Chapter 6
Surface Water

6.1 Environmental Setting/Affected Environment

California is characterized by 10 hydrologic regions, as shown in Figure 6-1. As described in Chapter 5, surface water that flows through the Delta and is conveyed by the State Water Project (SWP) and Central Valley Project (CVP) facilities primarily occurs in the Sacramento River and San Joaquin River hydrologic regions. A portion of the water from the Trinity River watershed in the North Coast hydrologic region is conveyed by the CVP into the Sacramento River basin, as described in Chapter 5. Some of the SWP/CVP water supplies are conveyed in rivers and streams within the Sacramento River and San Joaquin hydrologic regions, affecting surface water flows there. In San Francisco Bay, Central Coast, South Coast, Tulare Lake, South Lahontan, and Colorado River hydrologic regions, SWP/CVP water supplies are conveyed in pipelines and canals and do not directly affect surface waters.

For the purposes of this analysis, the surface water study area comprises the Sacramento hydrologic region and the Delta and Suisun Marsh located at the confluence of the Sacramento and San Joaquin rivers. These surface waters represent the geographic areas where potential changes could occur to surface waters as a result of modifications in SWP/CVP water supply operations, and implementation of habitat restoration in the Delta and Suisun Marsh Restoration Opportunity Areas (ROAs) identified in the Bay Delta Conservation Plan (Plan) alternatives.

Many topics related to surface water resources in the Sacramento River and San Joaquin hydrologic regions are also discussed in other chapters. Chapter 5, *Water Supply*, describes the effects of the No Action Alternative and BDCP alternatives on SWP/CVP contractors' water supply. Chapter 8, *Water Quality*, describes surface water quality in Sacramento River and San Joaquin River basins. Chapter 7, *Groundwater*, describes groundwater characteristics in the Sacramento River and San Joaquin River basins that are directly or indirectly affected by changes in surface water characteristics.

6.1.1 Potential Environmental Effects Area

The Sacramento River is the largest river by discharge in California and its basin is bounded by the Cascade and Trinity mountains on the north, the Delta on the south, the Sierra Nevada on the east, and the Coast Range on the west. It drains an area of about 27,246 square miles and discharges to the Sacramento–San Joaquin Delta (California Department of Water Resources 2009, Volume 3). The Sacramento River basin includes all or portions of 23 of the 58 counties in California. The Sacramento River extends approximately 365 miles from the slopes of Mount Shasta to Chipps Island in the Delta. The watershed also continues upstream of Mount Shasta to include the watersheds of the McCloud and Pit Rivers and Squaw Creek.

The San Joaquin River is the second largest river in California. It drains about 32,000 square miles and discharges to the Sacramento–San Joaquin Delta (U.S. Bureau of Land Management 2010). The San Joaquin River basin includes all or portions of 17 counties. The San Joaquin River extends approximately 330 miles from the slopes of the Sierra Nevada near Thousand Island Lake on the Middle Fork to Chipps Island in the Delta. The watershed is hydrologically separated from the Tulare

Lake watershed in the southern San Joaquin Valley by a broad ridge between the San Joaquin and Kings Rivers.

The Sacramento and San Joaquin Rivers join in the Delta and flow through Suisun Bay, San Pablo Bay, and San Francisco Bay to the Pacific Ocean.

6.1.2 Central Valley Hydrology

The hydrology of the Sacramento River and San Joaquin River basins and Suisun Marsh are described to support later discussions of environmental consequences associated with potential surface water changes resulting from temporary and permanent footprint of disturbance associated with construction and operation of water conveyance and related facilities, conservation components, and restored areas. The Tulare Lake basin is briefly described although the environmental consequences of the alternatives do not affect the surface waters in this basin.

6.1.2.1 Sacramento River Basin

The Sacramento River flows generally north to south from its source near Mount Shasta to the Delta near Freeport. The Sacramento River receives contributing flows from numerous major and minor streams and rivers that drain the east and west sides of the basin, including creeks upstream of the confluence with the Feather River (Cow, Battle, Cottonwood, Mill, Thomes, Deer, Stony, Big Chico, and Butte Creeks); Feather River (including flows from Yuba and Bear Rivers); American River; and Putah and Cache Creeks, which flow into the Yolo Bypass, which subsequently flows into the Cache Slough complex prior to entering the Sacramento River upstream of Rio Vista, as shown in Figure 6-2.

Sacramento River basin topography ranges in elevation from approximately 14,000 feet above sea level on Mount Shasta to approximately 1,070 feet at Shasta Dam, to sea level in the Delta, as shown in Figure 6-3. Generally, precipitation occurs in the form of snow during winter and early spring at elevations above 5,000 feet. The snowmelt generally occurs in April and May.

As described in Chapter 5, *Water Supply*, flows in the Sacramento River are regulated by operation of Shasta and Keswick dams. Water diverted from the Trinity River enters the Sacramento River through Keswick Reservoir. Major tributaries in the reach between Keswick Dam and Red Bluff include Clear and Cottonwood Creeks on the west and Battle, Bear, Churn, Cow, and Payne Creeks on the east. Major tributaries along the reach of the Sacramento River between Red Bluff and Verona are Antelope, Mill, Deer, Big Chico, Rock, and Pine Creeks on the east and Reeds, Red Bank, Elder, Thomes, and Stony Creeks on the west. Butte Basin, a natural basin that receives water from Little Chico Creek, Butte Creek and Cherokee Canal from the east and diverted water from Sacramento River through Moulton and Colusa Weirs, is also located in this reach. The Butte Basin drains to the south into the Sutter Bypass.

The Feather River flows into the Sacramento River immediately upstream of Verona. The Feather River watershed is approximately 3,607 square miles and located on the east side of the Sacramento Valley (Bureau of Reclamation 1997:III-5). The Feather River is the largest tributary to the Sacramento River below Shasta Dam. The Yuba River is a major tributary to the Feather River and flows into the Feather River near the town of Marysville (Bureau of Reclamation 1997:III-5). The Yuba River watershed is approximately 1,339 square miles. Yuba River flows are regulated primarily by New Bullards Bar Dam. The Bear River, with a watershed of about 295 square miles, is another major tributary to the Feather River. As described in Chapter 5, *Water Supply*, flows in the lower Feather River are regulated by operations of Oroville and Thermalito dams and diversions by Western Canal, Richvale Canal, the Pacific Gas and Electric Company (PG&E) Lateral, and the Sutter-Butte Canal.

Downstream of Verona, the Sacramento River continues to the Delta. At the Fremont Weir, downstream of Knights Landing and upstream of Sacramento, a portion of the Sacramento River water (up to 343,000 cubic feet per second [cfs]) flows into the Yolo Bypass during high water. Yolo Bypass conveys flood flows from the Sacramento River and Sutter Bypass to Cache Slough for continued conveyance into the Sacramento River upstream of Rio Vista. The Sacramento Weir and Bypass conveys high water from the Sacramento River downstream of Fremont Weir and upstream of the American River into Yolo Bypass. Yolo Bypass also conveys water from Knights Landing Ridge Cut, Willow Slough and Willow Slough Bypass, and Cache and Putah Creeks, located along the northern and western boundaries of Yolo Bypass.

Flows from the Yolo Bypass reenter the Sacramento River upstream of Rio Vista. Exports through SWP/CVP south Delta intakes may increase flows diverted through the Delta Cross Channel and Georgiana Slough, which in return may cause reduction of flows in the Sacramento River between Freeport and Rio Vista.

The Sacramento River enters the Delta near Freeport downstream of the American River confluence. During high water, the diversion of water to the Yolo Bypass Flood channel relieves the pressure of high flows along the Sacramento River. The design capacity of the Sacramento River at Freeport is 110,000 cfs (California Department of Water Resources 2005).

The American River watershed is approximately 1,895 square miles. The American River joins the Sacramento River at the City of Sacramento approximately 20 miles downstream of Verona. As described in Chapter 5, *Water Supply*, flows in the lower American River are regulated by operation of Folsom and Nimbus dams. American River flows are regulated upstream of Folsom Lake by operations of several reservoirs owned and operated by Placer County Water Agency, El Dorado Irrigation District, and Sacramento Municipal Utility District.

The surface water and groundwater systems in the Sacramento Valley are very strongly connected, as described in Chapter 7, *Groundwater*. The typically high groundwater levels in the Sacramento Valley cause the major rivers and the lower reaches of many of the tributary streams to gain flow through groundwater discharge. Surface water also seeps from the streams into the groundwater where groundwater elevations are lower than the stream water elevation, and the surrounding soils are porous. The quantities of groundwater that discharge into surface streams and the quantities of surface water that percolate into underlying aquifers change temporally and spatially, and are poorly understood. Estimates of these surface water/groundwater exchange rates have been developed for specific reaches on a limited number of streams in the Sacramento Valley (U.S. Geological Survey 1985), but a comprehensive valley-wide accounting has not been performed to date.

6.1.2.2 San Joaquin River Basin

The San Joaquin River originates in the Sierra Nevada and then flows west into the San Joaquin Valley through Millerton Lake at Friant. The San Joaquin River turns north near Mendota and flows through the San Joaquin Valley and into the Delta near Vernalis. The San Joaquin River receives contributing flows from the Fresno, Chowchilla, Merced, Tuolumne, Stanislaus, Calaveras, Mokelumne, and Cosumnes Rivers, as shown in Figure 6-2. The Calaveras, Mokelumne, and

Cosumnes Rivers flow into the San Joaquin River within the boundaries of the Delta. When Kings River in Tulare Lake hydrologic region floods, San Joaquin River also receives flood waters (as high as 5,000 cfs) from Kings River via Fresno Slough.

The San Joaquin River basin topography ranges in elevation from over 10,000 feet above sea level in the Sierra Nevada to sea level in the Delta. Generally, precipitation occurs in the form of snow during winter and early spring at the upper elevations and snowmelt occurs in the late spring and early summer months. As described in Chapter 5, *Water Supply*, flows in the San Joaquin River are regulated by operation of Friant Dam, which diverts water into the CVP Friant Division (as described in Chapter 5, *Water Supply*). The Friant Division conveys water in the Madera Canal to the north and the Friant-Kern Canal to the south for irrigation and municipal and industrial water supplies in the eastern portion of the San Joaquin Valley, and releases water in the San Joaquin River to meet downstream water rights and instream flow requirements. Hydropower generation facilities in the upper reaches of the San Joaquin River influence water flows into Millerton Lake (formed by Friant Dam). The water supply to the Friant Division was made available through an agreement with San Joaquin River water rights holders (Exchange Contractors), who entered into an exchange contract and purchase agreement with the Bureau of Reclamation (Reclamation) for delivery of water through the Delta-Mendota Canal. Flood management releases by Reclamation from Friant Dam may be used to satisfy portions of deliveries to the San Joaquin River Exchange Contractors. Millerton Lake operations are coordinated with operations of the Delta-Mendota Canal to manage releases, including flood management releases for the Exchange Contractors and other CVP water users (Bureau of Reclamation 1999:13-15).

In the San Joaquin River reach between Friant Dam and locations upstream of Mendota Pool, including Gravelly Ford, flows in the river have historically been extremely low or not discernible from the surface. The ongoing San Joaquin River Restoration Program is developing a comprehensive long-term effort to restore flows to the San Joaquin River from Friant Dam to the confluence of Merced River, ensuring irrigation supplies of water diverted from Friant Dam, and restoring a self-sustaining fishery in the San Joaquin River. The San Joaquin River Restoration Program is a direct result of a September 2006 legal settlement by the U.S. Departments of the Interior and Commerce, the Natural Resources Defense Council, and the Friant Water Users Authority to restore spring and fall run Chinook salmon to the San Joaquin River below Friant Dam while supporting water management actions within the Friant Division. Public Law 111-11 authorized and directed federal agencies to implement the settlement. Interim flows began October 1, 2009, and full restoration flows are scheduled to begin no later than January 2014 (California Department of Water Resources 2009:SJ-12).

San Joaquin River flow is diverted into several bypasses during high water. Upstream of the Mendota Pool and Mendota Dam, a major portion of the flow is diverted into the Chowchilla Bypass, which conveys water into the Eastside Bypass for further conveyance through Mariposa and Deep sloughs prior to discharge into the San Joaquin River near the confluence with the Merced River.

The Fresno River flows from the Sierra Nevada foothills near Madera to Hensley Lake, formed by Hidden Dam. Hidden Dam operations regulate the downstream Fresno River flows into the Eastside Bypass and subsequently into the San Joaquin River near the confluence with the Merced River.

The Chowchilla River flows approximately parallel to the Fresno River from the Sierra Nevada foothills and into Eastman Lake, which is formed by Buchanan Dam. Operations of the dam regulate the downstream reaches of the Chowchilla River, which flows into the San Joaquin River downstream of the City of Chowchilla and upstream of the confluence of the Merced and San Joaquin Rivers.

The Merced River originates in the Sierra Nevada and drains an area of approximately 1,273 square miles east of the San Joaquin River. Flows in the lower Merced River are regulated by operations of New Exchequer Dam, which forms Lake McClure, and three downstream dams. The Merced River is operated to meet water rights demands and instream flows and generate hydropower (Bureau of Reclamation 1999:3-8). The Merced River flows into the San Joaquin River downstream of the confluences with Deep Slough and Salt Slough.

The Tuolumne River drains a watershed in the Sierra Nevada of approximately 1,540 square miles. Flows in the upper Tuolumne River are regulated by the operation of O'Shaughnessy Dam, which forms the Hetch Hetchy Reservoir, and is diverted into Hetch Hetchy conveyance system that is owned and operated by the San Francisco Public Utilities Commission. Flows in the lower Tuolumne River primarily are regulated by the operation of New Don Pedro Dam that forms Lake Don Pedro. The Tuolumne River is operated to meet water rights demands in the watershed, water rights held by San Francisco Public Utility Commission, and instream flows; and to generate hydropower. The Tuolumne River flows into the San Joaquin River upstream of Modesto.

The Stanislaus River originates in the Sierra Nevada and drains a watershed of approximately 900 square miles. Snowmelt runoff contributes the largest portion of the flows in the Stanislaus River, with the highest monthly flows in April through June. Flows are regulated by New Melones Dam, which forms New Melones Reservoir, and is operated as part of the CVP as described in Chapter 5, *Water Supply*. Releases from New Melones Dam are reregulated by operations of the downstream Tulloch and Goodwin Dams. The Stanislaus River is operated to provide flood control; meet water rights demands in the watershed, including those of Oakdale Irrigation District and South San Joaquin Irrigation District; make deliveries to Central San Joaquin Water Conservation District and Stockton East Water District through CVP water service contracts; provide instream flows and water temperature management; and generate hydropower. The Stanislaus River flows into the San Joaquin River downstream of Modesto.

The San Joaquin River continues to flow to Vernalis. This reach of the river is influenced by flows from the San Joaquin River and return flows from agricultural operations that are supplied water from the San Joaquin River and the CVP Delta Mendota Canal. Vernalis is where the San Joaquin River enters the Delta. Downstream of Vernalis, the San Joaquin River splits into several channels including the main river channel that flows through Lathrop and Stockton; Middle River; and Old River. The Middle River and Old River channels are used by the SWP/CVP system to convey water from the Sacramento River to the SWP/CVP south Delta intakes, as described in Chapter 5, *Water Supply*. Middle River and Old River reconnect with the San Joaquin River downstream of the South Fork Mokelumne River and upstream of North Fork Mokelumne River. The channel capacity of the San Joaquin River near Vernalis is 52,000 cfs (California Department of Water Resources 2010a).

The Calaveras River originates in the Sierra Nevada and drains an area of approximately 363 square miles. The Calaveras River watershed is almost entirely below the effective average snowfall level (5,000 feet) and receives nearly all of its flow from rainfall. As a result, nearly all of the annual flow occurs between December and April. Flows in the lower Calaveras River are regulated by New Hogan Dam that forms New Hogan Lake. The Calaveras River is operated to meet water rights demands and instream flows, and flows into the San Joaquin River in the City of Stockton.

The Mokelumne River originates in the Sierra Nevada and drains a watershed of approximately 661 square miles. Flows in the Mokelumne River are regulated by several upstream reservoirs. Salt Springs Reservoir on the North Fork Mokelumne River is operated by PG&E to generate hydropower; and Pardee and Camanche reservoirs on the main stem of the Mokelumne River, are operated by East Bay Municipal Utility District to export water to their service area in the eastern San Francisco Bay Area. Downstream of these reservoirs, the Mokelumne River is operated to meet water rights demands in the watershed and instream flows, including flow requirements for a salmonid fish hatchery operated by East Bay Municipal Utility District. The mainstem Mokelumne River splits into the North and South Forks of the Mokelumne River at the southernmost tip of McCormack-Williamson Tract near New Hope Landing. The North and South Forks of the Mokelumne River flow south and converge at the southwestern tip of Staten Island. The Mokelumne River terminates in the San Joaquin River south of Bouldin Island in the Delta. Water from the Sacramento River is conveyed into the Mokelumne River system through the operable gates at the CVP Delta Cross Channel (see Chapter 5, *Water Supply*) and Georgiana Slough, which are located along the Sacramento River at Walnut Grove.

A major portion of the Cosumnes River water flows into the Mokelumne River near Thornton, and a portion flows into the Sacramento River upstream of Walnut Grove through Lost Slough. The Cosumnes River originates in the lower elevations of the Sierra Nevada and drains a watershed of approximately 537 square miles. The Cosumnes River receives most of its water from rainfall. The Cosumnes River flows are not regulated by major facilities, although Sly Park Reservoir is located in the upper watershed to meet local water rights demands. Holders of water rights to Cosumnes River flows in the watershed include several managed wetland areas.

The San Joaquin River flows through the Delta channels and joins the Sacramento River near Collinsville and flows into Suisun Bay. Several local tributaries flowing from the Delta lowlands into the San Joaquin River within the Delta include Mosher Creek, Bear Creek, Duck Creek, Pixley Slough flow and Disappointment Slough.

6.1.2.3 Delta Hydraulics

The Delta is a complex network of over 700 miles of tidally influenced channels and sloughs. Four strong forcing mechanisms drive circulation, transport, and mixing of water in the Delta: (1) freshwater river flow from drainages to the Delta; (2) tides from the west propagating from the Pacific Ocean through San Francisco Bay; (3) SWP/CVP water supply facilities operating in the Delta; and (4) collective effects of in-Delta agricultural diversions (U.S. Geological Survey 2005). Flow gages are located throughout the Delta, as shown in Figure 6-3.

Influence of Delta Inflows

Sacramento River is the primary contributor to Delta inflows (17,220 taf/yr). North Delta channels convey Sacramento River and Yolo Bypass flows (3,970 taf/yr) that move south and west as the Sacramento River reaches to the Delta. The Delta Cross Channel gates divert flows from the Sacramento River toward the SWP/CVP south Delta intakes. San Joaquin River is the second biggest contributor to Delta inflows (4,300 taf/yr) and it enters the Delta from south. While the natural direction of flow is towards north and west, channel flows in the southern Delta are sensitive to export operations. Pumping often slows or reverses flows that would naturally go north and west in the San Joaquin River and associated channels towards the Delta. Temporary barriers and tidal flow throughout the Delta add further complexity to the circulation and mixing of waters (U.S. Geological

Survey 2005). Finally, east side streams (Mokelumne, Cosumnes, and Calaveras Rivers) provide about 1,360 taf/yr inflow to Delta annually that join from east and flow towards west.

Influence of Delta Tidal Flows

Tidal flows have a major influence on Delta hydraulics. On average, tidal inflows to the Delta are approximately equal to tidal outflows. However, tidal flows vary with the gravitational effects of the moon. The spring tide, where the maximum tidal range occurs, coincides with full and new moon. The neap tide, where the minimum tidal range occurs, coincides with the quarter phases of the moon. At Martinez, the tidal range can vary by about 30% between the spring and neap conditions. Tidal flows at Martinez can be as high as 600,000 cfs.

All tidal flows enter and leave the Delta along the combined Sacramento and San Joaquin Rivers at Chipps Island. Further in the Delta, for example in Old River near Bacon Island, tidal flows can be as high as 16,000 cfs; and in relatively upstream locations such as Freeport and Vernalis, riverine conditions dominate the tidal effects. In the Sacramento River, for typical low flow conditions of around 15,000 cfs, the instantaneous flows at Freeport can vary by 4,000 cfs to 10,000 cfs within a day. Similarly, for low San Joaquin River flows (< 5,000 cfs), the instantaneous flows at Mossdale can vary by few hundred cfs to 2,000 cfs, within a day.

Water levels vary greatly during each tidal cycle, from less than one foot on the San Joaquin River near Interstate 5 to more than five feet near Pittsburg. The water levels at Freeport, at typical low flow conditions of around 15,000 cfs, can vary by one foot to two feet.

Sea level rise is another factor that has an influence on Delta hydraulics. Factors affecting sea level rise include tidal variations, storm surges, large-scale changes in water temperature and wind forces, and climate-related changes. Sea level has been rising at various rates over at least the past 20,000 years, with the most rapid rise of about 120 meters occurring from about 18,000 to 5,000 years ago. Data collected from tide gages indicate a global sea level rise rate of approximately 1.8 millimeters per year during the twentieth century. Using satellite altimetry data, the global sea level rise rate is estimated to be approximately 2.8 millimeters per year for the period from 1993 to 2003. Data from tectonically stable tide gages in California and other West Coast locations in the United States show similar rates, as described in Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*. The occurrence of extremes in sea level rise has increased markedly since the early 1900s (Cayan et al. 2008), as described in Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*.

Influence of SWP/CVP Delta Operations

The withdrawal rates at the south Delta intakes influence Delta hydraulics and can change the direction of flow of some waterways in the south Delta. The most influential effects occur on Old and Middle Rivers, as described in Chapter 5, *Water Supply,* Chapter 8, *Water Quality, and* Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*. Reverse flows also occur in False River in the western Delta and Turner Cut in the San Joaquin River.

South Delta hydraulics are influenced by several channels that have been widened or connected and by barriers to reduce connectivity between other channels to protect agricultural water uses or aquatic resources. Operations of these facilities affect operations of the SWP/CVP south Delta intakes.

Grant Line Canal and the Fabian and Bell Canal run in parallel and are commonly referred to collectively as the Grant Line Canal. This canal conveys flow from the Old River near the San Joaquin River to Old River near the diversion for the CVP south Delta intake.

Middle River is a relatively narrow and shallow channel that extends from Old River, past Victoria Canal to the San Joaquin River. In the lower 4 miles, from Victoria Canal to between the Tracy Boulevard and the Howard Road bridges, the channel bed has been dredged (California Department of Water Resources 2005).

Operation of major hydraulic control structures such as barriers and gates within the Delta has effects on water levels and flow and circulation patterns. These structures serve multiple purposes.

- Raise water surfaces for irrigation diversions
- Prevent fish from entering certain channels (fish protection)
- Affect circulation patterns to improve water quality

The locations of major hydraulic control structures in the Delta are shown in Figure 6-4.

In the south Delta, four temporary rock barriers are installed and removed seasonally as needed. The barriers include openings that allow a portion of the flow to pass downstream, but most flow is redirected into other channels. The four barriers historically have been installed at Head of Old River Gate, Old River at Tracy Gate, Middle River Gate, and Grant Line Canal Gate. The Head of Old River Gate (also referred to as the Head of Old River Barrier, see Chapter 5, *Water Supply*) is intended to prevent the movement of Chinook salmon into the southern Delta channels via the Old River, and to reduce channel water salinity. This gate is operated from April to May and September to November each year. The other three barriers are agricultural gates that are operated between April 15 and November 30 each year and during other periods of high tide and flooding as needed. These gates benefit agriculture within the Delta by maintaining required water levels and improving circulation patterns, which can help improve water quality. DWR also coordinates operations with South Delta Water Agency in the south Delta.

Tom Paine Slough is isolated from tidal influences by siphons. It essentially operates as a reservoir, supplying approximately 10 irrigation diversions. Portions of the channel have been dredged by the California Department of Water Resources (DWR) and the South Delta Water Agency, and siphons installed. In an effort to increase the water level maintained in Tom Paine Slough during unusually high tides, the Clifton Court Forebay gate operations were modified during flood-tide period of higher-high tides (California Department of Water Resources 2005).

Influence of Delta Diversions

There are over 1,800 diversions in the Delta area that are estimated to divert up to 5,000 cfs during peak summer months (DWR 2009). Most of these diversions are related to agricultural operations. However, several communities divert surface water from the Delta, including the City of Antioch and Contra Costa Water District. Numerous industries along the Contra Costa County shoreline from Martinez to Antioch, including power plants and refineries, and industries in San Joaquin County near Stockton also divert surface water. The community of West Sacramento diverts surface water immediately upstream of the Delta. New facilities being constructed near Sacramento (including Freeport Regional Water Authority Intake) and the City of Stockton also will divert water from the Delta for municipal uses.

Surface water in the Delta also is influenced by consumptive use of groundwater by agricultural crops and by seepage from the surface water into the interior of the islands and tracts. A substantial portion of the water diverted from the Delta or that seeps into the islands and tracts is returned to the Delta surface water by agricultural and drainage flows and seepage that is pumped from the islands and tracts into the Delta.

6.1.2.4 Suisun Marsh

Suisun Marsh is the largest contiguous brackish water marsh in North America, encompassing approximately 180 square miles comprising managed wetlands, upland grasses, tidal wetlands, bays, and sloughs. Suisun Marsh is located west of the Delta. Water Right Decision 1485 (D-1485) issued by the State Water Resources Control Board (SWRCB) in 1978 established channel water salinity standards and a water quality monitoring program and provided for the recently adopted Suisun Marsh Habitat Management, Preservation, and Restoration Plan (Bureau of Reclamation et al. 2010).

Suisun Marsh originally consisted of a group of islands separated by sloughs with inflow from tides and floods. In the 1860s and under federal and state legislation, reclamation of the swamps was accomplished through construction of a complex system of levees to develop managed seasonal wetlands and agriculture.

Both tidal and freshwater flows are conveyed into the marsh though an extensive network of sloughs. Green Valley, Suisun, Dan Wilson, Ledgewood, McCoy, and Denverton Creeks flow into Suisun Marsh from surrounding lands.

Several facilities have been constructed by DWR and Reclamation to maintain freshwater conditions in many portions of Suisun Marsh, including Suisun Marsh Salinity Control Gates, Morrow Island Distribution System, Roaring River Distribution System, Goodyear Slough Outfall, Lower Joice Island Unit, and the Cygnus Unit. The Suisun Marsh Salinity Control Gates are the primary facilities to maintain freshwater conditions and reduce tidal flows from Grizzly Bay into Montezuma Slough during incoming tides, and divert low salinity water from the Delta into Montezuma Slough. The Suisun Marsh Salinity Control Gates historically have operated from early October through May, depending on salinity conditions. The Roaring River Distribution System is designed to tidally pump water from the eastern end of Montezuma Slough to provide for the seasonal water needs of Suisun Marsh landowners and fisheries. The Morrow Island Distribution System consists of two channels that divert water from Goodyear Slough to the easternmost part of Morrow Island. Lower salinity water from Goodyear Slough is pumped into seasonal wetlands and drained into Grizzly Bay or Suisun Slough to prevent high-salinity drainage water from entering Goodyear Slough. The Goodyear Slough outfall connects the southern end of Goodyear Slough to Suisun Bay, which increases circulation and reduces salinity in Goodyear Slough. The Lower Joice Island Unit intake culverts on Montezuma Slough and on Suisun Slough near Hunter Cut divert water into a managed wetland area. The Cygnus Unit was constructed to provide drainage to another area of Suisun Marsh.

6.1.2.5 Tulare Lake Basin

The Tulare Lake basin consists of approximately 17,000 square miles located at the southern end of the San Joaquin Valley (California Department of Water Resources 2009:TL-5). It is an area bounded by the Sierra Nevada to the east, the Tehachapi Mountains to the south, the Coast Ranges to the west

(California Department of Water Resources 2009:TL-5), and by a broad ridge between the San Joaquin and Kings Rivers on the north. Historically, the Kings, Kaweah, and Tule Rivers flowed into the Tulare Lake bed, and the Kern River flowed into the Kern, Buena Vista, and Goose lake beds or into adjacent wetlands and marshes (California Department of Water Resources 2009:TL-5). Development of water supply and flood management projects on these rivers and drainage facilities in the lake beds transformed the lake beds into productive agricultural lands.

The Kings River, originating in Kings Canyon National Park, is regulated by Pine Flat Reservoir. Downstream of the reservoir, the South Fork flows to the Tulare Lake bed, and the North Fork flows to Fresno Slough (Bureau of Reclamation 1997:II-56). During periods with flood releases from Pine Flat Reservoir, portions of Kings River flow are diverted through the James Bypass/Fresno Slough system to the San Joaquin River basin (California Department of Water Resources 2009:TL-7); or may flow through Fresno Slough to Mendota Pool along the San Joaquin River (Bureau of Reclamation 1999:13-15). It is only under these conditions that the Tulare Lake basin has a surface water outflow.

The Kaweah River, originating in Sequoia National Forest, is regulated by Kaweah Lake and flows into the Tulare Lake bed (California Department of Water Resources 2009:TL-7). The Tule River, also originating in Sequoia National Forest, is regulated by Lake Success and also flows into the Tulare Lake bed (California Department of Water Resources 2009:TL-7).

The Kern River originates in the Inyo and Sequoia National Forests and Sequoia National Park, and is regulated by Lake Isabella. The Kern River flows into the Kern Lake bed and continues into the Buena Vista and Tulare Lake beds (California Department of Water Resources 2009:TL-7). Flows from the Kern River also may be diverted to the SWP California Aqueduct through the Kern River Intertie (California Department of Water Resources 2009, TL-7).

6.1.3 Central Valley Flood Management

Operations of surface waters in the Central Valley are affected by water supply requirements, as described in Chapter 5, *Water Supply*, and flood management operations, as described in this section.

6.1.3.1 Background of Central Valley Flood Management

Development of the Delta began in 1848 to provide food for the communities that were established during the Gold Rush in the California foothills. In 1850, the Swamp and Overflowed Lands Act was passed by Congress, ceding federal swamplands to the states to encourage reclamation. In 1868, the State Tideland Overflow and Reclamation Act passed by the California Legislature enabled the creation of local reclamation districts, which led to the transfer of much of this public land into private ownership. Most of the original levees constructed to reclaim wetlands in the Delta during the mid-1800s were less than 5 feet high (Thompson 1982). These small levees initially allowed the marshlands to be drained and farmed. Later, large steam-driven clamshell dredges were used to build and enlarge the levees to increase flood protection and to combat levee and land subsidence.

The organic peats and mucks used for construction in some areas of the Delta were not ideal levee construction materials, and seepage problems commonly developed. Organic soil material commonly shrank or compressed with placement of additional levee fill. Construction of the levees on the soft soil often resulted in irregular settlement and the creation of large cracks and fissures in levee and foundation soils. The surfaces of the reclaimed land also subsided as a result of oxidation of the organic soils. Levees required constant maintenance to overcome the land subsidence and settling.

Hydraulic mining in the Sierra Nevada, beginning around 1853 and lasting approximately three decades, washed vast amounts of material into the streams and canyons, resulting in reduced channel capacity downstream and increased flooding in the Sacramento Valley and the Delta. In 1893, the federal government established the California Debris Commission to regulate hydraulic mining, plan for improved navigation, deepen channels, protect river banks, and afford relief from flood damages. The California Debris Commission began surveys of Sacramento Valley streams in July 1905 and developed a flood management plan in 1907. The plan included constructing and enlarging levees along rivers, creating bypasses to convey flows greater than the river's capacity, and dredging the Sacramento River to Suisun Bay. The California Debris Commission had an influential role in the history of flood management, but was terminated by the Water Resource Development Act of 1986, and all its responsibilities were reassigned to the U.S. Army Corps of Engineers (USACE) (Kelley 1998).

Use of steam-powered dredges began in the Delta in the 1870s and continued for many decades (Dutra 1980). The general approach was to dredge alluvial sediments in the sloughs and rivers and deposit the wet, unconsolidated material on the levee. After the dredged material dried out, it would be shaped into an overall levee cross section. Today, many levees in the central Delta require periodic placement of new fill to meet specific design criteria to maintain flood protection.

The failure rate of Delta levees was generally greater in the early part of the twentieth century than during the latter half for several reasons.

- The construction of upstream storage reservoirs by the mid-1960s helped attenuate flood flows into the Delta.
- The construction of the two federal flood management projects significantly improved about a third of the levees in the Delta.
- Some of the islands that flooded in the early part of the century were not reclaimed. Consequently, this diminished the potential number of levee failures.
- The state began funding the Delta Levee Subventions and Special Projects programs in the 1980s as a result of ongoing levee failures. These grant monies helped fund levee maintenance and improvements in many areas of the Delta.
- More attention and resources have been given to flood fighting and responding to levee problems in the Delta.

In most levee failures, the breaches in the levees were repaired by either the USACE or by the local reclamation districts. The following islands are among those that were not reclaimed after flooding caused by levee failure.

- Western Sherman Island, approximately 5,000 acres, inundated in 1878.
- Big Break, approximately 2,200 acres, inundated in 1927.
- Franks Tract, approximately 3,300 acres, inundated in 1938.
- Mildred Island, approximately 1,000 acres, inundated in 1983.
- Little Franks Tract, approximately 330 acres, inundated circa 1983.

- Little Mandeville Island, approximately 376 acres, inundated in 1986.
- Liberty Island, 5,209 acres, inundated in 1998.

After the floods of 1986, USACE stated that it would no longer reclaim flooded islands that were protected by nonproject levees (levees not authorized or constructed under a federal flood management project [California Department of Water Resources 1995]). In 2004, after the Jones Tract levee failure occurred, Governor Schwarzenegger declared a state of emergency for San Joaquin County. The declaration allowed state funds to be used for repairing the breach. DWR assisted in the emergency response. The total cost of island and damage recovery was nearly $90 million (California Department of Water Resources 2008a).

Today, approximately 1,115 miles of levees protect 700,000 acres of land within the legal limits of the Delta, and approximately 230 miles of levees protect about 50,000 acres of the Suisun Marsh.

6.1.3.2 Flood Management Facilities in the Central Valley and the Delta

Upstream reservoirs, flood bypasses, and levees affect hydrology and flood management in the Central Valley and the Delta. Nineteen major multipurpose dams, the Sacramento River Flood Control Project, and San Joaquin River flood management facilities reduce flood potential in the Sacramento and San Joaquin Rivers and their tributaries, and the Delta. Levees built or adopted as part of the Sacramento River Flood Control Project (see Figure 6-5) are designated as “project levees” and are maintained by state and local public agencies pursuant to authority delegated to them by the federal government. Approximately 1,600 miles of project levees are part of federal flood management projects in the Central Valley, of which 385 miles are in the Delta. The remaining levees maintained by local districts are designated as “non-project levees.” High water is conveyed through the Delta and into San Francisco Bay for continued conveyance through the Golden Gate to the Pacific Ocean.

Flood management in the Delta also involves management of seepage water from Delta channels into the islands. If left unmanaged, this seepage could flood the islands. Excess seepage is pumped from the islands into the Delta channels.

Sacramento River Flood Control Project

The Sacramento River Flood Control Project (California Department of Water Resources 2010c) consists of the following features.

- Approximately 980 miles of levees along the Sacramento River, extending from Collinsville to Chico Landing (at River Mile 194), and the lower reaches of the major tributaries (American, Feather, Yuba, and Bear Rivers), minor tributaries, and distributary sloughs in the Delta.
- Moulton, Colusa, Tisdale, Fremont, and the Sacramento flood overflow weirs.
- Butte Basin; and Tisdale, Sutter, and Yolo bypasses and sloughs.

The principal features of the Sacramento River Flood Control Project extend from Ord Bend upstream of Yolo Bypass downstream to Collinsville, a distance of 184 river miles. These features include a comprehensive system of levees, overflow weirs, drainage pumping plants, and flood bypass channels (U.S. Army Corps of Engineers 1992). The flood bypass channels, to a certain extent, mimic natural and historical flooding patterns. The project levees begin on the western bank just downstream of Stony Creek. Upstream of the levees, high flows on the river flow to the east into the

Butte Basin, a trough created by subsidence. The Colusa Basin Drain, a similar trough located to the west of the river, intercepts runoff from westside tributaries.

The Tisdale Weir is usually the first flood overflow structure to spill. When the Sacramento River reaches 23,000 cfs, flows spill over the Tisdale Weir, through the Tisdale Bypass, and into the Sutter Bypass.

During major flood events, the major upstream reservoirs (including Shasta, Folsom, Oroville, Black Butte, and New Bullards Bar) intercept and store initial surges of runoff and provide a means of regulating flood flow releases to streams with levees, channels, and bypass floodways. To achieve the full flood flow-regulating benefits of the reservoirs, specific downstream channel capacities must be maintained. Reservoir operations are coordinated not only among various storage projects but also in accordance with downstream channel and floodway carrying capacities.

Yolo Bypass

The Yolo Bypass is an operational feature of the Sacramento River Flood Control Project, which was originally authorized by the Flood Control Act of 1917 and modified by various Flood Control and River and Harbor Acts in 1928, 1937, and 1941. The Yolo Bypass is located immediately west of the metropolitan area of Sacramento and lies in a general north-to-south orientation extending from the Fremont Weir (upstream of the Delta) downstream to Liberty Island (within the Delta), a distance of about 43 miles. The Yolo Bypass encompasses about 40,000 acres and varies in width from about 7,000 feet near the Fremont Weir to about 16,000 feet at Interstate 80. The eastern boundary of the Yolo Bypass is formed by the levees of the Sacramento River Deep Water Ship Channel.

During high flows in the Sacramento River, water enters the Yolo Bypass via the Fremont and Sacramento Weirs. Additional flows enter from the west along tributaries, including Willow Slough, Willow Slough Bypass, Cache Creek, Putah Creek, and Knights Landing Ridge Cut. Water flows from the Yolo Bypass into the Sacramento River upstream of Rio Vista. Every year, there is approximately 33% chance of flooding in the Yolo Bypass, and flood flows generally occur during the winter months of December, January, and February. Local surface waters in the Yolo Bypass flow through the Tule Canal and Toe Drain, which are west of the Sacramento Deep Water Ship Channel. USACE and the CVFPB regulate the Fremont Weir, Sacramento Weir, and the flood-carrying capacity of the Yolo Bypass. DWR is responsible for maintaining and operating those portions of the Sacramento River Flood Control Project.

The capacity of the Yolo Bypass ranges from 343,000 cfs downstream of Fremont Weir to 500,000 cfs near Rio Vista. The bypass was inundated 46 years out of the 65 years between 1935 and 1999 (CALFED Bay-Delta Program 2000a).

Sacramento River Project Levees in the Delta

Project levees in the northern Delta are primarily part of the Sacramento River Flood Control Project. The Sacramento River Flood Control Project was authorized by Congress in 1917 and was initially completed by USACE in 1960.

The Sacramento River Flood Control Project levees in the Delta include levees that protect, or partially protect, the following: West Sacramento, City of Sacramento, Walnut Grove, Courtland, Clarksburg, Ryde, Hood, lands between the Sacramento River and the Sacramento River Deep Water Channel (east levee of the Deep Water Ship Channel), Merritt Island, Sutter Island, Grand Island, Ryer Island, Tyler Island, Hastings Tract, Prospect Island, Brannan Island, Twitchell Island, Pierson Tract, and Sherman Island (California Department of Water Resources 1993).

San Joaquin River Flood Control Projects

Flood management features that affect the San Joaquin River include the Chowchilla Canal and the Eastside Bypass, which divert upper San Joaquin River high water flows and intercept streams draining the central Sierra Nevada (U.S. Army Corps of Engineers 2002). These bypasses and the Mariposa Bypass are part of the federal Lower San Joaquin River and Tributaries Project. These are levees in the Delta that do not meet the statutory definitions of project or nonproject levees.

The Lower San Joaquin River Flood Control Project includes levees that protect, or partially protect, Stockton, Lathrop, Manteca, Tracy, Stewart Tract, Upper Roberts Island, Middle Roberts Island, Lower Roberts Island, Pescadero District, and Union Island (U.S. Army Corps of Engineers 1999, 2008a).

Nonproject Levees in the Delta and Suisun Marsh

Most of the levees in the Delta are nonproject levees, comprising 730 of 1,115 miles. In Suisun Marsh, all of the approximately 230 miles of the levees are nonproject levees. These levees are not part of the federal flood management program and are maintained by local public reclamation districts (some are regulated by CVFPB and none are affiliated with Reclamation). Some of the maintenance activities are partially reimbursed by DWR under the Delta Levee Subventions Program established in 1973. The Delta Flood Protection Act of 1988 significantly increased reimbursement opportunities and added mitigation requirements to ensure no net long-term loss of habitat. Improvement and frequent maintenance of these levees are challenging for the reclamation districts because many districts have limited funds to both maintain the levees and protect levee wildlife habitat (California Department of Water Resources 1995).

Nonproject levees also protect portions of the deep water ship channels to the two major inland ports. The Stockton Deep Water Ship Channel was built in 1933 and follows the San Joaquin River past Rough and Ready Island to the Port of Stockton via Stockton Channel. The Sacramento River Deep Water Ship Channel follows the Sacramento River and Cache Slough prior to entering the excavated deep water channel that extends to the Port of Sacramento in West Sacramento. The levees on the east sides of the Sacramento River, Cache Slough, and the Sacramento River Deep Water Ship Channel are project levees. The levees on the west side of the Sacramento River upstream of Rio Vista, west side of Cache Slough, and a portion of the west side of the excavated channel near Cache Slough are nonproject levees.

6.1.3.3 Operation of Water Supply and Flood Management Flow Regulation Facilities in the Central Valley

Regulated flows for a river are the downstream flows that are controlled by major storage reservoirs, dams, or irrigation diversions. Flows into the Delta vary seasonally. High inflows are typically observed from mid-December until approximately mid-April. The low flow season is usually from mid-April through mid-December (CALFED Bay-Delta Program 2000a).

Both the Sacramento and San Joaquin Rivers have large, multipurpose dams, as summarized in Table 6-1. Most of the major dams have flood management storage capacity allocated in their reservoirs (U.S. Army Corps of Engineers 2002).

Table 6-1. Summary of Sacramento and San Joaquin River and Tributary Dams

Structure Name (Reservoir Name)	Stream	Type of Dam	Storage (TAF)[a]	Maximum Flood Control Storage (TAF)[a]	Owner	Year Constructed
Sacramento River Region						
Shasta Dam (Shasta Lake)	Sacramento River	Gravity	4,552	1,300	Reclamation	1945
Black Butte Dam (Black Butte Lake)	Stony Creek	Earth	144	136[c]	USACE	1963
New Bullards Bar Dam (New Bullards Bar Reservoir)	Yuba River	Variable Radius Arch	970	170	YCWA	1970
Oroville Dam (Lake Oroville)	Feather River	Earth	3,538	750	DWR	1968
Clear Lake[d] (Clear Lake)	Cache Creek	Gravity	315	0	YCFCWCD	1914
Indian Valley Dam (Indian Valley Reservoir)	North Fork Cache Creek	Earth	300	40	YCFCWCD	1976
Folsom Dam (Folsom Lake)	American River	Gravity	977	400[b]	Reclamation	1956
Monticello Dam (Lake Berryessa)	Putah Creek	Variable Radius Arch	1,602	0	Reclamation	1957
San Joaquin River Region						
Friant Dam (Millerton Lake)	San Joaquin River	Gravity	521	170[c]	Reclamation	1942
Los Banos Detention Dam (Los Banos Reservoir)	Los Banos Creek	Earth	35	14	Reclamation	1965
Hidden Dam (Hensley Lake)	Fresno River	Earth	90	65	USACE	1975
Buchanan Dam (Eastman Lake)	Chowchilla River	Rockfill	150	45	USACE	1975
New Exchequer Dam (Lake McClure)	Merced River	Rockfill	1,032	350[c]	Merced ID	1967
New Don Pedro Dam (Don Pedro Lake)	Tuolumne River	Rockfill	2,030	340	TID and MID	1971
New Melones Dam (New Melones Lake)	Stanislaus River	Rockfill	2,420	450	Reclamation	1979
Eastside Tributaries						
Pardee Dam (Pardee Reservoir)	Mokelumne River	Gravity	210	N/A[e]	EBMUD	1929
Camanche Dam (Camanche Reservoir)	Mokelumne River	Earth	417	200[c]	EBMUD	1963
New Hogan Dam (New Hogan Reservoir)	Calaveras River	Earth	317	165	USACE	1963
Farmington Dam (Littlejohns Creek)	Littlejohns Creek	Rockfill	52	52	USACE	1951

Sources: U.S. Army Corps of Engineers 1999, 2002

Notes: DWR = California Department of Water Resources; EBMUD = East Bay Municipal Utility District; ID = Irrigation District; N/A = not applicable; Reclamation = Bureau of Reclamation; TAF = thousand acre-feet; TID = Turlock Irrigation District; MID = Modesto Irrigation District; USACE = U.S. Army Corps of Engineers; YCFCWCD = Yolo County Flood Control and Water Conservation District; YCWA = Yuba County Water Agency

[a] Storage and flood control storage values are rounded to the nearest 1,000 acre-feet.

[b] Interim flood control storage exceeds this amount by as much as 670,000 acre-feet. Storage volume varies depending on upstream storage regulation.

[c] Maximum flood control space may vary depending on upstream storage and/or snowpack.

[d] Natural lake with a dam to increase storage.

[e] Total flood control storage can be shared between Camanche and Pardee reservoirs. It is reported for Camanche, the downstream reservoir.

The reservoirs are operated to reduce the potential for peak flows from multiple tributaries to simultaneously reach locations in the river systems. The reservoirs are operated in a coordinated manner based upon water's travel time from the reservoirs to the Delta. On the Sacramento River, the travel time for flows from Shasta Dam on the Sacramento River to the Delta is about 5 days. Travel time to the Delta from Oroville Dam on the Feather River and New Bullards Bar Dam on the Yuba River is 3 days. Travel time from Folsom Dam on the American River and New Melones Dam on the Stanislaus River to the Delta are generally 1 to 2 days. Because of its relative proximity to the Delta, and because the American River provides a large flow contribution, Folsom Dam's operation also can influence on Delta flood management and can increase flows in the Sacramento Bypass, which diverts water into the Yolo Bypass.

Water storage in reservoirs that are operated in part for flood management purposes is reduced gradually before the flood season begins in October and November. Reservoirs are operated throughout the winter and spring to reduce flood potential and replenish storage toward the end of the flood season, in March and April.

At least three types of high water events may occur in the Central Valley. Winter seasonal high water generally affects large portions of the Central Valley from November through April. High spring and early summer snowmelt high water originating from the higher elevations of the central and southern Sierra Nevada occur about once every 10 years on average from April through June. Local high water from strong thunderstorms with very intense rain over a relatively small areas occur from late spring to early fall in some years.

6.1.4 Delta Levee Failure Risks

Levee failures occur due to the following mechanisms: overtopping, seepage, erosion, instability, and seismic activity. Overtopping failure occurs when the capacity of the channel is inadequate to carry high water flows and water flows over the levee crown. The water flowing over the levee crown and down the landside slope erodes the levee section resulting in levee failure; this is of particular concern on levees built of sand or silt. Seepage failure is caused by water pressure within the levee or foundation large enough to cause material transport resulting in eternal erosion (often characterized by boils) leading to levee failure if unchecked. Failure due to erosion is caused by either wave action perpendicular to the levee or excessive water flow velocity parallel to the levee removing sufficient material that either seepage or instability of the levee failure occurs. Instability can take multiple forms. A slip can occur due to prolonged high water resulting in weakening of the foundation and levee materials such that the driving forces are greater than resisting forces. Instability may also occur when seepage forces cause sloughing of the levee landside slope. Progressive sloughs result in a shortened seepage paths leading to levee failure. Seismic activity may result in levee failure due to liquefaction of the levee or its foundation materials, resulting in excessive deformation or undesirable transverse cracks. No observed Delta levee failures have been directly linked to earthquake loading. However, it should be noted that levees in the Delta area have not yet been subjected to strong earthquake loading, as described in Chapter 9, *Geology and Seismicity*. Primarily because of the potential for liquefaction of levee embankments and foundations, it is assumed that an earthquake in the area would pose a significant threat to the Delta water supply, agriculture, and other land uses that rely on intact levees. Areas of reported levee problems in the Delta are shown in Figure 6-6.

As described in Chapter 9, *Geology and Seismicity*, it is generally believed that the primary seismic hazards in the Delta consist of faults and events primarily in the Western Delta and Suisun Marsh, and thus it is unlikely that the entire Delta region will be subjected to large motions from any single earthquake. Because of the large areal extent of the Delta and the varying distances from seismic sources, the Delta will experience different levels of ground shaking and potential associated geologic hazards. In addition, the Delta is underlain by blind thrust faults that are considered active or potentially active, but they are not expected to rupture to the ground surface. For a 100-year return period, controlling seismic sources for Peak Ground Acceleration would include the following fault zones: Southern Midland, Mt. Diablo, Northern Midland, Concord-Green Valley, Hayward-Rodgers Creek, and Calaveras, as described in Chapter 9, *Geology and Seismicity*.

6.1.4.1 Subsidence

Levee failure risks due to subsidence can be related to overall Delta subsidence, specific levee subsidence, and/or interior island subsidence.

Delta subsidence is an important issue when assessing the levee system. As the landside ground elevation decreases because of subsidence, the water level stays the same. This elevation difference increases pressure on the levee. This increase in pressure head through the levee foundation can cause serious issues with regard to seepage, piping, and slope stability. The theoretical volume of space between the ground surface and mean sea level within the Delta islands is referred to as anthropogenic accommodation space and is used to measure the effects of subsidence. The areas most susceptible to subsidence are the central, western, and northern Delta, where thick organic peat layers predominate (Public Policy Institute of California 2008b). However, as described in Chapter 9, *Geology and Seismicity,* peat soils only occur on portions of islands and tracts in the Delta.

Subsidence of soils beneath the existing levees and settlement of the levee embankment itself are caused by subsidence of island floors due to a number of factors, primarily due to oxidation of the organic soils and the reduction in soil volume through consolidation of soft, fine-grained soil. The soil experiences increased pressure as the embankment is constructed. Further consolidation occurs in response to the increased soil pressure due to the continued need to add more material to protect the levees from overtopping, as described in Chapter 10, *Soils*.

Subsidence resulting from the biochemical oxidation of organic soils and wind disturbance is described in Chapter 10, *Soils*. This process is related to the intense farming and flood management activities within the Delta that have removed moisture from the surficial soils, and allowed the highly organic peat soil to react with oxygen in the air to produce carbon dioxide and aqueous carbon (California Department of Water Resources 1995). This reaction allows the surficial soil to be displaced by wind. The loss of ground surface elevation because of wind is an important issue in assessing levee stability within the Delta. As the ground surface elevation is lowered, the landside slope of the levee becomes steeper and less stable. The lowered ground surface also increases the hydraulic loading on the levee and foundation.

6.1.4.2 Other Levee Failure Risks

Other potential risks that can affect the performance of levees within the Delta include encroachments, penetrations, excessive vegetation, burrowing animals, and security issues. These potential risks are relatively easy to control with proper implementation of operation and maintenance activities.

Encroachments

Encroachments such as boat docks, structures or farming practices on or close to the levee can adversely affect the levee if the structures are not constructed or maintained in accordance with the requirements of federal, state, and local agencies. Examples are irrigation pipes through the levee which can lead to increased seepage or instability. Obstructions such as fences and gates can interrupt access that is important for inspection, maintenance, and fighting floods. Another example is human intervention, such as off-road vehicle use, which can reduce the integrity of the levee crown and slopes. An encroachment on a project levee must obtain an encroachment permit from CVFPB.

Penetrations

Penetrations of the levee, such as culverts, can directly contribute to flooding if the waterside opening does not have an appropriate closure device that seals the opening and prevents excessive seepage and subsequent instability of the levee. Because of historic unregulated construction, levees also contain hidden risks that can cause water to seep through the levees including: abandoned sluiceways, drainage pipes and cables, concrete loading docks, fuel tanks, and storage drums (Johnson and Pellerin 2010). These risks will become less prevalent as state and local agencies identify and repair the levees (DWR 2011).

Burrowing Animals

The Delta provides an array of habitats, including marshlands, berms, and levees, for a variety of burrowing rodents. Burrows created by rodents, especially beavers, muskrats, and squirrels, can weaken the structural integrity of the levee and increase the likelihood of piping. Sunny-day levee failures may result from a combination of high tide and preexisting internal levee and foundation weaknesses that could be caused by burrowing animals. Rodent activities or preexisting weaknesses in the levees and foundations are believed to have contributed considerably to past levee failures. Reclamation districts and levee maintenance districts routinely check levees for indications of wildlife that could cause levee damage, and implement removal measures followed by levee repairs if necessary (Federal Emergency Management Agency 2005:64–70).

6.1.5 Delta Flood Risks

The Federal Emergency Management Agency (FEMA) and DWR have developed analytical procedures to define the probability of flooding and assess the risk of levee failures caused by flooding.

6.1.5.1 FEMA Analyses

FEMA is a primary source of present flood risk information. A key element of the program uses Flood Insurance Studies to produce Flood Insurance Rate Maps (FIRMs). Risk of flooding is defined by the probability that a flood will occur in any given year. For example, the “100-year flood” is a flood that has a 1% chance of occurring in any given year. This is also referred to by FEMA as a 1% annual chance of flooding. Likewise, the “200-year flood” and “500 year flood” are floods that have a 0.5% and 0.2% chance, respectively, of occurring in any given year.

The FEMA flood map database is used to help establish the level of flood risk at each community. FEMA’s floodplains are delineated as follows.

- Special Flood Hazard Areas (SFHA): Areas that are subject to inundation by the 1% annual chance flood event.
- Other Flood Areas: Areas subject to inundation by the 0.2% annual chance flood, or areas of 1% annual chance flood with average depths less than 1 foot or with drainage areas less than 1 square mile.
- Other Areas: Areas determined to be outside the 0.2% annual chance floodplain.

FEMA does not delineate floodplains for floods smaller than 1% annual chance floods, meaning floods that occur more frequently, such as 2% and 10% annual chance (50- and 10-year) floods. The SFHAs shown on these maps include areas described as "A" zones. Zone A means that flood elevations have not been determined for the area. Areas not in the "A" zones generally are less likely to flood because of ground elevation or protection by a certified levee or other protective feature.

In 2003, FEMA initiated a nationwide FIRM Modernization Project (Federal Emergency Management Agency 2010a). This project includes a strict review of levees protecting low-lying areas to ensure that they meet FEMA criteria for mapping a protected area as not being in a SFHA (i.e., not subject to inundation by a 1% annual chance flood).

Most areas of the Delta that were previously indicated as having 100-year protection (and therefore not included in SFHAs) are now having difficulty proving that their levees are adequate. Some areas, including West Sacramento and Reclamation District 17 in Lathrop, are initiating upgrade projects. Revised FEMA maps are planned to be issued over the next several years.

The Delta spans numerous FIRM panels and contains several FEMA flood zones. Encroachments within these flood zones are subject to federal, state, and local regulatory requirements. The federal regulatory requirements represent the minimum level of compliance needed. The local and state requirements may be more stringent. Existing FEMA flood zones within the Delta are broken into several groups: Special Flood Hazard Areas, Floodway Areas, Other Flood Areas, and Other Areas. The flood zones within the Delta are described below.

- Special Flood Hazard Areas–Special Flood Hazard Areas are subject to inundation by the 1% annual chance flood, or base flood. The following flood zones are Special Flood Hazard Areas that are present in the Delta.
    - Zone A refers to areas where the water surface elevations have not been determined for the base flood. No detailed studies were conducted for Zone A areas, and the boundaries are approximate. No floodways exist within Zone A boundaries. A significant portion of the Delta has been mapped as Zone A. The Zone A areas are primarily located near the boundaries of the legal limits of the Delta. The following RDs are mostly or entirely mapped as Zone A: 2068, 2104, 2060, 1667, 501, 1614, 828, 404, 2089, and 2117. A few small areas outside of these RDs are within the Delta boundaries and have been mapped as Zone A, as shown in Figure 6-7.
    - Zone AE characterizes Special Flood Hazard Areas where base floodwater surface elevations have been established. Floodway Areas in Zone AE are defined as the channel of a stream plus any adjacent floodplain areas. These areas must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights. A vast majority of the Delta is mapped as Zone AE. The areas mapped as Zone AE are primarily located in the central area of the Delta, but Zone AE areas encompass a greater part of all

  - regions of the Delta. Virtually all of the primary zone of the Delta, with the exception of RDs 744, 755, 551, and 554, is mapped as Zone AE, as shown in Figure 6-7.
  - Zone AH represents Special Flood Hazard Areas where base flood elevations have been determined and the depth of water is between 1 and 3 feet. Only a small region of the Delta has been mapped as Zone AH. The zone covers the portion of the City of Thornton that is east of North Nowell Road, as shown in Figure 6-7. The City of Thornton is part of RD 348, which is located between the eastern boundary of the primary zone and the eastern legal limit of the Delta.
- Other Flood Areas–Other Flood Areas are areas of 0.2% annual chance flood, areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile, and areas protected by levees from the 1% annual chance flood.
  - Shaded Zone X areas represent the areas that fulfill the criteria in place for "Other Flood Areas." Generally, Shaded Zone X areas are those areas that are within the 0.2% annual chance floodplain, and either outside or protected from a 1% annual chance flood. This is shown on the FEMA flood zone map, shown in Figure 6-7 as "0.2% annual chance of flooding."
- Other Areas–Other Areas consist of two flood zones: Un-Shaded Zone X, Zone D, and Zone VE.
  - Un-Shaded Zone X areas are those areas that are determined to be outside the 0.2% annual chance floodplain. A substantial portion of the Delta has been mapped as Un-Shaded Zone X. Un-Shaded Zone X areas include the following cities: Tracy in the southern Delta; Oakley, Antioch, and Pittsburg in the western Delta; and Stockton in the eastern Delta, as shown in Figure 6-7.
  - Zone D areas may contain flood hazards that have not been determined. These areas are located near Suisun Bay and Suisun Marsh, as shown in Figure 6-7.
  - Zone VE areas are coastal-related flood zones that occur in Suisun Marsh, as shown in Figure 6-7.

6.1.5.2 FEMA Flood Areas

The following descriptions of communities in the Delta and Suisun Marsh area are based on existing FEMA maps, which show floodplain delineations for areas subject to 1% annual chance floods.

- Antioch. The City of Antioch is within Contra Costa County and adjacent to the San Joaquin River. The City of Antioch is mapped into the 1% annual chance floodplain from the San Joaquin River and its tributaries (Federal Emergency Management Agency Flood Insurance Rate Maps - Maps 06013C: 0139F, 0143F, 0144F dated June 16, 2009).
- Benicia. The City of Benicia is in Solano County and adjacent to the Suisun Bay. Flooding from the Suisun Bay accounts for a portion of the 1% annual chance floodplain (Zone AE) mapped in Benicia (Federal Emergency Management Agency Flood Insurance Rate Maps - Maps 06095C: 0635E, 0633E, 0634E, 0642E, 0653E, and 0675E dated June 16, 2009).
- Clarksburg. Clarksburg is an unincorporated community on the western bank of the Sacramento River in Yolo County. Clarksburg does not have official boundaries, but it is situated to the north of the confluence of Elk Slough and the Sacramento River and south of Winchester Lake. Clarksburg is located within a 1% annual chance floodplain (Zone A). Levees exist along the

Sacramento River and Elk Slough but not along Winchester Lake. These levees are shown as not providing protection from the 1% annual chance flood (Federal Emergency Management Agency Flood Insurance Rate Maps - Map 06113C0745G dated June 16, 2010).

- Courtland. Courtland is an unincorporated community on the eastern bank of the Sacramento River in Sacramento County. Courtland is located in the Pierson District, which is bordered by the Sacramento River to the west and north, Snodgrass Slough to the east, and Meadows Slough to the south. Courtland is protected from the 1% annual chance flood by levees along the Sacramento River, Snodgrass Slough, and Meadows Slough, and is not mapped in a 1% annual chance floodplain (Federal Emergency Management Agency Flood Insurance Rate Map 0602620010D dated February 4, 1998).
- Lathrop. The City of Lathrop is divided by the San Joaquin River into two distinct land use sections: highly developed lands in the east and agricultural lands in the west. The area west of the San Joaquin River is subject to flooding by the 1% annual chance flood. However, the lands to the east are protected from the 1% annual chance flood by a levee along the eastern bank of the San Joaquin River, so this area is not mapped in a 1% annual chance floodplain. This levee is considered a Provisionally Accredited Levee (PAL), and levee owners or communities are required to submit the data necessary to comply with 44 CFR 65.10; otherwise, the levee can be de-accredited (Federal Emergency Management Agency Flood Insurance Rate Maps - Maps: 06077C: 0585F, 0595F, 0605F, 0610F, 0615F, and 0610F dated October 16, 2009).
- Locke. Locke is an unincorporated community on the eastern bank of the Sacramento River in Sacramento County. Locke does not have official boundaries, but its general area is mapped in a 1% annual chance floodplain. Levees around Locke line the Sacramento River on the west, the Delta Cross Channel to the south, and Snodgrass Slough to the east, but do not protect it from the 1% annual chance flood (Federal Emergency Management Agency Flood Insurance Rate Maps - Map 0602620560C, dated September 30, 1988; Map 0602620420D, dated February 4, 1998).
- Manteca (western portion). The City of Manteca is southeast of the City of Lathrop, adjacent to the San Joaquin River. A portion of Manteca is protected from the 1% annual chance flood (from the San Joaquin River) by the Western Ranch South Levee, which is considered a PAL (see discussion for Lathrop); this area is not mapped in 1% annual chance floodplain. South of the Western Ranch South Levee, a relatively small portion of the city is mapped in the 1% floodplain (Federal Emergency Management Agency Flood Insurance Rate Maps - Map 06077C0620F dated October 16, 2009).
- Oakley. The City of Oakley is in Contra Costa County east of the City of Antioch and adjacent to San Joaquin River, Big Break, and Dutch Slough. This city is mapped in the 1% annual chance floodplain from the San Joaquin River and its tributaries (Federal Emergency Management Agency Flood Insurance Rate Maps - Maps 06013C: 0165F, 0170F, 0355F, and 0360F dated June 16, 2009).
- Pittsburg. The City of Pittsburg is in Contra Costa County and adjacent to San Joaquin River and Suisun Bay. This city is mapped in the 1% annual chance floodplain from the Suisun Bay. Flooding sources also include the San Joaquin River (Federal Emergency Management Agency Flood Insurance Rate Maps - Maps 06013C: 0118F, 0119F, 0120F, and 0139F dated June 16, 2009).
- Rio Vista. The City of Rio Vista is drained east-southeasterly by Marina Creek, Marina Creek Tributary, and Industrial Creek as they flow toward the Sacramento River. The portion of the

city west of the Sacramento River is subject to the 1% annual chance flood (mapped in the 1% annual chance floodplain) because of flooding from the Watson Hollow and Cache Slough. The lower reaches of the Sacramento River are under the influence of tides. Severe flooding along this waterway could result when very high tides and a large volume of stream outflow coincide, and strong onshore winds generate wave action that would increase the flood hazard above that of the tidal surge alone (Federal Emergency Management Agency Flood Insurance Rate Maps - Maps 06095C: 0530E, 0537E, 0540E, 0541E, and 0539E dated May 4, 2009).

- Sacramento (Pocket Area). The City of Sacramento's Pocket Area is in the southern portion of the community. This community is bordered by Interstate 5 to the east and the Sacramento River to the south, west, and north. A levee located along the Sacramento River is shown as providing protection from the 1% annual chance flood; however, this levee is shown as a PAL; this area is not mapped in the 1% annual chance floodplain (Federal Emergency Management Agency Flood Insurance Rate Maps 0602660285G and 0602660305G dated December 8, 2008).

- Stockton (western portion). The City of Stockton is situated adjacent to a network of sloughs and canals that branch off the San Joaquin River. The western region of Stockton is protected from the 1% annual chance flood by levees along Bear Creek, Lower Mosher Creek, Fourteen Mile Slough, Five-Mile Slough, Disappointment Slough, Calaveras River, Smith Canal, Stockton Deep Water Ship Channel, Burns Cutoff, and the San Joaquin River. Each of these levees is considered a PAL (see discussion for Lathrop); this area is not mapped in a 1% annual chance floodplain (Federal Emergency Management Agency Flood Insurance Rate Maps - Maps: 06077C: 0295F, 0315F, 0320F, 0435F, 0455F, 0460F, 0465F, and 0470F dated October 16, 2009).

- Walnut Grove. Walnut Grove is an unincorporated community on the eastern bank of the Sacramento River in the northern part of Tyler Island. It is protected from the 1% annual chance flood by levees that line the Delta Cross Channel to the north and along the Mokelumne River to the south. This community is not mapped in a 1% annual chance floodplain.

- West Sacramento. The City of West Sacramento is currently designated as being protected from the 0.2% annual chance flood by levees that line the western bank of the Sacramento River (Federal Emergency Management Agency Flood Insurance Rate Maps - Maps 0607280005B and 0607280010B, dated January 19, 1995). However, FEMA is in the process of de-accrediting the city's levees. The northeastern portion of the city is close to the confluence of the American and Sacramento rivers, which is a FEMA-designated floodway. Levees are also located along the Yolo Bypass, Sacramento River Deep Water Ship Channel, and Sacramento Bypass.

FEMA maps indicate that much of the central Delta, essentially all of the non-urban Delta, is within SFHAs (mapped in the 1% annual chance floodplain) and considered to be subject to inundation by the 1% annual chance flood. Many local agencies are working to preserve their levee accreditation and thereby avoid being designated as "A" zones.

6.1.5.3 DWR State Plan of Flood Control

CVFPB recently adopted the *2012 Central Valley Flood Protection Plan* (State Plan of Flood Control) (California Department of Water Resources 2011). The plan addresses current and future flood risks and recommends an investment approach to improve public safety, ecosystem conditions, and economic sustainability in areas protected by the State Plan of Flood Control. The State Plan of Flood Control describes over 80 potential flood management actions that could be undertaken to addresses the Sacramento River Flood Control Project facilities and other flood facilities in the

Central Valley. The plan indicates that about 50% of the 300 miles of urban levees evaluated do not meet engineering design criteria for projected design water surface elevations based on criteria published in *Design and Construction of Levees Engineering Manual 1110-2-1913* (U.S. Army Corps of Engineers 2000) and *Interim Levee Design Criteria for Urban and Urbanizing Areas in the Sacramento Valley, Version 4* (California Department of Water Resources 2010b). The plan also indicates that about 60% of the 1,230 miles of non-urban levees have a high potential for failure at the projected design water surface elevations, based upon an analysis that correlated geotechnical data with levee performance history, but not relative to specific design criteria. The plan further notes that about 50% of the 1,016 miles of channels evaluated had potentially inadequate capacity to convey design flows; none of the 32 hydraulic structures and 11 pumping plants inspected were rated "unacceptable," but many were approaching the end of their design life; and 2 of the 10 bridges that were inspected required repairs (California Department of Water Resources 2011). This analysis only applies to the project levees in the Delta.

6.2 Regulatory Setting

This section provides the regulatory setting for surface water resources, including potentially relevant federal, state, and local requirements applicable to the BDCP.

Federal regulations that address water quality also may apply to surface water quality, as presented in Chapter 8, *Water Quality*, and Chapter 10, *Soils*. These regulations are federally mandated and implemented in California through the SWRCB. State regulations that address water quality also may apply to surface water quality, including Order No. 99-08-DWQ, NPDES General Permit No. CAS000002, and WDRs for Discharges of Stormwater Runoff Associated with Construction Permit (General Permit), as presented in Chapter 8, *Water Quality* and Chapter 10, *Soils*.

6.2.1 Federal Plans, Policies, and Regulations

The following federal regulations may apply to surface water, but are presented in other sections.

- Safe Drinking Water Act (42 USC 300f) – see Chapter 8, *Water Quality.*
- Clean Water Act (33 USC 1251–1376) – see Chapter 8, Water *Quality* and Chapter 9, *Soils*.
- Central Valley Project Improvement Act (PL 102-575) – see Chapter 5, *Water Supply*.
- Coordinated Operations Agreement – see Chapter 5, *Water Supply*.
- Trinity River Mainstem Fishery Restoration (per Central Valley Project Improvement Act) – see Chapter 5, *Water Supply*.
- San Joaquin River Agreement – see Chapter 5, *Water Supply* (under Section 5.1.2.1., CVP Facilities, East Side Division).
- Endangered Species Act– see Chapter 5, *Water Supply* (under National Marine Fisheries Service and U.S. Fish and Wildlife Service Biological Opinions for Continued Long-Term Operations of CVP/SWP)
- Federal Power Act – see Chapter 5, *Water Supply*.

Other federal plans, policies, and regulations that could affect surface waters are related to management of floodplains.

6.2.1.1 1850 Swamp and Overflowed Lands Act

In 1849, Congress granted Louisiana certain wetlands described as "swamp and overflowed lands, which may be or are found unfit for cultivation" in order to facilitate land reclamation and the control of flooding. On September 28, 1850, Congress passed a subsequent Swamp and Overflowed Lands Act to convey similar public lands to twelve other states with no cost. This act, sometimes referred to as the Arkansas Act, also applied to California. The only requirement of the act was that the states use the funds they realized from the sale of these lands to ensure that they would be drained, reclaimed, and put to productive agricultural uses. The State of California received 2,192,506 acres of land, which included 549,540 acres in the Sacramento Valley and approximately 500,000 acres in the Sacramento-San Joaquin Delta.

6.2.1.2 Federal Emergency Management Agency

FEMA is responsible for maintaining minimum federal standards for floodplain management within the United States and territories of the United States. As discussed below, FEMA plays a major role in managing and regulating floodplains. FEMA is responsible for management of floodplain areas, which are defined as the lowland and relatively flat areas adjoining inland and coastal waters subject to a 1% or greater chance of flooding in any given year (the 100-year floodplain).

Executive Order 11988, Floodplain Management

Under Executive Order 11988, all federal agencies are charged with floodplain management responsibilities when planning or designing federally funded projects or when considering any permit applications for which a federal agency has review and approval authority. These responsibilities include taking action to reduce the risks of flood losses, including adverse impacts to human safety, health, and welfare. Federal agencies also are charged with the responsibility of restoring the natural and beneficial values of floodplains. If a proposed action is located within a floodplain, measures should be identified to minimize flood hazards, and floodplain mitigation requirements should be incorporated into the proposed action (Federal Emergency Management Agency 1982).

National Flood Insurance Program

FEMA administers the National Flood Insurance Program (NFIP). The NFIP has three main components: risk identification and mapping, floodplain management assistance, and flood insurance assistance. The purpose of flood insurance is to enable property owners to purchase insurance against losses from physical damage or the loss of buildings and their contents caused by floods, flood-related mudslides, or erosion. Insurance is available to property owners belonging to NFIP-participating communities. The NFIP is administered by the Federal Insurance Administration under FEMA. Participation in the NFIP also makes communities eligible for federal flood disaster assistance. For a community to be eligible to participate in the NFIP, the community must adopt a local floodplain management ordinance that meets or exceeds the minimum federal standards defined in 44 CFR 60–65. Participating communities must adhere to all floodplain management requirements, with oversight from FEMA, for all activities that may affect floodplains within the Special Flood Hazard Areas.

As part of the NFIP, FEMA provides one or more FIRMs (discussed previously in the Floodplain Delineation section). Each FIRM contains flood zones that are used to determine a community's flood insurance rates and floodplain development restrictions. It identifies which communities are federally required to carry flood insurance. For example, communities can choose to participate or not participate in the NFIP. Homeowners with federally backed mortgages may be required to carry flood insurance, but otherwise may not be required to carry insurance. Flood zones are areas delineated to represent areas with similar flood risk, flood protection infrastructure, flood protection infrastructure certifications, and designated floodways. FEMA requires that local governments covered by federal flood insurance pass and enforce a floodplain management ordinance that specifies minimum requirements for any construction within the 100-year floodplain.

Flood Zone Regulations

Special Flood Hazard Areas are subject to federal and state requirements, which are defined primarily by federal regulations at 44 CFR 60.3 and 44 CFR 65.12. The first citation requires the following:

> (6) Notify, in riverine situations, adjacent communities and the State Coordinating Office prior to any alteration or relocation of a watercourse, and submit copies of such notifications to the Administrator;
>
> (7) Assure that the flood carrying capacity within the altered or relocated portion of any watercourse is maintained;
>
> (10) Require until a regulatory floodway is designated, that no new construction, substantial improvements, or other development (including fill) shall be permitted within Zones A1–30 and AE on the community's FIRM, unless it is demonstrated that the cumulative effect of the proposed development, when combined with all other existing and anticipated development, will not increase the water surface elevation of the base flood more than one foot at any point within the community [44 CFR 60.3(b)(6,7,10)].

These federal regulations are intended to address the need for effective floodplain management and provide assurance that the cumulative effects of floodplain encroachment do not cause more than a 1 foot rise in water surface elevation after the floodplain has been identified on the FIRM (local flood ordinances can set a more stringent standard). The absence of a detailed study or floodway delineation places the burden on the project proponent to perform an appropriate engineering analysis to prepare hydrologic and hydraulic analyses consistent with FEMA standards. These analyses would then be used to evaluate the proposed project together "with all other existing and anticipated development." Defining future anticipated development is difficult. The purpose of this requirement is to avoid inequitable encroachments into the floodplain.

For projects that are discovered to cause any increase in water surface elevations, 44 CFR 65.12, "Revision of flood insurance rate maps to reflect base flood elevations caused by proposed encroachments," states:

> (a) When a community proposes to permit encroachments upon the flood plain when a regulatory floodway has not been adopted or to permit encroachments upon an adopted regulatory floodway which will cause base flood elevation increases in excess of those permitted under paragraphs (c)(10) or (d)(3) of § 60.3 of this subchapter, the community shall apply to the Administrator for conditional approval of such action prior to permitting the encroachments to occur and shall submit the following as part of its application:
>
> (1) A for conditional approval of map change and the appropriate initial fee as specified by § 72.3 of this subchapter or a request for exemption from fees as specified by § 72.5 of this subchapter, whichever is appropriate;

(2) An evaluation of alternatives which would not result in a base flood elevation increase above that permitted under paragraphs (c)(10) or (d)(3) of § 60.3 of this subchapter demonstrating why these alternatives are not feasible;

(3) Documentation of individual legal notice to all impacted property owners within and outside of the community, explaining the impact of the proposed action on their property;

(4) Concurrence of the Chief Executive Officer of any other communities impacted by the proposed actions;

(5) Certification that no structures are located in areas which would be impacted by the increased base flood elevation;

(6) A request for revision of base flood elevation determination according to the provisions of § 65.6 of this part;

(7) A request for request floodway revision in accordance with the provisions of § 65.7 of this part.

The provisions of this regulation require either demonstration that the proposed project would cause no effect on the base flood elevations or else the project must obtain a Conditional Letter of Map Revision prior to permitting the project for construction. Also, as suggested, if the project causes no effect on the base flood elevations, it can be approved by the floodplain administrator for the community without any approvals by FEMA or Conditional Letter of Map Revision submittals to FEMA. However, the floodplain administrator can require a Conditional Letter of Map Revision if it is felt that the project is of sufficient complexity to warrant FEMA's review.

The minimum federal regulatory requirement pertaining to encroachments into the floodway is defined by 44 CFR 60.3(d)(3):

(3) Prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analyses performed in accordance with standard engineering practice that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge.

This regulation applies only to encroachments into the floodway. When there is such an encroachment, the FEMA effective hydraulic model should be used to evaluate the impacts and mitigation options for the encroachment.

FEMA Levee Design and Maintenance Regulations

Code of Federal Regulations

Guidance and criteria for levees included in the NFIP are provided in 44 CFR 65.10. The major criteria within the document include freeboard, closure structures, embankment protection, embankment and foundation stability, settlement, interior drainage, and other design criteria. Operation and maintenance requirements are also discussed. Each of these criteria includes specific design guidelines that must be met in order for the levee to remain in the NFIP. It should be noted that FEMA is not responsible for evaluating these levees; the evaluation is performed by others, which leads to FEMA accreditation when FEMA adopts the certification.

Procedure Memorandum 34

Procedural Memoranda supplement and clarify the information in Appendix H of FEMA's *Guidelines and Specifications for Flood Hazard Mapping Partners* (2003) regarding mapping the base flood in areas with levees. Procedural Memorandum 34, *Interim Guidance for Studies Including Levees*, provides FEMA staff, contractors, and mapping partners with guidance for the evaluation and mapping of levees and levee-affected areas as part of the FEMA Flood Map Modernization Program (Federal Emergency Management Agency 2010a).

Procedure Memorandum 43

Procedural Memorandum 43, *Guidelines for Identifying Provisionally Accredited Levees*, provides FEMA staff, contractors, and mapping partners with guidance for identifying Provisionally Accredited Levees and mapping levee-affected areas. Also included is a fact sheet, prepared in question-and-answer format, that provides detailed information regarding NFIP procedures for evaluating and mapping levee systems with emphasis on Procedural Memorandum 43 and Provisionally Accredited Levee systems. This fact sheet was designed for a more technical audience. Additional documents include flow charts and sample letters for different levee scenarios (National Committee on Levee Safety 2009).

Hazard Mitigation Plan Criteria

Guidance regarding Hazard Mitigation Plans for both state and local agencies is provided in 44 CFR 201. Hazard Mitigation Plans are necessary for receiving grant funding under the Stafford Act for prevention planning. The States must demonstrate a commitment to risk reduction from natural hazards, including levee failure. Hazard Mitigation Plans act as guidance for state decision makers in determining the appropriation of resources to the reduction of these risks.

In California, the Hazard Mitigation Plan design standards (based upon geometric criteria for the levees) were negotiated by the FEMA, DWR, California Office of Emergency Services, and the Delta Levee Maintaining Agencies between 1983 and 1987 to establish a minimal, short-term interim standard to reduce the risk of repeat flood damage. Although this standard was to be an interim standard, no adjustments based on subsequent or projected flood elevations have been used to modify the standard. Meeting this standard allows the Delta island or tract to be eligible for FEMA disaster grants and assistance following levee failures and island inundation. If even a portion of the levee around the island or tract does not meet the Hazard Mitigation Plan standard, the FEMA will deny claims for levee damage.

FEMA 100-year (Base Flood) Protection

The FEMA 100-year Protection standard, often called the 1% annual chance flood level of protection, is based on criteria established in the Code of Federal Regulations and is often used with established USACE criteria to meet certain freeboard, slope stability, seepage/underseepage, erosion, and settlement requirements. Numerical hydrologic models are used to project surface water elevations at different locations in the rivers for the statistically probable 100-year flood event. Model runs are updated periodically to reflect changes in river bathymetry and historical hydrology. Meeting this level of flood protection means that communities will not require mandatory purchase of flood insurance for houses in the floodplain or be subject to building restrictions. This standard generally does not address seismic stability. Currently, FEMA 100-year criteria are based on historical conditions and do not include considerations for climate change or sea level rise. FEMA is currently completing a study on the Impact of Climate Change on the National Flood Insurance Program (Federal Emergency Management Agency 2010b) to determine how to accommodate these factors and the long-term implications.

FEMA Levee Design and Maintenance Requirements

For levees to be accredited by FEMA, and to allow communities to participate in Preferred Risk programs of the NFIP, evidence must be provided that adequate design, operation, and maintenance systems are in place to provide reasonable assurance that protection from the base flood (1% annual chance of exceedance or 100-year flood) exists. These requirements are outlined in 44 CFR, Volume 1, Chapter I, Part 65.10 and summarized as follows:

- Freeboard. Riverine levees must provide a minimum freeboard of 3 feet above the water surface level of the base flood. An additional 1 foot above the minimum is required within 100 feet on either side of structures (such as bridges) riverward of the levee or whatever the flow is constructed. An additional 0.5 foot above the minimum at the upstream end of the levee, tapering to not less than the minimum at the downstream end of the levee, is also required.
- Closure. All openings must be provided with closure devices that are structural parts of the system during operation and designed according to sound engineering practice.
- Embankment protection. Engineering analyses must be submitted demonstrating that no appreciable erosion of the levee embankment can be expected during the base flood as a result of either currents or waves, and that anticipated erosions will not result in failure of the levee embankment or foundation directly or indirectly through reduction of the seepage path and subsequent instability.
- Embankment and foundation stability. Engineering analyses that evaluate levee embankment stability must be submitted. The analyses provided shall evaluate expected seepage during loading conditions associated with the base flood and shall demonstrate that seepage into or through the levee foundation and embankment will not jeopardize embankment or foundation stability.
- Settlement. Engineering analyses must be submitted that assess the potential and magnitude of future losses of freeboard as a result of levee settlement and demonstrate that freeboard will be maintained within the minimum standards.
- Interior drainage. Analysis must be submitted that identifies the source(s) of such flooding, the extent of the flooded area, and, if the average depth is greater than 1 foot, the water surface elevation(s) of the base flood.
- Operation plans. For a levee system to be recognized, a formal plan of operation must be provided to FEMA. All closure devices or mechanical systems for internal drainage, whether manual or automatic, must be operated in accordance with an officially adopted operational manual, a copy of which must be provided to FEMA.
- Maintenance Plans. Levee systems must be maintained according to an officially adopted maintenance plan. All maintenance activities must be under the jurisdiction of a federal or state agency, an agency created by the federal or state law, or an agency of a community participating in the NFIP that must assume ultimate responsibility for maintenance. The plan must document the formal procedure that ensures that the stability, height, and overall integrity of the levee and its associated structures and system are maintained. At a minimum, maintenance plans shall specify the maintenance activities to be performed, the frequency of their performance, and the person, by name or by title, responsible for their performance.

The information submitted to support that the levee complies with the above requirements must be certified by a registered professional engineer. Certified as-built plans of the levee also must be submitted.

6.2.1.3 U.S. Army Corps of Engineers

The following discussion provides an overview of USACE's regulatory responsibilities that apply to navigable waters and construction within the ordinary high water mark of other waters of the United States. In addition, USACE constructs flood and risk management projects and monitors their operations and maintenance. It also provides emergency response to floods. These functions are also described below.

Flood Control Act of 1936

USACE constructs local flood and risk management projects and navigation projects in the Delta. The Flood Control Act of 1936 established a nationwide policy that flood management on navigable waters or their tributaries is in the interest of the general public welfare and is, therefore, a proper activity of the federal government in cooperation with states and local entities. The 1936 Act, its amendments, and subsequent legislation specify details of federal participation. Projects are either specifically authorized through legislation by Congress or through a small projects blanket authority. Typically, a feasibility study is done to determine federal interest before authorization or construction. USACE has a Delta feasibility study underway. A study under the American River Common Features authority is studying additional flood protection for the City of Sacramento that could involve alteration to Sacramento River levees or the Yolo Bypass in the Delta. The planned San Joaquin River basin study will evaluate more flood protection for the City of Stockton and vicinity. The West Sacramento Feasibility Study is evaluating flood protection for the City of West Sacramento. The USACE is also engaged in design and construction of South Sacramento Streams which is also partially in the Legal Delta boundary.

The Clean Water Act

The Clean Water Act established the basic structure for regulating discharges of pollutants into waters of the United States and gave the U.S. Environmental Protection Agency the authority to implement pollution control programs such as setting wastewater standards for industry. The Clean Water Act sets water quality standards for all contaminants in surface waters and allows the U.S. Environmental Protection Agency to delegate some of its authority for enforcing such standards to states (the California State Water Resources Control Board, and associated Regional Boards, is the agency that helps enforce water quality standards in California).

Section 404 of the Clean Water Act regulates the discharge of dredged and fill material into waters of the United States, including wetlands. Activities in waters of the United States that are regulated under this program include fills for development, water resource projects (e.g., dams and levees), infrastructure development (e.g., highways and airports), and conversion of wetlands to uplands for farming and forestry. USACE has jurisdiction over all waters of the United States including, but not limited to, perennial and intermittent streams, lakes, ponds, as well as wetlands and marshes, wet meadows, and side hill seeps. Clean Water Act Section 404(b)(1) guidelines provide environmental criteria and other guidance used in evaluating proposed discharges of dredged materials into waters of the United States. For proposed discharges of dredged or fill material to comply with the guidelines, they must satisfy four requirements found in Section 230.10. Among these requirements are that those discharges of dredged or fill material do not result in significant degradation of the aquatic ecosystem and that all practicable means be used to minimize adverse environmental impacts.

Under Section 401 of the Clean Water Act, every applicant for a federal permit or license for any activity that may result in a discharge to a water body must obtain state certification that the proposed activity will comply with state water quality standards

Rivers and Harbors Act of 1899

33 United States Code 408 and Section 14 of the Rivers and Harbors Act of 1899 (RHA) provide that the Secretary of the Army, on the recommendation of the Chief of Engineers, may grant permission for the temporary occupation or use of any sea wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States. This permission will be granted by an appropriate real estate instrument in accordance with existing real estate regulations. This regulation is used by USACE as the legal authority to require permission to modify federal project levees or other federal flood control facilities.

Sections 9 and 10 of RHA authorize USACE to regulate the construction of any structure or work over, under, or within navigable waters. The RHA authorizes USACE to regulate the construction of infrastructure such as wharves, breakwaters, or jetties; bank protection or stabilization projects; permanent mooring structures, or marinas; intake or outfall pipes; canals; boat ramps; aids to navigation; or other modifications affecting the course, location condition, or capacity of navigable waters.

Emergency Flood Control Funds Act of 1955

In addition to regulatory activities, USACE has a number of projects and functions that can potentially affect activities in the Delta. The Emergency Flood Control Fund Act, Public Law 84-99, authorizes emergency funding and response for levee repairs and flood preparation. USACE can provide flood fighting readiness within hours; however, this action is supplemental to services provided by local reclamation districts and state agencies. USACE and DWR have a working relationship through a memorandum of understanding originally drafted in 1955 and amended since then (U.S. Army Corps of Engineers 2005).

The Public Law 84-99 also provided for development of a levee design standard as a minimum requirement for all federal flood management project levees. The standard was developed for major rivers, such as the Mississippi River, and was not necessarily appropriate for nonfederal flood management project levees. In 1987, USACE developed a Delta-specific standard based on the Delta organic soils and levee foundation conditions. Compliance with this standard allows for USACE emergency assistance for levee rehabilitation and island restoration following levee failures and island inundation, provided the reclamation district applies for and is accepted into the program, and passes a rigorous initial inspection and periodic follow-up inspections.

USACE Delta Levee Funding

The Water Supply, Reliability, and Environmental Improvement Act of 2004 (Public Law 108-361) authorizes the USACE to design and construct levee stability projects for purposes such as flood damage reduction, ecosystem restoration, water supply, water conveyance, and water quality objectives as outlined in the CALFED Bay-Delta Program, Programmatic Record of Decision (CALFED

ROD) (CALFED Bay-Delta Program 2000c). Furthermore, Section 103(f)(3)(B) of this Act authorizes the USACE to undertake the eight following activities.

- Reconstruct Delta levees to a base level of protection (also known as the ‘‘Public Law 84-99 standard”).
- Enhance the stability of levees that have particular importance in the system through the Delta Levee Special Improvement Projects Program.
- Develop best management practices to control and reverse land subsidence on Delta islands
- Develop a Delta Levee Emergency Management and Response Plan that will enhance the ability of federal, state, and local agencies to rapidly respond to levee emergencies.
- Develop a Delta Risk Management Strategy after assessing the consequences of Delta levee failure from floods, seepage, subsidence, and earthquakes.
- Reconstruct Delta levees using, to the maximum extent practicable, dredged materials from the Sacramento River, the San Joaquin River, and the San Francisco Bay.
- Coordinate Delta levee projects with flood management, ecosystem restoration, and levee protection projects of the lower San Joaquin River and lower Mokelumne River floodway improvements and other projects under the Sacramento-San Joaquin Comprehensive Study.
- Evaluate and, if appropriate, rehabilitate the Suisun Marsh levees.

The Act directed the USACE to identify and prioritize levee stability projects that could be carried out with federal funds. An initial amount of $90 million was authorized, with another $106 million authorized in the 2007 Water Resources Development Act of 2007 (WRDA). The USACE initially solicited proposals for various levee improvement projects and received 68 project proposals totaling more than $1 billion. In the short-term, the USACE plans to proceed with implementation of high-priority improvements that can be constructed with the limited funds appropriated to date.

The USACE also is proceeding with a Delta Islands and Levees Feasibility Study to develop long-term plans for flood-risk management, water quality, water supply, and ecosystem restoration. In addition, the USACE is working on a Lower San Joaquin Feasibility Study to determine whether there is a federal interest in providing flood risk management and ecosystem restoration on the lower San Joaquin River.

6.2.1.4 Bureau of Reclamation

Reclamation owns and manages several dams and distribution canals upstream of and within the Delta. Its upstream reservoirs and dams include such major facilities as Shasta, Folsom, New Melones, and Friant dams. These multipurpose facilities regulate flows to the Delta and provide water supply, hydroelectric, flood management, recreation, and other benefits. Reclamation consults with the state and provides technical assistance related to reservoir reoperation studies. Reservoir operations are covered in Chapter 5, *Water Supply*.

6.2.1.5 Other Federal Agencies

Other federal agencies have programs related to floodplain management. These include USGS and the Natural Resources Conservation Service (California Department of Water Resources 1997).

USGS, in cooperation with DWR, is responsible for collecting surface water data, which becomes the primary database used to develop the hydrologic information required for defining hydraulic studies.

The Natural Resources Conservation Service is involved in watershed planning. It has programs that can provide assistance to local governments and the state in constructing flood relief facilities and preventing flood damage.

6.2.1.6 CALFED Bay-Delta Program Levee System Integrity Program

The CALFED Bay Delta Program's Levee System Integrity Program is a federal and state program that provides maintenance and improvement work to the Delta levee system. Goals and objectives of the program include:

- Base Level Protection – This program provides funding to help local reclamation districts reconstruct Delta levees to a base level of protection (Public Law 84-99).
- Special Improvement Projects – This program is intended to enhance levee stability for particularly important levees. Priorities include protection of life, personal property, water quality, the Delta ecosystem, and agricultural production.
- Suisun Marsh Protection and Ecosystem Enhancement – This program provides levee integrity, ecosystem restoration, and water quality benefits by supporting maintenance and improvement of the levee system in the Suisun Marsh.
- Levee Emergency Response Plan – This program is intended to enhance agency and local efforts to respond to levee emergencies.

6.2.2 State Plans, Policies, and Regulations

State plans, policies, and regulations related to surface water address water rights issues and flood management issues. Regulations that address water quality are described in Chapter 8, *Water Quality*.

6.2.2.1 Suisun Marsh Preservation Agreement

On March 2, 1987, the Suisun Marsh Preservation Agreement was signed by DWR, CDFW (then DFG), Reclamation, and the Suisun Resource Conservation District. The purpose of the agreement was to establish mitigation for impacts on salinity from the SWP, CVP, and other upstream diversions. The Suisun Marsh Preservation Agreement has the following objectives.

- To ensure that Reclamation and DWR maintain a water supply of adequate quantity and quality to manage wetlands in the Suisun Marsh (to mitigate adverse effects on these wetlands from SWP/CVP operations, as well as a portion of the adverse effects of other upstream diversions).
- To improve Suisun Marsh wildlife habitat on these managed wetlands.
- To define the obligations of Reclamation and DWR necessary to ensure the water supply, distribution, management facilities, and actions necessary to accomplish these objectives.
- To recognize that water users in the Suisun Marsh (i.e., existing landowners) divert water for wildlife habitat management in the Suisun Marsh.

In 2000, the CALFED ROD was signed, which included the Environmental Restoration Program (ERP) calling for the restoration of 5,000 to 7,000 acres of tidal wetlands and the enhancement of 40,000 to 50,000 acres of managed wetlands (CALFED Bay-Delta Program 2000b). In 2001, the U.S. Fish and Wildlife Service, U.S. Bureau of Reclamation, Department of Fish and Wildlife (CDFW, then Department of Fish and Game), DWR, National Marine Fisheries Service, Suisun Resource Conservation District, and CALFED Bay-Delta Program (the Principal Agencies) directed the formation of a charter group to develop a plan for Suisun Marsh that would balance the needs of CALFED, the Suisun Marsh Preservation Agreement, and other plans by protecting and enhancing existing land uses, existing waterfowl and wildlife values including those associated with the Pacific Flyway, endangered species, and state and federal water project supply quality. In addition to the Principal Agencies, the charter group includes other regulatory agencies such as USACE, Bay Conservation and Development Commission, State Water Board, and RWQCBs.

In 2011, the Principal Agencies completed a Final EIS/EIR (Bureau of Reclamation 2011) that describes three alternative 30-year plans and their potential impacts. The adopted alternative will become the Suisun Habitat Management, Preservation, and Restoration Plan. The plan purposes/objectives to implement the CALFED ROD Preferred Alternative of restoration of 5,000 to 7,000 acres of tidal marsh and protection and enhancement of 40,000 to 50,000 acres of managed wetlands; maintain the heritage of waterfowl hunting and other recreational opportunities and increase the surrounding communities' awareness of the ecological values of Suisun Marsh; maintain and improve the Suisun Marsh levee system integrity to protect property, infrastructure, and wildlife habitats from catastrophic flooding; and protect and, where possible, improve water quality for beneficial uses in Suisun Marsh.

6.2.2.2 Department of Water Resources

DWR's mission is to manage the state's water resources, in cooperation with other agencies, to benefit the public and to protect, restore, and enhance the natural and human environments. Within this mission, DWR's goal, as related to flood, is to "protect public health, life, and property by regulating the safety of dams, providing flood protection, and responding to emergencies." DWR meets these responsibilities through the following activities (California Department of Water Resources 2008b and Water Code Section 6000).

- Supervising design, construction, enlargement, alteration, removal, operation, and maintenance of more than 1,200 jurisdictional dams.
- Encouraging preventive floodplain management practices; regulating activities along Central Valley floodways.
- Maintaining and operating specified Central Valley flood-control facilities.
- Cooperating in flood-control planning and facility development.
- Maintaining the State-Federal Flood Operations Center and the Eureka Flood Center to provide flood advisory information to other agencies and the public.
- Cooperating and coordinating in flood emergency activities and other emergencies.
- DWR also owns and operates the SWP, with numerous water storage and conveyance facilities throughout the state. DWR exports water from the Delta at its North Bay Pumping Plant at Barker Slough and at the Harvey O. Banks Pumping Plant in the south Delta.

State Delta Levees Maintenance Subvention Program

The Delta Levees Maintenance Subvention Program is a state cost-sharing program in which participating local levee maintenance agencies receive funds for the maintenance and rehabilitation of nonproject levees in the Delta. The program's goal is "to reduce the risk to land use associated with economic activities, water supply, infrastructure, and ecosystem from catastrophic breaching of Delta levees by building all Delta levees to the Bulletin 192-82 Standard" (California Department of Water Resources 1995). There is a statewide interest in levee maintenance in the Delta because the islands levees maintain flow velocities in the sloughs and channels that combat saltwater intrusion. The program is authorized in the Water Code, Sections 12980–12995. In 1988, with the passage of the Delta Flood Protection Act, financial assistance for several communities maintaining local Delta levees was increased through the Delta Levees Subvention Program. The intent of the program is given in Water Code article 12981 and states that the key to preserving the Delta physical characteristics is the system of levees defining the waterways and producing the adjacent islands. Thus, funds necessary to maintain and improve the Delta's levees to protect the physical characteristics should be used.

Delta Levees Special Flood Projects Program

The Delta Levees Special Flood Control Projects (Special Projects) provides financial assistance to local levee-maintaining agencies for levee rehabilitation in the Delta. The program was established by the California Legislature under SB 34 in 1988. Since the inception of the program, more than $200 million has been provided to local agencies in the Delta for flood management and related habitat projects. For example, some levees were raised above the 1-% annual chance water surface elevations, such as on Webb Tract, Bouldin Island, Empire Tract, King Island, Ringe Tract, and Canal Ranch (California Central Valley Flood Control Association 2011).

6.2.2.3 Assembly Bill 1200

Assembly Bill 1200 (2005) highlighted the complex water issues in the Delta and directed DWR and CDFW (then DFG) to report to the Legislature and Governor on the following:

- Potential impacts of levee failures on water supplies derived from the Delta because of future subsidence, earthquakes, floods, and effects of climate change
- Options to reduce the impacts of these factors
- Options to restore salmon and other fisheries that use the Delta estuary

The bill added Section 139.2 of the Water Code: "The department shall evaluate the potential impacts on water supplies derived from the Delta based on 50-, 100-, and 200-year projections for the following possible impacts on the Delta of subsidence; earthquakes; floods; and changes in precipitation, temperature, and ocean levels; and a combination of these impacts."

DWR and CDFW published their first evaluation report as required by AB 1200 in January 2008. The report, titled "Risks and Options to Reduce Risks to Fishery and Water Supply Uses of the Sacramento-San Joaquin Delta, "was issued in 2008 and summarizes the potential risks to water supplies in the Sacramento–San Joaquin Delta attributable to future subsidence, earthquakes, floods, and climate change. The report identifies potential improvements to reduce these risks (California Department of Water Resources and California Department of Fish and Game 2008). This report was based in part on the information provided as part of the Delta Risk Management Strategy investigations and analyses, also developed in 2008 and mandated by DWR.

6.2.2.4 Central Valley Flood Protection Board

The CVFPB, previously known as the Reclamation Board, was created in 1911. The CVFPB has jurisdiction throughout the Sacramento and San Joaquin valleys, which is synonymous with the drainage basins of the Central Valley, and includes the Sacramento-San Joaquin Drainage District.

The CVFPB's mission is:

- To control flooding along the Sacramento and San Joaquin rivers and their tributaries in cooperation with the USACE.
- To cooperate with various agencies of the federal, state, and local governments in establishing, planning, constructing, operating, and maintaining flood management works.
- To maintain the integrity of the existing flood management system and designated floodways through its regulatory authority by issuing permits for encroachments.

The CVFPB is a major partner for federal flood management works in the Central Valley. The CVFPB shares costs with the federal government and the local districts and provides land easements and rights-of-way for federal projects. The CVFPB assumes responsibility for operation and maintenance only after a local maintenance agency has agreed to assume ultimate responsibility for the operation and maintenance.

The CVFPB issues encroachment permits for projects that the CVFPB determines will not interfere with the integrity of the flood control system. Projects as small as installing a boat dock or a fence near a levee must obtain an encroachment permit. The CVFPB also approves or denies plans for reclamation, dredging, or improvements that alter any project levee. It has authority to approve or deny any land reclamation plan (related to public works) or flood protection that involves excavation near rivers and tributaries, and has legal responsibility for oversight of the entire Central Valley flood management system.

The CVFPB also adopts floodway boundaries and approves uses within those floodways. The purpose of the designated floodway program is to control encroachments and development within the floodways and to preserve floodways to protect lives and property. Various uses are permitted in the floodways, such as agriculture, canals, low dikes and berms, parks and parkways, golf courses, sand and gravel mining, structures that will not be used for human habitation, and other facilities and activities that will not be substantially damaged by the base flood event and will not cause adverse hydraulic impacts that will raise the water surface in the floodway. A permit from CVFPB is required for most activities other than normal agricultural practices within the boundaries of designated floodways.

California Water Code Section 8500 et. seq. outline the authority and responsibilities of the CVFPB. The CVFPB's regulations are published in Title 23 of the California Code of Regulations and explain the CVFPB's processes and standards. The regulations are comprehensive and include topics such as standards for construction, the permitting process, and the enforcement action process.

The CVFPB and the USACE are primarily responsible for the levees along the Sacramento River. Under California Water Code Section 8536 and related regulations, the CVFPB has no jurisdiction or authority over the construction, operation, or maintenance of the CVP or SWP. However, DWR will consult with these agencies to ensure that all construction of new structures or levee modifications within the waterways will not adversely affect the flood profile, and that the integrity of the levees is not degraded by structures that are constructed under, over, or through the levees.

The CVFPB exercises jurisdiction over the levee section, the waterward area between project levees, a minimum 10-foot-wide strip adjacent to the landward levee toe, within 30 feet of the top of the banks of unleveed project channels, and within designated floodways adopted by the Board. Activities outside of these limits that could adversely affect the flood control project are also under CVFPB jurisdiction. Such activities include the following.

1. Jeopardize directly or indirectly the physical integrity of levees or other works;
2. Obstruct, divert, redirect, or raise the surface level of design floods or flows, or the lesser flows for which protection is provided;
3. Cause significant adverse changes in water velocity or flow regimen;
4. Impair the inspection of floodways or project works;
5. Interfere with the maintenance of floodways or project works;
6. Interfere with the ability to engage in floodfighting, patrolling, or other flood emergency activities;
7. Increase the damaging effects of flood flows; or
8. Be injurious to, or interfere with, the successful execution, functioning, or operation of any adopted plan of flood control.
9. Adversely affect the State Plan of Flood Control, as defined in the Water Code (California Code or Regulations, Title 23, Waters. Division 1)

6.2.2.5 Delta Protection Act of 1992

The Delta Protection Act is described in Section 1.0, Water Resources Regulatory Framework. The Delta Protection Act of 1992 created the Delta Protection Commission and declared that a primary goal of the state for the Delta is, among other findings, to improve flood protection by structural and nonstructural means to ensure an increased level of public health and safety. Section 29704 of the Delta Protection Act focuses on the Delta levee system. The section recognizes that some of the Delta islands are flood-prone, and that improvement and ongoing maintenance of the levee system is very important to protect farmlands, population centers, the state's water quality, and significant natural resource and habitat areas of the Delta. Section 29704 also notes that most of the existing levee systems are degraded and in need of restoration, improvement, and continuing management.

Other sections include goals pertaining to the quality of the Delta environment (agriculture, wildlife habitat, and recreational activities) and the balanced conservation and development of Delta land resources.

6.2.2.6 State Realty Disclosure Law

California law (Government Code Section 8589.3) requires the seller (if acting without an agent) or the seller's agent to disclose to a prospective transferee of real property if the property is located within an SFHA (any type Zone "A" or "V") as designated by FEMA pursuant to 42 USC Section 4001. Disclosure must be made if:

- A seller (if acting without an agent) or the seller's agent has "actual knowledge" (Public Resources Code Section 2621.9(c)(1)) that the property is located within a SFHA, or
- The local jurisdiction has compiled a list of properties (identified by parcel) that are within an SFHA and a notice has been posted at the offices of the county recorder, county assessor, and county planning agency that identifies the location of the parcel list.

6.2.3 Regional and Local Plans, Policies, and Regulations

Local and regional flood management is provided through reclamation districts, individual cities and counties, and regional agencies composed of a combination of the former three, and created through a Joint Exercise of Powers Agreement.

The six counties that have lands within the Delta, as well as cities and special districts, are engaged in activities to reduce the risk of flooding. Activities may include construction, operation, and maintenance of structural features such as levees, and nonstructural activities. Nonstructural activities reduce property damage and loss of life and minimize economic impact in the event of a flood. These include floodplain zoning, enforcement of building restrictions in FEMA-designated regulatory floodplains, flood warning and evacuation plans, and flood proofing and relocation assistance.

6.3 Environmental Consequences

This section describes the potential effects of the No Action Alternative and action alternatives on surface water resources within the Delta and areas upstream of the Delta that could be directly affected by implementation of the alternatives. As previously described in this chapter, some of the SWP/CVP water supplies are conveyed in rivers and streams within Sacramento River and San Joaquin River basins, and thereby, affect surface water flows in those basins. In San Francisco Bay, Central Coast, South Coast, Tulare Lake, South Lahontan, and Colorado River hydrologic basins, SWP/CVP water supplies are conveyed in pipelines and canals and do not directly affect surface waters. Construction of facilities under the alternatives all would occur in the Delta of the Sacramento River and San Joaquin River basins. Therefore, the environmental consequences are focused on changes in surface water resources in the Sacramento River and San Joaquin River basins. Chapter 8, *Water Quality*, describes potential effects on surface water quality in the Sacramento and San Joaquin River basins and the Delta.

6.3.1 Methods for Analysis

The surface water analysis addresses changes to surface waters affected by changes in SWP/CVP operations in the Delta Region and Upstream of the Delta Region caused by implementation of BDCP conveyance facilities (CM1) and other conservation measures, especially tidal marsh habitat restoration. The alternatives would modify the operations of the SWP/CVP facilities but would not modify the operations of water resources facilities owned or operated by other water rights holders. Therefore, surface water resources on many of the tributaries of the Sacramento River and San Joaquin River would not be affected. The surface waters analyzed in this chapter include Sacramento River upstream of the Delta and downstream of Keswick Dam; Trinity River downstream of Lewiston Reservoir; Feather River downstream of Thermalito Dam; American River downstream of

Nimbus Dam; surface water diversions into Yolo Bypass; representative Delta channels; and San Joaquin River upstream of the Delta.

6.3.1.1 Quantitative Analysis of Surface Water Resources

The quantitative surface water analysis was conducted using the CALSIM II model. A brief overview of the modeling tools and outputs is provided in Chapter 4, *Approach to Environmental Analysis*, and a full description of the tools is included in Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*.

The results of the model alternative simulations are compared to CEQA Existing Conditions baseline and to the NEPA No Action Alternative baseline to assess potential effects of changes in SWP/CVP operations on surface water resources. SWP/CVP water supply operations are managed to meet instream flow requirements, water rights agreements, refuge water supply agreements, and other CVP water contracts in the Sacramento and San Joaquin Valleys. Water supplies are provided in a consistent manner in the Existing Conditions, No Action Alternative, and alternatives, for water rights holders (including Delta water rights holders), and refuge water supply agreements. Water quality changes in the surface water resources are described in Chapter 8, *Water Quality*.

SWP/CVP operations are determined in accordance with federal and state regulations and assumptions for each alternative, as described in Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*. Factors that affect surface water resources include operational requirements related to water supplies provided by SWP/CVP facilities (including water supplies to downstream water rights holders), SWP/CVP reservoir storage, and Delta outflow. As described in Chapter 5, *Water Supply*, the ability to release water from storage to SWP/CVP water users is dependent upon the capability of the reservoir to store adequate water to meet: 1) instream releases, especially with cold water to protect aquatic resources, and 2) requirements to maintain freshwater conditions in the western Delta (as described in Chapter 8, *Water Quality*). Delta outflow is also considered in the determination of the ability to divert water at the SWP/CVP south Delta intakes to minimize "reverse flow" conditions in which water from the western Delta is conveyed upstream towards the intakes when Delta outflow is relatively low, as described in Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*.

The discussion in this chapter of changes in surface water resources as related to changes in SWP/CVP water supply availability in the No Action Alternative and other alternatives is represented by descriptions of the following factors.

- SWP/CVP reservoir storage as it relates to flood management operations (Impact SW-1).
  - Shasta Lake (with maximum storage capacity of approximately 4.5 million acre-feet [MAF] and mean annual inflow of about 5.7 MAF)
  - Trinity Lake (with maximum storage capacity of approximately 2.4 MAF and mean annual inflow of about 1.2 MAF)
  - Lake Oroville (with maximum storage capacity of approximately 3.5 MAF and mean annual inflow of about 4.5 MAF)
  - Folsom Lake (with maximum storage capacity of 977,000 acre-feet [af] and mean annual inflow of about 2.7 MAF)
- Instream flows (Impact SW-2).

- Sacramento River at Freeport (downstream of the confluence with American River and diversions into Yolo Bypass and Sacramento Bypass)
- San Joaquin River at Vernalis (near where the river enters the Delta)
- Sacramento River downstream of potential north Delta intakes (and upstream of Delta Cross Channel gates)
- Trinity River downstream of Lewiston Reservoir
- American River downstream of Nimbus Dam
- Feather River downstream of Thermalito Dam
- Spills into the Yolo Bypass at Fremont Weir

- Combined flows for Old and Middle Rivers as an indication of reverse flow conditions in the south Delta (Impact SW-3).

Methods to Analyze Changes due to Implementation of Alternatives versus Changes due to Sea Level Rise and Climate Change

The analysis presented in this chapter compares simulated surface water conditions in the following manner:

- No Action Alternative (with sea level rise and climate change that would occur at Year 2060 [LLT]) compared to Existing Conditions (without sea level rise or climate change)
- **CEQA comparison:** The BDCP alternatives (with sea level rise and climate change that would occur at Year 2060 [LLT]) compared to Existing Conditions (without sea level rise or climate change)
- **NEPA comparison:** The BDCP alternatives (with sea level rise and climate change that would occur at Year 2060 [LLT]) compared to No Action Alternative (with sea level rise and climate change that would occur at Year 2060 [LLT])

The results of the comparison of Existing Conditions to the No Action Alternative and alternatives reflect differences in water supply conditions due to the following three changes.

- Changes in surface water conditions due to implementation of the alternative and related changes in SWP/CVP operations.
- Changes in surface water conditions due to sea level rise and climate change.
- Increase in water demands, implementation of facilities currently under construction, and inclusion of Fall X2 under the No Action Alternative, as described in Chapters 3 and 5 and in Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*.

Changes Due to Sea Level Rise

As sea level rise occurs, salinity would increase in the western and central Delta. The No Action Alternative and all of the alternatives include criteria to maintain freshwater in the western Delta, and the No Action Alternative and some of the alternatives include criteria to maintain Fall X2. As described in Chapter 5, *Water Supply,* and Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*, the assumptions for the No Action Alternative with sea level rise and climate change were based upon no change in the location, magnitude or duration of D-1641 salinity standards, except at

Emmaton, within the western Delta. These salinity standards are described in SWRCB Decision 1641. As sea level rise occurs, more water would need to be released from the SWP/CVP reservoirs to meet these salinity standards; therefore, less water would remain in storage at the end of September and less water would be available for SWP/CVP water supplies both upstream and downstream of the Delta, as described in Chapter 5, *Water Supply*.

As an example, increased salinity in the west Delta near Rock Slough with sea level rise would change the ability to divert water from the south Delta intakes at some times in the fall months. If the salinity is greater than the allowed criteria, as described in Chapter 8, *Water Quality*, operations of south Delta intakes would be limited and water would be released from the SWP/CVP reservoirs to maintain fresh water conditions at Rock Slough. Therefore, less water could be available for SWP/CVP water supplies downstream of the Delta.

Changes Due to Climate Change

In the future, changes in climate are assumed to increase the amount of rainfall and decrease the amount of snow that would occur in the watersheds of the Sacramento and San Joaquin Rivers. Consequently, peak runoff would be more likely to occur in the late winter and early spring, and runoff during the late spring and summer would be reduced as compared to Existing Conditions (described in more detail in Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix)*. These conditions could result in higher flood potential in the winter and early spring months.

Reduction in runoff from snowmelt in the summer months would reduce the ability of the SWP/CVP reservoirs to refill as water is released for downstream water supplies, instream flows, and Delta outflow. The reduction in reservoir storage would reduce water supply availability for all of these purposes in the current year or potentially the following year.

Reduction in runoff in the summer months also would reduce natural instream flows in the Sacramento and San Joaquin Rivers. Operations of the south Delta intakes under the No Action Alternative and alternatives would be dependent upon inflow/export and export/inflow ratios. If there is less inflow into the Delta, less water can likely be exported by the SWP/CVP.

The ability to operate the south Delta intakes also would be limited with less inflow from the San Joaquin River. The San Joaquin River inflows provide positive Old and Middle River outflows, and operations of the south Delta intakes lead to negative Old and Middle River outflows. The No Action Alternative and the alternatives that rely upon south Delta intakes operate with criteria to minimize reverse flows. If those criteria cannot be achieved, operations of the south Delta intakes could be limited and less water would be available for export.

Describing Changes Due to Sea Level Rise and Climate Change as Compared to Changes Due to New Facilities and Operations

In general, the incremental differences in SWP/CVP surface water conditions under the No Action Alternative due to sea level rise and climate change are similar or greater than the differences in SWP/CVP surface water conditions under the alternatives due to changes in proposed operational scenarios.

As is the case throughout this document, effects are analyzed in this chapter under both NEPA and CEQA, with the NEPA analysis being based on a comparison of the effects of action alternatives against a future No Action condition and the CEQA analysis being based on a comparison of these effects against Existing Conditions. One consequence of the different approaches is the manner in which sea level rise and climate change are reflected in the respective impact conclusions under the two sets of laws. Under NEPA, the effects of sea level rise and climate change are evident both in the future condition and in the effects of the action alternatives. Under CEQA, in contrast, the absence of sea level rise and climate change in Existing Conditions results in model-generated impact conclusions that include the impacts of sea level rise and climate change with the effects of the action alternatives. As a consequence, the CEQA conclusions in many instances either overstate the effects of the action alternatives or suggest significant effects that are largely attributable to sea level rise and climate change, and not to the action alternatives. Similarly, the CEQA conclusions may understate any beneficial effects of alternatives for the same reasons.

In both sets of analyses, the Lead Agencies, in preparing this EIR/EIS, agreed on the types of computer models that would be used to assess environmental effects. Predictions of conditions 50 years from the present, however, are inherently limited and reflect some speculation. In the interest of informing the public of what the Lead Agencies believe to be the reasonably foreseeable impacts of the action alternatives, the Lead Agencies have focused primarily on the contribution of the action alternatives, as opposed to the impacts of sea level rise and climate change, in assessing the impacts of these action alternatives. The opposite approach, which would treat the impacts of sea level rise and climate change as though they were impacts of the action alternatives, would overestimate the effects of the action alternatives. Similarly, the CEQA conclusions may underestimate any beneficial effect of the action alternatives. The approach taken here by DWR, as CEQA lead agency, also has the effect of highlighting the substantial nature of the consequences of sea level rise and climate change on California's water system.

For each alternative, the following impact assessment comparisons are presented for the quantitative analyses of Delta exports and SWP and CVP deliveries.

- Comparison of each alternative (at LLT) to Existing Conditions (the CEQA baseline), which will result in changes in SWP/CVP surface water conditions that are caused by four factors: sea level rise, climate change, increase in north of Delta demand, and implementation of the alternative. It is not possible to specifically define the exact extent of the changes due to implementation of the alternative using the model simulation results presented in this chapter. Thus, the precise contributions of sea level rise and climate change to the total differences between Existing Conditions and LLT conditions under each alternative cannot be isolated in the CEQA analyses in this EIR/EIS.
- Comparison of each alternative (at LLT) to No Action Alternative (at LLT) to indicate the general extent of changes in SWP/CVP surface water conditions due to implementation of the alternative. Because sea level rise and climate change are reflected in each action alternative and in the No Action Alternative, this comparison reflects the extent of changes in SWP/CVP surface water conditions attributable to the differences in operational scenarios amongst the different action alternatives.

Mitigation measures are related to the changes due to implementation of the alternative and not changes due to sea level rise and climate change. Therefore, mitigation measures are related to the comparison of each alternative to No Action Alternative.

For a thorough discussion of the methodologies used to predict sea level rise and climate change as of 2060, see Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*.

6.3.1.2 Analysis of Flood Management

This analysis uses monthly outputs from CALSIM II, a monthly time-step model described in Chapter 5, *Water Supply,* that is used for planning purposes in a comparative manner. CALSIM II can provide information about how the CVP/SWP reservoirs would be operated under assumptions developed for BDCP alternatives. While CALSIM II cannot provide daily real-time flood operations, two types of information from CALSIM II results can be used as indicators of potentially increased flood risk:

1. Increased upstream storage due to change in storage operations under BDCP alternatives could be interpreted as a reduction in flexibility of real-time operations to capture flood flows.
2. Increased instream flow releases (monthly average flows) during months that could be interpreted as potential higher peak flows that could exceed the channel capacity in a sub-monthly basis.

Accordingly, to analyze changes in flood potential related to reservoir storage, a qualitative evaluation was conducted by comparing high storage conditions from October through June (to cover even wettest winters or late spring precipitations).

CALSIM II operates to the flood control space determined for each reservoir by the USACE. Unlike real-time operations, CALSIM II does not have the discretion to encroach into the flood conservation space. An analysis is developed where the number of months that the reservoir storage is close to the flood storage capacity is recorded for each Alternative (within 10 TAF); and compared to the No Action Alternative (which is used to avoid consideration of changes in reservoir storage caused by sea level rise and climate change) for purposes of NEPA. For CEQA purposes, the comparison is against Existing Conditions. Results are presented in Tables 6-2 through 6-4 in summary format for the October through June period; and in Tables 6-5 through 6-7 in more detail for each individual month. If the reservoir storages are consistently higher, then it is interpreted as a significant reduction in flexibility for flood operations. (Please see Section 6.3.2, *Determination of Effects* for the significance criterion)

As mentioned in Section 6.1, the surface water study area comprises the Sacramento hydrologic region and the Delta and Suisun Marsh located at the confluence of the Sacramento and San Joaquin rivers. Therefore, the analysis described in this section evaluates changes in storage for Shasta Lake, Lake Oroville, and Folsom Lake (i.e. water bodies where potential changes could occur to surface waters as a result of modifications in SWP/CVP water supply operations). The analysis does not evaluate changes in storage for reservoirs where potential changes would not occur as a result of modifications in SWP/CVP water supply operations including reservoirs on the San Joaquin River and tributaries.

To evaluate changes in flood potential within the Sacramento and San Joaquin Rivers, predicted peak monthly flows were compared to channel capacity in the Sacramento River and San Joaquin River reaches. For the Sacramento River at Freeport, Sacramento River downstream of the proposed locations of north Delta intakes (upstream of Walnut Grove), San Joaquin River at Vernalis, Feather River at Thermalito Dam, or Yolo Bypass at Fremont Weir, average of flows with probability of exceedance of 10% or lower (top 10^{th} percentile of flows) is calculated. The increase of these flows as compared to flows under the No Action Alternative (which is used to avoid consideration of changes in reservoir storage caused by sea level rise and climate change) is compared to the channel capacity at each reach. While monthly flows simulated in any of the Alternatives are not close to the channel capacity, even a small increase in peak flows with respect to the channel capacity would be assumed to point to an increased risk of flooding. (Please see Section 6.3.2, *Determination of Effects* for the significance criterion).

Existing Conditions precipitation assumptions are consistent with historical patterns. These historical patterns have been used by USACE and DWR to develop reservoir storage criteria to reduce flood potential in the watersheds. The assumptions for snowfall and rainfall patterns for the alternatives have been modified to reflect climate change that is anticipated to increase surface water runoff from rainfall in the winter and early spring and to decrease runoff from snowmelt in the late spring and early summer, as described in Chapter 5, *Water Supply*. However, the flood management criteria for maintaining adequate flood storage space in the reservoirs (as defined by the USACE and DWR for flood control release criteria) were not modified to adapt to the changes in runoff due to climate change. No changes in monthly allowable storage values related to CALSIM II model assumptions were included because these changes were not defined under the alternatives to achieve the project objectives or purpose and need for the BDCP. If USACE and DWR modify allowable storage values in the future in response to climate change, it is anticipated that the surface water flows and related water supply and water quality conditions would change.

For this EIR/EIS analysis, it was determined that estimating peak flows in a sub-monthly time step based on monthly flows simulated in CALSIM II would not be reliable for flood risk analysis because CALSIM's flood control considerations are limited to maximum allowable end of month storage. Even weekly or daily time steps would likely be unable to reflect the actual conditions faced by reservoir operators, who, based on policy decisions, could operate in a different way under severe conditions in response to circumstances as they arise in order to try to avoid catastrophic outcomes. Detailed quantitative hydraulic analysis models are currently being improved by USACE, DWR, and CVFPB. Those models are not currently completed and not available for use in this EIR/EIS. Therefore monthly CALSIM II outputs are used to provide only an indication of consistently high storages or flows that may or may not result in flood conditions.

6.3.1.3 Analysis of Surface Water Conditions due to Construction and Operation of Conveyance Facilities in the Delta

Construction of facilities within or adjacent to waterways could change surface water elevations or runoff characteristics. The analysis describes the potential for temporary construction and long-term operations activities of the conveyance and the ecosystem restoration facilities to directly or indirectly affect local surface water resources related to the following.

- Substantial alterations of existing drainage patterns or streams, or increased rate or amount of runoff that would result in flooding during construction of conveyance facilities; or conditions not allowed under the regulations of USACE, DWR, and/or CVFPB (Impact SW-4).
- Substantial alterations of existing drainage patterns or streams, or increased rate or amount of runoff that would result in flooding during construction of habitat restoration areas; or conditions not allowed under the regulations of USACE, DWR, and/or CVFPB (Impact SW-5).
- Increased runoff which would exceed the capacity of existing or planned stormwater systems (Impact SW-6).
- Exposure of people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam (Impact SW-7).

- Exposure of people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam due to the operation of habitat restoration areas (Impact SW-8).
- Placement within a 100-year flood hazard area of structures that would impede or redirect flood flows, or be subject to inundation by mudflow (Impact SW-9).

6.3.1.4 Project- and Program-Level Components

For this analysis, changes in SWP/CVP surface water resources are evaluated at a project level if sufficient detail is available. It should be noted that SWP/CVP water supply operations are affected both by specific operations criteria identified for each alternative at a project level basis, and by assumptions for the location and extent of tidal marsh restoration under each alternative, which is identified only at a programmatic level.

6.3.2 Determination of Effects

As described in Section 6.3.1.1, the potential for effects related to surface water resources was determined by considering direct changes in the environment as identified in CEQA guidelines (described below for Surface Water Impacts 1–3). Section 6.3.2 describes the potential for changes in flood management operations as determined through a qualitative evaluation of CALSIM II model results (described below as Surface Water Impacts 4–7).

This effects analysis assumes that an action alternative would have an adverse effect under NEPA or a significant impact under CEQA if implementation would result in one of the following conditions.

- An increase of more than 10% in number of months that the reservoir storage is close to the flood storage capacity (within 10 TAF) compared to the No Action Alternative would be interpreted as a consistently high storage condition that would reduce the flexibility for flood operations. The value of 10% is used to provide consideration of uncertainties involved due to differences of real-time flood operations and monthly model output due to simulation techniques and assumptions used in this analysis (Impact SW-1).
- An increase in peak monthly flows when flood potential is high in the Sacramento River at Freeport, Sacramento River at Locations Upstream of Walnut Grove (downstream of north Delta intakes), San Joaquin River at Vernalis, Feather River at Thermalito Dam, or Yolo Bypass at Fremont Weir, that exceed flood capacity at these locations compared to river flows under the No Action Alternative (which is used to avoid consideration of changes in river flows caused by sea level rise and climate change). For the purposes of this analysis, a flood event is defined as an over-bank event.

  Flows simulated with CALSIM II do not exceed flood capacity. To assess the increased risk of flooding, the following methodology is used:

  - Average of flows with probability of exceedance of 10% or lower (top 10th percentile of flows) is calculated.
  - Average of flows with probability of exceedance of 10% or lower under each Alternative is compared to the average of flows with probability of exceedance of 10% or lower under the Existing Conditions and the No Action Alternative (which is used to avoid consideration of changes in reservoir storage caused by sea level rise and climate change).

- The change in average of flows with probability of exceedance of 10% or lower with respect to the Existing conditions and the No Action Alternative is compared to the channel capacity (analysis done for each reach).
- An increase of 1% in highest flows simulated (flows with probability of exceedance of 10% or less) with respect to the channel capacity is considered significant (increase is calculated by comparing flows to Existing Conditions or No Action Alternative). The value of 1% is used to avoid consideration of minor fluctuations in model output due to simulation techniques and assumptions (Impact SW-2).

- An increase of more than 1% in reverse flow conditions in Old and Middle River under the alternatives as compared to reverse flows under Existing Conditions and the No Action Alternative (which is used to avoid consideration of changes in reverse flows caused by sea level rise and climate change). The value of 1% is used to avoid consideration of minor fluctuations in model output due to simulation techniques and assumptions (Impact SW-3).
- Substantially alter the existing drainage pattern of the site or area during construction of conveyance facilities, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite (Impact SW-4).
- Substantially alter the existing drainage pattern of the site or area during construction of habitat restoration areas, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or offsite (Impact SW-5).
- Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff (Impact SW-6).
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam (Impact SW-7).
- Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the operation of habitat restoration areas (Impact SW-8).
- Place within a 100-year flood hazard area structures that would impede or redirect flood flows, or be subject to inundation by mudflow (Impact SW-9).

Changes in water surface elevations at certain locations in the Delta under Existing Conditions, No Action Alternative, and action Alternatives are presented in Appendix 5A, BDCP EIR/EIS Modeling Technical Appendix. Indirect effects of changes in water surface elevations in the Delta are addressed in other chapters addressing specific resources. Effects associated with changes in velocities and water surface elevations related to riparian corridor biological resources are addressed in Chapter 11, *Fish and Aquatic Resources,* and Chapter 12, *Terrestrial Biological Resources*. Effects associated with changes in water surface hydrodynamics related to availability of water for agricultural uses are addressed in Chapter 14, *Agricultural Resources*. Effects associated with changes in drainage conditions in agricultural areas and communities along the waterways are addressed in Chapter 14, *Agricultural Resources,* and Chapter 20, *Public Services and Utilities,* respectively. Effects associated with navigability issues are addressed in Chapter 19, *Transportation*. Effects associated with erosion, accretion, and sedimentation are addressed in Chapter 9, *Geology and Seismicity*.

As discussed in greater detail in Chapter 5, *Water Supply*, Section 5.3.2, the NEPA No Action Alternative, which reflects an anticipated future condition in 2060, includes both sea level rise and climate change (changed precipitation patterns), and also assumes, among many other programs, projects, and policies, implementation of most of the required actions under both the December 2008 USFWS BiOp and the June 2009 NFMS BiOp (inclusion of these actions is discussed in Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions,* Section 3D.3.2.3.1). The NEPA effects analyses in this chapter reflect these No Action assumptions.

6.3.3 Effects and Mitigation Approaches

6.3.3.1 No Action Alternative

The No Action Alternative would include continued implementation of existing maintenance, enforcement, and protection programs by federal, state, and local agencies, as well as projects that are permitted or under construction. Under the No Action Alternative, operations of the SWP/CVP facilities would be similar to those under Existing Conditions with the following changes.

- Effects of sea level rise and climate change on system operations as discussed in Section 6.3.1.1.
- An increase in demands and the buildout of facilities associated with water rights and CVP and SWP contracts of about 443 TAF per year, north of Delta at the future level of development. This is an increase in CVP M&I service contracts (253 TAF per year) and water rights (184 TAF per year) related primarily to urban M&I use, especially in the communities in El Dorado, Placer, and Sacramento Counties.
- An increase in demands associated with SWP contracts, up to full contract amounts, south of Delta at the future level of development. SWP M&I demands, which under the existing level of development vary on hydrologic conditions between 3.0 and 4.1 MAF per year, under the future condition are at maximum contract amounts in all hydrologic conditions. This represents a potential 25% increase on average in south of Delta demands under SWP M&I contracts between existing and future levels of development due to assumed additional development and demographics.
- New urban intake/Delta export facilities:
    - Freeport Regional Water Project (see Appendix 5A, *BDCP EIR/S Modeling* for information on additional EBMUD demand of about 26 TAF/YR on the average with increased demand in dry years)
    - 30 million-gallon-per-day City of Stockton Delta Water Supply Project
    - Delta-Mendota Canal–California Aqueduct Intertie
    - Contra Costa Water District Alternative Intake and 55 TAF/YR increased demand
    - South Bay Aqueduct rehabilitation, to 430 cfs capacity, from the junction with California Aqueduct to Alameda County Flood Control and Water Conservation District Zone 7.
- An increase in supplies for wildlife refuges including Firm Level 2 supplies of about 8 TAF per year at the future level of development. In addition, there is a shift in refuge demands from south to north (24 TAF per year reduction in south of Delta and 32 TAF per year increase in north of Delta).

- Implementation of the Fall X2 RPA action (see Appendix 5A, *BDCP EIR/S Modeling*), which requires maintenance of X2 at specific locations in wet and above normal years in September and October, plus releases in November to augment Delta outflow depending on hydrology.

A detailed description of the modeling assumptions associated with the No Action Alternative is included in Appendix 5A, *BDCP EIR/S Modeling.* Impacts on surface water conditions related to climate change and sea level rise are further described in Appendix 3E, *Potential Seismic and Climate Change Risks to SWP/CVP Water Supplies*.

Model results discussed for this Alternative are summarized in Tables 6-2 through 6-7.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity[1]

Reservoir storage in Shasta Lake, Folsom Lake, and Lake Oroville during the October through June period is compared to the flood storage capacity of each reservoir to identify the number of months when the reservoir storage is close to the flood storage capacity.

Under the No Action Alternative, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be fewer than under Existing Conditions, as shown in Tables 6-2 through 6-7. The changes in flood storage capacity are due to water releases to meet increased demands under the No Action Alternative compared to Existing Conditions, and changes due to sea level rise and climate change. The changes in reservoir flood storage capacity would provide additional flexibility for flood management.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

Analysis of monthly flows in high flow conditions could be indicative of the potential for changes in flood management in the Sacramento River at Freeport, San Joaquin River at Vernalis, Sacramento River upstream of Walnut Grove (downstream of proposed north Delta intake locations), Trinity River downstream of Lewiston Dam, American River downstream of Nimbus Dam, Feather River downstream of Thermalito Dam, and Yolo Bypass at Fremont Weir.

Sacramento River at Bend Bridge

Peak monthly flows that occur in Sacramento River at Bend Bridge are shown in Figures 6-8 and 6-9 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under the No Action Alternative would increase by 2% of the channel capacity (100,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

[1] An increase of more than 10% in number of months that reservoir storage is close to the flood storage capacity (within 10 TAF) compared to Existing Conditions would be interpreted as a consistently high storage condition that would reduce the flexibility for flood operations.

Sacramento River at Freeport

Peak monthly flows that occur in Sacramento River at Freeport are shown in Figures 6-10 and 6-11 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under the No Action Alternative would increase by no more than 1% of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

San Joaquin River at Vernalis

Peak monthly flows that occur in San Joaquin River at Vernalis are shown in Figures 6-12 and 6-13 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under the No Action Alternative would remain similar (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

Sacramento River at Locations Upstream of Walnut Grove (downstream of north Delta intakes)

Peak monthly flows that occur in the n the Sacramento River upstream of Walnut Grove are shown in Figures 6-14 and 6-15 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under the No Action Alternative would increase by no more than 1% of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

Trinity River Downstream of Lewiston Dam

Peak monthly flows that occur in the Trinity River downstream of Lewiston Dam are shown in Figures 6-16 and 6-17 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under the No Action Alternative would increase by 4% of the channel capacity (6,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

American River Downstream of Nimbus Dam

Peak monthly flows that occur in the American River downstream of Nimbus Dam are shown in Figures 6-18 and 6-19 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under the No Action Alternative would increase by no more than 1% of the channel capacity (115,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

Feather River Downstream of Thermalito Dam

Peak monthly flows that occur in the Feather River downstream of Thermalito Dam are shown in Figures 6-20 and 6-21 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under the No Action Alternative would remain similar (or show less than 1% change with respect to the channel capacity: 210,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

Yolo Bypass at Fremont Weir

Water generally spills into Yolo Bypass at Fremont Weir when the combined flows in the Sacramento River and Feather River upstream of Fremont Weir and flows from Sutter Bypass exceed 56,000 cfs. The Yolo Bypass floodplain capacity can accommodate a flow at Fremont Weir up to 343,000 cfs. Peak monthly spills into the Yolo Bypass at Fremont Weir during wet years is shown in Figure 6-22.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under the No Action Alternative would increase by no more than 1% of the channel capacity (343,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

Overall, the peak flows simulated in CALSIM under the No Action Alternative show increases from 1% to 4% in certain locations. However, these changes are primarily due to the change in flow patterns due to sea level rise and climate change. As described in section 6.3.1.2, the flood management criteria for maintaining adequate flood storage space in the reservoirs (as defined by the USACE and DWR for flood control release criteria) were not modified to adapt to the changes in runoff due to climate change. No changes in monthly allowable storage values related to CALSIM II model assumptions were included because these changes were not defined under the alternatives to achieve the project objectives or purpose and need for the BDCP. If USACE and DWR modify allowable storage values in the future in response to climate change, it is anticipated that the surface water flows and related water supply and water quality conditions would change.

***CEQA Conclusion*:** No Action Alternative could result in an increase in potential risk for flood management compared to Existing Conditions because of the changes due to sea level rise and climate change. It is expected that flood management criteria would be modified in the future to reduce risks due to sea level rise and climate change.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows on a long-term average basis under the No Action Alternative are similar to Existing Conditions, except in July through November. In these months, Old and Middle River flows are less negative due to reduced south Delta exports because of the sea level rise and climate change, increased demands in north of the Delta, and operations to comply with Fall X2 (Figure 6-23).

***CEQA Conclusion*:** There would be less reverse flows in Old and Middle Rivers under the No Action Alternative compared to Existing Conditions, due to reduced south Delta exports because of sea level rise and climate change, increased demands north of the Delta, and operations to comply with Fall X2.

Ongoing Plans, Policies, and Programs

The programs, plans, and projects included under the No Action Alternative are summarized in Chapter 3, *Description of Alternatives*. Most of the projects would not affect surface water resources under the No Action Alternative compared to Existing Conditions. The projects that could potentially affect SWP/CVP surface water conditions are summarized in Table 6-8.

Table 6-8. Effects on Surface Water Resources from the Plans, Policies, and Programs for the No Action Alternative as compared to the Existing Conditions

Agency	Program/Project	Status	Description of Program/Project	Effects on Surface Water
Contra Costa Water District, Bureau of Reclamation, and California Department of Water Resources	Middle River Intake and Pump Station (previously known as the Alternative Intake Pump Station)	Project completed and dedicated July 20, 2010	This project includes a potable water intake and pump station to improve drinking water quality for Contra Costa Water District customers.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (Contra Costa Water District 2006).
California Department of Water Resources	Federal Energy Regulatory Commission (FERC) License Renewal for Oroville Project	Draft Water Quality Certification issued December 6, 2010 and comments on Draft received December 10, 2010	The renewed federal license will allow the Oroville Facilities to continue providing hydroelectric power and regulatory compliance with water supply and flood management.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (California Department of Water Resources 2008c).
Freeport Regional Water Authority and Bureau of Reclamation	Freeport Regional Water Project	Intake was completed late 2010. Operations have not been initiated at this time.	Project includes an intake/pumping plant near Freeport on the Sacramento River and a conveyance structure to transport water through Sacramento County to the Folsom South Canal.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (Freeport Regional Water Authority 2003).
California Department of Water Resources and Solano County Water Agency	North Bay Aqueduct Alternative Intake Project	Study is ongoing.	An alternative intake on the Sacramento River and a new segment of pipeline to connect it to the North Bay Aqueduct system will be constructed.	No adverse effects on surface water resources are anticipated because the total diversions would be similar to the diversions allowed under the Existing Conditions.

Agency	Program/Project	Status	Description of Program/Project	Effects on Surface Water
City of Stockton	Delta Water Supply Project (Phase 1 only)	Completed in 2012.	This project consists of a new intake structure and pumping station adjacent to the San Joaquin River; a water treatment plant along Lower Sacramento Road; and water pipelines along Eight Mile, Davis, and Lower Sacramento Roads.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (City of Stockton 2005).
Tehama Colusa Canal Authority and Bureau of Reclamation	Red Bluff Diversion Dam Fish Passage Project	Completed in 2012.	Proposed improvements include modifications made to upstream and downstream anadromous fish passage and water delivery to agricultural lands within CVP.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (Bureau of Reclamation 2002).
Bureau of Reclamation, California Department of Fish and Wildlife, and Natomas Central Mutual Water Company	American Basin Fish Screen and Habitat Improvement Project	Completed in 2012.	This three-phase project includes consolidation of diversion facilities; removal of decommissioned facilities; aquatic and riparian habitat restoration; and installing fish screens in the Sacramento River. Total project footprint encompasses about 124 acres east of the Yolo Bypass.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (Bureau of Reclamation 2008).
Bureau of Reclamation	Delta-Mendota Canal/California Aqueduct Intertie	Completed in 2012.	The purpose of the intertie is to better coordinate water delivery operations between the California Aqueduct (state) and the Delta-Mendota Canal (federal) and to provide better pumping capacity for the Jones Pumping Plant. New project facilities include a pipeline and pumping plant.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (Bureau of Reclamation 2009).
Zone 7 Water Agency and California Department of Water Resources	South Bay Aqueduct Improvement and Enlargement Project	Completed in 2012.	The project includes construction of a new reservoir and pipelines and canals to increase the capacity of the South Bay Aqueduct.	No adverse effects on surface water resources are anticipated based upon environmental documentation for this project (California Department of Water Resources 2004).
USFWS	2008 Biological Opinion	Ongoing	The Biological Opinion issued by USFWS establishes certain RPAs that affect water supplies	No adverse effects on surface water resources are anticipated due to the federal biological opinions.

CEQA Conclusion: In total, the ongoing programs and plans under the No Action Alternative would not result in significant impacts on surface water resources based upon information presented in related environmental documentation.

6.3.3.2 Alternative 1A—Dual Conveyance with Pipeline/Tunnel and Intakes 1–5 (15,000 cfs; Operational Scenario A)

Alternative 1A would result in temporary effects on lands and communities associated with construction of five intakes with intake pumping plants and other associated facilities; two forebays; conveyance pipelines; and tunnels. Nearby areas would be altered as work or staging areas, concrete batch plants, and fuel stations, or be used for spoils storage areas. Sites used temporarily for borrow and then for spoils would also be anticipated to have a temporary effect on lands and communities. Transmission lines, access roads, and other incidental facilities would also be needed for operation of the project, and construction of these structures would have temporary effects on lands and communities.

Changes in SWP/CVP operations under Alternative 1A, described in Chapters 3 and 5 and Appendix 5A, would result in changes to surface water conditions. For example, most of the diversions at the north Delta intakes would occur in winter and spring, and most of the diversions at the south Delta intakes would occur in the summer under Alternative 1A. Alternative 1A does not include inflow/export ratio criteria for the San Joaquin River that limits use of the south Delta intakes under Existing Conditions and the No Action Alternative. The 2009 NMFS BiOp included specified inflow/export ratio criteria for the San Joaquin River flows at Vernalis compared to total exports at the SWP/CVP south Delta intakes to facilitate fish passage from the San Joaquin River into the western Delta, as described in Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix*.

Alternative 1A also would include installation of operable gates at Fremont Weir to increase the frequency and duration of inundation of Yolo Bypass, and modification of islands and channels in the Delta and Suisun Marsh to establish tidal marsh, channel margin, and riparian corridor habitat, compared to Existing Conditions and the No Action Alternative.

Alternative 1A would not include operations to comply with Fall X2. The Fall X2, included in the No Action Alternative, increases releases from SWP/CVP reservoirs upstream of the Delta to increase Delta outflow in September through November of above normal and wet water years. Under Alternative 1A, Delta outflows in October would increase to reduce salinity in the west Delta and comply with water quality criteria at Rock Slough, as under Existing Conditions and the No Action Alternative.

Model results discussed for this Alternative are summarized in Tables 6-2 through 6-7.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

Reservoir storage in Shasta Lake, Folsom Lake, and Lake Oroville during the October through June period is compared to the flood storage capacity of each reservoir to identify the number of months when the reservoir storage is close to the flood storage capacity.

NEPA Effects: Under Alternative 1A, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be similar to (or show no more than 10% increase) the No Action Alternative, as shown in Tables 6-2 through 6-7.

A comparison with storage conditions under the No Action Alternative provides an indication of the potential change due to Alternative 1A without the effects of sea level rise and climate change and the results show that reservoir storages would not be consistently high during October through June under Alternative 1A as compared to the conditions under the No Action Alternative. Therefore, Alternative 1A would not result in adverse impacts on reservoir flood storage capacity as compared to the conditions without the project.

CEQA Conclusion: Under Alternative 1A, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be less than under Existing Conditions, as shown in Tables 6-2 through 6-7. These differences represent changes under Alternative 1A, increased demands from Existing Conditions to No Action Alternative, and changes due to sea level rise and climate change. Alternative 1A would not cause consistently higher storages in the upper Sacramento River watershed during the October through June period. Accordingly, Alternative 1A would result in a less-than-significant impact on flood management. No mitigation is required.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

Sacramento River at Bend Bridge

Peak monthly flows that occur in Sacramento River at Bend Bridge are shown in Figures 6-8 and 6-9 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would remain similar (or show less than 1% change with respect to the channel capacity: 150,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would increase by 2% of the channel capacity (100,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 1A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 1A as compared to the No Action Alternative. Therefore, Alternative 1A would not result in adverse impacts on flow conditions in the Sacramento River at Bend Bridge as compared to the conditions without the project.

Sacramento River at Freeport

Peak monthly flows that occur in Sacramento River at Freeport are shown in Figures 6-10 and 6-11 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would decrease by 1% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would remain similar (or show less than 1% change with respect to the channel capacity: 110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 1A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 1A as compared to the No Action Alternative. Therefore, Alternative 1A would not result in adverse impacts on flow conditions in the Sacramento River at Freeport as compared to the conditions without the project.

San Joaquin River at Vernalis

Peak monthly flows that occur in the San Joaquin River at Vernalis are shown in Figures 6-12 and 6-13 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would remain similar to (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would remain similar (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 1A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 1A as compared to the No Action Alternative. Therefore, Alternative 1A would not result in adverse impacts on flow conditions in the San Joaquin River at Vernalis as compared to the conditions without the project.

Sacramento River at Locations Upstream of Walnut Grove (downstream of north Delta intakes)

Peak monthly flows that occur in the n the Sacramento River upstream of Walnut Grove are shown in Figures 6-14 and 6-15 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would decrease by 11% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would decrease by 9% of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This decrease primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 1A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 1A as compared to the No Action Alternative. Therefore, Alternative 1A would not result in adverse impacts on flow conditions in the Sacramento River upstream of Walnut Grove as compared to the conditions without the project.

Trinity River Downstream of Lewiston Dam

Peak monthly flows that occur in the Trinity River downstream of Lewiston Lake are shown in Figures 6-16 and 6-17 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would remain similar to (or show no more than 1% increase with respect to the channel capacity: 6,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would increase by 4% of the channel capacity (6,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 1A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 1A as compared to the No Action Alternative. Therefore, Alternative 1A would not result in adverse impacts on flow conditions in the Trinity River downstream of Lewiston Lake as compared to the conditions without the project.

American River Downstream of Nimbus Dam

Peak monthly flows that occur in the American River at Nimbus Dam are shown in Figures 6-18 and 6-19 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would remain similar to (or show less than 1% change with respect to the channel capacity: 115,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would increase by no more than 1% of the channel capacity (115,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 1A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 1A as compared to the No Action Alternative. Therefore, Alternative 1A would not result in adverse impacts on flow conditions in the American River at Nimbus Dam as compared to the conditions without the project.

Feather River Downstream of Thermalito Dam

Peak monthly flows that occur in the Feather River downstream of Thermalito Dam are shown in Figures 6-20 and 6-21 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would increase no more than 1% of the channel capacity (210,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would increase by no more than 1% of the channel capacity (210,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 1A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 1A as compared to the No Action Alternative. Therefore, Alternative 1A would not result in adverse impacts on flow conditions in the Feather River at Thermalito Dam as compared to the conditions without the project.

Yolo Bypass at Fremont Weir

Peak monthly spills into the Yolo Bypass at Fremont Weir during wet years is shown in Figure 6-22.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 1A would increase by 2% of the channel capacity (343,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 1A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 1A as compared to the No Action Alternative. Therefore, Alternative 1A would not result in adverse impacts on flow conditions in the Yolo Bypass at Fremont Weir as compared to the conditions without the project.

NEPA Effects: Overall, Alternative 1A would not result in an increase in potential risk for flood management compared to the No Action Alternative. Peak monthly flows under Alternative 1A in the locations considered in this analysis either were similar to or less than peak monthly flows that would occur under the No Action Alternative; or the increase in peak monthly flows would be less than the flood capacity for the channels at these locations.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative.

Increased frequency of spills due to the proposed notch under Alternative 1A would not cause any adverse effect in conveying flood flows, because the maximum capacity of the notch is 6,000 cfs (less than 2% of the channel capacity); and the notch is closed (no additional flow) when the River stage reaches the weir crest elevation. Therefore, even if the notch enables spills before the River stage reaches the crest elevation, these spills would be minor relative to the capacity of the Bypass. Velocity in the Bypass would increase as the spills occur over the crest; therefore the inertia due to earlier spills through the notch would decrease and would not be substantial by the time the Bypass reaches full capacity.

Therefore, Alternative 1A would not result in adverse effects on flood management.

CEQA Conclusion**:** Alternative 1A would not result in an increase in potential risk for flood management compared to Existing Conditions when the changes due to sea level rise and climate change are eliminated from the analysis. Peak monthly flows under Alternative 1A in the locations considered in this analysis either were similar to or less than those that would occur under Existing Conditions without the changes in sea level rise and climate change; or the increased peak monthly flows would not exceed the flood capacity of the channels at these locations. Accordingly, Alternative 1A would result in a less-than-significant impact on flood management. No mitigation is required.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would be reduced under Alternative 1A on a long-term average basis except in April and May; and October, compared to reverse flows under the No Action Alternative, as shown in Figure 6-23. Compared to flows under the No Action Alternative, Old and Middle River flows would be less positive in April and May under Alternative 1A because Alternative 1A does not include inflow/export ratio criteria for the San Joaquin River in those months; and it would be less positive in October because Alternative 1A does not include Fall X2. Therefore, Alternative 1A would result in reduced reverse flow conditions in Old and Middle Rivers in November through March and June through September and increased reverse flow conditions in April, May, and October.

Reverse flow conditions for Old and Middle River flows would be reduced under Alternative 1A on a long-term average basis except in April and May compared to reverse flows under the Existing Conditions, as shown in Figure 6-23. Compared to flows under the No Action Alternative, Old and Middle River flows would be less positive in April and May under Alternative 1A because Alternative 1A does not include inflow/export ratio criteria for the San Joaquin River in those months. Therefore, Alternative 1A would result in reductions in reverse flow conditions in Old and Middle Rivers in June through March and increased reverse flow conditions in April and May. However, these differences represent changes under Alternative 1A, increased demands from Existing Conditions to No Action Alternative, and changes due to sea level rise and climate change.

NEPA Effects: A comparison with reverse flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 1A without the effects of sea level rise and climate change and the results show that reverse flow conditions under Alternative 1A would be reduced on a long-term average basis except in October, April, and May as compared to No Action Alternative.

CEQA Conclusion: Alternative 1A would provide positive changes related to reducing reverse flows in Old and Middle Rivers in June through March and negative changes in the form of increased reverse flow conditions in October, April and May, compared to Existing Conditions. Determination of the significance of this impact is related to impacts on water quality and aquatic resources. The significance of these impacts is described in Chapter 8, *Water Quality*, and Chapter 11, *Fisheries and Aquatic Resources*.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

Construction of the conveyance facilities under Alternative 1A would involve construction of intakes in the water and extensive facilities on the land.

Construction of the earthen embankments, pumping plants, levees, tunnels, tunnel access shafts, forebays, canals, and access roads included in Alternative 1A would require excavation, grading, or stockpiling at project facility sites or at temporary worksites. These activities would result in temporary and long-term changes to drainage patterns, paths and facilities that would, in turn, cause changes in drainage flow rates, directions and velocities.

Site grading needed to construct any of the proposed facilities has the potential to block, reroute, or temporarily detain and impound surface water in existing drainages, which would result in increases and decreases in flow rates, velocities, and water surface elevations. Changes in drainage depths would vary depending on the specific conditions at each of the temporary work sites. As drainage paths would be blocked by construction activities, the temporary ponding of drainage water could occur and result in decreases in drainage flow rates downstream of the new facilities, increases in water surface elevations, and decreases in velocities upstream of the new facilities. Alternative 1A facilities could temporarily and directly affect existing water bodies and drainage facilities, including ditches, canals, pipelines, or pump stations.

These temporary changes in drainage would be minimized, and in some cases avoided, by construction of new or modified drainage facilities, as described in the Chapter 3, *Description of Alternatives*. Alternative 1A would include installation of temporary drainage bypass facilities, long-term cross drainage, and replacement of existing drainage facilities that would be disrupted by construction of new facilities. These facilities would be constructed prior to disconnecting or crossing existing drainage facilities. Locations of stockpiles and other temporary construction features would be selected to minimize flow impedance under flood flow conditions.

Paving, compaction of soil and other activities that would increase land imperviousness would result in decreases in precipitation infiltration into the soil, and thus increase drainage runoff flows into receiving drainages.

Removal of groundwater during construction (dewatering) would be required for excavation activities. Groundwater removed during construction would be treated as necessary (see Chapter 3, *Description of Alternatives*, and Chapter 7, *Groundwater*), and discharged to local drainage channels or rivers. This would result in a localized increase in flows and water surface elevations in the receiving channels. Dewatering would be a continuous operation initiated 1 to 4 weeks prior to excavation and would continue after excavation is completed. The discharge rates of water collected during construction would be relatively small compared to the capacities of most of the Delta channels where discharges would occur. Dispersion facilities would be used to reduce the potential for channel erosion due to the discharge of dewatering flows. Permits for the discharges would be obtained from the Regional Water Quality Control Board.

Intakes constructed under Alternative 1A would be on-bank facilities that could encroach into the existing river cross section and would involve construction activities in the Sacramento River, at the northern end of the Delta. Construction of intakes would include the installation of cofferdams at each of the intake locations. The cofferdams would impede river flows, resulting in hydraulic effects. Water surface elevations upstream of the cofferdams could increase under flood flow conditions by approximately 0.5 foot relative to Existing Conditions and the No Action Alternative. Under existing regulations, USACE, CVFPB, and DWR would require installation of setback levees or other measures to maintain existing flow capacity in the Sacramento River during construction and operations, which would prevent unacceptable increases in river water surface elevations under flood-flow conditions, reverse flow areas, areas of high velocities that could result in scour, and reflection of flood waves towards other levees.

Sediment and debris would accumulate at the intake locations and periodic dredging would occur, as described in Chapter 3, *Description of Alternatives*.

Construction of project facilities could affect agricultural irrigation delivery and return flow canals, pumps and other drainage facilities in locations where such agricultural facilities would be crossed by intakes, pumping plants, forebays, pipelines, canals, and tunnel access shafts. Stockpiled excavated material from forebays and sediment basins could affect agricultural irrigation deliveries and return flows. Alternative 1A would include installation of temporary agricultural flow bypass facilities and provision of replacement drainage facilities to avoid interruptions in agricultural irrigation deliveries or return flows, as described in Chapter 3, *Description of Alternatives*. The temporary flow bypass facilities would be installed and connected before existing facilities would be disconnected or otherwise affected. Replacement drainage facilities would be installed and connected before the end of construction of the proposed conveyance facilities.

NEPA Effects: Alternative 1A would involve excavation, grading, stockpiling, soil compaction, and dewatering that would result in temporary and long-term changes to drainage patterns, drainage paths, and facilities that would in turn, cause changes in drainage flow rates, directions, and velocities. Construction of cofferdams would impede river flows, cause hydraulic effects, and increase water surface elevations upstream. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. Mitigation Measure SW-4 is available to address effects of runoff and sedimentation.

***CEQA Conclusion*:** Alternative 1A would result in alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages, and from changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

BDCP proponents will have to demonstrate no-net-increase in runoff due to construction activities during peak flows. To achieve this, proponents will implement measures to prevent an increase in runoff volume and rate from land-side construction areas and to prevent an increase in sedimentation in the runoff from the construction area as compared to Existing Conditions. To reduce the potential for adverse impacts from large amounts of runoff from paved and impervious surfaces during construction, operations, or maintenance, the proponents will design and implement onsite drainage systems in areas where construction drainage is required. Drainage studies will be prepared for each construction location to assess the need for, and to finalize, other drainage-related design measures, such as a new onsite drainage system or new cross drainage facilities. Based on study findings, if it is determined that onsite stormwater detention storage is required, detention facilities will be located within the existing construction area.

To avoid changes in the courses of waterbodies, the BDCP proponents will design measures to prevent a net increase in sediment discharge or accumulation in water-bodies compared to Existing Conditions to avoid substantially affecting river hydraulics during peak conditions. A detailed sediment transport study for all water-based facilities will be conducted and a sediment management plan will be prepared and implemented during construction. The sediment management plan will include periodic and long-term sediment removal actions.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Construction of the restoration area facilities under Alternative 1A would involve construction of habitat restoration in the water and other facilities on the land.

Riparian habitat restoration is anticipated to occur primarily in association with the restoration of tidal marsh habitat, channel margin habitat, and inundated floodplains. The restored vegetation has the potential of increasing channel and/or floodplain roughness, which could result in increases in channel water surface elevations, including under flood flow conditions, and in decreased velocities. Modified channel geometries could increase or decrease channel velocities and/or channel water surface elevations, including under flood flow conditions. Under existing regulations, the USACE, CVFPB, and DWR would require the habitat restoration projects to be flood neutral. Measures to reduce flood potential could include channel dredging to increase channel capacities and decrease channel velocities and/or water surface elevations.

Expansion of seasonally inundated floodplain restoration areas generally would decrease flows in the existing channels under higher-flow conditions, resulting in lower channel velocities and water surface elevations. Hydraulic roughness in the inundated floodplain areas could vary based on the land use that would be allowed there, whether riparian vegetation would be allowed to establish, farming would be continued, or residual crop biomass would be used to provide cover, hydrodynamic complexity, and organic carbon sources. However, because these inundated areas would provide new flow area relative to the No Action Alternative, the overall hydraulic effect in the existing channels would be to lower channel velocities and water surface elevations under high-flow conditions.

CEQA Conclusion: see Impact SW-4 conclusion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

See Mitigation Measure SW-4 under Impact SW-4.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Construction of pumping plants, pipelines, tunnels, and other facilities that require excavation under Alternative 1A would contribute runoff from dewatering facilities at any location where dewatering systems discharge water into streams or tributaries. As described under Impact SW-4, paving, compaction of soil and other activities would increase land imperviousness, result in decreases in precipitation infiltration into the soil, and could increase drainage runoff flows into receiving drainages.

Removal of groundwater during construction (dewatering) would be required for excavation activities. Groundwater removed during construction would be treated as necessary (see Chapter 8, *Water Quality*), and discharged to local drainage channels or rivers. This would result in a localized increase in flows and water surface elevations in receiving channels. Dewatering would be a continuous operation initiated 1 to 4 weeks prior to excavation and would continue after excavation is completed. The discharge rates of water collected during construction would be relatively small compared to the capacities of most of the Delta channels where discharges would occur. Dispersion facilities would be used to reduce the potential for channel erosion due to the discharge of dewatering flows. Permits for the discharges would be obtained from the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4).

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects. The effects on drainage facilities are described in Chapter 14, *Agricultural Resources*, and Chapter 20, *Public Services and Utilities*.

CEQA Conclusion**:** Alternative 1A actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 1A would include provisions to design the dewatering system in accordance with these permits that would avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities sites during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

As described under Impact SW-4, facilities under Alternative 1A would be designed to avoid increased flood potential compared to Existing Conditions or the No Action Alternative in accordance with the requirements of USACE, CVFPB, and DWR. As described under Impact SW-1, Alternative 1A would not increase flood potential on the Sacramento River, San Joaquin River, or Yolo Bypass.

USACE, CVFPB, and DWR would require that any construction that would disturb existing levees to be designed in a manner that would not adversely affect existing flood protection. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures. Facilities construction would include temporary cofferdams, stability analyses, monitoring, and slope remediation, as described in Chapter 3, *Description of Alternatives*. For the excavation of the existing levee for the Sacramento River intake structures, sheet pile wall installation would minimize effects on slope stability during construction. For excavation of the existing levee for the Byron Tract Forebay, tie-back wall installation and dewatering to maintain slope stability and control seepage would minimize effects on slope stability associated with construction of the forebay and approach channel embankments. Providing tunnel shaft support would minimize the effects on slope stability from excavation adjacent to Clifton Court Forebay during excavation of the main tunnel shaft adjacent to the Clifton Court Forebay embankment. Dewatering inside the cofferdam or adjacent to the existing levees would remove waterside slope resistance and lead to slope instability. Slopes would be constructed in accordance with existing engineering standards, as described in Chapter 3, *Description of Alternatives*.

Some project facilities could require rerouting of access roads and waterways that could be used during times of evacuation or emergency response.

NEPA Effects: Alternative 1A would not result in increased exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential, as described in Section 6.2.2.4.

CEQA Conclusion**:** Alternative 1A would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential, as described in Section 6.2.2.4. These impacts are considered less than significant.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

Tidal marsh habitat, channel margin habitat, and inundated floodplains could increase flood potential due to impacts on adjacent levees. The newly flooded areas would have larger wind fetch lengths (unobstructed distance which wind can travel over water and potentially develop large waves caused by wind force not tidal force) compared to the existing fetch lengths of the adjacent leveed channels. An increase in fetch length would result in increases in wave height and velocities that reach the existing levees along adjacent islands and floodplains. These potential increases in wave action could also reach the land-side of the remaining existing levees around the restoration area. In accordance with existing requirements of the USACE, CVFPB, and DWR, Alternative 1A would be designed to avoid increased flood potential as compared to Existing Conditions or No Action Alternative.

NEPA Effects: Alternative 1A would not result in an increase to exposure of people or structures to flooding due to the operation of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. This impact could become more substantial with sea level rise and climate change.

CEQA Conclusion: Alternative 1A would not result in an increase to exposure of people or structures to flooding due to the operations of habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees. These impacts are considered significant. Mitigation Measure SW-8 would reduce this potential impact to a level of less than significant.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Measures will be implemented to prevent an increase in potential damage from wind-driven waves across expanded open water areas at habitat restoration locations. These measures will be designed based upon wind fetch studies that will be completed prior to construction of habitat restoration areas with increased open water in the Delta. To reduce the potential for adverse impacts from the increased open water areas during wind events, levees that would be subject to increased wind-driven waves will be strengthened and possibly raised to avoid levee damage from waves or water entering the landside of the levee due to high waves. Other mechanisms to reduce the effects of wind fetch will be considered to the extent feasible in the design of restoration areas, consistent with the biological goals and objectives of the BDCP.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

As described under Impact SW-4, facilities under Alternative 1A would include structures within the 100-year flood hazard area, but would not result in impeded or redirected flood flows or conditions that could lead to mudflows because the structures would be required to meet the criteria of USACE, CVFPB, and DWR. As described under Impact SW-4, Alternative 1A also would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 1A would include measures to address issues associated with alterations to drainage patterns, stream courses, runoff, and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

***CEQA Conclusion*:** Alternative 1A would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.3 Alternative 1B—Dual Conveyance with East Alignment and Intakes 1–5 (15,000 cfs; Operational Scenario A)

Alternative 1B would result in temporary effects on land and communities in the study area associated with construction of five intakes and intake pumping plants, one forebay, pipelines, canals, tunnel siphons, culvert siphons, and an intermediate pumping plant; alter nearby areas for retrieval of borrowed soils and spoils and reusable tunnel material (RTM) storage; and require development of transmission lines, access roads, and other incidental structures. This alternative would differ from Alternative 1A primarily in that it would use a series of canals generally along the east section of the Delta to convey water from north to south, rather than long segments of deep tunnel through the central part of the Delta.

Operations of the facilities and implementation of the other conservation measures would be identical to actions described under Alternative 1A.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

NEPA Effects: Effects on SWP/CVP reservoir storage under Alternative 1B would be identical to those described for Impact SW-1 under Alternative 1A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Effects on SWP/CVP reservoir storage under Alternative 1B would be identical to those described under Alternative 1A because the operations of the facilities would be identical. Alternative 1B would result in a less-than-significant impact on flood management. No mitigation is required.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

NEPA Effects: Effects on surface water flows under Alternative 1B would be identical to those described for Impact SW-2 under Alternative 1A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Effects on surface water flows under Alternative 1B would be identical to those described under Alternative 1A because the operations of the facilities would be identical. Alternative 1B would result in less-than-significant river flow impacts on flood management. No mitigation is required.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

NEPA Effects: Effects on Old and Middle River flows under Alternative 1B would be identical to those described for Impact SW-3 under Alternative 1A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Alternative 1B would provide positive changes related to reducing reverse flows in Old and Middle Rivers in June through March and negative changes related to increased reverse flow conditions in April and May, compared to Existing Conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Accordingly, the significance of these effects is described in Chapter 8, *Water Quality*, and Chapter 11, *Fisheries and Aquatic Resources*.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 1B would be similar to those described for Impact SW-4 under Alternative 1A because the operations of the facilities would be identical and provisions to avoid adverse effects on drainage patterns would be the same. Due to the construction of conveyance canals under Alternative 1B rather than tunnels, the potential for interruption of existing drainage facilities would be higher. However, the same types of activities related to installation of temporary and permanent drainage facilities and restoration of disturbed drainage facilities would occur under Alternative 1B as under Alternative 1A, as described in the Chapter 3, *Description of Alternatives*.

Alternative 1B construction would include potential alterations to drainage patterns, stream courses, and runoff, and the potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway, as described in Chapter 3, *Description of Alternatives*. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; as well as changes in sediment accumulation near the intakes.

Alternative 1B would incorporate measures to address adverse effects; Mitigation Measure SW-4 is available to address these effects.

***CEQA Conclusion*:** Alternative 1B would have potential impacts associated with alterations to drainage patterns, stream courses, and runoff, and the potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; as well as; changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 1B would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion: Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects on surface waters due to runoff under Alternative 1B would be similar to those described for Impact SW-6 under Alternative 1A because the operations of the facilities would be identical and provisions to avoid adverse effects on surface waters would be the same. Due to the construction of canals under Alternative 1B as opposed to tunnels, groundwater dewatering would occur over a larger area and the amount of dewatering would be increased because canals would require more dewatering activities than tunneling operations that can occur in high groundwater conditions. However, the same types of activities related to installation of temporary and permanent drainage facilities would occur under Alternative 1B as under Alternative 1A, as described in Chapter 3, *Description of Alternatives*.

NEPA Effects: Paving, soil compaction and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

***CEQA Conclusion*:** Alternative 1B actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 1B would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities sites during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Increased exposure of people or structures to flood risks under Alternative 1B would be similar to those described for Impact SW-7 under Alternative 1A because provisions to avoid adverse effects related to flood potential would be the same, and the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential, as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

***CEQA Conclusion*:** Alternative 1B would not result in increased exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees Alternative 1B would be same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion: Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Effects on flood potential would be similar under Alternative 1B to those described for Impact SW-9 under Alternative 1A because facilities would be designed to avoid increased flood potential compared to Existing Conditions or the No Action Alternative, in accordance with USACE, CVFPB, and DWR requirements. As described under Impact SW-4, Alternative 1B would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 1B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

***CEQA Conclusion*:** Alternative 1B would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.4 Alternative 1C—Dual Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario A)

Alternative 1C would result in effects on lands and communities in the study area associated with construction of five intakes and intake pumping plants, one forebay, conveyance pipelines, canals, a tunnel, culvert siphons, and an intermediate pumping plant. Nearby areas would be altered for the deposition of spoils. Transmission lines, access roads, and other incidental facilities would also be needed for operation of the project and construction of these structures would have effects on lands and communities.

Operations of the facilities and implementation of the conservation measures would be identical to actions described under Alternative 1A.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

NEPA Effects: Effects on SWP/CVP reservoir storage under Alternative 1C would be identical to those described for Impact SW-1 under Alternative 1A because the operations of the facilities would be identical.

CEQA Conclusion**:** Impacts on SWP/CVP reservoir storage under Alternative 1C would be identical to those described under Alternative 1A because the operations of the facilities would be identical. Accordingly, Alternative 1C would result in a less-than-significant impact on flood management. No mitigation is necessary.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

NEPA Effects: Effects on surface water flows under Alternative 1C would be identical to those described for Impact SW-2 under Alternative 1A because the operations of the facilities would be identical.

CEQA Conclusion**:** Impacts on surface water flows under Alternative 1C would be identical to those described under Alternative 1A because the operations of the facilities would be identical. Accordingly, Alternative 1C would result in less-than-significant river flow impacts on flood management. No mitigation is necessary.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

NEPA Effects: Effects on Old and Middle River flows under Alternative 1C would be identical to those described for Impact SW-3 under Alternative 1A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Alternative 1C would provide positive changes related to reducing reverse flows in Old and Middle Rivers in June through March and negative changes related to increased reverse flow conditions in April and May compared to Existing Conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects is described in Chapter 8, *Water Quality*, and Chapter 11, *Fisheries and Aquatic Resources*.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Effects on alteration of existing drainage patterns under Alternative 1C would be similar to those described for Impact SW-4 under Alternative 1A because the operations of the facilities would be identical and provisions to avoid adverse effects on drainage patterns would be the same. Due to the construction of canals under Alternative 1C compared to tunnels, the potential for interruption of existing drainage facilities would be higher. However, the same types of activities related to installation of temporary and permanent drainage facilities and restoration of disturbed drainage facilities would occur under Alternative 1C as under Alternative 1A, as described in the Chapter 3, *Description of Alternatives*.

Alternative 1C would incorporate measures to address adverse effects and Mitigation Measure SW-4 is available to address these effects.

***CEQA Conclusion*:** Alternative 1C would have potential impacts associated with alterations to drainage patterns, stream courses, and runoff, and the potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential adverse impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages, as well as changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 1C would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion: Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects on surface waters due to runoff under Alternative 1C would be similar to those described for Impact SW-6 under Alternative 1A because the operations of the facilities would be identical and provisions to avoid adverse effects on surface waters would be the same. Due to the construction of canals under Alternative 1C as compared to tunnels, groundwater dewatering would occur over a larger area and the amount of dewatering would be increased because canals would require more dewatering activities than tunneling operations that can occur in high groundwater conditions. However, the same types of activities related to installation of temporary and permanent drainage facilities would occur under Alternative 1C as under Alternative 1A, as described in Chapter 3, *Description of Alternatives*.

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

CEQA Conclusion**:** Alternative 1C actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 1C would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Increased exposure of people or structures to flood risks under Alternative 1C would be similar to those described for Impact SW-7 under Alternative 1A because provisions to avoid adverse effects related to flood potential would be the same, and the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

***CEQA Conclusion*:** Alternative 1C would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees Alternative 1C would be same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion: Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Effects on flood potential would be similar under Alternative 1C to impacts described for Impact SW-9 under Alternative 1A because facilities would be designed to avoid increased flood potential compared to Existing Conditions or the No Action Alternative, in accordance with USACE, CVFPB, and DWR requirements. As described under Impact SW-4, Alternative 1C would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 1C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

***CEQA Conclusion*:** Alternative 1C would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.5 Alternative 2A—Dual Conveyance with Pipeline/Tunnel and Five Intakes (15,000 cfs; Operational Scenario B)

Facilities construction under Alternative 2A would be identical to that described for Alternative 1A. Alternative 2A would involve relocation of two of the intakes to sites south of the confluence of Sutter and Steamboat Sloughs and the Sacramento River.

Operations under Alternative 2A would be similar to those under Alternative 1A except for the following actions.

- Alternative 2A would include operations to comply with Fall X2 that will increase Delta outflow in September through November when the previous water year's classification was above-normal or wet, as in the No Action Alternative. Outflow would decrease in other months due to increased total exports as compared to the No Action Alternative.
- Alternative 2A would include specific criteria to reduce reverse flows in Old and Middle River to a greater extent than under Alternative 1A. These criteria would reduce use of the south Delta intakes except in April and May, as compared to the No Action Alternative.
- Alternative 2A would include operation of a removable barrier at the Head of Old River. Use of this barrier would increase reverse flows in Old and Middle Rivers in April and May because there would be less water available from the San Joaquin River at these intakes.
- Due to reductions in the use of south Delta intakes, more water would be diverted through the north Delta intakes from December through July in Alternative 2A as compared to Alternative 1A. This operation increases total export patterns in the spring months and decreases total exports in the fall months when north Delta intake operations would be constrained by north Delta bypass flows, as described in Chapter 3, *Description of Alternatives*.
- Alternative 2A provides for more frequent spills into Yolo Bypass at Fremont Weir to increase frequency and extent of inundation.

Model results discussed for this Alternative are summarized in Tables 6-2 through 6-7.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

Reservoir storage in Shasta Lake, Folsom Lake, and Lake Oroville during the October through June period is compared to the flood storage capacity of each reservoir to identify the number of months where the reservoir storage is close to the flood storage capacity.

NEPA Effects: Under Alternative 2A, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be similar to (or show no more than 10% increase) the No Action Alternative, as shown in Tables 6-2 through 6-7.

A comparison with storage conditions under the No Action Alternative provides an indication of the potential change due to Alternative 2A without the effects of sea level rise and climate change and the results show that reservoir storages would not be consistently high during October through June under Alternative 2A as compared to the conditions under the No Action Alternative. Therefore, Alternative 2A would not result in adverse impacts on reservoir flood storage capacity as compared to the conditions without the project.

CEQA Conclusion: Under Alternative 2A, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be less than under Existing Conditions, as shown in Tables 6-2 through 6-7. These differences represent changes under Alternative 2A, increased demands from Existing Conditions to No Action Alternative, and changes due to sea level rise and climate change. Alternative 2A would not cause consistently higher storages in the upper Sacramento River watershed during the October through June period. Accordingly, Alternative 2A would result in a less-than-significant impact on flood management. No mitigation is required.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

Sacramento River at Bend Bridge

Peak monthly flows that occur in Sacramento River at Bend Bridge are shown in Figures 6-8 and 6-9 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would remain similar (or show less than 1% change with respect to the channel capacity: 100,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would increase by 2% of the channel capacity (100,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 2A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 2A as compared to the No Action Alternative. Therefore, Alternative 2A would not result in adverse impacts on flow conditions in the Sacramento River at Bend Bridge as compared to the conditions without the project.

Sacramento River at Freeport

Peak monthly flows that occur in Sacramento River at Freeport are shown in Figures 6-10 and 6-11 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would decrease by 1% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would remain similar (or show less than 1% change with respect to the channel capacity: 110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 2A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 2A as compared to the No Action Alternative. Therefore, Alternative 2A would not result in adverse impacts on flow conditions in the Sacramento River at Freeport as compared to the conditions without the project.

San Joaquin River at Vernalis

Peak monthly flows that occur in San Joaquin River at Vernalis are shown in Figures 6-12 and 6-13 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would remain similar to (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would remain similar (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 2A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 2A as compared to the No Action Alternative. Therefore, Alternative 2A would not result in adverse impacts on flow conditions in the San Joaquin River at Vernalis as compared to the conditions without the project.

Sacramento River at Locations Upstream of Walnut Grove (downstream of north Delta intakes)

Peak monthly flows that occur in the n the Sacramento River upstream of Walnut Grove are shown in Figures 6-14 and 6-15 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would decrease by 12% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would decrease by 11% of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This decrease primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 2A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 2A as compared to the No Action Alternative. Therefore, Alternative 2A would not result in adverse impacts on flow conditions in the Sacramento River upstream of Walnut Grove as compared to the conditions without the project.

Trinity River Downstream of Lewiston Dam

Peak monthly flows that occur in the Trinity River downstream of Lewiston Lake are shown in Figures 6-16 and 6-17 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would remain similar to (or show no more than 1% increase with respect to the channel capacity: 6,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would increase by 4% of the channel capacity (6,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 2A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 2A as compared to the No Action Alternative. Therefore, Alternative 2A would not result in adverse impacts on flow conditions in the Trinity River downstream of Lewiston Lake as compared to the conditions without the project.

American River Downstream of Nimbus Dam

Peak monthly flows that occur in the American River at Nimbus Dam are shown in Figures 6-18 and 6-19 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would remain similar to (or show less than 1% change with respect to the channel capacity: 115,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would increase by no more than 1% of the channel capacity (115,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 2A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 2A as compared to the No Action Alternative. Therefore, Alternative 2A would not result in adverse impacts on flow conditions in the American River at Nimbus Dam as compared to the conditions without the project.

Feather River Downstream of Thermalito Dam

Peak monthly flows that occur in the Feather River downstream of Thermalito Dam are shown in Figures 6-20 and 6-21 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would remain similar (or change no more than 1% of the channel capacity: 210,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would remain similar (or show less than 1% change with respect to the channel capacity: 210,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 2A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 2A as compared to the No Action Alternative. Therefore, Alternative 2A would not result in adverse impacts on flow conditions in the Feather River at Thermalito Dam as compared to the conditions without the project.

Yolo Bypass at Fremont Weir

Peak monthly spills into the Yolo Bypass at Fremont Weir occur in February during wet years, as shown in Figure 6-22.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 2A would increase by 2% of the channel capacity (343,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

NEPA Effects: A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 2A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 2A as compared to the No Action Alternative. Therefore, Alternative 2A would not result in adverse impacts on flow conditions in the Yolo Bypass at Fremont Weir as compared to the conditions without the project.

Overall, Alternative 2A would not result in an increase in potential risk for flood management compared to the No Action Alternative. Peak monthly flows under Alternative 2A in the locations considered in this analysis either were similar to or less than peak monthly flows that would occur under the No Action Alternative; or the increase in peak monthly flows would be less than the flood capacity for the channels at these locations.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative.

Increased frequency of spills due to the proposed notch under Alternative 2A would not cause any significant adverse effect in conveying flood flows, because the maximum capacity of the notch is 6,000 cfs (less than 2% of the channel capacity); and the notch is closed (no additional flow) when the River stage reaches the weir crest elevation. Therefore, even if the notch enables spills before the River stage reaches the crest elevation, these spills would be minor relative to the capacity of the Bypass. Velocity in the Bypass would increase as the spills occur over the crest; therefore the inertia due to earlier spills through the notch would decrease and would not be significant by the time the Bypass reaches full capacity.

Therefore, Alternative 2A would not result in adverse effects on flood management.

CEQA Conclusion: Alternative 2A would not result in an increase in potential risk for flood management compared to Existing Conditions when the changes due to sea level rise and climate change are eliminated from the analysis. Peak monthly flows under Alternative 2A in the locations considered in this analysis either were similar to or less than those that would occur under Existing Conditions without the changes in sea level rise and climate change; or the increased peak monthly flows would not exceed the flood capacity of the channels at these locations. Accordingly, Alternative 2A would result in a less-than-significant impact on flood management. No mitigation is required.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would be reduced under Alternative 2A on a long-term average basis except in April, as shown in Figure 6-23. Compared to flows under both Existing Conditions and the No Action Alternative, Old and Middle River flows would be less positive in April under Alternative 2A because Alternative 2A does not include inflow/export ratio criteria for the San Joaquin River in those months. Therefore, Alternative 2A would result in reduced reverse flow conditions in Old and Middle Rivers in May through March and increased reverse flow conditions in April.

NEPA Effects: A comparison with reverse flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 2A without the effects of sea level rise and climate change and the results show that reverse flow conditions under Alternative 2A would be reduced on a long-term average basis except in April as compared to No Action Alternative.

CEQA Conclusion: Alternative 2A would provide positive changes related to reducing reverse flows in Old and Middle Rivers in May through March and negative changes in the form of increased reverse flow conditions in April, compared to Existing Conditions. Determination of the significance of this impact is related to impacts on water quality and aquatic resources. The significance of these impacts is described in Chapter 8, *Water Quality*, and Chapter 11, *Fisheries and Aquatic Resources*.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Effects associated with construction and operations of facilities under Alternative 2A would be identical to those described under Alternative 1A because the facilities would be identical.

Alternative 2A would involve excavation, grading, stockpiling, soil compaction, and dewatering that would result in temporary and long-term changes to drainage patterns, drainage paths, and facilities that would in turn, cause changes in drainage flow rates, directions, and velocities. Construction of cofferdams would impede river flows, cause hydraulic effects, and increase water surface elevations upstream. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. Mitigation Measure SW-4 is available to address effects of runoff and sedimentation.

CEQA Conclusion: Alternative 2A would result in alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages, and from changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 2A would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion: Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects associated with construction and operations of facilities under Alternative 2A would be identical to those described under Alternative 1A because the facilities would be identical.

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

***CEQA Conclusion*:** Alternative 2A actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 2A would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities sites during construction or operations and could result in significant if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Effects associated with construction of conveyance facilities under Alternative 2A would be identical to those described under Alternative 1A because the facilities would be identical. Alternative 2A would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4 as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

***CEQA Conclusion*:** Alternative 2A would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 2A would be same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Effects associated with construction and operations of facilities under Alternative 2A would be identical to those described under Alternative 1A because the facilities would be identical. As described under Impact SW-4, Alternative 2A would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 2A would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

***CEQA Conclusion*:** Alternative 2A would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4 because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4 as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.6 Alternative 2B—Dual Conveyance with East Alignment and Five Intakes (15,000 cfs; Operational Scenario B)

Facilities construction under Alternative 2B would be identical to those described for Alternative 1B. Alternative 2B would involve relocation of two of the intakes to sites south of the confluence of Sutter and Steamboat sloughs and the Sacramento River.

Operations of the facilities and implementation of the conservation measures under Alternative 2B would be identical to actions described under Alternative 2A.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

NEPA Effects: Effects on SWP/CVP reservoir storage under Alternative 2B would be identical to those described for Impact SW-1 under Alternative 2A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Effects on SWP/CVP reservoir storage under Alternative 2B would be identical to those described under Alternative 2A because the operations of the facilities would be identical. Therefore, Alternative 2B would result in a less-than-significant impact on flood management. No mitigation is necessary.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

NEPA Effects: Effects on surface water flows under Alternative 2B would be identical to those described for Impact SW-2 under Alternative 2A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Effects on surface water flows under Alternative 2B would be identical to those described under Alternative 2A because the operations of the facilities would be identical. Therefore, Alternative 2A would result in less-than-significant river flow impacts on flood management. No mitigation is necessary.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

NEPA Effects: Effects on Old and Middle River flows under Alternative 2B would be identical to those described for Impact SW-3 under Alternative 2A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Alternative 2B would provide positive changes related to reducing reverse flows in Old and Middle Rivers in May through March and negative changes in increased reverse flow conditions in April as compared to Existing Conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects is described in Chapter 8, *Water Quality*, and Chapter 11, *Fisheries and Aquatic Resources*.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Effects associated with construction and operations of facilities under Alternative 2B would be identical to those described under Alternative 1B because the facilities would be identical.

Alternative 2B construction would include potential alterations to drainage patterns, stream courses, and runoff, and the potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway, as described in Chapter 3, *Description of Alternatives*. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; as well as changes in sediment accumulation near the intakes.

Alternative 1B would incorporate measures to address adverse effects and Mitigation Measure SW-4 is available to address these effects.

***CEQA Conclusion*:** Alternative 2B would have potential impacts associated with alterations to drainage patterns, stream courses, and runoff, and the potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; as well as; changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 2B would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects associated with construction and operations of facilities under Alternative 2B would be identical to those described under Alternative 1B because the facilities would be identical.

NEPA Effects: Paving, soil compaction and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

CEQA Conclusion**:** Alternative 2B actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 2B would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities sites during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Effects associated with construction of conveyance facilities under Alternative 2B would be identical to those described under Alternative 1B because the facilities would be identical. Alternative 2B would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures. However, increased wind fetch near open water areas of habitat restoration could cause potential damage to adjacent levees.

CEQA Conclusion**:** Alternative 2B would not result in increased exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 2B would be same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Effects associated with construction and operations of facilities under Alternative 2B would be identical to those described under Alternative 1B because the facilities would be identical. As described under Impact SW-1, Alternative 2B would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 2B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

***CEQA Conclusion*:** Alternative 2B would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.7 Alternative 2C—Dual Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario B)

Facilities construction under Alternative 2C would be identical to those described for Alternative 1C.

Operations of the facilities and implementation of the conservation measures under Alternative 2C would be identical to actions described under Alternative 2A.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

NEPA Effects: Effects on SWP/CVP reservoir storage under Alternative 2C would be identical to those described for Impact SW-1 under Alternative 2A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Effects on SWP/CVP reservoir storage under Alternative 2C would be identical to those described under Alternative 2A because the operations of the facilities would be identical. Accordingly, Alternative 2B would result in a less-than-significant impact on flood management. No mitigation is necessary.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

NEPA Effects: Effects on surface water flows under Alternative 2C would be identical to those described for Impact SW-2 under Alternative 2A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Effects on surface water flows under Alternative 2C would be identical to those described under Alternative 2A because the operations of the facilities would be identical. Accordingly, Alternative 2A would result in less-than-significant river flow impacts on flood management. No mitigation is necessary.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

NEPA Effects: Effects on Old and Middle River flows under Alternative 2C would be identical to those described for Impact SW-3 under Alternative 2A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Alternative 2C would provide positive changes related to reducing reverse flows in Old and Middle Rivers in May through March and negative changes in increased reverse flow conditions in April as compared to Existing Conditions. Determination of the significance of this effect is related to effects on water quality and aquatic resources. Therefore, the significance of these effects is described in Chapter 8, *Water Quality*, and Chapter 11, *Fisheries and Aquatic Resources*.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Effects associated with construction and operations of facilities under Alternative 2C would be identical to those described under Alternative 1C because the facilities would be identical.

Alternative 2C would incorporate measures to address adverse effects and Mitigation Measure SW-4 is available to address these effects.

***CEQA Conclusion*:** Alternative 2C would have potential impacts associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential significant impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 2C would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects associated with construction and operations of facilities under Alternative 2C would be identical to those described under Alternative 1C because the facilities would be identical.

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

***CEQA Conclusion*:** Alternative 2C actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 2C would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Effects associated with construction of conveyance facilities under Alternative 2C would be identical to those described under Alternative 1C because the facilities would be identical. Alternative 2C would not result in increased exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

CEQA Conclusion: Alternative 2C would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 2C would be same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Impacts associated with construction and operations of facilities under Alternative 2C would be identical to those described under Alternative 1C because the facilities would be identical. As described under Impact SW-1, Alternative 2C would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 2C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

***CEQA Conclusion*:** Alternative 2C would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.8 Alternative 3—Dual Conveyance with Pipeline/Tunnel and Intakes 1 and 2 (6,000 cfs; Operational Scenario A)

Facilities construction under Alternative 3 would be similar to that described for Alternative 1A but with only two intakes.

Operations under Alternative 3 would be identical to those under Alternative 1A except that there would be more reliance on the south Delta intakes due to the lower capacity provided by two north Delta intakes rather than five. Under Alternative 1A, the north Delta intake capacity was 15,000 cfs, compared to 6,000 cfs under Alternative 3.

Model results discussed for this Alternative are summarized in Tables 6-2 through 6-7.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

Reservoir storage in Shasta Lake, Folsom Lake, and Lake Oroville during the October through June period is compared to the flood storage capacity of each reservoir to identify the number of months where the reservoir storage is close to the flood storage capacity.

NEPA Effects: Under Alternative 3, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be similar to (or show no more than 10% increase) the No Action Alternative, as shown in Tables 6-2 through 6-7.

A comparison with storage conditions under the No Action Alternative provides an indication of the potential change due to Alternative 3 without the effects of sea level rise and climate change and the results show that reservoir storages would not be consistently high during October through June under Alternative 3 as compared to the conditions under the No Action Alternative. Therefore, Alternative 3 would not result in adverse impacts on reservoir flood storage capacity as compared to the conditions without the project.

CEQA Conclusion: Under Alternative 3, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be less than under Existing Conditions, as shown in Tables 6-2 through 6-7. These differences represent changes under Alternative 3, increased demands from Existing Conditions to No Action Alternative, and changes due to sea level rise and climate change. Alternative 3 would not cause consistently higher storages in the upper Sacramento River watershed during the October through June period. Accordingly, Alternative 3 would result in a less-than-significant impact on flood management. No mitigation is required.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

Sacramento River at Bend Bridge

Peak monthly flows that occur in Sacramento River at Bend Bridge are shown in Figures 6-8 and 6-9 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would remain similar (or show less than 1% change with respect to the channel capacity: 100,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would increase by 2% of the channel capacity (100,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 3 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 3 as compared to the No Action Alternative. Therefore, Alternative 3 would not result in adverse impacts on flow conditions in the Sacramento River at Bend Bridge as compared to the conditions without the project.

Sacramento River at Freeport

Peak monthly flows that occur in Sacramento River at Freeport are shown in Figures 6-10 and 6-11 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would decrease by 1% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would remain similar (or show less than 1% change with respect to the channel capacity: 110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 3 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 3 as compared to the No Action Alternative. Therefore, Alternative 3 would not result in adverse impacts on flow conditions in the Sacramento River at Freeport as compared to the conditions without the project.

San Joaquin River at Vernalis

Peak monthly flows that occur in San Joaquin River at Vernalis are shown in Figures 6-12 and 6-13 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would remain similar to (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would remain similar (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 3 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 3 as compared to the No Action Alternative. Therefore, Alternative 3 would not result in adverse impacts on flow conditions in the San Joaquin River at Vernalis as compared to the conditions without the project.

Sacramento River at Locations Upstream of Walnut Grove (downstream of north Delta intakes)

Peak monthly flows that occur in the n the Sacramento River upstream of Walnut Grove are shown in Figures 6-14 and 6-15 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would decrease by 6% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would decrease by 5% of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This decrease primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 3 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 3 as compared to the No Action Alternative. Therefore, Alternative 3 would not result in adverse impacts on flow conditions in the Sacramento River upstream of Walnut Grove as compared to the conditions without the project.

Trinity River Downstream of Lewiston Dam

Peak monthly flows that occur in the Trinity River downstream of Lewiston Lake are shown in Figures 6-16 and 6-17 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would remain similar to (or show less than 1% change with respect to the channel capacity: 6,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would increase by 4% of the channel capacity (6,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 3 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 3 as compared to the No Action Alternative. Therefore, Alternative 3 would not result in adverse impacts on flow conditions in the Trinity River downstream of Lewiston Lake as compared to the conditions without the project.

American River Downstream of Nimbus Dam

Peak monthly flows that occur in the American River at Nimbus Dam are shown in Figures 6-18 and 6-19 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would remain similar to (or show less than 1% change with respect to the channel capacity: 115,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would increase by no more than 1% of the channel capacity (115,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 3 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 3 as compared to the No Action Alternative. Therefore, Alternative 3 would not result in adverse impacts on flow conditions in the American River at Nimbus Dam as compared to the conditions without the project.

Feather River Downstream of Thermalito Dam

Peak monthly flows that occur in the Feather River downstream of Thermalito Dam are shown in Figures 6-20 and 6-21 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would increase no more than 1% of the channel capacity (210,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would increase by no more than 1% of the channel capacity (210,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 3 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 3 as compared to the No Action Alternative. Therefore, Alternative 3 would not result in adverse impacts on flow conditions in the Feather River at Thermalito Dam as compared to the conditions without the project.

Yolo Bypass at Fremont Weir

Peak monthly spills into the Yolo Bypass at Fremont Weir occur in February during wet years, as shown in Figure 6-22.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 3 would increase by 2% of the channel capacity (343,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 3 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 3 as compared to the No Action Alternative. Therefore, Alternative 3 would not result in adverse impacts on flow conditions in the Yolo Bypass at Fremont Weir as compared to the conditions without the project.

NEPA Effects: Overall, Alternative 3 would not result in an increase in potential risk for flood management compared to the No Action Alternative. Peak monthly flows under Alternative 3 in the locations considered in this analysis either were similar to or less than peak monthly flows that would occur under the No Action Alternative; or the increase in peak monthly flows would be less than the flood capacity for the channels at these locations.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative.

Increased frequency of spills due to the proposed notch under Alternative 3 would not cause any significant adverse effect in conveying flood flows, because the maximum capacity of the notch is 6,000 cfs (less than 2% of the channel capacity); and the notch is closed (no additional flow) when the River stage reaches the weir crest elevation. Therefore, even if the notch enables spills before the River stage reaches the crest elevation, these spills would be minor relative to the capacity of the Bypass. Velocity in the Bypass would increase as the spills occur over the crest; therefore the inertia due to earlier spills through the notch would decrease and would not be substantial by the time the Bypass reaches full capacity.

Therefore, Alternative 3 would not result in adverse effects on flood management.

CEQA Conclusion**:** Alternative 3 would not result in an increase in potential risk for flood management compared to Existing Conditions when the changes due to sea level rise and climate change are eliminated from the analysis. Peak monthly flows under Alternative 3 in the locations considered in this analysis either were similar to or less than those that would occur under Existing Conditions without the changes in sea level rise and climate change; or the increased peak monthly flows would not exceed the flood capacity of the channels at these locations. Accordingly, Alternative 3 would result in a less-than-significant impact on flood management. No mitigation is required.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would be reduced under Alternative 3 on a long-term average basis except in April and May; and October, compared to reverse flows under both Existing Conditions and the No Action Alternative, as shown in Figure 6-23. Compared to flows under the No Action Alternative, Old and Middle River flows would be less positive in April and May under Alternative 3 because Alternative 3 does not include inflow/export ratio criteria for the San Joaquin River in those months; and it would be less positive in October because Alternative 3 does not include Fall X2. Therefore, Alternative 3 would result in reduced reverse flow conditions in Old and Middle Rivers in November through March and June through September and increased reverse flow conditions in April, May, and October.

NEPA Effects: A comparison with reverse flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 3 without the effects of sea level rise and climate change and the results show that reverse flow conditions under Alternative 3 would be reduced on a long-term average basis except in October, April, and May as compared to No Action Alternative.

CEQA Conclusion**:** Alternative 3 would provide positive changes related to reducing reverse flows in Old and Middle Rivers in June through March and negative changes in the form of increased reverse flow conditions in April and May, compared to Existing Conditions. Determination of the significance of this impact is related to impacts on water quality and aquatic resources. The significance of these impacts is described in Chapter 8, *Water Quality*, and Chapter 11, *Fisheries and Aquatic Resources*.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Effects associated with construction and operations of facilities under Alternative 3 would be identical those described under Alternative 1A because the facilities would be identical with the exception of three fewer intakes, pumping plants, and associated conveyance facilities. Accordingly, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 3.

Alternative 3 would involve excavation, grading, stockpiling, soil compaction, and dewatering that would result in temporary and long-term changes to drainage patterns, drainage paths, and facilities that would in turn, cause changes in drainage flow rates, directions, and velocities. Construction of cofferdams would impede river flows, cause hydraulic effects, and increase water surface elevations upstream. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. Mitigation Measure SW-4 is available to address effects of runoff and sedimentation.

CEQA Conclusion**:** Alternative 3 would result in alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential significant impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 3 would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion**:** Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects associated with construction and operations of facilities under Alternative 3 would be identical those described under Alternative 1A because the facilities would be identical with the exception of three fewer intakes, pumping plants, and associated conveyance facilities. Accordingly, potential for effects would be less than described under Alternative 1A.

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

CEQA Conclusion**:** Alternative 3 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 3 would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities sites during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Effects associated with construction of conveyance facilities under Alternative 3 would be similar to those described under Alternative 1A because the facilities would be similar with the exception of three fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 3. Therefore, Alternative 3 would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

***CEQA Conclusion*:** Alternative 3 would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 3 would be same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Effects associated with construction and operations of facilities under Alternative 3 would be identical those described under Alternative 1A because the facilities would be identical with the exception of three fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 3. As described under Impact SW-1, Alternative 3 would not increase flood potential on the Sacramento River, San

Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 3 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

***CEQA Conclusion*:** Alternative 3 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages, as well as changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce these potential impacts to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.9 Alternative 4—Dual Conveyance with Modified Pipeline/Tunnel and Intakes 2, 3, and 5 (9,000 cfs; Operational Scenario H)

Facilities construction under Alternative 4 would include construction of three intakes. Alternative 4 water conveyance operations would be based on Alternative 2A, with the exception that a range of possible operations for the spring and fall Delta outflow requirements that are considered to be equally likely would be evaluated. This range of operations comprises four separate scenarios as described in detail in Section 3.6.4.2 in Chapter 3, *Description of Alternatives*, and in Appendix 5A, *BDCP EIR/EIS Modeling Technical Appendix.* These four scenarios vary depending on assumptions for Delta outflow requirements in spring and fall.

- Alternative 4 Operational Scenario H1 (Alternative 4 H1) does not include enhanced spring outflow requirements or Fall X2,
- Alternative 4 Operational Scenario H2 (Alternative 4 H2) includes enhanced spring outflow requirements but not Fall X2,
- Alternative 4 Operational Scenario H3 (Alternative 4 H3) does not include enhanced spring outflow requirements but includes Fall X2 (similar to Alternative 2A), and
- Alternative 4 Operational Scenario H4 (Alternative 4 H4) includes both enhanced spring outflow requirements and Fall X2.

Model results discussed for this Alternative are summarized in Tables 6-2 through 6-7.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

Reservoir storage in Shasta Lake, Folsom Lake, and Lake Oroville during the October through June period is compared to the flood storage capacity of each reservoir to identify the number of months where the reservoir storage is close to the flood storage capacity.

NEPA Effects: Under Alternative 4 scenarios, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be similar (or show no more than 10% increase) under the No Action Alternative, as shown in Tables 6-2 through 6-7.

A comparison with storage conditions under the No Action Alternative provides an indication of the potential change due to Alternative 4 without the effects of sea level rise and climate change and the results show that reservoir storages would not be consistently high during October through June under Alternative 4 as compared to the conditions under the No Action Alternative. Therefore, Alternative 4 would not result in adverse effects on reservoir flood storage capacity as compared to the conditions without the project.

CEQA Conclusion: Under Alternative 4 scenarios, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be less than under Existing Conditions, as shown in Tables 6-2 through 6-7. These differences represent changes under Alternative 4, increased demands from Existing Conditions to No Action Alternative, and changes due to sea level rise and climate change. Alternative 4 would not cause consistently higher storages in the upper Sacramento River watershed during the October through June period. Accordingly, Alternative 4 would result in a less-than-significant impact on flood management. No mitigation is required.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

Sacramento River at Bend Bridge

Peak monthly flows that occur in Sacramento River at Bend Bridge are shown in Figures 6-8 and 6-9 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 4 would remain similar (in scenarios H3 and H4) or increase by no more than 1% (in scenarios H1 and H2) of the channel capacity (100,000 cfs)as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 4 would increase by 2% (in scenarios H3 and H4) to 3% (in scenarios H1 and H2) of the channel capacity (100,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. The increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 4 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative

4 as compared to the No Action Alternative. Therefore, Alternative 4 would not result in adverse impacts on flow conditions in the Sacramento River at Bend Bridge as compared to the conditions without the project.

Sacramento River at Freeport

Peak monthly flows that occur in Sacramento River at Freeport are shown in Figures 6-10 and 6-11 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under all Alternative 4 scenarios would decrease by 1% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 4 would remain similar (in scenarios H3 and H4) or increase by no more than 1% (in scenarios H1 and H2) of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. The increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 4 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 4 as compared to the No Action Alternative. Therefore, Alternative 4 would not result in adverse impacts on flow conditions in the Sacramento River at Freeport as compared to the conditions without the project.

San Joaquin River at Vernalis

Peak monthly flows that occur in San Joaquin River at Vernalis are shown in Figures 6-12 and 6-13 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under all Alternative 4 scenarios would remain similar to (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under all Alternative 4 scenarios would remain similar (or show less than 1% change with respect to the channel capacity: 110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 4 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 4 as compared to the No Action Alternative. Therefore, Alternative 4 would not result in adverse impacts on flow conditions in the San Joaquin River at Vernalis as compared to the conditions without the project.

Sacramento River at Locations Upstream of Walnut Grove (downstream of north Delta intakes)

Peak monthly flows that occur in the n the Sacramento River upstream of Walnut Grove are shown in Figures 6-14 and 6-15 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 4 would decrease by 8% (in scenarios H1 and H2) to 9% (in scenarios H3 and H4)of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 4 would decrease by 7% (in scenarios H1 and H2) to 8% (in scenarios H3 and H4) of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This decrease primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 4 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 4 as compared to the No Action Alternative. Therefore, Alternative 4 would not result in adverse impacts on flow conditions in the Sacramento River upstream of Walnut Grove as compared to the conditions without the project.

Trinity River Downstream of Lewiston Dam

Peak monthly flows that occur in the Trinity River downstream of Lewiston Lake are shown in Figures 6-16 and 6-17 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 4 would remain similar (in scenarios H3 and H4) or increase by no more than 1% (in scenarios H1 and H2) of the channel capacity (6,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 4 would increase by 4% (in scenarios H3 and H4) to 5% (in scenarios H1 and H2) of the channel capacity (6,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 4 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 4 as compared to the No Action Alternative. Therefore, Alternative 4 would not result in adverse impacts on flow conditions in the Trinity River downstream of Lewiston Lake as compared to the conditions without the project.

American River Downstream of Nimbus Dam

Peak monthly flows that occur in the American River at Nimbus Dam are shown in Figures 6-18 and 6-19 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under all Alternative 4 scenarios would remain similar to (or show less than 1% change with respect to the channel capacity: 115,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under all Alternative 4 scenarios would increase by no more than 1% of the channel capacity (115,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 4 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 4 as compared to the No Action Alternative. Therefore, Alternative 4 would not result in adverse impacts on flow conditions in the American River at Nimbus Dam as compared to the conditions without the project.

Feather River Downstream of Thermalito Dam

Peak monthly flows that occur in the Feather River downstream of Thermalito Dam are shown in Figures 6-20 and 6-21 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 4 would remain similar (in scenarios H1 and H3) or increase by no more than 1% (in scenarios H2 and H4) of the channel capacity (210,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 4 would remain similar (in scenario H3) or increase by no more than 1% (in scenarios H1, H2, and H4) of the channel capacity (210,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. The increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 4 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 4 as compared to the No Action Alternative. Therefore, Alternative 4 would not result in adverse impacts on flow conditions in the Feather River at Thermalito Dam as compared to the conditions without the project.

Yolo Bypass at Fremont Weir

Peak monthly spills into the Yolo Bypass at Fremont Weir occur in February during wet years, as shown in Figure 6-22.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 4 (in all four Alternative 4 scenarios) would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 4 would increase by no more than 1% (in scenario H3) to 2% (in scenarios H1, H2, and H4) of the channel capacity (343,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 4 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 4 as compared to the No Action Alternative. Therefore, Alternative 4 would not result in adverse impacts on flow conditions in the Yolo Bypass at Fremont Weir as compared to the conditions without the project.

NEPA Effects: Overall, Alternative 4 would not result in an increase in potential risk for flood management compared to the No Action Alternative. Peak monthly flows under Alternative 4 in the locations considered in this analysis either were similar to or less than peak monthly flows that would occur under the No Action Alternative; or the increase in peak monthly flows would be less than the flood capacity for the channels at these locations.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative.

Increased frequency of spills due to the proposed notch under Alternative 4 would not cause any significant adverse effect in conveying flood flows, because the maximum capacity of the notch is 6,000 cfs (less than 2% of the channel capacity); and the notch is closed (no additional flow) when the River stage reaches the weir crest elevation. Therefore, even if the notch enables spills before the River stage reaches the crest elevation, these spills would be minor relative to the capacity of the Bypass. Velocity in the Bypass would increase as the spills occur over the crest; therefore the inertia due to earlier spills through the notch would decrease and would not be significant by the time the Bypass reaches full capacity.

Therefore, Alternative 4 would not result in adverse effects on flood management.

***CEQA Conclusion*:** Alternative 4 would not result in an increase in potential risk for flood management compared to Existing Conditions when the changes due to sea level rise and climate change are eliminated from the analysis. Peak monthly flows under Alternative 4 in the locations considered in this analysis either were similar to or less than those that would occur under Existing Conditions without the changes in sea level rise and climate change; or the increased peak monthly flows would not exceed the flood capacity of the channels at these locations. Accordingly, Alternative 4 would result in a less-than-significant impact on flood management. No mitigation is required.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would be reduced under Alternative 4 on a long-term average basis except in May in scenarios H2 and H4 and in April and May in scenarios H1 and H3, compared to reverse flows under both Existing Conditions and the No Action Alternative, as shown in Figure 6-23. Compared to flows under the No Action Alternative, Old and Middle River flows would be less positive in April and May under scenarios H1 and H3 because these scenarios do not include inflow/export ratio criteria for the San Joaquin River in those months, although there are other criteria for Old and Middle River flows assumed in these scenarios. This effect is only seen in May in scenarios H2 and H4 because these two scenarios include enhanced spring outflow requirements. Therefore, Alternative 4 would result in reduced reverse flow conditions in Old and

Middle Rivers in June through March and increased reverse flow conditions in April (in scenarios H1 and H3) and May (in all four Alternative 4 scenarios).

NEPA Effects: A comparison with reverse flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 4 without the effects of sea level rise and climate change and the results show that reverse flow conditions under Alternative 4 would be reduced on a long-term average basis except in April and May as compared to No Action Alternative.

CEQA Conclusion**:** Alternative 4 would provide positive changes related to reducing reverse flows in Old and Middle Rivers in June through March and negative changes in the form of increased reverse flow conditions in April and May, compared to Existing Conditions. Determination of the significance of this impact is related to impacts on water quality and aquatic resources. The significance of these impacts is described in Chapter 8, *Water Quality*, and Chapter 11, *Fisheries and Aquatic Resources*.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Effects associated with construction and operations of facilities under Alternative 4 would be similar to those described under Alternative 1A because similar construction methods and similar features would be used as under Alternative 1A. Accordingly, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 4.

Alternative 4 would involve excavation, grading, stockpiling, soil compaction, and dewatering that would result in temporary and long-term changes to drainage patterns, drainage paths, and facilities that would in turn, cause changes in drainage flow rates, directions, and velocities. Construction of cofferdams would impede river flows, cause hydraulic effects, and increase water surface elevations upstream. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. Mitigation Measure SW-4 is available to address effects of runoff and sedimentation.

CEQA Conclusion**:** Alternative 4 would result in alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages, and from changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this impact to a less-than-significant level

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 4 would be the same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion: Please see Impact SW-5 conclusion in Alternative 1A.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects associated with construction and operations of facilities under Alternative 4 would be similar to those described under Alternative 1A because similar construction methods and similar features would be used as under Alternative 1A. Accordingly, potential for effects would be less than described under Alternative 1A.

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

CEQA Conclusion: Alternative 4 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 4 would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities sites during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Effects associated with construction of conveyance facilities under Alternative 4 would be identical those described under Alternative 1A because similar construction methods and similar features would be used as under Alternative 1A. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 4. Alternative 4 would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

***CEQA Conclusion*:** Alternative 4 would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 4 would be the same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-8 conclusion in Alternative 1A.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Effects associated with construction and operations of facilities under Alternative 4 would be identical those described under Alternative 1A because similar construction methods and similar features would be used as under Alternative 1A. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 4. As described under Impact SW-1, Alternative 4 would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 4 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

***CEQA Conclusion*:** Alternative 4 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages, as well as changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.10 Alternative 5—Dual Conveyance with Pipeline/Tunnel and Intake 1 (3,000 cfs; Operational Scenario C)

Facilities construction under Alternative 5 would be similar to those described for Alternative 1A, but with only one intake.

Operations under Alternative 5 would be similar to those under Alternative 1A except for the following actions.

- Alternative 5 would include operations to comply with Fall X2 that will increase Delta outflow in September through November when the previous years were above-normal and wet water years, as in the No Action Alternative.
- Alternative 5 would include operations to restrict use of the south Delta exports through specific criteria related to the San Joaquin River inflow/export ratio.
- Alternative 5 also provides for more frequent spills into Yolo Bypass at Fremont Weir to increase frequency and extent of inundation.

Model results discussed for this Alternative are summarized in Tables 6-2 through 6-7.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

Reservoir storage in Shasta Lake, Folsom Lake, and Lake Oroville during the October through June period is compared to the flood storage capacity of each reservoir to identify the number of months where the reservoir storage is close to the flood storage capacity.

NEPA Effects: Under Alternative 5, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be similar (or show no more than 10% increase) under the No Action Alternative, as shown in Tables 6-2 through 6-7.

A comparison with storage conditions under the No Action Alternative provides an indication of the potential change due to Alternative 5 without the effects of sea level rise and climate change and the results show that reservoir storages would not be consistently high during October through June under Alternative 5 as compared to the conditions under the No Action Alternative. Therefore, Alternative 5 would not result in adverse impacts on reservoir flood storage capacity as compared to the conditions without the project.

CEQA Conclusion: Under Alternative 5, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be less than under Existing Conditions, as shown in Tables 6-2 through 6-7. These differences represent changes under Alternative 5, increased demands from Existing Conditions to No Action Alternative, and changes due to sea level rise and climate change. Alternative 5 would not cause consistently higher storages in the upper Sacramento River watershed during the October through June period. Accordingly, Alternative 5 would result in a less-than-significant impact on flood management. No mitigation is required.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

Sacramento River at Bend Bridge

Peak monthly flows that occur in Sacramento River at Bend Bridge are shown in Figures 6-8 and 6-9 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would remain similar (or show less than 1% change with respect to the channel capacity: 100,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would increase by no more than 1% of the channel capacity (100,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 5 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 5 as compared to the No Action Alternative. Therefore, Alternative 5 would not result in adverse impacts on flow conditions in the Sacramento River at Bend Bridge as compared to the conditions without the project.

Sacramento River at Freeport

Peak monthly flows that occur in Sacramento River at Freeport are shown in Figures 6-10 and 6-11 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would decrease by 1% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would remain similar (or show less than 1% change with respect to the channel capacity: 110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 5 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 5 as compared to the No Action Alternative. Therefore, Alternative 5 would not result in adverse impacts on flow conditions in the Sacramento River at Freeport as compared to the conditions without the project.

San Joaquin River at Vernalis

Peak monthly flows that occur in San Joaquin River at Vernalis are shown in Figures 6-12 and 6-13 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would remain similar to (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would remain similar (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 5 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 5 as compared to the No Action Alternative. Therefore, Alternative 5 would not result in adverse impacts on flow conditions in the San Joaquin River at Vernalis as compared to the conditions without the project.

Sacramento River at Locations Upstream of Walnut Grove (downstream of north Delta intakes)

Peak monthly flows that occur in the n the Sacramento River upstream of Walnut Grove are shown in Figures 6-14 and 6-15 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would decrease by 4% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would decrease by 3% of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This decrease primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 5 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 5 as compared to the No Action Alternative. Therefore, Alternative 5 would not result in adverse impacts on flow conditions in the Sacramento River upstream of Walnut Grove as compared to the conditions without the project.

Trinity River Downstream of Lewiston Dam

Peak monthly flows that occur in the Trinity River downstream of Lewiston Lake are shown in Figures 6-16 and 6-17 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would remain similar to (or show no more than 1% increase with respect to the channel capacity: 6,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would increase by 4% of the channel capacity (6,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 5 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 5 as compared to the No Action Alternative. Therefore, Alternative 5 would not result in adverse impacts on flow conditions in the Trinity River downstream of Lewiston Lake as compared to the conditions without the project.

American River Downstream of Nimbus Dam

Peak monthly flows that occur in the American River at Nimbus Dam are shown in Figures 6-18 and 6-19 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would remain similar to (or show less than 1% change with respect to the channel capacity: 115,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would increase by no more than 1% of the channel capacity (115,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 5 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 5 as compared to the No Action Alternative. Therefore, Alternative 5 would not result in adverse impacts on flow conditions in the American River at Nimbus Dam as compared to the conditions without the project.

Feather River Downstream of Thermalito Dam

Peak monthly flows that occur in the Feather River downstream of Thermalito Dam are shown in Figures 6-20 and 6-21 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would remain similar to (or show less than 1% change with respect to the channel capacity: 210,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would remain similar (or show less than 1% change with respect to the channel capacity: 210,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 5 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 5 as compared to the No Action Alternative. Therefore, Alternative 5 would not result in adverse impacts on flow conditions in the Feather River at Thermalito Dam as compared to the conditions without the project.

Yolo Bypass at Fremont Weir

Peak monthly spills into the Yolo Bypass at Fremont Weir occur in February during wet years, as shown in Figure 6-22.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 5 would increase by 2% of the channel capacity (343,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 5 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 5 as compared to the No Action Alternative. Therefore, Alternative 5 would not result in adverse impacts on flow conditions in the Yolo Bypass at Fremont Weir as compared to the conditions without the project.

NEPA Effects: Overall, Alternative 5 would not result in an increase in potential risk for flood management compared to the No Action Alternative. Peak monthly flows under Alternative 5 in the locations considered in this analysis either were similar to or less than peak monthly flows that would occur under the No Action Alternative; or the increase in peak monthly flows would be less than the flood capacity for the channels at these locations.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative.

Increased frequency of spills due to the proposed notch under Alternative 5 would not cause any significant adverse effect in conveying flood flows, because the maximum capacity of the notch is 6,000 cfs (less than 2% of the channel capacity); and the notch is closed (no additional flow) when the River stage reaches the weir crest elevation. Therefore, even if the notch enables spills before the River stage reaches the crest elevation, these spills would be minor relative to the capacity of the Bypass. Velocity in the Bypass would increase as the spills occur over the crest; therefore the inertia due to earlier spills through the notch would decrease and would not be significant by the time the Bypass reaches full capacity.

Therefore, Alternative 5 would not result in adverse effects on flood management.

CEQA Conclusion**:** Alternative 5 would not result in an increase in potential risk for flood management compared to Existing Conditions when the changes due to sea level rise and climate change are eliminated from the analysis. Peak monthly flows under Alternative 5 in the locations considered in this analysis either were similar to or less than those that would occur under Existing Conditions without the changes in sea level rise and climate change; or the increased peak monthly flows would not exceed the flood capacity of the channels at these locations. Accordingly, Alternative 5 would result in a less-than-significant impact on flood management. No mitigation is required.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

Reverse flow conditions for Old and Middle River flows would be reduced under Alternative 5 on a long-term average basis except in April and May compared to reverse flows under both Existing Conditions and the No Action Alternative, as shown in Figure 6-23. Therefore, Alternative 5 would result in reduced reverse flow conditions in Old and Middle Rivers in June through March and increased reverse flow conditions in April and May.

NEPA Effects: A comparison with reverse flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 5 without the effects of sea level rise and climate change and the results show that reverse flow conditions under Alternative 5 would be reduced on a long-term average basis except in October, April, and May as compared to No Action Alternative.

***CEQA Conclusion*:** Alternative 5 would provide positive changes related to reducing reverse flows in Old and Middle Rivers in June through March and negative changes in the form of increased reverse flow conditions in April and May, compared to Existing Conditions. Determination of the significance of this impact is related to impacts on water quality and aquatic resources. The significance of these impacts is described in Chapter 8, *Water Quality*, and Chapter 11, *Fisheries and Aquatic Resources*.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Effects associated with construction and operations of facilities under Alternative 5 would be similar to those described under Alternative 1A because the facilities would be similar with the exception of four fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 5.

In total, Alternative 5 would involve excavation, grading, stockpiling, soil compaction, and dewatering that would result in temporary and long-term changes to drainage patterns, drainage paths, and facilities that would in turn, cause changes in drainage flow rates, directions, and velocities. Construction of cofferdams would impede river flows, cause hydraulic effects, and increase water surface elevations upstream. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. Mitigation Measure SW-4 is available to address effects of runoff and sedimentation.

***CEQA Conclusion*:** In total, Alternative 5 1A would result in alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages, and from changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 5 would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects associated with construction and operations of facilities under Alternative 5 would be identical those described under Alternative 1A because the facilities would be identical with the exception of four fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A.

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

***CEQA Conclusion*:** Alternative 5 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 5 would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities sites during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Effects associated with construction of conveyance facilities under Alternative 5 would be similar those described under Alternative 1A because the facilities would be similar with the exception of four fewer intakes, pumping plants, associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 5. Therefore, Alternative 5 would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

CEQA Conclusion**:** Alternative 5 would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 5 would be the same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be similar and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion**:** Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Effects associated with construction and operations of facilities under Alternative 5 would be identical those described under Alternative 1A because the facilities would be identical with the exception of four fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 5. As described under Impact SW-1, Alternative 5 would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 5 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

CEQA Conclusion: Alternative 5 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.11 Alternative 6A—Isolated Conveyance with Pipeline/Tunnel and Intakes 1–5 (15,000 cfs; Operational Scenario D)

Facilities construction under Alternative 6A would be similar to that described for Alternative 1A.

Operations under Alternative 6A would be identical to those under Alternative 1A except that there would be more reliance on the north Delta intakes due to the elimination of the south Delta intakes, and Alternative 6A would include operations to comply with Fall X2, as in the No Action Alternative.

Model results discussed for this Alternative are summarized in Tables 6-2 through 6-7.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

Reservoir storage in Shasta Lake, Folsom Lake, and Lake Oroville during the October through June period is compared to the flood storage capacity of each reservoir to identify the number of months where the reservoir storage is close to the flood storage capacity.

NEPA Effects: Under Alternative 6A, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be similar (or show no more than 10% increase) under the No Action Alternative, as shown in Tables 6-2 through 6-7.

A comparison with storage conditions under the No Action Alternative provides an indication of the potential change due to Alternative 6A without the effects of sea level rise and climate change and the results show that reservoir storages would not be consistently high during October through June under Alternative 6A as compared to the conditions under the No Action Alternative. Therefore, Alternative 6A would not result in adverse impacts on reservoir flood storage capacity as compared to the conditions without the project.

CEQA Conclusion: Under Alternative 6A, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be less than under Existing Conditions, as shown in Tables 6-2 through 6-7. However, these differences represent changes under Alternative 6A, increased demands from Existing Conditions to No Action Alternative, and changes due to sea level rise and climate change. Alternative 6A would not cause consistently higher storages in the upper Sacramento River watershed during the October through June period. Accordingly, Alternative 6A would result in a less-than-significant impact on flood management. No mitigation is required.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

Sacramento River at Bend Bridge

Peak monthly flows that occur in Sacramento River at Bend Bridge are shown in Figures 6-8 and 6-9 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would increase by no more than 1% of the channel capacity (100,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would increase by 3% of the channel capacity (100,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 6A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 6A as compared to the No Action Alternative. Therefore, Alternative 6A would not result in adverse impacts on flow conditions in the Sacramento River at Bend Bridge as compared to the conditions without the project.

Sacramento River at Freeport

Peak monthly flows that occur in Sacramento River at Freeport are shown in Figures 6-10 and 6-11 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would decrease by 1% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would remain similar (or show less than 1% change with respect to the channel capacity: 110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 6A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 6A as compared to the No Action Alternative. Therefore, Alternative 6A would not result in adverse impacts on flow conditions in the Sacramento River at Freeport as compared to the conditions without the project.

San Joaquin River at Vernalis

Peak monthly flows that occur in San Joaquin River at Vernalis are shown in Figures 6-12 and 6-13 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would remain similar to (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would remain similar (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 6A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 6A as compared to the No Action Alternative. Therefore, Alternative 6A would not result in adverse impacts on flow conditions in the San Joaquin River at Vernalis as compared to the conditions without the project.

Sacramento River at Locations Upstream of Walnut Grove (downstream of north Delta intakes)

Peak monthly flows that occur in the n the Sacramento River upstream of Walnut Grove are shown in Figures 6-14 and 6-15 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would decrease by 12% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would decrease by 11% of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This decrease primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 6A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 6A as compared to the No Action Alternative. Therefore, Alternative 6A would not result in adverse impacts on flow conditions in the Sacramento River upstream of Walnut Grove as compared to the conditions without the project.

Trinity River Downstream of Lewiston Dam

Peak monthly flows that occur in the Trinity River downstream of Lewiston Lake are shown in Figures 6-16 and 6-17 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would remain similar to (or show no more than 1% increase with respect to the channel capacity: 6,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would increase by 5% of the channel capacity (6,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 6A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 6A as compared to the No Action Alternative. Therefore, Alternative 6A would not result in adverse impacts on flow conditions in the Trinity River downstream of Lewiston Lake as compared to the conditions without the project.

American River Downstream of Nimbus Dam

Peak monthly flows that occur in the American River at Nimbus Dam are shown in Figures 6-18 and 6-19 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would remain similar to (or show less than 1% change with respect to the channel capacity: 115,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would increase by no more than 1% of the channel capacity (115,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 6A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 6A as compared to the No Action Alternative. Therefore, Alternative 6A would not result in adverse impacts on flow conditions in the American River at Nimbus Dam as compared to the conditions without the project.

Feather River Downstream of Thermalito Dam

Peak monthly flows that occur in the Feather River downstream of Thermalito Dam are shown in Figures 6-20 and 6-21 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would remain similar to (or show less than 1% change with respect to the channel capacity: 210,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would increase by no more than 1% of the channel capacity (210,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 6A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 6A as compared to the No Action Alternative. Therefore, Alternative 6A would not result in adverse impacts on flow conditions in the Feather River at Thermalito Dam as compared to the conditions without the project.

Yolo Bypass at Fremont Weir

Peak monthly spills into the Yolo Bypass at Fremont Weir occur in February during wet years, as shown in Figure 6-22.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 6A would increase by 2% of the channel capacity (343,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 6A without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 6A as compared to the No Action Alternative. Therefore, Alternative 6A would not result in adverse impacts on flow conditions in the Yolo Bypass at Fremont Weir as compared to the conditions without the project.

NEPA Effects: Overall, Alternative 6A would not result in an increase in potential risk for flood management compared to the No Action Alternative. Peak monthly flows under Alternative 6A in the locations considered in this analysis either were similar to or less than peak monthly flows that would occur under the No Action Alternative; or the increase in peak monthly flows would be less than the flood capacity for the channels at these locations.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative.

Increased frequency of spills due to the proposed notch under Alternative 6A would not cause any significant adverse effect in conveying flood flows, because the maximum capacity of the notch is 6,000 cfs (less than 2% of the channel capacity); and the notch is closed (no additional flow) when the River stage reaches the weir crest elevation. Therefore, even if the notch enables spills before the River stage reaches the crest elevation, these spills would be minor relative to the capacity of the Bypass. Velocity in the Bypass would increase as the spills occur over the crest; therefore the inertia due to earlier spills through the notch would decrease and would not be significant by the time the Bypass reaches full capacity.

Therefore, Alternative 6A would not result in adverse effects on flood management.

***CEQA Conclusion*:** Alternative 6A would not result in an increase in potential risk for flood management compared to Existing Conditions when the changes due to sea level rise and climate change are eliminated from the analysis. Peak monthly flows under Alternative 6A in the locations considered in this analysis either were similar to or less than those that would occur under Existing Conditions without the changes in sea level rise and climate change; or the increased peak monthly flows would not exceed the flood capacity of the channels at these locations. Accordingly, Alternative 6A would result in a less-than-significant impact on flood management. No mitigation is required.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

NEPA Effects: Reverse flow conditions for Old and Middle River flows would not occur under Alternative 6A because there would be no exports from the south Delta intakes to cause reverse flow conditions.

***CEQA Conclusion*:** Alternative 6A would provide positive changes related to reducing reverse flows in Old and Middle Rivers in all months and the impacts would be less than significant.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Impacts associated with construction and operations of facilities under Alternative 6A would be identical to those described under Alternative 1A because the facilities would be identical.

Alternative 6A would involve excavation, grading, stockpiling, soil compaction, and dewatering that would result in temporary and long-term changes to drainage patterns, drainage paths, and facilities that would in turn, cause changes in drainage flow rates, directions, and velocities. Construction of cofferdams would impede river flows, cause hydraulic effects, and increase water surface elevations upstream. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. Mitigation Measure SW-4 is available to address effects of runoff and sedimentation.

***CEQA Conclusion*:** In total, Alternative 6A would result in alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, *Description of Alternatives*. Potential significant impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce these potential impacts to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 6A would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects associated with construction and operations of facilities under Alternative 6A would be identical to those described under Alternative 1A because the facilities would be identical.

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

***CEQA Conclusion*:** Alternative 6A actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 6A would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Effects associated with construction of conveyance facilities under Alternative 6A would be identical to those described under Alternative 1A because the facilities would be identical.

Alternative 6A would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

***CEQA Conclusion*:** Alternative 6A would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 6A would be the same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion**:** Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Effects associated with construction and operations of facilities under Alternative 6A would be identical to those described under Alternative 1A because the facilities would be identical. As described under Impact SW-1, Alternative 6A would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 6A would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

CEQA Conclusion**:** Alternative 6A would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.12 Alternative 6B—Isolated Conveyance with East Alignment and Intakes 1–5 (15,000 cfs; Operational Scenario D)

Facilities construction under Alternative 6B would be identical to that described for Alternative 1B.

Operations of the facilities and implementation of the conservation measures under Alternative 6B would be identical to actions described under Alternative 6A.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

NEPA Effects: Effects on SWP/CVP reservoir storage under Alternative 6B would be identical to those described for Impact SW-1 under Alternative 6A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Impacts on SWP/CVP reservoir storage under Alternative 6B would be identical to those described under Alternative 6A because the operations of the facilities would be identical. Therefore, Alternative 6B would result in a less-than-significant impact on flood management. No mitigation is necessary.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

NEPA Effects: Effects on surface water flows under Alternative 6B would be identical to those described for Impact SW-2 under Alternative 6A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Impacts on surface water flows under Alternative 6B would be identical to those described under Alternative 6A because the operations of the facilities would be identical. Accordingly, Alternative 6B would result in less-than-significant flow impacts on flood management. No mitigation is necessary.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

NEPA Effects: Effects on Old and Middle River flows under Alternative 6B would be identical to those described for Impact SW-3 under Alternative 6A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Alternative 6B would provide positive changes related to reducing reverse flows in Old and Middle Rivers in all months and the impacts would be less than significant.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Effects associated with construction and operations of facilities under Alternative 6B would be identical to those described under Alternative 1B because the facilities would be identical.

Alternative 6B would involve excavation, grading, stockpiling, soil compaction, and dewatering that would result in temporary and long-term changes to drainage patterns, drainage paths, and facilities that would in turn, cause changes in drainage flow rates, directions, and velocities. Construction of cofferdams would impede river flows, cause hydraulic effects, and increase water surface elevations upstream. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. Mitigation Measure SW-4 is available to address effects of runoff and sedimentation.

CEQA Conclusion: In total, Alternative 6B would result in alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, *Description of Alternatives*. Potential significant impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce these potential impacts to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 6B would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion: Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects associated with construction and operations of facilities under Alternative 6B would be identical to those described under Alternative 1B because the facilities would be identical.

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

CEQA Conclusion: Alternative 6B actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 6B would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce these potential impacts to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Effects associated with construction of conveyance facilities under Alternative 6B would be identical to those described under Alternative 1B because the facilities would be identical. Alternative 6B would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

***CEQA Conclusion*:** Alternative 6B would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 6B would be the same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Impacts associated with construction and operations of facilities under Alternative 6B would be identical to those described under Alternative 1B because the facilities would be identical. As described under Impact SW-1, Alternative 6B would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 6B would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

CEQA Conclusion**:** Alternative 6B would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.13 Alternative 6C—Isolated Conveyance with West Alignment and Intakes W1–W5 (15,000 cfs; Operational Scenario D

Facilities construction under Alternative 6C would be identical to that described for Alternative 1C.

Operations of the facilities and implementation of the conservation measures under Alternative 6C would be identical to actions described under Alternative 6A.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

NEPA Effects: Effects on SWP/CVP reservoir storage under Alternative 6C would be identical to those described for Impact SW-1 under Alternative 6A because the operations of the facilities would be identical.

CEQA Conclusion**:** Effects on SWP/CVP reservoir storage under Alternative 6C would be identical to those described under Alternative 6A because the operations of the facilities would be identical. Therefore, Alternative 6C would result in a less-than-significant impact on flood management.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

NEPA Effects: Effects on surface water flows under Alternative 6C would be identical to those described for Impact SW-2 under Alternative 6A because the operations of the facilities would be identical.

CEQA Conclusion**:** Impacts on surface water flows under Alternative 6C would be identical to those described under Alternative 6A because the operations of the facilities would be identical. Therefore, Alternative 6C would result in less-than-significant river flow impacts on flood management.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

NEPA Effects: Effects on Old and Middle River flows under Alternative 6C would be identical to those described for Impact SW-3 under Alternative 6A because the operations of the facilities would be identical.

***CEQA Conclusion*:** Alternative 6C would provide positive changes related to reducing reverse flows in Old and Middle Rivers in all months and the impacts would be less than significant.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Impacts associated with construction and operations of facilities under Alternative 6C would be identical to those described under Alternative 1C because the facilities would be identical.

Alternative 6C would involve excavation, grading, stockpiling, soil compaction, and dewatering that would result in temporary and long-term changes to drainage patterns, drainage paths, and facilities that would in turn, cause changes in drainage flow rates, directions, and velocities. Construction of cofferdams would impede river flows, cause hydraulic effects, and increase water surface elevations upstream. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. Mitigation Measure SW-4 is available to address effects of runoff and sedimentation.

***CEQA Conclusion*:** Alternative 6C would result in alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway as described in Chapter 3, *Description of Alternatives*. Potential significant impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce these potential impacts to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 6C would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects associated with construction and operations of facilities under Alternative 6C would be identical to those described under Alternative 1C because the facilities would be identical.

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

***CEQA Conclusion*:** Alternative 6C actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 6C would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce these potential impacts to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Effects associated with construction of conveyance facilities under Alternative 6C would be identical to those described under Alternative 1C because the facilities would be identical. Alternative 6B would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

***CEQA Conclusion*:** Alternative 6C would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with requirements of the USACE, CVFPB, and DWR to avoid increased flood potential.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 6C would be the same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Effects associated with construction and operations of facilities under Alternative 6C would be identical to those described under Alternative 1C because the facilities would be identical. As described under Impact SW-1, Alternative 6C would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 6C would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

***CEQA Conclusion*:** Alternative 6C would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce these potential impacts to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.14 Alternative 7—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 3, and 5, and Enhanced Aquatic Conservation (9,000 cfs; Operational Scenario E)

Facilities construction under Alternative 7 would be similar to that described for Alternative 1A, but with only three intakes.

Operations under Alternative 7 would be similar to those under Alternative 1A except for the following actions.

- Alternative 7 would include operations to comply with Fall X2 that will increase Delta outflow in September through November when the previous years were above-normal and wet water years, as in the No Action Alternative.
- Alternative 7 would include operations to restrict use of the south Delta exports through specific criteria to reduce reverse flows in Old and Middle River and changes to the south Delta/San Joaquin River flow ratio criteria to a greater extent than Alternative 1A. No diversions at the south Delta intakes would be allowed in April, May, October, and November.
- Alternative 7 would increase Delta outflow from January through August by increasing minimum flows in the Sacramento River at Rio Vista.
- Alternative 7 also would reduce diversions at the north Delta intakes for constant low flow pumping.
- Due to the restrictions on the use of south Delta intakes, more water would be diverted through the north Delta intakes from December through July under Alternative 7 compared to Alternative 1A. This operation increases total export patterns in the spring months and decreases total exports in the fall months when north Delta intakes operations would be constrained by north Delta bypass flows, as described in Chapter 3, *Description of Alternatives*. Delta outflow increases in fall months in above-normal and wet years to comply with Fall X2, but decreases in other months due to increased total exports compared to No Action Alternative LLT.
- Alternative 7 provides for more frequent spills into Yolo Bypass at Fremont Weir to increase frequency and extent of inundation.

Model results discussed for this Alternative are summarized in Tables 6-2 through 6-7.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

Reservoir storage in Shasta Lake, Folsom Lake, and Lake Oroville during the October through June period is compared to the flood storage capacity of each reservoir to identify the number of months where the reservoir storage is close to the flood storage capacity.

NEPA Effects: Under Alternative 7, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be similar (or show no more than 10% increase) under the No Action Alternative, as shown in Tables 6-2 through 6-7.

A comparison with storage conditions under the No Action Alternative provides an indication of the potential change due to Alternative 7 without the effects of sea level rise and climate change and the results show that reservoir storages would not be consistently high during October through June under Alternative 7 as compared to the conditions under the No Action Alternative. Therefore, Alternative 7 would not result in adverse impacts on reservoir flood storage capacity as compared to the conditions without the project.

CEQA Conclusion: Under Alternative 7, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be less than under Existing Conditions, as shown in Tables 6-2 through 6-7. These differences represent changes under Alternative 7, increased demands from Existing Conditions to No Action Alternative, and changes due to sea level rise and climate change. Alternative 7 would not cause consistently higher storages in the upper Sacramento River watershed during the October through June period. Accordingly, Alternative 7 would result in a less-than-significant impact on flood management. No mitigation is required.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

Sacramento River at Bend Bridge

Peak monthly flows that occur in Sacramento River at Bend Bridge are shown in Figures 6-8 and 6-9 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would remain similar (or show less than 1% change with respect to the channel capacity: 100,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would increase by 2% of the channel capacity (100,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 7 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 7 as compared to the No Action Alternative. Therefore, Alternative 7 would not result in adverse impacts on flow conditions in the Sacramento River at Bend Bridge as compared to the conditions without the project.

Sacramento River at Freeport

Peak monthly flows that occur in Sacramento River at Freeport are shown in Figures 6-10 and 6-11 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would decrease by 1% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would remain similar (or show less than 1% change with respect to the channel capacity: 110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 7 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 7 as compared to the No Action Alternative. Therefore, Alternative 7 would not result in adverse

impacts on flow conditions in the Sacramento River at Freeport as compared to the conditions without the project.

San Joaquin River at Vernalis

Peak monthly flows that occur in San Joaquin River at Vernalis are shown in Figures 6-12 and 6-13 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would remain similar to (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would remain similar (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 7 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 7 as compared to the No Action Alternative. Therefore, Alternative 7 would not result in adverse impacts on flow conditions in the San Joaquin River at Vernalis as compared to the conditions without the project.

Sacramento River at Locations Upstream of Walnut Grove (downstream of north Delta intakes)

Peak monthly flows that occur in the n the Sacramento River upstream of Walnut Grove are shown in Figures 6-14 and 6-15 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would decrease by 9% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would decrease by 8% of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This decrease primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 7 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 7 as compared to the No Action Alternative. Therefore, Alternative 7 would not result in adverse impacts on flow conditions in the Sacramento River upstream of Walnut Grove as compared to the conditions without the project.

Trinity River Downstream of Lewiston Dam

Peak monthly flows that occur in the Trinity River downstream of Lewiston Lake are shown in Figures 6-16 and 6-17 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would remain similar to (or show less than 1% change with respect to the channel capacity: 6,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would increase by 4% of the channel capacity (6,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 7 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 7 as compared to the No Action Alternative. Therefore, Alternative 7 would not result in adverse impacts on flow conditions in the Trinity River downstream of Lewiston Lake as compared to the conditions without the project.

American River Downstream of Nimbus Dam

Peak monthly flows that occur in the American River at Nimbus Dam are shown in Figures 6-18 and 6-19 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would remain similar to (or show less than 1% change with respect to the channel capacity: 115,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would increase by no more than 1% of the channel capacity (115,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 7 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 7 as compared to the No Action Alternative. Therefore, Alternative 7 would not result in adverse impacts on flow conditions in the American River at Nimbus Dam as compared to the conditions without the project.

Feather River Downstream of Thermalito Dam

Peak monthly flows that occur in the Feather River downstream of Thermalito Dam are shown in Figures 6-20 and 6-21 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would remain similar to (or show less than 1% change with respect to the channel capacity: 210,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would increase by no more than 1% of the channel capacity (210,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 7 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 7 as compared to the No Action Alternative. Therefore, Alternative 7 would not result in adverse impacts on flow conditions in the Feather River at Thermalito Dam as compared to the conditions without the project.

Yolo Bypass at Fremont Weir

Peak monthly spills into the Yolo Bypass at Fremont Weir occur in February during wet years, as shown in Figure 6-22.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 7 would increase by 2% of the channel capacity (343,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 7 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 7 as compared to the No Action Alternative. Therefore, Alternative 7 would not result in adverse impacts on flow conditions in the Yolo Bypass at Fremont Weir as compared to the conditions without the project.

NEPA Effects: Overall, Alternative 7 would not result in an increase in potential risk for flood management compared to the No Action Alternative. Peak monthly flows under Alternative 7 in the locations considered in this analysis either were similar to or less than peak monthly flows that would occur under the No Action Alternative; or the increase in peak monthly flows would be less than the flood capacity for the channels at these locations.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative.

Increased frequency of spills due to the proposed notch under Alternative 7 would not cause any significant adverse effect in conveying flood flows, because the maximum capacity of the notch is 6,000 cfs (less than 2% of the channel capacity); and the notch is closed (no additional flow) when the River stage reaches the weir crest elevation. Therefore, even if the notch enables spills before the River stage reaches the crest elevation, these spills would be minor relative to the capacity of the Bypass. Velocity in the Bypass would increase as the spills occur over the crest; therefore the inertia due to earlier spills through the notch would decrease and would not be significant by the time the Bypass reaches full capacity.

Therefore, Alternative 7 would not result in adverse effects on flood management.

CEQA Conclusion: Alternative 7 would not result in an increase in potential risk for flood management compared to Existing Conditions when the changes due to sea level rise and climate change are eliminated from the analysis. Peak monthly flows under Alternative 7 in the locations considered in this analysis either were similar to or less than those that would occur under Existing Conditions without the changes in sea level rise and climate change; or the increased peak monthly flows would not exceed the flood capacity of the channels at these locations. Accordingly, Alternative 7 would result in a less-than-significant impact on flood management. No mitigation is required.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

NEPA Effects: Reverse flow conditions for Old and Middle River flows would not occur under Alternative 7 because of export restrictions for the south Delta intakes to avoid reverse flow conditions.

CEQA Conclusion: Alternative 7 would provide positive changes related to reducing reverse flows in Old and Middle Rivers in all months and the impacts would be less than significant. No mitigation is necessary.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Impacts associated with construction and operations of facilities under Alternative 7 would be similar to those described under Alternative 1A because the facilities would be similar with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 7.

Alternative 7 would involve excavation, grading, stockpiling, soil compaction, and dewatering that would result in temporary and long-term changes to drainage patterns, drainage paths, and facilities that would in turn, cause changes in drainage flow rates, directions, and velocities. Construction of cofferdams would impede river flows, cause hydraulic effects, and increase water surface elevations upstream. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. Mitigation Measure SW-4 is available to address effects of runoff and sedimentation.

CEQA Conclusion: Alternative 7 would result in alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages and from changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level. These impacts are considered significant. Mitigation Measure SW-4 would reduce these potential impacts to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 7 would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion**:** Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects associated with construction and operations of facilities under Alternative 7 would be identical those described under Alternative 1A because the facilities would be identical with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A.

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

CEQA Conclusion**:** Alternative 7 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 7 would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Effects associated with construction of conveyance facilities under Alternative 7 would be similar to those described under Alternative 1A because the facilities would be similar with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 7. Therefore, Alternative 3 would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

CEQA Conclusion**:** Alternative 7 would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 7 would be the same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be similar and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion**:** Please see Impact SW-8 conclusion in Alternative 1A.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Impacts associated with construction and operations of facilities under Alternative 7 would be similar to those described under Alternative 1A because the facilities would be similar with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 7. As described under Impact SW-1, Alternative 7 would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 7 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

CEQA Conclusion: Alternative 7 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages, as well as changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.3.15 Alternative 8—Dual Conveyance with Pipeline/Tunnel, Intakes 2, 3, and 5, and Increased Delta Outflow (9,000 cfs; Operational Scenario F)

Facilities construction under Alternative 8 would be similar to those described for Alternative 1A with only three intakes.

Operations under Alternative 8 would be similar as under Alternative 1A except for the following actions.

- Alternative 8 would include operations to comply with Fall X2 that will increase Delta outflow in September through November when the previous years were above normal and wet water years, as in the No Action Alternative.
- Alternative 8 would include operations to restrict use of the south Delta exports through specific criteria to reduce reverse flows in Old and Middle River and changes to the south Delta/San Joaquin River flow ratio criteria to a greater extent than Alternative 1A. No diversions at the south Delta intakes would be allowed in April, May, October, and November.
- Alternative 8 would increase Delta outflow from January through August by increasing minimum flows in the Sacramento River at Rio Vista.
- Alternative 8 also would reduce diversions at the north Delta intakes for constant low flow pumping.
- Due to the restrictions on the use of south Delta intakes, more water would be diverted through the north Delta intakes from December through July in Alternative 8 as compared to Alternative 1A. This operation increases total export patterns in the spring months and decreases total exports in the fall months when north Delta intakes operations would be constrained by north Delta bypass flows, as described in Chapter 3, *Description of Alternatives*. Delta outflow increases in fall months in above normal and wet years to comply with Fall X2, but decreases in other months due to increased total exports as compared to No Action Alternative Late Long-Term.
- Alternative 8 provides for more frequent spills into Yolo Bypass at Fremont Weir to increase frequency and extent of inundation.

- Alternative 8 provides 55% of the unimpaired flow at Freeport January through June (up to 40,000 cfs) as Delta outflow.

Model results discussed for this Alternative are summarized in Tables 6-3 through 6-6.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

Reservoir storage in Shasta Lake, Folsom Lake, and Lake Oroville during the October through June period is compared to the flood storage capacity of each reservoir to identify the number of months where the reservoir storage is close to the flood storage capacity.

NEPA Effects: Under Alternative 8, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would less than under the No Action Alternative, as shown in Tables 6-2 through 6-7.

A comparison with storage conditions under the No Action Alternative provides an indication of the potential change due to Alternative 8 without the effects of sea level rise and climate change, and the results show that reservoir storages would not be consistently high October through June under Alternative 8 as compared to the conditions under the No Action Alternative. Therefore, Alternative 8 would not result in adverse impacts on reservoir flood storage capacity as compared to the conditions without the project.

CEQA Conclusion: Under Alternative 8, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be less than under Existing Conditions, as shown in Tables 6-2 through 6-7. These differences represent changes under Alternative 8, increased demands from Existing Conditions to No Action Alternative, and changes due to sea level rise and climate change. Alternative 8 would not cause consistently higher storages in the upper Sacramento River watershed during the October through June period. Accordingly, Alternative 8 would result in a less-than-significant impact on flood management. No mitigation is required.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

Sacramento River at Bend Bridge

Peak monthly flows that occur in Sacramento River at Bend Bridge are shown in Figures 6-8 and 6-9 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would increase by no more than 1% of the channel capacity (100,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would increase by 2% of the channel capacity (100,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 8 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 8 as compared to the No Action Alternative. Therefore, Alternative 8 would not result in adverse impacts on flow conditions in the Sacramento River at Bend Bridge as compared to the conditions without the project.

Sacramento River at Freeport

Peak monthly flows that occur in Sacramento River at Freeport are shown in Figures 6-10 and 6-11 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would decrease by 1% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would increase by no more than 1% of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 8 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 8 as compared to the No Action Alternative. Therefore, Alternative 8 would not result in adverse impacts on flow conditions in the Sacramento River at Freeport as compared to the conditions without the project.

San Joaquin River at Vernalis

Peak monthly flows that occur in San Joaquin River at Vernalis are shown in Figures 6-12 and 6-13 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would remain similar to (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would remain similar (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 8 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 8 as compared to the No Action Alternative. Therefore, Alternative 8 would not result in adverse impacts on flow conditions in the San Joaquin River at Vernalis as compared to the conditions without the project.

Sacramento River at Locations Upstream of Walnut Grove (downstream of north Delta intakes)

Peak monthly flows that occur in the n the Sacramento River upstream of Walnut Grove are shown in Figures 6-14 and 6-15 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would decrease by 9% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would decrease by 7% of the channel capacity (110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This decrease primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 8 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 8 as compared to the No Action Alternative. Therefore, Alternative 8 would not result in adverse impacts on flow conditions in the Sacramento River upstream of Walnut Grove as compared to the conditions without the project.

Trinity River Downstream of Lewiston Dam

Peak monthly flows that occur in the Trinity River downstream of Lewiston Lake are shown in Figures 6-16 and 6-17 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would increase no more than 1% of the channel capacity (6,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would increase by 5% of the channel capacity (6,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 8 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 8 as compared to the No Action Alternative. Therefore, Alternative 8 would not result in adverse impacts on flow conditions in the Trinity River downstream of Lewiston Lake as compared to the conditions without the project.

American River Downstream of Nimbus Dam

Peak monthly flows that occur in the American River at Nimbus Dam are shown in Figures 6-18 and 6-19 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would remain similar to (or show less than 1% change with respect to the channel capacity: 115,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would increase by no more than 1% of the channel capacity (115,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 8 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 8 as compared to the No Action Alternative. Therefore, Alternative 8 would not result in adverse impacts on flow conditions in the American River at Nimbus Dam as compared to the conditions without the project.

Feather River Downstream of Thermalito Dam

Peak monthly flows that occur in the Feather River downstream of Thermalito Dam are shown in Figures 6-20 and 6-21 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would increase no more than 1% of the channel capacity (210,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would increase by no more than 1% of the channel capacity (210,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 8 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 8 as compared to the No Action Alternative. Therefore, Alternative 8 would not result in adverse impacts on flow conditions in the Feather River at Thermalito Dam as compared to the conditions without the project.

Yolo Bypass at Fremont Weir

Peak monthly spills into the Yolo Bypass at Fremont Weir occur in February during wet years, as shown in Figure 6-22.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 8 would increase by 2% of the channel capacity (343,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 8 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 8 as compared to the No Action Alternative. Therefore, Alternative 8 would not result in adverse

impacts on flow conditions in the Yolo Bypass at Fremont Weir as compared to the conditions without the project.

NEPA Effects: Overall, Alternative 8 would not result in an increase in potential risk for flood management compared to the No Action Alternative. Peak monthly flows under Alternative 8 in the locations considered in this analysis either were similar to or less than peak monthly flows that would occur under the No Action Alternative; or the increase in peak monthly flows would be less than the flood capacity for the channels at these locations.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative.

Increased frequency of spills due to the proposed notch under Alternative 8 would not cause any significant adverse effect in conveying flood flows, because the maximum capacity of the notch is 6,000 cfs (less than 2% of the channel capacity); and the notch is closed (no additional flow) when the River stage reaches the weir crest elevation. Therefore, even if the notch enables spills before the River stage reaches the crest elevation, these spills would be minor relative to the capacity of the Bypass. Velocity in the Bypass would increase as the spills occur over the crest; therefore the inertia due to earlier spills through the notch would decrease and would not be significant by the time the Bypass reaches full capacity.

Therefore, Alternative 8 would not result in adverse effects on flood management.

***CEQA Conclusion*:** Alternative 8 would not result in an increase in potential risk for flood management compared to Existing Conditions when the changes due to sea level rise and climate change are eliminated from the analysis. Peak monthly flows under Alternative 8 in the locations considered in this analysis either were similar to or less than those that would occur under Existing Conditions without the changes in sea level rise and climate change; or the increased peak monthly flows would not exceed the flood capacity of the channels at these locations. Accordingly, Alternative 8 would result in a less-than-significant impact on flood management. No mitigation is required.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

NEPA Effects: Reverse flow conditions for Old and Middle River flows would not occur under Alternative 8 because of export restrictions for the south Delta intakes to avoid reverse flow conditions.

***CEQA Conclusion*:** Alternative 8 would provide positive changes related to reducing reverse flows in Old and Middle Rivers in all months and the impacts would be less than significant.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Impacts associated with construction and operations of facilities under Alternative 8 would be similar to those described under Alternative 1A because the facilities would be similar with the exception of two fewer intakes, pumping plants, and associated conveyance facilities.

Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 8.

In total, Alternative 8 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes.

***CEQA Conclusion*:** In total, Alternative 8 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff; potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential impacts could occur due increased stormwater runoff from paved areas that could increase flows in local drainages and from changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level. These impacts are considered significant. Mitigation Measure SW-4 would reduce these potential impacts to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4 under Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 8 would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Effects associated with construction and operations of facilities under Alternative 8 would be similar to those described under Alternative 1A because the facilities would be similar with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A.

NEPA Effects: Alternative 8 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 8 would include provisions to design the dewatering system in accordance with these permits to avoid adverse impacts on surface water quality and flows. However, increased runoff could occur from facilities locations during construction or operations and could result in adverse effects if the runoff volume exceeds the capacities of local drainages.

***CEQA Conclusion*:** Alternative 8 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 8 would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities locations during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

NEPA Effects: Effects associated with construction of conveyance facilities under Alternative 8 would be similar to those described under Alternative 1A because the facilities would be similar with the exception of two fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 8. Therefore, Alternative 8 would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the facilities would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

***CEQA Conclusion*:** Alternative 8 would not result in an increase to exposure of people or structures to flooding due to construction of the conveyance facilities because the facilities would be required to comply with USACE, CVFPB, and DWR requirement to avoid increased flood potential.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 8 would be the same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

***CEQA Conclusion*:** Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

Impacts associated with construction and operations of facilities under Alternative 8 would be similar to those described under Alternative 1A because the facilities would be similar with the exception of three fewer intakes, pumping plants, and associated conveyance facilities. Therefore, potential for effects would be less than described under Alternative 1A. However, the measures included in Alternative 1A to avoid adverse effects would be included in Alternative 8. As described under Impact SW-1, Alternative 8 would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 8 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

***CEQA Conclusion*:** Alternative 8 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the facilities would be required to comply with the requirements of the USACE, CVFPB, and DWR to avoid increased flood potential. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this potential impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

See Mitigation Measure SW-4 in the discussion of Impact SW-4 under Alternative 1A.

6.3.3.16 Alternative 9—Through Delta/Separate Corridors (15,000 cfs; Operational Scenario G)

Facilities constructed under Alternative 9 would include two fish-screened intakes along the Sacramento River near Walnut Grove, 14 operable barriers, two diversion pumping plants and other associated facilities, two culvert siphons, three canal segments, new levees, and new channel connections. Some existing channels would also be enlarged under this alternative. Nearby areas would be altered as work or staging areas or used for the deposition of spoils.

Alternative 9 does not include north Delta intakes. Instead, water continues to flow by gravity from the Sacramento River into two existing channels, Delta Cross Channel and Georgiana Slough. Alternative 9 operates in a manner more similar to the No Action Alternative with operational criteria related to minimizing reverse flows in Old and Middle rivers applying only to Middle River and not including San Joaquin River export/inflow ratio criteria.

Model results discussed for this Alternative are summarized in Tables 6-2 through 6-7.

SWP/CVP Reservoir Storage and Related Changes to Flood Potential

Impact SW-1: Changes in SWP or CVP Reservoir Flood Storage Capacity

Reservoir storage in Shasta Lake, Folsom Lake, and Lake Oroville during the October through June period is compared to the flood storage capacity of each reservoir to identify the number of months where the reservoir storage is close to the flood storage capacity.

NEPA Effects: Under Alternative 9, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be similar (or show no more than 10% increase) to the No Action Alternative, as shown in Tables 6-2 through 6-7.

A comparison with storage conditions under the No Action Alternative provides an indication of the potential change due to Alternative 9 without the effects of sea level rise and climate change and the results show that reservoir storages would not be consistently high during October through June under Alternative 9 as compared to the conditions under the No Action Alternative. Therefore, Alternative 9 would not result in adverse impacts on reservoir flood storage capacity as compared to the conditions without the project.

CEQA Conclusion: Under Alternative 9, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be less than under Existing Conditions, as shown in Tables 6-2 through 6-7. These differences represent changes under Alternative 9, increased demands from Existing Conditions to No Action Alternative, and changes due to sea level rise and climate change. Alternative 9 would not cause consistently higher storages in the upper Sacramento River watershed during the October through June period. Accordingly, Alternative 9 would result in a less-than-significant impact on flood management. No mitigation is required.

Peak Monthly Flows in Sacramento and San Joaquin Rivers and Related Changes to Flood Potential

Impact SW-2: Changes in Sacramento and San Joaquin River Flood Flows

Sacramento River at Bend Bridge

Peak monthly flows that occur in Sacramento River at Bend Bridge are shown in Figures 6-8 and 6-9 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would remain similar (or show less than 1% change with respect to the channel capacity: 100,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would increase by 2% of the channel capacity (100,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 9 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 9 as compared to the No Action Alternative. Therefore, Alternative 9 would not result in adverse

impacts on flow conditions in the Sacramento River at Bend Bridge as compared to the conditions without the project.

Sacramento River at Freeport

Peak monthly flows that occur in Sacramento River at Freeport are shown in Figures 6-10 and 6-11 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would decrease by 1% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would remain similar (or show less than 1% change with respect to the channel capacity: 110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 9 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 9 as compared to the No Action Alternative. Therefore, Alternative 9 would not result in adverse impacts on flow conditions in the Sacramento River at Freeport as compared to the conditions without the project.

San Joaquin River at Vernalis

Peak monthly flows that occur in San Joaquin River at Vernalis are shown in Figures 6-12 and 6-13 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would remain similar to (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would remain similar (or show less than 1% change with respect to the channel capacity: 52,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 9 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 9 as compared to the No Action Alternative. Therefore, Alternative 9 would not result in adverse impacts on flow conditions in the San Joaquin River at Vernalis as compared to the conditions without the project.

Sacramento River at Locations Upstream of Walnut Grove (downstream of north Delta intakes)

Peak monthly flows that occur in the n the Sacramento River upstream of Walnut Grove are shown in Figures 6-14 and 6-15 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would decrease by 1% of the channel capacity (110,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would remain similar (or show less than 1% change with respect to the channel capacity: 110,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 9 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 9 as compared to the No Action Alternative. Therefore, Alternative 9 would not result in adverse impacts on flow conditions in the Sacramento River upstream of Walnut Grove as compared to the conditions without the project.

Trinity River Downstream of Lewiston Dam

Peak monthly flows that occur in the Trinity River downstream of Lewiston Lake are shown in Figures 6-16 and 6-17 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would remain similar to (or show less than 1% change with respect to the channel capacity: 6,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would increase by 4% of the channel capacity (6,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 9 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 9 as compared to the No Action Alternative. Therefore, Alternative 9 would not result in adverse impacts on flow conditions in the Trinity River downstream of Lewiston Lake as compared to the conditions without the project.

American River Downstream of Nimbus Dam

Peak monthly flows that occur in the American River at Nimbus Dam are shown in Figures 6-18 and 6-19 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would remain similar to (or show less than 1% change with respect to the channel capacity: 115,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would increase by no more than 1% of the channel capacity (115,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 9 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 9 as compared to the No Action Alternative. Therefore, Alternative 9 would not result in adverse impacts on flow conditions in the American River at Nimbus Dam as compared to the conditions without the project.

Feather River Downstream of Thermalito Dam

Peak monthly flows that occur in the Feather River downstream of Thermalito Dam are shown in Figures 6-20 and 6-21 during wet years and over the long-term average.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would remain similar to (or show less than 1% change with respect to the channel capacity: 210,000 cfs) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would remain similar (or show less than 1% change with respect to the channel capacity: 210,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 9 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 9 as compared to the No Action Alternative. Therefore, Alternative 9 would not result in adverse impacts on flow conditions in the Feather River at Thermalito Dam as compared to the conditions without the project.

Yolo Bypass at Fremont Weir

Peak monthly spills into the Yolo Bypass at Fremont Weir occur in February during wet years, as shown in Figure 6-22.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would remain similar (or show less than 1% change with respect to the channel capacity) as compared to the flows under the No Action Alternative, as shown in Tables 6-2 through 6-4.

Average of highest spills simulated (flows with probability of exceedance of 10% or less) under Alternative 9 would increase by no more than 1% of the channel capacity (343,000 cfs) as compared to the flows under Existing Conditions, as shown in Tables 6-2 through 6-4. This increase primarily would occur due to sea level rise, climate change, and increased north of Delta demands.

A comparison with flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 9 without the effects of sea level rise and climate change and the results show that there would not be a consistent increase in high flow conditions under Alternative 9 as compared to the No Action Alternative. Therefore, Alternative 9 would not result in adverse impacts on flow conditions in the Yolo Bypass at Fremont Weir as compared to the conditions without the project.

NEPA Effects: Overall, Alternative 9 would not result in an increase in potential risk for flood management compared to the No Action Alternative. Peak monthly flows under Alternative 9 in the locations considered in this analysis either were similar to or less than peak monthly flows that would occur under the No Action Alternative; or the increase in peak monthly flows would be less than the flood capacity for the channels at these locations.

Average of highest flows simulated (flows with probability of exceedance of 10% or less) would increase no more than 1% of the channel capacity as compared to the flows under the No Action Alternative.

Increased frequency of spills due to the proposed notch under Alternative 9 would not cause any significant adverse effect in conveying flood flows, because the maximum capacity of the notch is 6,000 cfs (less than 2% of the channel capacity); and the notch is closed (no additional flow) when the River stage reaches the weir crest elevation. Therefore, even if the notch enables spills before the River stage reaches the crest elevation, these spills would be minor relative to the capacity of the Bypass. Velocity in the Bypass would increase as the spills occur over the crest; therefore the inertia due to earlier spills through the notch would decrease and would not be significant by the time the Bypass reaches full capacity.

Therefore, Alternative 9 would not result in adverse effects on flood management.

***CEQA Conclusion*:** Alternative 9 would not result in an increase in potential risk for flood management compared to Existing Conditions when the changes due to sea level rise and climate change are eliminated from the analysis. Peak monthly flows under Alternative 9 in the locations considered in this analysis either were similar to or less than those that would occur under Existing Conditions without the changes in sea level rise and climate change; or the increased peak monthly flows would not exceed the flood capacity of the channels at these locations. Accordingly, Alternative 9 would result in a less-than-significant impact on flood management. No mitigation is required.

Reverse Flows in Old and Middle River

Impact SW-3: Change in Reverse Flow Conditions in Old and Middle Rivers

Old and Middle River flow criteria in Alternative 9 is only applied to flows in the Middle River.

Reverse flow conditions for Old and Middle River flows would be reduced under Alternative 9 on a long-term average basis only June compared to conditions under the No Action Alternative, as shown in Figure 6-23. Therefore, Alternative 9 would result in adverse impacts in the form of increased reverse flow conditions in almost all months.

Reverse flow conditions for Old and Middle River flows would be reduced under Alternative 9 on a long-term average basis in months June through November compared to reverse flows under Existing Conditions, as shown in Figure 6-23. However, these differences represent changes under Alternative 9, increased demands from Existing Conditions to No Action Alternative, and changes due to sea level rise and climate change.

NEPA Effects: A comparison with reverse flow conditions under the No Action Alternative provides an indication of the potential change due to Alternative 9 without the effects of sea level rise and climate change and the results show that reverse flow conditions under Alternative 9 would be more likely to occur on a long-term average basis except in June as compared to No Action Alternative.

CEQA Conclusion: Alternative 9 would provide negative changes in the form of increased reverse flow conditions in all months except June, compared to Existing Conditions. Determination of the significance of this impact is related to impacts on water quality and aquatic resources. The significance of these impacts is described in Chapter 8, *Water Quality*, and Chapter 11, *Fisheries and Aquatic Resources*.

Impact SW-4: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

Construction of the conveyance facilities under Alternative 9 would involve construction of fish screens, operable barriers, armored levees, and setback levees in the water; dredging; associated facilities on adjacent lands.

Construction of the facilities included in Alternative 9 would require excavation, grading, or stockpiling at project facility sites or at temporary work sites. These activities would result in temporary and long-term changes to drainage patterns, drainage paths, and facilities that would, in turn, cause changes in drainage flow rates, directions and velocities.

Site grading needed to construct any of the proposed facilities has the potential to block, reroute, or temporarily detain and impound surface water in existing drainages, which would result in increases and decreases in flow rates, velocities, and water surface elevations. Changes in drainage depths would vary depending on the specific conditions at each of the temporary work sites. As drainage paths would be blocked by construction activities, the temporary ponding of drainage water could occur and result in decreases in drainage flow rates downstream of the new facilities, increases in water surface elevations, and decreases in velocities upstream of the new facilities. Alternative 9 facilities would temporarily and directly affect existing water bodies and drainage facilities.

Alternative 9 would include installation of temporary drainage bypass facilities, long-term cross drainage, and replacement of existing drainage facilities that would be disrupted due to construction of new facilities. These facilities would be constructed prior to disconnecting or crossing existing drainage facilities, as described in Chapter 3, *Description of Alternatives*.

Paving, compaction of soil and other activities that would increase land imperviousness could result in decreases in precipitation infiltration into the soil, and could increase drainage runoff flows into receiving drainages.

Removal of groundwater during construction (dewatering) would be required for excavation activities. Groundwater removed during construction would be treated as necessary (see Chapter 3, *Description of Alternatives*, and Chapter 7, *Groundwater*), and discharged to local drainage channels or rivers. This would result in a localized increase in flows and water surface elevations in the receiving channels. Dewatering would be a continuous operation initiated 1 to 4 weeks prior to excavation and would continue until the excavation is completed. The discharge rates of water collected during construction would be relatively small compared to the capacities of most of the Delta channels where discharges would occur. Dispersion facilities would be used to reduce the potential for channel erosion due to the discharge of dewatering flows. Permits for the discharges would be obtained from the Regional Water Quality Control Board.

Construction of facilities within water bodies would include the installation of cofferdams at each location. The cofferdams would impede river flows, resulting in hydraulic impacts. Water surface elevations upstream of the cofferdams could increase under flood flow conditions by approximately 0.5 foot relative to Existing Conditions and the No Action Alternative. Under existing regulations, USACE, CVFPB, and DWR would require installation of setback levees or other measures to maintain existing flow capacity in the waterways during construction and operations, which would prevent unacceptable increases in river water surface elevations under flood-flow conditions.

Construction of project facilities could affect agricultural irrigation delivery and return flow canals, pumps and other drainage facilities in locations where such agricultural facilities would be crossed or disrupted along existing levees. Stockpiled excavated material from dredging operations could affect agricultural irrigation deliveries and return flows. Alternative 9 would include installation of temporary agricultural flow bypass facilities and provision of replacement drainage facilities to avoid interruptions in agricultural irrigation deliveries or return flows. The temporary flow bypass facilities would be installed and connected before existing facilities would be disconnected or otherwise affected. Replacement drainage facilities would be installed and connected before the end of construction.

NEPA Effects: Alternative 9 would involve excavation, grading, stockpiling, soil compaction, and dewatering that would result in temporary and long-term changes to drainage patterns, drainage paths, and facilities that would in turn, cause changes in drainage flow rates, directions, and velocities. Construction of cofferdams would impede river flows, cause hydraulic effects, and increase water surface elevations upstream. Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. Mitigation Measure SW-4 is available to address effects of runoff and sedimentation.

CEQA Conclusion**:** In total, Alternative 9 would result in alterations to drainage patterns, stream courses, and runoff; and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities located within the waterway. Potential impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages, and from changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce this impact to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-5: Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Area Facilities

NEPA Effects: Effects of alternating existing drainage patterns under Alternative 9 would be same as those described for Impact SW-5 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion: Please see Impact SW-5 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-6: Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

Construction of the facilities under Alternative 9 would contribute runoff from dewatering facilities. As described under Impact SW-4, paving, compaction of soil and other activities that would increase land imperviousness would result in decreases in precipitation infiltration into the soil, and thus increase drainage runoff flows into receiving drainages. Drainage studies would be completed to determine the need for onsite stormwater detention storage during construction or operations.

Removal of groundwater during construction (dewatering) would be required for excavation activities. Groundwater removed during construction would be treated as necessary (see Chapter 8, *Water Quality*), and discharged to local drainage channels or rivers. This could result in a localized increase in flows and water surface elevations in the receiving channels. Dewatering would be a continuous operation initiated 1 to 4 weeks prior to excavation and would continue after excavation is completed. The discharge rates of water collected during construction would be relatively small compared to the capacities of most of the Delta channels where discharges would occur. Dispersion facilities would be used to reduce the potential for channel erosion due to the discharge of dewatering flows. Permits for the discharges would be obtained from the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4).

NEPA Effects: Paving, soil compaction, and other activities would increase runoff during facilities construction and operations. Construction and operation of dewatering facilities and associated discharge of water would result in localized increases in flows and water surface elevations in receiving channels. These activities could result in adverse effects if the runoff volume exceeds the capacities of local drainages. Compliance with permit design requirements would avoid adverse effects on surface water quality and flows from dewatering activities. The use of dispersion facilities would reduce the potential for channel erosion. Mitigation Measure SW-4 is available to address adverse effects.

***CEQA Conclusion*:** Alternative 9 actions would include installation of dewatering facilities in accordance with permits issued by the Regional Water Quality Control Board, USACE, and CVFPB (See Section 6.2.2.4). Alternative 9 would include provisions to design the dewatering system in accordance with these permits to avoid significant impacts on surface water quality and flows. As an example, the project would be designed to meet USACE requirements for hydraulic neutrality and CVFPB requirements for access for maintenance and flood-fighting purposes. However, increased runoff could occur from facilities sites during construction or operations and could result in significant impacts if the runoff volume exceeds the capacities of local drainages. These impacts are considered significant. Mitigation Measure SW-4 would reduce these potential impacts to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

Impact SW-7: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to the Construction of New Conveyance Facilities

As described under Impact SW-4, facilities under Alternative 9 would be designed to avoid increased flood potential as compared to Existing Conditions or the No Action Alternative in accordance with the requirements of USACE, CVFPB, and DWR. As described under Impact SW-1, Alternative 9 would not increase flood potential on the Sacramento River, San Joaquin River, or Yolo Bypass.

USACE, CVFPB, and DWR would require facilities constructed under Alternative 9 that would disturb existing levees to be designed in a manner that would not adversely affect existing flood protection. Facilities construction would include temporary cofferdams, stability analyses, monitoring, and slope remediation, as described in Chapter 3, *Description of Alternatives*. For the excavation of existing levees for installation of fish screens and operable barriers, sheet pile wall installation would minimize effects on slope stability during construction. Dewatering inside the cofferdams or adjacent to the existing levees would remove waterside slope resistance and lead to slope instability. Slopes would be constructed in accordance with existing engineering standards, as described in Chapter 3, *Description of Alternatives*.

Some project facilities could require rerouting of access roads and waterways that could be used during times of evacuation or emergency response.

Alternative 9 would be designed to avoid increased flood potential compared to Existing Conditions or the No Action Alternative, in accordance with the requirements of USACE, CVFPB, and DWR.

NEPA Effects: Alternative 9 would not result in an increased exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with USACE, CVFPB, and DWR requirements to avoid increased flood potential as described in Section 6.2.2.4. Additionally, DWR would consult with local reclamation districts to ensure that construction activities would not conflict with reclamation district flood protection measures.

CEQA Conclusion**:** Alternative 9 would not result in increased exposure of people or structures to flooding due to construction of the conveyance facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4.

Impact SW-8: Expose People or Structures to a Significant Risk of Loss, Injury, or Death Involving Flooding Due to Habitat Restoration

NEPA Effects: Effects of operation of habitat restoration areas on levees under Alternative 9 would be the same as those described for Impact SW-8 under Alternative 1A because the habitat restoration areas would be identical and provisions to avoid adverse effects on drainage patterns would be the same.

CEQA Conclusion**:** Please see Impact SW-8 conclusion in the Alternative 1A discussion.

Mitigation Measure SW-8: Implement Measures to Address Potential Wind Fetch Issues

Please see Mitigation Measure SW-8 under Impact SW-8 in the discussion of Alternative 1A.

Impact SW-9: Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

As described under Impact SW-4, facilities under Alternative 9 would be designed to avoid increased flood potential compared to Existing Conditions or the No Action Alternative, in accordance with the requirements of USACE, CVFPB, and DWR. As described under Impact SW-1, Alternative 9 would not increase flood potential on the Sacramento River, San Joaquin River, Trinity River, American River, or Feather River, or Yolo Bypass, as described under Impact SW-2. Alternative 9 would include measures to address issues associated with alterations to drainage patterns, stream courses, and runoff and potential for increased surface water elevations in the rivers and streams during construction and operations of facilities.

NEPA Effects: Potential adverse effects could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These effects are considered adverse. Mitigation Measure SW-4 is available to address these potential effects.

***CEQA Conclusion*:** Alternative 9 would not result in an impedance or redirection of flood flows or conditions that would cause inundation by mudflow due to construction or operations of the conveyance facilities or construction of the habitat restoration facilities because the BDCP proponents would be required to comply with the requirements of USACE, CVFPB, and DWR to avoid increased flood potential as described in Section 6.2.2.4. Potential adverse impacts could occur due to increased stormwater runoff from paved areas that could increase flows in local drainages; and changes in sediment accumulation near the intakes. These impacts are considered significant. Mitigation Measure SW-4 would reduce these potential impacts to a less-than-significant level.

Mitigation Measure SW-4: Implement Measures to Reduce Runoff and Sedimentation

Please see Mitigation Measure SW-4 under Impact SW-4 in the discussion of Alternative 1A.

6.3.4 Cumulative Analysis

This cumulative impact analysis considers projects that could affect surface water and, where relevant, in the same timeframe as an action alternative. Surface water resources in the Delta Region and in the areas Upstream of the Delta and in the Export Service Areas would be expected to change as a result of past, present, and reasonably foreseeable future projects, related to changes in potential risks of floods, surface water flows, drainage, and changes in stream courses during construction and operations of new facilities.

When the effects of the changes in surface water resources under the alternatives are considered in connection with the potential effects of projects listed in Appendix 3D, Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions, the potential effects range from beneficial to potentially adverse cumulative effects on surface water resources.

All of the BDCP alternatives included the assumption that the following programs identified to occur under the No Project Alternative and No Action Alternative were implemented and accordingly were modeled.

- Grasslands Bypass Project.

- Lower American River Flow Management Standard (simulated in Existing Conditions, No Action Alternative, and all Alternatives).
- Delta-Mendota Canal / California Aqueduct Intertie.
- Freeport Regional Water Project.

The effects of those projects were included in the surface water results presented in previous subsections of this chapter through the comparison of each BDCP alternative and the No Action Alternative.

The Cumulative Analysis for surface water includes a comparison of conditions that could occur with and without the BDCP alternatives with conditions that could occur with implementation of the BDCP alternatives to determine if the combined effect of implementation of all of these projects could be cumulatively significant, and if so, could the incremental effect of the BDCP alternatives be considered cumulatively considerable.

The following list presented in Table 6-9 includes projects considered for this cumulative effects section; for a complete list of such projects, consult Appendix 3D, *Defining Existing Conditions, No Action Alternative, No Project Alternative, and Cumulative Impact Conditions*.

Table 6-9. Effects on Water Supply from the Programs, Projects, and Policies Considered for Cumulative Analysis

Agency	Program/Project	Status	Description of Program/Project	Effects on Water Supply
Contra Costa Water District and Bureau of Reclamation	Los Vaqueros Reservoir Expansion Project	Draft EIS/EIR in 2009. Final EIS/EIR in 2010. Project completed in 2012.	Project will increase the storage capacity of Los Vaqueros Reservoir and divert additional water from the Delta intake near Rock Slough to fill the additional storage volume (Bureau of Reclamation and Contra Costa Water District 2009).	The Los Vaqueros Expansion Project would provide water to South Bay water agencies that otherwise would receive all of their Delta supplies through the existing SWP and CVP export pumps. The purpose of the project would be to improve water quality to Bay Area water users and to adjust the pattern of diversions from the Delta to reduce impacts to aquatic resources. The project would be implemented to provide water supplies for previously identified water demands and not for additional non-identified growth. An environmental impact report has been completed and indicates no significant adverse effects on Delta water levels, no significant alteration of drainage patterns, no runoff that would exceed existing or planned stormwater drainage systems or significant additional sources of polluted runoff during operation, no increased risk of exposure of people and/or structures to risks associated with dam or levee failure. The project also is reported to have less than significant impact on placing structures within a 100-year flood hazard area.

Agency	Program/Project	Status	Description of Program/Project	Effects on Water Supply
Department of Water Resources	North Delta Flood Control and Ecosystem Restoration Project	Completed in 2012.	Project that will modify certain levees in a portion of the North Delta to reduce flood hazards. In addition, an off-channel detention basin is planned to be built to improve channel capacity on Staten Island (California Department of Water Resources 2010c).	Environmental impact report has been completed and indicates no adverse effects on surrounding surface waters and benefits for local flood management.
Department of Water Resources	Dutch Slough Tidal Marsh Restoration Project	Project implementation began in 2012. Estimated completion in 2016.	Project that will include levee breaches and the restoration of a dendritic tidal channel system on three parcels between Dutch Slough and Contra Costa Canal (California Department of Water Resources 2010b).	Environmental impact report has been completed and indicates no adverse effects on surrounding surface waters.
Davis, Woodland, and University of California, Davis	Davis-Woodland Water Supply Project	Program under development. Final EIR in 2009. Specific design and operations criteria not identified.	Project that will divert water on the Sacramento River upstream of the American River confluence to be conveyed to a new water treatment plant (City of Davis 2007).	Water diversions under the Davis-Woodland Water Supply Project would be made in compliance with Standard Water Right Permit Term 91, which prohibits surface water diversions when water is being released from CVP or SWP storage reservoirs to meet in-basin entitlements, including water quality and environmental standards for protection of the Sacramento- San Joaquin Delta. Water supply needs during periods applicable to Term 91 would be satisfied by entering into water supply transfer agreements with senior water rights holders within the Sacramento River watershed. The total diversion would be less than 50,000 acre-feet/year. An environmental impact report has been completed and indicates no significant adverse effects on Sacramento River hydrologic conditions or Delta inflow and/or outflow in a way that would conflict with other water management objectives or existing beneficial uses.

Agency	Program/Project	Status	Description of Program/Project	Effects on Water Supply
West Sacramento Area Flood Control Agency and U.S. Army Corps of Engineers	West Sacramento Levee Improvements Program	Program under development. Construction initiated in several areas. Further environmental and engineering documentation required for future projects.	The West Sacramento Levee Improvements Program (WSLIP) would construct improvements to the levees protecting West Sacramento to meet local and federal flood protection criteria. The program area includes the entire WSAFCA boundaries which encompasses portions of the Sacramento River, the Yolo Bypass, the Sacramento Bypass, and the Sacramento Deep Water Ship Channel.	Program under development. Many actions have been constructed, or are under construction. Remaining actions are under design, with separate environmental documents which includes provisions to reduce impacts on surface water.
U.S. Bureau of Reclamation, U.S. Fish and Wildlife Service, National Marine Fisheries Services, Department of Water Resources, and Department of Fish and Wildlife	San Joaquin River Restoration Program	Final Programmatic EIS/EIR completed in 2012.	The San Joaquin River Restoration Program is a direct result of a September 2006 legal settlement by the U.S. Departments of the Interior and Commerce, the Natural Resources Defense Council, and the Friant Water Users Authority to restore spring and fall run Chinook salmon to the San Joaquin River below Friant Dam while supporting water management actions within the Friant Division. Public Law 111-11 authorized and directed federal agencies to implement the settlement. Interim flows began October 1, 2009, and full restoration flows are scheduled to begin no later than January 2014 (California Department of Water Resources 2009:SJ-12).	The San Joaquin River Restoration Program would modify the release pattern of water from Friant Dam into the San Joaquin River, implement a combination of channel and structural modifications along the San Joaquin River below Friant Dam, and reintroduce Chinook salmon into portions of the San Joaquin River. Part or all of water released from Friant Dam could be recirculated to upstream water users. A draft environmental impact report has been completed and indicates no significant adverse effects on hydrology and flood management.

All of these projects have completed draft or final environmental documents that analyzed their potential impacts on surface water resources. According to these documents, the impacts on surface water resources would be less than significant or less than significant after mitigation measures are implemented.

The SWRCB is conducting a concurrent program to update the Bay-Delta Water Quality Control Plan. This project is still under development, and the potential outcomes are not known at this time. Changes to surface water resources due to this project could result in changes in Delta outflow and Delta outflow patterns (increases and decreases depending on the time of the year for different scenarios) and water quality in the Delta watershed.

No Action Alternative

Under the No Action Alternative, the number of months where the reservoir storage is close to the flood storage capacity in Shasta Lake, Folsom Lake, and Lake Oroville would be fewer than under Existing Conditions, as shown in Tables 6-2 through 6-7. The cumulative changes in flood storage capacity are due to water releases to meet increased demands under the No Action Alternative compared to Existing Conditions, and changes due to sea level rise and climate change. Similar effects related to sea level rise and climate change would also occur under the action alternatives. The changes in reservoir flood storage capacity would provide additional flexibility for flood management. Overall, the peak flows simulated in CALSIM under the No Action Alternative show cumulative increases from 1% to 4% in certain locations. However, these cumulative changes are primarily due to the change in flow patterns due to sea level rise and climate change. Similar effects related to sea level rise and climate change would also occur under the action alternatives. As described in section 6.3.1.2, the flood management criteria for maintaining adequate flood storage space in the reservoirs (as defined by USACE and DWR for flood control release criteria) were not modified to adapt to the changes in runoff due to climate change. No changes in monthly allowable storage values related to CALSIM II model assumptions were included because these changes were not defined under the alternatives to achieve the project objectives or purpose and need for the BDCP. If USACE and DWR modify allowable storage values in the future in response to climate change, it is anticipated that the surface water flows and related water supply and water quality conditions would change.

Reverse flow conditions for Old and Middle River flows on a long-term average basis under the No Action Alternative are similar to Existing Conditions, except in July through November. In these months, Old and Middle River flows are cumulatively less negative due to reduced south Delta exports because of the sea level rise and climate change, increased demands in north of the Delta, and operations to comply with Fall X2 (Figure 6-23). Similar effects related to sea level rise and climate change would also occur under the action alternatives.

Action Alternatives

Impact SW-11: Cumulative Impact - Changes in SWP or CVP Reservoir Flood Storage Capacity

NEPA Effects: Implementing the projects listed in Table 6-9 in combination with any of Alternatives 1A through 9 would not result in cumulative adverse effects on upstream storage conditions because they are either restoration projects or water supply projects that would not affect operations in upstream reservoirs. These projects would not have any measurable effect on upstream reservoir flood storage capacity.

Implementation of BDCP Alternatives 1A through 9 would not result in a reduction in flood storage capacity of upstream reservoirs as described above. Therefore, Alternatives 1A through 9 when combined with the projects listed in Table 6-9 would not result in a cumulative adverse effect on flood storage.

***CEQA Conclusion*:** Implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in a significant cumulative impact.

Impact SW-12: Cumulative Impact - Changes in Sacramento and San Joaquin River Flood Flows

NEPA Effects: Implementing the projects listed in Table 6-9 in combination with any of Alternatives 1A through 9 would not result in cumulative adverse effects on Sacramento and San Joaquin rivers flows in the winter and early spring months of wet years when flood potential is high.

All of these projects would either specifically improve flood management conditions and reduce flood potential, including the North Delta Flood Control and Ecosystem Restoration Project that would expand the floodplain to reduce peak flood flows; divert additional water that could reduce peak flood flows, including Davis-Woodland Water Supply Project; or not substantially modify peak monthly flows in wet years, such as Dutch Slough Tidal Marsh Restoration Project and San Joaquin River Restoration Program.

Therefore, implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in cumulative adverse effects.

***CEQA Conclusion*:** Implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in a significant cumulative impact.

Impact SW-13: Cumulative Impact - Reverse Flow Conditions in Old and Middle Rivers

NEPA Effects: Implementing the projects listed in Table 6-9 in combination with any of Alternatives 1A through 9 would not result in cumulative adverse effects on Old and Middle River flows.

San Joaquin River Restoration Program would include recirculation of the water released from Friant Dam; however the increased south Delta exports would not cause increase in reverse OMR flows as they would be subject to the same OMR regulations. In addition, Alternatives 1A through 8 would include north Delta diversion facility that would help reduce south Delta pumping.

Therefore, implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in cumulative adverse effects.

***CEQA Conclusion*:** Implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in a significant cumulative impact.

Impact SW-14: Cumulative Impact - Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Conveyance Facilities

NEPA Effects: Implementing the projects listed in Table 6-9 in combination with any of Alternatives 1A through 9 would not result in cumulative adverse effects on altering the existing drainage pattern since these projects would not be built in the vicinity of BDCP conveyance facilities.

Therefore, implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in cumulative adverse effects.

***CEQA Conclusion*:** Implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in a significant cumulative impact.

Impact SW-15: Cumulative Impact - Substantially Alter the Existing Drainage Pattern or Substantially Increase the Rate or Amount of Surface Runoff in a Manner That Would Result in Flooding during Construction of Habitat Restoration Areas

NEPA Effects: Implementing the projects listed in Table 6-9 in combination with any of Alternatives 1A through 9 would not result in cumulative adverse effects on existing drainage patterns either near the cumulative projects or the restoration areas since these projects would not be built in the vicinity of BDCP restoration area facilities.

Therefore, implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in cumulative adverse effects.

***CEQA Conclusion*:** Implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in a significant cumulative impact.

Impact SW-16: Cumulative Impact - Create or Contribute Runoff Water Which Would Exceed the Capacity of Existing or Planned Stormwater Drainage Systems or Provide Substantial Additional Sources of Polluted Runoff

NEPA Effects: Implementing the projects listed in Table 6-9 in combination with any of Alternatives 1A through 9 would not result in cumulative adverse effects on increasing polluted runoff since these projects would not be built in the vicinity of BDCP facilities.

Therefore, implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in cumulative adverse effects.

***CEQA Conclusion*:** Implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in a significant cumulative impact.

Impact SW-17: Cumulative Impact - Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding As a Result of the Failure of a Levee or Dam Due to the Operation of New Conveyance Facilities

NEPA Effects: Implementing the projects listed in Table 6-9 in combination with any of Alternatives 1A through 9 would not result in cumulative adverse effects on exposing people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam due to the operation of new conveyance facilities since these projects would not be built in the vicinity of BDCP conveyance facilities.

Therefore, implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in cumulative adverse effects.

***CEQA Conclusion*:** Implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in a significant cumulative impact.

Impact SW-18: Cumulative Impact - Expose People or Structures to a Significant Risk of Loss, Injury or Death Involving Flooding, Including Flooding As a Result of the Failure of a Levee or Dam Due to the Operation of Habitat Restoration Areas

NEPA Effects: Implementing the projects listed in Table 6-9 in combination with any of Alternatives 1A through 9 would not result in cumulative adverse effects on exposing people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam due to the operation of habitat restoration areas since these projects would not be built in the vicinity of BDCP restoration areas.

Therefore, implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in cumulative adverse effects.

***CEQA Conclusion*:** Implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in a significant cumulative impact.

Impact SW-19: Cumulative Impact - Place within a 100-Year Flood Hazard Area Structures Which Would Impede or Redirect Flood Flows, or Be Subject to Inundation by Mudflow

NEPA Effects: Implementing the projects listed in Table 6-9 in combination with any of Alternatives 1A through 9 would not result in cumulative adverse effects on increased risk from floods or mudflows based upon information related to surface water resources presented in environmental documentation for these projects. Table 6-9 summarizes the potential effects on surface water as described in environmental compliance documents for each project.

Therefore, implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in cumulative adverse effects.

***CEQA Conclusion*:** Implementing these projects in combination with any of BDCP Alternatives 1A through 9 would not result in a significant cumulative impact.

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Table 6-2. Surface Water Summary Table

Location	Parameter	Units	Existing Condition	No Action Alternative (LLT)	Alternative 1A,1B,1C (LLT)	Alternative 2A,2B,2C (LLT)	Alternative 3 (LLT)	Alternative 4 H1 (LLT)	Alternative 4 H2 (LLT)	Alternative 4 H3 (LLT)	Alternative 4 H4 (LLT)	Alternative 5 (LLT)	Alternative 6A,6B,6C (LLT)	Alternative 7 (LLT)	Alternative 8 (LLT)	Alternative 9 (LLT)
Shasta Lake	Number of months within 10 TAF of the flood curve in October through June		218	159	160	151	162	173	175	156	158	158	171	160	145	158
Lake Oroville	Number of months within 10 TAF of the flood curve in October through June		240	154	171	149	172	167	167	148	152	156	168	169	62	155
Folsom Lake	Number of months within 10 TAF of the flood curve in October through June		361	268	249	255	252	266	285	261	272	255	266	261	236	269
Sacramento River at Bend Bridge	Wet Years January Flow	CFS	27,694	30,034	30,405	30,363	30,551	31,287	31,200	30,343	30,294	30,378	31,347	30,790	31,684	30,367
Sacramento River at Bend Bridge	Wet Years February Flow	CFS	29,943	33,147	33,133	33,068	33,451	33,659	33,789	33,177	33,188	33,167	33,367	33,122	33,526	33,287
Sacramento River at Bend Bridge	Wet Years March Flow	CFS	24,855	26,057	26,193	26,142	26,195	26,160	26,155	26,129	26,126	26,116	26,157	26,128	26,181	26,057
Sacramento River at Bend Bridge	Average of Top 10% Monthly Flows	CFS	32,352	33,978	34,153	33,961	34,265	35,172	35,172	34,068	34,078	33,687	34,855	34,289	34,586	34,101
Sacramento River at Freeport	Wet Years January Flow	CFS	50,800	52,716	52,200	51,256	52,229	52,108	51,968	51,332	50,819	51,769	52,118	51,333	52,529	51,122
Sacramento River at Freeport	Wet Years February Flow	CFS	57,222	59,754	58,768	58,565	58,650	58,857	58,557	58,619	58,286	58,589	58,561	58,112	58,337	58,235
Sacramento River at Freeport	Wet Years March Flow	CFS	49,436	51,011	49,080	48,817	49,129	48,981	49,060	48,787	48,940	48,942	49,074	48,339	49,003	48,936
Sacramento River at Freeport	Average of Top 10% Monthly Flows	CFS	60,876	62,307	61,362	60,828	61,297	61,470	61,567	60,839	60,917	60,811	61,416	60,912	61,559	60,792
San Joaquin River at Vernalis	Wet Years January Flow	CFS	9,089	9,681	9,811	9,689	9,794	9,714	9,723	9,675	9,760	9,742	9,768	9,754	9,785	9,778
San Joaquin River at Vernalis	Wet Years February Flow	CFS	12,750	13,191	13,196	13,181	13,195	13,178	13,192	13,182	13,194	13,199	13,199	13,169	13,161	13,202
San Joaquin River at Vernalis	Wet Years March Flow	CFS	14,374	15,235	15,234	15,230	15,242	15,246	15,235	15,236	15,243	15,234	15,240	15,243	15,244	15,245
San Joaquin River at Vernalis	Average of Top 10% Monthly Flows	CFS	16,782	16,722	16,725	16,700	16,717	16,704	16,715	16,704	16,713	16,702	16,702	16,707	16,698	16,715
Sacramento River upstream of Walnut Grove	Wet Years January Flow	CFS	50,961	52,878	42,014	40,419	47,110	44,637	44,482	43,883	43,431	49,145	40,766	44,047	45,128	51,284
Sacramento River upstream of Walnut Grove	Wet Years February Flow	CFS	57,314	59,847	48,632	46,712	52,834	50,234	50,033	49,932	49,815	55,715	45,420	49,513	49,638	58,328
Sacramento River upstream of Walnut Grove	Wet Years March Flow	CFS	49,416	50,993	40,210	38,511	43,239	40,575	42,051	40,299	41,904	45,934	38,019	39,986	40,489	48,918
Sacramento River upstream of Walnut Grove	Average of Top 10% Monthly Flows	CFS	60,949	62,388	50,697	49,052	55,730	53,113	53,217	52,387	52,532	58,026	48,699	52,405	53,025	60,877
Trinity River below Lewiston Reservoir	Wet Years May Flow	CFS	4,636	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620	4,620
Trinity River below Lewiston Reservoir	Average of Top 10% Monthly Flows	CFS	4,304	4,538	4,562	4,547	4,563	4,618	4,624	4,547	4,547	4,556	4,591	4,561	4,592	4,548
American River below Nimbus	Wet Years January Flow	CFS	8,806	11,036	11,011	11,011	10,985	11,143	11,115	11,040	10,995	11,070	11,187	11,133	11,121	11,134
American River below Nimbus	Wet Years February Flow	CFS	9,294	11,102	11,122	11,106	11,092	11,163	11,167	11,107	11,109	11,104	11,105	11,102	11,074	11,107
American River below Nimbus	Wet Years March Flow	CFS	6,089	6,992	6,987	6,989	6,987	6,982	6,989	6,987	6,987	6,992	6,997	7,000	6,996	6,998
American River below Nimbus	Average of Top 10% Monthly Flows	CFS	10,967	12,391	12,346	12,360	12,311	12,396	12,425	12,354	12,404	12,344	12,427	12,366	12,309	12,416
Feather River below Thermalito	Wet Years January Flow	CFS	11,257	11,896	14,399	11,116	14,347	13,569	13,308	11,023	12,161	12,002	14,106	13,052	15,693	12,037
Feather River below Thermalito	Wet Years February Flow	CFS	12,466	14,787	16,622	16,021	16,515	16,167	15,655	16,276	15,207	16,244	16,041	16,549	15,609	14,726
Feather River below Thermalito	Wet Years March Flow	CFS	12,895	14,772	14,988	14,470	15,093	14,854	14,943	14,401	14,813	14,732	14,991	14,548	15,495	14,525
Feather River below Thermalito	Average of Top 10% Monthly Flows	CFS	15,192	15,923	17,124	16,170	17,138	16,944	18,060	16,014	17,479	16,225	16,854	16,805	17,055	15,797
Fremont Weir Spills	Wet Years January Flow	CFS	20,528	24,758	28,086	25,924	28,120	28,253	28,095	25,795	27,172	26,319	28,783	28,039	30,139	26,900
Fremont Weir Spills	Wet Years February Flow	CFS	23,869	29,796	32,583	32,140	32,831	32,573	32,506	32,418	31,738	32,393	32,380	33,084	32,208	31,371
Fremont Weir Spills	Wet Years March Flow	CFS	15,897	18,802	21,084	20,785	21,135	21,004	21,030	20,724	20,999	20,896	21,060	21,322	21,535	20,664
Fremont Weir Spills	Average of Top 10% Monthly Flows	CFS	21,509	24,874	27,898	26,659	27,951	28,045	28,203	26,648	27,144	26,792	28,191	28,084	28,428	26,543
Old and Middle River	October Flow	CFS	-7,568	-4,427	-4,854	-1,371	-4,789	-2,112	-2,092	-1,333	-1,353	-2,956	279	186	153	-5,614
Old and Middle River	November Flow	CFS	-7,592	-5,636	-4,555	-1,867	-5,243	-4,054	-3,975	-2,013	-1,953	-3,356	324	352	349	-6,780
Old and Middle River	December Flow	CFS	-6,513	-6,155	-5,046	-4,509	-5,845	-4,607	-4,394	-4,764	-4,655	-6,300	1,548	1,067	1,019	-7,927
Old and Middle River	January Flow	CFS	-3,449	-3,228	-13	-40	-1,807	-1,167	-1,199	-1,097	-1,144	-2,634	2,809	1,832	1,798	-3,394
Old and Middle River	February Flow	CFS	-3,158	-2,964	1,049	709	-1,058	-430	-296	-570	-410	-2,351	3,296	1,886	1,833	-3,185
Old and Middle River	March Flow	CFS	-2,758	-2,487	1,844	1,129	-135	446	1,357	333	1,156	-1,874	3,324	2,103	2,057	-2,744
Old and Middle River	April Flow	CFS	843	659	379	536	-1,114	205	795	181	784	547	2,633	2,654	2,660	-3,098
Old and Middle River	May Flow	CFS	353	155	246	380	-934	133	449	148	467	268	2,249	2,246	2,263	-2,967
Old and Middle River	June Flow	CFS	-3,780	-3,504	-1,605	-1,721	-2,369	-1,926	-1,133	-1,981	-1,182	-3,383	232	145	144	-3,365
Old and Middle River	July Flow	CFS	-9,715	-8,473	-4,699	-5,611	-5,080	-6,380	-5,452	-6,373	-5,271	-7,508	-221	-8,401	-3,089	-9,215
Old and Middle River	August Flow	CFS	-9,283	-8,604	-4,261	-4,731	-4,416	-5,071	-5,367	-5,221	-5,412	-6,040	-1	-6,861	-4,883	-8,877
Old and Middle River	September Flow	CFS	-8,236	-6,868	-4,214	-1,773	-4,411	-4,111	-4,231	-1,819	-1,930	-2,760	394	-2,312	-1,745	-7,761

Notes:
1) "LLT" (Late Long-Term) indicates Alternatives that are simulated with 2060 climate change and sea level rise.
2) Water year types are determined by San Joaquin River Basin 60-20-20 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999) for San Joaquin River flows at Vernalis and by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999) for all other flows.

Table 6-3. Surface Water Summary Table - Differences from Existing Conditions

Location	Parameter	Units	No Action Alternative (LLT)	Alternative 1A,1B,1C (LLT)	Alternative 2A,2B,2C (LLT)	Alternative 3 (LLT)	Alternative 4 H1 (LLT)	Alternative 4 H2 (LLT)	Alternative 4 H3 (LLT)	Alternative 4 H4 (LLT)	Alternative 5 (LLT)	Alternative 6A,6B,6C (LLT)	Alternative 7 (LLT)	Alternative 8 (LLT)	Alternative 9 (LLT)
Shasta Lake	Number of months within 10 TAF of the flood curve in October through June	TAF	-59	-58	-67	-56	-45	-43	-62	-60	-60	-47	-58	-73	-60
Lake Oroville	Number of months within 10 TAF of the flood curve in October through June	TAF	-86	-69	-91	-68	-73	-73	-92	-88	-84	-72	-71	-178	-85
Folsom Lake	Number of months within 10 TAF of the flood curve in October through June	TAF	-93	-112	-106	-109	-95	-76	-100	-89	-106	-95	-100	-125	-92
Sacramento River at Bend Bridge	Wet Years January Flow	CFS	2,339	2,711	2,669	2,856	3,593	3,506	2,649	2,600	2,683	3,653	3,095	3,990	2,672
Sacramento River at Bend Bridge	Wet Years February Flow	CFS	3,204	3,190	3,125	3,508	3,716	3,846	3,234	3,245	3,224	3,424	3,179	3,583	3,344
Sacramento River at Bend Bridge	Wet Years March Flow	CFS	1,201	1,337	1,287	1,340	1,304	1,300	1,273	1,271	1,261	1,301	1,272	1,325	1,202
Sacramento River at Bend Bridge	Average of Top 10% Monthly Flows	CFS	1,626	1,801	1,608	1,913	2,820	2,820	1,716	1,726	1,334	2,503	1,937	2,233	1,749
Sacramento River at Freeport	Wet Years January Flow	CFS	1,916	1,400	456	1,429	1,308	1,168	532	19	969	1,318	533	1,729	322
Sacramento River at Freeport	Wet Years February Flow	CFS	2,532	1,547	1,343	1,429	1,635	1,336	1,398	1,065	1,367	1,340	890	1,115	1,013
Sacramento River at Freeport	Wet Years March Flow	CFS	1,575	-356	-620	-308	-455	-376	-649	-496	-494	-362	-1,098	-433	-500
Sacramento River at Freeport	Average of Top 10% Monthly Flows	CFS	1,431	486	-47	422	594	692	-37	42	-65	541	36	684	-84
San Joaquin River at Vernalis	Wet Years January Flow	CFS	592	722	600	705	625	634	586	671	653	679	665	696	689
San Joaquin River at Vernalis	Wet Years February Flow	CFS	441	445	431	445	428	442	432	444	449	449	419	411	452
San Joaquin River at Vernalis	Wet Years March Flow	CFS	861	860	856	868	872	861	861	868	860	865	869	869	871
San Joaquin River at Vernalis	Average of Top 10% Monthly Flows	CFS	-60	-56	-81	-64	-77	-66	-77	-69	-80	-79	-75	-84	-67
Sacramento River upstream of Walnut Grove	Wet Years January Flow	CFS	1,917	-8,947	-10,542	-3,851	-6,324	-6,479	-7,078	-7,530	-1,816	-10,195	-6,914	-5,834	323
Sacramento River upstream of Walnut Grove	Wet Years February Flow	CFS	2,533	-8,682	-10,602	-4,480	-7,080	-7,281	-7,382	-7,499	-1,599	-11,894	-7,801	-7,676	1,014
Sacramento River upstream of Walnut Grove	Wet Years March Flow	CFS	1,577	-9,206	-10,905	-6,177	-8,841	-7,364	-9,117	-7,512	-3,482	-11,397	-9,430	-8,927	-498
Sacramento River upstream of Walnut Grove	Average of Top 10% Monthly Flows	CFS	1,439	-10,253	-11,897	-5,219	-7,836	-7,733	-8,562	-8,417	-2,923	-12,250	-8,544	-7,924	-73
Trinity River below Lewiston Reservoir	Wet Years May Flow	CFS	-16	-16	-16	-16	-16	-16	-16	-16	-16	-16	-16	-16	-16
Trinity River below Lewiston Reservoir	Average of Top 10% Monthly Flows	CFS	234	258	242	259	314	320	243	243	252	287	257	288	244
American River below Nimbus	Wet Years January Flow	CFS	2,230	2,205	2,205	2,178	2,336	2,309	2,233	2,188	2,264	2,381	2,326	2,315	2,327
American River below Nimbus	Wet Years February Flow	CFS	1,808	1,828	1,812	1,798	1,870	1,874	1,814	1,815	1,810	1,812	1,809	1,781	1,813
American River below Nimbus	Wet Years March Flow	CFS	904	899	901	898	893	900	898	898	904	909	911	907	910
American River below Nimbus	Average of Top 10% Monthly Flows	CFS	1,424	1,379	1,393	1,344	1,429	1,458	1,386	1,436	1,376	1,460	1,399	1,342	1,449
Feather River below Thermalito	Wet Years January Flow	CFS	638	3,141	-141	3,089	2,312	2,051	-235	904	745	2,848	1,794	4,436	780
Feather River below Thermalito	Wet Years February Flow	CFS	2,321	4,156	3,555	4,049	3,701	3,189	3,810	2,741	3,778	3,575	4,083	3,143	2,260
Feather River below Thermalito	Wet Years March Flow	CFS	1,877	2,093	1,575	2,198	1,959	2,048	1,506	1,918	1,837	2,096	1,654	2,601	1,630
Feather River below Thermalito	Average of Top 10% Monthly Flows	CFS	730	1,932	978	1,946	1,752	2,868	822	2,287	1,033	1,662	1,613	1,862	605
Fremont Weir Spills	Wet Years January Flow	CFS	4,229	7,558	5,396	7,592	7,725	7,566	5,266	6,644	5,790	8,255	7,511	9,611	6,371
Fremont Weir Spills	Wet Years February Flow	CFS	5,927	8,714	8,271	8,962	8,704	8,637	8,549	7,869	8,524	8,511	9,215	8,339	7,502
Fremont Weir Spills	Wet Years March Flow	CFS	2,905	5,187	4,888	5,237	5,107	5,133	4,827	5,101	4,998	5,163	5,424	5,637	4,767
Fremont Weir Spills	Average of Top 10% Monthly Flows	CFS	3,365	6,389	5,150	6,442	6,537	6,694	5,139	5,636	5,283	6,682	6,575	6,919	5,034
Old and Middle River	October Flow	CFS	3,140	2,714	6,197	2,779	5,455	5,476	6,235	6,215	4,612	7,846	7,754	7,721	1,954
Old and Middle River	November Flow	CFS	1,956	3,038	5,725	2,349	3,539	3,617	5,579	5,640	4,236	7,916	7,944	7,941	812
Old and Middle River	December Flow	CFS	357	1,466	2,004	668	1,905	2,118	1,749	1,857	212	8,061	7,580	7,531	-1,415
Old and Middle River	January Flow	CFS	221	3,436	3,408	1,642	2,281	2,250	2,352	2,305	814	6,258	5,281	5,247	54
Old and Middle River	February Flow	CFS	194	4,207	3,866	2,099	2,728	2,862	2,588	2,748	807	6,453	5,043	4,991	-27
Old and Middle River	March Flow	CFS	271	4,602	3,887	2,623	3,204	4,115	3,091	3,914	884	6,081	4,861	4,815	14
Old and Middle River	April Flow	CFS	-185	-464	-308	-1,957	-638	-48	-663	-59	-296	1,790	1,810	1,817	-3,941
Old and Middle River	May Flow	CFS	-198	-108	27	-1,287	-220	96	-205	113	-85	1,895	1,893	1,909	-3,321
Old and Middle River	June Flow	CFS	276	2,175	2,059	1,411	1,854	2,647	1,799	2,598	397	4,012	3,925	3,924	415
Old and Middle River	July Flow	CFS	1,242	5,016	4,104	4,635	3,335	4,263	3,341	4,444	2,207	9,494	1,314	6,626	500
Old and Middle River	August Flow	CFS	680	5,023	4,553	4,868	4,212	3,916	4,062	3,871	3,243	9,283	2,422	4,400	407
Old and Middle River	September Flow	CFS	1,369	4,022	6,463	3,826	4,125	4,005	6,417	6,306	5,477	8,631	5,924	6,491	475

Surface Water Summary Table - Percent Differences from Existing Conditions

Location	Parameter	Units	No Action Alternative (LLT)	Alternative 1A,1B,1C (LLT)	Alternative 2A,2B,2C (LLT)	Alternative 3 (LLT)	Alternative 4 H1 (LLT)	Alternative 4 H2 (LLT)	Alternative 4 H3 (LLT)	Alternative 4 H4 (LLT)	Alternative 5 (LLT)	Alternative 6A,6B,6C (LLT)	Alternative 7 (LLT)	Alternative 8 (LLT)	Alternative 9 (LLT)
Shasta Lake	Percent increase in number of months within 10 TAF of the flood curve in October through June with respect to the total number of October-June months	%	-8	-8	-9	-8	-6	-6	-8	-8	-8	-6	-8	-10	-8
Lake Oroville	Percent increase in number of months within 10 TAF of the flood curve in October through June with respect to the total number of October-June months	%	-12	-9	-12	-9	-10	-10	-12	-12	-11	-10	-10	-24	-12
Folsom Lake	Percent increase in number of months within 10 TAF of the flood curve in October through June with respect to the total number of October-June months	%	-13	-15	-14	-15	-13	-10	-14	-12	-14	-13	-14	-17	-12
Sacramento River at Bend Bridge	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (100,000 cfs)	%	2	2	2	2	3	3	2	2	1	3	2	2	2
Sacramento River at Freeport	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (110,000 cfs)	%	1	0	0	0	1	1	0	0	0	0	0	1	0
San Joaquin River at Vernalis	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (52,000 cfs)	%	0	0	0	0	0	0	0	0	0	0	0	0	0
Sacramento River upstream of Walnut Grove	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (110,000 cfs)	%	1	-9	-11	-5	-7	-7	-8	-8	-3	-11	-8	-7	0
Trinity River below Lewiston Reservoir	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (6,000 cfs)	%	4	4	4	4	5	5	4	4	4	5	4	5	4
American River below Nimbus	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (152,000 cfs)	%	1	1	1	1	1	1	1	1	1	1	1	1	1
Feather River below Thermalito	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (210,000 cfs)	%	0	1	0	1	1	1	0	1	0	1	1	1	0
Fremont Weir Spills	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (343,000 cfs)	%	1	2	2	2	2	2	1	2	2	2	2	2	1

Notes:
1) "LLT" (Late Long-Term) indicates Alternatives that are simulated with 2060 climate change and sea level rise.
2) Water year types are determined by San Joaquin River Basin 60-20-20 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999) for San Joaquin River flows at Vernalis and by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999) for all other flows.
3) Channel capacities reported in Sacramento-San Joaquin Comprehensive Study (U.S. Army Corps of Engineers 2002) are used where applicable. Channel capacity of Trinity River below Lewiston Reservoir is assumed as 6,000 cfs, which is consistent with model input.

Table 6-4. Surface Water Summary Table - Differences from No Action Alternative (LLT)

Location	Parameter	Units	Alternative 1A,1B,1C (LLT)	Alternative 2A,2B,2C (LLT)	Alternative 3 (LLT)	Alternative 4 H1 (LLT)	Alternative 4 H2 (LLT)	Alternative 4 H3 (LLT)	Alternative 4 H4 (LLT)	Alternative 5 (LLT)	Alternative 6A,6B,6C (LLT)	Alternative 7 (LLT)	Alternative 8 (LLT)	Alternative 9 (LLT)
Shasta Lake	Number of months within 10 TAF of the flood curve in October through June	TAF	1	-8	3	14	16	-3	-1	-1	12	1	-14	-1
Lake Oroville	Number of months within 10 TAF of the flood curve in October through June	TAF	17	-5	18	13	13	-6	-2	2	14	15	-92	1
Folsom Lake	Number of months within 10 TAF of the flood curve in October through June	TAF	-19	-13	-16	-2	17	-7	4	-13	-2	-7	-32	1
Sacramento River at Bend Bridge	Wet Years January Flow	CFS	371	330	517	1,253	1,166	309	261	344	1,313	756	1,650	333
Sacramento River at Bend Bridge	Wet Years February Flow	CFS	-13	-79	304	512	643	30	42	20	221	-25	380	140
Sacramento River at Bend Bridge	Wet Years March Flow	CFS	136	86	139	103	99	72	69	60	100	71	124	1
Sacramento River at Bend Bridge	Average of Top 10% Monthly Flows	CFS	175	-18	287	1,194	1,194	90	100	-292	877	310	607	123
Sacramento River at Freeport	Wet Years January Flow	CFS	-516	-1,460	-487	-608	-748	-1,384	-1,897	-947	-598	-1,383	-187	-1,594
Sacramento River at Freeport	Wet Years February Flow	CFS	-985	-1,189	-1,103	-897	-1,196	-1,134	-1,467	-1,165	-1,192	-1,642	-1,417	-1,519
Sacramento River at Freeport	Wet Years March Flow	CFS	-1,931	-2,194	-1,882	-2,030	-1,951	-2,224	-2,071	-2,069	-1,936	-2,672	-2,007	-2,075
Sacramento River at Freeport	Average of Top 10% Monthly Flows	CFS	-945	-1,479	-1,010	-838	-740	-1,468	-1,390	-1,496	-891	-1,395	-748	-1,515
San Joaquin River at Vernalis	Wet Years January Flow	CFS	130	8	112	33	42	-7	79	61	86	72	104	97
San Joaquin River at Vernalis	Wet Years February Flow	CFS	5	-10	4	-13	1	-9	4	8	8	-22	-30	11
San Joaquin River at Vernalis	Wet Years March Flow	CFS	-1	-5	7	10	0	0	7	-1	4	8	8	10
San Joaquin River at Vernalis	Average of Top 10% Monthly Flows	CFS	4	-21	-4	-17	-6	-17	-9	-20	-19	-15	-24	-7
Sacramento River upstream of Walnut Grove	Wet Years January Flow	CFS	-10,864	-12,459	-5,768	-8,241	-8,396	-8,994	-9,446	-3,733	-12,111	-8,830	-7,750	-1,594
Sacramento River upstream of Walnut Grove	Wet Years February Flow	CFS	-11,214	-13,135	-7,013	-9,613	-9,814	-9,915	-10,032	-4,132	-14,427	-10,333	-10,209	-1,519
Sacramento River upstream of Walnut Grove	Wet Years March Flow	CFS	-10,783	-12,482	-7,754	-10,418	-8,941	-10,694	-9,089	-5,059	-12,974	-11,007	-10,504	-2,075
Sacramento River upstream of Walnut Grove	Average of Top 10% Monthly Flows	CFS	-11,691	-13,336	-6,658	-9,275	-9,171	-10,001	-9,856	-4,362	-13,689	-9,983	-9,363	-1,512
Trinity River below Lewiston Reservoir	Wet Years May Flow	CFS	0	0	0	0	0	0	0	0	0	0	0	0
Trinity River below Lewiston Reservoir	Average of Top 10% Monthly Flows	CFS	23	8	25	79	86	8	9	17	53	23	53	10
American River below Nimbus	Wet Years January Flow	CFS	-25	-25	-52	106	79	3	-42	34	151	96	85	97
American River below Nimbus	Wet Years February Flow	CFS	20	4	-10	61	65	5	7	2	3	1	-28	5
American River below Nimbus	Wet Years March Flow	CFS	-5	-3	-5	-10	-3	-5	-5	0	5	7	3	6
American River below Nimbus	Average of Top 10% Monthly Flows	CFS	-45	-31	-80	5	34	-38	13	-47	36	-25	-82	25
Feather River below Thermalito	Wet Years January Flow	CFS	2,503	-779	2,451	1,674	1,413	-873	265	107	2,210	1,156	3,798	142
Feather River below Thermalito	Wet Years February Flow	CFS	1,835	1,233	1,727	1,380	868	1,489	420	1,457	1,254	1,762	822	-61
Feather River below Thermalito	Wet Years March Flow	CFS	216	-302	321	82	171	-371	41	-40	219	-224	723	-247
Feather River below Thermalito	Average of Top 10% Monthly Flows	CFS	1,202	247	1,215	1,021	2,137	92	1,556	302	932	883	1,132	-126
Fremont Weir Spills	Wet Years January Flow	CFS	3,328	1,167	3,363	3,496	3,337	1,037	2,414	1,561	4,026	3,281	5,381	2,142
Fremont Weir Spills	Wet Years February Flow	CFS	2,787	2,345	3,035	2,777	2,710	2,622	1,942	2,598	2,584	3,288	2,412	1,575
Fremont Weir Spills	Wet Years March Flow	CFS	2,282	1,983	2,332	2,202	2,228	1,922	2,197	2,093	2,258	2,520	2,732	1,862
Fremont Weir Spills	Average of Top 10% Monthly Flows	CFS	3,024	1,785	3,077	3,171	3,329	1,774	2,270	1,918	3,317	3,210	3,554	1,669
Old and Middle River	October Flow	CFS	-427	3,056	-362	2,315	2,336	3,094	3,074	1,471	4,706	4,614	4,581	-1,187
Old and Middle River	November Flow	CFS	1,081	3,769	393	1,582	1,661	3,623	3,683	2,280	5,959	5,988	5,985	-1,144
Old and Middle River	December Flow	CFS	1,109	1,646	310	1,548	1,761	1,391	1,500	-145	7,703	7,223	7,174	-1,772
Old and Middle River	January Flow	CFS	3,216	3,188	1,422	2,061	2,030	2,131	2,084	594	6,037	5,060	5,027	-166
Old and Middle River	February Flow	CFS	4,013	3,673	1,905	2,534	2,668	2,394	2,554	613	6,259	4,850	4,797	-221
Old and Middle River	March Flow	CFS	4,331	3,616	2,352	2,933	3,844	2,820	3,643	613	5,811	4,590	4,544	-257
Old and Middle River	April Flow	CFS	-280	-123	-1,773	-453	137	-478	126	-111	1,975	1,995	2,002	-3,757
Old and Middle River	May Flow	CFS	90	224	-1,089	-22	294	-8	311	113	2,093	2,090	2,107	-3,123
Old and Middle River	June Flow	CFS	1,898	1,782	1,135	1,577	2,370	1,522	2,321	121	3,736	3,648	3,647	138
Old and Middle River	July Flow	CFS	3,775	2,862	3,393	2,093	3,021	2,100	3,202	965	8,252	73	5,384	-741
Old and Middle River	August Flow	CFS	4,343	3,873	4,188	3,533	3,236	3,383	3,192	2,564	8,603	1,743	3,720	-273
Old and Middle River	September Flow	CFS	2,654	5,095	2,457	2,757	2,636	5,049	4,938	4,108	7,262	4,555	5,123	-894

Surface Water Summary Table - Percent Differences from No Action Alternative (LLT)

Location	Parameter	Units	Alternative 1A,1B,1C (LLT)	Alternative 2A,2B,2C (LLT)	Alternative 3 (LLT)	Alternative 4 H1 (LLT)	Alternative 4 H2 (LLT)	Alternative 4 H3 (LLT)	Alternative 4 H4 (LLT)	Alternative 5 (LLT)	Alternative 6A,6B,6C (LLT)	Alternative 7 (LLT)	Alternative 8 (LLT)	Alternative 9 (LLT)
Shasta Lake	Percent increase in number of months within 10 TAF of the flood curve in October through June with respect to the total number of October-June months	%	0	-1	0	2	2	0	0	0	2	0	-2	0
Lake Oroville	Percent increase in number of months within 10 TAF of the flood curve in October through June with respect to the total number of October-June months	%	2	-1	2	2	2	-1	0	0	2	2	-12	0
Folsom Lake	Percent increase in number of months within 10 TAF of the flood curve in October through June with respect to the total number of October-June months	%	-3	-2	-2	0	2	-1	1	-2	0	-1	-4	0
Sacramento River at Bend Bridge	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (100,000 cfs)		0	0	0	1	1	0	0	0	1	0	1	0
Sacramento River at Freeport	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (110,000 cfs)	%	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1
San Joaquin River at Vernalis	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (52,000 cfs)	%	0	0	0	0	0	0	0	0	0	0	0	0
Sacramento River upstream of Walnut Grove	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (110,000 cfs)	%	-11	-12	-6	-8	-8	-9	-9	-4	-12	-9	-9	-1
Trinity River below Lewiston Reservoir	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (6,000 cfs)	%	0	0	0	1	1	0	0	0	1	0	1	0
American River below Nimbus	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (152,000 cfs)	%	0	0	0	0	0	0	0	0	0	0	0	0
Feather River below Thermalito	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (210,000 cfs)	%	1	0	1	0	1	0	1	0	0	0	1	0
Fremont Weir Spills	Percent Increase in Average of Top 10% Monthly Flows with respect to the Channel Capacity (343,000 cfs)	%	1	1	1	1	1	1	1	1	1	1	1	0

Notes:

1) "LLT" (Late Long-Term) indicates Alternatives that are simulated with 2060 climate change and sea level rise.

2) Water year types are determined by San Joaquin River Basin 60-20-20 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999) for San Joaquin River flows at Vernalis and by the Sacramento Valley 40-30-30 Index Water Year Hydrologic Classification (SWRCB D-1641, 1999) for all other flows.

3) Channel capacities reported in Sacramento-San Joaquin Comprehensive Study (U.S. Army Corps of Engineers 2002) are used where applicable. Channel capacity of Trinity River below Lewiston Reservoir is assumed as 6,000 cfs, which is consistent with model input.

Table 6-5. Surface Water Summary Table - Number of years where storage is within 10 TAF of the flood curve

Location	Parameter	Units	Existing Condition	No Action Alternative (LLT)	Alternative 1A,1B,1C (LLT)	Alternative 2A,2B,2C (LLT)	Alternative 3 (LLT)	Alternative 4 H1 (LLT)	Alternative 4 H2 (LLT)	Alternative 4 H3 (LLT)	Alternative 4 H4 (LLT)	Alternative 5 (LLT)	Alternative 6A,6B,6C (LLT)	Alternative 7 (LLT)	Alternative 8 (LLT)	Alternative 9 (LLT)
Shasta Lake	October	TAF	19	3	6	2	6	4	5	2	2	2	3	2	3	2
Shasta Lake	November	TAF	20	5	10	3	9	9	9	4	4	5	8	6	5	5
Shasta Lake	December	TAF	24	16	18	18	18	23	23	18	17	18	23	18	21	16
Shasta Lake	January	TAF	32	29	31	31	31	32	33	29	31	30	31	30	29	30
Shasta Lake	February	TAF	35	33	33	33	34	35	34	33	33	32	34	33	32	32
Shasta Lake	March	TAF	32	31	29	30	30	33	31	32	31	31	32	32	27	31
Shasta Lake	April	TAF	20	15	16	16	16	16	16	16	16	16	16	16	14	16
Shasta Lake	May	TAF	28	22	16	17	17	19	20	20	20	21	19	20	12	21
Shasta Lake	June	TAF	8	5	1	1	1	2	4	2	4	3	5	3	2	5
Lake Oroville	October	TAF	10	0	2	0	2	2	2	0	0	0	0	0	0	0
Lake Oroville	November	TAF	9	2	3	1	3	2	2	1	2	1	2	3	1	2
Lake Oroville	December	TAF	16	8	12	7	12	11	10	7	9	8	10	10	9	9
Lake Oroville	January	TAF	33	17	25	19	25	22	24	19	21	21	23	22	16	18
Lake Oroville	February	TAF	40	30	35	30	36	35	37	29	34	30	36	32	19	30
Lake Oroville	March	TAF	46	40	45	41	45	43	46	41	41	41	44	47	14	40
Lake Oroville	April	TAF	27	26	25	26	25	26	23	26	21	26	26	27	3	26
Lake Oroville	May	TAF	32	22	18	19	18	19	17	19	18	22	19	20	0	21
Lake Oroville	June	TAF	27	9	6	6	6	7	6	6	6	7	8	8	0	9
Folsom Lake	October	TAF	3	2	2	1	2	1	2	1	1	1	1	0	1	2
Folsom Lake	November	TAF	38	7	12	6	13	10	11	6	7	6	8	7	14	8
Folsom Lake	December	TAF	33	20	23	22	23	23	24	22	21	21	24	21	24	21
Folsom Lake	January	TAF	47	40	41	39	38	42	40	41	40	38	39	40	38	40
Folsom Lake	February	TAF	49	50	49	51	50	52	55	52	52	49	51	51	52	51
Folsom Lake	March	TAF	46	49	47	49	48	48	52	48	51	49	49	50	47	51
Folsom Lake	April	TAF	53	50	44	48	45	48	50	49	49	49	49	50	30	49
Folsom Lake	May	TAF	48	34	24	28	25	30	34	30	34	31	32	31	20	31
Folsom Lake	June	TAF	44	16	7	11	8	12	17	12	17	11	13	11	10	16

Notes: "LLT" (Late Long-Term) indicates Alternatives that are simulated with 2060 climate change and sea level rise.

Table 6-6. Surface Water Summary Table - Number of years where storage is within 10 TAF of the flood curve _ Differences from Existing Conditions

Location	Parameter	Units	No Action Alternative (LLT)	Alternative 1A,1B,1C (LLT)	Alternative 2A,2B,2C (LLT)	Alternative 3 (LLT)	Alternative 4 H1 (LLT)	Alternative 4 H2 (LLT)	Alternative 4 H3 (LLT)	Alternative 4 H4 (LLT)	Alternative 5 (LLT)	Alternative 6A,6B,6C (LLT)	Alternative 7 (LLT)	Alternative 8 (LLT)	Alternative 9 (LLT)
Shasta Lake	October	TAF	-16	-13	-17	-13	-15	-14	-17	-17	-17	-16	-17	-16	-17
Shasta Lake	November	TAF	-15	-10	-17	-11	-11	-11	-16	-16	-15	-12	-14	-15	-15
Shasta Lake	December	TAF	-8	-6	-6	-6	-1	-1	-6	-7	-6	-1	-6	-3	-8
Shasta Lake	January	TAF	-3	-1	-1	-1	0	1	-3	-1	-2	-1	-2	-3	-2
Shasta Lake	February	TAF	-2	-2	-2	-1	0	-1	-2	-2	-3	-1	-2	-3	-3
Shasta Lake	March	TAF	-1	-3	-2	-2	1	-1	0	-1	-1	0	0	-5	-1
Shasta Lake	April	TAF	-5	-4	-4	-4	-4	-4	-4	-4	-4	-4	-4	-6	-4
Shasta Lake	May	TAF	-6	-12	-11	-11	-9	-8	-8	-8	-7	-9	-8	-16	-7
Shasta Lake	June	TAF	-3	-7	-7	-7	-6	-4	-6	-4	-5	-3	-5	-6	-3
Lake Oroville	October	TAF	-10	-8	-10	-8	-8	-8	-10	-10	-10	-10	-10	-10	-10
Lake Oroville	November	TAF	-7	-6	-8	-6	-7	-7	-8	-7	-8	-7	-6	-8	-7
Lake Oroville	December	TAF	-8	-4	-9	-4	-5	-6	-9	-7	-8	-6	-6	-7	-7
Lake Oroville	January	TAF	-16	-8	-14	-8	-11	-9	-14	-12	-12	-10	-11	-17	-15
Lake Oroville	February	TAF	-10	-5	-10	-4	-5	-3	-11	-6	-10	-4	-8	-21	-10
Lake Oroville	March	TAF	-6	-1	-5	-1	-3	0	-5	-5	-5	-2	1	-32	-6
Lake Oroville	April	TAF	-1	-2	-1	-2	-1	-4	-1	-6	-1	-1	0	-24	-1
Lake Oroville	May	TAF	-10	-14	-13	-14	-13	-15	-13	-14	-10	-13	-12	-32	-11
Lake Oroville	June	TAF	-18	-21	-21	-21	-20	-21	-21	-21	-20	-19	-19	-27	-18
Folsom Lake	October	TAF	-1	-1	-2	-1	-2	-1	-2	-2	-2	-2	-3	-2	-1
Folsom Lake	November	TAF	-31	-26	-32	-25	-28	-27	-32	-31	-32	-30	-31	-24	-30
Folsom Lake	December	TAF	-13	-10	-11	-10	-10	-9	-11	-12	-12	-9	-12	-9	-12
Folsom Lake	January	TAF	-7	-6	-8	-9	-5	-7	-6	-7	-9	-8	-7	-9	-7
Folsom Lake	February	TAF	1	0	2	1	3	6	3	3	0	2	2	3	2
Folsom Lake	March	TAF	3	1	3	2	2	6	2	5	3	3	4	1	5
Folsom Lake	April	TAF	-3	-9	-5	-8	-5	-3	-4	-4	-4	-4	-3	-23	-4
Folsom Lake	May	TAF	-14	-24	-20	-23	-18	-14	-18	-14	-17	-16	-17	-28	-17
Folsom Lake	June	TAF	-28	-37	-33	-36	-32	-27	-32	-27	-33	-31	-33	-34	-28

Note: "LLT" (Late Long-Term) indicates Alternatives that are simulated with 2060 climate change and sea level rise

Table 6-7. Surface Water Summary Table - Number of years where storage is within 10 TAF of the flood curve - Differences from No Action Alternative (LLT)

Location	Parameter	Units	Alternative 1A,1B,1C (LLT)	Alternative 2A,2B,2C (LLT)	Alternative 3 (LLT)	Alternative 4 H1 (LLT)	Alternative 4 H2 (LLT)	Alternative 4 H3 (LLT)	Alternative 4 H4 (LLT)	Alternative 5 (LLT)	Alternative 6A,6B,6C (LLT)	Alternative 7 (LLT)	Alternative 8 (LLT)	Alternative 9 (LLT)
Shasta Lake	October	TAF	3	-1	3	1	2	-1	-1	-1	0	-1	0	-1
Shasta Lake	November	TAF	5	-2	4	4	4	-1	-1	0	3	1	0	0
Shasta Lake	December	TAF	2	2	2	7	7	2	1	2	7	2	5	0
Shasta Lake	January	TAF	2	2	2	3	4	0	2	1	2	1	0	1
Shasta Lake	February	TAF	0	0	1	2	1	0	0	-1	1	0	-1	-1
Shasta Lake	March	TAF	-2	-1	-1	2	0	1	0	0	1	1	-4	0
Shasta Lake	April	TAF	1	1	1	1	1	1	1	1	1	1	-1	1
Shasta Lake	May	TAF	-6	-5	-5	-3	-2	-2	-2	-1	-3	-2	-10	-1
Shasta Lake	June	TAF	-4	-4	-4	-3	-1	-3	-1	-2	0	-2	-3	0
Lake Oroville	October	TAF	2	0	2	2	2	0	0	0	0	0	0	0
Lake Oroville	November	TAF	1	-1	1	0	0	-1	0	-1	0	1	-1	0
Lake Oroville	December	TAF	4	-1	4	3	2	-1	1	0	2	2	1	1
Lake Oroville	January	TAF	8	2	8	5	7	2	4	4	6	5	-1	1
Lake Oroville	February	TAF	5	0	6	5	7	-1	4	0	6	2	-11	0
Lake Oroville	March	TAF	5	1	5	3	6	1	1	1	4	7	-26	0
Lake Oroville	April	TAF	-1	0	-1	0	-3	0	-5	0	0	1	-23	0
Lake Oroville	May	TAF	-4	-3	-4	-3	-5	-3	-4	0	-3	-2	-22	-1
Lake Oroville	June	TAF	-3	-3	-3	-2	-3	-3	-3	-2	-1	-1	-9	0
Folsom Lake	October	TAF	0	-1	0	-1	0	-1	-1	-1	-1	-2	-1	0
Folsom Lake	November	TAF	5	-1	6	3	4	-1	0	-1	1	0	7	1
Folsom Lake	December	TAF	3	2	3	3	4	2	1	1	4	1	4	1
Folsom Lake	January	TAF	1	-1	-2	2	0	1	0	-2	-1	0	-2	0
Folsom Lake	February	TAF	-1	1	0	2	5	2	2	-1	1	1	2	1
Folsom Lake	March	TAF	-2	0	-1	-1	3	-1	2	0	0	1	-2	2
Folsom Lake	April	TAF	-6	-2	-5	-2	0	-1	-1	-1	-1	0	-20	-1
Folsom Lake	May	TAF	-10	-6	-9	-4	0	-4	0	-3	-2	-3	-14	-3

Note: "LLT" (Late Long-Term) indicates Alternatives that are simulated with 2060 climate change and sea level rise.