Reinitiation of Consultation on the Coordinated Long-Term Operation of the Central Valley Project and State Water Project

Central Valley Project, California

Interior Region 10 – California-Great Basin

Alternatives Development Technical Memorandum

BUREAU OF RECLAMATION

U.S. DEPARTMENT OF THE INTERIOR

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Mission Statements

The Department of the Interior conserves and manages the Nation's natural resources and cultural heritage for the benefit and enjoyment of the American people, provides scientific and other information about natural resources and natural hazards to address societal challenges and create opportunities for the American people, and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities to help them prosper.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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Acronyms and Abbreviations

ACWA	Association of California Water Agencies
AF	acre-feet
ARG	American River Group
Banks Pumping Plant	Harvey O. Banks Pumping Plant
Basin Plan	Water Quality Control Plan for the Sacramento River and San Joaquin River Basins
Bay-Delta	San Francisco Bay/Sacramento–San Joaquin Delta
BO	biological opinion
CCF	Clifton Court Forebay
CCR	Sacramento River above Clear Creek gage
CDFG	California Department of Fish and Game
CDFW	California Department of Fish and Wildlife
CFR	Code of Federal Regulations
cfs	cubic feet per second
Charter	Real-Time Water Operations Charter
CNRA	California Natural Resources Agency
COA	Agreement between the United States of America and the State of California for Coordinated Operation of the Central Valley Project and the State Water Project
COS	Current Operations Scenario
CSAMP	Collaborative Science and Adaptive Management Program
CVP	Central Valley Project
CVPIA	Central Valley Project Improvement Act
D-893	Water Right Decision 893
D-1641	Water Right Decision 1641
DCC	Delta Cross Channel
DCID	Deer Creek Irrigation District Dam
Delta	Sacramento–San Joaquin Delta
DMC	Delta-Mendota Canal
DO	dissolved oxygen
DPIIC	Delta Plan Interagency Implementation Committee
DWR	California Department of Water Resources
EBMUD	East Bay Municipal Utility District
ECCID	East Contra Costa Irrigation District
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
EWMP	efficient water management practice
FCCL	Fish Conservation and Culture Laboratory
FERC	Federal Energy Regulatory Commission

GLC	Grant Line Canal
GYSO	Goodyear Slough Outfall
HAB	harmful algal blooms
HORB	head of Old River barrier
ID	Irrigation District
IEP	Interagency Ecological Program
JPOD	Joint Point of Diversion
KLCI	Knights Landing Catch Index
LFC	low flow channel
LMR	Lower Mokelumne River
M&I	municipal and industrial
MAF	million acre-feet
MCL	maximum contaminant level
mg/L	milligrams per liter
MIB	2-methylisoborneol
MIDS	Morrow Island Distribution System
MAF	million acre-feet
MOA	1960 Memorandum of Agreement
MOU	memorandum of understanding
MR	Middle River
Napa County FC&WCD	Napa County Flood Control and Water Conservation District
NBA	North Bay Aqueduct
NCWA	Northern California Water Association
NGO	nongovernmental organization
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
OBI	Old River at Bacon Island
OCO	State Water Project Operations Control Office
OID	Oakdale Irrigation District
OMR	Old and Middle River
ORT	Old River near Tracy
PP	pumping plant
PRG	pressure relief gate
Reclamation	U.S. Department of the Interior, Bureau of Reclamation
ROD	Record of Decision
RPA	Reasonable and Prudent Alternative
RRDS	Roaring River Distribution System
SCI	Sacramento Catch Index
Settlement Act	San Joaquin River Restoration Settlement Act
SMP	Suisun Marsh Habitat Management, Preservation, and Restoration Plan

SMPA	Suisun Marsh Preservation Agreement
SJRRP	San Joaquin River Restoration Program
SRCD	Suisun Resource Conservation District
SMSCG	Suisun Marsh Salinity Control Gates
SRP	stepped release plan
SRS	Sacramento River Settlement
SRTTG	Sacramento River Temperature Task Group
SSJID	South San Joaquin Irrigation District
SWP	State Water Project
SWPAO	State Water Project Analysis Office
SWRCB	California State Water Resources Control Board
TAF	thousand acre-feet
TCD	temperature control device
TFCF	Tracy Fish Collection Facility
transbasin diversion	diversion of Trinity Basin water to the Sacramento Basin
UC Davis	University of California, Davis
USDOI	U.S. Department of the Interior
USFWS	U.S. Fish and Wildlife Service
WOMT	Water Operations Management Team
WQCP	Water Quality Control Plan
WRO	Water Rights Order
WSRCD	Western Shasta Resource Conservation District

Chapter 1 Introduction

This Alternatives Development Technical Memorandum documents U.S. Department of the Interior, Bureau of Reclamation's (Reclamation's) efforts to identify, screen, and refine alternatives for consideration.

1.1 Study Area Location and Description

The study area includes areas that could be affected directly or indirectly by the action alternatives. For purposes of this Technical Memorandum, the study area encompasses the following reservoirs, rivers, and land between the levees adjacent to the rivers:

- Trinity Reservoir and the Trinity River downstream of Lewiston Reservoir
- Sacramento River from Shasta Lake downstream to, and including, the Sacramento–San Joaquin Delta (Delta)
- Clear Creek from Whiskeytown Reservoir to its confluence with the Sacramento River
- Feather River from the Federal Energy Regulatory Commission (FERC) boundary downstream to its confluence with the Sacramento River
- American River from Folsom Reservoir downstream to its confluence with the Sacramento River
- Stanislaus River from New Melones Reservoir to its confluence with the San Joaquin River
- San Joaquin River from Friant Dam downstream to, and including, the Delta
- San Francisco Bay and Suisun Marsh
- Nearshore Pacific Ocean on the coast from Point Conception to Cape Falcon in Oregon
- Areas that receive water from the Central Valley Project (CVP) or State Water Project (SWP)

Figure 1.1-1 is a map of the study area.

Figure 1.1-1. Study Area Map

Chapter 2 Alternatives Development Process

The purpose of the alternatives development process is to identify a reasonable range of alternatives for inclusion in the Environmental Impact Statement (EIS).

2.1 Process Overview

The alternatives development process involved input and review from water contractors, resource agencies, nongovernmental organizations (NGOs), and stakeholders. Resource agencies and water contractors were involved at a detailed level, including participation in meetings to identify the preferred alternative and range of potential alternatives.

The process began in 2016 with the reinitiation of Section 7 consultation. Reclamation has held over 100 coordination meetings with stakeholders and interested parties since that time. These included separate in-person meetings with the Yurok Tribe and Hoopa Valley Tribe. Reclamation worked to coordinate with the U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and California Department of Fish and Wildlife (CDFW) during development of this EIS through meetings every 2-3 weeks for the first 2 years of the project, in addition to brainstorming meetings and workshops. Reclamation has also been meeting with other interested parties since 2017, including CVP and SWP water contractors. Appendix Z, *ROC on LTO Consultation and Coordination*, presents a list of these meetings.

The alternatives development process included public scoping conducted in January 2018. Public scoping allowed Reclamation to solicit ideas for achieving the purpose and need, understand the scope of environmental issues that should be evaluated, and learn of potential impacts.

After the public scoping process, Reclamation collected initial components that could help achieve the purpose and need of the project. A component is a project or plan that could contribute to meeting the purpose and need but may not be able to fully accomplish it independently. Reclamation added to the list of components suggested at scoping by identifying components from scientific research, asking resource agencies and water contractors, and building on the technical understanding of the project team.

After identifying a list of initial components, Reclamation screened the components to identify the ones that could meet the purpose and need and help form a reasonable range of alternatives for analysis in the EIS. The components remaining after screening were combined into action alternatives. Section 2.2 lists the components, Chapter 3 describes the screening effort, and Chapter 4 describes the range of alternatives moving forward for additional analysis in the EIS.

2.2 Components

Table 2.2-1 shows the list of initial components by area, with descriptions provided by the agency or individual that proposed the component. This list formed the foundation for the screening effort described in Chapter 3.

Table 2.2-1. Initial Components

Region	Name	Description
CVP-wide	2003 guidance under CVPIA	Implement the 2003 guidance, as described under CVPIA that allows 800,000 AF for the purpose of the environment
CVP-wide	Alternate energy sources	CVP facilities should use solar or wind power
CVP-wide	Change definition of renewable energy	Change California's definition of renewable energy to include existing CVP hydropower facilities
CVP-wide	Coordinated Operations Agreement revisions	Revise the Coordinated Operations Agreement to improve sharing of resources and obligations between the CVP and SWP
CVP-wide	CVP termination	Terminate the CVP in its entirety
CVP-wide	D-1641 operations	Operate CVP and SWP facilities to meet D-1641 requirements (without additional flow requirements)
CVP-wide	Dam safety	Evaluate the safety of all CVP dams, specifically the earthen dam at Trinity Lake
CVP-wide	Decrease development in forests	Decrease forest cutting, road building, and development in the Cascade-Sierra Mountains
CVP-wide	Improve hatchery management	Improve management and use of fish hatcheries
CVP-wide	Limit hydraulic fracturing	Limit the transfer of CVP and SWP water from agriculture and municipal uses for energy extraction like hydraulic fracturing
CVP-wide	Nonflow measures	Construct habitat restoration and conduct intervention
CVP-wide	Recalculate flood curves	Reoperate reservoirs and recalculate flood curves to increase supply and storage
CVP-wide	Reduce predation	Reduce predation by nonnative fish on listed native fish
CVP-wide	Refuge supplies	Facilitate carryover storage of winter water for spring irrigation in San Luis Reservoir for South-of-Delta refuges
CVP-wide	Reservoir expansion	Focus on raising Shasta Dam and expanding San Luis Reservoir, Los Vaqueros Reservoir, Temperance Flat Dam, and Sites Reservoir
CVP-wide	Restoration studies	Conduct studies to reduce uncertainty in restoration actions, including genetic and otolith research, Steelhead population estimates and trends, Fall-Run population model, and sediment transport model, and to address how to avoid hatchery competition or genetic introgression with wild salmon
CVP-wide	Sediment management	Construct small dams near inflow points of lakes or reservoirs and annually dredge out sediments behind these small dams, sending the sediments to nearby farmlands
CVP-wide	Small screen program	Screen small diversions throughout system to reduce fish entrainment
CVP-wide	Specified release or transfer values	Release or transfer 25 to 100,000 AF per year for the next 10 years; releases would be made available March to May; any water not released would be stored by Reclamation, pursuant to a Warren Act contract
CVP-wide	Storage integration	Better integrate operations of storage facilities (see ACWA Storage Integration Study [MBK Engineers 2017])

Region	Name	Description
CVP-wide	Watershed management	Rehabilitate the Cascade-Sierra Mountains watershed to manage mountain meadows and restore wildfire into the fire-evolved ecosystem
Klamath River	Restore Lower Klamath Lake	Restore the Lower Klamath Lake and clean the Klamath Project's wastewater prior to reaching the Klamath River; restoring Lower Klamath Lake can provide additional water storage
Klamath River	Transfer groundwater in the Klamath Project	Use Klamath Project facilities to convey groundwater for transfer
Trinity River	Cold water conveyance system	Construct a cold water conveyance system from Trinity Reservoir through Lewiston Reservoir to Trinity River; more water from Trinity Reservoir would be available to valley users for power generation later in the season
Trinity River	Dam removal	Remove Trinity and Lewiston Dams
Trinity River	Grass Valley Creek flows	Increase releases from Buckhorn Dam for channel maintenance and provide migration flows for adult Coho Salmon
Trinity River	Lewiston Reservoir temperature management	Address the temperature issue at Lewiston Reservoir
Trinity River	Minimum pool volume at Trinity Reservoir	Establish a minimum pool volume of 900,000 to 1,000,000 AF at Trinity Reservoir to protect an adequate lake level for boating facilities and a cold water source for fishery restoration on the Trinity River; if unable to establish request, mitigate the impact by funding the construction of low-water boat launch facilities and Trinity Center and Fairview
Trinity River	Trinity flow augmentation	Augment Trinity River flows beyond the requirements of the 2000 Trinity River Record of Decision as necessary for preservation and propagation of fish
Trinity River	Upgrade hatchery facilities on Trinity River	Upgrade the Trinity River division hatchery facilities and fund Hoopa Valley Tribe plans for additional selective harvest; transfer hatchery facility management to the Hoopa Valley Tribe
Sacramento River	Adult rescue	Rescue adults stranded in locations without adequate fish passage (such as Fremont Weir)
Sacramento River	Increase floodplain	Increase the floodplain using setback levees along streams and the main stem of the Sacramento River between Red Bluff and Colusa; include the purchase of private lands within the floodplains
Sacramento River	Intake lowering near Wilkins Slough	Lower water intakes near Wilkins Slough so that navigation flow requirement can be relaxed, if appropriate, without affecting water supply
Sacramento River	Juvenile trap and haul	Collect juveniles to transport them past areas with high temperatures
Sacramento River	Reduce redd dewatering	Reduce the dewatering of Fall-Run redds in the Sacramento River after Keswick Dam releases are ramped down
Sacramento River	Reservoir storage targets	Implement storage targets in reservoirs, as suggested by NMFS in 2017
Sacramento River	Rice decomposition smoothing	Deliver rice decomposition water over a longer period to reduce the short period of high flow

Region	Name	Description
Sacramento River	Sacramento River spawning and rearing habitat restoration	Restore spawning and rearing habitat in the Sacramento River
Sacramento River	Shasta Lake cold water pool management	Change operations of Shasta Lake to improve year-round management of cold water pool, incorporate a spring pulse, and schedule fall and winter flows to balance storage and redd maintenance
Sacramento River	Shasta Dam TCD improvements	Improve function of Shasta Dam TCD
Sacramento River	Yolo Bypass habitat restoration	Deliver water to the Yolo Bypass in support of juvenile salmon rearing habitat and multibenefit projects
American River	American River flows	Incorporate the 2017 Modified Flow Management Standard
American River	American River spawning and rearing habitat restoration	Restore spawning and rearing habitat in the lower American River
American River	Drought temperature facility improvements	Construct improvements to temperature facilities to improvement management in dry years
Bay-Delta	Addition of pipeline to Jones Pumping Plant	Add 30-foot diameter pipeline from Sherman Island to Jones Pumping Plant to capture water on north side of Sherman Island
Bay-Delta	Clifton Court Forebay Aquatic Weed and Algal Bloom Management	Manage aquatic weeds and algal blooms through mechanical means and pesticides
Bay-Delta	Delta Cross Channel gate improvements	Evaluate improvements to automate and streamline operation of the gates to maximize water supply deliveries
Bay-Delta	Delta fish species conservation hatchery	Operate a conservation hatchery for Delta Smelt
Bay-Delta	Delta gate system	Construct a gate system to limit the intrusion of salt water into the Delta
Bay-Delta	Enhance Delta inflow and outflow	Include Delta inflow and outflow requirements to achieve recovery of federally listed and state-listed species
Bay-Delta	Flexible OMR management	Reduce OMR restrictions when they have less benefit to fish
Bay-Delta	Focusing on reduction of water	Consider alternatives that focus on reduction of water exports, including one or more alternatives that are consistent with the flow and export limitations identified in the SWRCB 2017 Final Scientific Basis Report
Bay-Delta	Improved Delta Cross Channel operations	Modify Delta Cross Channel operations in anticipation of water quality exceedance (rather than waiting for water quality exceedance to modify operations)
Bay-Delta	Increased exports during high flows	Capture and export more water during periods of high Delta outflow
Bay-Delta	Modify OMR restrictions specific to diversion site	Connect OMR restrictions to relative impact of individual diversion facilities; consider prescreen loss at Clifton Court Forebay
Bay-Delta	No Fall X2 action	Eliminate the USFWS RPA Fall X2 Action (Action 4) and Component 3 (improved Delta Smelt habitat) (in the USFWS 2008 BO)

Region	Name	Description
Bay-Delta	North Delta food subsidies	Route water from Colusa Drain into Yolo Bypass and Cache Slough to augment food supplies for Delta Smelt
Bay-Delta	Protection of winter and spring flows	Protect winter and spring flows as proposed in the Bay-Delta plan update process for the San Joaquin and Sacramento Rivers; consult with fisheries' genetic experts on how to improve the duration and timing of these flows to benefit spring and winter runs
Bay-Delta	Reintroduction efforts from Fish Conservation and Culture Laboratory	Construct an improved conservation hatchery focused on capturing existing genetic diversity; operations could expand to accommodate reintroduction
Bay-Delta	Remove San Joaquin River inflow and export requirement	Remove limitation on exports that is tied to inflow from the San Joaquin River
Bay-Delta	Replace levee with fish screen	Replace Clifton Court Forebay's 1.5-mile levee with a fish screen, specifically ZeeWeed fish screen; fill Clifton Court Forebay at nighttime and use only natural flows during the daytime; increase capacity of Clifton Court Forebay by dredging
Bay-Delta	Restore Delta natural flow regimes	Restore natural flow regimes in the Bay-Delta, which would provide water within basins for local use
Bay-Delta	RPA water temperature objectives	Eliminate RPA water temperature objectives because they either are met or cannot be met
Bay-Delta	Skinner Fish Facility improvements	Improve operations and effectiveness at Skinner Fish Facility
Bay-Delta	Suisun Marsh food subsidies	Add fish food to Suisun Marsh by coordinating managed wetland flood and drain operations, Roaring River Distribution System food production, and reoperation of SMSCG
Bay-Delta	Suisun Marsh Salinity Control Gate operations	Operate SMSCG in June through September to increase food production for Delta Smelt
Bay-Delta	Tidal habitat restoration	Complete 8,000 acres of tidal habitat restoration that DWR has begun
Bay-Delta	Tracy Fish Collection Facility improvements	Improve operations and effectiveness at Tracy Fish Collection Facility
Bay-Delta	Water transfers	Allow water transfers for a period longer than July through September
Stanislaus River	Alterations to New Melones Reservoir index	Change index for New Melones Reservoir to a hydrologic index for river releases so that it is more reactive to current hydrologic conditions of the year (e.g., 60-20-20 for the San Joaquin River Basin)
Stanislaus River	New Melones Reservoir allocations	Reschedule guidelines related to New Melones Reservoir for Stockton East Water District and Central San Joaquin Water Conservation District
Stanislaus River	Revert to previous New Melones agreements	Revert to CDFG 1988 agreement flows that are a condition of the New Melones project permits
Stanislaus River	Stanislaus River dissolved oxygen standard relaxation	Petition SWRCB to relax the dissolved oxygen objective for New Melones Reservoir and the Stanislaus River

Region	Name	Description
Tuolumne River	Tuolumne River conveyance facility	Consider a conveyance facility to move excess Tuolumne River water to Oakdale Irrigation District; back up Oakdale Irrigation District deliveries to New Melones Reservoir
CVP and SWP service area	Address Friant-Kern Canal subsidence	Provide a permanent fix to recently identified issues relating to land subsidence along the Friant-Kern Canal
CVP and SWP service area	Alternate water supplies	Incorporate alternate water supplies, such as desalinization plants, rain water retention ponds, urban storm water recapture, recycling, and water reuse (e.g., gray water)
CVP and SWP service area	Connection of Folsom South Canal to EBMUD aqueducts	Connect the Folsom South Canal via the Freeport pipeline extension 10.7 miles south to connect to EBMUD aqueducts; improve conveyance of and storage of water; using a "Lucid Pipe" can add hydroelectric power generation
CVP and SWP service area	Eastside San Joaquin Valley storage and groundwater banking	Include a proposed 100,000 AF per year Tulare Lake storage and floodwater protection project, a 100,000 AF per year Kern fan groundwater storage project, and a proposed 30,000 AF per year groundwater bank partnership between Delano-Earlimart Irrigation District and Pixley Irrigation District on the east side of San Joaquin Valley.
CVP and SWP service area	Fix aging infrastructure	Repair any aging infrastructure to improve capacity
CVP and SWP service area	Identify priority areas for delivery	Prioritize water deliveries based on crop type, soil portfolio, and groundwater conditions
CVP and SWP service area	Improve irrigation distribution systems	Update district irrigation delivery systems to provide water to farmers when needed
CVP and SWP service area	Land retirement	Retire land and water rights
CVP and SWP service area	Modified planting practices	Plant drought-tolerant crops, avoid permanent orchard crops, and improve irrigation practices
CVP and SWP service area	Restore Tulare Lake basin	Restore Tulare Lake Basin for increased storage capacity South-of-Delta and for percolation ponds to restore groundwater
CVP and SWP service area	Water to Salton Sea	Supply water to the Salton Sea to avoid air quality impacts
CVP and SWP service area	Water use efficiency	Increase efficiency in use of existing supplies

ACWA = Association of California Water Agencies, AF = acre-feet, Bay-Delta = San Francisco Bay/Sacramento–San Joaquin Delta, BO = biological opinion, CVP = Central Valley Project, CVPIA = Central Valley Project Improvement Act, CDFG = Department of Fish and Game, EBMUD = municipal utility district, NMFS = National Marine Fisheries Service, OMR = Old and Middle River, RPA = Reasonable and Prudent Alternative, SMSCG = Suisun Marsh Salinity Control Gates, SWP = State Water Project, SWRCB = State Water Resources Control Board, TCD = Temperature Control Device, USFWS = U.S. Fish and Wildlife Service

Chapter 3 Alternatives Component Screening and Formulation

3.1 Component Screening

Reclamation considered a number of screening criteria to identify components that should be combined into alternatives. Each criterion was considered consecutively, so if a component was screened out after the first criterion, it was not compared to the subsequent criteria.

3.1.1 Study Area

The first screening criterion considers whether the component is within the study area. Many suggestions received through scoping were outside of the study area considered in this effort, as defined in Section 1.1, *Study Area Location and Description*. Components outside the study area (such as changes to the Klamath Project) were not considered further.

3.1.2 Project Scope

Reclamation considers the project scope to be focused on flexibility for maximizing water deliveries and managing listed species through operational changes to the CVP and SWP. Components that Reclamation is implementing through other efforts are not within the scope of this effort. Components that are not in the project scope were not considered further.

3.1.3 Purpose and Need

This screening criterion focuses on how well each component would meet the purpose and need. If a component did not contribute to meeting the purpose and need, it was not considered further.

3.1.4 Results

Table 3.1-1 shows the results of the alternatives screening effort. Table 3.1-1 includes notes that help explain why certain components were not retained for further evaluation.

Attachment 1 includes a description of the components remaining after screening. These descriptions were used during the alternative formulation process and may have been updated in the alternative descriptions in Chapter 4.

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Table 3.1-1. Component Screening Results

Name	Description	Screening Criteria:	Reason to Screen Out		Notes	Retained/Not Retained for Further Evaluation
		Is not within the study area	*Is not in the project scope*	*Does not contribute to meeting the purpose and need*		
CVP-wide						
2003 guidance under CVPIA	Implement the 2003 guidance, as described under CVPIA, that allows 800,000 AF for the purpose of the environment		X		CVPIA implementation is following guidance currently	Not Retained as a separate component
Alternate energy sources	CVP facilities should use solar or wind power			X	Limited changes to water supply and no contribution to protect fish and wildlife; changing power sources would not change power marketability	Not Retained
Change definition of renewable energy	Change California's definition of renewable energy to include existing CVP hydropower facilities			X	Not an operational change to the CVP or SWP or addressing listed species	Not Retained
Coordinated Operations Agreement revisions	Revise the Coordinated Operations Agreement to improve sharing of resources and obligations between the CVP and SWP					Retained (in all alternatives including No Action Alternative)
CVP termination	Terminate the CVP in its entirety			X	Terminating the CVP would have adverse effects on water users and listed species	Not Retained
D-1641 operations	Operate CVP and SWP facilities to meet D-1641 requirements (without additional flow requirements)					Retained
Dam safety	Evaluate safety of all CVP dams, specifically the earthen dam at Trinity Lake		X		Dam safety is analyzed by a different program within Reclamation	Not Retained
Decrease development in forests	Decrease forest cutting, road building, and development in the Cascade-Sierra Mountains		X		Improved watershed management would have limited effects on water supply and listed fish	Not Retained
Improve hatchery management	Improve management and use of fish hatcheries					Retained
Limit hydraulic fracturing	Limit the transfer of CVP and SWP water from agriculture and municipal uses for energy extraction like hydraulic fracturing		X		Not an operational change to the CVP or SWP or addressing listed species	Not Retained
Nonflow measures	Construct habitat restoration and conduct intervention					Retained
Recalculate flood curves	Reoperate reservoirs and recalculate flood curves to increase supply and storage		X		This measure is not within the project scope	Not Retained
Reduce predation	Reduce predation by nonnative fish on listed native fish					Retained
Refuge supplies	Facilitate carryover storage of winter water for spring irrigation in San Luis Reservoir for South-of-Delta refuges			X	Water deliveries will continue pursuant to current agreements.	Not Retained
Reservoir expansion	Focus on raising Shasta Dam and expanding San Luis Reservoir, Los Vaqueros Reservoir, Temperance Flat Dam, and Sites Reservoir		X		Reservoir expansion projects are being evaluated through separate programs at Reclamation	Not Retained
Restoration studies	Conduct studies to reduce uncertainty in restoration actions, including genetic and otolith research, Steelhead population estimates and trends, Fall-Run population model, and sediment transport model and address how to avoid hatchery competition or genetic introgression with wild salmon					Retained
Sediment management	Construct small dams near inflow points of lakes or reservoirs and annually dredge out sediments behind these small dams, sending the sediments to nearby farmlands		X		Large reservoirs have substantial carryover storage; they would require multiple small dams, and the reservoir would have a lot of water that would make dredging impractical	Not Retained

Name	Description	Screening Criteria: *Is not within the study area*	Reason to Screen Out: *Is not in the project scope*	*Does not contribute to meeting the purpose and need*	Notes	Retained/Not Retained for Further Evaluation
Small screen program	Screen small diversions throughout system to reduce fish entrainment					Retained
Specified release or transfer values	Release or transfer 25 to 100,000 AF per year for the next 10 years; releases would be made available March to May; any water not released would be stored by Reclamation pursuant to a Warren Act contract.		X		New contracts are not being considered as part of the project.	Not Retained
Storage integration	Better integrate operations of storage facilities (see ACWA Storage Integration Study)		X		Components that Reclamation is implementing through other efforts are not within the scope of this effort. Reasonably foreseeable new storage projects are appropriately considered as part of the cumulative analysis. Reclamation operates the CVP in an integrated manner and the alternatives analyzed, including the operational modeling used, take into account integrated operations to the extent feasible.	Not Retained
Watershed management	Rehabilitate the Cascade-Sierra Mountains watershed to manage mountain meadows and restore wildfire into the fire-evolved ecosystem		X		Improved watershed management would have limited effects on water supply and listed fish	Not Retained
Klamath River						
Restore Lower Klamath Lake	Restore the Lower Klamath Lake and clean the Klamath Project's wastewater prior to reaching the Klamath River. Restoring Lower Klamath Lake can provide additional water storage.	X			Klamath Lake is not within the study area or project scope	Not Retained
Transfer groundwater in Klamath Project	Use Klamath Project facilities to convey groundwater for transfer	X			Klamath Lake is not within the study area or project scope	Not Retained
Trinity River						
Cold water conveyance system	Construct a cold water conveyance system from Trinity Reservoir through Lewiston Reservoir to the Trinity River; more water from Trinity Reservoir would be available to valley users for power generation later in the season		X		This construction project is not within the project scope	Not Retained
Dam removal	Remove Trinity and Lewiston Dams		X		Dam removal is not within the project scope	Not Retained
Grass Valley Creek flows	Increase releases from Buckhorn Dam for channel maintenance and provide migration flows for adult Coho Salmon					Retained
Lewiston Reservoir temperature management	Address the temperature issue at Lewiston Reservoir		X		Component does not provide specific ways to address temperature other than flows; flows are managed by the existing Trinity River Restoration Program Record of Decision	Not Retained
Minimum pool volume at Trinity Reservoir	Establish a minimum pool volume of 900,000 to 1,000,000 AF at Trinity Reservoir to protect an adequate lake level for boating facilities and a cold water source for fishery restoration on the Trinity River; if unable to establish request, mitigate the impact by funding the construction of low-water boat launch facilities and Trinity Center and Fairview		X		Revising flow releases and carryover storage from the Trinity River Restoration Program Record of Decision is not in the project scope	Not Retained
Trinity flow augmentation	Augment Trinity River flows beyond the requirements of the 2000 Trinity River Record of Decision as necessary for preservation and propagation of fish		X		Revising flow releases and carryover storage from the Trinity River Restoration Program Record of Decision is not in the project scope	Not Retained
Upgrade hatchery facilities on the Trinity River	Upgrade the Trinity River division hatchery facilities and fund Hoopa Valley Tribe plans for additional selective harvest; transfer hatchery facility management to the Hoopa Valley Tribe		X		Changes to fish management is part of the Trinity River Restoration Program Record of Decision and is not in the project scope	Not Retained

Name	Description	Screening Criteria: *Is not within the study area*	Reason to Screen Out *Is not in the project scope*	*Does not contribute to meeting the purpose and need*	Notes	Retained/Not Retained for Further Evaluation
Sacramento River						
Adult rescue	Rescue adults stranded in locations without adequate fish passage (such as Fremont Weir)					Retained
Increase floodplain	Increase the floodplain using setback levees along streams and the main stem of the Sacramento River between Red Bluff and Colusa; include the purchase of private lands within the floodplains					Retained
Intake lowering near Wilkins Slough	Lower water intakes near Wilkins Slough so that navigation flow requirement can be relaxed, if appropriate, without affecting water supply					Retained
Juvenile trap and haul	Collect juveniles to transport them past areas with high temperatures					Retained
Reduce redd dewatering	Reduce the dewatering of Fall-Run Redds in the Sacramento River after Keswick Dam releases are ramped down					Retained
Reservoir storage targets	Implement storage targets in reservoirs, as suggested by NMFS in 2017			X	Reservoir storage targets would not meet the purpose and need as they reduce operational flexibility, reducing water deliveries	Not Retained
Rice decomposition smoothing	Deliver rice decomposition water over a longer period to reduce the short period of high flow					Retained
Sacramento River spawning and rearing habitat restoration	Restore spawning and rearing habitat in the Sacramento River					Retained
Shasta Lake cold water pool management	Change operations of Shasta Lake to improve year-round management of cold water pool, incorporate a spring pulse, and schedule fall and winter flows to balance storage and redd maintenance					Retained
Shasta Dam TCD improvements	Improve function of Shasta Dam TCD					Retained
Yolo Bypass habitat restoration	Deliver water to Yolo Bypass in support of juvenile salmon rearing habitat and multibenefit projects					Retained
American River						
American River flows	Incorporate the 2017 Modified Flow Management Standard					Retained
American River spawning and rearing habitat restoration	Restore spawning and rearing habitat in the Lower American River					Retained
Drought temperature facility improvements	Construct improvements to temperature facilities to improvement management in dry years					Retained
Bay-Delta						
Addition of pipeline to Jones Pumping Plant	Add 30-foot diameter pipeline from Sherman Island to Jones Pumping Plant to capture water on north side of Sherman Island			X	A pipeline in this location would not help fish or increase times that water could be diverted	Not Retained
Barker Slough PP sediment and aquatic weed removal	Remove sediment and aquatic weeds through mechanical means					Retained

Name	Description	Screening Criteria: *Is not within the study area*	Reason to Screen Out *Is not in the project scope*	*Does not contribute to meeting the purpose and need*	Notes	Retained/Not Retained for Further Evaluation
Clifton Court Forebay Aquatic Weed and Algal Bloom Management	Manage aquatic weeds and algal blooms through mechanical means and herbicides					Retained
Delta Cross Channel gate improvements	Evaluate improvements to automate and streamline operation of the gates					Retained
Delta fish species conservation hatchery	Operate a conservation hatchery for Delta Smelt					Retained
Delta gate system	Construct a gate system to limit the intrusion of salt water into the Delta		X		New gates would be a challenge to permit and would cause problems for movement of fish	Not Retained
Enhance Delta inflow and outflow	Increase Delta inflow and outflow requirements to achieve recovery of federally listed and state-listed species					Retained
Flexible OMR management	Reduce OMR restrictions when they have less benefit to fish					Retained
Focus on water reduction	Consider alternatives that focus on water export reductions, including one or more alternatives consistent with the flow and export limitations identified in the SWRCB 2017 Final Scientific Basis Report					Retained
Improved Delta Cross Channel operations	Modify Delta Cross Channel operations in anticipation of a water quality exceedance (rather than waiting for a water quality exceedance to modify operations)					Retained
Increased exports during high flows	Capture and export more water during periods of high Delta outflow					Retained
Modify OMR restrictions specific to diversion site	Connect OMR restrictions to the relative impact of individual diversion facilities; consider prescreen loss at Clifton Court Forebay		X		Sharing of instream requirements (such as OMR) is controlled by the Coordinated Operations Agreement	Not Retained
No Fall X2 action	Eliminate Fall X2 Action (Action 4) and Component 3 (improved Delta Smelt habitat) of the USFWS RPA (in USFWS 2008 BO)					Retained
North Delta food subsidies	Route water from Colusa Drain into Yolo Bypass and Cache Slough to augment food supplies for Delta Smelt					Retained
Protection of winter and spring flows	Protect winter and spring flows as proposed in the Delta plan update process for the San Joaquin and Sacramento Rivers; consult with fisheries' genetic experts on how to improve the duration and timing of these flows to benefit spring and winter runs					Retained
Reintroduction efforts from Fish Conservation and Culture Laboratory	Construct an improved conservation hatchery focused on capturing existing genetic diversity; operations could expand to accommodate reintroduction					Retained
Remove San Joaquin River inflow and export requirement	Remove export limitations tied to the inflow from the San Joaquin River					Retained
Replace levee with fish screen	Replace Clifton Court Forebay's 1.5-mile levee with a fish screen, specifically ZeeWeed fish screen; fill the Clifton Court Forebay at nighttime and use only natural flows during the daytime; increase capacity of Clifton Court Forebay by dredging		X		This large construction component is not within the project scope	Not Retained

Name	Description	Screening Criteria: *Is not within the study area*	Reason to Screen Out: *Is not in the project scope*	*Does not contribute to meeting the purpose and need*	Notes	Retained/Not Retained for Further Evaluation
Restore Delta natural flow regimes	Restore natural flow regimes in the Delta, which would provide water within basins for local use			X	Ending exports (or drastically reducing them) does not meet the purpose and need of the project	Not Retained
RPA water temperature objectives	Eliminate RPA water temperature objectives because they either are met or cannot be met					Retained
Skinner Fish Facility improvements	Improve operations and effectiveness at Skinner Fish Facility					Retained
Suisun Marsh food subsidies	Add fish food to Suisun Marsh by coordinating managed wetland flood and drain operations, Roaring River Distribution System food production, and reoperation of SMSCG					Retained
Suisun Marsh Salinity Control Gates operations	Operate SMSCG in June through September to increase food production for Delta Smelt					Retained
Tidal habitat restoration	Complete 8,000 acres of tidal habitat restoration that DWR has begun					Retained
Tracy Fish Collection Facility improvements	Improve operations and effectiveness at Tracy Fish Collection Facility					Retained
Water transfers	Allow water transfers for a period longer than July through September					Retained
Stanislaus River						
Alterations to New Melones Reservoir index	Change index for New Melones Reservoir to a hydrologic index for river releases so that it is more reactive to current hydrologic conditions of the year (e.g., 60-20-20 for the San Joaquin River Basin)					Retained
New Melones Reservoir allocations	Reschedule guidelines related to New Melones Reservoir for Stockton East Water District and Central San Joaquin Water Conservation District		X		Rescheduling water as carryover between seasons could further complicate New Melones Reservoir operations	Not Retained
Revert to previous New Melones agreements	Revert to CDFG 1988 agreement flows that are a condition of the New Melones project permits		X		New Melones operations continue to move forward based on new information; reverting to old agreements would not benefit water supply or listed fish	Not Retained
Stanislaus River dissolved oxygen standard relaxation	Petition SWRCB to relax the dissolved oxygen objective for New Melones Reservoir and the Stanislaus River					Retained
Tuolumne River						
Tuolumne River conveyance facility	Consider a conveyance facility to move excess Tuolumne River water to Oakdale Irrigation District; back up Oakdale Irrigation District deliveries to New Melones		X		This large construction project is not within the project scope	Not Retained
CVP and SWP Service Area						
Address Friant-Kern Canal subsidence	Provide a permanent fix to recently identified issues relating to land subsidence along the Friant-Kern Canal		X		Reclamation is evaluating options to address subsidence through a separate project with the Friant Water Authority	Not Retained
Alternate water supplies	Incorporate alternate water supplies, such as desalinization plants, rain water retention ponds, urban storm water recapture, recycling, and water reuse (e.g., gray water)		X		Water users are working to develop alternate water supplies to address limited CVP and SWP supplies; component does not accomplish the purpose and need to increase CVP and SWP water deliveries	Not Retained

Name	Description	Screening Criteria: *Is not within the study area*	Reason to Screen Out *Is not in the project scope*	*Does not contribute to meeting the purpose and need*	Notes	Retained/Not Retained for Further Evaluation
Connection of Folsom South Canal to EBMUD aqueducts	Connect Folsom South Canal via the Freeport pipeline extension 10.7 miles south to connect to the EBMUD aqueducts; improve conveyance and storage of water; using a "Lucid Pipe" can add hydroelectric power generation		X		Construction is not within the project scope, and component would not enable increased CVP and SWP water deliveries	Not Retained
Eastside San Joaquin Valley storage and groundwater banking	Include a proposed 100,000 AF per year Tulare Lake storage and floodwater protection project, a 100,000 AF per year Kern fan groundwater storage project, and a proposed 30,000 AF per year groundwater bank partnership between Delano-Earlimart Irrigation District and Pixley on the east side of San Joaquin Valley		X		Groundwater storage facilities are currently available and do not need Reclamation involvement	Not Retained
Fix aging infrastructure	Repair any aging infrastructure to improve capacity		X		Districts are working on this effort without Reclamation involvement	Not Retained
Identify priority areas for delivery	Prioritize water deliveries based on crop type, soil portfolio, and groundwater conditions		X		Component is not consistent with existing contracts and does not meet the purpose and need.	Not Retained
Improve irrigation distribution systems	Update district irrigation delivery systems to provide water to farmers when needed		X		Districts are working on this effort without Reclamation involvement	Not Retained
Land retirement	Retire land and water rights			X	Component is not consistent with existing contracts and does not meet the purpose and need.	Not Retained
Modified planting practices	Plant drought-tolerant crops, avoid permanent orchard crops, and improve irrigation practices		X		Component is not consistent with existing contracts and does not meet the purpose and need.	Not Retained
Restore Tulare Lake basin	Restore Tulare Lake Basin for increased storage capacity South-of-Delta and as percolation ponds to restore groundwater		X		Restoring Tulare Lake Basin for storage would have substantial effects on agricultural land use and economics in the area	Not Retained
Water to Salton Sea	Supply water to the Salton Sea to avoid air quality impacts	X			Measure is not in the study area and it would not help achieve the purpose and need	Not Retained
Water use efficiency	Increase efficiency in use of existing supplies					Retained

ACWA = Association of California Water Agencies, AF = acre-feet, Bay-Delta = San Francisco Bay/Sacramento–San Joaquin Delta, CVP = Central Valley Project, CVPIA = Central Valley Project Improvement Act, Delta = Sacramento–San Joaquin Delta, CDFG = Department of Fish and Game, DWR = California Department of Water Resources, EBMUD = East Bay Municipal Utility District, M&I = municipal and industrial, NMFS = National Marine Fisheries Service, OMR = Old and Middle River, PP = pumping plant, Reclamation = U.S. Department of the Interior, Bureau of Reclamation, RPA = Reasonable and Prudent Alternative, SMSCG = Suisun March Salinity Control Gates, SWP = State Water Project, SWRCB = California State Water Resources Control Board, USFWS = U.S. Fish and Wildlife Service

3.2 Alternative Formulation

The purpose of this screening exercise is to develop a range of reasonable alternatives for consideration in the EIS. Reclamation considered this purpose during the screening effort and retained some components because those components would help establish a reasonable range. Reclamation combined components into four alternatives that help assess how different operational regimes could affect water deliveries and fish. Reclamation wanted to develop alternatives that would be different enough to characterize the benefits and impacts of different types of operational regimes.

The components remaining after screening generally fall into three categories: (1) flow-related components (changing flows or modifying facilities to accommodate changes in flows), (2) habitat restoration, and (3) intervention (such as improving fish passage or juvenile trap and haul).

The components retained after screening were combined into alternatives:

- Alternative 1: Combine all three component categories
- Alternative 2: Focus on flows required by existing legal decisions (California State Water Resources Control Board [SWRCB] D-1641 and other water rights decisions)Alternative 3: Use flows from Alternative 2 but add restoration and intervention measures
- Alternative 4: Operate storage reservoirs differently in order to increase flows for fish, which would decrease Delta exports

Table 3.2-1 shows how the components were included in each alternative. Alternative 2 addresses comments to consider the potential benefits and impacts of removing flow requirements and increasing operational flexibility. Alternative 4 addresses the scoping comments to consider an alternative that would increase instream flow requirements and decrease exports from the Delta to benefit fish species. Some scoping comments specified that the instream flow requirements should be based on SWRCB efforts to update the San Francisco Bay/Sacramento–San Joaquin Delta (Bay-Delta) Water Quality Control Plan (WQCP) (SWRCB 2006) and incorporate specified flow targets on the San Joaquin River, Sacramento River, and their tributaries. However, the details have not yet been developed about how these flow targets would be integrated with cold water pool management in reservoirs, so Alternative 4 does not meet these flow targets during drier years.

Table 3.2-1. Components Included in Each Alternative

Component Name	Description	Alternative
Coordinated Operations Agreement revisions	Revise the Coordinated Operations Agreement to improve sharing of resources and obligations between the CVP and SWP	All
D-1641 operations	Operate CVP and SWP facilities to meet D-1641 requirements (without additional flow requirements)	2, 3
Improve hatchery management	Improve management and use of fish hatcheries	1, 3
Nonflow measures	Construct habitat restoration and conduct intervention	1, 3
Reduce predation	Reduce predation by nonnative fish on listed native fish	1, 3
Studies	Conduct studies to reduce uncertainty in restoration actions	1, 3
Small screen program	Screen small diversions throughout system to reduce fish entrainment	1, 3

Component Name	Description	Alternative
Grass Valley Creek flows	Increase releases from Buckhorn Dam for channel maintenance and provide migration flows for adult Coho Salmon	4
Adult rescue	Rescue adults stranded in locations without adequate fish passage (such as Fremont Weir)	1, 3
Increase floodplain	Increase the floodplain using setback levees along streams and the main stem of the Sacramento River between Red Bluff and Colusa; include the purchase of private lands within the floodplains	1, 3
Intake lowering near Wilkins Slough	Lower water intakes near Wilkins Slough so that navigation flow requirement can be relaxed, if appropriate, without affecting water supply	1, 3
Juvenile trap and haul	Collect juveniles to transport them past areas with high temperatures	1, 3
Reduce redd dewatering	Reduce the dewatering of Fall-Run redds in the Sacramento River after Keswick Dam releases are ramped down	1
Rice decomposition smoothing	Deliver rice decomposition water over a longer period to reduce the short period of high flow	1
Sacramento River spawning and rearing habitat restoration	Restore spawning and rearing habitat in the Sacramento River	1, 3
Shasta Lake cold water pool management	Change operations of Shasta Lake to improve year-round management of cold water pool, incorporate a spring pulse, and schedule fall and winter flows to balance storage and redd maintenance	1
Shasta Dam TCD improvements	Improve function of Shasta Dam TCD	1, 3
Yolo Bypass habitat restoration	Deliver water to Yolo Bypass in support of juvenile salmon rearing habitat and multibenefit projects	1, 3
American River flows	Incorporate the 2017 Modified Flow Management Standard	1
American River spawning and rearing habitat restoration	Restore spawning and rearing habitat in the lower American River	1, 3
Drought temperature facility improvements	Construct improvements to temperature facilities to improvement management in dry years	1, 3
Barker Slough PP sediment and aquatic weed removal	Remove sediment and aquatic weed through mechanical means	1.3
Clifton Court Forebay Aquatic Weed and Algal Bloom Management	Manage aquatic weeds and algal blooms through mechanical means and herbicides	1, 3
Delta Cross Channel gate improvements	Evaluate improvements to automate and streamline gate operations	1, 3
Delta fish species conservation hatchery	Operate a conservation hatchery for Delta Smelt	1–4
Enhance Delta inflow and outflow	Increase Delta inflow and outflow requirements to achieve recovery of federally listed and state-listed species	4
Flexible OMR management	Reduce OMR restrictions when they have less benefit to fish	1
Reduce water deliveries to increase water for other purposes	Consider alternatives that focus on reduction of water exports, including one or more alternatives consistent with the flow and export limitations identified in the SWRCB 2017 Final Scientific Basis Report	4

Component Name	Description	Alternative
Improved Delta Cross Channel operations	Modify Delta Cross Channel operations in anticipation of a water quality exceedance (rather than waiting for a water quality exceedance to modify operations)	1
Increased exports during high flows	Capture and export more water during periods of high Delta outflow	1, 2, 3
No Fall X2 action	Eliminate Fall X2 Action (Action 4) and Component 3 (improved Delta Smelt habitat) of the USFWS RPA (in USFWS 2008 BO)	1, 2, 3
North Delta food subsidies	Route water from Colusa Drain into Yolo Bypass and Cache Slough to augment food supplies for Delta Smelt	1, 3
Protection of winter and spring flows	Protect winter and spring flows as proposed in the Delta plan update process for the San Joaquin and Sacramento Rivers and consult with fisheries' genetic experts on how to improve the duration or timing of these flows to benefit spring and winter runs	4
Reintroduction efforts from Fish Conservation and Culture Laboratory	Construct an improved conservation hatchery focused on capturing existing genetic diversity; operations could expand to accommodate reintroduction	1, 3
Remove San Joaquin River inflow and export requirement	Remove export limitations tied to inflow from the San Joaquin River	1-4
RPA water temperature objectives	Eliminate RPA water temperature objectives because they either are met or cannot be met	2, 3
Skinner Fish Facility improvements	Improve operations and effectiveness at Skinner Fish Facility	1, 3
Suisun Marsh food subsidies	Add fish food to Suisun Marsh by coordinating managed wetland flood and drain operations, Roaring River Distribution System food production, and reoperation of SMSCG	1, 3
Suisun Marsh Salinity Control Gates operations	Operate SMSCG in June through September to increase food production for Delta Smelt	1
Tidal habitat restoration	Complete 8,000 acres of tidal habitat restoration that DWR has begun	1, 3
Tracy Fish Collection Facility improvements	Improve operations and effectiveness at Tracy Fish Collection Facility	1, 3
Water transfers	Allow water transfers for a period longer than July through September	1
Alterations to New Melones index	Change index for New Melones to a hydrologic index for river releases so that it is more reactive to current hydrologic conditions of the year (e.g., 60-20-20 for the San Joaquin River Basin)	1
Stanislaus River dissolved Oxygen standard relaxation	Petition the SWRCB to relax the dissolved oxygen objective for New Melones and the Stanislaus River	1
Water use efficiency	Increase efficiency in use of existing supplies	4

AF = acre-feet, Bay-Delta = San Francisco Bay/Sacramento–San Joaquin Delta, BO = biological opinion, CVP = Central Valley Project, Delta = Sacramento–San Joaquin Delta, CDFG = California Department of Fish and Game, NMFS = National Marine Fisheries Service, OMR = Old and Middle River flows, RPA = Reasonable and Prudent Alternative, SMSCG = Suisun Marsh Salinity Control Gates, SWP = State Water Project, SMSCG = Suisun Marsh Salinity Control Gates, SWRCB = California State Water Resources Control Board, TCD = temperature control device, USFWS = U.S. Fish and Wildlife Service

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Chapter 4 Alternative Descriptions

This chapter describes the alternatives that are moving forward for further consideration in the EIS. Table 4.1-1 summarizes key components of the different alternatives.

4.1 Components Common to All Alternatives

The following sections describe information that is applicable to the No Action Alternative and the Action Alternatives. In developing these alternatives, Reclamation considered conditions estimated to occur through 2030. If conditions past 2030 are similar to the analysis period, new environmental documentation would not be needed. If new information is needed to address federal Endangered Species Act (ESA) requirements, Reclamation would reinitiate formal consultation and complete appropriate National Environmental Policy Act compliance.

4.1.1 Coordinated Operation Agreement

Reclamation and the California Department of Water Resources (DWR) would operate their respective facilities in accordance with the Agreement between the United States of America and the State of California for Coordinated Operation of the Central Valley Project and the State Water Project (hereinafter referred to as COA). The COA defines the project facilities and their water supplies, sets forth procedures for coordinating operations, and identifies formulas for sharing joint responsibilities for meeting Delta standards and other legal uses of water. COA further identifies how unstored flow is shared, sets up a framework for exchange of water and services between the projects, and provides for periodic review of the agreement.

Through the COA, Reclamation and DWR share the obligation for meeting in-basin uses. In-basin uses are defined in the COA as legal uses of water in the Sacramento Basin, including the water required under the provisions of COA Exhibit A, Standards for the Sacramento-San Joaquin Delta. Each project is obligated to ensure water is available for the in-basin uses as defined in the COA. The respective degree of obligation depends on several factors, described below.

The COA defines balanced water conditions as periods when it is agreed that releases from upstream reservoirs plus unregulated flows approximately equal the water supply needed to meet Sacramento Valley in-basin uses plus exports. The COA defines excess water conditions as periods when it is agreed that releases from upstream reservoirs plus unregulated flow exceed Sacramento Valley in-basin uses plus exports.

Reclamation's Central Valley Operations Office and DWR's SWP Operations Control Office (OCO) jointly decide when balanced or excess water conditions exist. During balanced water conditions, the CVP and the SWP share responsibility in meeting in-basin uses.

Table 4.1-1. Comparison of Alternatives

No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Sacramento River				
NMFS RPA I.2.1-I.2.4: Shasta Temperature Management, WRO 90-5 downstream temperature targets	WRO 90-5; and stabilize fall flows to reduce redd dewatering and rebuild cold water pool	WRO 90-5 downstream temperature targets	WRO 90-5 downstream temperature targets	WRO 90-5, and minimum instream flow requirement of 55% of unimpaired flow at Red Bluff (reduced flows during Shasta Critical years)
No spring pulses	Spring pulses up to 150 TAF if projected May 1 storage > 4.1 MAF	Releases to meet Delta standards; no additional releases required	Releases to meet Delta standards; no additional releases required	Minimum instream flow requirement of 55% of unimpaired flow (limited during Shasta Critical years)
3,250 cfs minimum flow	Measures to reduce Fall-Run redd dewatering and rebuild cold water pool, e.g., when end-of-September storage is: ≤ 2.2 MAF, flow is 3,250 cfs; ≤ 2.8 MAF, flow is 4,000 cfs; ≤ 3.2 MAF, flow is 4,500 cfs; > 3.2 MAF, flow is 5,000 cfs.	Releases to meet Delta standards and WRO 90-5; no additional releases required	Releases to meet Delta standards and WRO 90-5; no additional releases required	Minimum instream flow requirement of 55% of unimpaired flow (limited during Shasta Critical years)
Shasta Lake end-of-September minimum storage established by NMFS 2004 Winter-Run BO (1900 TAF in non-critically dry years), and NMFS BO (Jun 2009) Action I.2.1	No minimum end-of-September storage	No minimum end-of-September storage	No minimum end-of-September storage	No minimum end-of-September storage

No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Livingston-Stone National Fish Hatchery	Increased use of Livingston-Stone National Fish Hatchery during droughts	Livingston-Stone National Fish Hatchery operations as in No Action Alternative	Increased use of Livingston-Stone National Fish Hatchery during droughts	Livingston-Stone National Fish Hatchery operations as in No Action Alternative
No additional habitat restoration	Spawning and rearing habitat restoration, Deer Creek Irrigation Dam fish passage, Knights Landing outfall gates	No additional habitat restoration	Spawning and rearing habitat restoration	No additional habitat restoration
No additional intervention measures	Intervention measures (small screens, adult rescue, juvenile trap and haul), Yellow-billed cuckoo baseline survey	No additional intervention measures	Intervention measures (small screens, adult rescue, juvenile trap and haul)	No additional intervention measures
Trinity River				
Trinity ROD Flows + Lower Klamath Augmentation Flows	Trinity ROD Flows + Lower Klamath Augmentation Flows	Trinity ROD Flows + Lower Klamath Augmentation Flows	Trinity ROD Flows + Lower Klamath Augmentation Flows	Trinity ROD Flows + Lower Klamath Augmentation Flows + Little Grass Valley Flows
Clear Creek				
Base flow of 50–100 cfs based on downstream water rights, 2000 agreement between Reclamation, USFWS, and CDFG, predetermined CVPIA 3406(b)(2) flows, and NMFS BO Action I.1.1	Base flow of 200 cfs from October through May or 150 cfs in critical years and 150 cfs from June through September, downstream water rights, 2000 agreement between Reclamation, USFWS, and CDFG	Base flow of 50–100 cfs based on downstream water rights, 2000 agreement between Reclamation, USFWS, and CDFG	Base flow of 50–100 cfs based on downstream water rights, 2000 agreement between Reclamation, USFWS, and CDFG	Downstream water rights, 2000 agreement between Reclamation, USFWS, and CDFG, and minimum instream flow requirement of 55% of unimpaired flow at Igo

No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Channel maintenance flows when flood operations occur	10 TAF for channel maintenance, unless flood control operations provide similar releases, using the river release outlets, in all but dry and critical years	No channel maintenance flows	No channel maintenance flows	Channel maintenance from 55% unimpaired flow
Two pulse flows in Clear Creek in May and June of at least 600 cfs for at least 3 days for each pulse per year	10 TAF for pulse flows, using the river release, in June of all years	No pulse flows	No pulse flows	Pulse flows from minimum instream flow requirement of 55% of unimpaired flow
Daily water temperature of: (1) 60°F at the Igo gage from June 1 through September 15; and (2) 56°F at the Igo gage from September 15 to October 31.	Daily water temperature in below normal and wetter years of: (1) 60°F at the Igo gage from June 1 through September 16; and (2) 56°F or less at the Igo gage from September 15 to October 31; operate as close as possible to these targets in dry and critical years.	No temperature thresholds	No temperature thresholds	Temperatures controlled by minimum instream flow requirements
No additional intervention measures	Yellow-billed cuckoo baseline survey	No additional intervention measures	No additional intervention measures	No additional intervention measures
Feather River				
1983 DWR, CDFG Agreement (600 cfs) minimum flow below Thermalito Diversion Dam (in Low Flow Channel)	1983 DWR, CDFG Agreement (600 cfs)	1983 DWR, CDFG Agreement (600 cfs)	1983 DWR, CDFG Agreement (600 cfs)	1983 DWR, CDFG Agreement (600 cfs)

No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
1983 DWR, CDFG Agreement (750–1,700 cfs) minimum flow below Thermalito Afterbay outlet	1983 DWR, CDFG Agreement (750–1,700 cfs)	1983 DWR, CDFG Agreement (750–1,700 cfs)	1983 DWR, CDFG Agreement (750–1,700 cfs)	1983 DWR, CDFG Agreement (750–1,700 cfs) and minimum instream flow requirement of minimum of 55% of unimpaired flow below Thermalito (reduced flows under low storage or inflow conditions)

No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
American River				
American River 2006 Flow Management Standard	American River 2017 Flow Management Standard: Flows range from 500 to 2,000 cfs based on time of year and annual hydrology, and "planning minimum"	American River 2006 Flow Management Standard	American River 2006 Flow Management Standard	American River 2017 Flow Management Standard and minimum instream flow requirement of 55% of unimpaired flow below Nimbus (reduced flows under low storage or inflow conditions)
Daily average water temperature of 65°F or lower at Watt Avenue Bridge from May 15 through October 31. 56°F temperature target November 1 through December 31.	May 15 through October 31 daily average water temperature of 65°F (or target temperature determined by temperature model) or lower at Watt Avenue Bridge. When the target temperature requirement cannot be met because of limited cold water availability in Folsom Reservoir, then the target daily average water temperature at Watt Avenue may be increased incrementally (i.e., no more than 1°F every 12 hours) to as high as 68°F. November 1 through December 31 daily average water temperature of 56°F target if cold water pool allows. A temperature higher than 56°F may be targeted based on temperature modeling results.	No temperature thresholds	No temperature thresholds	55% unimpaired flow and qualitative cold water habitat objective
No additional habitat restoration	Spawning and rearing habitat restoration	No additional habitat restoration	Spawning and rearing habitat restoration	No additional habitat restoration

No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
No additional intervention measures	Yellow-billed cuckoo baseline survey	No additional intervention measures	No additional intervention measures	No additional intervention measures

No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Delta				
Exports controlled by D-1641 requirements; and OMR requirements based on USFWS RPA Actions 1-3 and NMFS RPA Actions IV.2.1 and IV.2.3	Exports controlled by D-1641 requirements; and risk-based OMR management incorporating real-time monitoring and models	Exports controlled by D-1641 requirements	Exports controlled by D-1641 requirements	Export constraints from April through May depending on San Joaquin River flows, consistent with NMFS RPA Action IV.2.1
DCC operations based on D-1641 and NMFS RPA that requires consultation to avoid exceeding water quality standards	DCC operations based on D-1641, closures for fish protections, and operations that avoid exceeding water quality standards	DCC operations based on D-1641	DCC operations based on D-1641	DCC operations based on D-1641 and NMFS RPA that requires consultation to avoid exceeding water quality standards
Delta outflow to meet D-1641 requirements; and maintain average X2 for September and October no greater (more eastward) than 74 km in the fall following wet years and 81 km in the fall following above normal years	Delta outflow to meet D-1641 requirements and Delta Smelt Summer-Fall Habitat to meet X2 of 80 km for September and October of above normal years, and wet years with transitional flows in last half of August	Delta outflow to meet D-1641 requirements	Delta outflow to meet D-1641 requirements	Bypass of reservoir releases for fish so they become Delta outflows (with adjustment for downstream natural depletions and accretions)
Old and Middle River Reverse Flows based on calendar date and workgroups per USFWS RPA Actions 1–3 and NMFS RPA Action IV.2.3	Old and Middle River Reverse flows based on species distribution, modeling, and risk analysis with provisions for capturing storm flows and real-time OMR restrictions and performance objectives for turbidity avoidance and cumulative and single-year salvage thresholds	No management of reverse flows	No management of reverse flows	Positive Old and Middle River flows from March through May

No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
HORB installed between September 15 and November 30 of most years when flows at Vernalis is <5,000 cfs; occasionally also between April 15 and May 30 if Delta Smelt entrainment is not a concern	No HORB installed	HORB not ordered in D-1641	HORB not ordered in D-1641	HORB not ordered in D-1641
U.C. Davis Fish Culture Center Refugial Population	Increased use of the U.C. Davis Fish Culture Center and a Delta Fish Species Conservation Hatchery for the introduction of cultured fish into the wild	U.C. Davis Fish Culture Center Refugial Population as in No Action Alternative	Delta Fish Species Conservation Hatchery and the introduction of cultured fish into the wild	U.C. Davis Fish Culture Center Refugial Population as in No Action Alternative
1986 COA with 2018 Addendum	1986 COA with 2018 Addendum	1986 COA with 2018 Addendum	1986 COA with 2018 Addendum	1986 COA with 2018 Addendum
No additional restoration measures	Fall Delta Smelt habitat, food subsidies, tidal habitat restoration	No additional restoration measures	Food subsidies, tidal habitat restoration, food studies, and 25,000 acres of habitat restoration	No additional restoration measures
No additional intervention measures	Intervention measures included (Barker Slough PP sediment and aquatic weed removal, Clifton Court aquatic weed removal, fish collection facility improvements, predator hotspot removal, reintroduction efforts for Delta Smelt, Delta fish species conservation hatchery, and sediment supplementation feasibility study)	No additional intervention measures	Intervention measures included (Barker Slough PP sediment and aquatic weed removal, Clifton Court aquatic weed removal, fish collection facility improvements, predator hotspot removal)	No additional intervention measures
Stanislaus River				

No Action Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4
1987 Reclamation, CDFG agreement and flows required for NMFS BO Action III.1.2 and III.1.3	Stepped Release Plan	1987 Reclamation, CDFG agreement	1987 Reclamation, CDFG agreement	Stepped Release Plan
7.0 mg/L DO requirement at Ripon from June 1 to September 30	7.0 mg/L DO requirement at Orange Blossom Bridge from June 1 to September 30	7.0 mg/L DO requirement at Ripon from June 1 to September 30	7.0 mg/L DO requirement at Ripon from June 1 to September 30	7.0 mg/L DO requirement at Ripon from June 1 to September 30
No additional restoration measures	Spawning and rearing habitat restoration, Yellow-billed cuckoo baseline survey	No additional restoration measures	Spawning and rearing habitat restoration	No additional restoration measures
San Joaquin River				
San Joaquin River Restoration Program flows	San Joaquin River Restoration Program flows	San Joaquin River Restoration Program flows	San Joaquin River Restoration Program flows	San Joaquin River Restoration Program flows
No additional restoration on the Lower San Joaquin River	Lower San Joaquin River rearing habitat restoration, Yellow-billed cuckoo baseline survey	No additional restoration on the Lower San Joaquin River	Lower San Joaquin River rearing habitat restoration	No additional restoration on the Lower San Joaquin River
South-of-Delta Water Contractors				
Water use efficiency measures as included in CVPIA and required by state law/state Executive Order	Same as No Action Alternative	Same as No Action Alternative	Same as No Action Alternative	Increased water use efficiency

AF = acre-feet, Bay-Delta = San Francisco Bay/Sacramento–San Joaquin Delta, BO = biological opinion, CVP = Central Valley Project, CVPIA = Central Valley Project Improvement Act, D-1641 = Water Right Decision 1641, Delta = Sacramento–San Joaquin Delta, DCC = Delta Cross Channel, DO = dissolved oxygen, DWR = California Department of Water Resources, CDFG = California Department of Fish and Game, cfs = cubic feet per second, HORB = head of Old River barrier ,MAF = million acre-feet, mg/L = milligrams per Liter, NMFS = National Marine Fisheries Service, OMR = Old and Middle River flows, PP = pumping plant, ROD = Record of Decision, RPA = Reasonable and Prudent Alternative, SMSCG = Suisun Marsh Salinity Control Gates, SWP = State Water Project, SWRCB = California State Water Resources Control Board, TAF = thousand acre-feet, TCD = temperature control device, USFWS = U.S. Fish and Wildlife Service, WRO = Water Rights Order

During excess water conditions, sufficient water is available to meet all beneficial needs, and the CVP and SWP are not required to supplement the supply with water from reservoir storage. Under COA Article 6(g), Reclamation and DWR have the responsibility (during excess water conditions) to store and export as much water as possible within physical, legal, and contractual limits.

Implementation of the COA principles has evolved since 1986, as changes have occurred to CVP and SWP facilities, operating criteria, and overall physical and regulatory environment. For example, updated water quality and flow standards adopted by SWRCB, Central Valley Project Improvement Act (CVPIA), and ESA responsibilities have affected both CVP and SWP operations. The 1986 COA incorporated the SWRCB Water Right Decision 1485 (D-1485) provisions regarding Delta salinity, outflow, and export restrictions. D-1485 included implementation provisions for the Bay-Delta WQCP that was current at the time, but has since been updated with Water Right Decision 1641 (D-1641). COA envisioned and provided a methodology to incorporate future regulatory changes, such as Delta salinity requirements, but did not explicitly envision or address sharing of export restrictions. D-1641 and the 2008 U.S. Fish and Wildlife Service (USFWS) Biological Opinion (BO) and 2009 National Marine Fisheries Service (NMFS) BO included various export restrictions not explicitly addressed in the 1986 COA. However, the available export capacity as a result of these export restrictions was shared between the CVP and the SWP in absence of a formal update to the COA.

In 2018, Reclamation and DWR modified four key elements of the COA to address changes since the COA was signed: (1) in-basin uses; (2) export restrictions; (3) CVP use of Harvey O. Banks Pumping Plant (Banks Pumping Plant) up to 195,000 acre-feet (AF) per year; and (4) periodic review. The COA sharing percentages for meeting Sacramento Valley in-basin uses now vary from 80% responsibility of the United States and 20% responsibility of the State of California in wet year types to 60% responsibility of the United States and 40% responsibility of the State of California in critical year types. In a dry or critical year following two dry or critical years, the United States and State of California will meet to discuss additional changes to the percentage sharing of responsibility to meet in-basin uses. When exports are constrained and the Delta is in balanced conditions, Reclamation may pump up to 65% of the allowable total exports with DWR pumping the remaining capacity. In excess conditions, these percentages change to 60/40.

4.1.2 CVP Water Contracts

Based on the provisions of federal reclamation law, the CVP delivers water pursuant to water service and water repayment contracts, as well as settlement, exchange, and refuge contracts. Reclamation delivers water pursuant to temporary Section 215 Contracts (not to exceed 1 year) when there are surplus flood flows. Pursuant to the Warren Act, Reclamation provides for conveyance of non-CVP water, which includes SWP water, when there is excess capacity available in CVP facilities. This consultation covers the operation of the CVP and the SWP to deliver water under the terms of all existing contracts up to full contract amounts, which includes the impacts of maximum water deliveries and diversions under the terms of existing contracts and agreements, including timing and allocation. Reclamation is not proposing to execute any new contracts or amend any existing contracts as part of this consultation.

Reclamation operates the CVP to meet its obligations to deliver water to senior water right holders who received water prior to construction of the CVP, wildlife refuge areas identified in the CVPIA, and water service contractors.

Many senior water right holders, such as Sacramento River Settlement Contractors and San Joaquin River Exchange Contractors, executed contracts with Reclamation. The terms of those contracts differ from water service contracts. The pattern of water diversion under a water service contract depends on the use of the water, with irrigation water typically diverted and used during the irrigation season (March through

October), and municipal and industrial (M&I) water diverted and used year-round. All water service contracts contain a shortage provision allowing Reclamation to reduce the amount of water made available for a variety of reasons, such as droughts. Table 4.1-2 summarizes the number of CVP water service and repayment contracts and the amount of water under contract.

Table 4.1-2. CVP Water Service and Repayment Contracts

CVP Division	Number of Contracts	Contract Quantity[1] (Acre-Feet)
Tehama-Colusa Canal, Corning Canal, Redding Area, and Trinity River Division	36	468,890
American River	9	328,750
New Melones/Eastside Contracts	2	155,000
South-of-Delta	44	2,112,898
Friant Division	27	2,249,475
Contra Costa Water District	1	195,000

[1] Contract quantities do not reflect actual deliveries due to system conditions.
CVP = Central Valley Project

CVP water service and repayment contracts include shortage provisions such as:

Article 12, Constraints on the Availability of Water, which provides for a Condition of Shortage, which is defined in Article 1(c) as:

> … a condition respecting the Project during any Year such that the Contracting Officer is unable to deliver sufficient water to meet the Contract Total." Article 12(c) provides "In any Year in which there may occur a shortage for any of the reasons specified in subdivision 12(b) above, the Contracting Officer shall apportion Project Water among the Contractor and others entitled, under existing contracts and future contracts (to the extent such future contracts are permitted under subsections (a) and (b) of Section 3404 of the CVPIA) and renewals thereof, to receive Irrigation Water consistent with the contractual obligations of the United States.

Article 12(d) states, "Project Water furnished under this Contract will be allocated in accordance with the then-existing Project M&I Water Shortage Policy. Such policy shall be amended, modified, or superseded only through a public notice and comment procedure."

The largest contracts belong to Sacramento River Settlement Contractors (approximately 2.1 million acre-feet [MAF]) and San Joaquin River Exchange Contractors (approximately 840 thousand acre-feet [TAF]). In very dry years, Reclamation and DWR are often limited to operating the CVP and the SWP solely to meet these and other senior water right requirements and to meet refuge water supply requirements and minimum instream and Delta flows, M&I deliveries pursuant to the CVP M&I Water Shortage Policy, and SWP exports for health and safety.

In recent drought years, limited water supplies, dry hydrology, and regulatory restrictions made it difficult for Reclamation to make water available to satisfy contracts already reduced by 25% in those years. Reclamation delivers Level 2 refuge water primarily from the CVP and acquires Incremental Level 4 water from voluntary measures, which include water conservation, conjunctive use, purchase, lease, donations, or similar activities, or a combination of such activities that do not require involuntary reallocations of project yield. The alternatives include operations to deliver up to full contract amounts,

including full Level 4 refuge contract amounts. Table 4.1-3 summarizes CVP senior water rights holders and the amount of water under contract.

Table 4.1-3. CVP Settlement Agreements

Contractor	Number of Contracts	Contract Quantity (Acre-Feet)
Sacramento River Settlement	132	2,112,194 (1,775,313 Base + 336,881 Project)
San Joaquin River Exchange	4	840,000
Oakdale/S. San Joaquin ID Agreement and Stipulation	1	≤ 600,000
American River Contracts	13	578,441
Friant Division Riparian Holding Contracts	n/a	5 cfs past each diversion
South-of-Delta Settlement Contractors	9	35,623
North-of-Delta Refuges—Level 2 CVP	2	179,000
South-of-Delta Refuges—Level 2 CVP	3	376,515

Contract quantities do not reflect actual deliveries due to system conditions.
≤ = less than or equal to, cfs = cubic feet per second, CVP = Central Valley Project. ID = Irrigation District

The contracts referenced above usually include articles such as Article 5, Constraints on the Availability of Water, which states, "in a Critical Year, the Contractor's Base Supply and Project Water agreed to be diverted during the period April through October of the Year in which the principal portion of the Critical Year occurs and, each monthly quantity of said period shall be reduced by 25 percent."

4.1.3 SWP Water Contracts

The SWP has signed long-term contracts with 29 water agencies statewide to deliver water supplies developed from the SWP system. These contracts are with both M&I water users and agricultural water users. The contracts specify the charges that will be made to the water agency for both conservation of water and conveyance of water. The foundational allocation of water to each contractor is based on its respective Table A entitlement (the maximum amount of water delivered annually by the SWP to the contractor). Typically, for a variety of reasons, annual water deliveries to individual agencies are less than the contractor's maximum Table A amount.

DWR operates the SWP in accordance with contracts with senior water right holders in the Feather River Service Area (approximately 983 TAF). Further, under State Water Contracts, DWR allocates Table A water as an annual supply made available for scheduled delivery throughout the year. Table A contracts total 4,173 TAF, with over 3 MAF for San Joaquin Valley and Southern California water users.

Article 21 of the long-term SWP water supply contracts provides an interruptible water supply made available only when certain conditions exist: (1) the SWP share of San Luis Reservoir is physically full or projected to be physically full; (2) other SWP reservoirs south-of-Delta are at their storage targets or the conveyance capacity to fill these reservoirs is maximized; (3) the Delta is in excess water conditions; (4) current Table A demand is being fully met; and (5) Banks Pumping Plant has export capacity beyond that which is needed to meet current Table A and other SWP operational demands.

4.1.3.1 *SWP Settlement Agreements*

DWR has water rights settlement agreements to provide water supplies with entities north of Lake Oroville, along the Feather River and Bear River, and in the Delta. These agreements provide users with water supplies that they were entitled to prior to construction of the SWP Oroville Complex. Collectively, these agreements provide over 1 MAF of water each year. DWR also has agreements with several (more

than 60) riparian diverters along the Feather, Yuba, and Bear Rivers to provide water for diversion. Table 4.1-4 summarizes the volumes under the water rights settlement agreements.

Table 4.1-4. SWP Settlement Agreements

Location	Entity	Amount (Acre-Feet)
North of Oroville	Andrew Valberde	135
North of Oroville	Jane Ramelli	800
North of Oroville	Last Chance Creek Water District	12,000
Feather River	Garden Highway Mutual Water	18,000
Feather River	Joint Water Districts Board	620,000
Feather River	South Feather Water & Power	17,555
Feather River	Oswald Water District	3,000
Feather River	Plumas Mutual Water	14,000
Feather River	Thermalito Irrigation District	8,200
Feather River	Tudor Mutual Water	5,000
Feather River	Western Canal/Pacific Gas & Electric Company	295,000
Bear River	South Sutter/Camp Far West	4,400
Delta	Byron-Bethany Irrigation District	50,000
Delta	East Contra Costa Irrigation District	50,000
Delta	Solano County/Fairfield, Vacaville, and Benicia	31,620

SWP = State Water Project

4.1.3.2 *SWP Contracting Agencies*

The SWP has signed contracts with 29 parties to provide water supplies developed by the SWP. Table 4.1-5 shows the maximum contracted annual water supply per DWR's most recent water supply reliability report.

Table 4.1-5. SWP Water Service Contracts

Contracting Agency	Maximum Supply (Acre-Feet)
Butte County	27,500
Plumas County	2,700
Yuba City	9,600
Napa County Flood Control and Water Conservation District	29,025
Solano County	47,756
Alameda County—Zone 7	80,619
Alameda County Water District	42,000
Santa Clara Valley Water District	100,000
Oak Flat Water District	5,700
Kings County	9,305
Dudley Ridge Water District	45,350
Empire West Side Irrigation District	3,000
Kern County Water Agency	982,730
Tulare Lake Water Storage District	87,471

Contracting Agency	Maximum Supply (Acre-Feet)
San Luis Obispo County	25,000
Santa Barbara County	45,486
Antelope Valley-East Kern Water Agency	144,844
Santa Clarita Valley Water Agency	95,200
Coachella Valley Water District	138,350
Crestline-Lake Arrowhead Water Agency	5,800
Desert Water Agency	55,750
Littlerock Creek Irrigation District	2,300
Metropolitan Water District of Southern California	1,911,500
Mojave Water Agency	85,800
Palmdale Water District	21,300
San Bernardino Valley Municipal Water District	102,600
San Gabriel Valley Municipal Water District	28,800
San Gorgonio Pass Water Agency	17,300
Ventura County Watershed Protection District	20,000

Source: DWR 2018.
SWP = State Water Project

4.1.4 Allocation and Forecasts

Reclamation allocates CVP water on an annual basis in accordance with contracts. Reclamation bases north-of-Delta allocations primarily on available water supply within the north-of-Delta system along with expected controlling regulations throughout the year. For south-of-Delta allocations, Reclamation relies on upstream water supply, previously stored water south-of-Delta (in San Luis Reservoir) and conveyance capability through the Delta. Flows on the San Joaquin River often limit conveyance, as these flows are a driver of the flow direction within the Delta and, through their influence on Old and Middle River net reverse flow, can affect entrainment levels at the state and federal pumps.

The water allocation process for the CVP begins in the fall when Reclamation makes preliminary assessments of the next year's water supply possibilities, given current storage conditions combined with a range of hydrologic conditions. Reclamation may refine these preliminary assessments as the water year progresses. Beginning February 1, Reclamation prepares forecasts of water year runoff using precipitation to date, snow water content accumulation, and runoff to date. All of CVP's Sacramento River Settlement Contractors' water rights contracts and San Joaquin River Exchange Contractors' contracts require contractors be informed no later than February 15 of any possible deficiency in their supplies. Reclamation targets February 20 as the date for the first announcement of all CVP contractors' forecasted water allocations for the upcoming contract year. Reclamation updates, at least monthly, forecasts of runoff and operations plans between February and May.

Reclamation intends to use a conservative forecast for seasonal planning of reservoir releases (including developing initial and updated allocations) and temperature management planning. Starting in January, Reclamation reviews various exceedances of inflow forecasts to determine a conservative monthly operations outlook. In many cases, Reclamation develops monthly release forecasts and associated allocations based on a 90% exceedance inflow forecast through September. Reclamation may deviate from relying on the 90% exceedance inflow forecast in order to develop a conservative outlook. Such instances include scenarios when a wetter hydrology produces a more conservative outlook, or the actual conditions are significantly drier than the existing forecast such that a more conservative forecast is appropriate. This conservative approach is intended to minimize

the frequency where real-time management results in a drier or warmer (water temperature) condition than forecasted.

Reclamation performs operations forecasting on a 12-month look-ahead cycle each month to determine how the available water resources can best be used to meet project objectives and requirements. Reclamation bases forecasts on the 12-month projected runoff volumes that would occur naturally and considers potential upstream operations where relevant. For October and November, projected runoff is based entirely on historical hydrology as no snowpack data are available. In December and January, inflow forecasts may include snow pillow information and precipitation, as well as historical hydrology. For the February through May period, the runoff volume estimates are based on the observed inflow to date and current snowpack measurements made at the end of each preceding month, projections through September, and historical hydrology for the next water year. These forecasts represent the uncertainty inherent in making runoff predictions. This uncertainty may include sources such as unknown future weather conditions, the various prediction methodologies, and the spatial coverage of the data network in a given basin.

In most years, the combination of carryover storage and runoff into CVP reservoirs and the Central Valley is not enough to provide sufficient water to meet all CVP contractors' contractual demands. Multiple legislative, contractual, and settlement obligations have created an increased tension in Reclamation's ability to make contractual deliveries of water to water users and to meet other legal obligations. As provided in Section 9 of the Reclamation Projects Act of 1939, Section 215 of the Reclamation Reform Act of 1982, and Section 3404(b) of CVPIA, Reclamation is authorized to enter into temporary contracts, not to exceed 1 year, for delivery of surplus flood flows.

4.1.4.1 *SWP Allocation and Forecasting*

At the beginning of each new water year, there is significant uncertainty as to the hydrologic conditions that will exist several months in the future and thus the water supplies that will be allocated by the SWP to its water contractors. In recognition of this uncertainty, DWR used a forecasting water-supply allocation process that is updated monthly, incorporates known conditions in the Central Valley watershed to date, and forecasts future hydrologic conditions in a conservative manner to provide an accurate estimate of SWP water supplies projected to be delivered to SWP contractors as the water year progresses.

There are many factors considered in the forecast water-supply process. Factors include:

- Water storage in Lake Oroville (both updated and end-of-water-year [September 30])
- Water storage in San Luis Reservoir (both updated and end-of-calendar-year)
- Flood operations constraints at Lake Oroville
- Snowpack surveys (updated monthly February through May)
- Forecasted runoff in the Central Valley (reflects both snowpack and precipitation)
- Feather River settlement agreement obligations
- Feather River fishery flows and temperature obligations
- Anticipated depletions in the Sacramento and Delta Basins
- Anticipated Delta standards and conditions
- Anticipated CVP operations for joint responsibilities
- Contractor supply requests and delivery patterns

Staff from the OCO and the SWP Analysis Office (SWPAO) coordinate their efforts to determine the current water supply allocations. The OCO primarily focuses on runoff and operations models to determine allocations. The SWPAO requests updated information on supply requests and delivery patterns from the contractors to determine allocations. Both OCO and SWPAO staff meet at least monthly with the DWR director to make final decisions on the OCO and SWPAO proposed allocations.

The initial allocation for SWP deliveries is made by December 1 of each year, with a conservative assumption of future precipitation to avoid over-allocating water before the hydrologic conditions are well-defined for the year. As the water year unfolds, Central Valley hydrology and water supply delivery estimates are updated using measured and known information and conservative forecasts of future hydrology. Monthly briefings are held with the DWR director to determine formal approvals of delivery commitments announced by DWR.

Another water supply consideration is the contractual ability of SWP contractors to carry over allocated (but undelivered) Table A allocations from one year to the next if space is available in San Luis Reservoir. The carryover storage is often used to supplement an individual contractor's current year Table A allocations if conditions are dry. Carryover supplies left in San Luis Reservoir by SWP contractors can result in higher storage levels in San Luis Reservoir. As project pumping fills San Luis Reservoir, the contractors are notified to take, or lose, their carryover supplies. Carryover water not taken, after notice is given to remove it, becomes project water available for reallocation to all contractors in a given year.

Article 21 (surplus to Table A) water that is delivered early in the calendar year may be reclassified as Table A later in the year, depending on final allocations, hydrology, and contractor requests. Reclassification does not affect the amount of water carried over in San Luis Reservoir and it does not alter pumping volumes or schedules.

4.1.4.2 *Daily Operations*

After the allocations and forecasting process, Reclamation and DWR coordinate their operations on a daily basis. Some factors considered by Reclamation and DWR when coordinating their joint operations include required in-Delta flows, Delta outflow, water quality, schedules for the joint use facilities, pumping and wheeling arrangements, and any facility limitations. Both projects must meet the flood obligations of individual reservoirs. The CVP operations must consider navigational flows at Wilkins Slough.

During balanced water conditions, Reclamation and DWR maintain a daily water accounting of CVP and SWP obligations. This accounting allows for flexible operations and avoids the need to change reservoir releases made several days in advance (due to travel time from the Delta). Therefore, adjustments can be made "after the fact," using actual observed data rather than by prediction for the variables of reservoir inflow, storage withdrawals, and in-basin uses. This iterative process of observation and adjustment results in a continuous truing up of the running COA account. The project that is "owed" water (i.e., the project that provided more or exported less than its COA-defined share) may request the other project adjust its operations to reduce or eliminate the accumulated account within a reasonable time.

The COA provides the mechanism for determining each project's responsibility for meeting in-basin use, but real-time conditions dictate real-time actions. Conditions in the Delta can change rapidly. For example, weather conditions combined with tidal action can quickly affect Delta salinity conditions and therefore the Delta outflow required to maintain joint salinity standards under D-1641.

Increasing or decreasing project exports can achieve changes to Delta outflow immediately. Imbalances in meeting each project's initial shared obligations are captured by the COA accounting and are balanced out later.

When more reaction time is available, reservoir release changes are used to adjust changing in-basin conditions. For example, if Reclamation decides the reasonable course of action is to increase upstream reservoir releases, then the response may be to increase Folsom Reservoir releases first because the released water will reach the Delta before flows released from other CVP and SWP reservoirs. DWR's Lake Oroville water releases require about 3 days to reach the Delta while water releases from Reclamation's Shasta Lake require 5 days to travel from Keswick Reservoir to the Delta. As water from another reservoir arrives in the Delta, Reclamation can adjust Folsom Reservoir releases downward. Alternatively, if sufficient time exists for water to reach the Delta, Reclamation may choose to make initial releases from Shasta Reservoir. Each occurrence is evaluated on an individual basis, and appropriate action is taken based on multiple factors. COA accounting captures imbalances in meeting each project's initial shared obligation.

The duration of balanced water conditions varies from year to year. Balanced water conditions never occur in some very wet years while very dry years may have long continuous periods of balanced water conditions, and other years may have several periods of balanced water conditions interspersed with excess water conditions. Account balances continue from one balanced water condition to an excess water condition to another balanced water condition. When the project that is owed water enters into flood control operations, which could be Shasta Reservoir for the CVP or Lake Oroville for the SWP, the accounting is zeroed out for that project.

4.1.5 Agricultural Barriers

DWR initiated the South Delta Temporary Barrier Project in 1991. Currently, DWR has permits extending the project through 2022. The South Delta Temporary Barrier Project BO issued in 2018 by USFWS and NMFS to USACE includes mandatory requirements of the 5-year Section 404 permit for construction and removal of the barriers. USACE issued separate permits for the agricultural barriers that run through 2022. CDFW issued two permits: the Incidental Take Permit and the Streambed Alteration Agreement, which provide coverage through 2021, and the Regional Water Quality Control Board Section 401 Water Quality Certification, which provides coverage through 2022.

The project consists of three rock barriers across south Delta channels. In various combinations, these barriers improve water levels for agricultural diversions and conditions for San Joaquin River origin salmonids in the south Delta. All alternatives include the seasonal installation and the removal of temporary rock barriers at the following locations:

- Middle River near the Victoria Canal, about 0.5 miles south of the confluence of Middle River, Trapper Slough, and North Canal.
- Old River near Tracy, about 0.5 miles east of the Delta-Mendota Canal (DMC) intake.
- Grant Line Canal near Tracy Boulevard Bridge, about 400 feet east of Tracy Boulevard Bridge.

The temporary barriers on Middle River (MR), Old River near Tracy (ORT), and the Grant Line Canal (GLC) are referred to as the agricultural barriers, which are flow control facilities designed to improve water levels and circulation for agricultural diversions and are in place during the irrigation season.

4.1.6 Suisun Marsh Preservation Agreement

The Suisun Marsh Preservation Agreement (SMPA) among DWR, Reclamation, CDFW, and Suisun Resource Conservation District (SRCD) contains provisions for DWR and Reclamation to mitigate the effects on Suisun Marsh channel water salinity from SWP and CVP operations and other upstream diversions. The SMPA requires DWR and Reclamation to meet salinity standards in accordance with D-1641, sets a time line for implementing the plan of protection, and delineates monitoring and mitigation requirements.

There are two primary physical mechanisms for meeting salinity standards set forth in D-1641 and the SMPA: (1) implementation and operation of physical facilities in the Marsh and (2) management of Delta outflow (i.e., facility operations are driven largely by salinity levels upstream of Montezuma Slough, and salinity levels are highly sensitive to Delta outflow). Physical facilities (described below) have been operating since the 1980s and have proven to be a highly reliable method for meeting standards.

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, California. The objective of 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.

The SMSCG are operated on an as needed basis to meet 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 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. Assuming no significant long-term changes in the operational data mentioned above, it is expected that gate operations (outside of additional actions described under Delta Smelt Summer-Fall Habitat Action) will remain at current levels (17 to 69 days) necessary to meet D-1641 standards. During drought conditions, gate operations are more likely to span the entire October through May period to meet D-1641 standards.

The SMSCG boat lock portion of the gate will be held partially open during SMSCG operation to allow for continuous salmon passage opportunity. After an engineering solution is implemented to prevent boaters from entering the boat lock prior to the operator closing it, the gate will be held open at all times. However, the boat lock gates may be closed temporarily to stabilize flows to facilitate safe passage of watercraft through the facility.

The Roaring River Distribution System (RRDS) was constructed to provide lower salinity water to 5,000 acres of private wetlands and 3,000 acres of CDFW-managed wetlands on Simmons, Hammond, Van Sickle, Wheeler, and Grizzly Islands. The RRDS includes a 40-acre intake pond that supplies water to Roaring River Slough. Water is diverted through a bank of eight 60-inch-diameter culverts equipped with fish screens into the Roaring River intake pond on high tides to raise the water surface elevation in RRDS above the adjacent managed wetlands. The intake to the RRDS is screened to prevent entrainment of fish larger than approximately 25 millimeters. After the listing of Delta Smelt, RRDS diversion rates have been controlled to maintain a maximum approach velocity of 0.2 feet per second at the intake fish screen except during September 14 to October 20, when RRDS diversion rates are controlled to maintain a maximum approach velocity of 0.7 feet per second for fall flood up operations.

The Morrow Island Distribution System (MIDS) allows Reclamation and DWR to provide water so that lands may be managed according to approved local management plans. The system was constructed primarily to channel drainage water from the adjacent managed wetlands for discharge into Suisun Slough and Grizzly Bay. This approach increases circulation and reduces salinity in Goodyear Slough. The MIDS is used year-round, but most intensively from September through June. When managed wetlands are filling and circulating, water is tidally diverted from Goodyear Slough just south of Pierce Harbor.

The Goodyear Slough Outfall (GYSO) connects the south end of Goodyear Slough to Suisun Bay. Prior to construction of the outfall, Goodyear Slough was a dead-end run slough. The GYSO was designed to increase circulation and reduce salinity in Goodyear Slough so as to provide higher water quality to the wetland managers who flood their ponds with Goodyear Slough water. GYSO has a series of four passive intakes that drain to Suisun bay. The outfall is equipped with slide gates on the interior of the outfall structure to allow DWR to close the system as needed for maintenance or repairs. The intakes and outfall of GYSO are unscreened but are equipped with trash racks to prevent damage. Any fish that entered the system would be able to leave via the intake or the outfall, as GYSO is an open system.

The Suisun Marsh Habitat Management, Preservation, and Restoration Plan (SMP) was developed by the Suisun Principal Agencies including USFWS, Reclamation, CDFW, DWR, NMFS, and SRCD. The SMP is a 30-year comprehensive plan designed to address the various conflicts regarding use of marsh resources, with the focus on achieving an acceptable multistakeholder approach. The plan balances the benefits of tidal wetland restoration with other habitat uses in the marsh by evaluating alternatives that provide a politically acceptable change in marshwide land uses, such as salt marsh harvest mouse habitat, managed wetlands, public use, and upland habitat. The SMP is intended to address the full range of issues in the marsh, which are linked geographically, ecologically, and ideologically.

4.1.7 CVPIA

Reclamation would operate in accordance with its obligations under the CVPIA, including but not limited to CVPIA 3406 (b)(2). DOI accounts for the following actions in meeting the 3406 (b)(2) requirement:

1. Primary Purposes: Any fish action (export reduction or upstream release) that predominantly contributes to one of the enumerated 3406(b) programs identified by the courts, including 3406(b)(1), (4), (5), (8), (9), (12), (18) and (19), must be counted against the up to 800 TAF of (b)(2) water. Thus, any upstream release or export reduction that predominantly contributes to one of those purposes will be deducted from the 3406(b)(2) account.
2. Secondary Purposes: Water operations in accordance with ESA and fish and wildlife objectives of D-1641 water quality actions may also be included in (b)(2) accounting. Upstream releases mandated by ESA Biological Opinions may also count toward 3406 (b)(2). Export reductions in ESA Biological Opinions or specified under D-1641 for fish and wildlife objectives may also count toward 3406 (b)(2). Releases for other water quality actions (i.e., net delta outflow) under D-1641 may also count toward 3406 (b)(2).

Pursuant to section 3406(b)(2)(C) the Secretary of the Interior may temporarily reduce deliveries of the quantity of water dedicated under this paragraph up to 25 percent of such total whenever reductions due to hydrologic circumstances are imposed upon agricultural deliveries of Central Valley Project water. The Secretary may also make water available for other purposes if the Secretary determines that the 800,000 acre feet identified in section 3406(b)(2) is not needed to fulfill the purposes of section 3406.

4.2 No Action Alternative

Under the No Action Alternative, Reclamation would continue with current CVP operations. Those operations are described below by system.

4.2.1 Upper Sacramento River (Shasta and Sacramento Divisions)

Reclamation operates the CVP Shasta Division for flood control, agricultural water supplies, M&I water supplies, fish and wildlife, hydroelectric power generation, Delta water quality, and water quality in the upper Sacramento River. The CVP Shasta Division is also authorized for navigation. Water rights, contracts, and agreements specific to the upper Sacramento River include SWRCB Water Right Decisions 990, 90-5, 91-1, and 1641, settlement contracts, the exchange contract, and water service contracts. Facilities include the Shasta Dam, Shasta Lake (4.552 MAF capacity), and Shasta Power Plant; Keswick Dam, Keswick Reservoir, and Keswick Power Plant; and Shasta Temperature Control Device (TCD). The CVP Sacramento Division includes the Red Bluff Pumping Plant, Corning Pumping Plant, and Corning and Tehama-Colusa Canals, for irrigation of over 150,000 acres of land in Tehama, Glenn Colusa, and Yolo Counties.

Flood control limits releases to less than 79,000 cubic feet per second (cfs) at the tailwater of Keswick Dam and a stage of 39.2 feet in the Sacramento River at Bend Bridge gauging station (approximately 100,000 cfs) to avoid inundating populated areas downstream. Flood control operations are based on regulating criteria developed by USACE pursuant to provisions of the Flood Control Act of 1944. Flood control may reserve up to 1.3 MAF of storage behind Shasta Dam, leaving 3.2 MAF for storage management.

Historical commerce on the Sacramento River resulted in a CVP authorization to maintain minimum flows of 5,000 cfs at Chico Landing to support navigation in accordance with the River and Harbors Act of 1935 and of 1937. Although no commercial traffic persists, long-time water users diverting from the river have set their pump intakes based on minimum navigation flows. Therefore, the CVP operates to approximately 5,000 cfs at the Wilkins Slough gage during periods when the intakes are being operated. This flow often is a challenge to meet under critical water supply conditions due to both water supply and cold water pool limitations, in which cases Reclamation has operated to approximately 4,000 cfs although impacts on senior diverters occur.

The intake that serves both the Tehama-Colusa Canal and the Corning Canal is located on the Sacramento River approximately 2 miles southeast of Red Bluff. Water is diverted from the Sacramento River through a 2,000 cfs pumping plant (with ability to expand to 2,500 cfs) into a settling basin for continued conveyance in the Tehama-Colusa Canal and the Corning Canal.

The Anderson-Cottonwood Irrigation District holds senior water rights and has a settlement contract with Reclamation. Water is diverted to its main canal (on the right bank of the river) from a diversion dam located in Redding, California, about 5 miles downstream from Keswick Dam. Reclamation coordinates with the irrigation district to ensure safe operation of the diversion dam during the irrigation season, from April through October.

In 1990 and 1991, SWRCB issued Water Rights Orders 90-05 and 91-01, modifying Reclamation's water rights for the Sacramento River. The orders stated Reclamation will operate Keswick and Shasta Dams and the Spring Creek Power Plant to meet a daily average water temperature of 56°F as far downstream in the Sacramento River as practicable during periods when higher temperature would be harmful to Winter-Run Chinook Salmon. Under the orders, the water temperature compliance point may be modified to an upstream location when the objective cannot be met at Red Bluff Pumping Plant. In addition, Order 90-05

modified the minimum flow requirements initially established in the 1960 Memorandum of Agreement (MOA) for the Sacramento River below Keswick Dam. The water rights orders also recommended construction of a Shasta TCD to improve the management of the limited cold water resources, monitoring, and coordination.

As a result, Shasta Dam is equipped with a TCD that allows temperature operations without affecting power generation. The TCD allows Reclamation to control the temperature of the water released from Shasta Dam. The TCD has four levels of gates from which water can be drawn: upper gates, middle gates, pressure relief gates (PRG gates) (i.e., lower gates), and side gates (coldest configuration).

The last tool to reduce temperatures is to operate the TCD in the full side gate position, drawing the lowest (and coldest) possible water from the reservoir. Reclamation must balance the objectives of pulse flows or water supply releases early in the season, which can conflict with the goal of maintaining a cold water pool sufficient to meet species' needs toward end of spawning and incubation season in the fall.

To operate the Shasta TCD, a defined amount of reservoir elevation above each set of gates is required to ensure safe operation. This requirement is reflected in Table 4.2-1 as 35 feet of submergence above the top of the gates.

Table 4.2-1. Shasta TCD Gates with Elevation and Storage

TCD Gates	Shasta Elevation with 35 feet of Submergence of the TCD Gates (feet)	Shasta Storage (MAF)
Upper Gates	1,035	approx. 3.66
Middle Gates	935	approx. 1.64
Pressure Relief Gates	840	approx. 0.59
Side Gates	720[1]	approx. 0.08

[1] Low level intake bottom
TCD = temperature control device, MAF = million acre-feet

4.2.1.1 *Seasonal Operations*

Reclamation operates in the winter for flood control, including both the channel capacity within the Sacramento River and the Shasta Reservoir flood conservation space. USACE is responsible for developing and maintaining the Water Control Manual for Shasta Reservoir. On a given date, Reclamation is not to exceed the top of the conservation pool storage level set by the USACE Water Control Manual. Releases for flood control would vary depending on current storage, forecasted inflow, and flow in the mainstem Sacramento River at Bend Bridge. Reclamation operates Shasta Dam releases to keep flows at Bend Bridge below 100,000 cfs and therefore reservoir elevations may temporarily exceed the top of conservation pool storage to protect downstream populated areas. During the winter period, there can be significant flow fluctuations from Keswick Dam due to the flood control operations. When not operating for flood control, Shasta Dam is operated primarily to conserve storage while meeting minimum flows both down the Sacramento River and in the Delta. These minimum flows are held until irrigation demands require increased releases.

During the winter to spring period there are accretions (flows from unregulated creeks) into the Sacramento River below Shasta Dam. These local accretions help to meet both instream demands and outflow requirements, minimizing the need for additional releases from Shasta and Folsom Reservoirs. In wetter year types, Reclamation may be able to operate mostly for flood control and minimum instream requirements because of the large volumes of accretions to the Sacramento River. In drier years, these

accretions may be lower and therefore require Reclamation to release a higher level of releases from the upstream reservoirs to meet state permit requirements and CVP exports in the Delta.

In the spring, releases are fairly steady (unless Shasta Reservoir is in flood control operations) until flows are needed to support instream demands on the mainstem Sacramento River and Delta Outflow requirements. Releases for Delta Outflow requirements are balanced between Shasta Reservoir and Folsom Reservoir. Both reservoirs have substantial temperature control requirements, and both need to substantially fill to fully meet their temperature control requirements. Therefore, releases must be carefully balanced to allow each reservoir to fill without negatively affecting the other. An overarching goal for Reclamation when operating the CVP is to fill the reservoirs as much as possible by the end of the flood control season (end of May) while meeting all other authorized project purposes.

Currently, the seasonal operation of the TCD is generally as follows: during mid-winter and early spring the highest possible elevation gates are used to draw from the upper portions of the lake to conserve deeper colder resources. During late spring and summer, the operators begin the seasonal progression of opening deeper gates as Shasta Reservoir elevation decreases and cold water resources are used. In late summer and fall, the TCD side gates are opened to use the remaining cold water resource.

During summer, operational considerations are mainly flows required for Delta outflows, instream demands, temperature control, and exports. In river temperatures below Shasta Dam can be controlled via two methods. The first method is changing release volume or shifting releases between Trinity and Sacramento Reservoirs. The second method is selective withdrawal through the TCD. Determination of which method to use is made on a daily basis as operators balance releases from multiple reservoirs to meet downstream needs.

Fall operations are dominated by temperature control and provision of fish spawning habitat. By late fall, the remaining cold water pool in Shasta Reservoir is usually limited. This can be a delicate balancing act in that if the early fall flows are too high then the fish may make their redds higher up on the edge of the river and they become subject to the possibility of dewatering when the flows are reduced later in the fall. Sacramento River releases cannot be too low early in the fall, as there are still significant instream diversion demands on the mainstem of the Sacramento River between Keswick Dam and Wilkins Slough, and depending on conditions, SWRCB Delta requirements may require upstream reservoir releases. This necessitates maintaining higher releases to support the instream demands until they fall off later in the season. At that time, Reclamation's objective is to drop Keswick Dam releases to a lower level to conserve storage.

4.2.2 Trinity River Division

Congress authorized the Trinity River Division in 1955 as an integrated component of the CVP to increase water supplies for irrigation and other beneficial uses in the Central Valley, recognizing that water "surplus" to the present and future needs of the Trinity and Klamath Basins could be diverted to the Central Valley "without detrimental effect to the [Klamath-Trinity Basin's] fishery resources."

Accordingly, Reclamation operates the Trinity River Division both to export water to the Sacramento River system and to ensure necessary flow releases into the Trinity-Klamath Basin, such as through implementation of the U.S. Department of the Interior Trinity River Mainstem Fishery Restoration Record of Decision (2000 ROD). Transbasin exports transfer water from the Trinity River to the Sacramento River system through Lewiston Reservoir, Carr Tunnel, Whiskeytown Reservoir, and Spring Creek tunnel.

4.2.2.1 *Seasonal Operations*

Diversion of Trinity Basin water to the Sacramento Basin (transbasin diversion) provides water supply and major hydroelectric power generation for the CVP and plays a key role in water temperature control in the Trinity River and upper Sacramento River. Transbasin diversions are managed to support water supply and temperature objectives within the Sacramento system and are regulated by the 2000 ROD and Trinity Reservoir supply. The 2000 ROD strictly limits Reclamation's transbasin diversions to 55% of annual inflow on a 10-year average basis to legal and trust mandates for the restoration and protection of the Trinity River fishery and restricts the amount of water authorized for exportation to the Central Valley. Reducing transbasin diversions was intended to improve the cold water pool in Trinity Reservoir to improve conditions for fall spawning down the Trinity River. This limitation on transbasin diversions significantly affects Reclamation's temperature operations on the Sacramento River and Reclamation's ability to satisfy senior water right holder and/or the Sacramento River Settlement Contractors commitments within the CVP system.

Trinity River exports are first conveyed through Carr Power Plant, which flows directly into Whiskeytown Lake, a heavily used recreation facility. From Whiskeytown Lake, the exported water continues to flow into Spring Creek Power Plant, ultimately outflowing into the Sacramento River below Keswick Dam, or water is released from Whiskeytown Lake to Clear Creek. Although Whiskeytown Lake is primarily used as conveyance system for transbasin transfers, operations at both Carr and Spring Power Plants are done in a manner to maintain specified elevations for supporting recreation (based on season).

The amounts and timing of Trinity River basin exports into the Sacramento River basin are determined by subtracting Trinity River scheduled flow and targeted carryover storage from the forecasted Trinity River water supply. Reclamation maintains at least 600 TAF in Trinity Reservoir, except during the 10 to 15% of water years when Shasta Reservoir is drawn down. Reclamation addresses end-of-water-year carryover on a case-by-case basis in Dry and Critically Dry water year types described in the water operations governance process below. As stated in the Trinity River ROD, "Implementation of drawdowns below the 600 TAF minimum end-of-year carryover level in Trinity Reservoir shall be determined by Reclamation, USFWS, and NMFS on a case-by-case basis in dry and critically dry water years."

The seasonal timing of Trinity River exports is a result of determining how to make best use of a limited volume of Trinity River exports (in concert with releases from Shasta Reservoir) to help conserve cold water pools and meet water temperature objectives on the upper Sacramento and Trinity Rivers, as well as power production economics.

These exports support better Trinity River temperatures by maintaining cold water and reducing residence time within Lewiston Reservoir. Transbasin diversions also typically help meet Sacramento River temperatures by providing additional cold water resources to the Sacramento River. As a result, Trinity River export operations are completely integrated with Shasta Dam operations.

Reclamation continues to operate in accordance with water rights requirements, including Water Right Order 90-5, which states, "If the temperatures in the Trinity River exceed 56^{o} degrees Fahrenheit at the specified locations during the specified periods," Reclamation will "demonstrate that the exceedance was not due to modifications of Trinity River operations for water temperature control on the Sacramento River."

4.2.2.2 *Trinity River Record of Decision*

The 2000 ROD prescribed increase flows to be released from Lewiston Dam down the Trinity River to meet federal statutory and other responsibilities to protect and restore the basin's fishery resources. Specifically, it entails: (1) variable annual instream flows for the Trinity River from the Trinity River Division based on forecasted hydrology for the Trinity River Basin; (2) mechanical habitat rehabilitation projects along with sediment management and watershed restoration efforts; and (3) an adaptive management program. The 2000 ROD flow release schedules vary among water-year classes and were designed to address the environmental requirements of anadromous fish and fluvial geomorphic function. The five water year classes and associated annual water volumes for release to the Trinity River are Critically Dry (369 TAF), Dry (453 TAF), Normal (636 TAF), Wet (701 TAF), and Extremely Wet (815 TAF).

Total river release can reach up to 11,000 cfs below Lewiston Dam (flood criteria) due to local high water concerns in the floodplain and local bridge flow capacities. Flood criteria provides seasonal storage targets and recommended releases November 1 to March 31.

4.2.2.3 *Long-Term Plan to Protect Adult Salmon in the Lower Klamath River*

In various years since 2003, particularly since 2013, certain fishery agencies, together with tribal governments, have requested additional late-season flows in the Trinity River above the 2000 ROD baseline flows (primarily in August and September) to prevent fish illness from instream crowding and warm waters in the lower Klamath River in drier years. In some cases, these releases were made in successive dry years and therefore had cumulative effects year to year, leading to lower storage in Trinity Reservoir and water supply and temperature impacts in the Sacramento and Trinity Rivers and Clear Creek.

Reclamation released the Record of Decision for the Long-Term Plan to Protect Adult Salmon in the Lower Klamath River in 2017 (2017 ROD), which identified an adaptive management approach, a process, and criteria for Reclamation to determine if and when to provide supplemental flows from mid-August to late September from Lewiston Dam and to prevent an episodic disease outbreak in the lower Klamath River in years when the criteria for such flows are met. The 2017 ROD cited Proviso 1 of Section 2 of the 1955 Act as authority for the releases.

4.2.3 Clear Creek

4.2.3.1 *Whiskeytown Reservoir Operations*

Reclamation operates Whiskeytown Reservoir to (1) regulate inflows for power generation and recreation, (2) support upper Sacramento River temperature objectives, and (3) provide for releases to Clear Creek, as proposed below. Two temperature curtains in Whiskeytown Reservoir were installed to pass cold water through the bottom layer of the reservoir and limit warming from Carr Power Plant to Clear Creek or Spring Creek Power Plant.

Whiskeytown Lake is annually drawn down by approximately 35 TAF during November through April to regulate flows for winter and spring flood management. Heavy rainfall events occasionally result in spillway discharges to Clear Creek. Operations at Whiskeytown Lake during flood conditions are complicated by its operational relationship with the Trinity River, the Sacramento River, and Clear Creek. On occasion, imports of the Trinity River water to Whiskeytown Reservoir may be suspended to avoid aggravating high flow conditions in the Sacramento Basin. Joint temperature control objectives similarly interact among the Trinity River, Clear Creek, and the Sacramento River.

4.2.3.2 *Clear Creek Flows*

Reclamation operates Clear Creek flows in accordance with the 2000 agreement between Reclamation, USFWS, and California Department of Fish and Game (CDFG), and the April 15, 2002 SWRCB permit, which established minimum flows to be released to Clear Creek at Whiskeytown Dam. Reclamation manages Whiskeytown releases to meet a daily average water temperature of (1) 60°F at the Igo gage from June 1 through September 15 and (2) 56°F at the Igo gage from September 15 to October 31.

4.2.3.3 *Spring Creek Debris Dam*

Runoff containing acid mine drainage from several inactive copper mines and exposed ore bodies at Iron Mountain Mine is stored in Spring Creek Reservoir. In January 1980, Reclamation, CDFW, and SWRCB executed a memorandum of understanding (MOU) to implement actions that protect the Sacramento River system from heavy metal pollution from Spring Creek and adjacent watersheds. However, since 1990, concentrations of toxic metals in acidic drainage from Iron Mountain Mine have progressively decreased due to several significant remedial actions by the U.S. Environmental Protection Agency (EPA). The completion of several efforts has resulted in a reduction of approximately 95 percent of the toxic metals that historically emptied into the Sacramento River:

- EPA's Minnesota Flats Iron Mountain Mine Acid Mine Drainage Treatment Plant (lime neutralization plant) in 1994,
- Slickrock Creek Retention Reservoir in 2004, and
- Dredging of approximately 180,000 cubic yards of contaminated sediments from the Spring Creek arm of Keswick Reservoir in 2009-10.

Lower concentrations of copper and zinc resulting from controlled and uncontrolled Spring Creek Debris Dam releases are expected as compared to pre-1990. The extent of heavy metal influence is usually limited to regions immediately downstream of Keswick Dam.

As a result of dramatic changes to the water quality in the vicinity of the Iron Mountain Mine watershed, Reclamation CDFW, SWRCB and EPA are progressing toward a revision of the 1980 MOU to address the improvements and changed conditions. Operation of the Spring Creek Debris Dam and Shasta Dam have deviated from the 1980 MOU to accommodate for these changes. Reclamation expects a revised MOU with similar guidelines to the interim operation.

The interim operation includes actions that protect the Sacramento River system from heavy metal pollution (i.e., acid mine runoff) from Spring Creek Dam and adjacent watersheds. This includes water quality criteria at the point of compliance (Below Keswick) shown in Table 4.2-2 and based upon the criteria for protection of aquatic life in the upper Sacramento River described in the Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan) (SWRCB 1995) and the California Toxics Rule (CTR) (SWRCB 2003).

Table 4.2-2. Water Quality Criteria for Surface Water Downstream of Keswick Dam

Analyte	Maximum Concentration for Acute Exposure (µg/L) [a]	Maximum Concentration for Chronic Exposure (µg/L) [b]
Dissolved copper	5.6 [c,d]	4.1 [e,f]
Dissolved zinc	16 [c,d]	54 [e,f]

[a] The maximum concentration for acute exposure of the 1-hour average concentration.
[b] The maximum chronic exposure is the continuous concentration (4-day average concentration).
[c] Based upon surface water with a hardness of 40 mg/L. Where deviations in water hardness from 40 mg/L occur, the criteria, in µg/L, would be determined by using the following formulas:

Dissolved Copper = (e[0.905 x ln(hardness) - 1.612])
Dissolved Zinc = (e[0.830 x ln(hardness) – 0.289])
[d] Based upon Water Quality Control Plan for the Sacramento River and San Joaquin River Basins (Basin Plan) (Water Board, 1998)
[e] Based upon surface water with a hardness of 40 mg/L. Where deviations in water hardness from 40 mg/L occur, the criteria, in µg/L, would be determined by using the following formulas:
Dissolved Copper = 0.96 x (e[0.8545 x ln(hardness) - 1.702])
Dissolved Zinc = 0.986 x (e[0.8473 x ln(hardness) – 0.884])
[f] Based upon the California Toxics Rule (CTR) (provided in Water Board, 2003)

Reclamation expects continued monitoring of the water quality of Spring Creek Debris Dam, Spring Creek Power Plan, Keswick, and Shasta and increased frequency of monitoring if Spring Creek Debris Dam releases water through the spillway or drops below the minimum elevation threshold. The operation described herein is also dependent on the water treatment capabilities afforded by USEPA.

When storage within Spring Creek Reservoir is less than capacity at 795 feet (approximately 5 TAF) and above 720 feet (note Reclamation's operation is conservative and includes an operational factor of safety of 5 feet), Reclamation would be able to make controlled undiluted releases that result in allowable concentrations of total copper and zinc in the Sacramento River below Keswick Dam. These undiluted releases from Spring Creek Debris Dam could occur throughout the year, typically December through June and less frequently in other months.

When Spring Creek Reservoir storage exceeds the capacity of the reservoir at 795 feet (approximately 5 TAF) water must be released through the spillway. In this situation, Reclamation anticipates an "emergency" relaxation of the criteria, as consistent with past protocol, of: a 50 percent increase in the objective concentrations of copper and zinc. Although the general operational goal is to avoid use of the Spring Creek Debris Dam spillway, some storm events or series of events would be unavoidable. The spillway operation would typically occur during a large storm or series of events, January through April, and would be coincident with large flood management flows released from Keswick Dam. In recent years, EPA, Reclamation, CDFG, and the RWQCB have agreed not to use the emergency criteria until a spill is imminent. During significant rain events, Spring Creek Debris Dam releases may target a dilution ratio with Keswick releases to achieve an acceptable water quality below Keswick Dam. Spring Creek Reservoir spillway dilution flows from Keswick would likely be coincident with large flood management flows and would be unlikely to impact water supply or cold water pool resources.

Reclamation would not plan to operate Spring Creek Reservoir below elevation 720 feet to avoid potentially significant degraded water quality when reservoir soils are exposed. However, if Spring Creek Reservoir were less than 720 feet, then a minimum dilution flow of 250 cfs from Spring Creek Power Plant and increased water quality monitoring would be expected.

At any time that dilution flows are necessary, Reclamation would minimize the build-up of toxic metals in the Spring Creek arm of Keswick Reservoir. To accomplish this, the releases from the debris dam would be coordinated with releases from Spring Creek Powerplant (Spring Creek Power Plant draws water from Whiskeytown Reservoir) to keep the metals in circulation within the main body of Keswick Reservoir.

4.2.3.4 *Clear Creek Restoration Program*

Since the early 1980s, numerous studies were conducted to evaluate methods to rehabilitate and/or restore habitat along lower Clear Creek. In the 1990s, additional studies were conducted following the adoption of the CVPIA. The Western Shasta Resource Conservation District (WSRCD) watershed management

plan evaluated methods to achieve healthy fish populations, diverse biological habitats, recreational opportunities, clean and safe conditions for visitors, and protection of property rights developed by the Lower Clear Creek Coordinated Resource Management and Planning Group of local landowners, stakeholders, and agencies (WSRCD 1998). The plan's recommendations included:

- Removal of the McCormick-Saeltzer Dam
- Inject gravel downstream of Whiskeytown Dam and reconstruct gravel channels below McCormick-Saeltzer Dam to reduce stranding
- Modify water release patterns from Whiskeytown Dam
- Reduce exotic vegetation along Clear Creek
- Reduce sands in Clear Creek through erosion control programs in the lower watershed

This and other studies led to the formation of the Lower Clear Creek Floodway Rehabilitation Project that was implemented under CVPIA. Initial actions under this project included gravel augmentation initiated in 1996, increase in Whiskeytown Dam releases initiated in 2001, removal of the McCormick-Saeltzer Dam in 2001, reconstruction and revegetation of the floodway, and reduction of watershed erosion.

4.2.4 Feather River

Oroville Dam and its related facilities comprise a multipurpose complex. The reservoir stores winter and spring runoff, which is released into the Feather River to meet the SWP's needs, Delta requirements, and fish and wildlife protection. The Oroville Complex provides power generation including pumpback operations, flood control storage, and recreation opportunities.

The Oroville project creates a lake with a maximum surface area of 15,810 acres, has total storage capacity of 3,538 TAF, and is fed by the north, middle, and south forks of the Feather River. Average annual unimpaired runoff into the lake is about 4.5 MAF.

Approximately 4 miles downstream of Oroville Dam and Edward Hyatt Power Plant is the Thermalito Diversion Dam. The Thermalito Diversion Dam consists of a 625-foot-long, concrete gravity section with a regulated ogee spillway that releases water to the low flow channel of the Feather River. On the right abutment is the Thermalito Power Canal regulating headwork structure.

The purpose of the diversion dam is to divert water into the 2-mile-long Thermalito Power Canal that conveys water in either direction and creates a tailwater pool (Thermalito Diversion Pool) for Edward Hyatt Power Plant. The Thermalito Diversion Pool acts as a forebay when the Edward Hyatt Power Plant is pumping water back into Lake Oroville. On the left abutment is the Thermalito Diversion Dam Power Plant, with a capacity of 615 cfs that releases water to the low-flow section of the Feather River.

Thermalito Power Canal hydraulically links the Thermalito Diversion Pool to the Thermalito Forebay (11.768 TAF), which is the off-stream regulating reservoir for Thermalito Power Plant.

Thermalito Power Plant is a generating-pumping plant operated in tandem with the Edward Hyatt Power Plant. Energy prices and availability have historically been the two main factors that determine if pumpback operations are desirable for economic benefits. Pumpback operations typically occurred during off-peak hours when energy prices are lower. However, due to recent changes in the energy market (i.e., solar power contributions) and a desire to reduce operational stress on aging infrastructure, pumpback operations have been infrequent recently. The Oroville Thermalito Complex has a capacity of approximately 17,000 cfs through the power plants. Water is returned to the Feather River via the Thermalito Afterbay river outlet.

The Feather River Fish Hatchery provides mitigation for the construction of Oroville Dam, rears Chinook Salmon and Steelhead and is operated by CDFW. Both indirect and direct take resulting from hatchery operations are authorized through ESA Section 4(d) through NMFS-approved hatchery and genetic management plans. DWR and CDFW are jointly preparing hatchery and genetic management plans for the Spring-Run and Fall-Run Chinook Salmon and Steelhead production programs at the hatchery.

4.2.4.1 *Flow Requirements*

DWR maintains a minimum flow of 600 cfs within the Feather River Low Flow Channel (LFC) as required by the 1983 CDFW Agreement (except during flood events when minimum flows are governed by USACE's Water Control Manual and under certain other conditions as described in the 1984 FERC order). Downstream of the Thermalito Afterbay outlet, in the high flow channel, per the license and the 1983 CDFW Agreement, minimum releases for flows in the Feather River are 1,000 cfs from April through September and 1,700 cfs from October through March, when the April to July unimpaired runoff in the Feather River is greater than 55% of normal. When the April to July unimpaired runoff is less than 55% of normal, the minimum flow requirements are 1,000 cfs from March to September and 1,200 cfs from October to February. The 1983 CDFW Agreement states that if the April 1 runoff forecast in a given year indicates that the reservoir level would be drawn down to 733 feet, water releases for fish may be reduced, but not by more than 25%.

In addition, according to the 1983 CDFW Agreement, during the period of October 15 to November 30, if the average highest 1-hour flow of combined releases exceeds 2,500 cfs, then the minimum flow must be no lower than 500 cfs less than that flow through the following March 31 (with the exception of flood management, accidents, or maintenance.) In practice, flows are maintained below 2,500 cfs from October 15 to November 30 to prevent spawning in the overbank areas.

4.2.4.1.1 Flow Change Rates

Maximum allowable ramp-down release requirements are intended to prevent rapid reductions in water levels that could potentially cause dewatering and stranding of juvenile salmonids and other aquatic organisms. Ramp-down release requirements to the LFC during periods outside of flood management operations, and to the extent controllable during flood management operations, are shown in Table 4.2-3.

Table 4.2-3. Lower Feather River Ramping Rates

Releases to the Feather River Low Flow Channel (cfs)	Rate of Decrease (cfs)
5,000 to 3,501	1,000 per 24 hours
3,500 to 2,501	500 per 24 hours
2,500 to 600	300 per 24 hours

Source: National Marine Fisheries Service 2004

4.2.4.2 *Federal Energy Regulatory Commission Relicensing of the Oroville Project*

The original FERC license to operate the Oroville project expired in January 2007. Since 2007, annual license renewals have been issued, requiring DWR to operate to the original FERC license conditions. The new FERC license has not been adopted by FERC. Until a new license for the Oroville project is issued by FERC, DWR is operating the Oroville facilities in accordance with the current (original) license conditions. In the future, DWR will operate to the new FERC license when it is issued.

4.2.5 American River Division

Reclamation operates the CVP American River Division for flood control, M&I and agricultural water supplies, hydroelectric power generation, fish and wildlife protection, recreation, and Delta water quality. Facilities include Folsom Dam, reservoir (967 TAF capacity), power plant, urban water supply and temperature control device, and the Joint Federal Project auxiliary spillway, as well as Nimbus Dam, Lake Natoma, Nimbus Power Plant, and Folsom South Canal.

Folsom Reservoir is the main storage and flood control reservoir on the American River. Numerous other smaller reservoirs in the upper basin (not owned by Reclamation) provide hydroelectric generation and water supply without specific flood control responsibilities. The total upstream reservoir storage above Folsom Reservoir is approximately 820 TAF, and these reservoirs are operated primarily for hydropower production. Five reservoirs contain 90% of this upstream storage: French Meadows (136 TAF), Hell Hole (208 TAF), Loon Lake (76 TAF), Union Valley (271 TAF), and Ice House (46 TAF). Reclamation coordinates with the reservoirs' operators to aid in planning for Folsom Reservoir operations. Releases from Folsom Dam are reregulated approximately 7 miles downstream by Nimbus Dam. Nimbus Dam creates Lake Natoma, which serves as a forebay for diversions to the Folsom South Canal. Releases from Nimbus Dam to the American River pass through the Nimbus Power Plant or the spillway gates at flows in excess of 5,000 cfs. Because Folsom Reservoir is the closest reservoir to the Delta, releases from Folsom Reservoir can more quickly address Delta water quality requirements under D-1641.

Releases to the lower American River are governed by multiple factors. Minimum releases are set based on the flow management study minimum river release. Releases above the minimum river release can be required for many reasons: instream temperature control, releases to help meet Delta outflow or salinity requirements, flood control releases, and export needs.

Reclamation would ramp down releases in the American River below Nimbus Dam as shown in Table 4.2-4.

Table 4.2-4. American River Ramping Rates

Lower American River Daily Rate of Change (cfs)	Amount of decrease in 24 hours (cfs)	Maximum change per step (cfs)
20,000 to 16,000	4,000	1,350
16,000 to 13,000	3,000	1,000
13,000 to 11,000	2,000	700
11,000 to 9,500	1,500	500
9,500 to 8,300	1,200	400
8,300 to 7,300	1,000	350
7,300 to 6,400	900	300
6,400 to 5,650	750	250
5,650 to 5,000	650	250
<5,000	500	100

Ramping rates would not apply during flood control or if needed for facility operational concerns. The working groups may also determine a need for a variance.

4.2.5.1 *Decision 893*

The minimum allowable flows in the lower American River are defined by SWRCB Water Rights Decision 893 (D-893), which states, in the interest of fish conservation, releases should not ordinarily fall below 250 cfs between January 1 and September 15 or below 500 cfs at other times. D-893 minimum flows are rarely the controlling objective of CVP operations at Nimbus Dam. Nimbus Dam releases are nearly always controlled during significant portions of a water year by either flood control requirements or are coordinated with other CVP and SWP releases to meet downstream SWRCB Bay-Delta WQCP requirements and CVP water supply objectives. Power regulation and management needs occasionally control Nimbus Dam releases. Nimbus Dam releases are expected to exceed the D-893 minimum flows in all but the driest of conditions.

4.2.5.2 *2006 Flow Management Standard*

In July 2006, Reclamation, the Sacramento Area Water Forum, and other stakeholders completed a draft technical report establishing a flow and temperature regime intended to improve conditions for fish in the lower American River (i.e., the Lower American River Flow Management Standard [Reclamation, et al 2006]). Minimum flow requirements during October, November, and December are primarily intended to address Fall-Run Chinook Salmon spawning, and flow requirements during January and February address Fall-Run Chinook Salmon egg incubation and Steelhead spawning. From March through May, minimum flow requirements are primarily intended to facilitate Steelhead spawning and egg incubation, as well as juvenile rearing and downstream movement of Fall-Run Chinook Salmon and Steelhead. The June through September flows are designed to address over-summer rearing by juvenile Steelhead, although this period partially overlaps with adult Fall-Run Chinook Salmon immigration. Reclamation began operating to the flow management study immediately thereafter.

4.2.5.3 *American River Flows to Meet Delta Salinity Requirements*

Folsom Reservoir is operated by Reclamation to release water to help meet Delta salinity and flow objectives established to improve fisheries conditions. Weather conditions combined with tidal action and local accretions from runoff and return flows can quickly affect Delta salinity conditions and require increases in Delta inflow to maintain salinity standards. In accordance with federal and state regulatory

requirements, the CVP and SWP are frequently required to release water from upstream reservoirs to maintain Delta water quality. Because Folsom Lake is closer to the Delta than Lake Oroville and Shasta Lake, if the need for salinity control is immediate, releases may be made first from Folsom Reservoir. As water from the other reservoirs arrives in the Delta, Folsom Reservoir releases can be reduced. In general, however, as the CVP is operated as an integrated project, releases to meet downstream needs are sourced from multiple locations, e.g., both Shasta Reservoir and Folsom Reservoir and SWP contributions from Lake Oroville. Water released from Lake Oroville and Shasta Lake generally reaches the Delta in approximately 3 days and 5 days, respectively. Travel time is considered when release decisions are made as part of operating as an integrated project.

4.2.6 Bay-Delta

The Delta and Suisun Marsh area constitutes a natural floodplain that covers 1,315 square miles and drains approximately 40% of the state (DWR 2013). The Delta and Suisun Marsh have a complex web of channels and islands and are located at the confluence of the Sacramento and San Joaquin Rivers.

The CVP and SWP facilities in the Delta provide for delivery of water supply to areas within and immediately adjacent to the Delta and to regions south-of-Delta. The major CVP features are the Delta Cross Channel (DCC), Contra Costa Canal and Rock Slough intake facilities, Jones Pumping Plant, and Tracy Fish Collection Facility (TFCF). The main SWP Delta features are Suisun Marsh facilities, Banks Pumping Plant, Clifton Court Forebay (CCF), Skinner Fish Facility, and Barker Slough Pumping Plant. Delta conditions are controlled by D-1641 (SWRCB 2000), which sets forth the water right requirements to meet the objectives in the Bay-Delta WQCP (SWRCB 1995).

The CVP Jones Pumping Plant, located about 5 miles north of the city of Tracy, has six fixed-speed pumps. It has a permitted diversion capacity of 4,600 cfs and sits at the end of an earth-lined intake channel about 2.5 miles long. The Jones Pumping Plant discharges into the head of the DMC. The upper portion of the DMC is heavily affected by subsidence that limits the maximum pumping rates to less than the permitted capacity. The SWP Banks Pumping Plant, located near the Jones Pumping Plant, has 11 variable speed pumps that allow for more control over the diversion rate. Pumping is limited to a maximum permitted capacity of 10,300 cfs per day. The Banks Pumping Plant discharges into the California Aqueduct. The DMC/California Aqueduct Intertie (capacity 467 cfs from DMC to California Aqueduct and capacity 900 cfs from California Aqueduct to DMC) is used to move water between the California Aqueduct and the DMC. This structure was built to help both CVP and SWP more effectively move water from the Delta into San Luis Reservoir. This helps both CVP and SWP when there are system restrictions that may prevent one party from moving water.

Banks Pumping Plant pumps water directly from storage in CCF. The CCF radial gates are closed during critical periods of the ebb and flood tidal cycle to protect water levels experienced by local agricultural water diverters in the south-of-Delta area. As a practical matter, Banks Pumping Plant pumping rates are constrained operationally by limits on CCF diversions from the Delta. The maximum daily diversion limit from the Delta into CCF is 13,870 AF per day (6,990 cfs per day) and the maximum averaged diversion limit over any 3 days is 13,250 AF per day (6,680 cfs per day). In addition to these requirements, DWR may increase diversions from the Delta into CCF by one-third of the San Joaquin River flow at Vernalis from mid-December through mid-March when flows at Vernalis exceed 1,000 cfs. These limits are listed in USACE Public Notice 5820A Amended (October 13, 1981).

During July through September, the maximum daily diversion limit from the Delta into CCF is increased from 13,870 AF per day (6,990 cfs per day) to 14,860 AF per day (7,490 cfs per day) and the maximum averaged diversion limit over any 3 days is increased from 13,250 AF per day (6,680 cfs per day) to 14,240 AF per day (7,180 cfs per day). These increases are for recovering water supply losses incurred

earlier in the same year and to protect ESA-listed fish species. The increases are a separate action permitted for short-term time periods. Banks Pumping Plant will pump 195,000 AF to the CVP per the 2018 COA addendum.

The Barker Slough Pumping Plant diverts water from Barker Slough into the North Bay Aqueduct (NBA) for delivery to the Solano County Water Agency and the Napa County Flood Control and Water Conservation District (Napa County FC&WCD) (NBA entitlement holders).

4.2.6.1 *Seasonal Operations*

Winter and spring pumping operations generally maximize exports of excess, unregulated, and unstored water to help meet project demands later in the season and for Delta water quality. To minimize and avoid adverse effects on listed species, actions have been taken or imposed in the past to protect fish migration and minimize fish entrainment at Jones and Banks Pumping Plants. These restrictions limit the CVP's and SWP's ability to export excess water in the winter and spring and place a higher reliance on exporting previously stored water in the summer and fall.

Summer is generally a period of higher export potential. During the summer, the CVP and SWP typically operate to convey previously stored water across the Delta for exporting at the CVP and SWP pumps or other Delta facilities. Delta concerns during the summer are typically focused on maintaining salinity and meeting outflow objectives while maximizing exports with the available water supply.

Fall Delta operations typically begin as demands decrease, accretions increase within the system, and reservoir releases are decreasing to start conserving water. Exports are typically maximized to export available water in the system and may decrease if the fall remains dry. As precipitation begins to fall within the Sacramento and San Joaquin Basins, the reservoirs focus on building storage and managing for flood control.

In order to meet health and safety needs, critical refuge supplies, and obligations to senior water rights holders, the combined CVP and SWP export rates at Jones Pumping Plant and Banks Pumping Plant would not be required to drop below 1,500 cfs.

4.2.6.2 *Delta Cross Channel*

The DCC is a controlled diversion channel between the Sacramento River and Snodgrass Slough. When DCC gates are open, water is diverted from the Sacramento River through a short excavated channel into Snodgrass Slough and then flows through natural channels for about 50 miles to the vicinity of Banks and Jones Pumping Plants.

Reclamation operates the DCC in the open position to (1) improve the movement of water from the Sacramento River to the export facilities at the Banks and Jones Pumping Plants, (2) improve water quality in the central and southern Delta, and (3) reduce salinity intrusion rates in the western Delta. During the late fall, winter, and spring, the gates are often periodically closed to protect out-migrating salmonids from entering the interior Delta and to facilitate meeting the D-1641 Rio Vista flow objectives for fish passage. In addition, whenever flows in the Sacramento River at Sacramento reach 20,000 to 25,000 cfs (on a sustained basis), the gates are closed to reduce potential scouring and flooding that might occur in the channels on the downstream side of the gates.

4.2.6.3 *Delta Water Diversions*

4.2.6.3.1 SWP NBA – Barker Slough Intake

The Barker Slough Pumping Plant diverts water from Barker Slough into the NBA for delivery to the Solano County Water Agency and the Napa County FC&WCD (NBA water contractors). The NBA intake is located approximately 10 miles from the main stem Sacramento River at the end of Barker Slough. Water quality in Barker Slough becomes degraded during winter and spring rainfall events. The Barker Slough drainage basin is characterized by grazing lands, erodible soils, and urban uses. Rainfall runoff can include elevated levels of coliform bacteria, organic matter, turbidity, and pollutants. The water is costly to treat to meet drinking water standards.

4.2.6.3.2 Clifton Court Forebay

The CCF is a 31 TAF reservoir located in the southwestern edge of the Delta, about 10 miles northwest of Tracy, California. The CCF provides storage to allow off-peak pumping of water exported through Banks Pumping Plant, moderates the effect of the pumps on the fluctuation of flow and stage in adjacent Delta channels, and collects sediment before it enters the California Aqueduct. Diversions from Old River into CCF are regulated by five radial gates.

Clifton Court Forebay Aquatic Weed and Algal Bloom Management

Aquatic weeds dominate CCF from late spring through fall. Surveys of the aquatic plant community in CCF show aquatic weeds were present in 91% of the forebay's surface area in 2014 compared to only 38% in 2006. Dense growth of submerged aquatic weeds in CCF can cause severe head loss and pump cavitation at Banks Pumping Plant when the stems of rooted plants break free, combine into "mats," and accumulate on the primary and secondary trash racks. This mass of uprooted and fragmented vegetation essentially forms a watertight plug at the trash racks and vertical louver array. The resulting blockage necessitates a reduction in the water pumping rate to prevent potential equipment damage through pump cavitation and excessive weight on the louver array causing collapse of the structure. Cavitation creates excessive wear and deterioration of the pump impeller blades. Excessive floating weed mats also block the passage of fish into the Skinner Fish Facility, thereby reducing the efficiency of fish salvage operations. Ultimately, this results in a reduction in the volume of water diverted by the SWP. In addition, dense stands of aquatic weeds provide cover for unwanted predators that prey on listed species within the CCF.

Mechanical methods are implemented to manually remove aquatic weeds. A debris boom and an automated weed rake system continuously remove weeds entrained on the trash racks. During high weed load periods in late summer and fall when the plants senesce and fragment or during periods of hyacinth entrainment, boat-mounted harvesters are operated on an as-needed basis to remove aquatic weeds in the forebay and the intake channel upstream of the trash racks and louvers. The objective is to decrease the weed load on the trash racks and to improve flows in the channel. Effectiveness is limited due to the sheer volume of aquatic weeds and the limited capacity and speed of the harvesters. Harvesting rate for a typical weed harvester ranges from 0.5 to 1.5 acres per hour or 4 to 12 acres per day. Actual harvest rates may be lower due to travel time to off-loading site, unsafe field conditions such as high winds, and equipment maintenance.

Aquatic weed assemblages change from year to year in the CCF from predominantly Brazilian waterweed (*Egeria densa*) to one dominated by curly-leaf pondweed, sago pondweed, and southern naiad. In past years, DWR has applied herbicides to control aquatic weeds, from July 1 to August 31.

Attached benthic cyanobacteria blooms have occurred in CCF that produce compounds that cause unpleasant tastes and odors to finished drinking water. The finished drinking water secondary maximum contaminant level (MCL) for taste and odor compounds is 10 ng/L of geosmin and 5 ng/L of 2-methylisoborneol (MIB). Copper sulfate was applied to the nearshore areas of CCF when results of solid phase microextraction analysis exceed the control tolerances (MIB < 5 ng/L and geosmin < 10 ng/L).

In recent years (2016–2018), DWR received approval to apply Aquathol® K aquatic herbicide from June 29 to August 31, but this application has not been permitted in the long term and is not included in the No Action Alternative.

4.2.6.3.3 SWP John E. Skinner Delta Fish Protective Facility

The John E. Skinner Delta Fish Protective Facility (Skinner Fish Facility) is located west of the CCF, 2 miles upstream of the Banks Pumping Plant. The facility screens fish away from the pumps that lift water into the California Aqueduct. Large fish and debris are directed away from the facility by a 388-foot-long trash boom. Smaller fish are diverted from the intake channel into bypasses by a series of metal louvers while the main flow of water continues through the louvers and toward the pumps. These fish pass through a secondary system of screens and pipes into seven holding tanks, where a subsample is counted and recorded. The salvaged fish are then returned to the Delta in oxygenated tank trucks.

CDFW and USFWS evaluated prescreen loss and facility and louver efficiency for juvenile and adult Delta Smelt at the Skinner Fish Facility, and DWR conducted prescreen loss and facility efficiency studies for Steelhead.

4.2.6.3.4 SWP Banks Pumping Plant

The Banks Pumping Plant is in south-of-Delta, about 8 miles northwest of Tracy, California, and marks the beginning of the California Aqueduct. The plant provides the initial lift of water 244 feet into the California Aqueduct by means of 11 pumps, including two rated at 375 cfs capacity, five at 1,130 cfs capacity, and four at 1,067 cfs capacity. Even though the installed capacity of the plant is 10,670 cfs, the maximum conveyance capacity of the California Aqueduct limits the pumping rate to 10,300 cfs.

Permits issued by USACE regulate the rate of diversion of water into CCF for pumping at the plant. This diversion rate is normally restricted to 6,680 cfs as a 3-day average inflow to CCF and 6,993 cfs as a 1-day average inflow to CCF. The CCF diversions may be greater than these rates between December 15 and March 15, when the inflow into CCF may be augmented by one-third of the San Joaquin River flow at Vernalis when those flows are equal to or greater than 1,000 cfs.

4.2.6.3.5 CVP Jones Pumping Plant and Tracy Fish Collection Facility

The Jones Pumping Plant, located about 5 miles north of Tracy, California, has six available pumps. The plant has a physical capacity of approximately 5,200 cfs and sits at the end of an earth-lined intake channel about 2.5 miles long. Because of limited capacity in the DMC, the facilities in which water pumped at the plant flows have current maximum pumping capacity at the plant is approximately 4,600 cfs. The plan can be operated to its permitted capacity of 4,600 cfs when Reclamation accesses the DMC/California Aqueduct Intertie.

The TFCF is located in the southwest portion of the Delta at the head of the intake channel for the Jones Pumping Plant. The TFCF uses behavioral barriers consisting of primary louvers and four rotating traveling screens aligned in a single row 7 degrees to the flow of the water to guide entrained fish into

holding tanks before transport by truck to release sites at the confluence of the Delta. The TFCF was designed to handle smaller fish (less than 200 mm) that would have difficulty fighting the strong pumping plant-induced flows, as the intake is essentially open to the Delta and impacted by tidal action.

The primary louvers are located in the primary channel just downstream of the trash rack structure. The traveling water screen is located in the secondary channel. The louvers allow water to pass through onto the pumping plant, but the openings between the slats are tight enough and angled against the flow of water to prevent most fish from passing between them and to enable the fish to enter one of four bypass entrances along the louver arrays.

Approximately 52 different species of fish are entrained into the TFCF each year; however, the total numbers are significantly different for the various species salvaged. It is difficult, if not impossible, to determine exactly how many safely make it all the way to the collection tanks to be transported back to the Delta. Hauling trucks used to transport salvaged fish to release sites inject oxygen and contain an 8 parts per thousand salt solution to reduce stress.

When south Delta hydraulic conditions allow, and conditions within the original design criteria for the TFCF, the louvers are operated to achieve water approach velocities for striped bass of approximately 1 foot per second from May 15 through October 31 and for salmon of approximately 3 feet per second from November 1 through May 14.

Fish passing through the facility are sampled at intervals of 30 minutes every 2 hours year-round. Fish observed during sampling intervals are identified by species, measured to fork length, examined for marks or tags, and placed in the collection facilities for transport by tanker truck to the release sites in the north Delta away from the pumps. In addition, TFCF personnel monitor for the presence of spent female Delta Smelt in anticipation of expanding the salvage operations to include sub-20 mm larval Delta Smelt detection.

TFCF personnel monitor for the presence of spent female Delta Smelt by euthanizing all adult Delta Smelt that are collected in the 30-minute fish count, determine the gender and the gonadal or sexual maturation stage of the Delta Smelt, and determine if the eggs have reached Stage IV, the stage when eggs are ready for release (0.9 to 10 mm in diameter and easily stripped). Stages V (i.e., postvitellogenic stage) and VI (i.e., postovulatory, or spent stage) are expected soon after Stage IV observation. Stages are determined and reported real-time when a biologist is present or the following morning after Delta Smelt detection and collection. Stage or gonad maturation is determined using egg stage descriptions from Mager (1996).

Larval Smelt sampling at the TFCF commences once a trigger is met (detection of a spent female at CVP and SWP being one of three triggers). Fish count screen with a 2.4 mm mesh size opening is replaced with one that has a mesh size of 0.5 mm to retain larval fish. Sampling is done four times a day (04:00, 10:00, 16:00, 22:00) and all larval Smelt are identified to species and reported the day after collection.

4.2.6.3.6 Contra Costa Water District Operations

CCWD diverts water from the Delta for irrigation and M&I uses under its CVP contract, under its own water right permits and license issued by the SWRCB and under East Contra Costa Irrigation District's (ECCID's) pre-1914 water right. CCWD's water system includes the Mallard Slough, Rock Slough, Old River, and Middle River (on Victoria Canal) intakes; Rock Slough Fish Screen (constructed in 2011 under the authority of CVPIA 3406[b][5]); Contra Costa Canal and shortcut pipeline; and Los Vaqueros Reservoir.

The Rock Slough Intake, Contra Costa Canal, and shortcut pipeline are owned by Reclamation and are operated and maintained by CCWD under contract with Reclamation. Mallard Slough Intake, Old River Intake, Middle River Intake, and Los Vaqueros Reservoir are owned and operated by CCWD. Federal legislation providing the authority for Reclamation to transfer title of the facilities was passed by Congress and signed by the President in March 2019. CCWD and Reclamation are beginning the title transfer process, which includes conducting the required environmental and property record review to execute the transfer. The process is anticipated to take approximately 2 years to complete. These facilities are described in Appendix C, *Facility Descriptions and Operations*.

Operations at CCWD's intakes and Los Vaqueros Reservoir are governed by NMFS BOs (NMFS 1993, 2007, 2010, 2017) and USFWS BOs (USFWS 1993, 2000, 2007, 2010, 2017), an MOU with CDFW (CDFG 1994), and an incidental take permit from CDFG (CDFG 2009), which are separate from the BOs for the coordinated long-term operation of the CVP and SWP. CCWD's operations in the No Action Alternative are consistent with the current implementation of the operational criteria specified in those separate BOs.

CCWD operates its intake facilities to meet its delivered water quality goals and to protect listed species. The choice of which intake to use at any given time is based in large part upon salinity at the intakes, consistent with fish protection requirements in the CCWD-specific BOs and permits listed above. In winter and spring months when the Delta is relatively fresh (generally January through July), deliveries to the CCWD service area are made by direct diversion from the Delta. In addition, when salinity is low enough, Los Vaqueros Reservoir is filled at a rate of up to 200 cfs from the Old River Intake and Middle River Intake. When salinity in the Delta is high (generally late summer and fall months), CCWD releases previously stored water from Los Vaqueros Reservoir to blend with its direct Delta diversions to meet its water quality goals.

The BOs for the Los Vaqueros Project, CCWD's Incidental Take Permit issued by CDFW, and SWRCB D-1629 include fisheries protection measures consisting of a 75-day period during which CCWD does not fill Los Vaqueros Reservoir (no-fill period) and a concurrent 30-day period during which CCWD halts all diversions from the Delta (no-diversion period), provided that Los Vaqueros Reservoir storage is above emergency levels. During the no-diversion period, CCWD customer demand is met by releases from Los Vaqueros Reservoir. The default dates for the no-fill and no-diversion periods are March 15 through May 31 and April 1 through April 30, respectively. USFWS, NMFS, and CDFW can change these dates to best protect the subject species.

In addition to the 75-day no-fill period and the concurrent 30-day no-diversion period, CCWD operates to an additional term in the Incidental Take Permit issued by CDFW that provides for an additional no-fill period of up to 15 days between February 14 and February 28. These dates can be changed to better protect Delta fish species, at the direction of CDFW.

CCWD currently coordinates the filling of Los Vaqueros Reservoir with Reclamation and DWR to avoid water supply impacts on other CVP and SWP customers. This coordination would also continue under the No Action Alternative.

4.2.6.3.7 Regulatory Limitations on Operations of Delta Water Diversions

Operations of the CVP and SWP are implemented in accordance with SWRCB water rights and water quality decisions, including D-1641, the 2008 USFWS BO, and the 2009 NMFS BO.

Decision 1641

The SWRCB adopted the 1995 Bay-Delta Plan on May 22, 1995. The plan became the basis of D-1641 (adopted December 29, 1999 and revised March 15, 2000). D-1641 amended certain terms and conditions of the SWP and CVP water rights to include flow and water quality objectives to assure protection of beneficial uses in the Delta and Suisun Marsh. (SWRCB grants conditional changes to points of diversion for the CVP and SWP under SWRCB D-1641). The requirements in D-1641 address the standards for fish and wildlife protection, water supply water quality, and Suisun Marsh salinity. These objectives include specific Delta outflow requirements throughout the year, specific export limits in the spring, and export limits based on a percentage of estuary inflow throughout the year. The water quality objectives are designed to protect agricultural, municipal and industrial, and fishery uses, and vary throughout the year and by water year type.

The export to inflow ratio limited exports at Banks and Jones pumping plants to 35% of total Delta inflow from February through June. The 35% E/I Ratio from February to June required in D-1641 was a significant change from D-1485. This spring requirement reduced the availability of unstored flow for export and storage in San Luis Reservoir. February to June became an unreliable season for conveying water across the Delta. Spring X2 reduced the unstored flow availability by dedicating a significant block of water to Delta outflow and salinity goals. The spring X2 Delta outflow is specified from February through June to maintain freshwater and estuarine conditions in the western Delta to protect aquatic life. The criteria require operations of the CVP and SWP upstream reservoir releases and Delta exports in a manner that maintains a salinity objective at an X2 location. The X2 standard was established to improve shallow water estuarine habitat in the months of February through June and relates to the extent of salinity movement into the Delta (DWR, Reclamation, USFWS, and NMFS 2013). The location of X2 is important to both aquatic life and water supply beneficial uses.

Joint Point of Diversion

D-1641 authorized the SWP and CVP to jointly use both Jones and Banks Pumping Plants in the south Delta, with conditional limitations and required response coordination plans (referred to as Joint Point of Diversion [JPOD]). Use of JPOD is based on staged implementation and conditional requirements for each stage of implementation. The stages of JPOD in D-1641 are:

- Stage 1, for water service to a group of CVP water service contractors (Cross Valley contractors, San Joaquin Valley National Cemetery, and Musco Family Olive Company) and recovery of export reductions implemented to benefit fish.
- Stage 2, for any purpose authorized under the current CVP and SWP water right permits.
- Stage 3, for any purpose authorized, up to the physical capacity of the diversion facilities.

In general, JPOD capabilities are used to accomplish four basic CVP and SWP objectives:

- When wintertime excess pumping capacity becomes available during Delta excess conditions and total CVP and SWP San Luis storage is not projected to fill before the spring pulse flow period, the project with the deficit in San Luis storage may elect to pursue use of JPOD capabilities.
- When summertime pumping capacity is available at Banks Pumping Plant and CVP reservoir conditions can support additional releases, the CVP may elect to use JPOD capabilities to enhance annual CVP south-of-Delta water supplies.
- When summertime pumping capacity is available at Banks or Jones Pumping Plant to facilitate water transfers, JPOD may be used to further facilitate the water transfer.

- During certain coordinated CVP and SWP operation scenarios for fishery entrainment management, JPOD may be used to shift CVP and SWP exports to the facility with the least fishery entrainment impact while minimizing export at the facility with the most fishery entrainment impact.

Each JPOD stage has regulatory terms and conditions that must be satisfied to implement JPOD. All stages require a response plan (i.e., water level response plan) to ensure water elevations in the south Delta will not be lowered to the injury of local riparian water users and a response plan to ensure the water quality in the south and central Delta will not be significantly degraded through operations of the JPOD to the injury of water users in the south and central Delta. Stage 2 has an additional requirement to complete an operations plan (i.e., fisheries response plan) that will protect fish and wildlife and other legal users of water. Stage 3 has an additional requirement to protect water levels in the south Delta. All JPOD diversions under excess conditions in the Delta are junior to CCWD water right permits for the Los Vaqueros Project and must have an X2 location west of certain compliance locations consistent with the 1993 Los Vaqueros BO for Delta Smelt.

Old and Middle River Reverse Flow Management

Old and Middle River (OMR) Net Flows provides a surrogate indicator for how exports at Banks and Jones Pumping Plants and San Joaquin River inflow influence hydrodynamics in the south Delta. The management of OMR, in combination with other environmental variables, can minimize or avoid the entrainment of fish in the South Delta and at CVP and SWP salvage facilities. Under the No Action Alternative, Reclamation and DWR would continue to operate the CVP and SWP to meet the Reasonable and Prudent Alternative (RPA) requirements in USFWS' 2008 BO RPA Actions 1–3 and NMFS 2009 BO RPA Action IV.2.3.

4.2.6.4 *Water Transfers*

The No Action Alternative includes water transfers through CVP and SWP facilities. Water transfers occur through various methods, including groundwater substitution, release from storage, and cropland idling, and include individual and multiyear transfers. The quantity and timing of Keswick releases would be similar to those that would occur absent the transfer. Water transfers would occur from July through September in total annual volumes up to those described in Table 4.2-5.

Table 4.2-5. Water Transfers in the No Action Alternative

Water Year Type	Maximum Transfer Amount (TAF)
Critical	Up to 600
Dry (following critical)	Up to 600
Dry (following dry)	Up to 600
All other years	Up to 360

4.2.7 Stanislaus River

Reclamation operates the CVP East Side Division for flood control, agricultural water supplies, hydroelectric power generation, fish and wildlife protection, and recreation. In the Stanislaus River watershed, Reclamation owns and operates New Melones Dam and New Melones Reservoir (2.4 MAF capacity). The Tri-Dam Project, a partnership between the Oakdale Irrigation District (OID) and South San Joaquin Irrigation District (SSJID), consists of Donnells and Beardsley Dams, located upstream of New Melones Reservoir on the middle fork Stanislaus River, and Tulloch Dam and Power Station, located approximately 6 miles downstream of New Melones Dam on the mainstem Stanislaus River.

Releases from Donnells and Beardsley Dams affect inflows to New Melones Reservoir. The main water diversion point on the Stanislaus River is Goodwin Dam, located approximately 2 miles downstream of Tulloch Dam. The OID and SSJID manage the Tulloch and Goodwin Dams infrastructure through separate agreements with both Reclamation and Reclamation's CVP water service contractors (Stockton East Water District and Central San Joaquin Water Conservation District) to meet Reclamation's Stanislaus River objectives, CVP contractor deliveries, and deliveries to the OID and SSJID service areas.

The Stanislaus River watershed has annual obligations that exceed the average annual runoff in a given year due to several factors, including SWRCB water rights decisions D-1641, D-1422, and D-1616; 1987 CDFG agreement; CVPIA objectives; 2009 BO; 1988 agreement and stipulation with OID and SSJID; riparian water right diverters; and CVP water delivery contracts.

Over the past decade, Reclamation has worked with Stanislaus River water users and related agencies in developing a revised operating plan for New Melones Reservoir to addresses multiple objectives, including a more predictable and sustainable operation, minimize low storage conditions in successive drought years, and provide flows to support listed species and critical habitat. These efforts have allowed multiple agencies and stakeholders to provide input on potential solutions; a final plan has not been completed.

4.2.7.1 *Reservoir Operations*

The operating criteria for New Melones Reservoir are constrained by water rights requirements, flood control operations, contractual obligations, and federal requirements under the ESA and the CVPIA. Reclamation must operate New Melones Reservoir to meet senior water rights and in-basin demands. Senior water rights are defined for both current and future upstream water right holders in accordance with D-1422 and D-1616, through protest settlement agreements with Tuolumne and Calaveras Counties, and for current downstream water right holders and riparian rights whose priorities are either senior to Reclamation or senior to appropriative rights in general. Reclamation is required to make full contract amounts available to Stockton East Water District and Central San Joaquin Water Conservation District except for when contractual shortage provisions apply.

Under the No Action Alternative, New Melones Reservoir releases would be controlled by Appendix 2E of the 2009 NMFS Biological Opinion, which specifies releases for endangered fish.

Tulloch Reservoir is owned and operated by the Tri-Dam Project for recreation, power, and flow re-regulation of New Melones Reservoir releases. Water released by Tulloch Reservoir and Power Station flows downstream to Goodwin Reservoir, where water is either diverted to canals to serve Oakdale Irrigation District, South San Joaquin Irrigation District, and Stockton East Water District or is released from Goodwin Reservoir to the lower Stanislaus River (SWRCB 2012).

Below Goodwin Dam, the lower Stanislaus River flows approximately 40 miles to the confluence with the San Joaquin River. Agricultural return flows and operational spills from irrigation canals enter the lower Stanislaus River.

4.2.7.2 *Dissolved Oxygen Requirement*

Reclamation's New Melones Reservoir water rights require that water be bypassed through or released from New Melones Reservoir to maintain applicable dissolved oxygen standards to protect the salmon fishery in the Stanislaus River. The Central Valley Regional Water Quality Control Board's 2004 San Joaquin Basin 5C Plan designates the lower Stanislaus River with cold water and spawning beneficial

uses, which have a general water quality objective of no less than 7 milligrams per liter (mg/L) dissolved oxygen. This objective is applied through Reclamation's water rights to the Stanislaus River near Ripon.

4.2.8 San Joaquin River

Reclamation operates the Friant Division for flood control, irrigation, M&I, and fish and wildlife purposes. Facilities include Friant Dam, Millerton Reservoir, and Friant-Kern and Madera Canals. Friant Dam provides flood control on the San Joaquin River, provides downstream releases to meet senior water rights requirements above Gravelly Ford, provides restoration flow releases under Title X of Public Law 111-11, and provides conservation storage as well as diversion into Madera and Friant-Kern Canals for water supply. Water is delivered to about a million acres of agricultural land in Fresno, Kern, Madera, and Tulare Counties in the San Joaquin Valley via the Friant-Kern Canal south into Tulare Lake Basin and via the Madera Canal northerly to Madera and Chowchilla Irrigation Districts. A minimum of 5 cfs is required to pass the last holding contract diversion located about 40 miles downstream of Friant Dam near Gravelly Ford.

4.2.8.1 *San Joaquin River Restoration Program*

The San Joaquin River Restoration Program (SJRRP) implements the San Joaquin River Restoration Settlement Act (Settlement Act) in Title X of Public Law 111-11. USFWS and NMFS issued programmatic BOs in 2012 that included project-level consultation for SJRRP flow releases. Programmatic ESA coverage is provided for flow releases up to a certain level, recapture of those flows in the lower San Joaquin River and the Delta, and all physical restoration and water management actions listed in the Settlement Act.

The Stipulation of Settlement of *Natural Resources Defense Council v. Rogers* is based on two goals: Restoration Goal and Water Management Goal. To achieve the Restoration Goal, the Stipulation of Settlement calls for, among other things, releases of water from Friant Dam to the confluence of the Merced River (referred to as Restoration Flows) according to the hydrographs in Exhibit B of the Stipulation of Settlement. To achieve the Water Management Goal, the Stipulation of Settlement calls for the development and implementation of a plan for recirculation, recapture, reuse, exchange, or transfer of restoration flows for the purpose of reducing or avoiding impacts caused by restoration flows on water deliveries to the Friant contractors. Recapture of restoration flows may occur upstream of a capacity restricted reach or downstream of the Merced River confluence. Recapture can occur at Banta-Carbona, Patterson, or West Stanislaus Irrigation District facilities or at Jones or Banks Pumping Plants. Recapture of restoration flows in the Delta would average 65 TAF, ranging from approximately 25 TAF to 78 TAF, depending on the year type.

4.2.8.2 *San Joaquin River from Merced River to the Delta*

Flows in the San Joaquin River below the Merced River confluence to the Delta are controlled in large part by releases from reservoirs, located on the tributary systems, to satisfy contract deliveries and instream flow requirements, as well as operational agreements such as D-1641. The Merced and Tuolumne Rivers, two tributaries to this reach of the San Joaquin River, are described below. The Stanislaus River was described in Section 4.2.6.

4.2.8.2.1 **Merced River**

The Merced River flows west out of the Sierra Nevada to its confluence with the San Joaquin River at the end of Reach 5. Merced River stream flows are regulated primarily by New Exchequer and McSwain Dams, which form Lake McClure and Lake McSwain, respectively. The Crocker-Hoffman Diversion

Dam is located downstream from New Exchequer and McSwain Dams. Lake McClure is a water supply, hydropower, and flood control reservoir. Lake McSwain is a regulating reservoir approximately 6 miles downstream from Lake McClure. Both reservoirs are owned and operated by the Merced Irrigation District. Minimum flow standards were established in 1964 (Project No. 2179) by a FERC license and the Davis-Grunsky Contract No. D-GGR17 between Merced Irrigation District and DWR. During high-flow events, a portion of the Merced River flows are conveyed to the San Joaquin River through Merced Slough.

4.2.8.2.2 Tuolumne River

The Tuolumne River enters the San Joaquin River downstream from the Merced River. The largest reservoir on the Tuolumne River is New Don Pedro Lake, owned and operated by the Turlock Irrigation District and Modesto Irrigation District for water supply, hydropower, and flood control purposes. La Grange Reservoir below New Don Pedro Lake is jointly owned by the two irrigation districts and is operated as a diversion dam. The 1995 New Don Pedro Settlement Agreement contains instream flow requirements on the Tuolumne River for the anadromous fishery downstream from the project (FERC 2009).

4.2.9 South-of-Delta

4.2.9.1 *DMC, San Luis Unit, and California Aqueduct Intertie*

4.2.9.1.1 Water Demands

Water provided to the DMC and San Luis Unit primarily meet demands from three types of contractors: CVP water service contractors (including both agricultural and M&I), exchange contractors, and wildlife refuge contractors. Distinct relationships exist between Reclamation and each contractor.

Exchange contractors "exchanged" their senior rights to water in the San Joaquin River for a CVP water supply generally provided from the Delta. Reclamation provides water to meet the 840 TAF per annum exchange contract obligation, with a maximum reduction under the Shasta critical year criteria to an annual water supply of 650 TAF.

South-of-Delta CVP agricultural water service contractors receive their supply from the Delta, but their supplies are subject to the availability of CVP water supplies that can be developed after senior obligations are met. The CVP also contracts with wildlife refuges to provide water supplies to specific managed lands for wildlife purposes. These contracts are subject to the availability of CVP water supplies but may be reduced under Shasta critical year criteria up to 25%.

4.2.9.1.2 DMC/California Aqueduct Intertie

The DMC-California Aqueduct Intertie between the DMC and the California Aqueduct allows water to flow in both directions between the CVP and SWP conveyance facilities. The DMC/California Aqueduct Intertie achieves multiple benefits, including meeting current water supply demands, allowing for the maintenance and repair of the CVP Delta export and conveyance facilities, and providing operational flexibility to respond to emergencies. The DMC/California Aqueduct Intertie can be used under one of the following three scenarios:

- Up to 467 cfs may be pumped from the DMC to the California Aqueduct to ease DMC conveyance constraints related to Jones Pumping Plant capacity limitations.

- Up to 467 cfs may be pumped from DMC to the California Aqueduct to minimize impacts on water deliveries due to temporary restrictions in flow or water levels on the lower DMC (south of the intertie) or the upper California Aqueduct (north of the intertie) for system maintenance or due to an emergency shutdown.
- Up to 900 cfs may be conveyed from the California Aqueduct to DMC using gravity flow to minimize impacts on water deliveries due to temporary restrictions in flow or water levels on the lower California Aqueduct (downstream of the intertie) or upper DMC (upstream of the intertie) for system maintenance or for an emergency shutdown.

4.2.9.1.3 San Luis Reservoir

The San Luis Reservoir (2.027 MAF), formed by Sisk Dam, is jointly operated by Reclamation and DWR, with approximately 0.965 MAF used by the CVP and 1.062 MAF used by the SWP. Water generally is diverted into San Luis Reservoir during late fall through early spring, when irrigation water demands of CVP and SWP water users are low and are being met by Delta exports.

4.2.9.1.4 Non-CVP and SWP Reservoirs That Store CVP and SWP Water

The CVP and SWP water is delivered to water agencies, and some of those agencies store the water in their own regional and local reservoirs. These reservoirs frequently store non-CVP and SWP water supplies, including local runoff or water diverted under separate water rights or contracts.

In the San Francisco Bay Area region, CVP water is stored in the CCWD Los Vaqueros Reservoir and the East Bay Municipal Utility District Upper San Leandro, San Pablo, Briones, and Lafayette Reservoirs and Lake Chabot. The Los Vaqueros Reservoir stores water diverted from the Delta under separate water rights. The East Bay Municipal Utility District reservoirs primarily store water diverted under water rights on the Mokelumne River.

In the Central Coast region, a portion of the SWP water supply diverted in the Coastal Branch can be stored in Cachuma Lake for use by southern Santa Barbara County communities. Cachuma Lake is a facility owned and operated by Reclamation in Santa Barbara County as part of the Cachuma Project (not the CVP).

In the Southern California region, SWP water is stored in the Metropolitan Water District of Southern California's Diamond Valley Lake and Lake Skinner; United Water Conservation District's Lake Piru; City of Escondido's Dixon Lake; City of San Diego's San Vicente, El Capitan, lower Otay, Hodges, and Murray Reservoirs; Helix Water District's Lake Jennings; Sweetwater Authority's Sweetwater Reservoir; and San Diego County Water Authority's Olivenhain Reservoir. There are future plans by local water agencies to expand local and regional water surface water storage.

4.3 Alternative 1

Alternative 1 includes a combination of flow-related actions, habitat restoration, and intervention measures. Table 4.3-1 shows each of the components of Alternative 1, including operational changes, nonflow habitat, and facility improvements. The table shows whether each action is covered at a project or program level of analysis in this EIS and whether it involves construction actions. Alternative 1 components within each basin are described in more detail in the sections following the table. If not mentioned in the table, the operations of the No Action Alternative remain.

Table 4.3-1. Components of the Alternative 1

Title	Project Level Analysis or Program-Level Analysis	Construction Effects
Upper Sacramento		
Spring Pulse Flows	Project	–
Shasta Cold Water Pool Management consistent with WRO 90-5	Project	–
Fall and Winter Refill and Redd Maintenance	Project	–
Rice Decomposition Smoothing	Project	–
Spring Management of Spawning Locations	Program	–
Temperature Modeling Platform	Program	–
Shasta Temperature Control Device Performance Evaluation	Program	–
Battle Creek Salmon and Steelhead Restoration Project and Battle Creek Reintroduction Plan	Program	X
Lower Intakes Near Wilkins Slough	Program	
Spawning and Rearing Habitat Restoration	Program	X
Deer Creek Irrigation District Dam (DCID) Fish Passage	Program	–
Small Screen Program	Program	X
Knights Landing Outfall Gates	Program	X
Winter-Run Chinook Salmon Conservation Hatchery Production	Program	X
Adult Rescue	Program	–
Juvenile Trap and Haul	Program	X
Directors Meeting	Program	
Yellow-billed Cuckoo Baseline Surveys	Program	–
Trinity		
Whiskeytown Reservoir Operations/Clear Creek Minimum Flows	Project	–
Yellow-billed Cuckoo Baseline Surveys	Program	–
Feather River		
FERC Project 2100-134 controls operations; Alt 1 analyzes downstream of the FERC boundary	Project	–
American River		
2017 Flow Management Standard Releases and Planning Minimum	Project	–
American River Pulse Flows	Project	–
Drought Temperature Management	Program	–
Spawning and Rearing Habitat Restoration	Program	X
Nimbus Hatchery Genetic Management Plans	Program	X
Yellow-billed Cuckoo Baseline Surveys	Program	–
Stanislaus		
Stanislaus Stepped Release Plan (including pulse flows)	Project	–
Alteration of Stanislaus DO Requirement	Project	–

Title	Project Level Analysis or Program-Level Analysis	Construction Effects
Spawning and Rearing Habitat Restoration	Program	X
Temperature Management Study	Program	–
Yellow-billed Cuckoo Baseline Surveys	Program	–
San Joaquin		
Lower San Joaquin River Habitat	Program	X
Yellow-billed Cuckoo Baseline Surveys	Program	–
Bay-Delta		
Delta Cross Channel Operations	Project	–
Barker Slough PP Sediment and Aquatic Weed Removal	Project	–
Water Transfers	Project	–
Clifton Court Aquatic Weed and Algal Bloom Management	Project	–
OMR Management	Project	–
Tracy Fish Collection Facility CO_2 Injector and Release Sites	Project	–
Operations		
Delta Smelt Summer-Fall Habitat	Project	–
Delta Smelt Summer-Fall SMSCG Operation	Project	–
North Delta Food Subsidies/Colusa Basin Drain Study	Program	–
Sacramento Deepwater Ship Channel Food Study	Program	–
Suisun Marsh and Roaring River Distribution System Food Subsidies Study	Program	–
San Joaquin Basin Steelhead Telemetry Study	Project	–
Steelhead Lifecycle Monitoring Program	Program	–
San Joaquin Basin Steelhead Collaborative	Program	–
San Joaquin River Scour Hole Predation Reduction	Program	X
Yellow-billed Cuckoo Baseline Surveys	Program	–
Habitat Restoration		
Predator Hot Spot Removal	Program	–
Facility Improvements		
Delta Cross Channel Gate Improvements	Program	X
Tracy Fish Collection Facility Improvements	Program	X
Clifton Court Forebay Mortality Reduction	Project	–
Skinner Fish Facility Performance Improvements	Program	X
Salvage Release Sites	Project	–
Small Screen Program	Program	X
Fish Intervention		
Reintroduction efforts from Fish Conservation and Culture Laboratory	Project	–
Delta Fish Species Conservation Hatchery	Program	X
Sediment Supplementation Feasibility Study	Program	–

DO = dissolved oxygen OMR = Old and Middle River flows; PP = pumping plant, SMSCG = Suisun March Salinity Control Gates, TCD = temperature control device

4.3.1 Upper Sacramento River (Shasta and Sacramento Divisions)

4.3.1.1 *Seasonal Operations*

Reclamation would continue to operate by season with the same primary purpose during each season as described for the No Action Alternative. For spring base flows under wetter hydrology, during the March through May period, downstream demands are minimal and are generally met through unstored accretions to the system. Under these conditions, Reclamation aims to reduce Keswick flows during the fall-winter period. Operations under these conditions help build storage in those types of years. Other changes to specific operations are described below.

In addition to the requirements under 90-5, ramping rates for Keswick Dam between July 1 and March 31 would be reduced between sunset and sunrise:

- Keswick releases > 6,000 cfs, reductions in releases may not exceed 15% per night, and no more than 2.5% per hour.
- Keswick releases 4,000 cfs to 5,999 cfs reductions in releases may not exceed 200 cfs per night, or 100 cfs per hour.
- Keswick releases between 3,250 cfs and 3,999 cfs; reductions in releases may not exceed 100 cfs per night.

Ramping rates would not apply during flood control or if needed for facility operational concerns. The working groups may also determine a need for a variance.

4.3.1.2 *Spring Pulse Flows*

Under Alternative 1, Reclamation would release spring pulse flows of up to 150 TAF in coordination with the Upper Sacramento Scheduling Team when the projected total May 1 Shasta Reservoir 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. Total storage provides a surrogate for the likely cold water pool prior to stratification of the reservoir and would inform the decision in addition to monthly winter reservoir temperature measurements and climate forecasts. Reclamation would evaluate the projected May 1 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 1 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 1 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 could also determine that the benefits of a spring pulse flow do not outweigh the potential negative impacts on the system, in which case Reclamation would not release one. Reclamation would also make a determination of whether water could be released without affecting temperature management; Reclamation thinks that this volume is about 4 MAF, which is used as a surrogate for planning and analysis. Reclamation would not make a Spring pulse release if the release would cause Reclamation to drop into a Tier 4 Shasta summer cold water pool management (i.e., the additional flow releases would decrease cold water pool such that summer Shasta temperature management drops in Tier 4), would interfere with meeting performance objectives, or would interfere with the ability to meet other

anticipated demands on the reservoir. Reclamation would also not release a spring pulse when Shasta Reservoir is making flood releases. The Upper Sacramento Scheduling Team would determine the timing, duration, and frequency of the spring pulse within the 150 TAF volume. Figure 4.3-1 summarizes this operational regime. This figure shows timing of pulse flows potentially in March, April, or May, but only one pulse flow would occur during the March through May period (up to 150 TAF total). Wet hydrology downstream of Keswick Dam may meet the need for pulse flows without increased releases.

Based on current science, which may be updated through the Upper Sacramento Scheduling Team, the spring pulse could be 0 to 2 pulses of 10,000 cfs at Wilkins Slough for 3 days each, in a time when Wilkins Slough flows are less than 9,000 cfs. Following the initial 3-day pulse targeting 10,000 cfs at Wilkins, 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.

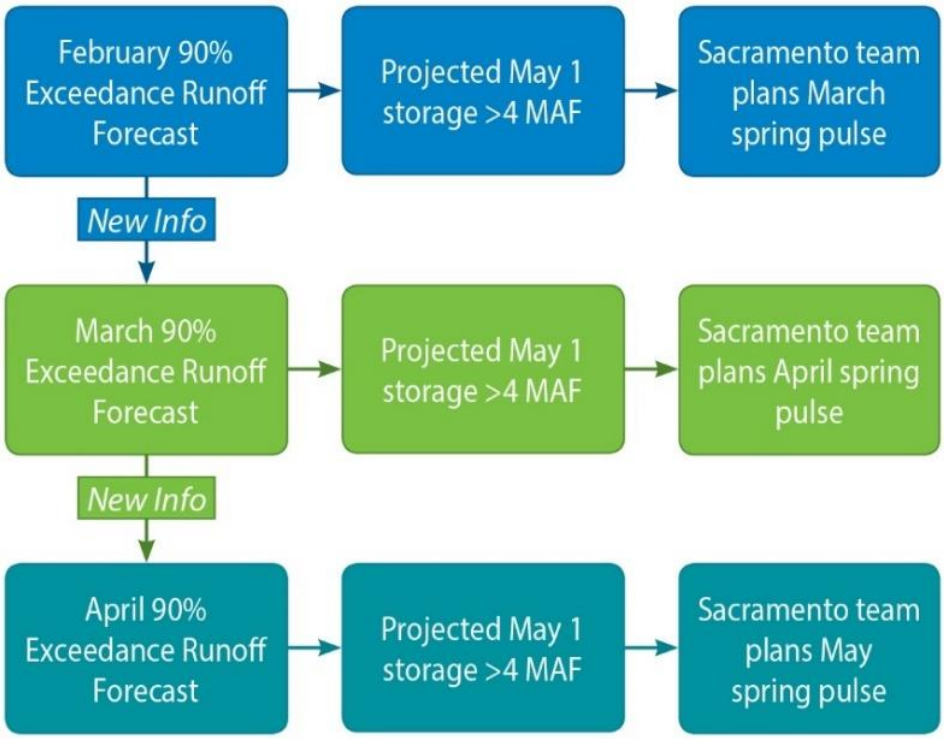

Figure 4.3-1. Lake Shasta Spring Pulse Flow Operations

4.3.1.3 *Summary of Alternative 1 Items to Improve Shasta Storage*

As described in the sections below, Alternative 1 includes several operational components that are intended to contribute to increased spring Shasta storage levels as compared to recent years. These include (1) Fall and Winter Refill and Redd Maintenance, which sets minimum late fall and winter flows, including modification of rice decomposition operations compared to the Current Operations Scenario (COS); (2) modified fall outflow requirements compared to the COS; (3) flexibility in export operations (especially in April and May) compared to the COS; and (4) December 2018 changes to COA (which are also included in COS). These operations, as well as real-time operations, are expected to result in increased end of September carryover storage, which Reclamation expects to benefit the following May 1 storage in years without flood control releases.

4.3.1.4 *Cold Water Pool Management*

The closer Shasta Reservoir is to full by the end of May, the greater the likelihood of being able to meet the Winter-Run Chinook Salmon temperature targets throughout the entire temperature control season. If Shasta Reservoir storage is high enough to use the Shasta TCD upper shutters by the end of May, Reclamation can maximize the cold water pool potential. Storage of 3.66 MAF allows water to pass through Shasta TCD's upper gates, but historical relationships suggest that storage of 4 MAF on May 1 generally provides enough storage to continue operating through the upper gates and develop a sufficient cold water pool to meet a daily average temperature of 53.5°F on the Sacramento River above Clear Creek (at the CCR gaging station) for Winter-Run Chinook Salmon spawning and egg incubation with minimal risks of higher temperatures in the late summer and fall. Figure 4.3-2 provides an approximate estimate of the relationship between temperature compliance, total storage in Shasta Reservoir, and cold water pool in Shasta Reservoir.

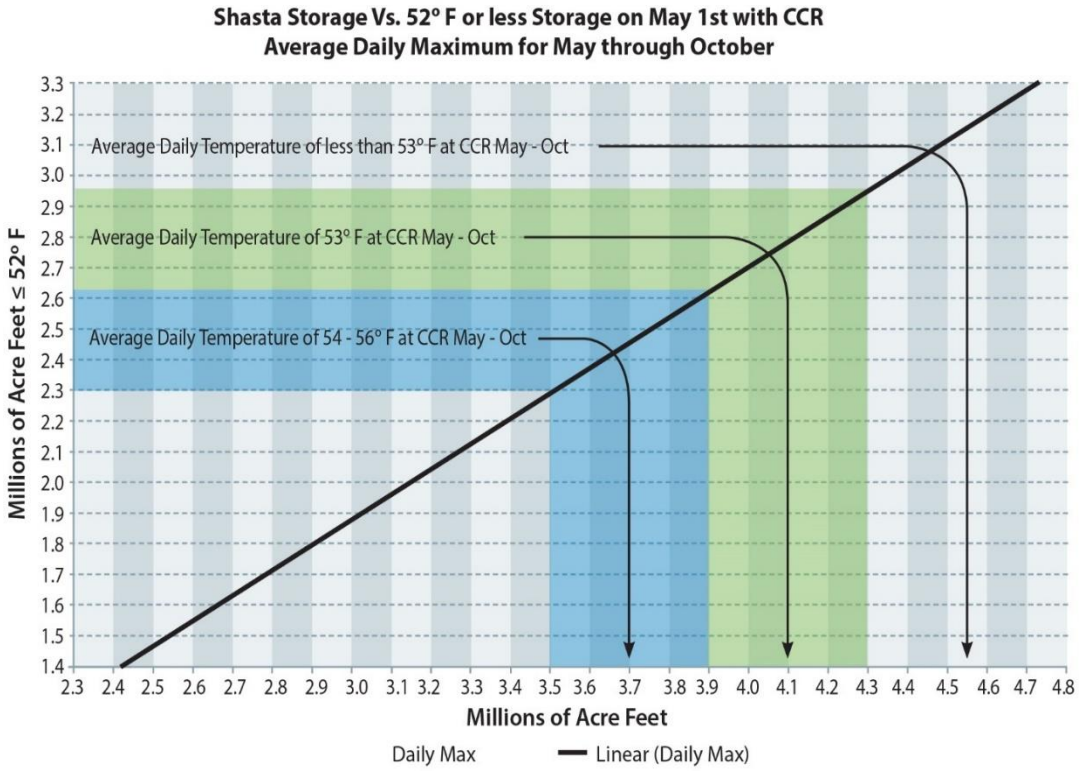

Figure 4.3-2. Relationship between Temperature Compliance, Total Storage in Shasta Reservoir, and Cold Water Pool in Shasta Reservoir

4.3.1.4.1 Summer Cold Water Pool Management

Under Alternative 1, Reclamation would operate the Shasta Dam TCD to continue providing temperature management in accordance with CVPIA Section 3406(b)(6) while minimizing impacts on power generation. Cold water pool is defined as the volume of water in Shasta Reservoir that is less than 52°F, which Reclamation would determine based on monthly (or more frequent) reservoir temperature profiles. The Sacramento River above Clear Creek (CCR) gage is a surrogate for the downstream extent of most Winter-Run Chinook Salmon redds. Temperature management would start after May 15 or when the Sacramento River Temperature Task Group (SRTTG) determines, based on real-time information, that Winter-Run Chinook Salmon have spawned, whichever is later. Temperature management would end October 31 or when the SRTTG determines, based on real-time monitoring, that 95% of Winter-Run

Chinook Salmon eggs have hatched and alevin have emerged, whichever is earlier. Real-time information will continue to be considered in this process, which includes redd, carcass, and juvenile surveys.

Reclamation would address cold water management using a tiered strategy that allows for strategically selected temperature objectives, based on projected total storage and cold water pool, meteorology, Delta conditions, and habitat suitability for incoming fish population size and location. The tiered strategy recognizes that cold water is a scarce resource that can be managed to achieve desired water temperatures for fisheries objectives. Figure 4.3-3 shows examples of water temperatures at CCR under the four tiers, with arrows indicating how temperatures would change in different years with less May 1 forecasted cold water pool. The proposed tiers are described below, along with storage levels that are likely to provide for cold water management within the tier. Actual operations would depend upon the available cold water and modeling. In any given year, cold water pool and storage could result in Reclamation switching between tiers within the year if needed to optimally use the cold water pool. Cold water pool management is proposed to start as early as May 15, however temperatures at the start of the temperature management season are often lower than the target temperatures.

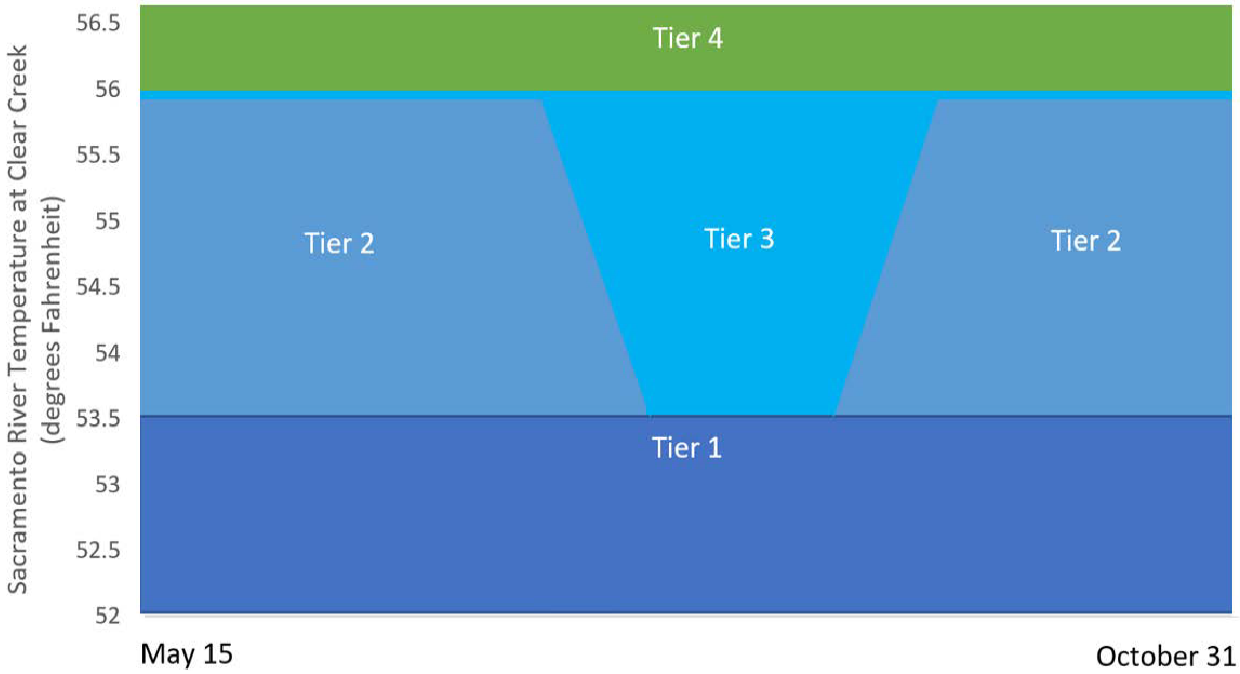

Figure 4.3-3. Tiered Temperature Management Strategy

Tier 1. In years when Reclamation determines that cold water pool is sufficient (e.g., more than 2.8 MAF of cold water pool in Shasta Reservoir at the beginning of May or modeling suggests that a daily average temperature of 53.5°F at CCR can be maintained from May 15 to October 31), Reclamation would operate to a daily average temperature of 53.5°F at the CCR gaging station to minimize temperature-dependent mortality. Although Tier 1 years generally have sufficient cold water to maintain 53.5°F through October 31, the unknown meteorology continues to present a risk of temperatures rising above 53.5°F, particularly toward the end of the summer in September and October. Reclamation can generally manage these risks through real time operations of the TCD, although temporary exceedances may occur, and thus allowable tolerances will be identified in the annual temperature management plan through coordination with SRTTG.

Tier 2. In years when cold water pool is insufficient to allow Tier 1 (e.g., less than 2.8 MAF of cold water pool in Shasta Reservoir at the beginning of May or modeling suggests that the 53.5°F at

CCR cannot be maintained from May 15 to October 31), Reclamation would optimize use of cold water for Winter-Run Chinook Salmon eggs based on life stage-specific requirements, reducing the duration of time of operating to 53.5°F target temperatures. Water temperatures at CCR would vary based on real-time monitoring of redd timing and life stage-specific temperature-dependent mortality models (Anderson et al. 2017). The period of a daily average temperature of 53.5°F at CCR would be centered on the projected time when the Winter-Run eggs have the highest dissolved oxygen requirement (37 to 67 days postfertilization). At 2.79 MAF of cold water pool, Reclamation would operate to 53.5°F from 37 days after the first observed redd to 67 days after the last observed redd, if the last day is earlier than October 31. The duration of the 53.5°F protection would decrease in proportion to the available cold water pool on May 1. Reclamation would determine this time period by running different temperature scenarios through the latest egg mortality model(s) and real-time monitoring of redds. Reclamation would operate to daily average temperatures at CCR during the temperature management season outside of the life stage-specific critical window no warmer than a daily average temperature of 56°F. Although Tier 2 years generally have sufficient cold water to maintain 56°F after the last observed red through October 31, the unknown meteorology continues to present a risk of temperatures rising above 56°F, particularly toward the end of the summer in September and October. Reclamation can generally manage these risks through real time operations of the TCD, although temporary exceedances may occur, and thus allowable tolerances will be identified in the annual temperature management plan through coordination with the SRTTG.

Tier 3. When Reclamation determines that life stage-specific temperature targets cannot be met per Tier 2 (e.g., less than 2.3 MAF of cold water pool in Shasta Reservoir at the beginning of May or modeling suggests that cold water pool management at colder tiers would cause loss of temperature control late in the season), Reclamation would use cold water pool releases to maximize Winter-Run Chinook Salmon redd survival by increasing the coldest water temperature target. In Tier 3, the targeted temperature at CCR during the early and late periods of cold water pool management will not exceed a daily average of 56°F. Based on latest egg mortality models, real-time monitoring, and expected and current cold water availability, Reclamation would decrease the temperatures during the period of greatest temperature stress on early life stages to minimize adverse effects to the greatest extent possible. During this critical period, temperatures will be targeted between 53.5°F and 56°F. Tier 3 will be selected if Reclamation's temperature management plan indicates that temperatures can be maintained to at least 56°F at CCR, otherwise Reclamation would operate to Tier 4. Although Tier 3 years generally have sufficient cold water to maintain 56°F through October 31, the unknown meteorology continues to present a risk of temperatures rising above 56°F, particularly toward the end of the summer in September and October. Reclamation can generally manage these risks through real time operations of the TCD, although temporary exceedances may occur, and thus allowable tolerances will be identified in the annual temperature management plan through coordination with the SRTTG. If the temperature management plan indicates a higher risk of exceeding 56°F before October 1, this is an indication that the cold water pool may not support a warm early fall and will therefore be treated as a Tier 4 year for the purposes of intervention measures and early season discussions and coordination.

Tier 4. If there is less than 2.5 MAF of total storage (note the use of "total" storage as opposed to the "cold water pool" used in the previous criteria) in Shasta Reservoir at the beginning of May, or if Reclamation cannot meet a daily average temperature of 56°F at CCR, Reclamation would attempt to operate to a less than optimal temperature target and period that would be determined in real-time with technical assistance from NMFS and USFWS. Reclamation would explore improved coordination of downstream diversions, and the potential for demand shifting. In addition, Reclamation would implement intervention measures (e.g., increasing hatchery intake and trap and haul, as described in the paragraph below).

At the March forecast (mid-March), if the forecasted Shasta Reservoir total storage is projected to be below 2.5 MAF at the beginning of May, Reclamation would initiate discussions with USFWS and NMFS on potential intervention measures should this low storage condition continue into April and May, as described in Tier 4. Reclamation would perform the first temperature model run in April after DWR Bulletin 120 has been received and the operations forecast has been completed and would provide this forecast to USFWS and NMFS if it is projected to be a Tier 4 year. The first temperature model run would be the first month that a model run would be feasible based on temperature profiles. Prior to April, there would be insufficient stratification in Shasta Reservoir to allow a temperature model to provide meaningful results. The April temperature model scenario is used to develop an initial temperature plan for submittal to SWRCB. This temperature plan may be updated as Reclamation has improved data on reservoir storage and cold water pool via the reservoir profiles at the end of May and throughout the temperature control season. Figure 4.3-4 provides a decision tree explaining the decision points for Shasta Reservoir temperature management.

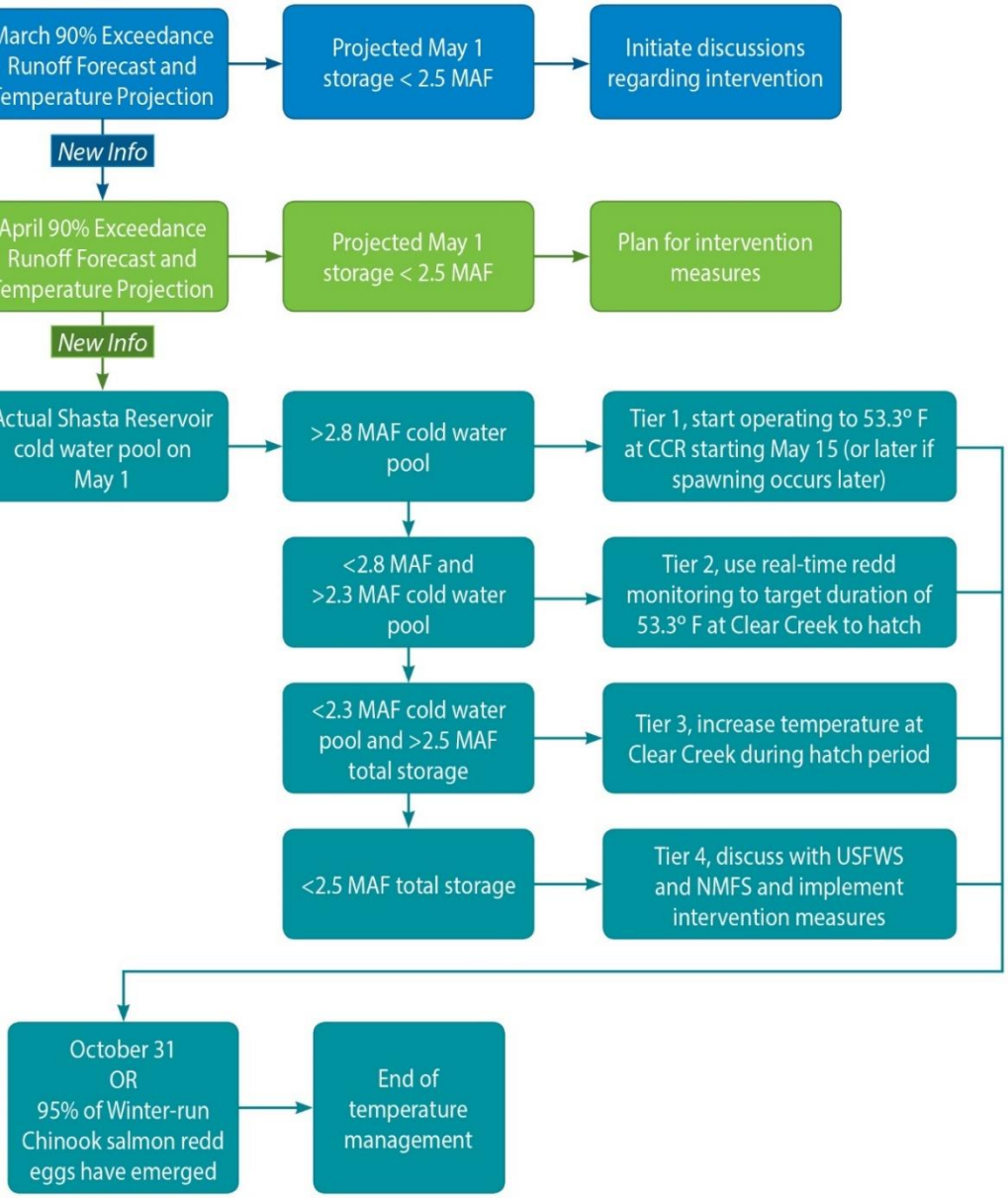

Figure 4.3-4. Decision Tree for Shasta Reservoir Temperature Management

Reclamation intends to collect temperature profile measurements for Shasta, Whiskeytown, and Trinity Reservoirs on the schedule shown in Table 4.3-2 and provide these to USFWS and NMFS if it is projected to be a Tier 4 year.

Table 4.3-2. Temperature Profile Measurements for Shasta, Whiskeytown, and Trinity Reservoirs

Reservoir	Every Month	Every 2 Weeks	Every Week	Comment
Shasta	January through February, December	March through April, November 15 – November 30	May 1 through November 14	25-foot intervals for "every month"; otherwise, 5-foot intervals
Whiskeytown	January through December	–	–	25-foot intervals
Trinity	January through December	–	–	25-foot intervals

Reclamation would provide a draft temperature management plan to the SRTTG in April for its review and comment, consistent with Water Rights Order (WRO) 90-5. The draft temperature management plan would describe which of the four tiers Reclamation forecasts for that year's summer temperature management season, along with a temperature modeling scenario and the operations forecast. The scenario would include projected reservoir releases, assumed meteorological conditions, and anticipated water temperatures and target locations for the planned water temperature targets For the final temperature management plan, Reclamation would use conservative assumptions for determining the Shasta Cold Water Management Plan including relying on the actual May 1 storage, a conservative forecast for inflow May through September, proposed releases based on a conservative forecast, and a conservative historical meteorology. Reclamation would utilize a forecast with 90% exceedance in the aggregate (when jointly considering multiple significant known uncertainties such as hydrology and meteorology) to develop conservative water temperature forecasts, although certain circumstances may lead Reclamation to use different exceedance levels to incorporate an appropriately more conservative approach. Reclamation would share forecast assumptions with NMFS through the SRTTG. Reclamation anticipates NMFS would provide technical assistance through the SRTTG.

Consistent with the Shasta Cold Water Management Plan, Reclamation would operate the temperature control device at Shasta Dam to manage water temperatures below Keswick Dam and would monitor the results. If monitored water temperatures exceed the target temperature (with allowable tolerances) in the Shasta Cold Water Management Plan for longer than 3 consecutive days, Reclamation would notify NMFS of what actions, if any, are being taken to address the exceedances and would arrange for a follow-up on day 5 if the actions do not resolve the issue.

4.3.1.4.2 Commitment to Cold Water Management Tiers

The temperature tier will be forecasted in April of each water year based on forecasted cold water pool volume and temperature modeling results indicating the feasibility of meeting a particular tier. This tier will be finalized in May when there is additional confidence in the hydrologic forecast. If, as the water year progresses, it is determined that additional cold water is available for temperature control purposes, then the tier may be upgraded to a more beneficial tier. Given the use of conservative forecasts, additional cold water pool would be expected more frequently than less cold water pool, although this would only lead to a change in tiers when the conditions are close to the tier boundaries. Reasons for a mid-season change in tier include (but are not necessarily limited to) changes in hydrology, unusual climate conditions that vary from the climate assumptions in the temperature model, changes in water service delivery patterns and changes in assumptions on water needs for regulatory requirement.

Temporary exceedances of target temperatures that are within the allowable tolerances identified in the temperature management plan will not be considered a shift into a different tier. In many cases, these can be corrected with real-time operational adjustments and do not indicate a deficit in cold water pool that would lead to a warmer temperature target. Reclamation will operate to the most protective temperature tier that is achievable.

Once the initial tier is selected by May 15, Reclamation would not cause a shift into a warmer tier during real-time implementation of the Shasta Cold Water Management Plan except in the event of responding to emergency and/or unforeseen conditions. Examples of emergency and/or unforeseen conditions may include, but are not limited to, higher water quality control plan compliance requirements, warmer meteorology, changes in forecasted inflow quantities and temperatures to Shasta, facility malfunctions, and higher than expected non-project water diversions (e.g., diverters other than those exercising water service and repayment contracts with Reclamation such as in-Delta diversions, riparian diversions, etc.).

Reclamation would check the temperature management plan (and associated tier) at least monthly and would notify NMFS within 2 business days of determining a potential change to the plan is necessary. Reclamation may be able to adjust operations to overcome unexpected events without changing to a lower tier. Should Reclamation be unable to remain within the same or cooler tier identified by the Shasta Cold Water Pool Management Plan, and require a mid-season change in tier, Reclamation would coordinate with NMFS on the need to charter an independent panel, at the end of the temperature management season, consistent with Section 4.3.9.6, *Chartering of Independent Panels*, under Section 4.3.9, *Governance*. The purpose of the independent review would be to evaluate the conditions experienced during the years under review, the success of the implementation of the tiered strategy, the effect of the implementation on the species, and, if needed, to develop recommendations to improve its implementation.

4.3.1.4.3 Upper Sacramento Performance Metrics

Reclamation would apply performance metrics for assessing cold water management under the different tiers. The objective is to ensure that the performance falls within the modeled range, and shows a tendency toward performing at least as well as the distribution produced by the simulation modeling of Alternative 1.

Reclamation reviewed the estimated temperature dependent mortality over the CalSim II period of record (1922–2002) with their modeled tier associated with each year. Reclamation's objective would be to meet the temperature criteria associated with each tier and expects the associated biological performance would fall within the full range of modeled performance. The summary of modeled results is listed below with the median, average, maximum and minimum, and standard deviation values with the years. Reclamation intends for an independent panel to review and refine potential alternative steps if the objectives are not occurring.

Future downstream temperature performance is estimated using a numeric model and assumed future hydrologic, operations, and meteorological conditions. The temperature model makes decisions to select a TCD configuration based on user defined Shasta Dam tail-bay target temperatures. This model representation is more coarse than actual operational flexibility and sometimes does not capture daily adjustments which can be managed in real-time to avoid downstream temperature exceedances. Historical performance compared to model results confirms real-time adjustment capabilities using short-term forecasts and operational adjustments, however, this does not alleviate actual short-term forecast uncertainty. In the spring, simulated storm events will accurately predict unavoidable downstream temperature exceedances due to warm side-flows that dominate the upper Sacramento River system. The summary of modeled temperature-dependent mortality:

- Tier 1 - Maximum (39%); Average (6%); Median (2%); Minimum (0.4%); Std. Dev (+/-9%)
- Tier 2 - Maximum (46%); Average (15%); Median (9%); Minimum (1%); Std. Dev (+/-16%)
- Tier 3 - Maximum (77%); Average (34%); Median (24%); Minimum (6%); Std. Dev (+/-31%)
- Tier 4 - Appropriate performance metrics would be addressed as described under Section 4.3.9.5, *Drought and Dry Year Actions*.

Reclamation reviewed the observed egg-to-fry survival over the past 21 years, excluding years with atypical temperature conditions (2015). Reclamation's objective in undertaking habitat restoration and facility improvements under Alternative 1 would be to improve the egg-to-fry survival associated with each tier and expects the associated biological performance to increase over time. The summary of results is listed below with the average, maximum and minimum values within the years analyzed. Reclamation intends for an independent panel to review and refine potential alternative steps if the objectives are not occurring.

Summary of historic egg-to-fry survival:

- Tier 1 - Average (29%); Maximum (49%); Minimum (15%); Median (28%); Std. Dev (10%)
- Tier 2/3 - Average (21%); Maximum (34%); Minimum (15%); Median (20%); Std. Dev (6%)
- Tier 4 - Appropriate performance metrics would be addressed as described under Section 4.3.9.5.

The 75th percentile values of the historical egg to fry survival would be included as a surrogate for expected improvements in egg-to-fry survival for each tier from the habitat restoration projects recently completed, currently underway, or proposed to be completed under Alternative 1. These values are: Tier 1 – 32%; and Tiers 2/3 – 27%. These values would be updated with the appropriate metrics once modeled results are available on the expected improvements from these projects.

In the course of developing "Drought and Dry Year" actions, Reclamation and DWR would develop a range of alternative strategies for temperature management. The SRTTG may consider alternative strategies to the approach described for Alternative 1 during development of plans for Tier 3 years. In acknowledging that Tier 3 years are expected to produce a range of outcomes that increase the threat of viability to salmonid species, Reclamation would work to limit those effects through the SRTTG. These alternative strategies may be based on new or evolving science on the key biological drivers of temperature dependent mortality. These strategies may require additional analytical methods and monitoring specific to the hydrologic and temperature conditions. Reclamation would evaluate and report upon the effectiveness of strategies. These strategies would be coordinated with the conservation measure that addresses two successive years with total egg-to-fry survival less than 15% in each year.

Reclamation would measure upper Sacramento River fisheries populations, in collaboration with federal, state, and local partners, to estimate the total survival from egg incubation to juvenile migration to Red Bluff Diversion Dam. Reclamation would estimate and report on the direct mortality and sublethal effects to egg incubation associated with water temperatures below Keswick Dam (temperature dependent mortality) using, at a minimum, the Martin et al. (2017) approach unless superseded by mutual agreement with NMFS. Reclamation would report annually on total survival and temperature dependent mortality. The Annual Reporting would include a technical team (e.g., SRTTG) hindcast evaluation of whether the total egg-to-fry survival or the temperature dependent mortality exceeded the tier objective. This evaluation would consider the central tendency of modeled expected survival results and would contribute to determining whether an independent review of the year is required. The annual accomplishments in each year would be compared to the metrics by the review panels in 2024 and 2028, consistent with

Section 4.3.9.7, Four Year Reviews, to review whether there is a tendency or trajectory that would not lead to matching or exceeding the distribution of the modeled results over the long-term.

If the actual temperature dependent mortality or egg-to-fry survival fall outside the range described above in any single year, Reclamation would convene with NMFS to determine if an independent panel is necessary. If a panel is deemed necessary, Reclamation would charter an independent panel consistent with Section 4.3.9.6. If the actual results are within the ranges described above, Reclamation would still convene an independent panel consistent with Section 4.3.9.7. The purpose of either panel would be to:

1. Review the drivers behind the management of cold water within the tiers including reservoir storage, releases, meteorology, hydrology, and other conditions affecting building and use of cold water (e.g., emergency, uncertainty, etc.).
2. Review the performance objectives, including the methods for determining temperature dependent mortality and methods for determining total survival.
3. Review the tier types that have occurred during the performance periods and the performance within each tier as compared to expected performance. The selected metrics are the average, median, standard deviation, min, and max of the base dataset. Additional higher-order time series statistics may be used at the request of the review panel. The objective is to ensure that the performance falls within the modeled range, and shows a tendency toward performing at least as well as the distribution produced by the simulation modeling of Alternative 1.
4. Recommend potential modifications to CVP and SWP operations that would improve cold water pool management that are within the agencies' authorities.
5. Review the effectiveness of habitat restoration, facility improvements, intervention, and research measures.

The panel would prepare a report incorporating discussion of the above items and recommendations, including alternate strategies. NMFS and Reclamation would meet and confer to discuss the report and any response.

Prior to the initial Four-Year Review independent panel, Reclamation would refine performance objectives for temperature dependent mortality and the total survival of Winter-Run Chinook Salmon from egg incubation to juvenile migration at Red Bluff Diversion Dam. Reclamation expects to participate in an effort by NMFS to establish early life stage survival rates that are required for a positive cohort replacement rate. Reclamation expects NMFS would submit for independent review temperature dependent mortality and egg-to-fry survival values that, as the species experts and with support from separate analyses, it expects would provide continued support of a viable population. Reclamation expects to participate in the panel and offer technical assistance regarding operations, understanding that these values, or any that result from addressing recommendations from the independent panel, could be adopted with mutual agreement as revised performance metrics for operations.

4.3.1.5 *Fall and Winter Refill and Redd Maintenance*

Under Alternative 1, Reclamation would rebuild storage and cold water pool during fall and winter 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. Reclamation would minimize effects with a risk analysis of the remaining Winter-Run Chinook Salmon redds, the probability of sufficient cold water in a subsequent year, and a conservative distribution and timing of subsequent Winter-Run Chinook Salmon redds. If the combined productivity of the remaining redds plus a conservative scenario for the following year is less than the productivity of maintaining releases, Reclamation would reduce releases to rebuild storage. Real-time fish monitoring data,

operational conditions, and modeling will be shared through SRTTG. Reclamation anticipates NMFS will provide technical assistance through the SRTTG.

The conservative scenario for the following year would include a 75% (dry) hydrology; 75% (warm) climate; a median distribution for the timing of redds, and the ability to remain within Tier 3 or higher (colder) tiers. The forecast for flows in the fall would include any approved water transfers that may be moved during this period.

If, based on the above analysis, Reclamation determines releases need to be reduced 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. These targets would be set based on end-of-September storage and the current hydrology after accounting for Winter-Run redd stranding. Base flows would be set based on historic performance to accomplish improved refill capabilities for Shasta Reservoir to build cold water pool for the following year. Table 4.3-3 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 4.3-3. Keswick Dam Release Schedule for End-of-September Storage

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

cfs = cubic feet per second

High storage years are not necessarily correlated with a following wetter fall and winter. As a result, Reclamation would manage the real time releases based on conditions observed. In scenarios where higher storage exists at the end of September but the fall hydrology is dry (generally defined as below 90% exceedance of historical hydrology), Reclamation would coordinate with appropriate agencies, including NMFS and CDFW at a minimum, to reduce flows below those described in the table, if possible.

This approach to selecting fall, winter, and spring minimum flows allows Reclamation to build and conserve storage for supporting cold water management and summer demands. Due to the effort to build storage, this often results in flood control releases well over the minimum flows, typically in the December through May periods. The low flow in the fall and winter period directly increases the likelihood and magnitude of the flood control releases in the winter and spring months.

4.3.1.6 *Additional Operations Components*

In addition to the changes to Shasta Reservoir cold water pool operations, Alternative 1 includes multiple components to increase water deliveries and protect listed fish:

- Rice Decomposition Smoothing – Following the emergence of Winter-Run Chinook Salmon and prior to the majority of Fall-Run Chinook Salmon spawning, upstream Sacramento Valley CVP contractors and Sacramento River Settlement Contractors would work to synchronize their diversions to lower peak rice decomposition demand. With lower late October and early November flows, Fall-Run Chinook Salmon are less likely to spawn in shallow areas that would be subject to dewatering during winter base flows. Early reductions (late October to early

November) would balance the potential for dewatering late spawning Winter-Run Chinook Salmon redds and early Fall-Run Chinook Salmon dewatering.

- Spring Management of Spawning Locations – Reclamation would coordinate with NMFS to establish experiments to refine the state of the science and determine if keeping water colder earlier induces earlier spawning or if keeping April to May Sacramento River temperatures warmer induces later spawning.
    - Temperature Modeling Platform – Reclamation would continue working with Watercourse Engineering as part of a collaborative model development effort to develop a new temperature model for the Upper Sacramento River (Shasta and Keswick reservoirs). NMFS Science Center, among others, would participate in the collaborative process. This new model would be on the CEQUAL-W-2 platform with the intention of developing similar platforms for all of Reclamation's major reservoirs.
    - Shasta Temperature Control Device Performance Evaluation – Reclamation will coordinate with NMFS to study whether there are problems or limitations with the function of the TCD under low storage conditions, and, if necessary, identify potential actions and/or modification for improving operational efficiency of the TCD.
    - Battle Creek Salmon and Steelhead Restoration Project and Battle Creek Reintroduction Plan – Reclamation will provide funding for ten years toward reintroduction of Winter-Run Chinook Salmon to Battle Creek. Reclamation will accelerate implementation of the Battle Creek Salmon and Steelhead Restoration Project, which is intended to reestablish approximately 42 miles of prime salmon and Steelhead habitat on Battle Creek and an additional 6 miles on its tributaries. The Battle Creek Restoration Project is a collaborative effort among several federal and state agencies and Pacific Gas & Electric Company. The partnership provides a framework for expanding Winter-Run Chinook Salmon spawning to cold water habitat not in the Sacramento River.
    - In August 2016, the California Department of Fish and Wildlife released the Battle Creek Winter-Run Chinook Salmon Reintroduction Plan. The U.S. Fish and Wildlife Service subsequently agreed to take responsibility for implementing the plan, and in 2018, approximately 200,000 juvenile Winter-Run Chinook salmon were reintroduced to Battle Creek to jumpstart the reintroduction effort. These fish have matured and started to return as adults in summer 2019. The jumpstart effort is intended to transition into implementation of the Reintroduction Plan with Reclamation support. Reclamation's support will go toward fish passage construction and reintroduction implementation activities. This includes ten years of annual Plan monitoring and implementation cost up to $1,400,000 annually. As the Reintroduction Plan continues additional funding will likely be needed to cover the annual costs.
    - Lower Intakes near Wilkins Slough – Due to temperature requirements, Sacramento River flows at or near Wilkins Slough can drop below the 5,000 cfs minimum navigational flow set by Congress. As many of the fish screens at diversions in this region were designed to meet the 5,000 cfs minimum, they may not function properly at the lower flows and as a result not meet state and federal fish screening requirements during the lower flows (Northern California Water Association [NCWA] 2014). This action would provide grants to senior water right holders within this area to install new diversions and screens that would operate at the lower flows, which would allow Reclamation to have greater flexibility in managing Sacramento River flows and temperatures for both water users and wildlife, including listed salmonids (NCWA 2014). The authority for this action is CVPIA Section 3406(b)(21). One example project under this program is screening of Meridian Farms.

4.3.1.7 *Habitat Restoration Components*

Alternative 1 includes the following habitat restoration components:

- Spawning Habitat Restoration – Reclamation would create additional spawning habitat by approximately 15,000 to 40,000 tons of gravel annually into the Sacramento River to 2030, using the following sites: Keswick Dam Gravel Injection Site, Market Street Injection Site, Redding Riffle, Turtle Bay, Tobiasson Island, Shea Levee sites, and Kapusta.
- Rearing Habitat Restoration – Reclamation, in coordination with Sacramento River Settlement Contractors would create 40 to 60 acres of side channel and floodplain habitat at 10 sites in the Sacramento River by 2030. The potential sites include Salt Creek, Turtle Bay Island, Kutras Lake Rearing Structures, Painter's Riffle maintenance, North Cypress maintenance, Cypress South, North Tobiasson Rearing Structures maintenance, Tobiasson Side Channel, Shea Side Channel, Kapusta Side Channel, Kapusta 1-A Side Channel maintenance, Kapusta 1-B Side Channel, Anderson River Park Side Channels, Cow Creek Side Channel, I-5 Side Channel, China Gardens, Rancheria Island Side Channel, Rancho Breisgau, Lake California Side Channel maintenance, Rio Vista Side Channel, East Sand Slough Side Channel, La Barranca Side Channel, Woodson Bridge Bank Rearing Improvement, Jellys Ferry, Dog Island, Altube Island, Blackberry Island, Oklahoma Avenue, Mooney Island, McClure Creek, Blethen Island, Wilsons Landing, McIntosh Island, Shaw, Larkins, Reilly Island, Hanson Island, and Broderick.
    - The Sacramento River Settlement Contractors approved A Resolution Regarding Salmon Recovery Projects in the Sacramento River Watershed, Actions Related to Shasta Reservoir Annual Operations, and Engagement in the Ongoing Collaborative Sacramento River Science Partnership Effort. Pursuant to the resolution, the Sacramento River Settlement (SRS) Contractors will continue to participate in, and act as project champions for future Sacramento Valley Salmon Recovery Program projects, subject to the availability of funding, regulatory approvals, acceptable regulatory assurances, and full performance of the SRS Contracts.
- Deer Creek Irrigation District Dam (DCID) Fish Passage – Reclamation will provide funding toward this collaborative fish passage project being completed by DCID, Trout Unlimited, California Department of Fish and Wildlife, and U.S Fish and Wildlife Service. The shovel-ready project will construct a natural like fishway downstream of the DCID's dam to provide Spring-Run Chinook Salmon and Central Valley Steelhead with unimpeded access to 25 miles of prime spawning habitat with no adverse effect on the DCID diversion. Improving fish passage at this site will improve upstream access to spawning, rearing and holding stream habitat. This will also improve anadromous fish passage, downstream of the project sites, through fish screen and bypass pipe modifications.
- Small Screen Program – Reclamation and DWR would continue to work within existing authorities (e.g., Anadromous Fish Screen Program) to screen small diversions throughout Central Valley CVP and SWP streams and the Bay-Delta.
- Knights Landing Outfall Gates – Reclamation will provide funding toward reconstruction of the Knights Landing Outfall Gates to reduce the potential for fish straying into the Colusa Basin Drain. These funds will go toward repairing the positive fish barrier hoist system and electric controls.

4.3.1.8 *Intervention Components*

Alternative 1 includes the following intervention components:

- Winter-Run Chinook Salmon Conservation Hatchery Production – In a Tier 4 year, Reclamation would increase production of Winter-Run Chinook Salmon. Increased production during drought could help populations continue over multiple years. Increased production would aim to offset temperature dependent mortality on the Sacramento River. Reclamation would consider New Zealand or Great Lake Winter-Run Chinook Salmon stock for augmenting conservation hatchery stock to improve heterozygosity. Reclamation would coordinate with USFWS and NMFS as described in Section 4.3.9.5 to determine the need to improve the facility and associate collection facilities. Improvements may include permanent chillers, additional tanks, and other features.
- Adult Rescue – Reclamation would trap and haul adult salmonids and sturgeon from Yolo and Sutter Bypasses during droughts and after periods of bypass flooding, when flows from the bypasses are most likely to attract upstream migrating adults, and move them up the Sacramento River to spawning grounds. This trap and haul are in addition to weir fish passage projects that are part of Alternative 1 elsewhere. This measure would improve survival of the adults, leading to increased juvenile production in the following year and more flexibility with salvage.
- Juvenile Trap and Haul – If Reclamation projects a Tier 4 year (less than 2.5 MAF of storage at the beginning of May), Reclamation would implement a downstream trap and haul strategy for the capture and transport of juvenile Chinook Salmon and Steelhead in the Sacramento River watershed in drought years when low flows and resulting high water temperatures are unsuitable for volitional downstream migration and survival. Reclamation would place temporary juvenile salmon collection traps (e.g., rotary screw traps, fyke nets, floating juvenile collectors, weirs, trawls, seines), at key feasible locations, downstream of spawning areas in the Sacramento River. Reclamation would transport collected fish to a safe release location(s) in the Delta upstream of Chipps Island or in the bay. Juvenile trap and haul activities would occur from December 1 through May 31, consistent with the migration period for juvenile Chinook Salmon and Steelhead (NMFS 2014), depending on hydrologic conditions. In the event of high river flows or potential flooding, trapping operations would cease and traps would be removed as appropriate.
- Directors Meeting –In the event of two successive years with total egg-to-fry survival less than 15% in each year, Reclamation would convene a meeting of the Regional Directors of DWR, NMFS, USFWS, and CDFW no later than the end of November. The Directors would meet and confer to develop a list of actions to address the potential for a third year of low survival. The Directors would continue to meet monthly, or more often as appropriate, through the next operational season. The Directors would hold a similar meeting in each of the two following Novembers to ensure that the years following the 2-year emergency condition appropriately address the need to recover from the multi-year event.
- Yellow-billed Cuckoo Baseline Surveys – Reclamation will coordinate with the USFWS to develop and conduct a baseline survey for the Yellow-billed cuckoo in the action area. The survey for this action would focus on the critical habitat areas, associated project sites, and occupied habitat within the action area. In addition, the baseline survey would incorporate the efforts from the Yolo Restoration Project and other related projects when conducting protocol-level surveys for Yellow-billed Cuckoo in the over-lapping project areas. Results from Yellow-billed Cuckoo surveys conducted by other agencies and organizations within the Action Area will be analyzed by Reclamation when determining baseline conditions for the species and effects resulting from project activities. By reducing redundant survey efforts, Reclamation would be able to leverage their resources to cover areas not recently surveyed and develop a more comprehensive baseline survey. Reclamation would coordinate and discuss with USFWS on the

potential need for additional surveys for specific project areas and surveys to monitor the effects of project activities over the project timeline. Information collected in the baseline surveys could be used to inform ecological surrogate models in the future, potentially replacing the need for follow-up presence/absence surveys. In addition, Reclamation will follow the nesting bird protocols during construction activities and consider the needs of Yellow-billed cuckoo when designing and implementing salmonid habitat restoration projects. Results of Yellow-billed cuckoo surveys and findings from ecological surrogate models shall be shared with the U.S. Fish and Wildlife Service Bay-Delta Fish and Wildlife Office no later than 120 days after completion.

4.3.2 Trinity River Division

Seasonal operations in Trinity Reservoir would continue to be integrated with Shasta Reservoir operations, as described in the No Action Alternative. Additionally, Reclamation would continue to implement the Trinity River Restoration Program ROD and lower Klamath River augmentation flows that are described in the No Action Alternative. Whiskeytown Reservoir operations would be similar to those described for the No Action Alternative, with minor changes to accommodate Clear Creek flow measures described below. While Lewiston Dam releases to the Trinity River would be in accordance with the ROD of 2000, modifications of operations of the CVP could cause minor changes in the operations on the Trinity River. Spring Creek Debris Dam operations and the Clear Creek Restoration Program would continue as described in the No Action Alternative.

4.3.3 Clear Creek

Reclamation would release Clear Creek flows in accordance with the 2000 agreement between Reclamation, USFWS, and CDFG and the April 15, 2002 SWRCB permit, which established minimum flows to be released to Clear Creek at Whiskeytown Dam. Under Alternative 1, Reclamation would release a minimum base flow in Clear Creek of 200 cfs from October through May and 150 cfs from June through September in all water year types except critical water year types. In critical years, Clear Creek base flows may 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 would create pulse flows for both channel maintenance and spring attraction flows. For spring attraction flows, Reclamation would release 10 TAF (measured at the release), with daily release up to the safe release capacity (approximately 900 cfs, depending on reservoir elevation and downstream capacity), in all water year types except for critical water year types to be shaped by the Clear Creek Implementation Team in coordination with the Central Valley Operations Office. For channel maintenance flows, Reclamation would release 10 TAF from Whiskeytown Dam, with a daily release up to the safe release capacity, in all water year types except dry and critical (based on the Sacramento Valley index) to be shaped by the Clear Creek Implementation Team in coordination with the Central Valley Operations Office. Pulses would be scheduled with the Central Valley Operations Office. 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 would reduce the channel maintenance flow volume for this year or the following year by 5,000 AF. If two Whiskeytown Gloryhole spills that meet this criterion in a year occur, 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 outlet from Whiskeytown Reservoir to Clear Creek is equipped with outlets at two different elevations. Releases can be made from either or both outlets to manage downstream temperature releases. Reclamation would manage Whiskeytown releases to meet a daily average water temperature of 60°F at the Igo gage from June 1 through September 16 and 56°F or less at the Igo gage from September 15 to October 31. Reclamation may not be able to meet these temperatures in critical or dry water year types. In these years, Reclamation would operate as close to these temperatures as possible.

4.3.3.1 *Yellow-Billed Cuckoo Surveys*

Reclamation will coordinate with the USFWS to develop and conduct a baseline survey for the Yellow-billed cuckoo in the action area.

4.3.4 Feather River

DWR would operate Oroville Dam consistent with the NMFS, USFWS, and CDFW environmental requirements applicable for the current FERC license for the Oroville Complex (FERC Project 2100-134), as under the No Action Alternative. If FERC issues a new license, DWR would operate to the terms in that license. The downstream boundary of the FERC Oroville Project area is the Feather River above the City of Gridley. During the summer, DWR typically releases water from Lake Oroville to meet the requirements of instream flows and D-1641. Additional releases are made for local deliveries and exports at Banks Pumping Plant. DWR balances the cumulative storage between Lake Oroville and San Luis Reservoir to meet its flood control requirements and Delta requirements and to deliver water supplies to its contracted water agencies consistent with all environmental constraints. Lake Oroville may be operated to convey water through the Delta to San Luis Reservoir via Banks Pumping Plant under different schedules depending on Delta conditions, reservoir storage volumes, storage targets, and regulatory requirements. Decisions as to when to move water from Lake Oroville to San Luis Reservoir are based on many real-time factors.

4.3.5 American River Division

Reclamation would operate Folsom Reservoir to meet water rights, contracts, and agreements that are specific to the American River Division and to those that apply to the entire CVP, including the Delta Division. For lower American River flows (below Nimbus Dam), Reclamation would adopt the minimum flow schedule and approach proposed by the Water Forum in 2017 in the document titled *Lower American River – Standards for Minimum Flows* dated December 2018. Flows range from 500 to 2,000 cfs based on time of year and annual hydrology. The flow schedule is intended to improve cold water pool and habitat conditions for Steelhead and Fall-Run Chinook Salmon. Specific flows are determined using an index intended to define the current and recent hydrology. Although Reclamation has assumed the index proposed by the Water Forum in 2017 for the purposes of modeling and analysis within this EIS, Reclamation intends to continue discussions with the Water Forum to ensure the index used for implementation is appropriate to meet the intended objectives under continuously changing hydrology.

Under Alternative 1, Reclamation would work together with the American River water agencies to define an appropriate amount of storage in Folsom Reservoir that represents the lower bound for typical forecasting processes at the end of calendar year (i.e., the planning minimum). The Folsom Reservoir planning minimum brings Reclamation's forecasting process together with potential local actions that either increase Folsom storage or reduce demand out of Folsom Reservoir. The implementation of a planning minimum would allow Reclamation to work with the American River Group to identify conditions when local water actions may be necessary to ensure storage is adequate for diversion from the municipal water intake at Folsom Dam and/or the extreme hydrology presents a risk that needs to be properly communicated to the public and surrounding communities. This planning minimum would be a

single value (or potentially a series of values for different hydrologic year types) to be used for each year's forecasting process into the future. The objective of incorporating the planning minimum into the forecasting process is to provide releases of salmonid-suitable temperatures to the lower American River and reliable deliveries (using the existing water supply intakes and conveyance systems) to American River water agencies that are dependent on deliveries or releases from Folsom Reservoir. This planning minimum would be initially defined in 2019; however, it would be continuously evaluated between Reclamation and the Water Forum throughout implementation.

Reclamation expects infrequent scenarios where the forecasted storage may fall below the planning minimum due to a variety of circumstances and causes. In those instances, Reclamation and the American River water agencies would develop a list of potential off-ramp actions that may be taken to either improve forecasted storage or decrease demand on Folsom Reservoir. In its forecasting process for guiding seasonal operations, Reclamation would plan to maintain or exceed the planning minimum at the end of the calendar year. Reclamation has no legal liability should it fall below the planning minimum. When Reclamation estimates, using the forecasting process, it would not be able to maintain Folsom Reservoir storage at or above the planning minimum for that water year type (such as in extreme hydrologic conditions) or unexpected events cause the storage level to be at risk, American River water agencies would coordinate with Reclamation to identify and implement appropriate actions to improve forecasted storage conditions, and the American River water agencies would work together to educate the public on the actions that have been agreed upon and implemented and the reasons and basis for them. If potential changes to Folsom Dam operations would have impacts on other aspects of the CVP and SWP or the entire integrated system, Reclamation would meet and discuss these potential changes and impacts with water contractors.

Reclamation will continue to work with the American River Group, a group that includes federal, state, and local agencies, water users, and NGOs, to coordinate spring pulse flow timing and communicate upcoming releases.

Reclamation would ramp down to the revised minimum flows from Folsom Reservoir as soon as possible in the fall and maintain these flows, where possible.

4.3.5.1 *Seasonal Operations*

In the winter and spring, flood control releases typically dominate the flow regime in the American River Division. Flood control operations occur to safely pass large storm events without exceeding the identified downstream levee capacity. This includes making dry-weather releases to ensure the maximum storage adheres to the flood control elevation identified in the applicable Water Control Manual.

As part of the 2017 Flow Management Standard, Reclamation would implement redd dewatering protective adjustments to limit potential redd dewatering due to reductions in the minimum release during the January through May period. Redd dewatering protective adjustments should limit the amount of dewatering due to a reduction of the minimum release, not the actual river release, and as such would not always minimize dewatering impacts to the same extent. In January and February, there is a Chinook Salmon redd dewatering protective adjustment, and in February through May there is a Steelhead redd dewatering protective adjustment.

During nonflood control operations within the fall and winter months, Reclamation would operate to build storage by making minimum releases and capturing inflows, although drier conditions may require releases for Delta requirements. To the extent possible, releases would be held relatively consistent to minimize potential redd dewatering.

Spring releases would be controlled by flood control requirements or, in drier hydrology, Delta requirements and water supply. Reclamation would operate Folsom Dam in a manner designed to maximize capture of the spring runoff to fill as close to full as possible. Reclamation would follow the 2017 Flow Management Standard, which includes a pulse flow event at some time during the period extending from March 15 to April 15 by supplementing normal operational releases from Folsom Dam under certain conditions when no such flow event has occurred between the preceding February 1 and March 1 time frame. In addition to the pulse flow under the 2017 Flow Management Standard, to the extent feasible, Reclamation proposes to accommodate additional requests for spring pulse flows by re-shaping previously planned releases; however, these requests will not be accommodated in times when they may compromise temperature operations later in the year. This spring pulse flow would provide a juvenile salmonid emigration cue before relatively low-flow conditions and associated unsuitable thermal conditions later in the spring and downstream in the lower Sacramento River.

Reclamation would continue making summer releases for instream temperature control, Delta outflow, and exports, typically above the planning minimum flows. By late October, it is typical for Folsom Reservoir to have depleted the cold water pool. The primary way to provide additional instream cooling is to release water from the lower outlet works. This operation bypasses the power penstocks and has a significant impact on power generation. To optimize power generation, Reclamation would limit power bypass operations solely to respond to emergency or unexpected events or during extreme drought years when a drought emergency has been declared by the governor of California.

4.3.5.2 *Temperature Management*

Reclamation would prepare a draft temperature management plan by May 15 for the summer through fall temperature management season using the best available (as determined by Reclamation) decision support tools. The information provided by the operations forecast would be used in the development of the draft plan. The draft plan would contain forecasts of hydrology and storage and a modeling run(s), using the operations forecasts to demonstrate what temperature compliance schedule can be attained. Reclamation would use an iterative approach, varying shutter configurations, with the objective to attain the best possible temperature schedule for the compliance point at Watt Avenue Bridge. The draft plan would be

shared with the American River Group before finalization and may be updated monthly based on system conditions.

Reclamation would manage the Folsom and Nimbus Dams complex and the water temperature control shutters at Folsom Dam to maintain a daily average water temperature of 65°F (or other temperature as determined by the temperature modeling) or lower at Watt Avenue Bridge from May 15 through October 31 to provide suitable conditions for juvenile Steelhead rearing in the lower American River. If the temperature is exceeded for 3 consecutive days, Reclamation would notify NMFS and outline steps being taken to bring the water temperature back into compliance. During the May 15 to October 31 period, if the temperature management plan-defined temperature requirement cannot be met because of limited cold water availability in Folsom Reservoir, then the target daily average water temperature at Watt Avenue may be increased incrementally (i.e., no more than 1°F every 12 hours) to as high as 68°F. The priority for use of the lowest water temperature control shutters at Folsom Dam would be to achieve the water temperature requirement for listed species (i.e., Steelhead), and thereafter may also be used to provide cold water for Fall-Run Chinook Salmon spawning.

4.3.5.3 *Water Operations Component*

In addition to the changes to Folsom Reservoir operations, Alternative 1 includes a component to increase water deliveries and protect listed fish:

- Drought Temperature Management: In severe or worse droughts, Reclamation would evaluate and implement alternative shutter configurations at Folsom Dam to allow temperature flexibility.

4.3.5.4 *Habitat Restoration Components*

Alternative 1 includes the following habitat restoration components:

- Spawning and Rearing Habitat Restoration: Project activities include primarily side channel and floodplain creation, expansion, and grading, spawning gravel and large cobble additions, and woody material additions. Pursuant to CVPIA Section 3406(b)(13), Reclamation would implement the following projects: Paradise Beach, Howe Avenue to Watt Avenue rearing habitat, William Pond Outlet, Upper River Bend, Ancil Hoffman, El Manto, Sacramento Bar-North, Sacramento Bar-South, Lower Sunrise, Sunrise, Upper Sunrise, Lower Sailor Bar, Upper Sailor Bar, Nimbus main channel and side channel, Discovery Park, Cordova Creek Phase II, Carmichael Creek Restoration and Sunrise Stranding Reduction.
- Reclamation would continue maintenance activities at Nimbus Basin, Upper Sailor Bar, Lower Sailor Bar, Upper Sunrise, Lower Sunrise, and River Bend restoration sites.

4.3.5.5 *Intervention Components*

Alternative 1 would include improvements to Nimbus Fish Hatchery to improve management. Reclamation would complete a Hatchery Genetics Management Plan for Steelhead and a Hatchery Management Plan for Fall-Run Chinook Salmon as part of Nimbus Fish Hatchery Management. Reclamation would work with USFWS and NMFS to establish clear goals, appropriate time horizons, and reasonable cost estimates for this effort. Reclamation will coordinate with the USFWS to develop and conduct a baseline survey for the Yellow-billed cuckoo in the action area.

4.3.6 Bay-Delta

As described in the No Action Alternative, the CVP and SWP divert water in the Delta through the Tracy and Banks Pumping Plants for delivery to the Central Valley and Southern California. Operations of these facilities would continue in Alternative 1 with the changes described below.

4.3.6.1 *Delta Cross Channel*

Under Alternative 1, Reclamation would operate the DCC gates to reduce juvenile salmonid entrainment risk beyond actions described in D-1641, consistent with Delta water quality requirements in D-1641. From October 1 to November 30, Reclamation proposes to operate the DCC gates consistent with past operations. If during this period Knights Landing Catch Index or Sacramento Catch Index are greater than three fish per day Reclamation would operate based on Tables 4.3-4 and 4.3-5 to determine whether to close the DCC gates and for how long. From December 1 to January 31, the DCC gates would be closed, except to prevent exceeding a D-1641 water quality threshold. If drought conditions were observed (i.e., fall inflow conditions were less than 90% of historic flows), Reclamation and DWR would consider opening the DCC gates for up to 5 days for up to two events within this period to avoid D-1641 water quality exceedances. Reclamation and DWR would coordinate with USFWS, NMFS, and the SWRCB on how to balance D-1641 water quality and ESA-listed fish requirements. Reclamation and DWR would conduct a risk assessment that would consider the Knights Landing Rotary Screw Trap monitoring, Delta juvenile fish monitoring program (Sacramento trawl, beach seines), Rio Vista flow standards, acoustic telemetered fish monitoring information as well as DSM2 modeling informed with recent hydrology, salinity, and tidal data. Reclamation would also consider the cumulative entrainment from prior years. Reclamation would share this information with the Water Operations Management Team (WOMT) to describe how fish responses may be altered by DCC operations. If the risk assessment determines that survival, route entrainment, or behavior change to create a new adverse effect or a greater range of an adverse effect, not considered under this alternative, Reclamation would not open the DCC. During a DCC gate opening between December 1 and January 31, the CVP and SWP would divert at health and safety pumping levels.

From February 1 to May 20, the DCC gates will be closed consistent with D-1641. From May 21 to June 15, Reclamation would close the DCC gates for a total of 14 days during this period, consistent with D-1641. Reclamation and DWR's risk assessment would consider the Knights Landing Rotary Screw Trap, Delta juvenile fish monitoring program (Sacramento trawl, beach seines), Rio Vista flow standards, acoustic telemetered fish monitoring information, DSM2 modeling informed with recent hydrology, salinity, and tidal data. Reclamation would evaluate this information to determine timing and duration of the gate closure.

Table 4.3-4. Delta Cross Channel October 1–November 30 Action

Date	Action Triggers	Action Responses
October 1–November 30	Water quality criteria per D-1641 are met and either the KLCI or SCI is greater than 5.0 fish per day.	Within 48 hours, close the DCC gates and keep closed until the catch index is less than 3.0 fish per day at both the Knights Landing and Sacramento monitoring sites.
	Water quality criteria per D-1641 are met and either KLCI or the SCI are greater than 3.0 fish per day but less than or equal to five fish per day.	Within 48 hours of trigger, DCC gates are closed. Gates would remain closed for 3 days.
	Water quality criteria per D-1641 are met, real-time hydrodynamic and salinity modeling shows water quality concern level targets are not exceeded during 28-day period following DCC closure, and there is no observed deterioration of interior Delta water quality.	Within 48 hours of start of LMR attraction flow release, close the DCC gates for up to 5 days (dependent upon continuity of favorable water quality conditions).
	Water quality criteria per D-1641 are met and real time hydrodynamic and salinity modeling shows water quality concern level targets are exceeded during 14-day period following DCC closure.	No closure of DCC gates.
	The KLCI or SCI triggers are met but water quality criteria are not met per D-1641 criteria.	Monitoring groups review monitoring data and provide to Reclamation. Reclamation and DWR determine what to do with a risk assessment.

D-1641 = Water Right Decision 1641, DCC = Delta Cross Channel; KLCI = Knights Landing Catch Index; LMR = Lower Mokelumne River; SCI = Sacramento Catch Index

Table 4.3-5. Water Quality Concern Level Targets

Water Quality Concern Level Targets (Water Quality Model Simulated 14-day Average Electrical Conductivity)	
Jersey Point	1800 umhos/cm
Bethel Island	1000 umhos/cm
Holland Cut	800 umhos/cm
Bacon Island	700 umhos/cm

umhos/cm = micromhos per centimeter

4.3.6.2 *North Bay Aqueduct Operations*

The North Bay Aqueduct and Barker Slough Pumping Plant would continue to operate under applicable regulatory requirements with an annual maximum diversion of 125 TAF. The maximum daily diversion rate for the Pumping Plant is 175 cfs.

Reclamation and DWR will work with USFWS to develop Delta Smelt minimization measures. These minimization measures will aim to protect larval Delta Smelt from entrainment through the Barker Slough Pumping Plant (PP) and will consider reduction in diversion through the NBA at the appropriate spring period and appropriate water year types by using effective detection measures or an appropriate proxy.

4.3.6.2.1 Sediment Removal

Sediment accumulates in the concrete apron sediment trap in front of the Barker Slough Pumping Plant fish screens and within the pump wells behind the fish screens. Sediment removal from the sediment trap and the pump wells would be removed as needed.

Accumulated sediment from the apron in front of the fish screen and in the pump wells behind the fish screen would be removed by suction dredge. Removal of sediment from within the pump wells would occur as needed, year-round. Removal of sediment from the apron area in front of the fish screens would occur during summer and early fall months and during the annual North Bay Aqueduct shutdown in March. The North Bay Aqueduct is annually taken off-line for one-to-two weeks for routine maintenance and repairs, and the Barker Slough Pumping Plant is non-operational during the shutdown.

4.3.6.2.2 Aquatic Weed Removal

Aquatic weeds would be removed, as needed, from in front of the fish screens at Barker Slough Pumping Plant. Aquatic weeds accumulate on the fish screens, blocking water flow, and causing water levels to drop behind the screens in the pump wells. The low water level inside of the pump wells causes the pumps to automatically shut off to protect the pumps from cavitation. The aquatic weed removal system consists of grappling hooks attached by chains to an aluminum frame. A boom truck, staged on the platform in front of the Barker Slough Pumping Plant pumps, would lower the grappling system into the water to retrieve the accumulated aquatic vegetation. The removed aquatic weeds would be transported to two aggregate base spoil sites located near the pumping plant. Removal of aquatic weeks from the fish screens would typically occur during summer and fall months when aquatic weed production is highest. Floating aquatic vegetation (i.e., water hyacinth) may need to be removed during spring months if it becomes entrained into Barker Slough and accumulates in front of the fish screens.

4.3.6.3 *Contra Costa Water District Operations*

Contra Costa Water District (CCWD) operations under Alternative 1 would remain unchanged from the No Action Alternative (discussed in Section 4.2.6.3.6).

CCWD facilities would continue to be operated and maintained under applicable permits. Reclamation would work with CCWD to ensure that implementation of the proposed action will not restrict CCWD operations beyond the restrictions of the separate biological opinions. Reclamation agrees to ensure that the implementation of Alternative 1 will not create new or additional restrictions on CCWD's ability to fill its Los Vaqueros Reservoir beyond the restrictions of the separate Biological Opinions that apply to CCWD's operations, thereby ensuring that CCWD will have opportunities to fill Los Vaqueros Reservoir that are at least comparable to the current conditions.

4.3.6.4 *Water Transfers*

Reclamation and DWR would continue to transfer project and nonproject water supplies through CVP and SWP facilities, including north-to-south transfers and Sacramento River north-to-north transfers. Alternative 1 would include the same volume of transfers as included in the No Action Alternative, but Reclamation and DWR would provide an extended transfer window from July 1 through November 30. Allowing fall transfers is expected to have water supply benefits and may provide flexibility to improve Sacramento River temperature operations during dry conditions, such as those that occurred during the 2014–2015 drought conditions. Real-time operations may restrict transfers within the transfer window so

that Reclamation and DWR can meet other authorized project purposes, e.g., when pumping capacity is needed for CVP or SWP water. This EIS analyzes the potential effects that water transfers from the Sacramento and San Joaquin river systems have on the operations of the CVP and SWP. Making water available for transfer is assessed through separate environmental documentation because the potential effects are dependent on the regions where water could be made available and the types of transfer.

4.3.6.5 *Clifton Court Aquatic Weed and Algal Bloom Management*

DWR would continue to apply copper-based aquatic herbicides and algaecides to control aquatic weeds and algal blooms and use mechanical harvesters on an as-needed basis in CCF (as described in the No Action Alternative), but would also apply Aquathol® K aquatic herbicide and peroxygen-based algaecides (e.g., PAK 27) and extend the treatment window beyond July 1 to August 31. Aquathol® K is effective at controlling pondweed species that are not affected by copper herbicides. Peroxygen-based algaecides are used to control algal blooms that can degrade drinking water quality through tastes and odors and production of algal toxins. Treatment areas would typically be about 900 acres and no more than 50% of the 2,180 total surface acres.

Aquatic weed and algae treatments would occur on an as-needed basis depending upon the level of vegetation biomass, the cyanotoxin concentration from the harmful algal blooms (HABs), or the concentration of taste and odor compounds. The frequency of aquatic herbicide applications to control aquatic weeds is not expected to occur more than twice per year. Aquatic herbicides are ideally applied early in the growing season when plants are susceptible to them during rapid growth and formation of plant tissues, or later in the season when plants are mobilizing energy stores from their leaves toward their roots for overwintering senescence. The frequency of algaecide applications to control HABs is not expected to occur more than once every few years, as indicated by monitoring data and demonstrated by the history of past applications.

Aquatic weed assemblages change from year to year in the CCF from predominantly *Egeria densa* to one dominated by curly-leaf pondweed, sago pondweed, and southern naiad. To effectively treat a dynamic aquatic weed assemblage and harmful algal blooms, multiple aquatic pesticide compounds are required to control aquatic weeds and algal blooms in CCF. The preferred products are:

- Aquathol® K, an endothall-based aquatic herbicide, that is effective on pondweeds.
- Copper-based compounds that are effective on *E. densa*, cyanobacteria and green algae. The copper-based aquatic herbicides include copper sulfate pentahydrate and chelated copper herbicides.
- Peroxygen-based algaecides (e.g., PAK 27) that are effective on cyanobacteria.

4.3.6.5.1 Aquathol® K

The dipotassium salt of endothall is used for control of aquatic weeds and is the active ingredient in Aquathol® K (liquid formulation). Aquathol® K is a widely used herbicide to control submerged weeds in lakes and ponds, and the short residual contact time (12–48 hours) makes it effective in both still and slow-moving water. Aquathol® K is effective on many weeds, including hydrilla, milfoil, and curly-leaf pondweed, and begins working on contact to break down cell structure and inhibit protein synthesis. Without the ability to grow, the weed dies. Full kill takes place in 1 to 2 weeks. As weeds die, they sink to the bottom and decompose. Aquathol® K is not effective at controlling *E. densa*.

Aquathol® K is registered for use in California and has effectively controlled pondweeds and southern naiad in CCF and in other lakes. Endothall has low acute and chronic toxicity effects to fish. The LC50 for salmonids is 20 to 40 times greater than the maximum concentration allowed to treat aquatic weeds.

The EPA maximum concentration allowed for Aquathol® K is 5 ppm. A recent study (Courter et al. 2012) of the effect of Cascade® (same endothall formulation as Aquathol® K) on salmon and Steelhead smolts showed no sublethal effects until exposed to 9 to 12 ppm, that is, 2 to 3 times greater than the 5 ppm maximum concentration allowed by the EPA and about 4-6 times greater than the 2 to 3 ppm applied in past CCF treatments. In the study, Steelhead and salmon smolts showed no statistical difference in mean survival between the control group and treatment groups, however, Steelhead showed slightly lower survival after 9 days at 9 to 12 ppm. Based on the studies with salmonids, Aquathol® K applied at or below the EPA maximum allowable concentration of 5 ppm poses a low to no toxicity risk to salmon, Steelhead and other fish. No studies have assessed the exposure risk to Green Sturgeon.

When aquatic plant survey results indicate that pondweeds are the dominant species in CCF, Aquathol® K would be selected due to its effectiveness in controlling these species. Aquathol® K would be applied according to the label instructions, with a target concentration dependent upon plant biomass, water volume, and forebay depth. The target concentration of treatments is 2 to 3 ppm, which is well below the concentration of 9–12 ppm where sublethal effects have been observed (Courter et al. 2012). DWR monitors herbicide concentration levels during and after treatment to ensure levels do not exceed the Aquathol® K application limit of 5 ppm. Additional water quality testing may occur following treatment for drinking water intake purposes. Samples are submitted to a laboratory for analysis. There is no "real time" field test for endothall. No more than 50% of the surface area of CCF would be treated at one time. A minimum contact time of 12 hours is needed for biological uptake and treatment effectiveness, but the contact time may be extended up to 24 hours to reduce the residual endothall concentration for National Pollutant Discharge Elimination System (NPDES) compliance purposes.

Copper-based Aquatic Herbicides and Algaecides

Copper herbicides and algaecides include chelated copper products and copper sulfate pentahydrate crystals. When aquatic plant survey results indicate that *E. densa* is the dominant species, copper-based compounds would be selected due to their effectiveness in controlling this species. *E. densa* is not affected by application of Aquathol® K. Copper-based algaecides are effective at controlling algal blooms (cyanobacteria) that produce cyanotoxins or taste and odor compounds.

Copper herbicides and algaecides would be applied in a manner consistent with the label instructions, with a target concentration dependent upon target species and biomass, water volume, and the depth of the forebay. Applications of copper herbicides for aquatic weed control would be applied at a concentration of 1 ppm with an expected dilution to 0.75 ppm upon dispersal in the water column. Applications for algal control would be applied at a concentration of 0.2 to 1 ppm with expected dilution within the water column. DWR would monitor dissolved copper concentration levels during and after treatment to ensure levels do not exceed the application limit of 1 ppm, per NPDES permit required procedures. Treatment contact time would be up to 24 hours. If the dissolved copper concentration falls below 0.25 ppm during an aquatic weed treatment, DWR may opt to open the radial gates after 12 hours but before 24 hours to resume operations. Opening the radial gates prior to 24 hours would enable the rapid dilution of residual copper and thereby shorten the exposure duration of ESA-listed fish to the treatment. No more than 50% of the surface area of CCF would be treated at one time.

Peroxygen-Based Algaecides

PAK 27 algaecide active ingredient is sodium carbonate peroxyhydrate. An oxidation reaction occurs immediately upon contact with the water destroying algal cell membranes and chlorophyll. There is no contact or holding time requirement, as the oxidation reaction occurs immediately and the byproducts are hydrogen peroxide and oxygen. There are no fishing, drinking, swimming, or irrigation restrictions following the use of this product. PAK 27 has National Sanitation Foundation/American National

Standards Institute Standard 60 Certification for use in drinking water supplies at maximum-labeled rates and is certified for organic use by the Organic Materials Reviews Institute.

PAK 27, or equivalent product, would be applied in a manner consistent with the label instructions, with permissible concentrations in the range of 0.3 to 10.2 ppm hydrogen peroxide. No more than 50% of the surface area of CCF would be treated at one time.

Operational Procedures

The following are operational procedures to minimize impacts on listed species during aquatic herbicide treatment for application of Aquathol® K and copper-based products and algaecide treatment for application of peroxide-based algaecides in CCF:

- Apply Aquathol® K and copper-based aquatic pesticides, as needed, from June 28 to August 31.
- Apply Aquathol® K and copper-based aquatic pesticides, as needed, prior to June 28 or after August 31 if the average daily water temperatures within CCF is at or above 77°F or and if Delta Smelt, salmonids, and Green Sturgeon are not at additional risk from the treatment as conferred by NMFS and USFWS.
    - Prior to treatment outside of the June 28 to August 31 timeframe, DWR would notify and confer with NMFS and USFWS on whether ESA-listed fish species are present and at risk from the proposed treatment.
- Apply Aquathol® K and copper-based aquatic pesticides, as needed, during periods of activated Delta Smelt and salmonid protective measures when average daily water temperature in CCF is below 77°F if the following conditions are met:
    - Prior to treatment outside of the June 28 to August 31 timeframe, DWR would notify and confer with NMFS and USFWS on whether ESA-listed fish species are present and at risk from the proposed treatment.
    - The herbicide application does not begin until after the radial gates have been closed for 24 hours or after the period of predicted Delta Smelt and salmonid survival within CCF (e.g., after predicted mortality has occurred due to predation or other factors) has been exceeded.
    - The radial gates remain closed for 24 hours after the completion of the application, unless it is conferred that rapid dilution of the herbicide would be beneficial to reduce the exposure duration to listed fishes present within the CCF.
- Apply peroxygen-based aquatic algaecides, as needed, year-round.
- There are no anticipated impacts on fish with the use of peroxygen-based aquatic algaecides in CCF during or following treatment.
- Monitor the salvage of listed fish at the Skinner Fish Facility prior to the application of the aquatic herbicides and algaecides in CCF.
- For Aquathol® K and copper compounds, the radial intake gates would be closed at the entrance to CCF prior to the application of pesticides to allow fish to move out of the targeted treatment areas and toward the salvage facility and to prevent any possibility of aquatic pesticide diffusing into the Delta.
- For Aquathol® K and copper compounds, the radial gates would remain closed for a minimum of 12 and up to 24 hours after treatment to allow for the recommended duration of contact time between the aquatic pesticide and the treated vegetation or cyanobacteria in the forebay, and to reduce residual endothall concentration for drinking water compliance purposes. (Contact time is

dependent upon pesticide type, applied concentration, and weed or algae assemblage). Radial gates would be reopened after a minimum of 36 hours (24 hours pre-treatment closure plus 12 hours post-treatment closure).

- For peroxide-based algaecides, the radial gates would be closed prior to the application of the algaecide to prevent any possibility of the algaecide diffusing into the Delta. The radial gates may reopen immediately after the treatment as the required contact time is less than 1 minute and there is no residual byproduct of concern.
- Application would be made by a licensed applicator under the supervision of a California-certified pest control advisor.
- Aquatic herbicides and algaecides would be applied by boat or by aircraft.
    - Boat applications would be by subsurface injection system for liquid formulations and boat-mounted hopper dispensing system for granular formulations. Applications would start at the shoreline and move systematically farther offshore, enabling fish to move out of the treatment area.
    - Aerial applications of granular and liquid formulations would be by helicopter or aircraft. No aerial spray applications would occur during windspeeds above 15 mph to prevent spray drift.
- Application would be to the smallest area possible that provides relief to SWP operations or water quality. No more than 50% of CCF would be treated at one time.
- Water quality samples to monitor copper and endothall concentrations within or adjacent to the treatment area, per the NPDES permit requirements, would be collected before, during, and after application. Additional water quality samples may be collected during and following treatment for drinking water compliance purposes. No monitoring of copper or endothall concentrations in the sediment or detritus is proposed.
- No monitoring of peroxide concentration in the water column would occur during and after application as the reaction is immediate and there is no residual. Dissolved oxygen concentration would be measured prior to and immediately following application within and adjacent to the treatment zone.
- A spill prevention plan would be implemented in the event of an accidental spill.

Aquatic weed and algae treatments would occur on an as-needed basis. The timing of application is an avoidance measure and is based on the life history of Chinook Salmon and Steelhead in the Central Valley's Delta region and of Delta Smelt. Green Sturgeon is present in the area year-round. Migrations of juvenile Winter-Run Chinook Salmon and Spring-Run Chinook Salmon primarily occur outside of the summer period in the Delta. Central Valley Steelhead have a low probability of being in the South Delta during late June when water temperatures exceed 77°F through the first rainfall flush event, which can occur as late at December in some years (Grimaldo et al. 2009). Delta Smelt are not expected to be in CCF during this time period. Delta Smelt are not likely to survive when water temperatures reach a daily average of 77°F, and they are not expected to occur in the Delta prior to the first flush event. Therefore, the likelihood of herbicide exposure to Chinook Salmon, Central Valley Steelhead, and Delta Smelt during the proposed herbicide treatment timeframe in CCF is negligible.

Additional protective measures would be implemented to prevent or minimize adverse effects from herbicide applications. As described above, applications of aquatic herbicides and algaecides would be contained within CCF. The radial intake gates to CCF would be closed prior to, during, and following the application. The radial gates would remain closed during the recommended minimum contact time based on herbicide type, application rate, and aquatic weed or algae assemblage. Additionally, following the gate closure and prior to the applications of Aquathol® K and copper-based pesticides, the water would be

drawn down in the CCF via the Banks Pumping Plant. This drawdown would help facilitate the movement of fish in the CCF toward the fish diversion screens and into the fish protection facility, lower the water level in the CCF to decrease the total amount of herbicide needed to be applied, per volume of water, and aid in the dilution of any residual pesticide post-treatment. Following reopening of the gates and refilling of CCF, the rapid dilution of any residual pesticide and the downstream dispersal of the treated water into the California Aqueduct via Banks PP would reduce the exposure time of any ESA-listed fish species present in CCF.

4.3.6.6 *OMR Management*

Under Alternative 1, Reclamation and DWR would operate the CVP and SWP in a manner that maximizes exports while minimizing entrainment of fish and protecting critical habitat. Net flow OMR provides a surrogate indicator for how export pumping at Banks and Jones Pumping Plants influence hydrodynamics in the south Delta. The management of OMR, in combination with other environmental variables, can minimize or avoid the entrainment of fish in the south Delta and at CVP and SWP salvage facilities. Reclamation and DWR would maximize exports by incorporating real-time monitoring of fish distribution, turbidity, temperature, hydrodynamic models, and entrainment models into the decision support for the management of OMR to focus protections for fish when necessary and provide flexibility where possible, consistent with the Water Infrastructure Improvements for the Nation Act Sections 4002 and 4003. Estimates of species distribution would be described by multiagency, Delta-focused technical teams.

From the onset of OMR management to the end, Reclamation and DWR would operate to an OMR index no more negative than a 14-day moving average of −5,000 cfs unless a storm event occurs (described below). Grimaldo et al. (2017) indicate that −5,000 cfs is an inflection point in OMR for fish entrainment. OMR could be more positive than −5,000 cfs if additional real-time OMR restrictions are triggered (described below) or constraints other than OMR control exports. Reclamation and DWR would operate to an OMR index computed using an equation. An OMR index allows for shorter-term operational planning and real-time adjustments. Reclamation and DWR would make a change to exports within 3 days of the trigger when monitoring, modeling, and criteria indicate protection for fish is necessary. The 3-day trigger would allow for efficient power scheduling.

4.3.6.6.1 **Onset of OMR Management**

Reclamation and DWR would start OMR management when one or more of the following conditions have occurred:

- Integrated Early Winter Pulse Protection (“First Flush” Turbidity Event): To minimize project influence on migration (or dispersal) of Delta Smelt, Reclamation and DWR would reduce exports for 14 consecutive days so that the 14-day averaged OMR index for the period would not be more negative than −2,000 cfs, in response to “First Flush” conditions in the Delta. The population-scale migration of Delta Smelt is believed to occur quickly in response to inflowing fresh water and turbidity (Grimaldo et al. 2009; Sommer et al. 2011). Thereafter, best available scientific information suggests that fish make local movements, but there is no evidence for further population-scale migration (Polanksy et al. 2018). “First flush” may be triggered between December 1 and January 31 and include:
    - Running 3-day average of the daily flows at Freeport is greater than 25,000 cfs and
    - Running 3-day average of the daily turbidity at Freeport is 50 Nephelometric Turbidity Unit (NTU) or greater, or

- Real-time monitoring indicates a high risk of migration and dispersal into areas at high risk of future entrainment.

This "First Flush" may only be initiated once during the December through January period and would not be required if:

- Spent female Delta Smelt are collected in a monitoring survey.

- Salmonids Presence: After January 1, if more than 5% of any one or more salmonid species (wild young-of-year Winter-Run, wild young-of-year Spring-Run, or wild Central Valley Steelhead) are estimated to be present in the Delta as determined by their appropriate monitoring working group based on available real-time data, historical information, and modeling.

4.3.6.6.2 Additional Real-Time OMR Restrictions and Performance Objectives

Reclamation and DWR would manage to a more positive OMR than −5,000 cfs based on the following conditions:

- Turbidity Bridge Avoidance ("South Delta Turbidity"): After the Integrated Early Winter Pulse Protection or February 1 (whichever comes first) and until a ripe or spent female is detected or April 1, Reclamation and DWR would manage exports in order to maintain daily average turbidity in Old River at Bacon Island (OBI) at a level of less than 12 NTU. The purpose of this action is to minimize the risk to adult Delta Smelt in the Old and Middle River Corridor, where they are subject to higher entrainment risks. This action seeks to avoid the formation of a continuous turbidity bridge from the San Joaquin River shipping channel to the south Delta fish facilities, which historically has been associated with elevated salvage of pre-spawning adult Delta Smelt. If the daily average turbidity at Bacon Island could not be maintained at less than 12 NTU, Reclamation and DWR would manage exports to achieve an OMR no more negative than −2,000 cfs until the daily average turbidity at Bacon Island drops below 12 NTU. However, if 5 consecutive days of OMR less negative than -2,000 cfs do not reduce turbidity at Bacon Island below 12 NTU in a given month, Reclamation and DWR could determine that OMR restrictions to manage turbidity are infeasible, and will instead implement an OMR target that is deemed protective, based on turbidity, adult Delta Smelt distribution and salvage, but not a more negative OMR than -5,000 cfs.

  Reclamation and DWR recognize that readings at individual sensors or localized groups of sensors can generate spurious results in real-time. To avoid triggering an OMR flow action during a sensor error or a localized turbidity spike that might be caused by local flows or a wind-driven event, Reclamation and DWR will consider and review data from other locations. In the event that the daily average turbidity at OBI is 12 NTU (or greater) and Reclamation and DWR believe that a Turbidity Bridge Avoidance action is not warranted based on additional data sources (isolated and/or wind-driven turbidity event at OBI), Reclamation and DWR will take no additional action and provide the supporting information to USFWS within 24 hours.

- Larval and Juvenile Delta Smelt: Reclamation and DWR will use results produced by USFWS approved life cycle models to manage the annual entrainment levels of larval/juvenile Delta Smelt. The USFWS's models will be publicly vetted and peer reviewed prior to March 15, 2020. The USFWS will coordinate with the Delta Fish Monitoring Working Group to identify a Delta Smelt recruitment level that Reclamation and DWR can use in OMR management. The life cycle models statistically link environmental conditions to recruitment, including factors related to loss as a result of entrainment such as OMR flows. In this context, recruitment is defined as the estimated number of post-larval Delta Smelt in June per number of spawning adults the prior February-March.

Reclamation and DWR, in coordination with USFWS will operationalize the life cycle model results through the use of real-time monitoring for the spatial distribution of Delta Smelt. On or after March 15 of each year, if QWEST is negative, and larval or juvenile Delta Smelt are within the entrainment zone of the pumps based on real-time sampling of spawning adults or young of year life stages, Reclamation and/or DWR will run hydrodynamic models and forecasts of entrainment, informed by the Enhanced Delta Smelt Monitoring Program or other relevant survey data to estimate the percentage of larval and juvenile Delta Smelt that could be entrained. If necessary, Reclamation will manage exports to limit entrainment to be protective based on the modeled recruitment levels. Reclamation and DWR will re-run hydrodynamic models when operational changes or new sampling data indicate a potential change in entrainment risk. This process will continue until the offramp criteria have been met as described in Section 4.3.6.6.4, *End of OMR Management*. In the event the life cycle models cannot be operationalized in a manner that can be used to inform real-time operations then Reclamation, DWR and USFWS will coordinate to develop an alternative plan to provide operational actions protective of this life stage.

- Cumulative Loss Threshold:
    - Reclamation and DWR would avoid exceeding cumulative loss thresholds over the duration of the 2019 Biological Opinions for:
        - Natural Winter-Run Chinook Salmon (cumulative loss = 8,738)
        - Hatchery Winter-Run Chinook Salmon (cumulative loss = 5,356)
        - Natural Central Valley Steelhead from December through March (cumulative loss = 6,038)
        - Natural Central Valley Steelhead from April 1 through June 15 (cumulative loss = 5,826).

    Natural Central Valley Steelhead would be separated into two time periods to protect San Joaquin origin fish that historically appear in the Mossdale trawls later than Sacramento origin fish. The loss threshold and loss tracking for hatchery Winter-Run Chinook Salmon does not include releases into Battle Creek. Loss (for development of thresholds and ongoing tracking) for Chinook salmon are based on length-at-date criteria.
- The cumulative loss thresholds would be based on cumulative historical loss from 2010 through 2018. Reclamation's and DWR's performance objectives are intended to avoid loss such that this cumulative loss threshold (measured as the 2010–2018 average cumulative loss multiplied by 10 years) would not be exceeded by 2030.
- If, at any time prior to 2024, Reclamation and DWR would exceed 50% of the cumulative loss threshold, Reclamation and DWR would convene an independent panel to review the actions contributing to this loss trajectory and make recommendations on modifications or additional actions to stay within the cumulative loss threshold, if any.
- In the year 2024, Reclamation and DWR would convene an independent panel to review the first 5 years of actions and determine whether continuing these actions are likely to reliably maintain the trajectory associated with this performance objective for the duration of the period.
- If, during real-time operations, Reclamation and DWR would exceed the cumulative loss threshold, Reclamation and DWR would immediately seek technical assistance from USFWS and NMFS, as appropriate, on the coordinated operation of the CVP and SWP for the remainder of the OMR management period. In addition, Reclamation and DWR would, prior to the next OMR management season, charter an independent panel to review the OMR Management Action consistent with Section 4.3.9.6. The purpose of the independent review would be to evaluate the

efficacy of actions to reduce the adverse effects on listed species under OMR management and the non-flow measures to improve survival in the south Delta and for San Joaquin origin fish.

- Single-Year Salvage Threshold:
    - In each year, Reclamation and DWR would avoid exceeding an annual loss threshold equal to 90% of the greatest annual loss that occurred in the historical record from 20010 through 2018 for each of:
        - Natural Winter-Run Chinook Salmon (loss = 1.17% of JPE)
        - Hatchery Winter-Run Chinook Salmon (loss = 0.12% of JPE)
        - Natural Central Valley Steelhead from December through March (loss =1,414)
        - Natural Central Valley Steelhead from April through June 15 (loss = 1,552)

Natural Central Valley Steelhead are separated into two time periods to protect San Joaquin Origin fish that historically appear in the Mossdale trawls later than Sacramento origin fish. The loss threshold and loss tracking for hatchery Winter-Run Chinook Salmon does not include releases into Battle Creek. Loss (for development of thresholds and ongoing tracking) for Chinook salmon would be based on length-at-date criteria.

- During the year, if Reclamation and DWR would exceed the annual loss from 2010 through 2018, Reclamation and DWR would review recent fish distribution information and operations with the fisheries agencies at the WOMT and seek technical assistance on future planned operations. Any agency could elevate from WOMT to a Directors discussion, as appropriate.
- During the year, if Reclamation and DWR would exceed 50% of the annual loss threshold, Reclamation and DWR would restrict OMR to a 14-day moving average OMR index of no more negative than −3,500 cfs, unless Reclamation and DWR determine that further OMR restrictions are not required to benefit fish movement because a risk assessment shows that the risk is no longer present based on real-time information.
- The −3,500 cfs OMR operational criterion adjusted and informed by this risk assessment would remain in effect for the rest of the season. Reclamation and DWR would seek NMFS technical assistance on the risk assessment and real-time operations.
- During the year, if Reclamation and DWR exceed 75% of the annual loss threshold, Reclamation and DWR would restrict OMR to a 14-day moving average OMR index of no more negative than −2,500 cfs, unless Reclamation and DWR determine that further OMR restrictions are not required to benefit fish movement because a risk assessment shows that the risk is no longer present based on real-time information.
- The −2,500 cfs OMR operational criterion adjusted and informed by this risk assessment would remain in effect for the rest of the season. Reclamation and DWR would seek NMFS technical assistance on the risk assessment and real-time operations.
- Risk assessments (identified above): Reclamation and DWR would evaluate and adjust OMR restrictions under this section by preparing a risk assessment that considers several factors including, but not limited to, real-time monitoring, historical trends of salmonids exiting the delta, entering the south delta fish detected in salvage, and relevant environmental conditions. Risks will be measured against the potential to exceed the next single year loss threshold. Reclamation and DWR would share its risk assessment and supporting documentation with USFWS and NMFS, seek their technical assistance, discuss the risk assessment and future operations with WOMT at its next meeting, and elevate to the Directors as appropriate.
- If, during real-time operations, Reclamation and DWR would exceed the single-year loss threshold, Reclamation and DWR would immediately seek technical assistance from USFWS and NMFS, as appropriate, on the coordinated operation of the CVP and SWP for the remainder of

the OMR management period. In addition, Reclamation and DWR would, prior to the next OMR management season, charter an independent panel to review the OMR Management Action consistent with Section 4.3.9.6. The purpose of the independent review would be to evaluate the efficacy of actions to reduce the effects on listed species under OMR management and the non-flow measures to improve survival in the south Delta and for San Joaquin origin fish.

Reclamation and DWR would continue monitoring and reporting the salvage at the Tracy Fish Collection Facility and Skinner Fish Protection Facility. Reclamation and DWR would continue the release and monitoring of yearling Coleman National Fish Hatchery Late-Fall run as yearling Spring-Run Chinook Salmon surrogates.

4.3.6.6.3 Storm-Related OMR Flexibility

Reclamation and DWR could operate to a more negative OMR up to a maximum (otherwise-permitted) export rate at Banks and Jones Pumping Plants of 14,900 cfs (which could result in a range of OMR values) to capture peak flows during storm-related events. A storm-related event occurs when precipitation falls in the Central Valley and Delta watersheds and Reclamation and DWR determine that the Delta outflow index indicates a higher level of flow available for diversion. Reclamation and DWR will define storm-related events in the first year of implementation of this proposed action. Reclamation and DWR would continue to monitor fish in real-time and would operate in accordance with the thresholds in Section 4.3.6.6.2, *Additional Real-Time OMR Restrictions and Performance Objectives*. Under the following conditions, Reclamation and DWR would not pursue storm-related OMR flexibility for capturing peak flows from storm-related events:

- Integrated Early Winter Pulse Protection (above) or Additional Real-Time OMR Restrictions (above) are triggered. Under such conditions, Reclamation and DWR would have already determined that more restrictive OMR is required.
- An evaluation of environmental and biological conditions indicates more negative OMR would likely cause Reclamation and DWR to trigger an Additional Real-Time OMR Restriction (above).
- Salvage of yearling Coleman National Fish Hatchery Late-Fall run (as yearling Spring-Run Chinook Salmon surrogates) exceeds 0.5% within any of the release groups.
- Reclamation and DWR identify changes in spawning, foraging, sheltering, or migration behavior beyond those anticipated to occur under OMR management.

Reclamation and DWR would continue to monitor conditions and could resume management of OMR to no more negative than −5,000 cfs if conditions indicate the above offramps are necessary to avoid additional adverse effects. If storm-related flexibility causes the conditions described in Section 4.3.6.6.2, Reclamation and DWR would implement additional real-time OMR restrictions.

4.3.6.6.4 End of OMR Management

OMR criteria may control operations until June 30 (for Delta Smelt and Chinook salmon), until June 15 (for Steelhead/Rainbow Trout), or when the following species-specific off ramps have occurred, whichever is earlier:

- Delta Smelt: When the daily mean water temperature at CCF reaches 77°F for 3 consecutive days.

- Salmonids:
  - When more than 95% of salmonids have migrated past Chipps Island, as determined by their monitoring working group, or
  - After daily average water temperatures at Mossdale exceed 71.6°F for 7 days during June (the 7 days do not have to be consecutive).

4.3.6.6.5 Real-Time Decision-Making and Salvage Thresholds

When real-time monitoring demonstrates that criteria in described in Section 4.3.6.6.2 are not supported, then Reclamation and DWR may confer with the Directors of NMFS, USFWS, and CDFW if they desire to operate to a more negative OMR than what is specified in this section. Upon mutual agreement, the Directors of NMFS and USFWS may authorize Reclamation and DWR to operate to a more negative OMR than described in Section 4.3.6.6.2, but no more negative than −5,000 cfs. This process would be separate from the risk analysis process referenced above.

Figure 4.3-5 shows OMR management in a decision tree.

4.3.6.7 *Tracy Fish Collection Facility Carbon Dioxide Injection and Release Sites*

Reclamation would continue to screen fish from Jones Pumping Plant with the TFCF. The TFCF uses behavioral barriers consisting of primary louvers and four rotating traveling screens aligned in a single row 7 degrees to the flow of the water to guide entrained fish into holding tanks before transport by truck to release sites at the confluence of the Delta. The TFCF was designed to handle smaller fish (less than 200 mm) that would have difficulty fighting the strong pumping plant- induced flows, as the intake is essentially open to the Delta and impacted by tidal action. The number of pumps (units) running at the Jones PP dictates the flow and velocity at the TFCF. There are 6 units at Jones PP but a maximum of 5 can used; each unit increases the velocity through the TFCF primary channel by approximately 0.5 feet per second.

The primary louvers are in the primary channel just downstream of the trash rack structure. The traveling water screen is in the secondary channel.

The louvers allow water to pass through onto the pumping plant, but the openings between the slats are tight enough and angled against the flow of water to prevent most fish from passing between them and to enable the fish to enter one of four bypass entrances along the louver arrays. Reclamation would install a carbon dioxide injection device to allow remote controlled anesthetization of predators in the secondary channels of the TFCF.

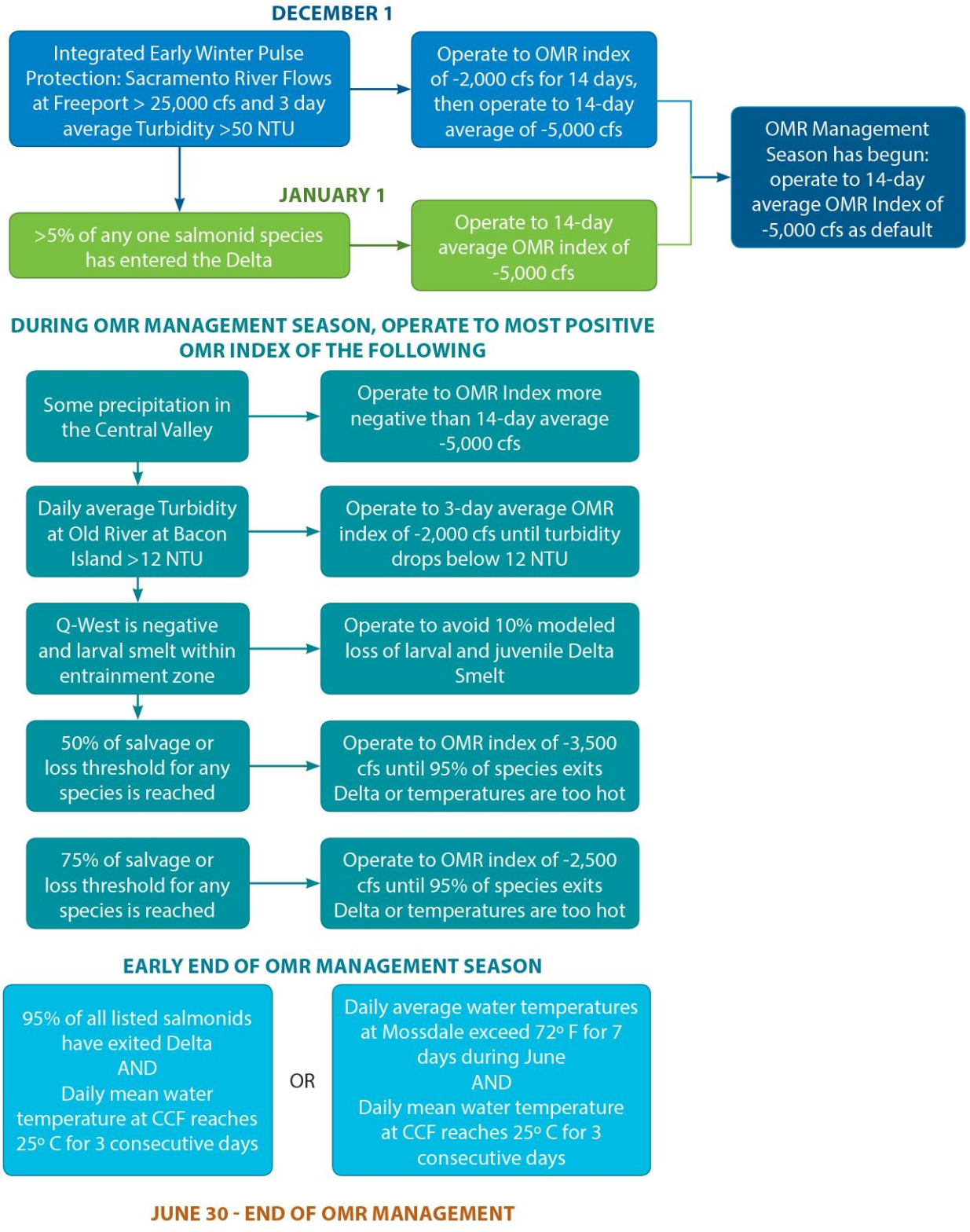

Figure 4.3-5. Decision Tree for Old and Middle River Reverse Flow Management

The current primary louver cleaning procedures and operations would continue. These procedures involve lifting each individual louver panel, 36 total, out of the water to spray wash the debris. Generally, each primary louver panel is lifted and lowered back into place three times per day, although frequency of cleaning may be increased or decreased according to pumping rate and debris loads. It takes approximately 3 to 7 minutes to lift, spray clean, and lower each louver panel back into place. While export pumping may be reduced to address damaged louver panels, issues during cleaning, or other maintenance scenarios where facilities are not capable of effectively salvaging fish, complete shutdown of pumping usually does not occur due to issues related to the primary louvers. At 5 Jones PP units running, louvers would be cleaned before the incoming tide as much as possible. The morning day shift would usually begin cleaning as soon as they start their work, around 6:00 a.m. During high debris periods, operators would monitor differentials and clean before any problems arise. At a minimum, all 36 louver panels would be cleaned 2 to 3 times a day but during heavy debris loads, operators would clean 3-6 times a day. At 2–4 Jones PP units, operators would determine when to clean and making sure the louvers do not reach 1 foot differential. At 1 Jones PP unit, operators would normally clean periodically during the incoming tide. Generally, less frequent cleaning is required in early summer (low averages of 60 minutes per day) and much higher during the winter months (high averages of 440 minutes per day). This means that there would be a louver panel lifted 1 to 7.5 hours per day depending on season, pumping rates, and debris loads.

When south Delta hydraulic conditions allow, and conditions are within the original design criteria for the TFCF, the louvers would be operated to achieve water approach velocities for striped bass of approximately 1 foot per second from May 15 through October 31 and for salmon of approximately 3 feet per second from November 1 through May 14.

Fish passing through the facility would be sampled at intervals of 30 minutes every 2 hours year-round. Approximately 52 different species of fish are entrained into the TFCF each year; however, the total numbers are significantly different for the various species salvaged. Fish observed during sampling intervals are identified by species, measured to fork length, examined for marks or tags, and placed in the collection facilities for transport by tanker truck to the release sites in the north Delta away from the pumps. Hauling trucks used to transport salvaged fish to release sites inject oxygen and contain an 8 parts per thousand salt solution to reduce stress. In addition, TFCF personnel monitor for the presence of spent female Delta Smelt in anticipation of expanding the salvage operations to include sub-20 mm larval Delta Smelt detection.

TFCF personnel would monitor for the presence of spent female Delta Smelt by euthanizing all adult Delta Smelt that are collected in the 30-minute fish count, determine the gender and the gonadal or sexual maturation stage of the Delta Smelt, and determine if the eggs have reached Stage IV, the stage when eggs are ready for release (0.9 to 10 mm in diameter and easily stripped). Stages V (i.e., postvitellogenic stage) and VI (i.e., postovulatory, or spent stage) are expected soon after Stage IV observation. Stages would be determined and reported real-time when a biologist is present or the following morning after Delta Smelt detection and collection. Stage or gonad maturation is determined using egg stage descriptions from Mager (1996).

Larval Smelt sampling at the TFCF would commence once a trigger is met (detection of a spent female at CVP and SWP being one of three triggers). Fish count screen with a 2.4 mm mesh size opening would be replaced with one that has a mesh size of 0.5 mm to retain larval fish. Sampling is done four times a day (4:00 a.m., 10:00 a.m., 4:00 p.m., and 10:00 p.m.) and all larval Smelt would be identified to species and reported the day after collection.

Salvage of fish would occur at the TFCF 24 hours per day, 365 days per year. Fish would be salvaged in flow-through holding tanks (6.1-m diameter, 4.7-m deep) that provide continuous flows of water

(Reclamation 2008). Fish would be maintained in these holding tanks for 8-24 hours depending on the species of fish that are being salvaged, the number of fish salvaged, and debris load. The number of fish that would be salvaged in TFCF holding tanks would be generally estimated by performing a 30 minute fish-count subsample every 120 minutes (2 hours). The number of each species of fish collected in the subsample would be determined and then multiplied by 4 (120 pumping minutes/30 minute fish-count subsample equals an expansion factor of 4) to estimate the total number of each species of fish, as well as the total number of fish, that were salvaged in TFCF holding tanks during the 120 minute period. Pumping minutes and fish-count minutes could potentially deviate from 120 minutes and 30 minutes, respectively, which would change the expansion factor used to estimate total fish salvage.

If no Chinook Salmon, Steelhead, or Delta Smelt were salvaged, fish could be maintained in TFCF holding tank for up to 24 hours. If a Chinook Salmon or Steelhead were collected during fish-counts, fish could only be maintained in TFCF holding tanks for up to 12 hours. If a Delta Smelt were collected during fish-count, salvaged fish could only be held in TFCF holding tanks for up to 8 hours. When fish could be maintained in TFCF holding tanks for 24 hours, fish transport (fish haul) would generally occur each morning. When two fish hauls per day would be necessary, a night fish haul would be added. When three fish hauls would be necessary, they would usually be completed at 7 a.m., 3 p.m., and 9:30 p.m. each day. Fish-haul would also be dictated by the Bates Tables which uses size classes, species, and water temperature as indicators for when to conduct a fish haul.

During normal operations, salvaged fish would be transported approximately 49.9 km and released at one of two Reclamation release sites near the confluence of the Sacramento and San Joaquin Rivers (Antioch Fish Release Site and Emmaton Fish Release Site). In general, the Emmaton Fish Release Site would be used for fish hauls performed during daytime hours and the Antioch Fish Release Site would be used for fish hauls performed during nighttime hours. This is done for safety and security reasons as the Antioch Fish Release Site has a gate that can be locked behind the operator after he/she enters the release site area. Upon arrival at release sites, operators would measure certain important water quality parameters (dissolved oxygen, salinity, and temperature) prior to releasing fish. This measurement would verify that water quality parameters remained acceptable during fish transport. In the future, Reclamation would increase the number of release sites to reduce predation.

Reclamation would conduct studies and physical improvements aimed to improve fish survival and improve TFCF efficiency, reducing mortality through the facility, fish hauling and release operations through the Tracy Fish Facility Improvement Program. Activities include louver improvement and replacement, predation studies and piscivorous predator control, improvement of hydrologic monitoring and telemetry systems, holding area improvements including fish count automation and tank aeration and screening, improvement of data management as well as aquaculture facility maintenance, operation and improvements. TFCF studies are established at annual multi-agency meetings of the Tracy Tech Advisory Team. Reclamation would provide written reports of study results on their website.

4.3.6.8 *Delta Smelt Summer-Fall Habitat*

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. The current conceptual model is that Delta Smelt habitat should include low salinity conditions of 0-6ppt, turbidity of approximately 12 NTU, temperatures below 75°F, food availability, and littoral or open water physical habitats (FLaSH Synthesis, pp. 15-25). The Delta Smelt Summer-Fall Habitat Action is being undertaken recognizing that the highest quality habitat in this large geographical region includes areas with complex bathymetry, in deep channels close to shoals and shallows, and in proximity to extensive tidal or freshwater marshlands and other wetlands. The Delta Smelt Summer-Fall Habitat Action is to provide these habitat components in the same geographic area through a range of action to improve water quality and food supplies.

Reclamation and DWR would use structured decision making to implement Delta Smelt habitat actions. In the summer and fall (June through October) of below normal, above normal, and wet years, based on the Sacramento Valley Index, the environmental and biological goals are, to the extent practicable, the following:

- Maintain low salinity habitat in Suisun marsh and Grizzly Bay when water temperatures are suitable.
- Manage the low salinity zone to overlap with turbid water and available food supplies.
- Establish contiguous low salinity habitat from Cache Slough Complex to the Suisun Marsh.

The action will initially include modifying project operations to maintain a monthly average 2 ppt isohaline at 80 km from the Golden Gate Bridge 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 for up to 60 additional days (not necessarily consecutive) from June 1 through October 31 of below normal and above normal, years. This action may also be implemented in wet years if preliminary analysis shows expected benefits.
- Food enhancement actions, e.g., those included in the Delta Smelt Resiliency Plan to enhance food supply. These projects include the North Delta Food Subsidies and Colusa Basin Drain project, Sacramento River Deepwater Ship Channel lock reoperation, and Suisun Marsh Food Subsidies (Roaring River distribution system reoperation). Reclamation and DWR will monitor dissolved oxygen at Roaring River distribution system drain location(s) during Delta Smelt food distribution actions to ensure compliance with Water Quality Objectives established in the San Francisco Bay Basin Plan. These actions are listed in further detail below:
    - North Delta Food Subsidies / Colusa Basin Drain Study – DWR, Reclamation, and water users propose to increase food entering the north Delta through flushing nutrients from the Colusa Basin into the Yolo Bypass and north Delta. DWR, Reclamation, and water users would work with partners to flush agricultural drainage (i.e., nutrients) from the Colusa Basin Drain through Knight's Landing Ridge Cut and the Tule Canal to Cache Slough, improving the aquatic food web in the north Delta for fish species. Reclamation would work with DWR and partners to augment flow in the Yolo Bypass in July and/or September by closing Knights Landing Outfall Gates and routing water from Colusa Basin into Yolo Bypass to promote fish food production.
    - Sacramento Deepwater Ship Channel Food Study – Reclamation proposes to partner with the City of West Sacramento and West Sacramento Area Flood Control Agency to repair or replace the West Sacramento lock system to hydraulically reconnect the ship channel with the mainstem of the Sacramento River. When combined with an ongoing food web study, the reconnected ship channel has the potential to flush food production into the north Delta. An increase in food supply is likely to benefit Delta Smelt and their habitat.
    - Suisun Marsh and Roaring River Distribution System Food Subsidies Study – Water users propose to add fish food to Suisun Marsh through coordinating managed wetland flood and drain operations in Suisun Marsh, Roaring River Distribution System food production, and reoperation of the Suisun Marsh Salinity Control Gates. As noted in the Delta Smelt Resiliency Strategy, this management action may attract Delta Smelt into the high-quality Suisun Marsh habitat in greater numbers, reducing use of the less food-rich Suisun Bay habitat (California Natural Resources Agency 2016). Infrastructure in the Roaring River Distribution System may help drain food-rich water from the canal into Grizzly Bay to

augment Delta Smelt food supplies in that area. In addition, managed wetland flood and drain operations can promote food export from the managed wetlands to adjacent tidal sloughs and bays. Reclamation and DWR will monitor dissolved oxygen at Roaring River Distribution System drain location(s) to ensure compliance with Water Quality Objectives established in the San Francisco Bay Basin Plan when Delta Smelt food actions are being taken.

- If the measures above (or others developed through collaborative science processes) result in benefits that are determined to provide similar or better protection than the 80 km salinity management action, Reclamation and DWR will work with USFWS to modify this component of Alternative 1 to implement the new actions in lieu of the salinity management action. When determining whether or not the measures above provide similar or better protection, Reclamation and DWR will consider, at minimum, the following:
    - Habitat acreages in Suisun Marsh, Grizzly Bay, and other adjacent areas available to support Delta Smelt recruitment (e.g., 0–6 ppt at Belden's Landing, non-lethal temperatures, etc.).
    - Recruitment projections based on lifecycle modeling and/or monitoring to evaluate the expected trend in Delta Smelt with and without the 80 km salinity management action.
    - The presence (or absence) of Delta Smelt in both the target areas (main Delta channels and Suisun Marsh) and other areas (such as Montezuma Sough and Cache Slough), including information from monitoring, presence/absence modeling, or similar tools.

These considerations (listed above) and implementation of other actions will be more fully defined and developed through the structured decision making or other review process. The review will include selection of appropriate models, sampling programs, and other information to be used. The process will be completed prior to implementation and may be improved in subsequent years as additional information is synthesized and reviewed as described below.

Reclamation and DWR will develop a Delta Smelt Summer-Fall Habitat Action Plan to meet the environmental and biological goals in years when summer-fall habitat actions are triggered. In above normal and wet years, operating to a monthly average X2 of 80 km in September and October is the initial operation to provide a specific acreage of low salinity habitat. In every year, Reclamation and DWR may propose, based on discussions with the USFWS, a suite of actions that would meet the action's environmental and biological goals.

Although Reclamation and DWR agree to treat the Delta Smelt Summer-Fall Habitat Action, as an in-basin use, Reclamation intends to meet Delta outflow augmentation in the fall primarily through export reductions as they are the operational control with the most flexibility in September and October. Storage releases from upstream reservoirs may be used to initiate the action by pushing the salinity out further in August and early September; however, the need for this initial action would depend on the hydrologic, tidal, storage, and demand conditions at the time. In addition, storage releases could be made in combination with export reductions during the fall period during high storage scenarios where near-term flood releases to meet flood control limitations are expected. In these scenarios, Reclamation would make releases in a manner that minimizes redd dewatering where possible. In the event that Reclamation determines the Delta outflow augmentation necessary to meet 2 ppt isohaline at 80 km from the Golden Gate as described above cannot be met through primarily export reductions and is expected to have a high storage cost, Reclamation would still implement the rest of this action, and would meet with NMFS and USFWS to discuss alternate potential approaches that improve habitat conditions.

4.3.6.8.1 Collaborative Planning Process

Reclamation would form a Delta Coordination Group (Reclamation, DWR, USFWS, NMFS, CDFW, and representatives from federal and state water contractors). The Group will utilize one of the existing structured decision-making models, or adopt a new model, to analyze proposed summer-fall habitat actions. Through the Delta Coordination Group Reclamation and DWR would develop a multi-year science and monitoring plan consistent with the structured decision-making models within 9 months of signing the ROD. The Delta Coordination Group may use the Interagency Ecological Program (IEP) or Collaborative Science and Adaptive Management Program (CSAMP) (or similar entity) to review project design and the science and monitoring plan.

Within 6 months of signing the National Environmental Policy Act Record of Decision (ROD), the Delta Coordination Group would meet to select a structured decision-making model; and complete model runs testing various approaches to satisfying the environmental and biological goals, utilizing the available tool box of approaches. The Delta Coordination Group would provide the initial results of its modeling exercise in a memorandum to Reclamation, DWR, and USFWS.

The process for Delta Smelt Summer-Fall Habitat Action development and approval is as follows:

- January: Reclamation and DWR will provide a synthesis of potential updates to the science and monitoring plan annually based on available data and analysis from prior years. Preliminary analyses from prior year will be shared with DCG.
- March: The water year designation is not fully known until approximately May 1; however, planning for a summer-fall action requires several weeks. Therefore, the Delta Coordination Group will develop an initial proposal accounting for varying forecasted hydrology and temperatures. The proposal will include the hypotheses to be tested, the suite of actions and operations to test the hypotheses, potential off-ramps, and expected outcomes.
- April: In April of each below normal, above normal or wet water year, Reclamation and DWR would meet to develop a Habitat Action Plan accounting for forecasted hydrology and temperatures over the summer and fall. The Habitat Action Plan would describe how the proposed action will meet the environmental and biological goals as well as assess and apply off-ramps as needed. The preliminary action shall be selected and fully described by April 30.
- June through October: Reclamation and DWR share preliminary monitoring results through the Delta Coordination Group.
- October (of following calendar year when an action is taken): Reclamation and DWR would provide a synthesis of the study results to the Delta Coordination Group by October of the following year an action is undertaken. The Delta Coordination Group shall review the synthesis of results and use the results of the monitoring to inform a subsequent Structured Decision-Making modeling exercise using the tool box of available approaches. Reclamation and DWR shall provide the results of the subsequent structured decision-making exercise to USFWS by March of the following year.

The Delta Smelt Summer-Fall Habitat Action would be incorporated into the "Four Year Review" described in Section 4.3.9.7, and all reasonable and practical recommendations would be incorporated into the Delta Smelt Summer-Fall Habitat Action. The structured decision-making model and the multi-year science and monitoring plan will be part of this Peer Review.

4.3.6.9 *Additional Operations Components*

In addition to the changes to CVP and SWP export operations, Alternative 1 would include studies to understand how operations interact with fisheries:

- San Joaquin Basin Steelhead Telemetry Study – Continuation of the San Joaquin Basin Steelhead Telemetry Study. This is a 6-year study on the migration and survival of San Joaquin Origin Central Valley Steelhead.
- Steelhead Lifecycle Monitoring Program – Development of infrastructure that would support a functioning life cycle monitoring program in the Stanislaus River and a Sacramento basin CVP tributary (e.g., Clear Creek, Upper Sacramento, American River) to evaluate how actions related to stream flow enhancement, habitat restoration, and/or water export restrictions affect biological outcomes including juvenile and adult population abundance, age structure, growth and smoltification rates, and anadromy and adaptive potential in these two populations. The goal of this monitoring program would be to improve understanding of Steelhead demographics and, when combined with other Steelhead-focused parts of Alternative 1 (San Joaquin and Delta Steelhead telemetry study), inform actions that would increase Steelhead abundance and improve Steelhead survival through the Delta.
- San Joaquin Basin Steelhead Collaborative – Within 1 year, Reclamation would coordinate with CSAMP to sponsor a workshop for developing a plan to monitor Steelhead populations within the San Joaquin Basin and/or the San Joaquin River downstream of the confluence of the Stanislaus River, including Steelhead and Rainbow Trout on non-project San Joaquin tributaries. The goal for the monitoring program will be to estimate the juvenile and adult population abundance in the San Joaquin River basin. The plan would be delivered to the IEP for prioritization and implementation, where feasible, for actions within the responsibility of the CVP and SWP and other members of the IEP. If the IEP is not able to implement the plan, the plan may be raised at the Director Level Collaborative Planning Meeting described in Section 4.3.9, *Governance*, for resolution.
- San Joaquin River Scour Hole Predation Reduction – Reclamation and DWR would form a project team to address the scour hole in the San Joaquin River at the Head of Old River. The project team would plan and implement measures to reduce the predation intensity at that site through modifications to the channel geometry and associated habitats.
- Habitat Restoration – DWR and Reclamation propose to continue to implement existing restoration efforts that are part of the environmental baseline but are not yet complete, including:
    - Tidal Habitat Restoration – Completing, by 2030, the remaining approximately 6,000 acres of tidal habitat restoration in the Delta of the 8,000 acres DWR has begun. Reclamation and/or DWR would monitor, operate, and maintain the tidal habitat restoration, including obtaining permanent land rights. Consistent with the current regulatory process, future separate consultations would address the effects to listed species from habitat restoration.
    - Yolo Bypass Salmonid Habitat Restoration and Fish Passage Project – Reclamation and DWR will provide increased acreage of seasonal floodplain rearing habitat available in the lower Sacramento River basin by 2030.
- Predator Hot Spot Removal – Reclamation would coordinate with water users to remove predator hot spots in the Bay- Delta. This includes minimizing lighting at fish screens and bridges, and possibly removing abandoned structures.
- Delta Cross-Channel Gate Improvements – The DCC is more than 65 years old and its gates rely on remote operators to travel to the facility to change their position. When the gates are open, they provide a critical diversion structure for fresh water reaching the CVP south Delta pumping

station. The gates are closed to prevent scouring (during high flows), reduce salinity intrusion in the western Delta, and protect Sacramento River ESA-listed and nonlisted salmonids. Additional DCC operation would allow for improved exports and water quality without additional adverse effects on salmonids. Reclamation would evaluate improvements to automate and streamline operation of the DCC gates. Reclamation would modernize the DCC gate materials and mechanics to include adding industrial control systems, increasing additional staff time, and improve physical and biological monitoring associated with the DCC daily and/or tidal operations as necessary to maximize water supply deliveries.

- Tracy Fish Collection Facility Improvements – Reclamation would improve the TFCF to reduce loss by (1) incorporating additional fish exclusion barrier technology into the primary fish removal barriers, (2) incorporating additional debris removal systems at each trash removal barrier, screen, and fish barrier, (3) constructing additional channels to distribute the fish collection and debris removal among redundant paths through the facility, (4) constructing additional fish handling systems and holding tanks to improve system reliability; and (5) incorporating remote operation into the design and construction of the facility. Facility improvements would improve survival of fish salvaged and potentially reduce the loss factors to allow for additional certainty on OMR management with low impacts from salvaging salmonids.
- Clifton Court Forebay Mortality Reduction – DWR would continue implementation of projects to reduce mortality of ESA-listed fish species. These measures that would be implemented include: (a) continued evaluation of predator relocation methods; (b) controlling aquatic weeds; and (c) exploration of additional predation reduction measures. Please see Appendix G, *Water Quality Technical Appendix* for study results from the last decade.
- Skinner Fish Facility Performance Improvements – DWR proposes to continue implementing studies to better understand and continuously improve the performance of the Skinner Fish Facility including: a) operational changes to salvage release scheduling and location to reduce post-salvage predation, and b) continued refinement and improvement of the fish sampling and hauling procedures and infrastructure to improve the accuracy and reliability of data and fish survival.
- Salvage Release Sites – Reclamation proposes to continue work with DWR to incorporate flexibility in salvage release sites, using DWR's sites, or sites on a barge.
- Small Screen Program – Reclamation and DWR propose to continue to work with existing authorities (Anadromous Fish Screen Program) to screen small diversions throughout Central Valley CVP/SWP streams and the Bay-Delta.
- Reintroduction Efforts for Delta Smelt – Reclamation proposes to fund a two-phase process that would lead to annual supplementation of the wild Delta Smelt population with propagated fish within 3 to 5 years from issuance of the biological opinion. The first step in this process will be the development of a supplementation strategy within 1 year of the issuance of the BO that will describe the capacity needed at hatchery facilities to accommodate the Delta Smelt production needed to meet genetic and other hatchery considerations with a goal of increasing production to a number and the life stages necessary to effectively augment the population. USFWS will be the lead on the development of this supplementation strategy. The strategy will include identification of regulatory processes to address, science studies to complete, potential facility expansion and improvements, and schedules and deliverables to support the second phases and the larger Conservation Hatchery, described below.

  The second step will involve using the existing UC Davis Fish Conservation and Culture Laboratory (FCCL). Reclamation and DWR are the primary funding sources for FCCL, which maintains the refugial population of Delta Smelt and generates additional captive-bred fish for

research. The FCCL has maintained a continuous refugial population since 2008. The FCCL has closed the life cycle of Delta Smelt meaning that they can produce new generations of fish at their facility with or without the addition of new wild spawners, and keep enough progeny alive to repeat the process for multiple generations. Annually, the FCCL exports approximately 33,000 fish of different life stages for use in research. Additionally, approximately 32,000 adults are reared in the refuge population. To achieve these production levels, the FCCL frequently removes fish at the egg and juvenile stages. Additional funding will support expansion of facilities to maintain these fish and increase rearing capacity to provide up to approximately 125,000 adults within 3 years. By 2030, Reclamation proposes to support a larger Conservation Hatchery, described below, to take over the role of supplementing the wild population.

- Delta Fish Species Conservation Hatchery – Reclamation proposes to partner with DWR to construct and operate a conservation hatchery for Delta Smelt, by 2030. The conservation hatchery would breed and propagate a stock of fish with equivalent genetic resources of the native stock and at sufficient quantities to effectively augment the existing wild population, so that they can be returned to the wild to reproduce naturally in their habitat.
- Sediment Supplementation Feasibility Study – Reclamation proposes to develop and implement a sediment supplementation feasibility study. The goal of this study will be to determine methods to reintroduce sediment in the Delta to increase turbidity which would provide better habitat conditions for all life stages of Delta Smelt, including increased cover for juveniles and feeding facilitation for larval Smelt. This study will include, at minimum, consideration of sediment placement upstream of the Delta during low flow periods in the spring, summer and/or fall, followed by sediment remobilization following inundation during seasonal high flows. Reclamation will coordinate with USFWS and other agencies to address necessary permitting for this study. Reclamation will coordinate with USFWS on the design and findings of this study, including monitoring measures to assess its effectiveness and feasibility as a long-term management program, a method to phase implementation if required for permitting and other compliance needs.

4.3.7 Stanislaus River

As discussed in the No Action Alternative, Reclamation has worked with water users and related agencies to develop an operating plan for New Melones Reservoir to meet the multiple objectives on the system, but a plan is not complete. Alternative 1 includes an operating plan, described below, which is intended to replace often overlapping and conflicting operational components of previous federal and state flow requirements and is representative of Reclamation's contribution to any current or future flow objectives on the lower San Joaquin River at Vernalis.

4.3.7.1 *Seasonal Operations*

Reclamation would meet water rights, contracts, and agreements that are specific to the East Side Division and Stanislaus River. Senior water right holders (OID and SSJID) would receive annual water deliveries consistent with the 1988 Agreement and Stipulation, and water would be made available to CVP contractors in accordance with their contracts and applicable shortage provisions.

In high storage, high inflow conditions, Reclamation would operate for flood control in accordance with the USACE flood control manual. Because New Melones Reservoir is large relative to its annual inflow, flood control is relatively infrequent; however, Tulloch Lake, located downstream of New Melones Reservoir, is subject to high local inflows, and may be in flood control operations for brief periods when

New Melones Reservoir is not. During these periods, releases from Tulloch Lake may be used to meet flow objectives, schedules, or requirements on the lower Stanislaus River below Goodwin Dam.

Reclamation would operate New Melones Reservoir (as measured at Goodwin Dam) in accordance with a Stepped Release Plan (SRP) that varies by hydrologic condition and water year type as shown in Table 4.3-6.

Table 4.3-6. New Melones SRP Annual Releases by Water Year Type

Water Year Type	Annual Release (TAF)
Critical	184.3
Dry	233.3
Below normal	344.6
Above normal	344.6
Wet	476.3

TAF = thousand acre-feet

The New Melones SRP would be implemented similarly to the No Action Alternative with a default daily hydrograph and the ability to shape monthly and seasonal flow volumes to meet specific biological objectives. The default daily hydrograph is the same as prescribed under the No Action Alternative for critical, dry, and below-normal water year types. The difference occurs in above-normal and wet years, where the minimum requirement for larger releases is reduced from the No Action Alternative to promote storage for potential future droughts and preserve cold water pool. When compared to minimum daily flows from the No Action Alternative, the daily hydrograph for the New Melones SRP is identical for critical, dry, and below-normal year types; above-normal and wet year types follow daily hydrographs for below-normal and above-normal year types from current operating requirements, respectively.

For the New Melones SRP, Reclamation would classify water year types using the San Joaquin Valley 60-20-20 Water Year Hydrologic Classification (60-20-20) developed for D-1641 implementation. Previous operating plans for New Melones Reservoir relied on the New Melones Index to determine water year type, calculated by summing end-of-February storage and forecasted inflow through September. Because the reservoir can store more than twice its average inflow, the New Melones Index resulted in a water year type determination that was more closely tied to storage rather than hydrology. Changing from the New Melones Index to 60-20-20 is expected to provide operations that better represent current hydrology and correlate more closely to water year types for other nearby tributaries.

Reclamation would convene the Stanislaus Watershed Team (successor to the Stanislaus Operating Group), consisting of agency representatives and local stakeholders having direct interest on the Stanislaus River, at least monthly to share operational information and improve technical dialogue on the implementation of the New Melones SRP. The Stanislaus Watershed Team would provide input on the shaping and timing of monthly or seasonal flow volumes to optimize biological benefits.

During the summer, Reclamation would be required to maintain applicable dissolved oxygen standards on the lower Stanislaus River for species protection. Reclamation currently operates to a 7.0 mg/L dissolved oxygen requirement at Ripon from June 1 to September 30. Reclamation would move the compliance location to Orange Blossom Bridge, where the species are primarily located at that time of year.

4.3.7.2 *Habitat Components*

Alternative 1 includes the following habitat components:

- Spawning Habitat Restoration – Under the CVPIA (b)(13) program, Reclamation's annual goal of gravel placement is approximately 4,500 tons in the Stanislaus River. Continued gravel placement sites would include River Mile 58 on the lower Stanislaus River, Goodwin Canyon (at the cable crossing and float tube pool), Honolulu Bar, Buttonbush, and Rodden Road. Reclamation could also work with new sites, including Two Mile Bar, Kerr Park, and Goodwin Canyon.
- Rearing Habitat Restoration – Reclamation would construct an additional 50 acres of rearing habitat adjacent to the Stanislaus River by 2030. Reclamation may improve or add to existing projects at Lancaster Road, Honolulu Bar, Buttonbush, or Rodden Road. Reclamation could also work with new sites at Two Mile Bar or Kerr Park.
- Temperature Management Study – Reclamation would study approaches to improving temperature for listed species on the lower Stanislaus River to include evaluating the utility of conducting temperature measurements or profiles in New Melones Reservoir.
- Yellow-billed Cuckoo Baseline Surveys – Reclamation will coordinate with the USFWS to develop and conduct a baseline survey for the Yellow-billed cuckoo in the action area.

4.3.8 San Joaquin River

Reclamation would continue to implement the SJRRP, as described in the No Action Alternative. Additionally, Reclamation would implement rearing habitat restoration on the lower San Joaquin River. Reclamation will coordinate with the USFWS to develop and conduct a baseline survey for the Yellow-billed cuckoo in the action area. Reclamation would work with private landowners to create a locally driven, regional partnership to define and implement a large-scale floodplain habitat restoration effort in the lower San Joaquin River. This stretch of the San Joaquin River is cut-off from its floodplain due to an extensive levee system, with two notable exceptions at Dos Rios Ranch (1,600 acres) and San Joaquin River National Wildlife Refuge (2,200 acres). In recent years, there has been growing interest in multibenefit floodplain habitat restoration projects in the Central Valley that can provide increased flood protection for urban and agricultural lands, improved riparian corridors for terrestrial plants and wildlife, and enhanced floodplain habitat for fish. The resulting restoration could include thousands of acres of interconnected (or closely spaced) floodplain areas with coordinated and/or collaborative funding and management. Such large-scale effort along this corridor would require significant support from a variety of stakeholders, which could be facilitated through a regional partnership.

4.3.9 Governance

Reclamation would work with DWR, NMFS, USFWS, CDFW, public water agencies, and other participants to manage operations in multiple ways. Key governance functions are described below.

4.3.9.1 *Core Water Operation*

Reclamation and DWR would operate the CVP and SWP, while reducing the stressors on listed species influenced by those ongoing operations. through real-time monitoring. Reclamation would implement activities, monitor performance, and report on compliance with the commitments in Alternative 1. The Real-Time Water Operations Charter (Charter) in the 2019 Biological Opinion establishes how Reclamation and DWR would monitor and report on ESA Section 7 commitments under Alternative 1 and how the five agencies, public water agencies, tribes, and other participants would communicate, and

coordinate real-time water operations decisions. The Charter also describes the deliverables, schedule, and decision-making processes.

NMFS, USFWS, and CDFW would provide information to Reclamation and DWR on the real-time disposition of species through specific monitoring workgroups. This information would inform the risk analysis performed by Reclamation and DWR.

4.3.9.2 *Scheduling*

Fishery agencies and water users in watershed-based groups would provide scheduling recommendations to Reclamation and DWR on duration, timing, and magnitude of specific blocks of water related to Alternative 1 components that have schedule flexibility. Reclamation and DWR would evaluate and consider the recommendations and operate the CVP and SWP to those schedules as feasible.

4.3.9.3 *Collaborative Planning*

As part of Alternative 1, Reclamation would pursue and implement certain actions through collaborative planning with the goal of continuing to identify and undertake actions that benefit listed species. Collaborative planning would make use of the CSAMP, CVPIA, IEP, and Delta Plan Interagency Implementation Committee (DPIIC), successors to the forums, or complementary forums (e.g., Voluntary Agreement forums). Each of these programs has established governance, work planning, implementation, reporting, and independent review.

Where necessary, Reclamation and DWR would form project teams comprised of fishery agency and water users that assist Reclamation and DWR on the implementation of specific actions. The CVPIA develops priorities across CVPIA fish-related provisions and watersheds in the Central Valley. The process uses an Adaptive Resource Management approach with support from Decision-Support Models to prioritize implementation of management actions that have the highest probability of achieving biological objectives for naturally produced populations of native anadromous fish. The Adaptive Resource Management approach also guides plans for monitoring and research by synthesizing existing monitoring data, annually updating Decision Support Models using new information, and estimating the value of new information to the decision making process. CSAMP and DPIIC have similar tools in various stages of development.

The Sacramento River Settlement Contractors approved *A Resolution Regarding Salmon Recovery Projects in the Sacramento River Watershed, Actions Related to Shasta Reservoir Annual Operations, and Engagement in the Ongoing Collaborative Sacramento River Science Partnership Effort*. Pursuant to the resolution, the SRS Contractors will continue their active engagement and leadership in the ongoing collaborative Sacramento River Science Partnership effort.

Reclamation would use CSAMP to convene an annual Directors Level Collaborative Planning meeting with NMFS, DWR, CDFW and UFWS to review collaborative planning actions (including restoration, monitoring, and research actions), discuss the resources each agency can contribute, and discuss strategies for collectively influencing and supporting the likelihood that priority restoration, monitoring, and research actions and their beneficial effects would be implemented.

Reclamation and DWR have a strong record of accomplishment in benefiting species through habitat restoration, facility improvements, monitoring, and science, as documented in work plans and accomplishment reports. Specific examples of recent projects in partnership with stakeholders, but not an exhaustive list, include:

- Shasta Division (Sacramento River)

  - Market Street gravel addition in 2019
  - Reading Island side channel restoration in 2018
  - Lake California side channel restoration in 2018
  - Additional gravel at the Keswick Dam launch site in 2018
- Clear Creek planning and 2019 award of funds for the completion of the Phase 3C
- American River
  - Nimbus side channel restoration in 2014
  - Sacramento Bar restoration in 2016
- Stanislaus River
  - Goodwin Canyon gravel addition in 2016
  - Landcaster Road side channel in 2017

- Delta and Suisun Marsh
  - McCormack Williamson Tract tidal and floodplain habitat in 2018
  - Yolo Flyway Farms tidal restoration in 2018
  - Decker Island tidal restoration in 2018
  - Tule Red tidal restoration in scheduled for fall of 2019
  - Winter Island tidal restoration scheduled for fall of 2019
  - Dutch Slough tidal and floodplain restoration construction ongoing since 2018
  - Freemont Weir adult fish passage in 2019
  - Knight's Landing Outflow Gates in 2016
  - Wallace Weir barrier and rescue facility in 2019
  - Suisun Marsh Gate Reoperation Pilot in 2018
  - Roaring River Drain Gate Installation in 2018
- Fish Passage and Screening
  - Deer Creek Irrigation District Dam in 2017
  - Mill Creek Fish Passage Assessment and Restoration Project in 2016
  - Lower Deer Creek Falls Fish Passage Improvement Project in 2018
  - RD2035 Woodland Davis intake in 2016
  - Small screen program through the Family Farm Alliance for Locke Ranch on the Mokelumne, Hidden Valley Range on the San Joaquin, Clover Creek/Millville on Clover Creek, and Oswald Water District on the Feather River in 2017
- Science and Monitoring
  - Directed Outflow Project in 2017, 18, and 19
  - Enhanced Delta Smelt Monitoring Program
  - Six-Year Steelhead Telemetry Study
  - Salmon and Sturgeon Assessment of Indicators by Lifestage
  - Salvage Monitoring Studies

The action agencies' collaborative planning programs are robust and account for the technical, social, and economic complexities of implementing large-scale habitat restoration programs. Reclamation has the authority to undertake these actions, subject to appropriations, under Reclamation Law including authorizations for the Central Valley Project, Fish and Wildlife Coordination Act, CVPIA (1992), CALFED Bay-Delta Authorization Act (2004), and Water Infrastructure Improvements for the Nation Act (2016). Reclamation's historical annual appropriations bills include funding of spawning and rearing habitat, fish screens, fish salvage, hatcheries, and specific restoration programs. Sources include the Bay-

Delta Fund, Central Valley Project Restoration Fund, and Water and Related Resources Fund. Future obligations and expenditures are subject to appropriation by Congress.

To fund these actions, DWR has the statutory authority to require the reimbursement in the SWP contracts for water and power for any costs DWR incurs for SWP-relate fish and wildlife preservation (Water Code Sections 11912, 12937 and 12938).

Reclamation and DWR also commit to continue to support collaborative efforts that are underway in other forums that benefit species. Reclamation and/or DWR agree to track, and where appropriate and within the agencies' authority, champion, sponsor, and/or implement projects consistent with applicable laws, similar to the processes described for the projects identified above.

4.3.9.4 *Compliance and Performance Reporting*

Reclamation and DWR would annually report on water operations and fish performance seasonally and in an annual summary. Changes to Alternative 1 would occur based on the reinitiation triggers provided by Title 50 of the Code of Federal Regulations (CFR) 402.16. These triggers include:

a) If the amount or extent of taking specified in the incidental take statement is exceeded;

b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;

c) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or

d) If a new species is listed or critical habitat designated that may be affected by the identified action.

Reclamation would monitor take for evaluating trigger (a) above; Reclamation would monitor the effects of Alternative 1 for the purpose of evaluating trigger (b) above. If Reclamation decides to modify Alternative 1, Reclamation would evaluate the changes to Alternative 1 based on trigger (c) above. Consistent with 50 CFR 402.16, the USFWS and/or NMFS could also reinitiate formal consultation as appropriate. Reclamation would coordinate with DWR as an "applicant" and support DWR's coordination with CDFW.

4.3.9.5 *Drought and Dry Year Actions*

Within 18 months of executing the Record of Decision, Reclamation would coordinate with DWR to develop a voluntary toolkit to be exercised at the discretion of Reclamation, DWR, other agencies, participating water users, and/or others for the operation of Shasta Reservoir during critical hydrologic year types. The toolkit would include, at a minimum: measures at the Livingston-Stone National Fish Hatchery; the potential for translocation of fish; and facility improvements to reduce the adverse effects of critical and dry years on listed species. Drought and dry year planning would include the measures under Shasta Cold Water Pool Management Dry Years, Drought Years, and Successive Dry Years.

In Tier 3 and Tier 4 years, Reclamation would meet and confer with USFWS, NMFS, DWR, CDFW, and Sacramento River Settlement Contractors on voluntary measures to be considered if drought conditions continue into the following year, including measures that may be beyond Reclamation and DWR's discretion. If dry conditions continue, Reclamation would regularly meet with this group (and potentially other agencies and organizations) to evaluate current hydrologic conditions and the potential for

continued dry conditions that may necessitate the need for development of a drought contingency plan (that may include actions from the toolkit) for the water year.

The Sacramento River Settlement Contractors approved A Resolution Regarding Salmon Recovery Projects in the Sacramento River Watershed, Actions Related to Shasta Reservoir Annual Operations, and Engagement in the Ongoing Collaborative Sacramento River Science Partnership Effort. Pursuant to the resolution, during drier water years with operational conditions as described in the Tier 3 and Tier 4 scenarios, the SRS Contractors will meet and confer with Reclamation, NMFS, and other agencies as appropriate to determine if there is any role for the SRS Contractors in connection with Reclamation's operational decision-making for Shasta Reservoir annual operations in those years. This determination will include consideration of what actions are feasible, consistent with the terms of the SRS Contracts. In addition to the 25% reduction during Shasta Critical Years as set forth in the SRS Contracts, the types of actions that may be considered include, but are not necessarily limited to: (1) the scheduling of spring diversions by the SRS Contractors; (2) voluntary, compensated water transfers by the SRS Contractors subject to Reclamation approval; and (3) delayed SRS Contractor diversion for rice straw decomposition during the fall months. Any mutually agreeable proposed actions resulting from these meet and confer discussions must be consistent with the terms of the SRS Contracts and may also be subject to other regulatory approvals.

By February of each year following a critical hydrologic year type, Reclamation would report on the measures employed and assess the effectiveness. The toolkit would be revisited at a frequency of not more than 5 years after the Record of Decision.

4.3.9.6 *Chartering of Independent Panels*

Reclamation and DWR would charter independent panels to review actions as described in certain components of Alternative 1. Independent panels would review actions consistent with the standards of the Delta Stewardship Council and applicable Reclamation and DWR guidance. Experts on the panel would provide information and recommendations but would not make consensus recommendations to Reclamation. NMFS and UFWS could provide technical assistance and input in the development of the charter. Reclamation and DWR would provide the results of the independent review to NMFS and IFWS. Reclamation would coordinate with DWR to document a response to the independent review including whether implementation of alternative strategies would require reinitiation consistent with the reinitiation triggers provided by 50 CFR 402.16. Nothing associated with the chartering of and responding to independent panels precludes NMFS nor UFWS from exercising its statutory responsibilities under the ESA.

4.3.9.7 *Four Year Reviews*

In January of 2024 and January of 2028, Reclamation and DWR would charter an independent panel to review the following actions:

- Upper Sacramento Performance Metrics
- OMR management and measures to improve juvenile salmonid survival through the South delta
- OMR management measures and life cycle models used to manage Delta Smelt larval/juvenile entrainment.
- Delta Smelt Summer-Fall Habitat Action
- Steelhead Research and Monitoring Actions

Reclamation and DWR could incorporate additional information into the reviews in coordination with local, state, and federal partners.

4.4 Alternative 2

Alternative 2 reflects a condition where Reclamation would operate the CVP to meet the legal requirements associated with its water rights, but would not release additional flows for fish and wildlife purposes. DWR would continue to operate Lake Oroville according to the most recent FERC license, and Delta operations would be governed by water right requirements. Most of the water right conditions are from D-1641 (SWRCB 2000), which sets forth the water right requirements to meet the objectives in the Bay-Delta WQCP (SWRCB 1995).

Table 4.4-1 shows each of the components of Alternative 2. The table includes a column that considers if a component is covered at a project or program level of analysis in this EIS, but Alternative 2 does not have any components considered at a program level. Unlike Alternative 1, this table does not include a column for construction effects because Alternative 2 does not have any construction components. If not mentioned in the table, the operations of the No Action Alternative remain.

Table 4.4-1. Components of Alternative 2

Title	Project-Level Analysis or Program-Level Analysis
Upper Sacramento	
Operations to meet WRO 90-5 downstream temperature targets	Project
Operations to meet Delta standards in D-1641	Project
Trinity	
Whiskeytown Reservoir Operations	Project
Feather River	
FERC Project #2100-134 controls operations; Alt 1 analyzes downstream of the FERC boundary	Project
American River	
2006 Flow Management Standard Releases	Project
Operations to meet Delta standards in D-1641	Project
Stanislaus	
1987 Reclamation, CDFG agreement	Project
Bay-Delta	
D-1641 control of exports, DCC operations, and Delta outflow	Project

4.4.1 Upper Sacramento River (Shasta and Sacramento Divisions)

As described under Alternative 1, Reclamation has multiple requirements that govern the operation of Shasta Reservoir. For Alternative 2, Reclamation would continue to operate Shasta Reservoir in accordance with water rights, contracts, and agreements specific to the upper Sacramento River, including 990, 90-5, 91-1, and 1641, settlement contracts, exchange contracts, water service contracts, flood control operations developed by the USACE, and navigation requirements in the Rivers and Harbors Acts.

4.4.2 Trinity River Division

As described in the No Action Alternative and Alternative 1, the Trinity River system would be operated according to the Trinity River ROD with lower Klamath River augmentation flows.

4.4.3 Clear Creek

Under Alternative 2, Clear Creek base flows would be 50 to 100 cfs based on the 2000 agreement between Reclamation, USFWS, and CDFG.

4.4.4 Feather River

Alternative 2 would have the same operations as the No Action Alternative and Alternative 1.

4.4.5 American River Division

Alternative 2 would include flow releases to meet D-893 on the American River, the 2006 American River Flow Management Standard, and releases to meet Delta standards, as needed.

4.4.6 Bay-Delta

The requirements in D-1641 address the standards for fish and wildlife protection, water supply water quality, and Suisun Marsh salinity. These objectives include specific Delta outflow requirements throughout the year, specific export limits in the spring, and export limits based on a percentage of estuary inflow throughout the year. The water quality objectives are designed to protect agricultural, M&I, and fishery uses and vary throughout the year and by water year type. One of the requirements is to provide a minimum flow on the Sacramento River at Rio Vista in September through December of 3,000 to 4,500 cfs, depending on the month and water year type, to protect water quality for Delta water users.

D-1641 includes two Delta outflow criteria: a Net Delta Outflow Index is specified for all months in all water year types and a spring X2 Delta outflow is specified from February through June to maintain freshwater and estuarine conditions in the western Delta to protect aquatic life.

CCWD facilities would continue to be operated and maintained under applicable permits. Reclamation would work with CCWD to ensure that implementation of the proposed action will not restrict CCWD operations beyond the restrictions of the separate biological opinions. Reclamation agrees to ensure that the implementation of Alternative 1 will not create new or additional restrictions on CCWD's ability to fill its Los Vaqueros Reservoir beyond the restrictions of the separate Biological Opinions that apply to CCWD's operations, thereby ensuring that CCWD will have opportunities to fill Los Vaqueros Reservoir that are at least comparable to the current conditions.

During February through June, D-1641 limits CVP and SWP exports at Banks and Jones Pumping Plants as compared to Delta inflows (also known as the E/I Ratio) to reduce potential impacts on migrating salmon and spawning Delta Smelt, Sacramento Splittail, and Striped Bass. Figure 4.4-1 summarizes Delta requirements.

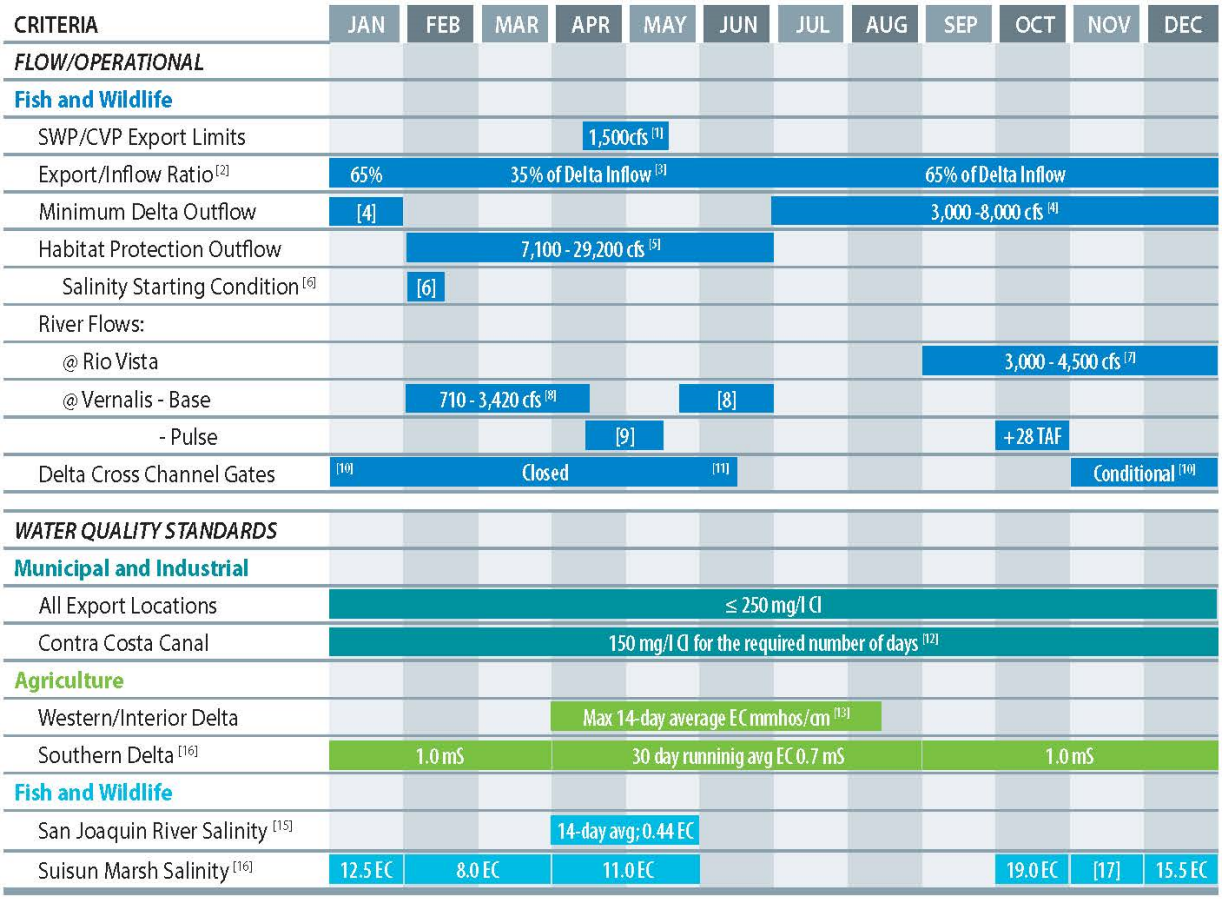

Figure 4.4-1. Delta Requirements in D-1641

FOOTNOTES

[1] Maximum 3-day running average of combined export rate (cfs) which includes Tracy Pumping Plant and Clifton Court Forebay Inflow less Byron-Bethany pumping.

Year Type	All
Apr15 - May15*	The greater of 1,500 or 100% of 3-day avg. Vernalis flow

* This time period may need to be adjusted to coincide with fish migration. Maximum export rate may be varied by CalFed Op's group.

[2]The maximum percentage of average Delta inflow (use 3-day average for balanced conditions with storage withdrawal, otherwise use 14-day average) diverted at Clifton Court Forebay (excluding Byron-Bethany pumping) and Tracy Pumping Plant using a 3-day average. (These percentages may be adjusted upward or downward depending on biological conditions, providing there is no net water cost.)

[3] The maximum percent Delta inflow diverted for Feb may vary depending on the January 8RI.

Jan 8RI	Feb exp. limit
< 1.0 MAF	45%
between 1.0 & 1.5 MAF	35%-45%
> 1.5 MAF	35%

[4] Minimum monthly average Delta outflow (cfs). If monthly standard ≤ 5,000 cfs, then the 7-day average must be within 1,000 cfs of standard; if monthly standard > 5,000 cfs, then the 7-day average must be ≥ 80% of standard.

Year Type	All	W	AN	BN	D	C
Jan	4,500*					
Jul		8,000	8,000	6,500	5,000	4,000
Aug		4,000	4,000	4,000	3,500	3,000
Sep	3,000					
Oct		4,000	4,000	4,000	4,000	3,000
Nov-Dec		4,500	4,500	4,500	4,500	3,500

* Increase to 6,000 if the Dec 8RI is greater than 800 TAF

[5] Minimum 3-day running average of daily Delta outflow of 7,100 cfs OR: either the daily average or 14-day running average EC at Collinsville is less than 2.64 mmhos/cm (This standard for March may be relaxed if the Feb 8RI is less than 500 TAF. The standard does not apply in May and June if the May estimate of the SRI IS < 8.1 MAF at the 90% exceedence level in which case a minimum 14-day running average flow of 4,000 cfs is required.) For additional Delta outflow objectives, see TABLE A.

[6] February starting salinity: If Jan 8RI > 900 TAF, then the daily or 14-day running average EC @ Collinsville must be ≤ 2.64 mmhos/cm for at least one day between Feb 1-14. If Jan 8RI is between 650 TAF and 900 TAF, then the CalFed Op's group will determine if this requirement must be met.

[7] Rio Vista minimum monthly average flow rate in cfs (the 7-day running average shall not be less than 1,000 below the monthly objective).

Year Type	All	W	AN	BN	D	C
Sep	3,000					
Oct		4,000	4,000	4,000	4,000	3,000
Nov-Dec		4,500	4,500	4,500	4,500	3,500

[8] BASE Vernalis minimum monthly average flow rate in cfs (the 7-day running average shall not be less than 20% below the objective). Take the higher objective if X2 is required to be west of Chipps Island.

Year Type	All	W	AN	BN	D	C
Feb-Apr14 and May16-Jun		2,130 or 3,420	2,130 or 3,420	1,420 or 2,280	1,420 or 2,280	710 or 1,140

[9] PULSE Vernalis minimum monthly average flow rate in cfs. Take the higher objective if X2 is required to be at or west of Chipps Island.

Year Type	All	W	AN	BN	D	C
Apr15 - May15		7,330 or 8,620	5,730 or 7,020	4,620 or 5,480	4,020 or 4,880	3,110 or 3,540
Oct	1,000*					

* Up to an additional 28 TAF pulse/attraction flow to bring flows up to a monthly average of 2,000 cfs except for a critical year following a critical year. Time period based on real-time monitoring and determined by CalFed Op's group.

[10] For the Nov-Jan period, Delta Cross Channel gates may be closed for up to a total of 45 days.

[11] For the May 21-June 15 period, close Delta Cross Channel gates for a total of 14 days per CALFED Op's group. During the period the Delta cross channel gates may close 4 consecutive days each week, excluding weekends.

[12] Minimum # of days that the mean daily chlorides ≤ 150 mg/l must be provided in intervals of not less than 2 weeks duration. Standard applies at Contra Costa Canal Intake or Antioch Water Works Intake.

Year Type	W	AN	BN	D	C
# Days	240	190	175	165	155

[13] The maximum14-day running average of mean daily EC (mmhos/cm) depends on water year type.

	WESTERN DELTA				INTERIOR DELTA			
	Sac River @ Emmaton		SJR @ Jersey Point		Mokelumne R @ Terminous		SJR @ San Andreas	
Year Type	0.45 EC from April 1 to date shown	EC value from date shown to Aug15 *	0.45 EC from April 1 to date shown	EC value from date shown to Aug15 *	0.45 EC from April 1 to date shown	EC value from date shown to Aug15 *	0.45 EC from April 1 to date shown	EC value from date shown to Aug15 *
W	Aug 15		Aug 15		Aug 15		Aug 15	
AN	Jul 1	0.63	Aug 15		Aug 15		Aug 15	
BN	Jun 20	1.14	Jun 20	0.74	Aug 15		Aug 15	
D	Jun 15	1.67	Jun 15	1.35	Aug 15		Jun 25	0.58
C		2.78		2.20		0.54		0.87

* When no date is shown, EC limit continues from April 1.

[14] As per D-1641, for San Joaquin River at Vernalis: however, the April through August maximum 30- day running average EC for San Joaquin River at Brandt Bridge,Old River near Middle River, and Old River at Tracy Road Bridge shall be 1.0 EC until April 1, 2005 when the value will be 0.7 EC.

[15] Compliance will be determined between Jersey Point & Prisoners Point. Does not apply in critical years or in May when the May 90% forecast of SRI ≤ 8.1 MAF.

[16] During deficiency period, the maximum monthly average mhtEC at Western Suisun Marsh stations as per SMPA is:

Month	mhtEC
Oct	19.0
Nov	16.5
Dec-Mar	15.6
Apr	14.0
May	12.5

Footnotes continued on following page.

[17] In November, maximum monthly average mhtEC = 16.5 for Western Marsh stations and maximum monthly average mhtEC = 15.5 for Eastern Marsh stations in all periods types.

Table A

Number of Days When Max. Daily Average Electrical Conductivity of 2.64 mmhos/cm must be maintained at Chipps Island and Port Chicago. (This can also be met with a maximum 14-day running average EC of 2.64 mmhos/cm, or 3-day running average Delta outflows of 11,400 cfs and 29,200 cfs, respectively.) Port Chicago Standard is triggered only when the 14-day average EC for the last day of the previous month is 2.64 mmhos/cm or less. PMI is previous month's 8RI. If salinity/flow objectives are met for a greater number of days than required for any month, the excess days shall be applied towards the following month's requirement. The number of day's for values of the PMI between those specified below shall be determined by linear interpolation.

	Chipps Island (Chipps Island Station D10)				
PMI (TAF)	FEB	MAR	APR	MAY	JUN
≤ 500	0	0	0	0	0
750	0	0	0	0	0
1000	28*	12	2	0	0
1250	28	31	6	0	0
1500	28	31	13	0	0
1750	28	31	20	0	0
2000	28	31	25	1	0
2250	28	31	27	3	0
2500	28	31	29	11	1
2750	28	31	29	20	2
3000	28	31	30	27	4
3250	28	31	30	29	8
3500	28	31	30	30	13
3750	28	31	30	31	18
4000	28	31	30	31	23
4250	28	31	30	31	25
4500	28	31	30	31	27
4750	28	31	30	31	28
5000	28	31	30	31	29
5250	28	31	30	31	29
≥ 5500	28	31	30	31	30

	Port Chicago (Continuous recorder at Port Chicago)				
PMI (TAF)	FEB	MAR	APR	MAY	JUN
0	0	0	0	0	0
250	1	0	0	0	0
500	4	1	0	0	0
750	8	2	0	0	0
1000	12	4	0	0	0
1250	15	6	1	0	0
1500	18	9	1	0	0
1750	20	12	2	0	0
2000	21	15	4	0	0
2250	22	17	5	1	0
2500	23	19	8	1	0
2750	24	21	10	2	0
3000	25	23	12	4	0
3250	25	24	14	6	0
3500	25	25	16	9	0
3750	26	26	18	12	0
4000	26	27	20	15	0
4250	26	27	21	18	1
4500	26	28	23	21	2
4750	27	28	24	23	3
5000	27	28	25	25	4
5250	27	29	25	26	6
5500	27	29	26	28	9
5750	27	29	27	28	13
6000	27	29	27	29	16
6250	27	30	27	29	19
6500	27	30	28	30	22
6750	27	30	28	30	24
7000	27	30	28	30	26
7250	27	30	28	30	27
7500	27	30	29	30	28
7750	27	30	29	31	28
8000	27	30	29	31	29
8250	28	30	29	31	29
8500	28	30	29	31	29
8750	28	30	29	31	30
9000	28	30	29	31	30
9250	28	30	29	31	30
9500	28	31	29	31	30
9750	28	31	29	31	30
10000	28	31	30	31	30
> 10000	28	31	30	31	30

4.4.7 Stanislaus River

Under Alternative 2, Reclamation would operate New Melones Reservoir in accordance with the 1987 CDFW agreement.

4.4.8 San Joaquin River

Alternative 2 would include implementation of the SJRRP and flows required in D-1641. D-1641 conditioned CVP water rights to meet flow requirements on the San Joaquin River at Vernalis from February to June to the extent possible.

D-1422 required Reclamation to operate New Melones Reservoir to maintain average monthly levels of 500 parts per million total dissolved solids in the San Joaquin River at Vernalis as it enters the Delta. D-1641 modified the water quality objectives at Vernalis to include the irrigation and nonirrigation season objectives contained in the Bay-Delta WQCP: average monthly electric conductivity of 0.7 mS/cm during the months of April through August and 1.0 mS/cm during the months of September through March.

4.5 Alternative 3

Alternative 3 would incorporate the same flow and operations as described in Alternative 2 to meet requirements in D-1641 and other legal requirements, but would also incorporate habitat restoration and intervention measures. Table 4.5-1 shows each of the components of Alternative 3, including whether each component is covered at a project or program level of analysis in this EIS. The table also indicates if a component involves construction. If not mentioned in the table, the operations of the No Action Alternative remain.

Table 4.5-1. Components of Alternative 3

Title	Project Level Analysis or Program-Level Analysis	Construction Effects
Upper Sacramento		
Operations to meet WRO 90-5 downstream temperature targets	Project	–
Operations to meet Delta standards in D-1641	Project	–
Cold Water Management Tools (e.g., Battle Creek Restoration, Intake Lowering near Wilkins Slough, Shasta TCD Improvements)	Program	–
Spawning and Rearing Habitat Restoration	Program	X
Small Screen Program	Program	X
Winter-Run Conservation Hatchery Production	Program	–
Adult Rescue	Program	–
Juvenile Trap and Haul	Program	–
Trinity		
Whiskeytown Reservoir Operations	Project	–
Feather River		
FERC Project #2100-134 controls operations; Alt 1 analyzes downstream of the FERC boundary	Project	–
American River		
2006 Flow Management Standard Releases	Project	–
Spawning and Rearing Habitat Restoration	Program	X
Drought Temperature Facility Improvements	Program	X

Title	Project Level Analysis or Program-Level Analysis	Construction Effects
Stanislaus		
1987 Reclamation, CDFG agreement	Project	–
Spawning and Rearing Habitat Restoration	Program	X
Temperature Management Study	Program	–
San Joaquin		
Lower SJR Habitat Restoration	Program	X
Bay-Delta		
D-1641 control of exports, DCC operations, and Delta outflow	Project	–
Barker Slough PP Sediment and Aquatic Weed Removal	Project	–
Clifton Court Aquatic Weed and Algal Bloom Management	Project	–
Tracy Fish Collection Facility Operations CO_2 Injection and Release Sites	Project	–
San Joaquin Basin Steelhead Telemetry Study	Project	–
Sacramento Deepwater Ship Channel Food Study	Program	–
North Delta Food Subsidies/Colusa Basin Drain Study	Program	–
Suisun Marsh Roaring River Distribution System Food Subsidies Study	Program	–
Habitat Restoration		
Predator Hot Spot Removal	Program	–
Additional habitat restoration (25,000 acres within the Delta)	Program	X
Facility Improvements		
Delta Cross Channel Gate Improvements	Program	X
Tracy Fish Facility Improvements	Program	X
Skinner Fish Facility Improvements	Program	X
Small Screen Program	Program	X
Fish Intervention		
Reintroduction efforts from Fish Conservation and Culture Laboratory	Project	–
Delta Fish Species Conservation Hatchery	Program	X

CDFG = California Department of Fish and Game, D-1641 = Water Right Decision 1641, DCC = Delta Cross Channel, WRO = FERC = Federal Energy Regulatory Commission; DO = dissolved oxygen, TCD = temperature control device

4.5.1 Upper Sacramento River

In addition to the operations described for Alternative 2, Alternative 3 would include spawning and rearing habitat restoration within the Sacramento River. These habitat restoration efforts would be the same as described for Alternative 1. Additionally, Alternative 3 would include intervention measures described for Alternative 1 (small screen program, adult rescue, and juvenile trap and haul).

4.5.2 Trinity River Division

As described in the No Action Alternative and Alternative 1, the Trinity River system would be operated according to the Trinity River ROD with lower Klamath River augmentation flows.

4.5.3 Clear Creek

Clear Creek base flows would be 50 to 100 cfs based on the 2000 agreement between Reclamation, USFWS, and CDFG.

4.5.4 Feather River

Alternative 3 would be the same as the No Action Alternative and other Action Alternatives for the Feather River.

4.5.5 American River Division

Alternative 3 would follow the operations described for Alternative 2 but would also incorporate spawning and rearing habitat restoration as described for Alternative 1.

4.5.6 Bay-Delta

Alternative 3 would have flows and operations as described for Alternative 2, but would incorporate additional habitat and intervention measures. Alternative 3 would include the habitat restoration measures (food subsidies and tidal habitat restoration) described in Alternative 1. Alternative 3 would also include the intervention measures described in Alternative 1 (Barker Slough PP sediment and aquatic weed removal, Clifton Court aquatic weed removal, fish collection facility improvements, predator hotspot removal). In addition to the measures in Alternative 1, Alternative 3 would include 25,000 acres of habitat restoration within the Delta.

CCWD facilities would continue to be operated and maintained under applicable permits. Reclamation would work with CCWD to ensure that implementation of the proposed action will not restrict CCWD operations beyond the restrictions of the separate biological opinions. Reclamation agrees to ensure that the implementation of Alternative 1 will not create new or additional restrictions on CCWD's ability to fill its Los Vaqueros Reservoir beyond the restrictions of the separate Biological Opinions that apply to CCWD's operations, thereby ensuring that CCWD will have opportunities to fill Los Vaqueros Reservoir that are at least comparable to the current conditions.

4.5.7 Stanislaus River

Alternative 3 would operate New Melones Reservoir based on the 1987 CDFW agreement as described in Alternative 2. In addition, Alternative 3 would include spawning and rearing habitat restoration as described for Alternative 1.

4.5.8 San Joaquin River

Alternative 3 would include SJRRP and D-1641 flows, as described for Alternative 2. Additionally, Alternative 3 would include rearing habitat restoration on the Lower San Joaquin River, as described for Alternative 1.

4.6 Alternative 4

Alternative 4 includes management of storage facilities to preserve cold water pool and additional instream flows in the Sacramento River and the Delta as proposed during scoping. Alternative 4 strives to meet instream flow targets by balancing instream flows with carryover storage sufficient to protect fish. Overall, this alternative prioritizes and attempts to hold water in storage to maintain the cold water pool while increasing instream flows to the extent possible. It would continue flood management and deliveries to senior water right holders. This alternative also would have the CVP and SWP operate to maintain a positive combined OMR from March through May.

Scoping comments proposed meeting a flow objective of 55% of unimpaired flows year round to mimic the natural hydrograph. However, a 55% requirement following the natural hydrograph results in high releases during winter and spring months, which constrain Reclamation's ability to meet cold water pool storage targets. Therefore, the flow objectives cannot be met in all conditions. For example, a flow action would not be taken in drier years to ensure cold water pool storage in reservoirs. During drier hydrologic conditions when the flow objectives are not met, Reclamation and DWR would operate the CVP and SWP to follow the operational objectives described in Alternative 1 and maintain the positive OMR. This operational regime would last from March through February, and the flow objectives would resume in the following March.

Table 4.6-1 shows each of the components of Alternative 4. The table includes a column that considers if a component is covered at a project or program level of analysis in this EIS and whether it involves construction actions. If not mentioned in the table, the operations of the No Action Alternative remain.

Table 4.6-1. Components of Alternative 4

Title	Project Level Analysis or Program-Level Analysis	Construction Effects
Upper Sacramento		
Operations to meet minimum instream flow requirement of 55% of unimpaired flow (reduced during Shasta Critical years)	Project	–
Trinity		
Whiskeytown Reservoir Operations	Project	–
Operations to meet Clear Creek water rights and agreements, and minimum instream flow requirement of 55% of unimpaired flow	Project	–
Grass Valley Creek Flows from Buckhorn Dam	Project	–
Feather River		
FERC Project #2100-134 controls operations of dam and low flow channel	Project	–
Minimum instream flow requirement of 55% of unimpaired flows (reduced during years with low storage or inflow conditions)	Project	–
American River		
2017 Flow Management Standard Releases and minimum instream flow requirement of 55% of unimpaired flow (reduced during years with low storage or inflow conditions)	Project	–

Title	Project Level Analysis or Program-Level Analysis	Construction Effects
Stanislaus		
Stanislaus Stepped Release Plan	Project	–
Alteration of Stanislaus DO Requirement	Project	–
Bay-Delta		
Export constraints from April through May depending on San Joaquin River flows	Project	–
Bypass of reservoir releases for fish so they become Delta outflows	Project	–
Positive OMR from March through May	Project	–
Tracy Fish Collection Facility Operations	Project	–
Skinner Fish Facility Operations	Project	–
U.C. Davis Fish Culture Center Refugial Population	Project	–
South-of-Delta Water Contractors		
Increased Water Use Efficiency	Program	X

FERC = Federal Energy Regulatory Commission; DO = dissolved oxygen, OMR = Old and Middle River

4.6.1 Upper Sacramento River

In the Sacramento River system, balancing instream flow releases with water in storage (to maintain the cold water pool) is critical for operations. Alternative 4 would increase instream flow releases with a target of 55% of unimpaired flows. Reclamation would release water from Shasta Reservoir to meet this flow target at the Sacramento River above Red Bluff and the confluence with the Feather River.

A "Shasta Critical" year is defined in CVP contracts as a year when forecasted inflow to Shasta Reservoir is less than 3.2 MAF, which represents a very dry year. During Shasta Critical years, Reclamation would reduce instream flow releases to less than the 55% target to maintain water in storage for cold water pool. Model results show that this occurs in about 10% of years.

4.6.2 Trinity River Division

As described in the No Action Alternative and Alternative 1, the Trinity River system would be operated according to the Trinity River ROD with lower Klamath River augmentation flows. In addition to these operations, Reclamation would modify operations at Buckhorn Dam, as described below.

4.6.2.1 *Grass Valley Creek Flows from Buckhorn Dam*

Reclamation would release water from Buckhorn Dam to Grass Valley Creek in accordance with requirements published in the Buckhorn Dam and Buckhorn Reservoir standard operating procedures manual for water rights permit 18879 issued to DWR, which establishes the timing and magnitude of minimum flows and flushing flows from the dam. Flow from the dam outlet could be as low as 5 cfs in the bypass channel or as high as 100 cfs from spill during March or April, both of which are dependent on season and the hydrologic conditions. Additional flushing of the channel can occur during the winter months when the reservoir fills and spills water at a natural inflow rate, which may exceed 100 cfs.

In addition, Reclamation would increase flow from the dam outlet works for maintenance of the outlet channel and to cue juvenile salmonids in the reach to begin their downstream migration to the Trinity River. Reclamation would release pulse flows when the reservoir water elevation exceeds 2,803.13 feet

above sea level between March 1 and April 15 to the extent feasible. Flow increases could range from 5 cfs to 100 cfs.

Reclamation would increase flow to the extent feasible in the outlet channel when necessary in October and November to provide adult Coho Salmon sufficient flow for upstream migration and spawning.

4.6.3 Clear Creek

Reclamation would release water from Whiskeytown Reservoir into Clear Creek to maintain flows at Igo that are 55% of unimpaired flows.

4.6.4 Feather River

Under Alternative 4, DWR would continue to operate Oroville Dam under the terms of its FERC license. The FERC license includes flow requirements in the Low Flow Channel just downstream from the dam that would govern these operations in Alternative 4. The FERC license also includes requirements downstream from the Thermalito outlet, but Alternative 4 would include additional flow targets. Under Alternative 4, DWR would operate Lake Oroville to maintain flows below the Thermalito outlet that are 55% of unimpaired flows. To balance these flow targets with water in storage, DWR would release less flow during years with low storage or forecasted inflow conditions. Model results show that this occurs in about 35% of years.

4.6.5 American River Division

Reclamation would operate the American River system consistent with the American River 2017 Flow Management Standard, with an additional target to have 55% unimpaired flow below Nimbus Dam. To balance these flow targets with water in storage, Reclamation would release less flow during years with low storage or forecasted inflow conditions. Model results show that this occurs in about 60% of years.

4.6.6 Bay-Delta

Releases from CVP and SWP reservoirs to meet the upstream flow targets would pass through the Delta and become Delta outflow. Additionally, Alternative 4 would include a positive combined OMR from March through May, subject to minimum health and safety pumping of 1,500 cfs.

CCWD facilities would continue to be operated and maintained under applicable permits. Reclamation would work with CCWD to ensure that implementation of the proposed action will not restrict CCWD operations beyond the restrictions of the separate biological opinions. Reclamation agrees to ensure that the implementation of Alternative 1 will not create new or additional restrictions on CCWD's ability to fill its Los Vaqueros Reservoir beyond the restrictions of the separate Biological Opinions that apply to CCWD's operations, thereby ensuring that CCWD will have opportunities to fill Los Vaqueros Reservoir that are at least comparable to the current conditions.

4.6.7 Stanislaus River

Alternative 4 would include the Stepped Release Plan described in Alternative 1.

4.6.8 San Joaquin River

Alternative 4 would include SJRRP flows.

4.6.9 South-of-Delta Water Contractors

Alternative 4 includes increased water use efficiency for CVP and SWP contractors.

4.6.9.1 *Agricultural Water Use Efficiency*

Under Alternative 4, agricultural water users would increase irrigation efficiency by implementing additional efficient water management practices (EWMPs). Mitigation measures identified rely on entities other than Reclamation to implement the measures. Because Reclamation does not have authority to implement these measures, Reclamation cannot ensure that they will be implemented. If they are implemented, they will reduce impacts on agricultural land. A substantial amount of water use efficiency already occurs under the No Action Alternative, which would limit the opportunity for additional water made available through efficient practices. Under the No Action Alternative, Reclamation already requires CVP contractors to implement cost-effective BMPs to manage water use, based on CVPIA Section 3405(e). The CVPIA and Section 210(b) of the Reclamation Reform Act of 1982 require the preparation and submittal of a Water Management Plan. Additionally, the state of California requires development of Agricultural Water Management Plans for agricultural water suppliers that supply water to more than 25,000 acres and provides grant funding related to these plans for water suppliers to 10,000 to 25,000 acres. These plans need to include drought management plans and report on the status of EWMPs. EWMPs are required where they are technically feasible and locally cost-effective.

Alternative 4 would increase water use efficiency above current and proposed practices. Water suppliers and growers would need to identify and invest in additional district-level or on-farm practices to improve irrigation efficiency. The California Water Code (Section 10608.48) defines conditional EWMPs, and the practices that are feasible and cost-effective have already been implemented. This component could involve some of these conditional practices from the Water Code that have not yet been implemented:

- Alter land use for lands with exceptionally high water use or whose irrigation contributes to significant problems, including problem drainage
- Use available recycled water that otherwise would not be used beneficially, meets health and safety criteria, and does not harm crops or soils
- Install more efficient on-farm irrigation systems or technology to better manage existing systems
- Line canals in distribution systems or replace canals with pipes to reduce water losses
- Construct and operate supplier spill and tailwater systems
- Automate canal control devices to reduce losses
- Improve pump efficiencies in distribution systems

Some of these measures would involve construction of new facilities, such as new on-farm irrigation systems or distribution canal improvements.

4.6.9.2 *Municipal and Industrial Water Use Efficiency*

A substantial amount of M&I water use efficiency has already been implemented under existing conditions. In 2015, because of the prolonged drought conditions, Governor Brown called for a reduction in urban water use of 25% through improved water use efficiency. Urban water users were successful in reducing water use by 24% (DWR 2017). California Executive Order B-37-16 and Senate Bill X7-7 have pushed M&I water providers to implement cost-effective measures to increase water use efficiency.

Under Alternative 4, this component would implement additional water use efficiency measures beyond what is already implemented or planned for implementation. Additional measures may include distribution system improvements, in-home modifications (plumbing and public outreach), landscape transformation, and commercial/industrial process improvements. Some of these measures would involve construction, such as distribution system improvements or landscape changes.

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