapter 6. South Coast Hydrologic Region Groundwater Update

Introduction

The primary goal of the South Coast Hydrologic Region (South Coast 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 that will guide prioritizing of 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. Nonetheless, where information is readily available, this update does report some aspects of the regional groundwater conditions in greater detail.

The South Coast region, depicted in Figure 6-1, covers about 11,100 square miles and includes all of Orange County, major portions of Los Angeles, Riverside, San Bernardino, San Diego, and Ventura counties, and a small portion of Santa Barbara County. Significant geographic features include the coastal plains of Los Angeles and Orange counties; the Transverse Ranges; the Peninsular Ranges; the San Fernando, San Gabriel, Santa Ana valleys; and the Santa Clara River Valley. The major rivers in the region include the Los Angeles, San Gabriel, San Diego, San Luis Rey, Santa Ana, Santa Clara, Santa Margarita, and Ventura.

The climate in the region ranges from Mediterranean to subtropical steppe. Annual precipitation in the region ranges from more than 40 inches in the mountains to less than 10 inches in some valleys, with an overall average of 17.6 inches for the region.

Information from the 2010 census indicates an overall population of approximately 20,000,000 in the South Coast region. The most populous areas, with nearly 11,000,000 people, overlie the Coastal Plain of Los Angeles, the Upper Santa Ana Valley, the San Fernando Valley, the San Gabriel Valley, and the Santa Clara River Valley groundwater basins.

The groundwater update for the South Coast region provides an overview and assessment of the region's groundwater supply and development, groundwater use, monitoring efforts, aquifer conditions, and various management activities. It also 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 improve the overall sustainability of this valuable resource. This is followed by a comprehensive overview of the relevant groundwater topics.

Figure 6-1 **South Coast Hydrologic Region**

Findings, Data Gaps, and Recommendation

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

Findings

The bulleted items 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, changes-in-groundwater-in-storage estimates, 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 of California Department of Water Resources (DWR) Bulletin 118 and the CWP, with the goal of generating information that can be used to make informed decisions related to sustainably managing California's groundwater resources. The following information highlights the groundwater findings for the South Coast region.

Groundwater Supply and Development

- The South Coast region contains 73 alluvial groundwater basins and subbasins recognized by DWR Bulletin 118-2003. Those groundwater basins and subbasins underlie approximately 3,500 square miles, or 32 percent, of the hydrologic region (Figure 6-2 and Table 6-1).
- Based on DWR well-log records, the total number of wells completed in the South Coast region between 1977 and 2010 is approximately 37,149 and ranges from a high of 15,041 wells for San Diego County to a low of 5,238 wells for Orange County (Table 6-2 and Figure 6-3).
- Based on the California Statewide Groundwater Elevation Monitoring (CASGEM) Basin Prioritization completed in December 2013, 14 basins or subbasins in the South Coast region are identified as high priority, 22 basins or subbasins are identified as medium priority, and 37 basins or subbasins are listed as low or very low priority. The 36 basins or subbasins designated as high or medium priority include 96 percent of the average annual groundwater use and 94 percent of the 2010 population living within the region's groundwater basin boundaries (Figure 6-6 and Table 6-3).
- There are 24 groundwater rights adjudications in California, and 15 of those adjudications are located in the South Coast region (Figure 6-13 and Table 6-21).

Groundwater Use and Aquifer Conditions

- The 2005-2010 average annual total water supply for the South Coast region, based on planning area boundaries, is estimated at 4.7 million acre-feet (maf). Water demands in the region are met through a combination of imported surface water supplies, Colorado River water, State Water Project (SWP) surface water deliveries, groundwater, and reuse/recycled water supplies (Figure 6-7).
- Groundwater contributes about 34 percent (1.6 maf) of the 2005-2010 average annual total water supply for the South Coast region (Figure 6-7).
- Groundwater supplies, based on average annual estimates for 2005-2010, contribute 54 percent of the total agricultural water supply, 31 percent of the supply of the total urban water supply, and 0 percent of the total managed wetlands supply in the South Coast region (Table 6-4).
- Between 2002 and 2010, annual groundwater use in the South Coast region ranged between 1.23 maf (in 2005) and 1.89 maf (in 2002) and contributed between 27 percent and 38 percent toward the annual water supply (Figure 6-8).
- Of the groundwater pumped on an annual basis between 2002 and 2010, between 72 percent and 89 percent of the groundwater was used for urban purposes (Figure 6-9).

- Recycled and reuse water was estimated to be as little as 8 thousand acre-feet (taf) in 2002 and as much as 414 taf in 2005 (Figure 6-8).

Groundwater Monitoring Efforts

- A total of 1,727 wells are actively monitored for groundwater-level information in the South Coast region (Figure 6-10 and Table 6-7).
- There are an estimated 420 community water systems (CWSs) in the South Coast region, with an estimated 2,093 active CWS wells; 584 of the CWS wells (28 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 162 CWSs in the region. In addition, 276 regional wells are affected by multiple contaminants, with 97 wells exceeding both nitrate and perchlorate MCLs. The most prevalent groundwater contaminants affecting community drinking water wells in the region include nitrate, perchlorate, tetrachloroethylene (PCE), trichloroethylene (TCE), gross alpha particle activity, carbon tetrachloride, and arsenic (Table 6-12).
- In the South Coast region, land subsidence associated with groundwater withdrawal has been documented in the Chino Groundwater Subbasin, Coastal Plain of Orange County Groundwater Basin, Oxnard Groundwater Subbasin, and San Jacinto Groundwater Basin (Appendix F).

Groundwater Management and Conjunctive Management

- There are 15 GWMPs within the South Coast region that collectively cover about 40 percent of the Bulletin 118-2003 alluvial basin area in the region and about 17 percent of the overall region.
- DWR's assessment of GWMPs in the South Coast region determined that 11 of the 15 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.
- Seven GWMPs in the region address all of the required components identified in California Water Code Section 10753.7 (Figure 6-12).
- Of the 89 agencies or programs identified as operating a conjunctive management or a groundwater recharge program in California, 32 programs are located in the South Coast region. The recharge programs consist of direct groundwater percolation, in-lieu recharge, direct injection, and aquifer storage-and-recovery projects. The effort to fully characterize the 89 conjunctive management programs was limited because numerous agencies were reluctant to make details about their groundwater recharge operations publically available. The details provided by agencies in the South Coast region were much more comprehensive and complete than most other regions (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 South Coast region, though 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 South Coast region is satisfactory, there is a need to improve the characterization of many of the region's aquifers, especially those aquifers that serve disadvantaged communities or have little groundwater data. 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 non-adjudicated areas of the South Coast region has been estimated primarily through water supply balance and land use information derived from DWR's land use surveys. Little-to-no information is known, or is publically available, about the fractured-bedrock aquifers located in the South Coast region and how they interact with the region's alluvial aquifer systems.

Some local water agencies in the South Coast region are collecting appropriate groundwater data, conducting necessary analyses, and sustainably managing their basins by using their existing authorities, often through the process of groundwater rights adjudication. Much of the locally collected and analyzed data, which could be used by RWMGs and State agencies to better characterize the groundwater basins in the South Coast 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 South Coast region.

Researchers have investigated land subsidence in the Chino Groundwater Subbasin, the Coastal Plain of Orange County Groundwater Basin, the Oxnard Groundwater Subbasin, and the San Jacinto Valley Groundwater Basin, but current occurrences and rates of land subsidence throughout most of the region are unknown.

Approximately 36 percent of the State's conjunctive management programs (32 of 89) were identified in the South Coast region. A survey, conducted as part of *California Water Plan Update 2013,* was unable to collect comprehensive information about those programs. For that reason, a general understanding of the effectiveness of the region'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 January 1, 2013.

Sustainable Management

The 11 active GWMPs in the South Coast region that meet some or all of the SB 1938 groundwater management requirements cover only 22 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.

Recommendations

While much information is known about some of the groundwater basins in the South Coast 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 South Coast 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 degree 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 Los Angeles Regional Water Quality Control Board.
- Update all existing GWMPs to meet the standards set forth in the California Water Code and ensure that GWMPs are prepared for all high- and medium-priority groundwater basins identified by the CASGEM Basin Prioritization process.
- Determine the extent and effectiveness of the groundwater recharge and conjunctive management programs in the South Coast region.
- DWR should work with local water managers to complete the conjunctive management survey 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 and roll-up to a minimum set of goals and actions established by the overlying integrated regional water management (IRWM) plan.
- Provide local and regional agencies in non-adjudicated groundwater basins 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, in addition to current and projected trends for groundwater extraction, groundwater levels, groundwater quality, land subsidence, and surface-water–groundwater interaction. Annual reports should evaluate how existing groundwater management practices contribute toward sustainable groundwater management. They should also identify 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 South Coast region are supplied by alluvial aquifers and by fractured-rock aquifers. Alluvial aquifers are comprised of sand and gravel or finer-grained sediments, with groundwater stored within the voids, or pore space, among the alluvial sediments. Fractured-rock aquifers consist of impermeable granitic, metamorphic, volcanic, or hard sedimentary rocks, with groundwater being stored within cracks, fractures, or other void spaces. The distribution and extent of alluvial and fractured-rock aquifers and water wells vary within the South Coast 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 from DWR Bulletin 118-2003.

Alluvial Aquifers

DWR Bulletin 118-2003 identifies 73 alluvial groundwater basins and subbasins in the South Coast region. These 73 groundwater basins and subbasins underlie approximately 3,500 square miles, or 32 percent, of the hydrologic region. Most of the groundwater in the South Coast region is stored in alluvial aquifers. A detailed description of aquifers in the South Coast region is beyond the scope of this chapter. This section is a brief summary of the major groundwater basins and aquifers in this hydrologic 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 6-2 shows the location of the alluvial groundwater basins and subbasins in the region, and Table 6-1 lists the name and number 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 within a thin overlying layer of alluvial deposits or a thick soil horizon may also contribute to a well's groundwater supply.

Among the most heavily extracted groundwater basins in the South Coast region are the Coastal Plain of Los Angeles, Coastal Plain of Orange County, the Upper Santa Ana Valley, and the Santa Clara River Valley groundwater basins. These groundwater basins are divided into subbasins, with the exception of the Coastal Plain of Orange County Groundwater Basin. The aquifer characteristics of the groundwater subbasins will be described collectively in each groundwater basin.

Coastal Plains of the Los Angeles and Orange County Groundwater Basins

The Coastal Plain of Los Angeles Groundwater Basin (4-11) is comprised of four groundwater subbasins: the Santa Monica (4-11.01), Hollywood (4-11.02), West Coast (4-11.03), and Central (4-11.04) subbasins. To the northeast of the Coastal Plain of Los Angeles Groundwater Basin is the San Gabriel Valley Groundwater Basin (4-13), and to the north is the San Fernando Valley Groundwater Basin (4-12). The Coastal Plain of Orange County Groundwater Basin (8-1) is located southeast and adjacent to the Coastal Plain of Los Angeles Groundwater Basin. That basin and the Coastal Plain of Los Angeles Groundwater Basin will be described collectively in this chapter as the CPLAOC groundwater basins because the two groundwater basins have similar depositional settings and aquifer characteristics.

The CPLAOC groundwater basins are bound on the north by the Santa Monica Mountains, the Hollywood fault, and the Elysian, Repetto, Merced, Puente, and Chino Hills areas; on the west by the Pacific Ocean; on the east by the Santa Ana Mountains; and on the south by the San Joaquin Hills and the Pacific Ocean. Collectively, the CPLAOC groundwater basins cover approximately 836 square miles. The major rivers that historically provided sediment to the basins are the Los Angeles, San Gabriel, and Santa Ana rivers.

The water-bearing units in the CPLAOC groundwater basins include multiple unconfined and confined aquifers. The CPLAOC groundwater basins are divided into forebay and pressure areas. In general, forebay areas refer to areas of higher permeability and recharge to underlying aquifers. Pressure areas refer to areas where groundwater percolation is impeded by deposits of low permeability and where groundwater is confined. Most of the central and coastal portions of the Coastal Plain of Orange County Groundwater Basin are in a pressure area, while the majority of the northeast portion of the basin is within the forebay area. In the Coastal Plain of Los Angeles Groundwater Basin, the primary forebay

Figure 6-2 Alluvial Groundwater Basins and Subbasins in the South Coast Hydrologic Region

Table 6-1 Alluvial Groundwater Basins and Subbasins in the South Coast Hydrologic Region

Basin/Subbasin		Basin Name	Basin/Subbasin		Basin Name
4-1	-	Upper Ojai Valley	-	8-2.07	Yucaipa
4-2	-	Ojai Valley	-	8-2.08	San Timoteo
4-3	-	Ventura River Valley	-	8-2.09	Temescal
-	4-3.01	Upper Ventura River	8-4	-	Elsinore
-	4-3.02	Lower Ventura River	8-5	-	San Jacinto
4-4	-	Santa Clara River Valley	8-6	-	Hemet Lake Valley
-	4-4.02	Oxnard	8-7	-	Big Meadows Valley
-	4-4.03	Mound	8-8	-	Seven Oaks Valley
-	4-4.04	Santa Paula	8-9	-	Bear Valley
-	4-4.05	Fillmore	9-1	-	San Juan Valley
-	4-4.06	Piru	9-2	-	San Mateo Valley
-	4-4.07	Santa Clara River Valley East	9-3	-	San Onofre Valley
4-5	-	Acton Valley	9-4	-	Santa Margarita Valley
4-6	-	Pleasant Valley	9-5	-	Temecula Valley
4-7	-	Arroyo Santa Rosa Valley	9-6	-	Cahuilla Valley
4-8	-	Las Posas Valley	9-7	-	San Luis Rey Valley
4-9	-	Simi Valley	9-8	-	Warner Valley
4-10	-	Conejo Valley	9-9	-	Escondido Valley
4-11	-	Coastal Plain of Los Angeles	9-10	-	San Pasqual Valley
-	4-11.01	Santa Monica	9-11	-	Santa Maria Valley
-	4-11.02	Hollywood	9-12	-	San Dieguito Creek
-	4-11.03	West Coast	9-13	-	Poway Valley
-	4-11.04	Central	9-14	-	Mission Valley
4-12	-	San Fernando Valley	9-15	-	San Diego River Valley
4-13	-	San Gabriel Valley	9-16	-	El Cajon Valley
4-15	-	Tierra Rejada	9-17	-	Sweetwater Valley
4-16	-	Hidden Valley	9-18	-	Otay Valley
4-17	-	Lockwood Valley	9-19	-	Tia Juana
4-18	-	Hungry Valley	9-22	-	Batiquitos Lagoon Valley
4-19	-	Thousand Oaks Area	9-23	-	San Elijo Valley
4-20	-	Russell Valley	9-24	-	Pamo Valley
4-22	-	Malibu Valley	9-25	-	Ranchita Town Area
4-23	-	Raymond	9-27	-	Cottonwood Valley
8-1	-	Coastal Plain of Orange County	9-28	-	Campo Valley
8-2	-	Upper Santa Ana Valley	9-29	-	Potrero Valley
-	8-2.01	Chino	9-32	-	San Marcos Area
-	8-2.02	Cucamonga	-	-	-
-	8-2.03	Riverside-Arlington	-	-	-
-	8-2.04	Rialto-Colton	-	-	-
-	8-2.05	Cajon	-	-	-
-	8-2.06	Bunker Hill	-	-	-

areas are identified in the northeast portion of the Central Groundwater Subbasin: the Los Angeles Forebay Area and the Montebello Forebay Area. The rest of the Central Groundwater Subbasin and the entire West Coast Groundwater Subbasin are identified as a pressure area (California Department of Water Resources 2003).

The water-bearing deposits consist of Pliocene-to-Holocene marine sediment and sediment eroded from the surrounding Transverse and Peninsular ranges. The oldest water-bearing deposits are composed of sand, siltstone, and conglomerates that form the Pliocene Upper Fernando Group. The Upper Fernando Group is approximately 350 to 500 feet thick, and the upper portion of this deposit is referred to as the lower aquifer system in the Coastal Plain of Orange County Groundwater Basin (California Department of Water Resources 2003). The lower aquifer system consists of numerous aquifers of variable thickness (California Department of Water Resources 1967). Groundwater is not heavily extracted from the lower aquifer system because of the colored water and higher costs associated with deeper well construction (Orange County Water District 2009). The Upper Fernando Group correlates with the Pico Formation, which underlies portions of the Coastal Plain of Los Angeles Groundwater Basin (California Department of Water Resources 1967).

The Pleistocene San Pedro Formation overlies the Pico Formation in the CPLAOC groundwater basins. The San Pedro Formation is primarily composed of marine and continental sands, gravel, silts, and clays, including the Timms Point Silt and Lomita Marl members (California Department of Water Resources 1967). The San Pedro Formation contains the following aquifers in downward succession: Hollydale, Jefferson, Lynwood, Silverado, and Sunnyside. The Lynwood and Silverado aquifers are the most important groundwater producers in this formation (California Department of Water Resources 1961).

Near the base of the San Pedro Formation is a sequence of continental and marine deposits consisting of coarse sand and gravel interbedded with lenses of silt and clay that comprise the Silverado Aquifer. The Silverado Aquifer ranges in thickness from 50 to 500 feet and merges with overlying aquifers in various areas of the Coastal Plain of Los Angeles Groundwater Basin. This aquifer is one of the main productive units in the groundwater basin (California Department of Water Resources 1961).

The Lynwood Aquifer is composed of continental and marine deposits of gravels, sands, silts, and clays (California Department of Water Resources 1961). The continental deposits appear to have been deposited by the Rio Hondo and San Gabriel rivers, while the marine deposits were deposited when the area was covered by shallow seas. The Lynwood Aquifer ranges in thickness from 50 to 200 feet, merges with other aquifers, and is an important groundwater resource in the Coastal Plain of Los Angeles Groundwater Basin (California Department of Water Resources 1961).

The Pleistocene Coyote Hills Formation, consisting of non-marine, massive-pebbly sandstone and mudstone, overlies the San Pedro Formation in the Coastal Plain of Orange County Groundwater Basin. The Coyote Hills and San Pedro formations have an average combined thickness of 1,600 feet and form the middle aquifer system. The middle aquifer system contains the greatest extent of interconnected aquifers among the three aquifer systems in the Coastal Plain of Orange County Groundwater Basin. Within the middle aquifer system, the uppermost aquifer is referred to as the main, or principal, aquifer. The principal aquifer is the primary producing unit within the groundwater basin and is the source of 95 percent of the entire basin's groundwater production used for drinking water (Orange County Water District 2009).

The upper or shallow aquifer system within the Coastal Plain of Orange County Groundwater Basin overlies the principal aquifer system. The shallow aquifer system consists of the Pleistocene Lakewood and La Habra formations, the older alluvium, and the recent alluvium. The shallow aquifer accounts for 5 percent of the total basin production, with the Talbert Aquifer being the most productive (Orange County Water District 2009).

The Lakewood Formation underlies the CPLAOC groundwater basins. The formation ranges in thickness from 10 to 400 feet and is composed of alluvial and floodplain deposits consisting of interbedded clay, silt, sand, and gravel. The Lakewood Formation is divided into the Artesia-Exposition Aquifer, the Gage-Gardena Aquifer, and the unnamed aquicludes separating the aquifers (California Department of Water Resources 1961). The Artesia Aquifer appears to have been deposited by the San Gabriel River, Coyote Creek, and the Santa Ana River, while the Exposition Aquifer appears to have been deposited by the Los Angeles River system. Both aquifers have similar composition and mode of deposition and are assumed to have been deposited contemporaneously. The general composition of the aquifers consist of coarse gravels, coarse-to-fine sand, and interbedded silts and clays. In the Coastal Plain of Orange County Groundwater Basin, the Lakewood Formation is the base of the shallow aquifer system (California Department of Water Resources 1961).

The Gage Aquifer ranges from 10 to 160 feet in thickness and generally consists of a fine- to medium-grained sand with gravel, sandy silt, and clay of both marine and continental origin (California Department of Water Resources 1961). The Gage Aquifer is thickest within the Central Subbasin. The Gardena Aquifer has a fluvial origin and is composed of coarse sand and gravel with discontinuous lenses of sandy silt and clay. The Gardena Aquifer is an important groundwater producer in the Coastal Plain of Los Angeles Groundwater Basin. The Gage and Gardena aquifers are in hydraulic continuity and have similar thicknesses and elevation (California Department of Water Resources 1961).

The La Habra Formation is locally deposited in the La Habra area of Orange County. The formation contains the shallow aquifer and is composed of marine conglomerates, a variety of sandstones, and massive siltstones. The formation ranges in thickness from 500 to 1,500 feet. Older terrace alluvial deposits and the recent alluvium overlie the La Habra Formation. The older alluvial and terrace deposits consist of semi-consolidated silt, sand, and gravel and have a maximum thickness of 100 feet. The recent alluvium is predominantly composed of unconsolidated gravel, sand, and silt and has a maximum thickness of 175 feet. The lower part of the recent alluvium contains interfingering lenses of coarse sand and gravel that comprise the Talbert Aquifer. The Talbert Aquifer is confined by lenses and sheets of clay (California Department of Water Resources 1961).

In the Coastal Plain of Los Angeles Groundwater Basin, the recent alluvium contains the youngest and shallowest aquifers and predominantly consists of coarse and unconsolidated deposits. The water-bearing units within the recent alluvium include the Semi-perched Aquifer, Bellflower Aquiclude, Gaspur Aquifer, and Ballona Aquifer. Portions of the Semi-perched Aquifer and Bellflower Aquiclude are Pleistocene-age and are a part of the Lakewood Formation.

The Semi-perched Aquifer consists of coarse sands and gravels deposited in stream channels. The aquifer is approximately 60 feet thick, but groundwater is not heavily produced from it. The Semi-perched Aquifer is separated from the underlying Gaspur Aquifer by the Bellflower Aquiclude. The Bellflower Aquiclude is a fine-grained floodplain deposit interbedded with marine and wind-blown sediments

(California Department of Water Resources 1961). The Bellflower Aquiclude ranges in thickness from 35 to 140 feet and underlies most of the Coastal Plain of Los Angeles Groundwater Basin (California Department of Water Resources 2003).

Below the Bellflower Aquiclude is the Gaspur Aquifer. The Gaspur Aquifer is a continental stream deposit consisting of sediment transported from the San Gabriel Mountains. The Gaspur Aquifer is approximately 120 feet thick and is composed of sediment ranging from boulder gravel to silt and clay. The Gaspur Aquifer underlies much of the Coastal Plain of Los Angeles Groundwater Basin, but not the Santa Monica Subbasin (California Department of Water Resources 1961, 2003).

One of the principal aquifers that underlie the Santa Monica Groundwater Subbasin is the Ballona Aquifer. The Ballona Aquifer varies in thickness from 10 to 50 feet and is composed of coarse sand, gravel, and cobbles with a provenance from the San Gabriel Mountains and possibly the Santa Monica Mountains (California Department of Water Resources 1961, 2003).

For a more detailed discussion regarding the stratigraphy, structural geology, and groundwater basin characteristics, refer to *Planned Utilization of the Ground Water Basins of the Coastal Plain of Los Angeles County* (California Department of Water Resources 1961); *Progress Report on Ground Water Geology of the Coastal Plain of Orange County: Southern District* (California Department of Water Resources 1967); California's Groundwater, Bulletin 118 (California Department of Water Resources 2003); and *Groundwater Management Plan 2009 Update* (Orange County Water District 2009).

Upper Santa Ana Valley Groundwater Basin

The Upper Santa Ana Valley Groundwater Basin (8-2) is composed of nine groundwater subbasins that underlie an area of approximately 761 square miles. The Upper Santa Ana Valley Groundwater Basin is bound on the west by the San Jose fault, Santa Ana Mountains, the San Gabriel Valley Groundwater Basin, Chino Hills, and unnamed hills in the Lake Matthews area west of Perris. The groundwater basin is bound on the north by the Cucamonga fault, San Andreas fault, the San Gabriel and San Bernardino mountains, and a surface drainage divide separating the Upper Mojave River Valley Groundwater Basin. It is bound on the east by the Redlands fault, Yucaipa Hills, San Bernardino Mountains, and a surface drainage divide with the Colorado River Hydrologic Region. It is bound on the south by the San Jacinto fault, Chino fault, Box Spring Mountains, Chino Hills, and Puente Hills. The Santa Ana River and its tributaries drain the watershed. The larger tributaries include Cucamonga, Mill, San Timoteo, East Twin, Lytle, and Warm creeks.

The sediments in the Upper Santa Ana Valley Groundwater Basin consist of Pleistocene-to-Holocene alluvial deposits derived from the San Gabriel, San Bernardino, Santa Ana, and San Jacinto mountains, and to a lesser degree from the Puente Hills and Chino Hills. The aquifers can be unconfined and confined and the water-bearing deposits are typically hundreds of feet thick and exceed 1,000 feet in some subbasins (California Department of Water Resources 2003).

The aquifer system in the Bunker Hill and Rialto-Colton groundwater subbasins is divided into upper and lower aquifers. The upper aquifer has a maximum thickness of 300 feet and consists of Holocene fluvial and alluvial fan deposits that grade into older river-channel deposits near the Santa Ana River (Hardt and Hutchinson 1980). Near the foothills, the upper member is not usually filled with water, though localized areas of perched groundwater exist. Within the central portion of the groundwater basins, the upper member yields water freely to wells where it is saturated. Separating the upper and lower aquifers is a 300-feet thick clay layer that produces confined groundwater conditions (Hardt and Hutchinson 1980). The lower water-bearing member consists of consolidated Pleistocene sand and clay ranging in thickness from tens of feet to approximately 650 feet. The lower member is not penetrated by most production wells and groundwater is not heavily produced because of the depth and lower permeability of the deposit (California Department of Water Resources 2003).

Besides Quaternary alluvium, the San Timoteo Formation is a widely deposited water-bearing unit in the eastern portion of the Upper Santa Ana Valley Groundwater Basin. The Plio-Pleistocene San Timoteo Formation is an alluvial deposit estimated to be 1,500 to 2,000 feet thick and is primarily composed of gravel, silt, and clay. The water-bearing portion of the formation is estimated to be 700 to 1,000 feet deep (California Department of Water Resources 2003).

The water-bearing units in the western portion of the Upper Santa Ana Valley Groundwater Basin consist of Holocene alluvium as much as 150 feet thick and Pleistocene alluvium as much as 700 feet thick throughout most of the Chino Groundwater Subbasin. Most of the wells extract water from the coarse deposits of the Pleistocene alluvium. The highest producing wells in the central portion of the groundwater subbasin yield 500 to 1,000 gallons per minute (gpm) (California Department of Water Resources 2003).

The Upper Santa Ana Valley Groundwater Basin aquifers are generally recharged by precipitation infiltrating the alluvial fans along the base of the surrounding mountains and along the Santa Ana River and its tributaries. The aquifers are also artificially recharged by local groundwater managers using a variety of conjunctive management methods.

Santa Clara River Valley Groundwater Basin

The Santa Clara River Valley Groundwater Basin (4-4) is composed of six groundwater subbasins that underlie 299 square miles. Collectively, the Santa Clara River Valley Groundwater Basin is bound on the west by the Topatopa Mountains and the Pacific Ocean; on the north by the San Cayetano fault and the Santa Ynez, Topatopa, and Piru mountains; on the east by the Pleasant Valley and Las Posas Valley groundwater basins and the San Gabriel Mountains; and on the south by the Oak Ridge, Santa Susana, San Gabriel, and Santa Monica mountains; the Oak Ridge and Saticoy faults; and the Pacific Ocean. The major river draining the watershed is the Santa Clara River. The Santa Clara River tributaries include the Bouquet, Castaic, Piru, Sespe, Santa Paula, and Calleguas creeks.

The primary water-bearing deposits within the Santa Clara Valley Groundwater Basin are Quaternary alluvium, Pleistocene terrace deposits, the Pleistocene San Pedro Formation, and the Pliocene-to-Pleistocene Saugus Formation. The provenance for the water-bearing deposits is from the surrounding mountains, including the Santa Ynez, Topatopa, Piru, San Gabriel, and Santa Monica.

One of the primary water-bearing units is the Pleistocene-to-Holocene alluvium. The alluvial aquifer system consists of stream channel and floodplain deposits generally composed of unconsolidated sand and gravel with silt and clay. The thickness of the alluvium is 200 to 240 feet throughout most of the basin and is thickest in the Mound Groundwater Subbasin (4-4.03), where thickness reaches 500 feet (California Department of Water Resources 2003). Groundwater in the alluvium is generally unconfined. Pleistocene alluvial terraces are deposited in low-lying areas of the foothills and along the upper reaches of the Santa Clara River tributaries. The terrace deposits consist of weakly stratified, consolidated, and cemented gravel, sand, and silt. The maximum thickness of the terrace deposits are 200 feet (California Department of Water Resources 2003). Water supply wells have not been constructed in the terrace deposits since the deposits are generally at elevations above the water table and have limited ability to supply groundwater (Castaic Lake Water Agency 2003).

In the Santa Clara River Valley East Groundwater Subbasin (4-4.07), the Pliocene-to-Pleistocene Saugus Formation underlies the alluvial deposits. The Saugus Formation consists of poorly consolidated and sorted sandstone, siltstone, and conglomerates. The lower member of the Saugus Formation is the Sunshine Ranch Member, and it has a marine and terrestrial origin (California Department of Water Resources 2003). The Sunshine Ranch Member has a maximum thickness of 3,000 to 3,500 feet, but is not a large supplier of municipal water since the deposits are generally less productive than the upper member, and the groundwater can be brackish (Castaic Lake Water Agency 2003). The upper member of the Saugus Formation consists of coarse-grained stream channel and floodplain deposits that are generally located at depths of 300 to 2,500 feet (Castaic Lake Water Agency 2003). Groundwater is present under unconfined, semi-confined, and confined conditions in the groundwater subbasin (Slade 2002). The upper member of the Saugus Formation supplies groundwater for municipal and agricultural uses.

Throughout the rest of the groundwater basin, the San Pedro Formation underlies the alluvial deposits. Because of the proximity of the provenance sources and a similar depositional environment, the San Pedro Formation in the Santa Clara River Valley Groundwater Basin is likely the same unit as the Saugus Formation (United Water Conservation District 2008). Still, the San Pedro Formation nomenclature is used to describe the aquifers underlying the Pleistocene-to-Holocene alluvium in the middle and lower reaches of the Santa Clara River. The San Pedro Formation consists of permeable sands and gravels that extend to a maximum depth of approximately 8,000 feet in the Piru Subbasin (4-4.06) (United Water Conservation District 1996). Confined and unconfined groundwater conditions exist within the San Pedro Formation (California Department of Water Resources 2003).

The Oxnard Groundwater Subbasin (4-4.02) is located in the lower reaches of the Santa Clara River and Calleguas Creek. The Oxnard Groundwater Subbasin contains five locally defined aquifers. The Oxnard Aquifer and Fox Canyon Aquifer are the two primary freshwater-bearing units (California Department of Water Resources 2003). The Oxnard Aquifer is composed of late Pleistocene-to-Holocene sands and gravels that are coarser-grained in the forebay area and become finer-grained toward the coast. The Oxnard Aquifer is generally located 100 to 220 feet below the ground surface. A 150-foot-thick confining sequence of silt and clay overlies the Oxnard Aquifer. A 50- to 100-foot-thick zone of sand and gravel forms a semi-perched aquifer of poor quality water above the confining silt and clay (California Department of Water Resources 2003). The semi-perched aquifer is rarely used for water supply (Fox Canyon Groundwater Management Agency 2007). The Oxnard Aquifer comprises the upper unit of the upper aquifer system.

The Mugu Aquifer underlies the Oxnard Aquifer. The Mugu Aquifer is a 170-feet-thick Pleistocene coarse-grained deposit and is considered the basic unit of the upper aquifer system. Below the upper aquifer system is the hydrologically connected lower aquifer system (Fox Canyon Groundwater Management Agency 2007).

The lower aquifer system is composed of the Hueneme and Fox Canyon aquifers, and both are located within the San Pedro Formation. Both of these aquifers are important suppliers of groundwater. The Hueneme Aquifer is deposited in most coastal areas of the Oxnard Groundwater Subbasin and is an important groundwater producer in the Oxnard Groundwater Subbasin and the adjacent Las Posas Valley (4-8) and Pleasant Valley (4-6) groundwater basins (Fox Canyon Groundwater Management Agency 2007). The Hueneme Aquifer consists of relatively thin sand and gravel deposits and is underlain by a silt-and-clay sequence as much as 1,000 feet thick. Below the thick silt-and-clay sequence is the Fox Canyon Aquifer. The Fox Canyon Aquifer is a 100- to 300-foot-thick permeable gravel sequence that is also the base of the San Pedro Formation (California Department of Water Resources 2003). The Fox Canyon Aquifer underlies the Oxnard Groundwater Subbasin, the Mound Groundwater Subbasin, and the adjacent Las Posas Valley and Pleasant Valley groundwater basins.

The upper and lower aquifer systems extend several miles offshore and are in direct contact with sea water (Fox Canyon Groundwater Management Agency 2007). Seawater intrusion has been observed in the Port Hueneme and Point Mugu areas (California Department of Water Resources 2003).

The aquifers within the Santa Clara River Valley Groundwater Basin are generally recharged by infiltration of water along the Santa Clara River, its tributaries, and through the valley ground surface. Artificial recharge methods, such as irrigation, water infiltration, and diverting runoff and imported water to percolation basins, also replenish the aquifers.

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 10 gpm or less. Although fractured-rock aquifers are less productive, compared with the alluvial aquifers in the region, these commonly serve as the sole source of water and are a critically important water supply for many communities.

The majority of the water used in the South Coast region is derived either from groundwater contained in alluvial aquifers or from imported water supplies. As a result, a detailed discussion of fractured-rock aquifers related to the region was not developed as part of *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 completed 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 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 that 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 to 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. Consequently, some well logs could not be used in this evaluation. Even so, for a regional-scale evaluation of well completion 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 South Coast region are grouped according to their location by county, and according to the 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 a combination of the less common well types, such as stock wells, test wells, or unidentified wells (no information listed on the well log).

The South Coast region includes all of Orange County, major portions of Los Angeles, Riverside, San Bernardino, San Diego, and Ventura counties, and a small portion of Santa Barbara County. A significant number of well logs for Riverside and San Bernardino counties exist in both the South Coast and Colorado River hydrologic regions, while many San Bernardino County wells also are in the South Lahontan Hydrologic Region. Some wells in Los Angeles County are located in the South Lahontan Hydrologic Region. Well-log data for counties that are in multiple hydrologic regions were assigned to the hydrologic region containing a majority of alluvial groundwater basins in the region.

Only the well logs submitted for Los Angeles, Orange, San Diego, and Ventura counties are included in the well-log analysis for the South Coast 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. Information regarding Riverside and San Bernardino county wells is in Chapter 12, "Colorado River Hydrologic Region," and in Chapter 11, "South Lahontan Hydrologic Region," of this report, respectively.

Table 6-2 lists the number of well logs received by the DWR for wells completed in the South Coast region from 1977 to 2010. Figures 6-3 and 6-4 provide an illustration of this data by county and for the region as a whole.

Table 6-2 Number of Well Logs, According to Well Use and County, for the South Coast Hydrologic Region (1977-2010)

County	Total Number of Well Logs by Well Use						
	Domestic	Irrigation	Public Supply	Industrial	Monitoring	Other	Total Well Records
Ventura	707	571	95	21	1,148	356	2,898
Los Angeles	2,820	283	425	128	7,611	2,705	13,972
Orange	59	114	125	23	3,863	1,054	5,238
San Diego	6,828	3,099	384	88	3,313	1,329	15,041
Total Well Records	**10,414**	**4,067**	**1,029**	**260**	**15,935**	**5,444**	**37,149**

Figure 6-3 Number of Well Logs, According to Well Use and County, for the South Coast Hydrologic Region (1977-2010)

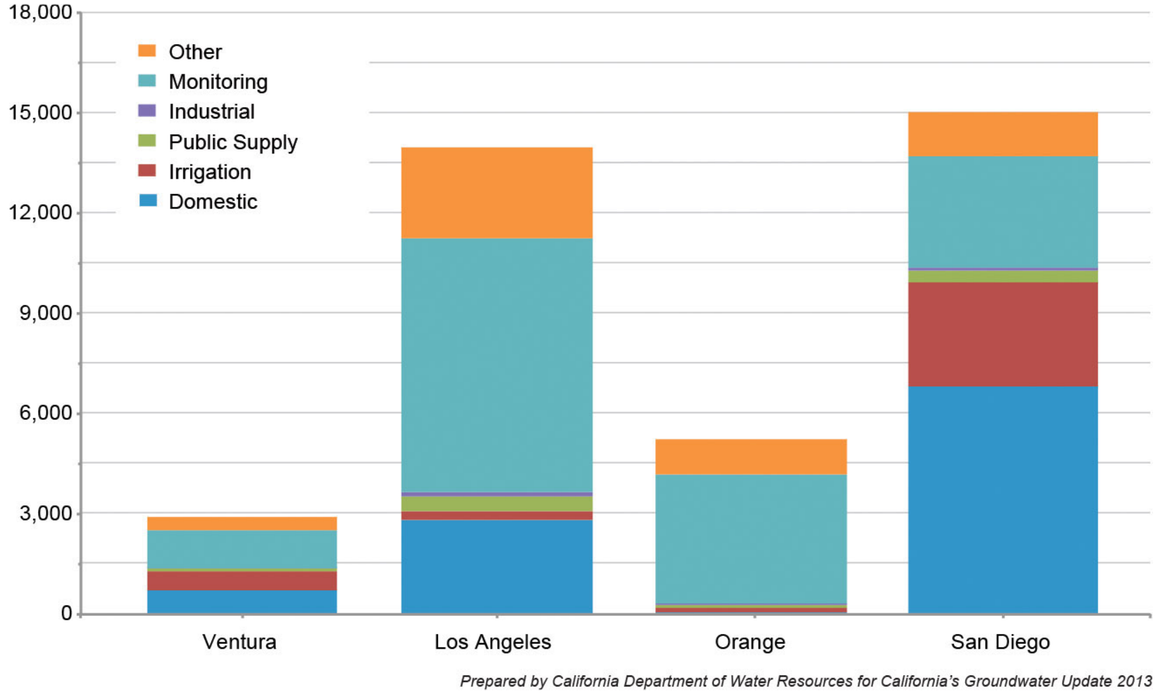
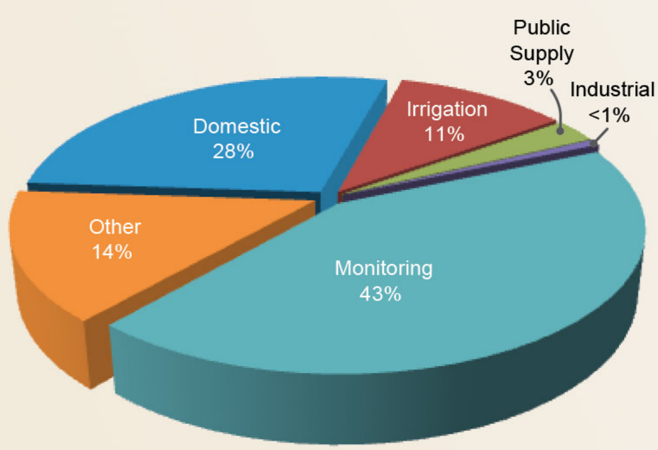


Figure 6-4 Percentage of Well Logs by Type of Use for the South Coast Hydrologic Region (1977-2010)



South Coast Well Logs Summary by Well Type

Well Type	Number of Well Logs
Domestic	10,414
Irrigation	4,067
Public Supply	1,029
Industrial	260
Monitoring	15,935
Other	5,444
Total	**37,149**

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

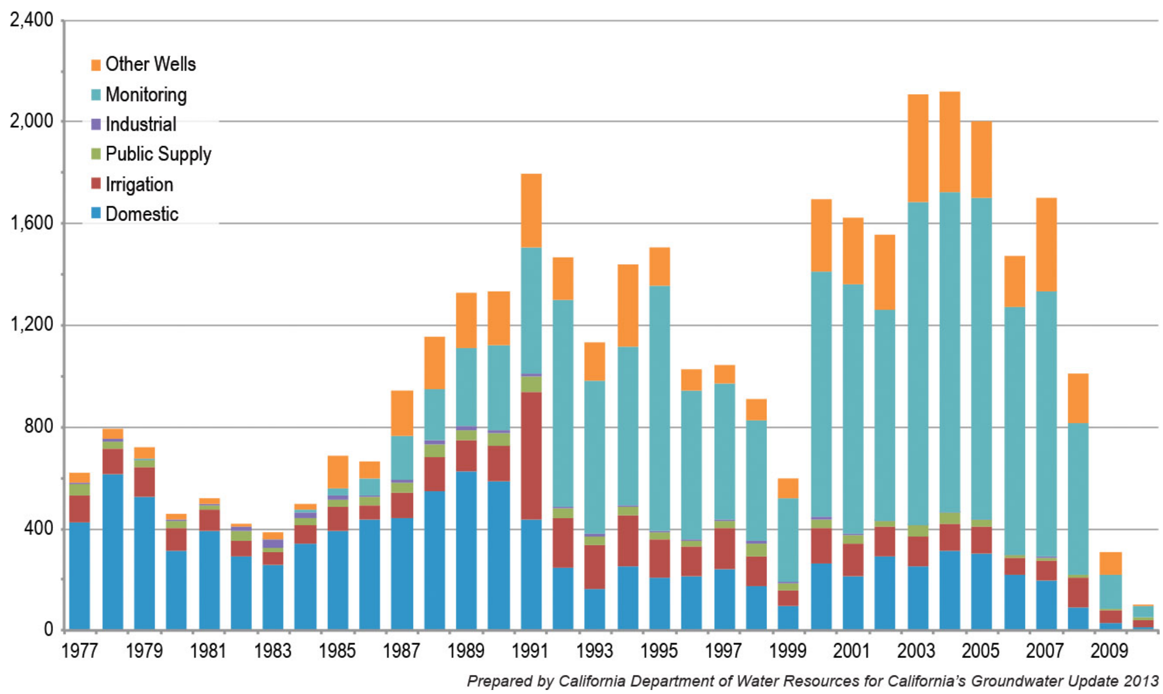
Figure 6-4 displays the percentages of wells, by well use, for the South Coast region between 1977 and 2010. Figure 6-4 shows that domestic, monitoring, and irrigation wells account for more than 80 percent of all wells installed in the region, with domestic wells comprising 28 percent and monitoring wells comprising 43 percent of all well logs on file. Statewide, domestic and monitoring wells average 54 and 24 percent, respectively, of the total number of wells.

Although groundwater accounts for 48 percent of the agricultural water supply for Los Angeles, Orange, San Diego, and Ventura counties, irrigation wells comprise about 11 percent of the wells for these counties. This is slightly higher than the statewide average of 10 percent.

In addition to analyzing the number of wells by location and use, well logs were analyzed by well installation date (Figure 6-5). 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. Well-log records for 2007 through 2010 are known to be less complete because of constraints associated with processing and incorporating the data.

Figure 6-5 shows a cyclic pattern of well installation for the South Coast region. Multiple factors are known to affect the annual number and type of wells constructed, such as the annual variations in weather, economy, agricultural crop trends, or alternative water supply availability. The apparent decline in well completions during 2007 through 2010 shown in Figure 6-5 was largely caused by DWR's backlog in processing the well logs received during that time.

Figure 6-5 Number of Well Logs per Year, by Well Use, for the South Coast Hydrologic Region (1977-2010)



The fluctuations in the number of domestic wells completed are likely associated with fluctuations in population growth and residential housing construction trends. According to the U.S. Census Bureau, the population in Los Angeles, Orange, San Diego, and Ventura counties increased by about 18 percent, 25 percent, 34 percent, and 26 percent, respectively, from 1980 to 1990. An economic downturn in the early 1990s resulted in a decline in the population growth and a reduction in the completion of new wells. Beginning in 2000, a 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 the result of declining economic conditions and a drop in new home construction, in addition to the backlog in processing well logs.

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 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 regulations required well drillers to begin submitting well logs for monitoring well completions. Well logs typically do not distinguish between monitoring wells that are installed as part of a groundwater cleanup project, compared with those installed primarily to collect changes in groundwater levels. Nevertheless, DWR estimates 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.

Irrigation well completions are more closely related to weather conditions, cropping trends, and available surface-water supplies. Figure 6-5 shows a relatively steady number of annual irrigation well completions, with the exception of 1991. In 1991, more than 500 irrigation wells were completed in the region, which is likely associated with the 1987-1992 drought.

CASGEM Basin Prioritization

As part of the 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. that 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 within each of the alluvial groundwater basins defined under Bulletin 118-2003 and to prioritize those basins to help identify, evaluate, and determine the need for additional groundwater-level monitoring. The basin prioritization process (California Water Code Section 10933[b]) directs DWR to consider, to the extent data are available, the following eight 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 within 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 identified in Bulletin 118-2003 and categorized them into four prioritization groups: high, medium, low, and very low.

Table 6-3 lists the medium and high priority CASGEM groundwater basins for the South Coast region, and Figure 6-6 graphically shows the groundwater basin prioritization for the region. The final full listing of the CASGEM Groundwater Basin Prioritization is provided in Appendix B. Of the 73 basins in the South Coast region, 14 basins were identified as high priority, 22 basins were identified as medium priority, five were listed as low priority, and the other 32 basins are listed as very low priority.

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 also 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 South Coast region, implementing sustainable groundwater resource management should focus initially on the 36 groundwater subbasins listed in Table 6-3 that have a medium or high priority. The 36 groundwater basins designated as high or medium priority comprise 96 percent of the annual groundwater use and 94 percent of the 2010 population that overlies the groundwater basins in the South Coast region.

Groundwater Use

The amount and timing of groundwater extraction, along with the location and type of groundwater use, are fundamental components for developing a groundwater basin budget and identifying effective options for groundwater management. While some types of groundwater uses are reported for some California groundwater 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 chapter 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 the first use of local surface water supplies is 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 demand is met and the overall supply and use for an area are 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 using the land- and water-use methods can be challenging.

DWR water supply and balance data are collected and analyzed by hydrologic regions that 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, hydrologic regions, and then 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.

Table 6-3 CASGEM Prioritization for Groundwater Basins in the South Coast Hydrologic Region

Basin Priority	Count	Basin/Subbasin Number	Basin Name	Subbasin Name	2010 Census Population
High	1	4-11.04	Coastal Plain of Los Angeles	Central	3,052,303
High	2	9-5	Temecula Valley	-	219,431
High	3	4-4.02	Santa Clara River Valley	Oxnard	235,973
High	4	8-2.01	Upper Santa Ana Valley	Chino	898,653
High	5	4-4.07	Santa Clara River Valley	Santa Clara River Valley East	221,204
High	6	8-2.03	Upper Santa Ana Valley	Riverside-Arlington	336,884
High	7	8-2.04	Upper Santa Ana Valley	Rialto-Colton	145,832
High	8	4-12	San Fernando Valley	-	1,745,338
High	9	4-23	Raymond	-	223,100
High	10	4-4.05	Santa Clara River Valley	Fillmore	16,417
High	11	8-4	Elsinore		60,946
High	12	4-11.03	Coastal Plain of Los Angeles	West Coast	1,195,195
High	13	8-1	Coastal Plain of Orange County	-	2,309,966
High	14	8-5	San Jacinto	-	474,317
Medium	1	8-2.07	Upper Santa Ana Valley	Yucaipa	65,180
Medium	2	4-4.04	Santa Clara River Valley	Santa Paula	46,816
Medium	3	4-13	San Gabriel Valley	-	1,275,187
Medium	4	8-2.08	Upper Santa Ana Valley	San Timoteo	54,169
Medium	5	9-7	San Luis Rey Valley		43,942
Medium	6	4-11.01	Coastal Plain of Los Angeles	Santa Monica	465,606
Medium	7	8-2.02	Upper Santa Ana Valley	Cucamonga	51,001
Medium	8	4-4.06	Santa Clara River Valley	Piru	2,666
Medium	9	4-6	Pleasant Valley	-	69,392
Medium	10	9-10	San Pasqual Valley	-	968
Medium	11	8-2.06	Upper Santa Ana Valley	Bunker Hill	363,394
Medium	12	8-2.09	Upper Santa Ana Valley	Temescal	141,436
Medium	13	9-4	Santa Margarita Valley	-	4,121
Medium	14	4-8	Las Posas Valley	-	39,835
Medium	15	4-7	Arroyo Santa Rosa Valley	-	2,211
Medium	16	9-6	Cahuilla Valley	-	1,993
Medium	17	9-15	San Diego River Valley	-	45,800
Medium	18	4-3.01	Ventura River Valley	Upper Ventura	15,961
Medium	19	8-9	Bear Valley	-	16,866
Medium	20	4-4.03	Santa Clara River Valley	Mound	77,886

Basin Priority	Count	Basin/Subbasin Number	Basin Name	Subbasin Name	2010 Census Population
Medium	21	4-2	Ojai Valley	-	8,268
Medium	22	9-1	San Juan Valley	-	61,131
Low	5	See Appendix B			
Very Low	32	See Appendix B			
Total	**73**	**Population of the South Coast Groundwater Basin Area:**			**14,849,557[a]**

Notes:
[a]Population of groundwater basin area includes the population of all basins in South Coast 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, DWR 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 impacts 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 DWR.
Using groundwater reliance as the leading indicator of basin priority, DWR evaluated California's 515 alluvial groundwater basins and categorized them into four groups — high, medium, low, and very low.

DWR water supply and balance data are collected and analyzed by hydrologic regions that 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, hydrologic regions, and then 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.

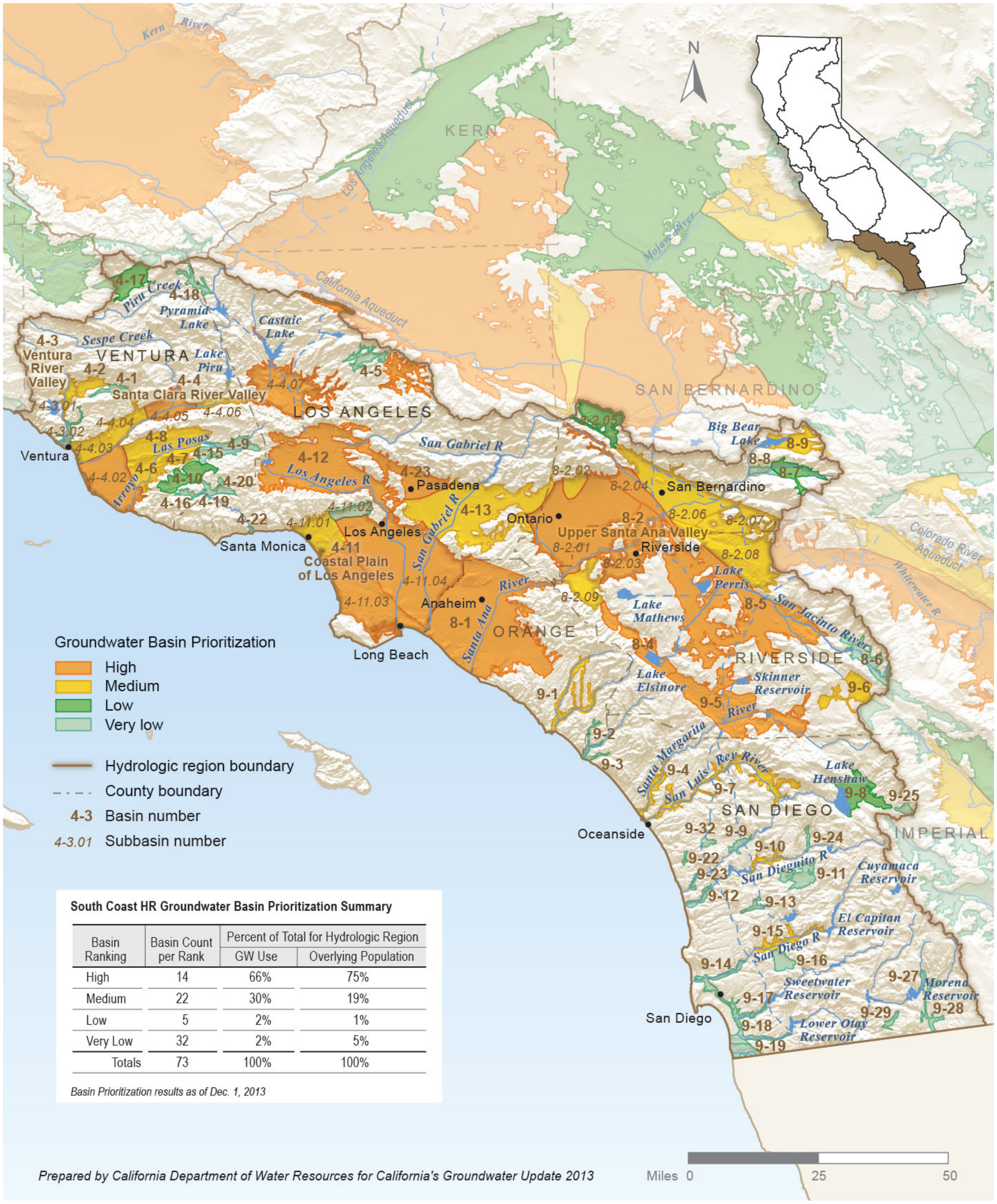
Water use is reported by water year (October 1 through September 30) and categorized according to urban, agriculture, and managed wetland uses. Reference to *total water supply* for a region represents the sum of surface water supplies, groundwater supplies, and reuse/recycled water supplies. Reuse/recycled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

2005-2010 Average Annual Groundwater Supply

Water demands in the South Coast region are met through a combination of water from the SWP, Colorado River, local groundwater, and recycled water supplies. The 2005-2010 average annual total water supply for the South Coast region, based on planning area boundary assumptions, is estimated at 4,707 taf. Of that average annual total water supply, approximately 34 percent (1,605 taf) is met by groundwater, with the remaining supply met by the SWP, Colorado River water, local supplies, and recycled water. While some areas in the South Coast region use groundwater to meet a small percentage of the overall water supply, groundwater provides 100 percent of the supply for some communities in the region and is an important resource to help facilitate conjunctive management.

Groundwater extraction in the South Coast region accounts for about 10 percent of California's 2005-2010 average annual groundwater use.

Figure 6-6 CASGEM Groundwater Basin Prioritization for the South Coast Hydrologic Region



South Coast HR Groundwater Basin Prioritization Summary

Basin Ranking	Basin Count per Rank	Percent of Total for Hydrologic Region: GW Use	Percent of Total for Hydrologic Region: Overlying Population
High	14	66%	75%
Medium	22	30%	19%
Low	5	2%	1%
Very Low	32	2%	5%
Totals	73	100%	100%

Basin Prioritization results as of Dec. 1, 2013

Groundwater Use by Planning Area Boundaries

The South Coast region includes four planning areas (PAs): the Santa Clara, Metropolitan Los Angeles, Santa Ana, and San Diego PAs. Table 6-4 lists the 2005-2010 average annual total water supply met by groundwater, by planning area, and by type of use. Groundwater use in Table 6-4 is reported in taf and by the percentage that groundwater contributes to the total water supply for the region. Table 6-5 identifies the percentage to which groundwater in the South Coast region is used by planning area and type of use. Figure 6-7 identifies the planning areas for the region and summarizes the groundwater use information presented in Table 6-4 and Table 6-5.

Table 6-4 Average Annual Total Water Supply Met by Groundwater, According to Planning Area and Type of Use, for the South Coast Hydrologic Region (2005-2010)

South Coast 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	%[b]
401	Santa Clara	218.0	73%	57.8	22%	0.0	0%	275.9	49%
402	Metropolitan Los Angeles	3.0	53%	633.7	37%	0.0	0%	636.7	37%
403	Santa Ana	130.5	86%	492.8	40%	0.0	0%	623.3	45%
404	San Diego	33.9	13%	35.3	5%	0.0	0%	69.2	7%
2005-2010 Annual Average HR Total		**385.4**	**54%**	**1,219.6**	**31%**	**0**	**0%**	**1,605.0**	**34%**

Notes:
HR = hydrologic region, PA = planning area, taf = thousand acre-feet

Based on the Santa Ana Water Project Authority's One Water One Watershed (OWOW) report, 58 percent of the total water use is met by groundwater in the Santa Ana planning area. The discrepancy between the California Water Plan and OWOW percentages will need to be addressed in the next California Water Plan Update.

[a]Total water use = groundwater + surface water + reuse.

[b]Percentage of use is the percentage of the total water supply that is met by groundwater, by type of use.

2005-2010 precipitation equals 91 percent of the 30-year average for the South Coast Hydrologic Region.

As previously stated, the 2005-2010 average annual total water supply for the South Coast region is 4,707 taf, and groundwater contributes 1,605 taf (34 percent) to the total supply. Surface water supplies, including recycled and reuse water, contribute the remaining 3,102 taf (66 percent). Table 6-4 shows that while groundwater supplies meet 34 percent of the average annual total water supply for the South Coast region, it also meets 31 percent (1,220 taf) of the region's total PA is the largest urban user of groundwater (634 taf). In contrast, the San Diego PA uses approximately 5 percent (35 taf) of what the Metropolitan Los Angeles PA uses.

As indicated on Table 6-5, groundwater resources in the South Coast region are primarily used to meet urban water demands, as 76 percent of the groundwater extracted in the region serves urban purposes. In the Metropolitan Los Angeles PA, almost 100 percent of the 637 taf of average annual groundwater extraction is used for urban needs, that also accounts for 40 percent of the total groundwater used in the region. The Santa Ana PA and the Santa Clara PA use 39 percent (623 taf) and 17 percent (276 taf), respectively, of the total groundwater extracted from the region, while the San Diego PA utilizes only 4 percent (69 taf) of the region's total groundwater extraction.

The largest groundwater user for agricultural purposes in the South Coast region is the Santa Clara PA, followed by the Santa Ana PA. These two areas use more than 90 percent of the 385 taf of groundwater used for agricultural purposes in the region. The Metropolitan Los Angeles PA only uses 3 taf of groundwater for agricultural purposes, which meets 53 percent of its agricultural needs.

Table 6-5 Percent of Average Annual Groundwater Supply, According to Planning Area and Type of Use, for the South Coast Hydrologic Region (2005-2010)

South Coast Hydrologic Region		Agriculture Use Met by Groundwater	Urban Use Met by Groundwater	Managed Wetlands Use of Groundwater	Groundwater Use by PA
PA Number	**PA Name**	%[a,b]	%[a,b]	%[a,b]	%[a,b]
401	Santa Clara	79%	21%	0%	17%
402	Metropolitan Los Angeles	0%	100%	0%	40%
403	Santa Ana	21%	79%	0%	39%
404	San Diego	49%	51%	0%	4%
2005-2010 Annual Average HR Total		24%	76%	0%	100%

Notes:

HR = hydrologic region, PA = planning area

[a]Percentage of use is average annual groundwater use by planning area and type of use, compared with the total groundwater use for the hydrologic region.

[b]Percentage of hydrologic region total groundwater use.

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 supply and use, will vary from the planning area estimates shown in Table 6-4 and Figure 6-7. Groundwater use is reported for Los Angeles, Orange, San Diego, and Ventura counties. Groundwater use for Riverside County is discussed in Chapter 12, “Colorado River Hydrologic Region.” Groundwater use for San Bernardino County is discussed in Chapter 11, “South Lahontan Hydrologic Region.” Tables showing groundwater use for all 58 California counties are in Appendix C.

Table 6-6 lists the 2005-2010 average annual groundwater use according to county, by type of use, and the percentage that groundwater contributes to the total water supply for each of the four counties in the South Coast region. The total amount of groundwater used in the region, based on county boundaries, is 1,066 taf, compared with the estimate of 1,605 taf, assuming planning area boundaries.

Overall, groundwater meets 28 percent of the total water needs for the four counties in the South Coast region. Los Angeles County extracts the most groundwater, 758 taf, which accounts for 38 percent of its average annual total water supply. Table 6-6 shows that groundwater contributes from as little as 2 percent of the total water supply for Orange County to as much as 53 percent for Ventura County.

Although Los Angeles County is the largest groundwater user for urban needs, Ventura County is the largest groundwater user for agricultural purposes. Most of the groundwater is pumped from groundwater basins beneath the Oxnard Plain-Pleasant Valley area. Of the 251 taf of groundwater extracted in Ventura

Figure 6-7 Groundwater Use and Total Water Supply Met by Groundwater, According to Planning Area, for the South Coast Hydrologic Region (2005-2010)

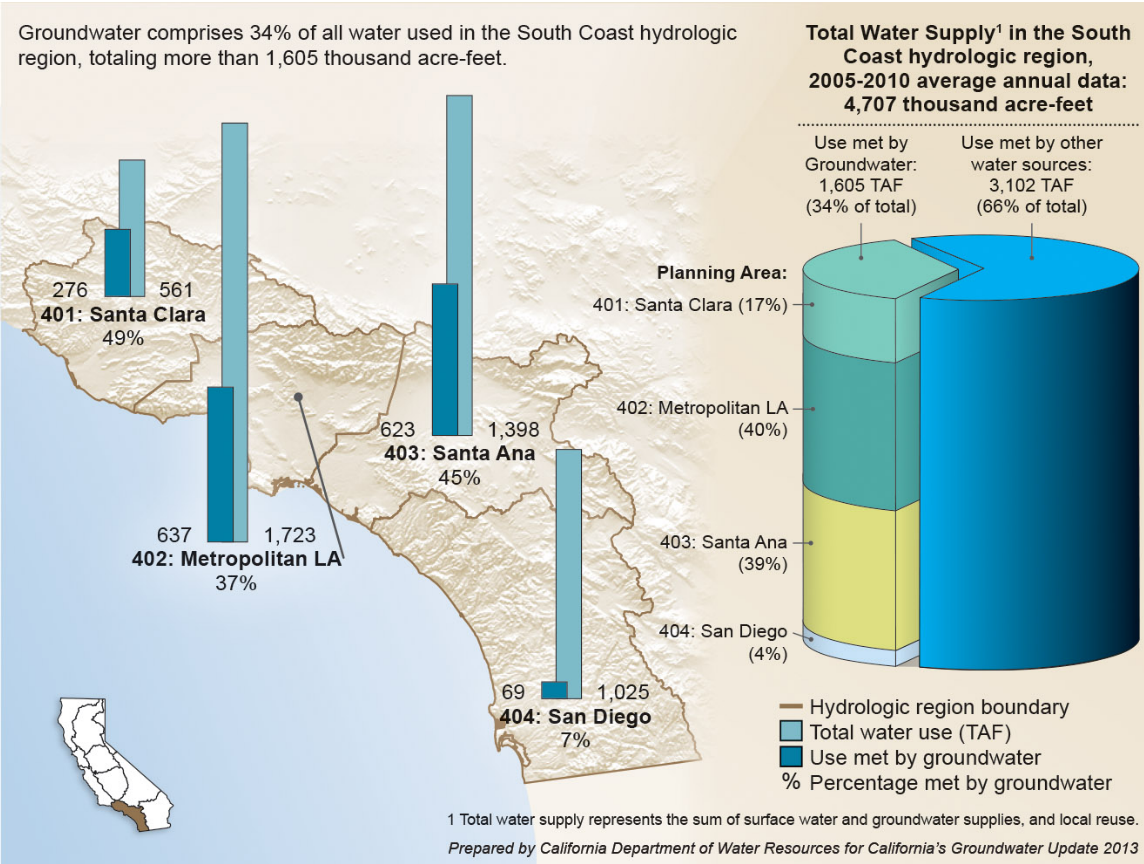


Table 6-6 Groundwater Use and Percentage of Total Water Supply Met by Groundwater, According to County and Type of Use, for the South Coast Hydrologic Region (2005-2010)

South Coast 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**	**%[a]**
Los Angeles	54.5	78%	703.4	37%	0.0	0%	757.8	38%
Orange	1.8	13%	10.2	2%	0.0	0%	12.1	2%
San Diego	18.0	8%	27.7	5%	0.0	0%	45.6	5%
Ventura	224.3	73%	26.6	16%	0.0	0%	250.8	53%
2005-2010 Annual Average Total	**298.5**	**48%**	**767.8**	**24%**	**0.0**	**0%**	**1,066.3**	**28%**

Notes:
taf = thousand acre-feet
[a]Percentage of use is the percentage of the total water supply that is met by groundwater, by type of use.
2005-2010 precipitation equals 91 percent of the 30-year average for the South Coast Hydrologic Region.

County, 224 taf (89 percent) is applied for agricultural needs (Table 6-6). Overall, groundwater resources meet 24 percent of the urban water needs of the South Coast region's counties and 48 percent of the agricultural needs.

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. The discussion of change in annual groundwater use presented below assumes the total water supply estimates and groundwater use are based on planning area boundaries rather than county boundaries.

Figure 6-8 illustrates the 2002-2010 water supply trend for the South Coast region. The right side of Figure 6-8 illustrates the total water supply volume by supply type (groundwater, surface water, and reuse/recycled water), while the left side shows the percentage of the overall water supply that is met by those sources of water. The center column identifies the water year along with the corresponding amount of precipitation, as a percentage of the previous 30-year average for the hydrologic region.

Figure 6-9 shows the annual amount and percentage of groundwater supply that met urban and agricultural demands between 2002 and 2010 in the South Coast region. No significant managed wetland demands were identified for the region, with exception of 0.4 taf of groundwater that was applied to a managed wetlands area in 2003. The center columns in Figure 6-9 identifies the water year along with the corresponding amount of precipitation, as a percentage of the previous 30-year average for the hydrologic region.

Figure 6-8 shows that the annual total water supply for the South Coast region from 2002 through 2010 fluctuated between a low of 4,055 taf in 2010 and a high of 5,201 taf in 2002. Groundwater use during this period ranged between a low of 1,238 taf in 2005 and a high of 1,898 taf in 2002. The reuse water supplied to the South Coast region was estimated to be as little as 8 taf in 2002 and as much as 414 taf in 2005. During each of the water years shown in Figure 6-8, the percentages that groundwater contributed to the total water supply ranged between 27 percent and 38 percent. Surface water supplies met between 55 percent and 64 percent of the total water use for the South Coast region, while reuse water contributed, with the exception of 2002, between 6 percent and 9 percent. Overall, this is a relatively consistent distribution of supplies in the South Coast region, regardless of the average precipitation amount in any water year between 2002 and 2010.

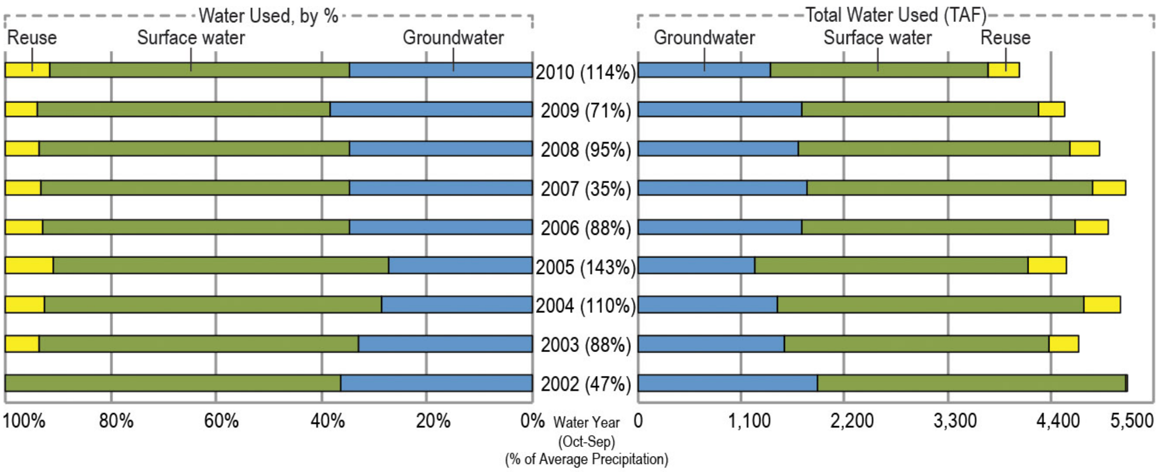
For each of the water years represented in Figure 6-9, the amount of groundwater used to meet urban demands was far greater than for agricultural purposes. With the exception of 2005, a wet year, the groundwater supply for urban use ranged between 72 percent and 80 percent, while groundwater use for agricultural applications ranged between 20 percent and 28 percent of the annual groundwater supply.

As previously indicated, the 36 groundwater basins in the South Coast region designated as high or medium priority under the CASGEM Program comprise 96 percent of the annual groundwater use. Ninety-four percent of the 2010 population in the region overlies these 36 groundwater basins.

Groundwater Monitoring Efforts

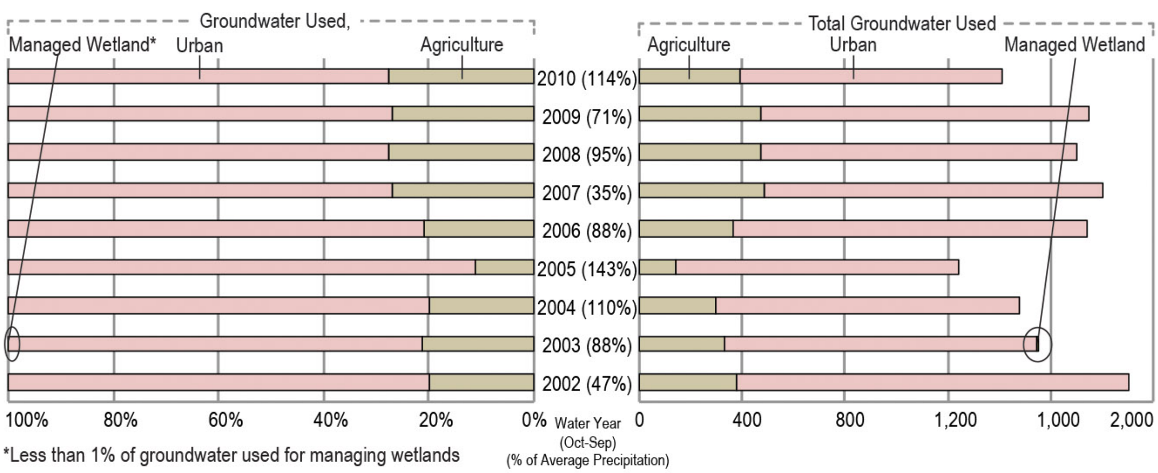
Groundwater resource monitoring and evaluation is a key aspect to understanding groundwater conditions, identifying effective resource management strategies, and implementing sustainable resource management practices. California Water Code Section 10753.7 requires local agencies seeking State funds, 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.

Figure 6-8 Annual Surface Water and Groundwater Supply Trend for the South Coast Hydrologic Region (2002-2010)



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

Figure 6-9 Annual Groundwater Supply Trend by Type of Use for the South Coast Hydrologic Region (2002-2010)



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

This section summarizes some of the groundwater-level monitoring, groundwater-quality monitoring, and land-subsidence monitoring activities in the South Coast 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 U. S. Geological Survey (USGS). Information regarding the groundwater monitoring methods, assumptions, and data availability is in Appendix A.

Groundwater-Level Monitoring

State and federal agencies with groundwater-level monitoring programs in the South Coast region include DWR and 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 is 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 South Coast 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 the USGS National Water Information System (http://waterdata.usgs.gov/nwis).

A list of the number of monitoring wells in the South Coast region by monitoring agencies and CASGEM-designated monitoring entities is in Table 6-7. The locations of these monitoring wells, by monitoring entity and monitoring well type, are shown in Figure 6-10.

Table 6-7 shows that 1,727 wells in the South Coast region are actively monitored for groundwater-level information. In addition to the 17 wells monitored by the DWR Southern Region Office, as listed in Table 6-7, Southern Region Office staff monitors 233 additional wells in three of the region's 73 groundwater basins. 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 339 wells in 15 groundwater basins and subbasins, including areas outside of Bulletin 118-2003 groundwater basins. Fifteen CASGEM monitoring entities monitor a combined 1,332 wells in 34 groundwater basins and subbasins, including areas outside of Bulletin 118-2003 groundwater basins. The locations of groundwater-level monitoring wells for many of the CASGEM monitoring entities correlates with groundwater basins identified as having a high or medium priority under CASGEM Groundwater Basin Prioritization.

Most of the groundwater-level monitoring networks include a variety of well-use types. 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 older inactive or unused wells.

Table 6-7 Groundwater-Level Monitoring Wells, According to Monitoring Entity, for the South Coast Hydrologic Region

State and Federal Agencies	Number of Wells
California Department of Water Resources	17[a]
U.S. Geological Survey	339
U.S. Bureau of Reclamation	0
Total State and Federal Wells	**356**
Monitoring Cooperators	**Number of Wells**
Ventura County Flood Control District[b]	39
Total Cooperator Wells	**39**
CASGEM Monitoring Entities	**Number of Wells**
Chino Basin Watermaster	46
County of Ventura, Watershed Protection District	362
Eastern Municipal Water District	312
Main San Gabriel Basin Watermaster	42
Orange County Water District	372
Rancho California Water District	25
San Bernardino Valley Municipal Water District	43
San Juan Basin Authority	9
Vista Irrigation District	6
Water Replenishment District Of Southern California	28
Western Municipal Water District	24
Puente Basin Watermaster	13
Raymond Basin Management Board	24
San Gorgonio Pass Water Agency	14
Six Basins Watermaster	12
Total CASGEM Entity Wells	**1,332**
Total Hydrologic Region Monitoring Wells	**1,727**

Notes:

CASGEM = California Statewide Groundwater Elevation Monitoring Program

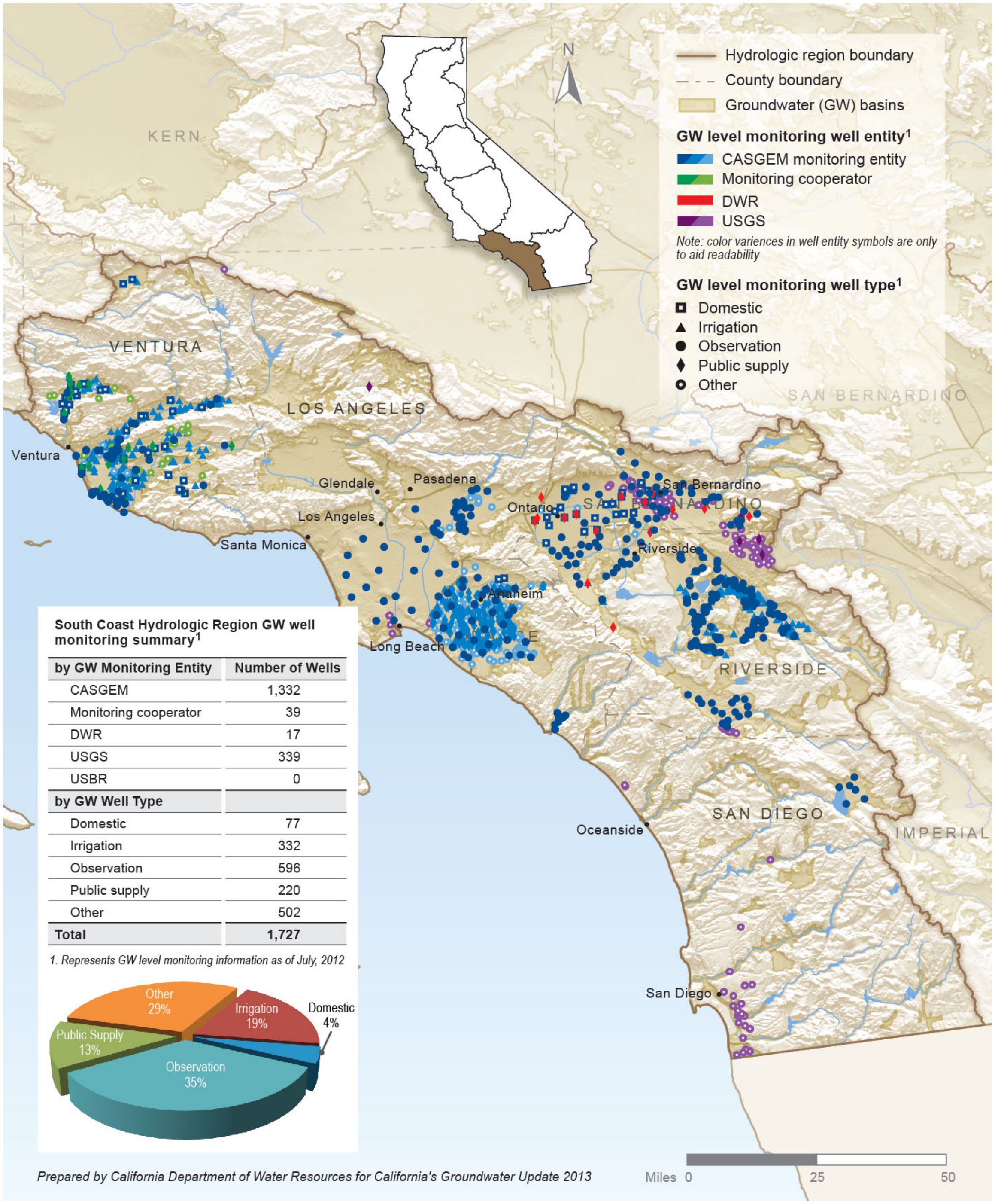
[a]DWR monitors 250 wells in the hydrologic region. Not all of the data are publicly available because of privacy agreements with well owners or operators.

[b]Ventura County Flood Control District is now referred to as the County of Ventura, Watershed Protection District.

Table represents monitoring information as of July 2012.

Table includes groundwater-level monitoring wells having publically available online data.

Figure 6-10 Monitoring Well Location According to Agency, Monitoring Cooperator, and CASGEM Monitoring Entity for the South Coast Hydrologic Region



South Coast Hydrologic Region GW well monitoring summary[1]

by GW Monitoring Entity	Number of Wells
CASGEM	1,332
Monitoring cooperator	39
DWR	17
USGS	339
USBR	0
by GW Well Type	
Domestic	77
Irrigation	332
Observation	596
Public supply	220
Other	502
Total	**1,727**

1. Represents GW level monitoring information as of July, 2012

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. These wells are designed to characterize groundwater conditions at specific and discrete intervals in the aquifer system.

Figure 6-10 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 is illustrated by the pie chart, which indicates wells identified as "observation" wells account for 35 percent of the groundwater-level monitoring wells. Wells identified by use as "other" account for 29 percent of the groundwater-level monitoring wells in the region. Irrigation wells and public supply wells comprise 19 and 13 percent of the monitoring wells, respectively, while domestic wells account for 4 percent.

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. Nonetheless, 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 the existing groundwater quality monitoring efforts were initiated as part of the Groundwater Quality Monitoring Act of 2001, which implemented goals to improve and increase the statewide availability of groundwater quality data. A comprehensive presentation of South Coast region groundwater-quality monitoring activities is beyond the scope of this chapter. A summary of the statewide and regional groundwater quality monitoring activities 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 Groundwater Ambient Monitoring and Assessment Program (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 publically 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.

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 more than 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, USGS, and Lawrence Livermore National Laboratory (LLNL). In addition to groundwater quality data, 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 the DWR Water Data Library primarily includes baseline minerals, metals, and nutrient data associated with regional monitoring.

Table 6-8 provides agency-specific groundwater quality information. Additional information regarding assessment and reporting of groundwater quality information is listed in the "Aquifer Conditions" section of this chapter.

Land Subsidence Monitoring

Land subsidence has been shown to occur in areas experiencing 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 sediment grain structure decreases. A decrease in water pressure causes more weight from the overlying sediments to be supported by the sediment grains within the aquifer. In unconsolidated deposits, the increased weight from overlying sediments may compact the fine-grained sediments and permanently decrease the porosity of the aquifer and the ability of the aquifer to store water. The partial collapse of the aquifer results in the subsidence of the land surface that overlies 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 caused by the collapse or compaction of the pore structure within the fine-grained portions of an aquifer system (U.S. Geological Survey 1999).

In the South Coast region, land subsidence associated with groundwater withdrawal has been documented in the Chino Groundwater Subbasin, Coastal Plain of Orange County Groundwater Basin, Oxnard Groundwater Subbasin, and San Jacinto Groundwater Basin. The results of the land subsidence investigations or monitoring activities are provided under the "Aquifer Conditions" section of this chapter. Additional information regarding land subsidence in California is 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 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, contributing to the overall base flow, or directly discharging to the surface via wetlands, seeps, and springs.

Table 6-8 Sources of Groundwater Quality Information for the South Coast 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) • Communities that Rely on a Contaminated Groundwater Source for Drinking Water http://www.waterboards.ca.gov/water_issues/programs/gama/ab2222/index.shtml • Hydrogeologically Vulnerable Areas http://www.waterboards.ca.gov/gama/docs/hva_map_table.pdf • Aquifer Storage and Recovery http://www.waterboards.ca.gov/water_issues/programs/asr/index.shtml Groundwater Ambient Monitoring and Assessment (GAMA) http://www.waterboards.ca.gov/gama/index.shtml • GeoTracker GAMA (Monitoring Data) http://www.waterboards.ca.gov/gama/geotracker_gama.shtml • Domestic Well Project http://www.waterboards.ca.gov/gama/domestic_well.shtml • Priority Basin Project http://www.waterboards.ca.gov/water_issues/programs/gama/sw_basin_assesmt.shtml • Special Studies Project http://www.waterboards.ca.gov/water_issues/programs/gama/special_studies.shtml California Aquifer Susceptibility Project http://www.waterboards.ca.gov/water_issues/programs/gama/cas.shtml **Contaminant Sites** • Land Disposal Program http://www.waterboards.ca.gov/water_issues/programs/land_disposal/ • Department of Defense Program http://www.waterboards.ca.gov/water_issues/programs/dept_of_defense/ • Underground Storage Tank Program http://www.waterboards.ca.gov/ust/index.shtml • 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 • Drinking Water Source Assessment and Protection (DWSAP) Program http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/DWSAP.shtml • Chemicals and Contaminants in Drinking Water http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chemicalcontaminants.shtml • Chromium-IV http://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/Chromium6.shtml • Groundwater Replenishment with Recycled Water http://www.cdph.ca.gov/services/DPOPP/regs/Pages/DPH14-003EGroundwaterReplenishmentUsingRecycledWater.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 • Bulletin 118 Groundwater Basins http://www.water.ca.gov/groundwater/bulletin118/gwbasins.cfm • California Statewide Groundwater Elevation Monitoring (CASGEM) http://www.water.ca.gov/groundwater/casgem/ • Groundwater-Level Monitoring http://www.water.ca.gov/groundwater/data_and_monitoring/gw_level_monitoring.cfm • Groundwater Quality Monitoring http://www.water.ca.gov/groundwater/data_and_monitoring/gw_quality_monitoring.cfm • Well Construction Standards http://www.water.ca.gov/groundwater/wells/standards.cfm • 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 • Well Sampling Database http://www.cdpr.ca.gov/docs/emon/grndwtr/wellinv/data_policy.htm • Groundwater Protection Area Maps http://www.cdpr.ca.gov/docs/emon/grndwtr/gwpa_locations.htm
U.S. Environmental Protection Agency http://www.epa.gov/safewater/	**Storage and Retrieval (STORET) Environmental Data System** http://www.epa.gov/storet/
U.S. Geological Survey http://ca.water.usgs.gov/	**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 widely 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 base flow of surface water systems, and reducing groundwater discharge to wetlands areas. Extensive lowering of groundwater levels can also result in land subsidence caused by the dewatering, compaction, and loss of storage within finer-grained aquifer systems.

Groundwater Occurrence and Movement

In the simplest of terms, groundwater comes from infiltration of precipitation and surface water from streams, canals, and other surface water systems and moves from areas of 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. 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 that can additionally alter natural groundwater flow conditions. Moreover, 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 over areas where there is little change in ground surface elevation.

South Coast region depth-to-groundwater contours were not developed as part of *California Water Plan Update 2013*. Depth-to-groundwater data for some of the groundwater basins in the South Coast region are available online from DWR's Water Data Library (http://www.water.ca.gov/waterdatalibrary/), DWR's CASGEM Program (http://www.water.ca.gov/groundwater/casgem/), and the USGS National Water Information System (http://waterdata.usgs.gov/nwis).

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 identify the hydrologic gradient and direction of groundwater flow. DWR monitors the depth to groundwater in some groundwater basins within the South Coast region and has produced groundwater elevation maps for the West Coast Groundwater Basin and the San Pasqual Valley Groundwater Basin. Groundwater elevation contours for the South Coast region were not developed for the South Coast region. Several local agencies independently or cooperatively measure groundwater levels and produce groundwater contour maps for basins within their jurisdictions. Examples of local agencies that produce groundwater contour maps include:

- Orange County Water District.
- Water Replenishment District of Southern California (WRD).
- United Water Conservation District.

- Chino Basin Watermaster.
- Main San Gabriel Basin Watermaster.
- Upper Los Angeles River Area Watermaster.

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 of data and analysis of seasonal and long-term groundwater-level variability and trends over time. Because of the highly variable nature of the aquifer systems within 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 illustrate or depict average aquifer conditions over a broad region. Rather, the hydrographs were selected to tell a story of how the local aquifer systems respond to changing groundwater extractions and resource management practices.

The following hydrographs are identified according to the State Well Number (SWN) system. The SWN identifies a well by its location using the U.S. Public Land Survey System of township, range, and section. Details about the SWN system are provided in DWR's information brochure, *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 6-11 shows hydrograph examples for three selected groundwater elevation monitoring wells in the South Coast region and provides a brief explanation of the hydrograph. Detailed information about each hydrograph can be found in the following paragraphs.

Hydrograph 04N18W29M002S

Figure 6-11a is a hydrograph for Well 04N18W29M002S, which is located in the Piru Groundwater Subbasin (4-4.06) portion of the Santa Clara River Valley Groundwater Basin. This hydrograph depicts the aquifer responses to weather variations, groundwater extraction, and the conjunctive management of water supplies. The well is constructed near the Santa Clara River in a narrow portion of the Santa Clara River Valley, which is dominated by agricultural developments. The well is constructed in alluvium and the underlying San Pedro Formation. Groundwater levels in this well have been measured monthly since 1968. The Piru Groundwater Subbasin is a medium-priority CASGEM groundwater basin.

The groundwater levels depicted in the hydrograph show aquifer responses to precipitation cycles and seasonal variations. During the winter or spring seasons, when the precipitation is typically the most abundant, the precipitation and associated runoff replenishes the aquifer system. During years with abundant precipitation, groundwater levels repeatedly reach the same approximate elevation, about 620 feet above mean sea level, and fully recharge the aquifer system (United Water Conservation District 2008). Groundwater levels typically decline during periods of low precipitation, such as the droughts of 1976-1977, 1987-1992, and 2007-2009.

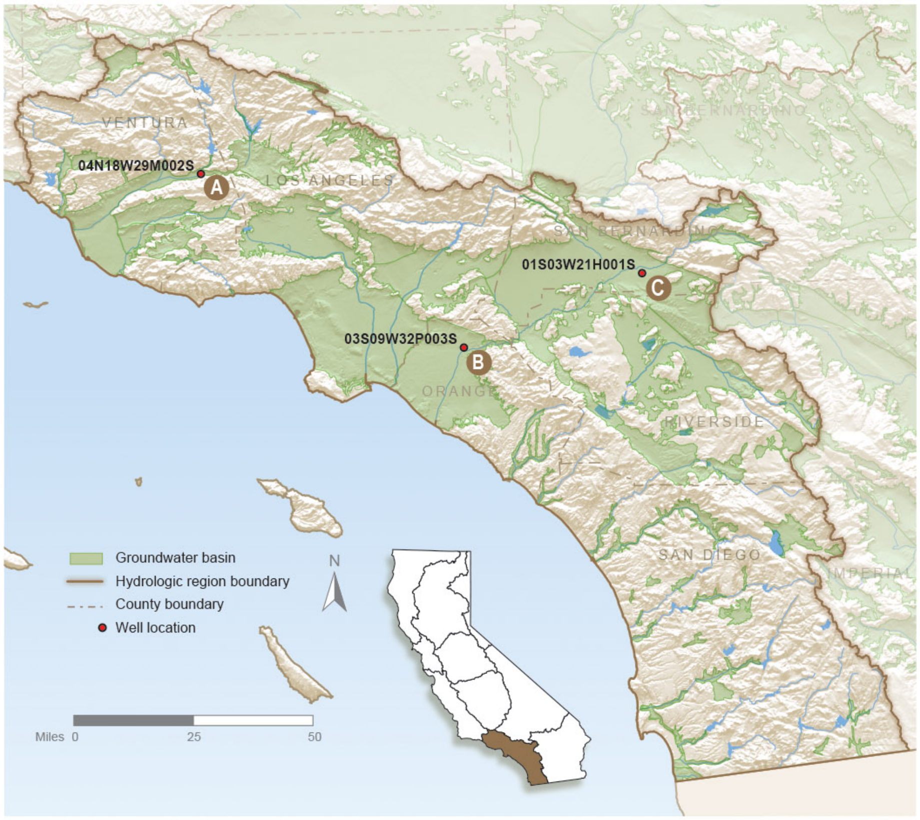
During the drought of 2007-2009, the United Water Conservation District (UWCD) released captured stormwater runoff and used SWP water from Lake Piru to facilitate recharge within the Piru Groundwater Subbasin and the down-gradient Fillmore Groundwater Subbasin. The water that did not percolate into the Piru and Fillmore groundwater subbasins flowed downstream to the Santa Paula Groundwater

Figure 6-11 Groundwater Hydrographs for the South Coast Hydrologic Region, Page 1

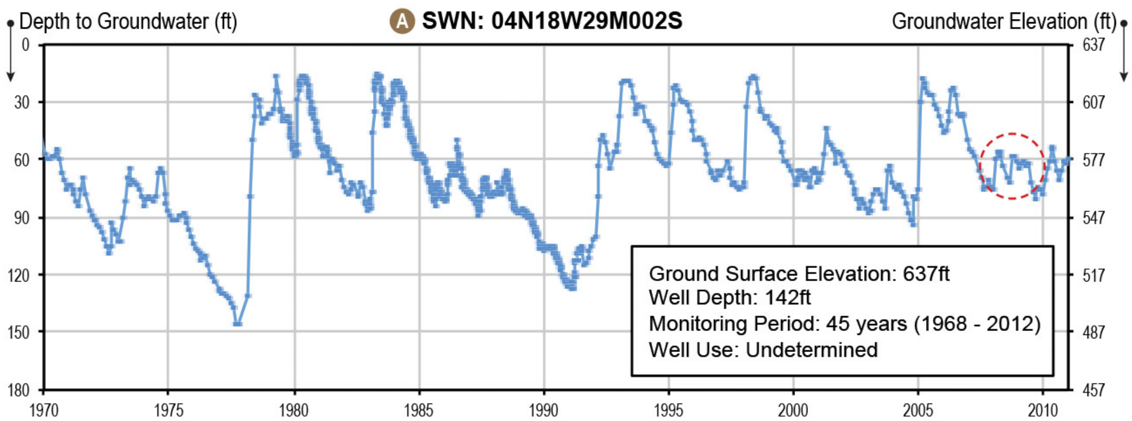
Aquifer response to changing demand and management practices

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.

Regional locator map



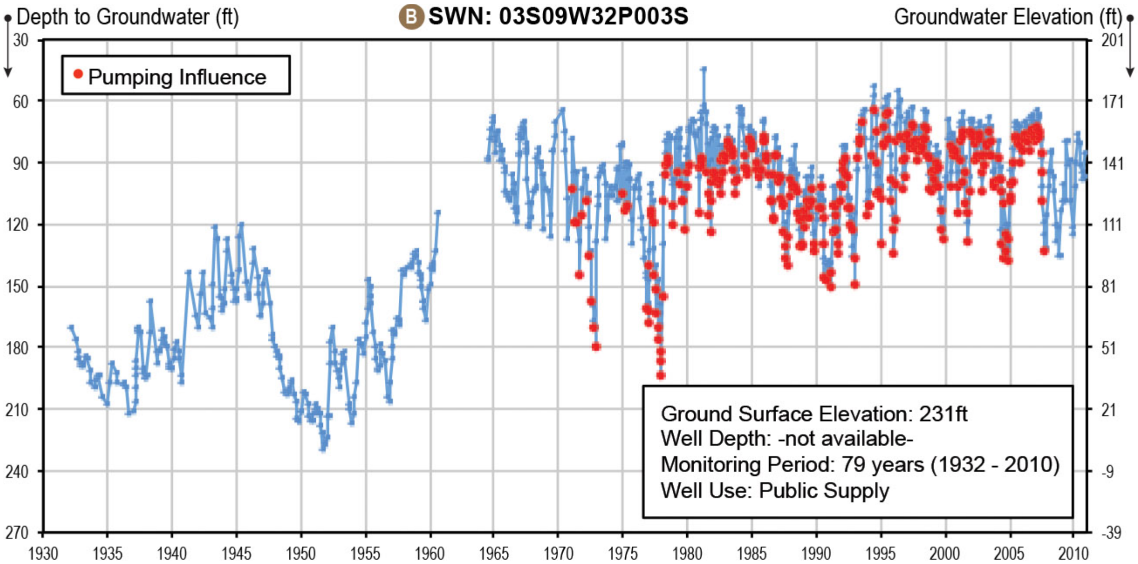
A Hydrograph 04N18W29M002S: illustrates the aquifer response to the long-term hydrologic cycles and seasonal variations associated with the local precipitation conditions. The surrounding aquifer was successfully recharged using captured stormwater runoff during the drought of 2007-09 (circled in red).



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

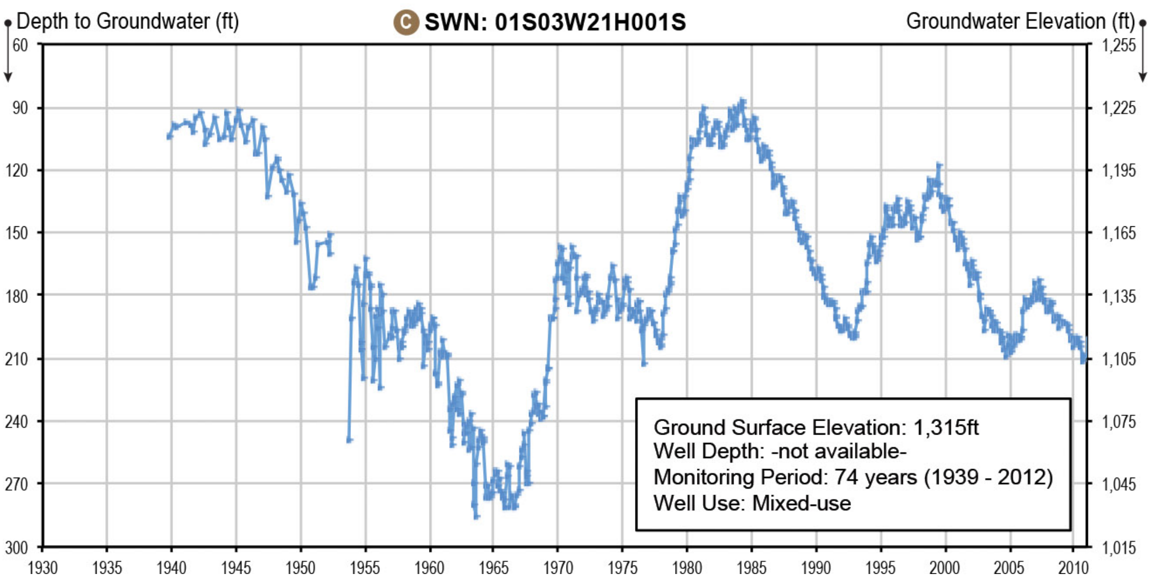
Subbasin and the Freeman Diversion Facility, which facilitated additional groundwater recharge (United Water Conservation 2008). In addition to artificial recharge, infiltration of irrigation water also replenishes the aquifer system (United Water Conservation 2011). The hydrograph shows small rises in groundwater levels caused by the 2008 release of stored surface water. The release of captured

Figure 6-11 Groundwater Hydrographs for the South Coast Hydrologic Region, Page 2



B Hydrograph 03S09W32P003S: Shows the successful recovery of groundwater levels associated with use of recycled and imported water in lieu of pumping groundwater, and conjunctive management of surface water and groundwater supplies.

C Hydrograph 01S03W21H001S: demonstrates the successful reversal of long-term decline in the groundwater levels as a result of basin adjudication in 1969 which triggered conjunctive management of surface water and groundwater supplies.



stormwater runoff and imported surface water to replenish aquifers during dry periods is a good example of conjunctive management and using multiple sources of water to maintain a sustainable groundwater resource.

Hydrograph 03S09W32P003S

Figure 6-11b is a hydrograph for Well 03S09W32P003S, which is located near Anaheim Lake in the Coastal Plain of Orange County Groundwater Basin (8-1), a CASGEM high-priority basin. This hydrograph depicts the long-term groundwater levels for a relatively stable aquifer that is managed conjunctively and is artificially recharged using recycled water and imported water. The well is a public supply well, constructed in alluvium, and is located approximately 1 mile north of the Santa Ana River. Anaheim Lake is a groundwater recharge basin that uses water from the Metropolitan Water District of Southern California (MWD), the Santa Ana River, and recycled water from the Groundwater Replenishment System (GWRS). GWRS is a project cooperatively operated by the Orange County Water District (OCWD) and the Orange County Sanitation District (Orange County Water District 2009). Groundwater-level measurements have been recorded nearly each month since 1932, except for a gap from 1961 to 1963.

The OCWD has been recharging the aquifers underlying their service area since 1949. In 1953, the OCWD began making improvements to the Santa Ana River bed and adjacent areas to increase recharge capacity. The district currently operates a network of recharge facilities that cover more than 1,000 acres (Orange County Water District 2009). The OCWD also operates seawater intrusion barriers by injecting recycled water into the ground to replenish the underlying aquifers and to prevent groundwater quality degradation caused by seawater intrusion. In addition to using groundwater and recycled water, the OCWD also imports water from the Colorado River and the SWP to meet the water demand in its service area.

Seasonal fluctuations in groundwater levels are observed in the hydrograph. The groundwater levels tend to decline during periods with little precipitation, such as during the 1976-1977, 1987-1992, and 2007-2009 droughts. During wet years, the groundwater levels tend to increase. Despite annual groundwater-level fluctuations of 40 to 80 feet, the groundwater levels have remained relatively stable for the last five decades. By using a variety of conjunctive management approaches, the OCWD has maintained relatively stable long-term groundwater levels at this well location.

Hydrograph 01S03W21H001S

Figure 6-11c is a hydrograph for Well 01S03W21H001S, which is located in Redlands in the Bunker Hill Groundwater Subbasin (8-2.06) portion of the Upper Santa Ana Valley Groundwater Basin. This hydrograph depicts the steep drawdown of groundwater levels from the 1940s to the 1960s, the rise in groundwater levels from the late 1960s to the 1980s, and the subsequent aquifer responses to weather patterns and groundwater use. The well is constructed in a mixed-use area near residential, commercial, and agricultural developments. The groundwater levels in the well were measured quarterly from 1939 to 1954 and nearly monthly from 1954 to 2010. The Bunker Hill Groundwater Subbasin is a medium-priority CASGEM groundwater basin.

The groundwater level in the well steadily declined from 1945 to 1966 and began to rise in 1967. The groundwater rights in the basin were adjudicated in 1969, and the long-term groundwater level has remained relatively stable since the adjudication. Seasonal fluctuations and weather variations can be seen in the hydrographs. Years with significant precipitation, such as 1978, 1993, 1998, and 2005, increase groundwater levels at the well location, while groundwater levels tend to decline between wet years.

The San Bernardino Valley Municipal Water District (SBVMWD) works cooperatively with local agencies to manage groundwater resources in the Bunker Hill Groundwater Subbasin. The SBVMWD imports water from the SWP and conjunctively manages water supplies in its service area. Surface water is preferentially used during periods of high precipitation so that the groundwater supply can be utilized during drought periods.

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 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 responses to changes in hydrology, land use, and groundwater management. If the change in groundwater in storage is negligible over a period represented by average hydrologic and land use conditions, the groundwater 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 manage 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.”

Changes-in-groundwater-in-storage estimates for groundwater basins in the South Coast region were not developed as part of *California Water Plan Update 2013*. Some local groundwater agencies in the South Coast region periodically develop change-in-groundwater-in-storage estimates for groundwater basins in their service area to evaluate changing trends against changing land use patterns, responses to hydrology, and sustainability. Examples of local agencies that have determined change-in-groundwater-in-storage estimates include the SBVMWD, the UWCD, the WRD, and the OCWD.

Groundwater Quality

The chemical character of groundwater in the South Coast region, as reported by the Los Angeles RWQCB, is variable and depends on the composition of the media that comes into contact with groundwater. Land use also plays a large role in the chemical character of local groundwater resources. The groundwater in the South Coast region generally has calcium and sodium cations and bicarbonate anions.

Groundwater in the Los Angeles subregion is generally calcium sulfate and calcium bicarbonate in character. The general quality of groundwater in this subregion has degraded substantially from background levels and much of the degradation reflects land use practices. In areas without sewers, nitrogen and pathogenic bacteria from overloaded or improperly sited septic tanks can come into contact with groundwater and result in health risks to those who rely on the groundwater for domestic supply. In areas with industrial or commercial activities, aboveground and underground storage tanks may contain hazardous substances. Thousands of these tanks in the region have leaked or are leaking, and have discharged petroleum fuels, solvents, or other substances into the subsurface. These leaks have the potential to pollute the groundwater, which is often difficult, costly, and slow to remediate.

The groundwater in the Santa Ana subregion and the San Diego subregion are primarily calcium and sodium bicarbonate in character. Local impairments to the groundwater include excess nitrates, sulfates, total dissolved solids (TDS), and volatile organic compounds (VOCs). Water from the Santa Ana River provides a large portion of the groundwater replenishment to the wetlands in Orange County. The wetlands improve water quality by effectively removing some of the nitrates in the surface water, while maintaining critical habitat for endangered species.

Several State and federal GAMA-related groundwater quality reports that help assess and outline the groundwater quality conditions for the South Coast region are listed below in Table 6-9.

Groundwater Quality at Community Drinking Water Wells

In 2013 the SWRCB completed a report to the Legislature, titled *Communities that Rely on a Contaminated Groundwater Source for Drinking Water* (State Water Resources Control Board 2013). The report focused on chemical contaminants found in active groundwater wells used by

CWSs. CWSs are defined under the California Health and Safety Code Section 116275 as "public water systems that serve at least 15 service connections used by yearlong residents or regularly serve at least 25 yearlong 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 raw untreated groundwater and do not necessarily reflect the final quality of groundwater delivered to these communities.

In the South Coast region, there are an estimated 420 CWSs, with an estimated 2,093 active CWS wells. Table 6-10 shows that 584 of the 2,093 CWS wells (28 percent) are identified as being affected by one or more chemical contaminants that exceed an MCL. The 584 affected wells are used by 162 CWSs in the region (Table 6-11). Multiple contaminants affect 276 wells, including 97 wells that are affected by both nitrate and perchlorate contamination. The most prevalent groundwater contaminants affecting community drinking water wells in the region include nitrate, perchlorate, PCE, TCE, gross alpha particle activity, carbon tetrachloride, and arsenic (Table 6-12).

Groundwater Quality at Domestic Wells

Private domestic wells are typically used by either single-family homeowners or other groundwater-reliant systems that 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).

Table 6-9 GAMA Groundwater Quality Reports for the South Coast Hydrologic Region

Data Summary Reports

- Santa Clara River Valley
  http://www.waterboards.ca.gov/gama/docs/dsr_santaclarariver.pdf
- Upper Los Angeles Basin (San Fernando — San Gabriel)
  http://www.waterboards.ca.gov/gama/docs/upper_labasin_dsr356.pdf
- Coastal Los Angeles Basin
  http://www.waterboards.ca.gov/gama/docs/dsr_coastallabasin.pdf
- Upper Santa Ana
  http://www.waterboards.ca.gov/gama/docs/dsr_uppersantaana.pdf
- San Diego
  http://www.waterboards.ca.gov/gama/docs/sandiego_data_summary.pdf

Assessment Reports

- Status of Groundwater Quality in the Coastal Los Angeles Basin
  http://pubs.usgs.gov/sir/2012/5048/pdf/sir20125048.pdf
- Status of Groundwater Quality in the Upper Santa Ana Watershed
  http://pubs.usgs.gov/sir/2012/5052/pdf/sir20125052.pdf
- Status of Groundwater Quality in the San Fernando — San Gabriel Study Unit
  http://pubs.usgs.gov/sir/2011/5206/pdf/sir20115206.pdf
- Status and Understanding of Groundwater Quality in the San Diego Drainages Hydrogeologic Province
  http://www.waterboards.ca.gov/gama/docs/san_diego_sir.pdf
- Status and Understanding of Groundwater Quality in the Santa Clara River Valley
  http://www.waterboards.ca.gov/gama/docs/santa_clara_river_assessment.pdf

Fact Sheets

- Groundwater Quality in the Coastal Los Angeles Basin
  http://pubs.usgs.gov/fs/2012/3096/pdf/fs20123096.pdf
- Groundwater Quality in the Upper Santa Ana Watershed
  http://pubs.usgs.gov/fs/2012/3037/pdf/fs20123037.pdf
- Groundwater Quality in the San Fernando — San Gabriel Groundwater Basins
  http://pubs.usgs.gov/fs/2011/3139/pdf/fs20113139.pdf
- Groundwater Quality in the San Diego Drainages Hydrogeologic Province, California
  http://www.waterboards.ca.gov/gama/docs/san_diego_fs.pdf
- Groundwater Quality in the Santa Clara River Valley
  http://www.waterboards.ca.gov/gama/docs/santa_clara_river_factsheet.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

Table 6-10 Community Drinking Water Wells that Exceed a Primary Maximum Contaminant Level Prior to Treatment in the South Coast Hydrologic Region

Well Information	Community Water System[a] Wells
Number of Affected Wells[b]	584
Total Wells in the Region	2,093
Percentage of Affected Wells[b]	28%

Source: State Water Resources Control Board's Report to the Legislature on 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 (California Health and Safety Code Section 116275).
[b]Affected wells exceeded a primary maximum contaminant level (MCL) 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 6-11 Community Drinking Water Systems that Rely on Contaminated Groundwater Wells in the South Coast 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	43	182	24%
Medium Systems Population 3,301-10,000	20	57	35%
Large Systems Population > 10,000	99	181	55%
Total	**162**	**420**	**39%**

Source: State Water Resources Control Board's Report to the Legislature on 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 (California 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 in the totals. These systems serve between 5 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 6-12 Contaminants Affecting Community Drinking Water Systems in the South Coast Hydrologic Region

Principal Contaminant (PC)	Number of Affected Community Water Systems[a,b] (PC exceeds the Primary MCL)	Number of Affected Wells[c,d,e,f,g,h,i,j,k] (PC exceeds the Primary MCL)
Nitrate	81	270
Perchlorate	47	166
Gross alpha particle activity	47	89
Tetrachloroethylene (PCE)	40	141
Trichloroethylene (TCE)	38	146
Arsenic	26	44
Uranium	18	35
Carbon tetrachloride	16	51
Fluoride	14	29
1,1-Dichloroethylene (1,1-DCE)	9	35
1,2-Dichloroethane (1,2-DCA)	9	23
1,2-Dibromo-3-chloropropane (DBCP)	7	29
cis-1,2-Dichloroethylene	7	10
Chromium, total	3	4
Aluminum	2	2
Total Trihalomethanes	2	2
Barium	1	2
Methyl tertiary butyl ether (MTBE)	1	2
1,1-Dichloroethane (1,1-DCA)	1	1
Cyanide	1	1
Nickel	1	1
Trichlorofluoromethane (Freon 11)	1	1
Vinyl chloride	1	1

Source: State Water Resources Control Board's Report to the Legislature on 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 (California 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]276 of the 584 affected wells have multiple contaminants including 97 wells that are affected by both nitrate and perchlorate contamination.

[e]158 wells are affected by two contaminants.

[f]59 wells are affected by three contaminants.

[g]27 wells are affected by four contaminants.

[h]20 wells are affected by five contaminants.

[i]Nine wells are affected by six contaminants.

[j]One well is affected by seven contaminants.

[k]Two wells are affected by eight contaminants.

The GAMA Domestic Well Project tests for chemicals that are most commonly a concern in domestic well water. These constituents include:

- Bacteria (total and fecal coliform).
- General minerals (sodium, bicarbonate, calcium, others).
- General chemistry parameters (pH, TDS, and others).
- Inorganics (lead, arsenic and other metals) and nutrients (nitrate, others).
- Organics (benzene, toluene, PCE, methyl tertiary butyl ether [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.

The GAMA Domestic Well Project sampled 137 private domestic wells in 2008 and 2009 in San Diego County that included 128 private domestic wells located in the South Coast region. San Diego County was selected for sampling because of the large number of private domestic wells 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. Attributable to the large population in unincorporated areas and the local climate, San Diego County withdraws an estimated 33 million gallons per day and ranks second in California in domestic well water use. This accounts for approximately 12 percent of California's total domestic well water withdrawals (State Water Resources Control Board 2010).

Groundwater quality results were compared against three public drinking-water standards established by the CDPH: primary MCLs, secondary maximum contaminant levels (SMCLs), and notification levels (NLs). These water quality standards were used for comparison purposes only, because private domestic well water quality is not regulated by the State. The groundwater quality results for the wells sampled in the South Coast region are shown in Table 6-13.

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 to 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 South Coast region, the USGS has completed data summary reports for the following study units:

- Santa Clara River Valley.
- Upper Los Angeles Groundwater Basin (San Fernando Valley and San Gabriel Valley groundwater basins).
- Coastal Plain of Los Angeles Groundwater Basin.
- Upper Santa Ana Watershed.
- San Diego Drainages.

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 (EPA). 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 6-13. In addition to these data summary reports, USGS has completed assessment reports and fact sheets for areas in the South Coast region (Table 6-9).

Groundwater Quality Protection

In the South Coast region, a number of efforts are underway to protect groundwater quality. Some of the major efforts to protect groundwater quality include the development of salt and nutrient management plans (SNMPs) and implementation of the Well Investigation Program for the San Gabriel Valley and San Fernando Valley groundwater basins.

Salt and Nutrient Management Plans

Recognizing that increased recycled water use could result in increased salt- and nutrient-loading to local groundwater basins, the SWRCB Recycled Water Policy requires every groundwater basin or subbasin in the state to have a SNMP. The intent of this requirement is to make certain that salts and nutrients from all sources are managed on a basin-wide or watershed-wide basis in a manner that ensures the attainment of water quality objectives and protection of beneficial uses.

Per the SWRCB Recycled Water Policy, SNMPs shall be tailored to address water quality concerns in each groundwater basin and may include constituents other than salt and nutrients that adversely affect groundwater basin/subbasin water quality. The policy also requires that each SNMP include:

- A groundwater basin- or subbasin-wide monitoring plan that includes an appropriate network of monitoring locations to determine whether concentrations of salt, nutrients, and other constituents of concern are consistent with applicable water quality objectives.
- A provision for annual monitoring of constituents of emerging concern.
- Water recycling and stormwater recharge/use goals and objectives.
- Salt and nutrient source identification, groundwater basin/subbasin assimilative capacity and loading estimates, together with fate and transport of salts and nutrients.
- Implementation measures to manage salt- and nutrient-loading in the groundwater basin on a sustainable basis.
- An antidegradation analysis demonstrating that the projects included in the plan will collectively satisfy the requirements of the SWRCB Antidegradation Policy (SWRCB Resolution No. 68-16).

Table 6-13 Groundwater Quality Results from GAMA Data Summary Reports for the South Coast Hydrologic Region

Constituent	Health Based Threshold	Number of Detections Greater Than Health Based Threshold					
		Santa Clara River Valley Study Unit	San Fernando-San Gabriel Study Unit	Coastal Los Angeles Basin Study Unit	Upper Santa Ana Watershed Study Unit	San Diego Drainages Study Unit	San Diego County Domestic Wells[a]
Number of Wells		53	52	69	99	58	128
Inorganic Constituents							
Arsenic	MCL	-	-	-	3	1	3
Barium	MCL	1	-	-	-	-	1
Boron	NL	2	-	2	1	-	4
Cadmium	MCL	-	-	-	-	-	2
Molybdenum	MCL	-	-	-	2	-	-
Nitrate	MCL	5	1	-	15	-	25
Strontium	HAL	4	-	-	-	-	-
Uranium	MCL	-	-	-	-	-	15
Vanadium	MCL	-	-	-	2	1	1
Organic Constituents							
VOCs	MCL	-	5	3	3	2	1
Pesticides	MCL	-	-	-	-	-	-
Constituents of Special Interest							
Perchlorate	MCL	-	-	-	11	-	-
NDMA	NL	-	1	-	-	-	-
1,2,3-TCP	NL	-	2	-	-	-	-
Radioactive Constituents							
Gross Alpha	MCL	1	-	-	1	-	18
Secondary Standards							
Chloride[b]	SMCL	5	-	1	3	2	3
Iron	SMCL	7	-	2	1	2	19
Manganese	SMCL	17	-	5	2	4	43
Sulfate[b]	SMCL	19	-	2	1	3	1
TDS[b]	SMCL	26	6	14	19	12	20

Sources: U.S. Geological Survey (2011a, 2011b, 2007a, 2007b, 2005); State Water Resources Control Board (2010)

Notes:

HAL = lifetime health advisory level (U.S. Environmental Protection Agency), MCL = maximum contaminant level (State and/or federal), NDMA = N-Nitrosodimethylamine, NL = notification level (State), SMCL = secondary maximum contaminant level (State), TCP =1,2,3-Trichloropropane, TDS = total dissolved solids, VOC = volatile organic compound

[a]The San Diego County domestic wells included 137 wells. 128 wells are in the South Coast Hydrologic Region and eight wells are in the Colorado River Hydrologic Region.

[b]Wells that exceed secondary maximum contaminant levels for chloride, sulfate, and total dissolved solids are greater than recommended levels.

Implementation plans developed for those groundwater basins exceeding, or threatening to exceed, water quality objectives for salts or nutrients are expected to be adopted by the RWQCBs as basin plan amendments.

San Gabriel Valley and San Fernando Valley Well Investigation Program

The San Gabriel Valley and San Fernando Valley groundwater basins are synclinal basins at the base of the San Gabriel Mountains. The two basins, separated by the San Raphael Hills, are largely filled with alluvial sediments eroded from the surrounding mountains and hills. Large volumes of groundwater flow through these alluvial sediments, and both basins are important sources of water for millions of people. In the early 1980s, significant contamination was detected in both basins. The primary contaminants of concern are VOCs and hexavalent chromium. Because of the extensive contamination, the EPA declared these areas as Superfund sites.

The Los Angeles RWQCB established the Well Investigation Program to locate and abate sources of pollutants affecting the public water supply wells in the San Gabriel Valley and San Fernando Valley groundwater basins. This program is implemented under the authority of California Water Code Section 13304. The Well Investigation Program:

- Identifies and address sources of pollutants in public water supply wells.
- Identifies responsible parties.
- Oversees remediation of contaminated soils and groundwater.
- Coordinates remediation activities with EPA on the San Gabriel Valley and San Fernando Valley Superfund sites.

The EPA acts as the lead agency and is responsible for long-term planning, case development, determination of responsible parties, and settlement negotiations. The Los Angeles RWQCB, in cooperation with the EPA, oversees the investigation and remediation of these areas.

In addition to meeting a large demand for potable water, the San Gabriel Valley and San Fernando Valley groundwater basins store large volumes of groundwater that can be pumped during droughts and then recharged during years of surplus surface water supplies. The discovery of significant pollution in these groundwater basins has significantly reduced groundwater production as well as the potential for conjunctive use, and in so doing increased dependence on imported supplies of water. To minimize the spread of pollution caused by groundwater pumping and recharge activities, the Los Angeles RWQCB oversees a comprehensive groundwater quantity and quality management program in the San Gabriel Valley. This management program, implemented by the Main San Gabriel Basin Watermaster and about 45 private and municipal water purveyors, has the following objectives:

- Prevent public exposure to contamination.
- Maintain adequate water supply.
- Protect natural resources.
- Control the migration of pollutants.
- Remove polluted groundwater.

Oversight of this management program is authorized by Los Angeles RWQCB Resolution No. 91-6, titled Amendment to the Water Quality Control Plan for the Los Angeles River Basin and Implementation Plan Concerning the Extraction of Groundwater Within the San Gabriel Valley Basin.

In the San Fernando Valley Groundwater Basin, the Watermaster for the Upper Los Angeles River Area cooperates with the Los Angeles RWQCB to achieve similar objectives.

Land Subsidence

In the South Coast region, researchers have investigated the occurrence of land subsidence in the Chino Groundwater Subbasin, the Coastal Plain of Orange County Groundwater Basin, the Oxnard Groundwater Subbasin, and the San Jacinto Valley Groundwater Basin. Overlying the southwestern portion of Chino Groundwater Subbasin, ground fissures resulting from regional subsidence have been identified as early as the 1970s (Chino Basin Watermaster 2007). The area of land subsidence coincides with an area that has experienced significant declines in groundwater levels — as much as 200 feet (Wildermuth 1999). The Chino Basin Watermaster published a subsidence management plan in 2007 and actively monitors aquifer-system deformation, vertical ground-surface deformation, and horizontal ground-surface deformation. Two extensometers, which record aquifer-system compression or expansion data, are installed at the Ayala Park Extensometer facility (Chino Basin Watermaster 2007). Investigations by Kleinfelder (1993, 1996) concluded that a maximum of about 2 feet of subsidence occurred in Chino from 1987 to 1995, and about 1 foot of this subsidence occurred from 1993 to 1995. Wildermuth (2011) concluded that 2.5 feet of land subsidence occurred from 1985 to 2000. Little inelastic subsidence has occurred since 2000.

Land subsidence has also been evaluated in the Coastal Plain of Orange County Groundwater Basin. A study conducted by DWR (1980b) cited survey data from the Orange County Surveyor that indicated a subsidence rate of as much as 0.84 inch per year from 1956-1961 near Santa Ana. Satellite radar images reviewed by Bawden et al. (2001) indicated a subsidence rate of about 0.5 inch per year near Santa Ana from 1993 to 1999, which coincided with a period of net groundwater withdrawal (Orange County Water District 2009). The OCWD estimates that the groundwater basin can be temporarily overdrafted by approximately 500 taf without causing irreversible seawater intrusion and land subsidence. The OCWD monitors and conjunctively manages groundwater in the basin, manages groundwater extraction, and also systematically replenishes the aquifer. The OCWD has been actively recharging groundwater since 1949 (Orange County Water District 2009). By conjunctively using surface water and groundwater resources and maintaining a long-term balance of groundwater production and recharge, the negative effects of seawater intrusion and land subsidence can be minimized.

The Oxnard Groundwater Subbasin in Ventura County has experienced land subsidence and seawater intrusion caused by groundwater pumping. As early as the 1940s, groundwater levels in the upper aquifer system declined beneath sea level, and widespread seawater intrusion commenced (Fox Canyon Groundwater Management Agency 2007). In the late 1950s, the groundwater levels in the lower aquifer system declined beneath sea level, but seawater intrusion was not detected in the lower aquifer system until the late 1980s. Groundwater levels in the lower aquifer system declined further as production increased to alleviate groundwater pumping from the upper aquifer system. The over-pumping of the aquifers led to seawater intrusion and resulted in as much as 2.6 feet of inelastic land subsidence in the adjacent Pleasant Valley Groundwater Basin (United Water Conservation District 2012). The permanent loss of aquifer storage caused by inelastic land subsidence is estimated to be about 200 taf (Fox Canyon Groundwater Management Agency 2007).

The San Jacinto Valley Groundwater Basin is located in a seismically active area within the San Jacinto fault zone in Riverside County. The groundwater basin has experienced tectonic subsidence at an average rate of 4.5 millimeters (mm) per year for the past 40,000 years (Morton 1995). In addition to tectonic subsidence, the San Jacinto area has undergone aquifer-system compaction because of long-term groundwater withdrawals. The rate of land subsidence caused by groundwater withdrawal is approximately 2.5-3 centimeters (cm) per year (Morton 1995). Although there is no active land subsidence monitoring, the local water agencies have agreed to reduce groundwater production to be within the safe yield of the area to minimize the potential for inelastic land subsidence (WRIME 2007).

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 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's role in groundwater management is to provide technical and financial assistance to support local agencies in their groundwater management efforts.

In addition to AB 3030, other legislation includes SB 1938, AB 359, and provisions of SB X7-6 and AB 1152. These significant pieces of legislation establish specific procedures on how GWMPs are to be developed and adopted by local agencies. They define the required and voluntary technical components that must be part of a GWMP and a CASGEM Groundwater Elevation Monitoring Plan. AB 359, introduced in 2011, made changes to the California Water Code that requires local agencies to provide a copy of their GWMP to DWR and require DWR to provide public access to those plans. Prior to the passage of AB 359, which went into effect on January 1, 2013, local groundwater management planning agencies were not required to submit their GWMPs to DWR. As such, the groundwater management information included in this chapter is based on documents that were readily available or submitted to DWR as of August 2012 and may not be all-inclusive, especially for those plans that were in the process of being finalized and adopted in 2012.

Groundwater management in California also occurs through other resource planning efforts. Urban water management plans (UWMPs) incorporate long-term resource planning to meet existing and future water demands. Agriculture water management plans (AWMPs) advance 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 described 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 South Coast region.

Groundwater Management Plan Inventory

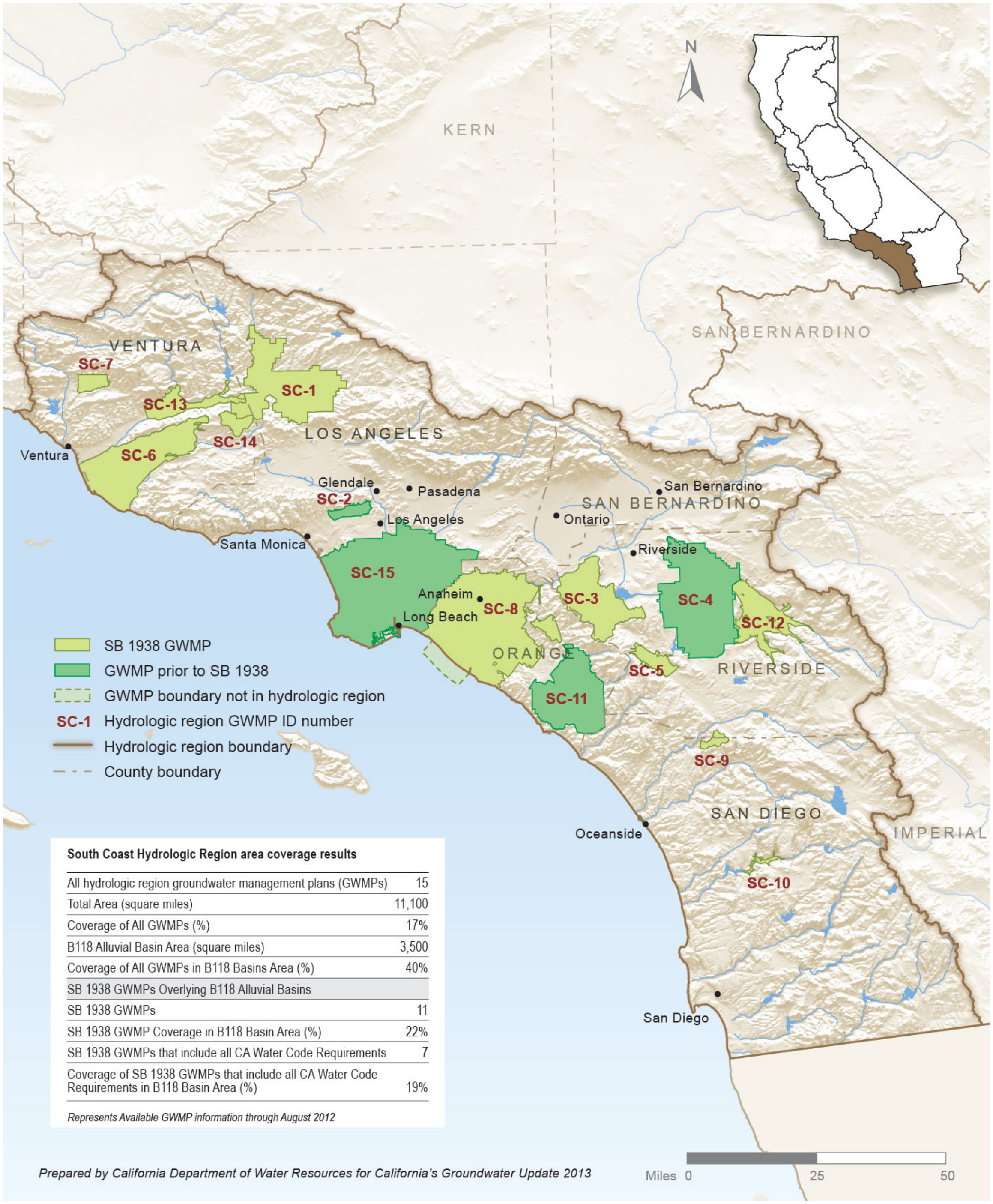
Groundwater management information included in this chapter is based on GWMP documents that were readily available or submitted to DWR as of August 2012. The inventory of GWMPs identifies adopting and signatory agencies, the date of plan adoption, the location of plans by county, and the groundwater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

The South Coast region includes 3,500 square miles of Bulletin 118–2003 alluvial groundwater basins. Figure 6-12 shows the location and distribution of the GWMPs in the South Coast region and indicates pre-SB 1938 GWMPs compared with post-SB 1938 GWMPs. Table 6-14 lists the results of the GWMP inventory for the region by adopting agency, signatories, plan date, and groundwater basin.

There are 15 GWMPs in the South Coast region. All 15 GWMPs are fully contained within the South Coast region, and all but one of the GWMPs cover areas overlying alluvial groundwater basins identified in Bulletin 118-2003. Many of the plans meet the requirements of a GWMP, but also include surface water management and are not exclusively GWMPs. The 15 GWMPs collectively cover a 1,900-square-mile area in the South Coast region. Of the 1,900 square miles, about 1,400 square miles coincide with Bulletin 118-2003 alluvial groundwater basins. The 1,400-square-mile area covered by GWMPs represents 40 percent of the alluvial groundwater basin area within the South Coast region.

Eleven GWMPs have been developed or updated to include the SB 1938 requirements and are considered active for the purposes of the *California Water Plan Update 2013* GWMP assessment. The 11 active GWMPs cover 15 of the 36 basins identified as high or medium priority under CASGEM Basin Prioritization. The high- and medium-priority basins account for about 94 percent of the population that overlie the groundwater basins and about 96 percent of groundwater use for the region. The 15 basins covered by the active GWMPs include about 22 percent of the population that overlie the basins and about 35 percent of groundwater use for the region.

Figure 6-12 **Groundwater Management Plans in the South Coast Hydrologic Region**



South Coast Hydrologic Region area coverage results

All hydrologic region groundwater management plans (GWMPs)	15
Total Area (square miles)	11,100
Coverage of All GWMPs (%)	17%
B118 Alluvial Basin Area (square miles)	3,500
Coverage of All GWMPs in B118 Basins Area (%)	40%
SB 1938 GWMPs Overlying B118 Alluvial Basins	
SB 1938 GWMPs	11
SB 1938 GWMP Coverage in B118 Basin Area (%)	22%
SB 1938 GWMPs that include all CA Water Code Requirements	7
Coverage of SB 1938 GWMPs that include all CA Water Code Requirements in B118 Basin Area (%)	19%

Represents Available GWMP information through August 2012

Table 6-14 Groundwater Management Plans in the South Coast Hydrologic Region

Map Label	Agency Name	Date	County	Basin Number	Basin Name
SC-1	**Castaic Lake Water Agency**	2003	Los Angeles	4-4.07	Santa Clara River Valley East Subbasin
-	Newhall County Water District	-	-	-	-
-	Santa Clarita Water Division	-	-	-	-
-	Valencia Water Company	-	-	-	-
SC-2	**City of Beverly Hills**	1999	Los Angeles	4-11.02	Hollywood Subbasin
-	No signatories on file	-	-	-	-
SC-3	**City of Corona**	2008	Riverside	8-2.09	Temescal Subbasin
-	No signatories on file	-	-	8-4	Elsinore Basin
SC-4	**Eastern Municipal Water District West San Jacinto Groundwater Basin**	1995	Riverside	8-5	San Jacinto Basin
-	No signatories on file	-	-	8-2.08	San Timoteo Subbasin
SC-5	**Elsinore Valley Municipal Water District**	2005	Riverside	8-4	Elsinore Basin
-	No signatories on file	-	-	-	-
SC-6	**Fox Canyon Groundwater Management Agency**	2007	Ventura	4-4.02	Oxnard Subbasin
-	United Water Conservation District	-	-	4-4.03	Mound Subbasin
-	Calleguas Municipal Water District	-	-	4-4.04	Santa Paula Subbasin
-	-	-	-	4-6	Pleasant Valley Basin
-	-	-	-	4-7	Arroyo Santa Rosa Valley Basin
-	-	-	-	4-8	Las Posas Valley Basin
SC-7	**Ojai Basin Groundwater Management Agency**	2007	Ventura	4-2	Ojai Valley Basin
-	No signatories on file	-	-	-	-
SC-8	**Orange County Water District**	2009	Orange	8-1	Coastal Plain of Orange County Basin
-	No signatories on file	-	-	-	-
SC-9	**Rainbow Municipal Water District**	2005	San Diego	9-7	San Luis Rey Valley Basin
-	No signatories on file	-	-	-	-

Map Label	Agency Name	Date	County	Basin Number	Basin Name
SC-10	**San Diego Water Department, City of San Pasqual Basin**	2007	San Diego	9-10	San Pasqual Valley Basin
-	No signatories on file	-	-	-	-
SC-11	**San Juan Basin Authority and the Metropolitan Water District of Southern California**	1994	Orange	9-1	San Juan Valley Basin
-	Trabuco Canyon Water District	-	-	9-2	San Mateo Valley Basin
-	Santa Margarita Water District	-	-	-	-
-	City of San Juan Capistrano	-	-	-	-
-	Moulton Niguel Water District	-	-	-	-
SC-12	**Stakeholders of the Hemet / San Jacinto Water Management Area**	2007	Riverside	8-5	San Jacinto Basin
-	Eastern Municipal Water District	-	-	-	-
-	Lake Hemet Municipal Water District	-	-	-	-
-	City of Hemet	-	-	-	-
-	City of San Jacinto	-	-	-	-
SC-13	**United Water Conservation District**	2011	Ventura	4-4.05	Fillmore Subbasin
-	-	-	-	4-4.06	Piru Subbasin
SC-14	**Ventura County Waterworks District No. 8 - City of Simi Valley**	2007	Ventura	-	Non-Bulletin-118 Basin
SC-15	**Water Replenishment District**	1998	Los Angeles	4-11.01	Central Subbasin
-	No signatories on file	-	-	4-11.03	West Coast Subbasin

Note:
Table reflects the plans that were compiled 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 management, and water-banking practices, and to develop 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 was not intended to be punitive in nature. It is widely understood that the application of 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 coordinate 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 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 GWMP 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 (BMOs) include:
   A. Components relating to the monitoring and management of groundwater levels within 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. A 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 that shows the area of the groundwater basin as defined in DWR Bulletin 118-2003, the area of the local agency that is subject to the plan, and the boundaries of other local agencies that overlie the basin for which the agency is developing a GWMP.

4. **Recharge Areas**. Commencing 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 adoption of the GWMP.
5. **Monitoring Protocols**. The local agency shall adopt monitoring protocols that are designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence (in groundwater basins for which subsidence has been identified as a potential problem), and flow and quality of surface water that directly affect groundwater levels or groundwater quality or are caused by groundwater pumping in the basin.
6. **GWMPs Located Outside Bulletin 118-2003 Groundwater Basins**. Plans located outside the DWR Bulletin 118-2003 alluvial groundwater basins will incorporate the above components and shall use geologic and hydrologic principles appropriate to those areas.

Three of the six components contain required 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. The requirement for local agencies located outside a Bulletin 118-2003 groundwater basin was applicable for one of the GWMPs in the South Coast region.

DWR determined that 7 of the 11 active GWMPs incorporated all of the required components evaluated. Table 6-15 identifies the percentage of the 11 active GWMPs that meet the required components and subcomponents of California Water Code Section 10753.7. The plans that did not meet all of the required components did not address the BMO subcomponents for monitoring inelastic land subsidence or the interaction of surface water and groundwater. A detailed description of the individual component assessments is provided in the following sections.

Basin Management Objectives

The BMO assessment consisted of four required subcomponents evaluated as part of the GWMP assessment. The subcomponents include the monitoring and management of (1) groundwater levels, (2) groundwater quality, (3) inelastic land subsidence, and (4) surface-water–groundwater interaction. Seven of the 11 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. The four GWMPs that did not meet the overall BMO component did have the required information for some of the BMO subcomponents. As a result, these GWMPs were found to be in partial compliance.

The BMO subcomponents that were not addressed in the partially compliant GWMPs were the planning requirements for the monitoring and management of inelastic land subsidence, surface-water–groundwater interaction, or both.

Agency Cooperation

All of the 11 active GWMPs in the South Coast region provided sufficient details on how the agency was going to coordinate and share groundwater management activities with neighboring agencies and local governments.

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 within the groundwater basin(s). The GWMP assessment determined that all 11 GWMPs met the three requirements for mapping.

Table 6-15 Assessment for GWMP Requirement Components in the South Coast Hydrologic Region

Senate Bill 1938 Required Components	Percentage of Plans that Meet Requirement
Basin Management Objectives	64%
BMO: Monitoring/Management Groundwater Levels	100%
BMO: Monitoring Groundwater Quality	100%
BMO: Inelastic Subsidence	91%
BMO: SW/GW Interaction and Affects to Groundwater Levels and Quality	64%
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	64%
MP: Changes in Groundwater Levels	100%
MP: Changes in Groundwater Quality	100%
MP: Subsidence	82%
MP: SW/GW Interaction and Affects to Groundwater Levels and Quality	82%
Met all Required Components and Subcomponents	64%

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

Monitoring Protocols

The monitoring protocol component consists of four subcomponents. In accordance with SB 1938, GWMPs are required to establish monitoring protocols for assessing groundwater levels, groundwater quality, inelastic land subsidence, and surface-water–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 7 of the 11 GWMPs (64 percent) met each of the required monitoring protocol subcomponents. The GWMPs that did not meet all of the BMO subcomponents lacked monitoring protocols for inelastic land subsidence, the interaction of surface water and groundwater, and how that interaction related to groundwater levels, 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 that create a reasonable risk of groundwater contamination.

The percentage of GWMPs in the South Coast region that included the voluntary components is shown on Table 6-16. The assessment of some voluntary components was expanded to include subcomponents, which helped determine a level of inclusion. In many cases, if the plan included one of more of the subcomponents, the plan was considered to fully meet the voluntary component.

Table 6-16 shows that 10 of the 11 GWMPs in the South Coast region included the voluntary components of wellhead protection and recharge, well abandonment and destruction policies, overdraft, groundwater monitoring, conjunctive use operations, and developing relationships with regulatory agencies. Nine of the GWMPs discussed implementing the voluntary components of groundwater contamination, groundwater extraction and replenishment, and land use. Eight of the GWMPs discussed implementing the control of saline intrusion. The least-included voluntary component was the construction and operation of projects. Many GWMP projects can take years to plan, fund, and implement. Continuing to update GWMPs with newly required component activities can be time consuming and expensive. Based on DWR’s discussions with several GWMP entities around the state, it was apparent that agencies do not regularly update their GWMP as new projects are implemented. It is likely that the construction and operation of newly developed projects have not been listed in many of the most recent GWMPs.

Six of the 11 GWMPs in the South Coast region incorporated all 12 of the voluntary components. One plan incorporated 11 voluntary components, and two plans incorporated 10 of the voluntary components. The two remaining plans incorporated eight or fewer of the voluntary components.

Table 6-16 Assessment for GWMP Voluntary Components in the South Coast Hydrologic Region

Voluntary Components	Percentage of Plans that Include Component
Saline Intrusion	73%
Wellhead Protection and Recharge	91%
Groundwater Contamination	82%
Well Abandonment and Destruction	91%
Overdraft	82%
Groundwater Extraction and Replenishment	82%
Monitoring	91%
Conjunctive Use Operations	91%
Well Construction Policies	91%
Construction and Operation	55%
Regulatory Agencies	91%
Land Use	82%

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

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. A summary of the recommended components in Bulletin 118-2003 are provided below.

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 meet the overall BMOs 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, groundwater basin conditions, and achievements.
7. **Evaluation**. Develop periodic assessments of conditions in relation to management objectives.

Table 6-17 identifies what percentage of the South Coast region GWMPs include the seven recommended components outlined in Bulletin 118-2003. Results from the GWMP assessment show that all of the GWMPs discuss the plans' management areas and the implementation and evaluation of the GWMP. More than 90 percent of the GWMPs discuss current or future IRWM planning and participation; they also discuss plans to create an advisory committee to guide the planning and implementation of the GWMP. More than 90 percent of the GWMPs stated how each of the adopted management objectives helps to attain the plans' goals and describes 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, 4 of the 11 GWMPs in the South Coast region incorporated all seven components recommended in Bulletin 118-2003, while six GWMPs incorporated six of the recommended components.

Table 6-17 Assessment of DWR Bulletin 118-2003–Recommended Components in the South Coast Hydrologic Region

Recommended Components	Percentage of Plans that Include Component
GWMP Guidance	91%
Management Area	100%
BMOs, Goals, and Actions	91%
Monitoring Plan Description	45%
IRWM Planning	91%
GWMP Implementation	100%
GWMP Evaluation	100%

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.

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. Eleven agencies from the South Coast region participated in the survey. Table 6-18 is a summary of the responses of the 11 agencies.

Ten of the responding agencies identified outreach and education, the collection and sharing of data, and sharing ideas and information, as key factors for a successful GWMP implementation. Other important factors identified include broad stakeholder participation, developing an understanding of common interests, adequate funding, adequate surface water supplies, adequate time, developing and using a water budget; and having adequate surface water storage and conveyance. Two agencies supplied additional key factors that were important for implementing their plan. These factors include agency collaboration, aquifer recharge, regulated pumping, and water conservation.

Table 6-18 Survey Results for Key Components Contributing to Successful GWMP Implementation in the South Coast Hydrologic Region

Key Components that Contributed to GWMP Success	Respondents
Sharing of Ideas and Information with Other Water Resource Managers	10
Data Collection and Sharing	10
Adequate Surface Water Supplies	8
Adequate Regional and Local Surface Storage and Conveyance Systems	7
Outreach and Education	10
Developing an Understanding of Common Interest	9
Broad Stakeholder Participation	9
Water Budget	8
Funding	9
Time	8
Additional Components Supplied by Participating Agencies	
Water Conservation	1
Regulated Pumping	1
Recharge	1
Agency Collaboration on Reporting	1

Notes:
GWMP = groundwater management plan
Results from an on-line survey sponsored by DWR and conducted by the Association of California Water Agencies — 2011 and 2012.

DWR/ACWA Survey — Key Factors Limiting GWMP Success

Survey participants were also asked to identify key factors that impeded implementation of their GWMP. Table 6-19 shows the survey results. Respondents pointed to a lack of adequate funding as the greatest impediment to GWMP implementation. Funding is a challenging factor for many agencies because the implementation and the operation of groundwater management projects typically are expensive, and the sources of funding for projects typically are limited to either locally raised monies or grants from State and federal agencies. Other factors that were identified as impeding successful GWMP implementation were unregulated groundwater pumping, lack of broad stakeholder participation, lack of surface storage and conveyance, and lack of groundwater. Additional research is needed to better understand the full extent to which these limitations affect successful 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. Nine respondents felt long-term sustainability of their groundwater supply was possible, while three respondents felt long-term sustainability could be an issue. Two separate individuals from the same management agency replied differently; one respondent believed long-term sustainability was possible, while the other respondent did not.

Table 6-19 Survey Results for Factors that Limited the Successful GWMP Implementation in the South Coast Hydrologic Region

Limiting Factors	Respondents
Participation Across a Broad Distribution of Interests	1
Data Collection and Sharing	1
Funding for Groundwater Management Planning	5
Funding for Groundwater Management Projects	7
Funding to Assist in Stakeholder Participation	4
Understanding of the Local Issues	2
Outreach and Education	1
Groundwater Supply	5
Surface Storage and Conveyance Capacity	4
Access to Planning Tools	-
Unregulated Pumping	2
Lack of Governance	-

Notes:
GWMP = groundwater management plan
Results from an on-line survey sponsored by DWR and conducted by the Association of California Water Agencies — 2011 and 2012.

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 authority 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 South Coast region; however, none of the ordinances provide for comprehensive groundwater management. The most common ordinances are associated with groundwater wells. These ordinances regulate well construction, abandonment, and destruction. Table 6-20 lists the ordinances adopted in the South Coast region.

Special Act Districts

Greater authority to manage groundwater has been granted to a few local agencies or districts created through a special act of the Legislature. 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.

Table 6-20 County Groundwater Ordinances for the South Coast Hydrologic Region

County	Groundwater Management	Recharge	Well Abandonment and Destruction	Well Construction Policies
Los Angeles	-	Yes	-	-
Orange	-	-	-	Yes
Riverside	-	-	Yes	Yes
San Bernardino	Yes[a]	-	Yes	Yes
San Diego	Yes[b]	-	-	-
Ventura	-	-	Yes	Yes

Notes:
[a]One or more ordinances exist that provide protection against exceeding the safe yield of a groundwater basin and impacts associated with exceeding the safe yield.
[b]General policies exist to reduce or prevent overdraft.
Table represents information as of August 2012.

There are many Special Act Districts established by the California State Legislature consisting of different authorities that may or may not have groundwater management authority. It was not part of the scope of the *California Water Plan Update 2013* to identify individual types of Special Act Districts or provide a listing of all the established agencies. This report includes the GWMPs that were prepared by these agencies and submitted to DWR, as discussed in the preceding 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 24 groundwater rights adjudications in California. The South Coast region contains 15 groundwater rights adjudications. Table 6-21 provides a list of the adjudications. Figure 6-13 shows the location of the groundwater rights adjudications in the South Coast 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 an 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.

IRWM planning include developing water management strategies that relate to water supply, water quality, water use efficiency, operational flexibility, land and natural resources stewardship, and groundwater resources. Statewide, the majority of IRWM plans address groundwater management in the form of goals, objectives, and strategies. These IRWM plans defer implementation of groundwater management and planning to local agencies through local GWMPs. Few IRWM plans actively manage groundwater. Efforts by IRWM RWMGs may include creating groundwater contour maps for basin operations criteria, monitoring groundwater elevations, and monitoring groundwater quality.

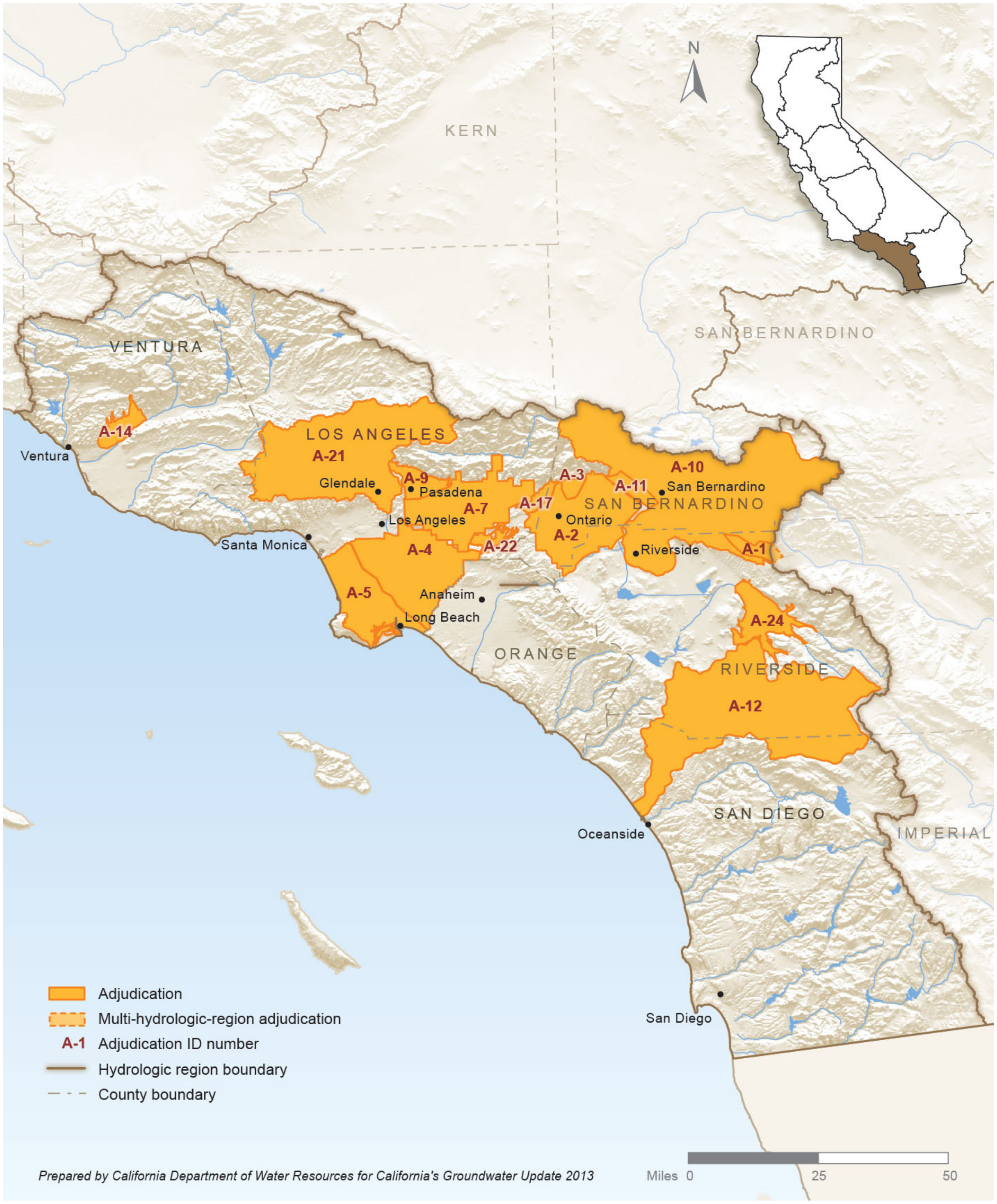
Table 6-21 Groundwater Rights Adjudications in the South Coast Hydrologic Region

ID	Court Judgment	Basin Number	Basin Name	County	Judgment Date
A-1	Beaumont Basin	7-21.04, 8-2.08	San Gorgonio Pass Subbasin	Riverside	2004
A-2	Chino Basin	8-2.01	Chino Basin	Riverside San Bernardino	1978
A-3	Cucamonga Basin	8-2.02	Cucamonga Basin	San Bernardino	1978
A-4	Central Basin	4-11.04	Central Subbasin	Los Angeles	1965
A-5	West Coast Basin	4-11.03	West Coast Subbasin	Los Angeles	1961
A-7	Main San Gabriel Basin	4-13	San Gabriel Valley Basin	Los Angeles	1973
A-9	Raymond Basin	4-23	Raymond Basin	Los Angeles	1944
A-10	Western San Bernardino	8-2.06, 8-2.04, 8-2.03, 8-2.05	Bunker Hill Subbasin Rialto-Colton Subbasin Riverside-Arlington Subbasin	Riverside San Bernardino	1969
A-11	Rialto-Colton	8-2.04	Rialto-Colton Subbasin	San Bernardino	1961
A-12	Santa Margarita River Watershed	8-4, 8-5, 9-4, 9-5, 9-6	Coahuila Valley Basin Elsinore Basin San Jacinto Basin Santa Margarita Valley Basin	Riverside San Diego	1966
A-14	Santa Paula Basin	4-4.04	Santa Paula Basin	Ventura	1996
A-17	Six Basins	4-13	San Gabriel Valley Basin	Los Angeles, San Bernardino	1998
A-21	Upper Los Angeles River Area	4-12	San Fernando Valley Basin	Los Angeles	1979
A-22	Puente Basin	4-13	San Gabriel Valley	Los Angeles	1985
A-23	San Jacinto	8-5	San Jacinto Basin	Riverside	1954

Note: Table represents information as of April 2013.

There are eight IRWM regions covering a portion of the South Coast region. All eight IRWM regions have adopted IRWM plans. The Watershed Coalition of Ventura County IRWM Plan (Ventura IRWM Plan) is the only plan crossing into an adjacent hydrologic region. The Ventura IRWM Plan covers portions of the Central Coast and South Coast hydrologic regions. Groundwater management in the Ventura IRWM Plan is conducted by local entities that use a variety of mechanisms to manage groundwater. The various management types include special act groundwater management agencies, an

Figure 6-13 Groundwater Rights Adjudications in the South Coast Hydrologic Region



AB 3030 GWMP, court adjudication, memorandums of understanding (MOUs), county ordinances, groundwater cleanup authority, total maximum daily load approaches, and enforcement actions.

The Upper Santa Clara River IRWM Plan relies on a MOU that was executed by local entities to cooperatively manage local groundwater supplies. As a result of the MOU, the cooperating agencies have integrated their database management efforts, developed and utilized a numerical groundwater flow model for analysis of groundwater basin yield and containing groundwater contamination, and continued to monitor and report on the status of basin conditions as well as geologic and hydrologic aspects of the overall stream-aquifer system.

Most of the groundwater basins are adjudicated within the Greater Los Angeles County IRWM planning area and follow the groundwater management guidelines established by their respective adjudications. This IRWM region relies on projects, such as artificial recharge, to maintain groundwater levels and production volumes. Groundwater management is identified as one of this IRWM region's strategies, while actual groundwater management has been deferred to local entities.

The Santa Ana Watershed Project Authority IRWM planning region contains some of the most sophisticated multi-agency groundwater management planning and saline management strategies in the U.S. A regional GWMP was developed by the IRWM group. Although the IRWM group is not directly responsible for managing groundwater basins in its watershed, the IRWM group coordinates the numerous groundwater management and local planning efforts in the watershed. There are adjudicated basins in the upper watershed of this IRWM region that, although not legally bound to be part of this regional planning effort, are a part of the overall planning effort because the IRWM group supports the idea of local agencies working cooperatively to manage groundwater resources. Groundwater management zones have been designated for this IRWM planning area to monitor water quality issues, such as high TDS and nitrates. Another key objective in this area is to balance groundwater pumping with increased recharge capabilities to fully utilize the storage capability of the groundwater basins.

The Upper Santa Margarita Watershed IRWM planning group does not identify groundwater management as an objective. Instead, the planning group leaves groundwater management to local entities. Groundwater management is accomplished by carrying out projects that enhance groundwater levels, such as artificial recharge to protect groundwater resources and water supply reliability, or by improving management of the basin through conjunctive use projects.

The San Diego IRWM planning group also defers groundwater management to local entities that have established GWMPs and implement groundwater management through projects in their areas. These water agencies have prepared plans for most of the IRWM region's groundwater basins, including plans for conjunctive management of groundwater basins. Much of the groundwater management infrastructure proposed in these plans awaits implementation. This IRWM region lists groundwater management strategies important to water supply diversity, such as:

- Promoting use of groundwater basins for seasonal or carryover storage and emergency storage.
- Implementing land use and developing methods that reduce the impacts of impermeable pavement on groundwater recharge and promote the use of permeable surfaces.
- Protecting and conserving open space that affects recharge areas or recharge water quality.
- Enabling opportunities for conjunctive use.
- Remediating contaminated groundwater supplies and installing seawater intrusion barriers.

The South Orange County IRWM planning group also defers groundwater management to local entities. The objective of this group is to balance groundwater pumping with increased recharge capabilities that effectively use the storage capacity of the groundwater basin. Because of potential seawater intrusion, economic concerns, and the need to protect groundwater from contamination, the groundwater basin storage capacity cannot be entirely used.

Table 6-22 lists the status of the IRWM planning areas by hydrologic region. Figure 6-14 shows the areas of the South Coast region covered by IRWM plans as of August 2012. More information about IRWM planning can be found at http://www.water.ca.gov/irwm/index.cfm.

Table 6-22 Status of Integrated Regional Water Management Plans in the South Coast Hydrologic Region

Hydrologic Region	IRWM Plan Name	Date	IRWM Plan Status	IRWM Map Number
South Coast	Gateway Region	2013	Active	9
South Coast	Greater Los Angeles County	2006	Active	10
South Coast	San Diego	2007	Active	26
South Coast	Santa Ana Watershed Project Authority	2010	Active	29
South Coast	South Orange County Watershed Management Area	2006	Active	32
South Coast	Upper Santa Clara River	2008	Active	41
South Coast	Upper Santa Margarita Watershed Planning Region	2007	Active	42
South Coast Central Coast	Watersheds Coalition of Ventura County	2006	Active	43
			Total IRWM Planning Regions:	8
			Active IRWM Plans:	8
			IRWM Plans In Development:	0
			IRWM Plans that Cross Hydrologic Boundaries:	1

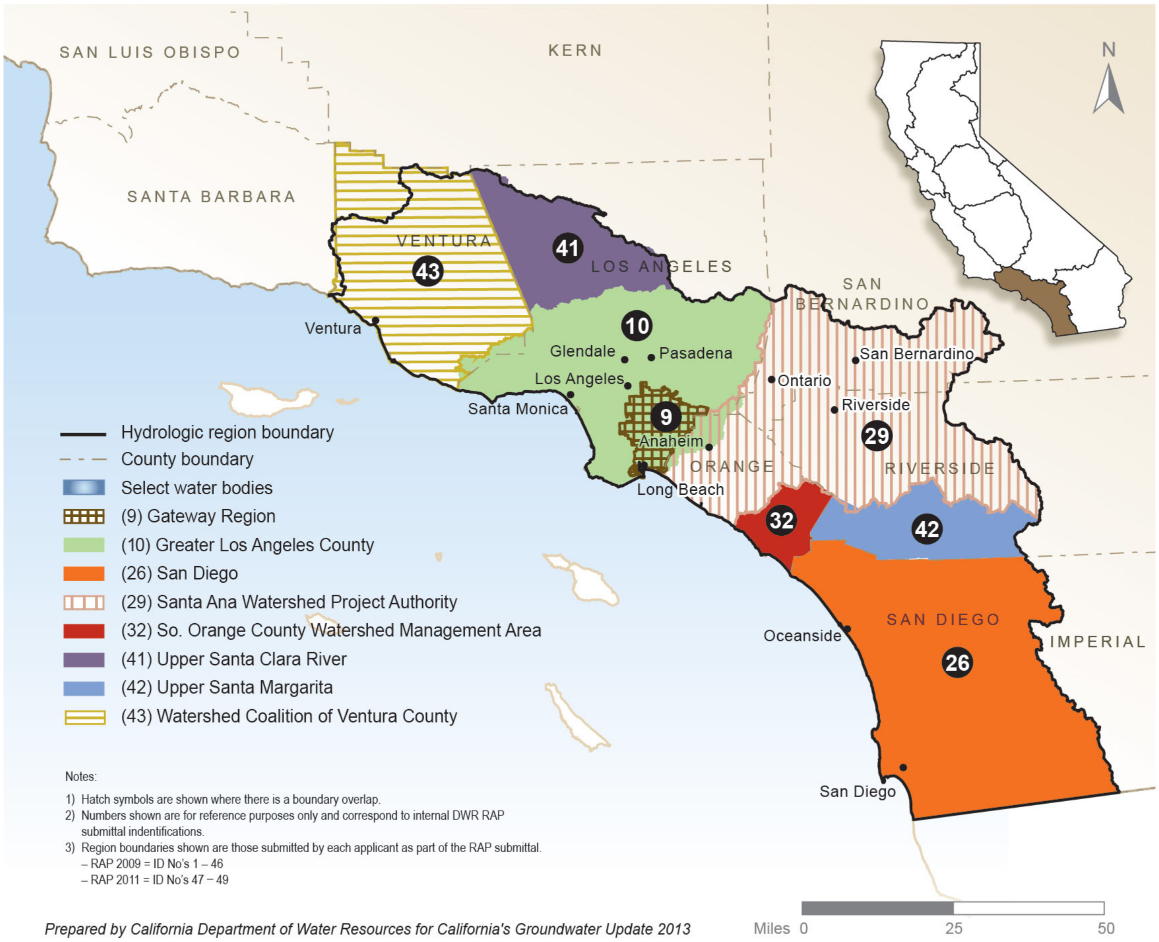
Notes:
IRWM = integrated regional water management
Table represents information as of August 2012.

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 urban water suppliers to:

- Develop a single standardized water-use reporting form for urban water suppliers.
- Develop method(s) by July 1, 2011, to 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.

Figure 6-14 Integrated Regional Water Management Plans in the South Coast Hydrologic Region



Urban use of groundwater is one of the few uses that meter and report annual groundwater extraction volumes. The groundwater extraction data are 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/.

Agricultural Water Management Plans

AWMPs are developed by water and irrigation districts to advance the efficiency of farm water management while providing benefits to 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 land use, using recycled water that otherwise would not be used beneficially, improving 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 to measure the volume of water delivered and for 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.

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 management of surface water, groundwater, and recycled water has been utilized in the South Coast region for decades. To meet water demand throughout the region, groundwater use is supplemented by surface water from the Colorado River and the SWP. One of the uses of both surface water and recycled water is to replenish aquifers. Many local agencies have developed groundwater recharge facilities to replenish aquifers, and some agencies have erected systems of physical 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 historical operational information. This information was updated and enhanced with data 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 the 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 local agencies identified as having a conjunctive water management program. DWR's follow-up request for information included 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, grouped by hydrologic region, with information specific to the 11 questions noted in this section, is provided in Appendix D.

Conjunctive Management Inventory Results

Of the 89 agencies or programs identified as operating a conjunctive management or groundwater recharge program in California, 32 programs are located in the South Coast region. The recharge programs in the South Coast region consist of direct groundwater percolation, in-lieu recharge, direct injection, and aquifer storage and recovery projects. The effort to fully characterize the 89 conjunctive management programs, as part of *California Water Plan Update 2013*, was largely unsuccessful because numerous agencies were reluctant to make details about their groundwater recharge operations publically available. The details provided by agencies in the South Coast region were much more comprehensive and complete than most other regions. A summary of selected conjunctive management programs in the South Coast region is presented below.

MWD has agreements with about half of its 26 member agencies to operate conjunctive management programs. According to the MWD, the locations of the conjunctive management programs include groundwater basins in the South Coast and Tulare Lake hydrologic regions. In the South Coast region, the conjunctive use project operators include about 30 public and private entities that use a variety of methods to conjunctively use surface water and groundwater supplies. The MWD does not directly store or extract water, but has contractual rights to request groundwater recharge and extraction. The conjunctive use methods used by the MWD-member agencies vary from in-lieu recharge, direct percolation, aquifer storage and recovery, and direct injection. Many of the project operators use a combination of these methods. The conjunctive use programs were developed between 2002 and 2006, and each program has a

25-year term. The goals and objectives of MWD and its member agencies include conjunctively using water resources to improve water supply reliability and sustainability, correcting overdraft where applicable, and meeting climate change challenges.

The annual recharge and extraction by these MWD-member agencies vary and are dependent on other factors, such as surface water availability and overall water demand. According to the MWD, the estimated annual recharge in the South Coast region is about 51 taf, and the estimated annual groundwater extraction is about 70 taf. These volumes correspond with the MWD agreement with its member agencies. In addition to the MWD agreements, some MWD-member agencies independently operate conjunctive use projects and recharge additional water to the groundwater basins they manage. The source of the water used for recharge is from the SWP and the Colorado River Aqueduct. The operating cost of the MWD-member agency conjunctive use programs range between $55 and $147 per acre-foot. The constraints of the conjunctive use programs were identified by the MWD and include political and institutional constraints, affected water quality, limited aquifer storage, and complex geology.

The WRD operates conjunctive use programs in the West Coast Groundwater Basin and the Central Groundwater Basin in the South Coast region. The WRD conjunctive use programs recharge the aquifers underlying its service area using direct percolation, in-lieu recharge, and direct injection. The WRD works cooperatively with the Los Angeles County Flood Control District, which physically applies the water resources acquired by the WRD. According to the DWR/ACWA survey, the WRD annually recharges about 255 taf of water and withdraws about 245 taf of groundwater. The water sources used by the WRD include the SWP, the Colorado River Aqueduct, recycled water, and local surface water. The objectives of the WRD conjunctive use programs are correcting overdraft, preventing seawater and salinity intrusion, and protecting groundwater quality. The major constraints of the WRD conjunctive use programs include political, institutional, legal, and infrastructural constraints. The WRD Web site, http://www.wrd.org/index.php, has additional information regarding its conjunctive use programs.

The OCWD conjunctive management programs use water from the SWP and recycled water to replenish the aquifers underlying its service area. The conjunctive management programs use direct percolation and in-lieu recharge to replenish about 16.5 taf of groundwater annually. In addition, the OCWD collaborates with the Orange County Sanitation District to operate the GWRS, the world's largest advanced water purification system for potable reuse. The GWRS became operational in 2008 and purifies treated wastewater, producing high-quality water that exceeds State and federal drinking water standards. The purified water is injected into a seawater intrusion barrier and is pumped to recharge basins, which allows water to percolate into the groundwater basin and replenish the aquifer system. The GWRS Web site, http://www.gwrsystem.com/home.html, has additional information regarding its conjunctive use programs.

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