5 Surface Water Supply

This chapter describes the surface water supply within the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project (Project) area and identifies potential effects of project implementation on water supply. The analysis provided in this chapter includes a description of existing environmental conditions, methods used to assess environmental effects, potential direct and indirect impacts of project implementation, and mitigation measures recommended to address adverse effects under the National Environmental Policy Act (NEPA) and significant impacts under the California Environmental Quality Act (CEQA). Federal, State of California (State), and local regulations that pertain to surface water supply are summarized.

5.1 Environmental Setting/Affected Environment

The Project area for the water supply analysis includes the Sacramento-San Joaquin Delta (Delta) region, areas upstream of the Delta region that may experience changes in operations as a result of changes in flows in the Yolo Bypass, and the State Water Project (SWP) and Central Valley Project (CVP) Export Service Areas.

Shasta, Folsom, and Oroville reservoirs would not be re-operated to inundate the Yolo Bypass. However, the increase of flows into the Yolo Bypass would reduce flows in the Sacramento River between Fremont Weir and the Delta, which in turn could affect water availability for diversion through the California WaterFix intakes. CVP and SWP service areas are described in greater detail below.

5.1.1 Central Valley Project

5.1.1.1 CVP Facilities

The CVP reaches approximately 400 miles, from the Cascade Mountains near Redding in the north to the Tehachapi Mountains near Bakersfield in the south. It consists of 20 dams and reservoirs, 11 power plants, 500 miles of major canals, conduits, tunnels, and related facilities. The CVP manages approximately 9 million acre-feet (MAF) of water, delivering about 7 MAF of water for municipal, industrial, agricultural, urban, and wildlife use.

The CVP facilities include reservoirs on the Trinity, Sacramento, American, Stanislaus, and San Joaquin rivers. Water from the Trinity River is stored and re-regulated in Trinity Lake, Lewiston Lake, and Whiskeytown Reservoir and diverted through a system of tunnels and power plants into the Sacramento River for the Central Valley.

Water is also stored and reregulated in Shasta Lake and Folsom Lake. Water from these reservoirs and other reservoirs owned and/or operated by the SWP and local water rights holders flows into the Sacramento River. Some CVP contractors divert water directly from or immediately below the dams' outlet works. Other CVP contractors, Sacramento River water rights contractors, and water rights holders divert water directly from the Sacramento and American rivers.

The Sacramento River carries water to the Delta. The C.W. “Bill” Jones (Jones) Pumping Plant at the southern end of the Delta lifts the water into the Delta Mendota Canal. This canal delivers water to CVP contractors and exchange contractors on the San Joaquin River and to water rights contractors on the Mendota Pool. The CVP water is also conveyed to San Luis Reservoir for deliveries to CVP contractors through the San Luis Canal. Water from San Luis Reservoir also can be conveyed through the Pacheco Tunnel to CVP contractors in Santa Clara and San Benito counties.

The CVP also serves water from Friant Dam on the San Joaquin River to CVP contractors located near the Madera and Friant-Kern canals. Water is stored in New Melones Reservoir for water rights holders in the Stanislaus River watershed and CVP contractors in the northern San Joaquin Valley (United States Department of the Interior, Bureau of Reclamation [Reclamation] 2017).

5.1.1.1.1 Shasta and Keswick Dams

Shasta Dam is a curved, gravity-type, concrete structure that rises 533 feet above the streambed with a total height above the foundation of 602 feet. The dam has a crest width of about 41 feet and a length of 3,460 feet. Shasta Lake has a storage capacity of 4.5 MAF and a water surface area at full pool of 29,600 acres. Maximum seasonal flood management storage space in Shasta Lake is 1.3 MAF. Releases from Shasta Dam can be made through the power plant, over the spillway, or through the river outlets. The power plant has a maximum release capacity of nearly 20,000 cubic feet per second (cfs); the river outlets can release a maximum of 81,800 cfs at full pool, and the maximum release over the drum-gated spillway is 186,000 cfs (Reclamation 2013).

Keswick Dam is about nine miles downstream from Shasta Dam. In addition to regulating outflow from the dam, Keswick Dam controls runoff from 45 square miles of drainage area. Keswick Dam is a concrete, gravity-type structure with a spillway over the center of the dam. The spillway has four 50- by 50-foot fixed wheel gates with a combined discharge capacity of 248,000 cfs at full pool elevation (587 feet). Keswick Reservoir storage capacity below the top of the spillway gates at full pool is 23,800 acre-feet (AF). The power plant has a generating capacity of 105,000 kilowatts and can pass about 15,000 cfs at full pool (Reclamation 2013).

5.1.1.1.2 Sacramento Valley Diversion Facilities

Below Keswick Dam, two facilities divert flows from the Sacramento River: the Anderson-Cottonwood Irrigation District Diversion Dam and the Red Bluff Pumping Plant. The primary purpose of these two facilities is to divert water into canals for local agricultural use.

5.1.1.1.3 Folsom and Nimbus Dams

Folsom Dam is a concrete gravity dam on the American River that rises 340 feet above the streambed. The dam has a crest width of about 36 feet and a length of 1,400 feet. Folsom Lake has a storage capacity of 1,087,000 AF and a normal maximum pool of 977,000 AF. The maximum seasonal flood management storage space in Folsom Lake is 600,000 AF. Releases from Folsom Dam can be made from the power plant, through the five main spillway gates, or through river outlets. The spillway capacity is 567,000 cfs; however, the maximum combined release through the river outlets and gated spillway is limited to 115,000 cfs due to downstream channel capacity. The generating capacity of the Folsom power plant is 198,720 kilowatts. An auxiliary spillway with six 23-foot by 34-foot gates is scheduled to be completed in 2017, which would allow a maximum total release of 160,000 cfs through the main spillway, auxiliary spillway, and river outlets.

Nimbus Dam, which impounds Lake Natoma, is located seven miles downstream of Folsom Dam on the American River. Nimbus Dam is a 1,093-foot-long and 87-foot-high concrete gravity-type structure with 18 radial gates. The 40-foot by 24-foot gates control flow to two generators with a capacity of 7,763 cfs each (Reclamation 2008).

5.1.1.1.4 C.W. “Bill” Jones Pumping Plant

The CVP Jones Pumping Plant, located about five miles north of Tracy, has a permitted diversion capacity of 4,600 cfs and sits at the end of a 2.5-mile long earth-lined intake channel that extends to Old River (Reclamation 2015). Water diverted at the Jones Pumping Plant is discharged to the CVP Delta-Mendota Canal (DMC), which extends 117 miles to the Mendota Pool. Water from the Jones Pumping Plant may be pumped from the DMC O’Neill Forebay and then pumped into San Luis Reservoir by the Gianelli Pumping-Generating Plant. The DMC has an initial capacity of 4,600 cfs at the Jones Pumping Plant that decreases to about 3,200 cfs at its terminus (Reclamation 2015).

5.1.1.1.5 O’Neill Forebay and San Luis Reservoir

The O’Neill Pumping-Generating Plant consists of six pump-generating units, with a capacity of 700 cfs each. The O’Neill Forebay is a joint CVP/SWP facility with a storage capacity of about 56,000 AF. In addition to its interactions with the Delta-Mendota Canal via the O’Neill Pumping-Generating Plant, it is a part of the SWP California Aqueduct. The O’Neill Forebay serves as a regulating water body for San Luis Reservoir; the William R. Gianelli Pumping-Generating Plant, also a joint CVP/SWP facility, can pump flows from the O’Neill Forebay into San Luis Reservoir and make releases from San Luis Reservoir to the O’Neill Forebay for diversion to either the DMC or the California Aqueduct. In addition, several water districts receive diversions directly from the O’Neill Forebay. The William R. Gianelli Pumping-Generating Plant consists of eight units, with 1,375 cfs of pumping capacity and 1,640 cfs of generating capacity each, for a total pumping capacity of 11,000 cfs and a generating capacity of 13,120 cfs.

San Luis Reservoir, impounded by the B.F. Sisk Dam, provides offstream storage for excess winter and spring flows diverted from the Delta. It is sized to provide seasonal carryover storage, with a total capacity of over 2 MAF. The CVP share of the storage is less than 1 MAF; the remaining 1 MAF of storage are the SWP share. During spring and summer, water demands and schedules are greater than the capability of Reclamation and the California Department of Water Resources (DWR) to pump water from the Jones Pumping Plant and Harvey O. Banks (Banks) Pumping Plant; water stored in San Luis Reservoir is used to make up the difference. The CVP share of San Luis Reservoir typically is at its lowest in August and September and at its maximum in April. The San Felipe Division of the CVP supplies water to customers in Santa Clara and San Benito counties from San Luis Reservoir (Reclamation 2008).

5.1.1.1.6 Delta Mendota Canal

South of O'Neill Forebay, the DMC terminates in Mendota Pool, about 30 miles west of Fresno. From the DMC, the CVP makes diversions to multiple water users and wildlife refuges. DMC capacity at the terminus is 3,211 cfs (Reclamation 2008).

5.1.1.2 CVP Contractors

At certain times of the year, operations of Shasta Lake are driven by the water supply needs of CVP contractors. The CVP provides water to approximately 145 settlement contractors in the Sacramento Valley, exchange contractors in the San Joaquin Valley, agricultural and municipal and industrial (M&I) water service contractors in both the Sacramento and San Joaquin valleys, and wildlife refuges both north and south of the Delta. Table 5-1 shows the maximum contract quantities for CVP contractors and the contract amounts for agriculture and the historical M&I use.

Table 5-1. Maximum Water Delivery Amounts for CVP Contractors

	Maximum Contract Quantity (AF)
North of Delta CVP Water Service and Water Rights Contracts	
Sacramento River Water Service	468,890
American River	313,750
Sacramento River Settlement Contractors	2,115,620
Subtotal	2,898,260
South of Delta CVP Water Service and Water Rights Contracts	
South of Delta Water Service	2,112,898
South of Delta Water Rights/Exchange Contracts	875,623
Subtotal	2,988,521
Friant Division	2,249,475
In-Delta	195,000
New Melones East Side	755,000
Wildlife Refuges	
North of Delta	151,250
South of Delta	271,001
Subtotal	422,251
Total CVP Contracts	9,508,507

Source: Reclamation March 2016 data

Key: AF= acre-feet; CVP= Central Valley Project

At the beginning of each year, Reclamation evaluates hydrologic conditions throughout California and uses this information to forecast CVP operations and estimate the amount of water to be made available to the Federal water service contractors for the year.

Most of the federal water service contractors have service areas located south of the Delta. In general, allocations to CVP water service contractors south of the Delta are lower than allocations to service contractors in the Sacramento Valley. Because of water rights secured before construction of the CVP, Sacramento Valley settlement contractors and San Joaquin Valley exchange contractors have a higher level of reliability for their supplies except in Shasta-critical years. The critical year is defined as years in which:

- the annual unimpaired inflow into Shasta Lake is less than 3.2 MAF or
- the average inflow for a two-year period is below 4.0 MAF and the total two-year deficiency for deliveries is higher than 0.8 In Shasta-critical years, settlement and exchange contractors receive 75 percent of their contract amounts.

5.1.2 State Water Project

5.1.2.1 SWP Facilities

The SWP's primary storage facility is Oroville Dam. Lake Oroville water is conserved and released to serve three Feather River water contractors, two contractors from the North Bay Aqueduct, and 24 South of Delta contractors from the Banks Pumping Plant.

5.1.2.1.1 Lake Oroville and Thermalito Facilities

Oroville Dam is an earth embankment dam on the Feather River with a total height of 770 feet. The dam is 6,920 feet long with a crest width of 80 feet. Lake Oroville has a storage capacity of 3.5 MAF and water surface area at full pool of 15,805 acres. Maximum seasonal flood management storage space in Lake Oroville is 750,000 AF. Typically, releases from Oroville Dam can be made through the Hyatt power plant, over the spillway, or through the river outlets. The river outlets can release a maximum of 5,400 cfs at full pool. The maximum release over the gated spillway is 150,000 cfs; the Hyatt power plant has a maximum release capacity of nearly 17,000 cfs. In April 2017, construction began to repair damage to the spillway that occurred during high-runoff from a series of storms in January and February 2017. The spillway is expected to be partly functional by November 2017. Normal operations should resume by November 2018.

Hyatt Power Plant is on the left when facing downstream of Oroville Dam. Facilities consist of an intake structure, two penstock tunnels, six penstock branches, an underground powerhouse with three turbine units and three reversible turbine-pump units, and two tailrace tunnels and outlet works. Water from the power plant is released through two tunnels into the Feather River just downstream of Oroville Dam.

The Thermalito Diversion Dam, about four miles downstream from Oroville Dam, forms the Thermalito Diversion Pool. The Thermalito Diversion Dam is a concrete, gravity-type structure with a gated spillway outlet. The spillway has fourteen 40- by 23-foot radial gates with a combined discharge capacity of 320,000 cfs at full pool. Thermalito Diversion Pool storage capacity below the top of the spillway gates is 13,350 AF. The power plant at the Thermalito Diversion Dam can pass about 615 cfs at full pool.

From the Thermalito Diversion Dam, flows enter the Thermalito Power Canal and Thermalito Forebay. The Thermalito Forebay is formed by a zoned earthfill dam that provides headwater for the downstream Thermalito Pumping-Generating Plant and tailwater for the upstream Hyatt power plant. The maximum storage of the Thermalito Forebay is 11,768 AF. Flows are conveyed to the Thermalito Pumping-Generating Plant, which operates in tandem with the Hyatt Power plant to provide 17,400 cfs of generating flow and 9,120 cfs of pump-back flow capacities.

Thermalito Afterbay is an offstream reservoir that provides pump-back storage, regulates the power system, and controls flow in the Feather River downstream from Oroville. Thermalito Afterbay Dam, a 39-foot-high earthfill dam, has a crest width of 30 feet and a length of 42,000 feet. The maximum storage of Thermalito Afterbay is 57,040 AF. The controlled maximum flow from the five Thermalito Afterbay eight-foot by eight-foot radial gates into the Feather River is 17,000 cfs. Thermalito Afterbay also has 12 irrigation outlets: five eight-foot by eight-foot radial gates, three six-foot by six-foot radial gates, and four five-foot by six-foot radial gates.

5.1.2.1.2 Harvey O. Banks Pumping Plant and Clifton Court Forebay

The nominal capacity of the Banks Pumping Plant is 10,300 cfs. Permits issued by the United States Army Corps of Engineers regulate the rate of diversion of water into Clifton Court Forebay (CCF). This diversion rate is normally restricted to 6,680 cfs as a three-day average inflow to CCF and 6,993 cfs as a one-day average inflow to CCF. CCF diversions may be greater than these rates between December 15 and March 15 when the inflow into CCF may be augmented by one-third of the San Joaquin River flow at Vernalis when those flows are equal to or greater than 1,000 cfs (Reclamation 2015).

The CCF is a 31,000 AF reservoir that provides storage for off-peak pumping and moderates the effect of the pumps on the fluctuation of flow and stage in adjacent Delta channels (Reclamation 2015).

5.1.2.1.3 O’Neill Forebay and San Luis Reservoir

O’Neill Forebay and San Luis Reservoir are joint CVP/SWP facilities and are discussed in Section 5.1.1.1.5. The SWP share of San Luis Reservoir’s storage is 1.0 MAF; the remaining 1.0 MAF are the CVP share.

5.1.2.1.4 California Aqueduct

South of the Banks Pumping Plant, California Aqueduct flows enter Bethany Reservoir, a 5,000-AF forebay for the South Bay Pumping Plant. Exiting Bethany Forebay, California Aqueduct flows go through a series of checks to the aforementioned O’Neill Forebay and are either pumped into San Luis Reservoir or released to San Luis Canal.

Parallel to the DMC, the San Luis Canal-California Aqueduct is a joint-use facility for the CVP and SWP. It begins on the southeast edge of O’Neill Forebay and extends about 101.5 miles southeasterly to a point near Kettleman City. Water from the canal serves the San Luis Federal service area, mostly for agricultural purposes and for some M&I uses. The canal has a capacity ranging from 8,350 to 13,100 cfs.

5.1.2.2 SWP Contractors

The SWP operates under long-term contracts with public water agencies throughout California. These agencies, in turn, deliver water to wholesalers or retailers or deliver it directly to agricultural and M&I water users (DWR 1999). The SWP contracts between DWR and individual state water contractors define several classifications of water available for delivery under specific circumstances.

5.1.2.3 SWP Contracts

The SWP delivers water to its contractors in accordance with long-term water supply contracts and other agreements. The contractors' maximum contract amounts, known as "Table A" amounts, are shown in Table 5-2.

Table 5-2. Maximum Annual Table A Water Delivery Amounts for SWP Contractors

Contractor	Maximum Table A Delivery Amounts (AF)
Feather River Area Contractors	
Butte County	27,500
Yuba City	9,600
Plumas County Flood Control and Water Conservation District	2,700
Subtotal	39,800
North Bay Area Contractors	
Napa County Flood Control and Water Conservation District	29,025
Solano County Water Agency	47,506
Subtotal	76,531
South Bay Area Contractors	
Alameda County Flood Control and Water Conservation District, Zone 7	80,619
Alameda County Water District	42,000
Santa Clara Valley Water District	100,000
Subtotal	222,619
San Joaquin Valley Area Contractors	
Dudley Ridge Water District	50,343
Empire West Side Irrigation District	2,000
Kern County Water Agency	982,730
Kings County	9,305
Oak Flat-Water District	5,700
Tulare Lake Basin Water Storage District	88,922
Subtotal	1,139,000
Central Coastal Area Contractors	
San Luis Obispo County Flood Control and Water Conservation District	25,000
Santa Barbara County Flood Control and Water Conservation District	45,486
Subtotal	70,486

Contractor	Maximum Table A Delivery Amounts (AF)
Southern California Area Contractors	
Antelope Valley–East Kern Water Agency	141,400
Castaic Lake Water Agency	95,200
Coachella Valley Water District	138,350
Crestline–Lake Arrowhead Water Agency	5,800
Desert Water Agency	55,750
Littlerock Creek Irrigation District	2,300
Metropolitan Water District of Southern California	1,911,500
Mojave Water Agency	82,800
Palmdale Water District	21,300
San Bernardino Valley Municipal Water District	102,600
San Gabriel Valley Municipal Water District	28,800
San Gorgonio Pass Water Agency	17,300
Ventura County Watershed Protection District	20,000
Subtotal	2,623,100
TOTAL TABLE A AMOUNTS	**4,171,536**

Source: State Water Project Final Delivery Capability Report 2015
Key: AF= acre-feet

SWP contractors can also participate in the Article 21 program, which provides water supplies to SWP contractors when water exceeding the current SWP need is available. Under Article 21 of the SWP’s long-term water supply contracts, contractors may receive additional water deliveries only under the following specific conditions:

- Such deliveries do not interfere with SWP Table A allocations and SWP operations
- Excess water is available in the Delta
- Capacity is not being used for SWP purposes or scheduled SWP deliveries
- Contractors can use the SWP Article 21 water directly or can store it in their own system (i.e., the water cannot be stored in the SWP system)

SWP contractors can also participate in the Turnback Pool, which allows SWP contractors to sell unused Table A water supply to other SWP contractors.

5.1.3 Non-CVP and SWP Water Users

There are hundreds of non-CVP and SWP water users with water rights junior to the CVP and SWP that divert from along the Feather and Sacramento rivers, within the Yolo Bypass, and in the Delta. These water rights holders are subject to water availability and are only allowed to divert non-CVP or SWP water during periods when there is unstored water from contributing tributaries in excess of the needs of the CVP and SWP.

5.2 Regulatory Setting

5.2.1 Federal Plans, Policies, and Regulations

5.2.1.1 2008 USFWS Biological Opinion

In 2008, the United States Fish and Wildlife Service (USFWS) issued a biological opinion (BO) for the coordinated long-term operations of the CVP and SWP (USFWS 2008). The USFWS determined that continued CVP and SWP operations were likely to jeopardize the existence of delta smelt and destroy or adversely modify its critical habitat. The USFWS BO included a reasonable and prudent alternative (RPA) that identifies a number of habitat improvements and monitoring requirements. RPA actions in the BO are intended to improve survival and habitat conditions for delta smelt, mainly through flow and Delta salinity conditions, through implementation of the following water operations (USFWS 2008; Reclamation 2015):

- Old and Middle River reverse flow limits of no more than -1,500 to -5,000 cfs during periods when delta smelt could be subject to entrainment at the pumps[1]
- X2 location[2] limits during the fall

Details on how these RPA actions were included in the modeling and subsequent analyses are included in Appendix E, *CalSim II Modeling*.

5.2.1.2 2009 NMFS BO

In 2009, the National Oceanic and Atmospheric Administration National Marine Fisheries Service (NMFS) issued a *Biological Opinion and Conference Opinion on the Long-Term Operations of the Central Valley Project and the State Water Project* (NMFS BO) The NMFS BO determined that continued CVP and SWP operations were likely to jeopardize the existence of Sacramento River winter-run Chinook salmon, Central Valley spring-run Chinook salmon, Central Valley steelhead, and the Southern Distinct Population Segment of North American green sturgeon (NMFS 2009). The NMFS BO included RPA actions that specify a number of actions, including forming operation groups; implementing habitat improvements; complying with monitoring requirements; and achieving objectives for fish passage, flow, and temperature. The RPA actions related to flow and temperature in the Sacramento River, American River, and Delta that would directly affect project water operations are described below (Reclamation 2015).

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[1] The flow standard on Old and Middle rivers is expressed as a negative value since Old and Middle Rivers have the potential to run in reverse of their natural direction when the CVP and SWP pumps are running.

[2] X2 is the location of the two parts per thousand salinity contour (isohaline), one meter off the bottom of the estuary, as measured in kilometers upstream from the Golden Gate Bridge (State Water Resources Control Board 2000). X2 is further described in Section 5.2.2.2.3.

5.2.1.2.1 Sacramento River Division

The 2009 NMFS BO included several RPA actions that directly affect Sacramento River Division operations. Those RPA actions include:

- Clear Creek flow and temperature objectives
- Reclamation deliverable water forecast procedures
- End-of-year (September 30) Shasta target storage
- Shasta cold-water management operations
- Sacramento River temperature objectives between Keswick Dam and Bend Bridge
- Restoration of lower Sacramento floodplain-rearing habitat

5.2.1.2.2 American River Division

The 2009 NMFS BO included one RPA action, lower American River temperature objectives, that directly affects American River Division operations

5.2.1.2.3 Delta Division

The 2009 NMFS BO included several RPA actions that directly affect Delta Division operations. Those RPA actions include:

- Delta Cross Channel gate operation
- San Joaquin River inflow to export ratio objectives
- Old and Middle rivers negative or reverse flow objectives

5.2.1.3 Central Valley Project Improvement Act

Following passage by Congress, Reclamation’s evolving mission was written into law on October 30, 1992 and signed by President George H. W. Bush. Public Law 102-575, the Reclamation Projects Authorization and Adjustment Act of 1992, included Title 34, the Central Valley Project Improvement Act (CVPIA) (Reclamation 1999). The CVPIA amended previous authorizations of the CVP to include fish and wildlife protection, restoration, and mitigation as project purposes having equal priority with irrigation and domestic water supply uses and fish and wildlife enhancement having equal priority with power generation. Among the changes mandated by the CVPIA are the following:

- Dedicating 800,000 AF annually to fish, wildlife, and habitat restoration
- Authorizing water transfers outside the CVP service area
- Implementing the Anadromous Fish Restoration Program
- Creating a restoration fund financed by water and power users
- Installing the Shasta Dam temperature control device
- Implementing fish passage measures at the Red Bluff Diversion Dam

- Planning to increase the CVP yield
- Mandating firm water supplies for Central Valley wildlife refuges

The CVPIA is being implemented on a broad front. The Final Programmatic Environmental Impact Statement (EIS) (Reclamation 1999) for the CVPIA analyzed projected conditions in 2022, 30 years from the CVPIA's adoption in 1992. The Final Programmatic EIS was released in October 1999, and the CVPIA Record of Decision was signed on January 9, 2001.

The CVPIA directs the Secretary of the Interior to develop and implement a program that makes all reasonable efforts to double natural production of anadromous fish in Central Valley streams (Section 3406(b)(1)). The program is known as the Anadromous Fish Restoration Program. Operations of the CVP reflect provisions of the CVPIA, particularly Sections 3406 (b)(1), (b)(2), and (b)(3). The United States Department of the Interior Decision on Implementation of Section 3406 (b)(2) of the CVPIA, October 5, 1999, provides the basis for implementing upstream and Delta actions with CVP delivery capability. The Anadromous Fish Restoration Program assumed Sacramento River water would be acquired under Section 3406 (b)(2).

5.2.1.4 CVP Long-Term Water Service Contracts

In accordance with CVPIA Section 3404(c), Reclamation is renegotiating long-term water service contracts. As many as 113 CVP water service contracts in the Central Valley may be renewed during this process. Reclamation issued a Notice of Intent for long-term contract renewal in October 1998. Environmental documentation was prepared on a regional basis. In February 2005, Reclamation issued decisions (a Record of Decision or Finding of No Significant Impact) for renewing contracts of the Sacramento River, San Luis, and Delta-Mendota Canal divisions, the Sacramento River settlement contracts, and several individual contracts.

5.2.2 State Plans, Policies, and Regulations

5.2.2.1 Water Quality Control Plan for the San Francisco Bay/San Joaquin Delta Estuary

The 1995 San Francisco Bay/Sacramento-San Joaquin Delta (Bay-Delta) Water Quality Control Plan (WQCP) (State Water Resources Control Board [SWRCB] 1995) established water quality control objectives for the protection of beneficial uses in the Delta. The 1995 WQCP identified 1) beneficial uses of the Delta to be protected, 2) water quality objectives for the reasonable protection of beneficial uses, and 3) a program of implementation for achieving the water quality objectives. Because these new beneficial objectives and water quality standards were more protective than those of the previous SWRCB Water Right Decision 1485, the new objectives were adopted in 1995 through a water right order for operation of the CVP and SWP. Key features of the 1995 WQCP include estuarine habitat objectives for Suisun Bay and the western Delta (consisting of salinity measurements at several locations), export/inflow (E/I) ratios intended to reduce entrainment of fish at the export pumps, Delta Cross Channel gate closures, and San Joaquin River electrical conductivity (EC) and flow standards. The SWRCB adopted a new Bay-Delta WQCP on December 13, 2006. However, this new WQCP made only minor changes to the 1995 WQCP.

The SWRCB is in the process of updating the Bay-Delta WQCP. On September 15, 2016, the SWRCB released a draft revised Bay-Delta WQCP and Substitute Environmental Document, which outlines proposed changes to the Bay-Delta WQCP, including revised southern Delta salinity objectives and San Joaquin River flow objectives. Draft changes to the Bay-Delta WQCP will become final upon approval by the SWRCB at a public meeting, which will be held in 2017.

5.2.2.2 State Water Resources Control Board Revised Water Right Decision 1641

The 1995 Bay-Delta WQCP contains water quality objectives. SWRCB Revised Decision 1641 (RD-1641) (SWRCB 2000) and Water Right Order 2001-05 contain the water right requirements as of June 2017 to implement the 1995 WQCP. RD-1641 incorporates water right settlement agreements between Reclamation and DWR and certain water users in the Delta and upstream watersheds regarding contributions of flows to meet water quality objectives. However, the SWRCB imposed terms and conditions on water rights held by Reclamation and DWR that require these two agencies, in some circumstances, to meet many of the water quality objectives established in the 1995 WQCP. RD-1641 authorizes the CVP and SWP to use joint points of diversion (JPOD) in the south Delta and recognizes the CALFED Bay-Delta Program Operations Coordination Group process for operational flexibility in applying or relaxing certain protective standards.

5.2.2.2.1 Delta Outflow Requirement

Delta outflow (inflow that is not exported or diverted) is the primary factor controlling water quality in the Delta. When Delta outflow is low, seawater can intrude farther into the Delta, impacting water quality at drinking water intakes. RD-1641 specifies minimum monthly Delta outflow objectives to maintain a reasonable range of salinity in the estuarine aquatic habitat based on the Net Delta Outflow Index (NDOI). The NDOI is a measure of the freshwater outflow and is determined from a water balance that considers river inflows, precipitation, agricultural consumptive demand, and project exports. The NDOI does not consider the semi-diurnal and spring-neap tidal cycles. The monthly minimum values of the NDOI specified in RD-1641 depend on the water year type. Minimum flows are specified for the months of January and July to December. The outflow objectives from February to June are determined based on the X2 objective.

5.2.2.2.2 Delta Salinity Objectives

RD-1641 salinity standards for the Delta are stated in terms of EC (for protection of agricultural and fish and wildlife beneficial uses) and chloride (for protection of M&I uses). Compliance values vary with water year and month. The salinity objectives at Emmaton on the Sacramento River and at Jersey Point on the San Joaquin River often control Delta outflow requirements during the irrigation season from April through August, requiring additional releases from upstream CVP and SWP reservoirs.

5.2.2.2.3 X2 Objective

RD-1641 includes an objective for X2. The location of X2 is used as a surrogate measure of ecosystem health in the Delta. The X2 objective requires specific daily surface criteria to be met for a certain number of days each month from February through June. Compliance can also be achieved by meeting a 14-day running average salinity or three-day average outflow equivalent. These requirements were designed to provide improved shallow water habitat for fish species in the spring. Because of the relationship between seawater intrusion and interior Delta water quality, the X2 objective also improves water quality at Delta drinking water intakes.

5.2.2.2.4 Maximum Export/Inflow Ratio

RD-1641 includes a maximum E/I ratio standard to limit the fraction of Delta inflows that are exported. This requirement was developed to protect fish species and reduce entrainment losses. Delta exports are defined as the combined pumping of water at Banks and Jones pumping plants. Delta inflows are the gaged or estimated river inflows. The maximum E/I ratio is 0.35 for February through June and 0.65 for the remainder of the year. If the January eight-river runoff index is less than 1.0 MAF, the February E/I ratio is increased to 0.45. The CVP and SWP have agreed to share the allowable exports equally if the E/I ratio is limiting exports.

5.2.2.2.5 Joint Point of Diversion

The JPOD refers to the CVP and SWP use of each other’s pumping facilities in the south Delta to export water from the Delta. The CVP and SWP historically have coordinated use of Delta export pumping facilities to assist with deliveries and aid each other during times of facility failures. In 1978, by agreement with DWR and with authorization from the SWRCB, the CVP began using the SWP Banks Pumping Plant for replacement pumping (195,000 AF) for pumping capacity lost at Jones Pumping Plant because of striped bass pumping restrictions in SWRCB Water Right Decision 1485. In 1986, Reclamation and DWR formally agreed that “either party may make use of its facilities available to the other party for pumping and conveyance of water by written agreement” and that the SWP would pump CVP water to make up for striped bass protection measures (Reclamation and DWR 1986). Reclamation filed a number of temporary petitions with the SWRCB to use Banks Pumping Plant for purposes other than replacement pumping and CVP deliveries that contractually relied on SWP conveyance. In RD-1641, SWRCB conditionally approved the use of the JPOD in three separate stages:

- Stage 1 – for water service to Cross Valley Canal contractors, Tracy Veterans Cemetery, and Musco Olive and to recover export reductions taken to benefit fish
- Stage 2 – for any purpose authorized under the current project water right permits
- Stage 3 – for any purpose authorized up to the physical capacity of the diversion facilities

Each stage of JPOD has regulatory terms and conditions that must be satisfied to implement JPOD.

All stages require a response plan to ensure water levels in the southern Delta will not be lowered to the injury of local riparian water users (Water Level Response Plan). All stages require a response plan to ensure the water quality in the southern and central Delta will not be significantly degraded through operations of the JPOD to the injury of water users in the southern and central Delta (Reclamation 2008).

5.2.2.2.6 Sacramento Valley Index Water Year-Type Definitions

The Sacramento Valley Index (SVI) for unimpaired runoff for the current water year (October 1 of the preceding calendar year through September 30 of the current calendar year), as published in DWR Bulletin 120, is a forecast of the sum of the unimpaired runoff at the following locations: Sacramento River above Bend Bridge, near Red Bluff; Feather River, total inflow to Oroville Reservoir; Yuba River at Smartsville; and American River, total inflow to Folsom Reservoir. Preliminary determinations of year classification shall be made in February, March, and April, with final determination in May. Each of these determinations is based on hydrologic conditions to date plus forecasts of future runoff, assuming normal precipitation for the remainder of the water year.

The SVI is calculated according to the equation, Index = 0.4 * X + 0.3 * Y + 0.3 * Z, where X is the current year's April to July combined Sacramento Valley unimpaired runoff, Y is the current water year's October to March combined Sacramento Valley unimpaired runoff, and Z is the previous year's SVI value.

The SVI defines five water year-types as follows:

- Wet: if the SVI is greater than or equal to 9.2 MAF
- Above Normal: If the SVI is greater than 7.8 MAF and less than 9.2 MAF
- Below Normal: If the SVI is greater than 6.6 MAF and less than or equal to 7.8 MFA
- Dry: If the SVI is greater than 5.4 MAF and less than or equal to 6.5 MAF
- Critical: If the SVI is less than or equal to 5.4 MAF

5.2.2.3 Coordinated Operations Agreement

The Coordinated Operations Agreement (COA) (Reclamation and DWR 1986) defines how Reclamation and DWR share their joint responsibility to meet Delta water quality standards and the water demands of senior water right holders and how the two agencies share surplus flows. The COA defines the Delta as being in either "balanced water conditions" or "excess water conditions." Balanced water conditions are periods when Delta inflows are just sufficient to meet water user demands within the Delta, outflow requirements for water quality and flow standards, and export demands. Under excess water conditions, Delta outflow exceeds the flow required to meet the water quality and flow standards. Typically, the Delta is in balanced water conditions from June to November and in excess water conditions from December through May. However, depending on the volume and timing of winter runoff, excess or balanced water conditions may extend throughout the year.

With the goal of using coordinated management of surplus flows in the Delta to improve Delta export and conveyance capability, the COA received Congressional approval in 1986 and became Public Law 99-546. The COA, as modified by interim agreements, coordinates operations between the CVP and SWP and provides for the sharing of surplus water supply. The COA requires that the CVP and SWP operate in conjunction to meet State water quality objectives in the Bay-Delta estuary, except as specified. Under this agreement, the CVP and SWP can each contract from the other for the purchase of surplus water supplies, potentially increasing the efficiency of water operations.

Since 1986, the COA principles have been modified to reflect changes in regulatory standards, facilities, and operating conditions. At its inception, the COA water quality standards were those of the 1978 WQCP; these were subsequently modified in the 1991 WQCP. The adoption of the 1995 WQCP by SWRCB superseded those requirements. Evolution of the Clean Water Act over time has also impacted implementation of the COA.

5.2.2.4 SWRCB Standard Permit Term 91

The CVP and SWP are required to release stored water to meet water quality standards in the Delta (including flow and salinity standards) where natural flows are insufficient. The obligation was originally placed on the CVP and SWP as an interim measure, pending future studies of how the obligation to meet water quality standards would be shared with other appropriators. In return for resolving CVP and SWP protests on subsequent applications to appropriate water, SWRCB Standard Permit Term 91 (Term 91) was developed and made a condition to Sacramento Valley water right permits issued after 1965. Term 91 prohibits diversions by these permittees when natural and abandoned flows to the Delta are insufficient to meet the water quality standards and the CVP and SWP are supplementing such flows with previously stored water to meet the standards.

Term 91 is initiated when two conditions occur simultaneously (SWRCB Decision 1594, page 13)—the Delta is in "balanced condition," as defined by COA and supplemental water is being released to meet water quality objectives (when releases from storage plus imports from the Trinity River are greater than combined exports from CVP and SWP Delta facilities, plus carriage water[3] requirements). As such, Term 91 is a measure designed to share the responsibility for meeting the water quality standards with specified junior diverters. Without Term 91, these diverters could take water that was otherwise being used to meet standards, thereby forcing the CVP and SWP to release more stored water. Thus, it serves to preclude post-1965 appropriators from interfering with the CVP and SWP's obligation to meet the standards and in practical effect requires such appropriators to share in meeting the water quality standards (SWRCB 2012).

5.2.3 Regional and Local Plans, Policies, and Regulations

There are no regional or local plans, policies or regulations associated with surface water supply relevant to the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project.

5.3 Environmental Consequences

This section describes the environmental consequences associated with the Project alternatives and the No Action Alternative. This section presents the assessment methods used to analyze the effects on surface water supply, the thresholds of significance that determine the significance of effects, and the potential environmental consequences and mitigation measures as they relate to each Project alternative. Detailed descriptions of the alternatives evaluated in this section are provided in Chapter 2, *Description of Alternatives*.

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[3] Carriage water is the extra water necessary to carry a unit of water across the Delta for export while maintaining existing water quality conditions or regulatory standards within the Delta.

5.3.1 Methods for Analysis

Under NEPA, water supply effects were determined by comparing the effect of each proposed alternative to the effects of the No Action Alternative (the NEPA baseline). Under CEQA, water supply effects were determined by comparing the effects of each proposed alternative to Existing Conditions (the CEQA baseline).

5.3.1.1 Models Used

Potential impacts to water supply were assessed using a combination of DWR/Reclamation's CalSim II operations model and post-processing spreadsheets.

5.3.1.1.1 CalSim II

The primary model used to assess effects on surface water supply was CalSim II. CalSim II simulates operations of the CVP and SWP under different conditions. More information about the CalSim II model, including assumptions, inputs, and model limitations, is provided in Section 4.3.1.1.3 and Appendix E, *CalSim II Modeling*.

5.3.1.1.2 Post-Processing Spreadsheets

Evaluation of Delta excess versus balanced conditions and Term 91 was completed using a post-processing spreadsheet developed by DWR, called "Operations Control_BST_102511.xlsm." The specific version being used was provided via email by Erik Reyes from DWR's Bay-Delta Office on February 5, 2013. The spreadsheet reads data from the CalSim II output files and computes the controlling factor (i.e., flood management, minimum flows) for each CVP and SWP facility represented in CalSim II.

5.3.1.2 Methodology for Determining Changes in CVP/SWP Deliveries

Changes in CVP and SWP operations as a result of each alternative are analyzed using the CalSim II model. CalSim II models a complex and extensive set of regulatory standards and operations criteria. Descriptions of both are contained in Appendix E, *CalSim II Modeling*. The hydrologic analysis conducted for this EIS/EIR used CalSim II models with 2030 and 2070 hydrology from the California Water Commission Climate Change Water Supply Improvement Project modeling to approximate system-wide changes in storage, flow, salinity, and reservoir system reoperation associated with the alternatives. Although CalSim II is the best available tool for simulating system-wide operations, the model also contains simplifying assumptions in its representation of the real system. CalSim II's predictive capability is limited and cannot be readily applied to hourly, daily, or weekly time steps for hydrologic conditions. The model, however, is useful for comparing the relative effects of alternative facilities and operations within the CVP/SWP system on a monthly time step. Reclamation's CalSim II modeling of Existing Conditions and the comparable level of development alternatives assumes a 2030 hydrology. Future conditions in the CalSim II modeling for the No Action Alternative and future conditions-level of development alternatives assume a 2070 hydrology, including estimates of climate change and sea level rise.

Deliveries to CVP and SWP water users located south of the Delta do not necessarily correspond to the same volume as the Delta export patterns because a portion of the exported water is stored in San Luis Reservoir and released on a different pattern than Delta exports, possibly even in another water year, so effects on exports are not included in the water supply analysis.

It also should be noted that the monthly CalSim II model results do not represent daily water operations decisions, especially for extreme conditions. For example, in very dry years, the model simulates minimum reservoir volumes (also known as “dead pool conditions”) that appear to prevent Reclamation and DWR from meeting their contractual obligations, including water deliveries to CVP Sacramento River Settlement Contractors, CVP San Joaquin River Exchange Contractors, SWP Feather River Service Area Contractors, and Level II refuge water supplies. Such model results are anomalies that reflect the inability of the monthly model to make real-time policy decisions under extreme circumstances. Projected reservoir storage conditions near dead pool conditions should only be considered as an indicator of stressed water supply conditions and not necessarily reflective of actual CVP and SWP operations in the future.

5.3.1.3 Methodology for Determining Changes in Delta Conditions

As used for this analysis, the Operations Control spreadsheet described in Section 5.3.1.1.2 computes how much of Delta outflow was used to meet Delta water quality requirements and how much is in excess of the flow required to meet water quality and outflow requirements. When the computed Surplus Delta Outflow is greater than zero cfs for a month, that month is determined to be in excess conditions. If the Surplus Delta Outflow is zero cfs, the month is determined to be in balanced conditions.

5.3.1.4 Methodology for Determining Changes in Water Supply to Non-CVP/SWP Water Users

Non-CVP/SWP water users with water rights junior to the CVP and SWP could be affected by changes in the application of Term 91. If Term 91 was not applied for the basis of comparison (either Existing Conditions or No Action Alternative) but was for the alternative, there could be an impact on a non-CVP/SWP water users’ ability to divert water.

As described in Section 5.2.2.4, two conditions are required to initiate Term 91; the first is the Delta must be in balanced condition, as determined using the approach described in Section 5.3.1.3. The second is that the projects must be releasing supplemental water to meet Delta standards. The method for calculating when supplemental water exists beyond Term 91 was developed in Order 81-15 (SWRCB 1981) and D-1594 (SWRCB 1984):

$$SW = SR - (EX + CW)$$

“SR” is the net storage release from Shasta, Oroville, and Folsom reservoirs plus imports to the Sacramento Valley from the Trinity River CVP facilities, minus exports from the Folsom South Canal. “EX” is the sum of CVP and SWP export diversions at Clifton Court Forebay, Jones Pumping Plant, North Bay Aqueduct, and Contra Costa Canal Intake. “CW” is the project carriage water (i.e., the additional outflow required to maintain water quality standards in the Delta while project exports are occurring). The carriage water term is zero when flow objectives, rather than salinity objectives, control CVP and SWP Delta operations. Reclamation’s Central Valley Operations Office publishes daily accounts of project supplemental water (http://www.usbr.gov/mp/cvo).

For this analysis, CalSim II output and data from the Operations Control spreadsheet were used to determine if Term 91 had been initiated for a month for a scenario and if there was a change in the frequency of the application of Term 91 between scenarios that could affect water supply for non-CVP/SWP water users.

5.3.1.5 Methodology for Determining Temporary Impacts during Construction

Temporary impacts to water supply include those of short duration related to the construction of the Project alternatives. Because all the Project alternatives would be constructed when water levels are below the proposed Fremont Weir invert elevations, there would be no temporary changes or temporary effects to water supply outside of the Yolo Bypass. Construction within the Yolo Bypass (such as at Agricultural Road Crossing 1) would include temporary measures to ensure water supply was maintained throughout the construction period. The analysis in this chapter, therefore, does not include a discussion of temporary impacts to water supply.

5.3.2 Thresholds of Significance – CEQA

A significant effect on the environment means “a substantial, or potentially substantial, adverse change in any of the physical conditions within the area affected by the project” (State CEQA Guidelines, Section 15382).

An alternative would result in a significant impact under CEQA on water supply if, relative to Existing Conditions, it would:

- Substantially reduce water supply deliveries to CVP or SWP contractors during operation, including:
  - North of Delta CVP contractors or wildlife refuges
  - South of Delta CVP contractors or wildlife refuges
  - SWP contractors north of the Delta
  - SWP contractors south of the Delta
- Substantially reduce water supply availability for non-CVP or SWP contractors along the Sacramento River and in the Delta during operation by increasing the incidence of Term 91 being initiated

The following thresholds of significance were developed based on the guidance provided in Appendix G to the CEQA guidelines. These thresholds also encompass the factors considered under NEPA to determine the context and the intensity of its impacts.

5.3.2.1 Impact Indicator for Changes in Water Supply Deliveries to CVP or SWP Contractors

Changes in water supply deliveries to CVP and SWP contractors could be represented by changes either to long-term annual water supply or to monthly water supply. Impact indicators for both conditions are described below.

5.3.2.1.1 Significance Threshold for Changes in Long-Term Average Annual Deliveries

For this analysis, a substantial reduction in long-term reliability is defined as a five percent or greater reduction in average annual or average dry and critical year reliability. This amount is assumed to represent a reduction that could not be replaced reliably from other sources such as groundwater pumping or water transfers. Furthermore, the SWP and CVP generally make their allocations to their contractors in five percent increments, whereas CalSim II computes allocations with much higher precision. Changes in long-term average deliveries and dry and critical year deliveries would be indicative of a systematic change in deliveries due to operation of the project. There are much greater stressors on the system during dry and critical years (as defined by the Sacramento Valley Index described in RD-1641), and reductions in water supply in dry and critical years are much more likely to result in impacts to the contractors due to a lack of ability to secure water supply from other sources.

5.3.2.1.2 Significance Threshold for Changes in Monthly Deliveries

Some flexibility would exist to adjust for changes in surface water supply from month to month. For example, temporarily increased groundwater pumping could be used to make up for a single month’s reduction in supply, but long-term changes in monthly supply could have a significant impact. For this analysis, a substantial reduction in monthly reliability is defined as a greater than 10 percent reduction in average monthly water supply. This amount is assumed to represent a reduction that could not be replaced reliably from other sources such as groundwater pumping or water transfers.

Temporary impacts to water supply include those of short duration related to the construction of the Project alternatives. Because all the Project alternatives would be constructed when water levels are below the proposed Fremont Weir invert elevations, there would be no temporary changes or temporary effects to water supply outside of the Yolo Bypass. Construction within the Yolo Bypass (such as at Agricultural Road Crossing 1) would include temporary measures to ensure water supply was maintained throughout the construction period. The analysis in this chapter, therefore, does not include a discussion of temporary impacts to water supply.

5.3.2.2 Impact Indicators for Increase in Incidence of Term 91 Being Initiated

Non-CVP and SWP water users would potentially be impacted if Term 91 was initiated under an alternative when it had not been initiated under the basis of comparison. If Term 91 is indicated more frequently, or in periods when it was not otherwise indicated for an alternative relative to the basis of comparison, non-CVP and SWP water users would be restricted from diverting and could incur reductions in water supply relative to the basis of comparison. For this analysis, changes in incidences of Term 91 initiation would be considered significant if the following conditions occur:

- Under the basis of comparison, Term 91 is not in effect.
- Under the alternatives, Term 91 is in effect.

5.3.3 Effects and Mitigation Measures

This section provides an evaluation of the direct and indirect effects on surface water supply from implementing the Project alternatives. This analysis is organized by Project alternative, with specific impact topics numbered sequentially under each alternative.

Changes in flow at Fremont Weir could change CVP and SWP operations. Increases in flow at Fremont Weir into the Yolo Bypass and corresponding decreases in flow in the Sacramento River between Fremont Weir and the California WaterFix North-Delta Diversion could lead to decreases in diversions in the North Delta Diversion under future conditions, which could lead to decreases in CVP and SWP exports from the Jones and Banks pumping plants. In turn, decreases in Jones and Banks exports could lead to decreases in San Luis Reservoir storage and, ultimately, a decrease in CVP and SWP deliveries to water service contractors south of the Delta.

Modeling of Existing Conditions and the comparable-level of development alternatives assumes a 2030 hydrology and sea level rise with existing infrastructure and regulatory conditions. Modeling of the No Action Alternative and the comparable-level of development alternatives assumes a 2070 hydrology and sea level rise and reasonably foreseeable infrastructure and regulatory conditions.

5.3.3.1 No Action Alternative

Under the No Action Alternative, no additional actions would be taken to increase seasonal floodplain inundation in the lower Sacramento River Basin or improve fish passage throughout the Yolo Bypass. The Yolo Bypass would continue to be inundated during overtopping events at Fremont Weir, and additional flows would not pass through Fremont Weir when the Sacramento River is below Fremont Weir. Therefore, there would be no construction-related impacts on water supply.

As described in Section 4.3.1.1.3, the No Action Alternative assumes reasonably foreseeable actions in addition to changes in hydrology and sea-level rise relative to Existing Conditions. These reasonably foreseeable actions, in addition to changes in regulatory conditions and water supply demands, would result in differences in flows on the Sacramento River and at the Delta between Existing Conditions and the No Action Alternative.

The California WaterFix Project, included for 2070-level scenarios, would have a notable influence on the effects of the No Action Alternative and its comparable alternatives. A change in diversion through the California WaterFix Project intakes could affect storage in San Luis Reservoir and subsequent deliveries to CVP and SWP contractors south of the Delta. Changes in San Luis Reservoir storage could also result in changes to operations of north-of-Delta reservoirs, such as Shasta, Folsom, and Oroville, to move water supply to fill the reduced San Luis Reservoir storage.

5.3.3.1.1 Impact WS-1: Changes in CVP Water Supply Deliveries North of Delta

Table 5-3 shows changes that would occur in CVP deliveries to North of Delta contractors under the No Action Alternative compared to Existing Conditions.

Table 5-3. Simulated Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta Central Valley Project Contractors and Wildlife Refuges under the No Action Alternative Compared to Existing Conditions

Month	Average All Years		Dry and Critical Years[1]	
	Existing Conditions (cfs)	No Action Alternative Change (cfs [%])	Existing Conditions (cfs)	No Action Alternative Change (cfs [%])
October	1,506	-33 (-2)	1,559	-80 (-5)
November	726	-22 (-3)	770	-49 (-6)
December	389	-7 (-2)	402	-15 (-4)
January	234	-10 (-4)	232	-11 (-5)
February	244	-8 (-3)	248	-14 (-6)
March	337	-14 (-4)	415	-24 (-6)
April	5,113	-98 (-2)	5,464	-134 (-2)
May	5,599	-172 (-3)	5,274	-43 (-1)
June	7,987	-225 (-3)	7,382	-41 (-1)
July	7,932	-327 (-4)	7,252	-201 (-3)
August	5,983	-231 (-4)	5,381	-62 (-1)
September	2,046	-102 (-5)	1,798	-73 (-4)
Total (TAF)	2,310	-76 (-3)	2,193	-45 (-2)

Source: CalSim II Output for DEL_CVP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

[1] Dry and Critical Years as defined by RD1641 Sacramento Valley Index

Under the No Action Alternative, changes in long-term average water supply deliveries to North of Delta CVP contractors and wildlife refuges would be less than five percent in all months and for the year relative to Existing Conditions. In dry and critical years, average monthly decreases in deliveries would be as high as six percent, but the annual change would only be two percent.

CEQA Conclusion

Because the changes in annual and monthly long-term average and dry and critical year deliveries to North of Delta CVP contractors and wildlife refuges would change by less than 10 percent for monthly deliveries and five percent for annual deliveries, changes in deliveries to North of Delta CVP contractors under the No Action Alternative would be **less than significant**.

5.3.3.1.2 Impact WS-2: Changes in CVP Water Supply Deliveries South of Delta

Table 5-4 shows changes that would occur in deliveries to South of Delta CVP contractors and wildlife refuges under the No Action Alternative compared to Existing Conditions.

Table 5-4. Simulated Monthly Average Water Supply Deliveries and Percent Change in Deliveries to South of Delta CVP Contractors and Wildlife Refuges under the No Action Alternative Compared to Existing Conditions

Month	Average All Years		Dry and Critical Years[1]	
	Existing Conditions (cfs)	No Action Alternative Change (cfs [%])	Existing Conditions (cfs)	No Action Alternative Change (cfs [%])
October	2,670	-129 (-5)	2,580	-140 (-5)
November	1,585	-102 (-6)	1,517	-111 (-7)
December	1,151	-138 (-12)	1,068	-143 (-13)
January	1,274	-230 (-18)	1,142	-234 (-20)
February	1,718	-283 (-16)	1,554	-284 (-18)
March	2,083	-184 (-9)	1,667	-40 (-2)
April	2,592	-317 (-12)	1,984	-86 (-4)
May	3,755	-405 (-11)	2,871	-109 (-4)
June	5,447	-671 (-12)	4,008	-184 (-5)
July	5,876	-771 (-13)	4,205	-230 (-5)
August	5,010	-489 (-10)	3,790	-115 (-3)
September	3,413	-200 (-6)	2,921	-45 (-2)
Total (TAF)	2,214	-237 (-11)	1,773	-104 (-6)

Source: CalSim II Output for DEL_CVP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

[1] Dry and Critical Years as defined by RD1641 Sacramento Valley Index

Long-term average annual deliveries to CVP South of Delta water service contractors and wildlife refuges would be decreased under the No Action Alternative relative to Existing Conditions, with average annual decreases of 11 percent and up to 18 percent in some months. The No Action Alternative would result in a decrease in average annual CVP South of Delta deliveries of six percent in dry and critical years and a decrease in average monthly CVP South of Delta deliveries by as much as 20 percent in January of dry and critical years relative to Existing Conditions. Much of these changes are due to changes in hydrology associated with climate change.

CEQA Conclusion

Since long-term average annual and monthly deliveries to South of Delta CVP contractors and wildlife refuges under the No Action Alternative, relative to Existing Conditions, would change by more than 10 percent and dry and critical year annual deliveries would be reduced by more than five percent, changes in deliveries to South of Delta CVP contractors would result in a **significant** effect compared to Existing Conditions. Neither NEPA nor CEQA require mitigation measures for the No Action Alternative.

5.3.3.1.3 Impact WS-3: Changes in SWP Water Supply Deliveries North of Delta

Table 5-5 shows changes that would occur in deliveries to North of Delta SWP contractors under the No Action Alternative compared to Existing Conditions.

Table 5-5. Simulated Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta State Water Project Contractors under the No Action Alternative Compared to Existing Conditions

Month	Average All Years		Dry and Critical Years[1]	
	Existing Conditions (cfs)	No Action Alternative Change (cfs [%])	Existing Conditions (cfs)	No Action Alternative Change (cfs [%])
October	1,449	-66 (-5)	1,476	-201 (-14)
November	1,463	-69 (-5)	1,422	-213 (-15)
December	935	-41 (-4)	924	-130 (-14)
January	345	-17 (-5)	377	-43 (-11)
February	14	-1 (-10)	11	-2 (-17)
March	92	-3 (-3)	145	-13 (-9)
April	2,122	-117 (-5)	2,302	-243 (-11)
May	2,685	-106 (-4)	2,457	-142 (-6)
June	3,217	-125 (-4)	2,925	-179 (-6)
July	3,169	-125 (-4)	2,883	-178 (-6)
August	2,515	-101 (-4)	2,264	-143 (-6)
September	1,874	-68 (-4)	1,611	-154 (-10)
Total (TAF)	1,205	-51 (-4)	1,139	-99 (-9)

Source: CalSim II Output for DEL_SWP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

[1] Dry and Critical Years as defined by RD1641 Sacramento Valley Index

Long-term average annual deliveries to SWP North of Delta contractors would be decreased by approximately four percent under the No Action Alternative relative to Existing Conditions. The No Action Alternative would result in a decrease in annual SWP North of Delta deliveries of nine percent on average in dry and critical years and a decrease in average monthly SWP North of Delta deliveries by as much as 17 percent in February of dry and critical years relative to Existing Conditions.

CEQA Conclusion

Since changes to long-term average annual and monthly SWP North of Delta deliveries under the No Action Alternative, relative to Existing Conditions, would be approximately four percent, with monthly reductions as high as 10 percent, and changes to dry and critical year annual deliveries would be reduced by nine percent, with reductions in monthly dry and critical year deliveries potentially as much as 17 percent, changes in deliveries to North of Delta SWP contractors would result in a **significant** effect compared to Existing Conditions. Neither NEPA nor CEQA require mitigation measures for the No Action Alternative.

5.3.3.1.4 Impact WS-4: Changes in SWP Water Supply Deliveries South of Delta

Table 5-6 shows changes that would occur in deliveries to South of Delta SWP contractors under the No Action Alternative compared to Existing Conditions.

Table 5-6. Simulated Monthly Average Water Supply Deliveries and Percent Change in Deliveries to South of Delta SWP Contractors under the No Action Alternative Compared to Existing Conditions

Month	Average All Years		Dry and Critical Years	
	Existing Conditions (cfs)	No Action Alternative Change (cfs [%])	Existing Conditions (cfs)	No Action Alternative Change (cfs [%])
October	4,044	-1 (0)	3,692	-129 (-4)
November	3,416	-432 (-13)	3,055	-325 (-11)
December	3,459	137 (4)	3,152	-197 (-6)
January	465	7 (1)	112	-10 (-8)
February	782	58 (7)	171	-7 (-4)
March	1,284	248 (19)	322	266 (83)
April	2,414	128 (5)	960	148 (15)
May	3,688	125 (3)	2,063	36 (2)
June	5,146	19 (0)	3,430	-70 (-2)
July	5,640	-105 (-2)	4,181	-177 (-4)
August	5,790	-84 (-1)	4,071	-112 (-3)
September	4,893	-64 (-1)	3,435	-48 (-1)
Total (TAF)	2,486	3 (0)	1,739	-38 (-2)

Source: CalSim II Output for DEL_SWP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Long-term average annual deliveries to SWP South of Delta contractors would be increased, with monthly reductions as high as 13 percent under the No Action Alternative relative to Existing Conditions. The No Action Alternative would result in a decrease in annual SWP South of Delta deliveries of two percent on average in dry and critical years and a decrease in average monthly SWP South of Delta deliveries as much as 11 percent in November of dry and critical years relative to Existing Conditions. Other months, such as March, April, and May, would have increases in dry and critical years under the No Action Alternative.

CEQA Conclusion

While long-term average annual and monthly deliveries to South of Delta SWP contractors under the No Action Alternative, relative to Existing Conditions, would increase, dry and critical year annual deliveries would be reduced by two percent, and reductions in monthly dry and critical year deliveries could be as much as 11 percent. These changes in deliveries to South of Delta SWP contractors would result in a **significant** effect compared to existing conditions. Neither NEPA nor CEQA require mitigation measures for the No Action Alternative.

5.3.3.1.5 Impact WS-5: Increase in Incidence of Term 91 Being Initiated

Table 5-7 shows a comparison of the number of years Term 91 would be initiated for each month under Existing Conditions but not under the No Action Alternative, or vice versa.

Table 5-7. Comparison of the Number of Years Term 91 would be Initiated Under Existing Conditions but not Under the No Action Alternative, or Vice Versa

Month	Incidents of Term 91 Initiation under Existing Conditions but Not Under the No Action Alternative	Incidents of Term 91 Initiation under the No Action Alternative but not under Existing Conditions
January	0	1
February	1	0
March	0	9
April	1	14
May	3	21
June	21	3
July	10	2
August	38	7
September	7	19
October	17	7
November	17	1
December	0	0
Total	115	84

When compared to Existing Conditions, there were 84 incidents when Term 91 had not been initiated under Existing Conditions but was initiated under the No Action Alternative.

CEQA Conclusion

There would be 115 incidents when Term 91 would be initiated under Existing Conditions but not under the No Action Alternative, indicating a potential benefit to non-CVP/SWP water users under the No Action Alternative. However, there would be 84 incidents when Term 91 would be initiated under the No Action Alternative but not under Existing Conditions. This would result in a **significant** effect compared to Existing Conditions. Neither NEPA nor CEQA require mitigation measures for the No Action Alternative.

5.3.3.2 Alternative 1: East Side Gated Notch

Alternative 1, East Side Gated Notch, would allow increased flow from the Sacramento River to enter the Yolo Bypass through a gated notch on the east side of Fremont Weir. The invert of the new notch would be at an elevation of 14 feet, which is approximately 18 feet below the existing Fremont Weir crest. Alternative 1 would allow up to 6,000 cfs to flow through the notch during periods when the river levels are not high enough to go over the crest of Fremont Weir to provide open channel flow for adult fish passage. See Section 2.4 for more details on the alternative features.

5.3.3.2.1 Impact WS-1: Changes in CVP Water Supply Deliveries North of Delta

Table 5-8 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to North of Delta contractors and wildlife refuges under Alternative 1 compared to Existing Conditions.

Table 5-8. Simulated 2030-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta CVP Contractors and Wildlife Refuges under Existing Conditions Compared to Alternative 1

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 1 Change (cfs [%])	Existing Conditions (cfs)	Alternative 1 Change (cfs [%])
October	1,506	0 (0)	1,559	0 (0)
November	726	0 (0)	770	0 (0)
December	389	0 (0)	402	0 (0)
January	234	0 (0)	232	0 (0)
February	244	0 (0)	248	0 (0)
March	337	0 (0)	415	0 (0)
April	5,113	0 (0)	5,464	0 (0)
May	5,599	0 (0)	5,274	0 (0)
June	7,987	0 (0)	7,382	0 (0)
July	7,932	0 (0)	7,252	0 (0)
August	5,983	0 (0)	5,381	0 (0)
September	2,046	0 (0)	1,798	0 (0)
Total (TAF)	2,310	0 (0)	1,559	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-9 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to North of Delta contractors and wildlife refuges under Alternative 1 compared to the No Action Alternative.

Table 5-9. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta CVP Contractors and Wildlife Refuges under the No Action Alternative Compared to Alternative 1

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])
October	1,473	0 (0)	1,479	0 (0)
November	705	0 (0)	722	0 (0)
December	382	0 (0)	387	0 (0)
January	224	0 (0)	221	0 (0)
February	236	-1 (0)	234	0 (0)
March	323	0 (0)	391	0 (0)

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])
April	5,015	0 (0)	5,330	0 (0)
May	5,427	0 (0)	5,231	0 (0)
June	7,762	0 (0)	7,341	0 (0)
July	7,605	8 (0)	7,051	20 (0)
August	5,752	0 (0)	5,319	0 (0)
September	1,944	0 (0)	1,726	0 (0)
Total (TAF)	2,234	0 (0)	2,147	1 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_N
Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 1 vs Existing Conditions

For 2030-level scenarios, deliveries to CVP North of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 1 compared to Existing Conditions. Average monthly and annual Alternative 1 deliveries would change less than one percent in each month and over the year relative to Existing Conditions for both long-term average and dry and critical years.

Alternative 1 vs No Action Alternative

For 2070-level scenarios, deliveries to CVP North of Delta water service contractors and wildlife refuges would be similar over the long-term average and similar in dry and critical years under Alternative 1 compared to the No Action Alternative. Average monthly and annual Alternative 1 deliveries would change less than one percent in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical years.

CEQA Conclusion

Changes in CVP deliveries to North of Delta contractors and wildlife refuges under Alternative 1 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.2.2 Impact WS-2: Changes in CVP Water Supply Deliveries South of Delta

Table 5-10 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to South of Delta contractors and wildlife refuges under Alternative 1 compared to Existing Conditions.

Table 5-10. Simulated 2030-Level Monthly Average Deliveries and Percent Change in Deliveries to South of Delta CVP Contractors and Wildlife Refuges under Existing Conditions Compared to Alternative 1

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 1 Change (cfs [%])	Existing Conditions (cfs)	Alternative 1 Change (cfs [%])
October	2,670	0 (0)	2,580	0 (0)
November	1,585	0 (0)	1,517	0 (0)
December	1,151	0 (0)	1,068	0 (0)
January	1,274	0 (0)	1,142	0 (0)
February	1,718	0 (0)	1,554	0 (0)
March	2,083	0 (0)	1,667	0 (0)
April	2,592	0 (0)	1,984	0 (0)
May	3,755	0 (0)	2,871	0 (0)
June	5,447	0 (0)	4,008	0 (0)
July	5,876	0 (0)	4,205	0 (0)
August	5,010	0 (0)	3,790	0 (0)
September	3,413	0 (0)	2,921	0 (0)
Total (TAF)	2,214	0 (0)	1,773	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-11 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to South of Delta contractors and wildlife refuges under Alternative 1 compared to the No Action Alternative.

Table 5-11. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to South of Delta CVP Contractors and Wildlife Refuges under the No Action Alternative Compared to Alternative 1

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])
October	2,541	0 (0)	2,441	0 (0)
November	1,483	0 (0)	1,406	0 (0)
December	1,013	0 (0)	925	0 (0)
January	1,043	0 (0)	908	0 (0)
February	1,435	0 (0)	1,270	0 (0)
March	1,900	0 (0)	1,627	0 (0)
April	2,274	0 (0)	1,897	0 (0)
May	3,350	-1 (0)	2,761	-1 (0)
June	4,776	-1 (0)	3,824	-1 (0)
July	5,105	-1 (0)	3,975	0 (0)

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])
August	4,521	-1 (0)	3,674	-1 (0)
September	3,213	0 (0)	2,876	0 (0)
Total (TAF)	1,977	0 (0)	1,669	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 1 vs Existing Conditions

For 2030-level scenarios, deliveries to CVP South of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 1 compared to Existing Conditions. Average monthly and annual Alternative 1 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both the long-term average and the dry and critical year average.

Alternative 1 vs No Action Alternative

For 2070-level scenarios, deliveries to CVP South of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 1 compared to the No Action Alternative. Average monthly and annual Alternative 1 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in CVP South of Delta deliveries under Alternative 1would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.2.3 Impact WS-3: Changes in SWP Water Supply Deliveries North of Delta

Table 5-12 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to North of Delta contractors under Alternative 1 compared to Existing Conditions.

Table 5-12. Simulated 2030-Level Monthly Average Deliveries and Percent Change in Deliveries to North of Delta SWP Contractors under Existing Conditions Compared to Alternative 1

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 1 Change (cfs [%])	Existing Conditions (cfs)	Alternative 1 Change (cfs [%])
October	1,449	0 (0)	1,476	0 (0)
November	1,463	0 (0)	1,422	0 (0)
December	935	0 (0)	924	0 (0)
January	345	0 (0)	377	0 (0)
February	14	0 (0)	11	0 (0)
March	92	0 (0)	145	0 (0)
April	2,122	0 (0)	2,302	0 (0)
May	2,685	0 (0)	2,457	0 (0)
June	3,217	0 (0)	2,925	0 (0)
July	3,169	0 (0)	2,883	0 (0)
August	2,515	0 (0)	2,264	0 (0)
September	1,874	0 (0)	1,611	0 (0)
Total (TAF)	1,205	0 (0)	1,139	0 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-13 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to North of Delta contractors under Alternative 1 compared to the No Action Alternative.

Table 5-13. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North-of-Delta SWP Contractors under the No Action Alternative Compared to Alternative 1

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])
October	1,383	4 (0)	1,275	0 (0)
November	1,394	5 (0)	1,210	0 (0)
December	894	3 (0)	794	0 (0)
January	328	0 (0)	334	0 (0)
February	13	0 (0)	9	0 (0)
March	89	0 (0)	133	0 (0)
April	2,005	0 (0)	2,059	0 (0)
May	2,578	0 (0)	2,315	0 (0)
June	3,092	0 (0)	2,746	0 (0)
July	3,044	0 (0)	2,706	0 (0)

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])
August	2,413	0 (0)	2,121	0 (0)
September	1,806	0 (0)	1,457	0 (0)
Total (TAF)	1,154	1 (0)	1,040	0 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 1 vs Existing Conditions

For 2030-level scenarios, deliveries to SWP North of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 1 compared to Existing Conditions. Average monthly and annual Alternative 1 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 1 vs No Action Alternative

For 2070-level scenarios, deliveries to SWP North of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 1 compared to the No Action Alternative. Average monthly and annual Alternative 1 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in SWP deliveries to North of Delta contractors under Alternative 1 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.2.4 Impact WS-4: Changes in SWP Water Supply Deliveries South of Delta

Table 5-14 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to South of Delta contractors under Alternative 1 compared to Existing Conditions.

Table 5-14. Simulated 2030-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to South of Delta SWP Contractors under Existing Conditions Compared to Alternative 1

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 1 Change (cfs [%])	Existing Conditions (cfs)	Alternative 1 (cfs [%])
October	4,044	0 (0)	3,692	0 (0)
November	3,416	0 (0)	3,055	0 (0)
December	3,459	0 (0)	3,152	0 (0)
January	465	0 (0)	112	0 (0)
February	782	0 (0)	171	0 (0)
March	1,284	0 (0)	322	0 (0)
April	2,414	0 (0)	960	0 (0)
May	3,688	0 (0)	2,063	0 (0)
June	5,146	0 (0)	3,430	0 (0)
July	5,640	0 (0)	4,181	0 (0)
August	5,790	0 (0)	4,071	0 (0)
September	4,893	0 (0)	3,435	0 (0)
Total (TAF)	2,486	0 (0)	1,739	0 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-15. shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to South of Delta contractors under Alternative 1 compared to the No Action Alternative.

Table 5-15. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to South of Delta SWP Contractors under the No Action Alternative Compared to Alternative 1

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])	No Action Alternative (cfs)	Alternative 1 (cfs [%])
October	4,043	-3 (0)	3,562	-3 (0)
November	2,984	-4 (0)	2,730	-5 (0)
December	3,596	-16 (0)	2,956	-5 (0)
January	472	-3 (0)	103	0 (0)
February	840	0 (0)	164	-1 (0)
March	1,531	-4 (0)	587	-2 (0)
April	2,542	-5 (0)	1,108	-8 (-1)
May	3,813	-7 (0)	2,098	-14 (-1)
June	5,165	-9 (0)	3,361	-18 (-1)

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 1 Change (cfs [%])	No Action Alternative (cfs)	Alternative 1 (cfs [%])
July	5,535	-8 (0)	4,005	-14 (0)
August	5,706	-9 (0)	3,960	-15 (0)
September	4,829	-10 (0)	3,387	-19 (-1)
Total (TAF)	2,489	-5 (0)	1,701	-6 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 1 vs Existing Conditions

For 2030-level scenarios, deliveries to SWP South of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 1 compared to Existing Conditions. Average monthly and annual Alternative 1 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and average dry and critical average.

Alternative 1 vs No Action Alternative

For 2070-level scenarios, deliveries to SWP South of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 1 compared to the No Action Alternative. Average monthly and annual Alternative 1 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical average.

CEQA Conclusion

Changes in SWP deliveries to South of Delta contractors under Alternative 1 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.2.5 Impact WS-5: Increase in Incidence of Term 91 Being Initiated

A comparison of the incidents of Term 91 being initiated was made between Existing Conditions and Alternative 1 for 2030-level scenarios and the No Action Alternative and Alternative 1 for 2070-level scenarios. Table 5-16 compares the number of incidents by month that Term 91 would have been initiated under Alternative 1 to Existing Conditions and the No Action Alternative.

Table 5-16. Comparison of the Simulated Number of Incidents Term 91 Would Have Been Initiated under Existing Conditions or the No Action Alternative but Not under Alternative 1

Month	2030-Level Conditions		2070-Level Conditions	
	Term 91 Initiated Under Existing Conditions but Not Under Alternative 1 (Years)	Term 91 Initiated Under Alternative 1 but Not Under Existing Conditions (Years)	Term 91 Initiated Under No Action Alternative but Not Under Alternative 1 (Years)	Term 91 Initiated Under Alternative 1 but Not Under No Action Alternative (Years)
October	0	0	0	0
November	0	0	0	0
December	0	0	0	0
January	0	0	1	0
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	0	0	0	0
June	0	0	0	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
Total	0	0	1	0

Source: Term 91 Calculation

Alternative 1 vs Existing Conditions

For 2030-level scenarios, there would be no changes in the number of times Term 91 is initiated under Alternative 1 relative to Existing Conditions.

Alternative 1 vs No Action Alternative

For 2070-level scenarios, there would be one month that Term 91 would be initiated under the No Action Alternative but not under Alternative 1.

CEQA Conclusion

There would be no impact from increases in the incidents of Term 91 being initiated under Alternative 1 since there would be no differences in the incidents of Term 91 being initiated compared to Existing Conditions.

5.3.3.3 Alternative 2: Central Gated Notch

Alternative 2, Central Gated Notch, would provide a similar new gated notch through Fremont Weir as described for Alternative 1. The primary difference between Alternatives 1 and 2 is the location of the notch; Alternative 2 would site the notch near the center of Fremont Weir. This gate would be a similar size but would have an invert elevation that is higher (14.8 feet) because the river is higher at this upstream location, and the gate would allow up to 6,000 cfs through to provide open channel flow for adult fish passage. See Section 2.5 for more details on the alternative features.

Because Alternative 2 would affect water flow and movement in the same way as described for Alternative 1, impacts under Alternative 2 would be identical to those discussed for Alternative 1.

5.3.3.4 Alternative 3: West Side Gated Notch

Alternative 3, West Side Gated Notch, would provide a similar new gated notch through Fremont Weir as described for Alternative 1. The primary difference between Alternatives 1 and 3 is the location of the notch; Alternative 3 would site the notch on the western side of Fremont Weir. This gate would be a similar size but would have an invert elevation that is higher (16.1 feet) because the river is higher at this upstream location. Alternative 3 would allow up to 6,000 cfs through the gated notch to provide open channel flow for adult fish passage. See Section 2.6 for more details on the alternative features.

Because Alternative 3 would affect water flow and movement in the same way as described for Alternative 1, impacts under Alternative 3 would be identical to those discussed for Alternative 1.

5.3.3.5 Alternative 4: West Side Gated Notch – Managed Flow

Alternative 4, West Side Gated Notch – Managed Flow, would have a smaller amount of flow entering the Yolo Bypass through the gated notch in Fremont Weir than some other alternatives, but it would incorporate water control structures to maintain inundation for longer periods of time within the northern portion of the Yolo Bypass. Alternative 4 would include the same gated notch and associated facilities as described for Alternative 3; however, it would be operated to limit the maximum inflow to 3,000 cfs. See Section 2.7 for more details on the alternative features. Implementation of Alternative 4 would result in direct and indirect effects on water supply.

5.3.3.5.1 Impact WS-1: Changes in CVP Water Supply Deliveries North of Delta

Table 5-17 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to North of Delta contractors and wildlife refuges under Alternative 4 compared to Existing Conditions.

Table 5-17. Simulated 2030-Level Monthly Average Deliveries and Percent Change in Deliveries to North of Delta CVP Contractors and Wildlife Refuges under Existing Conditions Compared to Alternative 4

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 4 Change (cfs [%])	Existing Conditions (cfs)	Alternative 4 Change (cfs [%])
October	1,506	0 (0)	1,559	0 (0)
November	726	0 (0)	770	0 (0)
December	389	0 (0)	402	0 (0)
January	234	0 (0)	232	0 (0)
February	244	0 (0)	248	0 (0)
March	337	0 (0)	415	0 (0)
April	5,113	0 (0)	5,464	0 (0)
May	5,599	0 (0)	5,274	0 (0)
June	7,987	0 (0)	7,382	0 (0)
July	7,932	0 (0)	7,252	0 (0)
August	5,983	0 (0)	5,381	0 (0)
September	2,046	0 (0)	1,798	0 (0)
Total (TAF)	2,310	0 (0)	2,193	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-18 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to North of Delta contractors and wildlife refuges under Alternative 4 compared to the No Action Alternative.

Table 5-18. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta CVP Contractors and Wildlife Refuges under the No Action Alternative Compared to Alternative 4

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 4 Change (cfs [%])	No Action Alternative (cfs)	Alternative 4 Change (cfs [%])
October	1,473	0 (0)	1,479	0 (0)
November	705	1 (0)	722	0 (0)
December	382	0 (0)	387	0 (0)
January	224	0 (0)	221	0 (0)
February	236	-1 (0)	234	0 (0)
March	323	0 (0)	391	0 (0)
April	5,015	0 (0)	5,330	0 (0)
May	5,427	0 (0)	5,231	0 (0)
June	7,762	0 (0)	7,341	0 (0)

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	**Alternative 4 Change (cfs [%])**	**No Action Alternative (cfs)**	**Alternative 4 Change (cfs [%])**
July	7,605	0 (0)	7,051	0 (0)
August	5,752	0 (0)	5,319	0 (0)
September	1,944	0 (0)	1,726	0 (0)
Total (TAF)	2,234	0 (0)	2,147	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_N
Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 4 vs Existing Conditions

For 2030-level scenarios, deliveries to CVP North of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 4 compared to Existing Conditions. Average monthly and annual Alternative 4 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 4 vs No Action Alternative

For 2070-level scenarios, deliveries to CVP North of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 4 compared to the No Action Alternative. Average monthly and annual Alternative 4 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in CVP deliveries to North of Delta contractors and wildlife refuges under Alternative 4 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.5.2 Impact WS-2: Changes in CVP Water Supply Deliveries South of Delta

Table 5-19 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to South of Delta contractors and wildlife refuges under Alternative 4 compared to Existing Conditions.

Table 5-19. Simulated 2030-Level Monthly Average Deliveries and Percent Change in Deliveries to South of Delta CVP Contractors and Wildlife Refuges under Existing Conditions Compared to Alternative 4

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 4 Change (cfs [%])	Existing Conditions (cfs)	Alternative 4 Change (cfs [%])
October	2,670	0 (0)	2,580	0 (0)
November	1,585	0 (0)	1,517	0 (0)
December	1,151	0 (0)	1,068	0 (0)
January	1,274	0 (0)	1,142	0 (0)
February	1,718	0 (0)	1,554	0 (0)
March	2,083	0 (0)	1,667	0 (0)
April	2,592	0 (0)	1,984	0 (0)
May	3,755	0 (0)	2,871	0 (0)
June	5,447	0 (0)	4,008	0 (0)
July	5,876	0 (0)	4,205	0 (0)
August	5,010	0 (0)	3,790	0 (0)
September	3,413	0 (0)	2,921	0 (0)
Total (TAF)	2,214	0 (0)	1,773	**0 (0)**

Source: CalSim II Output for DEL_CVP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-20 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to South of Delta contractors and wildlife refuges under Alternative 4 compared to the No Action Alternative.

Table 5-20. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to South of Delta CVP Contractors and Wildlife Refuges under the No Action Alternative Compared to Alternative 4

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 4 Change (cfs [%])	No Action Alternative (cfs)	Alternative 4 Change (cfs [%])
October	2,541	0 (0)	2,441	0 (0)
November	1,483	0 (0)	1,406	0 (0)
December	1,013	0 (0)	925	0 (0)
January	1,043	0 (0)	908	0 (0)
February	1,435	0 (0)	1,270	0 (0)
March	1,900	0 (0)	1,627	-1 (0)
April	2,274	0 (0)	1,897	-1 (0)
May	3,350	-1 (0)	2,761	-1 (0)
June	4,776	-1 (0)	3,824	-1 (0)

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 4 Change (cfs [%])	No Action Alternative (cfs)	Alternative 4 Change (cfs [%])
July	5,105	-1 (0)	3,975	-1 (0)
August	4,521	-1 (0)	3,674	-1 (0)
September	3,213	0 (0)	2,876	0 (0)
Total (TAF)	1,977	0 (0)	1,669	**0 (0)**

Source: CalSim II Output for DEL_CVP_TOTAL_S
Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 4 vs Existing Conditions

For 2030-level scenarios, deliveries to CVP South of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 4 compared to Existing Conditions. Average monthly and annual Alternative 4 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 4 vs No Action Alternative

For 2070-level scenarios, deliveries to CVP South of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 4 compared to the No Action Alternative. Average monthly and annual Alternative 4 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in CVP Deliveries South of Delta under Alternative 4 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.5.3 Impact WS-3: Changes in SWP Water Supply Deliveries North of Delta

Table 5-21 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to North of Delta contractors under Alternative 4 compared to Existing Conditions.

Table 5-21. Simulated 2030-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta SWP Contractors under Existing Conditions Compared to Alternative 4

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 4 Change (cfs [%])	Existing Conditions (cfs)	Alternative 4 Change (cfs [%])
October	1,449	0 (0)	1,476	0 (0)
November	1,463	0 (0)	1,422	0 (0)
December	935	0 (0)	924	0 (0)
January	345	0 (0)	377	0 (0)
February	14	0 (0)	11	0 (0)
March	92	0 (0)	145	0 (0)
April	2,122	0 (0)	2,302	0 (0)
May	2,685	0 (0)	2,457	0 (0)
June	3,217	0 (0)	2,925	0 (0)
July	3,169	0 (0)	2,883	0 (0)
August	2,515	0 (0)	2,264	0 (0)
September	1,874	0 (0)	1,611	0 (0)
Total (TAF)	1,205	0 (0)	1,139	0 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-22 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to North of Delta contractors under Alternative 4 compared to the No Action Alternative.

Table 5-22. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta SWP Contractors under the No Action Alternative Compared to Alternative 4

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 4 Change (cfs [%])	No Action Alternative (cfs)	Alternative 4 Change cfs [%])
October	1,383	4 (0)	1,275	-1 (0)
November	1,394	5 (0)	1,210	0 (0)
December	894	3 (0)	794	-1 (0)
January	328	-1 (0)	334	-2 (-1)
February	13	0 (0)	9	0 (0)
March	89	0 (0)	133	0 (0)
April	2,005	0 (0)	2,059	0 (0)
May	2,578	0 (0)	2,315	0 (0)
June	3,092	0 (0)	2,746	0 (0)
July	3,044	0 (0)	2,706	0 (0)
August	2,413	0 (0)	2,121	0 (0)
September	1,806	0 (0)	1,457	0 (0)
Total (TAF)	1,154	1 (0)	1,040	0 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_N
Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 4 vs Existing Conditions

For 2030-level scenarios, deliveries to SWP North of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 4 compared to Existing Conditions. Average monthly and annual Alternative 4 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 4 vs No Action Alternative

For 2070-level scenarios, deliveries to SWP North of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 4 compared to the No Action Alternative. Average monthly and annual Alternative 4 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in SWP Deliveries North of Delta under Alternative 4 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.5.4 Impact WS-4: Changes in SWP Water Supply Deliveries South of Delta

Table 5-23 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to South of Delta contractors under Alternative 4 compared to Existing Conditions.

Table 5-23. Simulated 2030-Level Monthly Average Deliveries and Percent Change in Deliveries to South of Delta SWP Contractors under Existing Conditions Compared to Alternative 4

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 4 Change (cfs [%])	Existing Conditions (cfs)	Alternative 4 (cfs [%])
October	4,044	0 (0)	3,692	0 (0)
November	3,416	0 (0)	3,055	0 (0)
December	3,459	0 (0)	3,152	0 (0)
January	465	0 (0)	112	0 (0)
February	782	0 (0)	171	0 (0)
March	1,284	0 (0)	322	0 (0)
April	2,414	0 (0)	960	0 (0)
May	3,688	0 (0)	2,063	0 (0)
June	5,146	0 (0)	3,430	0 (0)
July	5,640	0 (0)	4,181	0 (0)
August	5,790	0 (0)	4,071	0 (0)
September	4,893	0 (0)	3,435	0 (0)
Total (TAF)	2,486	0 (0)	1,739	0 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-24 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to South of Delta contractors under Alternative 4 compared to the No Action Alternative.

Table 5-24. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to South of Delta SWP Contractors under the No Action Alternative Compared to Alternative 4

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 4 Change (cfs [%])	No Action Alternative (cfs)	Alternative 4 (cfs [%])
October	4,043	0 (0)	3,562	-7 (0)
November	2,984	-4 (0)	2,730	-8 (0)
December	3,596	-14 (0)	2,956	-7 (0)
January	472	-3 (-1)	103	0 (0)
February	840	-1 (0)	164	1 (1)
March	1,531	-3 (0)	587	-1 (0)
April	2,542	-7 (0)	1,108	-14 (-1)
May	3,813	-8 (0)	2,098	-16 (-1)
June	5,165	-6 (0)	3,361	-9 (0)
July	5,535	-2 (0)	4,005	1 (0)
August	5,706	-3 (0)	3,960	-2 (0)
September	4,829	-4 (0)	3,387	-3 (0)
Total (TAF)	2,489	-3 (0)	1,701	-4 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 4 vs Existing Conditions

For 2030-level scenarios, deliveries to SWP South of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 4 compared to Existing Conditions. Average monthly and annual Alternative 4 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 4 vs No Action Alternative

For 2070-level scenarios, deliveries to SWP South of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 4 compared to the No Action Alternative. Average monthly and annual Alternative 4 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average

CEQA Conclusion

Changes in SWP Deliveries South of Delta under Alternative 4 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.5.5 Impact WS-5: Increase in Incidence of Term 91 Being Initiated

A comparison of the incidents of Term 91 being initiated was made between Existing Conditions and Alternative 4 for 2030-level scenarios and the No Action Alternative and Alternative 4 for 2070-level scenarios. Table 5-25 shows a comparison of the incidents of Term 91 being initiated, by month, for Alternative 4 and Existing Conditions and the No Action Alternative.

Table 5-25. Comparison of the Simulated Number of Incidents Term 91 Would Have Been Initiated under Existing Conditions or the No Action Alternative but Not under Alternative 4

Month	2030-Level Conditions		2070-Level Conditions	
	Term 91 Initiated Under Existing Conditions but Not Under Alternative 4 (Years)	Term 91 Initiated Under Alternative 4 but Not Under Existing Conditions (Years)	Term 91 Initiated Under No Action Alternative but Not Under Alternative 4 (Years)	Term 91 Initiated Under Alternative 4 but Not Under No Action Alternative (Years)
October	0	0	0	0
November	0	0	0	0
December	0	0	0	0
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	0	0	1	0
June	0	0	1	0
July	0	0	0	0
August	0	0	0	0
September	0	0	0	0
Total	0	0	2	0

Source: Term 91 Calculation

Alternative 4 vs Existing Conditions

For 2030-level scenarios, there would be no changes in the initiation of Term 91 between Existing Conditions and Alternative 4.

Alternative 4 vs No Action Alternative

For 2070-level scenarios, there would be two months that Term 91 was initiated under the No Action Alternative but not under Alternative 4.

CEQA Conclusion

There would be no impact from increases in the incidents of Term 91 being initiated under Alternative 4 since there would be no differences in the incidents of Term 91 being initiated compared to Existing Conditions.

5.3.3.6 Alternative 5: Central Multiple Gated Notches

Alternative 5, Central Multiple Gated Notches, would have a smaller amount of flow entering the Yolo Bypass through the gated notch in Fremont Weir than some other alternatives, but it would incorporate water control structures to maintain inundation for longer periods of time within the northern portion of the Yolo Bypass. Alternative 5 would include the same gated notch and associated facilities as described for Alternative 3; however, it would be operated to limit the maximum inflow to 3,200 cfs. See Section 2.7 for more details on the alternative features. Implementation of Alternative 5 would result in direct and indirect effects on water supply.

5.3.3.6.1 Impact WS-1: Changes in CVP Water Supply Deliveries North of Delta

Table 5-26 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to North of Delta contractors and wildlife refuges under Alternative 5 compared to Existing Conditions.

Table 5-26. Simulated 2030-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta CVP Contractors and Wildlife Refuges under Existing Conditions Compared to Alternative 5

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 5 Change (cfs [%])	Existing Conditions (cfs)	Alternative 5 Change (cfs [%])
October	1,506	0 (0)	1,559	0 (0)
November	726	0 (0)	770	0 (0)
December	389	0 (0)	402	0 (0)
January	234	0 (0)	232	0 (0)
February	244	0 (0)	248	0 (0)
March	337	0 (0)	415	0 (0)
April	5,113	0 (0)	5,464	0 (0)
May	5,599	0 (0)	5,274	0 (0)
June	7,987	0 (0)	7,382	0 (0)
July	7,932	0 (0)	7,252	0 (0)
August	5,983	0 (0)	5,381	0 (0)
September	2,046	0 (0)	1,798	0 (0)
Total (TAF)	2,310	0 (0)	2,193	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-27 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to North of Delta contractors and wildlife refuges under Alternative 5 compared to the No Action Alternative.

Table 5-27. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta CVP Contractors and Wildlife Refuges under the No Action Alternative Compared to Alternative 5

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 5 Change (cfs [%])	No Action Alternative (cfs)	Alternative 5 Change (cfs [%])
October	1,473	0 (0)	1,479	0 (0)
November	705	0 (0)	722	0 (0)
December	382	1 (0)	387	0 (0)
January	224	0 (0)	221	0 (0)
February	236	-1 (0)	234	0 (0)
March	323	0 (0)	391	0 (0)
April	5,015	0 (0)	5,330	0 (0)
May	5,427	0 (0)	5,231	0 (0)
June	7,762	0 (0)	7,341	0 (0)
July	7,605	0 (0)	7,051	0 (0)
August	5,752	0 (0)	5,319	0 (0)
September	1,944	0 (0)	1,726	0 (0)
Total (TAF)	2,234	0 (0)	2,147	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 5 vs Existing Conditions

For 2030-level scenarios, deliveries to CVP North of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 5 compared to Existing Conditions. Average monthly and annual Alternative 5 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 5 vs No Action Alternative

For 2070-level scenarios, deliveries to CVP North of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 5 compared to the No Action Alternative. Average monthly and annual Alternative 5 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in deliveries to CVP North of Delta water service contractors and wildlife refuges under Alternative 5 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.6.2 Impact WS-2: Changes in CVP Water Supply Deliveries South of Delta

Table 5-28 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to South of Delta contractors and wildlife refuges under Alternative 5 compared to Existing Conditions.

Table 5-28. Simulated 2030-Level Monthly Average Deliveries and Percent Change in Deliveries to South of Delta CVP Contractors and Wildlife Refuges under Existing Conditions Compared to Alternative 5

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 5 Change (cfs [%])	Existing Conditions (cfs)	Alternative 5 Change (cfs [%])
October	2,670	0 (0)	2,580	0 (0)
November	1,585	0 (0)	1,517	0 (0)
December	1,151	0 (0)	1,068	0 (0)
January	1,274	0 (0)	1,142	0 (0)
February	1,718	0 (0)	1,554	0 (0)
March	2,083	0 (0)	1,667	0 (0)
April	2,592	0 (0)	1,984	0 (0)
May	3,755	0 (0)	2,871	0 (0)
June	5,447	0 (0)	4,008	0 (0)
July	5,876	0 (0)	4,205	0 (0)
August	5,010	0 (0)	3,790	0 (0)
September	3,413	0 (0)	2,921	0 (0)
Total (TAF)	2,214	0 (0)	1,773	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-29 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to South of Delta contractors and wildlife refuges under Alternative 5 compared to the No Action Alternative.

Table 5-29. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to South of Delta CVP Contractors and Wildlife Refuges under the No Action Alternative Compared to Alternative 5

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 5 Change (cfs [%])	No Action Alternative (cfs)	Alternative 5 Change (cfs [%])
October	2,541	0 (0)	2,441	0 (0)
November	1,483	0 (0)	1,406	0 (0)
December	1,013	0 (0)	925	0 (0)
January	1,043	0 (0)	908	-1 (0)
February	1,435	0 (0)	1,270	-1 (0)
March	1,900	0 (0)	1,627	1 (0)
April	2,274	0 (0)	1,897	0 (0)
May	3,350	0 (0)	2,761	0 (0)
June	4,776	-1 (0)	3,824	0 (0)
July	5,105	-1 (0)	3,975	0 (0)
August	4,521	0 (0)	3,674	0 (0)
September	3,213	0 (0)	2,876	0 (0)
Total (TAF)	1,977	0 (0)	1,669	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 5 vs Existing Conditions

For 2030-level scenarios, deliveries to CVP South of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 5 compared to Existing Conditions. Average monthly and annual Alternative 5 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 5 vs No Action Alternative

For 2070-level scenarios, deliveries to CVP South of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 5 compared to the No Action Alternative. Average monthly and annual Alternative 5 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in deliveries to CVP South of Delta water service contractors and wildlife refuges under Alternative 5 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.6.3 Impact WS-3: Changes in SWP Water Supply Deliveries North of Delta

Table 5-30 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to North of Delta contractors under Alternative 5 compared to Existing Conditions.

Table 5-30. Simulated 2030-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta SWP Contractors under Existing Conditions Compared to Alternative 5

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 5 Change (cfs [%])	Existing Conditions (cfs)	Alternative 5 Change (cfs [%])
October	1,449	0 (0)	1,476	0 (0)
November	1,463	0 (0)	1,422	0 (0)
December	935	0 (0)	924	0 (0)
January	345	0 (0)	377	0 (0)
February	14	0 (0)	11	0 (0)
March	92	0 (0)	145	0 (0)
April	2,122	0 (0)	2,302	0 (0)
May	2,685	0 (0)	2,457	0 (0)
June	3,217	0 (0)	2,925	0 (0)
July	3,169	0 (0)	2,883	0 (0)
August	2,515	0 (0)	2,264	0 (0)
September	1,874	0 (0)	1,611	0 (0)
Total (TAF)	1,205	0 (0)	1,139	0 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-31 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to North of Delta contractors under Alternative 5 compared to the No Action Alternative.

Table 5-31. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta SWP Contractors under the No Action Alternative Compared to Alternative 5

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 5 Change (cfs [%])	No Action Alternative (cfs)	Alternative 5 Change (cfs [%])
October	1,383	0 (0)	1,275	-11 (-1)
November	1,394	-1 (0)	1,210	-15 (-1)
December	894	0 (0)	794	-9 (-1)
January	328	-2 (-1)	334	-5 (-1)
February	13	0 (0)	9	0 (0)
March	89	0 (0)	133	0 (0)

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 5 Change (cfs [%])	No Action Alternative (cfs)	Alternative 5 Change (cfs [%])
April	2,005	0 (0)	2,059	0 (0)
May	2,578	0 (0)	2,315	0 (0)
June	3,092	0 (0)	2,746	0 (0)
July	3,044	0 (0)	2,706	0 (0)
August	2,413	0 (0)	2,121	0 (0)
September	1,806	0 (0)	1,457	0 (0)
Total (TAF)	1,154	0 (0)	1,040	-3 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_N
Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 5 vs Existing Conditions

For 2030-level scenarios, deliveries to SWP North of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 5 compared to Existing Conditions. Average monthly and annual Alternative 5 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 5 vs No Action Alternative

For 2070-level scenarios, deliveries to SWP North of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 5 compared to the No Action Alternative. Average monthly and annual Alternative 5 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in deliveries to SWP North of Delta contractors under Alternative 5 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.6.4 Impact WS-4: Changes in SWP Water Supply Deliveries South of Delta

Table 5-32 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to South of Delta contractors under Alternative 5 compared to Existing Conditions.

Table 5-32. Simulated 2030-Level Monthly Average Deliveries and Percent Change in Deliveries to South of Delta SWP Contractors under Existing Conditions Compared to Alternative 5

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 5 Change (cfs [%])	Existing Conditions (cfs)	Alternative 5 (cfs [%])
October	4,044	0 (0)	3,692	0 (0)
November	3,416	0 (0)	3,055	0 (0)
December	3,459	0 (0)	3,152	0 (0)
January	465	0 (0)	112	0 (0)
February	782	0 (0)	171	0 (0)
March	1,284	0 (0)	322	0 (0)
April	2,414	0 (0)	960	0 (0)
May	3,688	0 (0)	2,063	0 (0)
June	5,146	0 (0)	3,430	0 (0)
July	5,640	0 (0)	4,181	0 (0)
August	5,790	0 (0)	4,071	0 (0)
September	4,893	0 (0)	3,435	0 (0)
Total (TAF)	2,486	0 (0)	1,739	0 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-33 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to South of Delta contractors under Alternative 5 compared to the No Action Alternative.

Table 5-33. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to South of Delta SWP Contractors under the No Action Alternative Compared to Alternative 5

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 5 Change (cfs [%])	No Action Alternative (cfs)	Alternative 5 (cfs [%])
October	4,043	-1 (0)	3,562	-5 (0)
November	2,984	-4 (0)	2,730	-7 (0)
December	3,596	-15 (0)	2,956	-7 (0)
January	472	-3 (-1)	103	0 (0)
February	840	-2 (0)	164	-2 (-1)
March	1,531	-9 (-1)	587	-2 (0)
April	2,542	-10 (0)	1,108	-16 (-1)
May	3,813	-9 (0)	2,098	-19 (-1)
June	5,165	-8 (0)	3,361	-13 (0)

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 5 Change (cfs [%])	No Action Alternative (cfs)	Alternative 5 (cfs [%])
July	5,535	-4 (0)	4,005	-4 (0)
August	5,706	-6 (0)	3,960	-6 (0)
September	4,829	-6 (0)	3,387	-7 (0)
Total (TAF)	2,489	-5 (0)	1,701	-5 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 5 vs Existing Conditions

For 2030-level scenarios, deliveries to SWP South of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 5 compared to Existing Conditions. Average monthly and annual Alternative 5 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 5 vs No Action Alternative

For 2070-level scenarios, deliveries to SWP South of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 5 compared to the No Action Alternative. Average monthly and annual Alternative 5 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in deliveries to SWP South of Delta contractors under Alternative 5 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.6.5 Impact WS-5: Increase in Incidence of Term 91 Being Initiated

A comparison of the number of incidents of Term 91 being initiated was made between Existing Conditions and Alternative 5 for 2030-level scenarios and the No Action Alternative and Alternative 5 for 2070-level scenarios. Table 5-34 shows a comparison of the incidents of Term 91 being initiated, by month, for Alternative 5 and Existing Conditions and the No Action Alternative.

Table 5-34. Comparison of the Simulated Number of Incidents Term 91 Would Have Been Initiated under Existing Conditions or the No Action Alternative but Not under Alternative 5

Month	2030-Level Conditions		2070-Level Conditions	
	Term 91 Initiated Under Existing Conditions but Not Under Alternative 5 (Years)	Term 91 Initiated Under Alternative 5 but Not Under Existing Conditions (Years)	Term 91 Initiated Under No Action Alternative but Not Under Alternative 5 (Years)	Term 91 Initiated Under Alternative 5 but Not Under No Action Alternative (Years)
October	0	0	0	0
November	0	0	0	0
December	0	0	0	0
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	0	0	1	0
June	0	0	1	0
July	0	0	0	0
August	0	0	0	0
September	0	0	1	0
Total	0	0	3	0

Source: Term 91 Calculation

Alternative 5 vs Existing Conditions

For 2030-level scenarios, there would be no changes in the initiation of Term 91 between Existing Conditions and Alternative 5.

Alternative 5 vs No Action Alternative

For 2070-level scenarios, there would be three months that Term 91 was initiated under the No Action Alternative but not under Alternative 5.

CEQA Conclusion

There would be no impact from increases in the number of Term 91 being initiated under Alternative 5 since there would be no differences in the number of incidents of Term 91 being initiated compared to Existing Conditions.

5.3.3.6.6 Tule Canal Floodplain Improvements (Program Level)

As described in Section 2.8.1.7, Alternative 5 would include floodplain improvements along Tule Canal, just north of Interstate 80. These improvements would not be constructed at the same time as the remaining facilities. They are included at a program level of detail to consider all the potential impacts and benefits of Alternative 5. Subsequent consideration of environmental impacts would be necessary before construction could begin.

The Tule Canal Floodplain improvements would not affect the timing of flows within the Yolo Bypass and would not increase or decrease the amount of flow within the Yolo Bypass in any months; therefore, these improvements would have no impact on water supply.

5.3.3.7 Alternative 6: West Side Large Gated Notch

Alternative 6, West Side Large Gated Notch, is a large notch in the western location that would allow flows up to 12,000 cfs. It was designed with the goal of entraining more fish by allowing more flow into the bypass when the Sacramento River is at lower elevations. See Section 2.9 for more details on the alternative features.

5.3.3.7.1 Impact WS-1: Changes in CVP Water Supply Deliveries North of Delta

Table 5-35 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to North of Delta contractors and wildlife refuges under Alternative 6 compared to Existing Conditions.

Table 5-35. Simulated 2030-Level Monthly Average Deliveries and Percent Change in Deliveries to North of Delta CVP Contractors and Wildlife Refuges under Existing Conditions Compared to Alternative 6

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 6 Change (cfs [%])	Existing Conditions (cfs)	Alternative 6 Change (cfs [%])
October	1,506	0 (0)	1,559	0 (0)
November	726	0 (0)	770	0 (0)
December	389	0 (0)	402	0 (0)
January	234	0 (0)	232	0 (0)
February	244	0 (0)	248	0 (0)
March	337	0 (0)	415	0 (0)
April	5,113	0 (0)	5,464	0 (0)
May	5,599	0 (0)	5,274	0 (0)
June	7,987	0 (0)	7,382	0 (0)
July	7,932	0 (0)	7,252	0 (0)
August	5,983	0 (0)	5,381	0 (0)
September	2,046	0 (0)	1,798	0 (0)
Total (TAF)	2,310	0 (0)	2,193	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-36 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to North of Delta contractors and wildlife refuges under Alternative 6 compared to the No Action Alternative.

Table 5-36. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta CVP Contractors and Wildlife Refuges under the No Action Alternative Compared to Alternative 6

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 6 Change (cfs [%])	No Action Alternative (cfs)	Alternative 6 Change (cfs [%])
October	1,473	0 (0)	1,479	0 (0)
November	705	1 (0)	722	0 (0)
December	382	1 (0)	387	0 (0)
January	224	0 (0)	221	0 (0)
February	236	0 (0)	234	0 (0)
March	323	0 (0)	391	0 (0)
April	5,015	0 (0)	5,330	0 (0)
May	5,427	0 (0)	5,231	0 (0)
June	7,762	0 (0)	7,341	0 (0)
July	7,605	0 (0)	7,051	0 (0)
August	5,752	0 (0)	5,319	0 (0)
September	1,944	0 (0)	1,726	0 (0)
Total (TAF)	2,234	0 (0)	2,147	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 6 vs Existing Conditions

For 2030-level scenarios, deliveries to CVP North of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 6 compared to Existing Conditions. Average monthly and annual Alternative 6 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 6 vs No Action Alternative

For 2070-level scenarios, deliveries to CVP North of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 6 compared to the No Action Alternative. Average monthly and annual Alternative 6 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in deliveries to CVP North of Delta contractors and wildlife refuges under Alternative 6 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.7.2 Impact WS-2: Changes in CVP Water Supply Deliveries South of Delta

Table 5-37 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to South of Delta contractors and wildlife refuges under Alternative 6 compared to Existing Conditions.

Table 5-37. Simulated 2030-Level Monthly Average Deliveries and Percent Change in Deliveries to South of Delta CVP Contractors and Wildlife Refuges under Existing Conditions Compared to Alternative 6

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 6 Change (cfs [%])	Existing Conditions (cfs)	Alternative 6 Change (cfs [%])
October	2,670	0 (0)	2,580	0 (0)
November	1,585	0 (0)	1,517	0 (0)
December	1,151	0 (0)	1,068	0 (0)
January	1,274	0 (0)	1,142	0 (0)
February	1,718	0 (0)	1,554	0 (0)
March	2,083	0 (0)	1,667	0 (0)
April	2,592	0 (0)	1,984	0 (0)
May	3,755	0 (0)	2,871	0 (0)
June	5,447	0 (0)	4,008	0 (0)
July	5,876	0 (0)	4,205	0 (0)
August	5,010	0 (0)	3,790	0 (0)
September	3,413	0 (0)	2,921	0 (0)
Total (TAF)	2,214	0 (0)	1,773	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-38 shows the long-term average changes and dry and critical year changes that would occur in CVP deliveries to South of Delta contractors and wildlife refuges under Alternative 6 compared to the No Action Alternative.

Table 5-38. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to South of Delta CVP Contractors and Wildlife Refuges under the No Action Alternative Compared to Alternative 6

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 6 Change (cfs [%])	No Action Alternative (cfs)	Alternative 6 Change (cfs [%])
October	2,541	0 (0)	2,441	0 (0)
November	1,483	0 (0)	1,406	0 (0)
December	1,013	0 (0)	925	0 (0)
January	1,043	0 (0)	908	-1 (0)
February	1,435	0 (0)	1,270	-1 (0)
March	1,900	1 (0)	1,627	2 (0)

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 6 Change (cfs [%])	No Action Alternative (cfs)	Alternative 6 Change (cfs [%])
April	2,274	0 (0)	1,897	0 (0)
May	3,350	0 (0)	2,761	0 (0)
June	4,776	1 (0)	3,824	0 (0)
July	5,105	1 (0)	3,975	0 (0)
August	4,521	1 (0)	3,674	0 (0)
September	3,213	0 (0)	2,876	0 (0)
Total (TAF)	1,977	0 (0)	1,669	0 (0)

Source: CalSim II Output for DEL_CVP_TOTAL_S
Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 6 vs Existing Conditions

For 2030-level scenarios, deliveries to CVP South of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 6 compared to Existing Conditions. Average monthly and annual Alternative 6 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 6 vs No Action Alternative

For 2070-level scenarios, deliveries to CVP South of Delta water service contractors and wildlife refuges would be similar for the long-term average and similar in dry and critical years under Alternative 6 compared to the No Action Alternative. Average monthly and annual Alternative 6 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in deliveries to CVP South of Delta contractors and wildlife refuges under Alternative 6 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.7.3 Impact WS-3: Changes in SWP Water Supply Deliveries North of Delta

Table 5-39 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to North of Delta contractors under Alternative 6 compared to Existing Conditions.

Table 5-39. Simulated 2030-Level Monthly Average Deliveries and Percent Change in Deliveries to North of Delta SWP Contractors under Existing Conditions Compared to Alternative 6

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 6 Change (cfs [%])	Existing Conditions (cfs)	Alternative 6 Change (cfs [%])
October	1,449	0 (0)	1,476	0 (0)
November	1,463	0 (0)	1,422	0 (0)
December	935	0 (0)	924	0 (0)
January	345	0 (0)	377	0 (0)
February	14	0 (0)	11	0 (0)
March	92	0 (0)	145	0 (0)
April	2,122	0 (0)	2,302	0 (0)
May	2,685	0 (0)	2,457	0 (0)
June	3,217	0 (0)	2,925	0 (0)
July	3,169	0 (0)	2,883	0 (0)
August	2,515	0 (0)	2,264	0 (0)
September	1,874	0 (0)	1,611	0 (0)
Total (TAF)	1,205	0 (0)	1,139	0 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-40 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to North of Delta contractors under Alternative 6 compared to the No Action Alternative.

Table 5-40. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to North of Delta SWP Contractors under the No Action Alternative Compared to Alternative 6

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 6 Change (cfs [%])	No Action Alternative (cfs)	Alternative 6 Change (cfs [%])
October	1,383	0 (0)	1,275	0 (0)
November	1,394	3 (0)	1,210	0 (0)
December	894	0 (0)	794	0 (0)
January	328	-1 (0)	334	0 (0)
February	13	0 (0)	9	0 (0)
March	89	0 (0)	133	0 (0)
April	2,005	0 (0)	2,059	0 (0)
May	2,578	0 (0)	2,315	0 (0)
June	3,092	0 (0)	2,746	0 (0)
July	3,044	0 (0)	2,706	0 (0)
August	2,413	0 (0)	2,121	0 (0)
September	1,806	0 (0)	1,457	0 (0)
Total (TAF)	1,154	0 (0)	1,040	0 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_N

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 6 vs Existing Conditions

For 2030-level scenarios, deliveries to SWP North of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 6 compared to Existing Conditions. Average monthly and annual Alternative 6 deliveries would change less than one percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 6 vs No Action Alternative

For 2070-level scenarios, deliveries to SWP North of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 6 compared to the No Action Alternative. Average monthly and annual Alternative 6 deliveries would change less than one percent on average in each month and over the year relative to the No Action Alternative for both long-term average and dry and critical year average.

CEQA Conclusion

Changes in deliveries to SWP North of Delta contractors under Alternative 6 would be **less than significant** under Alternative 6 because changes to monthly and annual long-term and dry and critical year averages would be less than one percent relative to Existing Conditions.

5.3.3.7.4 Impact WS-4: Changes in SWP Water Supply Deliveries South of Delta

Table 5-41 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to South of Delta contractors under Alternative 6 compared to Existing Conditions.

Table 5-41. Simulated 2030-Level Monthly Average Deliveries and Percent Change in Deliveries to South of Delta SWP Contractors under Existing Conditions Compared to Alternative 6

Month	Long-Term Average		Dry and Critical Average	
	Existing Conditions (cfs)	Alternative 6 Change (cfs [%])	Existing Conditions (cfs)	Alternative 6 (cfs [%])
October	4,044	0 (0)	3,692	0 (0)
November	3,416	0 (0)	3,055	0 (0)
December	3,459	0 (0)	3,152	0 (0)
January	465	0 (0)	112	0 (0)
February	782	0 (0)	171	0 (0)
March	1,284	0 (0)	322	0 (0)
April	2,414	0 (0)	960	0 (0)
May	3,688	0 (0)	2,063	0 (0)
June	5,146	0 (0)	3,430	0 (0)
July	5,640	0 (0)	4,181	0 (0)
August	5,790	0 (0)	4,071	0 (0)
September	4,893	0 (0)	3,435	0 (0)
Total (TAF)	2,486	0 (0)	1,739	0 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Table 5-42 shows the long-term average changes and dry and critical year changes that would occur in SWP deliveries to South of Delta contractors under Alternative 6 compared to the No Action Alternative.

Table 5-42. Simulated 2070-Level Monthly Average Water Supply Deliveries and Percent Change in Deliveries to South of Delta SWP Contractors under the No Action Alternative Compared to Alternative 6

Month	Long-Term Average		Dry and Critical Average	
	No Action Alternative (cfs)	Alternative 6 Change (cfs [%])	No Action Alternative (cfs)	Alternative 6 (cfs [%])
October	4,043	-4 (0)	3,562	-11 (0)
November	2,984	-8 (0)	2,730	-14 (-1)
December	3,596	-20 (-1)	2,956	-18 (-1)
January	472	-4 (-1)	103	0 (0)
February	840	-4 (0)	164	-5 (-3)
March	1,531	-13 (-1)	587	-1 (0)
April	2,542	-14 (-1)	1,108	-20 (-2)
May	3,813	-14 (0)	2,098	-24 (-1)
June	5,165	-12 (0)	3,361	-16 (0)
July	5,535	-9 (0)	4,005	-6 (0)
August	5,706	-11 (0)	3,960	-9 (0)
September	4,829	-10 (0)	3,387	-8 (0)
Total (TAF)	2,489	-7 (0)	1,701	-8 (0)

Source: CalSim II Output for DEL_SWP_TOTAL_S

Key: cfs = cubic feet-per-second; TAF = thousands of acre-feet

Alternative 6 vs Existing Conditions

For 2030-level scenarios, deliveries to SWP South of Delta water service contractors would be similar for the long-term average and similar in dry and critical years under Alternative 6 compared to Existing Conditions. Average monthly and annual Alternative 6 deliveries would change less than two percent on average in each month and over the year relative to Existing Conditions for both long-term average and dry and critical year average.

Alternative 6 vs No Action Alternative

For 2070-level scenarios, supplies would generally decrease by less than one percent compared to the No Action Alternative, but these decreases could be larger during dry and critical years under Alternative 6 compared to the No Action Alternative. Several months during dry and critical years show average decreases up to three percent.

CEQA Conclusion

Changes in deliveries to SWP South of Delta contractors under Alternative 6 would be **less than significant** because changes to monthly and annual long-term and dry and critical year averages would be less than two percent compared to Existing Conditions relative to Existing Conditions.

5.3.3.7.5 Impact WS-5: Increase in Incidence of Term 91 Being Initiated

A comparison of the incidents of Term 91 being initiated was made between Existing Conditions and Alternative 6 for 2030-level scenarios and the No Action Alternative and Alternative 5 for 2070-level scenarios. Table 5-43 shows a comparison of the incidents of Term 91 being initiated, by month, for Alternative 6 and Existing Conditions and the No Action Alternative.

Table 5-43. Comparison of the Simulated Number of Incidents Term 91 Would Have Been Initiated under Existing Conditions or the No Action Alternative but Not under Alternative 6

Month	2030-Level Conditions		2070-Level Conditions	
	Term 91 Initiated Under Existing Conditions but Not Under Alternative 6 (Years)	Term 91 Initiated Under Alternative 6 but Not Under Existing Conditions (Years)	Term 91 Initiated Under No Action Alternative but Not Under Alternative 6 (Years)	Term 91 Initiated Under Alternative 6 but Not Under No Action Alternative (Years)
October	0	0	0	0
November	0	0	0	0
December	0	0	0	0
January	0	0	0	0
February	0	0	0	0
March	0	0	0	0
April	0	0	0	0
May	0	0	1	0
June	0	0	1	0
July	0	0	0	0
August	0	0	0	0
September	0	0	1	0
Total	0	0	3	0

Source: Term 91 Calculation

Alternative 6 vs Existing Conditions

For 2030-level scenarios, there would be no changes in the initiation of Term 91 between Existing Conditions and Alternative 6.

Alternative 6 vs No Action Alternative

For 2070-level scenarios, there would be three months that Term 91 was initiated under the No Action Alternative but not under Alternative 6.

CEQA Conclusion

There would be no impact from increases in the number of Term 91 being initiated under Alternative 6 since there would be no differences in the number of incidents of Term 91 being initiated compared to Existing Conditions.

5.3.4 Summary of Impacts

Table 5-44 provides a summary of the identified impacts to surface water supply within the Project area.

Table 5-44. Summary of Impacts and Mitigation Measures for Surface Water Supply

Impact	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Impact WS-1: Changes in CVP Water Supply Deliveries North of Delta	No Action	LTS	--	LTS
	1, 2, 3, 4, 5 (Project), 6	LTS	---	LTS
	5 (Program)	NI	---	NI
Impact WS-2: Changes in CVP Water Supply Deliveries South of Delta	No Action	S	--	S
	1, 2, 3, 4, 5 (Project), 6	LTS	---	LTS
	5 (Program)	NI	---	NI
Impact WS-3: Changes in SWP Water Supply Deliveries North of Delta	No Action	S	--	S
	1, 2, 3, 4, 5 (Project), 6	LTS	---	LTS
	5 (Program)	NI	---	NI
Impact WS-4: Changes in SWP Water Supply Deliveries South of Delta	No Action	S	--	S
	1, 2, 3, 4, 5 (Project), 6	LTS	--	LTS
	5 (Program)	NI	---	NI
Impact WS-5: Increase in Incidents of Term 91 Being Initiated	No Action	S	--	S
	All Action Alternatives	NI	---	NI

Key:
LTS = less than significant; NI = no impact; S = significant

5.4 Cumulative Impacts Analysis

This section describes the cumulative impacts analysis for surface water supply. Section 3.3, *Cumulative Impacts*, presents an overview of the cumulative impacts analysis, including the methodology and the projects, plans, and programs included in the cumulative impacts analysis.

5.4.1 Methodology

This evaluation of cumulative impacts for surface water supply considers the effects of the Project and how they might combine with the effects of other past, present, and future projects or actions to create significant impacts on specific resources. The area of analysis for these cumulative impacts includes the Yolo Bypass, the Delta, and the larger Sacramento River system. The timeframe for this cumulative impacts analysis includes the past, present, and probable future projects that could produce related or cumulative impacts in the area of analysis.

This cumulative impacts analysis uses the project analysis approach described in detail in Section 3.3, *Cumulative Impacts*.

5.4.2 Cumulative Impacts

Given that the Project would not result in a change in recurrence of Delta excess conditions, the Lead Agencies do not anticipate that the Project would contribute to cumulative impacts to Delta excess conditions. Several related and reasonably foreseeable projects and actions could result in impacts to CVP and SWP deliveries North and South of the Delta. The Bay-Delta Water Quality Control Plan Update and the Sacramento-San Joaquin Delta Estuary TMDL for Methylmercury are ongoing activities and final determinations of the updates have not yet been made. However, all projects would implement their own mitigation measures to reduce impacts to less than significant levels.

Several of the local projects being analyzed serve to improve water supply within the region. The cumulative benefit of these projects, including the Delta Plan, the Sites Reservoir Project, the Shasta Lake Water Resources Investigation, and the North Bay Aqueduct Alternative Intake Project, also would serve to, at least in part, offset the water supply impacts associated with the projects described above.

Therefore, the cumulative impact of water supply, in both the long and short term, would be **less than significant**.

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6 Water Quality

This chapter presents existing water quality conditions and the regulatory setting for water quality in the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project (Project) area as well as environmental consequences and mitigation as they pertain to implementation of the Project alternatives.

6.1 Environmental Setting/Affected Environment

The water quality area of analysis includes waterbodies that could be affected by development of the Project alternatives, which would be constructed within the Yolo Bypass. Project alternatives would divert water from the Sacramento River into the Yolo Bypass, which would affect both the bypass (increased flow) and the river (decreased flow). Diverting more flow into the bypass may also have an impact downstream after water flow from the bypass and river are combined and enter the river delta.

The Yolo Bypass is a 59,300-acre contiguous floodplain area of the lower Sacramento River and conveys floodwaters from the Sacramento, American, and Feather rivers and their tributary watersheds. When flows in the lower Sacramento River exceed approximately 56,270 cubic feet per second (cfs), they begin to spill over Fremont Weir and enter the bypass (California Data Exchange Center [CDEC] 2017). Additionally, water from both the Sacramento and American rivers can enter the bypass via Sacramento Weir. These flood events affect the San Francisco Estuary and its two component regions, the Sacramento-San Joaquin Delta (Delta) and downstream water bodies, including Suisun, San Pablo, and San Francisco bays (Sommer et al. 2001). The Yolo Bypass also receives flow during flood and non-flood conditions from several westside tributaries, including Cache and Putah creeks, Willow Slough, and the Knights Landing Ridge Cut from the Colusa Basin. Figure 6-1 presents the Yolo Bypass and its tributaries, which form the water quality area of analysis.

6.1.1 Constituents of Concern

Various waterbodies that flow into the Yolo Bypass have been identified as impaired for certain constituents of concern on the 2012 303(d) list under the Clean Water Act (CWA). Water from these sources define existing water quality in the bypass.

CWA Section 303(d) requires states to identify waterbodies that do not meet applicable water quality standards after the application of certain technology-based controls on point source discharges. As defined in the CWA and Federal regulations, water quality standards include the designated beneficial uses of a waterbody, the adopted water quality criteria necessary to protect those uses, and an anti-degradation policy. As defined in the Porter-Cologne Water Quality Act (Porter-Cologne Act), water quality standards are associated with designated beneficial uses of a waterbody, the established water quality objectives (both narrative and numeric), and California’s non-degradation policy (State Water Resources Control Board [SWRCB] Resolution No. 68-16). Section 6.2.1.1 contains a description of the CWA and the 303(d) listing process.

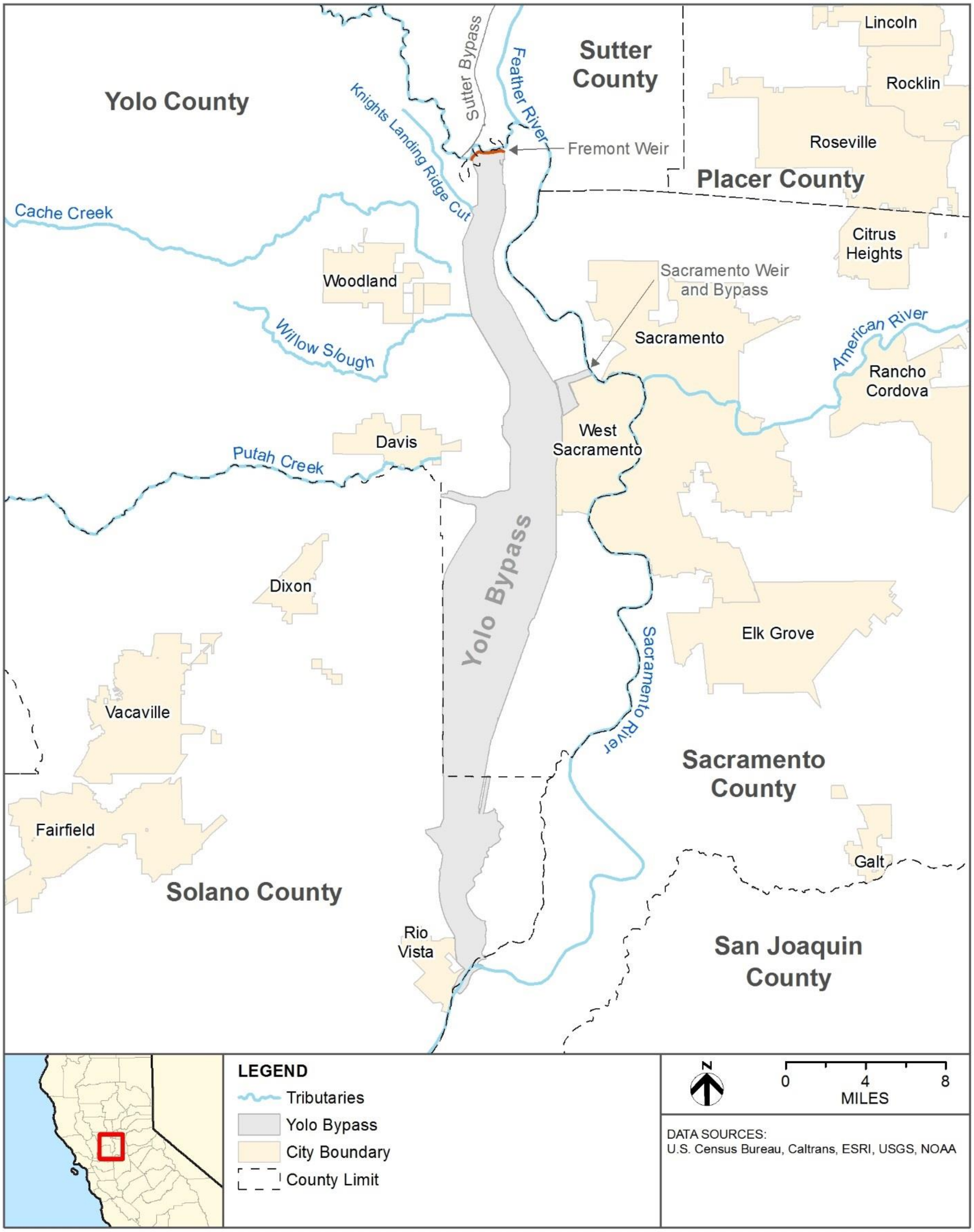

Figure 6-1. Water Quality Area of Analysis includes the Yolo Bypass and Tributaries.

Impaired waterbodies listed under 303d that deliver flow to the bypass, along with information concerning constituents that contribute to their impaired water quality are provided in Table 6-1.

Table 6-1. 303(d) Listed Waterbodies that deliver flow to the Yolo Bypass Area of Analysis and Their Associated Constituents of Concern

Name	Constituent	Potential Sources	Estimated Area Affected [1]	Proposed TMDL Completion Year	Region
Cache Creek, Lower	Boron Mercury Unknown Toxicity	Source Unknown Resource Extraction Source Unknown	96 miles 96 miles 96 miles	2021 2007 2019	Central Valley
Knights Landing Ridge Cut	Boron Dissolved Oxygen Salinity	Source Unknown Source Unknown Source Unknown	13 miles 13 miles 13 miles	2021 2021 2021	Central Valley
Putah Creek	Boron Mercury	Source Unknown Resource Extraction/ Source Unknown	27 miles 27 miles	2021 2017	Central Valley
Sacramento River (Red Bluff to Knights Landing Ridge Cut)	DDT Dieldrin Mercury PCBs Unknown Toxicity	Source Unknown Source Unknown Source Unknown Source Unknown Source Unknown	82 miles 82 miles 82 miles 82 miles 82 miles	2021 2021 2021 2021 2019	Central Valley
Sacramento River (Knights Landing Ridge Cut to the Delta)	Chlordane DDT Dieldrin Mercury PCBs Unknown Toxicity	Source Unknown Source Unknown Source Unknown Source Unknown Source Unknown Source Unknown	16 miles 16 miles 16 miles 16 miles 16 miles 16 miles	2021 2021 2022 2021 2021 2019	Central Valley
Tule Canal	Boron E. coli Fecal Coliform Salinity	Source Unknown Source Unknown Source Unknown Source Unknown	11 miles 11 miles 11 miles 11 miles	2021 2021 2021 2021	Central Valley
Willow Slough	Boron	Source Unknown	10 miles	2021	Central Valley
Willow Slough Bypass	Boron E. coli Fecal Coliform	Source Unknown Source Unknown Source Unknown	6 miles 6 miles 6 miles	2021 2021 2021	Central Valley

Source: SWRCB 2012.

Key: DDT = dichlorodiphenyltrichloroethane; E. coli = Escherichia coli; PCB = polychlorinated biphenyl; TMDL = Total Maximum Daily Load

[1] Estimated area affected is given as the surface area (acres) of lakes or estuaries or length (river miles) for river systems.

6.1.2 Beneficial Uses

Application of water quality objectives (i.e., standards) to protect designated beneficial uses is critical to water quality management in the State of California (State). State law defines beneficial uses to include (but not be limited to) "...domestic; municipal; agricultural and industrial supply; power generation; recreation; aesthetic enjoyment; navigation; and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves" (Water Code Section 13050(f)). Protection and enhancement of existing and potential beneficial uses are primary goals of water quality planning. Important points concerning the concept of beneficial uses are:

1. All water quality problems can generally be stated in terms of whether there is water of sufficient quantity or quality to protect or enhance beneficial uses (Central Valley Regional Water Quality Control Board [Central Valley RWQCB] 2016).
2. Beneficial uses do not include all the reasonable uses of water. For example, disposal of wastewaters is not included as a beneficial use. Such disposal of wastewaters is not a prohibited use; it is merely a use that cannot be satisfied to the detriment of beneficial uses. Similarly, the use of water for the dilution of salts is not a beneficial use although it may, in some cases, be a reasonable and desirable use of water (Central Valley RWQCB 2016).
3. The protection and enhancement of beneficial uses require that certain quality and quantity objectives be met for surface and ground waters (Central Valley RWQCB 2016).
4. Fish, plants, other wildlife, and humans use water beneficially.

Beneficial uses designated for waters within the area of analysis are presented in Table 6-2. Beneficial uses designated for any specifically identified waterbody generally also apply to its tributary streams. In some cases, a beneficial use may not be applicable to the entire body of water. In these cases, RWQCB judgment is applied. Waterbodies within the basins that do not have beneficial uses designated are assigned municipal and domestic supply designations in accordance with the provisions of SWRCB Resolution No. 88-63. These municipal and domestic supply designations in no way affect the presence or absence of other beneficial uses in these waterbodies.

The Porter Cologne Water Quality Control Act defines water quality objectives as, "… the limits or levels of water quality constituents or characteristics which are established for the reasonable protections of the beneficial uses of water or the preventions of nuisance within a specified area" (Water Code Section 13050(H)). Basin Plans present water quality objectives in numerical or narrative format for specified waterbodies or for protection of specified beneficial uses throughout a specific basin or region.

6.1.3 Existing Conditions

The following sections summarize water quality for each of the waterbodies evaluated in the area of analysis and that deliver water to the bypass. The descriptions cover land use for each waterbody because land use can affect the quality of runoff that the waterbody receives and therefore the water quality of the waterbody itself. Where available, data describing general water quality parameters are presented.

6.1.3.1 Yolo Bypass

Inundation of Yolo Bypass by the Sacramento River occurs to some extent in approximately 70 percent of years (Nurmi 2017), creating a large expanse of shallow water habitat which can expand to more than 59,300 acres. The frequency, timing, extent, and duration of flood inundation is dependent on regional weather and climate. The bypass is designed to hold flows up to 500,000 cfs (Smalling et al. 2005).

Table 6-2. Beneficial Uses of Waterbodies in the Yolo County Region[1]

Beneficial Use Designation	Yolo Bypass	Cache Creek (Clear Lake to the Yolo Bypass)	Putah Creek (Lake Berryessa to the Yolo Bypass)	Sacramento River (Colusa Basin to "I" Street Bridge)
Municipal and Domestic Supply (MUN)		X	X	X
Agricultural Supply – Irrigation (AGR)	X	X	X	X
Agricultural Supply – Stock Watering (AGR)	X	X	X	
Industrial Process Supply (PROC)		X		
Industrial Service Supply (IND)		X		
Water Contact Recreation (REC-1)	X	X	X	X
Canoeing and Rafting Recreation (REC-1)		X	X	X
Non-contact Water Recreation (REC-2)	X	X	X	X
Wildlife Habitat (WILD)	X	X	X	X
Navigation (NAV)				X
Cold Freshwater Habitat (COLD)	X	X	X	X
Warm Freshwater Habitat (WARM)	X	X	X	X
Cold Migration (MIGR)	X			X
Warm Migration (MIGR)	X			X
Cold Spawning (SPWN)		X		X
Warm Spawning (SPWN)	X	X	X	X

Source: Central Valley RWQCB 2016.

[1] Beneficial uses are taken from the most recent Water Quality Control Plan (July 2016) and do not include the recently adopted (May 2017) beneficial uses of Tribal Tradition and Culture (CUL), Tribal Subsistence Fishing (T-SUB), and Subsistence Fishing by other communities or individuals (SUB)

The floodplain historically has been inundated as early as October and as late as June, with a typical peak period of inundation during January through March (Sommer et al. 2001). The primary input to the bypass is through Fremont Weir in the north, which conveys floodwaters from the Sacramento and Feather rivers. This occurs when the combined flow of the Sutter Bypass and Sacramento and Feather rivers cause river elevations at Fremont Weir to exceed 32 feet North American Vertical Datum of 1988 (NAVD 88) (CDEC 2017). In major storm events, additional water from the American and Sacramento rivers enter from the east via Sacramento Weir. Flows also enter from several small, impaired streams along the west side of the Yolo Bypass, including Knights Landing Ridge Cut, Cache Creek, Willow Slough Bypass, and Putah Creek. Inflows from these western streams are generally small in comparison to floodwater discharges over Fremont Weir; however, they are often the greatest source of freshwater to the floodplain in fall, spring, and during dry years when Sacramento River water does not spill over the weirs (Schemel et al. 2002). Inputs from these tributaries can be identified as bands in aerial photographs of the basin and can substantially augment the Sacramento basin floodwaters or cause localized floodplain inundation prior to Fremont Weir inputs (Sommer et al. 2001). Additionally, urban stormwater runoff and wastewater treatment facility discharges come from the University of California, Davis campus and cities of Davis and Woodland, 2.5 and 6.8

million gallons per day, respectively (City of Woodland 2005). The mean depth of the floodplain does not exceed three meters, except in extreme flood events (Sommer et al. 2001).

The basin empties to the Delta through the Toe Drain channel, and the waters continue to drain after floodwaters stop entering the bypass. Under high flooding events, the basin may also drain through Shag Slough and Liberty Cut. During drier months, the Toe Drain channel is the primary source of tidally influenced perennial water.

The Yolo Bypass Wildlife Area is in the central part of the Yolo Bypass, primarily south of I-80, and could be affected by increased inundation by Project alternatives. Several high priority pollutants of concern have been identified in the Yolo Bypass Wildlife Area Management Plan (California Department of Fish and Game [CDFG] 2008). These include mercury, other toxic chemicals, salinity, bacteria, selenium, and boron. Several of these pollutants have been identified in the contributing waterbodies to the Yolo Bypass as part of the 303(d) program. A brief discussion of some of the primary pollutants of concern is provided below, with information specific to each contributing waterbody in the sections that follow.

6.1.3.1.1 Mercury

Mercury (Hg) is a toxic pollutant that readily transports through the environment and accumulates in fish tissue in both contaminated and seemingly pristine aquatic ecosystems (Cabana et al. 1994). Methylmercury (MeHg), the organic form of the metal that accumulates in the food web, is a potent neurotoxin that can impair reproduction and fetal development (Ratcliffe et al. 1996, Weiner et al. 2002). It can also impair the smoltification and subsequent outward migration behavior in juvenile salmon.

Hg is an important contaminant in the Sacramento River watershed. Mercury released during gold mining operations in the Sierra Nevada and mercury mining along the eastern edge of the Central Valley from south of Paso Robles to north of the Bay Area are primary sources of Hg to rivers and lakes, including the Sacramento River and Yolo Bypass. Many of the more than 500 mercury mines in California have not been remediated and many continue to release mercury to the environment (CDFG 2017).

This section provides a summary of mercury environmental chemistry and toxicology, and a discussion of implications of project alternatives on MeHg production and bioaccumulation in the bypass.

Overview of Mercury Environmental Chemistry

Mercury occurs naturally as a mineral and is globally distributed throughout the environment by both natural and anthropogenic processes. Mercury exists in solid, liquid, and vapor forms at typical temperatures, which facilitate its widespread occurrence. Global cycling of mercury involves release of mercury to the atmosphere, subsequent transport by winds, and deposition of mercury to land and surface water. Some deposited mercury adheres to soil and sediment, and some is re-released as vapor to air completing the cycle (Agency for Toxic Substances and Disease Registry [ATSDR] 1999).

Human activity has added considerable mercury to the global cycle. Major anthropogenic sources of mercury releases to the environment include chlor-alkali production facilities;

combustion of fossil fuels, primarily coal; production of cement; medical and municipal waste incinerators; and industrial/commercial boilers (USEPA 1996b).

In some cases, mercury is released directly to soils or surface waters without intervening atmospheric transport. In the Sacramento River watershed, such sources include elemental mercury used in placer mining for gold in the Sierra Nevada, and mercury mines in coastal ranges along the eastern edge of the Central Valley. Mining in the Cache Creek watershed (e.g., Sulfur Bank and Turkey Run) created mines that are still releasing mercury to Cache Creek and eventually to the Yolo Bypass. Discharge from the creek into the bypass was and is a major source of mercury now found in sediments in the bypass (Domagalski et al. 2004, Brown et al. 2015).

Cinnabar (HgS) is the only important ore of mercury and was the target for mines along the creek. The mineral is known for is bright red color and was used historically as a pigment. HgS is essentially insoluble, with a solubility product of about 10^{-52}. Under reducing conditions, HgS is quite stable. In the presence of oxygen, sulfur can be oxidized to sulfur oxyanions, releasing elemental mercury and mercury as Hg(I) and Hg(II) cations. In fact, processing of cinnabar involves heating the ore in the presence of oxygen (retorting) to convert Hg in cinnabar to elemental Hg vapor. The vapor is then cooled to condense Hg into its elemental, liquid form.

Historical mining of mercury thus converted stable, reduced ore bodies of HgS to cationic and elemental forms, which are far more mobile in the environment (ATSDR 1999). Some of these more mobile mercury forms enter global mercury cycling as fugitive vapors from ore processing, erosion and runoff from mine wastes, and release of process water.

In addition, some Hg that is released to surface water is bound to sediments, particularly HgS which erodes from mine wastes. Hg bound to particulates in sediments can be transformed by microbes into organic species, particularly MeHg. This process is most efficient in anaerobic (reducing) conditions. HgS is stable under these conditions. However, as mentioned above, HgS can be oxidized to ionic and elemental forms in aerobic conditions. These forms of mercury are available for methylation during periods of low oxygen concentrations (ATSDR 1999, Weiner et al. 2002, Marvin-DiPasquale et al. 2009).

Given this chemistry, methylation of mercury as HgS is efficient in aquatic systems where aerobic and anaerobic conditions alternate (e.g., Marvin-DiPasquale 2009, Henry et al. 2010). During drier seasons, mercury in surface sediments may be exposed to atmosphere and oxidized. Subsequently, in periods of inundation, microbial decomposition of organic matter in sediments can create anaerobic conditions that favor methylation. If periods of inundation are accompanied by deposition of additional HgS, MeHg production can continue seasonally for extended periods.

MeHg production in the bypass is ongoing and will continue regardless of whether any of the Alternatives is constructed. The focus of this the following discussion is what may happen when larger areas of flooded more often and, hence, subject to cyclical oxidative and reductive conditions. Since all areas of the bypass are currently subject to periodic flooding, soils throughout the bypass contain Hg that can be methylated. More frequent flooding will add Hg via deposition of suspended sediments to the existing inventory.

Further, MeHg produced at the sediment surface readily diffuses and enriches overlying waters, whereas MeHg produced deeper in the sediment diffuses through a layer of surface sediments and is less likely to reach the overlying water (Gill et al. 1999). Thus, situations where mercury is continually being deposited on the sediment surface, oxidized during dry periods, then subject to inundation and anaerobic conditions can be anticipated to result in substantial MeHg that is available for uptake into the food web.

MeHg production can be enhanced with freshly flooded soils. In a study of freshwater reservoirs, newly flooded soils took up to 10 to 20 years before MeHg production fell to levels similar to those found in other more established reservoirs (Bodaly et al. 2007). The study found that peak MeHg production in the sediment occurred within several years after permanent inundation; however, the lag in accumulation within the piscivorous species pushes the effects in the food web out to the 10- to 20-year mark. These time frames are likely to vary across sites and are not intended to represent what will occur if Hg sources to the bypass are eliminated. The time frames do provide an illustration of the extended periods of time that may be required for the mass of mercury available for methylation in sediments to be naturally attenuated.

MeHg is highly toxic (see below), soluble, and efficiently enters the food web. It accumulates in organisms that feed higher in the web and is a major source of mercury exposure for people and piscivorous mammals and birds that consume seafood (e.g., tuna) and freshwater fish. Piscivorous mammals (e.g., dolphins, whales, seals) also accumulate mercury in their tissues, at times to high levels, even in seemingly pristine environments such as the arctic (Wegemann et al. 1998).

Environmental Toxicology of Mercury

Mercury toxicity is complex, and the literature on this subject is voluminous. Included below is a summary of some of the key issues and hazards associated with MeHg production in sediments, particularly as they pertain to the Yolo Bypass. The discussion includes information on how mercury is taken into biota and how it is distributed, metabolized, and excreted in, to and from different tissues, as well as information on the adverse effects of mercury.

Toxicokinetics (absorption, distribution, metabolism, and excretion)

As noted above, mercury occurs in several of forms in the environment. Different forms of mercury vary in their impacts to human health and ecological receptors. Since the major issue for the Yolo Bypass, and, indeed, the Sacramento watershed, is the production and impacts of MeHg. This discussion of impacts focuses briefly on this aspect of mercury toxicology. A great deal of additional information on mercury toxicology can be found in the toxicology profile for this element produced by ATSDR (1999) for human toxicity and in Weiner et al. (2002) for impacts to wildlife.

When consumed (e.g., with a meal of seafood), about 95 percent of MeHg is absorbed from the gastrointestinal tract into the blood stream and is rapidly distributed to other parts of the body. MeHg that enters the brain and/or crosses the placenta into a developing child is of greatest concern. Ecologically, a similar concern arises for MeHg in the brain of predators and/or in developing offspring in utero or in eggs. MeHg can be changed in the brain and other tissues to inorganic mercury, typically Hg(II). In the brain, Hg(II) is trapped for extended periods. If exposure to mercury continues, inorganic mercury will accumulate to toxic levels. MeHg is excreted primarily in feces with a half-life of several months in most species. The limiting factor appears to be conversion to inorganic mercury in tissues other than brain. MeHg also exists in in breast milk, resulting in exposure of nursing young.

Toxicity

The nervous system is very sensitive to mercury toxicity, and kidneys are an important secondary target organ. In poisoning incidents that occurred in other countries, some people who ate fish contaminated with large amounts of MeHg or seed grains treated with MeHg or other organic mercury compounds developed permanent damage to the brain and kidneys (ATSDR 1999). Likewise, salmonids may suffer non-lethal neurological damage and reproductive effects in response to MeHg exposure (Weis 2009, Crump and Trudeau 2009). This toxicity can interfere with smoltification and migration behavior among other effects.

In utero, exposure caused severe mental dysfunction and associated birth defects in children whose mothers consumed contaminated seafood or grains. Less dramatic, but still severe and permanent, effects of MeHg exposure include personality changes (irritability, shyness, nervousness), tremors, changes in vision (constriction (or narrowing of the visual field), deafness, muscle incoordination, loss of sensation, and difficulties with memory. Animal studies indicate that some similar effects have been observed following mercury exposure.

Mercury accumulates in the kidneys, making these organs also sensitive to the toxic effects of mercury. All forms of mercury can cause kidney damage if large enough amounts enter the body. Mercury produces similar kidney damage in non-mammals and birds. This damage slows urine production and can, with sufficiently long and intense exposure, cause complete and irreversible loss of kidney function. In salmonids, damage to kidneys can inhibit smoltification processes by impairing the ability of kidneys to excrete the larger salt loads that accompany migration to marine conditions (Niimi, AJ and Kissoon, GP. 1994, Depew et al. 2012).

In addition to the nervous system and kidneys, mercury can also cause damage to other internal organs. Such effects occur at higher levels of exposure, and additional information can be found in ATSDR (1999).

Mercury in the Yolo Bypass

Mercury is a prominent contaminant in sediments in the Yolo Bypass. Much of this mercury is apparently due to erosion and runoff from historical mercury mines in upstream watersheds during rainfall events, as evidenced by notably lower mercury loading during drought years (Domagalski et al. 2004).

Mercury in the form of HgS and Hg(II) in mine wastes (calcines) and elemental Hg released during ore processing were historically transported to Cache Creek and other streams via erosion and runoff during precipitation events and perhaps other mechanisms such as dumping, resulting in Hg bound to sediment particles in the Cache Creek stream bed. Downstream, floodwaters historically filled the Yolo Basin, adding Hg-contamination to basin sediment before construction of the bypass. This process continued after the construction of weirs and levees designed to control floodwaters in the Sacramento area using the bypass as a buffer. Release of mercury from mine wastes in the Cache Creek and other watersheds continues currently (CDFW 2017).

Sediment transport from Cache Creek to the bypass was reduced after 1938 by construction of the Cache Creek settling basin. This basin was intended to reduce sediment loading to the bypass. It also had the effect of reducing the load of mercury entering the bypass. The basin does capture substantial amounts of sediment. Brown, et al. (2015) indicated that sediment load entering the bypass is reduced by about 55 percent from load entering the settling basin. The basin is reasonably effective at reducing sediment (hence, Hg loading) to the bypass. Still, almost half of sediment load under flood conditions enters the bypass; perhaps a similar percentage of mercury load also enters along with this sediment. Importantly, periodic flood events mean that parts of the bypass are inundated only seasonally and exposed to atmosphere for at least part of the year. These areas undergo cyclic dry and wet periods conducive to MeHg formation.

The bypass is essentially a seasonal wetland, with periodic flows of shallow, slow -moving water over vegetated soils. In an analysis of a suite of wetlands managed for either agriculture or wildlife, the presence of shallow slow-moving[1] water, flooding and drying cycles, and the presence of plant matter, overall enhanced the production of MeHg (Windham-Myers et al. 2014). This evaluation also concluded that increased MeHg concentration in the shallow water column fostered higher uptake into aquatic organisms, ultimately, leading to elevated fish body burdens.

Mercury in bypass sediments is metabolized by sediment microbes, particularly sulfur- and iron-reducing bacteria, to MeHg. This mercury is taken up into the aquatic food web. Henry et al. (2010) found that mercury uptake is higher for smoltifying salmon in the bypass than uptake in the Sacramento River. Fish in the bypass also grew more rapidly than their counterparts in the River, and both MeHg production and greater consumption of contaminated food may play a role in observed higher tissue concentrations in fish from the bypass. This conclusion is supported by the lack of greater growth and MeHg accumulation in caged fish which would be unable to pursue food items over a wide area.

Further, it is not clear from available information whether mercury in tissues of juvenile salmon from the bypass may cause adverse effects. Juvenile salmon in the bypass appear to grow more rapidly than their counterparts in the adjacent river, suggesting that habitat in the bypass is more favorable than river habitat. Studies in the literature suggest that non-lethal neurological effects might occur when fish tissue concentrations exceed 0.1 to 0.3 ng MeHg/g (wet weight) (Beckvar 2005, Depew et al. 2012, Eagle-Smith 2016, Niime and Kissoon 1994). Juvenile salmon from the bypass recently showed MeHg concentrations in tissue 1/5th to 1/10th of these thresholds (Henry et al. 2010).

Shallow, slow moving water is an important habitat characteristic for juvenile salmon during their growth and smoltification stage of their migration to the Pacific (Suchanek 1984). Thus, the same factors that may promote MeHg production may also provide the benefits anticipated for implementation of Project alternatives.

Mercury Release to the Delta

Because of both natural and anthropogenic sources in the environment, mercury continually cycles in the aquatic environments of the Sacramento River basins and the Delta, with historical gold and mercury mining as primary anthropogenic sources in this region. Mercury mines in the Cache Creek and Putah Creek watersheds in the coastal ranges supplied much of the elemental mercury used for gold placer mining in the Sierra Nevada. The Cache Creek watershed in

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[1] Flows in the bypass vary considerably with season and location. The intention here is to recognize that at some times and places water moves slowly enough for anaerobic conditions to develop, favoring the production of MeHg. No particular flow rate(s) is implied.

particular is implicated as the major source of Hg loading to the Delta and San Francisco Bay. Cache Creek has its mouth at the Yolo Bypass, and mercury from the creek must move through the bypass to reach the Delta (Domagalski et al. 2004, Brown et al. 2015).

When the Yolo Bypass is not flooded, the Sacramento and San Joaquin rivers are the largest sources of MeHg to the Delta, accounting for 60 percent of mercury entering the estuary (Central Valley RWQCB 2017). When the Yolo Bypass is flooded, it becomes the dominant source of MeHg to the Delta, and mass balance studies show that 40 percent of all MeHg exported from the Sacramento Basin is produced in the bypass even though it is typically flooded only two months of the year (Foe et al. 2008). Slotton (2007) observed that concentrations of MeHg in fish tissue increase following several months of Yolo Bypass flood flows, demonstrating that in-bypass flooding directly affects MeHg production and MeHg concentrations in fish tissue.

Research in the Delta and its tributaries indicates that sediment MeHg concentrations, mercury methylation and demethylation, uptake and bioaccumulation in the aquatic food web, and mass flux of MeHg from the sediment to overlying water and direct uptake by aquatic biota are all highly dynamic processes. Important factors affecting these processes include land use/community type (e.g., wetlands/marsh, agriculture, open water), location in the region, and other factors (e.g., hydrologic factors, salinity, pH, temperature, nutrients, sulfate, organic matter, and temporal-seasonal conditions [CDFG 2008; Benoit et al. 2003]).

Understanding of chemistry and impacts of MeHg production and subsequent uptake into the food web are dependent on site-specific information to bolster more general knowledge of sediment mercury contamination. Important gaps in understanding of bypass-specific issues exist that limit the evaluation of Project alternatives. A number of ongoing studies on various aspects of mercury in the bypass will eventually fill some of these gaps (Central Valley RWQCB 2017), and these efforts are considered as part of the cumulative effects analysis.

6.1.3.1.2 Organic Chemicals

Toxic chemicals, including pesticides, are included as 303(d) listed constituents of concern primarily in the Sacramento River. Due to agricultural land uses, pesticides are found throughout the waters and sediments of the bypass (CDFG 2008). The major pesticides that have been used on rice in this region are molinate, thiobencarb, and carbofuran. Molinate and thiocarb are applied to control aquatic grasses and weeds on flooded rice fields, while carbofuran is applied to control insects. These chemicals have been shown in the past to be acutely toxic to fish and were attributed to objectionable taste issues in drinking water in the City of Sacramento (Domagalski et al. 2000). Over the past 15 years, molinate use has declined by nearly half while thiobencarb use has more than doubled, and carbofuran has been eliminated and partially replaced by the pyrethroid pesticide lambda-cyhalothrin (Orlando and Kuivila 2004).

A management program is currently in place that requires rice-field water to be retained on fields for one month following pesticide application to allow concentrations in water to be reduced through mechanisms such as volatilization, biological processes, or photo-degradation (Domagalski et al. 2000). The *Central Valley Basin Plan*, explained in Section 6.2.3.1, contains the following rice pesticide performance goals applicable to all waters designated as freshwater habitat: carbofuran (0.4 micrograms per liter [µg/L]), malathion (0.1 µg/L), methyl parathion (0.13 µg/L), molinate (10 µg/L) and thiobencarb (1.5 µg/L). The Basin Plan also contains a water quality objective of one µg/L for thiobencarb in waters designated for municipal and domestic supply (Central Valley RWQCB 2010). Additionally, pesticides such as DDT, which are no longer used, can still be detected in streambed sediments and in the tissues of aquatic organisms because of their persistent chemical characteristics.

A study published in 2007 to evaluate the potential sources of pesticides to the Yolo Bypass found that 13 current-use pesticides were detected in water samples collected in 2004 from the bypass, with the highest concentrations observed at input sites during high flows. Additionally, 13 current-use pesticides, along with residual DDT and its metabolites, were detected in bed and suspended sediments. Results indicate soil samples were dominated by DDT and its degradation products, but also contained a variety of current-use pesticides at lower concentrations (Smalling et al. 2007).

6.1.3.1.3 Salinity

High salt content is a concern for the entire bypass area (City of Woodland 2005). Salinity can reduce the productivity of bypass agricultural fields and may create problems for seasonal wetlands, including stress on microorganisms, plants, and animals. Urban water uses increase salts content in wastewater discharges and irrigation practices, and leaching increases salt content of agricultural return flows. A water quality assessment completed as part of the *Yolo Bypass Water Quality Management Plan Report* (City of Woodland 2005) indicates that of 12 measured sample sites within the bypass region, salinity (measured as EC) within the agricultural drains of the Knights Landing Ridge Cut and Willow Slough Bypass had exceeded potentially acceptable EC criteria of 700 uS/cm. Readings at the Toe Drain averaged less than 500 uS/cm (City of Woodland 2005).

In-bypass salinity increases downstream through Tule Canal, but salinity at the farthest downstream site is lower than all other contributing sites, except the floodwaters (City of Woodland 2005).

6.1.3.1.4 Total Suspended Solids (TSS)

Sediment suspended in the water column is not a contaminant *per se*, but is discussed because many contaminants bind to fine particulates and are transported, deposited, and resuspended along with sediment. Sediment enters the bypass as TSS in water from the Sacramento River at flood stage, and continuously in water from westside tributaries such as Cache and Putah Creeks. Project alternatives will increase water flow and, hence, sediment transport into the bypass by lowering the elevation where Sacramento River water spills over the Fremont Weir and enters the bypass. Contaminants bound to sediment from the river will therefore have a greater influence on sediment quality in the bypass after the weir is notched.

As discussed above, water entering the bypass comes largely from waterbodies listed as impaired for one or more toxic constituents. The Yolo Bypass is also listed as impaired partly as a result of transport of contamination from these waterbodies. Current use of agricultural pesticides in the bypass is a second source of contaminants in water and sediment and is subject to mitigation measures to reduce their impact.

Introducing additional Sacramento River sediment into the bypass may have several effects in the bypass. Some constituents of concern (e.g. Hg) may be diluted in sediments in some areas of the bypass as a result of mixing of river sediment with sediment from tributaries carrying sediment with higher Hg concentrations. The total load of constituents of concern for the river may increase in the bypass as a result of deposition of river sediment. Deposition of contaminated sediments may increase in some areas of the bypass where inundation is currently less frequent, but which will be inundated more often under Project alternatives. Total load of some constituents, particularly current-use pesticides, may increase as a result of both greater flow and inundation of greater areas in the bypass.

6.1.3.1.5 Temperature

One of the consequences of increased withdrawal of river water for human uses is an increase in water temperature due to lowered volume both in the withdrawn water and remaining water in the river. Increase of river temperatures from their natural levels can have far-reaching effects on local ecology, including alteration of community processes and facilitating invasion by exotic species (UC Davis 2017).

Native salmonid species are of great ecological, economic, and cultural importance to local communities. They also serve as strong indicators of habitat quality and integrity in river systems, particularly with regard to water temperature, sediment load, and barriers to passage. They are well-studied, including behavioral and physiological responses to temperature extremes. The Central Valley spring-run Chinook salmon is listed as a threatened species under the Endangered Species Act (ESA), giving them a high priority for restoration. The main threats to the remaining populations are loss and degradation of habitat.

Maximum water temperature is a critical part of habitat quality for salmonids. Temperature affects every aspect of salmonid biology, from feeding and growth rates to migration and spawning, and stress levels and survival. Rainbow trout, for example, are more severely impacted by temperatures in excess of 20°C than by fishing pressure.

Temperature is discussed at length in Section 8, *Aquatic Resources and Fisheries* and is not further evaluated under water quality.

6.1.3.2 Sacramento River

The Sacramento River from Red Bluff to Knights Landing is listed on the Section 303(d) list for DDT, dieldrin, mercury, PCBs, and unknown toxicity. The Sacramento River from Knights Landing Ridge Cut to the Delta is on the Section 303(d) list for chlordane, DDT, dieldrin, mercury, PCBs, and unknown toxicity. Table 6-3 provides an overview of general water quality data collected at three-month intervals from 2010-2016 as reported by the California DWR for the Sacramento River below Knights Landing (Figure 6-2). Also from this data set, Figure 6-3 presents total mercury samples collected below Knights Landing from 2012 through 2016 (2010-2012 not available). As seen in Figure 6-2, total mercury concentrations fall well below the California Toxics Rule threshold of 50 nanograms per liter (ng/L) total mercury in water for consumption of water and aquatic organisms (SWRCB 2017).

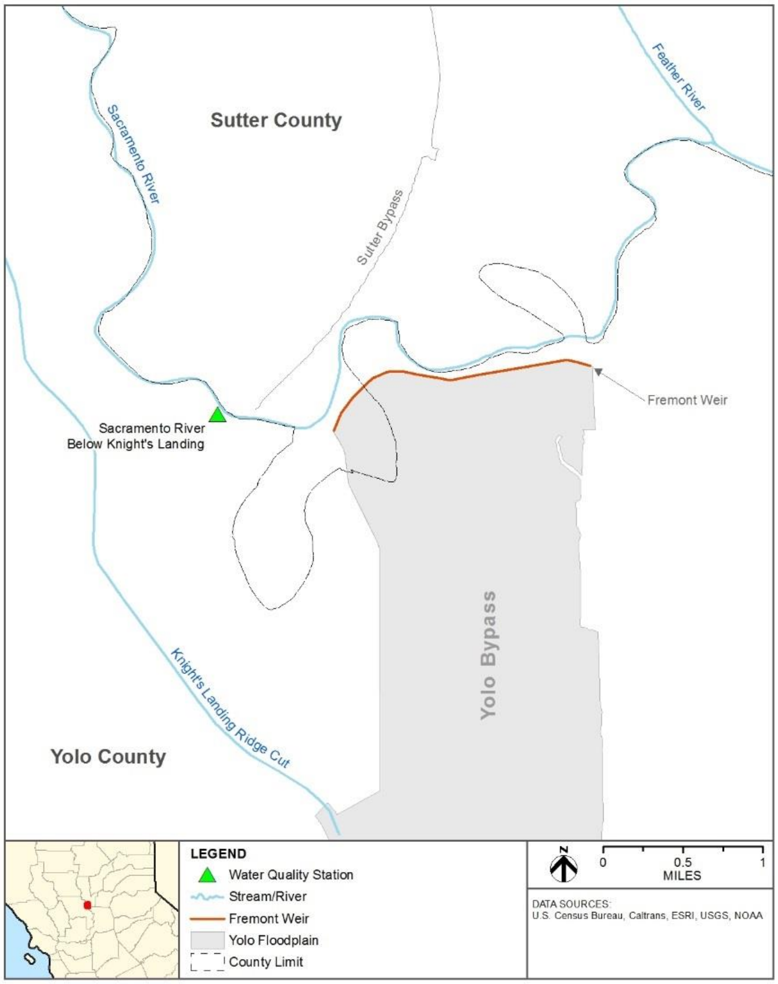


Figure 6-2. Sacramento River below Knights Landing Water Quality Monitoring Station

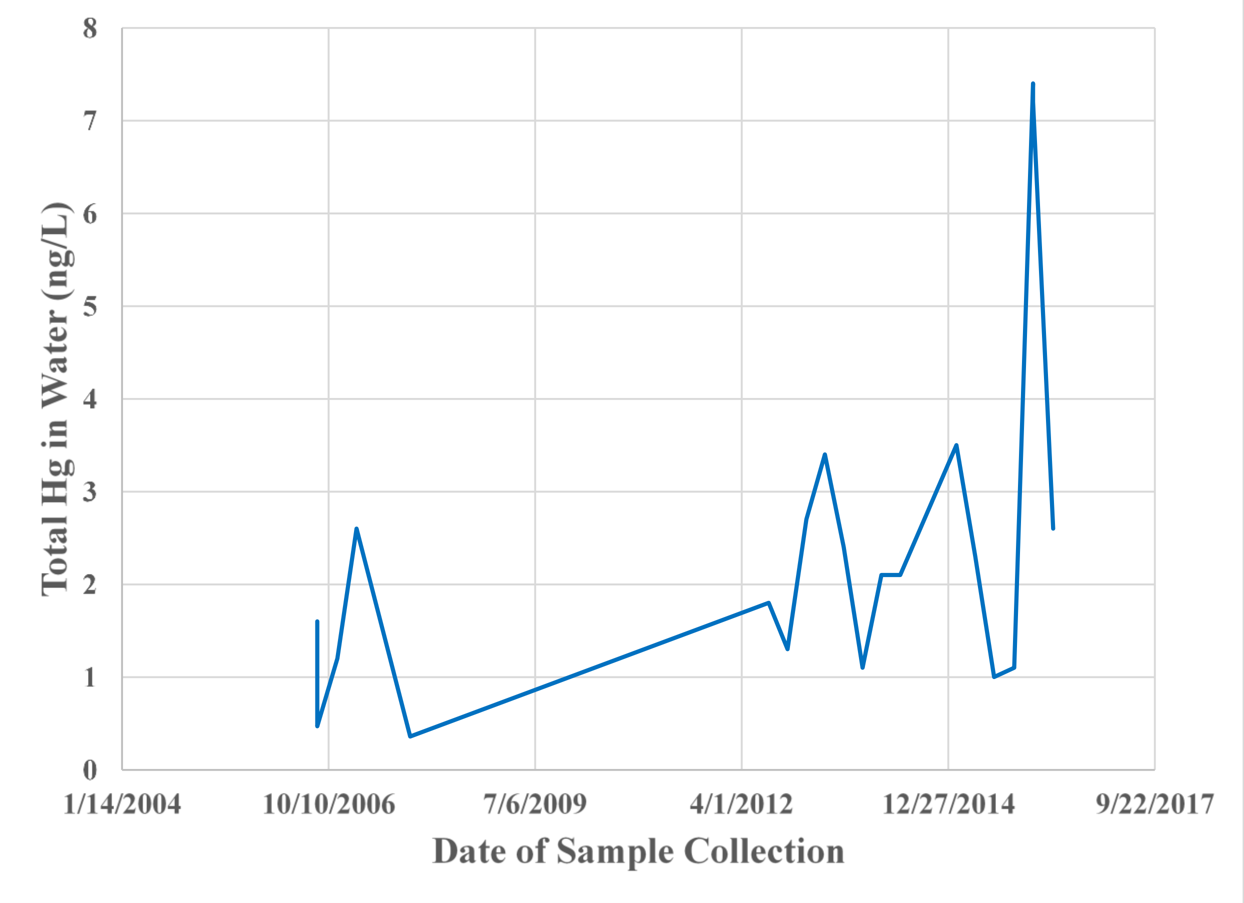
Table 6-3. Water Quality Parameters Sampled[1] on the Sacramento River below Knights Landing

Water Quality Parameter	Minimum	Maximum	Average
pH (standard units)	7.4	8.4	7.9
Turbidity (NTU)	4.3	64	13.3
Dissolved Oxygen (mg/L)	6.5	11.7	9.2
Total Organic Carbon (mg/L)	1.2	4.5	2.0
Total Nitrogen (mg/L)	0.02	0.94	0.16
Total Phosphorus (mg/L)	0.01	0.1	0.05
Electrical Conductivity (µS/cm)	140	462	235

Source: California Department of Water Resources (DWR) 2017

[1] Samples Collected 2/2010 – 11/2016

Key: mg/L = milligrams per liter; NTU = nephelometric turbidity units; µS/cm = microSiemens per centimeter



Source: California Department of Water Resources (DWR) 2017

Figure 6-3. Total Mercury in Water in the Sacramento River below Knights Landing

6.1.3.3 Western Stream Inputs

Inflows from western streams, including the Knights Landing Ridge Cut, Cache Creek, Willow Slough, and Putah Creek, are generally small in comparison to the Sacramento River floodwater influxes through Fremont Weir. However, these small streams serve as the primary source of freshwater to the floodplain in the fall and spring, and in dry years when the Sacramento River does not spill over the weir (Schemel et al. 2002). Water from Cache and Putah creeks is affected by upstream reservoirs, historical mining operations, agricultural return flows, and stormwater runoff. Water from each of these creeks is diverted for irrigation as it enters the bypass and eventually drains into the Toe Drain (Smalling et al. 2005). Willow Slough carries stormwater runoff and possibly agricultural and other discharges, as it principally drains agricultural areas west of the bypass and also conveys effluent from the City of Davis's wastewater treatment plant (Smalling et al. 2005). The Knights Landing Ridge Cut carries water from the Colusa Basin Drain to the Yolo Bypass. The Ridge Cut is an artificial overflow channel that connects the Colusa Basin Drain to the bypass. Under low-flow conditions, the Colusa Basin Drain discharges directly to the Sacramento River, but under high-flow conditions, water in the drain is directed through the Ridge Cut to the Yolo Bypass. Aerial observations suggest that inflows from the Knights Landing Ridge Cut and Cache Creek are the largest of the four western streams (Schemel et al. 2002).

Since much of the Yolo Bypass area is surrounded by and includes agricultural land use, inputs of pesticides, which could affect critical life stages of native fish, are a concern. A study completed in 2005 by the United States Geological Service assessed pesticide concentrations in water and sediment samples from six source watersheds to the bypass and three sites within the bypass during both dry and wet water years (Smalling et al 2005). Thirteen current-use pesticides and three insecticides were detected in surface water and sediment samples collected during the study. Suspended sediments had higher pesticide concentrations compared to bed sediments, indicating the potential for pesticide transport throughout the bypass, especially during high-flow events or during the first rainfall of the season as sediments move from the fields to the creeks (Smalling et al 2005).

6.2 Regulatory Setting

This section describes the laws related directly to water quality. A number of regulatory authorities at the Federal, State, and local level control the flow, quality, and supply of water in California.

6.2.1 Federal Plans, Policies, and Regulations

Federal laws and regulations pertaining to surface water quality are discussed below.

6.2.1.1 Federal Clean Water Act

Growing public awareness and concern for controlling water pollution led to enactment of the Federal Water Pollution Control Act Amendments of 1972. As amended in 1977, this law became commonly known as the Clean Water Act. The CWA established the basic structure for regulating discharges of pollutants into the waters of the United States. It gave USEPA the authority to implement pollution control programs such as setting wastewater standards for industrial and municipal dischargers. The CWA also continued requirements to set water quality standards for all known contaminants in surface waters. The CWA made it unlawful for any person to discharge any pollutant from a point source into navigable waters unless a permit was obtained under its provisions (USEPA 2002).

Section 303(d) of the 1972 CWA requires states, territories, and authorized tribes to develop a list of water quality-impaired segments of waterways. The 303(d) list includes waterbodies that do not meet water quality standards for the specified beneficial uses of that waterway even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waterbodies on their 303(d) lists and implement a process, called Total Maximum Daily Loads (TMDLs), to meet water quality standards (USEPA 2002).

The TMDL process is a tool for implementing water quality standards and is based on the relationship between pollution sources and in-stream water quality conditions. The TMDL establishes the maximum allowable loadings of a pollutant that can be assimilated by a waterbody while still meeting applicable water quality standards. The TMDL provides the basis for the establishment of water quality-based controls. These controls should provide the pollution reduction necessary for a waterbody to meet water quality standards. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The TMDL’s allocation calculation for each waterbody must include a margin of safety to ensure the waterbody can be used for the State-designated uses. Additionally, the calculation must also account for seasonal variation in water quality (USEPA 2002).

TMDLs are intended to address all significant stressors that cause or threaten to cause waterbody beneficial use impairments, including point sources (e.g., wastewater treatment plant discharges), nonpoint sources (e.g., runoff from fields, streets, range, or forest land), and naturally occurring sources (e.g., runoff from undisturbed lands). TMDLs may be based on readily available information and studies. In some cases, complex studies or models are needed to understand how stressors are causing waterbody impairment. In many cases, simple analytical efforts provide an adequate basis for stressor assessment and implementation planning. TMDLs are developed to provide an analytical basis for planning and implementing pollution controls, land management practices, and restoration projects needed to protect water quality. States are required to include approved TMDLs and associated implementation measures in State water quality management plans. Within California, TMDL implementation is through regional Basin Plans.

The CWA also establishes the basic structure for regulating discharges of pollutants into the waters of the United States and gives USEPA the authority to implement pollution control programs such as setting wastewater standards for industries (USEPA 2002). In certain states such as California, USEPA has delegated authority to State agencies.

Water quality of waters of the United States subjected to a discharge of dredged or fill material is regulated under Section 404 of the CWA. These actions must not violate Federal or State water quality standards. Specifically, in the State of California, the RWQCB administers Section 401 and either issues or denies water quality certifications, depending upon whether the proposed discharge or fill material complies with applicable State and Federal laws.

In addition to complying with State and Federal water quality standards, all point sources that discharge into waters of the United States must obtain a National Pollutant Discharge Elimination System (NPDES) permit under provisions of Section 402 of the CWA. In California, SWRCB and RWQCBs are responsible for the implementation of the NPDES permitting process at the State and regional levels, respectively.

The NPDES permit process also provides a regulatory mechanism for the control of nonpoint source pollution created by runoff from construction and industrial activities and general and urban land use, including runoff from streets. Projects involving construction activities (e.g., clearing, grading, or excavation) involving land disturbance greater than one acre must file a Notice of Intent with the applicable RWQCB to indicate their intent to comply with the State General Permit for Stormwater Discharges Associated with Construction Activity (General Permit). The State General Permit specifies Best Management Practices (BMPs) to achieve compliance as well as numeric action levels to achieve Federal standards to minimize sediment and pollutant loadings. The General Permit requires preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP) as well as a Rain Event Action Plan prior to construction. The SWPPP and Rain Event Action Plan are intended to help identify the sources of sediment and other pollutants and assess the effectiveness of BMPs in preventing or reducing pollutants in storm water discharges and authorized non-storm water discharges. The CWA also requires that a permit be obtained from USEPA and United States Army Corps of Engineers when discharge of dredged or fill material into wetlands and waters of the United States occurs.

Section 404 of the CWA requires USEPA and United States Army Corps of Engineers to issue individual and general permits for these activities.

6.2.2 State Plans, Policies, and Regulations

State laws and regulations pertaining to surface water quality are discussed below.

6.2.2.1 California Porter-Cologne Water Quality Control Act

The Porter-Cologne Act was enacted in 1969 and established the SWRCB. The Porter-Cologne Act defines water quality objectives as the limits or levels of water constituents that are established for reasonable protection of beneficial uses. Unlike the CWA, the Porter-Cologne Act applies to both surface and groundwater. The Porter-Cologne Act requires the nine semi-autonomous RWQCBs to establish water quality objectives while acknowledging that water quality may be changed to some degree without unreasonably affecting beneficial uses. Beneficial uses, together with the corresponding water quality objectives, are defined as standards, per Federal CWA regulations. Therefore, the regional plans provide the regulatory framework for meeting State and Federal requirements for water quality control. Changes in water quality are only allowed if the change is consistent with the most restrictive beneficial use designation identified by the State, does not unreasonably affect the present or anticipated beneficial uses, and does not result in water quality less than that prescribed in the water quality control plans (WQCP) (Central Valley RWQCB 2016).

A State of California General Permit for Discharges of Stormwater Associated with Construction Activity Construction General Permit Order 2009-0009-DWQ (as amended in 2010 and 2012) will be required prior to any ground disturbance that is greater than one acre or is part of a common plan of development greater than one acre. A Notice of Intent and SWPPP must be developed and electronically submitted to the Storm Water Multiple Application and Report Tracking System, an online database maintained by SWRCB. A qualified SWPPP Developer must prepare the SWPPP. The SWPPP, other permit-required documents, and monitoring data must be maintained on the construction site. A Qualified SWPPP Practitioner must implement the SWPPP during construction, including installation, inspection, and maintenance of BMPs required by the General Permit.

The General Permit requires dischargers to determine the relative risk levels at each construction site. The risk factors are based on the potential for sedimentation and impacts to downstream receiving waters.

Based on the site’s risk level, the SWPPP must list BMPs the discharger will use to protect stormwater runoff as well as the placement of those BMPs. These measures may include but would not be limited to revegetation, silt fences, turbidity fences, mulching of unstabilized areas, dewatering structures, stormwater drainage system, and construction fencing. The SWPPP will require a visual monitoring program, a chemical monitoring program for the “non-visual” pollutants to be implemented if there is a failure of BMPs, and a sediment monitoring plan if the site discharges directly to a waterbody listed on the 303(d) list for sediment. This monitoring program will assess compliance with numeric action levels appropriate to the project. The SWPPP should also contain a site map(s), showing the construction site perimeter; existing and proposed buildings, lots, roadways, stormwater collection and discharge points; general topography both before and after construction; and drainage patterns across the project. At higher risk sites, Rain Event Action Plans must be developed to ensure active construction sites have adequate erosion and sediment controls implemented prior to forecasted storm events.

6.2.2.2 Water Quality Control Plans

The California Water Code (Section 13240) requires the preparation and adoption of WQCPs (Basin Plans), and the Federal CWA (Section 303) supports this requirement. According to Section 13050 of the California Water Code, Basin Plans consist of a designation or establishment for the waters within a specified area of beneficial uses to be protected, water quality objectives to protect those uses, and an implementation program needed for achieving the objectives. State law also requires that Basin Plans conform to the policies set forth in the Water Code, beginning with Section 13000, and any State policy for water quality control. The Basin Plans are regulatory references for meeting the State and Federal requirements for water quality control (40 Code Federal Regulations 131.20). One significant difference between the State and Federal programs is that California's basin plans also establish standards for groundwater in addition to surface water (Central Valley RWQCB 2016).

Basin Plans are adopted and amended by nine regional water boards under a structured process involving full public participation and State environmental review. Basin Plans and amendments do not become effective until approved by SWRCB. Regulatory provisions must be approved by the Office of Administrative Law. Adoption or revision of surface water standards is subject to the approval of USEPA.

Basin Plans complement other WQCPs adopted by the SWRCB such as the WQCP for Temperature Control and Ocean Waters. The SWRCB and the regional water boards maintain each Basin Plan in an updated and readily available edition that reflects the current water quality control programs.

The fourth edition of the Basin Plan for the Central Valley RWQCB pertains to the Sacramento and San Joaquin River basins. The Sacramento River Basin covers 27,210 square miles in the entire drainage area of the Sacramento River. It also includes the drainage sub-basins of Cache and Putah creeks.

6.2.2.2.1 Delta Mercury Control Program (Basin Plan Amendment)

The Delta Mercury Control Program (DMCP) was adopted by the Regional Board in April 2010 and approved by the USEPA in October 2011. The DMCP includes fish-tissue objectives for the Delta and MeHg load allocations for NPDES facilities, municipal storm water, agricultural lands, wetlands, and open water in the Delta and Yolo Bypass. The DMCP uses an adaptive management approach that contains two phases. Phase I (spanning from October 2011 through approximately October 2020) emphasizes studies and pilot projects to develop and evaluate management practices to control MeHg as well as the development of upstream mercury control programs for major tributaries, the development and implementation of a mercury exposure reduction program to protect humans, and the development of a mercury offset program. Phase II, beginning after Phase I ends, requires dischargers to implement MeHg control programs and continuation of mercury reduction programs. This phased approach is designed to protect people eating one meal per week of trophic levels 3 and 4 Delta fish, plus some non-Delta fish.

The program provides MeHg load and waste load allocations for each Delta subarea (Central Valley RWQCB 2011) (Table 6-4, Sacramento River, Yolo Bypass, and Tributaries only).

Table 6-4. Methylmercury load allocations

Delta Subarea or Tributary	Current Load (g/yr)	Allocation (g/yr)
Sacramento River		
Agricultural drainage	36	20
Atmospheric wet deposition	5.6	5.6
Open water	140	78
Tributary Inputs	**2,034**	1,129
Wetlands	94	52
Yolo Bypass		
Agricultural drainage	19	4.1
Atmospheric wet deposition	4.2	4.2
Open water	100	22
Tributary Inputs	**462**	100
Wetlands	480	103
Cache Creek	-	30
Dixon Area	-	0.77
Fremont Weir	-	39
Knights Landing Ridge Cut	-	22
Putah Creek @ Mace Boulevard	-	2.4
Willow Slough	-	3.9

Source: Central Valley RWQCB 2011

Key: g/yr= grams per year

Bolded values emphasize the contribution of tributaries to mercury loads in the Sacramento River and Yolo Bypass

6.2.2.2.2 Cache Creek, North Fork Cache Creek, Bear Creek, and Harley Gulch Basin Plan Amendment

In October 2005, the Central Valley RWQCB adopted a Basin Plan amendment for methylmercury in Cache Creek, North Fork Cache Creek, Bear Creek, and Harley Gulch. The amendment was subsequently approved by the SWRCB and USEPA. The amendment added a beneficial use designation for Commercial and Sport Fishing on these waterways, and included water quality objectives for methylmercury in the waterways and in fish tissue (USEPA 2007).

6.2.2.2.3 Central Valley Pesticide and TMDL Basin Plan Amendment

In March 2014, the Central Valley RWQCB adopted Resolution RS-2014-0041 for control of diazinon and chlorpyrifos discharges. This amendment applies to the Sacramento and San Joaquin River basins in response to diazinon and chlorpyrifos concentrations, which exceed applicable water quality objectives. These contaminants are most often found in waterbodies because of application as a pesticide in agricultural areas. The aquatic life beneficial use is the most sensitive to both diazinon and chlorpyrifos. Maximum concentrations and averaging periods for each contaminant are listed in Table 6-5.

Table 6-5. Maximum concentrations and averaging periods for control of diazinon and chlorpyrifos discharges

Pesticide	Maximum Concentration (µg/L)	Averaging Period
Chlorpyrifos – acute	0.025	1-hour average
Chlorpyrifos – chronic	0.015	4-day average
Diazinon – acute	0.16	1-hour average
Diazinon – chronic	0.10	4-day average

Source: California Environmental Protection Agency 2014

Key: µg/L= micrograms per liter

Not to be exceeded more than once in a three-year period

6.2.2.2.4 Central Valley Diuron TMDL and Basin Plan Amendment

The Central Valley Regional Water Quality Control Board is developing a proposed amendment to the water quality control plan to establish water quality objectives, TMDLs, and a program of implementation to control discharges of the herbicide diuron. Diuron is the most widely used herbicide in California for both agricultural and non-agricultural uses to control annual broadleaf and grassy weeds. Alternatives proposed for water quality objectives include the most recently used evaluation guideline of 1.3 µg/L, a guideline of 0 µg/L, indicating no detectable concentration in surface would be allowed, or an acute criterion of 170 µg/L and chronic criterion of 1.3 µg/L (Central Valley RWQCB 2012).

6.2.2.2.5 Central Valley Organochlorine Pesticide TMDL and Basin Plan Amendment

The Central Valley Regional Water Quality Control Board is working toward a proposed amendment to the water quality control plan for the control of organochlorine pesticides, including DDTs and Group A pesticides, which have the ability to concentrate in sediments and fish. These pesticides historically have been used in urban, residential, and agricultural settings. Evaluation of targets is currently being completed (Central Valley RWQCB 2010b).

6.2.2.2.6 Central Valley Pyrethroid Pesticides TMDL and Basin Plan Amendment

In January 2017, the Central Valley RWQCB released proposed amendments to the water quality control plan for the control of pyrethroid pesticides discharges into selected surface waters in the Sacramento and San Joaquin river basins. Pyrethroids are currently widely used for structural pest control in urban and residential areas, in various consumer use pest control products, and in agriculture in the Central Valley, and have been found at levels of concern in the Sacramento and San Joaquin river basins since the early 2000s. The aquatic life beneficial use is the most sensitive pyrethroids. The proposed amendment offers a phased approach designed to monitor concentrations while moving toward water quality improvement. To determine appropriate levels for the pyrethroid concentration goals, the Central Valley RWQCB is currently recommending a methodology that directs use of the fifth percentile of the statistical species sensitivity distribution, unless a more sensitive species falls below that value. These criteria are all substantially lower than the concentrations currently observed in impaired waters, indicating reductions will need to be taken to attain water quality standards (Central Valley RWQCB 2017).

6.2.3 Regional and Local Plans, Policies, and Regulations

Regional and local plans and policies pertaining to surface water quality are discussed below.

6.2.3.1 Central Valley RWQCB Rice Pesticides Program

The Basin Plan states that the discharge of irrigation return flows containing carbofuran, malathion, methyl parathion, molinate, and thiobencarb is prohibited unless the discharger is following management practices approved by the Central Valley RWQCB. The plan further states that implementation of these management practices must be expected to result in compliance with the performance goals. The Basin Plan contains the following rice pesticide performance goals applicable to all waters designated as freshwater habitat: carbofuran (0.4 µg/L), malathion (0.1 µg/L), methyl parathion (0.13 µg/L), molinate (10 µg/L), and thiobencarb (1.5 µg/L). The Basin Plan also contains a water quality objective of one µg/L for thiobencarb in waters designated for municipal and domestic supply (Central Valley RWQCB 2010). As a result of 2009 thiobencarb monitoring, hold time requirements and outreach efforts were revised and continue to be in effect (Central Valley RWQCB 2016b).

6.3 Environmental Consequences

This section describes the environmental consequences associated with the Project alternatives, and the No Action Alternative, on water quality. This section presents the assessment methods used to analyze the effects on water quality, the thresholds of significance that determine the significance of effects, and the potential environmental consequences and mitigation measures as they relate to each Project alternative. Detailed descriptions of the alternatives evaluated in this chapter are provided in Chapter 2, *Description of Alternatives*.

6.3.1 Methods for Analysis

This section describes the approach for the analysis of water quality in the Project area. The evaluation of impacts on water quality considers the potential for increased degradation of water quality and flow regimes in the Yolo Bypass region and receiving waterbodies such that it would cause violations of water quality standards or negatively impact assigned beneficial uses.

Impacts to water quality are determined relative to existing conditions (for California Environmental Quality Act [CEQA]) and the No Action Alternative (for the National Environmental Policy Act [NEPA]). However, the No Action Alternative would be similar to existing conditions because water quality is not anticipated to experience substantive changes in the area of analysis. Therefore, the analysis compares the impacts of the action alternatives only to existing conditions.

6.3.2 Thresholds of Significance – CEQA

The thresholds of significance for impacts are based on the environmental checklist in Appendix G of the State CEQA Guidelines, as amended. These thresholds also encompass the factors considered under NEPA to determine the significance of an action in terms of its context and the intensity of its impacts. An impact resulting from the implementation of an alternative would be significant if it would:

- Result in the degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water

6.3.3 Effects and Mitigation Measures

This section provides an evaluation of the direct and indirect effects on water quality from implementing the Project alternatives. This analysis is organized by Project alternative, with specific impact topics numbered sequentially under each alternative.

6.3.3.1 No Action Alternative

Under the No Action Alternative, the Project would not be implemented, and none of the Project components would be developed. No Project-related construction activities or alteration of the Yolo Bypass region would occur. In addition to no changes in pesticides, herbicides, MeHg, TSS and salinity related to Project components, TMDL programs for MeHg, pesticides, and herbicides, as mentioned in Section 6.2.3, would continue in the region and would be likely to improve water quality.

CEQA Conclusion

Because no construction or alteration of the bypass under the existing conditions would occur, **no impact** to water quality in the area of analysis would ensue.

6.3.3.2 Alternative 1: East Side Gated Notch

Alternative 1, East Side Gated Notch, would allow increased flow from the Sacramento River to enter the Yolo Bypass through a gated notch on the east side of Fremont Weir. The invert of the new notch would be at an elevation of 14 feet, which is approximately 18 feet below the existing Fremont Weir crest. Alternative 1 would allow up to 6,000 cfs to flow through the notch, during periods when the river levels are not high enough to go over the crest of Fremont Weir, to provide open channel flow for adult fish passage. See Section 2.4 for more details on the alternative features.

6.3.3.2.1 Impact WQ-1: Construction- or maintenance-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water

Construction activities under Alternative 1 would involve demolition of a portion of the existing Fremont Weir; construction of a headworks structure, intake channel and outlet channel; and grading of the transport channel. These activities could affect water quality temporarily during the construction period. Possibilities include mobilizing sediment and associated contaminants during excavation and grading, release of construction-related chemicals such as oils, fuels, cement, solvents, etc. from improper handling or accidents.

Maintenance activities would include sediment removal every five years within the Fremont Weir Wildlife Area using construction equipment to load and haul it from the bypass; these maintenance activities have the potential to affect water quality in the Yolo Bypass in the same ways as construction activities at the beginning of the project. Maintenance activities would not include dredging in the Sacramento River or Tule Canal.

Contamination of the Sacramento River as well as its riverbanks and bed soils downstream of the Yolo Bypass could also occur during construction from leakage or accidental spills of petroleum products and other pollutants during construction. Improper handling, storage, or disposal of these materials could cause degradation of water quality the Sacramento River as well as the bypass.

CEQA Conclusion

Because Alternative 1 could increase downstream sedimentation and turbidity relative to existing conditions and might mobilize sediment-associated contaminants, the impact of construction and maintenance could be **significant** and any impact would depend on how well construction and maintenance are planned.

Mitigation Measure MM-HAZ-1: Implement a Construction Risk Management Plan (CRMP) to serve as a contingency plan for hazardous materials and waste operations, if encountered during construction, and construction near abandoned well sites.

The Lead Agencies and the contractor will prepare a CRMP that will include procedures to follow to identify soil contamination during excavation activities and the handling and disposal of any contaminated soil. The CRMP will also require DWR to obtain an opinion through the DOGGR Well Review Program prior to working near the sites. The CRMP will also identify procedures to follow for removal, handling, and disposal if underground storage tanks or other hazardous materials are found during construction of the site. The CRMP will be included in the final plans and specifications for project implementation.

Mitigation Measure MM-WQ-1: Implement a spill prevention, control, and countermeasure plan.

The Lead Agencies or their construction contractor shall develop and implement an SPCCP to minimize the potential for, and effects from, spills of hazardous, toxic, and petroleum substances during construction and maintenance. The SPCCP shall be completed before construction activities begin. Implementation of this measure shall comply with State and Federal water quality regulations. The SPCCP shall describe spill sources and spill pathways in addition to the actions that shall be taken in the event of a spill (e.g., an oil spill from engine refueling shall be cleaned up immediately with oil absorbents) or the exposure of an undocumented hazard. The SPCCP shall outline descriptions of containment facilities and practices such as double-walled tanks, containment berms, emergency shut-offs, drip pans, fueling procedures, and spill response kits. It shall also describe how and when employees are trained in proper handling procedures and spill prevention and response procedures.

The Lead Agencies shall review and approve the SPCCP before the onset of construction activities and shall routinely inspect the construction area to verify that the measures specified in the SPCCP are properly implemented and maintained. The Lead Agencies shall notify its contractors immediately if there is a noncompliance issue and shall require compliance.

If a spill is reportable, the construction contractor’s superintendent shall notify the Lead Agencies, and the Lead Agencies shall take action to contact the appropriate safety and cleanup crews to ensure the SPCCP is followed. A written description of reportable releases shall be submitted to the Central Valley RWQCB and the California Department of Toxic Substances Control. This submittal shall contain a description of the release, including the type of material and an estimate of the amount spilled, the date of the release, an explanation of why the spill occurred, and a description of the steps taken to prevent and control future releases. The releases shall be documented on a spill report form.

Mitigation Measure MM-WQ-2: Implement a stormwater pollution and prevention plan.

Prior to initiating construction and maintenance activities, the construction contractor shall prepare an SWPPP that describes BMPs that shall be implemented to control accelerated erosion, sedimentation, and other pollutants during and after Project construction. Specific BMPs that shall be incorporated into the SWPPP shall be site-specific and shall be prepared in accordance with the regional water board field manual. The SWPPP shall include, but not be limited to, the following standard erosion- and sediment-control BMPs:

- **Timing of construction.** All construction and ongoing operations and maintenance activities shall occur from April 15 through November 1 to avoid ground disturbance in the rainy season.
- **Stabilize grading spoils.** Grading spoils generated during construction may be temporarily stockpiled in staging areas located within two miles of Yolo Bypass. Such staging areas shall not contain native or sensitive vegetation communities and shall not support sensitive plant or animal species. Silt fences, non-monofilament fiber rolls, or similar devices shall be installed around the base of the temporary stockpiles to intercept runoff and sediment during storm events. If necessary, temporary stockpiles may be covered with a geotextile material to increase protection from wind and water erosion. Materials used for stabilizing spoils will be selected to be non-injurious to wildlife
- **Permanent site stabilization.** The construction contractor shall install structural or vegetative methods to permanently stabilize all graded or disturbed areas once construction is complete. Structural methods could include installing biodegradable fiber rolls or erosion-control blankets. Vegetative methods could include applying organic mulch and tackifiers, and/or an erosion-control native seed mix.

- **Staging of construction equipment and materials.** Equipment and materials shall be staged in designated staging areas that meet the requirements identified above regarding stabilizing grading spoils.
- **Minimize soil and vegetation disturbance.** The construction contractor shall minimize ground disturbance and the disturbance and/or destruction of existing vegetation. This shall be accomplished, in part, through establishing designated equipment staging areas, ingress and egress corridors, equipment exclusion zones and protecting existing trees before beginning any grading operations.
- **Install sediment barriers.** The construction contractor shall install silt fences, fiber rolls, or similar devices to prevent sediment-laden water from leaving the construction area to the extent feasible in areas where construction is occurring in saturated soils.

Mitigation Measure MM-WQ-3: Develop a turbidity monitoring program.

The Basin Plan for the Sacramento River and San Joaquin River basins (Fourth Edition) (Central Valley RWQCB 2016) contains turbidity objectives. Specifically, the plan states that where natural turbidity is between five and 50 NTUs, turbidity levels may not be elevated by 20 percent above ambient conditions; where ambient conditions are between 50 and 100 NTUs, conditions may not be increased by more than 10 NTUs; and where natural turbidity is greater than 100 NTUs, increases shall not exceed 10 percent. A sampling plan shall be developed and implemented based on specific site conditions and in consultation with the Central Valley RWQCB. If turbidity limits exceed basin plan standards, construction-related earth-disturbing activities shall slow to a point that would alleviate the problem.

Implementation of the Construction Risk Management Plan (CRMP), Spill Prevention, Control, and Countermeasure Plan (SPCCP), SWPPP, construction BMPs, and turbidity monitoring plan included in MM-HAZ1 and MM-WQ-1 through MM-WQ-3, respectively, would minimize all water quality risks, and, therefore, the impact would be reduced to **less than significant**.

6.3.3.2.2 Impact WQ-2: Operation-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water

Alternative 1 will result in inundation of the Yolo Bypass seasonally during times when water would not flow over the Fremont Weir under existing conditions. Agricultural land constitutes the majority of the area within the bypass, followed by wetlands and fallow land. Crop types and land use are further discussed in Chapter 11, *Land Use and Agricultural Resources*. Past and current application of pesticides and herbicides within the bypass have led to listing of many of these chemicals as pollutants of concern in the *Yolo Bypass Wildlife Area Land Management Plan* (CDFG 2008) as well as the *Central Valley Region Basin Plan* and *Yolo Bypass Water Quality Management Plan Report* (City of Woodland 2005).

Alternative 1, East Side Gated Notch, would allow increased flow from the Sacramento River to enter the Yolo Bypass through a gated notch. The bottom of the notch (the “invert”) would be at an elevation of 14 feet, which is approximately 18 feet below the existing Fremont Weir crest. Water would be able to flow through the proposed notch during periods when the river levels are not high enough to go over the crest of Fremont Weir. The additional flow from the gated notch would add water to the bypass from the Sacramento River during flows that would be considered non-flood events under existing conditions. The increased frequency of inundation from the Sacramento River due to the gated notch would allow greater areas within the bypass to be inundated seasonally. Since water quality in the Sacramento River would not be affected by the alternative, constituents of concern (see Table 6-1) entering the bypass would not be expected to change in comparison to existing conditions. However, the total load of contaminants would increase, depending in large measure on TSS in the river. Key contaminants such as Hg are mainly transported bound to sediment particles and the amount of sediment in water entering the bypass will be a critical determinant of the load of contaminants. The highest sediment loads in the river typically occur during periods of high runoff. When flood-conditions are not present, TSS may be lower and concentrations of sediment-bound contaminants such as Hg would be lower.

One water quality variable of particular concern in the Yolo Bypass is MeHg. Historical mining on Cache Creek and Putah Creek results in substantial contributions of inorganic mercury to the Yolo Bypass, and mercury methylation causes this mercury to enter the foodweb. Wetlands support the methylation process, and MeHg levels are increased in seasonal wetlands. Elevated MeHg uptake in aquatic biota and subsequent MeHg export to the Delta have been observed as a result of flooding in the Yolo Bypass, in particular the flooding of formerly dry or mostly dry soils (Slotton et al. 2007; Foe et al. 2008).

Additional inundation of the bypass (i.e. greater areas subject to periodic flooding) under Alternative 1 would likely increase net methylation, which could in turn increase the total amount of MeHg entering the foodweb within the bypass. It is not clear, however, whether increased total MeHg production would increase the amount of MeHg in fish tissues, or instead support growth and smoltification of juvenile salmon over a greater area where MeHg production is similar to production under existing conditions. MeHg production on a per unit area basis may not change substantially because notching would not affect water quality of sources of water to the bypass. Thus, Alternative 1 may expand conditions for juvenile salmon in a manner that resembles existing conditions, rather than increase the impact of MeHg production on uptake of MeHg into fish.

Total production of MeHg is likely to increase under Alternative 1 due to seasonal inundation of greater areas within the bypass. Most mercury methylation in an aquatic ecosystem occurs within the sediments and then diffuses out into the overlying water. Larger areas of inundation compared to existing conditions where efficient MeHg production may take place would increase export of total MeHg from the bypass to the Delta.

Increased total MeHg production might not increase, however, since mercury sources to the bypass would not be affected by construction of Alternative 1. Instead, MeHg concentrations might remain similar to existing conditions, with the main impact being expansion of the MeHg producing areas. With available information and data, determining the direction and magnitude of changes in MeHg production in the bypass and its uptake into the food web is quite difficult. However, since impacts to juvenile salmon are driven by concentrations rather than total load, bioaccumulation in these fish may not change substantively with implementation of Alternative 1.

Export of MeHg from the Yolo Bypass is best described in terms of load. Much of the Hg that exits the bypass is bound to sediment particles and deposits onto sediment in the low energy waters of the Delta and bays. Increasing the total load of Hg in sediments across the same area may allow increase of total MeHg available for transport out of the bypass. The major impact of implementing Alternative 1 could be on MeHg entering the Delta from the bypass rather than on juvenile salmon in the bypass.

Pesticides and herbicides from agricultural use are also contaminants of concern to water quality and are found in low concentrations throughout the waters and bottom sediments of the Yolo Bypass. The more persistent legacy organochlorine pesticides (e.g., DDT, dieldrin) are generally found at higher levels than the less persistent organophosphate compounds (e.g., diazinon). As discussed in Section 6.1.3.1.2, *Toxic Chemicals*, among pesticides detected, soil/sediment samples taken from the bypass have been dominated by DDT and its degradation products, DDE and DDD.

Increased flow into the bypass at the Fremont Weir could mobilize sediment and associated pesticides and PCB and deliver them to the Delta. Such occurrence would likely be temporary as the current inventory of pesticides in bypass sediments equilibrates with input from increased inflow from the Sacramento River. Moreover, the gradient in the bypass is shallow which discourages mass sediment mobilization under non-flood conditions. As indicated above, impacts would be noticeable during non-flood conditions.

Current-use pesticides tend to be more mobile and less stable in the environment. The load of these pesticides entering the bypass at the Fremont Weir and the amount of these same chemicals in the outflow to the Sacramento River will decrease by dilution and degradation. However, some pesticides may be mobilized in agricultural fields where their use continues and which will be inundated more often under Project considerations. Currently, a program to reduce pesticide residues by leaving fields dry and fallow for a time sufficient for pesticide degradation is being implemented.

Increased salinity in water in the bypass could adversely affect productivity of agricultural crops and upset aquatic fresh water communities. Increased flow from the Sacramento River would not cause a general increase in salinity above what is seen under existing conditions, where flows enter the Yolo Bypass from the same sources. As discussed in Section 6.1.3.1.3, while monitoring has shown high salinity in western tributaries inputs, salinity at the furthest downstream sample site in the bypass is lower than all contributing sites except for floodwaters. One data point from the Sacramento River above the Fremont Weir was 482 uS/cm, well within the range of typical drinking water (DWR, 2017).

CEQA Conclusion

Additional Project-related flow through the bypass may result in a **significant** impact because increased shallow inundation could increase MeHg production in bypass sediments, resulting in greater uptake of MeHg into both fish tissue and increased loading of MeHg in outflow from the bypass. Alternative 1 would not likely increase pesticides or salts within the Yolo Bypass or downstream.

Mitigation Measure MM-WQ-4: Develop a water quality mitigation and monitoring program.

The Lead Agencies shall develop and implement a program to reduce, minimize, or eliminate increases in water quality constituents.

The program shall include development of a monitoring plan, including frequent sampling and reporting, particularly for existing constituents of concern. The Lead Agencies shall coordinate with the implementation of the current TMDLs to share monitoring information and contribute to the efforts to reduce constituents of concern within the Yolo Bypass. If monitoring levels are found to be above water quality objectives, Lead Agencies will consider means to reduce discharges throughout the bypass region.

Implementation of the water quality mitigation and monitoring program included in MM-WQ-4 would reduce any impact of the Project. However, sources of Hg, such as Cache and Putah Creeks, continue to release Hg to the bypass, which can be anticipated to sustain production of MeHg in bypass sediments. Therefore, this impact would be **significant and unavoidable.**

6.3.3.3 Alternative 2: Central Gated Notch

Alternative 2, Central Gated Notch, would provide a similar new gated notch through Fremont Weir as described for Alternative 1. The primary difference between Alternatives 1 and 2 is the location of the notch; Alternative 2 would site the notch near the center of Fremont Weir. This gate would be a similar size but would have an invert elevation that is higher (14.8 feet) because the river is higher at this upstream location, and the gate would allow up to 6,000 cfs through to provide open channel flow for adult fish passage. See Section 2.5 for more details on the alternative features.

Impacts under Alternative 2 would be identical to those discussed for Alternative 1.

6.3.3.4 Alternative 3: West Side Gated Notch

Alternative 3, West Side Gated Notch, would provide a similar new gated notch through Fremont Weir as described for Alternative 1. The primary difference between Alternatives 1 and 3 is the location of the notch; Alternative 3 would site the notch on the western side of Fremont Weir. This gate would be a similar size but would have an invert elevation that is higher (16.1 feet) because the river is higher at this upstream location. Alternative 3 would allow up to 6,000 cfs through the gated notch to provide open channel flow for adult fish passage. See Section 2.6 for more details on the alternative features.

Impacts under Alternative 3 would be substantively the same as impacts discussed for Alternative 1.

6.3.3.5 Alternative 4: West Side Gated Notch – Managed Flow

Alternative 4, West Side Gated Notch – Managed Flow, would have a smaller amount of flow entering the Yolo Bypass through the gated notch in Fremont Weir than some other alternatives, but it would incorporate water control structures to maintain inundation for longer periods of time within the northern portion of the Yolo Bypass. Alternative 4 would include the same gated notch and associated facilities as described for Alternative 3; however, it would be operated to limit the maximum inflow to 3,000 cfs. See Section 2.7 for more details on the alternative features.

6.3.3.5.1 Impact WQ-1: Construction- or maintenance-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water

Similar to Alternative 1, Alternative 4 includes excavation activities that could lead to potential contamination of the area waterbodies as well as the riverbanks and bed soils from leakage or accidental spills of petroleum products and other pollutants during construction. Alternative 4 also includes construction of two water control structures on Tule Canal, fish passage and bypass channels, and improvements to Agricultural Road Crossing 1 and the downstream channel. Maintenance activities would include sediment removal every five years within the Fremont Weir Wildlife Area using construction equipment and removing it from the bypass; these actions have the potential to affect water quality in the Yolo Bypass in the same way as the construction at the beginning of the project. Construction and maintenance activities would not include dredging in the Sacramento River or Tule Canal. These activities could result in moderate ground disturbance within the area of analysis, contributing to downstream sedimentation and resulting in increased turbidity.

CEQA Conclusion

Construction and maintenance activities could result in moderate ground disturbance within the area of analysis, contributing to downstream sedimentation and resulting in increased turbidity. Although these impacts would be temporary, they could be **significant**.

Implementation of the HMMP, SPCCP, SWPPP, construction BMPs, and turbidity monitoring plan included in MM-HAZ-1 as well as MM-WQ-1 through MM-WQ-3, respectively, would ensure that all water quality risks would be minimized.

The impact would be reduced to **less than significant** due to the implementation of MM-HAZ-1 and MM-WQ-1 through MM-WQ-3.

6.3.3.5.2 Impact WQ-2: Operation-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water

Alternative 4 would have a smaller amount of flow entering the Yolo Bypass through the gated notch in Fremont Weir than some other alternatives, but it would uniquely incorporate water control structures to maintain inundation for longer periods of time while allowing a maximum flow of 3,000 cfs.

This longer inundation time and reduction in flow, as compared to Alternatives 1, 2, and 3, would result in additional sedimentation when faster moving water from upstream meets slower moving water within the Yolo Bypass. Alternative 4 would increase sediment entering the bypass to an estimated 701,000 cubic yards on an average annual basis. The increased sedimentation could deposit additional pollutants into the bypass.

The longer timeframe for inundation would also give additional time for the waters of the Sacramento River to mix with waters from Cache and Putah Creeks. This mixing could sequentially add additional mercury from the creeks to the outflow into the Sacramento River, although such effect may be diminished by sedimentation of TSS in creek water. Mixing might also reduce overall Hg concentrations in the water column and result in less Hg per unit area after sediment-bound Hg is deposited in the bypass. The longer inundation time combined with a larger cyclical inundated area also would likely increase the in-situ production of MeHg in the Yolo Bypass. Greater MeHg production could result in increased uptake of MeHg into fish tissue and result in non-lethal toxicity to juvenile salmon. This result is predicated on increased *concentrations* of MeHg rather than an overall increase in MeHg production. The latter could occur without increasing concentrations, for example, if the rate of MeHg remained steady, but the area over which this production occurred increased. Habitat suitability for juvenile salmon would also at least partially determine if and how much increasing the area of inundation would affect uptake into the food web. Any lack of correspondence between where MeHg is produced and where fish prefer to feed may affect bioaccumulation.

CEQA Conclusion

Because increased inundation time and reduced flows could sequentially add additional mercury from the creeks to the outflow into the Sacramento River and because the longer inundation time would likely increase the in-situ production of MeHg in the Yolo Bypass, impacts to water quality could be **significant** under Alternative 4. This judgment applies to water quality, but not necessarily to impacts on juvenile salmon or aquatic communities in the Delta and bays. As included in the impact discussion for Alternative 1, data are insufficient to determine if and by how much fish tissue concentrations may be affected.

Implementation of the water quality mitigation and monitoring program included in MM-WQ-4 would reduce the level of significance. However, mitigation would not be likely to lessen the effects of increased inundation, and any impact would be **significant and unavoidable.**

6.3.3.6 Alternative 5: Central Multiple Gated Notches

Alternative 5, Central Multiple Gated Notches, would increase the number of outmigrating juvenile fish that enter the Yolo Bypass by using multiple gates and intake channels to allow more flow to enter the bypass when the river is at lower elevations. Flows would move to other gates when the river is higher to control inflows. Alternative 5 incorporates multiple gated notches in the central location on the existing Fremont Weir that would allow combined flows of up to 3,400 cfs. See Section 2.8 for more details on the alternative features.

6.3.3.6.1 Impact WQ-1: Construction- or maintenance-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water

Similar to Alternative 1, Alternative 5 includes excavation activities that could lead to potential contamination of the area waterbodies as well as the riverbanks and bed soils from leakage or accidental spills of petroleum products and other pollutants during construction. Alternative 5 includes construction of multiple gates at Fremont Weir, with four sets of gates rather than one set in Alternative 1. While Alternative 5 has additional structures that would be constructed, the types of impacts from construction would be the same as discussed for Alternative 1. Maintenance activities would include sediment removal every five years within the Fremont Weir Wildlife Area using construction equipment and removing it from the bypass; these actions have the potential to affect water quality in the Yolo Bypass in the same way as the construction at the beginning of the project. Construction and maintenance activities would not include dredging in the Sacramento River or Tule Canal. These activities could result in moderate ground disturbance within the area of analysis, contributing to downstream sedimentation and resulting in increased turbidity.

CEQA Conclusion

Construction and maintenance activities could result in moderate ground disturbance within the area of analysis, contributing to downstream sedimentation and resulting in increased turbidity. Although these impacts would be temporary, they could be **significant**.

Implementation of the HMMP, SPCCP, SWPPP, construction BMPs, and turbidity monitoring plan included in MM-HAZ-1 and MM-WQ-1 through MM-WQ-3, respectively, would ensure that all water quality risks would be minimized.

The impact would be reduced to **less than significant** due to the implementation of MM-HAZ-1 and MM-WQ-1 through MM-WQ-3.

6.3.3.6.2 Impact WQ-2: Operation-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water

Possible impacts for Alternative 5 would be similar to impacts for Alternative 4, Maximum flows over the Fremont Weir would be somewhat greater than flows for Alternative 4 (3400 cfs versus 3000 cfs), but smaller than maximum flow entering the Yolo Bypass under Alternatives 1, 2, and 3. Alternative 5 would increase sediment entering the bypass to an estimated 701,000 cubic yards on an average annual basis. The increased sedimentation could deposit additional pollutants into the bypass. The longer inundation time could increase the in-situ production of MeHg in the Yolo Bypass and subsequently increase the accumulation in the food web and subsequent export of MeHg to the Delta.

CEQA Conclusion

Because the longer inundation time could increase the in-situ production of MeHg in the Yolo Bypass under Alternative 5, this impact could be **significant**.

Implementation of the water quality mitigation and monitoring program included in MM-WQ-4 would reduce the level of significance. However, mitigation would not be likely to lessen the effects of additional inundation of the bypass, and this impact would be **significant and unavoidable.**

6.3.3.6.3 Tule Canal Floodplain Improvements (Program Level)

As described in Section 2.8.1.7, Alternative 5 would include floodplain improvements along Tule Canal, just north of Interstate 80. These improvements would not be constructed at the same time as the remaining facilities. They are included at a program level of detail to consider all of the potential impacts and benefits of Alternative 5. Subsequent consideration of environmental impacts would be necessary before construction could begin.

Impact WQ-1: Construction-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water

Construction activities associated with development of a series of secondary channels to branch off from Tule Canal include excavation, which could lead to potential contamination of the area waterbodies as well as the riverbanks and bed soils from leakage or accidental spills of petroleum products and other pollutants during construction. In addition to construction of channels A, B, and C, these improvements also include construction of a fish bypass channel. These activities could result in moderate ground disturbance within the area of analysis, contributing to downstream sedimentation and resulting in increased turbidity.

CEQA Conclusion

These impacts would only occur during construction but could be **significant** because construction could increase downstream sedimentation and turbidity.

Implementation of the HMMP, SPCCP, SWPPP, construction BMPs, and turbidity monitoring plan included in MM-HAZ-1 and MM-WQ-1 through MM-WQ-3, respectively, would ensure that all water quality risks would be minimized.

The impact would be reduced to **less than significant** due to the implementation of MM-HAZ-1 and MM-WQ-1 through MM-WQ-3.

Impact WQ-2: Operation-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water

Operation of secondary channels would increase inundation of the surrounding areas, which are managed as wetland habitat for waterfowl under existing conditions. Since the area currently experiences inundation as well as wetting and drying periods, increased inundation from the Tule Canal is not expected to cause substantive changes in water quality.

CEQA Conclusion

This impact would be **less than significant** under Alternative 5 because the surrounding areas experience inundation due to operation as managed wetland habitat. The increased inundation from the Tule Canal is not expected to cause substantive changes in water quality.

6.3.3.7 Alternative 6: West Side Large Gated Notch

Alternative 6, Large Gated Notch, is a large notch in the western location that would allow flows up to 12,000 cfs. It was designed with the goal of entraining more fish by allowing more flow into the bypass when the Sacramento River is at lower elevations. See Section 2.9 for more details on the alternative features.

6.3.3.7.1 Impact WQ-1: Construction- or maintenance-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water

Similar to Alternative 1, Alternative 6 includes excavation activities that could lead to potential contamination of the area waterbodies as well as the riverbanks and bed soils from leakage or accidental spills of petroleum products and other pollutants during construction. Alternative 6 includes construction of a larger gated notch and associated channels than included in Alternative 1. While Alternative 6 has additional construction activities, the types of impacts from construction would be the same as discussed for Alternative 1. Maintenance activities would include sediment removal every five years within the Fremont Weir Wildlife Area using construction equipment and removing it from the bypass; these actions have the potential to affect water quality in the Yolo Bypass in the same way as the construction at the beginning of the project. Construction and maintenance activities would not include dredging in the Sacramento River or Tule Canal. These activities could result in moderate ground disturbance within the area of analysis, contributing to downstream sedimentation and resulting in increased turbidity.

CEQA Conclusion

Under Alternative 6, construction and maintenance activities could result in moderate ground disturbance within the area of analysis, contributing to downstream sedimentation and resulting in increased turbidity. These impacts would be temporary but could be **significant**.

Implementation of the HMBP, SPCCP, SWPPP, construction BMPs, and turbidity monitoring plan included in MM-HAZ-1 and MM-WQ-1 through MM-WQ-3, respectively, would ensure that all water quality risks would be minimized.

The impact would be reduced to **less than significant** due to the implementation of MM-HAZ-1 and MM-WQ-1 through MM-WQ-3.

6.3.3.7.2 Impact WQ-2: Operation-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water

Alternative 6 would increase the rate or speed at which flooding of the bypass would occur and potentially increase the area of inundation. Alternative 6 would also increase sediment entering the bypass to an estimated 827,000 cubic yards on an average annual basis. This increase in sediment entering the bypass would in turn increase the amount of constituents of concern, including mercury, entering the bypass and potentially increase turbidity. The increase in continuous flow through the bypass would continue to move these pollutants downstream, thus, increasing pollution in the outflow to the Sacramento River.

CEQA Conclusion:

This impact would be **significant** under Alternative 6 because the potential increase in the rate and area of inundation would increase the amount of sediment and constituents of concern entering the bypass and potentially moving downstream into the Sacramento River.

Implementation of the water quality mitigation and monitoring program included in MM-WQ-4 would reduce the level of significance. However, mitigation would not be likely to lessen the effects of additional inundation of the bypass, and this impact would be **significant and unavoidable.**

6.3.4 Summary of Impacts

Table 6-6 below provides a summary of the identified impacts to water quality within the Area of Analysis.

Table 6-6. Summary of Impacts and Mitigation Measures – Water Quality

Impact	Alternative	Level of Significance before Mitigation	Mitigation Measures	Level of Significance after Mitigation
Impact WQ-1: Construction- or maintenance-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water	No Action	NI	---	---
	All Action Alternatives	S	MM-HAZ-1 MM-WQ-1 MM-WQ-2 MM-WQ-3	LTS
Impact WQ-2: Operation-related degradation of surface water quality such that it would exceed regulatory standards or would substantially impair beneficial uses of surface water	No Action	NI	---	---
	1, 2, 3, 4, 5 (Project), 6	S	MM-WQ-4	SU
	5 (Program)	LTS	---	LTS

Key:
LTS = less than significant
NI = no impact
S = significant
SU = significant and unavoidable

6.4 Cumulative Impacts Analysis

This section describes the cumulative effects analysis for Water Quality. Section 3.3, *Cumulative Impacts*, presents an overview of the cumulative effects analysis, including the methodology and the projects, plans, and programs considered in the cumulative effects analysis.

6.4.1 Methodology

This evaluation of cumulative effects considers the effects of the Project and how they may combine with the effects of other past, present, and future projects or actions to create significant impacts on water quality. The area of analysis for these cumulative effects includes both the Yolo Bypass and the larger Sacramento River system. The timeframe for this cumulative analysis includes the past, present, and probable future projects producing related or cumulative impacts that have been identified around analysis.

Several projects are specifically designed to improve conditions for anadromous salmonids in the Sacramento River system, including the Yolo Bypass and may have long-term beneficial impacts. For example, the Fremont Weir Adult Fish Passage Modification Project is intended to improve upstream passage for adult salmonids and for sturgeon. Construction associated with some of these same projects could also have short-term detrimental impacts. In other cases, projects focused on flood control and/or drinking water supply could have both short-term, construction related and long-term negative impacts (e.g., Central Valley Flood Protection Plan).

Impacts of past, ongoing and planned projects are difficult to determine, for both short- and long-term time frames. A great deal of effort has been and continues to be spent to improve water quality, habitat, contamination, and migration for anadromous salmonids and other fish and wildlife in the Sacramento River watershed. It seems reasonable to anticipate beneficial impacts, at least in the long-term as projects are completed and their effects realized.

In the short-term, it is possible that construction/implementation of other projects could cause temporary cumulative impacts. Long-term impacts could be associated with projects not focused on restoring/improving fisheries.

This cumulative effects analysis utilizes the project analysis approach described in detail in Section 3.3, *Cumulative Impacts*. Several related and reasonably foreseeable projects and actions may result in water quality impacts in the Project area, in particular, levee removal and relocation, other construction-related activities and operational/management changes associated with flood control and drinking water supply:

- Agricultural Road Crossing #4 Fish Passage Improvement Project
- Battle Creek Salmon and Steelhead Restoration Project
- California EcoRestore projects
- California WaterFix
- Central Valley Flood Protection Plan
- Delta Wetlands Project
- EchoWater Project
- Folsom Dam Water Control Manual Update
- Fremont Weir Adult Fish Passage Modification Project
- Lisbon Weir Modification Project
- Lower Cache Creek Flood Risk Management Feasibility Study and the Woodland Flood Risk Reduction Project
- Lower Elkhorn Basin Levee Setback Project
- Lower Putah Creek 2 North America Wetlands Conservation Act Project
- Lower Putah Creek Realignment Project
- Lower Yolo Restoration Project
- North Bay Aqueduct Alternative Intake Project
- North Delta Flood Control and Ecosystem Restoration Project
- North Delta Fish Conservation Bank
- Sacramento River Bank Protection Project

- Sacramento River General Reevaluation Report
- Sacramento-San Joaquin Deltas Estuary Total Maximum Daily Load (TMDL) for Methylmercury
- Shasta Lake Water Resources Investigation
- Sites Reservoir Project
- Upstream Sacramento River Fisheries Projects
- Wallace Weir Fish Rescue Facility Project
- Yolo Habitat Conservation Plan/Natural Communities Conservation Plan
- Yolo Regional Conservation Investment Strategy/Local Conservation Plan.
- Yuba River Development Project Relicensing

These projects may result in additional construction equipment in the area of analysis, possibly introducing additional sedimentation and construction-related contaminants to the river and the Delta. These programs would be expected to utilize proper mitigation measures to prevent contamination and increases in turbidity and would likely coordinate proposed actions within this Project to avoid significant cumulative impacts.

These projects may also be beneficial in improving habitat in the Bypass and Delta and decreasing Hg load from Cache and Putah Creeks.

6.4.2 Cumulative Impacts

Cumulative effects with respect to changes in water quality standards could be associated with the California WaterFix, including evaluation and potential establishment of water quality criteria and flow objectives that protect beneficial uses on tributaries to the Sacramento River under Phase IV. Additionally, the Staff Report for the Delta Mercury Control Program (Central Valley RWQCB 2010c) proposes a number of changes to water management and storage in and upstream of the Delta. Changes to salinity objectives, dredging and dredge materials disposal and reuse, and changes to flood conveyance flows would be subject to the open water MeHg allocations. As a result, MeHg reductions are likely to comply with allocations by 2030.

The Lower Yolo Restoration Project, aimed at restoring tidal flux to 1,100 acres of existing pasture land, would be expected to have water quality impacts similar to the Project. This may increase the load of contaminants of concern, including MeHg loads to the Sacramento River.

While the projects that involve construction would be expected to have significant short-term impacts on the area of analysis, it is expected that these potential impacts would be mitigated to a less than significant level. Additionally, changes in water quality standards that could result from implementation of several projects in the cumulative analysis would be expected to improve water quality within the area of analysis. However, impacts associated with MeHg in the Yolo Bypass may continue to be cumulatively significant, and the increased inundation from the Project **could be cumulatively considerable.**

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7 Groundwater

This section presents the existing conditions of groundwater resources within the Project area and discusses potential effects of the Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project (Project) alternatives on groundwater levels, land subsidence, and groundwater quality.

7.1 Environmental Setting/Affected Environment

The alternatives described in this document include actions in the Yolo Bypass, which is in California's Central Valley, in an area north of the Sacramento-San Joaquin Delta (Delta). The project and primary potential impacts to groundwater resources occur in this "North of Delta" region, but the project could also cause indirect impacts for an area south of the Delta. The North of Delta and South of Delta areas are described in this Environmental Setting/Affected Environment section in a level of detail commensurate with the potential impacts in these areas.

7.1.1 North of Delta Area

The Project area is located within the Sacramento Valley Groundwater Basin. The Sacramento Valley Groundwater Basin is bordered by the Red Bluff Arch to the north, the Coast Range to the west, the Sierra Nevada to the east, and the San Joaquin Valley to the south. The California Department of Water Resources (DWR) Bulletin 118 further divides the Sacramento Valley Groundwater Basin into subbasins (DWR 2003, 2016f). The Project area for groundwater resources is limited to the area around the Yolo Bypass and includes portions of the Colusa, Yolo, and Sutter subbasins, as defined in Bulletin 118 and shown in Figure 7-1. Although the southern portion of the Yolo Bypass is in the Solano subbasin, this subbasin was not included in this analysis as it is well away from the portion of the bypass where modifications are proposed. Requests were made to adjust the boundaries of the Colusa subbasin as part of the Sustainable Groundwater Management Act (SGMA). These modifications, finalized and adopted on October 21, 2016, included portions of the southern Colusa subbasin and the northeastern portion of the original Yolo subbasin that are in Yolo County. These areas were consolidated into the Yolo subbasin for jurisdictional reasons. DWR evaluated local agency requests for basin boundary modifications and finalized approved modifications in Bulletin 118 (DWR 2016f).

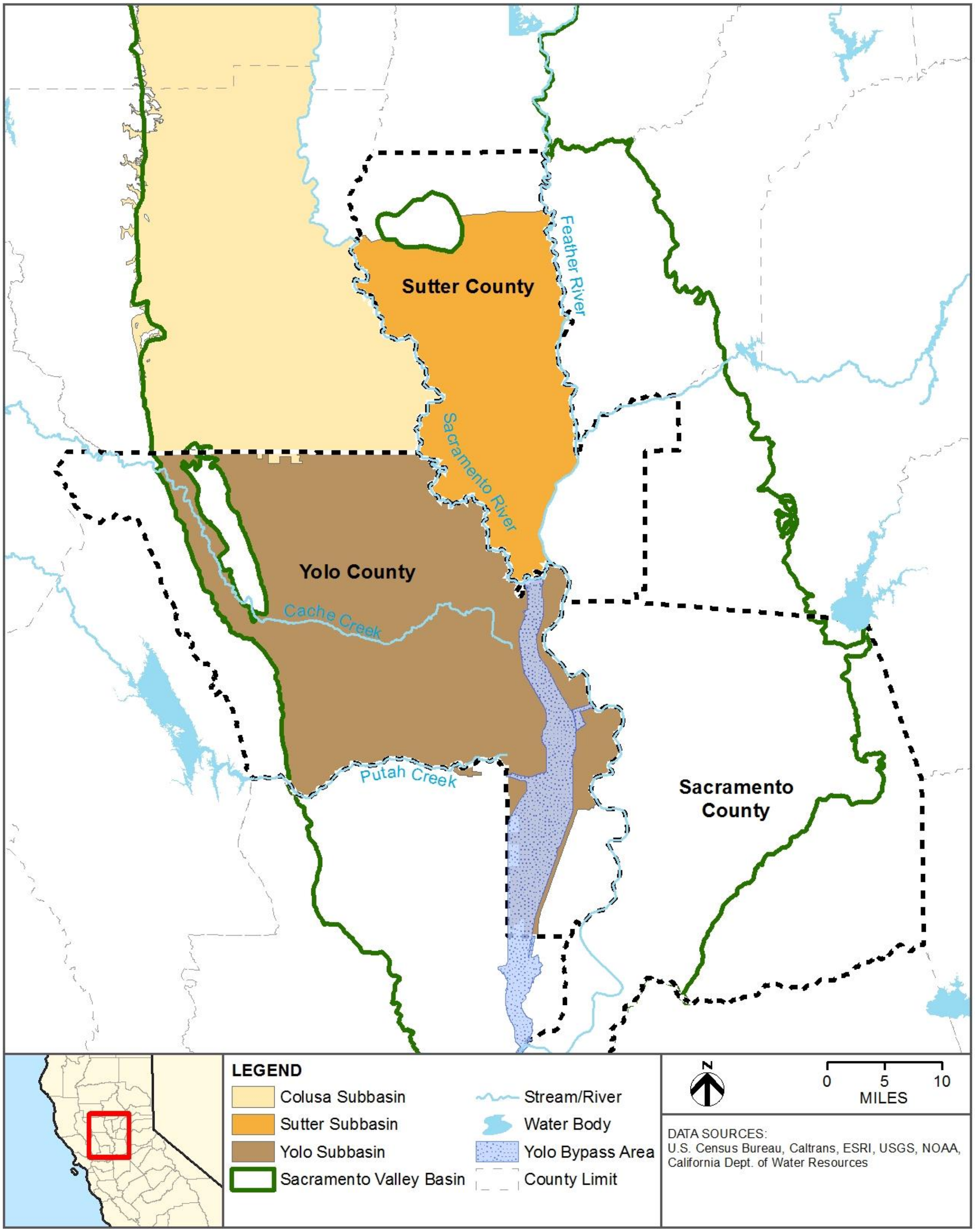


Figure 7-1. Project Area for Groundwater Resources

Table 7-1 summarizes the DWR groundwater basin prioritization ranking pursuant to SGMA and the proposed Groundwater Sustainability Agencies (GSAs) for each groundwater subbasin. Groundwater basins with high and medium priority are subject to regulations and accelerated timelines to which low priority basins are not subject.

Table 7-1. Groundwater Basin Prioritization Ranking and GSAs within the Project Area

Subbasin	DWR Groundwater Basin Prioritization Ranking	Proposed GSA (as of July 10, 2017)
Colusa	Medium	Two local agencies have submitted GSA formation notices for the majority of the Colusa subbasin that falls within the Sacramento River Groundwater Basin.
Yolo	High	Two local agencies have submitted GSA formation notices for the majority of the Yolo Basin that falls within the Sacramento River Groundwater subbasin.
Sutter	Medium	Seven local agencies have submitted GSA formation notices for the majority of the Sutter subbasin that falls within the Sacramento River Groundwater Basin.

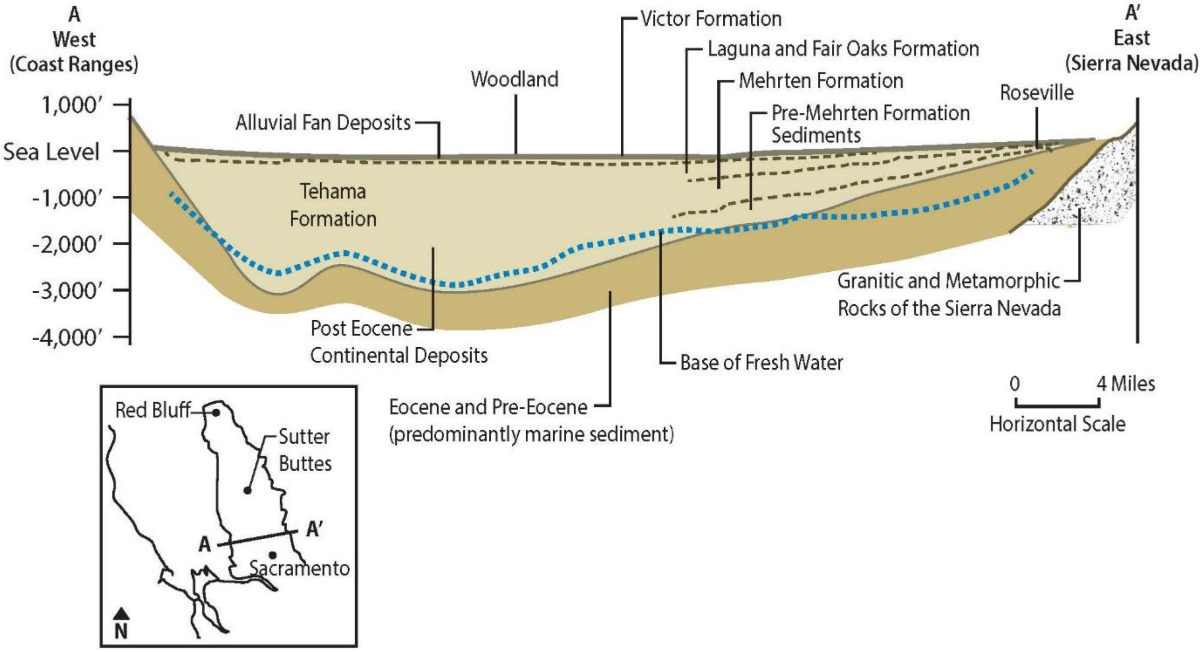
Source: DWR 2017

Key: DWR = California Department of Water Resources, GSA = Groundwater Sustainability Agency

7.1.1.1 Geology, Hydrogeology, and Hydrology

The Sacramento Valley Groundwater Basin is a north-northwest trending asymmetrical trough filled with both marine and continental rocks and sediment. On the eastern side, the basin overlies basement rock that rises relatively gently to the Sierra Nevada while on the western side the underlying basement rock rises more steeply to form the Coast Range. Overlying the basement rock are marine sandstone, shale, and conglomerate rocks, which generally contain brackish or saline water (DWR 1978). The freshwater-bearing formation in the valley comprises sedimentary and volcanic rocks that can absorb, transmit, and yield fresh water. The depth below ground surface (bgs) to the base of freshwater is approximately 1,600 feet in the southern portion of the Sacramento Valley (DWR 1978) but is shallower toward the edges of the valley.

The western portion of the Sacramento Valley Groundwater Basin, near the Project area (including the Colusa and Yolo subbasins), is predominantly underlain by the Tehama Formation (Figure 7-2). The Tehama Formation is derived from Coast Range sediments. The formation is composed of moderately compacted silt, clay, and fine silty sand that occurs between lenses of sand and gravel, silt and gravel, and cemented conglomerate (DWR 2003). The Tehama Formation ranges in thickness from 1,500 to 2,500 feet. DWR describes the Tehama Formation as a “moderately productive, deep, water-bearing zone” (DWR 2003). The other major formations in this area of the Sacramento Valley Groundwater Basin include the Mehrten and Laguna formations. The Mehrten and Laguna formations are primarily composed of heterogeneous gravel and sand layers.



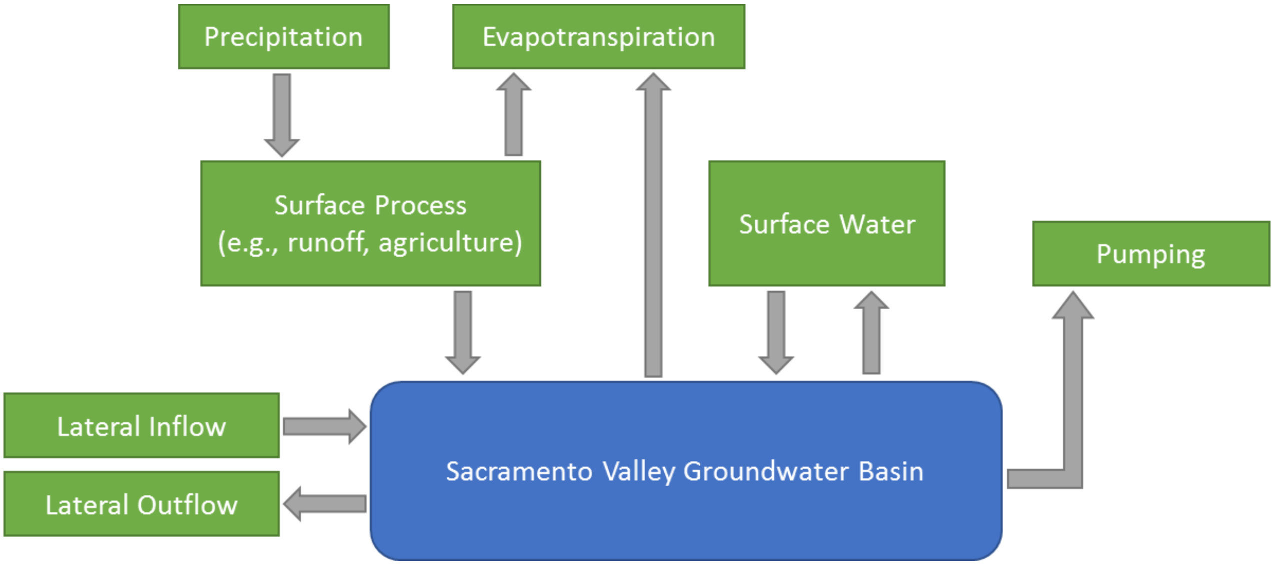
Source: DWR 1978

Figure 7-2. Geologic Cross-Section of the Sacramento Valley Groundwater Basin

These formations are typically overlain by both older and younger alluvial deposits. The younger alluvium primarily consists of silts and clays but can include channel deposits. The younger alluvial deposits can range from zero to 150 feet thick (DWR 2003). The older alluvium can range from 60 to 130 feet thick and consists of moderately compacted silt, silty clay, sand, and gravel deposited in alluvial fans (DWR 2003). The younger alluvium can yield significant quantities of water where it is saturated while the yield from the older alluvium can vary between 50 and 4,000 gallons per minute, depending on the area (DWR 2003).

Freshwater (groundwater) is present primarily in the heterogeneous gravel and sand layers of the Laguna, Mehrten, and Tehama formations. Groundwater is also present in the shallower alluvial deposits.

Groundwater is recharged by percolation from rainfall infiltration, shallow groundwater connectivity with perennial and ephemeral streambeds, lateral inflow along the basin boundaries, and other surface processes such as irrigation and managed aquifer recharge (Figure 7-3). Groundwater discharges primarily include evapotranspiration, discharge to streams, pumping, or other surface features such as marshes.



Source: Adapted from Faunt 2009

Figure 7-3. Generalized Components of the Groundwater Budget

The surface water inflow and outflow arrows in Figure 7-3 are a description of the interaction between groundwater and surface water. These terms reference the movement of water from the perspective of the stream/river. In a "losing" stream condition, the water elevation in the stream is higher than the groundwater elevation under and adjacent to the stream. In this condition, water flows through the riverbed, out of the stream, and into the groundwater system (i.e., the water is "lost" from the surface water). In a "gaining" system, the water elevation in the surface water is lower than the adjacent groundwater elevation. Under this condition, water flows from the groundwater into the surface water system (i.e., the water is "gained" by stream).

Depending on groundwater and stream levels, portions of the same stream system may be gaining while other portions are losing. The gaining/losing condition can also change at different times of the year based on changes in the groundwater level, the surface water level, or both. When the Yolo Bypass is in flood operations, the water levels in the Sacramento River and the bypass are higher than the groundwater level under and adjacent to the bypass, contributing to a "losing" condition. Under a "losing" condition, the water that exits the surface water (i.e., river, bypass) will recharge the shallow groundwater system, potentially resulting in an increase in groundwater levels. Under the reverse condition, a "gaining" condition, the groundwater level may be reduced, or at least not increase as much, as water drains from the shallow groundwater to the surface water feature.

7.1.1.2 Groundwater Production, Levels, and Storage

Bulletin 118 states that an estimated 310,000 acre-feet (AF) of groundwater is pumped for agricultural purposes in the Colusa subbasin. Municipal and industrial and environmental/ wetland pumping is estimated to be 14,000 and 22,000 AF, respectively (DWR 2003). In the Sutter subbasin, DWR estimates pumping for agricultural uses to be 171,400 AF and urban use to be 3,900 AF (DWR 2003). DWR does not provide a groundwater pumping estimate for the Yolo subbasin in Bulletin 118.

The California Water Plan (CWP) provides groundwater well and production information on a county basis. Yolo County, the county where most of the Project area is located, has 1,355 domestic, 828 irrigation, 89 public supply, and 42 industrial production wells as of July 2012 (DWR 2013). The CWP also provides estimates of groundwater use in the region. This use is provided by units called "Planning Areas". The Project area is located within three different Planning Areas —Colusa Basin, Central Basin West, and Sacramento-San Joaquin Delta. The area of the Yolo Bypass is much smaller than these areas however. The CWP estimates that 522,000 AF of groundwater is used as supply in the Colusa Basin, equating to approximately 25 percent of the supply (DWR 2013). Groundwater is estimated to be 520,000 AF in the Central Basin West (58 percent of supply) and 24,000 AF (4 percent) in the Sacramento-San Joaquin Delta Planning Area (DWR 2013). The CWP estimates that groundwater comprises approximately 30 percent of all the water used in the Sacramento River hydrologic region (totaling approximately 2,700,000 AF) (DWR 2013).

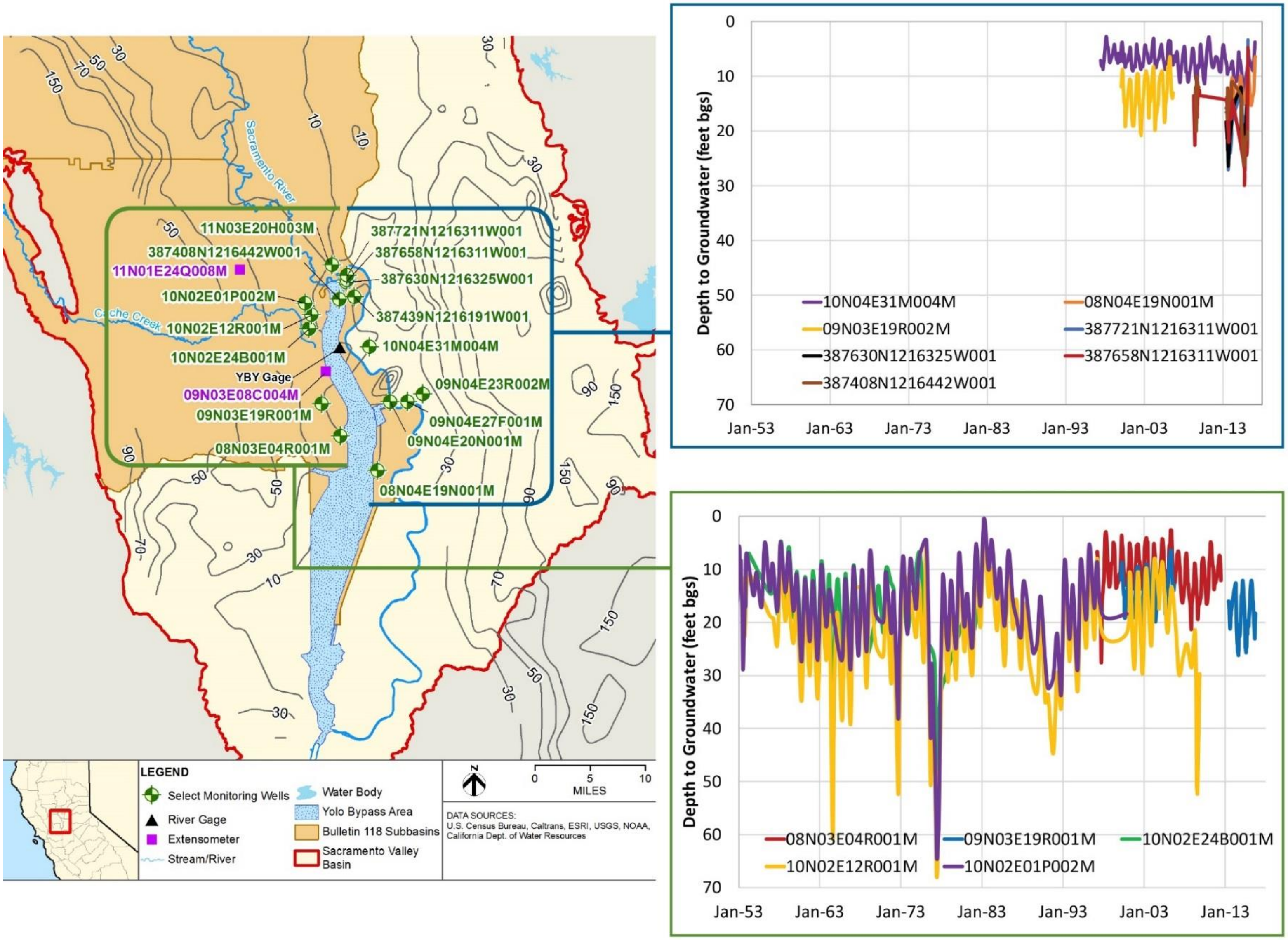
The estimated recharge to the Colusa subbasin due to deep percolation of applied water is 64,000 AF (DWR 2003). In the Sutter subbasin, DWR estimates natural recharge to be 40,000 AF and applied water recharge to be 22,100 AF.

DWR and other monitoring entities monitor groundwater levels in the subbasins. The total depth of monitoring wells ranges from 18 to 1,380 feet bgs within the Yolo, Colusa, and Sutter subbasins (DWR 2003).

Figure 7-4 shows the spring 2016 groundwater contours in the Yolo, Colusa, and Sutter subbasins and the available groundwater level hydrograph data at select monitoring wells within three miles of the Project area since the 1950s. Groundwater levels around the Yolo Bypass are typically shallow and range from as low as five to 70 feet bgs. Groundwater levels typically vary annually, with higher (shallower) levels at the end of the winter and lower (deeper) levels at the end of the summer. The annual fluctuations in water level are typically due to groundwater pumping in the area. The hydrographs in Figure 7-4 also show that the overall groundwater levels vary with wet and dry hydrologic conditions. When flow is present in the Yolo Bypass, additional groundwater recharge likely occurs, which could increase the groundwater elevations under and near the bypass. Groundwater levels along the eastern side of the bypass (between the bypass and the Sacramento River, in the Elkhorn area) vary from 10 to 30 feet bgs. Groundwater levels along the western side of the bypass near Interstate (I) 80 vary from three to 26 feet bgs under existing conditions.

7.1.1.3 Groundwater-Related Land Subsidence

Groundwater-related land subsidence, which is typically not reversible, occurs when groundwater extraction causes groundwater levels to fall below the historic levels. The reduction in water level causes the loss of pore pressure within the soil matrix. This loss in pore pressure can result in collapse (i.e., consolidation, compaction) of soils that may be susceptible to subsidence. Clays are typically the soils most susceptible to subsidence.



Source: DWR 2016c

Figure 7-4. Spring 2016 Groundwater Contours in the Colusa, Yolo, and Sutter Subbasins (depth to water below ground surface)

Historically, land subsidence occurred in the eastern portion of Yolo County and the southern portion of Colusa County because of extensive groundwater pumping in areas that have soils susceptible to subsidence (DWR 2014b). The earliest land subsidence studies in the Sacramento Valley occurred in the early 1970s when the United States Geological Survey (USGS), in cooperation with DWR, measured elevation changes along various survey lines.

DWR has prioritized the Colusa and Yolo subbasins as having a high potential for subsidence (DWR 2014b). Figure 7-4 shows the locations of two active DWR extensometers in Yolo County (09N03E08C004M and 11N01E24Q008M). As shown in Figure 7-5, these two extensometers have shown measurable subsidence. Extensometer 09N03E08C004M is near the Yolo Bypass and has recorded approximately 0.9 foot of subsidence from 1991 to the present (DWR 2016d). Extensometer 11N01E24Q008M, near the Yolo-Zamora area, has recorded approximately 1.1 feet of subsidence from 1992 to 2016 (DWR 2016d). DWR also measures subsidence trends from 319 continuous global positional system (CGPS) stations across the Central Valley. CGPS station Woodland_CN2004, located in the City of Woodland, has recorded approximately 0.05 feet of subsidence since 2004 (DWR 2016e).

As much as four feet of land subsidence has been measured east of Zamora over the last several decades. The area between Zamora, the Knights Landing Ridge Cut, and Woodland has been most affected (Yolo County 2009). This area is near extensometer 11N01E24Q008M (Figure 7-4).

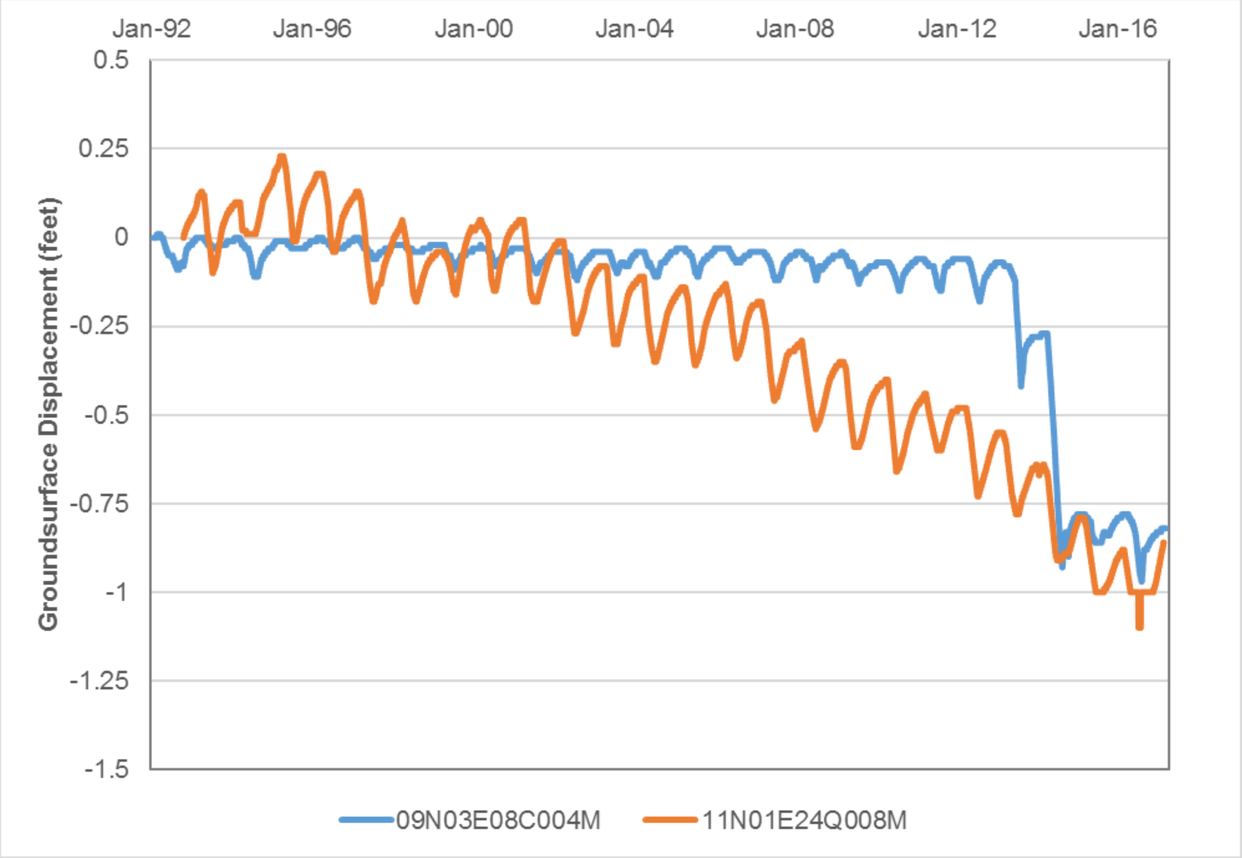


Figure 7-5. Land Subsidence Recorded at Active Extensometers in the Project area

7.1.1.4 Groundwater Quality

Groundwater quality in the Sacramento Valley Groundwater Basin is generally good and of sufficient quality for municipal, agricultural, domestic, and industrial uses. Groundwater quality in the Yolo, Colusa, and Sutter subbasins is generally hard and high in salt content. Groundwater in the Colusa and Yolo subbasins is characterized as the sodium magnesium, calcium magnesium, or magnesium bicarbonate type (DWR 2003).

The California Department of Public Health (CDPH) and United States Environmental Protection Agency's secondary drinking water standard for total dissolved solids (TDS) is 500 milligrams per liter (mg/L), and the agricultural water quality goal for TDS is 450 mg/L. TDS concentrations as high as 1,500 mg/L have been recorded in wells west of the Sacramento River in the Yolo subbasin, between Putah Creek and the confluence of the Sacramento and San Joaquin rivers (Bertoldi 1991). Groundwater in the Colusa subbasin has TDS concentrations that range from 120 to 1,200 mg/L (average 391 mg/L). In the Sutter subbasin, TDS concentrations range from 133 to 1,660 mg/L.

There are also some localized groundwater quality issues in all three subbasins. Localized areas of high electrical conductivity, TDS, adjusted sodium adsorption ratio, nitrate, and magnesium occur within the Project area. Based on the USGS's Groundwater Ambient Monitoring and Assessment (GAMA) program, most constituents that were detected in groundwater samples were found at concentrations below drinking water thresholds. GAMA detected volatile organic compounds (VOCs) in less than one-third and pesticides and pesticide degradates in just over one-half of the wells. These detections were below health-based thresholds. Additionally, the detections of trace elements in samples were below health-based thresholds, with the exceptions of arsenic and boron (USGS 2011a, 2011b).

Elevated levels of boron as high as two to four mg/L have been recorded along Cache Creek. Elevated selenium and nitrate concentrations have occurred in groundwater near the City of Davis (DWR 2003).

Groundwater that receives surface water recharge from streams has the potential to be of better quality. In general, rivers/streams that originate along the edges of the Central Valley have good water quality. As this water flows into the Central Valley basins, it has the potential to recharge the basins with groundwater basin good quality water.

7.1.2 South of Delta Area

The South of Delta area consists of several groundwater basins and subbasins that are in several hydrologic regions.

7.1.2.1 San Joaquin Valley Hydrologic Region

The predominant groundwater basin in the San Joaquin Valley hydrologic region is the San Joaquin Valley Groundwater Basin.

7.1.2.1.1 San Joaquin Valley Groundwater Basin

The San Joaquin Valley Groundwater Basin extends over the southern two-thirds of the Central Valley regional aquifer system and has an area of approximately 13,500 square miles. The San

Joaquin Valley Groundwater Basin extends from just north of Stockton in San Joaquin County to Kern County in the south.

The aquifer system in the San Joaquin Valley Groundwater Basin is mostly comprised of unconsolidated alluvial and lacustrine sediments, derived from parent materials of the Coast Ranges and the Sierra Nevada Mountains. The Valley fill reaches a thickness of about 28,000 feet in the southwestern corner (Page 1986). A significant hydrogeologic feature in the basin is the Corcoran Clay. This clay layer divides the aquifer system into two distinct zones—an upper unconfined to semi-confined aquifer and a lower confined aquifer.

Irrigated agriculture in the northern portion of the San Joaquin Valley Groundwater Basin increased from about one million acres in the 1920s to more than 2.2 million acres by the early 1980s (United States Department of the Interior, Bureau of Reclamation [Reclamation] 1997). Even with the increase in irrigated agriculture, the USGS estimates the cumulative change in groundwater storage for the entire San Joaquin Valley Groundwater Basin to be relatively constant from 1962 through 2003 (Faunt 2009). Groundwater storage typically drops during dry periods and increases during wetter years. Analyses by DWR, using their California Central Valley Simulation Model, showed storage within the San Joaquin Valley has been showing a steady decline since the 1940s. Annual average groundwater production in the basin is estimated to be 0.9 million AF in the CVHM model (Faunt 2009).

Land Subsidence

From the 1920s until the mid-1960s, the use of groundwater for irrigation of crops in the San Joaquin Valley increased rapidly, causing land subsidence throughout the west and southern portions of the valley. DWR has prioritized the western portion of the San Joaquin Valley (Tracy, Delta-Mendota, and Westside subbasins) as having a high potential for subsidence (DWR 2016c). Subsidence has also been observed recently along the San Joaquin River between Los Banos and Madera, with an estimated average subsidence rate of nearly 0.75 feet per year since 2012.

Groundwater Quality

Given the size of the San Joaquin Valley Groundwater Basin, groundwater quality can vary throughout the basin. For example, the western portion of the basin is characterized by mixed sulfates, bicarbonates, and chlorides in the water. There are also localized areas of high iron, fluoride, nitrate, and boron in the subbasin (DWR 2003).

7.1.2.2 San Francisco Bay Hydrologic Region

The predominant groundwater basins in the San Francisco Bay hydrologic region are the Santa Clara Valley and the Gilroy-Hollister Valley groundwater basins.

7.1.2.2.1 Santa Clara Valley Groundwater Basin

The Santa Clara subbasin is the primary portion of the Santa Clara Valley Groundwater Basin and occupies a structural trough parallel to the northwest trending Coast Ranges. The subbasin contains both confined and unconfined aquifer units (Santa Clara Valley Water District [SCVWD] 2001). Groundwater in the basin is managed by SCVWD using active recharge facilities and imposing limits on annual groundwater withdrawal. The operational storage capacity of the Santa Clara Valley subbasin is estimated to be 383,000 AF (SCVWD 2001 and SCVWD 2002 as cited in SCVWD 2012), accounting for available pumping capacity and the avoidance of land subsidence and problems associated with high groundwater levels.

Land Subsidence

Santa Clara County has experienced as much as 13 feet of historic subsidence caused by excessive pumping of groundwater. SCVWD currently manages its groundwater use to avoid subsidence and has established subsidence thresholds equal to the current acceptable rate of 0.01 feet per year (SCVWD 2012). DWR has categorized Santa Clara subbasin as having a low potential for future land subsidence (DWR 2016c).

Groundwater Quality

DWR has prioritized the Santa Clara Valley subbasin as medium priority based on groundwater quality concerns in some wells across the basin (DWR 2016c). Groundwater in the subbasin is suitable for most uses and meets drinking water standards at public supply wells without the use of treatment methods while being considered as “hard” water (SCVWD 2001).

7.1.2.2.2 Gilroy-Hollister Valley Groundwater Basin

The Llagas Area subbasin is a primary portion of the Gilroy-Hollister Groundwater Basin and occupies a northwest trending structural depression. The operational storage capacity of the Llagas Area subbasin is estimated to be between 150,000 and 165,000 AF, with annual average pumping in the subbasin of approximately 20,000 AF (SCVWD 2012).

Land Subsidence

SCVWD manages groundwater in the Llagas Area subbasin and has established subsidence thresholds equal to the current acceptable rate of 0.01 feet per year (SCVWD 2012). DWR has categorized Llagas Area subbasin as having a low potential for future land subsidence (DWR 2016c).

Groundwater Quality

DWR has prioritized the Llagas Area subbasin as high priority based on groundwater quality concerns over a significant number of wells across the subbasin (DWR 2016c). Groundwater is typically hard in the subbasin, but is suitable for most uses and meets drinking water standards at public supply wells without the use of treatment methods. The SCVWD created a Nitrate Management Program in October 1991 to investigate and remediate increasing nitrate concentrations in the subbasin (SCVWD 2001).

7.1.2.3 South Lahontan Hydrologic Region

The predominant groundwater basins in the South Lahontan hydrologic region are the Fremont Valley and the Antelope Valley groundwater basins.

The total storage capacity of these two groundwater basins is approximately 74,800 AF, with 70,000 of that total in the Antelope Valley (DWR 2003). Groundwater pumping was estimated to be between 130,000 and 150,000 AF (Antelope Valley 2013) and approximately 32,000 AF in the Fremont Valley (DWR 2003).

Land Subsidence

DWR has categorized theses basins as having a medium-to-high (Fremont Valley) or a high (Antelope Valley) potential for land subsidence (DWR 2016c). A monitoring station in California City (Fremont Valley) has recorded a little under 0.02 feet of subsidence since 2005. Stations in the Antelope valley have recorded 0.01 to 0.03 feet of recent subsidence (DWR 2016c).

Groundwater Quality

DWR has prioritized the Fremont Valley Groundwater Basin as a low priority basin with some groundwater quality concerns and the Antelope Valley basin as a high priority. The Fremont Valley basin has naturally high TDS. Hardness, high fluoride, boron, and nitrates are contaminants of potential concern in the Antelope Valley basin (DWR 2016c).

7.1.2.4 Colorado River Hydrologic Region

The Colorado River hydrologic region consists of the Ames Valley, Cooper Mountain Valley, Warren Valley, and Coachella Valley groundwater basins.

Groundwater storage in these basins is estimated to be 1,200,000 AF (Ames Valley), 106,000 AF (Warren Valley), and 38.7 million AF (Coachella Valley) (DWR 2003). The Warren Valley Groundwater Basin has been adjudicated since 1997 and is managed by Warren Valley Basin Watermaster.

Land Subsidence

DWR has categorized the Ames Valley, Cooper Mountain Valley, and Warren Valley basins as having low or low-to-medium potential for subsidence (DWR 2016c). The CGPS station north of Yucca Valley in Landers has not recoded any subsidence since installation in 1999 (DWR 2016c). Subsidence monitoring in the Ames and Warren valleys have not recorded any subsidence since they were installed in 1999 and 2000, respectively (DWR 2016c).

Groundwater Quality

There are areas of TDS, fluoride, nitrate, and chloride concentrations within these basins (DWR 2003).

7.1.2.5 South Coast Hydrologic Region

The South Coast hydrologic region consists of several groundwater basins where groundwater use and conditions vary.

7.1.2.5.1 Northwest Metropolitan Area Groundwater Basins

The Northwest Metropolitan Area Groundwater Basin and the subbasins that comprise it are generally east-west trending basins that drain into the Pacific Ocean to their west by the Santa Clara River, Calleguas Creek, and Conejo Creek. The total storage capacity is estimated to be between 3,000,000 to 5,000,00 AF (Metropolitan Water District of Southern California [(MWD] 2007). The natural and operational safe yields are estimated to be approximately 45,000 and 100,000 AF, respectively (MWD 2007). Groundwater pumping between 1995 to 2005 was estimated to be 122,000 AF per year.

Land Subsidence

The Oxnard Plain and Oxnard Forebay areas of the basin are categorized as having a medium to high potential for subsidence, with other areas as having a medium to low priority for subsidence (DWR 2016c). The five subsidence monitoring stations in the basin may show signs of subsidence. One station located in the coastal region recorded up to 0.13 feet of subsidence since 2000 (DWR 2016c).

Groundwater Quality

Water quality issues in the basin include seawater intrusion in the coastal aquifers and nitrate and sulfate concerns in the agricultural areas. TDS concentrations throughout much of the basin exceed 1,000 mg/L.

7.1.2.5.2 San Fernando Valley Groundwater Basin

The total storage capacity of the groundwater basin is estimated to be approximately 3,200,000 AF (MWD 2007). The natural and operational safe yields are estimated to be approximately 43,600 and 96,800 AF, respectively (MWD 2007). The San Fernando Valley groundwater basin has been adjudicated since 1979 (DWR 2016c).

Land Subsidence

DWR has prioritized the basin as having a low to medium potential for land subsidence (DWR 2016c). The three subsidence monitoring points in the basin have not recorded any subsidence since installation in 1999 (DWR 2016c).

Groundwater Quality

Bulletin 118 (DWR 2003) identified groundwater contamination of VOCs, such as trichloroethylene, perchloroethylene, petroleum compounds, chloroform, nitrate, sulfate, and heavy metals, in the basin.

7.1.2.5.3 San Gabriel Valley Groundwater Basin

The total groundwater storage capacity of the groundwater basin is estimated to be approximately 8,600,000 AF (MWD 2007). The natural safe yield is estimated to be approximately 152,700 AF (MWD 2007). The basin has been adjudicated since 1971 (DWR 2016c).

Land Subsidence

DWR has also categorized the basin to have a high potential for subsidence due to subsidence concerns in the adjacent subbasins (DWR 2016c). Two subsidence monitoring locations have shown indications of subsidence, with one location measuring up to 0.03 feet of subsidence since 2000 (DWR 2016c).

Groundwater Quality

DWR has prioritized the groundwater basin as high priority because of water quality concerns (DWR 2016c). Key constituents of concern in the basin include TDS, nitrate, VOCs, perchlorate, and N-Nitrosodimethylamine (MWD 2007).

7.1.2.5.4 Coastal Plain of Los Angeles Groundwater Basin

The total storage capacity of the groundwater basin is estimated to be approximately 13,800,000 AF (MWD 2007). The natural and operational safe yields are estimated to be approximately 125,800 AF and 217,300 AF, respectively (MWD 2007). DWR has prioritized the portions of this groundwater basin as either medium or high priority due to groundwater contamination and/or overdraft concerns. Two subbasins in this groundwater basin, the Central and West coast subbasins, have been adjudicated since 1965 and 1961, respectively (DWR 2016c).

Land Subsidence

Portions of this basin have been categorized as either low or medium-to-high potential for subsidence (DWR 2016c). Two monitoring stations in the Central subbasin have recorded up to 0.11 feet of subsidence since installation in 2000.

Groundwater Quality

Localized areas of poor water quality exist in the subbasin, including areas of VOC contamination. Portions of the shallower and deeper aquifers in the coastal region have been impacted by seawater intrusion.

7.1.2.5.5 Coastal Plain of Orange County Groundwater Basin

The total storage capacity of the groundwater basin is estimated to be approximately 66,000,000 AF, with a natural safe yield of 70,500,000 AF (MWD 2007).

Land Subsidence

DWR has categorized the basin as having a high potential for subsidence due to measured subsidence in the adjacent Coastal Plain of Los Angeles Groundwater Basin (DWR 2016c).

Groundwater Quality

Seawater intrusion along the coastal area has resulted in DWR prioritizing this groundwater basin as medium priority (DWR 2016c). The shallow aquifer has nitrate and VOC contamination issues. Colored groundwater concerns exist in the basin but are limited to the shallow aquifer near the coast (MWD 2007).

7.2 Regulatory Setting

The following section describes the applicable groundwater laws, rules, regulations, and policies.

7.2.1 Federal Plans, Policies, and Regulations

There are no applicable Federal regulations specific to groundwater use within the Project area.

7.2.2 State Plans, Policies, and Regulations

Groundwater use is subject to statewide regulation; additionally, all water use in California is subject to constitutional provisions that prohibit waste and unreasonable use of water. Some relevant provisions are listed below.

7.2.2.1 Water Code (Section 10750) or Assembly Bill 3030 of 1992

Assembly Bill (AB) 3030, commonly referred to as the Groundwater Management Act, permits local agencies to develop Groundwater Management Plans (GMP). Subsequent legislation has further amended the Water Code to make the adoption of a management program mandatory if an agency is to receive public funding for groundwater projects, creating an incentive for the development and implementation of plans.

7.2.2.2 Water Code (Section 10753.7) or Senate Bill 1938 of 2002

Senate Bill (SB) 1938 requires local agencies seeking State of California (State) funds for groundwater construction or groundwater quality projects to have the following: 1) a developed and implemented GMP that includes basin management objectives (BMOs)[1] and addresses the monitoring and management of groundwater levels, groundwater quality degradation, inelastic land subsidence, and surface water/groundwater interaction; 2) a plan addressing cooperation and working relationships with other public entities; 3) a map showing the groundwater subbasin the project is in, neighboring local agencies, and the area subject to the groundwater management plan; 4) protocols for the monitoring of groundwater levels, groundwater quality, inelastic land subsidence, and groundwater/surface water interaction; and 5) GMPs with the components listed above for local agencies outside the groundwater subbasins delineated by Bulletin 118 (DWR 2003).

7.2.2.3 Water Code (Sections 10920 to 10936 and 12924) or Senate Bill X7 6 of 2009

SB X7 6 established a voluntary statewide groundwater monitoring program and requires that groundwater data collected be made readily available to the public. The bill requires DWR to 1) develop a statewide groundwater level monitoring program to track seasonal and long-term

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[1] BMOs are management tools that define the acceptable range of groundwater levels, groundwater quality, and inelastic land subsidence that could occur in a local area without causing significant adverse impacts.

trends in groundwater elevation; 2) conduct an investigation of the State's groundwater basins delineated by Bulletin 118 and report its findings to the governor and legislature no later than January 1, 2012 and thereafter in years ending in five or zero; and 3) work cooperatively with local Monitoring Entities to regularly and systematically monitor groundwater elevation to demonstrate seasonal and long-term trends. AB 1152, Amendment to Water Code Sections 10927, 10932, and 10933, allows local monitoring entities to propose alternate monitoring techniques for basins meeting certain conditions and requires submittal of a monitoring plan to DWR for evaluation. In response to SB X7 6, DWR developed and maintains the California Statewide Groundwater Monitoring (CASGEM) program and database.

7.2.2.4 Sustainable Groundwater Management Act

SGMA, enacted in 2014, is a combination of the Senate and Assembly bills described below.

7.2.2.4.1 Water Code (Sections 10927, 10933, 12924, 10750.1, and 10720) or Senate Bill 1168

SB 1168 requires the establishment of GSAs and adoption of Groundwater Sustainability Plans (GSPs). GSAs must be formed by June 30, 2017. GSAs are new entities that consist of local agency(ies) and include new authority to 1) investigate and determine the sustainable yield of a groundwater basin, 2) regulate groundwater extractions, 3) impose fees for groundwater management, 4) require registration of groundwater extraction facilities, 5) require groundwater extraction facilities to use flow measurement devices, and 6) enforce the terms of a GSP.

Additionally, this bill requires groundwater basins to be ranked as high-, medium-, low-, or very low-priority with respect to groundwater conditions and adverse impacts on local habitat and local stream flow no later than January 31, 2015. DWR has determined that the initial basin prioritization developed in June 2014 would be the priority adopted under this legislation. DWR has identified and finalized 21 basins/subbasins with critical overdraft conditions as of January 2016.

GSPs for groundwater basins/subbasins designated by DWR as high- and medium-priority with critical overdraft conditions (per SB X7 6) are required to be developed by January 31, 2020. GSPs for the remaining high- and medium-priority groundwater basins/subbasins are to be developed by January 31, 2022. GSPs are encouraged to be developed for groundwater basins prioritized as low- or very low-priority. All high- and medium-priority basins must achieve sustainability within 20 years of adopting a GSP.

7.2.2.4.2 Water Code (Sections 10729, 10730, 10732, 10733, and 10735) or Assembly Bill 1739

AB 1739 1) provides the specific authorities to a GSA (as defined by SB 1168); 2) requires DWR to publish best management practices (BMPs) for the sustainable management of groundwater by January 1, 2017; and 3) requires DWR to estimate and report the amount of water available for groundwater replenishment by December 31, 2016. The bill authorizes DWR to approve and periodically review all GSPs.

The bill authorizes the State Water Resources Control Board (SWRCB) to 1) conduct inspections and obtain an inspection warrant; 2) designate a groundwater basin as a probationary groundwater basin; 3) develop interim plans for probationary groundwater basins in consultation with DWR if the local agency fails to remedy a deficiency resulting in the designation of probationary; and 4) issue cease and desist orders or violations of restrictions, limitations, orders, or regulations issued under AB 1739.

7.2.2.4.3 Water Code (Sections 10735.2 and 10735.8) or Senate Bill 1319

SB 1319 authorizes the SWRCB to designate high- and medium-priority basins (defined by SB 1168) as a probationary basin after January 31, 2025. This bill allows the SWRCB to develop interim management plans that may override a local agency. However, if the appointed GSA could demonstrate compliance with sustainability goals for the basin, then the SWRCB must exclude the groundwater basin or a portion of the groundwater basin from probationary status.

Per SB 1319, the local agency or GSA has a 90- to 180-day window to remedy certain deficiencies that caused the SWRCB to designate a basin as probationary. The SWRCB could develop an interim plan for certain probationary basins one year after the designation.

7.2.2.4.4 Water Code (Section 10722.2) or Basin Boundary Emergency Regulation

SB 1168 established a procedure for local agencies to request adjustment of basin boundaries identified in Bulletin 118. Boundary modification could be requested based on geologic or hydrologic criteria (scientific modification) or to promote sustainable groundwater management (jurisdictional modification). The Basin Boundary Emergency Regulation specifies the information a local agency is required to provide for the requested boundary adjustment and the procedure for the modification request and public input (DWR 2015).

7.2.2.4.5 Water Code (Sections 10722.4 and 10730) or Assembly Bill 939

AB 939 authorizes a GSA to impose fees to fund the GSP and requires the GSA to hold at least one public meeting prior to imposing or increasing the fee. The GSA is required to make the data upon which the proposed fee is based available to the public at least 10 days prior to the public meeting.

7.2.2.4.6 Water Code (Sections 10540, 10721, 10727.4, 10727.8, 10733.4, 10726.5, and 10732.2) or Assembly Bill 617

AB 617 requires measures addressing in lieu use to be included in the groundwater sustainability plan. This bill also requires groundwater sustainability planning to be incorporated into the integrated regional water management plan.

7.2.2.5 Other Groundwater Regulations

Groundwater quality issues are monitored through different legislative acts and are the responsibility of several different State agencies, including:

- SWRCBs and nine Regional Water Quality Control Boards – Responsible for protecting water quality for present and future beneficial use

- California Department of Toxic Substances Control – Responsible for protecting public health from improper handling, storage, transport, and disposal of hazardous materials
- California Department of Pesticide Regulation – Responsible for preventing pesticide pollution of groundwater
- CDPH – Responsible for drinking water supplies and standards
- California Integrated Waste Management Board – Oversees non-hazardous solid waste disposal
- California Department of Conservation – Responsible for preventing groundwater contamination due to oil, gas, and geothermal drilling and related activities

7.2.3 Regional and Local Plans, Policies, and Regulations

Local GMPs and county ordinances vary by authority/agency and region but typically involve provisions to limit or prevent groundwater overdraft, regulate transfers, prevent subsidence, and protect groundwater quality.

7.2.3.1 Yolo County

In 2009, Yolo County adopted the *2030 Countywide General Plan Conservation and Open Space Element* (County of Yolo 2009). The General Plan lists several goals related to groundwater resources within the county. Some of the groundwater-related goals pertinent to this project are listed below:

- Policy AG-2.1: Protect areas identified as significantly contributing to groundwater recharge from uses that would reduce their ability to recharge or would threaten the quality of the underlying aquifers.
- Policy CO-5.1: Coordinate with water purveyors and users to manage supplies to avoid long-term overdraft, water quality degradation, land subsidence, and other potential problems.
- Policy CO-5.3: Manage Yolo County’s groundwater resources on a sustainable yield basis that can provide water purveyors and individual users with reliable, high quality groundwater to serve existing and planned land uses during prolonged drought periods.
- Policy CO-5.14: Require that proposals to convert land to uses other than agriculture, open space, or habitat demonstrate that groundwater recharge will not be significantly diminished.
- Policy CO-5.23: Support efforts to meet applicable water quality standards for all surface and groundwater resources.

In 2006, Yolo County developed the *Yolo County Groundwater Management Plan* in compliance with AB 3030 and SB 1938. The GMP sets forth groundwater elevation triggers to avoid groundwater overdraft in the basin. When groundwater elevation triggers set forth in the GMP are reached, the county would institute groundwater conservation measures.

7.2.3.2 Sutter County

In 2011, Sutter County adopted the *Sutter County 2030 General Plan*. The General Plan lists the following groundwater related goals pertinent to this project:

- Policy AG 3.6: Support the efforts of the local water agencies to promote groundwater recharge, conjunctive use, conservation of significant recharge areas, and other activities to protect and manage Sutter County's groundwater resources.
- Policy I 2.10: Continue to regulate the siting, design, construction, and operation of wastewater disposal systems in accordance with Sutter County regulations to minimize contamination of groundwater supplies.
- Policy ER 6.4: Require new development to preserve areas that provide important groundwater recharge, stormwater management, and water quality benefits such as undeveloped open spaces, natural habitat, riparian corridors, wetlands, and natural drainage areas.
- Policy ER 6.6: Regulate stormwater collection and conveyance, as necessary, to protect groundwater supplies from contamination.
- Policy ER 6.11: Require new development to protect the quality of water resources and natural drainage systems through site design and use of source controls, stormwater treatment, runoff reduction measures, BMPs, and low impact development.
- Policy ER 6.12: Require new development to integrate natural watercourses and provide buffers between waterways and urban development to minimize disturbance of watercourses and protect water quality.

In 2012, Sutter County developed the *Sutter County Groundwater Management Plan*. The GMP sets forth BMPs to manage groundwater levels to ensure adequate water supplies while avoiding adverse impacts and mitigating them when they do occur. Adverse impacts related to groundwater levels can occur from excessively high or low groundwater levels. What constitutes an excessively high or low groundwater level may change over time, and will vary by land use and hydrologic and climatic conditions. To avoid groundwater level declines or abnormally high groundwater levels, Sutter County promotes conjunctive use, regularly monitoring groundwater levels within the county; participates in integrated regional water management programs; and implements polices listed in the General Plan to preserve and protect the county's groundwater resources (listed above).

7.2.3.3 Sacramento County

The Sacramento Groundwater Authority collectively manages groundwater in the northern portion of the Sacramento region. In 2008, the Sacramento Groundwater Authority adopted the *Sacramento Groundwater Authority Groundwater Management Plan*. The GMP sets the groundwater elevation targets, with the goal of improving groundwater elevations over time. Additionally, the GMP states the groundwater basin should be managed such that the impacts during drier years will be minimized when surface water supplies are curtailed and replaced by increased groundwater supplies.

7.3 Environmental Consequences

This section describes the environmental consequences associated with the Project alternatives and the No Action Alternative. This section presents the assessment methods used to analyze the effects on groundwater; the thresholds of significance that determine the significance of effects; and the potential environmental consequences and mitigation measures as they relate to each Project alternative. Detailed descriptions of the alternatives evaluated in this section are provided in Chapter 2, *Description of Alternatives*.

7.3.1 Methods for Analysis

Potential changes to groundwater levels, land subsidence, and groundwater quality were assessed qualitatively. Potential impacts to groundwater resources in the North of Delta and South of Delta service areas were estimated based on estimated changes in water supply using results from the CalSim II model (see Appendix E for description of the assumptions and methods used in the CalSim II model). Groundwater quality impacts were assessed by considering known areas of concern and determining whether the expected increase in groundwater pumping could cause those areas to migrate. For land subsidence, the changes in groundwater supply (using the CalSim II results) and drawdown were compared to areas that are susceptible to subsidence and areas with existing subsidence to identify areas that may be impacted. The potential for land subsidence was only considered when expected increases in groundwater pumping would be long-term and/or have the potential to cause groundwater level declines greater than historic minimum levels.

Impacts to groundwater resources are determined relative to existing conditions (for California Environmental Quality Act [CEQA]) and the No Action Alternative (for the National Environmental Policy Act [NEPA]). However, as described below, the No Action Alternative would be the same as existing conditions because groundwater resources are not anticipated to experience substantive changes in the area of analysis. Therefore, the analysis compares the impacts of the action alternatives only to existing conditions.

7.3.2 Thresholds of Significance – CEQA

The thresholds of significance for impacts are based on the environmental checklist in Appendix G of the CEQA Guidelines, as amended. These thresholds also encompass the factors considered under NEPA to determine the context and the intensity of impacts. An impact resulting from the implementation of an alternative would be significant if it would result in:

- A net change in groundwater levels that would deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a lowering of groundwater levels that would impact pre-existing or planned land uses
- Permanent land subsidence caused by significant groundwater level decline
- Degradation in groundwater quality such that it would exceed regulatory standards or substantially impair reasonably anticipated beneficial uses of groundwater

7.3.3 Effects and Mitigation Measures

This section provides an evaluation of the direct and indirect effects on groundwater from implementing the Project alternatives. This analysis is organized by Project alternative, with specific impact topics numbered sequentially under each alternative.

7.3.3.1 No Action Alternative

Under the No Action Alternative, the Project would not be implemented, and none of the Project features would be developed in the Project area. The No Action Alternative would not require any construction and would not affect groundwater.

7.3.3.1.1 Impact GRW-1: Temporary and Short-Term Construction-Related Effects on Groundwater Levels

Under the No Action Alternative, there would be no construction-related impacts in the Project area that could result in a decrease in groundwater levels. Therefore, groundwater levels would not experience short-term construction-related impacts and would be the same as existing conditions.

CEQA Conclusion

The No Action Alternative would have **no impact** on groundwater levels in the Project area because it would include no construction activities to affect groundwater levels.

7.3.3.1.2 Impact GRW-2: Temporary and Short-Term Construction-Related Effects on Groundwater Quality

Under the No Action Alternative, there would be no construction-related impacts to groundwater quality in the Project area. Therefore, groundwater quality would not experience short-term construction-related impacts and would be the same as existing conditions.

CEQA Conclusion

The No Action Alternative would have **no impact** on groundwater quality in the Project area because it would include no construction activities to affect groundwater quality.

7.3.3.1.3 Impact GRW-3: Operational Impacts to Groundwater Recharge Could Cause a Lowering of the Local Groundwater Level that Would Impact Pre-existing or Planned Land Uses in the Area Surrounding the Yolo Bypass

Under the No Action Alternative, there would be no changes to the operation of the Yolo Bypass; therefore, there would be no changes to groundwater recharge adjacent to the bypass.

CEQA Conclusion

The No Action Alternative would have **no impact** on groundwater recharge in the Project area because it would include no changes to the operation of the Yolo Bypass.

7.3.3.1.4 Impact GRW-4: Operational Impacts to Groundwater Quality in the Area Surrounding the Yolo Bypass

Under the No Action Alternative, there would be no changes to the operation of the Yolo Bypass; therefore, there would be no changes to groundwater quality adjacent to the bypass.

CEQA Conclusion

The No Action Alternative would have **no impact** on groundwater recharge in the Project area because it would include no changes to the operation of the Yolo Bypass.

7.3.3.1.5 Impact GRW-5: Long-term Changes to Groundwater Levels due to Decreased Allocation to North of Delta and South of Delta Contractors

Under the No Action Alternative, there would be no changes to the operation of the Yolo Bypass that could have indirect effects on the supplies for North of Delta and South of Delta Contractors; therefore, there would be no changes to groundwater levels in these areas.

CEQA Conclusion

The No Action Alternative would have **no impact** on groundwater levels in the Project area because it would include no changes to the operation of the Yolo Bypass.

7.3.3.1.6 Impact GRW-6: Long-Term Changes to Groundwater Quality due to Decreased Allocation to North of Delta and South of Delta Contractors

Under the No Action Alternative, there would be no changes to the operation of the Yolo Bypass that could have indirect effects on the supplies for North of Delta and South of Delta Contractors; therefore, there would be no changes to groundwater quality in these areas.

CEQA Conclusion

The No Action Alternative would have **no impact** on groundwater recharge in the Project area because it would include no changes to the operation of the Yolo Bypass.

7.3.3.1.7 Impact GRW-7: Increased Potential for Land Subsidence due to Decreased Allocation to North of Delta and South of Delta Contractors

Under the No Action Alternative, there would be no changes to the operation of the Yolo Bypass that could have indirect effects on the supplies for North of Delta and South of Delta Contractors; therefore, there would be no changes to groundwater levels that would result in land subsidence in these areas.

CEQA Conclusion

The No Action Alternative would have **no impact** on land subsidence in the Project area because it would include no changes to the operation of the Yolo Bypass.

7.3.3.2 Alternative 1: East Side Gated Notch

Alternative 1, East Side Gated Notch, would allow increased flow from the Sacramento River to enter the Yolo Bypass through a gated notch on the east side of Fremont Weir. The invert of the new notch would be at an elevation of 14 feet, which is approximately 18 feet below the existing Fremont Weir crest. Alternative 1 would allow up to 6,000 cubic feet per second (cfs) to flow through the notch during periods when the river levels are not high enough to go over the crest of Fremont Weir to provide open channel flow for adult fish passage. See Section 2.4 for more details on the alternative features.

7.3.3.2.1 Impact GRW-1: Temporary and Short-Term Construction-Related Effects on Groundwater Levels

Under Alternative 1, construction activities include excavation related to construction of the intake channel and headworks, transport channel, and downstream facilities. The headworks and intake channels under Alternative 1 would be constructed on the eastern side of Fremont Weir. As discussed in Appendix F of the *Assessment of Groundwater Impact on Project Excavation – Technical Memorandum*, excavation of the intake channel, headworks structure, and an outlet channel would occur within proximity to the Sacramento River and at depths below measured groundwater elevations. The headworks and inlet structure would require excavation down to an elevation of seven feet. Groundwater elevation near the excavation area on the eastern side of the Fremont Weir varies from seven to 15 feet between the spring and fall seasons, respectively. Dewatering efforts would be required to provide relatively dry conditions for construction. The groundwater pumping required for dewatering could cause temporary groundwater level declines in the shallow aquifer in the construction area during construction activities. Construction of the headworks structure, intake channel, and outlet channel would occur concurrently. It would take approximately 12 to 15 weeks to construct the headworks structure. Any dewatering activities would end after construction is complete, allowing groundwater levels to recover.

CEQA Conclusion

Construction-related impacts on groundwater levels under Alternative 1 would be **less than significant** because dewatering activities would be short-term and would end after construction is complete.

7.3.3.2.2 Impact GRW-2: Temporary and Short-Term Construction-Related Effects on Groundwater Quality

As discussed under Impact GRW-1, construction activities would occur below measured groundwater elevations. Construction equipment could cause increased waste discharge through onsite runoff or spills. Additionally, improper storage of construction waste could impact groundwater quality since construction is expected to occur below grade and within proximity to the shallow groundwater aquifer within the Project area. Contamination of surface water due to construction activities would also impact groundwater quality in areas where groundwater and surface water interaction occurs.

CEQA Conclusion

Because construction under Alternative 1 could occur below measured groundwater levels and within proximity to the shallow groundwater aquifer, potential onsite spills or waste discharge runoff during construction would be expected to impact groundwater quality. This impact would be **significant**.

Mitigation Measure MM-HAZ-1: Implement a Construction Risk Management Plan.

As discussed in the effects and mitigation measures of Chapter 19, *Hazardous Materials, Health, and Safety*, construction of the Project shall include implementation of an CRMP to eliminate accidental releases of hazardous materials.

Mitigation Measure MM-WQ-1: Implement a Spill Prevention, Control, and Countermeasure Plan.

As discussed in mitigation measures of Chapter 6, *Water Quality*, construction activities shall incorporate an SPCCP.

Mitigation Measure MM-WQ-2: Implement a Stormwater Pollution and Prevention Plan.

As discussed in mitigation measures of Chapter 6, *Water Quality*, construction activities shall incorporate a SWPPP and construction BMPs.

Mitigation Measure MM-WQ-3: Develop a turbidity monitoring program.

As discussed in mitigation measures of Chapter 6, *Water Quality*, a turbidity monitoring plan shall be developed and implemented. If turbidity limits exceed basin plan standards, construction-related earth-disturbing activities shall slow to a point that would alleviate the problem.

Implementation of the Construction Risk Management Plan (CRMP); Spill Prevention, Control, and Countermeasure Plan (SPCCP); Stormwater Pollution Prevention Plan (SWPPP); construction BMPs, and turbidity monitoring plan included in MM-HAZ-1, MM-WQ-1, MM-WQ-2, and MM-WQ-3, respectively, would ensure all surface water and groundwater quality risks would be minimized and the impact would be reduced to **less than significant**.

7.3.3.2.3 Impact GRW-3: Operational Impacts to Groundwater Recharge Could Cause a Lowering of the Local Groundwater Level that Would Impact Pre-existing or Planned Land Uses in the Area Surrounding the Yolo Bypass

Under Alternative 1, two cutoff walls would be constructed along the eastern side of the bypass: one from Fremont Weir to the central part of Tule Pond and another just south of Tule Pond. These cutoff walls would be included because the channel construction in these areas would cut through an existing clay blanket layer that currently prevents levee underseepage. Both cutoff walls would be approximately 30 feet deep and approximately 2,850 and 3,150 feet long, respectively. Construction of the cutoff walls along the eastern levee would act as a barrier to levee underseepage from the bypass to the Elkhorn area. Where there are higher water levels in the Tule Canal that would cause water to flow from the bypass to groundwater (“losing” conditions), the cutoff wall would prevent groundwater movement from the Yolo Bypass into the aquifer to the east. In areas where the bypass may be in a “gaining” condition (groundwater outside of the bypass is higher in elevation than surface water or groundwater inside the bypass), the cutoff wall could increase water in storage to the east of the Yolo Bypass as water builds behind the wall. Figure 7-6 shows that the eastern side of the Yolo Bypass is typically in a losing condition, with higher surface water levels in the bypass than in the surrounding groundwater (well locations shown on Figure 7-4). Therefore, the cutoff walls in Alternative 1 could prevent recharge to the groundwater aquifer under the Elkhorn area from the Yolo Bypass area. However, because the cutoff walls are would only be in areas that currently have a clay blanket layer which prevents levee underseepage (i.e., areas that currently have no groundwater recharge from the Yolo Bypass), the cutoff walls would not change recharge to the aquifer under the Elkhorn area.

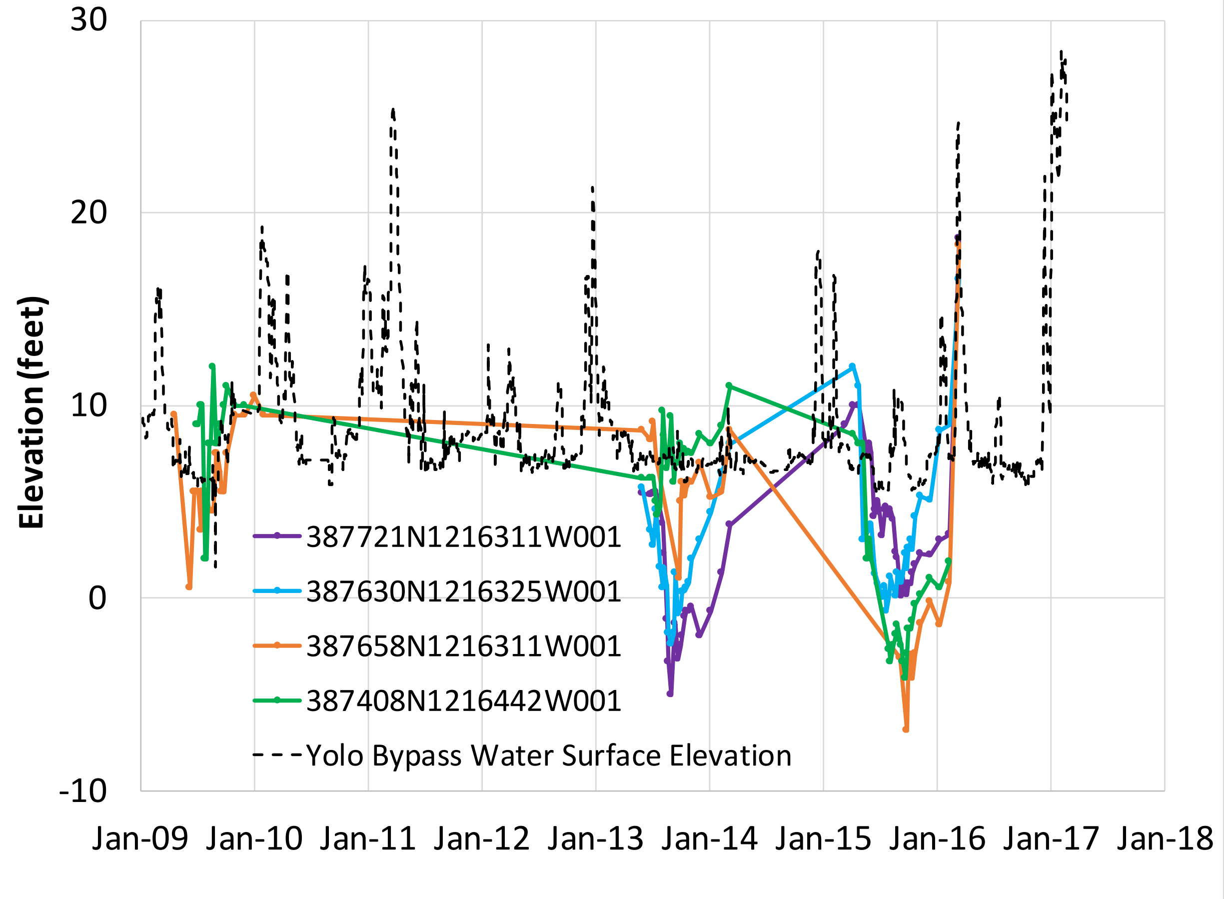

Figure 7-6. Groundwater Elevation at Wells along the East Side of the Yolo Bypass and Surface Water Elevation in the Yolo Bypass

Alternative 1 would improve an existing channel along the eastern side of the bypass running parallel to the cutoff wall discussed above. Improvements would include construction of a well-defined channel connecting the Tule Pond outlet to Tule Canal near Agricultural Road Crossing 1. This channel would go through the “wooded area” (see Figure 2-3 for details) that currently has standing water for much of the year, and shallow groundwater likely contributes to this standing water during winter and early spring. The new channel would have an invert elevation of approximately 12 feet and a typical water surface elevation of approximately 17 to 18 feet, except in the summer months when the channel most likely would be dry. The area surrounding the channel includes the wooded area to the east of the channel and the bypass to the west of the channel. Groundwater elevations in this area along the east and west of the channel range from 14.5 feet in the spring to four feet in the fall. This new channel has the potential to increase discharge out of the shallow groundwater aquifer into the channel in the spring months when the groundwater elevation is higher than the channel invert elevation. However, the channel would be wet during much of this period because of fish passage and inundation flows from Fremont Weir. During these periods, the water surface elevation would be approximately 17 to 18 feet, which is higher than groundwater elevation. When the channel is dry in the summer months, the channel elevation would be 12 feet, but the groundwater elevation in the fall and summer months would be at approximately four feet, which is lower than the channel elevation. Because the channel would be at a higher elevation than the surrounding groundwater, groundwater discharge into the channel is not expected to occur or cause a net deficit in aquifer volume.

Under Alternative 1, there is the potential for locally increased groundwater levels due to additional recharge to the shallow groundwater system from the additional flow introduced to the Yolo Bypass. Increased inundation provides for additional time when surface water in the bypass could infiltrate the ground and recharge the underlying groundwater aquifer, potentially affecting groundwater levels in and around the Yolo Bypass. Increased groundwater levels in these areas would not cause land use changes but could affect agricultural productivity. Therefore, this potential impact is discussed in Chapter 16, *Socioeconomics*.

CEQA Conclusion

Impacts to groundwater levels from changes to groundwater recharge under Alternative 1 would be **less than significant** because the cutoff walls would not fully impede groundwater recharge to the Elkhorn area and the new channel south of Tule Pond would be higher than the surrounding aquifer for most of the year.

7.3.3.2.4 Impact GRW-4: Operational Impacts to Groundwater Quality in the Area Surrounding the Yolo Bypass

Groundwater levels surrounding the Yolo Bypass may increase under Alternative 1 because of increased groundwater recharge from the additional flow in the bypass. While the Sacramento River quality upstream of Knights Landing is generally better than groundwater quality, some contaminants of concerns, like methylmercury and organochlorine pesticides, do exist. Chapter 6, *Water Quality*, more thoroughly discusses water quality issues in the Project area. Similar to surface water, groundwater in the Project area is also generally good, but there are some localized groundwater quality concerns in the Yolo subbasin, including high salt content and localized nitrate and selenium issues (see also Section 7.1.1.4, *Groundwater Quality*). Increased groundwater levels due to increased recharge from surface water likely would improve groundwater quality in the Project area but could introduce some new contaminants of concern into the groundwater.

CEQA Conclusion

Impacts from increased groundwater recharge in the bypass on groundwater quality under Alternative 1 would be **less than significant** because surface water quality in the Project area is generally better than groundwater quality.

7.3.3.2.5 Impact GRW-5: Long-Term Changes to Groundwater Levels due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased diversions from the Sacramento River to the Yolo Bypass under Alternative 1 could have minimal impacts on Central Valley Project (CVP) and State Water Project (SWP) deliveries to North of Delta and South of Delta Contractors. As discussed in Chapter 5, *Surface Water Supply*, the difference in deliveries under Alternative 1 compared to existing conditions and the No Action Alternative would be less than one percent. Decreased surface water deliveries could lead to increased groundwater pumping to make up for the difference in supplies. However, these reductions in deliveries would be rare and limited to a few months within limited years. Therefore, any increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent.

CEQA Conclusion

Impacts from the potential increase in groundwater pumping caused by decreased CVP and SWP surface water supplies under Alternative 1 would be **less than significant** because the reduction in supplies would be short-term, infrequent, and less than one percent of surface water supplies.

7.3.3.2.6 Impact GRW-6: Long-Term Changes to Groundwater Quality due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased groundwater pumping could substantially alter groundwater levels and/or flow patterns. Substantial reductions in groundwater levels for a long period of time could induce the movement or migration of reduced quality groundwater into previously unaffected areas. However, as discussed for Impact GRW-6, there would be minimal changes to groundwater pumping in lieu of surface water deliveries under Alternative 1. There would be no detrimental impacts from groundwater pumping causing a change in groundwater quality.

CEQA Conclusion

Because the potential increase in groundwater pumping in lieu of surface water deliveries would be short-term, infrequent, and of small magnitude, impacts to groundwater quality in the Project area would be **less than significant.**

7.3.3.2.7 Impact GRW-7: Increased Potential for Land Subsidence due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased groundwater pumping could substantially alter groundwater levels and/or flow patterns. Substantial reductions in groundwater levels greater than historic low groundwater levels could increase the potential for subsidence. However, as discussed for Impact GRW-6, there would be minimal changes to groundwater pumping in lieu of surface water deliveries under Alternative 1. The potential increase in groundwater pumping in lieu of surface water deliveries would be minimal, and any increase would be distributed over a large area (within the CVP and SWP contractors' service area). Any changes to groundwater levels would not contribute to land subsidence.

CEQA Conclusion

Because the potential increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent (less than one percent of surface water supplies), impacts to land subsidence would be **less than significant.**

7.3.3.3 Alternative 2: Central Gated Notch

Alternative 2, Central Gated Notch, would provide a new gated notch through Fremont Weir similar to the notch described for Alternative 1. The primary difference between Alternatives 1 and 2 is the location of the notch; Alternative 2 would site the notch near the center of Fremont Weir. This gate would be a similar size but would have an invert elevation that is higher (14.8 feet) because the river is higher at this upstream location, and the gate would allow up to 6,000 cfs through the notch to provide open channel flow for adult fish passage. See Section 2.5 for more details on the alternative features.

7.3.3.3.1 Impact GRW-1: Temporary and Short-Term Construction-Related Effects on Groundwater Levels

Under Alternative 2, construction activities include excavation related to the construction of the intake channel and headworks, transport channel, and downstream facilities. The headworks and intake channels under Alternative 2 would be constructed near the center of the Fremont Weir. As discussed in Appendix F, *Assessment of Groundwater Impact on Project Excavation – Technical Memorandum,* excavation activities under Alternative 2 would be below measured groundwater elevations. The headworks and inlet structure would require excavation to an elevation of eight feet. Groundwater elevation near the center of the Fremont Weir varies from nine to 17 feet between the spring and fall seasons, respectively, under existing conditions. Dewatering efforts would be required to provide relatively dry conditions for construction. The groundwater pumping required for dewatering could cause temporary groundwater level declines in the shallow aquifer at the proposed pumping sites during construction activities. Construction of the headworks structure, intake channel, and outlet channel would occur concurrently. It would take approximately 12 to 15 weeks to construct the headworks structure. Dewatering activities would end after construction is complete, allowing groundwater levels to recover.

CEQA Conclusion

Impacts from construction on groundwater levels under Alternative 2 would be **less than significant** because dewatering activities would be short-term and would end after construction is complete.

7.3.3.3.2 Impact GRW-2: Temporary and Short-Term Construction-Related Effects on Groundwater Quality

Short-term impacts to groundwater quality from construction under Alternative 2 would be identical to those discussed under Alternative 1.

CEQA Conclusion

Because construction could occur below grade and within proximity to the shallow groundwater aquifer, onsite spills or waste discharge runoff during construction under Alternative 2 would be expected to impact groundwater quality. This impact would be **significant**.

Implementation of the HMMP, SPCCP, SWPPP, construction BMPs, and turbidity monitoring plan included in MM-HAZ-1, MM-WQ-1, MM-WQ-2, and MM-WQ-3, respectively, would ensure all surface water and groundwater quality risks would be minimized and the impact would be reduced to **less than significant**.

7.3.3.3.3 Impact GRW-3: Operational Impacts to Groundwater Recharge Could Cause a Lowering of the Local Groundwater Level that Would Impact Pre-existing or Planned Land Uses in the Area Surrounding the Yolo Bypass

Under Alternative 2, a cutoff wall (3,150 feet long and 30 feet deep) would be constructed just south of Tule Pond. The cutoff wall would be included because the channel construction in this area would cut through an existing clay blanket layer that currently prevents levee underseepage. The cutoff wall along the eastern levee would act as a barrier to groundwater flow across the eastern side of the bypass. Where there are higher water levels in the Tule Canal that would cause water to flow from the bypass to groundwater (“losing” conditions), the cutoff wall would prevent groundwater movement from the Yolo Bypass into the aquifer to the east. In areas where the bypass may be in a “gaining” condition, the cutoff wall could increase water in storage to the east of Yolo Bypass as water builds behind the wall. The eastern side of the Yolo Bypass is typically in losing conditions, as shown by the higher surface water in the bypass than groundwater levels in Figure 7-6. Therefore, the cutoff wall in Alternative 2 could prevent recharge to the groundwater aquifer under the Elkhorn area from the Yolo Bypass area. However, since the cutoff wall does not extend over the entire eastern side of the bypass in areas that currently have a clay blanket preventing levee underseepage, the cutoff walls would not change recharge to the aquifer under the Elkhorn area.

Alternative 2 would improve an existing channel along the eastern side of the bypass running parallel to the cutoff wall discussed above. Improvements would include construction of a well-defined channel connecting the Tule Pond outlet to Tule Canal near Agricultural Road Crossing 1. This channel would go through the wooded area (see Figure 2-3 for details) that currently has standing water for much of the year, and shallow groundwater likely contributes to this standing water during winter and early spring. The new channel would have an invert elevation of approximately 12 feet and a typical water surface elevation of approximately 17 to 18 feet, except in the summer months when the channel most likely would be dry. Groundwater elevations in this area along the east and west of the channel range from 14.5 feet in the spring to 4 feet in the fall and summer months. This new channel has the potential to increase discharge out of the shallow groundwater aquifer into the channel in the spring months when the groundwater elevation is higher than the channel invert elevation. However, the channel would be wet during much of this period because of fish passage and inundation flows from Fremont Weir and would have a water surface elevation of approximately 17 to 18 feet, which is higher than groundwater elevation. When the channel is dry in summer months, the channel elevation would be 12 feet, but the groundwater elevation in the fall and summer months would be at approximately four feet, which is lower than the channel elevation. Because the channel would be at a higher elevation than the surrounding groundwater, groundwater discharge is not expected to occur from the aquifer into the channel or to cause a net deficit in aquifer volume.

Under Alternative 2, there is the potential for locally increased groundwater levels due to additional recharge to the shallow groundwater system from the additional flow introduced to the Yolo Bypass. Increased inundation provides for additional time when surface water in the bypass could infiltrate the ground and recharge the underlying groundwater aquifer, potentially affecting groundwater levels in and around the Yolo Bypass. Increased groundwater levels in these areas would not cause land use changes but could affect agricultural productivity. Therefore, this potential impact is discussed in Chapter 16, *Socioeconomics*.

CEQA Conclusion

Impacts to groundwater levels from changes to groundwater recharge under Alternative 2 would be **less than significant** because the cutoff wall is replacing the functionality of an existing clay blanket to reduce underseepage and improve levee stability and would not fully impede groundwater recharge to the Elkhorn area, and the new channel south of Tule Pond would be higher than the surrounding aquifer for most of the year.

7.3.3.3.4 Impact GRW-4: Operational Impacts to Groundwater Quality in the Area Surrounding the Yolo Bypass

Impacts to groundwater quality from operations of Alternative 2 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Impacts from increased flows in the bypass on groundwater quality would be **less than significant** because surface water quality in the Project area is generally better than groundwater quality, barring a few constituents of concern.

7.3.3.3.5 Impact GRW-5: Long-Term Changes to Groundwater Levels due to Decreased Allocation to North of Delta and South of Delta Contractors

Impacts to groundwater levels near CVP and SWP contractors from operations of Alternative 2 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Impacts from the potential increase in groundwater pumping caused by decreased CVP and SWP surface water supplies would be **less than significant** under Alternative 2 because the reduction in supplies would be short-term and infrequent.

7.3.3.3.6 Impact GRW-6: Long-Term Changes to Groundwater Quality due to Decreased Allocation to North of Delta and South of Delta Contractors

Impacts to groundwater quality near CVP and SWP contractors from operations of Alternative 2 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Because the potential increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent under Alternative 2, impacts to groundwater quality in the region would be **less than significant.**

7.3.3.3.7 Impact GRW-7: Increased Potential for Land Subsidence due to Decreased Allocation to North of Delta and South of Delta Contractors

Impacts to subsidence near CVP and SWP contractors from operations of Alternative 2 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Because the potential increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent under Alternative 1, impacts to land subsidence would be **less than significant.**

7.3.3.4 Alternative 3: West Side Gated Notch

Alternative 3, West Side Gated Notch, would provide a similar new gated notch through Fremont Weir as described for Alternative 1. The primary difference between Alternatives 1 and 3 is the location of the notch; Alternative 3 would site the notch on the western side of Fremont Weir. This gate would be a similar size but would have an invert elevation that is higher (16.1 feet) because the river is higher at this upstream location. Alternative 3 would allow up to 6,000 cfs through the gated notch to provide open channel flow for adult fish passage. See Section 2.6 for more details on the alternative features.

7.3.3.4.1 Impact GRW-1: Temporary and Short-Term Construction-Related Effects on Groundwater Levels

Under Alternative 3, construction activities include excavation related to the construction of the intake channel and headworks, transport channel, and downstream facilities. The headworks and intake channels under Alternative 3 would be constructed on the western side of Fremont Weir. As discussed in the Appendix F, *Assessment of Groundwater Impact on Project Excavation – Technical Memorandum*, excavation activities under Alternative 3 would be below measured groundwater elevations. The headworks and inlet structure would require excavation to an elevation of nine feet. Groundwater elevation on the western side of Fremont Weir varies from eight to 17 feet between the spring and fall seasons, respectively, under existing conditions. Dewatering efforts would be required to provide relatively dry conditions for construction. The groundwater pumping required for dewatering could cause temporary groundwater level declines in the shallow aquifer at the proposed pumping sites during construction activities. Construction of the headworks structure, intake channel, and outlet channel would occur concurrently. It would take approximately 12 to 15 weeks to construct the headworks structure. Any dewatering activities would end after construction is complete, allowing groundwater levels to recover.

CEQA Conclusion

Impacts from construction on groundwater levels under Alternative 3 would be **less than significant** because dewatering activities would be short-term and would end after construction is complete.

7.3.3.4.2 Impact GRW-2: Temporary and Short-Term Construction-Related Effects on Groundwater Quality

Short-term impacts to groundwater quality from construction under Alternative 3 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Because construction could occur below grade and within proximity to the shallow groundwater aquifer, onsite spills or waste discharge runoff during construction would be expected to impact groundwater quality, and this impact would be **significant** under Alternative 3.

Implementation of the HMMP, SPCCP, SWPPP, construction BMPs, and turbidity monitoring plan included in MM-HAZ-1, MM-WQ-1, MM-WQ-2, and MM-WQ-3, respectively, would ensure all surface water and groundwater quality risks would be minimized and the impact would be reduced to **less than significant**.

7.3.3.4.3 Impact GRW-3: Operational Impacts to Groundwater Recharge Could Cause a Lowering of the Local Groundwater Level that Would Impact Pre-existing or Planned Land Uses in the Area Surrounding the Yolo Bypass

Operational impacts to groundwater levels under Alternative 3 would be identical to those discussed for Alternative 2.

CEQA Conclusion

Impacts to groundwater levels from changes to groundwater recharge would be **less than significant** under Alternative 3 because the cutoff walls would not fully impede groundwater recharge to the Elkhorn area and the new channel south of Tule Pond would be higher than the surrounding aquifer for most of the year.

7.3.3.4.4 Impact GRW-4: Operational Impacts to Groundwater Quality in the Area Surrounding the Yolo Bypass

Impacts to groundwater quality from operations of Alternative 3 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Impacts from increased flows in the bypass on groundwater quality would be **less than significant** under Alternative 3 because surface water quality in the Project area is generally better than groundwater quality, barring a few constituents of concern.

7.3.3.4.5 Impact GRW-5: Long-Term Changes to Groundwater Levels due to Decreased Allocation to North of Delta and South of Delta Contractors

Impacts to groundwater levels near CVP and SWP contractors from operations of Alternative 3 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Impacts from the potential increase in groundwater pumping caused by decreased CVP and SWP surface water supplies would be **less than significant** under Alternative 3 because the reduction in supplies would be short-term and infrequent.

7.3.3.4.6 Impact GRW-6: Long-Term Changes to Groundwater Quality due to Decreased Allocation to North of Delta and South of Delta Contractors

Impacts to groundwater quality near CVP and SWP contractors from operations of Alternative 3 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Because the potential increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent, impacts to groundwater quality in the region would be **less than significant.**

7.3.3.4.7 Impact GRW-7: Increased Potential for Land Subsidence due to Decreased Allocation to North of Delta and South of Delta Contractors

Impacts to subsidence near CVP and SWP contractors from operations of Alternative 3 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Because the potential increase in groundwater pumping in lieu of surface water deliveries associated with Alternative 3 would be short-term and infrequent, impacts to land subsidence would be **less than significant.**

7.3.3.5 Alternative 4: West Side Gated Notch – Managed Flow

Alternative 4, West Side Gated Notch – Managed Flow, would have a smaller amount of flow entering the Yolo Bypass through the gated notch in Fremont Weir than some other alternatives, but it would incorporate water control structures to maintain inundation for longer periods of time within the northern portion of the Yolo Bypass. Alternative 4 would include the same gated notch and associated facilities as described for Alternative 3; however, it would be operated to limit the maximum inflow to 3,000 cfs. See Section 2.7 for more details on the alternative features.

7.3.3.5.1 Impact GRW-1: Temporary and Short-Term Construction-Related Effects on Groundwater Levels

Similar to Alternatives 1, 2, and 3, Alternative 4 includes excavation related to the construction of the intake channel and headworks, transport channel, and downstream facilities. This alternative would include additional improvements farther south in the Yolo Bypass, which consist of engineered berm improvements, fish bypass channels, and water control structures. As discussed in Appendix F, *Assessment of Groundwater Impact on Project Excavation – Technical Memorandum*, excavation activities under Alternative 4 would be below measured groundwater elevations. The headworks and inlet structure would require excavation to an elevation of nine feet. Groundwater elevation near the western side of Fremont Weir varies from eight to 17 feet between the spring and fall seasons, respectively. Construction associated with the berm improvements, fish bypass channel, and water control structures would require excavation to an elevation of 10 feet. Given that groundwater elevations in this area are a similar elevation, groundwater dewatering may be required. Dewatering efforts would be required to provide relatively dry conditions for construction. The groundwater pumping required for dewatering could cause temporary groundwater level declines in the shallow aquifer at the proposed pumping sites during construction activities. Construction of the headworks structure, intake channel, and outlet channel would occur concurrently. It would take approximately 12 to 15 weeks to construct the headworks structure. Dewatering activities would end after construction is complete, allowing groundwater levels to recover.

CEQA Conclusion

Impacts from construction on groundwater levels under Alternative 4 would be **less than significant** because dewatering activities would be short-term and would end after construction is complete.

7.3.3.5.2 Impact GRW-2: Temporary and Short-Term Construction-Related Effects on Groundwater Quality

Short-term impacts to groundwater quality from construction under Alternative 4 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Because construction could occur below grade and within proximity to the shallow groundwater aquifer, onsite spills or waste discharge runoff during construction would be expected to impact groundwater quality. This impact would be **significant** under Alternative 4.

Implementation of the HMMP, SPCCP, SWPPP, construction BMPs, and turbidity monitoring plan included in MM-HAZ-1, MM-WQ-1, MW-WQ-2, and MM-WQ-3, respectively, would ensure all surface water and groundwater quality risks would be minimized and the impact would be reduced to **less than significant**.

7.3.3.5.3 Impact GRW-3: Operational Impacts to Groundwater Recharge Could Cause a Lowering of the Local Groundwater Level that Would Impact Pre-existing or Planned Land Uses in the Area Surrounding the Yolo Bypass

Operational impacts to groundwater levels under Alternative 4 would be identical to those discussed for Alternative 2.

CEQA Conclusion

Impacts to groundwater levels from changes to groundwater recharge would be **less than significant** under Alternative 4 because the cutoff walls would not fully impede groundwater recharge to the Elkhorn area and the new channel south of Tule Pond would be higher than the surrounding aquifer for most of the year.

7.3.3.5.4 Impact GRW-4: Operational Impacts to Groundwater Quality in the Area Surrounding the Yolo Bypass

Impacts to groundwater quality from operations of Alternative 4 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Impacts from increased flows in the bypass on groundwater quality would be **less than significant** under Alternative 4 because surface water quality in the Project area is generally better than groundwater quality, barring a few constituents of concern.

7.3.3.5.5 Impact GRW-5: Long-Term Changes to Groundwater Levels due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased diversions from the Sacramento River to the Yolo Bypass under Alternative 4 could have minimal impacts on CVP and SWP deliveries to North of Delta and South of Delta Contractors. As discussed in Chapter 5, *Surface Water Supply*, there would generally be no difference in deliveries under Alternative 4 compared to existing conditions. Under Alternative 4 compared to the No Action Alternative, reductions in deliveries up to one percent could occur under certain months in dry and critical years. Decreased surface water deliveries could lead to increased groundwater pumping to make up the difference in supplies. However, these reductions in deliveries are rare and limited to a few months within limited years. Therefore, any increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent.

CEQA Conclusion

Impacts from the potential increase in groundwater pumping caused by decreased CVP and SWP surface water supplies under Alternative 4 would be **less than significant** because the reduction in supplies would be short-term and infrequent.

7.3.3.5.6 Impact GRW-6: Long-Term Changes to Groundwater Quality due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased groundwater pumping could substantially alter groundwater levels and/or flow patterns. Substantial reductions in groundwater levels for a long period of time could induce the movement or migration of reduced quality groundwater into previously unaffected areas. However, as discussed for Impact GRW-6, there would be minimal changes to groundwater pumping in lieu of surface water deliveries under Alternative 4. There would be no detrimental impacts from groundwater pumping causing a change in groundwater quality.

CEQA Conclusion

Impacts from the potential increase in groundwater pumping due to decreased North of Delta and South of Delta surface water supplies on groundwater quality in the region would be **less than significant** under Alternative 4 because the potential increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent.

7.3.3.5.7 Impact GRW-7: Increased Potential for Land Subsidence due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased groundwater pumping could substantially alter groundwater levels and/or flow patterns. Substantial reductions in groundwater levels greater than historic low groundwater levels elevations could increase the potential for subsidence. As discussed for Impact GRW-6, there would be minimal changes to groundwater pumping in lieu of surface water deliveries under Alternative 4. The expected increase in groundwater pumping in lieu of surface water deliveries would be minimal, and any increase would be distributed over a large area (within the CVP and SWP contractors' service area). Changes to groundwater levels would not cause detrimental impacts to land subsidence.

CEQA Conclusion

Because the potential increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent under Alternative 4, impacts to land subsidence would be **less than significant.**

7.3.3.6 Alternative 5: Central Multiple Gated Notches

Alternative 5, Central Multiple Gated Notches, would improve the capture of fish through using multiple gates and intake channels so that the deeper gate could allow more flow to enter the bypass when the river is at lower elevations. Flows would move to other gates when the river is higher to control inflows. Alternative 5 incorporates multiple gated notches in the central location on the existing Fremont Weir that would allow combined flows of up to 3,400 cfs. See Section 2.8 for more details on the alternative features.

7.3.3.6.1 Impact GRW-1: Temporary and Short-Term Construction-Related Effects on Groundwater Levels

Alternative 5 includes excavation related to construction of the intake channel and headworks, transport channel, and downstream facilities. The headworks and intake channels under Alternative 5 would be constructed in the central area of Fremont Weir. The channels would extend from this point to the southeast to connect with Tule Canal at Agricultural Road Crossing 1. As discussed in Appendix F, *Assessment of Groundwater Impact on Project Excavation – Technical Memorandum*, excavation activities under Alternative 5 would be below measured groundwater elevations. This alternative includes four inlet gates that would require excavation to an elevation of seven feet. Groundwater elevation near the excavation area near Fremont Weir varies from nine to 17 feet between the spring and fall seasons, respectively, under existing conditions. Dewatering efforts would be required to provide relatively dry conditions for construction. The groundwater pumping required for dewatering could cause temporary groundwater level declines in the shallow aquifer at the proposed pumping sites during construction activities. Construction of the headworks structure, intake channel, and outlet channel would occur concurrently. It would take approximately 12 to 15 weeks to construct the headworks structure. Dewatering activities would end after construction is complete, allowing groundwater levels to recover.

CEQA Conclusion

Impacts from construction on groundwater levels under Alternative 5 would be **less than significant** because dewatering activities would be short-term and would end after construction is complete.

7.3.3.6.2 Impact GRW-2: Temporary and Short-Term Construction-Related Effects on Groundwater Quality

Short-term impacts to groundwater quality from construction under Alternative 5 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Because construction could occur below grade and within proximity to the shallow groundwater aquifer under Alternative 5, onsite spills or waste discharge runoff during construction would be expected to impact groundwater quality. This impact would be **significant**.

Implementation of the HMMP, SPCCP, SWPPP, construction BMPs, and turbidity monitoring plan included in MM-HAZ-1, MM-WQ-1, MM-WQ-2, and MM-WQ-3, respectively, would ensure all surface water and groundwater quality risks would be minimized and the impact would be reduced to **less than significant**.

7.3.3.6.3 Impact GRW-3: Operational Impacts to Groundwater Recharge Could Cause a Lowering of the Local Groundwater Level that Would Impact Pre-existing or Planned Land Uses in the Area Surrounding the Yolo Bypass

Operational impacts to groundwater levels under Alternative 4 would be identical to those discussed for Alternative 2.

CEQA Conclusion

Impacts to groundwater levels from changes to groundwater recharge under Alternative 5 would be **less than significant** because the cutoff walls would not entirely impede groundwater recharge to the Elkhorn area.

7.3.3.6.4 Impact GRW-4: Operational Impacts to Groundwater Quality in the Area Surrounding the Yolo Bypass

Impacts to groundwater quality from operations of Alternative 5 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Impacts from increased flows in the bypass on groundwater quality under Alternative 5 would be potentially **less than significant** because surface water quality in the Project area is generally better than groundwater quality, barring a few constituents of concern.

7.3.3.6.5 Impact GRW-5: Long-Term Changes to Groundwater Levels due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased diversions from the Sacramento River to the Yolo Bypass under Alternative 5 could have a minimal impact on CVP and SWP deliveries to North of Delta and South of Delta Contractors. As discussed in Chapter 5, *Surface Water Supply*, there would generally be no difference in deliveries under Alternative 5 compared to existing conditions. Under Alternative 5 compared to the No Action Alternative, reductions in deliveries up to one percent could occur under certain months in dry and critical years. Decreased surface water deliveries could lead to increased groundwater pumping to make up the difference in supplies. However, these reductions in deliveries are rare and limited to a few months within limited years. Therefore, any increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent.

CEQA Conclusion

Impacts from the potential increase in groundwater pumping caused by decreased CVP and SWP surface water supplies under Alternative 5 would be **less than significant** because the reduction in supplies would be short-term and infrequent.

7.3.3.6.6 Impact GRW-6: Long-Term Changes to Groundwater Quality due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased groundwater pumping could substantially alter groundwater levels and/or flow patterns. Substantial reductions in groundwater levels for a long period of time could induce the movement or migration of reduced quality groundwater into previously unaffected areas. As discussed for Impact GRW-6, there would be minimal changes to groundwater pumping in lieu of surface water deliveries under Alternative 5. There would be no detrimental impacts from groundwater pumping causing a change in groundwater quality.

CEQA Conclusion

Impacts from increased groundwater pumping due to decreased North of Delta and South of Delta surface water supplies on groundwater quality under Alternative 5 in the region would be **less than significant** because the potential increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent.

7.3.3.6.7 Impact GRW-7: Increased Potential for Land Subsidence due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased groundwater pumping could substantially alter groundwater levels and/or flow patterns. Substantial reductions in groundwater levels greater than historic low groundwater level elevations could increase the potential for subsidence. As discussed for Impact GRW-6, there would be minimal changes to groundwater pumping in lieu of surface water deliveries under Alternative 5. The expected increase in groundwater pumping in lieu of surface water deliveries would be minimal, and any increase would be distributed over a large area (within the CVP and SWP contractors' service area). Changes to groundwater levels would not cause any detrimental impacts to land subsidence.

CEQA Conclusion

Because the potential increase in groundwater pumping in lieu of surface water deliveries under Alternative 5 would be short-term and infrequent, impacts to land subsidence would be **less than significant.**

7.3.3.6.8 Tule Canal Floodplain Improvements (Program Level)

As described in Section 2.8.1.7, Alternative 5 would include floodplain improvements along Tule Canal, just north of I-80. These improvements would not be constructed at the same time as the remaining facilities. They are included at a program level of detail to consider all the potential impacts and benefits of Alternative 5. Subsequent consideration of environmental impacts would be necessary before construction could begin.

The Alternative 5 program level improvements to the Tule Canal Floodplain would not affect groundwater resources because the improvements (a series of secondary channels that connect to Tule Canal north of I-80) would increase inundation of areas that are currently managed as wetland habitat for waterfowl. The secondary channels would improve functionality of the floodplain habitat but would have negligible effects on groundwater recharge, groundwater levels, or groundwater quality.

7.3.3.7 Alternative 6: West Side Large Gated Notch

Alternative 6, West Side Large Gated Notch, is a large notch in the western location that would allow flows up to 12,000 cfs. It was designed with the goal of entraining more fish with the strategy of allowing more flow into the bypass when the Sacramento River is at lower elevations. See Section 2.9 for more details on the alternative features.

7.3.3.7.1 Impact GRW-1: Temporary and Short-Term Construction-Related Effects on Groundwater Levels

Alternative 6 includes the intake channel and headworks, transport channel, and downstream facilities. As discussed in Appendix F, *Assessment of Groundwater Impact on Project Excavation – Technical Memorandum*, excavation activities under Alternative 6 would be below measured groundwater elevations. This alternative includes headworks and inlet structures that would require excavation to an elevation of nine feet. Groundwater elevation near the excavation area near Fremont Weir varies from nine to 17 feet between the spring and fall seasons, respectively, under existing conditions. Dewatering efforts would be required to provide relatively dry conditions for construction. The groundwater pumping required for dewatering could cause temporary groundwater level declines in the shallow aquifer at the proposed pumping sites during construction activities. Construction of the headworks structure, intake channel, and outlet channel would occur concurrently. It would take approximately 12 to 15 weeks to construct the headworks structure. Dewatering activities would end after construction is complete, allowing groundwater levels to recover.

CEQA Conclusion

Impacts from construction on groundwater levels under Alternative 6 would be **less than significant** because dewatering activities would be short-term and would end after construction is complete.

7.3.3.7.2 Impact GRW-2: Temporary and Short-Term Construction-Related Effects on Groundwater Quality

Short-term impacts to groundwater quality from construction under Alternative 6 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Because construction could occur below grade and within proximity to the shallow groundwater aquifer under Alternative 6, onsite spills or waste discharge runoff during construction would be expected to impact groundwater quality and this impact would be **significant**.

Implementation of the HMMP, SPCCP, SWPPP, construction BMPs, and turbidity monitoring plan included in MM-HAZ-1, MM-WQ-1, MM-WQ-2 and, MM-WQ-3, respectively, would ensure all surface water and groundwater quality risks would be minimized and the impact would be reduced to **less than significant**.

7.3.3.7.3 Impact GRW-3: Operational Impacts to Groundwater Recharge Could Cause a Lowering of the Local Groundwater Level that Would Impact Pre-existing or Planned Land Uses in the Area Surrounding the Yolo Bypass

Impacts on groundwater levels from operations of Alternative 6 would be identical to those discussed for Alternative 2.

CEQA Conclusion

Impacts to groundwater levels from changes to groundwater recharge under Alternative 6 would be **less than significant** because the cutoff walls would not entirely impede groundwater recharge to the east of the bypass and the new channel south of Tule pond would be higher than the surrounding aquifer for most of the year.

7.3.3.7.4 Impact GRW-4: Operational Impacts to Groundwater Quality in the Area Surrounding the Yolo Bypass

Impacts to groundwater quality from operations of Alternative 6 would be identical to those discussed for Alternative 1.

CEQA Conclusion

Impacts from increased flows in the bypass on groundwater quality under Alternative 6 would be **less than significant** because surface water quality in the Project area is generally better than groundwater quality, barring a few constituents of concern.

7.3.3.7.5 Impact GRW-5: Long-Term Changes to Groundwater Levels due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased diversions from the Sacramento River to the Yolo Bypass under Alternative 6 could have a minimal impact on CVP and SWP deliveries to North of Delta and South of Delta Contractors. As discussed in Chapter 5, *Surface Water Supply*, there would generally be no difference in deliveries under Alternative 6 compared to existing conditions. Compared to the No Action Alternative, Alternative 6 could reduce deliveries up to two percent in a few months in Dry and Critical years. Decreased surface water deliveries could lead to increased groundwater pumping to make up the difference in supplies. However, these reductions in deliveries would be rare and limited to a few months within limited years. Therefore, any increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent.

CEQA Conclusion

Impacts from the potential increase in groundwater pumping caused by decreased CVP and SWP surface water supplies under Alternative 6 would be **less than significant** because the reduction in supplies would be short-term and infrequent.

7.3.3.7.6 Impact GRW-6: Long-Term Changes to Groundwater Quality due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased groundwater pumping could substantially alter groundwater levels and/or flow patterns. Substantial reductions in groundwater levels for a long period of time could induce the movement or migration of reduced quality groundwater into previously unaffected areas. As discussed for Impact GRW-6, there would be minimal changes to groundwater pumping in lieu of surface water deliveries under Alternative 6. There would be no detrimental impacts from groundwater pumping causing a change in groundwater quality.

CEQA Conclusion

Impacts from increased groundwater pumping due to decreased North of Delta and South of Delta surface water supplies on groundwater quality under Alternative 6 in the region would be **less than significant** because the potential increase in groundwater pumping in lieu of surface water deliveries would be short-term and infrequent.

7.3.3.7.7 Impact GRW-7: Increased Potential for Land Subsidence due to Decreased Allocation to North of Delta and South of Delta Contractors

Increased groundwater pumping could substantially alter groundwater levels and/or flow patterns. Substantial reductions in groundwater levels greater than historic low groundwater level elevations could increase the potential for subsidence. As discussed for Impact GRW-6, there would be minimal changes to groundwater pumping in lieu of surface water deliveries under Alternative 6. The expected increase in groundwater pumping in lieu of surface water deliveries would be minimal, and any increase would be distributed over a large area (within the CVP and SWP contractors' service area). Any changes to groundwater levels would not cause any detrimental impacts to land subsidence.

CEQA Conclusion

Because the potential increase in groundwater pumping in lieu of surface water deliveries under Alternative 6 would be short-term and infrequent, impacts to land subsidence would be **less than significant.**

7.3.4 Summary of Impacts

Table 7-2 below provides a summary of the identified Project-related impacts to groundwater.

Table 7-2. Summary of Impacts and Mitigation Measures – Groundwater

Impact	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Impact GRW-1: Temporary and Short-Term Construction-Related Effects on Groundwater Levels	No Action	NI	----	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	----	LTS
	5 (Program)	NI	----	NI
Impact GRW-2: Temporary and Short-Term Construction-Related Effects on Groundwater Quality	No Action	NI	----	NI
	1, 2, 3, 4, 5 (Project), 6	S	MM-HAZ-1 MM-WQ-1 MM-WQ-2 MM-WQ-3	LTS
	5 (Program)	NI	---	NI

Impact	Alternative	Level of Significance Before Mitigation	Mitigation Measures	Level of Significance After Mitigation
Impact GRW-3: Operational Impacts to Groundwater Recharge Could Cause a Lowering of the Local Groundwater Level that Would Impact Pre-existing or Planned Land Uses in the Area Surrounding the Yolo Bypass	No Action	NI	----	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	----	LTS
	5 (Program)	NI	----	NI
Impact GRW-4: Operational Impacts to Groundwater Quality in the Area Surrounding the Yolo Bypass	No Action	NI	----	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	----	LTS
	5 (Program)	NI	----	NI
Impact GRW-5: Long-Term Changes to Groundwater Levels due to Decreased Allocation to North of Delta and South of Delta Contractors	No Action	NI	----	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	----	LTS
	5 (Program)	NI	----	NI
Impact GRW-6: Long-Term Changes to Groundwater Quality due to Decreased Allocation to North of Delta and South of Delta Contractors	No Action	NI	----	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	----	LTS
	5 (Program)	NI	----	NI
Impact GRW-7: Increased Potential for Land Subsidence due to Decreased Allocation to North of Delta and South of Delta Contractors	No Action	NI	----	NI
	1, 2, 3, 4, 5 (Project), 6	LTS	----	LTS
	5 (Program)	NI	----	NI

Key:

LTS = less than significant; NI = no impact; S = significant

7.4 Cumulative Impacts Analysis

This section describes the cumulative effects analysis for groundwater resources. Section 3.3, *Cumulative Impacts*, presents an overview of the cumulative impacts analysis, including the methodology and the projects, plans, and programs included in the cumulative impacts analysis.

7.4.1 Methodology

This evaluation of cumulative effects considers the effects of the project and how they may combine with the effects of other past, present, and future projects or actions to create significant impacts on groundwater resources. The Project area for these cumulative effects includes both the Yolo, Colusa, and Sutter subbasins. The timeframe for this cumulative analysis includes the past, present, and probable future projects producing related or cumulative impacts that have been identified in the Project area.

This cumulative effects analysis uses the project analysis approach described in detail in Section 3.3, *Cumulative Impacts*. The cumulative projects included in this analysis are:

- Battle Creek Salmon and Steelhead Restoration Project
- California EcoRestore projects
  - Agricultural Road Crossing #4 Fish Passage Improvement Project
  - Cache Slough Area Restoration – Prospect Island
  - Fremont Weir Adult Fish Passage Modification Project
  - Lisbon Weir Modification Project
  - Lower Putah Creek Realignment Project
  - Prospect Island Tidal Habitat Restoration Project
  - Tule Red Tidal Marsh Restoration Project
  - Wallace Weir Fish Rescue Facility Project
- California WaterFix
- American River Common Features General Reevaluation Report
- Central Valley Flood Management Planning Program
- Delta Plan
- Lower Cache Creek Flood Risk Management Feasibility Study and the Woodland Flood Risk Reduction Project
- Lower Elkhorn Basin Levee Setback Project
- Lower Putah Creek 2 North American Wetlands Conservation Act (NAWCA) Project
- Lower Yolo Restoration Project
- North Bay Aqueduct Alternative Intake Project
- Sacramento River Bank Protection Project

- Sacramento River General Reevaluation Report
- Sites Reservoir Project
- SGMA
- Upstream Sacramento River Fisheries Projects
- Yolo Habitat Conservation Plan/Natural Communities Conservation Plan and the Yolo Local Conservation Plan

7.4.2 Cumulative Impacts

Several related and reasonably foreseeable projects and actions may result in impacts to groundwater resources in the Project area. Several of the projects listed above (Agricultural Road Crossing #4, Lisbon Weir, and Lower Elkhorn Basin Levee Setback Modification) may involve construction activities near the Project area. These construction activities may include excavation related to construction of physical improvements. If construction activities occur near or below the groundwater table, dewatering efforts may be required to provide relatively dry conditions for construction. The groundwater pumping required for dewatering could cause temporary groundwater level declines in the shallow aquifer in the construction area during construction activities. Any dewatering activities would end after construction is complete, allowing groundwater levels to recover.

Several of the projects listed projects may result in a change to either the area that may be wetted or the depth of ponded water (Agricultural Road Crossing #4, Lisbon Weir, and Lower Elkhorn Basin Levee Setback Modification). These changes could increase the amount of recharge to groundwater in the Project area. These projects are not expected to include water with poor water quality that could degrade groundwater conditions. The additional recharge could raise groundwater levels in the Project area.

The projects listed above also are not expected to include the development of additional groundwater pumping, which could lower the groundwater table and/or cause subsidence. No activities are expected that would alter the existing, overall groundwater flow directions and/or groundwater quality.

The SGMA legislation, passed in 2014, requires that all groundwater basins categorized as medium- and high-priority form a GSA and be managed under a GSP by January 31, 2020. A GSA is a local entity tasked with developing the GSP and associated rules and regulations. The GSP will include provisions to avoid chronic lowering of groundwater levels along with avoiding significant and unreasonable degradation of water quality and land subsidence. When the GSP is in place and the basins are managed according to that GSP, the groundwater basin will be operated sustainably for the long term and not be subject to additional degradation of conditions.

Given that any construction activities would be short-term, the projects could provide additional recharge to the groundwater aquifer, and the projects are not expected to introduce additional pumping, subsidence, or quality issues, **the combined impact of the Project alternatives with other cumulative projects would not have a cumulatively considerable impact to groundwater levels and groundwater quality.**

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