# Chapter 9
# Groundwater Resources

## 9.1 Introduction

This chapter describes the environmental setting for groundwater resources, including the physical characteristics of the four groundwater subbasins (the Eastern San Joaquin, Modesto, Turlock, and Merced) that underlie the surface water delivery areas from the three eastside tributaries (the Stanislaus, Tuolumne, and Merced Rivers). It also discusses the regulatory setting associated with protecting groundwater resources and groundwater management and use by irrigation and water districts in this area. It evaluates the environmental impacts on groundwater resources that could result from the Lower San Joaquin River (LSJR) alternatives, and, if applicable, offers mitigation measures that would reduce significant impacts.

The impacts associated with groundwater resources and the LSJR alternatives are summarized in Table 9-1. Irrigation district and water district service areas may experience reduced surface water supplies as a result the LSJR alternatives, which could result in increased groundwater pumping. The impacts of LSJR alternatives on groundwater elevations and aquifer storage capacity cannot be determined with certainty because groundwater conditions vary within each aquifer subbasin and water users would have varied responses to reduced deliveries. However, the magnitude of potential groundwater impacts was quantified by assessing the expected increased pumping to replace the reduced surface water supplies. Groundwater use greater than the criterion of 5 percent of the current groundwater pumping from existing subbasins could result in long-term groundwater resource impacts include groundwater overdraft (i.e., pumping more than the sustainable yield from a subbasin), reduced water levels at existing wells, or degraded groundwater quality (i.e., salinity).

As discussed in Appendix B, *State Water Board's Environmental Checklist,* the southern Delta water quality (SDWQ) alternatives would not result in a change in the minimal groundwater pumping that currently takes place in the southern Delta; therefore, the SDWQ alternatives are not addressed in this chapter.

Impacts related to LSJR Alternative 1 and SDWQ Alternative 1 (No Project) are presented in Chapter 15, *LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative)*, and the supporting technical analysis is presented in Appendix D, *Evaluation of LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative)*. Impacts related to methods of compliance are discussed in Appendix H, *Evaluation of Methods of Compliance*.

**Table 9-1. Summary of Groundwater Resources Impacts**

| Alternative | Summary of Impact(s) | Significance Determination |
|---|---|---|
| GW-1: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge | | |
| LSJR Alternative 1 | See note. [1] | |
| LSJR Alternative 2 | Groundwater pumping to replace reduction in surface water diversions is expected to increase less than 5 percent of existing pumping. Therefore, a substantial depletion of groundwater supplies or substantial interference with groundwater recharge would not occur. | Less than significant |
| LSJR Alternative 3 | Groundwater pumping to replace reduction in surface water diversions is expected to be more than 5 percent of existing pumping in three subbasins (Modesto, Turlock, and Merced). Therefore, it is expected that a substantial depletion of groundwater supplies or substantial interference with groundwater recharge would occur. | Significant and unavoidable |
| LSJR Alternative 4 | Groundwater pumping to replace reduction in surface water diversions is expected to be more than 5 percent of existing pumping in four subbasins (Eastern San Joaquin, Modesto, Turlock, and Merced). Therefore, it is expected that a substantial depletion of groundwater supplies or substantial interference with groundwater recharge would occur. | Significant and unavoidable |

[1] The No Project Alternative would result in implementation of flow objectives and salinity objectives identified in the 2006 Bay-Delta Plan. See Chapter 15, *LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative)*, for the No Project impact discussion and Appendix D, *Evaluation of LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative)*, for the No Project Alternative technical analysis.

# 9.2 Environmental Setting

The Stanislaus, Tuolumne, and Merced Rivers, and the Lower San Joaquin River (LSJR), are located in the northern portion of the San Joaquin Valley Groundwater Basin. There are six smaller subbasins in northern portion of the Basin that underlie the plan area: Eastern San Joaquin, Tracy, Modesto, Merced, Turlock, and Delta-Mendota (Figure 2-2 and Figure 9-1). This section describes the location, geology, aquifers, recharge and precipitation, groundwater quality, and groundwater use of the San Joaquin Valley Groundwater Basin and the six subbasins.

## 9.2.1 San Joaquin Valley Groundwater Basin

The San Joaquin Valley Groundwater Basin is a large groundwater basin within the San Joaquin River Hydrologic Region, as defined in DWR Bulletin 118. DWR's Bulletin 118 series of reports summarize and evaluate California groundwater resources. The plan area lies almost entirely within

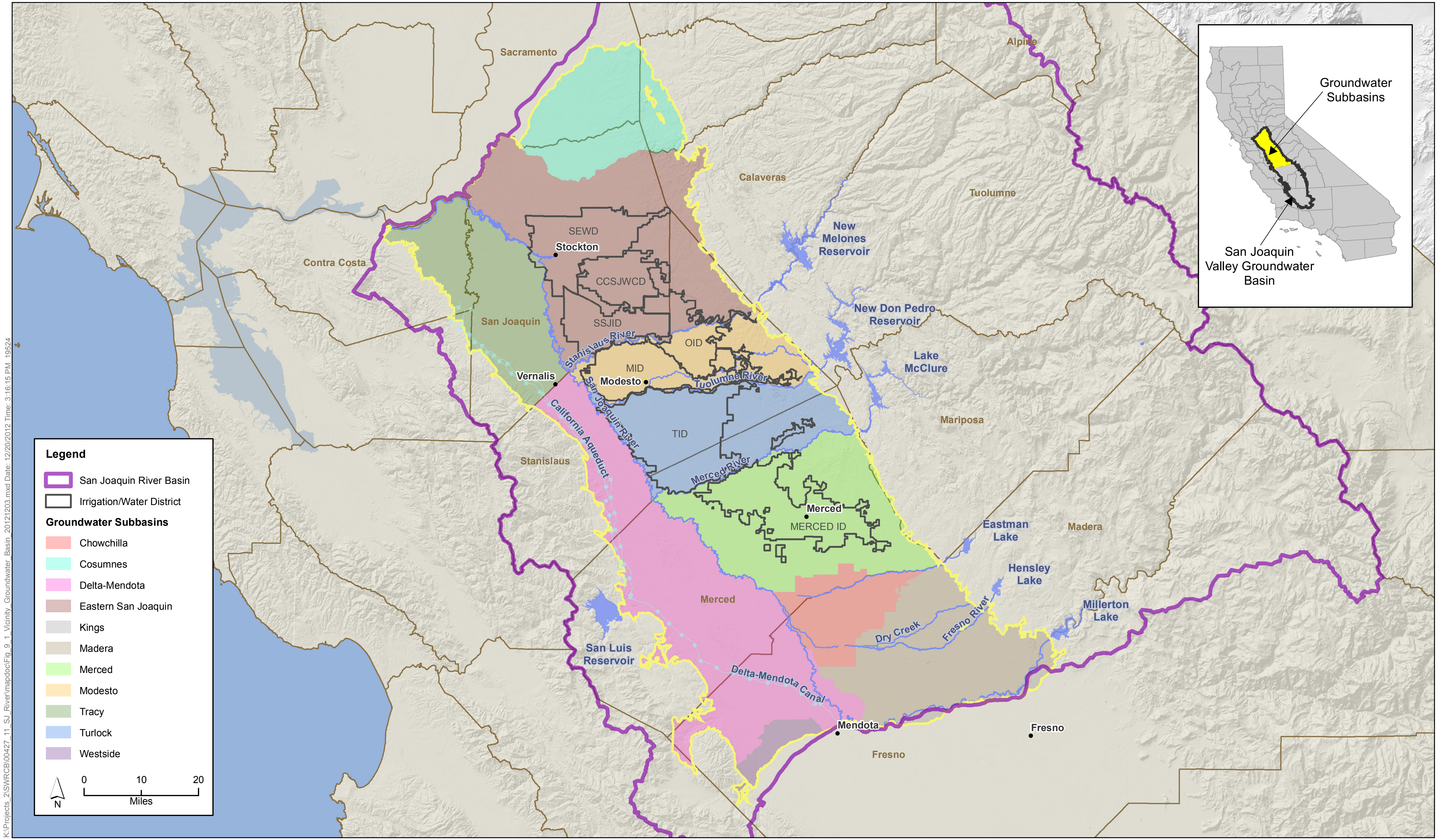


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**Figure 9-1**
**Vicinity Map of Groundwater Subbasins**

the boundaries of four subbasins on the east side of the San Joaquin Valley Groundwater Basin: Eastern San Joaquin, Merced, Turlock, and Modesto. Small portions of the plan area also lie within small parts of two additional subbasins: Tracy and Delta-Mendota. Aquifer characteristics of these subbasins (see Table 9-3) are described in *California's Groundwater*, the 2003 update of the California Department of Water Resources (DWR) Bulletin 118 (DWR 2003a).

Each groundwater subbasin may have multiple vertical layers (i.e., aquifers). Aquifers are underground layers of water-bearing permeable rock or unconsolidated materials (gravel, sand, or silt) from which groundwater wells can pump water. Each subbasin can be described with a surface area, boundaries (at bedrock or along streams) and geological layers (physical characteristics). The subbasin water budget is the fundamental description of the groundwater conditions, and is the basis for evaluating groundwater impacts. The storage volume for the subbasin may be quite large if the freshwater aquifers extend relatively deep (e.g., 500 feet); however, water surface elevation (or depths to groundwater) is more often used to describe the subbasin storage, and to identify whether the subbasin storage is steady (sustainable) or declining (overdraft). The inflows to the basin (recharge) may be from adjacent subbasins, from overlying rivers and streams, or from infiltration from rainfall or irrigation canals and applied water. The outflows from the subbasin are predominantly pumping from wells, but can also include seepage to springs and rivers when the groundwater elevation is higher than that of the surface water.

## Geology and Hydrogeology

Two distinct geologic areas are located in the eastern and western portions of the San Joaquin Valley Groundwater Basin. The eastern portion contains the Ione, Mehrten, Riverbank, and Modesto formations, which are composed primarily of sediments originating from the Sierra Nevada. The western portion is composed of the Tulare formation, which is the primary freshwater unit. The Tulare formation originated as eroded sediments from the Coast Ranges deposited in the San Joaquin Valley as alluvial fan, flood basin, delta or lacustrine, and marsh deposits. The presence of thick, fine-grained lacustrine (originating in lakes) and marsh deposits distinguishes the Tulare formation from other hydrologic units. These fine-grained units can be up to 3,600 feet thick in the Tulare Lake region, but more commonly occur as regional, laterally extensive deposits tens to hundreds of feet thick that create vertically differentiated aquifer systems. The most widespread of these fine-grained units, the Corcoran Clay, divides the groundwater in the Tulare Formation into an upper semiconfined zone and a lower confined zone.

Patterns of groundwater movement and rates of recharge in the San Joaquin Valley Groundwater Basin have been significantly altered from pre-water development conditions. Prior to development, groundwater generally moved from recharge areas in the higher ground surrounding the San Joaquin Valley toward the valley trough. Most groundwater discharges (losses) resulted from evapotranspiration and groundwater discharge to surface waters. In contrast, the majority of groundwater recharge to many subbasins today is from surface water for irrigation. Losses today typically result from groundwater pumped from both the shallow, semiconfined upper aquifer (400–800 feet) and lower confined aquifer(s) (500–4,000 feet) of the San Joaquin Valley Groundwater Basin (Trump 2008), unless one aquifer is substantially more permeable or if local groundwater quality issues exist.

### Groundwater Quality

Groundwater quality varies substantially throughout the San Joaquin Valley Groundwater Basin. Poor water quality conditions caused by agricultural and industrial contaminants are more common in the surface aquifer. In addition to agricultural and industrial sources, aquifer geology can cause adverse water quality conditions from naturally occurring constituents such as arsenic, molybdenum, iron, and uranium. Salinity is one of the primary water quality issues in the San Joaquin Valley Groundwater Basin. Salinity, measured by total dissolved solids (TDS) or electrical conductivity (EC), is generally lower on the eastern side of the basin than in the west, and higher in the shallow aquifer than in the deep aquifer. Water quality is generally good (low salinity and low contaminants) in the four subbasins evaluated for the LSJR Alternatives (DWR 2003a).

### Groundwater Budget

Groundwater accounts for about 30 percent of the annual agricultural and municipal water supply in the San Joaquin River Hydrologic Region (San Joaquin River Basin) (DWR 2003a). Most San Joaquin Valley cities rely on groundwater either wholly or partially to meet municipal needs. Groundwater pumping in this region is estimated to exceed the safe yield[1] by approximately 200,000 acre-feet per year (AFY). Each subbasin in this region has experienced some overdraft (reduced storage) (DWR 2003a).

Groundwater levels in the San Joaquin Valley Groundwater Basin have generally declined as a result of extensive agricultural pumping, by as much as 100 feet in some areas, primarily in the southern and western-most portions of the basin, outside of the plan area. A USGS study of Central Valley groundwater shows that groundwater storage in the San Joaquin Valley Groundwater Basin has varied by plus or minus 5 million acre-feet (AF) between 1962 and 2002, but the total storage of the San Joaquin Valley Groundwater Basin was about the same in 2002 as in 1962 (USGS 2009). Significant groundwater overdraft occurs outside the plan area in areas with very limited surface water supplies. While groundwater overdraft can cause land subsidence, there are no areas with major land subsidence issues in the plan area.

## 9.2.2 Subbasins

The plan area lies within the northern portion of San Joaquin Valley Groundwater Basin. This portion of the San Joaquin Valley Groundwater Basin approximately coincides with the San Joaquin River Hydrologic Region as defined in DWR Bulletin 118. There are eleven subbasins within the region, as shown in Figure 2-2, but the plan area lies almost entirely within the boundaries of four subbasins on the east side of the San Joaquin Valley Groundwater Basin: Eastern San Joaquin, Merced, Turlock, and Modesto. Small portions of the plan area also lie within small parts of two additional subbasins: Tracy and Delta-Mendota. The boundaries of these six subbasins are described in Table 9-2 and are shown in Figure 9-1. This section describes the geology and hydrogeology, groundwater elevations, groundwater quality, and groundwater use for the subbasins, including a description of the major groundwater users.

[1] The safe yield is the amount of usable groundwater that can be withdrawn and consumed each year for an indefinite period of time. It cannot exceed the sum of natural, artificial, or incidental recharge of the groundwater aquifer.

**Table 9-2. Description of Subbasin Boundaries**

| Subbasin | Subbasin Boundaries | Total Subbasin Surface Area (thousands of acres) |
|---|---|---|
| Eastern San Joaquin | Mokelumne River (north/northwest); San Joaquin River (west); Stanislaus River (south); consolidated bedrock (east) | 707 |
| Tracy[1] | The San Joaquin River (north); Diablo Range (west); San Joaquin–Stanislaus County line (south); San Joaquin River (east) | 345 |
| Modesto | Stanislaus River (north); San Joaquin River (west); Tuolumne River (south); Sierra Nevada foothills (east) | 247 |
| Turlock | Between the Tuolumne and Merced Rivers and bounded on the west by the San Joaquin River and on the east by crystalline basement rock of the Sierra Nevada foothills. | 349 |
| Merced | Merced River (north); San Joaquin River (west); Madera–Merced County line (south); Sierra Nevada foothills (east) | 491 |
| Delta-Mendota[1] | Stanislaus–San Joaquin County line (north); Coast Ranges (west); Fresno Slough (south); San Joaquin River and Chowchilla Bypass (east) | 710 |

Source: DWR 2003a, 2003b, 2003c, 2003d, 2003e, 2003f, 2003g

[1] The Tracy Subbasin and Delta-Mendota Subbasin comprise very little of the plan area.

## Geology and Hydrogeology

This section provides a description of groundwater basin geology and the distribution and movement of groundwater within subbasin aquifers. Freshwater-bearing aquifers within the subbasins include Younger Alluvium, Older Alluvium, Flood basin deposits, Lacustrine and marsh deposits, Continental deposits, Turlock Lake, Terrace deposits, Laguna Formation, Mehrten Formation, Tulare Foundation, Alluvium and Modesto/Riverbank formations, Ione, and Valley Springs. The Older Alluvium consists of loosely and moderately compacted sand, silt and gravel, is moderately to locally highly permeable, and is one of the main water-yielding units of the unconsolidated sedimentary deposits (City of Tracy 2011; DWR 2003a, 2003b, 2003c, 2003d, 2003e). The Younger Alluvium contains actively accumulating deposits, including sediments deposited in the channels of streams, and consists of unconsolidated silt, fine-to medium grained sand, and gravel that are highly permeable and, where saturated, can yield significant amounts of water (City of Tracy 2011). Because of their fine-grained nature, Flood Basin deposits generally have low permeability and yield low quantities of water that is typically also of poor quality (City of Tracy 2011; DWR 2003a, 2003b, 2003c, 2003d, 2003e). The Tulare formation generally yields poor-quality water above the Corcoran Clay layer, but contains freshwater deposits below the Corcoran Clay. The Alluvium and Modesto/Riverbank formations consist primarily of sand and gravel in the fan areas, while clay, silt, and sand are dominant in the interfan areas. Because these units are not very thick, most wells penetrate them to tap deeper aquifers in the area. The Laguna Formation consists of discontinuous layers of stream-laid sand and silt with lesser amounts of clay and gravel. Table 9-3 summarizes characteristics of the aquifers in each subbasin from which irrigation districts and water districts draw.

**Table 9-3. Freshwater Aquifers of the Northern San Joaquin Valley Groundwater Basin**

| Aquifer Name | Subbasin Occurrence | | | | | | Aquifer Age | Thickness (feet) | Estimated Yield (gpm) | General Description | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Eastern San Joaquin | Tracy | Modesto | Turlock | Merced | Delta-Mendota | | | | | |
| Younger Alluvium | | X | X | X | X | | Recent | 0–100 | Can yield significant water | Dredge tailing and stream channel deposits | Unconsolidated sedimentary deposits. |
| Older Alluvium (undifferentiated) | | X | | X | X | | Pliocene to Pleistocene | 150 | – | Alluvial fan deposits | One of main water-yielding units of the unconsolidated sedimentary deposits. Unconsolidated sedimentary deposits. |
| Older Alluvium (differentiated)[1] | | | X | | | | Pliocene to Pleistocene | 100–650 | – | Alluvial fan deposits | One of main water-yielding units of the unconsolidated sedimentary deposits. Unconsolidated sedimentary deposits. |
| Alluvium and Modesto/Riverbank formations | X | | | | | X | Recent to Late Pleistocene | 0–150 | 650+ | Alluvial and interfan deposits | |
| Flood basin deposits (undifferentiated) | X | X | X | X | X | X | Recent to Pliocene | 0–1,400 | low | Flood basin deposits | Unconsolidated sedimentary deposits. Generally poor water quality with occasional areas of fresh water. Basinward (finer-grained) lateral equivalents of the Tulare, Laguna, Riverbank, Modesto, and Recent formations occur within the Delta. |

| Aquifer Name | Subbasin Occurrence: Eastern San Joaquin | Tracy | Modesto | Turlock | Merced | Delta-Mendota | Aquifer Age | Thickness (feet) | Estimated Yield (gpm) | General Description | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Laguna Formation | X | | | | | | Pliocene to Pleistocene | 400–1,000 | Average of 900, but up to 1,500 | Fluvial | |
| Mehrten Formation | X | | X | X | X | | Miocene to Pliocene | 200–1,200 | On the order of 1,000 | Reworked volcaniclastics (permeable) and dense tuff breccia (confining units) | |
| Tulare Formation | | X | | | | X | | 1,400 | Up to 3,000 | Clay, silt, and gravel | Poor water quality above the Corcoran Clay, which occurs near the top of the formation. |
| Ione | | | X | X | X | | Miocene | | Generally low | | Consolidated sedimentary deposits. Lies in eastern portion. |
| Valley Springs | | | X | X | X | | Eocene | | Generally low | | Consolidated sedimentary deposits. Lies in eastern portion. |
| Lacustrine and marsh deposits | | | X | | X | | Pliocene to present | 50–200 | – | | Corcoran or E-clay aquitard. Lies in western portion. |
| Continental deposits | | | | X | X | X | Pliocene to present | | Generally low | | One of main water-yielding units of the unconsolidated sedimentary deposits. |

| Aquifer Name | Subbasin Occurrence: Eastern San Joaquin | Tracy | Modesto | Turlock | Merced | Delta-Mendota | Aquifer Age | Thickness (feet) | Estimated Yield (gpm) | General Description | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Turlock Lake | | | | | | | | 150 (unconfined aquifer) | – | | Unconsolidated sedimentary deposits. Lies in Western portion. Corcoran Clay aquitard separates into an upper unconfined and lower, confined aquifer |
| Terrace deposits | | | | | | X | Pleistocene | | – | | |

Sources: DWR 2003a, 2003b, 2003c, 2003d, 2003e, 2003f, 2003g

gpm = gallons per minute

– = California Department of Water Resources has not estimated subbasin yield.

[1] Differentiated units are the Modesto, Riverbank, Victor, Laguna, and Fair Oaks formations, and Arroyo Seco and South Fork gravels.

## Groundwater Elevations and Balance

Each subbasin has a different surface area and slightly different geological features (i.e., aquifers), and is subject to different pumping volumes. The inflows (recharge) are more difficult to estimate than outflows (discharge), but the inflows must be similar to the pumping in order to maintain groundwater levels in the subbasins. Mean annual rainfall in the plan area is low, ranging from 9 to 15 inches. Natural groundwater recharge in the subbasins is augmented by percolation of applied irrigation water and seepage from the distribution systems that convey this water (MAGPI 2008; Turlock Groundwater Basin Association 2008). Seepage originates from reservoirs and unlined water conveyances and distribution canals. It is estimated that urban and agricultural irrigation results in groundwater recharge of nearly 393,000 AFY in the Turlock subbasin. Recharge from croplands was estimated to be 375,000 AFY from 245,000 acres of irrigated crops (1.5 feet/year), while recharge from landscaping within urban areas was estimated to be 18,000 AFY (Turlock Groundwater Basin Association 2008). In addition to recharge from irrigation and unlined conveyance systems, there are several groundwater recharge programs being implemented within the Turlock subbasin.

Streams and rivers may provide an important component of the subbasin's groundwater balance (inflow). Stream seepage from the Stanislaus, Tuolumne, and Merced Rivers comprises a portion of recharge to the underlying groundwater aquifers. Groundwater can flow to springs or rivers when the river elevation is less than the groundwater elevation. For example, along the Merced River, groundwater elevations relative to the elevations of the river suggest that some sections of the rivers are "losing" and other sections are "gaining" (MAGPI 2008). Along the upper reaches of the Tuolumne and Merced Rivers (downstream of La Grange and Crocker-Huffman Dams), groundwater is recharged by streamflow, whereas, along the lower reaches of the rivers, groundwater typically discharges to the rivers (Turlock Groundwater Basin Association 2008). Between 1997 and 2006, the net groundwater discharge to Tuolumne and Merced rivers was estimated to average nearly 30,000 AFY (Turlock Groundwater Basin Association 2008). Modeling results for the 5-year period from 1989 to 1993 show that the Tuolumne and San Joaquin Rivers were also gaining rivers (San Joaquin County Department of Public Works 2004).

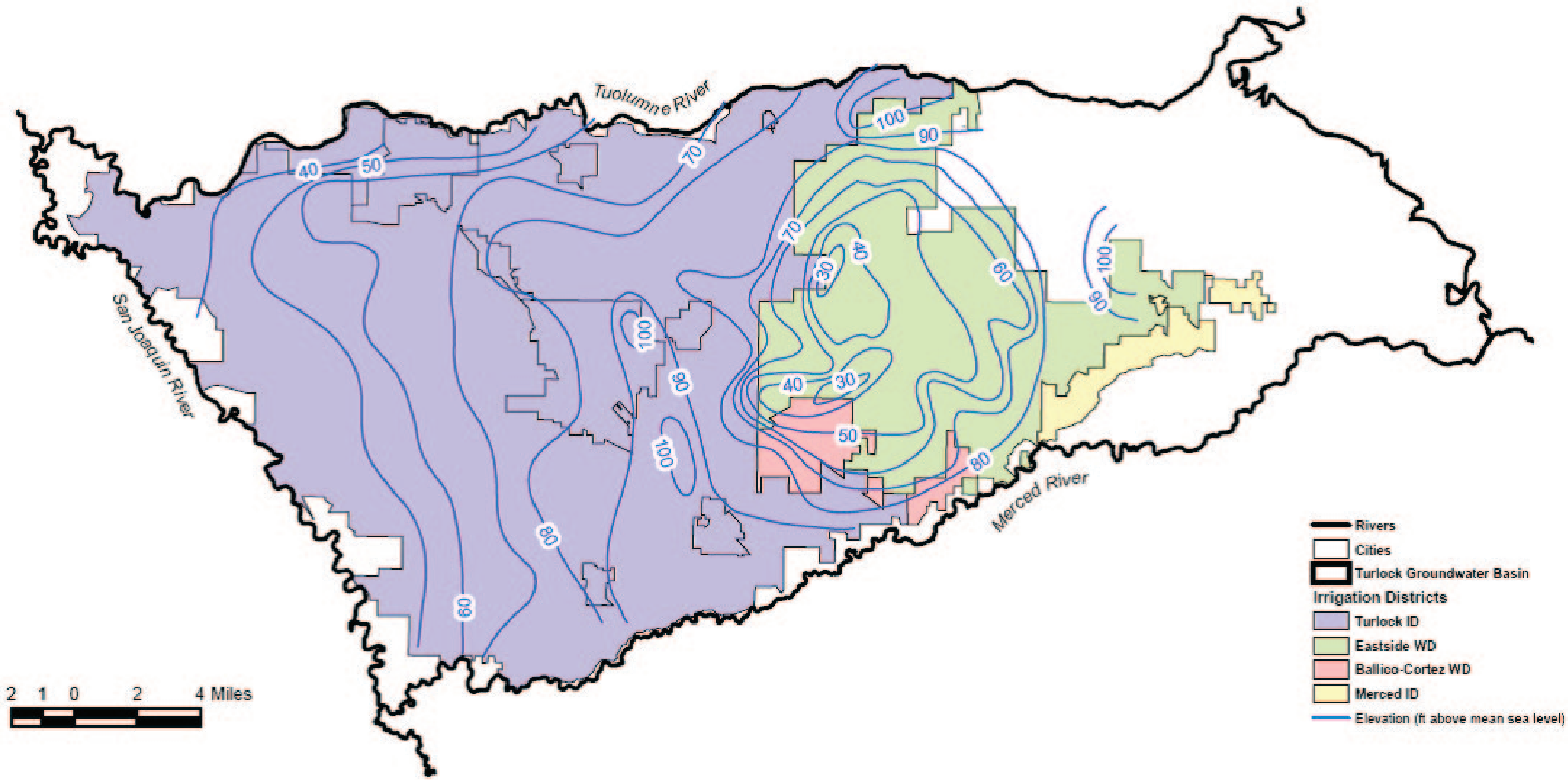
The depth to the water table (elevation of standing water in wells) of the near-surface unconfined aquifer is controlled by the surface water elevations of rivers. River elevation generally increases from about 0–50 feet in the western portion of the basin along the LSJR to about 150–200 feet in the eastern portion of each subbasin along the Sierra Nevada foothills. The groundwater elevations are monitored in a network of wells by DWR and the local irrigation or water districts. Each of the groundwater management plans prepared for the subbasins includes groundwater elevation contours for each year or every 3 to 5 years. The depth to groundwater in each well can also be plotted to determine the increases and decreases in the water elevations through time. Groundwater elevations generally decrease during drought periods because the balance between recharge from surface irrigation and pumping for irrigation shifts to more pumping than recharge. Seasonal changes can also affect water table elevations; for example, they may increase slightly during the winter from recharge and decrease during the summer from groundwater pumping.

To show how river elevations affect water table levels, Figure 9-2 shows recent (2005) groundwater elevations for the Turlock Subbasin. The Turlock Subbasin is located between the Tuolumne River on the north and the Merced River on the south, with the LSJR on the west. Its groundwater elevations are generally controlled by these river elevations. The groundwater elevations were about 150 feet mean sea level (MSL) at the eastern extent of the groundwater basin and declined to an elevation of about 50 feet MSL along the LSJR on the west.

Figure 9-3 provides an example of recent (2006) groundwater elevations in the Merced Subbasin. The Merced Subbasin is located between the Merced River on the north and the Chowchilla River on the south, with the LSJR on the west. The groundwater elevations are generally controlled by these river elevations. The groundwater elevations were about 200 feet MSL at the eastern extent of the groundwater basin and declined to an elevation of about 75–100 feet MSL along the LSJR on the west[2].

The general water balance of a subbasin can be identified by groundwater elevation observations over a number of years. Declining groundwater levels would indicate that average pumping was higher than the average total inflow to the subbasin. Rising groundwater levels would indicate that average pumping was less than the average total inflow. Groundwater levels declined, on average, nearly 30 feet from 1970 to 2000 in the Merced Subbasin (1 foot/year), and declined about 15 feet in the Modesto Subbasin (0.5 foot/year) (DWR 2003c and 2003e). Water level declines in these subbasins have been greater in their eastern portions. Water levels in the Turlock Subbasin declined about 7 feet during this time period (0.25 feet/year), with more severe declines in the eastern portion of the subbasin after 1982 (DWR 2003d). Groundwater levels in the Eastern San Joaquin Subbasin declined at an average rate of 1.7 feet per year (DWR 2003b). Because pumped water fills only a portion of the aquifer (specific yield of about 10%), a water level decline of 10 feet represents only 1 foot of water supply per acre of land. Each of the subbasins may be generally in balance, although the Eastern San Joaquin Subbasin appears to have a greater overdraft condition. Additional pumping in any of the subbasins would likely increase the drawdown, with a noticeable effect on groundwater levels over a number of years. Table 9-4 provides estimates of groundwater overdraft from other sources. These estimates vary widely because of the use of different data, time periods, and underlying assumptions to make the calculations.

[2] The information provided above summarizes measured groundwater elevations found in the Turlock and Merced subbasins. Table H-3 in Appendix H provides an average weighted depth from surface to standing water level for the San Joaquin Valley. This value of 189 feet is considered extremely conservative, as it includes depths to standing water in areas south of the plan area with considerably deeper depths to standing water.




Source: Turlock Groundwater Basin Association 2008

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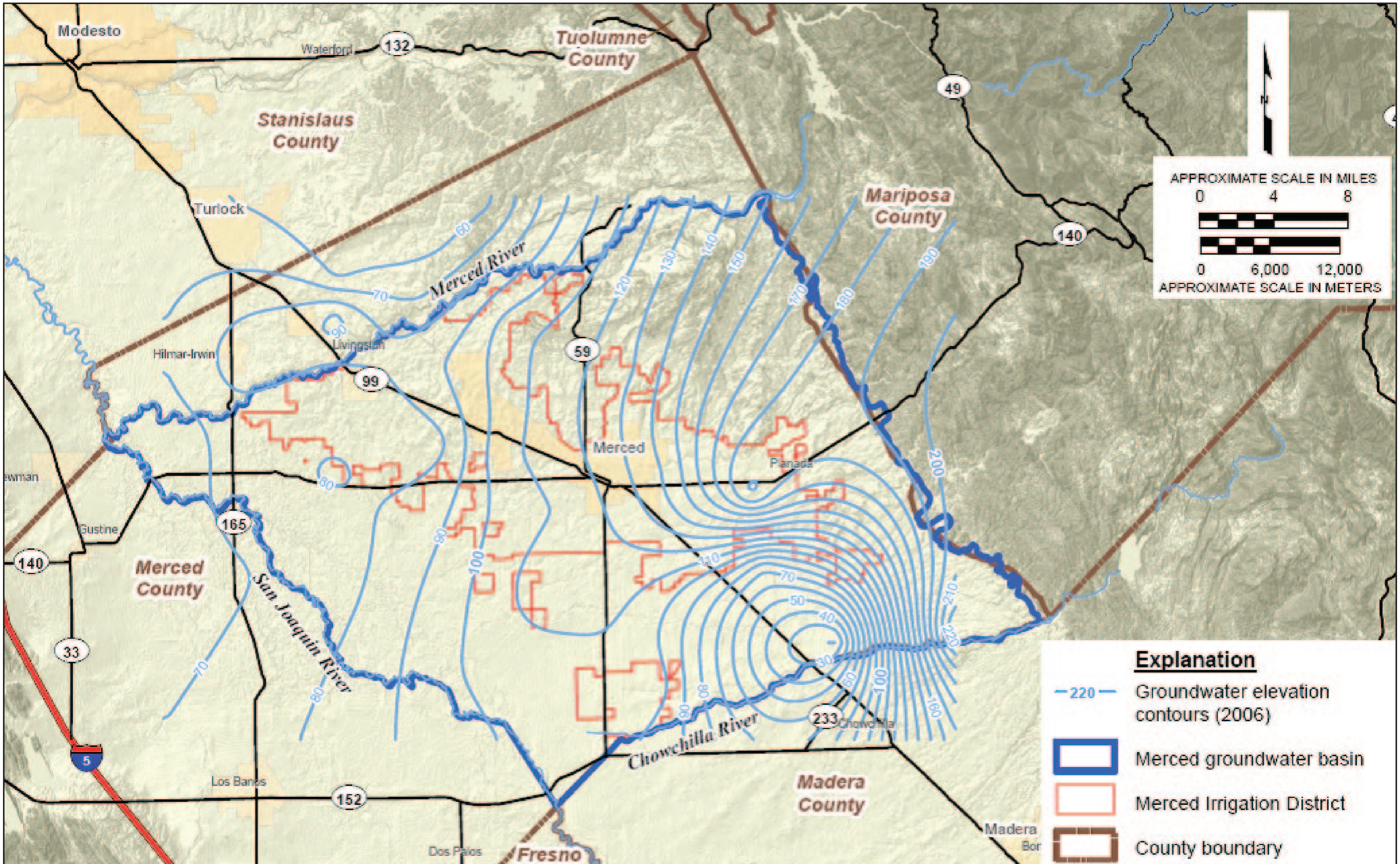
**Figure 9-2**
**Measured Groundwater Elevations (feet Mc_l Qc_ Jctcj) in the Turlock Subbasin for Spring of 2005**




Source: MAGPI 2008

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**Figure 9-3**
**Measured Groundwater Elevations (feet Mean Sea Level) in the Merced Subbasin for 2006**

**Table 9-4. Estimates of Groundwater Overdraft (TAF/y)**

| Subbasin | DWR Bulletin 118 | VAMP EIR | VAMP Supplemental EIR[1] | SJC (2004) | Turlock GW Basin Association (2008)[2] | Turlock GW Basin Association (2003)[2] | Merced County General Plan Update (2009) |
|---|---|---|---|---|---|---|---|
| Eastern San Joaquin | 70 | 7 | – | 151 | – | – | – |
| Modesto | – | 2 | 15 | – | – | – | – |
| Turlock | – | 80 | 85 | – | 21.5 | 30 | – |
| Merced | – | 20 | 20 | – | – | – | 27 |
| Time Period (if given) | – | – | – | – | 1997–2006 | 1953–2002 | 1980–2007 |

Sources: DWR 2003a; USBR and SJRGA 1999; USBR and SJRGA 2001; San Joaquin County Department of Public Works 2004; Turlock Groundwater Basin 2008; Turlock Groundwater Basin 2003; County of Merced 2009.

TAF/y = thousand acre-feet per year

– = no data

[1] Estimates only for Oakdale Irrigation District and South San Joaquin Irrigation District; USBR estimate is for San Joaquin County.

[2] Primarily located in the eastern part of the Turlock Groundwater Subbasin.

## Groundwater Quality

The groundwater quality of the subbasins varies depending on the location, substrate material, and land uses (e.g., agricultural runoff, urban runoff, etc.). Elevated salinity levels are common in San Joaquin Valley groundwater, but salinity is not generally a problem in the subbasins. This low salinity can be attributed to the low salinity of Sierra runoff and application of surface water as a major irrigation source in the subbasins. Increases in groundwater salinity have been detected in the Stockton area (Eastern San Joaquin Groundwater Subbasin) due to a lateral saline front to the west, which further exacerbated groundwater conditions (San Joaquin County Department of Public Works 2004).

A change in groundwater gradient associated with groundwater pumping can indirectly influence groundwater quality in the subbasins. If there is a known point source or nonpoint source of groundwater contamination in an area, groundwater pumping can influence the movement of contaminants from that source toward wells. The movement is influenced by the localized and regional changes in flow direction, which depends on the location and number of groundwater wells. For example, this can happen when there are releases from underground storage tanks within the area of influence of a groundwater well.

## Groundwater Use

Irrigation and water districts that divert water from the Stanislaus, Tuolumne, or Merced Rivers or the LSJR may also pump groundwater from the subbasins for agricultural or domestic water supplies. These irrigation and water districts include: South San Joaquin Irrigation District (SSJID), Oakdale Irrigation District (OID), Stockton East Water District (SEWD), Turlock Irrigation District (TID), Modesto Irrigation District (MID), Merced Irrigation District (Merced ID), and the Central San Joaquin Water Conservation District (CSJWCD). Eastside Water District (EWD) is also a large groundwater user in the Turlock Subbasin and receives some surplus water from TID and Merced ID during wet weather seasons. None of the groundwater subbasins are adjudicated (DWR 2011). More than half of all land within the subbasins is irrigated agriculture, and thus the largest use of groundwater is for agricultural purposes. Table 9-5 shows the number of acres of each water district that lie within each groundwater subbasin. The surface water diversions for each subbasin were assumed to be distributed according to the district's land.

**Table 9-5. Summary of Irrigated Land and Irrigation District Land in each Subbasin (acres)**

| | | | Stanislaus River | | | Tuolumne River | | Merced River |
|---|---|---|---|---|---|---|---|---|
| Subbasin | Total Land (acres) | Irrigated Area (acres) | SSJID | OID | SEWD[1]/ CSJWCD[2] | TID | MID | Merced ID |
| Eastern San Joaquin | 707,000 | 544,153 | 58,511 | 25,348 | 132,500 | - | - | - |
| Modesto | 247,000 | 193,805 | - | 35,262 | - | - | 66,296 | - |
| Turlock | 349,000 | 299,748 | - | - | - | 155,340 | - | 4,769 |
| Merced | 491,000 | 454,438 | - | - | - | - | - | 123,117 |
| Total | 1,794,000 | 1,492,144 | 58,511 | 60,610 | 132,500 | 155,340 | 66,296 | 127,886 |

SSJID = South San Joaquin Irrigation District
OID = Oakdale Irrigation District
SEWD = Stockton East Water District
CSJWCD = Central San Joaquin Water Conservation District
TID = Turlock Irrigation District
MID = Modesto Irrigation District
Merced ID = Merced Irrigation District
[1] SEWD acreage is approximately 68,100 acres.
[2] CSJWCD acreage is approximately 64,400 acres.

When surface water diversions are reduced during dry years, the water districts and irrigation districts (or individual growers) may increase groundwater pumping to compensate for a portion of the reduced surface water supplies. The total pumping capacity in each water or irrigation district may, however, limit the quantity of groundwater that can be pumped. The groundwater pumping required for irrigated areas that do not have surface supplies can be estimated from the total irrigated area, with an assumed application rate of about 3.0 feet (i.e., 3 AF per acre). Because groundwater pumping is not routinely reported, it is difficult to estimate the total groundwater pumping from the subbasins, except by using the total irrigated acreage and adjusting from the surface water supplies used within the irrigation and water districts. Table 9-6 gives the estimated total groundwater pumping for each of the subbasins (DWR 2003a). The irrigated land and the water or irrigation district land (1,000 acres) are shown for comparison. The percent of the total water supply from groundwater pumping in each subbasin varies with the available surface water supply. The baseline surface water supply deficit is assumed to be included in the agricultural pumping. These values are used to estimate the groundwater pumping impacts, which are assumed to be proportional to the baseline pumping in each subbasin.

**Table 9-6. Estimated Baseline Groundwater Pumping (TAF) from the San Joaquin Valley Subbasins Compared to the Full Surface Water Supply and Baseline Water Supply Deficits.**

| Subbasin | Agricultural Land (1,000 ac) | Irrigation District Land (1,000 ac) | Agricultural Pumping | Municipal Pumping | Full Surface Water Supply | Surface Water Supply Deficit |
|---|---|---|---|---|---|---|
| Eastern San Joaquin | 544 | 216 | 762 | 47 | 575 | 132 |
| Modesto | 192 | 101 | 145 | 81 | 490 | 116 |
| Turlock | 300 | 160 | 385 | 65 | 593 | 142 |
| Merced | 454 | 123 | 492 | 54 | 592 | 71 |
| Total | 1,490 | 600 | 1,784 | 247 | 2,250 | 461 |

Source: Land acreage and pumping from DWR Bulletin 118 (DWR 2003a, 2003b, 2003c, 2003d, 2003e); surface water supply and water supply deficits from WSE model assumptions.

TAF = thousand acre-feet

Characteristics of the individual irrigation districts, water districts, and other groundwater users in the four subbasins are described below.

## South San Joaquin Irrigation District

SSJID is a wholesale water agency that lies within the Eastern San Joaquin Subbasin. The SSJID derives its water supply from three sources: (1) surface water diverted from the Stanislaus River at Goodwin Dam, (2) groundwater, and (3) irrigation return flows from a neighboring water district (SSJID 2011). Although the district's main source of water is from the Stanislaus River, groundwater provides important reserves that can supplement surface water during droughts because groundwater is available year-round and is minimally impacted during droughts (SSJID 2011).

SSJID began delivering treated surface water to the cities of Lathrop, Manteca, and Tracy in 2005 through the South County Water Supply Program (SCWSP). The City of Ripon currently uses untreated SSJID water exclusively for groundwater recharge (SSJID 2011). Although groundwater is not a primary source for SSJID or the cities that rely on it, the cities use groundwater to meet much of their demands, and some district growers use groundwater as a regular source for irrigation water. SSJID has leased private wells during droughts to augment water supplies to farmers, which can help to minimize cuts to city water supplies (SSJID 2011).

## Oakdale Irrigation District

Approximately 60 percent of OID's service area is located within the Modesto Subbasin, and 40 percent is in the Eastern San Joaquin Subbasin (Stanislaus and Tuolumne Rivers Groundwater Basin Association 2005). More than 95 percent of the water served by OID is surface water diverted from the Stanislaus River at Goodwin Dam into the Joint Supply Canal and the South Main Canal (USBR and SJRGA 1999). During dry periods when surface water supplies are limited, surface water is supplemented by groundwater pumping from 22 wells throughout the district on both sides of the Stanislaus River. These wells produce an average of about 6,300 AFY (Stanislaus and Tuolumne Rivers Groundwater Basin Association 2005). Most of the private wells in the district are for small farm and domestic use (Stanislaus and Tuolumne Rivers Groundwater Basin Association 2005).

## Stockton East Water District

SEWD lies within the Eastern San Joaquin Subbasin and is an independent, publicly owned utility in the City of Stockton that provides surface water for both agricultural and urban uses. SEWD wholesales drinking water to the City of Stockton, Cal Water, and San Joaquin County. Currently, raw water sent to the SEWD Treatment Plant originates from either New Hogan Reservoir on the Calaveras River or New Melones Reservoir on the Stanislaus River.

SEWD has a number of surface water supply contracts with various entities. It has a contract with USBR to receive 75,000 AFY from the New Melones Reservoir through the Central Valley Project (CVP) (SEWD 2011a). However, this contracted amount has never been delivered. It is also contracted with SSJID and OID to receive up to 30,000 AFY from the Stanislaus River.

SEWD currently has two wells used only for emergency and dry year supply (SEWD 2011b). In critically dry years, SEWD has contracted with farmers along their pipeline to pump groundwater to supply the treatment plant (SEWD 2011b).

SEWD delivers a minimum of 20,000 AFY of treated surface water to the City of Stockton, Cal Water, and San Joaquin County. The amount delivered to each of the three retailers is based on the percentage of total groundwater and surface water used in each retailer's area during the previous year and is updated every year. SEWD currently has 236 agricultural customers outside the urban area. Approximately 170,000 AFY is needed for a normal agricultural irrigation season (120,000 AFY of groundwater[3] and 50,000 AFY of surface water).

As a result of groundwater pumping in the area over many decades, a pumping cone of depression exists east of the Stockton urban area. However, with the continued import of surface water to the area, groundwater levels in the Stockton urban area and SEWD service area have risen since the drought of 1987–1994. Groundwater levels, as recorded by the County, indicate that the 1999 water table in the Stockton area was greater than the level recorded 20 years prior to 1999. The water table in the southern and eastern areas of the city generally rose more than about 50 feet during the 8-year period from 1977–1985, reversing a downward trend that had taken place for many years as a result of pumping by various users (SEWD 2011b).

## Central San Joaquin Water Conservation District

The CSJWCD includes approximately 65,100 acres, of which 670 acres are within the sphere of influence for the City of Stockton. CSJWCD is contracted with USBR to receive 49,000 AFY of surface water from the Stanislaus River and up to an additional 31,000 AF per year on an interim basis. However, the contracted amount has never been fully delivered. Irrigation facilities have been installed and operated by individual landowners through a surface water incentive program sponsored by the district. SSJID and OID have occasionally made water available to CSJWCD for irrigation. Surface water deliveries from the New Melones Conveyance System have elevated

[3]SEWD does not sell groundwater but assesses its use.

groundwater levels by as much as 15 feet in some areas within the CSJWCD (San Joaquin County Department of Public Works 2004).

## Turlock Irrigation District

The TID service area is located within the Turlock Subbasin. TID utilizes a combination of surface water and groundwater to supply water to its agricultural users (Turlock Groundwater Basin Association 2008). Agricultural land within the TID service area is irrigated mainly with surface water, which is the main source of recharge within the Turlock Subbasin (City of Modesto 2008). TID also supplements its surface water supply with groundwater to satisfy crop-water requirements, the extent of which varies from year to year depending on the availability of surface water (Turlock Groundwater Basin Association 2008). In addition, some individual growers within the district pump groundwater to supplement their surface water allotments, while others use groundwater to meet their entire crop-water requirement.

## Modesto Irrigation District

The MID service area lies within both the Turlock and Modesto Groundwater Subbasins (City of Modesto and MID 2011). MID's water service area covers approximately 3,000 irrigation water customers and 62,000 irrigated acres (Stanislaus and Tuolumne Rivers Groundwater Basin Association 2005). MID claims pre-1914 water rights to surface water supply at diversion points along the Tuolumne River below New Don Pedro and La Grange Dams and pumps groundwater to supplement surface water supplies for irrigation. MID has more than 100 groundwater wells (irrigation and drainage) that it owns and maintains to supplement surface water supplies when supplies are limited (City of Modesto and MID 2011). Groundwater use in the MID management area varies from year to year and increases significantly during drought years, when groundwater is a more significant component of the agricultural water supply (Stanislaus and Tuolumne Rivers Groundwater Basin Association 2005). MID does not currently pump and deliver groundwater to urban suppliers, nor does it have plans to do so in the future (City of Modesto and MID 2011). The City of Modesto satisfies approximately half of its demand with MID surface water and half with groundwater it pumps from its own wells (City of Modesto and MID 2011).

## Merced Irrigation District

Merced ID primarily uses surface water diversions from the Merced River to supply irrigation water to its service area. Merced ID supplements its surface water supply with groundwater for irrigation water application. Merced ID owns, operates and maintains 239 deep irrigation wells, of which 170 are currently active (Merced ID 2011). These deep irrigation wells historically have developed a maximum of 182,900 AF (Merced ID 2011). The extent of groundwater supplementation by Merced ID varies from year to year depending on the availability of surface water (Turlock Groundwater Basin Association 2008). Only in severe drought conditions does Merced ID permit the discharge and wheeling of groundwater from privately owned wells into the Merced ID water conveyance system. In some areas of Merced ID, growers meet their crop-water requirements from their own groundwater supplies (Turlock Groundwater Basin Association 2008).

Merced ID has plans to provide a portion of its surface water allocation from the Merced River to the City of Merced. In 1992 the City of Merced and Merced ID entered into a Memorandum of Understanding (MOU) to develop a long-range water resources plan, and the City plans to use

Merced ID water supplies for landscape irrigation water by 2015 (City of Merced 2011). The City of Merced gets all of its municipal water from groundwater.

Groundwater elevations in the basin have been declining as a result of the groundwater extraction by all groundwater users in the area (City of Merced 2001). Long term hydrographs show that groundwater elevations have declined with time throughout most of the subbasin, and since 1980, average levels have declined approximately 14 feet (MAGPI 2008). It was recommended that groundwater elevations be stabilized at the 1999 levels by recharging the groundwater basin with surface water from the Merced River (City of Merced 2001). The City of Merced anticipates some increase in groundwater use by agricultural users, as well as by the University of California, Merced community, which places further demands on the groundwater basin.

### Other Groundwater Users

#### Eastside Water District

Urban land uses and irrigators in the Eastside Water District (EWD) depend on groundwater from the Turlock Subbasin for water supply. The EWD comprises approximately 54,000 acres in Merced and Stanislaus Counties. Most of the land in the EWD is agricultural and irrigated with groundwater. Groundwater levels in the vicinity have dropped dramatically since the mid-1950's. The only other source of water supply is a very limited amount of surface water purchased in wet years from the TID and Merced ID canals adjacent to EWD. Parcels with riparian water rights along the Tuolumne and Merced Rivers can utilize surface water for irrigation. The EWD does not actually supply water or own or operate water supply infrastructure. (Turlock Groundwater Basin Association 2008).

#### Communities

Each of the subbasins has multiple communities and water purveyors that do not have water supply contracts with the irrigation or water districts discussed above. The following communities generally rely solely on groundwater to meet their needs.

- Eastern San Joaquin Subbasin—Lodi and the locations in the Greater Stockton Area that do not receive SEWD water (San Joaquin County Department of Public Works 2004).
- Modesto Subbasin—City of Oakdale, City of Riverbank, and Stanislaus County (City of Oakdale 2009; Stanislaus and Tuolumne Rivers Groundwater Basin Association 2005).
- Turlock Subbasin—Ceres, Delhi, Denair, Hickman, Hilmar, Hughson, Keyes, south Modesto, and Turlock (Turlock Groundwater Basin Association 2008).
- Merced Subbasin—Cities of Atwater, Livingston, and Merced; the Black Rascal Mutual Water Company, Le Grand and Planada Community Service District, the Meadowbrook Water Company, and the Winton Water and Sanitary District (MAGPI 2008).

## 9.2.3 Southern Delta

Agricultural users in the southern Delta apply surface water to irrigate their crops. Some of the agricultural users apply additional surface water to reduce the salts in the root zone of the crops. However, the water sources in the southern Delta are primarily surface water coming from the southern Delta channels and not from groundwater pumping. Therefore, groundwater resources in the southern Delta are not discussed in this chapter.

# 9.3 Regulatory Setting

## 9.3.1 Federal

Relevant federal programs, policies, plans, or regulations related to groundwater resources are described below.

### Clean Water Act

The federal Clean Water Act (33 U.S.C., §§ 1251–1376) may apply indirectly to groundwater quality in relationship to the LSJR alternatives. This statutes is discussed in Chapter 13, *Service Providers.*

### Safe Drinking Water Act

The federal Safe Drinking Water Act (42 U.S.C., § 300f et seq.) may apply indirectly to groundwater quality in relationship to the LSJR alternatives. This statutes are discussed in Chapter 13, *Service Providers.*

## 9.3.2 State

Relevant state programs, policies, plans, or regulations related to groundwater resources are described below. For the most part, California does not regulate groundwater at the state level. The California legislature considers groundwater management to be a local responsibility. Pursuant to Water Code Section 1200, the State Water Board has permitting authority over subterranean streams flowing in known and definite channels. Groundwater not flowing in a subterranean stream, such as water percolating through a groundwater basin, is not subject to the State Water Board's permitting jurisdiction. However, the State Water Board may exercise its authority under the doctrines of reasonable use and the public trust to address diversions of surface water or groundwater that reduce instream flows and adversely affect fish, wildlife, or other instream beneficial uses. In addition, pursuant to Water Code Section 2100 et seq., in certain circumstances, the State Water Board may file an adjudicative action to protect the quality of groundwater.

### Porter-Cologne Water Quality Control Act

As discussed in Chapter 1, *Introduction* and Chapter 5, *Water Supply, Surface Hydrology, and Water Quality*, the Porter-Cologne Water Quality Control Act is California's primary authority for regulating surface and groundwater quality (CWC, § 13000 et seq.). The SJR Basin falls within the jurisdiction of the Central Valley Regional Water Quality Control Board (Central Valley Water Board). The Central Valley Board's Water Basin Plan for the Sacramento River and San Joaquin River Basins specifies the following beneficial uses of groundwater (Central Valley Water Board 1998).

- Municipal and domestic water supply (MUN).
- Agricultural supply (AGR).
- Industrial service supply (IND).
- Industrial process supply (PRO).

The basin plan provides exceptions in which these beneficial uses do not apply.

## Groundwater Quality Protection Strategy for the Central Valley Region

Central Valley Water Board adopted *Resolution No. R5-2008-0181 in Support of Developing a Groundwater Strategy for the Central Valley Region*. In 2010 the Central Valley Water Board also approved the *Groundwater Quality Protection Strategy for the Central Valley Region "a Roadmap"* (Resolution No. R5-2010-0095), which is a long-term strategy that identifies high priority activities; recognizes the water board's core responsibilities and existing commitments; and builds on existing processes. The document is intended to be an overarching framework for long range planning and is not a new regulatory program (Central Valley Water Board 2012).

## Groundwater Monitoring (California Water Code, Section 10920 et seq.)

California Water Code Section 10920 provides for monitoring groundwater elevations by local entities. It authorizes local entities to assume responsibility for monitoring groundwater elevations, and requires that monitoring and reporting to DWR commence by January 2012. DWR developed the California Statewide Groundwater Elevation Monitoring (CASGEM) program as a result of Section 10920 (DWR 2012). The intent of the CASGEM program is to establish a permanent, locally-managed program of regular and systematic monitoring in all of California's alluvial groundwater basins. The program relies on the many established local long-term groundwater monitoring and management programs and designates specific monitoring entities to report groundwater elevation data. A monitoring entity is a local agency or group that is responsible for coordinating groundwater level monitoring and data reporting and submitting the data to DWR so that it can be made available to the public. There are no designated monitoring entities for the groundwater basins discussed above. Monitoring entities submitted the first CASGEM groundwater elevation data in January of 2012.

## Area of Origin Limitations (California Water Code 1220)

California Water Code Section 1220 prohibits the pumping of groundwater "for export within the combined Sacramento and Delta–Central Sierra Basins…unless the pumping is in compliance with a groundwater management plan that is adopted by [county] ordinance." The statute enables, but does not require, the board of supervisors of any county within any part of the combined Sacramento and Delta–Central Sierra Basin to adopt groundwater management plans (GWMPs). Groundwater management plans have been adopted in some counties, as described below.

## Groundwater Management Plans (California Water Code Section 10750 et seq.)

California Water Code Section 10750 et seq. authorizes a local agency whose service area includes at least a portion of a groundwater basin to adopt and implement a GWMP to manage the groundwater resources within its service area. The GWMPs may include components relating to the control of saline water intrusion, regulation of migration of contaminated groundwater, mitigation of conditions of overdraft, and facilitating conjunctive use operations, among other issues.

Several GWMPs have been developed in San Joaquin, Stanislaus, Merced, Calaveras, Tuolumne, and Mariposa Counties (Table 9-7). These plans vary in terms of groundwater management components and implementation methods included. The plans generally require the protection of existing groundwater resources and identify ways to reduce groundwater pumping or increase the recharge of groundwater basins through surface water diversions. Plans that are relevant to the irrigation districts and four subbasins are summarized below. The GWMPs do not always include the entire subbasin, but generally describe the general subbasin characteristics.

**Table 9-7. Relevant Groundwater Management Plans**

| Relevant Groundwater Basin | Entity/Entities | Document Title | GWMP Report Date | Adoption Date | County |
|---|---|---|---|---|---|
| Eastern San Joaquin Subbasin | South San Joaquin ID | South San Joaquin Irrigation District GWMP | 12/1994 | 2/1995 | San Joaquin |
| Eastern San Joaquin Subbasin | Stockton East WD | Stockton East Water District GWMP | 10/1995 | No data | San Joaquin |
| Modesto Subbasin | Modesto ID | GWMP for the Modesto Irrigation District | 3/1996 | 3/1996 | Stanislaus |
| Eastern San Joaquin and Modesto Subbasins | Oakdale ID | Oakdale Irrigation District GWMP | 9/1995 | 11/1995 | Stanislaus, San Joaquin |
| Modesto, Turlock, Merced | Turlock Groundwater Basin Association | Turlock GW Basin GWMP | 8/1997 | 1997 | Merced, Stanislaus |
| Merced Subbasin | Merced ID | Merced ID GWMP | 1/1997 | 1/1997 | Merced |

Source: Diablo Water District 2012

GWMP = groundwater management plan
ID = irrigation district
WCD = water conservation district
WD = water district

# 9.3.3 Regional or Local

Relevant regional or local programs, policies, or regulations related to groundwater resources are described below. Although local policies, plans, and regulations are not binding on the State of California, below is a description of relevant ones.

## Agricultural Water Management Plans

Several of the irrigation districts have prepared Agricultural Water Management Plans (AWMPs) that identify methods for dealing with water supply shortages, and one of those methods is to rely on groundwater. The following AWMPs were reviewed for how they allocate water and their policies for water shortages. Table 9-8 compares the methods used in the different AWMPs for dealing with surface water shortages.

**Table 9-8. Irrigation District Methods for Dealing with Surface Water Shortages**

| Irrigation District | Conjunctive Use | Reduction in Surface Water Allotments | Allowable Internal Transfers | Ground-water Used for Permanent Crops | Holds Carryover Surface Water for Crops | All Shortages Managed with GW | Fair and Equitable Distribution | USBR Responsible for Shortages |
|---|---|---|---|---|---|---|---|---|
| SSJID | NA | NA | X | NA | NA | NA | X | X |
| OID | NA | NA | NA | X | NA | NA | X | X |
| SEWD | NA | NA | NA | NA | NA | NA | NA | X |
| TID | X | X | X | X | NA | NA | X | NA |
| MID | NA | NA | NA | X | X | NA | NA | NA |
| Merced ID | NA | NA | NA | NA | NA | X | X | NA |

Sources: SSJID 2011; SEWD 2001; City of Stockton 2011; TID 1999; MID 1999; Eastside Water District 2003; Merced ID 2003; City of Merced 2001.

SSJID = South San Joaquin Irrigation District
NA = Not Applicable
OID = Oakdale Irrigation District
SEWD = Stockton East Water District
TID = Turlock Irrigation District
MID = Modesto Irrigation District
Merced ID = Merced Irrigation District

## Groundwater Management Ordinances

Several ordinances applicable to groundwater basins that underlie the San Joaquin, Merced, Tuolumne, and Stanislaus Rivers have been passed. These include ordinances in San Joaquin, Calaveras, and Tuolumne Counties. No ordinances exist or have been proposed for groundwater basins in Stanislaus, Merced, or Mariposa Counties. Ordinances for San Joaquin, Calaveras, and Tuolumne Counties are discussed in the following sections.

### San Joaquin County

San Joaquin County's groundwater management ordinance was promulgated in 1996. It requires a permit for any groundwater exports from the Eastern San Joaquin Subbasin. Before a permit will be issued, an applicant is required to demonstrate that the proposed export will not exacerbate the existing groundwater overdraft condition. The ordinance was developed to protect investments supporting groundwater bank development (San Joaquin County Department of Public Works 2004).

### Tuolumne County

Tuolumne County's groundwater management ordinance requires a permit for exporting groundwater outside of the county (Tuolumne Utilities District 2010).

# 9.4 Impact Analysis

This section lists the thresholds used to define impacts on groundwater resources. It describes the methods of analysis and the approach to determine the significance of impacts on groundwater resources. The impact discussion describes the changes to baseline resulting from the alternatives and incorporates the thresholds for determining whether those changes are significant. Measures to mitigate (i.e., avoid, minimize, rectify, reduce, eliminate, or compensate for) significant impacts accompany the impact discussion where appropriate.

## 9.4.1 Thresholds of Significance

The thresholds for determining the significance of impacts for this analysis are based on the State Water Board's Environmental Checklist in Appendix A of the Board's CEQA regulations (23 Cal. Code Regs., §§ 3720–3781) and the Environmental Checklist in Appendix G of the State CEQA Guidelines. The thresholds derived from the checklist(s) have been modified, as appropriate, to meet the circumstances of the alternatives. (Cal. Code Regs., tit. 23, § 3777, subd. (a)(2).) Groundwater resources impacts were determined to be potentially significant (see Appendix B, *State Water Boards Environmental Checklist* in this SED) and therefore are discussed in the analysis. Impacts would be significant if the LSJR alternatives result in the following condition.

- Substantially deplete groundwater supplies or interfere substantially with groundwater recharge.

## 9.4.2 Methods and Approach

### LSJR Alternatives

The impact analysis uses results from the State Water Board's Water Supply Effects (WSE) model to determine if the LSJR alternatives would result in impacts on groundwater resources by increasing groundwater pumping in comparison to existing groundwater pumping in each subbasin. This analysis conservatively assumes that the water supply reductions predicted by the WSE in the three eastside tributaries, and thus the subbasins, would be replaced by groundwater pumping. There is limited information for evaluating the possible decline in groundwater elevations (i.e., overdraft) or the possible decline in groundwater quality caused by increased pumping; therefore, the impact evaluation was focused on the increased groundwater pumping caused by the alternatives and a qualitative discussion of other potential groundwater impacts. The increased groundwater pumping needed to replace the reduced surface water supplies was compared to the existing pumping estimated for each subbasin (Table 9-6). An increase of more than 5 percent of the existing groundwater pumping in a subbasin was used as the impact threshold. It is expected a 5 percent increase in the existing pumping would substantially increase the overdraft and thereby reduce groundwater elevations over time.

Characteristics of the individual irrigation districts, water districts, and other groundwater users in the four subbasins described in Section 9.2.2, *Subbasins* are used to estimate the existing groundwater pumping for each subbasin and determine the fraction of the total water supply obtained from groundwater and from surface water under baseline conditions. The combination of irrigated acreage and full surface water supply volumes (thousand acre-feet [TAF]) and available groundwater reports were used to determine these average annual water supply values.

Table 9-9 shows the baseline water supply deficits (estimated using maximum water supply diversion target volumes) and the surface water supply deficits that were estimated for LSJR Alternatives 2, 3, and 4 with the WSE model, as described in Chapter 5, *Water Supply, Surface Hydrology, and Water Quality*. The maximum surface water supply targets and the percent of the total river diversion for each irrigation district are shown in the first column; the water supply deficits and changes from the baseline water supply deficits are shown for LSJR Alternatives 2, 3, and 4.

**Table 9-9. Predicted Surface Water Deficits by River and Irrigation District for LSJR Alternatives 2, 3, and 4**

| River | Irrigation District | Maximum Surface Water Diversion TAF/(% of total river diversion) | Average Water Supply Deficits (change from baseline) | | | |
|---|---|---|---|---|---|---|
| | | | Baseline (TAF) | LSJR Alternative 2 (TAF) | LSJR Alternative 3 (TAF) | LSJR Alternative 4 (TAF) |
| Stanislaus | SSJID | 300/(40) | 173 (0) | 101 (-73) | 181 (8) | 294 (120) |
| | OID | 300/(40) | | | | |
| | SEWD/CJSWD | 155/(20) | | | | |
| Tuolumne | TID | 575/(65) | 215 (0) | 221 (6) | 388 (173) | 544 (329) |
| | MID | 310/(35) | | | | |
| Merced | Merced ID | 600/(100) | 73 (0) | 83 (10) | 160 (87) | 236 (164) |

Notes: Baseline water supply deficits are assumed to be included in the baseline agricultural pumping.
A negative number for predicted change in deficits represents an increase in water diversions.
The number zero (0) represents no predicted change in deficits.

TAF = thousand acre-feet
SSJID = South San Joaquin Irrigation District
OID = Oakdale Irrigation District
SEWD = Stockton East Water District
CSJWCD = Central San Joaquin Water Conservation District
TID = Turlock Irrigation District
MID = Modesto Irrigation District
Merced ID = Merced Irrigation District

Results from the WSE model for river diversions were used to determine the increased groundwater pumping within each irrigation district that would be required to make up for surface water deficits. These increased water supply deficits (increased pumping) were allocated to the groundwater subbasins based on the percentage of land for each irrigation district within the subbasin (Table 9-5). SEWD and CSJWCD lands are located entirely in the Eastern San Joaquin Subbasin. About 40 percent of OID lands are located in the Eastern San Joaquin subbasin and about 60 percent are in the Modesto subbasin. MID lands are located entirely in the Modesto subbasin. SSJID lands are located entirely in the Modesto subbasin. TID lands are located entirely in the Turlock subbasin. About 3 percent of Merced ID lands are located in the Turlock subbasin and the remainder are located in the Merced subbasin. Table 9-10 identifies the assumed increase in groundwater pumping from each subbasin for LSJR Alternatives 2, 3, and 4. This is compared to the estimated baseline pumping from each subbasin to determine significant groundwater pumping impacts.

**Table 9-10. Assumed Baseline Groundwater Pumping (including Baseline Surface Water Delivery Deficits) and Increases in Groundwater Pumping (TAF) for LSJR Alternatives 2, 3, and 4**

| Subbasins | Baseline Subbasin Pumping | Baseline Surface Water Deficits | LSJR Alternative 2 (increased pumping) | LSJR Alternative 3 (increased pumping) | LSJR Alternative 4 (increased pumping) |
|---|---|---|---|---|---|
| Eastern San Joaquin Subbasin | 809 | 133 | -73 | 6 | 92 |
| | 226 | 115 | 2 | 64 | 143 |
| Turlock Subbasin | 452 | 143 | 4 | 115 | 221 |
| Merced Subbasin | | | | | |
| | 546 | 70 | 10 | 84 | 157 |

TAF = thousand acre-feet

These groundwater pumping estimates are generally consistent with the irrigated acreage and an assumed general water application rate of 3 feet, reduced by the average surface water supplies in each subbasin. With increased groundwater pumping to replace surface water diversions, the groundwater levels may decline as a result of the increased pumping and slightly reduced recharge below lands currently irrigated with surface water. Because it generally costs more to irrigate with groundwater than with surface water due to the cost of pumping equipment and energy, groundwater may be delivered more efficiently than surface water supplies (e.g., delivered through sprinkler and drip irrigation). However, there is not enough information to estimate the reduced application rate for groundwater pumping, so the increase in pumping was assumed to be equal to the reduction in surface water supplies.

Table 9-11 gives the baseline water supply deficits (assumed to be included in the baseline pumping) and the WSE-calculated increases in groundwater pumping in each groundwater subbasin for LSJR Alternatives 2, 3, and 4. The increased pumping is considered a significant impact if the pumping would increase by more than 5 percent of the baseline pumping in a subbasin.

**Table 9-11. Average Baseline Surface Water Deficits (TAF) and Assumed Increase in Groundwater Pumping (TAF) with Percentage Increase in Total Groundwater Pumping**

| | Baseline Water Supply Deficits[1] | LSJR Alternative 2 | LSJR Alternative 3 | LSJR Alternative 4 |
|---|---|---|---|---|
| Eastern San Joaquin Subbasin (Average Baseline Pumping 809 TAF) | | | | |
| Total | 133 | 0 | 6 | 92 |
| % Change | 0 | 0 | 1 | 11 |
| Modesto Subbasin (Average Baseline Pumping 226 TAF) | | | | |
| Total | 115 | 2 | 64 | 143 |
| % Change | 0 | 1 | 28 | 63 |
| Turlock Subbasin (Average Baseline Pumping 452 TAF) | | | | |
| Total | 143 | 4 | 115 | 221 |
| % Change | 0 | 1 | 25 | 49 |
| Merced Subbasin (Average Baseline Pumping 546 TAF) | | | | |
| Total | 70 | 10 | 84 | 157 |
| % Change | 0 | 2 | 15 | 29 |

Notes: Agricultural pumping data for the Tracy Subbasin is unavailable and the water districts do not extend past the LSJR and over the Tracy Subbasin. The Delta-Mendota Subbasin includes a negligible percentage of TID's service area (approximately 100 acres).

The groundwater pumping assumes as populations increase, increased demands for municipal water would be generally supplied from baseline agricultural diversions for the developed land, not additional groundwater supplies.

TAF = thousand acre-feet

[1] Baseline water supply deficits are included in the baseline agricultural pumping.

Impacts are deemed significant if the average increase in groundwater pumping is greater than 5 percent of baseline groundwater use of the subbasin. This percentage was chosen because increased average groundwater pumping from the subbasins of more than this percentage of the baseline would likely result in physical environmental effects, such as subbasin depletion and groundwater quality degradation. These effects are discussed qualitatively with respect to the predicted increase in groundwater pumping identified in the basins.

The estimated groundwater pumping in each of the four relevant subbasins—Eastern San Joaquin, Turlock, Modesto, and Merced—is the basis for evaluating whether additional groundwater pumping would be necessary to meet the water supply needs for the existing irrigated acreage within each water or irrigation district; and for evaluating whether this increased pumping would have a significant effect on the environment. Although the baseline pumping may be somewhat different than the average values estimated for this analysis, the magnitude of the increased additional pumping (as a percentage of the baseline pumping) would be similar to what is discussed in the impact analysis for the LSJR alternatives.

## SDWQ Alternatives

The SDWQ alternatives are not considered in this analysis, as described in Section 9.2.3, *Southern Delta*, and Appendix B, *State Water Board's Environmental Checklist*, because increased groundwater pumping would not take place as a result of a change to the salinity objective. The primary land use in the southern Delta is agriculture, and agricultural users primarily obtain their water from the channels and rivers in the southern Delta. Some of the agricultural users apply additional water to reduce the salts in the root zone of the crops. However, they use surface water and would not pump groundwater as the source of supply.

# 9.4.3 Impacts and Mitigation Measures

### GW-1: Substantially deplete groundwater supplies or interfere substantially with groundwater recharge

Baseline groundwater pumping is extensive in the four subbasins. Some groundwater pumping is conducted by all of the irrigation districts and water districts, other water purveyors such as cities and counties, and by individual landowners. There are several groundwater management plans (Table 9-7) and groundwater ordinances, but the actual status of the groundwater supply in each subbasin is difficult to determine. Irrigation districts are already using groundwater pumping to compensate for reduced surface water supplies in dry years. A reduction in surface water diversions as a result of LSJR Alternatives 2, 3, and 4 could increase groundwater pumping from the different subbasins. The assumed increase in groundwater pumping under LSJR Alternatives 2, 3, and 4 is shown in Table 9-10.

#### *LSJR Alternative 1: No Project*

The No Project Alternative would result in implementation of flow objectives identified in the 2006 Bay-Delta Plan. See Chapter 15, *LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative)*, for the No Project impact discussion and Appendix D, *Evaluation of LSJR Alternative 1 and SDWQ Alternative 1 (No Project Alternative)*, for a No Project Alternative technical analysis.

#### *LSJR Alternative 2: 20% Unimpaired Flow (Less than significant)*

Estimated average groundwater pumping under LSJR Alternative 2 in each subbasin is predicted to be less than the baseline pumping or slightly more (1 to 2 percent). This is because generally the average surface water diversions under LSJR Alternative 2 are predicted to be slightly more than those identified for the baseline conditions. Since the change in groundwater pumping is expected to be small when compared to baseline pumping, it is not expected that it would deplete the groundwater supply. There would not likely be a degradation of groundwater quality because the direction of groundwater flow would not change such that any localized groundwater contamination that exists in the subbasins would be affected. Furthermore, because significantly more groundwater would not be applied to land (i.e., through irrigation), an increase in salts in groundwater is not expected. Changes in groundwater recharge are not expected because surface water diversions would remain similar or higher and the existing exchange between rivers and groundwater subbasins would be similar. Therefore, the slight increase in pumping of less than 5 percent compared to baseline pumping would not likely result in groundwater quality impacts or a significant reduction in groundwater levels. Accordingly, LSJR Alternative 2 would not substantially deplete groundwater supplies or interfere substantially with groundwater recharge. Impacts would be less than significant.

***LSJR Alternative 3: 40% Unimpaired Flow (Significant and unavoidable)***

LSJR Alternative 3 surface water deficits would result in conditions similar to those of dry year conditions in the region. Groundwater is used by several water suppliers to supplement surface water supplies during dry years. For example, SSJID has leased private wells during drought periods to augment water supplies to farmers. OID also uses groundwater resources to supplement surface water during drought periods. In dry years, when less surface water is available, groundwater makes up a larger portion of the overall TID water supply (Turlock Groundwater Basin Association 2008).

Average increases in groundwater pumping are expected to be minimal for irrigation districts and water districts with water supplies diverted from the Stanislaus River. This is likely due to the fact that the existing Stanislaus River flow requirements for fish habitat are high, and LSJR Alternative 3 would not require much more river flow, so the water supply deliveries would remain similar to baseline conditions.

LSJR Alternative 3 is expected to have a greater effect on surface water diversions from the Tuolumne and Merced Rivers (Table 9-9) . Because this analysis conservatively assumes that the reduction in surface water diversions would result in an increase in groundwater pumping to replace the lost surface water supply, it is expected LSJR Alternative 3 would result in an increase in groundwater pumping greater than 5 percent of the baseline pumping in the following subbasins: Modesto (28 percent more pumping), Turlock (25 percent more pumping), and Merced (15 percent more pumping). However, as a result of the increase in groundwater pumping, the overall water supply would not be reduced by the maximum possible amount (i.e., the surface water supply deficits predicted by the WSE). It is not expected that the impact to groundwater resource in these subbasins would occur at the same time as an impact or reduction to overall water supply. An increase in groundwater pumping in these subbasins would occur over time and the physical changes to the subbasins, described below, would also occur over time. The increase of greater than 5 percent of baseline groundwater pumping would likely result in a drawdown of the subbasins over time because this additional pumping would likely exceed the baseline balance between pumping and recharge. This could result in physical environmental effects, such as decreases in water quality or a significant reduction in groundwater levels. Degradation of groundwater quality could also occur because the direction of groundwater flow could change such that any localized groundwater contamination that exists in the subbasins would be affected. While there would be more water in the river that could infiltrate (recharge) the groundwater basins, it is unknown where the groundwater pumping would occur and if rates would exceed recharge from the river. Although the existing pumping in each subbasin is uncertain, the magnitude of the increased pumping for LSJR Alternative 3 is much greater than the 5 percent; therefore, the increased groundwater pumping would be a significant impact even if the existing pumping were considerably greater than estimated. Thus, for the Modesto, Turlock, and Merced subbasins, LSJR Alternative 3 is expected to substantially deplete groundwater supplies or interfere substantially with groundwater recharge. Impacts on groundwater resources would be significant.

An SED must identify feasible mitigation measures for each significant environmental impact identified in the SED. (Cal. Code Regs., tit. 23, § 3777(b)(3)). Mitigation to reduce significant impacts on groundwater resources could include the State Water Board or local agencies exercising their various authorities over groundwater users; however, as discussed in detail below, using these various authorities to implement mitigation measures would be infeasible. Water purveyors and agencies that pump groundwater are not under the permitting jurisdiction of the State Water Board (see Section 9.3.2) because the State Water Board's statutory water right permitting and licensing system does not apply to percolating groundwater. Subterranean streams, regulated by the State Water Board, are a very small subset of all groundwater, and therefore in most of the state, no state or local discretionary permit is required for pumping percolating groundwater. The legislature made a conscious decision to exclude percolating groundwater when it established the water right permitting system. Therefore, in considering potential mitigation to reduce or avoid environmental impacts associated with increased groundwater pumping, it is not reasonable to expect the legislature to enact comprehensive groundwater legislation or to expand the statutory water right system to include groundwater.

To the extent that any environmental effects of groundwater pumping due to LSJR Alternative 3 would require discretionary approval by the State Water Board, such as an application to appropriate groundwater from a subterranean stream, the State Water Board or other CEQA lead agency would evaluate the potential effects of groundwater pumping at the project level. Possible mitigation measures to reduce or avoid any potential effects include the following.

- Identify groundwater management goals (for maximum pumping or minimum water levels) so that reductions in groundwater pumping would result if certain thresholds are met.
- Establish water conservation measures, such as increased irrigation efficiency, for agricultural, municipal, and industrial uses such that reductions in groundwater pumping would result.
- Establish a conjunctive water management program that would divert surface water during nonirrigation months (e.g., October–April) during wet years into unlined canals and designated fields to recharge the groundwater basin.

The legislature determined that certain groundwater extractions should be monitored and reported to the State Water Board, and the Water Code includes provisions requiring the recording of groundwater extractions in four specific Southern California counties (outside the plan area) (CWC, § 4999 et seq.). If the State Water Board were to attempt to establish a generally-applicable reporting requirement for groundwater extractions, it would be argued that the statutory authority for reporting in the four-county area impliedly excludes the authority of the State Water Board to expand the program beyond that area. In addition, the State Water Board would lack the enforcement and fee-setting authority that applies to groundwater extractions subject to the statutory reporting requirements. (See Id., §§ 50065008.) It is also unreasonable to expect the legislature to expand this authority to other areas of the state any time soon. Accordingly, establishing a generally-applicable reporting requirement for groundwater extractions is not a legally feasible means to mitigate potential groundwater pumping impacts attributable to LSJR Alternative 3. (Pub. Resources Code, § 21004; 14 Cal. Code Regs., § 15040.)

The State Water Board has the authority to file a civil action to restrict groundwater pumping, or to impose a physical solution, or both, where necessary to protect groundwater quality. (CWC, §§ 21002102.) Unlike surface water adjudications, there is no provision for the State Water Board to recover its expenses for initiating and participating in an adjudication to protect groundwater quality. Thus, in light of the legal and funding constraints, a groundwater adjudication is not a feasible means of mitigating groundwater pumping impacts.

A proceeding by the State Water Board to prevent waste and unreasonable use is not considered a feasible mitigation measure. Constitution Article X, Section 2, and Water Code Section 100 prohibit the waste, unreasonable use, unreasonable method of use, and unreasonable method of diversion of water. The constitutional doctrine of reasonable use applies to all water users, regardless of basis of water right, serving as a limitation on every water right and every method of diversion. (Peabody v. Vallejo [1935] 2 Cal.2d 351, 367, 372.) Water Code Section 275 directs the State Water Board (and DWR) to take all appropriate proceedings or actions to prevent waste or violations of the reasonable use standard. Thus, the State Water Board may initiate proceedings, either administratively or in court, to prevent the waste and unreasonable use of water. Most likely, any proceedings initiated by the State Water Board would be in the nature of discretionary enforcement actions. The State Water Board's water right program is funded primarily through annual water right permit and license fees. The State Water Board has limited funding through general funds or other funding sources available for regulating the diversion and use of water not subject to the water right permit and license system. Most, if not all, of this non-fee funding is needed for other activities, such as applying public trust and reasonableness requirements to riparian and pre-1914 diversions. Thus, a proceeding to prevent waste or unreasonable use of groundwater is not a feasible mitigation measure.

The State Water Board also has authority to address the waste, unreasonable use, unreasonable method of use, and unreasonable method of diversion of water through quasi-legislative action. Questions of waste, unreasonable use, and unreasonable method of use or diversion are factual and to be determined according to the circumstances of a particular situation, limiting the utility of the regulatory process to only those cases where waste or unreasonableness can be clearly identified and prevented by an appropriately tailored regulatory response. The State Water Board has only twice made the findings required to proscribe waste, unreasonable use, and unreasonable method of use or diversion through regulation because of the highly complex nature of findings and proceedings. (Cal Code Regs., tit. 23, §§ 735, 862). Thus, determining the potential unreasonableness of increased groundwater pumping diversions resulting from LSJR Alternative 3 would be at least as complex as approving and establishing LSJR Alternative 3. Therefore, adoption of a regulation is not a feasible mitigation measure.

Although local governments have groundwater management authority, that authority has not been exercised in most of the state, including areas that have long been recognized as subject to conditions of critical overdraft. Although local governments can and should regulate groundwater pumping and avoid or reverse conditions of long-term overdraft, it is not reasonable to expect they will. Therefore, action by local governments is speculative and cannot be considered a feasible means of mitigating groundwater pumping impacts.

The State Water Board's water quality control planning process relies on periodic reviews of the water quality control plan. As a result, the planning process continually accounts for changing conditions related to water quality and water planning. As additional information and data are gathered regarding groundwater pumping in the subbasins, the State Water Board can and will continually revisit and analyze the groundwater situation during the periodic review of the water quality control plan.

However, based on the State Water Board's authority and local agencies' authority over groundwater resources described above, impacts on groundwater resources under LSJR Alternative 3 would remain significant and unavoidable.

***LSJR Alternative 4: 60% Unimpaired Flow (Significant and unavoidable)***

LSJR Alternative 4 would result in the greatest increase in groundwater pumping from the four subbasins compared to baseline pumping levels, assuming that the surface water supply deficits would cause similar increases in pumping (Table 9-9). LSJR Alternative 4 would cause a large reduction in the surface water diversions from the Stanislaus, Tuolumne, and Merced Rivers that is anticipated to cause increases in groundwater pumping. LSJR Alternative 4 would result in an increase in groundwater pumping greater than 5 percent of the baseline pumping in each of four subbasins: Eastern San Joaquin (11 percent more pumping), Modesto (63 percent more pumping), Turlock (49 percent more pumping), and Merced (29 percent more pumping). However, as a result of the increase in groundwater pumping, the overall water supply would not be reduced by the maximum possible amount (i.e., the surface water supply deficits predicted by the WSE). It is not expected that the impact to groundwater resource in these subbasins would occur at the same time as an impact or reduction to overall water supply. An increase in groundwater pumping in these subbasins would occur over time and the physical changes to the subbasins, described below, would also occur over time. The increase in groundwater pumping greater than 5 percent of baseline would likely result in a drawdown of the subbasins because this additional pumping would likely exceed the baseline balance between pumping and recharge. The increase of greater than 5 percent in groundwater pumping would result in a drawdown of all subbasins because the increased pumping would likely exceed the recharge. This could result in physical environmental effects such as decreases in water quality or a significant net reduction in groundwater levels similar to those impacts described under LSJR Alternative 3. Impacts associated with LSJR Alternative 4 with respect to groundwater quality and reduced recharge would be greater than for LSJR Alternative 3 because more groundwater would be pumped under LSJR Alternative 4. Although the existing pumping in each subbasin is somewhat uncertain, the magnitude of the increased pumping is much greater than the 5 percent. Therefore, the increased groundwater pumping would be a significant impact even if the existing pumping were considerably greater than estimated. Thus, LSJR Alternative 4 is expected to substantially deplete groundwater supplies or interfere substantially with groundwater recharge. Impacts on groundwater resources would be significant.

As discussed under LSJR Alternative 3, the landowners, water purveyors, and water districts that pump groundwater are not under the permitting jurisdiction of the State Water Board. In light of the legal and funding constraints, groundwater adjudication is not a feasible means of mitigating groundwater pumping impacts under LSJR Alternative 4. Although local governments have groundwater management authority, that authority has not been exercised in most of the state, including in areas that have long been recognized as subject to conditions of critical overdraft. Accordingly, impacts on groundwater resources would remain significant and unavoidable under LSJR Alternative 4.

# 9.5 Cumulative Impacts

## 9.5.1 Definition

Cumulative impacts are defined in the State CEQA Guidelines (14 Cal. Code Regs., § 15355) as “two or more individual effects which, when considered together, are considerable or which compound or increase other environmental impacts.” A cumulative impact occurs from “the change in the environment which results from the incremental impact of the project when added to other closely related past, present, and reasonably foreseeable future projects. Cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time." (14 Cal. Code Regs., § 15355(b)).

Consistent with the State CEQA Guidelines (14 Cal. Code Regs., § 15130(a)), the discussion of cumulative impacts in this chapter focuses on significant and potentially significant cumulative impacts. The State CEQA Guidelines (14 Cal. Code Regs., § 15130(b)) state the following.

> The discussion of cumulative impacts shall reflect the severity of the impacts and their likelihood of occurrence, but the discussion need not provide as great detail as is provided for the effects attributable to the project alone. The discussion should be guided by the standards of practicality and reasonableness, and should focus on the cumulative impact to which the identified other projects contribute rather than the attributes of other projects which do not contribute to the cumulative impact.

## 9.5.2 Past, Present, and Reasonably Foreseeable Future Projects

Chapter 16, *Cumulative Impact Summary*, *Growth-Inducting Effects, and Irreversible Commitment of Resources* includes a list of past, present, and reasonably foreseeable future projects considered for the cumulative analysis. Reasonably foreseeable probable future projects are projects that are currently under construction, approved for construction, or in final stages of formal planning. These projects were identified by reviewing available information regarding planned projects and are summarized in Chapter 16. For example, several water suppliers plan to augment existing surface water supplies in order to relieve stress on subbasins and prevent further overdraft and resulting saline intrusion. Past, present, and reasonably foreseeable future projects related to groundwater resources or that could affect groundwater resources are listed in Chapter 16 and include the following.

- Eastern San Joaquin Integrated Conjunctive Use Program.
- Farmington Groundwater Recharge Project.
- Semitropic Groundwater Banking program.
- Regional Surface Water Supply Project.
- South County Water Supply Project.
- SSJID and SEWD water transfer agreement.
- SSJID increased surface water agreements/sales to municipalities and associated infrastructure (e.g., Ripon to receive treated water as part of its SSJID water allotment; Escalon plans to convey SSJID treated water to their city limits; City of Tracy completed a second connection to SSJID sources).
- Modesto Regional Water Treatment Plant Phase Two.

## 9.5.3 Significance Criteria

Two significance criteria must be met for an environmental consequence to have a significant cumulative impact: (1) the effect must make a cumulatively considerable incremental contribution to an overall cumulative impact, and (2) the overall cumulative impact (considering past, present, and reasonably foreseeable probable future projects) must be significant. (See Cal. Code Regs., tit.

14, §§ 15064, 15065, 15130.) The cumulative analysis uses the impact threshold topics discussed in the impact analysis (i.e., substantially deplete groundwater resources).

## 9.5.4 Mitigation Measures for Significant Cumulative Impacts

As specified by Section 15130 of the State CEQA Guidelines (2012) the analysis of cumulative impacts will examine feasible options for mitigating or avoiding a project's contribution to any significant cumulative effects. With some projects, the only feasible mitigation for cumulative impacts may be the adoption of ordinances or regulations rather than the imposition of conditions on a project-by-project basis. Mitigation measures to reduce an alternative's contribution to significant cumulative effects are presented below where feasible and appropriate.

## 9.5.5 Cumulative Impact Analysis

### Methodology

The methodology to analyze cumulative impacts associated with groundwater resources identifies the significant impacts from the alternatives, qualitatively describes the cumulative impacts expected from past, present, and reasonably foreseeable projects, and then determines whether the alternatives have a cumulatively considerable impact when included with the past, present, and reasonably foreseeable future projects impacts. Where appropriate the cumulative analysis is combined for various alternatives.

### Geographic Scope

Cumulative impacts on groundwater can result from the combined demand of the LSJR alternatives with past, present, and reasonably foreseeable future projects on any of the groundwater basins in which the alternatives may have impacts. The geographic scope of the cumulative effect analysis of groundwater depends on the subbasin from which the groundwater is extracted. The geographic scope for groundwater resources cumulative impacts is the same as that described above for the LSJR alternatives and includes the various subbasins.

### Analysis

Past and present projects have regularly used groundwater in the San Joaquin Valley Groundwater Basin. There are documented areas of overdraft in the San Joaquin Valley Groundwater Basin, primarily in the southern region outside of the plan area, but also within the plan area. Recently, some of the subbasins have seen increased groundwater elevations due to active recharge by current projects. Additionally, recharge of the subbasins is expected to continue under some of the reasonably foreseeable future projects. However, overall, combined effects of the past, present, and reasonably foreseeable future projects have led to reduced groundwater resources, have resulted in cumulatively considerable conditions for groundwater resources, and impacts have been significant.

LSJR Alternative 2 would result in less-than-significant impacts on groundwater resources. This is because under LSJR Alternative 2, groundwater pumping is not expected to significantly increase as a result of the change in flows on the Stanislaus, Tuolumne, and Merced Rivers. In addition, future projects would be expected to continue using surface water to recharge groundwater basins, and municipalities would be expected to continue to use or plan on using surface water to augment or reduce current groundwater pumping. It is not expected that LSJR Alternative 2 will interfere with these present and future projects to use surface water diversions to recharge groundwater or reduce dependence on groundwater for municipalities. Therefore, LSJR Alternative 2 is not expected to substantially deplete groundwater supplies or interfere substantially with groundwater recharge. Thus, the incremental contribution of LSJR Alternative 2 would not be cumulatively considerable, and cumulative impacts would be less than significant.

LSJR Alternatives 3 and 4 are both expected to result in significant increases in groundwater pumping to continue to meet the needs of water users in the subbasins. This is expected because of the reduced surface water diversions from the three eastside tributaries that would be required under LSJR Alternatives 3 and 4. If surface water diversions are reduced, not only would an increase in groundwater pumping be expected, but a reduction of groundwater recharge may also result. This is because present and future projects are currently using surface water sources to recharge groundwater subbasins, and under LSJR Alternatives 3 or 4, the ability to use surface water sources to recharge groundwater basins would likely be reduced. In addition, the different municipalities and irrigation districts currently relying on groundwater are projecting population growth in their service areas, and they would continue to rely on groundwater to meet increasing demand as a result of population growth. For example, surface water demands from municipal water users (e.g., Lathrop, Manteca, and Tracy) are expected to increase as they plan on replacing groundwater pumping with surface water deliveries through present and reasonably foreseeable projects and agreements. Therefore, LSJR Alternatives 3 or 4 would likely result in limiting the ability of present and future projects to use surface water as a means of reducing their use of groundwater.

Therefore, both LSJR Alternatives 3 or 4 are expected to substantially deplete groundwater supplies or interfere substantially with groundwater recharge. The incremental cumulative contribution of LSJR Alternative 3 or 4 to impacts on groundwater resources would be significant, and when combined with past, present, and reasonably foreseeable future projects, LSJR Alternative 3 or 4 would result in a significant cumulative impact. As discussed under the analysis of LSJR Alternatives 3 and 4 (Section 9.4.3, *Impacts and Mitigation Measures*), measures that would reduce impacts on groundwater resource could be implemented by local or regional agencies; however, it is unlikely that they would reduce cumulative impacts to less-than-significant levels because of the quantity of water likely needed to offset the reduction in surface water diversions. Therefore, cumulative impacts would remain significant and unavoidable.

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