Appendix H Water Supply Technical Appendix

This appendix documents the water supply technical analysis to support impact analysis in the environmental impact statement (EIS).

H.1 Background Information

This section describes surface water resources and water supplies that could be potentially affected by implementation of alternatives considered in this EIS, including:

- **Surface Water Hydrology:** Changes in surface water hydrology may occur in Trinity, Sacramento, Clear Creek, Feather, American, Stanislaus, and San Joaquin Rivers, the San Francisco Bay and Sacramento and San Joaquin River Delta (Bay-Delta), and the Central Valley Project (CVP) and State Water Project (SWP) Service Area (south to Diamond Valley) due to changes in CVP and SWP operations. Full descriptions of CVP and SWP facilities and their operation are described in Appendix C, *Facility Descriptions and Operations,* and are not repeated in this section.
- **Overview of CVP and SWP Water Users:** Water users that may be affected by changes in CVP and SWP operations are located in Trinity, Sacramento, Clear Creek, Feather, American, Stanislaus, and San Joaquin Rivers, Bay-Delta, and CVP and SWP Service Area (south to Diamond Valley) regions.

H.1.1 Overview of California Water Supply and Water Management Facilities

H.1.1.1 *Sources of Water in California*

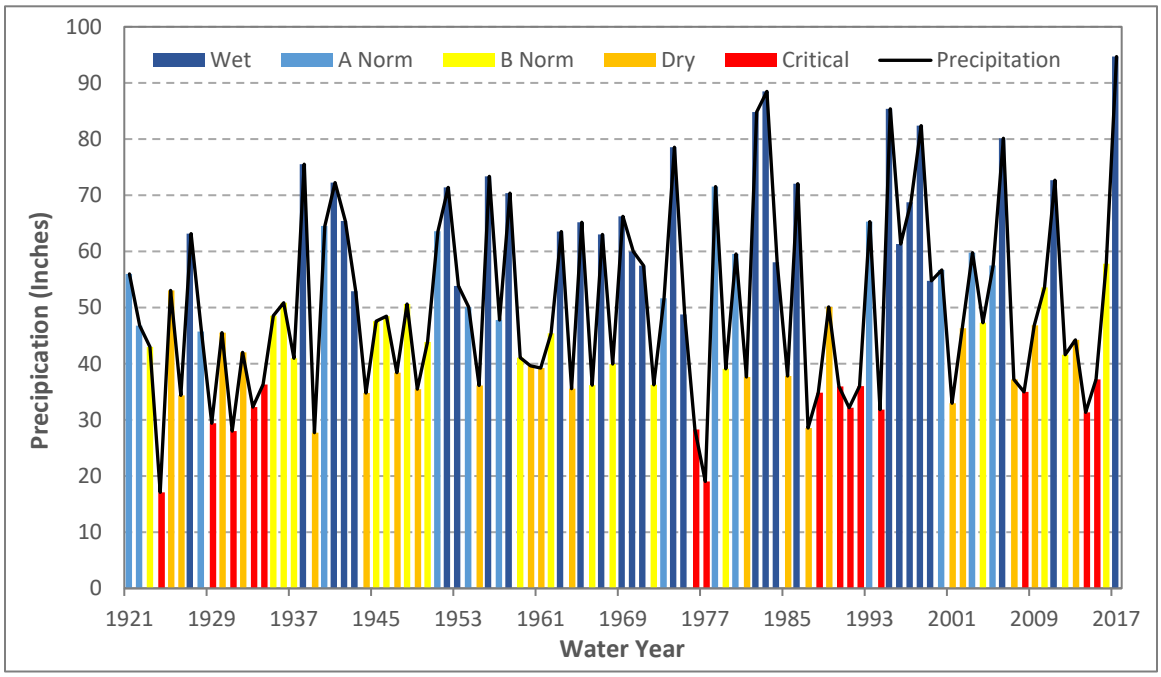
Variability and uncertainty are dominant characteristics of California's water resources. Precipitation is the primary source of California's water supply (California Department of Water Resources [DWR] 2018). It varies greatly from year to year, as well as by season and location within the state. Unpredictability and geographic variation in precipitation that California receives make it challenging to manage available runoff to meet urban, agricultural, and environmental water needs. With climate change, precipitation patterns are expected to become even more unpredictable, as described in Appendix F, *Modeling*.

In an average water year, California receives approximately 200 million acre-feet (MAF) of water from precipitation and imports from Colorado, Oregon, and Mexico (DWR 2013). The total volume of water the state receives from precipitation can vary dramatically between dry and wet years. California may receive less than 100 MAF of water during a dry year and more than 300 MAF in a wet year (Western Regional Climate Center 2011).

The majority of California's precipitation occurs between November and April, while most of the state's demand for water is in the summer months (Western Regional Climate Center 2011). In addition, most precipitation falls in the northern portion of the state and much of the demand comes from central and southern portions of the state where major agricultural and population centers are located. In some years,

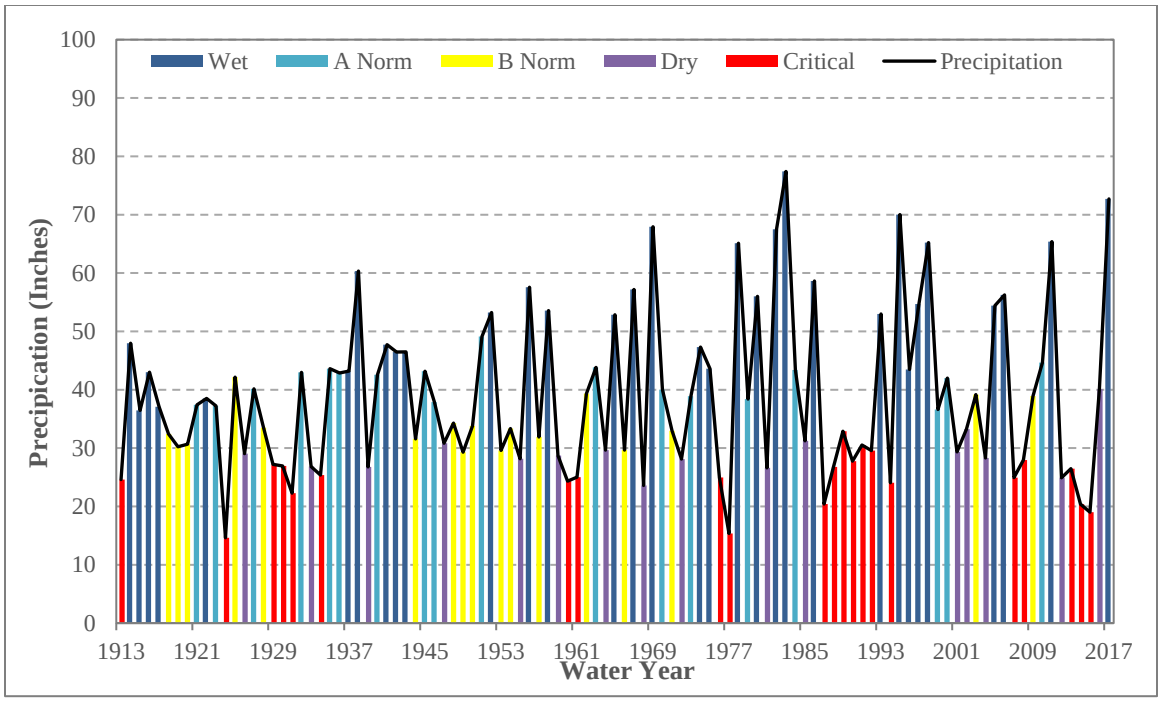
northern regions of the state can receive 100 inches or more of precipitation, while southern regions receive only a few inches.

Over time, annual precipitation trends have been changing and continue to change, as shown on Figure H.1-1, Sacramento River Hydrologic Region Precipitation Trends and Figure H.1-2, San Joaquin River Hydrologic Region Precipitation Trends. From 1906 to 1960, the California Department of Water Resources (DWR) classified 33% of water years in California as “dry” or “critically dry”; that percentage increased to 46% from 1961 to 2017 (DWR 2018). From 1906 to 1960, DWR classified 45% of water years in California as “above normal” or “wet” and that percentage increased to 48% from 1961 to 2017. Additionally, the 1906 to 1960 period had 42% of water years classified as extreme (“critically dry” or “wet”) and that percentage increased to 59% after 1960.



Source: DWR 2019.

Figure H.1-1. Sacramento River Hydrologic Region Precipitation Trends



Source: DWR 2019.

Figure H.1-2. San Joaquin River Hydrologic Region Precipitation Trends

Although there were more extreme water year classifications in the later period, overall precipitation averages in pre-1960 years and post 1960 years have little differences. Despite having similar precipitation averages, year to year variation and patterns of extreme condition occurrences are substantially different between time periods. Year to year statewide precipitation variation is larger and more frequent since 1961 when compared to the 1906 to 1960 period. Also, occurrence of a year to year change of more than 10 inches of precipitation is three times higher post 1960 as compared to pre 1960. There are also more occurrences of sequential "critically dry" years and sequential "wet" years after 1960.

Approximately 50% of precipitation that California receives evaporates, is used consumptively by native vegetation and crops (not including irrigation water supplies) and by managed wetlands, flows into streams within Oregon or Nevada and into saline water bodies (such as Salton Sea), or percolates into saline groundwater aquifers (DWR 2013). Therefore, less than 50% of water that enters California, or less than 100 MAF per year, is available for use by urban, agricultural, and other environmental uses, collectively.

H.1.1.2 *Development of Major California Water Management Facilities*

Due to hydrologic variability that ranges from dry summers and fall months to floods in winter and spring, water from precipitation in winter and spring must be stored for use in summer and fall. During an average hydrological year, approximately 15 MAF of water is stored in the Sierra Nevada snowpack (DWR 2013). However, not all snowpack becomes available in a timely manner for uses throughout the state. Therefore, federal, state, and local agencies and private entities have constructed reservoirs, aqueducts, pipelines, and water diversion facilities to capture and use rainfall and subsequent snowmelt.

H.1.1.2.1 Water Facilities Development through Early 1900s

Spanish settlements were initially established in late 1700s in southern California, including conveyance systems to bring water to the pueblos. The first water storage and diversion project in California was constructed in 1772, including a 12-foot high dam on San Diego River and 6 miles of canals to deliver water to San Diego Mission (U.S. Department of the Interior, Bureau of Reclamation [Reclamation] 1999). Over the next 80 years, other irrigation systems were constructed to provide water for communities and irrigated lands. The first major levee was constructed in Delta in 1840 along Grand Island to protect agricultural lands from floods.

After California became a state in 1850, the state legislature adopted English Common Law, which included the doctrine of riparian rights to provide water supplies to lands adjacent to rivers and streams (Reclamation 1999). The California legislature at this time also recognized "pueblo water rights" granted under both Spanish and Mexican governments, including water rights on Los Angeles and San Diego rivers. Water rights also were influenced by the practice of miners of "posting notice" at their points of diversion to substantiate water rights as an "appropriative right" for areas not adjacent to rivers and streams. This set of appropriative rights was catalogued with respect to "first in time, first in right." Appropriative water rights were given statutory recognition in 1872.

Between the 1850s and early 1900s, miners, agricultural water users, and communities constructed numerous dams and canals (Reclamation 1999). In the 1870s, the first wells were constructed with wood-burning engines. By the late 1890s, natural gas engines and electricity became available to power pumps. Between 1906 and 1910, over 4,000 natural gas or electric groundwater pumps were installed in San Joaquin Valley. Substantial use of groundwater caused extensive groundwater aquifer depletions and land subsidence in some areas of Central Valley. Availability of electricity to communities also resulted in more hydroelectric generation facilities and associated dams being constructed throughout the Sierra Nevada.

H.1.1.2.2 Conceptual Development of Central Valley Project and State Water Project

The need for coordinated water development was evaluated in the 1870s when Congress authorized the Alexander Commission to evaluate water supply concepts in Sacramento and San Joaquin Rivers watersheds, including reservoirs and large-scale irrigation water supply projects (Reclamation 1999).

1919 Marshall Plan

In 1919, Colonel Robert Marshall, chief geographer for the U.S. Geological Survey, proposed a major water storage and conveyance plan to irrigate lands in the Central Valley and San Francisco Bay Area and provide water to communities in San Francisco Bay Area and southern California (Marshall 1919). The Marshall Plan recommended two major dams on San Joaquin River near Friant and Stanislaus Rivers between the present locations of Tulloch and Goodwin dams to serve eastern San Joaquin Valley and reduce groundwater overdraft in Tulare and Kern Counties. The plan identified four dams on Kern River to serve the Los Angeles area; and dams on Sacramento River near Red Bluff. On the Klamath River the plan identified a new dam downstream of Klamath Falls. The plan also identified dams along Sacramento River tributaries to provide stored water into two canals along the western and eastern sides of Central Valley to provide exchange water to San Joaquin River water rights holders affected by San Joaquin River dam, water to other San Joaquin Valley users, and water to communities in Contra Costa, Alameda, Santa Clara, and San Francisco Counties.

1930s State Water Plan

During the 1920s, California State Legislature commissioned a series of investigations to further evaluate the Marshall Plan (Reclamation 1999). The 1930 Division of Water Resources Bulletin No. 25 outlined a statewide water plan, including the concept that became CVP and SWP. The plan included 37 water supply and flood management reservoirs, including a dam on San Joaquin River near Friant, and canals to distribute water along eastern San Joaquin Valley to reduce groundwater overdraft in Tulare and Kern Counties; 14 dams along Trinity River, Sacramento River, and Sacramento River tributaries to provide water to San Joaquin River water rights contractors affected by the dam on San Joaquin River and water users on the west side of San Joaquin Valley and in Contra Costa County; and eight dams on San Joaquin Valley rivers to provide water to San Joaquin Valley. These dams included recommended facilities near present CVP, Trinity, Shasta, Folsom, New Melones, and Friant Dams and present SWP Oroville Dam. Recommendations also included a Delta Cross Channel canal to improve south Delta water quality; a canal from a south Delta pumping plant to a regulating reservoir and pumping plant near Mendota; canals from Mendota to San Joaquin Valley; a canal from Delta into Contra Costa County; and expansion of San Joaquin River and associated channels with five operable barriers along San Joaquin River.

The study also addressed use of aquifer storage, improved navigation along Sacramento and San Joaquin Rivers, flood management, saltwater barrier along the western Delta, recycled wastewater and stormwater in Southern California, and importation of Colorado River water to Southern California.

In 1933, the state authorized the Central Valley Project Act. However, during the 1930s depression, the state could not raise funds. The state appealed to the federal government for assistance. The state legislature approved the overall SWP in 1941.

As described above, six of 37 dams in SWP were included in CVP and SWP facilities (Reclamation 1999). However, U.S. Army Corps of Engineers (USACE), local or regional water supply and/or flood management agencies, and hydropower entities constructed most of the recommended dams on Yuba, Bear, Feather, American, Mokelumne, Calaveras, Chowchilla, Fresno, Merced, Tuolumne, Stanislaus, Kings, Kaweah, Tule, and Kern Rivers. USACE initially developed dams on Fresno and Chowchilla Rivers; however, Hidden and Buchanan Dams, respectively, were integrated into CVP to supply water to portions of the eastern side of San Joaquin Valley (Reclamation 1999).

H.1.1.2.3 Overview of Central Valley Project

With passage of Rivers and Harbors Act of 1935, Congress appropriated funds and authorized construction of CVP by USACE (Reclamation 1999). When the Rivers and Harbors Act was reauthorized in 1937, construction and operation of CVP was assigned to Reclamation, and CVP became subject to Reclamation Law (as defined in the Reclamation Act of 1902 and subsequent legislation). A full description of CVP facilities that were ultimately developed their operation today is presented in Appendix C.

H.1.1.2.4 Overview of State Water Project

As CVP facilities were being constructed after World War II, the state began investigations to meet additional water needs through development of the California Water Plan. In 1957, DWR published Bulletin Number 3 that identified new facilities to provide flood control in northern California and water supplies to San Francisco Bay Area, San Joaquin Valley, San Luis Obispo and Santa Barbara Counties in the Central Coast Region, and southern California (DWR 1957, 2013; Reclamation 2012). The study identified a seasonal deficiency of 2.675 MAF/year in 1950 that resulted in groundwater overdraft throughout many portions of California. The report described facilities to meet water demands and reduce

groundwater overdraft, including facilities that would become part of SWP. In 1960, California voters authorized the Burns-Porter Act to construct initial SWP facilities. A full description of SWP facilities that were ultimately developed their operation today is presented in Appendix C.

H.1.1.2.5 Other Major Water Supply and Flood Management Reservoirs

During the past 100 years, numerous water supply, flood management, and hydroelectric generation reservoirs were constructed throughout California. Many of these projects were constructed on tributaries to Sacramento and San Joaquin Rivers and tributaries to Tulare Lake Basin. Operations of these non-CVP and non-SWP reservoirs affect flow patterns into Sacramento and San Joaquin Rivers and Delta. However, implementation of alternatives evaluated in this EIS would not result in changes in operations in most of these reservoirs, except on lower Stanislaus River.

Major non-CVP and non-SWP reservoirs in Sacramento Valley and San Joaquin Valley watersheds, generally with storage capacities greater than 100,000 acre-feet, which could affect operations of CVP or SWP reservoirs or Delta facilities or could be affected by implementation of alternatives evaluated in this EIS, are detailed in Appendix C.

H.1.2 CVP and SWP Water Users

This section provides an overview of CVP and SWP water users potentially affected by changes in surface water hydrology with implementation of the alternatives. Appendix C describes in detail hydrologic conditions in Trinity, Sacramento, Clear Creek, Feather, American, Stanislaus, and San Joaquin Rivers, Bay-Delta, and CVP and SWP Service Area (south to Diamond Valley) that could be changed by implementation of the alternatives. Figure H.1-3 displays CVP and SWP water users, rivers and reservoirs whose hydrologic conditions could change, and DWR hydrologic regions by which effects to CVP and SWP water users are organized.

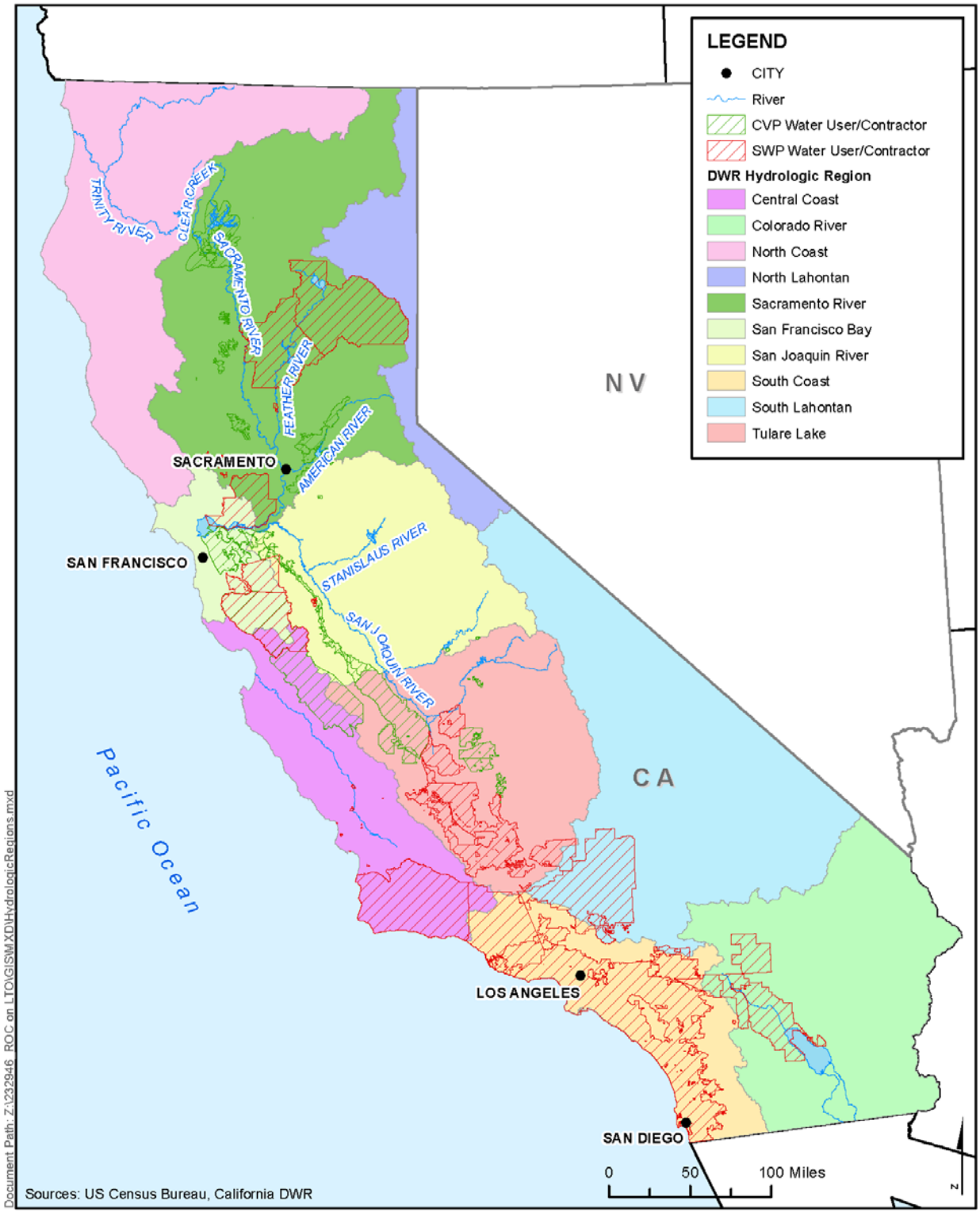


Figure H.1-3. CVP and SWP Water Users and DWR Hydrologic Regions

CVP serves a total of 271 water contracts, of which 88 are water service contracts with Reclamation for delivery of CVP water (Table H.1-1 lists agencies with CVP contracts). CVP water allocations for agricultural, environmental/refuges, and municipal and industrial (M&I) users vary based on factors such as hydrology, runoff forecast, prior water right commitments, reservoir storage, required water quality releases, required environmental releases, and operational limitations. Each year Reclamation determines the amount of water that can be allocated to each CVP water service contractor based on conditions for that year. In most cases, these allocations are expressed as a percentage of CVP water service contractors' contract total (for contracts that allow use of both agricultural and M&I water) or historical use (for M&I only contracts). North of Delta, there are 42 water service contractors across three CVP divisions that deliver water to agricultural water service contractors, M&I water users, or both agricultural and M&I water users. In Delta and south of Delta there are 31 water service contractors across three CVP Divisions and one unit that deliver water to agricultural water users, M&I water users, or both agricultural and M&I water users.

Table H.1-1. CVP Water Contractors

Contractor	M&I	AG	CVP Division	Hydrologic Region
Water Service Contracts North of Delta				
4-E Water District		X	Sacramento River Div	Sacramento River
Stony Creek Water District	X	X	Sacramento River Div	Sacramento River
U.S. Forest Service (Salt Creek)	X		Sacramento River Div	Sacramento River
Whitney Construction, Inc.	X		Sacramento River Div	Sacramento River
U.S. Forest Service	X		Sacramento River Div	Sacramento River
Colusa, County of (Stonyford)	X	X	Sacramento River Div	Sacramento River
Colusa Drain Mutual Water Company		X	Sacramento River Div	Sacramento River
Corning Water District	X	X	Sacramento River Div	Sacramento River
Proberta Water District	X	X	Sacramento River Div	Sacramento River
Thomes Creek Water District	X	X	Sacramento River Div	Sacramento River
Colusa County Water District	X	X	Sacramento River Div	Sacramento River
County of Colusa	X	X	Sacramento River Div	Sacramento River
4-M Water District	X	X	Sacramento River Div	Sacramento River
Colusa County Water District	X	X	Sacramento River Div	Sacramento River
Cortina Water District	X	X	Sacramento River Div	Sacramento River
Glenn Valley Water District	X	X	Sacramento River Div	Sacramento River
Holthouse Water District	X	X	Sacramento River Div	Sacramento River
La Grande Water District	X	X	Sacramento River Div	Sacramento River
Myers-Marsh Mutual Water Company	X	X	Sacramento River Div	Sacramento River
Davis Water District	X	X	Sacramento River Div	Sacramento River
Dunnigan Wd	X	X	Sacramento River Div	Sacramento River
Glide Water District	X	X	Sacramento River Div	Sacramento River
Kanawha Water District	X	X	Sacramento River Div	Sacramento River
Kirkwood Water District	X	X	Sacramento River Div	Sacramento River
La Grande Water District	X	X	Sacramento River Div	Sacramento River
Orland-Artois Water District	X	X	Sacramento River Div	Sacramento River
Westside Water District	X	X	Sacramento River Div	Sacramento River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Feather Water District	X	X	Sacramento River Div	Sacramento River
Centerville Community Services District	X		Sacramento River Div	Sacramento River
Mountain Gate Community Services District	X		Sacramento River Div	Sacramento River
City of Redding	X		Sacramento River Div	Sacramento River
Shasta County Water Agency	X		Sacramento River Div	Sacramento River
City of Shasta Lake	X		Sacramento River Div	Sacramento River
Bella Vista Water District	X	X	Trinity River Div	Sacramento River
Clear Creek Community Services District	X	X	Trinity River Div	Sacramento River
Shasta Community Services District	X		Trinity River Div	Sacramento River
American River M&I Contracts				
El Dorado Irrigation District	X		American River Div	Sacramento River
City of Roseville	X		American River Div	Sacramento River
City of Folsom	X		American River Div	Sacramento River
Sacramento County Water Agency	X		American River Div	Sacramento River
San Juan Water District	X		American River Div	Sacramento River
East Bay Municipal Utility District	X		American River Div	Sacramento River
Sacramento Municipal Utility District	X		American River Div	Sacramento River
Sacramento County (assignment from Sacramento Municipal Utilities District)	X		American River Div	Sacramento River
Placer County Water Agency	X	X	American River Div	Sacramento River
North of Delta - Sacramento River Settlement Contracts				
Alexander, Thomas & Karen		X	Sacramento River Div	Sacramento River
Anderson, Arthur L., et al.		X	Sacramento River Div	Sacramento River
Anderson, R. & J., Properties, L.P.		X	Sacramento River Div	Sacramento River
Anderson, R. & J., Properties, L.P.		X	Sacramento River Div	Sacramento River
Anderson-Cottonwood Irrigation District	X	X	Sacramento River Div	Sacramento River
Andreotti, Beverly F., et al.		X	Sacramento River Div	Sacramento River
Baber, Jack W., et al.		X	Sacramento River Div	Sacramento River
Cranmore Farms (Assigned to Pelger Road 1700)		X	Sacramento River Div	Sacramento River
Beckley, Ralph & Ophelia (Assigned to Mary Kristine Charter)		X	Sacramento River Div	Sacramento River
Butler, Dianne E., Revocable Intervivos Trust		X	Sacramento River Div	Sacramento River
Butte Creek Farms, Inc.		X	Sacramento River Div	Sacramento River
Butte Creek Farms, Inc.		X	Sacramento River Div	Sacramento River
Butte Creek Farms, Inc.		X	Sacramento River Div	Sacramento River
Butte Creek Farms, Inc.		X	Sacramento River Div	Sacramento River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Byrd, Anna C. & Osborne, Jane		X	Sacramento River Div	Sacramento River
Byrd, Anna C. & Osborne, Jane		X	Sacramento River Div	Sacramento River
Cachil Dehe Band of Wintun Indians		X	Sacramento River Div	Sacramento River
Carter Mutual Water Company		X	Sacramento River Div	Sacramento River
Chesney, Adona, Trustee		X	Sacramento River Div	Sacramento River
Churkin, Michael, Jr., et al.		X	Sacramento River Div	Sacramento River
Conaway Preservation Group, LLC (10,000 AF assigned to Woodland-Davis)		X	Sacramento River Div	Sacramento River
Cummings, William C.		X	Sacramento River Div	Sacramento River
Daniell, Harry W.		X	Sacramento River Div	Sacramento River
Davis, Ina M.		X	Sacramento River Div	Sacramento River
Driscoll Strawberry Associates, Inc.		X	Sacramento River Div	Sacramento River
Driver, Gary, et al.		X	Sacramento River Div	Sacramento River
Driver, Gregory E.		X	Sacramento River Div	Sacramento River
Driver, John A. & Clare M., Trustees		X	Sacramento River Div	Sacramento River
Driver, John A. & Clare M., Trustees		X	Sacramento River Div	Sacramento River
Driver, William A., et al.		X	Sacramento River Div	Sacramento River
Dyer, Jeffrey E. & Wing-Dyer, Jan		X	Sacramento River Div	Sacramento River
E.L.H. Sutter Properties		X	Sacramento River Div	Sacramento River
Eastside Mutual Water Company		X	Sacramento River Div	Sacramento River
Eggleston, Ronald H., et ux.		X	Sacramento River Div	Sacramento River
Ehrke, Allen A. & Bonnie E.		X	Sacramento River Div	Sacramento River
Exchange Bank (Nature Conservancy)		X	Sacramento River Div	Sacramento River
Fedora, Sibley G. & Margaret L., Trustees		X	Sacramento River Div	Sacramento River
Forry, Laurie & Adams, Lois		X	Sacramento River Div	Sacramento River
Furlan, Emile & Simone, Family Trust		X	Sacramento River Div	Sacramento River
Gillaspy, William F., Trustee		X	Sacramento River Div	Sacramento River
Giovannetti, B. E.		X	Sacramento River Div	Sacramento River
Giusti, Richard J. & Sandra A., Trustees		X	Sacramento River Div	Sacramento River
Gjermann, Hal		X	Sacramento River Div	Sacramento River
Glenn-Colusa Irrigation District		X	Sacramento River Div	Sacramento River
Gomes, Judith A., Trustee		X	Sacramento River Div	Sacramento River
Green Valley Corporation		X	Sacramento River Div	Sacramento River
Green Valley Corporation		X	Sacramento River Div	Sacramento River
Griffin, Joseph & Prater, Sharon		X	Sacramento River Div	Sacramento River
Hale, Judith. A. & Marks, Alice K.		X	Sacramento River Div	Sacramento River
Hale, Judith. A. & Marks, Alice K.		X	Sacramento River Div	Sacramento River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Hatfield Robert and Bonnie		X	Sacramento River Div	Sacramento River
Heidrick, Joe Jr., Trustee		X	Sacramento River Div	Sacramento River
Heidrick, Mildred M, Trustee		X	Sacramento River Div	Sacramento River
Heidrick, Mildred M, Trustee		X	Sacramento River Div	Sacramento River
Henle, Thomas N., Trustee		X	Sacramento River Div	Sacramento River
Hiatt, Thomas & Illerich, Phillip, Trustees		X	Sacramento River Div	Sacramento River
Hiatt, Thomas, Trustee		X	Sacramento River Div	Sacramento River
Howald Farms, Inc.		X	Sacramento River Div	Sacramento River
Howard, Theodore W. & Linda M.		X	Sacramento River Div	Sacramento River
J.B. Unlimited, Inc.		X	Sacramento River Div	Sacramento River
Jaeger, William L. & Patricia A.		X	Sacramento River Div	Sacramento River
Jansen, Peter & Sandy		X	Sacramento River Div	Sacramento River
Kary, Carol, Trustee		X	Sacramento River Div	Sacramento River
Kary, Carol, Trustee		X	Sacramento River Div	Sacramento River
King, Benjamin & Laura		X	Sacramento River Div	Sacramento River
King, Laura		X	Sacramento River Div	Sacramento River
KLSY, LLC		X	Sacramento River Div	Sacramento River
Knaggs Walnut Ranches Company, L.P. (Assigned to Yolo Land Trust)		X	Sacramento River Div	Sacramento River
Knights Landing Investors, LLC		X	Sacramento River Div	Sacramento River
Lake California Property Owners Association, Inc.	X		Sacramento River Div	Sacramento River
Lauppe, Burton H. & Kathryn L.		X	Sacramento River Div	Sacramento River
Lauppe, Burton H. & Kathryn L.		X	Sacramento River Div	Sacramento River
Leiser, Dorothy L.		X	Sacramento River Div	Sacramento River
Leviathan, Inc.		X	Sacramento River Div	Sacramento River
Lockett, William P. & Jean B.		X	Sacramento River Div	Sacramento River
Lomo Cold Storage & Micheli, Justin J.		X	Sacramento River Div	Sacramento River
Lonon, Michael E.		X	Sacramento River Div	Sacramento River
Maxwell Irrigation District		X	Sacramento River Div	Sacramento River
MCM Properties, Inc.		X	Sacramento River Div	Sacramento River
Mehrhof Montgomery, Susan & John McPherson Montgomery		X	Sacramento River Div	Sacramento River
Meridian Farms Water Company		X	Sacramento River Div	Sacramento River
Mesquite Investors, LLC (McClatchy/Riverby Limited)		X	Sacramento River Div	Sacramento River
Meyer Crest, Ltd.	X		Sacramento River Div	Sacramento River
Micke, Daniel H. & Nina J.		X	Sacramento River Div	Sacramento River
Morehead, Joseph A. & Brenda		X	Sacramento River Div	Sacramento River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Munson, James T. & Delmira		X	Sacramento River Div	Sacramento River
Natomas Basin Conservancy		X	Sacramento River Div	Sacramento River
Natomas Central Mutual Water Company	X	X	Sacramento River Div	Sacramento River
Nelson, Thomas L., Jr. & Hazel H.		X	Sacramento River Div	Sacramento River
Nene Ranch, LLC		X	Sacramento River Div	Sacramento River
O'Brien, Frank J. & Janice C.		X	Sacramento River Div	Sacramento River
Odysseus Farms Partnership		X	Sacramento River Div	Sacramento River
Oji Brothers Farms, Inc.		X	Sacramento River Div	Sacramento River
Oji, Mitsue, Family Partnership, et al.		X	Sacramento River Div	Sacramento River
Otterson, Mike, Trustee		X	Sacramento River Div	Sacramento River
Pacific Realty Associates. LP (dba M&T Chico Ranch, Inc.)		X	Sacramento River Div	Sacramento River
Pelger Mutual Water Company		X	Sacramento River Div	Sacramento River
Penner, Roger & Leona		X	Sacramento River Div	Sacramento River
Pleasant Grove Verona Mutual Water Company		X	Sacramento River Div	Sacramento River
Princeton-Codora-Glenn Irrigation District		X	Sacramento River Div	Sacramento River
Provident Irrigation District		X	Sacramento River Div	Sacramento River
Quad-H Ranches, Inc.		X	Sacramento River Div	Sacramento River
Rauf, Abdul & Tahmina		X	Sacramento River Div	Sacramento River
Reclamation District Nos. 900 & 1000		X	Sacramento River Div	Sacramento River
Reclamation District No. 1004		X	Sacramento River Div	Sacramento River
Reclamation District No. 108		X	Sacramento River Div	Sacramento River
Redding Rancheria Tribe		X	Sacramento River Div	Sacramento River
Redding, City of	X		Sacramento River Div	Sacramento River
Reische, Eric L.		X	Sacramento River Div	Sacramento River
Reische, Laverne C., et al.		X	Sacramento River Div	Sacramento River
Richter, Henry D., et al.		X	Sacramento River Div	Sacramento River
River Garden Farms Company		X	Sacramento River Div	Sacramento River
Riverview Golf & Country Club	X		Sacramento River Div	Sacramento River
Roberts Ditch Irrigation Company, Inc.		X	Sacramento River Div	Sacramento River
Rubio, Exequiel P. & Elsa A.		X	Sacramento River Div	Sacramento River
Sacramento River Ranch, LLC		X	Sacramento River Div	Sacramento River
Sacramento, County of		X	Sacramento River Div	Sacramento River
Seaver, Charles W. & Barbara J., Trustees		X	Sacramento River Div	Sacramento River
Schreiner (Sioux Creek Property, LLC)		X	Sacramento River Div	Sacramento River
Sutter Mutual Water Company		X	Sacramento River Div	Sacramento River
Sycamore Family Trust		X	Sacramento River Div	Sacramento River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Tarke, Stephen E. & Debra F., Trustees		X	Sacramento River Div	Sacramento River
Tisdale Irrigation & Drainage Company		X	Sacramento River Div	Sacramento River
Tuttle, Charles, Jr. & Noack, Sue T., Trustees		X	Sacramento River Div	Sacramento River
Wakida, Haruye, Trustee		X	Sacramento River Div	Sacramento River
Wakida, Haruye, Trustee		X	Sacramento River Div	Sacramento River
Wallace, Kenneth L. Living Trust		X	Sacramento River Div	Sacramento River
West Sacramento, City of	X		Sacramento River Div	Sacramento River
Willey, Edwin A. & Marjorie E.		X	Sacramento River Div	Sacramento River
Wilson Ranch Partnership		X	Sacramento River Div	Sacramento River
Wilson, Dennis, Farms, Inc.(Assigned to Wallace, Joseph V. & Janice C.)		X	Sacramento River Div	Sacramento River
Windswept Land & Livestock Company		X	Sacramento River Div	Sacramento River
Wisler, John W., Jr.		X	Sacramento River Div	Sacramento River
Young, Russell L., et al.		X	Sacramento River Div	Sacramento River
Zelmar Ranch, Inc.		X	Sacramento River Div	Sacramento River
Anderson-Cottonwood Irrigation District	X	X	Sacramento River Div	Sacramento River
Water Service Contracts South of Delta				
Banta-Carbona Irrigation District	X	X	Delta Div	San Francisco Bay, San Joaquin River
Byron-Bethany Irrigation District 1	X	X	Delta Div	San Joaquin River
Del Puerto Water District	X	X	Delta Div	San Joaquin River
Eagle Field Water District	X	X	Delta Div	San Joaquin River
Mercy Springs Water District	X	X	Delta Div	San Joaquin River
Oro Loma Water District	X	X	Delta Div	San Joaquin River
Pajaro Valley Water Management Agency, Santa Clara Valley Water District	X	X	Delta Div	Central Coast
Pajaro Valley Water Management Agency, Westlands Water District	X	X	Delta Div	Central Coast, San Joaquin River
Patterson Irrigation District	X	X	Delta Div	San Joaquin River
The West Side Irrigation District	X	X	Delta Div	San Joaquin River
Tracy, City of	X	X	Delta Div	San Joaquin River
U.S. Department of Veteran Affairs	X		Delta Div	San Joaquin River
West Stanislaus Irrigation District		X	Delta Div	San Joaquin River
Westlands Water District Distribution District 1	X	X	Delta Div	San Joaquin River
Westlands Water District Distribution District 1	X	X	Delta Div	San Joaquin River
Westlands Water District Distribution District 1	X	X	Delta Div	San Joaquin River
Westlands Water District Distribution District 2	X	X	Delta Div	San Joaquin River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Coelho Family Trust	X	X	Delta Div	Tulare Lake
Fresno Slough Water District	X	X	Delta Div	Tulare Lake
James Irrigation District	X	X	Delta Div	Tulare Lake
Laguna Water District	X	X	Delta Div	Tulare Lake
Reclamation District No. 1606	X	X	Delta Div	Tulare Lake
Tranquillity Irrigation District	X	X	Delta Div	Tulare Lake
Tranquillity Public Utility District	X	X	Delta Div	Tulare Lake
Westlands Water District (Assigned from Oro Loma)		X	Delta Div	Tulare Lake
County of Fresno	X	X	Miscellaneous	Tulare Lake
Hills Valley Irrigation District	X	X	Miscellaneous	Tulare Lake
Kern-Tulare Water District	X	X	Miscellaneous	Tulare Lake
Lower Tule River Irrigation District	X	X	Miscellaneous	Tulare Lake
Pixley Irrigation District	X	X	Miscellaneous	Tulare Lake
Kern-Tulare Water District	X	X	Miscellaneous	Tulare Lake
Tri-Valley Water District	X	X	Miscellaneous	Tulare Lake
Tulare, County of	X	X	Miscellaneous	Tulare Lake
San Benito County Water District	X	X	San Felipe Div	Central Cost
Santa Clara Valley Water District	X	X	San Felipe Div	San Francisco Bay, Central Coast
City of Avenal	X		West San Joaquin Div	Tulare Lake
State of California	X		West San Joaquin Div	San Joaquin River
State of California (Parks and Recreation)	X		West San Joaquin Div	San Joaquin River
City of Coalinga	X		West San Joaquin Div	Tulare Lake
City of Huron	X		West San Joaquin Div	Tulare Lake
Pacheco Water District	X	X	West San Joaquin Div	San Joaquin River
Panoche Water District	X	X	West San Joaquin Div	San Joaquin River
San Luis Water District	X	X	West San Joaquin Div	San Joaquin River, Tulare Lake
Westlands Water District	X	X	West San Joaquin Div	San Joaquin River, Tulare Lake
South of Delta - Exchange Contracts				
Central California Irrigation District		X	Delta Div	San Joaquin River
Columbia Canal Company		X	Delta Div	San Joaquin River
Firebaugh Canal Company		X	Delta Div	San Joaquin River
San Luis Canal Company		X	Delta Div	San Joaquin River
South of Delta - Settlement Contracts				
Dudley & Indart/Coelho/Hansen			Delta Div	San Joaquin River
Coelho Family Trust			Delta Div	San Joaquin River
Fresno Slough Water District			Delta Div	San Joaquin River
James Irrigation District			Delta Div	San Joaquin River

Contractor	M&I	AG	CVP Division	Hydrologic Region
Lempesis, Virginia L-Trustee			Delta Div	San Joaquin River
Meyers Farms Family Trust			Delta Div	San Joaquin River
Reclamation District No. 1606			Delta Div	San Joaquin River
Tranquillity Irrigation District			Delta Div	San Joaquin River
Tranquillity Public Utility District			Delta Div	San Joaquin River
In Delta				
Contra Costa Water District	X		Delta Div	San Francisco Bay, Sacramento River, San Joaquin River
Eastside Contracts/Agreement				
Central San Joaquin Water Conservation Dist.	X	X	East Side Div	San Joaquin River
Stockton-East Water District	X	X	East Side Div	San Joaquin River
Oakdale Irrigation District			East Side Div	San Joaquin River
South San Joaquin Irrigation District			East Side Div	San Joaquin River
Refuges - Contracts/Agreements				
North of Delta Refuges				Sacramento River
South of Delta Refuges				San Joaquin River

Ag = Agricultural
Div = Division
M&I = Municipal and Industrial

SWP delivers water to 29 public water agencies in Northern, Central and Southern California that hold long-term contracts for surface water deliveries. Table H.1-2 below list agencies with long-term SWP contracts. Agencies deliver water for both urban and agricultural use, representing over 25 million municipal water users and 750,000 acres of irrigated farmland. Five agencies use SWP water primarily for agricultural uses and the remaining 24 use SWP water primarily for municipal use. As noted above, Alameda County Flood Control and Water Conservation District (Zone 7), Alameda County Water District, and Santa Clara Valley Water District (SCVWD) all receive their SWP supplies through the South Bay Aqueduct (SBA).

Water supplies for agencies include imported SWP water, groundwater, local surface water, and for some agencies other imported supplies. The agencies collectively have received deliveries ranging from approximately 1.4 MAF in dry water years to approximately 4.0 MAF in wet years.

Table H.1-2. SWP Long-term Water Supply Contracting Agencies

Contractor	Hydrologic Region	Contractor	Hydrologic Region
Upper Feather River Area		**Central Coastal Area**	
City of Yuba City	Sacramento River	San Luis Obispo County Flood Control and Water Conservation District	Central Coast
County of Butte	Sacramento River	Santa Barbara County Flood Control and Water Conservation District	Central Coast, South Coast
Plumas County Flood Control and Water Conservation District	North Lahontan, Sacramento River	**Southern California Area**	
North Bay Area		Antelope Valley-East Kern Water Agency	South Coast, South Lahontan, Tulare Lake
Napa County Flood Control and Water Conservation District	Sacramento River	Castaic Lake Water Agency	South Coast,
Solano County Water Agency	Sacramento River, San Francisco Bay	Coachella Valley Water District	Colorado River
South Bay Area		Crestline-Lake Arrowhead Water Agency	South Coast, South Lahontan
Alameda County Flood Control and Water Conservation District – Zone 7	San Francisco Bay	Desert Water Agency	Colorado River, South Coast
Alameda County Water District	San Francisco Bay	Littlerock Creek Irrigation District	South Lahontan
Santa Clara Valley Water District	Central Coast, San Francisco Bay, San Joaquin River	The Metropolitan WD of Southern California	South Coast
San Joaquin Valley Area		Mojave Water Agency	Colorado River
County of Kings	Tulare Lake	Palmdale Water District	South Coast, South Lahontan
Castaic Lake Water Agency		San Bernardino Valley Municipal Water District	South Coast, South Lahontan
Dudley Ridge Water District	Tulare Lake	San Gabriel Valley Municipal Water District	South Coast
Empire West Side Irrigation District	Tulare Lake	San Gorgonio Pass Water Agency	South Coast, Colorado River
Kern County Water Agency	South Coast, South Lahontan, Tulare Lake	Santa Clarita Valley Water Agency	South Coast
Oak Flat Water District	Tulare Lake	Ventura County Watershed Protection District	Central Coast, South Coast, Tulare Lake
Tulare Lake Basin Water Storage District	Tulare Lake		

Source: DWR 2017.

H.2 Evaluation of Alternatives

This section describes the technical background for evaluation of environmental consequences associated with action alternatives and the No Action Alternative.

H.2.1 Methods and Tools

The impact assessment considers changes in water supply conditions related to changes in CVP and SWP operations under the alternatives as compared to the No Action Alternative. This section details methods and tools used to evaluate those effects.

H.2.2 Changes in CVP and SWP Deliveries

Changes in CVP and SWP operations under the alternatives as compared to the No Action Alternative would result in changes water supply deliveries to CVP and SWP contractors. Numerical models are available to quantitatively analyze changes in CVP and SWP systems proposed under the alternatives to determine potential impacts to delivery of CVP and SWP water. With the exception of the changes to reservoir conditions in the CVP Trinity River Division, changes in reservoirs that store CVP and SWP water outside of Central Valley are not included in CVP and SWP numerical models and are evaluated qualitatively.

Surface water supply analysis was conducted using the CalSim II model, as described in Appendix F, to simulate operational assumptions of each alternative that was described in Chapter 3, *Alternatives*.

H.2.2.1 *Use of CalSim II Model*

DWR and Reclamation developed the CalSim II reservoir-river basin planning model to simulate operation of CVP and SWP over a range of different hydrologic conditions. Inputs to CalSim II include water demands (including water rights), stream accretions and depletions, reservoir inflows, irrigation efficiencies, and parameters to calculate return flows, nonrecoverable losses and groundwater operations. Sacramento Valley and tributary rim basin hydrology uses an adjusted historical sequence of monthly stream flows over an 82-year period (1922 to 2003) to represent a sequence of flows at a future level of development and accounting for climate change. Adjustments to historic water supplies are imposed based on future land use conditions. The resulting hydrology represents water supply available from Central Valley streams to CVP and SWP at a future level of development. Water rights deliveries to non-CVP and non-SWP water rights holders are not modified in CalSim II simulations of alternatives. CalSim II produces outputs for river flows and diversions, reservoir storage, Delta flows and exports, Delta inflow and outflow, deliveries to project and nonproject users, and controls on project operations.

The CalSim II model monthly simulation of an actual daily (or even hourly) operation of CVP and SWP results in several limitations in use of model results. Model results must be used in a comparative manner to reduce effects of use of monthly and other assumptions that are indicative of real-time operations, but do not specifically match real-time observations. CalSim II model output is based upon a monthly time step. CalSim II model output includes minor fluctuations of up to 5% due to model assumptions and approaches. Therefore, if quantitative changes between a specific alternative and the No Action Alternative are 5% or less, conditions under the specific alternative would be considered to be “similar” to conditions under the No Action Alternative.

Under extreme hydrologic and operational conditions where there is not enough water supply to meet all requirements, CalSim II utilizes a series of operating rules to reach a solution to allow for continuation of the simulation. It is recognized that these operating rules are a simplified version of very complex

decision processes that CVP and SWP operators would use in actual extreme conditions. Therefore, model results and potential changes under these extreme conditions should be evaluated on a comparative basis between alternatives and are an approximation of extreme operational conditions.

H.2.2.2 *Analysis of Changes in Water Supply Deliveries*

CalSim II outputs for the alternatives are compared to CalSim II outputs for the No Action Alternative to evaluate changes in water supply deliveries to CVP and SWP water users by hydrologic region: Sacramento River, San Joaquin River, San Francisco Bay, Central Coast, Tulare Lake (not including Friant-Kern Canal and Madera Canal water users), South Lahontan, and South Coast.

The analyses presented in this EIS do not include specific analysis for Millerton Lake and deliveries to Friant-Kern Canal and Madera Canal water users under Alternatives 1 through 4 compared to the No Action Alternative. Results of these analyses (presented in Appendix F) indicated that there were no differences in Millerton Lake storage or deliveries from Millerton Lake to Friant-Kern and Madera Canals between Alternatives 1 through 4 compared to the No Action Alternative because implementation of the alternatives would not affect operations of Millerton Lake. Therefore, conditions at Millerton Lake and Friant Division are not analyzed in this EIS.

The CalSim II outputs for Alternative 1 presented in this appendix do not include the operations of the Suisun Marsh Salinity Control Gates (SMSCG) in some years or a fall action to maintain the X2 position at 80 kilometers in some above normal and wet years included as elements of the Summer-Fall Delta Smelt Habitat action due to uncertainty in the future frequency of these actions. Generally, the potential impacts and benefits of Alternative 1 could range between what is described in this appendix and the No Action Alternative, which includes a Fall X2 action in above normal and wet years. If the Summer-Fall Delta Smelt Habitat action includes operations of the SMSCG or a Fall X2 action, the water requirements in summer and fall could be greater than shown for Alternative 1 in this appendix. Alternative 1 indicates water supply benefits for CVP and SWP contractors. In years with the summer or fall actions, the water supply benefits would be less than indicated in the Alternative 1 modeling.

H.2.3 No Action Alternative

The No Action Alternative would generate no changes to water operations and there would be no improvement in existing limits to water supply availability that impact CVP and SWP water users. Therefore, in comparison to existing conditions there would be no impact to water supply.

H.2.4 Alternative 1

H.2.4.1 *Project-Level Effects*

H.2.4.1.1 Potential changes in water supply deliveries

Trinity River, Sacramento River, Clear Creek, Feather River, and American River

CVP and SWP deliveries to contractors in Trinity, Sacramento, Clear Creek, Feather, and American Rivers watersheds under Alternative 1 are detailed in Table H.2-1. As indicated in Table H.2-1, all contract delivery types, with the exception of deliveries to CVP Settlement Contractors, would increase slightly. CVP Settlement Contractors would see reductions of less than 5% in their total deliveries in both average water years as well as dry and critical water years. As discussed in Section H.2.2, *Changes in CVP and SWP Deliveries*, CalSim II model output includes minor fluctuations of up to 5% due to model assumptions; approaches and changes 5% or less are considered “similar” to conditions under the No

Action Alternative. The contract type with largest increase on a percentage basis would be CVP agricultural water users in dry and critical water year types with those increases averaging approximately 20%.

Table H.2-1. Alternative 1 - Trinity River, Sacramento River, Clear Creek, Feather River, and American River Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Settlement Contractors	1,599	-10	1,581	-10
CVP Refuge Level 2	162	4	144	1
CVP M&I	223	6	193	4
CVP Ag	255	24	152	26
SWP Feather River Service Area	937	0	874	1
SWP M&I	30	1	21	1

Yellow highlighting indicates a negative change.
[1] Sacramento River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Stanislaus River and San Joaquin River

CVP and SWP deliveries to contractors in Stanislaus River and San Joaquin River watersheds under Alternative 1 are detailed below in Table H.2-2. As is indicated in Table H.2-2, only CVP Refuge Level 2 deliveries would be reduced. These reductions would average less than 5% and are considered similar to conditions under the No Action Alternative. There would be no measurable change in CVP deliveries to Exchange Contractors and CVP and SWP M&I and CVP agricultural deliveries would all improve, with the largest increases identified for CVP agricultural water supply in dry and critical water years with those increases averaging approximately 32%.

Table H.2-2. Alternative 1 – Stanislaus River and San Joaquin River Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Exchange Contractors	852	0	825	0
CVP Refuge Level 2	259	-1	251	0
CVP M&I	17	1	15	1
CVP Ag	387	73	213	52
SWP Ag	4	1	2	0

Yellow highlighting indicates a negative change.
[1] San Joaquin River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Bay-Delta

CVP and SWP contract deliveries in Bay-Delta under Alternative 1 are detailed below in Table H.2-3. As is indicated in Table H.2-3, Alternative 1 would increase water supply deliveries for all contract types. The largest increase on a percentage basis would be for CVP agricultural water users in dry and critical water years with those increases averaging approximately 32%.

Table H.2-3. Alternative 1 - Bay-Delta Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP M&I	282	8	292	8
CVP Ag	47	9	26	6
SWP M&I	223	25	132	8

[1] San Francisco DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

CVP and SWP Service Areas

This section details changes in contract deliveries under Alternative 1 to CVP and SWP Service Areas in central coast, Tulare Lake, South Lahontan and south coast regions. In addition to the modeled estimates of changes to water supply, water transfers could increase water supplies in drier year types (but they are not included in the CalSim II modeling results). Water transfers are the same in the No Action Alternative, Alternative 2, and Alternative 3. Alternative 1 would have a longer time period that transfers could move through the Delta pumping facilities, so it would have the potential to increase water supplies a small amount compared to the other alternatives. The upper limits for transfer amounts would not change, but in many years, transfer quantities are limited by available capacity in the Delta. A longer transfer period would reduce this constraint.

Central Coast Region

SWP contract deliveries in the central coast region under Alternative 1 are detailed below in Table H.2-4. As is indicated in Table H.2-4, SWP M&I deliveries would increase on average approximately 10%.

Table H.2-4. Alternative 1 - Central Coast Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	44	4	25	2

[1] Central Coast DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Tulare Lake Region

CVP and SWP contract deliveries in Tulare Lake region under Alternative 1 are detailed below in Table H.2-5. As is indicated in Table H.2-5, only CVP Refuge Level 2 deliveries would be reduced. These reductions would average less than 5% and are considered similar to conditions under the No

Action Alternative. Deliveries to CVP and SWP agricultural water users and SWP M&I water users would all improve with largest increases forecast for CVP agricultural water users in dry and critical water years (approximately 32%).

Table H.2-5. Alternative 1 - Tulare Lake[1] Region Contract Deliveries[2] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Refuge Level 2	12	0	11	0
CVP Ag	783	139	446	108
SWP M&I	85	9	48	5
SWP Ag	669	97	356	36

Yellow highlighting indicates a negative change.
[1] Does not include Friant-Kern Canal or Madera Canal water users
[2] Tulare Lake DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

South Lahontan Region

SWP contract deliveries in south Lahontan region under Alternative 1 are detailed below in Table H.2-6. As is indicated in Table H.2-6 SWP M&I deliveries would increase on average approximately 14%.

Table H.2-6. Alternative 1 - South Lahontan Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	280	34	163	14

[1] South Lahontan DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

South Coast Region

SWP contract deliveries in south coast region under Alternative 1 are detailed below in Table H.2-7. As is indicated in Table H.2-7, SWP M&I deliveries would increase on average approximately 16%. SWP agricultural deliveries would increase approximately 9%.

Table H.2-7. Alternative 1 - South Coast Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	1,405	192	817	70
SWP Ag	8	1	5	0

[1] South Coast DWR Hydrologic Region
Ag = Agricultural
SWP = State Water Project
M&I = Municipal and Industrial

H.2.4.2 *Program-Level Effects*

Alternative 1 includes habitat restoration and improvement projects, fish passage improvements, fish hatchery operation programs, and studies to identify further opportunities for habitat improvement. All these actions are evaluated in this EIS as programmatic activities. Given their collective implementation to improve habitat conditions and survival rates for biological resources across the study area, it is assumed that they could improve conditions relative to those resources future survival and population health. Specific to water supply, implementation of these programmatic actions would be expected to help improve conditions for species that limit operation of CVP and SWP and potentially reduce restrictions on CVP and SWP operations in the future.

H.2.5 Alternative 2

H.2.5.1 *Project-Level Effects*

H.2.5.1.1 ***Potential changes in water supply deliveries***

Trinity River, Sacramento River, Clear Creek, Feather River, and American River

CVP and SWP deliveries to contractors in Trinity River, Sacramento River, Clear Creek, Feather River, and American River watersheds under Alternative 2 are detailed below in Table H.2-8. As is indicated in Table H.2-8, all contract delivery types with exception of deliveries to CVP Settlement Contractors and SWP Feather River Service Area, would increase slightly. CVP Settlement Contractors and SWP Feather River Service Area would see reductions of less than 5% in their total deliveries in both average water years as well as dry and critical water years. These deliveries are considered similar to conditions anticipated under the No Action Alternative. The contract type with the largest increase on a percentage basis would be CVP agricultural water users in dry and critical water year types with those increases averaging approximately 20%.

Table H.2-8. Alternative 2 - Trinity River, Sacramento River, Clear Creek, Feather River and American River Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Settlement Contractors	1,608	-1	1,589	-1
CVP Refuge Level 2	163	5	149	6
CVP M&I	220	2	187	-2
CVP Ag	254	24	142	16
SWP Feather River Service Area	937	0	873	-1
SWP M&I	31	2	24	4

Yellow highlighting indicates a negative change.
[1] Sacramento River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Stanislaus River and San Joaquin River

CVP and SWP deliveries to contractors in Stanislaus River and San Joaquin River watersheds under Alternative 2 are detailed below in Table H.2-9. As is indicated in Table H.2-9, only CVP Refuge Level 2 deliveries would be reduced. These reductions would average less than 5% and are considered similar to conditions under the No Action Alternative. There would be no measurable change in CVP deliveries to Exchange Contractors and CVP and SWP M&I and CVP agricultural deliveries would all improve, with largest increases identified for CVP agricultural water supply in dry and critical water years with those increases averaging approximately 49%.

Table H.2-9. Alternative 2 - Stanislaus River and San Joaquin River Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Exchange Contractors	852	0	824	0
CVP Refuge Level 2	260	0	249	-1
CVP M&I	18	2	15	1
CVP Ag	437	122	241	79
SWP Ag	4	1	3	1

Yellow highlighting indicates a negative change.
[1] San Joaquin River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Bay-Delta

CVP and SWP contract deliveries in Bay-Delta under Alternative 2 are detailed below in Table H.2-10. As is indicated in Table H.2-10, Alternative 2 would increase water supply deliveries for all contract types. The largest increase on a percentage basis would be for CVP agricultural water users in dry and critical water years with those increases averaging approximately 49%.

Table H.2-10. Alternative 2 - Bay-Delta Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP M&I	286	12	295	10
CVP Ag	53	15	30	10
SWP M&I	243	44	154	29

[1] San Francisco DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

CVP and SWP Service Areas

This section details changes in contract deliveries under Alternative 2 to CVP Service Areas in central coast, Tulare Lake, South Lahontan and the south coast regions.

Central Coast Region

SWP contract deliveries in central coast region under Alternative 2 are detailed below in Table H.2-11. As is indicated in Table H.2-11, SWP M&I deliveries would increase on average approximately 39% in dry and critical water years.

Table H.2-11. Alternative 2 - Central Coast Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	52	12	32	9

[1] Central Coast DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Tulare Lake Region

CVP and SWP contract deliveries in Tulare Lake region under Alternative 2 are detailed below in Table H.2-12. As is indicated in Table H.2-12, only CVP Refuge Level 2 deliveries would be reduced. These reductions would average less than 5% and are considered similar to conditions under the No Action Alternative. Deliveries to CVP and SWP agricultural water users and SWP M&I water users would all improve with largest increases forecast for SWP agricultural water users in dry and critical water years (approximately 58%).

Table H.2-12. Alternative 2 - Tulare Lake[1] Region Contract Deliveries[2] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Refuge Level 2	12	0	11	0
CVP Ag	892	248	503	164
SWP M&I	99	23	60	17
SWP Ag	863	291	507	187

Yellow highlighting indicates a negative change.
[1] Does not include Friant-Kern Canal or Madera Canal water users
[2] Tulare Lake DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial
South Lahontan Region

SWP contract deliveries in south Lahontan region under Alternative 2 are detailed below in Table H.2-13. As is indicated in Table H.2-13, SWP M&I deliveries would increase on average approximately 25% and by approximately 37% in dry and critical water years.

Table H.2-13. Alternative 2 - South Lahontan Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	308	61	204	55

[1] South Lahontan DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

South Coast Region

SWP contract deliveries in south coast region under Alternative 2 are detailed below in Table H.2-14. As is indicated in Table H.2-14, SWP M&I deliveries would increase on average approximately 34%, and by approximately 41% in dry and critical water years. SWP agricultural deliveries would increase approximately 48%, and by approximately 58% in dry and critical water years.

Table H.2-14. Alternative 2 - South Coast Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	1,621	408	1,055	308
SWP Ag	11	3	6	2

[1] South Coast DWR Hydrologic Region
Ag = Agricultural
SWP = State Water Project
M&I = Municipal and Industrial

H.2.6 Alternative 3

H.2.6.1 *Project-Level Effects*

H.2.6.1.1 Potential changes in water supply deliveries

Trinity River, Sacramento River, Clear Creek, Feather River, and American River

CVP and SWP deliveries to contractors in Trinity, Sacramento, Clear Creek, Feather and American Rivers watersheds under Alternative 3 are detailed below in Table H.2-15. As is indicated in Table H.2-15, all contract delivery types with exception of deliveries to CVP Settlement Contractors across all water years and to CVP M&I contractors in dry and critical water year types, would increase slightly. CVP Settlement Contractors would observe reductions of less than 5% in their total deliveries in both average water years as well as dry and critical water years. These deliveries are considered similar to conditions anticipated under the No Action Alternative. CVP M&I contractors would observe similar reductions of approximately 5% in dry and critical water year types. As discussed in Section H.2.2, CalSim II model output includes minor fluctuations of up to 5% due to model assumptions and approaches and changes 5% or less are considered “similar” to conditions under the No Action Alternative. The contract type with largest increase on a percentage basis would be SWP M&I water users in dry and critical water year types with those increases averaging approximately 21%.

Table H.2-15. Alternative 3 - Trinity River, Sacramento River, Clear Creek, Feather River, and American River Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Settlement Contractors	1,608	-1	1,589	-2
CVP Refuge Level 2	163	5	149	6
CVP M&I	219	2	186	-2
CVP Ag	252	22	140	13
SWP Feather River Service Area	937	0	874	0
SWP M&I	31	2	24	4

Yellow highlighting indicates a negative change.
[1] Sacramento River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Stanislaus River and San Joaquin River

CVP and SWP deliveries to contractors in Stanislaus River and San Joaquin River watersheds under Alternative 3 are detailed below in Table H.2-16. As is indicated in Table H.2-16, both CVP deliveries to Exchange Contractors and CVP Refuge Level 2 deliveries would be reduced. These reductions would average less than 5% and are considered similar to conditions under the No Action Alternative. CVP and SWP M&I and CVP agricultural deliveries would all improve, with largest increases identified for CVP agricultural water supply in dry and critical water years with those increases averaging approximately 38%.

Table H.2-16. Alternative 3 - Stanislaus River and San Joaquin River Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Exchange Contractors	852	0	823	-1
CVP Refuge Level 2	260	0	249	-1
CVP M&I	18	2	15	1
CVP Ag	432	118	236	74
SWP Ag	4	1	2	1

Yellow highlighting indicates a negative change.
[1] San Joaquin River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Bay-Delta

CVP and SWP contract deliveries in Bay-Delta under Alternative 3 are detailed below in Table H.2-17. As is indicated in Table H.2-17 Alternative 3 would increase water supply deliveries for all contract

types. The largest increase on a percentage basis would be for CVP agricultural water users in dry and critical water years with those increases averaging approximately 45%.

Table H.2-17. Alternative 3 - Bay-Delta Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP M&I	285	10	292	7
CVP Ag	52	14	29	9
SWP M&I	242	43	154	29

[1] San Francisco DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I – Municipal and Industrial

CVP and SWP Service Areas

This section details changes in contract deliveries under Alternative 3 to CVP Service Areas in central coast, Tulare Lake, South Lahontan and south coast regions.

Central Coast Region

SWP contract deliveries in central coast region under Alternative 3 are detailed below in Table H.2-18. As is indicated in Table H.2-18, SWP M&I deliveries would increase on average approximately 37% in dry and critical water years.

Table H.2-18. Alternative 3 - Central Coast Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	51	12	31	8

[1] Central Coast DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Tulare Lake Region

CVP and SWP contract deliveries in Tulare Lake region under Alternative 3 are detailed below in Table H.2-19. As is indicated in Table H.2-19, only CVP Refuge Level 2 deliveries would be reduced. These reductions would average less than 5% and are considered similar to conditions under the No Action Alternative. Deliveries to CVP and SWP agricultural water users and SWP M&I water users would all improve with largest increases forecast for SWP agricultural water users in dry and critical water years (approximately 58%).

Table H.2-19. Alternative 3 - Tulare Lake[1] Region Contract Deliveries[2] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Refuge Level 2	12	0	11	0
CVP Ag	886	242	492	154
SWP M&I	98	23	60	16
SWP Ag	855	283	506	186

Yellow highlighting indicates a negative change.
[1] Does not include Friant-Kern Canal or Madera Canal water users
[2] Tulare Lake DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

South Lahontan Region

SWP contract deliveries in south Lahontan region under Alternative 3 are detailed below in Table H.2-20. As is indicated in Table H.2-20, SWP M&I deliveries would increase on average approximately 26% and by approximately 36% in dry and critical water years.

Table H.2-20. Alternative 3 - South Lahontan Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	312	65	203	53

[1] South Lahontan DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

South Coast Region

SWP contract deliveries in south coast region under Alternative 3 are detailed below in Table H.2-21. As is indicated in Table H.2-21, SWP M&I deliveries would increase on average approximately 32%, and by approximately 39% in dry and critical water years. SWP agricultural deliveries would increase approximately 46%, and by approximately 55% in dry and critical water years.

Table H.2-21. Alternative 3 - South Coast Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	1,600	388	1,039	292
SWP Ag	11	3	6	2

[1] South Coast DWR Hydrologic Region
Ag = Agricultural
SWP = State Water Project
M&I = Municipal and Industrial

H.2.6.2 *Program-Level Effects*

Alternative 3 includes habitat restoration and improvement projects, fish passage improvements, fish hatchery operation programs, and studies to identify further opportunities for habitat improvement. All of these actions are evaluated in this EIS as programmatic activities. Given their collective implementation to improve habitat conditions and survival rates for biological resources across the study area, it is assumed that they could improve conditions relative to those resources future survival and population health. Specific to water supply, implementation of these programmatic actions would be expected to help improve conditions for species that limit operation of CVP and SWP and potentially reduce restrictions on CVP and SWP operations in the future.

H.2.7 Alternative 4

H.2.7.1 *Project-Level Effects*

H.2.7.1.1 Potential changes in water supply deliveries

Trinity River, Sacramento River, Clear Creek, Feather River, and American River

CVP and SWP deliveries to contractors in Trinity, Sacramento, Clear Creek, Feather, and American Rivers watersheds under Alternative 4 are detailed below in Table H.2-22. As is indicated in Table H.2-22, across all year types, average annual deliveries to all contract delivery types with the exception of CVP Refuge Level 2 deliveries and deliveries to the SWP Feather River Service Area would decrease. These reductions in average annual deliveries would be less than 5% and are considered similar to conditions under the No Action Alternative. As discussed in Section H.2.2, CalSim II model output includes minor fluctuations of up to 5% due to model assumptions and approaches and changes 5% or less are considered "similar" to conditions under the No Action Alternative. In dry and critical water year types, some reductions in average deliveries would exceed this 5% level with CVP M&I deliveries reduced by 6%, CVP agricultural deliveries reduced by 16%, and SWP M&I deliveries reduced by 10%.

Table H.2-22. Alternative 4 - Trinity River, Sacramento River, Clear Creek, Feather River, and American River Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Settlement Contractors	1,601	-9	1,584	-6
CVP Refuge Level 2	158	1	140	-2
CVP M&I	210	-7	176	-12
CVP Ag	226	-4	107	-20
SWP Feather River Service Area	937	0	873	0
SWP M&I	28	-1	18	-2

Yellow highlighting indicates a negative change.
[1] Sacramento River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Stanislaus River and San Joaquin River

CVP and SWP deliveries to contractors in Stanislaus and San Joaquin River watersheds under Alternative 4 are detailed below in Table H.2-16. As is indicated in Table H.2-23, across all year types, average annual CVP M&I, CVP agricultural and SWP agricultural deliveries would be reduced. These reductions in average annual deliveries would be less than 5% and are considered similar to conditions under the No Action Alternative. In dry and critical water year types, some reductions in average deliveries would exceed this 5% level with CVP agricultural deliveries reduced by 19% and SWP agricultural deliveries reduced by 17%.

Table H.2-23. Alternative 4 - Stanislaus River and San Joaquin River Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Exchange Contractors	852	0	825	0
CVP Refuge Level 2	260	0	252	2
CVP M&I	16	0	13	-1
CVP Ag	307	-8	131	-31
SWP Ag	3	0	1	0

Yellow highlighting indicates a negative change.
[1] San Joaquin River DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

Bay-Delta

CVP and SWP contract deliveries in Bay-Delta under Alternative 4 are detailed below in Table H.2-17. As is indicated in Table H.2-24, across all year types, average annual deliveries to all contract delivery types would be reduced. These reductions in annual average deliveries would be less than 5% and are considered similar to conditions under the No Action Alternative. In dry and critical water year types, the reductions in average deliveries would exceed this 5% level, with CVP M&I deliveries reduced by 6%, CVP agricultural deliveries reduced by 19%, and SWP M&I deliveries reduced by 9%.

Table H.2-24. Alternative 4 - Bay-Delta Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP M&I	266	-9	268	-17
CVP Ag	37	-2	16	-4
SWP M&I	190	-8	113	-12

Yellow highlighting indicates a negative change.
[1] San Francisco DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

CVP and SWP Service Areas

This section details changes in contract deliveries under Alternative 4 to CVP and SWP Service Areas in central coast, Tulare Lake, South Lahontan and south coast regions.

Central Coast Region

SWP contract deliveries in the central coast region under Alternative 4 are detailed below in Table H.2-25. As is indicated in Table H.2-25, across all year types, average annual deliveries to SWP M&I would be reduced by approximately 7% and by approximately 18% in dry and critical water years.

Table H.2-25. Alternative 4 - Central Coast Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	37	-3	19	-4

Yellow highlighting indicates a negative change.
[1] Central Coast DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

Tulare Lake Region

CVP and SWP contract deliveries in Tulare Lake region under Alternative 4 are detailed below in Table H.2-26. As is indicated in Table H.2-26, across all year types, average annual CVP Refuge Level 2 deliveries and deliveries in dry and critical water year types would not change. Average annual deliveries would be reduced to all other contract types. The reductions in average annual deliveries would, with the exception of SWP M&I deliveries, average less than 5% and are considered similar to conditions under the No Action Alternative. The reductions in annual SWP M&I deliveries would average 7% when compared to the No Action Alternative. In dry and critical water year types, CVP agricultural deliveries would be reduced by 19%, SWP M&I deliveries would be reduced by 17%, and SWP agricultural deliveries that would be reduced by 11%.

Table H.2-26. Alternative 4 - Tulare Lake[1] Region Contract Deliveries[2] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
CVP Refuge Level 2	12	0	12	0
CVP Ag	616	-28	275	-64
SWP M&I	70	-5	36	-7
SWP Ag	551	-20	285	-35

Yellow highlighting indicates a negative change.
[1] Does not include Friant-Kern Canal or Madera Canal water users
[2] Tulare Lake DWR Hydrologic Region
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

South Lahontan Region

SWP contract deliveries in south Lahontan region under Alternative 4 are detailed below in Table H.2-27. As is indicated in Table H.2-27, across all year types, average annual deliveries to SWP M&I would be reduced by approximately 6% and by approximately 15% in dry and critical water years.

Table H.2-27. Alternative 4 - South Lahontan Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	233	-14	128	-22

Yellow highlighting indicates a negative change.
[1] South Lahontan DWR Hydrologic Region
SWP = State Water Project
M&I = Municipal and Industrial

South Coast Region

SWP contract deliveries in south coast region under Alternative 4 are detailed below in Table H.2-28. As is indicated in Table H.2-28, across all year types, average annual deliveries to SWP M&I and to SWP agricultural water users would be reduced by less than 5% and are considered similar to conditions under the No Action Alternative. In dry and critical water year types, SWP M&I deliveries would be reduced by approximately 15% and SWP agricultural deliveries would be reduced by approximately 12%.

Table H.2-28. Alternative 4 - South Coast Region Contract Deliveries[1] (thousand acre-feet)

	Annual Average	Difference from No Action Alternative	Dry and Critical Water Years	Difference from No Action Alternative
SWP M&I	1,155	-57	632	-115
SWP Ag	7	0	4	0

Yellow highlighting indicates a negative change.
[1] South Coast DWR Hydrologic Region
Ag = Agricultural
SWP = State Water Project
M&I = Municipal and Industrial

H.2.7.2 *Program-Level Effects*

Alternative 4 includes actions to improve water use efficiency for M&I and agricultural water users. All of these actions are evaluated in this EIS as programmatic activities. Given their collective implementation to reduce demands for M&I and agricultural water supplies, implementation of these programmatic actions would offset some of the reductions in CVP and SWP water supply deliveries forecast under Alternative 4. Water use efficiency actions, however, would not be able to completely offset the reduced water supply deliveries under Alternative 4.

H.2.8 Mitigation Measures

No mitigation measures are identified for the water supply effects reported in this EIS. Of the reductions in average annual water supply deliveries identified for Alternatives 1, 2, and 3 evaluated above, all adverse changes were 5% or less of total supply delivered. As was noted in Section H.2.2, changes forecast in water supply deliveries are considered "similar" to conditions anticipated under the No Action Alternative given the evaluation approaches and assumptions relied on in the CalSim II model to estimate changes across CVP and SWP. Alternative 4 would generate reductions in average annual deliveries to some contractor types that would exceed 5% and would represent a measurable reduction in water supply when compared to the No Action Alternative. These reductions in water supply deliveries would not be able to be replaced reliably from other sources, such as water transfers or groundwater pumping. The water use efficiency actions included in Alternative 4 at a programmatic level could (as is noted in Section H.2.7.2, *Program-Level Effects)* reduce the severity of these reductions in water supply deliveries but would not fully replace that water supply. Water transfers are included in the No Action Alternative and would not be available further offset the reduced water supply deliveries generated by Alternative 4. Reliance on groundwater pumping to offset these reductions would not be feasible given the potential for numerous environmental effects generated by additional groundwater pumping in an area with declining groundwater levels and the limits on the availability of groundwater supplies with the implementation of the Sustainable Groundwater Management Act (see Appendix I, *Groundwater Technical Appendix*, for more information). Given the environmental and technological limits on the implementation other potential options to offset this impact, no feasible mitigation has been identified to reduce the severity of these reductions.

H.2.9 Summary of Impacts

Table H.2-29 includes a summary of impacts, magnitude and direction of those impacts, and potential mitigation measures for consideration.

Table H.2-29. Impact Summary

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures
Potential changes in water supply deliveries	No Action	No impact	--
	1	**Trinity River, Sacramento River, Clear Creek, Feather River, and American River Watersheds –** <5% reductions in water supply deliveries to CVP Settlement Contractors Improvements in water deliveries for all other contractor types **Stanislaus River and San Joaquin River Watersheds –** <5% reductions in water supply CVP Level 2 Refuge deliveries No measurable change in CVP Exchange Contractor deliveries Improvements in water deliveries for all other contractor types **Bay-Delta–** Improvements in water deliveries for all contractor types **CVP Service Areas** ***Tulare Lake[1] –*** <5% reductions in CVP Level 2 Refuge deliveries Improvements in water deliveries for all other contractor types ***Central Coast, South Lahontan Region, South Coast –*** Improvements in water deliveries for all contractor types	--

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures
	2	**Trinity River, Sacramento River, Clear Creek, Feather River, and American River Watersheds –** <5% reductions in water supply deliveries to CVP Settlement Contractors and SWP Feather River Service Area water users Improvements in water deliveries for all other contractor types **Stanislaus River and San Joaquin River Watersheds –** <5% reductions in water supply CVP Level 2 Refuge deliveries No measurable change in CVP Exchange Contractor deliveries Improvements in water deliveries for all other contractor types **Bay-Delta–** Improvements in water deliveries for all contractor types **CVP Service Areas** ***Tulare Lake[1] –*** <5% reductions in CVP Level 2 Refuge deliveries Improvements in water deliveries for all other contractor types ***Central Coast, South Lahontan, South Coast–*** Improvements in water deliveries for all contractor types	--

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures
	3	**Trinity River, Sacramento River, Clear Creek, Feather River, and American River Watersheds –** <5% reductions in water supply deliveries to CVP Settlement Contractors and CVP M&I water users Improvements in water deliveries for all other contractor types **Stanislaus River and San Joaquin River Watersheds –** <5% reductions in CVP Exchange Contractor and Level 2 Refuge deliveries Improvements in water deliveries for all other contractor types **Bay-Delta–** Improvements in water deliveries for all contractor types **CVP Service Areas** ***Tulare Lake[1]–*** <5% reductions in CVP Level 2 Refuge deliveries Improvements in water deliveries for all other contractor types ***Central Coast, South Lahontan, South Coast–*** Improvements in water deliveries for all contractor types	--

Impact	Alternative	Magnitude and Direction of Impacts	Potential Mitigation Measures
	4	**Trinity River, Sacramento River, Clear Creek, Feather River, and American River Watersheds –** <5% reductions in average water supply deliveries to all contractor types with the exception of with the exception of CVP Refuge Level 2 deliveries and deliveries to the SWP Feather River Service Area. **Stanislaus River and San Joaquin River Watersheds –** <5% reductions in average CVP agricultural deliveries No change in average deliveries for all other contractor types **Bay-Delta–** <5% reductions in average deliveries for all contractor types **CVP & SWP Service Areas** ***Central Coast*** 7% reduction in average deliveries to SWP M&I ***Tulare Lake[1]–*** No change in CVP Level 2 Refuge deliveries <5% reductions in average deliveries for CVP agricultural and SWP agricultural deliveries 7% reduction in average deliveries to SWP M&I ***South Lahontan*** 6% reduction in average deliveries to SWP M&I ***South Coast–*** <5% reductions in average deliveries for CVP agricultural and SWP agricultural deliveries	

[1] Does not include Friant-Kern Canal or Madera Canal water users
Ag = Agricultural
CVP = Central Valley Project
SWP = State Water Project
M&I = Municipal and Industrial

H.2.10 Cumulative Effects

H.2.10.1 *Potential changes in water supply deliveries*

The No Action Alternative would generate no changes to water operations and there would be no improvement in existing limits on water supply availability that impact CVP and SWP water users. Thus, No Action Alternative would have no contribution to cumulative water supply condition.

Alternative 1 would improve water supply deliveries to some CVP and SWP contractors and for other water users result in reductions below 5% which, as was detailed in Section H.2.2, would be "similar" to conditions anticipated under the No Action Alternative given evaluation approaches and assumptions relied on in CalSim II model to estimate changes across CVP and SWP. Alternatives 2 and 3 would have similar impacts to Alternative 1 and would not generate substantial contributions to cumulative water supply conditions. Alternative 4 would be similar to Alternatives 1, 2 and 3, resulting in reductions in average water supply deliveries to some CVP and SWP contractors. The reductions in surface water deliveries under Alternative 4 would for many water users be larger than the reductions anticipated under the other alternatives. As is detailed above in Section H.2.7, *Alternative 4*, these reductions in average deliveries in dry and critical water year types could for some contractor delivery types approach 20% when compared to the No Action Alternative.

The past, present, and reasonably foreseeable projects, described in Appendix Y, *Cumulative Methodology*, may have effects on water supply. These cumulative projects include actions across California to develop new water storage capacity, new water conveyance infrastructure, new water recycling capacity, and reoperation of existing water supply infrastructure - including surface water reservoirs and conveyance infrastructure. Cumulative projects also include ecosystem improvement and habitat restoration actions to improve conditions for special status species whose, in many cases, special status constrains water supply delivery operations. Collectively these cumulative projects would be anticipated to generate, directly or as an ancillary benefit, improvements in either local or broader regional water supply conditions. These cumulative projects could, however, generate potential short-term impacts to water supply during construction, or in the case of local water supply projects generate reductions in water supply deliveries to neighboring water users through improved efficiency of local water use at the expense of regional surplus water availability.

Alternative 1, 2, and 3's contribution to these conditions would not be substantial. In the case of cumulative projects anticipated to potentially generate temporary reductions in water supply deliveries or reduce surplus water supply availability to neighboring water users, Alternative 1, 2, and 3's improvement to water supply deliveries for many water users would help to reduce the severity of any potential cumulative effect. In the case of water users to whom Alternatives 1 through 3 are not forecasted to improve deliveries, potential changes in water supply deliveries would not contribute to any cumulative water supply impacts given, as was noted above, these alternatives' similarity to the No Action Alternative.

Given Alternative 4's larger reductions in CVP and SWP deliveries, its contribution to the potential cumulative conditions described above could be substantial in the event of a dry or critical water year type occurrence during a period when a cumulative project was generating temporary reductions in water supply deliveries or reduce surplus water supply availability to neighboring water users. Alternative 4 could in that situation, amplify an adverse effect on water users impacted by that cumulative project.

H.3 References

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