

Appendix 5A1 Model Assumptions

1 Introduction

The following action alternatives were prepared to evaluate effects of different project operations:

- No Action Alternative 051422
- Alternative 1A 051722
- Alternative 1B 051722
- Alternative 2 051722
- Alternative 3 051722

Sections 2 through 6 describe the assumptions used for each model simulation. Section 7 lists references cited.

The assumptions for all model simulations are also summarized in table format in the following appendices:

- Appendix 5A2, *CALSIM II Model Assumptions Callouts*
- Appendix 5A3, *DSM2 Model Assumptions Callouts*
- Appendix 5A4, *HEC5Q and Reclamation Temperature Model Assumptions Callouts*

Detailed tabulation of delivery specifications in CALSIM II are provided in Appendix 5A5, *CALSIM II Model Delivery Specifications*.

Any use of results of model simulations should observe limitations of the models used as well as the limitations to the modeled alternatives. These results should only be used for comparative purposes. More information regarding limitations of the models used as well as the limitations to the modeled alternatives is included Appendix 5A6, *Model Limitations and Improvements*.

2 Assumptions for the No Action Alternative

This section presents the assumptions used in developing the CALSIM II, DSM2, HEC5Q, and Reclamation Temperature Model simulations of the No Action Alternative.

The No Action Alternative represents CVP and SWP operations to comply with the 2019 Biological Opinions and the 2020 State Water Project Incidental Take Permit regulatory environment as of November 2021 under current climate conditions. The No Action Alternative assumptions include existing facilities and ongoing programs that existed as of November 2021. The No Action Alternative assumptions also include facilities and programs that received approvals and permits by November 2021.

2.1 CALSIM II Assumptions for the No Action Alternative

The following is a description of the assumptions listed in Appendix 5A2, *CALSIM II Model Assumptions Callouts*.

2.1.1 Hydrology

Inflows/Supplies

The CALSIM II model includes the historical hydrology with projected 2020 modifications for operations upstream of the rim reservoirs.

Level of Development

CALSIM II uses a hydrology which is the result of an analysis of agricultural and urban land use and population estimates. The assumptions used for Sacramento Valley land use result from aggregation of historical survey and projected data developed for the California Water Plan Update (Bulletin 160-98). Generally, land use projections are based on Year 2020 estimates (hydrology serial number 2020D09E), however the San Joaquin Valley hydrology reflects draft 2030 land use assumptions developed by Reclamation. Where appropriate Year 2020 projections of demands associated with water rights and CVP and SWP water service contracts have been included. Specifically, projections of full build out are used to describe the American River region demands for water rights and CVP contract supplies, and California Aqueduct and the Delta Mendota Canal SWP/CVP contractor demands are set to full contract amounts.

CVP Settlement Contractor Consumptive Use of Applied Water (CUAW) Demands are modified to match historical annual volumes and monthly distributions, based on historical data from 2000 – 2016. The monthly distributions of annual contract amounts were also modified to match the distributions of CUAW demand.

Demands, Water Rights, CVP/SWP Contracts

CALSIM II demand inputs are preprocessed monthly time series for a specified level of development (e.g. 2020) and according to hydrologic conditions. Demands are classified as CVP project, SWP project, local project, or non-project. CVP and SWP demands are separated into different classes based on the contract type. A description of various demands and classifications included in CALSIM II is provided in the 2008 OCAP BA Appendix D (USBR, 2008a).

The detailed listing of CVP and SWP contract amounts and other water rights assumptions are included in the delivery specification tables in Appendix 5A5, *CALSIM II Model Delivery Specifications*.

CCWD

Contra Costa Water District's (CCWD) annual service area demands are met by CVP service contract deliveries and other CCWD diversions. To be consistent with CCWD's latest modeling, the No Action Alternative model includes in-Delta transfers to meet CCWD demands not otherwise met by CVP service contract deliveries and other CCWD diversions.

2.1.2 Facilities

All CVP-SWP existing facilities are simulated based on operations criteria under current regulatory environment.

CALSIM II includes representation of all the existing CVP and SWP storage and conveyance facilities. Assumptions regarding selected key facilities are included in the callout tables in Appendix 5A2, *CALSIM II Model Assumptions Callouts*.

CALSIM II also represents the flood control weirs such as the Fremont Weir located along the Sacramento River at the upstream end of the Yolo Bypass (Bureau of Reclamation 2017).

The No Action Alternative also includes the Freeport Regional Water Project, located along the Sacramento River near Freeport and the City of Stockton Delta Water Supply Project (30 mgd capacity).

A brief description of the key export facilities located in the Delta and included under the No Action Alternative run is provided below.

The Delta serves as a natural system of channels to transport river flows and reservoir storage to the CVP and SWP facilities in the south Delta, which export water to the projects' contractors through two pumping plants: CVP's C.W. Jones Pumping Plant and SWP's Harvey O. Banks Pumping Plant. Jones and Banks Pumping Plants supply water to agricultural and urban users throughout parts of the San Joaquin Valley, South Lahontan, Southern California, Central Coast, and South San Francisco Bay Area regions.

The Contra Costa Canal and the North Bay Aqueduct supply water to users in the northeastern San Francisco Bay and Napa Valley areas.

Fremont Weir

Fremont Weir is a flood control structure located along the Sacramento River at the head of the Yolo Bypass. To enhance the potential benefits of the Yolo Bypass for various fish species, the Fremont Weir is assumed to be notched to provide increased seasonal floodplain inundation. It is assumed that an opening in the existing weir and operable gates are constructed at invert elevation 14 feet along with two smaller openings and operable gates at invert elevation 18 feet. This structure is further described in the Yolo Bypass Salmonid Habitat Restoration and Fish Passage EIS/EIR Alternative 1.

CVP C.W. Bill Jones Pumping Plant (Tracy PP) Capacity

The Jones Pumping Plant consists of six pumps including one rated at 800 cfs, two at 850 cfs, and three at 950 cfs. Maximum pumping capacity is assumed to be 4,600 cfs with the 400 cfs Delta Mendota Canal (DMC) –California Aqueduct Intertie that became operational in July 2012.

SWP Banks Pumping Plant Capacity

SWP Banks pumping plant has an installed capacity of about 10,300 cfs. The SWP water rights for diversions specify a maximum of 10,300 cfs, but the U. S. Army Corps' of Engineers (ACOE) permit for SWP Banks Pumping Plant allows a maximum pumping of 6,680 cfs. With additional diversions depending on Vernalis flows the total diversion can go up to 10,300 cfs during December 15 – March 15. Additional capacity of 500 cfs (pumping limit up to 7,180 cfs) is allowed to reduce impact of 2020 SWP ITP Spring Outflow Action on the SWP.

CCWD Intakes

The Contra Costa Canal originates at Rock Slough, about four miles southeast of Oakley, and terminates after 47.7 miles at Martinez Reservoir. Historically, diversions at the unscreened Rock Slough facility (Contra Costa Canal Pumping Plant No. 1) have ranged from about 50 to 250 cfs. The canal and associated facilities are part of the CVP; but are operated and maintained by the Contra Costa Water District (CCWD). CCWD also operates a diversion on Old River and the Alternative Intake Project (AIP), the new drinking water intake at Victoria Canal, about 2.5 miles east of Contra Costa Water District's (CCWD) intake on the Old River. CCWD can divert water to the Los Vaqueros Reservoir to store good quality water when available and supply to its customers.

To be consistent with CCWD's latest Los Vaqueros modeling, the No Action Alternative model includes updated local inflow, precipitation, and evaporation values for Los Vaqueros Reservoir.

Suisun Marsh Salinity Control Gates

The Suisun Marsh Salinity Control Gates (SMSCG) are located on Montezuma Slough about 2 miles downstream from the confluence of the Sacramento and San Joaquin Rivers, near Collinsville. The objective of the SMSCG operation is to decrease the salinity of the water in Montezuma Slough. The gates control salinity by restricting the flow of higher salinity water from Grizzly Bay into Montezuma Slough during incoming tides and retaining lower salinity Sacramento River water from the previous ebb tide. Operation of the gates in this fashion lowers salinity in Suisun Marsh channels and results in a net movement of water from east to west through Suisun Marsh.

Red Bluff Pumping Plant

No Action Alternative assumes that the pumping capacity at Red Bluff Pumping Plant is 2,000 cfs.

Hamilton City Pump Station

No Action Alternative assumes that the pumping capacity at Hamilton City Pump Station is 3,000 cfs.

2.1.3 Regulatory Standards

The regulatory standards that govern the operations of the CVP and SWP facilities under the No Action Alternative are briefly described below. Specific assumptions related to key regulatory standards are also outlined below.

D-1641 Operations

The SWRCB Water Quality Control Plan (WQCP) and other applicable water rights decisions, as well as other agreements are important factors in determining the operations of both the Central Valley Project (CVP) and the State Water Project (SWP).

The December 1994 Accord committed the CVP and SWP to a set of Delta habitat protective objectives that were incorporated into the 1995 WQCP and later, were implemented by D-1641. Significant elements in D-1641 include X2 standards, export/inflow (E/I) ratios, Delta water quality standards, real-time Delta Cross Channel operation, and San Joaquin flow standards.

Coordinated Operations Agreement (COA)

The CVP and SWP use a common water supply in the Central Valley of California. Reclamation and DWR have built water conservation and water delivery facilities in the Central Valley in order to deliver water supplies to project contractors. The water rights of the projects are conditioned by the SWRCB to protect the beneficial uses of water within each respective project and jointly for the protection of beneficial uses in the Sacramento Valley and the Sacramento-San Joaquin Delta Estuary. The agencies coordinate and operate the CVP and SWP to meet the joint water right requirements in the Delta.

The Coordinated Operations Agreement (COA), signed in 1986, defines the project facilities and their water supplies, sets forth procedures for coordination of operations, identifies formulas for sharing joint responsibilities for meeting Delta standards as they existed in SWRCB Decision 1485 (D-1485), identifies how unstored flow will be shared, sets up a framework for exchange of water and services between the Projects, and provides for periodic review of the agreement.

Reclamation and DWR re-negotiated COA in 2018. This model includes the new COA. The amendment stipulates a change in responsibility for making storage withdrawals to meet in-basin use (as noted in Table 5A1-1) and a change in export capacity when exports are constrained (Table 5A1-2).

Table 5A1-1. Sharing of Responsibility of Meeting In-basin Use

	CVP	SWP
W	80%	20%
AN	80%	20%
BN	75%	25%
D	65%	35%
C	60%	40%

Table 5A1-2. Sharing of Applicable Export Capacity When Exports Are Constrained

	CVP	SWP
Balanced Water Conditions	65%	35%
Excess Water Conditions	60%	40%

CVPIA (b)(2) Assumptions

Reclamation releases flows for Central Valley Project Improvement Act (CVPIA) 3406(b)(2) water allocation, management, and related actions (B2). The selection of discretionary actions for use of B2 water in each year was based on a May 2003 Department of the Interior policy decision. CALSIM II does not dynamically account for the use of (b)(2) water, but rather assumes (b)(2) actions are achieved through NMFS BO (2019) actions.

Clear Creek Flows

Reclamation releases Clear Creek flows in accordance with the 1960 Memorandum of Agreement (MOA) with CDFW, and the April 15, 2002 SWRCB permit, which established minimum flows to be released to Clear Creek at Whiskeytown Dam. Reclamation operates to a minimum baseflow in Clear Creek of 200 cfs from October through May, and 150 cfs from June through September in all year types except Critical year types. In Critical years, Clear Creek base flows would be reduced below 150 cfs based on available water from Trinity Reservoir. Additional flow may be required for temperature management during the fall. A ramping rate of no more than 25 cfs per hour during nocturnal hours will be used to reduce potential stranding risks to juvenile salmonids during Whiskeytown controlled flow reductions.

In addition, Reclamation creates pulse flows for both channel maintenance and spring attraction flows. For spring attraction flows, Reclamation releases 10 Thousand Acre-Foot (TAF) (measured at the release), with daily releases up to the safe release capacity (approximately 900 cfs, depending on reservoir elevation and downstream capacity), in all year-types except for Critical year-types to be shaped by the Clear Creek Implementation Team in coordination with CVO. For channel maintenance flows, Reclamation would release 10 TAF from Whiskeytown, with a daily release up to the safe release capacity, in all year-types except for Dry and Critical year-types (based on the Sacramento Valley index) to be shaped by the Clear Creek Implementation Team in coordination with CVO. Pulses would be scheduled with CVO. No channel maintenance flows would be scheduled before January 1. For each storm event that results in a Whiskeytown Gloryhole spill of at least 3,000 cfs for 3 days, Reclamation will reduce the channel maintenance flow volume for this year or the following year by 5,000 acre-feet. If two Gloryhole spills occur that meet this criterion in a year, additional channel maintenance flows would not be released in that year. In Critical years, Reclamation would release one spring attraction flow of up to the safe release capacity (approximately 900 cfs) for up to 3 days and would not release any channel maintenance flows. Reclamation could instead, or in addition, use mechanical methods to mobilize gravel or shape the channel if needed to meet biological objectives.

The Clear Creek operations, for CALSIM II modeling purposes, are assumed as follows:

- Minimum flow of 200 CFS from October through May and 150 CFS from June through September in all years except critical years. Minimum flow of 150 CFS in all months in critical years (water-year type based on SWRCB D-1641 40-30-30 index).
- Spring pulse flow totaling a volume of 10 TAF in June of non-critical years. Pulse flows are in addition to minimum flow and are distributed to the whole month's average flow rate.
- 3-day Spring pulse of 900 cfs in Critical years; the other 27 days are at the base flow.
- Channel maintenance flow totaling a volume of 10 TAF in February of all years except dry and critically dry years (volume in addition to minimum flow; distributed to the whole month's average flow rate).

As CALSIM II is a monthly model, ramping rates and release capacity limitations that constrain actual operations are not included. Other flow adjustments for consideration of actual storage and temperature operations are not included.

Previously modeled Clear Creek operations were removed from the CALSIM II model, including CVPIA 3406(b)(2) related flows pre-processed from 2008 OCAP BA model studies and the 2009 NMFS RPA Action 1.1.1 pulse flows.

Upper Sacramento River

In the No Action Alternative, SWRCB WR 90-5 requirements are included. In addition, seasonal operations for Fall flows and Spring pulse flows are included.

Fall flows

Reclamation rebuilds storage and cold water pool for the subsequent year. Maintaining releases to keep late spawning Winter-Run Chinook Salmon redds underwater may drawdown storage necessary for temperature management in a subsequent year.

If Reclamation determines reduced releases are needed to rebuild storage, targets for winter base flows (December 1 through the end of February) from Keswick would be set in October based on Shasta Reservoir end-of-September storage. Table 5A1-3 shows the initial schedule for Keswick Releases based on Shasta Reservoir storage condition; these would be refined through future modeling efforts as part of the seasonal operations planning.

Table 5A1-3 Keswick Dam Release Target Schedule based on Shasta Reservoir End-of-September Storage

Shasta Reservoir End-of-September Storage	Keswick Dam Release Target
≤ 2.2 MAF	3,250 CFS
≤ 2.8 MAF	4,000 CFS
≤ 3.2 MAF	4,500 CFS
> 3.2 MAF	5,000 CFS

For CALSIM II modeling purposes, the Keswick Dam release targets were specified as weighted goals. The weighted goals cause the model to increase or decrease the flow release as the model is able to meet the target flow. The selected weights for the goals would not prevent the model from releasing water from Shasta Reservoir for CVP project regulatory environmental, flood control or water supply purposes.

Shasta Spring pulse flows

Reclamation would release spring pulse flows of up to 150 TAF in coordination with the Upper Sacramento Scheduling Team when the projected total May 1st Shasta Reservoir storage indicates a likelihood of sufficient cold water to support summer cold water pool management, and the pulse does not interfere with the ability to meet performance objectives or other anticipated operations of the reservoir. Reclamation would evaluate the projected May 1st Shasta Reservoir storage at the time of the February forecast to determine whether a spring pulse would be allowed in March and would evaluate the projected May 1st Shasta Reservoir storage at the time of the March forecast to determine whether a spring pulse would be allowed in April. Reclamation anticipates that a projected May 1st storage greater than 4 MAF provides sufficient cold water pool management for Tier 1 and may release the spring pulse if it does not impact the ability to meet project objectives. Reclamation could also determine, in coordination with the Upper Sacramento scheduling team, that while the reservoir is less than 4 MAF, there is sufficient water to do a pulse of up to 150 TAF. The Upper Sacramento Scheduling Team would determine the timing, duration, and frequency of the spring pulse within the 150 TAF volume. Wet hydrology downstream of Keswick Dam may meet the need for pulse flows without increased releases.

The spring pulse could be 0 to 2 pulses of 10,000 cfs at Sacramento River at Wilkins Slough for 3 days each, in a time when Sacramento River at Wilkins Slough flows are less than 9,000 cfs. Following the initial three-day pulse targeting 10,000 cfs at Sacramento River at Wilkins Slough, Keswick flows could reduce by no more than 15% per night for flows greater than 6,000 cfs, and no more than 200 cfs per night for flows between 4,000 and 5,999 cfs.

The determination of when to make the spring pulse in the CALSIM II model depends on the forecasted May 1st storage. For modeling purposes, a rule-of-thumb was used based on water year type and the end-of February storage to estimate the storage forecast. The forecast is done in March and uses end-of previous month storage and forecasted inflows to Shasta until May. The May 1st Shasta Reservoir storage threshold of 4.1 MAF was used consistent with the storage threshold for Tier 1 in the tiered temperature management approach. The model does not consider spring pulses when the estimated May 1st Shasta storage is below 4.1 MAF. In addition, the spring pulses are limited to wet and above normal years (based on Sacramento River 40-30-30 index) as the 4.1 MAF storage threshold in below normal and drier years may not be adequate to identify conditions where the spring pulse will not adversely affect the temperature management or other obligations of the CVP. The model calculates flood control releases from Shasta Reservoir in March and April. If the flood control releases are sufficient to meet the 150 TAF pulse objective, then no additional releases are made. If not, Shasta Reservoir releases are increased to up to 75 TAF in March and then in April, up to a total of 150 TAF of pulse flow in two months.

Continued CALFED Agreements

The Environmental Water Account (EWA) was established in 2000 by the CALFED Record of Decision (ROD). The EWA was initially identified as a 4-year cooperative effort intended to operate from 2001 through 2004 but was extended through 2007 by agreement between the EWA agencies. It is uncertain, however, whether the EWA will be in place in the future and what actions and assets it may include. Because of this uncertainty, the EWA has not been included in the current CALSIM II implementation.

One element of the EWA available assets is the Lower Yuba River Accord (LYRA) Component 1 water. In the absence of the EWA implementation in CALSIM II, the LYRA Component 1 water is assumed to be transferred to South of Delta (SOD) State Water Project (SWP) contractors to help mitigate the impact of the NMFS BO and D1641 on SWP exports during April and May. An additional 500 cfs of capacity is permitted at Banks Pumping Plant from July through September to export this transferred water.

Water Transfers

Lower Yuba River Accord (LYRA)

Acquisitions of Component 1 water under the Lower Yuba River Accord, and use of 500 cfs dedicated capacity at Banks PP during July – September, are assumed to be used to reduce as much of the impact of the Apr – May Delta export actions on SWP contractors as possible.

Phase 8 transfers

Phase 8 transfers are not included in the No Action Alternative simulation.

Short-term or Temporary Water Transfers

Short term or temporary transfers such as Sacramento Valley acquisitions conveyed through Banks PP are not included in the No Action Alternative simulation.

2.1.4 Specific Regulatory Assumptions

Upper Sacramento Flow Management

Model includes SWRCB WR 90-5 and NMFS BO (Oct 2019) Section 3.1 achieved as possible through other modeled actions.

Lower Feather Flow Management

Model includes 1983 DWR, DFG Agreement (minimum flow 750 – 1,700 cfs, depending on runoff and month).

Lower American Flow Management

Model includes Water Forum's 2017 Lower American Flow Management Standard where the flows range from 500 to 2,000 cfs based on time of year and annual hydrology. Planning minimum storage is represented in CALSIM with a 275 TAF end-of December storage target in Folsom.

Folsom Flood Control Diagram

The 2019 Folsom Water Quality Control Manual relies on daily forecasts through the flood season; monthly implementation is able to use an updated time series instead of the old SAFCA-based timeseries.

Delta Outflow (Flow and Salinity)

SWRCB D-1641

All Delta outflow requirements per SWRCB D-1641 are included in the No Action Alternative simulation. Similarly, for the February through June period the X2 standard is included in the No Action Alternative simulation.

Delta Smelt Summer-Fall Habitat Action

The Delta Smelt Habitat Action is intended to improve Delta Smelt food supply and habitat, thereby contributing to the recruitment, growth, and survival of Delta Smelt. Reclamation and DWR propose to use structured decision making to implement Delta Smelt habitat actions as described in the 2019 BiOps and 2020 SWP ITP.

The action will initially include modifying project operations to maintain a monthly average 2 ppt isohaline at 80 km from the Golden Gate in above normal and wet water years in September and October. Reclamation and DWR will also implement additional measures that are expected to achieve additional benefits. These measures include, but are not limited to:

- Suisun Marsh Salinity Control Gate (SMSCG) operations described in the Operation Criteria section of this document.
- An additional 100 TAF of Delta Outflow is provided in Wet and Above Normal water years by cutting SWP exports in June through September as described in section 8.19 of the ITP. SWP allocations have been reduced in April and May to ensure the water is gained by cutting SWP exports. No more than 40 TAF of the additional outflow is immediately used to reach X2 of 80 km in June through August. The remaining SWP export cuts is backed up into Oroville for future use. If that carryover water in Oroville is likely to spill, it can be used to augment outflow in August to reach an X2 of 80 km. Otherwise, the carryover is used the following year depending on that year's water type as follows: the water is kept for SWP deliveries for critical water years, used for SMSCG operations in June through September for dry water years, released in May to augment Delta Outflow regardless of X2 for Below Normal water years, and used to either to meet X2 or for SMSCG operations by September for Above Normal and Wet water years.

In the Delta Smelt Habitat Action Plan, the specifics of the flow and habitat actions will be more fully defined through a structured decision making or other review process.

For CALSIM II modeling purposes, the Delta Outflow action is assumed as maintaining an X2 position of 80 km in September through October of wet and above normal years (based on the 40-30-30 Sacramento River Index). A ramping up of outflow preceding the action is assumed as achieving an X2 position of 82 km for last 14 days of August. The model tries to meet Delta outflow augmentation in the fall primarily through export reductions. CVP water operations were adjusted to balance reservoir operations in response to these reductions.

Combined Old and Middle River Flows

Reclamation and DWR propose to operate the CVP and SWP in a manner that maximizes exports while minimizing entrainment of fish and protecting critical habitat.

Proposed OMR management is modeled as follows:

Projects operate to an OMR index no more negative than a 14-day moving average of -5,000 cfs between January 1 and June 30 except for the following conditions:

- **Integrated Early Winter Pulse Protection:** After December 1, and when the 3-day average turbidity is 12 NTU or greater at Old River at Bacon Island (OBI), Prisoner's Point (PPT), and Victoria Canal (VCU), Reclamation and DWR propose to operate to -2,000 cfs of the 14-day average OMR index for 14 days. The same model index of SAC_RI developed for the USFWS RPA Action I representation is used in the model to determine when the turbidity exceeds 12 NTU.
- **Turbidity Bridge Avoidance:** For January and February in any water year type, if the Turbidity trigger is reached (SAC_RI greater than or equal to 20,000 cfs), Projects operate to 14-day average OMR Index if -2000 cfs for five days. For March through June of Wet and Above Normal years, it is assumed that there will be one event of turbidity bridge avoidance in each month (-2000 cfs for five days).
- **OMR Storm-Related Flexibility:** It is assumed that there may be storm-related OMR management flexibility in January and February. In wet years, it is assumed that storm events will coincide with turbidity bridge events and no OMR flexibility is modeled. In Above Normal and Below Normal years, it is assumed that there will be one opportunity in January and one opportunity in February to operate to a more negative OMR index than -5000 cfs. This is modeled as 14-day OMR index of -6,250 cfs for 6 days in each month. In dry years, it is assumed that one opportunity occurs either in January or February but not both months.
- **Species-specific cumulative salvage or loss threshold:** Since salvage or loss cannot be modeled in CALSIM II, historic salvage data at the fish facilities at Banks and Jones Pumping Plants and fish catch data at Chipps Island trawl during water years 2010 – 2018 were analyzed. Historic salvage data provides the potential timing of triggering the 50% and 75% levels of the proposed single year loss thresholds. The Chipps Island catch data provides the migration timing and estimates for when the 95% of Winter-Run and Steelhead have migrated out of the Delta, which is the proposed offramp for the real-time OMR management for these species. Based on this historic data, the modeling used an OMR index of negative 3,500 CFS in April and May of all non-critically dry year-types when it is assumed that the 50% of the proposed single year loss thresholds for one or more of the species will be exceeded.

South Delta Export-San Joaquin River Inflow Ratio

From April 1 to May 31, exports are restricted by the ratio of Vernalis flow (cfs) to combined CVP and SWP exports described in the ITP 8.17. The ratio varies based on water year type as shown in Table 5A1-4.

Table 5A1-4. San Joaquin River Inflow Ratio

Water Year Type	SJR I:E Ratio
Critically Dry	1:1
Dry	2:1
Below Normal	3:1
Above Normal	4:1
Wet	See below

Per section 8.10 of the ITP, the SWP share to meet the SJR I:E ratio requirement is 35% in balanced Delta conditions and 40% in excess Delta conditions.

During wet water years, the reduction in SWP exports in April and May to meet the SJR I:E ratio is capped at 150 TAF. The first 30 TAF of SWP exports that would be cut because of the SJR I:E ratio can instead be exported. Then, if needed, the next 150 TAF of SWP exports in April and May will be cut to meet the SJR I:E ratio. After 150 TAF of SWP exports has been cut, there is no more need to cut SWP exports to meet the SJR I:E ratio (8.18 ITP).

The following two requirements must be met for SJR I:E ratio offramp: Delta Outflow must be greater than 44,500 cfs and flow on the San Joaquin River at Vernalis must be greater than 21,750.

The decision to carryover water under ITP 8.18 would be made based on real-time analysis, including fish monitoring, which is difficult to simulate in CALSIM. Since no other actions in the ITP depends on the carryover water, this is not modeled.

Maintaining health and safety pumping standard of 1,500 cfs takes precedence over meeting the SJR I:E ratio.

Exports at the South Delta Intakes

Exports at Jones and Banks Pumping Plant are restricted to their permitted capacities per SWRCB D-1641 requirements. In addition, Banks Pumping Plant is subject to the 2020 SWP ITP Spring Outflow Action during April and May. Additional 500 cfs pumping is allowed to reduce impact of D1641 on SWP during the July through September period.

Under D-1641 the combined export of the CVP Tracy Pumping Plant and SWP Banks Pumping Plant is limited to a percentage of Delta inflow. The percentage ranges from 35 to 45 percent during February depending on the January eight river index and is 35 percent during March through June months. For the rest of the months 65 percent of the Delta inflow is allowed to be exported.

A minimum health and safety pumping of 1,500 cfs is assumed from January through June.

Delta Water Quality

The No Action Alternative simulation includes SWRCB D-1641 salinity requirements. However, not all salinity requirements are included as CALSIM II is not capable of predicting salinities in

the Delta. Instead, empirically based equations and models are used to relate interior salinity conditions with the flow conditions. DWR’s Artificial Neural Network (ANN) trained for salinity is used to predict and interpret salinity conditions at the Emmaton, Jersey Point, Rock Slough, and Collinsville stations. Emmaton and Jersey Point standards are for protecting water quality conditions for agricultural use in the western Delta and they are in effect from April 1 to August 15. The EC requirement at Emmaton varies from 0.45 mmhos/cm to 2.78 mmhos/cm, depending on the water year type. The EC requirement at Jersey Point varies from 0.45 to 2.20 mmhos/cm, depending on the water year type. The Rock Slough standard is for protecting water quality conditions for M&I use for water exported through the Contra Costa Canal. It is a year-round standard that requires a certain number of days in a year with chloride concentration less than 150 mg/L. The number of days requirement is dependent upon the water year type. The Collinsville standard is applied during October through May months to protect water quality conditions for migrating fish species, and it varies between 12.5 mmhos/cm in May and 19.0 mmhos/cm in October.

San Joaquin River Restoration Program

Friant Dam releases required by the San Joaquin River Restoration Program are included in the No Action Alternative. More detailed description of the San Joaquin River Restoration Program is presented in the Appendix 3A, *No Action Alternative: Central Valley Project and State Water Project Operations*, of the LTO EIS (Bureau of Reclamation 2015a).

Recapture of San Joaquin River Restoration water has been simulated. Recapture does not happen in months when there is a flood release from Friant. Recapture on the San Joaquin River occurs at Patterson Irrigation District (PID), West Stanislaus Irrigation District (WSID), and Banta Carbona Irrigation District (BCID) based on the assumptions for future capacities shown in Table 5A1-5. Delta Recapture at Banks and Jones Pumping Plants is assessed in a new final model cycle utilizing unused capacity. Simulated Banks Pumping of Recaptured water does not occur when Banks is making cuts for ITP Actions. Any San Joaquin River Restoration water that cannot be Recaptured is released as Delta Outflow.

Table 5A1-5. San Joaquin River Restoration Recapture

	PID	BCID	WSID
Oct	130	150	180
Nov	170	180	220
Dec	195	180	230
Jan	195	180	230
Feb	195	180	210
Mar	170	100	190
Apr	160	100	160
May	115	50	120
Jun	60	40	40
Jul	15	0	0
Aug	30	75	0
Sep	50	100	120

2.1.5 Operations Criteria

Fremont Weir Operations

To provide seasonal floodplain inundation in the Yolo Bypass, the 14- and the two 18-foot elevation gates are opened between November 1 and March 15. The gates would open to allow a maximum flow of 6,000 cfs when the water surface elevation in the river reaches 28 feet. The gates are operated to limit maximum spill to 6,000 cfs until the Sacramento River stage reaches the existing Fremont Weir crest elevation. When the river stage is at or above the existing Fremont Weir crest elevation, the notch gates are assumed to be closed. While desired inundation period is on the order of 30 to 45 days, gates are not managed to limit to this range, instead the duration of the event is governed by the Sacramento River flow conditions. The spills at about 21 feet river stage would be around 1,000 cfs. This operation is further described in the Yolo Bypass Salmonid Habitat Restoration and Fish Passage EIS/EIR Alternative 1.

Delta Cross Channel Gate Operations

Delta Cross Channel (DCC) Gates are assumed to be operated based on the proposed DCC operational changes described in Table 2 of the Delta Cross Channel Temporary Closure Final Environmental Assessment (Bureau of Reclamation 2012a). However, model representation of the proposed DCC operations remain the same as the SWRCB D-1641 standards and NMFS BO Action 4.1.2 (described below), as the proposed changes cannot be captured within the CALSIM model.

SWRCB D-1641 DCC standards provide for closure of the DCC gates for fisheries protection at certain times of the year. From November through January, the DCC may be closed for up to 45 days. From February 1 through May 20, the gates are closed every day. The gates may also be closed for 14 days during the May 21 through June 15 time period. Reclamation determines the timing and duration of the closures after discussion with USFWS, CDFW, and NMFS.

NMFS BO Action 3.4.1 requires gates to be operated based on the presence of salmonids and water quality from October 1 through November 30; and gates to be closed from December 1 to January 31, except for short-term operations to maintain water quality. CALSIM II includes the NMFS BO DCC gate operations in addition to the D-1641 gate operations. When the daily flows in the Sacramento River at Wilkins Slough exceed 7,500 cfs (flow assumed to flush salmon into the Delta), DCC is closed for a certain number of days in a month as described in Appendix 5A of the LTO EIS (Bureau of Reclamation 2015b). During October 1 – December 14, if the flow trigger condition is such that additional days of DCC gates closure is called for, however water quality conditions are a concern and the DCC gates remain open, then Delta exports are limited to 2,000 cfs for each day in question.

Suisun Marsh Salinity Control Gates

SWRCB D-1641

The SMSCG are operated on an as needed basis to meet SWRCB D-1641 water quality standards in Montezuma Slough. The water quality standard includes the period between October through May. Operations are determined from data at SWRCB D-1641 compliance stations, hydrologic conditions, weather, Delta outflow, tide, fishery considerations, and other factors. The duration of gate operation may range from no use to full use for the entire October through May period.

The No Action Alternative CALSIM II considers the effect of SMSCG operations, when SMSCG is used to meet SWRCB D-1641 water quality standards in Montezuma Slough. As the CALSIM ANN was trained with SMSCG operations occurring in the months from October through February, evaluation of an SMSCG operations trigger was focused to the months of March through May. Previously versions of CALSIM had not considered gate operations during these months. Historical operations and salinity were reviewed to develop a threshold parameter and value for commencing SMSCG operations. Through this analysis, use of prior month X2 to trigger SMSCG operations was selected. SMSCG operations are triggered in March through May based on the previous months X2 value. If the previous month's X2 is greater than the value in Table 5A1-6, then SMSCG operations are triggered.

Table 5A1-6. SMSCG X2 Triggers

Month	X2
October	88
November	88
December	84
January	82
February	71
March	71
April	73
May	73

During SMSCG operations, the net flow from east to west through the Montezuma Slough generally increases by 2,200 to 2,800 CFS, and salinity is reduced in Suisun Marsh channels. Concurrently, salinity may increase in the Sacramento River unless Delta outflow is increased to counteract the effect of the SMSCG operations. Through iterative testing with the CALSIM II and DSM2 models, it was determined that Delta outflow had to be increased by 500 CFS in order to balance the potential effect of SMSCG operations on the X2 position when the X2 position is estimated to be greater than 76 km.

The CALSIM II model used for the No Action Alternative was revised to include an adjustment to Artificial Neural Network (ANN) flow-salinity calculations when the SMSCG are being operated. In the ANN calculations for X2 position, the input value for Delta outflow for the ANN was reduced by 500 CFS for months in which SMSCG was assumed to operate. In the ANN calculations for EC at the compliance locations used in CALSIM II, the input value for net DICU for the ANN was increased by 500 CFS for months in which SMSCG was assumed to operate. This adjustment allows the ANN calculations in the CALSIM II model to recognize the potential salinity effect of the SMSCG operations when determining reservoir releases for maintaining Delta outflow and compliance with SWRCB D-1641 and other flow-salinity related model functions. When X2 or salinity conditions control water operations, these adjustments result in an increase in Delta outflow for a given salinity condition.

This revision to the CALSIM II model is an approximate method for evaluating changes in water operations due to changes in SMSCG operations. A more complete approach would be the use of ANN models that consider SMSCG operations directly as part of the flow-salinity calculations used in CALSIM II.

2019 BiOps

The Baseline considers the effect of SMSCG operations, when SMSCG is used to meet SWRCB D-1641 water quality standards in Montezuma Slough, and when SMSCG is used to achieve the goals of the Delta Smelt Habitat Action Plan. The revisions included the adjustment to Artificial Neural Network (ANN) flow-salinity calculations previously discussed.

The SMSCG operations to achieve the goals of the Delta Smelt Habitat Action Plan, for CALSIM II modeling purposes, are assumed as follows: for the below normal, above normal, and wet year types, during the months June through September, if the X2 position is estimated to be greater than 76 km and 60 days of SMSCG operations have not occurred since June 1, the SMSCG are assumed to operate for the month. These assumptions represent the maximum extent of the SMSCG operations in support of the Delta Smelt Habitat Action.

CDFW ITP

Based on section 9.3.1 of the ITP, a trigger is added for SMSCG operations for 30 days in Dry water years following either a Wet, Above Normal, or Below Normal water year when the carryover water from the additional 100 TAF of Delta Outflow (Section 19.9 of the ITP) described in the Delta Smelt Habitat Action Plan is available for use.

Allocation Decisions

CALSIM II includes allocation logic for determining deliveries to north-of-Delta and south-of-Delta CVP and SWP contractors. The delivery logic uses runoff forecast information, which incorporates uncertainty in the hydrology, and standardized rule curves (i.e. Water Supply Index versus Demand Index Curve). The rule curves relate forecasted water supplies to deliverable “demand,” and then use deliverable “demand” to assign subsequent delivery levels to estimate the water available for delivery and carryover storage. Updates of delivery levels occur monthly from January 1 through May 1 for the SWP and March 1 through May 1 for the CVP as runoff forecasts become more certain. The south-of-Delta SWP delivery is determined based on water supply parameters and operational constraints. The CVP system wide delivery and south-of-Delta delivery are determined similarly upon water supply parameters and operational constraints with specific consideration for export constraints and reservoir storage levels. The CVP south-of-Delta allocation may be increased through July if storage conditions in the Federal position of San Luis Reservoir are high enough to support an increase.

San Luis Operations

CALSIM II sets targets for San Luis storage each month that are dependent on the current South-of-Delta allocation and upstream reservoir storage. When upstream reservoir storage is high, allocations and San Luis fill targets are increased. During a prolonged drought when upstream storage is low, allocations and fill targets are correspondingly low. For the No Action Alternative simulation, the San Luis rule curve is managed to minimize situations in which shortages may occur due to lack of storage or exports.

New Melones Operations

In addition to flood control, New Melones is operated for four different purposes: minimum flows, water quality, Bay-Delta flow, and water supply.

Minimum Flows

These flows are patterned to provide fall attraction flows in October and outmigration pulse flows in spring months (April 15 through May 15 in all years), and total up to 98.9 TAF to 483.7 TAF annually depending on the hydrological conditions based on the San Joaquin 60-20-20 Index (Table 5A1-7 through Table 5A1-9). The 60-20-20 Index used in the modeling implements a 75% exceedance forecasted water year type for the months of February through April. The final water year type is used for May through January.

Table 5A1-7. Stanislaus Annual Flow Allocation

60-20-20 Index	Minimum Flow Allocation (TAF)
Critical	185.3
Dry	234.1
Below Normal	346.7
Above Normal	346.7
Wet	483.7

Table 5A1-8. Monthly “Base” Shaping of Minimum Flows Based on the Annual Volume

Annual Fishery Flow Volume (TAF)	Monthly Base Flows (cfs)											
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr. 1-14	May 16-31	June	July	Aug.	Sept.
185.3	577.4	200	200	212.9	214.3	200	200	150	150	150	150	150
234.1	635.5	200	200	219.4	221.4	200	500	284.4	200	200	200	200
346.7	774.2	200	200	225.8	228.6	200	1,471.4	1,031.3	363.3	250	250	250
483.7	796.8	200	200	232.3	235.7	1,521	1,614.3	1,200	940	300	300	300

Table 5A1-9. April 15 through May 15 “Pulse” Flows Based on the Annual Fishery Volume

Annual Fishery Flow Volume (TAF)	Fishery Pulse Flows (cfs)	
	April 15–30	May 1–15
185.3	687.5	666.7
234.1	1,000	1,000
346.7	1,625	1,466.7
483.7	1,212.5	1,933.3

Water Quality

Releases are made to the Stanislaus River below Goodwin Dam to meet the D-1422 dissolved oxygen content objective. Surrogate flows representing releases for dissolved oxygen requirement in CALSIM II are presented in Table 5A1-10. The surrogate flows are reduced for critical years under the San Joaquin 60-20-20 Index. These flows are met through releases from New Melones without any annual volumetric limit.

Table 5A1-10. Surrogate flows representing releases for dissolved oxygen requirement in CALSIM II

	Non-Critical Years	Critical Years
January	0.0	0.0
February	0.0	0.0
March	0.0	0.0
April	0.0	0.0
May	15.2	11.9
June	16.3	12.3
July	17.4	12.3
August	14.8	11.9
September	0.0	0.0
October	0.0	0.0
November	0.0	0.0
December	0.0	0.0

Water Supply

Water supply refers to deliveries from New Melones to water rights holders (Oakdale Irrigation District [ID] and South San Joaquin ID) and CVP eastside contractors (Stockton East Water District [WD] and Central San Joaquin Water Control District [WCD]).

Water is provided to Oakdale ID and South San Joaquin ID in accordance with their 1988 Settlement Agreement with Reclamation (up to 600 TAF based on hydrologic conditions),

limited by consumptive use. The conservation account of up to 200 TAF storage capacity defined under this agreement is not modeled in CALSIM II.

Water Supply-CVP Eastside Contractors

Annual allocations are determined using the San Joaquin 60-20-20 Index (using a 75% exceedance forecast for February through April) for Stockton East WD and Central San Joaquin WCD (Table 5A1-11) and are distributed throughout 1 year using monthly patterns.

Table 5A1-11. Annual allocations for Stockton East WD and Central San Joaquin WCD

60-20-20 Index	CVP Contractor Allocation (TAF)
Critical	0
Dry	49
Below Normal, Above Normal, and Wet	155

2.1.6 Non-CVP/SWP Operations

Yuba

The Yuba County Water Agency (YCWA) converted their operations model from a monthly timestep to a daily timestep as part of their FERC Relicensing process for a more accurate representation of Yuba River Development Project (YRDP) operations. To be consistent with YCWA’s planning model, Yuba River Development Project Model (YRDPM), the CALSIM II inputs related to the Yuba River operations have been updated.

Mokelumne

East Bay Municipal Utility District (EBMUD) provided the timeseries input for the Mokelumne River operation from EBMUD Study #8151. This model included a planning level demand of 194 MGD for EBMUD, assumptions for upstream diversions, Water Rights Permit 10478 Mitigation Measure FISH-1, the in-stream flow requirements from the Joint Settlement Agreement (JSA) with CDFW and U.S.FWS and the Drought Management Program Guidelines from June 2020.

Tuolumne

1996 FERC license number 2299 requires flows based on the San Joaquin Index. The Tuolumne simulation uses the final San Joaquin Index starting in April. The Base Flows (including an attraction pulse flow Oct 1-15) as set at LaGrange are shown in Table 5A1-12. For the Base Flows, if the actual Index is between to San Joaquin Index values in Table 5A1-12, the model releases the lower flow.

Table 5A1-12. Tuolumne River Base Flow Requirement

San Joaquin Index	October (cfs)	November through May (cfs)	June through September (cfs)
0	125	150	50
1499	125	150	50
1500	125	150	50
2000	150	150	50
2200	150	150	75
2400	207	180	75
2700	215	175	75
3100	397	300	250
10000	397	300	250

The FERC flow requirement at La Grange also includes an Outmigration Pulse in April 15 through May 15. The Pulse Flow (shown in Table 5A1-13) is in addition to the Base Flow. For the Pulse Flows, if the actual Index is between to San Joaquin Index values in Table 5A1-13, the model releases the lower flow.

Table 5A1-13. Tuolumne River Pulse Flow Requirement

San Joaquin Index	Pulse (cfs)
0	92
1499	92
1500	166
2000	270
2200	306
2400	297
2700	496
3100	743
10000	743

The FERC flow requirement requires linear interpolation between San Joaquin Index values. The model simulates this by releasing an additional pulse in the April 15 through May 15 pulse period that is the difference between the annual FERC flows using the linear interpolation and the FERC flows that were released using the lower flow value.

Merced

Minimum flows on the Merced River are set at Crocker Huffman Diversion Dam and Shaffer Bridge. At Crocker Huffman, minimum flows are set according to the 1926 Cowell Agreement.

Under the Cowell Agreement, flows are 100 cfs in March; 175 cfs in April; 225 cfs in May; 250 cfs from the first day in June until the natural flow of the Merced River falls below 1,200 cfs; 225 cfs flow for the next 31 days; 175 cfs flow for the next 31 days; 150 cfs for the next 30 days; and 50 cfs thereafter or the natural inflow into Lake McClure, whichever is less, through the last day of February. To be consistent with Merced Irrigation District’s FERC modeling, the minimum flow schedule in Table 5A1-14 was used.

Table 5A1-14. The Merced River’s modeled Cowell Agreement Flow Requirement

Month	Cowell Agreement (cfs)
October	50 or inflow
November	50 or inflow
December	50 or inflow
January	50 or inflow
February	50 or inflow
March	100
April	175
May	225
June	250
July	225
August	175
September	150

Minimum flows at Shaffer Bridge are set in accordance with FERC license numbers 2179 and 2467 and an additional 12.5 TAF release in October based on the 2002 Merced ID and CDFW Memorandum of Understanding (MOU). When determining the FERC flow requirement, a Wet year is a year with greater than 450 TAF of inflow to Lake McClure from April through July; otherwise it is a Dry year. The flows required under the FERC license are shown by month in Table 5A1-15.

Table 5A1-15. The Merced River’s FERC minimum Flow Requirement

Month	Wet (cfs)	Dry (cfs)
October	50.81	38.23
November	100	75
December	100	75
January	75	60
February	75	60
March	75	60
April	75	60
May	75	60
June	25	15
July	25	15

Month	Wet (cfs)	Dry (cfs)
August	25	15
September	25	15

The Davis-Grunsky contract expired on December 31, 2017, since which time MID has ceased providing the flows.

2.2 DSM2 Assumptions for the No Action Alternative

The following is a description of the assumptions listed in Appendix 5A3, *DSM2 Model Assumptions Callouts*.

2.2.1 River Flows

For DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CALSIM II.

2.2.2 Tidal Boundary

The tidal boundary condition at Martinez is based on an adjusted astronomical tide normalized for sea level rise (Ateljevich and Yu, 2007).

2.2.3 Water Quality

Martinez EC

The Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CALSIM II and the pure astronomical tide (Ateljevich, 2001).

Vernalis EC

For the DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CALSIM II.

2.2.4 Facilities

Delta Cross Channel

Delta Cross Channel gate operations are modeled in DSM2.

South Delta Temporary Barriers

South Delta Temporary Barriers are included in the No Action Alternative simulation. The three agricultural temporary barriers located on Old River, Middle River and Grant Line Canal are included in the model. The fish barrier located at the Head of Old River is not included in the model.

Clifton Court Forebay Gates

Clifton Court Forebay gates, which control flow to Clifton Court Forebay, are assumed in the model.

Suisun Marsh Salinity Control Gates

The model assumes installation of the SMSCG near the upstream end of Montezuma Slough.

2.2.5 Operations Criteria

Delta Cross Channel

The number of days in a month the DCC gates are open is based on the monthly time series from CALSIM II.

South Delta Temporary Barriers

South Delta Temporary Barriers are operated based on San Joaquin flow conditions. The agricultural barriers on Old and Middle Rivers are assumed to be installed starting from May 16 and the one on Grant Line Canal from June 1. All three agricultural barriers are allowed to operate until November 30. The tidal gates on Old and Middle River agricultural barriers are assumed to be tied open from May 16 to May 31.

Clifton Court Forebay Gates

Clifton Court Forebay gates are operated based on the Priority 3 operation, where the gate operations are synchronized with the incoming tide to minimize the impacts to low water levels in nearby channels. The Priority 3 operation is described in the 2008 OCAP BA Appendix F Section 5.2 (USBR, 2008b).

Suisun Marsh Salinity Control Gates

The DSM2 model used for the No Action Alternative reads CALSIM II output as an input to determine which months to operate the SMSCG. Refer to Section 2.1, *CALSIM II Assumptions for the No Action Alternative*, Suisun Marsh Salinity Control Gates description for more information.

2.3 HEC5Q and Reclamation Temperature Model Assumptions for the No Action Alternative

The following is a description of the assumptions listed in Appendix 5A4, *HEC5Q and Reclamation Temperature Model Assumptions Callouts*.

2.3.1 Sacramento-Trinity Rivers

Reservoir Storage Conditions

Trinity Lake, Lewiston Lake, Whiskeytown Lake, Shasta Lake, Keswick Reservoir, and Black Butte Lake are all operated per CALSIM II output.

Shasta Temperature Management

Temperature strategy focuses on maximizing duration of temperature below 53.5⁰ F at Sacramento River at Clear Creek (CCR) from May 15th through October 31st. The strategy consists of four temperature tiers, based on Shasta cold water pool or storage volume. As Shasta cold water pool or storage decrease, the 53.5⁰ F compliance time window narrows or focuses on the projected time when the Winter-run eggs have the highest dissolved oxygen requirement. The updated strategy applies a tactical approach. Temperature release targets are adjusted based on

information from near-term changes in Shasta storage and meteorological conditions. Review Shasta Summer Cold Water Pool Management section in 2019 NMFS BiOp for more details.

Trinity Temperature Management

Releases from lower, auxiliary outlet are allowed when normal outlet releases are too warm.

2.3.2 American River Reservoir Storage Conditions

Folsom Lake and Lake Natoma are operated per CALSIM II output.

Folsom Temperature Management

Similar to 2009 NMFS BiOp Appendix 2D (See 2015 LTO for details).

2.3.3 Stanislaus River Reservoir Storage Conditions

New Melones Lake, Lake Tulloch, and Goodwin Reservoir are all operated per CALSIM II output.

2.3.4 Feather River Reservoir Storage Conditions

Lake Oroville and Thermalito Afterbay are operated per CALSIM II output.

3 Assumptions for Alternative 1A

This section presents the assumptions used in developing the CALSIM II, DSM2, HEC5Q, and Reclamation Temperature Model simulations of Alternative 1A. Alternative 1A represents operations with a Sites Reservoir capacity of 1.5 MAF and a Dunnigan pipeline that connects the TC Canal to the CBD in addition to the facilities, regulations and operations described in the No Action Alternative. In Alternative 1A, a bridge across the reservoir provides access to the west of the Project; CVP operational flexibility is not considered; and Sites operations affect operations at Jones PP, Banks PP, Shasta, and Oroville. Alternative 1A conveys water from the Sacramento River through existing or upgraded TC Canal and GCID Main Canal facilities to new and upgraded regulating reservoirs and into the new Sites Reservoir. Existing and new facilities convey water from Sites Reservoir for uses along the TC Canal, along the GCID Main Canal and down the TC Canal to the new Dunnigan Pipeline and the CBD for release to the Yolo Bypass or Sacramento River.

The unique features of Alternative 1A include the following:

- Reclamation investment is not considered.

Please review Chapter 2, Project Description and Alternatives for more details.

3.1 CALSIM II Assumptions for Alternative 1A

The following is a description of the assumptions listed in Appendix 5A2, *CALSIM II Model Assumptions Callouts*.

3.1.1 Hydrology

Inflows/Supplies

Same as the No Action Alternative.

Level of Development

Same as the No Action Alternative.

Demands, Water Rights, CVP/SWP Contracts

Same as the No Action Alternative.

3.1.2 Facilities

Same as the No Action Alternative.

Fremont Weir

Same as the No Action Alternative.

CVP C.W. Bill Jones Pumping Plant (Tracy PP) Capacity

The Jones Pumping Plant consists of six pumps including one rated at 800 cfs, two at 850 cfs, and three at 950 cfs. Maximum pumping capacity is assumed to be 4,600 cfs with the 400 cfs Delta Mendota Canal (DMC)–California Aqueduct Intertie that became operational in July 2012.

Available capacity may be utilized for Sites deliveries to Incremental Level 4 Refuges.

SWP Banks Pumping Plant Capacity

SWP Banks pumping plant has an installed capacity of about 10,300 cfs. The SWP water rights for diversions specify a maximum of 10,300 cfs, but the U. S. Army Corps' of Engineers (ACOE) permit for SWP Banks Pumping Plant allows a maximum pumping of 6,680 cfs. With additional diversions depending on Vernalis flows the total diversion can go up to 10,300 cfs during December 15 – March 15. Additional capacity of 500 cfs (pumping limit up to 7,180 cfs) is allowed to reduce impact of 2020 SWP ITP Spring Outflow Action on the SWP.

Available capacity may be utilized for Sites deliveries to South of Delta Storage Partners and Incremental Level 4 Refuges.

CCWD Intakes

Same as the No Action Alternative.

Suisun March Salinity Control Gates

Same as the No Action Alternative.

Sites Reservoir

Alternative 1A assumes a Sites Reservoir with a maximum capacity of 1.5 MAF and 60 TAF of dead pool storage.

Dunnigan Pipeline

Alternative 1A assumes a pipeline, connecting the southern end of the TC Canal to the Colusa Basin Drain, with a maximum capacity of 1,000 cfs.

Red Bluff Pumping Plant

Alternative 1A assumes that the addition of two pumps will increase pumping capacity at Red Bluff Pumping Plant from 2,000 cfs to 2,500 cfs. TC Canal conveyance capacity from Red Bluff Pumping Plant to Funks Reservoir is limited to 2,100 cfs.

Hamilton City Pump Station

Alternative 1A assumes that the pumping capacity at Hamilton City Pump Station, used for diversion of water to Sites, is 3,000 cfs. GCID Main Canal capacity from Hamilton City Pump Station to the Terminal Regulating Reservoir is limited to 1,800 cfs.

3.1.3 Regulatory Standards

The regulatory standards that govern the operations of the CVP and SWP facilities are briefly described below. Specific assumptions related to key regulatory standards are also outlined below.

D-1641 Operations

Same as the No Action Alternative.

Coordinated Operations Agreement (COA)

Same as the No Action Alternative.

CVPIA (b)(2) Assumptions

Same as the No Action Alternative.

Clear Creek Flows

Same as the No Action Alternative.

Upper Sacramento River

Same as the No Action Alternative.

Continued CALFED Agreements

Same as the No Action Alternative.

Water Transfers

Lower Yuba River Accord (LYRA)

Same as the No Action Alternative.

Phase 8 transfers

Same as the No Action Alternative.

Short-term or Temporary Water Transfers

Same as the No Action Alternative.

3.1.4 *Specific Regulatory Assumptions*
Upper Sacramento Flow Management

Same as the No Action Alternative.

Lower Feather Flow Management

Same as the No Action Alternative.

Lower American Flow Management

Same as the No Action Alternative.

Folsom Flood Control Diagram

Same as the No Action Alternative.

Delta Outflow (Flow and Salinity)

Same as the No Action Alternative.

Combined Old and Middle River Flows

Same as the No Action Alternative.

South Delta Export-San Joaquin River Inflow Ratio

Same as the No Action Alternative.

Exports at the South Delta Intakes

Same as the No Action Alternative.

Delta Water Quality

Same as the No Action Alternative.

San Joaquin River Restoration Program

Same as the No Action Alternative.

3.1.5 *Operations Criteria*
Fremont Weir Operations

Same as the No Action Alternative.

Delta Cross Channel Gate Operations

Same as the No Action Alternative.

Suisun Marsh Salinity Control Gates

Same as the No Action Alternative.

Allocation Decisions

Same as the No Action Alternative.

San Luis Operations

Same as the No Action Alternative.

New Melones Operations

Same as the No Action Alternative.

Sites Operations

Sites Diversions

Diversions to Sites Reservoir would be made from the Sacramento River at the existing RBPP near Red Bluff and the existing GCID Hamilton City Pump Station near Hamilton City. RBPP serves as the primary diversion location. For diversions to occur, all the criteria below need to be met:

- Delta is in excess conditions
- Sacramento River is not fully appropriated (i.e., diversions may only occur between September 1 and June 14)
- Shasta is not operating to Upper Sacramento River Spring Pulse Flows
- Minimum Bypass flows in Sacramento River at:
 - RBPP: 3,250 cfs
 - Hamilton City Pump Station: 4,000 cfs
 - Wilkins Slough:
 - 10,700 cfs in October through June
 - 5,000 cfs in all other months
- Bend Bridge Pulse Protection:
 - Initiation: 3-day average Sacramento River must exceed 8,000 cfs and 3-day average tributary flow must exceed 2,500 cfs.
 - Duration: 7 days upon initiation, or exceedance of 25,000 cfs at Sacramento River at Bend Bridge
 - After completion of pulse protection period, resetting criteria must be met for another pulse protection period to commence: 3-day Sacramento River flow must go below 7,500 cfs for 7 consecutive days and 3-day moving average tributary flow must go below 2,500 cfs for 7 consecutive days

Sites Releases

Sites participants are located both north and south of the Sacramento-San Joaquin River Delta. Sites participants can be divided into several categories:

- Tehama Colusa Canal Authority,
- Reclamation District 108,
- Glenn Colusa Irrigation District,
- Colusa County groundwater replenishment,
- Delta/south-of-Delta member districts,
- CVP operational flexibility water, and
- ecosystem benefit water.

To provide water to all participants, releases may occur through four separate operations: 1) direct release through Dunnigan Pipeline, 2) exchange with Sacramento River at Hamilton City by replacing CVP diversions to GCID with releases from Sites, 3) Shasta exchanges, 4) Oroville exchanges.

Direct Release through Dunnigan Pipeline

Sites Reservoir may release water through the Dunnigan Pipeline, a 1,000 cfs pipe that connects the TC Canal to the Colusa Basin Drain. Releases through Dunnigan Pipeline provide water to Delta Participants, CVP operations flexibility objectives, refuges, and Yolo Bypass. The majority of releases through the Dunnigan Pipeline occur during the transfer window (July – November). Current modeling assumes that current operation and capacity in CBD do not limit Sites releases.

Real-Time Exchange

Sites Reservoir may release water via an in-lieu transfer with Glenn-Colusa Irrigation District (GCID). Instead of pumping water from the Sacramento River, GCID would receive its CVP allocations via Sites. The water released from Shasta Reservoir that would normally be used to meet the CVP allocations to GCID would instead serve as Sites releases to other Storage Partners.

Oroville Exchange

The Lake Oroville exchange period would be limited to June and July. This exchange period would start in June due to the high degree of uncertainty in forecasting south-of-Delta transfers during spring months. Forecasting south-of-Delta transfers any earlier than June would pose a substantial risk to losing Sites water via spills from Lake Oroville. The exchange period would end in July to protect green sturgeon (*Acipenser medirostris*) habitat in August.

In Wet and Above Normal Water Years, Sites transfers to south-of-Delta Storage Partners would be limited. As such, Lake Oroville exchanges would occur in Below Normal, Dry, and Critically Dry Water Year types.

The majority of exchange water would be released in August and September because releases October and November would be required to consider Feather River fall stability flow targets.

Per fall stability flow requirements, total Lake Oroville releases are limited to 2,500 cfs from October 16 through November (California Department of Water Resources 2008). All exchange water must be released in the August through November period. If exchange water is not released by the end of November, it would be subject to spill.

The Oroville Exchange operation is summarized in Table 5A1-16.

Table 5A1-16. Modeled Criteria for Oroville Exchange

	Modeled Criteria	Notes
Exchange Period	June – July	
Exchange Constraints		
Water year types	Below Normal, Dry and Critically Dry water years	
Release Period	August – November	
Release Constraints		
Max Feather River Flow	Oct: 4,000 cfs Nov: 2,250 cfs	Feather River fall stability flow requirements. Maximum October average flow of 4,000 cfs assumes flow requirement of 2,500 cfs for the 16 th through 31 st . Maximum November average of 2,250 cfs to protect fall stability flow requirement.
Spills	Spill Sites water in December	Unused Sites water in Oroville is subject to spill

Shasta Exchange

In the spring of Shasta Lake Exchange years, Sites would release water for CVP uses in lieu of Shasta Lake. As Sites is releasing for CVP uses, Shasta Lake releases would be reduced, preserving Shasta Lake storage and its cold-water pool through the spring (April through June). The volume of delivered water by Sites is equivalent to the exchange volume preserved in Shasta. The exchange volume sustains Shasta cold water pool for use during the critical months of the cold water pool management season (August and September). In Late-Summer and Fall (August – November), the preserved volume is released from Shasta Lake to Sites participants. At the end of the contract year (February), excess volume preserved in Shasta will be spilled.

In October through February, exchange operations may allow releases from Shasta Lake for Fall Flow Stability when: (1) end of prior May Sites storage is greater than 80% of total active capacity, (2) previous month Shasta storage is greater than 3.2 MAF, and (3) Fall Flow Stability is already active. If the desired exchange volume is not available in Shasta (e.g., from Sites releases made the preceding spring), releases are considered CVP credits in Sites. For Fall Flow Stability, credited water may not exceed 100 TAF in a given month, and the total credited volume may not exceed 200 TAF at any time. Credited water may be returned via exchange (releases from Sites to support temperature management in April through June, or Spring Pulse/Fall Flow Stability in July through September), or is considered returned when Shasta spills (volume of spill is the volume of return).

In May, exchange operations may allow a release from Shasta Lake for Spring Pulse when: (1) end of April Sites storage is greater than 80% of total active capacity, and (2) end of April Shasta storage (not including CVP OpFlex) is greater than 4.1 MAF. If the desired exchange volume is not available in Shasta, releases are considered CVP credits in Sites. For Spring Pulses, credited water may not exceed 75 TAF. Credited water may be returned via exchange (releases from Sites to support temperature management in April through June, or Spring Pulse/Fall Flow Stability in July through September), or is considered returned when Shasta spills (volume of spill is the volume of return).

The Shasta Exchange operation for temperature management is summarized in Table 5A1-17.

Table 5A1-17. Modeled Criteria for Shasta Exchange

	Modeled Criteria	Notes
Exchange Period	Apr – Jun	
Exchange Constraints		
Water year types	Dry and Critically Dry water years	
Temperature Management Tier	Tier 3 and 4 years	
Sacramento Valley Conditions	Only during Balanced conditions	
Release Period	Aug – Nov	Releases are prioritized in August through October.
Release Constraints		
Preferred flow at Sacramento River at Keswick	Aug: 12,000 cfs Sep: 10,000 cfs Oct: 5,000 cfs Nov: 5,000 cfs	Not explicitly modeled
Maximum volume	Limited to Banks Pumping Plant Capacity	Not an explicit constraint; model accounts for mass balance

Ecosystem Benefit Water

Deliveries for Incremental Level 4 refuge water needs are modeled as occurring in the fall. Water may occasionally be moved at other times within the transfer window (July – November), if the opportunity exists. Deliveries of refuge water occur in all water year types, with a focus on Dry and Critically Dry years.

Deliveries for Yolo Bypass ecosystem benefits occur in summer and fall months (August through October) in all water year types. Sites Reservoir releases for Yolo Bypass ecosystem benefits are conveyed through the Dunnigan Pipeline

Federal Participation

Federal participation is not assumed in Alternative 1A.

3.1.6 Non-CVP/SWP Operations

Yuba

Same as the No Action Alternative.

Mokelumne

Same as the No Action Alternative.

Tuolumne

Same as the No Action Alternative.

Merced

Same as the No Action Alternative.

3.2 DSM2 Assumptions for Alternative 1A

The following is a description of the assumptions listed in Appendix 5A3, *DSM2 Model Assumptions Callouts*.

3.2.1 River Flows

For DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CALSIM II.

3.2.2 Tidal Boundary

Same as the No Action Alternative.

3.2.3 Water Quality

Martinez EC

The Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CALSIM II and the pure astronomical tide (Ateljevich, 2001).

Vernalis EC

For the DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CALSIM II.

3.2.4 Facilities

Delta Cross Channel

Same as the No Action Alternative.

South Delta Temporary Barriers

Same as the No Action Alternative.

Clifton Court Forebay Gates

Same as the No Action Alternative.

Suisun Marsh Salinity Control Gates

Same as the No Action Alternative.

3.2.5 Operations Criteria

Delta Cross Channel

The number of days in a month the DCC gates are open is based on the monthly time series from CALSIM II.

South Delta Temporary Barriers

South Delta Temporary Barriers are operated based on San Joaquin flow conditions. The agricultural barriers on Old and Middle Rivers are assumed to be installed starting from May 16 and the one on Grant Line Canal from June 1. All three agricultural barriers are allowed to operate until November 30. The tidal gates on Old and Middle River agricultural barriers are assumed to be tied open from May 16 to May 31.

Clifton Court Forebay Gates

Clifton Court Forebay gates are operated based on the Priority 3 operation, where the gate operations are synchronized with the incoming tide to minimize the impacts to low water levels in nearby channels. The Priority 3 operation is described in the 2008 OCAP BA Appendix F Section 5.2 (USBR, 2008b).

Suisun Marsh Salinity Control Gate

The DSM2 model used for the No Action Alternative reads CALSIM II output as an input to determine which months to operate the SMSCG. Refer to Section 2.1, *CALSIM II Assumptions for the No Action Alternative*, Suisun Marsh Salinity Control Gates description for more information.

3.3 HEC5Q and Reclamation Temperature Model Assumptions for Alternative 1A

The following is a description of the assumptions listed in Appendix 5A4, *HEC5Q and Reclamation Temperature Model Assumptions Callouts*.

3.3.1 Sacramento-Trinity Rivers

Reservoir Storage Conditions

Trinity Lake, Lewiston Lake, Whiskeytown Lake, Shasta Lake, Keswick Reservoir, and Black Butte Lake are all operated per CALSIM II output.

Shasta Temperature Management

Temperature strategy focuses on maximizing duration of temperature below 53.5⁰ F at Sacramento River at Clear Creek (CCR) from May 15th through October 31st. The strategy consists of four temperature tiers, based on Shasta cold water pool or storage volume. As Shasta cold water pool or storage decrease, the 53.5⁰ F compliance time window narrows or focuses on the projected time when the Winter-run eggs have the highest dissolved oxygen requirement. The updated strategy applies a tactical approach. Temperature release targets are adjusted based on

information from near-term changes in Shasta storage and meteorological conditions. Review Shasta Summer Cold Water Pool Management section in 2019 NMFS BiOp for more details.

Trinity Temperature Management

Releases from lower, auxiliary outlet are allowed when normal outlet releases are too warm.

3.3.2 American River Reservoir Storage Conditions

Folsom Lake and Lake Natoma are operated per CALSIM II output.

Folsom Temperature Management

Similar to 2009 NMFS BiOp Appendix 2D (See 2015 LTO for details).

3.3.3 Stanislaus River Reservoir Storage Conditions

New Melones Lake, Lake Tulloch, and Goodwin Reservoir are all operated per CALSIM II output.

3.3.4 Feather River Reservoir Storage Conditions

Lake Oroville and Thermalito Afterbay are operated per CALSIM II output.

4 Assumptions for Alternative 1B

This section presents the assumptions used in developing the CALSIM II, DSM2, HEC5Q, and Reclamation Temperature Model simulations of Alternative 1B. Similar to Alternative 1A, Alternative 1B represents operations with a Sites Reservoir capacity of 1.5 MAF and a Dunnigan Pipeline that connects the TC Canal to the CBD in addition to the facilities, regulations and operations described in the No Action Alternative. Alternative 1B assumes Reclamation investment equivalent to 101 TAF of Sites storage for use as CVP operational flexibility. Aside from volume dedicated to CVP operational flexibility, Alternative 1B facilities and project components are the same as Alternative 1A, described above. Existing and new facilities convey water from Sites Reservoir for uses along the TC Canal, along the GCID Main Canal and down the TC Canal to the new Dunnigan Pipeline and the CBD for release to the Yolo Bypass or Sacramento River.

The unique features of Alternative 1B include the following:

- Reclamation investment of 7% of Project active capacity is considered.

4.1 CALSIM II Assumptions for Alternative 1B

The following is a description of the assumptions listed in Appendix 5A2, *CALSIM II Model Assumptions Callouts*.

4.1.1 Hydrology

Inflows/Supplies

Same as the No Action Alternative.

Level of Development

Same as the No Action Alternative.

Demands, Water Rights, CVP/SWP Contracts

Same as the No Action Alternative.

4.1.2 Facilities

Same as the No Action Alternative.

Fremont Weir

Same as the No Action Alternative.

CVP C.W. Bill Jones Pumping Plant (Tracy PP) Capacity

Same as Alternative 1A.

SWP Banks Pumping Plant Capacity

Same as Alternative 1A.

CCWD Intakes

Same as the No Action Alternative.

Suisun March Salinity Control Gates

Same as the No Action Alternative.

Sites Reservoir

Same as Alternative 1A.

Dunnigan Pipeline

Same as Alternative 1A.

Red Bluff Pumping Plant

Same as Alternative 1A.

Hamilton City Pump Station

Same as Alternative 1A.

4.1.3 Regulatory Standards

The regulatory standards that govern the operations of the CVP and SWP facilities are briefly described below. Specific assumptions related to key regulatory standards are also outlined below.

D-1641 Operations

Same as the No Action Alternative.

Coordinated Operations Agreement (COA)

Same as the No Action Alternative.

CVPIA (b)(2) Assumptions

Same as the No Action Alternative.

Clear Creek Flows

Same as the No Action Alternative.

Upper Sacramento River

Same as the No Action Alternative.

Continued CALFED Agreements

Same as the No Action Alternative.

Water Transfers

Lower Yuba River Accord (LYRA)

Same as the No Action Alternative.

Phase 8 transfers

Same as the No Action Alternative.

Short-term or Temporary Water Transfers

Same as the No Action Alternative.

4.1.4 Specific Regulatory Assumptions

Upper Sacramento Flow Management

Same as the No Action Alternative.

Lower Feather Flow Management

Same as the No Action Alternative.

Lower American Flow Management

Same as the No Action Alternative.

Folsom Flood Control Diagram

Same as the No Action Alternative.

Delta Outflow (Flow and Salinity)

Same as the No Action Alternative.

Combined Old and Middle River Flows

Same as the No Action Alternative.

South Delta Export-San Joaquin River Inflow Ratio

Same as the No Action Alternative.

Exports at the South Delta Intakes

Same as the No Action Alternative.

Delta Water Quality

Same as the No Action Alternative.

San Joaquin River Restoration Program

Same as the No Action Alternative.

4.1.5 Operations Criteria

Fremont Weir Operations

Same as the No Action Alternative.

Delta Cross Channel Gate Operations

Same as the No Action Alternative.

Suisun Marsh Salinity Control Gates

Same as the No Action Alternative.

Allocation Decisions

Same as the No Action Alternative.

San Luis Operations

Same as the No Action Alternative.

New Melones Operations

Same as the No Action Alternative.

Sites Operations

Sites Diversions

Same as Alternative 1A.

Sites Releases

Includes all assumptions described in Alternative 1A, with an additional action under the Shasta Exchange operation.

Shasta Exchange

Includes all assumptions described in Alternative 1A, with the following additional operations. In May, exchange operations may allow a release for Spring Pulse when: (1) end of April Sites storage is greater than 80% of total active capacity, and (2) end of April Shasta storage (not including CVP OpFlex) is greater than 4.1 MAF. If exchange volume is not available in Shasta, releases are considered CVP credits in Sites. For Spring Pulses, credited water may not exceed 75 TAF. Credited water may be returned via exchange (temperature management in April through June, or Spring Pulse/Fall Flow Stability in July through September), or is considered returned when Shasta spills (volume of spill is the volume of return).

Ecosystem Benefit Water

Same as Alternative 1A.

Federal Participation

Reclamation investment of up to 7 percent of the Project active capacity. Through Federal participation, up to 101 TAF are preserved in Shasta during drier years through augmenting its conservation pool. If preserved Shasta storage is not spilled during the Winter, Shasta enters the temperature management period with greater storage, improving cold water pool and release volumes in drier years. If additional storage remains at the end of the temperature management period, storage releases may occur to increase the duration of Fall Flow Stability releases.

4.1.6 Non-CVP/SWP Operations

Yuba

Same as the No Action Alternative.

Mokelumne

Same as the No Action Alternative.

Tuolumne

Same as the No Action Alternative.

Merced

Same as the No Action Alternative.

4.2 DSM2 Assumptions for Alternative 1B

The following is a description of the assumptions listed in Appendix 5A3, *DSM2 Model Assumptions Callouts*.

4.2.1 River Flows

For DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CALSIM II.

4.2.2 Tidal Boundary

Same as the No Action Alternative.

4.2.3 Water Quality

Martinez EC

The Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CALSIM II and the pure astronomical tide (Ateljevich, 2001).

Vernalis EC

For the DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CALSIM II.

4.2.4 Facilities

Delta Cross Channel

Same as the No Action Alternative.

South Delta Temporary Barriers

Same as the No Action Alternative.

Clifton Court Forebay Gates

Same as the No Action Alternative.

Suisun Marsh Salinity Control Gates

Same as the No Action Alternative.

4.2.5 Operations Criteria

South Delta Temporary Barriers

South Delta Temporary Barriers are operated based on San Joaquin flow conditions. The agricultural barriers on Old and Middle Rivers are assumed to be installed starting from May 16 and the one on Grant Line Canal from June 1. All three agricultural barriers are allowed to operate until November 30. The tidal gates on Old and Middle River agricultural barriers are assumed to be tied open from May 16 to May 31.

Clifton Court Forebay Gates

Clifton Court Forebay gates are operated based on the Priority 3 operation, where the gate operations are synchronized with the incoming tide to minimize the impacts to low water levels in nearby channels. The Priority 3 operation is described in the 2008 OCAP BA Appendix F Section 5.2 (USBR, 2008b).

Suisun Marsh Salinity Control Gates

The DSM2 model used for the No Action Alternative reads CALSIM II output as an input to determine which months to operate the SMSCG. Refer to Section 2.1, *CALSIM II Assumptions for the No Action Alternative*, Suisun Marsh Salinity Control Gates description for more information.

4.3 HEC5Q and Reclamation Temperature Model Assumptions for Alternative 1B

The following is a description of the assumptions listed in Appendix 5A4, *HEC5Q and Reclamation Temperature Model Assumptions Callouts*.

4.3.1 Sacramento-Trinity Rivers

Reservoir Storage Conditions

Trinity Lake, Lewiston Lake, Whiskeytown Lake, Shasta Lake, Keswick Reservoir, and Black Butte Lake are all operated per CALSIM II output.

Shasta Temperature Management

Temperature strategy focuses on maximizing duration of temperature below 53.5⁰ F at Sacramento River at Clear Creek (CCR) from May 15th through October 31st. The strategy consists of four temperature tiers, based on Shasta cold water pool or storage volume. As Shasta cold water pool or storage decrease, the 53.5⁰ F compliance time window narrows or focuses on the projected time when the Winter-run eggs have the highest dissolved oxygen requirement. The updated strategy applies a tactical approach. Temperature release targets are adjusted based on information from near-term changes in Shasta storage and meteorological conditions. Review Shasta Summer Cold Water Pool Management section in 2019 NMFS BiOp for more details.

Trinity Temperature Management

Releases from lower, auxiliary outlet are allowed when normal outlet releases are too warm.

4.3.2 American River

Reservoir Storage Conditions

Folsom Lake and Lake Natoma are operated per CALSIM II output.

Folsom Temperature Management

Similar to 2009 NMFS BiOp Appendix 2D (See 2015 LTO for details).

4.3.3 Stanislaus River

Reservoir Storage Conditions

New Melones Lake, Lake Tulloch, and Goodwin Reservoir are all operated per CALSIM II output.

4.3.4 Feather River

Reservoir Storage Conditions

Lake Oroville and Thermalito Afterbay are operated per CALSIM II output.

5 Assumptions for Alternative 2

This section presents the assumptions used in developing the CALSIM II, DSM2, HEC5Q, and Reclamation Temperature Model simulations of Alternative 2. Pipeline that connects the TC Canal to the Sacramento River in addition to the facilities, regulations and operations described

in the No Action Alternative. In Alternative 2 a local access road around the southern end of the reservoir provides access to the west of the Project; CVP operational flexibility is not considered; and Sites operations affect operations at Jones PP, Banks PP, Shasta, and Oroville. Alternative 2 conveys water from the Sacramento River through existing or upgraded TC Canal and GCID Main Canal facilities to new and upgraded regulating reservoirs and into the new Sites Reservoir. Existing and new facilities convey water from Sites Reservoir for uses along the TC Canal, along the GCID Main Canal and down the TC Canal to the new Dunnigan Pipeline and to the Sacramento River for direct release to the river. Alternative 2 also includes a partial release from the Dunnigan Pipeline into the CBD, for delivery to the Yolo Bypass.

The unique features of Alternative 2 include the following:

- Reservoir capacity is 1.27 MAF,
- Dunnigan Pipeline connects the TC Main Canal to the Sacramento River, and
- Reclamation investment is not considered.

5.1 CALSIM II Assumptions for Alternative 2

The following is a description of the assumptions listed in Appendix 5A2, *CALSIM II Model Assumptions Callouts*.

5.1.1 Hydrology

Inflows/Supplies

Same as the No Action Alternative.

Level of Development

Same as the No Action Alternative.

Demands, Water Rights, CVP/SWP Contracts

Same as the No Action Alternative.

5.1.2 Facilities

Same as the No Action Alternative.

Fremont Weir

Same as the No Action Alternative.

CVP C.W. Bill Jones Pumping Plant (Tracy PP) Capacity

Same as Alternative 1A.

SWP Banks Pumping Plant Capacity

Same as Alternative 1A.

CCWD Intakes

Same as the No Action Alternative.

Suisun March Salinity Control Gates

Same as the No Action Alternative.

Sites Reservoir

Alternative 2 assumes a Sites Reservoir with a maximum capacity of 1.27 MAF and 60 TAF of dead pool storage.

Dunnigan Pipeline

Alternative 2 extends the pipeline in Alternative 1A, connecting the southern end of the TC Canal to the Sacramento River, with a maximum capacity of 1,000 cfs.

Red Bluff Pumping Plant

Same as Alternative 1A.

Hamilton City Pump Station

Same as Alternative 1A.

5.1.3 Regulatory Standards

The regulatory standards that govern the operations of the CVP and SWP facilities are briefly described below. Specific assumptions related to key regulatory standards are also outlined below.

D-1641 Operations

Same as the No Action Alternative.

Coordinated Operations Agreement (COA)

Same as the No Action Alternative.

CVPIA (b)(2) Assumptions

Same as the No Action Alternative.

Clear Creek Flows

Same as the No Action Alternative.

Upper Sacramento River

Same as the No Action Alternative.

Continued CALFED Agreements

Same as the No Action Alternative.

Water Transfers

Lower Yuba River Accord (LYRA)

Same as the No Action Alternative.

Phase 8 transfers

Same as the No Action Alternative.

Short-term or Temporary Water Transfers

Same as the No Action Alternative.

5.1.4 *Specific Regulatory Assumptions*
Upper Sacramento Flow Management

Same as the No Action Alternative.

Lower Feather Flow Management

Same as the No Action Alternative.

Lower American Flow Management

Same as the No Action Alternative.

Folsom Flood Control Diagram

Same as the No Action Alternative.

Delta Outflow (Flow and Salinity)

Same as the No Action Alternative.

Combined Old and Middle River Flows

Same as the No Action Alternative.

South Delta Export-San Joaquin River Inflow Ratio

Same as the No Action Alternative.

Exports at the South Delta Intakes

Same as the No Action Alternative.

Delta Water Quality

Same as the No Action Alternative.

San Joaquin River Restoration Program

Same as the No Action Alternative.

5.1.5 *Operations Criteria*
Fremont Weir Operations

Same as the No Action Alternative.

Delta Cross Channel Gate Operations

Same as the No Action Alternative.

Suisun Marsh Salinity Control Gates

Same as the No Action Alternative.

Allocation Decisions

Same as the No Action Alternative.

San Luis Operations

Same as the No Action Alternative.

New Melones Operations

Same as the No Action Alternative.

Sites Operations

Sites Diversions

Same as Alternative 1A.

Sites Releases

Same as Alternative 1A.

Ecosystem Benefit Water

Same as Alternative 1A.

Federal Participation

Federal participation is not assumed in Alternative 2.

5.1.6 Non-CVP/SWP Operations

Yuba

Same as the No Action Alternative.

Mokelumne

Same as the No Action Alternative.

Tuolumne

Same as the No Action Alternative.

Merced

Same as the No Action Alternative.

5.2 DSM2 Assumptions for Alternative 2

The following is a description of the assumptions listed in Appendix 5A3, *DSM2 Model Assumptions Callouts*.

5.2.1 River Flows

For DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CALSIM II.

5.2.2 Tidal Boundary

Same as the No Action Alternative.

5.2.3 Water Quality

Martinez EC

The Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CALSIM II and the pure astronomical tide (Ateljevich, 2001).

Vernalis EC

For the DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CALSIM II.

5.2.4 Facilities

Delta Cross Channel

Same as the No Action Alternative.

South Delta Temporary Barriers

South Delta Temporary Barriers are included in the No Action Alternative simulation. The three agricultural temporary barriers located on Old River, Middle River and Grant Line Canal are included in the model. The fish barrier located at the Head of Old River is not included in the model. Temporary Barriers Project operated based on San Joaquin River flow time series from CALSIM II output.

Clifton Court Forebay Gates

Same as the No Action Alternative.

5.2.5 Operations Criteria

Delta Cross Channel

The number of days in a month the DCC gates are open is based on the monthly time series from CALSIM II.

South Delta Temporary Barriers

South Delta Temporary Barriers are operated based on San Joaquin flow conditions. The agricultural barriers on Old and Middle Rivers are assumed to be installed starting from May 16 and the one on Grant Line Canal from June 1. All three agricultural barriers are allowed to operate until November 30. The tidal gates on Old and Middle River agricultural barriers are assumed to be tied open from May 16 to May 31.

Clifton Court Forebay Gates

Clifton Court Forebay gates are operated based on the Priority 3 operation, where the gate operations are synchronized with the incoming tide to minimize the impacts to low water levels in nearby channels. The Priority 3 operation is described in the 2008 OCAP BA Appendix F Section 5.2 (USBR, 2008b).

Suisun Marsh Salinity Control Gate

The DSM2 model used for the No Action Alternative reads CALSIM II output as an input to determine which months to operate the SMSCG. Refer to Section 2.1, *CALSIM II Assumptions for the No Action Alternative*, Suisun Marsh Salinity Control Gates description for more information.

5.3 HEC5Q and Reclamation Temperature Model Assumptions for Alternative 2

The following is a description of the assumptions listed in Appendix 5A4, *HEC5Q and Reclamation Temperature Model Assumptions Callouts*.

5.3.1 Sacramento-Trinity Rivers

Reservoir Storage Conditions

Trinity Lake, Lewiston Lake, Whiskeytown Lake, Shasta Lake, Keswick Reservoir, and Black Butte Lake are all operated per CALSIM II output.

Shasta Temperature Management

Temperature strategy focuses on maximizing duration of temperature below 53.5⁰ F at Sacramento River at Clear Creek (CCR) from May 15th through October 31st. The strategy consists of four temperature tiers, based on Shasta cold water pool or storage volume. As Shasta cold water pool or storage decrease, the 53.5⁰ F compliance time window narrows or focuses on the projected time when the Winter-run eggs have the highest dissolved oxygen requirement. The updated strategy applies a tactical approach. Temperature release targets are adjusted based on information from near-term changes in Shasta storage and meteorological conditions. Review Shasta Summer Cold Water Pool Management section in 2019 NMFS BiOp for more details.

Trinity Temperature Management

Releases from lower, auxiliary outlet are allowed when normal outlet releases are too warm.

5.3.2 American River

Reservoir Storage Conditions

Folsom Lake and Lake Natoma are operated per CALSIM II output.

Folsom Temperature Management

Similar to 2009 NMFS BiOp Appendix 2D (See 2015 LTO for details).

5.3.3 Stanislaus River

Reservoir Storage Conditions

New Melones Lake, Lake Tulloch, and Goodwin Reservoir are all operated per CALSIM II output.

5.3.4 Feather River

Reservoir Storage Conditions

Lake Oroville and Thermalito Afterbay are operated per CALSIM II output.

6 Assumptions for Alternative 3

This section presents the assumptions used in developing the CALSIM II, DSM2, HEC5Q, and Reclamation Temperature Model simulations of Alternative 3. Alternative 3 represents operations with a Sites Reservoir capacity of 1.5 MAF and a Dunnigan Pipeline that connects the TC Canal to the CBD in addition to the facilities, regulations and operations described in the No Action Alternative. Alternative 3 assumes Reclamation investment equivalent to 360 TAF of Sites storage for use as CVP operational flexibility. Aside from volume dedicated to CVP operational flexibility, Alternative 3 facilities, and project components are the same as Alternative 1A, as described above. Existing and new facilities convey water from Sites Reservoir for uses along the TC Canal, along the GCID Main Canal and down the TC Canal to the new Dunnigan Pipeline and the CBD for release to the Yolo Bypass or Sacramento River.

The unique features of Alternative 3 include the following:

- Reclamation investment of 25% of Project active capacity is considered.

6.1 CALSIM II Assumptions for Alternative 3

The following is a description of the assumptions listed in Appendix 5A2, *CALSIM II Model Assumptions Callouts*.

6.1.1 Hydrology

Inflows/Supplies

Same as the No Action Alternative.

Level of Development

Same as the No Action Alternative.

Demands, Water Rights, CVP/SWP Contracts

Same as the No Action Alternative.

6.1.2 Facilities

Same as the No Action Alternative.

Fremont Weir

Same as the No Action Alternative.

CVP C.W. Bill Jones Pumping Plant (Tracy PP) Capacity

Same as Alternative 1A.

SWP Banks Pumping Plant Capacity

Same as Alternative 1A.

CCWD Intakes

Same as the No Action Alternative.

Suisun March Salinity Control Gates

Same as the No Action Alternative.

Sites Reservoir

Same as Alternative 1A.

Dunnigan Pipeline

Same as Alternative 1A.

Red Bluff Pumping Plant

Same as Alternative 1A.

Hamilton City Pump Station

Same as Alternative 1A.

6.1.3 Regulatory Standards

The regulatory standards that govern the operations of the CVP and SWP facilities are briefly described below. Specific assumptions related to key regulatory standards are also outlined below.

D-1641 Operations

Same as the No Action Alternative.

Coordinated Operations Agreement (COA)

Same as the No Action Alternative.

CVPIA (b)(2) Assumptions

Same as the No Action Alternative.

Clear Creek Flows

Same as the No Action Alternative.

Upper Sacramento River

Same as the No Action Alternative.

Continued CALFED Agreements

Same as the No Action Alternative.

Water Transfers

Lower Yuba River Accord (LYRA)

Same as the No Action Alternative.

Phase 8 transfers

Same as the No Action Alternative.

Short-term or Temporary Water Transfers

Same as the No Action Alternative.

6.1.4 *Specific Regulatory Assumptions*

Upper Sacramento Flow Management

Same as the No Action Alternative.

Lower Feather Flow Management

Same as the No Action Alternative.

Lower American Flow Management

Same as the No Action Alternative.

Folsom Flood Control Diagram

Same as the No Action Alternative.

Delta Outflow (Flow and Salinity)

Same as the No Action Alternative.

Combined Old and Middle River Flows

Same as the No Action Alternative.

South Delta Export-San Joaquin River Inflow Ratio

Same as the No Action Alternative.

Exports at the South Delta Intakes

Same as the No Action Alternative.

Delta Water Quality

Same as the No Action Alternative.

San Joaquin River Restoration Program

Same as the No Action Alternative.

6.1.5 *Operations Criteria*

Fremont Weir Operations

Same as the No Action Alternative.

Delta Cross Channel Gate Operations

Same as the No Action Alternative.

Suisun Marsh Salinity Control Gates

Same as the No Action Alternative.

Allocation Decisions

Same as the No Action Alternative.

San Luis Operations

Same as the No Action Alternative.

New Melones Operations

Same as the No Action Alternative.

Sites Operations

Sites Diversions

Same as Alternative 1A.

Sites Releases

Same as Alternative 1B.

Ecosystem Benefit Water

Same as Alternative 1A.

Federal Participation

Reclamation investment of up to 25 percent of the Project active capacity. Through Federal participation, up to 360 TAF are preserved in Shasta during drier years through augmenting its conservation pool. If preserved Shasta storage is not spilled during the Winter, Shasta enters the temperature management period with greater storage, improving cold water pool and release volumes in drier years. If additional storage remains at the end of the temperature management period, storage releases may occur to increase the duration of Fall Flow Stability releases.

6.1.6 Non-CVP/SWP Operations

Yuba

Same as the No Action Alternative.

Mokelumne

Same as the No Action Alternative.

Tuolumne

Same as the No Action Alternative.

Merced

Same as the No Action Alternative.

6.2 DSM2 Assumptions for Alternative 3

The following is a description of the assumptions listed in Appendix 5A3, *DSM2 Model Assumptions Callouts*.

6.2.1 River Flows

For DSM2 simulation, the river flows at the DSM2 boundaries are based on the monthly flow time series from CALSIM II.

6.2.2 Tidal Boundary

Same as the No Action Alternative.

6.2.3 Water Quality

Martinez EC

The Martinez EC boundary condition in the DSM2 planning simulation is estimated using the G-model based on the net Delta outflow simulated in CALSIM II and the pure astronomical tide (Ateljevich, 2001).

Vernalis EC

For the DSM2 simulation, the Vernalis EC boundary condition is based on the monthly San Joaquin EC time series estimated in CALSIM II.

6.2.4 Facilities

Delta Cross Channel

Same as the No Action Alternative.

South Delta Temporary Barriers

Same as the No Action Alternative.

Clifton Court Forebay Gates

Same as the No Action Alternative.

Suisun Marsh Salinity Control Gates

Same as the No Action Alternative.

6.2.5 Operations Criteria

Delta Cross Channel

The number of days in a month the DCC gates are open is based on the monthly time series from CALSIM II.

South Delta Temporary Barriers

South Delta Temporary Barriers are operated based on San Joaquin flow conditions. The agricultural barriers on Old and Middle Rivers are assumed to be installed starting from May 16 and the one on Grant Line Canal from June 1. All three agricultural barriers are allowed to operate until November 30. The tidal gates on Old and Middle River agricultural barriers are assumed to be tied open from May 16 to May 31.

Clifton Court Forebay Gates

Clifton Court Forebay gates are operated based on the Priority 3 operation, where the gate operations are synchronized with the incoming tide to minimize the impacts to low water levels

in nearby channels. The Priority 3 operation is described in the 2008 OCAP BA Appendix F Section 5.2 (USBR, 2008b).

Suisun Marsh Salinity Control Gate

The DSM2 model used for the No Action Alternative reads CALSIM II output as an input to determine which months to operate the SMSCG. Refer to Section 2.1, *CALSIM II Assumptions for the No Action Alternative*, Suisun Marsh Salinity Control Gates description for more information.

6.3 HEC5Q and Reclamation Temperature Model Assumptions for Alternative 3

The following is a description of the assumptions listed in Appendix 5A4, *HEC5Q and Reclamation Temperature Model Assumptions Callouts*.

6.3.1 Sacramento-Trinity Rivers

Reservoir Storage Conditions

Trinity Lake, Lewiston Lake, Whiskeytown Lake, Shasta Lake, Keswick Reservoir, and Black Butte Lake are all operated per CALSIM II output.

Shasta Temperature Management

Temperature strategy focuses on maximizing duration of temperature below 53.5⁰ F at Sacramento River at Clear Creek (CCR) from May 15th through October 31st. The strategy consists of four temperature tiers, based on Shasta cold water pool or storage volume. As Shasta cold water pool or storage decrease, the 53.5⁰ F compliance time window narrows or focuses on the projected time when the Winter-run eggs have the highest dissolved oxygen requirement. The updated strategy applies a tactical approach. Temperature release targets are adjusted based on information from near-term changes in Shasta storage and meteorological conditions. Review Shasta Summer Cold Water Pool Management section in 2019 NMFS BiOp for more details.

Trinity Temperature Management

Releases from lower, auxiliary outlet are allowed when normal outlet releases are too warm.

6.3.2 American River

Reservoir Storage Conditions

Folsom Lake and Lake Natoma are operated per CALSIM II output.

Folsom Temperature Management

Similar to 2009 NMFS BiOp Appendix 2D (See 2015 LTO for details).

6.3.3 Stanislaus River

Reservoir Storage Conditions

New Melones Lake, Lake Tulloch, and Goodwin Reservoir are all operated per CALSIM II output.

6.3.4 Feather River Reservoir Storage Conditions

Lake Oroville and Thermalito Afterbay are operated per CALSIM II output.

7 References Cited

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