III.6 GROUNDWATER, WATER SUPPLY, AND WATER QUALITY

The Regulatory Setting summarizes the federal, state, and local laws and regulations applicable to the use and management of water resources in the Desert Renewable Energy Conservation Plan (DRECP or Plan) Plan Area. A description of groundwater, water supply, and hydrologic conditions and processes, as they relate to the Plan, follows the Regulatory Setting.

III.6.1 Regulatory Setting

III.6.1.1 Federal

III.6.1.1.1 Clean Water Act

The Clean Water Act (CWA33 United States Code [U.S.C.] 1251 et seq.) requires states to set standards to protect water quality, including regulation of stormwater and wastewater discharges during facility construction and operation (Section 402). The CWA also establishes regulations and standards to protect wetlands and navigable waters (Section 404). The U.S. Army Corps of Engineers issues Section 404 permits for discharges of dredge or fill material. These permits cover discharges to U.S. waters, and are subject to Section 401 water quality federal license and permit certification. Section 401 certification is required if U.S. surface waters, including perennial and ephemeral drainages, streams, washes, ponds, pools, and wetlands, could be adversely impacted. The U.S. Army Corps of Engineers and a Regional Water Quality Control Board (RWQCB) can require that impacts to these waters be quantified and mitigated. Whenever a discharge is made to U.S. waters the RWQCB issues a National Pollution Discharge Elimination System (NPDES) and Waste Discharge Requirement (WDR) permit. If a discharge is only to state waters, such as to groundwater, only a WDR permit is required.

III.6.1.1.2 Resource Conservation Recovery Act

The Resource Conservation and Recovery Act (RCRA) (42 U.S.C. 6901 et seq.; 40 Code of Federal Regulation [CFR] Part 260 et seq.) grants the Environmental Protection Agency (EPA) the authority to control the generation, transportation, treatment, storage, and disposal of hazardous waste. RCRA also provides the framework for managing nonhazardous solid wastes. RCRA is administered jointly in California by the Department of Toxic Substances Control and RWQCBs.

III.6.1.1.3 Reclamation Reform Act

Under the Reclamation Reform Act of 1982 (Public Law 97–2933; 96 Stat. 1261), the U.S. Bureau of Reclamation (USBR) manages, develops, and protects U.S. waters and related resources.

III.6.1.1.4 Safe Drinking Water Act

The Safe Drinking Water Act (42 U.S.C. 300[f] et seq.) establishes requirements and provisions for the Underground Injection Control Program. One way this law safeguards the public health is by protecting underground drinking water sources from injection well contamination. General provisions for the Underground Injection Control Program (including state primacy for the program) are described in sections 1421–1426. The California Division of Oil, Gas, and Geothermal Resources has the authority to issue federal Class V Underground Injection Control permits for geothermal fluid injections.

III.6.1.1.5 Environmental Protection Agency Sole Source Aquifer Protection Program

The EPA Sole Source Aquifer Protection Program, established in Section 14245(e) of the Safe Drinking Water Act, requires that EPA review proposed federally assisted projects to determine their potential for aquifer contamination.

III.6.1.1.6 Colorado River Water Accounting Surface

Colorado River diversions are governed by the Colorado River Compact, signed in 1922, and by associated documents subsequently affirmed by the United States Supreme Court in Arizona v. California (547 U.S. 150 2006) (Consolidated Decree). For decades, California consumed the river's yield surplus from other western states that underspent their own allotments. Water demand grew outside California, and in 2001 the U.S. Department of the Interior (DOI) issued updated rules that restrict California to its yield allocation of 4.4 million acre-feet/year. The four most senior California diverters are Palo Verde Irrigation District, Yuma Project, Imperial Irrigation District, and Coachella Valley Water District. These districts are collectively entitled to 3.85 million acre-feet/year of California's 4.4 million acre-feet/year total yield (87.5 percent).

The USBR monitors and accounts for all water use in areas with diversions from the Lower Colorado River. In the 1990s, the U.S. Geological Survey, in cooperation with the USBR, developed an accounting surface method to further account for Colorado River water withdrawn by groundwater pumping wells. This accounting surface includes all areas where groundwater pumping "will yield water that will be replaced by water from the river" (Wilson and Owen-Joyce 1994, Owen-Joyce et al. 2000, Wiele et al. 2008). The accounting surface therefore now identifies geographic areas containing water-bearing sediment deposits that are hydraulically connected to the Colorado River, as well as the extrapolated depth of "river water" within those areas. In 2008, the USGS mapped the accounting surface using a physically-based groundwater flow model (Wiele et al. 2008). While the USBR has not yet published a proposed rule incorporating the accounting surface, it is considered to be the best available science on this issue. Significantly, even though water above the accounting surface is not considered river water, it is still considered tributary to the river.

III.6.1.1.7 Wild and Scenic Rivers Act

The 1968 National Wild and Scenic River Act (Public Law 90–542; 16 U.S.C. 1271 et seq.) protects the environmental values of free-flowing streams from degrading activities, including those from water resources projects. It establishes this policy for certain U.S. rivers that, together with their immediate environments, possess outstanding scenic, recreational, geologic, fish and wildlife, historic, cultural, or other similar values. These rivers are to be preserved in their free-flowing conditions for the benefit and enjoyment of present and future generations (16 U.S.C 1271).

The National Wild and Scenic River System is administered jointly by the U.S. Forest Service (USFS), the U.S. Department of Agriculture (USDA), the National Parks Service (NPS), and DOI. All development plans affecting water use and related land resources must consider potential impacts to national wild, scenic, and recreational river areas. River basin and project plan reports submitted to Congress shall also consider these potential impacts (16 U.S.C. 1276[d]).

III.6.1.1.8 Bureau of Land Management (BLM) Bishop Field Office Resource Management Plan

The BLM administers a large portion of the public lands in the Plan Area (44% of the total). BLM lands are managed according to the California Desert Conservation Area (CDCA) Plan, originally adopted in 1980. Localized BLM Resource Management Plans (RMPs) further define regulations and policies for CDCA land use. Examples related to groundwater include the following standard operating procedures and policies in the Bishop Field Office RMP:

- Existing water quality and beneficial uses shall be inventoried prior to authorizing any project with potential to impact water quality. Best management practices and appropriate mitigation will be identified during project level environmental review and applied during project implementation to ensure compliance with the federal anti-degradation policy.
- Activities involving discharge of dredged or fill materials into Waters of the U.S. or their adjacent wetlands will be reviewed for compliance with Section 404 of the CWA.
- Groundwater pumping is prohibited where it interferes with valid existing water uses, desired plant community goals, or other resource condition objectives.

III.6.1.2 State

III.6.1.2.1 California Constitution, Article X, Section 2

California Constitution, Article X, Section 2 states that water resources of the state be put to beneficial use to the fullest extent possible and prohibits water waste, unreasonable use, or unreasonable methods of use.

III.6.1.2.2 Porter–Cologne Water Quality Control Act

California's Porter–Cologne Water Quality Control Act, enacted in 1969 (Cal. Stats. 1969, Ch. 482), provides the legal basis for water quality regulation in California. It predates the CWA and regulates discharges to state waters. This law requires a Report of Waste Discharge for any discharge of waste (liquid, solid, or gaseous) to land or surface waters that may impair beneficial uses for surface and/or groundwater of the state. Waters of the state are more than just waters of the United States and include, for example, groundwater and some surface waters not meeting the definition of waters of the United States. In addition, it prohibits waste discharges or the creation of water-related "nuisances," which are more broadly defined than the CWA definition of "pollutant." Discharges under the Porter–Cologne Act are permitted by waste discharge requirements and may be required even when the discharge is already permitted or exempt under the CWA.

III.6.1.2.3 California Water Code

The California Water Code stipulates that the primary interest of the people of the State of California is the conservation of all available water resources, and requires that the maximum re-use of reclaimed water offset potable resource use (sections 451 and 13550 et seq.). The code divides California water rights into three categories: surface water, percolating groundwater, and subterranean streams that flow through known and definite channels (Section 1200). The code defines waters of the state (Section 13050) and requires regional basin plans. These plans define water quality objectives that protect the beneficial uses of surface water and groundwater and provide comprehensive water quality planning (sections 13240, 13241, 13242, and 13243). The code further includes many other provisions that (1) define reasonable and beneficial water uses; (2) set standards for well drilling; (3) require that water supplies for large new developments be demonstrated in advance; (4) require Storm Water Pollution Prevention plans; and (5) address other aspects of water resources, water rights, and water management.

III.6.1.2.4 State Water Resources Control Board and Regional Water Quality Control Boards

The State Water Resources Control Board (SWRCB) and Regional Water Quality Control Boards (RWQCB) are the principal state agencies responsible for water quality coordination and control. They jointly establish water quality standards including water quality objectives, beneficial uses, and an anti-degradation policy. They also regulate waste discharges to ensure compliance with water quality standards. These water quality standards are described in detail in their applicable RWQCB basin plans. States designate beneficial uses for all water body segments, then set criteria to protect those uses. Water quality standards developed for particular water segments are therefore based on designated uses, and vary depending on those uses. In addition, each state identifies waters that fail to meet standards for specific pollutants. These waters are then state-listed in accordance with CWA Section 303(d). If a state determines that those waters are indeed impaired, the CWA requires establishment of total maximum daily loads. Total maximum daily loads specify allowable pollutant loads from all sources (point, non-point, and natural) for a given watershed.

SWRCB Resolution No. 68-16 (Anti-degradation Policy) mandates that the state's high-quality waters be maintained until it can be demonstrated that any change in quality (1) will be consistent with maximum benefit to the people of the state, (2) will not unreasonably affect present and anticipated beneficial uses, and (3) will not result in water quality that violates adopted policies. Any activity that produces or may produce waste, increases the volume or concentration of waste, or discharges or proposes to discharge to existing high-quality waters must meet waste discharge requirements (WDRs). WDRs are intended to promote the best practicable treatment or control of the discharge to ensure that pollution or a nuisance will not occur, and to maintain the highest water quality with maximum benefit to the people of California.

SWRCB No. 88-63 (Sources of Drinking Water Policy) requires that all groundwater and surface water of the state be suitable for municipal or domestic water supply, with the exception of waters that state or regional boards certify under specific conditions.

III.6.1.3 Local

III.6.1.3.1 County General Plans

The Plan Area encompasses parts of seven counties: Imperial, Inyo, Kern, Los Angeles, Riverside, San Bernardino, and San Diego counties. Counties have primary authority over land use in privately held unincorporated areas, which could include most sites suitable for large solar projects. The primary authority over federally owned lands lies with the federal agency charged with managing the land. General plans contain goals, objectives, and policies related to many aspects of water resources and commonly include preserving water quality and availability and protecting open space, habitat areas, groundwater recharge areas, and agricultural areas. Land use zoning is mapped, and large projects usually require conditional use permits.

III.6.1.3.2 County Ordinances

Counties adopt ordinances to regulate land use activities and to implement goals and objectives in their General Plans. While each county has its own ordinances, their scope and content is often similar. Relevant regulated activities commonly include septic system siting and construction, well permitting, well construction and destruction procedures, grading, stormwater management, development in floodplains, and groundwater exports.

III.6.1.3.3 Municipal Ordinances

There are 46 incorporated areas that together cover approximately 2.5% of the Plan Area. Utility-scale solar projects generally require large tracts of undeveloped land, and are less likely to be sited within these municipal jurisdictional boundaries. If these locations are proposed, their respective municipal ordinances and regulations would apply either in lieu of or in addition to county ordinances.

III.6.1.3.4 Local Water and Wastewater Agencies

Local agencies that manage water and wastewater within the Plan Area include Mojave Water Agency, Los Angeles County Sanitation District, Imperial Irrigation District, and Palo Verde Irrigation District. Some agencies, including Mojave Water Agency, Hi-Desert Water District, and Tehachapi–Cummings County Water District, serve as Watermasters that implement the terms of basin adjudication (see Section III.6.2.1 Adjudicated Basins). Some agencies manage the distribution and use of surface water supplies, including State Water Project contractors in the adjudicated basins and Colorado River users (Imperial and Palo Verde irrigation districts). The County Sanitation District of Los Angeles County establishes recycled water use procedures within the county.

III.6.2 Groundwater Resources within the Plan Area

The California Department of Water Resources (CDWR) has mapped 113 groundwater basins in the Plan Area (Figure III.6-1) and published their descriptions in Bulletin 118 (Department of Water Resources 2003); Table III.6-1 lists the names and acreages for each of the basins.[1] The amount of groundwater use and the availability of groundwater information vary among basins. The existing level of groundwater use, available water-level data, and documented historical groundwater consumption affect basin conditions and their sensitivity to future development. The information provided from Bulletin 118, the CASGEM Program, and various other reports and maps are summarized in Table III-6-1.

III.6.2.1 Adjudicated Basins

Chronic declines in groundwater levels and storage can prompt local users to initiate basin adjudication, a legal settlement that quantifies water rights for all groundwater and surface water users in a basin. It has two implications for renewable energy projects. First, in adjudicated basins the perennial groundwater yield is essentially fully allocated to existing users. Second, despite that limitation, adjudication often enables the transfer of water use allowances among users within a basin. By this means, an energy project could conceivably purchase sufficient yield from other users to operate a project. Such transfers are less likely to generate objections in adjudicated basins because the sum of all allowances is managed within the range of the perennial yield.

[1] CDWR defines a groundwater basin as an aquifer or an aquifer system that is bounded laterally and at depth by features that affect groundwater flow: rocks or sediments of lower permeability, geologic structures (such as a fault), or hydrologic features (such as a stream, lake, ocean, or groundwater divide). Hydrologic basins, or watersheds, often include areas outside the groundwater basins that can contribute water to the basin (such as runoff from the watershed that percolates into the basin). In groundwater basins where many studies have been completed and the basin has been operated for a number of years, the basin boundaries are well defined. Even in these basins, however, there are unknowns and the boundaries may change as more information is collected and evaluated. Many of the CDWR subbasin boundaries were developed or modified with public input, but little physical data. Because they should not be considered precise boundaries, a detailed local study that defines actual groundwater-flow paths is required to determine whether a specific area lies within a groundwater basin boundary.

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
7-16	Ames Valley	108,000	<0.03	No Designation	No	A preliminary water budget indicates that the basin is close to balance under average conditions.[3] The pumping rates during 1990-1996 resulted in an observed rapid decrease in groundwater elevations.[4]
7-34	Amos Valley	130,000	<0.03	No Designation	No	Water level declines reported up to 29 ft. during 1979-2000.[5]
7-44	Antelope Valley	1,010,000	0.03-0.20	Yes[2]	Yes (pending)[2]	Water level declines, storage depletion, and subsidence reported.[5] Extractions likely exceed natural recharge.[2]
7-37	Arroyo Seco Valley	256,000	<0.03	No Designation	No	Uncertain.
6-26	Avawatz Valley	28,000	<0.03	No Designation	No	Uncertain.
7-15	Bessemer Valley	39,000	<0.03	No Designation	No	Uncertain.
6-25	Bicycle Valley	89,000	<0.03	No Designation	No	Long term hydrographs indicate that groundwater withdrawals have resulted in a water-table decline as much as 70 ft. since late 1960.[6]
7-24	Borrego Valley	152,000	0.03-0.20	Yes[2]	No	Overdraft of 15,000 acre-feet per year.[31]
7-8	Bristol Valley	497,000	<0.03	No Designation	No	Uncertain.

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
5-80	Brite Valley	3,000	0.03-0.20	Yes[2]	Yes[27]	Safe Yield is 500 acre feet annually.[32]
7-32	Broadwell Valley	92,000	<0.03	No Designation	No	Uncertain.
6-76	Brown Mountain Valley	22,000	<0.03	No Designation	No	Uncertain.
6-81	Butte Valley	9,000	<0.03	No Designation	No	Uncertain.
7-7	Cadiz Valley	270,000	<0.03	No Designation	No	A proposed aquifer storage and recovery project (the Cadiz Valley Water Project) is a significant consideration for groundwater resources.[30]
7-90	Cady Fault Area	8,000	<0.03	No Designation	No	Uncertain.
6-79	California Valley	58,000	<0.03	No Designation	No	Uncertain.
7-41	Calzona Valley	81,000	<0.03	No Designation	No	Uncertain.
6-38	Caves Canyon Valley	73,000	<0.03	No Designation	No	If large quantities of water were pumped from the basin, water levels would decline and might stop the flow out of the basin.[8]
7-43	Chemehuevi Valley	272,000	<0.03	No Designation	No	Uncertain.
7-32	Chocolate Valley	129,000	<0.03	No Designation	No	Uncertain.

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
7-5	Chuckwalla Valley	602,000	<0.03	No Designation	No	Water levels stable in central and eastern basin; water levels decline of 50 ft. starting in 1980 around the Desert Center.[5]
7-21.01	Coachella Valley–Indio	297,000	0.61-0.8	No Designation	No	Uncertain.
7-21.02	Coachella Valley–Mission Creek	48,000	0.21-0.40	Yes[9]	No	Supplemental recharge (artificial recharge) is needed to reduce annual and cumulative overdraft.[9]
7-11	Copper Mountain Valley	30,000	<0.03	No Designation	No	Uncertain.
6-55	Coso Valley	26,000	<0.03	No Designation	No	Uncertain.
6-37	Coyote Lake Valley	88,000	<0.03	No Designation	No	Declining water levels.[5]
7-29	Coyote Wells Valley	146,000	<0.03	Yes[5]	No	Overdraft is characterized by the sustained gw level declines in the past 30 years.[33]
6-35	Cronise Valley	126,000	<0.03	No Designation	No	Uncertain.
6-50	Cuddeback Valley	95,000	<0.03	No Designation	No	Not enough available data to provide groundwater budget estimates.[10]
5-27	Cummings Valley	10,000	0.41-0.60	Yes[2]	Yes[27]	Safe Yield is 4,090 acre feet annually.[32]
7-9	Dale Valley	212,000	<0.03	No Designation	No	Groundwater extraction seems very high for a basin with documented water quality issues.[4] USGS data shows declining water levels.[2]

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
7-13.01	Deadman Valley–Deadman Lake	89,000	<0.03	No Designation	No	Uncertain.
7-13.02	Deadman Valley–Surprise Spring	29,000	<0.03	No Designation	No	Between 1952 and 1996 water levels stayed constant in the west and declined by 115 ft. in the east.[5]
6-18	Death Valley	920,000	<0.03	No Designation	No	Uncertain.
6-78	Denning Spring Valley	7,000	<0.03	No Designation	No	Uncertain.
7-33	East Salton Sea	195,000	<0.03	No Designation	No	Steady WL decline from 1963-2000 (20 to 40 ft. bls).[5]
6-43	El Mirage Valley	76,000	0.03-0.20	No Designation	Yes[27]	In the past 15 years the water levels have only fluctuated slightly with a slight trend downwards. The amount of groundwater input to the system must be close to the output or possibly less.[11]
7-2	Fenner Valley	452,000	<0.03	No Designation	No	Water supplies are adequate for present needs. However, large-scale pumping would result in the lowering of the water table and a reduction of the ground water in storage.[12]
6-46	Fremont Valley	335,000	<0.03	No Designation	No	Groundwater pumping for agriculture in the Fremont Valley Basin resulted in historical groundwater overdraft.[29] Groundwater use has since declined.

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
6-85	Gold Valley	3,000	<0.03	No Designation	No	Uncertain.
6-48	Goldstone Valley	28,000	<0.03	No Designation	No	Uncertain.
6-77	Grass Valley	10,000	<0.03	No Designation	No	Uncertain.
6-84	Greenwater Valley	60,000	<0.03	No Designation	No	Uncertain.
6-47	Harper Valley	409,000	0.03-0.20	No Designation	No	During 1980 water levels rebounded but within the past couple years water levels have declined as much as 100 ft.[13]
6-74	Harrisburg Flats	25,000	<0.03	No Designation	No	Uncertain.
7-53	Hexie Mountain Area	11,000	<0.03	No Designation	No	Uncertain.
7-30	Imperial Valley	958,000	<0.03	No Designation	No	The decline in the water table in East Mesa began in 1980 and stabilized in the early 1990s.[14]
6-54	Indian Wells Valley	382,000	0.03-0.20	Yes[2]	No	Water quality issues with respect to overdraft and mixing of aquifers.[2]
7-50	Iron Ridge Area	5,000	<0.03	No Designation	No	Uncertain.
6-30	Ivanpah Valley	198,000	<0.03	No Designation	No	Uncertain.

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
7-18.01	Johnson Valley–Soggy Lake	77,000	<0.03	No Designation	No	Uncertain.
7-18.02	Johnson Valley–Upper Johnson Valley	35,000	<0.03	No Designation	No	Stable water levels and a preliminary water balance for the basin indicate that the basin is in balance with significant subsurface outflows and losses to evaporation at dry lakes.[3,15]
7-62	Joshua Tree	27,000	0.03-0.20	No Designation	No	Declining water levels since 1973.[5]
6-89	Kane Wash Area	6,000	0.03-0.20	No Designation	No	Not enough data to provide an estimate of groundwater budget.[10]
6-69	Kelso Lander Valley	11,000	<0.03	No Designation	No	Uncertain.
6-31	Kelso Valley	255,000	<0.03	No Designation	No	Water levels have declined by 100 ft. since pumping began in early 1950s.[10]
5-25	Kern River Valley	79,000	<0.03	No Designation	No	Uncertain.
7-1	Lanfair Valley	156,000	<0.03	No Designation	No	Random fluctuations are seen in the groundwater levels over the approximately 1950s-1980s period, i.e., no obvious patterns of decline or rise.[16]

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
6-36.02	Langford Valley–Irwin	10,000	<0.03	No Designation	No	From the early 1980s until mid-1990s, increased pumpage caused water levels to decline about 15 ft. Since 1993 water levels have been recovering in response to decreased pumpage and artificial recharge of wastewater.[17]
6-36.01	Langford Valley–Langford Well Lake	19,000	<0.03	No Designation	No	WL contours for 1995, 2000, 2005 and 2010 conditions show that groundwater withdrawals have resulted in a cone of depression in the central part of the basin. WLs have declined by 50 ft.[18]
7-14	Lavic Valley	102,000	<0.03	No Designation	No	Uncertain.
6-27	Leach Valley	61,000	<0.03	No Designation	No	Uncertain.
7-51	Lost Horse Valley	17,000	0.03-0.20	No Designation	No	Uncertain.
6-71	Lost Lake Valley	23,000	<0.03	No Designation	No	Uncertain.
6-21	Lower Kingston Valley	240,000	<0.03	No Designation	No	Uncertain.

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
6-40	Lower Mojave River Valley	285,000	0.03-0.20	Yes[2]	Yes[27]	The cumulative ground-water production upstream of the city of Barstow led to overdraft of the Mojave River ground-water basin.[34] The water-level change data from 334 wells show that more than one half (102) of the wells in the Mojave River ground-water basin had water-level declines of 0.5 feet or more, and almost one fifth (32) of the wells had declines greater than 5 feet between 2002 and 2004.[35]
7-19	Lucerne Valley	147,000	0.03-0.20	Yes[2]	Yes[27]	Since adjudication in 1996, water levels have remained relatively constant and, in fact, have begun to rise in some locations. This rise suggests that modern groundwater recharge must be similar to, or exceed, the volume of groundwater production.[19]
7-17	Means Valley	15,000	<0.03	No Designation	No	Uncertain.
6-29	Mesquite Valley	88,000	0.03-0.20	No Designation	No	Uncertain.
6-20	Middle Amargosa Valley	390,000	<0.03	No Designation	No	Uncertain.

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
7-41	Middle Mojave River Valley	211,000	0.03-0.20	No Designation	Yes[27]	The cumulative ground-water production upstream of the city of Barstow led to overdraft of the Mojave River ground-water basin.[34] The water-level change data from 334 wells show that more than one half (102) of the wells in the Mojave River ground-water basin had water-level declines of 0.5 feet or more, and almost one fifth (32) of the wells had declines greater than 5 feet between 2002 and 2004.[35]
7-20	Morongo Valley	7,000	<0.03	No Designation	No	Uncertain.
7-44	Needles Valley	88,000	<0.03	No Designation	No	Uncertain.
7-25	Ocotillo–Clark Valley	222,000	<0.03	No Designation	No	The computed decline from 1925 to December 1975 was 15 ft. in Ocotillo.[26]Groundwater levels declined 5 to 8 ft. during the period 1975 to 2001.[28]
7-35	Ogilby Valley	133,000	<0.03	No Designation	No	Uncertain.
7-31	Orocopia Valley	96,000	0.41-0.60	No Designation	No	Uncertain.
6-12	Owens Valley	661,000	0.03-0.20	No Designation	No	Uncertain.

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
6-88	Owl Lake Valley	22,000	<0.03	No Designation	No	Uncertain.
6-28	Pahrump Valley	93,000	0.03-0.20	Yes[2]	No	Groundwater development has caused more than 10 ft. of decline in water levels.[21] Excessive water level decline, subsidence, depletion of aquifer.[22]
7-39	Palo Verde Mesa	225,000	<0.03	No Designation	No	Uncertain.
7-38	Palo Verde Valley	73,000	<0.03	No Designation	No	Uncertain.
6-58	Panamint Valley	259,000	<0.03	No Designation	No	Uncertain.
6-51	Pilot Knob Valley	138,000	<0.03	No Designation	No	Uncertain.
7-6	Pinto Valley	182,000	<0.03	No Designation	No	Uncertain.
7-49	Pipes Canyon Fault Valley	3,000	<0.03	No Designation	No	Uncertain.
7-45	Piute Valley	175,000	<0.03	No Designation	No	Uncertain.
7-52	Pleasant Valley	10,000	<0.03	No Designation	No	Uncertain.
7-40	Quien Sabe Point Valley	25,000	<0.03	No Designation	No	Uncertain.

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
6-24	Red Pass Valley	96,000	<0.03	No Designation	No	Uncertain.
6-86	Rhodes Hill Area	16,000	<0.03	No Designation	No	Uncertain.
7-4	Rice Valley	188,000	<0.03	No Designation	No	Uncertain.
6-23	Riggs Valley	88,000	<0.03	No Designation	No	Uncertain.
6-56	Rose Valley	42,000	0.03-0.20	No Designation	No	Long term groundwater level monitoring data collect beginning in 2001 have shown increased levels by 1 to 2 ft.[23]
6-53	Salt Wells Valley	30,000	<0.03	No Designation	No	Uncertain.
6-52	Searles Valley	197,000	<0.03	No Designation	No	Not enough data to provide an estimate of groundwater budget.[10] WLs declined 110 ft. from 1917-1967.[5]
6-34	Silver Lake Valley	35,000	<0.03	No Designation	No	Uncertain.
6-33	Soda Lake Valley	380,000	<0.03	No Designation	No	Groundwater discharge occurs through evaporation since the water table is so close to the surface. Extensive pumping would most likely have negative effects.[24]
6-82	Spring Canyon Valley	5,000	<0.03	No Designation	No	Uncertain.

Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
6-49	Superior Valley	120,000	<0.03	No Designation	No	Not enough data to provide an estimate of groundwater budget.[10]
7-45	Tehachapi Valley East	24,000	<0.03	Yes[2]	Yes [27]	Safe yield for Tehachapi Valley (east and west combined) is 5,500 acre feet annually.[32]
5-28	Tehachapi Valley West	15,000	0.21-0.40	Yes[2]	Yes [27]	Safe yield for Tehachapi Valley (east and west combined) is 5,500 acre feet annually.[32]
7-10	Twenty nine Palms Valley	62,000	0.03-0.20	No Designation	No	Uncertain.
6-22	Upper Kingston Valley	177,000	<0.03	No Designation	No	Uncertain.
6-42	Upper Mojave River Valley	412,000	0.21-0.40	Yes[7]	Yes [27]	The cumulative ground-water production upstream of the city of Barstow led to overdraft of the Mojave River ground-water basin.[34]The water-level change data from 334 wells show that more than one half (102) of the wells in the Mojave River ground-water basin had water-level declines of 0.5 feet or more, and almost one fifth (32) of the wells had declines greater than 5 feet between 2002 and 2004.[35]
8-2.05	Upper Santa Ana Valley–Cajon	23,000	>0.8	No Designation	No	Uncertain.
7-28	Vallecito-Carrizo Valley	122,000	<0.03	No Designation	No	Uncertain.

**Table III.6-1
California Department of Water Resources Basins in the DRECP
(See Figure III.6-1 for basin locations.)**

CDWR Basin Number	Groundwater Basin Name	Table Basin Area[1] (acres)	Estimated Groundwater Use[2] (ac-ft/acre)	Designated Overdraft Conditions	Adjudicated Basin	Water Level and Water Budget Conditions
7-42	Vidal Valley	138,000	<0.03	No Designation	No	Uncertain.
7-3	Ward Valley	558,000	<0.03	No Designation	No	Uncertain.
7-12	Warren Valley	24,000	0.03-0.20	No Designation	Yes[27]	Water levels have increased since 2009.[25]
7-22	West Salton Sea	105,000	<0.03	No Designation	No	Uncertain.
6-75	Wildrose Canyon	5,000	<0.03	No Designation	No	Uncertain.
6-19	Wingate Valley	71,000	<0.03	No Designation	No	Uncertain.
7-36	Yuma Valley	124,000	<0.03	No Designation	No	Uncertain.

1 The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

2 California Groundwater Elevation Monitoring - Basin Prioritization Process. December 2013.

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7 Hydrogeologically vulnerable areas map' State Water Resource Control Board, November 2000.

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12 Freiwald, David A. Ground-water Resources of Lanfair and Fenner Valleys and Vicinity, San Bernardino County, California, Water-Resources Investigations Report 83-4082, 1984.

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20 Owens Valley Hydrogeology.' United States Geological Survey.

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28 Ocotillo/Coyote Wells Hydrology and Groundwater Modeling Study, Bookman-Edmonston, January 16, 2004.

29 Groundwater in the Koehn Lake Area, Kern County California, U.S. Geological Survey Water-Resources Investigation 77-66, J.H. Koehler 1977.

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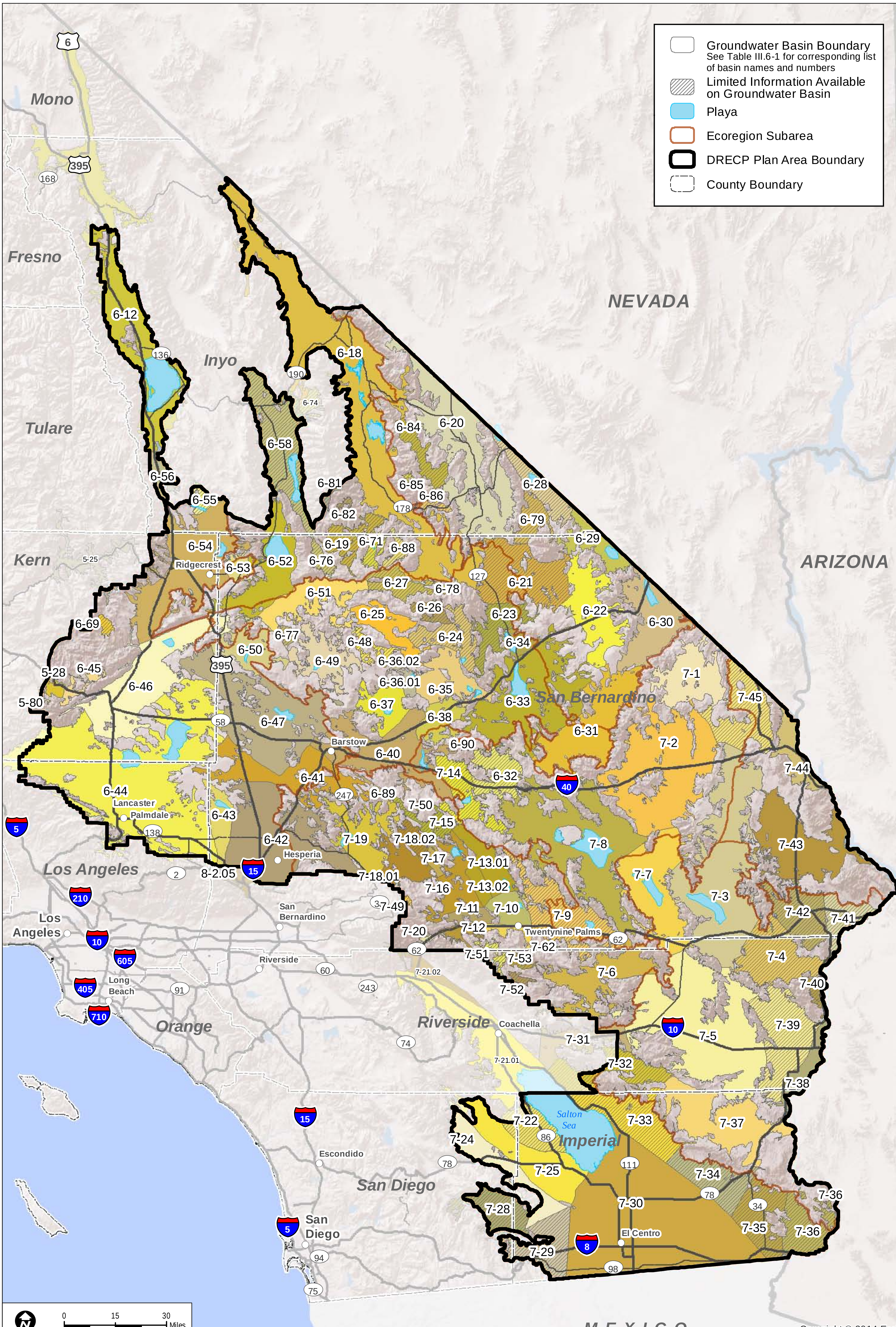

Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE III.6-1

Groundwater Basins and Data Availability

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One typical outcome of adjudication is the need for additional imported water supplies. Although imports and adjudication are not necessarily linked, in the Plan Area adjudicated groundwater basins are the same as those with State Water Project contractors. These are the upper, middle, and lower Mojave River Valley basins, Antelope Valley (adjudication is in progress), Brite Valley, Cummings Valley, Tehachapi Valley East, Tehachapi Valley West, El Mirage Valley, Warren Valley (partial), and Upper Santa Ana Valley–Cajon Sub-basin.

III.6.2.2 Sole-Source Aquifers

Since 1977, the EPA's Sole-source Aquifer (SSA) Program has been used by communities to prevent contamination of groundwater from federally funded projects; this has had the added benefit of increasing public awareness of groundwater resource vulnerability. The only existing SSA within the Plan Area is the Ocotillo–Coyote Wells Aquifer, which is part of the Ocotillo–Clark Valley shown in Figure III.6-1 (Basin 7-25) and straddles the Imperial–San Diego county line.

III.6.2.3 Basins Tributary to the Colorado River

Colorado River water rights are managed and operated under numerous compacts, federal laws, court decisions and decrees, contracts, and regulatory guidelines collectively known as the "Law of the River." This collection of documents apportions Colorado River water and regulates its use and management among the seven basin states and Mexico. It is administered by the USBR (U.S. Bureau of Reclamation 2010). This body of law was affirmed and clarified in the Consolidated Decree (547 U.S. 150, 2006).

Several groundwater basins along the eastern edge of the Plan Area are hydraulically connected and possibly coupled, or tributary, to flow in the Colorado River. These basins are segregated into three categories (Figure III.6-2): (1) "Floodplain Areas," as mapped for the USBR by the USGS; (2) the larger "River Aquifer," mapped for the USBR by the USGS; and (3) the basins described in CDWR Bulletin 118 with subsurface outflow toward the Colorado River and thus classified as "possibly tributary" to the river. The Colorado River Aquifer, which includes the river floodplain, defines the Colorado River Accounting Surface area. That aquifer also includes saturated sediments above the Accounting Surface that are more distant and hydraulically connected flows within the river channel itself. The Accounting Surface delineates the area where groundwater pumping is managed, pursuant to the USBR's accounting of the disposition of Colorado River water (U.S. Bureau of Reclamation 2011). Groundwater basins entirely or partially located within the Colorado River Aquifer include: Arroyo Seco Valley, Cadiz Valley, Calzona Valley, Chemehuevi Valley, Chuckwalla Valley, Imperial Valley, Needles Valley, Ogilby Valley, Palo Verde Mesa, Palo Verde Valley, Quien Sabe Point Valley, Rice Valley, and Yuma Valley. Four additional basins that are not located within the River Aquifer, but which CDWR Bulletin 118 indicates are potentially tributary to the aquifer, are the Chocolate Valley, Orocopia Valley, Pinto Valley, and Vidal Valley basins.

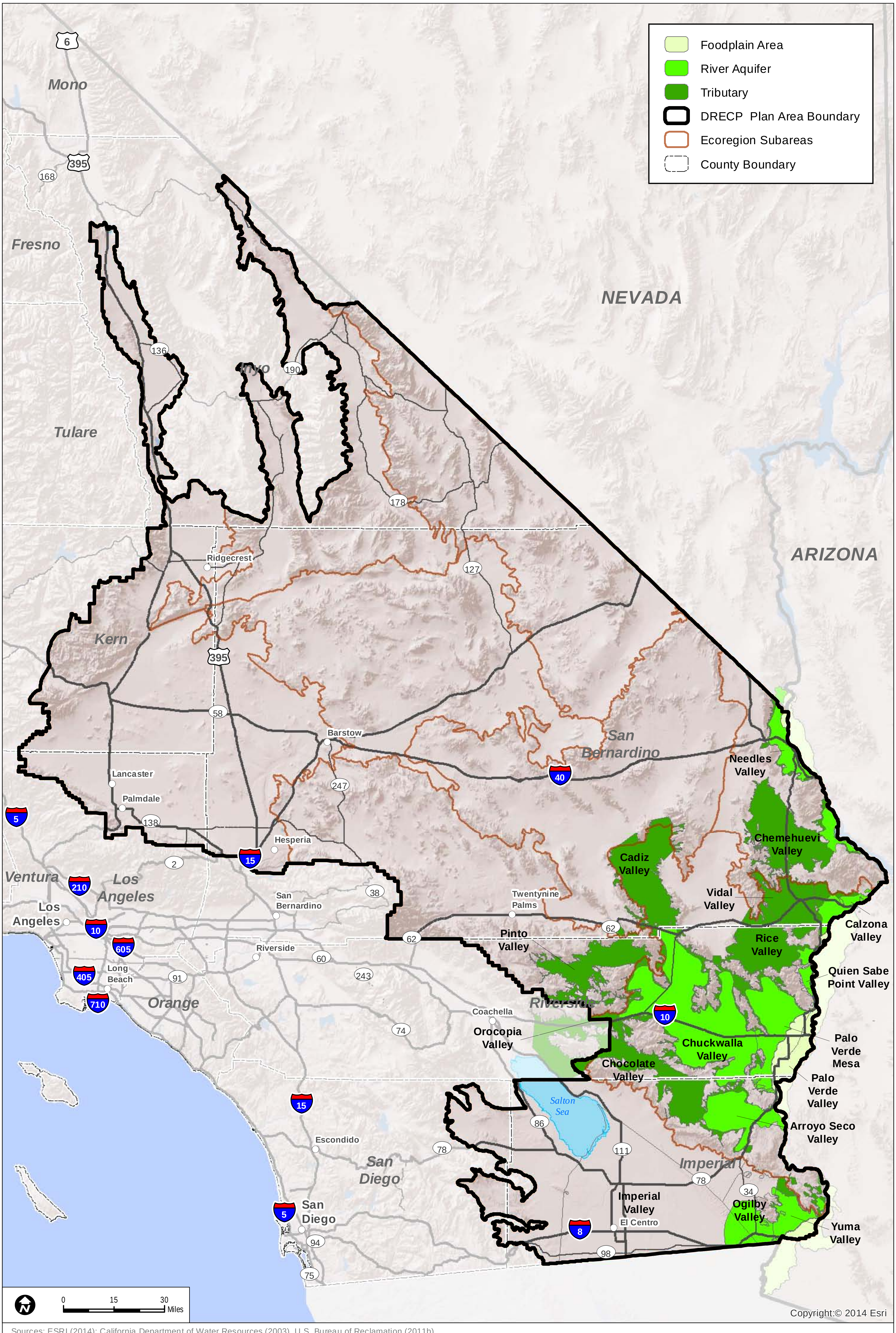
Extraction wells located in potentially tributary basins may intercept groundwater recharge that otherwise flows to the Colorado River Aquifer. Water-level data are sparse for these alluvial basins, so the direction and/or rate of groundwater flow are often uncertain. Given the low rates of groundwater recharge in the eastern part of the Plan Area, subsurface flow from these interior basins into the River Aquifer may represent only a small contribution to the overall volumetric groundwater budget (Wilson and Owen–Joyce 1994). Data are not available, however, to calculate these flows and determine their relative significance to the Colorado River Aquifer groundwater budget.

Renewable energy projects that consumptively use groundwater from either the floodplain, or from below the Accounting Surface in the interior parts of the aquifer, would need to acquire part of California's 4.4 million acre-feet/year Colorado River water allocation from an existing user. Presently, 87.5% of the state's 4.4 million acre-feet/year allocation goes to three irrigation districts with senior rights: Palo Verde Irrigation District, Imperial Irrigation District and Coachella Valley Water District. The fourth and fifth priority allocations are owned by the Metropolitan Water District of Southern California, of which the fifth priority only provides water in years of surplus flows (Metropolitan Water District of Southern California 2009).

III.6.3 Hydrogeological and Water Quality Framework

III.6.3.1 Aquifer Characteristics

Aquifers in the Basin and Range Province / Plan Area are often composed of unconsolidated Quaternary alluvial deposits underlain by older unconsolidated to semi-consolidated Quaternary to Tertiary alluvial deposits. These deposits consist of intermixed gravel, sand, silt, and clay. The less productive aquifers are composed of playa lake deposits, clays, and fine grained materials. Shallow dune sand deposits, and unconfined alluvial channel sands and gravels are also often dry.



Sources: ESRI (2014); California Department of Water Resources (2003), U.S. Bureau of Reclamation (2011b)

FIGURE III.6-2

Groundwater Basins Coupled or Possibly Tributary to the Colorado River

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The more productive aquifers vary in location and area. Certain basins have an extensive aquifer system with Miocene to Quaternary continental deposits of moderately consolidated sand, gravel, and boulders (for example, the Antelope Valley, Copper Mountain Valley, Deadman Valley [Deadman Lake and Surprise Spring], Joshua Tree, and Twentynine Palms Valley basins), or the coarse grained fanglomerate deposits of boulders, lacustrine clay, and interbedded basalt flow formed by the Pinto or Bouse Formation (for example, the Chuckwalla Valley, Death Valley, Needles Valley, Orocopia Valley, and Palo Verde Valley basins). In contrast, near the Mojave and Colorado rivers the most productive aquifers occur in the Pleistocene and younger floodplain deposits adjacent to the rivers.

In addition to alluvial basin aquifers, in some locations the Plan Area is underlain by deeper, regional carbonate aquifers. For example, springs and seeps in the Death Valley area are generally supported by groundwater discharge from the regional carbonate aquifer system that underlays a large portion of Nevada and part of Utah. Another example is the springs and seeps in the San Bernardino Mountains that are fed by groundwater from local carbonate sediments.

Another characteristic of desert aquifers in the Plan Area is that most seeps, springs, and rivers, are groundwater dependent. That is, these riparian areas occur due to subsurface structures or other geological conditions, and the groundwater discharge is generally from recharge that is relatively far away. Two examples of this are the Mojave River at Afton Canyon and the designated Wild and Scenic Amargosa River.

Fractured rock can form another type of aquifer. These fractured-rock aquifers generally occur in bedrock units with little to no primary permeability. Limited groundwater may be associated with these permeable fractures and joints. This type of aquifer will generally produce enough water for modest domestic use.

The storage capacities of Plan Area alluvial basins reported in CDWR Bulletin 118 vary widely and are mapped in Figure III.6-3. The groundwater storage capacity is primarily a function of basin area, basin depth, and sediment texture. Sediment texture refers to the relative proportions of clay, silt, sand, and cobles (particle size) and its influence on the porosity and permeability of the sediment deposit. Both groundwater storage and storage capacity estimates are relatively large for most of the basins due to the mapped size and scale of this analysis. Recharge, however, can be relatively small in the same basins because of the arid climate (see Section III.6.3.3.2), and the large storage capacity can create the misleading impression that groundwater availability is high, leading in turn to potentially erroneous long-term commitments or allocations of the resource that ignore perennial groundwater yield constraints.

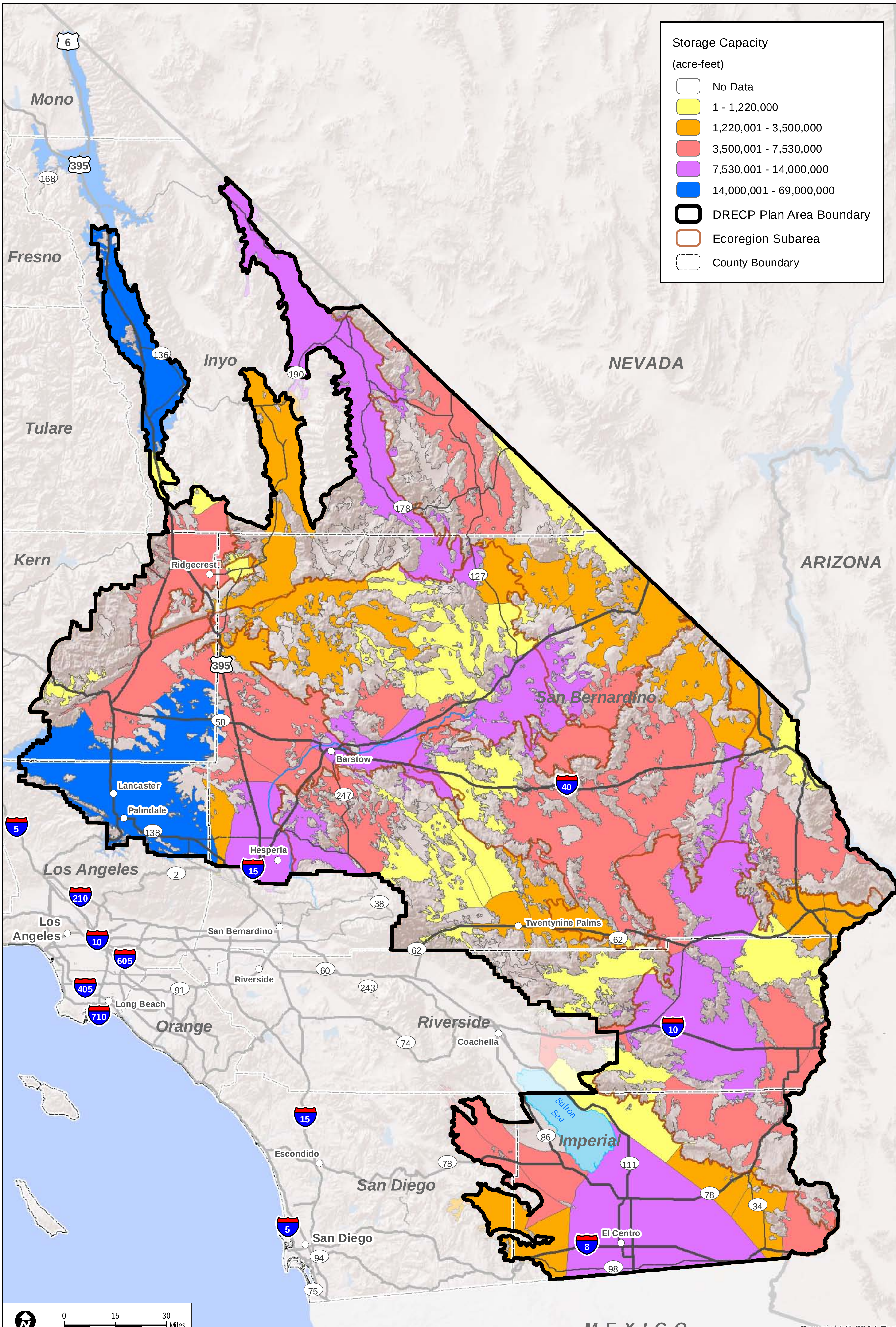
Recognizing this limitation, the comparison of basin storage capacities is only useful for qualitative comparisons of the relative resource potential between basins. Perennial (or sustainable) yield is a more useful gauge of groundwater availability; that is, water which is produced without damaging the aquifer or negatively affecting groundwater users and groundwater-dependent resources.

In general, basins with the lowest reported storage capacity values (less than 3,500,000 acre-feet) are south of Death Valley or near the Twentynine Palms area. Groundwater basins with higher reported storage capacity values (up to 14,000,000 acre-feet) occur near the Mojave River, in basins surrounding the Cadiz Valley, in Death Valley, and south of the Salton Sea. Owens Valley and Antelope Valley have the greatest reported storage capacity values (14,000,000 and 69,000,000 acre-feet, respectively). Although these storage capacities appear large, for practical purposes most of the water is likely unavailable due to high pumping costs, poor quality, or low perennial yield. For example, exceeding a basin's perennial yield can cause subsidence, increased pumping lifts, and drying of springs, streams and playas.

Reported well yields are a general indicator of a basin's ability to transmit groundwater. Distribution of typical irrigation and municipal supply well yields, as reported in CDWR Bulletin 118, are mapped in Figure III.6-4. In general, average yields vary from 16 gallons per minute (gpm) to 2,500 gpm. Of the basins with reported municipal/irrigation well yields, most yields fall between 200 and 500 gpm. However, 16 basins have relatively low reported municipal/irrigation well yields (less than 100 gpm), and 10 basins have reported yields greater than 1,000 gpm. Middle Amargosa Valley has the highest reported municipal/irrigation well yields, ranging from 2,500 to 3,000 gpm, which may correspond to extraction from the carbonate aquifer. Lanfair Valley has the lowest recorded municipal/irrigation well yields, ranging from 3 to 70 gpm and averaging 16 gpm, which may correspond to a thin alluvial or fractured rock aquifer.

III.6.3.2 Groundwater Basin Boundaries

A portion of the Plan Area is in the Basin and Range Geologic Province, where vertical movement along faults creates deep fault-bounded structural troughs filled with alluvial deposits derived principally from erosion of the steep, narrow mountain ranges that separate the basins. The boundaries between valley floor areas (groundwater basins) and adjacent mountain ranges are therefore commonly associated with faults.



Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE III.6-3

Distribution of Reported Storage Capacity

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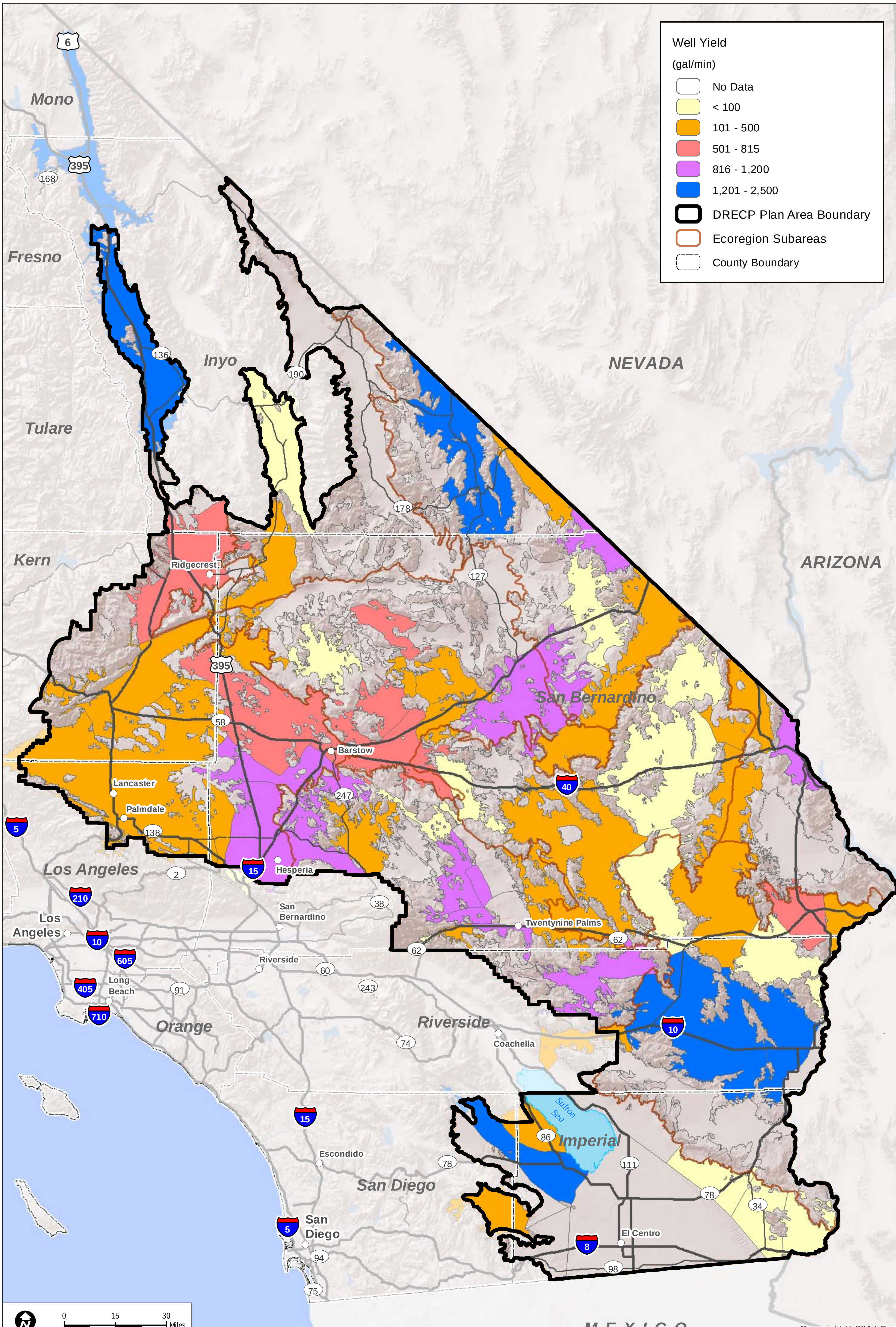

Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE III.6-4

Distribution of Average Reported Irrigation and Municipal Well Yields

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Figure III.6-5 shows alluvial basins bordered by faults, and additional faults that run through the interior of some basins. The hydraulic influence of these faults is variable. Some faults provide preferential pathways for vertical or horizontal groundwater flow along the fault; other faults act as a barrier and impede groundwater flow, either partially or completely. The San Andreas Fault Zone, Garlock Fault Zone, Elsinore Fault Zone, Granite Mountain Fault Zone, Pinto Mountain Fault Zone, and Death Valley-Furnace Creek Fault Zone may act as barriers or impediments to subsurface flow in many portions of the groundwater basins. Other smaller faults may or may not have similar characteristics with respect to influencing groundwater movement within basins. Hydrologic analyses for renewable energy projects will need to collect sufficient groundwater data to evaluate the influence of faults on groundwater flow into, within, and out of the basins.

Some alluvial groundwater basins are hydrologically connected, and water can move between basins across their boundaries, through or over fault planes, or through alluvium-filled gaps in mountain ranges. These basins are considered "interconnected basins," and their characteristics are discussed in Section III.6.3.3.4 Interconnected Basins and Subsurface Flow.

III.6.3.3 Water Inflows and Outflows

The water balance (or budget) is an accounting of all inflows (recharge) and outflows (discharge) to and from a basin. If relatively long-term inflows exceed outflows, water in storage increases and groundwater levels should rise until groundwater discharge increases to establish a new equilibrium between inflow and outflow. For example, rising water levels can cause groundwater to discharge at the ground surface and become surface-water outflow in the form of perennial streams, springs, or lakes. These surficial discharges either flow out from the basin or are consumed by either riparian vegetation (evapotranspiration), beneficial use, or simple evaporation . Shallow groundwater can also evaporate from playas, be transpired by phreatophytic vegetation, or leave the basin as groundwater underflow. Phreatophytic vegetation is deep-rooted and obtains water from a permanent groundwater supply or from the water table. In the opposite case, when groundwater is extracted and consumed, the increased outflow can sometimes exceed inflow; as a result, water in storage can decrease causing groundwater levels to decline and natural discharge to decrease. Declining groundwater levels can decrease the yields of existing wells, decrease discharge to streams, springs, and playas, and reduce the water supply available to phreatophytes. Declining groundwater levels can also cause compaction of previously saturated beds and subsidence of the land surface. Subsidence creates an irreversible reduction in groundwater storage capacity.

The CDWR reported basin water balance estimates are approximate at best. Bulletin 118 categorizes almost all basins in the Plan Area as having "Type C" water budgets, which means there is little knowledge of any of the budget's components at the time it was published. This means that detailed data collection and analysis will often be required to appropriately quantify the water budget components and assess the possible effects of groundwater consumption by renewable energy projects.[2]

The following sections describe budget-related variables that provide a partial basis for a relative comparison of water budget conditions among the basins.

III.6.3.3.1 Recharge from Imported Water

Imported water is a potential source of groundwater recharge– either intentionally through artificial injection or percolation (wells and ponds), or indirectly as deep percolation of applied water. Several basins in the Plan Area receive substantial amounts of imported surface water, and these basins have large acreages of irrigated agriculture. As shown in Figure III.6-6, these basins include nine that receive water from the State Water Project in the western part of the Plan Area, and four that receive water from the Colorado River. Several additional basins include irrigated areas along the Colorado River where groundwater pumping is considered equivalent to a river diversion.

III.6.3.3.2 Rainfall Recharge

Groundwater recharge derives mainly from precipitation on mountains adjacent to the basins and underflow from tributary basins. The spatial variability in recharge is high due to large differences in precipitation, potential evapotranspiration, bedrock permeability, soil thickness, vegetation characteristics, and contributions to recharge along gullies, washes, and stream channels. Because annual rainfall amounts are generally small and desert plants capture most of the rainwater, rainfall recharge rarely occurs on the valley floor except, perhaps, in very wet years (Stonestrom et al. 2007). In the mountain ranges between basins, rainfall is greater and much of the ground surface consists of exposed rock or thin soils. This prevents plants from capturing all of the rainfall before it either infiltrates into underlying bedrock fractures or runs off. Infiltration into the mountain bedrock fractures can gradually percolate downward and laterally into the alluvial basin deposits at lower elevations.

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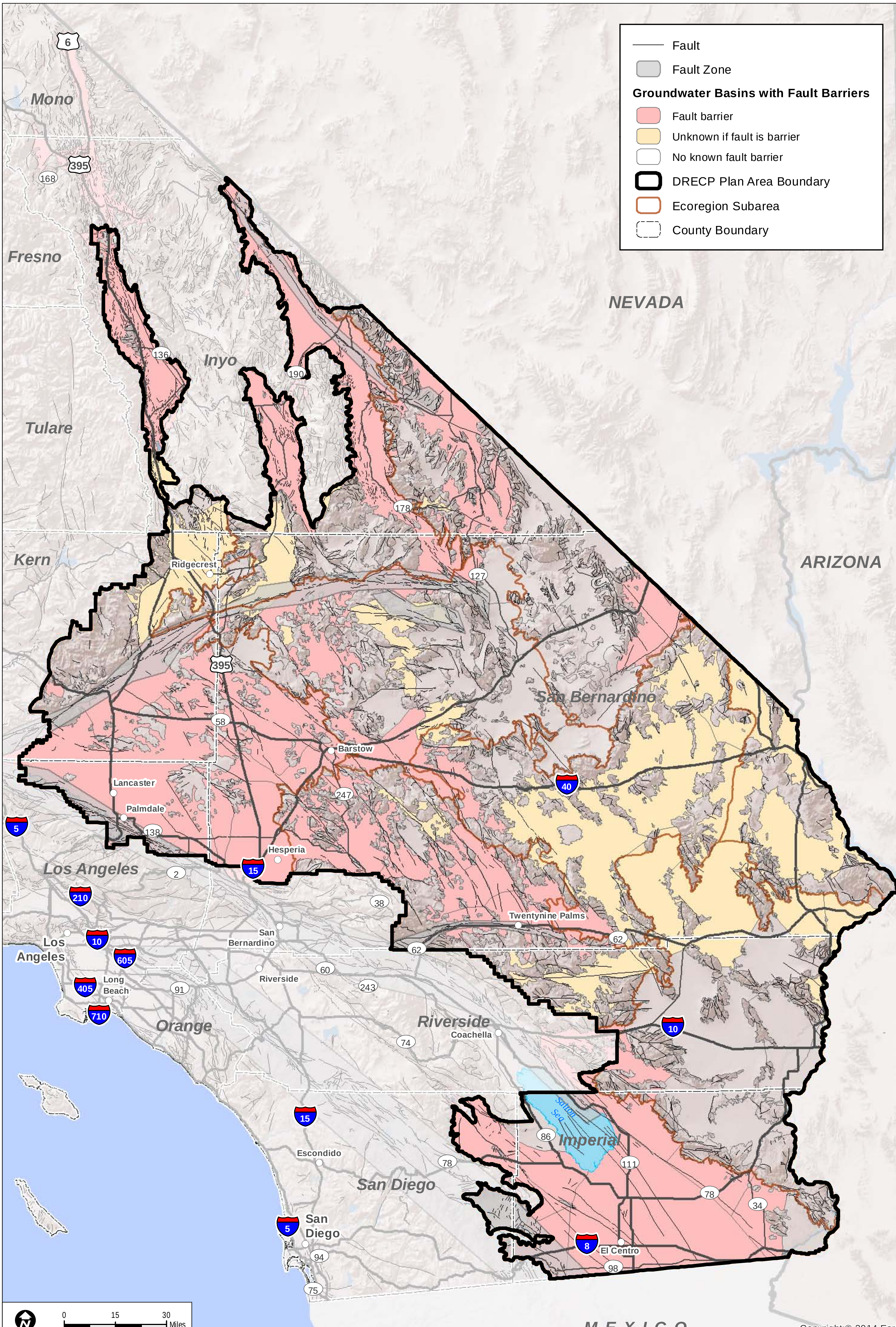
[2] Some water budget components reported as part of existing programs can provide a starting point for detailed water budget assessments. For example, in adjudicated basins the specific information can be obtained from the various court-appointed Watermasters that manage those basins. In other developed basins, some budget information can be obtained from Urban Water Management Plans (UWMP) prepared by the urban water suppliers. For example, UWMPs have been prepared for the Mojave Basin (http://www.mojavewater.org/planning.html) and the Antelope Valley Basin (http://www.ladpw.org/wwd/avirwmp/index.cfm?fuseaction=documents). Additional UWMPs for entities in the Plan Area are available from CDWRCDWR (http://www.water.ca.gov/urbanwatermanagement/2010uwmps).



Sources: ESRI (2014); California Department of Water Resources (2003), U.S. Geological Survey (2005)

FIGURE III.6-5

Groundwater Basins with Internal Fault Barriers

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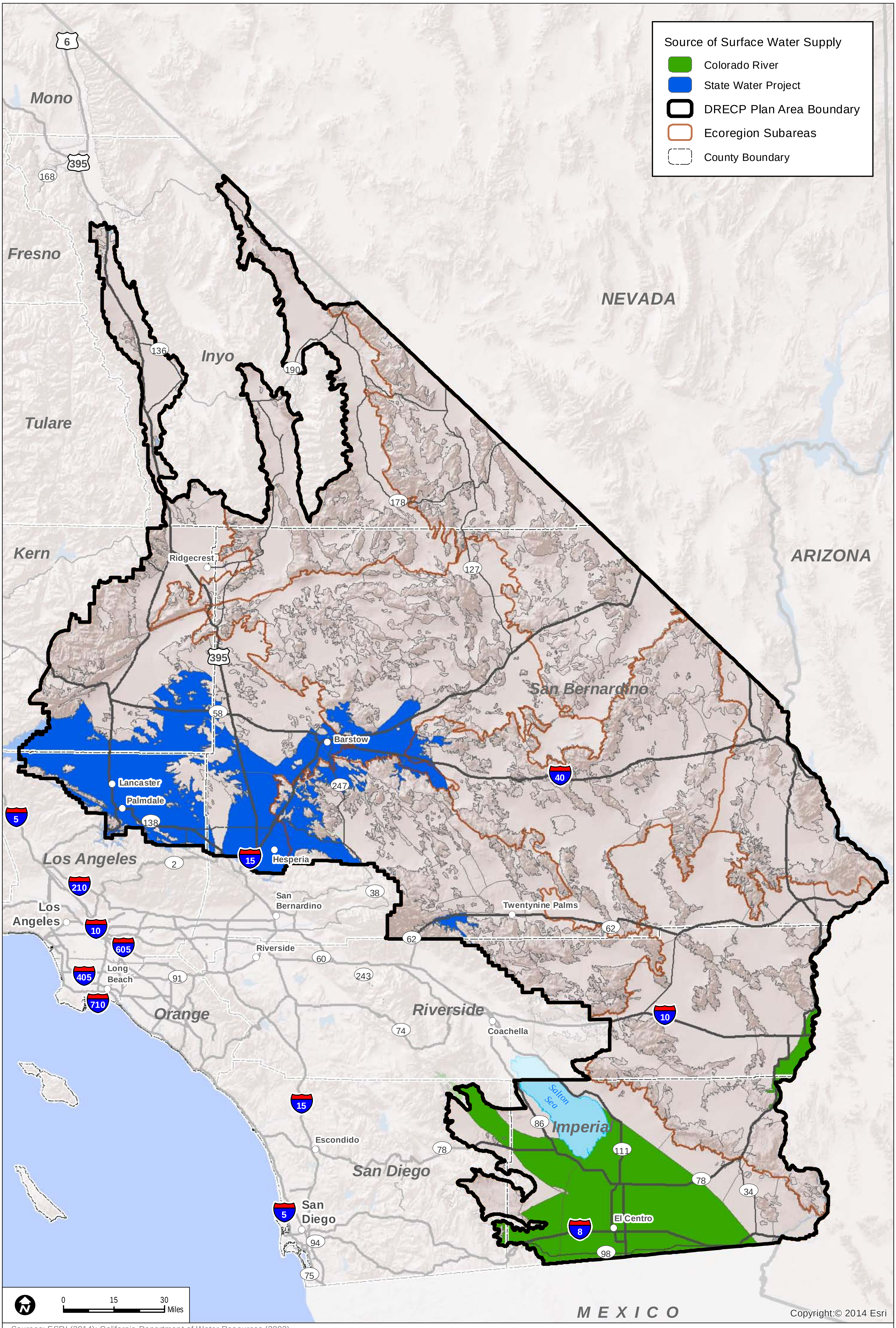

Sources: ESRI (2014); California Department of Water Resources (2003), U.S. Bureau of Reclamation (2011b), Metropolitan Water District of Southern California (2009)

FIGURE III.6-6

Groundwater Basins That Receive Substantial Surface Water Supplies

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Rainfall runoff from the mountain areas flows into gullies and washes of coarse-grained alluvial deposits that discharge onto the valley floor. Percolation from these washes, referred to as mountain front recharge, can recharge the groundwater basin beneath the valley floor. The percentage of runoff that becomes recharge varies from channel to channel and from event to event, but its volume typically exceeds the rate at which plants can intercept and consume it. Wilson and Guan (2004) summarized the relationships between precipitation and mountain front recharge at various desert locations in Arizona, Colorado, New Mexico, Nevada, and Utah, and reported that recharge ranged from 0.2- to 38% of total precipitation (median value of about 8%). They concluded that the large variation indicates these relationships are variable and site specific.

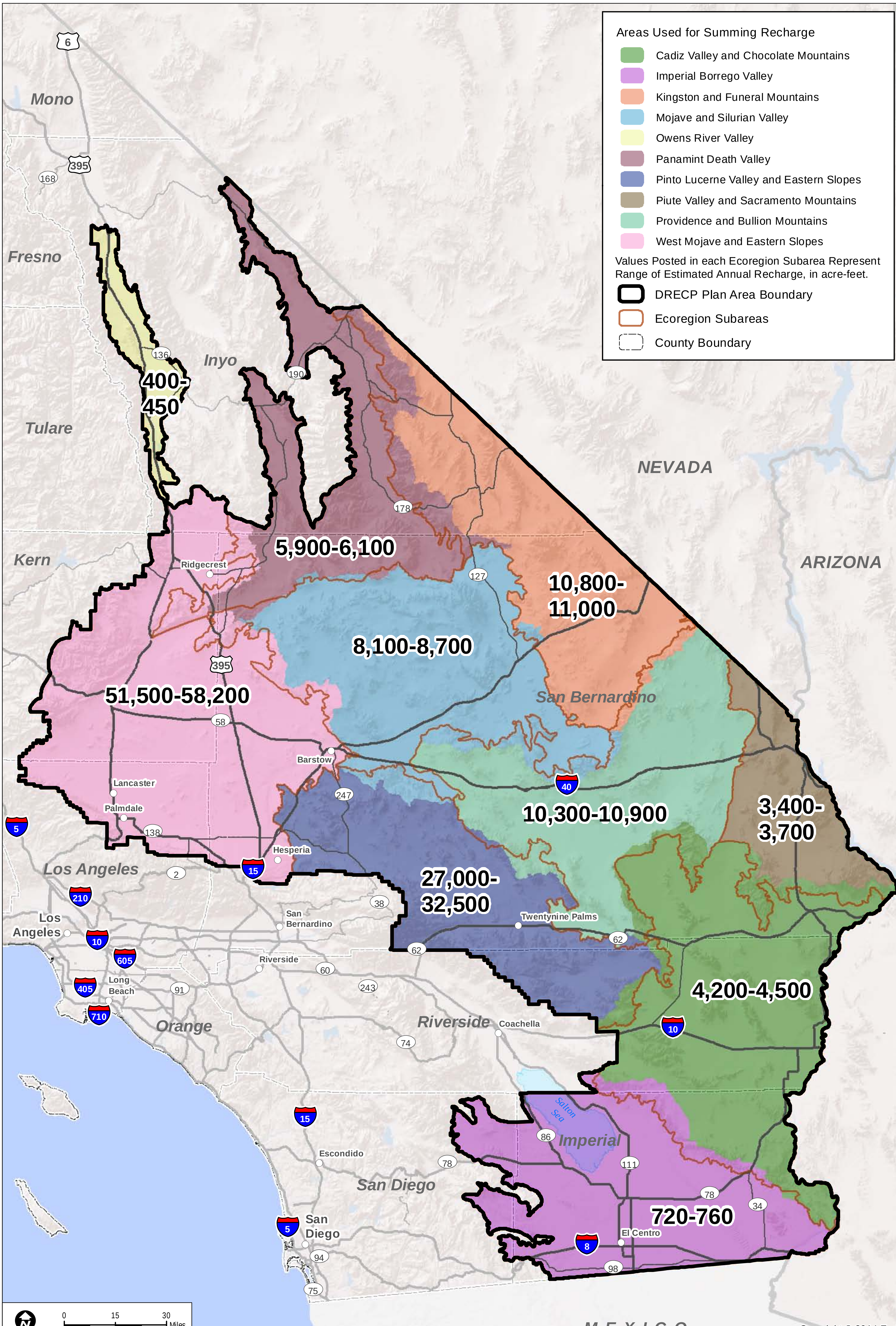
The USGS developed methods for estimating groundwater recharge for the large desert regions of the southwestern United States (Flint and Flint 2007). They employed a distributed-parameter water-balance model (Basin Characterization Model) that combines digital representations of topography, soils, geology, and vegetation with monthly precipitation and air-temperature data. Monthly potential evapotranspiration is estimated using a submodel for solar radiation that accounts for topographic shading, cloudiness, and vegetation density. Snowpack accumulation and melting are also modeled using precipitation and air-temperature data. For a 270-by-270-meter grid (approximately 890 by 890 feet grid) that covers the entire southwestern United States, the model computes monthly soil-water storage, in-place groundwater recharge, and runoff (potential stream flow). The model was not calibrated to recharge or runoff measurements, although results were compared with other recharge estimates at eight selected watersheds (one of the study-site basins, Mojave tributaries, is located in the Plan Area). The study area-wide average of simulated precipitation recharge, calculated as the sum of in-place recharge and 15% of the simulated runoff, ranged from 0.3% to 6% of average total precipitation; for the Mojave tributary study site, the simulated runoff was 2% of the total precipitation.

Figure III.6-7 shows a map of simulated average annual precipitation recharge for all Plan Area basins, summarized by ecoregion subarea. The recharge values represent the sum of simulated in-place precipitation recharge and from 0- to 15% of the simulated runoff. The internal Plan Area boundaries used for adding up the recharge values were modified somewhat from the Plan's ecoregion subarea boundaries to more closely follow internal watershed boundaries and thereby attribute recharge in some mountain areas to the correct internal basin area and ecoregion subarea. The mapped annual precipitation recharge results indicate that the values generally decrease from west to east. The recharge summed up and reported here does not include other potential sources of recharge like subsurface inflow, tributary inflows from adjacent areas outside the Plan Area, imported water supplies, and other components that can be relevant in some, but not all basins.

Watersheds and areas outside the overall general Plan Area boundary were not included in the recharge summation even though some of those areas may generate substantial amounts of surface runoff and subsurface inflow that could influence Plan Area basin water budgets. The rainfall recharge estimates in Figure III.6-7 can therefore underestimate total available recharge in some basins and ecoregion subareas. For example, the simulated average recharge within the boundaries of the Owens River Valley ecoregion subarea is only 400 to 450 acre-feet per year (Figure III.6-7), which is almost 2.5 orders of magnitude less than average recharge estimated for the valley by Danskin (1998), which used detailed water budget information that included tributary inflows. However, detailed evaluations like that reported for Danskin (1998) do not exist for most of the Plan Area. Therefore, the recharge estimates reported in Figure III.6-7 are limited, and do not represent absolute values for project specific analyses. They are rather approximate values for making relative comparisons between ecoregion subareas.

The precipitation recharge modeling shows that in-place recharge is significant only in the mountains; recharge is negligible in valley floor areas where all infiltrated rainfall is intercepted and consumed by plants (Hogan et al. 2004). On a per-area basis, basins with small valley floor areas and relatively extensive adjacent mountainous areas receive relatively large quantities of recharge. These variations among basins and differences between mountain and valley floor settings are obscured by the average ecoregion subarea values shown in Figure III.6-7. Detailed basin scale studies will be required for all projects planning to utilize groundwater as a water supply; these studies must identify and quantify the most significant components of groundwater recharge. Numerous previous investigations have used different methods and approaches to quantify the relationships between rainfall and estimated groundwater recharge in these desert environments (for example, Avon and Durbin [1994], Dettinger, [1989], Hevesi and others [2003], and Maxey Eakin [1950], to cite just a few).

The quantity of recharge in a basin is one factor influencing a basin’s capacity to support consumptive groundwater use on a sustainable, long-term basis. Natural discharge quantities (e.g., playas, springs, streams, and shallow-groundwater areas that support vegetation) also influence a basin’s capacity to support long-term consumptive groundwater use.



Sources: ESRI (2014); Flint and Flint (2007)

FIGURE III.6-7

Estimated Average Annual Recharge by Ecoregion Subarea Assuming 0- to 15-percent of Precipitation Runoff Becomes Recharge

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III.6.3.3.3 Discharge from Playas, Springs, Streams, and Shallow-Groundwater Areas

Groundwater can support vegetation or aquatic habitat where it discharges into playas, springs or streams, or where the water table is close enough to the land surface for plant roots to reach it. Detailed basin-scale studies are needed to identify and quantify the most significant components of groundwater discharge. The National Hydrography Dataset (NHD) represents the regional drainage network, and was used to map springs and playas in the Plan Area (Figure III 6-8). Following is a general assessment of these features, based on available regional scale information.

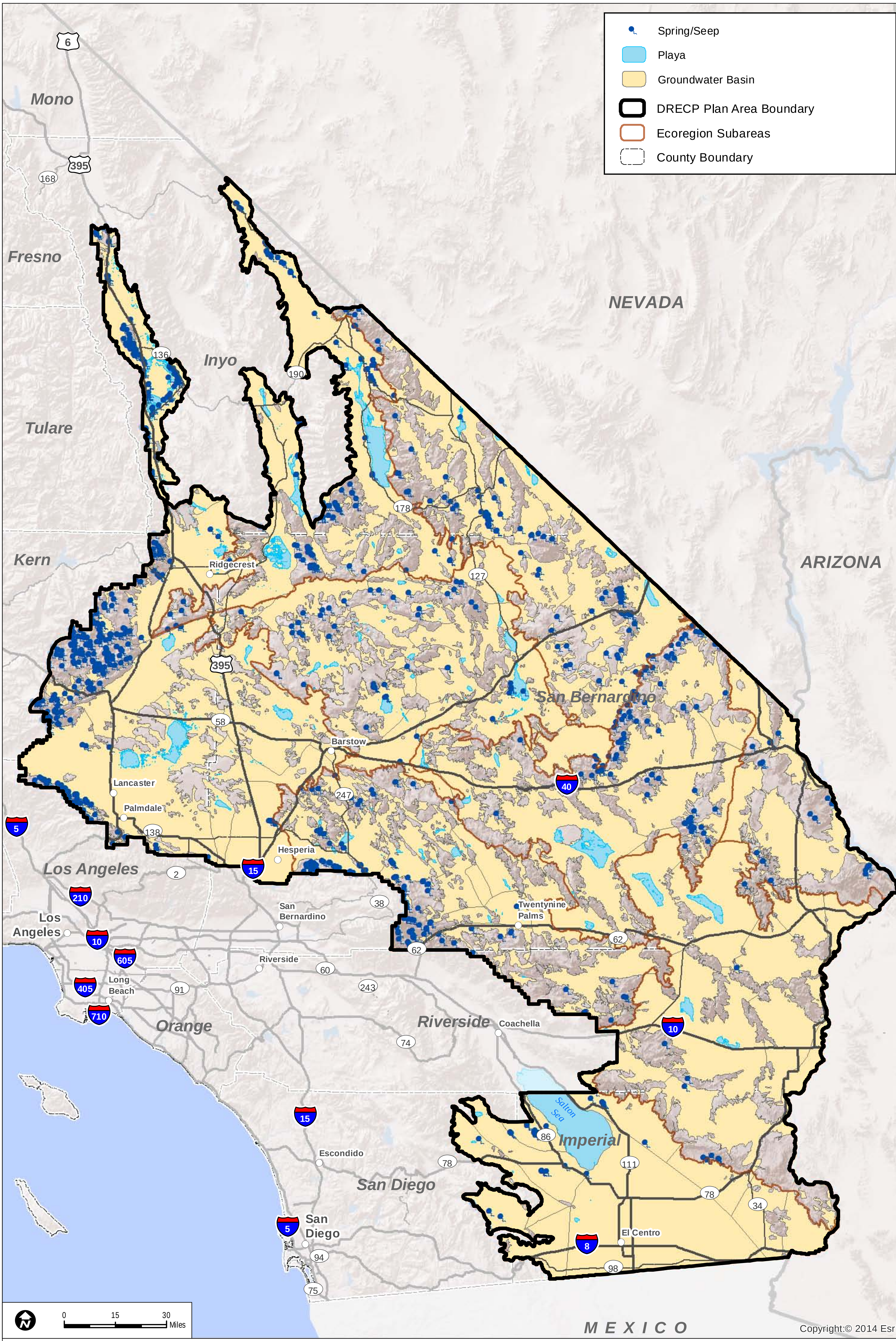
Plan Area basins containing playas appear in Figure III.6-8. Not all playas receive groundwater—for example, playas are also formed by the temporary ponding of runoff during significant mountain storm events. A reconnaissance-level survey of playa areas for groundwater discharge or shallow water-table conditions was therefore completed using aerial photo inspection (Google Earth). Photographs of all playas in the Plan Area were inspected, but the mapping method was ultimately only approximate. For example, if CDWR Bulletin 118 reported groundwater flow toward the playa, if open water was visible in the playa, or if denser/greener vegetation appeared around the shore of the playa, it was assumed that the playa receives groundwater. These results therefore confirmed the existence of groundwater-dependent habitats that are potentially sensitive to the effects of increased groundwater withdrawals within the Plan Area. However, since the reconnaissance was regional and not exhaustive in scope, basin scale investigations are additionally required to identify these conditions, relative to specific project assessments.

Springs are common in the Plan Area (Figure III.6-8), and most springs are found either in the mountain canyons between basins (mountain block springs) or in upper piedmont areas where mountain bedrock transitions into alluvial valley fill (mountain front springs). In the north-central portion of the Plan Area, one inventory of springs in the 2,500-square-mile Mojave National Preserve listed a total of 240 springs (Shepherd 1993). A comparison of that list against both USGS topographic maps and springs listed in the Colorado RWQCB Basin Plan confirm that most of the springs are in upland terrain. If the average density of springs in the Mojave National Preserve is typical of ridges and valleys in the Basin and Range Province, the total number of springs in the 35,300-square-mile Plan Area could be on the order of 3,400. Most of these inferred springs would presumably also be in the upland areas.

Mountain block springs generally appear together with localized flow systems, and are sustained from above by groundwater that percolates down through bedrock fractures in mountain blocks. Therefore, mountain block springs are generally hydraulically disconnected from valley fill aquifers. In contrast, mountain front springs are generally connected to valley fill aquifers. Evaluations of the effects of groundwater pumping from beneath the valley floor on mountain front springs must consider both the permeability contrasts between the mountain front transition zones where the springs are located, and the relatively less permeable valley floor alluvium where the pumping occurs.

Springs or shallow groundwater in valley floor areas are usually, but not always, associated with faults or narrow gaps between mountain blocks. Faults are abundant in the Plan Area, and many control groundwater flow (see Figure III.6-3). Wells on either side of faults sometimes have large differences in water levels. If permeability across a fault is sufficiently low, or if recharge is sufficiently high on the up-gradient side, the up-gradient groundwater levels can rise to the land surface and form springs that allow water to cross the fault as surface flow and support relatively thick stands of phreatophytes. The discharge typically percolates rapidly back into the ground on a fault's down-gradient side. Examples of these fault-induced springs are found in the Death Valley–Furnace Creek Fault Zone, the Surprise Spring Fault in the Deadman Valley Basin, and the San Andreas Fault in the Upper Santa Ana (Cajon) Basin. These alluvial groundwater basin springs can be vulnerable to groundwater pumping. For example, Surprise Spring, located in the Pahrump Valley basin, stopped flowing soon after pumping began in 1953, and all the mesquite trees dependent upon the spring died by 1985 (Londquist and Martin 1991). Springs supported by the regional carbonate aquifer in the northeastern part of the Plan Area can even be affected by pumping in adjacent basins. For example, springs along the eastern edge of the Death Valley basin could potentially be affected by pumping in the Middle Amargosa Valley or Greenwater Valley basins.

There are two examples along the Mojave River of shallow groundwater discharge-supported stream flow caused by narrowing of the alluvial cross-sectional area where it passes between two mountain blocks. At the "narrows" near Victorville, riparian vegetation lines the river channel and pools and there are intermittent flows along a 6-mile reach where alluvial narrowing and less permeable bedrock forces the water table up to the ground surface. Shallow groundwater supports phreatophytic vegetation as far as 0.5 mile from the channel. The river flows through a more pronounced bedrock gap area of thin alluvium at Afton Canyon (the downstream end of the Lower Mojave River Valley Basin). Riparian vegetation and persistent flow along this 4-mile reach of the river, because of steep terrain on either side, support phreatophytic vegetation for only 0.2 mile at its widest point.



Sources: ESRI (2014); National Hydrography Dataset

FIGURE III.6-8

Springs, Seeps, and Playas

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Shallow groundwater can support phreatophytic vegetation even if the water table does not intersect the ground surface to create surface flow. This appears to be the case at some playas classified as “discharging playas,” where denser and darker vegetation is visible in aerial photos but open water is not. Facultative phreatophytes such as mesquite have tap roots that can extend more than 100 feet below the ground surface. The growth habit reflects the depth to the water table—a taller, denser canopy, with a greater proportion of above-ground biomass, develops where the water table is shallow.

III.6.3.3.4 Interconnected Basins and Subsurface Flow

Some groundwater basins are hydrologically connected where water is exchanged between the basins as subsurface flow. This means that changes in water inflow or outflow conditions in one basin can potentially affect groundwater levels and storage conditions in adjacent basins. Three types of conditions allow groundwater flow between basins:

- **Alluvium is continuous between basins through a gap in bedrock**. Alluvium-filled gaps in the mountain ranges can allow groundwater to flow between basins. Examples include flow from the Middle Mojave River Valley Basin to the Harper Lake Valley Basin, from Lavic Valley to Broadwell Valley to Bristol Lake Basin, and from Pilot Knob to Brown Mountain Valley to Panamint Valley Basin.
- **Groundwater leaks across a fault boundary**. Many basins are bounded by relatively low permeability faults that obstruct groundwater flow and create large water-level differences across the fault. These faults are not always completely impervious, however, and regional gradients suggest they transmit some groundwater. Examples include the Pinto Mountain and Mesquite faults separating the Joshua Tree, Twentynine Palms and Dale Valley basins; the San Andreas Fault that separates the Ogilby Valley and Amos Valley basins from the Imperial Valley Basin; and the Coyote Creek–Superstition Mountain Fault that forms the boundary between the Borrego Valley and Ocotillo–Clark Valley basins.
- **Groundwater flows through regionally extensive limestone formations**. Exposed limestone formations can be bedrock in mountain ranges. Where these formations underlie alluvium, they transmit groundwater beneath and between the overlying alluvial basins. Examples include groundwater flow from the Greenwater Valley and Middle Amargosa Valley basins to springs along the east side of Death Valley Basin, and springs in the San Bernardino Mountains.

Figure III.6-9 groups the Plan Area basins that CDWR Bulletin 118 indicates are interconnected. There are other basins where flow between adjacent basins is likely, but where available geologic information and water-level data are insufficient to confirm existence of the flow. So even though available data do indicate that flow between basins is relatively common, it remains difficult to verify or quantify. Proposed renewable energy development applicants and existing grant holders will need to either collect or fund the collection of information so that the flow between interconnected basins can be adequately assessed and the effects of groundwater extraction on down-gradient conditions quantified.

III.6.3.3.5 Consumptive Use

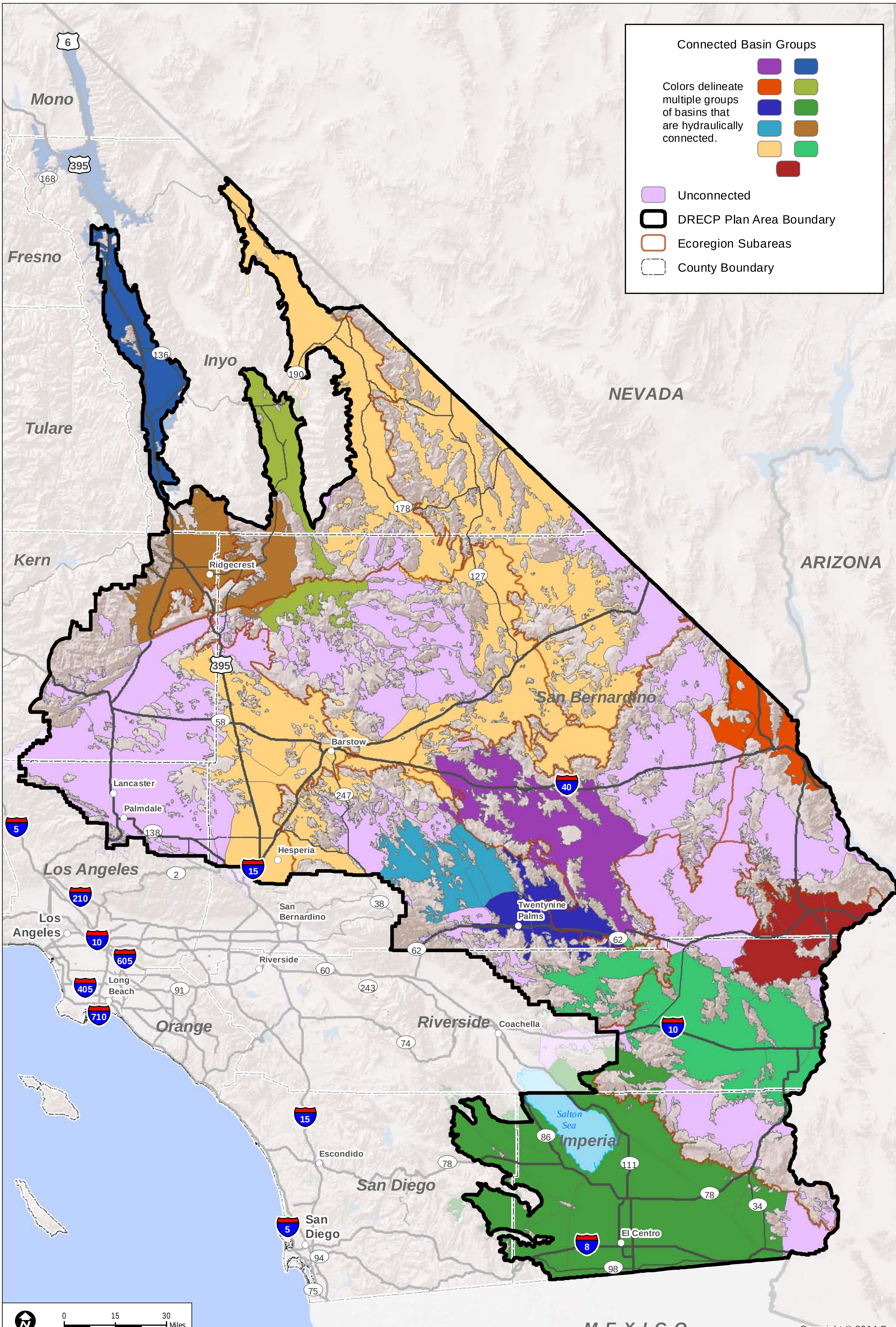
Irrigated Area

Water use in irrigated areas is one indicator of competition for groundwater. Where groundwater is used for irrigation, large areas of cropland indicate relatively heavy groundwater use. It also means that those users could be impacted by new future demands for additional groundwater. The current existence of large areas irrigated with groundwater does not necessarily mean that today's extraction rates are sustainable.

Figure III.6-10 shows cropland in the Plan Area. This figure shows that agriculture is predominantly in basins along the Colorado River, in Imperial Valley, along the Mojave River, and in Antelope Valley. All of these areas are supplied by imported surface water sources in addition to local groundwater. Some of these basins are adjudicated and administered through Watermasters. The inferred relatively large amount of water used in these basins does not necessarily imply either overdraft or, conversely, the long-term sustainability of current groundwater pumping. It rather illustrates the competition between water users. In adjudicated basins, Watermasters may require that new users acquire an existing right or allocation to access water.

Developed Area

Urban and rural land development other than agriculture also drives water demand. Water-dependent mining in the Bristol Lake area, as one example, extracts calcium and sodium chloride from a shallow aquifer. Large developed areas in a basin can also indicate strong competition among a large number of existing groundwater users for water yield. Developed lands in the Plan Area are shown in Figure III.6-11. The main developed areas, principally cropland, fall within many of the same basins but with slightly different proportions. The upper Mojave River Valley and portions of the Antelope Valley are highly developed areas, while the Imperial Valley and Colorado River floodplain areas are sparsely developed. Developed areas with little agriculture include the Morongo Valley–Yucca Valley–Twentynine Palms belt along Highway 62 in the central-west part of the Plan Area, and the Borrego Springs area in eastern San Diego County.



Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE III.6-9

Groundwater Basins with Evidence of Hydraulic Interconnection

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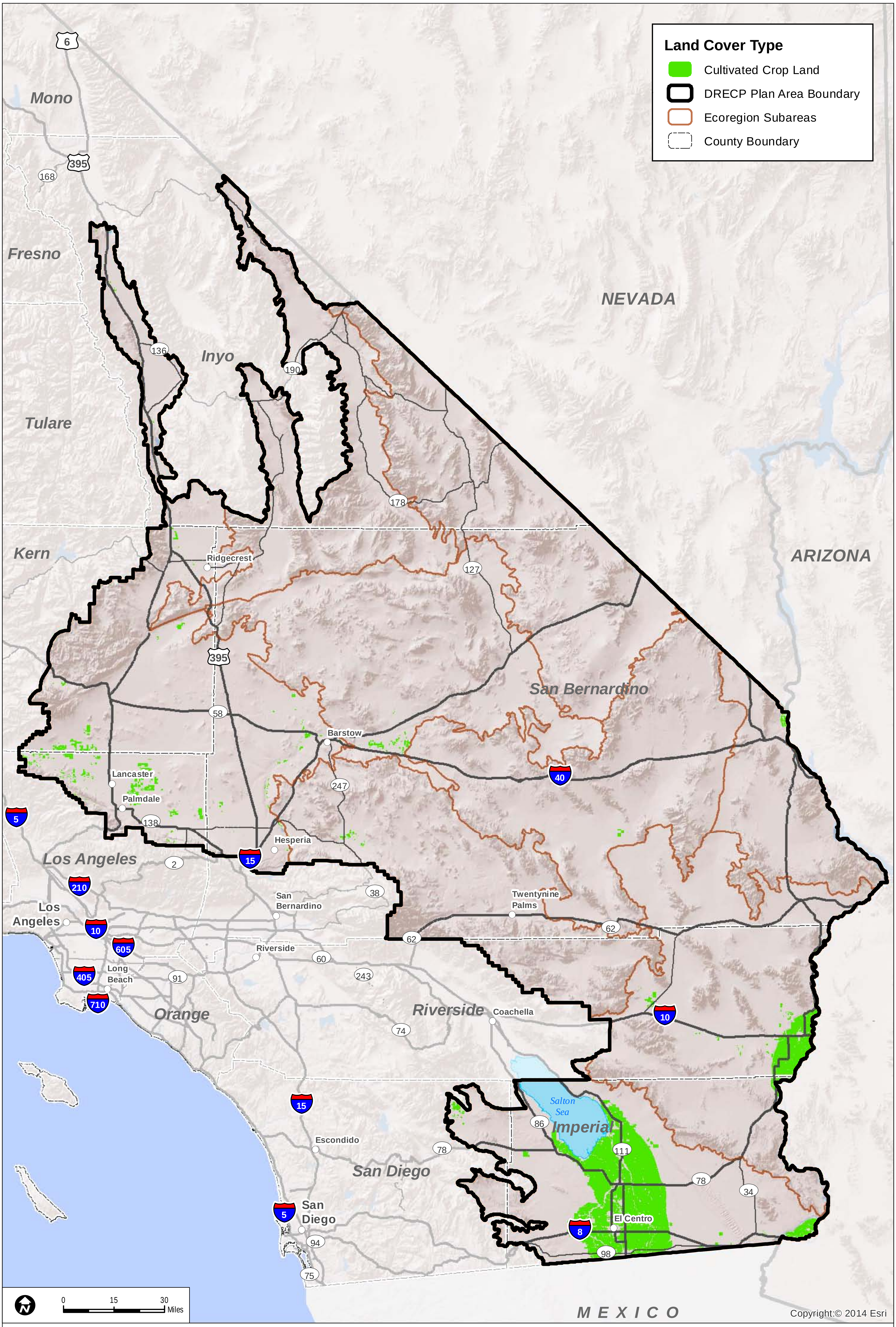

Sources: Modified from Figure II-5i, Preliminary Conservation Framework Strategy Report, DUDEK, May 2011; ESRI (2014)

FIGURE III.6-10

Cultivated Crop Land

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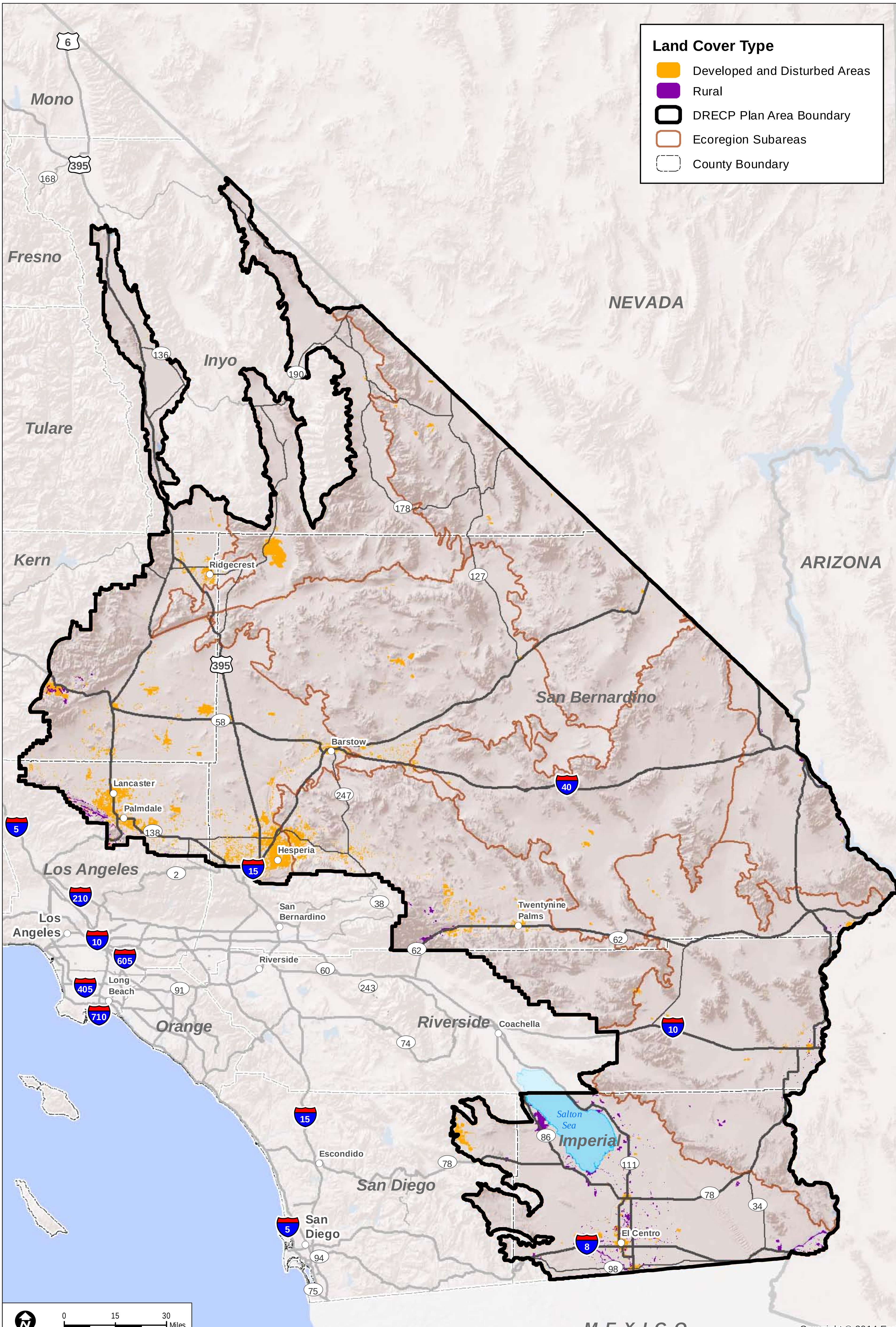

Sources: Modified from Figure II-5j, Preliminary Conservation Framework Strategy Report, DUDEK, May 2011; ESRI (2014)

FIGURE III.6-11

Developed and Disturbed Lands

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Water-Level Monitoring Wells

The number and distribution of water-supply wells, similar to land use, closely mirror groundwater use. And although water-level monitoring is not directly tied to basin water balance, it does indicate that local stakeholders are attempting to quantify and manage groundwater use.

Figure III.6-12 shows the locations of wells within the Plan Area that have measurements in the CDWR Water Data Library. Most of these are water supply wells, and their spatial pattern closely matches the developed land (see Figure III.6-11). Similar to land use factors, the number and distribution of these monitoring locations may indicate areas with existing groundwater users and a subsequent high competition for water.

Estimated Groundwater Use

As part of the CASGEM Program legislation, CDWR is required to prioritize California groundwater basins to identify, evaluate, and determine the need for both seasonal and long-term groundwater-level monitoring. Estimated groundwater use was one factor in the statewide groundwater volume information presented in the 2005 DWR Land and Water Use (LWU) survey data, which were compiled based on county boundaries and Detailed Analysis Unit areas. The CDWR region staff verified groundwater use, by basin, through aerial photography, local groundwater management plans, Bulletin 118 data, and other available information sources. However, detailed evaluations are required for project-specific assessments. For purposes of this regional assessment, the CDWR results provide approximate values representing general basin-by-basin trends within the Plan Area.

Figure III.6-13 shows groundwater use in the Plan Area, by basin. The highest-use levels are in western basin areas with substantial areas of disturbed lands (Figure III.6-11), and for wells with water-level data (Figure III.6-12).

III.6.3.4 Subsidence

III.6.3.4.1 Water Supply Well Extractions

When groundwater is pumped from an aquifer, the fluid pressure in voids between the sediment grains decreases so that sediment beds can compact. The compaction of sediment beds causes lowering of the overlying land surface elevation, or subsidence. Measureable amounts of subsidence are typically associated with large water-level declines over a broad area. Subsidence is a potential risk in most or all of the Plan Area groundwater basins.

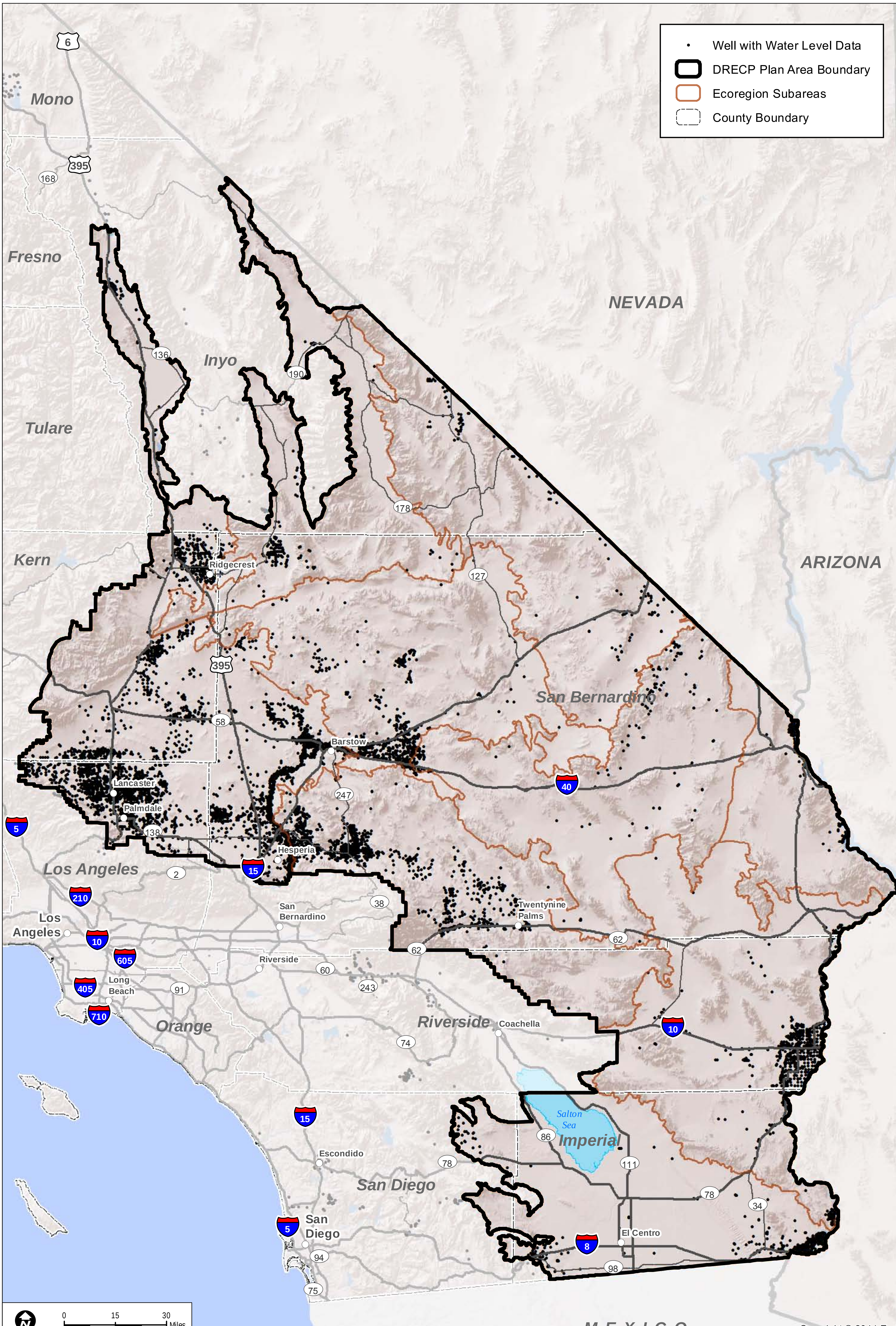
The degree of subsidence depends upon the amount of groundwater-level lowering and the compressibility of sediments. In the western portion of the Plan Area, groundwater levels in some basins have declined more than 100 feet from predevelopment conditions. For example, in the Antelope Valley up to 6 feet of subsidence occurred between 1950–1990 from groundwater pumping and associated water-level declines of up to 90 feet (Londquist et al. 1993). There have also been water-level declines of many tens of feet during the second half of the 20th century in basins along the Mojave River, and farther east from the Lucerne Valley to Morongo Valley Region. Concurrent geodetic monitoring was only implemented in the Lucerne Valley Basin, however, where up to 2 feet of subsidence were recorded (Sneed et al. 2003).

The effects of subsidence can sometimes be obvious (with ground fissures and changes in surface drainage patterns), and largely undetected in other areas. Subsidence can continue for decades even in the absence of further water-level declines because substantial time is required for pore-pressures within the clay beds and adjacent aquifer materials to equalize. Subsidence creates an irreversible loss in aquifer storage capacity.

III.6.3.4.2 Geothermal Extractions

Most existing geothermal energy production in the Plan Area is in or near Imperial Valley, where commercial geothermal production dates back to 1961 (Singer 2004). Proposed additional geothermal leasing by the BLM is in the adjacent West Chocolate Mountains area (Bureau of Land Management 2011). The BLM is also considering leases in the area of the Coso Geothermal Field, north of Ridgecrest, in the Haiwee Geothermal Leasing Area. Depending on local hydrogeology, well depth, and method of operation, withdrawal of fluids by geothermal wells can potentially cause both downward water leakage from overlying water supply aquifers and land subsidence.

The risk of inducing downward flow to geothermal wells from overlying water-supply aquifers is typically minimized by the large depth difference between most water supply wells and most geothermal wells. For example, water supply wells in the Imperial Valley area are typically 350-1,300 feet deep (Loeltz et al. 1975; Alward and Shatz 2009), whereas geothermal wells in the nearby Salton Sea, New Truckhaven and Orita project areas are 3,000-14,325 feet deep, with typical depths in the 5,000-8,000 foot range (Singer 2004; Nevada Geothermal Inc. 2011; Ram Power Corporation 2010). The potential for deep fluid extraction to affect shallower aquifers also depends on the type and extent of geologic layers in the depth interval between the geothermal well screen and nearby water well screens.



Sources: ESRI (2014); California Department of Water Resources' Water Data Library (www.water.ca.gov/waterdatalibrary)

FIGURE III.6-12

Locations of Wells with Water Level Data

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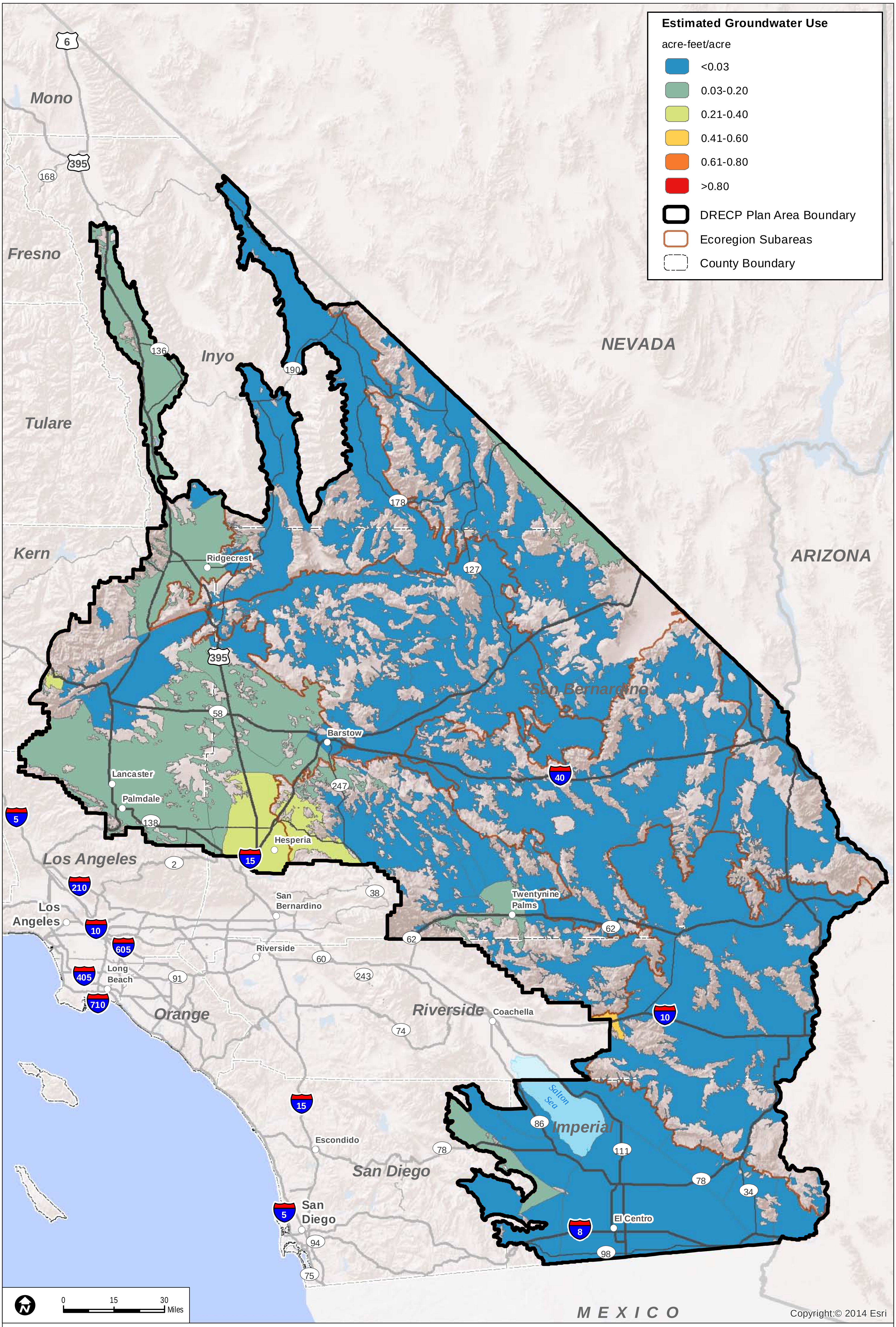

Sources: DWR, California Groundwater Elevation Monitoring, Basin Prioritization Process, December 2013; ESRI (2014)

FIGURE III.6-13
Estimated Groundwater Use

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All basins in the Plan Area are at risk of subsidence (Bureau of Land Management 2008), and concerns over that issue caused long delays in development of the Imperial Valley geothermal fields. In extreme cases, geothermal well operation has caused up to 42 feet of subsidence in other parts of the world (Wairakei, New Zealand), but so far there is evidence of little if any geothermal subsidence in the Imperial Valley (Northern Arizona University 2011).

III.6.3.5 Water Quality

III.6.3.5.1 Groundwater Salinity

Groundwater salinity can significantly vary within individual groundwater basins, particularly in basins with discharging playas (see Figure III.6-8 for playa locations). Highly saline playas are characteristic of the Plan Area. Groundwater evaporation from the playa surface leaves salts behind, which accumulate over geologic time to form brines many times saltier than seawater. These hypersaline brines are generally restricted to shallow aquifers in the immediate vicinity of the playa. However, groundwater pumping from wells in a basin can alter—and even reverse—natural groundwater flow directions and cause the brines to migrate away from the playa into areas that formerly contained fresh groundwater.

Figure III.6-14 shows an approximate map of average salinity in the Plan Area groundwater basins tabulated from basin descriptions in Bulletin 118 (California Department of Water Resources 2003). Salinity is represented here as the concentration of total dissolved solids (TDS). Water quality data are typically very sparse; some basins have no data and others have only one or two data points. Basins with several data points often include one or two values that are much higher than the rest. In some cases, these outliers were omitted from averaging so that the result would not be biased by local high-salinity conditions associated with a single playa. The color-coded salinity ranges correspond to suitability for beneficial uses. TDS concentrations less than 1,000 milligrams per liter (mg/L) meet secondary drinking water standards (for short-term use), and concentrations less than 3,000 mg/L are generally considered usable for irrigation.[3] Higher-salinity ranges are also shown, but those averages might be influenced by relatively high outliers.

About 6% of the sub-basin areas in the Cadiz Valley and Chocolate Mountains ecoregion subarea are disturbed (agriculture or developed areas). The Palo Verde Valley and Palo Verde Mesa are the most disturbed, with 92% and 21% of their areas already disturbed, respectively. Most of the disturbance is for agriculture (82%), and the Palo Verde Valley Basin receives imported water. Five of the sub-basins have no mapped disturbance:

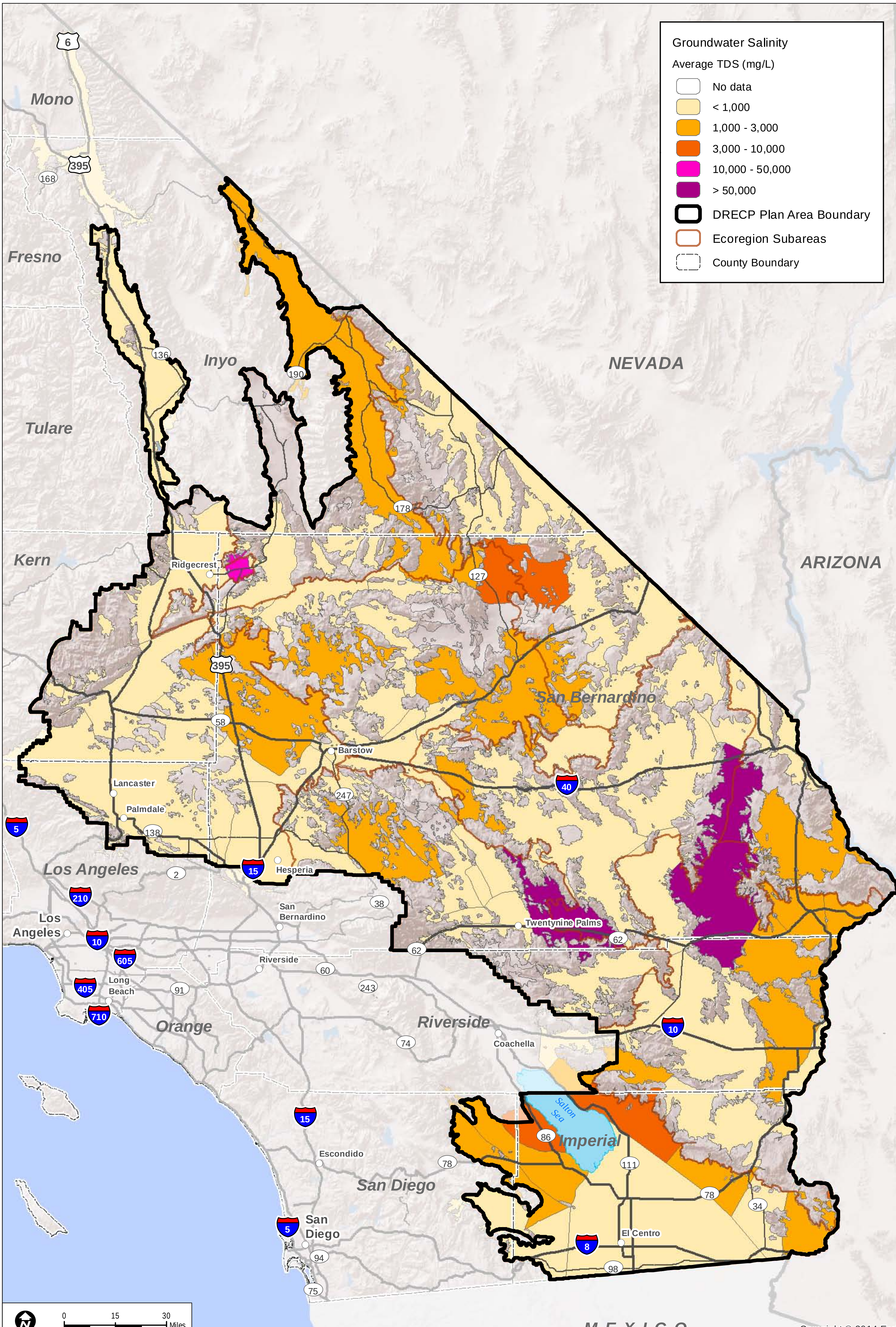
[3] 1 milligram per liter (mg/l) is the same as 1 part per million (ppm).

Bristol Valley, Chocolate Valley, East Salton Sea, Ogilby Valley, and Pinto Valley. A proposed aquifer storage and recovery project, the Cadiz Valley Water Project, is expected to produce billions of gallons of groundwater and storage space to bank surface water. The EIR for this project was certified by the Santa Margarita Water District (lead agency) in July 2012, and was approved by San Bernardino County in October 2012. The most significant renewable energy project development is in the Chuckwalla Valley, where more than 6,000 acres and over 800 megawatts of solar thermal and solar PV are either under construction or operational.

Within the Cadiz Valley and Chocolate Mountains ecoregion subarea, 10 of the 18 basins are partly or entirely within the Colorado River Aquifer, and 4 additional basins are possibly tributary to the river aquifer. Twelve of the basins within this ecoregion subarea are hydraulically connected, meaning that water may be exchanged between adjacent basins as subsurface flow, and one basin, Cadiz Valley, has a discharging playa.

The regional average annual precipitation recharge estimate for the Cadiz Valley and Chocolate Mountains ecoregion subarea is about 4,000 acre-feet/year (Figure III 6-7). This recharge is the total for areas within the ecoregion subarea, including mountain block areas between groundwater basins. However, it is a minimum estimate for recharge because it excludes potential irrigation return flows and rainfall in watershed areas outside the overall general Plan Area. The runoff from these outside watershed areas may generate substantial amounts of additional recharge as either percolating runoff or subsurface inflow. Additional discussion of the rainfall recharge estimates appears in Section III.6.3.3.2.

Groundwater storage capacity of the Cadiz Valley and Chocolate Mountain ecoregion subarea is approximately 43 million acre-feet (almost 19 acre-feet per acre [AF/Ac]), which was calculated by prorating the Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 25 to 1,800 gpm and average 450 gpm; 4 of the 18 basins (22%) have no reported well-yield data. More than 900 wells with water-level data in the CDWR data library are in this ecoregion subarea, and most are located in the Palo Verde Mesa (53%) and Palo Verde Valley (23%) basins.



Sources: ESRI (2014); California Department of Water Resources (2003)

FIGURE III.6-14

Average Groundwater Salinity

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Average TDS concentrations in the Cadiz Valley and Chocolate Mountains ecoregion subarea reportedly range from 300 mg/L to almost 150,000 mg/L. The predominant ions present in the groundwater include sodium, calcium, bicarbonate, chloride, and sulfate, and the concentrations of these ions can be high in some basins. In areas near playas, the groundwater is typically high in sodium and chloride. Significant concentrations of boron, fluoride, arsenic, and selenium are reportedly present in water extracted from some of the basins; uranium and radon concentrations in the Orocopia Valley are reported to be higher than allowable for drinking water standards (CDWR Bulletin 118).

Table III.6-2
California Department of Water Resources Basins in the Cadiz Valley and Chocolate Mountains Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,5]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin[3,5]*
7-34	Amos Valley	129,900	3,300	100	0
7-37	Arroyo Seco Valley	256,500	256,500	2,200	0
7-8	Bristol Valley	496,600	100	0	0
7-7	Cadiz Valley	269,800	239,900	1,200	0
7-41	Calzona Valley	80,600	78,000	3,900	0
7-32	Chocolate Valley	129,100	63,400	0	0
7-5	Chuckwalla Valley	601,500	593,200	10,800	6,100
7-33	East Salton Sea	194,800	15,700	0	0
7-35	Ogilby Valley	133,200	500	0	0
7-31	Orocopia Valley	96,200	16,600	500	0
7-39	Palo Verde Mesa	225,000	225,000	47,700	200
7-38	Palo Verde Valley	73,000	72,800	66,800	0
7-6	Pinto Valley	182,400	2,100	0	0
7-40	Quien Sabe Point Valley	25,100	25,100	1,000	0
7-4	Rice Valley	188,100	186,900	1,000	0
7-42	Vidal Valley	137,700	127,700	1,600	0
7-3	Ward Valley	557,600	352,900	900	0
7-36	Yuma Valley	124,000[4]	21,900	100	0

1 Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.

2 The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.

3 Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.

4 The area reported in Bulletin 118 is only 3,780 acres. Based on the map information provided by the CDWR, the acreage reported in Bulletin 118 appears to be wrong.

5 The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

III.6.3.6 Imperial Borrego Valley Ecoregion Subarea

The Imperial Borrego Valley ecoregion subarea contains all or portions of 12 mapped groundwater basins totaling 2,170,000 acres. Table III.6-3 lists the basin names, total basin areas, and sub-basin areas. Additionally, Table III.6-3 shows sub-basin areas that are disturbed by either agriculture or other developed land uses, and the footprint for existing renewable energy projects, in acres, where mapped locations fall within the sub-basins (see Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries).

Six of the 12 basins listed in Table III.6-3 are almost entirely within the Imperial Borrego Valley ecoregion subarea, or at least 90% of each of these basins. These 6 sub-basins represent 71% of the Borrego Valley ecoregion subarea: Amos Valley, Borrego Valley, Coyote Wells Valley, Imperial Valley, Ocotillo–Clark Valley, and Ogilby Valley basins. Of the remaining 6, 2 sub-basins represent less than 10% of their total basin area: Chocolate Valley and Coachella Valley-Indio. These two sub-basins together represent less than 0.5% of the ecoregion subarea.

Almost 30% of the sub-basin areas in the Imperial Borrego Valley ecoregion subarea are disturbed land areas. Most of the disturbance is for agriculture (85%), and three basins (the Coyote Wells Valley, Imperial Valley, and Ocotillo–Clark Valley) receive imported water. The Imperial Valley is the most disturbed sub-basin, with 56% of its area disturbed. Only two sub-basins have little to no disturbance – Chocolate Valley and Vallecito-Carrizo Valley. The most significant renewable energy project development is in the Imperial Valley (8,500 acres), which includes some acreage in the West Salton Sea. Less acreage of existing renewable energy project development is in Borrego Valley and Coyote Wells Valley (less than 100 acres each).

Within the Imperial Borrego Valley ecoregion subarea all of the basins are hydraulically connected (groundwater may flow between the connected basins) and groundwater in some areas flows to the Salton Sea. Three of the 12 basins are partly or entirely within the Colorado River Aquifer, and one additional basin might be tributary to the Colorado River Aquifer.

**Table III.6-3
California Department of Water Resources Basins in the Imperial Borrego Valley Ecoregion Subarea of the DRECP**

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,5]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*[3]
7-34	Amos Valley	129,900	126,600	2,000	0
7-24	Borrego Valley	152,500	139,700	14,800	< 100
7-32	Chocolate Valley	129,100	8,800	0	0
7-21.01	Coachella Valley-Indio	297,000	1,000	300	0
7-29	Coyote Wells Valley	145,600	134,800	2,200	< 100
7-33	East Salton Sea	194,800	174,000	22,100	0
7-30	Imperial Valley	957,600	956,100	539,700	8,500
7-25	Ocotillo–Clark Valley	222,100	211,000	17,700	0
7-35	Ogilby Valley	133,200	132,500	2,900	0
7-28	Vallecito–Carrizo Valley	121,700	96,900	< 100	0
7-22	West Salton Sea[4]	105,300	87,000	12,800	0
7-36	Yuma Valley	124,000	102,000	25,600	0

1 Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.

2 The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.

3 Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.

4 Groundwater storage capacity not reported for this basin in CDWR Bulletin 118.

5 The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

The regional average annual precipitation recharge estimate for the Imperial Borrego Valley ecoregion subarea is less than 800 acre-feet/year (Figure III 6-7). This number is the total for areas within the ecoregion subarea, including mountain block areas between groundwater basins. However, the recharge estimate is a minimum value because it excludes potential irrigation return flows and rainfall in watershed areas located outside the Plan Area. The runoff from these outside watershed areas may generate substantial amounts of additional recharge as either percolating runoff or subsurface inflow. Additional discussion of the rainfall recharge estimates appears in Section III.6.3.3.2.

Groundwater storage capacity of the Imperial Borrego Valley ecoregion subarea is reported for 11 of the 12 groundwater basins. Storage capacity for the West Salton Sea is not reported. The groundwater storage capacity of these 11 basins is approximately 38 million acre-feet (18 AF/Ac), which is an estimate calculated by pro-rating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 40 to 1,880 gpm; five 5 of the 12 basins have no reported well-yield data. Two of the basins (Imperial Valley and West Salton Sea) contain geothermal extractions. More than 500 wells with water-level data in the CDWR Water Data Library are in this ecoregion subarea. Most of the wells are found in the Yuma Valley (59%), Coyote Wells Valley (13%), Imperial Valley (12%), and Ogilby Valley (10%) basins.

Average TDS concentrations in the Imperial Borrego Valley ecoregion subarea basins reportedly range from 680 to 5,800 mg/L. Most of the basins have high TDS values, and the water is marginal to poor for domestic use. The predominant ions present in the groundwater include sodium, chloride, and sulfate, and the concentrations of these ions can be high. There reportedly are also significant concentrations of boron, fluoride, and nitrate in some basins; the Imperial Valley groundwater quality is also degraded by recharge from the New River.

III.6.3.7 Kingston and Funeral Mountains Ecoregion Subarea

The Kingston and Funeral Mountains ecoregion subarea contains all or portions of 15 mapped groundwater basins, with a combined area totaling 1,490,000 acres. Table III.6-4 lists the basin names, total basin areas, and sub-basin areas within this ecoregion subarea. Additionally, Table III.6-4 reports the sub-basin areas that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins (see Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries).

Table III.6-4
Department of Water Resources Basins in the
Kingston and Funeral Mountains Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,5]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
			Sub-Basin Area	*Developed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*[4]
6-79	California Valley[3]	58,100	58,100	< 100	0
6-18	Death Valley	919,800	43,500	400	0
6-85	Gold Valley[3]	3,200	3,200	0	0

Table III.6-4
Department of Water Resources Basins in the Kingston and Funeral Mountains Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,5]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
			Sub-Basin Area	*Developed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*[4]
6-84	Greenwater Valley[3]	59,800	59,800	600	0
6-30	Ivanpah Valley	197,900	195,700	800	3,500[4]
6-31	Kelso Valley	254,600	115,300	100	0
6-21	Lower Kingston Valley	239,600	141,700	0	0
6-29	Mesquite Valley	88,100	88,000	200	0
6-20	Middle Amargosa Valley	389,500	389,400	3,500	0
6-28	Pahrump Valley	92,800	92,800	100	0
6-86	Rhodes Hill Area[3]	15,600	13,500	0	0
6-23	Riggs Valley	87,500	9,800	0	0
6-34	Silver Lake Valley	35,200	2,900	0	0
6-33	Soda Lake Valley	379,800	100,000	0	0
6-22	Upper Kingston Valley	176,700	176,700	800	0

1 Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.

2 The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.

3 Groundwater storage capacity not reported for these basins in CDWR Bulletin 118.

4 Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.

5 The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

Eight of the 15 basins listed in Table III.6-4 are almost entirely within the Kingston and Funeral Mountains ecoregion subarea (90% or more of their basin areas are located in the ecoregion subarea). These 8 sub-basins represent 43% of the Funeral Mountains ecoregion subarea. These are sub-basins of the California Valley, Gold Valley, Greenwater Valley, Ivanpah Valley, Mesquite Valley, Middle Amargosa Valley, Pahrump Valley, and Upper Kingston Valley basins. Of the remaining 7 sub-basins, 2 represent less than 10% of their basins (Death Valley and Silver Lake Valley). These seven sub-basins together represent 17% of the ecoregion subarea.

Less than 1% of the sub-basin areas in the Kingston and Funeral Mountains ecoregion subarea are disturbed. There is no agricultural disturbance, and no basins receive imported water. Six of the 15 sub-basins have no mapped disturbance: Gold Valley, Lower Kingston Valley, Rhodes Hill Area, Riggs Valley, Silver Lake Valley, and Soda Valley. The only existing renewable energy project development is in the Ivanpah Valley (3,500 acres).

All of the basins within the Kingston and Funeral Mountains ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and four basins have discharging playas: Death Valley, Mesquite Valley, Middle Amargosa Valley, and Soda Lake Valley basins. Generally, groundwater flow in this region has two components: deep groundwater flow associated with the regional carbonate aquifer system, and flow in the overlying alluvial basins from the Mojave River drainage area north into the Amargosa/Death Valley area. Both of these flow paths terminate in the groundwater sink that is Death Valley. The Amargosa River is located in the Lower Kingston Valley and Middle Amargosa Valley basins, and the river has been designated a Wild and Scenic River. There are concerns that groundwater extraction by projects may deprive the river of flow needed to sustain the resources protected by this designation.

The regional average annual precipitation recharge estimate for the Kingston and Funeral Mountains ecoregion subarea is about 11,000 acre-feet/year (Figure III 6-7). This number is the total for recharge within the ecoregion subarea, including mountain block areas between groundwater basins. However, the estimate is a minimum value because it excludes precipitation in watershed areas outside the Plan Area. The runoff from these outside watershed areas may generate substantial amounts of additional recharge as either percolating runoff or subsurface inflow. Discussion of the rainfall recharge estimates appears in Section III.6.3.3.2. Additionally, the Kingston and Funeral Mountains ecoregion subarea receives flow from a regional carbonate aquifer adjoining areas in Nevada, including the Upper Amargosa Valley and the Pahrump Valley. This component of recharge is not included in the above estimate.

Groundwater storage capacity is reported for 11 of the 15 groundwater basins in the Kingston and Funeral Mountains ecoregion subarea. The groundwater storage capacity of these 11 basins is approximately 21 million acre-feet (15 AF/Ac), which was calculated by pro-rating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 24 to 2,500 gpm; eight of the 15 basins have no reported well-yield data. More than 100 wells with water level data reported in the CDWR Water Data Library are in this ecoregion subarea, and most are in only three 3 of the 15 basins: Middle Amargosa Valley (51%), Ivanpah Valley (25%), and Pahrump Valley.

Average TDS concentrations in the Kingston and Funeral Mountains ecoregion subarea reportedly range from 340 to 6,963 mg/L. Predominant ions in the groundwater include sodium, bicarbonate, calcium, magnesium, and sulfate, and the concentrations of these ions can be high in some basins. In areas near playa lakes, the groundwater is typically high in sodium and chloride. There are also reportedly significant concentrations of fluoride, boron, and chloride in some basins.

III.6.3.8 Mojave and Silurian Valley Ecoregion Subarea

The Mojave and Silurian Valley ecoregion subarea contains all or portions of 28 mapped groundwater basins, with a combined area totaling 1,784,000 acres. Table III.6-5 lists the basin names, total basin areas, and sub-basin areas within this ecoregion subarea. Additionally, Table III.6-5 reports the sub-basin areas that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins (see Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries).

Fourteen of the 28 basins listed in Table III.6-5 are almost entirely within the Mojave and Silurian Valley ecoregion subarea (90% or more of the area of each of these basins). These 14 sub-basins represent 32% of the Mojave and Silurian Valley ecoregion subarea. These are sub-basins of the Avawatz Valley, Bicycle Valley, Coyote Lake Valley, Cronise Valley, Denning Spring Valley, Goldstone Valley, Grass Valley, Langford Valley-Langford Well Lake, Langford Valley-Irwin, Leach Valley, Pilot Knob Valley, Red Pass Valley, Silver Lake Valley, Superior Valley basins. Of the remaining 14 sub-basins, seven represent less than 10% of their basins: Cady Fault Area, Death Valley, Fremont Valley, Harper Valley, Lavic Valley, Owl Lake Valley, and Searles Valley. These 7 sub-basins together represent about 3% of the ecoregion subarea.

Less than 2% of the sub-basin areas in the Mojave and Silurian Valley ecoregion subarea is disturbed. Agriculture represents 28% of the disturbed land area, and only one of the basins (Lower Mojave River Valley) receives imported water. Langford Valley-Irwin is the most disturbed, with 30% of its sub-basin disturbed. Eleven sub-basins have no mapped disturbance, and there is no renewable energy development.

Table III.6-5
California Department of Water Resources Basins in the Mojave and Silurian Valley Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,5]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*[3]
6-26	Avawatz Valley	27,600	27,600	0	0
6-25	Bicycle Valley	89,400	89,400	1,600	0
6-90	Cady Fault Area[4]	7,900	600	0	0
6-38	Caves Canyon Valley	72,900	54,800	300	0
6-37	Coyote Lake Valley	88,000	88,000	600	0
6-35	Cronise Valley	126,200	126,200	0	0
6-50	Cuddeback Valley	94,800	18,800	200	0
6-18	Death Valley	919,800	41,800	0	0
6-78	Denning Spring Valley[4]	7,200	7,200	0	0
6-46	Fremont Valley	335,000	17,700	100	0
6-48	Goldstone Valley	28,100	28,100	300	0
6-77	Grass Valley[4]	10,000	10,000	0	0
6-47	Harper Valley	409,200	7,800	< 100	0
6-31	Kelso Valley	254,600	129,000	< 100	0
6-36.01	Langford Valley–Langford Well Lake	19,300	19,300	600	0
6-36.02	Langford Valley–Irwin	10,500	10,500	3,100	0
7-14	Lavic Valley	102,200	4,300	0	0
6-27	Leach Valley	60,900	60,900	300	0
6-21	Lower Kingston Valley	239,600	97,900	0	0
6-40	Lower Mojave Valley	285,300	200,100	17,300	0
6-88	Owl Lake Valley[4]	22,200	600	0	0
6-51	Pilot Knob Valley	138,500	135,900	300	0
6-24	Red Pass Valley	96,200	96,200	200	0
6-23	Riggs Valley	87,500	77,700	0	0
6-52	Searles Valley	196,900	14,700	< 100	0
6-34	Silver Lake Valley	35,200	32,200	0	0

Table III.6-5
California Department of Water Resources Basins in the Mojave and Silurian Valley Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,5]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin[3]*
6-33	Soda Lake Valley	379,800	266,200	600	0
6-49	Superior Valley	120,200	120,200	300	0

1 Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
2 The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
3 Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
4 Groundwater storage capacity not reported for these basins in CDWR Bulletin 118.
5 The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

Thirteen of the basins within the Mojave and Silurian Valley ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and 4 basins have discharging playas: Death Valley, Fremont Valley, Searles Valley, and Soda Lake Valley. The Amargosa River is located in the Lower Kingston Valley and Death Valley basins, and the river has been designated a Wild and Scenic River. There are concerns that groundwater extraction by projects may deprive the river of flow needed to sustain the resources protected by this designation.

The regional average annual precipitation recharge estimate for the Mojave and Silurian Valley ecoregion subarea is less than 9,000 acre-feet/year (Figure III 6-7). This number is the total for areas within the ecoregion subarea, including mountain block areas between groundwater basins. However, the estimate is a minimum value because it excludes precipitation in watershed areas outside the Plan Area. The runoff from these outside watershed areas may generate substantial amounts of additional recharge as either percolating runoff or subsurface inflow. Discussion of the rainfall recharge estimates appears in Section III.6.3.3.2.

Groundwater storage capacity is reported for 24 of the 28 groundwater basins in the Mojave and Silurian Valley ecoregion subarea. The groundwater storage capacity of these 24 basins is approximately 40 million acre-feet (23 AF/Ac), which was calculated by pro-rating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 80 to 1,000 gpm; 14 of the 28 basins have no reported well-yield data. More than 750 wells with water-level data in the CDWR Water Data Library are in this ecoregion subarea, and most of these wells are found in Lower Mojave River Valley (70%) and Langford Valley–Irwin (12%).

Average TDS concentrations in the Mojave and Silurian Valley ecoregion subarea range from 418 to 6,963 mg/L. The predominate ions present in the groundwater include sodium, calcium, chloride, sulfate, and bicarbonate. There are also significant concentrations of boron, fluoride, iron, and nitrate in some groundwater basins. The Lower Mojave River Valley Basin contains nine LUST sites and one Superfund site contaminated with TCE, MTBE, BTEX, and other petroleum-based compounds.

III.6.3.9 Owens River Valley Ecoregion Subarea

The Owens River Valley ecoregion subarea contains all or portions of two mapped CDWR groundwater basins; 381,000 acres are within this ecoregion subarea. Table III.6-6 lists the basin names, total basin areas, and sub-basin areas within this ecoregion subarea. Additionally, Table III.6-6 reports the sub-basin areas that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins (see Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries).

The Owens River Valley ecoregion subarea contains a portion of only two CDWR ground-water basins, the Owens Valley (53%) and Rose Valley (79%). Less than 2% of these sub-basins are disturbed, and there is no renewable energy development. Neither basin receives imported water. Both basins are hydraulically connected, and the Owens Valley Basin has a discharging playa.

Table III.6-6
California Department of Water Resources Basins in the Owens River Valley Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,4]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,4]		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*[3]
6-12	Owens Valley	660,700	347,200	5,900	0
6-56	Rose Valley	42,500	33,700	1,000	0

1 Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
2 The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
3 Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
4 The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

The regional average annual precipitation recharge estimate for the Owens River Valley ecoregion subarea totals less than 500 acre-feet/year (Figure III 6-7). This relatively small number is for basin boundaries within the Plan Area only, which in the Owens Valley includes only the southern part of the valley floor. As noted in Section III.6.3.3.2, other factors contribute to recharge in groundwater basins within this ecoregion subarea. The Owens Valley Basin receives substantial runoff and groundwater inflow from the Sierra Nevada Mountains, which adjoin the western edge of the basin, and from the northern part of the valley floor, but neither of these areas is within the Plan Area. The recharge from these excluded areas is therefore not included in the rainfall recharge estimate. Recharge in the Owens Valley is therefore likely to be substantially greater than represented in the estimate. A comprehensive study of groundwater conditions in the Owens Valley estimated total recharge at about 190,000 AF/year, of which rainfall recharge on the valley floor contributed only 2,000 AF/year (Danskin 1998).

The groundwater storage capacity of the Owens River Valley ecoregion subarea is almost 18 million acre-feet (46 AF/Ac), which was calculated by pro-rating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 1,870 to 2,700 gpm. Almost 90 wells with water-level data in the CDWR Water Data Library are in this ecoregion subarea, and most of these wells are in the Owens Valley Basin (93%).

Average TDS concentrations in the Owens River Valley ecoregion subarea range from 130 to 350 mg/L, except in areas beneath Owens Lake where groundwater can contain concentrations up to 450,000 mg/L. The predominate ions present in the groundwater include sodium bicarbonate and calcium bicarbonate. There are significant concentrations of boron and fluoride in groundwater produced from some wells.

III.6.3.10 Panamint Death Valley Ecoregion Subarea

The Panamint Death Valley ecoregion subarea contains all or portions of 17 mapped CDWR groundwater basins, with a combined area of 1,391,000 acres. Table III.6-7 lists the basin names, total basin areas, and sub-basin areas. Additionally, Table III.6-7 reports the sub-basin areas that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins (see Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries).

Seven of the 17 basins listed in Table III.6-7 are almost entirely within the Panamint Death Valley ecoregion subarea (90% or more of the area of each of these basins is located in the ecoregion subarea). These 7 sub-basins represent 29% of the Panamint Death Valley ecoregion subarea. These are sub-basins of the Brown Mountain Valley, Lost Lake Valley, Owl Lake Valley, Panamint Valley, Searles Valley, Spring Canyon Valley, and Wingate Valley basins. Of the remaining 10 sub-basins, 6 represent less than 10% of their basins: Fremont Valley, Harrisburg Flats, Indian Wells Valley, Leach Valley, Pilot Knob Valley, and Wildrose Canyon Valley basins. These 6 sub-basins together represent less than 2% of the ecoregion subarea.

In the Panamint Death Valley ecoregion subarea, less than 2% of the sub-basin areas are disturbed, and none of the area is disturbed by agriculture; no basins receive imported water. Searles Valley is the most disturbed sub-basin (14% of the sub-basin is disturbed). Ten of the sub-basins have no disturbance: Brown Mountain Valley, Butte Valley, Fremont Valley, Harrisburg Flats, Leach Valley, Lost Lake Valley, Owl Lake Valley, Rhodes Hill Area, Spring Canyon Valley, and Wildrose Canyon. There is no renewable energy development.

Table III.6-7
California Department of Water Resources Basins in the Panamint Death Valley Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,5]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*[3]
6-76	Brown Mountain Valley[4]	21,700	21,700	0	0
6-81	Butte Valley[4]	8,800	7,600	0	0
6-18	Death Valley	919,800	790,600	600	0
6-46	Fremont Valley	335,000	200	0	0
6-74	Harrisburg Flats[4]	24,900	600	0	0
6-54	Indian Wells Valley	381,500	19,500	< 100	0
6-27	Leach Valley	60,900	200	0	0
6-71	Lost Lake Valley[4]	23,200	23,200	0	0
6-88	Owl Lake Valley[4]	22,200	21,700	0	0
6-58	Panamint Valley	259,100	240,000	100	0
6-51	Pilot Knob Valley	138,500	2,600	< 100	0
6-86	Rhodes Hill Area[4]	15,600	2,000	0	0
6-53	Salt Wells Valley	29,500	6,300	100	0
6-52	Searles Valley	196,900	178,500	25,400	0
6-82	Spring Canyon Valley[3]	4,800	4,800	0	0
6-75	Wildrose Canyon	5,100	< 100	0	0
6-19	Wingate Valley[4]	71,200	71,200	100	0

1 Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
2 The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
3 Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
4 Groundwater storage capacity not reported for these basins in CDWR Bulletin 118.
5 The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

In the Panamint Death Valley ecoregion subarea, 10 basins are hydraulically connected (groundwater may flow between the connected basins), and 4 basins contain at least one discharging playa: Death Valley, Brown Mountain Valley, Fremont Valley, and Searles Valley. The Amargosa River is located in the Death Valley basin, and the river has been designated a Wild and Scenic River. There are concerns that groundwater extraction may deprive the river of flow needed to sustain the resources protected by this designation.

The regional average annual precipitation recharge estimate for the Panamint Death Valley ecoregion subarea totals about 6,000 acre-feet/year (Figure III 6-7). This number is the total for areas within the Panamint Death Valley ecoregion subarea, including mountain blocks between basins. However, the estimate is a minimum value because it excludes rainfall in watershed areas located outside the Plan Area. The runoff from these outside watershed areas may generate substantial amounts of additional recharge as either percolating runoff or subsurface inflow. A discussion of the rainfall recharge estimates appears in Section III.6.3.3.2. Additionally, the recharge estimate excludes groundwater inflow from the regional carbonate aquifer from Middle Amargosa Valley in the Kingston and Funeral Mountains ecoregion subarea.

Groundwater storage capacity is reported for 8 of the 17 groundwater basins in this ecoregion subarea. The groundwater storage capacity of these 8 basins is approximately 15 million acre-feet (12 AF/Ac), which was calculated by pro-rating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 30 to 815 gpm; 12 of the 16 basins have no reported well-yield data. More than 150 wells with water-level data in the CDWR Water Data Library are in this ecoregion subarea, with most of the wells in the Searles Valley (74%) and Death Valley (19%) basins.

Average TDS concentrations in the Panamint Death Valley ecoregion subarea range from 360 to 21,500 mg/L. The predominant ions present in the groundwater include sodium, bicarbonate, calcium, sulfate, and chloride. There are also significant concentrations of boron, fluoride, nitrate, and arsenic in water from some of these basins. In the Indian Wells Valley, groundwater pumping has caused relatively poor quality shallow groundwater to leak down and negatively impact water quality in the deeper aquifer (CDWR Bulletin 118).

III.6.3.11 Pinto Lucerne Valley and Eastern Slopes Ecoregion Subarea

The Pinto Lucerne Valley and Eastern Slopes ecoregion subarea contains all or portions of 30 CDWR mapped groundwater basins, of which 1,268,000 acres are within this ecoregion subarea. Table III.6-8 lists the basin names, total basin areas, and sub-basin areas within this ecoregion subarea. Additionally, Table III.6-8 reports the sub-basins that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins (see Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries).

Table III.6-8
California Department of Water Resources Basins in the Pinto Lucerne Valley and Eastern Slopes Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,5]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*[3]
7-16	Ames Valley	108,400	108,400	7,500	0
7-15	Bessemer Valley	39,000	39,000	< 100	0
7-8	Bristol Valley	496,600	15,500	0	0
7-7	Cadiz Valley	269,800	100	0	0
7-5	Chuckwalla Valley	601,500	8,300	400	0
7-21.02	Coachella Valley-Mission Creek	48,500	800	0	0
7-11	Copper Mountain Valley[4]	30,300	30,300	4,400	1,500
7-9	Dale Valley	212,400	123,000	500	0
7-13.01	Deadman Valley-Deadman Lake	89,000	87,800	400	0
7-13.02	Deadman Valley-Surprise Spring	29,200	29,200	0	0
7-53	Hexie Mountain Area[3]	11,100	11,100	< 100	0
7-50	Iron Ridge Area[4]	5,200	5,200		0
7-18.01	Johnson Valley–Soggy Lake	77,200	77,000	1,000	0
7-18.02	Johnson Valley–Upper Johnson Valley[3]	34,800	34,800	0	0
7-62	Joshua Tree	27,200	27,200	2,400	0
6-89	Kane Wash Area	5,900	5,900	< 100	0
7-14	Lavic Valley	102,200	8,000	0	0
7-51	Lost Horse Valley[4]	17,300	16,900	< 100	0
6-40	Lower Mojave River Valley	285,300	15,300	< 100	0
7-19	Lucerne Valley	147,300	146,700	8,800	0
7-17	Means Valley	14,900	14,900	< 100	0
7-41	Middle Mojave River Valley	211,200	57,300	300	0
7-20	Morongo Valley	7,200	7,200	4,400	0
7-31	Orocopia Valley	96,200	800	< 100	0

Table III.6-8
California Department of Water Resources Basins in the Pinto Lucerne Valley and Eastern Slopes Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,5]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*[3]
7-6	Pinto Valley	182,400	170,100	< 100	0
7-49	Pipes Canyon Fault Valley[4]	3,400	2,800	300	0
7-52	Pleasant Valley[4]	9,600	9,600	0	0
7-10	Twentynine Palms Valley	62,200	62,200	7,200	200
6-42	Upper Mojave River Valley	412,500	129,200	31,000	< 100
7-12	Warren Valley	23,700	23,400	7,500	0

1 Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
2 The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
3 Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
4 Groundwater storage capacity not reported for these basins in CDWR Bulletin 118.
5 The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

Nineteen of the 30 basins listed in Table III.6-8 are almost entirely within the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea. 90% or more of the area of each of these basins is within the ecoregion subarea. These 19 sub-basins represent 39% of the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea. Of the remaining 11 sub-basins, 7 represent less than 10% of their basin: Bristol Valley, Cadiz Valley, Chuckwalla Valley, Coachella Valley-mission Creek, Lavic Valley, Lower Mojave River Valley, and Orocopia Valley. These 7 sub-basins together represent less than 3% of the ecoregion subarea.

In the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea, 6% of the sub-basin areas are disturbed and only 4% of the disturbed area is for agriculture. Four of the 30 basins receive imported water: Lower Mojave River Valley, Middle Mojave River Valley, Upper Mojave River Valley, and Warren Valley basins. The Morongo Valley, Upper Mojave

River Valley, Warren Valley and Copper Valley sub-basins are the most disturbed, with from 15% to 61% of their area disturbed. There is about 1,700 acres of renewable energy project development, with most of it (88%) located in the Copper Mountain Valley basin.

Twenty basins in the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and only four basins have discharging playas: Ames Valley, Bristol Valley, Cadiz Valley, and Dale Valley. Two basins partly or entirely overlie the Colorado River Aquifer, and an additional two basins are possibly tributary to the Colorado River Aquifer.

The regional average annual precipitation recharge estimate in the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea ranges from 27,000 to 32,500 acre-feet/year (Figure III 6-7). This number is the total for areas within the ecoregion subarea, including mountain blocks between basins and parts of the adjacent San Bernardino-San Gorgonio mountains. Annual precipitation exceeds 20 inches per year near these mountain summits, and other basins within the Plan Area might not include similar recharge generating mountain areas. Therefore, recharge in basin areas adjacent to these mountains might be substantially greater than for the sub-basin areas. A discussion of the rainfall recharge estimates appears in Section III.6.3.3.2.

Groundwater storage capacity is reported for 23 of the 30 groundwater basins in the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea. The groundwater storage capacity of these 23 basins is approximately 23 million acre-feet (about 20 AF/Ac), which was calculated by pro-rating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 60 to 3,000 gpm; 10 of the 30 basins have no reported well-yield data. More than 1,500 wells with water-level data in the CDWR Water Data Library are in this ecoregion subarea, and most of the wells are found in only two of the 30 basins. The monitoring wells with data are in the Upper Mojave River Valley (39%) and Lucerne Valley (27%) basins. Bulletin 118 reports show that Lucerne Valley wells have recorded significant water level declines since the 1950s, which have resulted in measured subsidence.

Average TDS concentrations in the Pinto Lucerne Valley and Eastern Slopes ecoregion subarea reportedly range from 160 mg/L to almost 53,500 mg/L. The predominant ions in the groundwater include sodium, bicarbonate, calcium, chloride, sulfate, and manganese. There are also significant concentrations of fluoride, boron, nitrate, and iron; the Orocopia Valley reports uranium and radon concentrations that are higher than allowed in drinking water standards (CDWR Bulletin 118).

The Lower Mojave River Valley and Upper Mojave River Valley contain 10 LUST sites and two Superfund sites contaminated with TCE, MTBE, BTEX, and other petroleum-based compounds.

The Middle Mojave River Valley Basin also contains high concentrations of volatile organic compounds and salts due to irrigation with effluent and leaching from a landfill.

III.6.3.12 Piute Valley and Sacramento Mountains Ecoregion Subarea

The Piute Valley and Sacramento Mountains ecoregion subarea contains all or portions of seven mapped groundwater basins, of which 589,000 acres are in this ecoregion subarea. Table III.6-9 lists the basin names, total basin areas, and sub-basins. Additionally, Table III.6-9 shows sub-basins that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins (see Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries).

Two of the seven basins listed in Table III.6-9 are almost entirely within the Piute Valley and Sacramento Mountains ecoregion subarea (90% or more of their total basin area is within this ecoregion subarea). These two sub-basins represent 33% of the Piute Valley and Sacramento Mountains ecoregion subarea. These are sub-basins of the Chemehuevi Valley and Needles Valley. Of the remaining 5 sub-basins, 3 represent less than 10% of their total basin areas: Calzona Valley, Rice Valley, and Vidal Valley basins. These 3 sub-basins together represent less than 2% of the ecoregion subarea.

Table III.6-9
California Department of Water Resources Basins in the Piute Valley and Sacramento Mountains Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,4]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,4]		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*[3]
7-41	Calzona Valley	80,600	2,500	0	0
7-43	Chemehuevi Valley	272,100	272,000	1,300	0
7-44	Needles Valley	87,900	86,100	8,200	0
7-45	Piute Valley	175,100	110,700	1,400	0
7-4	Rice Valley	188,100	1,200	0	0
7-42	Vidal Valley	137,700	10,000	100	0
7-3	Ward Valley	557,600	106,500	0	0

1 Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.

2 The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.

[3] Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.

[4] The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

In the Piute Valley and Sacramento Mountains ecoregion subarea, less than 2% of the sub-basin area is disturbed; about 30% of the disturbed area is for agriculture. None of the basins receive imported water. The Needles Valley sub-basin is the most disturbed (10%), and 1% or less of the sub-basin areas in the Chemehuevi Valley, Piute Valley, and Vidal Valley are disturbed. There is no renewable energy development.

Within the Piute Valley and Sacramento Mountains ecoregion subarea, four of the seven basins partly or entirely overlie the Colorado River Aquifer, and one other basin is possibly tributary to the River Aquifer. Five basins within this ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and none of the basins have a discharging playa.

The regional average annual precipitation recharge estimate in the Piute Valley and Sacramento Mountains ecoregion subarea is less than 4,000 acre-feet/year (Figure III 6-7). This number is the total for areas within the ecoregion subarea, including mountain blocks between basins. However, the estimate is a minimum value because it excludes rainfall in watershed areas located outside the Plan Area. The runoff from these outside watershed areas may generate substantial amounts of additional recharge as either percolating runoff or subsurface inflow. A discussion of the rainfall recharge estimates appears in Section III.6.3.3.2.

The groundwater storage capacity of the Piute Valley and Sacramento Mountains ecoregion subarea is approximately 9 million acre-feet (16 AF/Ac), which was calculated by pro-rating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 65 to 980 gpm; one of the seven basins has no reported well-yield data. More than 250 wells with water-level data in the CDWR Water Data Library are in this ecoregion subarea, and almost all of the wells are in the Needles Valley (70%) and Chemehuevi Valley (29%) basins.

Average TDS concentrations in the basins that comprise the Piute Valley and Sacramento Mountains ecoregion subarea range from 410 mg/L to almost 150,000 mg/L. Predominant ions in the groundwater include sodium, chloride, sulfate, and bicarbonate. There are also significant concentrations of fluoride and boron.

III.6.3.13 Providence and Bullion Mountains Ecoregion Subarea

The Providence and Bullion Mountains ecoregion subarea contains all or portions of 17 mapped CDWR groundwater basins, of which 1,646,000 acres are in this ecoregion subarea. Table III.6-10 lists the basin names, total basin areas, and sub-basins. Additionally, Table III.6-10 shows the sub-basins that are disturbed by either agriculture or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins (see Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries).

Table III.6-10
California Department of Water Resources Basins in the Providence and Bullion Mountains Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,5]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*[3]
7-8	Bristol Valley	496,600	481,000	4,100	0
6-32	Broadwell Valley	91,800	91,800	200	0
7-7	Cadiz Valley	269,800	29,700	< 100	0
6-90	Cady Fault Area[4]	7,900	7,400	0	0
6-38	Caves Canyon Valley	72,900	18,100	0	0
7-9	Dale Valley	212,400	89,500	400	0
7-13.01	Deadman Valley-Deadman Lake	89,000	1,200	0	0
7-2	Fenner Valley	452,400	452,400	200	0
6-30	Ivanpah Valley	197,900	2,200	0	0
6-31	Kelso Valley	254,600	10,300	< 100	0
7-1	Lanfair Valley	156,500	156,500	300	0
7-14	Lavic Valley	102,200	89,900	300	0
6-40	Lower Mojave River Valley	285,300	33,200	1,700	0
7-6	Pinto Valley	182,400	6,400	0	0
7-45	Piute Valley	175,100	64,400	0	0
6-33	Soda Lake Valley	379,800	13,700	0	0
7-3	Ward Valley	557,600	98,200	0	0

1 Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.

[2] The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.

[3] Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.

[4] Groundwater storage capacity not reported for this basin in CDWR Bulletin 118.

[5] The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

Five of the 17 basins listed in Table III.6-10 are almost entirely within the Providence and Bullion Mountains ecoregion subarea (90% or more of their total basin area is located in the ecoregion subarea). These 5 sub-basins represent 45% of the Providence and Bullion Mountains ecoregion subarea. These are sub-basins of the Bristol Valley, Broadwell Valley, Cady Fault Area, Fenner Valley, and Lanfair Valley. Of the remaining 12 sub-basins, 5 represent less than 10% of their basins: Deadman Valley–Deadman Lake, Ivanpah Valley, Kelso Valley, Pinto Valley, and Soda Lake Valley basins. These 5 sub-basins together represent less than 2% of the ecoregion subarea.

In the Providence and Bullion Mountains ecoregion subarea, less than 0.5% of the sub-basin areas are is disturbed, and only 21% of the disturbed area is for agriculture; only one of the sub-basins (Lower Mojave River Valley) receives imported water. The Lower Mojave River Valley sub-basin is the most disturbed (5%), and 1% or less of the other sub-basins is disturbed. There is no existing renewable energy development.

Eleven basins within the Providence and Bullion Mountains ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and four basins have discharging playas: Bristol Valley, Cadiz Valley, Dale Valley, and Soda Lake Valley. The southern end of the Cadiz Valley basin overlies the Colorado River Aquifer, and the Pinto Valley basin is also tributary to the Colorado River Aquifer.

The regional average annual precipitation recharge estimate in the Providence and Bullion Mountains ecoregion subarea totals less than 11,000 acre-feet/year (Figure III 6-7). This number is the total for areas within the Providence and Bullion Mountains ecoregion subarea, including mountain blocks between basins. However, the estimated rainfall recharge is a minimum value because it excludes rainfall in watershed areas located outside the Plan Area. The runoff from these outside watershed areas may generate substantial amounts of additional recharge as either percolating runoff or subsurface inflow. A discussion of the rainfall recharge estimates appears in Section III.6.3.3.2.

Groundwater storage capacity is reported for 16 of the 17 groundwater basins in the Providence and Bullion Mountains Subarea. The groundwater storage capacity of these 16 basins is approximately 24 million acre-feet (14 AF/Ac), which was calculated by pro-rating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 16 to 1,000 gpm; three of the 17 basins have no reported well-yield data. More than 100 wells with water-level data in the CDWR Water Data Library are located in this ecoregion subarea. Most of these wells are found in Lower Mojave River Valley (48%), Fenner Valley (25%), and Lanfair Valley (16%).

Average TDS concentrations in the Providence and Bullion Mountains ecoregion subarea basins range from 350 mg/L to almost 150,000 mg/L. Predominant ions in the groundwater include sodium, bicarbonate, chloride, calcium, and sulfate. In areas near playas, the groundwater is typically high in sodium and chloride. There are also significant concentrations of fluoride and boron, and the Lower Mojave River Valley Basin contains nine LUST sites and one Superfund site contaminated with TCE, MTBE, BTEX, and other petroleum-based compounds. The groundwater in the Ivanpah Valley Basin contains radioactive constituents due to naturally occurring rare earth ore bodies and associated industrial processes related to active and historic mining of these ore bodies.

III.6.3.14 West Mojave and Eastern Slopes Ecoregion Subarea

The West Mojave and Eastern Slopes ecoregion subarea contains all or portions of 20 mapped CDWR groundwater basins, of which 2,754,000 acres are in this ecoregion subarea. Table III.6-11 lists the basin names, total basin areas, and sub-basins. Additionally, Table III.6-11 shows the sub-basins that are disturbed by either agricultural or other developed land uses, and the footprint of existing renewable energy projects, in acres, where mapped locations fall within the sub-basins (see Figure III.1-2[a] and Figure III.1-2[b] for a map of project locations and ecoregion subarea boundaries).

Nine of the 20 basins listed in Table III.6-11 are almost entirely within the West Mojave and Eastern Slopes ecoregion subarea (90% or more of their total basin areas is located in the ecoregion subarea). These nine sub-basins represent 60% of the West Mojave and Eastern Slopes ecoregion subarea. These are sub-basins of the Antelope Valley, Coso Valley, El Mirage Valley, Fremont Valley, Harper Valley, Indian Wells, Kelso Lander Valley, Tehachapi Valley East, and Tehachapi Valley West basins. Of the remaining 11 sub-basins, five represent less than 10% of their basins: Cummings Valley, Kern River Valley, Rose Valley, Searles Valley, and Upper Santa Ana Valley–Cajon. These five sub-basins together represent less than 0.3% of the ecoregion subarea.

In the West Mojave and Eastern Slopes ecoregion subarea, almost 12% of the sub-basin areas are disturbed and only 18% of the disturbed area is for agriculture. Four of the basins receive imported water: Antelope Valley, Lower Mojave River Valley, Middle Mojave River Valley, and Upper Mojave River Valley. The Antelope Valley, Brite Valley, Lower Mojave

River Valley, Tehachapi Valley East, Tehachapi Valley West, and Upper Mojave River Valley sub-basins are the most disturbed, with 17% to 76% of their areas disturbed. Almost 1% of this ecoregion subarea has renewable energy project development, with the greatest acreages in the Antelope Valley (15,000 acres), Fremont Valley (4,000 acres), and Harper Valley (2,000 acres).

Nine basins in the West Mojave and Eastern Slopes ecoregion subarea are hydraulically connected (groundwater may flow between the connected basins), and 2 basins (Fremont Valley and Searles Valley) have discharging playas.

Table III.6-11
California Department of Water Resources Basins in the West Mojave and Eastern Slopes Ecoregion Subarea of the DRECP

			Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
Basin Number	**Groundwater Basin**	**Total Basin Area (acres)[1,5]**	*Sub-Basin Area*	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin[3]*
6-44	Antelope Valley	1,009,700	953,000	161,800	15,400
5-80	Brite Valley	3,200	2,000	900	0
6-55	Coso Valley	25,500	23,900	0	0
6-50	Cuddeback Valley	94,800	76,000	100	0
5-27	Cummings Valley	10,000	< 100	< 100	0
6-43	El Mirage Valley	75,800	73,100	5,700	< 100
6-46	Fremont Valley	335,000	317,200	16,400	4,000
6-47	Harper Valley	409,200	401,400	7,900	1,800
6-54	Indian Wells Valley	381,500	361,100	21,600	100
6-69	Kelso Lander Valley[4]	11,200	11,200	< 100	0
5-25	Kern River Valley[4]	79,400	3,900	100	0
6-40	Lower Mojave River Valley	285,300	36,700	11,200	0
6-41	Middle Mojave River Valley	211,200	153,900	5,800	0
6-56	Rose Valley	42,500	300	< 100	0
6-53	Salt Wells Valley	29,500	23,200	300	0
6-52	Searles Valley	196,900	3,200	0	0
6-45	Tehachapi Valley East	24,000	24,000	5,200	0
5-28	Tehachapi Valley West	14,800	14,800	11,200	0

Table III.6-11
California Department of Water Resources Basins in the West Mojave and Eastern Slopes Ecoregion Subarea of the DRECP

Basin Number	Groundwater Basin	Total Basin Area (acres)[1,5]	Portion of Basin (Sub-Basin) in Ecoregion Subarea[2,5]		
			Sub-Basin Area	*Disturbed Sub-Basin Area*	*Existing Renewable Energy Projects Located in Sub-Basin*[3]
6-42	Upper Mojave River Valley	412,500	274,600	77,400	< 100
8-2.05	Upper Santa Ana Valley–Cajon[4]	23,200	200	< 100	0

1 Groundwater basin areas were calculated using ArcGIS and the basin shapefile available from CDWR (http://www.water.ca.gov/groundwater/bulletin118/gwbasin_maps_descriptions.cfm). The calculated basin areas can be different than reported in the CDWR basin descriptions.
2 The basin area within each DRECP ecoregion subarea, herein referred to as the sub-basin, was determined by intersecting the CDWR groundwater basin shapefile with the DRECP ecoregion subarea boundary.
3 Reported acres of existing renewable energy projects having mapped locations within the sub-basin area. Note that the reported acres do not delineate between the renewable energy project footprint located within the CDWR basin boundary and portions of the footprint that might extend outside the basin boundary.
4 Groundwater storage capacity not reported for these basins in CDWR Bulletin 118.
5 The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

The regional average annual precipitation recharge estimate for the West Mojave and Eastern Slopes ecoregion subarea totals about 52,000 to 58,000 acre-feet/year (Figure III 6-7). This number is the total for areas that fall within the ecoregion subarea, including mountain blocks between basins, and includes parts of the adjacent San Bernardino-San Gorgonio mountains. Annual precipitation exceeds 20 inches per year near these mountain summits, and other basin and ecoregion subarea areas within the Plan Area might not include similar recharge generating mountain areas. Therefore, recharge in basin areas adjacent to these mountains might be substantially greater than for the sub-basin areas within the ecoregion subarea boundaries. For example, a comprehensive study of groundwater conditions in the Mojave River basin estimated average annual total recharge during 1931–1990 to equal 150,300 AF/year, of which two-thirds derived from mountain front recharge and runoff originating in upper watershed areas (Stamos et al. 2001). A discussion of the rainfall recharge estimates appears in Section III.6.3.3.2.

Groundwater storage capacity is reported for 16 of the 20 groundwater basins in the West Mojave and Eastern Slopes ecoregion subarea. The groundwater storage capacity of these 16 basins is approximately 100 million acre-feet (36 AF/Ac), which was calculated by pro-rating Bulletin 118 basin storage capacities on a per-area basis. Reported well yields range from 60 to 3,650 gpm; three of the 19 basins have no reported well-yield data. More than 5,500 wells with water-level data in CDWR Water Data Library are in this ecoregion subarea. Most are located in Antelope Valley (41%), Upper Mojave River Valley (17%), Indian Wells Valley (10%), and Lower Mojave River Valley (10%) basins. Significant subsidence has been measured in areas near Lancaster and Edwards Air Force Base, where by 1992 almost 190,000 acres had subsided more than 1 foot.

Average TDS concentrations in the West Mojave and Eastern Slopes ecoregion subarea basins range from 130 to 21,500 mg/L. Predominant ions in the groundwater include sodium, calcium, bicarbonate, chloride, and sulfate. There are also significant concentrations of boron, fluoride, nitrate, arsenic, iron, and magnesium. Middle Mojave River Valley Basin groundwater can contain high concentrations of volatile organic compounds and salts due to irrigation with effluent and leaching from a landfill. The Lower Mojave River Valley and Upper Mojave River Valley basins contain 10 LUST sites and two Superfund sites contaminated with TCE, MTBE, BTEX, and other petroleum-based compounds. In the Indian Wells Valley, groundwater pumping has caused relatively poor quality shallow groundwater to leak down and negatively impact water quality in the deeper aquifer. The Middle Mojave River Valley Basin groundwater also contains chromium, both naturally occurring and associated with industrial processes.

III.6.4 Bureau of Land Management Land Use Plan Amendment

The Bureau of Land Management (BLM) Land Use Plan Amendment (LUPA) Affected Environment for groundwater resources includes BLM-administered lands within the LUPA area. The LUPA area overlaps parts of 91 CDWR-delineated groundwater basins representing more than 6.7 million acres, which is 43% of the total area of groundwater basins in the Plan Area. The basin acreages within the LUPA Plan Area are summarized in Table III.6-12.

Table III.6-12
California Department of Water Resources
Basins within BLM LUPA Affected Environment

Basin Name	Total Basin Area (acres)	Area in BLM LUPA Plan Area (acres)	Percent of Basin Acreage Affected
Ames Valley	108,400	28,300	26%
Amos Valley	129,900	82,400	63%
Antelope Valley	1,009,700	11,300	1%

Table III.6-12
California Department of Water Resources
Basins within BLM LUPA Affected Environment

Basin Name	Total Basin Area (acres)	Area in BLM LUPA Plan Area (acres)	Percent of Basin Acreage Affected
Arroyo Seco Valley	256,500	106,500	42%
Bessemer Valley	39,000	28,100	72%
Borrego Valley	152,500	34,300	22%
Bristol Valley	496,600	317,900	64%
Broadwell Valley	91,800	85,500	93%
Cadiz Valley	269,800	233,300	86%
Cady Fault Area	7,900	5,600	71%
California Valley	58,100	55,500	96%
Calzona Valley	80,600	43,100	53%
Caves Canyon Valley	72,900	43,000	59%
Chemehuevi Valley	272,100	228,400	84%
Chocolate Valley	129,100	28,900	22%
Chuckwalla Valley	601,500	488,800	81%
Coachella Valley–Mission Creek	48,500	200	<1%
Copper Mountain Valley	30,300	1,900	6%
Coyote Lake Valley	88,000	45,300	51%
Coyote Wells Valley	145,600	97,500	67%
Cronise Valley	126,200	46,700	37%
Cuddeback Valley	94,800	65,800	69%
Dale Valley	212,400	132,500	62%
Deadman Valley–Surprise Spring	29,200	600	2%
Death Valley	919,800	46,400	5%
Denning Spring Valley	7,200	2,800	39%
East Salton Sea	194,800	30,700	16%
El Mirage Valley	75,800	5,000	7%
Fenner Valley	452,400	194,600	43%
Fremont Valley	335,000	93,200	28%
Grass Valley	10,000	6,700	67%
Greenwater Valley	59,800	100	<1%
Harper Valley	409,200	199,300	49%
Imperial Valley	957,600	319,800	33%
Indian Wells Valley	381,500	150,700	40%
Iron Ridge Area	5,200	5,000	96%

Table III.6-12
California Department of Water Resources
Basins within BLM LUPA Affected Environment

Basin Name	Total Basin Area (acres)	Area in BLM LUPA Plan Area (acres)	Percent of Basin Acreage Affected
Ivanpah Valley	197,900	74,000	37%
Johnson Valley–Soggy Lake	77,200	47,800	62%
Johnson Valley–Upper Johnson Valley	34,800	32,500	93%
Joshua Tree	27,200	700	3%
Kane Wash Area	5,900	4,000	68%
Kelso Lander Valley	11,200	2,600	23%
Kelso Valley	254,600	38,800	15%
Kern River Valley	79,400	2,400	3%
Lanfair Valley	156,500	13,300	8%
Langford Valley–Langford Well Lake	19,300	1,300	7%
Lavic Valley	102,200	36,600	36%
Leach Valley	60,900	8,500	14%
Lower Kingston Valley	239,600	228,000	95%
Lower Mojave River Valley	285,300	118,900	42%
Lucerne Valley	147,300	68,500	47%
Means Valley	14,900	13,800	93%
Mesquite Valley	88,100	72,200	82%
Middle Amargosa Valley	389,500	285,000	73%
Middle Mojave River Valley	211,200	91,900	44%
Morongo Valley	7,200	600	8%
Needles Valley	87,900	45,000	51%
Ocotillo–Clark Valley	222,100	69,500	31%
Ogilby Valley	133,200	119,200	89%
Orocopia Valley	96,200	9,000	9%
Owens Valley	660,700	133,200	20%
Owl Lake Valley	22,200	200	<1%
Pahrump Valley	92,800	73,800	80%
Palo Verde Mesa	225,000	136,400	61%
Palo Verde Valley	73,000	500	<1%
Panamint Valley	259,100	143,400	55%
Pilot Knob Valley	138,500	1,000	<1%
Pinto Valley	182,400	3,800	2%
Pipes Canyon Fault Valley	3,400	1,900	56%

Table III.6-12
California Department of Water Resources
Basins within BLM LUPA Affected Environment

Basin Name	Total Basin Area (acres)	Area in BLM LUPA Plan Area (acres)	Percent of Basin Acreage Affected
Piute Valley	175,100	109,800	63%
Quien Sabe Point Valley	25,100	12,900	51%
Red Pass Valley	96,200	6,100	6%
Rice Valley	188,100	164,200	87%
Riggs Valley	87,500	59,600	68%
Rose Valley	42,500	26,800	63%
Salt Wells Valley	29,500	11,000	37%
Searles Valley	196,900	147,400	75%
Silver Lake Valley	35,200	32,600	93%
Soda Lake Valley	379,800	136,400	36%
Superior Valley	120,200	23,500	20%
Tehachapi Valley East	24,000	4,100	17%
Twentynine Palms Valley	62,200	8,800	14%
Upper Kingston Valley	176,700	87,700	50%
Upper Mojave River Valley	412,500	37,700	9%
Upper Santa Ana Valley–Cajon	23,200	100	<1%
Vallecito-Carrizo Valley	121,700	4,800	4%
Vidal Valley	137,700	123,600	90%
Ward Valley	557,600	523,100	94%
Warren Valley	23,700	200	<1%
West Salton Sea	105,300	13,100	12%
Yuma Valley	124,000	57,500	46%

Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

III.6.5 Natural Community Conservation Planning Existing Conditions

The Natural Community Conservation Planning (NCCP) Affected Environment for groundwater resources is the Plan Area excluding the Department of Defense, Military Expansion Mitigation, and tribal lands. The area overlaps all or part of 106 CDWR-delineated groundwater basins. Almost 13.7 million acres of groundwater basins are overlain by the NCCP, representing 87% of the total area of groundwater basins in the Plan Area. The basin acreages within the NCCP Plan Area are summarized in Table III.6-13.

Table III.6-13
California Department of Water Resources Basins within NCCP Affected Environment

Basin Name	Total Basin Area (acres)	Area in NCCP Plan Area (acres)	Percent Basin Acreage in NCCP Plan Area
Ames Valley	108,400	72,200	67%
Amos Valley	129,900	91,900	71%
Antelope Valley	1,009,700	757,400	75%
Arroyo Seco Valley	256,500	160,100	62%
Bessemer Valley	39,000	31,200	80%
Bicycle Valley	89,400	100	<1%
Borrego Valley	152,500	139,700	92%
Bristol Valley	496,600	379,600	76%
Brite Valley	3,200	2,000	63%
Broadwell Valley	91,800	91,300	99%
Butte Valley	8,800	7,600	86%
Cadiz Valley	269,800	269,800	100%
Cady Fault Area	7,900	7,900	100%
California Valley	58,100	58,100	100%
Calzona Valley	80,600	53,800	67%
Caves Canyon Valley	72,900	67,100	92%
Chemehuevi Valley	272,100	251,000	92%
Chocolate Valley	129,100	31,300	24%
Chuckwalla Valley	601,500	601,500	100%
Coachella Valley–Indio	297,000	500	<1%
Coachella Valley–Mission Creek	48,500	800	2%
Copper Mountain Valley	30,300	30,300	100%
Coyote Lake Valley	88,000	62,200	71%
Coyote Wells Valley	145,600	124,600	86%
Cronise Valley	126,200	52,900	42%
Cuddeback Valley	94,800	92,100	97%
Dale Valley	212,400	180,300	85%
Deadman Valley–Surprise Spring	29,200	2,600	9%
Death Valley	919,800	867,200	94%
Denning Spring Valley	7,200	2,800	39%
East Salton Sea	194,800	89,100	46%

Table III.6-13
California Department of Water Resources Basins within NCCP Affected Environment

Basin Name	Total Basin Area (acres)	Area in NCCP Plan Area (acres)	Percent Basin Acreage in NCCP Plan Area
El Mirage Valley	75,800	73,100	96%
Fenner Valley	452,400	452,400	100%
Fremont Valley	335,000	324,300	97%
Gold Valley	3,200	3,200	100%
Goldstone Valley	28,100	200	<1%
Grass Valley	10,000	6,700	67%
Greenwater Valley	59,800	59,800	100%
Harper Valley	409,200	390,800	96%
Harrisburg Flats	24,900	600	2%
Hexie Mountain Area	11,100	11,100	100%
Imperial Valley	957,600	923,200	96%
Indian Wells Valley	381,500	218,800	57%
Iron Ridge Area	5,200	5,200	100%
Ivanpah Valley	197,900	197,900	100%
Johnson Valley–Soggy Lake	77,200	77,000	100%
Johnson Valley–Upper Johnson Valley	34,800	34,800	100%
Joshua Tree	27,200	27,000	99%
Kane Wash Area	5,900	5,700	97%
Kelso Lander Valley	11,200	11,100	99%
Kelso Valley	254,600	254,600	100%
Kern River Valley	79,400	3,900	5%
Lanfair Valley	156,500	156,500	100%
Langford Valley–Langford Well Lake	19,300	1,300	7%
Lavic Valley	102,200	45,300	44%
Leach Valley	60,900	10,800	18%
Lost Horse Valley	17,300	16,900	98%
Lost Lake Valley	23,200	23,200	100%
Lower Kingston Valley	239,600	239,600	100%
Lower Mojave River Valley	285,300	258,100	90%
Lucerne Valley	147,300	146,700	100%
Means Valley	14,900	14,900	100%
Mesquite Valley	88,100	88,000	100%
Middle Amargosa Valley	389,500	389,400	100%
Middle Mojave River Valley	211,200	191,400	91%

Table III.6-13
California Department of Water Resources Basins within NCCP Affected Environment

Basin Name	Total Basin Area (acres)	Area in NCCP Plan Area (acres)	Percent Basin Acreage in NCCP Plan Area
Morongo Valley	7,200	7,200	100%
Needles Valley	87,900	80,100	91%
Ocotillo–Clark Valley	222,100	207,800	94%
Ogilby Valley	133,200	133,000	100%
Orocopia Valley	96,200	17,400	18%
Owens Valley	660,700	346,600	52%
Owl Lake Valley	22,200	22,200	100%
Pahrump Valley	92,800	92,800	100%
Palo Verde Mesa	225,000	225,000	100%
Palo Verde Valley	73,000	72,800	100%
Panamint Valley	259,100	238,900	92%
Pilot Knob Valley	138,500	1,100	<1%
Pinto Valley	182,400	178,500	98%
Pipes Canyon Fault Valley	3,400	2,800	82%
Piute Valley	175,100	175,100	100%
Pleasant Valley	9,600	9,600	100%
Quien Sabe Point Valley	25,100	25,100	100%
Red Pass Valley	96,200	6,900	7%
Rhodes Hill Area	15,600	15,600	100%
Rice Valley	188,100	185,000	98%
Riggs Valley	87,500	64,000	73%
Rose Valley	42,500	30,400	72%
Salt Wells Valley	29,500	11,600	39%
Searles Valley	196,900	164,200	83%
Silver Lake Valley	35,200	35,100	100%
Soda Lake Valley	379,800	379,800	100%
Spring Canyon Valley	4,800	4,800	100%
Superior Valley	120,200	31,100	26%
Tehachapi Valley East	24,000	24,000	100%
Tehachapi Valley West	14,800	14,800	100%
Twentynine Palms Valley	62,200	49,400	79%
Upper Kingston Valley	176,700	176,700	100%
Upper Mojave River Valley	412,500	403,700	98%
Upper Santa Ana Valley–Cajon	23,200	200	<1%

Table III.6-13
California Department of Water Resources Basins within NCCP Affected Environment

Basin Name	Total Basin Area (acres)	Area in NCCP Plan Area (acres)	Percent Basin Acreage in NCCP Plan Area
Vallecito-Carrizo Valley	121,700	96,900	80%
Vidal Valley	137,700	137,700	100%
Ward Valley	557,600	557,600	100%
Warren Valley	23,700	23,400	99%
West Salton Sea	105,300	83,900	80%
Wingate Valley	71,200	39,600	56%
Yuma Valley	124,000	75,100	61%

Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

III.6.6 General Conservation Land Plan Affected Environment

The General Conservation Plan (GCP) Affected Environment includes all nonfederal lands within the Plan Area. The GCP for groundwater resources overlaps parts of 94 CDWR-delineated groundwater basins, representing almost 4.6 million acres (29% of the total area of groundwater basins in the Plan Area). The basin acreages within the GCP area are summarized in Table III.6-14.

Table III.6-14
California Department of Water Resources Basins within GCP Affected Environment

Basin Name	Total Basin Area (acres)	Area in GCP Area (acres)	Percent Basin Acreage in GCP Area
Ames Valley	108,400	43,900	40%
Amos Valley	129,900	9,500	7%
Antelope Valley	1,009,700	746,000	74%
Arroyo Seco Valley	256,500	50,100	20%
Bessemer Valley	39,000	3,100	8%
Bicycle Valley	89,400	100	<1%
Borrego Valley	152,500	105,400	69%
Bristol Valley	496,600	54,700	11%
Brite Valley	3,200	2,000	63%

Table III.6-14
California Department of Water Resources Basins within GCP Affected Environment

Basin Name	Total Basin Area (acres)	Area in GCP Area (acres)	Percent Basin Acreage in GCP Area
Broadwell Valley	91,800	5,800	6%
Cadiz Valley	269,800	25,700	10%
Cady Fault Area	7,900	2,300	29%
California Valley	58,100	2,600	4%
Calzona Valley	80,600	37,300	46%
Caves Canyon Valley	72,900	24,100	33%
Chemehuevi Valley	272,100	39,800	15%
Chocolate Valley	129,100	2,400	2%
Chuckwalla Valley	601,500	85,900	14%
Coachella Valley–Indio	297,000	1,000	<1%
Coachella Valley–Mission Creek	48,500	500	1%
Copper Mountain Valley	30,300	28,300	93%
Coyote Lake Valley	88,000	16,900	19%
Coyote Wells Valley	145,600	27,100	19%
Cronise Valley	126,200	6,200	5%
Cuddeback Valley	94,800	26,300	28%
Dale Valley	212,400	41,300	19%
Deadman Valley–Surprise Spring	29,200	1,900	7%
Death Valley	919,800	11,000	1%
East Salton Sea	194,800	57,500	30%
El Mirage Valley	75,800	68,100	90%
Fenner Valley	452,400	30,500	7%
Fremont Valley	335,000	231,100	69%
Goldstone Valley	28,100	200	1%
Greenwater Valley	59,800	600	1%
Harper Valley	409,200	191,500	47%
Imperial Valley	957,600	577,800	60%
Indian Wells Valley	381,500	68,100	18%
Ivanpah Valley	197,900	14,400	7%
Johnson Valley–Soggy Lake	77,200	29,200	38%
Johnson Valley–Upper Johnson Valley	34,800	2,300	7%
Joshua Tree	27,200	17,000	63%
Kane Wash Area	5,900	1,600	27%
Kelso Lander Valley	11,200	8,600	77%

Table III.6-14
California Department of Water Resources Basins within GCP Affected Environment

Basin Name	Total Basin Area (acres)	Area in GCP Area (acres)	Percent Basin Acreage in GCP Area
Kelso Valley	254,600	5,000	2%
Kern River Valley	79,400	1,500	2%
Lanfair Valley	156,500	38,800	25%
Lavic Valley	102,200	8,800	9%
Lost Lake Valley	23,200	1,500	6%
Lower Kingston Valley	239,600	11,600	5%
Lower Mojave River Valley	285,300	139,200	49%
Lucerne Valley	147,300	78,20000	53%
Means Valley	14,900	1,100	7%
Mesquite Valley	88,100	15,800	18%
Middle Amargosa Valley	389,500	23,000	6%
Middle Mojave River Valley	211,200	99,500	47%
Morongo Valley	7,200	6,700	93%
Needles Valley	87,900	27,300	31%
Ocotillo–Clark Valley	222,100	138,300	62%
Ogilby Valley	133,200	13,900	10%
Orocopia Valley	96,200	7,200	7%
Owens Valley	660,700	213,100	32%
Owl Lake Valley	22,200	600	3%
Pahrump Valley	92,800	19,000	20%
Palo Verde Mesa	225,000	86,200	38%
Palo Verde Valley	73,000	60,800	83%
Panamint Valley	259,100	8,800	3%
Pilot Knob Valley	138,500	100	<1%
Pinto Valley	182,400	1,700	1%
Pipes Canyon Fault Valley	3,400	900	26%
Piute Valley	175,100	21,100	12%
Quien Sabe Point Valley	25,100	6,100	24%
Red Pass Valley	96,200	800	1%
Rhodes Hill Area	15,600	400	3%
Rice Valley	188,100	21,900	12%
Riggs Valley	87,500	4,400	5%
Rose Valley	42,500	3,600	8%
Salt Wells Valley	29,500	700	2%

Table III.6-14
California Department of Water Resources Basins within GCP Affected Environment

Basin Name	Total Basin Area (acres)	Area in GCP Area (acres)	Percent Basin Acreage in GCP Area
Searles Valley	196,900	16,800	9%
Silver Lake Valley	35,200	2,500	7%
Soda Lake Valley	379,800	25,100	7%
Superior Valley	120,200	7,500	6%
Tehachapi Valley East	24,000	19,900	83%
Tehachapi Valley West	14,800	14,800	100%
Twentynine Palms Valley	62,200	40,500	65%
Upper Kingston Valley	176,700	9,000	5%
Upper Mojave River Valley	412,500	366,100	89%
Upper Santa Ana Valley–Cajon	23,200	200	<1%
Vallecito-Carrizo Valley	121,700	92,100	76%
Vidal Valley	137,700	14,100	10%
Ward Valley	557,600	34,500	6%
Warren Valley	23,700	19,900	84%
West Salton Sea	105,300	73,800	70%
Wingate Valley	71,200	200	<1%
Yuma Valley	124,000	54,500	44%

Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.

III.6.7 Groundwater, Water Supply, and Water Quality Outside of Plan Area

III.6.7.1 Transmission Out of Plan Area

The transmission required outside the DRECP would generally fall into four geographic areas: San Diego, Los Angeles, Central Valley, and the Rialto/Moreno Valley/Devers areas. An overview of the existing groundwater, water supply, and water quality in the basins underlying transmission corridors in each of these areas is provided below; information is generally summarized from California CDWR Bulletin 118 (California Department of Water Resources 2003). The regulatory setting related to groundwater, water supply, and water quality outside the Plan Area includes the laws, ordinances, and regulations described in Section III.6.1 Regulatory Setting.

III.6.7.1.1 San Diego Area

The transmission corridor in the San Diego Area would traverse seven groundwater basins: Coyote Wells Valley, Campo Valley, Cottonwood Valley, Jacumba Valley, Poway Valley, Potrero Valley, and San Diego River Valley. Of these, Coyote Wells Valley Basin extends into the Plan Area and is described in Section III.6.4.2 Groundwater Resources within the Plan Area.

These groundwater basins are small, ranging from 3.2 to 15.4 square miles. They are typically bounded by the impermeable crystalline rocks of the Peninsular Ranges. The primary water-bearing deposits of these basins are Quaternary alluvium and residuum.

Storage capacity is unknown for most of the basins in the San Diego area; however, the estimated capacity for the San Diego River Valley Basin is 97,000 acre-feet and 63,450 acre-feet for the Campo Valley Basin. Recharge is from direct precipitation. Septic tank effluent and irrigation waters also provide some recharge.

The alluvium typical of most basins in the San Diego Area contains water of calcium bicarbonate character trending toward sodium chloride in the westernmost basin (Poway Valley). Impairment is unknown for several basins. High chloride and high TDS levels make water from some wells in the Poway Basin inferior for agricultural or domestic use. Similarly, the northern portions of the Jacumba Valley Basin are characterized by high TDS.

III.6.7.1.1.1 Alternatives

The affected environment for the alternatives in the San Diego Area is the same as the Preferred Alternative, described above.

III.6.7.1.2 Los Angeles Area

The transmission corridor in the Los Angeles Area would traverse six groundwater basins: Coastal Plain of Los Angeles, San Gabriel Valley, Upper Santa Ana Valley, Raymond, Upper Mojave River Valley, Antelope Valley. Of these, Upper Mojave River Valley and Antelope Valley extend into the Plan Area and are described in Section III.6.4.10 West Mojave and Eastern Slopes ecoregion subarea.

The affected groundwater basins in the Los Angeles Area underlie portions of the San Gabriel Valley as well as the upper Santa Ana River Watershed in San Bernardino County and portions of western Riverside and Los Angeles counties. The water-bearing materials of the groundwater basins in the Los Angeles Area are dominated by unconsolidated to semi-consolidated alluvium deposited by streams flowing out of neighboring mountains. These deposits include Pleistocene and Holocene alluvium and the lower Pleistocene San

Pedro Formation. Upper Pleistocene alluvium deposits form most of the productive water-bearing deposits in these basins. Several faults, including the Raymond Fault, Rialto-Colton Fault, Chino Fault, San Jose Fault, and Cucamonga Fault, as well as impermeable and consolidated rocks, act as barriers to groundwater movement in portions of the groundwater basins in the Los Angeles Area.

Total storage capacity of the groundwater basins in the Los Angeles Area ranges from 18,300,000 acre-feet in the Chino Sub-basin of the Coastal Plain of Los Angeles Groundwater Basin to approximately 1,450,000 acre-feet in the of Raymond Groundwater Basin. Natural recharge is primarily from direct percolation of precipitation and percolation of ephemeral stream flow from neighboring mountains and applied water in spreading grounds.

Maximum contaminant levels (MCLs) are exceeded in several public supply wells for various contaminants, including TDS, nitrate, volatile organic compounds (VOCs), perchlorate, N-nitrosodimethylamine (NDMA), inorganics, radiology, semi-VOCs, pesticides, and perchlorate (DWR 2006).

III.6.7.1.2.1 Alternatives 1, 3, and 4

Alternatives 1, 3, and 4 are the same as the Preferred Alternative in the Los Angeles Area, with an additional new 500 kV transmission line corridor from the Vincent Substation to an upgraded Los Angeles Department of Water and Power (LADWP) Station E Substation. The affected environment for these alternatives is the same as for the Preferred Alternative, with the addition of the San Fernando Valley Groundwater Basin.

The San Fernando Valley Groundwater Basin is bounded on the north and northwest by the Santa Susana Mountains, on the north and northeast by the San Gabriel Mountains, on the east by the San Rafael Hills, on the south by the Santa Monica Mountains and Chalk Hills, and on the west by the Simi Hills. It is drained by the Los Angeles River and its tributaries. Water-bearing sediments consist of the lower Pleistocene Saugus Formation, and Pleistocene and Holocene alluvium. Several faults, rock types, and subsurface dams create complete or partial barriers to groundwater movement within the basin.

The total storage capacity of the San Fernando Valley Groundwater Basin is approximately 3,670,000 acre-feet. Recharge of the basin is from a variety of sources including spreading imported water and infiltration from natural streamflow from the surrounding mountains and precipitation.

Water is predominately of calcium sulfate-bicarbonate or calcium bicarbonate character. Primary contaminants include VOCs and elevated sulfate concentrations.

III.6.7.1.2.2 Alternative 2

In the Los Angeles Area, Alternative 2 is the same as for the Preferred Alternative, with an additional new 500 kV transmission line corridor from the Vincent Substation to the Moorpark Substation. The affected environment for these alternatives is the same as for the Preferred Alternative, with the addition of the Las Posas Valley and Acton Valley groundwater basins.

The Acton Valley Groundwater Basin is bounded by the Sierra Pelona Mountains on the north and the San Gabriel Mountains on the south, east, and west; this basin is drained by the Santa Clara River. The Las Posas Groundwater Basin underlies the Las Posas Valley in southern Ventura County. In this basin, Arroyo Las Posas drains surface waters westward to the Pacific Ocean.

Alluvium is the primary water-bearing material in both basins. Additional water-bearing materials in the Las Posas Basin include the San Pedro Formation and the Santa Barbara Formation. Faults are not barriers to groundwater movement in the Action Basin. Movement of groundwater in the Las Posas Basin is restricted by various folds, synclines, and faults.

The total storage capacity is estimated at 40,000 acre-feet in the Acton Valley Basin and 345,000 acre-feet in the Las Posas Basin. The basins are primarily recharged from percolation of precipitation on the valley floors. The Acton Basin is also recharged by subsurface inflow.

Groundwater in the basins is primarily calcium bicarbonate in character. Impairments include high concentrations of TDS, sulfate, and chloride.

III.6.7.1.3 Central Valley

The transmission corridor outside the Plan Area in the Central Valley is primarily within the San Joaquin Valley Groundwater Basin, which includes numerous subbasins and is bordered on the west by the Coast Ranges, on the south by the San Emigdio and Tehachapi mountains, on the east by the Sierra Nevada Range and on the north by the Sacramento–San Joaquin Delta and Sacramento Valley. On the east side of the Tehachapi Mountains, the corridor is within the Antelope Valley Groundwater Basin, which extends into the Plan Area and is further described in Section III.6.4.10 West Mojave and Eastern Slopes ecoregion subarea.

The southern portion of the San Joaquin Valley is internally drained by the Kings, Kaweah, Tule, and Kern Rivers that flow into the Tulare drainage basin, including the beds of the former Tulare, Buena Vista, and Kern lakes. The northern portion of the valley drains toward the Sacramento-San Joaquin Delta by the San Joaquin River and its tributaries: the Fresno, Merced, Tuolumne, and Stanislaus rivers.

Most basin aquifers in the Central Valley are composed of unconsolidated Quaternary alluvial deposits underlain by older unconsolidated to semi-consolidated Quaternary to Tertiary alluvial deposits.

Barriers to groundwater movement include various faults such as the Edison, Pond-Poso, and White Wolf faults, as well as folds such as the Elk Hills and Buena Vista Hills. Corcoran Clay restricts vertical movement of groundwater in some areas.

Storage capacity reported in the CDWR Bulletin 118 varies widely in the basin, up to more than 80,000,000 acre-feet in its northern parts. The majority of outflows are agricultural extraction. Other extraction sources include urban use, oil-industry-related use, and minimal subsurface outflow. Recharge is primarily from stream recharge and from deep percolation of applied irrigation water. Groundwater extraction and deep compaction of fine-grained units has resulted in subsidence within the basin.

Water types vary across the basin, from calcium bicarbonate in the shallow zones where sodium generally increases with depth. Bicarbonate is replaced by sulfate and reduced in chloride from east to west across the basin. Shallow groundwater presents problems for agriculture in the basin, including high TDS, sodium chloride, sulfate, arsenic in localized areas, nitrate, dibromochloropropane (DBCP), and ethylene dibromide (EDB). Groundwater at certain locations contains selenium and boron that may affect usability.

III.6.7.1.3.1 Alternatives

The affected environment for the alternatives in the Central Valley is the same as the Preferred Alternative.

III.6.7.1.4 Rialto/Moreno Valley/Devers Area

The transmission corridor in the Rialto/Moreno Valley/Devers Area would traverse seven groundwater basins: East Salton Sea, Chocolate Valley, Orocopia Valley, Coachella Valley, San Jacinto, Upper Santa Ana Valley, and Upper Mojave River Valley. Of these, East Salton Sea, Chocolate Valley, Orocopia Valley and Upper Mojave River Valley extend into the Plan Area and are described in Section III.6.4.1 Cadiz Valley and Chocolate Mountains ecoregion subarea, and Section III.6.4.2 Imperial Borrego Valley ecoregion subarea. The Upper Santa Ana Valley Groundwater Basin extends into the Los Angeles Area and is described in Section III.6.9.1.2 Los Angeles Area.

A portion of the transmission corridor is within the Desert Hot Springs Sub-basin of the Coachella Valley Groundwater Basin. This sub-basin underlies the northeastern portion of the Coachella Valley. The San Jacinto Groundwater Basin underlies the San Jacinto, Perris, Moreno, and Menifee valleys, which are drained by the San Jacinto River and its tributaries. The primary water-bearing materials in these basins are relatively undisturbed alluvial fan deposits of the late Pleistocene and Holocene eras. Several faults create barriers to ground-water movement including the mission Creek, Banning, Indio Hills, San Jacinto, Claremont, Hot Springs, Park Hill, and Casa Loma faults as well as smaller, related faults that parallel these larger faults.

The estimated groundwater storage capacity of the San Jacinto Basin and Desert Hot Springs is 3,070,000 and 4,100,000 acre-feet, respectively. Natural recharge to these basins is primarily from percolation of flow in the water courses and infiltration. In the San Jacinto Basin, natural recharge is augmented by spreading of State Water Project and reclaimed water through infiltration ponds throughout the valley. In years with low precipitation, artificial recharge can exceed natural recharge.

In the San Jacinto Groundwater Basin, typical groundwater character is sodium chloride, sodium-calcium chloride, calcium-sodium chloride, or calcium-sodium chloride-bicarbonate. The Desert Hot Springs Sub-basin is characterized by sodium sulfate type groundwater with high temperatures in some areas. In both basins, TDS is an impairment of concern.

III.6.7.1.4.1 Alternatives 1 and 3

The affected environment for alternatives 1 and 3 is the same as for the Preferred Alternative.

III.6.7.1.4.2 Alternatives 2 and 4

Alternatives 2 and 4 would include the same lines in the Rialto/Moreno Valley/Devers Area as the Preferred Alternative. Additionally, Alternatives 2 and 4 would require a new 500 kV line from the Lugo Substation to the Serrano Substation. The affected environment for these alternatives is the same as the Preferred Alternative, with the addition of the Coastal Plain of Orange County Groundwater Basin.

The Orange County Basin underlies the lower Santa Ana River watershed. An upper, middle, and lower aquifer system exists in this basin. The water-bearing formations within these aquifers include Holocene alluvium, older alluvium, stream terraces, and upper Pleistocene deposits (upper); lower Pleistocene Coyote Hills and San Pedro Formations (middle); and Upper Fernando Group of upper Pliocene Age (lower). There are three fault zones within this basin that restrict groundwater flow: Newport-Inglewood, Whittier, and Norwalk.

The total capacity of the Orange County Basin is 38,000,000 acre-feet. Recharge to the basin is primarily from percolation of Santa Ana River flow, infiltration of precipitation, and recharge injection wells.

Water within the basin is primarily sodium-calcium bicarbonate. Impairments of concern include increasing salinity, high nitrates and methyl tertiary butyl ether (MTBE).

III.6.7.2 BLM LUPA Outside of Plan Area

The BLM LUPA Affected Environment for groundwater resources includes almost 1.06 million acres of BLM-administered lands that are under the BLM CDCA Plan but outside the Plan Area. About 31% of these lands (348,700 acres) overlays 44 CDWR groundwater basins, and the remaining area is not associated with any groundwater basin identified by CDWR. Of the 44 affected groundwater basins, 25 are partially located in the Plan Area, while the remaining 19 basins are entirely outside the Plan Area. The 25 basins in the Plan Area with acreages under the BLM CDCA Plan but outside the Plan Area are summarized in Table III.6-15. Most of the outside acreages are small, and only 3 of the 25 basins have more than 5% of their total acreage under the BLM CDCA lands outside the Plan Area.

Table III.6-15
Department of Water Resources Basins in BLM LUPA Affected Environment but Outside the Plan Area

Basin Name	Total Basin Area (acres)	Basin Area within the CDCA Lands outside the Plan Area (acres)	Percent of Basin within the CDCA Lands outside the Plan Area
Antelope Valley	1,009,700	< 50	< 1%
Borrego Valley	152,500	3,300	2%
Butte Valley	8,800	< 50	< 1%
Chocolate Valley	129,100	27,900	22%
Coachella Valley–Mission Creek	48,500	11,300	23%
Coyote Wells Valley	145,600	7,500	5%
Death Valley	919,800	300	< 1%
East Salton Sea	194,800	1,500	< 1%
Imperial Valley	957,600	200	< 1%
Indian Wells Valley	381,500	500	< 1%
Johnson Valley–Soggy Lake	77,200	< 50	< 1%
Kern River Valley	79,400	100	< 1%
Lucerne Valley	147,300	< 50	< 1%
Middle Amargosa Valley	389,500	< 50	< 1%

Table III.6-15
Department of Water Resources Basins in BLM LUPA Affected Environment but Outside the Plan Area

Basin Name	Total Basin Area (acres)	Basin Area within the CDCA Lands outside the Plan Area (acres)	Percent of Basin within the CDCA Lands outside the Plan Area
Needles Valley	87,900	< 50	< 1%
Orocopia Valley	96,200	37,100	39%
Owens Valley	660,700	13,800	2%
Pahrump Valley	92,800	< 50	< 1%
Panamint Valley	259,100	4,700	2%
Pipes Canyon Fault Valley	3,400	< 50	< 1%
Piute Valley	175,100	< 50	2%
Rose Valley	42,500	1,900	< 1%
Searles Valley	196,900	300	< 1%
Upper Mojave River Valley	412,500	< 50	4%
Vallecito-Carrizo Valley	121,700	2,200	< 1%

Note: The following general rounding rules were applied to calculated values: values greater than 1,000 were rounded to nearest 1,000; values less than 1,000 and greater than 100 were rounded to the nearest 100; values of 100 or less were rounded to the nearest 10, and therefore totals may not sum due to rounding. In cases where subtotals are provided, the subtotals and the totals are individually rounded. The totals are not a sum of the rounded subtotals; therefore the subtotals may not sum to the total within the table.